Chapter 4

Recommendations for the ASEAN Region

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Chapter 4
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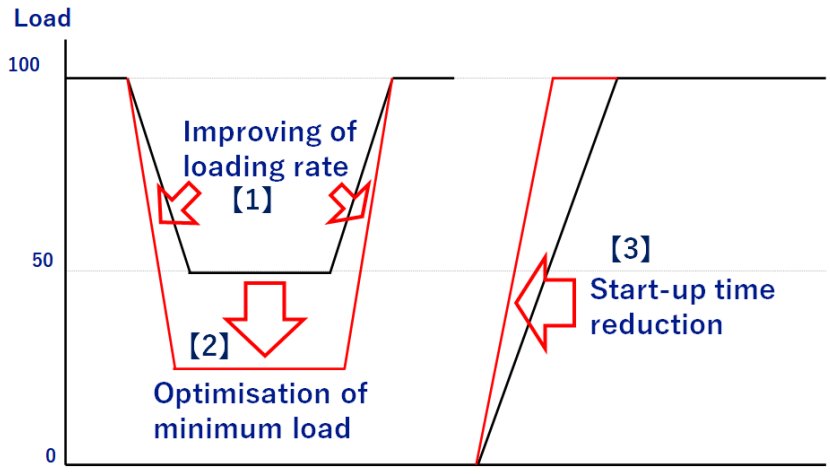
1. Available Technologies and Technical Solutions

Figure 4.1 shows the three key points of flexibilisation technology of CFPPs.

1) Improving loading rate
2) Optimising minimum load
3) Reducing start-up time

Figure 4.1. The Three Key Points of Flexibilisation Technology

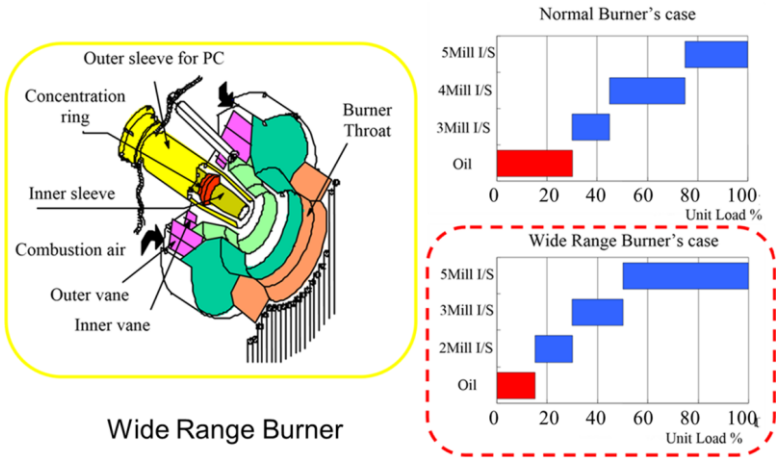


Source: Authors' calculation.

The most important factor in regulating the load of CFPPs is to improve the rate of load change. The first is the improvement of the burning characteristics of coal. The second is the improvement of steam temperature controllability. By introducing these, the load change rate can be improved to 3% to 5% per minute.

The next important point is the optimisation of minimum load. At the low load of the mill pulveriser, pulverised coal at the outlet of the mill pulveriser is in a lean condition with a high air and/or coal ratio of primary air, and oil support is required. Figure 4.2 shows an example of a WRB and burner turndown. The concentration ring is installed in the WRB. The figure on the right shows an example of a burner turndown. The above figure is for a normal burner, and the figure below is for a WRB. In the case of the WRB, the minimum load of coal firing without oil support is about 15% load.

Figure 4.2. Wide Range Burner and Burner Turndown



Source: Edited by JCOAL Original data from IHI.

The third important point is reducing the start-up time. Therefore, it is vital to quickly raise the turbine inlet steam temperature to shorten the start-up time. To that end, measures such as installing the following start-up bypass system, SH bypass system, and HP/LP turbine bypass system with RH cooling or turbine bypass system without RH cooling are essential. This start-up bypass system reduces the start-up time from ignition to full load from 120 minutes to 180 minutes.

To improve the load adjustment function, it is important to enhance equipment and systems and the control device, and optimise the adjustment. The operation ability improvement in the existing plant will be explained. In the case of existing plants, it is important to clarify the purpose of functional improvement and comprehensively examine and remodel two small areas: goals, effects, costs, and remodelling periods.

Table 4.1 summarises three main kinds of large energy storage technologies. A variety of electric energy conversion to potential, compressed, and electrochemical are currently available.

PSP is a kind of potential energy. Small hydro can be easily converted to this type by renovating the turbine and generator with an additional pump function.

The second one is compressed energy. The energy charge is done by an electric power–driven pump to the upper reservoir. Liquid air storage is an application of compressed energy. Charge–discharge is done by a simple mechanical operation of well-proven facilities and heat exchange without AD-DA conversion.

The application of electrochemical energy is normally known as BESS, a battery energy storage system. In this system, three kinds of technologies are suitable for large-scale energy storage: lithium-ion, sodium-sulphur (NAS), and redox flow batteries.

