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Implementation of the outcomes of the Second Asian and Pacific Energy Forum: national road maps for the implementation of Sustainable Development Goal 7

Supporting policy decisions to accelerate the implementation of Sustainable Development Goal 7 through the development of national road maps

Note by the secretariat

Summary

Achieving Sustainable Development Goal 7 by 2030 will require major transformation in the way countries generate, transport and use energy, which must be underpinned by transformative energy planning. Meeting growing energy demand while at the same time achieving Goal 7 will require reducing fossil fuels in the energy mix, replacing them with renewable energy sources and implementing substantial energy efficiency. The emission reduction target under the Paris Agreement needs to be considered as an integral part of the planning process, as the energy sector is responsible for about two thirds of global emissions.

The complex interaction between the targets under Goal 7 and the nationally determined contributions requires an integrated system-planning approach. The Second Asian and Pacific Energy Forum recognized this interaction in the Ministerial Declaration on Regional Cooperation for Energy Transition towards Sustainable and Resilient Societies in Asia and the Pacific, in which it also called for the development of national road maps for the implementation of Goal 7. The national expert Sustainable Development Goal tool for energy planning is an innovative tool being developed by the Economic and Social Commission for Asia and the Pacific (ESCAP) to address these challenges. It will examine national targets in the energy sector; perform modelling and analysis in connection with the expected gaps between the targets of Goal 7 and what will be achieved by 2030 and the expected gaps between the targets for nationally determined contributions and what will be achieved by 2030; and conduct policy analysis to suggest appropriate policy measures to bridge these gaps.

The present document contains an explanation of the need for developing this tool and of its development process, including the national consultation process in pilot countries and the expected output of the tool. Some early results from the trial process in pilot countries are also presented.

The Committee may wish to review and provide guidance on the development of the national expert Sustainable Development Goal tool for energy planning and how it could be utilized by a greater number of member States.

[*] Reissued for technical reasons on 28 August 2019.

[**] ESCAP/CE/2019/L.1.

I. Introduction

1. The Asia-Pacific region has emerged as an economic powerhouse over the past decade, with annual average economic growth of 4.8 per cent since 2010,[1] a growth rate higher than any other region in the world.

2. Economic growth, increasing urbanization and the desire for an improved quality of life have led energy demand in the region to rise faster than in any other part of the world. The Asia-Pacific region consumes approximately half of global final energy at 48 per cent in 2016, compared with 13.3 per cent in Europe and 17.9 per cent in North America.[2] Energy demand in the region experienced average annual growth of 3.4 per cent between 2000 and 2016, compared with the global average of 2 per cent. The International Energy Agency estimates that, under the current policy scenario, final energy consumption in the region will rise from 4,580 million tons of oil equivalent (mtoe) in 2016 to 5,119 mtoe in 2030.[3]

3. However, according to *Energy Transition Pathways for the 2030 Agenda in Asia and the Pacific: Regional Trends Report on Energy for Sustainable Development 2018,* disparities exist in how energy is used in the region. While the region has surpassed 90 per cent access to electricity, the quality of access in rural areas is very poor, with frequent blackouts caused by insufficient supply relative to demand. About half of the people of this region (44 per cent in 2017) are still cooking with traditional biofuel, one of the major causes of more than 2 million premature deaths that occur annually as a result of indoor air pollution.[4]

4. Historically, coal has been the dominant fuel in the primary energy supply (42.2 per cent in 2016) followed by oil (25 per cent) and natural gas (18.5 per cent). The annual growth rate of coal in the primary energy mix has slowed in recent years, but the amount of coal in the energy mix grew from 1,221 mtoe in 2000 to 2,873 mtoe in 2016 and is estimated to reach 3,485 mtoe in 2030 under the current policy scenario.[5] Heavy reliance on fossil fuels in the energy mix has been the key driver of increased greenhouse gas emissions in the region, which accounts for approximately half of global emissions.

5. The 2030 Agenda for Sustainable Development and the Paris Agreement call for a paradigm change in the way in which energy is used. Goal 7 is aimed at ensuring access to affordable, reliable, sustainable and modern energy for all, and comprises three key targets:

(a) Target 7.1 is to ensure universal access to affordable, reliable and modern energy services by 2030. Two indicators are used to measure this target: (i) the proportion of the population with access to electricity and (ii) the

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[1] Economic and Social Commission for Asia and the Pacific (ESCAP), Asia Pacific Energy Portal. Available at https://asiapacificenergy.org/ (accessed on 24 July 2019).

[2] Ibid.

[3] International Energy Agency, *World Energy Outlook 2017* (Paris, 2017).

[4] *Energy Transition Pathways for the 2030 Agenda in Asia and the Pacific* (United Nations publication, Sales No. E.18.II.F.14); and World Health Organization, "Household air pollution and health", 8 May 2018. Available at www.who.int/mediacentre/factsheets/fs292/en/.

[5] *Energy Transition Pathways for the 2030 Agenda in Asia and the Pacific*; and *World Energy Outlook 2017*.

proportion of the population with primary reliance on clean cooking fuels and technology;

(b) Target 7.2 is to increase substantially the share of renewable energy in the global energy mix by 2030. Renewable energy consumption includes hydropower, solid biofuels (including traditional use), wind, solar, liquid biofuels, biogas, geothermal, marine and waste;

(c) Target 7.3 is to double the global rate of improvement in energy efficiency, as measured by the energy intensity of the economy by 2030. This is the ratio of total primary energy supply to gross domestic product. Energy intensity is an indication of how much energy is used to produce one unit of economic output.

