LEAST COST ENERGY SUPPLY
Model For A Multiple Scenario Analysis Of Northern Africa


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Background

- High level of natural resources
- High levels of Renewable resources
- A long-term vision is needed to make optimal use of available domestic resources
- Tools have been developed to support African member countries
- IRENA to accelerate Africa’s development
CONTEXT OF THE PROJECT

The Focus

• **Least-cost energy system modelling**
  Appropriate tool to *explore investment decisions*
  Reach optimal energy mix & long term transition pathways with high RE

• Framework Northern Africa Energy Model
  Assess power sector investment needs
  Fuel economic development
  Public domain data

• What potential to offset the use of Natural gas with RE – to what benefit for the region?
MESSAGE MODELLING FRAMEWORK

Key Characteristics

Model for Energy Supply System Alternatives and their General Environmental impacts

- Medium- to longterm timeframe
- Energy system (as opposed to power system)
- Optimisation (as opposed to simulation or accounting frameworks)
- Linear and Mixed Integer
- Dynamic (as opposed to static, i.e., snap shots of time)
- Bottom Up (as opposed to top-down, e.g., CGE, econometric or input-output models).

Optimisation objective function

The discounted sum of

- Investment cost (minus salvage costs)
- Fixed & Variable operation and maintenance costs
- Fuel costs
- Any additional penalty costs defined for the limits, bounds and constraints on relations
Characteristics

Bottom up model ≡ technology intensive
Each technology can be characterised by
- (multiple) inputs and outputs
- Seasonal variation in capacity
- Efficiency varying with time
- Costs varying with time
- Limits on production
- Capacity build-up constraints
- Market penetration constraints
- Emission control

Demands & load regions
Defined exogenously
THE MODEL

General Characteristics

Model of North African states

Timeframe
2010 to 2050; reporting to 2030

Technology Data
Capacity data & Techno economic parameters
IRENA SPLAT modelling databases

Demand
Industrial – Rural – Urban & commercial levels
African Energy Outlook (AEO) 2040 – calibrated to 2010 data

Load regions
Hourly data for Morocco & Egypt
The reference energy system

- Each country is one node
- Transmission lines link each node
  - Existing & planned
  - ICA, WB & MED
- Natural gas is traded between nodes and to Europe
- Includes around 200 technologies
Scenario Development

Frozen future (FF)
- Local gas price (incl. subsidies)
- No improvement in technology performance
- No gas sale on international market
- Carbon mitigated valued at 25 USD/t

Progressive technology (PT) – builds on (FF)
- Renewable Energy Technology (RET) capital costs improve
- Local gas prices are maintained: no opportunity cost of other fuel uses

Diversification and environmental investments (DIVE)
- Adopts progressive environmental economics
- Netback pricing of Natural Gas
- RET development continues, the region actively diversifies its generation portfolio.
- Includes futures with a range of CO₂ mitigation incentives from 25-50USD/t
RESULTS

Generation

2010

2030
RESULTS

**CO2 mitigation & Costs**

- Potential revenue from NG increases with higher RE penetration
- Netback pricing
  - Increases the cost competitiveness of RET
  - Offsets higher annualised system costs by the sale of NG
  - Has a potential to help mitigate CO2 emissions
CONCLUSION

Food for thought

So far the analysis shows that

- Offsetting natural gas & fossil fuel use with RET in NA is possible and can be economically sound

- Potential benefits
  - Economic for NA & Energy security for EU

And further steps would include

- Further load region detail – regional peak shift
- Including the natural gas network in the analysis
- Improve elements of cost data
- Constraints associated with intermittency
THANK YOU FOR YOUR ATTENTION