HARVARD Kennedy School
ASH CENTER
for Democratic Governance
and Innovation

Vietnam's Crisis of Success in Electricity

Options for a Successful Clean Energy Mix

David Dapice
Senior Economist, Vietnam and Myanmar Program
Ash Center for Democratic Governance and Innovation
John F. Kennedy School of Government, Harvard University

December 2018

HARVARD Kennedy School
ASH CENTER
for Democratic Governance
and Innovation

Vietnam's Crisis of Success in Electricity

Options for a Successful Clean Energy Mix

This policy note was written by David Dapice (David_Dapice@harvard.edu) and benefited from input and feedback from Professors Le Viet Phu, Nguyen Quy Tam, and Thach Phuoc Hung at the Fulbright School of Public Policy and Management.

This piece, along with other Ash reports on Vietnam, is posted at ash.harvard.edu/policy-briefs and ash.harvard.edu/vietnam-program.

December 2018

CONTENTS

ABOUT THE AUTHOR

David Dapice is a leading expert on the economic development of Southeast Asia and has worked extensively in Indonesia, Thailand, Cambodia, Myanmar, and Vietnam. He was an advisor to the Indonesian Ministry of Finance when the country enjoyed its period of rapid growth and has studied the Vietnamese economy since 1990. Dapice's expertise on matters of economic policy is regularly sought by the Vietnamese government. He is Professor Emeritus of Economics at Tufts University, where he served as Chair of the Economics Department. He has taken leave at the World Bank (as a Brookings Policy Fellow), the Rockefeller Foundation, and the Harvard Institute for International Development. He has authored or co-authored a number of policy studies including *Choosing Success: The Lessons of East and Southeast Asia and Vietnam's Future*. He has contributed to analysis of macroeconomics, urbanization, regional development, agriculture and energy in Vietnam and Myanmar, often collaborating with local professors and experts.

ABOUT THE ASH CENTER

The Roy and Lila Ash Center for Democratic Governance and Innovation advances excellence and innovation in governance and public policy through research, education, and public discussion. The Ford Foundation is a founding donor of the Center. Three major programs support the Center's mission: The Program on Democratic Governance, the Innovations in Government Program, and the Rajawali Foundation Institute for Asia.

EXECUTIVE SUMMARY

As Vietnam looks to the future planning for energy production and use, key is a careful analysis of the cost of the variety of power generation systems that can contribute to a successful energy mix. This paper is designed to assist in that effort and in providing information for the research for Power Development Plan 8.

Efficiency and Use

1. Vietnam has hugely increased its output of electricity since 2000 and has reached virtually every village and improved the quality of service. Consumption now exceeds 2000 kWh per capita, higher than India and Indonesia and approaching that of Thailand – all are richer.

2. The annual growth rate of electricity demand has been 12%, faster than any other comparable Asian economy and is projected to be 8-9% annually out to 2030 – again much faster than likely GDP growth. Other economies have electricity demand growth at or below GDP growth. Vietnam requires twice as much electricity to produce the same amount of real GDP as Thailand. It uses more electricity per unit of output than China does, yet China is both more industrial and more urban and both tend to increase energy demand. In short, Vietnam uses electricity too inefficiently.

3. The reason for such poor energy efficiency is a low price of electricity which has fallen in real terms from 2010 to 2016 in spite of being priced below the cost of new production and its delivery. There is also ineffective enforcement of conservation policies, including in new buildings. China's efforts offer a good model for more aggressive and effective policies.

Coal vs Gas

4. Current Power Development plans (PDP-7-revised) are for coal to provide most incremental electricity. Vietnam's coal use in the last five years grew 75%, ***faster than any other country in the world.*** It is projected out to 2030 to continue growing very rapidly, with an increasing share of total output. This is in spite of coal being imported and intense political resistance to coal due to local pollution concerns. There is scant use of natural gas (kept at a sixth of total power) in spite of ample offshore domestic reserves and opportunities to import LNG. PDP-8, due in 2019, should reassess these plans.

5. Domestic gas production is taxed heavily even though it is a cleaner fuel. Imported coal is scarcely taxed at all. If coal were taxed on the same thermal basis as gas, the tariff would be $100 a ton. If local pollution costs are considered, gas electricity's total costs would be cheaper than coal. For coal and gas, equal taxation on a thermal basis and consideration of local pollution costs would decisively favor gas over coal, and would assist the government to accurately assess total costs.

6. EVN claims that it is dangerously unreliable or too expensive to move away from its coal-centric strategy. It could certainly import LNG and negotiate the supply of local offshore gas instead.[1] Gas-fired electricity is actually more flexible for ramping up and ramping down than coal and much cleaner. If excess disease and deaths are counted, gas is also cheaper than coal, and we learn more about the societal costs of air pollution every year. If changes were made to solar and wind policy, it could greatly increase the amount and reliability of these sources at a lower cost than coal by the time new coal plants come on line. EVN could find local resistance to coal makes it necessary to respond, probably at first with increased imports of power and larger use of high-priced diesel.

7. In both India and China, the capacity utilization of coal generating plants has fallen sharply due to a combination of lower demand growth (a shift to services), improved efficiency, lower renewable prices and rapidly increasing renewable production. In China, the capacity utilization for coal was below 50% in 2016 and as a result 40% of coal plants were losing money. This represents a financial risk, especially since it takes 3-5 years to complete a coal plant, they are a 30-40 year investment, and it is hard to stop construction once started. Gas and especially renewable energy take less time and capacity can be tailored to demand.

Renewables

8. Renewable energy (meaning solar and wind – excluding large hydro) was insignificant in 2017 but is expected to grow to a projected 10% of capacity in 2030. India is aiming for more than 20% in 2022 and China for 20% in 2030. In other countries, wind/solar bids in auctions are coming in below the cost of coal now. Vietnam's renewable costs are about double those of India or China.

[1] The costs of gas-fired electricity are said to be 10-12 cents per kWh in Vietnam but are 4-7 cents in other countries, including those which import LNG. Ships which have onboard generators and LNG storage and gasification facilities are available and should produce electricity for less than 10 cents per kWh.

8. There are several reasons for high renewable costs in Vietnam, mostly tied to the Power Purchase Agreement (PPA) constraints. First, land has been allocated or licensed by provinces to too many without the track record or finances to develop it. In some cases they intend to sell or cooperate with the real developers who put up the money and have the expertise – but seeking to charge 20% as their "equity" for having the best land. In more-crowded India, land is auctioned and costs only 5% of solar projects. (For accepted projects, the land cost is 10% or more.) Second, due to the high feed-in tariffs and limited grid capacity, under the PPA, EVN is reluctant to guarantee "take or pay" contracts that would attract much international funding. Instead, there is a much weaker promise to buy, which is acceptable so far mostly only to local banks. (Some foreign environmental funds will invest for "green" reasons in limited amounts.) A typical Vietnamese loan will be about 10% interest for ten years in local currency while foreign loans can be lower cost and more favorable terms. This raises the cost of renewable energy due to the faster payback period and higher interest rate by as much as 3-5 cents per kWh. Third, the developer in Vietnam has to build a transmission line to the grid from the project while in India, the grid comes to the project. Taken together, these PPA policies at least double the cost of solar and wind electricity.

