an active
INDEPENDENT
THINK TANK
since 8/2018
Thematic studies in VIET

- Options for wind power development to 2030
- Biomass co-firing and Renewable Standard Portfolio
- Scenarios for Solar power development to 2030
- OWE Strategy recommendation
- OWE potential zone and mechanism for sea surface exploitation
- Policy recommendation on ESIA; Supply chain and local content; Distance between wind farms and wind turbines

- Mechanism to mobilize investment capital for the transmission system in Vietnam
- Coal retirement mechanism
- Super-ESCO: Investment mechanism
- Green bonds, Carbon market

- Transparency in electricity price
- State management role in power sector
  - Virtual Power Plant
  - RE Auction mechanism
  - Energy storage

- Grid integration for offshore wind to 2030
- Grid capacity for onshore wind and solar integration to 2022 and 2025
  - Grid planning up to 2025 and 2030
  - Grid inter-connection standard

- RE development
- Offshore Wind
- Energy

- Power Market

- Finance mechanism

- Grid Integration

- Scenarios for Solar power development to 2030
- Biomass co-firing and Renewable Standard Portfolio
- Scenarios for Solar power development to 2030
- OWE Strategy recommendation
- OWE potential zone and mechanism for sea surface exploitation
- Policy recommendation on ESIA; Supply chain and local content; Distance between wind farms and wind turbines

- Mechanism to mobilize investment capital for the transmission system in Vietnam
- Coal retirement mechanism
- Super-ESCO: Investment mechanism
- Green bonds, Carbon market

- Transparency in electricity price
- State management role in power sector
  - Virtual Power Plant
  - RE Auction mechanism
  - Energy storage

- Grid integration for offshore wind to 2030
- Grid capacity for onshore wind and solar integration to 2022 and 2025
  - Grid planning up to 2025 and 2030
  - Grid inter-connection standard
2021’s publications
Content

• Overview of Vietnam Power System

• Power Development Plan:
  • Coal abatement scenarios
    • The scenarios
    • The finance and policy framework requirements

• Recommendations
Vietnam Power System
Power Installed Capacity

Installed capacity 2010 - 2021

 Installed capacity in 2021 (77.361 MW)

- Coal: 24,697 GW (31.9%)
- Oil: 1,579 GW (2.0%)
- Gas: 7,398 GW (9.6%)
- Hydro: 22,139 GW (28.6%)
- Wind: 4,596 GW (5.9%)
- Solar: 16,627 GW (21.5%)
- Biomass: 325 GW (0.4%)

56% includes hydro, wind & solar

Source: VIET’s analyze based on the data published by EVN NLDC Jan 2022
### Power Generation

#### Power generation by sources 2010 - 2021

<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Gas</th>
<th>RE</th>
<th>Hydro</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>17</td>
<td>27</td>
<td>27</td>
<td>95</td>
<td>104</td>
</tr>
<tr>
<td>2011</td>
<td>20</td>
<td>41</td>
<td>37</td>
<td>117</td>
<td>104</td>
</tr>
<tr>
<td>2012</td>
<td>22</td>
<td>41</td>
<td>37</td>
<td>126</td>
<td>117</td>
</tr>
<tr>
<td>2013</td>
<td>26</td>
<td>43</td>
<td>57</td>
<td>142</td>
<td>126</td>
</tr>
<tr>
<td>2014</td>
<td>37</td>
<td>45</td>
<td>56</td>
<td>161</td>
<td>142</td>
</tr>
<tr>
<td>2015</td>
<td>57</td>
<td>47</td>
<td>63</td>
<td>179</td>
<td>161</td>
</tr>
<tr>
<td>2016</td>
<td>69</td>
<td>40</td>
<td>86</td>
<td>195</td>
<td>179</td>
</tr>
<tr>
<td>2017</td>
<td>68</td>
<td>41</td>
<td>66</td>
<td>217</td>
<td>195</td>
</tr>
<tr>
<td>2018</td>
<td>92</td>
<td>43</td>
<td>73</td>
<td>237</td>
<td>217</td>
</tr>
<tr>
<td>2019</td>
<td>120</td>
<td>35</td>
<td>78</td>
<td>243</td>
<td>237</td>
</tr>
<tr>
<td>2020</td>
<td>123</td>
<td>27</td>
<td>78</td>
<td>255</td>
<td>243</td>
</tr>
<tr>
<td>2021</td>
<td>118</td>
<td>27</td>
<td>78</td>
<td>255</td>
<td>243</td>
</tr>
</tbody>
</table>

