This presentation

• The energy access challenge
• Energy scenarios for Africa
• Offgrid and minigrid technologies
• The role of technology standards
THE ENERGY ACCESS CHALLENGE
African energy access challenges

• Electricity access
• Electricity prices and subsidies
• Reliable electricity supply
• Traditional biomass use
1.3 billion people in the world live without electricity – ½ in Africa
2.7 billion live without clean cooking facilities – ¼ in Africa

Source: IEA WEO, 2011
Lighting Sources in Sub-Saharan Africa

- Grid electricity - reliable: 20%
- Grid electricity - unreliable: 10%
- Solar home system: 0%
- Solar portable lanterns: 0%
- Kerosene: 42%
- Candles: 21%
- Other: 7%

Source: Practical Action, 2011
Investment today is far from enough

Globally, $9.1 billion was invested in energy access in 2009

- Bilateral Official Development Assistance: 14%
- Multilateral organisations: 34%
- Developing country governments: 31%
- Private sector finance: 22%

*Current investment in providing energy access relies heavily on overseas development aid*

Source: IEA WEO, 2011
Where is the investment needed?

$48 billion investment required, a 5.3-fold increase

Nearly half of the investment is needed in sub-Saharan Africa

Source: IEA WEO, 2011
Energy subsidies often miss the mark

Share of fossil-fuel subsidies received by the lowest 20% income group, 2010

- LPG: 5%
- Gasoline: 6%
- Diesel: 6%
- Electricity: 9%
- Natural Gas: 10%
- Kerosene: 15%

Only 8% of the $409 billion spent on fossil-fuel subsidies in 2010 went to those on the lowest incomes – a failed access policy

Source: IEA WEO, 2011
Power supply reliability

- Frequent blackouts
- High transmission and distribution losses
- Widespread use of diesel generators
  - Very expensive power (>USD 0.4/kW)
  - 400 MW installed in Nigeria alone in 2011
- Loss of economic activity
ENERGY SCENARIOS FOR AFRICA
Sustainable Energy for All (SE4ALL) and REMAP

- An initiative of the UN Secretary General
- 2012 „Year of sustainable energy for all“

- Framework released January 2012:
  - Global access to modern energy in 2030
  - Doubling of energy efficiency improvements
  - Doubling the share of renewable energy in 2030

- Private and public sector engagement needed
- Opportunity areas and hotspots are being elaborated at this moment

- IRENA roadmap for renewables objective: REMAP
Prospects for Primary Energy Demand in Africa

High GDP/Low Biomass scenario

- Other biomass and waste
- Other renewables
- Nuclear
- Oil
- share of renewable

Low GDP/high biomass scenario

- Other biomass and waste
- Other renewables
- Nuclear
- Oil
- share of renewable

Source: IRENA, forthcoming
Prospects for decentralized generation for 2030

Southern Africa: Urban
219 TWh
- Decentralized: 12 TWh (5-45% range)
- Centralized: 207 TWh (88%)

Southern Africa: Rural
24 TWh
- Decentralized: 44 TWh (40-90% range)
- Centralized: 0 TWh (56%)

Western Africa: Urban
110 TWh
- Decentralized: 23 TWh (0-60% range)
- Centralized: 87 TWh (77%)

Western Africa: Rural
16 TWh
- Decentralized: 18 TWh (45-92% range)
- Centralized: 8 TWh (82%)

Legend:
- Orange: Decentralized
- Green: Centralized
Cost competitive distributed generation options in 2030

Elc Production share (%)

- Wind
- Dist. Oil
- Mini Hydro
- Dist. Solar PV

WEST
- Burkina
- Cote d’ivoire
- Guinea
- Guinea-Bissau
- Mali
- Niger
- Nigeria
- Senegal
- Togo/Benin
- Sierra Leone
- Total

SOUTH
- Angola
- Botswana
- DRC
- Lesotho
- Malawi
- Mozambique
- Namibia
- South Africa
- Swaziland
- Tanzania
- Zambia
- Zimbabwe
- Total
OFFGRID AND MINIGRID TECHNOLOGIES
Proper RE policies can create local jobs and economic activity. Mainly upfront cost. Once installed marginal cost are very low. Important to strive for local content in projects.
Minigrid and offgrid solutions

• Rationale: speed of grid extension, cost of grid extension
• Today diesel generators dominate in minigrids
  ▪ Expensive power: USD 0.4/kWh
• Renewable solutions are cheaper
• Minigrid solutions
  ▪ Small scale hydropower
  ▪ Small wind turbines
  ▪ Solar/diesel hybrids (where diesel supply is feasible)
  ▪ Biogas power is emerging
  ▪ Biomass gasification – limited application so far
• Offgrid solutions
  ▪ Cost of solar lanterns and solar panels are falling rapidly
# Rural electricity supply solutions

