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Strategic Environmental Assessment of the National Strategy of Azerbaijan on the Use of Alternative and Renewable Energy Sources 2015 – 2020

Executive Summary

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Baku

ETSN

IREA

REC CAUCASUS

OECD
BETTER POLICIES FOR BETTER LIVES

UNECE

UN environment

UNIDO

CONTENTS

ABBREVIATIONS

ARES - Alternative and Renewable Energy Sources

EaP GREEN – Program on Greening Economies for Eastern Partnership Countries

EIA – Environmental Impact Assessment

EU – European Union

MENR – Ministry of Ecology and Natural Resources

SAARES – The State Agency on Alternative and Renewable Energy Sources

SEA – Strategic Environmental Assessment

SEE – State Environmental Expertise

UNECE – United Nations Economic Commission for Europe

UNEP – United Nations Environment Programme

UNIDO – United Nations Industrial Development Organization

1. INTRODUCTION

1.1 Purpose of this document

This document provides an Executive Summary of the analyses, findings, main conclusions and recommendations of the Strategic Environmental Assessment (SEA) carried out for the 'National Strategy of Azerbaijan on the Use of Alternative and Renewable Energy Sources, 2015 – 2020' (the 'Strategy'). This is one of the first SEAs conducted in Azerbaijan and is therefore referred to as a 'SEA pilot'. It summarizes the outcomes of the main analyses conducted during the SEA process, including assessments of the impacts that are most likely to occur due to the implementation of the Strategy on the environment and human health. A critical step in the SEA process is to identify and formulate the most effective prevention and mitigation measures to address the impacts identified in this assessment of the proposed Strategy. These measures, along with the conclusions from the discussions and consultations with relevant agencies and the public, are also outlined in this document.

1.2 Background Information

An SEA is an important tool for evaluating the likely environmental (including health) effects of proposed new policies, plans and programmes (strategic documents), and to integrate the findings and recommendations into the decision-making process on whether to approval or reject the adoption of the strategic document. SEA is a necessary assessment method for taking into consideration environmental problems and sustainable development principles during the planning and at the initial stage of strategic decision-making.

The types of strategic documents that an SEA evaluates include relating to agriculture, forestry, fisheries, energy, industry, transport, waste and water management, natural resources, energy, tourism, telecommunication, environmentally sensitive areas, and land use and urban planning. SEA complements environmental impact assessment (EIA), which evaluates the likely environmental and health effects of development proposals (projects).

The SEA pilot has been implemented within the framework of the 'Greening Economies in the Eastern Neighbourhood'[1] (EaP GREEN) initiative, financed by the European Commission, and four implementing agencies (United Nations Economic Commissions for Europe – UNECE, Organisation for Economic Co-operation and Development – OECD, United Nations Environment Programme – UNEP, and United Nations Industrial Development Organisation – UNIDO). The project was supported by the UNECE Secretariat of the Convention on Environmental Impact Assessment in a Transboundary Context and its Protocol on SEA. The Ministry of Ecology and Natural Resources of the Republic of Azerbaijan and the State Agency on Alternative and Renewable Energy Sources (SAARES) were the key governmental institutions coordinating the SEA pilot, while the Regional Environmental Centre for the Caucasus[2], Baku office, provided logistical support for the implementation the activities under the pilot.

[1] EaP Green 'Greening Economies in the Eastern Neighbourhood' programme, more information can be found at http://www.oecd.org/env/outreach/eapgreen.htm

[2] Regional Environmental Centre for the Caucasus, URL: http://www.rec-caucasus.org/

The objectives of this SEA pilot are as follows:

- To enhance the experience with practical SEA application in Azerbaijan.
- To test the application of SEA provisions stipulated by the Draft Law on EIA and consider lessons learned for further development of the national legal framework for SEA.
- To formulate recommendations on optimizing the National Strategy on the Use of Alternative and Renewable Energy Sources 2015 – 2020 (from an environmental and human health perspective).

The types of ARES included in the Strategy and evaluated as part of this SEA are:

- Solar Energy,
- Solar Heating and Geothermal Energy,
- Biogas Energy,
- Wind Energy, and
- Small Hydropower Plants.

The Strategy promotes the use, development and legal basis for Alternative and Renewable Energy Sources (ARES)[3] in Azerbaijan, and creates the management and administrative structures for ARES. Therefore, this SEA evaluates and makes recommendations about the environmental and socio-economic impacts associated with the development of ARES. It does not evaluate the technical or site-specific issues associated with the individual ARES proposals, as development applications and approvals processes for specific ARES proposal are expected to be required by the EIA Law or other Azerbaijani national policies and legislation at a later stage.

1.3 Description of the National Strategy of Azerbaijan on the Use of Alternative and Renewable Energy Sources 2015 – 2020

The preparation of the 'National Strategy of Azerbaijan on the Use of Alternative and Renewable Energy Sources, 2015 – 2020' (the 'Strategy') was initiated on December 2011 by the Presidential Resolution. The State Agency on Alternative and Renewable Energy Sources (SAARES) has been responsible for preparation of the Strategy and will also be responsible for coordinating its implementation. The implementation of all planned measures under the Strategy should, by 2020:

(i) increase the share of Alternative and Renewable Energy Sources (ARES) on electricity production up to 20%, and

[3] The term 'Alternative and Renewable Energy Sources (ARES)' is used by the Government representatives of Azerbaijan and refers to the production of clean energy (i.e. Wind Farms, Solar Power Plants, Hydropower Plants, Geothermal, Biogas)

(ii) increase the share of ARES on total consumption up to 9.7%.

The implementation of the Strategy should lead to a reduction in greenhouse gas (GHGs) emissions as well as achieve a greater diversity of energy resources used in Azerbaijan. Thus, the Strategy is in accordance with the EU Directive 2012/27/EU on Energy Efficiency[4].

The Strategy stipulates the main priorities for renewable energy development and indicates the potential for various renewable energy resources. It does not provide any details regarding specific projects or measures, but it will be followed-up by an Action Plan.

The overall objectives of the Strategy are as follows:

- To define ARES, calculate ARES potential in Azerbaijan, and to establish the state cadastre (land areas and locations within the country) on ARES.
- To create a regulatory legal base for ARES.
- To arrange a tariff policy on ARES, and to adopt measures stimulating its innovative use;
- To ensure efficient use of ARES.
- To organize centralized management infrastructure for ARE, and to establish cooperation with other executive and self-governing authorities.
- To promote the creation of specialized human resources on ARES in educational institutions and research centres.

Strategy stipulates sectoral objectives and directions, including those listed below, to be further elaborated upon:

- Privatization, reorganization and reconstruction of existing small hydropower plants.
- Development of wind farms.
- Application of solar heating systems on the buildings.
- Increasing efficiency of photoelectric cells and commencement of their production.
- Installation of heating systems in public and residential buildings and other objects using geothermal water energy.
- Research work on sea waves energy.
- Enhancing technologies on production and application of bio substances, application of small biogas power plants.
- Enhancing technologies for production of coke briquettes and other products out of oil processing waste.
- Establishing statistics of ARES.

[4] The Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, https://ec.europa.eu/energy/en/topics/energy-efficiency/energy-efficiency-directive

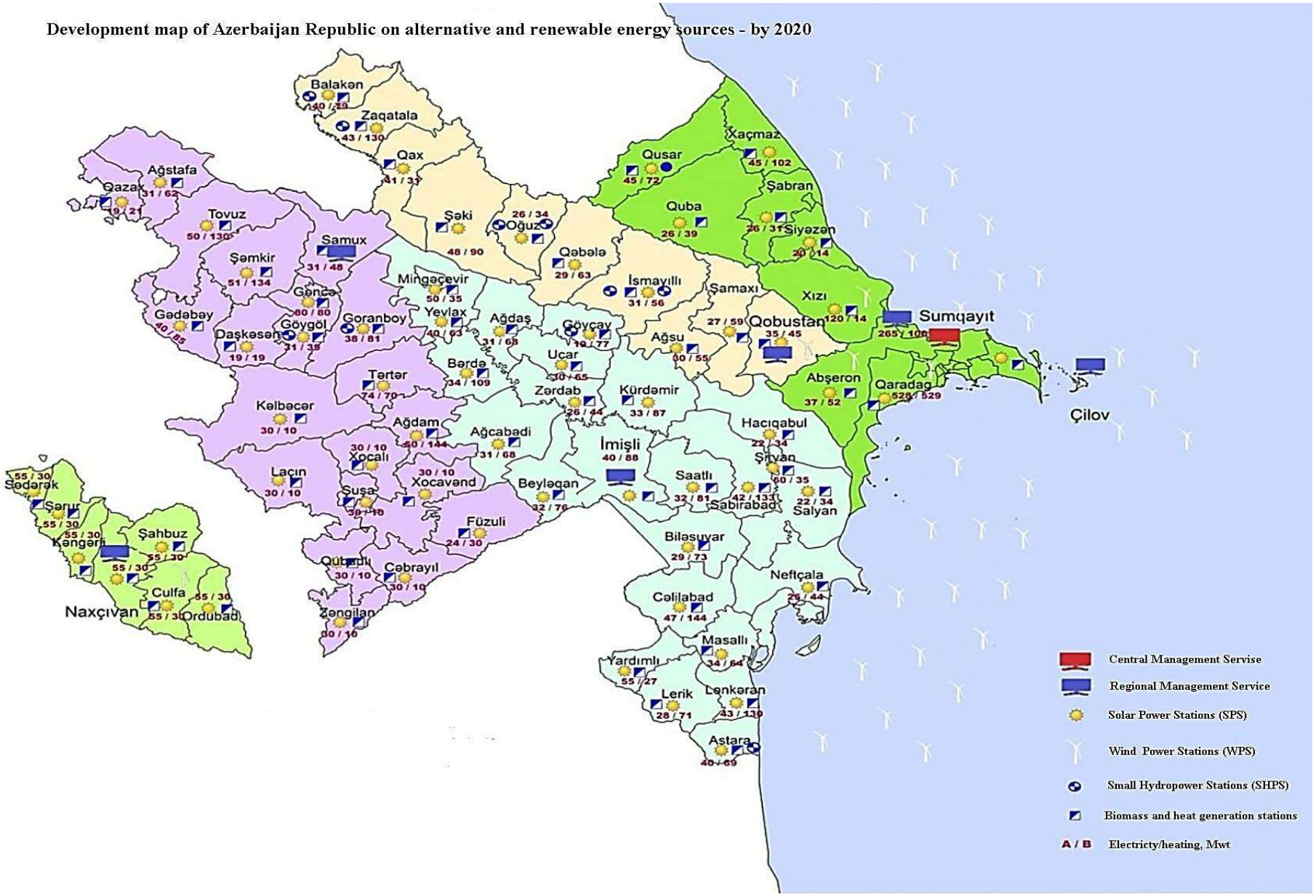
The table below outlines the planned capacities of ARES under the Strategy:

Years	Solar Energy (MWh)	Solar Heating and Geothermal Energy (MWh)	Biogas Energy (MWh)	Wind Energy (MWh)	Small Hydropower Plants (MWh)
2013 – 2016	790	1,000	100	150	15
2017 – 2018	685	1,500	200	150	20
2019 – 2020	730	2,000	215	212	25
Total (MWh)	**2,065**	**4,500**	**515**	**512**	**60**

The maps have been elaborated by the SAARES indicating the main areas where ARES will be explored. The scheme below illustrates the proposed spatial distribution of ARES development in the country.

An Action Plan will be prepared for the Strategy's implementation, and submitted to the Cabinet of Ministers after the adoption of the Strategy. Although the information prepared under the Action Plan is not directly part of the Strategy, the SEA pilot has taken the draft Action Plan's information into account, in order to gain a better understanding of the proposal's elements and to identify spatial dimensions of likely risks.

Development map of Azerbaijan Republic on alternative and renewable energy sources - by 2020



1.4 SEA process

The SEA pilot for the Strategy was initiated in January 2015. The first draft SEA report was prepared in December 2015, and further finalized in the period from January to June 2016.

The SEA pilot process was jointly coordinated by Azerbaijan's Ministry of Ecology and Natural Resources (MENR) and the SAARES, and the following main steps and analyses were conducted:

- ***Scoping:*** Defining the key environmental and health issues relevant to the Strategy that are to be addressed in the SEA.
- ***Environmental baseline:*** Identification and analysis of the baseline conditions (the existing socio-economic and environmental conditions within the study area), in order to be able to distinguish the key environmental and health impacts caused by the Strategy.
- ***Assessment:*** Evaluation of the likely environmental and health effects related to the Strategy and formulation of relevant mitigation measures.
- ***Environmental report:*** Drafting of the SEA report.
- ***Consultations:*** Engagement of the public, relevant stakeholders and government bodies (including those in neighbouring countries, in the case of transboundary effects) in the SEA process, and integration of these comments into the SEA analysis and recommendations.
- ***Conclusion and recommendations:*** Summary of the key findings, recommendations for the Strategy, and proposal of follow-up work, monitoring and evaluation to be undertaken.

