Energy Transition Pathways for the 2030 Agenda

SDG 7 Road Map for Azerbaijan

ESCAP
Economic and Social Commission for Asia and the Pacific

NEXSTEP
National Expert SDG Tool for Energy Planning

Energy Transition Pathways for the 2030 Agenda

SDG 7 Road Map for Azerbaijan

Developed using the National Expert SDG7 Tool for Energy Planning (NEXSTEP)

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*The shaded areas of the map indicate ESCAP members and associate members.**

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Foreword: ESCAP

Azerbaijan stands at a pivotal moment in its energy journey. As a long-standing energy producer with significant petroleum resources, the country has played a vital role in regional and global energy markets. At the same time, it faces emerging challenges including diversifying its energy mix, improving energy efficiency, reducing greenhouse gas emissions and aligning its development pathway with global climate commitments.

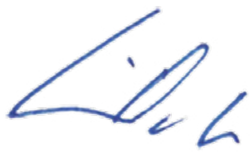
In this context, the *SDG 7 Road Map for Azerbaijan* provides an integrated and evidence-based framework to guide policy, investment and institutional action in support of the country's energy transition. The Road Map aligns national priorities with global goals, offering a coherent pathway to accelerate progress towards SDG 7 while advancing energy system diversification and resilience.

The *SDG 7 Road Map* highlights several strategic priorities. First, there is significant scope to improve energy efficiency across sectors, which can deliver immediate gains in reducing energy intensity, lowering costs and enhancing competitiveness. Second, Azerbaijan has already embarked on an expansion of renewable energy capacity, and the Road Map identifies opportunities to further accelerate this momentum -- particularly through enabling policies, infrastructure investments and private sector participation. Third, the transition to e-mobility is identified as an important step, requiring a gradual yet carefully planned approach that integrates infrastructure development, regulatory frameworks and incentives. Fourth, the shift towards clean and efficient heating systems is critical for reducing emissions and improving energy use, particularly in urban heating applications.

The Road Map also recognizes Azerbaijan's strong potential to become a regional green energy hub. By leveraging its renewable resource base, strengthening grid connectivity and advancing the development of green energy corridors, Azerbaijan can play a transformative role in facilitating the flow of clean energy across borders -- an ambition that directly aligns with its COP29 pledges.

The successful implementation of this Road Map will require sustained commitment, coordinated action across sectors and stakeholders, and the mobilization of adequate resources. ESCAP stands ready to support Azerbaijan in translating this Road Map into tangible outcomes and would welcome further engagement to advance its implementation.

I am confident that, through determined action and strategic partnerships, Azerbaijan can achieve SDG 7 and set an example for sustainable energy transition in the broader region.



Ms. Armida Salsiah Alisjahbana
Under-Secretary-General of the United Nations and
Executive Secretary of ESCAP

Foreword: Azerbaijan

We are in the midst of a historic moment as countries are transforming and complementing their traditional energy systems with renewable and clean energy solutions and technologies. On the way to meet this ambitious goal, governments, private institutions and businesses are investing substantial efforts in taking socially acceptable, cost-effective and technically feasible actions. In this regard it is important to highlight that the SDG7 Road Map for Azerbaijan presents a sound reference framework and indicates one of the significant milestones set by our country in building the cleaner, sustainable and resilient energy sector.

It is widely recognized that Azerbaijan's oil industry dates back to the mid 19th century. The first commercial production of oil in the Bibi-Heybat area of Baku began in 1846. Azerbaijan also pioneered world's first offshore oil well in the Azerbaijani sector of the Caspian Sea in 1949.

Today, Azerbaijan is leading the regional energy transition, in pursuit of achieving objectives of the 2030 Agenda for Sustainable Development and the Paris Agreement by developing both renewable capacities and cross-border transmission corridors. By 2027 11 solar and wind power plants will be integrated into the grid. The share of renewables in installed capacity will rise to 38 per cent by 2030 and 42.5 per cent by 2035.

Implementation of the COP29 Azerbaijan Presidency's Energy Initiatives, namely the Green Energy Pledge: **Green Energy Zones and Corridors**, the **Global Energy Storage and Grids Pledge**, and the **Hydrogen Declaration**, clearly demonstrates Azerbaijan's active role in advancing global energy and climate action.

Azerbaijan is determined to overcome global energy challenges by embracing a trilemma that covers energy security, energy equity and environmental sustainability, without compromising any of these directions, and ensuring a balanced approach.

Our country has positioned itself as an important energy hub at the crossroads of Asia and Europe, and today Azerbaijan is an initiator and active participant of the construction of four large green energy corridors that will deliver large volumes of green energy from Azerbaijan and the Central Asian countries to European and other markets.

The establishment of the *SDG7 Road Map for Azerbaijan* represents a timely and forward-looking initiative, and is a pivotal in accelerating our energy transition and energy security agenda. The strategies and key milestones outlined in the Road Map will contribute to a cleaner energy future by promoting the efficient use of energy resources and supporting projects aimed at improving energy performance across various sectors of the economy.

The *SDG7 Road Map for Azerbaijan* would not have been possible without technical and advisory support of the leadership teams and colleagues of ESCAP, UNECE and the Azerbaijan Renewable Energy Agency. I would like to thank the entire team for their dedication and strong spirit of collaboration. This Road Map is a part of the journey towards a sustained economic growth, reduction of emissions and preparedness to respond to the increasing energy demands.

We stand ready to accelerate efforts to strengthen and advance just and equitable energy transition.

Honourable Orkhan Zeynalov
Deputy Minister
Ministry of Energy
Republic of Azerbaijan

Abbreviations and acronyms

ADB	Asian Development Bank
BAU	business-as-usual
BESS	battery and energy storage system
CBA	cost-benefit analysis
CCGT	combined cycle gas turbine
CHP	combined heat and power
CO_2	carbon dioxide
CPS	current policy scenario
EE	energy efficiency
EERF	Energy Efficiency Revolving Fund
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ESCO	energy services companies
EV	electric vehicle
GDP	gross domestic product
GHG	greenhouse gas
GW	gigawatt
ICS	improved cooking stove
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producers
IRENA	International Renewable Energy Agency
ktoe	thousand tons of oil equivalent
kWh	kilowatt-hour
LCOE	levelized cost of electricity
LEAP	Low Emissions Analysis Platform
LED	light-emitting diodes
LPG	liquified petroleum gas
MCDA	Multi-Criteria Decision Analysis
MEPS	minimum energy performance standard
MJ	megajoule
$MJ/US\$_{2017}$	megajoules per US$ of gross domestic product in terms of power purchase parity in 2017
MoE	Ministry of Energy
MTF	Multi-Tier Framework
$MtCO_2$-e	million tons of carbon dioxide equivalent
Mtoe	million tons of oil equivalent
MW	megawatt
NDC	Nationally Determined Contributions
NEXSTEP	National Expert SDG Tool for Energy Planning
OECD	Organisation for Economic Co-operation and Development
PP	power plant
RE	renewable energy
SDG	Sustainable Development Goal
SPP	small power producers
TFEC	total final energy consumption
TPES	total primary energy supply
TWh	terawatt-hour
UNEP	United Nations Environment Programme
US$	United States dollar
VSD	variable speed drive
WHO	World Health Organization

Executive Summary

Transitioning the energy sector to achieve the 2030 Agenda for Sustainable Development and the objectives of the Paris Agreement presents a complex and difficult task for policymakers. It needs to ensure sustained economic growth as well as respond to increasing energy demand, reduce emissions, and consider and capitalize on the interlinkages between SDG 7 (Affordable and Clean Energy) and the other SDGs. To address this challenge, ESCAP has developed the National Expert SDG Tool for Energy Planning (NEXSTEP).[1] This tool enables policymakers to make informed policy decisions to support the achievement of the SDG 7 targets as well as the Nationally Determined Contributions (NDCs). The initiative has been undertaken in response to the Ministerial Declaration of the Second Asian and Pacific Energy Forum (held in April 2018, in Bangkok) and the Commission Resolution 74/9, which endorsed its outcome. NEXSTEP also garnered the support of the Committee on Energy in its Second Session, with recommendations to expand the number of countries being supported by this tool.

The key objective of this SDG 7 Road Map[2] is to assist the Government of Azerbaijan in assessing whether the existing policies and strategies are well aligned to achieving the SDG 7 and NDCs targets by 2030. This Road Map presents three scenarios – the Nationally Determined Contributions (NDC 3.0) pathway, the Sustainable Development Goal (SDG) scenario and the Green Energy Corridor (GEC) scenario – developed using national data, considering existing energy policies and strategies, and reflecting on other development plans.

A. Highlights of the Road Map

With the presence of multiple enabling frameworks, the progress that Azerbaijan has made towards achieving the SDG 7 and NDC targets is promising. In terms of access to modern energy, the country has achieved universal electricity access in recent years and the current pace is likely sufficient to close remaining gaps in access to clean cooking by 2030. Natural gas and LPG are serving as the bridging fuels to achieve this access. However, Azerbaijan can strengthen its measures to achieve universal access to clean cooking technology by 2030 by accelerating the adoption of highly energy-efficient induction cookstoves, particularly in areas with sufficient electric supply.

Azerbaijan depends heavily on natural gas in its energy system, resulting in a low share of renewable energy. Renewable energy capacity is expected to reach 49.2 per cent by 2030 in the SDG scenario, meeting the 30 per cent target, as significant solar and wind generation will be operational. The country's energy efficiency plans could significantly reduce energy intensity. In line with the SDG 7.3 energy efficiency definition, energy intensity in the country is expected to be 2.8 MJ/US$$_{2017}$ in 2030 under the current policy scenario or NDC 3.0 pathway. NEXSTEP analysis indicates that Azerbaijan can further lower its energy intensity to 2.4 MJ/US$$_{2017}$ to align with the global energy efficiency improvement rate of 4 per cent annually.

In addition to a highly efficient energy system, accelerating the transition to cleaner energy sources, especially renewables in both electricity and heat generation, will help Azerbaijan become a regional green energy exporter. This, however, requires an ambitious effort to transition from fossil fuel-based energy systems to renewables. A deeper analysis indicates that the lifecycle cost of renewable-based power generation is already lower than that of fossil fuel energy.

1 The NEXSTEP tool has been specially designed to perform analyses of the energy sector in the context of SDG 7 and the NDCs, with the aim that the output will provide a set of policy recommendations to achieve the SDG 7 and NDC targets.

2 This Road Map examines the current status of the national energy sector and existing policies, compares them with the SDG 7 targets, and presents different scenarios highlighting technological options and enabling policy measures for the Government to consider.

B. Achieving SDG 7 and NDC targets in Azerbaijan by 2030

1. Universal access to electricity

Azerbaijan achieved universal electricity access in 2024. The country can continue to improve system reliability to meet rising demand and support the increasing penetration of renewable energy in the future.

2. Universal access to clean cooking technology

Under current policy settings or NDC 3.0 pathway, clean cooking access is projected to reach 100 per cent by 2027, up from 99.4 per cent in 2024. Natural gas is expected to help close the remaining gap in this scenario, as it plays a significant role in Azerbaijani households, including for heating. The current electricity tariff also makes natural gas stoves more competitive than electric stoves. Natural gas and LPG stoves are expected to account for 98.6 per cent of the clean cooking share, while electric cookstoves will account for a 1.4 per cent share.

NEXSTEP analysis suggests that the adoption of electric cookstoves may be the most appropriate solution for Azerbaijan, given their reliability and environmental benefits. This technology is already widely used in the country. In the SDG scenario, at least 20 per cent of the population, or around half a million households, is expected to adopt electric cookstoves by 2030. Alternatively, an energy-efficient stove standard can be introduced to avoid the costly transition to electric stoves.

3. Renewable energy

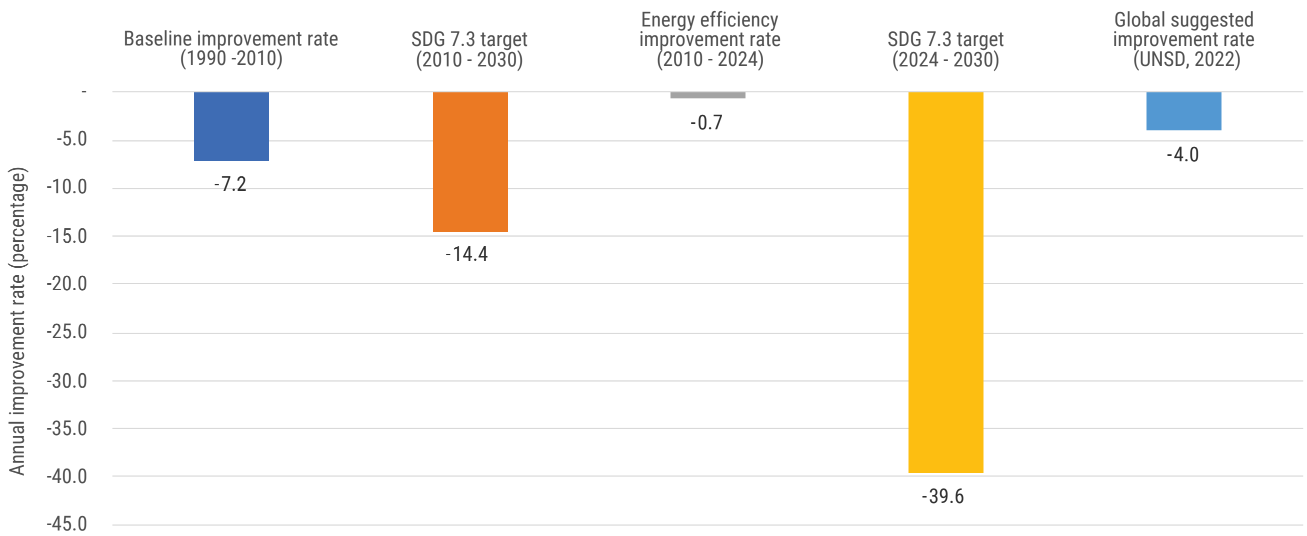
In 2024, the share of modern renewable energy (excluding traditional biomass for residential cooking) in total final energy consumption (TFEC, including non-energy use) was 2.1 per cent. Based on current policies, the share of renewable energy is projected to increase to 4.2 per cent by 2030. The increase is due to the projected increase in renewable electricity as per the current expansion plan. In the SDG scenario, the share of renewable energy is projected to increase to 9.6 per cent of TFEC in 2030. The additional increase can be attributed to the further addition of renewable energy capacity from 2028 onwards, compared to the NDC 3.0 pathway. Although the share of renewable energy will increase, natural gas will still dominate the energy system in Azerbaijan.

In terms of renewable energy in power generation, Azerbaijan aims to reach at least 30 per cent renewable capacity by 2030. The country is on track to achieve 49.2 per cent of its renewable capacity (including hydropower) if planned expansions are implemented. The Government must ensure that funding is secured, to ensure that projects become operational over the remaining five years until 2030.

4. Energy efficiency

Under the SDG 7.3 targets, energy intensity is defined as the total primary energy supply (TPES) in MJ/US$$_{2017}$. Energy intensity in Azerbaijan declined at an average annual rate of 7.2 per cent between 1990 and 2010. A doubling of the 1990-2010 improvement rate is required to achieve the SDG 7.3 target, which requires an average annual rate increase of 14.4 per cent between 2010 and 2030. However, between 2010 and 2021, the annual improvement rate was only around 0.7 per cent. To reach the expected 2030 intensity, the annual improvement rate between 2021 and 2030 must be around 39.5 per cent, which is challenging. Therefore, NEXSTEP analysis suggests that the energy intensity target must be aligned with the global target of 4 per cent annual improvement (IEA and others, 2023). This corresponds to an energy intensity target of 2.7 MJ/US$$_{2017}$ by 2030.

Figure I. **Energy intensity improvement in Azerbaijan**



Source: ESCAP.

Under the NDC 3.0 scenario, energy intensity in Azerbaijan is projected to decline to 2.8 MJ/US$$_{2017}$, corresponding to an annual improvement rate of 3.4 per cent. This reduction reflects the implementation of significant energy efficiency measures as outlined in the updated NDC 3.0. With more ambitious and accelerated implementation, energy intensity can further decline to 2.4 MJ/US$$_{2017}$, aligning with the global energy efficiency improvement rate of 4 per cent per annum.

5. Nationally Determined Contributions (NDCs)

The updated Nationally Determined Contribution (NDC) sets ambitious targets to reduce greenhouse gas (GHG) emissions by 40 per cent compared to the 1990 emissions by 2035 (Azerbaijan, 2025), and Azerbaijan is expected to meet this target. GHG emissions in the energy sector are projected to reach 28.7 $MtCO_2$-e in 2035, driven by the increasing share of renewables in electricity supply under existing renewable energy capacity expansion plans. Further reductions can be achieved by accelerating implementation of energy efficiency measures that are aligned with the global improvement target of 4 per cent. In the SDG scenario, total emissions will reach 25.1 $MtCO_2$-e by 2035, consistent with achieving the NDC target.

C. Increasing ambition beyond SDG 7

A well-planned, concerted effort must be undertaken by the Government of Azerbaijan to become a regional renewable energy exporter. Achieving this target will require a significant investment in the power sector. Fortunately, the energy system of Azerbaijan is well-positioned for an accelerated decarbonization effort, as many of the required net-zero technologies, such as renewable power generation, are mature and readily available. It is suggested that between 2033 and 2040, 4,000 MW of offshore wind, 300 MW of solar PV, 215 MW of onshore wind and 300 MW of a hybrid power plant be developed to meet the export target. This addition will further increase the renewable capacity to 61.5 per cent in 2040. In terms of generation, this will add up to 10.2 TWh to the system.

D. Important policy directions

This Road Map sets out the following four key policy recommendations to help Azerbaijan achieve the SDG 7 targets as well as reduce reliance on imported energy sources:

(1) **Accelerate energy efficiency across all economic sectors.** Azerbaijan needs to accelerate energy efficiency measures to align with the global improvement pathway of 4 per cent. This can be achieved by implementing best practices, such as energy management standards, building energy codes, modal shifts in transport and fuel economy improvement through 2030. Additional efforts are required to eliminate inefficient and unclean heating technology while simultaneously improving thermal insulation. Given that these targets are more ambitious compared to existing plans, international assistance will be essential.

(2) **Implement strong policy measures to address the gap in clean cooking by 2030.** Increasing the adoption of electric cookstoves will significantly help improve access to clean cooking. The cumulative deployment cost of both technologies would require US$ 57.1 million by 2030. The deployment of electric cookstoves will also help Azerbaijan enhance energy efficiency and reduce emissions.

(3) **Adopt fuel switching strategies, including electrification, to accelerate SDG 7 progress and provide multiple benefits in the long run.** Electrification of end uses would be critical to decarbonizing the economy. Since electrical equipment is more efficient than fossil fuel-based equipment, this shift will significantly reduce fossil fuel demand. Rapid adoption of electric vehicles, for instance, reduces the demand for oil products, thereby reducing the country's reliance on petroleum fuels.

(4) **Decarbonize the power and heating sector by investing in renewable energy to help establish Azerbaijan as a clean energy hub.** Under ambitious scenarios, a projected decrease in grid emissions can lead to substantial reductions in GHG emissions. Azerbaijan should accelerate its transition towards establishing itself as a major regional clean energy supply hub, leveraging initiatives such as the Green Energy Corridor (GEC).

(5) **Strengthen the position of Azerbaijan as a green energy exporter in the region and increase electricity exports toward Europe is strategically important, particularly within the framework of the Green Energy Corridor scenario.** However, this also requires the integration of large-scale renewable energy capacities and the expansion of transmission infrastructure. NEXSTEP analysis suggests that the lifecycle costs of renewables, such as hydropower, solar and wind, are lower than those of fossil fuel-based technologies.

(6) **Decarbonize the heating sector by pursuing and investing in modern low-carbon heating solutions.** The role of the heating sector requires stronger attention in the energy transition. In the urban areas in Azerbaijan, centralized and other collective heat supply solutions can play an important role in improving efficiency, reducing local emissions and enabling the gradual integration of low-carbon technologies. Modernization of existing district heating systems, improvement of heat network efficiency, deployment of digital monitoring and control systems, and assessment of cleaner heat generation options should therefore be treated as an important part of the country's decarbonization pathway.

In addition, smaller-scale cogeneration technologies can be an efficient solution for the country's urban context, especially where large-scale expansion of conventional district heating infrastructure is not technically or economically optimal. Small- and medium-sized CHP or modular cogeneration units can simultaneously provide heat and electricity with high fuel efficiency, support the modernization of existing boiler houses, and help balance the increasing electrification of end uses.

(7) **Digitalize energy systems and improve transmission and distribution infrastructure.** To accelerate the electrification of end use, substantial investments should be made in transmission and distribution grids, including storage. The expansion of the electricity grid, as well as improvements in transmission losses, will help Azerbaijan transition to electricity. Energy storage is critical to ensuring a reliable power system as renewable energy penetration increases in the future.

Digitalization is a critical enabler for expanding both power and heat system modernization. It can enhance system efficiency, balance supply and demand, and enable more flexible integration of renewable and distributed energy resources. Key technologies such as artificial intelligence (AI), the Internet of Things (IoT), blockchain, and advanced monitoring and control systems can optimize operations across electricity and heat networks, improve the management of distributed energy resources (DERs), and enhance grid flexibility to support the transition to cleaner energy systems. To enhance the effectiveness of power and heat system planning and modernisation, there is a need to establish or ensure access to advanced digital platforms and analytical tools for energy system modelling, data management, and scenario-based assessments. Furthermore, for effective management of the energy transition, the development of cross-sectoral environmental, social and governance (ESG) data systems and digital solutions, alongside strengthened data collection and analysis, and integration into decision-making processes is an important priority. A comprehensive assessment of potential impacts of regulatory initiatives on business entities should also be undertaken.

1. Introduction

1.1. Background

Transitioning the energy sector to achieve the 2030 Agenda for Sustainable Development and the objectives of the Paris Agreement presents a complex and difficult task for policymakers. It needs to ensure sustained economic growth, respond to increasing energy demand, reduce emissions as well as consider and capitalize on the interlinkages between SDG 7 (Affordable and Clean Energy) and the other SDGs. In this regard, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has developed the National Expert SDG Tool for Energy Planning (NEXSTEP). This tool enables policymakers to make informed decisions to support the achievement of the SDG 7 targets as well as the emission reduction targets of the Nationally Determined Contributions (NDCs). The initiative has been undertaken in response to the Ministerial Declaration of the Second Asian and Pacific Energy Forum (held in April 2018, in Bangkok) and the ESCAP Commission Resolution 74/9, which endorsed the meeting's outcome. NEXSTEP also garnered the support of the Committee on Energy in its Second Session, with recommendations to expand the number of countries being supported by this tool. The Ministerial Declaration advises ESCAP to support its member States, upon request, in developing national SDG 7 Road Maps.

The Government of Azerbaijan expressed interest in developing the SDG 7 Road Map to assess if its existing policies and strategies are well aligned with achieving the SDG 7 targets by 2030. The objective of this *SDG 7 Road Map* is to assist the Government of Azerbaijan in developing enabling policy measures to achieve the SDG 7 and NDC targets, as well as guide the country's energy sector towards establishing itself as a regional green energy hub.

1.2. SDG 7 targets and indicators

SDG 7 aims to ensure access to affordable, reliable, sustainable and modern energy for all. It has three key targets:

- Target 7.1. "By 2030, ensure universal access to affordable, reliable and modern energy services". Two indicators are used to measure this target: (7.1.1) the proportion of the population with access to electricity and (7.1.2) the proportion of the population with primary reliance on clean cooking fuels and technology.
- Target 7.2. "By 2030, increase substantially the share of renewable energy in the global energy mix". This is measured by the renewable energy share in TFEC. It is calculated by dividing energy consumption from all renewable sources by total energy consumption. Renewable energy consumption includes the consumption of energy derived from hydropower, solid biofuels (including traditional use), wind, solar, liquid biofuels, biogas, geothermal, marine and waste. Due to the inherent complexity of accurately estimating the traditional use of biomass, NEXSTEP focuses entirely on modern renewables for this target.
- Target 7.3. "By 2030, double the global rate of improvement in energy efficiency", as measured by the energy intensity of the economy. This is the ratio of the total primary energy supply (TPES) and GDP. Energy intensity is an indication of how much energy is used to produce one unit of economic output. As defined by the International Energy Agency (IEA), TPES is made up of production plus net imports, minus international marine and aviation bunkers, plus stock changes. For comparison purposes, GDP is measured in constant terms at 2017 PPP.

In addition to the above-mentioned targets, the SDG 7 goal includes target 7.A: promote access, technology and investments in clean energy; and target 7.B: expand and upgrade energy services for developing countries. These targets are not within the scope of NEXSTEP.

