Clean Energy Access for All -
Low Carbon Energy Technologies and Poverty Alleviation

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Global Network on Energy for Sustainable Development

PEGNET Conference 2010
DBSA, Midrand, South Africa
2 - 3 September 2010
Outline of presentation

• Global Network on Energy for Sustainable Development - GNESD
• Adequate access for the poor remains a global challenge
• Importance of improved energy access for MDG achievement
• Universal access vision – UN SG Advisory Group on Energy and Climate Change.
  – What would it take to provide universal access
  – Why a low carbon development focus
• GNESD analysis of RE options and experiences
• Practical examples of African action
• Conclusions and areas for further research
GNESD: A Type II partnership of the WSSD

GNESD Objective:
To promote sustainable development and poverty alleviation by expanding the knowledge base about environmentally sound provision of energy services.

GNESD structure
Network of 10 Centres of excellence on energy and development in Africa, Asia and Latin America

Activity areas:
- Power sector reform
- Renewable energy and rural development
- Peri urban energy development
- Role of bioenergy in improving energy access
Energy Access and the Poor

• Close to 50% of the world’s population is poor (< US$ 2.00 per day)

• Bulk of poor rely on traditional biomass (estimated global total = 2.4 billion)

• About 1.5 billion of the poor without electricity & clean/modern energy
FIGURE 1
TOO MANY PEOPLE IN DEVELOPING COUNTRIES STILL LACK ACCESS TO ELECTRICITY
(PERCENTAGE OF THE POPULATION WITH ACCESS, 2000)

Source: World Bank Group staff estimates

- 3% to 33%
- 33% to 66%
- Over 66%
Electrification rates in Africa

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Rate (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tunisia</td>
<td>99</td>
</tr>
<tr>
<td>2</td>
<td>Algeria</td>
<td>98</td>
</tr>
<tr>
<td>3</td>
<td>Egypt</td>
<td>98</td>
</tr>
<tr>
<td>4</td>
<td>Libya</td>
<td>97</td>
</tr>
<tr>
<td>5</td>
<td>Mauritius</td>
<td>94</td>
</tr>
<tr>
<td>6</td>
<td>Morocco</td>
<td>85</td>
</tr>
<tr>
<td>7</td>
<td>South Africa</td>
<td>70</td>
</tr>
<tr>
<td>8</td>
<td>Côte d’Ivoire</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>Ghana</td>
<td>49</td>
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<tr>
<td>10</td>
<td>Gabon</td>
<td>48</td>
</tr>
<tr>
<td>11</td>
<td>Cameroon</td>
<td>47</td>
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<tr>
<td>12</td>
<td>Nigeria</td>
<td>46</td>
</tr>
<tr>
<td>13</td>
<td>Botswana</td>
<td>39</td>
</tr>
<tr>
<td>14</td>
<td>Namibia</td>
<td>34</td>
</tr>
<tr>
<td>15</td>
<td>Zimbabwe</td>
<td>34</td>
</tr>
<tr>
<td>16</td>
<td>Senegal</td>
<td>33</td>
</tr>
<tr>
<td>17</td>
<td>Sudan</td>
<td>30</td>
</tr>
<tr>
<td>18</td>
<td>Benin</td>
<td>22</td>
</tr>
<tr>
<td>19</td>
<td>Eritrea</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>Zambia</td>
<td>19</td>
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<tr>
<td>21</td>
<td>Togo</td>
<td>17</td>
</tr>
<tr>
<td>22</td>
<td>Madagascar</td>
<td>15</td>
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<tr>
<td>23</td>
<td>Angola</td>
<td>15</td>
</tr>
<tr>
<td>24</td>
<td>Ethiopia</td>
<td>15</td>
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<tr>
<td>25</td>
<td>Kenya</td>
<td>14</td>
</tr>
<tr>
<td>26</td>
<td>Lesotho</td>
<td>11</td>
</tr>
<tr>
<td>27</td>
<td>Tanzania</td>
<td>11</td>
</tr>
<tr>
<td>28</td>
<td>Malawi</td>
<td>7</td>
</tr>
<tr>
<td>29</td>
<td>Burkina Faso</td>
<td>7</td>
</tr>
<tr>
<td>30</td>
<td>Democratic Republic of Congo</td>
<td>6</td>
</tr>
<tr>
<td>31</td>
<td>Mozambique</td>
<td>6</td>
</tr>
</tbody>
</table>

