Socio-economic benefits of off-grid technologies

Methodology for Mainstreaming Appropriate Green Technology Initiatives in Rural Areas of the Arab Region

25th of March 2015
Why is it important

- **1.3 billion** people live without electricity. More than **2.6 billion** cook with solid fuels.
- **65-80%** of the Access Deficit Concentrated in a few Countries.

The productive uses of energy are activities “that involve the utilization of energy – both electric, and non-electric energy in the forms of heat, or mechanical energy - for activities that enhance income and welfare. [In rural contexts] these activities are typically in the sectors of agriculture, rural enterprise, health and education” (Kapadia, 2004)
Assessing socio-economic impacts

Socio-economic impacts of off-grid applications

**Economic**
- Jobs and productivity
- Additional Income
- Savings on energy spending

**Environmental**
- Reduced deforestation
- Reduced emissions
- Waste management

**Health**
- Reduced respiratory illnesses
- Reduced contamination of food and water
- Improved medical facilities

**Welfare**
- Increased safety
- Gender empowerment
- Improved lifestyle

**Education**
- Increased lighting time
- Reduced time spent on other activities

**Heating and cooling**
- Water heating and cooking
- Refrigeration of food and medicine

**Processing**
- Drying (fish, flowers, spice, rubber)
- Processing (cereal, coconut fibre)
- Milling (grains, saw mills)
- Silk rearing
- Textile dying and weaving

**Water related**
- Pumping for irrigation
- Pumping for potable water
- Purification and desalination

**Lighting**
- Household lighting
- Workshop lighting
- School lighting
- Health clinic lighting
- Community lighting

**Communication**
- Telephone and mobile
- Internet
- Radio and TV

**Other**
- Battery charging
- Brick making, carpentry, sewing, welding and other electrical tools

**Heat energy**
- Biogas (community/standalone)
- Solar thermal (community/standalone)

**Mechanical energy**
- Wind
- Water mill (improved)

**Electricity**
- Minigrids (small hydro, small wind, biomass)
- Standalone (SHS, Biogas)

The linkages between energy, applications and socio-economic impacts (adapted from Kapadia, 2004)
IRENA’s work on the topic

- Publications
  - Renewable Energy Jobs & Access
  - Renewable Energy and Jobs
  - Socio-economic Benefits of Solar and Wind
  - Renewable Energy in the Water, Energy and Food Nexus

- IOREC
  - Two-day conference on scaling up of rural electrification through off-grid RE
  - Identify key barriers and drivers for stand-alone and mini-grid RE system deployment
  - Platform to share experiences, lessons learned and best practices
Renewable Energy Jobs & Access

- More than 4 million direct jobs by 2030 in the off-grid electricity sector alone
- Integrating access projects with local commercial activities present greater opportunities for employment and income generation
- Developing appropriate skills along the value chain critical to strengthening the sector
- Many of the required skills and training- technical and business- can be developed locally
- Women are beneficiaries and catalysts for growth in the sector through involvement in production and micro-enterprises
Key messages of IOREC 2014

- **Off-grid renewable energy needs to be integrated** into the national rural electrification strategy supported by dedicated policies relevant to the sector.

- **Private sector participation will be critical** to meet universal electricity access targets. It needs to be allowed and facilitated.

- **Sustainability is central** to energy access efforts to ensure long-term reliability and cost-effectiveness.

- **An enabling environment** based on effective policies and regulations, tailored financing models and technology solutions is necessary.

- **Frameworks for delivering affordable capital** need to be developed to make financing more accessible to entrepreneurs and end-users.

- **Tariffs for mini-grids** need to be flexible and tailored to the specific contexts to ensure the viability of mini-grid projects.

