



SCENARIOS FOR THE ENERGY TRANSITION

Experience and good
practices in Latin America
and the Caribbean

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www.get-transform.eu

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- Rocío Rodríguez: Co-ordinator for Energy and Climate Change, Energy Planning Section, Department of Energy, Ministry of Economy, Argentina
- Thiago Barral: President, Energy Research Office (EPE), Brazil
- Carlos Barría Quezada: Head, Energy Research and Policy Division, Ministry of Energy, Chile
- Christian Jaramillo: Director General, Mining and Energy Planning Unit, Ministry of Energy and Mines, Colombia
- Arturo Molina: Expert, Energy Subsector Planning Department, Costa Rica
- Alfonso Rodríguez: Vice-Minister, Energy Saving and Efficiency, Ministry of Energy and Mines, Dominican Republic
- Edward Veras: Executive Director, National Energy Commission, Dominican Republic
- Ramiro Díaz Castro: Director, Electricity Analysis and Energy Foresight, Ministry of Energy and Non-Renewable Natural Resources, Ecuador
- Juan José García: Director, Energy Planning, National Energy Council, El Salvador
- Gabriel Velázquez: Head, Energy and Mining Planning Unit, Ministry of Energy and Mines, Guatemala
- Jorge Cárcamo: Energy specialist, Ministry of Energy, Honduras
- Juan Ignacio Navarrete: Director of Policies and Programmes, National Commission for the Efficient Use of Energy, Mexico
- Guadalupe González: Director of Electricity, National Department of Energy, Ministry of Presidency, Panama
- Luis Aldo Vilchez León: Co-ordinator, Energy Planning and Renewable Energy, Ministry of Energy and Mines, Peru
- Alejandra Reyes: Director, Energy Planning, Statistics and Balance Unit, Ministry of Industry, Energy and Mines, Uruguay

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ABBREVIATIONS

AFD	French Development Agency
ANE	Ecuador's National Energy Agenda
BAU	business as usual
CLEW	climate, land, energy and water
CNE	National Energy Commission of Dominican Republic
CNE	National Energy Council of El Salvador
CONUEE	National Commission for Efficient Energy Use of Mexico
DNE	National Energy Directorate of Uruguay
ECLAC	United Nations Economic Commission for Latin America and the Caribbean
EPE	Brazilian Energy Research Office
ETE	Mexico's Energy Transition Strategy
FOREPLEN	Regional Technical Forum of Energy Planners
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GNCC	National Climate Change Cabinet of Argentina
IAEA	International Atomic Energy Agency
IDB	Inter-American Development Bank
IRENA	International Renewable Energy Agency
LAC	Latin America and the Caribbean
LEAP	Long-Range Energy Alternatives Planning
LTES	Long-Term Energy Scenarios
MERNNR	Ministry of Energy and Non-Renewable Natural Resources of Ecuador
NDC	Nationally Determined Contribution
OLADE	Latin American Energy Organization
PEN	Ecuador's National Energy Plan
PET	Transmission Expansion Plan of Guatemala
PLANEE	Ecuador's National Energy Efficiency Plan
SDG	Sustainable Development Goal
SIE	Superintendence of Electricity of Dominican Republic
SNE	Panama's National Department of Energy
TES	Sovereign Energy Transition
UNDP	United Nations Development Programme
UPME	Mining and Energy Planning Unit of Colombia

EXECUTIVE SUMMARY

This report is based on the main findings of the webinar series [Long-Term Energy Scenarios \(LTES\) for Developing National Clean Energy Transition Plans in Latin America and the Caribbean](#),¹ which was organised in 2021 by the International Renewable Energy Agency (IRENA), the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) and the European programme GET.transform. The series served as a platform to share knowledge and collect best practices and experiences from government energy planners in Latin America and the Caribbean (LAC) in the **development and use of long-term energy scenarios** to guide national energy planners for a clean energy transition.

The energy scenarios developed in LAC take into account not only technical and economic criteria but also social and environmental factors, particularly with a view to combating climate change. They are increasingly integrated and long-term in nature and reflect a more participatory approach. Renewable energy technologies and energy efficiency options play a growing role in many of the national planning scenarios presented. The LAC countries have endeavoured to improve their energy statistics so that they are able to develop more reliable scenarios. The support provided through international co-operation was essential for this process.

KEY FINDINGS

The good practices for energy planning processes and long-term scenario development and use identified in the course of the webinar series are summarised below. They include innovative approaches to developing and using long-term energy scenarios and corresponding advances in capacity building.

1. **The LAC region is developing energy scenarios with a broader scope that goes beyond techno-economic criteria.** Increasingly, they also incorporate more social and environmental factors, particularly in relation to climate change, quality of life and social inclusion. The level of ambition is being raised in these areas, and various countries in the region have already evaluated carbon neutral or deep decarbonisation scenarios.
2. **A number of LAC governments are developing increasingly integrated and long-term energy scenarios linked to their climate goals.** Integrated analysis has been made possible by the introduction of more complex tools that simultaneously model all energy sub-sectors (electricity, oil and gas, biofuel, energy efficiency) with non-energy sectors. These long-term scenarios have guided the development of medium- and long-term plans, strategies, roadmaps and agendas and are consistent with climate policy and goals. The region's countries have made significant progress in understanding the links between the energy sector and other sectors, such as education, housing, health, water, air quality and transport.
3. **There is a growing emphasis on participatory scenario development as part of energy planning processes in the LAC region.** In many countries in the region, planning processes are carried out frequently and seek to build consensus on a long-term vision through dialogue with all the sector's stakeholders, promoting geographic and institutional decentralisation. Effective governance of the energy planning process is crucial to empowering the community.

¹ www.irena.org/events/2021/Feb/LTES-for-developing-national-clean-energy-transition-plans-in-Latin-America

4. **The long-term scenarios analysed by LAC countries are increasingly based on larger shares of renewables in their energy mix and on more efficient energy consumption.** The region's countries are promoting the expansion of projects designed to generate power from renewable energy sources, particularly hydropower, solar photovoltaic (PV) power and wind power as well as other less common sources, such as geothermal power, biogas and solar thermal power, and thermal and electric storage options. A few countries are even including hydrogen, carbon capture and storage, and advanced biofuels in their scenarios. Finally, a number of countries are emphasising energy efficiency in end-use sectors, including electromobility options.
5. **Transparent energy data and statistics are crucial to the development of more reliable scenarios.** The results of these scenarios can then be used to formulate consistent energy policies. Modern digital platforms and publicly accessible information systems promote transparency in the process of developing scenarios for energy planning. In turn, this helps to build public trust and empower the community.
6. **The support provided through international co-operation has been crucial in enabling many LAC countries to develop energy scenarios for medium- and long-term energy planning.** Access to financial resources and technical assistance for capacity building have enabled countries to develop more integrated scenarios using more sophisticated tools and more comprehensive energy planning systems.

ABOUT THIS REPORT

ABOUT THE WEBINAR SERIES

This report is based on the main findings of the webinar series [Long-Term Energy Scenarios \(LTES\) for Developing National Clean Energy Transition Plans in Latin America and the Caribbean](#)² (IRENA, ECLAC and GET.transform, 2021), which was held between 3 February and 2 June 2021.

The webinar series was a joint initiative of the International Renewable Energy Agency (IRENA), the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) and the European programme GET.transform. It is one of the activities of IRENA's Long-Term Energy Scenarios Network (LTES Network) and was carried out as part of ECLAC's Regional Technical Forum of Energy Planners (FOREPLEN).

The series served as a platform to share knowledge and collect best practices and experiences from government energy planners in the Latin America and Caribbean (LAC) region in the development and use of long-term energy scenarios to guide national energy planners for a clean energy transition. Fourteen countries from the region took part in the series: Argentina, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Panama, Peru and Uruguay. At the end of each webinar, the participants completed a questionnaire. The results and findings of these surveys are provided in the Annex.

OBJECTIVES

The aim of the series was to explore how the region's countries are developing and using long-term energy scenario to address innovations in the way energy is generated, transmitted, distributed and consumed in an increasingly digitalised, decentralised and decarbonised energy system. Many Latin American countries have used long-term scenarios for decades to inform national long-term energy planning and strategy documents, such as electricity and energy master plans and outlooks.

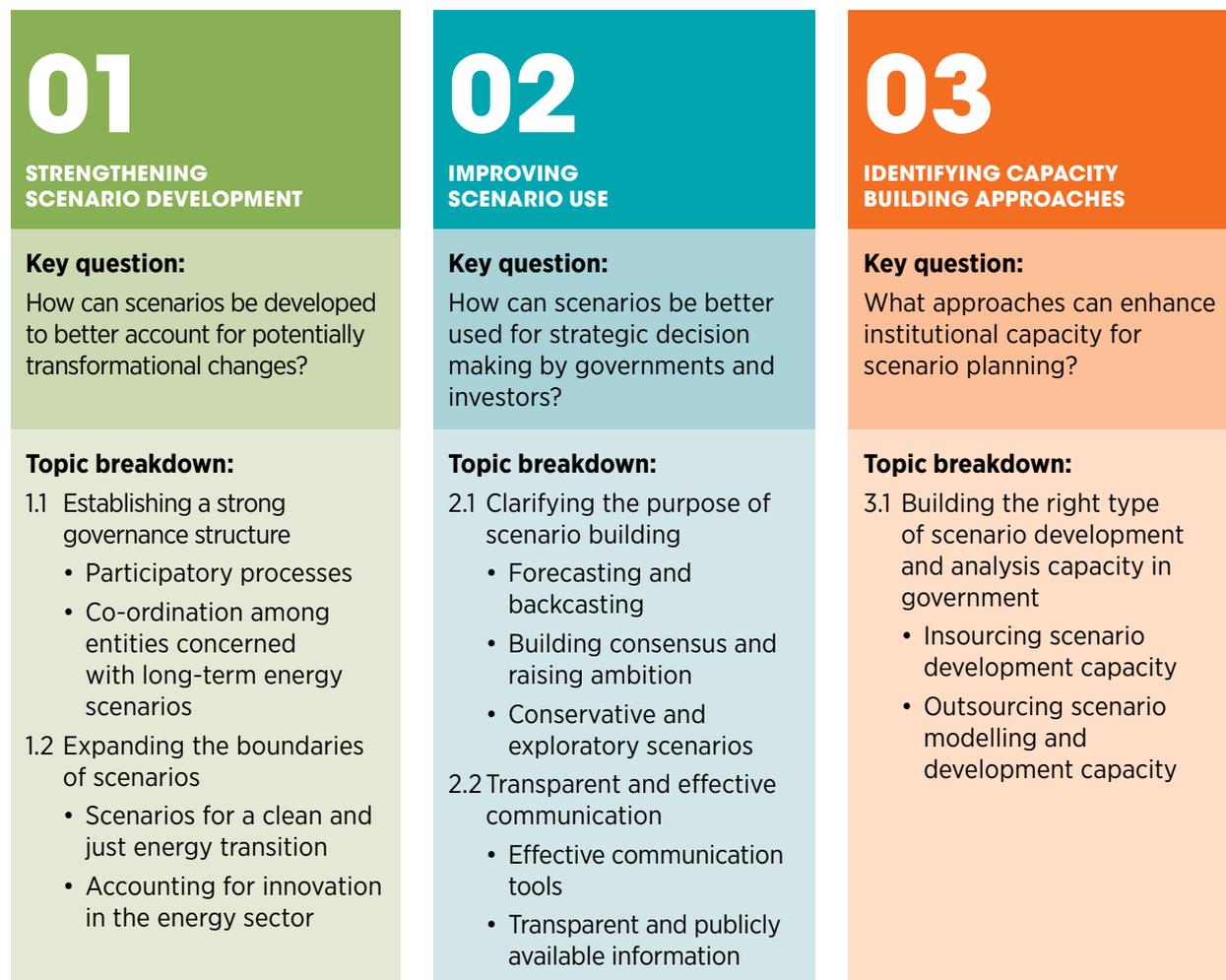
Long-term scenarios are essential for guiding policy makers and investors in the transition to non-polluting energy, as these scenarios enable them to make energy-related decisions with strategic foresight, taking into account new trends and uncertainties in technology, markets and policies. The scenarios are also a crucial communication tool for moving forward the national debate and reaching a consensus on visions for a just and inclusive energy transition. Many countries in the region are preparing or have recently completed national long-term energy plans based on scenario analysis.

The aim of the report is to present good practices extracted from the webinar series for the development and use of long-term energy scenarios to guide national energy planners for a clean energy transition, with a view to disseminating these practices so that they can be adopted by other countries in the region and beyond to improve planning processes. They include efforts by countries to improve the development and use of scenarios in ways that reflect the complexities of the clean energy transition.

The webinar series addressed **three main topics** that provided the framework for the presentations and discussions, as shown in Figure 1. The information for each of the participating countries, ordered alphabetically in the report, is structured according to the three main topics.

² www.irena.org/events/2021/Feb/LTES-for-developing-national-clean-energy-transition-plans-in-Latin-America

Figure 1 Main topics addressed in the webinar series, Long-Term Energy Scenarios (LTES) for Developing National Clean Energy Transition Plans in Latin America and the Caribbean



ORGANISING INSTITUTIONS

IRENA

The International Renewable Energy Agency (IRENA) has launched the LTES Network as its extension to the Clean Energy Ministerial LTES Initiative, which aims to provide a platform that can be used by national and regional energy scenario practitioners from member countries to share experiences and good practices in building and using scenarios for the clean energy transition. In 2020, IRENA published *Scenarios for the energy transition: Global experience and best practices* (IRENA, 2020a), which presents a collection of over 50 practices from more than 20 governments and technical institutions worldwide that are designed to improve the development and use of long-term energy scenarios to guide the clean energy transition. This webinar series also supports the energy planning component of IRENA's Regional Action Plan for Latin America.

ECLAC

The United Nations Economic Commission for Latin America and the Caribbean (ECLAC) has been organising and leading the Regional Technical Forum of Energy Planners (FOREPLEN) since 2018 to co-ordinate efforts among energy planners in the region and provide a platform for technical information sharing and dialogue with a view to strengthening co-operation between ECLAC member countries on regional energy planning issues.

As part of FOREPLEN, a study was conducted to map energy planning practices (Pistonesi, Bravo and Contreras, 2019). The study is used to highlight planning processes and identify challenges to energy planning in the region. It helps to create a framework for building a common understanding of the scope, methodology and processes of energy planning among the region's countries.

GET.TRANSFORM

GET.transform works with energy ministries, national and regional planning commissions, regulators as well as electric utility planning departments to advance the quantity and quality of power system expansion plans. Locally owned and driven LTES processes are supported to provide the ability for a comparative analysis considering the impact of least-cost, low carbon, net-zero and business-as-usual development pathways, as well as increased energy efficiency, electrification, sector-coupling, local-content options as well as regional integration. Such analysis considers energy efficiency technology shifts and fuel switching to electricity in different economic end-use sectors, such as the use of green hydrogen in the industry sector or the increasing volume of electric vehicles in the transport sector. By putting these considerations into perspective, analyses of the conflicting and complementary objectives of economic policy and climate policy are provided to support political decision-making processes, thus facilitating a power system transformation that is technically, economically, and environmentally sustainable.

In Latin America and the Caribbean, GET.transform supports regional and national institutions in identifying knowledge gaps along energy and climate planning processes, and offers capacity building and analytical support in establishing a holistic approach to sustainable development. Specifically, GET.transform facilitates the Regional Technical Forum of Energy Planners (FOREPLEN), organised by the UN Economic Commission for the region (UN ECLAC), which provides a platform for political and technical dialogue, where participating countries share and discuss best practices and lessons learned in advancing the energy transformation. In Peru, GET.transform also supports the General Directorate of Energy Efficiency (DGEE) of the Ministry of Energy and Mines (MINEM) in analysing the long-term planning process of the electricity system.



The following country chapters contain an outline of key planning institutions, publications and practices. This is followed by a summary of good practices shared by the country. Depending on the topic that the practices address, they are categorised under the three main pillars highlighted in the introduction: **strengthening scenario development, improving scenario use and identifying capacity building approaches.**

1. ARGENTINA



Institution responsible for energy planning and scenario development

Department of Energy, Ministry of Economy

Most recent energy planning documents

- [Towards a shared vision of Argentina's energy transition to 2050](#) (Plataforma Escenarios Energéticos, 2020)
- [Energy Scenarios 2030](#) (National Directorate for Energy Scenarios and Planning, 2019)
- [Energy Scenarios Platform – Argentina to 2040](#) (Plataforma Escenarios Energéticos, 2018)

Good practices for energy planning and scenario development

- Strong governance and institutionalisation of participatory processes under the National Climate Change Cabinet
- Dialogue and co-ordination within and among institutions
- Incorporation of social and environmental dimensions in long-term energy scenarios
- Scenarios to explore the role of new technologies

Pillar 1.1

Strengthening scenario development – establishing a strong governance structure

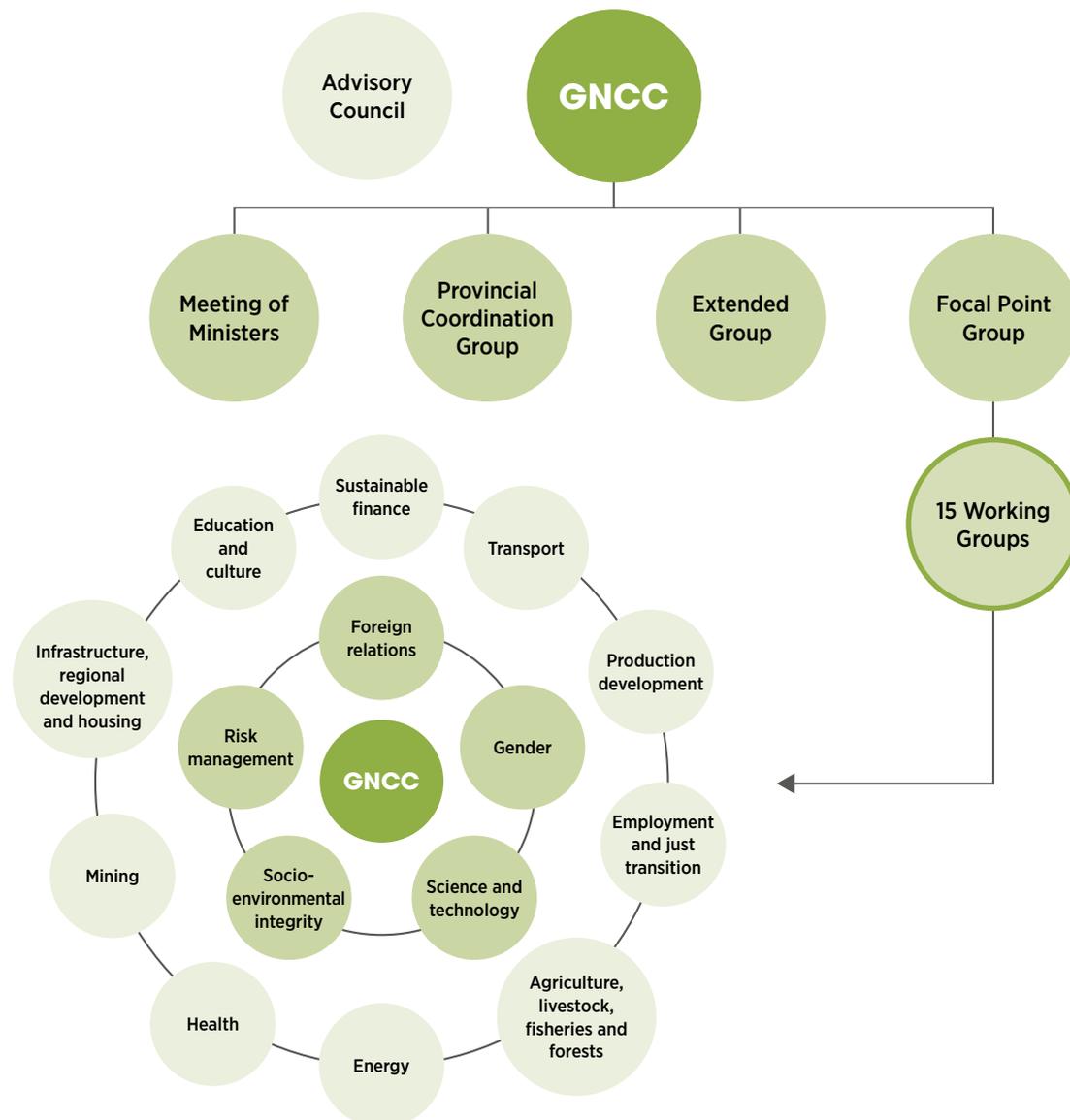
Argentina has established a governance structure that includes climate change action as government policy.

