G20 BRASIL 2024

IRENA
International Renewable Energy Agency

ENERGY PLANNING PROGRAMME HIGHLIGHTS

Global collaboration and capacity building support

About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. **www.irena.org**

Acknowledgements

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- The Ministry of Foreign Affairs of Denmark and the Federal Ministry for Economic Affairs and Climate Action of Germany for their support of the Global Long-Term Energy Scenarios (LTES) Network and co-leadership in the CEM LTES Initiative.
- The European Union, the United Arab Emirates, the German Agency for International Cooperation (GIZ), the Government of Wallonia, and the Ministry of Economy, Trade and Industry of Japan (METI) for their contributions to capacity-building programmes.

Disclaimer

Message from the Director General

Evidence-based energy planning is crucial in setting robust long-term strategies to support the energy transition, enabling countries to anticipate future energy needs and align their infrastructure investments with the UN Sustainable Development Goals. For energy plans to be effective, they must emerge from a comprehensive country-led process. Following years of leading international collaboration on energy planning, IRENA has developed a unique understanding of the diverse approaches that countries employ in developing national planning frameworks tailored to their unique circumstances. Our focus in energy planning co-operation is to strengthen planning governance by ensuring informed decisions based on rigorous data, sound methodologies and inclusive stakeholder engagement. This brochure showcases our approaches to co-operation in energy planning.

Francesco La Camera
Director-General, IRENA

Energy planning
Global collaboration at IRENA

IRENA has a strong track record of leading international collaboration on energy planning capacity building programmes at the national, regional and global levels. This experience, along with a repository of best practices from another IRENA-led initiative, the ***Global Long-term Energy Scenarios Network (Global LTES Network)***, has shown that truly effective energy plans require local stakeholders (*e.g.* national or regional institutions) to take ownership of the planning process from the outset. Furthermore, plans must be developed in co-ordination with a wide range of relevant stakeholders – both internal and external. The participation of a range of stakeholders ensures that development goals, climate considerations and other sectoral policies are integrated into the planning process. Alignment of energy planning frameworks with Nationally Determined Contributions (NDCs) and economic or financial strategies is a critical step towards that end. Finally, the entire planning process must be underpinned by a transparent methodology based on robust datasets.

Long-term energy planning lays the foundation for effective policies, investment strategies and targets at the national or regional level. An astute and up-to-date masterplan for energy development fosters predictable investment conditions. In recent years, NDCs have become key complementary planning documents to harmonise energy and climate planning. Taken together, these documents are essential prerequisites for scaling up renewable energy technologies.

Along with the plans themselves, the process behind them is at least as important. Effective energy planning, built on quantitative scenario modelling and stakeholder consultation, allows policy makers to understand and explore the complexities and uncertainties associated with the future evolution of energy systems. Around the world, governments rely on such model-based analysis to guide their key decisions on when, where and how to invest. Key learnings from planning iterations, such as the previous round of NDCs, can inform the development of more ambitious and impactful climate commitments.

This brochure provides an overview of the Agency's extensive expertise and experience in contributing energy planning support and collaborative platforms to its members. These initiatives are offered primarily through two channels:

- **Exchange of experience through the Global LTES Network**
- **Capacity building through national and regional Model Analysis and Planning Programmes**

IRENA's work on these programmes is outlined as well as presenting the planning partnerships and suite of tools that underpin their delivery. The brochure also provides links to various technical reports on energy planning and scenarios where key lessons and good practices gathered through the above-mentioned initiatives have been synthesised.

1 Empowering practitioners through the Global LTES Network

The ***Global Long-term Energy Scenarios Network (Global LTES Network)*** is a network of government institutions with a long history of practicing scenario-based energy planning. IRENA provides a curated platform for government scenario practitioners world-wide to exchange insights and experiences. This exchange in turn fosters peer-to-peer learning at the forefront of the clean energy transition. Many of the knowledge exchange discussions and events take place in prominent forums such as at the IRENA Assembly, the ***Clean Energy Ministerial (CEM)*** and the Group of Twenty (G20), highlighting their significant global impact. Other discussions are specifically tailored for scenario practitioners and take place in specialised forums facilitated by the Network. The Global LTES Network has a mission to collaboratively identify effective planning solutions, anticipate emerging challenges and advance the global energy planning agenda.

