THE REPORT

SAARC Dissemination Webinar on “Exploring Financing Opportunities for Clean Energy, Environment and Energy Efficiency Projects”

9 April, 2019, Islamabad
Organized by
SAARC Energy Centre

April 9, 2019
SAARC Energy Centre
697, Street 43, Sector E-11/4 (NPF),
Islamabad, Pakistan
www.saarcenergy.org
Introduction

SAARC Energy Centre, (SEC) under its approved programme activity for the year 2019 had successfully conducted a SAARC Webinar on “Exploring Financing Opportunities for Clean Energy, Environment and Energy Efficiency Projects” on Tuesday, April 09, 2019. Webinar Agenda is available at Annexure I.

2. The Webinar highlighted various financing opportunities and instruments that have been used in developing countries for renewable energy, environmental and energy efficiency projects. The experts shared theoretical knowledge, risks and barriers, best practices, and provided participants with information on successful case studies and large scale programmes /projects implemented in field of Clean Energy, Environment and Energy Efficiency through external financing.

Participation

3. The Webinar was attended by a total of 78 professionals that included delegates from Member States, Representatives of Regional/International organizations, academia and private sector. The Resource Persons from academia and industry gave detailed presentations on their theoretical knowledge, successful programmes, case studies, and initiatives undertaken in the field of external financing opportunities. The participants list is available at Annexure II.

Opening Remarks

4. Mr. Mohammad Naeem Malik welcomed all the delegates and participants for attending the webinar and showing keen interest. He also acknowledged the commitment and contribution of experts in materializing the conduct of webinar.
5. He started with brief introduction of the SEC and its annual program activities with specific emphasis on Renewable Energy. An overview of programme activities of SEC was given, which includes policy-based research studies, knowledge sharing events i.e., workshops, seminars, webinars, trainings, and pilot projects in all fields of Energy.

6. He apprised the participants that the Member States in SAARC region have huge and abundant resources of renewable energy which have not been harnessed to their actual potential. He also apprised the participants that projects in developing countries face multiple challenges at the institutional, policy, regulatory, market development and project level which can hinder the development and uptake of renewable energy. In such a scenario, it is very important for project developers to properly identify and choose the type of financing instrument. He hoped that the webinar will give due attention to local financial markets to help the participants understand the use of financing instruments.

7. He thanked the experts and participants for playing key role in realizing the importance of this webinar. He remarked that this webinar is just a first step, and the centre shall continue conducting such knowledge sharing webinars. At the end, he again thanked all the participants for taking out time to attend the webinar.

Technical Proceedings

8. All the presentations delivered during the webinar are available at SEC’s website www.saarcenergy.org. The Experts list is available at Annexure III and Presentations at Annexure IV. A brief information on the content of the delivered presentations is as follows:

Presentation 1 – Renewable Energy Markets Key to financing: Communities and Households
Expert: Mr. Amer Durrani, CEO Reenergia-Enhar, Pakistan.

9. Mr. Durrani gave an overview of distributed generation at community level and explained to the participants that how such distributed generation is the key of financing the renewable energy markets. He also provided an overview of different types of financing instruments, their financing risks and barriers, and explained power off-take structures.

10. He mentioned that distributed generation in the form of minigrids is the key to meeting SDG 7, and claimed that according to a recent study carried out in Pakistan; distributed generation has a competitive LCOE.

11. Mr. Durrani explained the minigrid business model, its actors, and the financing instruments for distributed generation. He also pointed out the tariffs and billing system for minigrids through a comparison of Indonesia, Pakistan, Senegal, South Africa, China and Ghana.

12. At the end, he discussed multiple case studies to help the participants understand the regulatory and policy level initiatives as well as renewable energy financing regimes in various countries of the world.
Presentation 2 – Financial Instruments for Renewable Energy Projects  
*Expert: Mr. Sandeep Kumar Mohanty, Associate Director, PwC India.*

13. Dr. Sandeep Kumar started his presentation by highlighting the need for Renewable Energy Finance, explaining the improved economics of renewable energy and the need for external finance. He highlighted that providing electricity in remote areas is a challenge for SAARC countries, therefore renewable energy comes out as a viable option.

14. He then explained a variety of debt or equity financing instruments available to support RE projects. He highlighted the advantages and challenges for each of the financing instrument, along with a successful case study. He also explained how those funds are raised, investment tenor and the expected IRR for the investor.

15. Lastly, he mentioned innovative financing instruments such as Green Bonds, Infrastructure Investment Trusts (InVITs), Carbon Financing, Asset Backed Securities (ABS), Micro-Financing, and Small-Scale Project (SREP) financing. For each innovative financing instrument, he also explained successful case studies.

Presentation 3 – Economics and Finance of Rooftop (distributed) and another PV  
*Dr. Rahul Tongia, Fellow, Brookings India and Adjunct Professor, Carnegie Mellon University*

16. Dr. Tongia started his presentation by giving various types of Solar PV, explaining nuances of economics and finance for each type of Solar PV, and giving example of India’s solar plans and ambitions. He clarified that grid scale solar installation has been far ahead of rooftop solar installations, and provided the reasons for it. Moreover, he explained challenges for rooftop solar, including fragmented markets, quality concerns, municipal limitations etc.

17. He mentioned the economics of minigrids, especially in the context of net metering, and explained payment schemes, metering schemes, and the importance of battery for each net metering project. He also highlighted the policies for net metering in India.

18. Finally, Dr. Tongia provided some basic calculations for household solar, techno-economic challenges, implications for business models and new finance options for rooftop solar. He concluded that time of day tariffs will become critical for rooftop solar, therefore government policies are required to ease large scale financing of these projects.

Knowledge Sharing Session

19. The participants of the webinar provided their feedback on the quality and content of the event. The main discussions during this session revolved around topics such as financing mechanisms applicable in SAARC Member States, solar home systems, green bonds, community scale solar minigrids etc.
Conclusion and Closing of Webinar
Mr. Muhammad Umar Mukhtar, Research Fellow (Energy, Transport & Environment), SAARC Energy Centre

20. Mr. Muhammad Umar Mukhtar, Research Fellow (ETE) informed all the participants that the presentations will be available on SAARC Energy Centre’s website (www.saarcenergy.org). He requested the participants to submit suggestions and comments to SEC for any further improvement, plus they may suggest and submit any topics of their interest to SEC for arranging future webinars. The webinar was closed with a thank you note to everyone attending the Webinar.
Agenda

SAARC Webinar on “Exploring Financing Opportunities for Clean Energy, Environment and Energy Efficiency Projects”

Tuesday, April 09, 2019; 1100–1300hrs Pakistan Standard Time (PKT)

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>1100</td>
<td>Welcome and Introduction&lt;br&gt;&lt;i&gt;Mr. Muhammad Umar Mukhtar, Research Fellow (Energy, Transport &amp; Environment), SAARC Energy Centre&lt;/i&gt;</td>
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<td>1105</td>
<td>Opening Remarks&lt;br&gt;&lt;i&gt;Mr. Mohammad Naeem Malik, Director, SAARC Energy Centre&lt;/i&gt;</td>
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<td>1115</td>
<td>Topic: Renewable Energy Markets - key to financing: Communities and Households&lt;br&gt;&lt;i&gt;Presenter: Mr. Amer Zafar Durrani, (Ex-World Bank and CEO, Reenergia-Enhar)&lt;/i&gt;</td>
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<td>1140</td>
<td>Q&amp;A Session</td>
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<td>1145</td>
<td>Topic: Overview of financial instruments for RE technologies&lt;br&gt;&lt;i&gt;Presenter: Mr. Sandeep Kumar Mohanty (Associate Director, PwC India)&lt;/i&gt;</td>
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<td>1210</td>
<td>Q&amp;A Session</td>
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<td>1215</td>
<td>Topic: Understanding the Rooftop and Distributed Solar Generation&lt;br&gt;&lt;i&gt;Presenter: Dr. Rahul Tongia (Fellow at Brookings Institution and Adjunct Professor at Carnegie Mellon University)&lt;/i&gt;</td>
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<td>1240</td>
<td>Q&amp;A Session</td>
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<tr>
<td>1245</td>
<td>Conclusions, Recommendations and Closing of Webinar&lt;br&gt;&lt;i&gt;Mr. Muhammad Umar Mukhtar&lt;/i&gt;</td>
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Information for the participants:

1. All times mentioned in agenda are according to Pakistan Standard Time (PKT). The participants from other Member States of SAARC and Australia may attend Webinar by following their own national time. The time conversion for all countries is given below for reference:

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<th>Bangladesh</th>
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2. The participants can ask questions to presenters by typing questions or clicking to the raised hand option into the Attendees pane of the main window of GotoWebinar software. You may send in your questions at any time during the presentations; we will collect these and address them during the Q & A session at the end of each presentation. You may also discuss your queries during the knowledge sharing session of webinar.
3. All participants can also submit comments/views and/or observations on the webinar to SAARC Energy Centre through email to Mr. Muhammad Umar Mukhtar, Research Fellow (ETE) (rfete@saarcenergy.org) by 12th April, 2019.
List of Participants

