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# Application of an Institutional Assessment and Design (IAD)-Enhanced Integrated Regional Energy Policy and Planning (IREPP) Framework to Island States

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**Abstract:** The integrated regional energy policy and planning (IREPP) framework was devised to evaluate the feasibility of energy policies in meeting declared national targets. While the framework advances the comprehensiveness of the feasibility assessment by bringing in concepts like environment economic equity, the muted way in which institutional factors and capacity are addressed remains weak and ineffective. Here, we corrected this weakness by presenting an IREPP framework that is enhanced by integrating principles of the institutional assessment and design (IAD) framework. The IAD framework emphasizes the careful consideration of contextual factors, it draws attention to the full range of transaction costs, and does not presume a priori that one type of institutional arrangement. This IREPP-IAD framework was used to evaluate the feasibility of energy policies in three different island jurisdictions—Taiwan, Mauritius, and Trinidad and Tobago. With ambitious national targets, these islands are good testing grounds for this updated approach. Through qualitative comparative case study analysis, several institutional factors were found to play an influence if national energy policies are likely to meet set targets. These factors included: government/policy decision makers and the decision/policymaking environment; governance structure and commitment for energy policy; existing policy instruments and tools that are in play and those planned; polycentricity; stakeholder participation and community building; market dynamics; information transparency; pilot programs and technology innovations/research; compliance or responsibilities under the Paris Accord; grid connectivity and monitoring of the policy implementation progress. This study contributes in two ways. First, by providing a more robust framework for assessing institutional arrangements that moderate how energy policies are implemented and second, providing insightful assessments of the energy policies in three island jurisdictions, thereby increasing our understanding of island energy policymaking and implementation in these understudied geographies.

**Keywords:** renewable energy targets; island states; energy planning; institutional capacity; patterns of interactions; institutional barriers

## 1. Introduction

Recent discourse on energy policy has pointed to various problems associated with use of the fossil fuel-based resources economy, including economic instability, energy insecurity, social inequity,

environmental pollution, and global warming. A solution to a majority of these problems is the proliferation of sustainable energy systems, including renewable energy, energy conservation, and energy efficiency, the three critical elements of a green economy transition [1]. Most prominently, island states or small island developing states (SIDS) are increasingly vulnerable to climate change due to sea level rise, overwhelming dependence on fossil fuel-based resources, and lack of financial resources for mitigation and adaptation [2]. For these countries, the three key targets of the United Nations Sustainable Development Goal 7 on energy that hold special importance are: ensuring affordable, reliable, and universal access to modern energy services; increasing substantially the share of renewable energy in the global energy mix; and doubling the global rate of improvement in energy efficiency [3,4]. National efforts to move towards these objectives often start with energy planning processes that include studies of sectorial demand and supply, forecasts of the trends of input–output items based on economics and technological models, and a list of actions, collecting several measures voted to fulfill the main objectives of the energy plan [5].

Regional energy planning approaches can capture granular details that have not been possible through national-level plans, as well as provide a broader outlook that is out of scope for extremely specific goals involved in local-level planning approaches [6,7]. This is especially recognized in the triangular relationship of regional development, energy planning, and environmental management [8]. The regional level of energy planning is directly linked to the interests and status of energy consumption within the region, as well as the direct impacts on the quality of energy supply, environmental health, economic development, and standard of life of the region's citizens [6]. These approaches are typically divided into three categories: planning by models, by analogy, and by inquiry. The most prevalent approach to date has been "planning by models", which includes creating bottom-up modeling and decision frameworks to analyze the supply–demand trends, growth, and other macro-level factors and formulate decisions based on prespecified criteria [9]. The energy planning discipline must consider political aspects, social and environmental considerations, and is carried out considering the historical data collected in the previous energy plans of the country under examination [10]. This is especially important for SIDS due to overlapping interests between energy and limited economic drivers (e.g., tourism). While the nature and extent of renewable energy potential and deployment varies considerably from country to country, most regions are pursuing the increased deployment of these technologies, largely due to their perceived environmental and socio-economic benefits, as well as their recently realized economic benefits. This has been achieved by setting ambitious targets, creating suitable governance structures, and creating policy supports like incentives and tax deductions at a regional level to achieve these targets [11].

Like other jurisdictions, island countries are placing more focus on formulating policy measures to combat climate change and global warming [12]. This has resulted in the introduction of ambitious renewable energy targets to reduce their dependency on oil, as well as to reduce electricity prices [13]. Previous energy planning studies for islands typically involved quantitative modeling using multicriteria decision-making approaches [14]. These methods, although comprehensive quantitatively, tend to overlook the underlying institutional characteristics and the interplay between the various actors and institutions specific to each of the individual island states, which are important to achieve these ambitious targets [15]. As in most of the world, the power sector of most SIDS developed as vertically integrated state-owned monopolies.

However, in some SIDS, power sector reforms have led to the privatization of utilities or their separation into generation, distribution/transmission, and retail components in a bid to facilitate competition [13]. It is also worth noting that due to impending vulnerabilities caused by climate change, SIDS have a greater role in international climate change discourse and negotiations. Institutional dynamics play a crucial role in the actual deployment of energy policies and measures specified in planning documents and reports. It would thus be worthy of a deeper look from the lens of institutional theory. The objective of this paper was to chart out the role of institutional dynamics in regional planning approaches pursued by island states and to create a more robust framework for assessing the

feasibility of the current institutional arrangements that moderate how energy policies are implemented in such contexts. We use three island jurisdictions—Mauritius, Taiwan, and Trinidad and Tobago.

## 2. Sustainable Energy Planning in Island States

Island states are heavily reliant on costly oil imports that are antithetical to the energy security goals of a nation. This can cause stresses in the government budgets and divert investment from economic and social sectors. Energy access is compromised when energy resources are not available or are too expensive to the end users. Indigenous renewable energy resources, such as hydropower, wind power, solar power, geothermal power, bioenergy, and wave power, can reduce these expensive imports and create important business and employment opportunities [16]. The distributed nature of these resources can also expand energy access to places where previously it was economically inviable to deliver electricity. Island states, on average, spend over USD 67 million per day on for oil imports [17]. These exorbitant amounts paired with a high poverty rate of over 20% cause economic stress on the island economy. The hefty expenditure on fuel imports also limit expanding an island's climate adaptation capacity. Adaptation capacity refers to the ability of an island to withstand and recover from the ill-effects of global climate changes. Building structures to limit flooding, availability of early warning systems, irrigation planning, comprehensive drainage, etc. are some of the initiatives an island can invest in from the avoided cost of the fuel imports. Increasing demand for foreign exchange for imports leads to an increase in forex spending on imports, which are sometimes more than 40%–60% of total export earnings. Extensive imports also have an adverse effect on the gross national income (GNI) of the nation. Development of renewable energy (RE) and energy efficiency can help redirect oil import savings to adaptation investments in the social and humanitarian initiatives.