The exchange of experiences facilitated by the Global LTES Network highlights institutional and governance frameworks across three key areas, all within the specific context of advancing the clean energy transition:

(1) Approaches to develop scenarios as evidence-based planning – key topics include co-ordination and alignment across government agencies (with a focus on climate and energy), broader stakeholder participation and embracing new technological and innovation trends.

(2) Approaches to use scenarios effectively for policy making – key topics include using scenarios that are fit for purpose, effective communication for improved stakeholder engagement and linking energy planning with investment planning and finance mobilisation.

(3) Institutional ownership of the scenario-based planning process – exploring insourcing and outsourcing approaches and enhancing national planning ecosystems.

MEMBERSHIP AND IMPACT

The government members of the ***Global LTES Network*** are institutions officially responsible for formulating long-term energy scenarios (LTES) (not necessarily modelling). Technical partner organisations directly or indirectly supporting national planning practices and also participate in the Network. The Network has a growing membership, with 30 government members, as well as 13 technical partners. The Global LTES Network is also built on a strategic partnership with the Clean Energy Ministerial through the operation of the ***LTES CEM Initiative***.

The Network members drive the Network's agenda and priority setting. They represent the broader strategic needs of the community. Each year, the Global LTES Network targets critical priorities identified by its members and partners as strategic issues that the LTES must address to advance in the clean energy transition (*e.g.* energy security, technological advancement, integration of high renewable energy shares, promotion of collaborative approaches for energy scenario development and leveraging of the LTES to mobilise investments).

Members and partners have acknowledged the Network's significant impact on their planning and policy-making processes. Peer-to-peer exchange has facilitated the sharing of knowledge and experiences gained by government planning institutions across countries, enabling collaborative solutions for common challenges. It thus facilitates comprehensive co-operation between North and North, North and South, and South and South. Members have reported improved governance of the scenario planning process, including communication to the public and better integration of scenarios into their broader energy policy-making processes. Institutions less experienced in scenario formulation have highlighted the Network's role in strengthening their capacities by enabling them to learn from the best practices of other countries.

I commend IRENA's leadership in identifying best practices in energy planning. Brazil's participation in the Long-term Energy Scenarios (LTES) network has significantly enriched our national energy planning process. I particularly value IRENA's approach of sharing diverse methodologies rather than prescribing specific solutions. This has given Brazil confidence in our own energy planning process and enabled us to objectively assess our strengths and weaknesses compared with our international peers. This valuable experience has also inspired us to propose the establishment of the G20 Global Coalition of Energy Planning.