The consultations with relevant stakeholders were carried out in the scoping stage as well as when the draft Strategy and SEA report were made available. The scoping consultation meeting was organized in Baku on May 12, 2015, which aimed to share and discuss the proposed scope of assessment and to get feedback on the key environmental and health issues. The findings and conclusions regarding likely impacts were presented at the public meeting in Baku on December 9, 2015. Opinions and proposals expressed during the public consultations were taken into consideration in the final SEA report. As well as consultations with stakeholders, regular meetings were held with the SEA expert team and representatives of the MENR and SAARES, where interim SEA outputs were discussed.

2. SCOPE OF SEA

The table below summarizes main environmental and health issues identified in the scoping stage of SEA pilot together with the risks and opportunities related to the Strategy.

Main issues	Risks and opportunities related to the Strategy
Air	• Higher use of ARES may lead to a reduction in energy produced from fossil fuels and thus to a decrease in emissions of pollutants into the air • Use of biogas and its decomposition may negatively affect air quality
Climate change	Greenhouse gas (GHG) emissions • Higher use of ARE may lead to a reduction in energy produced from fossil fuels and thus to a decrease of GHG emissions • Energy from biomass may cause an increase of CO_2 and methane emissions Adaptation to climate change The likely consequences of climate change can impact on natural resources and renewable energy production – such as the Caspian Sea level rise, reduction of water resources, more frequent floods, changes in biogas production (because of aridity), changes in wind direction, etc. Therefore, the proposed Strategy for using ARES should be able to adapt to these risks.
Soil	• Construction of large-scale solar power plants will require large areas of land and may adversely affect soil quality, especially the fertile upper layer of soil • Development of water reservoirs (for hydropower energy) can result in land erosion across the river bed • Geothermal energy installations may affect soil structure • Biomass production (for energy use) may have negative impact on soil

Water resources	The use of ARE may contribute to the decrease of fossil fuels for energy and thus the decrease in pollution and waste spills from fossil fuel facilities into water resources. Solar energy • Use of large amounts of water to wash solar panels and use of chemical substances to the clean dust off the surface of solar panels, and use of herbicides against insects on the surface of solar panels may cause water pollution. The chemical substances to be considered are hydrochloric acid, sulphate acid, nitrate acid, hydrogen fluoride and acetone. Hydropower: • Hydropower development can lead to changes in the water regime, which can result in drying out certain segments within river basins • Hydropower development may cause changes in the physicochemical characteristics of the river (including temperature and chemical content) • Dams and water reservoirs may change hydro-geological structures, which can result in an increase in ground water levels Wind energy: • Offshore wind farm development (construction, exploitation, transportation and operation of wind farms) may cause changes to sea water through water pollution (during transport and construction) • Offshore wind farms may affect sea currents Geothermal energy: • Geothermal energy development can result in an increase of deep ground water use
Landscape	• Solar plants and wind farms may affect natural areas of local, regional or national significance, including national parks, natural heritage and recreational places • Onshore wind farms' changes to the visual landscape and excavating for the turbines and underground infrastructure may affect areas that have heritage status • Wind farms may have visual impacts on marine areas as well as on coastal areas, which generally provide unique landscape views • Hydropower dams and water reservoirs (especially in lowland areas) would change the landscape characteristics of the area

Biodiversity	Hydropower • Development of hydropower plants may cause a change in physicochemical parameters of water flow (temperature, flow regime, dissolved gas) which can affect aquatic biodiversity as well as can lead to pressure on terrestrial ecosystems • Development of hydropower plants may reduce the water flow in rivers, resulting in water deficit, and thus negatively affect aquatic biodiversity in the rivers (e.g. fish populations) • Development of hydropower plants may lead to river fragmentation and thus negatively affect fish migratory corridors Wind energy • Wind farms can have adverse impacts on birds (sea birds, migratory birds) and bats, especially if located close to Special Protected Nature Areas Underwater noise and vibrations from construction of offshore wind turbines may disturb fish populations and other marine species (including seas mammals, benthos and plankton) Solar power • Birds, bats and insects may be impacted by solar plants
Waste management	• Rapid development of ARE may result in an increase in the amount of construction waste and may introduce new types of waste (e.g. used solar panels)
Human health	• Wind farms may cause disturbances to residents due to low level noise/vibrations • Supply of renewable energy may reduce the need for fossil fuel power generation, thus decreasing pollution and emissions of harmful gases such as nitrogen oxides, sulphur dioxide, and carbon dioxide, which can lead to better air quality, water quality, soil quality and overall human health • Biomass energy (and energy from waste) may cause air pollution, which can have negative impacts on human health
Livelihood	• ARE development may improve the quality of life of people, especially in remote and rural areas, through new sources of livelihood and employment, as well as through the upgrading of local infrastructure and community facilities • Diversifying energy resources can lead to a reduction in the use of energy from fossil fuels and an improvement in the energy supply • Changing the water regime as a result of hydropower development may have negative impact on fishing industry, which may negatively affect local economy • Hydro, solar, and wind energy plants demand land acquisition, which may impact material cultural heritage and traditional use of lands

Linkages to other economic sectors	• Offshore wind farms may have an impact on tourism by reducing the attractiveness or tourist interest in coastal areas • Offshore wind farms can lead to conflicts with the oil, gas and fishing industries • New construction works (including hydropower, solar, wind farm facilities and transmission lines) can compete with agriculture regarding the use of natural resources (e.g. producing biomass on agricultural soil)

3. POTENTIAL EFFECTS AND RISKS RELATED TO THE STRATEGY

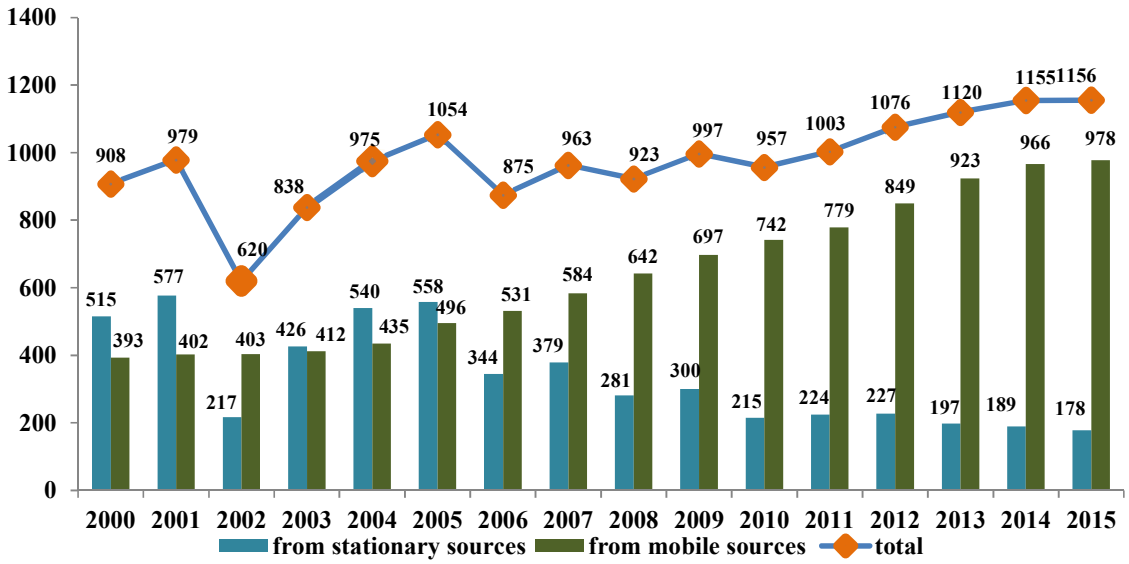
The following sections of this chapter provides a summary of the baseline (the existing environmental, social and economic conditions regarding the issues identified in scoping), followed by an analysis of the potential effects on the key issues that are likely to occur due to the implementation of the Strategy.

It should also be acknowledged that unknown future changes in land uses, other developments in the study area, and climate change can all add uncertainty to the impacts of ARES Strategy, and therefore more detailed assessments of the individual projects and their location-specific issues should be addressed at the development proposal stage.

3.1 Air quality

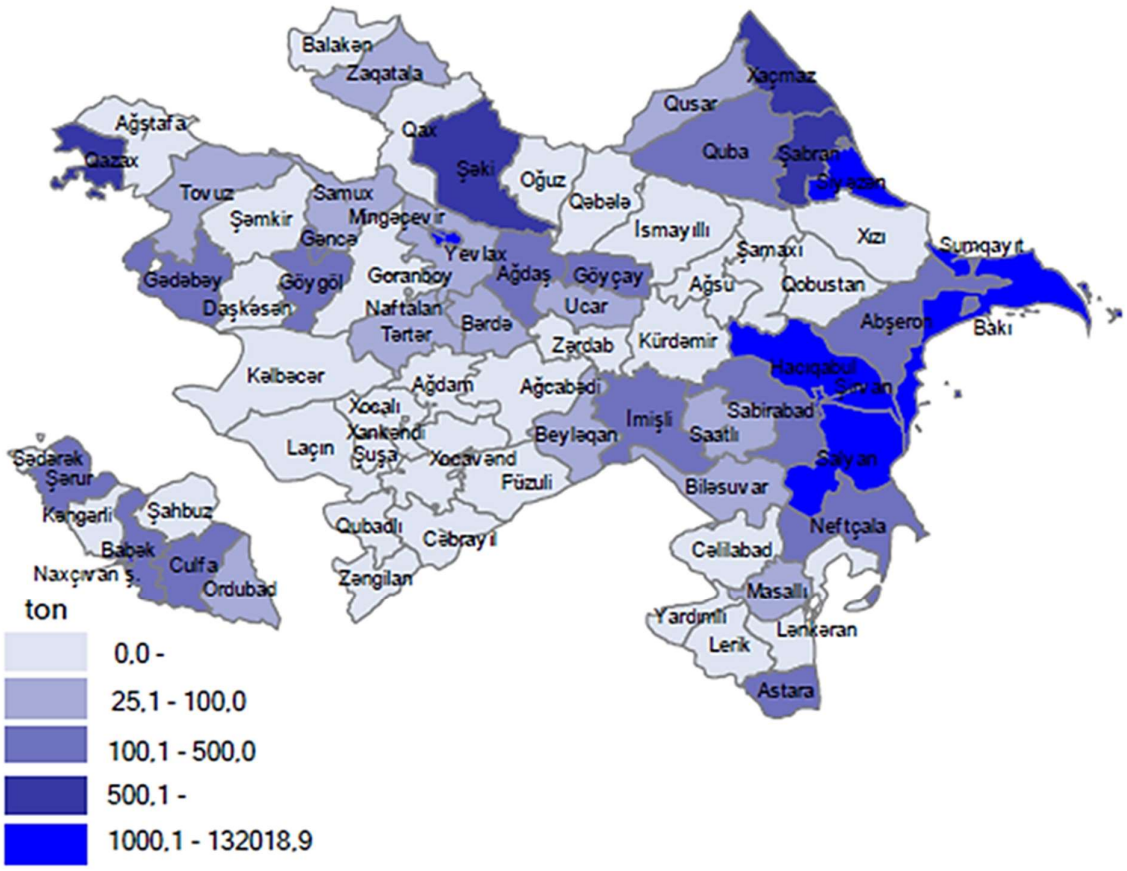
Baseline

The analysis of air quality concluded that the main sources of air pollution are the stationary sources in the energy sector (i.e. oil and gas production and processing), as well as industry and transport (mainly concentrated on Absheron Peninsula). The graph below illustrates the air emissions trend in the country (in thousands of tons).[5]



Territorially, the air quality is very low in the Absheron Peninsula, including Baku. The analysis demonstrated that air quality in other economic regions in the country is at a good level for environmental and human health, and not exceeding the allowed concentration levels. The map below illustrates the amounts of air pollutants in the regions in 2014 (in tons).[6]

[5] The State Statistical Committee of Azerbaijan Republic. "Environmental protection", 2015.
[6] The State Statistical Committee of Azerbaijan Republic. "Environmental protection", 2015.



Analysis of Potential Impacts of the Strategy

Considering the current environmental conditions and the objectives of the Strategy, it can be concluded that higher use of ARES may lead to a reduction in energy produced from fossil fuels and thus a decrease in emissions of air pollutants to the air. However, this positive effect can only be expected if ARES replace energy production from fossil fuels.

There may be local adverse impacts on air quality, especially during construction and decommissioning of the energy facilities, however these can be addressed and minimized at the project level by technical measures. In addition, the use of biogas and waste incineration may negatively affect the air quality (through emissions of methane, NO_x, sulphuric hydrogen, etc.), however, these will be localized impacts to be managed and minimized at the project stage, and should not significant at the strategic level.

