IMPLEMENTATION OF PHOTOVOLTAIC PROJECTS IN VIETNAM

Frankfurt, July 11th, 2019

Speaker: Minh Quang NGUYEN – National Load Dispatch Center - Vietnam
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01

OVERVIEW OF VIETNAMESE POWER SYSTEM
Structure of Vietnam’s Electricity Sector

MOIT – Ministry of Industry and Trade
EREA – Electricity and Renewable Energy Authority
ERAV – Electricity Regulatory Authority of Vietnam
EVN - Electricity of Vietnam
NLDC – National Load Dispatch Centre
IPPs – Independent Power Plant
BOT – Built-Operate-Transfer Power Plant
Gencos – EVN Owned Generation Companies
NPT – National Power Transmission Corporation
PCs – Power Corporations
DCs – Joint stock Distribution Companies
NLDC HISTORY

- **United control** of the national power system
- National Load Dispatch Center establishment, being a state-owned enterprise affiliated to EVN.
NLDC FUNCTION AND MANDATE

System analysis and planning

Power system operation

Manage & operate SCADA/EMS

Power Market operation

System analysis and planning
DISPATCHING HIERARCHY

NLDC

Northern RLDC
Central RLDC
Southern RLDC

Power corporations

Distribution control centers

500 kV

> 30 MW

220 & 110 kV

≤ 30 MW at 110/220 kV network

MV / LV

≤ 30 MW at MV/ LV network
POWER CAPACITY

China

Lao PDR

Hydro 20170 MW (40%)
Coal 18945 MW (37.6%)
Oil & Gas 9070 MW (18.1%)
Import 1400 MW (2.8%)
Renewable Energy 754 MW (1.5%)

Total 50339 MW

Data: 02/2019
ENERGY PRODUCTION 2018

- Hydro: 83,081 GWh (37.7%)
- Coal: 91,654 GWh (41.6%)
- Oil & Gas: 41,452 GWh (18.8%)
- Import: 3,125 GWh (1.4%)
- Renewable Energy: 997 GWh (0.5%)

Total: 220,310 GWh

Data: 2018

Source: National Load Dispatch Centre
EN năng lượng (MWh) và tải cao trong khoảng 2014 đến 2018

<table>
<thead>
<tr>
<th>Năm</th>
<th>Sản lượng năng lượng (GWh)</th>
<th>Tải cao (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>144655</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>164312</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>182900</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>198322</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>220309</td>
<td>35126</td>
</tr>
</tbody>
</table>

Trung bình tốc độ tăng trưởng (%)

<table>
<thead>
<tr>
<th></th>
<th>2014-2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tải cao</td>
<td>12.17</td>
</tr>
<tr>
<td>Sản lượng năng lượng</td>
<td>11.10</td>
</tr>
</tbody>
</table>
FUTURE DEVELOPMENT

Energy production (MWh) and Peak load (MW) from 2015 to 2030

Average growth rate (%)

<table>
<thead>
<tr>
<th></th>
<th>2016-2020</th>
<th>2021-2025</th>
<th>2026-2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Load</td>
<td>10.26</td>
<td>8.57</td>
<td>7.39</td>
</tr>
<tr>
<td>E. Production</td>
<td>10.07</td>
<td>8.57</td>
<td>7.39</td>
</tr>
</tbody>
</table>
TRANSMISSION SYSTEM

- 03 interconnected regions
- 500-22500 kV: 30 substations – 33300 MVA;
- 500 kV line: ~ 8000 km of line

<table>
<thead>
<tr>
<th>Unit</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>500kV substation</td>
<td>MVA</td>
</tr>
<tr>
<td>500kV line</td>
<td>km</td>
</tr>
<tr>
<td>220kV substation</td>
<td>MVA</td>
</tr>
<tr>
<td>220kV line</td>
<td>km</td>
</tr>
</tbody>
</table>

Transmission capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>North - Central</th>
<th>Central - South</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>2200-2400</td>
<td>4000</td>
</tr>
</tbody>
</table>
02

