RES4Africa Foundation

Knowledge Platform

Cornerstones to develop a national Energy Masterplan

Enel Green Power

RES4AFRICA FOUNDATION

A roadmap to guide the national energy sector towards sustainability

The Platform covers the following thematic areas:

- Technologies
- **Policies and regulations**
- Access to market
- Permitting
- Financing
- Operation
- Sustainability

Cornerstones to develop a national Energy Masterplan

What is the context: Energy Masterplans are usually drafted by Ministries in charge of energy and outline the way forward for the development of the energy sector by defining goals and drivers, critical infrastructure needs and an actionable strategy, including the investments needed to allow the country to meet the energy demand with the least cost

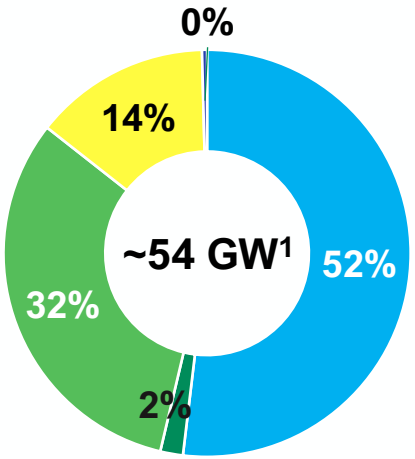
Why is this relevant: Energy Masterplans provide a roadmap to guide the national energy sector towards a future with adequate, sustainable, efficient and reliable supply that is environmentally friendly, competitively priced, and which puts the country on the path to achieving its development objectives in order to attract private capital

What are the key questions:

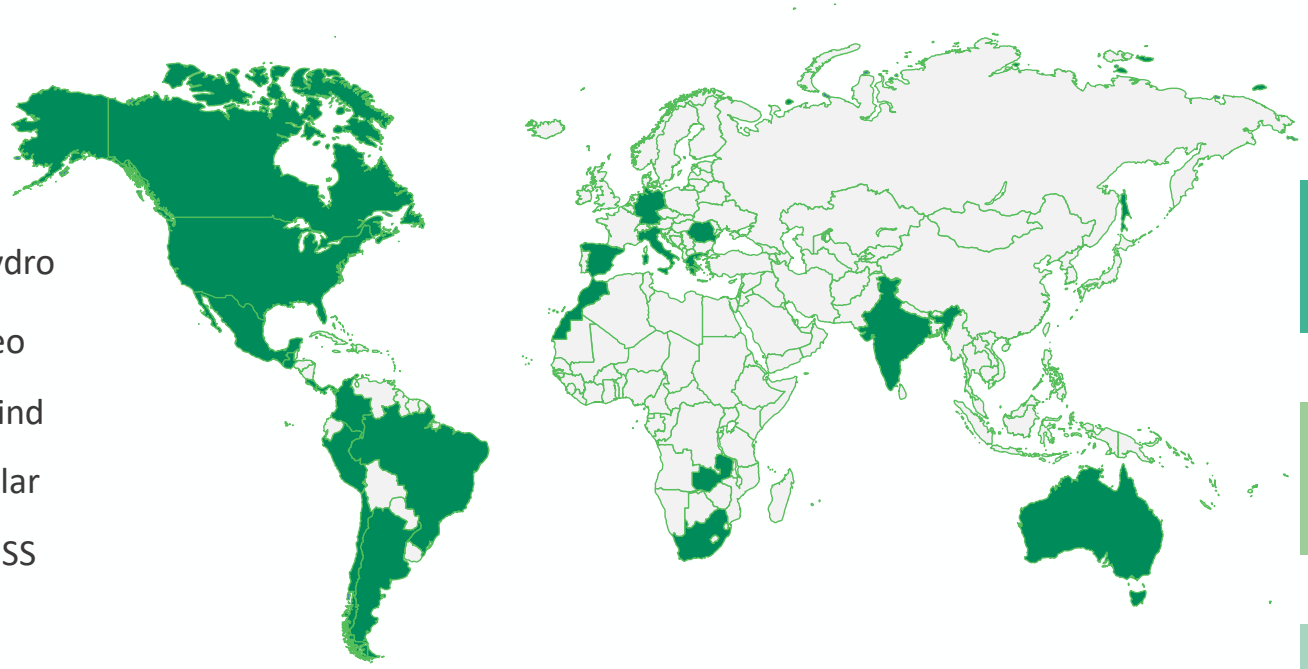
- Which are the main topics covered by a national Energy Masterplan? How do they work?
- Which are its key elements?
- How can a national Energy Masterplan be drafted?