3.2 Climate change

Baseline – GHGs emissions

The energy sector produces the largest share of GHGs emissions in Azerbaijan, as illustrated in the table below[7]:

[7] The State Statistical Committee of the Republic of Azerbaijan, http://www.stat.gov.az/source/environment/indexen.php

Greenhouse gas emissions by sectors (GHGs in CO_2 equivalent, million ton)					
Sectors	**Years**				
	2010	**2011**	**2012**	**2013**	**2014**
Energy	36.6	37.4	39.3	38.2	39.1
Industrial processes	2.1	2.9	3.0	3.1	3.2
Agriculture	7.2	7.1	7.0	6.9	7.1
Land use, land use change, forestry[1)]	-5.4	-5.4	-5.4	-5.4	-5.5
Waste	2.3	2.4	2.5	2.5	2.6
Total land use and its change, including forestry	48.2	49.8	51.8	50.7	52.0
Total land use and its change, excluding forestry	42.8	44.4	46.4	45.3	46.5
[1)] Negative values are used to indicate absorption of gas					

As obvious from the table, 39.1 million tons of GHGs in CO_2 equivalent were emitted by Azerbaijan's energy sector in 2014. At present, the entire country has access to electricity services, generated predominantly by thermal (oil-fired) power plants, as well as hydropower. The electrical energy system of Azerbaijan consists of 13 thermal and 15 hydropower plants.[8] The total power generated by the country was 7,348 MW in 2014 according to governmental official statistics, consisting of approximately 6,270 MW from thermal power plants and 1,078 MW from hydropower plants. According to the Second National Communication to the UNFCCC, Azerbaijan has high potential for alternative energy generation – particularly wind power and hydropower in the Absheron Peninsula, along the banks of the Kura River and in the Nakhchivan Republic[9].

Baseline – likely consequences of climate change

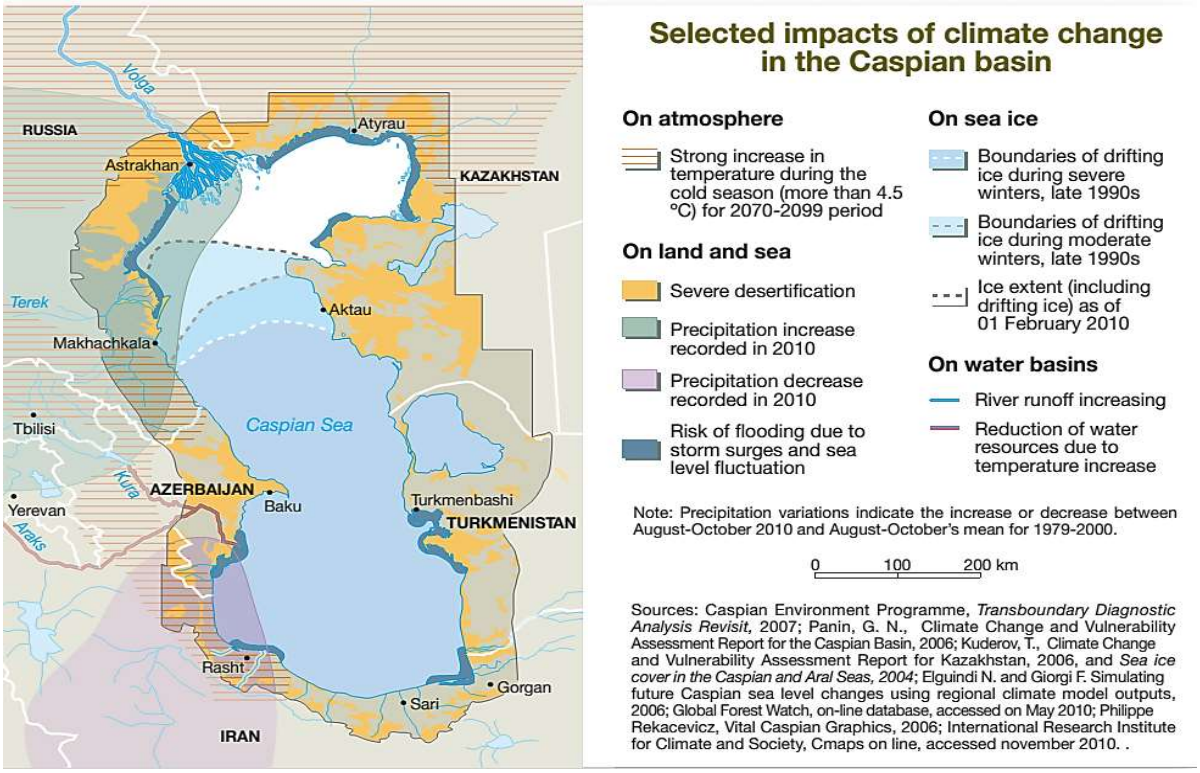
A recorded rise in annual mean temperature in Azerbaijan for the period from 1990 to 2000 was approximately 0.41°C. The yearly mean temperature in this period was increasing at a faster rate compare to the period 1961 – 1990[10]. Looking forward, according to climate change projections provided in the Second National Communication Report to the UNFCCC, the annual mean temperature in Azerbaijan will rise by 1.3°C – 1.6°C during the period from 2021 to 2050[11], in comparison to the period from 1961 to 1990.

There are several likely consequences of climate change that can significantly influence renewable energy production in Azerbaijan – the Caspian Sea level rise, the reduction of water

[8] http://www.azerenerji.gov.az/index.php?option=com_content&view=article&id=91&Itemid=112&lang=en
[9] UNFCCC, Azerbaijan Second National Communication, 2010
[10] Azerbaijan Second National Communication, 2010
http://www.adaptation-undp.org/sites/default/files/downloads/azerbaijan-second_national_communication_2010.pdf (Page 12).
[11] Azerbaijan Second National Communication, 2010
http://www.adaptation-undp.org/sites/default/files/downloads/azerbaijan-second_national_communication_2010.pdf

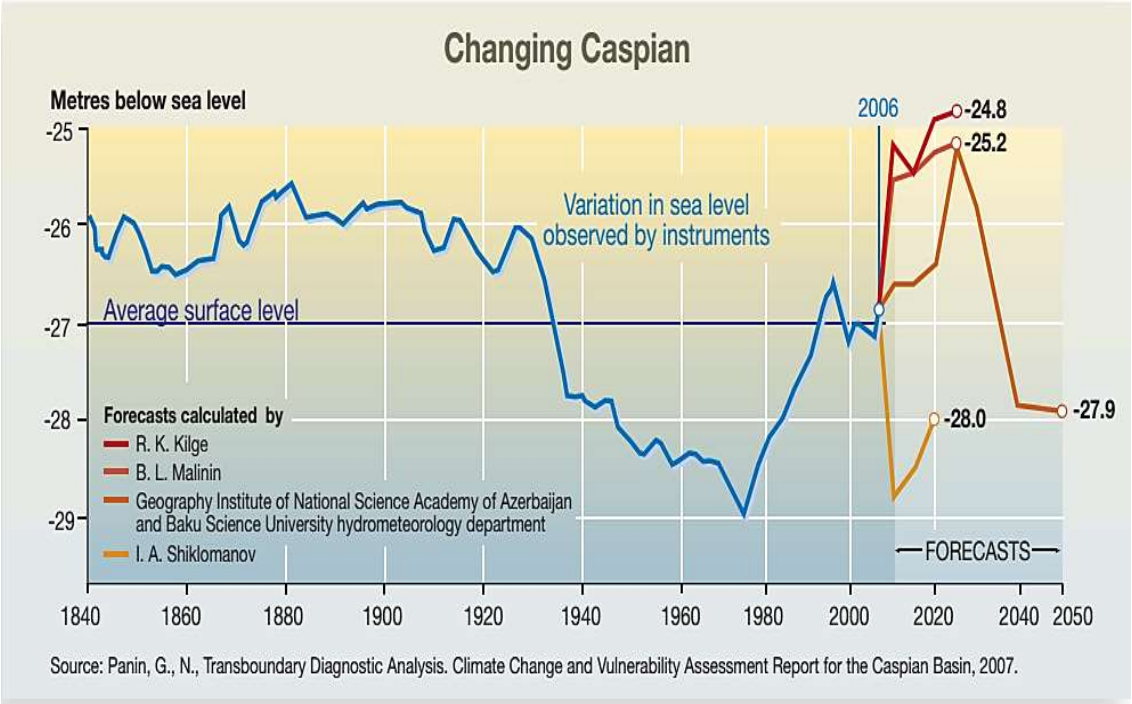
resources, more frequent floods, changes in biogas production (due to aridity), as well as changes in wind direction. Several studies predict that the frequency of certain natural events – torrential rains, flooding, mudflows, drought, sea level fluctuations in the Caspian Sea – may increase, and the change of climate may reduce forests and cultivable land resources in the country. The amount of precipitation is predicted to increase by 10 – 20% during the period from 2021 to 2050, in comparison to the period from 1961 to 1990 (such as an increase of 10% in Nakhchivan MR and 20% in the eastern regions of the country).

It is also forecasted that climate change will likely have a significant impact on Azerbaijan's water resources, agriculture, coastal zones, and the energy sector. For example, surface water resources are projected to reduce by 23% between 2021 and 2050, a loss of 22.5 km^3, which in turn would impact water supplies for agriculture. In addition, due to sea level rise, approximately 500 km^2 of the Caspian Sea coast in Azerbaijan has been subjected to flooding since 1978[12]. Although only limited assessments of the implications of climate change on Azerbaijan's resources are available, certain effects can be assigned to climate change e.g. temperature increases and changes in precipitation (Panin 2006). The map below illustrates selected likely climate change impacts to the Caspian Sea.



Computer modelled estimates for sea level vary considerably, with some predicting a drop of up to 4.5 metres while others forecast a rise of up to 6.4 metres. Even with maximum water flows into the Caspian Sea, it is unlikely the sea level will exceed the marks of 25 metres in the short to medium term (Panin 2006).

[12] Azerbaijan Second National Communication, 2010
http://www.adaptation-undp.org/sites/default/files/downloads/azerbaijan-second_national_communication_2010.pdf



Analysis of Potential Impacts of the Strategy

Taking into account the energy sector in Azerbaijan and the objective of the Strategy to reach 20% of total energy produced from ARES, it can be expected that implementation of the Strategy should lead to a reduction in GHGs emissions compared to the 'zero scenario' (i.e. the status quo, without the development of ARE). The calculations carried out within SEA show that 2,368.76 tons of the fossil fuels can be saved if energy production is replaced by the energy from ARES (taking into account Strategy's targets for individual energy sources).

The concludions above confirms that the Strategy's implemntation is in line with the Government of Azerbaijan's priorities regarding the reduction of GHGs emissions by increased use of ARES. However, it needs to be emphasized that this positive effect will only materialize if the energy production from fossil fuels decline simultaneously, meaning that a reduction in GHG emissions will only be achieved if energy produced from fossil fuels is replaced by energy produced from ARE. It also needs to consider biogas energy production and energy from waste produce GHGs emissions.

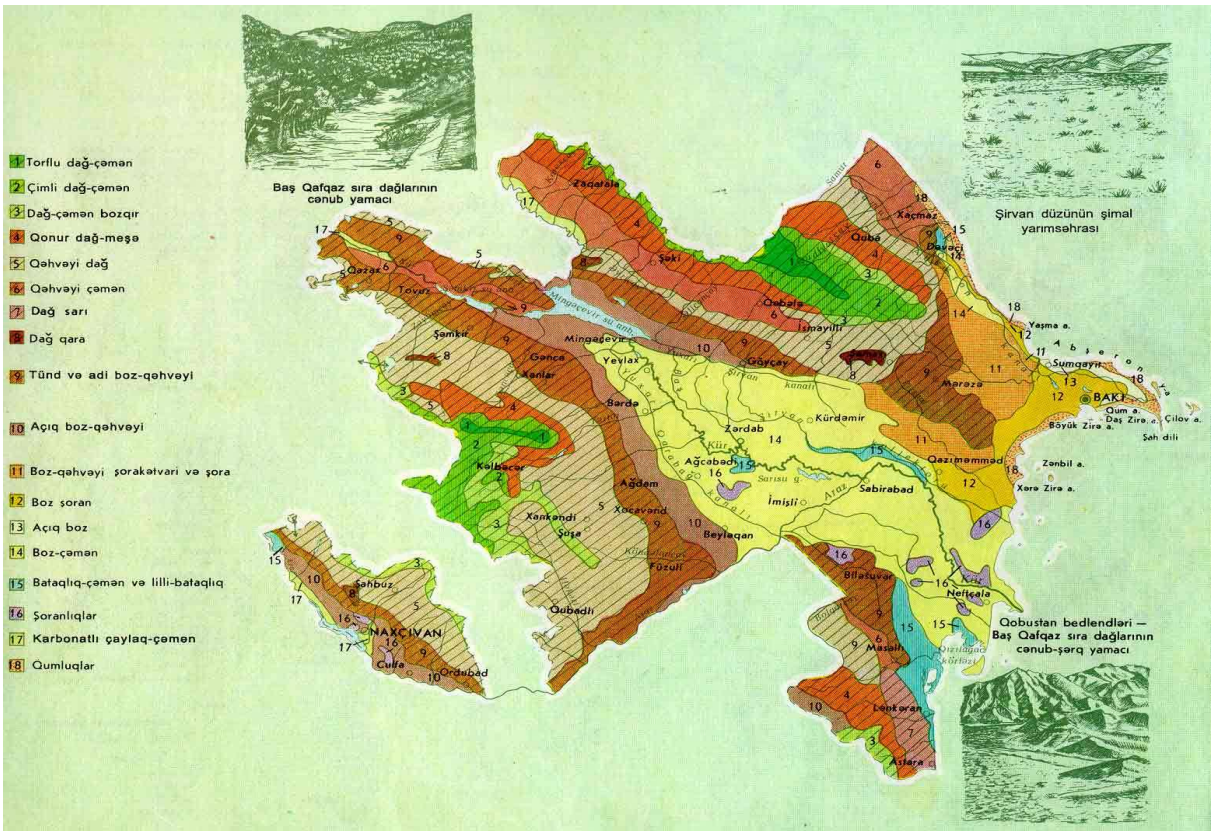
As mentioned above, the likely consequences of climate change may affect Azerbaijan's operation and efficiency in energy production from ARES. Therefore, climate change projections and impacts (such as changes in water resources) need to be taken into account when further planning ARE development. In addition, construction techniques and infrastructure development (such as hydropower plants and wind farms) should be adapted and built to withstand severe climatic conditions.

