

EXPLORING THE GREEN ECONOMY: ISSUES, CHALLENGES AND BENEFITS

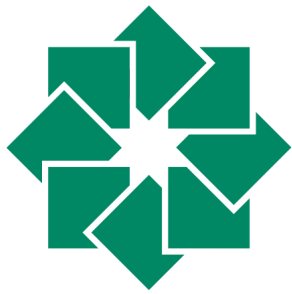
Adalat Muradov  
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*Editors*

# EXPLORING THE GREEN ECONOMY: ISSUES, CHALLENGES AND BENEFITS



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# Exploring the Green Economy: Issues, Challenges and Benefits

# Green Economy and Green Finance

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# CONTENTS

<b>#1</b>	<b>Introduction</b> Editorial board	<b>1</b>
	<b>Part I: Green Economy Transition</b>	<b>9</b>
<b>#2</b>	<b>Opportunities, Benefits and Challenges in the Transition to a Green Economy: The Case of Azerbaijan</b> Gulnar Maharramova and Mirlazim Dadashov	<b>11</b>
<b>#3</b>	<b>Green Transformation in Azerbaijan: Opportunities for Smes</b> Ayten Mekhraliyeva	<b>49</b>
<b>#4</b>	<b>Development Directions of the Energy Sector Based on Green Economy in Azerbaijan</b> Fuad Mammadov	<b>71</b>
<b>#5</b>	<b>Tools and Strategies for the Oil and Gas Sector Decarbonization in The Face of New Challenges</b> Maria A. Vetrova, Igor A. Arenkov, Dinara V. Ivanova and Elena E. Malysheva	<b>97</b>
<b>#6</b>	<b>Importance of Green Economy and Example on the Republic of Azerbaijan</b> Khayala Mirzayeva	<b>121</b>
<b>#7</b>	<b>Green Growth and Human Capital Development: The Case for Azerbaijan</b> Haydar Teymurov	<b>139</b>



<b>#8</b>	<b>The Impact of Green Capital Investment on Decarbonization Process in Azerbaijan: The Role of Green Banking Model in The Acceleration of SDGs Implementation</b>	<b>159</b>
	Maharram Huseynov and Rafiga Aliyeva	
<b>#9</b>	<b>Foundations of The Concept of Green Economy</b>	<b>173</b>
	Ayten Huseynli, Samira Shamkhalova and Aygun Abdulova	
<b>#10</b>	<b>Foreign Countries' Experience in Green Cities' Creating and its Possible Implementation in Azerbaijan</b>	<b>187</b>
	Samira Abbasova and Samira Shamkhalova	
<b>#11</b>	<b>The Role That Corporate Social Responsibility Takes in Green Economy</b>	<b>209</b>
	Ulkar Zeynalova	
	<b>Part II Green Finance</b>	<b>221</b>
<b>#12</b>	<b>Green Finance as A Factor of a Sustainable Economy: Global Trends and Prospects</b>	<b>223</b>
	Fakhri Murshudli and Liudmila Filipava	
<b>#13</b>	<b>The Development of Green Bonds in The Scope of Green Finance in The World</b>	<b>247</b>
	Ilkin Mammadov and Aygun Mammadova	
<b>#14</b>	<b>The Effect of International Green Banking Practices On Environmental Sustainability: An Empirical Study</b>	<b>265</b>
	Zahid Mammadov and Fakhri Murshudli	

<b>#15</b>	<b>Does Banking Regulation Matter for Green Investment?</b>	<b>287</b>
	Muslum Mursalov	
	<b>Part III Green Investment</b>	<b>313</b>
<b>#16</b>	<b>Green Investing and Its Benefits for Green Growth: The Case for Azerbaijan</b>	<b>315</b>
	Ramil Maharramov	
<b>#17</b>	<b>Integration of Green Finance into Investment Projects in Karabakh</b>	<b>355</b>
	Kenish Garayev and Leyla Tahirzadeh	
	<b>Part IV Green Accounting</b>	<b>369</b>
<b>#18</b>	<b>The Importance Of A Green Economy And Green Accounting: Analysis Of The Knowledge On Green Accounting And Economy In Azerbaijan</b>	<b>371</b>
	Laman Guliyeva	

# List of Figures

<b>Fig. 2.1.</b> Three key indicators to consider in the transition to a green economy ( <i>Source</i> Developed by the author based on the Jones B.,2011, Driving a Green Economy through Public Finance and Fiscal Policy Reform, Journal of International Commerce, Economics and Policy, 2(2))	<b>14</b>
<b>Fig. 3.1.</b> Environmental and resource productivity	<b>63</b>
<b>Fig. 3.2.</b> Environmental dimension of quality of life	<b>64</b>
<b>Fig. 3.3.</b> Natural asset base	<b>64</b>
<b>Fig. 3.4.</b> Economic opportunities and policy responses	<b>65</b>
<b>Fig. 3.5.</b> a) Khanoba Customs Border Checkpoint (on the left) b) Border crossing Yarag-Kazmalyar (Russia) (on the right)	<b>65</b>
<b>Fig. 4.1.</b> General view parabolic trough solar energy concentrator	<b>73</b>
<b>Fig. 4.2.</b> General view of solar water heaters	<b>73</b>
<b>Fig. 4.3.</b> General view of solar air heaters with heating accumulator	<b>74</b>
<b>Fig. 4.4.</b> General view of combined air heating accumulator	<b>75</b>
<b>Fig. 4.5.</b> General view of solar kitchen	<b>75</b>
<b>Fig. 4.6.</b> General view of PV accelerator	<b>76</b>
<b>Fig. 4.7.</b> General view of rotary solar desalter with parabolic reflector	<b>82</b>
<b>Fig. 4.8.</b> Dependence of solar desalter equipment efficiency on wind speed	<b>83</b>
<b>Fig. 4.9.</b> General view of rotary solar desalter with parabolic-through reflector	<b>84</b>
<b>Fig.4.10.</b> General view of rotary solar desalter with solar water boiler	<b>85</b>
<b>Fig.4.11.</b> Dependence heat loss of solar water boiler on temperature difference between working surface and air	<b>89</b>
<b>Fig.4.12.</b> Dependence heat coefficient of glass cover efficiency $\eta_{H.G.}$ (vertical axe) on temperature difference $\Delta t$ between the absorber surface and environmental air	<b>93</b>
<b>Fig. 5.1.</b> The effectiveness of countries' current strategies to limit CO <sub>2</sub> emissions compared to the required indicators to achieve the goals of the Paris Agreement ( <i>Source</i> Climate Action Tracker, 2021)	<b>100</b>

<b>Fig. 5.2.</b> Greenhouse gas emissions from oil and gas sector activities and production ( <i>Source</i> Compiled by the authors based on Grushevenko, 2021)	<b>104</b>
<b>Fig. 5.3.</b> Percentage of CO <sub>2</sub> emissions and decarbonization instruments at various stages of the value chain ( <i>Source</i> Beck, 2020)	<b>107</b>
<b>Fig. 9.1.</b> The stages of green development in the implementation of the green economic concept ( <i>Source</i> made by authors)	<b>176</b>
<b>Fig. 9.2.</b> Chart of factors values	<b>180</b>
<b>Fig. 12.1.</b> Financial Model based on the Green Fund establishment ( <i>Source</i> compiled by the authors)	<b>241</b>
<b>Fig. 13.1.</b> Green Finance Comprises ( <i>Source</i> Lindenbergh, N. (2014) Definition of Green Finance. German Development Institute and Deutsches Institut für Entwicklungspolitik)	<b>250</b>
<b>Fig. 13.2.</b> Green Finance Products and Services ( <i>Source</i> Jin Noh Hee, Financial Strategy to Accelerate Innovation for Green Growth (2010))	<b>251</b>
<b>Fig. 13.3.</b> Annual issuance of green bonds, US\$ billions ( <i>Source</i> www.bonddata.org)	<b>256</b>
<b>Fig. 13.4.</b> Quarterly issuance of GSSS bonds, US\$ billions ( <i>Source</i> www.bonddata.org)	<b>256</b>
<b>Fig. 13.5.</b> Regional Distribution of Global Green Bond Issues ( <i>Source</i> www.bonddata.org)	<b>258</b>
<b>Fig. 13.6.</b> Distribution of Global Green Bonds by Issuer ( <i>Source</i> www.bonddata.org)	<b>259</b>
<b>Fig. 13.7.</b> Top 15 Lead Issuer for Green Bonds 2020 (\$M) ( <i>Source</i> www.bonddata.org)	<b>260</b>
<b>Fig. 15.1.</b> Number of Scopus publications on “green investment” and “regulation” issues in 1993-2022, units ( <i>Source</i> Scopus, 2022)	<b>289</b>
<b>Fig. 15.2.</b> Network visualisation of co-occurrence of “green investment” and “regulation” issues in Scopus publications ( <i>Source</i> compiled by the author based on data Scopus, 2022; Vosviewer, 2022)	<b>294</b>
<b>Fig. 15.3.</b> Overlay visualisation of co-occurrence of “green investment” and “regulation” issues (time perspective) in Scopus publications ( <i>Source</i> compiled by the author based on data Scopus, 2022; Vosviewer, 2022)	<b>295</b>

<b>Fig. 15.4.</b> Network visualisation of country co-occurrence in terms of Scopus publications on “green investment” and “regulation” issues ( <i>Source</i> compiled by the author based on data Scopus, 2022; Vosviewer, 2022)	<b>296</b>
<b>Fig. 16.1.</b> Ozone depleting substances, Tonnes ( <i>Source</i> State Statistics Committee. 2022)	<b>324</b>
<b>Fig. 16.2.</b> Installed Renewable Capacity, 2019, MW ( <i>Source</i> Mustafayev, F.; Kulawczuk, P.; Orobello, 2022)	<b>326</b>
<b>Fig. 16.3.</b> Renewable resources potential in Azerbaijan (MW) ( <i>Source</i> Irena, 2019)	<b>326</b>
<b>Fig. 16.4.</b> Overview of renewable energy investments (AZN Mln), 2005–2015 ( <i>Source</i> Mustafayev, F.; Kulawczuk, P.; Orobello, 2022)	<b>327</b>
<b>Fig. 16.5.</b> Consumer Waste in Azerbaijan, Thsd Tonnes ( <i>Source</i> SSC. 2022)	<b>332</b>
<b>Fig. 16.6.</b> Employment in different energy sectors (jobs per MW) ( <i>Source</i> Mustafayev, F. and others,2022)	<b>343</b>
<b>Fig. 16.7.</b> Capital Investments Into Protection of Environment and Efficient Use of Natural Resources 2006-2020, Thsds. ( <i>Source</i> State Statistics Committee. 2022. Investment (Construction) Statistics)	<b>344</b>
<b>Fig. 16.8.</b> Electricity Sale Prices to Grid, by Country ( <i>Source</i> Globalpetrolprices.com, Accessed, June2022)	<b>346</b>
<b>Fig. 17.1.</b> Green finance and total finance ( <i>Source</i> TheCityUK analysis based on data from Refinitiv Workspace)	<b>357</b>
<b>Fig. 17.2.</b> Leading countries in green bond export ( <i>Source</i> TheCityUK analysis based on data from Refinitiv Workspace)	<b>361</b>
<b>Fig. 18.1.</b> The social responsibility pyramid created by Carroll ( <i>Source</i> Uner, Tugce and Bas, Mehmet (2018) “Social Marketing Scale Study Developed Using Carroll’s Corporate Social Responsibility Model”, Journal of Business Studies 10.4, page 304-332)	<b>375</b>
<b>Fig. 18.2.</b> Product cost calculated based on the Traditional Cost Accounting System ( <i>Source</i> EPA (Environmental Protecting Agency), June 1995, page 21)	<b>377</b>
<b>Fig. 18.3.</b> Revision of the product cost calculated based on the Traditional Cost Accounting System within the scope of Environmental Accounting ( <i>Source</i> EPA (Environmental Protecting Agency), June 1995, page 21)	<b>377</b>

# List of Tables

<b>Table 2.1.</b> Volume of carbon emissions by countries in 2017-2020 (TOP 10 countries) ( <i>Source</i> European Union Joint Research Centre, 2020)	<b>20</b>
<b>Table 2.2.</b> Electricity production in Azerbaijan in 2015-2020 (million kWh) ( <i>Source</i> State Statistics Committee of the Republic of Azerbaijan, 2020)	<b>30</b>
<b>Table 4.1.</b> Relative changing of the coefficients of passing through the glass depending on radiation falling angle	<b>79</b>
<b>Table 4.2.</b> Declination of the sun for Absheron peninsula	<b>80</b>
<b>Table 4.3.</b> Coefficients of diffuse radiation passing through the glass K D (on V.P. Kislov) s.g.	<b>86</b>
<b>Table 5.1.</b> Ranking of companies by CO <sub>2</sub> emissions ( <i>Source</i> Compiled by the authors based on Griffin, 2017)	<b>103</b>
<b>Table 5.2.</b> Emission reduction tools by supply chain stage ( <i>Source</i> compiled by the authors based on Beck, 2020)	<b>105</b>
<b>Table 5.3.</b> Assessment of climate neutral strategies for oil and gas companies ( <i>Source</i> Compiled by the authors based on open company data)	<b>111</b>
<b>Table 6.1.</b> Sustainable Development Goal Report 2021 by Azerbaijan ( <i>Source</i> Sachs, J., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. (2021). The Decade of Action for the Sustainable Development Goals: Sustainable Development Report 2021. Cambridge: Cambridge University Press.)	<b>133</b>
<b>Table 6.2.</b> Green Growth Index Performance and dimension ( <i>Source</i> Global Green Growth Institute Technical Report No. 16)	<b>134</b>
<b>Table 6.3.</b> Global Green Economic Index, Azerbaijan (2018) ( <i>Source</i> Dual Citizen Global Green Economic Index 2018)	<b>134</b>
<b>Table 6.4.</b> Environmental Performance Index, Azerbaijan (2020) ( <i>Source</i> Environmental Performance Index Report 2020)	<b>135</b>
<b>Table 7.1.</b> Opinion of relevant sector representatives on green areas of work in Azerbaijan ( <i>Source</i> Compiled as a result of the author's personal research)	<b>149</b>
<b>Table 8.1.</b> OLS regression analysis, p-value at 5 % significance level	<b>168</b>

<b>Table 8.2.</b> OLS regression analysis, p-value at 5 % significance level	<b>168</b>
<b>Table 9.1.</b> Compares the modern brown economy to the green economy ( <i>Source</i> made by authors)	<b>176</b>
<b>Table 9.2.</b> Statistical analysis of the sustainable development indicators for Regions of Azerbaijan for 2019	<b>180</b>
<b>Table 10.1.</b> Comparative analysis of Modern city and Green city ( <i>Source</i> compiled by the authors)	<b>191</b>
<b>Table 10.2.</b> Analysis of external impacts on new cities with an eco-system ( <i>Source</i> compiled by the authors)	<b>192</b>
<b>Table 10.3.</b> SWOT analysis of green city implementation in Azerbaijan ( <i>Source</i> compiled by S.Abasova)	<b>199</b>
<b>Table 11.1.</b> CSR 2.0 aims at bracing the transformation to the green economy	<b>215</b>
<b>Table 12.1.</b> The Green economy forms ( <i>Source</i> compiled by the authors)	<b>225</b>
<b>Table 12.2.</b> Informal Green Initiatives ( <i>Source</i> compiled by the authors)	<b>227</b>
<b>Table 12.3.</b> Comparative analysis of 'green' and 'brown' finance ( <i>Source</i> compiled by the authors)	<b>229</b>
<b>Table 12.4.</b> Top 10 Climate Bonds Certified Issuers in 2021 ( <i>Source</i> CBI (2022))	<b>234</b>
<b>Table 14.1.</b> Descriptive statistics of all the variables for all countries ( <i>Source</i> author's calculations)	<b>273</b>
<b>Table 14.2.</b> Panel unit root results ( <i>Source</i> author's calculations)	<b>276</b>
<b>Table 14.3.</b> Results of the correlation analysis ( <i>Source</i> author's calculations)	<b>277</b>
<b>Table 14.4.</b> Panel regression results for the fixed-effects model (example for CO2 emission and sustainable development indicators) ( <i>Source</i> author's calculations)	<b>278</b>
<b>Table 14.5.</b> Panel regression results for the random-effects model (example for CO2 emission and sustainable development indicators) ( <i>Source</i> author's calculations)	<b>279</b>
<b>Table 14.6.</b> Hausman test (example for loan bonds and sustainable development indicators) ( <i>Source</i> developed by authors)	<b>279</b>
<b>Table 14.7.</b> Robustness test (example for loan bonds and sustainable development indicators) ( <i>Source</i> author's calculations)	<b>280</b>

<b>Table 15.1.</b> TOP-10the most cited Scopus publications (Scopus, 2022) on “green investment” and “regulation” issues ( <i>Source</i> compiled by the author based on data Scopus, 2022)	<b>290</b>
<b>Table 15.2.</b> Characteristics of model variables ( <i>Source</i> compiled by the author)	<b>298</b>
<b>Table 15.3.</b> Descriptive Statistics ( <i>Source</i> compiled by the author)	<b>301</b>
<b>Table 15.4.</b> Pairwise correlation results ( <i>Source</i> compiled by the author)	<b>303</b>
<b>Table 15.5.</b> Regression results (model 1) ( <i>Source</i> compiled by the author)	<b>305</b>
<b>Table 15.6.</b> Regression results (model 2) ( <i>Source</i> compiled by the author)	<b>306</b>
<b>Table 15.7.</b> Regression results (model3) ( <i>Source</i> compiled by theauthor)	<b>307</b>
<b>Table 15.8.</b> Regression results (model4) ( <i>Source</i> compiled by the author)	<b>308</b>
<b>Table 16.1.</b> Azerbaijan electricity generation by source (GWh) ( <i>Source</i> State Statistical Committee 2022)	<b>325</b>
<b>Table 18.1.</b> Group Statistics- Differences by Gender of Respondents	<b>387</b>
<b>Table 18.2.</b> Group statistics- Differences according to the experience of the respondents	<b>389</b>
<b>Table 18.3.</b> Reliability Statistics	<b>391</b>
<b>Table 18.4.</b> Item Statistics	<b>391</b>
<b>Table 18.5.</b> Independent Samples Test	<b>392</b>
<b>Table 18.6.</b> Likert Questions (Numbers demonstrate percentage of the answers)	<b>393</b>





# Chapter 1

## Introduction

*Editorial board*

The global shift towards a sustainable and environmentally responsible future has placed the concept of green economy at the forefront of economic development discussions. This book offers a comprehensive exploration of the various aspects of transitioning to a green economy, with a specific focus on Azerbaijan. Through four distinct sections - Green Economy Transition, Green Finance, Green Investment, and Green Accounting - this book examines the challenges, opportunities, and potential benefits associated with adopting sustainable economic practices and instruments. By presenting a holistic approach that considers economic growth, social development, and environmental conservation, this book aims to provide valuable insights for policymakers, businesses, financial institutions, and individuals interested in fostering a more sustainable future for Azerbaijan.

The first section of this book, "Green Economy Transition," delves into the various aspects of transitioning to a green economy, specifically in the context of Azerbaijan. This part comprises a diverse range of articles that discuss the opportunities, benefits, and challenges associated with the shift towards a more sustainable and environmentally friendly economic model.

Throughout this section, the importance of the green economy in Azerbaijan is examined, with a particular focus on the potential advantages and obstacles that the country may face during this transition. The discussion highlights the need for a holistic approach that considers economic growth, social development, and environmental conservation.

The role of small and medium-sized enterprises (SMEs) in driving the green transformation is also explored in this section. By investigating the unique challenges and opportunities for SMEs in adopting sustainable business practices, readers gain valuable insights into how these entities can contribute to the country's green economy.

Energy plays an essential role in the transition to a green economy, and this section provides insights into the need for diversification of energy sources, the promotion of renewable energy, and the enhancement of energy efficiency. Additionally, the tools and strategies required for decarbonizing the oil and gas sector in Azerbaijan are examined, shedding light on the complexities of transitioning a historically oil-dependent country.

The significance of green economy principles and their potential impact on the country's development are also discussed in this section. The exploration of the benefits of embracing a green economy emphasizes the need for a comprehensive approach that accounts for economic, social, and environmental factors.

Human capital development is a critical aspect of the green economy transition. This section emphasizes the importance of education, training, and skill development in preparing the workforce for the challenges and opportunities presented by a green economy.

The financial aspects of the green economy transition are analyzed as well, with a focus on the potential of green capital investment and the green banking model in accelerating the implementation of Sustainable Development Goals in Azerbaijan. Innovative financial products and services, such as green loans and green bonds, are explored to showcase their role in promoting environmentally responsible investments.

To provide a solid foundation for understanding the green economy concept, this section also delves into the theoretical background, outlining the fundamental principles and objectives of a green economy. This comprehensive approach allows readers to better comprehend the subsequent articles in this section.

Drawing from international experiences in developing green cities, this section offers insights into the potential for implementing such practices in Azerbaijan. By examining successful case studies, the importance of urban planning and development strategies that prioritize environmental sustainability and resource efficiency is highlighted.

Finally, the significance of corporate social responsibility in the context of a green economy is discussed in this section. The need for businesses to adopt sustainable practices and promote environmental stewardship is emphasized as a vital aspect of contributing to the country's green transition.

In conclusion, Part I of this book provides a comprehensive exploration of the various facets of Azerbaijan's green economy transition. By examining

the challenges, opportunities, and potential benefits of adopting sustainable economic practices, this section offers valuable insights for policymakers, businesses, and individuals interested in fostering a more sustainable future for Azerbaijan.

Continuing from the exploration of the green economy transition, Part II of this book, titled "Green Finance," delves deeper into the financial aspects that support and facilitate the shift towards a more sustainable and environmentally friendly economic model. This section features a series of articles that examine global trends and prospects, as well as specific instruments and practices, such as green bonds and international green banking practices, and their impact on environmental sustainability.

In this section, the role of green finance as a driving factor for a sustainable economy is explored, along with an analysis of global trends and prospects. By examining the current landscape of green finance and its potential for further growth, readers gain valuable insights into the opportunities and challenges that lie ahead for countries like Azerbaijan in adopting sustainable financial practices.

Green bonds, a crucial instrument within the realm of green finance, are discussed in detail. The development of green bonds worldwide is analyzed, shedding light on their potential to mobilize capital for sustainable projects and investments. The success of green bonds in various countries serves as a guide for Azerbaijan to consider and learn from as it moves towards embracing green finance initiatives.

Another essential topic covered in this section is the effect of international green banking practices on environmental sustainability. Through an empirical study, the impact of green banking practices on reducing greenhouse gas emissions, promoting energy efficiency, and supporting sustainable development is examined. This analysis helps reveal the potential benefits of adopting green banking practices in Azerbaijan, as well as the challenges that need to be addressed to ensure their successful implementation.

Lastly, the section investigates the role of banking regulation in promoting green investment. The effectiveness of different regulatory approaches in fostering environmentally responsible investments is evaluated, highlighting the importance of a well-designed and coherent regulatory framework in facilitating the growth of green finance. This analysis underscores the need for Azerbaijan to develop and implement appropriate regulations that encourage green investments, thus enabling a smoother transition towards a green economy.

In conclusion, Part II of this book offers a comprehensive exploration of the various facets of green finance and its crucial role in supporting the transition to a green economy. By examining the challenges, opportunities, and potential benefits of adopting sustainable financial practices and instruments, this section provides valuable insights for policymakers, financial institutions, and investors interested in promoting a more sustainable future for Azerbaijan and the world at large.

Building upon the discussions in Parts I and II, which focused on the green economy transition and green finance, Part III of this book, titled "Green Investment," delves into the practical implementation of green finance in fostering environmentally sustainable projects and investments. This section features two articles that examine the benefits of green investing for green growth in Azerbaijan and the integration of green finance into investment projects in the Karabakh region.

In this section, the concept of green investing is explored, with a particular focus on its benefits for fostering green growth in Azerbaijan. By examining the potential advantages of incorporating environmentally responsible investments into the country's development strategy, readers gain valuable insights into how green investing can support the transition to a green economy. This exploration emphasizes the importance of aligning investment decisions with sustainable development goals, which, in turn, can lead to long-term benefits for both the environment and the economy.

Further, this section discusses the integration of green finance into investment projects in the Karabakh region, a territory with significant potential for sustainable development. By examining the challenges and opportunities of incorporating green finance into the planning and implementation of projects in this region, the articles shed light on the importance of adopting sustainable financing practices to ensure that development is aligned with long-term environmental goals.

In conclusion, Part III of this book offers a comprehensive exploration of the various facets of green investment and its role in promoting environmentally sustainable projects and growth. By examining the challenges, opportunities, and potential benefits of adopting green investment practices, this section provides valuable insights for policymakers, financial institutions, and investors interested in fostering a more sustainable future for Azerbaijan. The discussions in this part, together with those in Parts I and II, create a cohesive understanding of the green economy transition, green finance, and green investment, paving the

way for a sustainable, environmentally responsible future for Azerbaijan and beyond.

In culmination of the discussions on the green economy transition, green finance, and green investment presented in Parts I, II, and III, the fourth and final section of this book, titled "Green Accounting," delves into the critical aspect of monitoring and reporting the progress of green initiatives. This part features an article that examines the importance of a green economy and green accounting, with a focus on the current knowledge and understanding of these concepts in Azerbaijan.

The article in this section emphasizes the significance of green accounting in the context of a green economy. By analyzing the existing knowledge and awareness of green accounting practices and their role in fostering a sustainable economy in Azerbaijan, readers gain valuable insights into the challenges and opportunities associated with the implementation of such practices. This exploration highlights the need for establishing a comprehensive and transparent system of green accounting to effectively monitor and report the environmental and social impacts of economic activities.

Green accounting is crucial for tracking the progress of green initiatives and ensuring their alignment with sustainable development goals. The article in this section underlines the importance of raising awareness and promoting education on green accounting practices, as well as fostering collaboration between various stakeholders, including policymakers, businesses, and educational institutions. By doing so, Azerbaijan can create a solid foundation for the successful implementation of green accounting practices and, in turn, support the broader transition towards a green economy.

In conclusion, Part IV of this book offers a comprehensive exploration of the importance of green accounting in the context of a green economy. By examining the challenges, opportunities, and potential benefits of adopting green accounting practices, this section provides valuable insights for policymakers, businesses, and educational institutions interested in promoting a more sustainable future for Azerbaijan. The discussions in this part, together with those in Parts I, II, and III, create a cohesive understanding of the green economy transition, green finance, green investment, and green accounting. Collectively, these discussions contribute to a comprehensive framework that supports a sustainable, environmentally responsible future for Azerbaijan and beyond.

In conclusion, this book presents a cohesive understanding of the green

economy transition, green finance, green investment, and green accounting, paving the way for a sustainable, environmentally responsible future for Azerbaijan and beyond. By examining the challenges, opportunities, and potential benefits of adopting sustainable economic practices and instruments, this book highlights the importance of aligning policies, investments, and business practices with sustainable development goals. The discussions presented throughout the four parts emphasize the need for collaboration between various stakeholders, including policymakers, businesses, financial institutions, and educational institutions, to ensure the successful implementation of green initiatives. As we collectively strive towards a more sustainable future, the insights offered in this book serve as a valuable guide for understanding and navigating the complexities of the green economy, ultimately contributing to the global effort to address climate change and promote environmental stewardship.

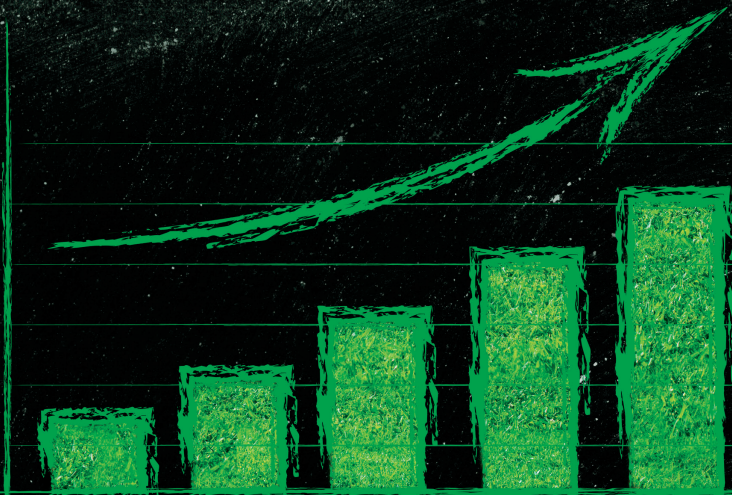






# Part I

## Green Economy Transition



GREEN ECONOMY



# Chapter 2

## Opportunities, Benefits and Challenges in the Transition to a Green Economy: The Case of Azerbaijan

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### Abstract

The transition to a green economy, which is a combination of economic, social and environmental features, is one of the main concerns of countries on the path to sustainable development. The policies pursued by countries to achieve sustainable development through the transition to a green economy are diverse. Each country implements this transition in accordance with its resources, its civil society. The green economy, which focuses on social, economic and environmental issues and seeks to achieve positive results by analyzing them, is a policy that should have been taken years ago, but it is now a global problem. The role of society in solving this problem is as great as the country's economy. In order to achieve the green transition goals, it is necessary to adapt to the requirements of the changing world and meet these requirements. Most countries in the world, including Azerbaijan, are accelerating the transition to a green economy by implementing various green economy policies.

The main purpose of the research is to analyze in depth the concepts of sustainable development and green economy, to identify the challenges faced by countries in the process of transition to a green economy, including Azerbaijan, and to identify ways to take advantage of potential opportunities. The study examines important literature on the green economy, using the interview method, collected information from representatives of the Secretariat of the First Vice President of the Republic of Azerbaijan, Baku Port, Baku Transport Agency, and obtained the necessary statistics from the State Statistics Committee of the Republic of Azerbaijan.

The study presents a general policy framework that includes relevant policies for the green economy, which is considered an economic, environmental and social complement to sustainable development. At the same time, the analysis of the issues of management of the green economy system, covering the highest priority areas for the elements that form this system during green development, defining new economic goals of ecological life and achieving the desired results.

**Keywords:** sustainable development, green economy, green transition, environment

### 2.1. Introduction

Today, the transition to a green economy is one of the most pressing issues in the international arena. In its simplest form, such an economy is low-carbon, efficient and clean in production, but also comprehensive in terms of consumption and results, based on sharing, turnover, cooperation, solidarity, flexibility, opportunity and interdependence. It aims to expand options and choices for national economies, using purposeful and appropriate fiscal and social protection policies. The green economy is supported by strong institutions, especially those aimed at protecting the social and environmental environment and recognizes that there are many and varied paths to environmental sustainability. The green economy speaks of the many economic, health, security, social and environmental benefits from the perspective of sustainable development.

Integrated sustainable development and green economy approaches can help governments to maximize, prioritize, and consistently understand the various benefits to human well-being that can be derived from a healthy environment. These approaches should ensure not only employment and income, but also our health, our environment and our future. This is a common problem that is a priority for improving the welfare of the world and increasing social equality.

The main challenges facing the green economy in most countries are poor governance, growing poverty, high economic dependence on natural resources and growing food security. Governments, as policymakers, can provide policies, rules, and incentives to promote a green economy. Therefore, countries are trying to use green policies to determine how the green economy can improve the security of life and the eradication of poverty.

The main goal of the idea of a green economy, which is a very important

link between economic growth and environmental sustainability, is to increase the quality of the environment and social inclusion through investment growth and economic growth. It aims to regulate or even eliminate the link between the idea of a green economy and the negative externalities created by uncontrolled economic growth and the environmental problems that result from it (Özçağand Hotunluoğlu 2015).

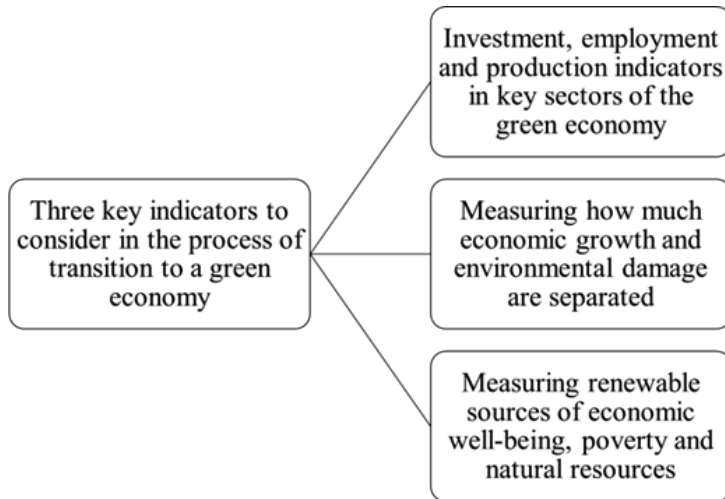
### 2.2. Literature Review

In connection with the revision of development and income distribution indicators in the transition to a green economy, there is a need for new measurement methods that will promote environmental priorities. If the balance between natural resources and economic activity is well established, a completely new macroeconomic framework can be created with key general indicators of the environment and the economy. As can be seen, one of the main issues of the green economy is the development of new methods of measuring national income that more realistically reveal the environmental impact of economic activity (Jones 2011, p. 328).

The three main groups of indicators to be considered in the transition to a green economy are shown in Figure 2.1 (Jones 2011, pp. 328, 329):

- a) The first group of key indicators is investment, employment and production in key sectors of the green economy. At this point, production, employment and investment in the renewable energy and waste recycling sectors are seen as important indicators of the transition to a green economy;
- b) The second key indicator group is the measurement of how much economic growth and environmental damage are separated. For example, the sources of energy used in production, the intensity of the use of raw materials in the economy, and how the waste recycling sector can be organized are considered important indicators for the transition to a green economy;
- c) The third key area of acceptance as an indicator of the transition to a green economy is the measurement of economic well-being, poverty and renewable sources of natural resources. This is because classical methods of measuring material well-being, such as gross domestic product (GDP), do not take into account environmental pollution.

Therefore, new measurement methods that will link human well-being with the country's ability to recover natural resources and environmental degradation are one of the cornerstones of the transition to a green economy (Jones 2011: 328-329).



**Fig 2.1** *Three key indicators to consider in the transition to a green economy (Source Developed by the author based on the Jones B., 2011, Driving a Green Economy through Public Finance and Fiscal Policy Reform, Journal of International Commerce, Economics and Policy, 2(2))*

One of the most important discussions about the green economy is whether the green economy is an alternative to sustainable development. Sustainable development is a development model developed as an alternative to the classical development phenomenon. It is not only economic in size, but also has the environmental and social dimensions required by the times. In this sense, sustainable development is a multidimensional development model that combines elements such as the elimination of income inequality, increasing civic participation in public activities and taking the environment as the basis of economic activity, as well as improving material well-being. From this point of view, contrary to the idea of the green economy as an alternative to the model of sustainable development, clarifying the tools to be used to achieve a sustainable world order, a clearer expression of public and private sector responsibilities and, as a natural consequence, sustainable development it can be seen as a new economic thinking that will be more effective in practice (Özçağ and Hotunluoğlu 2015).

It is generally accepted that the transition to a green economy will increase the sustainability of economic development and that the values that will be passed on to future generations will provide a sufficient level of prosperity for both them and future generations. According to Khor, the company

and the market need to be reorganized within the green economy. While the role of the private sector in the transition to a green economy is important, government regulation is especially important for large private sectors. Regulatory mechanisms covering air pollution, water pollution, environmental taxes and fines are important tools of the green economy. However, the main problem arises when it comes to providing the funds that will be used to make the necessary adjustments for the green economy. Neither the producer wants to incur higher costs, nor does the consumer want to face higher prices. In this context, there is a need for government intervention, which should be "should it be or should it not be?" (Khor 2011, p. 28).

Based on the general ideology of the concept of sustainable development, the issues of determining the long-term social and environmental consequences of modern economic development are fundamental, and the success of economic modernization and energy efficiency ideas depends on the active position of the state and regional authorities. Achieving sustainable development requires carefully coordinated action in all sectors of the economy. This activity requires a model of organizational mechanism that will ensure the transition to a green economy, as well as the priority of economic, environmental and social institutions. It is clear that there is a need for a transition to an economic model that will improve people's well-being while conserving resources and without exposing future generations to significant environmental risks. Therefore, in most developing countries, it is proposed to develop a model for the transition to a green economy, which will allow understanding the level, coordination and scale of activities to conduct effective environmental policies and assess the overall effectiveness of green growth.

The green economy is an economic trend that has developed over the last twenty years, and it is believed that the economy is linked to a natural component of the environment that is part of its existence. The concept of a green economy is attracting more and more public attention. Experts and public organizations actively discuss it. Proponents of the green economy concept believe that the current economic system is currently imperfect. This concept is designed to ensure a more harmonious coherence between the social, natural and economic components adopted by groups of all developed and developing countries and transition economies (Iskakov, Pygay and Rakhimbekova 2021).

One of the manifestations of the globalization of the world economy is the obvious dependence on the consumption of different types of resources,



which in turn suggests the need to harmonize international requirements in the field of environmental development. Today, economic growth is associated with the deterioration of the natural environment, the disruption of the ecological balance of the biosphere. This has a negative impact on human health, limiting the country's development potential (Holmberg and Sandbrook 1992).

The country's future development is undeniably linked to a number of technological innovations aimed at reducing the components of economic growth in the areas of energy efficiency and environmental potential of production processes. The latest trend, called the green economy, has been active for the past few decades. At the heart of this trend is the simultaneous solution of global environmental problems and the ability to generate competitive income using clean, green technologies (UNEP 2011). The development of a green economy must not only help prevent the depletion of non-renewable natural resources, but also reduce the environmental risks of environmental pollution, improve welfare and ensure the environmental security and social justice of the world's population. The green economy can also be seen as a system of principles, goals and activities. As a rule, the basic principles of a green economy include the following (ECLAC 2010; UNEP 2011a and OECD 2011a):

- equality and justice;
- compliance with the principles of sustainable development;
- application of the principle of caution in relation to potential impacts on society and the environment;
- adequate consideration of natural and social capital;
- sustainable and efficient use of resources, consumption and production;
- contribute to existing macroeconomic goals by creating green jobs, eradicating poverty, and increasing competitiveness and growth in key sectors of the economy.

For the formation of a green economy, the economy's path to sustainable, resource development requires a new belief system, a new methodology. UNEP has issued a number of general recommendations to national governments and those responsible for policy development and the transition to a green economy. These include (ECLAC 2010; UNEP 2011a and OECD 2011a):

- creating a transition to an effective regulatory framework;
- prioritizing public investment and spending in areas that promote the transformation of economic sectors into green sectors;
- limit spending in areas where natural capital is consumed;

- use of taxes and market-based tools to change consumer preferences and encourage green investment and innovation;
- investing in skills, training and education;
- strengthening international cooperation and leadership.

From the point of view of ecological sustainability, the future of the economy should have the following important features (Bobylyev 2012, pp. 60-89):

- conceptually, economic strategies, programs, plans cover the areas dedicated to the green economy in the UN and OECD documents;
- environmental conditions and their maintenance;
- priority in the development of high-level, high-tech, processing and infrastructure industries with minimal impact on the environment;
- reduction of the share of goods in the economy;
- more efficient use of natural resources and their economy: this is reflected in a sharp decrease in the value of natural resources and the amount of pollution per unit of output (reduction of pollution intensity);
- reduction of environmental pollution.

The above conditions indicate the need to strengthen the role of the government in the transition to a green economy and improve public policy (UNEP 2011).

### **2.3. Achievements, Benefits, Opportunities and Necessity of Application in The Process of Transition to Green Economy**

The green economy is a new and developed mechanism based on an innovative system of economic activities that enhances social welfare and ensures competitive but responsible business growth. The green economy, which stimulates transformation, encourages and facilitates progress towards the three pillars of sustainable development.

More than 60 countries around the world are moving towards a green economy, and many want to achieve their ambitions in the next 10 years. Leading governments in this transition are breaking the traditional line of thinking that there is an inevitable compromise between economic progress and environmental sustainability, and instead demonstrate significant opportunities for investment, growth and security (EMG 2020).

In the long run, investing in green economy policies will result in faster economic growth. A green economy will overcome challenges such as energy shocks, water scarcity and ecosystem loss, and investments will be directed more to employment and agricultural productivity, which will lead

to poverty reduction (Maran and Nedelea 2017).

Mechanisms that provide a green economy, such as renewable energy, a green business and technology-friendly environment, and the training of a skilled and agile workforce, are also the driving force and outcome of the transition. The creation of low, medium and highly skilled jobs is just one of the short-term benefits of the transition to a green economy. Other opportunities for governments include improving the health and well-being of the population, leading to higher productivity and reducing healthcare costs.

The clean or renewable energy sector is a tool for development and innovation in all industries. Investing in clean energy will not only improve energy security and increase the environment and public health, but also cleaner technology and investment opportunities will create the fastest job growth opportunities. Supporting the environment for the development of small and medium-sized businesses (SMEs) through various policy mechanisms promises a flexible and sustainable business sector.

The availability of viable clean energy resource and a skilled and skilled workforce provide many opportunities for innovation and diversification in the business environment, which in fact strengthens policymakers. Higher investment brings new technology and higher productivity, which means better incentives for long-term investors. It will also be possible to invest more in infrastructure development and welfare measures, and thus investments in the green economy will be integrated into the principles of sustainable development (Maran and Nedelea 2017).

When discussing and researching the green economy, scholars compare it to both developed and developing countries. They think that the green economy is more the subject of developed countries. Because these countries have the potential to pay more attention to environmental issues than developing countries. At the same time, the damage caused to the environment by these countries in the course of development must be eliminated. According to a group of scientists, the issue of green economy is more relevant for developing countries. In the development of these countries, along with environmental problems caused by environmental pollution, economic and social problems further slowdown their development.

The transformation of industrial parks in developing countries into eco-industrial parks is one of the key factors in solving these problems. Today, the number of eco-industrial parks in the world continues to grow. There

are currently more than 250 eco-industrial parks in operation or under development, compared to less than 50 in 2000 (World Bank 2018). Eco-industrial parks differ from traditional industrial parks in that they offer countries a variety of business benefits, but also provide more efficient use of resources, increase productivity, support enterprises in achieving their social responsibility goals, and reduce their exposure to climate change risks. In contrast, industrial parks bring industrial enterprises together in a special place to achieve efficiency and take advantage of cooperation opportunities. As a result, the concentration of economic activity in one area carries the risk of concentrating negative environmental and social impacts such as pollution, greenhouse gas emissions and poor labor standards.

Ulsan Mipo and Onsan Industrial Park in South Korea, home to thousands of companies in various fields such as car manufacturing, shipbuilding and oil refining, are examples of eco-industrial parks that are among the initiatives to transition to a green economy. As the industrial capital of South Korea, the industrial park employs up to 100,000 people. Ulsan Mipo and Onsan are part of South Korea's Eco-Industrial Park Initiative, which seeks to transform traditional industrial complexes into sustainable eco-industrial parks. Firms in Ulsan Mipo and Onsan have invested about USD 520 million in energy efficiency, industrial symbiosis, waste management and other environmentally friendly improvements. To date, the investment has saved USD 554 million, while firms in eco-industrial parks have earned USD 91.5 billion (World Bank 2018).

Thanks to the state investment of USD 14.8 million, the companies in the park reduced carbon emissions by 665,712 tons in 2015-2016 alone, reused 79,357 tons of water and saved 279,761 tons of oil equivalent in energy use. Ulsan Mipo and Onsan Industrial Park are examples of how eco-industrial parks can cope with the challenges of inclusive and sustainable industrial development (World Bank 2018). There are many obstacles to the design and construction of new eco-industrial parks or the improvement of existing ones, but one of the most critical challenges was the lack of clear indicators or international criteria to guide the process, and the steps taken in this area stimulate new efforts. Well-developed and effectively implemented strategies form the basis of countries' transition to green growth. Green development strategies under different names, such as green growth, green economy, low carbon emissions, and climate-sustainable development plan, can vary according to the political and institutional structure, level of development, resources, and economy of a

country.

Excessive CO<sub>2</sub> emissions resulting from increased consumption of carbon dioxide (CO<sub>2</sub>) fossil fuels, which are essential for keeping the Earth at a comfortable temperature, disrupt the Earth's carbon cycle and accelerate global warming. Carbon emissions are greenhouse gases produced by burning fossil fuels. Greenhouse gas is a gas that absorbs and emits heat radiation, creating a greenhouse effect. There are several ways for individuals to reduce carbon footprint: some choose to walk, ride a bike, or take public transportation instead of driving, and use reusable containers or bottles instead of buying individual packaging. China became the world leader in 2020 with emissions of 11,680 gigatons of carbon dioxide. This accounted for more than 32% of global emissions in 2020. The United States is in second place with 4,535 gigatons of carbon emissions, which is about 12.6% of total global emissions. Comparing 2017 to 2020 in Table 2.1, we can see a decrease in carbon emissions in some countries. The top 10 countries with declining carbon emissions include the United States, Japan, Germany, Mexico, Russia, Canada, Spain, Andorra, the United Kingdom, and Italy (EU JointResearch Center 2020).

No	Country	Carbon emissions in 2017 (in million tons)	Country	Carbon emissions in 2020 (in million tons)
1.	China	10877	China	11680
2.	USA	5107	USA	4535
3.	India	2454	India	2411
4.	Russia	1764	Russia	1674
5.	Japan	1320	Japan	1061
6.	Germany	796	Iran	690
7.	South Korea	673	Germany	636
8.	Iran	671	South Korea	621
9.	Saudi Arabia	638	Saudi Arabia	588
10.	Canada	617	Indonesia	568

**Table 2.1** *Volume of carbon emissions by countries in 2017-2020 (TOP 10 countries) (Source European Union Joint Research Centre, 2020)*

Existing modes of transport also use energy sources as fossil fuels, which emit large amounts of greenhouse gases into the environment. Today, the transition of the world's countries to green transport will help clean the atmosphere of

these toxic gases. Countries such as Sweden, Germany, the Netherlands and the United Kingdom have been identified as countries that actively address sustainable transport issues (Conserve EnergyFuture, 2022).

"Green" making noise in all industries, greening the business sector is even more important around the world. SMEs, startups and eco-entrepreneurs play an important role in the transition to a low-carbon economy by developing new green business models for various industries. In fact, young and small firms are emerging as key drivers of radical eco-innovation in the industrial and service sectors.

The main motivations for a green entrepreneur are to take advantage of market opportunities and promote environmental sustainability. Green business helps to implement innovative solutions, competes with established markets. Some of the most popular areas where small green businesses have historically been successful are renewable energy production (solar, wind and biomass), hybrid vehicles and recycling of waste. As for established green industries (such as waste management and waste water treatment), large companies dominate here, but SMEs and startups can leave a lasting mark if they can implement innovative processes and systems. An environmentally friendly transformation of existing practices is another attractive way for SMEs to participate in the green economy (Bioenergy Consult, 2021).

### **2.4. Difficulties Faced by Economies in The Process of Transition to a Green Economy**

The transition to a green economy requires special conditions. These favorable conditions include the government of national economies, domestic and foreign policy, subsidies and support, as well as international markets and legal infrastructure, trade and technical assistance to developing countries. Steps are now being taken through the green economy against the dominant brown economy, which is overly dependent on natural resources, depleting them and degrading the environment.

Some countries have achieved a high level of human development due to their natural resource base, environmental exploitation and high greenhouse gas emissions. Today, the task facing these countries is to reduce greenhouse gas emissions per capita without compromising quality of life.

There are two equally important aspects of the transition to a green economy: greening the brown economy and green growth. Any brown

economic sector can be greened through the application of clean, efficient and innovative technologies. Green growth should be stimulated by investing in new green industries.

Given the diversity of the world in which we live, as well as the uniqueness of each country's national conditions and development priorities, there is no single model or path to a green economy. However, the transition to a green economy for all countries will require large-scale structural and technological changes in the economy, or at least the greening of key sectors such as energy, urban infrastructure, transport, industry and agriculture. It also includes landscaping investments at the national and global levels, the creation of green jobs through new green sectors, and the support and facilitation of international green trade through national and international policies (Green Economy, 2017).

As the world moves towards a green economy and the demand for environmentally friendly products increases, the demand for environmentally harmful products will naturally decrease. Regardless of the overall balance of global influence, some countries will suffer from deteriorating trade conditions during the transition to a green economy, and some firms will suffer from market losses. Perhaps the best-studied example is the impact of climate change response on oil-producing countries.

Another important issue in the transition to a green economy is intellectual property rights, and in particular patents, a policy tool that has been hotly debated for more than a century. Although there is considerable (but uncertain) analysis of how strongly intellectual property rights stimulate trade and investment, and their international impact on the distribution of technology, the key question for a green economy is how they can help or hinder countries.

By systematizing and structuring the problems of transition to a green economy, we can conclude that international agreements should become the main tool for the transition to a green economy. But these agreements should really try to overcome all obstacles at the international level (Green Economy, 2017).

As can be seen when considering each problem separately, if there is a balance, all problems can be solved, but such a balance is extremely difficult to achieve. It is international agreements that can help achieve this balance, but they are not easy to work with. In order for international treaties to fulfill their obligations, it is necessary to achieve the fulfillment

of obligations by all countries of the treaty and to find leverage over countries that do not fulfill their obligations.

### 2.5. Grounds for the Transition to a Green Economy in Azerbaijan and Green Economy Initiatives

Along with Azerbaijan's oil industry, development in the non-oil sector, integration into global economic development and increasing economic sustainability are among the main target strategies. The measures taken to expand the green economy are important for the development of natural resources in the world, increasing demand for them, achieving sustainable and secure development against the background of environmental pollution. The green economy envisages the implementation of the principles of "taking as much from nature as necessary" and "producing more with less", which translates into the concept of brown economy, ie more use of natural resources, low energy efficiency, dependence on unsustainable energy sources and high environmental pollution used as the opposite term to a based economy (Azerbaijan Science Association 2020).

Today, Azerbaijan also pursues a successful policy to build a green economy as a component of sustainable development. The EU-funded EU4Environment program has been supported to accelerate the country's transition to a green economy in 2013-2017 as part of the EU-funded Eastern Partnership program. The program aims to protect and better use natural capital in the Eastern Partnership countries, as well as in Azerbaijan, improve people's environmental well-being and stimulate economic growth. Five implementing agencies - the Organization for Economic Co-operation and Development (OECD), the United Nations Economic Commission for Europe (UNECE), the United Nations Development Program (UNDP) and the United Nations The Environment Program (UNEP), the United Nations Industrial Development Organization (UNIDO) and the World Bank (WB) are involved (United Nation,2020).

Under the program, UNIDO continues advocacy activities to support the resource efficiency of SMEs. UNIDO also highlights opportunities to support the creation of circular value chains between governments, businesses and civil society institutions to increase the opportunities and benefits of a circular economy.

Substantial steps are being taken in Azerbaijan in terms of decarbonization and proper distribution of energy sources. Accelerating economic growth based on high, sustainable, inclusive and mainly private initiatives to increase the level of social welfare, ensuring the return of the population to



the liberated territories are the basis of Azerbaijan's new development strategy. The following five National Priorities for the socio-economic development of the country should be implemented in the next decade in the “Azerbaijan 2030: National Priorities for Socio-Economic Development” approved by the Decree of the President of the Republic of Azerbaijan dated February 2, 2021 (president.az 2021).

- 1.a steadily growing competitive economy;
- 2.a dynamic, inclusive and socially just society;
- 3.competitive human capital and a space for modern innovations;
- 4.great return to the liberated territories;
- 5.clean environment and green growth country.

These National Priorities are also of particular importance for the implementation of the UN commitments arising from the "Transformation of Our World: Agenda for Sustainable Development until 2030."

Achieving green growth, which is one of the priorities of socio-economic development in Azerbaijan, as well as planning to increase the share of renewable energy sources in electricity production to 30% by 2030, reflects Azerbaijan's goals for energy transformation. The expansion of projects and proposals for the transition to a green economy, the growing role of alternative and renewable energy will reduce the demand for oil, which in turn increases the likelihood that oil prices will not be high in the medium and long term. Therefore, the development of the non-oil sector in Azerbaijan will be supported in the direction of economic diversification. Although the transition to a green economy and the depletion of oil reserves have led to a decline in oil revenues, despite the increase in budget revenues from the non-oil sector in recent years, declining oil revenues are still not offset (The Ministry of Energy of the Republic of Azerbaijan, 2021). Given the scale of global climate change, we need to pay more attention to the application of environmentally friendly technologies, use clean energy sources, recycle waste and take steps to rehabilitate polluted areas. As a result of the steps to be taken, gas emissions, which create a thermal effect, will be maintained at the level of international standards. Along with the economic development of the country, the protection and restoration of the environment, increasing greenery, efficient use of water resources and sustainable energy sources must be ensured.

The Law of the Republic of Azerbaijan “On Rational Use of Energy Resources and Energy Efficiency”, which will come into force on July 1, 2022, provides for measures to promote energy efficiency and energy in

Article 15 of the Law. The use of renewable energy sources can be found in this item, and special attention is paid to this issue in Azerbaijan, as well as in other countries.

In the coming years, the use of alternative and renewable energy sources will be more observed in advanced countries. Therefore, it is necessary to identify effective ways to use energy in Azerbaijan and give preference to new sustainable energy sources.

The main goal of Tamiz Shahar Open Joint-Stock Company is to build and manage waste disposal and utilization in accordance with modern standards, to develop this area in stages in the future on the basis of market economy principles comes up with project initiatives. The following are examples of these projects (Tamiz Shahar JSC2022).

1. **Solid waste sorting plant.** The plant was built to develop the processing industry in the country. As a result of modern technology sorting, the total volume of waste is reduced, a cheap raw material market is formed, conditions are created for the establishment of a recycling process in the country, energy is saved and the negative impact of waste on the environment is reduced.
2. **Solid waste incineration plant.** The plant, built on the basis of fourth-generation technologies, is the largest plant of its kind in Eastern Europe and the Commonwealth of Independent States (CIS). Smoke ash from combustion products is captured by special filters and does not pollute the environment. Heavy and harmless bottom ash is used in the preparation of construction materials needed for road construction. The supply water used for cooling during waste incineration is discharged into the waste water after treatment.
3. **Balakhani Industrial Park.** The park is considered an area that helps to develop green business. In order to ensure sustainable and efficient use of resources and minimize waste, production facilities, as well as waste treatment and other service facilities are being established in the Park.
4. **Ecological restoration project of Absheron lakes.** The main goal of the project is to restore areas polluted by oil and oil wastes and other industrial wastes and to improve the environmental situation. An example of the project is the work done around Boyukshor Lake.
5. **Integrated Solid Waste Management Project.** Within the framework of this project, the improvement of the Balakhani landfill, control over the impact of solid waste on the environment, increasing the efficiency of the landfill, purchase of equipment and machinery in accordance with modern standards, construction work were financed. As planned, a

landfill meeting new and modern standards has been built.

One of the greatest achievements of Azerbaijan in the transition to a green economy is the presence of the Green Port. As part of the 2030 Agenda for Sustainable Development, the Port of Baku, which supports the SGPs identified by the UN General Assembly, is also working with investors, customers, employees and stakeholders to adapt and positively impact business priorities directly related to port activities. has adopted 12 DIMs aimed at building good relations. Baku Port has been developed as a Green Port and Logistics Center in the region in compliance with international standards and using modern technologies in various aspects such as energy, waste management, air quality, digitalization, automation, as well as sustainable business practices. Baku Port is one of the key players in the transition to a green economy in the transport sector. The port started this long-term and difficult operation in stages in 2016. In 2021, together with the EU, the Port has developed a strategy called "Climate", which stipulates zero emissions and will cover its activities until 2035. Baku Port has successfully completed ISO 9001: 2015 (Quality Management System), ISO 14001: 2015 (Environmental Management System), ISO 45001: 2018 (Health and Safety Management System) and ISO 50001 (Energy Management System) certification processes. It is important to note that Baku Port was the first port in the Caspian region to be awarded the PERS - EcoPorts certificate of the European Seaports Organization (ESPO), which helps to raise awareness of environmental protection and is a specific environmental management standard for environmental protection. The Green Port policy plays the role of a beacon in the decision-making process and forms the basis for the sustainable operation and development of the port. The main current projects of the "Green Port" policy include "Wastewater treatment plant", "Environmentally friendly operation building", "Coastal power supply to ships in the port", etc. an example can be given. Future projects such as Alternative Energy and Sustainable Supply, which support sustainable development and the green economy, are at the heart of this policy. For example, in the project "Coastal power supply to ships in the port" with the support of the European Bank for Reconstruction and Development (EBRD) plans to install solar panels in Baku Port and provide the port's electricity entirely from these panels. (Port of Baku, 2022).

Another green example in the transport sector, which covers the capital Baku, belongs to the Baku Transport Agency (BTA), which includes a land transport network. Since 2015, the global environmental situation has been

assessed and new requirements in transport policy and public investment have led to the replacement of diesel buses with modern buses running on compressed natural gas (CNG), a cleaner type of fuel. At present, 34% of Baku's total bus fleet consists of CNG-powered vehicles, and as a result, 11% less harmful gas emissions are emitted annually. According to the Resolution of the Cabinet of Ministers No. 73, from 2025 it will be possible to bring only CNG and other alternative energy buses to the capital. This means that buses running on CNG and other alternative energy will replace diesel and gasoline-powered buses. In terms of transportation, one bus with this engine is 30 times more environmentally friendly than private transport. After all the buses serving the city's public transport have been replaced by CNG, we can see a significant change in the environmental landscape. Each of these activities provides a green and sustainable transport system during the transition to a green economy (BTA, Strategic Development and Planning Department 2021).

There are many advantages to using green transport:

- Significant reduction in carbon emissions as a result of the reduction in the use of private vehicles and the transition to other alternative means of transport;
- Green transport means less cars, less road infrastructure and less investment. Building an alternative transport infrastructure, such as a bicycle, will also bring more benefits at a lower cost. Currently, the construction of a 7.5 km long bicycle path covering the center of Baku and the Boulevard has begun. According to the General Plan of Baku, the length of the bicycle road network will be 63.5 km by 2027 and 251.2 km by 2040;
- The creation and maintenance of infrastructure for pedestrians and cyclists will support employment growth, for example, it is estimated that there are 7,000 such jobs in Germany (BTA, Department of Strategic Development and Planning 2021).

BTA is taking rapid steps to ensure transport mobility in the capital, as well as cleaner and more economical green transport, and it is expected that high rates will be reached in the development of pedestrian transport in the near future.

The Eastern Partnership (EaP) initiative, initiated by Poland and Sweden, includes strengthening bilateral cooperation between Azerbaijan, Georgia, Armenia, Ukraine, Belarus and Moldova with EU countries and continuing it in a multilateral format. The EaP includes:

- new agreements on deep and comprehensive free trade;

- EU-funded programs;
- mobility and security pacts;
- visa-free travel;
- introduction to the EU labor market;
- Compliance with EU legislation and standards;
- Cooperation in the field of human relations.

The following platforms have been established for discussions within the EaP multilateral format and regular meetings are held within the platforms (Cooperation with the European Union 2022):

- Platform for Strengthening Institutions and Good Governance;
- Platform for Economic Development and Market Opportunities;
- Platform for Connectivity, Energy Efficiency, Environment and Climate Change;
- Platform for mobility and people-to-people contacts.

The EaP countries are cooperating with the EU, OECD, UNEP and UNIDO within the framework of the Green Economy project. The main goal of the program is to help EaP countries move away from the environmental crisis and resource depletion that hinder their economic growth, and to use strategic environmental assessment and environmental impact assessment as important planning tools for environmentally sustainable economic development. In all Eastern Partnership countries, including Azerbaijan, work is underway in this direction, from the establishment of a legal framework to the development and implementation of national guidelines. Ganja city, Azerbaijan's second largest city, has joined the EBRD's Green Cities project, a successful urban sustainability program that has helped transform 40 cities. As part of the program, the EBRD will assist Ganja city in developing a Green City Action Plan to identify, prioritize and address environmental issues. The Bank will also provide financial support to the city to improve its modern street lighting system, environmentally friendly urban transport, water and wastewater management, including solid waste management, and central heating and renewable energy infrastructure. The project provides great opportunities for cities, which account for 70 percent of global energy use and 80 percent of greenhouse gas emissions, to combat climate change and environmental degradation. This is especially true for cities in the EBRD regions where outdated urban infrastructure reduces quality of life, increases greenhouse gas emissions and prevents society from adapting to climate change. The EBRD is one of the most important institutional investors in Azerbaijan. To date, the bank has invested 3.3 billion euros in the country through 170 projects. It also

provides business advice to local small and medium enterprises and has helped more than 1,000 firms improve their operations.

Green work has also begun in Karabakh. Reconstruction works are being carried out in the planned region on the basis of modern urban planning concepts due to the application of the most advanced innovations. At the same time, given the availability of alternative energy sources, the transformation of this area into a green energy zone is of great importance. Taking into account international experience, the cities and villages of the region will be reconstructed on the basis of the concept of "smart city", "smart village", which in turn is one of the main services of the economy in the region. will facilitate the organization and development of almost all types of tourism at the most modern level (Medium-Term Budget Framework (2022-2025)). In addition to the funds allocated from the state budget to achieve these goals, increasing the role of local companies, as well as attracting foreign investors will also make a positive contribution. Various steps are being taken to attract foreign investment, and special attention is paid to the prospects and opportunities of these areas for foreign investors. Carrying out reconstruction and rehabilitation work on the basis of a single concept will lead to the expansion of the country's economic potential. The redevelopment of these areas will have a positive impact on the country's economy, which will result in economic growth. Given the multifaceted nature of the Karabakh recovery process, we can see that this process will also create new opportunities for the development of many sectors of the country's economy.

If we take into account that Karabakh has a great potential for renewable energy production, we can see that solar radiation per square meter of horizontal surface is 1,600-1,700 kilowatt-hours per year, and the total solar energy potential is 3,000-4,000 megawatts. The area will also be able to produce wind energy. In the mountainous part of the region there are large areas with an average annual wind speed of 7-8 meters per second at an altitude of 100 meters, as well as the border with Armenia in Kalbajar and Lachin regions up to 10 meters. In addition, the availability of thermal water resources in Kalbajar and Shusha raises the question of the possibility of using thermal sources for energy purposes ("Azerbaijan" news 2021). According to the Global Wind Report 2022 prepared by the Global Wind Energy Council (GWEC), Azerbaijan ranks second in the world in terms of wind energy potential. According to the report, Azerbaijan's wind energy potential is about 157 gigawatts, and the government plans to increase the share of renewable energy in total electricity investment to 30% by 2030.

In 2060, as part of a green hydrogen policy, the coastal zone will become a region with zero emissions. Along with Azerbaijan, the list also includes Australia, Sri Lanka and Turkey. Australia's wind energy potential is estimated at 4,963 gigawatts, Sri Lanka's at 92 gigawatts, and Turkey's at 70 gigawatts (Global Wind Report 2022).

	2015	2016	2017	2018	2019	2020
Electricity	24 688,4	24 952,9	24 320,9	25 229,2	26 072,9	25 839,1
From it:						
Electricity of HPP	1 637,5	1 959,3	1 746,4	1 768,0	1 564,8	1 069,5
Wind energy	4,6	22,8	22,1	82,7	105,4	96,1
Solar energy	4,6	35,3	37,2	39,3	44,2	47,0
Electricity from waste incineration	181,8	174,5	170,3	162,2	195,9	200,6

**Table 2.2** *Electricity production in Azerbaijan in 2015-2020 (million kWh) (Source State Statistics Committee of the Republic of Azerbaijan, 2020)*

All these sources allow to implement new energy projects in Karabakh. Large-scale work in this direction is being carried out in sequence.

In order to develop a concept for the creation of a green energy zone in Karabakh based on the efficient use of renewable energy potential such as wind, solar, hydro, geothermal and bioenergy, energy efficiency technologies, modern energy management approaches, the Ministry of Energy of Azerbaijan and Japan's Tepsco An agreement was signed between the company. The project will cover energy demand and energy supply scenarios depending on economic development and settlement in these areas, the integration of renewable energy into the network, energy efficiency, transport, urban planning, waste management, smart grids, green financing and other issues. Tepsco, which has international experience in the field of green energy, has offered green solutions in smart city projects in Japan, Vietnam, Malaysia, Indonesia, Brazil and Thailand.

The President of the Republic of Azerbaijan signed a relevant decree to establish the Aghdam Industrial Park in the Aghdam region as part of large-scale construction and restoration work to ensure the rapid integration of the Karabakh territory into the national economy, sustainable

development, as well as decent living conditions. Aghdam Industrial Park will be established and developed through the application of modern technologies as an area used for the production, processing, as well as processing and sale of competitive products in the field of industry, as well as the provision of services, helping entrepreneurs and the effective operation and development (president.az 2022).

### 2.6. Methodology

The main aim of the study is to analyze in depth the concepts of sustainable development and green economy, to identify the challenges facing the world, including Azerbaijan, in the transition from a brown economy to a green economy and to identify ways to take advantage of potential opportunities.

Data was collected through a semi-structured interview method. A semi-structured interview was selected to provide more detailed information on the topic. A semi-structured interview is a data collection method that relies on asking questions within a predetermined thematic framework. The population of research consists of all enterprises/institutions operating in the field of green economy. When selecting the sample, the snowball sampling method was chosen from the non-probability sampling methods. Snowball sampling is a method used when it is not possible to determine the boundaries of the population. The snowball method was chosen because the topic of green economy is new for Azerbaijan and it is difficult to determine which enterprises have enough relevant activities. In total, 12 questions were used in the semi-structured interview. In preparing the interview questions, a literature review was conducted, based on questions used in previous research around the world. An example of this is the questions used in the work of researchers such as Şahinöz A., Sulich A., Nhamo G., Maran R.M., Nedelea A.M., Kudelas D., Domru E., Stoianov A., Peters D., Lutz C., Zieschank R., Drosdowski T., Kasztelan A., Jones B.

### 2.7. Research Findings and Discussion

Representatives of various organizations involved in the transition to a green economy (Secretariat of the First Vice President of the Republic of Azerbaijan, Baku Port, Baku Transport Agency) and experts conducting research in related fields were interviewed about the processes of green transition in the world and in our country. In order to protect the anonymity of the interviewees, the individuals were conditionally marked as A, B, C and D. The interview questions and answers were as follows:



## Green economy and Green Finance

Question	A	B	C	D
1. What is a green economy? Who are the stakeholders in the green economy?	A green economy means ensuring the sustainability of society and the country's economy by focusing on environmental issues. The most important stakeholders here are the government and then the society.	The green economy is the trend of the future. Important areas for the country's economy can be protected and developed through the transition to a green economy. The brains that think about the positive consequences of this transition are the stakeholders here.	Everything that plays an important role in protecting the environment means a green economy. Both governments and private organizations, as well as society, play a stakeholder role here.	The green economy is a system that sets new goals for sustainable and inclusive development. Typically, all three sides of the Triple Helix Model - the academic sector, industry and government - are interested in building a green economy.
2. How can sustainable development be achieved with the transition to a green economy?	There are certain similarities and differences between sustainable development and the green economy. Therefore, the situation may change depending on the approach of each country to this transition.	The transition to a green economy directly ensures future economic growth and sustainable development. For example, in the near future, non-compliance with green standards in maritime trade will lead to sanctions against the country in this area and, as a	Reducing environmental carbon emissions, cleaner public transport and greater pedestrianization, which are key objectives of the green economy, will contribute to sustainable development in the green transition.	One of the main goals of the transition to a green economy is to achieve sustainable economic development. As a result, resources are scarce and there is a need to move to new systems that are less harmful and more profitable in order to manage these

		<p>result, the creation of financial obligations, which will create serious problems for sustainable development. Therefore, pursuing green policies is one of our top priorities.</p>		<p>limited resources rationally.</p>
<p>3. What are the issues of public concern regarding the green economy and the transition to a green economy? What is the role of free individuals in society in addressing these issues?</p>	<p>Implementing the green transition means a certain improvement in the percentage of people living a healthy life. Unfortunately, the free members of society also continue to pollute the environment with harmful waste. In this case, the process of green transition is somewhat delayed.</p>	<p>This is a strategic issue. A unified strategy defined together with the society plays a key role here. Of course, the society has many duties and responsibilities in this regard. Every citizen must fulfill his responsibilities in this transition.</p>	<p>Today, the growing use of private vehicles is a major concern. Free individuals in society should think that this is environmentally harmful and should use alternative means of transport for short distances.</p>	<p>In general, societies experience some concerns as they transition to a completely new system. The participation of society as a party in this process both facilitates the transition process and increases the chances of a positive outcome.</p>
<p>4. How appropriate do you think the transition to a green economy is for</p>	<p>The transition to a green economy is an ideal path for developing countries, but</p>	<p>This transition is appropriate for developing countries, including Azerbaijan. It's</p>	<p>The question of whether the transition is appropriate here depends more on society than</p>	<p>Although the transition to a green economy is both costly and difficult for developing</p>

## Green economy and Green Finance

<p>developing countries and Azerbaijan?</p>	<p>it should be borne in mind that this transition is very expensive and requires large investments. Therefore, in order to implement this transition, investments must be made from the state budget, private institutions and international organizations.</p>	<p>just that countries face certain difficulties here. The most important of these is investment. For example, the creation of a Green Port in Baku Port would not be possible without investment.</p>	<p>on the implementation of activities. How society participates in these activities also determines the appropriateness of this transition.</p>	<p>countries and Azerbaijan alike, the results are beneficial. The threat is that it is unclear how the economy will react to the transition to a new system. The opportunity is that the transition to a sustainable system creates opportunities to use the potential of the economy.</p>
<p>5. What are the challenges facing countries in the transition to a green economy? What steps need to be taken to make these challenges work?</p>	<p>If we approach the issue from the Azerbaijani point of view, the main difficulty here would be the lack of awareness. For this purpose, UNIDO has established 2 clubs called Resource Efficiency and Clean Production under 2 research centers established in 2 different universities of Azerbaijan. Clubs unite small and</p>	<p>The main challenge is that developing a green economy requires a lot of investment. International cooperation can be used as a basis to overcome this. Many international organizations play a stakeholder role in financing green economy initiatives.</p>	<p>See the answer to question 3</p>	<p>The main difficulties are related to finance, investment sources, infrastructure, technical capabilities. Short, medium and long-term transition strategies are needed to turn these challenges to their advantage.</p>

	<p>medium entrepreneurs. There are various assessments of their activities, as a result of which it is possible to obtain information on the resource efficiency and cleanliness of the production of these entrepreneurs. It also focuses on the transformation of constraints caused by various causes and effects into opportunities.</p>			
<p>6. What are the achievements in the transition to a green economy? What steps should the country's economy take to ensure the sustainability of the gains?</p>	<p>There are a number of achievements in the transition to a green economy around the world. An example of this is the transformation of industrial parks into eco-industrial parks. This trend can be seen in Azerbaijan today. Then there is the availability</p>	<p>The Green Port established in Azerbaijan is the first port in the Caspian region to be awarded the EcoPorts certificate. At the same time, a number of projects are being implemented in the port with the support of the EBRD.</p>	<p>An example of the achievements in the field of transport in the transition to a green economy is the introduction of CNG buses in the capital. These buses are one of the main tools to help minimize environmental damage. Later, the expansion of pedestrian lanes, even the organization of some streets</p>	<p>The transition to a green economy can not only diversify energy sources, but also develop industrial sectors. This requires a measurable and applicable national strategy.</p>

	<p>of green vehicles that do not emit pollutants into the environment, the supply of electricity to certain residential enterprises and facilities at the expense of energy from renewable energy sources, etc. is one of the main achievements.</p>		<p>entirely for pedestrians, the construction of bicycle lanes will be among such future achievements. This will also lead to urban transport mobility.</p>	
<p>7. What are the bodies and institutions that manage the idea of a green economy and have access to the planning processes of the green economy? What is the motivation of these bodies to carry out this activity? To what extent do foreign initiatives support domestic approaches to the transition to a green economy?</p>	<p>Many organizations and institutions around the world come up with the idea and initiatives of the green economy. Their initiatives also serve as a motivator for other countries.</p>	<p>Examples of the institutions governing this idea in Azerbaijan are the Ministry of Economy, the Ministry of Ecology and Natural Resources and the Ministry of Energy. There are a number of international organizations in the world that both take green initiatives and invest in this area. In order to benefit from the green economy in the future, it is necessary to accelerate this</p>	<p>There are a number of international and local institutions that are actively involved in the transition to a green economy. Even if we are not deeply acquainted with their activities, it shows that a certain amount of time is needed to ensure this transition. Not only financial issues solve these problems, but also the society's way of looking at and understanding</p>	<p>The academic sector, industry and the government are interested in building a green economy. Because it gives all three parties the opportunity to reduce losses, increase profits and build a more sustainable future. At the same time, there is a need for public participation in this process. Foreign initiatives can accelerate the flow of investment,</p>

		transition today. But is this transition fast now? - Not at all.	this issue.	technology and knowledge transfer in this area.
8. Who are or will be the winners and losers of green economy initiatives? Why are winners and losers classified or will be classified here? (On the example of the world and Azerbaijan)	Those who develop a green economy in accordance with their own development agendas in accordance with the right national economic priorities and interests may be the winners, while those who are more dependent on foreign finance and those who implement projects that do not meet their national economic interests may be the losers.	There is no defeat in this regard. Every entrepreneur is a winner here. Because the green economy is targeting the future. The target here is the government and the strategy it has adopted. The strategy adopted by the government has no chance of defeat.	The right policy always pays off.	As in the transition from each traditional system to a new system, the losers here are mainly traditional players who benefit more from the current system. The winners are usually high-potential and innovative members of society.
9. Who or what can best help to implement the transition to a green economy in the short and long term and the processes associated with the green economy in general?	Universities, governments and private institutions.	Universities, governments and private institutions.	Universities, governments and private institutions.	Universities, governments and private institutions.

<p>10. What steps are being taken, what initiatives and projects are currently being implemented in Azerbaijan to achieve sustainable development in connection with the transition to a green economy? What are the benefits of these initiatives? In general, do these initiatives accelerate the transition to a green economy?</p>	<p>Clean city, green port, green energy, smart village, etc. At the same time, the EBRD Green Cities project will be launched in Ganjacity.</p>	<p>One of the greatest successes of Azerbaijan in the transition to a green economy is the existence of the Green Port. Today, the institutions in the country are implementing the green transition within their framework. I think that if there is a single strategic plan, this transition will be even faster and the benefits will be visible in the short term.</p>	<p>Today, the transition to a green economy is one of the topics on the agenda in most areas of the country. The issue of accelerating the green transition of these initiatives depends on the parties, as a joint solution is needed, not a unilateral one. However, if we look at the current situation, we see that this transition is not going fast.</p>	<p>Azerbaijan has some domestic policies in this regard, as well as attracting foreign investment. However, it is difficult to implement this transition without the involvement of all three aspects of the triple development model, as well as society. If these parties can actively and openly participate, the transition process will be accelerated.</p>
<p>11. What are the opportunities for Azerbaijan in the transition to a green economy? Are these opportunities being used enough in the transition to a green economy?</p>	<p>We have ample opportunities for the transition to a green economy: solar and wind energy. Azerbaijan ranks second in the world for wind energy potential. These opportunities are still being explored in East Zangazur, Karabakh and Absheron.</p>	<p>Renewable energy sources are an example of this. If we take into account that the country covers about 300 days out of 365 days of the year and even more sunny days, this will give us the opportunity to make maximum use of solar energy.</p>	<p>Azerbaijan is rich in renewable energy potential. I think that these opportunities can be used enough.</p>	<p>Azerbaijan has potential and opportunities in terms of alternative energy, geographical location and resources. However, it seems that they are not used enough.</p>

12. What are the factors slowing down the transition to a green economy in Azerbaijan?	Lack of awareness	Lack of specialist potential	Human resources and public awareness on this issue	Weak institutional framework
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Interviews show that today the issue of green economy is relevant in Azerbaijan, as in all countries. A number of public and private entities have different obligations regarding the green transition. The implementation of these commitments is directly aimed at achieving sustainable development in the country.

In today's world, processes are changing rapidly. Topics that are relevant today may lose their relevance for tomorrow. From the answers given by the interviewees, it can be concluded that the green transition in Azerbaijan does not happen quickly. There are a number of problems and difficulties here. Thus, along with the problems of lack of stakeholders in this area, lack of initiatives, there are difficulties such as investment in this area and the behavior of free individuals in society. In addition to financial difficulties, weak infrastructure and lack of technical capabilities make it important to develop short-, medium- and long-term strategies to address them.

The achievements of Azerbaijan in the transition to a green economy are an indication that certain steps have been taken in connection with this transition. Examples include the transformation of industrial parks into eco-industrial parks, the creation of a "green port" that successfully completes the required certification processes, the operation of a large percentage of buses imported to the capital with CNG, the creation of green energy zones and smart villages in the liberated areas. The overall responses indicate that if a unified green transition strategy is adopted in the country, work in this area will proceed more quickly and systematically, but in the current situation, each institution is implementing certain initiatives in this transition. The fact that one body is unaware of the activities of another is an indication of the lack of coordinated working conditions. If there is a unified strategy, there will be a single platform for organizations involved in this field, which will report to the country, both by creating and expanding the necessary database in this area in the country, and strengthening cooperation and initiatives of



one institution by monitoring the activities of another. It is important to pay attention to cooperation in order to cope with the problems and difficulties. Also, Government-University-Industry cooperation will play a positive role in this transition.

According to the interviewees, renewable energy sources in Azerbaijan are one of the main potential opportunities for green transition. The import of equipment required to use these resources requires investment, and various measures are being taken in this regard, both by the country and by international initiatives interested in investing in this area.