Enel Green Power: the world leader in Renewables

A global presence and a different portfolio



- Hydro
- Geo
- Wind
- Solar
- BESS



2021 Installed RES Capacity[1] (GW)

of which 220MW BESS

~1.2k plants

21 Countries[2]

~15k employees

1. Including managed capacity by 3.3 GW
2. Countries with assets in operation or under construction

The importance of national Energy Masterplans

What is an Energy Masterplan?

- A Masterplan outlines the way forward for the **development of the energy sector by defining goals and drivers, critical infrastructure needs and an actionable strategy**, including the **investments needed** to allow the country to meet the energy demand with the least cost
- Energy Masterplans are usually drafted by Ministries in charge of energy, as this institution has usually a 360° view of the whole sector

Why is an Energy Master Plan so important?

- Energy Masterplans provide a roadmap to guide the national energy sector towards a future with **adequate, sustainable, efficient and reliable supply** that is environmentally friendly, competitively priced, and which puts the country on the path to achieving its development objectives
- It **shows the willingness of a country to engage in a sustainable development path**, through the technologies, the capacities and the market models selected for the evolution of generation and of the infrastructures. This is key to lower the risk perception of investors and to **attract private capital**

Main Topics covered by Energy Masterplans

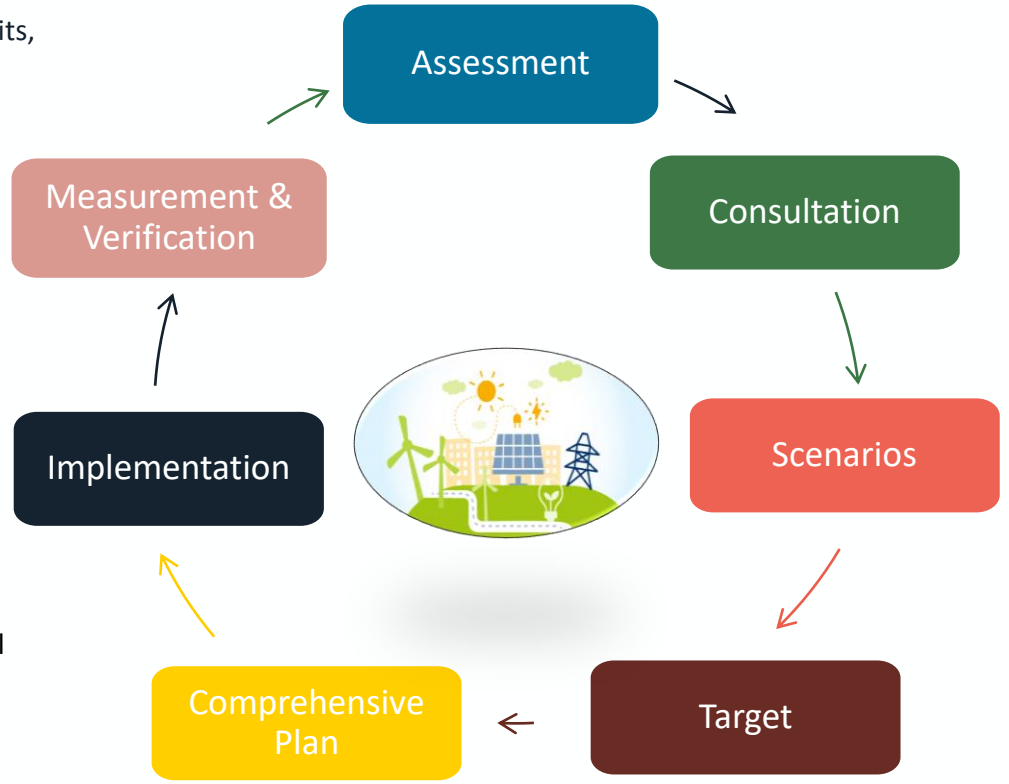
What are the key elements of a Masterplan?

