Energy Transition Pathways for the 2030 Agenda

SDG 7 Road Map for Tajikistan

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 Tajikistan

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

ESCAP
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Foreword: Tajikistan

I would like to express my heartfelt gratitude to ESCAP and all key stakeholders for their invaluable support to the Ministry of Energy and Water Resources of the Republic of Tajikistan in formulating the Road Map for Sustainable Development Goal 7 (SDG 7). SDG 7 is pivotal in attaining all SDGs and lays the groundwork for a sustainable, long-term energy transition, encompassing various facets of the energy system, such as access to modern and affordable energy, renewable energy, and energy efficiency.

The collaborative effort between the Ministry of Energy and Water Resources and ESCAP in developing the SDG 7 Road Map has provided a significant opportunity to assess Tajikistan's progress toward SDG 7 targets and the Nationally Determined Contribution (NDC). Utilizing the National Expert SDG Tool for Energy Planning (NEXSTEP) framework, the Road Map takes an integrated approach to energy transition. It is gratifying to observe that a thorough analysis has been conducted for the entire energy sector of the Republic of Tajikistan, and the Road Map presents valuable recommendations for necessary policy adjustments.

The analysis highlights a few remaining gaps in Tajikistan that require attention to fortify the energy transition and achieve the targets of SDG 7 and NDC. Moreover, the NEXSTEP analysis recommends a shift toward a net zero energy system with an increased utilization of sustainable energy sources.

I am pleased to acknowledge that this document has emerged from an open, transparent, inclusive, and participatory consultation process involving all stakeholders. The success of this collaboration between ESCAP and the Ministry of Energy and Water Resources underscores our shared commitment to realizing the energy vision outlined in the Sustainable Development Goals. I look forward to continued collaboration with ESCAP in implementing the recommendations as we progress toward the 2030 Agenda for Sustainable Development and beyond.

Safarzoda Manuchehr
Deputy Minister
Ministry of Energy and Water Resources

Abbreviations and acronyms

BAU	business-as-usual
CO_2	carbon dioxide
CPS	current policy scenario
EE	energy efficiency
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
EV	electric vehicle
GDP	gross domestic product
GHG	greenhouse gas
GW	gigawatt
HELE	high efficiency low emissions
ICS	improved cooking stove
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
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/USD_{2017}	megajoules per US$ of gross domestic product in terms of power purchase parity in 2017
MoEWR	Ministry of Energy, Water Resources
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
PP	power plant
RE	renewable energy
SDG	Sustainable Development Goal
TFEC	total final energy consumption
TPES	total primary energy supply
TWh	terawatt-hour
USD	United States dollar
UNSD	United Nations Statistics Division
WHO	World Health Organization

Executive Summary

Transitioning the energy sector toward sustainability and renewables is essential for achieving the 2030 Agenda for Sustainable Development and the objectives of the Paris Agreement. Such a transition needs to ensure sustained economic growth, respond to the increasing demand for energy, reduce emissions, and consider and capitalize on the interlinkages between SDG 7 (Affordable and Clean Energy) and the other SDGs, thereby presenting a complex and difficult task for policymakers. 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 those 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 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.

This SDG 7 Road Map was developed in collaboration with the Ministry of Energy and Water Resources (MEWR), Tajikistan and national stakeholders. It evaluates whether existing national policies are sufficient to meet the targets for energy access, renewable energy and energy efficiency. The Road Map introduces three key scenarios: the business-as-usual (BAU) scenario; the current policy scenario (CPS); and the Sustainable Development Goal (SDG) scenario. It also assesses an ambitious long-term scenario that works toward Tajikistan's net-zero (TNZ) emissions and carbon neutrality by 2050. These scenarios provide policymakers from across Tajikistan with robust options for navigating a sustainable energy transition aligned with national priorities and global climate commitments.

A. Highlights of the Road Map

Tajikistan has achieved near-universal access to electricity, with 99.3 per cent of its population having access in 2022. However, access to clean cooking technologies remains a major gap, with only 16.2 per cent of the population, corresponding to 252,888 households, still relying on unclean and polluting cooking solutions. Liquified petroleum gas (LPG) stoves were the most dominant primary clean cooking technology, with an estimated 45.3 per cent share. This was followed by electric cook stoves, which were estimated at 38.5 per cent. The SDG scenario closes this gap by 2030, prioritizing electric cooking stoves as a clean, cost-effective solution, particularly feasible as most (87.5 per cent) of country's electricity is from hydropower.

In 2022, the share of modern renewable energy (excluding traditional biomass) in total final energy consumption (TFEC) was 27.8 per cent in Tajikistan. In the SDG scenario, this rises to 35.1 per cent by 2030, driven by expanded hydropower and the integration of solar and wind resources which are especially valuable in the winter months when hydro capacity declines. The country's energy intensity was 4.7 MJ/USD2017 in 2022. Under the SDG scenario, this is expected to fall to 3.2 MJ/USD2017 by 2030 being consistent with the global target for energy efficiency. Achieving this target will require scaling up efficient appliances and heating technologies, building retrofits and modernizing industrial processes. GHG emissions from the energy sector are projected to remain well within the NDC commitments of Tajikistan. From a 1990 baseline of 21.2 $MtCO_2$-e, emissions will fall to 8.2 $MtCO_2$-e by 2030 under the SDG scenario, which is a 61.3 per cent reduction that surpasses both the 30 to 40 per cent reduction target of the updated NDC.

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

B. Achieving SDG 7 and NDC Targets in Tajikistan by 2030

1. Universal access to electricity

Tajikistan is on track to reach 100 per cent electricity access by 2024. The challenge now lies in improving supply reliability, particularly in rural and mountainous areas. Where grid extension is not feasible, off-grid and mini-grid solutions offer cost-effective alternatives.

2. Universal access to clean cooking technology

Access to clean cooking solutions is expected to reach 100 per cent by 2030 under the SDG scenario. Transitioning to electric cooking stoves, supported by the country's hydropower-based electricity grid, is identified as the optimal strategy. This transition also reduces indoor air pollution and health risks, especially for women and children.

3. Renewable energy

The share of renewable energy in Tajikistan is projected to grow significantly in the SDG scenario, reaching 35.1 per cent of TFEC by 2030 (excluding traditional biomass). While hydropower remains dominant, diversification through utilization of solar and wind power is essential for energy resilience and winter supply stability.

4. Energy efficiency

The energy intensity target under SDG 7.3 is expected to reach 3.2 MJ/USD_{2017} by 2030. Under CPS, this figure is projected to be 3.8 MJ/USD_{2017}, while the SDG scenario achieves the global target by expanding measures such as:

- LED lighting and energy-efficient appliances
- Clean heating (e.g., high-efficiency stoves and heat pumps)
- Deep retrofitting of commercial buildings
- Motor replacements and digitalization in industries

5. Nationally Determined Contributions (NDCs)

The updated NDC pledges a 30 to 40 per cent emissions reduction below 1990 levels by 2030. Under the SDG scenario, total emissions fall to 8.2 $MtCO_2$-e, exceeding both targets. This is primarily achieved through efficiency improvements and increased deployment of renewable energy.

C. Achieving Carbon Neutrality and Net-Zero GHG Emissions by 2050

The long-term decarbonization pathway requires a dual approach:

- Decarbonizing electricity supply by fully transitioning to renewables and phasing out fossil fuels
- Electrifying energy demand in all sectors, particularly for residential heating and transport

Widespread adoption of electric cooking, clean heating systems and electric vehicles (EVs) will be vital. For the industrial sector, modernization of technologies and switching fuel to electricity or green hydrogen will play key roles. Where residual emissions remain, carbon sinks (e.g., reforestation and/or ecosystem restoration) and carbon capture technologies must be explored to fully offset national emissions.

D. Important policy directions

To accelerate progress toward SDG 7 and the NDC targets, the Road Map proposes the following four policy pillars:

(1) **Expand access to clean cooking:** Promote electric cooking as the national solution, particularly targeting rural and low-income populations. Leverage financing schemes, subsidies and awareness campaigns to overcome adoption barriers.

(2) **Boost energy efficiency across sectors:** Enforce building energy codes, adopt minimum energy performance standards (MEPS) and provide incentives for efficient technologies. Public sector buildings should lead by example through retrofits and energy audits.

(3) **Enable fuel switching and electrification:** Prioritize electrification of space heating, transportation and industrial processes. Develop electric vehicle charging infrastructure and expand solar thermal and district heating solutions.

(4) **Decarbonize the power sector:** Scale up investments in hydropower and solar energy. Strengthen grid integration, storage capacity and regional interconnections (e.g., CASA-1000). Avoid future investments in fossil fuel-based power generation to prevent carbon lock-in.

1. Introduction

1.1. Background

Transitioning the energy sector of Tajikistan to align with the 2030 Agenda for Sustainable Development and the climate commitments under the Paris Agreement presents a multifaceted challenge. It necessitates simultaneously achieving sustained economic growth, meeting the nation's increasing energy demand, reducing greenhouse gas emissions and leveraging the synergies between SDG 7 and the other Sustainable Development Goals. Recognizing these complexities, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has introduced the National Expert SDG Tool for Energy Planning (NEXSTEP). This tool, developed in collaboration with the Stockholm Environment Institute (SEI), provides an evidence-based framework that enables national policymakers to make informed decisions on energy planning and policy development.

NEXSTEP supports countries to evaluate their current energy systems and identify optimal pathways for achieving both the SDG 7 targets and the Nationally Determined Contributions (NDCs) under the UNFCCC. Its development and implementation are outcomes of 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 encouraged the expansion of NEXSTEP's application across member States. The inclusion of Tajikistan in the NEXSTEP initiative represents a significant step in strengthening national energy planning capacity and aligning its energy transition with global sustainability and climate objectives.

The Government of Tajikistan expressed interest in developing the SDG 7 Road Map to assess if its existing policies and strategies are well aligned with the targets of SDG 7 by 2030. Thus, in partnership with the ESCAP, the Government of Tajikistan has prepared this SDG 7 Road Map to guide the country's energy transition and broader sustainable development efforts.

The SDG 7 Road Map serves as a comprehensive document that assesses current energy conditions, evaluates possible transition scenarios and offers policy recommendations to achieve SDG 7: Ensuring access to affordable, reliable, sustainable and modern energy for all. It draws on national energy plans and policies, and is aligned with the country's commitments under the 2030 Agenda for Sustainable Development and the Paris Agreement. The objective of this SDG 7 Road Map is to assist the Government of Tajikistan in formulating enabling policy measures to achieve the SDG 7 and NDC targets, as well as set the energy sector on a trajectory towards net-zero emissions by 2050.

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: (1) the proportion of the population with access to electricity; and (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 the consumption of energy from all renewable sources by total energy consumption. Renewable energy consumption includes 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 purchasing power parity (PPP).

In addition to the above-mentioned targets, the SDG 7 goal also 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.

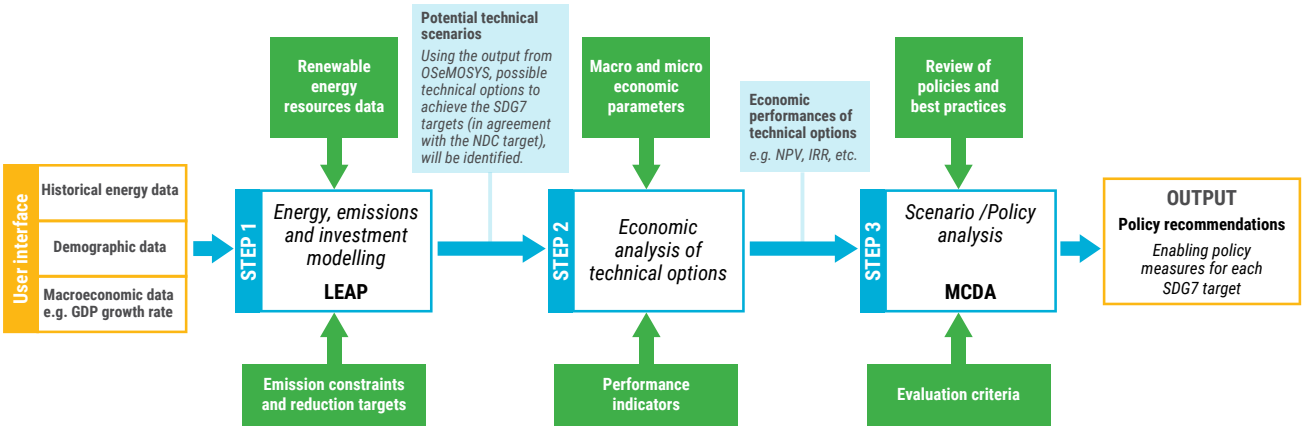
1.3. Nationally Determined Contributions

Nationally Determined Contributions (NDCs) serve as each country's pledge to reduce emissions and are fundamental to implementing the Paris Agreement. Since the energy sector typically accounts for the largest share of GHG emissions in most countries, decarbonizing energy systems must be prioritized. Key strategies for reducing emissions from the energy sector include expanding renewable energy in the generation mix and enhancing energy efficiency. In its NDC document, Tajikistan has committed to reducing GHG emissions by 30 to 40 per cent by 2030 compared to 1990 levels. This commitment is divided into an unconditional target of reducing emissions by 10 to 20 per cent and a conditional target of an additional 20 per cent reduction with international support. Tajikistan has also expressed its intention to pursue a low-carbon development pathway that aligns with global climate goals, focusing particularly on its hydropower potential and other renewable energy resources to support both mitigation objectives and national sustainable development priorities.