<table>
<thead>
<tr>
<th>Solution</th>
<th>Capital cost (USD)</th>
<th>Operating cost (USD/month)</th>
<th>Levelized monthly cost (USD/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid extension (coal/gas)</td>
<td>1000-3000</td>
<td>2-5</td>
<td>15-25</td>
</tr>
<tr>
<td>Mini-grids (biomass gasification, hydro, village biogas)</td>
<td>500-1500</td>
<td>2-4</td>
<td>10-20</td>
</tr>
<tr>
<td>Diesel generator</td>
<td>500-800</td>
<td>10-15</td>
<td>15-25</td>
</tr>
<tr>
<td>Biodiesel generator</td>
<td>500-800</td>
<td>10-15</td>
<td>15-25</td>
</tr>
<tr>
<td>Rooftop SHS incl 1 kWh battery</td>
<td>250-500</td>
<td>12-14</td>
<td>15-20</td>
</tr>
<tr>
<td>Solar kits (0.1 kW incl 0.5 kWh battery)</td>
<td>100-150</td>
<td>10</td>
<td>11-13</td>
</tr>
<tr>
<td>Solar lantern/rechargeable lanterns (0.01 kW/0.05 kWh battery)</td>
<td>20-40</td>
<td>1.5-2.5</td>
<td>1.75-3</td>
</tr>
</tbody>
</table>
Rapid and predictable cost reductions for PV modules

Learning curve: constant % cost reduction per doubling installed capacity

Source: Mints, Navigant, Bloomberg NEF, First Solar, NREL PV cost Model
PV grid projects in Africa

Larger projects in areas with good infrastructure are estimated to achieve competitive project costs.

**Typical LCOE grid connected Solar-PV: USD 0.24-0.37/kWh**
PV off-grid installed costs
Africa and Bangladesh

Poor data availability, some very expensive projects

Source: IRENA/GIZ
Not a single “true” cost figure – depends on system configuration – example island transition

Marginal incremental cost compared to diesel based power supply (UScents/kWh)
Electricity storage options

- Storage adds considerably to electricity supply cost
  - Typically USD 0.2-0.4/kWh cost addition
- Small scale electricity storage systems
  - Batteries – 80-95% efficient
    - Lead-Acid - USD 500/kW – USD 250/kWh capacity – short life
    - Lithium USD – USD 1000/kW - USD 1000/kWh capacity – long life
    - NaS – 0.3 GW installed capacity (2012), USD 2000/kW – USD 250/kWh
- Large scale electricity storage systems
  - Pumped hydro storage – 127 GW installed capacity (2009) – 70-80% efficient –
    Typically USD 2000/kW or USD 25/kWh capacity
THE ROLE OF TECHNOLOGY STANDARDS
Use of standards within RE regulatory framework

Technology standards
- Reliability and performance of technologies
- Demand, market acceptance, investment and uptake of technologies
- Technical capacity on testing, certification and reliability in developing countries

Source: CEN (2008), Powerpoint presentation “The Strategic Importance of Standardization”
Available international standards for PV systems

The IEC has developed standards for critical components of off-grid PV systems: solar module, charge controller, lead-acid battery, inverters

**Panels:**
- IEC 61215 Ed. 2.0: Crystalline silicon modules
- IEC 61646 Ed. 1.0: Thin-film photovoltaic Charge Controllers:

**Charge Controllers:**
- IEC 62509 Ed.1: Performance and functioning of photovoltaic battery charge controllers
- IEC 62109: Safety of power converters. Part 3: Controllers

**Inverters:**
- IEC 62109 Safety of power converters for use in photovoltaic power systems. Part 2: Particular requirements for inverters.

**BOS components and minor equipment:**
- IEC 60669-1: Switches for household and similar fixed-electrical installations. Part 1: General requirements.
- IEC 60227-1-4: Polyvinyl chloride insulated cables of rated voltage up to and including 450 V/750 V-Parts 1-4: General requirements

No testing and certification mechanisms?

Result

Lack of confidence on the technology (case small wind power)

Source: Peterschmidt, N. (2012), Powerpoint presentation “Small wind turbines for mini grid” - INENSUS
The use of PV modules certified to international standards is becoming increasingly common against the following standards:

- IEC 61215 – Crystalline silicon terrestrial photovoltaic (PV) modules; Design qualification and type approval – and;
- IEC 61646 - Thin-film terrestrial photovoltaic (PV) modules; Design qualification and type approval

Initiatives for ‘low-cost’ PV testing facilities:

- Lund University in Sweden with Maputo University
- Project: “Low-cost” modular solar laboratories for developing countries
- Based on the initial experience of build a solar lab in Mozambique, this project sets out the goal of build 15 solar low-cost laboratories using existing capacity in local Universities
Engagement from developing countries in the standardisation process is crucial:

• Examples of initiatives to promote this engagement are the ISO-DEVCO and the IEC-Affiliate Country Programme

• IRENA is working to continue exploring new options for:
  ▪ Increasing the participation and contribution of developing countries in the international standards development process
  ▪ Establishing affordable testing and certification schemes for RE equipment in developing countries

Stakeholders’ network met in IRENA’s IITC premises to discuss actions to address such issues. Workshop report to be available soon
Thank you!

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