A green economy also means zero carbon emissions, a waste-free and clean economy. In order to reduce carbon emissions, the import of modern buses has already become widespread. In the near future, this problem will be considered radically resolved. Eco-industrial parks are an example of the development of a waste-free and clean economy. The created parks are recycled and the amount of harmful waste released into the environment is minimized.

The research gives us reason to say that there is no statistical database of activities related to the green transition in Azerbaijan or it is not sufficiently developed. The availability of these statistics, in parallel with the dynamics of the transition, also requires specialists and researchers who can measure that data. One of the main points to pay attention to is the training of specialists and researchers in this field in the country and their competitive role in the labor market. The promotion of each area is directly related to its education. The organization of educational activities on the transition to a green economy through the initiative of public and private institutions, the teaching of this subject in schools and universities will make a positive contribution to the development of awareness about the green economy and sustainable development.

The close answers of the interviewees in most questions show that the problems with the green transition in the country are the same. This is a direct reason why the relevant agencies should focus on these problems. Unless the problems are resolved by the Ministry of Economy, the Ministry of Ecology and Natural Resources and the Ministry of Energy, there will be no transition, and there will be delays in future activities and a decline in the country's sustainable development.

In general, the results of the interview show that the country should develop and adopt a single strategic plan covering all areas related to the green transition, pay special attention to education and pursue a policy to attract investment that will accelerate the transition to the country through

cooperation.

### 2.8. Conclusion

The study concludes that the transition to a green economy means rapid and effective sustainable development. At a time when our world and the risks we face are changing significantly, these changes require a fundamentally new and different approach to our approach to the economy.

One of the main obstacles faced by the country's economies in the transition to a green economy is that this transition requires large investments. It is based on the use of renewable energy, and the infrastructure created for this requires a large amount of funding. If we take the use of solar energy as an example, then the issue of purchasing solar panels comes to the fore, as these panels are expensive and not lifelong. After a certain period of time, they expire and need to be renewed. These barriers will be removed as the green transformation becomes more widespread. At the same time, the green investment required in this transition will develop new sectors and technologies that will be key sources of future economic development: renewable energy technologies, resource and energy-saving buildings and equipment, low-carbon public transport systems, fuel-efficient and clean energy vehicles, infrastructure, waste management and recycling facilities, etc. In addition, additional investments in human capital, including knowledge, management and technical skills related to landscaping, and accelerating the awareness process are required to ensure a smooth transition to a more sustainable development path. Today, although the bulk of the investment required for a green transition comes from the private sector, public investment is needed to begin an effective transition.

The green economy is a concept that supports development, income and employment, and creates an exchange between economic progress and environmental sustainability. Although it is difficult to achieve economic growth under the green scenario in the short term, in the long run, all measures taken to move towards a green economy will result in both GDP growth and per capita income growth. In terms of employment, the green economy in a number of important sectors, such as agriculture, construction, forestry and transport, provides more jobs in the short, medium and long term than other jobs.

The green economy is fighting climate change, creating decent jobs, reducing dependence on imports, and replacing fossil fuels with clean

energy and low-carbon technologies. New technologies that promote energy and resource efficiency provide growth opportunities in new directions, compensating for job losses in the brown economy.

A green economy can provide as much economic growth and employment as a brown economy, and at the same time provide significantly more environmental and social benefits. Of course, there are many risks and difficulties along the way. However, the biggest risk is to stay in the status quo and not engage in the transition to a green economy. Moving towards a green economy requires world leaders, civil society and leading businesses to work together and actively in this transition. This will require continued efforts by governments to rethink and redefine traditional dimensions of income, decent living and well-being.

In recent years, Azerbaijan understands the importance of the transition to a green economy, and the country's leadership, including organizations interested in this field, is taking a number of important steps in this direction. Despite the active participation of Azerbaijan in this process among the Eastern Partnership countries, we face a number of factors slowing down the transition to a green economy. For example, there are three chains that are interconnected: poor education, lack of human capital, and weak research potential. It should also be borne in mind that the transition to a green economy is cost-effective, but costly. Therefore, as this transition is new for Azerbaijan, it needs some time for its promotion and development. A tripartite partnership between universities and research centers, the private sector and the government can be seen as a must to accelerate this promotion and development.

Although the participation of enterprises in the green transition is voluntary, it is to encourage all sectors in this transition. Of course, the performance of each enterprise will be different, but these sectors and most of the enterprises that choose to participate will constantly improve the level of landscaping. With the emergence of green competitors, the opportunities and benefits for businesses that are not interested in any aspect of landscaping in the long run will decrease. If each green opponent appears, a new one will be preferred. Green activities will be consolidated and developed for sustainable development. The role of governments, as well as societies, including environmental groups and universities, will help to clarify and implement the greenvision (or a version of it).

As the green economy is a new field, this field requires new policies, new initiatives, new staff, new technologies and so on. is required. The green transition, which is widespread in European countries in particular, has

become a topical issue around the world. Countries are using a variety of tools to accelerate this transition to achieve sustainable development.

### 2.9. Recommendations

Several proposals for the transition to a green economy in Azerbaijan can be considered, some of which may yield positive results in the short term and others in the long term. We can summarize the recommendations as follows:

- **Adoption of a unified Green Strategy in the country.** The study showed that one of the main reasons for the slow pace of the green transition in Azerbaijan is the lack of a Green Strategy Plan for Azerbaijan. The existence of this plan will also play a leading role in achieving sustainable development in the country. No matter how successful the individual green transitions of individual enterprises, it is important to develop and adopt a strategy and act in accordance with this strategy. Goals should be set for the strategic plan, and great opportunities should be created for the study and application of international experience. This strategy will also be identical to the strategic roadmap. The following issues must be reflected in the green plan:
  - Carrying out green enlightenment and training in this field;
  - Defining the roles of the university, the public and private sectors and working together;
  - Taking steps by the state to increase the interest of the private sector in the green transition by making special changes in the legislation;
  - Proper use of renewable energy sources;
  - Use of green transport (land and sea transport);
  - Environmental Protection;
  - Creation of green jobs, etc.

It should also be taken into account that Azerbaijan is new in this transition, and the application of tried world experience in a form adapted to the conditions of the country will be more successful than the development and application of new proposals.

- **Awareness.** Although green economy is a term that everyone hears, the level of awareness about what it is and what it promises is very low. There is a serious need to raise awareness about the green transition, not only in Azerbaijan, but in many developing countries. The main work here is the responsibility of educational institutions. Thus, the teaching of subjects that reflect such a green economy and sustainable

development in universities and even schools will contribute to increasing literacy in this area. At the same time, training in this area will directly support the government in implementing the green transition in the country.

- **Proper use of renewable energy sources.** For many years, dependence of Azerbaijan on the oil sector still creates various obstacles to the development of the non-oil sector. Having rich renewable energy resources is one of the main advantages we can use in the green transition. Thus, the efficient use of solar, wind and geothermal energy sources promises us a number of achievements in this transition. If obtaining energy from these sources requires a certain amount of money, the benefits are undeniable. The obtained energy can be used in lighting systems and insulation systems of buildings in the country. Also, the sale of the remaining energy will be reflected in the development of Azerbaijan's export potential.
- **Transition to green transport in the country.** As we know, currently only green buses (CNG-operated buses) are used in Azerbaijan, which is a type of green transport in the capital Baku. This covers only a part of the capital. As a result of overcrowding in Baku, the use of vehicles is increasing and there is an increase in the amount of harmful gases emitted into the environment. In many countries around the world, the use of bicycles is encouraged to ensure the mobility of large cities. Given the increase in the length of the bicycle road network in the Baku Master Plan, the promotion of the use of bicycles will not only ensure the transition to green transport, but also increase the production capacity of the ISMA BIKES bicycle plant. Over time, the introduction of this transition throughout the country will lead to the full use of green transport.
- **Promoting green investments.** One of the main problems and difficulties in the transition to a green economy is financing. We can see that there are few interested parties in investing in this area in Azerbaijan. To do this, the future benefits of the green transition must be shown to those who may be interested in the green transition, and steps must be taken to motivate them. Both the public and private sectors can participate here as stakeholders. At the same time, the issues of attracting foreign investment to the country through the initiatives of international organizations on the green transition should be kept in mind.

- **Waste recovery.** In industrialized countries, the absence of waste is impossible. However, today, the transition to a waste-free industry means stepping into the green transition. The main task of industrial parks is to recycle waste using modern technologies and reduce the amount of toxic fumes released into the environment using special filters. Recycling means new production, new exports, new jobs and environmental protection. Industrial symbiosis often manifests itself in eco-industrial parks. The concept of industrial symbiosis is mainly based on voluntary cooperation in various fields. Here, complementary enterprises can increase the viability and profitability of each other by merging and matching the respective production chains. Therefore, industrial symbioses consider resource scarcity and environmental protection to be crucial factors in the development of sustainable industry and profit.

The policies pursued by countries to achieve sustainable development through the transition to a green economy are diverse. Each country implements this transition in accordance with its resources, its civil society. The green economy, which focuses on social, economic and environmental issues and seeks to achieve positive results by analyzing them, is a policy that should have been abandoned years ago, but is now a global problem. The role of society in solving this problem is as great as the country's economy. In order to achieve the green transition goals, it is necessary to adapt to the requirements of the changing world and meet these requirements. The green transition, which is open to innovation and promises a better life for societies with a superior mindset, will also ensure the sustainable development of Azerbaijan.

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# Chapter 3

## Green Transformation in Azerbaijan: opportunities for SMEs

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### Abstract

Azerbaijan is in the process of redefining its medium-term development strategy by supporting private sector development and improving the enabling environment. In December 2016, it launched a strategic roadmap for development of the national economy and 11 key sectors, with medium and long-term goals for reforms and sustainable development. Several policy documents setting ambitious targets and creating a framework to encourage investment in low-carbon, climate-resilient development was elaborated. Recognizing its vital dependency on one sector, Azerbaijan aims to diversify its economy and follow a path of green growth. Along with other Eastern Partnership (EaP) countries of the European Union, Azerbaijan committed itself to the goal of a transition towards a green economy in the 2011, 2013 and 2017 Declarations of the “Eastern Partnership” Summits and in other international fora. More recently Azerbaijan launched a strategic roadmap for development of the national economy and 11 key sectors, with medium and long-term goals for reforms and sustainable development. It also developed several policies documents setting ambitious targets and creating a framework to encourage investment in low-carbon, climate-resilient development was elaborated. To meet these commitments and ambitious policy targets, Azerbaijan needs policies founded on a good understanding of what determines green growth. This requires appropriate indicators to monitor progress.

**Keywords:** Green economics, SME in Azerbaijan, economic growth

### 3.1. The Concept of Sustainable Development, The Main Aspects of Sustainable Development

Since the 1980s, the importance of sustainable development has been at the forefront, and in recent years the United Nations Environment Program

(UNEP) has highlighted the need for a “non-destructive development” approach, and for the first time widespread.

The term "sustainable development" was first used in 1983 by Gro Harlem Brundtland, the head of the International Commission for the Protection of the Environment.

According to the authors, sustainable development is such a development that "in addition to meeting the needs of future generations, it is possible to meet the needs of the current generation." This idea of sustainable development is recognized in many countries today.[1]

According to the traditional economy, the maximization of incomes in the market system and the full satisfaction of consumer needs are consistent with the maximization of people's living standards, and market inconsistencies can be corrected as a result of the effects of public policy.

According to the concept of sustainable development, meeting the growing needs of individual consumers and short-term maximization of incomes can ultimately lead to a decline and complete depletion of people's living standards and social and natural resources.

R. Costansa and K. Folke, who put forward ideas on sustainable development, note that sustainable development is related to the solution of three interrelated problems:

1. Sustainability of the economy in accordance with the ecological system of life support.
2. Fair distribution of resources among future generations and between humans and other biological species;
3. Effective allocation of resources over time.

Sustainable development involves two interrelated concepts.

- The concept of needs for the lower and poor;
- The concept of restrictions on the ability to meet the current and future needs of the environment and society.

The concept of sustainable development has five main principles:

1. Society can provide for the needs of the present generation and give sustainable and long-term character to development without depriving future generations of the opportunity to meet their needs.
2. The use of relative natural resources, as well as the current state of technology and social organization, is related to the ability of nature to cope with the consequences of human activity.
3. It is necessary to meet the basic needs of mankind and realize the hopes of a higher standard of living for everyone. Without this principle, sustainable and long-term development is impossible.

4. Lifestyle with high financial and material resources should be combined with energy consumption opportunities.

5. Demographic growth rates and growth rates must be aligned with the changing productivity potential of the global ecosystem.

The concept states that sustainable development is dynamic and that sustainable development is not a state of unchanging harmonious equilibrium, where resource use, investment, technological development and institutional change must meet current and future requirements.

The concept of sustainable development includes the definition and accounting of two boundaries:

- maximum ecological limit - the maximum amount of waste, as well as the degree of depletion of resources and wildlife, which will not lead to the destruction of the biosphere and the destruction of humanity;
- social minimum limit - the minimum limit of the use of natural resources that does not violate the basic needs of human existence and the right to a dignified and prosperous life.

The concept is the result of a combination of three perspectives on sustainable development - economic, social and environmental. Based on this, the concept of sustainable development is often called the three-dimensional concept of sustainable development. Recently, the fourth aspect of sustainable development - the aspect of organizational management - has also been emphasized.[5]

The economic aspect of sustainable development is John Hicks' definition of income, the principle of maximum aggregate income flow. Hicks noted that "the purpose of determining income is to show people that they need to determine consumption to avoid poverty.

According to Hicks, income is considered to be today's income, so that tomorrow's income will not be as limited as it is today. At the heart of the concept is the importance of optimal economic use of limited natural resources. Along with the optimal use of limited resources in the concept, with the right approach to the restoration of degraded natural landscape, it is possible to apply technologies by reducing the negative burden on nature, correcting unfavorable conditions, improving living standards and quality of life.

Limitation of natural resources has long been noted as a fundamental fact. The idea that natural resources are not free is based on the concept of sustainable development. It is the economic approach that underlies the concept of sustainable development. At the same time, the concept of sustainable development has provided an opportunity to look at the

concept of "economic efficiency" from a new perspective.

The social component of the concept is aimed at man, maintaining the stability of social and cultural systems, eliminating conflicts between people. The main aspect of the social approach is the fair distribution of benefits. It is the importance of overcoming social problems that ultimately led to the emergence of the concept of sustainable development. Sustainable development is impossible without a fair distribution of opportunities and resources in society among all members of human society. Achieving a high, decent standard of living for all the world's population should be the main goal of the world community.

An equal society is necessary for sustainable development at all levels of human society. Any minimum standard of living should be an essential right of every human being. Excessive material wealth is as much a problem for humankind as poverty.

The result of the development of the social components, one of the key components of this concept, was the basic idea of protecting the rights of existing and future generations. The transfer of the natural resources fund to future generations without pollution or damage is necessary for sustainable development.

Creating the right value system in the developing and emerging generation is one of the key issues. Highly demanding moral and aesthetic norms are an important step towards sustainable development. It is important to pay special attention to higher education on such issues. Depletion of natural resources, anthropogenic pollution and other environmental, legal and social problems, new scientific theories, new technologies, new criteria, goals, management of social and natural processes, necessitates design. The world community has made a political decision to create a new model of interconnectedness that can be a fundamental foundation for future development [3].

The transition to sustainable development and achieving significant changes in the pace of sustainable development is possible only if there is a radical positive change in higher education. To do this, it is necessary to expand the range of subjects taught, to include issues related to sustainable development in the curriculum, as well as to train specialists capable of creating a model of sustainable development of human life within the ecological, social and economic conditions formed on the basis of fundamental theories.

One of the next key components of sustainable development is the

environmental component. Environmentally sustainable development must ensure the physical and biological integrity of natural systems. One of the main issues facing every country today is to ensure economic growth. This is due to the disturbance of the balance of the biosphere, pollution and degradation of the environment, the destruction and depletion of natural resources, and reduces the opportunities for future development, causing harm to human health, climate instability. This means that the solution of such an important issue as raising the living standards of the people does not provide an important quality of life.

Today, a number of countries around the world are taking effective environmental measures to ensure sustainable development. The Scandinavian countries are reshaping their economies, which are designed to develop industries that produce environmentally friendly modern technologies, products and services. Combating global climate instability and increasing energy efficiency will have a strong impact on the future of the world economy. Currently, most of the global greenhouse gas emissions come from four countries - India, China, Russia and the United States.

Efforts by the European Union to increase energy efficiency by 20% and renewable energy sources to 20% by 20%, and to reduce greenhouse gas emissions by 20% (20:20:20 plan) could lead to radical changes in the European economy.

In this area, we can show the policy pursued by China, which has the world's second largest economy and is in a difficult and difficult environmental situation. It is implementing the largest and most important environmental reforms in China's history. The five-year "green" plan, adopted in 2011, is based on the application of modern technologies in environmental protection, prevention of anthropogenic impacts and use of natural resources, and the application of "green" taxation, implementation takes precedence. Even China is developing a system of environmental payments for waste, an internal scheme for the sale of waste quotas.

Over time, the idea of sustainable development shifts from theory to practice. The World Business Council has been working in the field of sustainable development for more than 20 years and was established during the summit in Rio de Janeiro, the main goal of the forum is to provide activities that will support the development of entrepreneurs. The board includes about 190 reputable companies from around the world (Canon, Hyundai, Ford, IKEA, etc.). According to research, the council's activities open up to \$ 6.3 trillion in business opportunities a year.

One of the important world policies is the development and preparation of comprehensive reports on sustainable development by companies and corporations. These reports already account for 75% of the total reports submitted by companies.

After mentioning sustainable development and its aspects, I would also like to mention the goals of sustainable development. Recognizing the need for more active assistance to the poorest nations at the beginning of the 21st century, UN member states have set key goals for sustainable development. In this document, called the Millennium Development Goals, the common goal is to accelerate development by improving the economic and social conditions in the world's poorest countries.

The 55th session of the UN General Assembly began in September 2000. Heads of state from 185 countries took part in the event. The Assembly adopted the Declaration "UN Millennium Development Goals" by Resolution 55/2. The Millennium Development Goals are:

Goal 1. Prevention of extreme hunger and poverty; Goal 2. Provide general primary education;

Goal 3. Increase gender equality and strengthen women's rights. Goal 4. Reduce child mortality;

Goal 5. Improving maternal protection;

Goal 6. Fight against AIDS / HIV, malaria and other diseases;

Goal 7. Protection of ecological sustainability;

Goal 8. Develop global cooperation for development [2].

In all countries, these goals are not being achieved successfully. While some countries have achieved their goals successfully, others have not. Examples of significant progress are China and India, which have strong internal and external development factors. Some African countries can be attributed to those who do not achieve these goals successfully, and poverty has decreased by only 1%.

The system of indicators developed by the UN Commission on Sustainable Development is a fully developed indicator of sustainable development in terms of scope. Sustainable development indicators are divided into the following main groups:

- Indicators of social aspects of sustainable development;
- Indicators of economic aspects of sustainable development;
- Indicators of environmental aspects of sustainable development
- Indicators of institutional aspects of sustainable development

According to the intended use, the indicators are divided into three groups:

- Driving force indicators. Characterizes the factors, processes and features that affect sustainable development;
- Situation indicators; characterizes the current and future state of various areas and aspects of sustainable development;
- Reaction indicators; creates conditions for the application of political and other methods of reaction to changes in the current and future situation of sustainable development.

### 3.2. The Role of The Transition to A Green Economy

The crisis that began in the US financial markets in 2008 and spilled over into the economy later turned into a global economic crisis. All of this was happening at a time when global climate change disasters were on the rise, and the world's environmental problems were exacerbated: shortages of drinking water and food, climate change, biodiversity and deforestation, desertification, and so on. these are the most important of the problems. If it continues in this way, in 2050 the countries of the world will not be able to meet their needs with natural resources. Repeated Keynesian policies no longer worked, and humanity was already at a crossroads. Mankind needed a new order, and it had to be "green" regardless of its name.

In recent times, with more frequent crises and aggravation of global problems than ever before, many countries and international organizations have begun to look for a new, intensive model of rapid development. As such a cardinal model, a "green economy" model was proposed - an economic system that would increase environmental welfare and increase social guarantees, while reducing environmental risks and deficits. The concept of "green economy" can be considered as a result of the development of the concept of "sustainable development". Introduced by the United Nations Environment Program (UNEP) in 2008, the term "green economy" refers to an economy that promotes human well-being, provides social justice, and significantly reduces environmental pollution and degradation. In the 21st century and the beginning of the 21st century, there are many projects that have caused significant damage to the environment.

According to the requirements of the "green" economy, all new strategies, programs and projects (in energy, industry, agriculture, transport and other sectors) should be low-carbon, limit greenhouse gas emissions, promote the development of renewable energy and protect ecosystems. One of the main shortcomings of the production stereotypes that existed in the world before the emergence of the concept of "green" economy is



the absoluteness of economic growth and its traditional indicators. The concept of "green" economy shows that previously accepted ideas such as "economic growth is the basis of progress", "first economic growth - then the solution of environmental problems" have already changed. However, it has already been proven that greening the economy does not prevent the creation of material goods or jobs, on the contrary, investing in many "green" sectors is a source of financial prosperity and increased employment.[7]

In the modern economy, there is a perception that the types of capital are interchangeable and complementary. This means that a decrease in one type of capital can be offset by an increase in another. The increase in these types of capital is usually accompanied by significant savings in natural resources and a reduction in environmental pollution. Ultimately, this leads to less and less involvement of natural resources in the economic cycle. This effect is achieved due to the increase in the technological efficiency of the nature-product chain, which connects the primary raw material with the final product, in other words, due to the decoupling effect.

### **3.3. Current State of Transition to Green Economy in Azerbaijan**

After the restoration of Azerbaijan's state independence, the successful development of the oil industry, as well as the increase in the competitiveness of the economy and the rapid development of the regions have become irreversible. Azerbaijan is currently pursuing a successful policy to develop a green economy as part of sustainable development. Emphasis on environmental issues and support for social and public initiatives determine the long-term prospects for green growth. 2010 was declared the Year of Ecology and a number of works were carried out in this field, propaganda work was carried out among the population and electronic sources were prepared.

Azerbaijan has developed a regulatory framework in the field of environmental protection and adopted many international conventions. The legislation in this area has been developed in accordance with international legal requirements and has laid the foundation for the implementation of a comprehensive environmental policy in the country. Environmental legislation and environmental policy in Azerbaijan have been improved in accordance with the decisions adopted at the Rio and Johannesburg summits.

The identified directions of environmental policy in our country are in line with the principles of the green economy:

- Application of new methods based on the principles of sustainable development to protect the environment and reduce pollution;
- Efficient use of natural resources to meet the needs of present and future generations, achieve energy efficiency through the use of inexhaustible energy sources using non-traditional and alternative methods;
- Assessment of global environmental problems at the national level and establishing relations with international organizations. [6]

The following principles of environmental protection legislation adopted in our country can be mentioned and they support the development of a green economy.

- joint solution of socio-economic and moral problems;
- maintenance and protection of ecological balance;
- to apply an ecosystem approach to the use of natural resources;
- to impose sanctions against environmental pollution;
- application of payments for the use of nature;
- restoration of damaged ecological systems;
- protection of biodiversity;
- effective use of natural resources and application of economic incentives for environmental protection;
- Application of the principle of "pays from pollution";
- Prosecution for violation of existing legislation in this area;
- ensuring environmentally sustainable socio-economic development;
- protection of human health and life;
- Everyone has a responsibility to protect the environment;
- participation of public organizations and the population in the field of environmental protection;
- Establishment of international relations in the field of environmental protection;
- harmonization of environmental legislation with international agreements and legislation.

In February 2021, the Strategy "Azerbaijan 2030: National Priorities for Socio-Economic Development" was approved, which includes five main areas:

- steadily growing competitive economy;
- a dynamic and inclusive society based on social justice;
- ensuring the competitiveness of human capital and land for the introduction of modern innovations;
- the great return to the territories liberated from occupation;

- a clean environment and a "green" country.

As it was emphasized, the above-mentioned national priorities are of particular importance for the fulfillment of our obligations arising from the "Transforming Our World: The 2030 Agenda for Sustainable Development" of the United Nations.

“In addition, by recent presidential decrees, the government was tasked with developing the «Smart City» and «Smart Village» Concept, as well as the Digital Transformation Concept. It is worth noting that in January 2021, the Center for Analysis and Coordination of the Fourth Industrial Revolution was established under the Ministry of Economy with the main goal of coordinating efforts related to the introduction of technologies of the Fourth Industrial Revolution and the digital economy in our country.

The measures taken to expand the "green" economy are of great importance in order to achieve sustainable development against the background of environmental pollution, declining natural resources and growing demand in the world. It is no coincidence that the 5th priority in the "Azerbaijan 2030: National Priorities for Socio-Economic Development" approved by President Ilham Aliyev is called "Clean Environment and Green Growth Country". The document sets specific tasks for the application of environmentally friendly technologies, the promotion of waste recycling and rehabilitation of contaminated areas, and the expansion of the use of environmentally friendly "green" technologies.[8]

It should be noted that the recycling process established in Azerbaijan serves the development of the "green economy", the expansion of production of competitive industrial products, the improvement of the environmental situation. The concept of "recycling" occupies an important place in the modern economy. After the consumption process, some of the waste can be recycled. Recycling is the periodic inclusion of reusable materials in the consumption process. The main goal is to prevent the waste of natural resources and environmental pollution, as well as to create an additional raw material base. Recycling, unlike primary production, is easy and quick to complete, which saves energy.

Supporting sustainable development and protecting the environment are two of the top priorities in Azerbaijan. In this context, accelerating this process with companies' social responsibility projects and strategic partnerships with large companies will be a very important contribution to the future of Azerbaijan.

The ESCO (Energy Service Campaign) model can be used to implement

green investments in our country. In recent years, Energy Service Campaigns, also known as ESCOs, have been launched to help businesses reduce the amount of energy they use, while also providing energy management services, which can make or help organize energy efficiency investments at any time. The main benefits provided by ESCO to the customer:

- Coverage of ESCO operating and maintenance costs;
- Realization of energy purchase and sale with the license owned by ESCO, there is no need for the enterprise owner to deal with them;
- Energy investments cover all financial and operational risks.

The ESCO system is a system that allows for the implementation of energy efficiency investments with the amount of savings provided in energy use, and then the realization of low energy costs. There is a wide range of tools for the transition to a green economy. These tools include:

- pricing in line with the principles of sustainable development, including the rejection of ineffective subsidies, monetary valuation of natural resources and taxation of everything that harms the environment;
- use of production methods in accordance with the principle of public procurement policy and sustainable development to stimulate the production of ecological products;
- Carrying out reforms in the system of environmental taxation, providing for the transition from labor tax to pollution tax;
- increase public investment in infrastructure (public transport, construction of energy efficient buildings, use of renewable energy sources, etc.) in accordance with the principles of sustainable development, as well as the restoration, maintenance and increase of natural capital as much as possible;
- state support for research and development related to the creation of environmentally friendly technologies;
- social strategies leading to the agreement between existing and planned economic strategies and social goals.

Many fiscal instruments are currently being used in many countries around the world to accelerate the transition to a green economy, as noted earlier. In Azerbaijan, the creation of a legislative framework in this area and the use of fiscal instruments can both increase government revenues and accelerate the transition to a green economy. As a developing country, this will have a negative impact on the economy, but the government can take incentives to prevent it.[9]

### 3.4. The "Green" Economic Potential of The Liberated Areas

In accordance with the National Priorities, the improvement of the environment, the rapid restoration and growth of greenery, and the efficient use of water resources and sustainable energy sources will be ensured.

One of the main directions in the course of economic development of the liberated territories defined by the President of the Republic of Azerbaijan Ilham Aliyev is the transformation of these territories into "green energy" zone. The President of the Republic of Azerbaijan, Mr. Ilham Aliyev, put forward a strategic vision for the establishment of a Green Energy Zone in the liberated territories, and stated that there was sufficient renewable energy potential in those territories.

Order No. 2620 of the President of the Republic of Azerbaijan dated May 3, 2021 "On measures to establish a "green energy" zone in the liberated territories of the Republic of Azerbaijan" envisages the involvement of an international consulting company. In cooperation with the Japanese company TEPSCO, a relevant Concept document has been prepared to implement the order. The purpose of the concept is to provide the area with environmentally friendly green energy using the high renewable energy potential available in the liberated areas and to formulate proposals by studying the prospects for the application of environmentally friendly and energy efficient green technologies. For this purpose, energy demand models of areas have been developed using different scenarios.[11]

Production of electricity from renewable energy sources in the liberated territories, energy efficiency measures, use of electric vehicles, installation of renewable energy devices (especially solar panels) on the roofs of buildings, as well as the use of solar-based LED lamps in street and road lighting as part of the Green Energy Zone, the use of renewable energy technologies in heating, cooling and hot water supply, the application of intelligent energy management technologies, energy management of waste.



At the same time, the UN Climate Change Conference (COP26) held by the Government of Azerbaijan in Glasgow in November 2021 reduced greenhouse gas emissions by 40% compared to the base year by 2050 and "net zero" in the liberated areas. The intention to create an "emission" zone was announced. This, in turn, will contribute to the transformation of the liberated territories into a green energy zone.

Preliminary observations show that there is a favorable potential for solar energy projects in Gubadli, Zangilan, Jabrayil and Fizuli regions, and this technical potential is estimated at more than 7,200 MW. At the same time, according to preliminary studies, the technical potential of wind energy in the mountainous areas of Lachin and Kalbajar is 2000 MW. In addition, the Tartar River, the Hakari River and its tributaries have great hydropower potential.[10]

Particular attention is paid to the construction of energy infrastructure and energy security as an important part of the process of restoring the liberated territories. In accordance with this goal, 4 hydropower plants with a capacity of 20.2 MW restored in Lachin, Kalbajar and Sugovushan have already been commissioned as part of the restoration of electricity generation capacity:

- "Gulabird" HPP - 8 MW;
- Sugovushan-1 HPP - 4.8 MW;
- Sugovushan-2 HPP - 3.0 MW;
- "Kalbajar-1" HPP - 4.4 MW.

At the same time, the construction of two hydropower plants on the Araz River in the Jabrayil region, with a total capacity of 140 MW for the Azerbaijani side (100 MW "Khudaferin", 40 MW "Maiden Tower") is underway.

Also, the implementation of the project to build a wind farm with a capacity of about 100 MW in the Lachin/Kalbajar area will further contribute to the establishment of a "Green Energy Zone" in the liberated areas.

In addition, on June 3, 2021, the Ministry of Energy of the Republic of Azerbaijan and BP signed an Executive Agreement on the evaluation and implementation of a project to build a 240 MW solar power plant in the Zangilan/Jabrayil zone.



### 3.5. EU4Environment Work in Progress: Perspectives for SME in Azerbaijan

The Agency for Small and Medium Business Development (SMED) under the Ministry of Economy attaches special importance to increasing the role of SMEs in the green economy and appreciates the initiatives in this direction.

SMEs are educated through SME development centers: The activities of companies involved in green energy, recycling and the circular economy are encouraged by supporting their participation in various local and international exhibitions. KOBIA has also developed and implemented special grant programs to stimulate SMEs. started.

The program includes financial support for the development, application of new green technologies, fuel economy, recycling and a number of other initiatives. Small and medium-sized businesses are expected to participate in these initiatives.

The Chairman of the Board of the Small and Medium Business Development Agency (SMBDA) met with Ben Butters, CEO of EUROCHAMBRES and representatives of EU4Business. The meeting in Brussels provided financial and technical support for joint projects, opportunities to participate in the organization's projects on "green economy" and SME digitalization, promotion of youth and women's entrepreneurship, cooperation in startup projects and other issues of mutual interest was discussed.

In order to improve the management experience and professional skills of the management staff of the Small and Medium Business Development Agency (SMBDA), a training was organized in Shabran with the participation of international and local experts. The training was implemented within the framework of the European Union project

"Support to creating a more favorable environment for small and medium enterprises and increasing their competitiveness." The event featured presentations on corporate governance standards, service improvement, project management skills and other topics in the field of management for the Agency's employees. The training also touched upon the best international practices of a number of countries in supporting SMEs, the promotion of the "green economy" in the activities of SMEs and other topics. In order to further develop the team spirit of the agency's employees and effectively organize their leisure time, various team competitions and contests were held as part of the training.[15]

### 3.6. Green Growth Indicators in Azerbaijan

1) Environmental and resource productivity: Higher CO<sub>2</sub> and energy productivity means a less polluting, more resource efficient economy, and a better climate and environment.

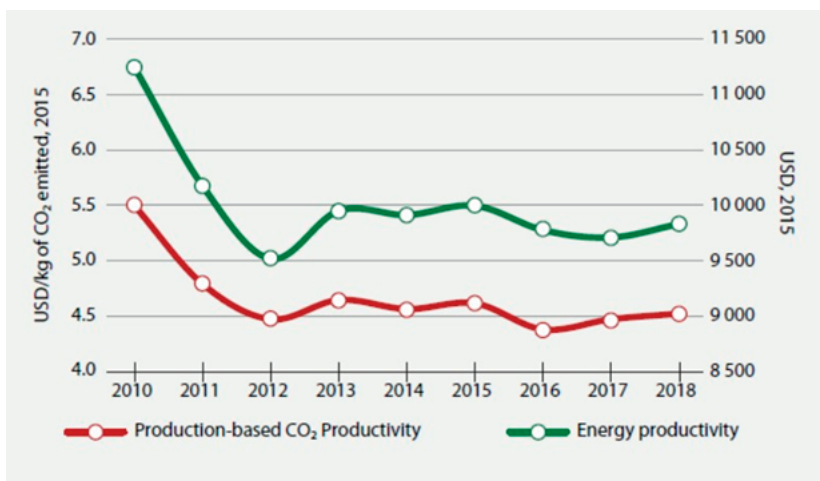


Fig. 3.1 *Environmental and resource productivity*

2) Environmental dimension of quality of life: Lower exposure to fine particles means cleaner air and healthier people, and is less costly for the government.



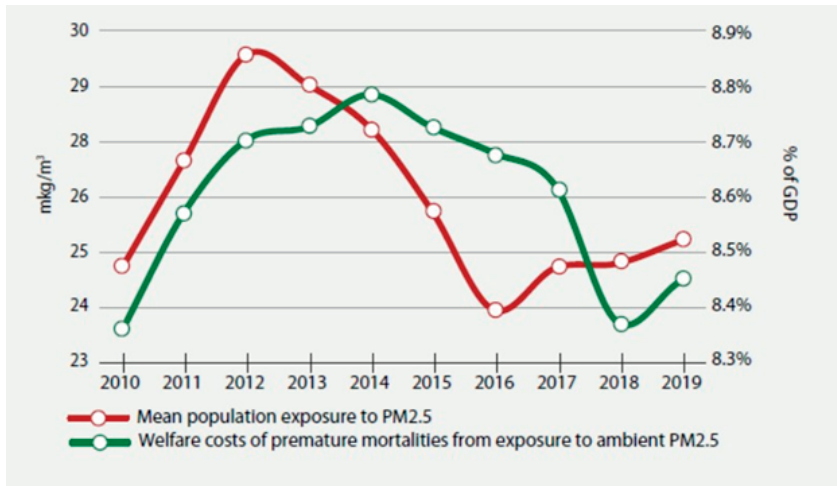


Fig. 3.2 Environmental dimension of quality of life

3) Natural asset base: Stablestocks of natural resources ensure sustainable use, which is essential for green economy transition.

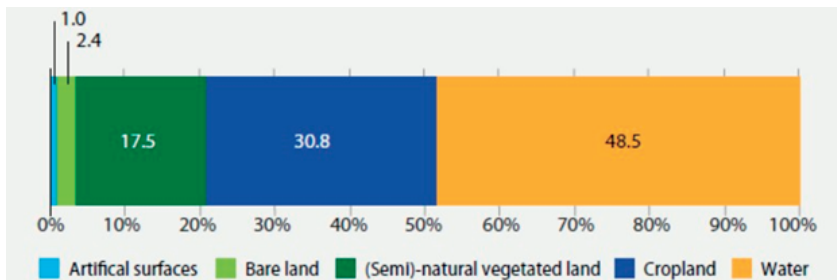


Fig. 3.3 Natural asset base

4) Economic opportunities and policy responses: Removing fossil-fuel subsidies can reduce fiscal deficits, make renewable energy more competitive, and lower carbon and air pollution. [4]

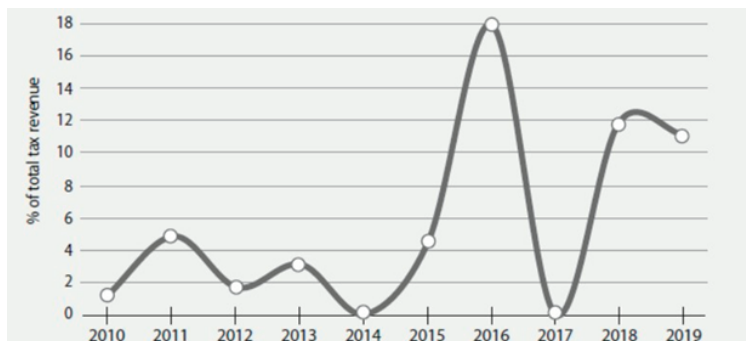


Fig. 3.4 *Economic opportunities and policy responses*

### 3.7 A "Green Corridor" Is Opening in Trade Between Russia And Azerbaijan

In March of this year, the presentation of the "Green Corridor" took place - a pilot project for organizing a simplified customs corridor for law-abiding participants in foreign economic activity. The Federal Customs Service (FTS) of Russia and the State Customs Committee (SCC) of Azerbaijan will determine the lists of project participants from among authorized economic operators (there are currently 164 AEOs in the Russian Federation) and other participants in foreign economic activity professionally oriented to trade in goods subject to the conditions project and characterized by a low level of risk.



Fig. 3.5 *a) Khanoba Customs Border Checkpoint (on the left)*  
*b) Border crossing Yarag-Kazmalyar (Russia) (on the right).*

In addition, he noted that when concluding foreign trade contracts between Russian and Azerbaijani participants in the Green Corridor, the customs authorities of the two states will automatically apply simplifications and facilitation of customs formalities in order to ensure

the smooth and accelerated movement of goods to Russia and Azerbaijan. It should be noted that at present, seven Russian authorized economic operators work on a permanent basis with about 100 Azerbaijani companies. This means that at least 20 percent of Azerbaijan's products supplied to Russia can be processed through the Green Corridor being created.[13]

The early launch of the Green Corridor project, along with the simultaneous completion of work on the reconstruction and expansion of the automobile checkpoints Khanoba (Azerbaijan) and Yarag-Kazmalyar (Russia), an increase in the supply of products using Agroexpress, will ensure a positive trend in Russia's foreign trade turnover and Azerbaijan.

*Main factors and conditions conducive to development innovation for a green economy and green growth.* Building on the conceptual ideas outlined above and linking innovation to key policy objectives, as well as necessitating policy development, the next question is which policies influence the various enabling factors and how government can manifest and possibly enhance the impact of innovation on performance. The state should take these measures into account when developing innovation policy. It is obvious that the set of such measures is much wider than those measures that are usually applied in innovation policy in the narrow sense - support for R&D in the business environment, financing of risk capital, etc. They constitute only a part - albeit an important one - of the full range measures affecting the results of innovation activity.

In addition, governments will need to consider how innovation and innovation policies affect other government objectives, and to consider additional measures that need to be taken to ensure that overall policy goals are achieved, for example, on economic growth, employment and income distribution, and health and the environment.[16]

So, what policies determine the contribution of innovation to economic growth? The OECD analysis suggests that innovation thrives in an environment characterized by:

- **A highly skilled workforce** that has the necessary knowledge and skills to create new ideas and technologies and bring them to market, and is also able to adapt to technological changes in society.

In this regard, reforms in the education and training system, as well as in skills policy more broadly, are of great importance for innovation. Necessary measures include a policy aimed at training specialists in the field of science, technology, engineering and mathematics (science, technology, engineering and mathematics (STEM)), however, do not limit

yourself to this group and cover a wider range of professional qualities. In addition, international talent mobility is playing an increasingly important role in meeting emerging skills needs.

- **A healthy business environment** that encourages investment in technology and intellectual capital, allows innovative firms to experiment with new ideas, technologies and business models and helps them grow, increase their market share and achieve new scale. The empirical analysis of these issues showed that the intensification of innovation activity can promote structural reforms:

- in the goods market - by stimulating competition and creating conditions for the entry of new participants;
- in the labor market, by creating conditions for a better distribution of resources;
- and in the financial market, through facilitating the mobilization of financial resources for risky investments.

Of great importance is the regulatory (regulatory) reform, which should stimulate, rather than stifle innovation.

Openness to foreign sources of knowledge is also important for innovation, as most innovation occurs outside national borders, requiring reforms to open up the economy to trade, investment, knowledge flows and people. [14]

- **A strong and efficient knowledge creation and dissemination system** that systematically discovers new fundamental knowledge and disseminates it throughout society through a range of mechanisms, including human resources, technology transfer and the formation of knowledge markets. Strong and well-run universities and public research institutes, and, mechanisms that support and facilitate the interaction of knowledge institutions with the economy and society are important for enhancing innovation.

- **Measures that encourage firms to engage in innovative and entrepreneurial activities.** More targeted policy action is often needed to address a number of barriers to innovation. An appropriate set of measures could include tax incentives for investment in R&D; direct state support through grants, subsidies and innovation competitions; measures to promote cooperation and networking, as well as indirect incentives through public procurement and other so-called demand-stimulating measures.

Developing a national innovation strategy is one thing; its implementation is often quite different. When designing innovation policy, it must be recognized

that innovation operates in a complex, dynamic and uncertain environment where government actions are not always right. A government's commitment to monitoring and evaluating policies, as well as learning from experience and adjusting policies over time, can ensure that its actions are effective and achieve the desired goals at the lowest cost. Moreover, policy implementation relies on effective and a well-developed institutional structure, good evaluation and monitoring capabilities, and an efficient and empowered government bureaucracy.

Finally, it must be recognized that innovation policy is part of a broader political agenda that aims to achieve a range of public policy objectives. In some cases, boosting innovation can help achieve these goals, for example with regard to growth, while in other cases, innovation can have a negative impact on specific other challenges that may need to be addressed with additional measures, such as ensuring that the benefits of innovation are ubiquitous, or addressing specific problems that come with strong innovations, such as the harmful use of particular technologies. Managing these risks and mitigating them, if necessary, is also a key objective of innovation policy.[12]

These priorities are critical to achieving the goals of a sustainable and viable economic recovery and growth in the long term after the end of the COVID-19 pandemic, and they determine the direction of the country's development for the next decade. These priorities are in line with the goals and priorities set out in the EBRD's Strategic and Capital Framework for 2021-2025, which sets the stage for new areas of cooperation between the EBRD and Azerbaijan.

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# Chapter 4

## Development Directions of The Energy Sector Based on Green Economy in Azerbaijan

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### Abstract

This chapter focuses on the technical parameters of the solar energy plants (more than 10). The types of the equipment are mainly parabolic, parabolic-trough, flat and other that were firstly projected and built in Azerbaijan. Each equipment is considered for various technological processes. Thus, some of the solar equipment were tested for desalination of the Caspian sea water by evaporating method. The chapter also provides energy and technical characteristics of heating accumulator, solar kitchen, PV accelerator and combined air heating collector-accumulator. All equipment has proper sun tracking systems. Due to the energy, ecological and other different validations, solar energy equipment is vindicated in the chapter.

**Keywords:** Renewable Energy, Solar Energy, Solar Desalination, Salt Water

### 4.1. Introduction

Increased energy demand will be approximately more than twice in comparison with the amount of the population [1]. At present more than 86% of the energy used are obtained from the fossil fuels (oil, natural gas, stone coal and so on). This causes  $5.5 \times 10^9$  tones carbon pollution in the atmosphere. If energy demand increases by this speed finally wide use of fossil fuels will give  $11 \times 10^9$  tones carbon by 2050. [2]

It is clear that we take into consideration the development of oil regeneration speed. All over the world it takes 2 million years. The wide utilization of the international energy sources warns oil exhaustion. Besides cheap prices of oil production certainly will bring the increment in the price of the energy sources. The ecological resolution expenditures negatively influences on the net price of the energy [3]. At the thermoelectric stations, at the oil refining equipments, in blast furnace, at



the factories, in boiler rooms and other large industry sectors the hazardous gases appear. Indeed these wastes massively damage whole ecosystem and cause the global warming generation and development. Due to the observations during late 100 years the average annual temperature of the Planet has increased till 0.3-0.6 oC. According to the calculations of the scientists, it was revealed that if the Planet temperature increases till 10 oC, ice cap melting will be increased. Of course melting might lead to level rise of the world oceans more than 5 m. This means that majority of the land area will be under the water during this period [4]. Now majority of world countries prefer renewable energy sources to traditional ones. In order to solve and prevent ecological questions among renewable energy sources wind and solar energy potentials are leader at present. In its term that's the influencing factor to the development of energy sector, economy, industry fields and other sectors. Because of the geographical location and climate condition Azerbaijan has greater solar and wind energy reserves than in many of world countries. In major regions of Azerbaijan (Absheron peninsula, Kur-Araz Plain, The Caspian Sea territory, Nakhchivan, and the surrounding regions) are rich with solar energy potential. In summer in Azerbaijan average daily solar radiation is 700-900W/m<sup>2</sup>. During a year, there are about 250-270 sunny days. For a year average index of solar radiation is ~400 W/m<sup>2</sup>. Except that in Azerbaijan the annual amount of sunny days is ~2500 hours that suits to 2000-2500kW/m<sup>2</sup> energy [5]. The development of this direction was described in the decree signed on the 24th of November on Increasing the Social-economical Development of Azerbaijan and the State Program on the 21st October 2004 on "Application of Alternative and Renewable Energy Sources in Azerbaijan". By this purpose from 2003 year some energy equipments for research realization by using renewable energy sources have been constructed, developed and built, then tested. Firstly, the brief information about each equipment is given here.

### **4.1.1. Solar Energy Equipment with Parabolic Trough Concentrator**

This equipment is the first focusing mirror developed in Azerbaijan. The equipment was use firstly in crude oil treatment process for refining in the world. The mirror square of the equipment is 5 m<sup>2</sup>. Complete thermal-energy, economical and ecological parameters have been theoretically and practically determined. Finally positive results were obtained [6, 7, 8, 9, 10]. In Figure 4.1 the general view of the equipment was described.



Fig. 4.1 General view parabolic trough solar energy concentrator

#### 4.1.2. Solar Water Heater

Flat solar heater is the widely applied equipment in solar power engineering. That is why its climatic, thermal-energy, economical parameters should be certainly studied. The flat solar collector mainly in hot water supply and heating systems is widely applied. For this purpose three flat solar collector which absorbers have been made from different materials were stabled and built. All collectors were tested in natural climatic condition of Absheron peninsula. In Azerbaijan collectors are sold made mainly in China and Turkey. However, their cost price in the local market for 1 m<sup>2</sup> averagely is 800 \$. Due to the technical showings the local collector production isn't backward. In individual production for 1 m<sup>2</sup> cost price is averagely 150-200 \$. In Figure 4.2 the general view of the collector produced in local condition was given.

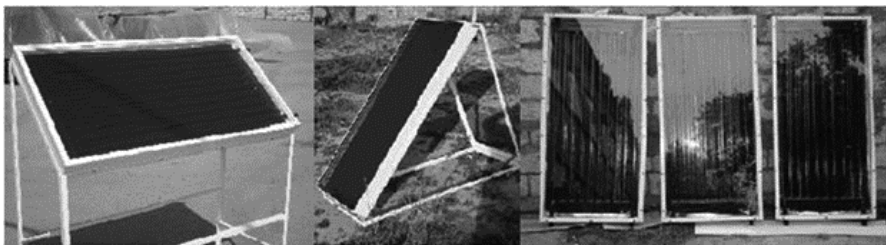


Fig. 4.2 General view of solar water heaters

### 4.1.3. Solar Air Heater with Heating Accumulator

Heating of the houses, public buildings, greenhouses and drying equipment for agriculture fruits and vegetables the air calorifiers are used on a large scale. That causes massively utilization of electricity energy. Azerbaijan is the agricultural region, for various technological processes this equipment is necessary. Firstly, in the simplest constructed solar air heater with heating accumulator was worked, developed and tested. As the cheapest and energy effective heating accumulator, mere pebbles from rivers have been used. The test process was realized by both solar air heater and solar heater accumulator. The surface of the absorber of the experimental equipment was made from steel and its blackness degree is ~92%. At  $750 \text{ W/m}^2$  solar radiations the surface temperature is  $96 \text{ }^\circ\text{C}$ . Due to results during the tests realized the heat loss was completely calculated and general energy effectiveness ( $\eta = 38\%$ ) was determined.

In Figure 4.3 the general view of the equipment was given.

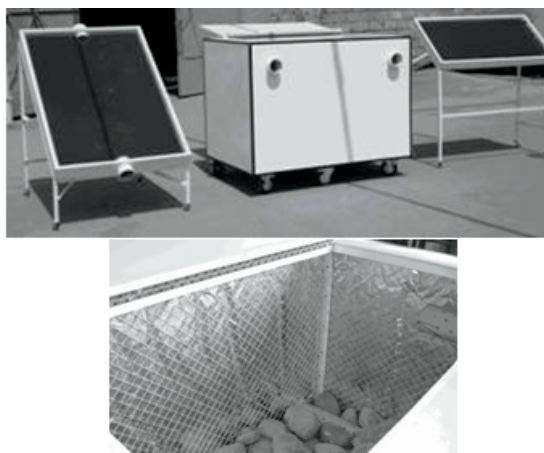
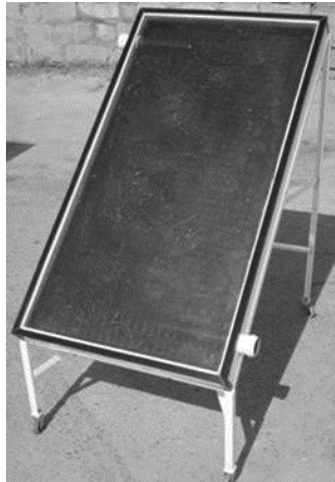


Fig. 4.3 General view of solar air heaters with heating accumulator

### 4.1.4. Combined Air Heating Collector - Accumulator

In half cloudy or cloudy weather condition the exchanging in sun rays intensity negatively influences on the work process of solar air heater. So, while the clouds shade the absorbers' surface the heating becomes weaker. Thus the massive heating capacity of absorber's material is less in this case. In order to solve this problem, by using spiral metal wastes obtained from the process realized by metal cutter, drilling apparatus combined air heating collector - accumulator was developed. In the half cloudy weather

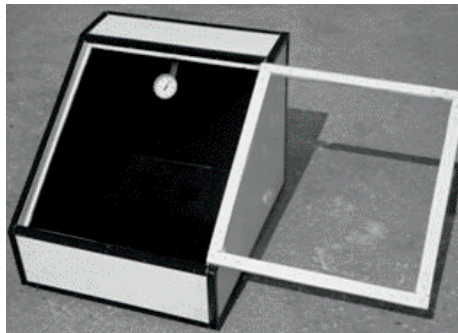
during experiments depending on the temperature averagely the stable heating has been observed within 15-20 minutes. In Figure 4.4 the general view of the equipment was given.



**Fig. 4.4** *General view of combined air heating accumulator*

### 4.1.5. Solar Kitchen

The solar kitchen was developed for fast foods and drinking preparation being used in summer months during the rest time. So, at  $800 \text{ W/m}^2$  solar radiations, the temperature inside the box is  $128^\circ\text{C}$ . The geometrical form and construction of the equipment have been selected like that without any movement it receives perpendicularly solar rays in both zenithal and azimuthal directions. In order to determine the temperature inside the equipment round thermometer was put in Figure 4.5 the general view of the equipment was described.



**Fig. 4.5** *General view of solar kitchen*

### 4.1.6. PV Accelerator

In the Solar power engineering the one of the wide applying exchanger is PV. The cost price of PV is so expensive, therefore supplying it with strengthen elements is advisable. In some experiments the location of photo elements in the focus line of the parabolic through concentrator, addition of the flat mirrors to the sides of the photo elements give the positive result. And to get maximal energy the movement of the side mirrors is more important. For this purpose two mirrors were put on the sides of the polycrystal photo element with 100 W depending the sun position to the necessary angle. Due to the results obtained I dare say PV's volt and volt-ampere characteristics and general out power is averagely 170-180%. In Figure 4.6 the general view of the energy equipment is given.

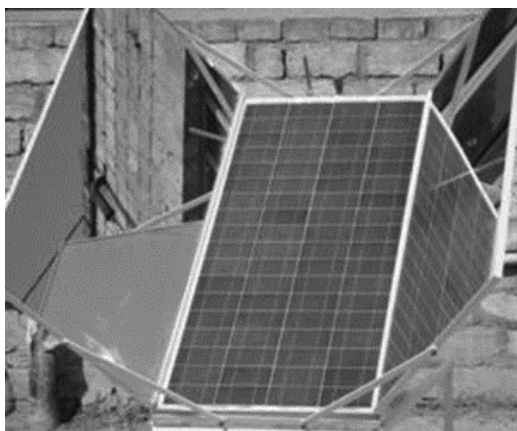


Fig. 4.6 General view of PV accelerator

Besides 4 solar energy equipments (hotbed shaped solar equipment, facet parabolic solar concentrator, parabolic trough and vacuumed flat solar collector) were constructed and built. By applying solar energy at these equipments experiments on the Caspian Sea water desalinization process has been carried out since May 2010. The most saltiness in the Caspian Sea water is around of Absheron peninsula. Generally, the most amount of the Caspian Sea water is saltiness. The saltiness of the water in the north and the south parts of the Caspian Sea changes within 12.82% - 12.86%. Only in Absheron peninsula this average index is 12.6%. In Azerbaijan and especially in Absheron peninsula and surrounding regions in order complete supply the demand to both drinkable and irrigation water laid out some tasks more than once. Now researches for the Caspian Sea water

desalinization by using wind energy has been begun. For this Azerbaijan and the Caspian Sea wind energy potential was studied, processed and calculated [11]. In order to desalinate the sea water there some methods, the most fruitful of them if the evaporating of the water. If we take into consideration water demand is especially in hot months, it gives opportunity to use solar energy more. For this purpose the above mentioned 4 equipments' calculation has been presented.

#### 4.2. Heat Calculation of Solar Desalter in the Form of Hotbed

Equation of the energy balance of the desalter for the definite time can be give as follow:

$$Q_{dir} + Q_{dif} + Q_{ref} + Q_{sw} = Q_{tr} + Q_{loss} \quad (1)$$

where,

$Q_{dir}$  - amount of the direct solar radiation, falling on glass surface of the desalter;

$Q_{dif}$  - amount of diffuse solar radiation falling on the glass surface of the desalter;

$Q_{ref}$  - solar radiation being reflected from the surrounding objects;

$Q_{sw}$  - amount of the heat, insertion in the desalter in which salt water floods;

$Q_{tr}$  - heat energy, transferring into vapor of the salt water;

$Q_{loss}$  - energy loss of the desalter.

Theoretically efficiency of the equipment, as instantaneous, so medium for 24 hours, it may be calculated on the formula (2).

$$\eta = \frac{\sum D_i (i - c_{s.w} \cdot t_{s.w})}{\sum Q_{inc} + V_{s.w} \cdot c_{s.w} (t_{s.w} - t_{min})} \quad (2)$$

where,

$D_i$  - amount of condensed vapor with heat content  $i$ ;

$\sum Q_{inc}$  - sum of direct and diffuse radiation falling on the glass surface;

$V_{sw}$  - amount salty water flooding into the desalter;

$c_{sw}$  - heat capacity of saltwater.

In the form of the relative trifle of the quantity  $Q_{ref}$ , it may be ignored.

In consequence, during the day ray energy comes in, as in the working season. Irregularly energy balance of the desalter is to be studied only on the average indexes of solar radiation. Taking into consideration thermal regime of the desalter the built equipment has been tested in duration propertime. While calculating diurnal and annual productivities of the greenhouse type desalter leads to calculate energy used for heating the equipment. In such way diurnal productivities of the equipment is calculated as the formula:

$$g_{diurnal} = \frac{0,85 \cdot \sum Q_{inc}^{day}}{i - c_{s.w.} \cdot t_{s.w.}} \cdot F \cdot \eta_{ave} \quad (3)$$

where,

$\sum Q_{inc}^{day}$  - total (direct and diffuse) radiation, being graphically calculated on the daily fall of solar energy on inclined surface, kcal/m<sup>2</sup>;

F - glassed surface of the desalter, m<sup>2</sup>.

Constant  $i$  depends on partial pressure of vapor in vapor-airmixture and oscillation from 610 to 620 kcal/kg; averagely  $i=615$  kcal/kg may be accepted.

Due to the calculation of the equipment annual productivity formula (3) is used in which together  $\sum Q_{inc}^{day}$  is included to the total radiation on the sloping surface for a year.

It was revealed that the green house type desalter equipment doesn't work at the temperature below than zero. For Absheron peninsula working period begins from the middle of March month and continues to the middle of December. During this time total solar energy consists of 1150000 kcal/m<sup>2</sup> for a year.

Angle of the inclination  $\alpha$  glass surface of the desalter is chosen pursuant to the following considerations. It must be satisfied with maximum solar radiation for all working period of the desalter (far the regions of Azerbaijan this angle is 35 or 40°C) and supplies very good film condensate flood, as well at little angles of the slope drop of the condensable vapor will flow back into the salty water.

Energy loss of the desalter happens in these cases: loss of rays energy coming through the glass; loss because of incomplete absorption of ray energy of the working surface of the desalter; loss in ventilation, that's thermal loss linking with going out vapor-air mixture via thinness in the

desalter; heat loss via glass, in sides and at the bottoms.

Loss of the ray energy passing through the glass depends on kind of the glass, its thickness, solar radiation fall angle on the glass surface and the dirtying stage of the glass.

At the same time work on helio-techniques of the solar ray energy loss passing through the glass underrates because of mistakes in the definite coefficient of the energy passing through the glass. This coefficient is determined to only the evident part of the spectra. While calculating the evident part of solar spectra the total passing coefficient of the window glass in perpendicular fall is 92% but separately not together that's 77%, it is the evident solar spectra. At Table 4.1 relative changing of the coefficients of passing through the glass (showing of the refraction  $n = 1.51$ ) depending on radiation falling angle.

	Ray fall angle $i$ , degree							
	0	20	40	55	70	80	85	90
Relative changing of passing coefficient, %	100	99.9	98.7	94.3	77.6	48.0	24.8	0

**Table 4.1** *Relative changing of the coefficients of passing through the glass depending on radiation falling angle*

Fall angle  $i$  of solar rays on the surface consisting with horizontal angle  $\alpha$  is variable for the current latitude of the location as during 24 hours, so in continuation of all seasons.

Angle  $i$  is determined on the formula:

$$\cos i = \cos \delta \cdot \cos 15 \cdot t \cdot (\sin \varphi + \cos \alpha \cdot \cos \varphi) + \sin \delta (\cos \alpha \cdot \sin \varphi - \cos \varphi) \quad (4)$$

where,

$\varphi$  - latitude of the location;

$\delta$  - declination of the sun;

$t$  - time in hours, midday.

Declination of the sun  $\delta$  can be taken from the astronomical table. For carrying out calculation of the desalter enough dates were given at the Table 4.2.



	Dates				
	19.II	19.III	23.IV	22.V	24.VI
	23.X	25.IX	24.VIII	25.VII	
<b>Declination of the sun <math>\delta</math>, degree</b>	-12.0	0	+12.0	+20.0	23.6

**Table 4.2** Declination of the sun for Absheron peninsula

Loss of the ray energy on dirty and dusty glass can reach to the considerable value. In the condition of necessary care and their periodical cleaning from the dust, loss of the ray energy because of dusty glass equals to 5%.

As for the loss of the ventilation, so thermal loss via thinness and gaps in desalter, especially during bad coating the glass and insufficient hermiticity, all these have huge influence on the loss. But they may down to minimum by careful installation and satisfactory care after the desalter at the time exploitation.

Heat losses were estimated on base of the general method:

$$Q_w = \sum_{i=1}^n \frac{\lambda_i}{\delta_i} (t_{v.a.} - t_w) \cdot F_w \quad (5)$$

where,

$\lambda_i$  - heat conductivity coefficient of the individual layers [kcal/m hour °C];

$\delta_i$  - each layer thickness [m];

$t_{v.a.}$  - vapor-air mixture temperature [°C];

$t_w$  - environmental weather temperature [°C];

$F_w$  - heating surface [m<sup>2</sup>].

The experiments show that vapor-air mixture temperature doesn't increase more than 75 °C. Environmental weather temperature for Absheron peninsula has been accepted as 23 °C.

Transparence of solar radiation causes heat losses on the glass surface. Consequently, the great amount of heat is separated in condensation.

For computation, the heat transfer during condensation was estimated by the Nusselt formula. Initial experiments regard to water vapor condensation from immobility vapor-air (0.5%). Coefficient of heat transfer decreases twice. The air capacity in vapor-air mixture was changed in the range of 0 to 100%.

Coefficient of heat transfer ( $\alpha_B$ ) is used during the condensation of water vapor from flexible vapor-air mixture for horizontal and vertical surfaces when extensional content of water in vapor-air mixture doesn't increase 2% ( $\varepsilon_{c.a} < 2\%$ ), it can be calculated on the empirical formula.

$$\frac{\alpha_w}{\alpha_v} = 0.43 P_m^{0.1} C_w^{-0.28} \quad (6)$$

where,

$\alpha_w$  - coefficient of heat transfer during condensation of water vapor from vapor-air mixture, kcal/m<sup>2</sup> hour °C;

$\alpha_v$  - coefficient of heat transfer "clean" vapor, kcal/m<sup>2</sup> hour °C;

$P_m$  - pressure of mixture, kg/cm<sup>2</sup>;

$C_w = \frac{G_a}{G_v} 100$  - weight content of weather in vapor, %;

$G_a$  - air consumption, kg/hour;

$G_v$  - vapor consumption, kg/hour;

For the vapor-air mixture, the air in the contain from  $\varepsilon_{c.a} > 2\%$  to  $\varepsilon_{c.a} = 11\%$  Legen formula can be used:

$$\beta = 22.9 (C_w)^{-0.6} (P_v - P_c)^{-0.5} \quad (7)$$

where,

$\beta$  - coefficient of the mass transfer, m/hour;

$P_v$  - partial pressure of vapor in mixture capacity, kg/cm<sup>2</sup>;

$P_c$  - partial pressure of vapor on condensation surface, kg/cm<sup>2</sup>;

Condensation of the water vapor from the mixture, containing of more quantity air ( $\varepsilon_{c.a} = 35-90\%$ ) can be calculated on Colborn and Khaugen formula:

$$\beta_p = 11.3 \frac{1}{\varepsilon_{c.a.}} \quad (8)$$

where,

$\beta_p$  - coefficient mass transfer, rating to the difference of the partial pressure, 1/hour;

$\varepsilon_{c.a.} = \frac{P_a}{P_m}$  - volumetric contain of the air in the mixture;

$P_a$  - partial pressure of air in the mixture, kg/cm<sup>2</sup>.

### 4.3. Solar Desalter with Rotary Concentrators

Comparatively little initial capital expenditure and constructive simplicity of green house type solar desalter's application was stipulated more solar desalter with rotary concentrators.

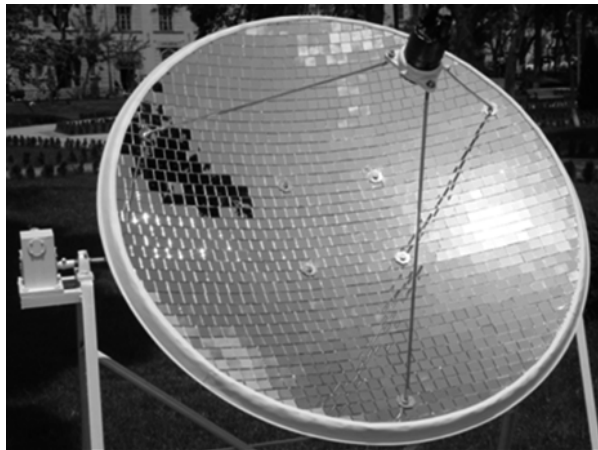


Fig. 4.7 General view of rotary solar desalter with parabolic reflector

But green house type desalters have fundamental deficiencies such as; Insufficient usage of solar energy on the working surface comes from nonrotary equipment (at the desalters with rotary concentrators ray energy  $\eta_{evaporation} = \eta$ ), then essential heat loss happen because of impossibility of utilization of multistage evaporators. All these served appearance and development of solar desalter with rotary concentrator.

The part of the corresponding equipment is mirror concentrator of solar energy, vapor-air boiler, evaporator or desalting battery and condenser.

Below the description of three desalters with solar energy condensers was given.

Mobile solar desalter system consists of 1 parabolic reflector with 1.1 square m<sup>2</sup> built by the simple mirror, 2 evaporator and 3 elemental coil pipe condenser

Total weight of the equipment is 55 kg.

Solar rays falling on the mirror are reflected front it and concentrated on the blackened bottom of the evaporator. To the evaporator, the salty water is poured in which it is boiled and evaporated at the atmosphere pressure. From the evaporator, the vapor through rubber hose pipe directs to the coil pipe of the condenser, where it is condensed and gives precipitated water during condensation of the heating of the cooling water flooded into the condenser.

Testing the desalter showed that the influence of environmental air temperature to efficiency of the equipment is insignificantly told and these factors can't be neglected. It explains too little (~3%) the surface of solar boiler of parabolic equipment in comparison with the total surface of the reflector and enough good isolation of the essential part of solar boiler (evaporator). Heat loss of the evaporator consequently efficiency equipment efficiency depends on wind speed (Fig. 4.8).

If it is accepted average annual wind speed in Absheron region consists of 5.8 m/sec, so the average equipment efficiency will equal to  $\eta_{ave} = 0.46$ .

Productivity of the desalter for clean sunny day is 8 l. Tests carried out in expeditionary condition in Absheron peninsula proved reliability of the desalting work.

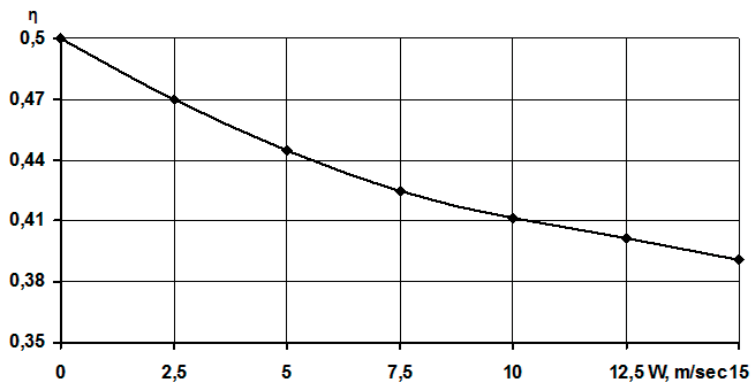


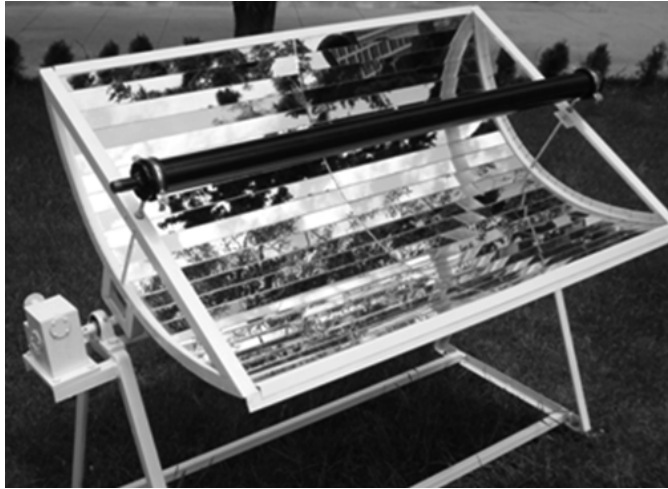
Fig. 4.8 Dependence of solar desalter equipment efficiency on wind speed

A rotary solar generative desalter system is appropriated to the maintenance of sweet water of small brigades and expedition. Experimental model was projected at Azerbaijan State Oil Academy, Baku, Azerbaijan in 2010.

The desalter consists of solar evaporating boiler having the first step

evaporation.

Solar evaporating boiler consists of parabolic-through reflector made from elemental mirror with  $1.2 \text{ m}^2$  square and molded iron turbo into which salty water flows.



*Fig. 4.9 General view of rotary solar desalter with parabolic-through reflector*

Condenser consists of four parts: low isolated brass tube 1, three molded brass buckets 2, into which salty water flows, up insulated brass trunks 3 and lids 4. Upper trunk and lid serve for condensation of vapor particles from solar boiler and particles of evaporated water from buckets. For more intensive condensation of the vapor onto the lids of the condensers water is poured.

Principle of desalter work is linking with the follows. Solar energy leads to the salty water boiling located in the boiler.

Saturated vapor at the pressure near lat is in the condenser where contact with the bottom of the first bucket having little temperature, the vapor is condensed and gives its mote heat to the salty water in the first bucket. Generating steam in the first bucket contacting the second bucket, gives it heat and here condensation happens and so on.

Test of the desalter showed that average efficiency of solar boiler is  $\eta_k=0.4$  from direct solar radiation; additional evaporation of salty water in condenser in considerable amount depends on productivity of boiler and its productivity fluctuates from 50-70%. Here on the axes abscissa holds hourly efficiency of the evaporator generator, on the ordinate axe is evaporator order (hourly efficiency relation of the desalter to evaporator

generator productivity). The left part of the figure (full line) concerns to the current desalter's work with 1.2 m<sup>2</sup> reflecting square, the first part (dotted line) can be used at the projecting the proper desalter with large reflecting surface.

Hourly efficiency of solar boiler at the pressure of direct solar radiation at 750 kcal/hour consists of 1.8 kg vapor, correspondingly the additional evaporation in the condenser equals to 74% from boiler productivity. In this case hourly efficiency of the desalter equals to  $1.8 \times 1.74 = 3.13$  kg sweet water. Daily productivity of the desalter is near 28 l.

Test of the desalter equipment showed that optima; coefficient of the regeneration, equals 1.89 at 2.1-2.5 kg/hour boiler productivity. That's why correspondingly it is necessary to increase the square of the solar boiler reflection to 3.8 m<sup>2</sup>, at such changing of the productivity of the desalter consists of 40-45 l sweet water a day.

#### 4.4. Coefficient Determination of Diffuse Radiation in Solar Water Boiler

As it is seen from heat balance map of Azerbaijan in clear days quantity of diffuse radiation doesn't increase to 10.2% from direct and averagely it consists of near 6-8%.

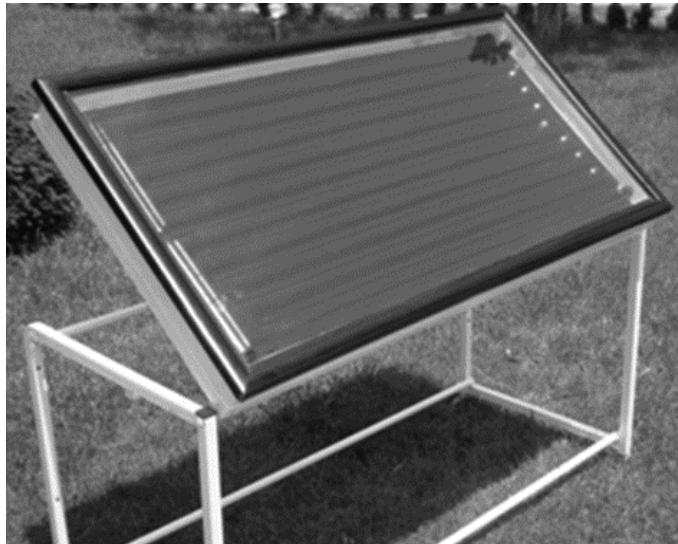


Fig. 4.10 General view of rotary solar desalter with solar water boiler

In cloudy and half cloudy days quantity of diffuse radiation intensity increases, but following sharp decreasing in this case direct solar radiation, sum of direct and diffuse radiation will always less than in clear days. More insignificant amount dissipated radiation falls on water boiler from the surface of the soil but its quantity might be taken into consideration.

Coefficient of diffuse radiation  $K_A^D$  depends on passing of this radiation through the glass, constructive cover and cleanness of the glass surface. At Table 4.3 indexes of these coefficients were given.

Coefficient of passing	Quantity of glass	Glass group		
		I	II	III
$K_{s.g.}^D$	1	0.817	0.787	0.746
	2	0.715	0.667	0.604
	3	0.641	0.581	0.505

**Table 4.3** Coefficients of diffuse radiation passing through the glass  $K_{s.g.}^D$  (on V.P. Kislov)

Inclination of water boiler to the horizon and cover existence of the frames complicate diffuse radiation passing to the working surface - solar boiler, but studying insignificant height scantling of the cover frames in comparison with the dimensions of cells of water boiler, without special loss for calculation exactness (as well as the general quantity of diffuse radiation is little) coefficient of the radiation passing is calculated equally

$$K_{c.p.}^D = 1 \frac{S_s}{S} \quad (9)$$

where,

$S_s$  - square of cover frame of water boiler, depending on one cell;

$S$  - square of cells in water boiler.

Thereby finally necessary dates are important for calculation

$$K_A^D = K_{s.g.}^D \cdot K_{c.p.}^D \cdot K_{s.c.}$$

### 4.4.1. Determination of Heat Loss of Solar Water Boiler in Environment

#### $Q_{H.L.}$

Heat loss in environment consists of heat loss through the glass, bottoms of the frame and side wall's frames. The most essential of them is the loss through the glass which depends on a lot of factors: thickness of air layer between working surface (boiler) and the glass (or between glasses), length of cell's frame, angle of inclination of water boiler to horizon, temperature of boiler and surrounding air, quality of the glass, stage of the darkness of

the boiler, state of the sky, wind and so on.

The process heat transfer blackened surface of the boiler through the glass in environment it is difficult to study perfectly (especially the influence on heat loss of absorbed solar energy by glass and heat exchanging between boiler and sky through the glass), that's why only in the condition of some assumptions the calculation of this loss can be realized.

Acceptance of solar energy absorption by the glasses doesn't influence on the amount of heat loss, the heat resistance of thick glasses is insignificant and ray exchange between blackened boiler surface and sky (through the glass) doesn't influence considerably on the amount of heat loss.

I should notice that during increasing the thickness of air layer between glasses, the loss decreases because of hear conductivity, but convection heat loss and cover shadowing increase. It is necessary to select the optimal thickness of air layer in which minimal heat loss is supplied (studying the shadowing), consequently and maximal  $Q_{full}$ .

Heat transfer through air layer happens by heat conductivity, convection (air movement inside air medium) and irradiation. Using the method equalization of heat transfer of convection to some additional immovable layers of air (transferring the same heat by heat conductivity way) may be

$$Q_{H.L.} = Q_{H+C} + Q_r \quad (10)$$

$$Q_{H+C} = \frac{\lambda'}{\delta} (t_{working} - t_{air}) \quad (11)$$

where,

$Q_{H.L.}$  - general amount of heat loss;

$Q_{H+C}$  - heat loss of heat conductivity and convection;

$Q_r$  - heat loss of radiation;

$\lambda'$  - reduced factor of heat conductivity.

Indicating  $\frac{\lambda'}{\lambda} = \varepsilon_c$  is coefficient of convection (in immovable air  $\varepsilon_c = 1$  and

studying the temperature regime of air layer in solar water boiler is in the rage of 30-60°C, coefficient of the convection  $\varepsilon_c$  can be given in the form



$$\varepsilon_c = A_0 \cdot \delta \cdot \sqrt{\frac{\Delta t}{\delta}} \quad (12)$$

For the air  $A_0$  meaning is given by definite experimental way:

at  $t_{air} = 0 \text{ }^\circ\text{C}$  ,  $A_0 = 20.0$  ;

when  $t_{air} = 50 \text{ }^\circ\text{C}$  ,  $A_0 = 16.0$  .

Heat loss by the radiation

$$Q_r = c \left[ \left( \frac{T_h}{100} \right)^4 - \left( \frac{T_c}{100} \right)^4 \right] \text{kcal/m}^2\text{hour} \quad (13)$$

where  $c = \frac{1}{\frac{1}{c_h} + \frac{1}{c_c} - \frac{1}{4.96}}$  is reducing coefficient of radiation for the flat surface,

kcal/m<sup>2</sup> hour °C;

$c_h$ ,  $c_c$ ,  $T_h$  and  $T_c$  are coefficients of radiation and absolute temperature concerned to hot and cold surfaces.

Thus, finally

$$Q_{H.L.} = k(t_{working} - t_{air}) \text{kcal/m}^2\text{hour} \quad (14)$$

$$K = \frac{1}{\frac{\delta_1}{\lambda_1 + \alpha_1 \cdot \delta_1} + \frac{\delta_2}{\lambda_2 + \alpha_2 \cdot \delta_2} + \frac{1}{\alpha_{working}} + \frac{1}{\alpha_{air}}} \text{kcal/m}^2\text{hour }^\circ\text{C} \quad (15)$$

(for double glassing), where,

$\delta_1$  and  $\delta_2$  - thickness of air layer, m;

$\lambda_1$  and  $\lambda_2$  reducing coefficient of heat conductivity of air layer, kcal/m hour °C;

$\alpha_1$  and  $\alpha_2$  - coefficients of heat transfer of radiation, kcal/m<sup>2</sup> hour °C;

$\alpha_{working}$  and  $\alpha_{air}$  - coefficients of heat transfer from working surface and from the glass in the air, kcal/m<sup>2</sup> hour °C.

