

# Applying ESCO to Advance Deployment of Solar PV – Chinese Taipei’s PV-ESCO Business Model

## CASE STUDY

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## Executive Summary

To achieve the energy transition goal, the Government of Chinese Taipei has set the target of reaching 20% of power supply from renewable energy sources by 2025, among which Solar PV will contribute a targeted 20-Gigawatt (GW) installed capacity. In order to achieve this ambitious target, the Bureau of Energy (BOE) has integrated the widespread Feed-in-Tariff (FiT) scheme with Chinese Taipei’s domestic Energy Service Company (ESCO) industry, and establishes Chinese Taipei’s PV-ESCO model. This case study first presents a brief introduction in terms of Chinese Taipei’s energy policy background and historical development for the promotion of renewable energy; followed by the descriptions on PV-ESCO model’s unique features and dynamics. Subsequently, this study provides several successful demonstration stories for rooftop as well as ground-mounted solar PV case that followed the PV-ESCO model. This case study concludes with a general discussion on the similarities and differences between Chinese Taipei’s PV-ESCO model and other nations that have adopted FiT scheme as the primary incentivizing policy tools for renewable energy deployments.

## Energy Policy Background and Energy Transition Goal

As an island country, Chinese Taipei is highly populated with limited land and a few natural energy resources. The country depends heavily on imports to meet its energy demand. Moreover, facing the challenge of global climate change and the pursuit of sustainable development, facilitating renewable energy deployment has become extremely important for Chinese Taipei’s future. The government has pledged to increase the percentage of renewable energy to 20% by 2025 while launching energy transition and power market reforms. To achieve the energy transition goal, Solar PV and offshore wind power will account for 66.3% and 19.0% of all renewable power capacity, i.e., accumulating to 20 Gigawatt (GW) and 5.7GW, respectively by 2025<sup>2</sup>. To incentivize private sector installation, the government has actively promoted a combination of the PV-ESCO business model, and a FiT mechanism. The model and the mechanism will be discussed in more detail in the following section.

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2. <https://english.ey.gov.tw/News3/9E5540D592A5FECD/777fcee7-90db-4b72-9927-573eef9ea9e>

## Renewable Energy Development Issues

Like many countries around the world, policy support from the governments has been vital to renewable energy investment and development either in the form of financial incentives or regulatory interventions. For most countries, government subsidies are seen as necessary to promote renewable energy sources especially in the early stages of their development, when the cost of renewable energy production is often not economically feasible compare to conventional fossil fuels. In order to stimulate market demands, governments all over the world provide various financial incentives to encourage its adoption since the price is often the key constraining factor. For example, Germany was the pioneer in enacting its Renewable Energy Sources Act in 2000 that guarantees a fixed FiT for at least 20 years in which the government pays users to reduce price gaps between solar-generated and traditional power sources and the banks offered a low interest rate for solar installation investors. The purpose is to reduce the financial risks of solar PV plant management by offering reasonable price compensation with the obligation of grid connection and electricity purchase mandated to grid operator. These policies successfully help the German solar industry market expand significantly and enabled Germany as the leading European country for renewable energy. Currently, the FiT scheme has been adopted by more than 80 countries and regions around the world<sup>3</sup>.

Put in Chinese Taipei's context, in the absence of government intervention policy, the potential site provider, whether an individual citizen or prospective investor groups would have to, by themselves, secure the investment capital from financial institutions—many of whom are not familiar with renewable energy—to pay for the high up-front price of initial construction cost. Even after power plant has been constructed, the operator would have to pay the subsequent fees to the energy service company for the power plant operation & management activities; negotiate with the state-owned utility enterprise Taipower, and reach an agreement in terms of

the power grid connection, the wholesale price for each of the electricity generated, after which wait for the payback period. As such, the market barriers in the traditional model often thwarted the development of renewable energy.

