Internalizing the Externalities: Strategic Environmental Assessment of the Viet Nam Power Development Plan VII

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Abstract

This paper presents the Strategic Environmental Assessment (SEA) for the 7th Viet Nam Power Development Plan – the first comprehensive SEA to be fully integrated (ex-ante) into a power development plan in the Greater Mekong Subregion. Emphasis of this SEA was on the identification, assessment, and valuation of all principle social and environmental costs and benefits that would be likely to accrue from different power generation alternatives and mixes. Traditionally considered “externalities”, the SEA successfully integrated them into the power development planning process, leading to adjustments in the power generation source mix and revisions of the renewable energy and energy efficiency targets in the final PDP VII.

Introduction

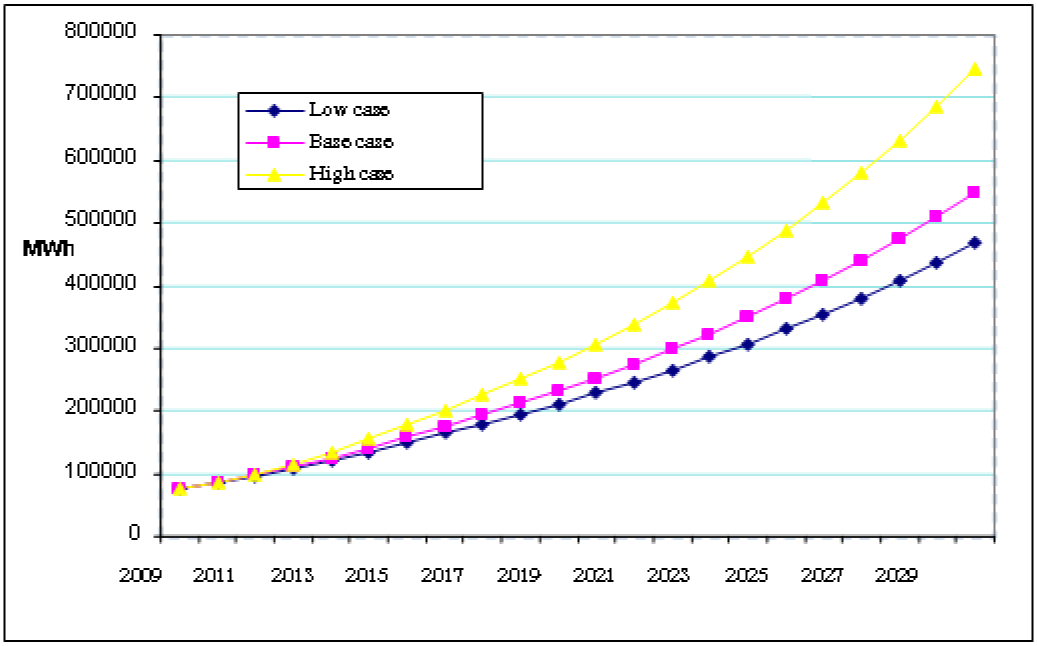
Meeting the Greater Mekong Subregions’ (GMS) demand for electricity has been fundamental to maintaining the regions rapid economic growth and development. In response, energy planners have tapped into almost every power generation source over the past decades (thermal, hydro, nuclear, renewable), but have faced challenges with regard to evaluating the environmental and social costs of these different power generation sources. Also, options for improved demand side management (energy efficiency and power systems improvements measures) remain underexplored. With these both factors underrepresentation in the energy sector’s strategic planning, existing margins for improving the economic, environmental and social performance and sustainability of the energy sector are not utilized sufficiently (optimized investment sequencing, optimized power generation mix, technology investments, and demand side management).

Strategic Environmental Assessments (SEA) have proven to be a powerful tool to assess and handle these challenges. GMS experience and national capacity in conducting SEA’s in the energy sector remains limited, but international development partners such as the Asian Development Bank (ADB) have provided active technical and financial support to establish and institutionalize SEA capacity in GMS line ministries. This has contributed significantly to SEA becoming mandatory in the strategic planning of several GMS countries, namely the People’s Republic of China, Thailand, and Viet Nam, all of which have passed legal requirements on SEA. Other GMS countries, for example Lao People’s Democratic Republic (Lao PDR), are working towards the promulgation of an SEA decree.

The SEA in PDP VII: Approach and Structure

The PDP is the national strategic development plan for power production and utilization in Viet Nam. The PDP VII provides a long-term strategic framework to guide the development of the power sector during 2011–2030 (Figure 1). It analyses likely future electricity demand scenarios by sector and takes into account likely future economic and social development trends. It also assesses the most effective, least-cost (taking into account full economic costs) methods for meeting the likely future demand.