3.3 Soil

Baseline

Azerbaijan comprises a total land area of 86,600 km^2, including 47,698 km^{2}of the land suitable for agriculture (55.08%) with 12,104 km^2 (22.95%) ha of arable land[13]. More than 16% of the total area of the country is irrigated land. There has been an increase of irrigated arable areas as well as of agricultural intensity.

The map below illustrates the soil types in Azerbaijan.

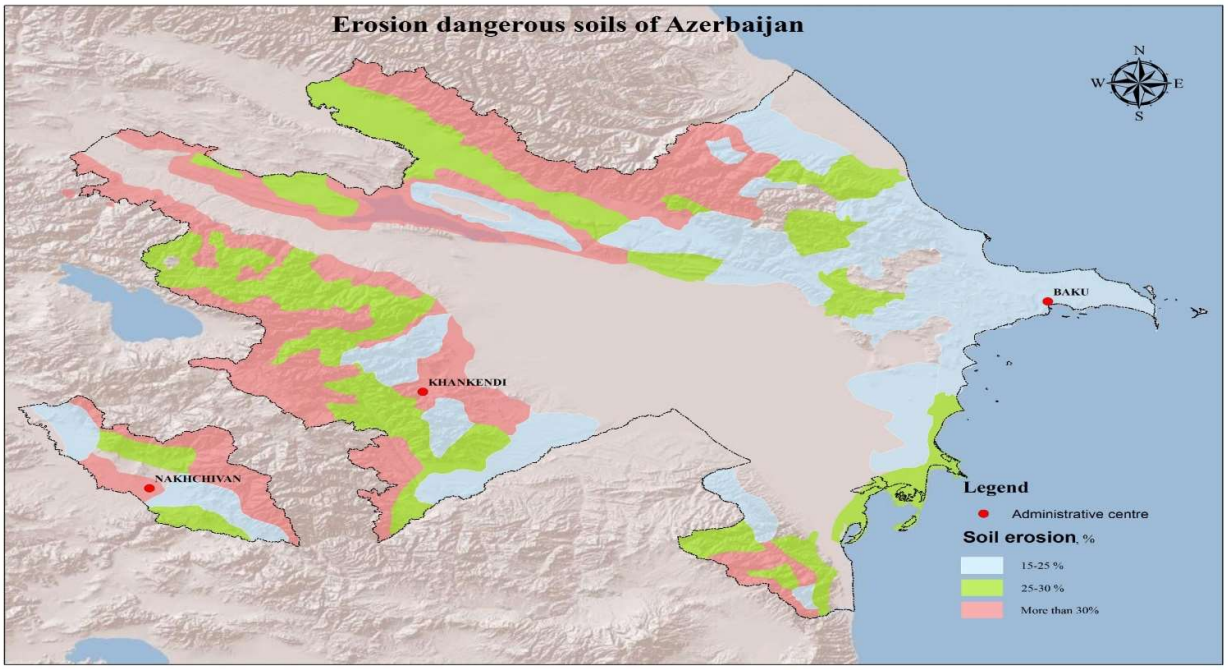


There are two types of factors affecting soil resources in the country:

1. **Natural factors: these include** droughts, flooding, mudflows, variations in climate, and Caspian Sea level fluctuations.
2. **Anthropogenic factors:** a wide range of factors have contributed to the degradation of soil cover in Azerbaijan, including erosion, salinity, intensive agricultural practices and inadequate and extensive irrigation systems, industrial operations (especially in oil and gas sector, ore mining, construction, etc.), contamination, desertification, depletion of forests and other human activities. Inappropriate overuse of soil resources has been partly due to rapid development in various economic sectors. It is estimated that approximately 14,000 hectares have been contaminated by oil and 5,571 hectares by irrigation channels[14].

[13] http://www.stat.gov.az/source/agriculture/indexen.php
[14] Azerbaijan Second National Communication, 2010

The salinization, erosion and gradual deterioration of the lands suitable for agriculture is one of the main environmental problems facing the country. It is estimated that erosion and salinity have affected approximately 3.7 million and 1.2 million hectares of soil respectively. Approximately 47% of irrigated arable land has become salinized, especially in Gazakh, Hajigabul, Kurdemir, Zardab, Ujar, Yevlakh, and Beylagan Regions. Almost 40 % of soil in mountainous areas has been eroded by rain or wind (wind erosion can be observed in Absheron Peninsula and its vicinity) to varying degrees.[15] The map below illustrates areas prone to erosion.[16]



Analysis of Potential Impacts of the Strategy

ARES development has less significant effects on soil. Impacts on soil may result from the development of ARES, however, these impacts are likely to have a lower impact in comparison to traditional energy resources.

The solar panel installations can require large areas of land, as well as the use of chemical substances to wash the panels, which can cause soil pollution.

Hydropower development can lead to both positive and negative impacts on soil. Newly constructed dams and reservoirs together with efficient water management can provide additional water resources for irrigation and thus decrease the pressures to soil resulting from inefficient irrigation. On the other hand, the riverside reservoirs constructed as a part of the hydropower power plants (to remove solid substances from the water) can increase the risk of erosion.

[15] The library of Administrative Department of the President of Azerbaijan Republic, The environmental problems of eroded soils in Azerbaijan, Source: Mammadov G.S., Halilov M.Y. Ecology, environment and human. Baku, "Elm", 2006, page. 394-400.

[16] The map was prepared within SEA pilot.

The use and development of energy from biogas can decrease pressure on soil and contribute to soil protection by using up residual waste material found in urban sites and farms across the country, replacing firewood as a source of energy, as well as yielding fertilizer. On the other hand, extensive biomass production negatively impact soil, such as crop monocultures causing high rates of soil erosion and requiring significant levels of agrochemicals that deplete the soils.

Adverse impacts on soil can also result from geothermal energy development due to the discharge of the processed water without desalination, leading to soil mineralization. These impacts can be considered as less significant if closed systems ensuring the reinjection of processed waters to the original layer are employed.

3.4 Water resources

Baseline

There are 8,359 rivers in Azerbaijan, with 5,141 belonging to Kura River basin and 1,177 to Araz River basin. More than 3,000 rivers flow directly into the Caspian Sea. Kura River is the main water resource and is the longest river in the southern Caucasus. The total natural water reserves of the Kura River and Araz River are 25.921 km^3.

As shown in the table below, the energy sector is the second largest water consumer (after agriculture).[17]

	Water abstraction from natural resources	Fresh water consumption	Volume of recycled and consequently used water	Water losses during transportation	Discharge of sewage waters	of which untreated waste water
Total	**12123,0**	**8115,3**	**2469,1**	**4007,7**	**5357,7**	**265,3**
including:						
Agriculture, hunting and forestry	10844,6	5928	415,4	3637,8	4087,2	0,6
Mining	222,5	222,5	215,9	0,1	227,6	7,6
Manufacturing industry	17,2	48,8	271,2	1,0	13,7	7,2
Production and distribution of electricity, gas and water	1022,1	1803,2	1542,3	365,6	656,2	62,6
Transport, storage and communication	9,9	55,1	9,8	2,4	12,3	9,1
Other branches	6,7	57,7	14,5	0,8	360,7	178,2

Analysis of Potential Impacts of the Strategy

The Strategy's major risks regarding water resources are related to the hydropower and solar energy development. Construction of dams, water reservoirs and/or small hydropower generation plants, as well as channels (derivation, intake and offtake channels) may have impacts on the water regime as well as can lead to the changes in the river bed and alter its geomorphological characteristics. Furthermore, during the construction period additional

[17] Data of Joint Open Company of Irrigation and Water Industry of Azerbaijan.

coastal fortification works may be required due to frequent flood events, especially in the rivers of the Sheki-Zaqatala and Shirvan regions (prone to mudflows and flooding), which can further increase anthropogenic pressures on the river ecosystem and the quality of water too.

The regions and areas with solar energy potential face water scarcity, such as Aran Region and Absheron-Gobustan Zone. Thus, solar energy development can lead to overexploitation of water resources, as water will be used for cleaning the solar panels. Therefore, the availability of water should be properly considered when planning solar energy development.

3.5 Landscape

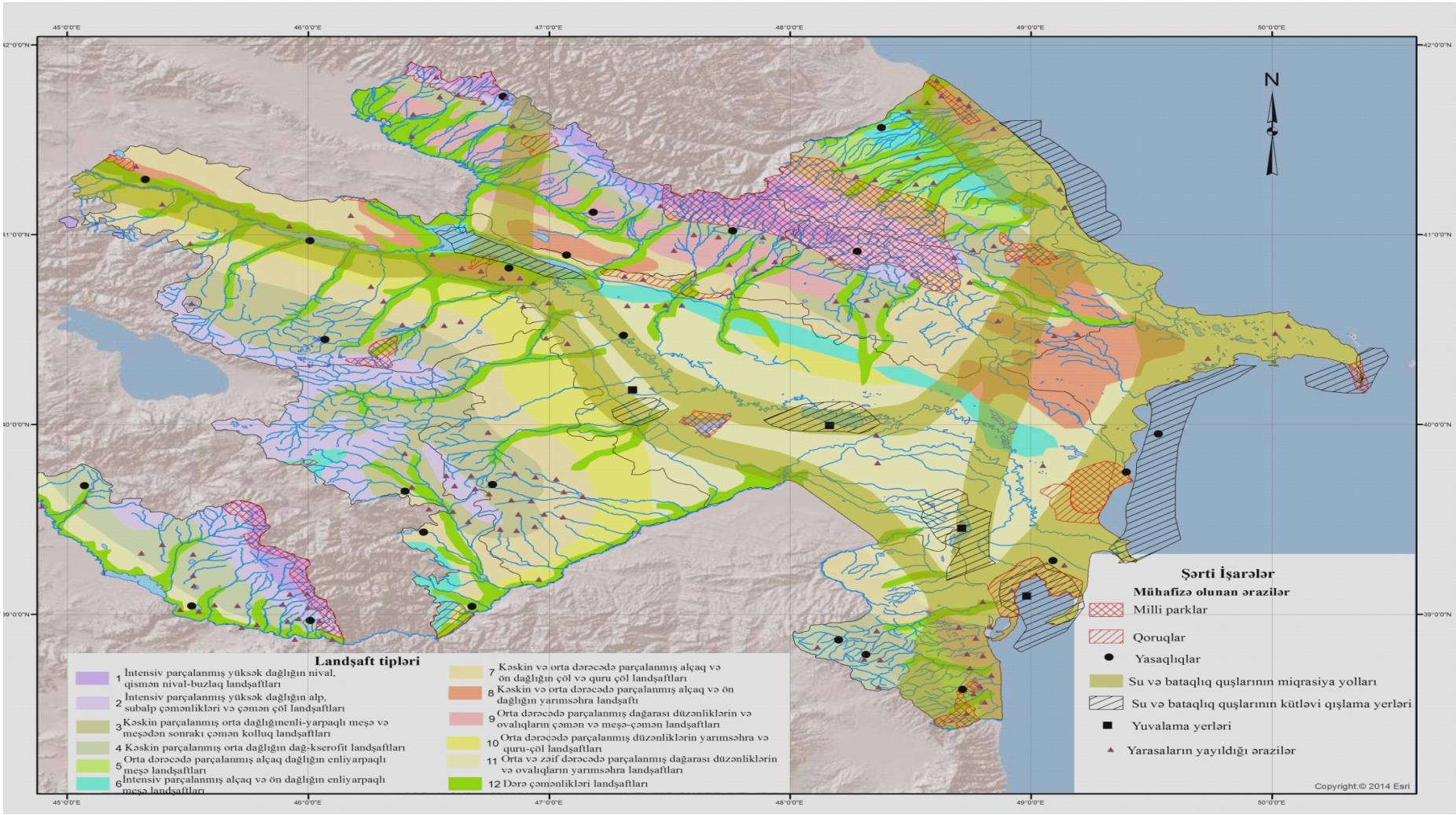
Baseline

The natural landscape in Azerbaijan can be divided into mountainous areas, plains and coastal areas (as it is shown on the map below).

