

# Research overview and outcomes: just transitions to decarbonisation in the Asia-Pacific

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*Abstract:* This paper presents a comprehensive overview of a study examining microgrids for off-grid rural electrification in Indonesia, Malaysia, the Philippines, and Vietnam within the ASEAN context. Utilising mixed methods, this study delved into the techno-economic aspects of these systems and explored varied business models and governance strategies. It assessed how these models and strategies impact rural electricity access and contribute to a just regional energy transition. The study highlights the dual benefits of enhancing regional energy access and community empowerment while addressing shared challenges in climate change and decarbonisation. It identified potential market opportunities at the national level, with an expectation of increased private sector involvement amid prospective system liberalisations. Viewed through the lens of energy justice, the regional energy transition is presented not only as an environmental imperative but also as a catalyst for economic growth. This involves creating jobs, expanding electricity access, and mitigating climate impacts for local communities and the broader region. This study also sheds light on workforce and labour support and industry transformation, suggesting avenues for future research.

*Keywords:* ASEAN, energy justice, microgrids, electricity access, energy transition, labour

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## **1. Introduction: the urgency of addressing climate change and quality of life**

The research presented in this paper is situated at a critical juncture where the global challenges of climate change intersect with local and regional imperatives to improve electricity access. Addressing climate change is an urgent global priority, highlighted by the Intergovernmental Panel on Climate Change (IPCC) as requiring immediate and substantial action to reduce emissions. Concurrently, enhancing electricity access is pivotal in improving the quality of life, particularly in off-grid rural areas of the Asia-Pacific region and the subregion of Southeast Asia. This dual focus frames the following research, acknowledging that balancing carefully against the environmental imperatives of climate change mitigation while expanding electricity access is crucial for development, and vice versa. It is urgent to recognise that approaches to climate change mitigation vary significantly across different global contexts. In Western or G7 nations, the primary emphasis often lies on the climate aspect, driven by a need to rapidly reduce carbon emissions. However, in the Global South, including many of Southeast Asia's economies, the approach is necessarily different. Here, the priority is to first address the immediate quality of life improvements that come with increased electricity access. Ensuring reliable and sustainable energy access is seen as a precursor to and enabler of effective climate action. This underscores the importance of developing tailored strategies that reflect the socio-economic realities of these regions, ensuring that climate change mitigation does not overshadow the critical need for development and improved living standards.

The quest for affordable and clean electricity access is pivotal to achieving many of the United Nations' 17 Sustainable Development Goals (SDGs) (UN 2023). This need has been further accentuated by the COVID-19 pandemic, which highlighted the critical importance of electricity and internet access for public health, especially in remote areas (REN21 & ADB 2021). However, in the Asia-Pacific region, particularly within the Southeast Asian subregion and among ASEAN (Association of Southeast Asian Nations) members, achieving universal electricity access presents unique challenges. Geographical constraints like unconnected islands and remote locations, compounded by rapid development and growing urban-rural divides, make rural and island electrification particularly challenging (Purwanto & Afifah 2016). Despite significant strides in recent years, the Alliance for Rural Electrification (2020) estimates nearly 1 billion people globally, with a substantial number in Southeast Asia, still lack access to modern electricity.

The Energy Sector Management Assistance Program (ESMAP) forecasts that falling technology costs and improving policy environments will enable microgrids to economically connect 490 million people globally by 2030 (ESMAP 2019). This scale of electrification necessitates substantial investment but also offers considerable economic potential, both in terms of profit for microgrid developers and in fostering local community revenues.

Access to reliable and affordable electricity is a key policy priority for ASEAN, with implications for poverty reduction and environmental sustainability (ACE 2023). The challenge lies in harmonising rural electrification with regional and global climate goals, transitioning from traditional energy systems to more sustainable models. This involves leveraging private sector participation and community engagement, employing commercially viable renewable energy technologies.

Distributed Renewable Energy Systems (DESSs) have emerged as a crucial component in achieving SDG objectives. Governments across the Asia-Pacific are increasingly focusing on renewable microgrids to enhance energy access and drive the energy transition away from fossil fuels (REN21 & ADB 2019). These microgrids, often situated in remote areas where grid connection is impractical, represent the first electricity source for many communities. Yet, they also face challenges in financial sustainability, maintenance, governance, and local community engagement, indicating a need for new business and governance models (IRENA 2019).

Realising this ambitious goal of rural electrification will necessitate the deployment of over 210,000 microgrids, requiring an investment close to US\$220 billion. The next decade is expected to see the establishment of approximately 1,700 mini-grids every month. Achieving this scale of development could generate significant economic returns, with projections estimating an annual profit of US\$3.3 billion for private microgrid developers from 2019 to 2030, and a collective net profit of US\$4.7 billion for all mini-grid component and service providers by 2030 (Alliance for Rural Electrification 2020). Therefore, developing effective business models that enable rural communities to tap into these revenue streams is of paramount importance, ensuring that the benefits of these investments are equitably shared and contribute meaningfully to local development.

This project aims to explore how local energy business models and intermediate technologies can be integrated with community governance to create equitable and sustainable energy solutions. It seeks to develop scalable models for rural electrification in the Asia-Pacific, enhancing energy access and contributing to a just and beneficial energy transition.