<table>
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<td><a href="mailto:write2nikhat@gmail.com">write2nikhat@gmail.com</a></td>
</tr>
<tr>
<td>67.</td>
<td>Iman</td>
<td>Meer</td>
<td><a href="mailto:imanmeer13@gmail.com">imanmeer13@gmail.com</a></td>
</tr>
<tr>
<td>68.</td>
<td>Muhammad Kamran</td>
<td>Siddiqui</td>
<td><a href="mailto:kamransiddiqui31@gmail.com">kamransiddiqui31@gmail.com</a></td>
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<tr>
<td>69.</td>
<td>Praveen</td>
<td>Devakota</td>
<td><a href="mailto:praveen.devakota@gmail.com">praveen.devakota@gmail.com</a></td>
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<tr>
<td>70.</td>
<td>Kushal</td>
<td>Shrestha</td>
<td><a href="mailto:kushal.shrestha3@gmail.com">kushal.shrestha3@gmail.com</a></td>
</tr>
<tr>
<td>71.</td>
<td>Bimal</td>
<td>Gyawali</td>
<td><a href="mailto:bimal.gyawali07@gmail.com">bimal.gyawali07@gmail.com</a></td>
</tr>
<tr>
<td>72.</td>
<td>Hamad</td>
<td>Khan</td>
<td><a href="mailto:engr.hamadkhan@gmail.com">engr.hamadkhan@gmail.com</a></td>
</tr>
<tr>
<td>73.</td>
<td>Ashish</td>
<td>Bhandari</td>
<td><a href="mailto:aashishbhandari@gmail.com">aashishbhandari@gmail.com</a></td>
</tr>
<tr>
<td>74.</td>
<td>Engr. Majid</td>
<td>Ali</td>
<td><a href="mailto:engr.majidali.baig@gmail.com">engr.majidali.baig@gmail.com</a></td>
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<tr>
<td>75.</td>
<td>Muhammad</td>
<td>Ali Qureshi</td>
<td><a href="mailto:muhammadaliqureshi1985@gmail.com">muhammadaliqureshi1985@gmail.com</a></td>
</tr>
<tr>
<td>76.</td>
<td>A.K.M. Humayan Kabir</td>
<td>Dewan</td>
<td><a href="mailto:humayandewan@gmail.com">humayandewan@gmail.com</a></td>
</tr>
<tr>
<td>77.</td>
<td>Muhammad khayyam</td>
<td>Ilyas</td>
<td><a href="mailto:khayyam.ilyas@gmail.com">khayyam.ilyas@gmail.com</a></td>
</tr>
</tbody>
</table>
### List of Experts

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name</th>
<th>Designation</th>
<th>Organization</th>
<th>Email address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mr. Amer Zafar Durrani</td>
<td>CEO</td>
<td>Reenergia-Enhar</td>
<td><a href="mailto:adurrani@reenergia.com">adurrani@reenergia.com</a></td>
</tr>
<tr>
<td>2.</td>
<td>Mr. Sandeep Kumar Mohanty</td>
<td>Associate Director</td>
<td>PwC India</td>
<td><a href="mailto:sandeep.kumar.mohanty@pwc.com">sandeep.kumar.mohanty@pwc.com</a></td>
</tr>
<tr>
<td>3.</td>
<td>Dr. Rahul Tongia</td>
<td>Adjunct Professor</td>
<td>Carnegie Mellon</td>
<td><a href="mailto:tongia.cmu@gmail.com">tongia.cmu@gmail.com</a></td>
</tr>
</tbody>
</table>
Presentations Delivered During the Webinar

Presentation on “Renewable Energy Markets - Key to Financing: Communities and Households” by Mr. Amer Zafar Durrani
**Types of Financing in Renewable Energy**

- **Equity Finance**
- **Project Development Capital**
- **Debt Finance**
- **Off-balance sheet project financing**
- **Corporate finance (small projects; less than $15 million)**
- **On-balance sheet corporate finance**

**The Range Of Financial Instruments**

<table>
<thead>
<tr>
<th>Financial Instrument Addresses:</th>
<th>Financing Barriers</th>
<th>Both Barriers &amp; Risks</th>
<th>Project Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project/Programme Financing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grants</td>
<td>-</td>
<td>-</td>
<td>Capital Grants</td>
</tr>
<tr>
<td>Equity</td>
<td>Equity (Venture Capital)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Debt</td>
<td>Senior Debt (Credit Line)</td>
<td>Subordinated Debt</td>
<td>Senior Debt (Project Loan)</td>
</tr>
<tr>
<td>Asset-Backed</td>
<td>Asset-Backed Securities</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Guarantees &amp; Insurance</td>
<td>Liquidity Guarantee</td>
<td>Pari-Passu/Subordinated Guarantees</td>
<td>Political Risk Insurance/Partial Risk Guarantee</td>
</tr>
<tr>
<td></td>
<td>Wind/Solar Insurance</td>
<td>Contingent Resource Insurance</td>
<td></td>
</tr>
</tbody>
</table>

**Targeted Instruments**

<table>
<thead>
<tr>
<th></th>
<th>-</th>
<th>Contingent Project Development Grants</th>
<th>OBA/OBD/AMC/PES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Result-Based Financing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Financing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small-Scale Project</td>
<td>Microfinancing for Customers</td>
<td>Portfolio Guarantees/Loss Reserves</td>
<td>-</td>
</tr>
<tr>
<td>Financing</td>
<td>Aggregation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: The risks and barriers are shown across the horizontal axis, with instruments shown below. Those instruments occupying the middle of the three columns are potentially suitable for addressing both risks and barriers.

*AMC = Advanced Market Commitments; OBA = output-based aid; OBD = output-based disbursement; PIS = payment for environment service.*
Financing and associated risks taken....

<table>
<thead>
<tr>
<th>Type:</th>
<th>Venture Capital</th>
<th>Private Equity</th>
<th>Infrastructure Funds</th>
<th>Pension Funds</th>
<th>Bank Mezzanine Debt</th>
<th>Bank Senior Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Taken:</td>
<td>Start ups, new technology, prototypes</td>
<td>Pre IPO Companies, demonstrator technology</td>
<td>Proven technology, private companies</td>
<td>Proven technology</td>
<td>Demonstrator/ proven technology, new companies</td>
<td>Proven technology, established companies</td>
</tr>
<tr>
<td>Approximate level of return, or margin</td>
<td>&gt;50% IRR</td>
<td>35% IRR</td>
<td>15% IRR</td>
<td>15% IRR</td>
<td>LIBOR + 700bps</td>
<td>LIBOR + 300 bps</td>
</tr>
</tbody>
</table>

Grid Offtake Projects
Annexure-IV

Grid Offtake Projects

Traditional Off taker
Utilities Serving Retail Load
Driver: Compliance
Offtaker: Integrated utilities and large retail electric providers

Other Common Off taker
Power Marketers
Driver: Profit

New Market Entrant
Corporate Purchasers
Driver: Sustainability — Demonstrate commitment to the environment — RE100 global initiative of influential businesses committed to go ‘100% renewable’
Offtaker: includes Microsoft, Google, Starbucks, Nike, Nestle, Goldman Sachs, Bloomberg, Credit Agricole, UBS

New Market Entrant Risk Solution Providers
Driver: Profit

2018 YTD Deal Tracker

As of October 10, 2018. Partially enumerated corporate capacity of corporate Power Purchase Agreements, Green Power Purchases, Green Tariffs, and Qualified Project Demonstrations in the US, 2013 – 2018 YTD. Includes on-site generation (e.g., rooftop solar PV) and deals with operating plants. ‘#’ indicates number of deals each year by individual companies.

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#REBA18
Tradational Power Purchase Agreement

Agreement to purchase physical power from the project

<table>
<thead>
<tr>
<th>Key Consideration</th>
<th>Tradional PPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offtakers:</td>
<td>Utilities Serving Retail Load</td>
</tr>
<tr>
<td>Delivery Point:</td>
<td>Project Node</td>
</tr>
<tr>
<td>Volume:</td>
<td>Actual Quantity Generated</td>
</tr>
<tr>
<td>Environmental Attributes:</td>
<td>Included, Compliance</td>
</tr>
<tr>
<td>Term:</td>
<td>20 years</td>
</tr>
</tbody>
</table>

Risks involved:

- Creditworthiness of the parties over the life of the contract, fluctuating market prices, and concerns about project performance.

Potential risk management:

- Credit support requirements (which, for the utility, may be triggered only in the event of a credit downgrade) or
- Performance guarantees backed by liquidated damage provisions.
Synthetic Power Purchase Agreement

Financially settled contract that replicates the economics of a traditional PPA

<table>
<thead>
<tr>
<th>Key Consideration</th>
<th>Synthetic PPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offtaker</td>
<td>Large Non-Energy Companies</td>
</tr>
<tr>
<td>Delivery Point</td>
<td>Project Node or Liquid Trading Hub</td>
</tr>
<tr>
<td>Volume</td>
<td>Actual Quantity Generated</td>
</tr>
<tr>
<td>Environmental Attributes</td>
<td>Included, Voluntary (Green-e)</td>
</tr>
<tr>
<td>Term</td>
<td>12 - 13 years</td>
</tr>
</tbody>
</table>

Risk Involved:

✓ Long-term creditworthiness of the offtaker is of critical concern

✓ Many corporate offtakers have strong credit ratings, but corporate PPA's may also provide for a guaranty from a creditworthy parent company and for posting of a letter of credit if the offtaker's or the parent guarantor's credit rating falls.