For accelerating the calculation on the determined heat loss through the glass the method of defining  $\Delta t = (t_{working} - t_{air})$  can be used at the given determined heat stream  $Q_{H.L.}$

For double glazing of solar collector, that's

$$t_1 = t_{air} + \frac{Q_{H.L.}}{\alpha_{air}} \tag{16}$$

$$t_2 = t_1 + \frac{Q_{H.L.}}{\frac{\lambda_1 + \alpha_1 \delta_1}{\delta_1}} \tag{17}$$

$$t_{working} = t_2 + \frac{Q_{H.L.}}{\frac{\lambda_2 + \alpha_2 \delta_2}{\delta_2}} \tag{18}$$

At  $Q_{H.L.} = 0$  and  $\Delta t = 0$  are enough for calculation of only two points to build the curve of heat loss as the function of temperature differences in the further these figures (Fig. 4.11) at the calculation on the selection of optimal quantity of air layer.

At the Fig. 4.11 the curve of through the glass was given for standard section of tube type solar water boiler (calculated on stated high method) in dependence on temperature difference between working surface and air. Heat loss through the bottoms and corner of the frames are determined on the general way and doesn't show any difficulties.

At the Fig. 4.11 these losses for the standard section of solar water boiler have been reduced to the low curve.

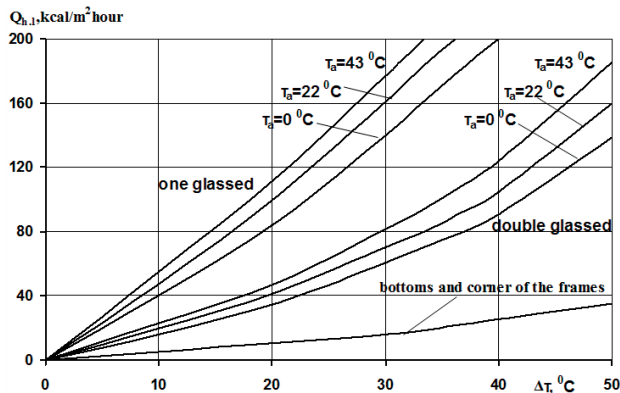


Fig. 4.11 Dependence heat loss of solar water boiler on temperature difference between working surface and air

4.4.2. Determination of Heat Loss of Solar Water Boiler in Environment

$Q_{boiler}$

At the beginning of the work solar water boiler depends on that when it heats the boiler, after cooling-down at night to the necessary working temperature.

Early morning details of chilled water boiler have similar temperature, equals to minimal night temperature of the air. In its further details it will heat at several temperatures, for example the boiler - to the average working temperature

$$t_{working}^{aver} = \frac{t_{h.w.} + t_{c.w.}}{2} \text{ } ^\circ\text{C} \text{ equal half-sum of hot } (t_{h.w.}) \text{ and cold } (t_{c.w.}) \text{ feed water,}$$

and the upper glass only at 5-8° higher temperature of the surrounding air. Consequently, for the heating process amount of water boiler, the heat amount is necessary 1 m<sup>2</sup> for its surface and will be

$$Q_{boiler} = \sum g_i \cdot c_i (t_i - t_{air.min}) \text{ kcal/m}^2 \tag{19}$$

where  $g_i$ ,  $c_i$  and  $t_i$  are all heat capacity and temperature of the details of the water boilers;

$t_{air.min}$  is minimal temperature of the air.

At the calculation of heat loss of water boiler in the surrounding medium temperatures were determined for the main details of solar water boiler in dependence on working temperatures difference of the boiler at air temperature, due to this the wall temperature graphic was built for various regimes in dependence on  $\Delta t = (t_{working} - t_{air})$ . Thus, all dates for determination of glass temperature at any temperature difference  $\Delta t$  and at any surrounding air temperatures. Temperature of the main wall frames is determined on the zone as half sum of average temperature inside of the boiler and minimal temperature of the air.

Temperature of scantling covers and transversal carrying scantlings equal half sum temperature of working surface and air is accepted. At the staged glassed cover's heat amount demanding for heating of water boiler it is necessary to determine separately for one glassed and separately for double glassed parts of water boilers, taking into consideration increment of working surface  $t_{c.w}$  to  $t_{h.w}$  temperature linearly.

For the decreasing warmth's heating  $Q_{heating}$  leads to reduce quantity water in the boiler, the weight of the boiler, size of the cover and weight of the isolation of side bottoms of cell (best of all air-layer isolation is).

For the standard construction of tube type solar water boiler, example average actual heat capacity  $c_{actual}$  at the isolation of bottoms of the box. In the laminar isolation of heat capacity can reduce approximately to 9.2 kcal/m<sup>2</sup> °C.

#### 4.5. Heat Transfer of Solar Collector

Solar energy through the glass, cover frames falls on the blackened surface of the boiler absorbs it. Coefficient of absorption depends on the stage of blackness of dyeing and can be accepted in the range of 0.96-0.98 for fresh dyeing and approximately 0.94-0.96 during passing through to the surface of the boiler.

In the boiler, presenting itself as flat tank from metal, heat is given through metal boiler immediately water and no any additional overheating of the surface in this case happens. Here insignificant temperature difference (2-4 °C) is necessary for transferring the heat from heated working surface of water boiler.

In the tube type water boiler great part of solar energy is given to the heating pipe because of heat conductivity from flipper, so grooved metal leaf in half-grooved which is in the boiling tube. Intensity of heat current of solar energy transmitted through the glass and cover,  $Q_{trans}$  kcal/m<sup>2</sup> hour, thickness of flipper  $\delta$  and heat conductivity of the material, from what flipper has been made,  $\lambda$  kcal/m<sup>2</sup> hour °C, for element of the flipper  $dx$  increasing of the temperature

$dt_x = Q_{trans} \cdot x \cdot r \cdot dx$  where  $r = \frac{1}{\lambda \cdot \delta}$  heat resistance of flipper element.

Integrating from  $x=0$  to  $x=a$ , that's

$$\int dt_x = \int_0^a Q_{trans} \cdot x \cdot r \cdot dx \tag{20}$$

$$t_x = Q_{trans} \cdot r \cdot \frac{a^2}{2} = \frac{Q_{trans} \cdot a^2}{2\lambda \cdot \delta} \tag{21}$$

It is clear that increasing the thickness of flipper making it from the material having high temperature conductivity, and selecting consequently the distance between boilers and tubes can give opportunity to get enough acceptable amount of heat in the center of the flipper.

For example for standard construction of tube type solar water boiler at the average indexes  $Q_{trans}$  375 kcal/m<sup>2</sup>hour overheating of the flipper made from aluminum consists of

$$\Delta t = \frac{375 \times 0.0675^2}{2 \times 175 \times 0.001} = 4.9 \text{ } ^\circ\text{C} \quad (22)$$

Here  $a$  is accepted equal  $\frac{l}{2}$ , and non-equal  $\frac{l-d}{2}$ , studying leakage contact between leaves and pipes. At the calculation heat loss of the average heating of all heating surfaces is accepted  $\frac{\Delta t}{2}$ .

Between center of the flipper and the pipe temperature differences were observed. During the experiment of tube type solar water boiler actually appeared higher calculated amount mainly due to the poor quality of the boiler surface (in sufficient contact between pipe and flipper).

Divergence between calculated value and the actual measurements consist of: averagely 6-10  $^\circ\text{C}$ .

At the presence of good relation between pipe and knurled lists average flipper heat doesn't increase 5-7  $^\circ\text{C}$  (at aluminum list).

### 4.6. Selection of Glass Covers of Water Boiler

Quantity of glass layers is necessary for solar water boiler and thickness of air layer depends on temperature difference on the working surface (boiler) and outside weather. This is to be selected like that the average coefficient of effective activation of the glassed cover should be maximal.

Chose of the glass cover must be produced for average working condition of the water boiler. As well as in hot summer one glass would be enough (but at low temperatures sweet water may be at the low part of the water boiler. Generally no glass is necessary but in spring and autumn such cover won't be enough.

What increasing of air layer means that reduces heat loss through the glass to the defined limit. As well as increasing in influence of the heat transfer of the convection rises and increases by the shadowing binding.

Consequently, suitably by the way of determination of heat efficiency of the glass cover for mean condition of water boiler work. Optimal quantity of air layer and amount of the glasses is to be taken into consideration in the dependence on difference between temperatures of the working surfaces and surrounding weather.

For the current place the graphic of average diurnal solar radiation decreasing (mid season) from what average amount of intensity  $Q_{dec}^{ave}$  and correspondingly its angle (on the time) of the solar rays fall on the water boiler  $i_{ave}$  can be

defined. Amount of  $Q_{trans}$  is calculated on one and double glasses with different thickness of air layer between glasses (taking into consideration the shadowing).

Subsequently taking into account the average daily air temperature, heat loss in the surrounding medium  $Q_{H.L.}$  also for one and two glasses is determined, in various thickness air layers between glasses is defined.

Then heat coefficient of the usable activation of glass cover is determined in several variants on the formula:

$$\eta_{Th.G} = \frac{Q_{trans} - Q_{H.L.}}{Q_{trans}} \quad (23)$$

Illustrated graphic  $\eta_{Th.G}$  in dependence on  $\Delta t$  (at different quantities of the glasses and various thickness of the air layer) was built on three points at:

- $Q_{H.L.} = 0$ , so at maximal  $\eta_{Th.G}$  and  $\Delta t = 0$
- $Q_{H.L.} = Q_{trans}$ , so at  $\eta_{Th.G} = 0$
- $Q_{H.L.} = \frac{Q_{trans}}{2}$ ,

for different temperature in calculated  $\Delta t$ .

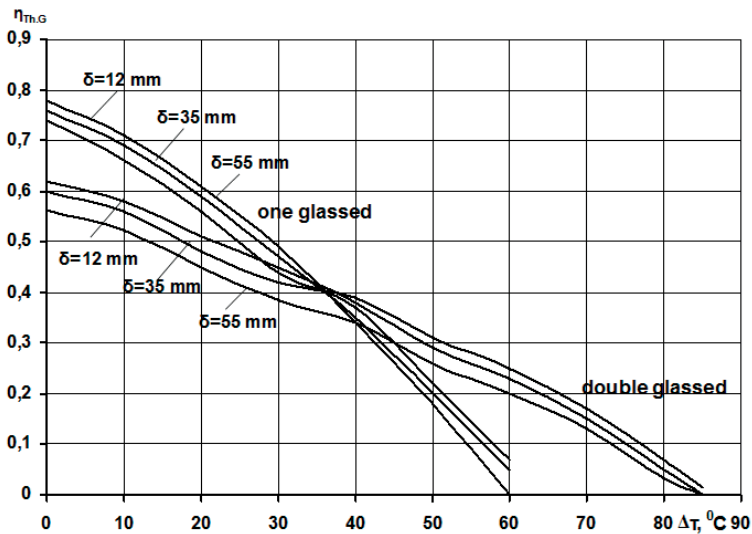


Fig. 4.12 Dependence heat coefficient of glass cover efficiency  $\eta_{H.L.}$  (vertical axe) on temperature difference  $\Delta t$  between the absorber surface and environmental air

For example the graphic (Fig. 4.12) leads to the dependence of  $\eta_{Th.G}$  on  $\Delta t$  for tube type water boiler working on latitude  $40^\circ\text{C}$  at the average quantity  $Q_{full} = 520 \text{ kcal/m}^2\text{hour}$  and at average daily air temperature  $20^\circ\text{C}$ . From the graphic it may be seen at temperature difference from  $\Delta t$  to  $32^\circ\text{C}$  one glassed cover gives better result and increasing of the air layer thickness more than 3 cm doesn't give especial favorable results.

That's clear advantage of the staged glass cover in which in the low part of solar water boiler one glass is put and on the upper side, hotter part two glasses are put.

### 4.7. Conclusions

The projected plants' technical and energy properties are profitable to realize necessary technological processes. Majority of solar equipments are applied in high power-consuming processes. In the desalination process parabolic, parabolic trough solar plants are advisable because of their temperature parameters. Daily productivity of the desalter is near 28 l. To supply drinkable water demand these solar energy equipments could be widely utilized in the industry.

### Acknowledgments

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# Chapter 5

## Tools and Strategies for The Oil and Gas Sector Decarbonization In the Face of New Challenges

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### Abstract

The article analyzes the development of legislation and regulatory frameworks for achieving climate neutrality of economic growth to respond to the global challenges of our time. Active actions taken by states and supranational organizations in the last three years form the institutional environment, but still do not have a significant impact on the transformation of the real sector, as evidenced by ever-increasing CO<sub>2</sub> emissions. The low activity of companies in the field of achieving carbon neutrality is mostly related with the great investment costs with along payback period. In this regard, the oil and gas industry companies are the object of special attention as they are key emitters of greenhouse gases formed throughout the whole supply chain. Among the tools for decarbonization of production and technological processes, the study systematizes various approaches from the transition to low-carbon energy sources to the introduction of CCUS technologies (CO<sub>2</sub> capture, transportation, processing or storage), which are being implemented by enterprises around the world. An analysis of best practices made it possible to formulate scenarios for the development of the Russian oil and gas sector in the context of achieving climate neutrality and substantiate

the most optimal strategy of CCUS technologies implementation to maintain and increase the competitiveness and sustainability of industry enterprises.

**Keywords:** carbon regulation, greenhouse gas emissions, decarbonization, climate neutrality, global challenges, oil and gas industry, CCUS technologies.

### 5.1. Introduction

In the report of The Union of Concerned Scientists, based on data from the International Energy Agency, in 2020 Russia was on the 4th place in the world in terms of greenhouse gas emissions and on the 7th place in terms of CO<sub>2</sub> emissions per capita (Union of Concerned Scientists, 2020). In total, Russia accounts for about 5% of global carbon emissions, only the United States, China and India are ahead of the Russian Federation.

According to Daly's theory, environmental damage and greenhouse gas emissions steadily increase with the growth of GDP per capita, at the same time there is no decrease in CO<sub>2</sub> emissions with the process of economic development (Onyango et al., 2021). Thus, the long-term trend of CO<sub>2</sub> emissions has a positive direction, in this regard, the climate agenda is becoming increasingly important despite the active actions of governments at the national and interstate levels to achieve climate neutral economic growth by the middle of the 21st century and keep temperatures at 1.5 degrees C (The Glasgow climate pact, 2021).

Every year, more and more different programs of environmental regulation of companies' activities appear around the world. In total, in 2021, there were more than 2,300 laws and policies related to climate change in the world, most of which were formed in the EU, but the trend is gradually spreading to all countries of the world and the number of regulations and policies continues to grow (Nachmany, 2017). The formation of an institutional environment should reduce the negative impact of production and consumption on the ecology; however, over saturation and different directions of draft laws can only complicate the company strategic planning in a changing environment.

The researchers note that the goal of creating a carbon-neutral economy by 2050 is technologically and economically achievable, and it will cost less than 0.5% of global GDP. Three steps must be taken: reduce resource and energy consumption through the transition to a circular economy and energy efficiency increase; broaden the scope of clean energy; use 'green' energy in all sectors of the economy. Additional costs for achieving these

goals are estimated at about 1-1.5% of GDP per year, which is not a very significant increase in investment in the greening of production and consumption compared to the total amount of global investment in various types of economic activity in a quarter of GDP. Thus, developed countries and China will be able to complete the transition to a carbon neutral economy by 2050, and developing countries, when attracting private investment in green technologies, by 2060 (Holbrook, 2020). Thus, a consistent policy of states and targeted business strategies for decarbonization will achieve climate neutrality in the long term.

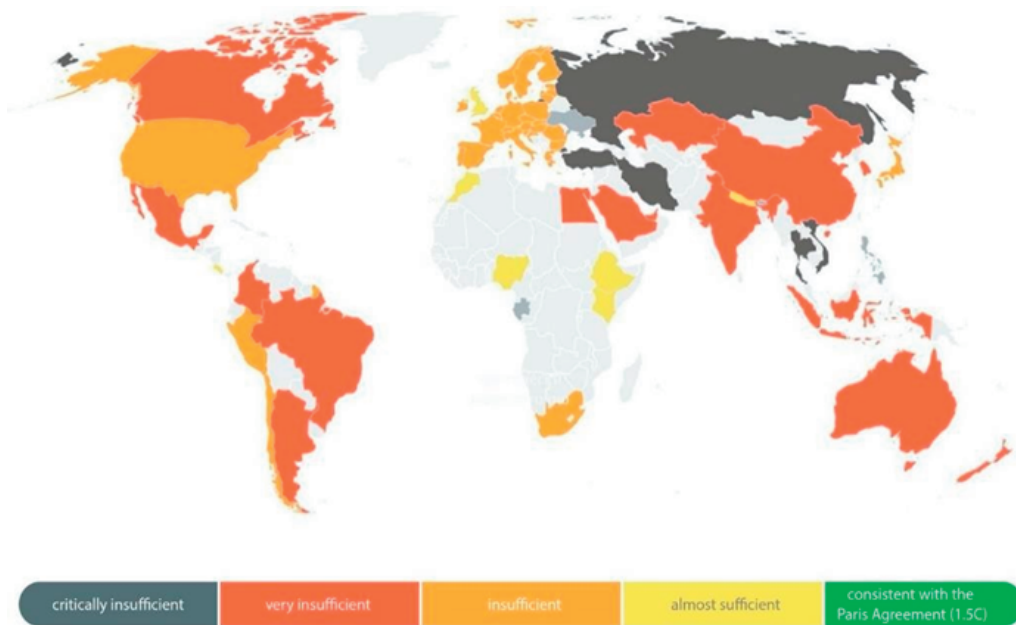
One of the main sources of greenhouse gas emissions is the burning of fossil fuels for energy production – about 76% of global CO<sub>2</sub> emissions. For Russia, this figure is 78.7%, the share of the oil and gas sector in these emissions is approximately 16% (Malceva, 2021). At the same time, in recent years oil and gas production has been growing more slowly than the amount of CO<sub>2</sub> emissions in this sector; it is expected that the demand for oil will still reach its peak in 2035 and only after that it will gradually decline. All this, taking into account the tightening of legislation in the field of greenhouse gas emissions, requires urgent actions from oil and gas companies to decarbonize production processes in order to reduce pressure on the environment and remain competitive in the domestic and international markets.

One of the available ways to achieve the goals set on the climate agenda is to reduce the consumption of oil and gas as well as replace them with renewable energy sources. However, a full transition to renewable energy can take many years, so a sharp cessation of the use of fossil fuels is not a solution to the problem of greenhouse gas emissions; it is likely to only lead to energy poverty (Pakhomova et al., 2021). A more priority task at the moment is the introduction of decarbonization technologies for production and technical processes. According to McKinsey, about 40% of identified decarbonization technology opportunities have a positive net present value (NPV) at current carbon unit prices (Beck, 2020). At the same time, a primary analysis of the practical experience in the implementation of innovative decarbonization technologies demonstrates the inertia of the Russian industrial sector, as evidenced by the continuing growth of CO<sub>2</sub> emissions. Thus, this study is aimed, firstly, at analyzing the legal regulation of climate neutrality in the Russian Federation as a key incentive for the decarbonization of oil and gas enterprises; secondly, at the systematization of technological solutions to achieve climate neutrality in the oil and gas sector; thirdly, at comparative analysis, evaluation and

justification of optimal strategies for decarbonization of production and technical processes of oil and gas enterprises. The study of these issues in a theoretical sense will be based on methods and approaches within the framework of the concept of sustainable development and green economy, the 4th industrial revolution and energy transition, the external effects and public goods theory, modern institutional analysis, methods of strategic management, including benchmarking.

### 5.2. Legal Regulation of Achieving Climate Neutrality in The Russian Federation

According to the Climate Action Tracker, as at October 2021, most countries have ineffective strategies to handle the challenges of the climate agenda, Russia has entered the category of countries with ‘critically insufficient’ efforts. The rating is compiled on the basis of indicators such as legal regulation, internal targets, financial support, land use and forestry (Figure 5.1).



**Fig. 5.1** The effectiveness of countries' current strategies to limit CO<sub>2</sub> emissions compared to the required indicators to achieve the goals of the Paris Agreement (Source Climate Action Tracker, 2021)

Despite the efforts to form the regulatory framework for achieving climate neutrality, Russia still faces a number of priority tasks: creation of a transparent legal framework for standards and reports on CO<sub>2</sub> emissions; creation of its own regulatory system similar to ETS and coordination of actions with existing international practices; possible subsidies for vulnerable strategically important industries and diversification of exports (BCG, 2020).

The first steps in the field of formation of the institutional environment and regulatory frameworks are being implemented from 2020-2021. Within the Strategy for the long-term development of the Russian Federation until 2050 with a low level of greenhouse gas emissions, two scenarios are provided: basic and intensive. Both scenarios assume an increase in the energy efficiency of the economy, but with different goals: the base scenario assumes a reduction in the carbon intensity of GDP by 48% by 2050 (compared to the current level), and the intensive scenario assumes the achievement of carbon neutrality of the economy in the second half of the 21st century (Ministry of Economic Development of the Russian Federation, 2020). The updated version of the project includes four types of scenarios: basic, intensive, aggressive and inertial one. The basic scenario is taken as the main scenario, which assumes a reduction in emissions to 1.19 billion tons in 2050 (in 2019 there were 2.12 billion tons of carbon dioxide equivalent). If this indicator is achieved, Russia's 'net' greenhouse gas emissions will be lower than in Europe (Deloitte, 2021).

As part of carbon regulation, a draft federal law was developed to implement low-carbon certificates for the fact of electricity production in the Russian Federation. It is planned to introduce an electronic low-carbon certificate, which will be issued for the production of electricity using renewable energy sources or nuclear energy. Such certificates will be in free circulation and be accounted in the unified information system (Ministry of Energy of the Russian Federation, 2020).

In February 2021, the Ministry of Science and Higher Education of the Russian Federation launched a pilot project to create carbon polygons in Russian regions to develop and test carbon balance control technologies. The project provides for the creation of 80 carbon polygons on the basis of universities, research centers and their industrial partners to form a national system for monitoring greenhouse gas flows in Russia's ecosystems.

In June 2021, the Law on Limiting Greenhouse Gas Emissions was adopted, it came into force on December 30, 2021. According to this document, reporting

is introduced for companies that produce large greenhouse gas emissions. At the first stage, companies whose emissions amount more than 150 thousand tons of carbon dioxide equivalent per year will fall under government report. They will be required to submit emission reports starting March 1, 2023. At the second stage, from 2024, organizations with emissions of 50 thousand tons or more per year will be subject to regulation (Ministry of Economic Development of the Russian Federation, 2021).

This draft law provides a legal basis for the implementation of climate projects and the circulation of carbon units. Individuals and legal entities receive the right to implement climate projects aimed at reducing greenhouse gas emissions (TASS, 2021). At the moment, it is not expected to introduce active regulatory methods in the form of taxes or quotas in order to mitigate the transition of companies to more environmentally friendly production, but the foundations of a mechanism for transferring carbon credits between legal entities are being laid.

This is how the trading scheme is being adapted as part of a pilot project in Sakhalin, where the first transaction using the emissions trading mechanism will take place in mid-2022 (Analytical Center under the Government of the Russian Federation, 2021). The Sakhalin experiment includes several components: accounting for greenhouse gas emissions, creating an infrastructure to support climate projects, and creating a system for trading carbon units. As a result, the region should achieve carbon neutrality by 2025. The implementation of such a project in the Sakhalin region is a kind of experiment to choose the most optimal strategy for achieving carbon neutrality at the national level (Ministry of Economic Development of the Russian Federation, 2021).

One of the important steps is the start of trading carbon units, planned for 2022 by VTB together with the Moscow Exchange, where the prices for quotas will be determined by law through carbon taxes and a centralized trading system for quotas with the setting of a emission ceiling (cap-and-trade) or determination of their specific levels (baseline-and-credit), designed to limit and reduce greenhouse gas emissions to protect against acute and short-term environmental threats. Such cooperation between VTB and the Moscow Exchange will make it possible to lay the foundations for a new promising market, to draw up a legal framework and requirements for the circulation of green certificates and the greenhouse gas emission quotas trading (RBK, 2021).

In addition, for the period from 2022 to 2024, it is planned to implement

the federal project ‘Low-Carbon Development Policy’, the total budget of which exceeds 10 billion rubles. Main activities are: establishment of the infrastructure of the national climate regulation system, the national network of greenhouse gas absorption observations, as well as priority scientific research. One of the activities will be the organization of a national registry of greenhouse gas emissions and the development of the GIS ‘Energy Efficiency’ (Finmarket, 2021).

Thus, the course towards climate neutrality can be seen as an incentive to restructure the economy, attract investment in high-tech carbon-free industries, change the structure of exports and switch to the best available technologies.

### 5.3. Approaches and Technological Solutions to Achieve Climate Neutrality in The Oil and Gas Industry

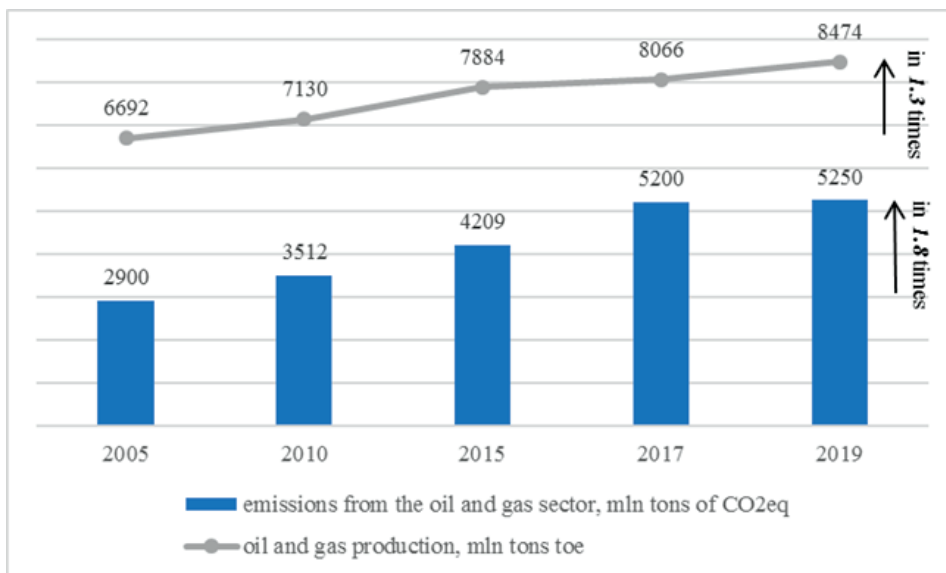
According to a 2017 CDP study, 100 fossil fuel companies have been responsible for more than 70% of industrial CO<sub>2</sub> emissions since 1988, and half of the emissions come from 25 private and public entities (Riley, 2017). The top emission leaders among private companies are ExxonMobil, Shell, BP and Chevron. Gazprom is the leader among Russian companies, taking the third place in the world ranking (Table 5.1).

Ranking	Company	Sector	Cumulative GHG emissions 1988-2015 Scope 1+3, MtCO <sub>2</sub> e	Cumulative industrial greenhouse gases emissions 1988-2015 Scope 1+3, %
1	China (Coal)	coal	128,933	14,3
2	Saudi Arabian Oil Company (Aramco)	oil / gas	40,561	4,5
3	Gazprom	oil / gas	35,221	3,9
4	National Iranian Oil Co	oil / gas	20,505	2,3
5	ExxonMobil Corp	oil / gas	17,785	2,0
6	Coal India	coal	16,842	1,9
7	Petroleos Mexicanos (Pemex)	oil	16,804	1,9
8	Russia (Coal)	coal	16,740	1,9
9	Royal Dutch Shell PLC	oil / gas	15,017	1,7
10	China National Petroleum Corp (CNPC)	oil / gas	14,042	1,6

**Table 5.1** Ranking of companies by CO<sub>2</sub> emissions (Source Compiled by the authors based on Griffin, 2017)



Most of the top CO<sub>2</sub> emitting companies are from the oil and gas industry. At the same time, over the past 15 years, oil and gas production has been growing more slowly than the sector's CO<sub>2</sub> emissions (Figure 5.2).



**Fig. 5.2** Greenhouse gas emissions from oil and gas sector activities and production (Source Compiled by the authors based on Grushevenko, 2021)

Most of the industry's emissions come from the extraction stage (nearly 60% of emissions), mainly from the operation of drilling rigs and pumps, as well as from the combustion of oil by-products. Transportation accounts for about 14% of CO<sub>2</sub> emissions from the oil and gas industry: almost half of this which is formed during the transportation of gas through pipelines. During processing and distribution, the main share of emissions occurs at the processing stage (Grushevenko, 2021). Such a significant share of the oil and gas industry in global greenhouse gas emissions already makes a possible conclusion that the impact of carbon regulation on the industry will be significant, in this regard, companies in the sector should decarbonize their production and technological processes.

The specific initiatives a company chooses to reduce CO<sub>2</sub> emissions will depend on factors such as its geographic footprint, asset structure (sea and land, gas and oil, extraction and processing), as well as local policies and practices (regulations, CO<sub>2</sub> emission quotas price, availability of renewable energy sources, reliability and proximity to the central grid). Projects also

differ in terms of where in the supply chain CO<sub>2</sub> emissions occur (extraction, transportation, processing or distribution). Figure 5.3 shows emissions distribution, and table 5.2 shows possible projects by value creation stages. The upstream stage has the largest amount of emissions (especially methane emissions), but at the same time, at this stage there are many projects to reduce emissions.

Value creation stage	Emission source	Emission reduction tools
<i>extraction</i>	extraction and drilling	energy efficiency
		electrification
		carbon capture,utilization, storage
	flaring (CO <sub>2</sub> )	carbon capture,utilization, storage
		without flaring
	volatile emissions/ventilation (CH <sub>4</sub> )	steam strapping equipment
systems of leaks detection and repair in compression stations		
<i>transportation</i>	crude oil transportation	crude oil transportation (ships)
		crude oil transportation (pipelines)
<i>processing and distribution</i>	heat power systems of oil refineries	energy efficiency
		replacing fuel with biogas or hydrogen
		electirification
		capturing, using and storing carbon

		replace crude oil with vegetable oil (refinery feedstock)
	hydrogen production/FCC emissions	renewable (external) hydrogen
		hydrogen stream methane reforming and capturing, using and storing carbon
		hydrogen based on local biogas
		replace crude oil with vegetable oil (refinery feedstock)
	volatile emissions	vapor recovery units on large tanks
		leaks detection and repair for compressors
		replacement of leaking equipment and pipelines

**Table 5.2** *Emission reduction tools by supply chain stage (Source compiled by the authors based on Beck, 2020)*

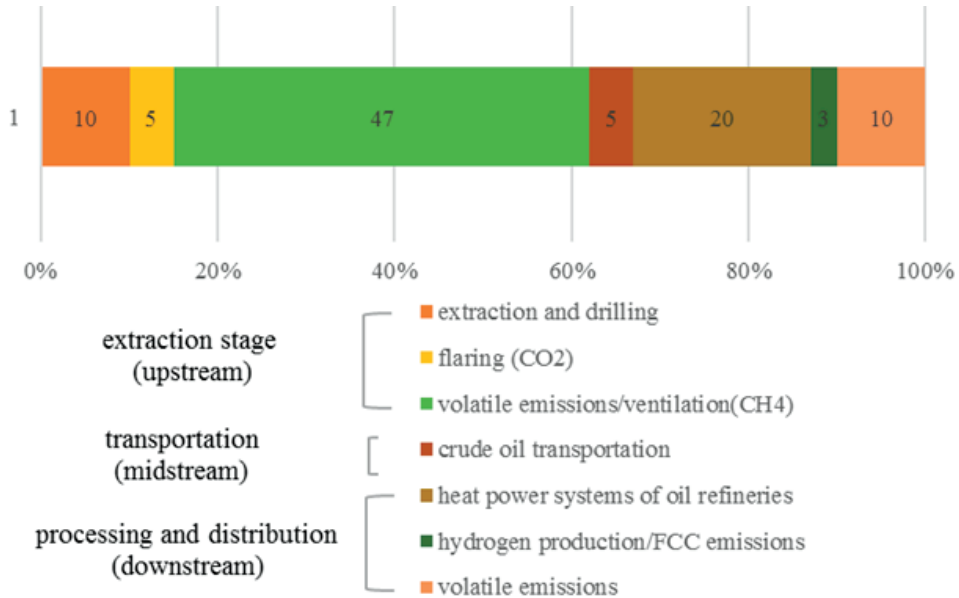


Fig. 5.3 Percentage of CO<sub>2</sub> emissions and decarbonization instruments at various stages of the value chain (Source Beck, 2020.)

As can be seen from this graph, there are various project options that can be implemented at the first stage of value creation – production, and even if they depend on local specifics, it is possible to identify common features of each of the tools.

1. Changing energy sources, transition to low-carbon energy sources. The electrification by extractive companies of their activities can lead to a reduction in emissions of up to 720 tons of CO<sub>2</sub>e per year by 2050. Onshore and offshore drilling rigs and platforms can be connected to electricity, including taking into account the transition to renewable energy sources. The PWC analysis notes that although it is technologically possible to operate production platforms and LNG terminals using electricity rather than burning hydrocarbons, such technologies are still expensive (Thomas, 2021). In this regard, it is necessary to evaluate electrification projects individually and compare with available alternatives. There is a number of areas in which the effectiveness of the use of renewable energy sources has already been proven: power supply of the watering operation to increase oil recovery (wind power), power supply of offshore platforms (solar power). The benefits of introducing renewable energy sources are various: greenhouse gas emissions and production costs are reduced, sustainability

of energy supply is increased. Such projects are being implemented in most large companies in the oil and gas industry.

2. Volatile emissions reduction. Companies can reduce methane emissions by improving leak detection and repair (LDAR), implementing vapor recovery units (VRUs), or applying best available technologies (such as double mechanical seals on pumps, dry gas seals on compressors, and carbon o-ring kits on valve stems). McKinsey estimates that reducing fugitive emissions and flaring could help reduce 1.5 Gt CO<sub>2</sub>eq per year by 2050.

3. At the stage of processing and distribution, both technologies similar to the previous stage and specific one can be introduced. For example, using renewable energy instead of steam methane reforming (SMR) to power electrolysis could give refineries the ability to cut emissions – a result known as ‘green hydrogen’. An example is the joint project between Shell and ITM Power, which announced the construction of the world’s largest hydrogen electrolysis plant at a refinery in Germany with the support of the European Union. The revenue will come from the sale of hydrogen to the refinery, which will use it to recycle and upgrade its products, as well as to balance power systems of Germany.

4. Using more environmentally friendly raw materials by replacing some traditional oil raw material in refineries with bio raw or recycled plastic materials, which will also lead to a reduction in CO<sub>2</sub> emissions – not only directly from the oil and gas industry, but also from consumers of its products. In an increasingly decarbonizing world, this could extend the life of oil refining assets.

5. CCUS technologies (capture, storage, utilization and processing of CO<sub>2</sub>). There are three varieties: CCUS (Carbon Capture, Utilization and Storage – carbon dioxide capture, utilization and disposal), CCS (Carbon Capture and Storage – carbon dioxide capture and disposal), CCU (Carbon Capture and Utilization – carbon dioxide capture and utilization). However, these terms are often used interchangeably. CO<sub>2</sub> capture can be divided into the following types: captured directly at production, by consumers and from the atmosphere.

Most major oil and gas companies are implementing projects with CCUS technology: Net Zero Teesside (BP, Total, ENI, Shell, Equinor) in England; Norske Shell, Equinor, Total E&P Norge in Norway; Chevron in Australia and others. However, most of the projects are still pilot ones, and unit cost assessment in CCUS projects show that in the oil and gas industry, CO<sub>2</sub> capture, transportation and utilization activities will require about 100 USD/tCO<sub>2</sub>-eq (Grushevenko, 2021). At

the same time, CCUS technologies have significant advantages, as they simplify the process of decarbonization and are a key way to achieve the goals of the zero-emissions policy pursued by the largest companies and certain countries. CCUS fits into the existing energy system and does not require fundamental changes, as a result, these technologies are accompanied by relatively low costs compared to structural shifts resulting from changes in key technologies (Fattouh, 2021).

### **5.4. Strategies for Decarbonization of The Oil and Gas Sector in Russia**

According to The Transition Pathway Initiative (TPI) 2021 report, oil and gas companies are among the most interested in and involved into the decarbonization process. Most of the companies in the industry studied by TPI set ambitious goals and implement a wide variety of practices into their processes today. At the same time, according to the World Benchmarking Alliance, all Russian companies received an assessment of the implemented decarbonization strategies at level E (the lowest), it is less than 6 points out of 100 in terms of a combination of indicators, while Gazprom ranked first with 5.5 points (47th in the world), and Surgutneftegaz received 1.2 points and ranked 86 out of 100 evaluated companies (World Benchmarking Alliance, 2022). Many oil and gas companies set ambitious goals to achieve zero emissions by a certain year (usually 2050), but such statements are not always accompanied by a real willingness to change. As noted in the TPI study, 'net zero' promises in the oil and gas sector usually cover operational emissions and only sometimes include emissions associated with the use of the company's products. In general, none of the assessed oil and gas companies in terms of carbon efficiency will reach net zero by 2050. In addition, the oil and gas industry has one of the lowest reductions in greenhouse gas emissions. It follows that companies often state their goals only to maintain their reputation and do not accompany this with a specific action plan (Dietz, 2021).

An analysis of international ratings makes it possible to identify general requirements for the decarbonization policy of oil and gas companies. First of all, these are information requirements: publication of reports on CO<sub>2</sub> emissions, disclosure of a decarbonization strategy with long-term, medium-term and short-term goals for climate neutrality at all three levels of coverage (Scope 3). An analysis of the decarbonization strategies of leading European oil and gas companies makes it possible to additionally highlight another requirement – the introduction of an internal price for CO<sub>2</sub> and the use of CCUS technologies.

Internal carbon pricing (ICP) is a mechanism that represents the monetary value of each tonne of carbon emissions, through which companies can determine the total cost of their greenhouse gas emissions and thereby take into account climate risks in making investment decisions. There are different types of internal carbon prices, the choice is greatly influenced by the scope of the company. Oil and gas companies mainly use shadow prices. Shadow pricing is the theoretical or estimated cost of one tonne of carbon emissions. Typically, the price is set at a high level that reflects the expected future price of carbon. The shadow carbon price method helps an enterprise understand carbon risk and prepare appropriately long before the shadow price becomes real. Shell, BHP and BP include shadow pricing into their business strategy, shifting investment in low-carbon assets or even shutting down high-carbon projects. In the absence of carbon pricing at the national level, Russian companies need to calculate their own internal price for CO<sub>2</sub> (the positive aspects of which are emphasized, for example, by BP and Total). Not a single oil and gas company in Russia has yet announced the use of the internal price in the investment evaluation of projects.

The assessment of the largest oil and gas companies according to the above requirements is presented in Table 5.3. At the moment, Russian oil and gas companies have some of the weakest decarbonization strategies that do not meet almost any criteria of an effective climate agenda. At the same time, it is worth noting that, although significant structural changes take time, significant progress can be achieved in a few years. An example of this is the company Rosneft, whose assessment has changed a lot over the period 2019-2021, moving from the status of one of the most vulnerable to the most advanced one in the implementation of decarbonization tasks. However, the WBA Climate Action 100+ ratings scores are not entirely accurate, since the data is presented at the beginning of 2021, but only during 2021, some Russian oil and gas companies have committed to achieving carbon neutrality.

Company	Net-zero	CCUS	Quantitative goals / clearactions	Target year	Inclusion Scope 3 in the goals	Internal price for CO2	CDP	Climate Action100+ score (max. 10)	WBA score (max.100)	Project examples
Shell	+	+	+	2050	+	+	B	5	34,3	Use of solar panels; projects for forest conservation, reforestation, creation of new forest areas
Eni	+	+	+	2050	+	+-	A-	5,5	43,6	Solar power plants; processing waste into biofuel, renewable energy, energy efficiency improvement
BP	+	+	+	2050	+	+	A-	4,5	42,9	Solar power plant in Vietnam, hydrogen projects, expansion of renewable energy capacity by 4 times since 2019, entry into offshore wind power market



## Green economy and Green Finance

Total	+	+	+	2050	+	+	A-	5	42,9	Biofuel development, 100% of the company's electricity needs in Europe are covered by RES, investment in plastic
ExxonMobil	+	+	+ -	2050	+	-	F	2	5,2	Plastic waste recycling, development of various less polluting fuels (BMF.5™ marine biofuel, renewablediesel), ongoing CCS projects
PetroChina	+	+	-	2050	-	-	F	0	3,3	Geothermal space heating
Aramco	+	+	-	2050	-	-	F	-	2,1	Planting 1 million
Gasprom	-	+	-	2030	-	-	B	2,5	5,5	Improving energy efficiency, 100 billion rubles of investments into the Clean Air project
Rosneft	+	+	+	2035/ 2050	-	-	B	2	3,6	Increasing the share of gas, developing infrastructure for electric vehicles (14 charging stations at petrol stations)

Tatneft	+	+	+ -	2050	-	-	C	-	5,2	7.8 million seedlings planted in 2021, Kama Retread truck tire retreading technology
Surgutneftegaz	-	-	-	-	-	-	F	-	1,2	Improving energy efficiency, reducing leakage, about 5 million green spaces in the last 5 years
Lukoil	+	-	- +	-	-	-	B-	1,5	5	Energy efficiency and reforestation

**Table 5.3** *Assessment of climate-neutral strategies for oil and gas companies (Source Compiled by the authors based on open company data)*

Oil and gas companies have several ways to develop under decarbonization and the introduction of a carbon tax: full tax payment without reducing emissions (avoidance strategy); reduction of emissions through energy efficiency and the introduction of renewable energy sources (classic strategy); introduction of the CCUS system and other innovative decarbonization technologies (proactive strategy).

The first option is to ignore the changes and pay the full tax on emissions of carbon-intensive products, that is, the avoidance strategy. Today, the market for carbon units in the Russian Federation is at the stage of formation, however, focusing on the ETS system and the forecast prices for emissions of 1 ton of CO<sub>2</sub> in the amount of 90 euros, it is possible to estimate the costs of companies when choosing an avoidance strategy. Using the example of Gazprom, it is possible to estimate costs. In total, in 2020, the company produced 453.5 billion cubic meters of gas.

According to the 2020 report, the specific greenhouse gas emissions for the exploration, production and processing segments are 0.464 tons of CO<sub>2</sub> per ton of production. In 2020 the company registered gross emissions in the amount of 210.32 million tons of direct emissions of CO<sub>2</sub> equivalent for the

whole group of companies (Gazprom, 2021). Thus, by ignoring the requirements of climate neutrality and maintaining production volumes and the cost of CU, the emission fee after 2050 could reach 18.9 billion euros per year. The threat of paying the full tax is possible only if the climate agenda is completely ignored. At the moment, the company has several options on how to minimize the amount of carbon tax paid. They can be combined into classic and proactive strategies.

The classic strategy is a set of decarbonization tools that are already being used by most companies. They are mainly aimed at reducing the carbon intensity of manufactured products and do not lead to carbon neutrality of the company. For example, in 2021, Gazprom published a statement that energy saving and efficiency programs allowed the company to reduce emissions by 16 million tons of CO<sub>2</sub> equivalent, or 14% in 2020 compared to 2019.

Such results were obtained due to the use of modern gas storage technologies during the repair work, including mobile compressor stations, as well as optimization of the use of energy resources, reconstruction and modernization of compressor stations (Gazprom, 2021). However, it is worth noting that in the same year the company reduced gas production by 9.5%, so the overall effect was likely to be significantly less. It is important to note that Gazprom currently has a relatively low carbon intensity of its products compared to other companies. It is likely that the processes are already quite energy efficient, which means that the return on investment in similar technologies will be quite low. Projects related to the classical strategy have two main features: they focus at the short and medium term, since their effect is rather limited (for example, it is possible to reduce leakage and transfer facilities to renewable energy only up to a certain limit), and assessing the effectiveness of such investment depends on the initial state of the company, the geography of its activities and other local aspects, so energy efficiency projects are quite difficult to compare with each other. With this strategy, the carbon intensity reduction limit can be reached relatively quickly, then the return on investment will drop sharply, and full decarbonization of production and technological processes will not be achieved.

A proactive strategy for the development and implementation of innovations, in particular CCUS technology, requires significant investment. The price of CO<sub>2</sub> capture and storage obtained from the use of CCUS technologies differs depending on the location of the facilities. So countries with lower labor costs (such as China, Mexico, Indonesia, and

Poland) and low energy costs (such as Saudi Arabia) have the lowest CCUS implementation costs. At the same time, Russia has good prospects for the introduction of CCUS due to the large number of natural reservoirs, which means that the cost of capturing and storing CO<sub>2</sub> will be at a relatively low level. There is a very large range in the cost of implementing CCUS technologies. For the lowest cost options, such as large scale natural gas processing, CCUS can cost less than \$20/t CO<sub>2</sub>. For dilute sources of CO<sub>2</sub>, such as flue gas of a gas power station, or where transport distances are long or storage costs are high, CCUS can cost more than \$120/tCO<sub>2</sub> (Irlam, 2017). At the same time, the use of captured CO<sub>2</sub> as a raw material in the production of, for example, carbon fiber significantly increases the commercial efficiency of implementing CCUS technologies (Vetrova et al., 2021).

By applying CCUS technologies, a company can completely reduce greenhouse gas emissions and become carbon neutral, which will allow to avoid paying taxes on CO<sub>2</sub> emissions. This will require quite a large initial investment with a long payback period, interaction with other market players and government support, but a proactive strategy will contribute to the sustainability of the company in the long term.

### 5.5. Conclusion

The growing urgency of climate change issues leads to an increasing number of laws, strategies and projects at the national and interstate levels. Many countries have already formed the basic legislation and strategies for climate neutrality, however, the actions of states are still ineffective, as evidenced by the continued growth of CO<sub>2</sub> emissions. The policy of states encourages enterprises to develop strategies and implement decarbonization technologies, however, not all companies that declare their desire to reduce their carbon footprint actually carry out the transformation of production and technological processes in practice.

The oil and gas sector remains one of the carbon-intensive industries, it accounts for a significant part of CO<sub>2</sub> emissions, and the transition to carbon-free production is difficult due to the capital intensity of technologies with a long payback period. All ways of responding to the climate agenda in the oil and gas sector can be divided into three strategies: 'avoidance', 'classic' and 'proactive' one.

With an avoidance strategy and complete changes ignorance, companies will have to pay the full carbon tax, while companies will continue to cause significant damage to the environment and become uncompetitive over time.

With a classic strategy and the use of common tools, such as energy efficiency technologies, companies will only be able to achieve changes in the short and medium term and, after some time, reach the limit of reducing carbon intensity while maintaining the carbon footprint of mining and product manufacturing.

The classic strategy may be useful at the beginning of the decarbonization, but the most promising is a proactive strategy with the introduction of innovative technologies such as CCUS, which require significant investments with a long payback period, but allow companies to become carbon neutral in the long term. Thus, in order to maintain and increase innovativeness and competitiveness, the Russian oil and gas sector requires the development and implementation of long-term strategies for the transition to the best available technologies and innovative transformation for the decarbonization of production and technological processes.

This study has enriched the theoretical and practical basis for the development and implementation of a justified strategy for the decarbonization of the oil and gas sector to enhance the competitiveness of products while reducing their carbon intensity in the face of aggravated climate threats. The results of this study provide guidance for future research in developing a step-by-step strategy for the formation of closed supply chains and the development of circular business models in the industrial sector of the economy with an assessment of the effectiveness of the proposed measures in terms of financial benefits and costs, social, economic and environmental effects in terms of reducing emissions CO<sub>2</sub>, capturing CO<sub>2</sub> for further storage and use in new production, generating additional income from new activities, creating additional jobs in the conditions of tightening carbon regulation and worsening climate threats.

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# Chapter 6

## Importance of Green Economy and Example on the Republic of Azerbaijan

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### Abstract

The availability of scarce resources and their unequal distribution, the inefficiency of production, and anthropogenic impacts pose a threat to climate change and living standards. In particular, the wars and crises in the world have confirmed the adoption of a new concept for the creation of a new model of production and possible economic development. The green economy is one of these concepts. The main goal of the concept is to achieve economic development through the efficient use of resources and fair distribution among generations.

The article examines the importance of the green economy, the study of its advantages and disadvantages in achieving economic development, and the opportunities and threats that will arise in the implementation of this plan. In addition, it studies the effects of the green economy on economic sectors and how its application will affect agriculture, trade, and tourism. Taking this into account, the projects implemented at the state level, regulations, and the transition of states to a green economy are touched upon.

Finally, the current situation with the projects implemented in the Republic of Azerbaijan, cooperation, and the transition to a green economy is reflected in the article.

**Keywords:** sustainable development, green economy, Azerbaijan

### 6.1. Introduction

The increase in industrial production as a result of the Industrial Revolution, the financial crisis, and food shortages paved the way for the emergence of a new concept in the economy. In particular, given the development caused by climate change and the losses incurred in production in the production process, the economy was created to build a

new model of sustainable development. On the other hand, the scarcity of resources and their distribution among people posed long-term economic and social threats. Especially recently, states and international organizations have been paying attention to this issue. The discussions at conferences and intergovernmental agreements on achieving long-term development and access to additional resources, and ensuring economic growth without risking the environment are of particular importance. (Article 15)

### 6.2. Sustainable Development

Ensuring economic development along with economic growth has become one of the main goals for every country. Especially after the Second World War, the development of industries, the dominance of material interests, and the sustainability and development of nature began to be questioned. (Article 22) Therefore, in order to ensure economic development and to ensure the sustainability of development, one of the factors that states will take as a basis in their development has been the development of the economy, the protection of nature, and the efficient use of natural resources. This situation seriously worried states and international organizations. For this purpose, they organize a series of projects and programs to ensure sustainable development. One of these initiatives is the 17 Sustainable Development Goals developed by the United Nations. In 2015, this agreement was signed between UN member states for the implementation of production and economic processes in order not to harm the environment. (UNEP) The program, organized by the United Nations, has set goals to improve living standards in the coming years in order to ensure sustainability, and member countries have considered these goals as an important element in their policies (UNEP):

1. No Poverty
2. Zero Hunger
3. Good Health
4. Education
5. Gender Equality
6. Clean Water
7. Clean Energy
8. Economic Growth
9. Industry and Infrastructure
10. No Inequality
11. Sustainability

12. Responsible Consumption
13. Climate Action
14. Life Underwater
15. Life on Land
16. Peace and Justice
17. Partnership

The main purpose of the Sustainable Development Goals is to ensure that future generations live a better standard of living, to prevent the depletion of scarce resources, and to ensure social welfare.

In recent years, climate change, and the crisis of 2008-2009 have encouraged politicians and economists to look for new concepts and create a new one to solve existing problems. (Article 10)

### 6.3. Concept of Green Economy

One of the key concepts for achieving sustainable development is the Green Economy. The term green economy was first mentioned in the Green Economy Plan Report published in 1989 by the London Center for Environment and Economics. (UNEP). Environmental problems, green economy taking into account the social situation, financial crises, food shortages, etc. There is no single definition of a green economy, but various international organizations have provided explanations for this concept (Article 10):

- UN - A model of economic growth that helps to reduce poverty while maintaining a sustainable economy, ensures the sustainability of a healthy ecosystem, supports sustainability in the process of production and consumption, contributes to the creation of new employment opportunities, and enhances social welfare.
- UNEP - It is about ensuring human well-being and social well-being while reducing environmental risks and shortages. In addition, the green economy includes issues such as efficient use of resources, reducing carbon emissions, and improving the social situation.
- UNESCAP - Ensuring economic growth by focusing on the environment, reducing carbon emissions, and addressing social issues.
- OECD - An environmentally friendly green economy is about achieving economic growth and development after ensuring the long-term use of natural resources based on human well-being. In addition, the green economy must support growth and contribute to investment and innovation to increase economic opportunities to achieve sustainable development.

- WB - It is a concept of economic growth that reduces the conditions that cause environmental problems, uses resources efficiently, does not harm living things in nature, and does not slow down development.
- G20 Platform - A model of sustainable development, the Green Economy is a growth model that allows old technologies in various sectors to be replaced by new technologies that are less harmful to the environment and increase energy efficiency.

The common denominator of these definitions is the concept of growth, which is designed to achieve economic development through the efficient use of resources, the focus on social welfare, and the use of technologies that pollute the environment less. The green economy is to achieve economic growth at the international level by preventing environmental pollution, efficient use of resources, and taking into account living standards, and it is based on 5 key principles (Green Economy Coalition):

### **1. The Well-Being Principle**

The green economy attaches special importance to human well-being. Its main goals are to improve the level of education for people, create new job opportunities, and improve living standards.

### **2. The Justice Principle**

Issues such as poverty reduction, gender equality, equal distribution of resources between generations, and strengthening social justice are reflected in the green economy.

### **3. Planetary Boundaries Principle**

In addition, one of the key issues to be considered during economic development is to increase environmental efficiency, minimize environmental pollution, prevent the extinction of living things, and encourage investment in recovery.

### **4. Efficiency and Sufficiency Principle**

Another key principle is to create a sustainable production and consumption process. It is the use of new innovative and environmentally friendly technologies that are less harmful to the environment and provide fewer carbon emissions. This will both accelerate the production process and make production more efficient and accessible to humans.

### **5. The Good Governance Principle**

The green economy creates a financial system designed to safely serve the interests of society, ensure prosperity and sustainability, and support competent decision-making and management of natural systems for local economies while maintaining a strong partner, centralized standards, procedures, and compliance systems.

### 6.4. Advantages and Disadvantages of Green Economy

The implementation of a green economy plays a special role in economic development and sustainability. It has significant benefits for the work environment and the environment. This process is important for public welfare and business development, but at the same time, there are disadvantages for companies in the transition to a green economy. Below are the disadvantages and advantages of the green economy in relation to the environment and business development, ensuring public welfare (Article 10):

#### Advantages:

- Contributes to the production of environmentally friendly, renewable products
- Encourages the development of small and medium-sized businesses, while creating new business opportunities.
- Facilitates the introduction of environmentally friendly new innovative technologies in all areas.
- Provides environmental recovery.
- Consumption of alternative energy sources will increase in order to increase resource efficiency.
- Social welfare increases in green cities
- Increased mobility in the workplace. In addition, the energy density in the workplace is reduced

#### Disadvantages:

- There may be an increase in energy prices
- There may be an increase in prices in the agricultural products industry
- Creates high costs for the application of innovative technological equipment in all areas
- There is an increase in prices for the sale and production of environmentally friendly products
- There may be reductions in the number of products produced by companies
- Decreases in per capita income may occur
- There may be a decline in the purchasing power of families
- It is expensive to implement transport that will provide economic benefits

### 6.5. Impacts of Macroeconomics on the Green Economy

According to UNEP, The Green Economy provides a macro-economic approach to sustainable economic growth with a central focus on investments,

employment, and skills. (UNEP)

The macroeconomic level of the green economy aims to reduce environmental problems and their overall economic level and achieve more sustainable levels of social welfare and focuses on quality protection. The main work in the macro-green economy suggests that more appropriate decisions can be made through the following indicators (Article 20):

- 1.Environmental damage and environmental protection measures and the consequences of these measures at the macro level.
- 2.Develop local or global environmental policy instruments and determine to what extent they can solve existing problems.
- 3.Environmental protection and the impact of its tools on macroeconomic goals, especially economic growth and employment.
- 4.Environmental policy, transport policy, energy policy, commercial political resources, etc. environmental protection and the impact of its instruments on other policy objectives.

### **6.6. Green economy in the example of the Republic of Azerbaijan**

Global problems, financial crises, food shortages, climate change, and inefficient use of natural resources have threatened the long-term development of countries, and in recent years, ensuring sustainable development has become an issue that has come to the fore all over the world. In the development of economic sectors, economic growth and sustainable development goals are taken into account, and countries pay special attention to economic and social policies for the transition to a green economy. This concept of development plays a balancing role in ensuring social welfare and economic growth (Minister of Environment and Natural Resource).

Since the Republic of Azerbaijan gained its independence, it has been dealing with global problems and fulfilling its commitment to minimizing these problems. The state has focused on efficient use of resources and protection for future generations, ensuring public welfare, and creating new employment during the policies pursued to ensure economic development. State programs on socio-economic development, sustainable development, protection of natural resources, and cooperation with international organizations are clear examples of this.

### **6.7. Activities to Transition to The Green Economy on The State Level**

State Programs on Socio-Economic Development

The main purpose of the state programs implemented in the Republic of Azerbaijan is to develop economic sectors with existing potential in the regions, efficient use of natural resources, environmental protection, improvement of social situation, use of new, innovative, low-carbon equipment in production processes, is the implementation of investments related to the creation of new jobs. Government programs prove once again that sustainable development and the green economy are the country's top priorities.

### **State Program on socio-economic development of the regions of the Republic of Azerbaijan for 2004-2008.**

The main task of this program is to assess the potential economic situation in the economic regions, efficient use of available resources, ensure social welfare, create new job opportunities in the economic sectors, analyzing and prevent problems in each region. In particular, the development of new technologies in these areas through the state program aimed at solving existing problems in the economic sector, and minimizing damage to the environment (State Program 2004-2008):

- State support and financing of veterinary-sanitary, technical control, sort-testing, phytosanitary, seed and breeding works, expansion of irrigation systems and ecological, agro, and hydrometeorological network
- From the natural resources of the regions - forests, water, wild plants, etc. strengthening efficient use
- Taking measures on efficient use of Dashkasan iron ore and Khoshbulag limestone resources
- Support the restructuring and expansion of the fishing and fish processing industries
- Development and implementation of comprehensive measures for the efficient use of forest, water, and other natural resources
- Rational use of local energy resources
- Supporting investment in the use of ground water for balneological and thermal energy sources,
- The population, especially the rural population, is provided with utilities, including electricity, water, gas, communications, etc. to bring the supply to the level of modern requirements, to continue the restructuring measures in these areas for this purpose, etc.

I want to note that this program has been given special attention to each economic region and designed for each in accordance with the economic and social potential.



### **State Program on socio-economic development of the regions of the Republic of Azerbaijan for 2009-2013**

According to the state program for 2009-2013, the main topics considered are balancing social welfare with sustainable economic development, improving living standards, developing the non-oil sector in the regions, ensuring economic diversification, and developing potential economic sectors.

These are the main tasks of the program (State Program 2009-2013):

- Ensuring the rapid development of the non-oil sector through the efficient use of the country's natural and labor potential
- Continuation of measures to improve infrastructure
- Implementation of targeted measures to improve the business environment and further accelerate the development of entrepreneurship
- Continuation of work to attract investments in economic development
- Stimulation of export-oriented production
- Creation of modern infrastructure facilities, bringing existing facilities in line with international standards
- Improving the provision of public utilities
- Continuation of measures to increase employment
- Poverty reduction

### **State Program on socio-economic development of the regions of the Republic of Azerbaijan for 2014-2018**

Improving social services, achieving rapid economic development of the regions, as well as improving infrastructure in rural areas, reconstruction of infrastructure, job creation, agriculture, industry, etc. Regional development of the non-oil sector, such as The main goal of the program is to minimize living standards and damage to the environment along with economic development.

These are the main tasks of the program (State Program 2014-2018):

- Continuation of measures to stimulate agricultural producers
- Increase grain production and strengthen competitiveness
- Stimulation of export-oriented activity of producers
- Stimulating the creation of new jobs
- Increasing the share of budget revenues in the non-oil sector in GDP
- The development of the agricultural sector will be continued to ensure food security
- Expansion of regional economic relations

- Formation and development of a fair competitive environment, ensuring control over compliance with labor legislation
- Directing part of the revenues from oil exports to the development of human capital and the application of advanced technologies and innovations related to the development of scientific fields
- Creating conditions that ensure a balance between the proposed workforce and the number of available jobs
- Increasing the level of employment of women and youth, etc.

During the implementation of state programs for 2004-2018, the Gross Domestic Product increased by 3.3 times, and progress was made in the economic sectors. Thus, there was an increase of 1.7 times in agriculture, 2.8 times in the non-oil sector, and 2.6 times in the industry.

One of the main goals of state programs is to increase the social welfare and living standards of the population. Thus, as a result of measures taken during this period, more than 2 million new jobs were created, of which 1.5 million were permanent jobs. In addition, more than 100 new enterprises have been established. The unemployment rate fell from 8% to 5% and the poverty rate fell to 5.1% in 2018.

### **State Program on socio-economic development of the regions of the Republic of Azerbaijan for 2019-2023**

The main goal of the State Program on socio-economic development for 2019-2023 is to increase the competitiveness of the economy based on the principles of sustainable development, contribute to improving the living standards of the population, protect the environment and build a reliable ecosystem.

The main priorities of the state program are (State Program 2019-2023):

- Taking measures to increase investment and innovation activity in the regions
- Strengthening local economic potential through the application of advanced technical equipment and technologies and their full involvement in the economy as much as possible
- Increasing the competitiveness of the economy by expanding the diversification and increasing efficiency
- Increasing the level of self-sufficiency of the country with important types of food products
- Increasing the production of environmentally friendly products
- Increasing employment opportunities in the regions
- Improving the reliability of environmental protection and sustainable management of natural resources

- Expanding the use of renewable energy sources in regions
- Further reduction of inequality in the level of socio-economic development between the capital and the regions
- Ensuring sustainable development of the regions, creating comfortable living conditions, forming a positive attitude to lifestyle in the regions, including in rural areas
- Improving the living standards of the population in the regions, reducing poverty, as well as strengthening the social protection of vulnerable groups
- Supporting the expansion of a network of new products and service enterprises based on modern technologies
- Improving state support mechanisms to increase agricultural production by intensive methods
- Implementation of mechanisms to support the creation and development of innovative forms of the economy, etc.

The project is being implemented, the tasks are being implemented in cooperation with government agencies and the implementation is scheduled for 2023.

### **Strategic view up to 2020 (Strategic Road Map):**

The main goal during this period is to stabilize economic problems caused by external shocks in the short term, diversify the economy in the medium term and restore development through new stimulus forces, to develop long-term international relations and competitiveness in the world market.

### **Long-term view to 2025 (Strategic Road Map):**

The main goal of the strategic vision until 2025 is to provide access to foreign markets by ensuring sustainable development and strengthening competitiveness. Access to the world market will be further enhanced by investing more in the national economy and supporting the development of the private sector. At the same time, the development of the business environment, and increasing macroeconomic stability are the basis of economic development and are included in the main goals during this period.

### **Target outlook for the post-2025 period (Strategic Road Map):**

Improving social welfare, reaching the highest human development index, creating an inclusive and more competitive economy, and achieving high, innovative technological development are among the key goals for the post-2025 period. In addition, ensuring national economic security and integration into the world economy will be the main focus for the period after 2025.

Strategic View for the future the implementation of a green economy plays a key role in achieving the 17 key UN sustainable development goals, and these development goals have been taken into account in achieving economic development. Also, the main goal of the strategic vision is to develop a green economy and achieve socio-economic prosperity.

### **6.8. International Partnerships to Transition Green Economy**

#### **One Road and One Belt Initiative**

Launched in 2013 by the People's Republic of China, the “One Belt and One Road Initiative” was launched to promote integration between countries. The main goal of the project is to provide countries with convenient access to the world market as a result of building infrastructure between Europe, Asia, and Africa continents, strengthening mobility, and cooperation, minimizing damage to the environment as a result of building new technological transport infrastructure, especially reducing carbon emissions and sustainable development. The initiative also directly supports the intensification of import-export operations, increasing competitiveness in the world market. The Republic of Azerbaijan has a special role in the implementation of the One Belt and One Road Initiative. (UNEP). Thus, the location of the East-West corridor and the North-South corridor in the country plays a special role in the optimal and efficient construction of transport infrastructure. By participating in this project, there are special prospects for the Republic of Azerbaijan to achieve economic development, create new jobs, increase competitiveness and ensure sustainable development. (RBI official page)

#### **Azerbaijan and World Bank**

On November 18, 2021, the Government of the Republic of Azerbaijan and the World Bank Group signed an Agreement on Cooperation. The main purpose of the agreement was to establish and operate an office of the World Bank in Azerbaijan. This cooperation will play an important role in ensuring socio-economic development and achieving the goals of green and sustainable development. It should be noted that the World Bank has financed more than 50 projects in Azerbaijan to improve the social situation of the population, create new jobs, develop the business environment, increase the competitiveness of agricultural products, develop human capital, and improve the social situation of IDPs. \$4.4 billion has been allocated for sustainable development. (World Bank)

On February 16, 2022, the European Union and the World Bank signed an agreement for Azerbaijan Rapid Technical Assistance Facility. This agreement

- Support the development of institutions
- Improving economic development and market relations
- Protecting the environment, ensuring energy efficiency
- allowing for mobility and people-to-people contacts.

The main goal of the project is to support the measures taken under the 2030 socio-economic development strategy of Azerbaijan and to provide analytical analysis and advice. €5.25 million has been allocated for the project.

Cooperation with the World Bank plays an important role for the Republic of Azerbaijan in developing a green economy, accelerating socio-economic development, ensuring sustainable development, and preventing environmental problems.

### **Azerbaijan and United Nations (United Nations)**

Ensuring integration between countries, overcoming environmental problems, and improving living standards have always been the focus of the United Nations. The 17 Sustainable Development Goals, a development map for all countries, have been developed by the United Nations to ensure sustainable development, efficient use of resources, as well as equitable distribution, and play a key role in economic development for each country. As a result of cooperation since 1992, a number of projects have been implemented to increase social welfare and minimize environmental problems.

On March 1, 2021, an agreement covering the years 2021-2025 was signed between the UN Country Group and the Republic of Azerbaijan. The main priorities of the document are (United Nations):

1. Development of institutions in the provision of social services
2. Formation of a society with a gender structure
3. Protect the environment by protecting against climate change
4. Ensuring sustainable inclusive growth

The fifth business framework plays a key and stimulating role in achieving sustainable development.

### **6.9. Indicators of Socio-Economic Development of The Republic of Azerbaijan**

Published reports on the green economy play a special role for countries to take the right steps in this area, to implement effective policies to ensure economic and social development and to increase competitiveness in the international arena. The reports submitted to achieve a green economy and ensure sustainable development make a great contribution to the study of the

measures taken and the impact of cooperation on the development of this area. In short, the indicators presented in relation to the green economy are the key for the state to measure the effectiveness of the policy pursued, and are a key guide for them in developing an action plan for the policy related to the green economy.

Sustainable Development Goal Report 2021 (Azerbaijan)		
Year	SDG Index Score	SDG Index Rank
2021	72.4	55
SDG Goals	Dash of Goals	Trend of Goals
Goal 1		↑
Goal 2		→
Goal 3		↗
Goal 4		↓
Goal 5		→
Goal 6		↑
Goal 7		↗
Goal 8		→
Goal 9		→
Goal 10		.
Goal 11		↗
Goal 12		.
Goal 13		↗
Goal 14		.
Goal 15		→
Goal 16		↗
Goal 17		↗

	SDG achievement	↑	On track or maintaining
	Challenges remain	↗	Moderately
	Significant challenges	→	Stagnating
	Major challenges	↓	Decreasing
	No Information	.	No information

**Table 6.1** Sustainable Development Goal Report 2021 by Azerbaijan (Source Sachs, J., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. (2021). *The Decade of Action for the Sustainable Development Goals: Sustainable Development Report 2021*. Cambridge: Cambridge University Press.)

The Sustainable Development Goals Report, designed to achieve the Sustainable Development Goals, provides an indicator of the 16 Sustainable Development Goals of 165 countries. (SDG Report 2021) The country has made significant progress in reducing poverty (Goal 1) in the report on the Republic of Azerbaijan in Table 6.1. There has been a decline in the development trend in improving the quality of education (Goal 4). Areas of focus for the country include gender equality, industry and infrastructure, and

## Green economy and Green Finance

life on land. There are significant problems in this area, and their development trend has remained stable.

Azerbaijan dashboard for dimensions and Green Growth Index Performance, by Asia region									
Country	Dimension Scores (2020)				2010		2020		Performance
	ESRU	NCP	GEO	SI	Index	Rank	Index	Rank	
Azerbaijan	44.68	64.58	21.25	58.84	52.88	16	50.53	21	↓

\*ESRU Efficient and sustainable resource use      \*GEO Green economic opportunities  
 \*NCP Natural capital protection      \*SI Social Inclusion

Rank [0, 100] 0-very low  
 100-very high

**Table 6.2** *Green Growth Index Performance and dimension (Source Global Green Growth Institute Technical Report No. 22)*

Table 6.2. shows the Green Growth Index for the Republic of Azerbaijan. The indicator covers 33 countries in the Asian region, and Azerbaijan ranks 13th in the Green Economic Growth Index. In 2019, this indicator increased by 4% compared to 2015. In terms of green economic opportunities on the dimensions score, the Republic of Azerbaijan is very low but has a higher advantage in terms of social inclusion and protection of natural capital. (GGGI Technical Report No. 16)

Global Green Economy Index, Azerbaijan (2018)		
Country	GGE Index	Rank
Azerbaijan	0.44	92

Rank [0,100] 0-worst  
 100-best

**Table 6.3** *Global Green Economic Index, Azerbaijan (2018) (Source Dual Citizen Global Green Economic Index 2018)*

Global Green Economy Index, Green is used to measure economic performance. This indicator is measured on a scale of 0-100. (GGEI 2018) The best indicator is close to 100. Table 6.3 shows the Global Green Economy Index for the Republic of Azerbaijan. According to this indicator, Azerbaijan ranks 92nd out of 130 countries and the Global Green Economy Index is 0.44. (GGEI 2018)

Environmental Performance Index, Azerbaijan (2020)		
Indicator	EPI Score	Rank
Environmental Performance Index	46.5	72
Environmental Health	32.7	113
Ecosystem Vitality	55.7	44

Rank [0,100] 0-worst  
100-best

**Table 6.4** *Environmental Performance Index, Azerbaijan (2020) (Source Environmental Performance Index Report 2020)*

Based on Environmental Health and Ecosystem Vitality, the Environmental Performance Index helps to study the sustainable development of countries in 11 categories. (EPI Report 2020) The report, compiled for 180 countries, helps countries see their current challenges and build a more effective sustainable development strategy. Table 6.4 shows the Environmental Performance Index for Azerbaijan. Azerbaijan ranks 72nd out of 180 countries. The Environmental Performance Index score for Ecosystem Vitality is 55.7. It has an advantage over environmental health. (EPI Report 2020)

### 6.10. Conclusion

The economic crises and shortages of recent years have hindered the development of countries for a long time, and this was a threat to them. Economic growth and changes in living standards made them think about their economic growth model. Lack of resources and climate change have led to unfair distribution of resources and unequal distribution of social status among the population. This problem was also discussed by international organizations. The measures are taken and the agreements signed played a key role in taking serious steps in this area. The UN Sustainable Development Goals play a key role in ensuring the sustainable development of countries, and states pay special attention to the Sustainable Development Goals when implementing economic and social development policies.

The green economy, which is one of the key parts of sustainable development, is one of the key concepts for the efficient use of resources, ensuring social welfare, and achieving green economic growth. The main



goal of the concept is to achieve economic development while reducing environmental damage and ensuring social welfare. The transition to a green economy helps to create new jobs, develop potential economic sectors, and create a better world for future generations, but the transition to this concept can cause problems such as rising prices and declining production. To this end, public and private investments play a special role in ensuring the transition to a green economy.

The transition to a green economy and the achievement of socio-economic development is one of the main goals of the Republic of Azerbaijan, and special attention is paid to this area. The implemented state programs and international cooperation are proof of this. The state programs implemented from 2004-to 2018 have had a significant impact on ensuring socio-economic development, creating new jobs, ensuring efficient use of resources, and minimizing environmental damage it has played a major role in its development.

In addition, cooperation with the World Bank and the United Nations is of great importance in creating the infrastructure for the transition to a green economy in the country, to stimulate investment in the development of this area. “The One Belt and One Road Initiative” contributes to the Republic of Azerbaijan in creating an effective transport structure, achieving sustainable development, and providing access to the international market.

Indicators of sustainable development show that sustainable development has been achieved in terms of poverty reduction, but there are problems with the development of education, gender equality, and the creation of industrial infrastructure. Special attention should be paid to the development of these goals.

In general, some progress has been made in the transition to a green economy. According to the indicators, Azerbaijan has an average performance in ensuring the transition and has the potential to develop this area.

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# Chapter 7

## Green Growth and Human Capital Development: The Case of Azerbaijan

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### Abstract

The rapid growth of the world's population, the inefficient use of resources, and the difficulty of providing the world's population with everything from the simplest necessities of life to services have forced economists and government mechanisms to look for new solutions. As a result of these needs and researches, the concepts of sustainable and green development have entered the scientific lexicon and have gained popularity all over the world in a short period of time. The most important factor in building an economy based on these concepts is the transition of human resources from the traditional approach to new methods and the creation of green jobs. The purpose of the study is a comprehensive study of green areas of work, analysis of prospects, obstacles and shortcomings, identification of the need for human capital and ways of development in the process of transition to a green economy in Azerbaijan. The study used an interview of comparative and systematic analysis and qualitative research. The limitation of the study is that the field is very new and the results of the measures taken are not yet in sight. The study of human capital in the field, which is also considered a new concept in Azerbaijan and the world, and the study of ways to develop human capital in the field of green economy in our country is a scientific novelty of the research. As a result of research, it can be said that employment opportunities in green areas in Azerbaijan are not so wide yet. Limited areas of work are mainly in the green energy sector, and even if we assume that the entire energy sector in Azerbaijan has been transferred to green systems, this does not mean that the economy and human capital in the country are in line with green principles. However, there are initiatives that promote sustainable development and protection of natural resources in areas such as agriculture, industry and the service sector. The green economy and, in parallel, the spread of green jobs depend primarily on efficiency and social responsibility.

**Keywords:** green economy, green growth, human capital, sustainability, employment

### 7.1. Introduction

Over the past two centuries, against the backdrop of rapid population growth, unplanned resource use, declining per capita green space, and declining productivity in all areas as a result of unsustainable production have led economists to consider new economic models and growth strategies. Taking into account the territory and population of our country, its geography and future priorities, the importance of protecting the environment and non-renewable resources comes to the fore. The concepts of green economy and green growth aim to achieve economic growth by prioritizing the protection of resources that are indispensable for human health and quality of life.

It is impossible to say that the concept of green economy, including the integration of human capital as a labor resource in areas created and reorganized based on this concept, has been developed in the last decade and has become a topical concept in the world. However, it is possible to obtain some information in the foreign literature about green areas of work adapted to the green economy. It also informs us of the annual reports prepared and published by international organizations in this field, the successes achieved and the challenges ahead. However, in the example of Azerbaijan, the study of this area has not yet begun on a large scale, so the adaptation of human capital to green areas of activity, prospects, ways of training and development, local conditions and opportunities have not been studied.

### 7.2. Literature Review

The Green Economy Concept, which first introduced a serious critical approach to the value of money and material wealth in the concept of human well-being after the 1960s and defined as an economic foundation, was held in Rio de Janeiro on June 20-22, 2012 and Rio+ 20 has become one of the most topical issues since the United Nations Conference on Sustainable Development. Twenty years after the 1992 Rio Conference on Sustainable Development, the concept of "green economy" became the focus of the UN Conference on Environment and Development (UNEP, 2012b).

The United Nations Environment Program (UNEP) sees the green economy as a growth strategy that addresses environmental risks and

environmental challenges, as well as increasing human well-being and social equality. More specifically, the green economy can be seen as an approach aimed at reducing greenhouse gas emissions, resource efficiency and social development. In a model that can be called a green economy, income and employment can be achieved through reducing pollution and carbon emissions, improving energy and resource efficiency, conserving and enriching biodiversity, and public and private sector investments. Given that the common future of mankind depends on the cooperation of states, the green economy, which requires a common understanding and common vision, includes the creation of a policy of environmentally friendly growth and development. In order to protect the common future, it must be borne in mind that consensus in the field of environment and sustainable development must not remain in theory and must be implemented. Accordingly, in October 2012, the United Nations Development Program (UNDP) seminar on "Fiscal Policy in an Inclusive Green Economy" focused on three key areas: environmental protection taxes and duties, energy subsidy revision, and financial reform. There have been lock issues. The United Nations Development Program supports the support of investments in the green economy through public spending and political and administrative reforms. In addition, the protection and development of natural assets, which are the main source of capital and are of great value, is extremely important for people who make a living from natural resources (Burkhard and Müller, 2008; UNEP, 2010).

Among the foundations of green policy is the concept of green economy, an economic concept that aims to minimize the destructive effects of man on nature and thus the permanence and sustainability of living things and civilizations in the world, partially rejecting existing dogmas about economic growth and development. (Pike and Makower, 2008).

Green growth is a paradigm in which green policies, innovations and investments ensure sustainable economic development. In a broader sense, green growth is an economic approach to achieving a number of goals that will be the result of parallel processes that bring countries closer to real sustainable development. Creating resilience to extreme natural and long-term changes, making more efficient use of resources, achieving sustainable and equitably distributed growth in GDP and living standards, and assessing long-term economic success, often underestimated, and their use are key to green growth can explain. The right green growth model for our country is still evolving, but one of the most important elements that will help develop this model is the experience of countries that are testing what is

wounded and what is useless. Certainly, local factors are of particular importance in the application of these approaches, which will be addressed (Burton, 2015).

Some scholars present a review of different international approaches to green growth and distinguish between weak, medium and strong versions of greens. In particular, they have adopted alternative approaches emphasizing weak, medium or strong versions of growth (UNIDO,2012b):

- **Weak green growth:** Growth is matched by reducing emissions and protecting the environment, but only taking a “harmless” approach. According to this version, economic growth is consistent with the prevention of environmental damage, and the benefits of focusing on natural capital as a driver for growth are identified (for example, cost savings from natural resource efficiency).
- **Medium greengrowth:** The more ambitious version sees green development as a way to increase jobs in new green sectors. According to this version, investments in low-carbon technology and infrastructure can create new employment opportunities (green jobs) in new green industries that are particularly attractive in declining economies.
- **Strong green growth:** In this version of green growth, green investment goes beyond job creation and can be seen as a transformative force in the medium and long-term economy. Decarbonising the economy could become a growth engine for the entire economy under the influence of massive technological investments and increased productivity across all economic sectors.