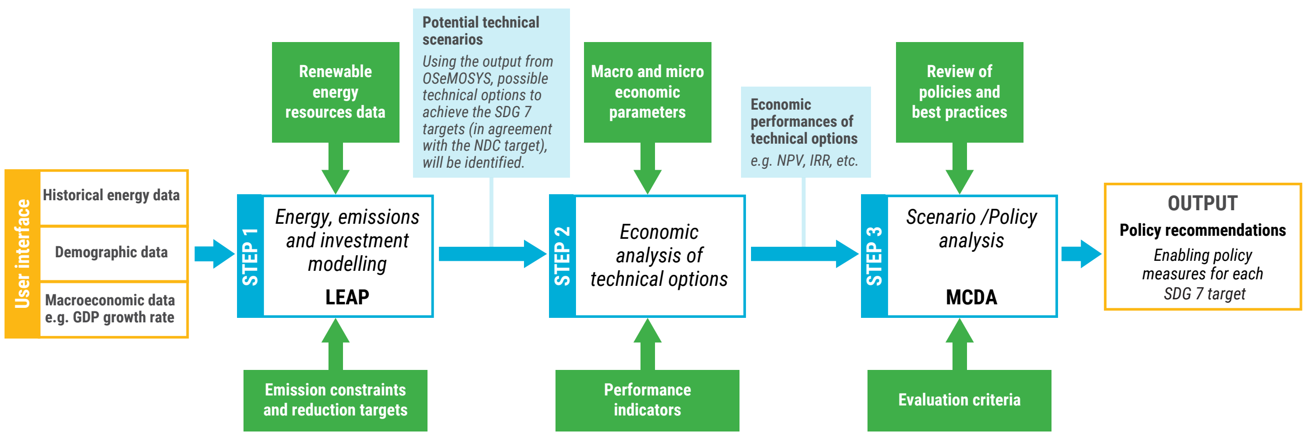
1.3. Nationally Determined Contributions

Nationally Determined Contributions (NDCs) represent pledges by each country to reduce its national emissions and serve as stepping-stones for the implementation of the Paris Agreement. Since the energy sector is typically the largest contributor of GHG emissions in most countries, decarbonizing energy systems must be prioritized. Key approaches for reducing emissions from the energy sector include increasing the share of renewable energy in the generation mix and enhancing energy efficiency. In its updated third NDC document (NDC 3.0), Azerbaijan has set a mitigation target, aiming to reduce its total national GHG emissions by 40 per cent by 2035 as compared to 1990 emissions (Azerbaijan, 2025).

1.4. NEXSTEP methodology

The main purpose of NEXSTEP is to help design the type and mix of policies that would enable the achievement of the SDG 7 targets and the emission reduction target (under NDCs) through policy analysis. The tool helps modelling energy, emissions and economics to analyse a range of policies and options for their suitability (figure 1). This tool is unique as no other tools focus on developing policy measures that are specifically aimed at achieving SDG 7. One key feature of this tool is the back-casting approach to energy and emissions modelling. This method is important in planning toward SDG 7, as it involves developing a trajectory by working backwards from the (known) 2030 targets to the present day. Figure 1 shows components of the methodology.

Figure 1. Components of the NEXSTEP methodology



Source: ESCAP.

1.4.1. Energy and emissions modelling

NEXSTEP analysis begins by developing a model of the energy system for each scenario, defining the technical options in terms of the final energy (electricity and heat) requirement for 2030, possible generation/supply mix, emissions and the size of investment required. The energy and emissions modelling component uses the Low Emissions Analysis Platform (LEAP) tool (Heaps, 2022). This proprietary software is widely used by many countries to develop scenarios for the energy sector, conduct policy analysis and develop NDC targets.

1.4.2. Economic analysis

The second step builds on the selection of appropriate technologies through an economic optimization process that identifies the least-cost energy supply options for the country. A comparative assessment of selected power generation technologies is done using the levelized cost of electricity (LCOE) as an economic indicator. This provides policymakers with insights into the costs and benefits of economically attractive technology options, allowing better allocation of resources and better-informed policy decisions. While the economic analysis has been kept to a simple level, it contains enough information to support policy recommendations in this Road Map. Some key cost parameters used in this analysis are (1) capital cost, including land, building, machinery, equipment and civil works; and (2) operation and maintenance costs, such as fuel, labour and maintenance costs.

1.4.3. Scenario analysis

The scenario analysis evaluates and ranks scenarios using the Multi Criteria Decision Analysis (MCDA) tool, with a set of criteria and weights assigned to each criterion. Although the criteria considered in the MCDA tool can include the following, stakeholders may wish to add/remove criteria to suit the local context:

- Access to clean cooking fuel
- Energy efficiency
- Share of renewable energy
- Emissions targets in 2030
- Alignment with the Paris Agreement
- Fossil fuel subsidy phase-out
- Price of carbon
- Fossil fuel phase-out
- Cost of access to electricity
- Cost of access to clean cooking fuel
- Investment cost of the power sector
- Net benefit from the power sector

This step is performed using the NEXSTEP online portal, as a means to suggest the best way forward for the countries by prioritizing the scenarios. Stakeholders can update this scenario ranking using various criteria and their specific weights (NEXSTEP, 2026). The top-ranked scenario from the MCDA process is used to inform the Government on the best possible energy transition pathway for the country.

1.5. Data sources

The primary source of data collection has been from government databases and reports. Some data has been collected directly from government agencies through a formal letter of request from the Ministry of Energy of Azerbaijan. In a few instances where government data was unavailable, research papers and analyses have been consulted. The final dataset has been presented to and approved by the Ministry of Energy.

2. Country overview

2.1. Demographic and macroeconomic profile

Azerbaijan is a landlocked country in Western Asia occupying a total land area of 86,600 km^2. It is bordered by the Islamic Republic of Iran in the south, Georgia in the north-west, the Caspian Sea in the east, and Armenia and Türkiye in the west. The country experiences wide seasonal temperature variation, with temperatures ranging from as high as 35°C in summer and dropping to as low as -10°C in winter.

The total population of Azerbaijan was 10.18 million people in January 2024,[3] with an average of 4.19 persons per household,[4] equivalent to an estimated 2.43 million households. Between 2023 and 2024, the annual population growth rate was approximately 0.53 per cent. Over the ten-year period between 2014 and 2024, the annual population growth rate averaged 0.7 per cent, indicating low population growth. The percentage of the urban population was estimated to be 54.5 per cent.[5] Baku, the capital of Azerbaijan, is the most populated city, with a population of around 2.34 million.

In 2024, the GDP of Azerbaijan was estimated to be $74.32 billion, representing a growth of 4.2 per cent from 2023. GDP per capita was $7,294.6 in 2024. In terms of sectoral share of GDP, the services sector accounted for 42.2 per cent, followed by mining at 29.0 per cent, manufacturing and construction at 12.1 per cent and agriculture at 5.6 per cent, with the remainder attributed to the other sectors.[6]

2.2. Energy sector overview

2.2.1. National energy profile in the baseline year 2024

The following section presents the estimated national energy consumption based on a bottom-up approach, using data on activity levels and energy intensity across different sectors. The bottom-up estimation is generally consistent with the national energy statistics in terms of total energy supply and total final energy consumption by fuel type. The baseline year of 2024 has been selected based on the latest availability of all data points.

Energy demand: In 2024, the total final energy consumption (TFEC[7]) was around 13.4 Mtoe (figure 2). Most of the demand came from the residential sector at 33.5 per cent, followed by the transport sector at 26.5 per cent. The industrial sector and the commercial sector accounted for 13.1 per cent and 8.1 per cent of energy demand, respectively. The agricultural sector accounted for 4.7 per cent, while the remaining share of 14.1 per cent was attributed to non-energy use.

The main source of energy in Azerbaijan is natural gas, which accounted for the highest share at 45.5 per cent, followed by oil products at 38.2 per cent. The transport sector, which operated predominantly with internal combustion engine vehicles, was the main consumer of oil products. Electricity and district heating accounted for 13.7 per cent and 2.3 per cent of energy demand, respectively. Traditional biomass use was approximately 0.2 per cent and mainly consumed by the residential sector.

3 Based on data provided by the national consultants and available at State Statistical Committee of the Republic of Azerbaijan, 2026b.

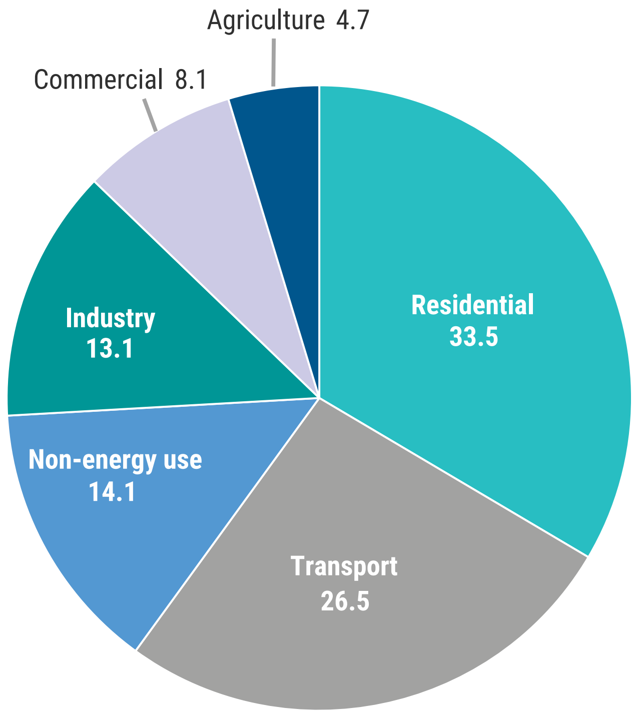
4 Based on the data provided by the national consultants and available at State Statistical Committee of the Republic of Azerbaijan, 2026a.

5 Based on the data provided by the national consultants and available at State Statistical Committee of the Republic of Azerbaijan, 2026b.

6 Based on the data provided by the national consultants and available at State Statistical Committee of the Republic of Azerbaijan, 2026c.

7 This includes residential, commercial, industry, transport, agriculture and non-energy use sectors.

Figure 2. Total final energy consumption (TFEC) by sector in 2024 (percentage)



Source: ESCAP.

In the residential sector, approximately 74 per cent of energy consumption was used for heating purposes (3.3 Mtoe). Heating demand in Azerbaijan is high, as more than 50 per cent of the residential buildings were built before 1980 without building efficiency standards (WHO, 2014). This high demand for residential heating was met primarily by gas boilers (95.3 per cent), district heating (3.6 per cent), electric heaters (1 per cent) and fuelwood (0.1 per cent).

Cooking accounts for around 13.4 per cent of residential energy demand. The distribution of cooking technology will be discussed in section 2.2.2. In addition to cooking and heating, the remaining percentage of energy is used to power electric appliances. Among these, air conditioners accounted for 28.8 per cent of electrical demand, followed by refrigeration at 16.5 per cent, televisions at 12.3 per cent and lighting at 11.1 per cent. The remaining 31.3 per cent is attributed to irons, washing machines and other appliances. Minimum Energy Performance Standards (MEPS) have not yet been implemented in Azerbaijan (IEA, 2024).

Within the transport sector, 92.3 per cent of energy was consumed by road transport, 6.2 per cent by aviation and 0.7 per cent by rail transport, with the remainder being attributed to the maritime sector.

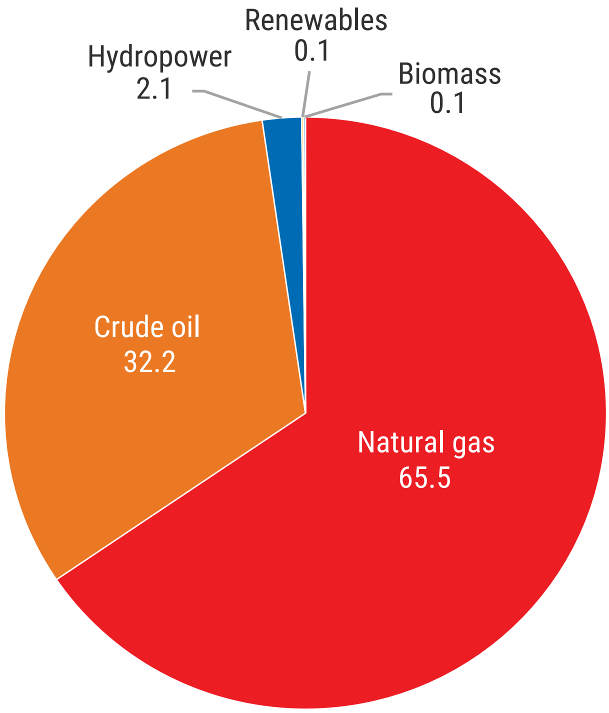
Within the road transport category, 45.5 per cent of energy was used by freight trucks. Passenger cars accounted for 45.8 per cent, buses for 8.5 per cent and motorcycles accounted for 0.2 per cent of energy demand. At least 80 per cent of passenger cars are more than 10 years old, and over 40 per cent of imported vehicles are second-hand, resulting in significant energy demand (IEA, 2024).

There are four energy-intensive industries in Azerbaijan: (1) non-metallic minerals; (2) chemical and petrochemical; (3) food, beverages and tobacco; and (4) construction industries. These industries collectively accounted for 84.3 per cent of industrial energy demand. The remaining was consumed by the iron and steel, pulp and paper, machinery and transport equipment, textile and leather, and other such processing industries.

Analysis of the commercial sector is usually based on floor space occupied by the sector and the energy intensity per square metre. However, due to limited information, only the total energy demand by fuel type could be obtained. In this sector, electricity accounted for 55.9 per cent of energy demand, natural gas for 40.5 per cent and district heating for 2.3 per cent. The remaining 1.3 per cent of demand was supplied by LPG, diesel and biomass.

Primary energy supply: In 2024, the total primary energy supply (TPES) was 18.5 Mtoe. The total energy supply of primary energy products comprised of natural gas at 65.5 per cent, crude oil at 32.2 per cent, hydropower at 2.1 per cent, renewables at 0.1 per cent, with the remainder, including biomass, at 0.1 per cent. Figure 3 presents the distribution of TPES by fuel type.

Figure 3. Total primary energy supply (TPES) by sector in 2024 (percentage)



Source: ESCAP.

Electricity and heat generation: In 2024, the total installed power generation capacity was 7,199.2 MW. In terms of capacity mix, natural gas accounted for 76.1 per cent of the capacity, while renewables[8] accounted for 19.7 per cent, of which hydropower was 14.8 per cent followed by solar at 3.6 per cent, wind at 0.9 per cent, waste-to-energy at 0.4 per cent and biogas at about 0.01 per cent. The remainder was attributed to diesel power plants at 4.2 per cent.

In 2024, total electricity generation was 26.5 TWh. Natural gas power plants accounted for 86.2 per cent of power generation, while renewable energy sources accounted for around 13.6 per cent, of which large and small hydropower accounted for 10.6 per cent, solar at 2.0 per cent, waste at 0.8 per cent and wind at 0.2 per cent, with the remainder being attributed to diesel power plants. The remainder 0.2 per cent came from diesel power plants. District heating generation, in 2024, was around 340.2 ktoe, of which 188.7 ktoe was from gas combined heat and power (CHP), and 151.5 ktoe from gas boilers.

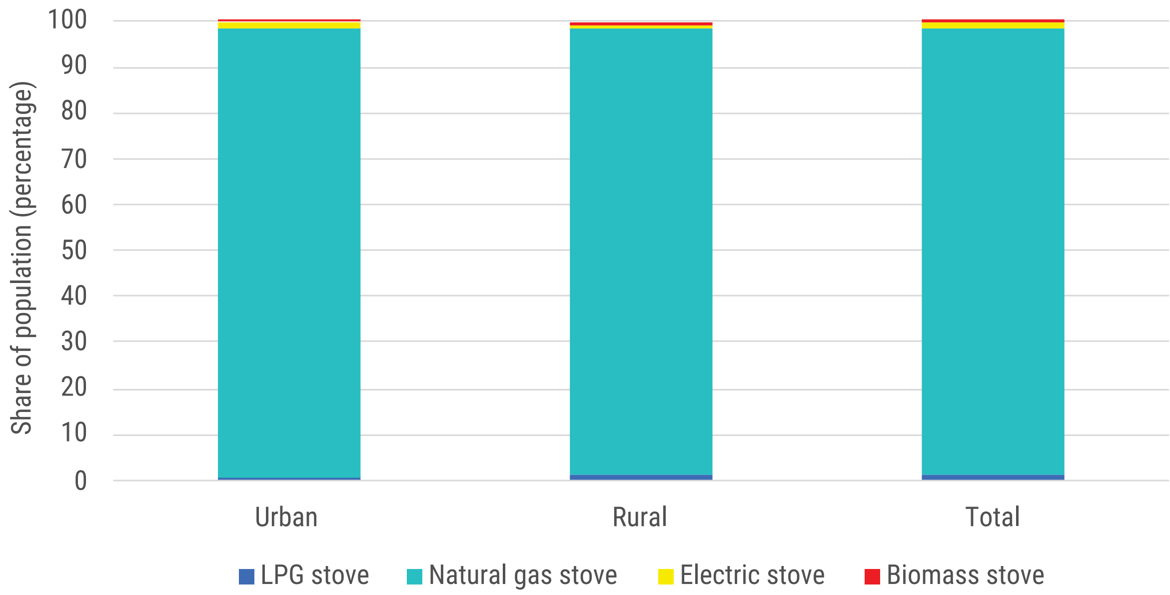
2.2.2. Status of SDG 7 targets in the base year 2024

Access to modern energy: Azerbaijan has made significant progress in providing its citizens with access to energy, with the electrification rate at 100 per cent since 2022. Access to clean cooking was estimated to be 99.4 per cent,[9] while the remaining 0.6 per cent of the population, which corresponds to 15,696 households, still relied on unclean and polluting biomass stoves as their primary cooking technology. Natural gas stoves were the most dominant primary clean cooking technology, with an estimated 97.6 per cent share. This was followed by LPG and electric cookstoves, which were estimated at 1 and 0.8 per cent, respectively. Figure 4 shows the distribution of different cooking fuels and technologies in 2024.

8 Large hydropower is classified as renewable energy under the SDG 7.2 definition.

9 Estimated based on the cooking distribution data provided for urban and rural sectors in accordance with WHO, 2024.

Figure 4. Population share of clean cooking access by fuel type (percentage)



Source: ESCAP.

Renewable energy share in the total final energy consumption (TFEC): Renewable energy (solar, wind, large and mini hydropower, as well as traditional biomass usage) delivered approximately 2.2 per cent of TFEC in 2024, which is equivalent to 2.3 per cent of TPES. If traditional biomass usage in the residential sector were excluded, the renewable share would be 2.1 per cent of TFEC. Despite being endowed with abundant renewable energy potential, Azerbaijan relies heavily on fossil fuels, such as natural gas and oil products, to meet its energy demands, both for stationary and mobile applications.

Energy intensity: Energy intensity under SDG 7.3 is defined as the total primary energy supply (TPES) in megajoules per US$ of gross domestic product at purchasing power parity in 2017 (MJ/US$$_{2017}$). In 2024, the energy intensity in Azerbaijan was 3.5 MJ/US$$_{2017}$.

Energy intensity in Azerbaijan declined at an average annual rate of 7.2 per cent between 1990 and 2010 from 17.1 MJ/US$$_{2017}$ to 3.8 MJ/US$$_{2017}$. A doubling of the 1990-2010 improvement rate is required to achieve the SDG 7.3 target, which requires an average annual rate increase of 14.4 per cent between 2010 and 2030, reaching 0.2 MJ/US$$_{2017}$ in 2030. However, between 2010 and 2024, energy intensity decreased by 0.7 per cent annually to 3.5 MJ/US$$_{2017}$. To reach the expected 2030 target for intensity, the annual improvement rate between 2024 and 2030 must be around 39.5 per cent, which is challenging. Therefore, NEXSTEP analysis suggests that the energy intensity target be aligned with the global target of 4.0 per cent annual improvement. This corresponds to a 2030 energy intensity target of 2.7 MJ/US$$_{2017}$.

GHG emissions: Energy-sector emissions from the combustion of fossil fuels were calculated using the IPCC Tier 1 emission factors assigned in the LEAP model and expressed in terms of 100-year global warming potential (GWP) values. In 2024, GHG emissions from the energy sector were estimated at 36.5 MtCO_2-e. Emissions from the electricity and heat generation sector were the largest at 11.5 MtCO_2-e (32.8 per cent), followed by the transport sector at 10.5 MtCO_2-e (28.8 per cent), which primarily resulted from direct fuel combustion in internal combustion engines. Emissions from the residential sector were 8.9 Mt CO_2-e (24.3 per cent), primarily from the combustion of natural gas and biomass for cooking and space heating, while emissions attributable to the industrial sector were estimated at 2.8 MtCO_2-e. Commercial and agricultural sector emissions together accounted for around 2.4 MtCO_2-e. This analysis, however, does not include emissions from the oil and gas sector resulting from fugitive and venting processes, as well as emissions from industrial processes and product use (IPPU).

2.2.3. National energy policies, plans, strategies and institutions

The energy sector in Azerbaijan is governed by several stakeholders. These include the Ministry of Energy (MoE), the Tariff Council, the Azerbaijan Energy Regulatory Agency (AERA) and the Azerbaijan Renewable Energy Agency (AREA). The MoE is responsible for governing and implementing regulations and policies, while the Tariff Council, chaired by the Ministry of Economy, regulates tariffs for electricity, gas, heating networks and refined petroleum products. Established in 2017, AERA is responsible for the regulation and state oversight of enterprises engaged in electricity, heat and gas supply, as well as matters related to consumer affairs, it also oversees the renewable energy sector. The main provider of energy-related data and statistics is the State Statistical Committee (SSC) of Azerbaijan (IEA, 2021a).

Energy sector development in Azerbaijan is guided by several national policies and legislations. These policies have served as guiding references for NEXSTEP modelling, enabling a deeper understanding of the country's context to provide recommendations that align with the national government's overarching direction. Where applicable, the currently implemented and adopted policies or regulations are considered in the current policy scenario or NDC 3.0 pathway to identify gaps in achieving the SDG 7 targets. The following policies or strategic documents have been consulted.

- **The Presidential Order No. 1209 on accelerating reforms in the Energy Sector** established on 29 May 2019, sets out a judicial framework for deregulation, enhanced market competition and green energy transition (Azerbaijan, 2019).
- **The Law of the Republic of Azerbaijan No 339-VIQ on the Use of Renewable Energy Sources in the Production of Electricity** is a crucial regulatory framework that manages the legal, economic and governance of renewable energy. This law also provides enabling mechanisms for the green energy transition (Azerbaijan, 2021a).
- **The Law of the Republic of Azerbaijan No. 359-VIQ on the Efficient Use of Energy Resources and Energy Efficiency** defines the legal, organizational, and economic foundations of state policy in the field of efficient use of energy resources and energy efficiency, and regulates the activities of state bodies (institutions), as well as individuals and legal entities, and the relations arising between them in this field. A slight amendment was implemented in 2024 through the Law of the Republic of Azerbaijan No. 106-VIIQD.
- **Socio-Economic Development Strategy of the Republic of Azerbaijan for 2022-2026** aims for a green energy transition, improved energy efficiency and the development of a low-carbon economy (Azerbaijan, 2022). The Government aims to increase renewable energy capacity to 30 per cent by 2030.
- **The Law of the Republic of Azerbaijan No. 1006-VIQ on Energy Provides** legal, economic and administrative foundations of activities in the energy sector, as well as the mechanisms for ensuring energy security, fostering a healthy competitive environment, supporting sustainable economic development, and providing consumers with reliable, high-quality, accessible and safe energy (Azerbaijan, 2023).
- **Law of the Republic of Azerbaijan on Electricity** regulates relations among electric power entities, consumers, and state bodies (institutions) operating in the electricity sector in connection with the generation, storage, transmission, distribution, supply, import, export and consumption of electricity. It also defines the legal, economic and organizational foundations of the sector.
- **Updated Third Nationally Determined Contribution 2021-2030 of The Republic of Azerbaijan To The Paris Agreement** sets a mitigation target for the NDC of Azerbaijan, aiming for a 40 per cent reduction in total national greenhouse gas (GHG) emissions by 2035 compared to 1990 emissions (Azerbaijan, 2025). The strategy includes optimizing fuel consumption, increasing the use of renewable energy and energy storage, improving the energy performance standard of newly constructed buildings, transitioning to electric heat pumps and electric stoves, and increasing the uptake of electric vehicles.

- **Law of the Republic of Azerbaijan on Gas Supply** regulates the relations among gas supply entities, consumers and state bodies (institutions) operating in the gas supply sector in connection with the transportation, distribution, storage, sale, import, consumption of gas, and the operation of gas facilities, and defines the legal, economic and organizational foundations of gas supply.
- **Law of the Republic of Azerbaijan on Heat Supply** regulates the relations among heat supply entities, consumers and state bodies (institutions) operating in the heat supply sector in connection with the production, distribution (including transmission), sale, and consumption of thermal energy, and defines the legal, economic and organizational foundations of heat supply.

2.2.4. National energy resources and potentials

Natural gas is the primary fuel used for electricity and heat generation in Azerbaijan. The country produces oil and gas domestically, and refines crude oil to meet domestic demand for oil products. Natural gas reserves are estimated to be approximately 1,718 billion cubic metres, while oil reserves are around 4.11 billion barrels (IEA, 2021a).

Azerbaijan has abundant hydro, solar and wind potential, with substantial experience with hydropower technologies. Numerous rivers in the mountainous areas have a technical small hydropower potential of approximately 520 MW, generating up to 3.2 TWh annually (IEA, 2021a). Plans are in place to further increase solar PV and wind deployment in the next few years. Azerbaijan has a technical potential of approximately 115 GW and an economic potential of approximately 23 GW, with solar irradiance of approximately 1,500–2,000 kWh/m² per year. There is also considerable wind energy resource potential, located around the Caspian Sea, which can support up to 3 GW of installed capacity (IEA, 2021a). Beyond generating solar and wind energy, economic growth in Azerbaijan can provide opportunities for heat and power generation from biomass and waste, with a technical potential of around 0.38 GW. Geothermal potential is expected to be up to 800 MW despite low reservoir temperature. Table 1 presents a SWOT analysis of renewable energy resources in Azerbaijan.

In addition to its potential in the power sector, Azerbaijan also has opportunities to decarbonize heat supply. This is particularly important because natural gas remains the dominant fuel for space heating in buildings, while district heating already forms part of the national energy system. In the medium and long term, cleaner heat supply could be supported through a combination of modernizing centralized heating systems, deploying large and medium-scale heat pumps, integrating waste heat where feasible, modernizing cogeneration-based heat supply, and gradually increasing the use of renewable and other low-carbon heat sources. Given the importance of heat demand in urban areas, the heating sector should be treated as a strategic component of the country's energy transition planning.