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 emissions 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 its back-casting approach to energy and emissions modelling. This method is important for planning toward SDG 7, as it involves developing a trajectory by working backwards from the (known) 2030 targets to the present day, thereby ensuring a clear path for achieving the goals.

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 establish NDC targets.

1.4.2. Economic analysis

The second step builds on the selection of appropriate technologies through an economic optimization process which 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 the 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 cost, comprising 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 by 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 phased 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. 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. In a few instances where government data was unavailable, such as resource potential data, research papers and analyses have been consulted. The final dataset has been presented to and approved by the Ministry of Energy and Water Resources.

2. Country overview

2.1. Demographic and macroeconomic profile

Tajikistan, a landlocked and mountainous country in Central Asia, shares borders with Afghanistan, Uzbekistan, Kyrgyzstan and China. As of 2022,[2] Tajikistan had a population of approximately 10.1 million, reflecting a year-on-year growth rate of 1.9 per cent between 2021 and 2022. In the decade between 2012 and 2022, the population expanded at an average annual rate of 2.26 per cent, indicating sustained demographic momentum. Around 33 per cent of the population lives in urban areas,[3] while the majority (67 per cent) remains rural, depending primarily on agriculture for livelihood . The capital city, Dushanbe, is the country's most populous urban centre, with an estimated population of 0.8 million. Other population centres include Khujand, Kulob and Bokhtar.

The GDP of Tajikistan, in 2022, was estimated at US$ 10.71 billion, marking a significant growth of 8 per cent from the value in 2021. Over the ten-year period between 2012 and 2022, the GDP growth rate averaged 7.1 per cent. The GDP per capita increased from just 856 in 2012 to $1,356 in 2022. The country's GDP relies heavily on the industrial sector (23.5 per cent), the agricultural sector (22.9 per cent) and the commercial sector (13.6 per cent). The remaining goes to the other sectors (Agency Statistics under the President of the Republic of Tajikistan, 2024).

2.2. Energy sector overview

2.2.1. National energy profile in the baseline year 2022

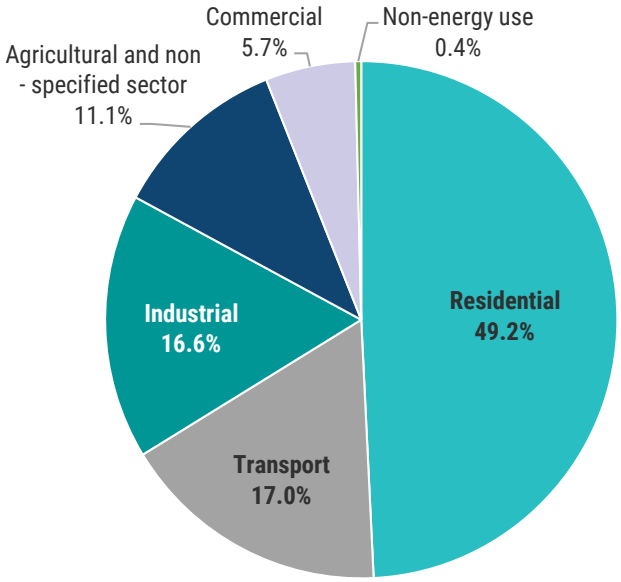
The baseline energy data for the different sectors has been constructed using a bottom-up approach and generally aligns with the national energy statistics, in terms of total energy supply and total final energy consumption by fuel type. However, it is important to note that biomass usage data is negligible in the national energy statistics, particularly with respect to its use for residential cooking and heating. As a result, biomass consumption data has been estimated based on authors' assumptions and use of benchmarks taken from the International Energy Agency (IEA) (2024).

Energy demand: In 2022, the total final energy consumption (TFEC), including biomass, was 4.3 Mtoe (figure 2). Most of the demand came from the residential sector (49.2 per cent), followed by transport sector (17 per cent). The industrial sector and the commercial sector accounted for 16.6 per cent and 5.7 per cent of energy demand, respectively. The agriculture and non-specified energy use accounted for 11.1 per cent, while the remaining share was attributed to non-energy use.

2 According to the data provided by the national consultant, in consultation with the Ministry of Energy and Water Resources.

3 According to the data provided by the national consultant, in consultation with the Ministry of Energy and Water Resources.

Figure 2. Percentage share of total final energy consumption by sector in 2022



Source: ESCAP analysis based on data collected by the national consultant.

The demand for heating in Tajikistan is quite high as the country experiences long and cold winters. Therefore, in the residential sector, around 67 per cent of energy was consumed for space heating purposes (1.4 Mtoe). In 2022, this demand for heating was supplied mainly by biomass (72.1 per cent), coal (11.7 per cent), electricity (7.5 per cent) and district heat (8 per cent). Cooking activities accounted for approximately 18.9 per cent of residential energy demand. The distribution of cooking technology will be discussed in section 2.2.2. Apart from cooking and space heating, refrigeration consumed 4.4 per cent of energy demand, followed by televisions at 2.4 per cent, air conditioners at 1.7 per cent and lighting at 1.6 per cent. The remaining 4 per cent was attributed to hot water systems and other electrical appliances.

Within the transport sector, 99.9 per cent of energy was consumed by road transport and 0.1 per cent by rail transport. Within the road transport category, 74.2 per cent of energy was used by passenger cars. Minibuses and buses accounted for 11.7 per cent of energy demand. Trucks accounted for 6 per cent, while vans accounted for 5.2 per cent. The remaining was attributed to taxis and motorcycles.

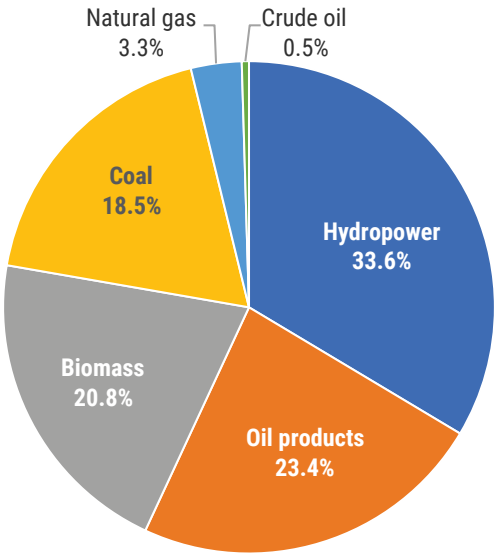
There are two energy-intensive industries in Tajikistan; non-ferrous metals and non-metallic minerals. These industries together consumed 78.7 per cent of industrial energy demand. The remaining was consumed by iron and steel, pulp and paper, machinery and transport equipment, fertiliser and chemical products, textile and leather, and other processing industries.

The commercial sector analysis 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 the commercial sector, electricity accounted for 99.6 per cent of the energy demand, while the remaining 0.4 per cent was allocated to coal demand.

Primary energy supply: In 2022, the total primary energy supply (TPES) was 5.1 Mtoe. The energy supply mix comprised of hydropower at 33.6 per cent; oil products at 23.4 per cent; biomass[4] at 20.8 per cent; coal at 18.5 per cent; natural gas at 3.3 per cent; and crude oil at 0.5 per cent. Additionally, around 4 per cent of the total supply was exported electricity. Figure 3 presents the distribution of TPES by fuel type.

4 Including fuelwood, paddy husk, bagasse, agricultural residue and biogas.

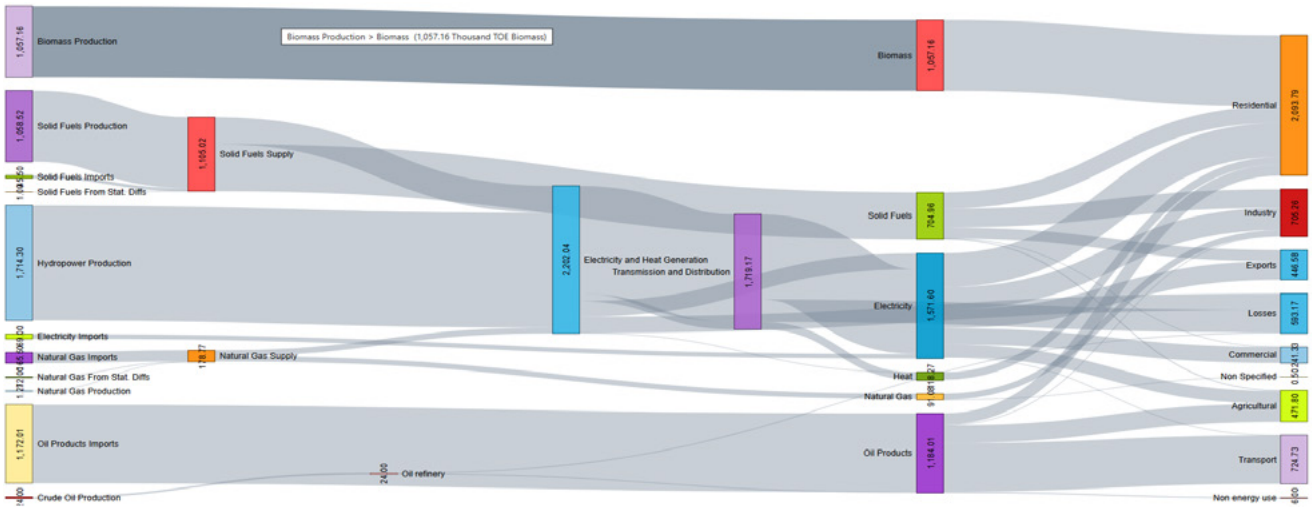
Figure 3. Percentage share of total primary energy supply by fuel type in 2022



Source: ESCAP analysis based on data provided by the national consultant.

Electricity generation: In 2022, the total installed power generation capacity[5] was 6,373 MW.[6] In terms of capacity mix, hydropower accounted for 90.6 per cent of the capacity, while coal-fired combined heat and power (CHP) accounted for 6.3 per cent. Gas turbines accounted for 3.1 per cent of capacity. Total electricity generation, in 2022, was 22.8 TWh.[7] Hydropower accounted for 87.5 per cent of power generation, while around 9.3 per cent came from coal CHP, and the remainder was attributed to gas turbines. Total heat generation, in 2021, was 1.4 Mtoe comprising coal CHP (66.6 per cent) and gas turbine (33.4 per cent). Figure 4 illustrates the Sankey diagram with energy flows and sources.

Figure 4. Total primary energy supply by sector in 2019



Units: Million tons of oil equivalent (Mtoe)

Source: ESCAP.

5 Based on data from the power plant database maintained by the Office of the Energy Regulatory Commission, as provided by national consultants.