There is an increasing trend for countries at all development levels to develop and implement nationally adapted policies and programs for a green economy and/or green growth. More and more countries are trying to formulate more comprehensive national sustainable development strategies and policies along the green economy lines, including low-carbon green growth or development strategies. Recognizing that the move towards a green economy is linked to structural change in governing institutions, such as technological change and investment in innovation, there is a clear focus on early wins to build confidence and momentum behind green growth strategies. Embracing green growth can ensure a strong, stable and sustainable future for developing countries. By placing green growth at the center of economic development, governments can achieve sustainable economic growth while maintaining social stability, protecting the environment and conserving resources for future generations. Coordinating

economic development with environmental protection and poverty reduction is critical to minimizing the risks of natural capital depletion, adverse climate change and social instability. This is a priority especially for developing countries, which are exposed to environmental risks such as poverty, pollution and dependence on natural resources to support economic growth (Christmann and Taylor, 2002).

According to the OECD, green growth means promoting economic growth and development while ensuring that natural resources continue to provide the resources and environmental services on which our well-being depends. To do this, it must regulate investment and innovation that will support sustainable growth and create new economic opportunities (OECD, 2013).

According to the classical growth theory (Solow, 1956), the Y function representing economic growth is constructed using technology and human capital (A), physical capital(K) and labor (L). The attitude is usually as follows: “ $Y = f(A, K, L)$ ”.

Economic growth is explained by an increase in K and L production factors and an increase in A productivity. The increase in labor force L is explained by population growth, labor force participation, and advances in health and education. The increase in K is explained by investment, and growth models assume that the share of production is used to increase the reserve of K capital. The increase in variable A is due to technological change and the development of social capital, including better institutions, social progress, and so on. is expressed by.

In some growth theory models (such as the 1956 Solow model), labor and overall productivity growth are exogenous. In other models (Mankiw, 1992), productivity growth is endogenous and depends on investment in education, research and development, and product scale. Economic policies can influence the accumulation of physical capital, social capital, and human capital to maximize output or maximize product growth (ie, GDP growth). The environment has no productive role in this approach, although it can be accessed through a useful function through its own welfare value. The idea that economic production depends directly on natural resource resources and the quality of the environment has existed since Malthus, and has been featured in many environmental economic literature (Malthus, 1965).

The environment becomes "natural capital" that is directly needed for growth. Environmental management, on the other hand, can be directly compared to investing in physical capital and becoming a productive investment. Lack of



environmental management results in the depletion and destruction of natural capital, which in turn has a direct impact on gross domestic product. If we add the environmental factor (E) to the economic growth function, we get the following formula:

$$"Y = f(A, K, L, E)"$$

Natural capital, which includes natural resources, lands and ecosystems, is often underestimated and mismanaged. This puts additional burdens on the economy and people's budgets. Even when the prices of the products obtained from its exploitation are determined in the markets, the scarcity of natural resources may not be fully reflected in the value of goods and services resulting from their exploitation. Identifying and resolving the nature of the situation provides opportunities to improve efficiency that generates net profit for society (Potts, 2010).

The main potential short-term and long-term benefits of green growth are:

- Preservation and enhancement of the country's natural resources through the recognition and evaluation of the ecosystem services provided;
- Poverty reduction through well-designed green development policies that fairly distribute development revenues;
- To use new development opportunities and employment by investing in technological innovations;
- Invest in sustainable infrastructure that will keep the country away from fuel dependence and intensive emissions;
- Increasing resistance to climate change and natural hazards;
- Low carbon emissions, reducing the environmental impact of the economy (UNEP,2010).

### 7.3. Problems and Obstacles

Recent discussions on "The Future We Want", a draft project based on the final documents of the Rio+ 20 Conference, reveal deep contradictions about the green economy approach. Developing countries, and especially civil society actors, focus their criticism on some of the key short comings of the green economy (UNEP, 2012a):

- Ignoring social dimensions: In this approach, only when the green economy is rooted in sustainable development can it help reduce poverty and create international equality. As a result, institutional and structural parameters should prevent "green protection" in the form of eco-labels, eco-taxes and customs, patents and intellectual property regulations and other barriers to trade created by industrialized countries.

- The point that developing countries are wary of is that financial support from industrialized countries will be conditioned by a one-size-fits-all strategy that envisages a green economy for all, regardless of their level of economic development. However, the fear of lack of competitiveness is not limited to developing countries; Industrialized countries share their concerns about job losses and economic growth.
- Some organizations criticize the characteristics of the Green Economy, especially the basic concepts based on the use of price mechanisms to protect nature, and claim that it will expand corporate control to new areas, from forestry to water.

Therefore, critics argue that the creation of a green economy would serve to make nature more dependent on the common goods in accordance with the logic of capitalist exploitation (Durent, Fiorino, O'Leary, 2004).

In addition, the possible difficulties in implementing the new concept are (UNEP, 2010b):

- New global governance and economy. The protection of support systems for the world economy is a scientifically defined new general category that clearly requires a new economy and new forms of governance. This also requires radical changes.
- Technology is socially and ecologically integrated into the system. Technology has had a major impact on large-scale changes that have affected society and led to an industrial revolution, such as increasing and rapid urbanization of society due to lower morbidity and lower child mortality, and greater population. Some attempts to transfer technology to developing countries have not brought significant social development.
- Efficiency gains can backfire. Initial reductions in pollution and resource use can drive down prices from technological innovations that increase demand for goods and services, resulting in resource use and pollution. Finally, it can lead to complex economic problems in energy use.
- Behavior change and requirements. Technology-based changes in energy supply aren't enough to create a green economy. In parallel with these technological changes, there is a need to create demand for goods and services. Particular attention is paid to consumer behavior and changes in consumer behavior. To re-evaluate customer behavior changes, we need to analyze and shape customer values about greener energy products.

The main potential short-term and long-term costs of green growth are (Stern and Toman, 2010):

- Rapid green growth can lead to transition costs in the short term, as the economy's limited appropriation capacity to accommodate rapid investment leads to overcrowding effects and rising inflation costs (e.g., labor costs). Each country may have its own "speed limit" to optimize the expansion of its green development program.
- Avoid the negative effects on the poorest sections of the community and understand the compromises involved in green growth, such as increasing inequality.
- Weak potential and resources for both public and private innovation and investment. This limits the ability of developing countries to seek and use the opportunities that come from green growth planning.
- There may be negative pressure on the protection of natural capital, as there are limited mechanisms to ensure that conservationists (for example, forests and peatlands for carbon capture) receive sufficient financial incentives to maintain them. Without strong financial incentives, the political viability of green growth may weaken.
- Inequality and downward competition - There is a lot of effort to reduce absolute poverty, especially in developing countries. Equal attention should be paid to reducing the inequalities of different nations. High inequalities will lead to conflicts and migration activities within ethnic groups and the lower strata of society. Inequality can lead to undesirable or unsustainable behavior. In short, people need to adapt to the changes needed to transform sustainability.

However, the proper integration of green growth into key planning and policy development processes is not easy and requires strategic leadership from the government in cooperation with the private sector and civil society. Favorable conditions for green growth are also important in terms of strong institutions and governance structures. There are important exchanges that need to be understood between short-term priorities and longer-term needs, and some natural capital depletion can be justified to support economic and social development. Thus, for developing countries, green growth is not only about protecting the environment, but also about making sure that development is sustainable in the long run and understanding how a country can grow and be green at the same time (Grantham Research Institute, 2012).

### 7.4. Analysis of Economic Indicators of Green Growth on The Labor Market

The intensity of green capacity needs to be increased in every sector and country to create the supply and meet the demand to achieve climate goals. Some progress has been made in this area. In 2019, the balance shifted towards green talent, as green employment rates accelerated in most forms in most of the world's economies. This means that globally, green workers are hired at a higher rate than non-green workers. At the same time, the share of green talent in the global workforce increased from 9.6% in 2015 to 13.3% by 2021 (annual growth rate of 6% and aggregate growth rate of 38%). We have not made enough progress, especially when it comes to equipping employees with the green skills needed to meet this growing demand. The growing demand for green-skilled workers has outpaced the increase in the supply of green talent. Although green skills job advertisements have increased by 8% each year over the past five years, the share of green talent has increased by about 6% each year over the same period (Global Green Skills Report, 2022). In Azerbaijan, it is still impossible to reach and evaluate such statistics due to the lack of a large labor force in this area. We have a historic opportunity to rethink how we approach the transition of the workforce in Azerbaijan to a greener economy based on skills. By adding insights from new information to this challenge, we can develop a plan to increase the intensity of green skills around the world. If we look at the distribution of human resources around the world and within sectors in terms of green skills, we can clearly see that the demand for green talent and green skills exceeds the supply. The impact of the green transition has been felt in all sectors and countries of the world, and no sector has remained unchanged (Mampira, 2013).

Great change and a green transition in Azerbaijan will ensure a fair and secure future not only for the environment but also for workers. The public and private sectors should seize this opportunity to ensure a more diverse and inclusive future for all workers. However, the current trends are not going in the right direction. Our data show that we continue to have inequalities not only between countries, but also on gender, demographic and educational lines.

1. Green skills tend to vary between a country's income levels. Countries at all income levels demonstrate high skills and competencies in broad green skills such as environmental services, agriculture and the environment, health and safety. However, while high, high-middle, and low-middle-income countries show growth in more modern production

capabilities, such as sustainable textiles, photovoltaics, and lithium-ion batteries, low-income countries lag behind in environmental issues and environmental education.

2. The country's income levels are linked to the degree of greening. The share of green talent increased by 39% in high-income countries and 37% in upper-middle-income countries between 2015 and 2021; 31% in low- and middle-income countries; in low-income countries it is 18%. Looking at the relative green talent hiring rate, we can see that high-income and upper-middle-income countries maintain a stable green hiring rate in 2020, while low-income countries begin to slow down (World Bank, 2021).

### 7.5. Methodology

The purpose of the study is a comprehensive study of green areas of work, analysis of perspectives, obstacles and shortcomings, identification of the need for human capital and ways of development in the process of transition to a green economy in Azerbaijan. A semi-formal interview was selected to provide more detailed information on the topic. For this purpose, 12 questions covering the current state and prospects of green growth in Azerbaijan were prepared and asked to the relevant respondents. The universe of research consists of all enterprises/institutions operating in the field of green economy. When selecting the sample mass, the snowball method was chosen from the non-probable sampling methods. Snowball sample mass is a method used when it is not possible to determine the boundaries and boundaries of the main mass. The snowball method was chosen because the topic of green growth is new for our country and it is difficult to determine in which enterprises there are enough relevant activities.

### 7.6. Research Findings and Discussion

A research was conducted on the green economy and green growth in Azerbaijan, as well as the impact of this process on the country's human capital, the level of preparation of human resources and the labor market for the process, the current general picture, problems and prospects. As mentioned many times, to collect information on the current situation and outcomes, including future prospects, given the novelty of this concept, its application at the present time, and the limited resources available in open resources to present or analyze the results of green policies in Azerbaijan. The opinions of experts in the field were taken into

account. As the mechanisms that will ensure the green economy of the country are the state, the private sector and the academic community, the study received feedback from all three parties. Some of the questions were specifically addressed in one direction, and the answers to some were obtained from experts and officials in various fields in order to approach the issue from different angles. The questions are designed to analyze the situation in the national economy, covering as many topics as possible. In the table below, the questions and answers are summarized in the form of short statements (Table 7.1).

Issue	Private sector	Public sector	Academic approach
Job opportunities in accordance with the principles of green economy in Azerbaijan	Job opportunities are limited, the market is not fully formed		
Knowledge and skills of human resources in accordance with the green areas of work	Insufficient technical and management staff.	The state continues to train personnel in universities with the teaching of relevant specialties and textbooks	
Tendencies of entrepreneurs to act in accordance with green principles	Access to the sector is limited due to legal loopholes.	With the state support, foreign investment is attracted in this area, and there are many projects of foreign companies.	

<p>Action plans on the acquisition of green skills in the personnel training policy of the state for the labor market</p>		<p>This process continues in the training centers of government agencies and companies</p>	
<p>Action plans to build green skills in the human resources of companies</p>	<p>The number and opportunities of companies operating in this field are limited. It is easier to adapt nearby professions to the process.</p>		
<p>The impact of the transition to a green economy and the spread of green jobs on employment</p>			<p>Serious changes can create structural unemployment in the short term, and negative effects can be eliminated in the medium and long term.</p>
<p>The transition to green principles and skills and what are the barriers to acceptance of change</p>		<p>There is a need to analyze the effectiveness of green methods in certain areas.</p>	<p>Problems related to the transfer of knowledge in the labor market and educational institutions.</p>

<p>Changes in the material and social opportunities created by green jobs for employees</p>			<p>Increasing labor productivity and employee incomes.</p>
<p>The impact of the proliferation of green jobs on mass redundancies in traditional jobs</p>		<p>Mass redundancies do not seem realistic because the process is not going fast and there is a need for traditional export-oriented industries.</p>	<p>It is possible to solve these issues in the long run with the right strategy.</p>
<p>State plans in teaching the concept of green economy</p>		<p>Development of specialties, curricula and textbooks related to green and sustainable economy in universities, organization of seminars.</p>	
<p>Plans for the creation and improvement of human resources for the green economy in the liberated lands</p>	<p>Currently, there is enough staff to implement ongoing projects, but in the future there may be a need to attract foreign experts.</p>	<p>The declaration of the liberated areas as a green energy zone, as well as the training of human resources throughout the country for the implementation of projects with</p>	



		zero emission targets continues.	
Private and academic cooperation in human capital development			As a system that sets new goals for sustainable and inclusive development, the green economy depends on the participation of all three aspects of the Triple Helix Model - the academic sector, industry and the state. Because it gives all three parties the opportunity to reduce losses, increase profits and build a more sustainable future.

**Table 7.1** *Opinion of relevant sector representatives on green areas of work in Azerbaijan (Source Compiled as a result of the author's personal research) environmental Performance Index, Azerbaijan (2020) (Source Environmental Performance Index Report 2020)*

An analysis of the results of the interview shows how important the field of training, promotion and management of human resources is in Azerbaijan during the transition to a green economy. It can be said that human capital is at the heart of the measures to be taken to master this new concept of the economy. Although green growth, which is relevant in Azerbaijan as well as in the whole world, has different approaches and responsibilities of the state, private sector and academic society in the approach to green energy, the green and sustainable growth of our national economy depends on the effectiveness of measures in all three areas. During the interview, all three sides expressed their views on the problems, obstacles, advantages and future prospects of the current situation in Azerbaijan.

### 7.7. Conclusion

First of all, it should be noted that the opportunities for the private sector to work in accordance with the principles of the green economy are still limited. Limited areas of work are mainly in the green energy sector, and even if we assume that the entire energy sector in Azerbaijan has been transferred to green systems, this does not mean that the economy and human capital in the country are in line with green principles. As mentioned earlier, green jobs cover all sectors of the economy, light and heavy industry, agriculture, services, etc. covers areas. In Azerbaijan, there are initiatives that contribute to sustainable development, such as reducing waste in industry and other areas, minimizing the impact on the environment, but they can not be considered as adapting human resources to green principles. In order to spread green principles to all spheres of the country's economy, it is important to create new industries and agro-parks, to adapt all enterprises to the requirements of green principles as much as possible, to train qualified personnel to fill new jobs.

Knowledge and skills of human resources in Azerbaijan in accordance with the green professions are also directly related to the scale of job opportunities. Based on the answers, it can be said that the scope of training and education in these areas has lagged behind the traditional training process in previous years, as green jobs are not very wide spread in the economy. Respondents agree that in recent years, universities have taken measures to create new specialties for sustainable development, to promote progress in this area. However, the private sector has some difficulty in finding a specialist with practical skills. Given that the concept of green economy is very new, it can be said that in order to work on green projects, it is necessary to increase the number of blue-collar staff, engineers, project managers and improve their professional skills.

So far, there have been some initiatives in Azerbaijan to shift the private sector to green production, especially green energy. However, some legal loopholes in energy production and the state's natural monopoly on the energy sector limited opportunities for progress in this area. We can see the special support and protection of the state for some international alternative energy companies that have come to Azerbaijan in recent years. However, the private sector is waiting for new legislative changes in this area and is eager to act in this area when the appropriate legal framework is in place. Companies are reluctant to invest heavily in either technology or human capital development, given that the drafting, approval and entry into force of these laws, as well as the process of establishing the mechanism

by the state, will take some time. The initiative of the population and non-population groups to create a legal mechanism that allows the production and sale of alternative energy should be welcomed. This initiative will increase the country's energy supply, prevent private investment in energy infrastructure and contribute to the green growth of the national economy as an additional source of income for the population.

Another nuance that stimulates the transition of the private sector to green principles is the attempt of companies in the modern world to be "eco-friendly" in public. This trend can be seen mainly in Western societies that are more enlightened about nature and the environment. Such cases are also found in Azerbaijan. Many companies are certified by international and local organizations for clean energy-based, green production, and are proud to say that their products and activities are "eco-friendly." From simple market research and advertising content of companies in Azerbaijan, it can be concluded that the Azerbaijani consumer is mainly interested in the ecological purity of the product he will use, rather than the impact on the environment in the production process. However, as environmental awareness increases in Azerbaijani society, it can be said that companies will pay more attention to these issues.

As part of the measures taken by the state in recent years to transition to a green economy, we can note the introduction of green specialties in universities, training of new specialties and courses, training centers of government agencies and companies, as well as students, pupils and other categories of citizens. Having more opportunities for government agencies and companies and providing them directly with the financial strength of the state facilitates the transition of their employees to the integration of new green areas of work and increase their knowledge and skills.

The situation is different for the private sector in terms of human resource development and capacity building. It should be noted that the number of companies willing to advance in this area is limited, and with the exception of a few large companies, many companies do not have enough resources to improve their human resources. Although the skills of some occupational groups are more suited to integration, small and medium-sized businesses may have difficulty adapting their employees' knowledge and skills to the new requirements.

Experts' views on the impact of the transition to a green economy on employment and social security are mostly positive. Considering that the transition process did not go suddenly and very fast, we can say that it does not seem realistic that this process will create large-scale structural unemployment

in the labor market. We can also see positive changes in the country's economy in the medium and long term. On the other hand, the organization of the work process with green and sustainable economic principles will lead to increased productivity, reduced workload and improved living conditions of workers. One of the main goals of the state in increasing the use of green energy is to reduce the consumption of fossil resources for electricity, to increase budget revenues by attracting these resources to exports as much as possible.

According to the respondents, the main problem in the field of human resource development in the transition to a green economy is the realities of the labor market, the gaps in the process of knowledge and skills transfer between academic institutions and the private sector. One of the measures to be taken to address this issue is to create platforms that combine the private and academic sectors to accurately involve labor market data in research and to communicate the results of research to private sector representatives and companies. The representative of the private sector emphasizes that the concept of green energy is not fully understood in society, and there is a need to raise awareness about it. As mentioned above, small and medium-sized businesses say that their resources will be insufficient in the field of education, and that the state should conduct public education and propaganda in a broader system.

Cooperation and support with foreign organizations in the framework of the transition to a green economy in Azerbaijan can be listed under several headings. We cooperate with several international financial institutions in the field of financing of implemented projects and obtaining loans. Necessary equipment is purchased from some foreign companies to build the technological infrastructure used in the projects. Most importantly, consultations are held with foreign companies and organizations in the field of project planning, implementation and management, and the experience of other countries is studied. Students also study abroad in these fields. The vast majority of all these measures are implemented with the direct support of the state.

The declaration of the liberated territories as a green energy zone can be a very important dynamic for the transition to green energy and green economy in Azerbaijan. We are witnessing great initiatives of the state in this direction. There are enough opportunities to meet the energy needs of Karabakh and East Zangazur in completely alternative sources. The announcement that the region will be formed as a "net zero emission" zone by 2050 allows for the establishment of a completely green economy. This

paves the way for the implementation of green principles not only in the energy sector, but also in agriculture, industry and every sector of the economy. Although the complete reconstruction of the infrastructure will be very costly, creating everything from scratch will make the planning and execution process easier than integrating existing traditional economies into the green economy. The private sector representative says that they do not need foreign labor and support for the implementation of these projects. However, in the coming years, the support of foreign experts may be needed for the implementation of larger projects, the human resource training process and practical support. In general, the project of building a green economy in the liberated lands can be an experience for the whole of Azerbaijan and even the world. Many pilot projects have been implemented in this area, and then this experience can be used in the transition to a green economy throughout Azerbaijan.

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Chapter  
8

# The Impact of Green Capital Investment on Decarbonization Process in Azerbaijan: The Role of Green Banking Model in The Acceleration of SDGs Implementation

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## Abstract

The meaning of the current crisis is not the regression of scientific and technological civilization, rather, it is a transformation process from an industrial period based on the Fossil Fuel Compendium to an ecological mode of production, that is already visible (Ralf Fucks, *The Green Revolution: Economic growth without compromising the environment*, 2019) For successful implementation of this transformation to ecological mode, Azerbaijan accepted the 2030 Agenda for Sustainable Development. This agenda supports an expanded and global project for peace and well-being for people and the planet. 13th Sustainable Development Goal (SDG) is dedicated to taking urgent and inevitable action to fight against climate change and its impacts effectively. For the determination of main obstacles in the implementation process of this goal, we conduct research in the field of green finance. Our main goal is the determination the impact of green capital investment on the decarbonization process in Azerbaijan. We organize empirical research by using a linear regression model (OLS). This paper examines the possible relationship between green capital investment (investment in the protection of the environment and the efficient use of natural resources) and annual carbon emission. Also, we analyze mediating effect of access to clean fuels and technologies for cooking, urban and total natural resource rents, and renewable energy consumption on carbon emission. According to the result of our empirical research, the increase in



green capital investment in Azerbaijan is not affected decarbonization process positively. It gives us an important signal about the ineffectiveness of green capital investment in Azerbaijan. International practice demonstrates that the use of the green banking model plays a critical role in reducing carbon emissions.

**Keywords:** decarbonization, green banking, green capital investment, renewable energy, OLS model, Sustainable Development Goals

### 8.1. Introduction

As a post-Soviet country, the economy of the Republic of Azerbaijan is mainly based on oil production. This factor poses a major threat to the sustainable development of energy not only in our country but in the whole world. First of all, Azerbaijan's dependence on fossil fuels is the biggest obstacle to long term economic growth due to falling oil prices and depletion of oil resources. The combination of these new challenges will give Azerbaijan the impetus to diversify its economy through a green economy that will lead to long term economic stability in addressing environmental and social challenges (Japan Special Fund (JSF), 2014). The adoption of the 2030 Agenda for Sustainable Development by Azerbaijan, as for all United Nations Member States is the important way for successful transformation to environmentally sustainable and socially responsible country. For the effective implementation of Sustainable Development Goals countries should seek strategies that are more applicable and real for their markets. In our research we have tried to empirically answer to some questions regarded to these strategies. Is green capital investment developed at an effective level in Azerbaijan? What type of strategy can our country implement for the success of green projects? For answering these questions, we have explored literature and observed international experiences.

"Green finance is a broad term that can refer to financial investment flowing into sustainable development projects and initiatives, environmental products, and policies that encourage the development of a more sustainable economy" (Höhne, Khosla, Fekete, Gilbert, 2014). The concept of green finance includes two main functions: the financing of public policies (including operational costs) is considered the main stimulation for the implementation of environmental and environmental-damage projects and efforts; the financing and supporting of public and private sector green investments (including preparatory and capital costs)

(Nannette Lindenberg, 2014). Today, the main problem is that financial institutions are more interested in investment in fossil fuel projects than green projects, mainly because of the high possible risk in this innovative sphere and low profitability.

For achievement of sustainable development goals, the main place should be given to green projects and their financing through investments for environmental benefits, through new financial instruments and new policies, such as green banks, green bonds, financial technologies, fiscal policy, community-based green funds, green central banking etc., which are collectively accepted as “green finance” (Jeffrey D. Sachs, Wing Thye Woo, Naoyuki Yoshino, Farhad Taghizadeh-Hesary, 2019). In our research, we choose green banking as one of the most effective financial instruments. Why is it effective? We answer this question by giving examples based on international experience.

Promotion of ecology friendly projects and decreasing carbon footprint from banking sector is what we call “green banking”. Financing green technology and pollution reducing blueprints is the main condition for reduction of external carbon emission (Bahl Sarita, 2012). In terms of conventional banks mechanism is based on security and profitability, and as a result, these banks are reluctant to expand the scope of their ethical policies. Today, the theme is all about expanding the international idea of green banking activities. A clear example of this process is Islamic banks and financial institutions introduced and rendered a green banking system in a big way. The requirement of ethical obligations is the determination of the ethical values in an objective way that is oriented to mankind's responsibilities and green banks must provide these requirements (Raad Mozib Lalon, 2015). Biswas (2011) accentuated on the important challenges of green banks. The important challenge for green banks is their low developed start-up mode. So, as a result restriction of their business to a smaller scope of customers will decrease their profit. On another hand, operating expenses of green banks usually are in high level. Because going green means requirement for specialized talent, skills, expertise based on the type of customers they were servicing. Also the reputation of the banks becomes vulnerable as if they are involved in the projects which are accepted associably and environmentally damaging. But benefits of green banking can show themselves in the long term. The important ones are banking services through the internet, cash backs for new customers for opening and using green accounts, phone and ATM, free electronic bill payment services, SMS, e-statements, online account opening and etc. (Vikas Nath, Nitin Nayak, Ankit Goel, 2014)

At the end, the banking sector that has an intermediary role between economic development and environmental protection, for promoting socially responsible and environmentally sustainable investment and projects, can be stated as “Green Banking” (Ravi Meena, 2013).

### 8.2. Literature Review

The transition to a green economy should also benefit from research that includes a range of impact assessments, including methodological innovations in evaluation research. Such an assessment may be important for understanding the possible future trajectories of greening and decarbonising key technology industries (Patrik Söderholm, 2020). In general, the green economy is not a substitute for the concept of sustainable development, but an essential part of economic policies aimed at stability and the three main drivers of economic, social and environmental development against stability. At the same time, the result of the multivariate regression analysis shows that there is a very high correlation between the green economy indicator (independent variable) and the transition to regional stability (dependent variable). The value of this ratio is the green economy indicator (Dr. Issa Ibrahimzadeh, Diman Kashefi box. 2018). As most green bonds are issued by governments, government agencies, corporations, banks, and financial companies, there is evidence that green bonds issued by non-financial corporations do not cover the full scope of green bond financing. One study found that green bond financing could play an important role in decarbonising the global economy. This role is more important in countries with developed credit markets, in countries with a high level of technological development and in countries with a high potential for climate risk. (Md Al Mamun, Sabri Boubaker, Khuong Nguyen, 2022). In order to achieve the Sustainable Development Goals (SDGs), countries are increasingly using sustainable financing mechanisms through green bond financing. Green bonds are attracting the attention of industry and politicians, but the effect of green bond financing on environmental and social sustainability has not been confirmed. Based on different research result, it can be concluded that green financing mechanisms can have progressively negative transformative effects on social and environmental responsibility (Avik Sinha, Shekhar Mishra, Arshian Sharif, Larisa Yarovaya, 2021).

Given the growing role of green finance, one of the researches defines green financing as "financing for climate change mitigation" and examines the environmental impact of 26 Asian economies. Empirical results show

that green funding reduces the carbon footprint and builds a new green horizons for the future. Especially from an Asian point of view, green finance is delivering the expected results (Muhammad Asif Khan, Hammad Riaz, Masood Ahmed, Abubakr Saeed, 2021). The overall results confirm that the progress in clean energy, green finance and the green economy are important measures of sustainable development. Also, if all three pillars of sustainable development practice are analyzed separately, green links, clean energy and green economic development will play a constructive role. The association remains stable after observing the impact of environmental regulations, economic growth and foreign investment (Qin Yang, Qiang Du, Asif Razzaq, Yunfeng Shang, 2022).

It is true that impact of the green policies on different countries is dependent on differences between market environments, regions and types of companies. In some cases adopting the green credit policy is not conducive to the research and development process of "two high and one leftover" companies. High uncertainty in economic policy retards the process of transformation to a green economy (Dongyang Zhang, Qunxi Kong, 2022).

According to the study that is based on Hofstede's six cultural dimensions on 122 countries' green economy finds strong evidence that individualism, uncertainty avoidance, and long term orientation positively influences green economy. By contrast, power distance, masculinity, and indulgence have negative and robust impact on all measures of a green economy. In more masculine countries, green economies can be promoted through technology rather than regulation. Finally, research states that the level of economic and financial development influences the relationship between national culture and the green economy (Chien-Chiang Lee, Chih-Wei Wang Shan-Ju Ho, 2022).

Under the China green finance, green credit is seen as a key tool to facilitate China's transition to a low-carbon economy. China's green debt prevents carbon emissions in three main ways: industrial structure, energy system and energy intensity (Yi Hu, JiayuZheng, 2022). Healthy environmental and social indicators are needed to stimulate and monitor the transition to a sustainable economy. In one study, the Italian government developed a Green Investment Financial Product (GIFT) approach as part of a pilot project to assess the environmental performance of investments using quantitative indicators based on systematic thinking and life cycle analysis. It aims to comply with the "no harm" principle (ie no return to the six environmental objectives set out in

the EU classification scheme for sustainable activities) and social protection requirements (Leonardo Becchetti, Mauro Cordella, Piergiuseppe Morone, 2022). Also it should be emphasized that technological progress plays the crucial role in the increasing energy efficiency (Zilong Wang, Xinbin Wang, 2022).

So, as crucial part of our research we explore green banking term broadly based on different economies experience. Green Bank is funded by banks that protect the environment. Banks can be of great help in restoring the ecological balance and preserving the living conditions of future generations through a Green Bank. In reality, when leaders are committed to achieving the SDGs by 2030, the process of introducing bank participation in green practice can be accelerated. Among 17 SDG, №7 it is available and neat energy; № 9 jobs, innovations and infrastructure; № 11 standard cities and communities; №12 aimed at consumption and adoption in responsible way;

№ 13 are successfully implemented because it is associated with a green bank. The Green Bank policy introduced by the Bangladesh Central Bank includes below mentioned terms:

- first, the Green Bank emphasizes the green results of all banks. This means that all banks must use renewable energy sources, automation and other methods to reduce environmental degradation caused by banking activities;
- second, banks must approve responsible environmental financing. Before making any financial decisions, they must have an environmental risk assessment and support the development of “green” plans (Taslina Julia, Salina Kassim, 2021).

A new approach to promoting sustainability is environmental management based on the creation of an “organizational environment”. This system has been scientifically analyzed and supported. The scientific elements that support its formal integrity are defined as "organizational dominants" (institutions with high reputation in the market), "organizational replications" (developers of the most effective decisions) and "organizational actors" (first providers of policies implication) (Viktor Sabadash et al. 2021).

Today, business is turning green. From Wal-Mart to Apple, everyone is talking about the eco-friendliness of their approach, packaging or methods. But now green business is really in its infancy, and being green definitely filters out some real and tangible goals and actions. Banks, credit card companies, insurance companies, consumer financial

institutions, stock exchange companies and investment funds are some of the various financial services that Green Trade accepts. Green Bank seeks to promote green practices and reduce the carbon footprint of banking. The bank needs to fund green technologies and pollution reduction projects to help reduce external carbon emissions. (Bahl Sarita, 2012). In our research we mostly observe Bangladesh and India green banking model experience. Under the leadership of Bank of Bangladesh, the commercial bank will build a solar power plant, ETP, biogas power plant and HHK (Hoffman Hybrid Furnace). Private commercial banks and non-bank financial institutions have signed mandatory and rigorous training programs for senior, middle and junior managers to provide green lending, automation and improving green internal operations. Governing bodies should be aware of current activities and events in the green banking sector. Green banking is no longer about perception, but about action. All planned banks will now allocate budgets for green financing, green activities or green projects, green marketing and capacity building, as well as ensure the efficient use of budget funds (Raad Mozib Lalon, 2015).

It is important for Indian banks to recognize their responsibilities as global corporate citizens if they want to enter Western markets. For achieving that purpose they should adopt below-mentioned strategies:

1. banks need to transform their day-to-day operations through paperless banking, online banking, mobile banking, transit systems, recycled plastic green cards and resource efficiency.
2. the concept of LEED-certified green buildings adopted by the bank: solar power plants, powered lighting units, motion sensors, wastewater treatment plants for recycling, urine and sink sensors, rainwater collection systems, dry waste treatment, etc. It also reduces employee turnover by improving public relations and employee satisfaction.
3. banks need to invest in low-carbon technologies and develop new sustainable products and services that reduce the risk of climate change. There is a need to be able to process carbon loans or invest in projects that can get carbon loans.
4. it is important to set environmental standards for borrowing and financing principles so that borrowers can focus on reducing their carbon footprint by using the right technology. They qualify for preferential rates on hybrid products, equatorial approvals, green mortgages, green loans and more (Vikas Nath, Nitin Nayak, Ankit Goel, 2014).

President Ilham Aliyev's main goal is to make Azerbaijan one of the most developed countries by 2025. The idea of sustainable development will bring more prosperity to the country. Today, Azerbaijan's latest economic achievements are based on the principles of innovation management, and this trend is fundamental for Azerbaijan's transition to a green economy. The knowledge-based economy goes hand in hand with innovation management, which helps restore environmental balance and efficient resource management. At the same time, increasing the effectiveness of innovative development for the population ensures social well-being (Ahmadov, E. 2016). It can be concluded that recent developments in the global energy markets and in Azerbaijan have increased the potential for the use of renewable energy sources. The Azerbaijani government is expected to be more motivated by the reality of the economic situation and to pay more attention to investments and the use of renewable energy sources, especially energy production, which will eventually slow down the development of traditional energy sources. (Nurtaj Vidadilia et al., 2017)

### 8.3. Methodology

Baseline model of our research is linear regression (OLS) that integrates green capital investment directed to the protection of the environment and the efficient use of natural resources, renewable energy consumption (% of total energy consumption), access to clean fuels and technology for cooking, urban (% of urban population) and total natural resource rents (% of GDP) as independent variables and annual carbon emission as dependent variable.

$$CO_2 = \beta_0 \pm \beta_1 GCI \pm \beta_2 REC \pm \beta_3 AFT \pm \beta_4 TNRR + u \quad (1)$$

where

$CO_2$  is annual carbon emission in Azerbaijan, measured in kilotonnes (kt), given in natural logarithm;

$\beta_1 \dots; \beta_5$  are the respective sensitivity coefficients for the four dependent variables;  $GCI$  is annual green capital investment in Azerbaijan, measured in manats (azn) and given in natural logarithm;

$REC$  is annual renewable energy consumption (% total energy consumption), measured in percent;

$AFT$  is annual access to clean fuels and technologies for cooking, urban (% urban population), measured in percent;

$TNRR$  is total natural resources rents (% of GDP), measured in percent;

$u$  is the error term.

The data for variables such as CO<sub>2</sub>, REC, AFT and TNRR are downloaded from the World Bank Data, which is publicly available on the official website of the World Bank. Information about carbon emission in Azerbaijan is taken from the State Statistical Committee of the Republic of Azerbaijan. We use data from 2000 to 2020, based on data availability on green finance.

Our main goal in building of this model is observation of the relationship between these variables to determine level and direction of the impact. For checking robustness of our model we use Ramsey-Reset test (functional misspecification), normality test (normal distribution of residuals), White's and Breusch-Pagan test (heteroscedasticity) and autocorrelation test. Also based on observed international experience we apply to comparative analysis in this article. This analysis helps us identify how the green banking model can be practically applied to Azerbaijan's economy. Will it be effective in achievement of expected results? What kinds of challenges and advantages can it create? To answer these questions firstly we should conduct our empirical analysis.

### 8.4. Result and Discussion

According to the result of conducted empirical analysis, annual green capital investment in Azerbaijan, annual renewable energy consumption (% total energy consumption), annual access to clean fuels and technologies for cooking, urban (% urban population) and total natural resources rents (% of GDP) have significant impact on annual carbon emission as shown in table 8.1. This conclusion is based on their p-value that is statistically significant at 5 % significance level. Total natural resources rents (% of GDP) as a variable does not have significant impact on annual carbon emission in Azerbaijan based on p-value that is statistically insignificant at 5 % significance level. The main reason for that is insufficient level of renewable energy use that can potentially decrease the level of carbon emission. The cause of insufficient use of these resources is low interest and motivation for both, commercial companies and households. So, by omitting insignificant variables we empower quality of our model. In this case, our linear regression model can be considered acceptable and useful.



	coefficient	std.error	t-ratio	p-value
Const	21.0030	2.35463	8.920	4.48e-06 ***
TNRR	0.00305560	0.00319260	0.9571	0.3611
REC	-0.140295	0.0322710	-4.347	0.0014 ***
AFT	-0.110863	0.0255946	-4.332	0.0015 ***
I_GCI	0.0474491	0.0180562	2.628	0.0253 **

**Table 8.1** OLS regression analysis, *p*-value at 5 % significance level

So, after omitting *TNRR* variable from our model, we can see that significance level of other variables become much more strong. As shown in table 8.2, *REC* (annual renewable energy consumption) and *AFT* (annual access to clean fuels and technologies for cooking, urban) have negative impact on *CO2* (carbon emission). If *REC* increases by 1 %, *CO2* would decrease by 0.12 %. If *AFT* increases by 1 %, *CO2* would decrease by 0.11 %. Finally, if *GCI* increases by 1 %, *CO2* would increase by 0.04 %. Even if renewable energy consumption is in highly insufficient level in Azerbaijan, it has negative strong relationship with carbon emission. So optimal level of renewable energy consumption can reduce carbon emission in high level. Also access to clean energy and technology among urban population also significantly reduce level of carbon emission. But *I\_GCI* (green capital investment) impact on *CO2* is positive. It means that this variable impact is not going as a expectable. The main reason for that is an insufficient amount of investment and ineffective channels of their use.

	coefficient	std.error	t-ratio	p-value
Const	21.4235	2.30443	9.297	1.52e-06 ***
REC	-0.127246	0.0291376	-4.367	0.0011 ***
AFT	-0.114748	0.0251741	-4.558	0.0008 ***
I_GCI	0.0491044	0.0179045	2.743	0.0191 **

**Table 8.2** OLS regression analysis, *p*-value at 5 % significance level

Based on functional misspecification test (Ramsey-Reset) we ensure that linear regression model (OLS) is suitable for our analysis with *p*-value 0.54 that accept null hypothesis (specification is adequate). Normality test states that with *p*-value 0.06 we accept null hypothesis (error is normally distributed). Autocorrelation test with *p*-value 0.36 shows that there is no

autocorrelation. At the end, we conduct two types of heteroscedasticity test, White's and Breusch-Pagan. According to p-values of these tests, 0.67 and 0.57, we ensure that heteroscedasticity is not present in our model. So, the robustness of our model is tested by the program.

Green banking model can solve the problem of ineffectiveness of the green capital investment and accelerate implementation of SDGs strategies in our country, especially goals related to climate change. Why is green banking? Reasons are given below:

- banks are the main stimulators in Azerbaijan for financing commercial companies. The financial sector in Azerbaijan is dominated by banks, which hold about 95% of total assets. So, green banking is more suitable strategy for implementation in such types of countries as Azerbaijan;
- also based on research, green banking is implemented more in the Asian region because of the weak development of the financial securities market and high interest in the banking system;
- most green investments are supported by international donors. In the area of financing for development, the OECD Development Assistance Committee (DAC) estimates that approximately \$ 200 million went into climate change-related financial development flows between 2011 and 2015, and more than 75% was in the form of market loans. It shows that market is more oriented to loans with concessional rates as a source of financing because people are adapted to this type of market;
- development partners often finance their environment through local financial institutions. The Caucasus Energy Efficiency Program of the Caucasus (CEEP) operates in Azerbaijan and has supported four regional banks (Demirbank, Muganbank, FINCA and Unibank) with a total creditline of \$ 16.5 million since 2014. Green Growth Fund (GGF) also has credit lines with two other banks (Accessbank and Muganbank). This line of credit will help local businesses and homes purchase and install energy-saving equipment, devices and materials, as well as renewable micro-technology. A line of credit is provided along with the technical assistance needed to help develop and revise the project.

### 8.5. Conclusion

Finally, in Asian region most practices in implementation of the SDGs are related to green banking. The important reason for that is weak development of green financial market in this region. We can observe the same situation in our country. So for being successful in achievement of SDGs we should explore practicing of green banking as a field that is more

suitable for Azerbaijan economy.

Based on our research and given results we can formulate specific conclusions in the form prospects and suitable suggestions:

- specific privileges of Central Bank of Azerbaijan Republic for commercial banks that are engaged in green projects can stimulate their actions. These privileges can be in terms of reserve requirements, concessional rates;
- governmental support in building development partnership relationships with international organizations that provide markets with different energy efficiency programs. This partnership should be with national banks which control most part of country market at regional level;
- development partnership programs should not only provide credit lines, but also provide technical assistance and training programs to banks for the development of their infrastructure (online banking, specialization, mobile banking);
- international development programs also can provide long term international banking partnerships by incorporating national banks to the foreign market (transparency, digitalization);
- government guarantee program for green banks in case of non-performing loans that will compensate some part of loss.

### Credit authorship contribution statement

All authors contributed and gave suggestions equally to the development of the manuscript.

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# Chapter 9

## Foundations of the Concept of Green Economy

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### Abstract

The article analyzes the philosophical foundations of the green economy notion, which is one of the most promising current economic approaches. The writers examine the essence of the green economy and provide a historical overview of its conceptual evolution. They conclude that the philosophical foundations of the concept of the green economy are based on the philosophical principles of systemness and integrity, the principle of eco-centrism, and the ethics of bio-centrism; they examine the role of the ecological imperative in green economy research, and they examine the understanding of the world as an ecological and economic system in the concept of the green economy. The "green economy" concept strives to achieve a more peaceful cohabitation between nature and society. According to proponents of the green economy, the current economic model is ineffective. It generates environmental concerns like as loss of biological diversity, depletion of natural capital, climate change, and widespread poverty by improving the material well-being of certain parts of the world's population. All of this poses a serious threat not only to current generations, but also to future generations, and the concept of "green economy" is critical to ensuring humanity's harmonic evolution. The creation, distribution, and consumption of goods will promote a man's well-being in this scale of green economy, even in the long run, and will have no negative environmental repercussions.

**Keywords:** green economy, integrity, sustainable economy

### 9.1. Introduction

Currently, an innovative information economy is forming all across the globe. If environmental issues were not previously considered in economic activity, and inefficient exploitation of natural resources resulted in irreversible effects, the post-industrial digital economy is built on environmental factors. The environment is becoming one of the most pressing issues among the top priorities for reversing the global economy's negative effects. The emergence of a new economy creates new difficulties for science to address in order to address the world economy's current unfavorable trends.

The answer to these difficulties was aided by a modern economic theory and practice known as the "green" economy. The "green economy" is currently one of the most popular sectors of economic development. At the same time, many issues of theory and practice of considering environmental factors in investment and at work in order to ensure sustainable development in market conditions have yet to be resolved in the context of the new economy and require further study and research, both in the economic and social sciences.

The "green economy's" importance necessitates a philosophical justification, establishing its position and role in the evolution of modern social life. The term "green economy" refers to an economics tendency that contends that economics is a dependent component of the environmental environment in which it operates. Within the scope of sustainable development theory, the notion of "green economy" is the most important theoretical and practical approach to solving the present ecological challenge. This concept and method to economic science are relatively new, having first surfaced around four decades ago. This strategy is founded on three key principles: 1) all life on the planet is mutually dependent, 2) the obligation to meet ever-growing requirements with a finite amount of resources is refused, and 3) the refusal of endless expansion in a restricted place is refused. The "green economy" concept strives to achieve a more peaceful cohabitation between nature and society. According to proponents of the greeneconomy, the current economic model is ineffective. It generates environmental concerns like as loss of biological diversity, depletion of natural capital, climate change, and widespread poverty by improving the material well-being of certain parts of the world's population. All of this poses a serious threat not only to current generations, but also to future generations, and the concept of "green economy" is critical to ensuring humanity's harmonic evolution. The creation, distribution, and consumption of goods will promote a man's

well-being in this scale of green economy, even in the long run, and will have no negative environmental repercussions.

The term "green economy" has just recently entered the public discourse. The initiatives done by global and regional groups seeking a way out of the multidimensional economic, ecological, and social crisis sparked widespread interest in the green economy (Walker and Plotnikova, 2018). The concept of a green economy began with the concept of sustainable development and was aided by technology breakthroughs (Ryszawska, 2013), which combined provide countries (citizen societies) with a competitive edge (Grudziski and Sulich, 2018).

Green economy is undeniably a challenge for each country's legal structure, which sets the tone for the business climate (Kulhanek and Sulich, 2018). Business is not only subject to regulations and changes in its environment (consumer preferences and trends), but it also interacts with other businesses on a regular basis in search of a new competitive position (Kulhanek and Sulich, 2018). If the emphasizing strategy is chosen to produce well-known new value, this can be ensured through innovation and societal backing (Staczyk, 2013). The green economy idea realization process, often known as green development, might reflect such value (Egorova et al., 2015).

Developing country governments are progressively committing to greening their economy, most notably under the Paris Climate Agreement, where nearly all governments pledged to build national decarbonization road maps. In order to establish a green economy, many countries have implemented comprehensive national green growth programs (Lutz, 2017). Even in the most developed countries, declared changes and lofty goals are not always realized (Egorova et al., 2015). However, there are concerns that poorer countries lack the financial and institutional resources to internalize environmental costs, and that their economies are primarily factor-driven, so internalizing environmental costs could erode their competitive advantages in comparison to innovation-driven economies (Grudziski and Sulich, 2018).

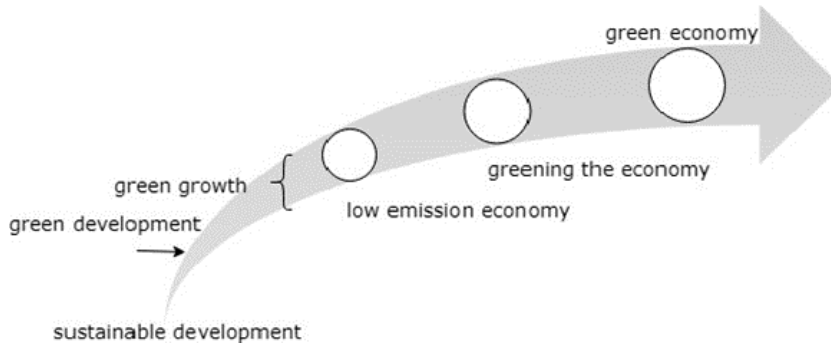
### 9.2. The Green Economy

In the last quarter of the twentieth century, innovative solutions to social, economic, and ecological challenges were developed (Piórkowska and Staczyk-Hugiet, 2017). These solutions are interconnected and linked to humanity's evolution, and they manifest as a shift in two dimensions. The first is a transition away from closed and centralized economies toward open



## Green economy and Green Finance

and cooperative communities that primarily seek to live closer to nature and maintain a work-life balance (Ostrom, 2009). This concept is known as the green economy, and it is built on a long-term development strategy (Fig 9.1).



**Fig. 9.1** *The stages of green development in the implementation of the green economic concept (Source made by authors)*

<b>Brown economy</b>	<b>Green economy</b>
"Unlimited" economic growth	Separating economic growth from the consumption of natural resources
Non-renewable energy sources	Renewable energy sources
Intensive consumption of natural resources (energy and material-intensive)	Energy efficiency
Greenhouse gas emissions	Clean production
Destruction of biodiversity	Biodiversity protection
Global social inequalities	Intergenerational and interregional justice
Unlimited consumption (over consumption)	Sustainable consumption
Lack of Corporate Social Responsibility of Businesses and Investors	Corporate Social Responsibility of Businesses and Investors
Weakening of social trust	Rising social trust

**Table 9.1** *Compares the modern brown economy to the green economy (Source made by authors)*

If the green model is chosen, proper management of natural assets or natural capital is important for the state to improve productivity and, as a result, national economy competitiveness. Furthermore, decarbonization can be understood as a process of charting practical pathways to drastically reduce greenhouse gas emissions while gradually abandoning brown economy technologies (Ryszawska, 2013).

For society, the transition to a green economy can influence people's lifestyles by developing self-governing ecological villages or other revolutionary changes (Walker and Plotnikova, 2018). As a result, the adoption of a green economy can have a tremendous impact on human society (Sulichand Zema, 2018):

- a. eradicating poverty and hunger through targeted measures to alleviate and eliminate poverty, as well as improving agricultural production capacities and food security;
- b. implementing innovation-driven development strategies and generating momentum for sustainable, healthy, and stable economic growth;
- c. advancing industrialization to inject impetus to coordinated development between urban and rural areas, as well as among the three dimensions of sustainable development;
- d. improving agricultural production capacities and food security;
- e. ensuring equity and social justice to improve people's well-being and promote all-round human development;
- f. protecting the environment and erecting protective barriers for eco-security;
- g. actively addressing climate change and incorporating climate change responses into national development strategies;
- h. promoting efficient resource utilization and sustainable energy;
- i. improving national governance and ensuring economic and social development in line with the 2030 Agenda for Sustainable Development.

Governments all around the world are increasingly recognizing that creating long-term citizen society value is also dependent on the state's ability to understand and adapt to changing demands (Grudziski and Sulich, 2018). Green development has a social dimension that is linked to technologies that speed up economic development. The need for innovative environmentally friendly production management methods and approaches is becoming more apparent. Green growth toward a green economy allows for the simultaneous achievement of economic, environmental, and social goals (Rutkowska-Podoowska and Wglarz, 2017). It offers

the possibility of making established sectors more sustainable while also fostering new industries and a more diverse economy.

### 9.3. Innovativeness of Green Economy

The large-scale deployment of green technologies across major sectors such as electricity generation, transportation, and energy use is required to address climate change while encouraging economic growth (Rutkowska-Podoowska et al., 2016). These industries, when combined, form the green economy. Although many of these technologies, such as wind and solar energy or hybrid and electric cars, are already available, they are frequently more expensive than existing fossil fuel-based alternatives, implying that either further refinement or the development of new technologies is required (Rutkowska-Podoowska et al., 2017).

Investing in R&D, promoting commercialization, strengthening markets, and stimulating technology diffusion are all important policy activities that must be taken to ensure the deployment of new technologies and discoveries (Organa and Sus, 2018). As a result, the development of the green economy is founded on the transfer of knowledge (know-how and skills) (Picture 2). Piórkowska and Staczyk-Hugiet (2017) define innovation as "the use of the outcomes of technological advancement, novel combinations of current technology, or the use of other knowledge desired by the organization."

### 9.4. Corporate Social Responsibility

Both theoreticians and practitioners participate in this debate, emphasizing the relevance of a company's interaction with the environment. Furthermore, the ongoing debate is attempting to establish the responsibilities that globalization organizations must play as well as the activities that they must perform for one another (Organa and Sus, 2018). Green jobs, which combine in-depth communication and cooperation with many groups of stakeholders with environmental conservation, have been advocated as a new approach for CSR development.

Green jobs are defined as "jobs in business that produce goods or services that benefit the environment or conserve natural resources" or "jobs in which workers' responsibilities include making their establishment's production processes more environmentally friendly or use fewer natural resources," according to the Bureau of Labor Statistics (Bureau of Labor Statistics, 2013). The publications by Kozar (2017) and Rutkowska-Podolowska et al. (2016) provide a more in-depth look at the notion of green

jobs. Green occupations are also a hotbed of new solutions that aid in the eradication of local community issues (Kozar, 2017).

Because, according to Demków and Sulich (2017), corporate social responsibility is also a collection of obligations made by a corporation to refresh and strengthen the society in which it operates. Furthermore, green jobs are expected to be created as a result of the greening of the economy, making it feasible to combat unemployment while also preventing environmental damage (Rutkowska-Podoowska et al., 2016). Green economy in the CSR dimension, as well as in socio-economic practice, has progressed as a result of their efforts. Furthermore, many green jobs are the result of the implementation of innovations, and are sometimes referred to as eco-innovations, because people working in green jobs contribute to new products and processes that provide customer and business value while reducing environmental impacts significantly (Kozar, 2017).

### 9.5. Method

In this paper, exploratory factor analysis was used to analyze secondary data collected from the Polish Central Statistical Office (GUS, 2018). This method's purpose is to reveal the underlying structure of a huge number of variables. Unmeasurable factors are presumed to be entangled with measurable variables (indicators of sustainable development) in this article. As a result, this technique is used in factor analysis to find the underlying correlations between measured variables.

The plot of own values generated as a consequence of the exploratory factor analysis technique suggests that there are two main variables that are related to all measurable indicators.

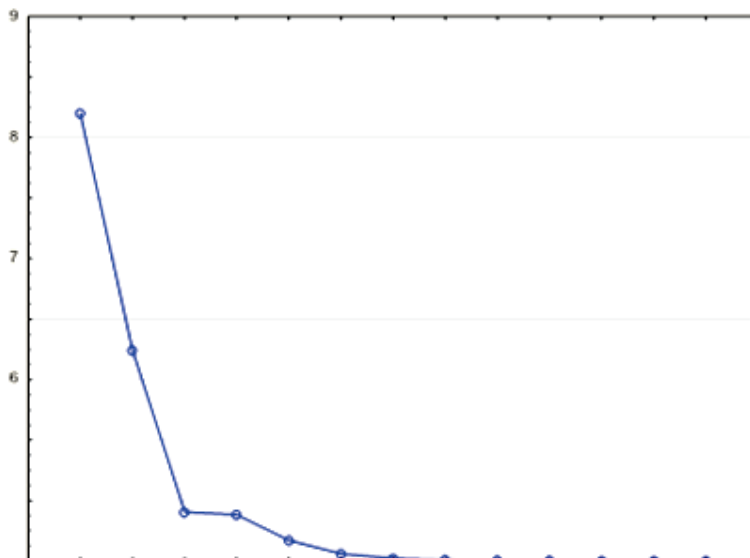


Fig. 9.2 Chart of factors values

There are indicators in Azerbaijan that represent sustainable development, and you can choose from three groupings of these indicators that are also related to the growth of the green economy. A statistical analysis of 13 sustainable indicators for 16 Azerbaijani areas is shown in table 9.2. There are three types of indicators: those associated with the environment (group E), those associated with the economic sector of development (group G), and those associated with society (group S). The basis value of each of the 13 indicators was converted into a basic unit per region citizen.

Indicator symbol and meaning [basis unit/citizen]	Median	Variation coefficient	Minimum value	Maximum value
			Region	Region
E1 = underground water exploitation resources	0,02	43,43	-1,26	2,08
			Baku	The North region
E2 = expenditure on protection of atmospheric air and climate	-0,46	99,73	-0,85	2,14
			The South region	The North region
E3 = fees and receipts for the environmental protection and water management fund	0,02	41,35	-1,29	1,66
			The South region	The North region

E4 = legally protected areas	-0,15	42,35	-1,40	1,85
			Baku	The North region
E5 = expenditures on fixed assets for water management	-0,51	66,74	-0,87	2,53
			The South region	Lesser Poland
S1 = registered unemployment rate	-0,05	22,17	-1,33	2,13
			Baku	The South region
S2 = students of post-graduate studies and participants of doctoral studies	-0,16	60,46	-1,01	3,25
			Baku	Baku
S3 = average monthly expenses on health	0,10	10,02	-1,57	2,41
			The North region	Baku
G1 = gross domestic product per capita	-0,10	22,89	-1,08	3,01
			The South region	Baku
G2 = gross value of fixed assets per capita	-0,13	20,61	-0,83	3,30
			The North region	Baku
G3 = investment outlays in enterprises per capita	-0,32	161,21	-0,58	3,53
			The North region	The South region
G4 = capital expenditures on total fixed assets	-0,22	126,96	-0,74	3,30
			The North region	The South region
G5 = gross operating surplus	-0,37	77,70	-0,82	3,00
			Baku	The South region

**Table 9.2** *Statistical analysis of the sustainable development indicators for Regions of Azerbaijan for 2019*

Table 9.2 shows the values of the next step factor loads, which were calculated to be greater than 0,55. Two variables, E3 (environmental protection and water management fund fees and receipts) and S1 (registered unemployment rate), are unrelated to the main two factors. Despite the fact that there are two primary components that are negatively associated to indicators. The first element combines environmental (E1, E2, E4, E5) and economic (E1, E2, E4, E5) indicators (G3, G4, G5). The second factor depicts the relationship between society (S2, S3) and the economy (S4) (G1, G2).

Because they frequently employ the environment as a resource for economic development, eco-innovations can be classified as the first factor. Eco-innovation is based on the local environment and has an impact on the local economy. The number of educated people in each region, as well as the development of local society and their well-being and welfare, are indicators of corporate social responsibility.

### 9.6. Conclusion

Technology innovation, as well as how it is utilized, is critical for enabling industry to develop new commercial values while also benefiting people and the environment. Individual firms, regions, and countries all benefit from innovation in order to create and sustain a competitive position and competitiveness. Green employment are a specific sort of green economic development that incorporates both dimensions. Manufacturing businesses have been improving their efforts toward sustainable manufacturing in recent years, moving away from pollution prevention and toward integrated approaches that consider product lifecycles and wider implications. Eco-innovation contributes to this evolution by combining technological and non-technological advances that can result in significant environmental benefits.

The recent economic crisis and climate change negotiations should be seen as a fantastic opportunity to accelerate innovation and develop a citizen-driven society on the way to a green economy. Due to the environmental cost and violation of sustainability principles, the green economy model's implementation approach of "grow first, clean up later" is not feasible. As a result, the social dimension represented by the CSR concept and the concept of green jobs are inextricably linked to innovation. These two areas are potential sources of green economic development and should be investigated further in future studies.

The results of the exploratory factor analysis for Poland show that the country has to adjust its plans and policies to become more environmentally friendly. There are environmental issues that could have a long-term impact on the economy and society of the country. There are two major factors that influence Poland's green growth. Eco-innovation and corporate social responsibility are the two universal factors. There are insufficient of them in both circumstances to classify Poland as a green country. In the future, it is proposed that countries' green competitiveness be compared in these two dimensions utilizing the multicriteria analysis method. The results of such a study can provide a more accurate picture of

current tactics in both developing and developed countries.

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# Chapter 10

## Foreign Countries' Experience in Green Cities' Creating and its Possible Implementation in Azerbaijan

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### Abstract

The last century is characterized by the emergency of new models of urban planning, which include large cities of an innovative type, cities of the future. Green cities are one example of greening the urban environment. Green cities contribute to the improvement of the urban environment, the greening of the city, and the purification of water flows. These cities use to modern digital technologies to manage communications and public transport. It is supposed to use only public transport, bicycles, electric vehicles. Interchanges in these cities are digitally driven. Separation of garbage is the most important problem in large cities of Azerbaijan. Over the past 30 years, local authorities have taken decisions on this issue several times. These events came to nothing. It is necessary to actively promote the separation of waste through the media, through preschool institutions, as well as in secondary and higher schools. Green cities are distinguished by the fact that green corridors are created in them, greening of walls and roofs of buildings is used. The application of the experience of green cities in Azerbaijan is possible when such cities are created from scratch with the attraction of huge funds from foreign investors and government subsidies. Green cities differ from other cities in that the population actively makes decisions on various types of management jointly by local authorities. It is necessary to create state official websites of local authorities, which will reflect urban greening activities and a dialogue box with representatives of the population.

**Keywords:** green city, difference of green city from healthy and eco-cities, green city experience of foreign countries, green city creating terms in Azerbaijan

### 10.1. Introduction

The formation of a high-quality environment acts as a factor in the city's competitiveness. Active investment in improving environmental infrastructure, increasing the geographic accessibility of the city, the integrated development of "green" resources, environmental education of young people and agitation of the older generation to protect nature, environmental education and eco-marketing are the main characteristics of green cities.

It is necessary to systematize and classify healthy, green and eco-city models, study of factors and resources that affect green city planning, and study both everyday management tasks and strategic forecasting of green city development. Green cities are characterized by their closed ecosystems. In them all communications - water supply, heat supply, gas supply, garbage chute, power lines, as well as Internet supply lines are hidden underground. These cities not only use natural resources and renew them. Green cities differ from conventional ones in that they are consistent with their strategic goals - city management is aimed at the end result - the protection of the ecosystem.

In writing this article was assessed method of observation, comparative analysis of new city building models, either analysis of external influences of healthy, eco and green cities to economic indicators and SWOT analysis of green city implementation in Azerbaijan.

### 10.2. Green City and Modern City: Comparative Analysis

"Green" and "greening" are used for sustainability and related issues where energy and resource efficiency are central elements in urban green/smart city modelling. The deterioration of the ecological situation in Europe due to air pollution, water supply led to the study of the ecological situation in the industrial cities of Europe. In the 1980s, the reports: "The Limits to Growth" introduced the idea of sustainable economic growth; "Our Common Future" demonstrated it was possible to reconcile economic growth, environmental preservation and social development [5]; and the New Urbanism Movement advocated ways to limit dispersed urban expansion of cities by using more environmentally friendly urban design practices such as walkable neighbourhoods, mixed land use and Transit Oriented Developments (TODs)

(Klaas O.B.J., 2018).

In the 1990s many scientists began to develop the different concepts such as sustainable city (Tjallingii, 1996), green urbanism (Lehmann, 2011), liveable city (Duijvestein, 2002; Economist Intelligence Unit, 2017), and compact city (Jabareen, 2006; UN Habitat, 2015). Discussions on urban forms including energy, resources efficiency and environmental performance became central elements in the search for new concepts and methods to define and measure city sustainability. These latest developments led to the development of the term “green”(Klaas O.B.J., 2018).

The green city means a way to increase the sustainability of urbanized areas. It is a concept of urban planning relying on the ecosystem services that green infrastructure can supply. In essence, this concept includes the characteristics of all the urban concepts described previously (city meeting with nature, restoring the values of urban ecosystem, minimizing resource and energy consumption, and taking advantage of the ecosystem services of the blue-green natural components) (Tîrlă L., Manea G., Cicoș O., Luliana V., Matei E., 2014).

For example, German government had demonstrated the results of greening program for industrial cities which ended in success since 1960 (Dushkova&Kirillov, 2016). The city of Hamburg has got the environmental strategy “Green Network Plan”. This program supports the creation of bicycle and pedestrian lanes meant to connect all the green areas of the city – parks, gardens and cemeteries, playing grounds. The green corridor network will expand throughout city of Hamburg from periphery to downtown. The city of Hamburg has an environmental strategy that is included in the “Green Network Plan”. This document supports the creation of bicycle and pedestrian lanes meant to connect all the green areas of the city – parks, playing grounds, gardens and cemeteries. The green corridor network will expand throughout the city from periphery to downtown. It will also connect the animal habitats, allowing wildlife to move safely from place to place. And even more important is the fact that these green belts will absorb the CO<sub>2</sub> emissions, thus mitigating the global warming effect (Tîrlă and etc., 2014).

The Green City demonstrates high environmental performance against established criteria in terms of quality of environmental assets (air, water, land/soil and biodiversity), efficient use of resources (water, energy, land and materials) and either risk mitigation and adaptation to the risks associated with climate change, while maximizing economic and social co-

benefits, taking into account the context of the city (population, socio-economic structure and geographical and climatic characteristics). Healthy cities constantly create and improve their physical and social environment and expand community resources that enable people to mutually support each other in fulfilling all life functions and maximizing their potential. The Healthy Cities concept was inspired and supported by the WHO European Health for All strategy and the Health 21 goals (Guide to City Development Strategies Improving Urban Performance, 2016). Health 2020 recognizes that governments can achieve real health gains if they work at the government level to achieve two interrelated strategic goals:

1. improving health for all and reducing health inequalities;
2. improving leadership and co-management for health.

Modern cities of the future can or can't include the concept of greenery. Only in terms of improving the ecosystem and the environment, the builders of future cities need to consider the concept of urban greening. All of green cities include smart city possibilities. Of course, projects for the construction of new "smart" cities from scratch are few in number and require huge investments and strategic planning. In this regard, large cities prefer the introduction of certain technologies, approaches, elements of the smart city model into the actual practice of managing urban development.

Many theorists of the smart cities model and the concept of digitization assume that new information technologies will lead to an equalization of the level of urban development, opening up new opportunities also for municipalities.

The involvement of citizens in the management of urban processes with the help of electronic portals makes it possible to involve the broad masses in government, to realize the idea of equal partnership. Data openness allows citizens to be informed about the activities of local authorities, involve various stakeholders in active cooperation, and create experience in developing compromise solutions. Table 10.1 demonstrates comparative analysis of modern and green cities (Frolov&Solovieva, 2016; Shemyakina, 2014).

Characteristic	Modern city	Green city
Perception of the city	The city as a mechanism for industry and business	The city as a closed ecosystem
Main energy sources	Non-renewable (traditional), sometimes alternative	Renewable (alternative)
Main modes of transport	Automotive, freight, underground and surface public transport	Public electric transport, cycling
Food supply	Agro-industrial complexes	Local ecological farms
Water treatment	Chemicals, mechanical filters	Reuse of biofilters
Waste management	Landfills, partial reclamation	Separate collection, complete recycling
Preservation of biodiversity	Alienation of the city from the natural environment	"Green" corridors, frame, matrix (integration of nature into the urban environment)
Emphasis of environmental planning	Greening, sanctions for pollution of the atmosphere and water resources	Comprehensive planning for the development of "green" resources
The role of environmental organizations	Criticism of the administration	Involvement in joint work with the administration
Ecological culture	Periodic campaigns	Ecological education and eco-marketing

**Table 10.1** *Comparative analysis of Modern city and Green city (Source compiled by the authors)*

It should be noted that the cities of the future will be markedly different from all new types of modern cities. The future city will be less dense and will develop solutions not only for urban but also rural residents. Future cities will be characterized by green spaces, sustainable practices and high-tech innovation. Green areas will be integrated into residential and office buildings to enhance comfort and well-being.

The future city should be characterized by public open beautiful and maintainable areas. The "City of the Future" must move towards environmentally sustainable and energy efficient structures that reduce the consumption of water and other natural resources. Recycling will become a main characteristic of the cities of the future and motivate citizens to improve the environment (Global Business Cities 2025, 2019).

In the 21st century, a number of new configurations in urban planning have emerged. In the 21st century, Smart City, Green City, Eco-City and others are being created mainly in Asia, in Middle and Middle East and Africa (Moser, 2013).



Green cities include a new green city in Morocco - Mohammed VI Green City (VVM6). In recent years China has created new ultra-modern cities, among which we can highlight Sino-Singapore Tianjin Eco-City. Putrajaya Intelligent garden city is the new capital of Malaysia (Shemyakina, 2017). The Philippine new city of Clark Green City is a city in which a special economic zone is also being created.

### 10.3. Analysis of The Assessment of The Possibilities of "Green City" Model

To be considered "green", a modern city needs to comprehensively, systematically prepare a program for the creation of urban planning based on the latest technologies for the careful use of natural resources. Green city implies a long-term orientation of urban development by solving global environmental problems, on the one hand, and a comprehensive improvement of the environmental situation, on the other hand, and a balanced development of the inner city natural environment, on the third hand (Green Cities, 2012, p. 9].

A green city also involves the use of "green" tools - environmental infrastructure, architectural solutions, forums and actions, etc. - to increase the attractiveness of the city for residents, tourists and businessmen. Table 10.2 looks at the characteristics of healthy cities, eco-cities and green cities (Frolov&Solovieva, 2016; De Roo, 2015).

Characteristics	Healthy cities	Eco-cities	Green cities
Urban planning	Traditional	Traditional or from scratch	From scratch
Communications	Uptodate technologies	Uptodate technologies	Hidden uptodate technologies
Transport infrastructure	Road, freight, underground and surface public transport	Road, freight, underground and surface public transport	Public electric transport, cycling
Food supply	Agro-industrial complexes, trade facilities	Agro-industrial complexes, trade facilities	Local ecological farms, points of sale
Water purification	Chemicals, mechanical filters	reuse of biofilters	reuse of biofilters
Waste management	Landfills, partial reclamation	Separate collection, complete processing	Separate collection, complete processing

Biodiversity conservation	Harmony of the city and the natural environment	Closed urban eco-system	"Green" corridors, frame, matrix (integration of nature into the urban environment)
Emphasis of environmental planning	Minimization of negative anthropogenic impact on the environment, landscaping, sanctions for pollution of the atmosphere and water resources	Comprehensive planning for the development of "green" resources	Comprehensive planning for the development of "green" resources
The role of environmental organizations	Criticism of city authorities and administration	Involvement in joint work with the administration	Involvement in joint work with the administration
Ecological culture	Periodic promotions, environmental education	Eco-city branding, environmental education and eco-marketing	Environmental education, education and eco-marketing

**Table 10.2** *Analysis of external impacts on new cities with an eco-system (Source compiled by the authors)*

The development of green cities solves the issues of greening urban areas, increases energy efficiency, expands opportunities for outdoor activities, improves the physical and psychological health of the population, creates incentives for the growth of consciousness of urban residents, unites the local population with city authorities, minimizes anti-social behavior, forms new tourist spots (OECD Green Growth Studies, pp. 6–7).

It is impossible to imagine green cities without public, private, and social institution funding. Banking and financial institutions focused on supporting green cities have invested in greening programs in Germany, Austria and Switzerland. In Latin American countries, such financial support is referred to as "responsible financing". The main goal of responsible finance is to create an institutional environment in which public and private fundings combined for the development of green infrastructure (Bocharnikov, 2021).

Over the past 60+ years, Germany has become one of the leading green powers in the European Union in the development and implementation of renewable energy, as well as a leader in the green technology markets (Thierfelder, 2014). At the same time the "green" policy of Germany takes into account not only the interests of the economy, but also environmental

protection. Germany has accumulated significant experience in the development and implementation of the concept of "green" infrastructure in the cities of Berlin, Leipzig and industrial areas (Dushkova&Kirillov, 2016).

The main elements of green infrastructure are:

- green building: with a low share of energy consumption (20-25% lower) and environmental emissions (5-10% lower than usual). It is based on the use of the 3R approach (Reduce, Reuse, Recycle) (Dushkova&Kirillov, 2016);
- the use of green transport: the introduction of electric buses and hybrids, which have been successfully operated in Germany since 2008. Germany has developed a network of electric car rentals (ecocars) and the "TeilAuto" system, designed for the sharing of one car by several owners, which reduces the level of environmental impact; mass reorientation to cycling, including the active development of a network of bike paths, bike parking, a shared system for using bicycles, etc. (Dushkova&Kirillov, 2016);
- environmentally friendly waste management: waste recycling that does not apply high temperatures;
- carrying out active awareness-raising work among the population, which is aimed at stimulating the use in everyday practice of the method of sorting garbage and separate collection of solid waste components in order to subsequently use them as secondary raw materials;
- green transport routes and ecological corridors, which, due to green spaces, create a special microclimate, maintain the health and well-being of people, and also form a special attitude towards the city among residents (sense of place, identification with the place of residence, etc.). Recently, the use of landscaping the roofs of urban buildings and the creation of vertical gardens contributes to the purification and thermoregulation of the air.

With the introduction of the state greening program, Germany from one of the polluted countries in Europe in the 1960s–1970s. became environmentally friendly by 2000. The quality of water in the rivers has improved significantly, and many watercourses previously heavily polluted by industrial waste have become suitable for fishing. In most cities, the problem of smog has disappeared in the Ruhrgebiet coal and smelting district. A number of abandoned quarries, in particular in Central Germany, have been reclaimed and are today places of recreation for the population (a

suburb of Leipzig with its lakes - the former quarries of Markleeberg, Kospudener See, etc.) (Dushkova&Kirillov, 2016).

The newly created city of Iskandar (Malaysia) is located next to Singapore and has a strategic goal - to unload trade flows going to Singapore and develop tourism along with industrial production with all the attributes of transport and communication, banking infrastructure. The entire territory of the city is divided into "flagship" zones in one line of the coast.

Each of the zones consists of a number of thematic clusters: zone A - financial and business district with heritage sites; zone B - a multifunctional administrative center with education, recreation, tourism and healthcare facilities; zone C - port, free trade zone, industrial and logistics center; zone D - port, industrial zone, technological park; zone E - luxury retail facilities, cybercity, industrial and logistics center (Moser, 2013). Iskandar is a pilot experimental site for developments in the field of low-carbon environment. This involves the creation of technologies for recycling and converting by-products, waste, useless or unwanted products into new, better and more environmentally friendly materials (the technology is known as Upcycling). The city encourages the use of renewable energy sources (Moser, 2013; Shemyakina, 2017).

When planning Iskandar, it will take into account the world experience of coexistence in the immediate vicinity of a new urban formation with a large prosperous city. In particular, Vancouver and Melbourne, Shenzhen and its synergy with Hong Kong, as well as healthy competition between Abu Dhabi and Dubai. The city organizes a more orderly, clean and "green" way of life than in other places in Malaysia. In Iskandar, as in a special economic zone, various schemes for stimulating business development have been adopted, as well as a special regulatory framework (Moser, 2013). There is already a strong industrial base on the territory of Iskandar, which includes the production of electronics, the chemical industry (oil and gas processing), the production of oils, the agro-food industry. The development of service infrastructure, tourism industry, education, health care, and financial services is planned.

King Abdullah Economic City (KAEC) is the core of logistics and industrial production. A new port, an "industrial valley" is being built in the city to develop such areas of activity as logistics, the production and distribution of consumer goods, the production of plastics and building materials, the automotive industry, the development and manufacture of pharmaceuticals. In the transport system, priority is given to pedestrians, cyclists and public transport. A high-speed rail line is under construction to

connect the city to Jeddah, Makkah and Medina (Shemyakina, 2017). Singapore's largest NEWater plant was built in 2010 to meet the water needs of 30% of the country's population. It is estimated that by 2060, NEWater will be able to meet 55% of the demand for clean water. A smart monitoring system using multifunctional water sensors will reduce water waste in Singapore by 4.6%, which is the best indicator in the world (Frolov& Solovieva, 2016).

An intelligent lighting system that calculates the current traffic density in cities and can make decisions based on an integrated approach is another perfect solution for urban traffic management. In Singapore, for example, all traffic signals are monitored by Green Link Determining (GLIDE). Under this system, green light is distributed in accordance with real-time traffic requirements, and traffic signals at neighboring intersections are connected to the main roads, which minimizes the number of stops when drivers travel from one intersection to another (this is known as a green wave). The presence of pedestrians is determined by the button they press at the traffic light while crossing the road (Frolov&Solovieva, 2016).

Russians consider Sochi the most environmentally friendly and green city in Russia. This follows from a survey conducted in 2021 on social networks by the [www.tvil.ru](https://www.tvil.ru) vacation rental booking service (<https://ierarp.ru/samyeyelyonye-goroda-rossii>). The second place was taken by Gorno-Altai. He received 17 percent of the vote. The forested area of Altai Republic is 3.56 million hectares. "Bronze" received Yalta (also 17 percent of the vote). The top ten were (in descending order of the number of votes received): Petrozavodsk, Novosibirsk, Ufa, Tolyatti, Perm, Irkutsk and Kemerovo. Vladivostok is also considered the most "green" city. In it, 72% of the territory is covered with trees, shrubs and grasses. In second place and third place are Kemerovo and Penza (about 68% each) ([https://lenta.ru/news/2021/09/21/green\\_cities/](https://lenta.ru/news/2021/09/21/green_cities/)).

The current ecologization program in the Russian Federation requires scientific justification and targeted development of a legislative and executive legal framework, the development of socio-economic indicators of "green growth". Russian studies have not yet disclosed all the "pluses" and "minuses" of using green infrastructure. In the face of even a slight increase in "green products" and ecosystem services, it is possible to identify the most serious environmental problems between businessmen and government agencies.

Energy efficiency is extremely important, most of the green buildings consuming 40% less energy than conventional edifices. In order to reach this performance engineers take into account the following aspects:

- buildings' shape and orientation;
- the use of natural light; passive systems of energy;
- automatic and efficient lighting systems;
- efficient air conditioning systems and optimum thermal insulation (for instance, cork in the Iberian Peninsula; natural wool in Romania);
- the use of warm colors, having psychological and sanogenic effects; and the use of alternative, clean energies.

Nevertheless, the issues of green roofs in industrial cities do not require large costs, and in Moscow they gradually began to build new buildings with green roofs, which will help reduce electricity costs (heating, air conditioning) by 10% or more.

From 2008 to the present, a number of projects have been implemented in Tbilisi, Georgia, supporting green/sustainable city objectives. The most important of them are Urban Development Strategy 2030 and Sustainable Energy Action Plan 2011-2020 (Methodology of the Green Cities Program, 2016). At these two projects and other activities, the municipality received support from the following international organizations:

- The World Bank (through the Cities Alliance), UNDP and the German Technical Cooperation (GTZ) provided assistance to the Municipality of Tbilisi in development of urban development strategy 2030;
- ADB completed a sustainable urban transport strategy (study) in 2015 in Tbilisi;
- The Covenant of Mayors supported the Municipality of Tbilisi in developing an Action Plan for sustainable energy 2011-2020.

In general, activities (with the exception of the Urban Development Strategy 2030 for Tbilisi) most attention to energy and transport due to air pollution problems, a high proportion private transport, an inefficient public transport system, commitments in climate change and low energy efficiency in buildings.