**Source:** VIET’s analyze based on the data published by EVN NLDC Jan 2022

#### Power generation by sources 2021 (total 255 TWh)

- **Coal:** 118,3 TWh (46%)
- **Gas:** 27,2 TWh (11%)
- **Hydro:** 77,7 TWh (30%)
- **RE:** 29,9 TWh (12%)
- **Other:** 2,2 TWh (1%)

Average annual growth 7%/year

Average annual growth 11%/year
RE growth → private share in power sources increased

Share of power capacity (MW) based on ownership in 2021

- EVN; 8925; 12%
- EVNGENCO1; 7929; 10%
- EVNGENCO 2; 4420; 6%
- EVNGENCO 3; 8593; 11%
- BOT; 7273; 9%
- TKV; 1810; 2%
- PVN; 5605; 7%
- Private, 32784, 42%
- Import and others, 644, 1%

Source: VIET’s analyze based on the data published by EVN NLDC Jan 2022
Growth of peak load 2010-2021

Power generation and load by region 2021

Source: VIET’s analyze based on the data published by EVN NLDC Jan 2022
Wind and solar in operation (1/2022)

- 147 Solar plants ~ 8.87 GW
- 104 k Rooftop Solar System ~ 7.75 GW

84 wind plants - 4.6 GW

Source: VIETSE analyzed based on official documents issued by the government
Challenges

• Transmission overload:
  • 20 lines/MBA 220/110kV is overloaded
  • 159 plants are facing generation restriction
  • Impact to 500kV lines

• Low system’s inertia
  • Risk of affecting system’s stability

• Forecasting errors
  • Generation forecasting errors
  • Load forecasting errors → difficulties for grid planning

• Share of VRE in total installed capacity ~ 25% → challenges for system operation

• Pricing mechanism
  • Incentives for auxiliary services are not yet attractive → Lack of reserves for RE sources (due to increasing share of intermittent VRE sources)
  • Incentives for BESS are not yet in place
Power Development Plan
### Power mix – Executing scenario

<table>
<thead>
<tr>
<th>Source: PDP8 version 29/4/2022 (Letter 2297/TTr-BCT)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Added capacity 2022-2030 (GW)</th>
<th>Added capacity 2031-2045 (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal/biomass/amoniac</td>
<td>12.8</td>
</tr>
<tr>
<td>Domestic gas</td>
<td>5.9</td>
</tr>
<tr>
<td>Imported LNG/hydrogen</td>
<td>23.9</td>
</tr>
<tr>
<td>Oil</td>
<td>0</td>
</tr>
<tr>
<td>Hydro (incl. Small hydro)</td>
<td>6.8</td>
</tr>
<tr>
<td>Onshore wind</td>
<td>11.5</td>
</tr>
<tr>
<td>Offshore wind</td>
<td>7.0</td>
</tr>
<tr>
<td>Solar - Utility scale</td>
<td>0</td>
</tr>
<tr>
<td>Biomass and other RE</td>
<td>0.9</td>
</tr>
<tr>
<td>Pump storage, storage</td>
<td>2.5</td>
</tr>
<tr>
<td>Flexible sources (hydrogen)</td>
<td>0.15</td>
</tr>
<tr>
<td>Imported electricity</td>
<td>4.4</td>
</tr>
<tr>
<td>Rooftop solar</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>75.8</strong></td>
</tr>
</tbody>
</table>