6. These targets are interlinked; the achievement of one target affects the other targets, either positively or negatively. For example, the achievement of universal access to electricity will slow progress on target 7.2, if the business-as-usual energy mix is used to supply the additional electricity. Universal access to clean cooking fuel will reduce the use of solid biofuel by up to 80 per cent. However, as solid biofuel constitutes a share of renewable energy, progress on target 7.1 will hamper the achievement of target 7.2. On the other hand, greater improvement in energy efficiency (target 7.3) will reduce final energy consumption which, in turn, will require relatively less renewable energy deployment to achieve a given share. Alternatively, if the amount of installed renewable energy capacity is kept fixed, the share of renewable energy will increase. This illustrates the fact that a higher level of energy efficiency will increase the renewable energy share in the final energy mix without any additional investment in renewable energy.

7. Nationally determined contributions are the instruments by which parties have expressed their emission reduction targets under the Paris Agreement. Collectively, the Asia-Pacific region aims to reduce its greenhouse gas emissions by 39 per cent by 2030. As the majority of emissions (about 70 per cent) result from the combustion of fossil fuels, the successful implementation of the Paris Agreement will rely greatly on how the energy sector transitions in the period leading up to 2030. An optimum combination of Goal 7 targets will help the region to achieve the nationally determined contributions in the most economical manner.

8. In this context, the achievement of Goal 7 targets requires an integrated system-planning approach that takes into consideration the synergies between their constituent elements: increasing access to modern energy services, improving energy efficiency, reducing emissions from the energy sector and increasing the share of renewable energy. Each of these actions has an effect on the others. Therefore, a system optimization process is needed to identify the best available pathway to the energy system by 2030.

9. A national road map for the implementation of Goal 7 can serve to realign the existing national energy plans and strategies with Goal 7 targets and nationally determined contributions. It can provide guidance for policymakers on what is required to achieve those targets and can offer a set of policy recommendations based on suggested energy transition pathways.

II. National expert Sustainable Development Goal tool for energy planning

10. According to the *Energy Transition Pathways* report, these pathways present a new challenge for policymakers in the context of the 2030 Agenda and the Paris Agreement. In addition, national capacities to carry out planning and identify the appropriate policy options to achieve Goal 7 targets and nationally determined contribution targets are often limited. Recognizing this, the Second Asian and Pacific Energy Forum adopted the Ministerial Declaration on Regional Cooperation for Energy Transition towards Sustainable and Resilient Societies in Asia and the Pacific, which the Commission endorsed in resolution 74/9. In the Declaration, the Forum requested the Executive Secretary to support member States in developing national road maps for the implementation of Goal 7. The Forum also recommended that a tool be developed to enable policymakers to make informed policy decisions to support the achievement of Goal 7 and emission reduction targets. In response, ESCAP is developing the national expert Sustainable Development Goal tool for energy planning.

11. The aims of the national expert Sustainable Development Goal tool for energy planning are the following:

(a) To support policymakers in estimating the national energy demand in the period leading up to 2030 by taking into consideration a range of issues, including Goal 7 targets, national development objectives and interlinkages between Goal 7 and other Sustainable Development Goals;

(b) To estimate the costs and capital investment required to achieve the targets;

(c) To develop scenario-based 2030 projections for both energy and emissions and examine the synergies between sustainable energy and emission reduction;

(d) To help to identify appropriate policy measures, primarily to enable the achievement of Goal 7 targets, but also to respond to other issues, such as emission reduction targets under the Paris Agreement.

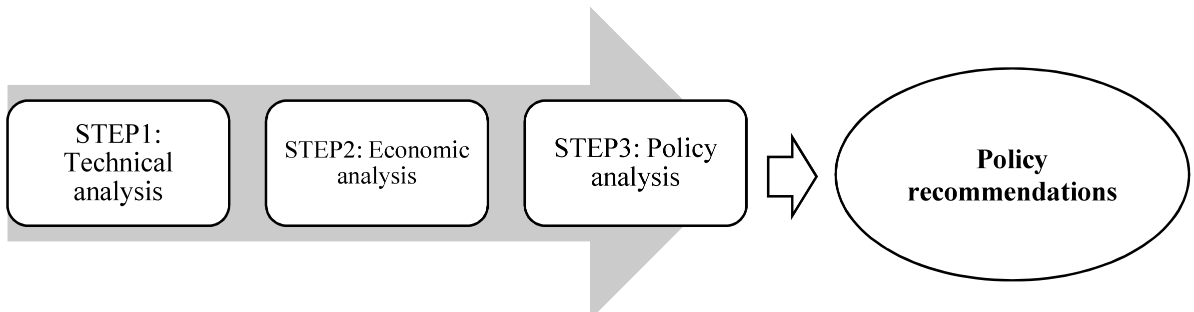
12. In that regard, ESCAP has been working with three pilot countries (Bangladesh, Georgia and Indonesia) to understand the needs at the national level and to design a tool that policymakers could use to achieve Goal 7 by 2030. This has helped to develop the national expert Sustainable Development Goal tool for energy planning. The methodology has been peer-reviewed by a group of external experts and has been improved by incorporating their suggestions and comments. It has also been tested to ensure that it can produce the intended outcomes and be applied at the national level.

13. Once the tool is fully developed and sufficiently tested (by 2020), it will be available online for use by member States. At that point, ESCAP will organize training for national energy planners and experts on how to use the tool to develop national Goal 7 road maps. The monitoring feature of the tool will enable member States to monitor progress on Goal 7 targets and nationally determined contributions. A biennial progress report could be produced by ESCAP from 2021 onwards and presented to the Committee on Energy to summarize the progress being made regionally. This would offer an opportunity to discuss national plans and make adjustments if the progress appeared to be insufficient for achieving the targets by 2030.

