

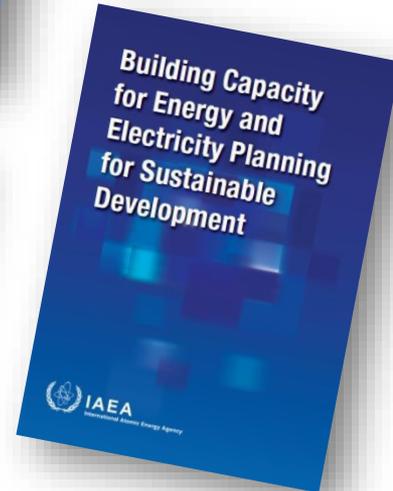
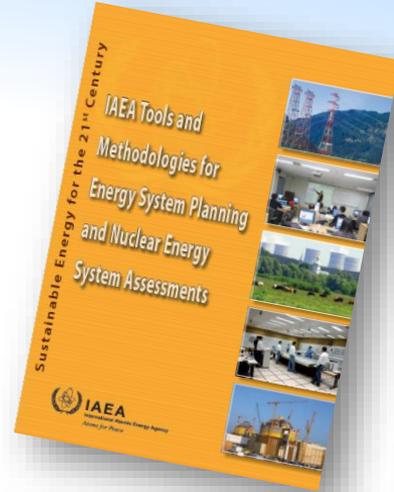
Transition (jump) to Net-zero by 2050: Theory vs. Practice?

Summer 2022 Semi-annual ETSAP Meeting
23 May 2022

*On the behalf of the PESS-PCB unit:
Mario TOT, IAEA, Vienna, Austria*

IAEA Support in Energy Planning

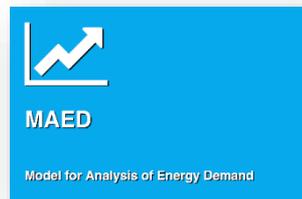
- ... **assist** Member States in reinforcing national capabilities to conduct energy system analysis, so that countries can assess options and develop **their own sustainable energy strategies**, i.e. support decision and policy making



IAEA's Energy System Assessment Tools



*Energy Statistics
and Energy
Balances
compilation*



*Energy Demand
Analysis and
Projections*



*Energy Supply
Optimization and
Simulation*



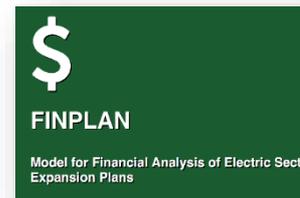
*Energy Scenario
Simulation Tool for
fast estimates*



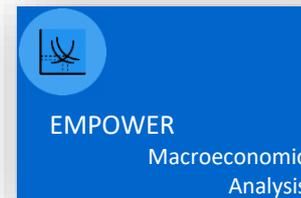
*Power Generation
Investments and
Expansion Planning*



*Analysis of Power
Plants Environmental
Impacts*



*Analysis of financial
viability of power
generation projects*



*Quantification of
macroeconomic
effects of strategies*

Net Zero Future

A subset of general Energy Planning exercise



Multiple and
Conflicting
Objectives

Fuel and Technology Mix
Investment intensive
Long life-times

Evaluate long-term
outcomes, while
capturing short- and
medium-term
challenges

Everchanging
Environment
(options, costs,
policies...)

Uncertain
Present and
Horizons

Avoid lock-in into
unsustainable
alternatives

Transition Towards Net Zero Future

Pledges, promises and commitments...

- Many countries and industries are stating plans to transition towards net-zero objectives by 2050

Questions, challenges and uncertainties...

- How to sustain such a fundamental change at national and global levels?
- Development of new technologies, many non-existing, not-clearly identified or at an early concept stage
- A complete revamp of infrastructures, systems, and behaviours
- Keep energy flows and prices secure, stable and predictable, supporting uninterrupted economic development...

