

Article

A Study on Regulations Mandating Obligation on Renewable Energy in Taiwan

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Abstract: The shift toward renewable energy has become a global trend today. In the past, power producers or the private sector were encouraged to install renewable energy equipment mainly through incentives (e.g., feed-in tariff, tax credits). Some countries also impose “renewable portfolio standards”, which mandate power producers to include RE. However, it is rare to see any mandatory requirements on electricity users anywhere in the world. Since 2018, Taiwan’s government has started to draft the RPS-TW to establish such obligation; but as a new mechanism, the greatest challenge lies in formulating feasible requirements that are apt to Taiwan’s circumstances. This study aimed to assist Taiwan’s government in this effort by formulating content that was feasible and meets external expectations regarding the applicable entities, scope, and methods of fulfillment. Once the draft had been revised accordingly, the public (electricity users, environmental groups, general public) were actively consulted, and the draft was modified and optimized based on widely collected feedback. The regulations were ultimately promulgated on 31 December 2020.

Keywords: electricity user; RPS-TW; obligation on renewable energy



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1. Introduction

The development of low-carbon energy is a clear global trend, and the ratio of RE will only grow incrementally in the future to eventually become the predominant source. Taiwan must take an aggressive stance to align with this trend, especially in light of its heavy dependence on energy import. How to mitigate the associated risks and boost the RE ratio are urgent issues for the government.

REDA 2019 mandates a certain ratio of RE for electricity users; however, there are no concrete requirements around the scope of the applicability, ratio, and method of fulfillment. As such, this study aims to clarify these along with the necessary complementary measures, while also scrutinizing public concerns to arrive at the most suitable way forward, with a view to formulate a feasible code stipulating user obligations.

Since the RPS-TW is a new framework, an introduction (Section 1) is first provided on the current state and forecast for global energy supply, energy supply and demand in Taiwan, and the impact of energy import on Taiwan’s GDP. Next, Taiwan’s energy-related implementation strategies are outlined to help illuminate the background of the RPS-TW formulation (Section 2). Major RE-related policies and measures around the world are then compiled as a reference and the intent behind REDA 2019 is analyzed (Section 3.1). The scope of applicability (Section 3.2), method of fulfillment (Section 3.3), and complementary mechanisms (Section 4) are explored and, finally, external opinions (Section 5) are referenced to round off the RPS-TW.

1.1. Current Status and Forecast of Global Energy Supply

Countries worldwide have been aggressively driving the use of low-carbon energy to mitigate the impact of global warming. According to global shares of primary energy

for 2000–2018 in the 2020 Edition of BP’s Energy Outlook [1] (Figure 1), oil dropped from 39% to 33%, and coal peaked in 2011 (31%) before declining to 28% in 2018; meanwhile, renewable energy (RE) grew from 1% to 5%. BP forecasted a tremendous growth in RE between 2025 and 2050 (Figure 2) from 11% (2025) to 44% (2050), a drop in coal from 22% (2025) to 4% (2050), and an uptick in oil from 11% (2025) to 14% (2050). As shown in Figures 1 and 2, oil and coal will remain the dominant primary energy sources globally for 2018–2025 but, beginning in 2035, RE will become the main source, while coal will continue to decline from 2025 until halving its 2025 ratio in 2050.

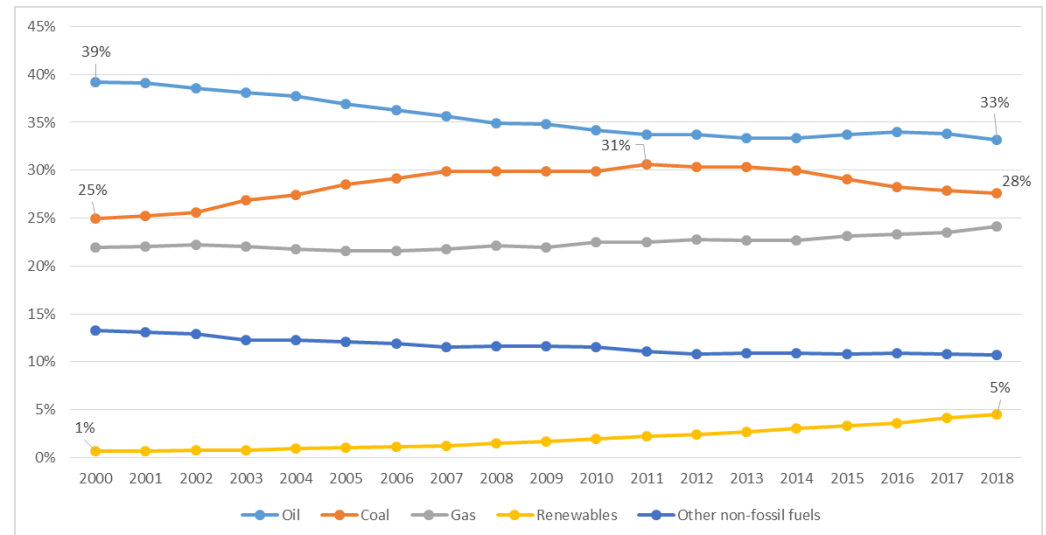


Figure 1. Global shares of primary energy 2000–2018. Source: BP.

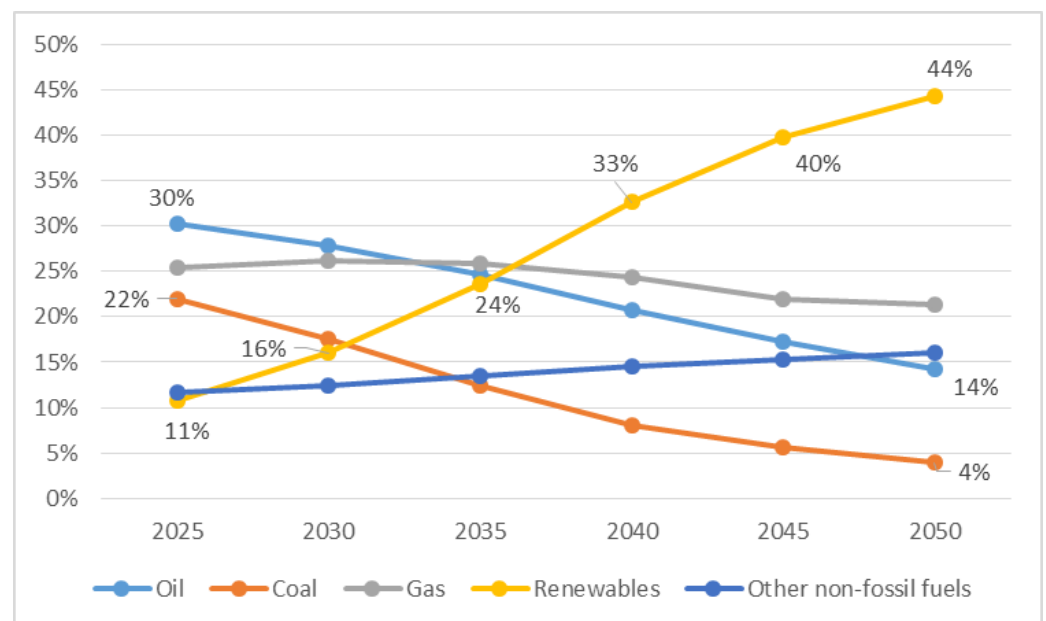


Figure 2. Global shares of primary energy in 2025–2050. Source: BP.

Moreover, IEA’s January 2022 Electricity Market Report [2] points out that coal-generated power will incrementally decrease in ratio starting in 2015, while RE will trend upward (Figure 3), with newly installed power generation equipment favoring RE as the primary new source by 2024.

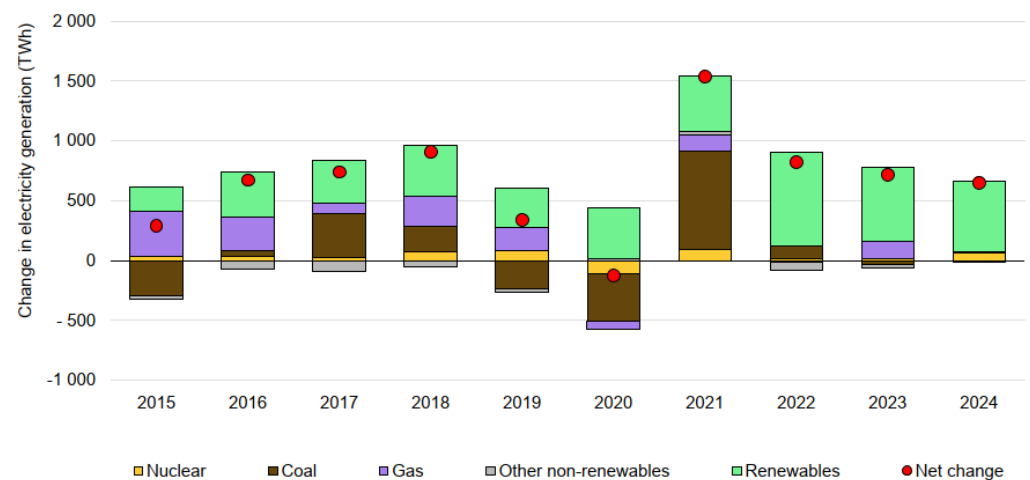


Figure 3. Global change in electricity generation 2015–2024. Source: IEA.