III. The concept of the national expert Sustainable Development Goal tool for energy planning

14. The purpose of the national expert Sustainable Development Goal tool for energy planning is to use policy analysis to help to design the type and mix of policies that would enable the achievement of the Goal 7 targets and the emission reduction targets under the nationally determined contributions. However, policy analysis requires energy systems modelling to forecast energy and emissions to 2030 and an economic analysis to assess which policies or options would be economically suitable in the national context. On that basis, a three-step methodology has been proposed (see as shown in figure I):

Figure I
Steps of the methodological approach



Source: ESCAP.

(a) Step 1 of the methodology will include technical analysis, in the form of energy systems modelling, to identify potential technical options[6] for each target. Each option will contain important information, including the final energy requirement (electricity and heat) by 2030, the possible generation/supply mix, the emissions and the size of investment required. For the modelling of energy systems, the tool will use the well-established Open Source Energy Modelling System platform, with support from the Division of Energy Systems Analysis at the KTH Royal Institute of Technology, in Sweden;

(b) In step 2, the results (for each target) will be fed into the economic analysis module. The purpose of this step is to perform an economic analysis of the technical options identified in the previous step and to prioritize least-cost options. While the Open Source Energy Modelling System has its own built-in investment analysis module, this economic analysis step will be used to examine the economic performance of individual technical options identified by the Open Source Energy Modelling System;

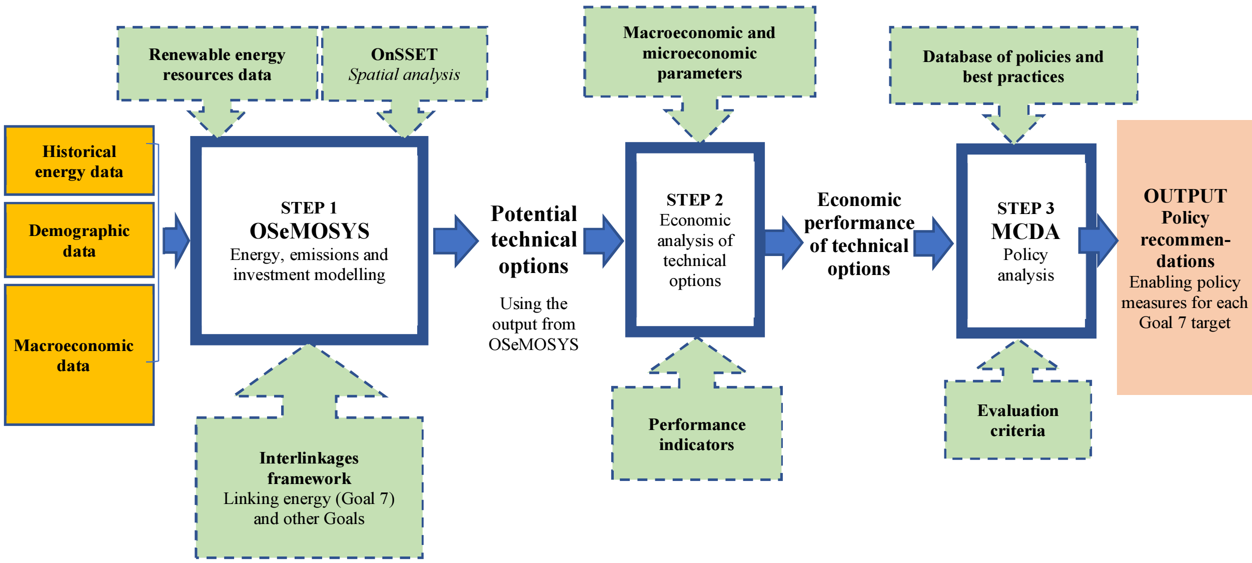
(c) In step 3, the prioritized options will be assessed on the basis of how likely they are to be converted into policy measures in a given national context. This will be done using multi-criteria decision analysis. The final set of solutions from that analysis is the output of the national expert Sustainable Development Goal tool for energy planning, expressed in the form of policy recommendations.

[6] A technical option is a measure that would help achieve a certain Sustainable Development Goal 7 target. For example, grid-based electricity may be a technical option to increase access to electricity. Often there may be multiple options for one target.

IV. Sustainable Development Goal 7 road map development using the national expert Sustainable Development Goal tool for energy planning

15. Figure II shows a block diagram of the three-step process with further elaboration. A description of the major components is given in the annex.

Figure II
Detailed components of the overall process of the methodology



Source: ESCAP.

Abbreviations: OSeMOSYS, Open Source Energy Modelling System; OnSSET, Open Source Spatial Electrification Tool; MCDA, multi-criteria decision analysis.

A. Technical analysis (step 1)

16. The energy and emission modelling task will be performed using the Open Source Energy Modelling System platform. It will include energy supply and demand analysis, emission analysis and cost estimation. The modelling system is a full-fledged system optimization model for long-run energy planning. Unlike long-established energy systems models (partial equilibrium models), such as the MARKet Allocation model (MARKAL), the Integrated MARKAL/Energy Flow Optimization Model System and the Model for Energy Supply Strategy Alternatives and their General Environmental Impact, the Open Source Energy Modelling System potentially requires a less significant learning curve and time commitment to build and operate. In addition, it requires no upfront financial investment, as it is not a proprietary software or commercial programming tool. These two advantages facilitate greater access to energy modelling for communities of students, business analysts, government specialists and energy researchers in developing countries.[7] The objective of the modelling system is to estimate the lowest net

[7] Mark Howells and others, "OSeMOSYS: the Open Source Energy Modeling System – an introduction to its ethos, structure and development", *Energy Policy*, vol. 39, No. 10 (October 2011), pp. 5850–70.

present value cost of an energy system to meet a given demand for energy or energy services.