### **10.4. Applying the Experience of Green Cities in Azerbaijan**

Ecologically sustainable socio-economic system adopted in Azerbaijan in 2003. The state program based on development covers all important environmental aspects. This program includes clean atmosphere, water resources, land resource saving. In 2004 Azerbaijan government adopted state program on the use of alternative energy sources: using wind energy and the construction of wind power plants. Azerbaijan's industrial cities have been using a variety of methods since the 1960s to prevent emissions. It is also planned to increase the number of metro stations operating to 60 in 2040.

The Green Growth Strategy like as branch of Green Economy Concept, was adopted by the Azerbaijan Government of in 2005. This strategy initially included four priority areas:

- rational model of production and consumption;
- "greening" of enterprises and markets;
- sustainable infrastructure;
- "green" tax and budget reforms.

Later, two more were added to these directions:

- investments in natural capital;
- indicators of environmental efficiency.

It will currently support low-carbon production in Azerbaijan, resource-efficient a policy that will ensure the use and transition to a socially inclusive economy performed. In 2009 were established "Alternative and Renewable Energy" State Agency for Sources (hereinafter referred to as ABOEMDA) and "Alternativenerji" LLC. Out Household waste as a result of structural reforms and the State Program Combustion Plant, about 10 hydropower plants in the regions, 5 in Khizi and Absheron created a wind power plant, a hybrid power plant in Gobustan, a lot Heat pumps and solar panels have been installed at facilities located in the regions.

As a result, 65 MW of wind energy with a total installed capacity of 260 MW, 126 MW hydroelectric power, 39 MW biomass and waste, 32 MW solar power plants was built and put into operation. At the same time was built Sumgayit Technology Plant and Azguntex solar panels enterprise for solar panels' producing.

Last four years Azerbaijan create a new innovation institutions: the intelligent transport management system in Baku - NIIS ([www.niis.az](http://www.niis.az)), StreetArt, the application of scientific achievements to urban infrastructure (ASAN, DOST agencies in Baku). Finally, authors came to the conclusion that latest technologies and innovation methods help to use to smart or green urban concepts in Azerbaijan cities. The main directions of green city creation are 1) urban transport and traffic problems' solving, 2) digital technologies using, and 3) organization of effective relationships between (via QR codes, NFC or other applications); providing comfort in public transport; Fast passenger transportation by special lines already exists in Baku, but is not fully implemented. Another smart concept could be to improve the parking system and prevent parking on city streets by introducing online the population and local authorities.

Urban Transport. The German government has saved \$ 1.68 billion as a result of a ban on private cars in Berlin. It is estimated that ensuring the

dominance of micro-vehicles, such as bicycles, electric scooters, etc., on the roads could lead to a 60% reduction in annual traffic accidents in London. The use of robotic services (trains, electric buses) can lead to a reduction in carbon emissions in Los Angeles or a 100% increase in public areas in New York (Valiyev, 2021). Digital technology is the monitoring of all traffic of citizens with their mobile phones. The use of such digital technologies supports the efficient management of transport in large-scale cities. Flexible flat payment mechanism reservations and variable payments (Valiyev, 2021). Table 10.3 demonstrates SWOT analysis of green city implementation in Azerbaijan by S.H.Abasova.

S - Strengths	W – Weaknesses
<ul style="list-style-type: none"> <li>• The presence of green urban-type housing estates in Azerbaijan (Sumgayit, Mingachevir city experience, Baku boulevard) will stimulate the development of living standards in accordance with health requirements;</li> <li>• According to EBRD, new types of containers, expansion of the existing fleet and the introduction of more environmentally friendly vehicles will be provided, which will significantly reduce the carbon footprint of municipal services of the Ganja city;</li> <li>• The presence of 2 artificial satellites in Azerbaijan will create conditions for the development of the ICT sector and meeting the demand for smart technologies in digital campuses.</li> </ul>	<ul style="list-style-type: none"> <li>• Weak promotion of smart/green city concept among the population;</li> <li>• Lack of smart/green urban promotion among preschool and high school students;</li> <li>• Lack of propaganda among the population on separate waste collection;</li> <li>• Insufficient activity of local authorities and municipalities on environmental propaganda.</li> </ul>
O - Opportunities	T – Threats
<ul style="list-style-type: none"> <li>• Construction of smart housing quarters for population in Baku which was implemented in Barcelona, Spain in 1950-60;</li> <li>• Construction of Sumgayit and Mingachevir cities from scratch and creation of smart modern residential complexes there;</li> </ul>	<ul style="list-style-type: none"> <li>• Decrease of water in the basin where the Kura River flows into the Caspian Sea as a result of construction of modern reclamation systems for arable lands and flooding of the sea shore;</li> <li>• Mass felling of trees in Baku for the last 30 years.</li> </ul>



<ul style="list-style-type: none"><li>• Partial application of technologies for the movement of smart traffic lights in cities, water and heat supply, gas supply management, as well as the regulation of public transport on demand by ICT;</li><li>• Existence of water treatment system for the population created on the basis of German technologies in Baku and Sumgayit;</li><li>• Creation of green belts in Baku for more than 100 years;</li><li>• European Bank of Reconstruction and Development (EBRD) has allocated 10 million euros for smart waste collection and route optimization systems in Ganja city.</li></ul>	
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**Table 10.3** *SWOT analysis of green city implementation in Azerbaijan (Source compiled by S.Abasova)*

The Paris model is a good example for application in Azerbaijan cities. The main goal was to create sustainable neighborhoods that would allow people to reach their destination within 15 minutes. The model also focuses on minimizing carbon emissions and preventing road accidents.

The European Bank of Reconstruction and Development (EBRD) is an important institutional investor in Azerbaijan. To date the EBRD has invested over 3.5 billion euros through 181 projects there. European Bank of Reconstruction and Development (EBRD)'s First Vice President Jurgen Rigterink said in interview to AZERNEWS correspondent: "More than 300,000 people living in Ganja will benefit from improvements in their urban environment. Today's agreement will also pave the way for a follow-on project that will complete the solid waste management improvements by way of a new modern regional sanitary landfill" The project is part of Ganja's engagement in the EBRD Green Cities program and will contribute to the development of a Green City Action Plan (GCAP). Ganja joined the program in 2020 (EBRD supports Azerbaijan's Ganja in further "green" transition. – <https://www.azernews.az/business/193690.html>).

The application of Smart/Green City in Azerbaijan is complicated by the low level of use of digital technologies in other regions of the country, except for the urban population and business environment. Only digital technologies have a stable infrastructure in all areas, as well as the creation of smart/green settlements due to faster, cheaper and more accessible broadband Internet. The

lowest internet speed in Azerbaijan in Europe makes it difficult to implement the concept of smart/green city (Azerbaijan Statistic indicators, 2021).

The use of digital technologies in the banking and financial sector is very weak. In 2017 only one in 20 people (5% of the population) in Azerbaijan made online purchases. The world average is almost one in four (24%). During the pandemic, along with high schools and universities, the banking infrastructure turned to digital technologies and the population's demand for online services increased. During the 11 months of 2020 e-commerce turnover increased 2.4 times compared to retail trade turnover. In pandemic terms more of customers used to online trade opportunities: ordering food, clothing and footwear, electrical goods, computers and mobile phones, medicines (Abasova, 2021).

Factors which influences to e-trade development in Azerbaijan are:

- 1.lack of infrastructure;
2. weakness of the postal system;
- 3.inability to meet customer needs in electronic space.

For development of e-trade it is necessary to take into consideration some features. The growth of Internet use in Azerbaijan in recent years has begun to create the infrastructure for the development of e-trade. E-trade involves all activities that affect and support many areas (education, advertising, information exchange, etc.). It is necessary to create the strong information infrastructure, the security system of e-trade operations and customer's financial information, legal regulation mechanisms, new management methods, the different business models "customer demand - online trade – goods' advertising - payment methods" (Abasova& Safarov, 2021).

Firms engaged in online sales should take into account the behavior of consumers who shop online. Consumers are becoming more inclined to shop online by saving time.From the point of view of the e-trade sector, the study of online shopping behavior of consumers in Azerbaijan is of great importance.

However, despite this, user knowledge of technology, e-commerce and e-payment systems is limited and trust in such systems is low. While all of the problems listed above can be solved through advanced technology and technical solutions, the main obstacle is management. For the successful implementation of the concept of a smart/green city, the population in these cities must cooperate with local authorities and play an active role in making decisions about the fate of the city. Smart/green city concept can't work without

the participation of the population and their voice.

One of the main problems in Azerbaijan is the use of a monocentric model in the process of governance and urbanization. Observations of the current situation in Baku show that the management of such a large metropolis in the traditional way is inefficient, and there is a need to resort to new innovative management methods based on digital technologies. There is a great need for digital technology management of traffic congestion, waste and utilities. The weakest sub-sector in which Azerbaijan lags behind many countries is the level of use of knowledge and technology. Although digital systems such as e-government, e-education, e-banking, e-medicine have been created, their comprehensive use of high-speed internet and information technologies is required for their use in accordance with modern standards.

Establishment and effective management of smart/green settlements should establish mechanisms for public relations with municipalities and local authorities, and attention should be paid to increasing the civic role of the population. Bringing municipalities and local communities together can play a key role in building the first stone of a smart city.

### 10.5. Recommendations

Taking into account all the above, it should be noted that some experience of foreign countries can be used in the construction of smart/green type settlements in Azerbaijan:

- first of all, it is necessary to develop a package of scientific, educational and educational programs with the aim of greening the consciousness of the population of cities and towns, where the Azerbaijan government is going to create green belts or green cities. Taking into account the fact that internally displaced persons mostly live in Baku, Sumgayit and the suburbs of the Absheron Peninsula for about 30 years, it is necessary to conduct classes both in preschool institutions, in secondary and higher schools, and among the population. The mass media should also join the agitation of the population;
- to use the experience of the cities of Berlin and Leipzig (Dushkova&Kirillov, 2016) in involving local authorities in solving the problems of improving the region. Large, diverse institutions, subordinated to the Departments of Environment and Health of the cities of Berlin and Leipzig (Dushkova&Kirillov, 2016), not only supervise the quality of air, water, soil, emissions/discharges, noise levels, the state of flora and fauna, food safety, but also carry out sanitary

- epidemiological control, monitor the correct placement and maintenance of litter bins, implement new environmentally friendly technologies;
- therefore, it is necessary to create the same institutions in large cities of Azerbaijan that actively interact with the population (not only through the official websites of these institutions, but also through social networks);
  - to maintain the ecological balance of the territory, it is necessary to rationally use both natural and other resources. Urban planners in Germany (Dushkova&Kirillov, 2016) created such a transport infrastructure of the city, in which the "islands of nature" in the city's major transport interchanges help purify the air;
  - it is necessary to place the elements of natural and technogenic frameworks in the space of the city in such a way that their mutual intersection does not occur at the same level;
  - it is necessary to continuously improve the intelligent transport management in Baku ([www.niim.az](http://www.niim.az)), which will contribute to the rational use of public transport - reducing or increasing the number of buses depending on the density of passengers, which will ultimately affect the reduction of exhaust gases;
  - it is necessary to create green stripes and build fountains in each housing quarter of Baku center for improve the environmental cleanliness of these areas;
  - creation of city greening projects requires joint efforts of government bodies with ecologists and managers. The European Bank for Reconstruction and Development (EBRD) has allocated a loan in the amount of 10 million euros for the introduction of smart waste collection and route optimization systems in Ganja city (<https://www.azernews.az/business/193690.html>);
  - promote separate waste collection and actively consistently implement these innovations. About 30 years, from time to time, local authorities in Baku have organized events in this area. But the population still throws out all the garbage indiscriminately into plastic, paper, glass and biomass;
  - it is necessary to introduce digital technologies that will take into account not only the consumption of water, gas, electricity and heat supply, but also keep a record of the volume in order to rationalize the supply depending on the season, time of day, and the needs of the population.

### 10.6. Concluding Remarks

It is necessary to use various elements of the identified urban development models, combining them depending on the characteristics of Baku or Sumgayit in socio-economic development strategies' planning. It is in the combination of the identified basic models of urban development that it is possible to create a city of the future, taking into account environmental problems, striving for harmony, which was the city of Baku before industrial oil production.

It should be noted four main directions for the creation of green cities and towns:

- organization of waste management based on digital technologies. Waste management includes the recycling of waste, the production of biofuels from waste raw materials. Local authorities, together with activists of the green movement, should agitate and stimulate the use of the waste sorting method in everyday practice. Propaganda and education of greening should start from preschool educational institutions to higher educational institutions, active promotion of green cities is expected through educational lectures of the Knowledge and Media Society for the elderly population of the country;
- purification of the urban environment from harmful impurities and smog. The government and local authorities should encourage the transition from private cars to public ecological transport, bicycles, scooters, Singways. It is necessary to consistently create an infrastructure for the use of alternative types of energy. The large cities of Azerbaijan – Baku, Sumqayit and Ganja - are actively involved in the programs of landscaping, separate waste disposal and purification of the air from burning and smog;
- use of “clean energies”. It is necessary to implement the series-parallel introduction of renewable energy sources (solar batteries, wind power plants in the suburban area), the introduction of energy-efficient technologies and "smart" electrical systems. Implementation of energy infrastructure improving, climate-neutral buildings in Baku and Sumqayit cities will influence to city greening effect. Glass high-rise buildings in the Absheron Peninsula have a number of disadvantages, which include the collection of multilayer dust by strong winds, the reflection of sunlight by several skyscrapers, which creates the effect of infrared radiation, which also increases the temperature of the city in summer. It is necessary to use the experience of greening roofs, which will significantly improve the climate in a hot city;

- the use of various types of landscaping in large cities - Baku, Sumgayit, Lankaran. Methods for reducing and preventing the "spread" of coastal cities contribute to the preservation of the natural landscape of the Caspian Sea coast, planting trees and shrubs adapted to the climate of the Absheron Peninsula - pistachio, pomegranate, quince and fig trees, cherry plum, cherry, Eldar pine, roses and carnations, saffron bulbs and others. It is necessary to maintain and expand green open areas that compensate for the effect of the "urban heat island" (gardens and parks, fountains, planting roses, vertical gardening, rooftop greening, etc.). It is also necessary to expand green areas and corridors, update irrigation water supply, road network and infrastructure, bike paths, etc.).

Harmonious coexistence with nature, minimizing the consumption of exhaustible resources, reducing the amount of waste and emissions to the level of natural regeneration is not only possible in Azerbaijan, but also brings its economic, environmental and social efficiency.

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# Chapter 11

## The Role That Corporate Social Responsibility Takes in Green Economy

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### Abstract

The concept of CSR is identified as an appliance via which private sector forms up funding and frames sustainable development. The acquired latest economic pattern of the green economy has been redirected by most of the highly developing states and institutions. The green economy is not only an innovative but also a thorough regulation that leads to the improvement of states in various ways. Hence, this economy is regarded as an optional attitude of the present-day economy. Double economic decline that happened in 2008 brought huge significance to the idea of the green economy. That incident forced people to change their perceptions. Thus, the idea of “usual business” lost its essence. While preserving the ecosystem of the planet, the green economy still guarantees surplus and also to put up to fight against poorness. This research study aims at highlighting the part that CSR takes in transforming to green economy. Since, this type of economy is new, it requires new business models.

**Keywords:** Corporate Social Responsibility, Green Economy, Welfare green city

### 11.1. Introduction

Recently, the idea of the green economy came out during public discussions. The universal curiosity to implement the green economy derives from trying to get back to normal after crisis. Moreover, this idea has mainly set up by international bodies. After 1930, the most drastic crisis that happened was in 2008. As soon as the crisis ended the situation was identified. Thus, the disclosed imbalance that had been going on for a long time (Jessop, 2011) and the enforcement on the atmosphere left humans' lives in danger (Jackson, 2009). The legislative powers of the countries started to analyze the existing systematic link between up-to date

issues after being informed about the contrast in measurements. Since, both the origins and the outcomes of international economic recession have been investigated, this also proves that the characteristics of the present-day economic system leads to the disproportion. The international debate primarily focused on suggesting new ways to get back to normal after crisis and completely modern development policies. Hence, the final decision was to put economic, social and ecological balance back by taking advantages of the possibilities that the conceptualization of sustainable development promises (Geels 2013). Taking both environmental and social equity as essence, the major awareness of the study is to demonstrate conversion (2008-2017) of the economic and social pattern to the one that is considered as a more supportive one. The inquiry concentrates on giving stress to the role that corporate social responsibility plays (CSR) while moving from traditional to the green economy. The major argument to be: failure of present-day economic pattern and traditional approach to CSR. The lack of the availability of the procedures that are applied during the implementation of corporate social responsibility confines moving to green economy. The innovative economy is badly in need of gaining newly discovered patterns. Furthermore, it is important to have a fresh concept of either CSR or CSR 2.0.

### 11.2. The Concept of Green Economy

The expression that was called “green economy” and was constructed by the contemporary economists (D. Pearce, A. Markandya and E. B. Barbier) for the first time in history was revealed at the end of 1990s. In addition to that, the term was addressed in the report. Thus, the essence of the report was to assist the government in the way to carry out the improvement of the government at a certain rate (Pearce et al. 1989)

In 2008, as a result of ongoing financial and economic crises in many countries, the concept of Green Economy started to be used in the meetings of major international organizations, including the United Nations Environment Program (UNEP), the Organization for Economic Development and Cooperation (OECD) and the G20. The definition of a green economy states that, it is an environmentally friendly economy that promotes human well-being and social equality while trying to significantly reduce environmental risks and environmental scarcity. Both public and private investments will be made within the green economy, which will increase income and employment, reduce carbon emissions and environmental pollution, increase energy and resource efficiency, and

prevent the loss of biodiversity and ecosystems.

The United Nations Environment Program (UNEP) 2009 report has three main objectives for the new regulation for the green economy. First and foremost, it aims at stimulating the world economy by creating quite new employment opportunities to protect the groups that were affected by the global and financial crisis in 2008. The second purpose is to create a balanced and sustainable development economy by creating a world that uses clean energy. Last but not least, the Green Economy focuses on eradicating poverty in the future by ensuring sustainable development (UNEP, 2009, p.5).

With a more specific definition in the 1999 OECD report, the green economy consists of all kinds of clean technology, goods and services production activities aimed at measuring, preventing and eliminating environmental, water, air and land damage, as well as ecosystem problems. (OECD, 1999, p. 9).

In terms of space and time, the green economy method attracts new perspectives to traditional economic instruments. The basic logic of the green economy is the natural pressure of economic production, consumption and distribution activities (UNEP, 2011). The reconstruction of the system of production, distribution and consumption of goods and services - are the main notions of green economy. In the long run, this system aims to improve people's quality of life, increase social equality, reduce environmental risks and reduce environmental scarcity. It is essential to carry out and implement political reforms on a global scale so that the use of resources and the environment do not adversely affect the implementation of economic growth.

Moving to the green economy initiatives new economic activities, such as creating "green jobs" in many spheres, building giant wind turbines, producing electric and hybrid vehicles and production of organic products - all of the mentioned ones lead to set up new job opportunities. Globally, green employment is estimated at about 2.3 million per day. The number of people working in the green sector is expected to increase significantly in the future. The more green jobs, the more important employment for sustainable economy.

The demand for new skills necessary to work in green sectors is driving the emergence of new occupations. In order to meet this demand, a comprehensive lifelong learning strategy and a teaching system that is integrated into sustainable development and that can supply the right skills are needed. The creation of a vocationally trained workforce to be employed

in green jobs emphasizes the essence of setting up a sustainable society. (CEDEFOP, 2009, p. 1).

Principally, the green economy is comprehended in various ways, as:

- an orientation to alter not only the economy but also the whole economy – the community environmental system (moral, responsible, grounded on high regard both for the planet and the living soul) (Jackson 2009),
- a procedure of variations in human development, as it is inevitable because of surpassing the maximum of the planet process (Zovanyi, 2013),
- a leading component and target of policies to regain its strength right after economic decline (UNEP, 2011),
- an advantageous pattern that could be used in sustainable development operation, that unites 3 viewpoints: economic, environmental and social (Kosoy et al., 2012),
- a replacement for the brown economy (UNEP, 2011),
- the action to accomplish intentions (greening the economy, change to green economy) (EEA, 2010),
- a particular aim of the present day strategies (Jänicke, 2011),
- an actual, accelerated branch of the economy which expresses configurational alterations in the economy (Ocampo, 2011).

In one initial explanation of the emerging ideology, the UNDP defined a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. Poor carbon growth, productivity assets and social involvement – are mainsprings of the economy. Thus, the environmental and community based underpinnings of the conception and the prime concerns are accentuated straight away. The main factors that lead to profit and employment increase in the green economy are the expenditure spent on to decrease carbon outrush and pollution, to extend productivity of energy and hinder to be deprived of ecosystem. The World Bank represents the "green growth" as - the economy that leads to broadens commodities and services of the economy. Hence, this results in creating more job opportunities for people and increasing profit.

### 11.3. Traditional CSR and CSR in the Green Economy

One of the most debatable topics in the modern world is corporate social responsibility. The definition of CSR is expressed both in tight and extensive ways. Initially, CSR takes credit three types of dangers: social, ecological and moral. The aim is to increase the worth of the company for

the stakeholders (Davis and Blomstrom, 1975). Carroll took the step to give broader definition of CSR (1979). He explains that corporate social responsibility actually meets people's expectations (financial, lawful and charitable) to the organization. The local environment gives an opportunity to each organization to cooperate with members of the society, which gives them hope to expect to recover after economic crisis. B. Rok writes: "Facing challenges of the severe recent economic crisis leaders of largest companies, as well as representatives of leading research centers, search ways of further development which includes the expectations of the various groups of stakeholders in the process of creating value in the rapidly changing environment" (Rok, 2010).

In order to be able to comprehend concerns of CSR, we are going to pay attention to the lack of success the CSR had right after the fiscal crisis. The current notion of the CSR is the center point of criticism in the international economic crisis. According to W. Visser: CSR, as a business, governance and ethics system, has failed. Predominantly, the success and failure of CSR is estimated according to the influence of the net of business both on public and environment (Visser, 2012).

The dishonorable measurements taken by several organization, the ones that are in the rankings of CSR, lead to the creation of hazardous fiscal tools. In addition to that, selling them to the clients is a good example of Negative externalities. Being kept within bounds to the big companies and limited to PR, accepting the brand management model, that ends up in having increase which do not even adapt importance of the matters - are the main causes that lead to the lack of success of the concept.

According to the UN Global Compact the types of responsibilities that CSR has are the following ones (UNECLAC, 2007): internal, external and environmental responsibility. The first type, internal responsibility, deals with activities belong to the workers. The second one is tightly connected with creating relationships with stakeholders. Last but not least, the environmental responsibility, as the name indicates, aims at conducting influence of the attempts made by the organization on natural surroundings. The formulation mentioned above has been addressed as high point which will help us to differentiate the CSR with green economy context.

The neo-institutional point of view indicates that companies are usually demanded to have good relations with people, thus, supporting CSR might be an effective way to get rid of that kind of stress. The more the instructions of green economy instilled in society, the more likely they will

inspect actions of companies and the productions of CSR. Since the society tends to readjust its aims and priorities, companies will be obliged to take initiatives to keep them and increase their own legitimacy (Mitchell et al., 1997). As governments urge forced pressures, companies are highly required to go after particular actions counting on lawful approbations or danger. Benefits and behaviors encouraged by professional networks, manufacturing associations and academic institutions create normative pressures. Counting on peer compulsion and awkwardness of low performances lead normative pressures to leave impact on firms. Mimetic pressures are demands on firms to appear legitimate by imitating the behavior of the most respected, perhaps most CSR-centric, competitors in the market (McWilliams and Siegel, 2010).

The stakeholder hypothesis emphasizes that the impact of CSR is inevitable on CSR green (Doh and Guay, 2006). At the same time, the conceptions of stakeholders maintain being the vital notions in the sphere of CSR (Bendell, 2005). Most of the stakeholders are able to leave an impact on corporate activities. The prime concern of the green economy in the CSR is social fairness. Thus, in terms of social integrity, the two main elements, the dialogue and mutual relation are expected to expand not only fundamental stakeholders, but also to a bigger group of stakeholders. Involvement of the stakeholders will still remain as a major requirement of the organizations, even though the groups are in shortage of assets, governmental potential or organized occupations (Aguilera et al., 2007; Shah and Rivera, 2007).

The Internal CSR includes three main factors: to accent workers' benefits, needs/wants and gratification (Van Buren, 2005). The indicators of internal CSR arranged are the following ones: progress in job/career, variety, equal chance to get promoted, insufficiency, unbiased age approach, the stability between life and work, alternative working choices, health, safety, creating new job opportunities and the like. In order to energize the increase of two-sided faith and value creation, the best way addressed by organizations is to take the advantage of these strategies. If both sides are aware of existing fairness among employees, satisfactory working conditions and are able to take part in contributing to the company, these will definitely flame mutual faith. In exchange, employees will actively engage in behavior that supports achievement of the firm's goals (Fey et al., 2009). Becoming strategically and practically advantageous for Internal CSR is important to gain luck in an employee oriented approach. The organizational engagement, increase performance

and productivity of the employees could be achieved, in case the internal strategy of CSR is correctly approached.

Apart from all, the internal CSR in green economy is able to set accent on increasing not only the mental feeling of workers but also the pleasure and engagement. It is quite clear that, currently the employees, especially the highly educated ones, as well as good payment and advancement, they highly appreciate the type of workplace that is away from toxic environment and owns good staff members. The main policy of the green economy, is to own the smartest labor force, that will be able to handle with upcoming risks.

The following vital feature of CSR is called the European Strategy that aims at converting poor carbon economy. Within the help of this set of actions, CSR is identified as a design which attempts to find the existing influence of business on stakeholders. Contemporary plans of action in the sphere of corporate social responsibility was approved in October, in 2011 (EU strategy 2011-2014 for Corporate Social Responsibility 2011). The paper underlines the influence of CSR based on 6 main elements, such as; decreasing prices, human resource management, relations with buyers, innovation, risk management and fiscal consequences. The main demand of CSR is to gather and reveal data especially on business activities that take control both in social and environmental way. The countries that are members of EU tend to apply Directive 2014/95/EU (which is named CSR directive) that belongs to The European Parliament and of the Council. Hence, this policy is considered as an announcement of non-fiscal and variety of data. Last but not least, all yearly reports need to cover information about "strategies, possibilities and consequences" that are tightly connected with "public, ecological and human rights impact, variety and anti-corruption plans". In addition to that, the European Union still keeps to be the best in publishing of non-fiscal data.

DNA code	Policy goals	Basic indicators	spheres and merits
Forming advantages	Financial growth	Capital investment (financial, manufacturing, social, human and natural capital), beneficial products (sustainable and responsible goods and services, inclusive business (wealth distribution, the bottom of the pyramid markets)	New economic model sustainable development, Sustainable production and consumption, Sharing economy Green growth, Wealth distribution



Good management	Institutional productivity	Leadership (strategic commitment to sustainability and responsibility) transparency (sustainability and responsibility reporting, government payments) ethical practices (bribery and corruption prevention, values in business)	Responsibility, transparency, social trust, partnership, long-term perspective
Societal contribution	Determination of the stakeholders	Philanthropy (charitable donations, provision of public goods and services) fair labor practices (working conditions, employee rights, health and safety) supply chain integrity (SME empowerment, labor and environmental standards)	Social justice Poverty eradication Stakeholder orientation Intergenerational justice, reduction of inequalities
Ecological entirety	Sustainable ecosystem	Ecosystem protection (biodiversity conservation and ecosystem restoration) renewable resources (tackling climate change, renewable energy and materials) zero waste production (cradle-to-cradle processes, waste elimination)	Low carbon emission, renewable energy, resource efficiency, biodiversity conservation, tackling climate change, zero waste production (cradle-to-cradle)

**Table II.1** CSR 2.0 aims at bracing the transformation to the green economy

The basic trends demonstrated above clearly state that CSR takes a very important role in transforming to green economy.

### II.4. Conclusion

The transformation from traditional to the green economy still remains quite complicated. Majority of the adjustments, strategies and fiscal substructures of European Union are created by Strategy Europe 2020. As well as bright increase, modern and smart economy, poor steps in both industry and agriculture, efficiency of resources, renewable power are stressed points of the programs. In order to be able to comprehend the happening transformation to green economy, the analysis of CSR 2.0 and the conceptualization of green economy is highly recommended. In this circumstance, CSR remains as a of the

action. This includes being a part of community regulation, plans and also perception by users and community. It is inevitable not to observe increasing significance of sustainability cases. As Visser states: while there could be slight difference between sustainability and responsibility, these are immediate components of CSR. While, on the one hand sustainability is referred as goals, the essential part of responsibility aims at figuring out settlements (Visser 2015).

The measurements that are considered to be firm level, which especially play an important role to intensify CSR green are quite vital data. Hence, that information leads the government take up deliberate actions to apply CSR green economy. The essential part is to make sure the stakeholders apply the green economy via utilizing the structure of CSR investment. Since, the firm-level drivers are reliable, this makes decision-makers to take steps to use the help of the drivers. The other step to be taken by the government is to arrange the business structure in the way that would be applicable to the construction of the green economy. Yet, this might arise new requirements, such as interference of the introduction points, thus, those points are currently enable to increase the comprehension the way to use the strategy aiming at reinforcing companys' CSR green. Finally, countries gain power to regulate the role of business in order to push forward the activities of CSR. So, the drivers could be estimated as a small branch that dominates the "tone and pitch" of companies' CSR green investments. In a nutshell, decision makers become enthusiastic about bringing unity of investments together with the requirements to evolve.

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# Part II

## Green Finance





# Chapter 12

## Global Green Finance Market: Banking Aspect

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### Abstract

The article discusses key initiatives in sustainable development (UNEP Financial Initiative, Global Green New Deal, Covenant of Mayors for Climate and Energy, etc.). The conceptual approaches to the definitions of 'green economy' and 'green finance' are described. Based on the study of world experience, the efficient financial instruments and mechanisms are analyzed, such as green bonds and loans, which are classified as not fundamentally new in technical terms, but are characterized by an environmental component. Modern trends in the development of the global green finance market have been studied. The role of private financial institutions in sustainable development issues is revealed, including the major investment banks and companies, European financial centers (London – The Green Finance initiative, Luxembourg – The Green Exchange, Paris – The Finance for Tomorrow initiative), informal green associations in corporate and financial sectors (mutual obligations platforms, joint industry initiatives, lobby groups). Finally, the article contains the recommendations for the financial model based on the green fund establishment.

**Keywords:** sustainable development, green economy, green finance, green bonds, green funds

### 12.1. Introduction

There is often a divergence of views on the term 'sustainable development' in the world scientific community. Many scholars interpret it in the context of economic growth based on an increase in GDP. At the same time, the global economy presupposes a harmonious and balanced development of three processes: economic, social, and environmental. It is



noted that it is impossible to achieve sustainable economic growth in the long term without social and environmental factors (Agenda 21, 1992).

The concept of sustainable development was initially formulated in the report 'Our Common Future,' prepared by the UN World Commission on Environment and Development in 1987. According to the report, sustainable development "meets the needs of the present, but does not compromise the ability of future generations to meet their own needs"(G. H. Brundtland) (UN, 1987). This term was widely recognized in 1992 at the United Nations Conference on Environment and Development as part of adopting the Framework Convention on Climate Change (UNFCCC), aimed at implementing the concept of global sustainable development by countries. Subsequently, as a result of globalization and the growth of the influence of transnational corporations, the primary vector of the concept began to shift from the national level to the corporate one, as evidenced by the growing number of private initiatives in the sphere of sustainable development and green investment, although governments are still trying to remain resilient in their development agenda.

In 2015, the world community adopted the 2030 Agenda (UN, 2015), which includes 17 global Sustainable Development Goals (SDGs). The new SDGs are in line with international law, consider national characteristics, opportunities, and priorities, are comprehensive, and ensure a balance of all three components of sustainable development: economic, social, and environmental. It is assumed that achieving the sustainability goals will contribute to the transition to a new economic model – a green economy model (Grabowska et al, 2022).

### **12.2. Green Economy as An Integral Part of Sustainable Development: A Conceptual Approach**

The transition from the traditional economic growth model to 'green' is becoming a worldwide global trend. The green economy acts as a tool for achieving sustainable development, aiming to increase people's well-being while reducing environmental risks (UNEP, 2015).

As already noted, the foundations for a green economy were laid within sustainable development in the late 1980s. The term 'green economy' was first mentioned in 1989 in "Plan for a Green Economy" (Pierce et al., 1989), substantiating the need for economic support for environmental policy. In subsequent works, researchers touched upon such issues as climate change, depletion of the ozone layer, massive deforestation of tropical forests, etc. (UNDESA, 2012).

Since the mid-2000s, within the framework of implementing the global strategy for sustainability, new models of a green economy have become widespread: low-carbon, bioeconomy, blue (European Commission, 2018, 2020, 2022). Although these concepts in economic theory and practice are often considered identical (the principle of environmental orientation can be traced in all models), there are specific differences between them. General and characteristic directions of developing modern forms of the green economy are shown in Table 12.1.

Green economy			
Low-carbon	Bioeconomy	Cyclic economy	Blue economy
Efficient use of energy resources			
Widespread use of renewable energy sources			—
Minimization of the use of traditional hydrocarbons	Sustainable agriculture	Extension of the life cycle of the resources (products) used	
—	Efficient use of waste		

**Table 12.1** *The Green economy forms (Source: compiled by the authors)*

Thus, the low-carbon economy aims to reduce the emission of greenhouse gases into the atmosphere to stabilize the climate system (Solomon et al., 2007). Low-carbon development is associated, foremost, with measures to improve the efficiency of energy use: minimization of the use of traditional hydrocarbons, primarily coal (Flavin, 2008), and the widespread use of renewable energy sources.

Bioeconomy involves the transition to a new technological paradigm based on energy efficiency and biotechnology, involving renewable biological raw materials to produce energy and materials. Bioeconomics is also identified with sustainable agriculture and organic food production, efficient use of waste.

A circular (cyclic, or closed-loop) economy involves reusing materials and resources, their regeneration, restoration, and optimization to preserve the environment. The circular economy is based on resource efficiency and increased responsibility of producers due to reducing the ecological footprint of production and manufactured goods (Stahel & MacArthur, 2019).

The blue economy was first formulated in 2009 by Gunter Pauli (2010); it

is enables society to obtain value from the oceans and coastal regions, whilst respecting their long-term ability to regenerate and endure such activities through the implementation of sustainable practices (The EU Blue Economy Report, 2022).

Currently, new hybrid forms are also emerging, for example, circular bioeconomy, etc.

In general, the green economy:

- democratic, strive for the rule of law, based on the principles of equality, responsibility, transparency, stability, justice between countries and generations (UNEP,2011);
- is a means of achieving sustainable development (Bobylev, 2017), which assumes the assessment of not only economic but also social indicators (poverty reduction, ensuring the well-being of the population, social protection, access to essential services) (Lindenberg, 2014) as a result of the implementation of resource and energy efficiency policies;
- aims to protect biodiversity and ecosystems.

At the international level, the fundamental principles of a green economy (i.e. global peaking and ‘climate neutrality,’ voluntary cooperation, adaptatopn, transparency, ‘global stocktake’) are laid down in the Paris Agreement (UN Framework Convention on Climate Change). Furthermore, the goals, objectives, and requirements for participants are designed for the long term until the end of the 21st century (UNFCCC, 2015).

Recently, the cooperation of the G20 countries has reached a significant level of development within the framework of the G20 Climate Finance Study Group and the Task Force on Climate-related Financial Disclosures. In addition, the informal “green” associations in the corporate and financial sectors are represented by mutual obligations platforms, joint industry initiatives, and lobby groups. The priority areas of their activity are developing dialogue and cooperation in green finance, assistance to effective financial instruments to stimulate climate-friendly projects, mobilization of private investment to accelerate the “green” transformation of the world economy (Table 12.2).

Initiative	Corporate sector	Financial sector
<p>MUTUAL OBLIGATIONS PLATFORMS</p>	<p>Primary purposes: reduction of harmful emissions; energy efficiency, construction (purchase) of renewable energy sources for own needs; decrease in hydrofluoro carbons (HFCs) in supply and operations</p> <p>Initiatives: Science-Based Targets Initiative, RE100 Initiative, WWF’s Climate Savers, Oil and Gas Climate Initiative, Consumer Goods Forum’s, Sustainable Refrigeration Resolution, Refrigerants Naturally!</p>	<p>Primary purposes: decarbonization of investment portfolio, carbon footprint measurement; development of tools for analyzing climate and carbon risks when making investment decisions</p> <p>Initiatives: Climate Wise Principles, Investor Platform for Climate Actions, RiSE, Montreal Carbon Pledge, CDP’s Carbon Action Initiative, Principles for Responsible Investment (PRI)</p>
<p>JOINT INDUSTRY INITIATIVES</p>	<p>Primary purposes: development and implementation of industry roadmaps to limit the increase in global average surface temperature to 2 °C, support the transformation of the market with the aim of new low-carbon goods and services; implementation of public-private partnership projects in the field of environmental protection</p> <p>Initiatives: International Air Transport Association’s 2020 and 2050 Emission Targets, Cement Sustainability Initiative, International Road Transport Unions, 30 by 30 Resolution, Lighten Initiative, Tropical Forest Alliance 2020, Consumer Goods Forums, Zero Net Deforestation, World Business Council for Sustainable Development (WBCSD) Low Carbon Technology Partnership Initiative (LCT Pi)</p>	<p>Primary purposes: distribution of green bonds to stimulate investment in low-carbon projects; publication of reports containing environmental data</p> <p>Initiatives: Portfolio Decarbonization Coalition, Banking Environment Initiative’s Soft Commodities Compact, Low Carbon Investment Registry, Climate Bonds Initiative, Green Bonds Principles 101 in a 100 Initiative, Ceres’ Investor Network on Climate Risk (INCR), Ceres’ Shareholder</p>

<p>LOBBY GROUPS</p>	<p>Primary purposes: developing an international framework agreement and policies to achieve low carbon and sustainable development</p> <p>Initiatives: We Mean Business Coalition’s International Policy Support Statements, CEO Climate Leaders Statement, World Bank Carbon Pricing Leaders Coalition, Caring for Climate Business Leadership Platform, Ceres Business for Innovation Climate and Energy Policy (BICEP), The Prince of Wales’s Corporate Leaders Group</p>	<p>Primary purposes: decarbonization of investment portfolio, carbon footprint measurement; development of tools for analyzing climate and carbon risks when making investment decisions</p> <p>Initiatives: Climate Wise Principles, Investor Platform for Climate Actions, RiSE, Montreal Carbon Pledge, CDP’s Carbon Action Initiative, Principles for Responsible Investment (PRI)</p>
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**Table 12.2** *Informal Green Initiatives (Source: compiled by the authors)*

In general, the central idea of global cooperation is the search for solutions to international, regional, national climatic, and environmental problems through the tools of modern world financial markets and the ‘greening’ of the world financial system, improving environmental conditions.

### 12.3. Scientific Approaches to The Definition of Green Finance

Sustainable finance is an integrated approach that combines different strategies to improve the financial system’s social, economic, and environmental performance. In this regard, green finance can be seen as part of the strategic agenda for sustainable finance.

In modern practice, there are two main approaches to the definition of green finance. In the broadest sense, this is an investment in the development and implementation of programs in the field of rational (balanced) environmental management (for example, water resources management, soil protection, biodiversity conservation) (Daily, 2002; Makower & Pike, 2002), ecological projects (in particular, to reduce greenhouse gas emissions and adapt to changing climatic conditions – climate finance) (UNEP, 2011) and industries focused on measures to improve efficiency, processing, and recycling of resources, support for renewable energy (low-carbon finance). This approach is implemented

within the closed-loop economy at the macro level, which provides for the repeated use of resources through their regeneration, restoration, and optimization to preserve natural conditions.

Narrow approach (Krugman, 2010; 33. Lindenbergh, 2014; Mazzucato, 2014) implies the implementation of environmentally friendly investments and low-carbon technologies, projects, industries, and enterprises based on appropriate tools and products used in making decisions on loans, monitoring, and risk management considering environmental factors.

Initially, green finance was designated in 1992 by the American economist R. Sandor (2012) and envisaged mainly climate change investment. Later, this term began to be used in a narrower meaning, implying implementing projects and programs to ensure mitigation and adaptation to climate change. Currently, in the economic literature there are concepts of environmentally friendly investment, low-carbon finance, circularity finance, impact finance, ESG-finance, etc.

In foreign practice, responsible investment has become widespread, which involves considering environmental, social, and managerial factors when choosing and managing investments. Funding that, in addition to economic benefits, aims to bring social and environmental benefits is also called targeted social investment (or impact investing). In 2006, the Responsible Investment Association (RIA), with the support of the UN, developed six basic Principles for Responsible Investment (PRI, 2018). These Principles are a voluntary initiative in which companies consider environmental and social projects in their investment strategy.

In modern conditions, 'brown' ('gray' or 'dirty') investments appear opposed to 'green' ones. A comparative analysis of 'green' and 'brown' financing presented in Table 12.3. As a rule, green finance involves a different verification stage for compliance with 'green' requirements and standards and the provision of appropriate reporting.

Criteria	Brown finance	Green finance
Sectors of the economy (or types of activities)	Economic and social infrastructure	Renewable energy; water supply, sewerage; organic agriculture, sustainable forest management; collection, processing, disposal of waste; elimination of pollution
Sources of financing	Traditional credit and financial instruments	'Green' financial instruments (green loans and bonds)

Participants	Financial institutions, investors, construction companies, TNCs, etc.	Green banks, World Bank, regional development banks (RDBs: ADB, IDB, etc.)
Project selection criteria	Economic and (or) social efficiency	Environmental friendliness
Features of project implementation	Investment and industry risks	Investment and industry risks, additional verification tools for compliance with environmental standards

**Table 12.3** *Comparative analysis of ‘green’ and ‘brown’ finance (Source compiled by the authors)*

Therefore, the term ‘brown financing’ is found in the context of implementing projects in traditional areas of social and economic infrastructure without a claim to environmental friendliness. At the same time, most international organizations refused to identify priority sectors of the economy (or types of activities) that fall under the definition of ‘green,’ thus noting the multidisciplinary nature of green financing.

### 12.4. Green Economy Financing Instruments

The following instruments have become widespread in the global green finance market: green bonds (including sustainable, climatic, collateralized), green loans (eco-loans), and weather derivatives. These financial instruments are not fundamentally new in technical terms; however, they are distinguished by their environmental component.

Green bonds are used to finance projects that, according to the generally accepted definition, meet the criterion of ‘environmental friendliness’ (projects in the fields of energy saving, energy efficiency, renewable energy, etc.) (UNEP, 2016). Most of these financial instruments undergo special labeling, and the issuer or an independent appraiser can do the labeling.

According to the IFC definition, a ‘green’ bond is a bond that meets the following criteria: 1) attracted capital must be directed to the implementation of ‘green’ projects,

2) investments must be assessed for compliance with eco-principles, 3) the funds attracted by the issuer are exclusively targeted, 4) information on the spending of funds is transparent and should be published annually (IFC, 2020). The priority areas of green bonds are energy efficiency (38%),

transport based on low-carbon energy (16%), water resources (14%), adaptation to climate change (6%), forestry, and agriculture (2%). Utilities are issuing green bonds primarily to invest in water supply and sanitation. This trend is typical mainly for developed countries (USA, France).

Within the described terminology, the broadest definition of green bonds (climate-aligned bonds) was proposed by the Climate Bonds Initiative (CBI) to designate financial instruments to finance projects on creating low-carbon and climate-resilient infrastructure. Similarly, the World Bank defines green bonds, implementing a program to finance environmentally sustainable growth in developing countries.

For the first time, green bonds were issued by the European Investment Bank in 2007, called Climate Awareness Bonds (CABs). The volume of the issue was \$ 600 million, AAA rating, maturity 5 years. The bonds were intended to finance alternative energy projects and energy efficiency improvements. In 2008, the IBRD also issued bonds that were labeled green. For the first time, the World Bank used environmental criteria and an independent assessment carried out by experts from the University of Oslo to select projects. Funds from the placement of green bonds in the amount of 2.85 billion Swedish kronor were used to finance 'green' projects in the agricultural sector, waste processing, and forest management.

The standardization and labeling of green bonds were caused by the need to identify their specifics in the financial instruments market. Until recently, the lack of good investor interest in green financial instruments was caused not so much by the requirements for profitability and pricing as by the lack of recognized standards and an effective mechanism to control the direction of cash flows at the international level.

The initial stage in the standardization of green bonds can be considered adopting the Wind Criteria of the Climate Bonds Standard, developed by the CBI in 2011. In addition, CBI has approved four industry standards (version 2.0): wind and solar energy, low carbon public transport, energy-efficient buildings. Version 2.0 of the CBI standards also includes a description of the certification process, requirements for issuers, and industry standards for green bonds. Simultaneously, the Principles of Green Bonds were improved (CBI, 2018).

In 2014, the International Capital Market Association (ICMA) published the Green Bonds Principals (GBP), which are similar in many respects to the CBI Standards but address a broader set of issues. The Green Bond Principles provide guidelines for issuersto disclose information about the



upcoming green bond issue, allowing investors and other stakeholders to assess the key characteristics of bonds and make strategic investment decisions. In the present, the principles provide 1) the target orientation of investments as a result of the placement of green bonds, 2) the process of evaluating and selecting a 'green' project, 3) the management of funds of issue, 4) reporting (ICMA, 2021). Thus, the certification of securities provides for disclosing information on the expenditure of emission funds, which is necessary for two reasons. First, it guarantees the investor that their funds are spent on 'climatic' purposes. Secondly, public authorities have the opportunity to support the green bond market both from the demand side for borrowed funds (the issuer) and from the supply side (investors in securities). Thus, marking is carried out based on international rules and procedures in the Green Bond Principles and the Climate Bond Standard adopted by international organizations. At the same time, the European Green Bond Standard (EUGBS) certification is being developed, which will become mandatory in the countries of EU.

Green bond ratings are assigned to both individual issues and securities programs. Thus, Moody's international rating agency has developed a methodology for assessing green bonds (Green Bonds Assessment, GBA) based on the issuer's compliance with the principles of targeted use of funds, assessment of the quality of project management, and reporting. The GBA uses the Climate Bonds Initiative (CBI) criteria and The International Organization of Securities Commissions (IOSCO). If a company expects to receive a CBI certificate for issuing green bonds, it attracts experts who have received CBI accreditation. Those institutions include international consulting and audit companies, certification agencies (i.e., ERM Certification and Verification Services, Kestrel Verifiers, TÜV NORD CERT), consulting companies in responsible investment and green finance (i.e., Sustainalytics, Vigeo Eiris). However, the listed standards are voluntary and are currently only partially considered in the ratings (Standard & Poors estimates their share at 5%). Thus, the main problem in the international green bond market is the lack of a unified system for their verification.

In recent years, the dynamics of the green bond market are most fully presented in the statistical reviews of the CBI. A continued acceleration of green issuance drove the green bond market to just over half a trillion (USD517.4bn) in 2021. The annual figure is the highest since market inception and maintains the trend of 10 consecutive years of green market expansion. The current growth trajectory could land the first annual green

trillion in the year ahead – a goal first set by the Conference of Parties (COP22) in 2016. Hitting this milestone early this decade serves as key indicator that capital is being shifted at scale towards climate solutions as the world races the clock (CBI, 2022).

World experts give different, often sharply different estimates of the annual issue of green bonds, but it does provide a headline reference against which to compare current investment levels. Thus, Climate Bonds CEO, Sean Kidney, has nominated an annual USD5tn in green bond issuance by 2025 as the next global milestone governments, policy makers and investors need to reach as the necessary contribution to achieving our climate goals. (CBI, 2022). According to estimates of the International Monetary Fund (IMF) and International Energy Agency (IEA), achieving net-zero carbon emissions by 2050 will require additional global investments in the range of 0.6 to 1% of annual global GDP over the next two decades, amounting to a cumulative USD12tn to USD20tn (IMF, 2021a; IMF, 2021b, p. 60; IEA, 2021). A total of USD9tn a year in green investment is required to reach zero by 2050, according to a McKinsey Global Institute (MGI) report (MGI, 2022). In the Reuters poll of economists in Europe, Asia, and the Americas (the September-October, 2021), there was substantial divergence in the scale of dollar estimates for the cumulative investment needed, reflecting the differing methodologies used by economists. The median view provided was USD44tn. In turn, Oxford Economics experts put the cumulative amount of investments needed in the energy and other sectors at almost USD140 tn by 2050, the highest estimate obtained in the survey (CBI, 2022).

As for the issuers, in 2021 about 54% of the issue volumes are provided by the USA, Germany, China, France. Moreover, the first two countries retained their leading positions, and this trend continues. Recently, China has also become one of the leading countries, where the issuance of green bonds is based on the refinancing of green loans. In 2021, China moved up one position to take the podium place from France, the third largest emitter of greens in the previous year. Major Chinese banks, including the Industrial and Commercial Bank of China (ICBC), actively place green bonds in the domestic market and the world's largest financial centers.

Currently, more than 3/4 of the green bond issue is provided by development banks and TNCs. Top 10 Climate Bond Certified Issuers in 2021 leadership belongs to Chinese banks (China Development Bank and ICBC), Société du Grand Paris (France), Queensland Treasury Corp (Australia), ABN AMRO Bank NV (Netherlands), as well

as: Norwegian financial group DNB ASA, Republic of Chile, Australian bank Westpac, National state railway holding of Italy Ferrovie dello Stato (FS) Italiane, Indian renewable energy company ReNew Power (Table 12.4).

Issuer Name	Certified in 2021 (USD billion)
1. China Development Bank	7.4
2. Société du Grand Paris	5.8
3. ICBC	4.2
4. Queensland Treasury Corp	2.2
5. ABN AMRO Bank NV	2.2
6. DNB ASA	1.8
7. Republic of Chile	1.2
8. Westpac	1.2
9. FS Italiane	1.2
10. ReNew Power	1.0

**Table 12.4** *Top 10 Climate Bonds Certified Issuers in 2021 (Source: CBI (2022))*

21 sovereign green bonds were priced in 2021, including a GBP10bn (USD13.7bn) UK Gilt, the largest single debut sovereign green bond to date and the largest green bond of 2021. A smaller GBP6bn (USD8.25bn) deal followed in the UK later in the year, placing it among the top largest sovereign green bond issuers in the world. Consistently committed, the German state-owned development bank Kreditanstalt für Wiederaufbau (KfW) and the financial conglomerate, the largest US mortgage agency Fannie Mae, became the leading green issuers of the year (2nd and 3rd places) with a total volume of USD13.6bn and 13.4bn, respectively.

In China, major banks continuing their practice of issuing multiple green bonds aligned with the Climate Bonds Standard. In 2016, the Bank of China, together with the China Development Bank (CDB) and the Chinese Bank of Communications (BoCom), issued the most significant overseas green bond issue of EUR1bn (with an initial target of EUR2.25bn) to finance

Belt and Road Initiative projects. The investors were the EU and the Middle East banks.

Several prominent Certified Climate Bonds originated from China in 2021. The world's largest bank, ICBC returned to the market with another Certified Climate Bond of GBP2.3bn (USD3.2bn), with use of proceeds certified in accordance with the Low Carbon Transport, Marine, Solar, and Wind Renewable Energy Criteria of the Climate Bonds Standard. State-led CDB raised USD7.4bn in three deals, with funds used for ecological protection and green development along China's Yellow River Basin. As a result, the CDB was the largest Certified Climate Bond issuer in 2021. The CDB issuance puts them ahead of French transport operator Société Du Grand Paris (SGP) for 2021. SGP was an early adopter of Programmatic Certification process and is the all-time largest Certified green debt issuer, funding a decade-long upgrade of the Paris rail network, one of the largest infrastructure projects in Europe. Overall, cumulative certified issuance reached USD210bn by December 31st, 2021, helping to establish green market investment standards and harmonised definitions in multiple jurisdictions in both developed and emerging economies. (CBI, 2022).

Municipal bonds appeared in 2012 in France (Île-de-France region), then in Sweden (Gutenberg), the USA (New York), South Africa (Cape Town), China (Wuhan, Hong Kong). In 2018, Indonesia issued the first Islamic green sovereign bonds (the so-called green Sukuk). In 2017, three green sovereign bond issues marked this year as the year of sovereign green bonds. In 2017, the US issued green bonds worth \$18.5 billion, accounting for 60% of sub-sovereign issues worldwide (EU countries – \$8.8 billion; Canada – \$2 billion, US – \$1 billion, Australia– US \$962 million) (CBI, 2018). There is an increase in sovereign green bonds by emerging countries (Nigeria, Fiji, Indonesia), mainly due to decreased emission volumes by territorial units of developed countries with practically unchanged indicators.

A variety of green bonds are green high-yield bonds. Payments on income bonds and project bonds are made through the sale of goods and services produced due to the project. However, unlike project bonds, recourse applies only to green assets that are collateral and used in a green project.

One of the significant problems of green project finance is the relatively small size of green projects, making it economically inefficient to issue and invest in bonds. It leads to implementing mechanisms for aggregating collateral assets (cash claims, loans, leasing, mortgages) and the issuance of securitized green bonds on this basis. There are two types

of them: green bonds secured by a separate (withdrawn from the issuer's balance sheet) pool of assets (asset-backed securities, ABS), and green bonds with coverage secured by non-segregated (remaining on the issuer's balance sheet) assets. Unlike green general bond bonds, ABS bonds bear the risk of default on the investor. In case of default, the right of recourse refers to the pool of green (and not only) assets that act as collateral. Unlike ABS bonds, covered green bonds are backed by a non-segregated (retained on the issuer's balance sheet) pool of assets. When in default, investors can turn their claims to both the issuer and collect collateralized assets (double recourse), which serves as an additional guarantee for them to repay the debt. These bonds are issued exclusively by banks.

The essential instrument for green financing is green credit. The main contribution to green investment, including low-carbon projects, comes from direct bank loans, which account for about 2/3 of debt and about half of the total funding. In just one year, 104 banks in the United States issued loans for projects in renewable energy sources. In 2014 loans of more than 1 billion dollars were provided by 12 banks, and in 2015, their number increased to 20.

Among the instruments of climate finance, green loans (or environmental lending) are also distinguished. A variation is the conversion of debt into ecological investments. A creditor country and a less developed country agree that the latter will be written off in return for financing environmental funds to protect biodiversity. Currently, the USA, Germany, Sweden are the countries applying debt-to-environmental investment conversion. More than 30 countries have become beneficiaries of this instrument (OECD, 2016). The United States and Poland also signed a similar agreement of over \$370 million.

The term green (eco-) loans refer to lending to environmental projects and companies. Typically, international development banks provide such loans. In some cases, banks offer preferential interest rates for ecological projects (i.e., preferential mortgages for energy-efficient buildings).

Currently, carbon finance for adaptation to climate change is actively implemented in the following mechanisms (UNFCCC, 1998):

- emissions trading, when the state or its economic entities sell (or buy) quotas for greenhouse gas emissions on the national, regional, or international markets (Art. 17);
- joint projects to reduce greenhouse gas emissions (CO<sub>2</sub> Joint implementation) (Art. 12);

- clean development mechanisms envisage projects to reduce greenhouse gas emissions implemented in one of the countries (usually developing countries) that have signed the Framework Convention on Climate Change (UNFCCC) (Art. 6).

Weather derivatives are financial products that manage the risk of losses caused by changes in climatic conditions. Weather derivatives entered the market in the mid- 1990s. According to the Chicago Mercantile Exchange data, the volume of the corresponding transactions for 2002-2016 exceeded 1 billion dollars. USA (Laurent, 2015). At the same time, despite the growth of the green bond market, less than 1% of the global bond market is labeled as 'green,' that is, the market segment is still relatively modest and does not exceed 1% of the global derivatives.

In the global economy, 'green' indices and ratings are spreading, assigned to international companies that adhere to sustainable development goals and ESG standards (European Standards & Guidelines). In 2012, the United Nations Environment Program (UNEP) published A New Angle on Sovereign Credit Risk Analysis, which outlines environmental considerations in the sovereign credit assessment process. Standard & Poor's corporate credit ratings assess factors such as global warming, carbon emissions, and clean energy. Corresponding criteria to evaluate these factors are included in the so-called group – credit management factors (UNEP, 2012).

The leading 'green' stock indices include Standard & Poor's global 'clean' energy index; Nasdaq Clean Edge Green Energy Index (CELS); FTSE Japan Green Chip 35, calculated based on Japanese companies in the environmental industry. In addition, there are various specialized indices and funds such as DB x-trackers (Deutsche Bank), Carbon Effective Index (Standard & Poor's), iPath Global Carbon ETN (Barclays Bank PLC).

### 12.5. Modern Trends of The Global Green Finance Market Development

At the current stage of development, the global green finance market is characterized by the growing interest of private financial institutions in sustainable development issues. With the increasing influence of transnational corporations in the world economy, the primary vector of sustainable development and green investments began to shift from the national level to the corporate one. Many institutional investors have affirmed their commitment to the principles of socially responsible investment (impact investing) in their declarations to the problems of climate change. To date, more than 400 of the largest investment companies

have refused to invest in traditional energy (Porfir'ev, 2016). Since 1999, the United Nations Global Compact has been in operation – the world's largest international voluntary Initiative in the field of sustainable corporate development, aimed at promoting sustainable economic growth and increasing the level of corporate citizenship (UN, 2018). The Initiative supports companies in the implementation of social and environmental projects. More than 13,000 companies and organizations have already joined the Global Compact.

Investment banks are also showing interest in the green finance market. It is assumed that the transition to a low-carbon sustainable economic model will require significant financial resources of the banking sector (IFC, 2016). Within the framework of ensuring a positive environmental and social effect and stimulating the implementation of sustainable development principles, there is a process of merging the largest banks in the world (for example, the merger of the Sustainable Banking Network and the Institute of International Finance). Thus, the Network of Central Banks and Supervisors for Greening the Financial System (NGFS), formed in 2017, promotes the implementation of measures necessary to achieve the goals of the Paris Agreement. Currently, NGFS unites 18 members, including the Central Banks of Germany (Deutsche Bundesbank), Great Britain (Bank of England), Finland (Bank of Finland), France (Banque de France), Mexico (Banco de México), the Netherlands (De Nederlandsche Bank), China (People's Bank of China), Singapore (Monetary Authority of Singapore), as well as the Swedish Financial Supervision Authority (Finansinspektionen). As part of the UNEP Financial Initiative, a roadmap for banks and institutional investors has been drafted to create an enabling environment for the development of green banking. The Sustainable Banking Network also plays an active role in this direction, formed in 2012 as an informal group uniting banking regulators and associations interested in developing environmentally sustainable practices and initiatives.

The role of insurance companies in the green finance market is also increasing. In 1990, the German government passed the Environmental Liability Act (Umwelthaftungsgesetz), which requires compulsory insurance for 96 sectors of the economy. The Association of British Insurers coordinates the launch of similar insurance services by British insurance companies, which, in a pollution incident, cover cleaning costs and fines, property damage, and losses, all legal and medical expenses. In 2004, the EU countries adopted the Directive on Environmental Liability, which significantly contributes to developing 'green' insurance services (EUR-lex, 2004).

Global financial centers, including London (Green Finance Initiative), Luxembourg (Luxembourg Green Exchange), Paris (Finance for Tomorrow Initiative), demonstrate a particular interest in environmental programs. Stock exchanges in Dublin, Milan, Stockholm, and Frankfurt are also launching their sustainable finance initiatives. Collaboration between major financial centers is expected to facilitate the exchange of best practices and ensure the convergence of crucial principles and dimensions towards sustainable development.

There is an emphasis on climate change and the development of low-carbon finance. Projects attract significant interest from both private investors and the state. For example, the EU countries subsidize the implementation of alternative energy projects that reduce greenhouse gas emissions and adapt to climate change (renewable portfolio standard), i.e., special quotas and network tariffs (feed-in-tariff). The European Commission also launched the International Initiative 'Covenant of Mayors for Climate and Energy' (2008). Their activities are aimed at supporting local authorities to achieve the environmental goals of the European Union. Joining the Covenant of Mayors provides local authorities with an opportunity to build sustainable economies in ecological and social aspects, aiming to reduce carbon dioxide emissions.

Globally, the UN program produced nine joint anti-crisis initiatives (2008), including the Global Green New Deal, which formulated recommendations in public investment and necessary policy reforms designed to initiate the transition to a green economy, increase employment, and tackle poverty.

The role of non-profit organizations to disseminate environmental practices in the business environment is growing. For example, in March 2018, the Green Bond Pledge was launched with the joint participation of the largest non-profit organizations specializing in climate change and the environment (including Climate Bonds Initiative, Mission 2020, The Climate Group, Carbon Disclosure Project, American climate organizations Citizens' Climate Lobby, and Natural Resources Defense Council). Participants in this Initiative commit to finance infrastructure projects through green bonds. Another informal association is the Coalition for Environmentally Responsible Economies (CERES). The main goal is to mobilize investors and business communities to introduce environmental practices into business relationships, promote renewable energy programs, develop reports on climate change and global warming.



### 12.6. Recommendations

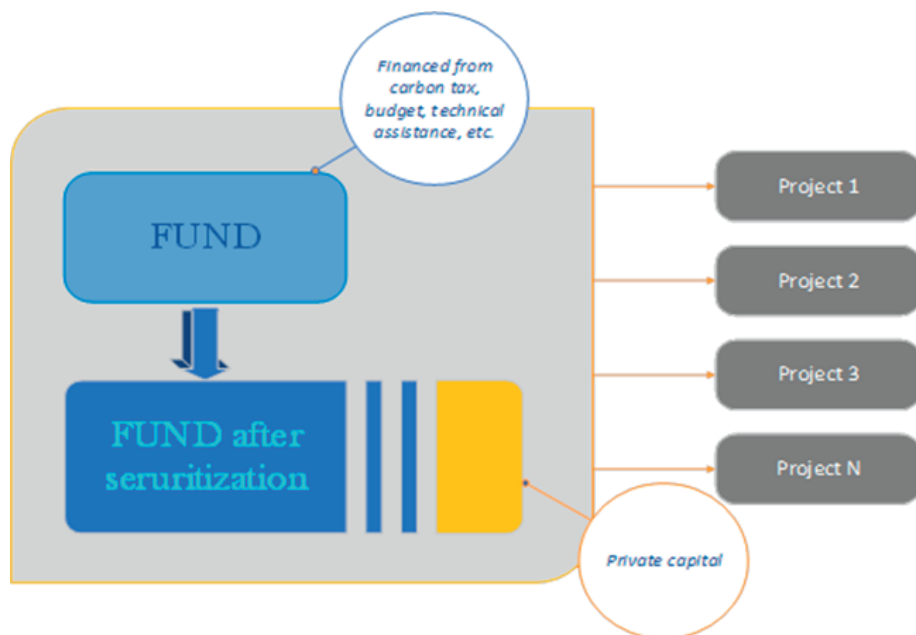
At the same time, the green finance market is at the initial stage of formation, and traditional lending mechanisms are most often used to achieve sustainable development goals.

The implementation of green projects provides for state support from the budget or funds from development institutions. At the same time, one of the problematic aspects is the lack of guaranteed payment flows from budgetary organizations or local authorities. In world practice, this problem is solved by establishing specialized 'green' funds, including individual legal entities, with the prospect of their subsequent capitalization (Fig. 12.1). The primary sources of its financing can be budgetary resources (direct and indirect investments of the state and utilities), credit instruments of international organizations (i.e., technical assistance), carbon tax. Thus, the share of financing by international development institutions in the creation of national 'green' banks (funds) can range from 20% to 80% (Kazakhstan and Kyrgyzstan, respectively), by federal governments – from 10% to 80% (Uganda and Zambia), at the expense of private capital – from 10% to 30% (Kenya, Kyrgyzstan, Mongolia). In addition, private financial organizations that provide capital on a grant basis (for example, as part of crowdfunding, voluntary contributions, etc.) can also be attracted.

After its formation, the Fund is expected to securitize its assets by issuing green bonds, thereby attracting additional private capital. Subsequently, the Fund can finance investment projects that meet specific criteria, including:

- economic;
- social (criteria of sustainability);
- environmental.

The latter will include particular criteria by type of economic activity, depending on the criterion for adaptation to climate change, the criterion for mitigating the effects of climate change (including the efficient use of resources, environmental protection, pollution prevention, prevention of emergencies, etc.), criteria for a closed-cycle economy. (For example, for projects in the field of water treatment and sanitation, such criteria are: water retention on the soil surface, storage of water for subsequent distribution or delayed use, changing water characteristics by specific standards, flood protection, drought-resistant structures, rainwater use, etc.). Such criteria are detailed in the European Union Taxonomy Technical Report (European Commission, 2019).



**Fig. 12.1** *Financial Model based on the Green Fund establishment (Source: compiled by the authors)*

The Fund is also expected to play an essential role in promoting public-private partnerships by developing standards for tracking climate-related investments and subsequently assessing their environmental and social impacts. For this, incentives can be provided to redirect private investment to green projects (so-called adaptation of financial instruments to the SDGs). In addition, the implementation of the National Infrastructure Strategy (NIS) aimed at economic transformation, including support for small and medium-sized enterprises, business incubators, initiatives and cooperation in industry, financial alternatives to improve energy efficiency, and renewable energy sources, should be intensified.

With the introduction of new financial mechanisms and instruments in developing a green economy, the leading role is traditionally assigned to the state. The need is to acquire a regulatory legal, and methodological framework for regulating 'green' project financing issues, primarily the standardization of green bonds. It is planned to develop guidelines and standards for green projects and investment performance indicators, which will provide guarantees for the interests of both government agencies and private investors.

### 12.7. Concluding Remarks

Until now, there has not been a unified approach to the definition of green finance. It creates difficulties in managing the risks of green investments, just as conducting effective monitoring of the implementation of relevant projects, ensuring proper control, accounting, reporting, and competently assessing their socio-economic efficiency. According to world practice, implementing green projects involves the circulation of particular financial instruments (green bonds and credits).

Typical participants in the green finance market are investment banks, insurance companies, international corporations, stock exchanges, global financial centers. However, European financial centers (including London – the Green Finance initiative, Luxembourg – the Green Exchange, Paris – the Finance for Tomorrow initiative) and informal green associations in corporate and financial sectors (mutual obligations platforms, joint industry initiatives, lobby groups) are the most significant interest in sustainable development issues. At the same time, such factors as the lack of widespread practice of using financial instruments in the implementation of environmental projects; the small number of currently used green financing instruments, as well as the presence of numerous restrictions on their use, including the lack of a unified system for verification and certification of green bonds; low interest in environmental issues for several states to a large extent hinders the widespread use of green financial instruments.

The development of green financing provides special funds with subsequent capitalization based on financial instruments (green bonds). It should also be noted the need for state support for environmental projects by providing financial incentives and fiscal preferences, guarantees at the government level; attracting funds from the Global Environment Facility (GEF), major international institutions, and banks; developing an appropriate legal and methodological framework, as well as guidelines and standards for the implementation of green projects.

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# Chapter 13

## The Development of Green Bonds in The Context of Green Finance

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### Abstract

Today, all environmental issues have reached a point where individuals, businesses, and governments can no longer ignore them. At this point, the fact that the measures taken are insufficient has pushed various circles to seek more effective solutions. In this sense, financial businesses begin to implement environmental policies in their operations and contribute to environmental awareness by developing a variety of products. Green bonds are exciting instruments in this context, with the potential to play a transformative role in financing climate projects and increasing activity toward ambitious international climate goals. This excitement appears to be justified, given that green bonds have grown tremendously over the last decade, allowing for massive capital inflows. The concept of green finance, which has gained prominence in recent years around the world, is explained in this study, as are green bonds. The most recent evaluations were made using data from green bond databases. As a result of the evaluations, it has been discovered that the global importance of green bonds is growing, as is their market volume.

**Keywords:** green finance, green bonds, green financial products and services

### 13.1. Introduction

Given the current state of the world, awareness is critical. It is unavoidable to run out of resources when confronted with a constantly consuming social structure. The production required to meet consumption results in both resource waste environmental problems. The need for energy appears to be the most pressing issue in the world today. Water resources and soil, on the



other hand, have become signals to meet today's needs before future generations. Individual awareness is critical for everything that is included in our consumption area. As a result, social responsibility campaigns, training, fairs, and events are becoming more prevalent. In the long run, conscious society behaviors direct producer behaviors.

Raising awareness in individual societies is critical for taking the necessary precautions, but policies implemented by states are required at this point. The reason for this is that environmental issues affect not only a specific region, but also the area in which they live. To take global action and impose mandatory sanctions on states through agreements, an organizational study is required. In this regard, the United Nations has the lion's share.

With the Rio Conference, the organization's environmental perspective gained seriousness, and the understanding that all world states must work together to overcome global environmental problems was accepted, and it was decided to take decisions to protect natural resources (Duru, 2016). The study's Environmental Policies section goes into greater detail about the transformation of the United Nations with the Rio and Stockholm Conferences, as well as the environmental decisions made.

When the dimension of individual awareness is applied to the search for solutions to existing problems, it reveals that consumer behaviors are oriented toward green consumption.

Today, more consumers are concerned with being environmentally conscious when purchasing a vehicle, building a new home, or renovating an existing home. The fact that loans are being used not only for product consumption but also for green features such as Green Home Loans and Green Vehicle Loans has become a reason for preference. This type of consumer behavior has energized both the manufacturing and financial sectors.

In terms of investors, green investments are seen to provide both prestige and various profits in the long run. There are serious movements, particularly in financial circles, to respond to the needs of a more conscious society. Although the diverse green finance instruments are not yet large enough, they are becoming more well-known and attracting the attention of investors.

### 13.2. Green Finance

The goal of green finance, according to the United Nations Environment Program, is to increase the level of financial flow from the public, private,

and non-profit sectors toward sustainable development priorities. An important part of this is seizing opportunities that offer a reasonable rate of return, environmental benefits, and increased accountability by better managing environmental and social risks ([www.unenvironment.org](http://www.unenvironment.org)).

Green finance is defined by Price Waterhouse Coopers Consultants (PWC) as financial products and services provided to the banking sector to encourage environmentally friendly investments and low-carbon technologies, projects, industries, and businesses, taking environmental factors into account in the decision to lend (PWC, 2013).

Green finance, which is frequently used interchangeably with green investment, is a broad concept that encompasses more than just investments. The most significant distinction is that in green finance, operating costs of green investments, which are not included in the definition of green investment, as well as costs such as project preparation and land acquisition costs, which may cause different financing difficulties, are evaluated (Zadek and Flynn, 2013).

Green finance, according to Böhnke et al., includes all forms of investment or lending that consider environmental impact and increase environmental sustainability. Sustainable investment and banking are fundamental components of green finance, with investment and lending decisions based on environmental scanning and risk assessment to meet environmental sustainability standards (cited by Böhnke et al., Lindenberg, 2014). Green finance is defined as financial investments in sustainable development projects and initiatives, environmental products and policies that encourage the development of a more sustainable economy in the Global Environment Facility (GEF) report "Introduction to Green Finance." Green finance, according to the report, also refers to a broader range of other environmental goals, including but not limited to climate finance, such as industrial pollution control, water control, or biodiversity conservation ([www.thegef.org](http://www.thegef.org)).

There is no definitive and common definition of green finance because the definitions made thus far differ significantly from one another and institutions such as the International Finance Corporation (IFC) have not made a specific definition (Lindenberg, 2014).



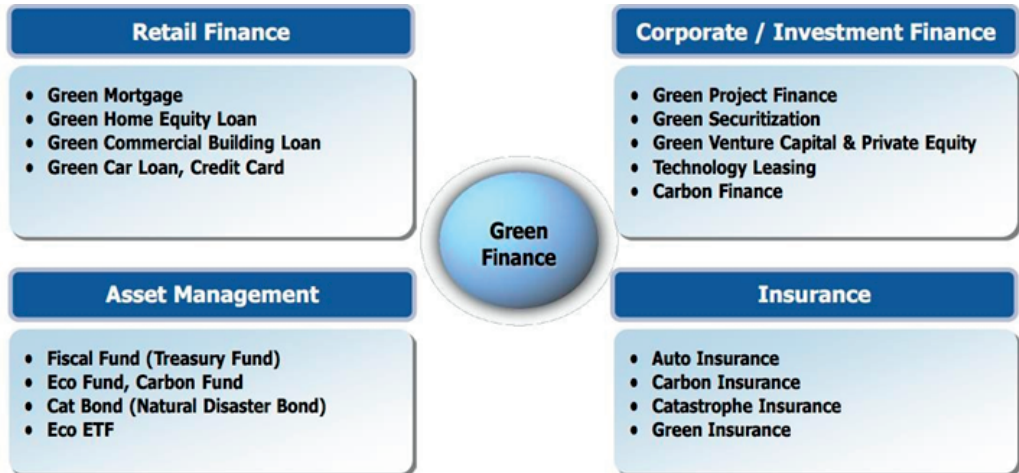
**Fig. 13.1** *Green Finance Comprises* (Source Lindenberg, N. (2014). *Definition of Green Finance. German Development Enstitute and Deutsches Institut für Entwicklungspolitik*)

According to Lindenberg (2014), the issues that form the basis of green finance can be listed as follows based on the definitions made:

1. Public and private investment financing areas, including preparation and capital costs.
  - a. Eco-friendly products and services (such as water management or biodiversity conservation).
  - b. Prevent, mitigate, and compensate for environmental and climate damage (such as dams or energy efficiency).
2. Making public policy funding available to mitigate environmental practices and damage, or to encourage environmental projects (such as tax breaks for renewable energy).
3. Establishment of financial system components dealing specifically with green investment, such as a green climate fund or financial instruments for green investments (e.g., green bonds and structured green funds), as well as legal, economic, and institutional framework conditions.

### 13.3. Green Finance Products and Services

To be considered a green financial product or service, a financial product or service must be products or services that reduce or provide positive effects on the environment. The products and services evaluated within this framework are classified into four categories based on international examples (Sevim et al., 2018).



**Fig. 13.2** *Green Finance Products and Services* (Source JinNoh Hee, *Financial Strategy to Accelerate Innovation for Green Growth* (2010))

When looking at Figure 2, green financial products and services are concentrated in the banking sector. Although banking transactions do not directly harm the environment, the projects that are funded may do so. The sector's diversity of investments has resulted in more green financial products and services in this area. Following banking transactions, green financial products are concentrated in various funds and insurance transactions.

While banking and financial transactions can pollute the environment through loans made to trade and industrial companies or projects, environmental issues can also have an impact on bank management strategies and daily operations (Kuloğlu ve Öncel, 2015).

In this study, we will concentrate on green bonds and attempt to provide information on the most recent global developments.

### 13.4. Green Bonds

Green bonds are bonds that generate funds for projects that benefit the environment or the climate (<https://wvAv.climatebonds.net/market/explaininggreen-bonds>). The main feature that distinguishes green bonds from other bonds is that the bond income is used in green projects (Escarus, 2016). As a result, it is possible to say that green bonds are used to fund green projects. Renewable energy, energy efficiency, pollution prevention and control, sustainable natural resource management, biodiversity protection,

clean transportation, and sustainable water management are all part of the green project statement (Jun, Kaminker, Kidney, & Pfaff, 2016). Green projects, according to this framework, are projects that promote progress in environmentally friendly activities (European Commission, 2016). Although green bonds can be used for any green project, they are most prevalent in renewable energy and energy efficiency. Seventy-five percent of the proceeds from these bonds are invested in renewable energy and energy efficiency (Bartels, Kurznack, Briaut, & Krimphoff, 2016). Green bonds provide the expected returns from a financial investment while also providing environmental benefits. Green bonds are gaining popularity among investors because of these two significant benefits (Galaz, Gars, Moberg, Nykvist, & Repinski, 2015).

The European Investment Bank issued the first green bonds in the world in 2007. (CAIAA, 2016). This first green bond issuance, known as a climate awareness bond, was worth 600 million Euros. Projects in renewable energy and energy efficiency were funded with the funds obtained. The World Bank issued its second green bond, totaling 440 billion dollars, in 2008. This issuance was made in response to a request from Scandinavian pension funds to fund climate-related projects. Green bond issuances by the International Finance Corporation and other public institutions totaled \$4 billion in 2010. Until 2013, the issuance of green bonds in small transactions increased rapidly, owing to state and local government issuance (Cochu et al., 2016). As an example, In the first half of 2017, the total value of green bonds in circulation worldwide surpassed \$200 billion (CBI, 2017).

Since 2013, private companies have begun to issue green bonds, which were first issued by international organizations such as the European Investment Bank in 2007 and the World Bank in 2008. Green bonds are becoming more popular as the world's sensitivity to the environment grows (Ozer, 2017). In the European Union (EU), for example, it has been stated that green bonds can play a significant role in financing the investments required to meet the 2030 climate and energy targets, as well as the United Nations Sustainable Development Goals (European Commission, 2016).

Green bonds are debt instruments used to fund green projects that benefit the environment (Jun, Kaminker, Kidney, & Pfaff, 2016). Green bonds, according to another agriculture, are debt instruments issued by the public, private, or multilateral institutions to finance climate-friendly and environmental projects in accordance with the four basic green bond

principles (Chiang, 2017; ICMA, 2017). These definitions draw attention to two key characteristics of green bonds. The first is that green bonds are issued based on four fundamental principles. Second, green bonds are issued to raise funds for green project financing.

Green projects are investments in the following areas (Jun, Kaminker, Kidney, & Pfaff, 2016):

- Renewable energysources
- Energy conservation
- Pollution prevention and management
- Natural resource management that is sustainable
- Biodiversity preservation
- Transportation that is environmentally friendly
- Water management that is sustainable
- Climate change adaptation

There is no legal sanction for putting the four basic green bond principles mentioned in the definition of green bonds into action, and these principles are open to interpretation (Krupa and Harvey, 2017). These principles are summarized below (ICMA,2017).