- **Capacity Building** efforts improve the sustainability of projects by reducing dependence on foreign know-how.
Electricity applications

Solar Home Systems in Bangladesh

Strategy for Dissemination and Employment

• A micro-financing system tailored in line with the cash flow of rural households

• Vocational education system and on-the-job training

• Domestic research to reduce panel cost, adapt technology and develop accessories

• Government led equipment quality standards

• Jobs for 60,000 people

• 46 Participating Organisations (POs), including women run

Solar Sisters

Strategy for Dissemination and Employment

• Multiple lighting products on offer

• Use natural networks distribution channel to rural and hard-to-reach customers

• Business in a bag

• Women become their own bosses, creating sustainable businesses

• Careful tracking and flexible targets

• 63,995 people benefitting from solar lights

• 501 entrepreneurs, mostly women
Electricity applications

Enabling/Constraining Factors Identified

- Policy & Regulation
- Community Engagement
- Quality/performance of electricity supply and equipment
- Costs and Access to Finance
- Knowledge, Skills and Capabilities
- Access to Markets & Employment
- Pre-existing Industry
- Infrastructure & Security
- Access to Other Resources
Benefits of using solar dryers to dry fruits, grains, rice, corn or rubber

- Capability to dry harvest with high moisture content
- Capability to dry larger quantities of agricultural products in a shorter period of time
- Saving harvest otherwise lost to mould, insects or left unharvested because of the time needed
- Additional income from larger quantity and better quality of products that can be sold at a higher price
- Additional income from saving on fossil fuel spending

- Banana chips produced in Thailand sold for USD 0.36/kg compared to USD 0.21/kg for chips dried over fire or in the sun
- The increased income from drying 9.6 thousand tons of bananas is USD 1.5 million per year
- The increased income from drying 2.9 million tons of rubber is between USD 71 and USD 107 million more in earnings

Source: www.lowcarboneconomy.com
Heating and cooling applications

Cooking and water purification

Around 3 billion people rely on wood, straw, dung, or coal for their cooking needs (WHO and UNDP, 2009)

Benefits of cooking and purifying water using renewables:

- Improved sanitation from cooking food and purifying water
- Reduced time collecting firewood
- Reduced respiratory diseases from burning firewood
- Reduced deforestation and environmental impacts

Benefits of Biogas

- Savings made on expensive fuelwood and on commercial fertiliser which amount to about USD 230 per year for a small farm
- Waste management to treat agricultural residues, animal dung and human sewage from latrines (8,500 tons of manure a year in Vietnam)
- Permits for extension of farms

- Local procurement of material and job creation

<table>
<thead>
<tr>
<th>Country</th>
<th>Systems by Date</th>
<th>Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>40 million by 2011</td>
<td>90,000</td>
</tr>
<tr>
<td>India</td>
<td>100,000 systems</td>
<td>85,000 jobs</td>
</tr>
<tr>
<td></td>
<td>installed during 2008–2009</td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>225,000 systems by 2011</td>
<td>11,000 jobs by 2005 only</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>48,700 systems by 2012</td>
<td>3,300 jobs in 2011</td>
</tr>
</tbody>
</table>
Heating and cooling applications

Refrigeration

- Almost one-third of the food produced for human consumption (1.3 billion tons per year) is lost or wasted.
- Per capita food waste of 6-11 kg/year in sub-Saharan Africa and Southeast Asia compared to 95-115 kg/year in Europe and North-America.
- Mainly due to “financial, managerial and technical limitations in harvesting techniques, storage and cooling facilities in difficult climatic conditions” (FAO, 2011).
- Food preservation, namely refrigeration can significantly minimize food losses where they mostly occur.
- Preserving medicine and vaccine for the improvement of health services.
- There are approximately 1.5 billion residential refrigerators and freezers in use globally today, only about 4% of these units are deployed in Sub-Saharan Africa which hosts almost 13% of the world’s population.
- Partly due to the lack of affordable electricity supply.
- Stand-alone systems based on renewable energy technologies can be used.
Heating and cooling applications