10. The high feed-in tariff is slated to expire in mid-2019 for new projects starting after that date and it should not be continued. The only way for renewable energy to play as large a role as in other countries is by lowering its costs and improving the grid and thus the certainty of power supply contracts so that solar and wind electricity can profitably be sold for less than coal. Working on ways to integrate renewable energy with existing sources, and supplementing storage with batteries, would help Vietnam reach higher economic levels of renewable energy.

11. By strictly applying existing laws, if a developer fails to get a signed power project within one or two years, the province should recall the land for auction. By lowering feed-in tariffs but strengthening the PPA commitment to buy electricity, lower-cost international funding could be attracted. By having EVN or the government arrange for land rights for connecting lines from the project to the grid, the costs and delays associated with grid connections would be reduced. These steps would help EVN get lower-priced energy and increase their incentive to improve the grid more rapidly. If finance were short, minority FDI or top-tier Vietnamese private company investment in transmission could be negotiated, including storage. Direct Power Purchase Agreements (DPPA) of green energy to FDI firms that want to buy it would add another mechanism to help speed a transition to a more robust energy mix.

12. By lowering the cost of and boosting the investment in solar and wind; rapidly improving the grid and storage; and lowering the growth of demand through steady but modest annual price increases and tiered pricing to encourage efficiency programs, it

should be possible to substantially reduce the amount of thermal capacity needed in the next decade while keeping financial costs reasonable. Coordination of grid capacity and renewable production should be part of the licensing process.

VIETNAM'S CRISIS OF SUCCESS IN ELECTRICITY

Background

Vietnam has increased the supply of electricity to its economy since 2000 by eight times and extended supply to virtually every village. EVN, the state monopoly utility, has reduced blackouts and increased the quality of electricity since 2010. In 2018 it will have produced more than 2200 kWh per capita, which while just less than half of that of China, surpasses that of India and Indonesia and is approaching that of Thailand – all of which are richer than Vietnam. Vietnam's growth rate of electricity in 2018 is 10%, which would double use in seven years. Longer range projections in the Power Development Plan revised (PDP7), from 2020 to 2030, project an 8% annual growth. This growth rate is faster than that of other Asian economies, many of which have electricity growth rates below that of GDP growth due to realistic pricing, conservation and efficiency programs.

Vietnam compared to its neighbors is different with respect to electricity in several other ways. It has much less renewable energy per capita (excluding large scale hydro) than any other neighbor. It has had a rapid growth of coal for generating electricity with 75% growth in coal use from 2012 to 2017, while China declined and others were slower. (See Appendix 4.) The current (PDP-7, revised) energy plan projects further rapid growth in coal at a time when neighbors and indeed most of the world are reducing or slowing coal use, due as much to economics, government assessment of proper pricing structures and local pollution concerns as climate issues.[2] (See Appendix 4.)

Another key issue is that Vietnam has chosen to price energy lower than its neighbors and close to average cost, using low cost legacy hydro power to soften the higher costs of new thermal plants. But this means that expansion is costly and requires continuing and unpopular price increases. It also helps to explain the extremely inefficient energy consumption – Vietnam uses twice as much electricity as Thailand to produce the same amount of real output.[3]

While Vietnam's solar and wind power production are historically low, they are set to increase due to high feed-in tariffs announced in recent years. While new coal plants are priced at 7-8 cents per kWh and LNG perhaps a half-cent more than coal, onshore wind power is now priced at 8.5 cents per kWh and solar at 9.4 cents. These high prices for solar and wind are double or more than those of auction prices in India or Chile and have induced a huge number of proposals – more than 25,000 MW – at a time when

[2] An excellent 2016 study on coal pollution is "Synthesis Report on Socio-environmental Impacts of Coal and Coal-fired Power Plants in Vietnam" (https://hal-enpc.archives-ouvertes.fr/hal-01441680) Minh Ha-Duong is the lead author. It describes the negative results of burning large amounts of coal on economic activity and health.

[3] Some argue that the unmeasured economic activity of Vietnam is so large that comparisons are not fair. However, studies of the informal sector suggest Indonesia and India have even larger unrecorded output and they also have much lower use of electricity per unit of output in spite of higher measured GDP per capita.

total capacity is only 48,000 MW (48GW). EVN objects, truthfully, that it cannot transmit so much on its existing grid and is reluctant to sign "take or pay" contracts that would commit it to buy electricity it cannot move to where it could be sold. However, it is unclear how much of a priority they place on improving the grid so that more solar or wind energy – primarily produced in the southern third of the country – could be bought, moved and sold to customers. There is no doubt that it is not easy to move from a model where central power plants produce power as needed to one where they adjust to accommodate fluctuating renewable energy output. In any case, such a change does not come naturally to a cash-strapped utility.

Change, however, may be forced upon EVN. Air pollution levels in many Vietnamese cities exceed WHO guidelines and are already unhealthy. Burning tens of millions of tons more coal will make air quality worse, even with somewhat improved boilers and pollution control equipment. Local governments in the south – including the Mekong Delta, HCMC and nearby provinces, and even Ninh Thuan all have asked for either LNG generation and/or renewable energy rather than new coal plants. Simply saying no to such requests and failing to upgrade transmission lines will result in energy shortages, possibly as soon as 2019. While some relief can come from using high-cost diesel generation and importing energy from Cambodia and Laos, it is not likely to be an adequate response.

The Government should find a different path than the coal-centric one which is now planned and has been used in recent years. A cleaner path would have lower total costs for Vietnam.

This paper will first document the facts with respect to Vietnam's lavish electricity consumption pattern, its limited renewable deployment and PMP7's reliance on coal for new power. It will examine the logic of feed-in tariffs compared to auctions as a way to buy electricity not produced by EVN. It will suggest reasons why renewable energy in Vietnam is so expensive and ways to reduce its cost. If the costs of wind and solar fall to a level well below that of coal, the costs of integrating them, even in considerable amounts, into a reliable, year-round electricity system would be more attractive. However, this does not mean that all future electricity can come from renewable sources. Some combination of gas and current coal will be needed unless conservation and efficiency programs more realistically reduce projected energy demand. Such conservation is entirely possible but not within the scope of this paper.

Vietnam's Electricity Situation

Vietnam has increased its production of electricity from 26.7 million in 2000 to 208 million kWh in 2018, a growth rate of more than 12% a year. Per capita production rose from 347 to 2213 kWh per capita, a six-fold gain. Virtually every village is connected and the quality of electricity is improving according to the EVN 2017 Annual Report.[4] Retail

[4] According to the EVN 2017 Annual Report, p. 22, the duration of outages declined 80% from 2012 to 2016 and the number of times power was cut fell 73% in the same period. Total transmission and distribution losses also fell from 9.2% to 7.6% over those years.

prices of about 7.5 cents per kWh are set by the government and have been slowly growing in local currency terms - 45% from 2010 to 2016 – a decline in real terms after adjusting for inflation - but currency depreciation has cut the rate of dollar price increase to just 22% in those six years. Most costs of new electricity involve foreign currency costs for the generating equipment and fuel. EGAT, the profitable Thai utility, charges 12 cents per kWh for generation and transmission and distribution. If EVN were a private company it is likely a regulatory board would allow 11-12 cents a kWh for its average retail price. EVN reports a nominal profit by averaging in low cost historical hydro power with newer and more costly thermal power. However, this means that fast growth causes a smaller portion of total power comes from low cost hydro sources and a growing portion from higher cost thermal sources, largely coal. This requires constantly raising prices. Pricing power close to its marginal cost – the cost of new capacity and delivery – is a better strategy. Subsidized pricing for those with little consumption would soften the impact on the needy.

