Chapter 2

Energy Supply Security of Lao PDR and Implications for ASEAN

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1. Lao PDR's Primary Energy Supply

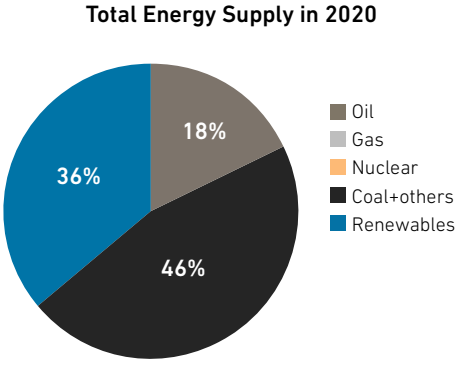
The heavy reliance of Lao People's Democratic Republic (Lao PDR) on fossil fuels made oil and coal account for 64% of the country's total energy supply mix in 2020 (Figure 2.1).

Figure 2.1. Lao PDR's Total Energy Supply

Total Energy Supply (TES)

Total Energy Supply (TES)	2015	2020
Non-renewable (TJ)	95 192	162 506
Renewable (TJ)	85 638	90 940
Total (TJ)	180 830	253 445
Renewable share (%)	47	36

Growth in TES	2015-20	2019-20
Non-renewable (%)	+70.7	-6.2
Renewable (%)	+6.2	-8.6
Total (%)	+40.2	-7.1



TJ = terajoule.

Source: IRENA (2023).

The country's abundant coal reserves, which have a reserves–production ratio of more than 100 years (Table 2.1), contribute to the country's high coal supply security. Coal serves as Lao PDR's major additional source of electricity generation, supplementing hydroelectric power.

Table 2.1. Lao PDR's Coal Reserve Status

Type	Tonnes	Global Rank
Coal Reserves	554,461,930	37
Coal Production	5,330,918	31
Coal Consumption	5,247,934	47
Yearly Surplus	82,984	
Coal Imports	8,732	
Coal Exports	24,000	
Net Exports	15,268	

Source: Worldometer, Laos Coal, https://www.worldometers.info/coal/laos-coal/ (accessed 21 June 2024)

Based on Kimura, Phoumin, and Purwanto (2023), coal accounted for 3.93 million tonnes of oil equivalent (Mtoe) in Lao PDR's energy supply mix for 2020. Hydropower came in second at 2.24 Mtoe, biomass at 1.62 Mtoe, and oil at 1.04 Mtoe. The high rate of coal consumption is primarily due to the Hongsa coal-fired power plant, and plans are underway to build additional coal-fired power plants for exportation purposes, with a 4.2% increase in consumption projected between 2020 and 2050. It is estimated that coal's total primary energy supply share will rise from 62.4% in 2020 to 71.5% in 2050 (Kimura, Phoumin, Purwanto, 2023).

Lao PDR lacks domestic oil reserves; however, it uses oil extensively, which necessitates importing all finished oil products. Oil has consistently been the primary fuel in the country, and this trend is still present – although Lao PDR plans to phase out fossil fuels with renewables as a part of its efforts to reach carbon neutrality by 2050. However, the oil supply is still projected to more than double from 1.04 Mtoe in 2020 to 3.56 Mtoe in 2050 in the business-as-usual scenario (Kimura, Phoumin, Purwanto, 2023). The share of oil in the final energy demand would also increase from 32% in 2020 to 42% in 2050.

Lao PDR acknowledges that its oil consumption has increased over the past decade; however, there are no substitute fuels available. Given that one of the primary risks to the country's energy security stems from its reliance on oil imports, this chapter highlights potential strategies to help Lao PDR enhance its oil security status, which will ultimately raise the country's overall energy security.

Indeed, Lao PDR's energy supply security will remain vulnerable for an extended period, as its increasing oil consumption suggests that Lao PDR's 100% reliance on oil imports for finished fuel products may persist well past 2050 (Kimura, Phoumin, Purwanto, 2023). Therefore, the country should develop energy security measures to cope with unanticipated supply disruptions, which can originate from external sources like geopolitics and conflicts, disasters, accidents, and terrorist attacks on the oil logistics system. Establishing a national emergency response and preparedness protocol is essential.