The Department of Energy forms part of the National Climate Change Cabinet (GNCC), created under the Climate Change Act in 2016. As part of the GNCC's work, the Department of Energy leads long-term energy planning and scenario development efforts, which are strongly driven by the climate change agenda: the country's Nationally Determined Contribution (NDC) and Long-Term Strategy. The GNCC comprises the Meeting of Ministers, the Provincial Coordination Group, the Extended Group (to facilitate citizen engagement) and the Group of Focal Points from different ministries, which supervises 15 technical working groups (Figure 2). Lastly, the Climate Change Act establishes a GNCC advisory council. Co-ordination within and among institutions and public participation were key aspects of the process to develop the 2020 NDC, which sets targets for 2030.

The vision, pillars and goals of Argentina's energy transition to 2050 were agreed in an intersectoral dialogue.

With a view to involving civil society in the development of long-term energy scenarios as input for official planning, the Department of Energy launched the initiative Towards a Shared Vision of Argentina's Energy Transition to 2050. This participatory process was led by the Executive Committee of the Argentine Energy Scenario Platform, which brought together the Energy Regulation Training and Research Centre (CEARE) of the University of Buenos Aires, the Technology Institute of Buenos Aires (ITBA), the Avina Foundation, the United Nations Development Programme (UNDP) and the Department of Energy itself. A total of 23 institutions took part in the process, providing input for energy scenarios up to 2050. The Business Meeting Facility, the General Confederation of Labour (CGT) trade union, consumer representatives, energy industry representatives and former energy ministers also took part.

Figure 2 Governance structure for climate action planning in Argentina



Source: Rodriguez, 2021.

Pillar 1.2 Strengthening scenario development - expanding the boundaries of scenarios

The aim of Argentina’s long-term energy planning is to bring about a clean and just energy transition.

The process carried out under the initiative, Towards a Shared Vision of Argentina’s Energy Transition to 2050, resulted in the identification of four pillars that served as the basis for stakeholders to agree, in a participatory process, on the goals that energy planning would aim to achieve by 2050. These four pillars are: energy security; environmental sustainability; energy efficiency and competitiveness; and social inclusion and employment. The aim is to ensure that energy planning is inclusive, dynamic, stable, federal, sovereign and sustainable. Sustainability was established as a cross-cutting goal, and climate action as a driver of the energy transition process. Various social dimensions were taken into account in setting the goals.

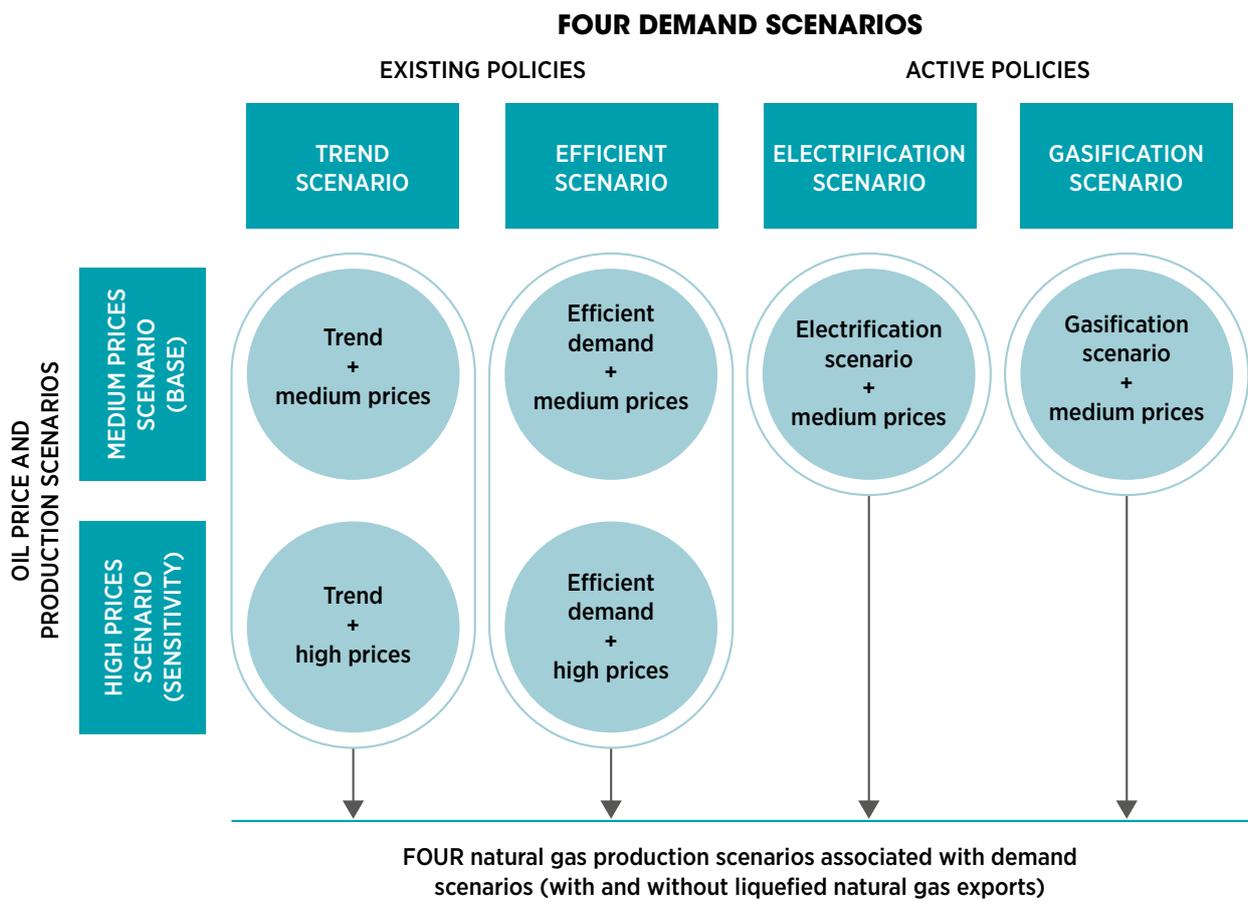
Pillar 2.1

Improving scenario use - clarifying the purpose of scenario building

Argentina has developed scenarios to 2030 and is now working on scenarios to 2050, exploring different levels of ambition in the end-use and supply sectors.

In co-operation with the Energy Scenario Platform, the Department of Energy took part in an initiative in which various organisations presented their energy supply scenarios to 2040. This provided an opportunity to evaluate proposals, discuss relevant issues and identify areas of agreement and divergence over the future of energy in Argentina. Separately, as part of a periodic planning exercise, the Department of Energy has developed a series of scenarios to 2030. In 2019, in addition to the trend scenario, it analysed three scenarios with policies aimed at end-use sectors: energy efficiency, increased electrification and greater access to local natural gas (Figure 3). This included analysis of oil price and production sensitivity. Lastly, taking the goals established in the backcasting process of Towards a Shared Vision of Argentina's Energy Transition to 2050 as a starting point and further developing them, work is now being carried out to explore scenarios with different levels of ambition to evaluate the potential development of new technologies in supply and demand sectors: renewable energy, energy storage, electric vehicles, hydrogen, intelligent networks, and carbon capture and storage.

Figure 3 Energy scenarios to 2030 developed by Argentina's Department of Energy in 2019



Source: Rodriguez, 2021.

2. BRAZIL



Institution responsible for energy planning and scenario development

Ministry of Mines and Energy (MME)
Energy Research Office (EPE)

Most recent energy planning document

- National Energy Plan 2050 (MME and EPE, 2020)

Good practices for energy planning and scenario development

- Planning is carried out by the Ministry of Mines and Energy in co-operation with EPE, which is responsible for conducting studies. The long-term energy strategy (National energy plan 2050) will guide policy making for the energy transition.
- Participatory processes to achieve consensus among the government, companies and society
- Continuous capacity building and interaction with other national and international entities

Pillar 1.1

Strengthening scenario development
- establishing a strong governance structure

EPE is a public federal agency with ongoing responsibility for energy planning studies to support the formulation of policies and plans.

EPE provides services to the Ministry of Mines and Energy, carrying out studies and research to support planning. At the same time, the energy policies and guidelines published by the Ministry are used as input for planning. This synergy enables the government to objectively formulate the questions to be addressed with each plan. Although plans are developed from a government perspective, it is very important to build consensus among government, companies and society. EPE therefore conducts participatory processes that enable contributions from other stakeholders to be taken into account. This involves workshops, public consultations, presentations and discussions. The gaps identified in these participatory processes are analysed in additional studies. Given the complexity of the electricity and the oil and gas sectors, EPE's preferred method is integrated analysis of the results of detailed sector modelling.

Pillar 2.1

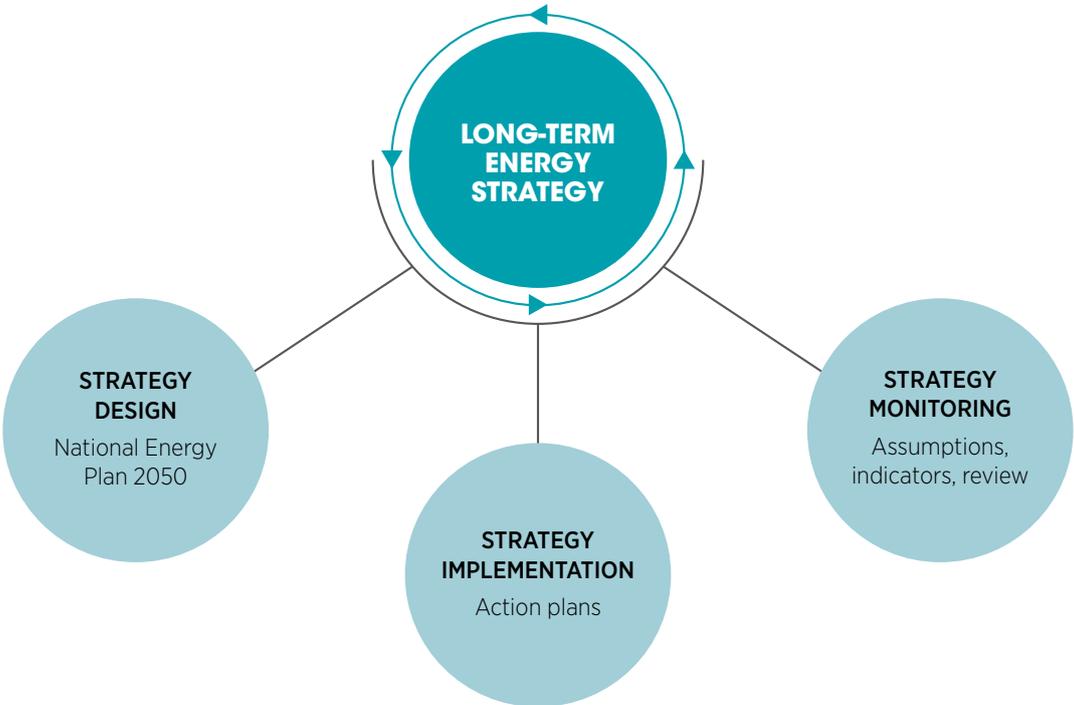
Improving scenario use
- clarifying the purpose of scenario building

The National Energy Plan 2050 was conceived to support the design of a long-term strategy that will guide policy making for the energy transition.

The purpose of the National Energy Plan 2050 was not to set ambitious quantitative targets, but to harmonise existing policies, explain the rationale behind them and guide the formulation of new actions required to bring about the energy transition. Efforts are being undertaken to build consensus on this (with companies, citizens and consumers), taking into account social and economic issues. Based on the

strategy, specific action plans and mechanisms for monitoring implementation will be designed (Figure 4). Brazil has extensive experience in scenario development and analysis for the evaluation of power system expansion and operation, using highly sophisticated methods to analyse the uncertainty associated with hydropower generation.

Figure 4 Concept of Brazil’s National Energy Plan 2050



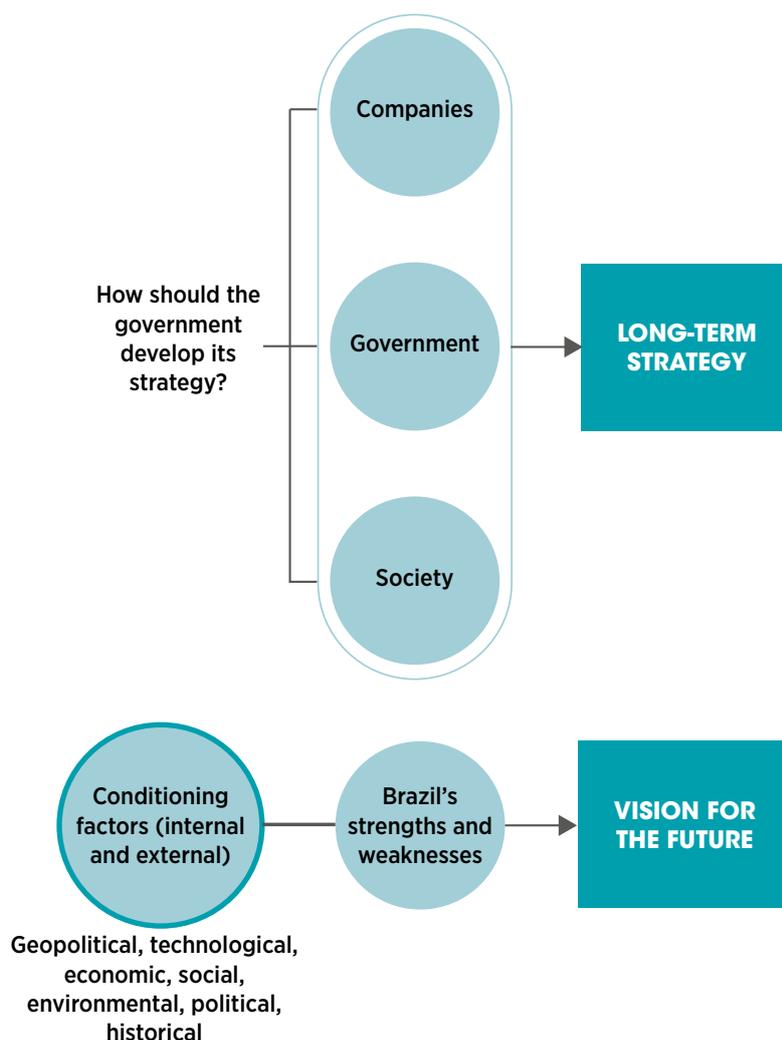
Source: Barral, 2021.

Pillar 2.2 Improving scenario use – transparent and effective communication

Transparent communication is key to achieving consensus among the government, companies and society to ensure that government plans are aligned with the country’s long-term vision.

Political leaders in Brazil regard energy scenarios as valuable input for policy making. The process that resulted in the development of the National Energy Plan 2050 required a considerable communication effort to explain how to interpret the plan. This was a crucial factor in the high level of receptiveness and the success of the dialogue. The main purpose of the plan was to build consensus, and to achieve this it was necessary to explain the importance of “focusing less on the figures and more on strategy consistency, pathway flexibility, analysis of the risks involved in each decision and technology lock-in”. Businesses, institutions, the media and the public came together to understand, discuss and debate the strategy that Brazil will follow in the long term (Figure 5).

Figure 5 Purpose of Brazil’s National Energy Plan 2050



Source: Barral, 2021.

**Pillar
3.1**

Identifying capacity building approaches
– building the right type of scenario capacity in government

In-house training programmes, partnerships with other entities and participation in international forums to share experiences and lessons learned have yielded successful results in Brazil.

In-house training courses have been held at EPE on the development and application of scenarios and on the use of analytical tools. Capacity building activities have helped to provide a better understanding of technical aspects. Partnerships have created opportunities to inform and educate stakeholders and develop new scenarios, such as the Energy Transition Programme involving EPE, the Inter-American Development Bank (IDB) and the Brazilian Center for International Relations (CEBRI). A good practice that emerged was the sharing of experiences and lessons learned internationally, for example in the series Long-Term Energy Scenarios for Developing National Clean Energy Transition Plans organised by the Clean Energy Ministerial and IRENA, and in FOREPLEN, which is organised by ECLAC.

