Integrating Renewables into the Distribution Network

MERALCO Experience

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MERALCO
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I. Meralco in perspective
III. Integrating Renewables into the Distribution network
   - Meralco Experience
   - Challenges
IV. Way Forward
Manila Electric Company (MERALCO)

Largest electric distribution utility in the Philippines
On its 112th year in service since 1903

5.6 million customers served

9,337km² area covered

supplying > 50% of Philippine energy sales
Meralco serves a strategic market

- Powers more than **5 million customers** in 34 cities and 77 municipalities
- The country’s center of commerce & industry
  - About **50% of the country’s GDP**
  - An estimated **60% of manufacturing output**
  - More than 30 manufacturing economic zones
Market has been steadily growing
Energy Sales (2010-2014)

- Annual energy sales (in GWh)
  - 2010: 30,247 GWh
  - 2011: 30,592 GWh
  - 2012: 32,771 GWh
  - 2013: 34,084 GWh
  - 2014: 35,160 GWh

Breakdown by customer segment:
- Residential: 10,850 GWh (31%)
- Commercial: 13,814 GWh (39%)
- Industrial: 10,364 GWh (30%)
Peak Demand (2010-2014)

Industrial and flat streetlights customers account for less than 1% of total customer count.
Policy and Regulatory Environment
**Republic Act 9513**: An Act Promoting the Development, Utilization and Commercialization of Renewable Energy Resources

**Policy Declaration**: 
- Accelerate the exploration and development of RE resources
- Institutionalize commercial application through fiscal & non-fiscal incentives
- Sustainable energy development
Since the enactment of the RE Law, 2 policy mechanisms have been implemented so far, Net Metering (2013) and FIT schemes (2015).
**Net-Metering** “a system, appropriate for distributed generation, in which a distribution grid user has a two-way connection to the grid and is only charged for his net electricity consumption and is credited for any overall contribution to the electricity grid”.

**FIT** is a scheme that involves the obligation on the part of the electric power industry participants to source electricity from RE generation at a guaranteed fixed price applicable for a given period of time.

**RPS** “a market-based policy that requires electricity suppliers to source an agreed portion of their energy supply from eligible RE resources”.

**Green Energy Option** “the mechanism to empower the end-users to choose renewable energy in meeting their energy requirements”.

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**RE Policy Mechanisms**
Salient Features of the Net Metering Rules
(ERC Res. No. 09, Series of 2013)

<table>
<thead>
<tr>
<th>9 July 2013</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 July 2013</td>
<td>On the effectivity date, Meralco started formally receiving applications for Net Metering</td>
</tr>
</tbody>
</table>

## Salient Features of the Rules

<table>
<thead>
<tr>
<th>Scope</th>
<th>Applicable to <strong>ALL end-users</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligible RE Tech</td>
<td><strong>wind, solar, biomass</strong> or biogas energy systems w/ a maximum capacity of 100 kW</td>
</tr>
<tr>
<td>Interconnection Set-up</td>
<td>2 uni-directional meters, one for export and one for import, or a single bi-directional meter, at the DU’s option</td>
</tr>
<tr>
<td>Pricing Methodology</td>
<td>• Initially, the price of the <strong>exported energy at DU’s blended generation cost</strong></td>
</tr>
<tr>
<td>DU Cost Recovery</td>
<td>Cost of RE purchased by the DU under the net metering agreements shall automatically be included in the DU’s total generation cost</td>
</tr>
</tbody>
</table>
| Net Metering Charge | Additional charges to Net Metering Customers:  
  • ERC-approved Php/customer/month metering charge  
  • ERC-approved Php/customer/month supply charge  
  • ERC-approved Php/kWh metering rate on the export energy |
Net Metering Framework

Inter-connection Set-up

- Option for 2 uni-directional meter or a single bi-directional meter
- Registration for 2 meter readings (export and import energies)
- RE generation intended primarily to offset load requirements, excess generation compensated at average generation cost

![Diagram of inter-connection set-up]

- DU meter for IMPORT energy
- DU meter for EXPORT energy
- DU
- RE Source
- END-USER LOAD
- I
- E
How Net Metering works

Customer Imports Energy from the Distribution Network
- E.g., Night time with no Energy generated by the Solar PV
- Household Energy demand is supplied by the Distribution Network

Customer Exports Energy to the Distribution Network
- Daytime with Energy generated by the Solar PV
- Household uses up a portion of the Energy generated by Solar PV for basic load
- Energy generated in excess of the Household load is exported to the Distribution Network

Energy Imported

Energy Exported

Net Billed Amount
**What is FIT?**

FIT is a guaranteed payment in Peso/kWh for electricity generated from emerging renewable energy technologies for the duration specified in the FIT Rules.

