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How can microgrids help the Philippines' energy transition? Adapting the Institutional Analysis and Development (IAD) framework for microgrid development

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Abstract. The Philippine energy sector remains plagued with issues of energy security, high electricity costs, and vulnerable grid infrastructure. This paper argues for the increased uptake of microgrids as a solution for these issues, using the Institutional Analysis and Development (IAD) Framework as a guide for microgrid policy. We begin this paper with an analysis of existing energy policies in the Philippines, highlighting a lacking integrated approach for energy security. The main discussion explores the IAD framework for microgrid development in the Philippines, identifying key barriers and dynamics among institutions and actors in the local energy sector. We then conclude with policy implications for adopting microgrids for the Philippine energy landscape.

Keywords: microgrid, IAD framework, sustainable energy, energy policy, energy transition

1. Introduction

The ability of the Philippines to achieve energy security is important for the archipelago, as it is particularly vulnerable to naturally occurring disasters throughout the year [1]. The country, however, faces barriers towards increased energy security: a heavy reliance on fossil fuels and imported energy, namely crude oil and coal, and a high energy demand [2]. Reliance on imported fuels has continued to increase, with imported oil retaining a large percentage of Total Primary Energy Supply (TPES) at 28.4%, while imported coal provides 18.6% as of 2020. It is only in the last decade that indigenous energy has risen to provide a slight majority of 56.37% in the country's TPES. This heavy reliance on imported energy leaves the Philippines vulnerable to oil supply disruptions, oil price fluctuations, and geopolitical dynamics shaping the countries that export energy [3].

The country's indigenous sources of fossil fuels have also experienced declines in 2020. Crude oil production has trended downwards since 2015, due to variability in the country's oil fields. The Malampaya gas field, the only natural gas field in the Philippines, is also expected to be depleted by 2024, which has driven plans by the Philippine Department of Energy (DOE) to develop liquefied natural gas (LNG) import terminals across the country. The DOE sees natural gas shifting from an



indigenous supply of 3.29 MTOE per year to 23.72 MTOE of LNG imports by 2040 under the reference scenario and 13.26 MTOE under the clean energy scenario (CES). Indigenous coal similarly posted a 5.8% decline in 2020, attributed to water build-up issues in the Philippines' largest coal mine on Semirara island [4].

The case for increased microgrid deployment in the Philippines is a neat matching of perceived benefits with existing issues. Energy security and reliability continue to be pressing concerns. Red alerts were issued by the DOE to warn against potential power shortages during peak months in 2021, triggering hearings from the Senate Committee on Energy [5]. The ability of a microgrid to generate power locally and distribute via 'islanding' in the case of grid shortages would hedge end-consumers against potential blackouts.

The Philippines also suffers from having one of the highest electricity prices in Asia [6], primarily due to a lack of end-consumer subsidies and expensive distribution and transmission networks. The potential of microgrids to not just compete from a price point perspective to the end-user, but also offer an attractive alternative to traditional grid infrastructure for incumbent utilities provides a unique opportunity. Lastly, rural electrification has been a laggard in the Philippines, with some sixteen (16) million people without access to reliable electricity. The inability to extend primary grid services to these rural areas is a function of high capital costs, with little demand to justify the expenses incurred. In these cases, deploying off-grid microgrid services sidesteps some of the costs, while providing access to electrification.

The concept of a microgrid has been present for several decades now, with definitions varying across use-cases given the highly context-specific nature that goes into building them. Motjoadi, Bokoro, and Onibonoje (2020), for example, defined systems between 5 to 12 kW as "mini" grids. In this study, the Philippine Department of Energy's (2019) definition is used: "a group of interconnected loads and Distributed Energy Resources (DERs) within clearly defined electrical boundaries that act as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the [main] grid which enables it to operate both in grid-connected or in island."

Variability is high across microgrid sizing, ranging from tens of megawatts to under 10 kilowatts, and across distribution, from low or medium voltage lines. Service, similarly, can range from multiple loads to a single customer [7]. Functionality is also highly dependent on the use-case—some microgrids can stand in isolation while others are grid-connected. Grid-connected systems have a point of common coupling (PCC), where they connect to the upstream network. These systems should be capable of transitioning from grid-connected to "islanded" where they are effectively operating as an isolated system. Isolated microgrids have no need for islanding, as they are already isolated.