Developing Countries' Horizons



- Significant contributions of developing world towards global targets are needed (and expected)
- Are net zero aspirations within a reach?
- DCs approach energy system from a different angle – as a development enabler and a driving force, while addressing many other *burning* issues that require immediate actions (e.g. reduce poverty, secure sustainable agriculture and food production, water supply, sanitation services, improving health systems, providing education, job creation, reducing extreme environmental pollution and damages etc.)
- Therefore decisions related to energy sector (and other) tend to be more of a short term nature – i.e. provide service with available options *now*, even at significantly higher price or with a reduced quality or quantity

Examples – Real Case Studies



- Two African countries in which the IAEA provided capacity building and where official energy planning documents were produced
 - Botswana
 - Eswatini

Real Case Study 1

Developing IRP Botswana



- Project completed 2018-2020
 - Developing Scenario Modelling on Different Energy Sources for Sustainable Energy Development
 - National team was trained in Energy Demand Analysis (MAED) and Energy Supply Assessment (MESSAGE)
 - Overseen by a National Steering Committee
 - Project results/analysis directly fed into national energy policy document
- Official planning document
 - [Integrated Resource Plan for Electricity for Botswana, 2020](#)
 - While project covered all energy uses, only power sector plan was used to propose official policy

IRP Botswana

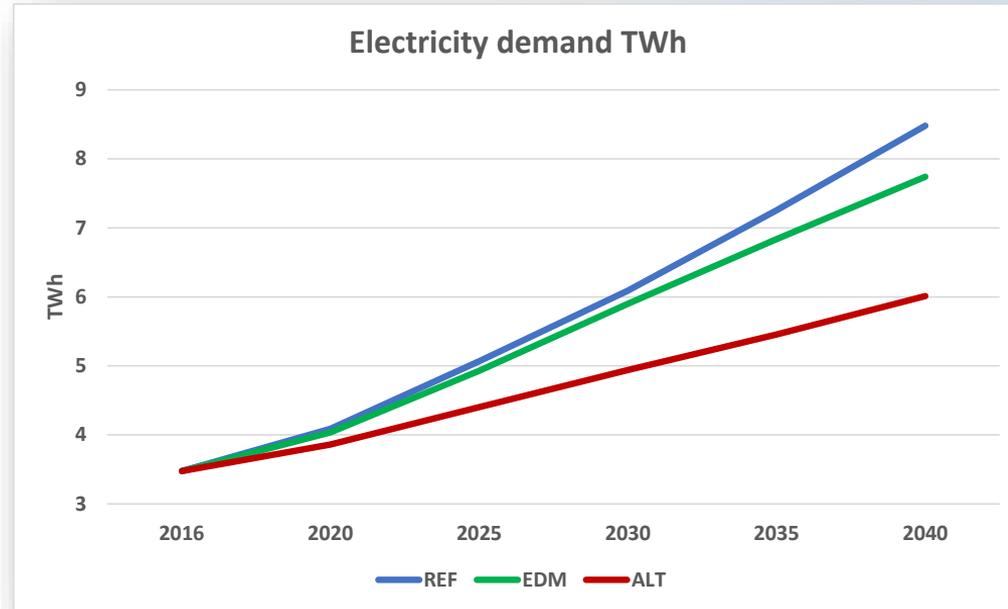


- Energy planning process guided by its National Development Plan (NDP) and other sector policies and ambitions
 - NDP focuses on increasing self-reliance on the country's energy resources
 - Diversification and support development of the economy by securing competitive, cost-reflective and sustainable electricity prices for industry, services and households
 - Geographical position and SAPP interconnections (existing and planned) offer opportunity for electricity export and imports to/from the region
- IRP outlines least cost power generation expansion plan for a period 2020-2040
 - Various scenarios of energy demand and supply strategies
 - Simultaneously looking at (1) demand-side measures, (2) energy efficiency improvements and (3) electricity supply options from domestic and regional sources