To address the market barriers and to encourage more solar PV installation, the BOE decided to adopt the successful FiT mechanism from Germany experience as the main policy tool to promote renewable energy development. Aside from introducing the FiT incentivizing mechanism to alleviate some of the high initial financial cost and risks, a successful renewable energy project also requires specialized knowledge and expertise in several different areas, such as efficiency improvements, equipment manufacturers, or utilities. In other words, many of the technical know-hows are beyond the typical interested groups who wish to enter into the renewable energy market, which requires the input from ESCOs. As such, BOE integrates the FIT scheme with ESCOs role and establishes Chinese Taipei's PV-ESCO model. Oftentimes, the PV-ESCOs operate by installing solar panels on the rooftops of buildings and sharing electricity profits (or even paying rent) for the property owners. The government encourages this business service model to reduce the costs of renewable energy installation, operation and maintenance for their customers, who are very often end-users of electricity.

## PV-ESCO Business Model

The PV-ESCO business model intends to facilitate renewable installation and deployment, originally derived from the concept of the ESCO model that helps to provide a broad range of energy consulting and services to consumers, including energy savings, energy conservation, risk management, and retrofit engineering for weatherization projects. With integration of FiT mechanism and diverse financing sources, residents or the public sector can lease land or rooftops of buildings to PV-ESCOs. The PV-ESCO is responsible for procurement, installation and management of the solar PV plant (see Fig. 1). In addition, Chinese Taipei's state-owned utility enterprise, Taipower<sup>4</sup>, has the obligation to pur-

3. REN21, Renewables 2011 Global Status Report, REN21 Secretariat, Paris, 2011.

chase electricity produced by renewable energy generation equipment with long-term contracts (20-years contract for solar PV) and connect them to the power grid<sup>5</sup>. Specifically, Taipower is in charge of establishing grid connection for any operators of renewable energy power generation<sup>6</sup>. In this business model, the potential site providers can benefit by paying lesser amounts or having zero expenses towards initial investment for solar PV installation by receiving rent from PV-ESCOs, while PV-ESCOs make profits by selling solar power through the grid to Taipower with long-term contracts. From PV-ESCOs viewpoint, by being able to do this on a larger scale, these companies can leverage their buying power with manufacturers of solar panels to reduce purchase and installations costs, and thus lower the payback period to more reasonable levels. By addressing the barrier of high initial investment, the business model results in a win-win situation for site providers and PV-ESCOs for solar PV deployment. Figure 1 below illustrates how PV-ESCOs function and their relationship with site providers, banks and Taipower.

One of the fundamental requirements of the PV-ESCO model implementation is that it needs to build on offering solid financial support to the PV site producer. Therefore, in order to provide

a friendly investment environment and flexible loan programs, the BOE visited several financial organizations such as associations of banks, local banks, and insurers to introduce FiT operations and loan programs for solar PV systems (see Fig. 2). The current policy and business model were modified after collecting feedback and recommendations from these financial sector stakeholders to create a well-established market for residents and solar PV producers that includes sound loan mechanism, professional consulting and open opportunities. Several hundred employees from financial institutions have been trained to facilitate the solar PV loan model, in risk assessment and control, and to build communication platforms for policy advocacy. Each year, the BOE invites relevant governmental and non-governmental organizations, scholars, and experts to reassess tariff calculation. Based on inputs from these stakeholders, the tariffs are determined for solar power specific to the technology, type of system (rooftop or ground-mounted), and location. The idea is to provide reasonable return for solar PV investors through financial support from banking institutions, hence leading the PV-ESCO business model to further drive solar PV expansion and meet the goals of solar PV deployment.