The uptake and development of microgrids globally has greatly increased over the years. Increasingly large commitments to inject RE into power supply from major market players such as China, The United States of America, and the European Union, have also similarly driven microgrids, as they play a significant role in balancing power in the electricity grid [8]. Investors have begun to leverage decreasing RE prices as a strong alternative to the extremely high capital expenditure needed for fuel-powered plants. Several financing models for microgrids have also emerged, with third party financing providing promising returns for both investors and homeowners [9].

China has approximately 22,000 microgrid projects, with several South and Southeast Asia nations such as Vietnam, Sri Lanka, India, and Nepal with between 50-700 apiece [10]. The Philippines has severely lagged in this regard. Low adoption rates of microgrid projects in the Philippines can be attributed to economic, socio-political, and technological issues [11]. Furthermore, microgrid data in the Philippines is extremely limited. Currently, the Department of Energy has no centralized database on existing microgrid deployments in the Philippines.

This paper argues for microgrid development to address local energy security issues in the Philippines. In order to inform energy policy, we explore the arena within which microgrid implementation takes place, along with its actors and their various interactions in the country. This will be achieved through the lens of the Institutional Analysis and Development (IAD) Framework, as

Aligica (2006) notes, “using institutional and stakeholder assessments in order to link theory and practice, analysis and policy.”

2. Energy policy framework in the Philippine context

A number of landmark energy laws have been enacted that sought to push for more sustainable and clean energy in the country. The Philippines’ power industry has been defined by the Electric Power Industry Reform Act of 2001 (EPIRA), which launched a comprehensive restructuring at the turn of the millennium to address the country’s power crises in the 1990’s [12]. The structuring of the distribution sector as per EPIRA defines the operational parameters of a microgrid project. An important requirement is that franchise rights given to a Distribution Utility (DU) cannot be superseded by a microgrid project. Without the direct cooperation of a local utility in a microgrid project, microgrid configurations are extremely limited to small projects within a restricted scope or in off-grid, missionary areas.

Generally, the EPIRA has followed suit to similar reform structuring that has proven historically successful in countries such as Australia, Canada, and Brazil [13]. Despite achievements that reflect improved efficiency and electrification [14], there are several major issues that remain. Prices have remained relatively high as compared to pre-EPIRA levels [15], while in a sentiment echoed by Tañada III and Malaluan (2011), energy reliability and security remain a concern. Both issues are potentially alleviated by microgrids, whose benefits include power reliability and security, along with decreased end-consumer power costs [16].

In 2006, the Biofuels Act (RA 9367) mandated the use of biofuel-blended gasoline and diesel fuels. In the microgrid context, biofuels may serve as a suitable replacement for diesel in backup generators, which account for 97% of power generation in off-grid areas and small islands [17]. Given more readily available local supply, microgrid energy security may similarly increase.

The Renewable Energy Act of 2008 (RA 9513) aimed to increase the renewable energy produced in the country, reducing both reliance on importations and carbon emissions and health issues in the country. In the Southeast Asia region, the Renewable Energy Act was the first of its kind. It provides a wide range of both fiscal and non-fiscal incentives to promote the utilization of renewable energy such as the feed-in-tariff system, the renewable portfolio standard, net-metering, and the green energy option.

However, actual implementation of the Renewable Energy Act has been sluggish, and in some instances, still missing [18]. The Feed-in-Tariff (FIT) was only implemented 4 years after RA 9513’s enactment, and significantly lower than initially proposed. Several other key mechanisms, such as the Renewable Portfolio Standard (RPS), Net Metering, Green Energy Option, priority dispatch, among others were even further delayed, with the RPS only having mandated compliance in 2020.

The permitting process attached to RE projects has also been a significant deterrent towards their uptake in the Philippines. In some cases, the permitting process alone can take up to 3 years [19]. This, however, does not extend so much to solar projects, which may only take 3 to 4 months. Solar construction is also much quicker, on a scale of months, compared to structure intensive technologies such as geothermal or hydropower which can take several years. This may perhaps explain the rapid uptake of solar compared to other RE technologies, despite incentives being generally the same across technologies.