<table>
<thead>
<tr>
<th>RE Technology</th>
<th>FIT Rates (Php/kWh)</th>
<th>Installation Targets (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROR- Hydro</td>
<td>5.90</td>
<td>250</td>
</tr>
<tr>
<td>Biomass</td>
<td>6.63</td>
<td>250</td>
</tr>
<tr>
<td>Wind</td>
<td>8.53</td>
<td>200</td>
</tr>
<tr>
<td>Wind 2</td>
<td><strong>7.93</strong>*</td>
<td><strong>200</strong></td>
</tr>
<tr>
<td>Solar</td>
<td>9.68</td>
<td>50</td>
</tr>
<tr>
<td>Solar 2</td>
<td><strong>8.69</strong></td>
<td><strong>450</strong></td>
</tr>
<tr>
<td>OTEC*</td>
<td>Deferred</td>
<td>10</td>
</tr>
</tbody>
</table>

*applied
FIT implementation Timeline

- **2010**
  - FIT Rules
  - Promulgated by the ERC in July 2010

- **2012**
  - FIT Rates
  - Approved by the ERC in July 2012

- **2014**
  - FIT-All Guidelines
  - Promulgated by the ERC on 3 February 2014
  - On 10 October 2014, the ERC provisionally-approved the FIT-All rate of Php0.0406/kWh in January 2015 bill to customers.

- **2015**
  - FIT-All Rate
  - Collecting agents, such as distribution utilities, started implementing the approved rate of Php0.0406/kWh in January 2015 bill to customers.
What is FIT-ALL?

- a uniform charge in peso per kWh (Php/kWh) which will be billed to all customers in support of the Feed-in-Tariff Program.

- will form part of the fund which will be used to pay the FIT-eligible RE developers for the energy they will produce.

FIT-All is “akin to the Universal Charge”, but DU will be collecting only from its CAPTIVE customers.

- Provisionally-approved rate is Php0.0406/kWh, effective in the January 2015 billing of the customers.
From Policy to Deployment: Meralco Experience
Mandate for the Distribution Utility (DU)

- Making systems (technical and commercial) available to accommodate distributed generation using RE system, subject to technical considerations

- Priority connections to the grid for electricity generation from emerging renewable energy resources such as wind, solar ...

(Renewable Energy Act, Sections 7 and 10)

- Responsible Generation: Integrating diversified new and inexhaustible electricity generation sources balanced against tariff affordability (least cost power supply procurement)

- Reliable Distribution: Distributors having access to embedded and distributed supply but ensuring a stable and robust grid infrastructure
Meralco’s Preparations

Update of Internal Processes and Guidelines

Internal Capability Building

Net Metering Pilot Project
- 6.16 kWp solar PV rooftop inside the Meralco compound
- Commissioned on June 5, 2013

Meralco connected the first Net Metering customer in the country (residential rooftop solar at 5.4 kWp)
Key Learnings from the Solar NM Pilot Project

- Test bed for Meralco in a controlled environment
- Proof of Concept: 1st Net Metering Installation in the country

Learnings:

- **Grid-tied technology.** Solar PV system operates in parallel with the DU system thus must conform to the Interconnection standards with or without exporting capacity while connected to the DU’s Distribution System. *(Annex A-1 Interconnection Standards, 3.15)*

- **Grid form compatibility.** Inverters must be configured in accordance with the DU system parameters.

- **Distribution Impact Study** is a critical step to assess the technical feasibility of each interconnection at the existing distribution feeder.

- **Commissioning Test.** Customer- based generation is both a load user and generation source & may feed into the grid. The test is conducted when the equipment is installed to verify correct operation. *(Annex A-1 Interconnection Standards, 3.1)*
MERALCO Preparations: Development of Processes for Interconnection

**Application Process**

1. RECEIPT of APPLICATION
2. TECHNICAL EVALUATION
3. DESIGN of INTERCONNECTION FACILITIES*
4. PROJECT AGREEMENT*
5. APPROVAL of FACILITIES
6. EXECUTION of PROJECT*
7. TESTING & COMMISSIONING

**Technical Evaluation**

- Conduct of a **Distribution Impact study** (DIS) with the following Scope of Work:
  - Circuit Modelling
  - Load Flow and Short Circuit Analysis
  - Voltage Study
  - Verification of Penetration Limit
  - Load Profiling

- Testing and Commissioning before energization
Net Metering customers (count & capacity) (as of October 2015)

1 As of October 2015
Source: Regulatory Compliance, Network Asset Planning

Customer count
Installed kWp\textsuperscript{1} capacity
Total kWp capacity
Average kWp capacity