**Power source development to 2045**
(Highload scenario for execution- Letter 2279/TTr-BCT, 29/4/2022)

Source: PDP8 version 29/4/2022 (Letter 2297/TTr-BCT)
Electricity from domestic/import sources

Power generation by sources

Historical data from NLDC

Energy Transition scenario PDP8 04/2022

Source: PDP8 version 29/4/2022 (Letter 2297/TTr-BCT)
Coal abatement scenarios

Hanoi, 7 June 2022
Ensure energy security + Affordable + Better emission reduction = CO₂ Abatement scenarios for power sector in Vietnam
Method to develop CO2 Abatement Scenarios

- Technical modeling
- Economic assessment
- Social & Environmental Assessment
## Assumptions CO2 Abatement scenarios

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Unit</th>
<th>2021 - 25</th>
<th>2026 - 30</th>
<th>2031 - 35</th>
<th>2036 - 40</th>
<th>2041 - 45</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP growth rate</td>
<td>%/year</td>
<td>6.8</td>
<td>6.4</td>
<td>6.0</td>
<td>5.6</td>
<td>5.5</td>
</tr>
<tr>
<td>Electricity demand growth rate</td>
<td>%/year</td>
<td>9.09</td>
<td>7.95</td>
<td>5.8</td>
<td>3.66</td>
<td>2.61</td>
</tr>
<tr>
<td>Elasticity per GDP – BAU scenario</td>
<td></td>
<td>1.35</td>
<td>1.24</td>
<td>0.96</td>
<td>0.64</td>
<td>0.46</td>
</tr>
<tr>
<td>Electricity Generation – BAU scenario</td>
<td>TWh</td>
<td>378.3</td>
<td>551.3</td>
<td>727.0</td>
<td>864.9</td>
<td>977.0</td>
</tr>
<tr>
<td>Elasticity per GDP – EE scenario</td>
<td></td>
<td>1.2</td>
<td>1.0</td>
<td>0.8</td>
<td>0.6</td>
<td>0.4</td>
</tr>
<tr>
<td>Electricity Generation – EE scenario</td>
<td>TWh</td>
<td>364.0</td>
<td>496.4</td>
<td>627.5</td>
<td>740.2</td>
<td>825.3</td>
</tr>
</tbody>
</table>

Source: Drafted PDP8, 09/2021 and authors’ calculation
Assumptions CO2 Abatement scenarios

Power demand forecast through different PDPs

Source: Power Development plans
## Power mix in 2030

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Solar (GW)</th>
<th>Wind (GW)</th>
<th>Biomass &amp; other RE (GW)</th>
<th>Hydro power (GW)</th>
<th>Coal (GW)</th>
<th>Oil &amp; Gas (GW)</th>
<th>Storage (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAU (PDP8)</td>
<td>18.6</td>
<td>11.8</td>
<td>1.2</td>
<td>25.5</td>
<td>40.6</td>
<td>27.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Blue (No new coal)</td>
<td>18.6</td>
<td>11.8</td>
<td>1.2</td>
<td>25.5</td>
<td>40.6</td>
<td>14.4</td>
<td>2.4</td>
</tr>
<tr>
<td>Green (Phase out coal)</td>
<td>18.6</td>
<td>21.3</td>
<td>1.2</td>
<td>25.5</td>
<td>22.1</td>
<td>14.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Cyan-EE (Real transition)</td>
<td>18.6</td>
<td>11.8</td>
<td>1.2</td>
<td>25.5</td>
<td>22.1</td>
<td>14.4</td>
<td>2.15</td>
</tr>
</tbody>
</table>

* 3 Old coal-fired power plants to be phased out: Ninh Binh (operated since 1976); Pha Lai 1 (operated since 1986) and Pha Lai 2 (operated since 2001).
Modeling results – GAMS
Installed Capacity compared to BAU

| Source: VIETSE’ study |

![Bar chart showing added installed capacity (GW) for different energy sources in 2030.](image-url)
Investment in ancillary activities to increase system flexibility, including grid upgrades → Increase in cost for generators and communities impacted by transition → Impact on state budget and balance of payments → Requirement for additional resources?
Multiple scenarios offer improved economics for the power sector, with cost savings realized compared to BAU in the longer term out to 2045 through the Blue, Green and Cyan-EE scenarios.