3. CHILE



Institution responsible for energy planning and scenario development

Ministry of Energy

Most recent energy planning document

- [First five-year long-term energy planning process \(2018-2022\)](#) (Chilean Ministry of Energy, 2018)
- [Second five-year long-term energy planning process \(2023-2027\)](#) (Chilean Ministry of Energy, 2021)

Good practices for energy planning and scenario development

- Institutionalisation of long-term energy planning and periodic updates
- Promotion of citizen engagement and regional development planning
- Ambitious quantitative targets to achieve carbon neutrality by 2050
- Energy scenarios built on long-term narratives and visions

Pillar 1.1

Strengthening scenario development - establishing a strong governance structure

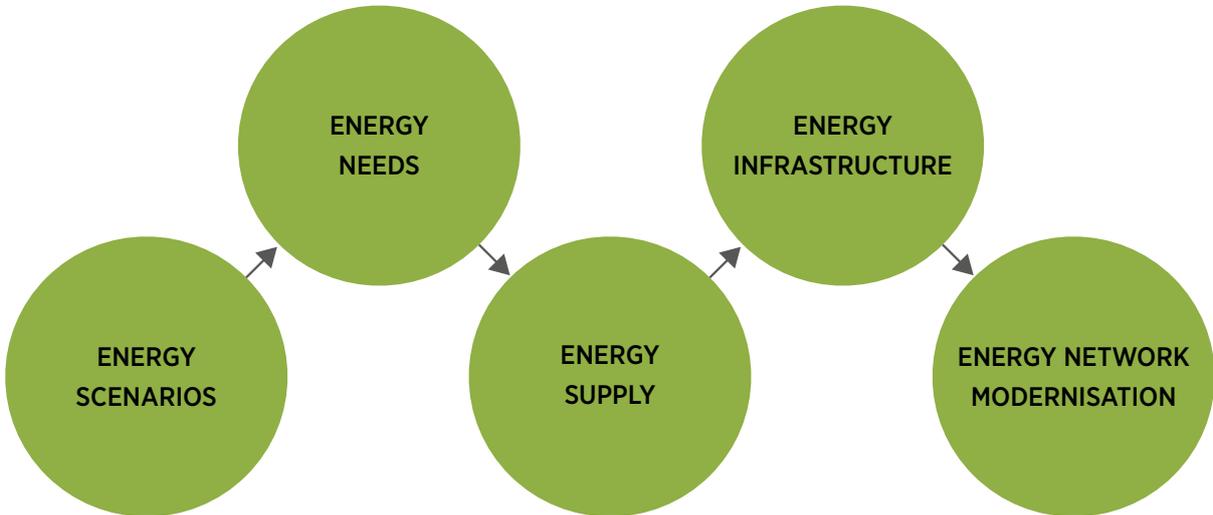
Chile has institutionalised long-term energy planning as a public regulatory instrument.

Chile has institutionalised long-term energy planning under the Electricity Services Act, which establishes five-year energy planning processes and annual updates. The process (Figure 6) starts with the development of long-term energy scenarios (in this case up to 2060), drawing on the outcomes of citizen engagement and input from the regions. Other inputs are the National Energy Policy, the Framework Law on Climate Change and the commitment to achieve carbon neutrality by 2050 established by Chile in 2019, in addition to the different national sectoral policies, strategies, initiatives and commitments, and regional, provincial and district plans. The Electricity Services Act requires energy supply and demand projections to be updated annually. The process concludes with the identification of development opportunities for the energy sector and infrastructure requirements.

The energy planning process promotes citizen engagement and regional development planning.

To ensure the legitimacy of the energy scenarios developed and the energy planning process, individuals and legal entities can register to take part. More than 700 people are registered to participate in the second five-year process (2023-2027). To ensure that the vision is not too centralised, regional participation is promoted and regional development criteria are taken into account. For example, Chile has established a process in which various institutions are responsible for preparing an annual transmission expansion plan. Environmental and territorial variables are taken into account in the routing study that will determine where the power lines are to run.

Figure 6 Flowchart showing the energy planning process in Chile



Pillar 1.2 Strengthening scenario development - expanding the boundaries of scenarios

Chile has set ambitious quantitative targets to achieve the goal of carbon neutrality by 2050.

The target of achieving carbon neutrality by 2050 depends to a large extent on measures taken in the energy sector - which in 2020 generated 77% of national carbon dioxide (CO₂) equivalent emissions - and on CO₂ sequestration in forests. Chile's carbon neutrality scenarios are based on five measures: sustainable industry, green hydrogen, electromobility (including the drive to electrify mass transit), the phasing out of coal-fired power plants by 2040 and energy efficiency. Chile aims to develop its renewable energy potential and become an exporter of green hydrogen. In the electricity sector, there are plans to carry out projects for concentrated solar power with thermal energy storage, solar PV power, wind power, hydropower and batteries. Energy planning plays a key role in power transmission expansion because it guides the process, identifying optimal sites for future renewable energy generation projects.

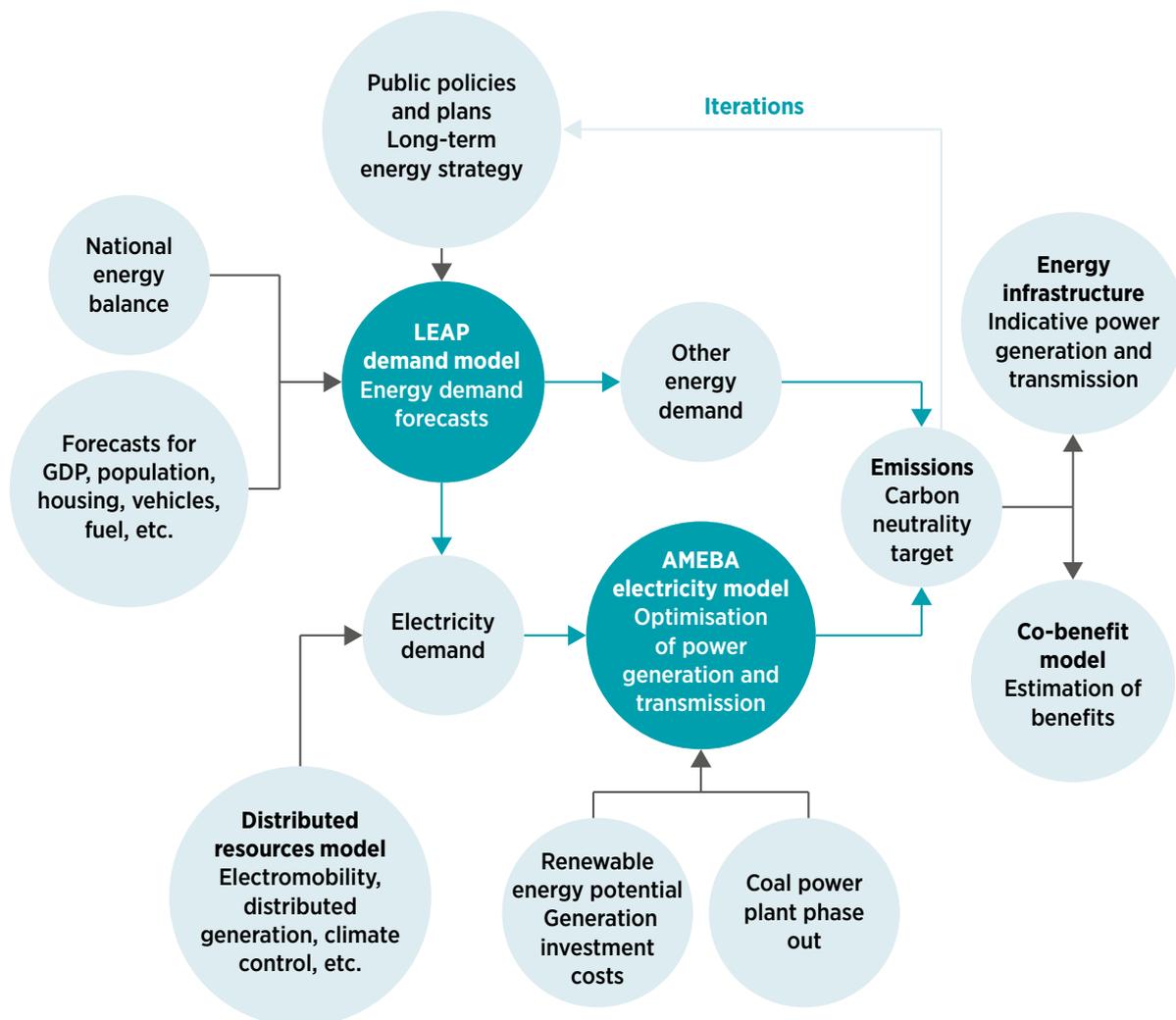
Pillar 2.1

Improving scenario use - clarifying the purpose of scenario building

Energy scenarios are built on long-term narratives and visions to guide short-term decision making and help understand situations that may arise in the medium term.

Chile is mapping out a set of long-term energy scenarios to cover a broad range of possible developments, thus helping to reduce uncertainty and risk in short-term decision making. Future pathways are determined by consistent narratives and visions establishing sectoral commitments and targets. During the scenario building process, the Long-Range Energy Alternatives Planning (LEAP) model, which forecasts energy demand, is combined with the AMEBA (cloud-based analysis tool) model, which co-optimises power system expansion and operation (Figure 7). Finally, models are used to estimate sectoral co-benefits associated with policies and to analyse distributed energy resources, such as distributed generation and electromobility.

Figure 7 Methodological relationship between scenario building models in Chile



Source: Barriá, 2021.

4. COLOMBIA



Institution responsible for energy planning and scenario development

Mining and Energy Planning Unit (UPME), Ministry of Energy and Mines

Most recent energy planning document

- National Energy Plan 2020-2050 (UPME, 2020)

Good practices for energy planning and scenario development

- Participatory process contributing to governance during planning and implementation
- Use of scenarios to explore potential energy transformation pathways and determine their cost and implications
- Effective communication strategy tailored to target audience for the purpose of identifying the strengths and limitations of the plan
- Website allowing public access to the input data used for modelling

Pillar 1.1

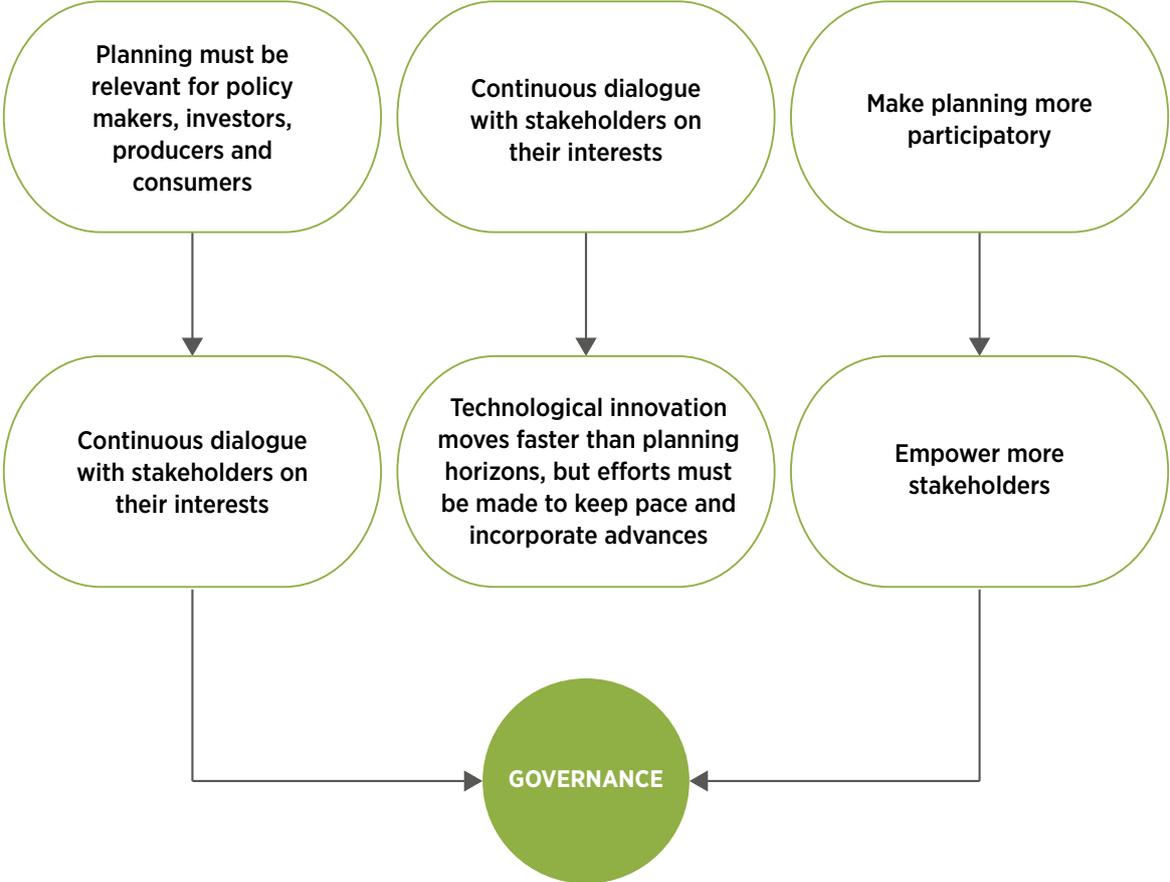
Strengthening scenario development
- establishing a strong governance structure

The main planning challenge lies not in developing content but in negotiating its implementation, as this requires effective governance throughout the process.

The participatory process involved in developing the National Energy Plan 2020-2050 helped to build a strong governance structure. UPME held a series of participatory workshops for this purpose. The engagement of Colombia's rural communities was important, allowing those involved to gain a clear picture of the mutual benefits and fostering a relationship of trust. The process also included interviews with experts and public consultations.

Figure 8 shows how UPME aims to strengthen governance in the planning process. This will be an ongoing effort, as the plan will be updated every two years. UPME believes that more participatory planning promotes stakeholder empowerment and ensures that the instruments developed are relevant to a wider cross-section of the population. Stakeholder involvement helps ensure the continuity of the National Energy Plan's vision and areas of action, regardless of changes of government. In the future, decentralisation and digitalisation will help strengthen engagement among those stakeholders.

Figure 8 Strengthening governance in the process to develop Colombia’s National Energy Plan 2020-2050



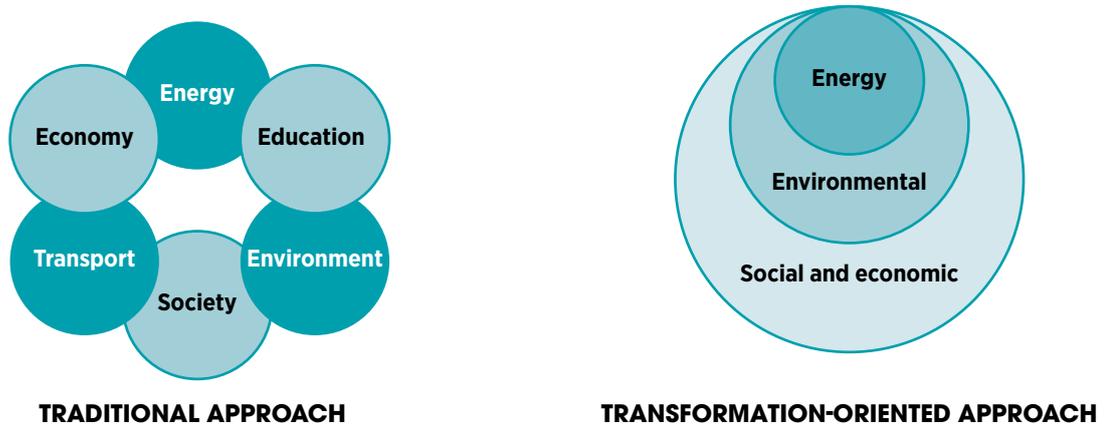
Source: Jaramillo, 2021.

Pillar 2.1 Improving scenario use
- clarifying the purpose of scenario building

The government is widening the scope of planning and adopting a transformation-oriented approach.

The purpose of the National Energy Plan 2020-2050 is to establish a common long-term vision, map out potential pathways for achieving it and identify trade-offs. Four energy transformation scenarios consistent with Colombia’s sustainable development objectives are being explored. Figure 9 shows a new approach that is more conducive to the energy transformation and compares it with the traditional approach. The transformation scenarios incorporate technological, environmental, economic, social and regional aspects. Climate change was considered in the scenarios in two ways: 1) by modelling decarbonisation goals; and 2) by including the effects of climate change on the energy mix (extreme heat, high rainfall variability, increased drought and lack of rainfall).

Figure 9 Comparison of the traditional approach and the transformation-oriented approach in Colombia



Source: Jaramillo, 2021.

**Pillar
2.2**

Improving scenario use
- transparent and effective communication

The communication strategy for disseminating the National Energy Plan 2020-2050 was designed to foster interaction, transparency and effectiveness.

The plan was discussed with a broad and diverse but not necessarily technical audience. Different communication approaches were therefore used depending on the target audience. The quantitative modelling used to help formulate the National Energy Plan was based on a series of considerations and assumptions that had to be communicated in an effective and honest way, highlighting the strengths and limitations of the planning process without undermining its relevance or authority. Lastly, transparency was enhanced by sharing the modelling data, assumptions and results on the UPME website³.

**Pillar
3.1**

Identifying capacity building approaches
- building the right type of scenario capacity in government

Stakeholders with planning expertise acted as partners in the discussions to prepare the National Energy Plan 2020-2050.

Although UPME plays the leading role in energy modelling know-how, various stakeholders are qualified to make useful contributions to the discussion. Two key groups with valuable in-house modelling expertise are companies and academic and research institutions, and they contributed as partners to the workshops held to develop the National Energy Plan. However, this expertise is generally not yet available within local government and civil society. UPME aims to involve these stakeholders more actively in the process. To this end, it developed a strategy (Pillar 4 of the National Energy Strategy: knowledge and innovation) to increase dissemination and build stakeholder capacities in order to facilitate more constructive engagement.