In 2013, the National Electrification Administration Reform Act sought to revamp the National Electrification Administration (NEA), the mandate of which concerns total household electrification. The NEA operates as a regulatory agency that supervises all electric cooperatives in the country. As of 2019, electrification has reached 95% of households [20].

While primacy has typically been on renewable energy, the other ‘pillar’ of sustainable energy—energy efficiency, [21] was only recently formally enacted in national policy. The Energy Efficiency and Conservation Act (RA 11285) was enacted in 2019, addressing energy efficiency, management, and conservation in the country. While renewable energy centers around the generation or supply of energy, energy efficiency concerns the end-use or demand of it. Ultimately a microgrid concerns both aspects of sustainable energy, as Distributed Energy Resources (DERs) typically through renewable energy generate electricity at a local level, while microgrid controllers have to balance intermittent supply with

local demand. Given the inherent variability of RE technologies, incorporating demand-side management (DSM) in microgrid developments has become almost a necessity in order to realize maximum output and efficiency [22]. While a timeline for the finalization of such a DSM program through the Act is not yet in place, any incentive or pathway towards mainstreaming DSM would serve to benefit future microgrid deployments.

A brief summary of the five Acts are highlighted in Table 1. These five acts of legislation will herein after be referred to as the Philippine energy policy framework.

Table 1. Key objectives and pertinent sections of major RE policies in the Philippines.

Title	Key Objectives	Pertinent Sections for Microgrids
Electric Power Industry Reform Act of 2001 (EPIRA)	Reliable, secure, and affordable electric power Transparent and reasonable electricity pricing Free and fair competition Independent regulation Consumer protection	Sec. 5 – Organization of power sector into four (4) sectors Sec. 26 – DUs may engage maximize utilization of their assets Sec. 27 – Franchising power Sec. 29 – Supply sector Sec. 31 – Retail competition and open access (RCOA) Sec. 34 – Universal charge
Biofuels Act of 2006 (RA 9367)	Mandatory use of biofuels Reduce dependence on imported oil Mitigate toxic and greenhouse gases (GHG) emissions Increase rural employment and income Ensure availability of renewable and clean energy	Sec. 6 – Incentive scheme to encourage investments
Renewable Energy Act of 2008 (RA 9513)	Accelerate the exploration and development of renewable energy resources (biomass, solar, wind, hydro, geothermal, ocean energy) Achieve energy self-reliance Developing national and local capabilities in renewable energy systems Reduce harmful emissions Establish necessary infrastructure and mechanisms	Sec. 6 - Renewable Portfolio Standard (RPS) Sec. 7 – Feed-in-Tariff (FIT) System Sec. 8 – Renewable Energy Market Sec. 9 – Green Energy Option Sec. 10 – Net Metering for Renewable Energy Sec. 11 – Transmission and Distribution System Development Sec. 12 – Off-grid areas Sec. 15 – Incentives for Renewable Energy Projects and Activities Sec. 17 – Exemption from the Universal Charge Sec. 19 – Hybrid and cogeneration systems Sec. 20 – Intermittent RE resources Sec. 21 – Incentives for RE commercialization Sec. 23 – Tax Rebate for purchase of RE components Sec. 30 – Adoption of waste-to-energy technologies Sec. 31 – Incentives for RE host communities
National Electrification Administration (NEA) Reform Act of 2013	Promote the sustainable development of rural areas through rural electrification Empowers NEA to pursue the electrification program and bring electricity to the countryside, even in missionary and unviable areas	Sec. 10 – Mandates, powers, functions, and privileges of ECs Sec. 18 – Incentives of ECs Sec. 26 – Total Electrification Plan
Energy Efficiency and Conservation Act of 2019 (Enercon Act)	Institutionalize energy efficiency and conservation Promote development of efficient RE technologies and systems Reinforce related laws to energy efficiency, conservation, sufficiency, and sustainability Market-drive approach	Sec. 30 – Local Energy Efficiency and Conservation Plan Sec. 31 – Local Investment Incentives Plan Sec. 69 – Development of a Demand Side Management (DSM) Program

3. Institutional and policy analysis using the IAD framework

3.1. IAD framework overview

As illustrated in Figure 1, Ostrom's IAD framework is an outlay of different interconnected variables that help to understand institutional arrangements, taking into account contextual factors to identify and evaluate interactions and outcomes. This structure has considerable potential towards analyzing and understanding the introduction of microgrids, which exist at a nexus between institutions.