Hedge (Physical and Financial)

Financial: Energy “sold” through a “fixed for floating” swap based on fixed volume of energy

Physical: Physical sale of a fixed volume of energy

<table>
<thead>
<tr>
<th>Key Consideration</th>
<th>Financial Hedge</th>
<th>Physical Hedge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Offtakers</td>
<td>Power Marketer</td>
<td>Power Marketer</td>
</tr>
<tr>
<td>Delivery Point</td>
<td>Liquid Trading Point</td>
<td>Liquid Trading Point</td>
</tr>
<tr>
<td>Volume</td>
<td>Fixed Volume (P99)</td>
<td>Fixed Volume (P99)</td>
</tr>
<tr>
<td>Environmental Attributes</td>
<td>Often Not Included</td>
<td>Often Not Included</td>
</tr>
<tr>
<td>Term</td>
<td>12-13 years</td>
<td>12-13 years</td>
</tr>
</tbody>
</table>

Risk Involved:

✓ Basis Risk:
   Over time, the market price received by the project owner at the project node will be less than the market price paid by the project owner at the trading hub for resale to the hedge provider

✓ Volume Risk:
   Over time, the volume of energy generated by the project is less than the volume the project is required to deliver at the trading hub
The On-Grid Finance Continuum

<table>
<thead>
<tr>
<th>Often Secured</th>
<th>Occasionally Secured</th>
<th>Gaps and Barriers</th>
<th>Proposed Interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developers/Sponsors Equity</td>
<td>Grants</td>
<td>Underscoring Project Developers</td>
<td>Contingent Project Development Grants</td>
</tr>
<tr>
<td>Corporate/Project Financed Loans</td>
<td>Mezzanine Finance</td>
<td>Weakening Cost/Equity gap</td>
<td>Public Participation in Private Equity Funds</td>
</tr>
<tr>
<td>Insurance</td>
<td>Export Credits, other Risk Management</td>
<td>Lack of Appropriately Risk Management Instruments</td>
<td>Public Participation in Mezzanine Funds</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-Traditional RE Risks</td>
<td>Barriers to New RE Products</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inflexible Underwriting Mentality</td>
<td>Public/Private partnerships to share risks and costs/benefits of innovation</td>
</tr>
</tbody>
</table>

Distributed Generation

![Diagram of Distributed Generation](image)
Global policy makers predict that 7th SDG—energy access to all—will be met primarily by DG relying on localized grids.

The world’s energy thinkers have already coalesced on the fact that the energy access challenge posed by the 7th SDG will be met primarily through a distributed generation model relying on localized grids—

Bloomberg NEF estimates that microgrids relying on solar alone will be a $443 billion market by 2030.

...and a recent AFD study in Pakistan also proved that distributed generation has a competitive LCOE.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Potential Sector</th>
<th>Final Score</th>
<th>Market Key</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Wind 5-30MW</td>
<td>7.73</td>
<td>L</td>
</tr>
<tr>
<td>2</td>
<td>Wind 30-50MW</td>
<td>7.67</td>
<td>K</td>
</tr>
<tr>
<td>3</td>
<td>Solar 5-20MW</td>
<td>7.22</td>
<td>A</td>
</tr>
<tr>
<td>4</td>
<td>EPCo (basic bankable edition)</td>
<td>6.95</td>
<td>B</td>
</tr>
<tr>
<td>5</td>
<td>Solar distributed generation (Tier 3)</td>
<td>6.30</td>
<td>M</td>
</tr>
</tbody>
</table>

**BCG Matrix for Bankability of RE Projects**

**LCOE analysis**
Minigrids more affordable on the average...

And, this is how China electrified its villages with million plus population even in the remotest villages...

- Distinctive Phases of Rural Electrification
  - Maoist era of central planning (1949-1977), Era of market reform (1978-1997), a subsequent move towards a dynamic market economy from 1997 till date
  - Renewable energy based rural electrification programme in China
    - Brightness Electrification & Township Electrification Program
    - Electricity for All (2011-2015)
..using MHPs, mini-grids, other renewables, and other off-grid technology

- China relied on three specific approaches....
  - small- and micro-hydro in high hydro potential areas;
  - mini-grids and village networks using renewable energies were developed in areas with “clustered households and township infrastructure” (Zhang and Kumer, 2011).
  - Other off-grid technology options in remote areas

Recognized rural electrification and rural development link and worked with devolved/communities

Success Factors

- Bottom up approach to electrification
- Phase approach to development (localized and decentralized generation)
- Early recognition of rural electrification-rural development link
- Organizational arrangements-devolution of power & responsibilities to lowest governance tiers
- Pilot Projects and technical capacity programs
- Technological flexibility- right technology at the right place (mini grids, hybrid, SHS)
- Locally manufacturing base
- Funding Arrangements
- Policy Influence
Mini-grid Business Model Actors...

- Demand Management
- Promoting Income-Generating End Uses
- Quality of Electricity Service
- Tariff Design
- Revenue Collection
- End User Finance

Securing financing for mini-grid development is challenging, partly because of the inherent weaknesses of mini-grid financial models and partly because of risk perceptions.

Current Distributed Generation Financing...

- Grants and Subsidies
  - International development agencies
  - Local government agencies
  - Trusts and foundations, private individuals, and others.

- Equity Investors
  - Early stage seed capital
  - Expansion capital
  - Impact investors
  - Development financing institutions (DFIs)

- Loans
  - DFIs – Short term/conventional loan providers
  - Commercial banks – only in case of proven business models or mitigated project risks.
  - International lenders – usually concerned about foreign exchange risks

- Guarantees
  - Loan guarantees
  - Risk guarantees

Foreign Exchange Risk
Case Study: Sub-Saharan Africa
Capital Cost: hard Currency
Revenues: local currency
For DG financing; a fundamental shift in investments is required...

- With only 0.4 percent of institutional capital currently in the clean energy space, a fundamental shift in the current financing mechanisms is required for delivering institutional capital to distributed generation such as rooftop solar, community solar, energy efficiency and more.

- Must look to aggregation financing models including:
  - Institutional equity
  - Institutional debt

Quarterly Investments ($bn) | Asset Owners AUM

$22 trillion of investment required to meet global carbon reduction goals over next 20 years

But only 0.4% of institutional capital is in clean energy


Institutional equity: the yieldco model

A yieldco is a dividend-paying company created for the long-term ownership of assets. The yieldco typically buys operating assets, including renewable assets, with long-term, predictable cash flows.

The American Experience:
- Eight publicly traded yieldcos launched from 2013 to 2015.
- Led by existing sponsors to purchase the sponsor’s assets.
- Focused: utility-scale wind and solar projects
- Aggressive approach: Rapid stock growth based on promise of substantial pipeline
- Challenge: excessive debt and more modest growth outlooks

The European Experience:
In contrast, the European yieldcos took a much more modest approach:
- performed much better than their U.S. counterparts
- minimal stock growth
- reliable dividends of about 6 percent per annum

Restructuring In The Yieldco Space:
Improvements required to the corporate governance structure, project valuation methods, and “end game” strategy of YieldCos
Institutional debt: $1 billion-plus in solar securitizations

Asset-backed securitization (ABS)/Institutional bond offerings:

In a securitization, the issuer creates a large enough pool of similar assets such that no single asset should affect debt repayment. Investors purchase bonds or notes that are repaid through the cash flows of the underlying assets.

Challenges:
- Standardizing the underwriting process
- Achieving sufficient scale
- Collection, organization & communication of data

Green Bonds

- Debt instrument
- Offers fixed return
- May be issued by a financial institution, the government or even a company to raise funds for a defined period
- European Investment Bank (EIB) First issuer of Green bond

Drivers for issuing Green Bonds...
- Attracts environmentally conscious investors who may otherwise invest in your company
- Growing investor demand for green-friendly, socially responsible business practices
- Stakeholder demand for responsible business practices is growing
- Helps project the company’s environmental and social consciousness through enhancing the brand

- Almost all green bonds issued in past have been oversubscribed
- Competition from lending agencies that have issued green bonds
- Accessible and powerful instrument for financing sustainable low carbon economy
- Economical and convenient financial model by product developers

AC Energy
3410m USD
MidAmerican Energy
Alliant Energy
Navarro government
EUR 50 million (USD 56.7m)
Dominion Energy
($382 million)
**Green Bond – Investors Demand**

- **ABS**: 0 to 150 USD Billion
- **Financial corporate**: 0 to 150 USD Billion
- **Non-financial corporate**: 0 to 150 USD Billion
- **Development bank**: 0 to 150 USD Billion
- **Local government**: 0 to 150 USD Billion

**Use of green bond proceeds - 2018**

- **Energy**: 2016 USD 167
- **Buildings**: 5%
- **Transport**: 12%
- **Water**: 5%
- **Waste**: 18%
- **Land Use**: 28%
- **Adaptation**: 28%
- **Industry**: 28%
- **ICT**: 28%

**Supply of Green Bonds**

- **Emerging Markets 2017**: USD 5.3bn
  - 44% ABS
  - 18% Development Bank
  - 7% Financial Corporate
  - 7% Government Backed Entity
  - 4% Loan
  - 7% Local Government
  - 13% Non-Financial Corporate
  - 8% Sovereign

- **Emerging Markets 2018**: USD 8.4bn
  - 33% ABS
  - 16% Development Bank
  - 16% Financial Corporate
  - 8% Government Backed Entity
  - 13% Loan
  - 7% Local Government
  - 8% Non-Financial Corporate
  - 7% Sovereign
Overview of Renewable Energy Tariffs...
## Tariffs for Grid Off-Take and Distribution Generation...

<table>
<thead>
<tr>
<th>Grid off-Take</th>
<th>Distributed Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generation Tariff</strong></td>
<td><strong>Uniform Tariff</strong></td>
</tr>
<tr>
<td>- Includes Distribution Margin and Power Purchase Price charge to DISCOs under pool charge cost methodology approved by NEPRA</td>
<td>- mini-grid tariffs are set on par with national utility tariffs</td>
</tr>
<tr>
<td>Feed-in tariffs</td>
<td>Cost-reflective Tariffs</td>
</tr>
<tr>
<td>- Fixed electricity prices paid to renewable energy (RE)</td>
<td>- consumers pay tariffs that match the cost of the efficient operation and maintenance of the mini grid</td>
</tr>
<tr>
<td>- paid by electricity grid, system or market operators</td>
<td>- Cambodia - private developers charge high but cost-reflective tariffs, allowing them to operate sustainably</td>
</tr>
<tr>
<td>- Solar PV Upfront Tariff by NEPRA</td>
<td>Hybrid Tariff Scheme</td>
</tr>
<tr>
<td></td>
<td>- It supports a cost-reflective tariff with some sort of subsidy</td>
</tr>
<tr>
<td></td>
<td>- In Nepal, isolated mini-grids receive capital subsidies in order to address viability gap</td>
</tr>
<tr>
<td>Avoided-cost Tariff</td>
<td>Avoided-cost Tariff</td>
</tr>
<tr>
<td>- mini-grid operators design tariffs that translate into monthly bills</td>
<td>- mini-grid operators design tariffs that translate into monthly bills</td>
</tr>
<tr>
<td>- Tanzania, the Energy and Water Utilities Regulatory Authority (EWURA) [link is external], annually reviews and estimates stand-alone, small-power purchase tariffs for small-power projects of 10 MW, based on avoided cost</td>
<td></td>
</tr>
</tbody>
</table>

**Power Tariff or Energy Tariff**
A power tariff allows consumers to use as much energy as they desire long as they do not exceed their maximum permitted wattage.