Rural access still below 20%
Energy services have a significant role in facilitating both social and economic development. Energy underpins economic activity, enhances productivity, and provides access to markets for trading purposes. It enables fulfillment of the basic human needs of nutrition, warmth, and lighting, in addition to education and health. Therefore, ensuring energy access to all remains important in order to achieve the MDGs (Millennium Development Goals).
<table>
<thead>
<tr>
<th>Myth</th>
<th>Reality</th>
</tr>
</thead>
<tbody>
<tr>
<td>The poor do not consider access to energy a priority</td>
<td>The poor may not use the term “energy” but they often spend far more time and effort obtaining energy services compared to the richer section of the population. They spend a substantial proportion of their household income on energy for basic survival activities that is cooking, keeping warm, and so on.</td>
</tr>
<tr>
<td>Access to electricity, grid or decentralized, will solve all the</td>
<td>People need to access a range of energy sources to satisfy their energy needs, that is cooking, heating, transport, and communication.</td>
</tr>
<tr>
<td>energy service needs of the poor</td>
<td></td>
</tr>
<tr>
<td>Poor people cannot pay for their energy services.</td>
<td>Many poor people pay more per unit of energy than the better off, partly due to inefficient conversion and lack of integrated planning.</td>
</tr>
<tr>
<td>Only rural areas suffer from lack of access to energy</td>
<td>Poor people in urban and peri-urban areas also suffer from lack of access to energy services, and their numbers are likely to increase. It is predicted that almost 61% of the world’s population will be living in urban and peri-urban areas and services are not expected to grow commensurately</td>
</tr>
<tr>
<td>Commercial energy required to satisfy the needs of the poor is</td>
<td>Reaching the poor with basic modern energy services as envisioned in the <em>MDG Energy Vision</em> would increase global commercial energy consumption by about 900 TWh (terrawatt-hour) per year, which is less than 1% of the global energy demand.</td>
</tr>
<tr>
<td>significant with respect to total global energy consumption</td>
<td></td>
</tr>
</tbody>
</table>
New global political impetus

What will it take and can it be done?

Ensure universal access to modern energy services by 2030. The global community should aim to provide access for the 2-3 billion people excluded from modern energy services, to a basic minimum threshold of modern energy services for both consumption and productive uses. Access to these modern energy services must be reliable and affordable, sustainable and, where feasible, from low-GHG-emitting energy sources. The aim of providing universal access should be to create improved conditions for economic take-off, contribute to attaining the MDGs, and enable the poorest of the poor to escape poverty. All countries have a role to play: the high-income countries can contribute by making this goal a development assistance priority and catalyzing financing; the middle-income countries can contribute by sharing relevant expertise, experience and replicable good practices; and the low-income countries can help create the right local institutional, regulatory and policy environment for investments to be made, including by the private sector.
With current efforts the total number will remain quite constant

By 2030, nearly 45% of population without electricity access will be in SSA

Population without electricity access in reference case¹

<table>
<thead>
<tr>
<th>Region</th>
<th>Billion</th>
<th>2007</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>0.2</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>East Asia &amp; Pacific</td>
<td>0.6</td>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>0.6</td>
<td></td>
<td>0.7</td>
</tr>
<tr>
<td>South Asia</td>
<td>0.7</td>
<td></td>
<td>0.6</td>
</tr>
</tbody>
</table>

¹ WEO 2009 Reference Scenario, access increasing by 5% in all regions other than 15% in South Asia and East Asia & Pacific

SOURCE: WEO 2009 (IEA), team analysis
Lessons from the 1990s indicate that the scale of universal electricity access challenge is not insurmountable

Average number of households gaining access to electricity
Millions

New connections 1990-2000

[Diagram showing East Asia and Rest of the World with numbers: 210 and 240]

New connections required per decade to meet universal access by 2030

Implementation had to be done with great speed and intensity. In the early 90s, China was electrifying over 30 villages a day. Viet Nam granted almost 400 people access to electricity per hour for 15 years. South Africa made a new grid connection every 30 seconds, placed a pole in the correct position every 10 seconds and strung 200m of cable every minute.
Energy access can be viewed as incremental

Increasing level of access

**Stage 1**
- Location of access: Community level
  - Electricity capacity for lighting for school and clinic/health centre, with community charging station for battery powered devices (e.g., LED lights, cell phones)
  - No residential electricity access
  - Partial access to modern cooking fuel and/or efficient cook stoves
  - 25 kWh per capita p.a.

