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To buy the system or to buy the service: the emergence of a solar service model in Thailand

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Thailand has experienced a rapid increase in utility-scale solar PV investment (>1 MWp), while the growth of investment in smaller-sized rooftop PV systems is far behind. Due to the continuous decline in PV module costs and the discontinued support in the form of feed-in tariffs, the market is gradually transitioning to installations for the purpose of self-consumption. The main barrier for market expansion is the high upfront costs of solar PV systems. Rather than buying the system, new business models are offering customers to buy the service from solar PV systems instead. The Solar PPA model is an emerging solar service business model in Thailand. This model eliminates the investment cost and operating risks for the customer. This paper takes on the view of a commercial-sized customer to compare the options between the Buying Model and the Solar PPA model. From the customer's viewpoint, the cost of electricity generation, or the levelized cost of electricity (LCOE), under the Solar PPA model is more attractive. The results show an LCOE of 4.82 THB/kWh (0.14 USD/kWh) for the Solar PPA model, 9.56% less than buying the system at 5.28 THB/kWh (0.16 USD/kWh). The Solar PPA model also proves to be a more attractive option in most sensitivity cases. This paper discusses conditions under which the model is feasible and recommends that the design of future support schemes for solar PV self-consumption should enable the expansion of innovative business models, including the Solar PPA model and other third-party ownership models.

Introduction

Thailand has experienced a rapid increase in the installed capacity of solar PV since the initiation of the adder subsidy to promote the use of solar power and other types of renewable energy in 2006. The total installed capacity of grid connected solar PV grew from 1.86 MW to 19.57 MW to 1389 MW, from 2006 to 2010 to 2015, respectively.[1] The majority of the increase came from ground-mounted, utility-scale PV systems since investment was feasible for large-scale projects prior to the end of the adder program. Policy support for smaller-sized rooftop solar PV systems ('rooftop PV') have been restricted to a limited number of feed-in tariff (FiT) quotas. Despite declining costs of solar PV systems, their high upfront costs remain a major barrier for market expansion [1]. To overcome this constraint, new business models are offering customers to buy the service (electricity) instead of buying the system. An emerging business is termed as the Private Solar Power Purchase Agreement model ('Solar PPA model'). In this model, the solar developer company ('Developer') builds, owns, and operates the rooftop PV system

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[1] The growth of the annual cumulative installed capacity from 2006 to 2015 approximately doubled year on year at a compound annual growth rate (CAGR) of 109%.

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and sells electricity to the customer at a price that is typically lower than the utility's retail electricity tariff ('retail tariff').

Overholm [2] coined the term 'solar service' and defined it as a business that 'builds, owns and maintains solar panels on end-customer premises, only selling electricity to the customer' [2]. These models have been studied extensively in the U.S., where they are termed 'third-party photovoltaics ownership' [3–5]. There are several variations of solar service business models – the developer builds, owns, and operates the solar systems on the roof of the customer and then charges a fee for the electricity produce through a lease contract (Solar Lease model) or a power purchase agreement (Solar PPA model) [6]. In 2013, solar service models accounted for 60–80% of the installation in three of the top U.S. residential markets [7]. These models offer solar electricity as a service rather than as a product. The main advantages of solar service business models include: (1) the models remove customers' upfront investment cost; (2) the developer selects, installs, and secures permits on behalf of the customers; and (3) the developer takes liability for the operation & maintenance (O&M) [2].

According to Overholm, solar service business models have emerged in the UK, the Netherlands, and Singapore [2], but they have been most successful in the U.S. In residential solar markets in the U.S., they help those in cash-strapped situations [8], and the same factor may also drive solar market expansion in emerging economies where 'purchasing power is low and most people do not have access to commercial financing' [9]. In Thailand, a survey of potential solar consumers shows that such alternative options would help those residential customers who would otherwise not be able to afford rooftop solar systems upfront [10]. For commercial customers, solar service models are attractive for those who do not view solar PV as part of their core business and hence would like to a third-party to manage the risks associated with ownership [11]. As more people adopt solar PV through solar service business models, evidence from the U.S. shows that the price of PV systems under these models became competitive with the customer-owned model. In Southern California, for example, the third-party residential PV system prices were initially higher than the customer owned system but the prices decreased over time until they converged with customer owned system prices from 2009 onward [5]. So, the attractiveness of the solar service models becomes self-reinforcing.

