SOLAR WATER PUMPING
Ready for Mainstreaming?
December 2, 2015

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Outline

• The Solar PV Market (a disruptive technology?)
• Evolution of Solar Pumps
• The Technology of Choice
• A Pro-Poor Technology?
• Challenges and Risks
• Mainstreaming Without Piloting
• Financing Models
• Working Across Practices: Beyond Large Hydro…
• Next Steps?
The Solar Market: PV Cell Efficiency Risen...
The Solar Market: Price of PV Cells Drops

Price history of silicon PV cells
in US$ per watt

Source: Bloomberg New Energy Finance & pv.energytrend.com
The Solar Market: Dramatic Increase in PV Deployment

Projected global growth (MW)

Projected global cumulative capacity in MW
- historical cumulative capacity
- average projection for 2015 (+55 GW, 233 GW)
- low scenario reaches 396 GW by 2019
- high scenario reaches 540 GW by 2019

Source: SPE, Global Market Outlook 2015, amended with industry average for 2015
The Solar Market: Price of Silicon Plunges, Accelerating another Price Reduction Cycle

Polysilicon Plunges
Prices in dollars-per-kilogram

Source: Bloomberg New Energy Finance

Bloomberg
Solar PV Price Declines are Compounded by Similar Advances in Other New Technologies

• **Solar energy has become a disruptive technology opening new market niches**

• Early PV breakthrough niches were rural energy supply through solar home systems (SHS)—current PV breakthroughs are price-competitive grid-scale PV plants

• **Lighting Africa:** Other new technologies with declining price spirals interact with PV sector, leading to real virtuous cycle of PV-centered technology development
  - Light-emitting diodes (LEDs)—more light for less electricity spurred innovative lanterns
  - **Mobile Telephony—”Pay-as-you-go” (PAYG) systems** facilitating controlling systems and receiving payments remotely—reducing barrier of down payments for SHS
The Issue of Storage

• Generally, the big challenge for solar remains that the sun does not shine at night which leads to the current **focus on energy storage**.

• In the water sector, solar energy has **one key advantage**, the issue of storage is solved with one disruptive technology: **The Water Tank!**
Understanding Main Components

- Solar Array
- Controller
- DC Pump
Evolution of Solar Pumps

- **Early Solar Pumps**
- **Flex Pumps (DC)**
- **Smart Inverters**

Year:
- 1980
- 2002
- 2009
Understanding Main Components

- Solar Array
- Controller/Inverter
- AC Pump
Should PV Pumping be the technology of choice?

# Solar Pumps: Widening the Range

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Source: Recent analysis from Tanzania, Nov 2015 (forthcoming)
## Operation and Maintenance Costs

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<tr>
<th>Solar System</th>
<th>Diesel Generator</th>
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<td><strong>Operation</strong></td>
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<tr>
<td>• No operational cost</td>
<td>• Diesel</td>
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<tr>
<td><strong>Maintenance</strong></td>
<td><strong>Maintenance</strong></td>
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<tr>
<td>• Wipe panels every month</td>
<td>• 250h minor</td>
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<td>• Check wires</td>
<td>• 1,500h major</td>
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<td><strong>Replacement</strong></td>
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<td>• Solar Panels: 25 years</td>
<td>• 8-12 years</td>
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<td>• Inverter 8-12 years</td>
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Life-Cycle Costs Analysis

LIFE CYCLE COST OVER 20 YEARS IN US$
For 50m Lift, 20 m³/day Flow

The additional costs of diesel pumping have to be covered by the community

Is PV a pro-poor technology?
Challenge/Risk: Solar pumping may lead to over-irrigation and depleting of groundwater resources through indiscriminate pumping as farmers face no additional costs of pumping water.

Potential mitigation measures:

- Treat solar power as a “cash crop” and allow farmers to sell surplus power to the grid at an attractive fee-in tariff. In this case the farmers become micro-level Independent Power Producers (IPPs) to the grid.
- Future potential: Monitor farmers water usage via remote monitoring features and strengthen the role of groundwater regulators.
Operational Challenges

Repair and spare parts of solar pumping systems

- The inverter needs replacement
- Technical capacity of pump operators
Lessons from Tanzania – Mainstreaming without Piloting

Water Sector Development Program (2007-2014) less than 1% investments in solar.

Client: Key Barriers to Solar Pumping:

- Awareness and Antiquated Perceptions
- Lack of Technical Capacity on: Design, Security and O&M
- Limited connections to key private stakeholders
Mainstreaming PV Pumping:

- Focused efforts on institutions not pilots!
- Life Cycle Costs Analysis
- Awareness and capacity building of
  - National Level Stakeholders
  - Local Level Stakeholders
  - Private Sector
  - Learning Institutions
  - Donor Partners
- Collaboration with WB energy colleagues
- Result: Policy Change
Potential Financing Models
### Diesel Scheme vs. Solar Scheme

<table>
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<tr>
<th>Component</th>
<th>Diesel Scheme</th>
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<tr>
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**Rural Water Supply: Retrofitting existing diesel pumping schemes with solar**

- **Does this open up for a Financing Mechanism?**
- **PAYG – Can we learn from financing schemes for solar home systems?**
Financing Models for Solar Pumping

**Off-Grid**

**Rural Water Supply**
- Retrofitting *existing* diesel pumping schemes with solar
- Financed via a remote mobile-banking pay-as-you-go (PAYG) payment system
- Mimics the payment modality of the diesel scheme

**On-Grid**

**Urban Water Supply**

Energy Service Companies and Independent Power Producers (ESCO/IPP)

Challenges:
- Creditworthiness
- Price of electricity
- Limited private sector capacity
Leading Countries

- India
- Bangladesh
- Morocco
- Namibia
- Uganda
Solar for Water Pumping: A low hanging fruit?
Working Across Practices: It Makes Sense…

Water and Energy share similar sectoral challenges & opportunities—already collaborate on Large Hydro

- Shared focus on provision of a basic service to the population (including the poor) in both urban and rural areas
- Both Water and Energy missed out on having their own MDG but now have their own SDG (SDG6 and SDG7)
- Share a primary client: Public utilities
- Share euphemistic terms: e.g. Non-Revenue Water; Losses; Technical and Non-Technical Losses
- Both face similar disruptive technological opportunities
- Similar analytical tool boxes
Working Across Practices: But concretely, How?

- Share consultant pool(s): PV experts (pumping, ESCO or otherwise)
- Share Business Models: ESCO or WaSCO?
- Share Program Approach: Integrated Rural Infrastructure Programs?
- Share Network Analyses
- Share Financial Instruments: (?)
- Plus, Water and Energy Practices are made of really “nice people”—invite one of “them” for coffee
Next Steps?