No-New-Coal: Could this be the new reality for the Laotian power sector?

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This policy brief is part of a series developed by Laotian analysts during an OSeMOSYS (an open source modelling tool) modelling workshop in Vientiane, Lao PDR, in October 2024. There are four policy briefs in total, each addressing a question pertinent to the expansion of the Laotian electricity sector. This brief, fourth in the series, focuses on a Laotian future with no new investments in coal power plants. The first policy brief focuses on the impacts of increasing electric vehicle penetration on the Laotian Power system. The second brief highlights concerns related to energy security in the country during the dry season. The third explores the impact of ending of the concessionary power agreements in Laos and its impact on the power system. The briefs are based on analyses developed using an OSeMOSYS model of the Laotian Power sector co-created by Laotian analysts and CCG researchers.

Summary

Lao PDR faces a complex energy challenge balancing coal-fired power exports with its climate goals. Currently Laos operates three coal-fired power plants; however, it also aims to reduce greenhouse gas emissions by 60% by 2030 and achieve net-zero by 2050. This analysis, utilising an energy systems optimisation model, explores a future with no new coal investments, revealing potential for significant changes. By 2028, solar PV and wind power could substitute coal in meeting export commitments. The analysis reveals that a no-coal future could reduce CO_2 emissions, save on infrastructure costs, and maintain export commitments while enhancing energy security. Strategic investments in renewable energy are crucial for this transition.

Key Messages

- Accelerate renewable energy investments by 2028 to replace coal and meet export requirements.
- Strengthen grid infrastructure to effectively integrate variable renewable energy and ensure stable transmission.
- Create a transition mechanism to balance export commitments with the gradual phase-out of coal-fired power plants.

Introduction

Coal-fired power plants significantly contribute to greenhouse gas emissions, driving global warming and climate change. They release harmful pollutants causing respiratory diseases and health problems. “No New Coal”, a global initiative launched in 2021, aims to phase out coal for electricity generation [1]. Many countries have pledged not to build new coal plants to accelerate the transition to clean energy. However, according to the latest National Power Development Plan (NPDP) [2], Lao PDR (Laos) plans to use coal power plants predominantly for exports and use a minor share to meet base load in the local grid. Simultaneously, Laos also aims to reduce its greenhouse gas emissions by 60% by 2030 in comparison to a business-as-usual case and achieve net-zero emissions by 2050, as per its 2021 Nationally Determined Contribution [3]. This presents a unique conundrum as electricity export revenues contributed to about 25% (~2.3 billion USD) of Laos’ export revenue in 2022.

Currently, Lao PDR has three coal-fired power plants with a total capacity of ~2,000 MW, producing 13,042.56 GWh annually, about 16% of the country’s total energy production. The majority of this generation comes from the Hongsa coal power plant and is exported to Thailand [4]. To align with international commitments and the Paris Agreement, Laos needs to make a conscious decision about expanding its coal-based generation capacity. However, Laos also needs to make these changes before committing to export trade agreements to avoid trade repercussions. In this analysis, using an energy system optimisation model, we examine a hypothetical scenario where Laos adopts a no-new-coal policy but must honour its export commitments that were planned assuming extra coal-based power would be available. We explore the techno-economic considerations of a no-new coal future.