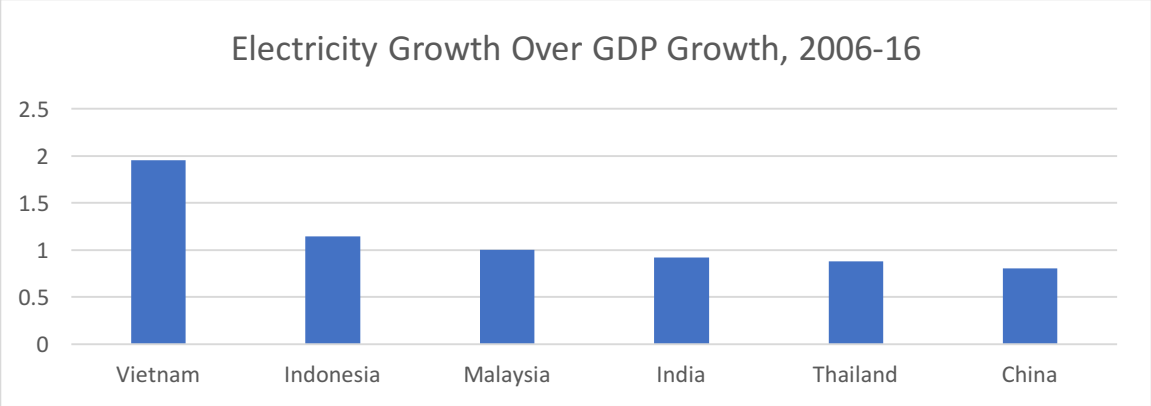
The financial cost of new coal is negotiated at 7-8 cents per kWh – about half from Chinese supplied and financed generation stations, with the balance mainly from Japan and South Korea. While China is slowly reducing its own coal use, it is aggressively financing the export of coal generating units abroad. The marginal cost of power from new coal is about 4 cents per kWh – the cost of fuel and maintenance costs associated with operations. Coal burning is associated with the production of ash and air, water and soil pollution. These are all local or national costs, separate from any consideration of carbon dioxide and separate from the price paid by EVN. Estimates in the US put the pollution cost of coal burning for power generation at more than 3 cents per kWh – this is in addition to financial costs of fuel and capital. If a similar cost applies to Vietnam, then the total financial and pollution cost of coal-fired electricity is 10-12 cents per kWh. Since US coal plants have significant coal pollution control equipment not always found or used in Vietnam, it would not be surprising if pollution costs in Vietnam were higher.[5]

This paper does not consider a carbon pollution tax in comparing coal with other sources of electricity, even though Vietnam has committed to reducing carbon emissions by 8% to 25% (with international aid) by 2030 compared to a "Business as Usual" scenario. The October 8, 2018 report of the UN IGPCC (http://ipcc.ch/news_and_events/pr_181008_P48_spm.shtml) predicted earlier and much more severe damage from climate change, including to low-lying areas such as much of the Mekong Delta. It suggested that drastic efforts to reduce the potential damage from rising global temperatures associated with increasing carbon dioxide levels were needed and still just barely possible. If concerted international action were called for in the next decade, carbon-heavy investments could be exposed to possible carbon taxes or other measures. This is a potential ***financial*** risk which is one reason

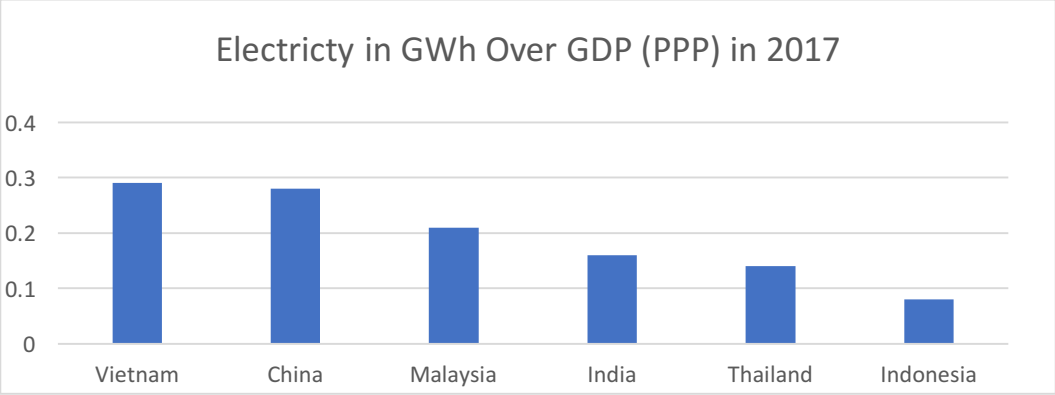
[5] Beyond electrostatic precipitators and scrubbers for sulfur oxides, mercury control devices are required in the US which can cost $400 million per generating plant. Ash disposal also remains a concern for local communities. In Tra Vinh, the 30 hectares set aside for ash storage from a recently opened coal plant are already 2/3 full and heavy metals are a concern for local agriculture and fish and shrimp growing.

why many western banks and investment funds have stopped financing coal plants. There is a real risk that a coal-centric strategy could end up with Vietnam having stranded assets that are no longer economic.[6]

The increase in electricity demand in Vietnam is much higher than in comparable Asian economies, even when correcting for the GDP growth. The graph below shows the growth of electricity from 2006 to 2016 divided by the GDP growth rate over the same period. (Data from BP and World Bank.)



The graph shows that Vietnam uses about twice as much electricity per unit of growth as its neighbors. Since many of them are more urban and have more industry, both of which use more electricity, this difference is even more surprising. Nor is it because Vietnam's electricity use is so low per capita – India and Indonesia have higher GDP per capita but have much lower electricity use per capita. Indeed, at projected rates Vietnam will overtake Thailand's per capita electricity use in a few years even though Thailand has 2.5 times Vietnam's income level per capita. When the use of electricity is divided by GDP at comparable international prices, Vietnam is more energy-intensive than any of its neighbors as well:

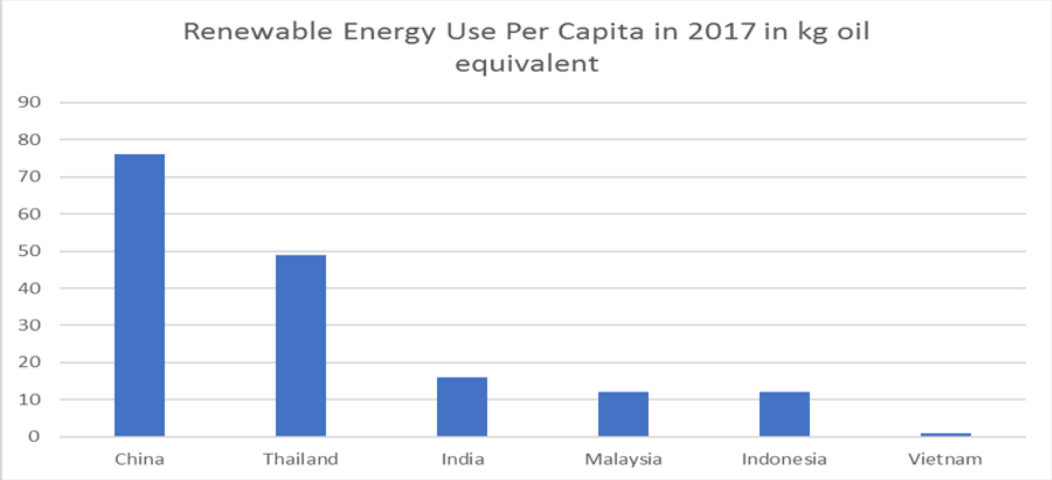


Sources: BP Statistical Review of World Energy 2018 and World Bank PPP GDP data.