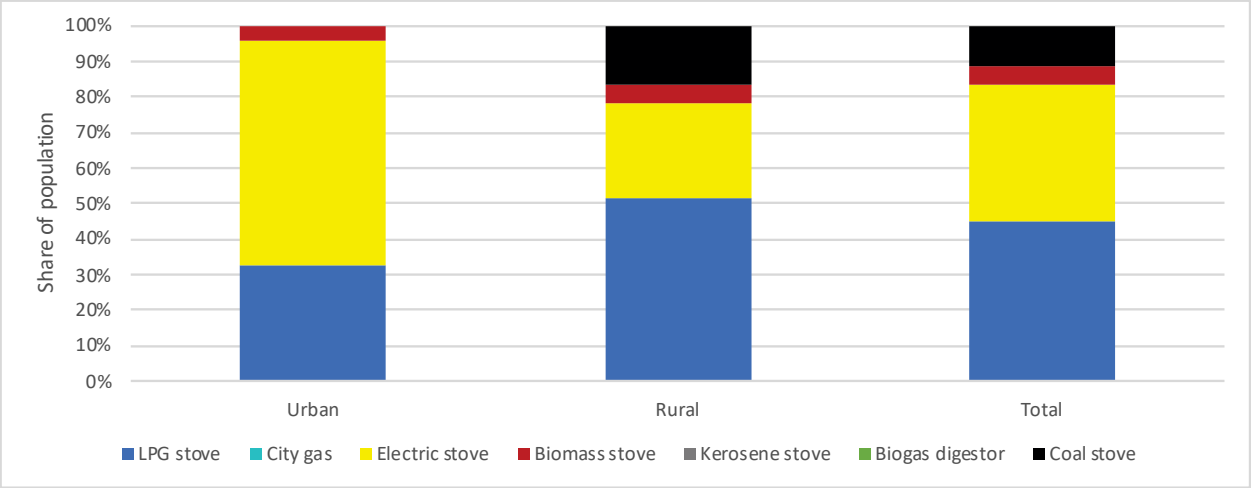
6 Excluding imports.

7 Based on the data (excluding imports) from the power plant database maintained by the Office of the Energy Regulatory Commission, as provided by national consultants.

2.2.2. Status of SDG 7 targets in the base year 2022

Access to modern energy: Tajikistan has progressed well in providing energy access to its citizens. The electrification rate was 99.3 per cent in 2022. The clean cooking access rate was estimated at 83.8 per cent.[8] The remaining 16.2 per cent of the population, corresponding to 252,888 households, still relied on unclean and polluting biomass stoves as their primary cooking technology. LPG stoves were the most dominant primary clean cooking technology, with an estimated 45.3 per cent share. This was followed by electric cook stoves, with a share estimated at 38.5 per cent (figure 5).

Figure 5. Share of cooking access by technologies



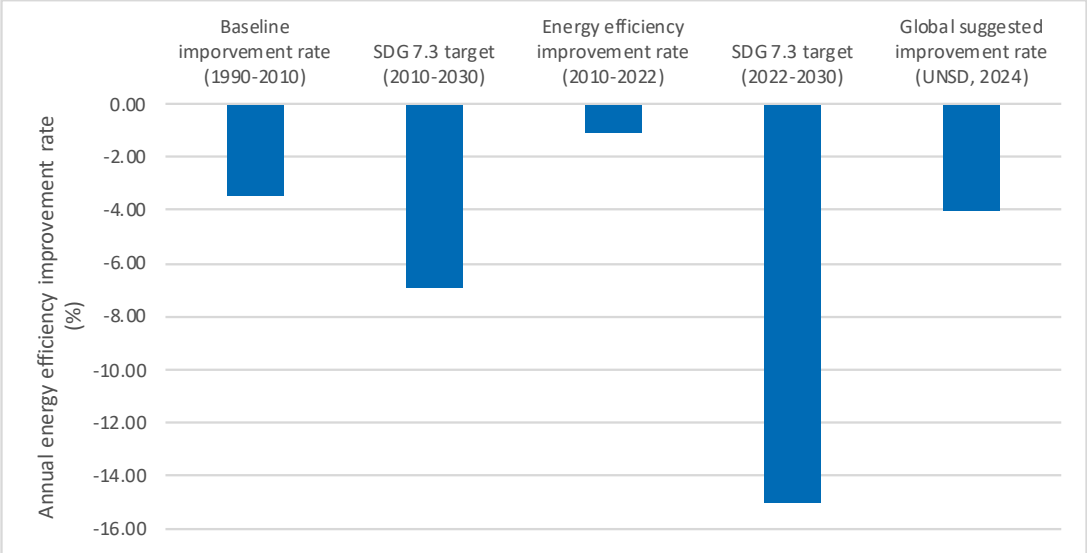
Source: ESCAP.

Renewable energy share in the total final energy consumption (TFEC): Renewable energy including hydropower and traditional biomass usage, accounted for approximately 52.6 per cent of TFEC in 2022, which is equivalent to 52.4 per cent of TPES. Excluding traditional biomass usage in the residential sector, the renewable share drops to 27.8 per cent of TFEC. Despite being endowed with abundant renewable energy potential, Tajikistan relies heavily on imported fossil fuels, particularly oil products, to meet its stationary and mobile energy demands.

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 in terms of power purchase parity in 2017 (MJ/USD_{2017}). Between 1990 and 2010, energy intensity in Tajikistan declined at an average annual rate of 3.45 per cent, dropping from 10.9 MJ/USD_{2017} to 5.4 MJ/USD2017. To meet the SDG 7.3 target, this rate of improvement must double, requiring an average annual improvement rate of 6.9 per cent between 2010 and 2030, reaching 1.3 MJ/USD2017 in 2030 (figure 6). However, between 2010 and 2021, the energy intensity reduced by only 1.1 per cent, to 4.7 MJ/USD_{2017}. In 2022, the energy intensity in Tajikistan was estimated to have been 4.7 MJ/USD_{2017}.To reach the expected 2030 intensity, the annual improvement rate between 2021 and 2030 must be around 15 per cent, which would be quite challenging. Therefore, NEXSTEP analysis suggests that the energy intensity target for Tajikistan should be aligned with the global target of 4 per cent annual improvement (UNSD, 2024). This corresponds to a 2030 energy intensity target of 3.2 MJ/USD_{2017}.

8 Estimates are based on the cooking distribution data provided for urban and rural sectors in accordance with WHO (2025).

Figure 6. Energy efficiency target for Tajikistan



Source: ESCAP.

GHG emissions: The energy sector emissions, from the combustion of fossil fuel, were calculated based on IPCC Tier 1 emission factors assigned in the LEAP model and expressed in terms of 100-year global warming potential (GWP) values. In 2022, GHG emissions from the energy sector were estimated at 8.2 $MtCO_2$-e. Emissions from the transport sector were the largest at 2.1 $MtCO_2$-e, arising from direct fuel combustions in internal combustion engines. The emissions from the residential sector were 2 $MtCO_2$-e, resulting from the use of natural gas and biomass for cooking and space heating. The power generation sector contributed 1.8 $MtCO_2$-e, while emissions from the industrial sector were estimated at 1.3 $MtCO_2$-e. Combined emissions from the agriculture and non-specified energy use sector were around 0.9 $MtCO_2$-e.

2.2.3. National energy policies and targets

Several national policies and legislative frameworks guide the energy sector development in Tajikistan. These policies have been used as guiding references for the NEXSTEP modelling, to better understand the country context and provide recommendations that align with the national government's overarching strategic direction. Where applicable, only currently implemented and adopted policies or regulations are considered in the current policy scenario (CPS) to identify gaps in achieving the SDG 7 targets.[9] The following policies or strategic documents have been consulted.

- **National Development Strategy (NDS) of the Republic of Tajikistan for the period up to 2030** sets out the socioeconomic development priorities for the country for the period up to 2030. In relation to the energy sector, the Government of Tajikistan has based the strategic development of the electricity sector in the country based on the '10/10/10/10/500' concept, which includes:
  - o increasing the design capacity of the electric power system to 10 GW;
  - o increasing the export of annual electricity to neighbouring countries to 10 billion kWh;
  - o ensuring diversification of the country's electric power system capacity by at least 10 per cent by increasing the capacity of other energy sources, including oil, gas, coal and RE sources;
  - o reducing power losses to 10 per cent; and
  - o achieving electricity savings of 500 GWh from energy efficiency measures.

9 Only policies with concrete and implemented measures are considered in the scenario modelling for the current policy scenario. Furthermore, measures mentioned in strategy policy or planning documents that are yet to be enforced or have been implemented prior to November 2024 are not considered in the modelling of the current policy scenario.

- **Sustainable Energy for All Framework** includes the following objectives that are to be achieved in Tajikistan by 2030:
  - ***Access to energy:*** ensure access to regular and reliable electricity for the 5.6 million people living in the rural areas of Tajikistan;
  - ***Energy efficiency:*** reduce energy losses up to 10 per cent in power grids and up to 20 per cent in thermal grids, as well as increase the efficiency of energy use in all economic sectors, irrigation systems and final users by up to 20 per cent against the baseline;
  - ***Renewable energy sources:*** (1) an increase in power production from RE sources up to 20 per cent against the 2010 baseline, which corresponds to 10 per cent share of RE in the total electricity balance; and (2) an increase in indigenous RE sources in the energy sector from 59.3 per cent in 2010 to 80 per cent in 2030.
- **Green Economy Development Strategy** lays down a plan to create an e-mobility-friendly environment leading up to 2037. By 2037, the goal is for 55 per cent of all vehicles to be electric (Asian Transport Outlook, 2024).
- **CASA-1000 Project,** a landmark cooperation among Tajikistan, Kyrgyzstan, Pakistan and Afghanistan, involves the building of a functioning, efficient electricity system across Central and South Asia. This project aims to provide clean power export revenues for the Central Asian countries while alleviating electricity shortages in the South Asian countries. The project will involve the building of 477 km of 500kV AC line from Datka, Kyrgyzstan to Khudjand, Tajikistan.
- **Law on Energy No. 33 of 2000** establishes policy objectives for the national energy sector, with a particular focus on: 1) increasing supply of reliable energy to meet the growing demand for energy; 2) ensuring energy

security in the Republic of Tajikistan; 3) protecting the environment and population from the hazardous impacts; 4) creating enabling conditions for a gradual transition to deregulate energy markets; 5) attracting domestic and foreign investors; 6) introducing advanced technologies to enhance operational efficiency of the fuel and energy sector; and 7) promoting energy conservation technologies. National energy sector regulation shall be carried out through legal provision, licensing, taxation, investment and implementation of social and R&D policies.

- **Law on the Use of Renewable Energy Sources No. 587 of 2010** regulates the legal relations arising between state bodies, individuals and legal entities in the field of priority and efficient use of renewable energy sources and determines the legal and economic basis for increasing the level of energy saving, reducing the level of anthropogenic impact on the environment and climate, saving and preserving non-renewable energy sources for future generations.
- **Law on Energy Efficiency and Conservation No. 1018 of 2013** regulates public relations in the field of energy saving and energy efficiency, as well as determines procedures for the use of fuel and energy resources and their by-products.
- **Presidential Decree on Additional Measures on Economical Use of Energy and Energy Conservation No. 653 of 2009** bans the manufacturing, import and use of traditional incandescent bulbs and promotes energy-saving luminescent lamps and light-emitting diodes (LEDs).
- **Updated Nationally Determined Contribution of Tajikistan** stipulates the country's updated unconditional commitment to limiting its GHG emissions to no more than 60 to 70 per cent of its 1990 levels by 2030. Additionally, under international support, the country aims for a more ambitious target to not exceed 50 to 60 per cent of its 1990 GHG emissions by 2030. In 1990, the energy sector's emission was approximately 21.37 $MtCO_2$-e.

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

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 2022 was chosen, as it is the most recent year with sufficient data and information for modelling. In the NEXSTEP model for Tajikistan, four scenarios have been developed. These include three core scenarios: (1) business-as-usual (BAU) scenario; (2) current policy scenario (CPS); and (3) Sustainable Development Goal (SDG) scenario. In addition, the towards net-zero (TNZ) emissions by 2050 scenario has been developed to present technological options and policy measures that would be required for Tajikistan to transition beyond 2030.

3.1.1. The business-as-usual (BAU) scenario

This scenario hypothetically projects energy demand and emissions trajectory based on historical improvement and in the absence of any new actions or policies. While this scenario is not a practically true scenario, since there will be policies and plans implemented along the way, it is helpful in comparing the emissions trajectories. In this scenario, the final energy demand is met by a fuel mix reflecting the current shares in TFEC, with the trend extrapolated to 2030.

3.1.2. Current policy scenario (CPS)

Inherited from the BAU scenario, this scenario considers initiatives implemented or scheduled to be implemented during the analysis period of 2022-2030 to establish baseline performance, with reference to the SDG 7 and NDC targets, as well as national targets for energy efficiency improvement and renewable energy share. Otherwise, the energy intensities from different demand sectors are assumed to be constant throughout the analysis period. Only policies with concrete measures have been considered in this scenario. Plans, strategies and policies that are unlikely to be implemented have not been considered but are compared with scenario results and findings later in this Road Map.