**Stage 2**
- Location of access: Household level
  - Electricity/mechanical power capacity for productive use at communal level, e.g., water pumps for irrigation, agricultural processing equipment
  - Residential electricity access for lighting and basic appliances (cell phone, radio, small B/W tv)
  - Access to sufficient modern cooking fuel and/or efficient cook stoves
  - 100 kWh per capita p.a.

**Stage 3**
- Capacity for productive use at communal level, e.g., water pumps for irrigation, agricultural processing equipment
  - Sufficient electricity capacity for more appliances (e.g., tv, refrigerator)
  - Access to sufficient modern cooking fuel and technology
  - 250 kWh per capita p.a.

1 Applies UNDP 100 kWh per capita urban and 50 kWh per capita rural assumptions
2 Improved cook stove

SOURCE: WEO 2009, UNDP-WHO 2008 report, team analysis
A 20 year program to close the access gap to modern fuels will require and average investment of $2-3 bn per year

<table>
<thead>
<tr>
<th>Target population</th>
<th>Proportion of population (%)</th>
<th>Capital costs ($/capita)</th>
<th>Total capital cost ($ bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LPG</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban population with access to fuel distribution</td>
<td>25-40%</td>
<td>$10-15</td>
<td>7-15</td>
</tr>
<tr>
<td>channels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Biogas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural population with access to sufficient biomass (e.g., dung)</td>
<td>20-30%</td>
<td>$30-40</td>
<td>21-34</td>
</tr>
<tr>
<td><strong>Improved cook stoves</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolated rural population lacking access to sources of biomass</td>
<td>35-50%</td>
<td>$12-17</td>
<td>36-56</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>36-56</td>
</tr>
</tbody>
</table>

A program to provide 2.8bn people with access to modern fuels by 2030 will require a capital investment of $2-3 bn per annum

**SOURCE:** EIA, IEA, team analysis
Providing a universal basic level of electricity access will require an investment of $14-21 bn per year.

<table>
<thead>
<tr>
<th>Electrification Strategy (%)</th>
<th>Cost assumptions</th>
<th>Capex cost Estimates ($bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Grid extension</td>
<td>Grid extension</td>
</tr>
<tr>
<td></td>
<td>– $2,600/kW for Gx</td>
<td>180-220</td>
</tr>
<tr>
<td></td>
<td>– $300-450/connection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mini grids</td>
<td>Mini grid</td>
</tr>
<tr>
<td></td>
<td>– $7,000/kW for Gx</td>
<td>90-110</td>
</tr>
<tr>
<td></td>
<td>– $140/connection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SHS (40Wp)– $660 incl installation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grid rural</td>
<td>Off grid</td>
</tr>
<tr>
<td></td>
<td>– $3,500/kW for Gx</td>
<td>130-150</td>
</tr>
<tr>
<td></td>
<td>– $300-450/connection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mini grids</td>
<td>Off grid</td>
</tr>
<tr>
<td></td>
<td>– $8,400/kW for Gx</td>
<td>210-230</td>
</tr>
<tr>
<td></td>
<td>– $140/connection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SHS (40Wp)– $660 incl installation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>280-340</td>
<td>350-410</td>
</tr>
</tbody>
</table>

1 Roads, water supply, fuel supply infrastructure

SOURCE: IEA, UCT, ESMAP, McKinsey analysis
What will it take?