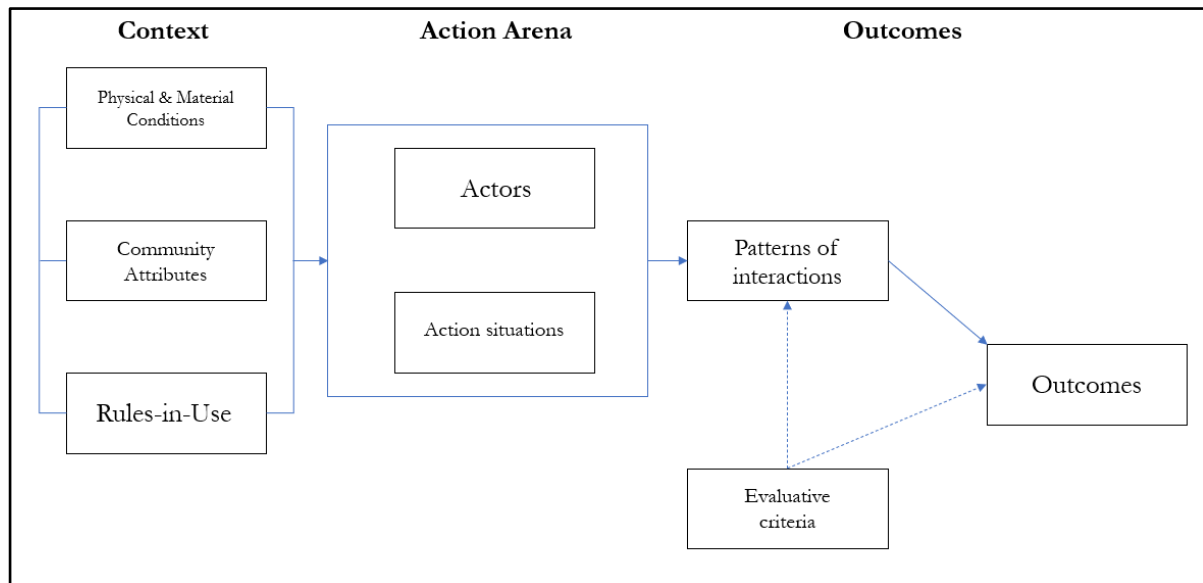


Figure 1. Institutional Analysis and Development, adapted from Ostrom (2005).

The framing of the action arena against contextual factors helps to better understand the challenges and bottlenecks that have insofar prevented market penetration of microgrid systems. The IAD framework neatly breaks down a complex issue into manageable chunks, allowing patterns of interaction to emerge as a result.

The IAD Framework has had applications across several different categories of policy analysis, ranging from common-pool resources, international relations, and economic development issues. Within the energy sector, the IAD framework has been met with success. The framework was used in one study to contextualize Brazil's sustainable development efforts within the energy industry [23]. Similarly, the framework was proposed for its value within the Caribbean green economy context [24]. The researchers cited its 'principled, organized approach to analyzing current Caribbean institutional arrangements.'

The IAD Framework has also been used prospectively, proposing policy directions and framing Ecuador's energy policy within the complex structure of political and economic objectives [25]. Shah et al. provided an amalgam of the IAD framework with the Integrated Regional Energy Policy and Planning (IREPP) Framework within the context of Small Island Developing States (SIDS), used to evaluate energy policy feasibility in Taiwan, Mauritius, and Trinidad and Tobago. From a climate equity perspective, similarities exist between SIDS and the Philippines given its archipelagic nature and vulnerability to the adverse effects of climate change [26]. The applications of the IAD Framework within the Global South in the context of energy policy is evident, although literature of its usage towards microgrids in the region of Southeast Asia yet exists.