3.1.3. The Sustainable Development Goals (SDG) scenario

The SDG scenario builds on the CPS 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 renewable energy share and doubling the rate of energy efficiency improvement. For clean cooking, different technologies (electric cooking stoves, LPG cooking stoves and improved biomass cooking stoves) have been assessed, with subsequent recommendation on the uptake of the most appropriate technology. Energy intensity has been modelled to help achieve the SDG 7 target. It also allows the achievement of the unconditional NDC target by 2030.

3.1.4. Towards net-zero (TNZ) emissions by 2050 scenario

This scenario explores technological interventions, timeframes of implementation of different measures and technologies and policy frameworks that would be needed if Tajikistan would like to make a plan for net-zero emissions by 2050.

3.2. Assumptions

Energy demand is estimated by using the activity level and energy intensity in the LEAP model. The demand outlook throughout the NEXSTEP analysis is influenced by factors such as annual population growth and annual GDP growth for a given period of time. The assumptions used in the NEXSTEP modelling are detailed in Annex II, while table 1 provides a summary of key modelling assumptions for the three main scenarios (i.e., BAU, CPS and SDG scenarios).

Table 1. Important factors, targets and assumptions used in NEXSTEP modelling

Parameters	Business-as-usual scenario	Current policy scenario	Sustainable Development Goal scenario
Economic growth	8.3 per cent between 2022 and 2023, 6.3 per cent between 2023 and 2024, and 4.5 per cent per annum from 2024.[10]		
Population growth	2.2 per cent per annum.		
Urbanization rate	33 per cent in 2022, growing to 34.4 per cent in 2030.[11]		
Commercial activity	Assumed annual energy consumption increasing at the same growth as GDP.		
Industrial activity	Assumed annual energy consumption increasing at the same growth 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 appliance ownership for electrical appliances is projected to grow at a rate like the growth in GDP per capita.		
Access to electricity	Projected based on the historical penetration rate between the 2000-2020 period. The 100 per cent access to electricity has been achieved by 2024.		
Access to clean cooking fuels	Projected based on the historical penetration rate between the 2000-2020 period. Clean cooking access rate is projected to reach 86 per cent in 2030.		Clean cooking access rate is projected to reach 100 per cent in 2030.
Energy efficiency	Additional energy efficiency measures not applied.	Improvement based on current policies.	Global improvement in energy intensity adopted.
Power plant	Considers 2022 share in power generation and grid emissions.	Considers capacity plan expansion provided by national consultant.	Considers capacity expansion to 10 GW and 10 per cent capacity of other energy sources, in accordance with the National Development Strategy.

10 Historical data and estimation from the International Monetary Fund, available at https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/TJK?zoom=TJK&highlight=TJK.

11 This assumes that the urbanization rate grows with an annual rate of 0.52 per cent, with reference to the national historical urbanization growth from 2012 to 2022.

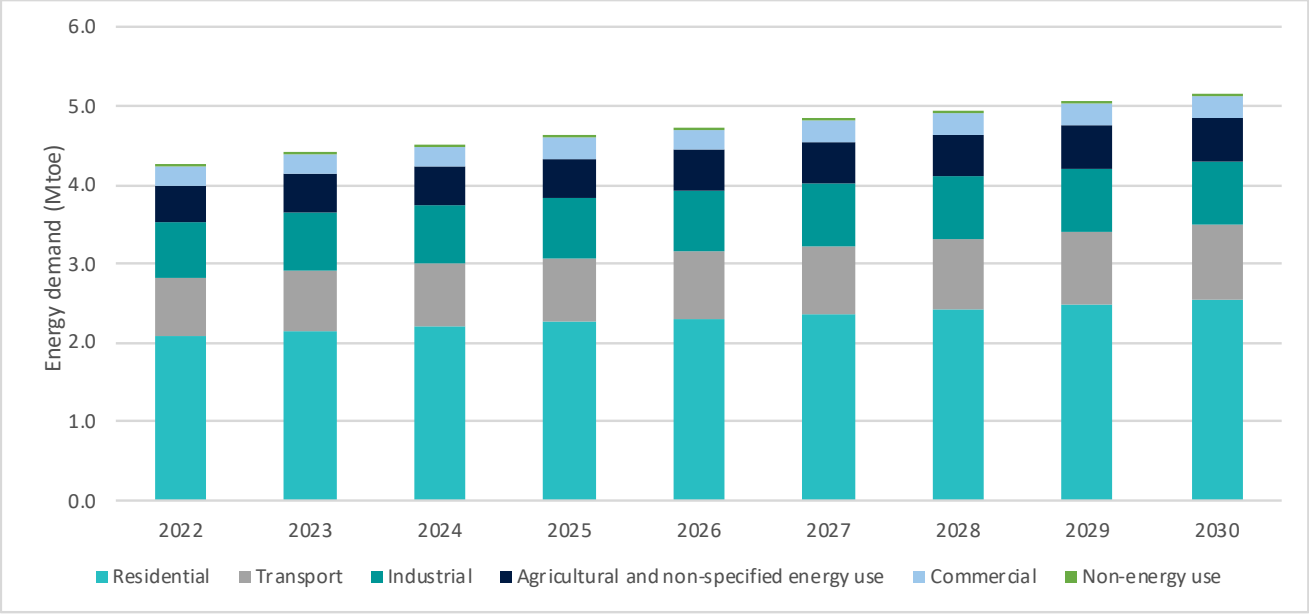
4. Energy transition outlook in the current policy scenario (CPS)

This section presents key results of modelling under the NEXSTEP's current policy scenarios, focusing on impacts in key areas of the economy and the energy sector.

4.1. Energy demand

Under the current policy setting, the demand for total final energy is expected to increase from 4.3 Mtoe in 2022 to 5.2 Mtoe in 2030, marking an average annual growth rate of 2.4 per cent. In 2030, the residential sector will remain the largest energy consuming sector with a 49 per cent share, followed by the transport sector with a share of 18.6 per cent and the industry sector with a 16 per cent share. Consumption in the agricultural and commercial sector will be 10.6 per cent 5.4 per cent, respectively. The non-energy use will account for the remaining 0.5 per cent of energy demand. Figure 7 displays the forecast of TFEC by sector under the CPS.

Figure 7. Energy demand outlook in the current policy scenario (CPS), 2022 - 2030



Source: ESCAP.

Residential sector: Energy demand in the residential sector will increase from 2.1 Mtoe in 2022 to 2.5 Mtoe in 2030, with an annual growth of 2.4 per cent. Around two-thirds of energy demand will be used for cooking. The remaining 33 per cent will be consumed to power electric appliances. The urban and rural split of energy consumption would be 35 per cent and 65 per cent, respectively. In terms of fuel, biomass will be the main energy source, with a share of about 49.4 per cent, followed by electricity at 25.7 per cent and coal at 11.3 per cent. Biomass is used mainly for cooking purposes. A large share of electricity will be used for space cooking and heating at 27 per cent and 20.8 per cent, respectively. The remaining will be consumed by refrigeration (18.1 per cent), televisions (10 per cent), lighting (6.7 per cent) and air-conditioners (6 per cent), while the remainder will be used for computers, washing machines, etc.

Transport sector: The residential sector will consume 1 Mtoe in 2030, up from 0.7 Mtoe in 2022. Road transport will consume 99.9 per cent of the energy requirement in the transport sector and a small share (0.1 per cent) will be consumed by rail transport. Among the road transport categories in 2030, passenger cars will consume 0.7 Mtoe, followed by freight transport (freight truck and freight van) at 0.12 Mtoe, minibuses at 0.08 Mtoe, and buses and taxis will consume 0.07 Mtoe.

Industrial sector: Energy consumption in the industrial sector will rise from 0.7 Mtoe in 2022 to 0.8 Mtoe in 2030, marking an average growth rate of 1.9 per cent. Much of energy in this sector (about (78.7 per cent) will be consumed by two subsectors; non-ferrous metals (45.8 per cent) and non-metallic minerals (32.9 per cent). These will be followed by food and tobacco at 4.2 per cent, and textiles and leather at 4 per cent. The balance will be consumed by the remaining sectors.

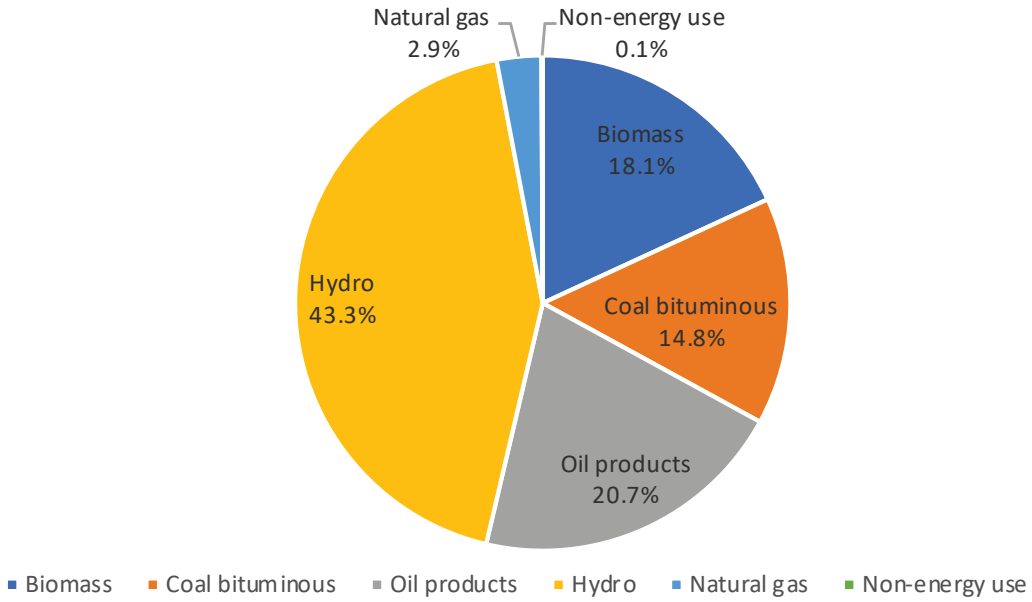
Agricultural sector: Total energy consumption in the agriculture sector under the CPS will increase from 0.47 Mtoe in 2022 to 0.55 Mtoe in 2030, with an average annual growth of 1.9 per cent. Although detailed information about end-use energy consumption in this sector is limited, however, in terms of fuel, diesel consumption will be the highest at 56.7 per cent, followed by electricity at 40.8 per cent and the remaining share is supplied by coal.

4.2. Energy supply outlook

Primary energy supply

In the CPS, TPES is forecasted to increase from 5.1 Mtoe in 2022 to 6.9 Mtoe in 2030. The fuel shares in 2030 (figure 8) will be dominated hydro at 3 Mtoe (44 per cent). This will be followed by oil products at 1.4 Mtoe, biomass at 1.3 Mtoe and the balance of the supply will be from coal and natural gas.

Figure 8. Total primary energy supply by fuel type in the current policy scenario (CPS), 2030



Source: ESCAP analysis based on data provided by the national consultant.