## **1.1 Defining just transitions**

At the centre of this research is the concept of ‘just transitions’, which has become increasingly relevant in the discourse on sustainable development and climate action. Defined in the COP26 Just Transitions Declaration (UN Climate Change Conference 2021) and the International Labour Organization (ILO) Guidelines (ILO 2015), just transitions refer to the spectrum of social interventions necessary to secure workers’ rights and livelihoods as economies transition towards sustainable practices. This concept is particularly pertinent to the Asia-Pacific region’s efforts towards decarbonisation, which must harmonise the need for increased electricity access with sustainable environmental practices that are in line with national and subregional climate targets (ACE 2023).

Following these issues, this article provides an in-depth overview of a study into the use of microgrids for off-grid rural electrification in Indonesia, Malaysia, the Philippines, and Vietnam, within the broader ASEAN context. Employing mixed methods, this research investigates the techno-economic aspects of these microgrid systems, examining the associated business models and their role in promoting equitable energy access.

An integral component of this study is the exploration of potential market opportunities at a national level, particularly considering an expected increase in private sector participation and potential system liberalisation. This exploration is crucial for understanding the changing market dynamics in the region and their implications for rural electrification initiatives.

From the perspective of energy justice, the regional energy transition is viewed not only as an environmental necessity but also as a driver of comprehensive regional development. This transition presents opportunities for economic growth, job creation, broader electricity access, and significant reduction in climate change impacts. The consequences of such a transition for local populations and the broader region are substantial, highlighting the importance of a well-rounded approach to energy policy and planning in the Asia-Pacific.

The following article provides a comprehensive exploration into the complex interplay between climate change mitigation, electricity access, and just transitions in the Asia-Pacific region. The subsequent sections of this paper will delve deeper into the nuances of these interrelated themes. We will explore how the unique geographical, political, economic, and cultural contexts of Indonesia, Malaysia, the Philippines, and Vietnam shape their approaches to just transitions. The importance of language in framing positive narratives, the critical role of consultation and collaboration with diverse stakeholders, and the imperative of workforce transitions for sustainable employment will be examined in detail. These discussions

will not only contextualise the concept of just transitions within the Asia-Pacific region but also highlight lessons learned and potential strategies for policymakers. By synthesising these insights, this paper aims to contribute significantly to the discourse on sustainable development, energy justice, and the broader implications of decarbonisation efforts in this dynamic and evolving region.

## 2. Methodology and research approach

This study employed a mixed-method, comparative case study approach, conducted between December 2021 and March 2022, to investigate rural electrification in the Asia-Pacific region. Our methodological framework was multi-faceted, incorporating both quantitative and qualitative elements to provide a comprehensive understanding of the subject matter.

- i. **Techno-economic modelling:** We conducted basic techno-economic modelling for each project, encompassing factors such as cost per kilowatt-hour, subsidies, investment, and operational costs, expected load consumption, energy generation as well as distributional impacts. This quantitative analysis provided a solid foundation for understanding the financial and technical aspects of the microgrid systems in our case studies.
- ii. **Qualitative analysis of governance and institutional arrangements:** Through semi-structured interviews and small workshops, we engaged with project developers, technology providers, local policymakers, and community leaders. Approximately fifteen interviews were conducted across the case study locations—Indonesia, Malaysia, the Philippines, and Vietnam. This qualitative component allowed us to delve into the socio-cultural dimensions and energy justice aspects of low-carbon electrification, acknowledging the regional diversity and varying contexts.
- iii. **Policy workshops for stakeholder engagement:** We organised policymaker engagement workshops, involving local, national, and international stakeholders, including NGOs (nongovernmental organisations). These workshops facilitated discussions on the research findings and explored avenues to upscale rural electrification through equitable and sustainable business models.

### 2.1 Rationale for case study selection

This study strategically selected Indonesia, Malaysia, the Philippines, and Vietnam as case studies due to shared characteristics that are significant for exploring energy

access, energy justice, and energy transitions within the Asia-Pacific. These countries, members of ASEAN, not only share geographical locations in the Asia-Pacific and Southeast Asian subregion, but also have parallel objectives regarding energy and electrification access, diverse energy systems, and potential for enhanced renewable energy use (ACE 2023). Moreover, they face unique geographical challenges pertinent to remote and island communities.

These nations represent a broad spectrum of cultural, economic, and political systems, reflecting the diversity of the Asia-Pacific region. This includes similarities with other countries in Southeast and Northeast Asia, as well as the Pacific subregions. Given their role in the rapidly developing Southeast Asian subregion and their active participation in regional and global climate and energy initiatives, these countries offer a critical microcosm for the study.

The chosen case studies also encompass diverse types of micro-grid configuration, including systems with diesel generators, microgrids combining renewables and battery energy storage systems (BESSs) with centralised and decentralised governance, and communities on the verge of acquiring microgrid facilities. The intent was to explore a variety of off-grid situations, ranging from those already using renewable energy to areas preparing for transition away from diesel generators. Each case study represented a unique approach to rural electrification:

- i. Indonesia's Ulu-Danau Micro Hydro Power Plant, illustrating a community-driven on-grid system integrated with state electricity.
- ii. Malaysia's Sarawak Alternative Rural Electrification Scheme, showcasing an off-grid innovative state government–community partnership with standalone solar or micro hydro systems.
- iii. The Philippines' Timodos Micro Hydro Plant, a community-driven off-grid system focusing on rural electrification.
- iv. Vietnam's Lotus projects, which represent pre-electrification stages in remote communities underserved by grid connections.