## Tariffs and Billings Systems - Experience Matrix

- Which challenges have been identified?
- Which tariffs and billing systems have been successful?

### Country / Project / System
- Indonesia / MHP / Micro Hydro Schemes
- Pakistan
- Planned in Ethiopia / EnDev / Micro Hydro Schemes
- Republic South Africa / SHS Pakistan / SHS
- Senegal / SHS, Burkina Faso / SHS

### System applied successful

<table>
<thead>
<tr>
<th>System</th>
<th>Successes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communal-set tariffs</td>
<td>• Flat rate (households)</td>
</tr>
<tr>
<td></td>
<td>1. Flat rate (households)</td>
</tr>
<tr>
<td></td>
<td>2. Item based (e.g. # of bulbs)</td>
</tr>
<tr>
<td></td>
<td>3. Cluster metering</td>
</tr>
<tr>
<td>Item based (e.g. # of bulbs)</td>
<td>• Overloading</td>
</tr>
<tr>
<td></td>
<td>• Sanction management</td>
</tr>
</tbody>
</table>
| Flat rate (no productive use) + mech. load limiter; only CLE, no social tariff | • Expected challenges:
| | 1. Billing - recovery rate too low |
| | 2. Monitoring of applied devices |
| | 3. Static system |
| | • Risk: pilot → not cost covering |
| Fee for service with pre-paid metering | • Fee for service with pre-paid metering |
| | 1. Complete financial failure |
| | 2. Conceptual design resulted in no ownership and caused vandalism, theft, ... |
| Fee for service successful | • Fee for service successful |

### Challenges

| Country / Project / System
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia / MHP / Micro Hydro Schemes</td>
</tr>
<tr>
<td>Pakistan</td>
</tr>
<tr>
<td>Planned in Ethiopia / EnDev / Micro Hydro Schemes</td>
</tr>
<tr>
<td>Republic South Africa / SHS Pakistan / SHS</td>
</tr>
<tr>
<td>Senegal / SHS, Burkina Faso / SHS</td>
</tr>
<tr>
<td>Country / Project / System</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Ghana / grid</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>China / grid – households</td>
</tr>
<tr>
<td>Rwanda / grid</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Zambia / grid</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Senegal / Mini-grids</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Morocco / planned for island grid</td>
</tr>
</tbody>
</table>

**Case Studies**

Financing schemes for renewable energy use in public and private buildings
## The Less Carbon Climate Fund – Almada, Portugal

<table>
<thead>
<tr>
<th>Beneficiaries:</th>
<th>Municipality/Municipal Enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Projects Financed:</td>
<td>Municipal investments in energy efficiency and RES featured in the city Sustainable Energy Action Plan (developed in the frame of the Covenant of Mayors Initiative)</td>
</tr>
<tr>
<td>Type of Financial Support Provided:</td>
<td>Municipal investment</td>
</tr>
<tr>
<td>Date of Creation:</td>
<td>2009</td>
</tr>
</tbody>
</table>
| Fund Size: | Initial fund size: USD 157,265 (evaluation of the CO₂ emissions for the first year 2008)  
Annual budget, in USD  
| | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| | 157,265 | 168,500 | 179,733 | 213,433 | 561,692 | 561,692 |
| Total size of the Fund (by 2014): USD 1,842,348 |
| Financial Sources: | Municipal budget line which internalizes the compensation of the previous year’s municipal CO₂ emissions |
| Fund Character: | Budget line |
| Operational Costs of the Scheme: | Unknown |

## The Amsterdam Investment Fund – Amsterdam, Netherlands

| Date of Creation: | 2011 |
| Fund Size: | Initial fund size: USD 64,280,054 (committed)  
USD 10,856,031 (26%) – for social projects  
USD 57,424,043 (84%) – for commercially viable products  
Annual budget: not applicable |
| Financial Sources: | City of Amsterdam – revenues from the sale of shares in “N.V. Nuon Energy” – a former local utility company that provides electricity, gas and heat in the Netherlands |
| Fund Character: | Revolving – any profits will be reinvested in the coming 15 years |
| Operational Costs of the Scheme: | General:  
- Staff (annually): 2 full-time workers  
- Communication, legal, other costs: USD 56,390  
- Administration:  
- European tender for selection of fund manager USD 168,570  
Financial return: Professionally managed funds:  
- Start up costs of USD 280,000  
- Management fee of 1.5% per year on the actually invested capital of the fund  
- Performance fee of 0.5% for project investments:  
  - A realized (at completion of a project) average annual net financial return of > 7% per year end  
  - A social outcome of at least 5 kg of CO₂ savings per project dollar invested  
- The performance fee is 0.5% per year on the actually invested capital invested in the project investment. |
The Delft Energy Saving Fund – Delft, Netherlands

<table>
<thead>
<tr>
<th>Date of Creation:</th>
<th>2006</th>
</tr>
</thead>
</table>
| Fund Size:       | Period 2006-2011: a budget of USD 224,904 approved by the City Council  
|                   | Period 2012-2016: a budget of USD 563,180 approved by the City Council |
| Financial Sources: | Municipal budget |
| Fund Character:  | Revolving |
| Operational Costs of the Scheme: | The management fee for the bank is paid from the Fund.  
|                   | Operational costs are part of the operational budget of the Delft Local Energy  
|                   | Action Plan:  
|                   | - Staff: 0.5 full time persons,  
|                   | - Communication costs |
| Beneficiaries:   | Citizens – house owners and non-profit organizations |
| Type of Projects Financed: | Energy saving measures  
|                   | Renewable energy heating and green electricity production |
| Type of Financial Support Provided: | Soft loans  
|                   | Amount lent:  
|                   | - Private house owners: USD 1,686 – USD 11,245  
|                   | - Non-profit organizations: USD 1,686 – USD 56,240  
|                   | Interest rate: 4% below the market rate, with a minimum of 1.5% (this has also been an average for several years)  
|                   | Maturity: 10 years  
|                   | Guarantee: no guarantees (if there’s no repayment the Fund value decreases and less projects can be supported)  
|                   | Insurance: not applicable  
|                   | Grace period: not applicable  
|                   | Self-financing: not applicable  
|                   | Maximum monthly installment: depends on the size of the loan (min. USD 16.17/month up to USD 539/month (interest + instalment)) |

International Renewable Energy Financing Regimes
# Germany

## Initiatives/Incentives

### Regulatory / Policy Level Initiatives

**Feed-in-tariff scheme**
- Government of Germany provides technology and capacity specific feed-in-tariffs for following renewable technologies for a period of 15-20 years:
  - Hydro power – ranges from ‘Up to 500 kW’ to ‘Over 50 MW’;
  - Landfill gas – ranges from ‘Up to 500 kW’ to ‘Up to 50 MW’;
  - Sewage gas – ranges from ‘Up to 500 kW’ to ‘Up to 50 MW’;
  - Mine gas – ranges from ‘Up to 1 MW’ to ‘Over 5 MW’;
  - Biomass – ranges from ‘Up to 150 kW’ to ‘Up to 20 MW’;
  - Geothermal (Onshore & offshore wind);
  - Solar energy.

### Fiscal Incentives

**Capital Subsidies/Grants/Rebates**
- Capital subsidies up to 40% of investments are provided to individuals and small and medium-sized businesses for installations of solar collectors under Market Simulation Program.
- Non-refundable grants for research and development in the field of photovoltaic, wind power, geothermal, solar thermal power grants and low temperature solar thermal.
- Soft loans and investment incentives by the market incentive programme for biomass combined heat and power (CHP), small hydro power, photovoltaic (PV) in schools.
- Several soft loans schemes indirectly support renewable energy technologies including the "BKA Umweltinstitut Förderung" program, "KfW-Infrastrukturprogramm", the "KfW-Umweltprogramm", for enterprises, and the "KfW-Infrastrukturprogramm", for municipalities. Credit terms range from 10 to 20 years. The interest rates offered are 1% to 2% below market interest levels.

### Investment Tax Credits
- Deducations and accelerated depreciation are provided for leased and owned buildings meeting green building requirements.