Refrigeration using Evaporative Cooling

Benefits of using evaporative cooling

- It is simple and does not require any external power supply
- Holds up to 12 kg of vegetables, and costs less than USD 2 to produce
- Preserves food, maintains the vitamin and nutrient content of the products, and prevents diseases
- Farmers sell more due to minimized losses, and at favorable market prices
- Reduced time spent on selling vegetables
- Raise income levels in the rural farming communities, can lead to an additional 25 to 30 per cent profit on farmer’s income
- Jobs creation and income generation for pot makers and distributors, mainly for women

The effectiveness of the Zeer system in preserving food

<table>
<thead>
<tr>
<th>Produce</th>
<th>Shelf-life of produce without using the Zeer</th>
<th>Shelf-life of produce using the Zeer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>2 days</td>
<td>20 days</td>
</tr>
<tr>
<td>Guavas</td>
<td>2 days</td>
<td>20 days</td>
</tr>
<tr>
<td>Rocket</td>
<td>1 day</td>
<td>5 days</td>
</tr>
<tr>
<td>Okra</td>
<td>4 days</td>
<td>17 days</td>
</tr>
<tr>
<td>Carrots</td>
<td>4 days</td>
<td>20 days</td>
</tr>
</tbody>
</table>

Source: Practical Action Sudan
Heating and cooling applications

Refrigeration using Solar Thermal

Benefits of using solar thermal refrigeration for the preservation of Milk in Kenya

• The installation of three solar icemakers produces up to 50 kg of ice per sunny day, capable of chilling up to 100 litres of milk
• Health benefits due to preservation of milk
• Economic benefits include:
  • Excess milk produced can be preserved to be sold and products can be transported to the market when refrigerated with ice
  • Induced businesses for milk collection, packaging and sale for cooperatives,
  • Enabled the production of yogurt and mala, sold at a higher price, generating additional profits
  • In the first five months of operation, around USD 25,720 of revenue generated out of which USD 15,906 was distributed to 184 dairy farmers
  • Job creation in the installation of the coolers (preparing the foundation, positioning and assembling the components, installing the collector, and charging with refrigerant)

Source: Erickson, 2009
Motive power applications

Milling, pressing, and other activities using Improved Water Mills

Benefits of using improved water mills

- Reduced workload and improved living standards of farmers, particularly women and children
- Improve health and financial security of farmers
- Simple technology requiring little maintenance

- Estimated 25,000 improved water mills operating in Nepal, and 200,000 in India
- Increased the power and efficiency of the traditional system by 80–90%
- Increase in the grinding capacity from about 10-15 kg of grain per hour to about 25–30 kg per hour
- Initiated other activities such as floriculture, fisheries, small-scale industries beekeeping (2–10 boxes can give a return of about USD 580 per year)
- Investment of USD 810 gave a return of USD 135 a month
- Women empowerment 4.68 percent are owned by women
- Considerable job creation. The installation of 8,493 water mills has created additional employment for around 7,572 people.
Motive power applications

Milling, pressing, and other activities using Improved Water Mills

Benefits of wind mills

• Reduced workload and development of industries
• Simple technology requiring little maintenance

• The windy Zaan district near Amsterdam became a major industrial area with thousands of windmills, including hundreds of wind powered sawmills
• Increased productivity and reduced hard work
• With hand sawing, 60 beams or trunks would take 120 working days, with wind power this only took 4 to 5 days
• Allowed the Dutch to produce ships faster and cheaper
• Suitable for areas with insufficient water resources (Spain)
• Too flat with not enough river low (Netherlands)
• Freezing rivers during winter (Scandinavia, Russia and parts of Germany)
Key messages

• Presenting anecdotal evidence on these impacts can be a first step to a more thorough assessment
• Benefits are not quantified in monetary value most of the time – difficult to assess
• Impacts are all interlinked and affect each other
• Electricity is not the only form of energy
• Simple solutions have big impacts
• Impacts are mostly observed where there is potential for economic activity, already something in place
Thank you!