The choice of these locations was driven by their representativeness of different energy systems, governance models, and the diverse socio-economic contexts within the Asia-Pacific region. This selection enables a comprehensive understanding of the dynamics at play in rural electrification and the pursuit of energy justice, offering valuable insights for policymakers and stakeholders.

## 2.2 Business models for rural electrification

The concept of business models encompasses the creation and capture of social and economic value by various economic entities. Historically rooted in business and management studies, this conceptual framework has gained traction among social science and sustainability researchers (Bocken *et al.* 2014). It offers a powerful tool for bridging the gap between social and economic aspects, enabling comparative analyses of different economic approaches within similar sectors.

In the realm of energy research, particularly concerning Distributed Energy Systems (DESS), business models have become a focal point for examining the interplay between energy providers, consumers, and technological infrastructures (Richter 2012). DES, characterised by their decentralised nature, necessitate closer and more localised interactions between energy producers and consumers, often leading to the blurring of traditional roles in what is known as the ‘prosumer’ phenomenon (Parag & Sovacool 2016). Emerging business models in this field have the potential to forge new socio-economic pathways, creating opportunities and challenges alike.

According to Brown’s (2018) formulation, energy business models can be dissected into five key components: the value proposition, supply chain, customer interface, financial model, and governance. The value proposition relates to the benefits offered to consumers, while the supply chain encompasses upstream relationships and logistics. The customer interface deals with downstream interactions, marketing, and service relationships. Financial models represent the blend of capital and operational expenses with revenue strategies, and governance encapsulates the coordination and organisational structure of the model. Hence, Table 1 applies the framework of business models specifically to rural microgrids. This application offers critical insights into both the social and technical characteristics of these systems, presenting a methodical approach for their comparison. In Section 4, this analytical framework is employed to assess and compare the diverse business models identified in our case studies.

While research in DES business models has been prominent in the Global North, focusing on liberalised electricity markets and full electricity access, there is a notable gap in studies addressing the Global South, where electricity access is often limited, and utility models are typically state-owned (Hostettler 2015). This gap highlights the need for further exploration of DES business models in diverse socio-economic and political contexts.

Microgrids, a subset of DES, illustrate this point well. These can be grid-connected, maximising on-site consumption of generated electricity, or off-grid, serving as the sole electricity source in remote areas; the latter of which is

**Table 1.** Business model components for rural microgrids.

<i>Business model component</i>	<i>Considerations for rural microgrids</i>
Value proposition	<ul style="list-style-type: none"> <li>• What level of electrification is offered?—are there limits on daily consumption? Is power available at certain hours of the day?</li> <li>• What tariff (if any) is there for power consumption?</li> <li>• What other services are included—support in power utilisation, infrastructure works, training programmes?</li> </ul>
Supply chain	<ul style="list-style-type: none"> <li>• What are the systems technical features?</li> <li>• Who are the system designers?</li> <li>• Who are the equipment suppliers?</li> <li>• Who are the system installers?</li> <li>• Who undertakes maintenance?</li> </ul>
Customer interface	<ul style="list-style-type: none"> <li>• How is the community engaged during the planning process?</li> <li>• How is the ongoing relationship managed and by whom?</li> </ul>
Financial model	<ul style="list-style-type: none"> <li>• How is the capital cost of the system funded?</li> <li>• How are the operational costs of the system funded?</li> <li>• What is the tariff structure (if any) for the system?</li> <li>• Are there additional revenues: e.g., from exported power?</li> </ul>
Governance	<ul style="list-style-type: none"> <li>• Who owns the system?</li> <li>• How are key decisions taken?</li> <li>• What is the relationship between the funder/installer/owner and the host community?</li> </ul>

increasingly prevalent in the Global South, posing unique technical, economic, and social challenges (Borghese *et al.* 2017). The business model framework provides a valuable lens to understand these systems, bridging technical aspects with the social value they generate or impact. This comprehensive approach is crucial for evaluating and comparing various business models in rural microgrid applications, as explored in this study.

The integration of these methodological components enabled a thorough examination of the winners and losers in regional electricity access projects, while also identifying impactful and replicable business models for sustainable electricity provision. This research approach culminated in a comprehensive understanding of DES within the Asia-Pacific context, illuminating effective business models for sustainable electricity provision. By examining various DES configurations and governance models, our study offers critical insights into the economic and social dynamics of rural electrification. The exploration into diverse business models, from community-based initiatives to state-driven projects, highlights the intricate balance between technological feasibility, economic viability, and social acceptability. The findings underscore the importance of adaptable and inclusive business models in achieving energy justice and access, particularly in geographically challenging regions. These models not only address the immediate need for electricity



but also pave the way for sustainable and equitable energy solutions that can be replicated across the Asia-Pacific region and the Southeast Asian subregion, contributing significantly to the global discourse on sustainable energy transitions.

### **2.3 Energy justice: intersecting local, national, and regional considerations**

Our methodological approach incorporated a theoretical framework of energy justice, integrating the concepts developed by McCauley *et al.* (2013), Sovacool and Dworkin (2015), and Jenkins *et al.* (2016). This framework encompasses four key dimensions: distributional, recognition-based, procedural, and restorative justice. Each dimension addresses different aspects of energy justice: ‘distributional’ focuses on identifying and resolving injustices; ‘recognition’ emphasises acknowledging overlooked communities; ‘procedural’ seeks fairness in processes; and ‘restorative’ aims to repair past damages. This multi-faceted approach provides a comprehensive lens for examining energy justice, ensuring that our analysis is not solely based on Western paradigms but also reflects the diverse political, economic, and social realities of developing countries (McCauley & Heffron 2018). Crucially, this research intertwines the theoretical underpinnings of energy justice with the practical examination of Distributed Energy System (DES) business models. This novel combination, applied specifically to ASEAN’s remote communities, offers fresh insights, and contributes to expanding the energy justice literature in new, international contexts (Heffron *et al.* 2021).

