Extending the Frontier of PV Reliability: The Role of Quality Infrastructure

Solar Bankability Workshop

8 February 2017
Brussels, Belgium
## Solar power investments


**By Sector**

<table>
<thead>
<tr>
<th>Year</th>
<th>Investment (USD billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>11.9</td>
</tr>
<tr>
<td>2005</td>
<td>16.1</td>
</tr>
<tr>
<td>2006</td>
<td>22.2</td>
</tr>
<tr>
<td>2007</td>
<td>38.9</td>
</tr>
<tr>
<td>2008</td>
<td>61.6</td>
</tr>
<tr>
<td>2009</td>
<td>64.4</td>
</tr>
<tr>
<td>2010</td>
<td>103.7</td>
</tr>
<tr>
<td>2011</td>
<td>154.8</td>
</tr>
<tr>
<td>2012</td>
<td>146.2</td>
</tr>
<tr>
<td>2013</td>
<td>119.1</td>
</tr>
<tr>
<td>2014</td>
<td>143.8</td>
</tr>
<tr>
<td>2015</td>
<td>161.0</td>
</tr>
</tbody>
</table>


- **2015:** 161 USD billion
- **2030:** 2.7 trillion USD in 15 years | 186 billion USD/yr (1800 GW)

Source: www.irena.org/resource
Failure risks present in their majority at early and mature stages

Life expectation of modules is 25+ years, however they have to deal with failure PV curve

**Lenders’ perspective:** revenues only important during first 10-15 years
- Risk of infant failures are passed to EPC
- Bankability assessments further minimize risks of midlife failure
  - Valid renown certifications
  - Track record of company and modules
  - Quality of manufacturing facility
  - Warranty conditions

**Source:** Adapted from Solar World 2016
Equipment selection considering quality aspects

PV Modules represent around a third of PV installed costs

Performance of PV modules is dependent on:
- Module technical characteristics
- Quality of materials used
- Testing procedures
- Quality of manufacturing facility
- Manufacturing process

More than half of non-schedule hardware repairs happen due to equipment selection

Source: IRENA (2016) Power to Change
Holistic View - Quality Covers the Whole System, not Hardware only

Implementation of Quality Schemes covers not only equipment but whole systems
Including Design, Installation, O&M services

TÜV Rheinland

“Every other fault that we detect is due to incorrect installation.”
Source: TÜV Rheinland

Quality is a key aspect to mitigate environmental impact

High failure rates lead to a significant amount of waste

In Germany:

1 MW represents approximately 100 tons of waste
Current installed capacity is 40 GW = 4 million tons

With ca. 1% failure = 40K tons of additional waste to be disposed

Positive Energy Balance

Higher revenues

Consumers protection

Mitigate Carbon Footprint

Source: Adapted from Solar World 2016
Quality Infrastructure

Which **instruments** do we have to mitigate technical risk, attract investment and public acceptance, and meet expectations by all stakeholders in a USD trillion market?

**International standards and conformity assessment schemes**
The benefits of QI services outweigh their costs – QA in EPC contracts

Example: Higher plant outputs due to module performance testing

Monetary case

• 20 MW PV plant in southern Europe
• kWh-sales price of 10 ctEUR
• 2-3% higher performance
• Measurement cost 5 – 10 kEUR
• Annual revenue increase 75 – 115 kEUR
The benefits of QI services outweigh their costs – acceptance testing

Example: batch acceptance testing

Pre-construction PV module batch acceptance testing allows for additional revenues in financial model

- 6% of commercial modules do not pass IEC thermal cycling test (200 cycles)
- Thermal cycling test as batch acceptance test can trigger a reduced assumed degradation rate from 0.75% per year to 0.4% - 0.6% per year
- Higher revenues in the financial model
- Cost-benefit rate about 1:10
Different country context to develop a QI