[6] It is true that China, India and the US are not agreeing to curtail coal use, but the US cut coal use by 20% in five years in favor of gas and renewables, while China's use declined from 2012-17 and India's slowed. They are preparing for a climate tax while Vietnam is not.

Vietnam is more energy intensive per unit of output now and is using about twice as much electricity to get equal amounts of extra output. Its projected energy use is well above likely GDP growth, making it one of the least energy efficient economies in the region – and becoming more so over time. This creates tremendous pressure on EVN to invest heavily in production when more efficient use of electricity would almost certainly be less expensive and certainly be less polluting. Lowering the growth of electricity to the GDP growth rate should be entirely possible – it is in fact normal for virtually all large Asian economies.[7] An effective efficiency effort would create much more time for EVN to update its grid and develop a technical ability to use other sources of generating capacity. Raising electricity prices in a predictable way in a tiered structure paired with a public education campaign could help.

The other way in which Vietnam stands out is their historically extremely limited use of renewable energy, excluding large hydro. The following graph, using energy data taken from the 2018 BP Statistical Review of World Energy Report, shows the per capita production of renewable energy by country in 2017.[8] Clearly, Vietnam has not developed renewable sources to any significant extent, at least through 2017. In 2018, EVN signed renewable contracts for 2271 MW of capacity, or 4% of expected 2020 capacity.



[7] Only Bangladesh is at all close to Vietnam, with a 9% electricity demand growth over the last decade, but with less than 500 kWh per capita (Vietnam has more than 2000 kWh pc), it is normal to have electricity demand grow from such low levels.

[8] This includes solar, wind, biomass, geothermal and small scale hydro. In 2017, global wind capacity was 514 thousand MW and solar capacity was 391 thousand MW. Annual additions are 50-100 thousand MW each. The industry no longer needs high feed-in tariffs as scale economies have been achieved.

Current Plans for Capacity Expansion

The current Power Development Plan 7-revised was released in 2016. It is expected to be replaced by PDP-8 in late 2019. The current plan forecasts coal to rise from 34% of all electricity generated in 2015 to 53% by 2030, Gas and hydro fall from 30% each in 2015 to 17% and 12% respectively by 2030. Renewable energy rises from 3.7% to 10.7% of all electricity generated. Imports remain at 1-2% of total power and nuclear was supposed to rise from zero to 5.7%, but those plans have been suspended. Normally, nuclear and coal are substitutes as both are used for base load generation, so coal's share could approach 60% by 2030 if it replaced nuclear. Total capacity in 2030 is planned to be 130 GW, up from 38.6 GW in 2015, a compound growth rate of about 8.5% a year.[9]

The relative decrease in large-scale hydro is easily explained. There are not many large sites left for development. For gas, it is more complicated. Vietnam has significant offshore deposits of gas which it has not developed and exploration has suffered. Though it would take 5-7 years to develop them once all the required contracts are signed, they could provide a greater share of electricity than scheduled. One reason progress has been slow in signing development deals is first, it is often said it is too expensive to develop offshore fields –$10 billion or more – with gas prices of $5-6 per thousand cubic feet of gas. (PVN is saying the same for Block B) However, the slowdown in exploration is because the Government has decided that offshore gas must be heavily taxed, apparently by $3-4 per thousand cubic feet in addition to the $5-6 price. At that price of $9-10, gas has been viewed as too expensive and is not developed. In contrast, imported coal is barely taxed at all and a similar tax on coal's thermal content as gas would amount to $100 a ton! That would also make coal uneconomic. So a decision to tax offshore gas but not to tax imported coal is what makes coal competitive. Gas – a domestic asset - has far fewer environmental drawbacks and is less carbon-intensive than coal, and with exploration, greater potential. The government could reexamine these policy decisions.

Another possibility is to import LNG – liquefied natural gas.[10] This is an internationally traded commodity, like coal, and imports are typically arranged under long-term contracts since the specialized ships carrying LNG and degasification terminals are expensive. LNG from the US would probably cost the exporter about $6-$7 per thousand cubic feet (the price in the US is only $3-$4 but liquefying and transport add $3 to the cost), but LNG's price in Asia is bid up or down depending on demand from China, South Korea and Japan. It appears that LNG electricity is more expensive than what EVN is paying for coal-fired electricity.[11] However, it can be used more easily with renewable

[9] The 2016 GIZ Report, "Vietnam Power Development Plan for the Period 2011-2020: Highlights of the PDP revised" provide the data in this paragraph. The report is based on the PDP-7-revised.
[10] If Vietnam needs to bargain with the US to reduce its trade surplus and maintain access to the US market, importing LNG from the US would be one way to show "good faith" in highly transactional negotiations.
[11] We were told by MOIT that replacing 6000 MW of coal with 6000 MW of LNG would raise system-wide electricity costs by 0.6%. Since 6000 MW is about a tenth of total 2020 capacity, this

sources since gas generators cycle up and down more quickly than coal boilers, adjusting to varying supply from solar and wind sources. This is also true for hydroelectricity.

The plan to have about 10% solar and wind by 2030 is not aggressive – India plans to have more than 20% solar and wind generated electricity by 2022 – and a detailed study suggests that even India's coal-centric grid will be able to take wind and solar of 175 GW of total capacity without major changes to the grid, though predictive modeling and better controls of coal plants will be incorporated.[12] Of course, as a more developed market, India has an auction system and is getting solar bids at less than 4 cents per kWh, which is cheaper than coal. It will actually lower total system costs by using cheap solar and wind. China plans to have 20% renewables by 2030 and is now getting solar bids for less than 5 cents per kWh.[13] Developers in Vietnam claim that the costs of renewable in Vietnam are at least twice as high as India, and have successfully argued for high feed-in tariffs of 8.5 cents per kWh for onshore wind and 9.4 cents for solar. Why should Vietnamese costs be so much higher than costs in India?

Reasons for High Renewable Costs in Vietnam - PPA

When high feed-in tariffs were announced, there was a surprising response from firms wishing to supply renewable electricity – more than 20,000 MW of solar project proposals were submitted. This is a third of 2020 generating capacity and far more than the grid can currently absorb – most solar and wind sites are some distance from major cities that need that much power. But, in addition, there was a rush at the provincial level to hand out land licenses to local developers. Most of the "developers" were said to lack capital or expertise in building large solar or wind projects. They hoped to sell their rights or co-invest in the projects by taking a share based on their license rights. The actual developer would have to provide all capital and expertise but give up 10-20% of the ownership share, or so we were told in interviews. In India, land costs are only about 5% of project costs, even though India is more densely populated.

Since EVN was not in a position to transport so much renewable energy, it is reluctant to sign firm "take or pay" contracts for it. Instead, the contracts allowed them to take only so much as they needed or were able to absorb. These contracts are not acceptable to most international banks or investors. Therefore, it was local banks and firms that had to provide the capital for most projects that were licensed. Local banks have higher interest rates and shorter terms than international banks. A typical local loan is about 10% a year for ten years rather than 6-8% for 15-20 years from commercial international sources – with Export/Import Bank financing is even cheaper. (US Export/Import Bank

implies a 6% higher cost than coal. That is roughly 0.5 cents per kWh more than coal. Other news-based estimates are 10 cents per kWh for LNG.