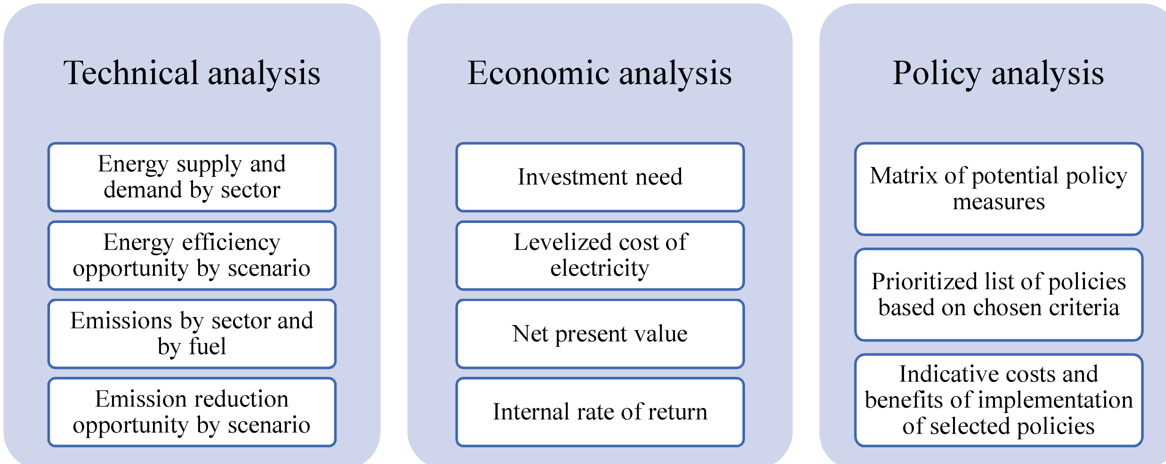
17. A full analysis of both supply and demand is expected from the Open Source Energy Modelling System. The demand-side analysis will provide information such as the current level of demand at the national level and a breakdown of demand by sector and by fuel source. An estimate of future demand through 2030 will also be presented. The supply-side analysis will provide information on the primary energy sources and technologies that would be required to meet the estimated final energy demand.

18. The modelling system is able to analyse historical energy consumption data to forecast future energy demand in a given country, including a sectoral breakdown, and optimize the supply mix to show how energy demand (in terms of capacity and generation) can be met with various fuels or energy sources. The energy supply and demand analysis will also take into account the impact of the Sustainable Development Goals on energy (Goal 7) by considering the interlinkages between them. It can develop multiple scenarios, including reference scenarios and alternative scenarios. The national expert Sustainable Development Goal tool for energy planning will develop three scenarios: the business-as-usual scenario, the current policy scenario and the Sustainable Development Goal scenario (a combination of the Sustainable Development Goals and the nationally determined contributions).

19. One of the key advantages of the Open Source Energy Modelling System utilized in the national expert Sustainable Development Goal tool for energy planning is that it is not limited to certain built-in technologies. Rather, the user can create a technology, such as rooftop solar photovoltaic, and provide its characteristics or constraints (for example, only in urban areas) for the modelling system to perform an analysis. Several constraints can be included in the modelling system to help to optimize the entire energy scenario. For example, the modelling system can perform iteration to seek the optimum supply mix for the energy sector to achieve a given emission reduction target. The growth of technology can also be limited by the resources in a given country, such as the availability of land area for the installation of large-scale solar photovoltaic.

20. The entire assessment will be done in three key steps: technical, economic and policy analyses, as shown in figure III. The technical analysis will be focused on energy and emission modelling and produce a list of technologies that will help to achieve a given Goal 7 target. The economic analysis will be used to filter out technical options that are likely to result in poor economic returns. The policy analysis will use a multi-criteria decision analysis framework to rank policies that are best suited to the country context.

Figure III
Examples of major components of the national expert Sustainable Development Goal tool for energy planning



Source: ESCAP.

21. The model will provide the following information in relation to renewable energy: the share of renewable energy that would be achieved if the country followed the historical trajectory (the business-as-usual scenario); the trajectory of renewable energy share under the current policy scenario; and the share of renewable energy that is feasible under the Sustainable Development Goal scenario. It will take into consideration a number of factors including renewable energy resources in the country, technological maturity, cost-benefit ratio, investment size and emission reduction potential. This will also need to be assessed in conjunction with energy efficiency opportunities, given the emission reduction synergies between renewable energy and energy efficiency.

22. The share of renewable energy that would be required to achieve the nationally determined contribution target relevant to the energy sector will be estimated. This will also be assessed in conjunction with energy efficiency, using the synergies between energy efficiency and renewable energy.

23. For energy efficiency, the modelling system will develop the business-as-usual scenario based on the trajectory of energy intensity through 2030, including the changes in energy intensity under the current policy scenario. It will also identify the target to be reached under the Sustainable Development Goal scenario and the energy intensity reduction required to achieve the nationally determined contributions. The targets will be calculated using an iterative method to analyse a range of possible values of renewable energy share and energy intensity reduction, and the interaction between them, relying on the concept of synergies between renewable energy and energy efficiency.