3.2. Contextual setting

Policy situations and outcomes are a result of context- particular places, peoples, and conditions. These institutional arrangements are a critical pretext to good policy design. The IAD framework categorizes

the contextual setting primarily via physical and material conditions, community attributes, and rules-in-use. The Philippine setting, particularly in the case of microgrids, provides a wide range of contexts and institutional arrangements. Here we present a baseline of the contextual setting, while posing key questions and considerations.

3.2.1. Physical and material conditions. Physical and material conditions refer to the “physical and human resources and capabilities related to providing and producing goods and services” [27]. The Philippines power system is comprised of three main grids, each serving the three major regions of the country, namely Luzon, Visayas, and Mindanao. The Luzon power system is the largest of the grids, with a generating capacity of 14,540 MW as of 2019 [28] and is interconnected with the Visayas grid via submarine cables [29]. The Visayas grid has a generating capacity of 3,131 MW and is divided into five sub-grids, Panay, Negros, Cebu, Bohol, and Leyte-Samar. The Mindanao grid is separate from the other two grids as of the writing of this paper but is projected to interconnect with the Visayas grid to form a fully interconnected national grid by 2022 [30]. The Mindanao grid has a generating capacity of 3,486 MW.

Several studies have found that installation of additional RE capacity in the Philippines is highly suitable [31] given its archipelagic geography, high irradiation [32], and price of alternatives. In fact, a study produced by the United States Agency for International Development (USAID) and the National Renewable Energy Laboratory (NREL) highlighted that 30% and 50% RE power sector penetration targets were achievable using only wind and solar. A recent study also demonstrated that significant decreases (20%) in the levelized cost of energy (LCOE) could be attained by shifting to photovoltaic-battery-diesel hybrids, although this was limited to remote, off-grid areas [33].

Despite the RE potential of the country, significant barriers remain. Yaqoot et al. (2016) reviewed barriers specific to decentralized RE systems and found technical barriers through inappropriateness of technology, unavailability of skilled manpower, and unavailability of spare parts, along with financial barriers such as high cost and lack of access to credit to hinder RE deployment. A case study in Pangasinan Island found that poverty and poor management led to the failure of a solar deployment [34]. Similarly, while geographic suitability for RE is high, this also leads to logistical difficulties when transporting materials and equipment to project sites [35].

3.2.2. Community attributes. Typically bundled as “culture”, variables that factor into this analysis include demographics, social accepted norms, degree of understanding, and the homogeneity of community values, beliefs, and preferences on policy-oriented strategies and outcomes [27]. With respect to microgrids, off-grid and grid-connected modalities will have a wide variance of community attributes. Rural communities with limited or no access to the grid are typically impoverished, with low technical or political literacy [36]. This can be starkly contrasted against microgrid development for commercial or industrial use that are grid-connected, which are situated in urban and more populated areas.

The discrepancy between modalities and their target communities is of the utmost importance, and a critical contextual consideration in policymaking. Prospective microgrid policy and regulation must consider community attributes across different modalities and situations. Policymaking that only involves industrial and commercial stakeholders and their input may succeed in those particular action arenas, and fail in off-grid use-cases, while the opposite scenario may also occur. Careful integration of sociological studies in policymaking can help to avoid potential policy failure.

For community grid development, the case study in Pangasinan Island provides some insight. The authors found that the large disparity in incomes among households in the island was detrimental for the financial viability of the microgrid: low income users could not afford the minimum cost for microgrid connection and opted to disconnect, leading to higher prices for connected users. In the Philippines, where both rural and urban areas have high levels of inequality, microgrid development must establish pricing mechanisms appropriate to social attributes to ensure feasibility.

3.2.3. *Rules-in-use*. There are seven primary rules to consider, summarized in Table 2 below.

Table 2. Types of rules-in-use within the IAD framework.

Rule	Coverage
Position	Positions and roles that participants assume Number and type of participants who hold each position
Boundary	Which participants enter or leave a position, and how they do
Authority	Actions participants in a position may take
Aggregation	How decisions are made in an action situation
Scope	Jurisdiction and finality of outcomes
Information	Amount and type of information available to participants
Payoff	Costs and benefit distribution in action arena

Analysis will likely have to occur over different action arenas such as in off-grid and grid-tied modalities. Given the variable nature of microgrids as well, there are several setup options that will entail separate analysis. Bronin and McCary outline several possible configurations of a microgrid, such as a single end-user with multiple facilities on a single parcel of land, or multiple end-users on multiple parcels with intervening public streets [37]. Each configuration may involve distinct action arenas but with overlapping rules. A systematic analysis through rigorous application of the framework may help to narrow down the policy question sufficiently in each arena, which allows for better organization and assessment of the entire policy system.