³ www1.upme.gov.co/DemandayEficiencia/Paginas/PEN.aspx

5. COSTA RICA



Institution responsible for energy planning and scenario development

Ministry of Environment and Energy (MINAE)

Most recent energy planning document

- [7th National Energy Plan 2015-2030 and Update 2019-2030 \(matrix of actions and targets\)](#) (MINAE, 2020)
- [National Decarbonisation Plan 2018-2050](#) (Government of Costa Rica, 2019)

Good practices for energy planning and scenario development

- Transparent citizen engagement bringing a diversity of visions and interests into the dialogue
- Scenario development to 2050 for foresight planning
- Use of quantitative (modelling) and qualitative (environmental and socio-economic narratives) elements
- Co-operation between academia and government to improve capacities for modelling and analysis

Pillar 1.1

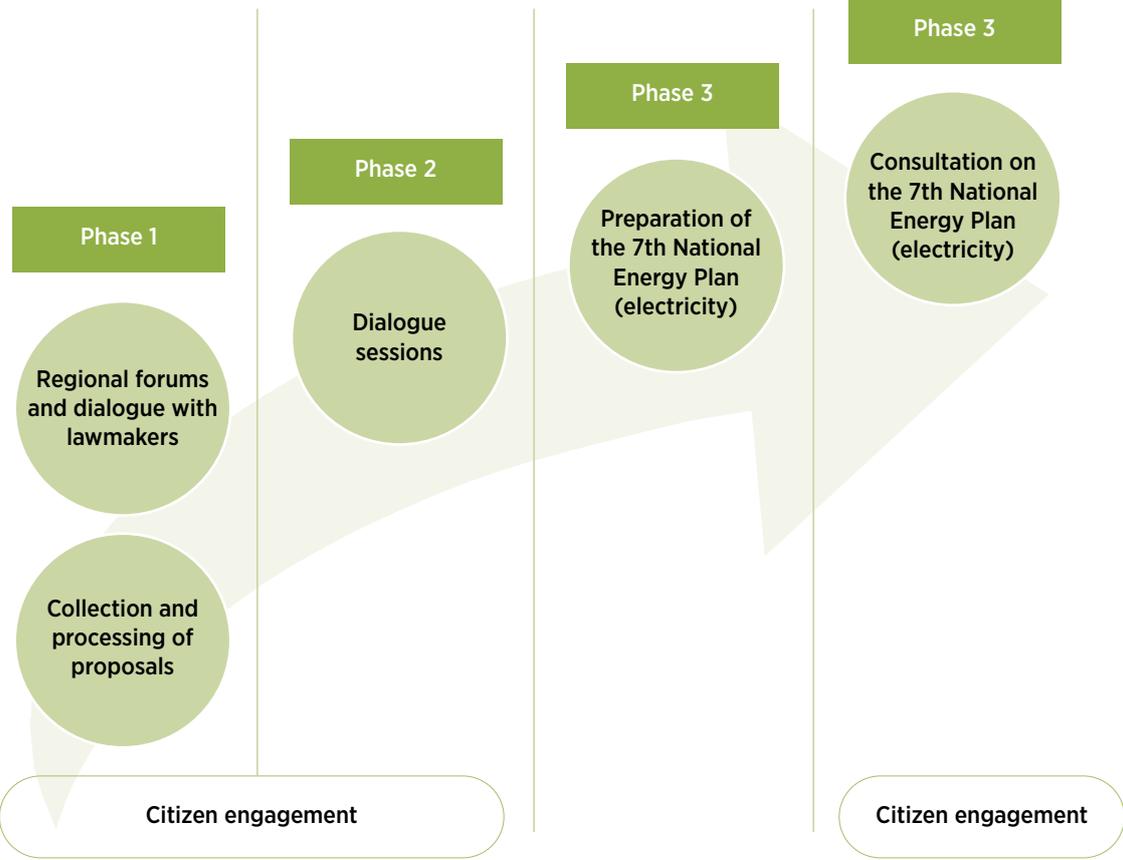
Strengthening scenario development - establishing a strong governance structure

The development of long-term energy policy is based on a transparent citizen engagement process that incorporates the widest possible range of sectoral visions and interests.

Costa Rica's National Energy Plan 2015-2030 was developed using a long-range foresight approach, which takes into account complex local issues and disruptive and transformational change. The approach includes a transparent citizen engagement process for long-term energy policy making and investment prioritisation based on future scenarios. The aim of the National Energy Plan was not to set quantitative targets, but to guide policy and strategy and establish the actions required.

Figure 10 shows the four steps in the process to develop the National Energy Plan: 1) collection and processing of proposals and comments on the preliminary document; regional forums and dialogues with lawmakers; 2) dialogue sessions with broad multisectoral representation; 3) preparation of the National Energy Plan by the Ministry of Environment and Energy; and 4) public consultation on the National Energy Plan and feedback.

Figure 10 Process to develop long-term energy policy for Costa Rica’s National Energy Plan 2015-2030



Source: Molina, 2021.

Pillar 2.1 Improving scenario use
 - clarifying the purpose of scenario building

Scenarios for the National Decarbonisation Plan 2018-2050 were taken into account in the preparation of Costa Rica’s 2020 NDC.

Costa Rica’s 2020 NDC was developed taking into account two types of elements: 1) quantitative elements based on computational energy planning models; and 2) qualitative elements based on possible future narratives. The quantitative elements included the pathways modelled for the National Decarbonisation Plan 2018-2050. The qualitative elements were established on the basis of socio-economic and environmental narratives exploring uncertainty and potential implications for each sector.

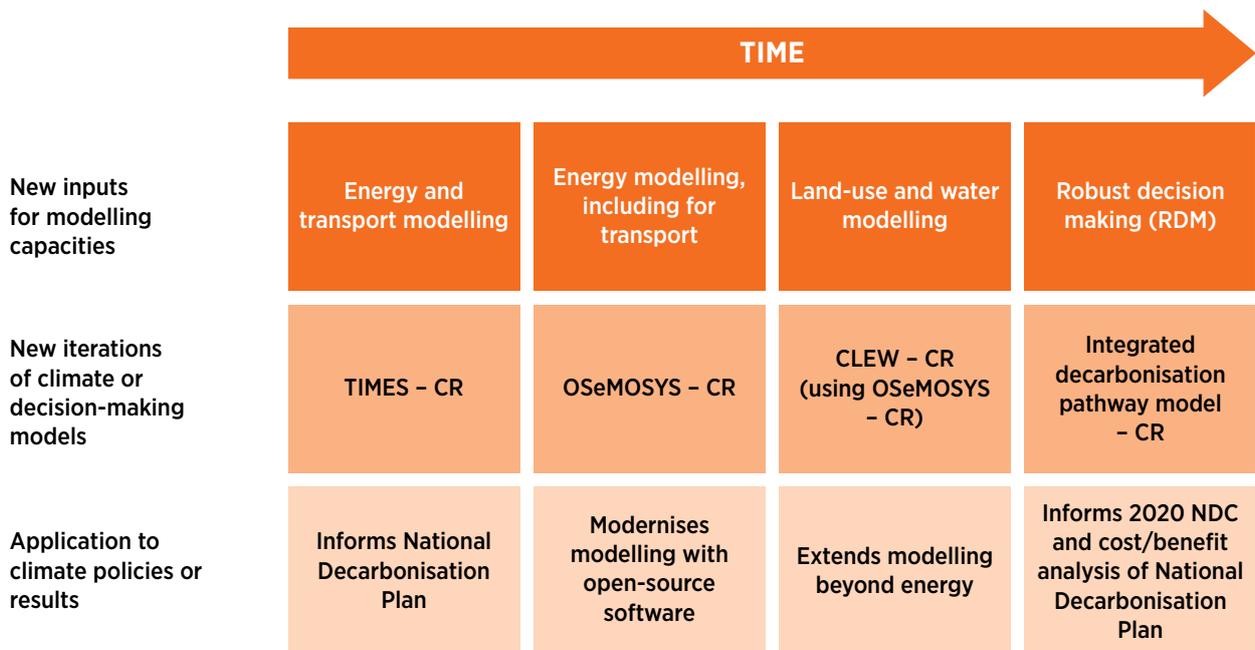
**Pillar
3.1**

**Identifying capacity building approaches
- building the right type of scenario capacity in government**

Capacities for modelling action to achieve climate targets in Costa Rica have been progressively strengthened with support from academic institutions and national and international organisations.

The Ministry of Environment and Energy leads the development and use of energy and climate action planning models, working in close collaboration with the University of Costa Rica and national and international organisations, such as the IDB and the French Development Agency (AFD). Figure 11 shows how these capacities have evolved, progressing from sectoral modelling using commercial software to integrated modelling that assesses long-term interlinkages between climate, land, energy and water (CLEW) using open-source energy modelling software (OSeMOSYS for Costa Rica). With support from academic institutions, technical personnel with the Ministry of Environment and Energy were trained to develop the expertise required to use these models.

Figure 11 Evolution of climate action modelling capacities in Costa Rica



Source: Molina, 2021.

6. DOMINICAN REPUBLIC



Institution responsible for energy planning and scenario development

Ministry of Environment and Energy (MINAE)

Most recent energy planning document

- 7th National Energy Plan 2015-2030 and Update 2019-2030 (matrix of actions and targets) (MINAE, 2020)
- National Decarbonisation Plan 2018-2050 (Government of Costa Rica, 2019)

Good practices for energy planning and scenario development

- Planning of incentives to promote projects aligned with the energy transition
- Scenario development to assess new pathways for energy sector development consistent with national policy guidelines

Pillar 1.1

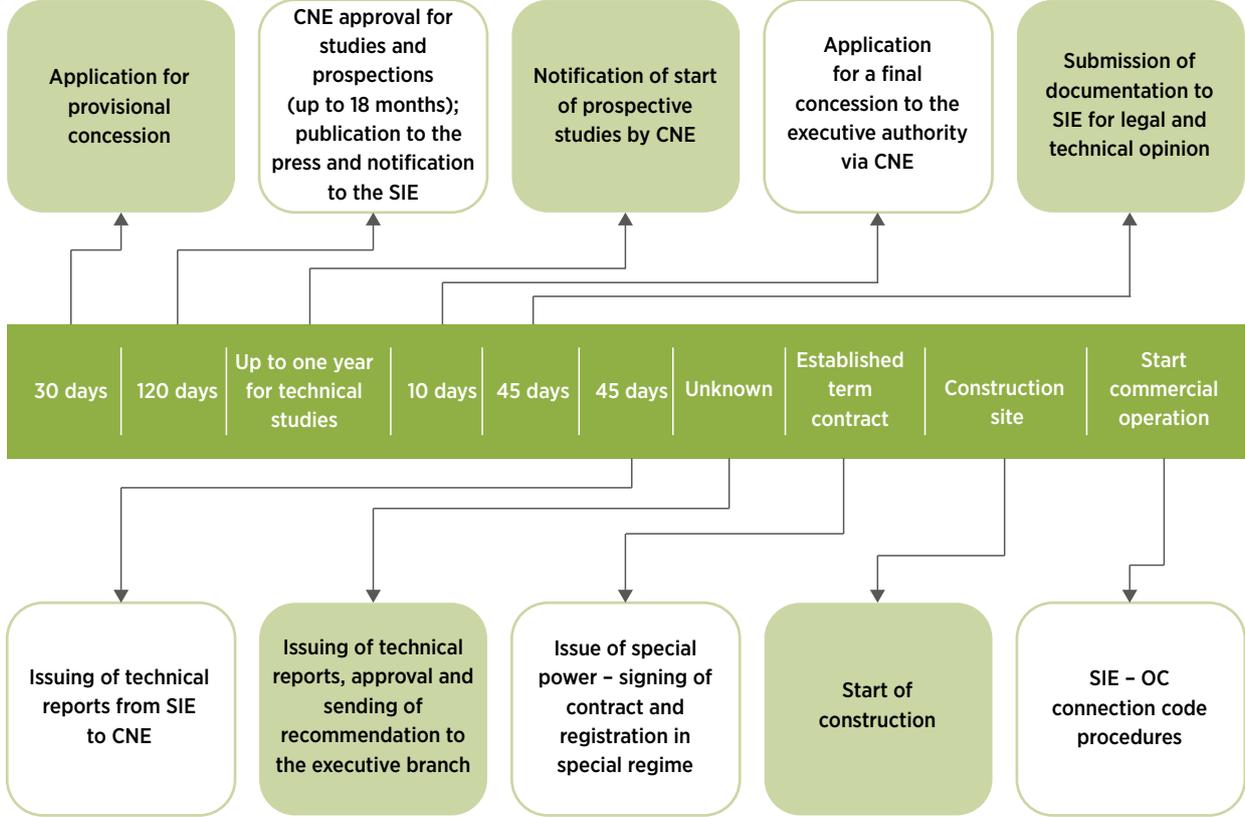
Strengthening scenario development
– establishing a strong governance structure

Electricity sector institutions co-ordinate with one other to implement the regulatory framework that offers incentives for the implementation of projects for power generation from renewable energy.

The National Energy Commission (CNE) is responsible for national energy planning and, with technical and legal support from the Superintendence of Electricity (SIE), manages the process of granting concessions for renewable energy power generation projects under Act 57-07 and its implementing regulations. The aim is to create an enabling environment to promote the growth of renewable energy and increase the overall resilience of the system.

Figure 12 shows the process for obtaining a concession for renewable energy power generation projects. The provisional concession is granted by unanimous decision of the CNE members. The applicant then has 12 months to complete the final studies and obtain environmental, interconnection and other secondary permits before submitting an application for the definitive concession. Finally, on the recommendation of the CNE and the SIE, the President of the Republic issues the final decision on the award of a concession for each project.

Figure 12 Process for awarding concessions for renewable energy power generation projects in the Dominican Republic



Source: Rodriguez and Veras, 2021.

Pillar 1.2 Strengthening scenario development – expanding the boundaries of scenarios

In an island country, it is important for power system expansion studies to take into account operational security in hurricane situations.

Power system expansion planning in the Dominican Republic places special emphasis on two factors: 1) “geographic security” and 2) system flexibility. As it is a small island country that is occasionally affected by hurricanes, the aim is to minimise the risk of power outages and reduce service restoration time when outages do occur. The country’s power system expansion plans therefore involve wind power generation distributed across the north and south and solar PV generation, which should also be distributed geographically and not concentrated in a small number of systems.

The current power system is not very flexible. For this reason, as well as to increase the share of variable renewable energy, the country intends to increase firm power generation using flexible technologies. To this end and in accordance with climate goals, the country is promoting measures to phase out the use of fuel oil at thermal power plants and repower them with natural gas. It also welcomes projects by private investors for energy storage at renewable energy power plants. With a view to achieving these goals, Act 57-07 establishes a scheme offering incentives and awarding concessions for renewable power generation projects.

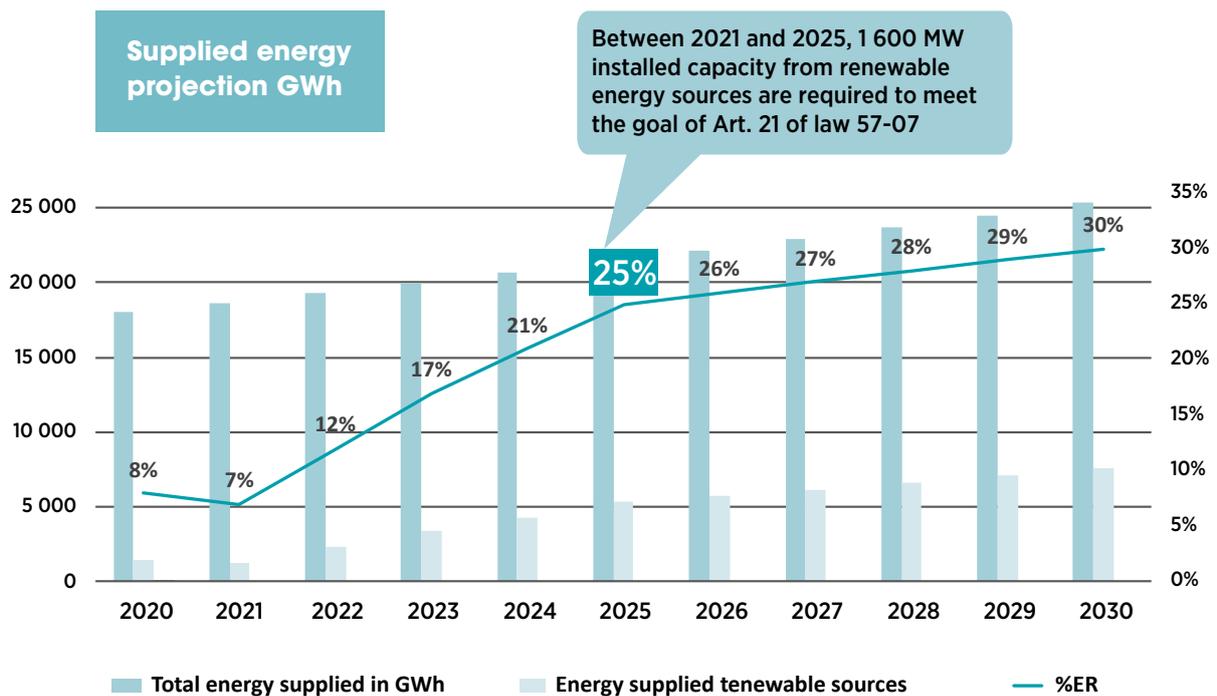
Pillar 2.1

Improving scenario use
- clarifying the purpose of scenario building

The Dominican Republic's new government aims to increase the share of renewable energy generation to 30% by 2030 and to prepare the country to achieve carbon neutrality by 2050.

The government that recently took office is seeking to map out a new pathway for energy sector development, which was assessed using medium-term energy scenarios. The prioritised scenario was used to prepare the National Development Strategy, which sets targets consistent with the agreements signed with the Latin American Energy Organization (OLADE) and the United Nations. The targets include increasing the share of renewable energy in power generation to 25% by 2025 and to 30% by 2030 and achieving carbon neutrality by 2050. Priority has been given to scenarios where the electricity system is most resilient and less reliant on fossil fuels. To achieve the targets set, an agile and co-ordinated process has been put in place to award concessions and grant incentives to investors that implement projects for power generation from renewable energy (Figure 13).

Figure 13 Scenario to 2030 to comply with Article 21 of Act 57-07 of the Dominican Republic



Source: Rodriguez and Veras, 2021.

7. ECUADOR



Institution responsible for energy planning and scenario development

Ministry of Energy and Non-Renewable Natural Resources (MERNNR)

Most recent energy planning document

- Electricity Master Plan 2018-2027 (MERNNR, 2020)
- National Energy Efficiency Plan 2016-2035 (MERNNR, 2017)
- National Energy Plan (PEN) 2050 (under development) (MERNNR, 2021)

Good practices for energy planning and scenario development

- Publication of planning tools promoting economic development and the energy transition
- Institutional support to develop integrated long-term energy planning
- Participatory planning process
- Analysis of scenarios showing the change in the energy and production mix
- Assessment of alternative scenarios considering new technologies to address climate change

Pillar 1.1

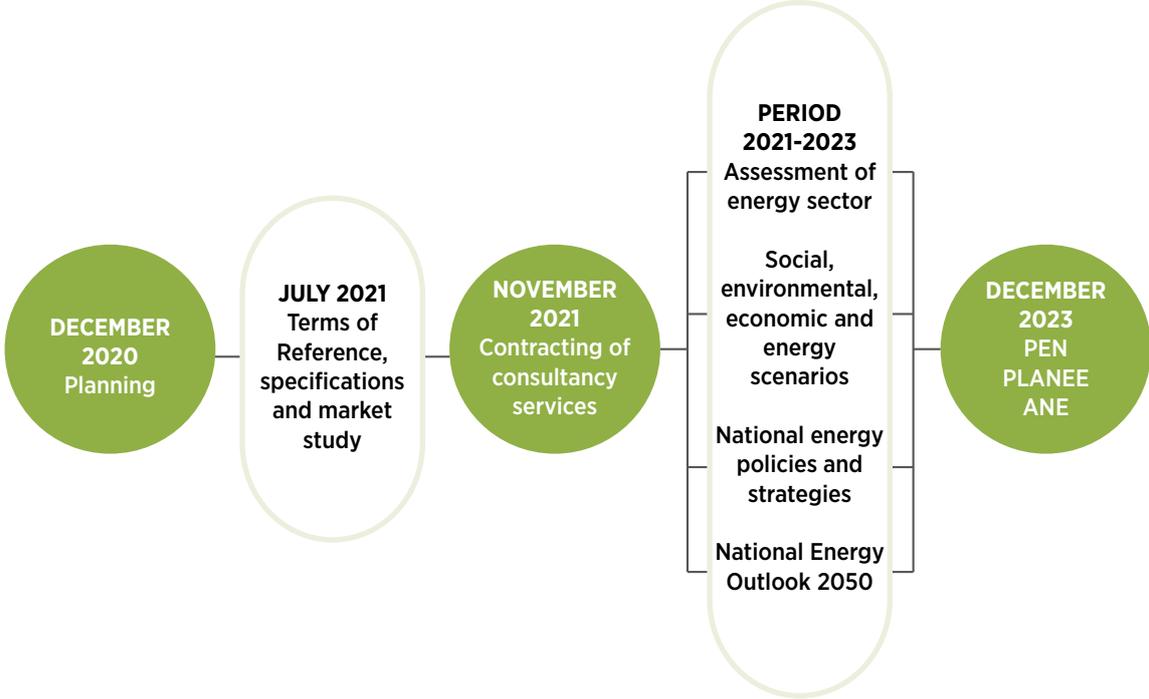
Strengthening scenario development
- establishing a strong governance structure

Ecuador has various planning instruments promoting energy development, the energy transition and climate action.