24. Countries can benefit from important synergies between renewable energy and energy efficiency, in particular for achieving the Goal 7 targets. For example, target 7.2 requires substantially increasing the share of renewable energy in total final energy consumption. According to the *Energy Transition Pathways* report, the aim of the Sustainable Development Goal scenario is to achieve 22 per cent renewable energy share in Asia and the Pacific by 2030, when final energy consumption is expected to reach 4,875 mtoe, with an energy intensity level of 3.22 megajoule per dollar. If further energy efficiency improvement could reduce final energy consumption by an additional 25 per cent, to 3,656 mtoe, the renewable energy share would increase

from 22 per cent to about 29 per cent, without any additional investment in energy efficiency.

25. Synergies between renewable energy and energy efficiency play an important role in reducing the cost of achieving nationally determined contributions. More efficient use of energy reduces greenhouse gas emissions, and renewable energy also offsets emissions. However, the marginal abatement cost of energy efficiency is usually less than that of renewable energy technologies. For example, the International Renewable Energy Agency estimates the average marginal abatement costs of renewable-based electricity generation and energy efficiency measures at $75 per ton of carbon dioxide equivalent and $35 per ton of carbon dioxide equivalent, respectively.[8] This indicates that each unit of emission reduction would require more than twice the investment in renewable energy as it would in energy efficiency. Since energy efficiency is a more economically viable approach, countries should consider prioritizing the implementation of energy efficiency improvement to meet their nationally determined contributions, with the balance achieved by renewable energy.

26. Through emission analysis, the national expert Sustainable Development Goal tool for energy planning aims to provide the following information: business-as-usual emissions (based on historical trajectory), emissions under the current policy scenario and emissions under the Sustainable Development Goal scenario. The Sustainable Development Goal scenario will show the level of emission reduction that would be possible if renewable energy and energy efficiency met the Sustainable Development Goal targets. Emissions under the nationally determined contribution scenario will indicate whether the country will be able to achieve a given emission reduction target, and if it will not, what energy scenario would be required to do so.

B. Economic analysis (step 2)

27. The energy systems modelling step will select the appropriate technologies, and the economic analysis will build on this by selecting the least-cost energy supply mix for the country. The Open Source Energy Modelling System will perform an investment analysis to identify the level of investment required by an energy system. The purpose of the economic analysis, on the other hand, is to assess how each technical option would perform when implemented and to rank the technologies accordingly. This will require the calculation of key economic indicators. A separate model using standard econometric principles will be developed to that end. The ranking of selected technologies will help policymakers to identify and select economically effective projects for a better allocation of resources.

28. The economic analysis will present several economic parameters and indicators that would be useful for policymakers in making informed policy decisions, including the levelized cost of energy, the net present value, the internal rate of return and the payback period.

29. The levelized cost of energy is widely used in the energy industry to compare the economic value of various electricity generation technologies. It calculates the unit energy cost (in dollars per megawatt-hour) over the lifetime

[8] International Renewable Energy Agency (IRENA), "Synergies between renewable energy and energy efficiency", Working Paper (Copenhagen, IRENA and Copenhagen Centre on Energy Efficiency, 2015).

of the project, including the capital, operating and financing costs, and simplifies costs into one number. This is useful for comparison and implies only one optimal economic outcome. However, the use of this method has drawbacks because it is affected by factors such as discount rates, inflation effects and future commodity prices. For example, in the comparison of a combined cycle gas turbine plant and offshore wind farm, major costs for the turbine plant include fuel and operational costs, whereas for the offshore wind farm, they are mainly construction costs. Therefore, a fall in future commodity prices would be favourable for the turbine plant, but the offshore wind farm would be less susceptible to inflation effects.

30. Additional economic parameters estimated in the economic analysis are the net present value, the internal rate of return and the payback period. The net present value of an energy system is a comprehensive review of all costs and benefits occurring at different points in time, used for project ranking and decision-making. The internal rate of return is the discount rate for which the net present value of a project is zero. For a project to be economically viable, this should be above the market interest rate or a social discount rate. The payback period of a project is the time required to amortize the initial investment. Further economic indicators and parameters that would be identified and analysed by the national expert Sustainable Development Goal tool for energy planning are given in table 1 of the annex.

31. In the economic analysis step of the national expert Sustainable Development Goal tool for energy planning, the net present value, internal rate of return and payback period of energy systems are used to rank projects. In case of contradictory results, the net present value is selected as the basis for ranking. In this method, the discount rate is applied for cash flows over the lifetime of the project. Integrating this method with a sensitivity analysis would help policymakers analyse the impact of future commodity prices to mitigate project risks.

32. The business-as-usual or current policy scenario for the period 2020–2030 will act as the baseline for the cost-benefit analysis, and all selected technologies will be compared to the country's existing energy supply. The capital expenditure, operating expenditure, fuel and other costs of energy technologies will be calculated to estimate the overall costs of the project. The benefits section will include estimated revenue and environmental benefits, such as the abatement of greenhouse gas emissions in monetary value, carbon pricing (if applicable) and the salvage value of projects. The calculation of costs and benefits is to be completed for all selected technologies in a country, and the final profits/losses from the project will also be calculated. The time value of money will be considered, and a discount rate will be applied to convert the future values to present values, and scenario results will be compared to the business-as-usual scenario to estimate the project's viability.