A recent study on renewable mini-grids was conducted by IRENA that examined specifically off-grid modalities. Institutional analysis found that key government agencies, namely the National Electrification Administration (NEA), the Small Power Utilities Group (SPUG), and the Department of Energy (DOE), were all unilaterally pursuing rural electrification which led to confusion surrounding accountability [38]. Recommendations of the study included clearly defining roles and responsibilities of these key government agencies alongside other key stakeholders such as NGOs, to undertake comprehensive and strategic planning, to establish a clear policy approach for mini-grids, to review the regulatory approach for mini-grid projects, and to increase project development and support. Future application of the IAD framework can build off this study and similar research on rural and off-grid electrification through micro-grids, replicating across other action arenas.

3.3. Action arena and patterns of interaction

There are currently no policies in place targeted specifically at microgrids. However, the DOE issued a draft circular titled “Providing a National Smart Grid Policy Framework for the Philippine Electric Power Industry and Roadmap for Distribution Utilities”, which does include a definition for microgrids, but no real scope or roadmap for their deployment [39]. However, this has yet to be enacted and is subject to change. Senate Bill No. 1928 or the Microgrid Systems Act [40] has recently been approved by the Senate as of the writing of this paper, with projections to have it ratified by 2022. However, this Bill focuses specifically on microgrids for unserved and underserved areas; entirely off-grid modalities.

Without clear regulatory progress in microgrid development, the technology has hardly been deployed in the Philippines. High risks in developing microgrids in unserved and underserved areas have insofar prevented large private investment in the sector [38]. Meanwhile, the current structure of the power industry from EPIRA only allows for on-grid microgrids in very specific configurations. Interface with distribution utilities for example is limited to the Net-Metering program and only for a single end-user with on-site generation of up to 100 kWp.

These patterns of interaction that subsequently arise within the action arena flow logically from the current structure and context of the action situation. Actors in the microgrid industry are constrained in the sense that microgrid projects need to operate within existing rules-in-use, which in turn are tailored for traditional grid structures. Ultimately, there is no unified and coordinated whole-of-government approach in Philippine energy policy, and the policy environment (parameters for investors, rules-in-use) for microgrid deployment remains nascent.

3.4. Evaluative criteria for microgrid policy design

Here we briefly outline how to assess outcomes of the action arena and future policy design through a series of evaluative criteria. Based on the IAD Framework, we can focus on four criteria that are applicable to current microgrid development as well as a means of evaluating alternative or future policy design. These are economic efficiency, distributional equity, accountability, and adaptability.

An economically efficient outcome can be assessed from a variety of perspectives, but simple cost effectiveness may suffice in the case of microgrids, particularly given the country's high electricity prices and need for electrification. Electricity prices of the average household in the Philippines may be twice the price of nearby countries such as Malaysia, Vietnam, and Thailand [41]. In small islands that are powered by NPC-SPUG, the true cost of generation by diesel can reach as high as 154.89 Php per kWh [42]. The approved subsidized rate however averages to about 5.53 Php per kWh [43], which is only 3.5% of the generation cost. The difference between the rates are paid by consumers under the Universal Charge for Missionary Electrification (UCME). The total amount projected to be shouldered by consumers in 2022 is around 20.2 billion pesos [44]. The average household in the Philippines pays about 8.75 Php per kWh as of 2021 [41], which includes the additional costs from the UCME. In areas covered by NPC-SPUG, it should not be enough to simply compare approved subsidized rates to potential rates under microgrids. The true cost of generation should be the basis of comparison in order to account for the heavy costs shouldered by consumers. In areas with ready access to electricity, a social welfare perspective can be utilized wherein efficiency is a function of marginal social benefits and costs. This would allow for a more equitable economic assessment of critical benefits of microgrids, such as increased reliability, security, and reduced carbon emissions.