• Governments need to prioritize energy access and set national targets
• Minimize costs to increase affordability
• Access to finance to cover upfront capital costs
  — grant funding of $15bn per year will be required by 2020 to cover capital costs
  — concessional finance of $10bn per year will be required by 2020 to provide loan capital to banks and microfinance institutions to fund end user capital requirements
• Financially sustainable business models
• Local institutions, capacities and capabilities need to be developed
The Global Energy Investment Challenge

- Key numbers from IEA and World Bank
  - US$ 16 to 20 trillion over next 30 years for energy sector investments
  - US$ 10 to 12 trillion (60%) for electricity
  - Approx. 5-6 trillion in DCs/CEITs where risks are perceived as high and private investments declining
  - Stable policy frameworks necessary to attract international finance and local finance needs to be much more engaged
  - Dedicated funding required for an energy access for all target is a small fraction of energy investments, but current national and international resources far from enough
  - New climate funds and carbon markets can help close the gap
Role of Carbon Finance

- Carbon market is only emerging and is still fragmented with the CDM and EU ETS dominating.
- RE dominate number of CDM projects but are small on credits.
- Market value for CDM during 2008–12 estimated to be between 2 and 10 billion USD potentially leveraging 5 to 10 times in core investment.
- EU ETS crucial for short term market and Post 2012.
- Global carbon market in 2008 close to 120 billion $.
- Global Cap and Trade important for longer term and could create a market with 1–2 Trillion USD annually.
Why Low Carbon Energy Development

- Long term climate rationale – embarking on a new energy development path
  - Short term CC argument is basically not correct
- CC Funds should become available to cover the incremental cost
- Energy security for countries with no fossil resources
- Green Economy benefits – employment, local environmental improvement etc…
- Many technologies suitable for decentralized applications
- Costs for many RE technologies have come down dramatically
Typical barriers to RE expansion

• Lack of policy attention and institutional framework for promotion of RETs,
• Financial institutions are risk adverse and unfamiliar with RETs requiring different financial packages than fossil systems due to high up front investments and low operational cost
• Lack of certification systems for the RETs often resulting in low quality, extending from the equipment itself right through to installation, operation and maintenance.
• Missing capacity at all levels from policy to manufacturing and installation
• Low awareness both in policy institutions and among potential users
Ways of overcoming barriers

- Integration of RE into development policies and strategies aimed at the poor
- Development of adequate institutional framework to manage and implement local programs
- Ensuring financial viability of rural distribution
- Balancing public and private sector engagement
- Allowing both grid and off grid approaches
- Providing incentives to improve affordability ⇒ Costs reduction, targeted financing schemes and reduced connection charges
- Building capacity in national and local electricity companies
- Improving awareness at the political level
Results of GNESD studies

- RE technologies can play an important role in improving electricity access either through central generation or local mini-grids.
- However, there are many opportunities for access to other Modern Forms of Energy from non-electrical RE technologies.
- A few examples from GNESD studies and from other UNEP programs are presented in the following
Results of GNESD studies

• Increased agricultural productivity and land under irrigation (treadle pumps in Kenya & RE pumping in Africa)

• Low cost energy for SMiEs (Biomass Gasification in India, China and Cambodia)

• Energy savings and employment generation (SWHs in South Africa, Lebanon and Argentina)

• Conservation of agricultural products (Vegetable Oil in Brazil)
## Millennium Development Goals (MDGs)

<table>
<thead>
<tr>
<th>Energy Technology</th>
<th>Halve poverty</th>
<th>Reduce hunger</th>
<th>Ensure environmental sustainability</th>
<th>Increase gender equality and empowerment</th>
<th>Reduce child mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical water pumping and irrigation technologies</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Low cost efficient hand tools and animal drawn implements</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Solar dryers</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Improved biomass Cook stoves</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Pico and micro hydro</td>
<td>√</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Solar water pasteurisers</td>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>
Some examples from UNEP work

• Local mini grid
• SME development
• Engaging the finance sector
  – SME
  – Consumer lending
• Carbon finance
Greening the Tea Industry in East Africa

Greening the Tea Industry in East Africa, a small-hydro power initiative, co-implemented by UNEP & the African Development Bank (AfDB) and executed by East African Tea Trade Association (EATTA).
African Rural Energy Enterprise Development (AREED)

Demonstrating that needed energy services can be delivered on a sustainable commercial basis by clean energy SMEs.