SIDS offer both opportunities and challenges for low carbon economic development. The opportunities arise from the fact that almost all these states, with a few exceptions (e.g., Trinidad and Tobago, Papua New Guinea, Timor-Leste), have very limited fossil fuel resources and have abundant renewable energy resources to meet their energy demand. Most SIDS are composed of several small islands that do not require large-scale energy intensive infrastructure and can be served through distributed renewable generation resources (or off-grid electricity supply systems) for their electricity needs [18]. Regional energy planning approaches have typically included the application of renewable energy resources in their energy mix with specific targets and consideration of environmental impacts. The integrated energy modelling approach includes all the energy sectors, as opposed to a sole focus on a single sector, such as the power sector [19]. It has been claimed that the cross-sectoral integration can achieve significant energy savings and result in a cheaper sustainable energy system [20]. The targets set by these countries can be achieved with a mix of technical energy planning approaches (in energy planning software) paired with significant domestic and foreign investment into profitable renewable energy projects, depending on the resource availability.

The literature is dominated by methodologies for the regional energy decision-making process and planning [5,14,21–23]. There are also studies and reports that highlight the integration of alternative energy sources in local environmental, economic, and social circumstances. While setting ambitious targets is a good indication of a country's intention to promote its renewable energy resources, countries often miss the targets for various reasons, including lack of financing, policy incentives, and locational disadvantages for private investment. The regional planning models have a few missing pieces that can be critical in the eventual success or failure of the planning agenda. Some of these factors are inclusion of social equity, monitoring and evaluation of energy planning efforts, as well as the broader institutional aspects of regional energy planning. These institutional factors can be crucial since they provide a platform for necessary technical efforts, policy, and regulations, as well as financial investments. Currently, due to limited institutional and private sector capacity, there has been a prevalence of small-scale/low-cost environments, which is inhibiting use of vast renewable energy resources in these islands.

## 3. Enhancing the Institutional Aspect of the IREPP Framework

Integrated regional energy policy and planning (IREPP) advances integrated energy planning by introducing a monitoring and evaluation aspect to provide a mechanism to evaluate whether the "targets" set previously are being met, and if not, provide corrective measures in the form of redesign and improved adaptation of policy instruments to ensure that they follow the course [24]. A basic component of the IREPP is to set a clear target year and objective(s) of the regional energy plan. Policymakers are thus able to link the energy objective with regional economic, environmental, and social goals. The basic tenet of the IREPP framework is to bridge the gap between demand and supply in the electricity sector by maximizing the use of "soft" and "sustainable" pathways. This is done by utilizing renewable energy, demand response, energy efficiency, and conservation measures stipulated in the RE target set initially in the energy planning document for a country. The monitoring and evaluation form the last step of the loop, which can be conducted in different timeframes depending on the scenarios mentioned during the target-setting phase i.e., short-term, medium-term, or long-term. In doing so, IREPP enhances sustainability by contributing the potential co-benefits of energy policy and planning to environments, economies, and social equity (such as improved air quality, job creation, and equitable access to energy). This framework places emphasis on successful policy implementation by not just fiscal and technical feasibility, as done in previous modeling efforts, but also assesses political and cultural feasibility. Thus, the IREPP is a process not an end product, which addresses the crucial role of monitoring and evaluation of the plan for its continuing success.

The four major factors that affect renewable energy development in island nations are political priority, market framework, technical planning, and capacity building [18]. Even as the IREPP framework attempts to unpack each of these factors, especially though consideration of supply and demand dimensions, it does not fully encompass the institutional aspects of these factors nor overall institutional design at a national level. Without such an assessment, recommendations emerging through the IREPP process tend to become inviable to deploy. While the application of the IREPP framework is suited towards island countries and has been applied, for example, in Jeju Island [24], a treatise of the prevalent institutional dynamics is a weak point of the overall assessment. Institutional dynamics play a pivotal role in the application phase of the renewable energy targets/goals and help in defining the how and where for the implementation of these goals. These include, but are not limited to, corporate, regulatory, advocacy (or not-for-profit), government, and renewable support institutions, which converge together in different parts of renewable energy project implementation in these island countries.

Institutional analysis and design framework (IAD) provides a useful mechanism for unpacking institutional dimensions of regional energy planning. It avoids many of the 'pitfalls' encountered by other approaches to institutional analysis by emphasizing the careful consideration of contextual factors [25]. Essentially, it does not contain any normative biases and treats each institutional arrangement as unique without assigning any priority. The IAD framework is one of several approaches to conducting institutional analysis [26]. However, a strength of the IAD approach that will benefit the SIDS context is the principled and organized approach to analyzing the strength and capacity of current institutional arrangements to advance the energy policy that underpins the green economy transition. The approach emphasizes the careful consideration of contextual factors and it draws attention to the full range of transaction costs, which are significant in the regional contexts of SIDS [1]. The application of IAD approaches in theory, proposition, and actuality are evident in the energy sector in many geographic, political, and sector contexts.

The IAD lens has been applied to national energy planning in a few instances, including Shah and Niles (2016) [1], to analyze the current state of the Caribbean energy policy development arena and propose the policy and institutional design regime may be weak in its attempt to propel a green economy ethos. Escribano [27] utilized the IAD framework to propose policy directions for Ecuador's energy policy given the complexity of political and economic objectives, which were historically difficult to reconcile in a consistent manner. Bryner [28] used the IAD lens to analyze the challenges

of developing a diverse domestic energy portfolio in the western United States by tackling the dual challenges of integrating energy and climate change policy at a juncture in time where the sector was highly unstable due to foreign energy dependence.

While both IREPP and IAD address different critical issues in the regional energy policy and planning space, an amalgam of both can provide an even more comprehensive outlook by adding the institutional approach to the current IREPP framework to test the feasibility of national energy policies and targets (See Figure 1). This would involve an institutional analysis of the various components present in the IREPP framework, namely (1) identification of energy policy issues and national targets, (2) integration of current demand and supply resources to meet energy needs, (3) alternative supply options for meeting the energy demand, and (4) monitoring and evaluation of action towards achieving the specified targets. This structure would be implemented by utilizing targeted stakeholder research, surveys, and focus groups of current as well as planned institutional arrangements that are directly involved in decision-making for regional energy planning in the island nations. The IAD framework assists in adding an institutional context to the three components of the IREPP framework by highlighting the proposed policy reforms, identifying the various public and private sector actors and the pattern of interaction between these actors to achieve the end-goal, i.e., renewable energy deployment to meet the national targets set by the government to counter the effects of climate change. The end product of this analysis would be identification and explanation of institutional factors or themes pertinent for each of the three island states to achieve their targets.

