Thailand's Renewable Energy Policy:
FiTs and Opportunities for International Support

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Abstract

Thailand was one of the first Asian countries with a comprehensive feed-in tariff, or adder, program. The program has been in place for six years and gone through successive phases of adjustment, in particular in response to higher-than predicted response by industry in the form of applications submitted for interconnection. As of December 2011, Thailand has about 8,000 megawatts of renewable energy projects in the pipeline seeking adder and about 1,000 megawatts already connected and selling power to the grid. This paper provides an overview of Thailand's grid-connected renewable energy support with a focus on the adder measure, which has been the major mechanism that drives the growth in Thailand's renewable energy capacity. The paper discusses the strengths and weaknesses of the adder program and recent policy and regulatory changes that have reduced the program's effectiveness.

Keywords: feed-in tariff, adder, Thailand, renewable energy policy

1. Introduction

Thailand is located in Southeast Asia and has a population of about 70 million people. Compared with other Southeast Asian countries, Thailand has the highest electricity demand, with plans for increasing imports from neighboring countries such as Laos, Myanmar, and China. The electricity consumption in 2010 was 149.32 billion kWh. Over the past ten years, electricity demand has been growing at about 770 MW per year or about 3.2% per year. The current installed capacity is 31,447 MW, with the majority of energy sources from natural gas (66%) and coal (20%) (EPPO, 2011). Non-hydro renewable energy contributes a minor (around 5%) but increasing share of total electric power generation (DEDE, 2010).

Thailand was one of the first Asian countries to implement a feed-in tariff (FiTs) program. Thailand's FiT program, or "adder" program, ensures guaranteed purchases and attractive tariff rates to eligible grid-connected renewable power projects. The policy directive was initiated in 2006 and implemented in early 2007. The program is called "adder" because it

adds additional payment to RE generators on top of the normal prices that power producers would receive when selling electricity to the power utilities.

This paper provides a summary and an analysis of Thailand's Adder Program – its features, strengths, and weaknesses, and the context in which it operates. We also highlight recent changes to the program which have rendered the program less effective.

2. The State of Play of Renewable Energy Policy in the Country

Over the past 20 years, Thailand's electricity sector has evolved from a government monopoly to a semi-unbundled structure called the "Enhanced Single Buyer" model. This model, shown in **Figure 1**, consists of the state-owned Electricity Generating Authority (EGAT) of Thailand owning about 50% of generation assets and 100% of transmission assets. The other half of the generation assets are developed and owned by private companies, including Independent Power Producers (IPPs), Small Power Producers (SPPs), and Very Small Power Producers (VSPPs). IPPs and SPPs produce and sell power to the high-voltage transmission system owned by the only buyer, EGAT. VSPPs sell power through the two state-owned distribution systems, the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA). Thailand's policies related to energy, including electric power and renewable energy policies, are drafted and proposed by the Ministry of Energy (MoE). Policies related to electric power and natural gas transmission are regulated by the Energy Regulatory Commission (ERC).

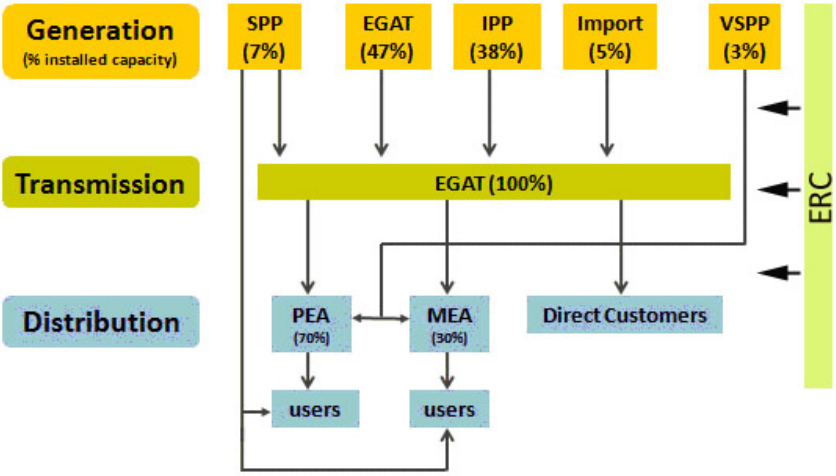

Figure 1: The Structure of Thailand's Electric Power Industry Source: Data as of December 2010, compiled from EGAT's *2010 Annual Report*, section "2.1: Planning and Strategy"

To understand the context in which Thailand's Adder program operates, we will first provide background on Thailand's broader energy policy and how the broader energy policy shapes implementation of the adder. As of January 2012, Thailand has five separate long-term energy plans, each of which corresponds to a single or a group of energy sources and is prepared by different government divisions. There is currently no unified energy plan that integrates those separate plans together to indicate the country's policy direction. This is partly because the planning process is carried out by different government departments, depending on the functions of the departments and there has been little co-ordination between these departments to assess how the plans can contribute to meet joint goals. The five plans include the long-term Power Development Plan (PDP 2010-2030), the 15-Year Renewable Energy Development Plan (REDP 2009-2022), the 20-Year Energy Efficiency Development Plan, Natural Gas Plan, and Natural Gas Vehicle Roadmap. In addition, unlike in many other countries, Thailand lacks a renewable energy law.