- The funds raised through the issuance of green bonds must be used in green projects, which must be documented at the time of issuance.
- The green bond issuer must clearly articulate how the green projects to be funded will be chosen and evaluated.
- A transparent management of information regarding fund management is also envisaged. It is recommended that you seek the assistance of an external auditor in this regard.
- It is recommended that the issuer prepare and publish reports on the management of green bond funds on a regular basis.

Green bonds are divided into two categories. Green bonds, like traditional bonds, are classified into different types according to the first classification. The second classification divides green bonds into two types based on the intended use of the funds. The traditional classification makes no distinction between green bonds and traditional bonds. As a result, green bonds are classified as corporate bonds, project bonds, asset- backed securities, guaranteed bonds, and municipal bonds (Shishlov, Morel, & Cochran, 2016).

Green bonds are divided into labeled green bonds and unlabeled green bonds according to their specific classification. Labeled green bonds are green bonds that are marketed as such. Unlabeled green bonds, on the other hand, are green bonds that are issued to finance environmentally

friendly projects but are not marketed under the definition of green bonds. As a result, labeling a bond as a green bond indicates that the funds raised through the issuance of that bond will be used in environmentally sensitive projects (Ng and Tao, 2016). Although classifying green bonds as labeled or unlabeled appears to be a simple process, the fact that the classification is not regulated can create uncertainty. The issuer of green bonds has sole authority over labeling, and there is no authority for the issuer to seek approval in this regard. The issuer is required to declare in writing its commitment to directing the proceeds of the green bond issuance to green projects. Furthermore, the issuer is expected to continue making these statements in the periodic reports to be prepared in the following periods. However, there is no standard for the report's content or format, and the reports differ from one issuer to the next. To summarize, there is no authority that governs a green bond issuer's relationship with green projects. Due to the lack of regulation, independent assessments of green bonds by a few organizations are critical. Green bond issuers pay for these assessments. The evaluation reports can be used to make investment recommendations to investors (NEPC, 2016).

Green bonds, in essence, have many of the same characteristics as traditional bonds. Green bonds, like traditional bonds, have features such as periodic interest payments, interest payments deducted from the tax base, and a relatively long maturity. These characteristics make green bonds an appropriate financing tool for large-budget, long-term renewable energy investments. Green bonds differ from traditional bonds in that the funds raised through the issuance of green bonds must be invested in renewable or sustainable energy projects (Wang and Zhi, 2016). Of course, in order to direct the funds made available by the green bond issuance, the scope and quality of the green projects must first be determined, and the process of transferring the funds to the designated areas must be overseen by an independent institution (external evaluator) (Van Dijk, Arnaud, 2015). Traditional bond investors, on the other hand, do not have the authority to determine where the funds they lend will be used by the company (Ng and Tao, 2016).

### 13.5. Green Bond Markets

Because of the many similarities between green bonds and traditional bonds, market participants in these two bond markets are similar. Green bond market participants include issuers, underwriters, external evaluators, brokerage houses, index publishers, and investors. Green bond issuers are

institutions that borrow green funds, and common issuers include the World Bank, private banks and similar financial institutions, local governments, and businesses. The issuer's qualifications are important because they influence the risk of the green bond. Contractors help to issue green bonds and deliver them to investors.

External evaluators are organizations that independently assess whether green bonds meet standards. In terms of defining bonds as "green," external assessors provide an important service to investors. The results of their external evaluations can be made public by green bond issuing institutions. Intermediary institutions, such as stock exchanges, play an important role in the green bond market. Securities markets, for example, may create lists or markets for green bonds that meet certain green bond conditions.

As a result, stock exchanges can demonstrate their support for the green economy transformation. Green bond markets exist on some stock exchanges, such as the Luxembourg Stock Exchange. Typically, index issuers are banks or credit rating agencies. Index issuers provide a valuable service to investors by developing a benchmark that can be used to assess the overall performance of green bonds. Each index may have different green bond criteria. Among the leading green bond indices are the S&P Green Bond Index, the S&P Green Project Bond Index, the China Climate-Aligned Bond Index, and the Bank of America Merrill Lynch index (Kandr, 2017).

### 13.6. The Current State of the World's Green Bond Markets

Green bonds, which are attempting to establish themselves in the market as a new instrument, see an increase in market volume each year. According to a Moody's report, the global volume of green bonds is expected to reach \$775 billion by 2023. In Figure 13.3, we can see the global development trend of green bond markets in recent years. One striking feature is that the rate of increase decreased slightly in 2020 compared to previous years, but there appears to be a visible increase since 2021. The main reason for this situation in 2020 is, of course, the COVID-19 pandemic. However, as the normalization process progresses, this situation will fade, and the increased environmental sensitivity will have a positive effect on the field of green bonds. In addition, there may be potential headwinds to overall global debt issuance in 2022, particularly in more established markets, with expectations of gradually decreasing growth rates over time as the market grows and matures, as well as in a potentially tightening monetary policy environment.



## Green economy and Green Finance

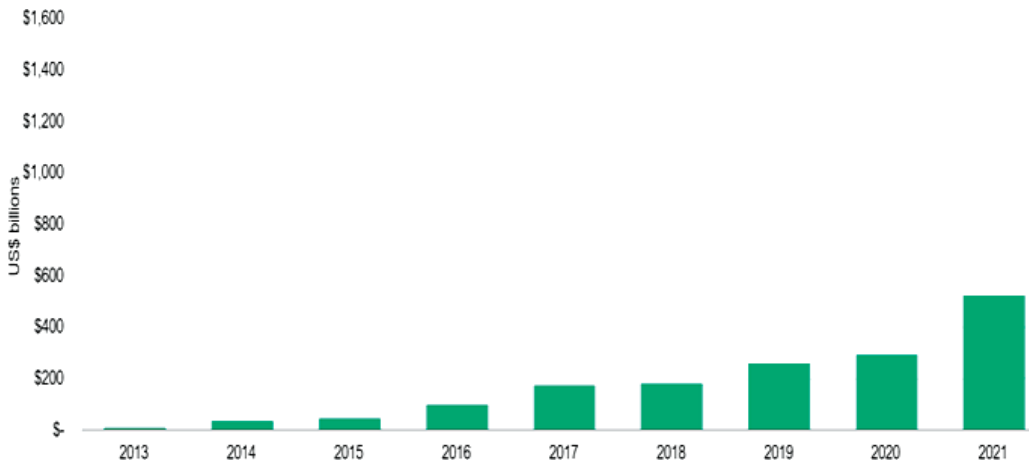


Fig. 13.3 Annual issuance of green bonds, US\$ billions (Sources [www.bonddata.org](http://www.bonddata.org))

At the same time, the risk of global fragmentation in sustainable investment policies and practices, as well as increased scrutiny over the dependability of some sustainable debt instruments, could weigh on the sustainability of free market growth. Despite these risks, 2022 is expected to be a year of growth, as the number of issuers who have included sustainability strategies in their capital market plans has increased. As a result, GSSS (Green Bond, Social Bond, Sustainability Bond, Sustainability Bond) bonds are expected to grow as a percentage of global issuance volumes. GSSS bonds represent 11.3 percent of total global bond issuance, up from 6.7 percent in 2020. (Fig 13.4). Despite very high overall debt issuance levels that rivaled the pandemic-driven records set in 2020, this increase in the share of global issuance has occurred.

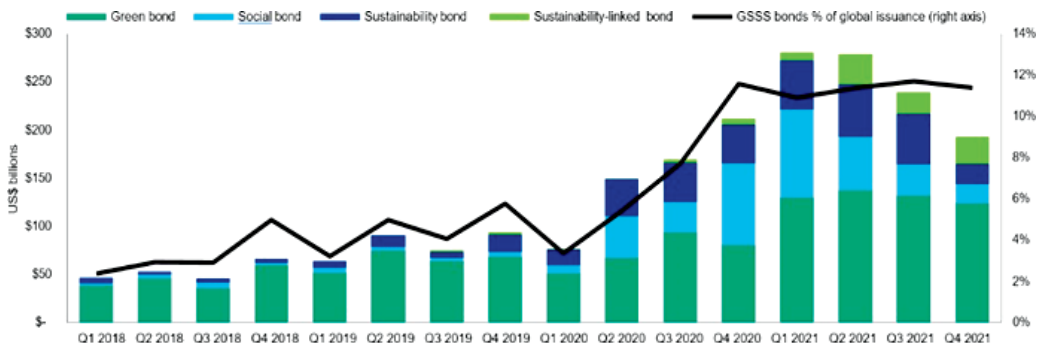


Fig. 13.4 Quarterly issuance of GSSS bonds, US\$ billions (Sources [www.bonddata.org](http://www.bonddata.org))

When we look at this share over time, we can see that green bonds have a significant share. As shown in Figure 13.4, GSSS group bond volumes fell modestly throughout the year, reaching \$193 billion in the fourth quarter of 2021, the lowest in five quarters, in line with the trend seen in overall global debt issuance. While the low borrowing costs that helped support these volumes are likely to reverse as interest rates rise throughout the year, the focus on sustainable development and achieving net zero commitments indicate that sustainable finance will continue to be strong drivers through 2022.

Green bond issuance in 2021 totaled \$523 billion, a 78 percent increase from the \$293 billion issued in 2020. (Figure 13.5). The steady growth in global issuance is expected to continue into 2022 as more independent issuers expand their green bond programs and an increasing number of issuers seek to finance climate mitigation and adaptation efforts and advance their net zero commitments.

With \$294 billion in green bond issuance, European green bond issuers account for 56% of total global green bond issuance, making it the region with the greenest bond issuance in 2021. (Figure 13.5). Since 2017, when the region accounted for 32% of global issuances, European green bonds have represented an increasing share of the global total. This is largely due to the region's continued emphasis on the transition to a green economy, with European sovereigns such as the United Kingdom, France, Italy, and the European Union being the market's largest issuers (EU). As independent green bond programs such as the EU's €250 billion Next Generation EU green bond program continue to be an important driver of market growth, this trend is likely to continue.

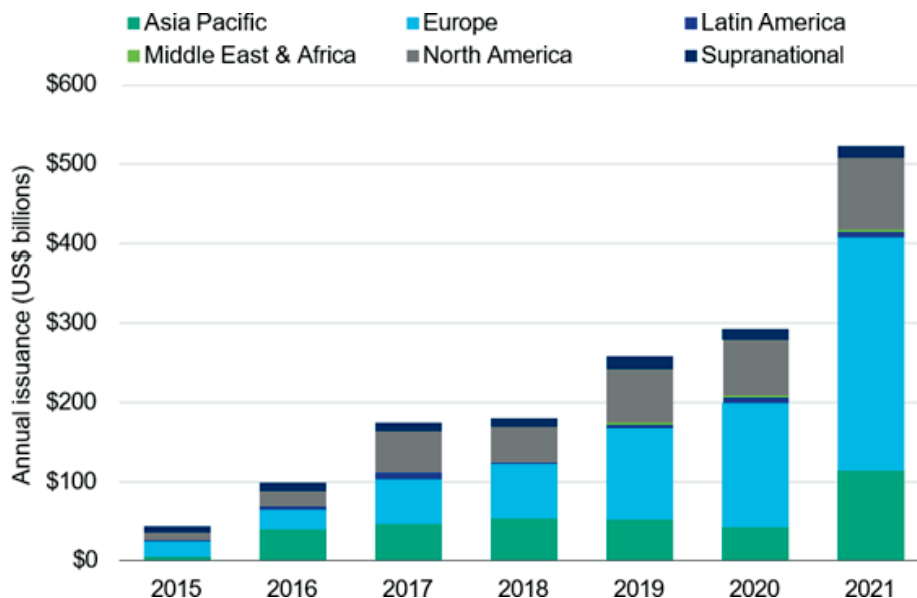


Fig. 13.5 *Regional Distribution of Global Green Bond Issues* (Sources [www.bonddata.org](http://www.bonddata.org))

Asia-Pacific and North American issuers trail Europe with 22 percent and 18 percent of global issuance in 2021, respectively. Latin America, the Middle East, and Africa have contributed very little to green bond volumes to date, with a total contribution of \$8.4 billion. In 2021, this will account for only 2% of the global green bond market. International corporations contributed 3 percent of global green bond issuance in 2021, down from 5% in 2020.

When we examine the distribution of green bonds by issuer in global markets, we can see that non-financial companies have the largest share of green bond issuance, with a \$223 billion issue in 2021, accounting for 43 percent of the global total (Figure 13.6). However, the issuance of green bonds broadens the sector, with significant participation from financial institutions (19%), sovereign (17%), agencies (11%), municipal issuers (7%), and supranational (3%). Diversification and growth will continue across all segments as the green bond market matures and becomes a viable option for issuers across all sectors.

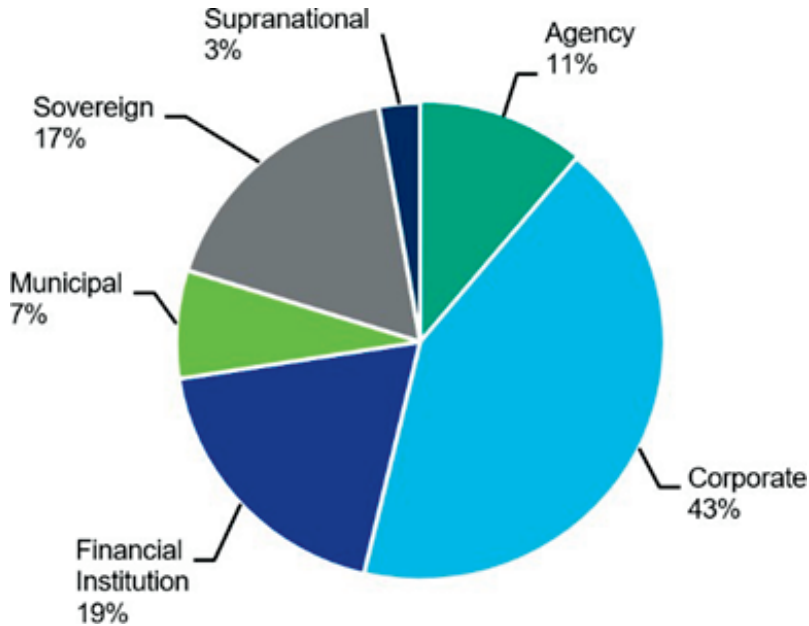


Fig. 13.6 Distribution of Global Green Bonds by Issuer (Sources [www.bonddata.org](http://www.bonddata.org))

Figure 13.7 shows the largest green bond issuers in the world in 2020, based on Bonddata data. As this chart shows, companies based in Europe and North America stand out more among the top 15 companies in the world that issue green bonds. JP Morgan is the world leader in green bond issuance, having issued \$17.4 billion in green bonds. The fact that such global leaders value green finance and green bonds will serve as a model for many other businesses in the future. This situation will also benefit the green bond market in terms of company enrichment.

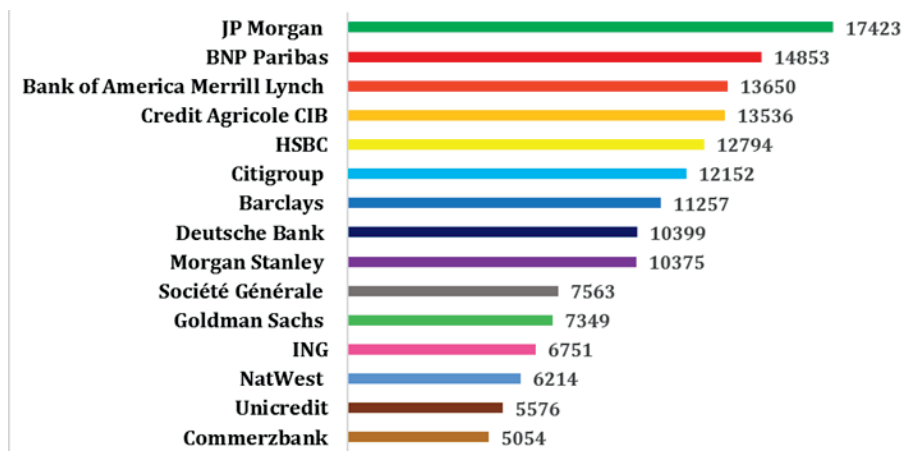


Fig. 13.7 Top 15 Lead Issuer for Green Bonds 2020 (\$M) (Sources [www.bonddata.org](http://www.bonddata.org))

### 13.7. Discussion

The environment is an issue that is increasingly on the global agenda, and its significance is becoming clearer by the day. The most difficult aspect of this goal is that individuals must pay to protect the environment. As a result, the development of green financial products and services is critical. Green bond issuance and green financing products are becoming increasingly popular around the world. The analyses we conducted for this study led us to the conclusion that the green bond markets have experienced a significant expansion in the last decade, and that this expansion will continue in the future. The fact that international companies, governments, and private sector companies are all paying close attention to this issue suggests that such products will become more prevalent in global bond markets in the coming years. One of the expected outcomes is that the green bond market will reach \$1 trillion by 2030. Although green bonds can be used for any type of green project, they are most used in renewable energy and energy efficiency projects. The most important reason for this is to eliminate both the environmental damage and other negative effects of using fossil fuels to meet countries' increasing energy needs. The increasing prevalence and importance of these bonds will undoubtedly lead to extensive empirical and academic research on the subject in the future.

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# Chapter 14

## International Banking Business and Its Impact on Green Finance

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### Abstract

One of the biggest problems of today, the consequences of which are observed in all aspects of human functioning, are environmental. The ever-increasing threat of global climate change, environmental pollution, and the destructive impact of human activities highlight the need for more detailed research into tools to increase the country's environmental sustainability. In addition, it provokes the search for additional sources of funding for these activities. For developing countries, one of the main sources of environmentally sustainable development is international bank financing. Therefore, this study aims to analyze how international green banking affects the environmental sustainability of developing countries. For this purpose, the data series were compiled for 2010 to 2020. The annual data for panel regression analysis are retrieved from the OECD and World Bank Open Data. The empirical analysis employed a set of estimation procedures such as the panel unit root test (Levin, Lin & Im, Pesaran, Shin W-Stat; ADF-Fisher Chi-square; and PP-Fisher Chi-square methods), the Pearson correlation, fixed- and random-effects models, generalized method of moments (GMM), Hausman and the robustness tests. The identified effects can be useful for government officials in terms of determining the benefits of using international green banking towards gaining environmental sustainability.

**Keywords:** international green banking, environmental sustainability, green financing, environmental performance, green loan

### 14.1. Introduction

One of the most pressing issues of today, attracting public attention around the world, is environmental. Their manifestations are energy crisis, air and water pollution, rising morbidity and more. Significant rates of world economic development only increase the consumption of natural resources, thereby deepening the existing problems in the world. Thus, the analysis of statistical data (World bank data) showed a steady increase in global consumption of electricity, water, carbon emissions. In recent years, the risk of depletion of non-renewable energy resources has increased significantly, which creates another cause for concern for the world community. This provokes adverse climate change, increases environmental pollution and threatens national and international environmental security (Chien et al., 2021; Tu et al., 2021; Nawaz et al., 2021).

At the same time, despite the destructive impact of economic activity on the environment, economic development creates favorable conditions for scientific progress, the introduction of green technologies (use of renewable energy sources, smart technologies, green innovations, etc.). This, in general, allows society to solve environmental problems (Hsu, Quang-Thanh, Chien and Mohsin, 2021).

One of the main documents regulating the problems of sustainable development are the 2030 Agenda for Sustainable Development and Sustainable Development Goals (SDG) developed in 2015 by the UN General Assembly. These documents define a list of measures aimed at improving the economic and environmental situation in the world. However, the problems of recent years (COVID-19 pandemic and economic crisis) have significantly slowed down and threatened to reduce the prospects for achieving these goals in the near future.

A significant gap in the financial capacity to fund these activities in countries around the world leads to the search for additional sources of accumulation of funds. International banking is a key part to this process.

International banking institutions are a key source for environmental sustainability due to the large network of branches of banking institutions in the world and proximity to the direct beneficiary. The resources of international banks play a key role in financing environmentally friendly programs and supporting sustainable development in the world, especially during periods of financial crisis.

Despite the general problems caused by the pandemic and the crisis in the economy, the performance of the international banking sector is assessed as

positive and as an important component of global financial services for economic stability.

A significant number of international banks, together with the International Monetary Fund (IMF), are constantly focusing their efforts on achieving the SDG. Due to the implementation of innovative financial solutions, these institutions have made some progress in meeting quality of life standards, including environmental sustainability. The financial resources allocated by these organizations (direct financing and financial support of public and private institutions) have a significant impact on sustainable development.

Thanks to a wide range of financial services provided by international banks (capital market operations, investment banking, securities brokerage and lending, risk management, operational and technology centers, research and development centers, credit services, treasury operations and intra-group financial activities) beneficiaries have the opportunity to fund sustainable development programs through a significant number of tools and areas of development.

Today, at the international level, a number of environmental protection initiatives are being implemented with the direct participation of international banks. Thus, one of the most common is the the United Nations Environment Program Finance Initiative (UNEP FI) and Equator Principles (EPs). UNEP FI is a network of financial institutions (mainly international banks and insurance companies) that are committed to developing mechanisms to promote sustainable development and mechanisms for their environmental responsibility. Measures to establish and promote the relationship between sustainability and financial performance of the organization are implemented by establishing cooperation with more than 200 members, including leading international banks, investment funds and insurance companies.

The principles of the equator are the basis of credit risk management in terms of identification and assessment of environmental and social risks in the implementation of project financing by international banks. The principles were first developed in 2003 and put into practice by ten global financial institutions. These principles are applied in project financing and related consulting activities for projects above \$ 10 million. Today, the Equator Principles are signed by financial institutions in 32 countries, whose funding is more than 70% of the total project funding in countries with rapid economic development.

In recent years, along with traditional instruments for financing environmental

programs, international green banking has become important as an integral part of the international banking business, aimed at creating conditions for better living conditions and sustainable development for present and future generations (Bahl, 2021; Sachs, Kroll, Lafortune, Fuller and Woelm, 2021).

International banks are increasingly resorting to concessional financing or grants directly aimed at implementing SDGs in the poorest countries. One of the activities of the International Monetary Fund is the implementation of joint development programs, technical assistance and knowledge to partners to address issues related to the achievement of the SDG.

For example, the World Bank Group annually directs more than \$65.9 billion in search solutions that reduce poverty and build shared prosperity in developing countries in Sub-Saharan Africa, East Asia and the Pacific, South Asia, Europe and Central Asia, Latin America and the Caribbean. Middle East and North Africa. New Development Bank annually mobilizes \$7.2 billion to implement infrastructure and sustainable development projects in the BRICS and other market economies and developing countries. Islamic Development Bank Group is allocating more than \$7.8 billion to empower people in the Middle East, Africa, Asia and Latin America to ensure their sustainable future.

The European Bank for Reconstruction and Development has developed the Green Cities program (totaling more than €1.5 billion) to help cities develop environmental action plans, facilitate access to sustainable infrastructure financing and share technical expertise. The object of financing are measures in the field of energy, green building and reconstruction of buildings, renewable energy, water and wastewater treatment, solid waste management, etc.

The implementation of this measures on the one hand helps to enhance the reputation and image of these banks, promotes their visibility among customers and demonstrates their commitment to environmental protection. On the other hand, this policy, by supporting and implementing environmentally friendly technologies, reduces the burden on the environment, carbon emissions and more.

At the same time, the role of international green banking in sustainable development is not fully understood. There are still many issues that need to be studied in more detail: which components of the sustainable development mechanism are most sensitive to the level of international green banking in the country, the effectiveness of these mechanisms in the world, how effective international green banking is compared to more

traditional tools for sustainable development.

### 14.2. Literature Review

Liberalization of financial flows, integration and globalization of financial and economic systems significantly accelerate the pace of cash flow and stimulate the development of the international banking sector, which is characterized by banking activities that cross national borders. This creates additional opportunities to raise capital at much higher volumes and rates.

According to Tandon & Setia (2017) based on primary and secondary analysis data and Garrett's ranking techniques concluded that the international banks play an important role in shaping green policy principles.

On the other hand, Gopi (2016), the international banking is one of the catalysts for environmental degradation. By financing projects, the implementation of which has a negative impact on the environment, banking institutions indirectly threaten the environment. Awareness of this problem has led to a revision of the policy of banking institutions at the international level and the implementation of policies for the use of incentive tools to encourage projects that demonstrate their concern for the environment.

Awareness of the growing role of international banks in achieving the SDG has contributed to the emergence of the concept of "green banking" as the most innovative component of environmental sustainability policy. The preconditions for the emergence of this concept and the active involvement of the banking sector in these activities were the world community's awareness of the effects of the environmental crisis and environmental pollution, which are asking the international banking industry to take an active part in overcoming the environmental crisis and global warming. Every year, this concept covers more and more aspects that can be implemented through direct or indirect participation of financial institutions in ensuring environmental sustainability, in particular: green finance, green marketing and green behavior, and so on.

United Nations representatives, with the support of the 30 most powerful international banks in the world, identified six principles of sustainable banking. These principles are based on the implementation of the roadmap to increase public confidence in international banking institutions and bring the main vectors of their activities (operational activities, specific decisions and even the principles of capital allocation) in line with the principles of sustainable development defined by international rules (Paris

Climate Agreement or 17 UN Sustainable Development Goals), national and regional programs in a particular countries.

According to these principles, international green banking is to streamline the decision-making process for responsible capital allocation: where is the best place to invest and who is best not to lend? These activities require verification of clients, projects and partners for compliance with the principles of sustainable development, as well as the introduction of key performance indicators (KPIs) on environmental and social benefits of projects (Bhardwaj & Malhotra, 2013; Taghizadeh-Hesary & Yoshino, 2020; Malliga & Revathy, 2016).

Today, one of the mainstream developments of scientific thought in the field of sustainable development, the most common tool for solving climate problems, environmental pollution and ensuring sustainable development of the country is international green banking (Aubhi, 2016; Jayabal & Soundarya, 2016; Ritu, 2014; Shaumya & Arulrajah, 2017; Tandon & Setia, 2017; Mamedov & Qurbanov, 2022). Every year, more and more banks are transforming their policies towards sustainable development, social responsibility and ethical behavior.

Today, international green banking is implemented in various forms: replacement of banking services in branches with online customer service; creating opportunities to pay bills online; opening accounts in online banks, not in large multi-branch banks, etc (Deka, 2018).

Jha & Bhome (2013) among the most common international green banking strategies for sustainable development are: Going Online (e-banking, which reduces the use of paper, energy, and expenditure on projects assists in power saving and resource preservation); Using Green Checking Accounts; Green Loans for households (loans with low or differentiated interest rates for the purchase of solar equipment); Power Saving Equipment (using of solar-powered ATM); Green Credit Cards; Green product and services; Green Strategies; Green Checking Accounts; Saving Papers (use of recycled paper products with the highest post-consumer waste content possible).

The implementation of all these operations promotes the development and exchange of sustainable business practices in support of environmentally friendly initiatives in the world and reduces the negative impact on the environment.

However, despite the fact that green banking is already considered an integral part of the international banking system, it is still not popular in most middle-and low-income countries. In addition, a significant number of scholars emphasize that the implementation of international

green banking policy, in addition to the direct environmental effect has a positive effect on the activities of banking institutions. The implementation of these measures shapes the community's perception of this financial institution as one that is not only profit-oriented, but also cares about the environment and ultimately leads to an increase in their reputational value.

Salvado, Castro, Verde and Lopez (2013) based on an empirical study using questionnaire and research resume methods proved the positive impact of international banking environmentally friendly strategies on the level of eco-innovation and growth of banking sector competitiveness.

Risal & Joshi (2018) in their study analyzed the impact of green banking on environmental activities in Nepal. Using the tools of simple and step-by-step multiple regression analysis based on data from 189 banks, the authors proved the important role of international banks in encouraging the use of environmentally sustainable technologies to enhance the bank's reputation and awareness among customers.

Zhang, Wang, Zhong, Yang and Siddik (2022) analyzed the impact of international green banking on green finance and environmental performance of banks. Based on the modeling of structural equations for 352 bankers, the authors substantiate the mediating effect of green finance on the relationship between international green banking and the environmental performance of private commercial banks. Empirical calculations have shown that green banking has a significant positive impact on the environmental performance of banks and sources of green finance. At the same time, sources of green finance significantly affect the environmental performance of banks. The main shortcomings hindering the pace of green banking are the lack of customer awareness of green banking, high investment costs, technical barriers, lack of capable and competent staff to evaluate green loans, and difficulties in evaluating green projects. At the same time, increasing the competitiveness of banks, reducing long-term costs and expenses, providing online banking services, improving customer reputation and reducing carbon emissions is identified by the author as the main benefits of green banking.

Thus, the results of the analysis of the existing scientific contributions on the development of international banking as part of the implementation of policies to achieve sustainable development goals showed the important role of these processes at both national and international levels. At the same time, some of their aspects require more detailed research on the example of more countries and over a longer time horizon. Therefore, the



primary purpose of this study is to determine the impact of international green banking on environmental sustainability. The main hypothesis of the study is the assumption that international banking plays an important role in achieving sustainable development goals in terms of all their components (reduction of energy consumption, carbon emissions, water use, etc.).

### 14.3. Materials and Methods

The information base of this study is the annual data obtained from the Organization for Economic Co-operation and Development and the World Bank Open Data for 2010-2020. The hypotheses established in the paper will be tested on the basis of a data series from such countries as Austria, Denmark, Finland, France, Sweden, Czech Republic, Netherlands (EU countries with the best indicators according to the level of achievement of sustainable development goals) and Ukraine, Azerbaijan, Greece, Luxembourg, Georgia (countries with medium and low level of achievement of sustainable development goals). Data collection and preprocessing was performed using the Microsoft Office Excel toolkit, and Stata software packages were used for further econometric analysis.

In the framework of this study, the following indicators were used as indicators that characterize the effectiveness of achieving the sustainable development goals: Renewable energy consumption (% of total final energy consumption); CO<sub>2</sub> emissions (metric tons per capita); Energy consumption in industry, % total energy consumption; Production-based CO<sub>2</sub> emissions (millions of tons); Non-energy material productivity, GDP per unit of DMC (domestic material consumption) (US dollars per kilogram, 2015); Environmentally adjusted multifactor productivity growth (percentage points); Development of environment-related technologies (% all technologies). The factor indicators that determine the effectiveness of this policy include economic indicators, which allow to determine the impact of international banking financing on the effectiveness of the country's achievement of sustainable development goals compared to other sources of funding: GDP per capita (current US \$); environmentally related R&D expenditure (% GDP); energy public RD&D budget (% GDP), annual investment needs for renewable energy, energy efficiency and low-emission vehicle (bn), climate bonds (bn), green loan (bn).

Table 14.1 shows the results of descriptive statistics for all factor and outcome variables used to analyze the impact of international green banking on environmental sustainability. As a result of statistical analysis,

the same number of observations was used for each of the analyzed indicators (n=190). This number of samples allowed to balance the analyzed data panel.

Variable	Description	Mean	Min→Max	St. Dev.
REC	Renewable energy consumption (% of total final energy consumption)	22.148	0.897→62.547	19.027
CO2	CO2 emissions (metric tons per capita)	5.032	0.047→17.051	3.785
EC	Energy consumption in industry, % total energy consumption	28.947	14.598→54.428	9.624
PBE	Production-based CO2 emissions (millions tonnes)	35.978	17.926→52.547	4.236
NEM	Non-energy material productivity, GDP per unit of DMC (US dollars per kilogram, 2015)	1.547	0.562→2.172	0.012
EAM	Environmentally adjusted multifactor productivity growth (percentage points)	0.547	0.545→4.958	0.024
DET	Development of environment-related technologies, % all technologies (Percentage)	9.95	6.012→14.367	2.185
RDE	Environmentally related R&D expenditure, % GDP	0.08	0.020→0.155	0.032
EPB	Energy public RD&D budget, % GDP	0.01	0.01→0.090	0.002
GDP	GDP per capita (current US \$);	47035.47	631.785→124,874.4	23,328.74
INV	Annual investment needs for renewable energy, energy efficiency and low-emission vehicle, bn	839	235→1012	13256
CB	<b>Climate Bonds, bn</b>	24	7→32	15
GL	<b>Green loan, bn</b>	123	52→164	24

**Table 14.1** *Descriptive statistics of all the variables for all countries*

*Notes: Min – minimum value. Max – maximum value. St. Dev – Standard deviation (Source author's calculations)*

The role of international green banking in ensuring the environmental sustainability of the country will be assessed by building regression models of panel data (Bahl, 2012; Purwanto, Sinaga and Sidik, 2021; Chen, Siddik, Zheng, Masukujjaman and Bekhzod, 2022; Ullah, Ahmed, Raza and Ali, 2021). The use of this method is due to its advantages over the cross-section and time-series data in the analysis of consecutive data series (Kumari & Sharma, 2017).

The dependence of individual indicators of sustainable development on the analyzed independent variables can be represented as follows:

$$SD_i = f(GDP, EPB, RDE, INV, CB, GL) \quad (1)$$

where  $SD_i$  - i-th indicator of sustainable development.

The advantage of this model is to ensure high reliability of the results. Greater reliability and validity of the results will be ensured through the use of the generalized method of movement (GMM), which minimizes the impact of endogenous factors.

The Hausman test will be used to determine the model that most fully describes the established interdependencies (fixed or random effects) and allows to determine a statistically significant relationship between factor and result variables.

Given the confirmation of the statistical significance of factors and resulting variables, the formalization of the relationship between indicators should be carried out using a model of fixed effects. Otherwise, it is advisable to use a model of random effects.

Formalization of the relationship between the analyzed indicators using a regression equation with fixed effects can be done as follows:

$$Y_{it} = \alpha_0 + \beta_1 X_{1t} + \dots + \beta_i X_{it} + \varepsilon_{it} \quad (2)$$

where  $Y_{it}$  - i-th indicator of environmental sustainability;  $X_{it}$  - the independent variables ( $GDP, EPB, RDE, INV, CB, GL$ );  $i$  - the subscript of entity ( $i = 1, \dots, 10$ );  $\alpha_0$  - an unknown intercept;  $\beta_{i..n}$  - the coefficient of explanatory variables;  $\varepsilon_{it}$  - the error terms.

Given the different nature of the data used in the process of increasing the reliability of the results obtained, it is important to bring them to a comparable form and avoid the difficulties associated with the dynamic properties of data series. This can be achieved by logarithmic the right side of the equation and reducing it to the following form:

$$Y_{it} = \alpha_0 + \beta_1 \ln X_{1t} + \dots + \beta_i \ln X_{it} + \varepsilon_{it} \quad (3)$$

Formalization of dependencies using the equation of random effects can be done as follows:

$$Y_{it} = \alpha + \beta \ln X_{it} + \mu_{it} + \varepsilon_{it} \quad (4)$$

where  $Y_{it}$  - i-th indicator of environmental sustainability;  $X_{it}$  - the independent variables ( $GDP, EPB, RDE$ );  $\alpha$  - an unknown intercept;  $\beta$  - the coefficient of explanatory variables;  $\varepsilon_{it}$  - the error terms;  $\mu_{it}$  - the random heterogeneity specific to the i-observation (constant through time).

In the next step of the study, we will check the connection using the Hausman test. The choice of the most acceptable model was made on the basis of the following equation:

$$p = (\beta_{RE} - \beta_{FE}) \times (\Sigma FE - \Sigma RE)^{-1} \times (\beta_{RE} - \beta_{FE}) \quad (5)$$

where  $\beta_{RE}$  – the coefficient estimates from random effects;  $\beta_{FE}$  – the coefficient estimates from the fixed effects;  $\Sigma_{FE}$  – covariance matrix of the coefficients estimated from fixed effects estimator;  $\Sigma_{RE}$  – covariance matrix of the coefficients estimated from random effects estimator.

Exceeding the p-level above 0.05 allows us to confirm the hypothesis that there is a relationship between the analyzed indicators. At the same time, a small p-level confirms the alternative hypothesis, which indicates the acceptability of the model.

An important component of testing the validity of the hypotheses established in the work and improving the reliability of the results is the procedure of panel regression analysis. To this end, we estimate the correlation between the analyzed variables by the Pearson coefficient using the following equation:

$$R = \frac{E((X-E(X))(Y-E(Y)))}{\sqrt{\text{var}(X)\text{var}(Y)}} \quad (6)$$

where  $E(X)$  and  $E(Y)$  – dependent and independent variables;  $\text{var}(X)$  and  $\text{var}(Y)$  – the variance of X and Y variables.

Interpretation of the obtained results can be carried out as follows:

$0 < R < 0.2$  – they are not correlation between variables;

$0.2 < R < 0.5$  – the low level of correlation;

$0.5 < R < 0.7$  – an average level of correlation;

$0.7 < R < 0.9$  – the strong correlation between variables;

$0.7 < R < 0.9$  – the highly strong correlation between variables;  $R < 0$  – the negative correlation between variables;

At the last stage of the study, a series of data on the presence of single roots will be analyzed using Levin, Lin and Chu, Im, Pesaran, Shin W-Stat method, ADF-Fisher Chi-square and PP-Fisher Chi-square. The general equation is as follows:

$$Y_{it} = \rho_i \gamma_{it-1} + \sum_{j=1}^{\rho_i} \varphi_{ij} \varepsilon_{it-j} + \dots + \delta_i X_{it} + u_{it} \quad (7)$$

where  $\rho_i$  – the number of lags;  $X_{it}$  – independent variables of equation (3);

$\varepsilon_{it}$  – stationary error;  $i$  – index of essence ( $i = 1, \dots, 10$ );  $u_{it}$  – a stationary process.

14.4. Results

The initial stage of modeling the impact of international green finance on environmental sustainability is to check all series of data for stationarity. To this end, we will analyze the indicators using tests Levin, Lin and Chu (LLC), Im, Pesaran, Shin W-Stat (IPS), ADF-Fisher Chi-square (ADF), and PP-Fisher Chi-square (PP) for the presence of single roots. In order to avoid the presence of erroneous regression and conversion of all exogenous variables to stationary, we will analyze the variables for the presence of single roots in the first difference.

The results of the analysis shown in Table 14.2 confirm the hypothesis of the presence of unit roots at the level of statistical significance of 1, 5 and 10%.

Tests	Stat. param.	Variables													
		Unit Root in Level													
		REC	CO <sub>2</sub>	EC	PBE	NEM	EAM	DET	RDE	EPB	GDP	INV	CB	GL	
LLC	Stat.	-0.81	-2.87	-1.58	-0.36	-2.17	-2.36	-0.87	0.98	-1.54	-2.87	-3.14	-2.85	-1.25	
	Prob.	0.21	0.00*	0.01*	0.01*	0.00*	0.01*	0.01*	0.05*	0.02*	0.24	0.01*	0.00*	0.01*	
IPS	Stat.	2.36	1.37	0.36	1.47	-2.16	3.17	-2.18	-0.58	-0.69	1.98	3.69	-0.56	21.35	
	Prob.	0.99	0.98	0.00*	0.65	0.46	0.69	0.36	0.00*	0.01*	0.36	0.01*	0.00*	0.00*	
ADF	Stat.	5.47	17.87	21.36	23.24	18.98	26.32	68.25	34.29	28.47	34.29	2.02	17.36	17.85	
	Prob.	0.98	0.47	0.24	0.36	0.01*	0.38	0.02*	0.47	0.00*	0.28	1.58	0.02*	0.04*	
PP	Stat.	8.17	26.94	69.98	54.84	25.67	22.38	34.69	54.97	46.98	28.39	31.65	45.94	23.68	
	Prob.	0.96	0.18	0.56	0.00*	0.17	0.25	0.59	0.67	0.01*	0.26	0.69	0.02*	0.00*	
		Unit Root in 1st Difference													
LLC	Stat.	-4.76	-6.87	-4.71	-8.14	-7.45	-7.06	-4.98	-5.21	-6.87	-6.98	-5.17	-8.98	-1.75	
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
IPS	Stat.	-4.81	-3.58	-2.06	-7.98	-5.78	-3.31	-5.74	-2.68	-5.19	-4.63	-8.96	-7.52	-6.24	
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
ADF	Stat.	48.98	51.89	46.69	62.85	74.36	56.98	54.29	61.28	66.59	57.85	47.29	55.69	24.69	
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PP	Stat.	136.85	147.95	132.47	98.74	65.45	120.36	225.21	87.87	113.27	158.25	107.96	187.89	98.24	
	Prob.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table 14.2 Panel unit root results

Notes: \*  $p < 0.01$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.1$ . L (Source author's calculations)

At the next stage we will analyze the presence of correlation between the analyzed variables, which will confirm the hypothesis of a causal relationship between them and significant impact of international green banking on environmental sustainability. Table 14.3 shows the results of the correlation analysis between variables, which confirms the relationship between sustainable development indicators of the country and components of bank financing of sustainable development.

	REC	CO <sub>2</sub>	EC	PBE	NEM	EAM	DET	RDE	EPB	GDP	INV	CB	GL
REC	1.00	0.04	0.32	0.36	0.44	0.26	-0.24	-0.19	-0.42	0.36	-0.44	-0.36	-0.17
CO <sub>2</sub>		1.00	0.56	0.24	0.33	0.27	-0.41	-0.24	-0.36	0.38	-0.45	-0.54	-0.21
EC			1.00	0.19	0.26	0.21	-0.28	-0.27	-0.23	0.47	-0.68	-0.62	-0.23
PBE				1.00	0.15	0.23	-0.36	-0.19	-0.44	0.32	-0.51	-0.37	-0.25
NEM					1.00	0.21	-0.10	-0.17	-0.21	-0.16	-0.65	-0.49	-0.17
EAM						1.00	0.31	0.34	0.18	0.23	-0.25	-0.41	-0.21
DET							1.00	0.17	0.11	0.09	-0.35	0.33	-0.15
RDE								1.00	0.22	0.19	0.64	0.28	0.11
EPB									1.00	0.24	0.71	0.39	0.09
GDP										1.00	0.54	0.37	0.12
INV											1.00	0.27	0.17
CB												1.00	0.16
GL													1.00

Table 14.3 Results of the correlation analysis (Source author's calculations)

Thus, the results of the analysis show that there is a negative relationship between indicators of sustainable development and financial indicators of the country's development. The development of environment-related technologies and the energy public RD&D budget have the strongest impact on sustainable development indicators (medium and low levels of correlation). International green banking instruments that are climate bonds, green loan positive impact on the environmental sustainability of the country. Thus, an increase in the volume of climate bonds issued by 1% leads to a reduction in CO<sub>2</sub> emissions by 0.54%. At the same time, GDP has a positive impact on the consumption of renewable and non-renewable energy sources, CO<sub>2</sub> emissions. These results are evidence of a high level of destructive impact of economic development, industrial development on the environment, in which the negative effects far outweigh the positive impact of economic development on the use of energy-saving and resource-saving technologies.

Confirmation of the hypothesis of a causal relationship between the analyzed indicators allows us to evaluate the parameters of the model, which most fully describes the relationship between indicators (fixed effects or random-effects model).

Variables	Coefficient	Std. Error	t-Statistic	Prob
<b>DET</b>	-0.132*	0.072	-14.023	0.000
<b>RDE</b>	-0.245*	0.012	-24.365	0.000
<b>EPB</b>	-0.325**	0.023	-7.985	0.000
<b>GDP</b>	0.421*	0.132	6.235	0.000
<b>INV</b>	-0.358*	0.095	-10.256	0.000
<b>CB</b>	-0.284*	0.045	-9.854	0.000
<b>GL</b>	-0.257*	0.023	-7.921	0.000
<b>R-Squared</b>	0.915			
<b>Prob (F-statistic)</b>	0.000			

**Table 14.4** Panel regression results for the fixed-effects model (example for CO2 emission and sustainable development indicators)

Notes: \*  $p < 0.01$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.1$ . (Source author's calculations)

The results shown in Table 14.4 indicate a high level of reliability of the model with fixed effects (R-Squared - 0.915). Thus, all analyzed exogenous variables can explain the change in carbon emissions by 91.5%. At the same time, the obtained values show a negative relationship between the development of environment-related technologies, environmentally related R&D expenditure, energy public RD&D budget, GDP per capita, annual investment needs for renewable energy, energy efficiency and low-emission vehicle, climate bonds, green loan and CO2 emissions. Thus, a 1% increase in environmentally related climate bonds leads to a 0.28% reduction in emissions. At the same time, a 1% increase in GDP leads to a 0.42% increase in CO2 emissions.

Similar relationships have been obtained for other indicators of sustainable development: GDP has a positive impact on renewable energy consumption, energy consumption in industry, production-based CO2 emissions, non-energy material productivity, while other factors negatively affect their volumes.

At the next stage we will evaluate the parameters of the random-effects model. The results in Table 14.5 confirm the high reliability of the regression parameters from the random effects model (R-square is 0.795).

Variables	Coefficient	Std. Error	t-Statistic	Prob
<b>DET</b>	-0.325*	0.058	-2.158	0.000
<b>RDE</b>	-0.564*	0.023	-17.365	0.000
<b>EPB</b>	-0.258**	0.031	-5.854	0.000
<b>GDP</b>	0.487*	0.105	4.658	0.000
<b>INV</b>	-0.685*	0.112	-8.245	0.000
<b>CB</b>	-0.458*	0.068	-5.205	0.000
<b>GL</b>	-0.327*	0.042	-6.542	0.000
<b>R-Squared</b>	0.795			
<b>Prob (F-statistic)</b>	0.000			

Table 14.5 Panel regression results for the random-effects model (example for CO2 emission and sustainable development indicators)

Notes: \*  $p < 0.01$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.1$ . (Source author's calculations)

The evaluation of the parameters of the regression model of random effects (Table 14.5) confirmed the negative relationship between CO2 emissions and indicators that determine the level of funding for sustainable development measures. Thus, an increase in climate bonds by 1% leads to a reduction in CO2 emissions by 0.46%, global loans – by 0.32%. In turn, an increase in GDP by 1% leads to an increase in CO2 emissions by 0.49%.

Similar to the results obtained in Table 14.5, the financial indicators of sustainable development affect other indicators of achieving sustainable development goals.

Variable	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
<b>REC</b>	0.0007	0.0006	1.1813	0.0029	0.0016	0.0030
<b>CO<sub>2</sub></b>	-0.0125	0.0199	-0.5738	0.0001	-0.0980	0.0730
<b>EC</b>	0.1497	0.0420	0.1800	0.0001	-0.3897	0.4284
<b>PBE</b>	-0.0464	0.0585	-0.7200	0.0000	-0.2981	0.2054
<b>NEM</b>	-0.7065	0.0150	-0.6075	0.0052	-0.7431	0.5079
<b>EAM</b>	0.0117	0.0170	0.6300	0.0000	0.0001	0.0001

Table 14.6 Hausman test (example for loan bonds and sustainable development indicators) (Source developed by authors)



The formalization of the relationship between environmental sustainability and financial indicators of its provision using the Hausman test (Table 14.6) shows that the model with fixed individual effects best describes the relationship between these indicators. For all analyzed dependent variables p-level is less than 10%, and the value of the coefficient of determination is quite high.

The last stage of the study is to verify the validity of the hypotheses established in the paper using weighted least square statistical method, the advantage of which is the ability to neutralize the problems of autocorrelation and heteroskedasticity of panel data series. The coefficients shown in Table 14.7 confirm the preliminary results of the relationship between the analyzed data series.

The value of the regression coefficient for the volume of bank financing and CO<sub>2</sub> emissions is 0.454 (at the level of statistical significance 1%), renewable energy consumption - 0.165, production-based CO<sub>2</sub> emissions - 0.547, non-energy material productivity - 0.702. This confirms the negative statistically significant relationship between green banking and the resulting variables. At the same time, the obtained values for GDP confirm the positive relationship between the variables: CO<sub>2</sub> emissions are 0.236 (at the level of statistical significance 1%), renewable energy consumption - 0.075, production-based CO<sub>2</sub> emissions - 0.125, non-energy material productivity - 0.321 per 1% level of statistical significance.

Variables	Coefficient	Std. Error	t-Statistic	Prob
REC	-0.165*	0.013	-11.325	0.000
CO <sub>2</sub>	-0.454*	0.017	-26.325	0.000
EC	-0.236**	0.025	-17.697	0.000
PBE	-0.547*	0.118	-9.578	0.000
NEM	-0.702*	0.036	-14.628	0.000
EAM	-0.552*	0.051	-6.985	0.000
<b>R-Squared</b>	0.895			
<b>Prob (F-statistic)</b>	0.927			
<b>Adjusted R-squared</b>	0.000			
<b>Durbin-Watson stat.</b>	0.298			
<b>Schwarz criterion</b>	0.127			
<b>Hannan-Quinn criterion</b>	0.031			
<b>Akaike info criterion</b>	-0.02			

Table 14.7 Robustness test (example for loan bonds and sustainable development indicators)  
Notes: \*  $p < 0.01$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.1$ . (Source author's calculations)

### 14.5. Discussion

The actualization of environmental problems and the low effectiveness of existing tools for environmentally sustainable development of the country necessitates the search for innovative mechanisms to stimulate these processes at the global level. Awareness of these trends forces economic entities to reorient their activities in accordance with the principles of sustainable development. Every year more and more financial institutions are involved in these processes. International banking institutions are no exception.

Today, international green banking has become an integral part of global banking policy and a fairly common tool for financing environmental activities. Systematization of scientific literature showed a significant intensification of research on these issues and allowed us to conclude that the level of achieving sustainable development goals depends on a number of exogenous and endogenous factors, including: levels of economic development (one indicator of which is GDP) (Nejat,2015; Luqman, Ahmadand Bakhsh, 2019; Shahbaz, Topcu, Sarıgül and Vo, 2021), social responsibility of the population (Sadiqet al., 2022) and business (Debnath & Roy, 2019), political stability, etc. Along with these factors, international green banking is becoming important for sustainable development.

Given the above, this study is devoted to substantiating the role of international green banking as one of the most modern ways to encourage compliance with the principles of corporate social responsibility, implementation of environmentally friendly programs, introduction of innovative resource-saving technologies in European countries and more.

According to the hypothesis of the positive impact of international green banking on environmental sustainability, the results of econometric analysis showed that international green banking has a positive impact on indicators of environmental development. Funds of international banking institutions aimed at implementing environmental programs have a positive impact on the environmental situation in the country and reduce the level of destructive impact on the environment. At the same time, GDP growth has a negative impact on the achievement of sustainable development goals, which can be explained by the destructive impact of industry on the environment. The obtained results are characterized by a high level of statistical significance and confirmed by both random-effects models and fixed-effects models. At the same time, the study concludes that the fixed-effects model more accurately describes the impact of financial performance on environmental sustainability.

Based on the use of panel unit root test (Levin, Lin & Im, Pesaran, Shin W-Stat; ADF- Fisher Chi-square; and PP-Fisher Chi-square methods), the Pearson correlation, fixed- and random-effects models, generalized method of moments (GMM), Hausman and the robustness tests proved a negative relationship between the development of environment-related technologies, environmentally related R&D expenditure, energy public RD&D budget and environmental performance indicators, while GDP growth per capita leads to increase the level of environmental pollution and the use of natural resources.

Thus, the obtained results form the basis for expanding the list of traditional mechanisms to stimulate environmentally sustainable development and more active use of international green banking to stimulate these processes. Government institutions (including global financial market players) should develop and implement appropriate policies aimed at stimulating business to implement environmental initiatives, create the conditions for financial support for measures to implement green technologies to reduce the burden on the environment. The obtained empirical results form the basis for stimulating the development of green banking in the world as an integral part of ensuring the functioning of the financial sector in accordance with the principles of sustainable development.

The main limitation of this study is the small sample of factor indicators. To date, there are no comprehensive studies on the amount of international green funding in terms of different areas of funding for programs to achieve sustainable development goals. These restrictions do not allow to generalize the nature of the impact of international green banking on sustainable development indicators for all countries and sources of funding. Therefore, further research should be aimed at expanding the list of indicators that characterize the financial conditions of environmental sustainability policy, and developing scenarios for achieving sustainable development goals in the future, depending on the sources of financial support for environmentally friendly measures.

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# Chapter 15

## Does Banking Regulation Matter for Green Investment?

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### Abstract

Large-scale destructive anthropogenic impact on the environment has led not only to exacerbation of national environmental problems, but also to the intensification of global threats. It determines the search for the most effective mechanisms for solving environmental problems such as green investment. The genesis of green investments is generalized in the paper, preconditions of their efficiency (ecological, economic, institutional, regulatory, etc.) are defined. The purpose of this work is to determine the relevance of the impact of banking regulation on green investment. It is realized a bibliometric analysis with VOSviewer based on Scopus publications on relevant topics. It revealed the contextual, geographical and temporal patterns of research on the relationship between banking regulation and green investment. In order to quantify the impact of regulatory aspects (including banking regulation) on green finance and investment, panel data regression modelis performed. The country sample covers European and Asian countries. Preliminary determination of the variable relevanceis made on the basis of correlation analysis. The specification of the regression model (fixed or random effects) is determined using the Hausman test. The obtained empirical results can be useful for both scientists and practitioners and government officials to improve the regulatory policy of the state based on environmental friendliness and sustainability.

**Keywords:** green economy, green investment, banking regulation, sustainability



### 15.1. Introduction

The intensification of industrial and technological development in the late XX – early XXI centuries led not only to a number of positive economic consequences, but also to the aggravation of a set of environmental problems. Thus, the destructive anthropogenic impact on the environment goes far beyond the threats to the national security of a particular state, and is rapidly becoming global scale. These environmental threats are associated with rapid depletion of natural resources, soil degradation, drinking water shortages, air pollution, food security damage, etc. Therefore, the concept of the "green economy" plays an important role today as the driving force behind the transition to a new model of growth and development. The "green economy" is the basis for the implementation of the concept of sustainable development based on more efficient resource and energy consumption, reduction of CO<sub>2</sub> emissions, reduction of harmful effects on the environment and development of a socially integrated society.

In turn, the concept of green economic development is based on green finance, which links economic growth, environmental action and financial institutions. Developing countries expect expansion of green investment volumes from being included in greening processes, while increasing resource efficiency, creating new jobs and increasing opportunities for access to new markets. The effectiveness of the return on green investment depends on a number of prerequisites. Thus, an important prerequisite is the creation of appropriate regulatory support for these processes, formalization of incentives for businesses that are actively involved in green initiatives (including green investments), as well as punishment of those enterprises that engage in environmentally harmful activities. It is also worth noting that over the last decades, researchers have paid more and more attention to the study of fundamental principles, patterns and architecture of the green economy, green finance and green investment, while much less attention has been paid to identifying regulatory determinants of their effectiveness. This statement is especially relevant in terms of identification of the linkage of the above-mentioned processes with banking and financial regulation. Due to this fact this research aimed at empirical analysis of the impact of regulatory aspects (including banking regulation) on green investment and the transition from "grey" to "green" economy become very crucial.

## 15.2. Literature Review

In the context of determining the impact of regulatory burden (including banking regulation) on the development of green investment, a bibliometric analysis was performed using VOSviewer v.1.6.17 (Vosviewer, 2022). The basis for this study were Scopus publications (Scopus, 2022), which contain such key words as "green investment" and "regulation". In total, the analysis covered 229 publications from 1993- 2022 (Figure 15.1).

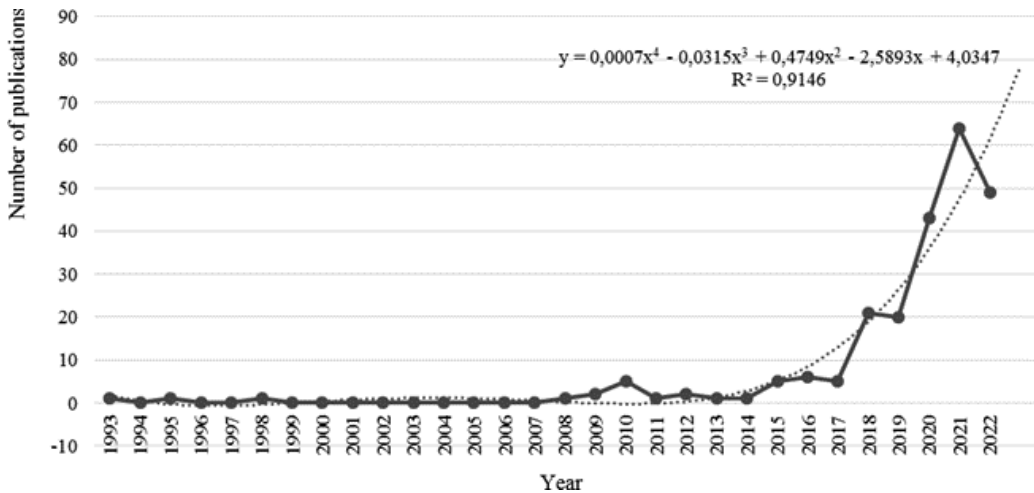


Fig. 15.1 Number of Scopus publications on "green investment" and "regulation" issues in 1993-2022, units (Source Scopus, 2022)

Considering data from the Figure 15.1, it might be noted that research field on regulation of green investment have been appeared not so far – the first paper was published in 1993. It is also remarkable that in this field there were no intensive publication activity during 1993-2014, while from 2015 the amount of articles began to increase considerably. That might be connected with the adoption of Sustainable Development Goals by the United Nations member states (United Nations, 2022). New targets of the worldwide sustainable development paradigm to 2030 lead to the boost of scientific interest to green investment as a viable instrument of solving environmental problems. It is also should be noted that on May 01, 2022, there were 49 relevant Scopus publication, but forecasted with polynomial trend number of publications till the end of 2022 might reach almost 80 papers. Therefore, it should be concluded that researches on regulation of green investment become urgent and popular.

It also can be seen from Figure 15.1 that the first publication in this research field was published in 1993 (Cormier, Magnan, and Morard, 1993). The article is aimed at an empirical study of the impact of the company environmental performance on its market value. Researchers found that the company's environmental profile does not have a significant impact on the attractiveness of the company's corporate rights for the most of investors, but is an additional relevant decision-making factor for responsible investors (green investment). The authors also support the idea of appropriateness of non-financial reporting implementation for all market participants. Thus, this publication clearly illustrates the relevance of green investment almost 30 years ago. The latest publication on this topic (Z. Wang, N. Wang, Hu, and H. Wang, 2022) is devoted to the study of the impact of environmental regulation on the dynamics of green investment by heavily polluting enterprises. In particular, the authors conducted research on the example of Chinese enterprises. The results of empirical analysis revealed that formal environmental regulatory instruments have a U-shape dependency with the volume of green investment, while the impact of informal environmental regulation on the volume of green investment is positive.

In terms of clarification the genesis of green investments it is interesting to analyse key findings revealed by authors of the TOP-10 most cited Scopus publications on relevant topic presented in Table 15.1.

No	Document title	Authors	Year	Source	Number of citation
1	Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy	Campiglio, E.	2016	Ecological Economics 121, pp. 220-230	186
2	Public appeal, environmental regulation and green investment: Evidence from China	Liao, X., Shi, X.R.	2018	Energy Policy 119, pp. 554-562	137
3	The impact of corporate pollution on market valuation: some empirical evidence	Cormier, D., Magnan, M., Morard, B.	1993	Ecological Economics 8(2), pp. 135-155	95

4	Does green investment, financial development and natural resources rent limit carbon emissions? A provincial panel analysis of China	Shen, Y., Su, Z.-W., Malik, M.Y., (...), Khan, Z., Khan, M.	2021	Science of the Total Environment 755,142538	90
5	Determinants of Carbon Emission in China: How Good is Green Investment?	Li, Z.-Z., Li, R.Y.M., Malik, M.Y., (...), Khan, Z., Umar, M.	2021	Sustainable Production and Consumption 27, pp. 392-401	86
6	Pricing decisions for substitutable products with green manufacturing in a competitive supply chain	Ma, P., Zhang, C., Hong, X., Xu, H.	2018	Journal of Cleaner Production 183, pp. 618-640	70
7	Evolutionary game of the green investment in a two-echelon supply chain under a government subsidy mechanism	Sun, H., Wan, Y., Zhang, L., Zhou, Z.	2019	Journal of Cleaner Production 235, pp. 1315-1326	69
8	Assessment of green investments' impact on sustainable development: Linking gross domestic product per capita, greenhouse gas emissions and renewable energy	Lyeonov, S., Pimonenko, T., Bilan, Y., Štreimikiene, D., Mentel, G.	2019	Energies 12(20), 3891	69
9	Fostering green investments and tackling climate-related financial risks: Which role for macroprudential policies?	D'Orazio, P. et al.	2019	Ecological Economics 160, pp. 25-37	61
10	Green credit financing versus trade credit financing in a supply chain with carbon emission limits	An, S., Li, B., Song, D., Chen, X.	2021	European Journal of Operational Research 292(1), pp. 125-142	56

**Table 15.1** TOP-10 the most cited Scopus publications (Scopus, 2022) on “green investment” and “regulation” issues (Source compiled by the author based on data Scopus, 2022)

The most cited publication (Campiglio, 2016) was cited 186 times. It is dedicated to the research of the role of banking and monetary regulation in terms of implementing low-carbon economy basics. The author found out that differentiation of reserve requirements might help to increase volume of low-carbon investment, especially in developing countries.

The second most cited article (Liao and Shi, 2018) was mentioned in other Scopus publications 137 times. This research is aimed at modelling influence of some regulatory instruments on green investment. It considered data for 30 Chinese provinces for 1998-2014. Empirical results showed that public pressure led to the increase of green investment in China. Moreover, authors found out that the volume of green investment is positively affected by GDP dynamics, population and industrial proportions. In turn, trade openness, foreign direct investment and energy mix have negative impact on it.

One of the most cited publications (Shen et al., 2021) is dedicated to the research of the influence of green investment and other financial instruments on CO<sub>2</sub> emission. This research also is based on data for 30 Chinese provinces for 1995-2017. In order to point out both operational and strategic perspectives of linkage between above-mentioned variables, authors used cross-sectional augmented autoregressive distributed lags approach. Authors concluded that an increase of green investment might result to decrease of carbon emission in Chinese provinces. They also mentioned that environmental taxes might also have positive influence on the dynamics of environment pollution. Li et al. (2021) also researched Chinese experience in terms of green investment efficiency in carbon-lowering issues and went to familiar conclusions.

Authors of another the most cited paper (Ma, Zhang, Hong, and Xu, 2018) used game theory to point out “optimal pricing strategies of substitutable products”. They found out that green investment has positive impact on green manufacturer performance. Research (Sun, Wan, Zhang, and Zhou, 2019) aimed at enrichment of the above-mentioned publication research results. Specifically, they used evolutionary game theory model in order to clarify cooperation between suppliers and manufacturers, which use government subsidy mechanism to promote their “green” performance. Using simulation model authors identified that green investment triggers evolutionary development of the market with those suppliers and manufacturers.

Paper (Lyeonov, Pimonenko, Bilan, Štreimikiene, and Mentel, 2019) was also cited 69 times as previous publication and dedicated to the research of

the interconnectedness between green investment and sustainable development. Authors revealed that green investment have positive impact on GDP per capita (+6.4%), renewable-to-total-energy consumption ratio (+5.6%), and negative impact on the carbon emission (-3.08%). Therefore, that might be concluded that green investment triggers sustainable development.

Authors (D'Orazio et al., 2019) realized research that is more specific and focused their attention on clarifying the role of banking and financial regulatory instruments in promoting transformational movement to low-carbon economy. Scientists analysed and systematized “green” macroprudential instruments used by the central banks and other financial authorities in 56 OECD and non-OECD member countries. Authors developed Green Macroprudential Index in order to identify the most successful countries in terms of green banking and financial regulation. They also developed Green Prudential Instrument Index, which consists of such instruments as “differentiated reserve requirements, lending limits and green financial principles, disclosure requirements, green financial principles, disclosure requirements and lending limits and liquidity instruments, disclosure requirements and risk assessment, disclosure requirements and stress test, lending limits and stress test, green financial principles and stress test”.

Consequently, authors created a background empirical base for more in-depth analysis in terms of evaluation of the green regulatory instruments role in promoting sustainable development.

At the bottom of the TOP-10 the most cited Scopus publications (Scopus, 2022) on “green investment” and “regulation” issues, there is an article (An, Li, Song, and Chen, 2021) that is dedicated to the identification of the role of green credit financing in the supply chain.

Thus, summarizing the work of flagship scientists in a particular research field, it can be noted that green investment plays an important role in ensuring sustainable development through the transition to the low-carbon economy. It should also be noted that certain evolutionary patterns in the context of determining the role of green investment can be highlighted:

- germinal stage (1993–2008) – green investments are studied partially and mainly at the micro level, their role in the structural ecologically oriented transformation of the national economy is underestimated;
- moderate development stage (2009–2017) – increasing scientific attention to green investment, studying their role in supply chains, identifying industry specifics;

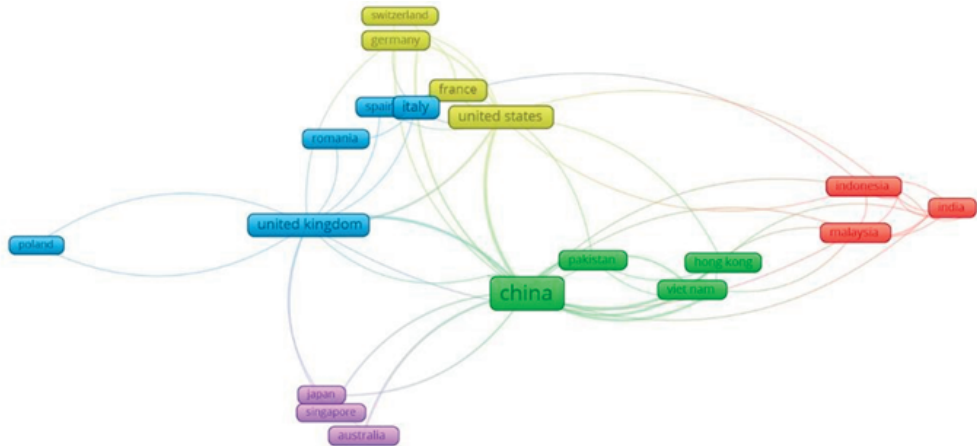






Overlay visualization results support trend presented at Figure 15.1, and allow concluding that most of relevant papers were published in 2017-2022. According to Figure 15.3, in the focus of scientific interest in 2021-2022 are green investment efficiency, green credit, green innovation, capital constraints, etc.

In turn, Figure 15.4 presents network visualisation of country co-occurrence in terms of Scopus publication on relevant topic.



**Fig 15.4** Network visualisation of country co-occurrence in terms of Scopus publications on “green investment” and “regulation” issues (Source: compiled by the author based on data Scopus, 2022; Vosviewer, 2022)

Considering data from Figure 4, it can be noted that there are five geographical clusters of scientific research on “green investment” and “regulation” issues. China is a country with the most amount of papers in this research field. There are also big number of researches realized by scientists from the United States of America and the United Kingdom.

As a conclusion of the literature review block of the paper, it can be noted that there are lack of publications aimed at identification of a certain empirical linkages between green investment and financial or banking regulation. Most of articles are focused on the identification of indirect impact of regulatory instruments on green economy, green finance and green investment. In addition, numerous publications also dedicated to the

clarification of the green investment impact on promotion of sustainable development goals and targets. It is also might be highlighted that most of the existed publication (especially, those that are dedicated to the impact of regulatory burden on green investment) are based not on the specific statistical data but on the questionnaires of different targeted groups of stakeholders. Such peculiarity of papers in this research field does not allow clarifying a comprehensive framework of regulatory impact on green investment.

### 15.3. Data and Methodology

Therefore, the purpose of this paper is to determine the relevance of the impact of banking regulation on green investment using econometric methods of revealing linkages between indicators based on the relevant statistical data. In order to identify channels of banking (or related to it) regulation influence on green investment it is proposed panel data regression model. This research is based on official statistical data collected for six Eastern Partnership countries (Azerbaijan, Armenia, Belarus, Georgia, Moldova, and Ukraine) and four European Union Member states (Estonia, Latvia, Lithuania, and Poland). The choice of such a geographical coverage is due to the common historical patterns of socio-economic development. Period of the analysis – 2000-2020 (or latest available data). Technically the empirical research is realized in Stata 12/SE software.

In order to realize the aim of the paper, it was chosen such dependent variables as direct or indirect proxies of green investment efficiency:

- Carbon Productivity (CP);
- Comparative advantage in environmental goods (CA<sub>d</sub>);
- Environmental goods export to import ratio (ExIm);
- Expenditure on environment protection, % of GDP (ExpEnv).

It was also chosen such explanatory variables as proxies of regulatory banking influence (including banking regulation and related):

- Control of Corruption: Estimate (CC);
- Government Effectiveness: Estimate (GE);
- Political Stability and Absence of Violence/Terrorism: Estimate (PS);
- Regulatory Quality: Estimate (RQ);
- Rule of Law: Estimate (RL);
- Voice and Accountability: Estimate (VA);
- Financial Development Index (FDIndex);
- Financial Freedom Score (FinFre);
- Monetary Freedom Score (MonFre).

It was also chosen some control variables aimed at improvement of the modelling results quality:

- Foreign direct investment, net (BoP, current US\$) (FDI);
- General government final consumption expenditure (current US\$) (GCFCE);
- Gross capital formation (current US\$) (GCF);
- Inflation, GDP deflator (annual %) (Infl);
- Research and development expenditure (% of GDP) (RD);
- Trade (% of GDP) (Trade).

Detailed characteristics of all variables are presented in table 15.2.

Indicator	Characteristic	Source
DEPENDENT VARIABLES		
Carbon Productivity	Ratio between GDP (current US\$) and CO2 emissions (kt). It characterizes contribution of 1 kiloton of carbon emissions to the country's GDP formation. Higher value of the indicators demonstrates better carbon productivity.	World Development Indicators (World Bank DataBank, 2022)
Environmental goods export to import ratio	Ratio between export and import of environmental goods. Environmental goods are goods that help to improve environmental performance, optimize resource consumption, decrease pollution, and also those goods that are considered as more environmentally friendly in comparison to substitutes.	Country Climate and Development Report (World Bank DataBank, 2022)
Comparative advantage in environmental goods	“Comparative advantage is a measure of the relative advantage or disadvantage a particular country has in environmental goods, and can be used to evaluate export potential in that class of goods”.	Country Climate and Development Report (World Bank DataBank, 2022)

Expenditure on environment protection, % of GDP	“Government expenditures on a specified set of activities including pollution abatement, protection of biodiversity landscape, waste and wastewater management, within the framework of the Classification of Functions of Government”.	International Monetary Fund, 2022
<b>INDEPENDENT VARIABLES</b>		
Control of Corruption	Estimated indicator characterizes “perceptions of the extent to which public power is exercised for private gain”. It varies from -2.5 to 2.5. Higher value of estimation characterizes better performance in corruption violation	Worldwide Governance Indicators (World Bank DataBank, 2022)
Government Effectiveness	Estimated indicator characterizes ability of government to create effective and independent government policy, and realize it in the most appropriate way. It varies from -2.5 to 2.5. Higher value of estimation characterizes better government effectiveness	Worldwide Governance Indicators (World Bank DataBank, 2022)
Political Stability and Absence of Violence/Terrorism	Estimated indicator characterizes perception of the state of political stability in the country, counteraction to violence because of political reasons and terrorism. It varies from -2.5 to 2.5. Higher value of estimation characterizes better political stability	Worldwide Governance Indicators (World Bank DataBank, 2022)
Regulatory Quality	Estimated indicator characterizes ability of government authority to effectively realize policy on promotion of private sector development. It varies from -2.5 to 2.5. Higher value of estimation characterizes better regulatory quality	Worldwide Governance Indicators (World Bank DataBank, 2022)

Rule of Law	Estimated indicator characterizes confidence and fulfillment of society rules and legal requirements. It varies from -2.5 to 2.5. Higher value of estimation characterizes better rule of law	Worldwide Governance Indicators (World Bank DataBank, 2022)
Voice and Accountability	Estimated indicator characterizes ability of country citizens to participate in government election, be involved in decision-making process, and express their opinion freely. It varies from - 2.5 to 2.5. Higher value of estimation characterizes better voice and accountability	Worldwide Governance Indicators (World Bank DataBank, 2022)
Financial Development Index	Estimated indicator consists of nine sub-indices and characterizes development of financial institutions, financial market, and financial policy efficiency.	International Monetary Fund, 2022
Financial Freedom Score	Estimated indicator characterizes “banking efficiency as well as a measure of independence from government control and interference in the financial sector”.	Heritage Foundation, 2022
Monetary Freedom Score	Estimated indicator characterizes ability of government authorities to maintain price stability and counteract inflation.	Heritage Foundation, 2022

**Table 15.2** *Characteristics of model variables (Source compiled by the author)*

It should be noted that there is a lack of public macro data on the value of green investment. Therefore, in order to assess it qualitatively it was chosen such dependent indicators as Carbon Productivity, Comparative advantage in environmental goods and Environmental goods export to import ratio, which characterize results of green investment. In turn, Expenditure on environment protection allow us to understand to which extend government and public authorities are involved in financing of crucial operational and strategical environmental projects.

It is also necessary to highlight that to the list of explanatory variables it were chosen both indicators of the quality of general regulatory framework

and also specific indicators that characterizes efficiency of central bank activity (monetary freedom), banking regulation efficiency (financial freedom) and financial intermediaries (including banks) capacity (financial development index).

It is also included to the models a set of control variables, which characterize general of macroeconomic conditions in the country (Inflation, GDP deflator; Research and development expenditure; Trade) and general preconditions for expansion of investment activity (Foreign direct investment, net; General government final consumption expenditure; Gross capital formation). These control variables are regularly used in economic growth models (Barro, 1991; Barro, 2000; Cigu, Petrișor, Nuță, Nuță, and Bostan, 2020; Islam, 1995).

General descriptive statistics of the whole variables set is presented in Table 15.3. This information allows to clarify amount of observations in total, mean, minimum and maximum values of each indicator, and also standard deviation.

Variable	Observations	Mean value	Standard Deviation	Minimum value	Maximum value
CP	190	1500000	1090000	109000	4640000
CAd	198	0.62	0.354	0.005	1.87
ExIm	198	0.963	1.013	0.003	8.943
ExpEnv	179	0.407	0.281	-0.258	1.339
FDI	210	-1.85e+09	3.18e+09	-1.74e+10	5.03e+09
GGFCE	210	1.30e+10	2.41e+10	1.89e+08	1.15e+11
GCF	210	1.62e+10	2.71e+10	3.09e+08	1.32e+11
Infl	210	9.012	16.683	-18.845	185.291
RD	180	0.607	0.369	0.079	2.285
Trade	210	104.555	26.526	54.542	170.76
CC	200	-0.127	0.737	-1.301	1.613

GE	200	0.065	0.703	-1.13	1.343
PS	200	0.025	0.68	-2.021	1.072
RQ	200	0.287	0.832	-1.701	1.698
RL	200	-0.029	0.767	-1.336	1.382
VA	200	0.003	0.913	-1.767	1.214
FDIndex	180	0.23	0.092	0.065	0.477
FinFre	210	55.381	20.754	10	90
MonFre	210	73.095	13.151	0	91.1

**Table 15.3** Descriptive Statistics (Source compiled by the author)

Note: CP – Carbon Productivity; Cad – Comparative advantage in environmental goods; ExIm – Environmental goods export to import ratio; ExpEnv – Expenditure on environment protection; FDI – Foreign direct investment, net; GGFCE – General government final consumption expenditure; GCF – gross capital formation; Infl – Inflation, GDP deflator; RD – Research and development expenditure; Trade – trade openness; CC – Control of Corruption; GE – Government Effectiveness; PS – Political Stability and Absence of Violence/Terrorism; RQ – Regulatory Quality; RL – Rule of Law; VA – Voice and Accountability; FDIndex – Financial Development Index; FinFre – Financial Freedom Score; MonFre – Monetary Freedom Score.

### 15.4. Results and Discussion

In this section of the paper, it is presented panel data regression results and its discussion. First of all it should be noted that this section consists of several stages namely:

- 1) realization of correlation analysis (pairwise correlation) in order to identify the most fitted explanatory and control variables to describe variation of each of the dependent variables (Table 15.4);
- 2) running of Hausman test in order to identify panel data regression model specification (models with fixed or random effects);
- 3) running of panel data regression analysis for each explanatory variables with consideration of model specification (Tables 15.5-15.8), characteristics of modelling results.

Considering results of pairwise correlation analysis, it should be noted that there is necessity to eliminate some explanatory variables in order to

increase general quality of the regression model and its predicative reliability. Those variables that are shadowed grey are needed to be eliminated because of low significance of its correlation with dependent variable. Model 1 (dependent variable – carbon productivity) and Model 3 (dependent variable – environmental goods export to import ratio), while Model 2 (dependent variable – comparative advantage in environmental goods) and Model 4 (dependent variable – expenditure on environment protection) will include almost all preliminary chosen explanatory variables.