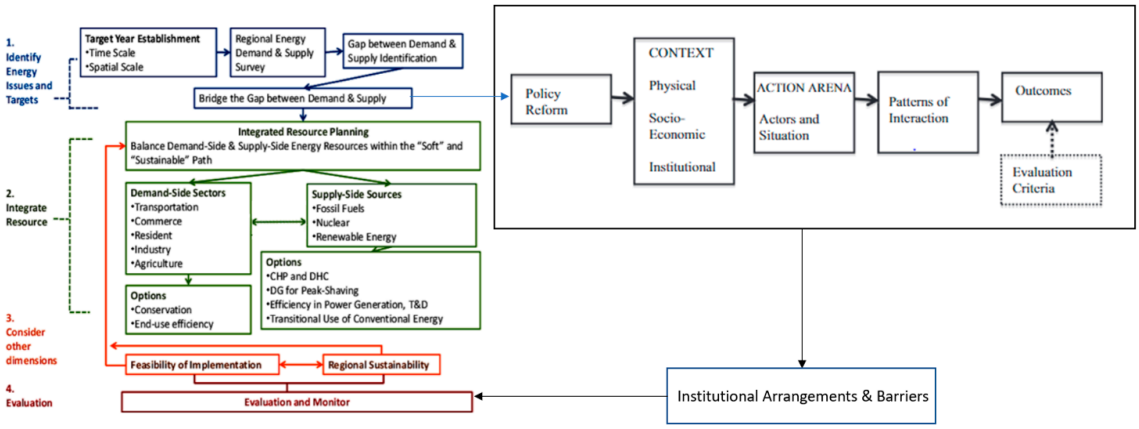


**Figure 1.** Modification of the integrated regional energy policy and planning (IREPP) framework complemented by the institutional analysis and design (IAD) framework. Source: Author Adaptation from Chen et al., 2015 and Ostrom, 2010 [24,26].

## 4. Materials and Methods

### *4.1. Application of IREPP-IAD Framework to Island States*

We applied the modified IREPP-IAD framework to elucidate institutional factors and conditions that are in place or need to be in place for selected island nations to achieve their national renewable energy objectives. This can only be executed through supportive institutional design and dynamics between main actors. Our case analysis systematically moved through identifying the roles and responsibilities of current institutions, their actors, patterns of interaction between the actors, their shortcomings, and how to further strengthen the dynamics between the various institutional actors that would address policy reforms to proliferate renewable energy development in these island states. A multiple case study comparison method was employed across three island nations: Taiwan, Mauritius, and Trinidad and Tobago. The case study approach has been utilized by numerous studies to compare and contrast between countries in social science research [29]. It rests on multiple sources of evidence, with data needing to converge in a triangulating fashion, and benefit from prior development of theoretical propositions to guide data analysis and collection [30]. As per best research practice,

we made use of six evidentiary sources: documentation, archival records, interviews (in this study conducted through semi-structured questionnaires), and direct observations from research travel to the island nation, each of which has its own strengths and weaknesses. Following the collection of the data, the analysis consisted of examining, categorizing, tabulating, testing, or otherwise recombining both quantitative and qualitative evidence to address the initial propositions of a study [31]. Table 1 provides a deeper look into the specific data collection techniques for each island nation. The rationale behind selecting these three island states is straightforward. The island nations considered here are on the different ends of the spectrum in the journey of energy transition from a hard path (fossil fuel-dominated) to a softer path dominated by renewable energy and energy efficiency. Mauritius represents a stable governance structure with targeted policy focus on growth of renewable energy while Trinidad and Tobago represents island nations with high dependence on fossil fuel production and consumption to fulfil their economic goals. Taiwan represents a nation undergoing transition from oil dependence to a more renewables-dominated energy regime.

Taiwan is currently going through a phase of energy transition by reducing dependence on fossil fuel imports as well as nuclear energy and increasing development of renewable energy technologies by building institutional capacity in the form of a national energy policy and setting up various acts, conferences, and commissions to achieve the required goals. Foreign direct investment has been a boon for the island due to its strategic location, lucrative feed-in tariffs, and a stable regulatory framework. Its stable governance structure is reflected in its high World Bank 'Ease of Doing Business' rank. Taiwan still obtains 50% of the total share through fossil fuel-based resources despite having tremendous potential for renewable energy resources such as solar, hydro, and wind [31].

Mauritius is an upper-middle income country with significant climate change targets. The two main islands are Mauritius (1865 $km^2$) and Rodrigues (104 $km^2$). With a globally commended governance and political system, it ranks 82nd in political stability, 78th in governance effectiveness, 80th in regulatory quality, 76th in the rule of law, and 62nd in terms of corruption [32]. Mauritius heavily depends on imported petroleum products to meet its energy requirements. The country does not have oil, natural gas, or coal reserves, but has significant levels of biogas, hydro, solar, and wind resources. The island has a potential average annual solar radiation value of 6 $kWh/m^2$/day and an annual average speed of 8.1 m/s, signifying vast potential to develop solar and wind generatiion [32].

Trinidad and Tobago is a domestic producer of oil, natural gas, and other fossil fuels and one of the top ten natural gas exporters per capita globally as recently as a decade ago [33]. The energy sector is crucial for the growth of its economy driven by crude oil production, natural gas production, liquefied natural gas (LNG) production, compressed natural gas, and electric power. Trinidad and Tobago is a net exporter of petroleum products and enjoys low electricity rates and low fuel subsidies. Its economy has now shifted its focus from oil-based production to natural gas production. Thus, Trinidad and Tobago has lacked the economic motivation to introduce and develop RE technologies.

**Table 1.** Data collection techniques and components for the case study analysis (lists are not exhaustive).

| | Documentation | Archival Records | Stakeholder Interviews | Direct Research/Observations |
|---|---|---|---|---|
| **Taiwan** | National energy plans and laws<br>1. Taiwan New Energy Policy (Taiwan Bureau of Energy, M. of E.A., 2016)<br>2. Renewable Energy Development Act (Taiwan Ministry of Economic Affairs, 2019)<br>3. The Electricity Act (Taiwan Ministry of Economic Affairs, 2019) | Governmental planning from the Bureau of Energy, Ministry of Economic Affairs<br>1. Energy statistics (https://www.moeaboe.gov.tw/ECW/english/content/SubMenu.aspx?menu_id=979)<br>2. Energy policies (https://www.moeaboe.gov.tw/ECW/english/content/ContentLink2.aspx?menu_id=965)<br>3. Energy regulations and laws (https://www.moeaboe.gov.tw/ECW/english/content/SubMenu.aspx?menu_id=8688) | One governmental official at the Office of Energy and Carbon Reduction, two renewable energy industry representatives | Travel to Taiwan to interview stakeholders and questionnaire survey. |
| **Mauritius** | National energy plans and targets<br>Renewable Energy Roadmap 2030 for the electricity sector<br>Long-Term Energy Strategy, 2009–2025 | Long-term energy strategy document.<br>MEPU (Ministry of Energy and Public Utilities). "Renewable Energy Roadmap 2030 for the electricity sector" August 2019.<br>MEPU (Ministry of Energy and Public Utilities). "Long-Term Energy Strategy, *2009–2025*"; *October 2009*. | One government employee, one utility official | Travel to Mauritius to interview stakeholders and observe the institutional response. |
| **Trinidad & Tobago** | National Development Strategy of Trinidad and Tobago 2016–2030 | DRAFT: Energy Conservation and Energy Efficiency Policy and Action Plan For Trinidad and Tobago<br>*DRAFT: Framework For Development of a Renewable Energy Policy For Trinidad And Tobago. A Report of the Renewable Energy Committee (2011)* | One representative from the Ministry of Energy and Energy Affairs, one respresentative from the Ministry of Public Utilities. | Face to face interviews with industry experts in T&T provided detailed background on RE targets and deployment. |