Table 1. **SWOT analysis of renewable energy resources in Azerbaijan**

	Strengths	Weaknesses	Opportunities	Threats
Hydro energy	• Endowed with water resources • Already established technology	• Seasonal variability	• Player in the market is already available • Favourable investment incentive	• Biodiversity loss • Damage to nature • River loading problems
Solar energy	• Abundant resource availability • Already commercially mature technology	• Stronger competition among bidder and lender	• Huge potential to meet the supply and demand gap • Reduction in GHG emissions	• High capital cost
Wind energy	• Moderate potential	• Limited availability of suitable sites with adequate wind speeds • Isolated nature	• Reduction in GHG emissions	• High capital cost • High transport and construction costs
Geothermal and heat pump	• Low to moderate potential	• Temperature too low for power generation	• Potential to meet the heating demand	• Very high capital cost • Lack of investor interest
Biomass and waste energy	• Availability of biomass and waste	• Limited research has been conducted	• Opportunity to retrofit the old thermal power plants	• Very high capital cost

3. Modelling assumptions

This chapter presents an outline of the scenarios considered by NEXSTEP, together with the key demographic and macroeconomic assumptions used in modelling the energy system in Azerbaijan.

3.1. Scenario definitions

NEXSTEP is designed for scenario analysis, using the LEAP modelling system to enable energy specialists to model energy system evolution based on current energy policies. The baseline year 2024 was chosen as it is the most recent year with sufficient data for modelling. In the NEXSTEP model, three scenarios have been developed. These include: (a) the NDC 3.0 scenario (b) the Sustainable Development Goal (SDG) scenario; and (c) Green Energy Corridor (GEC) scenario.

3.1.1. The NDC 3.0 scenario

This scenario considers initiatives implemented or scheduled for implementation during the analysis period of 2024-2030 to establish baseline performance, with reference to SDG 7 and NDC targets, as well as national targets for energy efficiency improvement and the share of renewable energy. These policies are largely reflected in the updated Nationally Determined Contributions (NDC 3.0). The energy intensities from different demand sectors are assumed to be constant throughout the analysis period. Only policies with concrete measures are considered in this scenario. Plans/strategies/policies that are unlikely to be implemented are not considered, but are compared with scenario results and findings later in this Road Map.

3.1.2. The Sustainable Development Goals (SDG) scenario

The SDG scenario builds on the NDC 3.0 scenario to provide recommendations for achieving the SDG 7 targets. This scenario aims to achieve the SDG 7 targets, including universal (100 per cent) access to electricity and clean cooking fuel, substantially increasing the share of renewable energy and doubling the rate of energy efficiency improvement. For clean cooking, different technologies (electric, LPG and improved cookstoves) have been assessed, with subsequent recommendations on the uptake of the most appropriate technology. Energy intensity has been modelled to help achieve the SDG 7 target and ensure the achievement of country's NDC target by 2030.

3.1.3. Green Energy Corridor (GEC) scenario

With reference to the pledges made at COP 29, the key focus of this scenario is to examine the potential for Azerbaijan to contribute to the Green Energy Corridor (GEC) initiative. GEC is a strategic initiative to export renewable energy (mainly wind and solar energy) from the Caspian Sea and Central Asia to Europe via a subsea cable. As such, this scenario explores technological interventions, the timeframe of implementation of different measures and technologies, and the policy framework that would be needed if Azerbaijan would like to increase its renewable energy supply significantly to become a renewable exporter under the GEC initiative.

3.2. Assumptions

Energy demand is estimated using activity level and energy intensity in the LEAP model. Demand outlook throughout NEXSTEP analysis is influenced by factors such as annual population growth and GDP growth. The assumptions used in the NEXSTEP modelling are further detailed in Annex B, while table 2 provides a summary of key modelling assumptions for the three main scenarios (i.e., NDC 3.0, SDG and GEC scenarios).

Table 2. Important factors, targets and assumptions used in NEXSTEP modelling

Parameters	NDC 3.0 Scenario	Sustainable Development Goal scenario	Green Energy Corridor scenario
Economic growth	4.2 per cent between 2023 and 2024, and using 2.6 per cent per annum from 2024[10] onwards in the model		
Population growth	0.4 between 2023 and 2024, and using 0.7 per cent per annum* from 2024 onwards in the model		
Urbanization rate	54.5 per cent in 2024, growing to 55.3 per cent in 2030[11]		
Commercial floor space	Assumed annual energy consumption increases at the same rate as GDP		
Industrial activity	Assumed annual energy consumption increases at the same rate as GDP		
Transport activity	Passenger transport activities and freight transport activities are assumed to grow at a rate like the growth in GDP per capita		
Residential activity	The ownership of electrical appliances is projected to grow at a rate similar to the growth in GDP per capita		
Access to electricity	The 100 per cent access to electricity has been achieved		
Access to clean cooking fuels	Projected based on the historical penetration rate between the 2000-2024 period. 100 per cent clean cooking access rate is expected to be achieved by 2027.		
Energy efficiency	Improvement based on current policies	Global improvement in energy intensity adopted	Global improvement in energy intensity adopted
Power plant	Considers capacity expansion to increase renewable capacity by at least 30 per cent in 2030	Considers capacity expansion to increase renewable capacity by at least 30 per cent in 2030	Extension of timeframe beyond 2030 by considering capacity expansion to be able to export renewable energy

10 Historical data and estimation from Asian Development Bank Key Indicators Database (see ADB, 2025).

11 This assumes that the urbanization rate grows with an annual rate of 0.24 per cent, with reference to the national historical urbanization growth from 2010 to 2024.

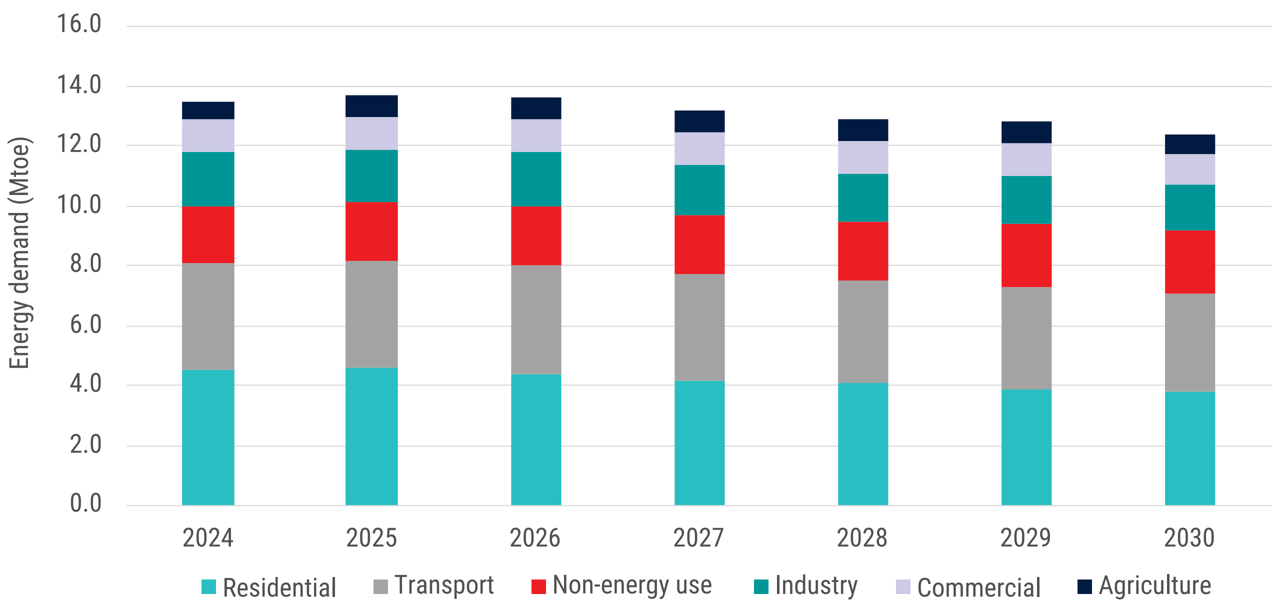
4. Energy transition outlook in the NDC 3.0 scenario

This chapter presents key modelling results under NEXSTEP's current policy scenarios – the NDC 3.0 pathway - focusing on impacts across key areas of the economy and the energy sector.

4.1. Energy demand outlook

Under the NDC 3.0 scenario, the demand for total final energy is expected to decrease from 13.4 Mtoe in 2024 to 12.4 Mtoe in 2030, representing an average annual growth rate of -1.3 per cent. The planned implementation of energy efficiency measures in the industry, residential and commercial sectors, as noted in the NDC 3.0 document, will reduce energy demand. It is expected that peak demand will occur in 2025, provided the measures are implemented in a timely and effective manner. In 2030, the residential sector is expected to remain the largest consumer at 30.4 per cent, followed by the transport sector at 26.4 per cent, the industrial sector at 12.3 per cent and the commercial sector at 8.5 per cent. Agriculture will account for 5.4 per cent, while the remaining 17.1 per cent will go to non-energy use. Figure 5 shows the forecast of TFEC by sector under the NDC 3.0 scenario. The sectoral energy efficiency measures are further described below.

Figure 5. Energy demand outlook in the NDC 3.0 scenario 2024 - 2030



Source: ESCAP.

4.1.1. Residential sector

Energy demand in the residential sector will decrease from 4.5 Mtoe in 2024 to 3.8 Mtoe in 2030, with an annual growth of -3.0 per cent. The decrease in demand is expected due to improvements in energy efficiency in the residential sector. Around 66.8 per cent of energy demand will be used for heating, while 16.8 per cent will be consumed for cooking. The remaining will be consumed to power electric appliances.

Azerbaijan experiences long and cold winters, hence, demand for heating is quite high. The Government introduced the Minimum Energy Efficiency Standard for Buildings in August 2023, which enforces a stricter energy performance requirement. Buildings should incorporate adequate insulation of heating and cooling systems, as well as thermal insulation of equipment and pipelines. By 2035, buildings are expected to install electric water heat pumps and electric stoves. Retrofitting buildings with high-performance insulation materials and promoting high-efficiency appliances, such as air conditioners, will lower energy consumption. While external insulation can theoretically save up to 36 per cent on annual energy demand, actual savings can be lower depending on the condition of the building. A typical improvement for thermal insulation and heating efficiency ranges from 21 per cent to 27 per cent (Yang, 2022). Energy savings in the residential sector are expected to be around 0.75 Mtoe in 2030, compared to 2024 levels.

4.1.2. Transport sector

The transport sector will consume 3.3 Mtoe in 2030, representing an annual growth of -1.4 per cent, down from 3.5 Mtoe in 2024. The road transport sector will account for 90.3 per cent of total energy demand. Rail transport and aviation will consume around 0.9 per cent and 7.9 per cent of energy demand, respectively. The remaining 0.9 per cent will be consumed by maritime transport. The Government is currently improving the road network to reduce congestion. Expansion of railway transport and awareness raising on eco-driving are also underway. In addition, the Government limits the import of passenger cars older than 10 years from the date of manufacture. By 2035, plans will be in place to reduce road transport distances through the expansion of public transport and the gradual phase-out of internal combustion engine (ICEs) vehicles. Biofuels are also being considered for aviation and maritime transport.

4.1.3. Industry sector

The industrial sector will consume 1.5 Mtoe in 2030, an annual growth of -2.5 per cent, down from 1.8 Mtoe in 2024. Within the industrial sector, it is projected that the chemical and petrochemical sectors will consume 27.7 per cent of energy in 2030. The non-metallic mineral industry will account for 23.5 per cent of industrial energy demand, followed by the construction industry at 14.8 per cent. The food and tobacco sector will account for 12.7 per cent, while the remaining 21.3 per cent will be consumed across eight industries, including machinery and transport equipment, pulp and paper, and textile and leather. Energy efficiency measures will be driven by policies to improve investment attractiveness. By 2035, the Government plans to modernize and electrify equipment and machinery, including replacing gas boilers with electric boilers and heat pumps.

4.1.4. Commercial sector

Total energy consumption in the commercial sector will decrease from 1.1 Mtoe in 2024 to 1.0 Mtoe in 2030, at an average annual growth rate of -0.6 per cent. This is based on the expectation that the Government will implement measures to reduce heat loss. The Energy Management System (EMS) requires commercial buildings with an area of at least 10,000 m² or with energy consumption exceeding 0.25 ktoe to conduct energy management and energy audits every 3 years. The Government also encourages the installation of solar rooftops in buildings.

4.1.5. Agricultural sector

The agricultural sector will consume 0.7 Mtoe of energy in 2030. There will be a transition from diesel-powered agricultural machinery and equipment to electric alternatives. During the stakeholder consultation, the Agrarian Credit and Development Agency (AKIA) stated that energy transition should not rely solely on technological measures but should also be supported by financial instruments, subsidy mechanisms and institutional coordination. In this regard, AKIA applied a range of green finance incentives, as explained in Box 1.

Box 1. Green finance incentives in the agricultural sector by the Agrarian Credit and Development Agency (AKIA)

The technologies eligible for incentives under AKIA's approach to climate and natural resource sustainability are as follows: (1) soil preparation and cultivation machinery; (2) modern irrigation system packages; (3) technological equipment for drones, robotics and smart management; (4) agrometeorological devices and equipment for monitoring climate and irrigation; (5) innovative laboratory equipment providing a rapid cell growth environment for seed selection; (6) strip-tillage machinery and a no-till seeding unit for preventing soil erosion and preserving fertility; (7) phenological and pheromone cameras for monitoring plant pests and diseases; (8) machinery and technological equipment used to protect crops from climate impacts (hail cannon, the net part of anti-hail net covering, frost protection equipment, anti-freeze spraying device, trailer and other machinery of the same purpose); and (9) machinery and equipment for the preparation of organic and bio-fertilizers.

In terms of agricultural machinery and equipment electrification, AKIA focuses on: (1) primary processing equipment; (2) machinery, machines, equipment, aggregates and installations used in livestock and poultry farming; (3) set of technological equipment for the production of feed products; (4) technological equipment for growing green fodder products; (5) equipment used for the storage of agricultural products; as well as (6) machinery and equipment used in seed processing, beekeeping and sericulture.

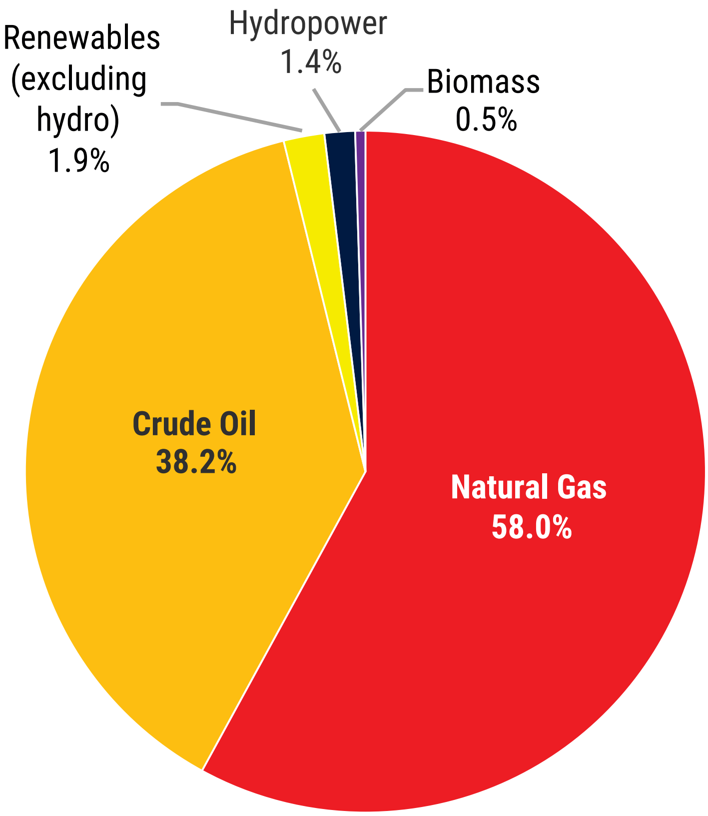
AKIA develops a financing model for the purchase of agricultural machinery and equipment with a leasing amount of up to 1,000,000 AZN. The interest rate is subsidized by AKIA with terms up to 5 years. The preferential amount constitutes 40 per cent of the customs value, or in the case of local machinery, 40 per cent of the value determined based on evaluation results. The initial payment constitutes a minimum of 20 per cent of the sales value determined by the evaluator. After the preferential amount and the initial payment, the remaining amount is financed by an authorized credit institution through a loan (or leasing). AKIA also conducted a special planting subsidy for field protection belts between 1 September 2024 and 31 May 2025. Under this scheme, at least 1,500 seedlings must be planted per hectare, with a subsidy of 1,000 AZN per hectare. The main objective of the subsidy is to contribute to environmental protection in agricultural areas by preventing soil degradation caused by water and wind erosion. At the same time, field protection belts regulate the microclimate of land plots and thereby support increasing agricultural productivity.

4.2. Energy supply outlook

Primary energy supply

In the NDC 3.0 scenario, TPES is forecasted to decrease to 17.7 Mtoe in 2030. Fuel shares in 2030 (figure 6) will still be dominated by fossil fuels: natural gas at 69 per cent and crude oil at 38.2 per cent. The remaining share will be for hydropower at 1.6 per cent, solar and wind energy at 1.9 per cent and biomass at 0.5 per cent.

Figure 6. Total primary energy supply (TPES) by fuel type in 2030 in the NDC 3.0 scenario



Source: ESCAP.

4.2.1. Electricity and heat generation

To ensure the sustainability of energy sector development and lay the basis for enhanced deployment of renewables in the future, Azerbaijan targets raising the share of renewable electricity (RE) in electricity generation capacity to 30 per cent by 2030. At present, no specific renewable target for heat generation has been formalized; however, the development of such targets and related pathways may be addressed through ongoing and future sectoral work on heat supply development and decarbonization.

According to the capacity expansion plan of the country, installed power generation capacity is expected to be 10.9 GW by 2030. Fossil fuels will continue to dominate installed capacity at 70.5 per cent. The share of renewables will be on track to exceed 35 per cent, a substantial increase from 19.7 per cent in 2024. This increase is due to the significant amount of solar and wind generation that will be operational in Azerbaijan (table 3 and figure 7).

In terms of generation, electricity generation is expected to rise to 34.5 TWh in 2030. The share of renewable energy in electricity supply will increase from 13.6 per cent, in 2024, to 22.4 per cent in 2030. District heating generation is expected to remain broadly unchanged under the current policy scenario, since no major additional capacity is included in the current baseline assumptions. At the same time, this modelling assumption should not be interpreted as a long-term limitation for the development of centralized heating in Azerbaijan. In line with the recent legislative and policy direction in the heat supply sector, centralized heating is expected to retain and strengthen its role as one of the main heat supply solutions for multi-apartment urban buildings, alongside individual renewable-based heating options in cases where centralized supply is not feasible or appropriate.

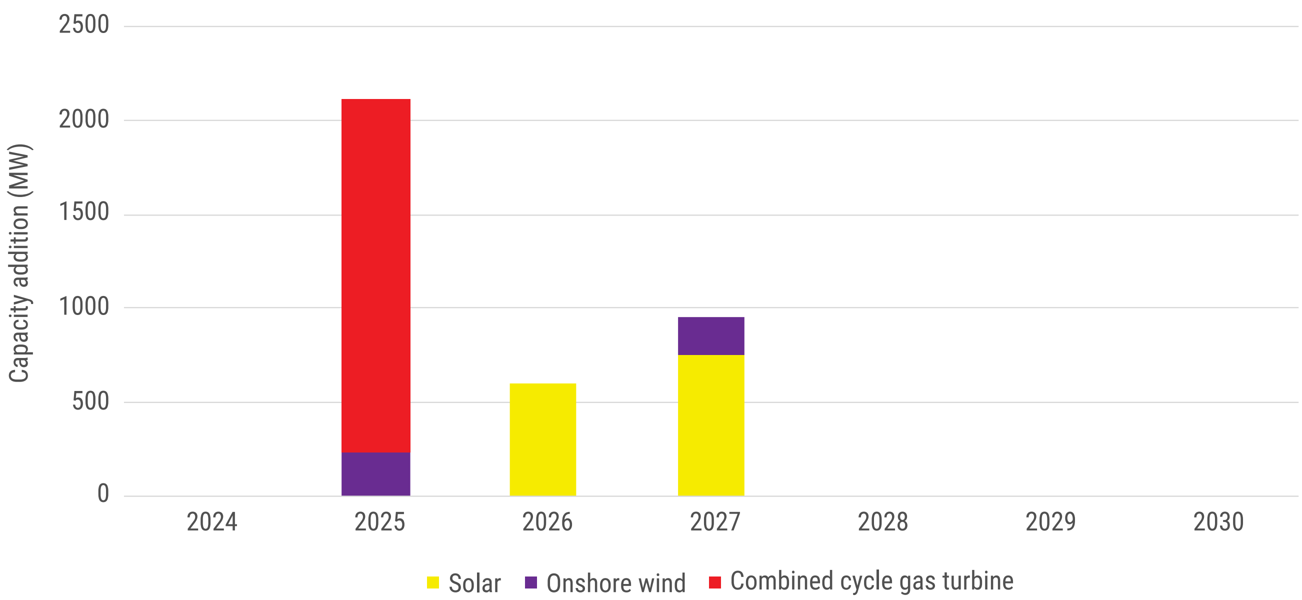
Accordingly, the long-term outlook for the heating sector is a differentiated pathway combining modernization and gradual expansion of energy-efficient centralized heating in suitable urban areas with the use of renewable- and electricity-based individual heating solutions, where justified by local conditions. In this context, future development of the centralized heating sector may include modernization of boiler houses and heat networks, reduction of technical losses, wider deployment of digital monitoring and control systems, and gradual integration of lower-carbon heat supply options, including efficient cogeneration, large-scale heat pumps, waste heat utilization, and renewable-based heat where technically and economically feasible. District heating generation will remain the same, coming from CHP, since there is no plan to add additional capacity. No renewable energy system is planned for the centralized heating sector in Azerbaijan.

Table 3. Power capacity expansion plan by technology type

Technology	Capacity (MW)	Timeframe
Combined cycle gas turbine	1,880	2025
Onshore wind	240	2025
Onshore wind	200	2027
Solar PV	595	2026
Solar PV	755	2027

Source: ESCAP.

Figure 7. Power capacity expansion plan 2024 - 2030

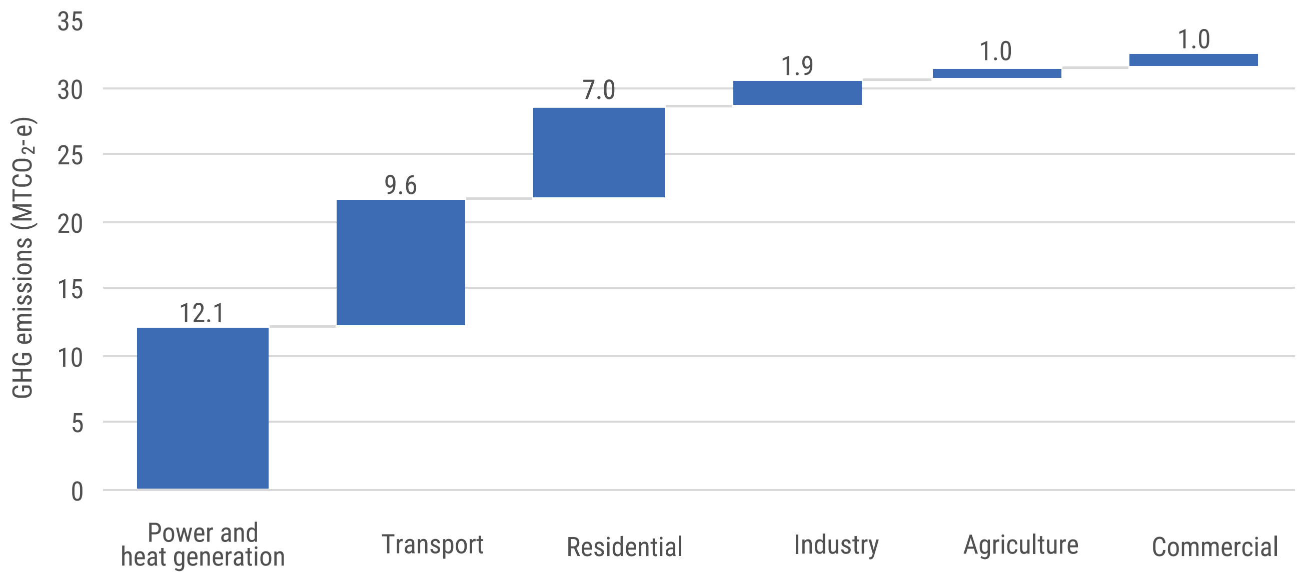


Source: ESCAP.

4.3. GHG emissions

Due to the reduction in overall energy demand, GHG emissions from the energy sector are estimated to decrease to 32.6 MtCO_2-e in 2030, from 36.5 MtCO_2-e in 2024. Emissions from the power and heat sector are expected to be the largest at 12.1 MtCO_2-e, followed by the transport sector at 9.6 MtCO_2-e, primarily due to direct fuel combustion in internal combustion engines. The residential sector accounts for 7.0 MtCO_2-e, mainly from natural gas combustion for cooking and space heating, while emissions from the industrial sector are estimated at 1.9 MtCO_2-e. Commercial and agricultural sectors together are projected to emit around 2 MtCO_2-e. Figure 8 illustrates the emissions distribution by sector in 2030.