Variable	CP (model 1)	CAd (model 2)	ExIm (model 3)	ExpEnv (model 4)
FDI	0.1083 (0.1369)	-0.3825 (0.0000)	0.0489 (0.4863)	-0.1629 (0.0293)
GGFCE	-0.0215 (0.7683)	0.4148 (0.0000)	-0.0800 (0.2624)	0.1993 (0.0075)
GCF	-0.0148 (0.8392)	0.3932 (0.0000)	-0.0950 (0.1829)	0.1830 (0.0142)
Infl	-0.2737 (0.0001)	-0.0223 (0.7547)	-0.0478 (0.5038)	-0.1962 (0.0085)
R&D	0.0529 (0.4804)	0.4272 (0.0000)	0.0160 (0.8317)	0.3795 (0.0000)
Trade	0.1105 (0.1291)	0.1976 (0.0053)	-0.0395 (0.5801)	0.3036 (0.0000)
CC	0.4191 (0.0000)	0.5352 (0.0000)	0.1884 (0.0096)	0.6578 (0.0000)
GE	0.5964 (0.0000)	0.4305 (0.0000)	0.1417 (0.0524)	0.6469 (0.0000)
PS	0.3478 (0.0000)	0.3567 (0.0000)	-0.1464 (0.0450)	0.5474 (0.0000)
RQ	0.5543 (0.0000)	0.3790 (0.0000)	0.1251 (0.0870)	0.6295 (0.0000)



RL	0.5514 (0.0000)	0.4414 (0.0000)	0.0719 (0.3268)	0.6714 (0.0000)
VA	0.3900 (0.0000)	0.5607 (0.0000)	0.1919 (0.0083)	0.6178 (0.0000)
FDIndex	0.2649 (0.0005)	0.4306 (0.0000)	-0.1164 (0.1019)	0.5361 (0.0000)
FinFre	0.3949 (0.0000)	0.1989 (0.0050)	0.0496 (0.4876)	0.5731 (0.0000)
MonFre	0.3721 (0.0000)	0.1184 (0.0967)	0.0496 (0.5117)	0.3475 (0.0000)

**Table 15.4** Pairwise correlation results (Source compiled by the author)

*Note:* CP – Carbon Productivity; CA<sub>d</sub> – Comparative advantage in environmental goods; ExIm – Environmental goods export to import ratio; ExpEnv – Expenditure on environment protection; FDI – Foreign direct investment, net; GGFCE – General government final consumption expenditure; GCF – gross capital formation; Infl – Inflation, GDP deflator; RD – Research and development expenditure; Trade – trade openness; CC – Control of Corruption; GE – Government Effectiveness; PS – Political Stability and Absence of Violence/Terrorism; RQ – Regulatory Quality; RL – Rule of Law; VA – Voice and Accountability; FDIndex – Financial Development Index; FinFre – Financial Freedom Score; MonFre – Monetary Freedom Score; in brackets it is mentioned p-value of the pairwise correlation: [0.00; 0.01] – significance at 1% level; [0.01; 0.05] – significance at 5% level; [0.05; 0.1] – significance at 10% level.

The next stage of this paper section is in identification of panel data regression model specification (models with fixed or random effects). Using “hausman” command in Stata 12/SE allow identifying that in Model 1 (dependent variable – carbon productivity) and Model 3 (dependent variable – environmental goods export to import ratio) it is better to use random effects panel regression, while in Model 2 (dependent variable – comparative advantage in environmental goods) and Model 4 (dependent variable – expenditure on environment protection) it is better to use fixed effects panel regression.

The last stage of the paper is running of the panel regression models and characteristics of their results presented in Tables 15.5-15.8. Considering modelling results from Table 15.5, it can be concluded that:

- predictive quality of the Model 1 is sufficient ( $R^2=0.564$ ), specifically all selected independent and control variables explain 56.4% of carbon productivity variation;
- such independent variables as inflation, political stability, regulatory quality and monetary freedom have no statistically significant impact on carbon productivity;
- government effectiveness and rule of law are considered as drivers of carbon productivity increase, while improvement of control of corruption, voice and accountability, financial development and financial freedom might result to decrease of carbon productivity.

CP	Coefficient	Standard Error	t-value	p-value	95% Confidence Interval		Sig
Infl	-1566.388	4232.361	-0.37	0.711	-9861.664	6728.887	
CC	-1390000.000	241000.000	-5.75	0.000	-1860000.000	-915000.000	***
GE	2010000.000	389000.000	5.16	0.000	1250000.000	2770000.000	***
PS	170000.000	143000.000	1.19	0.233	-110000.000	450000.000	
RQ	-53000.000	419000.000	-0.13	0.899	-874000.000	768000.000	
RL	1240000.000	467000.000	2.65	0.008	322000.000	2150000.000	***
VA	-516000.000	174000.000	-2.96	0.003	-857000.000	-174000.000	***
FDIndex	-2000000.000	1030000.000	-1.94	0.053	-4030000.000	23766.541	*
FinFre	-17300.000	6117.406	-2.82	0.005	-29300.000	-5285.649	***
MonFre	1257.503	7378.455	0.17	0.865	-13200.000	15719.008	
Constant	2640000.000	632000.000	4.18	0.000	1400000.000	3880000.000	***
Overall r-squared	0.564						

**Table 15.5** Regression results (model 1) (Source compiled by the author)

Note: CP – Carbon Productivity; Cad – Comparative advantage in environmental goods; ExIm – Environmental goods export to import ratio; ExpEnv – Expenditure on environment protection; FDI – Foreign direct investment, net; GGFCE – General government final consumption expenditure; GCF – gross capital formation; Infl – Inflation, GDP deflator; RD – Research and development expenditure; Trade – trade openness; CC – Control of Corruption; GE – Government Effectiveness; PS – Political Stability and Absence of Violence/Terrorism; RQ – Regulatory Quality; RL – Rule of Law; VA – Voice and Accountability; FDIndex– Financial Development Index; FinFre – Financial Freedom Score; MonFre – Monetary Freedom Score; Sig – significance: \*\*\* – significance at 1% level; \*\* – significance at 5% level; \* – significance at 10% level.

CAAd	Coefficient	Standard Error	t-value	p-value	95% Confidence Interval		Sig
FDI	0.000	0.000	2.12	0.036	0.000	0.000	**
GGFCE	0.000	0.000	-2.39	0.018	0.000	0.000	**
GCF	0.000	0.000	2.79	0.006	0.000	0.000	***
RD	0.217	0.088	2.46	0.015	0.043	0.392	**
Trade	0.003	0.001	2.66	0.009	0.001	0.006	***
CC	-0.242	0.122	-1.99	0.049	-0.483	-0.001	**
GE	0.042	0.124	0.34	0.736	-0.203	0.287	
PS	0.098	0.049	1.99	0.049	0.001	0.195	**
RQ	-0.023	0.126	-0.18	0.857	-0.273	0.227	
RL	0.240	0.177	1.36	0.178	-0.110	0.591	
VA	-0.146	0.111	-1.31	0.191	-0.366	0.074	
FDIndex	-1.115	0.618	-1.80	0.073	-2.338	0.107	*
FinFre	0.002	0.002	1.21	0.227	-0.001	0.006	
MonFre	0.001	0.002	0.58	0.565	-0.003	0.005	
Constant	0.207	0.248	0.83	0.405	-0.284	0.699	
R-squared	0.523						

**Table 15.6** Regression results(model 2) (Source compiled by the author)

Note: CP – Carbon Productivity; CAAd – Comparative advantage in environmental goods; ExIm – Environmental goods export to import ratio; ExpEnv – Expenditure on environment protection; FDI – Foreign direct investment, net; GGFCE – General government final consumption expenditure; GCF – gross capital formation; Infl – Inflation, GDP deflator; RD – Research and development expenditure; Trade – trade openness; CC – Control of Corruption; GE – Government Effectiveness; PS – Political Stability and Absence of Violence/Terrorism; RQ – Regulatory Quality; RL – Rule of Law; VA – Voice and Accountability; FDIndex– Financial Development Index; FinFre – Financial Freedom Score; MonFre – Monetary Freedom Score; Sig – significance: \*\*\* – significance at 1% level; \*\* – significance at 5% level; \* – significance at 10% level.

Considering modelling results from Table 15.6, it can be noted that:

- predictive quality of the Model 2 is a little bit lower ( $R^2=0.523$ ), all selected independent and control variables explain 52.3% of comparative advantage in environmental goods;
- all control variables have positive influence on comparative advantage in environmental goods; due to this fact it can be concluded that general macroeconomic conditions and determinants of investment attractiveness are crucial for ensuring additional competitive advantages;
- government effectiveness, regulatory quality, rule of law, voice and accountability, financial and monetary freedom have no statistically significant impact on comparative advantage in environmental goods; consequently this lead us to assumption that regulatory framework does not play significant role in promoting comparative advantage;

- increase of anti-corruption efficiency and financial development index lead to worsening of comparative advantage in environmental goods;
- political stability has significant (at 5% level) positive impact on comparative advantage in environmental goods – an increase of estimated value of political stability in 1 point might result in strengthening of comparative advantage in environmental goods in 0.098 units.

ExIm	Coefficient	Standard Error	t-value	p-value	95% Confidence Interval		Sig
CC	-0.581	0.292	-1.99	0.046	-1.154	-0.009	**
GE	0.139	0.309	0.45	0.654	-0.468	0.745	
PS	0.162	0.130	1.25	0.213	-0.093	0.417	
RQ	-0.283	0.329	-0.86	0.389	-0.927	0.361	
VA	0.083	0.242	0.34	0.732	-0.392	0.558	
FDIndex	-1.350	1.277	-1.06	0.291	-3.853	1.154	
Constant	1.335	0.410	3.26	0.001	0.532	2.138	***
Overall r-squared	0.024						

**Table 15.7** Regression results (model 3) (Source compiled by the author)

Note: CP – Carbon Productivity; Cad – Comparative advantage in environmental goods; ExIm – Environmental goods export to import ratio; ExpEnv – Expenditure on environment protection; FDI – Foreign direct investment, net; GGFCE – General government final consumption expenditure; GCF – gross capital formation; Infl – Inflation, GDP deflator; RD – Research and development expenditure; Trade – trade openness; CC – Control of Corruption; GE – Government Effectiveness; PS – Political Stability and Absence of Violence/Terrorism; RQ – Regulatory Quality; RL – Rule of Law; VA – Voice and Accountability; FDIndex– Financial Development Index; FinFre – Financial Freedom Score; MonFre – Monetary Freedom Score; Sig – significance: \*\*\* – significance at 1% level; \*\* – significance at 5% level; \* – significance at 10% level.

Considering results from Table 15.7, it might be summarized that general predictable potential of the model 3 is quite low – independent variables explain only 2.4% of environmental goods export to import ratio. Therefore, it can be concluded that regulatory measures (including banking and financial regulation) do not influence significantly on environmental goods trade balance. Nevertheless, the only variable with sufficient level of significance on the linkage with environmental goods export to import ratio is control of corruption.

In terms of the regression results analysis on the influence of regulatory measures (including banking and financial regulation) on environmental expenditures (Table 8) it can be noted as follows:

- predictive quality of the Model 4 is a little bit lower ( $R^2=0.540$ ), all selected independent and control variables explain 54% of environmental expenditures;
- expansion of research and development expenditures negatively affected expenditures on environmental protection: an increase of the independent variable in 1% results in decrease of expenditures on environmental protection in 0.34%; that might be explained by substitution effect;
- contrary an increase of trade openness in 1% will result in an increase of expenditures on environmental protection in 0.004%;
- notable that in increase of rule of law in a point might result in 0.42% increase of expenditures on environmental protection;
- it is also quite valuable findings that financial and banking regulatory efficiency stimulate expansion of financing environmental protection issues: an increase of Financial Development Index and Financial Freedom Score in a point might result in 2.23% and 0.008% increase of expenditures on environmental protection respectively.

ExpEnv	Coefficient	Standard Error	t-value	p-value	95% Confidence Interval		Sig
FDI	0.000	0.000	0.01	0.994	0.000	0.000	
GGFCE	0.000	0.000	0.15	0.885	0.000	0.000	
GCF	0.000	0.000	-0.69	0.495	0.000	0.000	
Infl	-0.001	0.002	-0.59	0.554	-0.005	0.003	
RD	-0.340	0.097	-3.49	0.001	-0.533	-0.147	***
Trade	0.004	0.001	2.58	0.011	0.001	0.006	**
CC	-0.182	0.132	-1.38	0.170	-0.444	0.079	
GE	-0.237	0.146	-1.63	0.107	-0.527	0.052	
PS	0.038	0.055	0.70	0.487	-0.070	0.146	
RQ	-0.067	0.146	-0.46	0.645	-0.356	0.221	
RL	0.423	0.193	2.19	0.030	0.041	0.804	**
FDIndex	2.225	0.673	3.31	0.001	0.893	3.558	***
FinFre	0.008	0.002	3.66	0.000	0.004	0.012	***
MonFre	-0.002	0.002	-1.01	0.316	-0.007	0.002	
Constant	-0.491	0.270	-1.82	0.072	-1.025	0.044	*
R-squared	0.540						

**Table 15.8** Regression results (model 4) (Source compiled by the author)

Note: CP – Carbon Productivity; Cad – Comparative advantage in environmental goods; ExIm – Environmental goods export to import ratio; ExpEnv – Expenditure on environment protection; FDI – Foreign direct investment, net; GGFCE – General government final consumption expenditure; GCF – gross capital formation; Infl – Inflation, GDP deflator; RD – Research and development expenditure; Trade – trade openness; CC – Control of Corruption; GE – Government Effectiveness; PS – Political Stability and Absence

*of Violence/Terrorism; RQ – Regulatory Quality; RL – Rule of Law; VA – Voice and Accountability; FDIndex– Financial Development Index; FinFre – Financial Freedom Score; MonFre – Monetary Freedom Score; Sig – significance: \*\*\* – significance at 1% level; \*\* – significance at 5% level; \* – significance at 10% level.*

According to the results of the panel data regression analysis for 10 European and Asian countries, it can be summarized that in most of models regulatory measures (including financial and banking regulation) have no significant linkage with the majority indicators of environmental performance. Nonetheless, it is also empirically proved that government green investment (expenditures on environment protection) highly dependent on financial market development (including development of the network of financial intermediaries – banks, investment funds, insurance companies, etc.) and financial freedom (proxy of efficiency of banking regulation).

### 15.5. Conclusions

Based on the results of theoretical and empirical analysis it can be concluded that green economy, green finance and specifically green investment became in focus of scientific interest several decades ago and is triggered by worsening of global environmental problems. Considering analysis of 229 Scopus publications from 1993-2022 on “green investment” and “regulation” it was identified three stages of scientific interest to this research field: germinal stage (1993–2008) – partial study of green investment, lack of comprehensiveness and scale of such researches, focus on micro-level perspective; moderate development stage (2009–2017) – increasing scientific attention to green investment, studying their role in supply chains, identifying industry specifics; dynamic development stage (2018–present) – boost of research interest to green investment and its role for national and global environment security, multidimensional and cross-sectoral studies.

Bibliometric analysis of 229 Scopus publications from 1993-2022 on “green investment” and “regulation” using VOSviewer tool allow identifying:

1) contextual clusters of scientific research in the field (environmental – focused on green investment role in carbon emission reduction and ensuring national energy security; financial – consists of papers on identification of financial and commercial preconditions of green investments, cap-and-trade initiative; technological – includes publications aimed at clarification of green investment role in company

technological transformation, supply chains, manufacturing process and clients loyalty; institutional – combine papers focused on underlining market and competition drivers and inhibitors of green investment; stakeholder – clarify economic, environmental and innovative benefits of green investment; specifically investment – covers publications focused on investment efficiency of green investment);

2) temporal patterns (most of papers are published in 2017-2022, recent priority topics – green investment efficiency, green credit, green innovation, capital constraints);

3) geographical clusters of scientists residence (5 clusters, China is a country with the most amount of papers in this research field).

Empirical block of the research allow concluded that:

1) government effectiveness and rule of law are considered as drivers of carbon productivity increase, while improvement of control of corruption, voice and accountability, financial development and financial freedom might result to decrease of carbon productivity;

2) control of corruption and financial development index are considered as inhibitors of comparative advantage in environmental goods, while political stability has significant positive impact on it;

3) regulatory measures (including banking and financial regulation) do not influence significantly on environmental goods trade balance;

4) research and development expenditures inhibits government green investment (expenditures on environmental protection) because of substitution effect, while rule of law, financial intermediary development and effective banking regulation help to boost it.

The obtained empirical results can be useful for both scientists and practitioners and government officials to improve the regulatory policy of the state based on environmental friendliness and sustainability.

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# Part III

## Green Investment





# Chapter 16

## Green Investing and Its Benefits for Green Growth: The Case for Azerbaijan

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### Abstract

This paper examines the current status and trends of green investing and growth in Azerbaijan, and determines that Azerbaijan's long-term development strategy is well aligned with the transition to the innovative and green economy. Even though Azerbaijan has begun its transition to the green economy since 2010, a lot needs to be done for greening the economy and financial system. The renewable energy industry still accounts for only 17.4% of total installed electricity generation capacity. The country currently uses around 5% of its IRENA estimated potential renewal energy potential despite it has invested more around USD 3 billion in green economy since 2005. The paper determines that there are structural and policy issues limiting the transition to the green economy. The installation of renewable energy capacity above certain threshold requires permission from relevant agencies. The sale prices of renewables to the on-grid systems are not optimal enough to generate attractive returns on investment in renewable energy and green technologies.

The country uses only a limited number of green finance or investment tools, and no public or private green bond has been issued. Green finance taxonomy and regulations are yet to be developed. ESG requirements are yet to be made part of the corporate governance and reporting system in the financial system and its leading part – the banking sector which accounts for the largest share of financial assets. Domestic capital markets are still at initial stages of formation, and as such doesn't have the capacity to speed up the growth of green capital markets. The state business and entrepreneurship support schemes doesn't have dedicated products to support the transition to the green economy. The Entrepreneurship Development Fund and SME Development Agency identify green technology projects as a priority sector for borrowing from concessional resources and tapping business support services.

The literature review determines strong positive impact of green economy on the economic growth, domestically produced value-add, decent jobs, and climate change mitigation. The green economy sectors generate significantly higher number of jobs per MW capacity than the fossil powered electricity generation plants. The green economy mitigates climate change and reduces GHG through expansion of green energy sources, transition to climate friendly modes of transportation, more efficient water supply and irrigation systems, and sustainable and environmental resource management systems for water systems.

The paper concludes that transition to the green economy would bring significant economic growth, job creation and less GHG emission for Azerbaijan which can be achieved by addressing structural and policy issues in the energy, transport, and financial markets. The government can support this transition by applying internationally proven best practices in pricing the electricity produced in the renewable energy industry (REI), reducing the cost of financing for green investments and enabling the solar, wind, and hydropower producers and investors to achieve shorter payback period for their investments. Greening the financial system through developing sustainable finance taxonomy, integrating ESGs into the corporate governance codes for commercial banks, developing ESG reporting and disclosure principles, ESG disclosure requirements, annual reporting etc. and increasing awareness about the sustainable finance framework can also have substantial positive impact on the transition to the green economy. The government can also apply several economic tools to support the renewable energy industry and energy efficiency projects through exempting green bonds from taxes, allowing for shorter tax amortization and reducing tax base for investing in green projects, exempting capital investments in renewable energy from all taxes, providing grants and blended conventional and concessional public and private financing options for acquisition and installation of green technology equipment, and grants with business advisory for REI. Public policy tools such as the quota for the minimum level of energy consumption from renewables, Feed-In-Premium, Feed-In-Tariff, Net Metering, and bids for build, operate and transfer and other PPP mechanisms are also widely used across countries with leading green growth status.

**Keywords:** green economy, green investing, green finance, green bonds, low- carbon, climate finance, green lending, sustainable finance

### 16.1. Introduction

Driven by the UN and grounded on the scientific work, the world is in fast transition to the green economy model to keep the global warming at less than 2 Celsius till end 2100 to keep the climate safe. The green economy model is based on the development and extensive application of green and low carbon technologies and resources to mitigate the climate change and reduce GHG emissions to achieve clean and healthy environment for future generations. Green energy, sustainable water and land resources management, climate friendly mobility or transport, green buildings, and circular economy are regarded as the major components of the green economy.

The transition to the green economy requires mobilizing massive capital to green tech investments through green finance. In emerging markets, it also requires integrated application of the green and social finance to address low-carbon, climate adaptation and also social issues at the same time. To achieve the internationally agreed climate targets and reduction in GHG emission, the world needs annual \$800 billion investments into green energy alone by 2050. This is the triple of the current investment amount (IRENA & CPI, 2020).

Green investing has many proven tools in its arsenal to channel massive capital resources to green economy. Countries and corporations can use green stock investing, green equity investing, green bonds, green funds including ETFs and index funds, green loans, public investments, blended financing tools, mitigation banking to invest in the transition to the green economy. Azerbaijan's financial markets lack most of these green investing tools (James Chen, 2022).

Green economy also comes with substantial productivity and employment benefits. Several high-level economic researches indicate the solar and wind energy projects generate the highest number of good jobs with decent pay per 1MW compared to traditional energy projects (Mustafayev, F.; & others, 2022).

Azerbaijan's transition to the green economy has started relatively recent since late 2000s. The country has invested around USD 3 billion for green and low-carbon projects. Further greening of the economy needs significant investments, as Azerbaijan has been able to tap and use only 5% of its massive renewable energy potential. Renewable energy accounts for 17% of the total electricity production capacity. Three new investment projects with Masdar, bp and ACWA Power with the targeted installed capacity of 700 MW electricity production are the

most significant investments the country is making into the green energy sector.

### 16.2. Methodology

This paper seeks to scientifically examine the green economy concept and its key drivers including green finance and investing, the current status and major challenges of the transition to green economy in Azerbaijan, best global practices applied for accelerating the green growth through green finance. Finally, the research aspires to develop select high-priority policy recommendations. This research specifically focuses on exploring the potential of green investing in Azerbaijan for accelerating the transition to the green economy. Our hypothesis is that Azerbaijan has massive unused potential in green finance and green growth which can generate positive economic impact on the GDP and employment. The paper also analyzes current status of green economy, best practices for greening the economy, economic policies used to accelerate the green growth, major green investing instruments, the major issues in Azerbaijan's transition to the green and suggests mechanisms to boost the green growth. The research process focused on assuring maximum relevance of the collected data to the research questions and its dimensions. The selection criteria preferred the first resort sources (e.g., created by public bodies or international organization) and scientific materials which revealed facts important for the study.

### 16.3. Green Finance as the Critical Pillar of Sustainable Finance and Green Growth

A green economy is an economy that achieves sustainable development without degrading the environment. It is by definition a low-carbon or net zero emission economy when the transition to green economy takes place. The UN Environment Programme defines green economy as a low-carbon, resource efficient and socially inclusive economy (UNEP, 2011). Some economists such as Karl Burkart define green economy in terms of sectors. He defines it as an economy based on six main sectors including renewable energy, green buildings, sustainable transport, waste management, water management, and land management.

Green economics which studies the transition to the green economy and the socio-economic impact of the green economy transition argues for the change in the way economic productivity are calculated. Environmental pollution, water contamination and resource depletion are excluded from

estimations of the conventional GDP measure. The green economics attaches certain value to the extracted natural resources which are deducted from the GDP estimation to account for the depletion of natural resources and externalities the natural resource extraction generates.

Green economies require transition to the green energy generation based on renewable energy, energy conservation and efficient energy use along with the sustainable use of natural resources. This process demands mobilization of billions of capital resources for investing in green and net zero emission technologies. Thus, the vibrant green finance market is inevitable driver of the green economy transition. It is noteworthy that green sectors and renewables, like solar energy and wind energy, possess the potential to eliminate the use of fossil fuels for electricity by 2035 and replace fossil fuel usage altogether by 2050 (David Vetter, 2021).

The UN Environment Programme and the World Bank were the first to define the green finance, which is defined as to cover low-carbon, climate, green, and sustainable finance, i.e. all financing that are mobilized and deployed for the transition to the green economy. It refers to all lending and investment towards climate (greenhouse gas) mitigation and low carbon economy, climate adaptation and resilience, and other environmental objectives – including biodiversity management and nature-based solutions. It constitutes an important part of the broader sustainable finance landscape, which in addition to green finance covers social and good - governance related financing. For emerging markets and developing countries in particular, the relevance of social and governance issues are often intricately linked with climate and environmental objectives (WB, 2021).

The EU is one of the entities that unified and harmonized green finance classification system to determine if an economic activity is environmentally sustainable. The EU Technical Expert Group published its first classification system in 2019, based on which for an investment or loan to qualify as green, it needs to contribute to the following: climate change mitigation, climate change adaptation, sustainable use of water and marine resources, circular economy, pollution prevention and healthy ecosystem (EU, 2019).

Reinhardt argues that the market failures in respect to environmental protection and climate protection needs are attributed to high external costs and high initial costs for research, development, and marketing of green energy sources and green products (Reinhardt, 1999). Therefore, the green economy can benefit a lot from government support schemes



and market incentives to incentivize businesses to invest and produce green products and services. Germany, EU and USA all have established market incentives through legislation (Amory Lovins and others, 2000).

The transition to the green economy requires mobilizing capital to green growth objectives through green finance and investment markets. In emerging markets, it also requires integrated application of the green and social finance to address low-carbon, climate adaptation and social issues. Green finance incorporates both investments and lending for green economy purposes (WB, 2021).

The transition to a low-carbon economy and the green recovery from the COVID-19 crisis presents a tremendous investment opportunity across both the developed and developing world. Public and private investments are needed to achieve the Paris Agreement on keeping the global warming within 2 degrees Celsius and the UN Sustainable Development Goals (SDGs). IFC has estimated that supporting a green post-COVID recovery can generate more than \$10 trillion in investment opportunities and create over 200 million jobs in emerging markets alone. World Economic Forum (WEF) estimates that the global transition away from fossil fuels is a \$50 trillion opportunity (IFC, 2021). It is estimated that to make EU climate neutral by 2050, Europe alone will need Euro 175-200 billion additional annual investments.

Currently, the green finance globally is falling short of the level required to meet climate objectives. There are institutional, policy, strategic and operational barriers inhibiting green finance. In some countries, there is misalignment between financial sector policies and incentives for climate objectives. Sectors that are not aligned with low-carbon agenda receive state subsidies and pricing of externalities are not fully priced. There could also be uncertainty regarding long-term government policy which in turn inhibits the development of a project pipeline; or limited motivation or capacity of financial institutions to identify and originate green assets and manage climate-related and environmental risks. Furthermore, the high upfront financing costs, transactions costs, lack of track record of new technologies, and long payback periods for some green projects could increase the real and perceived riskiness of green projects overall.

### **16.4. Transition to Green Economy in Azerbaijan: Current Status and Trends**

#### **Green Growth is the Priority of the Long-Term Development Strategy**

Azerbaijan has made a strategic choice to invest in sustainable development

and healthy environment, joining the global pursuit for climate friendly and green economies. The sustainable development and green growth comprise two out of five priorities of the country's recently adopted 2030 long-term development strategy. The fifth priority of this strategy is the clean environment and green growth country, which notes that due to the scale of the climate change, the adoption and application of green technology and energy resources shall be accelerated. The strategy also supports recycling, restoration of green zones, and de-pollution efforts to ensure healthy environment and efficient use of water, land and renewable energy resources. The renewable energy shall become the dominant source of energy in the primary energy consumption and clean mobility technologies shall be supported to achieve these priorities. In line with these priorities, high quality environment and green energy space are the two results the strategy will strive to achieve (Presidential decree, 2022). The long-term strategy demonstrates that the Government is aware that environmental factors are increasingly affecting the dynamics of economic growth. The need for maintaining the balance and optimal equilibrium between the economic growth and environment is one of the top national strategic goals. Increasing investments into the renewables and green technology-based energy resources have become necessity (Adigozalov, 2022).

In line with the sustainability and green growth focused long-term strategy, the country's new macro-economic policy framework changed the medium and long-term "driving forces" of the economy towards sustainability and green growth, human capital development and diversification. The current macroeconomic framework is designed for meeting the national commitments to the United Nations' 2030 Agenda for Sustainable Development and the Nationally Determined Contributions (NDC) to the Paris Agreement (World Bank, 2022).

In a first step towards greening the financial system, one of the key drivers and stakeholders of the green economy transition, the Central Bank of Azerbaijan (CBA) has developed the Azerbaijan Sustainable Finance Action Plan (2022-2025), focused on embedding sustainability and climate risk into public and private financing schemes. This Action Plan includes wide range of activities including but not limited to (i) skill and capacity development in sustainable finance within the CBA and other industry associations; (ii) climate and ESG risk assessments, disclosure and reporting within economic and financial sectors; (iii) developing a sustainable finance taxonomy; (iv) creating climate and ESG

risk management and internal control systems; (v) devising incentive mechanisms to enhance public-private mechanisms and sustainable finance products, stimulate local investors, and mobilize donor financing. All of these actions are steps in the right direction towards minimizing financial market uncertainties around greening the growth while also reducing the cost of financing the transition process (WB, 2021, Climate Change Budget Tagging).

At the moment, the country does not have legally binding climate targets or measures. It has, however, outlined climate change mitigation actions in its strategic roadmaps for the national economy and main economic sectors (approved in 2016) including energy, oil and gas, construction, transport, agriculture and waste management sectors. The roadmap included the Government's vision and priorities for the economy and its main sectors up to 2020, medium-term (2020–2025) and long-term (post-2025) periods. These actions primarily entail adoption and extensive use of green technologies and regulatory changes for sustainability and efficiency purposes as well as to reduce the environmental footprint of various sectors of the economy. The strategic roadmap for the development of utilities (electricity, heating, water and gas) was also approved as part of the strategic roadmap for the national economy (IEA, 2021).

This long-term development strategy also includes measures for the development of a favorable climate for attracting investments in renewable energy (mainly wind and solar); distributed power generation by consumers for self-sufficiency and the installation of rooftop PV panels; and the development of bioenergy and geothermal resources. The development of distributed generation is also planned, using solar PV, small combined heat and power (CHP) stations, and small wind turbines. At the consumer level, the long-term vision envisages improved energy efficiency in the industrial and commercial sectors, and the development of infrastructure for electric vehicles.

For energy efficiency there are no specific policies or incentive schemes, but the topic is addressed in the strategic roadmap. Furthermore, the draft Law on the Efficient Use of Energy Resources and Energy Efficiency is expected to be submitted by the President to the Parliament in the near future. The government is also developing the National Energy Efficiency Action Plan (NEEAP), the National Strategy for Low-Carbon Development and the Climate Change Adaptation Plan, and working groups with representatives of all the relevant ministries and state agencies have been established (IRENA, 2019).

### The global climate change agenda and Azerbaijan

Azerbaijan joined the UN Framework Convention on Climate Change (UNFCCC) as a non-Annex I country in 1995, approved the Kyoto Protocol in 2000, signed the Paris Agreement in 2016 and ratified it in 2017. The government has outlined climate change mitigation actions in a number of sectors including energy. The Adaptation Plan for climate change and a national low carbon strategy are being prepared (IEA, 2021).

The country's Nationally Determined Contribution (NDC) is to reduce GHG emissions by 35% by 2030 from the 1990 level selected sectors of energy, agriculture, transportation, and land use. In November 2021, at the UN Climate Change Conference (COP26) conference, Azerbaijan adopted a new commitment to reduce emissions by 2050 by 40% as a voluntary commitment (the proposed update is pending a formal commitment by the Government) and to create a "Netto Zero Emission" Zone in the liberated territories. To achieve these goals, by 2030, the country needs to increase the share of the installed capacity of renewable energy to 30% in the country's overall energy balance (MoE, 2022). The latest official GHG emissions figures are from 2017, when emissions were 38% below 1990 levels and the energy sector accounted for 75% of total emissions. According to the most recent IEA data, in 2017 Azerbaijan's CO<sub>2</sub> emissions from fuel combustion amounted to 30.9 Mt (+6.6% since 2005, -42.1% since 1990). Attaining the 2030 NDC target, however, will be complicated without tackling the rise in transport fuel demand (unrestrained by prices or taxes) and the rise in natural gas demand (largely subsidized) (IEA, 2021). One of the major positive achievements of Azerbaijan has been the elimination of the consumption of the ozone depleting substances in solidarity and cooperation with the global public policy institutions, demonstrating the country's ability to tackle difficult climate change challenges with the right amount of determination (Figure 16.1).

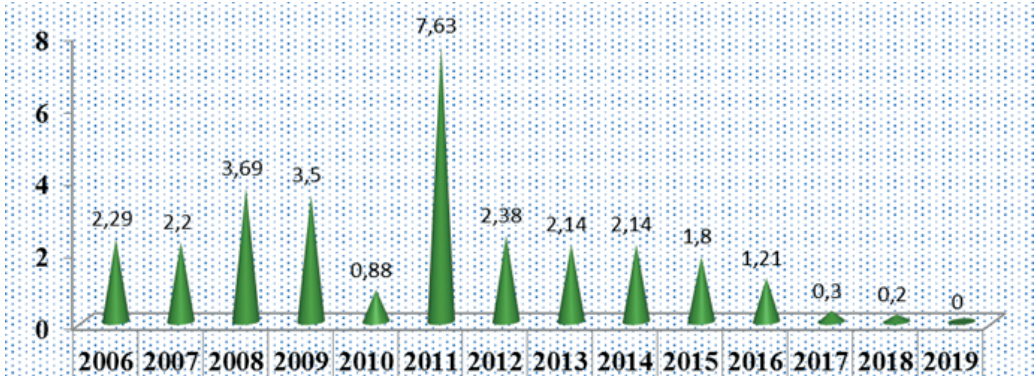


Fig. 16.1 Ozone depleting substances, Tonnes (Source State Statistics Committee. 2022)

### Current State and Potential of Azerbaijan's Green Economy

Azerbaijan has a significant green energy potential including wind, solar, hydro, biomass and geothermal resources. The country is however yet to tap into its significant potential for green economy including renewable energy (only 5% of the estimated renewable generation potential is used), energy efficiency, circular economy, sustainable use of water, land and other natural resources, low-carbon mobility and agriculture. Practical deployment has been limited in sharp contrast to the scale of the country's available resources and long-term ambitions. Higher ambition and more effort in green economy sectors will also help the country save natural gas and oil for exports and also meet its GHG commitments.

The country still has a sizable energy subsidy system in place. The cost of the energy subsidy was equivalent to almost 3.4% of GDP in 2016, with an average energy subsidy estimated at USD 130 per capita. The total value of subsidies almost doubled in the period between 2014 and 2016 from USD 751 million to USD 1.3 billion. In 2015 and 2016, more than half of the subsidies were provided to the electricity sector through support to oil and gas energy sources, while subsidies to renewable energy were negligible (IRENA, 2019). Transformation to green economy and tapping into the potential of renewables industry can enable the government to lift subsidies and channel these resources to other pressing socio-economic challenges including those that will emanate from the transition to the green economy.

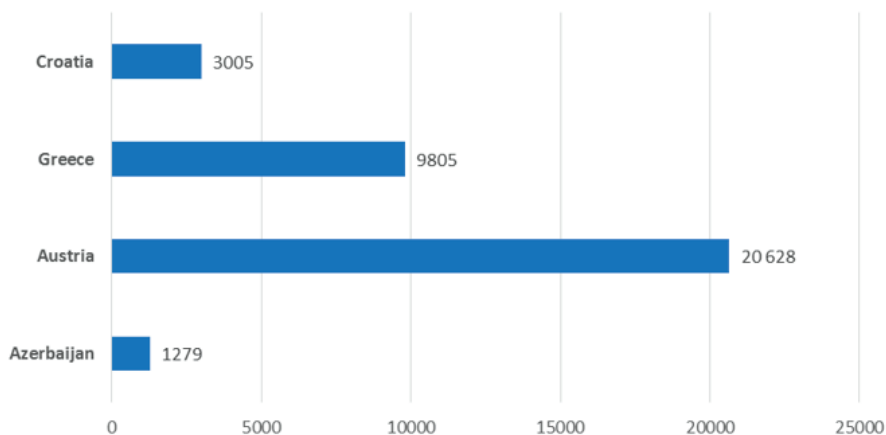
The current energy infrastructure of Azerbaijan is heavily dependent on fossils (see Table 16.1), as 5550.5 MW out of 6721.5 total installed capacity relies on hydrocarbons to produce electricity. Hydropower plants are the

second major contributor to the overall generation with an installed capacity of 1.171 MW. Agency for Alternative and Renewable Energy (SAARE) has implemented and drafted a number of wind and solar farm projects. There are about 12 wind plants with a total installed capacity of 402.94 MW. The total installed solar capacity was 40 MW across 11 plants (Mustafayev, F.and others, 2022).

Years	Total	Thermal	Hydro	Wind	Solar PV	Biomass
1990	23,152.6	21,494.6	1,658.0	-	-	-
2000	18,699.1	21,482.1	1,534.0	-	-	-
2010	18,709.2	21,658.7	3,446.0	0.5	-	-
2013	23,354.4	23,063.0	1,489.1	0.8	0.8	134.1
2014	24,727.7	23,247.1	1,299.7	2.3	2.9	173.5
2015	24,688.4	23,354.3	1,637.5	4.6	4.6	181.8
2016	24,952.9	23,461.0	1,959.3	22.8	35.3	174.5
2017	24,320.9	23,298.5	1,746.4	22.1	37.2	170.3
2018	25,229.2	23,333.1	1,768.0	82.7	39.3	162.2
2019	26,072.9	23,271.9	1,564.8	105.4	44.2	195.9
2020	25,839.1	23,353.6	1,069.5	96.1	47.0	200.6

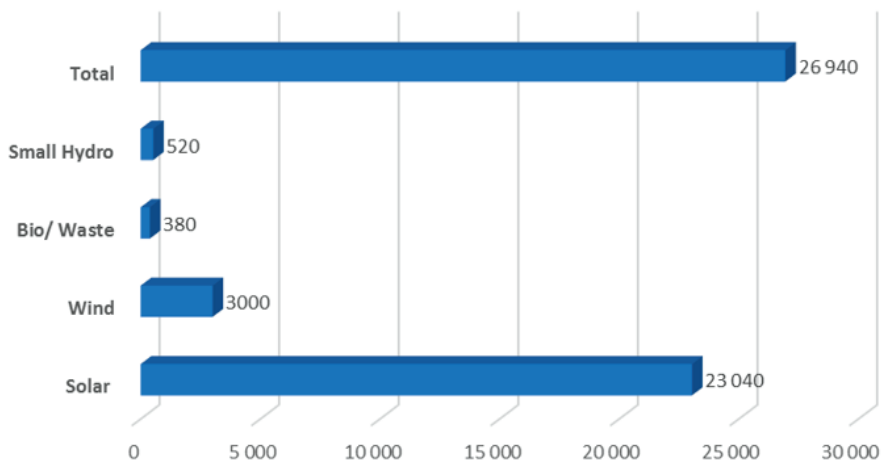
**Table 16.1** Azerbaijan electricity generation by source (GWh) (Source State Statistical Committee 2022)

Even though Azerbaijan has begun its transition to the green economy since 2010, a lot needs to be done for greening the economy and financial system. Azerbaijan has enormous renewable energy capacity. Just by comparing with countries of similar size, geographic location, we can see that Azerbaijan’s renewable energy potential is significantly under-developed. The renewable energy industry still accounts for only 17% of total installed electricity generation capacity. The country currently uses around 5% of its IRENA estimated potential renewable energy potential. Azerbaijan could reach the renewable energy generation level of Croatia or Greece by tripling or increasing its installed renewable energy capacity by 8 times (Figure 16.2).



**Fig. 16.2** *Installed Renewable Capacity, 2019, MW (Source Mustafayev, F.; Kulawczuk, P.; Orobello, 2022)*

Though Azerbaijan is located in a favorable geographical location to farm solar and wind power, its renewable potential has never been fully studied until recently. In 2002 and 2009, a few studies were conducted by the members of the Azerbaijan National Academy of Sciences to assess the wind energy potential. As of 2019, the Ministry of Energy of Azerbaijan started collecting more data on the renewable potential of the country. The major research in this direction was concluded in 2020 by IRENA who confirmed the high solar and wind potential of the country (Figure 16.3).



**Fig. 16.3** *Renewable resources potential in Azerbaijan (MW) (Source Irena, 2019)*

The state budget has been the main financing source for the development of renewable energy in Azerbaijan. According to SAARES, between 2005 and 2015, AZN 987.4 million was invested in selected energy sources, including solar PV and heat pumps, wind, small hydro, biomass and waste, of which AZN 820 million – or 83% – were from public investments (Figure 16.4). Biomass and waste management ranks first by the amount of capital investments made. The Waste-to-Energy Plant in Baku, which has been built to process the waste generated in Baku, accounts for the large share of this investment. The Government has invested 365 million Euro for the construction of the plant, around half of which came from the loan of the Islamic Development Bank. This plant has 37MW installed electricity generation capacity, of which 4MW are used for the electricity demand of the plant, and the rest is supplied to the electricity distribution system (President’s office, Press Release, 2012). The plant is operating with loss as its revenues cover only 26% of its operational costs, and accumulated losses of the plant is estimated AZN 241 million (Report.az 2022). Low revenue level is explained with low fees charged for residential waste collection service.

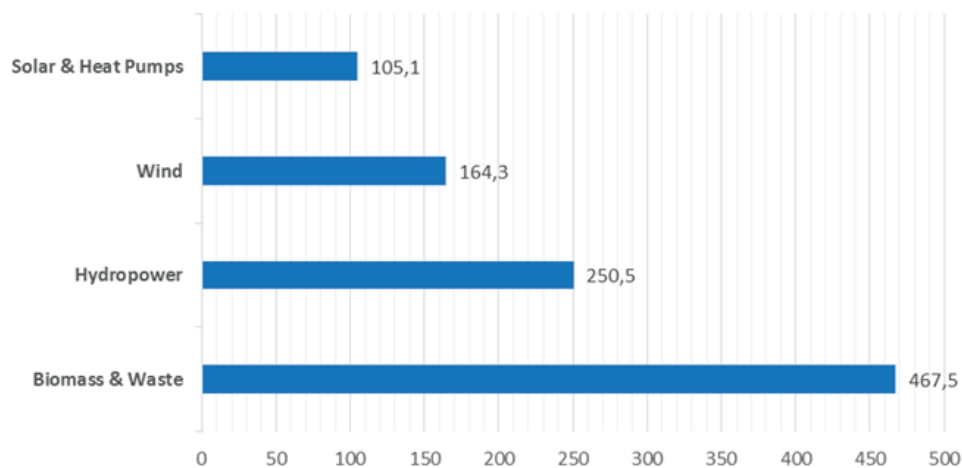


Fig. 16.4 Overview of renewable energy investments (AZN Mln), 2005–2015 (Source Mustafayev, F.; Kulawczuk, P.; Orobello, 2022)

Hydropower sector comes as the second major receiver of investments. Solar energy has received the least level of investment. This is going to radically change with planned investments of USD 400 million to be made in new solar and wind energy projects together with the Abu Dhabi Future



Energy Company “Masdar” and the “ACWA Power”. In addition, Azerbaijan and bp has just signed an agreement to build 220MW solar plant in the Jebrayil district. These projects will have combined 700 MW of installed electricity generation capacity, making the wind as the largest receiver of investments and larger electricity generator than biomass and waste.

### **Azerbaijan Green Growth Policy and Programs**

The benefits of green energy are obvious, and they have the potential to support the socio-economic development of the country. Azerbaijan possesses enough renewable resources to significantly develop its green economy. The legal framework and capacity on the green energy are still being developed. In the near future, we will witness rapid developments in the renewables industry, as the government has approved “clean environment and ‘green growth’ country” as one of the five socio-economic development objectives of Azerbaijan till 2030. According to this strategy, the share of alternative and renewable energy sources in primary consumption should be increased in all sectors of the economy in order to reduce the negative effects of climate change. At the same time, the use of electric and low carbon vehicles will be encouraged. In December 2021, the government approved the program for "Acceleration of Economic Development in the Liberated Territories" which states that investors will be supported in investing, adopting and using green technologies and renewable energy sources that create "green growth" in the liberated territories.

Because securing energy independence in the long term is central to Azerbaijan’s energy policy, it has recognised the value of diversifying its economy, increasing energy efficiency and supporting GHG emission mitigation programmes. It therefore supports the growth of renewable energy sources with the objectives of:

- Recognising the potential of alternative and renewable energy sources in electricity generation.
- Exploring alternative and renewable sources for the sake of energy efficiency.
- Diversifying and improving the energy capacity of the country to ensure energy security. (IEA 2021)

In addition, another Presidential decree signed in May 2021 requires the development of a concept and master plan for the establishment of a 'green energy' zone in the liberated economic districts of the country. The

Ministry of Energy has selected the Japanese company TEPCO to prepare the concept note and master plan of green energy zone. According to preliminary government estimates, the solar energy potential of these areas is 7,200 MW and the wind energy potential is 2,000 MW. The region is also conducive to hydropower generation due to massive water resources. There are currently 45 hydropower plants (HPPs) with a total capacity of 241.3 MW in these districts, and 34 of them are in need of rehabilitation (Rovshan Aghayev, 2022).

In 2004 the government adopted the State Strategy on the Use of Alternative and Renewable Energy Sources in Azerbaijan for 2012-20. A new legislative framework for the support of renewable energy sources is currently under preparation: the draft law “On using renewable energy sources in electricity production” will provide the legal basis for developing renewable energy projects in the country. The draft law envisages the introduction of auctions and tenders as support mechanisms. It also includes other draft legislative documents, including a draft of a power purchase agreement (PPA) and a connection agreement. In addition, rules on auctions and rules on net-metering/net-billing schemes application are also being drafted.

Furthermore, the draft Law on the Efficient Use of Energy Resources and Energy Efficiency is expected to be submitted by the President to the Parliament in the near future. The government is also developing the National Energy Efficiency Action Plan (NEEAP), the National Strategy for Low-Carbon Development and the National Climate Change Adaptation Plan (NAP), and working groups with representatives of all the relevant ministries and state agencies have been established. The National Adaptation Plan (NAP) will set significant and time bound actions in line with adaptation priorities and updated NDC. The National Strategy for Low-Carbon Development shall define new sectoral abatement strategies in the perspective until 2030 and 2050. The strategies elaborate on the scenarios considering abatement effectiveness and cost-effective analysis. To achieve these ambitious goals of GHG reduction Azerbaijan needs to gradually launch a total of about 1,500 MW of newly installed renewable energy capacity during 2021-2030 (IEA, 2022).

The government aims to increase the share of renewable energy from its current level of 17% to 30% to enable the transition to 'green energy' by 2030. This target requires the Government to add another 1,200MW of installed green energy (renewables) capacity during the next 8 years. If this additional generation green electricity capacity wouldn't be used

to meet increasing domestic demand or won't exported, then the share of the thermal electricity generation capacity shall decline over time. This additional renewable capacity can come from the restoration of existing Hydropower plants (HPPs), or from the construction or expansion of HPPs. Restoration of HPPs in the liberated areas can add 240MW of renewables capacity to the green energy system. The real activities in the renewable energy space such as solar and wind are the two projects designed for the construction of a 230 MW solar and 240 MW wind farm in cooperation with Masdar of the United Arab Emirates and ACWA Power of Saudi Arabia. The groundbreaking ceremony for these stations took place on March 2022 (Rovshan Aghayev. 2022.). These two projects will add 470MW combined renewable electricity generation capacity helping with the achievement of the Government's above green economy target.

The Asian Development Bank (ADB) has just approved a \$35.7 million senior loan to Masdar Azerbaijan Energy LLC to build, own, and operate a 230MWAC solar photovoltaic project (the Alat Solar Power Project or the Project), a site located 9-kilometre northwest of the Alat settlement in eastern Azerbaijan. The project is the first major utility-scale solar independent power project in Azerbaijan, paving the way to the diversification of the energy supply that will support socio-economic resilience. This is particularly important in the context of societal and economic recovery from the COVID-19 pandemic and in light of geopolitical conflicts in Eurasia, which is expected to impact the country's trade, particularly food security and inflation. European Bank for Reconstruction Development (EBRD) plans to allocate \$51 million to the project. The project is also expected to be financed by the International Finance Corporation (IFC is part of the World Bank Group). The project consists of three components - the construction of a solar photovoltaic installation and a new substation; a 330 kV overhead transmission line connecting the local substation with the national grid; road improvement to create a new access road along the existing track (report.az, 31 May 2022).

Another ambitious project in the green energy space has come from bp. In June 2022 The Ministry of Energy (MoE) of Azerbaijan and bp signed an Addendum to the Implementation Agreement that they had previously signed in June 2021 committing them to work together to take the next steps towards joint implementation of a 240MWAC solar power plant in the Jabrayil district (bp Azerbaijan, 4 June 2022).

With the restoration of HPPs these solar and wind projects with Masdar,

ACWA Power and bp alone, will achieve 80% of the 2030 target on the share of renewable energy (adding 950MW of installed capacity). The Government seems on track and has sufficient resources and time to deliver even beyond its target of 30%.

Consumer adoption and use of renewable energy sources are of great importance for increasing the share of renewable energy and speeding up the transition to green economy. The Government has approved the "Rules for technical terms to develop electricity production capacity and connect to the power distribution network" in Azerbaijan, which exempts individuals from any licensing or permission for the installation of a renewable power capacity and energy facilities less than 150 kW. This green power capacity (with an average 25% utilization capacity per year can generate 350 thousand kWh of energy annually and 30 thousand kWh per month) is enough to power an apartment building with 60-70 apartments including heating needs. Currently the cost of the acquisition and installation of 1 kW of power capacity varies in the range of about AZN 1200-1500, meaning an average homeowner with needs of 7-8KW will need AZN 7500-10000 manats to install this capacity (Aghayev 2022).

Azerbaijan also has significant biomass and waste-to-energy potential. experience in generating electricity based on waste incineration at the Baku Waste-to-Energy plant. In 2021, 2.6 million tons of industrial and consumer waste were generated, out of which only 21.3% or 553,000 tons were processed and incinerated for electricity generation, while 0.4% were recycled. In addition to the electricity production, the plant sorts and recycles certain amount of the waste (about 200 thousand tons per year). The consumer waste has grown by 3% per annum in the last decade till 2021 reaching 255kgs per capita (SSC, 2022). The country needs to add to its waste-to-energy and recycling capacity to handle the growth in the consumer and industrial waste and to cover regional districts of the country, which for the most part lacks efficient waste management systems and any waste management and processing plant. If two additional waste-to-energy plants would be built till 2030, this would add roughly 80-90MW installed capacity, enabling the Government to achieve 86% of its renewable electricity capacity. These plants not only generate electricity, but would with the circular economy and creation of green jobs in addition to contributing to healthier environment.

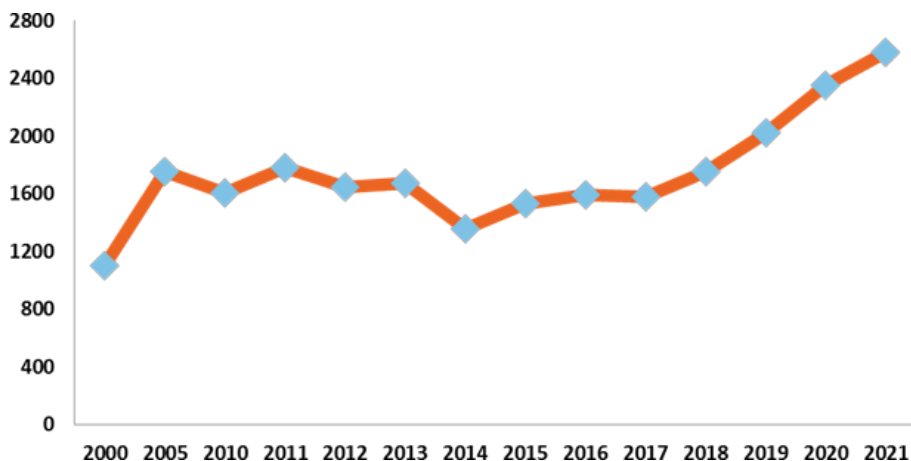


Fig. 16.5 *Consumer Waste in Azerbaijan, Thsd Tonnes (Source SSC. 2022)*

In accordance with Presidential Decree dated 29 May 2019 “On the acceleration of the reforms in the energy sector of the Republic of Azerbaijan”, the development of the draft law on “Use of renewable energy sources in power generation” was initiated. The draft law defines the main principles of state policy relating to renewable energy power generation. It has been developed with the support of the Norwegian company DNV GL. The draft law provides for additional concessions on tax and duties, feed-in-tariffs, off-taker obligations and other support mechanisms, such as for foreign direct investment and scientific research.

The draft law on “Efficient use of energy resources and energy efficiency” was prepared with technical assistance from the Energy Charter Secretariat, under the EU4Energy4 programme and was submitted to the Ministry of Energy in 2018. The draft law has subsequently been presented to the Cabinet of Ministers for review after co-ordination with related state agencies. Also with assistance from the EU, drafting of a standard PPA for renewable energy was initiated in late 2018.

The Ministry of Energy / SAARES is taking steps to create the basis for skills and expertise development. As part of these efforts, students of several higher education institutions in Azerbaijan have the opportunity to conduct field studies at Azalternativenergy LLC, the Gobustan Experimental Polygon and Training Centre and associated solar installations. A renewable energy engineering training and research centre has been created within the Baku Higher Oil School. The main purpose of this centre is to develop recommendations for the

efficient use of renewable energy, train qualified renewable energy specialists and participate in the dissemination of knowledge in this field. The UNEC has established the Sustainable Development and Green Economy Research Center named after Nizami Gandjavi for analysis, research, policy making and capacity development purposes which unites all related international and national stakeholders. The Center is designed to become the center of excellence and expertise in green economy for Azerbaijan (SAARES).

### 16.5. Green Investing Tools

Global investment in green energy made significant progress between 2013 and 2018, with a cumulative USD 1.8 trillion invested. The decrease in installation costs, resulting from improvements in technology and the adaptation of procurement mechanisms to changing market conditions, has proven to be an effective catalyst in ramping up investment and building additional capacity. The private sector remains the main provider of capital for green technologies including renewables, accounting for 86% of investments in the sector between 2013 and 2018. Project developers provided 46% of private finance, followed by commercial financial institutions at 22%. Project-level equity was initially the most widely used financial instrument, linked to 35% of the investments in renewables in 2013-2016. Since 2017, it has been overtaken by project level conventional debt, which reached 32% in 2017-2018 (IRENA & CPI, 2020).

Green investing seeks to support public infrastructure or economic activities that have a favorable impact on the natural environment. Often grouped with socially responsible investing (SRI) or environmental, social, and governance (ESG) criteria, green investments focus on companies or projects committed to the conservation of natural resources, land and water management, pollution reduction, or other environmentally conscious business practices with positive impact on low-carbon economy, climate change adaptation and resilience, green economy and environment.

Green investing counts a large number of tools which includes green bonds, green exchange-traded funds (ETFs), green index funds, or green mutual funds, or stocks in environmentally friendly companies, to support green initiatives. While profit is not the only motive for green investors, there is some evidence that green investing may reach or beat the returns of more traditional assets (JamesChen, 2022).

Because there is no firm global definition of the word “green,” what

qualifies as a green investment is open to interpretation. Some investors want only pure-play options like renewable fuels and energy-saving technology. Other investors put money behind companies that have good business practices in how they use natural resources and manage waste but also draw their revenue from multiple sources. EU is the one of the first economic spaces that harmonized and defined the green finance taxonomy. The other widely used standard in green bonds is the Green Bond Principles of the International Capital Markets Association (ICMA 2022).

### Types of Green Investing

**Green Equities.** The most direct form of green investing is investing in stocks or projects of companies with strong environmental commitments. Many new startups are seeking to develop renewable energies, technologies and materials, and even some traditional players are making sizable bets on a low-carbon future.

Renewable energy projects are financed mainly with project-level conventional (i.e., non-concessional) debt, which peaked at USD 119 billion in 2017 and accounted for 32% of the total investment in 2017-2018, on average. Balance sheet financing, both equity and debt, also supported considerable investment, each contributing to 27% (or 54% combined) of total commitments in 2017-2018, on average. Balance sheet financing was almost exclusively used to finance the development of solar PV and onshore wind, whereas project-level conventional debt was used for a wider range of technologies, including offshore wind.

**Green Bonds & Debt.** Green bonds, also known as climate bonds, are fixed-income securities that represent loans to help banks, companies, and government bodies finance projects with a positive impact on the environment and greening the economy. Approximately \$1.1 trillion new green debt related to all forms of climate and sustainability themes were issued in 2021 (CBI 2021). This debt also may come with tax incentives, making them a more attractive investment than traditional bonds. Green bonds have the potential to channel significant volumes of capital into renewable energy. Annual issuance of green bonds solely earmarked to renewable energy experienced a rapid increase in recent years, from USD 2 billion in 2013 to USD 38 billion in 2019. Often used to re-finance existing assets, green bonds can attract institutional investors due to their large ticket sizes (The Impact Investor, 2022).

Green Funds. Another green investing tool is green funds which enables investors to invest in shares of a mutual fund, ETF, or index funds that provides wider exposure to green companies. These green funds invest in a basket of promising securities, allowing investors to spread their money on a diversified range of environmental projects rather than a single stock or bond. More than \$70 Bln was invested in sustainable funds in 2021.

There are quite a number of large green mutual funds, such as the TIAA-CREF Social Choice Equity Fund (TICRX), Trillium ESG Global Equity Fund (PORTX), and the Green Century Balanced Fund (GCBLX), etc.. Several indexes seek to track environmentally favorable businesses as well. For example, the NASDAQ Clean Edge Green Energy Index and the MAC Global Solar Energy Index both target renewable energy industries. Funds that follow these indexes invest in renewable energy companies, allowing investors to support the new technology while earning a potential profit.

To determine if a “green fund” is sufficiently sustainable, prospective investors in the USA or EU can examine the securities listed in the fund’s assets. In addition, some investment research firms may offer independent evaluations, such as Morning star’s sustainability rating or State Street’s R-Factor (James Chen, 2022).

One of the largest green index funds in the US is Dow Jones Sustainability North America Index. The Dow Jones Sustainability Index (DJSI) is a collection of indexes launched in 1999 as the first global sustainability benchmarks. The focus of these Dow Jones Indexes is to evaluate the sustainability of various publicly traded companies. The Dow Jones Sustainability North America Index comprises the top 20% of the largest 600 North American companies in the S&P Global BMI based on long-term economic, environmental, and social criteria. The corporate sustainability of each company is assessed through an intricate weighting system that Dow Jones uses to evaluate economic, environmental, and social metrics, including:

- Risk and crisis management in the event of environmental disasters
- Supply chain standards
- Climate change mitigation
- Operational eco-efficiency
- Labor practices and human rights
- Human capital development (S&P Global, 2022).

**Mitigation Banking.** One of the innovative green investing instruments is the mitigation banking, which is a system of credits and debits devised to ensure that ecological loss, especially loss to wetlands and streams resulting



from various development works, is compensated by the preservation and restoration of wetlands, natural habitats, and streams in other areas so that there is no net loss to the environment. A mitigation bank is a site developed for such a purpose, whereas the person or entity undertaking such restoration work is referred to as a mitigation banker. Just as a commercial bank has cash as an asset that it can loan to customers, a mitigation bank has mitigation credits that it can eventually sell to those who are trying to offset mitigation debits. Generally, these purchasers of mitigation credits are individuals or entities undertaking commercial projects. When a mitigation banker purchases an environmentally damaged site that they wish to regenerate, they work with regulatory agencies to approve plans for building, maintaining, and monitoring the bank.

These agencies also approve the number of mitigation credits that the bank may earn and sell with a particular restoration project. Anyone who plans to undertake commercial development on or near a wetland or stream can buy these mitigation credits to offset the negative effects of their project on the local ecosystem. The mitigation banker is responsible for not just the development, but also the future upkeep and maintenance of the mitigation bank (James Chen, 2022).

**Public Investments in Green Infrastructure and Technologies.** Public support to green economy and green investments is critical in fighting the climate change and meeting the low-carbon economy objectives across developed and developing countries. Public finance, representing 14% of total investments in renewables in 2013-2018, came mainly via development finance institutions. Public financing resources, although limited, can be crucial to reduce risks, overcome initial barriers, attract private investors and bring new markets to maturity (IRENA & CPI, 2020). The US Government has allocated \$15 billion for the green energy innovation and infrastructure in the 2022 Budget. These funds will support scaling up of domestic manufacturing of key climate and clean energy technologies, accelerate deployment of the clean energy innovation including carbon-free electricity, zero emission vehicles, and low-carbon industrial solutions, and creating jobs in the USA.

The US Government is using such tools as Innovative Technology Loan Guarantee Program to support projects that avoid, reduce, or sequester GHG. \$5 billion is allocated for this Program in 2023. The US Government also uses public finances to support development of the resilient green economy supplies, green energy generation and transmission infrastructure.

It has also allocated \$200 million for establishing the new Solar Manufacturing Accelerator, demonstrating the commitment of the US to development in-house solar energy capabilities and technology and maintaining leadership in this field. The US has allocated more than \$1 billion for grants to the transport agencies to enable their transition to zero-emission vehicles. It has allocated \$7 billion to the US Department of Agriculture for loans to support clean energy, energy storage and transmission projects in rural areas. The 2020 US Federal Budget also includes \$1 billion in grants and \$400 million in competitive grants to build out a network of electric vehicles charging stations across key Alternative Fuel Corridors (White House, 2022).

The state budget has been the main financing source for the development of green economy in Azerbaijan as well. According to the SAARES, between 2005 and 2015, AZN 987.4 million was invested in selected energy sources, including solar PV and heat pumps, wind, small hydro, biomass and waste, of which AZN 820 million – or 83% – were from public investments. 350 million Euros were invested in the Baku waste-to-energy plant. Compared to a neighboring Turkey, Azerbaijan's investments into the green economy fares fine, but needs to increase substantially to reach its GHG emission reduction target as per Paris and Glasgow agreements.

China has by far outpaced the rest of the world with its renewable energy investments. From 2010 through 2019 China reported \$818 billion in renewable energy investments, beating out all of Europe at \$719 billion and nearly doubling the United States in the second-place ranking at \$392 billion. Over the same period Turkey has invested \$21.1 billion, while Korea invested around \$15 billion (UNEP, 2020).

### **Results of Green Investing**

Once considered a niche sector, green investing has swelled after several natural disasters brought attention to the oncoming climate crisis. Although profit is not the only goal of green investing, there is evidence that environmentally friendly investments can match or beat the profits of more traditional assets. A 2022 study by Morningstar Inc. reported "another year of broken records" between environmentally sustainable funds and the wider market. The study also found that sustainable U.S. large-blend funds "beat their traditional peers (Morningstar, 2021). NASDAQ Clean Edge Green Energy Index and Mac Global Solar Energy Index increased by 212% and 291.7% in the last 5 years, respectively.

### Green Investing vs. Greenwashing

Greenwashing refers to the practice of branding a company or product as “environmentally friendly” to capitalize on the growing demand for sustainability. While green marketing is often sincere, many companies have overstated the impact of their environmental practices or downplayed the ecological costs of their products.

### 16.6. Greening The Financing and Investment System to Speed Up The Transition to Green Economy: Best Practice Policies and Programs

Climate change and other environmental concerns could pose risks to financial systems and the economy. In the context of climate change, a rapid and unmanaged transition to a low carbon economy could translate into significant transition risks for the financial sector, especially if there is a need to drive a rapid transition toward green investments to meet climate goals; and financial institutions have large exposures to carbon-intensive and other transition-sensitive sectors. On the other hand, the physical impacts of climate change could also translate into risks for the financial sector. Not only would climate change, create new sources of risks for financial stability, the lack of understanding or awareness of climate risks by financial institutions could also delay the low carbon transition. Since the perceived level of risk has a direct impact on investment decisions, managing climate and environmental risks through financial supervision and increasing awareness can play an important role in changing financial behavior and driving capital towards green goals (WB, 2021). To ensure timely transition to the green economy and climate-safe future, the world will require \$800 billion investments annually till 2050 (Irena 2020).

Green finance also comes with opportunities and risks. In terms of opportunities, green finance will increase the flow of financing to sectors and projects that support transition to the low-carbon and green economy. In terms of risks, greening the financial system refers to climate related and financial risks.

The greening of the financial system in Azerbaijan will require achieving following results:

- Alignment of financial policies and incentives with sustainable development and climate goals Azerbaijan.
- Enhancing understanding and awareness of climate / environmental risks and opportunities

- Improving stability and soundness of the overall financial system, and changing the behavior of financial institutions to accelerate to low-carbon transition
- Increasing transparency and long-termism in the financial system
- Improving risk adjusted returns to green investments, introducing policy reforms to catalyze new markets for green growth.

The results will require the strategic and policy leadership from the government authorities and policymakers in developing the green finance roadmap for the financial sector to outline the long-term strategic direction to green the financial system giving due to consideration to the role of different stakeholders, supply and demand sides of the green finance and alignment with the overall long-term development strategy of the country (WB and UNEP, 2017). The authorities also need to develop the national green finance strategy to define how the required short and long-term financing will be mobilized to implement climate objectives and facilitate a country's transition to a low-carbon, climate-resilient economy. The strategy is intended to cover climate finance required for various sectors. Establishing a multi-stakeholder platform to support the development and implementation of the green finance roadmap and strategy to ensure coronation among various stakeholders is also useful. Relevant authorities and stakeholders shall join international networks to facilitate knowledge sharing and collaboration including but not limited to the Central Banks and Supervisors Network for Greening the Financial System, the Finance Ministers Coalition for Climate Action, and the Sustainable Stock Exchange Initiative, G20 Sustainable Finance Working Group, etc.

The financial supervisory/regulatory authorities in Azerbaijan can play different roles in getting their financial sectors to align with Paris goals. Key tools and options include: (a) convening a financial sector platform with the objective of committing to Paris alignment; (b) encouraging the financial sector to formally sign up to the government's climate strategy; (c) educating the financial sector on the different tools and methodologies that exist for each step of the "alignment journey".

ESG matters shall also be integrated into the bank and financial supervisory frameworks including the updates of the supervisory rating system to account for climate and environmental risks. Financial regulators shall also issue a supervisory guidance on climate-related and environmental financial risks to enhance financial institutions' approaches to managing climate change and environmental risks. The

financial regulator can also green its open market operations and supervision frameworks to increase interest of financial institutions to lending for low-carbon and green projects.

The Peoples Bank of China (PBOC) offers relending and interest subsidies/guarantees for green lending facilities. Green loans are now accepted as part of the standing lending facility (SLF), and green bonds at AA rating are accepted as collateral in its medium-term lending facility (MLF), both of which deliver favorable capitalization and interest rate benefits. The evaluation of banks' green performance is also included in PBOC's macroprudential assessment (MPA) framework, giving banks additional incentive to expand and report on their green portfolios.

Authorities can also support transition to green economy by developing and adopting a national green taxonomy to enhance transparency and facilitate alignment of capital flows to low-carbon and green technologies and investments. They can also green a national development bank or development financing institution to stimulate them to mobilize capital towards green finance. One of the options authorities can consider could be establishment of the National Green Finance Entity or Green Bank. UK Green Bank has been established for to advance the green economy transition in the country. Authorities can also stimulate issuance of corporate green bonds by developing green bond standards and guidelines to support development of green bond markets. One of the effective and widely used financial instruments for greening the financial system is the issuance of sovereign green bonds to fund climate mitigation, adaptation, resilience and environmental projects and to develop local green bond markets. Many corporations and governments in emerging economies have issued green bonds, which also help reduce the borrowing cost of the country. Authorities can also promote use of blended finance to promote private sector investments into the green economy by blending public finance with private investments to reduce risks and increase returns for green investments. Authorities can stimulate the origination and growth of green loans and lending products to increase the flow of capital to the green economy (WB, 2021).

### 16.7. Literature Review on Economic Benefits of Green Economy

Global investment in green energy made significant progress between 2013 and 2018, with a cumulative USD 1.8 trillion invested. However, to ensure a climate-safe future, annual investment in renewables – including various types of power generation, solar heat and biofuels – would have to

almost triple to USD 800 billion by 2050 (IRENA & CPI, 2020).

A higher share of renewable energy in the energy mix can offer multiple benefits beyond economic diversification. Renewable energy can act as a catalyst for new employment opportunities in a country traditionally dominated by oil and gas, providing avenues for technological innovation and opening new sectors for economic value creation and associated GDP growth. Furthermore, the accelerated deployment of renewable energy, coupled with continuing improvements in energy efficiency, could decrease domestic consumption of oil and gas, providing opportunities to generate additional revenue through exports and reduce domestic subsidies (IRENA, 2019).

Globally, the transformation of the energy system, that aims to limit the rise in global average temperature to below 2 degrees Celsius above pre-industrial levels, requires that renewables provide for two-thirds of energy consumption and 86% of power generation by 2050. Renewable energy could also play a role in supporting Azerbaijan's drive for economic diversification. Currently renewable energy sources account for only 17.4 % of installed electricity production capacity (IRENA, 2019). This transformation would also deliver a growth in global GDP of 2.5% and a 0.2% increase in global employment, compared to a business-as-usual scenario (IRENA, 2019). Meanwhile, the share of renewables in global energy generation increased to 29% in 2020, a 2% rise on a year to – year basis. Increased economies of scale, manufacturing and technology improvements, greater competition in supply chains, support for research and development, and direct deployment policies (e.g., auctions and feed-in tariffs) that have supported the uptake and increased maturity of renewable energy contributed to a 12% decrease in the levelised costs of electricity for solar PV and 14% for onshore wind between 2017 and 2018 (Mustafayev, F. and others, 2022).

### **Growth**

The positive impact of green technologies on economic growth, social welfare, and employment has already been studied and proved by many individuals and organizations. Measuring the Economics report presented by the IRENA in 2016 and Renewable Energy Development as a Driver of Economic Growth: Evidence from Multivariate Panel Data Analysis (2019) study by Nadia Singh, Richard Nyuur, and Ben Richmond has proved a significant positive correlation between the development of the REI and the increase in GDP. The latter study conducted among the OECD countries revealed 57% potential of GDP growth with successful

REI development, though the scale of interdependency between the two variables differs across contexts. Given the projected increase in energy demand in Azerbaijan, green energy also provides a technical solution to deploy power generation capacity more rapidly due to the relatively shorter lead times for project construction compared to conventional sources (Mustafayev, F. and others, 2022).

### **Employment**

The IRENA's Measuring the Economics report has also proved the positive impact of the REI on social welfare through economic, social, and environmental dimensions. The "How Clean-Energy Policies Can Fight Poverty and Raise Living Standards in the United States" study presented by Robert Pollin et al., and Veronika Czako's "Employment in the Energy Sector: Status Report 2020" revealed REI's positive impact on employment [47,48]. It is quite clear that economic development is near impossible without renewable energy technologies, however, for technology to be ubiquitous, there needs to be a reliable and cheap source of power (1) as noted by the report of the G8 Renewable Energy Task Force [49] "no country has been able to develop its economy beyond subsistence level without access to more than a minimum level of modern energy"; (2) additionally, the report states that "Economies can only grow if they are not threatened by environmental catastrophe or social unrest"; (3) this again strengthens the case for not only affordable energy but sustainable and renewable energy choices. As displayed in the Figure 16.6, renewable energy sectors, solar and wind energy technologies generate more jobs in the labor market. Poverty reduction through sustainable job development, improved health through a cleaner environment, and low-cost energy for consumers seems to be a win-win.

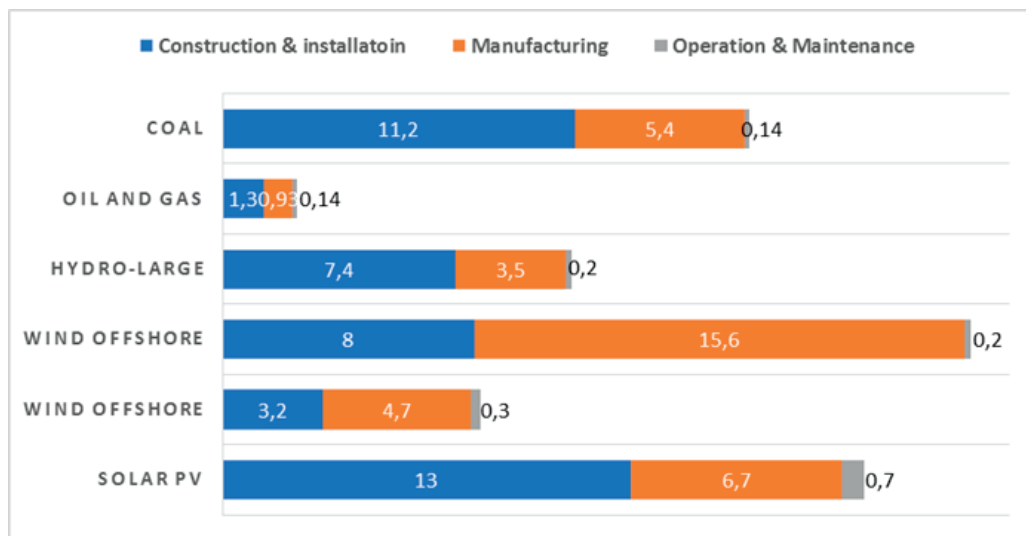


Fig. 16.6 Employment in different energy sectors (jobs per MW) (Source Mustafayev, F. and others, 2022)

### 16.8. Major Issues in Transition to The Green Economy and The Expansion of Green Finance: The Case of Azerbaijan

Greening of the financial system is key to the green transition. In setting the public investment programs (PIP), the Ministry of Economy (MoE) closely coordinates with the Ministry of Finance (MoF) which is responsible for setting the medium-term fiscal targets and assigning costs to sectoral public expenditures. The MoF has recently adopted a Medium-Term Expenditure Framework (METF) which should enable the MoF to provide realistic estimates for costing green budget and linking expenditure allocations to government policy priorities and move to results-based budgeting. Starting from this year, results-based budgeting began to be implemented in three pilot areas, namely Environment, Agriculture and Education. In an effort to ensure that climate financing is well reflected in the state budget, the MoF has identified the implementation of the Climate Budget Tagging as one of the medium-term fiscal policy priorities.

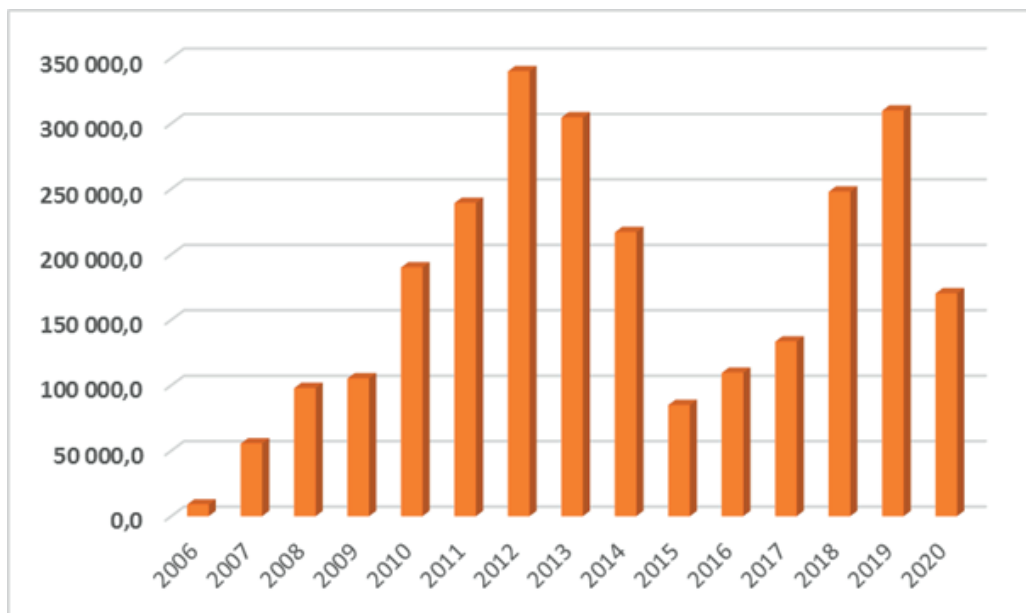
The transition to a carbon neutral and climate resilient economy provides banks and investors with significant opportunities in green investing. There is both a need as well as an opportunity for the financial sector to support the efforts by firms to re-align their business models by funding private sector initiatives, innovations, and adoption of green technology. To realize



## Green economy and Green Finance

these opportunities, the right framework would need to be put in place so that financial sector can make decisions and allocate capital to align with the goals of climate risk management and mobilization of green finance, and to stimulate the development of instruments and markets.

Azerbaijan needs to increase the flow of capital investments into the green economy to achieve its low-carbon and green growth strategic objectives. However, the amount of financing flowing to green economy has been limited. According to SAARES, between 2005 and 2015, AZN 987.4 million was invested in selected energy sources, including solar PV and heat pumps, wind, small hydro, biomass and waste, of which AZN 820 million – or 83% – were from public investments. The country has also made AZN 2.6 billion (USD 2.6 using AZN – USD exchange rates pre 2015 and post 2015 devaluation) capital investments into the protection of land, water and air resources. In total, it is then estimated that Azerbaijan has invested AZN 3.6 billion (roughly USD 3 billion) for low-carbon, green and climate friendly projects since 2005. The new two solar and one wind projects to be implemented in coming years by bp, Masdar, and ACWA Power would channel additional estimated investments of USD 550 million.