Of particular relevance to this paper are the PDP and the REDP since they contain renewable energy targets[1]. In the absence of a unified energy plan, the PDP and the REDP can be seen as competing rather than complementary. The PDP specifies, 20 years into the future, a forecast of load growth, the additional capacity of power plants to be built to meet the forecasted load growth, the types of energy sources for new generation capacity, and the share of investment by EGAT and IPPs. The REDP seeks to bring renewable energy to 20% of final energy consumption by 2020 and sets targets for different forms of renewable energy. The two plans were prepared by different government departments and motivated by different policy drivers. As a result, the plans have set diverging targets for renewable power generation. Between 2009 and early 2010, the early drafts of the PDP specified relatively low renewable energy targets and did not at first include the REDP as part of the inputs. In the process of finalizing PDP, two rounds of public hearings were held, from which members of the public pointed out the lack of consistency between the renewable energy projections in the REDP and the draft PDP (PDP Documents, 2010a; PDP Documents, 2010b). The PDP calls for much lower

[1] It should be noted that the Alternative Energy Development Plan (AEDP 2012-2021) has been approved by the Thai Cabinet in late 2011 to replace the REDP. The AEDP sets higher targets for most types of RE than the REDP, with the exception of biomass and MSW energy whose targets remain the same.

deployment of renewable energy than the DEDP plan. The PDP also calls for very high levels of conventional generation including new coal, natural gas, nuclear, and large-scale hydropower, and various citizens groups have raised concerns that the capacities of these sources in the PDP far exceeds the actual growth in electricity demand. The relatively high share of conventional generation, which is planned twenty years into the future, can potentially erode the need for renewable energy in the country's generation mix, especially in conditions of lower-than-expected demand for power. And while the build-out of the power plants specified in the PDP is the core business of a group of large well-established companies, including EGAT and IPPs, the attainment of the REDP targets depends upon numerous diverse players, large and small, in the business of renewable energy that still requires many forms of support from the government. As shown in Table 1 and **Figure 2,** the REDP has set goals to achieve specified capacity for different types of renewable energy, including 500 MW of solar power, 800 MW of wind, 324 MW of hydro power, 3,700 MW of biomass power, 120 MW of biogas power, 160 MW of MSW power, and 3.5 MW of hydrogen power by 2020. **Table 2** shows that the achievement of these targets has been mixed, with on-grid capacity exceeding short-term targets for solar and biogas, and capacity far below targets for other types of renewables.

Energy Type	Technical Potential	Capacity at 2008[2]	2008-2011 Targets		2012-2016 Targets		2017-2022 Targets	
(Electric Power)	MW	MW	MW	Ktoe	MW	ktoe	MW	Ktoe
Solar	50,000	32	55	6	95	11	500	56
Wind	1,600	1	115	13	375	42	800	89
Hydro	700	56	165	43	281	73	324	85
Biomass	4,400	1,610	2,800	1,463	3,220	1,682	3,700	1,933
Biogas	190	46	60	27	90	40	120	54
MSW	400	5	78	35	130	58	160	72
Hydrogen			0	0	0	0	3.5	1
Total	57,290	1,750	3,273	1,587	4,191	1,906	5,607.5	2,290

Table 1: Renewable Power Goals in Thailand's 15-year Renewable Energy Development Plan (2008-2022)

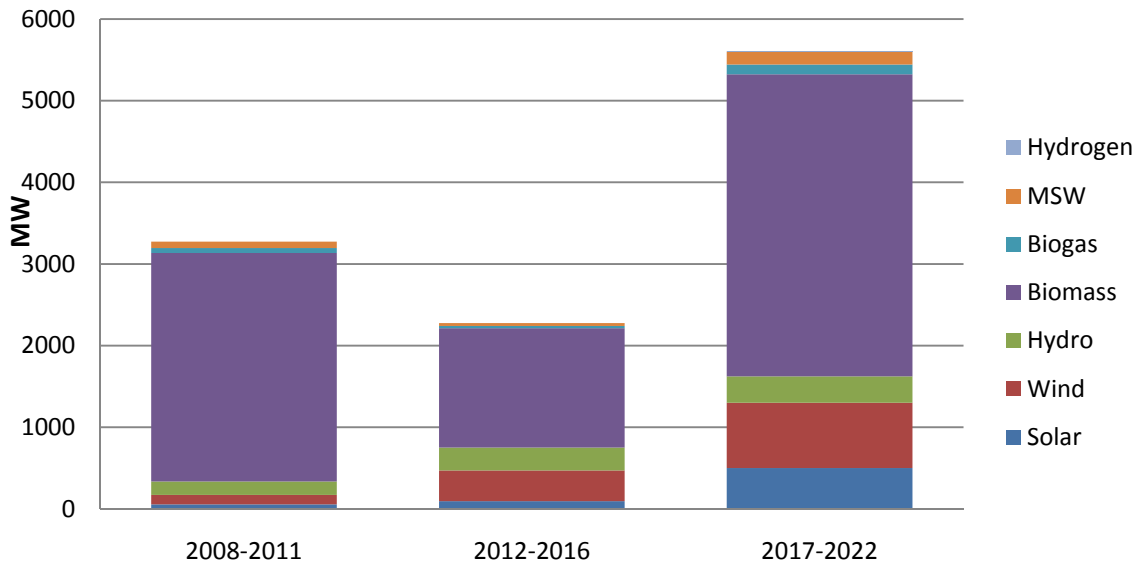

Figure 2: Thailand's renewable energy targets according to the 15-Year Renewable Energy Development Plan (REDP 2008-2022)

[2] The process of planning for 15-Year REDP took place in 2008.

Type of RE	15-Year Target (until 2022), MW	2008-2011 Target	Actual On-grid Capacity (SPP+VSPP) as of Dec 2011	Difference (+ = above target - = below target)	% difference (% above target or below target)
Solar	500	55	110.97	55.97	+101.76%
Wind	800	115	0.38	-114.62	-99.67%
Small/Micro Hydro	324	165	13.28	-151.72	-91.95%
Biomass	3,700	2,800	724.72	-2,075	-74.12%
Biogas	120	60	98.69	38.69	+64.49%
MSW	160	78	37.33	-40.67	-52.14%
Hydrogen	3.5	0	0	0	n/a

Table 2: A comparison of Thailand's renewable energy targets and 2011 status

The fact that Thailand's renewable energy policy is not yet the central part of Thailand's long-term energy policy has served as an impediment to Thailand's renewable energy development overall. The most immediate manifestation of this policy ambivalence has been discontinuous support for the Adder measure, which – when operational –is one of the major mechanisms that will help the country meet its renewable energy targets. Discontinuous support for the Adder, in turn, has created a high level of uncertainty for investors.