## Programme

<table>
<thead>
<tr>
<th>Programme</th>
<th>Targeted Group</th>
<th>Targeted Technology</th>
<th>Type of Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>KfW Renewable Energies Programme – Standard</td>
<td>Private individuals and not-for-profit organizations which feed the generated electricity/heat into the grid</td>
<td>Electricity from solar (PV), biomass, wind energy, hydro, geothermal energy</td>
<td>Up to 100% of investment costs eligible for financing, not more than EUR 25 million</td>
</tr>
<tr>
<td></td>
<td>Self-employed professionals, farmers, &amp; non-German enterprises majority-owned by private individuals</td>
<td>Electricity and heat from renewable energies, generated in combined heat and power stations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enterprises in which local authorities, churches or charities hold an interest</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Investment funds</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| KfW Renewable Energies Programme – Storage | Private individuals | New installations of stationary battery storage systems combined with photovoltaic systems | Up to 100% of investment costs for the battery storage system and the photovoltaic system |
| | Self-employed professionals, farmers | |
| | Enterprises | |

| KfW Renewable Energies Programme - Premium | Private individuals and not-for-profit organizations which use the generated heat exclusively for their own needs | For large plants in which heat is generated from renewable energies | Up to 100% of the financeable costs of investment, not more than EUR 10 million |
| | Self-employed professionals | |
| | Small and medium-sized enterprises (SMEs) | |
| | Enterprises that are majority-owned by municipalities and that do not meet the SME threshold values for turnover and number of employees | |
| | Large enterprises only if their solar thermal, deep geothermal, heat storage and heating network measures are particularly deserving of support | |
| | Municipalities, municipalities owned enterprises and municipal special-purpose associations | |
| | Energy service providers | |
## Spain

<table>
<thead>
<tr>
<th>Initiatives/Incentives</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulatory / Policy Level Initiatives</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **Feed-in-tariff scheme** | Government of Spain provided technology and capacity specific feed-in-tariffs for following renewable technologies under "Royal Decree 436/2004":  
  - Solar photovoltaic and Solar thermal for electricity generation  
  - Geothermal power and ocean power  
  - Hydroelectric with power ≤ 30 MW  
  - Biomas (energy crops or wastes from agriculture and forestry)  
  - Biomas (biogas or sewage sludge) controlled landfill gases  
  - Biomass/Industrial installations in the agriculture and forestry sector  
  - Municipal solid waste  
  - Currently, the FIT scheme has been replaced by a new scheme wherein renewable energy generators will receive a guaranteed return of 7.5% for the next six years. |
| **Utility Purchase Obligation** |  
  - As per the Royal Decree RD 436/2004, electricity distributors are obliged to buy electricity produced and the National Commission of Energy looks at settlement of costs incurred by small producers under the regulations set up by RD 436/2004  
  - Solar obligations in Barcelona and Madrid in residential buildings, sport centers, hospitals and industrial buildings using hot water  
  - Under Technical Buildings Code (CTE), buildings have to meet 30-70% of the Domestic Hot Water (DHW) demand with solar thermal energy. |
| **Fiscal Incentives** | |
| **Capital Subsidies/Grants/Rebates** | Under the "General Direction of the Institute for Energy Saving and Diversification", subsidies provided for supporting solar thermal energy as a part of "Promotion Plan for Renewable Energy." This includes all investments in installations of solar thermal such as hot, clean water applications, climatization of swimming pools, hot water process industries, applications for heating and climatization. Maximum funding does not exceed 40% of the eligible costs and is provided to Beneficiaries to natural or legal persons, private or public, groups of non-profit local corporations in the renewable energy and solar thermal energy sector. |
| **Investment Tax Credits** | 10% reductions in investment tax for investments in solar thermal and solar PV technologies under Law on Fiscal, Administrative and Social Measures |

## United Kingdom

<table>
<thead>
<tr>
<th>Initiatives/Incentives</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Regulatory / Policy Level Initiatives</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **Utility Purchase Obligation** | The Renewables Obligation (RO) was introduced in UK power sector for the first time in 2002 in order to provide incentives for the deployment of large scale renewable electricity in the UK. Licensed UK electricity suppliers are obliged to source a specified proportion of electricity procured eligible renewable sources. There are three different types of RO in UK. These are:  
  - The RO for England and Wales  
  - The RO for Scotland – The Scottish Government  
  - The RO for Northern Ireland – The Department of Enterprise, Trade and Investment  
  - Suppliers can meet their obligation by:  
    - Promoting ROCs or  
    - Making a buy-out payment to Ofgem to cover any shortfall in ROCs' requirement (set at £42.02 per ROC for 2013/14); or  
    - Combination of both.  
  - The RO is expected to close to new generators on 31 March 2017. And electricity generation accredited under the RO will continue to receive its full lifetime of support (20 years) until the scheme closes in 2017.  
  - Renewable Transport Fuels Obligation (RTFO) requires obligated energy suppliers to consume a share of fuel for road transport supplied in the UK from renewable sources or pay substitute amount of money. Applicable for fuel suppliers supplying at least 450,000 liters fuel per year. |
| **Renewable Transport Fuels Obligation** | The Renewable Transport Fuel Obligation (RTFO) requires obligated energy suppliers to consume a share of fuel for road transport supplied in the UK from renewable sources or pay substitute amount of money. Applicable for fuel suppliers supplying at least 450,000 liters fuel per year. |
| ** Tradable Certificates** | Renewable Obligation Certificates (ROCs) are tradable certificates issued by Office of Gas & Electricity Markets (OFGEM). Long-term value of a ROC is made up of the buyout price, i.e., the payment avoided by the supplier for presenting ROCs to OFGEM, plus 20% i.e., roughly £46 per ROC in 2013/14. |
## United States of America

<table>
<thead>
<tr>
<th>Initiatives/Incentives</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory / Policy Level Initiatives</td>
<td></td>
</tr>
</tbody>
</table>
| Feed-in-tariff scheme                  | Unlike a single feed-in-tariff for entire country, utility-based and state-level FIT policies have been implemented in the USA.  
• Utility-based FIT scheme – Initiated by state utility to meet utility-specific goals such as RPS targets; encouraging distributed generation. For example, Madison Gas & Electric in the State of Wisconsin purchases renewable energy at a pre-determined FIT in green power purchase program  
• State-level FIT scheme – Initiated by State Government and is followed by the Utilities in respective states such as California, Washington among others. |
| Renewable Purchase Standards           | Renewable portfolio standards (RPS) / renewable electricity standards (RES) are designed to promote renewable electricity generation by obligating energy utilities to supply a certain minimum share of their electricity from designated renewable resources. Although, no nationwide RPS program exists in the US, around 30 States have already implemented or are considering renewable portfolio standards or similar mandated renewable energy policies. Suppliers can meet their obligation by:  
• Presenting RECs; or  
• Supplying renewable energy or  
• Combination of both. |
| Renewable Energy Credits or Green Tags  | In US, most States with RPS programs have developed renewable energy certificate trading programs for promoting renewable energy development. For each unit of power that a eligible producer generates, a certificate or credit is issued which can be sold either in conjunction with the underlying power or separately to energy supply companies. |
| Net Metering Policies                  | Many States have issued “Net Metering Policy” for enabling customers to use electricity generated in excess of their consumption for offsetting use of electricity from the grid in order to encourage distributed renewable generation. The net metering policies of States may differ from each other in terms of technology and kilowatt-hour limits, aggregate capacity, compensation to customers etc. |

## United States of America

<table>
<thead>
<tr>
<th>Loan Program</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiscal Incentives</td>
<td></td>
</tr>
</tbody>
</table>
| Clean Renewable Energy Bonds          | Under Clean renewable energy bonds (CREBs) program, certain public entities such as electric cooperatives, government entities can issue bonds to finance renewable energy projects. The bondholder receives federal tax credits in lieu of a portion of the traditional bond interest, resulting in a lower effective interest rate for the borrower.  
• Eligible technologies – Solar thermal electric, Photovoltaic, Landfill Gas, Wind, Biomass, geothermal electric, municipal solid waste, hydrokinetic power, anaerobic digestion, Tidal energy, wave energy, ocean thermal  
| Qualified Energy Conservation Bonds   | Issued by state, local and tribal governments to finance certain types of energy projects under the Energy Improvement and Extension Act of 2008, enacted in October 2008. QECBs are qualified tax credit bonds similar to Clean Renewable Energy Bonds (CREBs). The bondholder receives federal tax credits in lieu of the traditional bond interest. Credits exceeding a bondholder’s tax liability may be carried forward to the succeeding tax year.  
• Eligible technologies – Solar Thermal Electric, Photovoltaic, Landfill Gas, Wind, Biomass, geothermal electric, municipal solid waste, hydrokinetic power, Anaerobic Digestion, Tidal Energy, Wave Energy, Ocean Thermal  
• Applicable sectors – State, local and tribal governments |
| Loan Guarantee Program                | Under this program, U.S. Department of Energy DOE is authorized to offer > $10 billion in loan guarantees for energy efficiency and renewable energy projects (usually > $25 million)  
### Brazil

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Direct Funding</th>
<th>Indirect Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNDES Financial Cost</td>
<td>At least TLP*</td>
<td>At least TLP*</td>
</tr>
<tr>
<td>BNDES Basic Spread</td>
<td>1.0% per annum</td>
<td>1.0% per annum</td>
</tr>
<tr>
<td>Credit Risk Rate</td>
<td>Up to 2.87% per annum based upon credit risk</td>
<td>-</td>
</tr>
<tr>
<td>Financial Intermediation Rate</td>
<td>-</td>
<td>0.1% per annum; 0.5% per annum for other companies</td>
</tr>
<tr>
<td>Financial Institution spread</td>
<td>-</td>
<td>As negotiated between financial institution &amp; the client</td>
</tr>
</tbody>
</table>

* TLP long term interest rate – 5.00% per annum 31st May 2014

### Segment

<table>
<thead>
<tr>
<th>Segment</th>
<th>Maximum Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cogeneration using biomass boiler with pressure greater than or equal to sixty (60) bar</td>
<td>90</td>
</tr>
</tbody>
</table>

### Segment

<table>
<thead>
<tr>
<th>Segment</th>
<th>Maximum Amortization Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro plants (&gt;1000 MW)</td>
<td>20 Years</td>
</tr>
<tr>
<td>Hydro plants (30 MW – 1000 MW)</td>
<td>20 Years</td>
</tr>
<tr>
<td>Wind energy and biomass</td>
<td>16 Years</td>
</tr>
<tr>
<td>Small hydro and other alternative energy</td>
<td>20 Years</td>
</tr>
</tbody>
</table>

**Concluding Remarks**
Financial Instruments for Renewable Energy Projects

April 2019

Agenda

1. Setting The Context
2. Traditional Financial Instruments
   • Debt Finance
   • Equity Finance
3. Guarantees
4. Innovative Financial Instruments
1

Setting The Context

The Need for Renewable Energy Finance

**Improved Economics of Renewable Energy**
- SAARC countries are emerging economies with emphasis on encouraging the lowest cost of energy generation.
- With technological advances and increased scale of renewable energy installations worldwide, renewable energy has now become very competitive and in some countries has also reached cost parity with thermal.
- Additionally, renewable energy brings in qualitative benefits such as environment friendly power source and reducing carbon footprint. This stands in line to the INDC targets proposed UNFCCC Conference of the Parties in Paris in December 2015.
- In order to provide energy in the most remote areas, which sometimes is a challenge in SAARC nations, renewable energy comes out as a viable option with use of small scale projects and off-grid projects to reach these areas.

