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Renewable energy policy and investment for Nationally Determined Contributions: the case of Pacific small island developing states

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Affidavit

I, **JINSUN LIM**, hereby declare

1. that I am the sole author of the present Master's Thesis, "RENEWABLE ENERGY POLICY AND INVESTMENT FOR NATIONALLY DETERMINED CONTRIBUTIONS: THE CASE OF PACIFIC SMALL ISLAND DEVELOPING STATES", 66 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
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Renewable energy policy and investment for Nationally Determined Contributions: the case of Pacific small island developing states

Abstract

Pacific Small Island Developing States (SIDS) are under the biggest threat of climate change with high pressures on economic growth due to the losses caused by extreme weather events. To break the chain between climate change vulnerability and underdevelopment, the Pacific SIDS have played a leading role in the energy transition towards renewable energy. The Pacific SIDS affirm that the penetration of renewable energy technologies would reduce the risks of climate change and accelerate their economic growth by minimizing their dependence on imported fuels.

In 2016, the five Pacific SIDS including Fiji, Vanuatu, Tuvalu, Samoa, and Papua New Guinea, announced the targets of 100% power generation solely from renewable energy sources in their Nationally Determined Contributions (NDCs). However, the targets would hardly be attained without the private sector's investment since the targets are contingent on the availability of funding.

In order to facilitate private investments in these countries, proper policies to eliminate market barriers, reduce uncertainty and increase profitability are essential. Thus, this study looks into the effectiveness of 18 renewable energy policies based on a literature review of previous studies.

Among the policies, the positive effect of Feed-in Tariffs (FITs) is widely demonstrated and supported by previous research outcomes. In addition to FITs, grants prove to be effective in alleviating finance constraints and mobilizing investments in a short-term, particularly for the solar and biomass sectors.

Meanwhile, the effectiveness of the other renewable energy policies are still opaque. Tax-based measures, loans and guarantee schemes reveal mixed outcomes. Production quotas such as RPS show contradictory evidences depending on renewable energy sources. Net metering also has different results in expanding the generation of renewable electricity.

As these research outcomes demonstrate, the effectiveness of renewable energy policies may vary by energy source, policy instruments, stages in a technology's development, and other conditions. Therefore, selecting appropriate renewable energy policies considering the unique situation of the Pacific countries is required.

Still, the Pacific SIDS have only a few supportive renewable energy policies in place. The most widely adopted renewable energy policy in the Pacific SIDS is FITs although it remain at an initial level. Other regulations such as tax credits, tax reduction, net metering, and public loans are being implemented or pursued in one or two countries only.

In order to scale up investments from the private sector, FITs should be actually implemented and encouraged by the governments. In addition, the Pacific SIDS should develop a customized package of renewable energy policies for each country. For Fiji, involvement of IPPs with PPAs would be effective in reducing financial burdens. For Vanuatu, where a net metering scheme has been adopted, a series of technical assistance can accelerate deployment of renewable energy sources.

Keywords: Renewable Energy Policy, Renewable Energy Investment, Small Island Developing States (SIDS), Nationally Determined Contributions (NDCs), Pacific Island Countries

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1. Introduction

The Pacific Small Island Developing States (SIDS) are under the biggest threat of climate change among SIDS. According to the Climate Risk Index (CRI) for 2015 which ranks countries' exposure and vulnerability to climate-related risks along with other analyses, the Pacific SIDS indicate the highest vulnerability to climate change impacts with the lowest CRI score among the regions. It implies that there are a large number of human losses and high pressures on economic growth due to extreme weather events.

To break the chain of climate change vulnerability and underdevelopment, the Pacific SIDS have committed themselves to climate change mitigation and sustainable development. In order to address the challenges, the Pacific SIDS have served a major role in shifting to renewable electricity generation. The increasing deployment of renewable energy technologies for power generation would reduce the risks of climate change and accelerate their economic growth by minimizing the impacts of imported fuels.

Indeed, the extraordinary dependence on imported oil in some Pacific island countries has been repeatedly pointed out as one of the biggest obstacles for their sustainable development. Cook Islands, Kiribati, Nauru, Solomon Islands, and Tonga have relied almost exclusively on imported oil for their commercial energy requirements, and their heavy dependence on it makes them highly vulnerable to the volatility of oil prices. In these states, an increase of fuel prices tends to be translated into a rise in transpofrtation costs and retail prices of agricultural products (K. Jayaraman and Lau, 2011), adding a pressure on the livelihoods of local people. Indeed, when the global financial crisis hit the world in 2009, the Gross Domestic Product (GDP) growth fell sharply in these countries widening the current account deficits of these countries from an average of 8.6% of GDP in 2006 to an average of 10% in 2008 (M. Kida, 2009), due to the soaring costs of energy and commodities driven by surging oil prices (IRENA 2012).

Thus, the Pacific countries are now seeking for a transition toward renewable energy sources to enhance energy security and sustainable development, and mitigating climate change impacts. They have announced specific targets of their nationally determined contributions (NDCs) for the energy transformation and accomplishment of the Paris Agreement's objectives. In specific, Fiji, Vanuatu, Tuvalu, Samoa and Papua New Guinea have announced that they will achieve 100% renewable electricity generation by 2030 at the latest.

To meet their renewable electricity targets, introduction of appropriate policies has been widely recognized as key to facilitating necessary investment for the agenda of a transformation toward renewable sources. Although the Pacific SIDS urge investment for the fulfillment of the targets, their policy commitments often lag behind and not specified enough to promote investment significantly.

The main objective of this paper is to derive policy implications for the selected Pacific SIDS; Fiji; Vanuatu; Tuvalu; Samoa; and Papua New Guinea; by capturing the current status of these countries and assess the effectiveness of diverse renewable energy policies. This paper will identify challenges the Pacific SIDS are faced with; provide a comprehensive review of the NDCS of the countries; give a snapshot on renewable energy policies for facilitation of private investments; discuss the effectiveness of these renewable energy policies; check ongoing renewable energy policies in the selected Pacific SIDS; and draw policy implications for these countries.

In Chapter 2, a methodology would be described. In Chapter 3, background information of SIDS and the movement toward energy transition in Pacific SIDS. Chapter 4 will provide a summary of the selected countries situation and analyze their NDCs. Chapter 5 will evaluate the demand for investment to achieve the renewable energy targets, and introduce renewable energy policy instruments which can contribute to attaining the targets of the five Pacific SIDS fostering enabling environments.

2. Methodology

The paper focuses on the five Pacific countries which announced renewable energy targets in their NDCs. Since there is only limited information on renewable energy and power generation in these countries, the paper concentrates on providing an overview and in-depth analysis on the current situation and implemented policies in these countries. Based on the work, the main objective of this paper is to derive policy implications for the selected countries.

To do so, a broad range of official documents such as national energy plans and roadmaps published by the governments, and reports from international organizations such as International Renewable Energy Agency (IRENA), International Energy Agency (IEA), REN21, and the United Nations have been reviewed.

However, there are frequent discrepancies between the reports and the official documents due to the lack of reliable data in these countries. Thus, there are some parts needed to be examined further or updated when new data become available. To enhance accuracy and reliability, the sources used in the paper have been double-checked.

To define and categorize renewable energy policies for private investment mobilization, definitions and a classification method suggested by the IPCC Special Report and the IRENA Report are used. In the part of discussing the effectiveness of renewable energy policies, research outcomes of previous studies on the relationship between energy policy and private investment has been used.

3. Energy transition: Breaking the chain of underdevelopment and climate vulnerability in Pacific SIDS

In this chapter, background information on SIDS and their peculiarities will be provided to understand why the Pacific SIDS set the proactive renewable energy target in their NDCs. First, the peculiarity of SIDS and historical attempts to overcome the susceptibility will be described. Then, the correlation between climate change vulnerability and underdevelopment in the Pacific SIDS will be highlighted. In the last part of the chapter, the specific situation of the Pacific SIDS such as their extraordinary dependence on imported oil will be explained. Then, their efforts to reducing the risks of climate change and accelerate their economic growth will be stated.

3.1. Small Island Developing States (SIDS) and global efforts for their sustainable development

The group of SIDS consists of 57 states, including 37 UN members and 20 non-UN members or associate members of regional commissions. SIDS are comprised of three geographical regions, the Pacific; the Caribbean; and the Atlantic, Indian Ocean, Mediterranean and South China Sea (AIMS). The list of countries are indicated below (Table 1).

Table 1 Small Island Developing States (SIDS)

UN member	Region	Country
UN Member	Atlantic, Indian Ocean, Mediterranean and South China Sea (AIMS)	Cabo Verde
		Comoros
		Guinea-Bissau
		Maldives
		Mauritius
		Sao Tomé and Principe
		Seychelles
		Singapore
	Caribbean	Antigua and Barbuda
		Bahamas
		Barbados
		Belize
		Cuba
		Dominica
		Dominican Republic
		Grenada
		Guyana
		Haiti
		Jamaica
		Saint Kitts and Nevis
		Saint Lucia
		Saint Vincent and the Grenadines
		Suriname
		Trinidad and Tobago
	Pacific	Fiji
		Kiribati
		Marshall Islands
		Micronesia (Federated States of)
		Nauru
		Palau
		Papua New Guinea
		Samoa
		Solomon Islands
		Timor-Leste
		Tonga
		Tuvalu
		Vanuatu
Non-UN Members/Associate Members of Regional Commissions		American Samoa
		Anguilla
		Aruba
		Bermuda
		British Virgin Islands
		Cayman Islands

	Commonwealth of Northern Marianas
	Cook Islands
	Curacao
	French Polynesia
	Guadeloupe
	Guam
	Martinique
	Montserrat
	New Caledonia
	Niue
	Puerto Rico
	Sint Maarten
	Turks and Caicos Islands
	U.S. Virgin Islands

Source: United Nations. Sustainable Development Knowledge Platform. Retrieved on September 11 2017

Since 1990s, the peculiar vulnerabilities of SIDS to climate change impacts have been widely acknowledged and highlighted. Even if other developing countries have their own environmental concerns, it has been recognized that SIDS tend to be more susceptible to climate change due to their geographical features, remoteness, limited resource, and the increasing number of natural disaster (UNDESA, 2013). In fact, Dominica was ranked second with other SIDS including Vanuatu (fifth) and the Bahamas (seventh) in the Climate Risk Index for 2015 (Table 2). Affected by the tropical storm Erika in August 2015, large parts of Dominica's infrastructure were severely damaged. The economic damages were even estimated to around 90% of the country's GDP. Similarly, Vanuatu was hit by the tropical cyclone Pam in March 2015 and it destroyed the majority of food products and affected more than two thirds of the states' population. The Hurricane Joaquin ruined transport, housing and communication infrastructure of the Bahamas in September 2015 (Germanwatch, 2017).

