The need for RE and new energy technologies for small scale-grids in South East Asia

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ASEAN – Community of Opportunities
50 years Journey of ASEAN

Population (in million)
- 185 (1967)
- 634 (2016)

GDP per capita (in US$)
- 122 (1967)
- 4,021 (2016)

Trade (in US$ billion)
- 10 (1967)
- 2,219 (2016)

Trade service quadrupled between 1999 and 2016 to reach US$681 billion

ASEAN population was 8.5% of the world population in 2016

In 2016, attracted US$ 96 billion FDI

Poverty has decline from, 47% in 1990 to 14% in 2015,

Electricity Consumption
- 1,287 kWh/cap

One Community for Sustainable Energy
ASEAN Electrification Ratio by 2015

- Indonesia: 91%
- Philippines: 88%
- Vietnam: 98%
- Cambodia: 65%
- Laos: 92.05%
- Thailand: 99%
- Malaysia: 98%
- Singapore: 100%
- Brunei Darussalam: 100%

Electrification ratio ASEAN: 78%

Not Including Off-grid
Off-grid demand

107 million people live without electricity
- Huge part of it lives in remote area

ASEAN covers wide area & islands
- 13,000 inhabited island
- Indonesia & Philippine owns big islanded communities

Off-grid generation is still dominated by diesel-based plant

Data source: ASEAN Secretariat Data base 2016
ASEAN Off-grid Electrification Status

Capacity of decentralized diesel-generator in Indonesia

953 MW
969 MW
567 MW
198 MW
266 MW
120 MW

Capacity of diesel generators

Data source: GIZ, 2014
ASEAN Off-grid Electrification Status

Annual Energy Sales in Off-grid Areas in the Philippines by 2014

- Diesel-based generation: 89.5%
- RE-based generation: 10.5%

Data source: NPC-SPUG 2017
Off-grid Electricity Supply Status: The case of Philippines

True cost of Diesel generation by NPC-SPUG vs Effective Selling rate in 2012

<table>
<thead>
<tr>
<th>NPC SPUG Area</th>
<th>Municipality</th>
<th>True Cost of Diesel (pesos per kWh)</th>
<th>Effective Selling Rate (pesos per kWh)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romblon</td>
<td>Alad</td>
<td>28.03</td>
<td>6.59</td>
<td>21.44</td>
</tr>
<tr>
<td>Catanduanes</td>
<td>Palumbanes</td>
<td>21.56</td>
<td>6.59</td>
<td>14.97</td>
</tr>
<tr>
<td>Mindoro</td>
<td>Cabra</td>
<td>19.8</td>
<td>5.75</td>
<td>14.05</td>
</tr>
<tr>
<td>Leyte</td>
<td>Caluya</td>
<td>18.89</td>
<td>6.84</td>
<td>12.05</td>
</tr>
<tr>
<td>Tawi-Tawi</td>
<td>Manuk Mankaw</td>
<td>17.6</td>
<td>6.27</td>
<td>11.33</td>
</tr>
<tr>
<td>Kalinga</td>
<td>Lbuangan</td>
<td>16.52</td>
<td>5.76</td>
<td>10.76</td>
</tr>
<tr>
<td>Davao Del Norte</td>
<td>Talicud</td>
<td>16.87</td>
<td>6.27</td>
<td>10.6</td>
</tr>
<tr>
<td>Siiquior</td>
<td>Siiquior</td>
<td>15.49</td>
<td>6.07</td>
<td>9.42</td>
</tr>
<tr>
<td>Cebu</td>
<td>Camotes</td>
<td>15.35</td>
<td>6.07</td>
<td>9.28</td>
</tr>
<tr>
<td>Palawan</td>
<td>El Nido</td>
<td>14.93</td>
<td>6.59</td>
<td>8.34</td>
</tr>
<tr>
<td>Batanes</td>
<td>Basco</td>
<td>14.04</td>
<td>6.59</td>
<td>7.45</td>
</tr>
<tr>
<td>Quezon</td>
<td>Pailio</td>
<td>13.92</td>
<td>6.59</td>
<td>7.33</td>
</tr>
<tr>
<td>Basilan</td>
<td>Basilan</td>
<td>13.7</td>
<td>6.58</td>
<td>7.12</td>
</tr>
</tbody>
</table>

- Diesel generation has volatile fuel cost and high transportation cost
- Causing curtailment of service hours (4-12 hours supply only)
- In some remote area, fuel can exceed USD 1.2 per liter, 1.5x than Philippines average
- **10.32 billion** PHP is estimated to cover projected fuel and transportation cost in 2017 to meet off-grid demand
- **Huge subsidies** disbursed for covering fuel and transport cost

Source: GIZ, SPUG-NPC (2012)

Source: Electricity Sector Opportunity in the Philippines – IEEFA, 2017
Off-grid Generation Issues using fossil-fuel based generation