In the period from 2017 to 2021, the ministries responsible for electricity, oil and gas, and mining were merged to form the current Ministry of Energy and Non-Renewable Natural Resources (MERNNR). This institutional restructuring created the enabling environment needed for the development of Ecuador's National Energy Plan (PEN) 2050. The process undertaken to develop PEN 2050 is shown in Figure 14. One of the main pillars is the development of energy, economic, social and environmental scenarios.

PEN 2050 will guide the development of all the short- and medium-term plans and programmes for the energy sector, in particular the National Energy Agenda (ANE) 2040, the Electricity Master Plan 2027 and the National Energy Efficiency Plan (PLANEE) 2035. The laws concerning the latter two instruments establish an obligation to develop and implement them. All these planning instruments are consistent with the National Development Plan, the 2030 Agenda for Sustainable Development and the United Nations Sustainable Development Goals (SDGs).

Figure 14 Milestones in Ecuador’s National Energy Plan 2050



Source: Diaz, 2021.

The current legal framework promotes participatory and intersectoral energy planning processes.

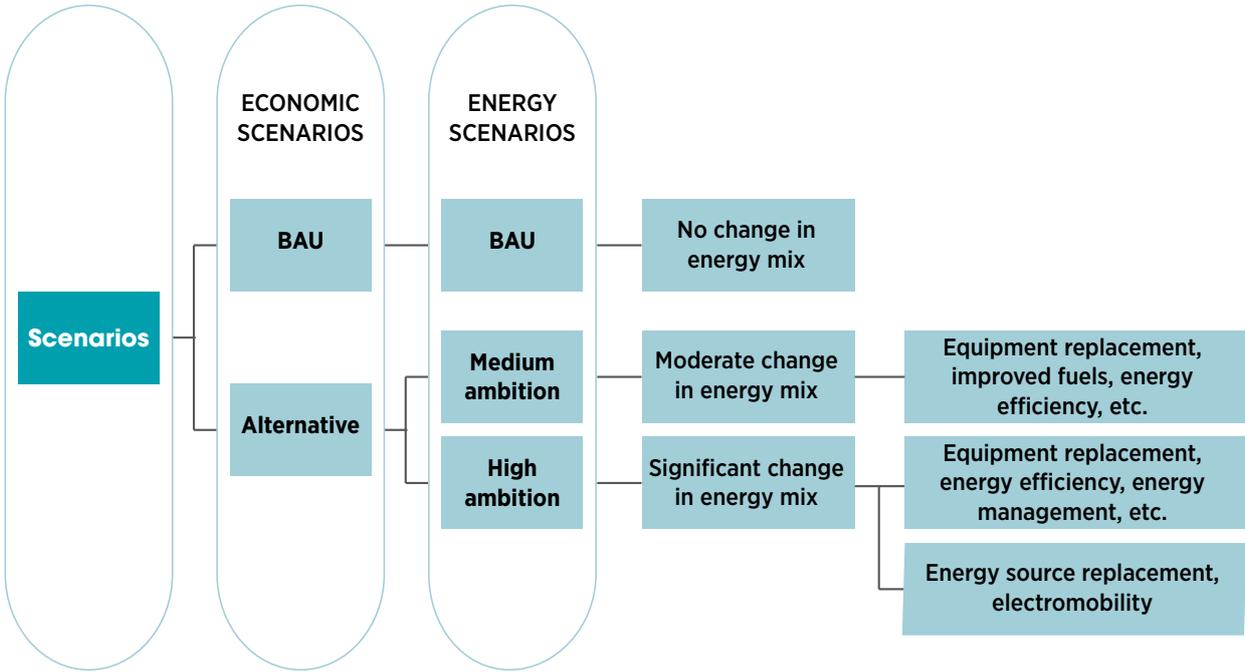
The Energy Efficiency Act (LOEE) promotes co-ordinated intersectoral energy planning. To facilitate this process, the LOEE established the National Energy Efficiency Committee (CNEE), formed by representatives from various ministries, including MERNNR, the Ministry of Industry and Productivity (MIPRO), the Ministry of Environment, Water and Ecological Transition (MAATE), the Ministry of Transport and Public Works (MTOP) and the Ministry of Urban Development and Housing (MIDUVI). The participatory processes for the PEN are co-ordinated through the CNEE.

Pillar 2.1 Improving scenario use
- clarifying the purpose of scenario building

The National Energy Plan (PEN) 2050 analyses scenarios for change in the energy and production mix.

Work on the development of PEN 2050 started by analysing three scenarios combining economic and energy-related assumptions (Figure 15). The first of these is the business-as-usual (BAU) or reference scenario. An analysis will also be made of two alternative scenarios that share the same economic assumptions but differ in the level of ambition with regard to change in the country’s energy and production mix. Ecuador has set a goal of changing this mix, with the aim to stop being an exporter of raw materials and to establish itself in the long term as an exporter of goods and services with high added value. In the higher-ambition scenario, there is a focus on electric vehicle penetration as a strategy for achieving decarbonisation of the land transport sector. The alternative scenarios indicate the need for international co-operation support.

Figure 15 Proposed scenarios for Ecuador’s National Energy Plan 2050



Source: Diaz, 2021.

Pillar 3.1 Identifying capacity building approaches - building the right type of scenario capacity in government

Ecuador is currently developing its first National Energy Plan with the help of external expertise, while at the same time strengthening its own capacities to ensure sustainability.

PEN 2050 is being developed with support from the IDB and AFD. Although the plan is being prepared with the support of a consultancy firm, the government’s aim is to develop its own capacities for scenario modelling using integrated energy planning tools so that the Ministry of Energy can update the plan itself in the future.

8. EL SALVADOR



Institution responsible for energy planning and scenario development National Energy Council (CNE)

Most recent energy planning document

- El Salvador Energy Policy 2020-2050 (CNE El Salvador, 2020)

Good practices for energy planning and scenario development

- Strengthening of the government's lead role in long-term energy planning
- Use of participatory and consultation processes
- Co-ordination of different sectoral visions and plans in the long-term energy plan
- Support through international co-operation to strengthen energy planning capacities

Pillar 1.1

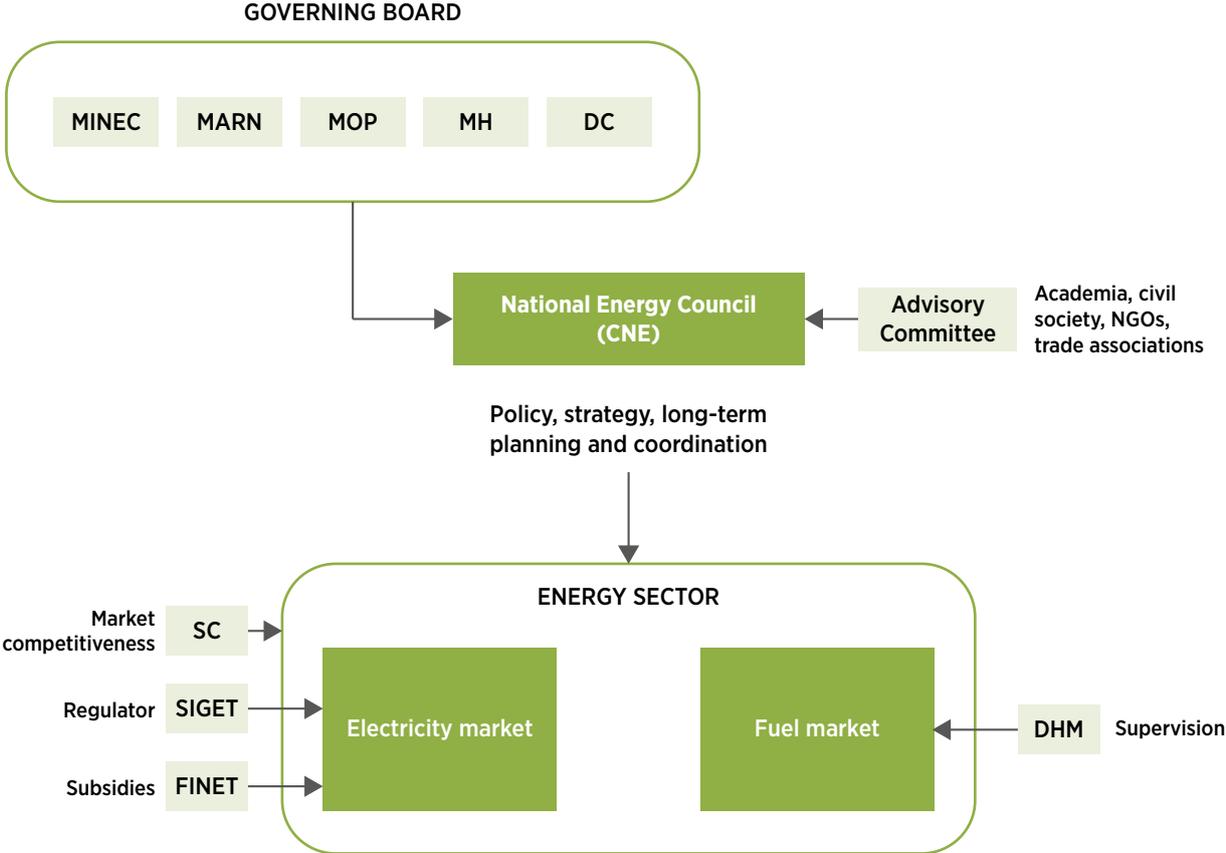
Strengthening scenario development
– establishing a strong governance structure

The government is strengthening its lead role in integrated long-term energy planning through an approach in which participatory and consultation processes are key to achieving broad national consensus.

The government has been gradually restoring its lead role in integrated energy planning since 2010, when it set up the National Energy Council (CNE). According to the law that created the CNE, its purpose is to carry out short-, medium- and long-term energy planning and formulate the country's energy policy. These processes begin with the development of long-term energy scenarios. The CNE is led by a Governing Board made up of top ministry officials from the Ministry of Economy (MINEC), the Ministry of Environment (MARN), the Ministry of Public Works (MOP), the Treasury (MH) and the Consumer Protection Department (DC) (Figure 16).

In addition, the implementing regulations for the CNE Act provide that sectoral consultation processes must be carried out to achieve broad consensus for the development of policies, strategies and scenarios, long-term planning and co-ordination of the electricity and the oil and gas subsectors. The CNE therefore receives input and guidance from an Advisory Committee, which includes representatives from academia, civil society, non-governmental organisations and trade associations. Power distribution companies, the power transmission company and international organisations, such as OLADE and IRENA, also participated in the process to develop the National Energy Policy 2020-2050.

Figure 16 Institutional framework for integrated energy planning in El Salvador



Source: García, 2021.

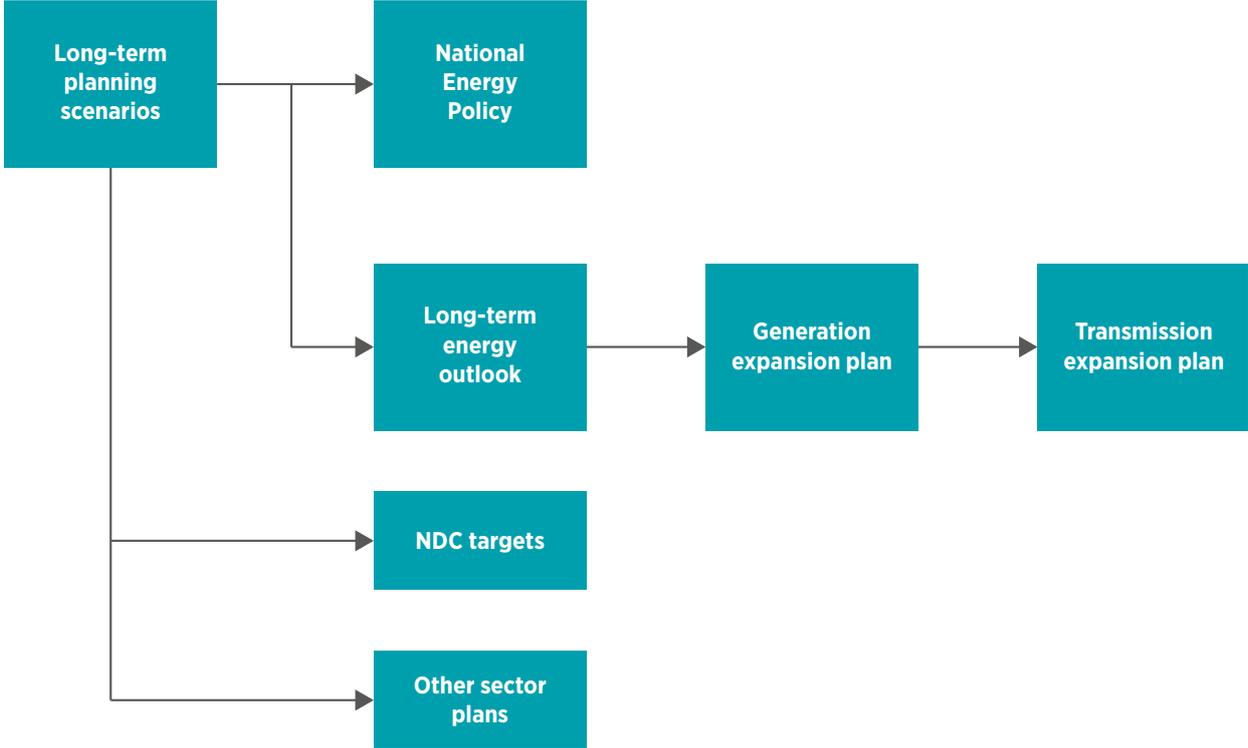
Note: NGO = non-governmental organisation, SC = Superintendence of Competition; SIGET = General Superintendence of Electricity and Telecommunications; FINET = National Electricity and Telecommunications Investment Fund; DHM = Directorate of Oil, Gas and Mines.

Pillar 2.1 Improving scenario use
- clarifying the purpose of scenario building

Long-term energy scenarios are the basis for developing public policy instruments.

Long-term planning scenarios are the basis for developing national energy policy, generation and transmission expansion plans, NDC targets and other energy sector plans concerning, for example, the development of electromobility (Figure 17). In addition to addressing technical aspects, such as long-term scenario development and comparison, energy planning is recognised as a tool for ensuring consistency across a diverse range of factors and priorities, such as reducing energy prices, addressing the need for more investment, meeting growing demand for energy, promoting renewable energy, achieving universal access and creating jobs. In other words, it draws together and integrates different sectoral economic development plans, policies to attract investment, climate change targets, the SDGs, ambitions for developing new technologies and regional development plans.

Figure 17 Purpose of long-term energy scenarios in El Salvador



Source: García, 2021.

Pillar 3.1 Identifying capacity building approaches - building the right type of scenario capacity in government

International co-operation and participation in international forums are crucial for building scenario development and energy planning capacities.

Long-term scenario development and energy planning capacities are gradually being strengthened with support provided through international co-operation (OLADE, IRENA, etc.). Participation in international forums has enabled El Salvador to learn about good practices in other countries. The CNE aims to improve the use of modelling, information management systems, the characterisation of energy end-uses, the incorporation of social and environmental variables, and knowledge of new technologies.

9. GUATEMALA



Institution responsible for energy planning and scenario development

Energy and Mining Planning Unit, Ministry of Energy and Mines (MEM)

Most recent energy planning document

- [Indicative Generation System Expansion Plan 2020-2050](#) (MEM, 2020a)
- [Transport System Expansion Plan 2020-2050](#) (MEM, 2020b)

Good practices for energy planning and scenario development

- Mapping of government and state priorities and national and international commitments
- Co-ordination among institutions on sectoral plans with a view to facilitating the energy transition
- Access to clean, modern forms of energy to improve the quality of life of Guatemalans
- Promotion of non-conventional renewable energy

Pillar 1.1

Strengthening scenario development
- establishing a strong governance structure

Energy planning begins with the mapping of government and state priorities and the identification of national and international linkages.

The Ministry of Energy and Mines (MEM) is responsible for the energy sector. In 2014, it initiated an institutional capacity building process to enable its Energy and Mining Planning Unit to carry out integrated energy planning and develop power generation and transmission expansion plans. These tasks were previously performed by the regulator, the National Electricity Commission (CNEE). The first step in the energy planning process was to analyse the policy environment (Figure 18), which involved mapping the priorities set out in the General Government Policy 2020-2024 and in the K'atun Plan: Our Guatemala 2032 (national development plan), relevant national policy instruments and international commitments. The main national links are with the National Energy Policy 2019, the National Energy Plan 2017-2032 (established in the Climate Change Act) and the National Energy Efficiency Plan 2019-2032. At the international level, Guatemala aims to achieve the SDGs and meet its NDC targets.

Figure 18 Guatemala’s national policy environment and international links

POLICY ENVIRONMENT						
PRIORITIES		NATIONAL LINKS			INTERNATIONAL LINKS	
General Government Policy 2020-2024	K’atun Plan: Our Guatemala 2032	National Energy Policy	National Energy Plan 2017-2032	National Energy Efficiency Plan 2019-2032	2030 Agenda and SDGs	Paris Agreement
Bringing electricity to over 60 000 families	Access to clean renewable energy and generation	5 priority areas of action	Inter-institutional energy and climate change action	Legislation, standards and culture	Affordable, non-polluting energy	NDC 11.2% (unconditional) and 22.6% (conditional)

Source: Velázquez, 2021.

Guatemala has developed various sectoral energy plans up to 2050. Co-ordination among the institutions involved is crucial to achieving the common goal of implementing the energy transition.

In the electricity and energy efficiency subsectors, Guatemala has various long-term plans: the Generation Expansion Plan 2050, the Transmission Expansion Plan 2050, the Rural Electrification Plan 2050 and the Energy Efficiency Policy 2021-2050, which is currently awaiting approval. The first two plans are being updated to 2052. The promotion of electrified transport is particularly important for Guatemala as a country that exports electricity and imports fossil fuels. The National Electromobility Plan was due to be published at the end of 2021. Various policy instruments will be proposed in the plan, including pilot projects for electric fleets and free charging and time-of-use electricity tariffs.