33. In its research on six energy-economy models,[9] the World Bank analysed three scenarios: the well below 2 degrees scenario, the business-as-usual scenario and the nationally determined contribution scenario. The results show that investment costs depend more on the energy-economy model used than on the climate objective for each scenario, with no clear conclusion on the relative cost of implementation. Studies that analyse investments in energy

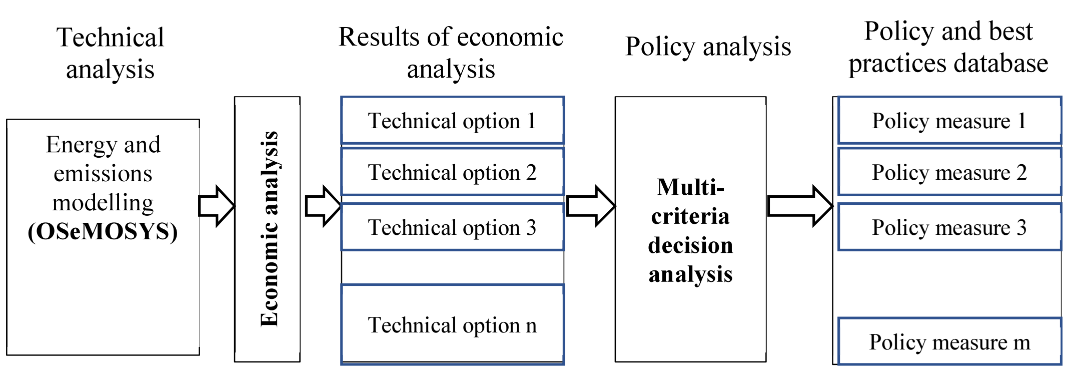
[9] Julie Rozenberg and Marianne Fay, eds., *Beyond the Gap: How Countries Can Afford the Infrastructure They Need While Protecting the Planet* (Washington, D.C., World Bank, 2019). Available at https://openknowledge.worldbank.org/handle/10986/31291.

access often omit decentralized energy investments. They are focused on capital costs but ignore variable costs. Operation and maintenance costs represent nearly half of all costs associated with achieving universal access. They vary between 1 per cent and 6 per cent, depending on the technology used. Energy-economy models focus on generation and disregard transmission and distribution costs, which vary depending on the level of urbanization. For rural areas, microgrid or off-grid solutions may be cheaper than grid extension. Coal power plants in a low carbon future will need to be phased out, but they can be politically and financially difficult to retire. The most desirable policy is one that limits stranded assets and invests mostly in renewable energy and storage.

C. Policy analysis (step 3)

34. The third and final key component of the national expert Sustainable Development Goal tool for energy planning is policy analysis. This step is aimed at informing policymakers about the types of policies that will enable the implementation of a given technical option for a given Goal 7 target (see figure IV). A database of policies and best practices for the energy sector will be developed, divided into categories based on the Sustainable Development Goal 7 targets and indicators. It will use information from various sources, including the Regulatory Indicators for Sustainable Energy,[10] the International Renewable Energy Agency and the International Energy Agency. The database will be linked to the technical solution matrix (the output of the modelling component) through a policy analysis module, as shown in figure IV. The policy analysis will use multi-criteria decision analysis to connect the right policy or policies to the right technical option.

Figure IV
Linking technical options to policy measures

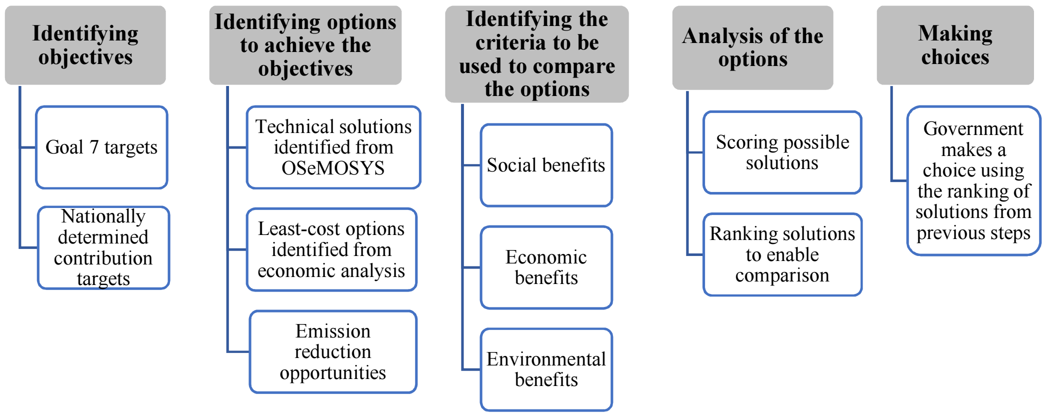


Source: ESCAP.

35. Multi-criteria decision analysis is a tool that is widely used in governmental decision-making. It can be applied to many areas, including the energy sector, where potential options can be narrowed down or ranked on the basis of selected criteria. The decision-making process of multi-criteria decision analysis adheres to the following logical sequence (see figure V):

[10] See https://rise.esmap.org/.

Figure V
Decision-making sequence using multi-criteria decision analysis



Source: ESCAP.