## **3. Contextualising just transitions in the Asia-Pacific**

The Asia-Pacific region’s approach to just transitions is deeply shaped by its diverse geographical, political, economic, and cultural landscapes. This diversity brings forth varying perceptions and strategies towards achieving sustainable energy access and climate change mitigation. Countries like Indonesia, Malaysia, the Philippines, and Vietnam face unique challenges due to their geographical features, from dense forests and high mountains to sprawling archipelagos, which complicate the electrification process. Rapid growth and an expanding urban–rural divide further magnify these challenges (Setyowati 2021). Geographically, this diversity significantly impacts the implementation of just transitions, particularly in rural and island locations where infrastructure costs and maintenance are challenging; Politically, the region is also host to a variety of governance styles, which affects policy formulation and implementation; Economically, there is a juxtaposition of rapidly growing economies alongside others with more modest growth, creating

varied priorities and capacities for the global climate and energy transition; Culturally, the variation of traditions and values across the region influences public perception and acceptance of new technologies and reforms.

### **3.1 Acknowledging regional diversity**

The diversity within the ASEAN member states necessitates tailored approaches to electrification and decarbonisation. Efforts towards achieving 100% electrification are ongoing, with each nation grappling with its own set of geographical and resource constraints. These constraints pose additional pressures on meeting national and subregional targets and require innovative solutions that cater to the specific needs of each locale.

In the pursuit of sustainable energy goals, acknowledging the regional diversity is paramount. For instance, Indonesia's archipelagic nature poses unique challenges in electrification compared to the more mainland-centric challenges of Vietnam. Malaysia and the Philippines, too, present their own set of challenges and opportunities, shaped by their specific socio-economic and geographical contexts. Recognising these nuances is crucial for developing strategies that are not only efficient but also equitable and culturally sensitive.

### **3.2 Emphasising the role of context-specific timescales**

The journey towards a just transition in Southeast Asia must also consider the context-specific timescales unique to each country. The pace of progress in one nation may not be feasible in another due to varying political, economic, and infrastructural realities. Recognising these differences is essential for setting realistic goals and creating effective strategies for energy access and climate change mitigation. For example, the pace at which Vietnam can implement renewable energy projects may differ significantly from that of the Philippines, due to differences in regulatory environments, economic structures, and resource availability. It is important to set realistic and achievable goals within these individual contexts to ensure the success and sustainability of just transitions.

### **3.3 Lessons learned**

- i. **Specific and sensitive definitions:** Understanding the unique challenges and opportunities in the Asia-Pacific requires definitions of just transitions that are specific and sensitive to the regional context. This specificity ensures that pol-

icies and initiatives are relevant and effective. The definition of just transitions in the Asia-Pacific region must be rooted in the specific realities of each country. For instance, what constitutes a just transition in Malaysia might look different in Indonesia, owing to their distinct economic statuses and energy infrastructures.

- ii. **Promoting mutual learning between regions:** The diversity within the region offers an opportunity for mutual learning and there is much to be gained from a collaborative approach. Sharing experiences and best practices among countries can lead to more innovative and effective approaches to just transitions. Countries within the region can learn from each other's successes and challenges. For example, Vietnam's and the Philippines' successes in gaining international NGO funding for projects could offer valuable insights to their ASEAN counterparts.
- iii. **Engaging policymakers in all regions:** Effective implementation of just transitions strategies requires the active engagement of policymakers across the region. This engagement is crucial, irrespective of the current stage of industry development in their respective countries, as it fosters a collaborative approach to addressing common challenges. Engagement should not be limited to countries with advanced energy sectors but should also include those at different stages of energy development to foster a more inclusive and comprehensive approach.

A just transition in Southeast Asia is inherently complex, influenced by a variety of geographical, political, economic, and cultural factors. The lessons learned from addressing these complexities are invaluable for shaping future strategies. Section 4 takes this diversity further, exploring how the use of language and the creation of positive narratives play a pivotal role in the success of these transitions. Our research highlighted this challenge, underscoring that understanding and harnessing the power of language can be instrumental in aligning diverse understandings and expectations, ultimately contributing to the achievement of just transitions across this dynamic and varied region.

#### 4. Positive narratives and diverse understandings

The adoption of positive narratives in the discourse surrounding rural electrification and energy transitions in Southeast Asia is crucial for their success. Language plays a pivotal role in shaping perceptions and aligning community-driven energy access programmes with local values and aspirations. This research indicates that justice

frameworks, as currently articulated, often come across as top-down, academic-driven constructs, highlighting the need for a language and conversation that resonate naturally with local communities, integrating their perspectives and cultural context into the narrative.