SME Energy Enterprise Development

- Enterprise Development Services
- Seed Financing
- Entrepreneur
- Energy Services
- Customers

Partner Logos:
- KITE
- CEEEZ
Example Enterprises

**Usiss, Mali**
- **Business:** Solar Crop Drying
- **Stage of Sector Dev.:** Very Early proof of concept phase
- **AREED Support:** $18,000, 4 yr loan and enterprise development support from MFC, E+Co
- **Status:** Operating. Repayments current.

**BETL, Tanzania**
- **Business:** Logistics company coordinating ag. wastes for fuel substitution
- **Stage of Sector Development:** Early commercialization phase
- **AREED Support:** $50,000 3-yr loan and Enterprise Dev. Support from Tatedo, E+Co
- **Status:** Increased sales from 500 Mt to 1200 Mt per month. Repayments current.
Example Enterprises

Anasset, Ghana
• Business: LPG distribution
• Stage of Sector Dev.: replication phase
• AREED Support: $38,000, 4 yr loan and enterprise development support from KITE, E+Co
• Status: Repayments current, expanding with bank financing.

KPBS, Zambia
• Business: Charcoal production from sawmill waste
• Stage of Sector Dev.: Proof of concept phase
• AREED Support: $73,000, 4 yr loan and enterprise development support from CEEEZ, E+Co
Financing the Customers of SMEs

In markets where small scale clean energy is economically viable, ....why aren’t banks lending ? .... and, what can be done about it ?

- **Example** – Indian Solar Loan Programme
- **Before**: many SHS vendors, small total sales, little credit
- **During**: consumer finance programme offered through Canara bank and Syndicate bank, interest rate subsidy, 16,000+ systems financed, other banks starting to lend
- **After**: subsidy phased out, banks continuing to lend, although lose market share in an increasingly competitive credit market
- **Real Driver** -> access to financing provided through 2076 bank branches

![Progress as of March 2005](chart.png)
CDM examples

Kuyasa low-cost urban housing energy upgrade project, South Africa

Insulated ceilings; Solar Water Heater installation; and Energy Efficient Lighting. Validated as qualifying for the "Gold Standard".
Solar PV drinking water disinfection in Rwanda

Will provide bacterially decontaminated water safe for drinking, food preparation and personal hygiene at two sites in rural Rwanda.

Figure 6: Typical Water Boiling in Rwanda
Partial Substitution of Coal by Jatropha Fruits and Biomass Residues in the Production of Portland Cement in Rwanda.

Substitution of Diesel for truck transport in Zambia
6 MW Bagasse Based Cogeneration Project in Nyanza, Kenya

Heaps of bagasse behind the factory premises
Key messages

• No single or simple solutions:

  – Action needs to combine different policies and approaches. Solutions that address both climate change and energy security at the same time are favorable.
  – Long-term and predictable policy support is crucial to develop and sustain markets and industries.
  – Market forces should be used where appropriate, but solutions are individual and no mantras exist.
  – Lots of political, economic and institutional resistance to overcome along with personal perception by many types of actors, so awareness based on solid information is key with credible data on technologies, policies etc.…
  – International and regional collaboration essential.
Core Areas for International Action

- Systematic support to energy development as a part of poverty reduction and economic development strategies
- Systematic inclusion of energy in design and cost of all development assistance addressing other sector MDGs
- Commitment to long term financing of low carbon energy sector development as part of NAMA
- Increase the global funding for energy poverty programs focusing on increased access to clean and efficient energy services
Time to act is now – on improving energy access for MDG achievement and enhancing resilience

• Many low carbon energy technologies have become economically attractive for both large and small scale applications and financing opportunities through CDM or new international climate funds can facilitate further access expansion

• Improving access to energy services important for both MDG achievement and increasing climate resilience for poor families

• Improving energy supply for SMEs and productive uses crucial when traditional livelihood approaches is under “climate threat”
Some areas for further research

- Links between energy services and poverty alleviation – social vs productive uses of energy etc…
- Green economy benefit possibilities for rural and peri urban poor and how to design programs to maximize these
- Peri urban energy development options and constraints
- Resource mapping for wind and solar
- Small grid options for rural and peri urban settlements
- Regulatory reform and policy development in support of LCE
- Models for public-private engagement in providing social and productive energy services
- Options for enhanced carbon finance for small scale systems
- Adaptation – mitigation links
- Water and energy
- Gender and empowerment aspects of new energy structures