Table 2 The Climate Risk Index for 2015: the 10 most affected countries

Source: Germanwatch (2017), Global Climate Risk Index 2017 : Who Suffers Most From Extreme Weather Events? Weather-related Loss Events in 2015 and 1996 to 2015

The susceptibility of SIDS may significantly undermine their efforts toward sustainable development, increasing costs for energy, water and transportation services, putting additional pressure on natural resources, and exacerbating volatility to external shocks. Thus, the idea that sustainable development cannot be achieved without addressing climate change has been extensively shared among the leaders of SIDS (The Steering Committee on Partnerships for Small Island Developing States, 2016).

In 1994, at the UN Global Conference on the Sustainable Development of Small Island Developing States in Barbados, the Barbados Programme of Action for the Sustainable Development of SIDS (BPOA), which explicitly identified emerging climate change issues as the particular challenges faced by SIDS, was adopted. It includes climate change and sea-level rise, natural and environmental disasters and resources (Sustainable Development Knowledge Platform). The participants at the meeting emphasized the special and unique situation of SIDS and agreed that special policy approaches were required to effectively address and resolve the problems (United National General Assembly).

After 10 years, however, SIDS still remained susceptible to climate change. The devastative impacts of Hurricane Ivan to Grenada in 2004, demonstrated how fragile SIDS were to climate change and intense natural disasters (The Steering Committee on Partnerships for Small Island Developing States, 2016). Thus, for a comprehensive review of the BPOA, the high level Mauritius International Meeting was held in Port Louis, Mauritius in 2005, mandated by UN General Assembly resolution 57/262. It adopted the Mauritius Strategy for Further Implementation of the BPOA (MSI) and recognized that there were still barriers in achieving the goal of the BPOA.

5 years later, the Five-year Review of the Mauritius Strategy of Implementation (MSI+5) was undertaken during the 65th Session of the General Assembly (Sustainable Development Knowledge Platform). Participants reaffirmed that SIDS continued to be a special case for sustainable development and the adverse effects of climate change and sea-level rise presented significant risks to the sustainable development of SIDS (Report of the International Meeting to Review the Implementation of the Programme of Action for the Sustainable Development of Small Island Developing Countries, 2005).

In The Future We Want, an outcome report of the RIO+20 United Nations Conference on Sustainable Development in 2012, the BPOA and the MSI were reaffirmed and the unique and particular vulnerabilities of SIDS to climate change and natural disasters were revisited. It stated;

> We reaffirm that small island developing States remain a special case for sustainable development in view of their unique and particular vulnerabilities … including to a large range of impacts from climate change and potentially more frequent and intense natural disasters (Rio+20 United Nations Conference on Sustainable Development, 2012).

To address the peculiar problems which SIDS are faced with, the Third International Conference on SIDS was held in Apia, Samoa in 2014 with the theme of “The

Sustainable Development of Small Island Developing States through Genuine and Durable Partnerships”. About 300 partnerships were announced and the SIDS Accelerated Modalities of Action (SAMOA) Pathway was adopted at the Conference calling for urgent actions and support for SIDS. Furthermore, as a result of the SAMOA Pathway, a SIDS Partnership Framework was established through the General Assembly resolution 70/202 to monitor and ensure the full implementation of pledges and commitments. After two years of the Conference, as an outcome of a series of global efforts, the first annual Global Multi-stakeholder SIDS Partnership Dialogue was held in 2016 (Sustainable Development Knowledge Platform).

However, despite the continuous efforts for sustainable development of SIDS, still one fourth of SIDS remain Least Developed Countries, with the lowest indicators of socioeconomic development and Human Development Index. Moreover, SIDS tend to be more heavily affected by climate change than any other countries, although their contributions to greenhouse gas emission are comparatively small. With the growing environmental concerns such as sea-level rise and intensified natural disasters, more enhanced efforts to implement the BPOA and MSI are required.

3.2. Pacific SIDS tied up by the chain of underdevelopment and climate vulnerability

The Pacific island countries are under the biggest threat of climate change among SIDS. The Pacific SIDS consist of 13 countries including Fiji; Kiribati; Marshall Islands; Micronesia; Nauru; Palau; Papua New Guinea; Samoa; Solomon Islands; Timor-Leste; Tonga; Tuvalu; and Vanuatu. According to the Climate Risk Index for 2015 which explains countries’ exposure and vulnerability to climate-related risks along with other analyses, the Pacific SIDS indicate the highest vulnerability to climate change impacts with the lowest Climate Risk Index (CRI) score among the regions (Table 3). It implies that there are a large number of deaths and economic losses due to extreme weather events including storms, floods, extreme temperature and mass movements.

Table 3 Climate Risk Index 2015 by country

Country	CRI Score
Cabo Verde	52
Comoros	124.5
Guinea-Bissau	54.83
Maldives	-
Mauritius	124.5
Sao Tomé and Principe	-
Seychelles	124.5
Singapore	124.5
AIMS	100.805
Antigua and Barbuda	124.5
Bahamas	22.83
Barbados	124.5
Belize	124.5
Cuba	-
Dominica	13
Dominican Republic	74.83
Grenada	124.5
Guyana	124.5
Haiti	50.33
Jamaica	124.5
Saint Kitts and Nevis	124.5
Saint Lucia	124.5
Saint Vincent and the Grenadines	124.5
Suriname	124.5
Trinidad and Tobago	124.5
Caribbean	102.0327
Fiji	51
Kiribati	75.5
Marshall Islands	124.5
Micronesia (Federated States of)	28.5
Nauru	-
Palau	-
Papua New Guinea	41.5
Samoa	124.5
Solomon Islands	76.83
Timor-Leste	124.5

Tonga	124.5
Tuvalu	75.17
Vanuatu	20.33
Pacific	78.80273

Source: Germanwatch (2017), Global Climate Risk Index 2017

Because of the losses caused by climate risks, the Pacific SIDS lag far behind other developing countries in social and economic development (Table 4). The GNI per capita of the Pacific was 2,571 USD in 2014[1] while those of AIMS and the Caribbean were 31,149 USD and 3,481 USD respectively. In 2014, the GNI per capita of the world was 10,918 USD which was about four times of the GNI per capita in the Pacific SIDS. Moreover, 5 Pacific SIDS, Kiribati, Solomon Islands, Timor-Leste, Tuvalu and Vanuatu, are designated as LDCs which indicate a low status in GNI per capita, Human Assets Index, and economic vulnerability assessments (Table 5).

Table 4 GNI per capita by SIDS and Region

Country Name	GNI[1]	Population	GNI per capita[1]
Cabo Verde	1,745,111,395	526,437	3,315
Comoros	630,054,766	759,385	830
Guinea-Bissau	1,061,593,960	1,725,744	615
Maldives	2,614,595,229	401,000	6,520
Mauritius	12,345,279,479	1,260,934	9,791
Sao Tome and Principe	320,754,669	191,266	1,677
Seychelles	1,288,183,822	91,359	14,100
Singapore	304,747,116,617	5,469,724	55,715
AIMS	324,752,689,937	10,425,849	31,149
Antigua and Barbuda	1,232,243,688	98,875	12,463
Bahamas, The	8,072,862,606	382,169	21,124
Barbados	4,184,087,988	283,385	14,765

[1] based on the World Bank Atlas Method

Belize	1,545,138,774	351,694	4,393
Cuba[2]	-	11,439,767	-
Dominica	506,958,736	72,778	6,966
Dominican Republic	63,562,887,086	10,405,844	6,108
Grenada	868,166,940	106,360	8,163
Guyana	3,134,191,869	763,393	4,106
Haiti	8,710,547,341	10,572,466	824
Jamaica	14,130,969,472	2,862,087	4,937
St. Kitts and Nevis	813,316,040	53,739	15,135
St. Lucia	1,318,676,603	176,421	7,475
St. Vincent and the Grenadines	725,130,711	109,357	6,631
Suriname	5,128,054,368	547,928	9,359
Trinidad and Tobago	23,851,089,395	1,354,493	17,609
Caribbean	137,784,321,618	39,580,756	3,481
Fiji	4,298,899,214	885,806	4,853
Kiribati	359,024,399	110,458	3,250
Marshall Islands	232,002,134	52,898	4,386
Micronesia, Fed. Sts.	333,414,536	104,015	3,205
Nauru	174,592,403	11,853	14,730
Palau	224,726,309	21,094	10,654
Papua New Guinea	16,724,491,575	7,755,785	2,156
Samoa	776,550,613	192,290	4,038
Solomon Islands	1,048,747,189	575,504	1,822
Timor-Leste	3,540,950,967	1,212,814	2,920
Tonga	462,036,792	105,782	4,368
Tuvalu	52,386,213	10,908	4,803
Vanuatu	819,454,147	258,850	3,166
Pacific	29,047,276,491	11,298,057	2,571
World	79,365,364,933,157	7,268,986,176	10,918

Note: 1. Based on Atlas method (current US$).

2. Cuba is not included in the calculation because the data is not provided.

Source: Edited by Author, based on the World Development Indicators database, World Bank

Table 5 Pacific SIDS by Income level and LDCs

Country	GNI per capita (USD)[1]	Income level[2]	LDC[3]
Fiji	4,853	upper-middle-income	
Kiribati	3,250	lower-middle-income	O
Marshall Islands	4,386	upper-middle-income	
Micronesia (Federated States of)	3,205	lower-middle-income	
Nauru	14,730	upper-middle-income	
Palau	10,654	high-income	
Papua New Guinea	2,156	lower-middle-income	
Samoa	4,038	upper-middle-income	
Solomon Islands	1,822	lower-middle-income	O
Timor-Leste	2,920	lower-middle-income	O
Tonga	4,368	upper-middle-income	
Tuvalu	4,803	upper-middle-income	O
Vanuatu	3,166	lower-middle-income	O

Note: 1. The GNI per capita is calculated based on Atlas Methodology.

2. The World Bank defines economies using the World Bank Atlas method. The economies with a GNI per capita between 1,006 USD and 3,955 USD are categorized as low-middle-income economies and the ones between 3,956 USD and 12,235 USD are regarded as upper middle-income economies.

3. The "Least Developed Countries (LDCs)" are designated based on three criteria: i) a three-year average estimate of the GNI per capita ii) a composite Human Assets Index (HAI) based on indicators of nutrition, health, education and adult literacy, and iii) economic vulnerability based on indicators of the instability of agricultural production; the instability of exports of goods and services; the economic importance of non-traditional activities (share of manufacturing and modern services in GDP); merchandise export concentration; and the handicap of economic smallness.

Source: Edited by Author, based on the World Development Indicators database and the World Economic Situation and Prospects 2017

3.3. Transition toward renewable energy in Pacific SIDS

To break the chain of climate change vulnerability and underdevelopment, the Pacific SIDS have committed themselves to climate change mitigation and sustainable development. In order to address the challenges, the Pacific island countries have served a major role in reducing fossil fuel consumption and shifting to renewable sources for electricity generation in the world. The Pacific SIDS argue that the increasing deployment of renewable energy technologies would reduce the risks of climate change and accelerate their economic growth by minimizing economic instability.