Measurement & Verification

- Define monitoring actions & KPIs
- Evaluate and measure costs, benefits, environmental and social impacts
- Seek improvements actions
- Keep Masterplan updated

Implementation

- Define institutional roles and responsibilities for the implementation of the masterplan
- Define actions and strategies to achieve the targets
- Set an enabling Regulatory Framework to reach those targets (RES priority, incentive & support system)
- Define rules for procurement, local content and ownership



Comprehensive Plan (short-, mid- and long-term)

- Define rules for procurement of new generation capacity & local content
- Define support measures for key technologies (eg RES, BESS….)
- Coordination of Generation & Transmission to avoid Grid connection issues
- Define measures and tools for flexibility and resiliency of the power system
- Define cross-border cooperation areas (eg cross border trading, import / export)
- Action plan can include also energy access and job creation strategies

Assessment

- Understand and evaluate energy demand and supply
- Macroeconomic, demography and fuel price data
- In-depth analysis of energy demand and resource potential
- State of the infrastructure

Consultation

- Integration of key stakeholders' views; Ministry of Energy, Environment, Finance, Energy Regulator, Planning and Development authorities, energy efficiency Agencies, TSO…
- Align local visions with national plan (need for energy access, socio-economic development of specific areas…

Scenarios

- Establish scenarios based on demand, macroeconomics and other relevant variables
- Mapping resource potential & zoning Analysis for the identification of high potential locations per technologies to serve as a basis to set new targets

Target

- Set feasible & realistic targets for energy access and capacity increase
- Short-, mid- and long-term targets differentiated by technologies (eg solar PV, onshore wind, BESS…)
- Clear, Updated and Realistic targets provide evidence of a government's long-term commitment to clean energy transitions and serve as critical signals to attract investment

Key steps to draft a Masterplan

1. Have a **responsible organizational structure**, but with the **involvement of all relevant stakeholders** (Ministry of Energy / Environment / Finance, the Energy Regulator, Energy Planning and development authorities, state / regional / provincial institutions, specialized funds and Agencies) and providing a consultation period.
2. **Measuring and evaluating fundamentals** (resources, macroeconomics…)
3. Conduct an analysis of past and ongoing renewable energy initiatives to identify **success factors and implementation gaps**, as well as consider lessons learnt from international experience. → what policies are missing? What went wrong in past initiatives? How implementation can be ensured?
4. **Enabling framework**: objectives, support schemes, enhance local benefits.
5. Develop a **roadmap** that includes all relevant technologies (and sectors)
6. Evaluate and measure costs, benefits, environmental and social impacts
7. **Implementation** plan
8. Assessing the situation, reviewing variables and updating

Focus on targets

Clear, updated and realistic targets provide evidence of Government commitment to sustainable development, and attract investments

Targets can be expressed in :

- **MW**
- **% of the energy mix** in generation, consumption or installed capacity
- **GWh** (less frequently)

In the table below, targets from Ghana Renewable Energy Master Plan-2019:

INTERVENTION	UNITS	BASELINE	2020	2025	2030
1. Utility scale Solar	MW	23	150	225	300
2. Rooftop/net metering Solar PV	MW	1.7	40	120	200
3. Standalone Solar PV Systems	MW	2.5	7	9	10
4. Street/Community lighting	MW	1.5	4	6	8
5. Lanterns	Units	70,000	500,000	1,300,000	2,000,000
6. Solar Irrigation/water supply	Units	<30	200	350	500

Targets must be:

- **Challenging**
- **Achievable**
- **Long-term** with **intermediate milestones**
- **Declined per technology**

In Ghana there are long-term targets with intermediate milestones (5-years blocks) in line with other plans such as the Strategic National Energy Plan (SNEP) and SE4ALL action agenda to 2030

Source: Renewable Energy Masterplan for Ghana - 2019

Examples of energy Masterplanning in Africa

	Ghana	Senegal	Cameroun	Ethiopia	Angola	South Africa	Zambia	Uganda	Kenya	Mozambique	DRC	Rwanda	Seychelles	Morocco	Tunisia	Mauritius	Egypt
Generation Masterplan																	
Existence of a Masterplan																	
Updated (after 2015)											n.a		n.a				
RES Target																	
Intermediate milestones											n.a						
Targets per Technology											n.a						
Mapping Resource & Potential											n.a						
Generation Investment Plan																	
Investment Plan																	
Publicly available																	
Transmission Investment Plan																	
Integrated with Transmission																	
Publicly available																	
Energy Access																	
Energy access target													n.a				

Current Masterplans can give us a clear picture of what are the energy priorities in most of African countries :

- RES Power generation
- Energy access, as a key issue for Sub-Saharan Africa. Maghreb countries have already reached their electrification target
- Long-term planning for Grid investments is done by National DSOs and usually not disclosed to the public
- In some cases, Masterplans were developed with the support of international organizations (eg United Nations Development Programme (UNDP) in Nigeria and Ghana; IRENA in Eswatini).