Figure 8. Distribution of emissions by sector in 2030 in the NDC 3.0 scenario



Source: ESCAP.

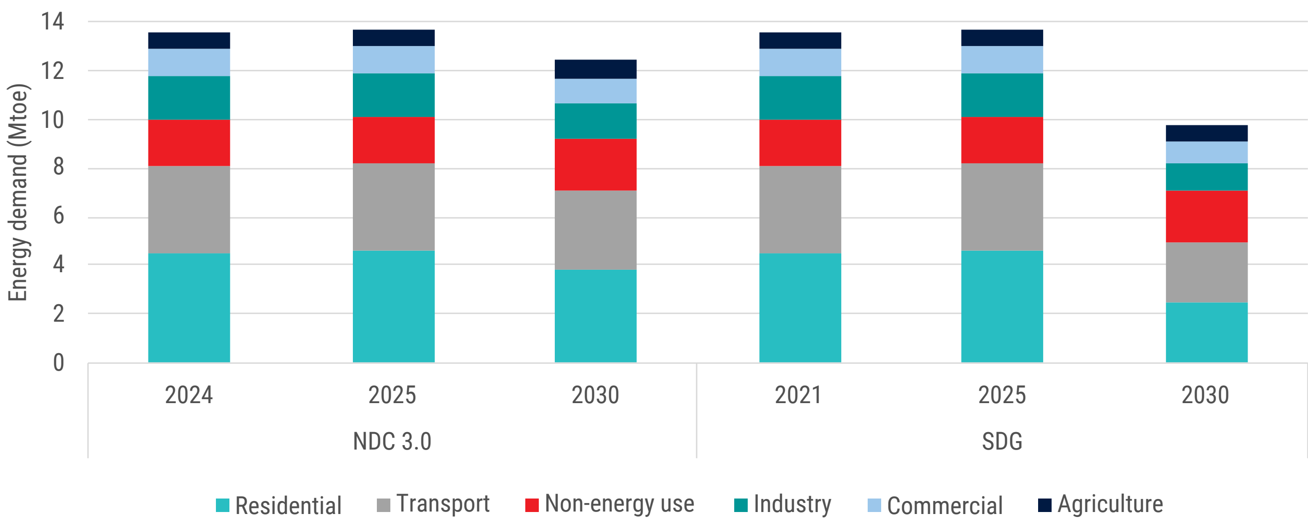
5. SDG scenario: An assessment of SDG 7 targets and indicators

This chapter begins with a concise overview of the energy demand projections under the SDG scenario. Later, the results are evaluated against the SDG 7 and NDC targets, along with other relevant indicators. This evaluation is based on the outputs from the NEXSTEP analysis, aiming to spotlight any policy gaps in the current energy policies in Azerbaijan. To conclude, the future energy supply outlook is presented.

5.1. Energy demand outlook

The total final energy consumption is expected to decrease from 13.4 Mtoe in 2024 to 9.7 Mtoe in 2030, indicating a further reduction of 2.7 Mtoe compared to the NDC 3.0 scenario (figure 10). This reduction is due to the adoption of higher-efficiency measures, which will be presented in section 5.2.3. In 2030, the residential sector consumption will be the largest at 25.7 per cent, followed by the transport sector at 25.4 per cent, the industrial sector at 11.0 per cent and the commercial sector at 9.8 per cent. Agriculture will account for 6.2 per cent, while the remaining will go to non-energy use. Figure 9 shows the total final energy consumption by scenario in 2030.

Figure 9. Comparison of energy demand between NDC 3.0 and SDG scenarios in Azerbaijan



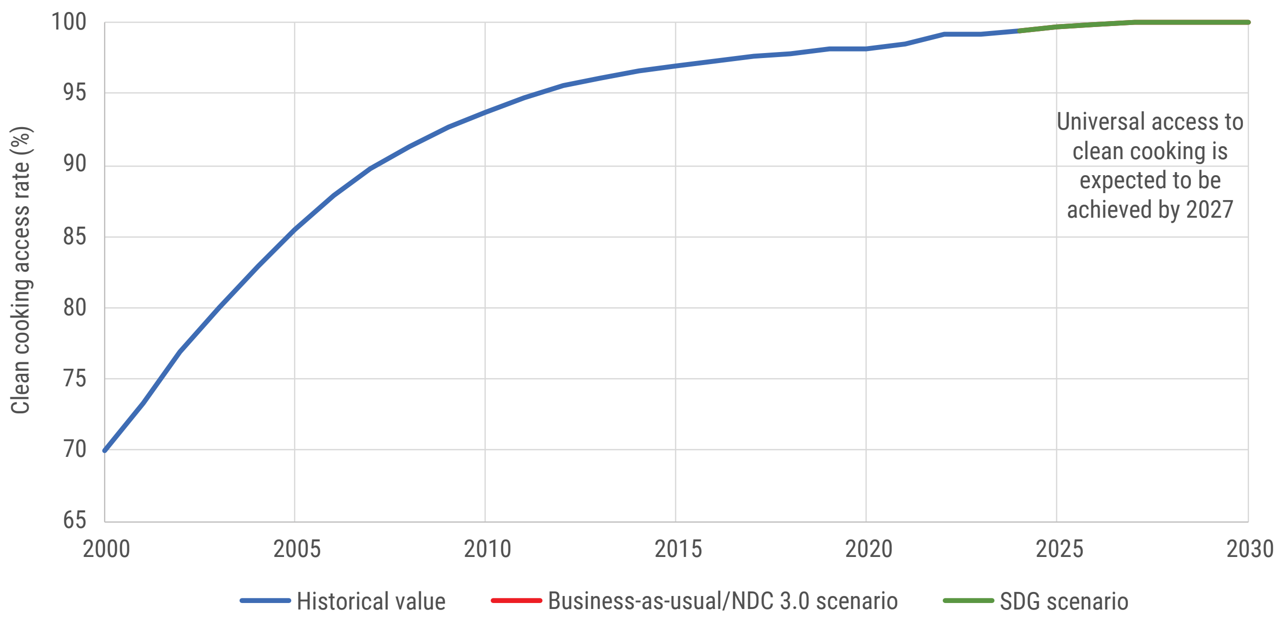
Source: ESCAP.

5.2. SDG 7 targets

5.2.1. Energy access

Azerbaijan achieved universal access to electricity in 2024. With this remarkable achievement, the Government of Azerbaijan should continue its efforts to improve power supply reliability to accommodate increasing demand and higher renewable energy penetration. Azerbaijan has made progress towards clean cooking, reaching 99.4 per cent in 2024. As of 2024, only 0.6 per cent of households relied on polluting cooking technologies, specifically biomass as a primary fuel. Considering the current trend, access to clean cooking fuels and technologies will be achieved in all scenarios – reaching 100 per cent by 2027 (figure 10).

Figure 10. Access to clean cooking in the NDC 3.0 and SDG scenarios in Azerbaijan



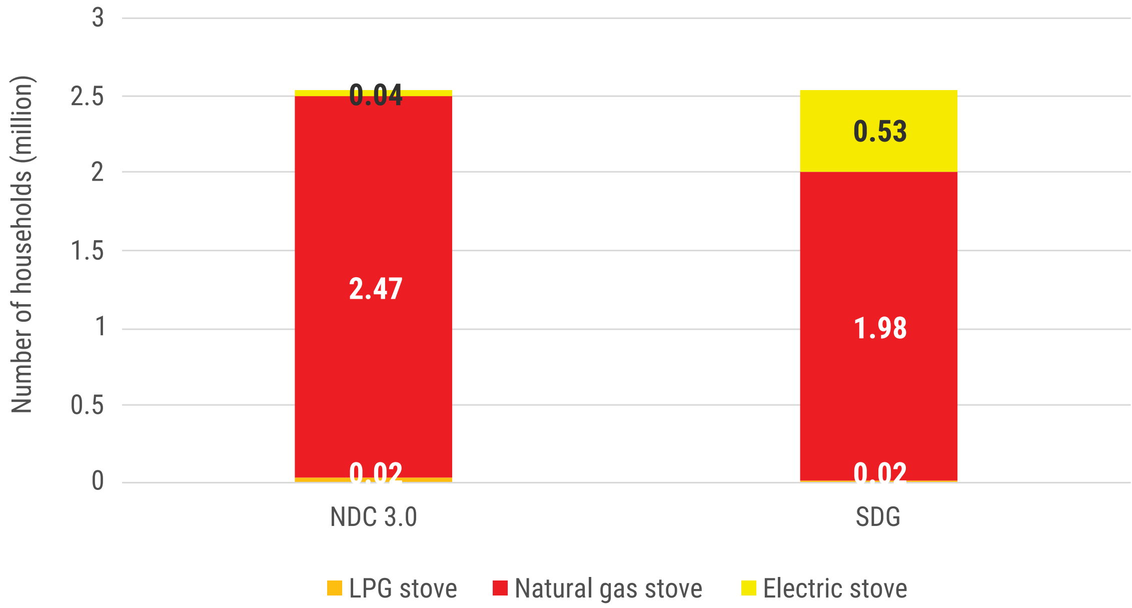
Source: ESCAP.

Although current electricity tariffs make natural gas stoves more competitive than electric stoves, the Government plans to increase the share of electric cooking stoves. Natural gas plays a significant role in households in Azerbaijan, particularly as a source of heating. However, electric cookstoves are likely to be the most appropriate long-term solution, given their better reliability, higher efficiency and positive environmental benefits. Yet, considering the current adoption rate, the share of electric cookstoves will just be around 1.4 per cent in Azerbaijan by 2030. Therefore, the SDG scenario suggests that at least 20 per cent of the population adopt electric cookstoves by 2030. This 20 per cent value is based on the suggested recommendation in the *Net Zero 2050 Roadmap* document developed by the IEA (IEA, 2021b) translates to at least 0.5 million households adopting electric cookstoves by 2030 (figure 11). Table 4 summarizes the estimated annualized cost of different cooking technologies in Azerbaijan. Box 2 explains the basis for evaluating clean cooking technologies. Annex D summarizes the cost and technical assumptions used in the economic analysis.

Table 4. The annualized cost of cooking technologies

Technology	Annualized cost
Electric cookstove	US$ 107
Natural gas stove	US$ 49

Figure 11. Share of clean cooking technologies by 2030 under NDC 3.0 and SDG scenarios



Source: ESCAP.

Box 2. Evaluation of clean cooking technologies

Electric cookstoves

Electric cooking technology is classed as Level 5 in the World Bank Multi-Tier Framework (MTF) for Indoor Air Quality Measurement. Electric cookstoves are more efficient than other cookstoves, including gas stoves and can generally be divided into two types – solid plate and induction plate. While solid plate cookstoves use a heating element to transmit radiant energy to the food and reach about 70 per cent efficiency, induction plate cookstoves, on the other hand, use electromagnetic energy to directly heat pots and pans, and can be up to 90 per cent efficient.

Improved cookstoves (ICS)

ICS programmes initially require strong advocacy to promote adoption, followed by ongoing support, including monitoring, training, maintenance and repairs to facilitate continued use. In addition, according to World Health Organization (WHO) guidelines on emissions for clean cooking, only certain types of ICS technologies are compliant, particularly when considering that cookstove emissions in the field are often higher than those measured in laboratory testing.[a] Tier 3+ ICS, which meets the WHO clean cooking guidelines, has the potential to reduce GHG emissions and provide socioeconomic and health benefits, when promoted in carefully planned programmes.

Natural gas stoves

Clean cooking with natural gas might be an attractive solution in the short term since Azerbaijan has natural gas reserves. Natural gas is also a viable solution for rural households as gas distribution infrastructure has been available. However, in the long run, gas stoves may still produce emissions compared to clean cookstoves.

LPG cookstoves

LPG is constrained due to supply chain challenges. LPG cookstoves generate lower indoor air pollution compared to ICS. They are classified as Level 4 in the World Bank Multi-Tier Framework (MTF) for cooking exposure and reduce indoor air pollution by 90 per cent compared to traditional cookstoves.[b]

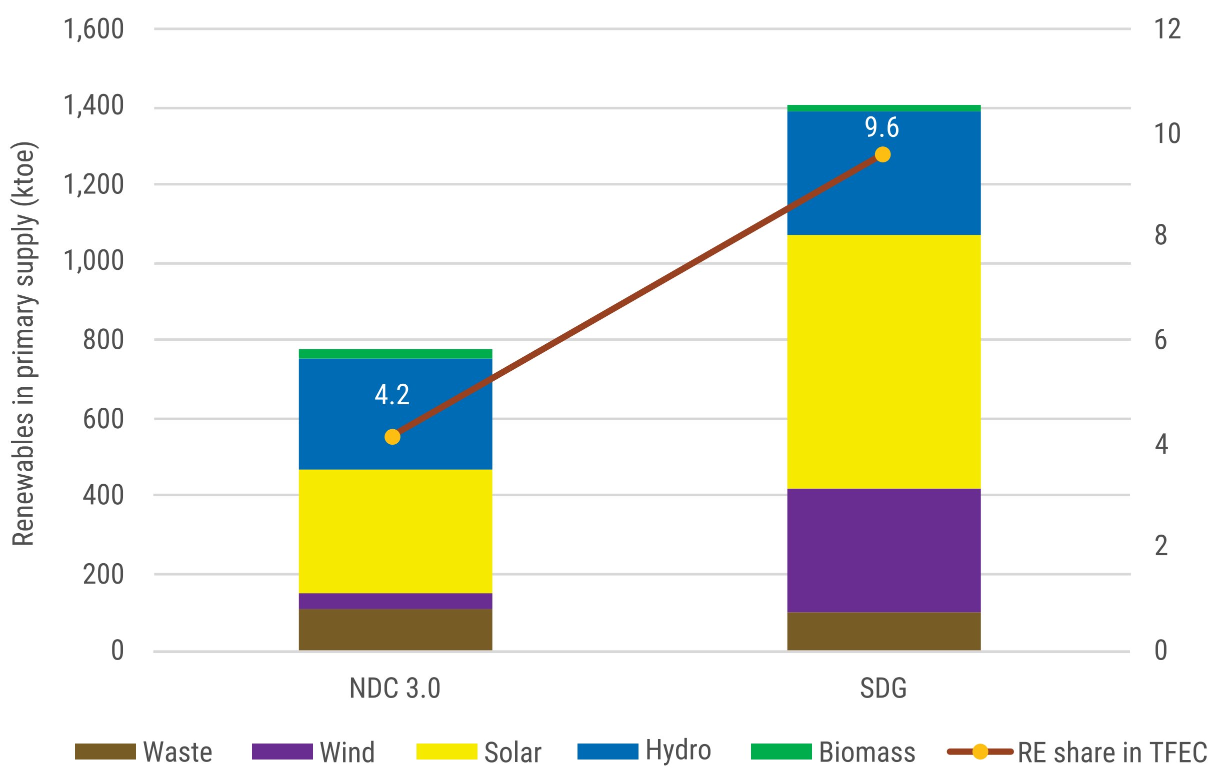
a World Health Organization (WHO), "Defining clean fuels and technologies", 2024. Available at https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-7-defining-clean

b Energy Sector Management Assistance Program (ESMAP), "Multi-tier framework for energy access (MTF)", 2024. Available at https://www.esmap.org/mtf_multi-tier_framework_for_energy_access

5.2.2. Renewable energy

SDG 7.2 does not have a quantitative target but encourages a "substantial" increase in the renewable energy share in TFEC. The share of renewable energy (excluding traditional biomass usage) in TFEC in 2030 will be 4.2 per cent in the NDC 3.0 scenario and 9.6 per cent in the SDG scenario. The increase is attributable to the increasing share of renewable energy in power generation. Azerbaijan will be able to increase the share of renewable energy in power generation capacity from 19.7 per cent in 2024 to 49.2 per cent in 2030, as per the capacity expansion plan. The improvement in energy efficiency also contributes to the additional increase in the renewable energy share of TFEC in the SDG scenario. However, natural gas and oil products will still dominate the energy systems.

Figure 12. Renewable energy in TPES and TFEC in 2030 under NDC 3.0 and SDG scenarios

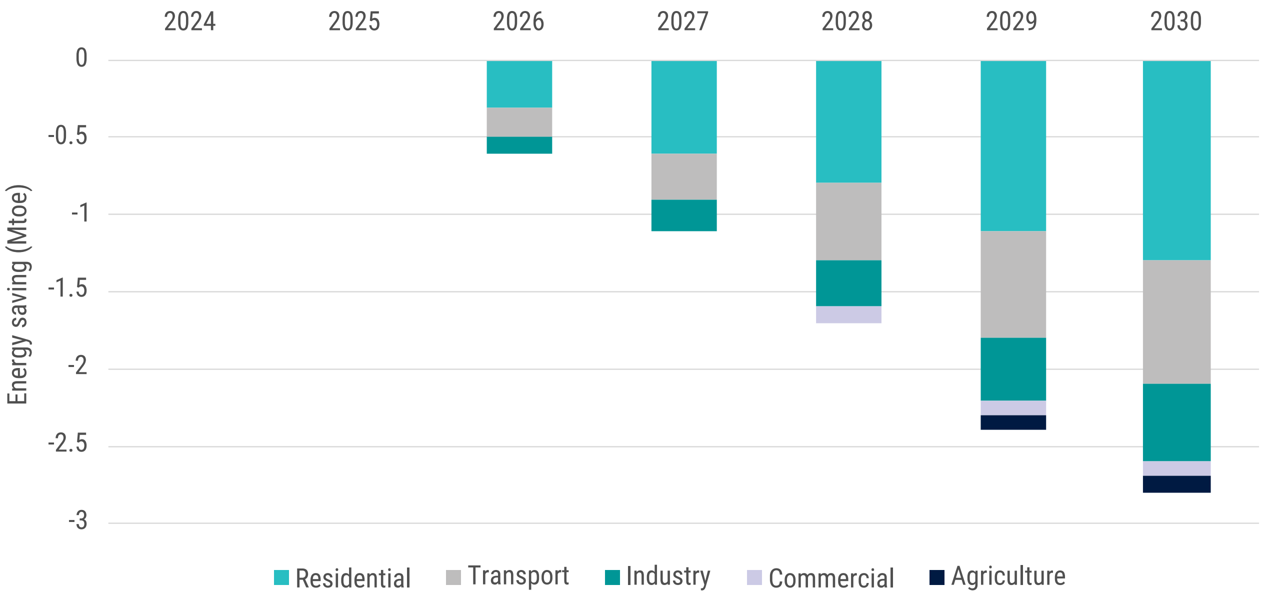


Source: ESCAP.

5.2.3. Energy efficiency

As discussed in section 2.2.2, the energy intensity target for Azerbaijan is 2.7 MJ/US$$_{2017}$, to be achieved by 2030. Under the NDC 3.0 scenario, energy intensity in 2030 is estimated to be 2.8 MJ/US$$_{2017}$, marking a reduction from 3.5 MJ/US$$_{2017}$ in 2024. The annual improvement rate is expected to be 3.4 per cent between 2024 and 2030 due to the planned implementation of energy efficiency measures. NEXSTEP analysis finds that Azerbaijan can further reduce energy intensity to 2.4 MJ/US$$_{2017}$, to align with the global energy efficiency target of 4 per cent annual improvement for SDG 7. This requires the addition of 2.7 Mtoe of energy demand reduction compared to the NDC 3.0 scenario. Figure 13 illustrates additional energy-saving opportunities under the SDG scenario compared to the NDC 3.0 scenarios.

Figure 13. Energy saving potential in different sectors under the SDG scenario compared to the NDC 3.0 scenario



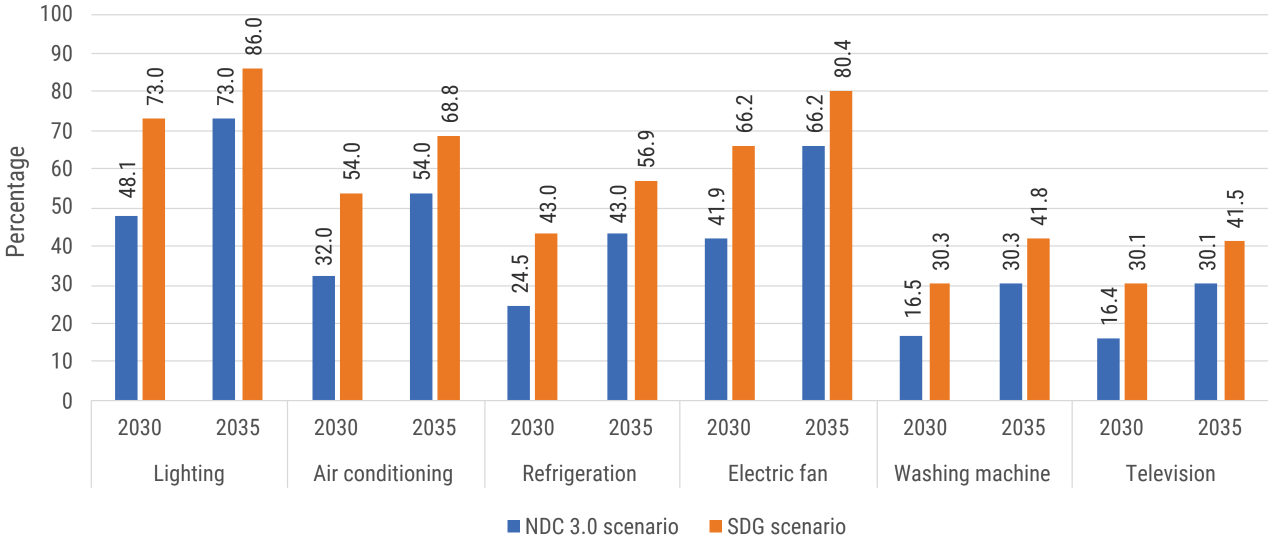
Source: ESCAP.

5.2.4. Residential sector

Energy demand in the residential sector will reduce from 4.5 Mtoe in 2024 to 2.5 Mtoe in 2030 – a 1.3 Mtoe reduction compared to the NDC 3.0 scenario. In addition to achieving 100 per cent access to clean cooking, phasing out a proportion of cooking technologies and replacing them with more efficient electric cookstoves (e.g., induction type) might help reduce cooking demand, since these stoves are more efficient than other stoves. Although the Government plans to introduce electric cookstoves, more aggressive distribution is needed, as the current trend shows little progress. NEXSTEP suggests a further adoption of electric cookstoves for 30 per cent of urban households and 10 per cent of rural households by 2030.

Additionally, in the SDG scenario, the adopting of MEPS must be accelerated to ensure that a significant proportion is achieved by 2030 instead of 2035 (figure 14). The adoption of MEPS will help reduce electricity consumption for lighting, air conditioning, refrigeration, electric fans, washing machines and televisions (the six appliances with the highest energy consumption), with savings estimated to be 992.4 GWh.

Figure 14. Comparison of efficient appliance shares in the NDC 3.0 and SDG scenarios (percentage)



Source: ESCAP.

Due to its climatic conditions, Azerbaijan has high energy consumption for heating, particularly during the long, cold winter season and most of this demand is supplied by natural gas boilers or heaters. To address this, the Government plans to develop standards to improve thermal insulation, particularly for new buildings, as comprehensive retrofitting of entire existing buildings, including their envelopes (i.e. external walls, insulation, windows, doors, etc.), can be significantly challenging.

At the same time, the transition in the heating sector should not be viewed solely through the lens of individual heating technologies. A differentiated approach based on settlement patterns, building type and technical feasibility will be necessary. In dense urban areas, collective heat supply solutions, including modernized district heating and efficient local boiler house or cogeneration-based systems, may offer important economic, technical and environmental advantages. These systems can achieve better fuel efficiency at system level, allow centralized emissions management, improve service reliability for multi-apartment buildings and public facilities, and create better conditions for the gradual integration of low-carbon heat sources. At the same time, individual low-carbon solutions, such as electric heating and/or heat pumps, can be selectively deployed where centralized heat supply is not available or justified. Therefore, the heating transition strategy of Azerbaijan should be differentiated by building type, urban density and technical feasibility, rather than relying on a single technology pathway.

In this context, NEXSTEP suggests replacing 15 per cent of natural gas boilers with heat pumps in urban areas and increasing the use of electric heaters to one-third of the urban population. The combination of residential retrofitting and increased adoption of electric heaters and heat pumps can reduce energy demand by 1.1 Mtoe. While this shift may increase electricity demand for heating by around 259 GWh, the additional demand can be offset by the reductions achieved through the introduction of MEPS.

Rural households that still rely on fuelwood can transition to high-efficiency, low-emission (HELE) heating stoves as a short-term option. These stoves can reduce fuel consumption by 40 per cent due to higher efficiency, while providing more heating across larger areas of the home. Additionally, they significantly reduce indoor air pollution, thereby mitigating negative health impacts. For example, a

World Bank study found that mean $PM_{2.5}$ exposure decreased by 65 per cent from 92.3 µg/m³ to 32.4 µg/m³ (Zhang, Adams and Pemberton-Pigott (2019), meeting the WHO interim target (IT-1) of 35 µg/m³, for annual mean concentrations (WHO, 2014). The results also indicate that CO_2 exposure dropped below WHO air quality guideline levels.

More can be done to raise community awareness of the benefits of efficient heating technologies, including electric heating, and heat pumps and modern centralized heating solutions. Similar to promoting clean cooking technologies, a participatory approach involving key stakeholders, together with frequent monitoring, evaluation and feedback should be pursued to ensure successful implementation of programmes. In addition, sustainable heating options should receive greater attention and be more fully incorporated into national policies and plans.

