Economic and financial risks of coal power in Vietnam

Briefing
October, 2018
About Carbon Tracker

The Carbon Tracker Initiative is a team of financial specialists making climate risk real in today’s capital markets. Our research to date on unburnable carbon and stranded assets has started a new debate on how to align the financial system in the transition to a low carbon economy.

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1 Summary

By 2020 it will be cheaper to invest in new solar PV than new coal and 2022 for onshore wind. This represents the first inflection point when new investments in coal capacity become economically uncompetitive relative to new investments in renewable energy. These changing cost dynamics call into question over 30 GW or $40 bn of planned coal investments in Vietnam and the long-term role of the existing fleet to deliver an economic return to investors.

It will be cheaper to build new solar PV than operate existing coal plants by 2027 and onshore wind by 2028, calling into question the economic viability of the operating fleet in Vietnam thereafter. The second inflection point highlights the risk when new investments in renewables outcompete existing coal plants. Both solar PV and onshore wind have experienced impressive cost reductions over the past four years, declining around 50% and 30%, respectively. We expect this deflationary trend to continue such that in the future new investments in renewable energy will likely cost less than operating coal. Based on prevailing fuel costs, building new solar PV will be cheaper than operating coal by 2027 and onshore wind by 2028. Coal plants’ relative cost competitiveness could be further exacerbated with the introduction of tighter air pollution regulations, which would require expensive plant retrofits.

Existing market structure is dominated by state-owned energy companies that are financially burdened by higher coal prices. Vietnam Electricity (EVN), the state-owned utility, uses low-subsidised tariffs to incentivise private investment in power generation. However, EVN has incurred critical financial losses, due to lower tariff rates that do not cover the full cost of power production. Higher coal prices have increased the cost of power generation and could further compromise EVN’s financials, if it remains committed to coal. Indeed, plans to create fully competitive retail market by 2023 will allow consumers to purchase power from those utilities less exposed to coal.

In a scenario where coal is phased-out consistent with the Paris Agreement, Vietnamese coal power owners risk losing $11.7 bn of mostly operating capacity. We have developed a cost-optimised asset-level methodology and scenario analysis which phases out coal power in a manner consistent with the temperature goal in the Paris Agreement. In such a scenario, Vietnamese coal power owners are borne with $11.7 bn of stranded value stemming from the premature retiring of coal capacity. EVN, PetroVietnam, and Vinacomin are at most risk due to increasing unviability of coal, with stranding asset risk of $6.1 bn, $1.5 bn and $0.8 bn, respectively. This financial risk is material, representing 79% of Vinacomin’s total capital and 66% for PetroVietnam. This scenario, however, does not take into consideration existing PPA agreements and any changes to future market dynamics of the Vietnamese power market.
2 Background

Coal is the second largest source of power generation in Vietnam, responsible for 34% of electricity generated in 2017. The electricity production from coal-fired plants surged by 72% between 2010 and 2017, going up to 67.5 TWh in 2017. Coal capacity increased by 84% from 2.7 GW in 2010 to 17 GW in 2017. Coal’s share of capacity was 37% in 2017, whereas onshore wind and solar PV was 0.4%. According to the revised Power Development Plan VII (PDP 7), the share of coal capacity is expected to be 42.6% by 2030, equivalent to 43 GW of new coal plants.

Vietnam has reformed its power sector towards a more competitive system. Before 2012, the Vietnam Electricity (EVN) had a monopoly over the generation, transmission, and distribution. The Electricity Law of 2004 initiated the restructuring of the EVN to encourage private players’ participation. With the establishment of the Vietnam Competitive Generation Market (VCGM) in 2012, EVN’s affiliate power generation companies (Gencos) and IPPs began selling power to a single-buyer, the Electricity Power Trading Company (EPTC).

In 2016, Vietnam began a pilot scheme of Wholesale Electricity Market (VWEM). VWEM will be fully operational in 2019, allowing generators to sell electricity to industrial consumers at the spot market. The EVN owns 60% of power generation assets, and the remaining is held by PetroVietnam (13%), Vinacomin (4%) and IPPs. A fully competitive retail market will be in working order by 2023, giving the consumers the option to choose the supplier.

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5 EPTC is a subsidiary of EVN and responsible for regulating the price of electricity in the competitive power pool.
Vietnam committed to cut its greenhouse gas emissions up to 25% compared to business-as-usual levels by 2030. To reach this goal, the government targets the deployment of 18 GW of onshore wind and solar PV by 2030. The revised PDP 7 plans to increase renewable capacity by 10% by 2020 and 21% by 2030. The majority of new renewable capacity additions will be from solar PV, rising from 8 MW in 2017 to 12 GW in 2030. Wind capacity is also expected to grow from 183 MW in 2017 to 6 GW by 2030.