1.2. Energy Supply and Demand in Taiwan

According to data on self-produced and imported energy supply in Taiwan [3], Taiwan's dependency on external sources was around 98% in 2005–2020 (Figure 4). The annual average for imported energy is 138 million kiloliters of oil equivalent (klOE), with dependency as high as 98.02% during the last 15 years (Table 1). Despite some local production in oil and LNG, their ratios are merely 0.021% and 2.457% of the category total, respectively (Figure 5), evidencing severe shortage in domestic fossil fuel supply in Taiwan.

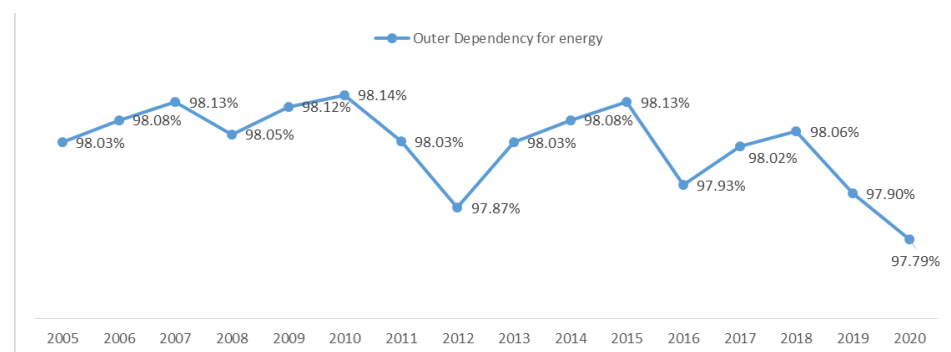


Figure 4. Taiwan's energy dependency (2005–2020). Source: Bureau of Energy, MOEA.

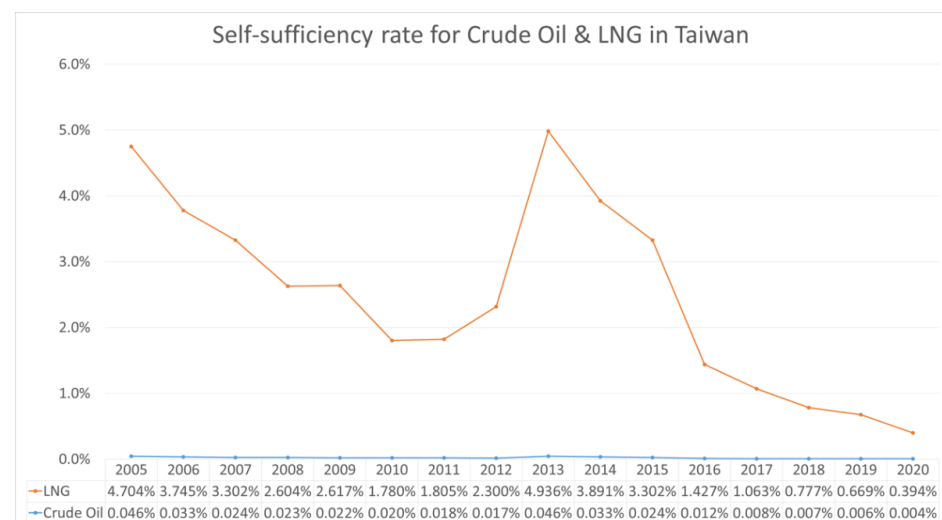


Figure 5. Self-sufficiency rate for crude oil and LNG in Taiwan 2005–2020. Source: Bureau of Energy, MOEA.

Table 1. Domestic and imported energy in Taiwan.

Year	Domestic (A)	Imported (B)	B/(A + B)
2005	2641.77	131,438.71	98.03%
2006	2621.00	134,148.87	98.08%
2007	2696.09	141,299.91	98.13%
2008	2716.80	136,502.82	98.05%
2009	2569.599	133,843.5	98.12%
2010	2653.8	140,354.0	98.14%
2011	2733.261	136,104.6	98.03%
2012	3017.046	138,593.9	97.87%
2013	2641.8	131,438.7	98.03%
2014	2621.9	134,148.9	98.08%
2015	2696.1	141,299.9	98.13%
2016	3042.3	143,586.1	97.93%
2017	2904.4	143,668.055	98.02%
2018	2890.353	145,736.558	98.06%
2019	3110.1	145,290.317	97.90%
2020	3057.20	135,423.377	97.79%
Average	2788.35	138,304.89	98.02%

Unit: 10³ kLOE. Source: Bureau of Energy, MOEA.

According to the Energy Statistical Annual Reports (2020) published by Taiwan's Bureau of Energy (BOE), Ministry of Economic Affairs (MOEA) [3] (see Figure 6), primary energy sources in Taiwan included petroleum products, coal and coal products, natural gas, and nuclear. Petroleum products were mainly used in the transportation and non-energy sectors, while the rest were primarily used for power generation. Around 50% of the 2020 total energy supply was used to generate electricity, which was then supplied to industrial, residential, and service sectors.

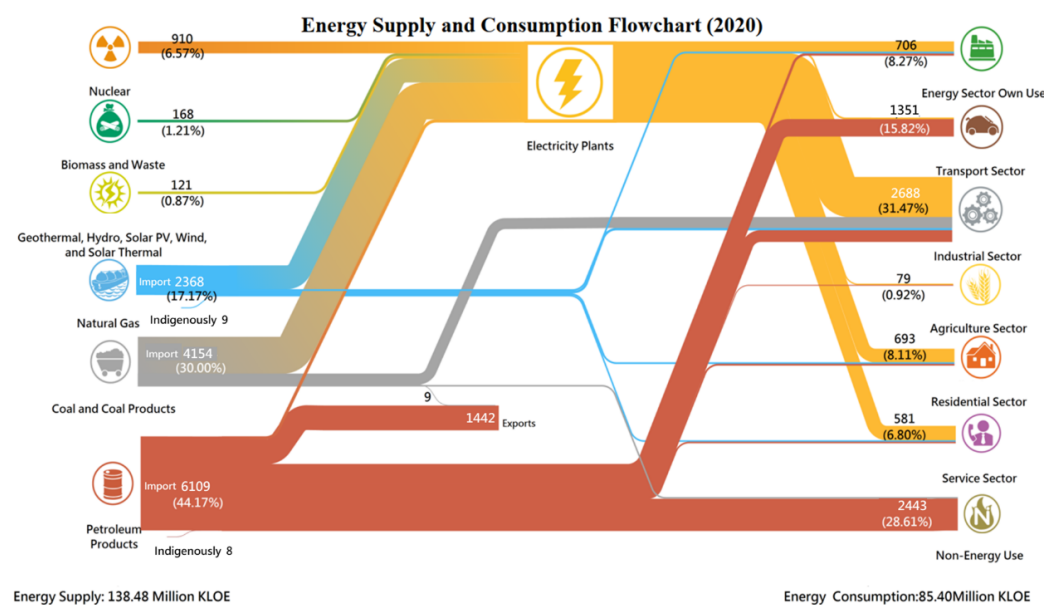
**Figure 6.** Energy supply and consumption flowchart 2020. Source: Bureau of Energy, MOEA.

Figure 6 highlights the fact that 54.65% of Taiwan's energy is supplied as electricity to the demand end, and Figure 7 shows that most of the island's electricity demand comes from the industrial, service, and residential sectors. Thus, placing RE obligation on the demand end will effectively raise Taiwan's RE ratio and accelerate its RE development.

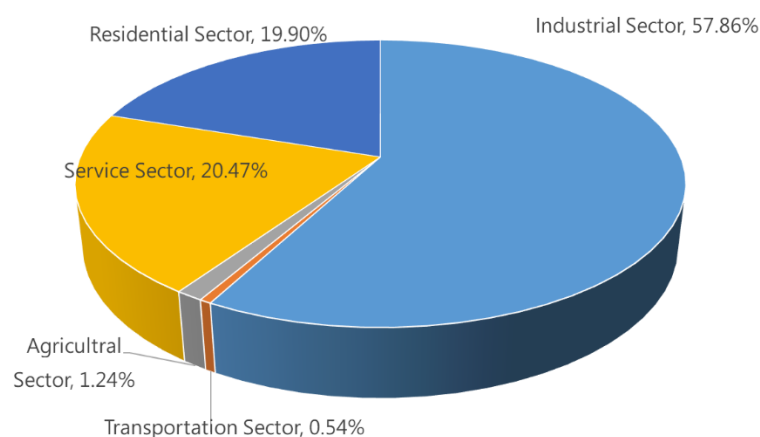


Figure 7. Average electricity demand by sector for 2005–2020. Source: Bureau of Energy, MOEA.