#### 4.1 Considering issues of inequalities and historical injustices

The narrative around energy transitions should also consciously incorporate considerations of historical injustices and current inequalities. In the context of Southeast Asia's rural electrification, it is essential to address language in a way that reflects the region's complex history and diverse socio-economic landscape. Many communities in this region have experienced historical injustices and disparities, which are often intertwined with rural electrification efforts. Acknowledging these inequalities is vital in framing the narrative around energy transitions:

- i. **Acknowledging past inequities:** In Southeast Asia, many rural communities have historically been marginalised in terms of infrastructure development, including energy access. This is true for the experience of the Ulu-Danau Micro Hydro Power Plant in Indonesia, where road access was limited and highly susceptible to weather conditions. Recognising this history in communication strategies is crucial for building trust and demonstrating a commitment to equitable development.
- ii. **Reflecting cultural sensitivities:** The region is home to a rich history of cultures and languages. Communication strategies must be culturally sensitive and inclusive, respecting local customs and traditions. This is particularly important in areas where minority groups may have faced historical disadvantages.
- iii. **Addressing socio-economic disparities:** Southeast Asia's rural areas often exhibit significant socio-economic disparities compared to urban centres. Language used in the context of energy projects should be mindful of these disparities, ensuring that the narratives do not inadvertently reinforce existing inequalities.
- iv. **Empowering local voices:** Encouraging and facilitating local communities to express their needs and concerns in their own words can be empowering. They allow for a more authentic and respectful dialogue about energy access and justice.
- v. **Creating inclusive narratives:** The language used in the discourse on rural electrification should aim to create narratives that are inclusive of all community members, regardless of their socio-economic status, ethnicity, or gender.

This inclusivity is key to ensuring that the benefits of energy transitions are shared equitably.

By considering these aspects, the narrative surrounding rural electrification in Southeast Asia can become more inclusive and attuned to the historical and current context of the communities involved. This approach not only fosters a sense of fairness and respect but also helps in building more sustainable and effective energy solutions. The use of language and the creation of positive narratives play a significant role in the success of energy transitions not just in Southeast Asia, but potentially across other regions of the Global South. Effective communication—acknowledging and integrating local perspectives and historical contexts—is vital in aligning community-driven energy access programmes with the principles of energy justice.

## **4.2 Lessons learned**

Engaging in broad, open conversations that include diverse local perspectives is key to fostering a comprehensive understanding of energy justice. This approach ensures that the dialogue around energy transitions is inclusive and reflects the multi-faceted nature of local communities. These discussions must also transcend technical and economic aspects, considering social, cultural, and ethical dimensions of energy access and sustainability.

Addressing and reframing any negative associations with energy access initiatives are also crucial. In conversations with local communities, researchers noted that these can be achieved by highlighting the tangible benefits of these initiatives and aligning them with local priorities and values. Varied understandings of energy access across communities necessitate a nuanced approach in communication, and one that is sensitive to the local socio-cultural frameworks.

## **5. Fostering success through consultation and collaboration in DES projects**

The success of DES in rural localities of Southeast Asia is deeply rooted in the active consultation and collaboration among diverse stakeholders. Engaging a wide range of participants—from local authorities and NGOs to private sector players and community members—is crucial for the effective implementation and sustainability of DES projects and was pivotal in the success of the case studies explored. Such broad-based engagement ensures that these energy initiatives are not only

technically sound but also socially and culturally attuned to the communities they serve.

### **5.1 Broad engagement for just transitions**

Local knowledge is an invaluable asset in designing and implementing energy projects, particularly in the case of DES in Indonesia and Malaysia. Engaging with communities provides insights into their unique challenges, aspirations, and cultural nuances. This local understanding is crucial in developing solutions that are not only technically viable but also socially and culturally acceptable, garnering buy-in from the communities that are benefiting from these systems, as well as offering opportunities for the continued success and utilisation in these systems in the medium and long term. In Indonesia, the Ulu-Danau Micro Hydro Power Plant exemplifies the power of community engagement. Managed by IBEKA, a local NGO, the project not only secured funding but also fostered the creation of village-based organisations, including the active participation of women, to ensure the project's sustainability. This local involvement was crucial in addressing the unique challenges and aspirations of the community.

Consultation with a diverse array of stakeholders, including local authorities and NGOs, also provides a multi-dimensional perspective for comprehensive project planning and execution. This collaborative approach ensures that various viewpoints are considered, leading to more robust and sustainable energy solutions while also incorporating aspects of justice that may otherwise be overlooked. In Malaysia, the Sarawak Alternative Rural Electrification Scheme (SARES) demonstrates the effectiveness of collaboration between government and community. This off-grid initiative, implemented by Sarawak Energy and funded by the Sarawak Government, provided remote households with solar or micro-hydro systems. Community training for operation and maintenance was integral to the project's success, ensuring long-term viability and local ownership.

### **5.2 Key lessons for effective collaboration**

- i. **Community-centric approaches:** Ultimately, the four case studies highlight the importance of placing communities at the heart of DES projects. By engaging them in planning and decision-making, projects become more sustainable and culturally sensitive.
- ii. **Building trust through transparency and engagement:** In Vietnam, the Lotus project, focusing on renewable electrification, demonstrates the

importance of trust-building. By engaging communities in the planning stages and considering their future needs, Lotus ensures long-term project success and community buy-in.

Emphasising the need for a community-focused participatory approach, transparent communication, and the engagement of young people in sustainable energy initiatives, these case studies underscore the essence of consultation and collaboration in DES projects within the Asia-Pacific. By involving diverse stakeholders, respecting local cultures and needs, and ensuring community participation, these projects have not only achieved technical success but have also contributed to local economic development and energy justice. As we move forward, the path to sustainable energy solutions in rural areas lies through a collaborative, inclusive approach that values and integrates the voices of all stakeholders.