Vietnam supports renewables through a feed-in-tariff (FiT) of $0.08/kWh for wind and $0.09/kWh for solar PV. The Ministry of Industry and Trade (MoIT) is also partnering with the USAID to develop a direct power purchase agreement policy that will enable direct power purchases from independent renewable energy producers.

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9 Intended Nationally Determined Contribution of Viet Nam, 2016. Available: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Viet%20Nam%20First/VIETNAM%20INDC.pdf
3 Current situation

Vietnam’s power market liberalisation has not changed EVN’s monopolistic position as a single buyer. In 2017, PPA contracts supplied 80% of the power output sold, and the rest is sold at the spot market. Fluctuations in electricity prices at the VCGM, imported fuel prices and foreign exchange rate affects the profitability of coal plants. EVN endured significant financial losses due to tariff rates below the cost of power generation. Vietnam is heavily dependent on coal imports from Australia, Indonesia, and Russia. In 2017, the imported coal volume was 11.7 million tons, and by 2030 it is expected to reach 102 million tons. The steady increase in coal prices slumped the imported fuel costs since 2016, and by 2021 an additional $1.27 billion will be spent on importing coal per year, according to IEEFA estimates.

We modelled the operating cost and gross profitability of each coal unit in Vietnam in 2018 and found the coal fleet is currently cash flow positive and operates at a lower cost than building new solar PV and onshore wind. However, the levelised cost of renewable energy has declined significantly over the last four years, with the levelised cost of solar PV and onshore wind falling around 50% and 30%, respectively. These deflationary trends contrast with the cost of coal power, which has increased 30% over the same period.

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22 Unless otherwise stated, we define cost as long-run operating cost which includes fuel, variable O&M, fixed O&M, and capital additions from meeting regulation and maintaining unit performance.
**Figure 2 – Short-Run Marginal Cost of Vietnam’s Coal Fleet in 2018**

Source: CTI analysis.

Note: The short-run marginal cost (SRMC), or cash cost, includes fuel and variable operating and maintenance costs.
4 Future situation

There are two main inflection points that will make coal power economically uncompetitive: when new investments in renewables outcompete new investments in coal; and when new investments in renewables outcompete the operating costs of existing coal.

Deflationary renewable energy costs will undermine the competitiveness of new coal power in Vietnam. As depicted in Figure 3, the first inflection point will be reached in the near term, where new solar PV will be cheaper than new coal by 2020 and for onshore wind by 2022. We estimate that the second inflection point will be reached by 2027, when operating coal will be more costly than building new solar PV and by 2028 for onshore wind, where fuel costs are $100/t, and by 2032 where fuel costs are $60/t. This inflection point could be brought forward should pollutant emission limits for coal plants tighten in Vietnam24, which will also require plants to incur additional costs from the installation of post-combustion control technologies. Coal overcapacity has already resulted in underutilisation of coal power plants, with average capacity factors declining from 73% in 2010 to 57% in 2017.25 These changing cost dynamics call into question the $40 bn of planned coal investments and the long-term role of the existing fleet.26

Since coal power is expected to peak by 2020, $60 billion will be saved by not building new coal plants according to a study by GreenID.27 It shows cancelling 30 GW of new coal power from the revised PDP 7 would save $7 bn per year on imported coal costs.28 If coal use grows as planned, the health burden of coal pollution will increase from 4300 premature deaths per year to 21,100 cases by 2030.29

26 Based on planned and under-construction capacity. Assumed capital costs of $1,000/kW, $1,200/kW, $1,400/kW, $1,600/kW and $1,600/kW for subcritical, supercritical, ultra-super critical, IGCC and CFB, respectively.
**Figure 3 - The Cost of New Renewables versus the Capacity-Weighted Operating Cost of Coal Under Different Fuel Prices**

[Graph showing the cost comparison between new renewables and coal over time with specific years where new renewables are cheaper than coal.]