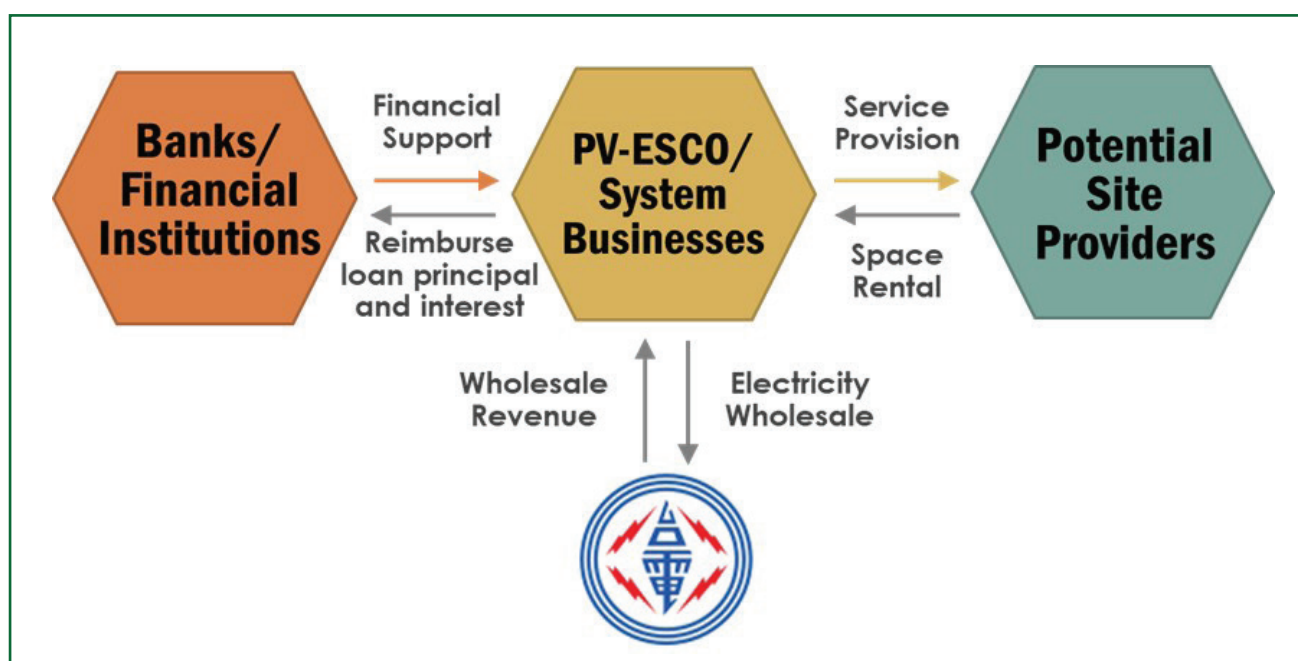


Figure 1: Illustration of PV-ESCO business model

4. <https://www.taipower.com.tw/en/index.aspx>
5. <https://www.re.org.tw/information/more.aspx?cid=193&id=3457>
6. <https://law.moj.gov.tw/Eng/LawClass/LawAll.aspx?PCODE=J0130032>

Since one of the fundamental requirements of the PV-ESCO model implementation is that it needs to build on offering solid financial support to the PV site producer. Therefore, in order to provide a friendly investment environment and flexible loan programs, the BOE visited several financial organizations such as associations of banks, local banks, and insurers to introduce FiT operations and loan programs for solar PV systems (see Fig. 2). The current policy and business model were modified after collecting feedback and recommendations from these financial sector stakeholders to create a well-established market for residents and solar PV producers that includes sound loan mechanism, professional consulting and open opportunities. Several hundred employees from financial institutions have been trained to facilitate the solar PV loan model, in risk assessment and control, and to build communication platforms for policy advocacy. Each year, the BOE invites relevant governmental and non-governmental organizations, scholars, and experts to reassess tariff calculation. Based on inputs from these stakeholders, the tariffs are determined for solar power specific to the technology, type of system (rooftop or ground-mounted), and location. The idea is to provide reasonable return for solar PV investors through financial support from banking institutions, hence leading the PV-ESCO business model to further drive solar PV expansion and meet the goals of solar PV deployment.



*Figure 2: Illustration of diverse financing sources for PV-ESCO business*

Since one of the major requirements for solar PV deployment is the amount of available space areas, when the PV-ESCO model first being imple-