(a) There are two major objectives in the case of the national expert Sustainable Development Goal tool for energy planning: the Goal 7 targets and the nationally determined contribution targets;

(b) The options for achieving the objectives will be the output of Open Source Energy Modelling System and will include various technical solutions to achieve the objectives. In addition, the economic analysis will serve to narrow down some of the economically unattractive options. Each of the final options will be assigned a preference value on a scale of 0 to 10. The user will have the ability to set their own preference (based on the country context) through the user interface of the national expert Sustainable Development Goal tool for energy planning;

(c) A set of criteria will be developed to help analyse the options identified in the previous step. These may include, for example, affordability, investment cost, increased employment, greenhouse gas mitigation potential and commercial maturity. The final set of criteria will be identified through stakeholder consultations held in ESCAP member States. Each criterion will be weighted using a pre-defined weight distribution. The user will have the ability to adjust the weight through the user interface;

(d) Each option will be scored according to its preference value and the weight of the criterion against which it is measured. The options will then be ranked according to their weighted average scores;

(e) The principal idea behind the national expert Sustainable Development Goal tool for energy planning is to present the preferred policy options using an analytical approach. The selection of a policy option depends entirely on Governments and is subject to national socioeconomic and political contexts.

V. Conclusion and key points for discussion

36. Ensuring energy security will be the critical challenge for policymakers in their efforts to facilitate the transition of the energy sector between now and 2030. The 2030 Agenda offers an opportunity to augment the energy sustainability and security of the region. The three Goal 7 targets call for a shift in the energy paradigm that will bring about a transition to a more secure, diversified and cost-effective energy system. The implementation of the Paris

Agreement will not be possible without considering Goal 7, as the energy sector is responsible for about two thirds of national emissions.

37. Planning for the energy transition in the context of the 2030 Agenda and the Paris Agreement will require an integrated system-planning approach that reflects the interlinkages among the targets under Goal 7 and the emission reduction commitments under the nationally determined contributions. Identifying and prioritizing appropriate technologies and strengthening the capacity of policymakers to create an enabling policy environment will be key to a successful transition by 2030.

38. The national expert Sustainable Development Goal tool for energy planning has been specifically designed to enhance the capacity of policymakers to make informed policy decisions that will help to achieve these targets and commitments. It will provide a coordinated approach to aligning road maps for the implementation of Goal 7 with existing national energy plans, as well as strategies pertaining to nationally determined contributions. The output of the tool will be a national Goal 7 road map containing matrices of technical and policy options along with economic and environmental parameters and indicators to enable informed decision-making. This free-to-use online tool will be useful for member States in their integrated system-planning efforts.

39. The Committee may wish to provide comments and guidance on the national expert Sustainable Development Goal tool for energy planning and the development of national road maps for the implementation of Goal 7.

Annex

Detailed overview of the national expert Sustainable Development Goal tool for energy planning

I. Description of the major components of the national expert Sustainable Development Goal tool for energy planning

1. **User interface module**: The user interface enables users to input country-relevant data and information that are necessary to customize the national expert Sustainable Development Goal tool for energy planning in the national context. Each user, or country, will have a username and password to access their country page.

2. **Energy data**: The user will be able to input their country-relevant energy data, including historical data on total final energy consumption, the sectoral breakdown of energy consumption, the supply of various energy sources and the remaining energy gap.

3. **Historical energy data**: The first-order source for historical energy data will be the Asia Pacific Energy Portal. Once the user accesses the country page, the national expert Sustainable Development Goal tool for energy planning will search for the country-relevant data from the Portal and populate data as required. Each country will also have the option to upload its own data.[1]

4. **Demographic data**: Data, including their historical trend, will be provided by the user. Examples could include population figures and the urbanization rate.

5. **Macroeconomic data**: Economic growth, expressed in terms of annual gross domestic product (GDP) growth, will be provided by the user. Other data for input could include the exchange rate against the dollar, the inflation rate and energy prices.

6. **Sustainable Development Goal targets**: The tool will set Sustainable Development Goal targets 7.1 and 7.3 at the optimum levels, namely 100 per cent access to modern energy services and energy intensity reduced by half. For target 7.2 (substantially increased share of renewable energy), the tool will offer various scenarios based on the country's energy situation, renewable energy resources, energy efficiency opportunities and emission reduction target.

7. **Nationally determined contribution targets**: The user will input the emission reduction target for the energy sector as expressed in the current nationally determined contributions. If the submitted nationally determined contribution does not specify an emission reduction target for the energy sector, the tool will calculate the sector's share of the target pro rata on the basis of total energy sector emissions.

8. **Other parameters**: Other parameters that will be available for user input include cost parameters (including the cost of energy sources, electricity tariffs and cost of fuel), targets and goals (including Sustainable Development Goal targets and emission reduction targets) and assumptions.

[1] A data quality control mechanism will be put into place to ensure the accuracy and comparability of results.

II. Scenario descriptions

9. **Business-as-usual scenario**: This scenario will rely on historical data and information to perform a simple forecast using an average growth rate. The purpose of this scenario is to demonstrate where the country will be in 2030 with regard to achieving the Goal 7 targets as well as nationally determined contribution targets if no action is taken. While this scenario may not reflect the policies that have been introduced in the recent past, it will nevertheless give an indication to policymakers of the country's current performance.

10. **Current policy scenario**: This scenario takes into account the policies that have been announced and adopted by the country. The tool will use the targets specified in those policies to assess the amount of progress the country would achieve with regard to the Goal 7 targets and the nationally determined contribution target. This is more of a hypothetical scenario, as the introduction of a policy does not always lead to its implementation. Moreover, the performance of a policy will largely depend on how it is enforced across the economy.