Analysis of Potential Impacts of the Strategy

The key potential impacts of the Strategy on the natural landscape are related to wind farms. In particular, wind farm facilities can significantly change the visual characteristics of a coastal area. However, it should be noted that fossil fuels developments also have negative effects on the landscape, such as large industrial buildings and offshore drilling platforms. Therefore, implementation of the Strategy – if it leads to less energy production from fossil fuels – can have a positive effect on the landscape.

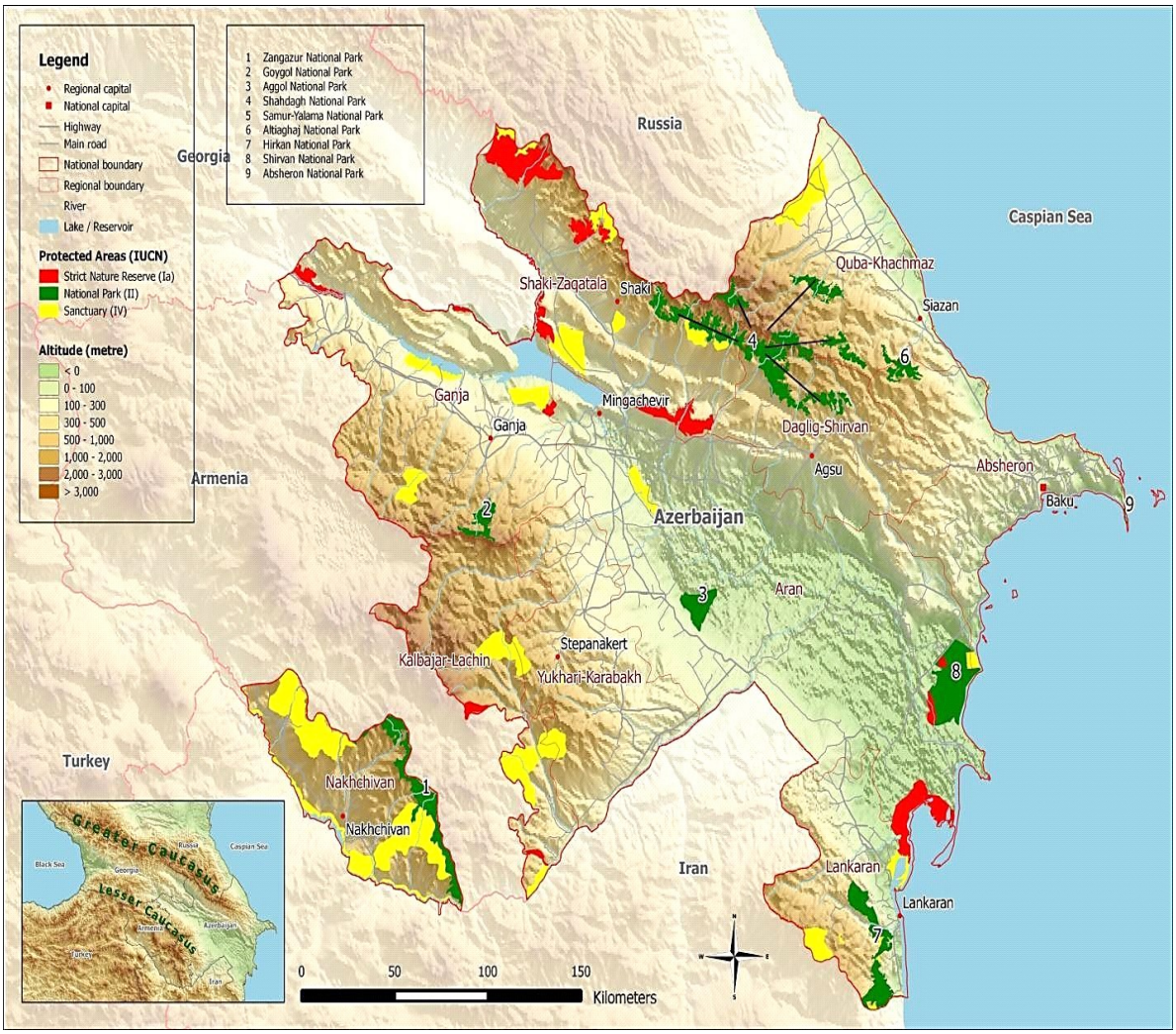
The map below illustrates the types of landscape, protected areas, areas with bat population, and water and wetland birds wintering sites.



3.6 Biodiversity

Baseline

The diversity of flora and fauna in Azerbaijan is associated with the country's climatic and landscape patterns, which range from highland mountain alpine areas to semi-desert and desert zones. A total land area of 892,500 hectares has been designated as specially protected natural areas including, 9 national parks, 11 state nature reserves, and 24 state nature wildlife sanctuary (as shown in the map below).



There are many endemic species in Azerbaijan as well as a number of important habitats, including forests and coastal areas. As of 2010, 4,500 plant species and 18,000 fauna species (of which 140 are rare and endangered species[18]) were recorded in the country[19]. However, urban and agricultural activities have negatively impacted biodiversity. For example, due to a lack of gas and other energy sources in some regions, wood is being sourced for fuel, leading to the depletion of forests.

[18] Red Data Book of Azerbaijan http://www.azerbaijans.com/content_1706_en.html
[19] Azerbaijan Second National Communication, 2010
http://www.adaptation-undp.org/sites/default/files/downloads/azerbaijan-second_national_communication_2010.pdf (Page 8)

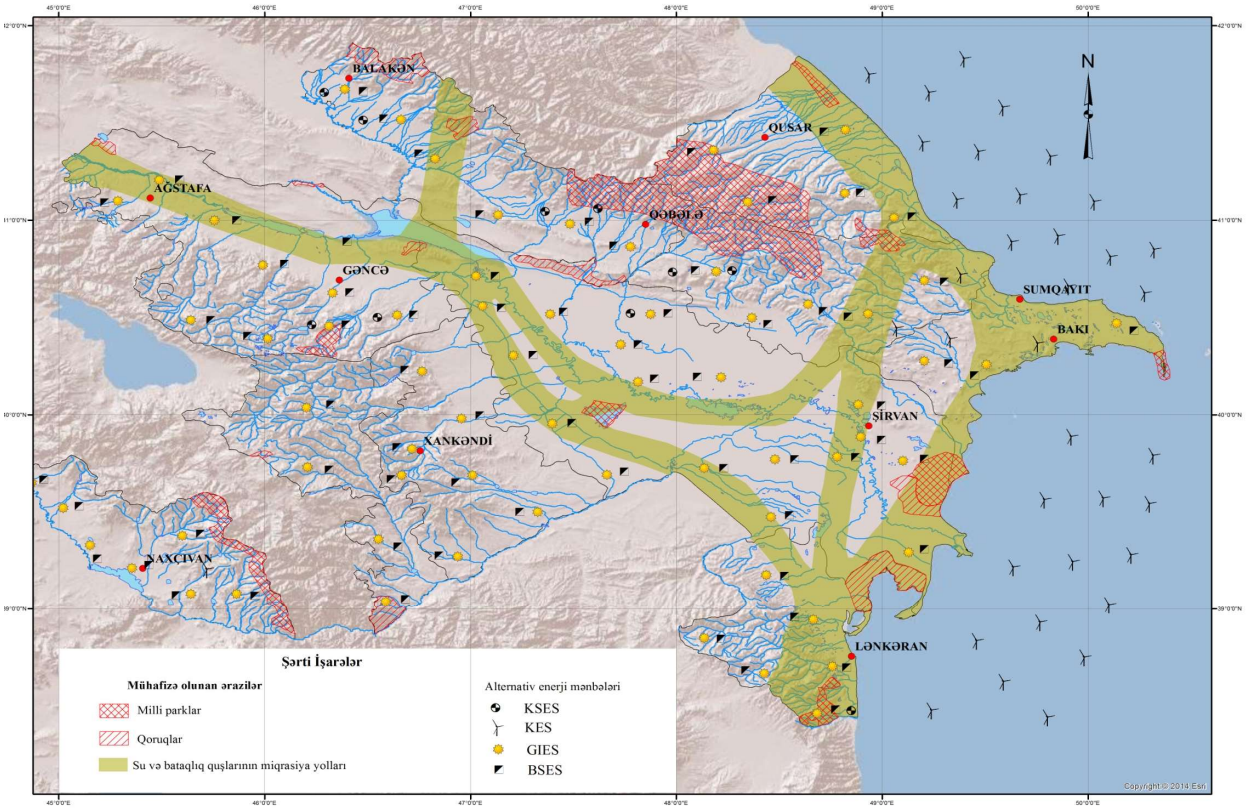
Approximately 30 fish species can be found in freshwaters as well as in Caspian Sea. Many of these species are anadromous (migrate up to the rivers to spawn) or catadromous (migrate down to the rivers for spawning). Hydropower development on main rivers flowing into the Caspian Sea has already caused fragmentation of rivers, such as the construction of the Mingachevir and Bahramtapa reservoirs on the Kura and Araz rivers. This has reduced the breeding areas for the Sturgeon fish species, since they are unable to pass through the dams to reach breeding areas upstream, resulting in a population decline.

In relation to avian species, one of the largest migratory bird corridors in Euro-Asia passes through Azerbaijan, which is used by millions of birds to migrate from Eastern Europe and Western Siberia to Eastern Africa, South-Western Asia, and back. Wetlands represent another important habitat type in the country, covering more than 200,000 hectares. The largest wetlands are located in Larger and Lesser Gizilaghaj Bay, Aghgol, Mahmudchala, Lake Hajigabul, Kura River Delta, and the Caspian coastal areas.

Analysis of Potential Impacts of the Strategy

There are both opportunities as well as risks to biodiversity in relation to the implementation of the Strategy. As described above, the Strategy can lead to improved air quality, and thus reducing the pressure on forest ecosystems and biodiversity.

Of the ARES proposed under the Strategy, it is expected that the main risks to biodiversity relate to the development of wind farms and hydropower plants. The risks to avian species, including local and migrating birds, can be significant, especially if the ARES development is located nearby Protected Nature Areas, important ornithological areas, and migratory corridors. In particular, wind farms increase the risk of bird and bat injuries and death due to collisions with the turbines. The map below provides an indication of the likely conflicts between these areas and different renewable energy resources.



Offshore wind farm development can lead to seabed disturbances and increased water turbidity, which may negatively affect plankton and thus impact fish population, sea mammals, turtles, as well as birds (since plankton represent an important food source). The Caspian Sea coastline is considered a particularly sensitive ecosystem in Azerbaijan, and the location and development of wind farms in this area should be carefully planned to avoid significant adverse impacts.

Construction of hydropower plants in mountainous areas poses risks to aquatic diversity, since these developments may change physio-chemical as well as morphological conditions (such as flow, temperature, dissolved oxygen). The Kura River basin has a particularly high energy potential[20](see the map below), as well as the Great and Lesser Caucasus mountainous rivers and Lenkoran-Astara region rivers. Therefore, the most significant impacts due to the implementation of the Strategy can be expected in these rivers flowing from mountains to lowland areas. The river fragmentation as a result of hydropower development can adversely affect migratory fish species and construction work can impact on the populations of species. Considering the impacts of existing projects, the likely impacts on aquatic biodiversity can be estimated as significant, especially on vulnerable species such as *Salmo trutta fario* (River Brown Trout) and *Salmo trutta caspius* (Caspian salmon).

[20] Azerbaijan Second National Communication, 2010
http://www.adaptation-undp.org/sites/default/files/downloads/azerbaijan-second_national_communication_2010.pdf (Page 11)

Zones of location of planned small HPSs

The likely impacts on biodiversity due to biomass energy relate mainly the use of pesticides and other chemicals to increase biomass production, which may contaminate soil and water resources. Therefore, extensive use of biomass (the Strategy's target is 515 MWt to be produced from biomass) can lead to significant changes can lead to significant changes in biodiversity.

Similar risks can be seen regarding solar energy development, where the cleaning of solar panels with the use of additives and chemicals may cause soil and water pollution, and thus have negative impacts on biodiversity. However, these impacts can be considered as local and possible to mitigate at the project level. In addition, the location of solar power plants may cause fragmentation of habitats and habitat corridors – these likely impacts also need to be managed and offset at the project level.