Methods

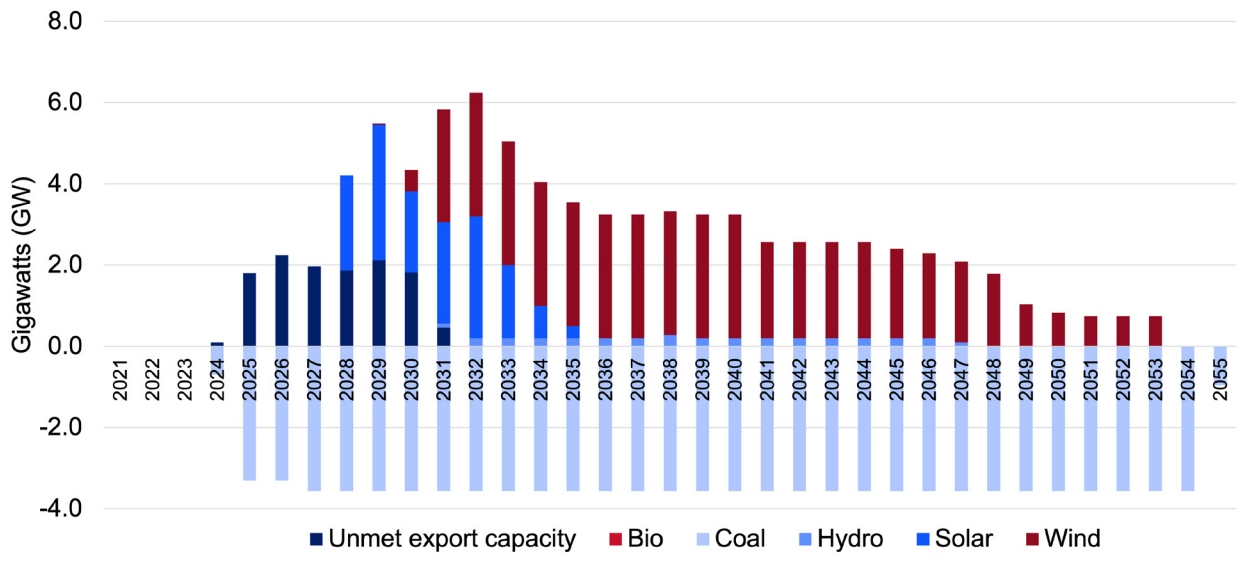
A comprehensive energy systems optimisation model (ESOM) for the Laotian power sector (Lao-PSM) was developed using the OSeMOSYS framework to investigate implications of a no-coal future. OSeMOSYS is a flexible and open-source modelling tool [5], with a proven track record of informing policy discussions and establishing a robust evidence base across various temporal [6–7] and spatial dimensions [8–9]. Lao-PSM is a multi-regional power sector model with three distinct regional classifications (Central, Southern, and Northern). The current model iteration employs a temporal resolution of eight time steps, incorporating a two season structure to capture wet and dry season dynamics and four daily time divisions to reflect variations in demand profiles and variable renewable energy (VRE) generation. Lao-PSM’s modelling horizon extends from 2021 to 2055. Lao-PSM considers the expansion plan presented in the latest revision of the National Power Development Plan (NPDP) [2], it and accounts for electricity demand projections obtained from Électricité du Laos (EDL). Two distinct scenario options were developed to explore the implications of a no-new-coal future. The first is a Business-as-Usual (BaU) scenario that adheres to Laos’ expansion plans outlined in the NPDP, including investments in coal generation capacity designated for exports to neighbouring nations. Concurrently, a No-Coal scenario was formulated, prohibiting new coal power plants in the generation mix.

This scenario assumes Laos will strive to fulfil its export commitments as originally planned with additional coal-based power. To implement this dynamic, coal-based export projections from the BaU are applied as constraints in the No-Coal scenarios. Furthermore, it is postulated that Laos will limit dry season imports from 2024 onwards, focusing on enhancing energy security.

Results and analysis

Our analysis indicates that a no-new-coal future with export commitments as in the BaU scenario will have major implications on Laos' future generation mix. To begin with, the national expansion strategy does not account for large infrastructure investment in the first few years of the modelling period to satisfy this sudden export requirement. This is evident in **Figure 1**, where it is noticeable that the export demand in the first few years cannot be satisfied. However, starting from 2028, solar PV and wind power investments are expected to fill in the export requirement. Both scenarios have the same solar PV and wind capacity towards the end of the modelling period. However, in the No-Coal scenario, the investments are rushed in earlier than in the BaU scenario to meet the export demand.

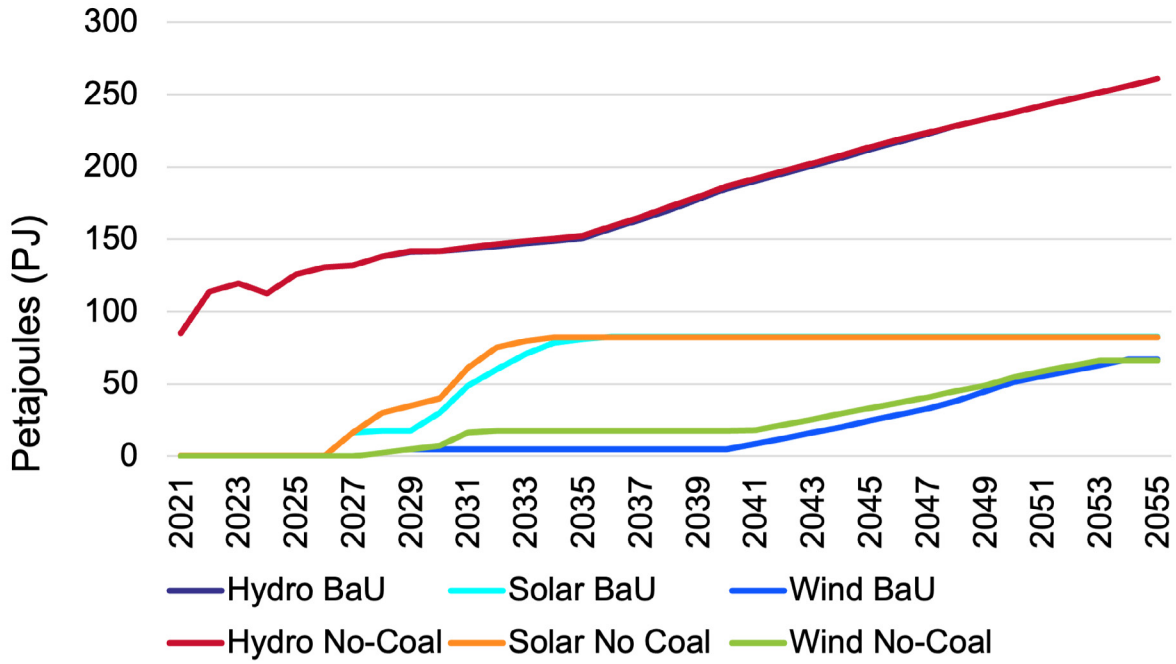
***Figure 1:** Difference in installed generation capacity between the No-Coal scenario relative to the BaU scenario in Gigawatts*