Electricity generation

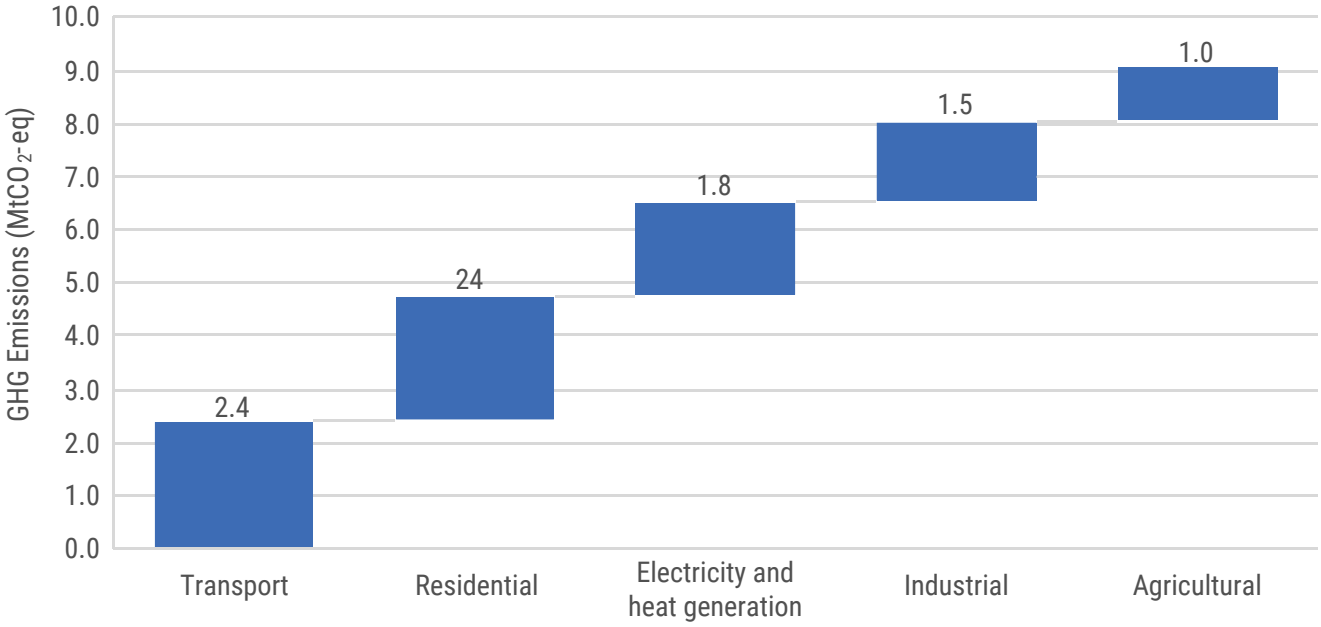
The modelling of the power generation sector has been guided by the National Development Strategy (NDS) targets, which include: (1) increasing the design capacity of the electric power system to 10 GW; (2) increasing the annual electricity exports to neighbouring countries to 10 billion kWh (10 TWh); (3) ensuring diversification of the country's electric power system capacity by at least 10 per cent by increasing the capacity of other energy sources, including oil, gas, coal and RE sources; and (4) reducing power losses to 10 per cent. The power capacity expansion plan projects a total capacity

of 10.3 GW by 2030, based on the assumption that the remaining capacity of 3.6-GW of the Rogun hydropower plant is completed according to the planned timeline.

4.3. GHG emissions

GHG emissions from the energy sector are estimated to increase to 9.2 $MtCO_2$-e in 2030. Figure 9 shows that emissions from the transport sector will be the largest at 2.4 $MtCO_2$-e, rising from direct fuel combustions in internal combustion engines. The residential sector will have the same emissions at 2.4 $MtCO_2$-e from fossil-fuel combustion for cooking and space heating. The power and heat generation sector will account for 1.8 $MtCO_2$-e. Emissions attributable to the industrial sector were estimated at 1.5 $MtCO_2$-e, while emissions from the agricultural sector emissions will be approximately 1.1 $MtCO_2$-e. The remainder emissions of 0.1 MtCO2-e will be from non-energy use.

Figure 9. Power and heat capacity expansion plan 2019 - 2037



Source: ESCAP.

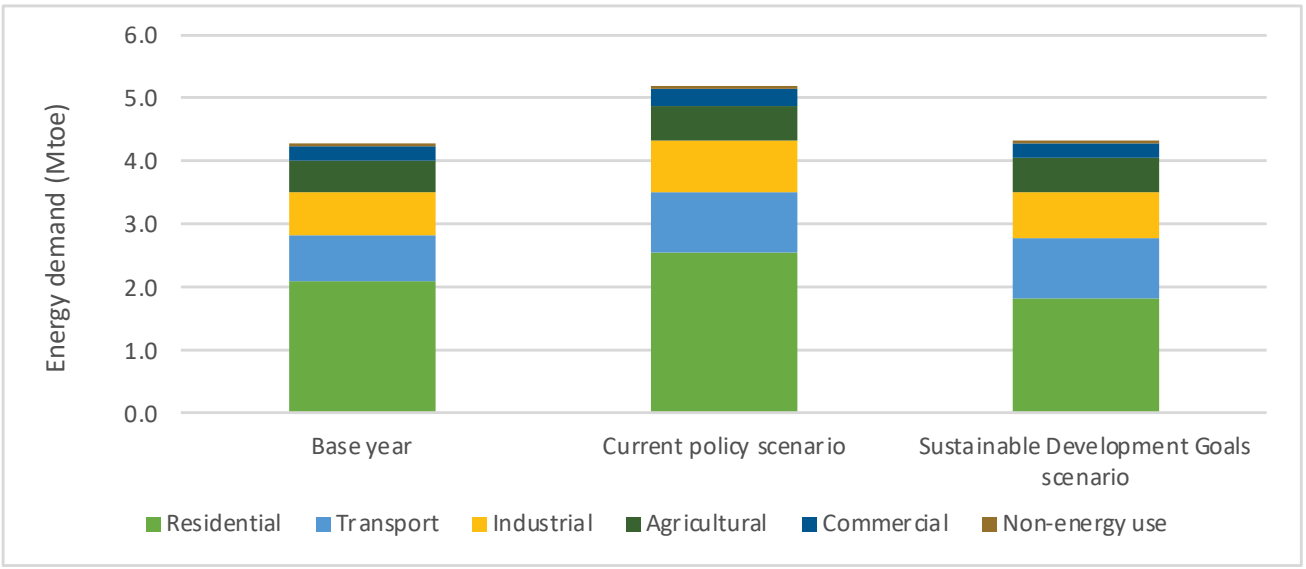
5. SDG scenario: An assessment of SDG 7 targets and indicators

The Sustainable Development Goals (SDG) scenario outlines a range of strategies designed to achieve economy-wide energy efficiency improvements that align with both the 2030 Agenda for Sustainable Development and the Paris Agreement. This scenario also identifies suitable technological options to support the transition of Tajikistan toward a more sustainable energy system. By mapping out specific pathways and solutions, the SDG scenario provides a framework for implementing energy policies that can simultaneously advance development priorities and climate objectives in the Tajikistan context. 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 of Tajikistan. To conclude, the future energy supply outlook is presented.

5.1. Energy demand outlook

In the SDG scenario, TFEC is expected to increase from 4.3 Mtoe in 2022, reaching a peak of 4.4 Mtoe in 2027, before decreasing again to 4.3 Mtoe. This is a reduction of 0.85 Mtoe compared to the CPS (figure 10). This reduction is due to the adoption of higher energy efficiency measures, which will be presented in section 5.2.3. In 2030, the residential sector will have the largest share of TFEC at 42.6 per cent, followed by the transport sector at 21.8 per cent, the industry sector at 16.6 per cent, and the commercial sector at 5.7 per cent. Agriculture and non-specified energy use will account for 12.7 per cent, while the remaining will go to non-energy use.

Figure 10. Comparison of 2030 energy demand between the current policy and Sustainable Development Goal scenarios



Source: ESCAP.

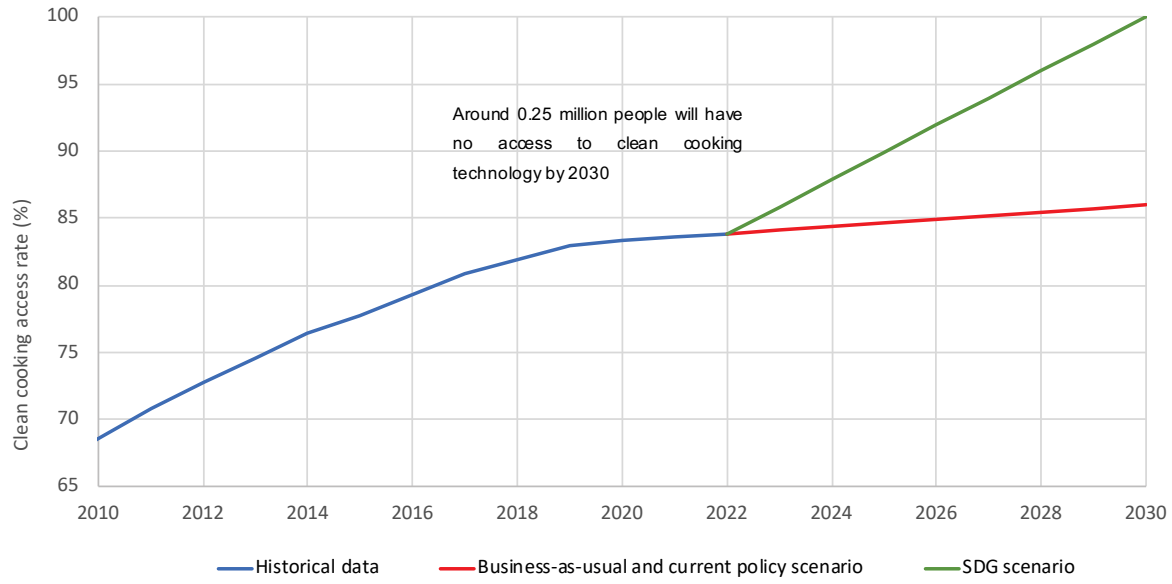
5.2. SDG 7 targets

5.2.1. Energy access

In 2022, the electrification rate in Tajikistan was 99.3 per cent. In all scenarios, it is projected that Tajikistan is on track to achieve universal access to electricity by 2030. However, additional effort is required to achieve universal access to clean cooking. As of 2022, 16.2 per cent of households relied on polluting cooking technologies, specifically solid fuel stoves (assuming biomass and coal as a primary fuel). Under the CPS, access to clean cooking fuels and technologies will not be achieved; reaching only 86 per cent by 2030 and leaving 14 per cent of the population reliant on inefficient and hazardous cooking fuels and technologies. While notable progress was made in the past decades, the pace has slowed in recent past years. The COVID-19 pandemic further disrupted the situation, halting the deployment of clean cooking technology. Therefore, under the SDG scenario, the clean cooking access rate is set to achieve universal access (100 per cent) by 2030 (figure 11).

NEXSTEP identifies (induction-type) electric cooking stoves as the most appropriate long-term clean cooking solution for Tajikistan due to its cost effectiveness and environmental benefits. This technology has been adopted widely in the country especially since the country is endowed with hydropower. While LPG has also been utilized by many households in the country, this technology is vulnerable to supply chain disruptions and price volatility, as Tajikistan relies on imported oil products. Table 2 summarizes the estimated annualized cost of different cooking technologies in the context of Tajikistan. Box 1 presents an assessment of different clean cooking technologies.

Figure 11. Access to clean cooking in the business-as-usual (BAU), current policy (CP) and Sustainable Development Goals (SDG) scenarios in Tajikistan



Source: ESCAP.

Note: BAU = business-as-usual scenario; CPS = current policy scenario; SDG = Sustainable Development Goals scenario

Table 2. The annualized cost of cooking technologies

Technology	Annualised cost in US dollars
Electric cooking stove	$ 41.0
Improved cooking stove	$ 41.0
Biogas digester	$ 131.0
LPG stove	$ 185.0

Source: ESCAP.

Box 1. Evaluation of clean cooking technologies

Electric cook stoves

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

Improved cook stoves

ICS programmes initially require strong advocacy to promote adoption, after which they require ongoing follow-up, monitoring, training, maintenance and repairs in order to facilitate continuing usage. In addition, based on the World Health Organization (WHO) guidelines for emissions for clean cooking, only certain types of ICS technology comply, particularly when considering the fact that cook stove emissions in the field are often higher than they are in laboratory settings used for 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 it is promoted in carefully planned programmes.