A closer look at the distribution of electricity demand by sector (Figure 7) reveals the industrial sector to account for 57.86%, followed by service at 20.47% and residential at 19.9% [4].

1.3. Impact of Energy Import on Taiwan's GDP

Taiwan is heavily dependent on imported energy, with petroleum products serving as the main production feedstock, transportation fuel, and fuel for power generation. Such dependency is a tremendous cause for concern for Taiwan's energy autonomy and security, and any fluctuation in global energy prices may engender a significant impact on Taiwan's economy. As shown in Figure 8, the soaring price of oil in 2008 resulted in the value of energy imports accounting for 14.85% of Taiwan's nominal GDP, while the rising energy price between 2010 and 2014 due to global economic recovery also kept the same figure hovering between 11% and 13% [3].

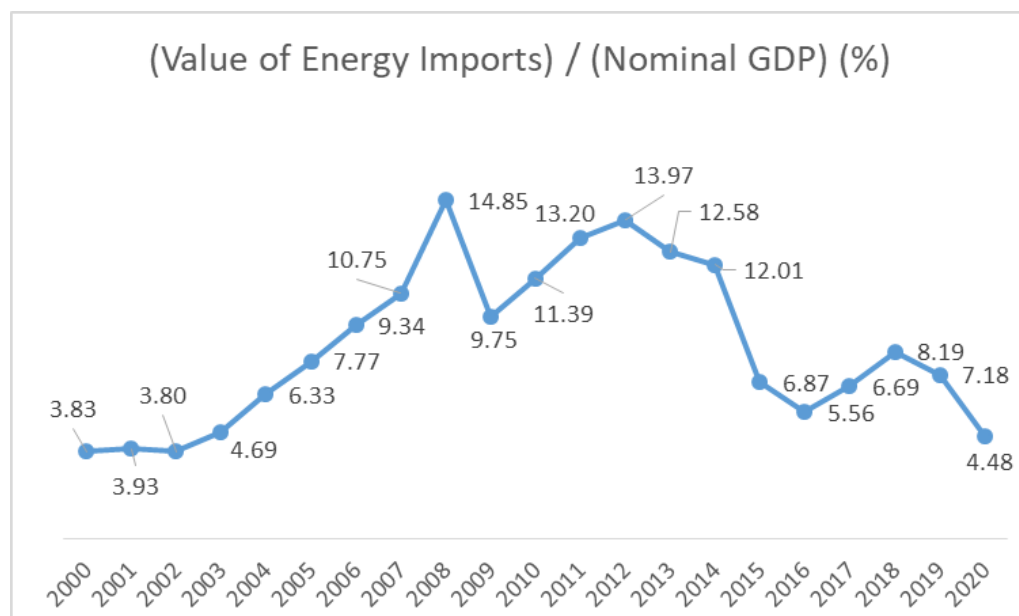


Figure 8. Value of energy imports/nominal GDP in Taiwan for 2000–2020. Source: Bureau of Energy, MOEA.

Energy imported into Taiwan is primarily used for power generation, transportation fuel, and feedstock for fossil fuel products, with the latter two relatively more difficult to replace with other energy sources in the short term. However, it is more feasible to change

the fuel structure for power generation by boosting the ratio of domestic energy supply, thereby reducing the ratio of imported energy in this sector. In light of this, Taiwan's government is aggressively developing RE toward its 2025 target of a 20% RE ratio in power supply.

2. The Energy Transformation in Taiwan

Around the world, governments are gradually transforming from providing subsidies or incentives for RE toward allowing market competition, while private corporations are also declaring their own RE targets. Taiwan with its high dependence on energy import is pursuing a similar policy direction in response to its environmental constraints and international trends, striving to mitigate the associated risks while assisting Taiwanese businesses to align themselves with the shifting winds as soon as possible.

2.1. Trends in Energy Transformation

There are many drivers for RE development, with the main one being the mitigation of global warming, followed by reducing energy-related air pollution, improving national energy security and diversification, and shaping new economic behaviors [5]. A 2020 REN21 report suggested that as of the end of 2019, there were 143 countries worldwide with RE power generation policies and 166 with RE targets [6]. The policies include renewable portfolio standards (RPS) and other quota obligations, feed-in policies (tariffs, premiums), renewable power tenders and auctions, financial incentives (grants, rebates, tax credits), and, more recently, community choice aggregation programs. In 2019, there was a notable shift away from feed-in policies toward mechanisms such as auctions and tenders [7].

IRENA's 2018 report noted that national RE policies were shifting across the globe [5]. For instance, the number of countries with RE tendering schemes grew from 8 in 2004 to 73 in 2016—a 9-fold growth. In addition, there are 21 countries with a solar heat obligation, requiring photovoltaic installation in new or renovated buildings. The trends in measures taken by various countries indicate that in addition to using existing incentives or subsidies to catalyze RE installations, they also leverage RE tendering schemes to reduce the cost of RE generation. At the same time, some countries are beginning to apply restrictive measures in their RE policies, such as requiring RE equipment to be installed in new or reconstructed buildings. Evidently, RE measures of a competitive or restrictive nature are beginning to be applied on top of installation subsidies or high FIT prices.

RE is a distributed energy option permitting small-scale installation. Furthermore, declining installation costs means suppliers of RE electricity are no longer limited to traditional utility companies. Distributed, small-scale RE terminals are also actively encouraged by governments, with many incentives, such as small-scale feed-in tariff, tax reduction, grant/subsidy, and financing, further boosting the will of non-utility businesses or individuals to build RE power plants. In addition, the government is gradually transitioning its role from managing the utility sector to monitoring the electricity market [8]. One example is the application of renewable portfolio standards (RPS), which requires the utility sector to produce or purchase a certain percentage of RE based on its generation capacity, and the RE purchased in this case usually comes from distributed RE generation terminals.

An analysis indicates that the increase in the RE ratio has brought about a shift in power production from a centralized, large-scale model toward a decentralized, small-scale one. As a result, there is frequently an overlap between electricity users and suppliers, blurring the boundary between the two roles compared to in the past. IRENA is also reporting [9] the diversification of RE players. In addition to central or local governments establishing policies and measures, some businesses (e.g., Ikea, Google, Apple) are also beginning to set their own RE goals and require their suppliers to set corresponding targets.

IRENA's 2018 report [5] pointed out that 48% of the US-based Fortune 500 companies and 63% of the Fortune 100 companies had at least one climate or clean energy target, and 10% of the Fortune 500 companies had set a specific RE target. RE100's Annual Report [10]

stated that as of the end of 2020, over 260 businesses had committed to 100% RE. An analysis of the motivation behind their commitment shows 99% of them to be motivated by greenhouse gas (GHG) reduction and corporate social responsibility (CSR), with 70% indicating cost savings to be a driver for switching to 100% RE. The RE procurement strategy of these companies is to sign power purchase agreements (PPAs) with RE producers in order to raise their RE supply ratio. In addition, RE100's report on Taiwan [11] shows that as of the end of 2019, there were 85 companies in Taiwan who have joined RE100, and they are mostly key suppliers of multinational companies. Consequently, around 38% of RE100 companies will demand Taiwanese suppliers to carry significant RE content if they were to successfully achieve 100% RE.

Using Taiwan as an example, statistics from the BOE [12] show that electrical or electronic parts account for roughly half of Taiwan's total export of US\$315.51B. Taiwanese companies will have to set their own RE targets and corresponding measures to meet those of the multinationals with whom they do business. In view of a changing power production structure and the issues faced by Taiwanese exporters, it is imperative for Taiwan's government to introduce timely policies and measures to guide them in raising their RE ratio and meeting RE demand arising from the supply chain or other environmental factors.

2.2. Overview of Transformation in Taiwan's Energy Policies

Taiwan is highly dependent on energy import. With an eye to improve energy autonomy and reduce the import ratio, the Taiwanese government published the first version of "The Energy Policy of the Taiwan Area" in 1973, which emphasized stable supply, secure import, and diversification in class and source. The policy was first amended in 1979 to incorporate guidelines on replacing oil with coal, establishing domestic production targets, and promoting energy-saving measures, with further reviews and amendments undertaken in 1984, 1990, and 1996 [13]. Finally, with the 4th amendment as the foundation, the "2008 Strategic Framework for Sustainable Energy Policy" was published, complete with four policy targets: high efficiency, high value, low carbon, and low dependency [14]. The "Guidelines on Energy Development" were promulgated in October 2012 following the 2011 Fukushima nuclear accident in Japan. This was the first set of guidelines established in accordance with the Energy Administration Act. The principles and guidelines in energy development established therein were further amended in 2017 with the following goals: ensuring balanced development in energy security, green economy, environmental sustainability, and social equity so that the target of the nuclear-free homeland can be achieved by 2025 and sustainable development in energy can be attained [15].