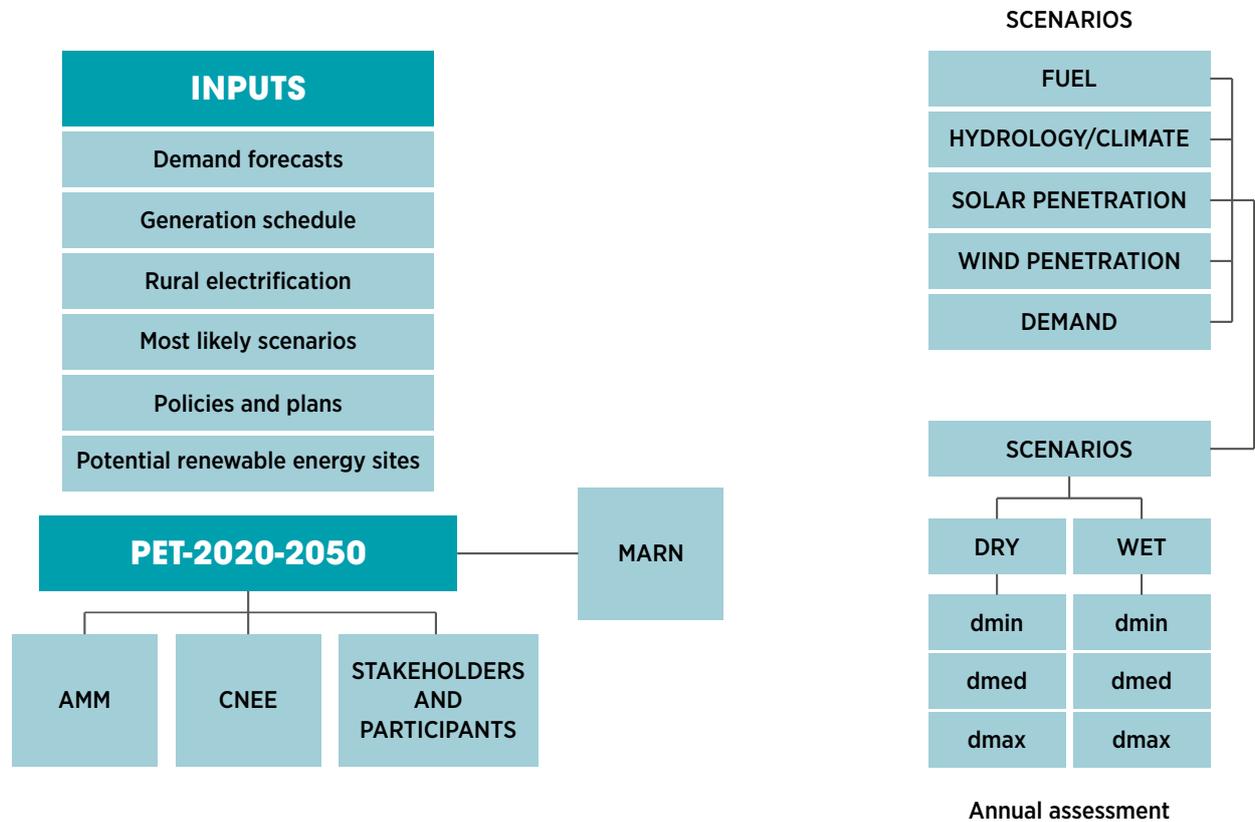
**Pillar
2.1**

Improving scenario use
- clarifying the purpose of scenario building

The Transmission Expansion Plan (PET) 2020-2050 was formulated taking into account a wide range of scenarios.

As part of the drafting process for the Transmission Expansion Plan (PET) 2020-2050, probability analyses were carried out for a wide range of scenarios to 2050. The scenarios consider changes in the availability and price of fossil fuels, solar PV and wind power penetration, different electricity demand projections, and rainfall and climate variability (dry and wet scenarios) (Figure 19). Other inputs used for the PET include the implementation schedule for the Generation Expansion Plan 2020-2050, the Rural Electrification Policy 2020-2050, the National Energy Efficiency Plan and the National Electromobility Plan.

Figure 19 Inputs and scenarios developed as part of Guatemala’s PET 2020-2050 drafting process



Source: Velázquez, 2021.

10. HONDURAS



Institution responsible for energy planning and scenario development

Ministry of Energy

Most recent energy planning document

- [Energy Agenda: Honduras 2019-2021](#) (Honduran Ministry of Energy, 2020)
- [Proposed Road Map 2050: Creating spaces, closing gaps](#) (Honduran Ministry of Energy, 2021)

Good practices for energy planning and scenario development

- Inter-institutional co-ordination
- Alignment of short-, medium- and long-term targets
- Vision to 2050 developed in a participatory process and incorporating social criteria

Pillar 1.1

Strengthening scenario development – establishing a strong governance structure

Co-ordination among energy sector institutions and the climate community has permitted the development of short-, medium- and long-term plans for the energy transition.

The Ministry of Energy is responsible for energy planning. To improve co-ordination between the energy sector and the climate community, the Ministry has a Climate Change Committee. It forms part of the Inter-institutional Climate Change Committee, which is tasked with preparing the country's NDC and national long-term strategy. The National Energy Policy sets targets for three different milestone dates: 2030, 2038 and 2050. The first milestone entails meeting the goals set in the NDC and the SDGs by 2030, and the second is aligned with the goals set in the Law on the Establishment of a Country Vision and Adoption of a National Plan 2010-2038. The third milestone is aligned with decarbonisation targets to be achieved by 2050.

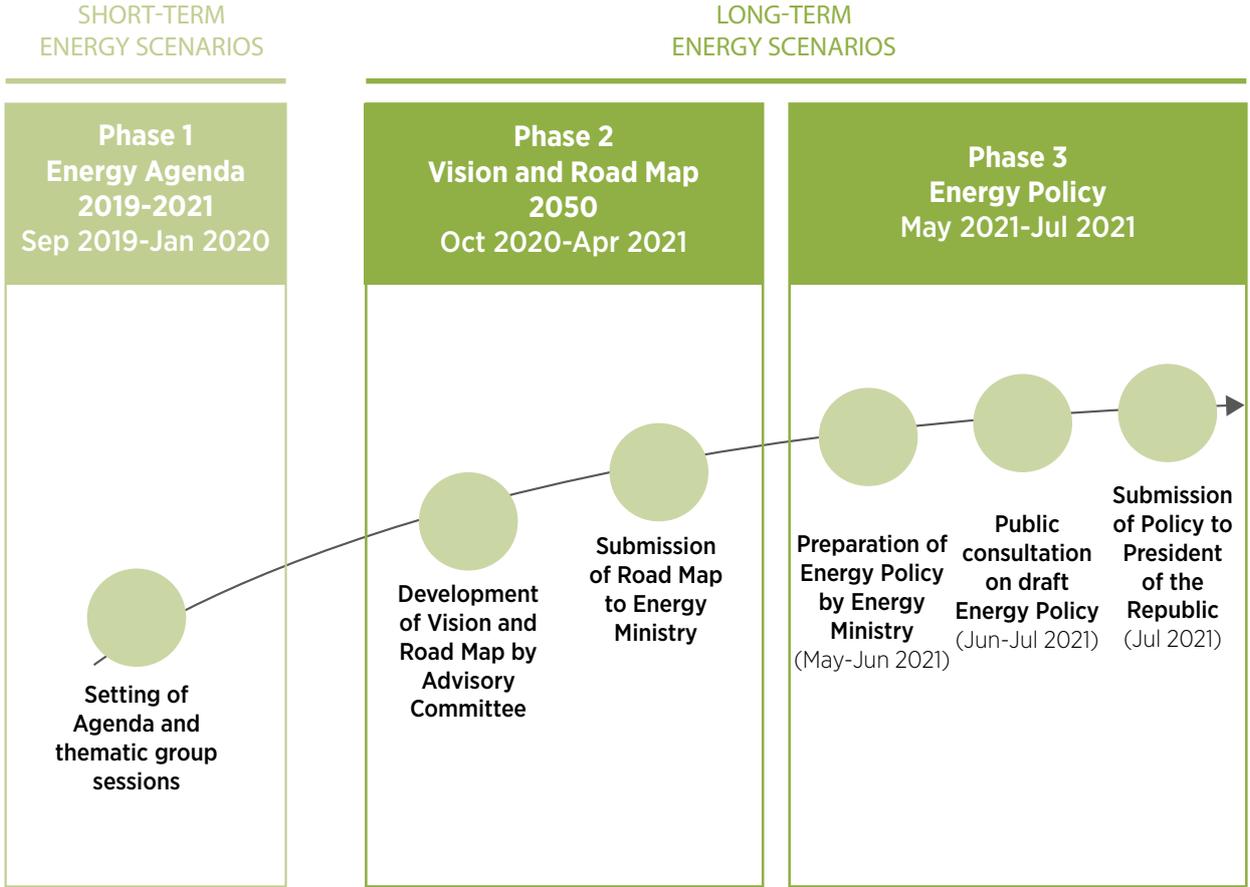
The Energy Policy is described as: “an instrument that sets out how the sustainable development of the energy sector will be achieved in the short, medium and long term, as established in a participatory process undertaken for this purpose. The ultimate aim of this public policy is to improve the standard of living of the Honduran people, satisfying their energy needs and meeting all the country's national and international commitments.”

Short-, medium- and long-term targets were set in a two-year participatory process implemented in various phases.

The National Energy Policy is an instrument developed in a participatory manner to guide the sustainable development of the sector in the short, medium and long term. It was prepared in three phases (Figure 20). In the first phase, which lasted five months, the Energy Agenda 2019-2021 was drawn up. It provides a summary of the government's work plan and its goals, targets and actions in this area. Virtual workshops were held at the national level with energy sector stakeholders to discuss medium- and long-term scenarios in 14 thematic working groups. More than 900 specialists and representatives from academic institutions, public institutions, businesses and international co-operation organisations took part.

Based on the results of the work of the different workshop groups, a high-level Advisory Committee prepared the Vision and Road Map 2050. This Advisory Committee was formed by around 40 people, including ministers, business leaders, university rectors and representatives of international co-operation and civil society organisations. The Road Map sets out 376 actions, 104 targets, 24 strategic goals and 5 strategic pillars. In the third phase, the Ministry of Energy drafted the National Energy Policy, which is currently out for public consultation.

Figure 20 Methodology for the development of the National Energy Policy of Honduras



Source: Velázquez, 2021.

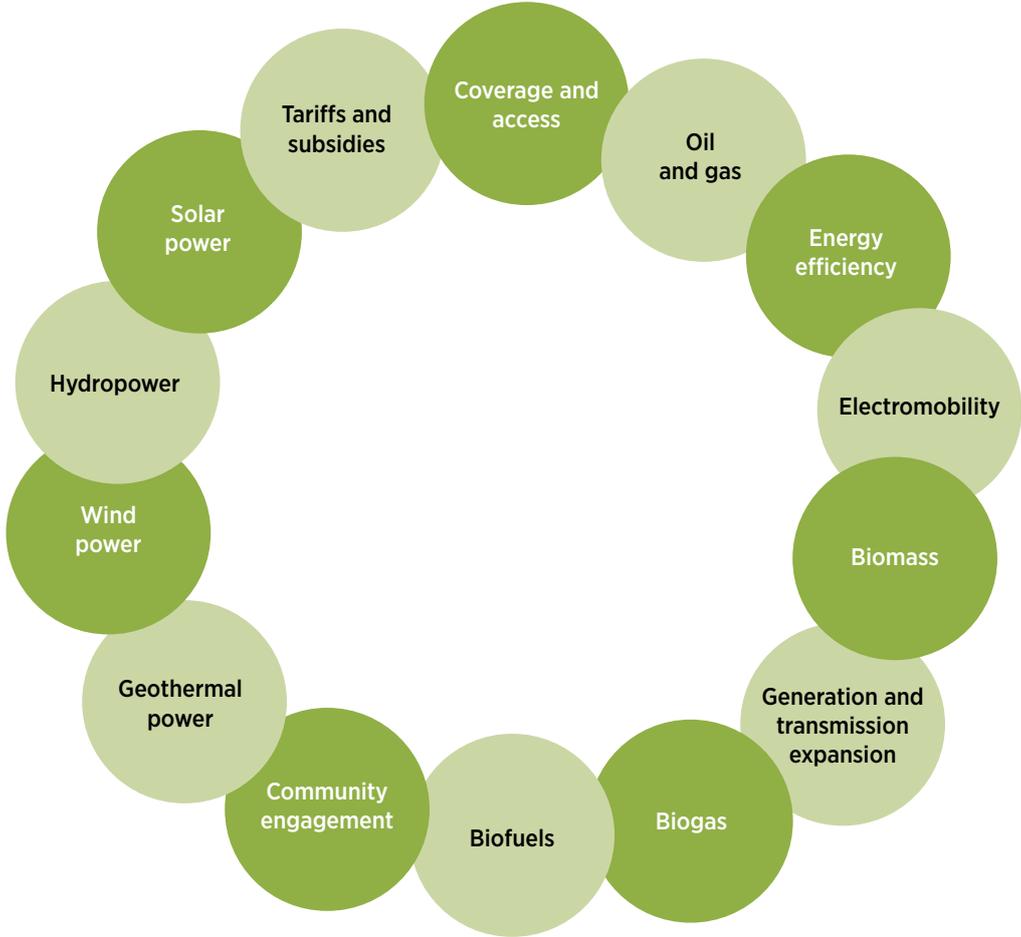
Pillar 1.2 Strengthening scenario development - expanding the boundaries of scenarios

Public policy instruments developed for the energy sector take into account the outcomes of the discussions of thematic working groups on the needs of the population and problems facing the sector.

The working groups formed to develop the Road Map 2050 discussed 14 topics of importance to the country (Figure 21). The outcomes were used by the Advisory Committee to develop the energy policy vision and the final version of the Road Map 2050. Honduras aims to achieve an inclusive, comprehensive,

resilient, efficient, transparent and competitive energy sector that is aligned with the 2030 Agenda for Sustainable Development and ensures universal access to affordable modern energy. The National Energy Policy states that its main objective is to improve the standard of living of Hondurans and to meet all national and international commitments.

Figure 21 Topics relevant to the energy transition to 2050 in Honduras discussed by thematic working groups



Source: Cárcamo, 2021.

11. MEXICO



Institution responsible for energy planning and scenario development

National Commission for Efficient Energy Use (CONUEE)
Ministry of Energy (SENER)

Most recent energy planning document

- [Transition Strategy to Promote the Use of Cleaner Technologies and Fuels \(updated 2020\)](#) (CONUEE, 2018)
- [National Electricity System Development Programme \(PRODESEN\) 2018-2032](#) (SENER, 2018)

Good practices for energy planning and scenario development

- Ensure that planning takes into account all policies relevant to the development of the technologies required
- Inter-institutional co-operation to pool modelling capacities
- Consideration of useful energy demand
- Integration of energy planning tools

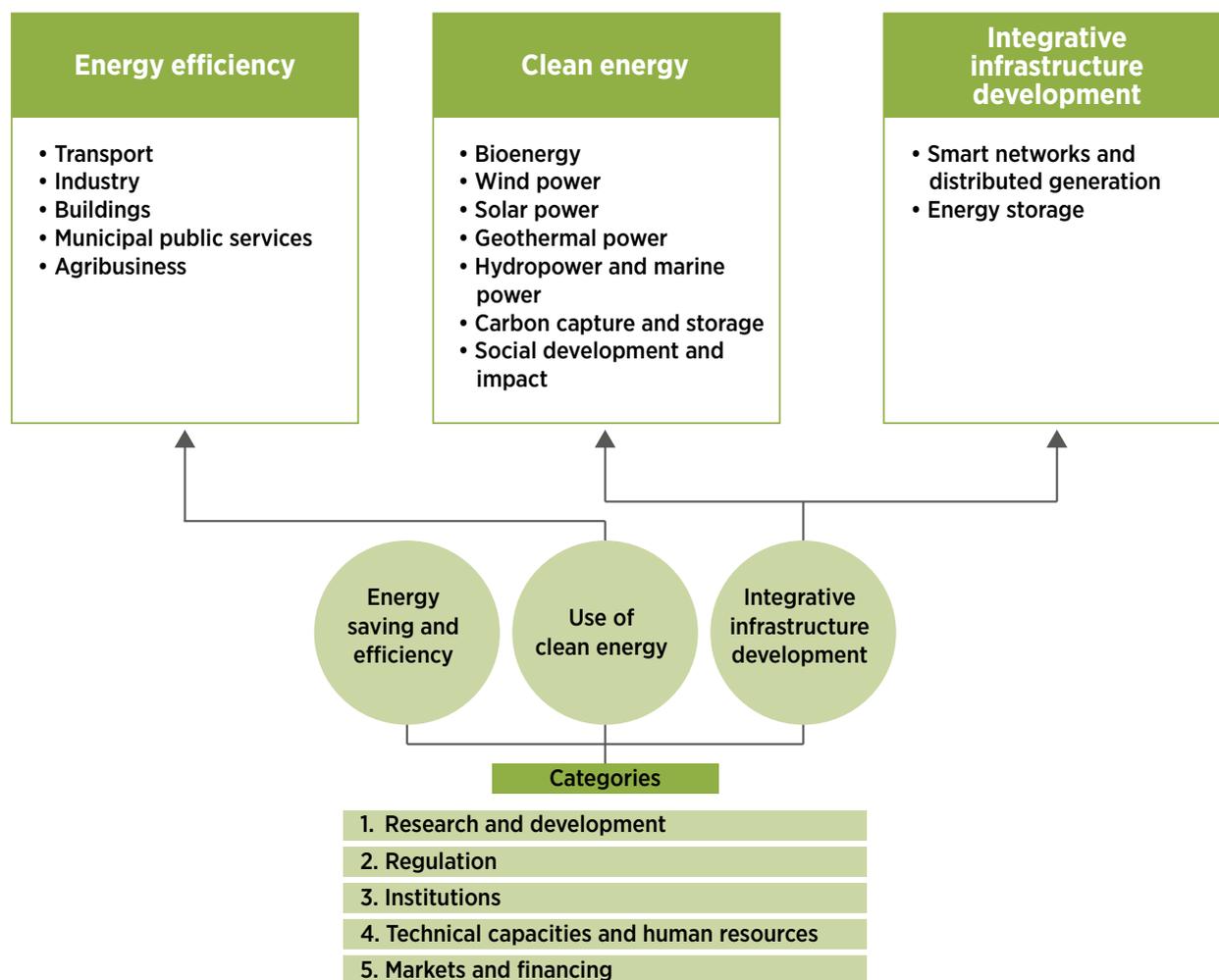
Pillar 1.1

Strengthening scenario development
- establishing a strong governance structure

Mexico's Energy Transition Strategy (ETE) identifies the type of public policies that would promote the development of technologies for clean electricity generation and energy efficiency in end-use sectors.