**Need for External Finance**
- In order to meet the renewable energy targets set by the countries, there is a clear need to accelerate investments and expand finance access significantly in the sector to bridge the currently prevailing financing gap.
- To this end, various stakeholders need to be engaged, including governments, national financing vehicles, development finance institutions and the private sector.
- Some of the challenges faced by the private sector in accessing finance and attracting capital into renewables include:
  1. **Developer Issues:**
     - weak or underdeveloped local financial markets constraining re-finance or exit from the project, lack of long-term project financing, investment risks.
  2. **Financer Issues:**
     - technical knowledge, unfavorable scale of project, resource adequacy and capacity gaps among the project stakeholders.
Overview of Financial Instruments

A variety of debt or equity financing instruments are available to support RE projects. Over the years, various kinds of innovative financial instruments and structures have also been deployed. These innovative instruments have proved to be a successful mode of investment into certain markets. The selection of instruments varies from projects to projects depending on the type of risks faced by the investors and the maturity of the financial markets.

**Debt Finance Instruments**
- Senior Debt
- Subordinated Debt (Mezzanine Finance)
- Grants/Support from Multi-lateral agencies

**Equity Finance Instruments**
- Venture Capital Funds
- Private Equity Funds
- Infrastructure Funds
- Pension Funds

**Guarantees**
- Government Guarantee
- Political Risk Guarantee
- Currency Risk Guarantee

**Innovative Finance Instruments**
- Green Bonds
- Infrastructure Investment Trusts (InVITs)
- Carbon Financing
- Small-Scale Project (SREP) Financing
- Asset Backed Securities (ABS)
- Micro Financing

2

Traditional Financial Instruments
Debt Finance

Overview of Debt Finance

- Debt funding, through conventional term loans which would cover ~70% of project costs
- The major sources of debt financing are international and national commercial banks. Other sources of debt financing include multilateral development banks (MDBs) and the International Finance Corporation (IFC), debt investment funds, equipment suppliers, and private investors
- In debt funding, lenders have priority on the cash flows over shareholders/equity holders.

**Senior Debt**
- Provided by banks during the start-up and construction phases with flexible payment structures against the life of the project.
- Lenders are risk averse and seek covenants and measures to minimize losses in an event of a default

**Case Study**
- SBI’s customized financial product for grid connected rooftop solar PV program
- Standard Chartered’s renewable energy and environmental finance team that has lent $4.2 billion worldwide

**Advantages**
- Debt will be at the level of project company (SPV) instead on the books of the parent company

**Challenges**
- Local commercial banks in developing countries are reluctant to extend long-term loans. Instead, they offer a mid-term loan with a potential follow-up finance at the end of the term
Overview of Debt Finance Continued...

<table>
<thead>
<tr>
<th><strong>Subordinated Debt (Mezzanine Finance)</strong></th>
<th><strong>Advantages</strong></th>
<th><strong>Challenges</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• The product insulates senior debt investors from unforeseen risks and reduces cost of capital where equity is too expensive</td>
<td>It improves the cash flows in a project and reduces the risk of senior lenders. As a result, the willingness to lend and to accept long-term loan increases</td>
<td>High risk is compensated for by a higher rate of interest as compared to RoI on senior debt</td>
</tr>
<tr>
<td>• Some forms of subordinated debt can be converted to shares or, preferred shares or take the form of equity but with lesser or no rights of control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Public Funding/Grants</strong></th>
<th><strong>Advantages</strong></th>
<th><strong>Challenges</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• This includes funding of renewable initiatives through budgetary allocations or grants from global/ multilateral agencies like the World Bank, Asian Development Bank, etc. The same is common across SAARC countries.</td>
<td>The main motive is to provide energy access to the population, and there is no return expectation involved from the funds invested.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Sri Lanka Renewable Energy Program:</strong></th>
<th><strong>Advantages</strong></th>
<th><strong>Challenges</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The World Bank is funding projects related to in grid-connected, mini-hydro, off-grid village-level hydro and SHS. These funds are channeled to the MoF and Planning as an International Development Association (IDA) credit.</td>
<td>The lending is generally in foreign currency and hence, countries availing such grants run into high currency risk along with increased hedging cost.</td>
<td></td>
</tr>
</tbody>
</table>
Overview of Equity Finance

Renewable energy equity investors take an ownership stake in a project or company. It involves a range of financial investors including Private Equity Funds, Infrastructure Funds and Pension Funds with varied features in terms of risk appetite, loan tenor and expected returns.

<table>
<thead>
<tr>
<th></th>
<th>Venture Capital Funds</th>
<th>Private Equity Funds</th>
<th>Infrastructure Funds</th>
<th>Pension Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>How funds are raised</td>
<td>Funds are raised from wide range of sources with high-risk appetite like High net worth individuals or seed capital</td>
<td>Funds raised from a wide range of sources with medium risk appetite to include institutional investors and high net worth individuals</td>
<td>Funds drawn from a range of institutional investors</td>
<td>Funds are drawn via Public equity, corporate &amp; Government bonds, cash and inflated linked assets</td>
</tr>
<tr>
<td>Appetite for Risks</td>
<td>High</td>
<td>Medium</td>
<td>Medium - Low</td>
<td>Low</td>
</tr>
<tr>
<td>Investment Tenor</td>
<td>3-5 years</td>
<td>4-7 years</td>
<td>7-10 years</td>
<td>8 - 12 years</td>
</tr>
<tr>
<td>Expected IRR</td>
<td>50% to 500%</td>
<td>20-25%</td>
<td>12-15%</td>
<td>10-12%</td>
</tr>
</tbody>
</table>

Overview of Equity Finance Continued...

<table>
<thead>
<tr>
<th></th>
<th>Venture Capital Funds</th>
<th>Private Equity Funds</th>
<th>Infrastructure Funds</th>
<th>Pension Funds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of Investment</td>
<td>New Technology</td>
<td>Upcoming and Matured Stage projects</td>
<td>Upcoming and Matured Stage projects</td>
<td>Mature Stage projects</td>
</tr>
</tbody>
</table>

Raising finance through the equity route...

- **GIC Private Limited**, a Singapore-based sovereign wealth fund and Abu Dhabi Investment Authority (AIDA), have acquired an undisclosed stake in Greenko Energy Holdings, an India-based renewable energy company, for a consideration of USD 447.4 mn.
- **CPPIB** acquired equity stake in ReNew Power, the India-based producer of renewable energy for a consideration of USD 247 mn.
- **Warburg Pincus LLC**, the US-based private equity and venture capital firm, has acquired a significant minority stake in CleanMax, the India-based rooftop solar developer, for a consideration of USD 100 mn.
Guarantees

Investors and lenders are naturally averse to risks that give rise to negative fluctuations in project cash flows. To attract investors, the RE projects should be strategized in such a way, that it minimizes the probability of an occurrence that gives rise to negative financial impact on the projects. Financial risk instruments such as guarantees transfer specific risks away from project sponsors and lenders to insurers and other parties.

**Government Guarantee:**
By issuing guarantees, governments are in a better position to mitigate project risks that help enable financing.

The most popular form is an assurance to enter a contract through the state utility to purchase electricity from the project.

**Political Risk Guarantee:**
It provides a broad coverage of risks, which occur by political events such as war, terrorism and civil disturbance, which may include losses from revolution, insurrection, sabotage and terrorism.

**YAP Renewable Energy Project:**
The State of Yap, in the States of Micronesia, developed a 3.6 MW solar-wind- diesel hybrid project to reduce dependency on imported diesel financed by the ADB. To reduce the risk of late- or non-payment of loan obligations by the borrower the Federated States of Micronesia provided a sovereign loan guarantee. Commercial risk associated with securing leases for the solar installations was reduced by a long-term leasehold rights to install, maintain and operate the systems on government-owned rooftops.

**Wind-power in NICARAGUA:**
Nicaragua’s electrification rate is among the lowest in Central America. MIGA’s $16.3 million in form of political risk guarantees to Eolo de Nicaragua S.A., for a 44 MW wind farm in Rivas province, helped the country rectify its power-sector issues. The Agency’s guarantees covered an equity investment by Globoleq Mesoamérica Energy Limited, Bermuda.
Guarantees Continued..

Currency Risk Guarantee:
Currency risk arises in situations in which the project has revenue in one-currency and loan payments in another.

For renewable energy projects, a mismatch between the financing currency (hard) and the revenue currency (local) is often a problem for debt repayment. Due to these concerns, some transnational project developers would only sign a contract in hard currency to insulate themselves from currency risk.

Although it can remove currency risk, it also opens up exposure to non-payment risk if the off-taker cannot pay the PPA price in hard currency. Some governments take some of the currency risk by offering USD tariffs payable in local currency. Instruments such as currency swaps can also be used for this purpose.