Distributional equity needs to also be evaluated, especially against use-cases. Who bears the cost of microgrid development, and how does this change across use-cases? This will likely lead to differing answers across rural and impoverished areas versus industrial use-cases. For example, electric cooperatives (EC) that run distribution networks in rural or small island areas have had difficulty accessing financial support due to their lack of creditworthiness or a successful business track record [35]. In these cases, financial costs could be shouldered by the government, either through budget allocation or financing from international development partners. This could provide an alternative for a better use-case of the UCME rather than subsidizing high diesel costs. Alternatively, in commercial or industrial areas where consumers are incentivized and have the financial resources to build microgrids for lower energy costs, increased resilience, and other benefits, government may not need provide such a strong subsidy in comparison.

Accountability, when used as the evaluative criteria for policy performance [27], seeks to understand three main areas: information sharing and transparency, the capacity to evaluate other actions within the arena, and accessibility of mechanisms for monitoring and sanctioning. This criterion might seek to reduce information market failures, which may lead to a lack of uptake from willing markets. Increased accountability could be expected to decrease behavioral failures associated with heuristic decision-making [45]. Opportunistic behavior can also result from a lack of accountability. One such example might be a recent piece of legislation, RA 11357 or "An Act Granting Solar Para sa Bayan Corporation a Franchise to Construct, Install, Establish, Operate, and Maintain Distributed Energy Resources and Microgrids in the Remote and Unviable, Or Unserved or Underserved Areas in Selected Provinces of the Philippines to Improve Access to Sustainable Energy", which provides a private firm a distinct advantage in the targeted areas [18].

Lastly, adaptability is a critical aspect of microgrid policy, given the variety of configurations, use-cases, and the potential for microgrid technology to further grow in unexplored areas. The sustainable energy industry as a whole has made incredible leaps over the past decade, and microgrid policy should avoid the imposition of rigidities in order to accommodate technological advancements.

4. Policy recommendations

First, we recommend the inclusion of microgrid development as a key instrument for the Philippine Energy Plan through legislation. The Philippine Energy Plan aims to increase renewable energy in its power generation mix by 50% in 2040 [4]. Deployment of microgrid technology and infrastructure could thus be a reliable instrument for two purposes: to encourage the growth of renewables and increase energy security by decentralizing electricity systems around the Philippines. Second, it is necessary to harmonize mandates and clarify responsibilities of government agencies responsible for energy policy implementation by updating the implementing rules and regulations (IRR) of energy laws. The Department of Energy could be proposed as the main implementation agency for microgrid development, overseeing its sub-institutions in the administration of national deployment. IRRs of the Philippine energy policy framework should also clarify rules-of-use for investors seeking to participate in microgrid development. Lastly, the Philippine Government should create finance mechanisms such as fiscal incentives and open public tenders with favorable yet equitable terms for investors.

5. Conclusion

Microgrids are a highly viable option in increasing energy security for the Philippines. We have thus far laid out the physical, socio-economic, and institutional context of Philippine energy policy, the action arena, which explains the complex dynamics that have led to the current energy landscape (patterns of interaction), and the evaluative criteria recommended for overhauling energy policies, starting with microgrid development. The study has deliberately outlined the IAD Framework as an important tool towards analyzing and designing policy for increased microgrid integration in the country. Utilizing the structured approach of institutional analysis allows us to better understand the current status of microgrid integration in the Philippines, which is highly dependent on uncoordinated institutional arrangements. Nonetheless, there are a wide variety of contextual analyses that remain to be done. Complexity surrounding the technology demands that delineation between microgrid configurations, off-grid and grid-tied modalities, pricing mechanisms, and technologies needs to be considered, which will allow for more robust and contextually situated policy design.

The IAD approach to future policy design is practical for unraveling complex action situations, especially for emerging technologies for a country's energy transition. We present a contextualized pathway to enhanced policy design that aims to be economically efficient, equitable, accountable, and adaptable. The study provides a solid foothold from which policymakers and researchers can begin further work into the research area, having adapted the IAD framework specifically towards policymaking for microgrids. Due to developmental similarities between other nations in the region, the IAD framework may similarly benefit studies that seek the same policy objective in countries across Southeast Asia and potentially the Global South.

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