### *4.2. Case Studies on Island States*

#### 4.2.1. Taiwan

By 2025, Taiwan is aiming to meet 20 percent of the energy mix from renewable energy [34]. When the government announced the target in 2016, renewable energy contributed 4.8 percent of electricity generation [35]. To reach the "20% by 2025" target, the Taiwanese government designed various mechanisms to accelerate renewable energy utilization. Major policies including (1) the introduction of feed-in tariffs and subsidy, (2) the amendments to the 2017 Electricity Act to liberalize green energy supply [36], (3) the initiation of financing plans to attract foreign investors [37], and (4) the establishment of new governmental institutions to foster renewable energy development. Taiwan's renewable energy target is embedded in a broader national blueprint proposed by President Tsai Ing-Wen, along with the goals of green economy, national security, low carbon energy transition, and nuclear-free homeland. To reach multiple goals, inter- and intra-agency communication, cooperation, and coordination (3C) play a crucial role. The Taiwanese recognized that institutional feasibility plays a crucial role in public policy success. Therefore, new institutions have been established under existing government structure, which presents some loopholes for renewable energy promotion.

The Bureau of Energy (BoE) is the central governmental institution for energy management. The BoE is responsible for evaluating national energy demand and supply, reviewing energy prices, granting permission on energy development, and formulating energy policies and energy-related regulations [38]. However, BoE is a "third level" agency in the central government, under the Ministry of Economic Affairs (MoEA) (second level), and the Executive Yuan (first-level) [39]. In the past, the energy industry in Taiwan was dominated by two state-owned companies, i.e., the Taiwan Power Company for electricity generation (taipower.com.tw) and the CPC Corporation as the gas and petroleum supplier (https://en.cpc.com.tw/). BoE governed these two companies with the mission of economic development. In other words, energy was served as an input for the economy. However, after electricity market liberalization and the introducing of a new energy paradigm, energy issues became broader, more diverse, and dynamic. Energy not only serves as an input for economic growth but also plays a significant role in environmental protection and public participation. Under the new circumstances, more governmental institutions are involved in energy management, with various narratives and focusing. For example, the Environmental Protection Administration monitors the greenhouse gas emission of power generation. The Ministry of Interior manages the land use for installing energy facilities. The National Development Council integrates renewable energy into the National Pioneering Development Plan. The Ministry of Science and Technology implemented two phases of the National Energy Program. As more private developers enter the energy market, more regulations and administrative coordination are needed, particularly when renewable energy development requires several permits from different governmental institutions and some of them are beyond the administrative scope of BoE. Therefore, President Tsai ordered to establish the Office of Energy and Carbon Reduction (OECR) in 2016 to foster energy transition and renewable utilization.

The OECR acts as a coordinator between governmental agencies and energy stakeholders. Its committee includes agency leaders under the Executive Yuan and representatives from state-owned companies, industries, academy, and NGOs. The committee is a 3C platform to facilitate clean energy transition and greenhouse gas reduction. The committee members meet regularly and have a special meeting when in need. The OECR currently has ten "focusing projects" (e.g., solar PV and wind power) and four "tracking issues" (e.g., smart meters) [40]. Solar PV and offshore wind power are two main contributors to the 2025 renewable energy target. The goals for solar PV are 20 GW capacities and 25 TWh power generations by 2025. Regarding wind energy, the goal is 1.2 GW for onshore and 3 GW for offshore wind capacities. The power generation goals are 2.9 TWh and 11.1 TWh for onshore and offshore power, respectively [41]. The government set up two "single service windows" to promote solar PV and wind energy. These windows provide a starting point for interest groups to collect information, understand new technology, and regulations. While renewable energy involves

innovative technology and the application procedure of installing renewable facilities are complicated in Taiwan, the windows are designed to help developers jump-start the entire procedure. Change in the institutional setting is a strategy to foster renewable energy development. Office of Energy and Carbon Reduction accelerates information sharing and interagency communications. The single service windows help solar PV and offshore wind developers and investors understand renewable development environment in Taiwan, ranging from law, regulatory, policy, administration, and technology. However, the limited-term presidency causes uncertainty for Taiwan's long-term energy plan and creates risks for investors. Also, lack of coordination between local and central governments held by opposite political parties sets obstacles for renewable developers in Taiwan.

Political upheavals and policy support inconsistency between the central and local governments are the institutional challenges highlighted by renewable energy developers interviewed for this study. The controversy between local and central became a key issue after the 2018 nine-in-one local elections. Taiwan ruling party (i.e., the Democratic Progressive Party) suffered "crushing defeat" and the opposition Nationalist Party (also known as the KMT) won 15 seats among the 22 county and city chief posts [41–43]. The KMT and the DPP have a different approach and perspectives to energy policy. When DPP promotes the 20% by 2025 target, the KMT presents a skeptical attitude towards the target. However, the construction of renewable facilities requires several permissions from both the central and local government governed by different political parties. Therefore, the developers need to engage with the two-party system and gain developing permissions from local and central governments in the counties ruled by opposition political parties.

One example is the turmoil of offshore wind projects after the local election. Changhua County is the home for six offshore wind projects. After the 2018 election, the newly elected Changhua County Commissioner (a KMT member) expressed reservations on the offshore wind development. The local government suspended issuing developing permission because "the developers had only made vague promises to local fishers" [44]. As approval from the local government is essential for the BoE to issue a final permit, the offshore wind projects faced a deadlock. The permission suspension time was sensitive because a new offshore feed-in-tariff (FIT) would be applied in January 2019. The new FIT would be cut by 12.7 percent to TWD 5,106/MWh (US $165/MWh). After the new Changhua County Commissioner took office on December 25, 2018, developers had only three days to receive all the permissions to secure a lucrative FIT rate [45]. Solar power developing also faces the institutional barrier. However, unlike the above example, the barrier is not entirely related to political parties, but rather the administrative mechanism. For solar energy, the central government set the target of 20 GW capacities in 2025, including 17 GW ground solar PV. Sufficient land areas were needed to reach the goal. Therefore, the government released 2,385 hectares of subsidized farmland in 2015 and 2017 for the development of PV projects [45]. However, solar developers describe the land acquirement as an "invisible obstacle". The developers have to find land, communicate with the owner, ensure the land is allowed to build on PV, and clarify which governmental institution issues the land use permits.