LPG/butane can cook stoves

LPG/butane can is constrained due to fuel import dependency and supply chain challenges. LPG/butane can cook stoves 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 cook stoves.[b]

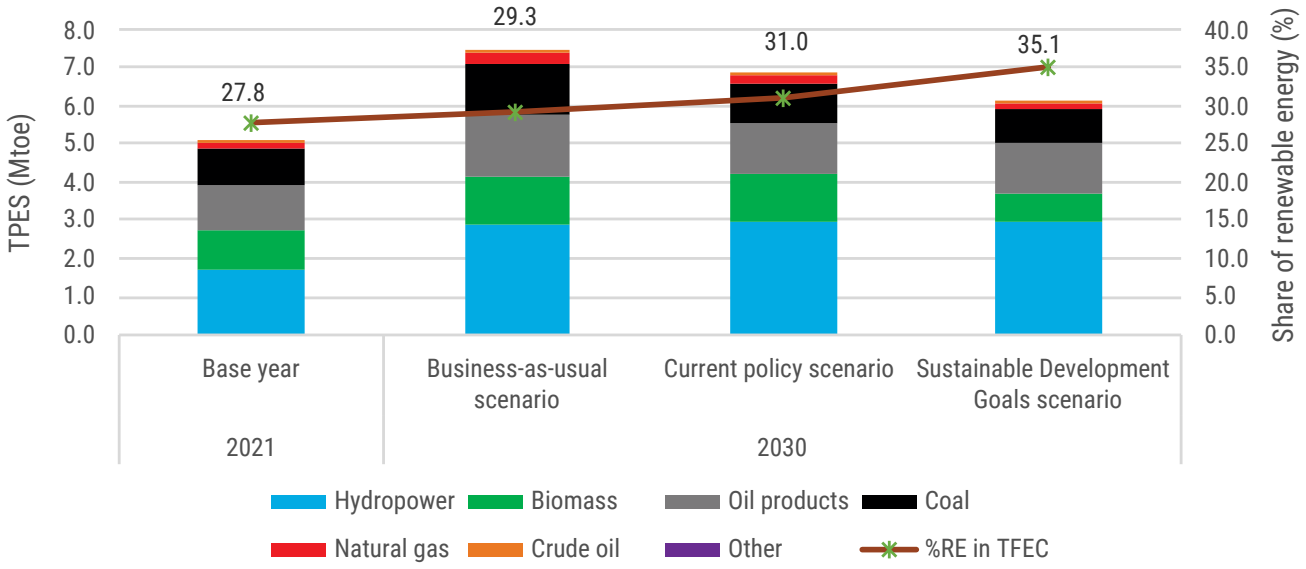
a World Health Organization, "Defining clean fuels and technologies", 2024. Available at https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-7-defining-clean

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 31 per cent in the CPS and 35.1 per cent in the SDG scenario (figure 12). The increase from 27.8 per cent in 2022 is attributable to the higher share of large hydropower in power generation. The additional increase in the renewable energy share of TFEC in the SDG scenario is due to the improvement in energy efficiency despite the reduction in traditional biomass usage.

Figure 12. Renewable energy share comparison in the base year, business-as-usual (BAU) scenario, current policy scenario (CPS) and Sustainable Development Goals (SDG) scenario, 2030



Source: ESCAP.

5.2.3. Energy efficiency

Between 1990 and 2010, energy intensity in Tajikistan declined at an average annual rate of 3.45 per cent, dropping from 10.9 MJ/USD$_{2017}$ to 5.4 MJ/USD$_{2017}$. To meet the SDG 7.3 target, this rate of improvement must double to reach an energy intensity of 1.3 MJ/USD$_{2017}$ by 2030 (discussed in section 2.2.2). Given that it would be challenging to achieve this ambitious target, it is suggested that Tajikistan align its energy intensity target with the global improvement rate of 4 per cent between 2022 and 2030 (UNSD, 2024). Consequently, this means that energy intensity in 2030 would need to be capped at 3.4 MJ/USD$_{2017}$.

Under the CPS, energy intensity will be around 3.8 MJ/USD$_{2017}$, a 2.7 per cent average annual drop from the 2022 value of 4.7 MJ/USD$_{2017}$. This is a significant improvement due to the planned implementation of energy efficiency measures, resulting in a 0.54 Mtoe energy reduction under the CPS. Table 3 lists various energy-saving opportunity measures under the CPS.

Table 3. Energy saving opportunities in 2030 under the current policy scenario

Sector	Measure	Energy demand reduction in 2030 (ktoe)
Residential	The **phasing out of incandescent lamps into LED** through the *Presidential Decree on Additional Measures on Economical Use of Energy and Energy Conservation.*	30.6
Transportation	According to the *Green Economy Development Strategy,* the adoption of electric vehicles will reach **a 55 per cent EV penetration rate by 2037**. In this scenario, it is assumed that the passenger cars will be the first focus.	93.38
Industry	The implementation of the *Sustainable Energy for All* framework which aims to **increase the efficiency of energy use** in all economic sectors, irrigation systems and final users **up to 20 per cent against the baseline.** This can be achieved through: • Financing measures for modernizing technological processes and equipment. • Introducing energy-saving measures in all industries, which will reduce physical wear and tear and increase the efficiency of existing equipment. • Increasing the share of purchased energy-efficient equipment.	204.4
Commercial		69.9
Agriculture and non-specified sector		136.8
Total		**535.2**

The savings under the CPS are substantial but fail to achieve the SDG 7 target by a small margin. NEXSTEP analysis finds that Tajikistan can improve its energy intensity in 2030 further to 3.2 MJ/USD2017, which is a reduction of 4.7 per year, to meet the global energy efficiency target for SDG 7. An additional 0.85 Mtoe of energy demand reduction can be achieved through several measures.

Firstly, the phasing-out of inefficient cooking technologies, which are replaced with more efficient stoves, has two merits: it improves both energy access and energy intensity. NEXSTEP suggests the adoption of electric cook stoves, aiming to reach 67.2 per cent of urban households and 46.3 per cent of rural households by 2030. This transition also supports the pathway towards net-zero emissions by ensuring that at least 20 per cent of the total population uses clean cooking solutions. Additionally, while Tajikistan plans to adopt LED lighting, more progress can be made by improving the efficiency of electric appliances. The adoption of MEPS will be help reduce electricity consumption, particularly for refrigeration and televisions, which are the two household appliances that consume the most energy.

While clean heating is not specifically addressed in SDG 7 targets, it is an important issue in the Central Asian region, contributing to indoor air pollution and associated health impacts. A substantial portion of the population in Tajikistan, particularly low-income households, relies on traditional solid fuel heating stoves, making them susceptible to the consequences of inadequate heating and increased risks of respiratory illness from indoor air pollution. The SDG scenario proposes the use of clean heating technologies,

specifically high efficiency low emissions (HELE) solid fuel stoves, to achieve the goal. Typical HELE stoves can reduce energy demand by at least 40 per cent.

Table 4 lists additional energy-saving opportunities under the SDG scenario in the residential sector, as compared with the CPS.

Table 4. Additional energy-saving opportunities in 2030 in the residential sector under the SDG scenario

Sector	Measure	Energy demand reduction in 2030 (ktoe)
Residential cooking	The adoption of electric cookstoves to 67.2 per cent of urban households and 46.3 per cent of rural households in 2030.	51.2
Residential heating	The adoption of HELE to reduce the usage of fuelwood and coal by at least 60 per cent.	591.1
Residential MEPS	Increase the adoption of energy-efficient refrigeration and television through MEPS implementation.	52.6
Total		**694.9**

NEXSTEP investigated the potential to achieve an additional 30 per cent energy reduction in both the commercial and industrial sectors (table 5). In the commercial sector, significant improvements in energy intensity can be achieved by deep retrofitting of commercial buildings. Similar measures can also be implemented in the industrial sectors. Furthermore, at least 15 per cent of electricity savings can be achieved through actions such as motor replacement, oversizing correction, variable speed drives (VSD) installation and digitization (de Almeida, Ferreira and Fong, 2023).

Table 5. Additional energy saving opportunities in 2030 in the commercial and industry sectors under the SDG scenario

Sector	Measure	Energy demand reduction in 2030 (ktoe)
Commercial	External insulation of commercial buildings to achieve additional 10 per cent energy saving in heating.	102.2
Industrial	Improvement of efficiency of electricity through motor replacement and deep retrofitting to reduce thermal loss.	34.9
Total		**137.1**

It is evident in the CPS that the Government of Tajikistan can significantly reduce the demand for transport energy by promoting the use of electric vehicles (EVs). There should be a more ambitious target for passenger cars since a significant amount of energy is needed in this category. As an initial step, the Government could replace its own fleet of cars with EVs before promoting them to the wider public. Since internal combustion engine (ICE) vehicles will remain in use during the transition period, it is also critical to increase the fuel economy standards. Table 6 presents energy-saving opportunities in the transport sector under the SDG scenario, compared to the CPS.

Table 6. Additional energy saving opportunities in 2030 in the transport sector under the SDG scenario

Sector	Measure	Energy demand reduction in 2030 (ktoe)
Transport – Passenger transport	Improve fuel economy of passenger cars while implementing eco-driving and routine maintenance.	18.2
Total		**18.2**

In the future, the Government might also consider electrifying trucks and buses. The electrification of heavy trucks is challenging because of the competition with long-range diesel trucks. However, it is expected that the electrification of freight trucks could become an economically feasible option. Regarding infrastructure, the Government could initially focus on developing charging facilities in urban areas where mobility is usually concentrated.

5.3. Energy supply outlook

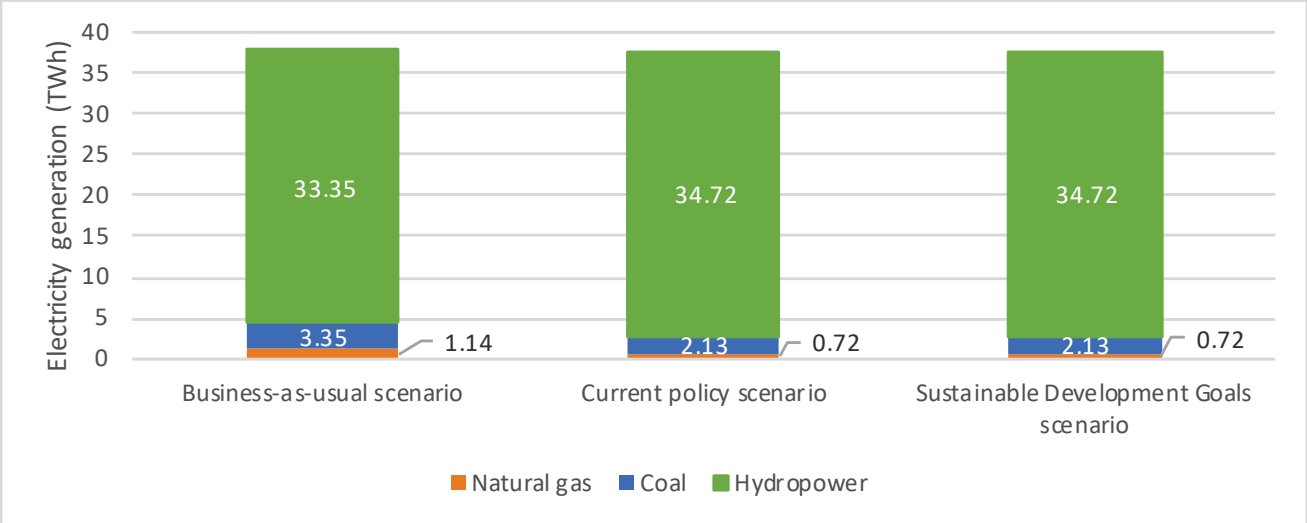
Primary energy supply

In the SDG scenario, the TPES is forecasted to decrease from 5.7 Mtoe in 2019 to 4.8 Mtoe in 2030. The projected fuel shares for 2030 are as follows: hydro at 3 Mtoe (62 per cent), oil products at 1.4 Mtoe (29 per cent), coal at 0.9 Mtoe (18 per cent), biomass at 0.7 Mtoe (15 per cent) and natural gas at 0.17 Mtoe (4 per cent). An amount of 1.3 Mtoe (28 per cent) of this supply is used for electricity generation, which largely comes from hydropower. The supply reduction of 0.9 Mtoe as compared to the CPS is attributed to the additional energy efficiency improvements discussed in section 5.2.3.

Electricity generation

In the CPS, based on the NDS target, the share of renewable energy (primarily hydropower) in the supply of electricity is expected to increase from 87.5 per cent in 2022 to 92.4 per cent by 2030. The supply mix in generation of electricity will remain unchanged in the SDG scenario as the NDS target is already high. Therefore, any increase in renewable energy share in the supply mix has not been suggested. Figure 13 presents a comparison of supply mix and corresponding shares of renewable energy in the base year and under the three scenarios.