Despite being theoretically possible, this will warrant strengthening the grid to absorb such high levels of variable renewables (VRE). **Figure 2** illustrates the difference in electricity generation between the two scenarios for hydropower, solar PV, and wind technologies. It is noticeable that hydropower generation does not differ by a big margin as it is the cheapest source of power in Laos. We can notice an increase in generation from solar PV between 2028–2032, after which both the scenarios match. The most interesting insight is that of the wind power investments. Due to the export requirements from the Central region to Vietnam, wind power capacity is increased despite the low capacity factors. This might not be the case in reality, as financiers

might not be inclined to invest in low yielding power capacity. A more detailed analysis needs to be conducted to validate this insight. Additionally, more investments in wind power take place in the Southern region with high capacity factors; this power is then evacuated through domestic inter-regional transmission lines to the Central region, before being exported to neighbouring countries.

Figure 2: *Electricity generation from VRE technologies under the BaU and No-Coal scenarios (PJ)*



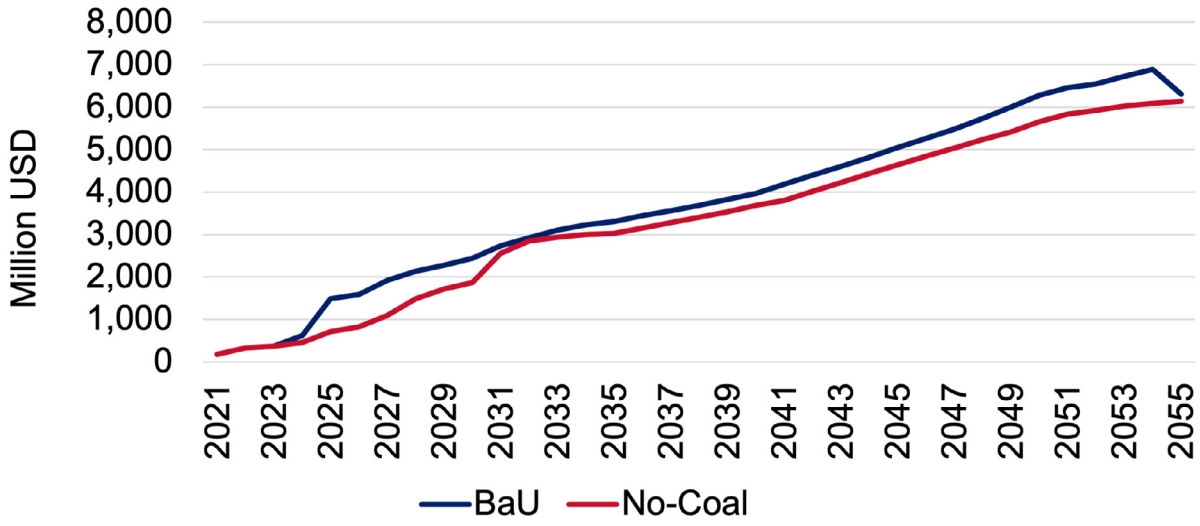
Nam Ngum dam near Vientiane, Lao PDR

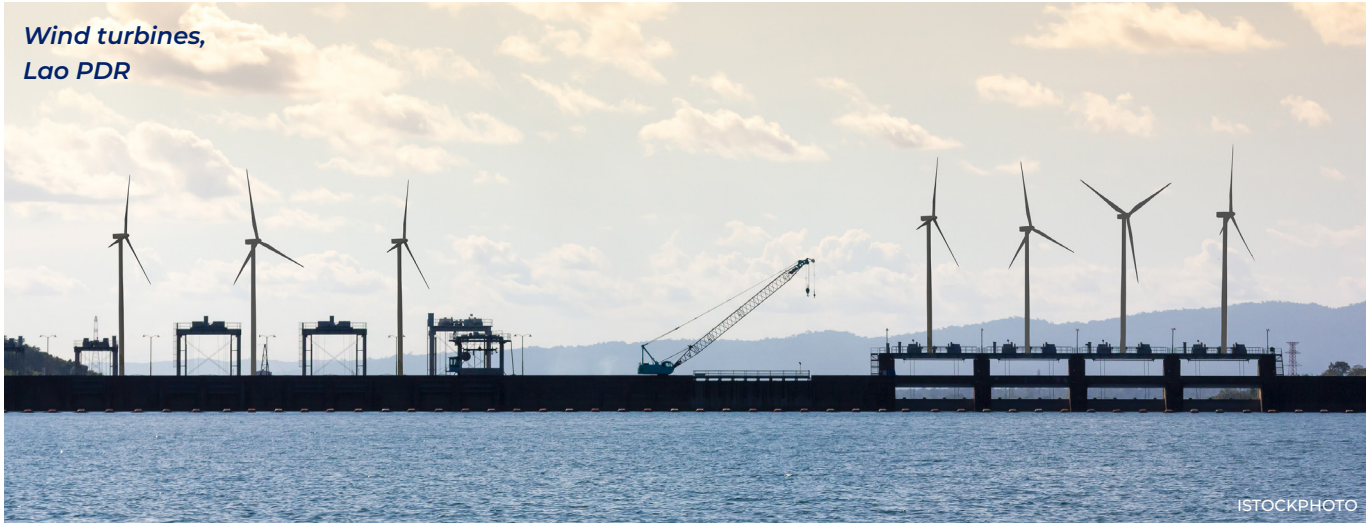
Furthermore, after 2046, the historical coal power plants in operation reach the end of their concessionary contracts and cease operations in both scenarios. In the BaU scenario, Laos is expected to finish its local reserves and expected to import coal from 2045 to generate electricity. Therefore, importing coal, and burning it in Laos, to only export electricity back to the neighbours makes it an unfavourable proposition for Laos. By not approving the new coal power plants, Laos is expected to reduce its CO_2 emissions by ~500 million tonnes cumulatively. Additionally, avoiding the uncertainty with coal imports only improves Laos' energy security.

From the point of view of infrastructure capital expenditure (CAPEX), the No-Coal scenario is expected to cost ~10.5% less than the BaU, resulting in ~14 billion USD (2021 prices) in savings.