In the case of the Solar PPA model, the customer has zero upfront cost for the installation and is obliged to enter into a long-term power purchase agreement (PPA) with the developer. Therefore, the model eliminates the high upfront cost and allows customers to pay for the service over a long period of time, sometimes up to 20 years in the U.S. In addition to addressing the high upfront cost of rooftop solar systems, the Solar PPA model developers have offered electricity from solar PV that is competitive to the local utility's retail electrical tariff. The Levelized Cost of Electricity (LCOE) is a commonly used indicator to compare the costs from different types of power generation sources. There is a wide range of solar LCOEs, when compared across regions in the world. A study by NREL indicated that the LCOE of PV electricity in 2014 ranged from 0.085 to 0.282 USD/kWh in U.S., 0.188 to 0.317 USD/kWh in Germany and 0.112 to 0.214 USD/kWh in China [12]. Lazard reported that the LCOE for residential, commercial-industrial and utility scale ranged from 0.180 to 0.265 USD/kWh, 0.126 to 0.177 USD/kWh, and 0.072 to 0.086 USD/kWh, respectively, for the same year [13]. These LCOEs cannot be compared directly across regions due to the differences of cost components, such as soft costs and financing costs, etc. as well as input assumptions into the models.

This paper helps fill the research gap in the literature by analyzing the economics of Solar PPA structures in an emerging economy, which will serve as a baseline for future market studies in this same region. As the Solar PPA model is relatively new, there is no previous literature on the LCOE of the Solar PPA model in Thailand. Also, by comparing the favorable economics of the Solar PPA vs. Buying Model, the results of this study points to the potential for policy and regulatory change in order for the Solar PPA model be successfully replicated in the context of Thailand and perhaps other emerging economies. The paper takes on the view of a commercial-scale customer ('Customer') to compare the options between buying the system ('Buying Model') and buying the service through a Solar PPA model. The calculation of the levelized cost of electricity (LCOE) is use as the basis for comparison and discussion. This paper is organized as follows. The second section discusses Thailand's policy context and the details of the emerging Solar PPA model in Thailand. The methodology and results are shown in the third and fourth sections, followed by discussion, conclusions and policy recommendations in the fifth and sixth sections.

Background

Progression of Thailand's PV policy

The inception of the adder scheme for solar energy between 2006 and 2010 [14] triggered a PV market expansion in Thailand. The adder scheme is a subsidy that gave 'a premium-price feed-in tariff payment paid on top of the utilities' avoided cost' [15]. The adder scheme for solar power projects granted a tariff rate of 8 Thai Baht (THB)/kWh (0.24 USD/kWh[2]) for 7 years, which was later extended to 10 years in 2009 [16]. In 2010, the tariff was reduced to 6.50 THB/kWh (0.19 USD/kWh) [17]. Upon shifting to a fixed price feed-in tariff (FiT) payment in 2013, the government assigned limited quotas and distinct FiT rates to different scales of installations [18]. Table 1 summarizes the progression of solar incentive measures from the adder scheme to a FiT scheme. To date, most the solar installations in Thailand have been utility-scale[3] (>1 MWp), ground-mounted solar PV systems that resulted from the adder scheme. The rooftop PV market (<1 MWp) currently account for only 1% of the total installed capacity in Thailand [19].

In 2013, the government launched a FiT program for rooftop solar PV systems with a quota of 200 MW. For commercial scale (>10–250 kWp) and industrial scale rooftop PV (>250 kWp to 1 MWp), there were strong interests to receive the FiT and the quota of 100 MW was over-subscribed upon the opening of the application process. The remaining quota of 100 MW allocated for

[2] The exchange rates used in this paper are 33.34 THB to 1 USD (*Note*: Exchange rate as of July 2015).

[3] This paper uses the Thai government's definition of scales. Different scales of installations are defined by the system's installed capacity. Systems' sizing at 0–10 kWp, >10–250 kWp, >250 kWp to 1 MWp, and >1–MWp are categorized as residential scale, commercial scale, industrial scale, and utility scale, respectively.