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研究課題名（和文）Sustainable cross-border energy planning by using participatory multi-criteria evaluation in the Thai-Laos electricity system

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研究成果の概要（和文）：本研究では、東南アジアに拡大したタイ・ラオス間の電力融通について、異なる視点と最近の変化を調査した。特に、ステークホルダーによってその受け止め方が異なる（あるステークホルダーにとってはプラスであるが、あるステークホルダーにとってはマイナスである）ことを考慮すると、電力貿易の複数の影響を統合することが課題であることが確認された。とりわけ、拡大する電力取引の規模は、国全体はともかく、特定の地域の開発部分に大きな影響を与える可能性がある。そのため、新たな代替案が必要になるかもしれないが、当初は持続可能な開発目標やジャスト・トランジションの原則など、確立されたフレームワークの利用を提案する。

研究成果の学術的意義や社会的意義

This study contributes to bridging of the literatures on Energy regionalism and Sustainability Transition. It supports ASEAN regional energy cooperation policies

研究成果の概要（英文）：This study investigated the different perspectives, and the recent changes, of power connectivity between Thailand and Laos, which has expanded to Southeast Asia. The research confirmed the challenges to integrate the multiple impacts of power trade, particularly considering that different stakeholders may perceive these differently (positive for some while negative for others). Among others, the scale of expanded power trade may impact significantly the development part of certain areas, even if the entire country. For that, the use of certain established frameworks such as the Sustainable Development Goals or the Just Transition principles are proposed initially, although new alternative ones might be needed.

研究分野：Environmental policy and social systems-related

キーワード：Energy regionalism ASEAN Power connectivity Energy transition

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様式 C - 19、F - 19 - 1、Z - 19 (共通)

1. 研究開始当初の背景

This research goal was to investigate the differences in perspectives on cross border power trade, with a special focus on Thailand and Laos interconnections.

2. 研究の目的

This study aims to propose methods for broader consensus building for cross border power planning. It is expected that by incorporating more perspectives, the transboundary energy planning methods could deliver more widely accepted projects, reducing the negative backlash that this projects receive at times.

3. 研究の方法

The research was conducted through a combination on desk reviews, experts interviews and discussions, and impact analysis of experience with power trade and perspectives for the future. The initial focus to Thailand and Laos has been gradually extended to consider more broadly Southeast Asia (Greater Mekong Subregion and ASEAN) as well as the Asia-Pacific.

4. 研究成果

First, the experience in the Greater Mekong Subregion was reviewed. The GMS is regarded as one of the most advanced regional power trade and integration programmes in the world, particularly in the Global South. Since its inception in 1992, the region has evolved from a single cross-border electricity trade agreement between Lao PDR and Thailand to a rapid expansion of the electricity trade now involving all GMS countries. It has also successfully started trading with other countries through the Lao PDR-Thailand-Malaysia-Singapore Power Integration Project. Interestingly, the advancement of cross-border electricity trade in the GMS has been possible even though it lacked a political integration framework and began when relations between countries were still scant. This raises the question of how the GMS managed to move from being a divided region to become a global example of regional trade.

An analysis of the historical process of regional power trade in the GMS reveals three important points. First, the initial consensus-building was possible thanks to honest brokers as well as the rapid implementation of a small representative project even before the design of the larger programme. Second, physical construction moves faster than institutional development, leading to an array of bilateral projects that may narrow the scope of cooperation. Third, institutional construction requires longer periods of negotiation, including failures, than does the development of interconnections. However, this process allows for further development and exchanges that expand cooperation.

Then, we focused on the case of Thailand and Laos to analyze the regional economic impacts of electricity trading in the GMS looking into the different impacts across different economic sectors. A quantitative analysis of cross-border electricity trade (CBET) between Laos and Thailand found that promoting CBET had a slight positive impact on Lao GDP and a slight negative impact on Thailand. The impact on each economic sector also showed different trends in the two countries. The analysis of the economic impact of strategic choices of specific power generation methods and import levels also showed that changes in specific power generation methods and import levels have different economic impacts in different countries. The analysis also showed that the impact could be negative for some combinations of transaction levels and generation methods, suggesting the need for strategic planning.