ASEAN’s Energy-related CO2 Emission by fuel & sector

Reserve to Production ratio of ASEAN’s Fossil fuels

Source: ACEAN REmap, the 5th ASEAN Energy Outlook
Off-grid Generation Issues using fossil-fuel based generation

Classification of Mini-grid per hours of Generation in Philippines

<table>
<thead>
<tr>
<th>Service Hours of Mini Grids</th>
<th>Mini Grid Areas (Numbers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-8 hours</td>
<td>149</td>
</tr>
<tr>
<td>10-15 hours</td>
<td>36</td>
</tr>
<tr>
<td>16-20 hours</td>
<td>11</td>
</tr>
<tr>
<td>24 hours</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>221</td>
</tr>
</tbody>
</table>

Source: NPC-SPUC, 2011
Issues for Off-grid Generation

Apply in On-grid generation, but Off-grid?

Common diesel-plant generation in off-grid areas

Not addressed in

Converted to

RE & new technologies

Issues:
- Reliability
- Affordability
- Sustainability
# RE & New Technologies for Off-grid Generation

## Levelized Cost of Energy Generation Technology

<table>
<thead>
<tr>
<th>Technology</th>
<th>Levelized Cost of Energy</th>
<th>Carbon Neutral/Rec Potential</th>
<th>State of Technology</th>
<th>Location</th>
<th>Dispatch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>$46 - 222</td>
<td>✓</td>
<td>Commercial</td>
<td>Distributed</td>
<td>Intermittent</td>
</tr>
<tr>
<td>Solar Thermal</td>
<td>$199 - 182</td>
<td>✓</td>
<td>Commercial</td>
<td></td>
<td>Peaking</td>
</tr>
<tr>
<td>Fuel Cell</td>
<td>$106 - 167</td>
<td>?</td>
<td>Emerging/Commercial</td>
<td></td>
<td>Load-Following</td>
</tr>
<tr>
<td>Micro turbine</td>
<td>$76 - 89</td>
<td>?</td>
<td>Emerging/Commercial</td>
<td></td>
<td>Base-Load</td>
</tr>
<tr>
<td>Geothermal</td>
<td>$79 - 117</td>
<td>✓</td>
<td>Mature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass Direct</td>
<td>$77 - 110</td>
<td>✓</td>
<td>Mature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offshore Wind</td>
<td>$32 - 62</td>
<td>✓</td>
<td>Mature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel Reciprocating Engine</td>
<td>$212 - 281</td>
<td>x</td>
<td>Mature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas Reciprocating Engine</td>
<td>$68 - 101</td>
<td>x</td>
<td>Mature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas Peaking</td>
<td>$165 - 217</td>
<td>x</td>
<td>Mature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGCC</td>
<td>$94 - 210</td>
<td>x</td>
<td>Emerging</td>
<td>Co-located or rural</td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>$97 - 136</td>
<td>✓</td>
<td>Mature/ Emerging</td>
<td></td>
<td>Co-located or rural</td>
</tr>
<tr>
<td>Coal</td>
<td>$60 - 143</td>
<td>✓</td>
<td>Mature</td>
<td></td>
<td>Co-located or rural</td>
</tr>
<tr>
<td>Gas Combined Cycle</td>
<td>$48 - 78</td>
<td>x</td>
<td>Mature</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **No fuel & transport cost**
- **Abundant indigenous resource**
- **Cheaper cost over the lifetime**

Source: Electricity Sector Opportunity in the Philippines – IEEFA, 2017
RE & New Technologies for Off-grid Generation

- Huge RE & New technology potential in Off-grid areas

Source: GIZ Indonesia, 2013
RE & New Technologies for Off-grid Generation

• High Flexibility and Expandability

RE Off-grid system

RE-Hybrid Off-grid system

Mini-grid system

More Sustainable & Reliable
Opportunities and Challenges

Opportunities

- Abundant RE and new technology resource to be utilized
- Huge off-grid market potential to be untapped
- Commitment to increase RE share in the region

Challenges

- High investment cost for RE & new technologies
- Capability in developing RE & new technologies
- Lack of financing support for RE & new technologies in off-grid electrification
- No stringent target & rule for RE in off-grid electrification
Conclusion

- There are huge opportunities of utilizing RE & new technologies for fulfilling off-grid demand in islanded communities in ASEAN
- RE & new technologies can be more affordable, reliable, and sustainable solution than fuel-based generation to provide electricity in off-grid areas
- ASEAN should support RE & new technologies for off-grid electrification by establishing target, supporting policies and financing scheme.
- By using RE & new technologies for off-grid electrification it can fulfill off-grid demand while help achieving regional RE target of 23% energy mix in 2025
Thank you.

For more information, please visit our website: www.aseanenergy.org
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