3. Thailand's Adder Program

Thailand's adder program gives incentives for private investors to invest in renewable energy projects by guaranteeing attractive power purchasing rates. Eligible participants enter into long-term contracts with the local utility to sell renewable electricity at a pre-specified tariff for a pre-specified period of time.

The program is implemented through Thailand's three electric utilities: EGAT, MEA, and PEA. The three utilities purchase electricity from renewable electricity generators using two types of regulations:

-**VSPP (Very Small Power Producers) regulations**: for generators sized less than or equal to 10 MW

- **SPP (Small Power Producers) regulations**: for generators sized greater than 10 MW and less than 90 MW

The Adder rates are distinguished by technology type, installed capacity, contracted capacity, and project location. The features of the program are summarized below:

3.1 Basic Features of Thailand's Adder Program

Eligibility

VSPPs and SPPs that utilize solar, wind, biomass, biogas, hydro, and waste energy are eligible to participate in the program. VSPPs and SPPs may be private or public entities, but may not include the utilities themselves.

Rate Structure

The rate structure of feed-in tariffs used in Thailand since 2007 is paid on top of the utility's avoided costs. This constitutes a "premium-price FiT payment" as defined by Cory et al. (2009). In contrast, a "fixed-price FiT payment" (Cory et al., 2009) is characterized by a FiT rate that is independent of the country's electricity prices. In June 2010 the Thai government approved a plan to switch from a premium-price FiT payment to fixed-price FiT payment, and studies to determine the rate for each type of RE are under way.

Rates

Thailand's Adder rates are differentiated by technology and installed capacity. In addition, there are 'additional' adders paid to RE generators in special locations. Those special areas include the three southernmost provinces, which have experienced political unrest; and off-grid areas where the PEA typically delivers electricity from local diesel power plants. The Adder rates are listed in **Table 3**.

Type of RE	Unit: US Dollars per kWh					Years Supported
	2007 Adder Rate	2009 Adder Rate	2010 Addder Rate	Special Adder for Diesel Replacement	Special Adder for Three Southernmost Provinces	
Biomass						
Installed Capacity ≤ 1 MW	0.010	0.017	0.017	0.033	0.033	7
Installed Capacity > 1 MW	0.010	0.010	0.010	0.033	0.033	7
Biogas						
Installed Capacity ≤ 1 MW	0.010	0.017	0.017	0.033	0.033	7
Installed Capacity > 1 MW	0.010	0.010	0.010	0.033	0.033	7
Waste						
Landfill and Digestor	0.083	0.083	0.083	0.033	0.033	7
Thermal Process	0.083	0.117	0.117	0.033	0.033	7
Wind						
Installed Capacity ≤ 50 kW	0.117	0.150	0.150	0.050	0.050	10
Installed Capacity > 50 kW	0.117	0.117	0.117	0.050	0.050	10
Small/Micro Hydro						
50 kW <Installed Capacity < 200 kW	0.013	0.027	0.027	0.033	0.033	7
Installed Capacity ≤ 50 kW	0.027	0.050	0.050	0.033	0.033	7
Solar	0.267	0.267	0.217	0.050	0.050	10

Table 3: Thailand's Adder Rates (Exchange Rate: 1 US Dollars = 30 Thai Baht). **Note**: **the current (May 2012) Adder Rate remains at 2010 levels.levels.**

Cost control mechanism: Cap and Deadline

The first phase of the Adder program had a deadline for submitting applications at the end of 2008. In March 2009, the program was resumed to accept more applications with no new deadline but the NEPC imposed a broad guideline that new project approval would be subject to acceptable cumulative impacts on pass-through cost to ratepayers[3]. This broad guideline, however, does not specify the level at which pass-through cost becomes unacceptable. This means that utilities, which are tasked with approving project applications, are aware of this eventual ceiling, but there is currently no rule to guide them when to stop approving applications. As a result, the utilities use their own discretion to reject or accept applications.

Another type of cost control mechanism, a degression rate, is being studied as a form of cost control. If implemented, the degression system would provide lower tariffs for future projects, reflecting generally declining costs in the renewable energy industry.

[3] NEPC Resolutions on 9 March 2009.

Approval Process and Criteria

In the early phase of the program (from 2007-2009), the utility that owns the transmission or distribution system to which the applied project is to be connected was the sole party responsible for application approval and Power Purchase Agreement (PPA) signing approval. The main criterion for project approval was grid availability. Since June 2010, however, the final approval authority has moved to the Ministry of Energy and additional criteria were implemented, including projects' readiness in terms of access to loans, land, and government's permits. Furthermore, since August 2009 each new applied project has also been required to submit a security deposit, which is returned after project commissioning. These changes will be discussed in more details in section 2.3.

Contract Term

Approved projects sign a PPA with the utility which owns the grid to which the project is connected. The contract term is 5 years and is renewed automatically if none of the contract parties express the need to terminate the contract.[4]

Support Period

Once the project commences operation and starts selling electricity to the grid, the adder is paid for 10 years (wind and solar projects) or 7 years (other renewables).

Financing Mechanism

The cost of the adder is financed through a pass-through mechanism to all electric power customers. There are two components to the electric rate structure in Thailand: the base tariff (which is adjusted every four years) and an automatic fuel price volatility adjustment tariff, which is adjusted every quarter and is known in Thailand as the "Ft charge". The incremental cost of premium Adder payments to RE generators is passed through directly to rate payers, as a special charge in the Ft charge, which is charged as a line-item on customers' monthly electricity bills.