The PDP estimated that meeting Viet Nam's energy demand for the period of 2011-2030 would require an expansion of the country's generation capacity to an installed capacity of 75,000 MW by 2020 and 146,800 MW by 2030. The projected financial costs of these expansions are huge: $69.5 billion by 2020 and $156.2 billion by 2030.



MWh = megawatt hour.
Figure 1: Power Demand Forecasts, 2010–2030

To evaluate improvements in environmental and social sustainability and related cost savings (increased performance, reduced mitigation costs), the SEA plugged into several sequential steps of the PDP process: 1) *baseline review* of existing power consumption data for each sector, 2) *amendment of power demand and supply scenarios* through with assumptions on socioeconomic development and potential savings from energy efficiency improvements (Figure 4[1]), 3) *quantification and valuation of environmental and social impacts* of major power generation sources (thermal, hydro), and 4) *identification of least-cost alternative* and related optimal power generations targets and mix.

Impact Assessment

Thermal power constitutes by far the largest component of Viet Nam's power generation, with atmospheric pollution from the combustion of fossil fuels – especially coal – being the main environmental and social risk factor. Following the PDP VII base case supply and demand projections, carbon dioxide (CO_2) and particulate matter releases will increase more than ten-fold until 2030 and sulfur dioxide (SO_2) and nitrogen oxides (NOx) will increase seven fold. It is estimated that related environmental and social impacts (e.g. acid rain, health risks and related loss of productivity) will cost Viet Nam nearly $9.0 billion per annum by 2030 (Table 1). These impacts and costs of atmospheric pollution are significant for thermal plants planned in and

[1] These and most other data in this paper are taken from "Strategic Environmental Assessment report of Vietnam National Power Development Master Plan for the period of 2011-2020 with perspective to 2030, Ministry of Industry and Trade, 2011".

around major urban areas with large populations – and particularly severe when plant clustering leads to a concentration of atmospheric pollution of several plants. Particularly thermal plants near Ho Chi Minh City and the North and Southeast of Hanoi expose such cumulative impacts and related high costs (Figure 2).

Table 1: Total Environmental Costs for Each Pollutant ($ million)

Year	2011	2015	2020	2025	2030
Particulate matter	98.86	134.95	289.57	439.40	710.24
Sulfur dioxide	93.77	148.09	311.85	448.18	728.74
Nitrogen oxides	234.15	274.48	386.09	494.30	638.86
Carbon dioxide	1,215.5	2,190.5	4,118.7	6,075.9	9,071.9

Although not a significant source of atmospheric pollution – and therefore often considered clean and sustainable – hydropower can produce adverse social and environmental impacts. With hydropower, most of these impacts are associated with the development of the scheme, resulting in loss of land and ecosystems, disruption to hydrological systems, and displacement of people or disturbance of their traditional livelihoods. The SEA's impact assessment calculated that the 21 hydropower candidate plants identified in the PDP will submerge an area of 25,133 hectares, with an estimated economic value of goods and services of around $75 million a year. A total of 61,571 people would be displaced if all 21 schemes are constructed; two thirds of them displaced by four particular hydropower plants: Ban Chat, Bac Me, Huoi Quang, and Lai Chau. Over 90% of the displaced people are ethnic minorities with a poverty rate more than twice as high as the national average.