Table 4.1. Available Energy Storage Technologies

(same as Table 2.4)

Technologies	Features	
Potential energy Pumped-storage power	Pumped storage stores and generates energy by moving water between two reservoirs at different elevations. At times of low electricity demand, like at night or on weekends, excess energy is used to pump water to an upper reservoir.	
Compressed energy Liquid air energy storage	The liquified air is converted back into pressurised gas, which drives turbines to produce electricity. Cost-effective supply–demand balancing besides ancillary services, such as grid stability, inertia, and reactive power	
Electrochemical energy Lithium-ion	Lithium-ion batteries are suitable for storing high-capacity power. They are used in a wide range of applications, including consumer electronics such as smartphones and personal computers, industrial robots, production equipment, and automobiles.	
Electrochemical energy Sodium-sulphur (NAS)	NAS battery is a high-temperature battery. Full discharge (SOC 100% to 0%) is available without capacity degradation. No self-discharge. Best performed with long-duration application.	
Electrochemical energy Redox flow	Redox flow batteries are rechargeable batteries that are charged and discharged through the oxidation–reduction reaction of ions of vanadium or the like. The batteries are expected to serve as a technology to stabilise the power grids that will be needed to expand the introduction of renewable energy, including solar and wind power.	

Source: JCOAL.

2. Available Technologies and Technical Solutions: By-country Recommendations

2.1. Indonesia

Due to the COVID-19 pandemic, electricity growth during 2020 was below the target initially set out in RUPTL 2019. In the new RUPTL, the national generation mix is revised to maintain demand–supply balance as follows:

- No additional CFPP and sequential reduction of existing plants
- Increase the NRE to achieve the minimum target of 23% NRE mix starting in 2025.

Additionally, towards carbon neutrality in 2060, only NRE power plants will be added after 2031, and CFPPs will be phased out. Reducing CFPPs and increasing the NRE by reviewing oversupply are also effective from the carbon neutrality perspective.

As mentioned, the Indonesian government is considering the new electricity development plan:

1) A rapid increase in NRE from 2025, especially biomass, will enhance procurement in terms of fuel availability. In addition, due to its high cost, it is necessary to consider efficiency improvement and economic efficiency.

2) NRE will increase as a substitute for coal. Since hydropower, geothermal, and biomass are the main source for the time being, grid stabilisation and load adjustment are not necessary. However, in response to the abolition of CFPPs and the increase in NRE, especially solar power, towards carbon neutrality in 2060, a detailed study of securing base power sources, battery development, and grid stabilisation is needed.

2.2. Malaysia

Malaysia is steps ahead of other AMS in considering its energy transition pathway, as we understand from the past policies and legal frameworks in the power sector. According to the GSO, in expectation of the possible grid fluctuation, a study on renewable energy penetration is in progress. They envisage CFPPs to be cycled to minimum loading during solar peak time, possibly 50% to 70% during the weekdays, and the technical and power purchase agreement minimum during weekends or public holidays. In the case of high solar penetration, with which variation is considered to be higher, the range will be 30% to 70%. They also envisage the possible challenges in managing the three cycles of load variation in a day.

As we have seen, Malaysia is expected to experience grid fluctuation after 2030 even if the government will go for the new scenario, i.e. no more new CFPPs, regardless of greenfield or brownfield. Therefore, in the medium term, flexibilisation measures with thermal power, including coal-fired power and hydropower, would address grid requirements while renewable energy penetration proceeds. Storage technology will help ensure a non-intermittent power supply in the medium to long term. The Government of Malaysia is already planning to introduce energy storage facilities as part of power

development.

Recommendations for ensuring grid stability in the period of energy transition

In the medium term, flexibilisation measures with thermal power, including coal-fired power and hydropower, will address the requirements of the grid while renewable energy penetration proceeds.

Storage technology will help ensure a non-intermittent power supply in the medium to long term. Consideration of policy initiatives from this stage to enable local manufacturing in the near future is recommended. It is also possible for Malaysia to make a hub supplying made-in-Malaysia storage facilities.

Consideration of policy initiatives by the federal government to enable local manufacturing in the near future is recommended.

According to the 12th Malaysia Plan, the federal government encourages local manufacturing in emerging industries, so such direction aligns with government policy. It is also possible for Malaysia to make a hub supplying made-in-Malaysia storage facilities.

Localisation of battery and manufacturing of some other key products is crucial, as these will enable Malaysia to maintain growth and development while maintaining system stability. It is important in energy economy and energy security through sustainable supply. Also, such an arrangement would benefit neighbouring countries and contribute to ensuring ASEAN's energy security.

2.3. Philippines

Based on DOE data, a detailed analysis was conducted to find the measures to be taken in the three grids, mainly from the viewpoint of the balance of the generation type. The flexibilisation measures to be taken in the power grid are as follows:

- Maximise the flexible operation by gas and hydro, which is normally operated as an intermediate mode;
- Install large-scale energy storage, such as BESS and pumped hydro; and
- Operate part of the coal-fired power flexibly, like partial load and/or 'daily start and stop' mode.