11. **Sustainable Development Goal scenario**: The Sustainable Development Goal scenario will be developed based on the Goal 7 targets. For target 7.1 (for both access to electricity and access to clean cooking fuel), the target will be set at 100 per cent achievement. For target 7.3, the target will be calculated using the rate of change of energy intensity between 2000 and the present, and halved for 2030. Target 7.2 is more complicated, as it lacks a definite numerical value. The tool will therefore identify the optimum share of renewable energy possible in the country, taking into consideration such factors as renewable energy resources, technological maturity, the cost of technology in the local market and the current share of renewable energy. This scenario is also aimed at achieving the emission reduction target for the energy sector (under the nationally determined contribution) in a cost-effective way (least-cost approach). The key focus will be to increase renewable energy and reduce energy intensity. The system will optimize the correlation between renewable energy share and energy intensity to find the least-cost solution and achieve the nationally determined contribution target.

Table 1
Major economic indicators and parameters to be identified by the national expert Sustainable Development Goal tool for energy planning

Criteria	*Economic appraisal*	*Technical calculations*
Costs		
Capital expenditure per megawatt	The capital investments for technologies will be based on country-specific data to improve the analysis.	
Fuel costs	Calculated for each technology.	$\text{Fuel cost (\$/year)} = \text{Fuel use (kg fuel/hour)} \times \text{Operating hours} \left(\frac{\text{hour}}{\text{year}}\right) \times \text{Coal price(\$/kg fuel)}$
Labour costs	Per cent of capital expenditure per year.	
Operation and maintenance costs	Per cent of capital expenditure per year.	
Benefits		
Revenue	The output from a project sold on the market is the main benefit in the economic analysis.	
Revenue from greenhouse gas abatement	The avoided cost of carbon dioxide generation is calculated in monetary value based on carbon tax (if applicable).	$\text{Emissions}_{\text{GHG,fuel}} = \text{Fuel consumption}_{\text{fuel}} \times \text{Emissions factor}_{\text{GHG, fuel}}$ $\text{GHG abatement (kgCO2 e)} = \text{Emissions}_{\text{GHG,base}} - \text{Emissions}_{\text{GHG,technology}}$ $\text{Revenue from GHG abatement (\$)} = \text{GHG abatement (kgCO2e)} \times \text{Carbon price (\$/kgCO2e)}$
Salvage value	Per cent of capital expenditure.	

Source: ESCAP.

Abbreviations: KgCO2e, kilogramme of carbon dioxide equivalent; GHG, greenhouse gas.

III. The description of the road map

12. The output of the national expert Sustainable Development Goal tool for energy planning will be a summarized report, or road map, based on a predefined template. This report will contain graphs and tables with important data. The report will also contain policy matrices for each of the Goal 7 targets.

13. **Graphs and tables**: The graphs and tables will present key findings from energy and emission analysis. Examples of graphs and tables that may appear in the road map are shown in table 2.

Table 2
Examples of graphs and tables in the road map

Graph or table topic	*Description of topic*
Access to clean cooking fuel	The rate of access to clean cooking fuel, broken down by scenario. This will also list potential technologies and investment required. This information may not be relevant or applicable in countries where access is already universal.
Access to electricity	The rate of access to electricity (broken down by scenario and potential technology) to bridge the gap and the associated investment required. This information may not be relevant or applicable in countries where access is already universal.
Electricity demand	Electricity demand through 2030 will be presented for different scenarios. This demand estimate will not only include universal access to electricity, but also other macroeconomic and demographic factors such as GDP, population and urbanization.
Enabling policy framework	The impact of financing instruments on new investments. This would inform policymakers whether it would be worth considering actions to level the playing field for renewable energy by, for example, phasing out fossil fuel subsidies and/or applying a tax on carbon emissions.
Energy efficiency	The optimum balance of renewable energy and energy efficiency that will produce the greatest emission reduction opportunity at the lowest cost.
Investment and financing	The capital investment required to achieve each of the Goal 7 targets, and possible funding mechanisms to support capital investment, broken down by target.
Optimization of renewable energy and energy efficiency	Types of energy efficiency measures in different sectors and subsectors that will help to achieve target 7.3.
Renewable energy	The optimum level of renewable energy possible in the country, including the technology/resources mix, under different scenarios and conditions (such as technological maturity and market conditions).
Total final energy consumption	Total final energy consumption will be presented by sector as well as by energy sources (fuel/resources) and for different scenarios.

Source: ESCAP.

14. **Policy matrix**: The policy matrix will contain different policies grouped into each target area. Each of these measures will include information such as capital investment, operating costs, a marginal abatement cost curve (applicable to emission reduction measures), economic performance, and emission and energy reduction opportunities. This information will help to compare different policies and identify those that are suitable for implementation in the national context.

15. **Sankey diagram**: Using the energy balance figures from the Open Source Energy Modelling System, a Sankey diagram will be developed for each country. Sankey diagrams summarize all of the energy transfers taking place in a process by displaying flows of energy and their quantities in proportion to one another.

16. **Marginal abatement cost curve**: A marginal abatement cost curve is a useful tool for policymakers seeking to identify least-cost options with the highest emission reduction opportunity, because it provides two critical pieces of information about a technology: the volume of emission reduction in tons of carbon dioxide equivalent and the unit cost of emission reduction in dollars per ton of carbon dioxide equivalent. This curve is extremely useful when policymakers need to select one mitigation technology over another. First, the emission reduction is estimated by comparing the emissions of the new technology with that of the baseline technology. Next, the net present value of implementing the new technology is calculated. The marginal abatement cost is then calculated, by dividing the net present value by the total emission reduction, and placed on a graph with the x-axis showing the volume of emission reduction and the y-axis representing dollars per ton of carbon dioxide equivalent. The marginal abatement cost curve should not be regarded as constant, because as the cost of technology changes, the marginal abatement cost value also changes, either over time or in the geographical context.