India’s Solar Support Fund:
The Indian government has been experimenting with the concept and has plans to launch such a fund to support solar development. Under this scheme, distribution companies will quote their price for solar energy in hard currency (USD) with a lock in period of 25-year and charging customers in Indian Rupees (INR). MNRE created a hedging fund of USD 1 billion by charging developers a hedging fee of INR 0.90/kWh (about USD 0.015/kWh). The fees would be transferred to an escrow account to cover against local currency depreciation. It will help developers access international capital and reduce high hedging costs.
Green Bonds

Green bonds are the fixed income financial instruments that are used to promote and implement environment solutions. In this instrument, the issuer of green bonds gets a capital to finance green projects while the investors receive fixed income in form of interest. When the bond matures, the principal is repaid. In a way, green bonds are a subset of corporate bonds, where the use of proceeds are allocated to environment related activities.

The European Investment Bank issued the first green bond in 2007 and raised Euro 600 million under the label Climate Awareness Bond. These bonds constitute a small fraction of the global debt market. Hence, green bond has a huge potential to grow in the debt market around the globe.

**Green Bonds in India a $7 billion market:**

Green bonds in India have grown from virtual non-existence in early 2015 to a US $7 billion market, with participation from public and private sector corporations such as ReNew, Greenko and Azure who are opting to raise finance, especially for renewable energy projects through this mechanism. The investors include pension and insurance funds.

Infrastructure Investment Trusts (InVITs)

InVITs are instruments that work like mutual funds. InVITs are designed to pool small sums of money from a number of investors to invest in assets. Part of the cash flow generated by the project would be distributed as dividend back to investors. There are 4 important parties—sponsors, investment managers, project managers and the trustee. InVITs are formed by complying with regulatory authority.

The infrastructure company interested in getting funds from the public will form this trust, and then appoint an investment manager who will be responsible for how the assets and investments of the InVIT are managed. There is also a project manager, who actually executes the projects. The investment manager oversees it. Since the instrument is essentially a trust, the company will also appoint a trustee, who has to ensure that the functions of the InVIT, investment manager and project manager comply with regulatory rules.

**InVITs in India**

According to SEBI, India there are certain rules that the InVIT issuers have to follow to safeguard the investor. First, the sponsor should hold a minimum 15 % of the InVIT units with a lock-in period of three years. Second, InVITs have to distribute 90 % of their net cash flows to investors. The trust is required to invest a minimum of 80 % in revenue generating infra assets. Only the rest can be used for under-construction assets. Dividends from the trust will be distributed to the investor depending on its cash flow and there is no dividend distribution tax on InVIT units. InVITs are suitable for high net worth individuals, institutional and non-institutional investors like pension funds, foreign portfolio investors, mutual funds, banks and insurance firms.
Carbon Financing

Clean Development Mechanism (CDM) is a mechanism which is intended to contribute to the ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC), which is to prevent dangerous climate change. The basic principle of the CDM is simple; it allows developed countries to invest in low cost abatement opportunities in developing countries and receive credit for the resulting emissions reductions (CER). Developed countries can then apply this credit against their carbon emission reduction targets, reducing the cutbacks that would have to be made within their borders. As a result, projects in developing countries will get a new source of financing for sustainable development in the introduction of clean and renewable technologies by selling their emission reduction on the market.

Brazil & Mexico’s Successful Carbon Financing Programs

Brazil is a successful promoter of Clean Development Mechanism (CDM) projects. Brazil’s CDM projects account for 40% of all CDM projects in South America and for 44% of contracted Certified Emission Reduction (CER) credits up to 2012.

In Mexico, a 250.5 MW and USD 600 million EURUS wind park was set up in the midst of the financial crisis. EURUS benefits from the sale of Certified Emission Reduction (CER) credits for offsetting a total of 599,571 tonnes of CO₂ annually.

Asset Backed Securities (ABS)

Asset backed securities are bonds or similar instruments, which are backed by the cash flow generated by RE projects. Asset-backed securities are used for refinancing projects that are generating positive cash flows, although they can also be issued in the form of project bonds ahead of construction. Such refinancing offers a potential way to free up public funds that have been committed for development and investment, thereby allowing these funds to be refinanced to support new projects. ABS requires financial markets able to analyze and value the risks associated with such securities and, to price them. The experience with mortgage-backed securities in the recent financial crisis shows how even the most sophisticated markets can get this wrong. According to Kroll Bond Rating Agency Transaction report, the total ABS market value increased in 2017 to USD 1.3 billion from USD 321 million in 2016.

<table>
<thead>
<tr>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>These are generally long term and lower cost loan</td>
<td>Sophisticated markets required to be able to analyze and price the risk associated with this type of security.</td>
</tr>
<tr>
<td>Allows the developer to further invest into the area/project</td>
<td></td>
</tr>
<tr>
<td>Potential to bundle projects together in a single security can reduce risks and substantially reduce financing costs</td>
<td></td>
</tr>
</tbody>
</table>

Few Players in Renewable Energy Securitization Market

<table>
<thead>
<tr>
<th>Mosaic - USA</th>
<th>Sunnova Solar Energy - USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dividend Solar Finance</td>
<td>AES Distributed Energy - USA</td>
</tr>
</tbody>
</table>
Micro Financing

Microfinance is a type of banking service that is provides microloans in the range from $100 to $25,000 to unemployed or low-income individuals or groups who otherwise would have no other access to financial services.

Like conventional lenders, microfinanciers charge interest on loans, and can also require loan recipients to set aside a part of their income in a savings account, which can be used as insurance if the customer defaults. Because many applicants cannot offer collateral, microlenders often pool borrowers together as a buffer. After receiving loans, recipients repay their debts together.

The first microfinance organization to receive attention was the Grameen Bank, which was started in 1976 by Muhammad Yunus in Bangladesh. India's SKS Microfinance (Bharat Financial Inclusion Limited) also serves a large number of clients. Formed in 1998, it has grown to become one of the biggest microfinance operations in the world.

Bangladesh's Solar Home System (SHS) Initiative

The SHS initiative which began in January 2003 is an example of micro finance in the renewable energy space. The government-owned Infrastructure Development Company Limited (IDCOL) facilitated it. Its aim is to fulfill the basic electricity requirement of the off-grid rural people of Bangladesh. Initial funding from the World Bank was extended several times over the years via Rural Electrification and Renewable Energy Development Project. As on May 2017, 4 million solar home systems had been installed and directly impacting more than 12% of population.

Small-Scale Project (SREP) Financing

Small-scale renewable energy projects (SREP) play a crucial role in increasing deployment of renewables in developing countries. Small projects are well suited to conditions in emerging markets as they allow developers and banks to gain experience at limited risk profile and small scale projects. However, financing options in these markets are not well-aligned with the needs of small-scale projects.

Given the high costs of project finance transactions, small projects are typically financed with corporate loans, which are not designed to finance RE investments. Risks include high interest rates, short tenors that doesn’t comply to the long-term nature of RE. These prevent viable projects from being pursued and hinder the long-term development of the renewables sector.

THE LAB by Climate Policy Initiative:

CPI is an independent, non-profit organization, which is considered a leader expert group in global climate finance. It has started an initiative called ‘THE LAB’ which contributes to the transformational development of local institutions to enable a wider scale-up of renewable energy finance. It has pitched the idea of SREP which is essentially an instrument that aims to increase investment in small-scale renewables from 1-20MW that typically do not have access to project finance. It will do so by increasing access to long-term debt and construction finance through a “Discounting Facility” which will allow operational renewable energy projects to refinance into long-term debt and increase its financial leverage by “discounting” its future cash flows from a power purchase agreement. A review of projects with potential for refinancing found more than 100 projects totaling 840MW in Nepal and Indonesia. A regional pilot with USD 10 million in donor funds and USD 90 million from development finance institutions and/or commercial investors could mobilize USD 90 million in equity and up to USD 260 million in total investment for new small-scale renewable energy projects.
Thank you
Economics and Finance of Rooftop (distributed) and other PV

SAARC Energy Center Webinar
April 9, 2019

Rahul Tongia, Ph.D.
Fellow, Brookings India
Adj. Professor, Carnegie Mellon University
Tech. Advisor, Smart Grid Task Force, Govt. of India
Founding Advisor, India Smart Grid Forum (ISGF)

With special thanks to ISGF for some material

3 Types of Solar PV

<table>
<thead>
<tr>
<th>Type</th>
<th>Benchmark cost or reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Standalone</td>
<td>1. (If not darkness)</td>
</tr>
<tr>
<td>a. Flashlight/lantern</td>
<td>a. Candle/kerosene</td>
</tr>
<tr>
<td>b. Solar Home System</td>
<td>b. [a] plus niches (diesel)</td>
</tr>
<tr>
<td>2. Grid Interactive distributed (aka “rooftop”)</td>
<td>2. Consumer tariffs (prices)??</td>
</tr>
<tr>
<td>FINPRINT: MINIGRIDS?</td>
<td>3. Lowest alternative supply source</td>
</tr>
<tr>
<td>3. Solar Farm</td>
<td></td>
</tr>
</tbody>
</table>
**Nuances of Economics and Finance**

- Standalone systems
  - Willingness to pay is highly variable, including by volume
  - First few units people can per a lot (per unit)
  - Total monthly cost is key

- Rooftop systems
  - Are they expected to consume all or do they send back into the grid? Does “when” matter?
  - Is this a comparison of consumer RETAIL tariffs versus generation costs? Is that apples to apples?

- Grid Scale
  - Most calculations only examine Levelized Cost of Energy (LCOE)
  - What about system-level costs? Time of Day?

---

**India’s Example of Solar Plans and Ambitions**

- 100 GW of solar by 2022
  - 40 GW Rooftop aka behind the meter
  - 60 GW Grid-scale

(add in other and it’s 175 GW by 2022, = ~25% CAGR!)