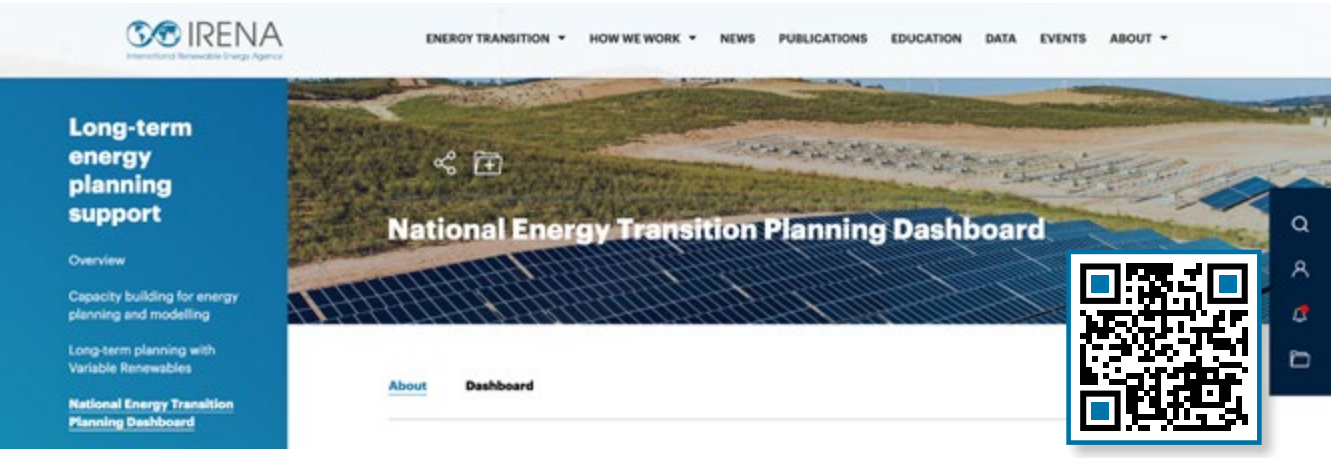
Thiago Barral, Secretary of Planning and Energy Transition of the Ministry of Mines and Energy, Brazil

LTES International Forum

The Network hosts exchange sessions. The discussions in these exchange sessions highlight the national planning experience within members' own institutional contexts. IRENA's global membership enables broad participation in these exchanges; in turn, it ensures that a diverse range of perspectives and experiences are shared, thus enhancing the learning process. The Network brings further technical expertise from non-government sectors through engagement with LTES technical partners, which often present innovative approaches towards energy planning.

IRENA syntheses the key outcomes from the technical discussions, and presents them at high-level political fora. Over 350 scenario experts as well as high-level decision makers from governments and industries have presented their insights at exchanges, and hundreds more have actively engaged in technical workshops since 2018. Beyond the workshops, the Network's exchage of experiences have attracted thousands of attendees in total, demonstrating the broad interest in the LTES agenda. IRENA has also fostered collaboration by co-hosting events and building partnerships with dozens of international organisations, scientific institutions and think tanks.

This extensive knowledge, best practices and the lessons learnt have been synthesised into six comprehensive LTES publications (select publications listed further below), which serve as valuable resources to guide countries in accelerating the clean energy transition.



The ***IRENA National Energy Transition Planning Dashboard*** was developed to disseminate information on national energy planning. It is managed by the Global LTES Network. The Dashboard is an online global repository of energy planning documents and modelling tools developed and/or used by government institutions for official planning purposes. Its purpose is to enable planners in the government sector to access information, which can be used to benchmark their national planning practices, and/or aid them in learning about relevant approaches used by global peers.

The data in the Dashboard were partly collected through surveys shared with government officials. Desktop research complemented where necessary. The information is being updated consistently as more data become available through other IRENA's engagements, such as the ***"Addressing Variable Renewables in Long-Term Modelling" project (AVRIL)***.

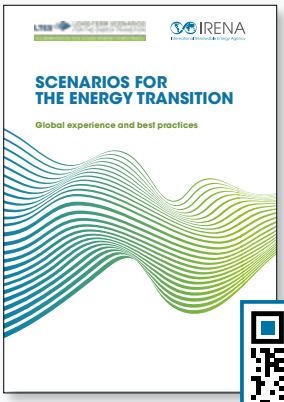
KEY LESSONS LEARNT

The process of energy planning varies widely across countries and contexts. While some governments have specific steps and outputs stipulated in national law, others have less formal processes or none at all. While diverse approaches are acknowledged, several common elements of long-term energy planning with scenarios have been identified by countries as effective in supporting decision making and investment:

1. Strengthening LTES development requires establishing robust and well-defined governance structures, which include inter-ministerial co-ordination mechanisms and/or legislatively mandated processes that streamline the development of energy scenarios and ensure their effective contribution to national energy policies.
2. Effective LTES rely on structured and inclusive stakeholder engagement processes, which are crucial for successful planning because they integrate the perspectives and concerns of different societal groups, foster legitimacy and buy-in, and in turn make scenarios more effective.
3. For the complexities of the clean energy transition to be reflected adequately, scenarios (and any underlying methodologies) also need to clearly address and incorporate new technologies, business models and disruptive innovations.