Integrating various measures that make up emergency response measures is the fundamental concept behind an emergency response design. These strategies include supply and demand response plans, strategic petroleum reserves (SPR) or oil stockpiling, interruptible contracts, and fuel switching. SPR, sometimes referred to as emergency stocks, is the most crucial of the aforementioned requirements.

2. Petroleum Reserve Design Strategy for Lao PDR

To carry out a petroleum reserve design strategy for Lao PDR, it is recommended that these specific procedures be followed:

(i) evaluate the reserve alternatives and their pros and cons;
(ii) delegate a responsible party to evaluate the risk to and to determine the amount of oil reserves;
(iii) design different scenarios that can impact Lao PDR's oil security;
(iv) conduct a risk analysis of each scenario, and assess its impact and probability;
(v) calculate the quantity of oil to be reserved for emergencies in terms of percentages of monthly oil consumption or the number of days that Lao PDR must always have oil in storage;
(vi) design the logistics system to keep the oil reserves in secure locations, which are ready to be distributed; and
(vii) apply this systematic approach to electricity and other energies used in Lao PDR if the need arises.

3. Strategic Petroleum Reserves versus Mandatory Petroleum Reserves

Lao PDR must begin to design its fuel and power reserves due to the country's continued reliance on petroleum products and its growing electricity consumption. For oil, Lao PDR must choose between (i) establishing a national SPR, which the government would control and would not affect the commercial stock; or (ii) enforcing laws of reserve and mandating that oil traders always keep certain stock for national mandatory petroleum reserves (MPR). Note that the cost of the fuel to be reserved will rise in proportion to the amount reserved. In theory, the expenses will be borne by customers and accumulated.

Despite having a legal reserve already in place, Lao PDR should conduct an assessment to determine whether to implement a full-scale SPR or to maintain an MPR. Table 2.2 shows MPRs across the Association of Southeast Asian Nations (ASEAN) region.

Table 2.2. ASEAN Mandatory Oil Stockpiles

Country	Global Rank
Brunei Darussalam	31 days for refineries
Cambodia	30 days for companies importing oil
Indonesia	14 days (crude oil) 23 days (oil products) for the national oil company
Lao PDR	21 days for companies importing oil 10 days for distributors
Malaysia	30 days for the national oil company
Myanmar	6 day for oil companies
Philippines	30 days (crude oil) for refineries 15 days (oil products) for companies importing oil
Singapore	90 days (oil products) for power companies
Thailand	21.5 days (crude oil) 3.5 days (oil products) for refineries and traders
Viet Nam	10 days (crude oil) 40 days (oil products) for oil companies

Source: IEA (2022).

If Lao PDR decides to set up an SPR, the government must fund its construction; that is, the government would possess ownership of the tank terminals entirely. Oil traders would conduct normal business using their commercial stock and report their commercial reserve as additional to the SPR.

It is challenging to justify an SPR because it is very costly, requiring the government to fund the establishment of SPR facilities, provide operational staff training, establish a department to oversee reserve inventory, and purchase oil products using the government budget or taxpayer money. The government must also consider the financial complications if oil prices change, particularly if oil prices drop and there is a potential stock loss.

The government has the option to rent SPR through 'ticketing' once the oil volume to be reserved has been decided. Ticketing is an alternative for a country without significant infrastructure to store a physical reserve. Lao PDR could pay a rental fee to another country that can store stock outside of Lao PDR's borders rather than holding a reserve on site according to a bilateral agreement.

If Lao PDR confirms that the MPR will remain, however, then the responsible party must ascertain the reserve requirement that is suitable for the oil value chain environment in Lao PDR. The MPR option is less complicated because the reserve is controlled by the government rather than owned by the government. The government may establish legal reserve laws to draw on the necessary inventory in an emergency, although the government is not the actual owner of the stock. By law, Lao PDR does have the authority to obligate oil companies to stockpile a certain amount of oil for national security. Yet to address all aspects of oil supply security, Lao PDR must determine whether it has other, adequate measures to handle an emergency. These measures would go beyond the legal reserve and should, at the very least, involve demand and supply response strategies.

4. Evaluating Risk and Determining the Reserves

Lao PDR should designate a responsible party to evaluate risk and to determine the actual amount of oil reserves necessary. The responsible party may be a subcommittee or an existing department within the Ministry of Energy and Mines or related ministries. This body should also assess any ongoing risks, such as those related to geopolitics and the supply and demand of oil outside of Lao PDR. It should also define the protocols for determining the trigger point at which the government must intervene when a situation reaches a predetermined level of oil supply insecurity.