Cyan-EE offers the most significant reduction in total costs (expressed in net present value) with 16% savings compared to BAU.

These cost savings help Vietnam’s electricity sector remain highly competitive and supports national economic development.
Overall, upfront investment costs for all scenarios are relatively similar (within 25%):

- Small amounts of savings can be realized with the Blue scenario compared to Business-as-Usual (5%).
- Green and Cyan-EE scenarios require more investment than Business-as-Usual, however, these scenarios can provide savings in the longer term.

Generation makes up about 75% of the total new generation investment cost for each scenario.
The Green and Cyan EE scenarios create the most jobs in the coming years.

Across scenarios, most employment is created during the construction period; more RE generation in Green and Cyan EE account for major increase in construction jobs.

Transmission and distribution creates at least 540,000 jobs per scenario.

<table>
<thead>
<tr>
<th></th>
<th>BAU</th>
<th>Blue</th>
<th>Green</th>
<th>Cyan EE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>384,684</td>
<td>403,331</td>
<td>913,435</td>
<td>800,074</td>
</tr>
<tr>
<td>Operations Jobs</td>
<td>50,028</td>
<td>45,281</td>
<td>96,683</td>
<td>82,338</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>-</td>
<td>-</td>
<td>3,649</td>
<td>3,649</td>
</tr>
<tr>
<td>Fuel Supply Jobs</td>
<td>339,130</td>
<td>315,897</td>
<td>300,165</td>
<td>276,149</td>
</tr>
<tr>
<td>Construction</td>
<td>428,070</td>
<td>446,714</td>
<td>1,214,245</td>
<td>1,108,402</td>
</tr>
<tr>
<td>Transmission</td>
<td>541,745</td>
<td>541,745</td>
<td>572,058</td>
<td>541,745</td>
</tr>
</tbody>
</table>
## Modelling results – Abatement Scenarios for Power sector in Vietnam

<table>
<thead>
<tr>
<th>Metrics</th>
<th>2030</th>
<th>2045</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy efficiency and DSM</td>
<td>↑From 1.5% to 10%</td>
<td>↑From 1.5% to 16%</td>
</tr>
<tr>
<td>Electricity generated from renewable sources</td>
<td>54%, ↑VRE contribution from 4% in 2020 to 28%</td>
<td>60%, ↑VRE contribution from 4% in 2020 to 42%</td>
</tr>
<tr>
<td>Share of generation from coal</td>
<td>↓30% from 50% in 2020</td>
<td>↓19.5% from 50% in 2020</td>
</tr>
<tr>
<td>Import dependency of power sector</td>
<td>↓27% vs 42% for BAU</td>
<td>↓25% vs 46% for BAU</td>
</tr>
<tr>
<td>Total investment cost (for power, infrastructure and EE measures)</td>
<td>USD155 billion</td>
<td>USD410 billion</td>
</tr>
</tbody>
</table>
Recommendations

- Address barriers to clean technology – embedded subsidies for fossil fuels and lack of curtailment protection for VRE
- Energy efficiency could dampen the demand trajectory by 16% in 2045, just in BAU
- Balancing and flexibility capacity for the grid
  - Improve flexibility of existing infrastructure, especially hydro and coal
  - Addition of new resources – gas and LNG, battery storage, demand side
  - Add transmission and distribution, upgrade of substations
- Market solutions – emissions trading systems, and integrated ASEAN power market
- Financial levers – curtailment insurance for VRE, capacity development in domestic debt markets
- Financial mechanisms for coal to clean transition
Thank you!