In conclusion, the Taiwanese government aims to have 20 percent renewable energy by 2025 and has established new institutes to foster communication between governmental institutions and between different renewable stakeholders, including but not limit to renewable developers, foreign investors, and the public. New institutes also serve as the information hub to help interest groups familiarize themselves with the laws and rules of renewable facility construction and operation in Taiwan. However, developers need to acquire several permits from different agencies, which increases the procedure difficulty and complexity. Moreover, policy support inconsistency between the central and local governments with opposite political parties brought obstacles and risks to renewable developers. How to design a long-term renewable target supported by different political parties in Taiwan is a challenge.

#### 4.2.2. Mauritius

Situated within the southwest of the Indian Ocean, the population of Mauritius stands at 1.3 million based on the 2019 statistics. With a surface area extending over 2040 $km^2$, 43% of the land surface is occupied by agriculture, 25% is settled areas, forest and pastures occupy 25%, and the remnants are reservoirs, roads, and abandoned fields. From the World Bank ranking of country economic development, Mauritius is within the cluster of upper-middle income countries; with a GDP of 14.22 billion USD and a GDP per capita of 11,238 USD in 2018.

The power generation sector is formed by the Central Electricity Board (CEB), who is wholly involved in the transmission, distribution, and supply of electricity in the island, and the independent power producers (IPPs) with cogeneration facilities. The share of the CEB's production for 2018 was 43%, while the remaining 57% was purchased from IPPs [46]. In collaboration with the Mauritian Government, the CEB devised an integrated electricity plan (IEP) that aims to balance the demand and supply of energy in Mauritius. Having no reserves of fossil fuels, Mauritius relies heavily on coal, petroleum-based sources, bagasse, and hydropower to cater for its energy requirements. The energy statistics of 2018 indicated that coal was the major fuel used to produce electricity with a percentage of 40.2 followed by fuel oil (39.0%) and bagasse (14.0%).

With the objective to promote long term sustainable development, the government came up with the Long-Term Energy Strategy (LTES) Plan 2009–2025 to increase the shares of renewable energy (RE) in the electricity mix to 35% by 2025. As support to the LTES plan, the government listed several policies to accelerate the uptake of RE including (i) diversifying the energy landscape to ensure energy security, (ii) setting up essential institutional structure to implement the long term plan, (iii) encouraging the participation of private sectors, (iv) promoting energy management and improving energy efficiency in all sectors, (v) setting up of an Energy Efficiency Management Office (EEMO) with a national date on energy usage, and (vi) targeting demand side management. The LTES plan has recently been revised in the Renewable Energy Road 2030 where Vision 2030 articulates that "Government will aim at ensuring energy security by promoting cleaner and sustainable energy through the development of renewable energy and energy efficient technologies". Investing significantly in renewable energy opportunities, for instance solar, bagasse, and cane trash; waste-to-energy; and onshore/offshore wind and wave, the government brought forward the target to achieve 40% RE by the year 2030.

Recognizing the need to strengthen national energy strategies and accomplish multiple goals, the Mauritian government established institutions and policy frameworks within the system. Adopted in 2011, the Maurice Ile Durable (MID) is a national development concept focused on transforming Mauritius into an environmentally sound and sustainable island through five main areas: environment, energy, employment, equity, and education. Encouraging institutional capacity-building in the transition to a low-carbon economy, the government introduced the National Program on Sustainable Consumption and Production (2008–2013); proposing national sensibilization campaigns on energy savings and energy audit programs. With the government undertaking legal and institutional reforms, the Mauritian energy sector witnessed the setting up of two establishments, namely the National Energy Commission (NEC) in 2013 and the Mauritius Renewable Energy Agency (MARENA) in 2016. The NEC mandate comprises reviewing the national energy requirements, guiding the government and relevant stakeholders in planning and executing energy projects to meet growing demand, and overseeing the MID vision. With the goal of achieving the RE target for Mauritius, MARENA's mission is to ensure that the country's electricity demand is increasingly being met by renewable energy sources, while supporting sectoral advancements and international commitments.

Bestowed with adequate and varied RE sources, particularly solar and wind, Mauritius has started to capitalize on its resources through the implementation of solar and wind farms. Significant progress in this direction is substantiated by the 4.0% increase of electricity generated from RE sources from 624 GWh to 649 GWh for the period 2017–2018. As of 2019, the total solar capacity in Mauritius stands at 125.5 MW, out of which 105 MW is owned by private sectors. Additionally, the government launched

the Home Solar Project in 2018, which included the installation of 10,000 rooftop solar panels. As for wind energy, the first project for a 9.3 MW farm was completed in 2016.

The government and the CEB are coming forward with innovative incentives to further exploit the potential of solar power in Mauritius. One such incentive that has incentivized solar deployment at an accelerated rate was the Small-Scale Distributed Generation scheme launched by the CEB in 2010. It allowed small scale IPPs to generate energy on their own through sustainable sources and export the excess to the grid through a net metering system. In its 2016 budget, the government of Mauritius decided to remove all value-added taxes on PV invertors and batteries as a means to increase the interest of investors and the population in solar energy. In addition, solar water heaters saw significant growth with increase in local companies' manufacturing capacity leading to a drop in costs. A subsidy scheme was aimed at lower income families to decrease their dependency on electric water heaters, while commercial enterprises are adopting SWHs on a massive scale.

Despite considerable efforts have been made in the acceleration of renewable energy development in the country, there still exist some institutional challenges. Limited measures of energy management and efficiency, insufficient concern towards renewable energy barriers, and poorly formulated governance frameworks and policies have been highlighted as the main factors contributing to the receding development of renewable energy in the generation mix. Transitioning to a green economy has mostly been limited to a few projects, for instance solar water systems instead of devising a holistic approach to develop other renewable opportunities. As mentioned above, several institutions have been put in place to promote the RE in the country, however the success of these establishments depend on their ability to operate without any interdependence. Bundhoo (2018) [47] observed the fact that MARENA and the CEB Green Energy Co. Ltd. can duplicate their tasks regarding renewable energy; thereby leading to interference and interdependence among institutions. He further pointed out the shortcoming of a social impact assessment within the Mauritius Renewable Energy Act—a factor essential to ascertaining that the lives of inhabitants are in no way adversely impacted through green energy projects.