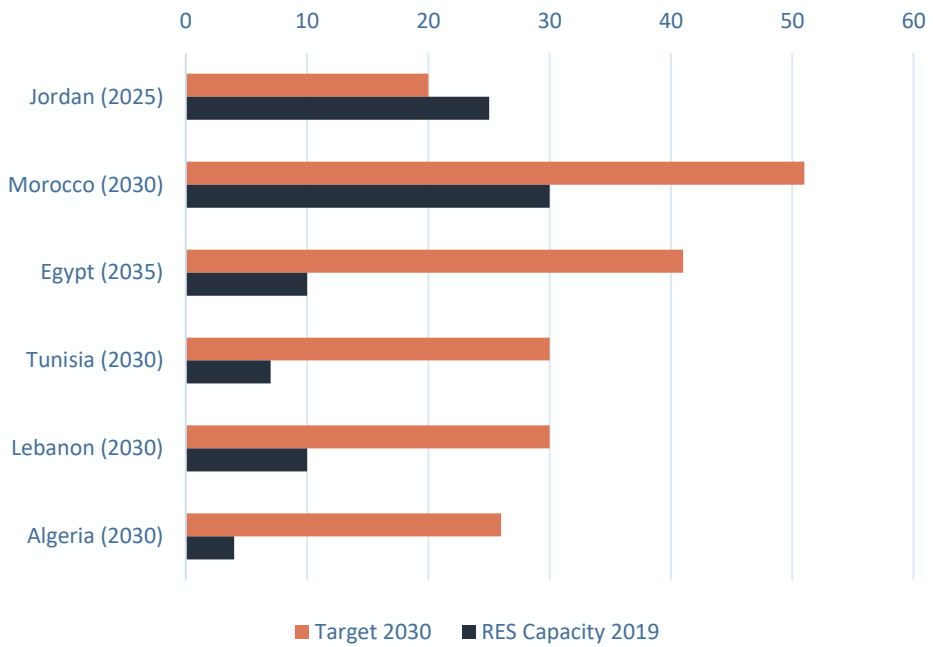
The Middle East and North Africa experience

18 over 19 countries have adopted national renewable energy targets

But only

- **10** countries have updated targets (revision or set after 2015)
- **10** countries have targets differentiated per technology
- **8** countries have mid-term milestones
- **2** countries (Morocco and Egypt) are on track to meet their respective targets.
- **1** country (Jordan) has already met its official target of 20% of RES production by 2025

PROGRESS TOWARD RE TARGETS AS OF 2019



Masterplans are frequently adopted in MENA, but targets are often eye-catching, as Countries are keen to show their green commitment

Source: RES4Africa Connecting the Dots Study MENA Edition (2021)

Case study: South African Integrated Resource Plan (IRP)

	Coal	Coal (Decommis-sioning)	Nuclear	Hydro	Storage	PV	Wind	CSP	Gas & Diesel	Other (Distributed Generation, CoGen, Biomass, Landfill)
Current Base	37,149		1 860	2,100	2 912	1 474	1 980	300	3 830	499
2019	2,155	-2,373					244	300		Allocation to the extent of the short term capacity and energy gap.
2020	1,433	-557				114	300			
2021	1,433	-1403				300	818			
2022	711	-844			513	400 1,000	1,600			
2023	750	-555				1000	1,600			500
2024			1,860				1,600		1000	500
2025						1000	1,600			500
2026		-1,219					1,600			500
2027	750	-847					1,600		2000	500
2028		-475				1000	1,600			500
2029		-1,694			1575	1000	1,600			500
2030		-1,050		2,500		1000	1,600			500
TOTAL INSTALLED CAPACITY by 2030 (MW)	33,364		1,860	4,600	5,000	8,288	17,742	600	6,380	
% Total Installed Capacity (% of MW)	43		2.36	5.84	6.35	10.52	22.53	0.76	8.1	
% Annual Energy Contribution (% of MWh)	58.8		4.5	8.4	1.2*	6.3	17.8	0.6	1.3	

Installed Capacity
Committed/Already Contracted Capacity
Capacity Decommissioned
New Additional Capacity
Extension of Koeberg Plant Design Life
Includes Distributed Generation Capacity for own use

- 2030 Coal Installed Capacity is less capacity decommissioned between years 2020 and 2030.
- Koeberg power station rated/installed capacity will revert to 1,926MW (original design capacity) following design life extension work.
- Other/ Distributed generation includes all generation facilities in circumstances in which the facility is operated solely to supply electricity to an end-use customer within the same property with the facility.
- Short term capacity gap is estimated at 2,000MW.