With the 2017 amendment of the "Guidelines on Energy Development", Taiwan's energy policies shifted toward enhancing energy autonomy and diversity, optimizing energy supply structure and management, establishing distributed energy sources, and energy efficiency. Since increasing RE is key to meeting Taiwan's energy objectives, the 2009 Renewable Energy Development Act [16] (hereinafter the "REDA") was revised in 2019 with two key features. First, RE producers could now choose whether to sell electricity via direct supply, wheeling, or wholesale to Taiwan Power Company (TPC). Second, when the chartered capacity on contract capacity to TPC signed by the user of electricity exceeds a certain capacity, the user shall install on their own or provide space to install RE power generation and storage facilities with certain installed capacity or purchase a certain amount of electricity generated from RE and certificates. If the user fails to take actions according to the aforesaid regulations, the user shall pay a monetary substitution to the competent authority toward the development of RE [17].

2.3. Brief Summary

Renewable energy has become a global trend today. Presently, Taiwan relies heavily on imported energy with little autonomy, exposing its energy security and energy prices to substantial impact from volatile energy prices caused by fluctuations in the international landscape [18]. The priority in its national energy transformation strategy will be to reduce

energy dependency and boost domestic sources. However, a lack of domestic supply in fossil fuel renders increasing the RE ratio its only option for improving autonomy.

Furthermore, increasing the RE ratio and cutting emissions is a global trend. Not only are governments striving to ramp up RE production and carbon reduction, over 260 multinational companies have also committed to fully adopting RE over the next decades and facilitating green supply chains [19]. It will be imperative for Taiwanese manufacturers supplying products or parts to these companies (e.g., TSMC, ASE Group) to act upon their RE policies and introduce RE into production lines to meet such demand [20].

Taiwanese industries comprise primarily of component suppliers to multinationals, so the government must give serious thoughts on how to guide its industries in RE adoption to satisfy their RE targets or those they impose on suppliers. Most mainstream RE measures around the world today are based on incentives or subsidies and geared toward existing power producers or those interested in producing RE, rather than non-electricity suppliers or disinterested businesses [21].

Therefore, Taiwan must think outside the box in trying to encourage local companies to adopt RE. One must consider the viewpoint of electricity users and contemplate how to coax them into doing so. Some countries or regions are achieving this through RPS and translating national RE targets to an obligation for large-scale electricity producers, who are then required to include a certain ratio of RE in their production. Similar measures may be devised for electricity users, where big users are obligated to share responsibility in national RE targets. At the same time, businesses may be coached to raise their RE uptake, thereby meeting multinationals' demand on the supply chain.

Taiwan is naturally disadvantaged in energy autonomy and has an economy centering on foreign trade [22]. It is therefore critical to formulate RE measures aimed at electricity users to improve its energy supply structure and maintain the competitiveness of industries in the international arena. Since electricity is a basic need, the design of such measures must focus on big users first to minimize the impact on residential ones.

3. Design of Subsidiary Legislation Pertaining to RE Obligation

The 2019 amendment of REDA introduced for the first time an RE obligation for the electricity user. Article 12 (4) outlines the following provisions.

When the chartered capacity on contract capacity signed by the electricity user exceeds a certain capacity, the user shall install on one's own or provide space to install RE power generation and storage facilities with a certain installed capacity or purchase a certain amount of RE and a certificate. If the user fails to take action according to the aforesaid regulations, the user shall pay a monetary substitution to the competent authority for the development of RE [17].

The "Regulations for the Management of Setting up RE Power Generation Equipment of Power Users above a Certain Contract Capacity" [23] (hereinafter the "RPS-TW") is the first obligatory law in Taiwan to focus on an RE obligation placed on the end consumer. The study herein on the RPS-TW, which is subsidiary to REDA, commenced in 2018 and, following the enactment of REDA 2019, was expanded to include the scope, applicable entities, method of fulfillment, and feasibility of the RPS-TW. The following paragraphs outline the results of this probe into its design.

3.1. Obligation of the Energy Consumer

According to a REN21 report [6], RE policy measures in major countries around the world may be classified into "regulatory policies" and "fiscal incentives and public financing" (Table 2). Common measures include feed-in tariff/premium payment, electric utility quota obligation/RPS, net metering/billing, biofuel blend, renewable transport obligation/mandate, tradable REC, and tendering, and they are supplemented by fiscal incentives and public financing. However, a further probe into the subject of these measures reveals that most of them set out to catalyze RE installation either by electricity suppliers or, through financing and FIT, by energy consumers. Some countries require the utility

sector to meet a certain RE ratio via RPS. None of them places any RE obligation on energy consumers.

Table 2. Policies on renewable energy.

Category	Subcategory	Major Countries
Regulatory Policies	Feed-in tariff/premium payment	Australia, China, Denmark, Germany, Italy, Japan, Taiwan (Taipei, China), United Kingdom
	Electric utility quota obligation/RPS	Australia, China, Republic of Korea, United Kingdom
	Net metering/billing	Australia, Denmark, Italy, Republic of Korea
	Biofuel blend, renewable transport obligation/mandate	Australia, China, Denmark, Germany, Italy, Republic of Korea, Taiwan (Taipei, China), United Kingdom
	Renewable heat obligation/mandate, heat feed-in tariff, fossil fuel ban for heating	Australia, China, Denmark, Republic of Korea, Germany, United Kingdom
	Tradable REC	Australia, Denmark, Germany, Japan, Republic of Korea, United Kingdom
Fiscal Incentives and Public Financing	Tendering	Australia, China, Denmark, Germany, Italy, Japan, United Kingdom
	Reductions in sales, energy, CO ₂ , VAT, or other taxes	China, Denmark, Germany, Italy, Japan, Republic of Korea, United Kingdom
	Investment or production tax credits	China, Denmark, Germany, Italy, Taiwan (Taipei, China), Republic of Korea
	Energy production payment	China, Japan, Republic of Korea, United Kingdom
	Public investment, loans, grants, capital subsidies, or rebates	Australia, China, Denmark, Germany, Italy, Japan, United Kingdom

Source: IEA.

A further examination of energy-related restrictions on consumers worldwide and of IEA's policies database [24] indicates that some countries set energy conservation targets for consumers (e.g., China, Japan, India, Taiwan). They require the applicable entities to continue to improve energy efficiency (e.g., 1% annual target in energy saved by the user), where any RE content in the energy consumed contributes toward the target by being counted as energy saved or excluded from the total consumption.

The thinking behind an RE obligation placed on the consumer end is similar to the RPS mechanism in developed countries, except the applicable entity is changed from producer to consumer. Although restrictive measures on consumers have precedents elsewhere in the world, most of them focus on energy conservation rather than compelling the consumers to use RE. With nothing to reference to from other countries, Taiwan's government needed a scrutiny on Article 12 (4), REDA 2019, in drafting the RPS-TW and the relevant measures and applicable entities to establish obligatory measures that are fair and executable.

Before investigating its complementary mechanisms, the study team compiled the following principles for the RPS-TW after assessing the intent behind adding this subsidiary law to REDA 2019 and its future implementation.

- The RPS-TW is the first legislation obligating RE in Taiwan, so its design should consider the fairness and feasibility of the four permitted options of fulfillment. As for the quota and scope of applicability, its content should be designed to minimize the scope of impact and yet maximize the benefit, with a follow-up assessment of whether the scope or quota should be expanded.
- The RPS-TW requires the applicable entity to fulfill an RE obligation and it should not receive a direct cash benefit in doing so. The electricity as well as environmental

benefit obtained as a result of the fulfillment shall be restricted to self-use and must not be sold or transferred to a third party.

- Based on the intent of the REDA, the four options of RPS-TW fulfillment should be prioritized as follows: RE installation, battery energy storage system, purchase of RE electricity and certificates, and finally, payment for the RE obligation. The last one is a compensatory measure in lieu of fulfilling the obligation, so applicable entities should be urged to pursue the first three wherever possible. The measures corresponding to each of the options should be formulated in the same order as their priority.
- The drafting of the RPS-TW should be mindful of existing systems and policies and, upholding the same principles as the foregoing, stipulate complementary measures that are user-friendly. Its goals are to smooth the way for businesses to fulfill their corporate social responsibility and encourage electricity users to increase the ratio of green energy used. Consequently, they will reduce carbon emissions in their processes, enhance the environmental value of their products, boost their competitiveness in the global market, and become a part of the global green supply chain.