mented, the Chinese Taipei government started by surveying the potential rooftops and lands owned by the central government or other state-owned enterprises. Secondly, it is important to note that due to different climate conditions, the interests and application volumes of constructing solar PV projects mainly located in the western and southern city and county districts where there are ample amount of sunlight. In recent years, the local governments of Chinese Taipei have also started to seek guidance from the central government, hoping to replicate central government's success, such as environmental benefits and additional revenues from installing solar panels on their rooftops, and willing to provide their own building rooftops or idle spaces as the potential sites for PV-ESCOs. Specifically, the BOE has collaborated with 19 local governments to lease unused rooftops and land for solar PV deployment with the PV-ESCO business model. To ensure the progress of solar PV development, the Government of Chinese Taipei has also established a three-tier coordination mechanism and dedicated units led by the Vice-Premier, Executive Yuan, to conduct regular performance reviews. In addition, the BOE has also organized working groups with local governments, for example Chiayi County, Yunlin County, Tainan City, etc., to accelerate solar PV programs in local areas. As such, the coordination and cooperation among central and local-level government agencies is also an important factor for Chinese Taipei's solar PV deployment. As of now, the majority of solar PV installation in the island has been based on PV-ESCO model. The next section provides some of the successful projects that utilized such model.

## PV-ESCO Showcase Projects

To briefly recap, Chinese Taipei's energy transition goal of 20% of power generation from renewables by 2025, the Government has set the target of installing 20 gigawatts (GW) capacity for solar photovoltaic (Solar PV), of which 8 GW shall be installed on rooftops and 12 GW from ground-mounted solar PV. To achieve this goal, the government has adopted the PV-ESCO model as the main policy tool to facilitate the Solar PV deployment. Chinese Taipei has limited land resources suitable for large utility-scale solar PV, for instance roughly two-thirds of its territo-

ry is in the mountainous region. Therefore, the proper siting for renewable energy deployment and the need to create a symbiosis relationship between renewable energy and environment has been the top priority. Due to this limitation the government has been prioritizing the installation of rooftop solar PV. The following successful solar projects are categorized into two types: rooftop solar PV and ground-mounted solar PV (shown in Fig. 3 and 4.).

### Successful projects of rooftop solar PV

As mentioned before, the implementation of Chinese Taipei's renewable energy policy first began with installing solar PV on central government's and state-owned enterprises buildings as demonstration projects, with the aim of encouraging private and residential buildings willingness to participate. In the beginning, many of the public rooftop solar cases were installed in: agencies office buildings, school campus, and military compound. Later, it also expanded to industrial factories districts, commercial harbors, and parking structures. The basic information for each of the four cases shown in figure 3. (1) the GFun Industrial Corporation is an example for industrial factories since it is a textile manufacturer located in the Taoyuan industrial

district; (2) the Suao Port Branch Office is an example of central government's effort in promoting solar PV as this site is the branch office to the Ministry of Transportation and Communications (MOTC); (3) the Chiyai Zhulu community is a group of residents that were impacted by a typhoon event and relocated to a new housing community<sup>7</sup>; and (4) the Tainan Meikuei Farm is an example of integrating solar PV with farm houses.

In terms of benefit and impact of installing solar PV, it is estimated that 1 kW of solar PV installation could contribute to more than six hundred kg of carbon dioxide reduction annually. Also, it is important to note that since most of ESCOs are specialized in energy conservation and retrofit engineering for weatherization projects, solar PV systems installed on rooftops reduce the thermal stresses on buildings by lowering the roof temperature and thereby enabling reduced energy consumption of indoor air conditioning, as such, one of the immediate and obvious benefit of installing the rooftop solar panel is the reduction of the climate control cost. For example, in a recent interview<sup>8</sup>, the owner of Meikuei Farm, a dairy farmer who was going to renovate her 25-year old farm house, was ad-



Figure 3: PV-ESCO showcases of rooftop type

7. <https://www.youtube.com/watch?v=UanYwVVzqyk>

8. <https://www.youtube.com/watch?v=JDvYNOR-OQA>

vised by an energy service company to install rooftop solar PV to minimize climate control costs, as dairy cattle are very sensitive to heat, the cost of electricity often skyrocketed during summer time. After 3 years of installing solar panel, the average temperature of the farm house decreases by 2-3 Celsius degree as well as the subsequent electricity bills. In another, the textile factory of GFun Industrial Corp. also experienced the benefit of retrofitting the rooftops of their facilities, and the cooling effects of their production lines.