We also looked at the entire Asia-Pacific region in order to evaluate several relevant strategic objectives for region power connectivity

Table 1 - STEEP summary of strategic objectives for regional power connectivity

Category	Cod.	Description
Social	So1	To improve electricity access (such as border electrification)
	So2	To promote green jobs growth and overall welfare improvement
	So3	To induce poverty alleviation
	So4	To promote economic development in remote areas
Technical	Te1	To improve supply-demand matching
	Te2	To benefit from seasonal power trade (e.g. solar or thermal in one country and hydro in another)
	Te3	To transport electricity rather than raw fuels
	Te4	To manage regional resource endowment differences (e.g. surplus in one country and demand in another)
Economic	Ec1	Lower curtailment or storage demands
	Ec2	Increased economic opportunities for excess power generation capacity
	Ec3	Lower price volatility
	Ec4	Reduction of energy prices
Environmental	En1	Contribution to a higher share of renewable electricity
	En2	To reduce operating reserves
	En3	To promote investments in new more environmentally friendly generation technologies (e.g. floating solar PV, offshore wind farms, battery storage)
	En4	To reduce air pollution
Political	Po1	To incentivize further market integration
	Po2	To align the power sector's policy and regulatory environments across neighbouring countries (e.g. grid codes, performance standards, regulatory frameworks)
	Po3	To enhance the institutional capacity of power utilities and energy ministries
	Po4	To promote political collaboration with neighbouring countries

Figure 1 - Overall prioritization of categories

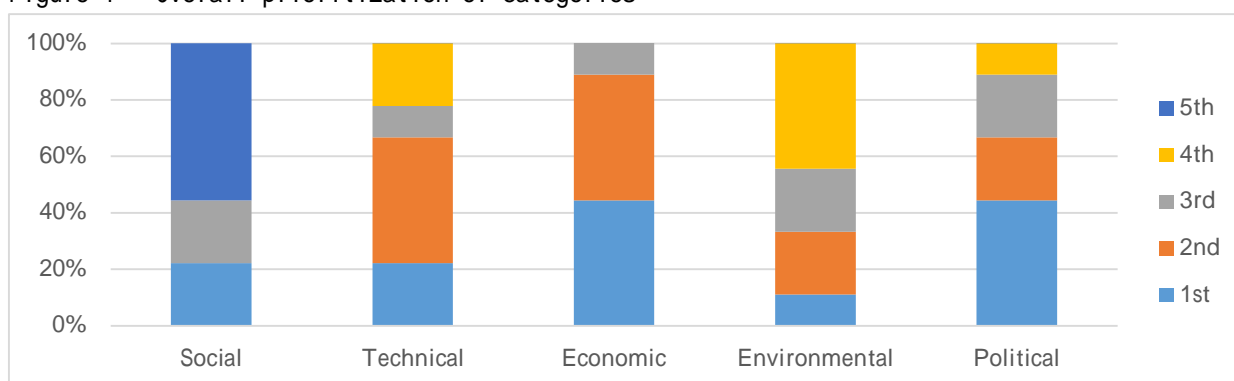
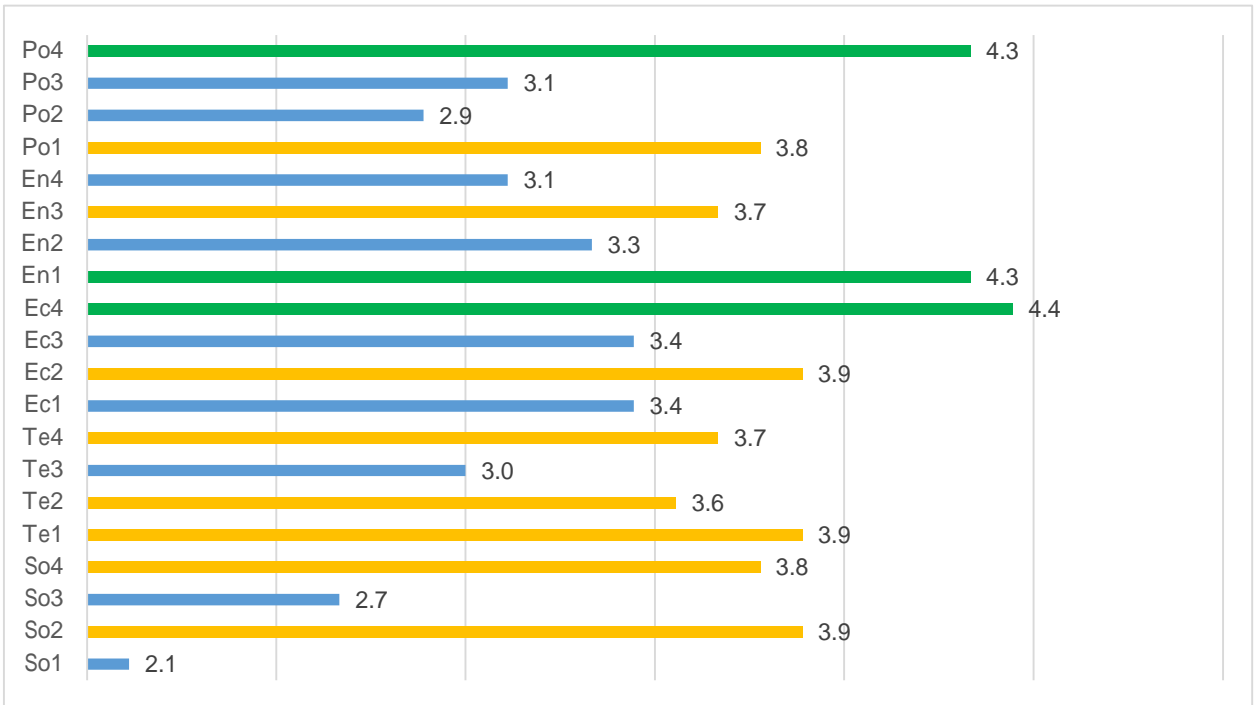