Indeed, the extraordinary dependence on oil in some Pacific island countries has been repeatedly pointed out as one of the biggest obstacles for their sustainable development. Cook Islands, Kiribati, Nauru, Solomon Islands, and Tonga have relied almost exclusively on petroleum for their commercial energy requirements, and their heavy dependence on oil makes them highly vulnerable to rising oil prices (Asian Development Bank, 2009). As indicated below (Figure 1), the Pacific SIDS highlighted in red show high intensity of oil use with low GDP per capita. In fact most Pacific island countries, with a few exception (e.g., Papua New Guinea and Timor-Leste), have very limited fossil fuel resources (Govinda R. Timilsina et al. 2016). Since oil plays an important role in their economies, when the global financial crisis hit the world in 2009, the GDP growth fell sharply in these countries due to the soaring costs of energy and commodities driven by surging oil prices (IRENA, 2012a). Even Papua New Guinea often suffers from market fluctuations due to its high dependency on imported goods which are heavily influenced by increase of oil prices. Similarly, in most of the Pacific states, increase of fuel prices tends to be translated into rise in transportation costs and retail prices of agricultural products needed to be transported to urban areas. Other industries such as fisheries and tourism are also fuel-intensive, making their economies vulnerable to volatile fuel prices (Tiru K. Jayaraman and Evan Lau, 2011).

Figure 1 Dependence on Oil, 2005 (relative to per-capita income levels)

Source: Asian Development Bank (2009), Taking Control of Oil: Managing Dependence on Petroleum Fuels in the Pacific

Thus, the Pacific countries are seeking for a transition toward renewable energy sources to enhance energy security and sustainable development, mitigating climate change impacts in power generation. The Pacific SIDS are now eager to use their abundant renewable energy sources and satisfy their electricity demand through distributed renewable energy generation resources (Govinda R. Timilsina et al., 2016). A series of regional policy strategies and initiatives have been endorsed to support each country's national policies toward the transformation of energy system and enhanced energy security in the Pacific.

In 2002, the Pacific Islands Energy Policy and Plan (PIEPP) was endorsed as a guideline for drafting the national policies of the Pacific SIDS. It underlined the active involvement of national policy makers to avoid previous failures and promote ownership. It was revised in 2004, and the associated Strategic Action Plan (PIEPSAP) was adapted as a result to formulate a critical energy policy and implementation plan for the region. It aimed to increase the share of renewable resources in the energy mix in the Pacific (IRENA, 2012a).

In 2010, the Framework for Action on Energy Security in the Pacific (FAESP) was established to improve energy security in the region. The newly outlined approach provided guiding principles for environment friendly energy solutions and other sectors. Its associated Implementation Plan for Energy Security in the Pacific (IPESP 2011-15) was endorsed in 2011 to promote collective action among the participants and support the national efforts.

Thanks to the efforts, the Pacific SIDS have been gradually increasing the share of renewable energy sources to their energy mix. For instance, solar energy applications are in operation in various islands in Nauru, Niue, Samoa and Tuvalu, while hydropower serves as one of the main contributors to the gird in Fiji, Papua New Guinea and Samoa (IRENA, 2012a). However, many Pacific countries are still relying on fossil fuels for a significant share of their power generation. Thus, the Pacific SIDS recognize a transformation into renewable sources in power generation could remarkably enhance their energy security, accelerate sustainable development and mitigate climate change impacts.

4. Renewable energy targets of Pacific SIDS' NDCs

In accordance with Article 4 paragraph 2 of the Paris Agreement, all 13 Pacific SIDS agreed to prepare, communicate and maintain their nationally determined contributions (NDCs) pursuing domestic mitigation measures and ultimately contributing the objectives of the Agreement. They already completed their first submissions of NDCs to the UNFCCC secretariat. All the NDCs, except for Timor-Leste, were ratified before October 2016 and entered into force immediately when the Paris Agreement did (Table 6) (UNFCCC).

Table 6 NDCs - Status of Ratification

Participant	Signature	Ratification	Entry into Force
Fiji	22 Apr 2016	22 Apr 2016	4 Nov 2016
Kiribati	22 Apr 2016	21 Sep 2016	4 Nov 2016
Marshall Islands	22 Apr 2016	22 Apr 2016	4 Nov 2016
Micronesia	22 Apr 2016	15 Sep 2016	4 Nov 2016
Nauru	22 Apr 2016	22 Apr 2016	4 Nov 2016
Palau	22 Apr 2016	22 Apr 2016	4 Nov 2016
Papua New Guinea	22 Apr 2016	21 Sep 2016	4 Nov 2016
Samoa	22 Apr 2016	22 Apr 2016	4 Nov 2016
Solomon Islands	22 Apr 2016	21 Sep 2016	4 Nov 2016
Timor-Leste	22 Apr 2016	16 Aug 2017	15 Sep 2017
Tonga	22 Apr 2016	21 Sep 2016	4 Nov 2016
Tuvalu	22 Apr 2016	22 Apr 2016	4 Nov 2016
Vanuatu	22 Apr 2016	21 Sep 2016	4 Nov 2016

Source: Edited by Author, UNFCCC

Although all the Pacific SIDS expressed their eagerness to move toward a sustainable future through implementation of their NDCs, this paper would focus on 5 states – Fiji, Papua New Guinea, Samoa, Tuvalu and Vanuatu – which made pioneering declarations in their NDCs in terms of an energy transition toward renewables. These five Pacific Island countries announced their targets of achieving

100% electricity generation solely based on renewable energy sources (Table 7).[2] It is very ambitions and enthusiastic because the goal has been achieved by only a dozen of countries – Iceland, Lesotho, Bhutan, Paraguay, Albania, Mozambique, Zambia, Democratic Republic of the Congo, Nepal, Ethiopia, Burundi and Norway – as of 2012 (EIA) and these countries have been considered as the ones with a high dependence on fossil fuels for their electricity generation. In fact, in these 5 countries the share of fossil fuels in power generation exceeds 40%. In particular, Samoa and Vanuatu, the shares of fossil fuels reach 70% (Figure 2).

Table 7 Targets to achieve 100% electricity Generation from Renewable Sources

Country	Target
Fiji	100% by 2030
Papua New Guinea	100% by 2030
Samoa	100% by 2030
Tuvalu	100% by 2020
Vanuatu	100% by 2030

[2] Although Cook Islands in the Pacific also included the target of 100% power generation from renewable sources, it is not included in the discussion of the paper, since it is not in the list of SIDS due to the absence of UN-membership.

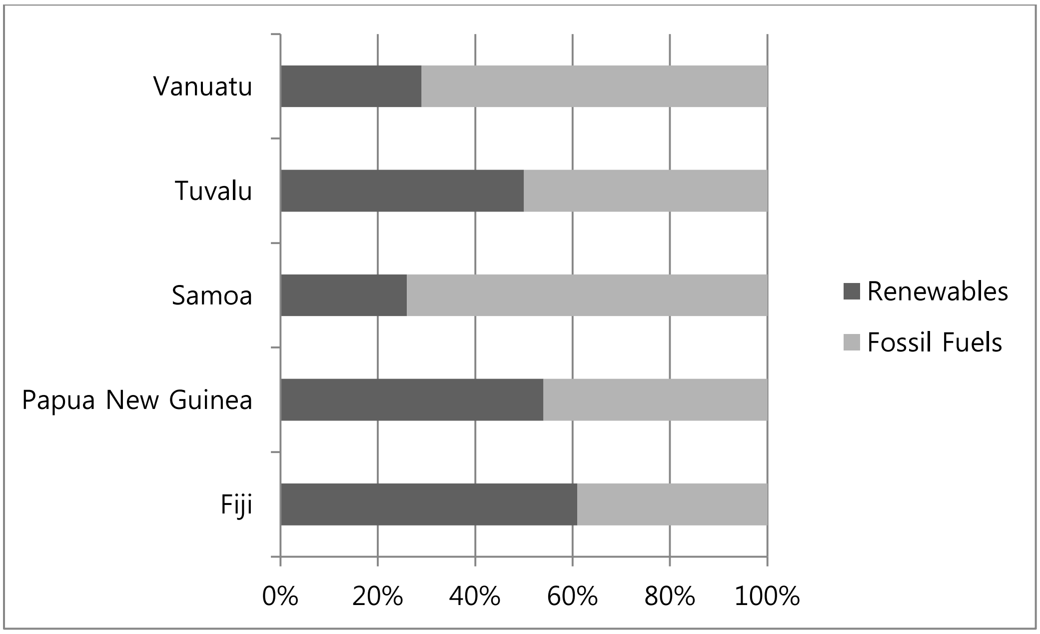

Figure 2 Power Generation by Sources

Note: 1. The year of the figures are: Fiji (2013), Papua New Guinea (2010), Samoa (2014), Tuvalu (2015), Vanuatu (2015).

2. The data is from each country's NDC except for the figure of Papua New Guinea and Vanuatu. The data of Papua New Guinea (2010) is based on the Papua New Guinea Development Strategic Plan 2010-2030. The data of Vanuatu is extracted from the Updated Vanuatu National Energy Roadmap 2016-2030.

Source: Edited by Author based on Fiji NDC, Samoa NDC, Tuvalu NDC, Papua New Guinea Development Strategic Plan 2010-2030, Updated Vanuatu National Energy Roadmap 2016-2030

In this chapter, the renewable energy targets of each country's NDC will be thoroughly analyzed. Brief summaries on a current situation of each country's power sector, an introduction on historical progresses, each government's vision and objectives, and conditionality of the target will be covered. Based on the analysis, investment demand for the fulfillment of the NDCs will be discussed in the next chapter.

4.1. Fiji

Fiji has a population of 837,217 (2007) and an annual population growth of 0.8%, and currently the majority of the population has access to modern energy services. As of 2013, approximately 90% of the population could access to electricity. However, despite of the high access rate to modern energy services, Fiji's energy situation has been characterized by a high reliance on imported fuels. Fiji's economy has been extremely volatile to external and internal shocks (i.e. natural disasters, global oil shocks, and spikes in fuel prices) because of the increasing dependence on the imported fuels. For example, petroleum imports grew from around 400 million FJD in 2004 to over 1.2 billion FJD in 2012 per year taking more than one third of its total imports (Ministry of Strategic Planning, National Development & Statistics of Fiji, 2014).

Due to the rise in imported fossil fuels, the trade deficit is incrementing in Fiji (Figure 3). For example, in 2000 the trade deficit was FJD 500 million of which FJD 200 million was contributed by fuel imports, but eight years later, the trade deficit increased to FJD 1,600 million, while the contribution of imported fuels was quadrupled, FJD 800 million (Review of the Fiji National Energy Policy, 2013). To address the problem, the Government of Fiji has attempted to reduce the reliance on fossil fuels and utilize abundantly endowed renewable energies by encouraging the research and development of renewable energy sources.