3.7 Waste management

Baseline

Waste management is a significant issue in the country, as wastage and contamination of land and water resources have been occurring in environmentally sensitive areas as a result of urbanization, industrial activities and economic development in Azerbaijan and the wider region. Each year, approximately 1.5 million tons of municipal waste is produced, of which half is generated from Baku and its surrounding area, and is distributed across the 200 landfills in Azerbaijan[21].

[21] Azerbaijan Second National Communication, 2010

In particular, the Caspian Sea is under a constant threat of pollution from waste, a problem which is exacerbated by different countries adjoining the Sea. Stronger waste management systems and improvement projects are required in Azerbaijan and the wider region. The main polluters of the Caspian Sea are the wastewaters flowing from cities nearby, the offshore oil fields, transportation of oil products, sea ships, agricultural waste[22]. Baku Bay is one of the most polluted areas of the Caspian Sea, resulting in deep soil pollution and a reduction of benthos and organisms, and depleting marine fauna populations. The most hazardous contamination of the Caspian Sea is due to wastes containing chemical substances from oil products, including hydrocarbons, chloric organic compounds and heavy metals. The extent of oil and gas extraction and industrial transport activity continues to pose a significant risk to water quality.

Analysis of Potential Impacts of the Strategy

The development of ARES, as proposed by the Strategy, would contribute to some wastage as well as substances and materials released into the environment or into landfills during the construction phase, such as polluted water run-off entering water bodies. However, the implementation of the Strategy would overall have a positive impact on waste levels by contributing to the increased use of clean energy sources and a decrease in the use of oil, gas and other fossil fuels that are significant generators of waste.

3.8 Human health

Baseline

The quality of the environment is a very important factor for human health. There are several environmental issues related to human health and the development of ARES that need to be considered: water pollution and the quality of drinking water; air quality; the ecological conditions of the Caspian Sea; climate change; and biodiversity. Also, potential effects to human health related to noise levels (including infrasound); vibrations; and shadow flickering need to be considered. In addition, the need for working conditions to meet environmental and health standards is a topic to be explored, which the Strategy's ARES development could address.

The table below provides an overview of the causes of death in Azerbaijan.[23]

Diseases	2010	2011	2012	2013
Number of deaths from all reasons	53,580	53,762	55,017	54,383
○ some infectious and parasitic diseases	1013	875	580	597
- neoplasms / cancer	**6,633**	**5,999**	**5,886**	**6,383**

[22] Caspian Sea: State of the Environment, 2011, Report by the Interim Secretariat of the Framework Convention for the Protection of the Marine Environment of the Caspian Sea, supported by UNEP and UNDP, 2010

[23] http://www.stat.gov.az/source/healthcare/indexen.php, Distribution of population by main disease groups by economic and administrative regions and towns in 2015 (patients registered with the diagnosis set for the first time, system of the Ministry of Health Care)

- diseases of the blood and blood-forming organs and separate disorders involving immune mechanism	70	112	91	89
- endocrine system diseases and metabolic disorders	1,094	942	920	971
- psychological diseases, mental and behavioural disorders	35	31	23	21
- diseases of the nervous systems	789	1,284	1,338	985
- diseases of the circulatory system	**32,554**	**32,835**	**34,832**	**34,379**
- respiratory diseases	**2,377**	**2,185**	**1,743**	**1,529**
- diseases of the digestive system	**3,137**	**3,097**	**2,970**	**2,806**
- diseases of the skin and subcutaneous tissue	31	5	4	2
- diseases of the musculoskeletal system and connective tissues	56	95	97	125
- diseases of the genitourinary system	1,163	1,023	912	913
- pregnancy, childbirth and the postpartum period	26	27	26	25
- some cases arising in the perinatal period	367	627	937	1,142
- congenital anomalies (malformations, deformations and chromosomal abnormalities)	357	392	355	287
- symptoms, signs and deviations identified by clinical and laboratory examines that are not classified anywhere else	1,343	1,771	1,836	1,892
- injuries, poisoning and other consequences of external impact	**2,529**	**2,460**	**2,467**	**2,234**
- other causes	6	2	-	3

Analysis of Potential Impacts of the Strategy

The use and development of clean energy and a reduction in polluting sources may lead to better health in a long-term perspective, including lower rates of circulatory and respiratory diseases and cancer, which were among the leading causes of death in Azerbaijan from 2010-2013 (as illustrated in the table above. However, these likely positive effects presume that ARES will replace energy production from fossil fuels.

Although the development of ARE in accordance with the Strategy poses a number of risks to human health, these are considered minimal and localized, and not significant at the strategic level. More detailed site-specific evaluations of impacts can be addressed and managed at the project level. These risks to human health can be summarized as follows:

- General
  - The Strategy's implementation relating to the use and development of ARES across the country (in place of traditional energy sources using fossil fuels) is deemed to have an overall positive impact on human health, mainly due to better

air quality, lower levels of water pollution, and a contribution to the mitigation of climate change for future generations.
    - At the future project stages of individual ARES developments, a high standard of health and safety measures should be employed during the construction, in order to protect and minimize impacts on residents, workers, economic sectors, agriculture, biodiversity and traffic levels.
- Wind Farms
    - The operation of wind farms may lead to a range of effects on human health, mainly in relation to lighting/shadow flicker effects from the turbines, low-frequency vibration, noise and infrasound, visual landscape changes, and other impacts resulting from construction.
    - However, it needs to be noted that the World Health Organisation (WHO) has stated that "Wind energy is associated with fewer health effects than other forms of traditional energy generation and in fact would have positive health benefits" and "In relation to all sources of energy, the health effects associated with wind energy are negligible"[24]. Wind farms are also cited "to have the lowest level of impacts (health and environmental), of all the fuel cycles considered" (CIEMAT 1998 cited in WHO 2004).
- Solar power plants
    - The development of solar may indirectly affect human health as a result of water pollution by toxic substances used for cleaning the panels.
    - However, the impacts will be localized, and not significant at the strategic level.
- Hydropower development
    - The development of hydropower may lead to adverse effects to the human health by affecting the water regimes and thus decreasing the availability of drinking water as well as deteriorating water quality.
- Biomass
    - Impacts on human health that may occur due to biomass energy include odours, allergies and respiratory diseases, water pollution from pesticides and fertilizers used for biogas production.
    - However, these issues can be seen as localized, to be addressed at the development proposal stages, and not significant at the strategic level.

As described above, a range of impacts that are specific to different types of ARE development have been identified. However, considering the major health pressures in Azerbaijan and causes of death (circulate and respiratory diseases and cancer), it can be concluded that the development of ARES together with adequate mitigation measures, which would replace fossil fuels in the country's energy mix, should improve the quality of environment and thus have a general positive impact on human health.

[24] World Health Organization (WHO) (2004): Energy, sustainable development and health. Background document for the Fourth Ministerial Conference on Environment and Health, 23-25 June 2004, Geneva.

3.9 Livelihood

Baseline

Azerbaijan's population was 9.48 million in 2014, with 51% under 30 years old. The increasing old-age dependency ratio will be offset by the relatively high fertility rate and the slow decrease of the child dependency ratio. At the same time, the population growth adds to the acute pressure to create more and better jobs. In 2011, 53% of the population lived in urban areas and 47% in rural areas. A slight increase in the urban population can be observed since the 2001. Since the early 2000s, Azerbaijan has achieved remarkable success in reducing poverty. According to the World Bank, poverty reduction was driven by strong economic growth, a rise in wages, and successful social protection measures.[25]

Analysis of Potential Impacts of the Strategy

The Strategy's proposal to generate energy from ARES will have a range of direct and indirect socio-economic impacts upon the livelihoods of the population, arising from three phases of the life cycle of ARES developments: (i) planning and construction, (ii) operational, and (iii) decommissioning. These impacts include job creation in some sectors (e.g. green energy development, construction and operation), potential job losses in other sectors (e.g. traditional energy sectors replaced by green energy) and economic improvement (e.g. rural economic centres that benefit from ARE development and ARE workers spending money on local products and services in those communities).

The Strategy's ARES developments would be likely to stimulate the economy in Azerbaijan as a result of greater income generation and subsequent expenditure in the region. The proposed Strategy has the potential to deliver direct and indirect benefits to communities and the local and regional economies, due to flow on economic benefits in terms of employment and commercial opportunities from the economic investment along with the benefits of up-skilling of the local workforce within a growing energy market. In addition, some landowners with lease agreements are expected to benefit directly from additional income.

The major direct economic impacts on the local economy include employment, capital investment and land use revenue. In addition, the development of ARES is likely to provide a range of flow-on effects and noticeable boosts to the local economy through various income and expenditure effects. Personnel employed during the construction phase may contribute to the local economy via expending some proportion of their salaries on local goods and services, in turn supporting existing jobs or creating new ones. The extent of this impact and the amount of money invested in the local economy is greater when the labour force resides within the local community.

Moreover, the creation of new workplaces in the green energy sector provides a significant opportunity to improve the quality of working conditions and access to a greater diversity of occupations in Azerbaijan, which helps to safeguard jobs in the future.

[25] Asian Development Bank: Country Partnership Strategy: Azerbaijan, 2014 – 2018

The implementation of the Strategy also provides the opportunity to create direct community investment funds for each future ARES project. It is recommended that the Strategy outlines measures for this in the Action Plan (see Chapter 4). These community investment funds mean that the operator of the ARES developments pays an annual monetary contribution, which would directly fund local community enhancement projects within a close proximity to the ARES developments. These community enhancement projects may include upgraded roads, a new community building, sports fields or other needed facilities.

Like any development, the ARES may in some situations compete with other industries (including the agricultural sector) for natural resources and land. In addition, changing of the water regime due to hydropower development may have a negative impact on the fishing industry and their livelihoods. However, it is anticipated that the positive economic contributions of the implementation of the Strategy would outweigh potential negative economic impacts, such as concerns regarding impacts on other economic sectors such as oil and gas and agriculture. As described in the previous section, the replacement of standard energy sources, fossil fuels and related pollution with clean energy can have a positive impact on human health and therefore the livelihoods of Azerbaijan's population.

In addition, diversifying and supplementing the energy mix with new and clean sources of energy can improve the power supply and distribution of energy across the country. Greater access to a diverse range of energy sources may improve the livelihoods of the population by providing more reliable or more accessible energy supplies to local businesses, the agricultural sector, and to homes. Moreover, the Strategy's development of local ARES projects can directly benefit local areas that have in recent times have experienced power shortages or have a lack of connection to the national electricity grid.

3.10 Linkages to other economic sectors

Baseline

Azerbaijan has undergone significant economic transformation and development since the country's independence in 1991. The rapid economic development is mainly attributed to the exploitation of hydrocarbon resources.[26] Besides oil and gas production, also metallurgy, mechanical engineering, textiles and food industry have been developed. The agriculture represents an important economic sector. The government has been recently providing a significant support to the tourism sector.

Analysis of Potential Impacts of the Strategy

Like any new development, there is the potential for conflicts between ARES development and other economic sectors, such as:

- Changing of the water regime due to hydropower development may negatively impact on the fishing industry and the local economy
- Offshore wind farm development may reduce the attractiveness of coastal areas and thus lead to less tourist interest

[26] Asian Development Bank: Country Partnership Strategy: Azerbaijan, 2014 – 2018

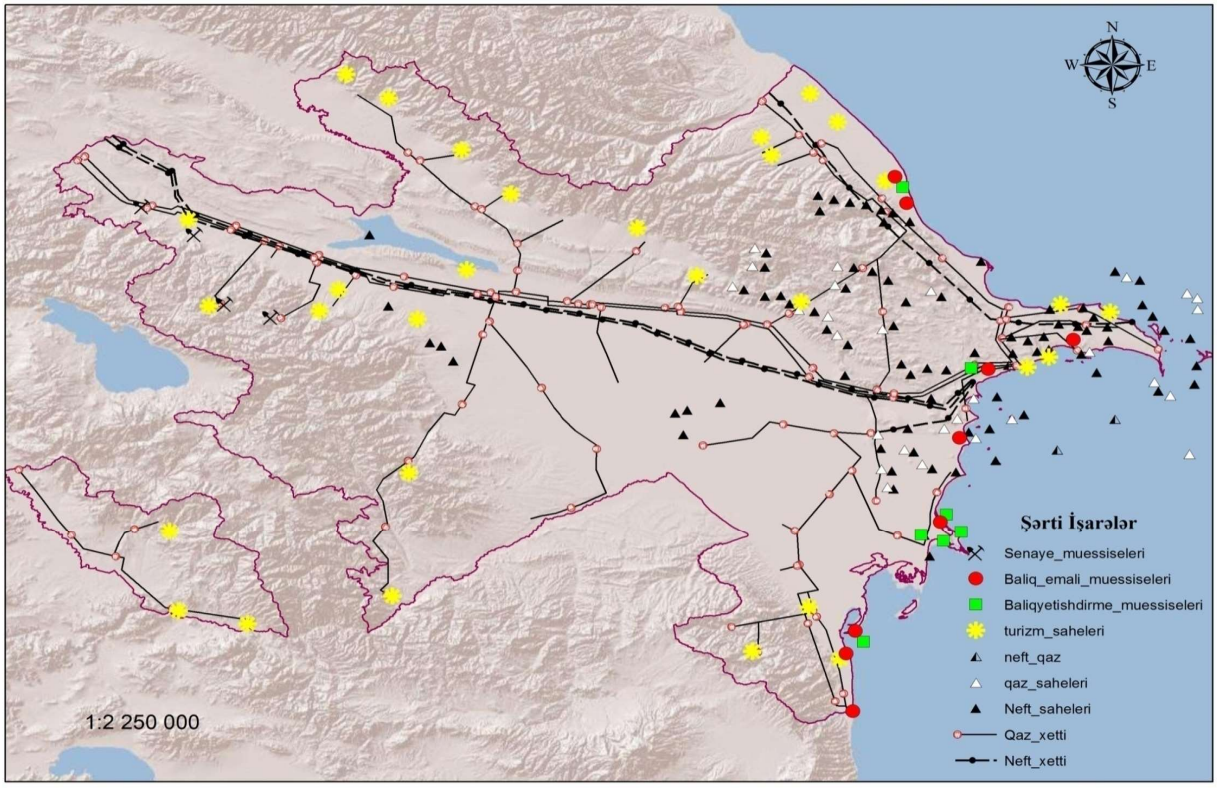
- Offshore wind farm development can lead to conflicts with the oil, gas and fishing industries
- New construction works and infrastructure (including transmission lines) may compete with agricultural activities and yields in relation to the use of natural resources, including pastures, soil and water (e.g. producing biogas on agricultural soil)