RENEWABLE ENERGY DEVELOPMENT
PROSPECTS FOR RENEWABLES DEVELOPMENT

- Target & Policy
- Potential
- Demand
RENEWABLE ENERGY POTENTIAL

- **Small hydro power**
  - Potential: > 7,000 MW
  - Current use: 3300 MW

- **Biomass**
  - Potential: >3000 MW
  - Current use: 400 MW

- **Biomass**
  - Potential: >3000 MW
  - Current use: 400 MW

- **Solar power**
  - Potential: 4-5 kWh/m²
  - Current use: ~5000 MWp

- **Biogas**
  - Potential: 58 MW
  - Current use: 0.5 MW

- **Municipal wastes**
  - Potential: 220 MW
  - Current use: 2.4 MW

- **Wind power**
  - Potential: 27 GW
  - Current use: 300 MW

- **Geothermal**
  - Potential: 340 MW
  - Current use: 0 MW

- **Tidal**
  - Potential: 100-200 MW
  - Current use: 0 MW
WIND AND SOLAR POTENTIAL

Wind maps: https://energypedia.info/

Solar maps: https://solargis.com/
DEMAND FOR RE DEVELOPMENT

Energy production (MWh) and Peak load (MW) from 2015 to 2030

Average growth rate (%)

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<td>7.39</td>
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DEMAND FOR RE DEVELOPMENT

- All the big potential hydro source have been exploited.
- From 2017, Vietnam begins importing big amount of Coal for power generation.
- Natural gas supply for electricity is not enough from 2018:
  - Start to import LNG from 2021.
- All nuclear projects cancelled until at least 2030
- Results of COP 21 will lead to the fact that renewable energies will be pushed worldwide in order to avoid climate turbulences and boost the transition towards resilient, low-carbon societies and economies.
STRATEGIC TARGET & POLICY

Renewable Energy Development target (PDP7 – revised)

- Renewable energy capacity and energy shares are shown as the below

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capacity (MW)</td>
<td>Energy %</td>
<td>Capacity (MW)</td>
</tr>
<tr>
<td>Wind</td>
<td>800</td>
<td>0.8</td>
<td>2000</td>
</tr>
<tr>
<td>Solar</td>
<td>850</td>
<td>0.5</td>
<td>4000</td>
</tr>
</tbody>
</table>

Policy:

<table>
<thead>
<tr>
<th></th>
<th>Feed in Tariff (UScents/kWh)</th>
<th>COD</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onshore wind farm</td>
<td>8.5</td>
<td>01/11/2021</td>
<td>39/2018/QD-TTg</td>
</tr>
<tr>
<td>Offshore wind farm</td>
<td>9.8</td>
<td>01/11/2021</td>
<td>39/2018/QD-TTg</td>
</tr>
<tr>
<td>Solar</td>
<td>9.35</td>
<td>30/06/2019</td>
<td>11/2017/QD-TTg</td>
</tr>
</tbody>
</table>
SOLAR PROJECTS DEVELOPMENT IN 2019

SOLAR PROJECTS in 2019

MW

Week 1: 84
Week 2: 84
Week 3: 84
Week 4: 174
Week 5: 174
Week 6: 211
Week 7: 260
Week 8: 260
Week 9: 260
Week 10: 260
Week 11: 310
Week 12: 398
Week 13: 559
Week 14: 712
Week 15: 882
Week 16: 1097
Week 17: 1780
Week 18: 2231
Week 19: 2834.4
Week 20: 3323.4
Week 21: 3570.7
Week 22: 4231.4

EVN NLDC
NATIONAL LOAD DISPATCH CENTRE
**TENTATIVE FIT FOR SOLAR AFTER 30/06/2019**

<table>
<thead>
<tr>
<th></th>
<th>Price in Uscent / kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zone 1</td>
</tr>
<tr>
<td>Solar Project -Floating</td>
<td>9.98</td>
</tr>
<tr>
<td>Solar Project</td>
<td>9.20</td>
</tr>
<tr>
<td>Rooftop</td>
<td>9.35</td>
</tr>
</tbody>
</table>