4. The LTES can be used for different purposes, depending on the context and the goals being pursued. Such distinctions should be clear to avoid misinterpretation of scenarios.
5. Transparency ensures the quality of scenarios and builds trust. Scenario assumptions and results need to be clearly communicated in the context of the more complex clean energy transitions, and innovative communication methods that are now emerging.
6. While a country may have its own unique ecosystem of planning institutions, it is critical that policy makers have the capacity to understand the implications of underlying methodologies and interpret scenario results to make effective policies.

MAJOR PUBLICATIONS OF THE GLOBAL LTES NETWORK



Scenarios for the energy transition
Global experience and best practices

Scenarios for the energy transition
Experience and good practices in Latin America and the Caribbean

Long-term energy scenarios and low-emission development strategies
Stocktaking and alignment

Scenarios for the energy transition
Experience and good practices in Africa

2 Capacity building for energy planning and modelling

Many countries and regions around the world choose to develop energy/electricity sector masterplans as part of their planning processes. A reliable and updated masterplan helps to create a stable and predictable investment environment and provides a framework for renewable energy deployment and the design of suitable energy/electricity sector policies. Robust energy system modelling can underpin such plans and policies by allowing for system-wide considerations of security of supply, energy access, affordability, environmental impacts and investment needs.

IRENA provides ***capacity building for energy planning*** in these areas, at the national and regional levels, through a mix of in-depth, hands-on workshops and online training using dedicated software tools. With customised technical support, on-demand advisory services and draft output reviews, IRENA and its expert partners guide country teams through the training activities and the process of developing and updating national energy masterplans. IRENA's approach is grounded in the belief that country ownership of the energy planning process is of singular importance for sustainable energy sector development.

NATIONAL MASTERPLAN DEVELOPMENT SUPPORT PROGRAMME

At the national level, IRENA's ***Masterplan Development Support Programme*** helps governments build and improve their institutional capacity for energy planning. A series of structured in-depth training sessions are provided for national energy planning practitioners. The support is tailored to meet each country's specific requirements, and the programmes are co-developed with the requesting government.

The purpose of the programme is to enable countries to improve their capacity to analyse energy data and develop scenarios using modelling tools for long-term energy planning while good practices around the institutional arrangements discussed under the LTES Network are used to help design the suitable institutional frameworks on development of LTES and thier usage for policy making. In particular, IRENA supports designing the effective stakeholder consultation process with the partner government. IRENA's suite of planning tools (see annex for more details) is made available as part of the training, and individual countries may select additional tools to support energy planning based on their specific needs and current modelling expertise. Such a programme typically includes analysis of long-term investments and may also be supplemented by analysis of off-grid investments and assessments of power system flexibility.

The programme typically spans one to two years and includes several weeks of in-country training sessions to calibrate a national model, explore energy planning scenarios and develop a national energy masterplan document. In-country sessions are complemented with online training and other meetings. By the end of the programme, an official national team of expert planners is in place, having received hundreds of hours of dedicated training.

Through this programme, IRENA has successfully supported national teams for ***Senegal***, ***Cameroon***, ***Eswatini***, ***Sierra Leone*** and the United Arab Emirates. Multi-year training has been provided to enhance national energy planning capabilities and masterplan development. In total, across these programmes, hundreds of hours of training have been provided to nearly 100 national energy planning experts.

