Connecting Asia with Renewables
Asia Super Grid Concept

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Three REvolutions are Coming

1. Cost of renewables are declining
2. Cost of batteries are declining
3. HVDC are becoming cheap and expanding
Three REvolutions are Coming

![Graph showing the decline in price of Solar PV and rise in Fossil fuel indices.](source: Jeremy Legget, 8 SEP 2016 REI's 5th anniversary event)
Three REvolutions are Coming

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2. Cost of batteries are declining
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Three REvolutions are Coming

Butteries only becoming better - prices and quality

source: Bloomberg New Energy Finance
Three REvolutions are Coming

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Three REvolutions are Coming

HVDC transmission system expanding

【Since 1910s】
- 1915 Denmark-Sweden Interconnection
- 1920 Interconnection between France, Switzerland and Italia.

【After WWII】
- 1951 UCPTE among 8 countries.
  (West-Germany, France, Italy and others)
- 1963
  NORDEL in Northern Europe
  UFIPTFE by France, Spain and Portugal

【Currently】
The region is divided into four synchronous grids, Continental Europe, Nordic, UK, and Baltic, and they are connected asynchronously through direct current transmission, so that electricity trade can be conducted among them.

Figure 5  Power flows between countries in Europe (2015)
Source: ENTSO-e, Statistical Factsheet 2015
# Three REvolutions are Coming

HVDC transmission system expanding

<table>
<thead>
<tr>
<th>NO.</th>
<th>Project</th>
<th>Distance (km)</th>
<th>Strait, etc. (km)</th>
<th>Transmission method</th>
<th>Grid voltage (kV)</th>
<th>DC voltage (kV)</th>
<th>Transmission capacity (MW)</th>
<th>Came into operation in</th>
<th>Transformer cost</th>
<th>Transmission line cost</th>
<th>Total cost</th>
<th>¥10,000/MW km (reference)*</th>
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<tbody>
<tr>
<td>1</td>
<td>SAPEI Italy</td>
<td>435</td>
<td>420</td>
<td>Line-Commutated</td>
<td>400</td>
<td>±500</td>
<td>1,000</td>
<td>2011</td>
<td>$180m</td>
<td>€400m</td>
<td>€750m</td>
<td>20</td>
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<tr>
<td>2</td>
<td>BritNed UK-Netherlands</td>
<td>259</td>
<td>250</td>
<td>Line-Commutated</td>
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<td>±450</td>
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<td>€600m</td>
<td>26</td>
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<td>3</td>
<td>Nemo Link UK-Belgium</td>
<td>141</td>
<td>130</td>
<td>Self-Commutated</td>
<td>400 380</td>
<td>±400</td>
<td>1,000</td>
<td>2019</td>
<td>—</td>
<td>—</td>
<td>€500m</td>
<td>40</td>
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<td>4</td>
<td>Estlink 2 Estonia-Finland</td>
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<td>145</td>
<td>Line-Commutated</td>
<td>330 400</td>
<td>450</td>
<td>650</td>
<td>2014</td>
<td>€100m</td>
<td>$180m</td>
<td>€320m</td>
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<td>Line-Commutated</td>
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<td>700</td>
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<td>€51m</td>
<td>€600m</td>
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<td>Line-Commutated</td>
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<td>800</td>
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<td>±525</td>
<td>1,400</td>
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<td>$900m</td>
<td>€500m</td>
<td>€1.5-2.0b</td>
<td>20~26</td>
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</tbody>
</table>

*Converted at ¥114.0/€ and ¥103.8/$ (forex rates on October 19)

Source: “On Preparation of Long-term Cross-regional Network Development Policy,” Material No. 1 for the 18th Meeting of the Cross-regional Network Development Committee, OCCTO (October 25, 2016, Committee Secretariat)
CHANGE IS RAPID, THAN WE EXPECT
Three REvolutions are Coming

Easter Parades on Fifth Avenue in New York, 13 years apart

1900: where’s the first car
1913: where’s the last horse?

source: Amory Lovins, Presentation at REI’s event in March 2016
고마웠습니다
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