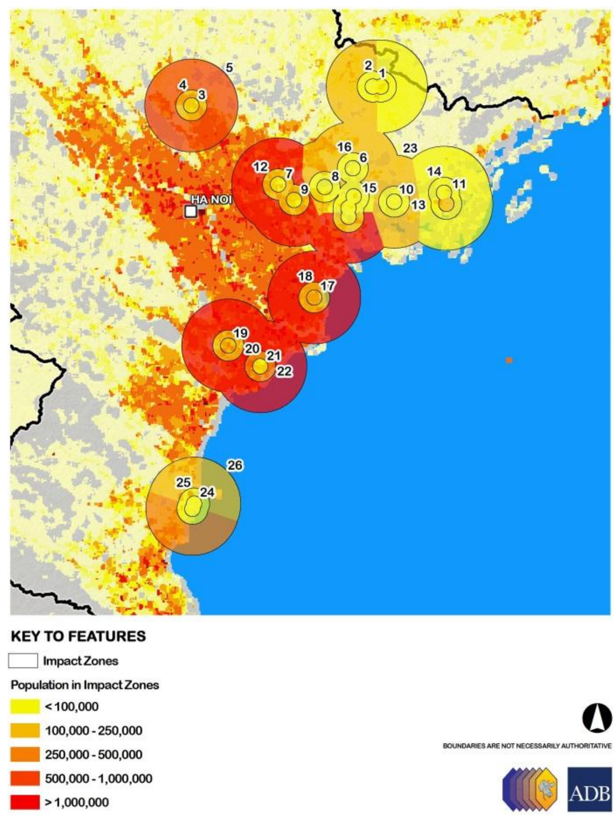


Figure 2: Thermal Power Station Clusters in North Viet Nam

Transmission lines constitute a third group of energy sector infrastructure that is expected to generate significant adverse impacts, particularly through clearance of land along the routes of the transmission lines. The value of natural resources and services potentially lost through forest clearing along transmission lines was estimated at $218 million. The transmission lines planned under PDP VII will pass through 59 protected areas and 39 key biodiversity areas with habitat fragmentation potentially compromising – besides biodiversity itself – important environmental services such as water regulation, flood protection, soil protection etc.).

Evaluating the Potential of Alternatives

Improving Energy Efficiency

The Electricity of Viet Nam (EVN) demand side management assessment study estimating an energy savings potential of 36% in the residential sector, 20% in the industrial sector, and 12% in the commercial sector. These findings are roughly in line with the World Bank's Commercial Energy Efficiency Program (CEEP) assessments, estimating the energy savings potential between 15%–30%. Realizing these potential savings rates would bring down the country's electricity elasticity (ratio of growth rate of electricity demand and growth rate of GDP demand) from 1.90 in 2010 down to 0.85 in 2030, which is consistent with those of many developed countries.

The SEA evaluated the potential of energy efficiency measures by developing an alternative demand scenario in which the energy savings potential was discounted from the PDP VII base case scenario. Under this scenario, electricity generation savings increase from 1,639 gigawatt hours (GWh) in 2015 to more than 22,000 GWh by 2030. The reduction of electricity demand is equivalent to the capacity of 16 coal-fired power plants presently planned for the period of 2027–2030, which would no longer be needed. The energy savings would also save over 56 million tons of coal a year by 2030 (Table 2) which would reduce CO_2 emissions by over 100 million tons a year, SO_2 emissions by over 72 million tons per year, NO_x emissions by over 42 million tons per year, and particulate matter emissions by nearly 10 million tons per year (Table 3). The economic value of related reductions in social and environmental impacts (health, acidification) was calculated to be over $3.3 billion (Table 4), a cost saving that would be much higher than the costs of the implementing related energy efficiency measures and investments. To operationalize these measures and investments efficiently, regulatory and management measures need to go hand in hand with leverage private sector investments (e.g. through an energy efficiency fund) and the stimulation of market mechanisms to trade energy efficiency services.

Table 2: Energy Efficiency Scenario: Reductions in Demand for Coal, 2011–2030

Year	2011	2015	2020	2025	2030
Coal (million ton)	10.9	28.2	57.9	89.6	135.1
Domestic	10.6	26.2	39.8	53.2	69.5
Imported	0.34	2	18.1	36.4	65.6
Coal reduction (million tons)	0.6	3.8	19.2	26.9	56.3

Table 3: Reduction of Pollutant Emissions Compared to the Base Case (Carbon dioxide, `000 ton)

Year	2011	2015	2020	2025	2030
Particulate matter	312.91	995.04	3,552.45	4,933.26	9,873.90
Sulfur dioxide	4,538.23	5,837.31	22,184.68	32,609.93	72,868.86
Nitrogen oxides	12,140.97	113,65.97	20,593.53	29,154.38	41,291.30
Carbon dioxide	6,921.10	115,08.16	39,806.59	49,275.07	104,685.02

Table 4: Reduction of Health Costs ($ million) due to energy efficiency measures.

Year	2011	2015	2020	2025	2030
Particulate matter	-45.05	9.72	73.19	101.65	203.47
Sulfur dioxide	13.19	17.21	65.59	96.41	215.45
Nitrogen oxides	31.55	36.14	66.38	93.97	133.09
Carbon dioxide	644.40	791.70	1,578.70	2,195.80	3,348.10

Increasing Renewable Energy Generation

The second major element of any strategy to reduce the environmental and social costs from of coal-fired power generation is to generate electricity from other sources. Under the existing base case of PDP VII, Viet Nam's hydropower potential (large scale) is almost entirely realized, and the development of oil, gas and nuclear capacity cannot fill the gap between supply and increasing demand alone. A viable option is to consider substituting coal with alternative power generation sources.