**Source:** BNEF, CTI analysis

**Notes:** Operating coal cost is capacity-weighted and based on long-run marginal cost, which includes fuel, variable O&M and fixed O&M (SRMC plus fixed operating and maintenance costs). Imported bituminous coal is assumed from Australia, Russia and Indonesia. The low range assumes $55/t for imported bituminous coal and $55/t for domestic anthracite. The high range assumes $80/t for imported bituminous coal and $80/t for domestic anthracite. Calorific values assumed at 3,713 kcal/kg, 4,897 kcal/kg and 5,316 kcal/kg respectively. New coal is based on LCOE estimates for Vietnam from BNEF, which assumes an average of coal-fired power over 2017-18 at $81/MWh.30

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5 Company ranking

Carbon Tracker has developed a Paris-compliance scenario analysis. This involved three steps: (i) identify the amount of capacity required to fill the generation requirement in the IEA’s Beyond 2°C Scenario (B2DS)33; (ii) rank the units based on long-run operating cost to develop a cost-optimised retirement schedule; and (iii) calculate the cash flow of every operating and under-construction unit in both the B2DS and business as usual (BAU) outcomes to understand stranded risk. More information on this methodology is provided in the Appendix. This does not consider the existing PPA arrangements in place.

In a scenario where Vietnam phases-out coal power in accordance with the Paris Agreement, coal power owners risk losing $11.7 bn. This asset stranding is due to the premature retirement of coal capacity. Our cost-optimised retirement schedules show an average plant lifetime of 13 years, which is 27 years less than the typical lifetime of a coal plant. EVN, PetroVietnam, and Vinacomin are most at risk from a scenario that sees Vietnamese coal power phased-out in a manner consistent with the temperature goal in the Paris Agreement with asset stranding risk of $6.1 bn, $1.5 bn and $0.7 bn, respectively. Regardless of whether Vietnam phases-out its coal fleet in accordance with Paris, coal capacity overbuild, and the deflationary trajectory of renewables could result in asset stranding. This financial risk is material, representing 79% of Vinacomin’s total capital and 66% for PetroVietnam.
### Table 1 - Asset-level economic modelling and climate scenario analysis of Vietnam’s top coal owners

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>CAPACITY (MW)</th>
<th>CAPACITY-WEIGHTED AVERAGE COST 2018 ($/MWH)</th>
<th>CAPACITY-WEIGHTED AVERAGE PROFITABILITY 2018 ($/MWH)</th>
<th>AVERAGE PLANT AGE AT RETIREMENT</th>
<th>STRANDED RISK ($/MN)</th>
<th>STRANDED RISK AS % OF TOTAL CAPITAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVN</td>
<td>9,587</td>
<td>51.09</td>
<td>3.69</td>
<td>16</td>
<td>6,129</td>
<td>N/A</td>
</tr>
<tr>
<td>Petrovietnam</td>
<td>1,800</td>
<td>53.68</td>
<td>1.10</td>
<td>11</td>
<td>1,534</td>
<td>66%</td>
</tr>
<tr>
<td>Vinacomin</td>
<td>1,584</td>
<td>47.92</td>
<td>6.86</td>
<td>14</td>
<td>760</td>
<td>79%</td>
</tr>
<tr>
<td>Formosa Plastics Group</td>
<td>900</td>
<td>55.07</td>
<td>-0.29</td>
<td>15</td>
<td>189</td>
<td>1%</td>
</tr>
<tr>
<td>Geleximco Group</td>
<td>300</td>
<td>47.34</td>
<td>7.44</td>
<td>18</td>
<td>91</td>
<td>N/A</td>
</tr>
<tr>
<td>An Khanh Group</td>
<td>100</td>
<td>43.05</td>
<td>11.73</td>
<td>14</td>
<td>45</td>
<td>N/A</td>
</tr>
<tr>
<td>Hoa Dau Son Limited Company</td>
<td>75</td>
<td>62.22</td>
<td>-7.44</td>
<td>10</td>
<td>-5</td>
<td>N/A</td>
</tr>
<tr>
<td>Vedan Vietnam JSC</td>
<td>60</td>
<td>50.95</td>
<td>3.83</td>
<td>12</td>
<td>17</td>
<td>N/A</td>
</tr>
<tr>
<td>Other</td>
<td>2,440</td>
<td>50.61</td>
<td>4.17</td>
<td>7</td>
<td>2,922</td>
<td>N/A</td>
</tr>
<tr>
<td>Total</td>
<td>16,846</td>
<td>51.1</td>
<td>3.6</td>
<td>13</td>
<td>11,683</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: CTI analysis

**Notes:** Those coal-fired power plants with multi-ownership structures are included under ‘Other’. Total capital represents total investment that shareholders and debt holders have made in a company. Short-term borrowings plus long-term borrowings plus preferred equity plus minority interest plus total common equity.
6 References


Intended Nationally Determined Contribution of Viet Nam, 2016. Available: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Viet%20Nam%20First/VIETNAM%50INDC.pdf


7 Appendix – scenario methodology and key assumptions

Plant-level generation model outputs allow us to apply ‘investment grade’ climate scenario analysis for coal power. Our modelling approach involves three steps.

