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Why Energy Planning ?

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The Energy System and Policy

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Some energy system characteristics

- Energy is big business
- There are strong geopolitical considerations
- Its effect on people’s lives are immense
- Energy policies affect and are affected by a myriad of other policy areas

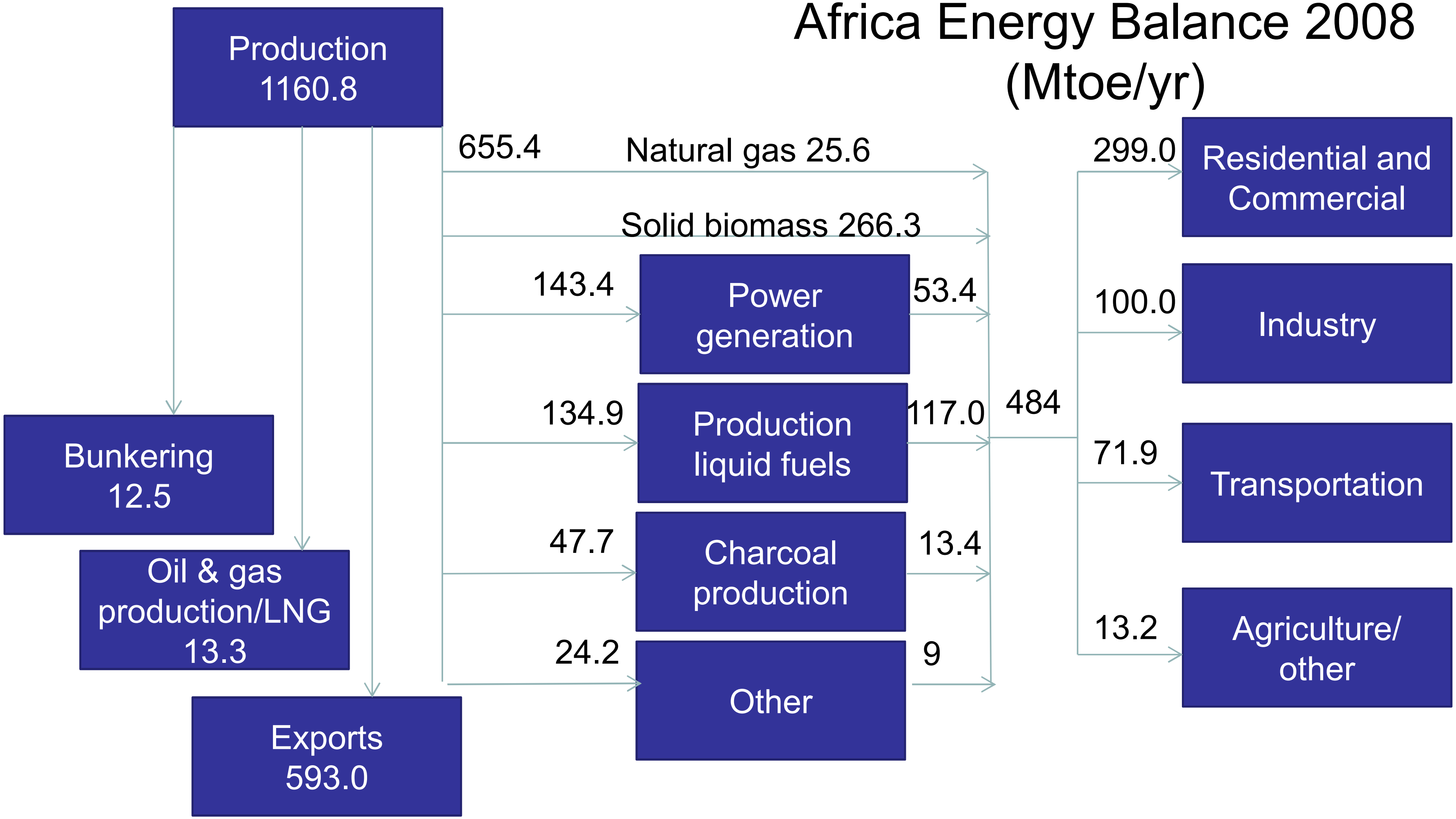
- Policy maker must make sense of these views, in the context of the energy policy priorities:

i. Enable adequate affordable access to services

ii. Ensure energy supply security

iii. Acceptable social and environmental impacts

Africa Energy Balance 2008 (Mtoe/yr)



Unique Characteristics of the African Energy System

- Significant net exports
- Big differences between countries and regions in terms of resource endowment
- The worlds lowest energy access rates are in sub-Saharan Africa
- Also some of the worlds highest economic growth rates
  - And therefore rapidly rising electricity demand
- Dominance of traditional biomass for cooking and heating
- In many countries the utilities are not bankable
  - Investment rates are too low to meet rising demand resulting in blackouts
  - As a consequence massive investments in expensive diesel power generation
- Excellent untapped renewables resources
  - Large hydro
  - Wind
  - Solar
  - Biomass
  - Geothermal (in the East)