Figure 3 Retained Fuel Imports and Current Account of Fiji

Source: Review of the Fiji National Energy Policy (2013)

In this context, Fiji established a national vision for a resource efficient, cost effective, and environmentally sustainable energy sector in the National Energy Policy 2014-2020 (Review of the Fiji National Energy Policy, 2013), and actively participated in discussions for Pacific SIDS, including the Mauritius Strategy 2005-2015, the Barbados Plan of Action 1994, the Post 2015 SAMOA Pathway and the Pacific Island Framework for Action on Climate Change 2006-2015. The Government of Fiji set three major objectives to: "(i) provide all Fijians with access to affordable and reliable modern energy services; (ii) establish environmentally sound and sustainable energy systems for energy production, procurement, transportation, distribution and end use; and (iii) increase the efficient use of energy and the use of indigenous energy sources to reduce the financial burden of energy imports" (Review of the Fiji National Energy Policy, 2013).

Consistent with the National Energy Policy, Fiji's Intended Nationally Determined Contribution reaffirms its objective to achieve outcomes in renewable energy and energy efficiency improvement. For the period of 2020-2030, Fiji would expand the share of renewable energy in electricity generation from 60% in 2013 to 100% in 2030, with an indicative reduction of 10% CO_2 emissions reduction for energy efficiency improvements.

In Fiji the share of renewable energy in power generation has increased from 40% in 2003 to over 60% in 2013. The electricity supply from renewables is mainly from hydropower, which has gradually increased (Figure 4) reaching an installed capacity of around 120MW. Although a small number of solar PV panels and two Independent Power Producers (IPPs) using biomass, the share of these renewable sources is negligible.

Figure 4 Historical Hydro/Diesel Generation Mix 1993-2011 of Fiji

Source: Review of the Fiji National Energy Policy (2013)

According to the Green Growth Framework for Fiji, Fiji has exploitable potential to raise the share of renewable power generation to over 80% by 2020 mainly using undeveloped hydro sites and other renewable sources such as solar systems and biomass. However wind, wave, and geothermal energies have been investigated and concluded not close to implementation. Fiji Electricity Authority has identified a few potential renewable energy project sites, such as Qaliwana hydro project (17MW); Wailoa downstream hydro project (28.6MW); upper Navua river project; Naboro waste to energy project; and Waibutasavu hydro project (4.4MW) (Ministry of Strategic Planning, National Development & Statistics of Fiji, 2014).

As of 2013, Fiji emits 1,500Gg of CO_2 from its energy sector, and among the emission, 340Gg of CO_2 comes from the power sector. The commitments of the NDC are assumed to reduce CO_2 emissions in the energy sector by around 30% (750Gg) from BAU(2,500Gg) by 2030 curtailing 500Gg in the transition toward renewables, and 250Gg in the energy efficiency improvements. Furthermore, the diminished dependence on imported fuels would significantly improve energy security reducing volatility of Fiji’s economy (The Government of Fiji, 2015).

However, the target of 100% electricity generation from renewable energy sources may not be accomplished because it has conditionality. From the 30% emission reduction target, 10% would be achieved, utilizing resources available in country (unconditional) whereas the remaining target could only be met with external funding amounting to US$500 million (conditional) (The Government of Fiji, 2015).

4.2. Papua New Guinea

Papua New Guinea (PNG) in the West Pacific has 7.4 million people (Asian Development Bank) and it grows about 2.7% per year. Only 13% of the people can access to electricity grid showing little change from a 1996 household survey when 12% had electricity (IRENA, 2013a). The anticipated increase in demand due to economic growth and an incrementing population would pose a threat to the system (Asian Development Bank).

Since PNG is an oil and gas producing country, it does not share the problem of high dependence on imported fossil fuels like other Pacific SIDS. However, since the development of PNG is mainly dependent on the extraction of natural resources such as minerals, oil and gas, the economy is environmentally unsustainable. The CO2eq emissions of PNG in 2014 were around 10,000 Gg excluding emissions and about half of the greenhouse gas emissions came from the oil and gas production. Without appropriate measures undertaken, the emission would increase up to 18,000 Gg in 2030.[3] Thus, the Government of PNG set a goal towards the economy to move “from an economy heavily dependent on non-renewable natural resources to one with developed industries”(Department of National Planning and Monitoring of Papua New Guinea, 2014) .

In 2009, the Government of PNG established a development strategy, PNG Vision 2050 to move toward educated, healthy and prosperous society. Among the seven Strategic Focus Areas of the Vision, environmental sustainability and climate change are underpinned, encouraging a shift from emissions-intensive growth strategy towards a more sustainable path. Furthermore, in the Papua New Guinea Development Strategic Plan 2010-2030, a model of an economic corridor including

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[3] According to the INDC of PNG, the forestry CO_2 emissions (FOLU) as 413 Gg for 1994 and 2199 Gg for 2010 or around 2 Mt for 2010. It was noted in the draft Second National Communication to the UNFCCC (SNC) that forestry removals are estimated to vary considerably from year to year. Due to the uncertainty in forestry emissions, waste emission and agricultural emissions, these sectors were not included in the calculation of the INDC.

an electricity grid powered mainly by hydro and other renewables was constructed. Based on the model, PNG declared 2030 targets to expand the share of renewable energy sources in power generation to more than 1,000MW by 2030 (Table 8). In 2015, the PNG Government passed the Climate Change Bill to limit climate change impacts from infrastructural development.

Table 8 Planned New Generation Capacity to meet Future Electricity Demand, PNG

Source: Asian Development Bank, Energy Sector Assessment – Papua new Guinea

One step further from the Papua New Guinea Development Strategic Plan 2010-2030, PNG is now seeing reduction of fossil fuel in the electricity generation as the biggest opportunity for climate change mitigation. It announced in its NDC the target to achieve 100% power generation from renewable energy by 2030, with energy efficiency sector wide improvements.

PNG has numerous opportunities to transfer its electricity generation to renewable options. In 1994, the World Bank estimated the gross potential of large-scale hydro power generation as 20,000 MW. Even when only economically feasible sites were counted, the estimated capacity was about 4,200MW. Solar energy is also considered to have the largest potential in PNG. Average insolation appears to be sufficient with between 4.5 and 8 hours of sunshine daily (IRENA, 2013a). As of 2010, hydro and other renewable generation capacities already constituted about 54% (273MW) of the total capacity (503MW) (Department of National Planning and Monitoring of Papua New Guinea, 2010).

The comparatively higher portion of renewable energy sources in power generation is partially due to the active participation from the private sector. PNG is unique in the Pacific region, since private generation is of the same order of magnitude as the public utility. Private generation is mostly done by large mines, plantations and other resource extraction industries using hydro, biomass and geothermal energy (IRENA, 2013a).

The Government of PNG is eager to extend the private finance and international contributions further for the achievement of its renewable energy target. PNG has attached conditionality to its contributions saying that “the target of 100% electricity generation from renewable energy sources is contingent on external, adequate and predictable funding availability.” It emphasizes that little domestic finance is available, thus the transition to renewable energy in the power sector would need to be financed from external sources. Indeed, PNG has suffered from lack of funding for the energy sector. Energy services have been deteriorated because utilities could not afford to rehabilitate or maintain routinely their systems (Asian Development Bank).

4.3. Samoa

Samoa has a population of 187,820 (2011) and an annual population growth of 0.8% since 1991 (IRENA, 2013a). As of 2014, approximately 98% of the population could access to electricity.

Samoa has had a comparatively better condition due to its consistent and successful petroleum policy for the past 20 years. By assuring access to and ownership of petroleum storage, it could have a bargaining power in negotiations on petroleum supply arrangements. As a result, it could enjoy relatively low prices for petroleum products in the Pacific (IRENA, 2013a). However, the imported fuels have taken a large portion of GDP even in Samoa and make it heavily reliant on fossil fuels. For instance, the total cost of petroleum imports in 2009 was about 60.5 million US$, which represent 12.2% of GDP (SPC, 2009). To address the problem, the Government of Samoa has attempted to reduce the reliance on fossil fuels and utilize abundantly endowed renewable energies.

In this context, Samoa developed a comprehensive Samoa National Energy Policy in 2007 with an associated Strategic Action Plan. In 2012, the policy were reviewed and developed to the Samoa Energy Sector Plan 2012-2016 and its Programme of Activities. It highlighted reducing reliance on fossil fuels and developing sustainable renewable energy sources. It targeted to increase the contribution of renewable energy consumption by 10% by 2016, and increase in the supply of renewable energy for energy services by 10% by 2016 (Ministry of Finance of Samoa, 2012). Also, the Strategy for Development of Samoa (SDS) highlighted sustainability and importance of the environment as a priority area. It emphasized the necessity of increased investment in renewable energy, and political commitment to mainstream climate change issues and reduce greenhouse gas emissions.

Moving a step forward from these, Samoa reaffirms its objective to achieve outcomes in renewable energy in its NDC. Samoa would expand the share of renewable energy in electricity generation from 26% in 2014 to 100% by 2025. This commitment is proposed to be implemented over two time periods. The first target is to reach 100% renewable electricity generation by the year 2017 and the second target is to maintain this 100%.

The total emissions for the year 2007 was estimated at 352 Gg CO_2 and the electricity sub-sector accounted 44 Gg CO_2 representing emissions from diesel-fueled thermal plants. In 2014, 55 Gg CO_2 emissions were from the electricity sub-sector and accounted for 13% of total greenhouse gas emissions, assuming BAU scenario in all sectors since 2007 (Figure 5). By reaching the target of 100% power generation from renewable energy sources, 55 Gg CO_2 emissions would be reduced (The Government of Samoa, 2015).

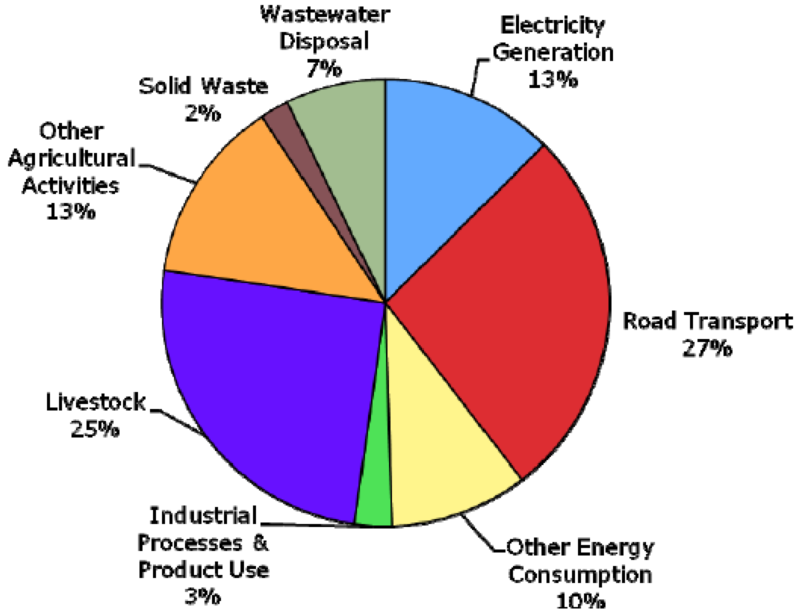

Figure 5 Sectoral Greenhouse Gas Emissions, Samoa

Source: Samoa's NDC

However, the target may not be achieved since Samoa stated that attaining the target would be conditional and depend on receiving external assistance including human, technical and financial resources from international community. Foreign aids and investment would be essential for the fulfillment of the target.