[12] "Greening the Grid: Pathways to Integrate 175 GW of Renewable Energy into India's Electricity Grid" – Volume I, National Study, June 2017, India Ministry of Power and USAID. A similar study for Vietnam is needed,

[13] China Is Slashing Its Subsidies on Solar Power, Forbes, 6/18/2018, Jill Baker

financing had interest rates of 4.2% for 18 years in October, 2018.[14]) If a 100 MW project costs $1000 a kilowatt, the total cost of the material and construction is $100 million. (These are typical costs.) To show the impact of different costs of capital, consider a 100% debt financed project. (In practice, debt is about 70-85% and the rest is equity, which has a higher capital charge.) The table below shows annual interest costs and the term of the loan available.

Annual Payments on a 100 MW/ $100 Million Project		***Cost per Kilowatt-hour***
10%/10 years (Local)	$16.3 million	9.6 cents
7%/15 years (Foreign/commercial)	$11.0 million	6.5 cents
4.2%/18 years (Foreign/ Ex-Import Bank)	$ 8.0 million	4.7 cents

If the project produced 1700 kWh a year per kilowatt of capacity, it would produce 170 million kWh a year. The different repayment costs per kilowatt-hour are shown in the table. Clearly, if contracts were written so that international loans could be used, the repayment costs would be much lower. Note that this table is only illustrative – actual world-wide interest rates are rising and equity finance typically has a capital charge of 12-15%, so the actual cost would have to be calculated for an actual project.[15] There is also the important complication of foreign exchange risk. Since the dong has been slowly depreciating against the dollar[16], dollar-based loans have to be adjusted if the revenue is in local currency. There could be hedging (a kind of insurance) or simply adding 3% a year to the dollar interest rate to offset the expected depreciation. With a depreciation adjustment, the main advantage of international commercial lending is its longer term and the spreading of risk away from Vietnamese banks who might otherwise put "too many eggs in one basket" and face high losses if problems developed with renewable energy loans.

There is a third factor which explains why Vietnam has high renewable energy costs. The transmission line from the project to the national grid has to be built by the project developer. He (or she) has to negotiate with each land holder along the route that the project-to-grid line will take and pay them for the land or rent it for 10-20 years. In addition, the developer must pay the cost of building the high voltage line from the project to the grid. A 110 kilovolt transmission line is $400,000 per kilometer so a 25 km line would add $10 million in construction costs plus land acquisition costs. This would add at least 10% to the cost of the 100 MW project.

Putting the three factors together under the PPA – land speculation taking up the best sites; higher interest rates due to contracts which do not satisfy international standards,

[14] The recently imposed tariffs on solar panels make the US a bad choice for exporting solar equipment, but other countries have Export-Import financing at roughly similar rates.
[15] While the blended cost of loan and equity capital would be higher, the actual cost of panels and reasonably priced land could well be lower. Solar panel costs are falling 20-30% in 2018.
[16] The dong exchange rate at the end of 2008 was 17,000 = $1 and it was $23,300 = $1 in October 2018, an annual depreciation rate of 3.2%.

insufficient take or pay guarantees, and transmission line requirements – it is clear that renewable energy costs are higher than need be. Roughly speaking, these costs at least double the cost per kilowatt hour that would otherwise be possible.

Measures to Reduce the Cost of Renewable Energy in Vietnam

There are steps that could be taken so that the cost of renewable energy falls to levels closer to those of other countries.

1. For land, the current national "use it or lose it" regulation should be strictly applied once the investors fail to implement their proposed project within a year, or sometimes two years, since the granting of investment license. The province could then auction the land to developers who wanted to build the projects. Evidence might be required that the bidder has some capacity to develop the project and is not a speculator. EVN and the Generating Companies [or Gencos - SOE owners of generating capacity spun off from EVN] should be allowed to bid for provincial land on an equal basis if they plan to invest in renewable energy themselves.
2. For contracts, there is no financial incentive for EVN to buy large amounts of power at prices higher than coal, or indeed higher than its retail price of electricity. The high feed-in tariffs are loss making for them, and while they are a SOE they need to be credit worthy and thus are not be eager to buy high-cost power which requires billions of dollars of grid investments. By emphasizing real but manageable grid connection problems, they can and likely will resist signing contracts that worsen their situation and put pressure on retail electricity prices. The solution is to lower the cost of renewable energy by reducing the fixed price and eventually allowing auctions, but this requires solving the problems in the PPA. The private sector thinks auctions have been shown to not work until there is a market developed and thinks it is too early for EVN to go to auction. Even the World Bank is coming to the conclusion that EVN can't be ready soon for auctions. Alternatives are to have auctions but with a minimum share set aside for wind and solar; lower renewable feed-in tariffs with stronger contractual certainty that output will be bought; or to have a truly neutral party manage the auctions. Of the three, perhaps a lower feed-in tariff with a firm contract would be preferred by developers in the next few years.

If Vietnam decides it wants to move towards a high proportion of renewable energy, as other countries are doing, it should find a way to sign contracts that attract international funding and reap the benefits of longer term loans and lower interest rates, at least from Export-Import Banks. If it is content with a small fraction of renewable energy, it will maintain the current practice of signing contracts that put more uncertainty on the developer and lender at the cost of excluding most international financial participation. But then renewable energy will be more expensive than it might be and also more expensive than coal, at least at current solar panel costs.

3. For transmission lines connecting the solar or wind project to the national grid, various remedies exist. The government might take over land acquisition

responsibility and/or pay for the first several kilometers of transmission lines or cost-share with the developer. Having smaller projects close to each other sharing a single transmission line is already being explored and is another step that would lower the effective cost of renewable energy. If the cost come in at 4-6 cents per kWh, that would be cheaper than the current fixed coal price – though the variable nature of renewable power imposes extra costs on EVN relative to thermal or hydro, which can be called upon as needed. It is likely that if EVN followed India in predicting the amounts of renewable energy and setting their coal, gas and hydro to combine with renewable energy as it became available, it would be possible to utilize much more renewable energy at a reasonable cost than is currently planned for, especially in the south.

An important aspect of renewable energy in Vietnam is that many of the best solar and wind locations are in the southern third of the country. This lies within a region that has a relatively high share of offshore gas and hydro sourced energy relative to coal. Since gas and hydro can be cycled up or down more quickly than coal can, they work better with renewable energy. While this by no means eliminates the challenges associated with integrating renewable energy – there would still have to be an upgraded grid to carry more power – it should make it easier to manage the integration at a reasonable cost.

If EVN found it hard to invest enough or rapidly enough in the grid, it could (if allowed) welcome foreign investment as a minority interest in upgraded transmission lines. The contract would allow a transmission fee for a specified distance and amount, payable to the foreign investor. Control could remain with EVN. The FDI or domestic private investment could include batteries or other energy storage which would help stabilize supply and extend the availability of solar and wind beyond the periods when they are generating. Such stored renewable peak period supply will soon, if not already, be cheaper than keeping seldom-used excess thermal capacity. Diesel power, for example, costs more than 25 cents per kWh.