Table 5. Additional energy saving in the residential sector under the SDG scenario by 2030, compared to the NDC 3.0 scenario

Sectoral scopes	Measure	Energy demand reduction in 2030 (ktoe)
Residential cooking	Accelerate the adoption of electric cookstoves to reach 30 per cent of urban households and 10 per cent of rural households in 2030.	61.1
Residential heating	Replace 15 per cent of natural gas boilers with heat pumps and accelerate the promotion of electric heaters to reach a third of the urban population. The retrofit is also implemented in all building types.	1,127.6
Residential MEPS	Accelerate the adoption of energy-efficient lighting, air conditioning, refrigeration, electric fans, washing machines and televisions.	85.3
Total		**1,274.0**

5.2.5. Transport sector

In the SDG scenario, the transport sector will consume 2.5 Mtoe in 2030, representing an additional reduction of 0.8 Mtoe compared to the NDC 3.0 scenario (table 6). Road transport will account for 87.1 per cent of total energy demand, followed by aviation at around 10.5 per cent, while rail and maritime transport each account for 1.2 per cent.

The Government of Azerbaijan significantly reduce demand for transport energy by promoting the adoption of electric vehicles and improving fuel economy. NEXSTEP analysis suggests that, under the SDG scenario, achieving at least a 20 per cent share of electric cars, combined with accelerated improvements in fuel economy by 2030, could reduce energy demand by around 814.9 ktoe. The target for passenger cars must be higher, given their high energy use. The Government could lead this transition by initially replacing its own fleet of cars with electric vehicles before promoting them to a wider public.

Electrification of freight transport is challenging, particularly for heavy trucks that compete with long-range diesel trucks. However, it is expected that electrifying freight trucks may also become economically feasible. NEXSTEP suggests that the Government consider adopting hybrid and electric trucks to improve energy efficiency in this category. Regarding infrastructure, the Government can prioritize the development of charging facilities in urban areas, where mobility is concentrated, particularly in the capital region. See Box 3 for information on electric vehicles.

Table 6. Additional energy saving in the transport sector under the SDG scenario by 2030, compared to NDC 3.0

Sectoral scopes	Measures	Energy demand reduction (ktoe) 2030
Passenger cars	Accelerate the adoption of electric cookstoves to reach 30 per cent Increase penetration of electric cars to 20 per cent in 2030 (from only 2.4 per cent in the NDC 3.0 scenario based on the current trend).	814.9
Total		**814.9**

Box 3. Electric vehicles gain global interest

Electric vehicles have attracted significant global interest, growing exponentially over the past decade. Electric car sales passed 2 million globally in 2019, with a projected compound annual growth rate of 29 per cent to 2030.[a] Various government policies have been introduced that directly or indirectly promote the adoption of electric vehicles to achieve environmental and climate objectives. For example, 17 countries have stated their ambition to phase out internal combustion engines before 2050, while the European Union's stringent CO_2 emissions standard has accelerated the adoption of electric vehicles.[b]

Despite supply chain bottlenecks and the impacts of the COVID-19 pandemic, electric car sales hit a new high in 2021. Sales nearly doubled to 6.6 million, representing a world sales share of approximately 9 per cent, compared to 2020, increasing the total number of EVs on the road to 16.5 million. In 2021, the share of EV sales rose by 4 percentage points, with China generating the most sales, tripling those in 2020 to 3.3 million, followed by Europe with 2.3 million, up from 1.4 million in 2020. In 2021, 630,000 EVs were sold in the United States of America, doubling their market share to 4.5 per cent. Electric car sales increased by more than twice as much in emerging nations, although they remain relatively small.[c]

Vehicles with an electric motor assisting the conventional internal combustion engines that cannot be charged are not considered electric vehicles. The following categories may be considered EVs: (1) battery electric vehicles (BEV); (2) plug-in hybrid electric vehicles (PHEV); and (3) fuel cell electric vehicles (FCEV).

a Woodward and others,, "Electric vehicles: Setting a course for 2030", Deloitte Insights, 28 July 2020. Available at https://www2.deloitte.com/uk/en/insights/focus/future-of-mobility/electric-vehicle-trends-2030.html

b International Energy Agency (IEA), "Electric Vehicles", 2022. Available at https://www.iea.org/reports/electric-vehicles

c Ibid.

Aviation energy demand will increase from 220.4 ktoe in 2024 to 257.1 ktoe in 2030, representing an annual growth of 2.6 per cent. There are opportunities to improve operational and energy efficiency within airport and air traffic management, including measures to improve fuel efficiency, although this may be offset by the increasing travel demand. Sustainable Aviation Fuel (SAF) can reduce emissions, though production is more expensive than traditional jet fuel. SAF might be economically viable after 2030, but financial support will be needed through subsidies or tax incentives. In the meantime, within the framework of electrification and energy efficiency measures, it is recommended to promote the deployment of renewable energy sources at airports, electrify ground operations, as well as implement and expand energy management systems (e.g., ISO 50001).The Government can also encourage airline manufacturers to focus on improving aircraft and engine efficiency. Ensuring alignment with international mechanisms (CORSIA, EU ETS, ReFuelEU Aviation), including the development of emissions measurement, reporting and verification (MRV) systems, is considered appropriate.

5.2.6. Industry sector

In the SDG scenario, the industrial sector will consume 1.1 Mtoe in 2030, marking a reduction of 0.5 Mtoe compared to the NDC 3.0 scenario. According to the IEA (2021a), energy efficiency (EE) measures could save energy intensity by up to 50 per cent. Improvements in energy intensity in industrial buildings can be achieved by expanding the Energy Management System requirements, although potential savings will be lower as compared to commercial buildings, typically ranging between 15 and 20 per cent. For example, at least 15 per cent of electricity savings can be achieved by simply replacing motors, correcting oversizing, installing variable speed drives (VSDs) and digitizing (de Almeida, Ferreira and Fong, 2023). In the SDG scenario, these measures would need to be accelerated to 2030 rather than 2035. Several implementation pathways are available in Azerbaijan (Box 4). NEXSTEP suggests that the Government begin by enforcing energy management standards, energy audits, equipment standards and labelling in the industrial sector.

Box 4. Energy efficiency measures in the industry sector

The areas of potential savings that are generally present in different subsectors include (but not limited to) the following:

- Improve motor loading.
- Replace old and rewound motors.
- Install capacitor banks and increase efficiency of existing capacitor banks.
- Improve combustion efficiency of boilers.
- Clean and maintain boiler equipment (i.e. condenser pipes) regularly.
- Install more efficient electric motors.
- Improve the steam distribution system including controlling leakage and improving insulation.
- Manage electricity load.
- Minimize energy losses by partitioning cooling areas, installing and effectively using air curtains.
- Minimize heat losses from boilers (or kilns for the cement sector).
- Condensate and waste heat recovery.

In addition, several policy measures can be considered to accelerate the green transformation. These can include market instruments (i.e., subsidies or taxes), emissions caps and trade systems or regulatory instruments. The *Practitioner's Guide to Strategic Green Industrial Policy* by Partnership for Action on Green Economy (PAGE) provides industrial policymakers with tools and information for developing a strategic green industry policy (SGIP) (UNIDO, 2016).

Table 7. Additional energy saving in the industry sector under the SDG scenario by 2030, compared to the NDC 3.0 scenario

Sectoral scopes	Measures	Energy demand reduction in 2030 (ktoe)
Industry – Energy audit and energy efficiency improvement	Accelerate the modernization and electrification of equipment and machinery by 2030. The appointment of energy managers and the implementation of an energy management system	450.0
Total		**450.0**

5.2.7. Commercial sector

In the SDG scenario, the commercial sector will consume 0.95 Mtoe in 2030, representing a reduction of 0.1 Mtoe compared to the NDC 3.0 scenario. NEXSTEP suggests that further improvement in energy intensity in commercial buildings can be achieved by expanding the energy management system requirement to buildings greater than 5,000 m^2 (Box 5), to ensure sustainable building designs for upcoming buildings. The Government should consider providing financial incentives and, simultaneously, raising public awareness of energy conservation.

NEXSTEP identified difficulties in collecting data on commercial floor space. While the statistical office provided a comprehensive database on commercial buildings, it is suggested that, in the future, the Government start collecting information on floor space and energy requirements for different types of commercial buildings, such as restaurants, shopping malls, schools, hospitals and offices. This will help the Government to monitor energy-intensive activities in the commercial or service sector and conduct a more detailed assessment on commercial buildings in the future.

Box 5. Policy options for a more sustainable building sector

The building sector accounts for a significant share of global energy consumption and GHG emissions. This calls for the adoption of green building measures and designs in new and existing building stocks to allow energy savings and rapid GHG emissions reduction to meet the Paris Agreement. A 'green' building can be defined as a *building that, in its design, construction or operation, reduces or eliminates negative impacts, and can create positive impacts, on our climate and natural environment*.[a] Green building adoption can be made mandatory through the implementation of building codes or promoted through certification/rating systems. In Azerbaijan, such requirements are supported by the *Minimum Energy Efficiency Standards for Buildings* approved by the Cabinet of Ministers of the Republic of Azerbaijan (Resolution No. 287, 26 August 2023).

Building codes are a comprehensive set of mandatory minimum building standards. One example is the 2018 International Green Construction Code (IgCC), developed to aid government jurisdictions in administering minimum requirements covering the design, construction and operation of buildings.[b] Another implemented green building code by state jurisdiction is the California Green

Building Standards Code (CALGreen).[c] Certification systems or rating tools, which provide third-party assessment and confirmation that a building meets certain green requirements or standards, are also widely used. Examples include the LEED (Leadership in Energy and Environmental Design) rating system and the Green Star Buildings rating tool in Australia. For instance, the Green Star certification has been given to almost 3,000 buildings with an average reduction of 56 per cent.[d]

a World Green Building Council (WorldGBC), "What is a green building?" 2021. Available at https://worldgbc.org/article/green-buildings-and-healthy-buildings/

b International Code Council (ICC), "International Green Construction Code (IgCC)", 2024. Available at https://www.iccsafe.org/products-and-services/i-codes/igcc/

c State of California, "CALGreen", 2021. Available at https://oneclicklca.com/en/resources/articles/calgreen-a-comprehensive-guide-to-title-24-regulations

d Green Building Council of Australia, "A year in focus: 2019-2020", December 2020. Available at https://gbca-web.s3.amazonaws.com/media/documents/green-star-in-focus-2020-final-spreads-sml.pdf

Table 8. Additional energy saving in the commercial sector under the SDG scenario by 2030, compared to NDC 3.0 scenario

Sectoral scopes	Measure	Energy demand reduction (ktoe) 2030
Buildings	Expand the energy management system requirement to include buildings greater than 5000 m^2.	100.6
Total		**100.6**

5.2.8. Agricultural sector

The agricultural sector will consume around 0.6 Mtoe in 2030. Similar to the commercial sector, the internal structural diversity of agriculture and real farm conditions are not fully reflected, as this sector lacks the detailed data needed to support bottom-up calculations. Thus, establishing an energy and emissions monitoring framework at the subsector level is recommended.

5.3. Energy supply outlook

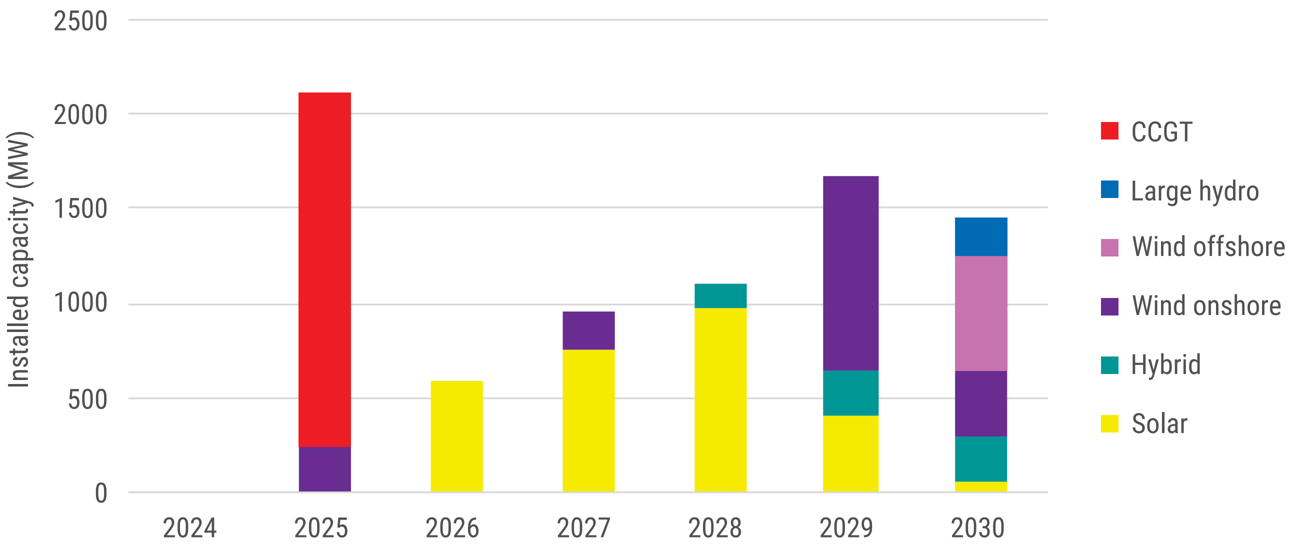
Primary energy supply

In the SDG scenario, the TPES is forecasted to decrease to 14.9 Mtoe in 2030. Compared to the NDC 3.0 scenario, the 2.8 Mtoe supply reduction stems from the additional energy-efficiency improvements discussed in section5.2.3. Fuel shares in 2030 are projected to be 52.3 per cent for natural gas and 40.5 per cent for crude oil. The remaining share will be split between hydropower, biomass and other renewables.

5.3.1 Electricity and heat generation

In 2030, the installed power generation capacity would be 15,099 MW, with renewables accounting for 49.2 per cent, meeting the target of at least 30 per cent by 2030. Compared to the NDC 3.0 scenario, 4,230 MW of renewables will be added between 2028 and 2030. Electricity generation is expected to be 41.6 TWh. Despite increasing electricity demand which is driven by the higher penetration of electric cookstoves, heaters and vehicles, this is offset by energy-saving improvements, such as those enabled by MEPS.

Figure 15. Power plant capacity addition 2024 - 2030



Source: ESCAP.

Note: CCGT = Combined cycle gas turbine

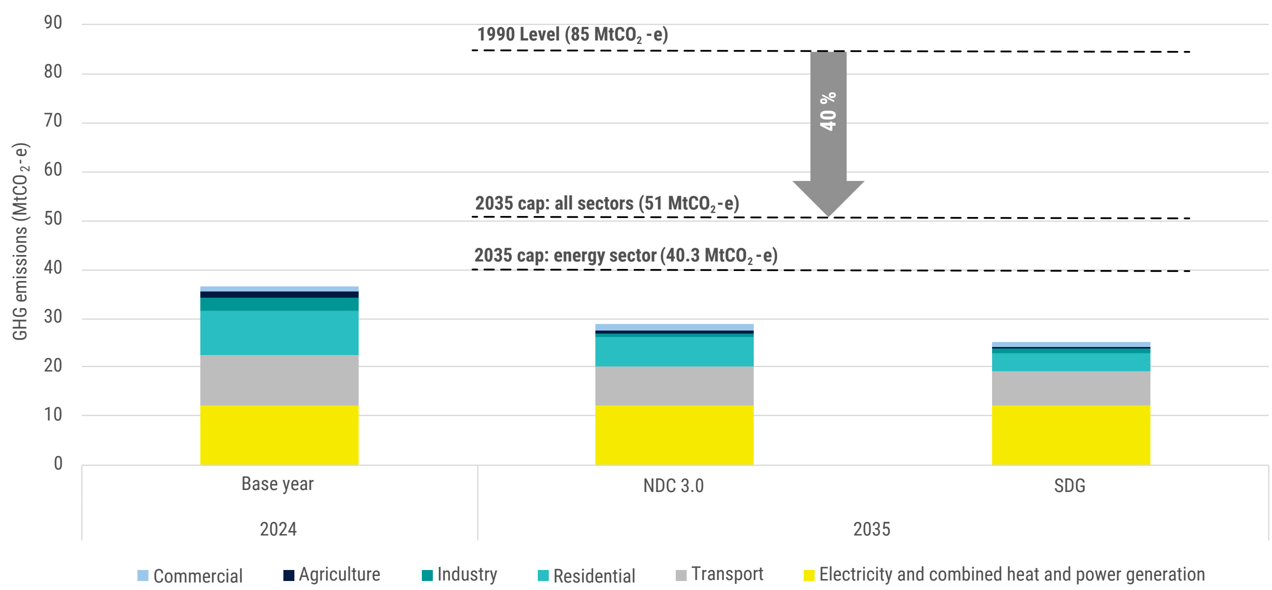
5.4. Nationally Determined Contributions targets

Emissions from the combustion of fossil fuels are calculated based on IPCC Tier 1 emission factors. For the combustion of biomass and biomass products, carbon emissions are not attributed to the energy sector but are accounted for in the agriculture, forest and land-use change (AFOLU) as per the accounting system suggested by IPCC. Nevertheless, emissions from other GHGs, such as methane and nitrous oxide, are included in total energy-sector emissions.

Azerbaijan has committed to reducing GHG emissions by 40 per cent from 1990 levels by 2035. In 1990, emissions were approximately 85 $MtCO_2$-e, across the entire sector. This translates to a cap of 51 $MtCO_2$-e in 2035. Assuming energy sector emissions are around 79 per cent, the cap for this sector is approximately 40.3 $MtCO_2$-e. Under the NDC 3.0 (current policy settings), total emissions are expected to be 28.7 $MtCO_2$-e in 2035, achieving the NDC target, driven by the increased share of renewables in electricity supply under the capacity expansion plan (figure 16).

Azerbaijan can further enhance its efforts to achieve higher emission reduction by accelerating the implementation of energy-saving measures to align with the global improvement target of 4 per cent as discussed in section 5.2.3. In the SDG scenario, total emissions are expected to further decrease to 25 $MtCO_2$-e by 2030, which also meets the NDC target in the energy sector.

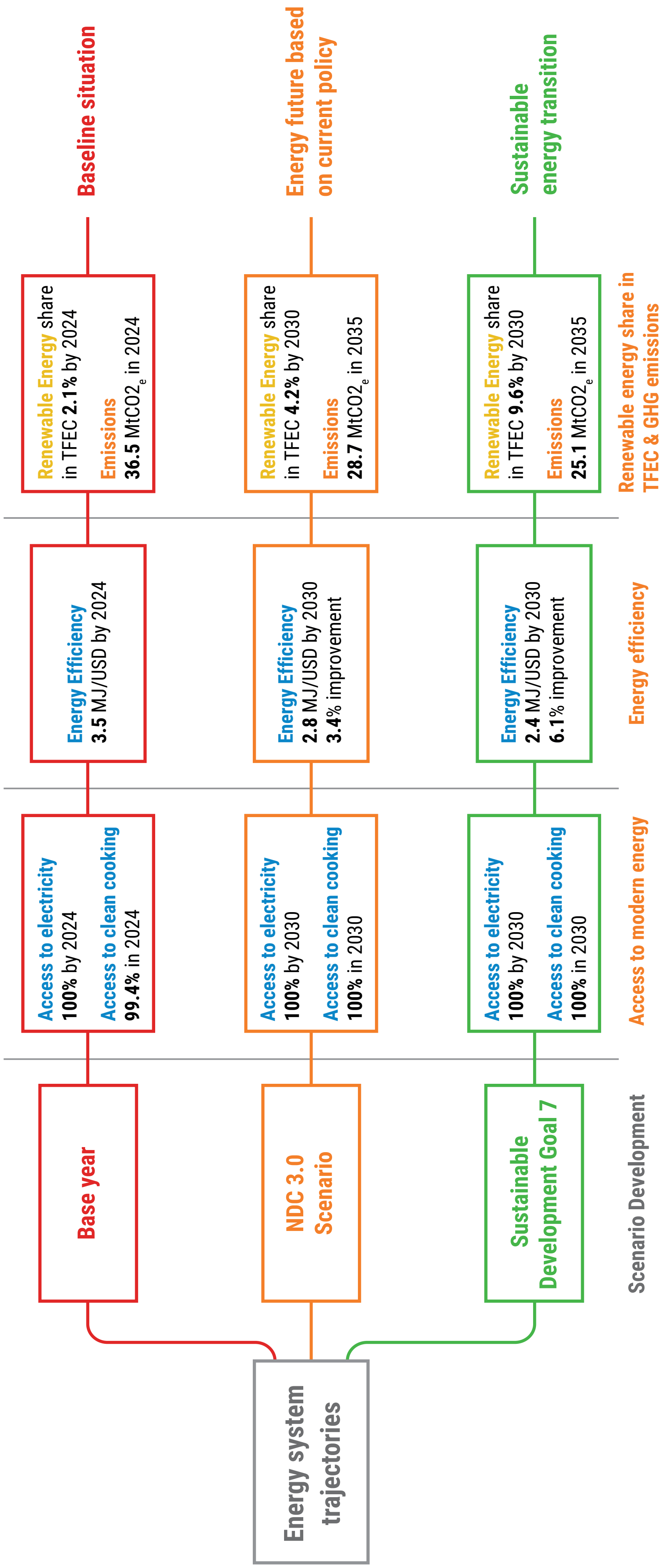
Figure 16. Emission trajectories across the base year, NDC 3.0 and SDG scenarios



Source: ESCAP.

Despite achieving universal access to electricity and the NDC target, Azerbaijan must accelerate and strengthen its effort to achieve universal access to clean cooking, increase renewable share in TFEC and improve energy efficiency. These can be enforced in the updated national energy policy if any. Figure 17 summarizes the SDG 7 indicators for the base year, the NDC 3.0 and the SDG 7 scenarios.

Figure 17. Summary of SDG 7 indicators for base year, NDC 3.0 and SDG 7 scenarios for Azerbaijan



Source: ESCAP.

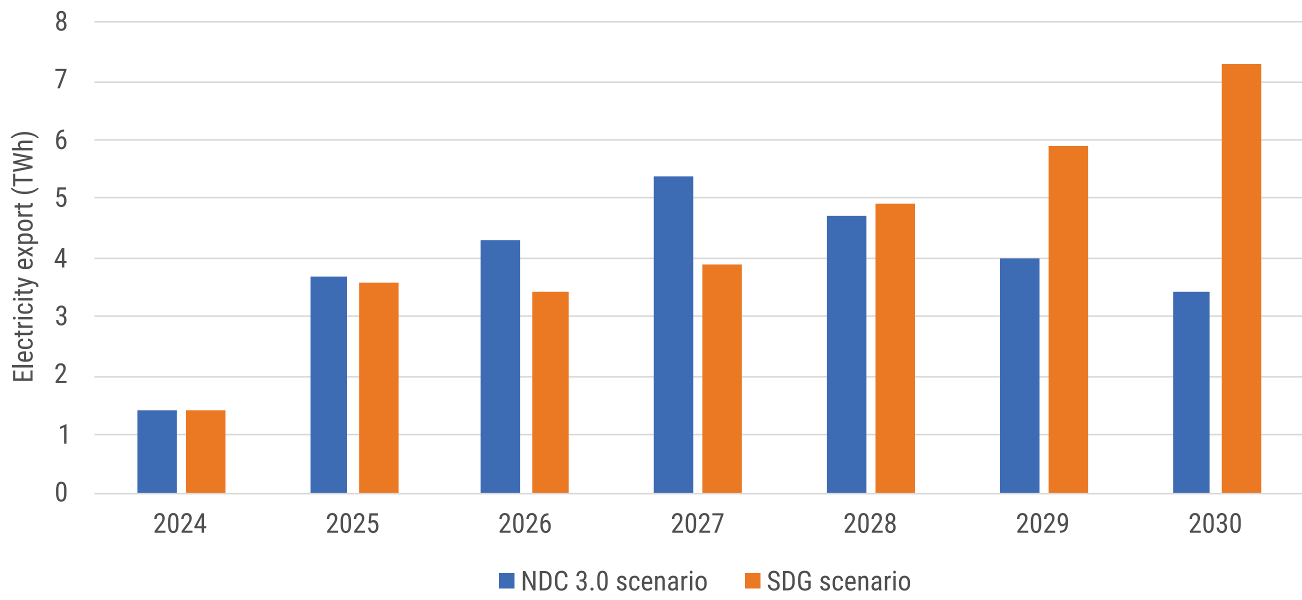
6. Going beyond SDG 7 with ambitious scenarios

The SDG scenario, as discussed in chapter 5, outlines various strategies to facilitate economy-wide energy-efficiency improvement in line with the 2030 Agenda for Sustainable Development and the Paris Agreement. It also identifies appropriate technology options for advancing sustainable energy transition in Azerbaijan. However, this scenario focuses more on demand-side factors. The Green Energy Corridor (GEC) scenario further explores technological interventions required for Azerbaijan to significantly increase its renewable energy supply and become a regional renewable energy hub.

6.1. Green Energy Corridor (GEC) scenario

Under both the NDC 3.0 and the SDG scenarios, excess electricity is available for export. However, in the NDC 3.0 scenario, the absence of additional planned capacity expansion from 2028 onwards limits the amount of electricity available for export. For instance, the electricity available for export in 2030 under the NDC 3.0 is 3.4 TWh, whereas under the SDG scenario it is 7.3 TWh (figure 18).

Figure 18. Potential for electricity export under the NDC 3.0 and SDG scenarios in Azerbaijan



Source: ESCAP.

The GEC scenario has been developed to increase electricity available for exports. As discussed below, Azerbaijan is actively implementing several green energy corridor projects. On 17 December 2022, in Bucharest, the 'Agreement on a Strategic Partnership in the Field of Green Energy Development and Transmission between the Governments of the Republic of Azerbaijan, Georgia, Romania and Hungary, was signed. The agreement is being implemented through the GECO Power Company, with the project currently in the feasibility study phase and expected to be completed by the end of 2025. The project has also been accepted for inclusion in the ENTSO-E TYNDP and a PCI/PMI application is planned.