## **6. Workforce transitions and decent employment**

In Southeast Asia's journey towards sustainable energy systems, the entwinement of economic and environmental goals is critical. Workforce changes are necessary for achieving these intertwined objectives, particularly in the context of rural electrification through renewable energy sources. The transition presents both challenges and opportunities, especially in terms of employment and workforce development in rural communities. This research highlighted some of these issues, but further analysis, over a longer period of time, would benefit both the research and the long-term outcomes of programmes in these spaces.

In the context of rural electrification in Southeast Asia, the interconnectedness of economic and environmental vulnerabilities is particularly pronounced. This entwinement highlights the fact that environmental changes, such as those necessitated by the shift to renewable energy sources, have direct and profound economic implications, especially for rural communities. These populations often face dual vulnerabilities: economic instability due to changing labour markets and environmental risks exacerbated by climate change and unsustainable energy practices. Recognising this interconnectedness is crucial in ensuring that the transition to renewable energy systems not only addresses environmental concerns but also supports and enhances economic stability and growth for these communities. This approach underlines the need for energy policies and initiatives that are holistic, considering both environmental sustainability and economic vitality as inseparable and equally important objectives.

### **6.1 Recognising interconnected vulnerabilities**

The shift to renewable energy systems is not just an environmental imperative; it has significant socio-economic implications, particularly for local workforces. Many rural communities in Southeast Asia, dependent on traditional forms of livelihood, face vulnerabilities that are both economic and environmental. The transition to renewable energy offers an opportunity to address these vulnerabilities by creating new jobs and promoting sustainable economic growth.

The move towards increased renewable energy use in Southeast Asia's rural areas offers a paradigm shift in how local communities interact with their environment and economy. Historically, many communities have relied on agricultural or traditional industries, which are often susceptible to environmental changes and economic fluctuations. Renewable energy projects, such as solar and micro-hydro power installations found in Indonesia, Malaysia, and the Philippines, not only reduce environmental degradation but also introduce new forms of livelihood that are more resilient to climate change. This shift has the potential to rejuvenate local economies by diversifying income sources. Moreover, it empowers these communities to participate in energy projects and their continued utilisation and management (particularly those in remote or underserved areas) by fostering local entrepreneurship and skill development. In this way, the move to greener energy sources and the distributed energy systems studied is a path to economic resilience, helping communities withstand and adapt to both current and future economic and environmental challenges.

### **6.2 Prioritising workers' benefits in just transitions**

The concept of just transitions is pivotal in the discourse on transitioning to more sustainable energy systems, underscoring the imperative to prioritise the well-being and advancement of workers. Central to this approach is the commitment not to overlook the workforce implications, especially for those traditionally employed in non-renewable energy sectors. The global shift in energy systems presents unique opportunities and challenges, often at the crossroads of traditional and modern energy practices. As the energy landscape undergoes changes to achieve climate and energy goals, it becomes essential to implement strategies that encompass retraining programmes, fair compensation, and the development of new job opportunities within burgeoning energy sectors. These measures are fundamental in ensuring an equitable and inclusive shift towards sustainable energy practices. This transition presents a unique opportunity not only to redefine the energy landscape but also to reshape workforce dynamics in a way that benefits and empowers workers:



- i. **Transitioning rural workforces:** The move towards DES involves transitioning rural workforces towards new forms of employment. This includes providing training and development opportunities focused on skills relevant to DES, such as installation, maintenance, and management of renewable energy technologies. Tailoring these programmes to local contexts is vital for ensuring that they are both accessible and beneficial to rural populations.
- ii. **Incorporating traditional energy sector skills:** Many skills from traditional energy sectors are transferable to DES. For example, mechanical and electrical skills used in conventional energy can be adapted to renewable technologies. Recognising and harnessing these existing skills can facilitate smoother transitions for workers and enhance the efficiency of DES projects.
- iii. **Local economic development through DES:** DES projects offer more than just energy solutions; they can stimulate local economies by creating jobs and supporting ancillary services. Engaging local workers in these projects not only provides employment but also helps in building a sense of ownership and community involvement in the energy transition.
- iv. **Community-centric approach to workforce development:** A community-centric approach is essential in DES projects. This involves understanding the unique socio-economic dynamics of rural communities and designing workforce development initiatives that are aligned with these nuances. By doing so, the transition to DES can contribute to broader community development goals, including poverty alleviation and social empowerment.
- v. **Policy support for just transitions in rural areas:** Government policies and support mechanisms play a critical role in facilitating just transitions in rural areas. This includes creating incentives for renewable energy companies to hire locally, providing funding for workforce training programmes, and ensuring that rural communities are actively involved in planning and decision-making processes related to DES.

Aligning workforce transitions with the adoption of DES in rural communities is not just about technological change, but also about nurturing human capital and supporting local economies. This approach ensures that the benefits of renewable energy extend beyond environmental impact, fostering sustainable development and enhancing the quality of life in rural areas.

Prioritising workers' benefits in the transition to renewable energy is not just a matter of equity or fairness; it is a strategic approach to ensure the long-term success and sustainability of this transition, and the projects that power it. By focusing on retraining, fair compensation, job creation, local economic development, and community involvement, just transitions can deliver tangible benefits to workers

and communities, thus supporting the development of a more equitable and sustainable energy future.