In Samoa, traditionally electricity generation has relied on two main sources, hydro and diesel thermal power plants. Renewable energy contributed 48% of total electricity requirements in 2007. However, by 2014, renewable energy sources including solar photovoltaic, wind and hydropower had contributed 26% to total electricity generation. This drop in renewable energy contribution was due to the reduction in hydropower contribution when three hydropower plants were destroyed by Cyclone Evan, highlighting the vulnerability of Samoa to extreme climatic events (The Government of Samoa, 2015). Although there are hydro and wind potentials in Samoa for further deployment (IRENA, 2013a), without enhancing resilience against climate change, a transition to renewable energy may not be attained.

4.4. Tuvalu

Tuvalu has a population of 11,100 (2016) (World Bank Data) and currently about the half of the population has access to modern energy services. As of 2016, approximately 94% of the population could access to electricity. Currently, the emissions from the energy sector of Tuvalu consist of nearly 100% of CO_2 emissions. Within the sector, electricity generation contributes to 41% of the greenhouse gas emissions (Government of Tuvalu, 2015). By attaining the target of achieving 100% electricity generation solely from renewable sources with achievements in agriculture and waste, the amount of greenhouse gas emissions from the energy sector is projected to decrease by 60% below the level of 2010 by 2025 (Government of Tuvalu, 2015).

Tuvalu’s energy situation has been characterized by a high reliance on imported fuels, primarily petroleum, which makes Tuvalu’s economy extremely volatile to external and internal shocks. Indeed, fluctuations of international fuel prices hinder growth of business and threaten food security. Also, transporting the oil is costly as it has to be transported in drums (Tuvalu Electricity Corporation, 2012). Furthermore, the heavy reliance on imported fuels also poses environmental risks because fuel spill could possible happen during transportation of the fuels to outer islands (Government of Tuvalu, 2015).

To solve these problems, the Government of Tuvalu has attempted to reduce the reliance on fossil fuels and utilize abundantly endowed renewable energies by encouraging the research and development of renewable energy sources. The Tuvalu National Energy Policy (TNEP) was established in 2009 with the Energy Strategic Action Plan to direct a way to achieve the target of 100% renewable electricity generation by 2020 and suggest future energy developments (The Government of Tuvalu, 2012). Based on the assessment of TNEP, Tuvalu set a renewable energy target in its NDC to implement 100% power generation from renewable energy sources, raising the share of renewables in power generation from 50% in 2013 to 75% by 2020 and 100% by 2025 (The Government of Tuvalu, 2015). The installed capacity of power systems in Tuvalu is described in Table 9 and the projected cumulative total of renewable electricity capacity, proposed by the Master Plan for

Renewable Electricity and Energy Efficiency in Tuvalu is indicated in Figure 6.

Table 9 Summary of Power Systems in Tuvalu

Stations	Diesel Capacity (kW)	Solar Capacity (kW)
Nanumea	144	195
Nanumaga	144	205
Niutao	144	230
Nui	120	60
Vaitupu	144	400
Nkufetau	120	77
Nukulaelae	60	45
Funafuti	1200	735
Total	2076	1947

Source: Tuvalu's NDC

Figure 6 Projected Cumulative Total of Renewable Electricity Capacity Installed, Tuvalu

Source: Tuvalu Electricity Corporation (2012), Enetise Tutumau 2012-2020: Master Plan for Renewable Electricity and Energy Efficiency in Tuvalu

Tuvalu’s proposed approach requires significant development of solar and wind energy, improvement in energy efficiency (IRENA, 2013b). Since the percentage of electrical energy that currently comes from renewables is only about a half of the total power generation, diverse scopes for deployment of renewables in Tuvalu should be explored for the next ten years (IRENA, 2013b).

To meet the renewable energy target of the NDC, the Government of Tuvalu states that it will generate electricity in all the nine islands of Tuvalu using renewable energy sources. For instance, installation of roof-mounted solar panels which is called “the 100 Solar Roof Programme” will be promoted in the islands of Funafuti with a high population density. (The Government of Tuvalu, 2015).

Since Tuvalu’s NDC includes conditional targets, although it declares that it will promote renewables in power generation unconditionally, securing fund is crucial to enable further actions. The NDC clearly states that “the goal to pursue a zero carbon development pathway by 2050 is dependent on availability of finance and technology” (The Government of Tuvalu, 2015).

4.5. Vanuatu

According to the Vanuatu National Statistics Office (VNSO), the population of Vanuatu in 2009 was 234,023. It represents an average annual growth rate of 2.3% per year since the last Census in 19999. As of 2013, about 80% of urban households could access to electricity while only 17% of rural households could not. The difference in energy access is linked to high poverty levels and low human development in rural areas. The lack of electricity access undermines its economic competitiveness and impedes progress on human development across the nation.

Moreover, Vanuatu is highly dependent on imported fuels and it makes consumers vulnerable to oil price shock and interruptions in the delivery of fuel by natural disasters or political turmoil. Since the petroleum price in Vanuatu is comparatively higher than Kiribati, Tonga and Fiji, the lives of poor people have been severely threatened by the price volatility and supply shocks (Figure 7). In order to solve the problem, the Government of Vanuatu is seeking for a way to diversify the energy supply using indigenous renewable sources and supporting hydro-, wind- solar-, and geothermal-based power generation.

Figure 7 Retail Petroleum Prices (excluding tax and duty) in 2014 and 2015

Note: The retail prices for Tonga and Kiribati price are the average retail prices by the different providers in those countries (for Tongatapu and Vavau in Tonga, and Gilbert Group and Line & Phoenix Group in Kiribati). All figures exclude tax and duty.

Source : The Government of Vanuatu (2016), Vanuatu National Energy Road Map 2016-2030

To solve the problem, Vanuatu's National Energy Road Map (NERM) has been established with a vision "to energize Vanuatu's growth and development through the provision of secure, affordable, widely accessible, high quality, clean energy services for an educated, healthy and wealthy nation". It identifies five priorities for the energy sector: i) accessible energy, ii) affordable energy, iii) secure and reliable energy, iv) sustainable energy and v) green growth. In particular, the NERM underlined a role of renewable energy in reducing greenhouse gas emission, providing affordable, reliable energy access, and facilitating green growth (The Government of Vanuatu, 2016).

Along with the NERM, the Vanuatu Infrastructure Strategic Investment Plan (2013), Nationally-Appropriate Mitigation Action on Rural Electrification in Vanuatu (2015), Scaling up Renewable Energy in Low Income Countries Program Investment Plan (SREP, 2014) and Vanuatu published the Renewables Readiness Assessment (IRENA,

2015) were established to support implementation of the NERM and reduce its dependence on imported fuels.

Although Vanuatu has indeed experienced a certain level of progress in recent years thanks to the continuous efforts, the achievement was not enough to meet the originally targeted renewable energy share (40%) which was set by the NERM 2013-2020. Electricity generation is still the single largest source of greenhouse gas emission among energy industries while all the other subsectors constitute less than 15% of all greenhouse gas emission.

After reviewing the progress in the energy sector, Vanuatu set the target of 100% renewable energy in electricity generation, increasing the share of renewables to 65% by 2020 and 100% by 2030. As of 2015, the share of renewable energy in power generation was 29%, increased from 19% in 2012 (Figure 8). In order to jump to 65% from 29% within 5 years, Vanuatu proposed a concrete plan for scaling up installed capacities for renewable energy in its NDCs. The detailed components are:

- "Doubling of the wind installed capacity to 5.5 MW by 2025
- Installing 10 MW grid connected solar PV by 2025
- Commissioning the proposed first stage 4 MW Geothermal plant by 2025
- Adding 10 MW grid connected solar PV by 2030
- Commissioning the second stage 4 MW Geothermal plant by 2030
- and Substituting and/or replacement of fossil fuels with coconut oil based electricity generation" (Government of Vanuatu, 2015).

Figure 8 Comparison of Electricity Generation Sources, Vanuatu

Source: The Government of Vanuatu (2016), Vanuatu National Energy Road Map 2016-2030

By doing so, it may achieve 100% power generation solely from renewable sources, curtailing 100% greenhouse gas emissions from the power sector. The power sector has been the single largest source of greenhouse gas emission in the energy sector. If the targets are achieved, about 72Gg of emissions, 30% of the emissions from the energy sector in a BAU scenario, could be reduced by 2030.

However, the target of 100% power generation from renewable energy sources may not be achieved due to lack of funding. The transformation toward renewable energy in power generation is estimated to require at least 250 million USD (The Government of Vanuatu, 2016) including a substantial external funding of around 180 million USD (The Government of Vanuatu, 2015). Since an installation of new generating capacities tends to be more expensive than energy efficiency improvements of diesel generators, proposed renewable power plant projects had been often stalled due to the difficulty in securing funding (The Government of Vanuatu, 2016).

5. Renewable Energy Policy and Investment Needs to Attain Renewable Energy Targets

Chapter 5 will discuss the investment needs to attain the renewable energy targets and the importance of renewable energy policies to promote private investment in the renewable energy sector. This chapter will introduce diverse renewable energy policy instruments and assess effectiveness of each policy based on the literature review of previous studies. Then, an analysis of ongoing renewable energy policies in the Pacific SIDS will be provided deriving policy implications for the Pacific SIDS.

5.1. Investment Needs to Attain Renewable Energy Targets

In 2016, the global energy investment in total was around 1.7 trillion USD which accounts for 2.2% of the global gross domestic product (GDP). Electricity sector was the largest recipient of the investment reaching more than 700 billion USD. 297 billion USD was invested for renewable energy power generation, but still the amount is insufficient to attain the objectives of the Paris Agreement. To limit the rise of global temperature up to 2°C by 2100 with a probability of 66%, investment for renewable energy should be rapidly scaled up. International Renewable Energy Agency (IRENA) estimates that the share of renewable energy in the primary energy supply must increase to around 65% by 2050 to achieve the goal of the Paris Agreement. To make this happen, a total of 25 trillion USD should be invested in renewable energy up by 2050 or 700 billion USD every year at a global level (IRENA).

This massive amount of the total investment needed requires a significant contribution of the private sector. Historically, the private sector including utilities, companies, developers and investment funds has played a major role in renewable energy investment accounting for over 85% of total investment (IRENA, 2016). Along with the traditional investors in the renewable energy sector, institutional investors such as insurance companies, sovereign wealth funds and pension funds are being highlighted and expected to serve an important role in renewable energy investment in the future (The Government of Vanuatu, 2016).