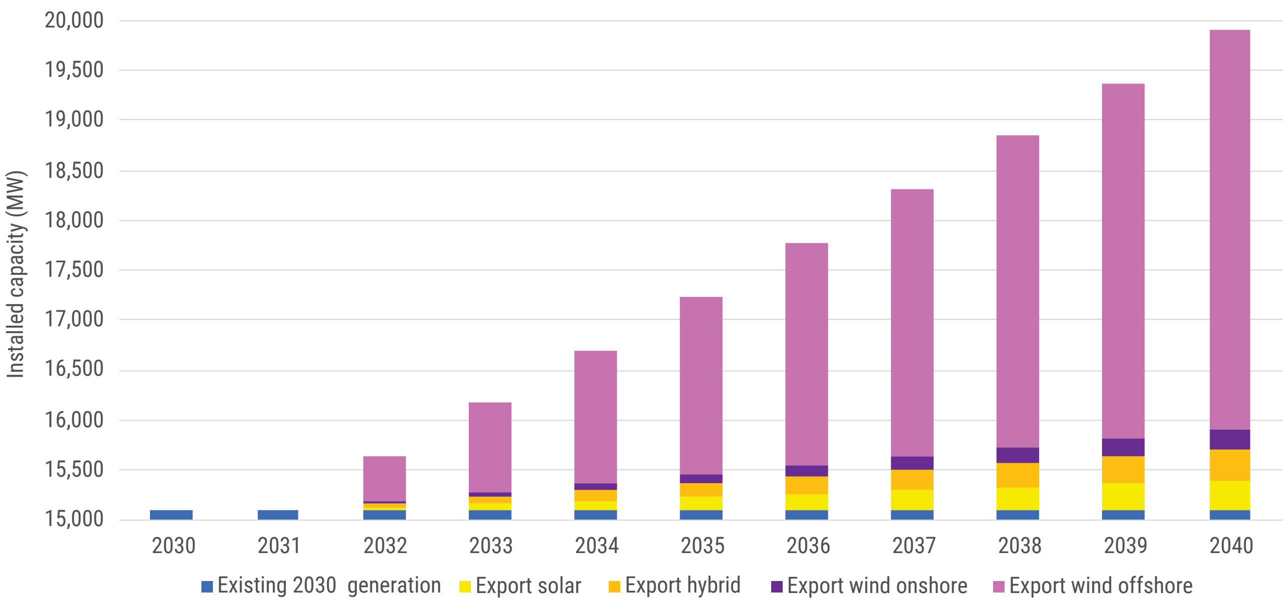
The Central Asia-Azerbaijan Green Energy Corridor is based on a 'Strategic Partnership Agreement' that was signed at COP29 between Azerbaijan, Kazakhstan and Uzbekistan. The partnership marks the first interconnection of the region's national power systems across the Caspian and aligns with broader regional geo-economic integration objectives. CESI S.p.A. is conducting a feasibility study as a consultant to Green Corridor Alliance LLC, which is the joint entity established by transmission system operators of the three countries.

The Azerbaijan-Georgia-Türkiye-Bulgaria Green Energy Corridor is a regional initiative established under a Memorandum of Understanding signed in April 2025, aimed at expanding green power transmission and trade, and strengthening cross-border interconnectors, with the Terms of Reference for the project already completed.

The Azerbaijan-Nakhchivan-Türkiye Green Energy Corridor is a regional initiative with a successfully completed feasibility study, focusing on enhancing renewable energy generation in Nakhchivan, Azerbaijan and strengthening cross-border electricity interconnection with Türkiye. In connection with strategic projects implemented for the development and transmission of green energy in the country, work is underway to conduct relevant technical studies on integrating renewable energy sources into the transmission grid starting from 2028.

During the stakeholder consultation workshop, it was suggested that between 2033 and 2040, Azerbaijan should develop 4,000 MW of offshore wind, 300 MW of solar PV, 215 MW of onshore wind and 300 MW of a hybrid power plant (solar and wind) to meet its export targets. It is assumed that the development of the power plan will be distributed evenly over this period. This expansion will further increase renewable capacity to 61.5 per cent in 2040 and will add 10.2 TWh of electric generation to the system. However, since demand is also expected to increase in both the NDC and the SDG scenarios, the excess electricity will be offset significantly if demand follows the SDG profile, given the high-level of electrification of the energy system. Therefore, careful planning is needed to ensure that the domestic demand can be met.

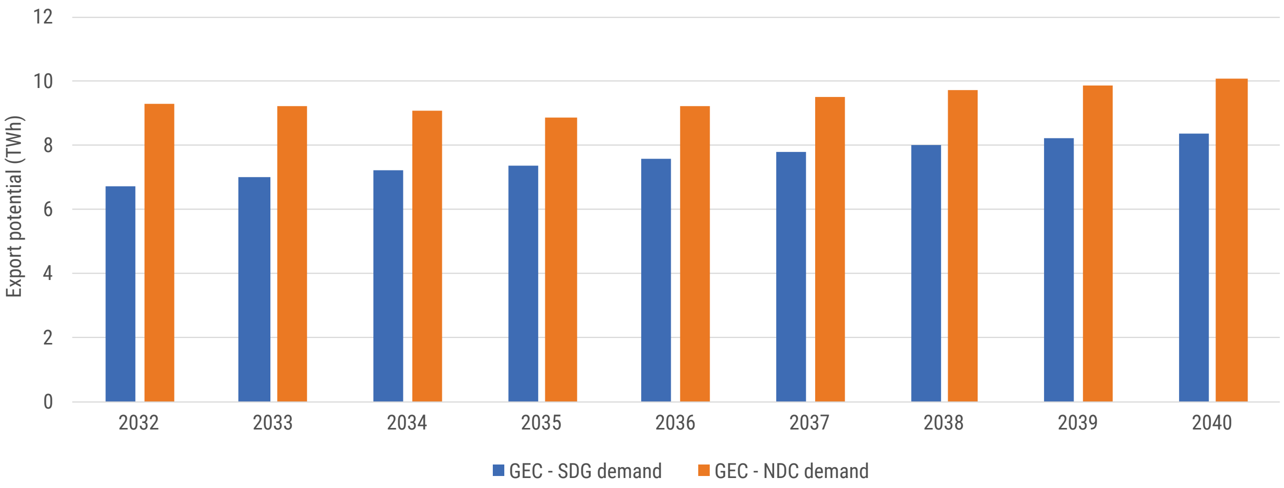
Figure 19. Installed capacity expansion under the GEC scenario in Azerbaijan



Source: ESCAP.

Figure 20 presents the differences in export potential under the GEC scenario considering the SDG and NDC 3.0 demand scenarios.

Figure 20. Export potential considering the SDG and NDC 3.0 demand scenarios



Source: ESCAP.

NEXSTEP has not conducted a quantitative analysis of hydrogen for implementation in Azerbaijan as hydrogen is not commercially available and the technology has numerous unknown variables (Box 6). Azerbaijan would need to significantly increase renewable energy-based power generation capacity to produce green hydrogen (Worley Consulting Group Limited, 2025). This would pose significant challenges to system stability and reliability.

Box 6. Hydrogen gains global interest, but application is still limited

Green hydrogen, created using renewable electricity, has garnered great interest globally, primarily driven by an increasing interest to use renewable heat in large industry sectors. For example, five countries (Australia, Brazil, South Africa, Spain and Sweden) have road maps that include green hydrogen in the industry sector.[a] Furthermore, various government policies have been introduced that directly or indirectly promote the adoption of renewable hydrogens as a means to achieve environmental and climate objectives.

The implementation of green hydrogen, however, is still limited due to high production costs and the need for associated infrastructure. According to the IEA , producing hydrogen from low-carbon energy is still costly despite declining costs of renewables.[b] IEA noted that the cost of hydrogen production from solar PV and wind in the ASEAN region will be around $3/kg. The development of hydrogen through electrolysis may also require a significant amount of water and electricity. IEA estimated that if all current dedicated global hydrogen were produced through water electrolysis, this would result in an annual electricity demand of 3,600 TWh, with water requirements at 617 million cubic metres. Widespread adoption of hydrogen is also being hindered due to slow development of hydrogen infrastructure. Planning and coordination between governments and industries are required to address future problems in refuelling stations.

a REN21, "Renewables 2023: Global Status Report collection: Renewables in energy demand", Paris, 2023. Available at https://www.ren21.net/wp-content/uploads/2019/05/GSR2023_Demand_Modules.pdf

b International Energy Agency (IEA), "The future of hydrogen: Seizing today's opportunities", Japan, 2019. Available at https://iea.blob.core.windows.net/assets/9e3a3493-b9a6-4b7d-b499-7ca48e357561/The_Future_of_Hydrogen.pdf

7. Economic analysis and financing options

Sustainable, green transition in the energy sector offers financial benefits in the long term. This may include financial incentives to promote efficient vehicles and household appliances. The transport, residential, commercial and industrial sectors all have high GHG mitigation potential, with most scenarios being cost-effective in the long term. For instance, mode shifting in the transportation sector can deliver the highest savings with high abatement potential. In addition, cost savings can be expected from the reduced reliance on expensive imported oil products.

Azerbaijan can consider the role of energy service companies (ESCOs) in promoting energy efficiency in the building sector. The key to supporting the growth of ESCOs is the availability of accessible financing. Azerbaijan can draw lessons from countries, such as Thailand, which has demonstrated leadership in this area by establishing a "revolving fund" for energy conservation and efficiency. ESCOs can borrow funds from financial institutions at interest rates that are lower than commercial rates, with extended repayment periods (Box 7).

Box 7. Case study – Energy Efficiency Revolving Fund in Thailand

In 2003, the Government of Thailand launched the Thai Energy Efficiency Revolving Fund (EERF) as part of its Energy Conservation Programme to attract investments in energy efficiency, create confidence in entrepreneurs and promote ESCOs as a vehicle to improve energy efficiency. The EERF works to overcome barriers in the Thai financial sector by mobilizing adequate financing for energy efficiency and greenhouse gas emissions reduction. It was designed to strengthen the capacity of commercial banks to finance energy efficiency (EE) projects, develop an ESCO fund to enable smaller companies to access EE financing and collaborate with the Bureau of Investment to provide tax/duty exemptions for EE products. The establishment and implementation of the Revolving Fund has been successful in supporting initial investments in energy efficiency and creating a self-sustained market by encouraging the involvement of commercial banks.

The fund was made available by DEDE with financial support from the Ministry of Energy. The total budget for five phases of the fund was US$ 245.10 million. During the first phase (2003-2006), the fund was made available to commercial banks without interest, however, an interest rate of 0.5 per cent was introduced from Phase 2 onwards and continued at the same rate through to Phase 5. Phase 5 of the fund operated from June 2010 to May 2013. Facility owners, ESCOs and project developers are eligible to borrow from this fund for a maximum of 7 years for EE and renewable energy (RE) projects. The size of single loans was capped at about $1.56 million with an interest rate of 4 per cent. Until 2013, 295 project proposals were received (60 per cent EE projects and 40 per cent RE projects) for a total investment of $498.7 million of which $226 million was contributed from the Revolving Fund and the remaining supported by financial institutions.[a]

a A. Achavangkool, "Experiences on energy efficiency financing instruments in Thailand", presentation made at the Inter-regional Workshop on Energy Efficiency Investment Projects Pipeline, Thailand, 2014.

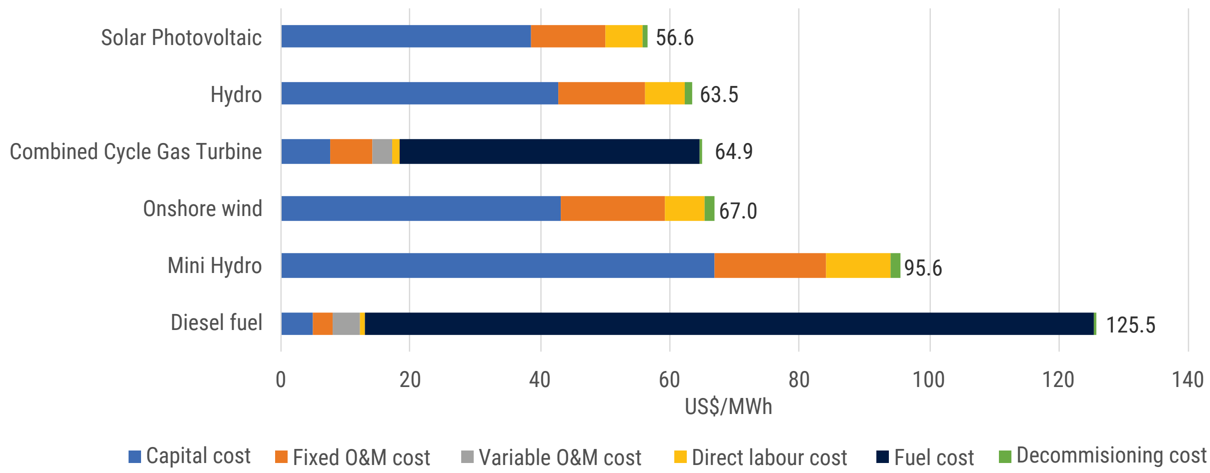
The Government can also consider blended finance, sustainability-linked bonds and public-private partnerships to support industrial decarbonization. Blended finance can unlock bankable efficiency projects suitable for innovative and early-stage projects. This financing mechanism can fund mature low-carbon technologies, with the use of proceeds being monitored. When projects are large and involve the government, a public-private partnership can be considered to leverage private-sector efficiency. However, political and regulatory risks might hamper the process. Simultaneously, sustainability-linked bonds can encourage company-wide decarbonization, as interest rates can be adjusted based on sustainability performance. The linked bonds and loans can fund general corporate sustainability action tied to debt pricing. Concessional finance may suit smaller companies or innovative technologies on the verge of commercialization.

Azerbaijan can also consider dedicated financing mechanisms for modernization of the heating sector, especially in urban areas where collective heat supply remains relevant. Such financing may support rehabilitation of boiler houses, modernization of district heating networks, installation of digital monitoring and control systems, building-level substations, and deployment of efficient cogeneration or large-scale heat pump solutions where appropriate. Because many heating investments require substantial upfront capital but generate long-term efficiency, reliability and emissions-reduction benefits, concessional finance, revolving funds, public-private partnerships, and blended finance mechanisms may be particularly relevant for this segment.

Raising ambition for a green energy corridor might seem challenging, as the country must significantly increase its renewable energy share. However, it will be feasible in the future. In the past, investment in fossil fuel generation was a cheap and reliable, albeit polluting, way to generate electricity. This is no longer the case as renewables have matured and costs have dropped significantly. It is cheaper today to generate electricity from renewables such as solar, hydropower, wind and biomass than fossil fuel technologies. The levelized cost of electricity (LCOE) is a widely used metric in the energy industry for comparing the economic value of different electricity generation technologies. It calculates the unit cost of electricity (US$/MWh or cents/kWh) over the project's lifetime, including capital, operating and financing costs. The LCOE is measured using the lifecycle cost of a system and therefore balances out the disparity where some technologies have a high capital cost but low operating cost, whereas others have low capital but high operating cost.

NEXSTEP has calculated the LCOE for Azerbaijan (figure 21) using cost figures presented in Annex C. The LCOE component analysis highlights renewable electricity generation technologies, including solar photovoltaic (5.7 cents/kWh), hydro (6.4 cents/kWh) and onshore wind (6.7 cents/kWh), which are cheaper than current diesel generation technologies in Azerbaijan. The given LCOE for renewable energy does not include energy storage. Box 8 presents the impact of battery energy storage system (BESS) on the LCOE.

Figure 21. Comparison of the levelized cost of electricity (US$/MWh)

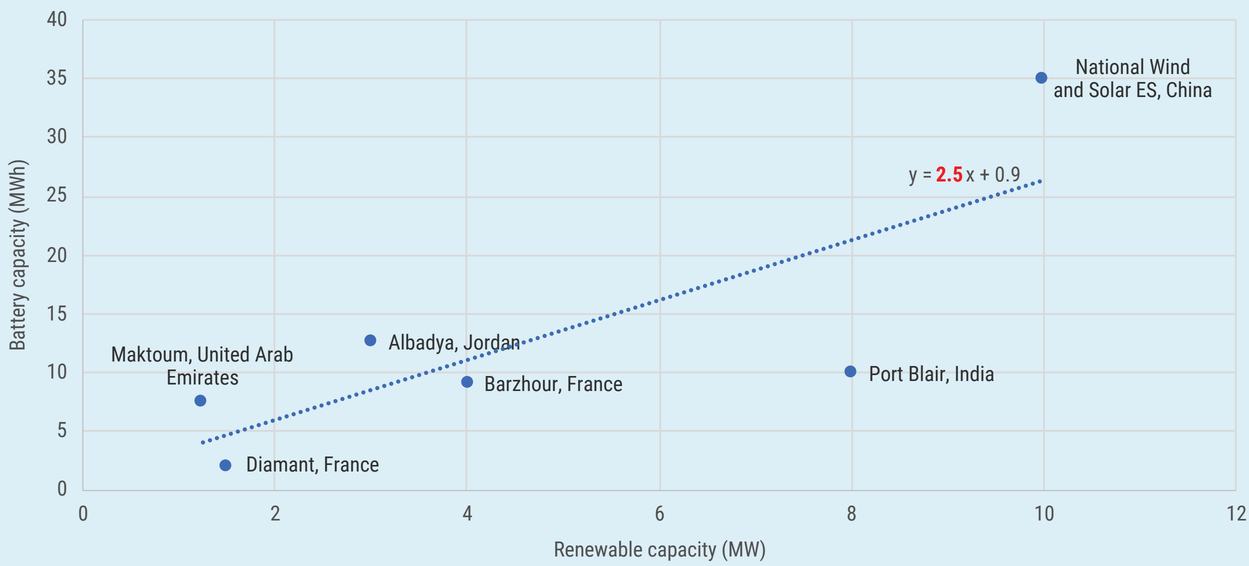


Source: ESCAP.

Box 8. LCOE of electricity generation with battery energy storage system

Battery energy storage systems (BESS) will play a critical role in a fully decarbonized energy system. However, calculating battery capacity requirements at the national level is impractical as the ratio between battery capacity and renewable capacity varies depending on project size and location. For instance, the Port Blair project in India has a battery-to-renewable capacity ratio of 1.25 (8 MW/10 MWh Li-ion). However, the Maktoum project in the United Arab Emirates has a battery-to-renewable capacity ratio of around 6 (1.25 MW/ 7.5 MWh). In France, the Diamant and the Barzhour projects have different ratios despite being installed in the same country. Given this variability, storage capacity is better estimated at the project level. Due to these inherent difficulties, NEXSTEP analysis does not estimate specific storage capacity at the national level. Instead, it has estimated a battery-to-renewable capacity ratio of around 2.5, as shown in figure 22.

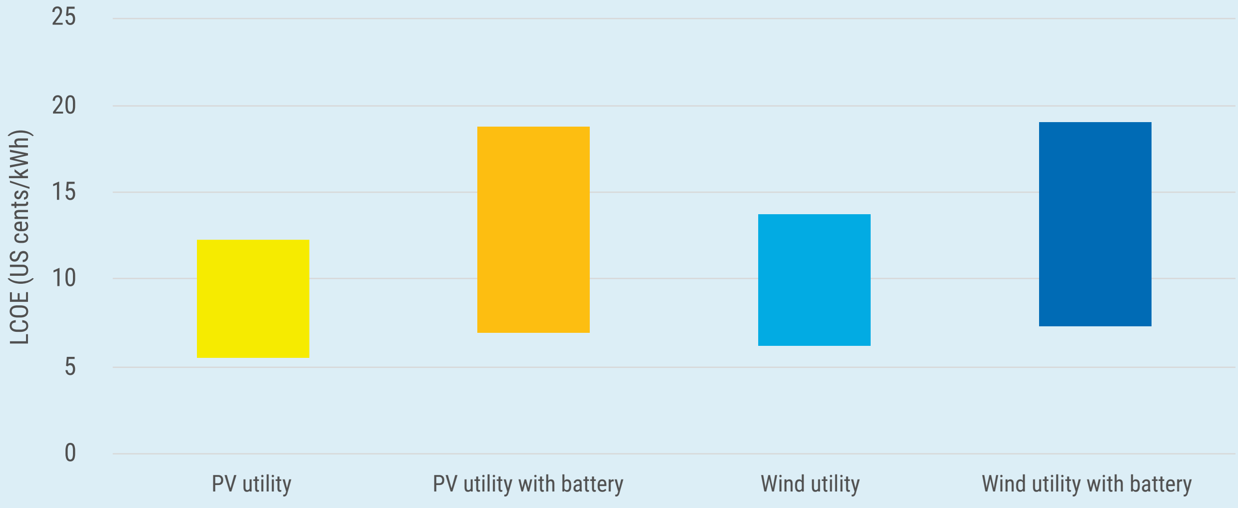
Figure 22. Relationship between battery capacity and renewable capacity



Source: ESCAP, based on data from H. Beltran and others, "Battery size determination for photovoltaic capacity firming using deep learning irradiance forecasts", *Journal of Energy Storage*, vol. 33 (January 2021). Available at https://www.sciencedirect.com/science/article/abs/pii/S2352152X20318594

Using this factor, NEXSTEP has estimated the LCOE of utility-scale renewable project with and without storage (figure 23). Without storage, the LCOE of utility-scale solar photovoltaic will range from 5.5 to 6.8 cents/kWh, while the LCOE of utility-scale onshore wind will range from 6.2 to 7.6 cents/kWh. With storage, the LCOE of utility-scale solar photovoltaic will range from 7 to 11.8 cents/kWh, while the LCOE of utility-scale onshore wind range from 7.3 to 11.7 cents/kWh, depending on the capacity of storage. The higher the battery size, the higher the LCOE. Therefore, finding the optimum battery size will be critical for the development of renewable with BESS projects.

Figure 23. **Comparison of LCOE with and without batteries for Azerbaijan**



Source: ESCAP.

There are a few pathways that Azerbaijan can explore, in collaboration with citizens and/or private investors, in order to achieve a net-zero carbon power supply objective. One viable solution and a recent policy instrument is the renewable energy auction, which is likely to substantially decrease the cost of electricity supply through competitive pricing bidding and therefore, return a greater net benefit. Recent auctions, such as the 60 MW solar PV auction in Cambodia achieved $0.0387 per kWh.

A renewable energy auction, also known as a "demand auction" or "procurement auction", is essentially a call for tenders to procure a certain capacity or generation of renewables-based electricity. The auction participants submit a bid with a price per unit of electricity at which they are able to realize the project. The winner is selected on the basis of the price and other criteria, and a power purchase agreement is signed. Such auctions have the ability to achieve deployment of renewable electricity in a well-planned, cost-efficient and transparent manner. Most importantly, they make the achievement of targets more precise compared to other policy instruments, such as a Feed-in-Tariff (FiT).

Auctions are flexible and they allow governments to combine and tailor different design elements to meet deployment and development objectives. Unlike FiTs, where the government decides on a price, auctions are an effective means of discovering the price appropriate to the industry, which is the key to attracting private sector investment. In addition, an auction provides greater certainty about future projects and is a fair and transparent procurement process. However, administrative and logistic costs associated with auctions are very high unless multiple auctions are undertaken at regular intervals. Azerbaijan has an existing framework for renewable energy auction, as summarized in Box 9.

Box 9. Renewable energy auction in Azerbaijan

Azerbaijan conducted the first renewable auction in 2024. The auction was supported by the European Bank for Reconstruction and Development (EBRD). During the United Nations Climate Change Conference in Baku (COP29), Universal International Holding Limited was announced as the winner. They submitted the lowest bid to develop a 100 megawatt (MW) solar power plant in

Garadagh, Azerbaijan, with a competitive tariff of US$ 3.54 cents per kilowatt-hour (kWh). The government shows an effective key design elements:

- Auction demand. Government clearly indicates the scale or size of each auction, the preferred technology (technology neutral of a specific technology), auction frequency, and the upper and lower limits of projects size and price.
- Pre-qualification. Government makes a trade-off, depending on the project size and other development objectives. A strict or high pre-qualification for bidders will leave out the smaller entities, while a relaxed pre-qualification may undermine the quality of the project and increase the administrative costs.
- Selection criteria. Government considered various selection criteria. Commonly two selection criteria are used: (a) the lowest bid where only the lowest bidder will win; and (b) lowest bids plus other objectives where in addition to the price, other objectives such as local content and jobs are taken into consideration.