3.2. Scope of Applicability

The first and foremost question to be answered in designing the RPS-TW is how to define the applicable scope of the RE obligation. In doing so, the list of 800 kW+ users published annually by the BOE [25] was referenced to determine the scope of obligated users, and the status of power consumption in the different contract tiers was analyzed (Table 3). The most intensive consumption came from 5000 kW+ users and accounts for 66.98% of 800 kW+ users, followed by the 3000–5000 kW tier (10.14%). As for the number of users across the tiers, the 800–1000 kW tier has the greatest number of users at 1102, followed by 571 in the 1000–1200 kW tier and 604 in the 5000 kW+ tier.

Table 3. The 800 kW+ electricity consumers.

Range	Electricity Demand (Twh)	Electricity Demand (%)	Accumulative Electricity Demand	No. of Users
800–1000 kW	3.8 Twh	3.28%	115.3 TWh (800 kW+)	1102
1000–1200 kW	2.5 Twh	2.17%	111.5 TWh (1000 kW+)	571
1200–1500 kW	4.4 Twh	3.79%	109.0 TWh (1200 kW+)	804
1500–2000 kW	6.6 Twh	5.77%	104.6 TWh (1500 kW+)	888
2000–3000 kW	9.1 Twh	7.87%	98.0 TWh (2000 kW+)	816
3000–5000 kW	11.7 Twh	10.14%	88.9 TWh (3000 kW+)	610
5000 kW+	77.2 Twh	66.98%	77.2 TWh (5000 kW+)	604
Total			115.3 TWh (800 kW+)	5395

Source: This study.

With the RPS-TW being the first time Taiwan is placing an RE obligation on users, the aim is to minimize the scope of impact while maximizing the benefit. Hence, the 5000 kW+ tier will be obligated first since it covers 66.98% of the consumption but involves only 604 users. This is the tier that has the minimum impact on users and yet covers the greatest amount of consumption.

On the issue of the applicable entities, this law is intended as an obligatory one pertaining to the end energy users and should include all users whose contract capacity reaches a certain tier. However, some users are providers of public services, social services, or public goods, and imposing an RE obligation would add to their operating costs and therefore the cost of their services.

Based on this reasoning, 5000 kW+ users falling under the public service category were identified as follows: education, healthcare, social work and services, transportation, government bodies, power plants, and state-run research institutions. These sectors provide services essential to keep the society running. Furthermore, some of these users already carry obligations under Article 12 (1), REDA 2019, "... government bodies (institutions), public schools, and state-run enterprises matching the conditions for RE installation shall be prioritized to put in place such installation." It was thus concluded that they should be exempted from the RPS-TW obligation.

In addition, the aim of the education or healthcare sectors is to elevate the education level of the society or maintain the life and health of the public. Imposing an RE obligation would add to their overhead, which would then be inevitably transferred to the public and hinder them from enjoying their rights to education and health. Moreover, state-run research institutions use government funding to contribute to the betterment of fundamental sciences and industrial technology and innovations, and it would not be favorable to use such funding to fulfill the RPS-TW obligation.

Thus, this study is recommending the scope of applicable entities to cover all sectors with the exception of education, healthcare, social work and services, transportation, government bodies, power plants, and state-run research institutions.

3.3. Method of Fulfillment

In accordance with Article 12 (4), REDA 2019, the RPS-TW shall specify details on the following: a certain installed capacity, a certain amount (quota), categories of the RE power generation facilities to be installed, categories of storage facilities, payment of monetary substitution, and calculation formula. In drafting the RPS-TW, the study team reviewed similar legislation already enforced by the local governments and found them in the self-government ordinances of three cities as of the end of 2018: Tainan City [26], Taichung City [27], and Taoyuan City [28]. The regulations are summarized in Table 4. All of them have requirements on users reaching a certain contract capacity, and though the threshold varies, they all include 5000 kW+ users. There is also a requirement in all ordinances for RE installation of a minimum of 10% of the contract capacity, although Tainan qualifies only solar equipment while the other two also allow for other RE equipment or energy-saving equipment.

A deep dive into the variation in obligatory measures across local and central governments is shown in Table 5. Differences exist between each of the three municipalities, with Tainan City being the strictest and allowing only solar power. Taichung City and Taoyuan City not only do not limit the type of RE, but they also allow the installation of energy-saving equipment as a way to fulfill the local ordinance. A comparison between the fulfillment options between the central and local governments shows that like the local ordinances, Article 12 (4), REDA 2019, also permits RE installation as a way to fulfill the obligation, although REDA does not give the option of installing energy-saving equipment. That is to say, with the exception of energy-saving equipment, the central regulations allow for more choices in ways to fulfill the obligation. Besides, the RPS-TW is subsidiary to a central law, so it would not be able to permit the option of installing energy-saving equipment without amendment to its parent law. It is recommended that further coordination and communication be pursued with local governments to make these options for obligation fulfillment more consistent across central and local legislation.

Table 4. RPS rules at the local government level.

City	Self-Government Ordinances	Year of Implementation	Rules
Tainan City	Tainan City Self-Government Ordinance for a Low-Carbon City	2012	Users with 800 kW+ contract capacity shall install solar power systems equivalent to at least 10% of the contract capacity at adequate locations within the city.
Taichung City	Taichung Municipal Self-Government Ordinance on Developing Low-Carbon City	2014	Users with 800 kW+ contract capacity shall install systems providing solar, wind, or other power or conserving energy equivalent to at least 10% of the contract capacity at the place of power consumption or adequate locations within the city.
Taoyuan City	Regulations on Developing Taoyuan City as a Low-Carbon-Emission and Green City	2016	Users with 5000 kW+ contract capacity shall install systems providing solar, wind, or other power or conserving energy equivalent to at least 10% of the contract capacity at the place of power consumption or adequate locations within the city.

Source: This study.

Table 5. Variations in obligation rules between local governments.

Government	Obligation Rule	Applicable Entity	Deviation from Central Government (MOEA)
Tainan City (Local)	Install solar systems equivalent to at least 10% of the contract capacity Users with 800 kW+ contract capacity shall install systems providing solar, wind, or other power or conserving energy equivalent to at least 10% of the contract capacity at the place of power consumption or adequate locations within the city.	800 kW+ users	Only one way to fulfill the obligation, with a wider scope of applicable entities
Taichung City (Local)	1. Install solar, wind, or other green systems equivalent to at least 10% of the contract capacity 2. Install energy-saving equipment	800 kW+ users	Energy-saving equipment is added as a way to fulfill the obligation but the options of energy storage, RE and certificate purchase, or cash payment are not allowed, and there is a wider scope of applicable entities
Taoyuan City (Local)	1. Install solar, wind, or other green systems equivalent to at least 10% of the contract capacity 2. Install energy-saving equipment	5000 kW+ users	Energy-saving equipment is added as a way to fulfill the obligation but the options of energy storage, RE and certificate purchase, or cash payment are not allowed

Source: This study.

To ensure the executability of the RPS-TW, cities already enforcing a similar obligation should be referenced in setting the quota. Provisions should also be made for Article 12 (5),

REDA 2019, and flexibility given to local governments over their own regulations: “To be in line with the characteristics and planning of the local development, the local governments may prescribe and implement stricter autonomous laws and regulations within their jurisdiction than the aforesaid regulations.” Accordingly, the RPS-TW quota should be set as 10% of the contract capacity and the scope of applicable entities 5000 kW+, in keeping with local ordinances.

4. Complementary Mechanisms

Now that the applicable entities, scope, and methods of fulfillment have been set, the detailed rules must be outlined. Based on the analyses and principles described above, results relating to the four ways to fulfill the RE obligation and related complementary measure are described as follows.

4.1. RE Installation Option

Installation of RE equipment is the first way to fulfill the RE obligation set out in the RPS-TW, and the one preferred by REDA. The requirement of Article 12 (4), REDA 2019, is to provide “a certain installed capacity”, so the related calculations shall be carried out in accordance with this parent law, which means “installed capacity” should be used. To ensure fairness across different user scales regulated under the RPS-TW, the obligated quota shall be based on the user scale. Additionally, since similar measures are already stipulated by local governments, the calculations should also reference local ordinances to avoid levying an additional burden on users. Consequently, a set percentage (10%) of the user’s contract capacity should be adopted as the quota for installed capacity.

Hence, this study recommends using 10% of the contract capacity, and the applicable entities shall install RE equipment to meet this quota (see Table 6 for sample calculation). The same number should also be used to calculate the other three options.

Table 6. Sample calculation: RE installation option.

Contract capacity	5000 kW
RPS-TW Quota	500 kW
Required RE Capacity	500 kW

Source: This study.