The Ministry of Energy (SENER) and CONUEE share responsibility for preparing the Transition Strategy to Promote the Use of Cleaner Technologies and Fuels (ETE). This policy instrument includes medium- and long-term scenarios, presents the Vision for 2050 and sets out actions structured into three technological categories (energy saving and efficiency, use of clean energy and integrating infrastructure development). It also sets out the policies, divided into five categories, that will enable the targets set for these actions to be achieved (Figure 22). The strategy must be reviewed every six years to update policy content and actions, and every three years its 15- and 30-year scenarios and targets must be updated for both clean energy generation and energy efficiency.

Figure 22 Structure of lines of actions for the energy transition as established in Mexico’s ETE



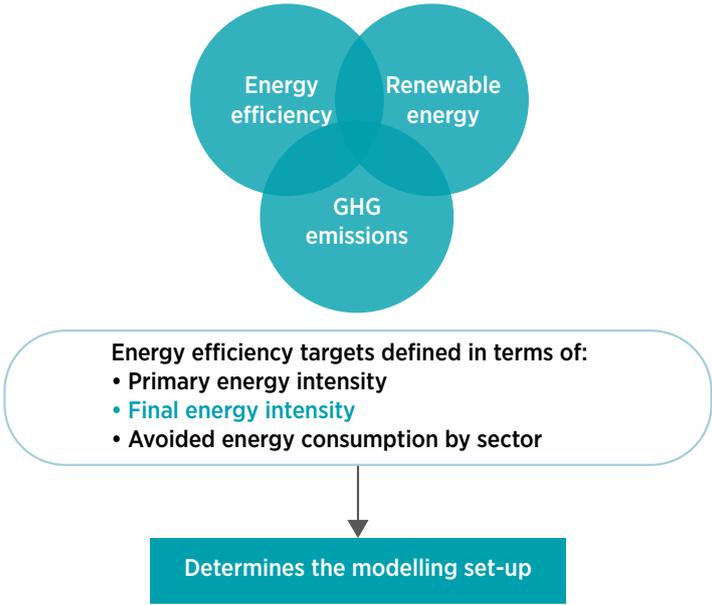
Source: Navarrete, 2021.

Pillar 2.1 Improving scenario use
- clarifying the purpose of scenario building

Final energy demand forecasts used to calculate power system expansion are made on the basis of useful energy demand simulation.

Mexico’s ETE presents two scenarios: Business as Usual (BAU) and Sovereign Energy Transition (TES). When designing such scenarios, it is important to ensure that there is no overlap of targets for renewable energy penetration, energy efficiency and the reduction of greenhouse gas emissions (Figure 23). To avoid this happening, integrated analysis is crucial. The scenario modelling set-up is selected according to the indicators required. It is good practice to design scenarios based on final energy intensity indicators in each sector. Mexico uses scenario simulation techniques, with modelling based on the use of energy services and useful energy demand. This is used to calculate final energy demand in each end-use sector. The legal framework for the energy transition in Mexico specifies that these consumption scenarios must be used as input to calculate long-term power system expansion at the national level.

Figure 23 Criteria for designing scenarios and avoiding target overlap.



Source: Navarrete, 2021.
 Note: GHG = greenhouse gas.

Pillar 3.1 Identifying capacity building approaches – building the right type of scenario capacity in government

Mexico uses a number of planning tools for modelling and including energy efficiency measures in energy transition scenarios.

The ETE’s Sovereign Energy Transition (TES) scenario was developed using various planning tools. CONUEE received MEDPRO software as a donation from French co-operation, and the associated training was provided by the French Agency for Ecological Transition (ADEME) and Enerdata. As part of an international consultancy project funded by the European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the LEAP software tool was introduced. RETScreen and the System Advisor Model (SAM) were also used to model specific technologies for renewable energy generation and energy efficiency in industry.

Inter-institutional co-operation on scenario development is a crucial factor in leveraging sectoral knowledge and modelling expertise.

Under the ETE, the development of integrative infrastructure requires effective co-ordination among institutions to ensure a good understanding of the interaction between technologies throughout the energy transformation chain. Although climate targets are set by the Ministry of Environment and Natural Resources (SEMARNAT), together with the Ministry of Foreign Affairs, the modelling expertise and sectoral knowledge of CONUEE and the Ministry of Energy were crucial in the formulation of the ETE. For example, the results of a participatory process led by CONUEE, in which energy efficiency measures were modelled and discussed with representatives of industry associations and small and medium-sized enterprises, were taken into account in the development of the ETE’s TES scenario.

12. PANAMA



Institution responsible for energy planning and scenario development

National Department of Energy (SNE), Ministry of Presidency

Most recent energy planning document

- [Strategic Guidelines for the Energy Transition Agenda 2020-2030](#) (SNE, 2020)
- [National Energy Plan 2015-2050](#) (SNE, 2015)

Good practices for energy planning and scenario development

- Participatory planning process promoting citizen engagement in energy transition plans
- Short- and medium-term sectoral strategies aligned with the long-term National Energy Plan
- Integrated and quantitative assessment of decarbonisation scenarios to 2050

Pillar 1.1

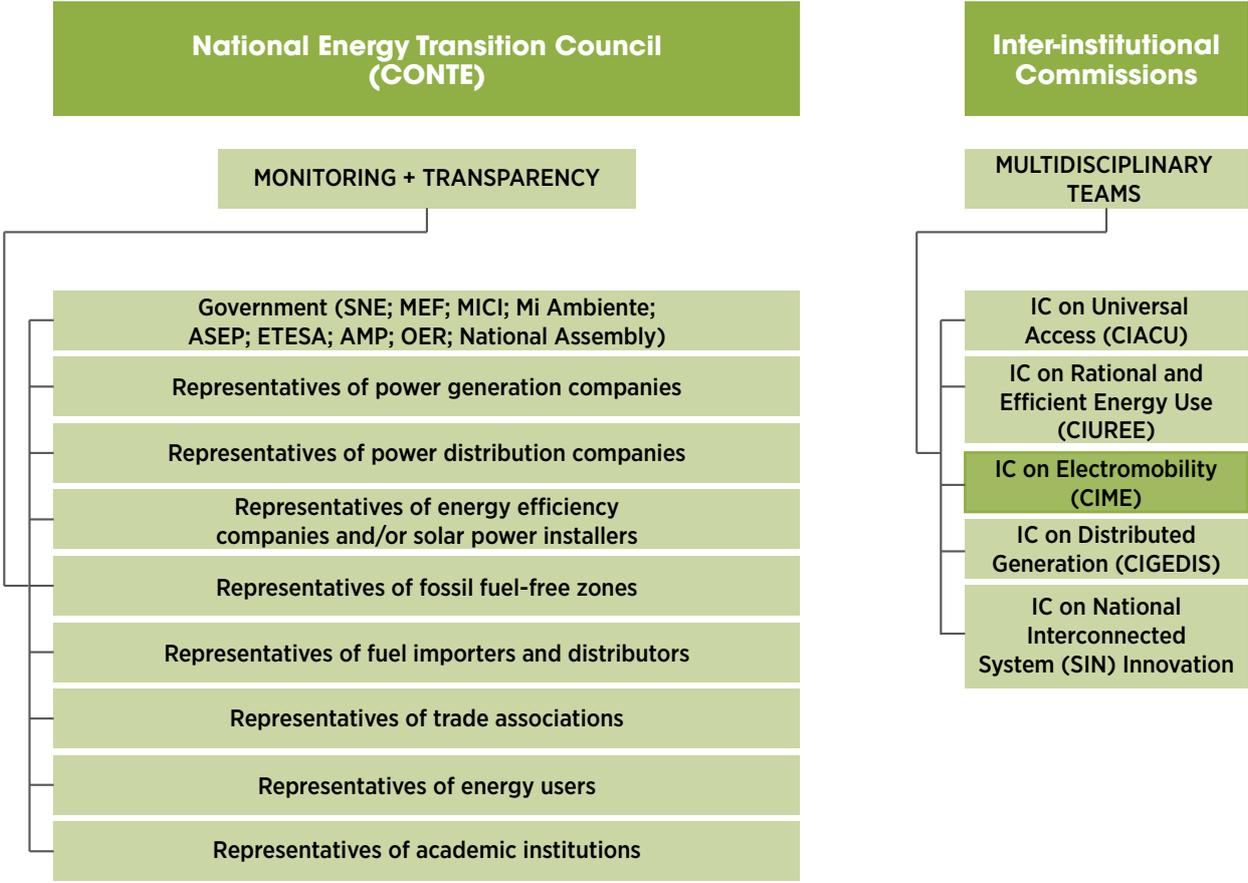
Strengthening scenario development – establishing a strong governance structure

A participatory process is essential to ensure that stakeholders take ownership of long-term planning and that this planning results in the development of government policy.

The National Department of Energy (SNE) encourages stakeholders to take ownership of energy transition plans. Its strategy is to induce stakeholders to work as a team, with government, business and academia playing a prominent role. In the course of the process to develop the National Energy Plan 2015-2050, working group sessions were held with various stakeholders to ensure that they were involved in validating the priority areas of action. Regional community leaders and representatives of trade associations, academia, government and business took part in the sessions. A participatory process was also conducted to prepare the Energy Transition Agenda (ATE) 2020-2030, the purpose of which is to implement and monitor the medium- and long-term energy policies adopted.

The work to develop the Agenda was carried out through two types of commissions: the inter-institutional commissions and the National Energy Transition Council (CONTE) (Figure 24). The inter-institutional commissions develop instruments to facilitate the adoption and implementation of the national strategies set out in the Agenda. CONTE is an advisory, consultative and accountability body for the Agenda. It follows up on the actions put forward by each of the inter-institutional commissions and ensures transparency.

Figure 24 Commissions working on Panama’s Energy Transition Agenda



Source: González, 2021.

Note: MEF = Ministry of Economy and Finance; MICI = Ministry of Trade and Industry; Mi Ambiente = Ministry of Environment; ASEP = National Public Services Authority; AMP = Maritime Authority; OER = Rural Electrification Office.

Pillar 1.2 Strengthening scenario development – expanding the boundaries of scenarios

Energy foresight planning in Panama includes analysis of climate action and post-COVID-19 economic recovery scenarios.

The SNE analyses, in quantitative terms, three scenarios with an increasing level of climate action ambition: Business as Usual (BAU), Energy Transition Agenda (ATE) and Complete Decarbonisation of Panama by 2050. They all take into account post-COVID-19 economic recovery. The three scenarios forecast the impact on the economy in terms of employment, health benefits, investment and savings. Based on the long-term foresight analysis, milestones are set for 2024, 2030, 2040 and 2050 for each scenario.

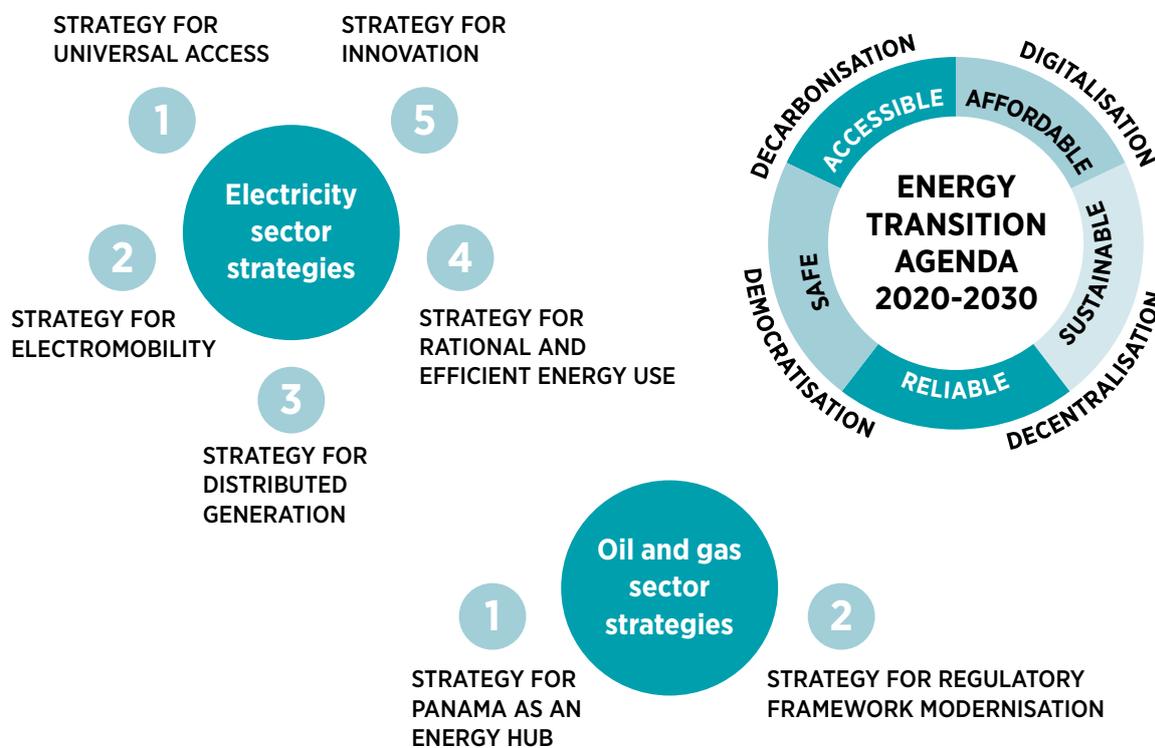
Pillar 2.1

Improving scenario use
- clarifying the purpose of scenario building

The medium-term sectoral strategies set out in the Energy Transition Agenda 2020-2030 are aligned with the long-term policies of the National Energy Plan 2015-2050.

The Energy Transition Agenda presents seven strategies or roadmaps for the electricity and the oil and gas sectors and one cross-cutting strategy aimed at strengthening institutional capacities (Figure 25). The quantitative targets set in the Agenda take into account technological advances, the SDGs, the vision for the energy sector (to be accessible, affordable, sustainable, reliable and safe) and actions to drive the energy transition, guided by the “4Ds” (decarbonisation, digitalisation, decentralisation and democratisation).

Figure 25 Strategies in Panama’s Energy Transition Agenda 2020-2030



Source: González, 2021.

Pillar 3.1

Identifying capacity building approaches
- building the right type of scenario capacity in government

Quantitative analyses support the actions proposed to achieve decarbonisation by 2050.

Thanks to technical support from the United Nations Environment Programme (UNEP) for local capacity building, the Green Economy Modelling (GEM)⁴ tool is used in Panama for integrated analysis of the energy system. It facilitates technical and economic analysis of decarbonisation scenarios to 2024, 2030, 2040 and 2050.

⁴ www.unep.org/explore-topics/green-economy/what-we-do/economic-and-trade-policy/green-economy-modelling

13. PERU



Institution responsible for energy planning and scenario development Ministry of Energy and Mines (MINEM)

Most recent energy planning document

- [Transmission Plan 2021-2030](#) (COES, 2021)
- [National Energy Plan 2014-2025](#) (MINEM, 2015)

Good practices for energy planning and scenario development

- Dynamic co-ordination among energy sector stakeholders
- National energy planning system
- Understanding of real consumer needs at the regional level
- Conceptual framework for interaction between planning tools

Pillar 1.1

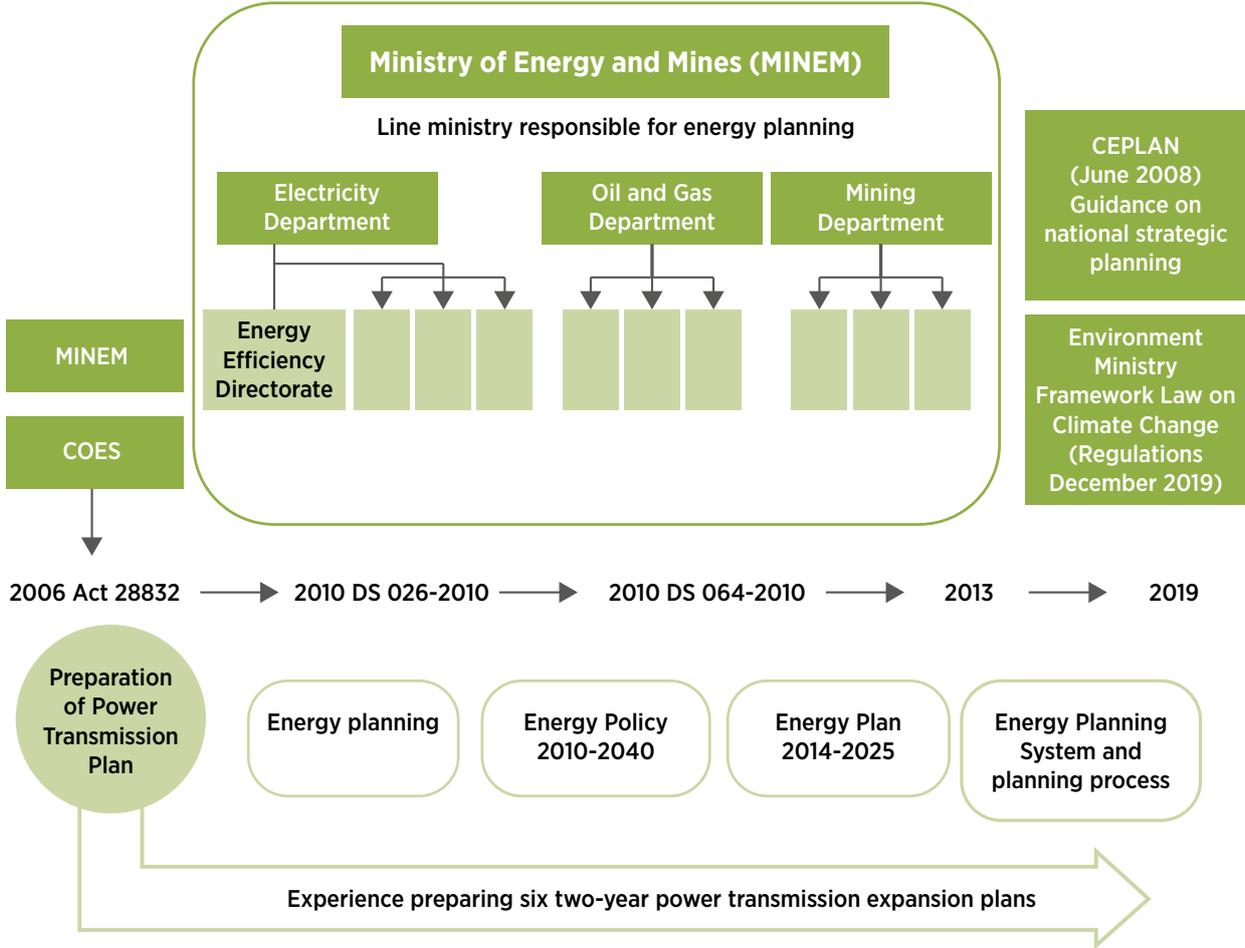
Strengthening scenario development
- establishing a strong governance structure

Thanks to dynamic co-ordination among energy sector stakeholders, various participatory processes have been carried out for scenario development and planning.