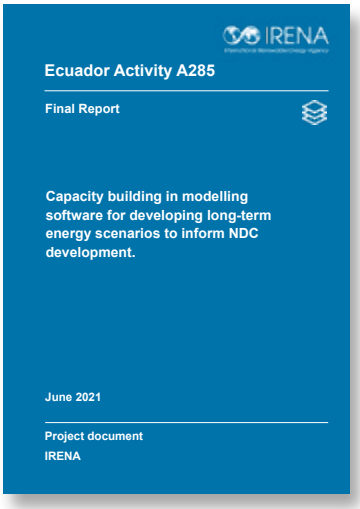
Masterplan Development Support Programme for Senegal

Masterplan Development Support Programme for Cameroon

ENERGY PLANNING TRAINING PROGRAMME FOR NDCS

In the framework of the Paris Agreement, countries are raising their climate ambition as part of the five-year cycles to revise the Nationally Determined Contributions (NDCs). In this context, IRENA provides training on long-term energy planning. The training, designed for staff of relevant national ministries, is customised to support the NDC revision process.

Energy Planning Training Programmes for NDCs can also leverage the suite of planning tools designed by IRENA. The content of these programmes is specially designed to prioritise the identification of energy sector priorities to enhance the national ambition on climate action. Thus far, five countries have received this training in the revision of their NDCs: ***Cameroon***, ***Ecuador, Gabon***, ***Mali*** and ***Niger***.



Energy Planning Training Programme for NDCs: Ecuador

REGIONAL MODEL ANALYSIS AND PLANNING PROGRAMME

IRENA provides ***regional energy modelling and planning programmes*** for groups of countries and regional planning organisations that aspire to improve their planning processes, capture cross-border dynamics related to energy or electricity production and trade, and/or develop regional planning documents. Regional capacity building is tailored to the specific regional institutional context and level of national planning expertise. The programmes are co-developed with official regional planning organisations.

The programmes offer training sessions of varied depths – from introductory sessions, to training to familiarise countries with the importance of best practices and tools for energy planning, to more in-depth training on model-based analysis and the development of long-term scenarios.

Through this programme, IRENA has delivered or is in the process of delivering multi-year regional capacity building for the organisations of the ***West***, ***Central*** and East African power pools. Most recently, it supported the ***African Union Development Agency's New Partnership for Africa's Development (AUDA-NEPAD)*** as an official modelling partner for the ***Continental Power Systems Masterplan***.

Box 1. Continental Power Systems Masterplan programme

IRENA supported the African Union Development Agency's New Partnership for Africa's Development (AUDA-NEPAD) as a modelling partner for the Continental Power Systems Masterplan (CMP) together with the European Union, African Development Bank, German Agency for International Cooperation (GIZ) and International Atomic Energy Agency (IAEA). Under the programme, experts from AUDA-NEPAD and the five regional power pools were trained in using modelling tools, including ***IRENA's System Planning Test (SPLAT)*** and the IAEA's Model for Energy Supply System Alternatives and their General Environmental Impacts (MESSAGE).

The CMP provides a strategic roadmap for the long-term, continent-wide inter-connection of Africa's physical energy infrastructure of trans-national importance. To attract investment, the focus is to bring energy planning aspects to the attention of the financial sector, where there is often a disconnect. Therefore, the CMP highlights the vital role of robust energy planning processes as critical enablers for achieving and accelerating renewable energy deployment through the dissemination of analysis that informs policy and investment decisions.

The CMP represents a groundbreaking collaborative platform for energy planning. It emphasises full ownership of the planning process by African institutions, in compliance with the mandate set forth by African heads of state. The CMP has been validated through a multi-stakeholder, collaborative framework, involving extensive stakeholder engagement, technical and economic analysis, and strong political endorsement.