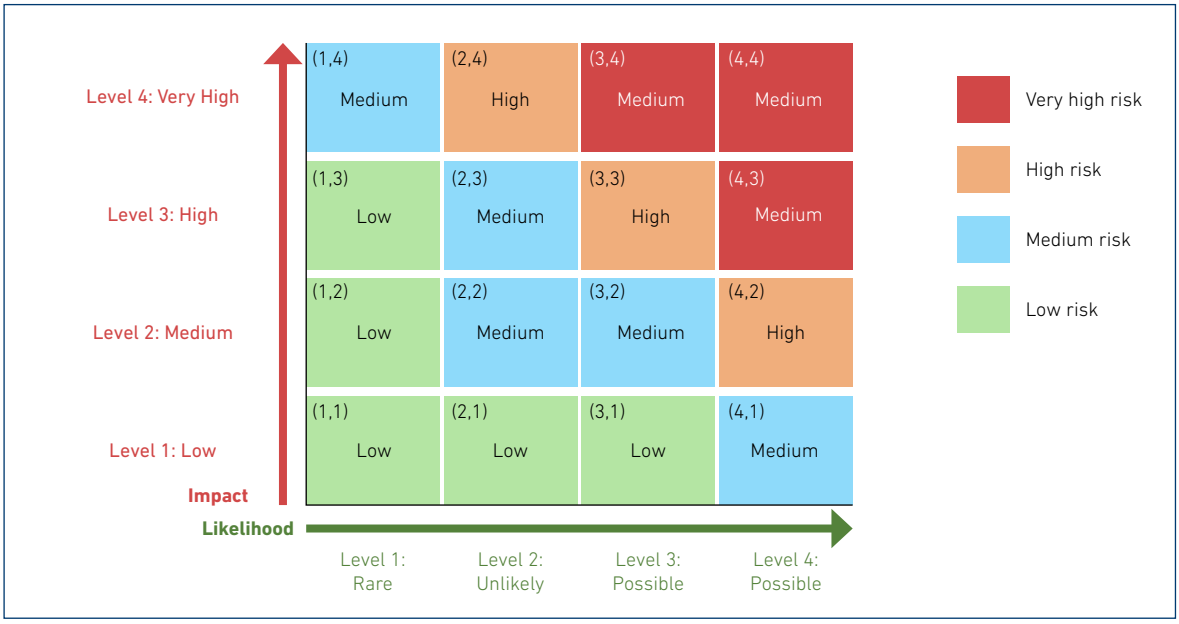
5. Scenarios Influencing the Oil Security of Lao PDR

Multiple scenarios should be developed that may influence the oil security of Lao PDR, the risks associated with each scenario should be analysed, and their probability and impact should be determined. These actions include formatting action plans to manage various incidents and other emergencies that may arise in Lao PDR or its neighbours that could disrupt the supply of oil imports into Lao PDR. Incidents can occur domestically or in nearby countries or be due to geopolitical risks, such as the emergency closure of domestic oil terminals, emergency shutdown of refineries in countries that supply oil (e.g. Thailand), the crisis between Israel and Hamas, or the conflict between the United States and Iran.

Risk analysis should be undertaken simultaneously and spontaneously to assess the likelihood of potential damage and the seriousness of the emergencies. The government can evaluate an oil shortage incident in advance and use planned countermeasures to mitigate the effects by analysing the appropriate reserves during a crisis or unusual circumstance.

It is recommended that a qualitative risk assessment be developed by professionals in the oil and related industries to determine the risk factors on the supply and demand sides, degree of severity of the impact, and probability of an event occurring. An example of a table of risk analysis is shown in Figure 2.2.

Figure 2.2. Risk Analysis to Evaluate Energy-Related Emergencies



Source: PTIT (2024).

Furthermore, Lao PDR should conduct routine emergency response drills to update the scenarios as needed. Establishing an emergency response team or committee and creating an annual tabletop exercise schedule are important.

