Sustainable Development Perspectives on Energy Modelling

Kirsten Halsnæs
Scope

• Transformation need to include all countries in the world at different development stages
• Addressing sustainable development (SD) is a prerequisite for meeting low stabilization targets
• IPCC Chapter 17: Acceleration of mitigation in the context of sustainable development
• State of the art in international energy research: IAM's
• Challenges facing studies for developing countries - access, affordability, income generation
The Synergies and Tradeoffs Issue

- Major criteria in decision making
- Tradeoffs have to be openly addressed
- Mapping of mitigation options synergies and tradeoffs need to be context specific
- Conclusions like "the benefits of mitigation exceed the costs at very aggregate level" are not very useful
- Tradeoff and synergies issues are linked Just transition and stranded assets issues
Policy Relevant Questions

- Energy sector planning perspective:
  - Impacts of mitigation options on SDG's. Energy and SDG
  - What to consider beyond energy system modelling boundaries
- What can be considered as green energy options - EU shortlist criteria
- Green investments and finance:
  - Financial climate policy risk
  - Institutional investors
Energy Model Structures and SD

- Energy models are structured around technologies and systems - SDG7 energy access and costs can directly by modelled
- Indirect impacts on e.g. health (airpollution), and energy for education, health clinics, industry etc can also be assessed
- Energy modelling studies have to be supplemented with studies on other sustainable development issues - e.g. land use models
- Socioeconomic sustainability include human and society centric aspects - e.g. development studies on energy access and income generation
SDG Energy Modelling Results

SDG Energy Modelling Results

IPCC 1.5 report
General Model Conclusions

- There are **tradeoffs** between some energy supply options and landuse related to bioenergy crops, renewable energy facilities etc
- **Tradeoffs** on water demand for energy and agriculture
- **Tradeoff SDG's**: No poverty, zero hunger, biodiversity etc
- **Synergies** are related to no poverty, education, health, industry etc
- Large agreement across modelling studies

**Supplementary policies and finance are needed**
# Renewable Energy Study for Ghana

## GHANA ELECTRICITY MIX PROPORTION BY SOURCE AND GENERATION IN GWh

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fossil fuel</th>
<th>Large Hydro</th>
<th>Other ren.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAU</td>
<td>25.6</td>
<td>8.8</td>
<td>7.9</td>
</tr>
<tr>
<td>Climate Change</td>
<td>24.8</td>
<td>17.3</td>
<td>8.8</td>
</tr>
<tr>
<td>National Plan</td>
<td>18.9</td>
<td>22.9</td>
<td>11.7</td>
</tr>
<tr>
<td>Electricity Access and Beyond</td>
<td>22.9</td>
<td>22.9</td>
<td>8.9</td>
</tr>
<tr>
<td>Climate Smart 2030</td>
<td>18.9</td>
<td>9.2</td>
<td>9.0</td>
</tr>
<tr>
<td>Climate Smart 2050</td>
<td>11.7</td>
<td>9.2</td>
<td>8.9</td>
</tr>
</tbody>
</table>

### GHANA ENERGY EFFICIENCY

- **Climate Change**: 44.2 TCO2eq
- **National Plan**: 33.9 TCO2eq
- **Access and Climate Smart**: 6.3 TCO2eq

### GHANA ENERGY CAPACITY IN THOUSAND MW

- **Biomass**: 2 MW
- **Tidal Power**: 2 MW
- **Wind**: 5 MW
- **Solar PV**: 11 MW
- **Small Hydro**: 2 MW
- **Large Hydro**: 2 MW
- **Fossil fuel**: 1 MW

### GHANA ENERGY EFFICIENCY OVER TIME

- **BAU**: 45.1 TCO2eq
- **Climate Change**: 44.2 TCO2eq
- **National Plan**: 33.9 TCO2eq
- **Access and Climate Smart**: 6.3 TCO2eq

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*Technical University of Denmark*

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Energy Access in Poor Ghana Regions

<table>
<thead>
<tr>
<th>What is the most used source of electricity in your household pct. share</th>
<th>Northern</th>
<th>Upper East</th>
<th>Upper West</th>
</tr>
</thead>
<tbody>
<tr>
<td>National grid</td>
<td>53,5</td>
<td>42,2</td>
<td>56,0</td>
</tr>
<tr>
<td>Local Mini grid</td>
<td>0,0</td>
<td>0,0</td>
<td>0,8</td>
</tr>
<tr>
<td>Private generator</td>
<td>0,1</td>
<td>0,0</td>
<td>0,0</td>
</tr>
<tr>
<td>Solar home system</td>
<td>0,6</td>
<td>0,8</td>
<td>0,3</td>
</tr>
<tr>
<td>Solar lantern/Lighting</td>
<td>0,4</td>
<td>5,8</td>
<td>0,1</td>
</tr>
<tr>
<td>Rechargeable battery</td>
<td>2,2</td>
<td>5,9</td>
<td>0,3</td>
</tr>
<tr>
<td>Other</td>
<td>0,3</td>
<td>0,0</td>
<td>0,0</td>
</tr>
<tr>
<td>No electric power</td>
<td>43,0</td>
<td>42,5</td>
<td>42,5</td>
</tr>
</tbody>
</table>

Power supply of households in Ghana in the Northern, Upper East and Upper West Regions in 2017 based on GLSS 7

<table>
<thead>
<tr>
<th>Main reasons for not being connected to the main grid, percentage shares in the Northern, Upper East, and Upper West regions of Ghana (GLSS 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
</tr>
<tr>
<td>Gird is too far away</td>
</tr>
<tr>
<td>Cost of electricity connection</td>
</tr>
<tr>
<td>Monthly fee is too high</td>
</tr>
<tr>
<td>Satisfied with current connection</td>
</tr>
<tr>
<td>Landlord decision</td>
</tr>
<tr>
<td>Service unreliable</td>
</tr>
<tr>
<td>Administrative procedures</td>
</tr>
<tr>
<td>Company refused to connect</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>
SDG Measures in LDC's

• Energy demand - willingness and ability to pay
• Quantity and type of energy supplied:
  – Energy supply reliability (renewable versus other sources)
  – Costs and affordability issues (renewable versus other sources)
• Water-food-energy tradeoffs and synergies:
  – Irrigation, pumping, drinking water
  – Land use for biomass
• Income generation associated with:
  – Energy for production
  – Energy for water: pumping, irrigation
  – Profit of energy companies and services
  – Ownership / cost-benefit sharing models for local energy supply
• Access to the markets: Prices, business opportunities, information, internet
• Education:
  – Lighting for reading
  – Time savings and childrens' school attendance
• Health:
  – Pollutants, Work quality
  – Health clinics
Focal Areas for Energy SD Studies

- Common conclusions: land use conflicts, energy and food access, employment, costs, biodiversity
- Green finance play a key role in meeting low stabilization targets
- More complete assessment of costs and benefits are needed to promote investments
- Assessments in low income countries are particularly challenging in order to access development energy access links
- Standardized framework could be an option to support renewable investments by ODA’s, MDB’s, and private investors
- Support methodology development and applications by local institutions
- Other important issues of concern include stranded assets and just transition