### **6.3 Identifying net-zero job opportunities and initiating retraining programmes**

The renewable energy sector is expected to generate a multitude of job opportunities, marking a significant shift in the employment landscape. Identifying these opportunities, particularly in off-grid rural electrification, and aligning them with the skills and capacities of the local workforce are crucial. This alignment requires targeted skill development programmes and educational initiatives to prepare the workforce for new roles in renewable energy projects.

In line with the findings of our research, the transition to renewable energy in rural Asia-Pacific regions, especially through off-grid electrification, is not just an infrastructural change but a catalyst for socio-economic transformation. Our case studies in Indonesia, Malaysia, the Philippines, and Vietnam reveal that localised renewable energy projects, such as microgrids, have the potential to create a variety of jobs that go beyond the traditional energy sector roles. These range from technical positions like system installation and maintenance to community-oriented roles such as project coordination and user education. To harness this potential, it is imperative to establish retraining programmes tailored to the unique contexts of these communities. These programmes should focus on equipping the local workforce with necessary technical skills, while also fostering an understanding of sustainable energy management and its broader socio-economic benefits. Moreover, educational initiatives should be designed to not only transfer knowledge but also to empower communities to become active participants in their energy systems. This approach aligns with the broader goals of energy justice and inclusivity, ensuring that the shift to renewable energy contributes to a holistic development of rural areas, as observed in our case studies.

### **6.4 Collaborating across sectors for holistic impact**

The effective transition of the workforce in the context of rural electrification projects in Southeast Asia demands a concerted effort from a variety of stakeholders. Our research findings emphasise the importance of such collaboration, particularly in the diverse socio-economic landscapes of Indonesia, Malaysia, the Philippines, and Vietnam. Engaging trade unions, local communities, non-governmental organisations, and academic institutions is crucial in ensuring that the transition to renewable energy is both inclusive and beneficial to all sections of society. Engagement across these groups would provide the following:

- i. **Role of trade unions and NGOs:** In the context of Southeast Asia's rural electrification, trade unions and NGOs can play pivotal roles in advocating for workers' rights and ensuring fair labour practices. These organisations can also be instrumental in facilitating dialogue between the community and associated energy companies, ensuring that local voices are heard and considered in decision-making processes.
- ii. **Community engagement:** Our case studies highlight the importance of deeply involving local communities in renewable energy projects. This involvement goes beyond mere consultation; it encompasses active participation in planning, implementation, and management. This type of engagement ensures that projects are tailored to meet the specific needs of the community, thereby enhancing the social acceptability and sustainability of these initiatives.
- iii. **Academic contributions:** Academics can contribute significantly through research and analysis, providing data-driven insights into the most effective strategies for workforce transition in the renewable sector. Researchers, like those at UiTM (Universiti Teknologi MARA) in Malaysia, have already contributed significantly to the evaluation and monitoring of these programmes. By studying the impacts of various renewable energy initiatives, academic research can guide policy development and programme design, ensuring they are based on sound evidence and best practices.
- iv. **Policy development and programme design:** The collaboration between these diverse stakeholders is essential in developing policies and programmes that address the multi-faceted aspects of workforce transition in rural electrification. Policies need to be sensitive to the unique economic and cultural contexts of rural communities in Southeast Asia, ensuring that they support sustainable development and social equity.
- v. **Integrating local and regional perspectives:** Our research underscores the necessity of integrating both local and regional perspectives in the transition to renewable energy. The varied cultural, economic, and political systems in the case study countries require a nuanced approach to workforce transition, one that aligns with broader regional goals while respecting local specificities.

In essence, this multi-stakeholder collaboration, as evidenced in our research, is key to a holistic and impactful transition to renewable energy in rural areas of Southeast Asia. It not only supports the economic and social aspects of the transition but also ensures that the benefits are equitably distributed, contributing to the overall resilience and sustainability of these communities.

## **6.5 Towards sustainable employment**

The transition to renewable energy in Southeast Asia's rural areas presents a unique opportunity to drive economic growth and create sustainable employment. However, this transition must be managed inclusively and justly to ensure that the benefits are equitably distributed and that local workforces are adequately prepared and supported. As the region moves towards a greener future, it is imperative that these transitions are not only environmentally sustainable but also socially equitable and economically beneficial for all.

The transition to renewable energy within the rural locales of Southeast Asia stands as a critical juncture for economic evolution and the creation of sustainable employment. Our research has highlighted the workforce opportunities embedded within this transition, including upskilling and retraining initiatives, essential for realigning the workforce from traditional energy roles to burgeoning opportunities in the green energy sector. The pivotal role of collaborative efforts across various sectors has also been underscored, emphasising the need for integrated approaches to ensure inclusive growth and equitable benefit distribution.

Through the examination of four of Southeast Asia's rural DES projects, it is evident that these initiatives offer more than environmental solutions; they are instrumental in driving socio-economic development. These projects contribute to diversifying rural economies and enhancing the resilience of local communities. As the region progresses towards increased renewable energy adoption, the intertwined goals of environmental sustainability, economic vitality, and social equity remain at the forefront, guiding the path towards a balanced and sustainable future.