The table below provides an overview of the linkages (both synergies as well as conflicts) of the ARES development and the main economic sectors in Azerbaijan, evaluated as:

Synergy: +
Conflict: –
No link: 0

Strategy's targets	Economic sectors					
	Agriculture	Industry	Energy	Tourism	Water supply and sanitation	Waste management
Small Hydropower Plants	–	+	+	–	–	0
Solar power	–	+	+	+	–	0
Wind farms	+	+	+	–	0	0
Biomass (biogas) energy	+	–	+	–	–	+
Geothermal	0	+	+	0	–	0

The map below provides a spatial illustration of the key selected economic sectors in Azerbaijan, which needs further consideration to avoid conflicts between ARES and other economic sectors.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4. RECOMMENDATIONS AND MITIGATION MEASURES

In light of the potential effects (both positive and negative) that may occur due to the implementation of the Strategy (as identified and described in Chapter 3), this chapter provides a number of recommendations and measures to mitigate or avoid the potential adverse effects and to enhance the environmental and health performance of the Strategy.

As the Strategy is a high-level, strategic document stipulating the main priorities for ARES development, many SEA recommendations and mitigation measures can be only implemented in the future stages of planning and/or at the project level. To ensure these measures will be implemented, it is suggested that the Strategy assigns incorporation of the SEA's recommendations and measures into the Action Plan and in further steps of ARES planning and project development. Optimally, the final draft of the Strategy should include a section indicating how recommendations and mitigation measures formulated by SEA will be followed in the Action plan and further ARES development.

4.1 General recommendations for the Strategy

The SEA's general recommendations and measures that the SAARES should consider incorporating into the Strategy and the Action Plan are:

- **Macro-level siting guidance:** The location of ARES developments should be carefully selected so that these developments are not situated within or directly impacting upon identified natural areas (i.e. important bird migratory routes, key ornithological areas, natural and biosphere reserves, national parks, etc.). Therefore, is it recommended that – following findings and results of SEA – the Strategy or its Action Plan provide:
    - A detailed **'Existing Conditions Map'** showing the location of: existing energy developments; industrial facilities; urban settlements; important environmental areas; land use zones; and other important sites.
    - A detailed **'ARES development Areas Map'**, which shows the details of the first map, overlaid by potential sites/areas where ARES could be developed. This map should also indicate
        - **'Key Development Zones'** (where ARES are highly encouraged),
        - **'Potential Development Zones'** (where ARES are suitable depending on further assessment), and
        - **'No-Go Zones'**[27] (where ARES are not permitted).

    - These zones should be **represented on a set of maps**, and may be specific to certain types of ARES (e.g. a 'Key Development Zone - Solar', or a 'Potential Development Zone - Wind', or a 'No-Go Zone - Hydro').
    - These zones should be determined based on the location of: environmentally sensitive or protected natural areas; synergies or conflicts with existing economic activities; urban settlements; potential cumulative impacts; etc. For

[27] Several maps that show areas where ARES development should not be permitted (e.g. Protected Natural Areas) have been developed within SEA, and are recommended to be used for further elaboration.

example, solar power plants could be directed towards areas with lower soil quality, to ensure that further soil degradation and competition with agricultural activities on prime land does not occur.
    - Development and use of these maps would help to identify the most appropriate locations for ARES to be developed, taking into account the existing conditions and likely environmental and health risks and impacts.

- **Cumulative impacts:** It is recommended that the Strategy's Action Plan propose strategies to address the potential cumulative impacts of development projects (existing and proposed) in certain areas of the country, where multiple ARES developments are proposed (e.g. river basin).

- **Avoid, Minimize, Compensate:** The Strategy/Action plan should consider incorporating the **'Mitigation Hierarchy'** as its primary measure for environmental and health protection – which firstly seeks to 'avoid' any adverse impacts on the environment, then (if impacts cannot be avoided) 'minimize' the impacts, and then 'compensate' for any unreasonable damage to the environment or human health:
    - Strategy / Action Plan stage: Firstly, in the early stages of strategic planning, the general locations (on a macro-level) of ARES developments should be carefully selected to **avoid** the country's sensitive or protected natural areas in the first place (such as bird migration corridors, and sites with bat population).
    - EIA / project stage: Next, the micro-siting of buildings and infrastructure should be carefully designed and planned to **minimize** their impacts on the local environment (such as habitats, flora and fauna),
    - EIA / project stage: Finally, where environmental impacts cannot be avoided or minimized, **compensation** measures should be implemented that offset the losses and enhance the environment. For example, if the degradation of a key habitat area cannot be avoided or minimized, compensation measures may include the relocation or creation of new habitat that will adequately accommodate the relevant species.

4.2 Further steps to be undertaken at the EIA / Project stage

As mentioned in Chapters 1 and 2, the purpose of this SEA is to analyse the impacts of the implementation of the Strategy as a national document. Therefore, this SEA provides a high-level analysis of the impacts at a broader scale, and provides recommendations on the detail and implementation of Strategy (i.e. in its Action Plan), which will help to influence the location and specifics of future ARES development projects. Intentionally, the SEA does not fully address some environmental issues at the site-specific and project-level, and there is a need for more technical, in-depth impact assessments and location-specific analyses to be performed by proponents and authorities at the development application stage of each ARES individual proposal.

For future ARES project proposals, it is likely that a permit application and/or EIA process will be required to be prepared by proponents, in order for these projects to receive approval from the authorities. The specific impacts that the planning permit applications and EIAs will address

include (but are not limited to): air quality, land use, soils and geologic resources including erosion, water resources, hazardous materials and waste management, noise, human health and safety habitats and habitat fragmentation, threatened and endangered species, avian and bat impacts, cultural resources It is also important to ensure that EIAs also consider development of necessary servicing infrastructure and other activities associated with a specific ARE project e.g. road construction and maintenance, transportation, pesticide use, etc.

In accordance with the draft *Law of Azerbaijan Republic on Environmental Impact Assessment* (which includes SEA), the following types of activities (listed in the Annex) that are relevant to ARES projects require the preparation and submission of an EIA to the relevant authorities for approval:

- Disposal and processing of hazardous and non-hazardous wastes, as well as, construction of plants and landfills for these purposes.
- Construction of dams, water reservoirs and reservoirs with a height of 15 meters or more.
- Distribution of water resources between river basins.
- Urban planning
- Large-scale construction measures in the zones referring to water fund (creation of artificial islands etc.).
- Development of renewable energy sources (wind, geothermal, biogas etc.).

4.3 Measures regarding air quality

The recommended measures to mitigate or avoid the potential adverse impacts of the Strategy's implementation on air quality are as follows:

- The facilities for energy production from biomass and waste should not be located in areas that currently have low air quality.
- .
- Wind farms and solar energy are preferred in areas with low air quality, to reduce GHG emissions and other air pollutants from traditional sources of energy and fossil fuels.
- The Best Available Techniques (BAT) should be employed to minimize adverse effects to the air quality
- The likely effects on air quality during construction (including transport) stage should be properly assessed in the EIA process and appropriate mitigation measures defined.
- Geothermal energy production should use closed systems equipped with special gasholders to minimize emissions into the air.
- Biogas should be optimally produced from sorted household garbage, organic waste, or agricultural manure.

4.4 Measures regarding climate change

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on climate change are as follows:

- The Best Available Techniques (BAT) should be employed for biomass and waste energy production to minimize GHG emissions.
- The sources for energy production should be identified to minimize GHG emissions. –

- The locations for biomass energy facilities should be identified considering the source of materials to be used.

4.5 Measures regarding soil

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on soil are as follows:

- Solar power plants should not be located on prime agricultural land or forest land, while areas currently unsuitable for other purposes are preferred (e.g. abandoned mining areas, areas with low quality soil, etc.).
- Installation of solar panels on the roofs of buildings should be supported.
- The following techniques and methods should be considered in the design of solar energy projects and properly addressed at the EIA level:
    - Dry-cleaning methods should be used in order to avoid soil contamination.
    - The movement of machinery and facilities beyond the defined route should be limited.
    - Restoration of the extracted vegetation and employing compensation measures such as planting of vegetation should be undertaken.
- Existing roads and tracks should be used for transportation, especially in agricultural areas and environmentally sensitive areas, in order to prevent soil degradation or depletion from the creation of new vehicle paths.
- The following techniques should be considered for biogas production:
    - Use solid waste as first raw material, from solid waste landfills.
    - Use manure and green mass as first raw material, from cattle breeding complexes.
    - Use slime from the process of purification of waste water as first raw material, from biological water purification plant complexes that are supplied with appropriate gas separating equipment.

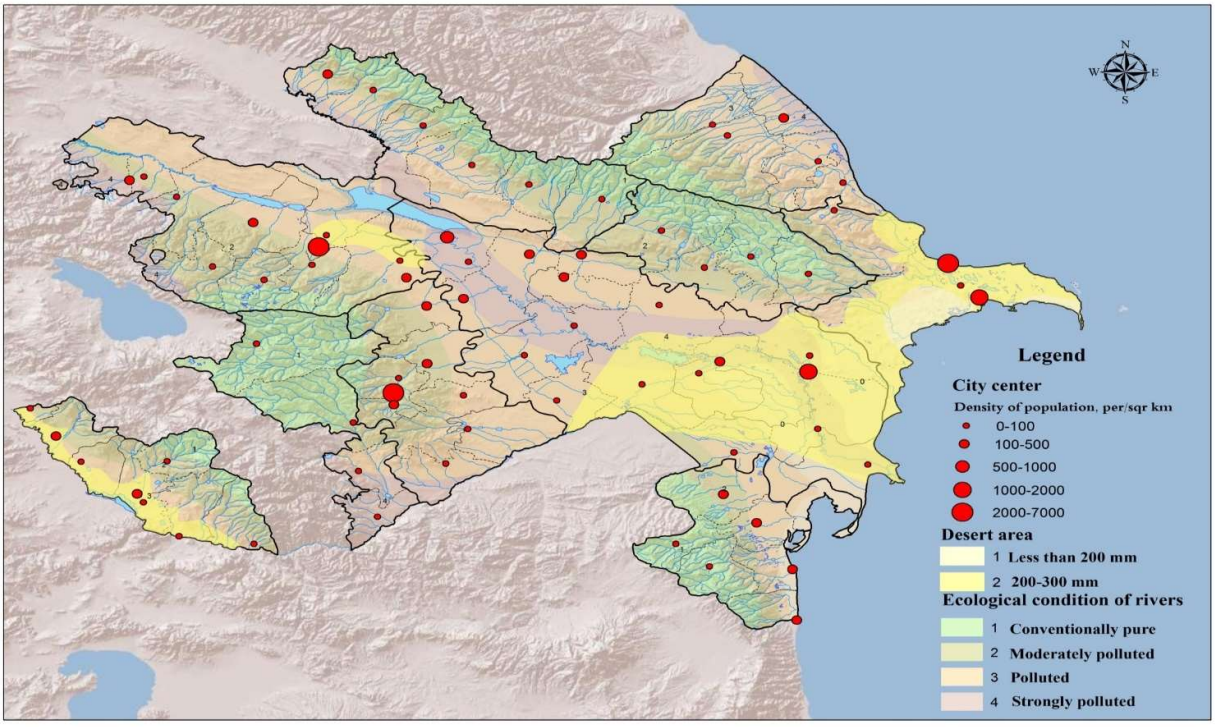
4.6 Measures regarding water resources

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on water resources are as follows:

- Hydropower plants should not be located in the natural reserves (natural and biosphere reserves, national parks, important ornithological areas, etc.), as shown on the figures in Chapters 3.4 and 3.5.
- The planning of small hydropower plants should consider impacts on the drinkable water sources, the water demands of various sectors, and local fishing facilities.
- New, efficient technologies should be used for dry cleaning of solar panels to minimize water consumption.
- Avoid and significantly limit stormwater runoff containing pollutants from cleaning and construction into water bodies.
- As the location of geothermal power stations is limited to regions where sources of geothermal water exist, factors affecting water resources such as steam pipes, buildings and other infrastructure, the level of groundwater, land subsidence, swamping, seismic activity, and the transfer of methane, hydrogen, nitrogen and hydrogen sulphide from

lower layers of the earth to the surface should all be taken into consideration when selecting location of specific projects.