- **Targets in MW**
- **Targets in % of installed capacity**
- **Targets per technology**
- **Targets per year**

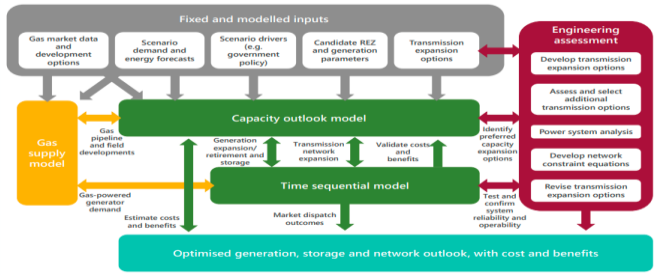
- In 2019 and after several years of extensive public consultations, South Africa published its updated Integrated Resource Plan (IRP), that identifies the preferred energy generation mix required to meet the expected demand growth up to 2030
- PV and Wind are identified as key technologies to replace coal (11+GW of coal to be decommissioned by 2030)
  - 1600 MW per year for wind for 2022-2030
  - 1000 MW per year of solar PV for 2022-2030
- For the first time, a target on Storage is included, to ensure flexible generation from renewables

Source: IRP Targets – Ministry of Mineral Resources and Energy - DOE - 2019

Best practices overseas

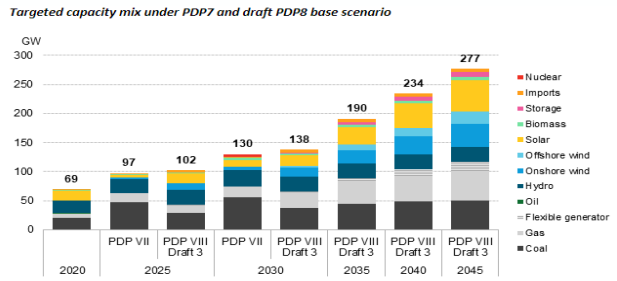
- The Australian Integrated System (ISP) is released every 2 years by the Australian Energy Market Operator. It defines an optimized long-term outlook (20+ years) in terms of generation, storage and network need

- By 2050, ISP 2022 identifies:
  - 10.000 km of new network investments (USD 9 bn)
  - 9 X increase in grid-scale wind & solar capacity to 141 GW
  - 3X solar capacity to 71 GW
  - 5X increase in distributed solar to 69 GW



- In 2021, the Ministry of Trade and Industry issued a draft for the period 2021-2030, with a vision to 2045, currently awaiting approval from the Prime Minister ("Revised Draft Master Plan VIII")

- The "Revised Draft Master Plan VIII" identifies:
  - No new coal-fired power plants pre-2030 & Priority for RES
  - Preparation of a mechanism to encourage the development of flexible power sources including storage technologies
  - Grid connectivity issues are mitigated by a long-term planning of grid improvements



Source: BNEF, *Vietnam Focuses on Gas and Wind in Latest Power Plan*, 17th March 2021

Source: Australian Energt Market Operator (AEMO), Bnef 2021

Key recommendations for an effective Energy Masterplan

1 *Include & collaborate*

- Involve all relevant stakeholders: public entities, but also Utilities, which have extensive experience in planning networks and in cost definition; complement with academic and industrial partners
- Avail of international cooperation for technical assistance and capacity building on demand forecasting, generation and transmission planning and financial modeling

2 *Ensure consistency and coordination*

- Ensure consistency with other Plans / strategies / regulations of the country (eg RE development plan must be consistent with any National Energy Strategy)
- Ensure coordination between generation and transmission development

3 *Data driven approach*

- Positioning of policy on this basis can be done transparently

4 *Targets are a key driver*

- Targets must be long-term with shorter-term milestones. They must be challenging but achievable. Where possible, they should be legislated to make them more enforceable

5 *Implementation!*

- Make sure that regulations for effective implementation follow soon the Masterplan

6 *Periodic, consistent updating with transparent governance*

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