Program Review

[4] http://www.pea.co.th/vspp/vspp/PPA10MW_Renew.doc and http://www.pea.co.th/vspp/

To date, the Adder program does not specify any timetable for program revision. However, the most recent draft policy revision proposal addresses a need for a yearly review of the program and the FiT rates.

3.2 How FiT Rates are Determined in Thailand

According to Cory et al. (2009), there are four fundamental approaches for determining FiT rates:

(1) Based on actual levelized cost of electricity generation

(2) Based on the "value" of renewable energy generation, either to society or to the utility (the avoided cost of utility)

(3) Based on a fixed price incentives that are unrelated to the actual levelized cost of electricity generation or the value of renewable energy generation

(4) Based on the result of an auction or bidding process

The studies that provided inputs into Thailand's Adder rate setting included the consideration and comparison of all calculation methods listed above, including methods based on the levelized cost of electricity generation, utilities' avoided cost of renewable energy generation, the value of RE in terms of externalities avoidance, and the result from a bidding process. However, getting the prices right is not the only goal in actual FiT rates determination. Choosing which FiT rates to implement is not a mere matter of engineering-economics but a process involving the balance of multiple policy goals. These policy goals are listed in **Box 1**.

Box 1: Policy goals expected to be achieved through the Adder program

-More green energy

-Private sector participation and increase in competition

-Economic growth

-Rural development

-Utilization of agricultural waste

-Fuel diversification

-Local pollution reduction

-Less trade deficits from imported equipment

3.3 Planning Process of the Adder Program

Figure 3 shows the major process of planning for Thailand's Adder program and the involved stakeholders. The Ministry of Energy (MoE) drafts the program and proposes it to the National Energy Policy Commission. The Energy Regulatory Commission (ERC) has legal authority to set rules and regulate the implementation of power policies, including the Adder measure, in Thailand.

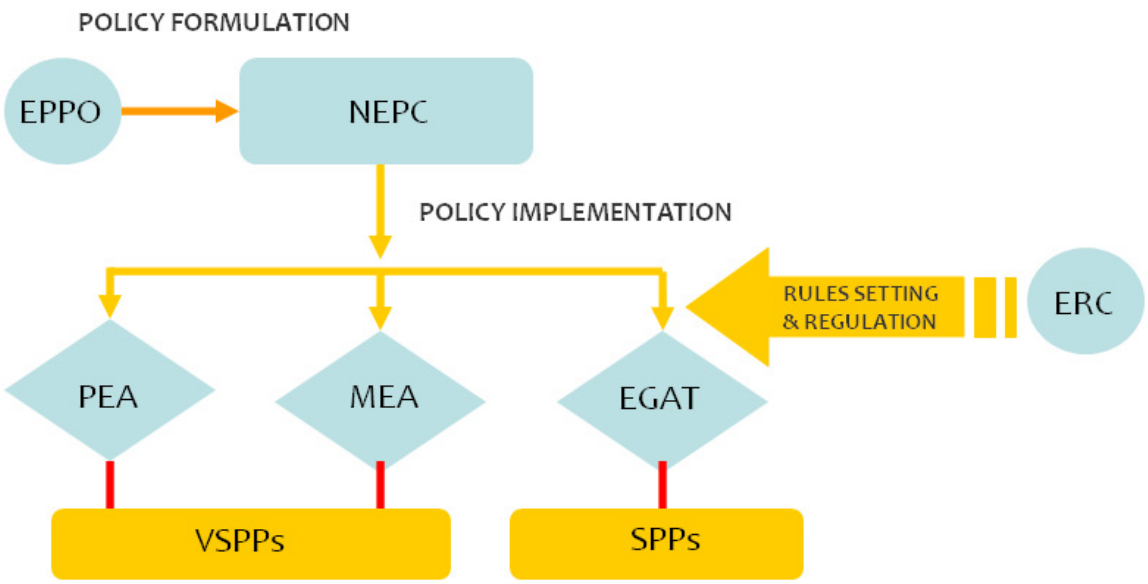

Figure 3: Adder (FiT) Policy Process

When compared to other energy policy formulation in Thailand, the planning for the Adder program in its first two phases (between 2007-June 2010) was among the most systematic and transparent. Representatives from the private sector routinely sent comments to the Energy Policy and Planning Office offering suggestions for potential improvement to the Adder program, some of which were incorporated the policy design process. Before the policy was launched for the first and second phase of the Adder program, policymakers organized a consultation process, in which participants provided comments to the draft policy. The consultation process detailed the assumptions used for rate setting but not the actual model used to calculate the rates. Some feedback from this consultation process was integrated into the final

draft before the policy was proposed to the NEPC. The planning in the later phases (from June 2010 to the present), however, was carried out without public participation and resulted in a major change to the rate and the regulations.

3.4 The Evolution of Thailand's Adder Program

The development of Thailand's Adder program can be divided into 3 phases, differentiated by changes to the rules and regulation of the program. In the first phase (between 2007-July 2009), the rules and regulations were simplified and streamlined. This is because the rules and regulations were drawn directly from an earlier phase of Thailand's grid-connected renewable energy support, which includes a net-metering program designed for installations exporting no more than 1 MW. In 2006, the government eased the capacity restriction so that VSPPs included generators exporting up to 10 MW, and introduced Adder rates but the same rules and regulation were still used. The attractive Adder rates and streamlined application process led to a rush of applicants eager to secure their rights to the Adder – sometimes with inadequate assessment of project feasibility.

In the second phase (August 2009 to June 2010), a bid bond, or security deposit, of about $6/kW was introduced in reaction to high interest in applications.[5] The security deposit was applicable to new applications only and was designed to discourage the applicants that had the intention of reserving and reselling their Power Purchase Agreements (PPAs). The rest of the application process remained simplified and streamlined.