High level discussions at IRENA assembly

Abu Dhabi, January 2022

SPLAT training

Addis Ababa, June 2022

Cairo, August 2022

Bonn, November 2022

Kigal, March 2023

CMP validation and ministers' endorsement in STC meeting

Zanzibar, September 2023

AU heads of states endorsement of CMP agenda 2063 flagship project

Addis Ababa, February 2024

Testimony from our parner

AUDA–NEPAD extends its appreciation for the invaluable support provided by IRENA towards the development of CMP. The technical assistance and knowledge sharing provided have been pivotal in addressing the unique challenges faced by our continent. The SPLAT Africa model developed by IRENA and other stakeholders identified priority generation projects that will make it possible for countries to take advantage of the complementarities between national systems, with surpluses from some countries offsetting the deficits in others, by leveraging on national and regional diversity in resources and demand. In addition, the model will create a common and harmonised platform that will assist in project decision-making regarding the location, size and timing of investments in generation and transmission infrastructure to unlock cross-border power exchanges and inter-power pool trade.

Some of the key lessons learnt in CMP phase II are: There is need to develop capacity of power pools and Member States to update their masterplans and harmonising the energy planning tools adopted at the continental level, through the CMP mechanism, should be embraced at the sub-regional and national levels.

Tichakunda Simbini, Principal Programme Officer – Energy,
African Union Development Agency–NEPAD

IRENA ENERGY PLANNING PARTNERSHIPS

IRENA is positioned as a leading institution in co-ordinating capacity building and modelling activities with both international and regional partners, leveraging complementary resources and amplifying the impacts of programmes. The Agency benefits from strategic partnerships with the International Atomic Energy Agency, AUDA-NEPAD, the United Nations Department of Economic and Social Affairs, and the German Agency for International Cooperation (GIZ) through Get. transform, the World Bank and others.

IRENA is also an active member of the ***Roundtable Initiative on Strategic Energy Planning*** – a network of major development partners and technical institutions aspiring to improve their support to developing countries for energy planning. The Roundtable, administered by the Climate Compatible Growth programme, has endorsed a set of principles to ensure (1) the organisations providing capacity building follow a robust code of conduct in their energy planning activities and (2) there is co-ordination with international as well as regional partners to make support more effective.

Besides its in-house expertise, IRENA maintains a broad network of global, regional and national partners, which it engages to provide countries with advice and support in addressing their energy planning needs.

Annex
IRENA's suite of planning tools

Efficient energy planning requires robust modelling capabilities and methodologies, which help base energy decisions on quantitative analysis of the energy sector.

IRENA's suite of planning tools includes freely accessible long-term capacity expansion models, system flexibility assessment models, off-grid planning tools and model-ready datasets for renewable energy.

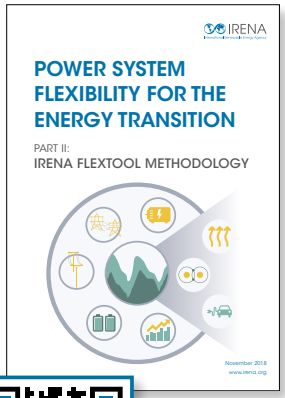
SPLAT-MESSAGE AFRICA MODELLING FRAMEWORK

The System Planning Test (SPLAT) capacity expansion models are a key component and product of IRENA's energy planning support. These models, built using the International Atomic Energy Agency's Model for Energy Supply System Alternatives and their General Environmental Impacts (MESSAGE) software, currently cover detailed representation of ***power system capacity expansion in 47 African countries*** across the five African power pools. The SPLAT-MESSAGE model is uniquely calibrated to represent the power sector configuration in each country and corresponding regional inter-connections, and it allows national energy planners to assess a wide range of least-cost supply scenarios towards 2040.

MODEL-READY DATASETS FOR RENEWABLES

Accurate representation of the potential contribution of modern renewable resources to electricity mixes requires including resource profiles for sources like solar, wind and hydropower in capacity expansion models at high spatial and temporal resolutions. With this in mind, IRENA has developed detailed geospatial databases for hydropower, wind and solar potential in Africa. These databases have served as sources of data inputs for the modelling of the CMP. The datasets behind these "Model Supply Regions (MSRs)" for all wind and solar technologies, as well as the IRENA Africa hydropower database, are provided in the following IRENA webpage: ***www.irena.org/Energy-Transition/Planning/Model-ready-datasets-for-renewables***. These include the datasets for IRENA's African Renewable Electricity Profiles for Energy Modelling (AfREP), which are open-access sources of model-ready data on site-specific generation profiles.