Another aspect hindering the process of RE development is public awareness. Nonetheless, this obstacle is not fully related to the institutional perspective, but more on the role of the governmental authorities to sensitize and help change the social mindset towards the acceptance of clean energy technologies. In a survey conducted in 2012 on the number of households not interested in solar water heaters, 51.8% considered it to be an unnecessary change. To trigger the movement towards a green economy shift, making people aware of the benefits and the consequent changes in their routine lives, frequent and rigid promotion on the part of relevant stakeholders is a must.

#### 4.2.3. Trinidad and Tobago

Trinidad and Tobago has been engaged in the production and export of petroleum for more than 100 years. With 1.4 million persons, its GDP per capita stood at $32,227.85 [48]. A key component of the country's development strategy is the leveraging of indigenous petroleum reserves by using them as a feedstock and means through which other industries (e.g., petrochemicals) could be established. As a result, relevant authorities within Trinidad and Tobago have sought to utilize guarantees of access to competitively priced indigenous petroleum resources to market to foreign investors. At the level of the individual and institutional user therefore, though access to renewable sources of energy exists, petroleum is the primary, and largely the only, source of energy that is used for power generation and transport on both islands. A significant amount of strategic attention has therefore been placed by the state on boosting local production of indigenous petroleum production, primarily for export—specifically in the interest of increasing foreign exchange earnings.

Notwithstanding the above, the unique structure of both the natural gas value chain and the electricity sector in Trinidad and Tobago should be considered. In terms of the natural gas value chain, an important differentiator of this market is that while upstream exploration and production activities are conducted by private and publicly owned entities, the transmission and distribution infrastructure

for natural gas is operated by the National Gas Company of Trinidad and Tobago (a wholly state-owned company). Natural gas is either processed for export as liquid natural gas or sold via the Natural Gas Company (NGC) to the petroleum sector in order to facilitate the production of other products, inclusive of natural gas liquids, for export. Approximately 17% of natural gas production is used for power production [49]. Lesser quantities of natural gas are processed for local transport in the form of compressed natural gas (CNG), converted into liquified petroleum gas (LPG) for cooking or used to drive manufacturing.

In terms of electricity, natural gas is transported via the NGC to the Trinidad and Tobago Electricity Commission (T&TEC), which sends it to independent power producers (IPPs) who generate electricity according to the terms of previously signed power purchase agreements (PPAs). Having converted natural gas to power, the IPPs send the electricity to T&TEC for onward transmission to residential, commercial, and industrial customers. T&TEC (a wholly owned state enterprise) is solely responsible for the distribution and transmission of power. Moreover, T&TEC is the sole legal entity that is allowed to sell a supply of electricity to any class of customer for any purpose. This has the unintended effect of removing the legal basis upon which any individual or enterprise could utilize renewable energy installations to earn revenue from marginal power (i.e., power that is additional to the requirements of the generator, which could be sold and transmitted back to the grid). As articulated by the Ministry of Energy and Energy Industries in Trinidad and Tobago, "the Trinidad and Tobago Electricity Commission (T&TEC Act), Chapter 54:70 and Regulated Industries Commission (RIC) Act, Chapter 54:73 make no provision for renewable energy power generation by Independent Power Producers (IPPs). The Government of the Republic of Trinidad and Tobago is seeking to establish a legislative framework for the generation of electricity from renewable energy sources".

Legislative changes, in addition to enabling a policy framework that would allow private individuals and enterprises to receive remuneration for the generation and sale of electricity, perhaps through the use of a feed-in tariff, is a necessary precondition for the proliferation of renewable energy deployment in Trinidad and Tobago. It should be noted that policy mechanisms geared toward the distributed generation would signal a significant institutional shift in Trinidad and Tobago. Hitherto, energy management (inclusive of generation, retail, and supply of electricity) has been centralized within state agencies—including government ministries and the local (state-owned) power utility. It should also be noted that in Trinidad and Tobago, the price of electricity, water, and waste collection and treatment as well as, to some extent, liquid fuels, are subsidized. This was seen as a means of sharing the benefits of indigenous petroleum resource deposits and revenue with the wider population. Consumers, however, have therefore become accustomed to paying below-market prices for the aforementioned services. While subsidizing the public goods and services has served to increase access to such amenities to citizens, it has also served to reduce incentives to conserve such resources. Trinidad and Tobago remains one of the most carbon and energy intensive economies in the world [50]. A rudimentary National Climate Change Policy was developed in 2011 and ratified in 2018. In this regard it should be noted that the nationally determined contribution (NDC) submitted by Trinidad and Tobago under the Paris Agreement targets a reduction of 15% carbon dioxide-equivalent cumulative emissions from the power generation, transportation, and industrial sectors by the year 2030 [51].

A draft Framework for Development of a Renewable Energy Policy was developed in 2011 [52] and to date is still to be approved by government. The National Development Strategy of Trinidad and Tobago for the period 2016–2030 indicates that "Government has committed to increase input to the energy supply using renewables to 10 percent by 2021" [53]. In order to meet this target, the government published a request for expressions of interest (EOI) for grid-integrated, utility scale renewable energy (RE) projects. By 2017, the Ministry of Energy and Energy Industries (MEEI) indicated that it was interested in receiving, "Expressions of Interest from suitably qualified developers to Build, Own and Operate renewable energy projects with installed capacity of 3 MW or greate to put GoRTT on the path towards achieving its target of 10% power generation from RE Sources by 2021" [54].

In the absence of a specific energy policy, the government's omnibus national development strategy is driving the deployment of renewable energy in Trinidad. This approach, however, can be described as being a somewhat "top-down" and centralized path toward renewable energy development. The current approach has almost precluded the adoption of distributed generation by private individuals and enterprises. Distributed generation is largely facilitated by the state for rural electrification. Even though more than 95% of electricity demand is met via the grid, in special cases where persons live in particularly rural areas, the Ministry of Public Utilities (MPU) facilitates access to electricity by the use of solar energy. Pending a feasibility study by the utility to ascertain whether it is, or is not, commercially viable to extend the grid to the user in question, beneficiaries of this 'electrification program' are given a 1500 W solar panel for residential use [55]. In lieu of any tariffs or rates based on their consumption of electricity, beneficiaries of this program are asked to make periodic financial contributions toward the maintenance of the panel.

## 5. Analysis and Discussion

The case analysis using the lens of the IREPP-IAD framework yielded insights for each island country. We documented very ambitious renewable energy targets in all three cases, with advice from industry experts in Trinidad and Tobago that the current 2021 target will not be achieved. As far as government organization for implementation of activities to meet these objectives, there is more commonality. In Mauritius and Trinidad and Tobago, a public utilities ministry sets policy, while a national electricity commission regulates the industry actors. In Taiwan, new statutory agencies have been and are being created to implement renewables development and regulation. In all three cases, a primary institutional barrier has been cited as the strong centralized government with public sector monopolies and bureaucratic, slow-paced administrations. In Taiwan, the formation of newer, more agile and specialized agencies may be an attempt to overcome such institutional inertia. Table 2 below summarizes some key findings along with high level recommendations.