IRP Botswana – Energy Demand Assessment



- Three scenarios
 - Reference (REF)
 - Energy Demand Management (EDM)
 - Alternative (ALT – Slower economic development)
- EDM scenario is a desired outcome, based on the National Energy Efficiency Strategy (NEES) and SE4ALL Action Agenda
 - Doubling of electricity demand



IRP Botswana – Electricity Supply Assessment



- Status
 - Electricity is primarily generated from domestic coal resources
- Potential
 - Large Coal reserves and Coal-bed methane
 - Solar (3,200 hours of sunshine)
 - Wind (areas with average speeds above 7 m/s, and power density above 200 W/m²)
 - Biogas and fuel wood
 - No hydro potential
 - Petroleum products are imported
- Generation expansion scenarios
 - Competition
 - Self reliance
 - Clean electricity

IRP Botswana – Policy Decisions



- Energy Savings and Self-reliance are preferred development paths
 - Diversification by 2040
 - Gas (coal-bed methane) 20%, renewables 20% (mainly solar PV/CSP + wind)
 - Coal share to reduce to 60%
 - Reduction of import dependency
 - By 2040 country is net exporter (with large transits due to position)
 - Mitigation of environmental impacts
 - While CO₂ emissions will almost double by 2030 (from current 3.7 Mt), during period 2030-2040 will see annual levels stabilise at around 6.5 million tons
 - Flexibility
 - Batteries

IRP Botswana – Implementation Actions



- Document produced clear plan of actions for next 5 years
 - Procurement of 135 MW of solar PV and 10 MW CBM started (2021)
 - Additional 350 MW in RES and 300 MW in coal to be procured in the next 5 years
- Net zero conclusions?
 - Botswana 1st NDCs indicate intention to reduce GHG emissions by 15% by 2030, relative to 2010 level of 8.3 Mt
 - Still, through IRP decision makers choose another route
 - Emissions from power sector almost double by 2040

Real Case Study 2

Developing Power System Master Plan of Eswatini

Kingdom of Eswatini



- Cumulative effort of IRENA and IAEA capacity building support
- IRENA provided SPLAT-Eswatini and LEAP modelling, supported stakeholders dialogue
 - Developing an Integrated Resource Plan for Evidence-Based Decision Making in the Energy and Electricity Sectors
- IAEA Project completed 2020-2021
 - Further training of national team in Energy Demand Analysis (MAED) and Energy Supply Assessment (MESSAGE) to Ministry of Natural Resources and Energy
- Official planning document
 - [Energy Masterplan 2034](#)
 - First comprehensive energy policy document since 2003
 - Analysis covered all energy uses, with clear main focus in power