4.2. Battery Energy Storage System Option

For the battery energy storage system (BESS), its capacity and charging/discharge rate must be considered, while the capacity should be set up the same way as the RE installation option. Thus, 10% of the capacity stipulated in the contract capacity will be used as the required BESS capacity. However, the same BESS capacity may offer a different discharging quantity and rate, which must also be considered in setting this option. The discharging rate may be roughly split into either ≥ 1 C or ≤ 0.5 C in C-rate terms. Common requirements on energy storage equipment include to offset peak/off-peak hours, adjust supply frequency, modulate power supply, and provide backup during power outage. Adjusting supply frequency demands the shortest response time, and such equipment should be ready to rapidly discharge (capacity > 1 C). Nevertheless, Taiwan already has a robust grid and TPC has other modulating mechanisms. With adjusting supply frequency excluded, a discharging rate below 0.5 C is sufficient.

Although the RPS-TW stipulates an RE obligation, BESS also serves the functions of RE smoothing and demand response. Additionally, since the applicable entities are big users, they may be able to leverage the BESS to modulate their power load, thereby reducing the peak-hour burden on the public grid and contributing to stabilizing the overall demand and supply. For these reasons, TPC’s measures to suppress the peak-hour load should be referenced in designing the BESS option, and users can use a minimum 2 h supply offset to

modulate their power load [29]. Thus, it is recommended that users who pursue the BESS option be required to ensure at least 2 h of continuous supply with their BESS equipment.

In light of the foregoing factors, it is recommended that the BESS option, taking account of both the user's potential needs and fairness across the four options, follows the same calculation method as RE installation and be based on the discharging rate of 0.5 C. The calculation is defined as follows (see Table 7 for sample calculation):

$$\text{Quota required in RE Electricity and Certificates (kW)} = \text{Obligation Quota} \quad (1)$$

$$\text{Quota required in RE Electricity and Certificates (kWh)} = \text{Obligation Quota} \times 2 \text{ h} \quad (2)$$

where the Obligation Quota is the RPS-TW obligation quota, and 2 h is the output hours of the BESS.

Table 7. Sample calculation: BESS option.

Contract Capacity	5000 kW
RPS-TW Quota	500 kW
Required BESS	500 kW/1000 kWh (for 2 h)

Source: This study.

4.3. RE Electricity and Certificates Option

This study uses 10% of the contract capacity as the RPS-TW quota and kW as the unit, but the unit used in RE electricity and certificates is kWh. In addition, different types of RE generate different amounts of electricity. As such, a fair conversion formula is required for different types of RE and to ensure consistency in obligation fulfillment. Taiwan's RE promotion policies had focused on advancing RE development with a feed-in tariff (FIT), with FIT rates and "full-load hour" published for various types of RE (Table 8). The quota of RE electricity that applicable entities are required to purchase may be calculated by the capacity of the RE equipment multiplied by the full-load hour. Hence, using the full-load hour to convert the amount of electricity serves as a fair method for calculating the quota.

Table 8. RE full-load hour in Taiwan.

RE Type	Full-Load Hour (h/year)
Solar photovoltaic	1250
Offshore wind power	3750
Onshore wind power (above 30 kW)	2500
Onshore wind power (below 30 kW)	1750
Small hydro	3900
Biomass energy (anaerobic digestion)	6600
Biomass energy (no anaerobic digestion)	5300
Waste energy	7200
Geothermal power	6400

Source: Bureau of Energy, MOEA.

Thus, it is recommended that users pursuing the RE electricity and certificates option use the annual purchased amount of RE and type of RE to derive the corresponding quota, defined as follows (see Table 9 for sample calculation):

$$\text{Quota required in RE Electricity and Certificates} = \text{Obligation Capacity} \times \text{Full Load Hour} \quad (3)$$

where the Obligation Capacity is the RPS-TW obligation quota, and Full-Load Hour is the full-load hour for the corresponding type of RE.

Table 9. Sample calculation: RE electricity and certificates option.

Contract Capacity	5000 kW
RPS-TW Quota	500 kW
Type of RE	Solar photovoltaic full-load hour = 1250 h/year
RE Electricity (h/year)	500 kW × 1250 h = 625,000 kWh

Source: This study.

4.4. Payment Option

This option is designed to enable applicable entities who cannot use the previous three options to still fulfill their RPS-TW obligation, so it is supplementary to the first three. In light of this, it should be designed to prevent applicable entities from simply jumping to this option; that is to say, the cost of fulfillment for this option should be equal or higher than that of the previous three.

RPS-TW is subsidiary to REDA, which aims to develop RE in Taiwan. For this reason, the payment option in RPS-TW should be designed in such a way that the applicable entities are led first toward RE installation. Furthermore, at the core of REDA lies the FIT measure, which incentivizes power producers to install RE equipment via favorable purchase rates. The market for RE certificates in Taiwan also primarily references FIT rates for pricing. It is therefore recommended to use Taiwan's FIT rates as the design basis for the payment option, and the BOE-published rates, "Feed-in Tariffs and the Calculation Formula for the Electricity Generated by the RE Power Generation Equipment of 2018" [26], are shown below in Table 10.

Table 10. RE feed-in tariffs in Taiwan by 2018.

RE Type	Tariff (NTD/kWh)
Solar photovoltaic (Roof PV Systems)	4.2429~5.8744
Solar photovoltaic (Ground-mounted PV Systems)	4.2943~4.3785
Solar photovoltaic (Floating System)	4.6901~4.7723
Offshore wind power	5.8498
Onshore wind power	2.7315~8.6685
Small hydro	2.7988
Biomass energy	2.5765~5.0161
Waste energy	3.8945
Geothermal power	5.1956
Other RE (Ocean Energy and Green Hydrogen)	2.3226

Source: Bureau of Energy, MOEA.

To calculate the payment for the RE obligation, the foremost problem in setting the formula is how to convert the working unit from kW to kWh, since the RPS-TW obligation is calculated as 10% of the contract capacity in kW but the unit for FIT in Taiwan is NTD/kWh.

The focus for RE development is solar and wind power, as set out by "Green Energy Innovation" published by the Executive Yuan [30]. It is therefore recommended to take the average of the full-load hour (kW) for solar and wind power as the factor for converting the unit from kW into kWh. Additionally, since onshore wind power below 30 kW is not a focus for wind power development in Taiwan, it is recommended to take the average of the full-load hour for solar, onshore wind power (>30 kW), and offshore wind power, which is 2500 h/year. The FIT tariffs for solar and wind power are also referenced. Thus, the payment can be defined as follows:

$$\text{Payment for the RE Obligation} = 2500 \text{ (h/year)} \times \text{Obligation Tariff} \quad (4)$$

where 2500 h/year is the average of the full-load hour for solar, onshore wind power (>30 kW), and offshore wind power, and Obligation Tariff is the average of FIT tariffs for solar, onshore wind (>30 kW), and offshore wind.

5. External Opinions Collected While Drafting Taiwan's RE Obligation

The RPS-TW is the first law in Taiwan that places an RE obligation on the electricity consumers. Although the RPS system has been enforced internationally for years, the obligation has been placed on electricity producers rather than consumers. However, the RPS-TW applies to the consumer, and there were a lot of concerns in the society when it was being drafted. The general public was concerned about how the RE obligation could be imposed on the consumption end without impacting the average users, while big users wanted to know how the obligation was to be calculated and fulfilled. Elected representatives I-Ru Tsai, Sun-han Hung, and Chen-Yuan Chiu together with Greenpeace held a joint press conference on 9 September 2020 [31] and advocated for the RPS-TW to cover 800 kW+ users and the quota to be calculated as 20% of their consumption; in addition, government bodies, state-run enterprises, and public schools should also be obligated so as to lead by example.

Energy laws do not just involve companies and consumers but also a wider range of actors, such as civil society groups, the media, and government ministries [32]. To ensure that the RPS-TW meets expectations from different sectors as much as possible and assist the government in matching it to the intent of the law, the following five areas of public concern were investigated in-depth: the scope and method of calculation, grace period and enforcement date, complementary mechanisms set in place prior to its enforcement, method of settling the fulfillment result, and other opinions.

5.1. Scope and Method of Calculation

5.1.1. External Opinions

Since the intent of the RPS-TW is to ensure big electricity users fulfill their social responsibility by meeting a certain RE ratio, non-governmental and public opinion representatives argued that the applicable entities for energy conservation stipulated in Articles 8, 9, and 12, The Energy Administration Act [33], should be referenced, and that the amount of electricity consumed should serve as the basis for calculating the obligation quota. The energy conservation obligation stipulated therein applies to energy users with a contract capacity of 800 kW or more, who must submit their "objectives and implementing plan for energy conservation" every year and meet the obligation of 1% in energy saving every year.