The case study findings were analyzed through the lens of the IREPP-IAD framework, resulting in the identification of ten salient institutional themes pivotal to integrated energy planning that are more likely to support the accomplishment of national targets. These ten institutional themes, summarized in Figure 2 below, are: government/policy decision makers and the decision/policymaking environment; governance structure and commitment for energy policy; existing policy instruments and tools that are in play and those planned; polycentricity; stakeholder participation and community building; market dynamics; information transparency; pilot programs and technology innovations/research; compliance or responsibilities under the Paris Accord—such as nationally appropriate mitigation actions (NAMAs) and NDCs; grid connectivity and monitoring of policy implementation progress.

Policy decision makers and the decision-making environment. Energy planning towards targets requires both a decision-making structure that is mandated and empowered to execute policy and manned by policymakers unified by the vision of the target and having the knowledge and tools to move towards them. Trinidad and Tobago lack a legislative framework to facilitate connection to grid by renewable energy suppliers and proven policies such as feed-in tariffs. Taiwan's current (2016–2020) government, which is led by President Tsai Ing-Wen, has a clear target for energy policy, i.e., 20 percent of the energy mix from renewable energy by 2025. President Tsai won her re-election in 2020, so the continuing promotion of renewable and low-carbon policy is expected (2020–2024). In Mauritius the government listed several policies to accelerate the uptake of RE, such as diversification of the energy landscape to ensure energy security, and the government has set up essential institutional structures to implement the long-term plan, such as think-tanks, including the National Energy Commission in 2013 and the Mauritius Renewable Energy Agency in 2016.

**Table 2.** Drivers, barriers, and recommendations for the three island states based on institutional analysis.

| Country | National-Level Target | Main Institutional Drivers | Main Institutional Barriers | Recommendations |
| --- | --- | --- | --- | --- |
| Taiwan | 20% Renewable Energy by 2025 | New institutions are established to promote renewable energy and facilitate communication among stakeholders | Need more harmonic cooperation between central and local governments that lead by different political parties | Taiwan has a democratic political system. All elected officials are limited terms. Reaching a consensus on long-term energy goal from different political parties is essential and critical. |
| Mauritius | 35% Renewable Energy by 2025 | MARENA (Mauritius Renewable Energy Agency), MEPU (Ministry of Energy and Public Utilities), CEB (Central Electricity Board) | Lack of evidence–based assessment of renewable energy potentials and high level of bureaucracy | Setting up of a mechanism to enable them to unlock financial issues. Implement a carbon tax on fossil fuels which can be used to fund renewable energy technologies like biomass. |
| Trinidad & Tobago | 10% Renewable Energy by 2021 | Ministry of Public Utilities, Ministry of Energy and Energy Affairs, Trinidad and Tobago Electricity Commission | Policy and regulatory approach is currently very centralized and state centric. This has the effect of limiting the participation of the private sector, communities, and individuals. | Decentralization of regulatory approach to incentivize private participation in sectors related to renewable energy, energy efficiency, and/or energy conservation |

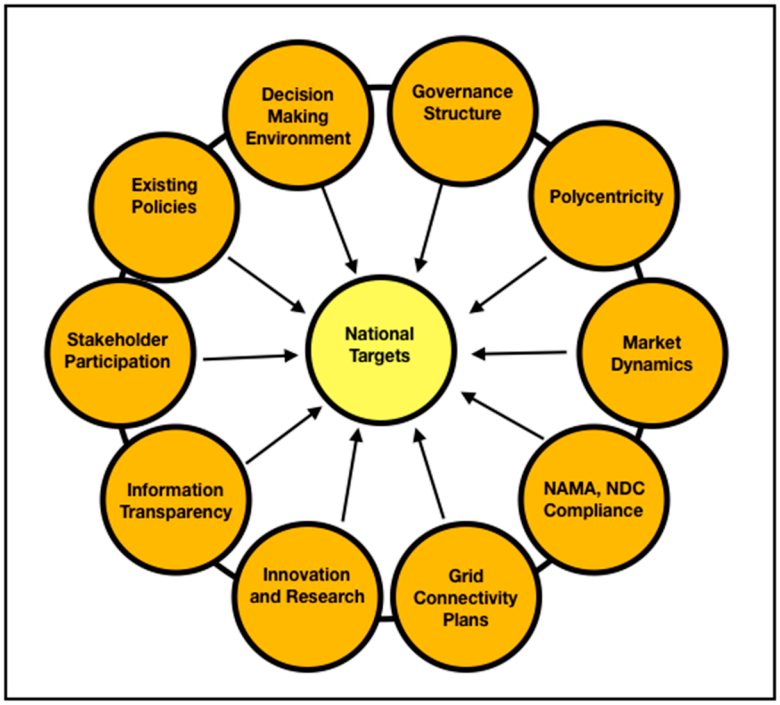


**Figure 2.** Institutional themes linked to national-level renewable energy targets for small island states.

Governance structure and commitment. National energy plans are implemented through government-designed vehicles, including specialized agencies, ministries, and commissions, the structures of which serve the particular context and ambition of the targets. Both centralized and decentralized structures are prevalent. Trinidad and Tobago has no government-approved energy policy. Responsibilities related to renewable energy straddle two different government ministries. In Taiwan, the Bureau of Energy is the central governmental institution for energy management. However, it is a "third level" agency in the central government, under the Ministry of Economic Affairs (second level), and the Executive Yuan (first level). The government established the Office of Energy and Carbon Reduction (under the Executive Yuan) in 2016 to enhance intergovernmental coordination. Mauritius exhibits a strong central governance system and national schemes and incentives to subsidize renewable energy. The government target is renewables to supply 40 percent of the country's energy needs by 2030.

Existing and planned suite of policy instruments. Policy instruments to be deployed should not only be technically feasible but also gain social and political acceptability. Trinidad and Tobago's draft Energy Conservation and Energy Efficiency Policy and Action Plan is pending approval. Taiwan has recently introduced feed-in tariffs and green finance instruments through amendments to the 2017 Electricity Act, which liberalizes green energy supply and incentivizes financing plans to attract foreign investors. The act also establishes new governmental institutions to foster renewable energy development. Mauritius has strong incentives, such as allowing small scale IPPs to generate energy on their own through sustainable sources and export the excess to the grid through a net metering system. It also has a subsidized approach to deployment of PV technology that increases access to rooftop PV systems.

Polycentricity. Polycentric government systems have multiple governing bodies interacting to make and enforce rules within a specific policy arena or location. It is considered to be one of the more effective ways to achieve collective action in the face of drastic policy change [56]. Trinidad and Tobago has an overall state-centric approach. Responsibilities related to renewable energy straddle two different government Ministries. Taiwan lacks county or municipal decision-making systems. The broader energy policy is primarily driven by central policymaking. Mauritius has a weak polycentric tradition largely due to prevalent and historic national level policy action.