The third phase of the Adder program can be characterized by frequent rule changing. A combination of factors – including simplified and streamlined regulations in the first two phases; dropping solar prices in the third quarter of 2008; and the December 2008 deadline for application filing, resulted in a rush to secure power purchase agreements (PPAs) for renewable energy projects with the utilities. At the end of 2008, a total of 1,075 applications, for 5,147 megawatts of renewable capacity, were filed to receive Adders. The greatest numbers among those were the applications for the solar adder of 8 Baht/kWh, with 471 applications exceeding 2,000 megawatts. This "solar gold rush" was not at first seen as a problem until most of them

[5] 200 Thai Baht/kW for installation sized larger than 100 kW, National Energy Policy Commission Resolution 9 March 2009, implemented since August 2009.

easily went through the simplified application process and secured PPAs to be selling power to the utilities. Many of these PPAs were made by small companies that lacked ability to develop the projects themselves and were clearly getting PPAs with the intention of reselling them.

It was not until the end of 2009, however, that the Ministry of Energy (MoE), began to take notice of the unexpected amount of the PPAs. From the perspectives of the MoE, the 2 GW solar applications exceeded the government's official target of 500 MW and could result in a sharp increase in the pass-through cost to consumers' power tariffs. Furthermore, the MoE has been concerned that many of these megawatts in the pipeline are "speculated megawatts" rather than potentially realizable projects.

The reaction of policymakers has resulted in the sudden changes in the third phase of the program which have affected not just solar projects but the whole renewable energy industry. A number of resolutions were passed by the NEPC in June 2010. On June 28, 2010, the National Energy Policy Commission (NEPC) passed a resolution to reduce the adder rate for solar projects and establish a new committee that would oversee policy formulation and regulation of renewable energy policy. The Managing Committee on Power Generation from Renewable Energy Promotion (hereafter, the "Managing Committee") was appointed to coordinate, follow up, and ensure that the implementation of measures promoting power generation from renewable energy is in compliance with policy. Many of the tasks accomplished by the Managing Committee have important implications not just for solar energy development in Thailand, but also the whole renewable energy industry. The new rules and regulations are summarized in **Figure 4.**

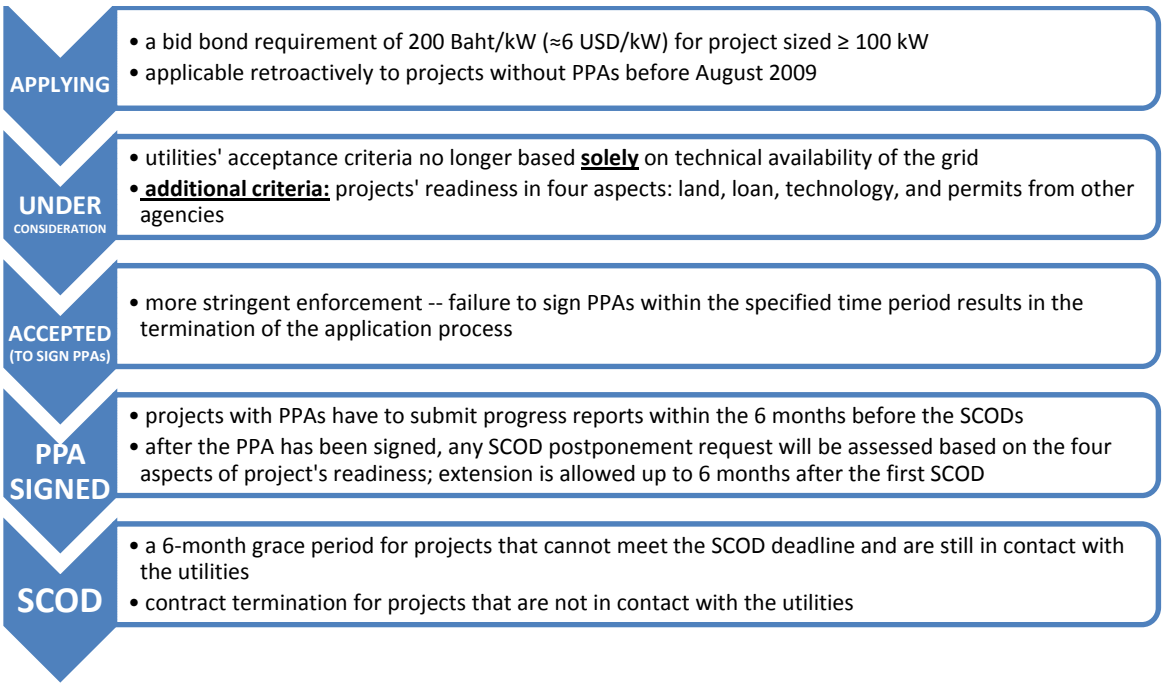

Figure 4: Rules and Regulations put in place by the MoE and the Managing Committee

These new rules and regulations mark a major departure from the original principles of the VSPP program, on which earlier phases of the adder program were based. Under the initial VSPP program design, utilities were required to grant projects permission to interconnect if they met basic safety and power quality standards, subject to substation capacity. New rules added by the committee involve additional paperwork requirements, including proof of sound financial status, which are designed to prove the projects' readiness to follow through until project completion. This has introduced somewhat highly subjective judgment and stalled the applications process due to the lack definite timeline on how long the Committee would process applications.

In addition to passing new and more stringent regulations, the Managing Committee has also approved new projects and PPA signings, and cancelled some old, idle contracts. The role of the Managing committee has hence been to centralize all decisions regarding renewable SPP and VSPP projects, taking on responsibilities for in policy design (the purview of EPPO) and regulation (the purview of the ERC). Another question concerns the lack transparency – there is no channel that allows the public to monitor the work of this committee, hence causing confusion and doubts whether the process is fair and clean of business interests and political intervention (e.g., Tongtup, 2011; Bangkokbiznews, 2010). There are no clear guidelines on which projects

will receive approval first and which projects advance in the queue, increasing the risk for rent-seeking by those with the authority to approve projects.