They therefore recommended that the same threshold of 800 kW+ users should apply in the RPS-TW and that the obligation quota should be 10–20% of the user's annual consumption, or even higher. They further believed that the public sector in addition to the private sector should also lead by example, so government bodies, state-run enterprises, and educational institutions should all take on the RE obligation.

5.1.2. Analysis and Recommendations

Since this law applies at the national level, the scope of applicable entities should be designed on the principle of the minimum number of people impacted but the maximum effect. Additionally, adopting the threshold of 5000 kW+, which is already currently used by local ordinances, will ensure consistency throughout the country without an additional burden on the users. Furthermore, the 5000 kW+ threshold also meets the aforementioned design principle because it would already encompass 49% of total usage in Taiwan. A two-year review mechanism has also been built in for a rolling review of its scope. As for whether or not to use the electricity consumption in the calculations, Article 12 (3) of REDA 2019, which is the basis of RPS-TW, has the requirement of "a certain capacity". Thus, the contract capacity should be used in the RPS-TW calculations to stay consistent with REDA 2019.

Regarding the inclusion of government bodies, state-run enterprises, and educational institutions, Article 12 (1), REDA 2019, already requires the foregoing to install RE generation equipment as a priority in any new construction or reconstruction. Evidently, they are already subjected to certain obligations in REDA 2019 and should be excluded from the RPS-TW obligation to avoid duplicate burden.

5.2. Grace Period and Enforcement Date

5.2.1. External Opinions

The drafting of the RPS-TW coincided with the COVID-19 pandemic, and trade associations lobbied for postponing the promulgation date on the account of local and international economic recessions, feedstock shortage, and uncertain market demand. They asked for the enforcement to be delayed until the pandemic has stabilized so that businesses had more time to adapt [34]. Non-governmental representatives, however, argued that global warming is an aggravating problem, and that the government had already set the target of 20% RE by 2025, and therefore that the grace period should actually be shortened and exemptions and deductions eliminated from the draft so that businesses could do their part in helping the government meet its 2025 target [35].

Some trade associations asked if the grace period may be designed and adjusted in phases, for instance, requiring only 8% in Phase 1 and then gradually ramped to the 10% upon review of the overall environment for promoting RE.

5.2.2. Analysis and Recommendations

There are two sets of opinions regarding the timeline, with one advocating for the elimination of a grace period so that businesses can fulfill the obligation as soon as possible, and the other arguing for postponing or enforcing in phases on account of COVID-19. Since RE installations or purchases both require some preparation, such as evaluating the required space, planning and installing the equipment, and procurement evaluation for RE and certificates, it is necessary to allow for a grace period so that businesses have sufficient time to prepare for the planning and fulfillment of the obligation.

This study proposes to keep the 5-year grace period, which should give businesses enough time to prepare. An incentive is also proposed for early completion of such preparation so that businesses who begin fulfilling the obligation earlier than required are rewarded with exemptions. This approach also helps to meet the public expectation for businesses to fulfill their obligation sooner rather than later.

As for the suggestion of incrementally increasing the ratio, a grace period and incentive for early completion have already been provided, and it is relatively easy to meet the obligation of 10% of the contract capacity (instead of electricity consumed) vis-a-vis the RE100 or RE50 commitment declared by multinationals. It is therefore recommended to keep the original design ratio.

5.3. Complementary Mechanisms Set in Place Prior to Its Enforcement

5.3.1. External Opinions

Trade associations indicated that in answering the government's call to promote RE, even before the RPS-TW was enforced, many companies had already either installed photovoltaic (PV) equipment on their own roofs and sold all the electricity generated via FIT to Taiwan Power Company (TPC) or rented their roofs to PV operators. Since the roof space was already being utilized, they may not have any more space left to fulfill the RPS-TW obligation. In addition, they had responded to the policy ahead of time, so there should be complementary mechanisms to reward them and lessen their burden [36]. Moreover, they continued to say that there was already a similar system in place in Tainan City, Taichung City, and Taoyuan City, so companies that already had RE installed on their own sites should be exempted from the RPS-TW obligation.

5.3.2. Analysis and Recommendations

A review of the models of RE installation shows that they include self-produced/self-consumed, FIT, and roof for rent. With the exception of the first one, the other two models both generate revenue either via selling the electricity or renting out the space. For the first two types, the ownership of the equipment belongs to the company, but the electricity generated in the first one is consumed by the company itself, whereas in FIT it is sold to the public utility company. As for the latter, the company rents out its roof for a charge to PV operators to install equipment, and the ownership of the equipment belongs to the operator.

In the past, the government has leveraged the RE feed-in tariff in REDA to motivate companies to install RE equipment, guaranteeing full purchase of the power generated at a preferred rate. Since this policy provides an operating model with guaranteed revenue, companies or PV operators were willing to undertake the installation and sell the produced energy. However, both the self-installation then FIT and the roof for rent models generate income for the company.

With regard to local ordinances, companies are required to install RE equipment of a certain capacity but not limited to how it is used, so they can choose the first or second model. The RPS-TW only requires those who choose the RE installation option to undertake the first model, so there is no conflict between the two requirements. They are still free to choose the most advantageous approach in fulfilling the central or local obligation. Those who choose to maintain their original local fulfillment model (install and then sell electricity to the publicly owned electricity supplier) can still satisfy the central obligation with other options. On the contrary, if they choose to switch to the self-produced/self-consumed model, they can satisfy both obligations at the same time.

Another consideration is that with the RPS-TW being a central law, it would not be fair to relax the requirement for specific local jurisdictions. Without impacting specific local ordinances while ensuring fairness across different jurisdictions, it is recommended to maintain the self-produced/self-consumed model. However, companies may have limited space at their applicable place of consumption, and those who already had RE equipment installed before the enforcement of this law may run into obstacles with their installation. Thus, the recommendation is to design an approach that reduces such obstacles without impacting the overall fairness.

5.4. Method of Settling the Fulfillment Result

5.4.1. External Opinions

In terms of how the fulfillment result is settled, trade associations stated that the local ordinances did not restrict the RE generated to be self-consumed and wished for the RPS-TW to do the same and allowed businesses to sell it to public utility. Furthermore, if they chose the BESS option, they wished to be able to participate in bidding for automatic frequency control in the power trading market.

There was also a request to consider allowing those choosing the RE installation option in conjunction with the self-consumption requirement to apply to T-REC (National Renewable Energy Certification Center) and sell to a third party, or those with the payment option to receive a tariff reduction or utility bill offset against the payment.

5.4.2. Analysis and Recommendations

The intent of the RPS-TW is for the applicable entities to fulfill their social responsibility, and such obligation has a mandatory and restrictive nature. The mandatory part refers to the fact that businesses should fulfill the obligation without gaining additional revenue. Furthermore, the external proposal offered sought to fulfill the obligation without any additional burden, which by its nature defeats the purpose of asking the applicable entity to fulfill their social responsibility.

The other external proposals—to make a lump sum sale of RE and certificates to a third party (other businesses or public utility), bid for automatic frequency control, or offset

the utility bill—all turn the RE generation or storage equipment into a commercial activity. Allowing for revenue generation in obligation fulfillment may turn it into a profiteering act.

The cost and revenue efficiency of the foregoing operating models vary according to the economy of scale. Besides, the four RPS-TW options have been carefully costed. If the obligation were relaxed to produce revenue, businesses with a smaller obligation quota would still have the same cost, while those with a larger quota would be able to offset the cost with revenue thanks to the economy of scale. As a result, those with a greater quota would face a smaller impact, while those with a smaller quota and unable to generate additional revenue would shoulder a heavier burden.

The proposals discussed above defeat the intent of the RPS-TW to “fulfill one’s social responsibility”. Since the RPS-TW is an obligation placed on specific entities rather than a market stimulus to catalyze RE or energy storage, the recommendation is therefore to keep the existing mechanisms. Although applicable entities are not prevented from commercial activities, the equipment engaged in such activities may not be counted toward obligation fulfillment.

5.5. Other Opinions

5.5.1. External Opinions

Non-governmental and public opinion representatives requested the publication of the applicable entities for RPS-TW [36] to allow public oversight. Nevertheless, trade associations take an opposing stance because electricity consumption data involve the trade secrets of businesses and reveal indirect insight into their production status.

With regards to the RE installation option, trade associations asked for the consideration to allow businesses to install RE equipment for self-production/self-consumption at a site they own other than the RPS-TW-regulated one due to spatial limitations on the latter.

5.5.2. Analysis and Recommendations

On the issue of whether or not to disclose the RPS-TW obligation list, the source of the list is TPC electricity agreements, which are commercial contracts signed by and between TPC and another company. Although this law requires TPC to provide such data to determine its scope of applicability for the purpose of public good, it is still necessary to safeguard the consumption data of businesses. The use of such data should be restricted to the determination of the applicable entity and must not be disclosed without prior consent from the businesses involved. Hence, the recommendation is to obtain such consent before the list is published, or to redact the names and consumption data as necessary.