Currently, in addition to the Meikuei Farm depicted in Fig. 3 there are several successful cases of installing rooftop PV on livestock housing, existing operating solar PV cases also includes hen houses, and pig husbandry<sup>9</sup>. Both the farmers and ESCOs have benefited from this dual-use solar installations. For farmers, the solar panels provide self-generated energy, which decreases the cost of utility bills. On the other hand solar developers did not have to spend as much time and resources scouting the sites for installation, as most agriculture farms are already on level ground with existing buildings in place. Due to popular demand of solar PV in livestock housing, the Council of Agriculture (COA) has proposed

solar PV for agricultural facilities project<sup>10</sup>, and are developing guidelines, best practices and standards. The purpose is to ensure the solar PV deployment does not grow at the expense of farmland, and to create a symbiotic relationship between the agricultural activity and the solar array, as both benefit from the co-location. The COA's project would utilize the PV-ESCO business model. Livestock farmers would provide rooftop space, and the PV-ESCOs would be responsible for PV construction, loan applications, site management and maintenance with long-term contracts in place for electricity purchase.

### Successful projects of ground-mounted solar PV

Chinese Taipei is a densely populated island and roughly two-thirds of the country is mountainous. As such, the land constraint is an important issue, especially for the deployment of large utility-scale ground-mounted solar PV parks. Therefore, the government has been working on establishing a proper siting decision mechanism that can assure the public about environmental and ecological concerns while assisting the renewable energy companies in alleviating the challenges and barriers with promoting solar PV. The unique features of ground-mounted



Figure 4: PV-ESCO showcases of ground-mounted type

9. <https://www.youtube.com/watch?v=FmMK9cVLxLw>

10. <https://age.triwra.org.tw/Home/Index>

PV projects highlighted in Fig 4 is that, these ground-mounted solar PV cases are deployed on parcels of lands that are either suitable for multi-functional land uses, or do not require valuable land areas such as the case for floating solar PV. The basic information for each of the four cases shown in figure 4 are as follows: (1) the Fudekeng Environmental Restoration Park used to be a waste landfill site and has now been converted into an integrated solar PV park ; (2) the Chiayi County Salt Industry Land was a historical area for salt production; (3) the Agongdian Reservoir case is the country's first floating solar PV project that was deployed in a reservoir; and (4) the Dawuding Retention Basin case is an example of deploying floating solar PV at the flood prevention facilities. In short, Chinese Taipei's solar PV deployment for utility-scale ground-mounted solar PV has been based on the spirit of creating a symbiosis relationship between renewable energy and environment, with compound land uses as guiding principle.

## Concluding Remarks

The Chinese Taipei government has introduced a number of programs and fiscal incentives to increase the deployment of solar PV in the country since the 2010s. Subsequently, the government has revamped their long-term view on the country's energy policy by reducing the dependency on nuclear energy and focusing more on renewables. In recent years, the government has shown its support for PV power development through its passage of the Renewable Energy Development Act and the implementation of FiT mechanisms. This study provides the policy environment and background for the development of its PV-ESCO model, with several successful deployed solar PV projects using such model. With the introduction of the PV-ESCO model, and contribution from central and local government agencies, it allows for the possible transformation of potential unused spaces into PV sites systematically and spur the private investment needed to achieve a sustainable green energy future.

Each year, the BOE invites relevant governmental and non-governmental organizations, scholars, and experts to reassess the tariff calculation for each renewable energy sources. The decision-making process often include collect-

ing information and lessons from other countries such as Germany and Japan. In particular, Chinese Taipei benefited from the experiences in the German system, especially with regard to degression of feed-in tariff rates over time, which could significantly reduce payments to producers over the course of a contract, and in turn encourage greater competitiveness among renewable power providers in the future. Second, Germany uses fixed and regulated FiTs to provide greater protection to investors. In this system, tariffs are predictable and can reduce the investment risks in the next several years for investors. In Chinese Taipei, the central government hold annual tariff evaluation commissions to decide the tariff standards for solar PV that are adjusted every six months. On one hand such method provide flexibility for policymakers, on the other this system lacks predictability and might be less conducive for investors in long-term investment. With the adoption of the PV-ESCO model, the country's installed PV capacity has grown significantly since then, and it is expected that the PV-ESCO model will remain as the main policy tool for promoting solar PV.

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