While some of the measures imposed by the Managing Committee have reduced speculation in VSPP projects, this improvement comes at the cost of sharply reduced applications and application approval overall. This is summarized in **Figure 5**, cumulative applications rose sharply in the first phase until June 2009, after which the cumulative applications began to decline due to the introduction of the bid bond. After the establishment of the Managing Committee in June 2010, the program's progress significantly slowed down. Since then few projects were approved and few projects have signed new PPAs with the utilities.

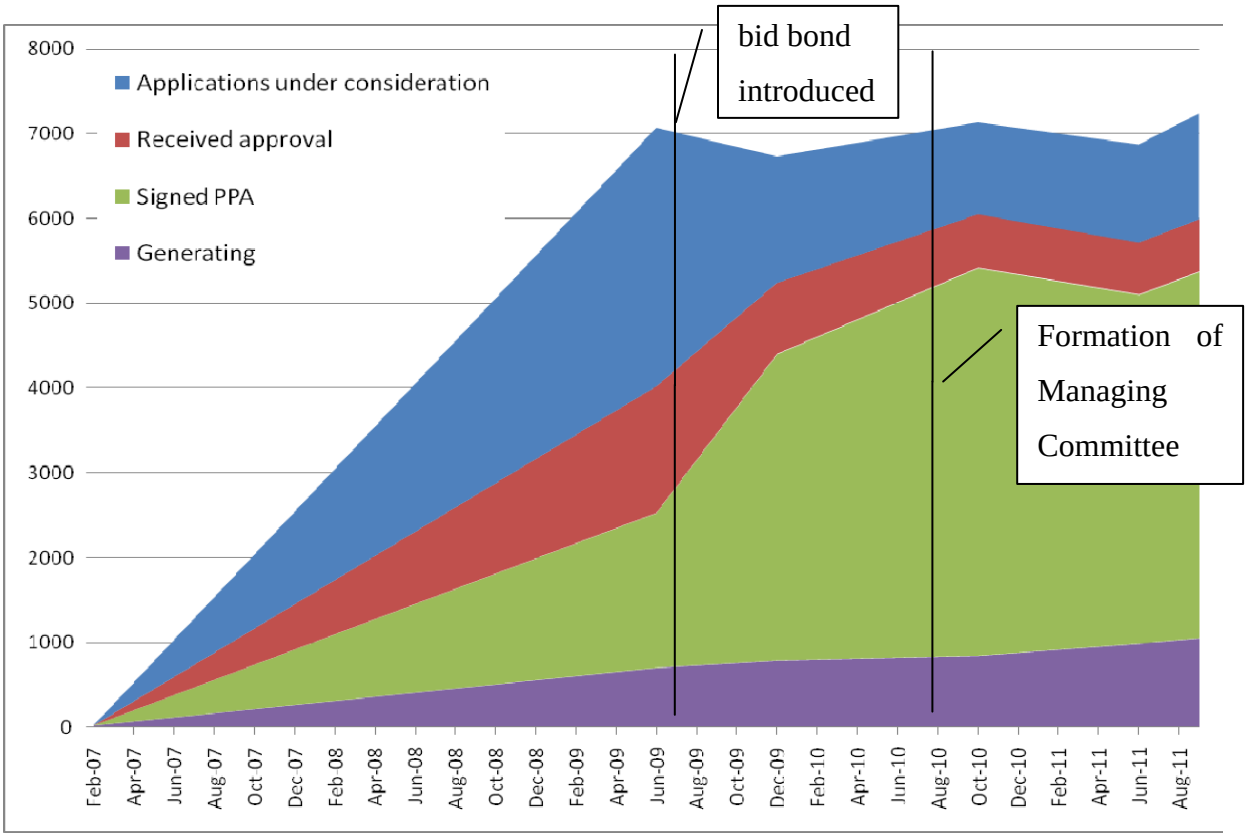

Figure 5: MW of renewable energy under the VSPP program in various stages of development from "under consideration" (top) to "generating electricity" (bottom wedge).

3.5 Overall Assessment of Thailand's Adder Program: Strengths and Weaknesses

To summarize, the strengths of Thailand's Adder program lie in rates that have been set high enough to attract private investment in diverse forms of renewable energy, and in its early framework for streamlined interconnection arrangements and standardized documents including power purchase agreements. In addition, special rates for the three southernmost provinces help address the increased risks of investors that operate in those areas. The provision of special rates for remote areas with PEA-supplied diesel generation is also a good step toward advancing the concept of fossil fuel substitution and helping lower utility costs in rural areas with expensive diesel fired generation. The rate structure is simple and easy for investors to integrate into investment plans. The program also provides secure contracts that ensure confidence to the investors that the support will not likely be revoked or cancelled once they have signed the contracts. As a result, the Adder program has been able to induce impressive amount of investment in RE since its implementation in 2007, as shown in **Figure 6.** As of December 2011, the on-grid RE capacity of Thailand is 985.36 MW (589.96 MW of renewable VSPP and 395.40 MW of renewable SPP), and 7,558 MW of RE capacity are in the pipeline[6] (5,547 MW of renewable VSPP and 2,011 MW of renewable SPP), as detailed in Tables 4 and 5. The combined on-grid capacity and the amount of RE in the pipeline amounts to 8,543 MW or around 27% of the current installed capacity in Thailand[7].

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[6] Projects that are in the pipeline are projects that are not yet selling power to the utility and are in one of the following stages of development: (1) the project's application has been proposed to the utility and awaiting approval to join the Adder program (2) the approved project prepares documents prior to the signing of the power purchase agreement (PPA) and (3) the project has a PPA with the utility.

[7] The installed capacity of Thailand (as of December 2012) is 31,447 Megawatts (Source: http://www.eppo.go.th/info/5electricity_stat.htm , Assessed December 2012).