- Before determining the location of hydropower plants (especially when a series of hydropower plants is planned), a detailed study should be conducted that analyses the likely cumulative effects on the entire river basin, taking into consideration the following issues (but not limited to):
    - Minimal environmental flows (i.e. the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems)
    - River fragmentation for fish and other aquatic species.
    - River water consumption, seasonal flow regime, and the environmental sensitivity of the water bodies (e.g. limiting the construction of hydropower plants on rivers that are vulnerable to drying up in 5-10 years, or avoiding of the construction of several hydropower plants in one river)
    - Water demand of the population living within the river basin (including technical and irrigation water)
- Derivative Types of (Run-of-River) hydropower plants should be preferred
- Technical measures to avoid fragmentation of migratory fish corridors should be integrated into the project design, and their efficiency should be evaluated during the EIA process.
- Studies of the potential impacts of ARES developments on water resources should be prepared, evaluating this issue and determining the areas where ARES can be located (i.e. areas with sufficient water resources), taking into consideration the figure below which presents the areas with high population densities, water scarcity, water pollution stress zones, which helps to determine the locations where the risk of overexploitation is higher.



- Regular monitoring of water quality should be undertaken for ARES developments, as well as measures regarding the use of chemical substances for cleaning the solar panels, which should be formulated in the EIAs for specific projects (e.g. using dry-cleaning methods in order to avoid water contamination)
- Closed systems that reinject the water back into the original layers of earth should be used for geothermal energy installation.

4.7 Landscape

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on the landscape are as follows:

- The effects on the landscape should be analysed within detailed studies to be carried out when selecting the locations for wind farms (i.e. within SEA for local spatial plans and/or as a part of EIA for specific projects).
- The following issues should be considered in the design of wind farm projects and addressed at the EIA level:
    - Selecting grey or light blue colours for the turbines, buildings and other infrastructure as well as to use natural materials (such as timber) for associated infrastructure that are characteristic and complementary to the local natural elements.
    - Avoid the placing of signs, emblems of companies, advertising, pictures or graphics on the wind farm facilities.

4.8 Biodiversity

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on biodiversity are as follows:

- Wind farms should not be located within bird migratory corridors or within areas of importance for bird species (e.g. migration routes, key habitats, nesting places etc.), or within the Protected Nature Areas, and the potential impacts to these places within the vicinity of the project should be carefully analysed and managed.
- When selecting locations for wind farms, the significance of the area's vegetation should be taken into consideration, and impacts to important or protected flora species should be avoided.
- Additional attention should be provided to protecting and enhancing the environment for threatened or protected flora and fauna species.
- Planned construction works onshore and offshore should take into consideration the location of habitats and the behaviour and activities of birds, bats, fish, mammals, and other fauna species.
- Implementing activities should not be carried out during significant periods of reproduction, nesting and migration of certain fauna species.
- Prevent accidents involving hazardous substances or other substances from entering the environment and causing adverse effects on biodiversity by employing best-practice preventative and response measures.
- Construction of auxiliary facilities should be minimized and/or managed, such as fencing around the plants, minimizing the connecting roads, and using underground

power transmission lines, in order to mitigate or minimize likely adverse effects on biodiversity.

- Before determining the exact location of offshore wind farms, strategic plans and detailed studies should be carried out to identify areas to be avoided due to likely effects to aquatic and relevant avian species.
- Reduce the risks of avian fauna species colliding with wind turbines by placing restrictions on what times of the day or what times of the year the turbines operate (e.g. shutting down turbine operations during peak breeding season).
- When planning location of wind farms, the following features should be identified and shown on strategic spatial plans, and then addressed in EIAs for specific projects):
    - Key sites and flight paths of bats
    - Migratory routes of bird species
    - Areas with night bird populations
    - Coastal area habitats
    - Wetland habitats
    - Other natural features containing important habitats for fauna species

4.9 Waste management

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on wastage are as follows:

- The Strategy should promote the recycling and reuse of precious natural resources and materials to the greatest extent possible, in order to enhance the environmental sustainability of the ARES projects.
- Where possible, the materials, water and other resources used in the construction of the ARES developments should be recycled or reused.
- Where possible, the road infrastructure, footings, access tracks and other elements created for the construction phases of ARES developments should be reused for the operation and decommissioning phases.
- The Strategy and its Action Plan should outline the activities to ensure there are adequate capacities available to manage wastes related to ARES (e.g. used solar panels).

4.10 Human health

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on human health are as follows:

- Wind turbines should not be located closer than 0.5km – 1km (depending on the noise studies and other impact studies) from residential buildings and 500m from work facilities.
- The Best Available Techniques (BAT) should be employed to minimize adverse effects to the health.
- Potential impacts associated with wind turbines on 'shadow flicker' and 'blade glint' which may cause distractions to local people (e.g. car drivers) should be managed through measures such as micro-siting turbines, orienting turbines appropriately,

stopping wind turbine operation temporarily (e.g. during intense light periods at sunset), and selecting non-reflective white coatings of the turbine blades.

- Noise levels of wind farms and other ARES developments should comply with the relevant noise guidelines, including those recommended by the World Health Organisation (WHO).
- When further planning hydropower development, the water demands of the local population should be considered in order to avoid water shortages.
- Potentially hazardous facilities, such as biogas processing facilities and enterprises, should be located at least 1km from residential buildings or settlements.
- Effective safety strategies, contingency plans and response measures should be developed in accordance with national and international legislation, in case of accidents or emergency situations.
- The public should be provided accessible information on ARES impacts including the benefits, and project details, processes and updates.
- Inclusive and meaningful public consultation should be undertaken in relation to the planning and decision-making on ARES developments, and the views of the public should be incorporated into the relevant procedures on ARES.
- Warning signs and information should be provided at ARES sites to alert the public against unauthorised site entry.
- ARES infrastructure and facilities should be regularly inspected and monitored by professional safety workers to reduce the risk of accidents.

4.11 Livelihood

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on livelihoods are as follows:

- The implementation of the Strategy provides the opportunity to establish community investment funds for each future ARES project. The Strategy should outline measures for monetary contributions that the operators/developers of the ARES pays, which would directly fund local community enhancement projects within a close proximity to the ARES developments, such as upgraded roads, new community buildings, sports fields or other needed facilities.
- The Strategy should establish and publicly promote a local employment and purchasing policy for preferentially sourcing labour, services and products from the local communities where the ARES are being developed.
- Local workers should be given strong preferences for employment in the ARES fields of work.
- To ensure that ARES developments do not directly compete with other industries (including the agricultural sector) for natural resources and land, the Strategy's Action Plan (and spatial plans) should show the location of existing energy facilities, tourism facilities and other conflicting land uses, and it should encourage ARES developments to be located away from these sites.
- The planning of hydropower plants should consider if the location is appropriate in terms of the effects on the water regime and any negative impacts on the fishing industry and their livelihoods.

- The location and extent of ARE developments within the country should be carefully planned, so as not to significantly impact on material cultural heritage, traditional use of lands and agricultural activities.
- The micro-siting of the various ARE developments should be rigorously evaluated at the project level (e.g. during the EIA process), including the siting of buildings, infrastructure, transportation, transmission lines and construction works.

4.12 Linkages to other economic sectors

The recommended measures to avoid or mitigate the potential adverse impacts of the Strategy's implementation on other economic sectors are as follows:

- The planning of small hydropower plants should consider impacts on the drinkable water sources, the water demands of various sectors, and local fishing facilities.
- To ensure that ARES developments do not directly compete with other industries (including the agricultural sector) for natural resources and land, the Strategy's Action Plan should show the location of existing energy facilities, tourism facilities and other conflicting land uses, and it should encourage ARES developments to be located away from these sites.
- Solar power plants should not be located on prime agricultural land or forest land, while areas currently unsuitable for other purposes are preferred (e.g. abandoned mining areas, areas with low quality soil, etc.).
- Wind turbines should not be located closer than 400 – 800 metres (depending on the noise studies and other impact studies) from tourism facilities.
- Biogas production facilities should be used close to existing solid waste landfills and cattle breeding farms, in order to primarily use the solid waste and manure, and lengthy transportation of these resources.
- Biogas production facilities should be located within waste water treatment plants, which are equipped with appropriate gas separating equipment.
- As the location of geothermal power stations is limited to regions where sources of geothermal water exist, factors affecting water resources such as steam pipes, buildings and other infrastructure, the level of groundwater, land subsidence, swamping, seismic activity, and the transfer of methane, hydrogen, nitrogen and hydrogen sulphide from lower layers of the earth to the surface should all be taken into consideration.

5. PROPOSED MONITORING SCHEME

5.1 Environmental and health monitoring

The purpose of monitoring is to ensure that the actual environmental and health effects associated with the implementation of the Strategy are reflective of the impacts predicted by the SEA, and – if any actual significant effects are identified – necessary actions need to be taken. Regular monitoring and reporting of the actual impacts that are occurring provides the best mechanism for taking action to address these impacts.

However, taking into account a general level of the Strategy, tt is recommended that a set of indicators for the key issues addressed in SEA is developed as part of the Action Plan, which would be used for the monitoring programmes. These indicators would allow experts to make accurate judgements as to whether the impacts are manageable or significant.

In addition, the SAARES should consider incorporating a number of monitoring programmes into the Action Plan. These monitoring programmes would be conducted by operators/developers and/or authorities for ARES development projects, and would help to identify the level of implementation and the administrative resources required. These include (but are not limited to):

- 'Water Resources Mitigation and Monitoring Plan',
- 'Monitoring of the Site for Presence of Endangered Species',
- 'Habitat Linkage Management and Monitoring Plans',
- 'Monitoring of Waste Management',
- 'Noise Monitoring and Compliance', and
- 'Monitoring of Bird and Bat Collisions, Injuries and Deaths'.

5.2 Scheme to monitor implementation of SEA recommendations

Since the Strategy presents the 'umbrella' strategic document that will guide the future development of ARES in Azerbaijan, many recommendations formulated by SEA can be only implemented at a further level of planning (e.g. in the Action Plan) or at the project stage. Therefore, it is important to monitor if and how the recommendations formulated by the SEA for the Strategy are being implemented.

For this purpose, it is recommended that the SAARES should consider preparing annual monitoring reports. These monitoring reports would be discussed with the MENR and made publicly available. The monitoring reports should provide information on:

- The activities implemented during the reporting period.
- The relevant SEA recommendations and impact mitigation measures.
- How the SEA recommendations and measures have been implemented.
- Further comments and future actions.

The monitoring reports can utilize a simple matrix outlined below:

Activities implemented during reporting period	Relevant SEA mitigation recommendation(s)	How SEA recommendations have been implemented	Comments
Construction of 15 wind power plants in areas XY was initiated	WPPs should not be located within birds migratory corridors	Area XY is located approx. 20km from the closest birds' migratory corridor. Also, likely effects on biodiversity were analysed in detail in EIA for a given project and any significant impacts on bird population were ruled out.	

6. CONCLUSIONS

Higher utilization of alternative and renewable energy resources undoubtedly contributes to sustainable energy – it leads to diversification of energy production and thus to its better stability. Also, exploration of alternative and renewable energy may decrease the adverse environmental and health effects of energy sector – air and water pollution, GHG emissions etc. However, these likely positive impacts assume that new ARES resources will replace the energy production from standard (fossil) resources. Should this be the case, then implementation of the Strategy will have overall positive effects on the environment and health in Azerbaijan.

On the other hand, there are certain environmental and health risks related to ARES development – biodiversity can be adversely affected by wind farm development, water resources significantly altered by hydropower plants, there can be negative impacts on human health. The likely risks and adverse effects, which may result from the Strategy's implementation, were identified in SEA and relevant recommendations and measures proposed on how to minimize or avoid these negative consequences, and thus enhance environmental and health positive effects of ARES development. Since the Strategy is a rather general document stipulating main priorities for ARES development, many SEA recommendations can be only implemented in further stages of planning and/or within project design, approval, and implementation. However, to ensure these mitigation measures will be implemented, it is suggested that the Strategy clearly acknowledge the SEA mitigation measures will be followed when developing the Action Plan and in further steps of ARES planning and project development.