However, global investment remains below the level expected, due to a range of barriers in financing renewable energy projects. Despite the growing profitability and the falling technology costs of renewable energy projects, the front-loaded cost structure with the comparatively high initial costs, and long lags in generating revenues and profits make investors hesitate to invest in renewables (IRENA, 2016; Yong Zhao et al., 2013). Therefore, the share of renewable energy in global power generation remains at the level of 24% (IEA), far below the demanded level for the achievement of the Paris Agreement.

The Pacific SIDS, which ambitiously set the targets of 100% power generation solely from renewable energy sources, recognize that the targets cannot be attained without the private sector's investment. Indeed, all the five Pacific SIDS clearly stated that the targets are conditional and contingent on availability of funding. They emphasized the importance of private investment in installing, maintaining and managing energy infrastructure to meet their targets (The Government of Samoa, 2015).

In fact, large-scale renewable energy projects tend to require the capital which exceeds public budgets. But, private investors often perceive renewable energy projects and technologies as risky. The risks come from political situations, regulatory uncertainty, liquidity as well as transmission. The high risk perception contributes to the high cost of capital for renewable energy projects, and hindering investments from institutional investors (IRENA, 2016). Especially, in the Pacific SIDS, the private investors are deterred by small project size and poor financial performance of power utilities (IRENA, 2012b).

In order to facilitate private investments in these countries, proper policies to eliminate market barriers, reduce uncertainty and increase profitability are required. Policy makers should implement necessary measures to attract private investors for accelerate their country's energy transition towards renewables, since policies affect investment risk and the cost of capital indirectly (IRENA, 2016). In particular, in the countries with rapidly increasing electricity demand and financing constraints, appropriate policies to improve cost-reflectiveness of electricity pricing must be in place for further deployment of renewable energy (IEA, 2017). In fact, 94% of global power generation investment was made in 2016 by companies operating under fully regulated revenues or regulatory mechanisms. It clearly shows that government policies have a profound impact on electricity supply.

In this context, IPCC emphasized the necessity of tailored policies to overcome the obstacle limiting uptake in investment, stating;

> There is now clear evidence of success, on the local, regional and national levels, demonstrating that the right policies have a substantial impact on the uptake of renewable energy and enhanced access to clean energy (Mitchell, C., et al., 2011).

5.2. Renewable Energy Policies Overview

Although policy-makers acknowledge the importance of policies in attracting investment and increasing the share of renewables in power generation, they often experience difficulties in identifying the most appropriate policies to address challenges. Indeed, there are diverse deployment policies with different ways of approaches.

In this part, 18 renewable energy policy options to support further deployment of renewable energy in the power sector will be described largely based on the definitions of IRENA and IPCC.

1) Grants

Grants are a monetary assistance which does not have to be repaid. They are usually bestowed by a government for specified purposes to the entities which are eligible with conditions including certain qualifications on the use, maintenance of specified standards, or a proportional contribution by the grantee. The fiscal incentives of grands can help reduce system investment costs and sometimes create concessional financing instruments (IRENA, 2012a).

2) Energy production payment

Governments offers an economic incentive directly per unit of renewable energy production.

3) Rebate

Rebate is a direct payment from public authorities, usually governments, to private investors to compensate certain amount of the investment cost of a renewable energy installation or service. Eligible projects could receive it after completion of the projects (IRENA, 2012a).

4) Tax Credit (Production or Investment)

It offers an annual income tax credit based on the calculation of investment into the renewable energy projects or the generated amount of energy during a certain period of time. It promotes investments in renewable energy by deducting the costs from tax obligations or income (IRENA, 2012a).

5) Tax Reduction / Exemption

This is an incentive through reduction in tax to the renewable energy production or purchase of renewable energy technologies (IRENA, 2012a).

6) Investment

This is a financing offered in return for an equity ownership interest in a renewable energy project or company. It tends to be delivered as a type of government-managed fund which invests equity directly in projects and companies, or finance privately managed funds (IRENA, 2012a).

7) Guarantee

It is a risk-sharing mechanism to facilitate domestic lending from commercial banks for renewable energy companies and projects with a high perceived credit risk. In general, a guarantee is partially covers a portion of the outstanding loan principal with 50 - 80% (IRENA, 2012a).

8) Loan

This is a financing provided by governments or development banks to a renewable energy company or project in return for a debt obligation on concessional terms, generally of low interest (IRENA, 2012a).

9) Public procurement

Public entities preferentially purchase renewable energy services and/or equipment to encourage deployment of renewable energy (IRENA, 2012a).

10) Renewable Portfolio Standard (RPS) / Quota Obligation or Mandate

These regulations obligate designated parties, mainly electricity producers, to meet minimum or gradually incrementing renewable energy targets which are generally indicated as percentages of total energy supplies. The cost would be borne by consumers. The implementation of an obligation system may involve a penalty for violation of the obligation. In some nations, the regulations are combined with efficiency investments in renewable energy heating purchase mandates or Renewable Energy Certificate (REC) which is a certificate given to the generation of one unit of renewable energy (Y. Chang et al., 2016). The parties which fail to meet the quota can purchase certificates instead (IRENA, 2012a).

11) Tendering/ Bidding

Public authorities can organize tenders for given quota of renewable energy supplies and provides remuneration to winners of the bids at the prices which are generally above market prices (IRENA, 2012a). Under this system the government can accelerate deployment of renewable electricity systems. The system is supported by a pricing law (UNDP).

12) Feed-in Tariff (FIT)

The system sets a price to guarantee renewable energy supplies with priority access over a certain period of time to motivate investors by reducing risks during the installation's lifetime. The fixed tariff may vary by technology, and power producers can sell renewable electricity into the grid at guaranteed rate. The cost of the system shall be met by public money (UNDP).

13) Premium Payment Feed-in Tariff

The scheme guarantees renewable supplies providing additional fixed premiums on top of market tariffs or end-use values (IRENA, 2012a).

14) Green Energy Purchasing

Green energy purchasing regulates the supply of voluntary renewable energy purchases by consumers which is a step further beyond existing renewable energy obligations (IRENA, 2012a).

15) Green Labelling

Public authorities or private entities guarantee that energy products satisfy certain criteria for sustainability to catalyze green energy purchasing. Some countries are implementing a labelling on consumer bills with information on the energy mix and the share of renewable energy in their consumptions (IRENA, 2012a).

16) Net Metering / Net Billing

Net metering allows a two-way flow between distribution grid and customers. Homes or businesses can sell the electricity which they generated from renewables exceeding their use, at wholesale or retail prices (UNDP). It is widely adopted in the United States and Europe although it varies across states (Y. Chang et al., 2016).

17) Priority or Guaranteed Access to Network

The priority or guaranteed access to network ensure that renewable energy supplies can access to established energy networks without difficulties (IRENA, 2012a).

18) Priority Dispatch

It mandates that renewable energy supplies are integrated into energy systems before supplies from other sources (IRENA, 2012a).

5.3. Renewable Energy Policies Classification

Since there are diverse policies with multiple effects on markets, prices and fiscal incentives, it is hard to allocate a policy to a single category. However, there have been some attempts to provide a criterion of classification for these policies.

For instance, Y. Chang et al. developed a classification method for renewable energy policies with five criteria which consists of market; profitability; uncertainty; technology; and finance resources (Figure 9). It provides a balanced overview on renewable energy policies based on the five criteria. However, the classification method seems to have limitations since the criteria are not mutually exclusive, but crafted purposely to give an equal weight to each criterion.

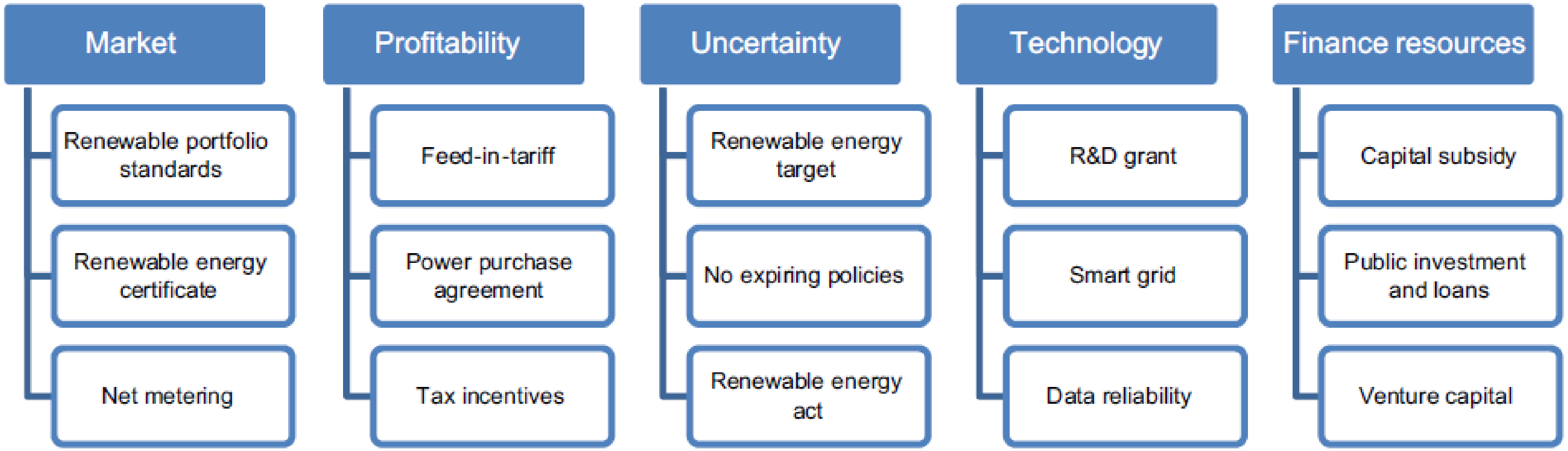

Figure 9 Renewable Energy Deployment Policy Classification by Y. Chang et al.

Source: Renewable energy policies in promoting financing and investment among the East Asia Summit Countries: Quantitative assessment and policy implications, Y. Chang et al., Energy Policy 95 (2016) 427-436

Another classification method was presented in the article of F. Polzin et al. It classifies renewable energy policies into five categories; fiscal and financial incentives; market-based incentives; direct investments; policy support; and regulatory instruments. The category of fiscal and financial incentives includes FIT, grants, subsidies, loan, guarantee, and tax-based measures, while the category of market-based incentives consists of emission trading schemes, green certificate schemes and quota-based systems. The third category of the classification method is direct investments which includes funds to sub-national governments. Policy support such as institutional creation and establishment of a clear long-term energy strategy is under the fourth category of renewable energy policies, while RPS and other forms of standards are categorized as regulatory instruments (F. Polzin et al., 2015).