Introduction to energy assessments

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- **Energy supply and demand are integrated:** One part of the system affects another part
- The energy system and its technologies are **dynamic**

- Energy modelling can help decision makers to deal with complexity.
- Given complexity, models are needed.
- Energy modelling is an art, however there are various “accepted methods”
- Energy modelling provides **insights** NOT answers
- Different actors require different answers and thus different approaches (no “one size fits all”)

Introduction to energy assessments: Complexity and models

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- With a **model** we make an abstraction of the real world and simulate / plan … something
- A typical "energy systems model" will relate techno-physical aspects of **the energy system** *such as:*

  type of energy technology (eg Gas GGCT vs Wind) required, the capacity of that installation (MWs) required, when the installation operates, its level of activity etc.

  to **attributes** *such as:*

  cost, environmental or economic impact, flexibility, robustness
- And this may (and may not) be to meet some overarching goal, subject to various constraints
- For different **scenarios** of the future
- Often related to **policy** formulation, implementation and monitoring

Types of energy planning

- Need to deploy a range of models
- Power sector planning
  - Long term planning – decades – technology rich partial equilibrium models
  - Long term planning – years – econometric models
  - Short term planning – minutes-hours-days
  - Grid stability planning – sub-second and second scale (IRENA uses Power factory)
- Energy system planning – all types of energy supply and demand
- Financial project evaluation tools
- Other static tools: Homer, LEAP etc

Energy systems models

- Bottom up “energy systems models” – typically decades ahead
  - Accounting (e.g. LEAP, MAED etc.)
  - Simulation (e.g. Balance etc.)
  - Optimisation (e.g. MARKAL, MESSAGE etc.)
- Top down “energy-economy models” – typically years ahead
  - Econometric
  - Input-Output
  - Computable General Equilibrium models (e.g. SGM, AMIGA)
- And different levels of integration of each...
  - (MARKAL-MACRO, IOSYM etc.)

Long term planning – bottom-up models

- Widely used: IEA ETP and WEO, EIA IEO, IIASA Global Energy Assessment, etc
  - Especially for power sector planning
- A range of software platforms MARKAL, MESSAGE, NEMS, OSEMOSYS etc
- Account for technological change, capital stock turnover
- Good practice
  - Scenario analysis
  - Sensitivity analysis
  - Iterative approach and gradual refinement – analysis - report – review- analysis etc.
- Strong points
  - Good for transition planning with significant change (eg Africa power sector expansion)
- Weak points:
  - Demand projections
  - Cost optimization does not always reflect real world decision making (esp. in end use sectors)
  - Decentralized renewables planning is often not well captured in national planning
  - Garbage in = garbage out
  - Independent validation not really possible

Scenario planning practice

- "It is difficult to predict, especially the future"
- A search for the "true" prediction will fail
- Instead policy strategies should account for uncertainty
- Scenarios are one tool to account for uncertainty
- Few scenarios account for "black swan" effects
- Basic principles
  - One scenario = no scenario – two or more scenarios needed
  - Every scenario is equally valid
  - Even number avoids focus on "central" scenario
  - Translation of scenarios into strategies is not well understood
    - Various interpretations possible – least regret, most prominent technologies etc
  - Complexity has limited policy appeal

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Grid stability assessment studies

- Frequency and voltage control
- High shares of variable renewables make control more challenging
- Especially challenging for minigrids (island operation etc)
- Rapid technology progress to deal with the problem
  - Smart inverters
  - Battery technology
  - Fly wheels
  - Wind/solar plant output control
  - New system control technologies
  - etc
- A range of software tools available but validity of results needs to be checked

Why use energy planning?

(Good) Models enable:

- Comparative assessment of options
- Transparency & boundaries
- Quantification
- Repeatability / reproducibility
- Sensitivity analyses
- Documentation
- Communication & acceptance
- What – if questions
- Indicators for monitoring progress
- Re-occurring or rolling activity
- Providing visions to mobilize and motivate

Energy planning challenges

- Centralized vs decentralized power supply solutions
- Local characteristic of the resource vs national/regional model scope
- One market or a grouping of many smaller markets?
- Functioning of the market with high shares of variable renewables
  - Marginal cost drop to zero
  - Who pays for backup power supply? Capacity credits? – European discussion
  - Grid planning issues
- Demand side response/opportunities not well understood
- Macro-economic benefits not well understood – a different type of analysis
  - Front-loading of expenses
  - Energy for productive uses
  - Impact on trade balance, jobs etc

Conclusion

- Energy modelling can help to deal with complexity and uncertainty
- A significant modelling effort is a lot cheaper than a wrong investment
- Modelling is an iterative process.
- It is good practice to use a suite of models of different type
- Modelling is especially important for the power sector
- A model can NOT provide the answer to any question
- How the models are used is just as important as the model features
    - Transparency of methodology and assumptions
    - Understand model validity range
    - Uncertainty analysis and scenario analysis
    - Iterative process with engagement of decision makers
    - In-house capacity and continuity are critical (a team/center not a single expert)
- "Model for insights, not for numbers"

THANK YOU !