6. Lao PDR's Oil Logistics

Oil logistics play a crucial role in the integration of the oil supply network, significantly influencing the distribution of oil to end-users. A well-designed and functional oil logistics system helps facilitate timely, efficient oil transport from suppliers to customers in the appropriate quantity at the proper time. If oil logistics are not operating at maximum efficiency, they can harm both the country's transport system and its economy.

It is recommended that Lao PDR investigate how the oil supply logistics system can be enhanced to improve the security of the oil supply. It is also recommended that Lao PDR begin the analysis immediately by compiling information on the tank facilities (i.e. tank capacities and fuel services) across provinces and regions and comparing the tank capacities with local demand. The scope of this exercise could be expanded to include monitoring the effects of seasonal variations in demand. Moreover, tank–consumption ratios should be examined to ascertain the optimal ratio for every area. The proper ratio or index for major cities and rural provinces must be determined, and corresponding facilities must be designed to ensure that the quantity of reserves and storage meets demand.

Lao PDR could also construct an integrated oil logistics network or oil hub to connect its oil terminals to the pipeline system in the northern region of Thailand to facilitate oil distribution from Thailand to Lao PDR for quick supply in an emergency.

7. Lao PDR's Online Oil Inventory System

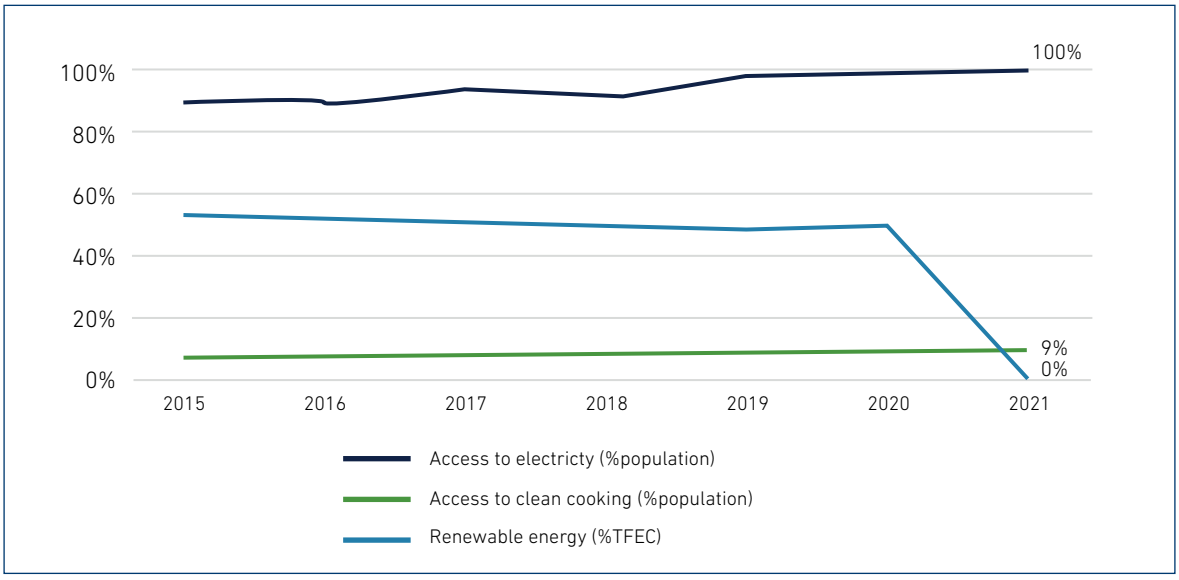
Lao PDR already has a system to track the country's oil inventory, but because all of the oil in Lao PDR is imported, this inventory system must be strengthened. The current oil inventory system could be transformed into an online monitoring system. As a result, Lao PDR would be in a better position to assess possible crises, respond to situational changes, and adjust the oil inventory to address any future energy crisis more spontaneously. Lao PDR should conduct regular and systematic reviews of the mandatory reserve requirement as well.

8. LPG Strategic Reserves

Those seeking better fuel for their homes are increasingly adopting liquefied petroleum gas (LPG) to replace biomass in Lao PDR. Figure 2.3 shows the growth of access to clean cooking, which in part refers to the use of LPG. LPG is sometimes the preferred choice because it generates consistent heat as opposed to unevenly burning biomass, which is also less convenient. Because it is convenient and clean, LPG has become the standard fuel in the industrial sector.