*Tentative only!*
POWER SYSTEM OPERATION CHALLENGES
CONGESTION

Heavy overload

110 / 220 / 500 kV
USING AGC TO AVOID GRID OVERLOAD

AGC

Control signals

Grid status

Power

Solar panels

Electrical grid
USING AGC TO AVOID GRID OVERLOAD

Giam sat DZ AGC 26/06

AGC3_172 Ninh Thuan - 174 Thap Cha
AGC3_171 Eco Seido - 171 Phan Ri

Time Span: 0:12:17:16
RES POWER OSCILLATION

Phong Điện output power - 05/10/2018
FREQUENCY CONTROL

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro Installed Capacity</td>
<td>~ 21.6 GW (30 %)</td>
<td>~24.6 GW (21%)</td>
<td>~27.8 GW (16%)</td>
</tr>
<tr>
<td>Solar</td>
<td>~ 0.85 GW</td>
<td>~ 4 GW</td>
<td>~12 GW</td>
</tr>
<tr>
<td>Wind</td>
<td>~0.8 GW</td>
<td>~ 2 GW</td>
<td>~6 GW</td>
</tr>
<tr>
<td>Peak demand</td>
<td>~ 42 GW</td>
<td>~ 63 GW</td>
<td>~ 90 GW</td>
</tr>
</tbody>
</table>

- **Currently**, good operation flexibility thanks to high percentage of hydro power plants
- **In the future:**
  - Proportion of hydro will gradually reduced
  - Thermal coal-fired will dominate the generation mix
  - Renewable energy share will be increased
### NEED FOR RESERVE CAPACITY

- **Result of Consultant Project with EGI**

<table>
<thead>
<tr>
<th>In MW</th>
<th>Forecast error (2025)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Total reserves (2+4)</td>
<td>1055</td>
</tr>
<tr>
<td>Spinning reserves (up) (2)</td>
<td>668</td>
</tr>
<tr>
<td>Spinning reserves (down)</td>
<td>-657</td>
</tr>
<tr>
<td>Non-spinning reserves (4)</td>
<td>387</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>In MW</th>
<th>Forecast error (2030)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
</tr>
<tr>
<td>Total reserves (2+4)</td>
<td>1190</td>
</tr>
<tr>
<td>Spinning reserves (up) (2)</td>
<td>668</td>
</tr>
<tr>
<td>Spinning reserves (down)</td>
<td>-657</td>
</tr>
<tr>
<td>Non-spinning reserves (4)</td>
<td>522</td>
</tr>
</tbody>
</table>
PROSPECT OF BATTERY ENERGY STORAGE SYSTEM
CURRENT STATUS OF BESS DEVELOPMENT

0 MW of BESS

Lack of experience

Lack of regulation

Lack of incentive mechanism

Grid issues may need BESS
CURRENT TECHNICAL ASSISTANT PROJECTS

- **Feasibility Study of using advanced energy storage technology to solve issues of the Vietnamese power system:**
  - Funded by USTDA
  - Consultant: GE
  - Expected results: technical & economical analysis, recommendations on technologies, evaluation of benefits and risk, policy recommendations for BESS use cases ...
  - Completion date: September 2020

- **Technical assistance on BESS Pilot Investment Preparation and BESS Technical Requirement**
  - Funded by Asian Development Bank (ADB)
  - Consultant: Consortium of INTEC (Germany), CENER (Spain) and IE (Vietnam)
  - Expected result: development of a detailed design of BESS to serve the specific purposes, drafting of technical requirements for BESS to be added into the Grid Codes
PROSPECT OF BESS DEVELOPMENT

BESS might be solution to grid issues

Preparation process is being conducted

BESS price is progressively reduced

Potentially first project in 2 – 5 years
THANK YOU FOR YOUR LISTENING