Figure 13. Comparison of electricity generation by technologies under different scenarios

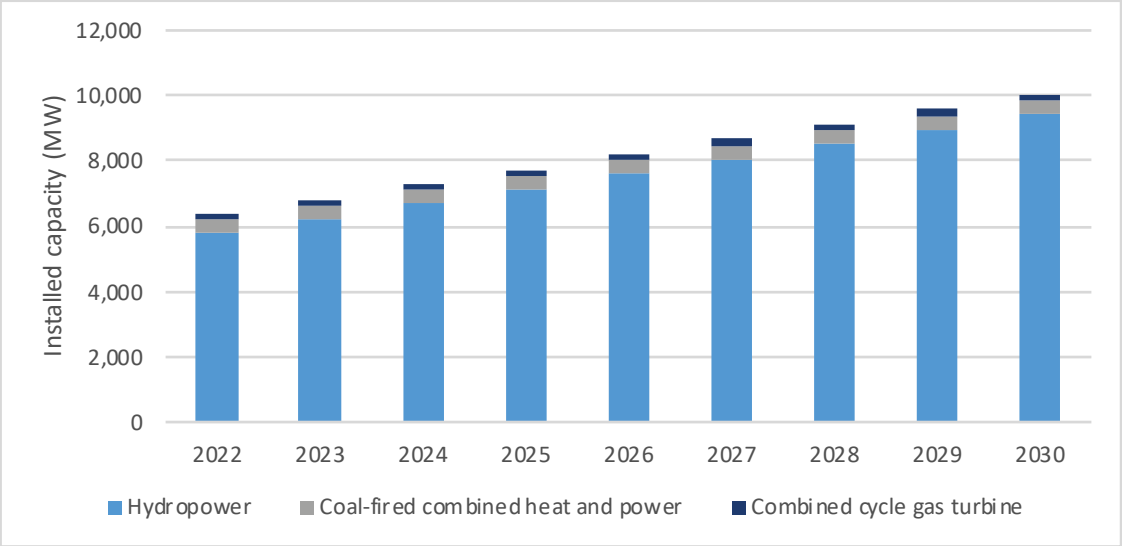


Source: ESCAP.

NDS target for installed capacity

Figure 14 displays the installed capacity of different electricity generation technologies under the SDG scenario. The share of hydropower in the generation supply mix increases from 90.6 per cent in 2022 to 94 per cent in 2030.

Figure 14. Power plant installed capacity 2022-2030

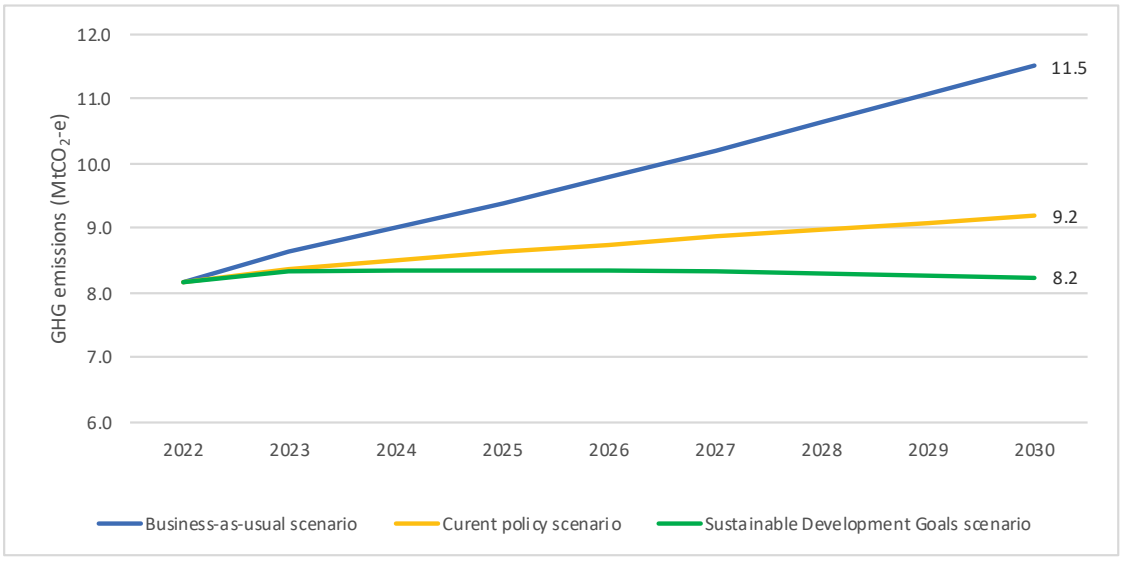


Source: ESCAP.

5.4. NDC target

Tajikistan has committed to reducing GHG emissions by 30 to 40 per cent compared to the 1990 level unconditionally. In 1990, the energy sector's emission was around 21.2 $MtCO_2$-e. This translates to a cap between 12.7 $MtCO_2$-e and 14.8 $MtCO_2$-e. Under the CPS, the total emissions are expected to be 9.2 $MtCO_2$-e or a 56.6 per cent emission reduction compared to the 1990 level. This means that the NDC target would be achieved given the increase of renewable share in electricity supply as per the capacity expansion plan. In the SDG scenario, total emissions are expected to further decrease to 8.2 $MtCO_2$-e by 2030, marking an emission reduction of 66 per cent compared to the 1990 level, which also meets the NDC target in the energy sector. Figure 15 summarizes the SDG 7 indicators for the three scenarios.

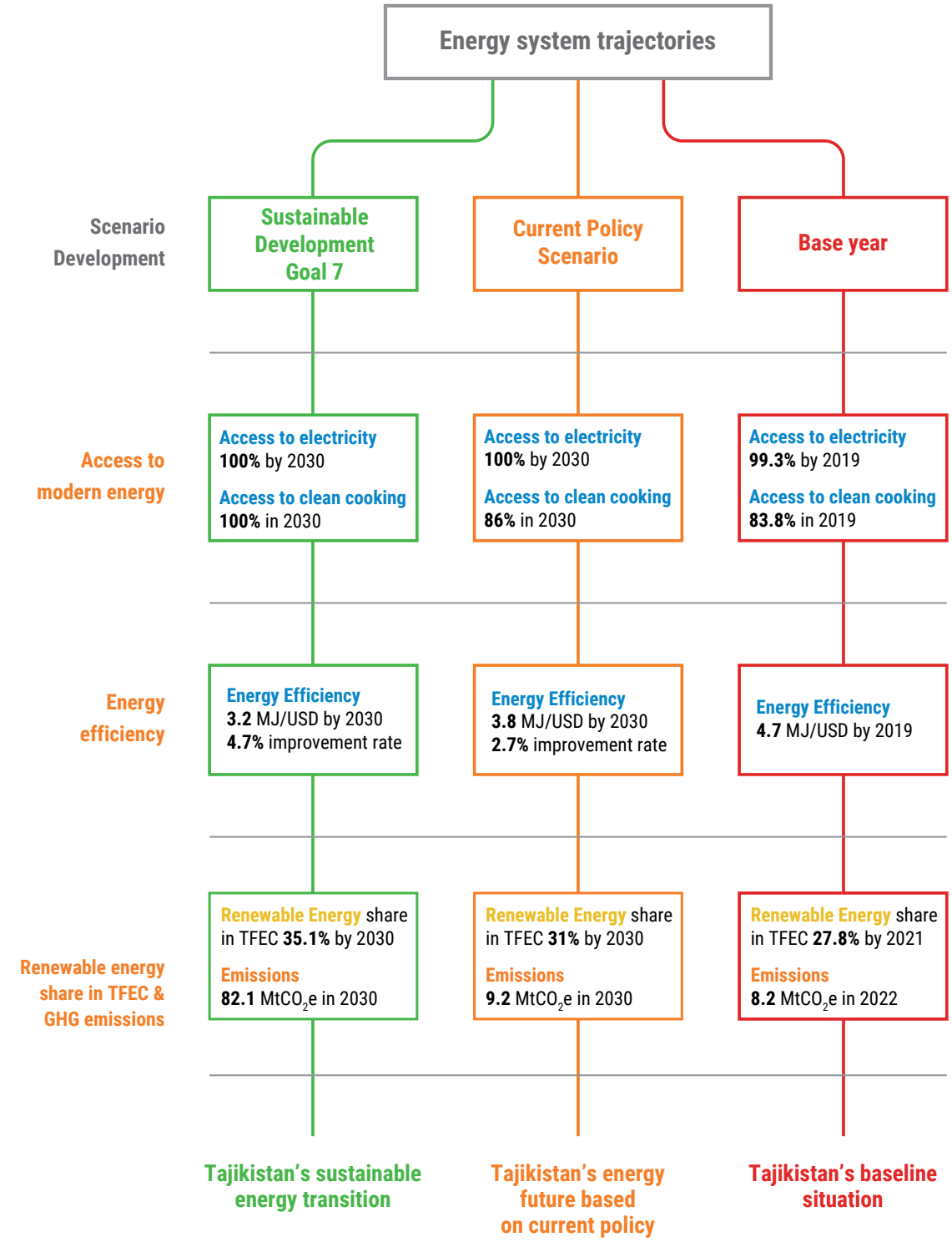
Figure 15. Comparison of emissions for the business-as-usual (BAU) scenario, the current policy scenario (CPS) and the Sustainable Development Goal (SDG) scenario



Source: ESCAP.

Figure 16 summarizes the SDG 7 indicators for the baseline year, the current policy scenario (CPS) and the Sustainable Development Goals (SDG) scenarios.

Figure 16. Summary of SDG 7 indicators for current policy (CP) and Sustainable Development Goal (SDG) scenarios for Tajikistan



Source: ESCAP.

6. Going beyond SDG 7 with ambitious scenarios

As discussed in Chapter 1, the following scenario has been developed, looking beyond 2030 to provide the Government of Tajikistan with information on how the country can raise its ambitions in the energy sector and align with future global goals and targets.

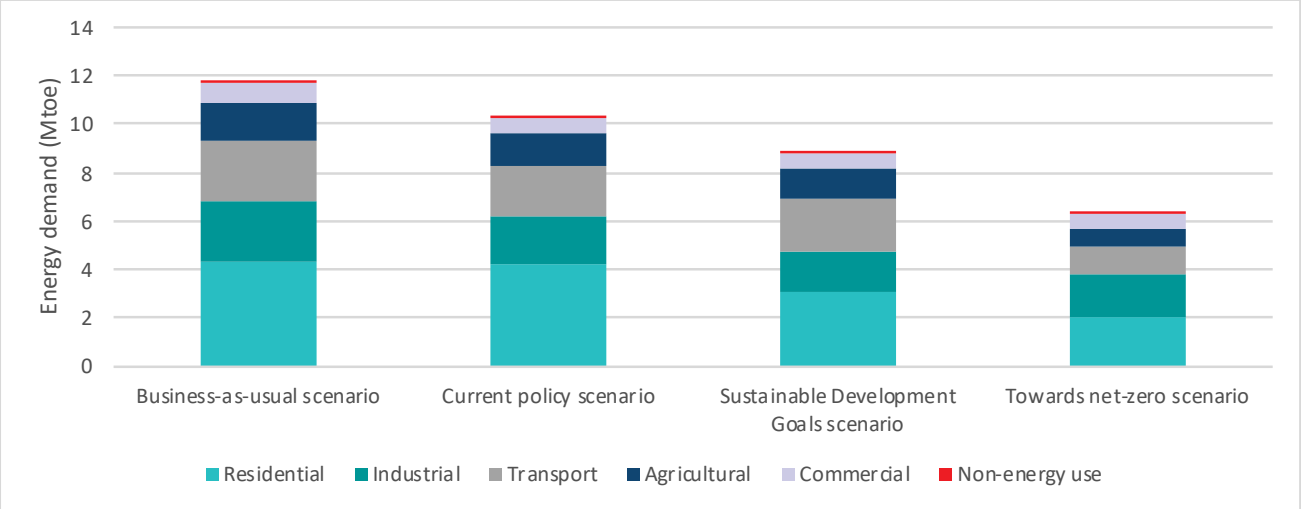
6.1. Towards net-zero (TNZ) emissions by 2050 scenario

This scenario explores challenges and opportunities for the Government of Tajikistan to align its energy sector with the global ambition of achieving net zero emissions by 2050. Various stringent measures across different sectors will need to be implemented as we move beyond 2030. Achievement of the net-zero emissions target will require decarbonization of the energy sector of Tajikistan, which will best be achieved by decarbonizing the power sector and switching all energy sources to electricity. Fortunately, some of the necessary net-zero technologies for decarbonizing the energy system, such as electric cook stoves and electric vehicles, are readily available commercially.