Another issue relevant to the South, but also to other regions, is to allow DPPA or direct sales of green energy to firms that prefer to buy it. Many foreign companies want to reduce their carbon footprint and are willing to pay extra for that. If a solar or wind developer or group could send their energy to a willing buyer at a negotiated price and wheeling fee, that would help speed the development of clean energy and investment in the grid, since EVN (and any foreign partners in the grid) could be paid for such transport. Such direct sales require no government money and could be a simple regulatory change.

Similar comments apply to allowing sales from rooftop collectors in apartments, industrial or office buildings to nearby consumers in a compact area, such as an industrial zone. Current regulations discourage or even prohibit rooftop collector sales except to the grid. Allowing direct sales could generate several thousand megawatts of electricity with no public spending – estimates are for 6GW in HCMC alone. Since many

other countries have been able to issue supportive regulations, it would be surprising if Vietnam could not do the same.

Gas Compared to Coal for Baseload Generation

In global generic analysis, the costs of coal and gas-fired electricity are similar.[17] Coal is attracting favorable investments terms from China, Japan and South Korea as they scale down investment at home but look for international markets such as Vietnam and the Philippines. In Vietnam, it appears that gas-fired electricity using LNG is somewhat more expensive than coal if only EVN's financial costs are considered, though it is not clear why costs are higher than in other LNG importing countries.

The WHO in 2018 released a study[18] finding 60,000 excess early deaths in Vietnam in 2016 due to air pollution. While coal burning significantly contributes to that total, so do vehicles, industrial production and even agriculture from burning wastes. However, increasing coal burning would certainly add to the total air pollution and thus death and disease. Another study examined plans to increase coal burning in Southeast Asia and predicted almost 20,000 deaths a year in Vietnam from coal by 2030.[19]

There is no doubt that coal burning has a higher health and environmental cost than gas. There are little or no particulate emissions from natural gas and nitrogen and sulfur oxide emissions are also lower.[20] (Of course, carbon pollution is also less, but that is more of a global problem.) Pending future research, it would be reasonable to conclude that the local pollution costs of coal are higher than gas and would make the total cost (financial + pollution) higher for coal relative to gas. Since gas can be imported as coal is now or produced in Vietnam if offshore deposits are developed, it is or ought to be considered as a preferable competitor to coal, especially given the concern of the public towards new coal plants. Since gas is both used for baseload and quickly responsive to changes in demand or renewable supply, it is a strong contender to be a larger part of the energy mix. This is the direction China is taking already. However, ultimately it is the

[17] https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf Even if $3 per thousand cubic feet is added to the US gas cost, that brings total gas-fired electricity costs up to 6 cents per kWh, still less than coal. The cost of gas relative to coal is critical in determining which is cheaper in financial terms.

[18] http://www.wpro.who.int/vietnam/mediacentre/releases/2018/air_pollution_vietnam/en/

[19] https://pubs.acs.org/doi/pdf/10.1021/acs.est.6b03731

[20] The Union of Concerned Scientists wrote: "Cleaner burning than other fossil fuels, the combustion of natural gas produces negligible amounts of sulfur, mercury, and particulates. Burning natural gas does produce nitrogen oxides (NOx), which are precursors to smog, but at lower levels than gasoline and diesel used for motor vehicles. DOE analyses indicate that every 10,000 U.S. homes powered with natural gas instead of coal avoids the annual emissions of 1,900 tons of NOx, 3,900 tons of SO2, and 5,200 tons of particulates [7]. Reductions in these emissions translate into public health benefits, as these pollutants have been linked with problems such as asthma, bronchitis, lung cancer, and heart disease for hundreds of thousands of Americans." Found at: https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas#.W8TwG_lReUk

government that sets the relative price of untaxed coal and heavily taxed gas, while the public absorbs pollution costs.[21]

The other aspect of gas is that a single-cycle unit can be installed in less than a year and a combined cycle (more efficient) unit in two or three years. This allows supply to be matched more closely to actual demand and reduces the risk of overbuilding due to a global slowdown, shift to services that use less electricity, greater efficiency or greater role of cheap renewable energy. See Appendix 1 for examples of why gas and/or renewable sources have less risk than coal in a financial sense.

SUMMARY - OPTIONS FOR THE FUTURE

Demand

Vietnam's PDP8 should reexamine revised PDP-7 that projects electricity demand to grow at 8.8% from 2018 to 2030. Electricity demand would jump in that plan from 208 GWH in 2018 to 569 GWH in 2030. Vietnam's per capita use of electricity would rise from about 2200 in 2018 to 5400 kWh per capita in 2030. Hong Kong had electricity consumption of less than 6000 kWh per capita in 2017 – when its per capita income was $60,000. Vietnam's PPP GDP per capita is less than $7000 and may double in the next twelve years. Is it reasonable to approach per capita electricity consumption levels of an economy several times richer?

Again, it would be reasonable for Vietnam to aim for electricity demand growth about equal to GDP growth. At 7% a year growth, total electricity production would grow to only 468 GWH, saving 101 GWH compared to business-as-usual. Per capita demand would still rise sharply to 4400 kWh, while Vietnam's PPP GDP per capita would be in the $14-$16 thousand per capita range by 2030. A major decision point is if electricity demand should grow "as usual" or slow down to reflect the nearly universal experience of other Asian economies.

In order to encourage energy efficiency, EVN should ideally raise the price of retail electricity to reflect the cost of new production and its delivery. This is likely to be 10-12 cents per kWh, the same as Thailand's utility. Getting there eventually is more important than trying to get there fast. Very rapid electricity price increases generate dissatisfaction and are difficult to implement. Single digit annual price increases in percentage terms, somewhat higher than in the recent past, are likely to be acceptable if combined with an explanation that EVN is choosing cleaner sources of energy and the price for initial kWh use remains lower for the disadvantaged. Simply announcing that electricity prices will rise slowly but steadily will signal to both household and industrial consumers that it will pay to invest in more efficient equipment. Helping with information, labeling, and even loans for such equipment will hasten its adoption. There are ample examples of successful conservation programs in China and other countries.

[21] Coal has historically been untaxed or lightly taxed while gas has historically been more heavily taxed due to its profitability. This habit could be re-evaluated so equal taxation of thermal values allowed efficient decisions.

Combining gentle but predictable price increases with nudges and information would help Vietnam's electricity demand slow down and its efficiency rise.

Supply

Even with slower growth, a lot of new capacity will be needed. Each new Power Development Plan will consider coal, gas and renewable energy. If renewable costs, particularly for solar, continue to decline rapidly, the renewable price advantage (with supportive policies) will grow over time.[22] If a *political* decision were made to opt for higher shares of renewable and gas-fired electricity relative to coal, it is unlikely that system-wide costs after 2020 would be very different in financial terms. With pollution costs and financial uncertainty considered, a choice that reduces coal's role would certainly be less costly and less risky.

At the very least, Vietnam may ask itself why it is almost alone among its neighbors in choosing a path that heavily uses a fuel more associated with previous centuries and widespread public health problems than with future energy use in middle-income economies.

A point not always incorporated in comparing renewable energy with coal is the time to completion. Once land access issues are settled, it is quite possible to implement a solar or wind project within one year or even less. A green-field (new site) coal plant will take at least four years and often five or more. Thus, an uncontested decision to build a new coal plant now will result in available energy in 2022 or 2023. It could take even longer if the province objects to the coal plant. A decision to build even cheaper renewable energy early in 2021 will result in power available in late 2021. The *future* (and lower) price of renewable energy should be compared to the *current* price of coal plants.