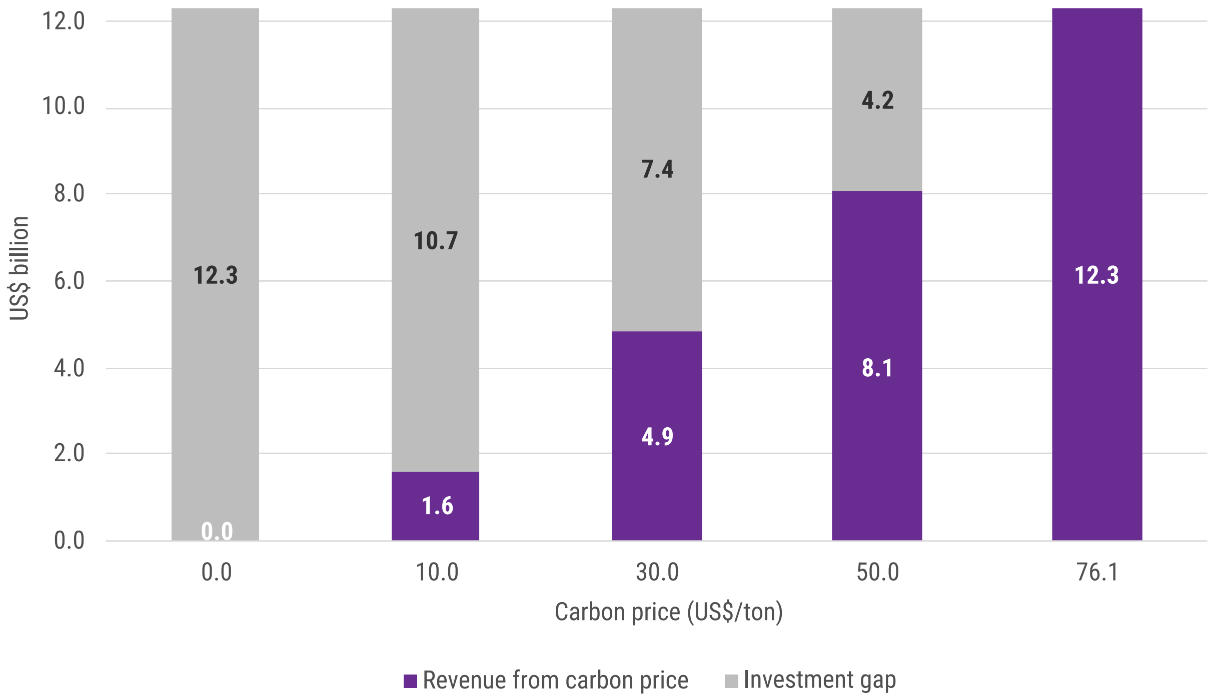
Another consideration for the long term is internalizing externalities. The challenges associated with accurately estimating the externalities of fossil fuel energy technologies have continued to result in unfair comparisons with renewables. If the external costs of fossil fuel systems are considered, energy generation from renewables would have been equal, if not lower, to that of conventional energy systems. External costs arise from pollution and environmental degradation caused by the extraction of fossil fuel resources, indoor and outdoor air pollution, and the negative economic impacts of extreme weather events caused by global warming, such as its impact on agricultural yields.

Carbon pricing is recognized around the world as an effective policy tool to facilitate sustainable energy transition. The external cost of carbon emissions paid by society should be shifted towards the producers and consumers responsible for producing pollution-causing goods by directly setting a price on carbon emissions. There are two main mechanisms for carbon pricing – emission trading schemes (cap and trade) and carbon taxation. Emission trading systems place a cap on CO_2-e emissions and allow participants to trade an allowance of CO_2-e emissions under the cap. The mechanism results in a wealth transfer from high emission to low-emission technology proponents, increasing the attractiveness of low-emission technology investments. Carbon taxes simply put a price on the GHG emissions or on the carbon content of fuels. Governments may choose to treat this as a revenue stream or hypothecate these funds to use it as a wealth transfer mechanism.

In today's market, there is no consistency in carbon price, and it is therefore very difficult to choose a carbon price that will suit the national context. The *State and Trend of Carbon Pricing 2022* report published by the World Bank (World Bank, 2022) suggests that a minimum carbon price of $50-$100 per ton is needed by 2030 to cost-effectively reduce emissions in line with the temperature goal of the Paris Agreement. In Singapore, the carbon tax rate will be increased to $18/tCO_2$-e in 2024 and 2025, and $33/tCO_2$-e in 2026 and 2027, with a view to reaching $37-59/tCO_2$-e by 2030. Further in-depth investigation should be performed, involving subject matter experts and stakeholders, to identify the price suitable for Azerbaijan.

NEXSTEP identified that a price on carbon can close the investment gap in the long term. For example, the investment gap in the power sector between the NDC 3.0 and green energy corridor scenarios will be US$ 12.3 billion between 2027 and 2040. It is estimated that the remaining emissions from the power sector (the balance that will remain after implementing all measures, including increasing renewable energy and improving energy efficiency) will be 0.16 billion tCO_2-e cumulatively up to 2040. NEXSTEP analysis shows that a carbon price of US$ 76.1 can entirely cover the investment gap (figure 24). Further in-depth investigation should be performed, involving subject matter experts and stakeholders, to identify the price suitable for Azerbaijan.

Figure 24. Impact of carbon price on investment gap



Source: ESCAP.

8. Policy recommendations


RECOMMENDED

8.1. Scenario evaluation

The NDC 3.0, the SDG and the ambitious GEC scenarios have been evaluated and ranked, using the Multi-Criteria Decision Analysis (MCDA) tool, with a set of 12 criteria and weights assigned to each criterion (table 9). While the criteria and weights have been selected based on expert judgement, ideally the process should involve stakeholder consultations. If deemed necessary, this step can be repeated using the NEXSTEP tool in consultation with stakeholders where the participants may want to change weights of each criterion. The following factors have been considered to assume comparative weights across the set of criteria, where the total weight needs to be 100 per cent:

(a) Universal access to electricity to be achieved;

(b) Universal access to clean cooking fuel to be achieved;

(c) Renewable energy share in the total final energy consumption to increase;

(d) Energy efficiency improvement should be doubled, and where there is an economic benefit, it should be further enhanced;

(e) The unconditional NDC target should be achieved. Where possible, the conditional target should be achieved if it is economically viable;

(f) Total investment should be kept low, but the net benefit should be high. This was done by assigning both indicators the same weight to ensure that a scenario is chosen on the value-for-money basis; and

(g) Carbon pricing should be introduced to encourage investments in clean energy.

Table 9. Criteria with assigned weights for MCDA

Criterion	Weight (percentage)
Access to clean cooking fuel	10
Energy efficiency	10
Share of renewable energy	11
Emissions targets in 2030	10
Alignment with Paris Agreement	10
Fossil fuel subsidy phased out	5
Price on carbon	5
Fossil fuel phase-out	5
Cost of access to electricity	7
Cost of access to clean cooking fuel	7
Investment cost	10
Net benefit from the power sector	10
Total	**100**

Table 10 shows the summary of results obtained through this evaluation process. The scenario evaluation suggests that the Green Energy Corridor scenario, developed from SDG driven demand, is the highest-ranked energy transition pathway for Azerbaijan since there will be a significant improvement in energy efficiency, an increase in renewable share and a substantial emission reduction. Since the GEC scenario is developed based on the SDG scenario, it is recommended that Azerbaijan begin developing/aligning strategies and plans in line with the GEC scenario, which will also ensure the achievement of all SDG 7 targets as well as the NDC conditional targets.

Table 10. Scenario ranking based on MCDA

Scenarios	Weighted scores	Rank
Green Energy Corridor	46	1
Sustainable Development Goals	31	2
Nationally Determined Contributions 3.0	20	3

8.2. Revisiting existing policies

Current energy policies in Azerbaijan have been evaluated based on the outputs from the LEAP model, in order to highlight any revisions required to achieve the SDG 7 and NDC targets by 2030. These are summarized in table 11.

Table 11. Assessment of SDG 7 and NDC targets

Category	Existing policy	Policy evaluation	NEXSTEP analysis
Access to electricity	Not applicable since Azerbaijan has achieved universal access to electricity.	Azerbaijan has achieved 100 per cent universal access to electricity.	Azerbaijan should continue its efforts to improve the power supply reliability to accommodate the increasing demand and higher renewable energy penetration.
Access to clean cooking	Not available.	NEXSTEP analysis projects that Azerbaijan may reach a 100 per cent clean cooking access rate, based on the historical trend of improvement.	NEXSTEP analysis suggests bridging the remaining gap with electric cookstoves as the most appropriate clean cooking solution. It is also critical to aggressively promote electric stoves to increase penetration to at least 20 per cent of the population by 2030.
Renewable Energy in TFEC	Not a specific policy targeting the renewable energy share in TFEC.	The share of renewables in TFEC is projected to be 4.2 per cent in the NDC 3.0 or current policy scenario due to the increase in planned renewable power capacities under the existing capacity expansion plan.	The renewable energy share in TFEC will further increase to 9.6 per cent in the SDG scenario. This increase is attributable to additional measures in energy efficiency and the addition of renewables from 2028 onwards.

Category	Existing policy	Policy evaluation	NEXSTEP analysis
Renewable energy in power sector	The *Socio-Economic Development Strategy of the Republic of Azerbaijan for 2022-2026* aims for a green energy transition, improved energy efficiency and the development of a low-carbon economy (Azerbaijan, 2022). The Government aims to increase renewable energy capacity to 30 per cent by 2030.	Azerbaijan will almost reach 30 per cent renewable capacity in 2030.	Azerbaijan can further reach 50 per cent renewable capacity in 2030, requiring additional RE development from 2028 onwards. Azerbaijan can introduce renewable energy auctions and a carbon tax to accelerate the development of renewable energy.
Energy efficiency	The Government has enacted laws and regulations governing energy efficiency. The NDC 3.0 document also sets an energy efficiency strategy.	The NDC 3.0 or current policy scenario will not achieve the suggested global energy efficiency improvement target of 4 per cent or 2.7 MJ/US$$_{2017}$ in 2030. It is projected that the energy intensity will be 2.8 MJ/US$$_{2017}$ in 2030.	The energy intensity is further reduced to 2.4 MJ/US$$_{2017}$ in 2030 under the SDG scenario, which meets the global energy efficiency target. Achieving this target requires accelerating the timeline for activities under NDC 3.0 so that the target is met by 2030. This, however, requires incentives, including ESCO, blended finance, green bonds and PPP.
Emission reduction	*Updated Third Nationally Determined Contribution 2021-2030 of The Republic of Azerbaijan To The Paris Agreement* sets a mitigation target for Azerbaijan's NDC, aiming for a 40 per cent reduction in total national greenhouse gas (GHG) emissions by 2035 compared to 1990 emissions (Azerbaijan, 2025). The strategy includes optimizing fuel consumption, increasing the use of renewable energy and energy storage, improving the energy performance standard of newly constructed buildings, transitioning to electric heat pumps and electric stoves, and increasing the uptake of electric vehicles.	Azerbaijan is on track to achieve the target of a 40 per cent reduction in emissions by 2030.	Azerbaijan will further achieve significant emission reduction by 2030 because of the additional measures in the demand sector to improve its energy efficiency.

8.3. Policy recommendations

Adopt multisectoral approach to raise energy efficiency strategies by 2030 to align with the global improvement target

Energy efficiency policies across sectors can help achieve substantial energy savings by reducing the need for investment in energy infrastructure, fuel costs and vulnerability to fossil fuel prices. Policymakers should improve the energy efficiency strategy by including well-defined best practice policies, implementation timelines and enforcement. Achievement of the SDG 7 target of 2.7 MJ/US$ by 2030 (4 per cent annual improvement rate), will require a reduction of TFEC by 2.7 Mtoe compared to the NDC 3.0 scenario. To achieve this target, the Government should consider accelerating the activities and targets under NDC 3.0 to 2030.

Promote electric cookstoves to provide a sustainable solution to achieving universal access with multifold benefits

Achieving universal access to clean cooking solutions should be a key priority in Azerbaijan and should be included into the national energy policy. NEXSTEP analysis suggests that the remaining clean cooking gap can be closed through the promotion of electric cookstoves. These are more efficient than other cookstoves, including gas stoves. However, electric cookstoves have higher annualized costs compared to natural gas stoves, due to lower gas tariffs. The annualized cost of an electric cookstove is estimated at $107, compared to $49 for a natural gas cookstove. NEXSTEP recommends increasing the adoption of electric cookstoves to 30 per cent of urban households and 10 per cent of rural households in 2030. It is estimated that total investment of $57.1 million will be required to distribute electric cookstoves to 0.53 million households.

Fuel switching strategies, including electrification, to accelerate SDG 7 progress and provide multifold benefits in the long run.

NEXSTEP identifies electricity as an important strategy for Azerbaijan to replace demand for oil products given the current uncertainties in the hydrogen market. Further in-depth analysis involving subject matter experts and stakeholders is needed to identify the techno-economic potential of hydrogen in the country.

The current plan to limit second-hand vehicles will help improve fuel economy. However, electrification of the transport system will also be critical. Accelerating adoption of electric vehicles, for example, would reduce the demand for oil products. In addition, electric vehicles help absorb excess renewable energy. With specialized networks and large numbers of electric vehicles connected to the grid, their combined stationary battery capacity can contribute to load levelling. To support this transition and encourage investments, Azerbaijan can set financial and tax incentives, and safety standards.

Decarbonize the power and heating sector by investing in renewable energy to help establish Azerbaijan as a clean energy hub

Azerbaijan aims to achieve a 30 per cent share of renewable energy in installed capacity by 2030. As renewables have matured and costs have dropped significantly, it is cheaper today to generate electricity from renewables such as solar, hydropower and wind compared to fossil fuel technologies. Strategies such as renewable auctions and carbon pricing can be considered to provide revenue streams for investing in renewable energy generation in a fully decarbonized energy system. Additional revenue can also be generated from the excess electricity available for export. For heating, electric heaters are critical for individual heating systems, while heat pumps are critical for centralized systems. A further detailed technical analysis is needed.

Develop green financing policy

Accelerating green financing is critical to achieving the proposed sustainable energy transition. Policymakers need to collaborate with central banks, regulatory authorities and investors to examine the possibility of developing a green finance policy or fund to help close the investment gap. Another option is the use of green bonds to mobilize resources from domestic and international capital markets to finance climate solutions. In developing countries, renewable energy technologies have relatively high financing costs, which reflects their unattractive risk/return profile. This is because of their long-term horizon, high initial capital costs (including high infrastructure cost), unfavourable policy for grid access, illiquid equipment and project risks. Policymakers can reduce high financing costs by using two methods: de-risking and direct incentives. De-risking has two basic forms: policy de-risking instruments that reduce risk and financial de-risking instruments that transfer risk. Direct incentives involve direct finance transfers or subsidies to support low carbon investments. The United Nations Development Programme's (UNDP) (2021) *De-risking Renewable Energy Investment* is an important guide for policymakers to develop strategies that reduce investment risks in renewable energy.

8.4. Energy transition action plan

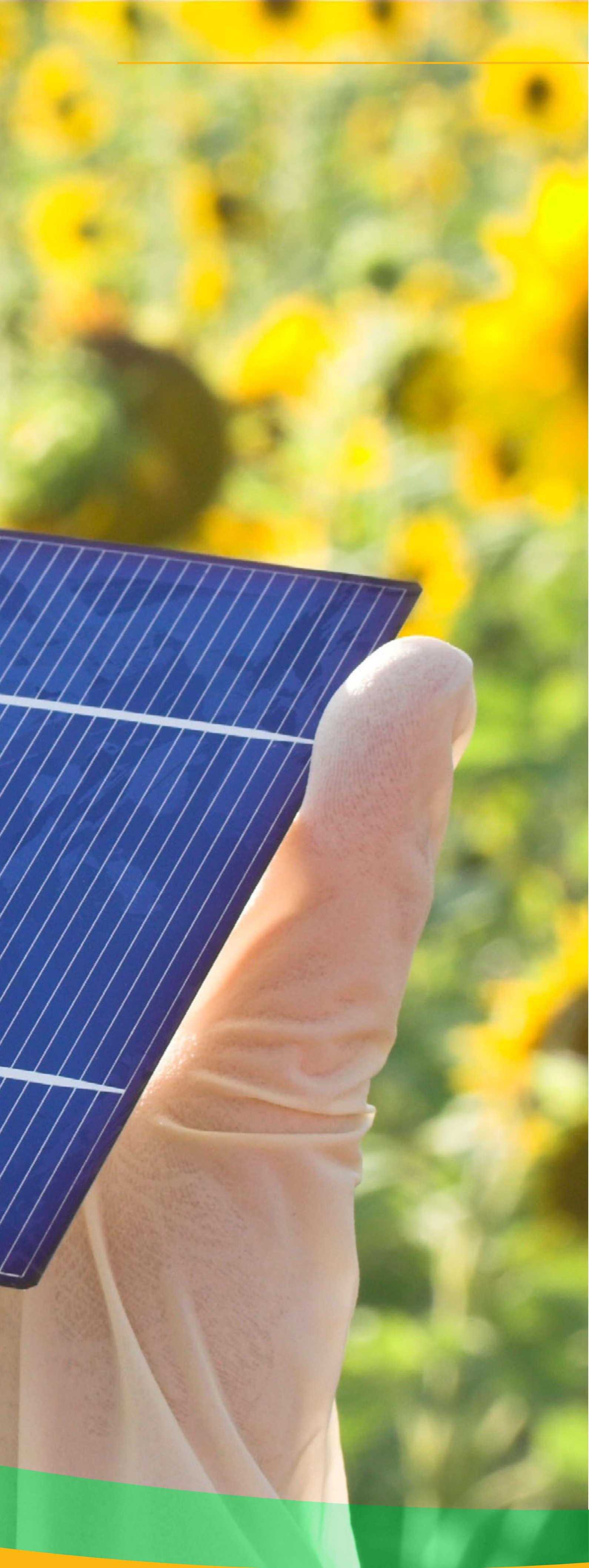
This *SDG 7 Road Map* provides detailed insights into the energy system of Azerbaijan and recommends possible pathways to transition to a sustainable, cost-effective and low-carbon energy future. Importantly, this Road Map also provides important information on establishing the country as a clean energy hub in the region, as discussed in the Green Energy Corridor (GEC) scenario in chapter 6. Several policy and technological actions are needed to make this transition possible. Table 12 summarizes the action plan for the short, medium and long term.

Table 12. Energy transition action plan for the short, medium and long term

Category	2026 - 2030	2031 - 2035	2035 - 2040
Residential	Reduce the clean cooking gap in rural areas using natural gas. Accelerate the adoption of clean cooking stoves to reach at least half a million households by 2030, incentives may be needed. Promote electric heaters to reach a third of the urban population by 2030. Accelerate the adoption of MEPS in urban households. Prioritize retrofitting old high-rise buildings in urban areas, while ensuring new buildings follow the green building code.	Encourage the adoption of MEPS in rural households. Retrofit old buildings, low and medium rise, in urban areas. Encourage rooftop solar PV in urban areas.	Retrofit rural area buildings.
Transport	Introduce electric vehicles (EV) to at least 20 per cent of passenger cars, focusing on government cars and high-income households. Develop public transport and EV charging infrastructure. Accelerate the number of EV buses. Improve fuel economy through import bans and eco-driving.	Introduce EVs to passenger trucks. Introduce SAF to aviation and maritime transport up to 15 per cent.	Introduce fuel cell vehicles. Adopt EV trucks widely.
Industrial	Increase energy efficiency and fuel switching in high-intensive industry.	Increase energy efficiency and fuel switching in medium-sized industry.	Implement energy efficiency and fuel switching across all types of industry.

Category	2026 - 2030	2031 - 2035	2035 - 2040
Commercial	Ensure adequate insulation of heating and cooling systems. Implement mandatory energy management system for buildings with an area of at least 10,000 m^2. Develop data collection process capturing subsectoral energy use in the commercial sector, including floor space.	Ensure expansion of the mandatory energy management system for buildings with an area of at least 5,000 m^2.	Ensure expansion of the mandatory management system to all types of commercial buildings.
Agricultural	Implement electrification of machinery.	Develop an energy monitoring system to capture internal structure of agricultural sector.	
Power and heat	Improve transmission and distribution networks. Expand solar and onshore wind. Modernize existing central heating.	Expand offshore wind and hybrid systems. Retrofit old thermal power plants with biomass and waste. Expand the heat pump for centralized heating in urban areas rapidly.	Expand more renewables to produce hydrogen.
Other measures	Provide incentives and subsidies. Develop public-private partnerships (PPP) for energy infrastructure. Collaborate with third parties for blending finance and green bonds.	Introduce carbon pricing and renewable auctions.	

9. Conclusion and the way forward



The 2030 Agenda for Sustainable Development and Paris Agreement provide a common framework for all countries to achieve sustainability and climate objectives. While achieving SDG 7 and NDC targets is not an easy feat, it will contribute to creating a more sustainable and resilient society. This Road Map has presented a number of scenarios together with their technical feasibility, investments, benefits, challenges and opportunities to inform policymakers on various pathways for the energy transition.

Azerbaijan has achieved universal access to electricity. While the remaining gap to achieve universal access to clean cooking by 2030 is small, a coordinated approach between private and public sectors is needed to provide advanced clean technologies to the population. For example, electric cookstoves, which build on commonly used practices, should be promoted to reduce fuel consumption and household indoor pollution. Opportunities also exist in the residential, industrial, transport and commercial sectors to improve energy efficiency by implementing measures, such as mode shifting, fuel switching, energy management standards and energy codes. Increased efforts can help achieve the global energy efficiency improvement target of 4 per cent annually.

Azerbaijan is on track to achieve the renewable energy capacity target by 2030. The share of renewable energy in TFEC will increase, as Azerbaijan has an ambitious plan to expand renewable generation. In the long run, promoting electric cookstoves and electric vehicles will require substantial electric supply. Diversifying generation sources using solar PV, wind and hydropower will be essential to meet the increasing demand for electricity and heat, while improving energy security. MCDA analysis suggests that the Green Energy Corridor scenario ranks highest, building on demand trends outlined in the SDG scenario. In addition to achieving the SDG 7 targets, this scenario will enable Azerbaijan to fully exploit its potential to become a regional supplier of green electricity.

References

Achavangkool, A. (2014). Experiences on Energy Efficiency Financing Instruments in Thailand. Presentation at the Inter-regional Workshop on Energy Efficiency Investment Projects Pipeline, Thailand. Available at https://www.unescap.org/sites/default/files/Session_7c_Thailand_Amaraporm.pdf

Asian Development Bank (ADB) (2025). Asian Development Bank Key Indicators Database – Azerbaijan. Available at https://kidb.adb.org/economies/azerbaijan

Azerbaijan (2019). *The Presidential Order No. 1209 On Accelerating Reforms in the Energy Sector of Azerbaijan*.

_________ (2021a). *The Law of the Republic of Azerbaijan No 339-VIQ on the Use of Renewable Energy Sources in the Production of Electricity*. 31 May.

_________ (2021b). *The Law of the Republic of Azerbaijan No. 359-VIQ on the Efficient Use of Energy Resources and Energy Efficiency*. 9 July.

_________ (2022). *Socio-Economic Development Strategy of the Republic of Azerbaijan for 2022-2026*.

_________ (2023). *The Law of the Republic of Azerbaijan No. 1006-VIQ on Energy*. 24 October.

_________ (2025). *Azerbaijan's Nationally Determined Contribution 3.0*. Available at https://unfccc.int/sites/default/files/2025-11/NDC%203.0%20Report_Azerbaijan.pdf

Beltran, H., and others (2021). Battery size determination for photovoltaic capacity firming using deep learning irradiance forecasts. *Journal of Energy Storage*, vol. 33 (January). Available at https://www.sciencedirect.com/science/article/abs/pii/S2352152X20318594

Clean Cooking Alliance (2021). LPG/NG 4B SS. Available at https://cleancooking.org/market-intelligence-hub/fuels-and-tech-knowledge-center/

de Almeida, A. T., F. J. Ferreira and J. Fong (2023). Perspectives on Electric Motor Market Transformation for a Net Zero Carbon Economy. *Energies*, vol. 16, No. 3. Available at https://www.mdpi.com/1996-1073/16/3/1248

Energy Sector Management Assistance Program (ESMAP) (2024). Multi-tier framework for energy access (MTF). Available at https://www.esmap.org/mtf_multi-tier_framework_for_energy_access

Green Building Council of Australia (2020). A year in focus 2019-2020. Available at https://gbca-web.s3.amazonaws.com/media/documents/green-star-in-focus-2020-final-spreads-sml.pdf

Heaps, C.G. (2026). LEAP: The Low Emissions Analysis Platform. Software version: 2024.7.0.1. Stockholm Environment Institute. Somerville, MA, USA. Available at https://leap.sei.org

International Code Council (ICC) (2024). International Green Construction Code (IgCC). Available at https://www.iccsafe.org/products-and-services/i-codes/2018-i-codes/igcc/

International Energy Agency (IEA) (2012). Cooking Appliances. Available at https://iea-etsap.org/E-TechDS/PDF/R06_Cooking_FINAL_GSOK.pdf

_________ (2019). The future of hydrogen: Seizing today's opportunities. Japan. Available at https://iea.blob.core.windows.net/assets/9e3a3493-b9a6-4b7d-b499-7ca48e357561/The_Future_of_Hydrogen.pdf

_________ (2021a). *Azerbaijan 2021: Energy Policy Review*. Available at https://iea.blob.core.windows.net/assets/49662c46-575f-4561-a541-5541f5342b07/Azerbaijan2021EnergyPolicyReview.pdf

_________ (2021b). *Net Zero by 2050*. Paris. Available at https://www.iea.org/reports/net-zero-by-2050

_________ (2022). *Electric Vehicles*. Available at https://www.iea.org/reports/electric-vehicles

_________ (2024). *Energy Efficiency Policy in Azerbaijan: A Roadmap*. Paris. Available at https://iea.blob.core.windows.net/assets/6a347f18-ebd9-42ff-8e2a-9b617caccb7f/EnergyEfficiencyRoadmapforAzerbaijan.pdf

International Energy Agency (IEA) and others (2023). Tracking SDG 7: The Energy Progress Report. Washington, D.C.: World Bank. Available at https://unstats.un.org/unsd/energystats/pubs/documents/sdg_7.pdf

National Expert SDG Tool for Energy Planning (NEXSTEP) (2026). Overview. Available at https://nexstepenergy.org/landing

REN21 (2023). Renewables in Energy Demand Modules. Available at https://www.ren21.net/wp-content/uploads/2019/05/GSR2023_Demand_Modules.pdf

State of California (2021). CALGreen. Available at https://oneclicklca.com/en/resources/articles/calgreen-a-comprehensive-guide-to-title-24-regulations

State Statistical Committee of the Republic of Azerbaijan (2026a). Budget of households. Available at https://www.stat.gov.az/source/budget_households/?lang=en

__________ (2026b). Population. Available at https://www.stat.gov.az/source/demoqraphy/?lang=en

__________ (2026c). System of national accounts and balance of payments. Available at https://www.stat.gov.az/source/system_nat_accounts/?lang=en

United Nations Development Programme (UNDP) (2021). *De-risking Renewable Energy Investment*. 1 December. Available at https://www.undp.org/publications/derisking-renewable-energy-investment

United Nations Industrial Development Organization (UNIDO) (2016). Practitioner's Guide to Strategic Green Industrial Policy. Partnership for Action on Green Economy (PAGE). Available at https://www.unido.org/sites/default/files/2016-11/practitioners_guide_to_green_industrial_policy_1__0.pdf

Woodward, Michael and others (2020). Electric vehicles: Setting a course for 2030. Deloitte Insights. 28 July. Available at https://www2.deloitte.com/uk/en/insights/focus/future-of-mobility/electric-vehicle-trends-2030.html

World Bank (2014). Household cooking fuel choice and adoption of improved cookstoves in developing countries: A review. Policy Research Working Paper 6903. July. Available at https://openknowledge.worldbank.org/entities/publication/3f5f7652-40de-5ab6-9343-4aba71819e4d

__________ (2022). State and trends of carbon pricing 2022. Washington, D.C. 24 May. Available at http://hdl.handle.net/10986/37455

World Green Building Council (WorldGBC) (2021). Gree buildings and healthy buildings, Available at https://worldgbc.org/article/green-buildings-and-healthy-buildings/

World Health Organization (WHO) (2014). WHO guidelines for indoor air quality: Household fuel combustion. Available at https://www.who.int/publications/i/item/9789241548885

__________ (2024). Defining clean fuels and technologies. Available at https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-7-defining-clean

Worley Consulting Group Limited (2025). *Azerbaijan National Hydrogen Strategic Outlook – November 2024*. London. Available at https://enerjiportali.az/wp-content/uploads/2025/02/Azerbaijan-National-Hydrogen-Strategic-Outlook-Rev_14.02.2025.pdf

Yang, Y. (2022). Building energy efficiency and thermal retrofitting, Ulaanbaatar, Mongolia. Case study. Asia LEDS Partnership Secretariat, ICLEI – Local Governments for Sustainability, South Asia. New Delhi. Available at https://eastasia.iclei.org/wp-content/uploads/2022/05/ALP_Ulaanbaatar-Building-Energy-Efficiency-and-Thermal-Retrofitting.pdf

Zhang, Y., N. Adams and C. Pemberton-Pigott (2019). Beyond the last mile: Piloting high-efficiency, low-emissions heating technologies in Central Asia. World Bank Group. Available at https://openknowledge.worldbank.org/bitstream/handle/10986/31774/Beyond-the-Last-Mile-Piloting-High-Efficiency-Low-Emissions-Heating-Technologies-in-Central-Asia.pdf

Annexes

Annex A. National Expert SDG 7 Tool for Energy Planning (NEXSTEP) methodology

The analysis presented in this national Road Map is based on the results from the National Expert SDG 7 Tool for Energy Planning (NEXSTEP) project. NEXSTEP is an integrated tool for assisting policymakers in making informed policy decisions that will help in achieving SDG 7 and NDC targets by 2030. The SDG 7 and NDC targets are integrated in the LEAP energy model and back-casted from 2030, since the targets for 2030 are already defined.