Building on the SDG scenario and extending the timeframe to 2050, the TNZ scenario suggests the following additional measures. On the demand side, the utilization of 100 per cent electric cook stoves will be needed to decarbonize the residential sector by 2050. The demand for heating is expected to be met by electric heaters and heat pumps. NEXSTEP proposes utilizing heat pumps for community heating, as compared to individual electric heaters, as they offer greater long-term technical efficiency and cost-effectiveness. Additional power generation capacity will be required to meet the expected increase in demand due to the large-scale adoption of heat pumps. The transport sector will need to adopt 100 per cent e-mobility (box 2). Fuel switching will play a significant role in the agricultural and industrial sectors, particularly shifting from fossil fuels to electricity.

With the adoption of the above-mentioned measures, the TNZ scenario is projected to save energy demand by around 4.2 Mtoe as compared to the CPS by 2050 (figure 17). However, this scenario requires 69.3 TWh of electricity, which is an additional 21.7 TWh as compared to the CPS. Further implementation of energy efficiency measures would help reduce this electricity demand. In terms of supply, the power sector will need to be decarbonized. It is estimated that at least 15 GW of hydropower and 12.5 GW of solar power plants are required to meet the rising electricity demand. Additionally, the existing thermal power plants can be retrofitted to operate on the biomass power plant for further decarbonization of the energy system.

Figure 17. Comparison of energy demand by scenario in 2050



Source: ESCAP.

Box 2. Electric vehicles gain global interest

Electric vehicles have garnered great interest globally, growing exponentially during the past decade. Electric car sales passed 2 million globally in 2019, with a projected compound annual growth rate of 29 per cent through to 2030.[a] Various government policies have been introduced that directly or indirectly promote the adoption of electric vehicles as a means 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 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 sales share of EVs rose by 4 percentage points. China had the most sales in 2021, tripling those of 2020 with 3.3 million, followed by Europe with 2.3 million sales, an increase 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 more than twice as much in emerging nations, although they are still relatively small.[c]

Vehicles which have an electric motor assisting the conventional internal combustion engines, that cannot be charged are not considered to be electric vehicles. The following categories may be considered as EV: (1) battery electric vehicle (BEV); (2) plug-in hybrid electric vehicle (PHEV); and (3) fuel cell electric vehicle (FCEV). The Government of Tajikistan can take the lead with government-owned vehicles before promoting it to the public.

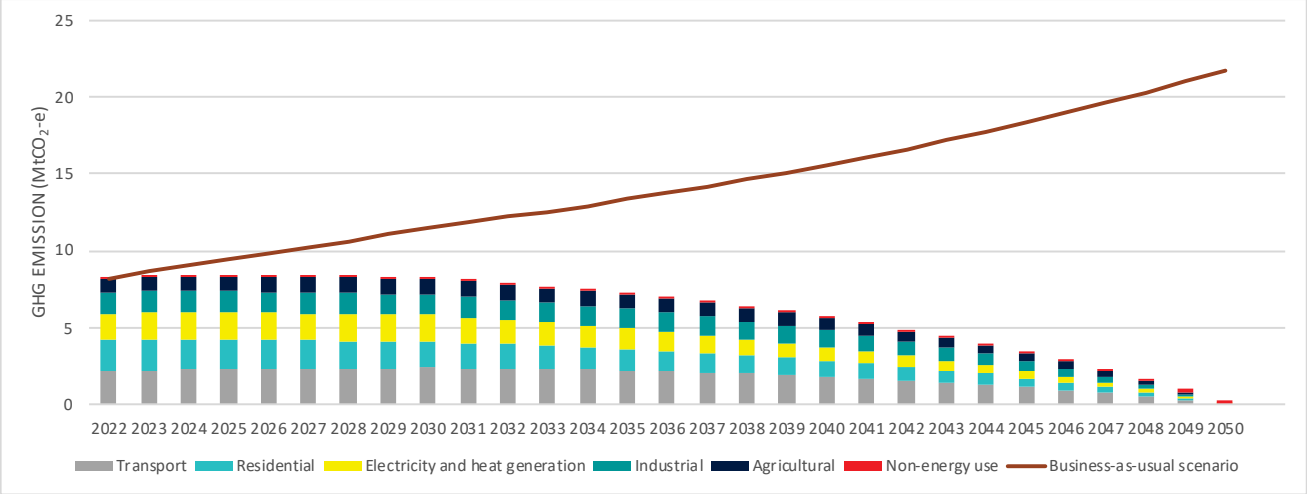
a Woodward and others,, "Electric vehicles: Setting a course for 2030", Deloitte Insights, 28 July 2020. Available at https://www2.deloitte.com/uk/en/insights/focus/future-of-mobility/electric-vehicle-trends-2030.html

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

c Ibid.

A significant reduction in emissions is projected in the TNZ emissions by 2050 scenario. This can be achieved by: (1) the full implementation of fuel switching; and (2) complete decarbonization of the electricity supply. In this scenario, the emissions will start to decline gradually until 2050 as a result of the measures discussed above (figure 18). While a significant emission reduction is expected, however, a small amount of emissions would still remain due to limitations in implementing decarbonization measures in the transport sector. Therefore, carbon sinks, such as reforestation, forest management, or other carbon capture technologies should be considered to absorb the remaining carbon emissions.

Figure 18. GHG emission in the demand sector 2022-2050 by sector in the towards net-zero (TNZ) emissions scenario and in the business-as-usual (BAU) scenario



Source: ESCAP.

7.1. Scenario evaluation

The CPS, SDG and the ambitious TNZ emissions by 2050 scenarios have been evaluated and ranked, using the Multi-Criteria Decision Analysis (MCDA) tool, with a set of 12 criteria and weighting assigned to each criterion (table 7). While the criteria and weights have been selected based on expert judgement, ideally the process should also include 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 the weighting of each criterion. The following factors have been considered to assume comparative weighting 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.

7. Scenario analysis and policy recommendations

Table 7. Criteria with assigned weighting for the Multi-Criteria Decision Analysis (MCDA)

Criterion	Weighting (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**

Source: ESCAP.

Table 8 provides a summary of results obtained through this evaluation process. The scenario evaluation suggests that the TNZ emissions by 2050 scenario is the highest-ranked energy transition pathway for Tajikistan since there will be a significant improvement in energy efficiency, an increase in renewable share and a reduction in emissions. Most importantly, it would set the course of the energy sector to achieve the goal of net-zero emissions. Therefore, Tajikistan should begin developing and aligning its strategies and plans in line with this scenario, which will also ensure the achievement of all SDG 7 targets and the conditional targets outlined in the NDCs, as the scenario is developed based on the SDG scenario.

Table 8. Scenario ranking based on the Multi-Criteria Decision Analysis (MCDA)

Scenarios	Weighted scores	Rank
Towards net-zero emissions by 2050	56.2	1
Sustainable Development Goal scenario	50.6	2
Current policy scenario	26.6	3
Business-as-usual scenario	20.0	4

Source: ESCAP.

7.2. Policy recommendations

7.2.1. Implement strong policy measures to improve clean cooking by 2030

Improving access to clean cooking technologies remains one of the most significant challenges in achieving the SDG 7 targets in Tajikistan. The current reliance on biomass and coal stoves, in both urban and rural areas, contributes to indoor air pollution, health issues and environmental degradation.

The adoption of electric cookstoves offers a promising solution. By replacing traditional biomass and coal stoves with electric alternatives, Tajikistan can significantly improve access to clean cooking for its population. This transition would reduce harmful emissions, improve indoor air quality and decrease the time spent collecting fuel – benefits that particularly support women and children.

Successful implementation of this initiative would require significant investment. The estimated cost for deploying electric cookstoves across the country amounts to US$ 10.7 million by 2030. This investment should be complemented by policies ensuring reliable electricity access, especially in rural areas, along with affordability measures to facilitate adoption across all income groups.

7.2.2. Increase the efficiency of energy use in all economic sectors

The National Development Strategy (NDS) of Tajikistan provides a foundation for reducing energy intensity by 2030. However, additional implementation measures under the Sustainable Development Goals (SDG) scenarios could further accelerate energy reduction targets.

The residential sector is currently the largest energy-consuming sector in Tajikistan. Replacing inefficient coal and biomass stoves with HELE stoves for space heating in rural areas would significantly improve energy efficiency and reduce GHG emissions. In the long term, transitioning to electric heaters and heat pumps will be essential to support the country to achieve net-zero emissions.

To further reduce energy demand, more aggressive Minimum Energy Performance Standards (MEPS) can be introduced for household appliances, particularly televisions and refrigerators. These standards would ensure that new appliances meet specific energy efficiency requirements, gradually reducing overall energy consumption across the residential sector.

Beyond residential use, the industrial and commercial sectors offer significant energy-saving potential. Measures such as deep retrofitting, motor replacement, upgrading industrial equipment, implementing energy management systems and improving building envelopes in commercial spaces could yield substantial energy savings.

The high consumption of fossil fuels across Tajikistan, specifically for cooking and space heating, presents a major obstacle to achieving net-zero emissions. Consequently, fuel-switching options need to be carefully considered and integrated into long-term energy planning.

7.2.3. Prioritize transport electrification to achieve multiple long-term benefits

The electrification of transport offers numerous advantages for Tajikistan. By vigorously adopting electric vehicles, the country can reduce its demand for oil products, thereby decreasing reliance on imported petroleum fuels. This shift would enhance energy security while simultaneously contributing to climate mitigation efforts and improving local air quality.

Transport electrification will be crucial for decarbonizing the passenger transport sector by 2050. Tajikistan has already set an ambitious target to achieve 55 per cent electric vehicle penetration by 2037. This goal demonstrates the country's commitment to sustainable transportation and emissions reduction.

For the remaining internal combustion engine (ICE) vehicles, it is critical to improve fuel economy through measures such as eco-driving techniques and routine maintenance. These relatively simple interventions have the potential to save approximately 18.2 ktoe of energy, representing a significant efficiency gain with minimal investment.

7.2.4. Decarbonize power supply to achieve net-zero emissions by 2050

Decarbonizing the power sector is essential to prevent emissions from simply shifting between sectors when implementing policies, particularly those related to clean cooking and electric vehicles. A clean electricity supply ensures that electrification efforts genuinely reduce overall emissions rather than relocate them.

The transition to a fully clean power system would be necessary if Tajikistan plans to achieve carbon neutrality or net-zero emissions by 2050. The country has already demonstrated promising potential in this area through its focus on hydropower generation. However, diversification of renewable energy sources should be considered, with solar power plants representing a viable alternative.

Decarbonization efforts will require an increase in renewable energy capacity, focusing on solar and biomass power. These investments will offer multiple benefits, including emissions reduction and improved energy security through the utilization of indigenous resources.

For Tajikistan to meet its rising electricity demand by 2050, it is estimated that at least 12.5 GW of solar power capacity, 0.4 GW of biomass power capacity and 15 GW of hydropower capacity would be required.

8. Conclusion and the way forward

The 2030 Agenda for Sustainable Development and the Paris Agreement offer a shared vision for countries to pursue energy access, economic development and climate resilience in tandem. For Tajikistan, achieving SDG 7 and its NDC targets requires both commitment and innovation. This SDG 7 Road Map has presented multiple scenarios, highlighting their feasibility, investment needs, benefits and trade-offs, to inform decision makers of the pathways available for a just and inclusive energy transition.

Tajikistan has made commendable progress in expanding electricity access and leveraging its abundant hydropower resources. However, closing the gap in clean cooking access and reducing energy intensity at the required pace remain pressing priorities. A focused effort involving both public and private stakeholders will be essential to scale up electric cooking technologies and energy efficiency measures, particularly in the residential and industrial sectors.

Energy efficiency improvements in transport, industry, and residential heating and cooking offer the highest potential for reducing energy demand and enhancing resilience. Investments in clean technologies, smart grids and renewable generation will be critical for decarbonizing the power sector and enabling large-scale electrification. Such an energy transition also presents Tajikistan with an opportunity to reduce reliance on imported fossil fuels and strengthen national energy security.

The scenario analysis conducted using NEXSTEP shows that the toward net-zero emissions by 2050 scenario is the most sustainable option for long-term planning. Beyond SDG 7, this scenario positions Tajikistan to achieve broader climate goals and deliver on its Conference of the Parties (COP) commitments.

By embracing clean energy technologies, fostering innovation and strengthening regional cooperation, Tajikistan can pave the way for a resilient and low-carbon future - one that ensures affordable, reliable and sustainable energy for all by 2030, and achieves net-zero emissions by 2050.

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