As LPG consumption seems to be rising recently, LPG consumption in Lao PDR should be better monitored. It is recommended that Lao PDR investigate the quantity of LPG that should be reserved for future supply security.

Figure 2.3. Lao PDR's Access to Clean Cooking



TFEC = total final energy consumption.

Source: IRENA (2023).

The strategy for reserving LPG can be developed similar to that for oil:

(i) evaluate the reserve requirement based on different scenarios that may impact LPG security;
(ii) conduct a risk analysis of each scenario, and assess its impact and probability;
(iii) determine how much LPG should be reserved for emergencies, either as a percentage of monthly LPG consumption or as the number of days needed in storage; and
(iv) establish a logistics system to keep LPG reserves in secure locations ready to be distributed to support the entire LPG system throughout Lao PDR.

It should be noted, however, that the reserves of LPG and oil do not have to be the same due to their different types of use. LPG is primarily used in the residential sector, whereas oil is primarily used in the transport sector. Lao PDR must also consider the fact that, unlike LPG users in households who may choose to switch back to biomass in the event of a shortage, oil consumers in the transport sector lack alternative fuel sources as a backup. Yet most industrial plants have backup alternative fuel sources. Therefore, it is important to consider potential differences in the urgency of demand use when determining the rate of reserve for LPG versus oil.

9. Oil Demand Shift

Lao PDR's decision to pursue a net-zero emissions target for 2050 should be considered when projecting oil demand (Table 2.3). Based on the government's decisions regarding the pathway towards net-zero emissions, it is possible to evaluate the amount of fossil fuels, including oil, that will be phased out. The amount of oil required for consumption will establish how much oil makes up Lao PDR's fuel mix and assist in determining how serious the oil security issue is to the country's overall energy security. This will thus help the government determine the appropriate level of oil inventory to be set aside. The reserve quantity can be calculated by assessing the risk of any possible threats following the determination of demand.

Table 2.3. Lao PDR's National Determined Contribution and Net-Zero Emissions Target

Target	Details
Energy access	Achieve electrification rate of 98% by 2025
Efficiency	Reduce final energy consumption for 10% from the BAU level
Renewable energy	Reach 30% share of renewable energy in total primary energy consumption by 2025.
Climate change	Reach net-zero missions conditionally in 2050.

BAU = business as usual.

Source: IEA (2022).

10. Recommendations

Oil security is a major threat to overall energy security in Lao PDR; coal and hydroelectric power generation are massive, but their security is not threatened. Enhancing the security of supply for coal and electricity is less complicated than improving the supply security for oil, as imports account for all of the supply. Therefore, it is imperative that Lao PDR concentrate on and discuss an oil security strategy urgently. Based on this analysis, it is advised that Lao PDR undertake the following actions:

(i) Design a petroleum reserve strategy with specific implementation protocols that include an assessment of reserve alternatives, scenarios, a risk analysis, oil reserve calculation, improvement of the logistics system, and oil inventory system review.
(ii) Apply this systematic approach to determine whether to improve the supply security of electricity and other energies as well.
(iii) Assess Lao PDR's oil security status to determine whether to maintain the MPR in its current form or implement a full-scale SPR.
(iv) Appoint a responsible party to supervise the reserve requirements appropriate for the oil value chain environment, assess risk, and calculate the quantity of oil reserves. The accountable entity could manifest as a standing department or subcommittee within the Ministry of Energy and Mines or affiliated ministries.
(v) Develop multiple scenarios that could affect the oil security of Lao PDR, analyse the risks associated with each scenario, and assess their probability and impact.
(vi) Establish the point at which the government must intervene when a certain degree of insecurity in the oil supply occurs.
(vii) Investigate how the oil supply logistics system can be improved to increase the supply's security.
(viii) Compile information on the tank facilities located throughout the provinces and regions of Lao PDR, compare these tank capacities with local demand, and monitor the tank–consumption ratios to determine the ideal ratio for the country's oil supply chain.
(ix) Determine further steps that can be taken to deal with the oil shortage in addition to an oil reserve; these steps should, at the very least, include supply and demand response measures.
(x) Consider modifying the current oil inventory system into an online system.
(xi) Establish protocol and requirements for LPG reserves using a strategy similar to those used for oil reserves.
(xii) Evaluate how much oil and other fossil fuels should be phased out by 2050 based on the government's pathway towards net-zero emissions.

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