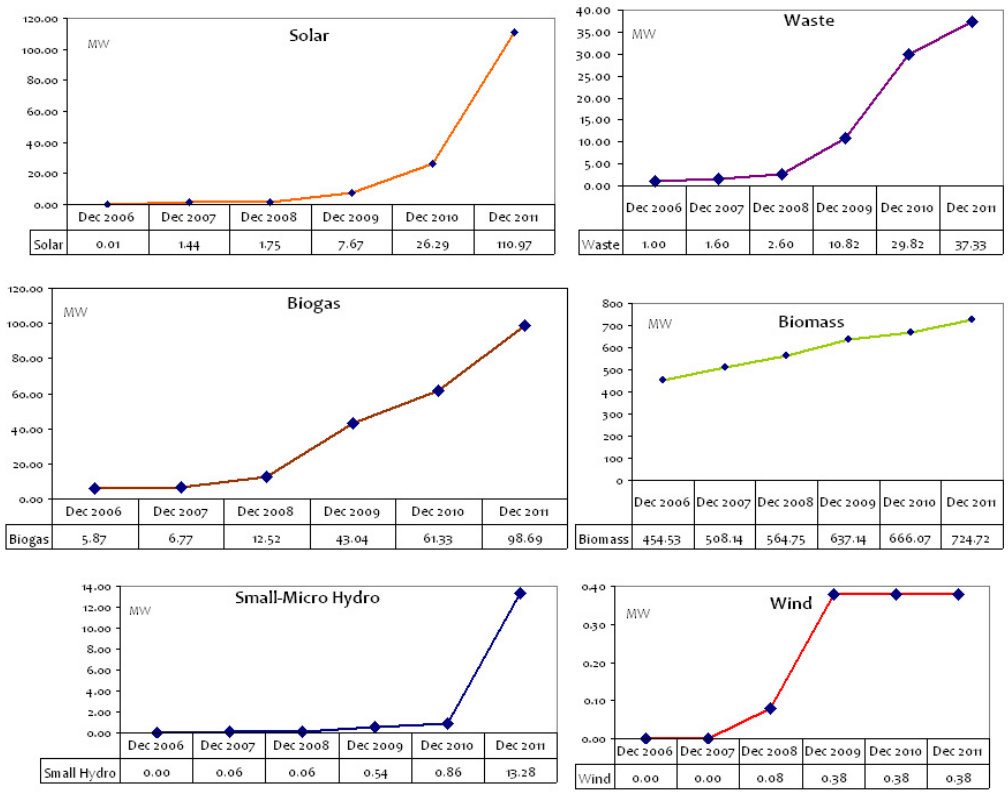

Figure 6: Trends of SPP and VSPP as a result of Adder implementation since 2007

Type of RE	Under Consideration		Accepted (Awating PPA signing)		PPA signed (not yet selling)		Selling to the grid	
	Number of Plants	Proposed Capacity (MW)	Number of Plants	Proposed Capacity (MW)	Number of Plants	Proposed Capacity (MW)	Number of Plants	Proposed Capacity (MW)
Solar	174	901.81	45	96.22	443	2,036.34	96	102.97
PV	174	901.81	32	50.53	182	723.46	95	94.97
Thermal	0	0.00	13	45.70	261	1,312.88	1	8.00
Biogas	33	68.13	36	52.75	42	72.31	71	98.69
Biomass	27	127.07	55	264.80	230	1,637.26	63	349.52
MSW	10	38.15	7	6.14	23	114.17	12	37.33
Micro/Small Hydro	3	1.07	2	0.31	5	6.10	5	1.08
Wind	10	22.35	19	34.00	14	68.28	3	0.38
Total	257	1,158.58	164	454.22	757	3,934.46	250	589.96

Table 4: Status of Renewable VSPP Projects by Type and Stage of Application Process

Type of RE	Under Consideration		Accepted (Awaiting PPA signing)		PPA Signed (not yet selling)		Selling to the grid	
	Number of Plants	Proposed Capacity (MW)	Number of Plants	Proposed Capacity (MW)	Number of Plants	Proposed Capacity (MW)	Number of Plants	Proposed Capacity (MW)
Solar	3	171.00	0	0.00	3	210.00	1	8.00
Biogas	0	0.00	0	0.00	0	0.00	0	0.00
Biomass	7	165.00	5	218.50	1	4.00	24	375.20
MSW	1	55.00	0	0.00	0	0.00	0	0.00
Small Hydro	0	0.00	0	0.00	0	0.00	1	12.20
Wind	7	347.50	7	550.00	4	290.00	0	0.00
Total	18	738.50	12	768.50	8	504.00	26	395.40

Table 5: Status of Renewable SPP Projects by Type and Stage of Application Process

Despite the strong policy directives that have been successful at attracting interests from investors and project developers, the Adder program could benefit from a stronger regulatory framework. Weak regulatory support and a lack of a public discourse on the acceptable level of pass-through costs to ratepayers have been a fundamental problem in Thailand's FiT program. In its first two phases, the lack of a program cap in combination with a deadline resulted in greater-than-expected number of applications, which raised the MoE's concerns regarding ratepayers' impacts. But regulatory reaction to this concern has resulted in more red tape and a bottleneck for application processing in the third phase of the program. As shown in **Figure 5**, application processing has been largely stalled since the major adjustment of the program in 2010 when the Managing Committee was established to revise and regulate the Adder program.

4. Other Financial Incentives

Besides FiT, the Thai government has put in place various low-interest loan options for different target groups, including large-scale investors and small-and-medium sized enterprises (SMEs). The major source of low-interest funding comes from the Energy Conservation Promotion Fund (ENCON Fund), which is collected from a tax per liter on all petroleum products sold in Thailand through Thailand's Revolving Fund Program. Large-scale investors in renewable energy projects can receive financial assistance in the form of low-interest loans with an interest rate ceiling of 4%. Smaller-sized investments can receive financial assistance from

the ESCO Fund in the form of equity investment (up to 50 million Baht or 1.7 million USD), venture capital, equipment leasing, and CDM project development.