Figure 3 depicts the annualised investment costs for the two scenarios. This reduction is primarily driven by investment in solar PV and wind starting from the 2030s. The CAPEX of these renewable technologies is expected to drop significantly in the next decade [4], contributing to the overall cost reduction.

Figure 3: *Annualised capital expenditure in the BaU and No-Coal scenarios expressed in million USD.*




Wind turbines, Lao PDR

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Conclusion

The analysis demonstrates that a no-new-coal future for Laos is not only feasible but also advantageous. This transition would require strategic early investments in renewable energy sources, particularly solar PV and wind power. Such a shift aligns with global climate goals and Laos' own emissions reduction targets. By adopting this approach, Laos could significantly reduce its carbon footprint, enhance its energy security, and achieve substantial cost savings in infrastructure development. Importantly, this strategy allows Laos to maintain its electricity export commitments, a crucial component of its economy. While challenges exist, particularly in grid strengthening to accommodate variable renewable energy, the long-term benefits of a no-coal policy outweigh the initial hurdles.

Policy Recommendations

a) **Prioritise early renewable energy investment:** Accelerate investments in solar PV and wind power, even before 2028, to meet export requirements and replace coal-based generation capacity.

b) **Robust grid development strategy:** Create a comprehensive plan to enhance grid infrastructure to absorb high levels of variable renewable energy, ensuring stable electricity transmission and export capabilities.

c) **Transition mechanism for export commitments:** Develop a structured approach to honour existing export commitments while simultaneously phasing out coal-fired power plants, ensuring minimal disruption to international electricity trade and maintaining Laos' economic interests.

Solar powered street lights, Lao PDR

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Electrical grid – Thakhek loop, Lao PDR

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DISCLAIMER STATEMENT

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