## **5. Conclusions: summarising the critical insights for policymakers**

This study rigorously examined four case studies—Indonesia, Malaysia, the Philippines, and Vietnam—to unravel the complexities of energy justice and rural electricity access in the Southeast Asian sub-region. This analysis revealed distinct realisations of academic energy justice concepts, influenced by local variations in energy access and interactions with support programmes. Notably, community narratives exhibited a conspicuous absence of justice considerations, often perceived as externally imposed rather than intrinsic principles. Varied perspectives on well-being, quality of life, and choices related to electricity access challenged established academic notions of justice across the case studies. The ensuing key findings present a synthesis that holds significant implications for policymakers navigating the intersection of energy access, justice, and sustainable development in the region:

- i. Academic concepts of energy justice manifest diversely in Asia-Pacific communities, shaped by energy access levels and support programmes.
- ii. Justice framings are notably absent from local narratives, often perceived as top-down, academic-driven processes.
- iii. Well-being, quality of life, and choices related to electricity access vary across case studies, sometimes deviating from academic notions of justice.
- iv. Community-driven energy access programmes take various technical forms, garnering support from public, NGO, and private sectors across Indonesia, Malaysia, the Philippines, and Vietnam.
- v. Successful distributed energy systems often result from a partnership between publicly funded NGOs, the state, and civil society, leveraging their complementary skills.
- vi. Local authorities play a crucial role post-funding, ensuring sustained success and emphasising the local economic impact for long-term viability.
- vii. Future research avenues include assessing the long-term viability of business models beyond initial project phases and exploring new markets in state-driven systems with increased private sector involvement.

In consolidating the salient findings of this research, we have identified several key insights with substantive implications for policymakers that are navigating the intricate terrain of energy justice in Southeast Asia. Academic conceptualisations of energy justice exhibit distinctive realisations within local communities, contingent upon their specific energy access levels and participatory engagement with support programmes. Notably, justice considerations exhibit a marked absence within community narratives, often manifesting as imposed, top-down constructs rather than intrinsic principles. Divergent perceptions regarding well-being, quality of life, and choices pertaining to electricity access challenge established academic paradigms of justice, presenting a nuanced outlook across the diverse case studies. The emergence of community-driven energy access initiatives, supported by public, NGO, and private sectors, underscores a promising trend in Indonesia, Malaysia, the Philippines, and Vietnam. The symbiosis between publicly funded NGOs, state entities, and civil society emerges as pivotal, while the indispensable role of local authorities post-funding becomes evident in ensuring sustained success. These findings prompt further exploration into the enduring viability of business models and the intricacies of nascent markets in state-driven systems undergoing evolving private sector involvement.

### **7.1 Implications for future research**

The findings from this study not only illuminate the current landscape of rural electrification in Southeast Asia, but also highlight critical areas for future research. A significant aspect that warrants deeper investigation is the impact of these energy transitions on local labour markets and workplace dynamics. Future studies could explore how shifts towards renewable energy systems affect employment patterns, especially in communities transitioning from traditional energy sources to distributed energy systems. This includes examining the potential for job creation in new energy sectors, the need for skills training and workforce development, and the socio-economic implications of such transitions on local labour markets.

Moreover, there is opportunity to delve into the potential for distributed energy systems to create decentralised, community-based employment opportunities. This could involve studying the viability of local entrepreneurship models in the maintenance, operation, and management of these systems. Another crucial area is understanding how these transitions affect gender dynamics in the workforce, exploring how increased access to electricity might empower women and provide them with new economic opportunities.

In addition, investigating the long-term sustainability of business models in post-funding phases remains a key area of focus. This research should aim to comprehend how these models adapt and sustain themselves amidst changing economic, environmental, and political contexts. The role of private sector involvement in traditionally state-driven systems, and the interplay between public and private entities, also present an interesting area for exploration, especially in terms of funding and governance structures. Understanding these dynamics is essential for developing resilient, adaptable, and inclusive rural electrification strategies that not only address energy needs but also contribute to the broader socio-economic development of the region.

### **7.2 A holistic and collaborative approach for a just transition**

This study's insights into the multi-faceted nature of rural electrification in Southeast Asia call for a concerted, action-oriented response from various stakeholders. The research underscores the need for an integrated approach that marries the technical and socio-economic aspects of energy transitions, particularly in the context of achieving energy justice in rural communities. Policymakers, practitioners, and the private sector must collectively prioritise the development of energy systems that are not only efficient and sustainable but also equitable and inclusive.

The absence of justice frameworks in local narratives, as highlighted by our findings, suggests an urgent need for more grassroots-oriented and culturally sensitive approaches to energy policy and implementation. Efforts should be directed towards demystifying the concept of energy justice and embedding it into the fabric of community engagement and participation. This involves moving beyond top-down, academic-driven processes to more inclusive, locally driven initiatives that resonate with the everyday experiences and aspirations of rural communities.

Moreover, the potential of community-driven energy access programmes, supported by a mix of public, NGO, and private sector involvement, highlights the importance of collaborative models that leverage the strengths of diverse stakeholders. Such partnerships can lead to more resilient and adaptive energy solutions that address not only the technical aspects of electrification but also the socio-economic needs of the communities.

Addressing the gap in labour and workplace dynamics within these energy transitions is also crucial. Future strategies should focus on creating sustainable employment opportunities, enhancing workforce capabilities, and ensuring that the benefits of energy transitions are distributed fairly across all sections of society. This includes special attention to vulnerable groups, such as women and ethnic minorities, to ensure that these transitions do not perpetuate existing inequalities but rather contribute to broader social and economic development.

The path to rural electrification Southeast Asia, grounded in the principles of justice and sustainability, requires a holistic, multi-stakeholder approach. It is a call to action for all involved to foster energy systems that are not only environmentally sound and economically viable but also socially just and empowering for the communities they serve.

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