Under the PDP VII base case scenario, the share of renewable energy in power generation increases from 3.6% in 2015 (1,679 MW) to 5.8% in 2025, declining to 4.4 % in 2030 (6,029 MW) as the share of coal-fired power generation increases. Although significant, these figures are still far below Viet Nam's renewable energy potential, especially from wind, solar power, and small-scale hydropower. As an alternative scenario to the PDP VII base case, this could translate into 5% share of renewable energy in 2015 (1,979 MW), 8% in 2020 and close to 10% in 2030 (13,829 MW), the latter being more than double presently laid out in the base case scenario (6,029 MW). This entails raising the capacity from 1,979 MW in 2015 to 13,829 MW in 2030, more than double the level presently found in the PDP VII base case scenario. The difference of 7,800 MW between base case and a renewable energy alternative scenario would constitute of an additional 4,800 MW from small hydropower systems and an additional 3,000 MW of wind power plants by 2030. This expansion would allow a reduction in coal-fired power generation (Table 5) with corresponding reductions in atmospheric pollution (Table 6). Environmental cost savings (including health) would amount to $1.7 billion by the year 2030 compared to the base case scenario (Table 7). With the economics of renewable energy likely to change in coming decades (technological developments, economies of scale), the benefits of investing into renewable energy sources are expected to outweigh the impacts from conventional power generation sources.

Table 5: Reduction in Demand for Coal with Expanded Renewable Energy

Year	2011	2015	2020	2025	2030
Coal (million ton)	11.2	31.9	75.8	111.9	177.5
Domestic	10.8	29.9	46.2	61.9	64.8
Imported	0.38	2	29.7	50	112.7
Coal reduction (million ton)	0	0.1	1.2	4.6	10.6

Table 6: Reduction of Atmospheric Pollution from Expanded Renewable Energy (Carbon dioxide `000 ton)

Year	2011	2015	2020	2025	2030
Particulate matter	-7.03	35.23	223.81	849.02	1,941.73
Sulfur dioxide	377.61	818.72	940.08	4,865.65	13,575.04
Nitrogen oxides	12,356.55	11,253.20	10,166.70	13,561.26	14,575.81
Carbon dioxide	7,440.86	6,635.29	7,056.78	14,736.98	26,264.91

Table 7: Reduction of Health Costs due to Reduced Emissions ($ million)

Year	2011	2015	2020	2025	2030
Particulate matter	-57.42	-15.65	4.59	17.48	40.00
Sulfur dioxide	0.87	2.34	2.76	14.37	40.12
Nitrogen oxides	31.33	35.43	32.77	43.71	46.98
Carbon dioxide	638.50	694.20	938.80	1,472.50	1,739.90

SEA Recommendations and Conclusion

The SEA formulated a wide range of recommendations, identifying both improvements in the PDP VII content as well as overall power planning process.

Key recommendations were to reduce the heavy dependency on coal whose impacts amount to several billion dollars by 2030. A strategy that combines improved energy efficiency with accelerated renewable energy development – including identification of specific sites for RE investments – would go far to reducing coal related dependency and impacts. Additional recommendations were made for hydropower, particularly focusing on improvements in the support and compensation measures PDP VII lays out for people displaced by hydropower plants. The SEA also recommended to evaluate payment for environmental services (PES) mechanisms as a means to share the benefits of environmental services for hydropower performance with local communities and engage them actively in related forest and watershed protection (community forestry, biodiversity management plans). Two particularly high-impact schemes – Dak Mi 1 and Dong Nai 5 – were recommended to be cancelled due to their high environmental cost.

Overall, the SEA of the Viet Nam PDP VII was a critical step towards the integration of environmental and social costs into a power development plan. For the the first time, an SEA was run ex-ante to a national power development plan, and related environmental and social cost/benefit calculations fed right into the PDP process and became – in parts – internalized into the base case scenario calculations. Energy efficiency and renewable energy targets were reviewed and adjusted. Last but not least, the SEA was implemented by a national team with support from international experts, marking a signficant step forward from institutionalization of SEA capacity (SEA PDP VI) to the actual successful operationalization of this capacity. To close remaining capacity gaps and challenges are among the main targets and strategic trusts of regional development programs such as the GMS Economic Cooperation Program and the embedded Core Environment Program.

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