11 Countries from Developed and Developing Countries

3 PV Systems: off-grid applications, distributed generation, and utility scale

<table>
<thead>
<tr>
<th>Utility-scale</th>
<th>Distributed Generation</th>
<th>Off-grid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing</td>
<td>Egypt, Chile</td>
<td>China, Philippines, India, Tanzania</td>
</tr>
<tr>
<td>Developed</td>
<td>USA, Germany</td>
<td>Singapore, The Netherlands, Australia</td>
</tr>
</tbody>
</table>

Picture Source: Amcharts
STRATEGY TO DEVELOP AND IMPLEMENT QI - PHILIPPINES

Context

- 2014- first E-guidebooks for both utility and rooftop PV (IEC standards for the procurement and construction of PV
- Standardised administrative framework for FiT qualification

Challenges

1. **Regulatory barriers** - rooftop PV developers often cite the existing legal and administrative processes to be complex
2. Enhance the attractiveness of incentive schemes
3. Control sale of sub-standard PV equipment

Building on QI

- Formalisation of “licensed” training courses for installation
- Adoption net metering schemes to improve QI attractiveness
- Guidelines for testing and certification of PV panels
STRATEGY TO DEVELOP AND IMPLEMENT QI -TANZANIA

Context
Tanzania Bureau of Standards (TBS) adopted:
- **IEC PV system** related standards
- Verification of Conformity of imported products
- Certificates of Conformity
- Market surveillance. Product fails, the importer must pay all costs relative to the removal of the products from the market.

Challenges
1. Parallel **counterfeit market** of substandard products developed
2. **Lack of coordination** of inter-governmental institutions

Building on QI
- Encourage **fair competition** in the market
- **Collaboration** between different institutions on control of imports
- Train importers on **technology and product registration**
- Inform **end user** on importance of selecting registered product
IRENA uses a five-stage approach for the development of QI:

1. **Market Assessment**
   - Initial studies
   - Develop in-country knowledge
   - Develop a PV market strategy and plan
   - Start the adoption of standards

2. **Market Introduction**
   - Import/screening control in rural areas
   - Market support
   - Develop human resources
   - Facilitate guideline development
   - Implement initial incentives

3. **Market Growth**
   - Facilitate test activities, laboratories & metrology
   - Develop certification schemes
   - Implement incentives to end users
   - Early published ratings
   - Facilitate participation in international standardization

4. **Market Consolidation**
   - Improve test laboratories & metrology
   - Published ratings
   - Advance Regional/International QI

5. **Market Maturity**
   - Accreditation infrastructure
   - Market support evolution
Policy linked to Quality Requirements

USA
- 14 states: Contractor Licensing Requirements for Renewable Energy
- 4 States: Equipment Certification Requirements for Renewable Energy

Source: http://www.dsireusa.org/
Acting on quality now and in the short future

Durability Testing

Not assure PV systems last longer than expected project lifetime (20+ years)

Private sector can incorporate batch acceptance testing in large wholesale procurements or utility scale projects.

Value Chain

Further International standards in installation, operation, maintenance, documentation and decommissioning, end of life.

Encourage QI addressing the entire PV life-cycle

Gap

Possible Solution
Supporting countries to develop and implement QI for RET
Assistance to countries

**Workshop – Developing quality infrastructure for solar water heating systems in LAC**
ICE- PTB LAC Project – IRENA -

**Green Quality Dialogue**
PTB -IRENA

**Planning and Technical Standards Development for China’s Renewables**
IRENA – CREEI – IEC – IECRE
Take away

- **Quality must be part of the equipment selection criteria** for the implementation of PV systems in addition to capital cost – liability is transferred to different actors across the project life cycle.

- We entered into an era of low equipment cost | quality infrastructure is critical to mitigate risks and achieve the **expected LCOE**.

- **Quality is not about hardware only**, but a system approach is needed.

- Progress on standards and conformity assessment schemes need to **accelerate the pace** to meet the market needs.

- **Cost – benefit** ratio of assuring quality is positive.

- Building up a quality infrastructure – country and market context is crucial | **Incremental approach**.
Quality pays!

We are collecting illustrative cases on the impact of standards and CA on RE markets.

Interested in sharing your case?

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