<table>
<thead>
<tr>
<th></th>
<th>Residential</th>
<th>Commercial &amp; Industrial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer count</td>
<td>184</td>
<td>23</td>
</tr>
<tr>
<td>Installed kWp\textsuperscript{1} capacity</td>
<td>989</td>
<td>663</td>
</tr>
<tr>
<td>Total kWp capacity</td>
<td>1652</td>
<td></td>
</tr>
<tr>
<td>Average kWp capacity</td>
<td>5</td>
<td>28</td>
</tr>
</tbody>
</table>

\textsuperscript{1} As of October 2015
DISTRIBUTED GENERATION IN MERALCO
(Categories and scale)

Utility Scale Generators *
(120 MW)

- Interconnected RE generators with most of them not directly selling power to Meralco
  - Power Supply Contract
  - Feed-in Tariff (FIT) qualified
  - Distribution Wheeling customer

End-Use Installations

<table>
<thead>
<tr>
<th>Below 100 kWp</th>
<th>Net Metering customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Above 100 kWp</td>
<td>RE Generators for Self-consumption</td>
</tr>
</tbody>
</table>

* Source: Network Asset Planning: List of Installed Renewable Energy Generators connected at the Distribution and Sub-transmission voltage level.
Way Forward
Challenges to the Distribution Utility (1/2)

Integration Issues for Distributed Generation (DG)

1. Technical aspect of integration to ensure Grid stability
   - Impact Assessment Studies (assessment of power flow at both direction allowing for generation sources at low voltage lines)
   - Defining technical process for interconnection
   - Establishing Hosting capacity/Penetration limit at the Feeder level
   - Infrastructure Upgrades with increased penetration of DG

2. Commercial Process to accommodate end-use generation
   - Establishment of application process for different customer segments (Net Metering scale and above the 100 kW capacity)
   - Internal capacity building (i.e. metering & billing, testing & commissioning of small grid-tied generation facilities)
   - Customer information, education and communication
Challenges to the Distribution Utility (2/2)

3. Distribution Utility Revenue Integrity
   - **Incremental cost** for interconnecting end-use generation (capex requirements for system upgrades)
   - **Declining sales volume** & corresponding revenue drop (i.e. for customer segments with pure volumetric rates)
   - **Tariff redesign** (e.g. define new customer segment) avoiding the “death spiral”

4. Operational Implications at high levels of DG penetration
   - Dispatch Protocol **addressing Intermittent Generation** (solar & wind)
   - **Sourcing strategy** to address increased penetration of Variable Renewable Energy (VRE)
Challenges to the Industry

- **Capacity Building**
  - Customer education on right sizing and proper selection of system components
  - Local government capacity building in the permitting process

- **Accreditation of Installers**
  - Generation facility configured to match DU system operating parameters (aligned with Interconnection Standards)

- **Certification of Equipment/Components**
  - Protection of customers and the DU from substandard system components

- **Regulatory Reforms**
  - Recognition of lost sales volume to the DU
  - Tariff reforms to cover for incremental cost of providing the service and recovery of fixed cost of serving the peak requirements of customers with RE facilities
Way Forward

- **Main Drivers for the increased adoption**
  - **Declining system price** for solar PV system & other RE technologies
  - Rapid penetration of solar PV, initially a *niche market* in upscale residential rooftop spaces but seen to be expanding to a wider customer base (mid-income households and commercial & industrial segments)
  - **Changing demands and preferences of customers** towards managing their power supply (alternative power source)
  - **Green initiative** towards clean and sustainable energy
Way Forward: Transformation of the Distribution Utility

- Assess adoption rate to more accurately project impact on sales and define the residual system load curve.

- Impact Assessment Studies to plan for infrastructure upgrades and address other grid integration issues.

- Adopt Smart Grid tools to address operational challenges of Variable Renewable Energy (VRE).

- Gain regulatory recognition of additional CAPEX/OPEX needed to accommodate distributed energy resource:
  - Analyze Electricity Tariff Effect not only on the sales impact (denominator) but also on the expenditure on the power grid investment (numerator).
  - Advocate Tariff reforms towards inter-customer equity.

Network Upgrade

Customer value

Grid Stability/Equitable Tariff

Tariff Review
Our Vision

A Distribution Utility capable of meeting the demands of the evolving industry.

- Smooth integration of RE facilitated with a **robust and intelligent network**
- Increased customer satisfaction and empowerment
- Correct pricing signals through rate redesign
- Thought leadership in the RE industry
“It is not the strongest of the species that survives nor the most intelligent that survives. It is the one that is most adaptable to change.”

Charles Darwin