Affordable and Clean Energy:
1. Economics of High VRE Penetration
2. ESCAP-GTI Project:
   Capacity Building Needs Assessment for Promoting Power Interconnection

LEI Xiaomeng
China Electricity Council
Electricity generation 2021 in China

Total generation: 8376.8TWh

VRE: 26.72% in capacity
11.73% in generation (9.53% 2020)

Coal: 46.66% in capacity (49.07% 2020)
60.01% in generation (60.75% 2020)

2020 annual generation of the 3 big economies in TWh

<table>
<thead>
<tr>
<th></th>
<th>Hydro</th>
<th>Coal</th>
<th>Gas&amp;oil</th>
<th>Nuclear</th>
<th>Solar</th>
<th>Wind</th>
<th>otherRES</th>
<th>Other</th>
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<tbody>
<tr>
<td>China</td>
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<td>OECD-Europe</td>
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1. Economics of High VRE Penetration

A model system

- Demand: 10000 MW annual peak, 60000 GWh annual consumption
- Coal generating capacity: 12000 MW

Assumptions

- Contribution factors to annual peak: wind 5%, PV 0%
- Capacity factors (CEC annual report): wind 0.255, PV 0.146
- Capacity cost in CHY / KW (CEC annual report): Wind 7460, PV 4600, PSH 4926, coal 3650
- VRE generation price = Coal generation price

Methodology: VRE + PSH replaces Coal generating capacity, Coal capacity factor 0.62~0.68
Background

Objective:
Information exchanges
Overcoming obstacles
Narrowing gaps
Closing to consensus on...

Training programme:
Demand driven
Key issues focused
In depth discussion

2. Capacity Building Needs Assessment for Promoting Power Interconnection

Strategy 1: Building trust and political consensus on a common vision for power grid connectivity.

Strategy 2: Developing a Master Plan for regional power grid interconnection.

Strategy 3: Developing and implementing Intergovernmental Agreements, creating a broader institutional framework.

Strategy 4: Coordinating, harmonizing and institutionalizing policy and regulatory frameworks.

Strategy 5: Moving towards multilateral power trade and creating competitive cross-border electricity markets.

Strategy 6: Coordinating cross-border transmission planning and system operations.

Strategy 7: Mobilize investments in cross-border grid and generation infrastructure.

Strategy 8: Capacity-building.

Strategy 9: Ensuring that energy connectivity initiatives are compatible with the Sustainable Development Goals.
## Project Timeline

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<th>Date</th>
<th>Task Description</th>
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<tr>
<td>03</td>
<td>Inception meeting to agree on scope of needs assessment</td>
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<tr>
<td>04</td>
<td>Methodology development and hiring of local consultants</td>
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<tr>
<td>05</td>
<td>Outreach to key stakeholders on capacity needs</td>
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<tr>
<td>06 ~ 07</td>
<td>National consultation meetings and Compile inputs and draft preliminary report</td>
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<tr>
<td>07 ~ 08</td>
<td>Report to GTI Energy Board during the 10th Energy Board Meeting</td>
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<tr>
<td>09 ~ 10</td>
<td>Finalize report on recommended capacity building programme</td>
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<tr>
<td>11</td>
<td>Translation and printing</td>
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2. Capacity Building Needs Assessment for Promoting Power Interconnection
# 2. Capacity Building Needs Assessment for Promoting Power Interconnection

## Outline of capacity building programme

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<th>Module 6</th>
<th>Module 7</th>
<th>Module 8</th>
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<tr>
<td>Overview of regional power interconnection worldwide</td>
<td>Gap analysis and recommendations</td>
<td>Regulatory framework and power market development</td>
<td>Case studies of power pools development</td>
<td>International power interconnection planning study</td>
<td>Economic Issues</td>
<td>Operational Agreement of Interconnected Power Systems</td>
<td>HVDC Technology and DC Submarine Cables</td>
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<tr>
<td>1.1 Overview of regional power interconnection worldwide</td>
<td>1.1 Gap analysis</td>
<td>3.1 EU case study</td>
<td>4.1 Case study 1 - ENTSO E (TYNDP, Transmission tariff)</td>
<td>5.1 Methodology</td>
<td>6.1 Economic assessment for the power interconnection</td>
<td>7.1 The basics of cross-border interconnected system</td>
<td>8.1 HVDC basics and operational experience</td>
</tr>
<tr>
<td>1.2 Some of the important cases</td>
<td>1.2 Recommendations</td>
<td>3.2 Case study of China and GTI member countries</td>
<td>4.2 Case study 2 - SAPP</td>
<td>5.2 Case studies (ADB-NAPSI, GEIDCO…)</td>
<td>6.2 Power Purchase Agreement</td>
<td>7.2 ENTSO-E grid codes</td>
<td>8.2 HVDC submarine power cable</td>
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<td>7.3 SAPP operating guidelines or some others</td>
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**Module 1: Overview of regional power interconnection worldwide**

- Regional Power Pools worldwide

**Module 2: Gap analysis and recommendations**

- GTI Greater Tumen Initiative

**Module 3: Regulatory framework and power market development**

- Map of the world

**Module 4: Case studies of power pools development**

- Maps of different regions

**Module 5: International power interconnection planning study**

- Schematic of GEIDCO

**Module 6: Economic Issues**

- Image of wind turbines and desert

**Module 7: Operational Agreement of Interconnected Power Systems**

- Map of Europe

**Module 8: HVDC Technology and DC Submarine Cables**

- Map of the world
Thank You!

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