Implementation of the above-mentioned flexibilisation measures is recommended. Especially, private utilities' tariff incentives for non-baseload operation are key to maximising the flexible capacity.

Large-scale energy storage technologies are to be selected appropriately for grid situations. Commercially available pumped storage might have a cost advantage over BESS if local site condition suits.

In the case of flexible operation by a CFPP, additional investment for modification of mill, steam bypass, and operating software may be required. In this regard, a supporting

programme under the Resiliency Compliance Plan (DOE, 2018) or other suitable national plan is recommended.
As facilitation of demand-side management, daytime operations are recommended for the power-intensive industry, like electric arc furnace steel and electrolytic smelting. A necessary tariff mechanism to specify such daytime operation is also recommended.

2.4. Viet Nam

Viet Nam has been trying to achieve a balanced energy mix to ensure energy security and grid stability. The feed-in tariff mechanism for expediting renewable energy development is continuously applied. PDP8 indicates that in parallel with the expected massive renewable energy introduction, the national power system will be further optimized by transmitting large amounts of renewable energy from the central and south-central "supply regions" to the northern and southern "demand regions" .

In the north and south regions, where existing and under-construction coal-fired power generation is the mainstay, it is recommended to address the maximum flexibilisation performance of coal-fired power generation and enable flexible operation of gas-fired power generation. As for coal-fired power generation, coal power with imported coal would provide flexible generation sources if appropriate technology and operation techniques are introduced for flexible and environmentally compliant plant operation.

On the other hand, in the central and south-central "supply regions", it is recommended to retrofit conventional hydropower into pumped hydropower. Pumped hydropower as a flexible generation source will be definitely contributing to the increasing requirements for grid stabilisation.

In addition, although a bit of energy loss in AD-DA should be considered, it might be efficient for grid management to concentrate BESS in the north and south regions where many substations are located.

Looking from the aspect of demand-side management, daytime operations are recommended for the power-intensive industry, like electric arc furnace steel and electrolytic smelting. A necessary tariff mechanism to specify such daytime operation is also recommended.

3. Policy Recommendations for ASEAN

3.1. For all-ASEAN and/or individual AMS recommendations on technical aspects

1) For AMS that will not have new CFPPs but will continue utilising existing ones up to the individual target period of the phasing out during the energy transition period – It is unconditional that environmental measures by clean coal technology will be taken as long as the existing CFPPs are continuously used. Then the following measures are recommended to ensure grid stabilisation while renewables are

introduced on a massive scale:

- Identify and ensure flexible sources of power generation
- Identify the optimal measures for flexible operation of CFPPs and ensure the implementation (Note: It is important to introduce the optimal measures from operational improvements to minor modifications while the plant economy is considered.)
- Identify the kinds, scale, and introduction timing of large energy storage facilities and ensure their introduction.

2) For AMS that will develop new CFPPs as per their current plan and will continue utilisation of the existing ones up to the individual target period of the phasing out during the energy transition period:

- Identify and ensure flexible sources of power generation
- Identify the optimal measures for flexible operation of CFPPs and ensure the implementation (Note: It is important to introduce the optimal measures from operational improvements to minor modifications while the plant economy is considered.)
- Identify the kinds, scale, and introduction timing of large energy storage facilities and ensure their introduction
- Ensure the flexibility of CFPPs that are to be newly introduced.

3) For AMS that will not utilise CFPPs at all or will utilise the existing ones to the minimum extent – In this case, the impact of coal power on the national energy transition pathway would be none or very little. Following are two recommended measures:

- Identify and ensure flexible sources of power generation
- Identify the kinds, scale, and introduction timing of large energy storage facilities and ensure their introduction.

3.2. For all-ASEAN and/or individual AMS recommendations on policy and institutional aspects

1) ASEAN regional policy for grid system integration has been in progress, and relevant bilateral and multilateral cooperation is in place. The initial main objective of the regional system integration was to ensure sustainable supply in respective AMS. In the context of the immense benefit that system integration would provide in terms of grid stabilisation, relevant cooperation would proceed while considering both the desired degree of grid flexibility and regional capability for coordinated measures.

2) Phased formulation of the regional and/or local value chain of energy storage facilities and relevant equipment to ensure the future production and procurement in time for the energy transition – AMS governments have been making strenuous efforts to increase local procurement in key industries. Enhancing regional coordination in this regard will help such individual policy facilitation and will be

conducive to support regional industry and energy security.

3) For AMS on steady growth pathways, it is essential to ensure sustainable electricity supply through grid stabilisation while sustaining the economy of power generation at respective power plants during the energy transition period when renewable energy introduction on a massive scale is expected. In this regard, not only policy, technical, and operational measures will be required but also policy arrangements and implementation of market and electricity tariff system formulation and reform.

3.3. Conclusion

Energy transition is the first-ever experience for ASEAN and all countries, however, the transition is a must pathway. At the same time, every country must consider its peculiar factors, such as global and national energy situation, existing and required system configuration, fuel availability, economy, growth, and culture. Each country should also stick to ASEAN's policy direction – that ASEAN and the AMS utilise all affordable and available fuels for power generation in the most environmentally compliant manner.