The classification method is focusing on the characteristics of policies in mobilizing investment. However, it does not provide a detailed overview of renewable energy policies, failing to capture the differences between fiscal incentives (Grant, tax-based measures) and regulations to reflect real prices (i.e. FIT).

The criteria developed by IPCC are being widely used by relevant stakeholders to classify policies in a more comprehensive way. It classifies policies into three categories; fiscal incentives; public finance; and regulations. Under the category of fiscal incentives, grant, energy production payment, rebate, tax credit and tax reduction are included, while investment, guarantee, loan and public procurement are classified as public finance related policies. Under the category of regulations, Renewable Portfolio Standard (RPS) / Quota and Tendering/ Bidding are regarded as quantity-driven options, whereas green energy purchasing and green labelling are considered as quality-driven approaches. Also, Feed-In Tariff (FIT) and premium FIT are classified as price-driven approaches, and Net metering / billing, priority or guaranteed access to network, and priority dispatch are categorized as access-related regulations (Table 10).

Table 10 Renewable Energy Deployment Policy Classification by IRENA and IPCC

Category		Policy
Fiscal Incentives		Grant
		Energy production payment
		Rebate
		Tax credit (production or investment)
		Tax reduction/ exemption
Public Finance		Investment
		Guarantee
		Loan
		Public procurement
Regulations	Quantity-driven	Renewable Portfolio Standard/Quota obligation
		Tendering/ Bidding
	Price-driven	Fixed payment feed-in tariff (FIT)
		Premium payment FIT
	Quality-driven	Green energy purchasing
		Green labelling
	Access	Net metering (also net billing)
		Priority or guaranteed access to network
		Priority dispatch

Source: IRENA (2012), Mitchell, C., et al. (2011)

5.4. Effectiveness of Renewable Energy Policies Demonstrated in Previous Studies

A number of previous studies on the relationship between renewable energy policy and investment have generated academic evidences for policy makers to identify and implement new renewable energy policies. However, there have been mixed or unclear results on the effectiveness of renewable energy policies such as tax-based measures, production quotas, loan, guarantee and net metering. A certain renewable energy policy has a significant and positive effect on the deployment of renewable energy in certain countries with particular energy sources, while it has a negative or insignificant effect in other cases.

IRENA emphasizes the importance of assessing the effectiveness of renewable energy policies given the high financial costs associated with renewable energy deployment (IRENA, 2012). A thorough review of renewable energy policies is essential for the countries which are eager to promote renewable energy share in their energy mix, to capture how policies can mobilize private investment and how the scarce financial resources should be allocated efficiently.

Effectiveness of renewable energy policy could be measured by “the extent to which intended objectives are met, for instance the actual increase in the output of renewable electricity generated or shares of renewable energy in total energy supplies within a specified time period” (Mitchell et al., 2011). It is expected that successful renewable energy policies will reduce the costs through economy of scale, market maturity and confidence, research and development and increased competitiveness among the technology suppliers (G.R. Timilsina and K.U. Shah, 2016). IRENA highlights that “effective support must be comprehensive, sustained and set against a background of firm but plausible targets, as well as minimize investment risks” and “effective and efficient support must balance stability with adaptability” (IRENA, 2012).

Among the policies, FITs have been the most widely adopted form of regulations for the renewable energy deployment (REN21, 2017). The positive effects of FITs have been proven by numerous academic research outcomes. For instance, Couture and

Gagnon's work and other following works have demonstrated that it has significant and positive effects for deployment of all types of renewables in power generation, regardless of other policy variables (Couture and Gagnon, 2010; Yong Zho et al., 2013; Y. Chang et al., 2016). Although some exceptions have been found in several case studies, in most countries FITs have been successful in mobilizing investors by adjusting risk and return of renewable energy investments (Cardenas-Rodriguez et al., 2013, F. Polzin et al., 2015).

In addition to FITs, grants prove to be effective in alleviating finance constraints and mobilizing investments in a short-term, particularly for the solar and biomass sectors. However, since grants can reduce the cost of renewable energy projects only temporarily, they are considered less stable than FITs (F. Polzin et al., 2015).

Meanwhile, the effectiveness of other renewable energy policies are still opaque. Tax-based measures such as tax credit and tax reduction have revealed mixed outcomes. Tax reductions tend to raise generation from renewables, especially in the solar sector, but it may bring negative impacts on subsequent capacity additions in renewables (F. Polzin et al., 2015).

Also, production quotas such as RPS have showed contradictory evidences depending on renewable energy sources. Production quotas are demonstrated to have significant and positive effects on the biomass, waste and solar sectors, while having negative effects on the wind renewable energy production (Yong Zhao et al., 2013).

Regarding the effectiveness of loans and guarantee schemes, previous studies have found different results. Some literature show that policymakers can promote institutional investments by providing loan and loan guarantee programs, whereas others argue that these instruments do not spur the deployment of renewables (De Jager et al., 2011; Bergek et al., 2013; F. Polzin et al., 2015)

Net metering also has different results in expanding the generation of renewable electricity due to the low rate for excess electricity. If the price paid for the generated electricity does not reach a sufficient level to attract investment in renewable energy facilities, and there are entry barriers such as grid connection standards, net metering schemes are not as effective as FITs (UNDP).

As these research outcomes demonstrate, the effectiveness of renewable energy policies may vary by energy source, policy instruments, stages in a technology's development, and other conditions of the country where the renewable energy policies are implemented (Yong Zhao et al. 2013; IRENA, 2012). Local economic conditions, natural endowment, and institutional environment should be taken into consideration when policymakers determine the effectiveness of renewable energy policies (Delmas and Montes-Sancho, 2011; Klein et al., 2008; Yong Zhao et al. 2013).

For instance, market based approaches such as emission trading or green certificates tend to be more effective for the technologies which are mature enough to compete with conventional fuels. On the other hands, less mature technologies prefer to have FITs for technological innovation and development (Johnstone et al., 2010; F. Polzin et al., 2015).

As the importance of customizing renewable energy policies for expanding renewable electricity generation capacities, new types of policies are being developed. For instance, recently, tenders such as competitive bidding or auctions for renewables are rapidly increasing in supporting deployment of large projects. According to a REN21 report, Malawi and Zambia launched their first renewable energy tenders while China tendered 5.5 GW of capacity. Some European countries including Poland, Slovenia and Greece adopted policy schemes which support small projects through FITs and large ones through tenders (REN21, 2017).

In order to fulfill the renewable energy targets of the Pacific SIDS, appropriate renewable energy policies are essential, because large-scale deployment of renewables in power generation tends to be encouraged by policies which enhance the competitiveness of renewable energy sources compared with conventional energy sources. Therefore, the penetration of renewable energy depends on effectiveness of policies and their successful implementation, and, above all, the effective renewable energy policies must take into consideration economic conditions, natural resources endowment, public budgets, and other unique characteristics of the Pacific countries (G.R. Timilsina and K.U. Shah, 2016).

5.5. Renewable Energy Policy Implications for the Pacific SIDS

IRENA points out that “renewable energy deployment requires an enabling environment with conditions that are conducive to fostering investments” (IRENA, 2012b). In this context, governments’ role in fostering enabling environments with appropriate policies and regulations has been emphasized in many studies.

As the importance of renewable energy policies to foster investment and formulate enabling environments is highlighted, an increasing number of renewable energy policies in the power sector are being carried out. The number of countries with power policies including FITs, premium payment, tendering, net metering, and RPS grew from 117 in 2014 to 126 in 2016. The number of countries with other renewable energy policies related to heating and cooling also increased (Figure 10).

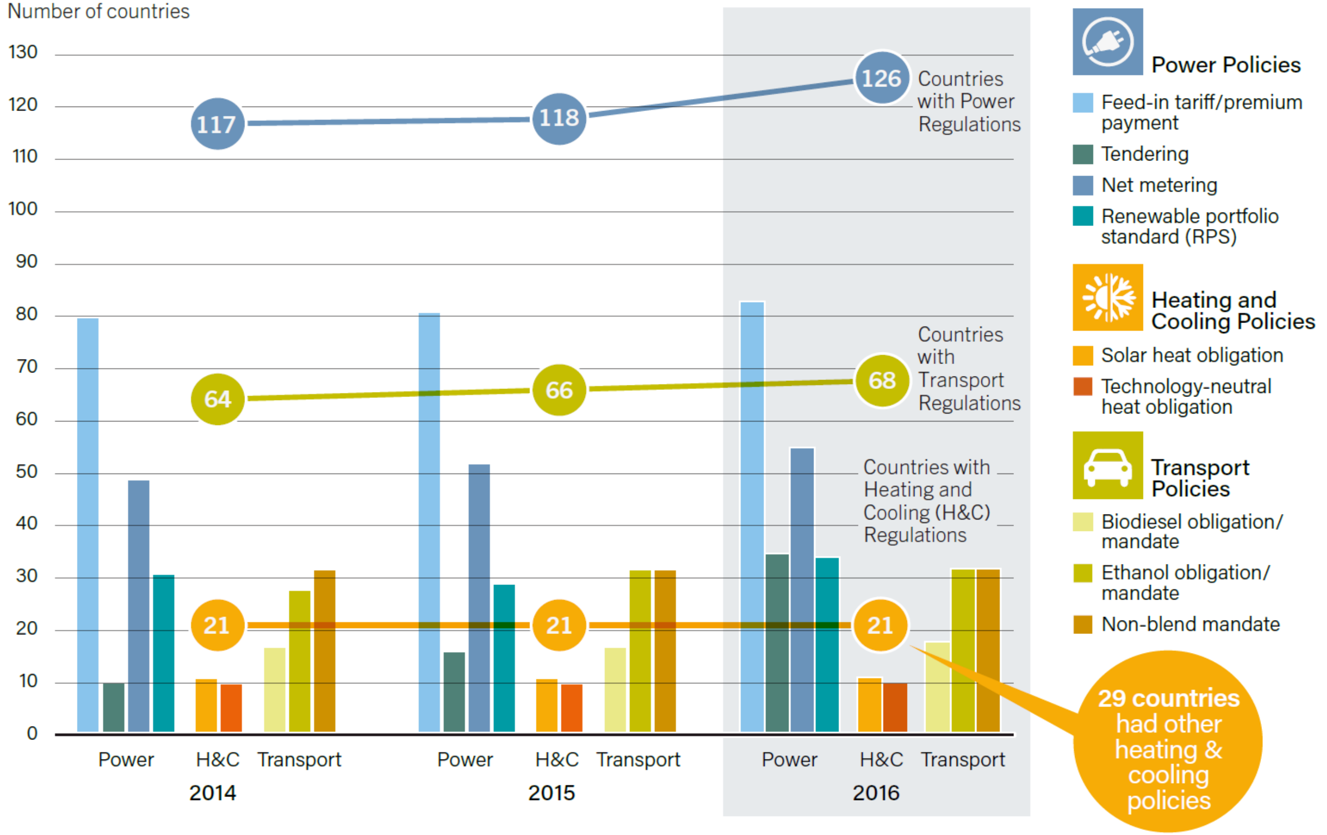

Figure 10 Number of Countries with Renewable Energy Policies

Source: REN21, Renewables Global Status Report (2017)

In spite of the overall increase in the number of renewable energy policy implementation, however, some low-income countries still lag behind the trends. According to IRENA, high-income countries had an average of 4.8 policies, while low-income countries had merely 2.2 policies (IRENA, 2012a). Similarly, Yong Zhao et al. reveals that developed countries has twice more renewable energy policy instruments in place (1.62) than emerging economies (0.84). Developing countries have only 0.17 renewable energy policy instruments in hands (Yong Zhao et al. 2013).