It is likely that the world will face an economic slowdown that would depress Vietnam's exports and overall growth rate. Being able to adjust electricity supply to demand by delaying short-cycle capacity additions like renewables (and to a lesser extent gas) rather than being caught in a long-term coal investment cycle would save EVN and the nation a significant amount in avoided costs. This factor is already evident in both China – where coal generators run less than half of the time – and also in India.[23] Note that when coal, with its high fixed costs, runs at a low capacity utilization, the cost per

[22] Battery and other kinds of energy storage costs will also fall – these help make renewable energy more reliable, even after dark or when the wind is still. In the next decade, renewable energy will be much more smoothly and reliably supplied than it is now over a longer time period with batteries or other storage .See, for example https://about.bnef.com/blog/tumbling-costs-wind-solar-batteries-squeezing-fossil-fuels/

[23] https://www.reuters.com/article/us-china-power-capacity/china-suspends-new-coal-fired-power-plants-in-29-provinces-report-idUSKBN1880P4 states that in 2016, average thermal generating plants in China, mostly coal, operated 4165 hours a year or at 47.5% of potential. . According to https://eneken/ieej.or.jp/data/7498.pdf In India, the coal capacity utilization in 2016 was 56.7%, down from 77.5% in 2010 according to "A Tale of Three Coal Markets" by J. Nakano and S. Ladislaw, CSIS, March 2018, p. 21

kilowatt-hour generated rises. This could make coal even more expensive. (See "Box" on coal in appendix 1.)

If renewable energy does grow rapidly, there will have to be significant upgrades to the physical capacity of the grid and also to its ability to carry and incorporate information about varying supply and demand levels. Budgeting for serious grid investments, predictive modeling and energy storage is part of a transition to a cleaner energy mix. It would also help poor provinces like Lai Chau. There are 18 hydro projects waiting for transmission lines so they can start construction. The poor province would get construction jobs and income from the improved grid – and private investors would fund the dams.

If investments are made in the grid and storage, EVN would have incentives to buy renewable energy and hydroelectricity first. The marginal costs of solar, wind and hydro are close to zero and even a price below four cents, the marginal cost of coal (fuel and variable maintenance) is still a gain for the renewable developer, while a price below four cents is a loss for the coal plant. There is also no pollution from renewable energy and hydro, while there are significant costs to disposing properly of ash, controlling local air pollution, and the impact on local water supplies. Taking both financial and external pollution costs into account, EVN and Vietnam would be better off calling on renewable and hydro power first and limiting the amount of power that is not dispatched (used) when it is available from clean sources. The choice between coal and gas is more complicated and should be approached as a Levelized Price of Electricity modeling to be determined by a variety of factors, including local pollution levels, costs, tax revenues, available supply and local demand, and base load adjustability of the various plants. An important complication is that EVN may have entered into long-term coal purchase contracts and these will increase the cost of not using coal. However, curtailing new coal investments will help allow existing plants to produce with their contracts while limiting future liability.

The expansion of grid capacity and improving the agility of the grid to respond to demand and supply fluctuations will not be cheap. Foreign and top tier domestic companies, could partner with EVN to invest in grid upgrading and storage if firm contracts were written to reward higher electricity transmission volumes and storage for peak periods. This could speed the ability of EVN to sign firm supply contracts with solar and wind developers.[24] If firm contracts were signed, the feed-in tariff should be lower to reflect reduced risks. There will be a chance to reassess feed-in tariffs after June 2019.

[24] Another option would be for a private firm to build transmission lines from projects to users and negotiate with the solar/wind producer (which could be itself) and the consumer. This option would require a change in law.

If sensible steps are taken to reduce renewable costs to those of other countries, a large amount of incremental power could come from solar and wind by the 2020's. If this is combined with serious efficiency policies, it is likely that a much more modest role for coal and gas would be needed even while controlling costs and improving pollution emissions. The argument that renewable energy is too uncertain and experimental is no longer valid, though changes in grid infrastructure and management would be needed to make the transition to reliable, cleaner and ultimately cheaper energy. The question is if Vietnam wishes to make the transition as fast as other Asian economies or more slowly.

The Costs of a High Feed-In Tariff

High feed-in tariffs are justified if a technology is just getting started or if institutional costs are high and scare off potential investors. In Vietnam, the decision to offer solar electricity prices more than double Indian auction prices has falsely persuaded many in EVN that solar is too costly and experimental for large scale use. It also gives the opportunity and incentive for government officials to require developers to pay to get on approved project lists. In general, honest government comes not only from enforcing legal procedures but also creating conditions that do not create "rents" or excess potential profits that are selected by administrative decisions. If a lower feed-in tariff is combined with serious steps to reduce costs for land and capital, there would be less excess profit and less opportunity to demand side payments. Ultimately, fair auctions are a solution, after a stable market mechanism is developed. Ending the high feed-in tariff after June 2019 is wise and should be followed by joint efforts to lower costs and improve certainty of contracts.

BIBLIOGRAPHY

Synthesis Report on Socio-environmental Impacts of Coal and Coal-fired Power Plants in Vietnam, Minh Ha-Duong, An Ha Truong, Hong Nam Nguyen, Hoang Anh Nguyen Trinh, 2016 found at: https://hal-enpc.archives-ouvertes.fr/hal-01441680

Burden of Disease from Rising Coal-Fired Power Plant Emissions in Southeast Asia, 1/12/2017, Environmental Science and Technology, S. Koplitz, D. Jacob, M. Ulprizio, L. Myllyvirta, C. Reid at: https://pubs.acs.org/doi/pdf/10.1021/acs.est.6b03731

Vietnam Power Development Plan for the period 2011-2020: Highlights of the PDP 7 revised, GIZ, 2016, http://www.gizenergy.org.vn/media/app/media/legal%20documents/GIZ_PDP%207%20rev_Mar%202016_Highlights_IS.pdf

BP Statistical Review of World Energy, June 2018, 67th edition found at: https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review/bp-stats-review-2018-full-report.pdf

Lazard's Levelized Cost of Energy Analysis, v. 11.0, November 2017 found at: https://www.lazard.com/media/450337/lazard-levelized-cost-of-energy-version-110.pdf

Lazard's Levelized Cost of Storage Analysis, v. 3.0, November 2017 found at: https://www.lazard.com/media/450338/lazard-levelized-cost-of-storage-version-30.pdf

Fossil Power Plant Capacity Utilization Rate Falling in China, Lu Zheng, Energy Data and Modeling Center, July 2017 at https://eneken.ieej.or.jp/data/7498.pdf

Tumbling Costs for Wind, Solar, Batteries Are Squeezing Fossil Fuels, Bloomberg New Energy Finance, 3/28/2018 at: https://about.bnef.com/blog/tumbling-costs-wind-solar-batteries-squeezing-fossil-fuels/

"Solar Leader China is Slashing Its Subsidies on Solar Power – What You Need to Know, Forbes, 6/18/2018, Jill Baker at: https://www.forbes.com/sites/jillbaker/2018/06/18/solar-leader-china-is-slashing-its-subsidies-on-solar-power-what-you-need-to-know/#5d1b2b7d2f9a

A Take if Three Coal Markets: Common Challenges and Unique Attributes of U.S., Chinese and Indian Markets, CSIS, March 2018, J. Nakano and S. Ladislaw at: https://www.csis.org/analysis/tale-three-coal-markets