**Fig. 16.7** Capital Investments Into Protection of Environment and Efficient Use of Natural Resources 2006-2020, Thsds. (Source State Statistics Committee. 2022. Investment (Construction) Statistics)

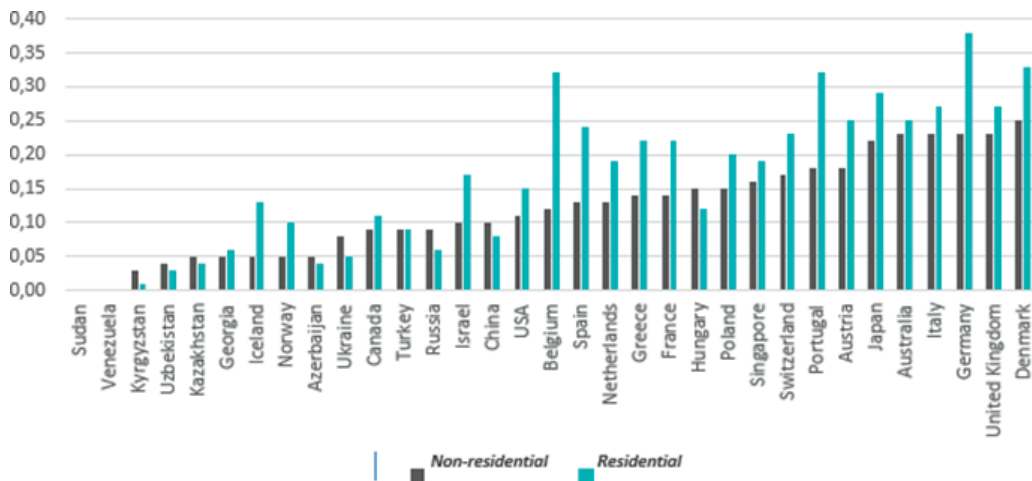
In general, the cost of financing is high in Azerbaijan, and without concessional financial resources or preferential tax treatment of financial resources flowing to the green economy, the green finance won't become a large portion of the financial market. No green bond standards and guidelines do exist as of now. Authorities can support development of green bond markets through developing these standards. No sovereign green bond has been issued by Azerbaijan. However, one of the effective and widely used financial instruments for greening the financial system is the issuance of sovereign green bonds to fund climate mitigation, adaptation, resilience and environmental projects and to develop local green bond markets. USD 1.25 billion Azerbaijan Eurobond is maturing in March 2024. Azerbaijan could take this opportunity to do the ground work and roll-over half of this bond as a green bond, which is guaranteed to command significant green investor investment (CBONDS, 2022). The green bond would reduce the cost of financing for Azerbaijan. No blended or co-financing opportunities, which would blend private investment with a public finance thus reducing risks and increasing returns to green bond investments.

Currently, ESG matters are not formally integrated into the bank and financial supervisory frameworks in Azerbaijan including the supervisory rating system to account for climate and environmental risks. No supervisory guidance exists on climate-related and environmental financial risks to enhance financial institutions' approaches to managing climate change and environmental risks. No information is available whether CBA applies any preferential treatment to green finance instruments in its open market operations and supervision frameworks to increase interest of financial institutions to lending for low-carbon and green projects.

At the moment, Azerbaijan doesn't have a national green taxonomy to enhance transparency and facilitate alignment of capital flows to low-carbon and green technologies and investments. However, the major development financing institution of the country, the Entrepreneurship Development Fund (EDF will be renamed to Business Development Fund after merging with the Azerbaijan Investment Company) has formally made green technologies eligible for its concessional lending, a major milestone to stimulate flow of resources to green economy.

One of the main issues for mobilizing and attracting capital flows to green technologies is the low purchase price of power in Azerbaijan. As can be seen in the Graph 8, Azerbaijan has one of the lowest purchase prices for power including

renewables energy. This price level leads to longer payback periods for investments into renewables and isn't conducive to generating attractive returns on renewable energy investments. Currently, the estimated payback periods for the solar panels with below or above 100 kVt capacity are 8 and 12 years respectively. Estimates are based on the annual production of 1kVt solar panel (1400 kVt) multiplied to acquisition prices of solar panels (<100kVt = 1500AZN/kVt and >100kVt = 1000 AZN/kVt).



**Fig. 16.8** Electricity Sale Prices to Grid, by Country (Source Globalpetrolprices.com, Accessed, June 2022)

Azerbaijan also does not have a Green Bank as of now. Like UK, authorities may consider establishment of the National Green Finance Entity or Green Bank as one of the options to have a dedicated institution to mobilize and lend resources for green technology investments. The UK has established the UK Green Bank to advance the green economy transition in the country.

Lack of a dedicated Law on Renewable Energy inhibits the development of a local market for renewables (IRENA 2020). Currently, the Ministry of Energy is developing a draft law on the use of renewable energy sources in power generation.

There are no streamlined procedures or a 'one-stop shop' system for renewable energy in the country. The overarching principles for the design of permitting procedures are simplicity, transparency and the flexibility to adapt to regulatory and market changes. The establishment of a 'one-stop shop' system for renewable energy projects could be considered to simplify

and streamline the permitting process. The country doesn't apply standard power purchasing agreement (PPA), which would have reduced the risk perceived by the private sector and improve transparency and predictability in Azerbaijan's renewable energy market.

Research and development of the green economy, including collection and compilation of the proper statistical data, should be promoted and supported by the government. The authorities including the CBA, SSC and other agencies shall develop rich statistical infrastructure for the green tech and green finance to facilitate expansion of the research and analysis in green economy of Azerbaijan.

### **16.9. Economic Policies Used for Supporting Green Investing**

The government can support the green economy transition by applying internationally proven best practices in pricing the green electricity, reducing the cost of financing for green investments and enabling the solar, wind, and hydropower producers and investors to achieve shorter payback period for their investments. Greening the financial system through developing sustainable finance taxonomy, integrating ESGs into the corporate governance codes for commercial banks, developing ESG reporting and disclosure principles, ESG disclosure requirements, annual reporting etc. and increasing awareness about the sustainable finance framework can also have substantial positive impact on the transition to the green economy. The government can also apply several economic tools to support the renewable energy industry and energy efficiency projects through exempting green bonds from taxes, allowing for shorter tax amortization and reducing tax base for investing in low-carbon energy, exempting capital investments in renewable energy from all taxes, providing grants and blended public and private financing options for acquisition and installation of green energy equipment, and grants with business advisory for the green energy. Public policy tools such as the quota for the minimum level of energy consumption from renewable energy industry, Feed-In-Premium, Feed-In-Tariff, Net Metering and bids for build, operate and transfer and other PPP mechanisms are also widely used across countries with leading green growth status.

One of the policies used for greening the economy is "extended producer responsibility" concept which stimulates or requires producers to recycle and re-use their products or to make investments into creating the recycling infrastructure for their goods.

The Peoples Bank of China (PBOC) offers relending and interest

subsidies/guarantees for green lending facilities. Green loans are now accepted as part of the standing lending facility (SLF), and green bonds at AA rating are accepted as collateral in its medium-term lending facility (MLF), both of which deliver favorable capitalization and interest rate benefits. The evaluation of banks' green performance is also included in PBOC's macroprudential assessment (MPA) framework, giving banks additional incentive to expand and report on their green portfolios.

Climate Budget Tagging (CBT) and expenditure tracking could be an effective tool in addressing Azerbaijan's climate-related policy ambitions and goals. The CBT and result-based budgeting are currently piloted by MoF in three sectors – Environment, Education and Agriculture. Along with the public finance, aligning the private financial sector with national sustainability and green growth goals is a short-term priority to scale up and speed the green transition. Introducing CBT may be hampered by the lack of expertise in MOF. Introducing clear measurable targets and performance indicators for green investments consistent through the entire program implementation and accountability of eligible beneficiaries could facilitate the greening of public and private finances. For instance, since 2014 Indonesia has introduced mitigation budget tagging in key ministries to track resources spent to achieve the national emission reduction target of 26% by 2020. Introducing Climate Budget Tagging (CBT) and expenditure tracking in public financial management can be another important milestone in addressing Azerbaijan's climate-related policy ambitions and goals.

The experience of countries with successful shift paths to renewables demonstrates the importance of supporting mechanisms in attracting private investment into the energy market. This is another aspect that historically lacked in Azerbaijan, although back in the 1990s, the idea of introducing incentivizing schemes was mentioned.

In 2018, the Council of European Energy Regulators (CEER) presented its Status Review of Renewable Support Schemes in Europe for 2016 and 2017 where the following policies were highlighted as the most commonly adopted in European countries: Feed-in-Tariffs (FITs) – refers to purchasing renewable electricity at the market prices; Feed-in-premiums – refers to purchasing renewable electricity above the market prices, used by Germany, UK, Italy, Spain; Tradeable green certificates; and Investment grants. India and Estonia use grants and subsidies to support investments into renewables and low-carbon technology. Lebanon provides credit insurance support for green loans (WB, 2022).

### 16.10. Conclusion and Recommendations

The shift of Azerbaijan to green energy production and reduction of carbon footprint in power generation is a universally accepted trend with the majority of countries reaching significant achievements, or at least submitting action plans with clear-cut targets to achieve. Azerbaijan grasped this trend in the 2010s, although since the 1990s, numerous legal acts had provisions on renewables.

The paper concludes that transition to the green economy would bring significant economic growth, decent job creation and less GHG emission for Azerbaijan which can be achieved by addressing policy and infrastructure issues in the energy, transport, and financial markets. The green economy sectors generate significantly higher number of jobs per MW capacity than the fossil powered electricity generation plants. Azerbaijan possesses enough renewable resources to significantly develop the renewables industry. The deficiencies are the lack of a strong legal framework and expertise on the matter. The upcoming years will witness rapid developments in the renewables industry, as the “clean environment and ‘green growth’ country” to be one of five strategic objectives to be reached by 2030.

Authorities can support this transition by applying internationally proven best practices in pricing the electricity produced in the REI, enabling the solar, wind, and hydropower producers and investors to achieve shorter payback period by reducing the cost of financing for green investments. Greening the financial system through developing sustainable finance taxonomy, integrating ESGs into the corporate governance codes for commercial banks, developing ESG reporting and disclosure principles, ESG disclosure requirements, annual reporting etc. and increasing awareness about the sustainable finance framework will also generate substantial positive impact on the green growth.

Achieving low-carbon green growth entails Azerbaijan to take into account following recommendations which correspond with identified green economy transition issues and policies:

The government can also apply several economic policy incentives to support the renewable energy industry and energy efficiency projects through exempting green bonds from taxes, allowing for shorter tax amortization and reducing tax base for investing in REI, exempting capital investments in renewable energy from all taxes, providing grants and blended public and private financing options for acquisition and installation of RE equipment, and grants with business advisory for REI.

Public policy tools such as the quota for the minimum level of energy consumption from REI, Feed- In-Premium, Feed-In-Tariff, Net Metering and bids for build, operate and transfer and other PPP mechanisms are also widely used across countries with leading green growth status.

The energy market should be liberalized and supported with easy access to relevant information for all participants. A dedicated law on green energy could provide overall direction to the renewable energy sector in Azerbaijan and significantly contribute to the development of a local market for renewables. Such a law would serve as an important reference point for renewable energy market players by providing a clear and reliable long-term perspective. Currently, the Ministry of Energy of the Republic of Azerbaijan, is developing the draft of the law on renewables. The law will cover all key elements of a sound legal and regulatory framework for renewable energy by defining the most appropriate sources and technologies based on the existing technical potential in Azerbaijan. In addition, the law could also allocate roles and responsibilities to relevant government entities.

Permitting requirements and procedures for the green energy could be streamlined under the renewable energy law to provide reference and direction for any future amendments. The overarching principles for the design of permitting procedures are simplicity, transparency and the flexibility to adapt to regulatory and market changes. The establishment of a 'one-stop shop' system for renewable energy projects could be considered to simplify and streamline the permitting process. Publishing permit procedures online, alongside information on the different steps to take, would increase transparency for developers and investors.

Supportive policies should be applied to stimulate the inflow of private capital into the green economy. Green Banks, sovereign green bonds, green loans, green funds, concessional lending for green technology, greening of the financial system, preferential treatment of green finance assets by the CBA, blended public-private finance are all proven effective in increasing the mobilization and flow of capital to the green economy.

Efforts should be put in place to promote and support private and community-scale green energy generation. Research and development of the green economy, including collection and compilation of the proper statistical data, should be promoted and supported by the government. The authorities including the CBA, SSC and other agencies shall develop rich statistical infrastructure for the green tech and green finance to facilitate expansion of the research and analysis in green economy of Azerbaijan.

Government institutions could benefit from tailored capacity building on green economy and tech policy development, regulation, analysis and evaluation. For the private sector, courses could be offered explaining opportunities for setting up green tech enterprises, including information on available government support schemes and partners.

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# Chapter 17

## Integration of Green Finance into Investment Projects in Karabakh

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### Abstract

Over time, high temperatures, rising sea levels and changing climate conditions seriously disrupt productivity and macroeconomic balance. The risks that are being taken, the unreasonable consumption and the costs that need to be endured, unsustainable existing energy sources. Therefore, the transition to a low carbon emission model increases the need for alternative energy sources. The green word is brought to the beginning of many concepts, and serves as an adjective that states the environmental sensitivity of that concept. Then green finance can be briefly described as environmentally responsible finance. Green finance itself contains green investment, green financial products. In this study, green investment opportunities were discussed in the Karabakh region, which has a very high potential for Azerbaijan development. Opportunities for foreign investors in Karabakh are included in this study in renewable energy projects in the region.

**Keywords:** integration, green finance, green investment, Karabakh

### 17.1. Introduction

As time goes by, people face different kinds of ecology problems in the world. The risk of resources, especially underground and water resources, global warming, environmental pollution, and a variety of ecological problems like this, have led people to look for alternatives to ensure the sustainability of life. Wind, solar energy, and so on, the rise in the direction of a variety of energy sources is that underground resources are now going to run out. Human beings have come up with a variety of solutions, such as

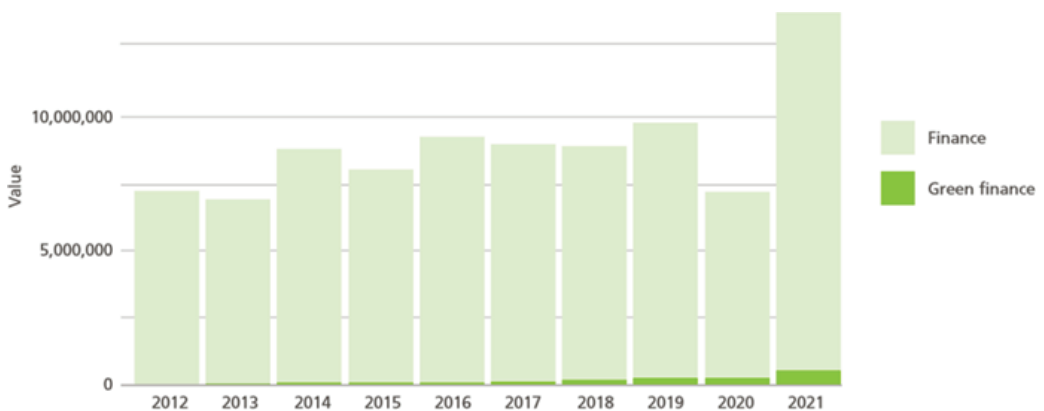
preserving natural resources, paying more attention to environmental cleanliness, making the use of fossil fuels more consciously, reducing the release of toxic gas. It is a matter that should be discussed how well these solutions are implemented and how successful they are. But the important thing is: Are there enough incentives to enable such actions to be carried out with another phrase and solutions?

Over time, high temperatures, rising sea levels and changing climate conditions can seriously disrupt productivity and macroeconomic balance. The risks that are being taken, the unreasonable consumption and the costs that need to be endured, unsustainable existing energy sources. As a result, the need for alternative energy sources grows as the transition to a low-carbon economy progresses. Because green technology, such as wind turbines or solar panels, that do not harm the environment, need a considerable amount of cash, the shift to alternative energy sources will necessitate significant expenditures (Eyraud, Clements, & Wane, 2013). The green word is brought to the beginning of many concepts, and serves as an adjective that states the environmental sensitivity of that concept. Then green finance can be briefly described as environmentally responsible finance. This means that the issues related to green finance are explained from an environmental perspective (Komşuoğlu Yılmaz, 2019).

In recent years, global warming has been affecting everyone, rapidly changing climate conditions and their poor impact on human life has started to make the world's countries and organizations uneasy. The world is now focused on reducing and eliminating the negative effects of elements that contribute to global warming and climate change. The green economy and green finance are at the forefront of the approach and policies designed to minimize global warming to a minimum. In recent years, the export (or offer) of green financial instruments such as green bonds, green loans, and other similar financial products has increased in support of initiatives that have a good environmental impact and safeguard the most vital environment (Gilchrist, Yu, & Zhong, 2021). Financial institutions, individual and corporate investors and other organizations have a change of preferences in investment. This change tends to increase investment in projects that contribute positively to the environment (or contribute negatively to the environment). Financing of investment in eco-friendly projects has actually revealed the concept of green financing. Green funding will become one of the more popular currents today and in the future as the world's environmental sensitivity grows and governments embrace clean energy (KULOĞLU & ÖNCEL, 2015).

It is possible to see green financial assets in different countries have different definitions and meaning, from the world. As a result, there is no universally accepted definition for these assets. This distinction is more obvious, especially when comparing the European and Asian continents. This is due to the disparity in objectives between developed and developing nations, as well as the influence of diversity on green financial products. For example, when environmental pollution (water, soil, etc.) is a really big problem in China, it is unlikely to say the same about the size of the problem for Europe ( Gilchrist, Yu, & Zhong , 2021).

The purpose of green financial products is to enable investors to invest in projects that produce environmentally friendly products, while encouraging organizations to make environmentally friendly initiatives. For example, if a business is producing products that pollute the environment or harm the environment by any other action, investors can stop investing in this business. This sensitivity may be lower in previous years, but it has been increasing in recent years. International Energy Agency estimates that demand for renewable energy by up to 2030 worldwide will increase by 40%. The work on this issue is made by different policies for governments (KULOĞLU & ÖNCEL, 2015).



**Fig. 17.1** *Green finance and total finance (Source TheCityUK analysis based on data from Refinitiv Workspace)*

As seen in the graphic in illustration 1, the share of green finance in total finance increased in 2012-2021. It is possible to say that green bonds dominate green finance in the years indicated because they constitute 93.1% of total green financing. Green public supply and green private capital both accounted for 3.4 percent of total green finance in the same years.

**Green financial products.** In recent years, different methods have been developed to finance eco-friendly, green projects. Green bonds, green bank loans, and other green financial instruments such as these have the potential to aid in the development of renewable energy. In terms of financial institution offers, the distinction between traditional financial products and green financial goods is that financial institutions provide better circumstances for green initiatives that have a positive impact on the environment. Financial institutions are also bringing together small projects with offerings to green finance projects, which is how it expands the market (Sachs, Woo, Yoshino, & Taghizadeh, 2019).

**A. Green insurance.** In a modern society, it is the duty of the social state and the insurance organizations to deal with loss and damage. In most countries, the insurance companies are very interested in damages caused by severe weather disasters such as storms, floods, avalanche and hail as well as the tendency to privatize public goods and services. The sector now also covers damage caused by global climate changes or severe weather events. These events alone can harm people, families, and businesses, but they also constitute a threat to all governments and societal institutions across the world. Climate change, human-induced hazards, environmental responsibility, natural resources, recycling, and other global challenges such as these all require the involvement of the insurance business. Climate change has an impact on firms in a variety of industries, particularly those in the agricultural, industrial, and service sectors. Businesses are exposed to risks they have never faced before. At this point, the insurance industry is one of the ways businesses use it to take measures against risks (Hayta& Gürbüzler, 2020).

Insurance companies offer customers different types of green insurance. For example, car insurance serves with the same pay-as-you-drive logic. This signifies that the fuse is set based on the vehicle's distance traveled. At the same time, some insurance firms provide a 10% discount for hybrid and fuel-efficient automobiles. There are many banks throughout the world that use the vehicle's annual emission level as a criteria. In addition, if customers use replacement parts that can be recycled in their vehicles when the vehicle is damaged or serviced in the recycling insurance center, up to 20% off vehicle insurance will be applied (KULOĞLU& ÖNCEL, 2015).

As part of “Environmental pollution Financial responsibility Insurance”, one of the insurance types; claims of damages against the insured and insured under the environment legislation due to the risk of contamination

or contamination in one several or all sudden and unexpected, depending on the scope of the contract, of the land, underground water, domestic waters and seas are secured. Under this insurance policy: death, disability, treatment costs, property damage, cleaning costs and the transportation of waste and disposal are cases taken under guarantee (Hayta & Gürbüzler, 2020).

It is advisable to say that the number of natural disasters caused by global warming and climate change and the increase in damage caused by the insurance sector, which is obligated to compensate for the damage it has caused, are increasing in the likelihood of leaving the insurance sector with serious problems.

**B. Green loans.** High interest rates tend to reduce investment. The majority of the cost of renewable energy generation is cash pre-paid. Because these investments are prepaid, their financing costs are frequently greater than regular investments, making them more susceptible to interest rate fluctuations (Eyraud, Clements, & Wane, 2013). It is possible to collect loans that support the green finance under two topics: Loans related to individual banking and loans related to corporate banking. Corporate loans are banking services that corporate and investment banks lend to other institutions, enterprises, and governments in order to satisfy their financial demands. These financial intermediaries let corporations export stock to primary markets, deal in foreign currencies, and trade in commodities. Individual loans are commercial banking products and services provided by individual banks to individuals and small businesses rather than corporations. Products and services in the individual area include credit and mortgages, debit and credit card services, payment orders, cash management services and insurance (KULOĞLU & ÖNCEL, 2015).

Green loans used frequently up to date are development credits developed by international development organizations such as the World Bank, often tailored to the environment, renewable energy and energy efficiency areas. Green credit is distinct from conventional loans in that it serves as a fund for projects that commit to decreasing any environmental, social, cultural, or economic disturbances that the lenders require be addressed. Green credit applications, user energy efficiency, energy savings, etc. evaluating its green performance gives customers different benefits, such as a decrease in interest rates, thus creating an incentive mechanism for customers (Turguttopbaş, 2020).

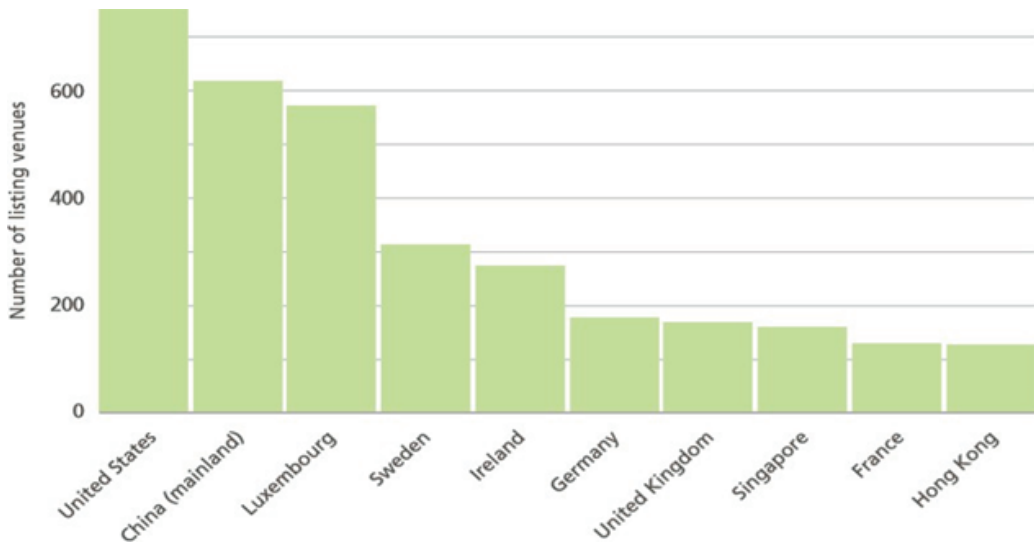
For example, mortgage housing loan offers a 1% interest reduction to those



who meet environmental criteria. Free energy rating and carbon emission reduction assistance can be supplied to the residences for each year of the loan. New and old houses can benefit from low interest rates from existing mortgage dwellings. To do this, all projects must meet state requirements. In some countries, a loan called a green power-based mortgage loan encourages owners to use renewable energy. The product is more concerned with the customer's long-term behavior than with the building's physical infrastructure. Other instances like this might be offered as well. Customers can give up to 10% of their mortgage credit insurance payments as an incentive if they acquire or modify energy-efficient properties (KULOĞLU & ÖNCEL, 2015).

When green credit becomes available to the general public, it may be promoted through various promotional channels or through direct bank branches to reach potential clients. The inclusion of a third party with no vested financial interests can aid in the development of mutual trust. These corporations include, for example, public institutions (Zabot, Monguzzi, & Ruggieri, 2011).

**C. Green bond.** The bond is debt tools that are more than 365 days in the amount of time that businesses and states use as funding sources. The most significant difference between bonds and commercial paper is the maturity. Commercial paper is also a debt debt tool that is exported by both businesses and the state and has a maturity of more than 30 days and less than 364 days. Green bonds are fixed return securities exported by the state, companies and other institutions to finance environmental and climate-friendly projects. Although the use of green bonds is not very common compared to normal bonds, it is possible to say that the amount of exports has increased since 2013. The first green bond was issued by the World Bank in 2007.



**Fig. 17.2** *Leading countries in green bond export (Source TheCityUK analysis based on data from Refinitiv Workspace)*

Figure 17.2 shows countries that were leading in green bond export among countries around the world in 2021. The United States is first in the export of green bonds and China is second in line. It is possible to say that the most green bond exports after the United States and China are in European countries. As it turns out, the weight of green bond exports is in developed countries. But it is good to say that China is a developing country.

The green bond is defined as bonds that will be used to finance projects that have a positive impact on nature and the environment in part or in whole, while also financing investment focused on emissions reduction can be financed. Renewable energy, described as green bond green projects, is utilized in this context for sustainable use and management of endangered natural resources, environmental protection, sustainable water management, and project finance. In order to establish environmental and social responsibility policy of states and financial institutions related to green bond exports, to follow the objectives in politics, the establishment of the relevant governance structure within the institution, the management of environmental and social risks that may be encountered and the establishment of an action plan for such issues need to happen (Turguttopbaş, 2020).

Descriptions and descriptions of the green bonds issued should also be

transparent and open for investors in other countries. Because the variability of such explanations and definitions causes investors to make mistakes, resulting in increased cost of loss. Therefore, the explanations made must be carried out globally and in parallel in the region (Komşuoğlu Yılmaz, 2019).

Green bonds create a continuous investor demand in financial markets because of its contribution to environmental processes, while also providing financial returns. The first green bond issuer was issued by the European Investment Bank in 2007 as a Climate Awareness bond. The interest rate on green bonds is low since funding environmentally friendly, sustainability-supporting initiatives can only be done at a low cost. To diversify their portfolio, some corporate investors want green bonds. They can accept a lower cost as compared to ordinary bonds, but they also lesser returns. However, it is important to note that green bond returns must be satisfactory for investors who do not have a green project finance priority in order to improve the green bond market (Turguttopbaş, 2020).

In Switzerland, the Leu Prima Disaster Bond Fund is the first public fund to be established for the world's disaster bonds. The Disaster Bond Fund targets natural disasters caused by climate change. This fund is designed to protect against climate risks, unlike protection in the traditional insurance market (KULOĞLU & ÖNCEL, 2015).

It is important to say that this increase is not at the desired level, even if demand for green financial products increases, especially in developed countries around the world. It is prudent to state that the poor return rate and risks connected with long-term financing of green energy projects are the primary reasons why financial institutions are cautious to do so. Green bonds, green loans, green fuses, and other innovative green financial instruments like these are needed to improve the financing of initiatives that help the environment in order to meet sustainable development goals (Sachs, Woo, Yoshino, & Taghizadeh, 2019).

### 17.2. Literature Review

According to the information obtained from the work made by Turguttopbas (2019), the first Turkish green bond is the 5-year bond issuance of the Turkish Industrial Development Bank in 2016 amounting to USD 300 million. A total of approximately US\$4 billion has been requested from a large geography, particularly in the UK. Taking into consideration the charges mentioned in the claims, the bank has only covered \$300 million of the claim. The first Turkish bond issuer received

the green bond issuer of the year award from Global Capital and International Financial Review structures.

According to the information obtained from the work carried out by Komşuoğlu Yılmaz (2019), sustainable Banking and Finance working Group Turkey was established in 2013 in order to create environmental awareness in the financial sector, to develop creditation and investment instruments that comply with international standards for carbon emissions sensitive and sustainable growth. The Borsa Istanbul Sustainability Index, which was launched in 2014 and is still active, is based on concepts such as sustainability, climate and environmental sensitivity for asset managers, stock market investment funds, and structured products.

According to information obtained from Kortt and Dollery (2012)'s work, Australia offered low interest loans to make public houses greener in the Sun, Green Energy and water Renewal Plan, which was announced for the people in 2007. The Australian government has set aside \$300 million from its budget to carry out this strategy. The goal of this strategy was to encourage water and energy efficiency in Australian households, as well as to assist the public in investing in technology that support water and energy efficiency, and to provide environmental advice to the public.

According to the information obtained from Kuloglu and Öncel (2015)'s work, despite more than 200% increase since 2005, the deterioration in clean energy investments has started between 2008-2009 due to the impact of the financial crisis. However, it broke a record of 243 billion dollars in 2010, which showed that investments doubled 2006 years and doubled 2004 to almost four. China, which made a big comeback from the recession in 2009, was the largest attack in the solar and wind energy sector outside Europe with an investment leap of 30%.

According to information obtained from the work done by Zobot and others (2011), the Energy efficiency Program was launched in 2005, aimed at reducing the final consumption of primary energy in industrial and residential sectors in the State of Milan. This initiative has been working on operational techniques to help control the use of fossil fuels and, as a result, reduce air pollution. Workgroups were formed to attain this goal.

According to the information obtained from Hayta (2020)'s study, fossil fuels are still predominantly used due to various restrictions, as the country's level of development of renewable energy use in Turkey has not reached sufficient levels of environmental awareness in relation to developed countries, and the media does not produce adequate environmental propaganda. In Turkey, such limitations must be avoided in

order to pave the way for renewable energy and so improve its funding. This will establish a competitive environment between fossil fuels and renewable energy, lowering prices and preserving the progressively deteriorating natural environment when the initial investment cost of renewable energy is covered.

According to the information obtained from Sachs and others (2019)'s work, fiscal policy has an important role in increasing the return rate of green projects. Other taxes, such as income tax or corporate tax, may be reduced to stimulate the spread of renewable energy. The production tax credit, for example, is frequently used in the United States to promote wind energy, while the investment tax credit is commonly used to promote solar energy.

### 17.3. Integration of Green Finance into Potential Finance Projects in Karabakh

There are three main challenges facing investment projects that support the green finale:

- a) identifying the right projects for each region;
- b) building and developing plans that include the public and private sector;
- c) structuring the financing of these projects.

Governments must be able to plan, fund, and effectively implement projects with the private sector in order to succeed in green financial investments. Electric cars must be substantially invested in by governments throughout the world. Not just in terms of technology, but particularly in developing nations, the health and education sectors must be developed, as well as large investments in water and sanitation projects in metropolitan areas (Sachs, Woo, Yoshino, & Taghizadeh, 2019).

The importance of oil and natural gas in the state revenues of the Republic of Azerbaijan is great. Growth in global demand for oil and gas is estimated to slow to about 0.7 per cent annually by 2050, reducing the share of fossil fuels in the total energy sector. Under these conditions, high steady growth is not expected in the near future due to oil revenues, as oil prices are not expected to return to their previous high levels. The International Monetary Fund estimates that Azerbaijan economy will grow by 2-3% annually by 2025. This pace of increase is comparable with the rate of growth seen in recent years. However, such slow development is insufficient to meet the economy's objectives, which include producing enough jobs for present and future generations. As a result, in the setting of reduced oil prices, Azerbaijan's economy will be built on new foundations,

resulting in a greater growth rate.

As the economic development potential of the oil and gas sector weakens, the world's resource-rich countries, such as Kazakhstan, Saudi Arabia and Russia, face challenges and try to diversify their economy. Today's situation is similar in Azerbaijan. The country has a strong political will and capability to further strengthen its position in the global economy, mainly in the last decade. Therefore, the importance of green investments is growing more and more in Karabakh, which has a wealth of environment. Karabakh has great potential for water and alternative energy investments. The investment of foreign investors and entrepreneurs in this area is particularly attractive because the expected return opportunities are very high, even at a high cost.

It is possible to say that Azerbaijan is interested in investing in green projects. The Azerbaijan State Petroleum Fund was established to invest in achieving sustainable income. Funding assets are estimated to be 35 billion dollars in 2017. The Fund has made various investments in water supply, irrigation and transportation. The government of Azerbaijan has adopted a number of policies that set lofty targets and establish a framework for encouraging investment in carbon-free, climate-stable growth. The concept document for Azerbaijan 2020 Future Vision examined the potential influence of climate change on the country's social and economic life, as well as the significance of establishing key governmental measures to address this issue. The document also said that the energy used to generate a single GDP and the amount of CO<sub>2</sub> should be the same as the relevant standards of the OECD countries by 2020.

Measures to expand the green economy are crucial to ensure sustainable development in the world's environment pollution, declining natural resources and growing demand. "Azerbaijan 2030: National Priorities for socio-economic development" approved by President Ilham Aliyev 5. It is not a coincidence that the priority is called "the Land of Clean Environment and Green growth." The document sets specific tasks for the implementation of environmentally friendly technologies, promoting waste recycling and rehabilitation of contaminated areas and for the proliferation of environmentally friendly green technologies. The implementation of these tasks, especially in the Karabakh region where growth and investment potential are high, will attract foreign green investors and help promote investment in the region.

The Global Wind Report 2022, prepared by the Global Wind Energy Council (GWEC), says Azerbaijan has a wind energy potential of about 157

GW and that the government will increase its share of renewable energy in total energy investment to 30% by 2030. Due to the "Green hydrogen" policy, this region will be a zero emission zone in 2060. According to the report, Azerbaijan and Australia, Sri Lanka and Turkey are among countries with wind energy potential. Australia's capacity is 4,963 GW, Sri Lanka's capacity is 92 GW and Turkey's capacity is 70 GW. So Azerbaijan is second in the world. It is also important to note that the Azerbaijan government has a special strategy for green energy. According to this policy, the Karabakh region was declared a "green energy" zone. In Karabakh, Saudi Arabia's Acwa Power will build a 240-megawatt wind farm and Masdar of UAE from the United Arab Emirates will build a 230-megawatt solar power plant. Both stations are expected to be completed and opened in mid-2023. At the same time, SOCAR and Technip Energies signed a co-operation agreement to work on a joint floating offshore wind pilot project to strengthen the upper basin operations in Azerbaijan's Caspian Sea sector.

The "Smart Village" pilot project to be implemented in the Karabakh region covers the 1st, 2nd and 3rd Agali villages of Zangilan. The project will mainly be implemented on 5 components. These are housing, manufacturing, social services, "intelligent agriculture" and alternative energy. First of all, the area is planned to build 200 individual dwellings using fully insulated and innovative construction materials. Internal engineering communications and heating systems will also be built on the basis of intelligent technologies. Modern schools, kindergarten, polyclinic and e-state centers will be built in these villages and tourism infrastructure will be established. The process of processing and producing all housing, social facilities, administrative and public eating drinking buildings, agricultural products will be provided by alternative energy sources.

International donors fund the majority of green investments. In terms of development funding, the OECD Development Aid Committee (DAC) forecasted a \$200 million climate change flow from 2011 to 2015, with more than 75% of it coming through market loans or concessions. Donors also contributed money to help with technical issues. The standards and incentive mechanisms that green financing strategies have fundamentally are the two key factors that distinguish them from traditional techniques.

As it is known, banks are getting money reserves, other words, and resources from deposits. Deposits are generally short and medium-term in Azerbaijan, as in other developing countries. Green finance projects are financed in the opposite way, i.e. over a lengthy period of time. Banks face

a vade mismatch when it comes to short and medium-term deposits, as well as green finance initiatives, which require long-term funding. That's why banks are inadequate in financing green projects. Therefore, new financing channels need to be investigated and alternatives evaluated.

### 17.4. Conclusion

If global fossil fuel usage is not controlled, the planet's temperature might rise by 4-6 degrees Celsius above pre-industrial levels. This outcome is exceedingly hazardous to human health and food production. Despite the fact that governments and agencies want to limit global warming below 2°C, it is impossible to state that they have taken concerted action to build a low-carbon energy system. Azerbaijan, like many other countries, invests in renewable energy initiatives. In 2022, Azerbaijan designated the Karabakh area as a "green energy" zone. The green initiatives to be executed in the Karabakh have been covered in this research, as well as possible prospects. This article provides information on what developments occur after the Karabakh occupation and which projects will take place.

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# Part IV

## Green Accounting





# Chapter 18

## The Importance of a Green Economy and Green Accounting: Analysis of the Knowledge on Green Accounting and Economy in Azerbaijan

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### Abstract

Natural resources are being depleted rapidly and therefore, calculating environmental costs will help in efficient use of resources and complying with environmental policies. In this context, it is important to establish an effective environmental information system in terms of determining the status of environmental assets and resources, specifying the use of them, communicating the developments and changes that occur after the activities (Orhan Suphi M. and Ag Alirıza, 2017). In order to minimize the damage, they cause to nature, businesses have to bear a certain cost and account for these costs (Shirin Aslan, 2017). The aim of the green economy is to harmonize economic growth with environmental sustainability, to increase the eco-efficiency of economic growth and to improve the synergy between the environment and the economy.

In this article focus is to determine knowledge of graduates and students in Azerbaijan about Green Accounting and to find the prospects for companies and individuals to protect the green economy. The need of this study is to enable people to understand and awareness of the importance of environmental accounting and reporting in companies for better sustainability as well as social responsibilities of companies.

**Keywords:** Environment, Green Economy, Green Accounting, Green Growth, Environmental Accounting, Sustainability

### 18.1. Introduction

Green accounting began to develop from the 1970s in Europe, starting in Norway, which was influenced by the publication of *Limits to Growth* and the growing environmental movement. Norwegian Ministry of Environment developed statistics for the measurement of natural resources as a tool to better manage natural resources which resources will be depleted due to overuse. Later, this environmental issue attracted the attention of the Danish government as a result of the 1977 oil crisis, and energy reserves and savings calculations began to be made. In the 1980s, France developed an accounting system to assess both quantitative and qualitative changes and natural resources. As a result, as professional auditors grew in the 1990s and industry standards increased, the American Institute for Certified Public Accounts (AICPA) published universal guidelines on environmental auditing (Joy E. Hecht, 2007). EPA (United States Environmental Protection Agency) uses three different levels in the definition of green accounting as macro level, financial accounting level and management accounting level. At the macro level, green accounting is about measuring the consumption of renewable and non-renewable national natural resources. In the financial accounting dimension, green accounting is based on the process of reporting environmental information and presenting it to the relevant parties. At the level of management accounting, green accounting is the examination of the environmental relationship with environmental costs, production-related processes and planning issues, which are of great importance for the business (Nurcan Suklum, 2020).

Two types of policies are followed to reduce the effects of human-induced climate change, these are mitigation and adaptation. The “mitigation” action primarily addresses the alleged causes of climate change by reducing greenhouse gas emissions. “Adaptation” refers to action aimed at adapting to climate change and reducing the assumed risks associated with it. Achieving success in mitigation will reduce impacts that people need to adapt and adaptation will reduce influence of the climate change in the future. Both policies related with “green economy”, “green growth” and “green innovation”. According to the United Nations Environment Program (UNEP), the green economy substantially reduces environmental risks and environmental scarcity during improving people's prosperity and social equality (United Nations publication, 2000). Within scope of these guidelines, environmental accounting mainly targets organizations. Environmental accounting is the framework for integrating physical units

and monetary values and addresses the issue of cost performance versus benefit. It also encompasses eco-balance, where a table of input and output data on environmental impacts. When a product is produced, only raw material, labor and general production costs are included in the product cost, causing misleading results in determining the unit production cost. For this reason, environmental costs should be included in the accounting records. Thus, the unit cost will be determined more accurately and accounting will have done its part in determining the competitive unitsales price. As a result, with green accounting, businesses report the costs of preventing environmental damage, the costs of using environmental products and the coststhey incur for the damage they cause to the environment.

### **18.2. Environment and Business**

The environment can be defined as the biological, physical, economic, social and cultural environment in which living things and people maintain their mutual relations and interact throughout their lives. People have been interacting with the environment since its existence. In order to meet human needs, businesses harm the environment at every stage of production. Due to the fact that people perceive the resources they have benefited from as unlimited, problems have arisen in the self-renewal process of the polluted environment in order to produce. Businesses take inputs, which are factors of production, and turn them into outputs due to their interaction with the environment. Companies use the limited resources that resulting with environmental losses during input phases, pollute the environment by solid, liquid, gaseous wastes during production phases, damage to environment with using goods and services during output phases. Due to the shortage of the resources used, businesses cause damage tothe environment that is difficult or even impossible to compensate. As a result of unconscious and rapid consumption of natural resources in this way, universal problems such as global warming and climate change have begun to be experienced. Because of these features, businesses need to undertake important responsibilities for a livable and clean world. It is accepted that environmental problems arise primarily in industrialized countries and it has been accepted globally and it has been concluded that global steps should be taken for their solution. As a result, legal measures have been taken at the national and international level. Businesses take various measures in order to eliminate these damages to the environment, however sometimes these steps are insufficient and legal

measures are taken. In order to minimize the damage, they cause to nature, businesses try to create a corporate image that is compatible with the expectations of the society and is interested in environmental problems. In this case corporate social responsibility emerges. Corporate social responsibility can be defined as the voluntary contribution of organizations for a better society and a better environment. The concept of Corporate Social Responsibility is basically explained by two economic approaches, the Classical Economic Approach, which argues that the goal of businesses is only to make profit, and the Modern Economic Approach, which argues that the goal of businesses is not only to increase and advance social welfare, but also to make a profit. Milton Friedman, who is the most important representative of the classical economic approach, rejects corporate social responsibility, declared that such responsibilities are only applied by people and that the most important responsibility of an organization is to comply with the law and earn profits (Theaker, Alison, 2006). The Modern Economic Approach is explained by stakeholder theory. The concept of stakeholder, which was used for the first time by Edward Freeman in 1963, refers to the parties that are affected by the activities and practices of an organization. According to the stakeholder theory, it is aimed not only to meet the expectations of the partners, but also to participate in the management processes of the internal and external stakeholders that contribute to the business (Edward Freeman, Jeffrey S. Harrison and others, 2010).

Archie Carroll's four-part social responsibility model has examined corporate social responsibility in four sub-dimensions: economic dimension, legal dimension, ethical dimension and volunteering dimension. The social responsibility pyramid created by Carroll consists of these four sub-dimensions (Zeittey Karmilla Kaman, Zaleha Othman, 2017):



**Fig. 18.1** *The social responsibility pyramid created by Carroll (Source Uner, Tugce and Bas, Mehmet (2018) "Social Marketing Scale Study Developed Using Carroll's Corporate Social Responsibility Model", Journal of Business Studies 10.4, page 304- 332)*

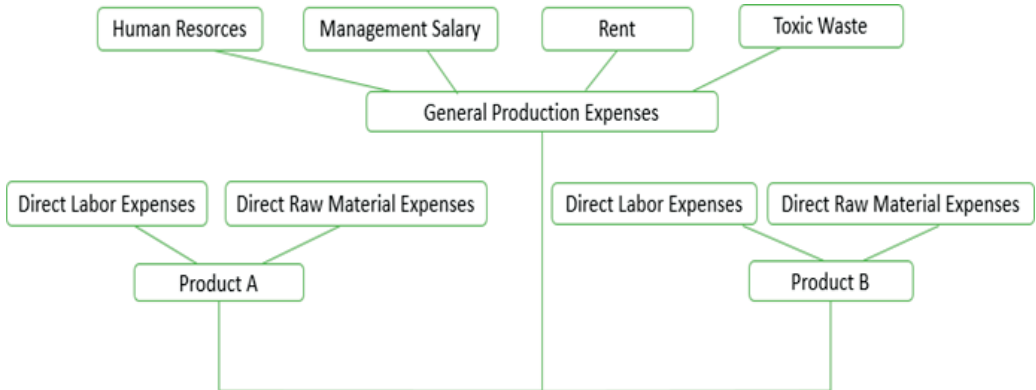
In the 1970s, businesses went through a very rapid social development process both in line with their own interests and in response to social pressures. Thus, businesses have started a process that can be defined as "Corporate Social Responsibility Management". Civil society movements increased in the 1980s and the World Environment and Development Commission was established by the United Nations General Assembly in 1983. Today, in addition to the quality and price of the product or service, the social responsibility activities of the enterprises are also effective in the purchasing behavior of consumers. In accordance with the social responsibility concept of accounting, businesses have to consider not only the interests of business owners, but also the interests of all segments, including the environment outside the business, and be "environmentally friendly". A study conducted in the USA revealed that consumers are more attracted to products that are environmentally sensitive and that new product studies are not carried out on living things (Aktan, Can and others, 2007). Thus, the mission of enterprises should be to observe environment and to produce environmental solutions, also to implement activities that can be called "green" within the scope of obligation or social responsibility as required by legal regulations. Instead of implementing green management practices only due to legal obligations and social pressure, it will give healthier results if businesses evaluate green management in developing their strategic goals (Siegel, 2009). There are a lot of steps in order to act sensitively to environmental problems, one of them is environmental accounting. Businesses have started their activities in order to calculate, monitor, classify and report the costs that may occur



by determining the damages they have caused to the nature. For this reason, the concept of Green Accounting has arrived. EPA (United States Environmental Protection Agency) uses three different levels in the definition of green accounting as macro level, financial accounting level and management accounting level.

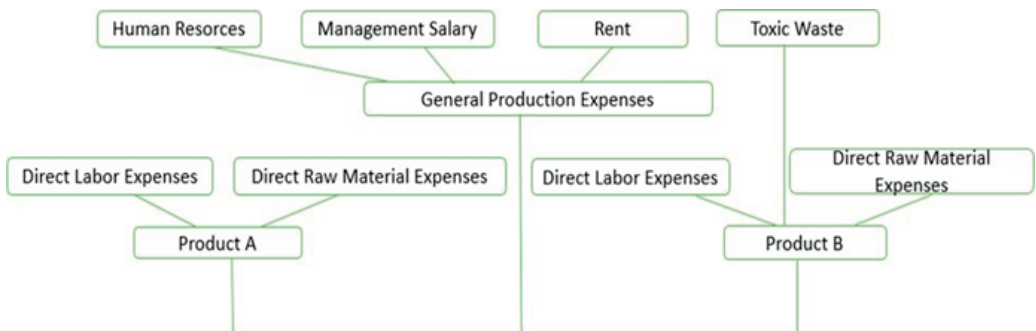
- Financial accounting provides information to the relevant people by reporting the changes in resources and assets related to an accounting period and the results of the activities carried out by the enterprises. In the context of financial accounting, environmental accounting provides general purpose financial reports on the fulfillment of environmental obligations to various interest groups such as shareholders, potential investors and creditors, and guides the possible decisions of these groups. In short, environmental accounting in financial terms is the process of estimating and reporting environmental costs.
- Management accounting provides information from cost accounting and financial accounting. Management accounting is a type of accounting that provides objective data and measures of past results and expected future events in the business, or it is a branch of accounting that deals with how accounting data and other financial data can be used in the management of businesses and other organizations. Environmental management accounting is defined as the creation, examination and use of financial and non-financial information to support management operating within a company or business.
- Calculation of total and unit costs is different between cost accounting and environmental accounting. Environmental resources and costs are not be evaluated or they are account for in a scattered in today's accounting system. Those are called as “social costs”, toxic gases from factory chimneys, waste chemicals and water can be given as examples.

Because of some interest groups of opinions, social costs are not valued, however it is incompatible with the social responsibility purpose of the enterprise. In an industrial enterprise that produces two types of products, A and B, product A does not cause any toxic waste in the processing process, while toxic waste occurs in the processing process of product B. In short, product B creates environmental costs. According to classical cost accounting, costs are distributed as follows:



**Fig. 18.2** Product cost calculated based on the Traditional Cost Accounting System (Source EPA (Environmental Protecting Agency), June 1995, page 21)

According to the figure, all expenses are transferred to the general production expense, and the cost of the products is calculated from there. According to the above system, the cost of both product A and B is calculated incorrectly. Because although product A did not create any environmental cost, it received a share from the environmental cost incurred for toxic wastes. While a product should not take a share from the environmental cost, this situation has been ignored in the classical system. Product B created an environmental cost due to toxic waste, and the cost of product B could not be calculated correctly, since all of the related costs should be transferred to product B, and product A also receives a share of this environmental cost. Environmental accounting comes into play at this point, and the cost of the products is calculated as it should be. The distribution envisaged by environmental accounting is as follows:



**Fig. 18.3** Revision of the product cost calculated based on the Traditional Cost Accounting System within the scope of Environmental Accounting (Source EPA (Environmental Protecting Agency), June 1995, page 21)

According to the figure, product costs were calculated more accurately and product A, which does not contain toxic waste, only received a share from the general production expenses, and did not receive any share from the expense that creates environmental costs. On the other hand, product B, received a share from both general production costs and environmental costs.

### 18.3. Importance of Green Accounting

National income measures such as Gross Domestic Product and Net Domestic Product are important for all countries, and a country's economic situation and living standards are evaluated using these measures in the most general sense. Traditional accounting is not sufficient to measure national income due to underdetermine of the impact of natural resources on economic activities, inconsistent practices related to depletion of natural resources, and insufficient indicators of environmental degradation. Despite the decrease in natural wealth, improper increases in national income mislead decisionmakers and researchers. In order to eliminate this misdirection, the use of green accounting in the calculation of national income is important. In order to be used green accounting more effectively, it is necessary for practitioners to have knowledge on this subject, and therefore, trainings on the subject should be organized. The responsibility for green accounting is related with educational institutions, businesses, the government and the whole society. Green accounting (also known as environmental accounting), which takes into account the interests of society, not individuals, and acts in accordance with this principle in its applications, has some objectives (Rout, 2010). These are preparing a balance sheet that gives a profile of the resource inventory at a given time and shows its level, determining how much of the resource stock is used, what is added to the stock and how much has changed form at a given time, and performing the relevant calculations, showing current assets and fixed assets are consistent, and thus, each balance sheet is in the form of transferring current asset accounts of this year over the previous year's balance sheet.

As the result, environmental accounting aims to identify the decreases and attrition in natural resources after consumption and production activities and present them as environmental costs in the financial statements of businesses. In accordance with the concept of social responsibility, it is also important for businesses to know how much they can contribute voluntarily for environmental and social purposes, in the

cost-benefit evaluation of the market conditions in which they operate (Jennifer K. Lynes & Mark Andrachuk, 2008). The main issue in environmental accounting is the phenomenon of "pricing". The principle underlying the pricing practice is "Prices should reflect the social costs of use and production". Pricing also complies with the "polluter pays" principle in this system. The idea of sustainable development is based on the fact that the decisions taken today do not adversely affect the living standards of future generations. In general, establishing an environmental department within the business and establishing an effective communication with other departments can be considered as an important step in the success of green accounting practices and in the management of environmental costs. Companies prepare and present reports containing their statements regarding their environmental activities, together with their financial statements. These are called integrated reporting and includes financial reports, corporate social responsibility reports and sustainability reports. Companies disclose information about their interactions with the environment with these resources (Gucenme Gencoglu and Aytac, 2016).

Moreover, changes in accounting standards and systems are necessary for constructing sustainable economies and providing success of the European Union's "green deal". The development process of green accounting in European countries has passed through many stages. Norway was among the first countries to commit to environmental accounting and was an innovator in the development of accounting frameworks. Norwegians began to worry that their natural resources would be depleted, on which their economy was relatively dependent compared to other European countries. Due to this reason they developed accounts that track their natural resource use, focusing on forests, fisheries, energy, and land. The Netherlands and Germany were also leaders in adoption of environmental accounting. Sweden has been working on environmental accounting from 1990s and made it a formal decision routine in 1996 (Joy E. Hecht, 2000). They have worked closely with Eurostat and have received financial support from the European Union. The core work of the Swedish accounts has been on energy, air pollutant emissions, and climate change models. However, there is a limited literature on environmental accounting in developing countries compared to their western counterparts. However, there are some obstacles in the implementation of environmental studies in underdeveloped and developing countries, and the obstacles are related to the political and social structures of the countries. Problems may differ

significantly according to country, but these obstacles can be seen more clearly in underdeveloped countries compared to developing countries. In developing countries, there are very few scientists, managers and technical staff who will work on the causes, dimensions and solution proposals of environmental destruction. Moreover there is no equipment to assist these studies. At the same time, use of the limited financial resources in areas which will provide economic return within the framework of the fight against poverty make it impossible to invest in other areas. The authority gap in the implementation of existing environmental laws is also among the current problems. Problems such as the lack of environmental awareness of legislators, inadequate environmental laws, many of them far from current problems, the lack of clear determination of those responsible in the laws, and the inability to monitor and control the practices are among the short comings of these countries in protecting the environment. The fact that there are many bureaucratic processes in these countries and that the leadership given to economic activities is so clear against the environment are the main reasons for non-compliance with environmental laws. In addition, factors such as corruption in control mechanisms, lack of control systems make it difficult to enforce laws. The reason that make invest difficult in the field of environmental security is the weak financial structure. The fact that countries, which technological structures are dependent on technological imports from developed countries poses an obstacle in terms of environmental protection studies. The another problem is related to fragile political structures. Within the scope of a structure that is far from political stability, neither the implementation of laws nor investments in the field of environmental protection are possible.

### **18.4. Green Accounting and Economy in Azerbaijan**

The environmental problem is a necessary issue in today's context due to the damages caused by natural and human activities. Its protection and prevention is therefore a serious concern for the entire society and business community. One of the developing countries is Azerbaijan, where the adaptation process to the green economy is important and is being implemented. In this case Environmental Management Accounting have become an important research topic globally as well in Azerbaijan. The geographical location of Azerbaijan in the Caucasus region uniquely endows the country with rich biodiversity and diverse landscapes. Azerbaijan also has economically important natural resources,

most importantly oil and gas, which is central to Azerbaijan's economic growth. In the 19th century, Azerbaijan was one of the world's leading oil producers, however the sector was not greatly developed during Soviet period. After the independence of Azerbaijan hydrocarbon sector was develop due to discovery of significant new oil and gas reserves. During the last years, Azerbaijan economy has become more integrated into the global economic market and wide-ranging economic reforms have resulted in improved regulatory efficiency and fostering local economic diversity, particularly in the areas of agriculture, tourism and communication technology. Foreign investments are an important factor in the social and economic development of the country. Many years of production and industrial development have had environmental consequences on soil, water, air, nature and directly on the health of citizens.

Between 2000 and 2010, gross domestic product of Azerbaijan (GDP) at constant prices quadrupled and average annual rate of growth of real GDP more than a 15%, which is excellent achievements making Azerbaijan the fastest-growing economy in the world during these years. Azerbaijan jumped on the World Bank classification scale from being classified as a "low-income country" to being considered an "upper middle-income country" in 2000 (Azerbaijan Policy assessment and recommendations, 2013). Current years, Azerbaijan is facing a variety of environmental challenges inherited from both the Soviet era and the consequences of an unsustainable development model, especially during the years of rapid growth. The institution responsible for environmental protection and natural resource management in Azerbaijan is the Ministry of Environment and Natural Resources (MENR). Other public bodies such as Ministry of Industry and Energy and the Ministry of Economic Development also has responsibility in order to protect certain aspects of environment. Current structure of Azerbaijan dominated by oil and gas sector, necessity of economic diversification make on developing the green economy and re-orientation towards green growth in order to promote eco-innovation. The "Greening Economies in the Eastern Neighborhoods of the European Union" program supports the six Eastern Partnership countries' progress by separating economic growth from environmental deterioration and resource consumption. One of this country is Azerbaijan. Green economy is urgently needed in Azerbaijan for focus on stocks of natural assets and integrity of ecosystem services. Moreover about 70% of available surface water resources are heavily polluted by industrial operation, but there is also insufficient municipal wastewater treatment.

Also waste disposal practices have been significantly improved, but existing landfills do not meet international sanitary standards and waste recovery, reuse and recycling practices are limited. There are some challenging for companies, especially for SMEs, doing business outside of oil sector in Azerbaijan, because they contribute approximately 3% to the economy. Agriculture sector is 5.7%, to the economy. Both SMEs and agriculture could benefit from being more environmentally conscious, as key export market for Azerbaijan is EU, where consumers are increasingly considering environmental considerations. Although various environmental strategies are being implemented in Azerbaijan, there is an urgent need to better coordinate actions to green the economy across different economic sectors.

Last decade is determinative in the context of environmental challenges, that is why modification of current model will be soon. The change is becoming appropriate in the context of the global health emergency of coronavirus pandemic. Azerbaijan has made commitments to the green economy as part of its cooperation with the European Union. Thus “EU4 Environment” which is EU-funded Action in 2019, support to Azerbaijan protect its capital and enhance people's environmental well-being, demonstrating and opening to opportunities for greener growth, and managing to environmental risks. EU4 Environment related with a single strategic framework as greener decision-making, built of sustainable economics and green growth, bright landscaping, protection of ecosystem and sharing of knowledge. In order to support these efforts in Azerbaijan, the EU4Environment Program has held virtual consultations with government officials. The participants reviewed the situation in Azerbaijan at the level of COVID-19, discussed how activities of the EU Environment Program can be adapted to more effectively support the green way out of the crisis (Environment Program, Azerbaijan Project of 2019-2020: 4).

Realizing that it is vitally dependent on a single sector, the goal of Azerbaijan is to diversify economy and track a green growth path. Together with the Eastern Partnership (EaP) countries, Azerbaijan has committed to the goal of transitioning to a green economy in the 2011, 2013 and 2017 Declarations of the “Eastern Partnership” Summits and other international forums. Under the Environment for Europe (EfE) process, Azerbaijan has made a voluntary commitment for green economy actions until 2030 under “Batumi Green Economy (BIG-E) Actions”. Green economic growth can increase productivity, innovation, create new jobs or markets, generate additional financial income. Strategic

economic policy document of Azerbaijan is “Azerbaijan 2020: Look to the future”. It unites environmental concerns, find ecological problems from oil recovery among the major challenges and set a target “to attain sustainable socio-economic development from an ecological point of view” (Azerbaijan - 2030: From the Millenium Development Goals Towards the Sustainable Development Goals, 2017). The year 2020 was marked by an unprecedented global problem of the COVID-19 pandemic, impact of which on the health and socio-economic spheres is felt in all countries of the world. In response to economic downturn, Azerbaijan has taken urgent measures to decrease socio-economic consequences of the pandemic and also is taking important steps to decrease influence of plastic waste on the environment. The draft Law on Environmental Protection is to restrict the import, production, sale and delivery of polyethylene bags up to 15 microns thick, as well as disposable plastic products.

Some of these measures, highlighted below, are aimed at advancing environmental goals ((Development Concept of Azerbaijan: Outlook for the Future 2020 Project):

- Azerbaijan 2030: One of the key elements, "Azerbaijan 2030: National Priorities for Socio-Economic Development" aims to ensure a high-quality environment, the promotion of green technologies and the development of alternative and renewable energy sources.
- Establishment of a new green development structure under the Ministry of Ecology and Natural Resources: The Green Development and Innovation Division of the International Cooperation Department is established.
- Commissions on Climate Change and Effective Management of Water Resources: Azerbaijan has approved the composition of the State Commission on Climate Change. A new commission on effective management of water resources has been established by a presidential decree to address water shortages.
- Creating green jobs: The number of public jobs has been increased from 38,000 to 90,000 to support employment development during the pandemic. In addition to work, disinfection and social services for vulnerable groups, the city also includes landscaping activities.
- Improving Solid Waste Management: The Action Plan covers solid waste management to prevent unsanitary and environmental pollution in order to reduce the negative effects of COVID-19.



- Supporting cleaner air: Azerbaijan plans to import 300 environmentally friendly buses. They will either run on compressed natural gas or have hybrid engines, replacing old cars that cause high levels of air pollution in Baku. It aims to maintain reduced levels of air pollution during a pandemic. Work is underway on financial and administrative measures to increase imports of new and environmentally friendly vehicles and reduce the use of old ones.
- Promotion of energy efficiency: Azerbaijan is working on the project "Action Plan for Rational Use of Energy Resources" with the support of the EU Energy Program. This document aims to develop the energy sector by promoting the efficient use of energy resources and the use of renewable energy sources.

Support for biodiversity: A project to create a biosphere reserve in the Zagatala region, the first reserve in the South Caucasus, has been launched.

### 18.5. Research Methodology and Results

Green accounting is a system that produces information in the form of businesses using their environmental resources, measuring the increase or decreasing after the use of these natural resources, determining the damage caused by this use to the environment, and the interaction of the business with the environment. In order to carry out green accounting practices, businesses need to have awareness and knowledge on this issue. In addition to professional accountants, it is essential that university students who are candidates to become accountants and managers realize necessity of green accounting in their education processes.

Many studies have been conducted on green accounting. In the study "Green Accounting in Imperfect Market Economies" written by Aronsson and Löfgren (1998), green accounting processes in systems with defective or incomplete market economies are examined and social accounting researches are summarized. In the study titled "Green Accounting: From Theory to Practice" written by Vincent (2000), the subject of green accounting was examined theoretically and the future of countries in green accounting was tried to be explained with the model established. Cairns (2004) determined green accounting principles for renewable and non-renewable energy sources. In a study by Halberg et al. (2005), farms in eight European countries were examined and it was concluded that green accounting could be used in terms of environmental indicators. In the study conducted by Fleischman and Schuele (2006), it was determined that the training given to the students on green accounting increased the awareness

of the students about environmental issues. There have been many applications in Turkey as well, which is one of the developing countries. Rout (2010) examined the issue of green accounting from a theoretical perspective and evaluated the difficulties in practice. Korukoglu (2011) investigated the effects of environmental accounting on employees in his study. Abdel Rahim (2012) examined the concept of environmental accounting and the applicability of environmental reporting in his study. Zuleyha Yilmaz and Zeynep Sahin (2017) and Seyhan Cil Kocoyigit and Sinan Tarsuslu (2020) also conducted a survey to raise awareness of the society about environmental accounting. The questions asked in the survey application were applied based on generally accepted ideas. According to the answers taken from the survey questions prepared based on these literature reviews, it was attempt to reveal the green accounting awareness in Azerbaijan. The philosophy on which environmental accounting is based on "This world has not been inherited from our ancestors, we borrowed it from our children" which expressing the importance of the natural environment of the North American Indians (Seyhan Cil Kocoyigit and Sinan Tarsuslu, 2020). Environmental strategies should be integrated into all corporate ideas and business objectives, and each element of the strategy should be translated into environmental actions in order to be contributed financial and competitive performance (Garzella and Fiorentino, 2014). Businesses have to find a balance point between increasing their profitability and protecting the environment (Wu, 2014). Businesses be aware importance of compliance with environmental regulations that is of fundamental importance not only for reducing ecological damage, but also for ensuring economic profit (Cosimato and Troisi, 2015). Green management practices also contribute to the principle of social responsibility, which is one of the establishment goals of enterprises, by increasing environmental awareness in users (Yang, 2017). The research questions in this article were especially applied based on the researches applied in Turkey and the aim of the article is to reveal green accounting awareness in Azerbaijan, which is one of the developing countries. As a result of the researches in Turkey, it has been revealed that training of green accounting is insufficient and the result of analysis in Azerbaijan also the almost same with Turkey.

This research focus to learn about sustainability, clean environment, clean production, etc, which have gained significance in the recent years to determine their perceptions about the issues of green accounting and to measure level of awareness about green accounting. The purpose of

this survey is to study the knowledge of graduates and students of business administration faculties about Green Accounting in Azerbaijan and prospects for companies / individuals to protect green economy. The other objects of article is to comprehension about environmental accounting which to realize the importance of Green accounting, to make an attempt to make green accounting a part of company's accounts.

**Methodology.** Questionnaire method which one of the primary data collection methods, was used to obtain the research data. A survey was conducted for this purpose and the obtained data were analyzed by factor analysis, Anova, and two independent sample t-tests by using the SPSS package program. The questionnaire was designed to consist of 2 different parts for student who are not working, and 3 different parts for workers. In the first part, 9 questions were asked to determine the demographic characteristics of the responders. In the second part also consists of 9 questions which are answers only for people who are working. Last section are directed to the participants using a Likert scale in order to learn the thoughts on green accounting. Participants in the survey were asked to code each statement as "1: I strongly disagree", "2: I do not agree", "3: I have no idea" "4: I agree", "5: I strongly agree", in accordance with their thoughts. The questionnaires were administered in April, 2022 and a total of 206 people responded, and people who are responded 70.9% are men and 29.1% are women. There are no any results which are invalid.

**Research Result.** 60 responders to the survey are women and 146 are men. 79.6% of the respondents are 20-29 years, 9.2% are 30-39 years, 9.7% are 40-49 years and the rest are over 50 years old. Graduates of bachelor degree is 56.3% and master degree is 21.4% in the survey. Public and private sector employees make up a total of 43.7% of respondents, with a share of 19.9% and 23.8%, respectively. 56.3% of respondents are currently unemployed students. Most of the respondents are currently students and 64.6% have no experience as an accountant. Another important answer is that according to the most of people respond 58.7% of respondents learned information about Green Accounting from articles, books, internet, and other resources, which shows the lack of sufficient resources during the study period in accounting.

According to 63.1% of the respondents, Green Accounting should be applied in all companies and the government should take strict measures to implement it. The chart below also shows that according to the respondents, the chemical industry, light industry and food industry were the most environmentally damaging industries.

The second part of the questionnaire consists of questions which are only focus to workers in this sector. The number of respondents in this section is 90 people. 57.2% of employees declare that many ways are used to protect the environment in the enterprises where they work. However, 46.7% of respondents proclaim that the trainings on green accounting were not conducted for the employees in the enterprises, while 43.3% said that the trainings were conducted. According to answers, 47.8% of respondents notify that companies asses the natural resources and use them in efficient way, however 42.2% of them do not have the same thought. The 54.4% of workers notice that although companies carry out social activities they do not have a waste management department. According to the 54.4% of people's answers companies prepare an "environmental report" for the public, indicating the costs associated with environmental protection.

Group Statistics					
Gender		N	Mean	Std. Deviation	Std. Error Mean
I regularly follow the innovations related to the solution of environmental problems	Women	60	2.93	1.351	0.174
	Men	146	2.23	1.358	0.112
When buying products, I prefer to buy products that are the least harmful to the environment	Women	60	3.87	0.911	0.118
	Men	146	3.95	1.029	0.085
I buy recycled products, although they are expensive	Women	60	3.50	1.112	0.144
	Men	146	3.61	1.211	0.100
I save electricity, water and fuel to protect the environment	Women	60	3.57	1.140	0.147
	Men	146	2.67	1.169	0.097
I advise people around me not to harm the environment	Women	60	3.73	1.071	0.138
	Men	146	3.01	1.117	0.092

Enterprises need to use green accounting practices in solving environmental problems and managing production waste	Women	60	3.67	0.968	0.125
	Men	146	3.76	1.294	0.107
Since the introduction of environmental accounting by the enterprise will create additional costs for it, it is necessary to provide financial support from the relevant agencies to cover these costs	Women	60	3.88	1.043	0.135
	Men	146	3.10	1.343	0.111
There is no set of specific principles and rules for the application of green accounting in Azerbaijan	Women	60	3.25	1.284	0.166
	Men	146	3.34	1.152	0.095
Businesses should be required to participate in green accounting practices and report on their environmental activities	Women	60	3.98	1.033	0.133
	Men	146	3.53	1.128	0.093
The introduction of green accounting in enterprises indirectly reduces their costs	Women	60	3.52	0.930	0.120
	Men	146	3.62	1.249	0.103
Insufficient information on environmental issues, lack of skilled staff and lack of environmental accounting standards affect accountability	Women	60	4.08	0.809	0.104
	Men	146	4.20	1.068	0.088
I think that green accounting practices will be useful in reducing the waste of natural resources	Women	60	3.90	0.951	0.123
	Men	146	3.68	1.214	0.101

**Table 18.1** *Group Statistics- Differences by Gender of Respondents*

With the answer of "I buy recycled products, although they are expensive", 3.50 average of women agrees, but 3.61 of men have no idea related with. With the answer of "I buy recycled products, although they are expensive", and "I save electricity, water and fuel to protect the environment" 3.50 average of women agrees, but 3.61 of men have no idea related with. According to all answers, the topic that everyone agreed on was "Enterprises

should be required to participate in green accounting practices and report on their environmental activities. "This average is 3.98 which is also high average of the result of the analysis. The topic of "Insufficient information on environmental issues, lack of skilled staff and lack of environmental accounting standards affect accountability" is also accepted by the respondents and has an average score of more than 4. In general, according to the questions in this section, the general opinion of the respondents is that green accounting will be useful in reducing the waste of natural resources, and if implemented, will result in an indirect reduction in costs for companies. However, another common answer is that there are more sections that think that there is no specific set of principles and rules for the application of green accounting in Azerbaijan, and this figure is 3.25 for women and 3.34 for men. In general, since  $p > 0.05$ , there is no difference between the opinions of the responding men and women.

Group Statistics					
Do you have any experience in accounting?		N	Mean	Std. Deviation	Std. Error Mean
I regularly follow the innovations related to the solution of environmental problems	Yes	133	2.58	1.426	0.124
	No	73	2.16	1.291	0.151
When buying products, I prefer to buy products that are the least harmful to the environment	Yes	133	3.89	0.997	0.086
	No	73	3.99	0.993	0.116
I buy recycled products, although they are expensive	Yes	133	3.65	1.123	0.097
	No	73	3.45	1.281	0.150
I save electricity, water and fuel to protect the environment	Yes	133	2.95	1.224	0.106
	No	73	2.89	1.242	0.145
I advise people around me not to harm the environment	Yes	133	3.27	1.142	0.099
	No	73	3.12	1.166	0.136

Enterprises need to use green accounting practices in solving environmental problems and managing production waste	Yes	133	3.83	1.143	0.099
	No	73	3.55	1.302	0.152
Since the introduction of environmental accounting by the enterprise will create additional costs for it, it is necessary to provide financial support from the relevant agencies to cover these costs	Yes	133	3.42	1.333	0.116
	No	73	3.16	1.258	0.147
There is no set of specific principles and rules for the application of green accounting in Azerbaijan	Yes	133	3.24	1.109	0.096
	No	73	3.44	1.323	0.155
Businesses should be required to participate in green accounting practices and report on their environmental activities	Yes	133	3.74	1.072	0.093
	No	73	3.52	1.192	0.139
The introduction of green accounting in enterprises indirectly reduces their costs	Yes	133	3.64	1.089	0.094
	No	73	3.51	1.292	0.151
Insufficient information on environmental issues, lack of skilled staff and lack of environmental accounting standards affect accountability	Yes	133	4.16	0.920	0.080
	No	73	4.18	1.135	0.133
I think that green accounting practices will be useful in reducing the waste of natural resources	Yes	133	3.77	1.084	0.094
	No	73	3.68	1.257	0.147

**Table 18.2** *Group statistics- Differences according to the experience of the respondents*

“Insufficient information on environmental issues, lack of skilled staff and lack of environmental accounting standards affect accountability” and “I save electricity, water and fuel to protect the environment” based on these indicators, the average value of the answers is over 4, and although whether or not responders have experience all of them think the same. “I regularly follow the innovations related to the solution of environmental problems” is above 2, which indicates that they are undecided about their sensitivity to environmental problems. The answers for the other sections

are almost the same, and the indicator is over 3. As a result of this analysis, as  $p > 0.05$ , there is no difference between the answers of those who have accounting experience and those who do not.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.589	0.579	12

**Table 18.3** *Reliability Statistics*

The Cronbach's Alpha value obtained from the study is 0.589, indicating that the study is reliable.

Item Statistics			
	Mean	Std. Deviation	N
Insufficient information on environmental issues, lack of skilled staff and lack of environmental accounting standards affect accountability	4.17	0.999	206
The introduction of green accounting in enterprises indirectly reduces their costs	3.59	1.164	206
Businesses should be required to participate in green accounting practices and report on their environmental activities	3.66	1.118	206

**Table 18.4** *Item Statistics*

In general, the most agreed topic was “Insufficient information on environmental issues, lack of skilled staff and lack of environmental accounting standards affect accountability” and the average score was 4.17. Other more accepted titles among 206 person`s answers were "The introduction of green accounting in enterprises indirectly reduces their costs" and "Businesses should be required to participate in green accounting practices and report on their environmental activities". The averages are 3.59 and 3.66 as appropriately.



I advise people around me not to harm the environment		I save electricity, water and fuel to protect the environment				Independent Samples Test
Equal variances not assumed	Equal variances assumed	Equal variances not assumed	Equal variances assumed	F		Levene's Test for Equality of Variances
	0.034		0.003	Sig.		t-test for Equality of Means
	0.853		0.958	T		
4.366	4.290	5.083	5.030	Df		
114.226	204	112.443	204	One-Sided p	Significance	
0.000	0.000	0.000	0.000	Two-Sided p	Mean Difference	
0.000	0.000	0.000	0.000	Std. Error Difference		
0.726	0.726	0.895	0.895		95% Confidence Interval of the Difference	
0.166	0.169	0.176	0.178	Lower		
0.397	0.393	0.546	0.544	Upper		
1.056	1.060	1.244	1.246			

**Table 18.5** *Independent Samples Test*

The reason for the analysis of this test is to determine whether there is a difference between the answers of women and men, and if there are any differences, to determine the cause. If  $Sig < 0,05$  it indicates a difference between groups. According to the analysis there were disagreements among the respondents related with the topics about “I save electricity, water and fuel to protect the environment” and “I advise people around me not to harm the environment”. The main reason for this difference is that people still do not have a complete understanding of green accounting and do not know enough about the financial aspects of the subject. It is estimated that introduction of green accounting in Azerbaijan is a very difficult task, because of the lack of sufficient financial support and only focus on the high costs on the current short-term instead of its future benefit. The implementation of this system is valued as a temporary financial loss and a waste of time, because conducting trainings

for using the new system is a burden.

Likert questions	1	2	3	4	5
I regularly follow the innovations related to the solution of environmental problems	34				
I save electricity, water and fuel to protect the environment		31.6			
I advise people around me not to harm the environment		29.6			
The introduction of green accounting in enterprises indirectly reduces their costs			29.1		
There is no set of specific principles and rules for the application of green accounting in Azerbaijan			28.2		
When buying products, I prefer to buy products that are the least harmful to the environment				38.3	
I buy recycled products, though expensive				37.9	
Environmental accounting will create additional costs, it is necessary to provide financial support from the relevant agencies to cover costs				28.6	
Businesses should be required to participate in green accounting practices and report on their environmental activities					31.1
Insufficient information on environmental issues, lack of skilled staff and lack of environmental accounting standards affect accountability				46.6	
I think that green accounting practices will be useful in reducing the waste of natural resources					31.6
Enterprises need to use green accounting practices in solving environmental problems and managing production waste					34.5

Table 18.6 Likert Questions (Numbers demonstrate percentage of the answers)

Likert question types were evaluated in 5 ways as 1: Strongly disagree, 2: Disagree, 3: No idea, 4: Agree, 5: Strongly agree according to the participation of the respondents. 34% of respondents determine that they do not regularly follow the innovations related to the solution of environmental problems. This shows that people's sensitivity to the environment is low. According to the survey 31.6% and 29.6% of people disagreed to "I save electricity, water and fuel to protect the environment" and "I advise people around me not to harm the environment" as respectively. Respondents are indecisive about the topics related with "The introduction of green accounting in enterprises indirectly reduces their costs" (29.1%) and "Azerbaijan does not have a set of specific principles and rules for the application of green accounting" (28.2%). Respondents answer that they agree with "When buying products, I prefer to buy products that are the least harmful to the environment" (38.3%), "I buy recycled products, though expensive" (37.9%), "Environmental accounting will create additional costs, it is necessary to provide financial support from the relevant agencies to cover costs" (28.6%) and they strongly agree with "Businesses should be required to participate in green accounting practices and report on their environmental activities" (31.1%), "I think that green accounting practices will be useful in reducing the waste of natural resources" (31.6%) and "Enterprises need to use green accounting practices in solving environmental problems and managing production waste" (34.5%).

### 18.6. Conclusion

Green growth is referred as economic growth, because it leads to a green economy. According to The United Nations Environment Programme (UNEP) green economy is one of the ways for improve human well-being and social equity, reducing environmental risks and ecological scarcities. Target of the green economy is to harmonize eco-efficiency strategies between the environment and the economy. Current models for growth continues to erode natural resources and economic services which are depends on economic activity. The development of economic capacity is unpredictable because it does not follow a linear, foreseeable trajectory and failure to manage natural capital results in increasing costs of services it provides. Adoption of green economy is still a difficult topic to implement in underdeveloped and developing countries. Because most companies are oblivious outcomes of impementation of green accounting. The company's current actions towards the green cause will have a long-term

or a short-term influence on the environment.

Companies could be a leader if they implement green changes and encourage to other companies integrate as well. Higher environmental responsibility can be achieved when green accounting is incorporated at all levels of the organization. All the costs undertaken by the enterprises are within the scope of environmental cost and these costs must comply with environmental obligations. Environmental costs are considered as the costs that are important to be incurred by businesses for purpose of taking appropriate measures to achieve environmental objectives, taking actions to prevent negative impact on the natural environment, implementing national environmental protection laws, amendments, policies (Jing and Songqing, 2011).

In this article, it has been to find out how the green accounting implement in Azerbaijan with using survey questions applied by reaching 206 people. As a general result of the survey, respondents declare that green accounting is used in large companies in Azerbaijan. According to the answers, respondents learn green accounting mainly during their work or from other resources, not during their education. It shows that there is an insufficient theoretical background in Azerbaijan. As a result, there are reasons such as the lack of specific principles for green accounting and insufficient information on environmental issues, lack of skilled personnel and low sensitivity of people to environmental problems. According to employee responses, although the apply of green accounting in companies has increased, not all companies provide separate training for employees and do not allocate sufficient financial budgets for waste management. As a result, according to the results of both theoretical and survey research, in general in Azerbaijan, these expenses are very onerous for small companies and it is a short-term focus for them, but large companies have a department for these activities and waste management. Although the environmental awareness is insufficient in Azerbaijan, but it is increasing day by day as a result of recent environmental agreements and new practices. As can be understood from the answers of the respondents, the importance of environmental accounting is understood and applied as possible as by both individuals and businesses in the recent years.

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