Firstly, identify the amount of capacity required to fill the generation requirement in the IEA’s B2DS. Under the B2DS, coal-fired power in Vietnam is phased-out by 2040. To keep coal generation consistent with a below 2°C pathway, units are retired when generation exceeds the B2DS generation. For example, the model keeps retiring units on a yearly basis until generation reaches or goes below B2DS generation.

Secondly, rank the units to develop retirement schedule. We rank units based on operating cost per power grid, due to the regulated nature of the Vietnamese power market and our expectation that economics will become the primary driver to phase-out coal. This scenario aims to replicate a phaseout from the perspective of a utility interested in providing cost-optimised generation. We define cost as long-run operating cost which includes fuel, variable O&M, fixed O&M and capital additions from meeting regulation and maintaining unit performance.

Thirdly, calculate the cash flow of every operating and under-construction unit in both the B2DS and BAU outcomes to understand stranded risk. Stranded risk under the B2DS is defined as the difference between the net present value (NPV) of cashflow in the B2DS (which phases-out all coal power by 2040) and the NPV of cashflow in the BAU scenario (which is based on retirements announced in company reports).

Our modelling uses the following inputs: asset inventory data, technical, marketing and regulatory assumptions and asset performance data. These inputs produce the following outputs: (i) Paris Agreement compliance analysis; (ii) asset modelling economics; and (iii) market scenario analysis. These inputs and outputs are illustrated in Figure 4 below.

The asset modelling in this report is based on a series of reasonable assumptions about commodity prices (fuel, power and carbon), asset operating costs (variable and fixed) and policy outcomes (out of market revenues and control technologies costs).

Fuel costs include the expenses incurred in buying, transporting and preparing the coal. For the cost of coal for producers we use coal price benchmarks from Wood Mackenzie and Bloomberg. For the transport of coal, a cost-optimised supply route algorithm has been developed, which calculates the distance between a unit’s demand and the nearest suitable coal mine, considering coal type, mode of transport and related costs and other charges, and available port, mine and import capacities. Bituminous coal is imported from Australia, Russia and Indonesia via seaborne and then land routes to mine. Anthracite is sourced domestically. Prices from the newly introduced competitive wholesale market are used with limited visibility on PPAs and we assume no carbon pricing throughout the modelling horizon.

The variable costs we used depend on the size of the unit: 0-100 MW ($4.49/MWh), 100-300 MW ($3.59/MWh) and 300 MW or more ($3.37/MWh). Fixed costs include the costs incurred at a power plant that do not vary significantly with generation and include: staffing, equipment, administrative expenses, maintenance and operating fees. The fixed cost assumptions included in this report depend on the combustion technology of the unit:
$7.79/kW for subcritical; $10.39/kW for supercritical; $11.87/kW for ultra-supercritical; $18.37/kW for integrated gasification combined cycle (IGCC); and $10.39/kW for circulating fluidized bed (CFB). We adopt a conservative view on future air pollution regulation and assume no additional capital costs for the installation of environmental control technologies across the fleet.
**Figure 4 - Diagram of the Research Methodology for Coal Power Analysis**

**Asset Inventory Data**
- Unit and plant name
- Financial sponsor
- Parent company
- Nameplate capacity
- Start year
- Planned retirement year
- Combustion technology
- Coal type
- Cooling technology

**Technical, Market and Regulatory Assumptions**
- Mine location and capacity
- Coal type and transportation
- Long-term coal contracts
- Fixed and variable O&M costs
- Environmental regulations
- Electricity system structure
- Power and carbon prices
- Tariffs
- Out-of-market revenues
- Taxation and inflation

**Asset Performance Data**
- Heat rate
- Capacity factor
- Efficiency
- Coal consumption
- Calorific value of coal
- Fuel cost**
- Fixed and variable O&M cost
- Capex and opex control tech
- In-market payments
- Out-of-market payments***

* **transport, tax, washing, etc.
*** Capacity payments, ancillary services, etc.

**Outputs**
- Paris Agreement scenario analysis
- Cost-optimised retirement schedules
- Stranded asset risk
- Company and country ranking

- Asset economics modelling
- Current and future short-run marginal cost, long-run marginal cost and gross profitability
- Company and country ranking

- Market scenario analysis
- Year when building new wind and solar is cheaper than operating coal
- Company and country ranking

**Carbon Tracker’s Coal Power Analysis Offering**
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