In addition to financing options provided by the Thai government, a few renewable energy projects in Thailand have received funding from international lenders, including the Asian Development Bank (ADB) and World Bank's International Finance Corporation (IFC). The ADB's Solar Energy Initiative provided funding for two Bangchak Petroleum solar power plants totaling 34.5 MW and 9.3 MW respectively, as well as for the 73 MW Natural Energy Development solar electric power plant. IFC and the Clean Technology Fund are also financing two 6-MW solar power projects in Thailand.

Despite various financing options available domestically and internationally, financing for grid-connected renewable energy projects remains a challenge for developers in Thailand. Project financing has been limited to relatively few investors from well-established companies. In the case of biomass, most grid-connected power plants are owned by large agro-businesses with strong balance sheets, such as sugar mills, rice mills, and palm oil production plants. In the case of solar farms, companies that have been able to secure loans are often associated with other well-established businesses, including a television channel, a plastic surgery hospital, a solar manufacturing company, a petroleum company, and an Independent Power Producer (IPP).

5. Necessary Technical Environment

As more renewable projects are connected to the utilities' grid, utilities will be facing more complex challenges of meeting power quality and stability requirements. The regulations that deal with technical synchronization between renewable energy systems and the utilities' grid have been revised periodically to address problems associated with increasing RE penetration as they arise. For example, in order to prevent potential adverse impact of renewable energy on the grid and to minimize the complexity of grid operation, the updated VSPP Grid Code[8] of 2008 specifies the number and size of power plants that can be connected to each feeder. However, this approach to grid integration may be too limited if renewable energy is to be increased to the scale specified in the government's renewable energy targets. Studies on grid-RE interactions will help determine how to utilize RE in the most efficient manner and in a way that maximizes

[8] http://www.pea.co.th/vspp/etc/grid_code.pdf

RE penetration. For example, if RE were to be planned as an option to transmission and distribution (T&D) upgrades, RE could be incentivized to be added to locations with increasing loads but limited transmission and distribution capacity. As renewable energy generation increases, it will be increasingly important for utilities to conduct location-specific studies for each project that investigate the impact of each specific proposed renewable energy generator in a specific location on the grid, rather than blanket studies and blanket policies that may miss location-specific or context-specific opportunities for greater renewable energy penetration.

6. Conclusions and Recommendations

Thailand has the foundations for a good renewable energy program but major barriers still remain that have slowed down market expansion. As shown in **Table 2**, short-term targets according to the 15-Year REDP have been reached for solar and biogas energy, but other renewables are still far from reaching their short-term targets. And as the REDP has been replaced by a more ambitious Alternative Energy Development Plan (AEDP 2012-2021), which set higher targets for most types of RE, effective implementing mechanisms become even more important. Unfortunately, recent policy changes discussed in this paper have served to hamper, rather than facilitate, greater renewable energy penetration.

Thailand's renewable energy framework still needs improvement the following four areas: (1) planning and strategy (2) policy and regulatory framework for FiT (3) financing options, and (4) the technical environment:

(1) Planning and Strategy: The lack of strategic integration in Thailand's energy policies and measures serve as an impediment to renewable energy growth in Thailand overall. In particular, major policies that affect the renewable power industry are not unified, including Thailand's long-term power procurement plan, or the Power Development Plan (PDP), and the 15-Year REDP. This lack of a unified energy policy makes the expansion of RE discontinuous, subject to the will of each political party that comes into power. And unlike FiT programs of other countries, Thailand's FiT program is not backed up by a renewable energy law. Having such a law could provide some legal mandates for the involved agencies to act in concerted effort.

(2) Policy and Regulatory framework for FiT: Though Thailand has made advances in putting in place an attractive feed-in tariff measure, the implementation of the FiT faces increasing barriers over time due to ad hoc responses to problems as they arise. Overall, the landscape for RE support can be characterized by a weak regulatory framework. Unforeseen problems that arose during the implementation process included the problem of speculation and the "solar gold rush". Ad hoc and non-transparent responses to these caused delays in the application process for adder support and led to public criticism of poor governance. The planning process for an updated FiT scheme (which is currently underway) should take lessons from the regulation of successful FiT schemes in other countries and practice light-handed regulation wherever possible.

(3) Financing options: financial support does exist from both the private and public sector, both domestically and from international financers. The credit rating of the investors has played a key role in influencing the banks' tendency to lend to relatively well-established companies. In order for the market for RE to expand in a continuous and sustainable manner, there is a need for an increase in capacity building in private and public financial institutions to evaluate risks and opportunities in renewable energy.

(4) Supportive technical environment: RE deployment in Thailand faces eventual technical limits. These limits will be more severe in the absence of utility-level planning to accommodate increasing RE grid penetration. In this regard, a review of strategic planning of the grid in countries with successful FiT implementation will be worthwhile, such as that of Germany and Denmark (e.g., Decker, 2008), and utility-wide implementation of best-practices in transmission, distribution, and generation planning, construction, and operation that accommodate distributed generation.

Furthermore, we have found that Thailand's renewable energy framework is supply-side oriented. Policy measures have been designed to focus on incentivizing the increase in RE supply, i.e., in the forms of financial incentives (FiTs and loans) and regulations. Little emphasis has been placed on creating demand for renewable energy from the general population. The demand for increased renewable energy generation in Thailand has been limited to a small circle of investors and entrepreneurs and not from the broader public. In this sense, the role of consumers of electricity is merely as the bearers of costs of renewable energy investment. The

public does not perceive itself to be the direct beneficiaries of renewable energy deployment. Renewable energy remains a remote and abstract concept for many Thai electricity users. Hence continuous support for renewable in Thailand should include initiatives to call for more strategic planning, better regulatory support, better governance, and better public communication.

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