"Greening the Grid: Pathways to Integrate 175 GW of Renewable Energy into India's Electricity Grid" – Volume I, National Study, June 2017, India Ministry of Power and USAID; Executive Summary at: https://www.nrel.gov/docs/fy17osti/68720.pdf

"Environmental Impacts of Natural Gas", Union of Concerned Scientists, found at: https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas#.W8TwG_lReUk

"The Made in Vietnam Energy Plan: Executive Summary and Recommendations" November, 2016, a study commissioned by the Vietnam Business Forum found at: https://www.auschamvn.org/wp-content/uploads/2016/10/Made-in-Vietnam-Energy-Plan-MVEP-v12.pdf

Appendix 1: Risks Associated With Coal

One of the major risks associated with coal in India and China now is that the coal generating plants are built in anticipation of demand that does not develop. It takes 4-6 years to build a "greenfield" plant and that requires projecting electricity demand. As efficiency improves; as economies shift more to services (which use less energy); as China's growth slows down; and as renewable sources provide low-cost competition, the utilization ratio of coal generating plants falls. In India, the utilization of coal plants fell from 77.5% in 2010 to 56.7% in 2016/17. On average China's coal stations operated at less than half of capacity in 2016. This raises the average cost of coal-fired electricity since fixed capital and maintenance costs must be spread over fewer kilowatt-hours of production. If a plausible capital and fixed maintenance charge of $200 per kW of capacity per year is taken, falling from 80% to 50% utilization raises fixed costs by 1.8 cents per kWh. The marginal cost of hydro, wind and solar is effectively zero, so once their capacity is built it is only rational to use those sources first if the grid is able to take the power to where it is needed. (Foreign BOT operators of coal plants may lobby for priority in supplying EVN if they have invested in coal plants. This introduces a political complication beyond the scope of this paper.)

As a country becomes middle-income, the public becomes more concerned with pollution. Intense resistance to new coal plants is already evident in the southern part of Vietnam and, at the very least, this increases delays and costs of a new coal plant. As further evidence of public health, ash disposal, and air and water pollution issues come to light, this resistance will increase. Even EVN may begin to worry that it will have to fix the ash storage sites that will cover thousands of hectares. The record of Japan, South Korea, Taiwan and China are clear evidence that this is a risk. All of them are reducing or stabilizing coal use. The local pollution costs of coal in Vietnam are likely to be several cents per kWh, though more research is needed to confirm if Vietnam is similar to other countries in this regard. India, with a similar per capita income, put coal's external costs at 2-3 cents per kWh.

The October 2018 release of a UN climate study found that the cost and threats of rising global temperatures will grow to alarming levels by 2030 unless strong action is taken raises the likelihood of some collective international action to reduce carbon emissions. It is true that Vietnam has very low per capita carbon emissions and should not pay for the mistakes of other countries. On the other hand, an international agreement that requires all countries to impose a carbon tax or its regulatory equivalent is becoming more likely. Even if the tax is collected and spent locally, the cost of coal-fired electricity would rise by several cents per kWh in most plausible scenarios. This is why many western banks and investors are not willing to finance new coal plants – there is too much financial risk. (Each $10 per ton of CO2 tax adds one cent per kWh of tax to coal-fired electricity. Carbon taxes of $20 to $50 a ton are likely if they are imposed, though the UN Report argues for even higher carbon taxes.)

Finally, there is a risk from importing coal. Will an international carbon tax be applied at the point of export? Will national decisions to reduce coal production drive up prices? What if the currency depreciates and coal prices jump in terms of dong? These risks are not ones that have to be taken if efficiency grows or local gas deposits are developed or if solar panels are used – once paid for, there is no further drain of foreign currency.

Appendix 2: Even General Electric (GE) Gets It Wrong

GE is a major US company that helped create the electric age and is a major producer of generating equipment for coal and gas. Its stock price has suffered in spite of 7500 gas turbines world-wide, which should be a base for profitable service contracts. But its stock price has plummeted from $30 to $7 a share. Why?

According to a story in the October 31, 2018 *New York Times*:

"Energy efficiency programs and renewable sources like solar and wind have both expanded and dropped in price faster than anticipated. And further advances in battery technology could make renewables consistently reliable rather than dependent on the weather. These forces have prompted utility executives to hold off new orders for gas turbines, after years of growth***. The demand for gas-turbine power generation this year [2018] will be more than 40% less than in 2016***, analysts estimate." (Emphasis added]

GE's experience suggests that energy efficiency and renewable energy can cause large declines in the need for thermal energy – even gas-fired electricity which is displacing coal in the US due to fracking (a way of drilling) and the resulting cheap natural gas that makes even newer coal plants less competitive. But this is not just a US phenomenon – it is happening across the globe. When companies face market forces, they have to adjust to new technological and economic realities. If EVN responded to the same pressures, it would not plan for expansion of electric power in the way it does. A political decision is needed to persuade EVN to respond more to market forces, though better policy towards renewable energy and electricity pricing would be needed as well. Less growth in electricity, used more efficiently and produced in a cleaner way, would end up being cheaper for Vietnam than the alternative.

Appendix 3: The Real Price of Electricity in Vietnam Fell from 2010 to 2016

Vietnam has decided to charge less than the marginal cost of generating and distributing the electricity it sells. Instead, it charges something close to the average cost, using cheap hydroelectric projects to offset the higher cost of new thermal units. Most competitive companies charge the cost of increased production plus distribution, because otherwise they would lose money as they added more high-priced capacity.

However, Vietnam does not just undercharge compared to other ASEAN utilities like EGAT, the profitable Thai utility that charges 12 cents (plus taxes) per kWh to EVN's 7.5 cents. It often actually lowers the real price of electricity! In 2010, EVN reported 96.4 trillion dong in non-financial revenue and sold 91.7 billion kWh for a price of 1051 dong per kWh. In 2016, revenue rose to 268.4 trillion while sales jumped to 178.6 billion kWh. The price per kWh in 2016 was 1503 dong per kWh. However, in that time period, the GDP deflator rose 47%. In real terms, the electricity price in 2016 (after correcting for inflation) was 1020 dong per kWh. Over six years, real price fell. (The GDP price index rose from 100 in 2010 to 147.4 in 2016.)

We do not have audited reports for 2017 and 2018, but the estimated 2017 price was 7.5 cents per kWh, or about 1670 dong per kWh. In real terms, that is 1090 dong per kWh. So, in seven years the real price of electricity rose by ½ of 1% a year, while the cost of electricity likely increased more as Vietnam had to switch to imported coal on new plants and the share of low cost hydro fell. If Vietnam had managed to increase the price of electricity by 3% a year in real terms, EVN would be in a stronger position and financing grid and capacity expansion would be much easier. Conservation would have grown and pollution would be less.

Appendix 4: Annual Growth Rate in Coal Use of Major Asian Consumers, 2012-17

("Major" consumers use more than 10 million tons in 2017; Global consumption of coal declined.)

Declining:	Australia, China
Slow Increases:	Indonesia – 1.6% a year Japan – 0.8% South Korea – 1.4% Taiwan – 0.8% Thailand – 2.0%
Moderate increases:	India – 5.1% Malaysia – 4.7%
Fast Increases:	Philippines – 10.2% Vietnam – 11.9%

A publication of the
Ash Center for Democratic Governance and Innovation
Harvard Kennedy School
79 John F. Kennedy Street
Cambridge, MA 02138
617-495-0557
www.ash.harvard.edu