Table A. 1. Targets and indicators for SDG 7

Target	Indicators	2024	2030
7.1. By 2030, ensure universal access to affordable, reliable, and modern energy services.	7.1.1. Proportion of population with access to electricity.	100%	100%
	7.1.2. Proportion of population with primary reliance on clean fuels and technology for cooking.	99.4%	100%
7.2. By 2030, increase substantially the share of renewable energy in the global energy mix.	7.2.1. Renewable energy share in total final energy consumption.	2.1% (excluding traditional biomass)	9.6%
7.3. By 2030, double the global rate of improvement in energy efficiency.	7.3.1. Energy intensity measured as a ratio of primary energy supply to gross domestic product.	3.5 MJ/US$ (2017) PPP	2.4 MJ/US$ (2017) PPP

SDG 7.2. Renewable Energy

Methodology: Share of renewable energy in total final energy consumption, where TFEC is total final energy consumption, ELEC is gross electricity production and HEAT is gross heat production.

$$\%TFEC_{RES} = \frac{TFEC_{RES} + \left(TFEC_{ELEC} \times \frac{ELEC_{RES}}{ELEC_{TOTAL}}\right) + \left(TFEC_{HEAT} \times \frac{HEAT_{RES}}{HEAT_{TOTAL}}\right)}{TFEC_{TOTAL}}$$

SDG 7.3. Energy Efficiency. "By 2030, double the global rate of improvement in energy efficiency", as measured by the energy intensity of the economy. This is the ratio of the total primary energy supply (TPES) and GDP. Energy intensity is an indication of how much energy is used to produce one unit of economic output. As defined by the IEA, TPES is made up of production, plus net imports minus international marine and aviation bunkers plus stock changes. For comparison purposes, GDP is measured in constant terms at 2017 PPP.

$$Primary\ energy\ intensity = \frac{Total\ Primary\ Energy\ Supply\ (MJ)}{GDP\ (USD\ 2017\ PPP)}$$

$$CAGR = \left(\frac{EI_{t2}}{EI_{t1}}\right)^{\frac{1}{(t2-t1)}} - 1$$

where EI_{t_1} is energy intensity in year t1 and EI_{t_2} is energy intensity in year t2.

Base period improvement rate for Azerbaijan (1990-2010): 7.2 per cent.

Doubling the improvement rate requirement for Azerbaijan (2010-2030): 14.4 per cent.

Historical improvement rate for Azerbaijan (2010-2024): 0.7 per cent.

Required improvement rate for Azerbaijan in the remaining period to achieve the doubling improvement rate (1990-2010): 39.5 per cent.

SDG 7.3. improvement rate for Azerbaijan (suggested global improvement rate): 4 per cent.

Annex B. Key assumptions for NEXSTEP energy modelling

(a) General parameters

Table B. 1. GDP, PPP and growth rate

Parameter	Value (US dollars)
GDP (2024, constant US dollar)	$74.3 billion
PPP (2024, constant US dollar)	$225.2 billion
Growth rate	2025 forward (2.6%)

Table B. 2. Population, population growth rate and household size

Parameter	Value
Population (2024)	10,180,800
Population growth rate	0.7% per annum
Number of households (01.01.2024)	2,429,785
Household size (constant throughout the analysis period)	4.19

(b) Demand-side assumptions

(i) Residential

- The residential sector is further divided into urban and rural households. Both urban and rural households have achieved a 100 per cent electricity access rate and the overall clean cooking rate was 99.4 per cent in 2024.[12] The breakdown is shown in table B.3.

12 This is based on the extrapolation. The clean cooking access rate was indicated as 99.2 per cent in 2023 and 99.1 in 2022. The energy intensity is based on assumptions provided by the local consultant.

Table B. 3. Cooking distribution in urban and rural households

Stove type	Energy intensity (GJ/household)	Urban (percentage)	Energy intensity (GJ/household)	Rural (percentage)
LPG stove	11.3	0.6	11.3	1.4
Natural gas stove	10.5	98	10.5	97.2
Electric stove	5.4	1.3	5.4	0.1
Biomass stove*	32.3	0.1	32.3	1.3

* This is assumed as unclean fuel/technology.

- The residential appliance ownership data and energy use intensity in the baseline year were provided by the local consultant. The appliance ownership is projected to grow at a rate similar to the growth in GDP. The average electrical demand per owning household for the different appliances is assumed to be constant throughout the analysis period, unless further energy efficiency measures are implemented.

Table B. 4. Residential appliance baseline assumptions

Appliance	Electricity intensity (kWh/HH/year)	Ownership – urban (percentage)	Electricity intensity (kWh/HH/year)	Ownership – rural (percentage)
Lighting	300.9	100	300.9	100
Air conditioner	1,571.3	70	902.6	40
Refrigerator	401.2	100	501.5	100
Television	334.3	100	334.3	100
Electric fan	100.3	50	100.3	70
Washing machine	167.2	70	167.2	50
Water pump	167.2	-	401.2	80
Iron	133.7	100	133.7	100
Other	334.3	100	501.5	100

- The residential heating technology data and energy use intensity in the baseline year were provided by the local consultant. The average heat demand per owning household for the different technologies is assumed to be constant throughout the analysis period, unless further energy efficiency measures are implemented.

Table B. 5. Heating distribution in urban and rural households

Heating technology	Energy intensity (GJ/household)	Urban (percentage)	Energy intensity (GJ/household)	Rural (percentage)
Electric heater	5.4	10	7.5	9
Wood furnace	-	-	74.1	1
District heating	69.2	5.5	-	-
Natural gas boilers	51.4	84.5	76.1	90

(ii) Transportation

- Land transport consumption is estimated using the vehicle statistics, load factor, annual travel mileage and estimated fuel economy as shown in table B.6. The factors are based on vehicle statistics compiled by the local consultant.
- Land transport activities in 2024 are estimated to have been 55.3 billion passenger-kilometres and 13.5 billion ton-kilometres. The growth in both passenger transport and freight transport activities is assumed to grow at the same rate as the GDP per capita.

Table B. 6. **Passenger-km and ton-km distribution**

Passenger transport	Percentage share of vehicles by fuel type	Annual travelled mileage (km)	Fuel consumption	Percentage share of passenger-km
Passenger car	Gasoline – 82.9	7,173	6.4 km/l	51.4
	Diesel – 11.7		4.7 km/l	
	Hybrid – 4.2		9 km/l	
	Electric – 0.4		1.25 km/kWh	
	CNG – 0.9		6 km/l	
Motorbike	Gasoline – 100	7,173	11.7 km/l	0.2
Bus	Gasoline – 32.1	20,814	2.6 km/l	48.4
	Diesel – 66.7		1.9 km/l	
	Electric – 0.6		0.6 km/kWh	
	CNG – 0.7		3.6 km/l	
Freight transport	**Number of vehicles (percentage)**	**Annual travelled mileage (km)**	**Fuel consumption**	**Percentage share of ton-km**
Freight truck	Gasoline – 32.2	43,800	1.4 km/l	100
	Diesel – 66.2		1 km/l	
	Electric – 0.1		1.9 km/kWh	
	CNG – 1.6		1.3 km/l	

(iii) Industry

- The industry sector is differentiated into 13 subcategories. The fuel consumption by industry subcategories is detailed in table B.7.
- The industrial GDP is assumed to grow at a rate similar to the national GDP growth rate. The energy intensity is assumed constant throughout the analysis period in the absence of energy efficiency interventions.

Table B. 7. Fuel consumption by industry subcategories in 2024

Industry	Fuel consumption (ktoe)							
	LPG	Diesel	Fuel oil	Natural gas	Renewables and waste	Heat	Electricity	Total
Iron and steel				42.1			38.1	80.2
Chemical and petrochemical			3.3	288.2		168.6	56.4	516.5
Non-ferrous metal				3.8			69.2	73.0
Non-metallic minerals	0.1			497.9			61.6	559.6
Transport equipment				0.2			0.2	0.4
Machinery	0.1			12.2			20.8	33.1
Mining and quarrying		6.8		9.5			9.3	25.6
Food and tobacco	0.2	0.2	0.3	144.2	5.6		71.0	221.5
Paper, pulp and printing				1.6			6.2	7.8
Wood and wood products				0.1			0.5	0.6
Textile and leather		0.5		9.9			12.6	23.0
Construction	0.9	110.6	1.8	27.3			52.0	192.6
Non-specified		1.0		6.0	0.9		26.6	34.5
Total	**1.3**	**119.1**	**5.4**	**1043.0**	**6.5**	**168.6**	**424.5**	**1,768.4**

(iv) Commercial sector

- The total annual energy consumption in the commercial sector was 1,084.3 ktoe in 2024. It is projected to grow at an annual rate similar to the national GDP growth rate.
- The commercial sector energy consumption is shown in table B.8.

Table B. 8. Commercial sector fuel consumption in 2024

Floor space (million m^2)	Fuel consumption (ktoe)							
	LPG	Diesel	Fuel oil	Natural gas	Renewables and waste	Heat	Electricity	Total
32.8	0.9	4.5	0.4	439.5	8.1	24.7	606.2	1,084.3

(v) Other sectors

- The remaining demand is used for agriculture and non-energy use. The consumption growth is projected to grow at the same as the national GDP growth rate.

Table B. 9. Consumption by other sectors in 2024

Fuel consumption (ktoe)	Category		
	Agriculture	Non-specified	Non-energy use
Refinery gas	-	-	39.8
LPG	0.1	-	230.9
Gasoline	8.3	-	-
Diesel	293	-	3.6
Fuel oil	-	-	-
Bitumen	-	-	264.1
Other oil product	-	-	666.6
Natural gas	164.4	-	668.0
Renewables and waste	0.1	-	-
Electricity	171.8	-	20.7
Total	**638.1**	**-**	**1,893.7**

Annex C. Key measurement assumptions for NEXSTEP energy modelling

(a) Cooking share assumptions

By 2035, buildings are expected to install electric stoves. However, under the current policy scenario, there is no specific information available on what the share will be by 2035. Considering the current trend, the percentage of electric stoves is expected to be around 1.4 per cent in 2030.

Table C. 1. Clean cooking share in 2030 in the NDC 3.0 scenario

NDC 3.0 (2030)	Number of households			Percentage		
Stove technology	Urban	Rural	Total	Urban	Rural	Total
LPG stove	8,405	15,859	24,264	0.6	1.4	1.0
City gas stove	1,372,820	1,101,084	2,473,904	98.0	97.2	97.6
Electric stove	19,612	15,859	35,471	1.4	1.4	1.4
Biomass stove	-	-	-	0.0	0.0	0.0
Total	**1,400,837**	**1,132,802**	**2,533,639**	**100.0**	**100.0**	**100.0**

NEXSTEP suggests that in the SDG scenario, at least 20 per cent of the population is expected to adopt electric cookstoves by 2030. This 20 per cent value is chosen as per the suggested recommendation in the Net Zero 2050 Road Map document developed by IEA (IEA, 2021b). Since the urban community has greater purchasing power than the rural one, NEXSTEP estimates that at least 30 per cent of urban households and 10 per cent of rural households will use electric stoves by 2030.

Table C. 2. Clean cooking share in 2030 in the SDG and CEG scenarios

SDG (2030)	Number of households			Percentage		
Stove technology	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**
LPG stove	5,967	14,476	20,443	0.4	1.3	0.8
City gas stove	974,619	1,005,046	1,979,665	69.6	88.7	78.1
Electric stove	420,251	113,280	533,531	30.0	10.0	21.1
Biomass stove	-	-	-	0.0	0.0	0.0
Total	**1,400,837**	**1,132,802**	**2,533,639**	**100.0**	**100.0**	**100.0**

(b) Efficient appliance stock turnover analysis assumptions

Based on the NDC, the Government plans to promote high-efficiency appliances until 2035. NEXSTEP calculates the projected share of energy-efficient household appliances until 2035 using stock turnover analysis. In the SDG scenario, the 2035 target is expected to be accelerated to be achieved by 2030.

Table C. 3. Stock turnover analysis lighting

Year	Total stock	Sales	Non-energy-efficient stock	Energy efficient stock	Energy efficient (saturation) (percentage)
2024	2,429,785		2,429,785	-	0.0
2025	2,493,077	306,270	2,493,077	-	0.0
2026	2,558,018	314,248	2,558,018	314,248	12.3
2027	2,624,650	322,434	2,302,216	605,257	23.1
2028	2,693,018	330,833	2,071,994	875,564	32.5
2029	2,763,166	339,450	1,864,795	1,127,458	40.8
2030	2,835,142	348,293	1,678,315	1,363,005	48.1
2031	2,908,993	357,365	1,510,484	1,584,069	54.5
2032	2,984,767	366,674	1,359,435	1,792,336	60.0
2033	3,062,515	376,225	1,223,492	1,989,328	65.0
2034	3,142,289	386,025	1,101,143	2,176,420	69.3
2035	3,224,140	396,080	991,028	2,354,858	73.0

Table C. 4. Stock turnover analysis of air conditioning

Year	Total stock	Sales	Non-energy-efficient stock	Energy efficient stock	Energy efficient (saturation) (percentage)
2024	1,369,184		1,369,184	-	0.0
2025	1,405,671	104,946	1,405,671	-	0.0
2026	1,443,130	107,743	1,335,387	107,743	7.5
2027	1,481,587	110,614	1,268,618	212,969	14.4
2028	1,521,069	113,561	1,205,187	315,882	20.8
2029	1,561,603	116,588	1,144,928	416,676	26.7
2030	1,603,218	119,695	1,087,681	515,537	32.2
2031	1,645,941	122,884	1,033,297	612,644	37.2
2032	1,689,803	126,159	981,632	708,171	41.9
2033	1,734,834	129,521	932,551	802,283	46.2
2034	1,781,065	132,972	885,923	895,142	50.3
2035	1,828,527	136,516	841,627	986,901	54.0

Table C. 5. Stock turnover analysis refrigerator

Year	Total stock	Sales	Non-energy-efficient stock	Energy efficient stock	Energy efficient (saturation) (percentage)
2024	2,429,785		2,429,785	-	0.0
2025	2,493,077	136,185	2,493,077	-	0.0
2026	2,558,018	139,733	2,418,285	139,733	5.5
2027	2,624,650	143,373	2,345,736	278,914	10.6
2028	2,693,018	147,107	2,275,364	417,653	15.5
2029	2,763,166	150,939	2,207,103	556,063	20.1
2030	2,835,142	154,871	2,140,890	694,252	24.5
2031	2,908,993	158,905	2,076,663	832,329	28.6
2032	2,984,767	163,044	2,014,364	970,404	32.5
2033	3,062,515	167,291	1,953,933	1,108,583	36.2
2034	3,142,289	171,649	1,895,315	1,246,974	39.7
2035	3,224,140	176,120	1,838,455	1,385,685	43.0

Table C. 6. Stock turnover analysis electric fan

Year	Total stock	Sales	Non-energy-efficient stock	Energy efficient stock	Energy efficient (saturation) (percentage)
2024	1,436,003		1,436,003	-	0.0
2025	1,472,599	151,476	1,472,599	-	0.0
2026	1,510,127	155,336	1,354,791	155,336	10.3
2027	1,548,612	159,295	1,246,408	302,204	19.5
2028	1,588,078	163,355	1,146,695	441,383	27.8
2029	1,628,549	167,518	1,054,959	573,590	35.2
2030	1,670,052	171,787	970,563	699,489	41.9
2031	1,712,612	176,165	892,918	819,695	47.9
2032	1,756,257	180,654	821,484	934,773	53.2
2033	1,801,015	185,258	755,766	1,045,249	58.0
2034	1,846,913	189,979	695,304	1,151,608	62.4
2035	1,893,980	194,821	639,680	1,254,300	66.2

Table C. 7. Stock turnover analysis washing machine

Year	Total stock	Sales	Non-energy-efficient stock	Energy efficient stock	Energy efficient (saturation) (percentage)
2024	1,479,739		1,479,739	-	0.0
2025	1,518,795	53,853	1,518,795	-	0.0
2026	1,558,882	55,275	1,503,607	55,275	3.5
2027	1,600,026	56,734	1,488,571	111,455	7.0
2028	1,642,257	58,231	1,473,685	168,572	10.3
2029	1,685,602	59,768	1,458,948	226,654	13.4
2030	1,730,092	61,345	1,444,359	285,733	16.5
2031	1,775,755	62,964	1,429,915	345,840	19.5
2032	1,822,624	64,626	1,415,616	407,008	22.3
2033	1,870,730	66,332	1,401,460	469,270	25.1
2034	1,920,105	68,083	1,387,445	532,660	27.7
2035	1,970,784	69,880	1,373,571	597,213	30.3

Table C. 8. Stock turnover analysis television

Year	Total stock	Sales	Non-energy-efficient stock	Energy efficient stock	Energy efficient (saturation) (percentage)
2024	2,429,785		2,429,785	-	0.0
2025	2,493,077	87,590	2,493,077	-	0.0
2026	2,558,018	89,871	2,468,146	89,871	3.5
2027	2,624,650	92,212	2,443,465	181,185	6.9
2028	2,693,018	94,614	2,419,030	273,987	10.2
2029	2,763,166	97,079	2,394,840	368,326	13.3
2030	2,835,142	99,608	2,370,891	464,251	16.4
2031	2,908,993	102,202	2,347,183	561,810	19.3
2032	2,984,767	104,864	2,323,711	661,056	22.1
2033	3,062,515	107,596	2,300,474	762,042	24.9
2034	3,142,289	110,399	2,277,469	864,820	27.5
2035	3,224,140	113,274	2,254,694	969,446	30.1

(c) Residential heating

By 2035, buildings are expected to install electric heaters. It is expected that, in the NDC 3.0 scenario, the percentage will be twice as high. In the SDGs, a more ambitious target for electric heaters is needed, particularly in urban areas. According to the IEA (2021a), the share of electric heating is expected to be 35 per cent in 2030, while heat pumps are expected to account for at least 8 per cent. In terms of energy intensity, retrofitting can reduce energy demand by 50 per cent. Under the NDC 3.0 scenario, the retrofit is expected to be prioritized for high-rise buildings (apartments), whereas in the SDG scenario, it is expected to be implemented in all buildings.

Table C. 9. Heating share in 2030 NDC 3.0 and SDG scenarios (percentage)

	NDC 3.0 (2030) (percentage)			SDG (2030) (percentage)		
Heating technology	**Urban**	**Rural**	**Total**	**Urban**	**Rural**	**Total**
Electric heater	20	18	19.1	33	18	26.3
Fuelwood heating	-	0.9	0.4	-	-	-
District heating	4.9	-	2.7	4.9	-	2.7
LPG heating	-	-	-	-	-	-
Natural gas boilers	75.1	81.1	77.8	31.6	82	62.7
Heat pump	-	-	-	15	-	8.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

(d) Transport sector

The Government plans to improve the road network to reduce congestion and limit the import of passenger cars older than 10 years from the date of manufacture. This initiative is expected to improve the fuel economy of motorcycles to 18.7 km/l, cars to 10.2 km/l, buses to 2.9 km/l and trucks to 2.1 km/l (this value is calculated by converting the world average fuel economy from mpg to km/l). By 2035, there will be a gradual phase-out of ICEs, although considering the current progress, the share is expected to remain low. NEXSTEP identifies that in the SDG scenario, the share of electric cars must be at least 20 per cent.

(e) Commercial sector

In terms of energy intensity, retrofitting can reduce energy demand by 50 per cent. Under the NDC 3.0 scenario, it is expected that the retrofit will be prioritized for commercial buildings with an area of at least 10,000 square metres. In the SDG scenario, it is also expected to be expanded to buildings with an area greater than 5,000 square metres. Using the typical frequency distribution for building floor area around the world, it is estimated that the frequency of buildings greater than 10,000 square metres is 2.4 per cent, covering 34.3 per cent of the floor space. On the other hand, buildings exceeding 5,000 square metres account for 6.1 per cent, covering 50.2 per cent of commercial floor space.

(f) Industrial and agricultural sector

By 2035, the Government plans to modernize and electrify equipment and machinery. Gas boilers will be replaced by electric boilers and heat pumps. It is also expected that behavioural changes and efficiencies will help reduce the industrial energy demand by 15 to 20 per cent. NEXSTEP analysis assumes that implementation will be prioritized for the energy-intensive industry first. In the SDG scenario, NEXSTEP suggests accelerating implementation to achieve it earlier, in 2030. There will also be a transition from diesel-powered agricultural machinery and equipment to electric alternatives.

Annex D. Power technologies cost and key assumptions

The cost parameters considered for the power technologies are as follows:

Table D. 1. Power technologies key assumption

Technology	Efficiency (percentage)	Investment cost (US$/kW)	Fixed O&M (US$/kW-year)	Variable O&M (US$/MWh)
Solar	-	995	20	-
Wind	-	1,391	35	-
Small hydro	-	3,966	70	-
Large hydro	-	3,319	70	-
Waste-to-energy	20	2,501	20	5
Diesel	44	520	20	4.4
Internal combustion	45	630	20	2.9
Combined cycle gas turbine (CCGT)	44	823	50	2.9
Gas CHP	52	1,092	50	2.9
Nuclear	33	3,606	80	-
Biogas	-	891	20	-

Annex E. Economic analysis data for clean cooking technologies

The NEXSTEP economic model utilizes the technological and cost parameters to estimate the annualized cost of clean cooking technologies (table E.1). The calculation assumes an annual cooking thermal energy requirement of 4,510 MJ per household. In addition, a discount rate of 5.37 per cent is assumed.

Table E. 1. Technology and cost data for clean cooking technologies

Technologies	Efficiency[13] (percentage)	Lifetime[14] (years)	Stove cost (US dollar)	Variable O&M (US$/year) (ESCAP analysis)	Fuel cost (US dollars)
Natural gas stove	45 Clean Cooking Alliance (2021)	20 Clean Cooking Alliance (2021)	44	10	0.129 per m^3 (220 Manat/1000 m^3)
Electric stove	80 (IEA, 2012)	15 (IEA, 2012)	37	10	0.059 per kWh (0.1 Manat/kWh)

13 Sourced from: ICS – own estimation, LPG stove efficiency ranges – (World Bank, 2014), electric cookstove (induction stove) – (IEA, 2012).

14 Sourced from: ICS – own estimation, LPG stove – (Clean Cooking Alliance, 2021), electric stove – (IEA, 2012).