Figure 2 - Average weights for all objectives



In general, respondents agree on its importance of economic objectives, with an emphasis on the reduction of energy prices followed by the income generated through the export of electricity. The importance of power connectivity for the decarbonization of power mixes is already widely shared. However, there seems to be still a predominance on the role of hydropower over other technologies. This can be partially explained by the still largely untapped potential in many countries (Darmawi et al. 2013). However, a focus only on the generation costs can lead to a miscalculation of the actual economic impact when considering the total environmental cost (which include also vital economic activities such as fishing) (Intralawan et al. 2018) and of the dam safety and hazard potential (A. Huber 2019). Furthermore, there is a risk that some new projects are motivated by income generation rather than actual energy needs, either for local consumption or export (Hennig et al. 2016). Hydropower has, and will, played a vital role in transboundary power trade; however, it is required to improve its development to incorporate adequate benefit sharing arranging and tackling governance asymmetries (Llamosas and Sovacool 2021).

We also found an apparent broadly shared interest in the promotion of investments in, mainly, solar and, also to a certain degree, wind. However, it was not clear whether this was mostly targeted for locally generated, locally consumed (understanding locally as within the country) or this has entered the actual interest of cross-border projects. There has been an undeniable growth in solar and wind energy in Asia, but it is also true that the core has been limited to some countries (i.e., China, India, Australia, Japan), and whilst this “renewables boom” can be observed to be expanding to other countries (e.g., Vietnam, Thailand), there are still many countries in which variables renewables play a modest role. Even though, solar and wind play a central role in some of the regional initiatives, especially the newest, such as the GEI and the ASG. SunCable, if finally developed, is to become one of the most exemplary cross-border solar energy projects. Nevertheless, hydropower projects still dominate the “portfolio” of cross border power trade, and countries are targeting their investments in solar and wind for domestic consumption, and these have not reached yet major issues for their integration (although power curtailments of renewables have already occurred). This can also explain the relatively low priority that is given to some of the objectives identified that are closely linked to variable renewables, such as lower curtailment or storage demands.

The research confirmed the challenges to integrate the multiple impacts of

power trade, particularly considering that different stakeholders may perceive these differently (positive for some while negative for others). Among others, the scale of expanded power trade may impact significantly the development part of certain areas, even if the entire country.. For that, the use of certain established frameworks such as the Sustainable Development Goals or the Just Transition principles are proposed initially, although new alternative ones might be needed.

5. 主な発表論文等

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掲載論文のDOI（デジタルオブジェクト識別子） 10.1080/13602381.2022.2093528	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 該当する

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〔産業財産権〕

〔その他〕

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6. 研究組織	氏名 (ローマ字氏名) (研究者番号)	所属研究機関・部局・職 (機関番号)	備考
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7. 科研費を使用して開催した国際研究集会

〔国際研究集会〕 計0件

8. 本研究に関連して実施した国際共同研究の実施状況

共同研究相手国	相手方研究機関
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