The Ministry of Energy and Mines (MINEM) is responsible for energy planning, with the support of the Energy Efficiency Directorate (Figure 26). It co-ordinates the planning process with the regulatory authority (Osinermin), the electricity system operator (COES), the Ministry of Environment (MINAM) and the National Strategic Planning Centre (CEPLAN). Co-ordination between the Ministry of Energy and the Ministry of Environment has been important in ensuring that national climate change commitments are taken into account. Since 2006, participatory processes involving energy sector stakeholders have become firmly established. These involve developing scenarios and formulating transmission expansion plans that are updated every two years.

In 2010, Peru's National Energy Policy 2040 was adopted. In 2013, a working document was prepared for the Energy Plan 2014-2025. Peru is focusing efforts on establishing a continuous integrated energy planning process to enable it to achieve its long-term vision. To this end, in 2019, the country implemented integrated planning systems and models, and it is now carrying out updates, generating information and assessing scenarios to strengthen the National Energy Planning System (SIPEN).

Figure 26 Institutional framework for energy planning in Peru



Source: Vilchez, 2021.

Pillar 2.2 Improving scenario use – transparent and effective communication

The strengthening of the National Energy Planning System will contribute to the institutionalisation of long-term integrated planning in Peru.

The National Energy Planning System (SIPEN) is based on systematised information compiled from interviews with energy sector stakeholders. This approach provides a better understanding of real needs in terms of energy end-use in each of the country’s regions. In this regard, Peru aims to systematically compile the results of surveys to facilitate the updating of key indicators in the 2013 National Useful Energy Balance for high energy-consuming sectors and uses. It also intends to enhance scenario development by incorporating the projected impact of climate change on water flows for hydropower projects. For this purpose, it plans to conduct specific studies in co-ordination with the regional directorates of the Ministry of Energy, national and international entities and Peru’s National Meteorology and Hydrology Service (SENAMHI).

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3.1**

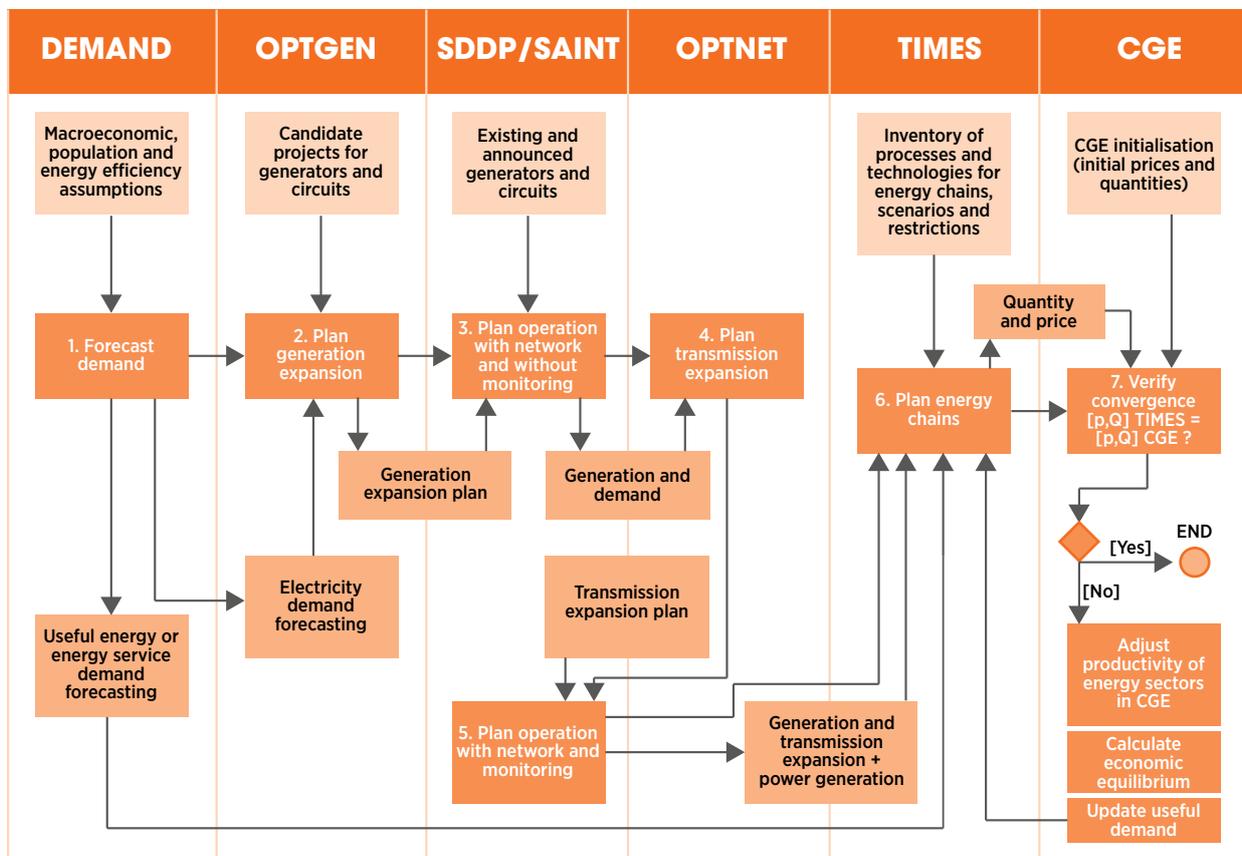
**Identifying capacity building approaches
- building the right type of scenario capacity in government**

With support provided through international co-operation, a conceptual framework was developed and tools were introduced to strengthen integrated planning.

Within the National Energy Planning System (SIPEN), a conceptual framework for long-term integrated energy planning was developed (Figure 27). It was applied in the preparation of the National Energy Plan 2040 (MINEM, 2019) and provides the basis for the review of the National Energy Plan that is currently in progress. In addition to the commercial software tools, such as OPTGEN, SDDP (stochastic dual dynamic programming) and OPTNET, used by Peru to plan power system expansion and operation, a Peruvian TIMES model was introduced with a soft-link to a computable general equilibrium (CGE) model. It was developed with financial support from the Canadian Government, management support from the IDB and technical support from Brazilian consultants. It is a tool for optimising long-term integrated energy planning that interacts with a dynamic macroeconomic tool.

Figure 27 shows how the tools interact and the outputs at each stage. The aim is to strengthen the capacities of the Ministry of Energy so that it can use and improve the tools, incorporating new information on energy consumption and promising technologies.

Figure 27 Conceptual model and models for integrated planning.



Source: Vilchez, 2021.

14. URUGUAY



Institution responsible for energy planning and scenario development

Ministry of Industry, Energy and Mines (MIEM)

Most recent energy planning document

- Energy Policy 2005-2030 (MIEM, 2018)
- National Energy Efficiency Plan 2015-2024 (MIEM, 2015)

Good practices for energy planning and scenario development

- Update of Energy Policy 2005-2030 to 2050
- Establishment of a strong governance structure
- Well-defined energy planning process and team of technical experts trained in modelling
- Clear conceptualisation of the purpose of energy scenarios

Pillar 1.1

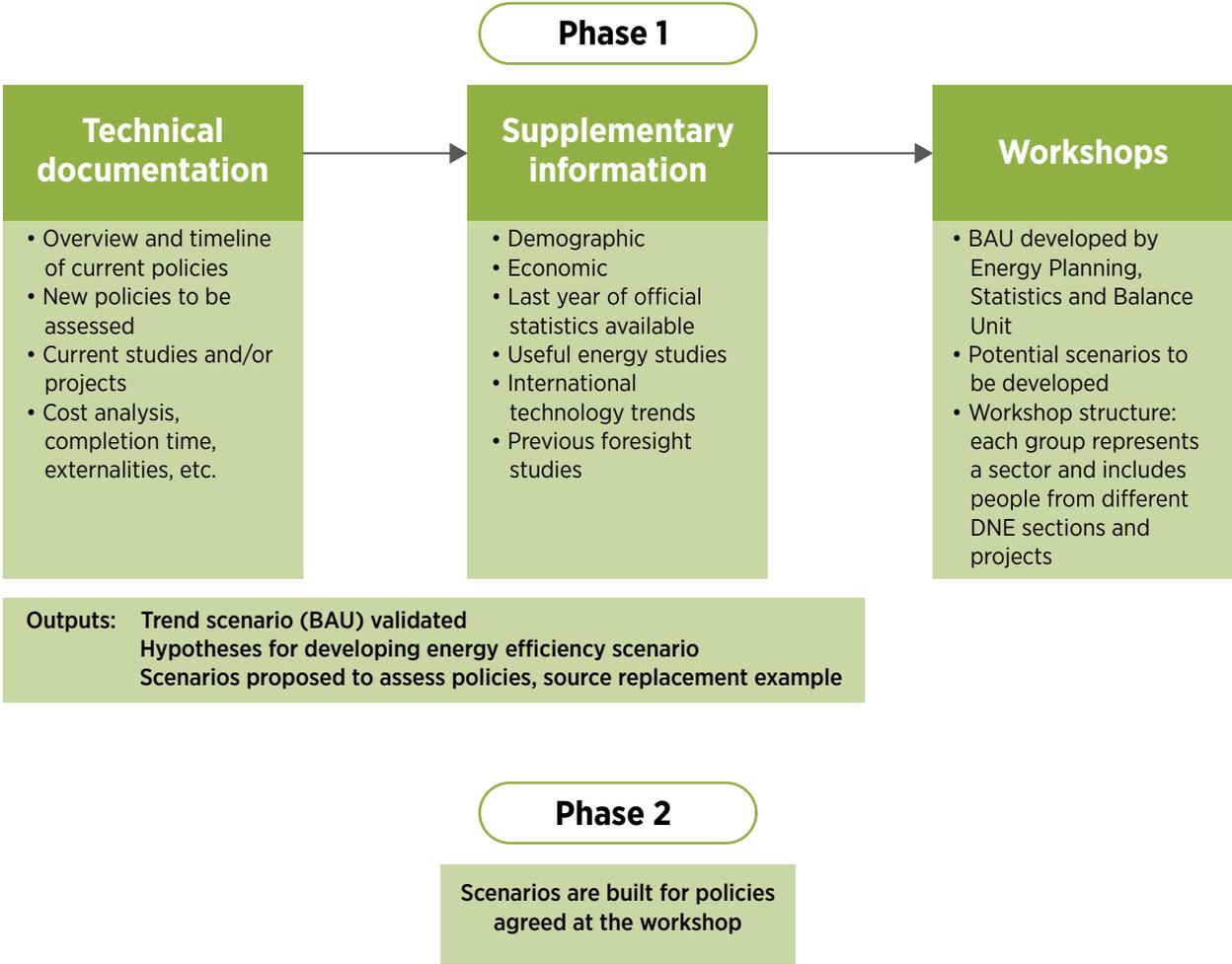
Strengthening scenario development - establishing a strong governance structure

Uruguay has established a strong governance structure with the creation of a Multi-Party Energy Commission.

The country's Energy Policy, developed by the National Energy Directorate (DNE) of the Ministry of Industry, Energy and Mines, was approved and validated in a participatory process. The current policy, which sets targets to 2030, was formulated in 2005 and approved in 2008 by the Council of Ministers (representing the executive branch) and in 2010 by the Multi-Party Energy Commission, which includes all the political parties with parliamentary representation. The Energy Policy is currently being revised to update targets to 2050.

Efforts are also being made to ensure consistency between energy scenarios and decarbonisation scenarios for climate change mitigation (National Climate Change Policy 2050). This is facilitated by the participation of the Ministry of Industry, Energy and Mines in the inter-institutional group for the Climate Change Response System. The energy planning process is based on the planning methodology of the International Atomic Energy Agency (IAEA, 2008) (Figure 28). The first phase of the process involves workshops to validate the trend scenario developed by the DNE's Energy Planning, Statistics and Balance Unit and to establish hypotheses for the development of alternative scenarios. In the second phase, the policy scenarios designed during the workshop are developed.

Figure 28 Energy planning and scenario development process in Uruguay.



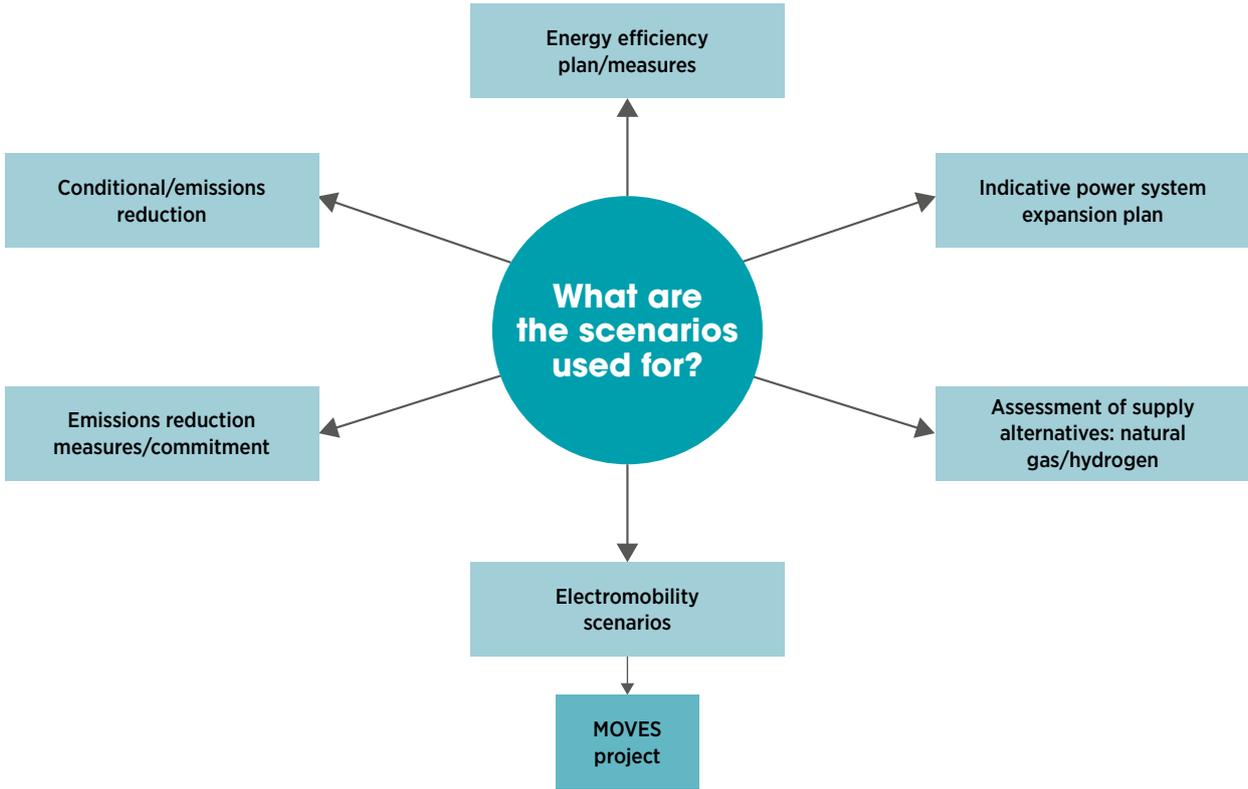
Source: Reyes, 2021.

Pillar 2.1 Improving scenario use
 - clarifying the purpose of scenario building

Various alternative scenarios have been assessed, exploring technology and policy options for the decarbonisation of the energy sector, including hydrogen and electromobility.

Figure 29 shows how the energy scenarios developed have been used. Discussion of the decarbonisation of the transport sector is based on alternative supply scenarios – green hydrogen and natural gas for vehicles – and electromobility scenarios. Scenarios have also been used to assess measures to reduce greenhouse gas emissions, for example in the preparation of the country’s NDC. The scenarios are used as input to establish specific policy instruments, such as the National Energy Efficiency Plan and the Indicative Power System Expansion Plan.

Figure 29 Use of energy scenarios in Uruguay



Source: Reyes, 2021.

Pillar 3.1 Identifying capacity building approaches – building the right type of scenario capacity in government

A robust national team combined with external support from consulting firms and international organisations makes effective scenario modelling possible.

Uruguay aims to complement the work carried out with consulting firms and international organisations and agencies, such as IRENA, ECLAC, IAEA, OLADE and UNDP, with analyses and input from a robust national team specialised in energy planning and modelling. The work carried out with external support makes it possible to conduct complex analyses and to assess many different scenarios, while the internal DNE team plays a crucial role in evaluating the viability of the modelled measures, given their knowledge of the local situation and culture.

Strengthening the DNE in terms of human resources and technical expertise within the Ministry of Industry, Energy and Mines has been a key factor in ensuring an effective energy planning process. The DNE comprises five technical sections: 1) renewable energy; 2) energy demand, access and efficiency; 3) oil and gas; 4) electricity; and 5) energy planning, statistics and balance. The expertise and networking of the first four sections contribute to the specific energy planning and scenario development work carried out by the energy planning, statistics and balance team.

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ANNEX

RESULTS AND FINDINGS OF THE SURVEYS COMPLETED BY PARTICIPANTS AT THE END OF EACH WEBINAR

The results and findings of the surveys completed by participants can be summarised as follows:

- The survey was sent out to the more than 700 participants in the event. A total of 50 responses were received from 21 countries.
- The majority of respondents (64%) attended three or more events in the webinar series, and 30% attended all seven.
- With regard to the profile of the respondents, more than 40% were from government, 23% from the private sector, 19% from academic institutions and 15% from international organisations. Over 30% indicated that they were technical experts, 21% managers or co-ordinators, 17% consultants, 15% lecturers and around 5% students.
- With regard to their satisfaction with the webinar series, approximately 95% of respondents said they agreed or strongly agreed that it addressed highly valuable topics, provided new information and helped them to understand how energy planning relates to the 2030 Agenda for Sustainable Development and the SDGs. Furthermore, 80% of respondents said they agreed or strongly agreed that the webinars increased their appreciation and understanding of planning issues and provided specific tools and knowledge to support decision making or help them perform their duties. Lastly, around 75% of respondents reported that they agreed or strongly agreed that the webinars helped strengthen inter-institutional links and therefore improve planning in the energy sector.
- The respondents suggested a wide range of potential technical topics of interest for future webinars, including energy efficiency, electromobility, energy storage systems, development of sustainable public policy, geothermal power, demand management, planning models, energy transition, electricity markets and systems, scenarios for net-zero emissions by 2050, hydrogen, use of biomass, energy sector governance, risk management in financing, simulation models and the role of subsidies in energy transformation.
- Other feedback and suggestions from respondents included publicising the webinars more widely, offering options to accommodate different time zones, organising networking sessions, creating a newsletter to present summaries and technical articles and holding webinars twice a year for discussions among experts.