With the RE installation option, seeing that the intent is to require businesses to fulfill their social responsibility and the principle is that they must install RE equipment to generate energy for their own use, those who are unable to do so at the applicable site but choose to install at another self-owned, non-applicable site and consume the electricity on site still satisfy the principle of fulfillment. Thus, the recommendation is to allow for this practice as part of RPS-TW fulfillment.

5.6. Recommendations for Optimizing the RPS-TW

Upon considering the intent of the RPS-TW and external opinions, the following optimizing revisions are recommended to facilitate future implementation and mitigate the impact on businesses.

5.6.1. Maintain the 5-Year Grace Period but Add an Incentive for Early Completion

Considering that businesses need to evaluate the feasibility of the various options, it is recommended to maintain the 5-year deadline but add an incentive for early completion. The grace period may be shortened from 5 to either 3 or 4 years. Those who complete within 3 years may receive an exemption of 20% of the obligation quota, and 10% for within 4 years. To ensure the applicable entities are able to plan out the fulfillment in a timely manner within the grace period, it is also recommended that they be required to submit a

plan at the start of the second year. This way, the competent authority may keep abreast of their status and provide guidance as required, thereby ensuring timely fulfillment in the end (Figure 9).

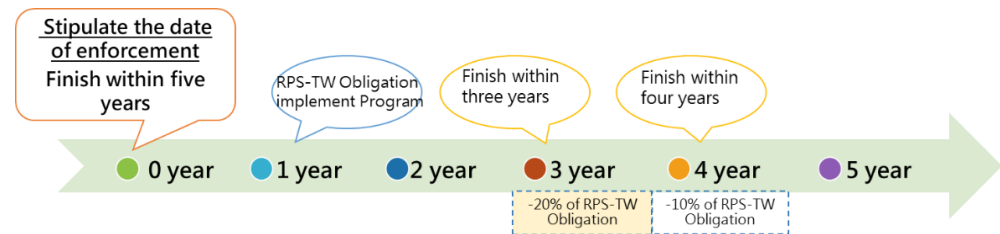
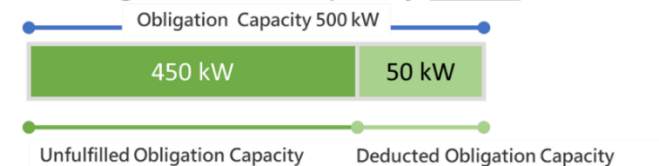


Figure 9. Design of the RPS-TW grace period. Source: This study.

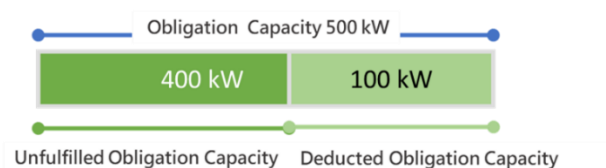
5.6.2. Deductions for RE Equipment Installed Prior to RPS-TW Enforcement

A deduction is recommended for those who had installed RE equipment at the applicable site, whether or not the installation was completed by the applicable entity and whether the RE is for self-consumption or for sale. The deduction should consider the installed capacity and type and be capped at 20% of the obligation quota based on capacity. As illustrated in Figure 10, if the obligation quota of an applicable entity is 500 kW and it already has 50 kW in existing RE installation, the full capacity can be deducted from the total quota as it does not exceed the cap of 20% (100 kW). On the other hand, one with the same obligation quota but 200 kW of existing RE installation may only be allowed the cap of 20% (100 kW) because its existing capacity exceeds the maximum deduction limit.

Existing Installed Capacity 50kW < 20%



Existing Installed Capacity 100kW = 20%



Existing Installed Capacity 200kW > 20%

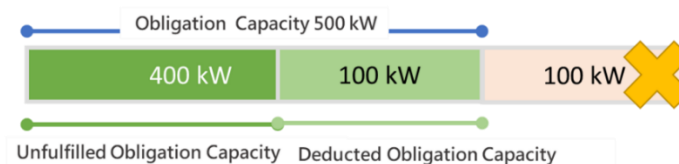


Figure 10. Deduction program for existing installed capacity. Source: This study.

5.6.3. Conditional Relaxation on Place of Fulfillment on the Principle of Self-Production/Self-Consumption

Where the applicable entity is unable to install RE equipment at the RPS-TW-regulated site of consumption due to environmental limitations at their factories, RE equipment installed for self-production/self-consumption at another self-owned site may be recognized toward fulfilling the installation obligation, provided the provision of “self-installed by the applicable entity with the generated energy completely self-consumed” is complied.

Special attention should be given to verify that the owner of the equipment is the same as the applicable entity, and such equipment must not be used to sell electricity.

6. Conclusions

If the recommendations of this study are heeded, there would be 604 users that fall within the applicable tier, and exempting public goods, social services, and non-profit users leaves 500. Based on the BOE's user data [26], the number of users impacted by the RPS-TW would account for 2.26% of the total users but 49.6% of the total consumption in Taiwan, with an accumulative total of 11.45 GW in contract capacity. At 10% of the contract capacity, the RE installed capacity generated to fulfill the obligation is estimated at 1.1 GW.

The implementation of the RPS-TW helps businesses fulfill their corporate social responsibility, boost Taiwan's RE ratio, and internalize the costs of energy-related emissions, and thus enhance their global competitiveness. Nevertheless, it serves as only the first step to mandating RE obligations for electricity users. More will need to be done to optimize the related mechanisms while reducing corporate resistance to smoothen its implementation.

6.1. Benefit of the RPS-TW and Impact on Businesses

As a subsidiary law of REDA, the purpose of the RPS-TW is to encourage electricity users above a certain consumption level to fulfill their social responsibility. Its implementation is estimated to cover applicable entities accounting for 74.1% of the total usage and generating 1 GW in RE potential, or 1.74% of RE installed capacity in Taiwan. Albeit with limited contribution to the country's total installed capacity, its implementation engages users in domestic RE development and helps reduce their emission from energy consumption, internalizing the external cost in the process of energy consumption. In other words, the RPS-TW is a policy mechanism that guides businesses toward green energy and sustainability.

Using low-carbon energy is already a global trend. Many multinationals or international brands are declaring a shift toward production or operation via green energy and are asking companies across their supply chains to cooperate through incremental adoption. As industries in Taiwan are dominated by foreign trade and export, it is advisable to take corresponding actions and gradually transform energy consumed in the production process to green energy, or else eventually face the problem of dwindling orders or supplier disqualification. The RPS-TW is a good way to guide businesses to make this shift and tackle the issue of the global green supply chain in advance, as they learn how to introduce green energy into their operation through its fulfillment. As a result, the international competitiveness of Taiwan's industries will be maintained.

6.2. Suggestions for Future Research

Article 3 of the RPS-TW requires a biannual review of its scope. Seeing as international requirements on the green supply chain are growing more and more stringent, and economies such as the EU and USA are all establishing carbon tariffs, Taiwan must leverage the RPS-TW to accelerate RE adoption by businesses, thus bolstering their ability to respond to the global call for green energy and emission reduction. Further, businesses are facing a growing demand on carbon reduction, so the potential of imposing a higher mandatory requirement on specific industries or sectors to help them overcome the emission problem will be another key topic of study.

The RPS-TW is a law that binds businesses to fulfill their RE obligation, so how the 2021 enforcement regulations may be improved also needs to be studied in the future. The recommendation herein is to continue to do so during the implementation process according to feedback from the applicable entities, e.g., by improving the wording of the law for better clarity in the content, or provisions for handling changes in the obligation quota.

Despite its nature as an obligatory law, the RPS-TW and its implementation can enhance the external competitiveness of companies as well as promoting RE development in Taiwan. It is, for this reason, recommended that the benefit of its implementation

for businesses be continuously analyzed in further studies. The measures they take in responding to global emission requirements and the effectiveness of the RPS-TW upon its implementation should also be investigated to motivate their willingness to fulfill the obligation and provide a conducive foundation for expanding its scope in the future.

6.3. Closing Remarks

The RPS-TW was promulgated on 31 December 2020 and came into effect on 1 January 2021. Its full name is “Regulations for the Management of Setting up Renewable Energy Power Generation Equipment of Power Users above a Certain Contract Capacity”. There are a total of 15 articles [37], outlining the scope of applicable entities, calculation of the obligation quota, methods of fulfillment, and reporting and verification of fulfillment.

The research and design behind the RPS-TW spanned a period of two years. During the drafting process, its wide range of impacts and the number of stakeholders involved (e.g., electricity users, environmental protection groups, general public) necessitated ongoing communication with the related groups, and rolling revisions were made based on opinions of various stakeholders with a view to safeguard their rights and interests. This is the reason why the process and results of research are described and compiled herein only after the RPS-TW has come into effect.

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