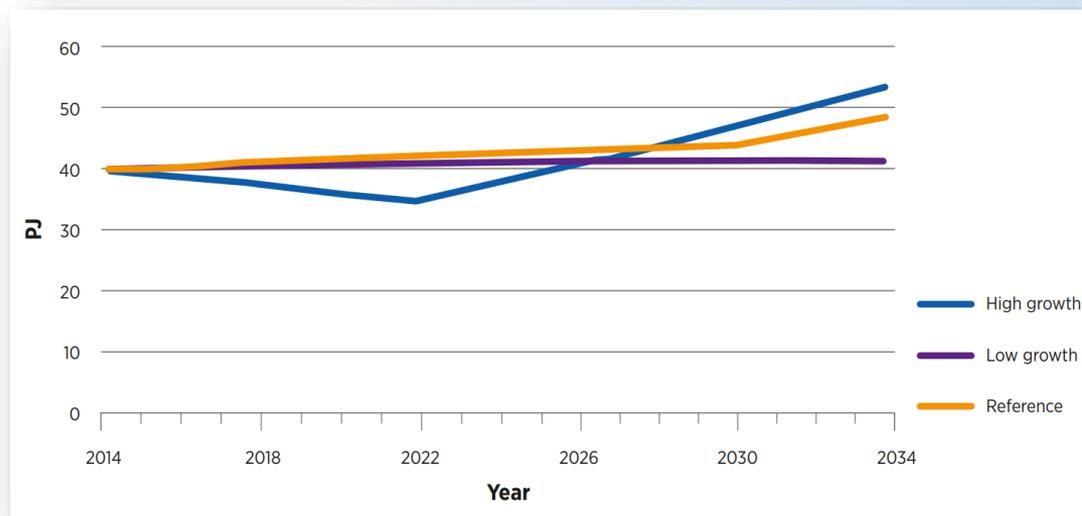
Energy Master Plan of Eswatini



- Seeks to provide national decision makers with the quantitative basis for planning future energy sector development
 - Identifies and addresses the country's barriers in the supply of energy (limited domestic options, emphasized security of supply)
 - Maximises energy use for sustainable energy development.
 - Helps shape appropriate policy and regulatory choices through the determination of suitable energy sources and technologies that are relevant and consistent with national priorities (poverty alleviation, improving life quality, increasing access to clean technologies, attract investments)

Energy MP Eswatini – Energy Demand

- Three scenarios
 - Reference (REF)
 - High growth (HIGH)
 - Low growth (LOW)
- Reference case
 - Demand for oil products increases by 50 % by 2034, with 95 % of growth coming from transport
 - Coal has a constant share of 5 % and remains concentrated in sugar, commerce and government services sectors.
 - Electricity demand more than doubles, from 1.27 TWh in 2014 to 2.65 TWh in 2034



Energy MP Eswatini – Energy Supply Assessment



- Status
 - Oil products are entirely imported
 - 70% of electricity is imported
- Potential
 - Coal, hydro, and biomass residues (sugar and forestry)
 - Very good wind and solar potential
 - Unsustainable use of fuelwood
- Key policy issues addressed
 - Self-sufficiency in energy supply and security concerns
 - Optimal use of domestic resources
 - Diversification of the energy supply mix to meet energy
 - Universal access to clean and affordable energy
 - Climate change goals, as captured in Eswatini's NDC

Energy MP Eswatini – Policy Directions



- Security of supply and self reliance
 - Base case shows reduction of electricity import from 64% to 38%
 - Further reduction of import can be achieved at additional cost (ranging from 1% to 22% higher cost compared to the base)
- Energy access
 - Universal electricity access should be reached in short term
 - State supported program is needed to move away from inefficient traditional biomass uses to LPG
 - Individual solar PV and solar water heating systems
 - Electricity cost is expected to increase across all analysed scenarios (especially in no-import cases where domestic coal is deployed)
- Environmental impact minimisation
 - Deployment of local coal would develop a new industry and offer new jobs, but to the detriment of environmental pollution and it's not compatible with government commitment to the Paris Agreement
 - Scenario with limited import and diversification of renewables options offers a balanced solution in terms of emission reduction (4 times) and cost increase (slightly more expensive over base case)

Energy MP Eswatini – Implementation Actions



- Document was subject to an extensive process of stakeholder consultation and review
 - Clear preference for embracing a renewable energy pathway and for gradually phasing out the use of fossil fuels and/or rejecting new fossil fuel capacity options
 - Support to government to stay committed to the Paris Agreement
 - Need for support schemes for clean energy options
- Net zero conclusions?
 - Clear orientation of government towards low carbon solutions/options
 - Opening market for private investors, but with a careful design of incentives

Overall Comments

- While there's a clear desire of many countries to adhere to clean energy / low carbon / net zero targets, incomplete or lack of planning and policy making processes still represents an important obstacle to streamline transition
 - Issue is especially emphasized in developing countries
- Realities and horizons of many developing economies towards net-zero are significantly different compared to advanced countries
 - Many countries do not have capacity to govern the process and technological choices are limited to short-term decisions to address current issues

Thank you!

More on support and tools:

PESS.Contact-Point@iaea.org

[Energy Modelling Tools & Services](#)