Stakeholder participation. While stakeholder involvement in crafting of energy policies has been more prevalent in recent times, some aspects, such as their involvement in monitoring and evaluating progress towards targets and transparency and accountability, remain weak. In many developing countries, full stakeholder involvement is also stymied by lack of information and equitable inclusion processes [57]. In Trinidad and Tobago there has been limited but active stakeholder engagement in the formulation of the draft Energy Conservation and Energy Efficiency Policy and Action Plan. In Taiwan, community renewable energy projects are promoted, led by grassroots organizations or local residents. Stakeholder participation is a key requirement in the environmental impact assessment (EIA) regulations, where developers must elaborate stakeholder participation and community building efforts in the EIA. Mauritius currently lacks official prerequisites of community participation in national-level policies, including for utility-scale rooftop PV systems and other renewables development.

Market and industry dynamics. Due to both a strong push from governments and technological progress, energy markets are experiencing dynamic changes. Some of these changes may facilitate energy transition, others may create challenges to existing markets. The ability for countries to navigate these market forces is necessary to promote energy transition, otherwise the challenges could work against energy transition. For island nations susceptible to external market dynamics that they are unable to control, this is a critical consideration. In Trinidad and Tobago, state-centric approaches limit private sector participation in the power sector to the production of energy by independent power producers via power purchase agreements. The solar PV and offshore wind power markets are vibrant in Taiwan, building up the renewable industry and supply chain, as well as attracting foreign investments. In Mauritius, we noted that rooftop PV systems have captured the majority of the market, with a lack of development in wind, biomass, and other RE sources. The market is dominated by PV-based products limiting participation by other RE sources.

Information transparency. Strong institutional values and organization facilitate access to relevant information to all actors involved in policy implementation, monitoring, and evaluation. Information asymmetries between actors can create unfair power differentials affecting goal attainment. In Trinidad and Tobago, information transparency is limited, along with stakeholder engagement. The decision-making process is very centralized. In Taiwan, the Office of Energy and Carbon Reduction accelerates information sharing and interagency communications. The solar PV and offshore wind "single service windows" help interested individuals and companies collect information, ranging from law, regulatory, policy, administration, and technology. In Mauritius, there is centralized decision-making and a lack of substantial information on current and planned projects.

Pilot, innovation, and research programs. Strong institutional portfolios for national research programs are necessary to adapt, tailor, revise, and elaborate on activities being undertaken towards renewable targets. Overall investments in such portfolios are minimal in developing countries but play an important role in embedding energy policy direction and vision. In Trinidad and Tobago, pilot programs involving the deployment of electric vehicle charging stations have been executed. Research related to RE is ongoing at the University of Trinidad and Tobago and the University of the West Indies. In Taiwan, the National Development Council integrates renewable energy into the National Pioneering Development Plan. The Ministry of Science and Technology implemented two phases of the National Energy Program to encourage renewable and low-carbon technology research and innovations. Mauritius has a small-scale distributed generation scheme that allows small scale IPPs to generate energy on their own through sustainable sources and export the excess to the grid through a net metering system. It has removed all value-added taxes on PV invertors and batteries as a means to increase the interest of investors and the population in solar energy.

Established NAMAs and NDCs. Nationally appropriate mitigation action (NAMA) refers to a set of policies and actions that countries undertake as part of a commitment to reduce greenhouse gas emissions. NDCs are national climate plans highlighting climate actions, including climate-related targets, policies, and measures that governments aim to implement in response to climate change and as a contribution to global climate action. Central to the NDCs is the concept of national determination.

Trinidad and Tobago has a Climate Change Policy (2011), Carbon Reduction Strategy, and NDC all in process of being executed. The government is compliant with responsibilities under the Kyoto Protocol. The Taiwan Environmental Protection Administration (EPA) monitors the greenhouse gas emission from power generation and other sectors. The EPA compiles Taiwan's GHG data aligned with the NDCs and Paris Agreement. Mauritius is a non-Annex 1 country i.e., does not have binding emission targets. It is not on target to meet its NDC of 40% energy from renewable sources by 2030 based on lack of sizeable deployment.

Grid connectivity regulations. The growth of renewable power generation and integration into the utility grid requires security and stability of the power system operation. Hence, the grid integration requirements have become the major concern as renewable energy sources start to slowly replace conventional power. New requirements and technical regulations have been established to ensure grid stability. Trinidad and Tobago has 99% of the population connected to their grid, including rural populations to be connected via the Residential Electrification Assistance Program (REAP) and Electrification Program. The Taiwan Power Company, the only grid operator in Taiwan, is required by the government to open grid access. Mauritius has excellent grid connectivity with almost 100% access to grid-based electricity in the islands.

## 6. Conclusions

As a theoretical contribution, this study provides a robust framework based on the IREPP-IAD approach to assess renewable energy development initiatives and targets in small island states and sheds light on the broader institutional factors affecting the growth of the renewable energy sector in these countries. The enhanced IREPP-IAD framework can serve to make energy target attainment more participatory and democratic. IREPP can serve as the basis to engage a wider cross-section of the population, not only in decision-making but in the supply of electricity, in a manner that is complimentary to medium- and long-term energy planning (and more specifically, to electricity-generation planning). It is likely to have positive and synergistic implications for energy policy in island states.

From a practice perspective, we also provide some key insights on institutional barriers, supports, and recommendations that can serve to enhance individual countries' efforts. In Taiwan, there is a democratic political system. All elected officials have limited terms. Reaching a consensus on long-term energy goal from different political parties is essential and critical. In Mauritius, the government can prioritize the setting up of a mechanism to enable them to unlock financial issues. One option that could be considered for detailed study is implementing a carbon tax on fossil fuels, which can be used to fund renewable energy technologies like biomass. In Trinidad and Tobago, decentralization of the regulatory approach is critical to incentivizing private participation in sectors related to renewable energy, energy efficiency, and/or energy conservation. These island states also experience some common institutional challenges, including being short on financial capacity and long on calcified, inflexible bureaucratic processes. The renewable energy potential in these island states can catapult them to their projected targets if these institutional barriers are addressed. Addressing these factors will not only lead to short-term benefits in achieving these renewable energy targets, but also to long-term benefits in terms of shifting them from a harder path (dependent on fossil fuels) to a 'softer' path of energy regime (i.e., majority of energy from sustainable and renewable energy).

Using this IREPP-IAD framework that has been introduced and tested through application to selected cases here, future studies can include application to other developing countries' contexts for comparison. While this study focused on one dimension of energy policy implementation, that is, the institutional context, plans to meet ambitious renewable targets will need to incorporate these deeper institutional insights with other dimensions, such as economic and social factors, in order to gain a holistic perspective.

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