FLEXTOOL



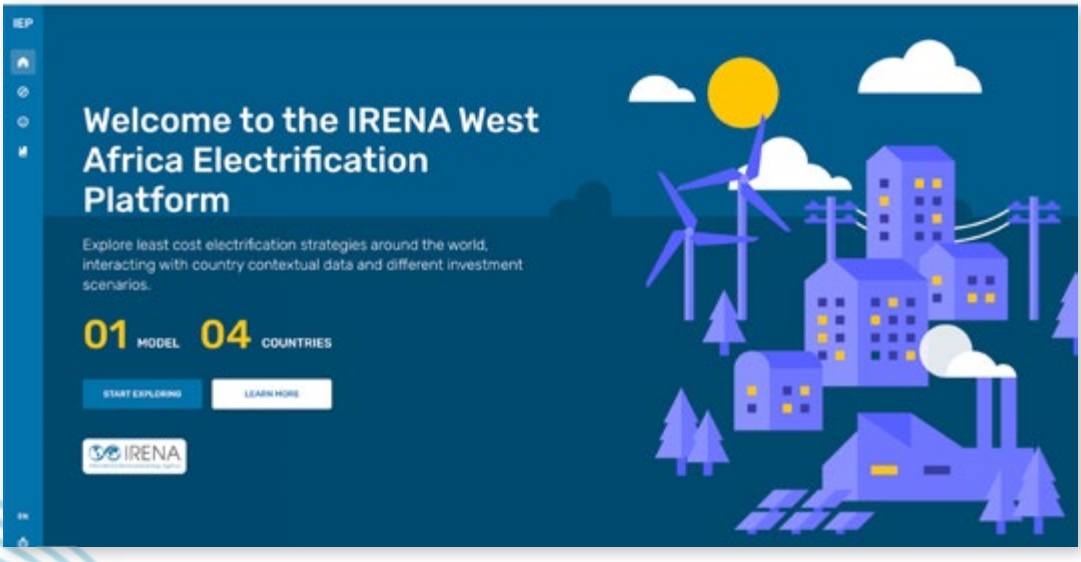
IRENA developed the FlexTool in response to the emerging need to identify and address flexibility issues in energy system planning. FlexTool, an easy-to-use and publicly available modelling tool, helps analyse power system flexibility. As of 2024, FlexTool had been applied by energy planners in eight countries. FlexTool has also been used by IRENA to support regional assessments in Africa, the Association of Southeast Asian Nations and Central America. IRENA has developed comprehensive publicly available training material for using FlexTool. Also, partners provide online training on the use of the tool. The following options are available in FlexTool: flexible generation, demand-side flexibility and energy storage, alongside sector-coupling technologies such as power-to-heat, electric vehicles and hydrogen production via electrolysis. Further information can be found IRENA's website at: *www.irena.org/Energy-Transition/Planning/Flextool*.

IRENA FlexTool 3.0/Pro (Python based)

IRENA FlexTool 2.0/LITE (Excel based)

OFF-GRID PLANNING WITH ONSSET – WEST AFRICA ELECTRIFICATION PLATFORM

IRENA has developed the West Africa Electrification Platform to support Member Countries in the region, namely, Burkina-Faso, Mali, Nigeria and Senegal, in planning for universal energy access. The platform, an open-access and interactive tool, explores multiple pathways to universal access and showcases the role of battery storage in mini-grids. Key results can be visualised here: ***https://accessplanning.irena.org***. IRENA's energy planning support is able to integrate this type of analysis, using the Open Source Spatial Electrification Tool (OnSSET) modelling framework, alongside the Agency's complete suite of modelling tools.



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