- Where is “rooftop”?
  - Estimated 3.3 GW as of December 2018
Why is rooftop “behind schedule”?

- Grid-scale can be pushed top-down
  - Bids, RPOs, etc.
  - Rs. 2.44/kWh used to be a benchmark (we’ll come back to this)
- Rooftop needs consumer buy-in
  - Aside – Germany and California solar is mostly rooftop or edge-based
  - Consumer value depends on THEIR prices
    - BUT that is retail prices
    - May have distortions

Rooftop Challenges

- Fragmented market
- Quality concerns
- Lower PLF/CUF
  - Cleaning is a major issue, as is urban pollution
- Other risks
  - Vagaries of what neighbors do (shading)
  - Municipal limitations on design (e.g., stilts)
    - Consumers lose an “empty roof”
MiniGrid Economics Issues

• Will the “real” grid come and disrupt?
• In some countries, it’s a household aka last mile challenge
• Most costs are fixed costs
  • Sizing it right is tough
• “Cheap solar” doesn’t cut it
  • Backup (battery) and fixed infra (wiring/metering) costs dominate
• For low monthly usage, per kWh costs WILL be high
  • Same is true for the regular grid

What’s holding it back?

• Fundamental Economics?
• Fundamental technicals – roofspace?
• Policies and frameworks?
  • Technical
  • Pricing
• Human capacity?
• Finance?
• Awareness and behaviour?
• Maybe it’s a bit of all of the above – the ecosystem
History of Net Metering

- One of the first legislations was the Public Utility Regulatory Policy Act (PURPA) 1978 in USA
  - Made utilities buy back power at their avoided cost
- State to state variations are policies exist in USA (like India) on how to handle net metering (size requirements, prices, etc.)

Net metering is a loose term: There are many types of “Net Metering”

- Differences include
  - Is this for gross or net feed-in?
    - The more a consumer uses in-house, the less they can feed-in
  - At what tariff (rate) are they paid?

- What these mean, technologically?
  - What type(s) of meters are installed?
  - Where do you install the meter(s)?
  - What flows does it measure, and at what rate?
Simplest world: Meter spins backwards

- Means consumer gets paid only equal to their *marginal* tariff
  - Varies a lot by consumer type and size/scale
    - A small home would be paid far less than a large/commercial consumer

- Are they consuming any power in-house?
  - The more one uses in-house, the better (from a losses perspective)

- Does this make sense?
  - Consumer: Is this enough?
  - Utility: Can I afford to pay so?
    - Usually the largest/richest consumers are the ones to go in for such schemes

Will they have a battery?

- If there is no battery, all the power must be used up immediately
  - IF grid connected, can handle all loads, but then GRID MUST BE ON
  - IF not grid-connected, then is there enough load in the house (esp. in the middle of the day)?

- All consumers who pay for such systems would want back-up power
  - This implies a battery
  - BUT, most grid-tie inverters (today) cannot feed a home during power outages (safety design)
    - Other risk – can a consumer game the system via a battery?
      - If GBI > tariff plus battery losses, then what is to stop them from charging it via the grid?

- Battery raises costs by 70-90%, perhaps more (efficiency losses plus investment)
Fundamental Qs for Net Metering

1. Where do you put in meters?
   a. Cannot be answered independently of payment schemes?
      i. What happens when you want to change your mind?

2. How is a meter capable of Net-metering technologically different?
   a. Import and Export registers
   b. Tampers encoding

3. What is the legal status of 3rd party ownership

4. How are readings taken?
   a. Digital downloads vs. AMR vs. AMI

Where do you meter?

• This fundamentally links to the payment schemes (gross vs. net)
• Gross generation
  • Right after the inverter
  • BUT, what about a battery?
Where do these go?

One proposed metering schema (ISGF, courtesy S. Govindarajan)

Gross feed-in metering (proposed)
- Gross Generation meter for GBI / feed-in compensation as per feed-in tariff
- Gross Consumption meter

Net-metering (proposed after grid-parity has been reached)
- Gross Generation meter for GBI and production monitoring
- Bidirectional import export meter for net metering

Source: ISGF
Policies in India

- There is no single policy
- States and even utilities have offered different mechanisms
  - Capital subsidies
  - Operating support
    - GBI (Generation Based Incentive)
    - Feed-in-Tariff
  - Etc.
- Other mechanisms
  - SPOs (overall or by consumer type)
    - 6% SPO by generation means FAR more by capacity
  - Mandatory rooftop solar PV (Haryana), and now Chandigarh
  - Mandatory solar thermal in Bangalore
    - Avoids est. 400+ MW of morning load
- CEA has notified some technical specifications for <33 kV interconnections to the grid
- There are often other restrictions, e.g., Mumbai and construction

Utility Death Spiral...driven by Solar

For India, it's not renewables but theft and tiered slabs (tariffs) that can have similar impacts

Source: The Appalachian Voice
Where is the conversation in India?

- Limited or no talk about Smart Inverters (IEEE 1547)
- The economics are a main issue AT A SYSTEMS LEVEL
  - Most consumers use the grid as a battery
  - Should we allow ‘free banking?’
- What about actual PLFs?
  - Cleaning matters
- Where are RESCos/YieldCos?
  - At most they talk to C&I

Also see Rooftop Solar Policy Coalition’s Report (2015-16)

- We have lots to grow, but are NOT on track for the 40 GW target
- Complexity, human capacity, and incentive (conflicts) are the main challenge
  - Even if someone WANTS it, what are the practical, on-ground challenges
What does this all mean?

- Think from a consumer perspective
  - Is this worth it?
  - What’s my net cost vs. benefits?
    - Depends on the scheme
    - Depends where I am (my SLAB in tariffs) [if net]
  - “Why not wait?” – prices are falling
  - What else can I do with my capital/roof/land/etc.?

- Think from a utility perspective
  - Is this worth it?

Basic calculations (estimates)

- Just talked to a large household user who paid (2017) for:
  - 6 kW system (no battery – that would raise costs)
  - 2.83 lakh cost AFTER 30% subsidy (else 4.10 lakh)
  - Net cost?
    - Depends on discount rate
    - Assuming a low discount rate (low risk) then power is about Rs. 4.5/kWh only
      - Marginal tariff is over 7....
  - 2018 numbers are about 25% lower maximum
  - It is viable?
    - For some consumers
    - Assuming it works on time and continuously
    - Benefit from free banking within the month

- WHY do we have subsidies for the rich?
Challenges

- Bi-directional meters are needed
- Techno-economic challenges
  - Investments are relatively high, viewed as risky
  - Grid scale (large) is itself expensive
    - What is parity?
  - Tariff slabs impact different folks differently
  - Marginal costs and value
    - Time of Day and other pricing??
  - Germany as an example and warning – is very expensive
- Unstable grid
  - Most grid-tie systems disconnect on grid failure
- Inverter technology improvements – IT’S NOT JUST THE METER THAT MATTERS!
  - Hawaii demo’ed Smart Inverters
    - Can provide reactive power
    - Can manage variations in the local grid
  - Proposed updates to IEEE 1547

Implications for Business Models

- The economics are not YET ripe – esp. as a win-win-win (utilities, consumers, and society)
  - Else we wouldn’t need support mechanisms
- What else can we appeal to or rely on?
  - Social responsibility
  - CSR
  - Vanity
- Business models
  - Lessons from wind
    - SIMPLIFICATION
      - Investor just gives money
  - Here, they would also offer rooftop space
Implications for Business Models

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    - Here, they would also offer rooftop space

New Finance Options...

- Mortgage loan funding – slightly cheaper than market
- Per unit payout models
  - Consumer bears little risk
- YieldCos (?) – Subset of patient capital
  (like a rental instead of flipping)
  - Most worried about risk – what if they invest but don’t get paid?
    - Disputes over baseline can be avoided via gross metering
    - What happens if they cannot clean?
      - Leaving to the consumers to clean has dual problems
        - No incentive to clean
        - Poor quality (damaging) cleaning
      - Consumer risk profiles (credit ratings) are sketchy at best
- New idea being discussed: Can the utility become involved?
Some Recommendations

- Psychology – people must want it
- New builds – enable the infrastructure
- If “net”, offer the highest possible slab else will lose consumer interest
- Change the metering as/when grid parity is reached??
  - *Start with a feed-in tariff mechanism and transition to net-metering when solar energy costs reach grid parity (?) [ISGF recommendation]*
  - *OR, just leave it as gross metering??*
- Non-financial instruments for support
  - Enhanced FSA/FAR build-ups

Future of Rooftop solar and net metering

- Future policy discussions cannot ignore storage technologies, Electric Vehicles, etc.
- Time of Day tariffs will also become critical
- Will this be a niche technology or widespread?
  - If we truly want it to scale, it should NOT depend on support (else, will be a burden on the utilities, or perhaps exchequer)
- Good news is technology is improving, esp. for batteries but also panels and inverters
  - This then becomes a useful tool in the portfolio of solutions for energy security and sustainability
Grid Scale PV Finance

- “Green Finance” means what?
  - Designated?
  - Lower costs of capital

- What are the risks for solar?
  - NOT fuel risks (ala coal)
  - Biggest is counter-party risk (utilities)
    - Poor cash flows
    - Delayed payments (contracts don’t help as no one calls in failure i.e., dispute/arbitration)
    - Attempts to re-negotiate PPAs
      - New solar is usually cheaper than old solar
    - Cancelling bids
      - Some price rise wasn’t markets only – change in govt. policy (such as GST, import tariffs of 25%, etc.)

Ultimate Aim – Cheap Global Capital

- The pension and sovereign funds are willing to take a VERY low rate of return
  - BUT that is in USD or Euros – today’s forex hedge is about 6% cost

- What such investors want is not returns but risk-adjusted returns
  - Their priorities are:
    - Governance
    - Predictability
    - Returns (in that order)