Like other developing countries, the Pacific SIDS which announced the 100% power generation from renewable energy, have only a few supportive renewable energy policies in place (Table 11).

The most widely adopted renewable energy policy is FITs. FITs which includes a guaranteed price per unit of energy production, are in place in four Pacific SIDS (except for Tuvalu) while other regulations such as tax credits, tax reduction, net metering, and public loans are being implemented in one or two countries only. However, even the most widely adopted FITs are not in actual operation, but remain at an initial level. Until 2016, no countries had initiated FITs, while over 30 developing countries had had. (G.R. Timilsina and K.U. Shah, 2016).

Table 11 Renewable Energy Policies: the Pacific SIDS

	Feed-in tariff / premium	Electricity utility quota obligation/ RPS	Net metering	Renewable energy certificate	Tendering	Investment or production tax credits	Reductions in sales, energy, VAT or other taxes	Energy production payment	Public investment, loans, grants, capital subsidies or
Fiji	O					O	O		O
Papua New Guinea	O								
Samoa	O								
Tuvalu									
Vanuatu	O		O				O		

Sources : Edited by Author based on REN21 (2017); Lomaloma Makereta: Regional Overview of Energy situation in the Pacific Island Countries (PICs); Atul Raturi (2015); G.R. Timilsina and K.U. Shah (2016)

Among the five Pacific SIDS, Fiji is leading the trends of renewable energy policies, recognizing the importance of renewable energy policies to attract private investors and scale up financing for renewable energy projects. For instance, the Power Development Plan for Fiji 2011-2020 highlights the importance of private investments and the role of policies, underlining a potential benefit of IPPs. It estimates that the total investment needs for power generation could be reduced to one fourth, from 1.08 billion FJD to 0.29 billion FJD with an establishment of IPPs (Table 12) (Fiji Electricity Authority, 2010; Fiji Renewable Energy Power Project, 2014).

Table 12 Power Sector Investment Needs 2011-2020

Source: Fiji Electricity Authority (2010)

To mobilize financing to achieve the renewable target of Fiji's NDC, renewable energy policies which address challenges such as lack of a clear regulatory framework for encouraging third party electricity generation; lack of public information on researches; and weak business climate should be implemented (Ministry of Strategic Planning, National Development & Statistics of Fiji, 2014). These barriers must be overcome to meet the target of its NDC and meet the growing electricity demand in Fiji.

Vanuatu is also seeking for further deployment of renewables in electricity generation, adopting new renewable energy policies. A net metering scheme is being pursued in Vanuatu, allowing electricity consumers to generate their own electricity and to feed it into the grid. These consumers would be billed or paid based on the amount of power consumption and generation. However, still many Pacific island countries are not aware of the influence of net metering policy on the performance of utilities. Further technical assistance to the utilities would help them understand the potential benefits of net metering (G.R. Timilsina and K.U. Shah, 2016).

In a survey conducted in Pacific island countries by IRENA, participants pointed out the lack of regulatory frameworks, the high upfront cost of renewable energy technologies, and small market sizes as the obstacles in scaling up the private sector’s investment. As one of potential solutions, the respondents suggested the involvement of Independent Power Producers (IPPs) through Power Purchase Agreements (PPAs) to address the lack of capital, transferring part of the financial risks from the utility to the developer. Indeed, an increasing number of countries including Fiji are exploring opportunities through introducing IPPs through PPAs (IRENA, 2012b). It is likely to promote sustainable financing schemes which would support the penetration of renewable energy sources in power generation.

6. Conclusion

This paper captured the current status of the selected Pacific SIDS; Fiji; Vanuatu; Tuvalu; Samoa; and Papua New Guinea; and assessed the effectiveness of diverse renewable policy instruments and drew policy implications for the Pacific countries to attain their renewable targets of NDCs.

The Pacific SIDS are under the biggest threat of climate change with the highest vulnerability to climate change impacts compared with other regions. It implies that there are a large number of human losses and high pressures on economic growth due to extreme weather events.

To break the chain between climate change vulnerability and underdevelopment, the Pacific SIDS have committed themselves to climate change mitigation and sustainable development. In order to address the challenges, the Pacific SIDS have played a leading role in shifting to renewable electricity generation. The Pacific SIDS argue that the penetration of renewable energy technologies would reduce the risks of climate change and accelerate their economic growth by minimizing economic instability.

Indeed, the extraordinary dependence on oil in some Pacific island countries has been repeatedly pointed out as one of the biggest obstacles for their sustainable development. In fact most Pacific island countries, the GDP growth fell sharply in these countries due to the soaring costs of energy and commodities when the global financial crisis hit the world in 2009. Moreover, in most of the Pacific states, increase of fuel prices tends to be translated into rise in transportation costs and retail prices of agricultural products.

Thus, the Pacific countries are seeking for a transition toward renewable energy sources to enhance energy security and sustainable development and use their abundant renewable energy sources. A series of regional policy strategies and initiatives have been endorsed to support each country's national policies toward the transformation of energy system and enhanced energy security in the Pacific.

In 2002, the Pacific Islands Energy Policy and Plan (PIEPP) was endorsed as a guideline for drafting the national policies of the Pacific SIDS. It was revised in 2004, and the associated Strategic Action Plan (PIEPSAP) was adapted as a result to formulate a critical energy policy and implementation plan for the region. In 2010, the Framework for Action on Energy Security in the Pacific (FAESP) was established to improve energy security in the region.

Thanks to the efforts, the Pacific SIDS have been gradually increasing the share of renewable energy sources to their energy mix. The Pacific SIDS recognize a transformation into renewable sources in power generation could remarkably enhance their energy security, accelerate sustainable development and mitigate climate change impacts. Therefore, the five Pacific SIDS including Fiji, Vanuatu, Tuvalu, Samoa, and Papua New Guinea, ambitiously announced the targets of 100% power generation solely from renewable energy sources.

However, it is widely accepted that the targets cannot be attained without the private sector's investment. Indeed, all the five Pacific SIDS clearly stated that the targets are conditional and contingent on availability of funding. They emphasized the importance of private investment in installing, maintaining and managing energy infrastructure to meet their targets.

In fact, large-scale renewable energy projects tend to require the capital which exceeds public budgets. But, private investors often perceive renewable energy projects and technologies as risky, hesitating investments. Furthermore, in the Pacific SIDS, the private investors are deterred by small project size and poor financial performance of power utilities.

In order to facilitate private investments in these countries, proper policies to eliminate market barriers, reduce uncertainty and increase profitability are required. Policy makers should implement necessary measures to attract private investors for accelerate their country's energy transition towards renewables.

Thus, this paper looks into the 18 renewable energy policies including grant, energy production payment, rebate, tax credit, tax reduction, investment, guarantee, loan, public procurement, Renewable Portfolio Standard (RPS) and quota, tendering and bidding, green energy purchasing, green labelling, FITs, net metering and billing, priority or guaranteed access to network, and priority dispatch.

However, not all the policies are effective. There have been mixed or unclear results on the effectiveness of renewable energy policies. A certain renewable energy policy has a significant and positive effect on the deployment of renewable energy in certain countries with particular energy sources, while it has a negative or insignificant effect in other cases.

Thus, a thorough review of renewable energy policies is essential for the countries which are eager to promote renewable energy share in their energy mix, to capture how policies can mobilize private investment and how the scarce financial resources should be allocated efficiently.

Effectiveness of renewable energy policy could be measured by "the extent to which intended objectives are met, for instance the actual increase in the output of renewable electricity generated or shares of renewable energy in total energy supplies within a specified time period" (Mitchell et al., 2011).

Among the policies, FITs have been the most widely adopted form of regulations for the renewable energy deployment and their positive effects have been proven by numerous academic research outcomes. In addition to FITs, grants prove to be effective in alleviating finance constraints and mobilizing investments in a short-term, particularly for the solar and biomass sectors. However, grants can reduce the cost of renewable energy projects only temporarily, they are considered less stable than FITs.

Meanwhile, the effectiveness of other renewable energy policies are still opaque. Tax-based measures such as tax credit and tax reduction have revealed mixed outcomes. Production quotas such as RPS have showed contradictory evidences depending on renewable energy sources. Regarding the effectiveness of loans and guarantee schemes, previous studies have found mixed results. Net metering also has different results in expanding the generation of renewable electricity.

As these research outcomes demonstrate, the effectiveness of renewable energy policies may vary by energy source, policy instruments, stages in a technology's development, and other conditions of the country where the renewable energy policies are implemented. Therefore, to fulfill the renewable energy targets of the Pacific SIDS, appropriate renewable energy policies are essential, and the effective renewable energy policies must take into consideration economic conditions, natural resources endowment, public budgets, and other unique characteristics of the Pacific countries.

However, similar to other developing countries, the Pacific SIDS which announced the 100% power generation from renewable energy, have only a few supportive renewable energy policies in place. The most widely adopted renewable energy policy is FITs. FITs are in place in four Pacific SIDS (except for Tuvalu) while other regulations such as tax credits, tax reduction, net metering, and public loans are being implemented in one or two countries only. However, even the FITs are not in actual operation, but remain at an initial level. A net metering scheme is being pursued in Vanuatu, allowing electricity consumers to generate their own electricity and to feed it into the grid. But still many Pacific island countries are not aware of the influence of net metering policy on the performance of utilities.

In fact, according to a survey conducted in Pacific island countries by IRENA, participants pointed out the lack of regulatory frameworks, the high upfront cost of renewable energy technologies, and small market sizes as the obstacles in scaling up the private sector’s investment.

In order to address these issues, FITs should be actually implemented and encouraged by the governments. Although Fiji, Papua New Guinea, Samoa and Vanuatu have recently adopted FITs or started pursuing implementation of FITs, the FITs are not virtually implemented all over the nations. Since, the positive effects of FITs have been demonstrated in many countries, and FITs tend to be more stable than any other renewable policies, the Pacific SIDS should allocate their limited budgets intensively for FITs.

In addition, the Pacific SIDS should develop a customized package of renewable energy policies for each country. For instance, for Fiji, involvement of IPPs with PPAs would be effective, significantly reducing financial burdens for the penetration of renewable energy. For Vanuatu where a net metering scheme has been adopted, a series of technical assistance such as raising awareness programs, public campaign and capacity building activities can accelerate deployment of renewable energy sources.

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