

## Investing Decentralized Energy: Condition and Joint Efforts from National to Local

Wang Xin, Haixing Meng

### Highlights

The development of decentralized energy system, take the example of Solar PV, processed from the stage of Large Scale PV (LSPV) to the stage of Decentralized Scale PV (DSPV). To some extent, the experience and efforts on promoting LSPV programme (Golden Sun Programme), created conditions for DSPV, including the domestic production, technical standard establishment, and exploration on policy design and related policy instruments implementation. However, lack of top-down design of policy intervention as well as down-top feedback mechanism increase the challenge of decentralized energy system development. Based on the main drivers and concerns found in the study for promoting DSPV, It is highly recommend that more joint effort from central government to local government should working together and take actions on this as following:

### Recommendations:

- Launching high level education institute initiatives for energy policy study and evaluation, especially by broadening the role of Higher Education Institutions (HEIs) on research and curriculum development on SD to effectuate a longer-term impact of policy.
- Creating and identify suitable site or consumer for DSPV construction, including the good financial situation of local government and also good conditions of consumers with large electricity consumption and suitable roofs. It is advisable to use the Multi-Stakeholder Partnerships as a methodology in the policy making and coordination practices.
- Promoting policy and financial innovation to increase funding and investment, including increase confidence bank to issue loans by policy, adjusting the amounts of subsidies and electricity price.

## Challenge and opportunity for decentralized energy development in China

### 1. Development from LSPV to DSPV

The development of decentralized energy system, take the example of Solar PV, processed from the stage of Large Scale PV (LSPV) to the stage of Decentralized Scale PV (DSPV). The Golden Sun Programme is one typical example of LSPV. We believe the development of LSPV create the fundamental conditions for DSPV, which includes as following points:

#### (1) Quick-start of domestic PV market

In prior to 2009, the domestic PV market grew slowly. More than 90% of domestic PV assemblies were exported to overseas market. After 2009, the annual growth rate of domestic PV market exceeds 100%, and export proportion was decreased to 82.5% in 2012 compared to 95% several years earlier.

#### (2) Promote the cost decrease of PV power generation construction

Due to the expansion of domestic PV market and improvement of supporting industries, polysilicon gained a substantial increase in production and reduction in cost, making rapid decline in the price

of PV modules and photovoltaic systems. According to the survey carried out in 2012 on the PV module manufacturer, the manufacturing cost of PV modules is about \$ 0.62- \$ 0.65USD, all-around cost about \$ 0.7USD, reasonably priced at \$ 0.73USD (about 4.5 yuan), a total investment of rational system rated at 10,000 yuan / kW. In the areas where have the equivalent annual utilization hours of 1100 hrs, photovoltaic electricity is about 1 yuan / kWh (in July 2008, the National Development and Reform Commission approved the Shanghai Chongming Island 1MW grid-connected photovoltaic power plant electricity tariff of 4.0 yuan / kWh). Compared with 2007, PV module prices fell by 87.5%, system prices fell 83.3%, photovoltaic electricity tariff fell by 77.8%.

### **(3) Substantial design improvement of distributed PV power generation**

Through years of practice, the design capacity of distributed photovoltaic systems has been greatly improved, including resource assessment and forecasting electricity, BIPV design, direction, shelter, heat and other solutions to the problem, design optimization and coordination in terms of the PV array tilt, power generation, combined with the design and construction of photovoltaic systems, photovoltaic building construction, grid connection systems, distributed photovoltaic monitoring, operation and maintenance of photovoltaic building etc.

### **(4) Provide impetus to the issue of related technical standards and management regulation**

The development of LSPV promote the study of related technical standards for product production and also installation process, especially the technical standards and process on grid connection.

There are still some challenge and experience from Golden Sun Programme, which includes the increased cost of the whole system, the use of low-quality products (even including discarded returns from abroad) meant subsidy requirements were not being met. It is understood that some factories supplying crystalline silicone components declared costs of just 9.5 yuan per watt and, for thin membrane batteries, just 6.5 yuan: 20% lower than the current lowest production cost. In addition, the focus of Golden Sun subsidies is on installation, rather than resolving the substantive issue of grid prices. The government holds in its own hand the right to approve each project.”

## **2 Challenge on Policy design on promoting DSPV**

However, lack of Top-down design of policy interventions as well as down-top feedback mechanism is the main challenge for promoting decentralized energy system in China. Which embodied with the following points:

### **(1) Multiple Departments/Authorities mixed on policy design and release.**

Except the Development and Reform Commission from Country level to Local government level to set the main target, budget or price making for decentralized energy system, there are also other departments like Construction and Housing, Environment, Energy sector and National Grid company doing the relevant policy interventions to promote the main policy released from country level. However, these complex and various interventions need more combined re-design to make it more effective.

In addition, decentralized energy system is still one new things in China. Usually there should be more time for different stage of the product cycle, including the research and design of product, pilot project, popularizing the product and related policy, regulation and technical standard adjustment. Actually, we are developing this application of decentralized energy product at a very fast speed without enough time on research and evaluation. That makes our policy interventions

adjusting frequently and not stable.

**(2) Data base construction for analysis**

In order to evaluate the development of decentralized energy system development, there is the requirement to normalize the data collection and reporting system, which includes the classification of indicators on energy supply and use, standardized data measurement, monitoring and reporting system, platform or institute responsible for data base construction and analysis.

**(3) Financial shortage and unstable subsidy interventions**

The private investor request that more annual subsidy based on power generation capacity in order to get the investment back earlier. There is the challenge for government if have enough budget on this and also adventure on possible financial loss for the reason of technical innovation and product replacement.

**3 Local Roles and their roles on promoting decentralized energy project**

As the difference on economic development and also natural environment in different provinces in China. There is the opportunity that local government may perform a more and more important role in promotion decentralized energy system. It will be more flexible and easier for local government to take actions on decentralized energy system development according to the current situation of local area including the energy resource amount and quality, Institution on research and technical innovation, financial funds and so on.

In the decentralized Roof-top PV project in Shanghai, there are four main actors including the local government, local national grid, the investor and power producer, and the consumer. This project is one typical case on decentralized PV power system in Shanghai, so the scale of the mechanism of this project is based on province scale ( Shanghai is municipality directly under the Central Government as same level as the province) and also the technical part of PV power . As the local government department, Shanghai National Development and Reform Commission (NDRC) is very important to implement the related policy and incentives coming from the center government including Promotion and adjustment on the national policy, regulation related to decentralized energy system and guarantee its implementation in Shanghai, to approve the project starting, and to provide subsidies to the decentralized power generators. Shanghai Power Company is at the position to provide overall technical support between the decentralized energy system and national grid and to be the judge on the power generation capacity of the decentralized power generator. Its role and contribution includes setting the technical standard and to approve the grid connection from the decentralized energy system, and it the third party for judging the electricity generation capacity from the decentralized energy system. Shanghai Shilite New Energy Technology Co., Ltd. Is the investor of this project providing the total loan for this project and Shanghai Safegreen Technology Co.Ltd is the main implementer of this project and is responsible for Project design, installment and maintain for the system and it will get the subsidy from the government. Shanghai HITACHI Company is the consumer of this project providing suitable roof placing the project,consumption of the electricity generated from the decentralized energy system and coordinating the cooperation for the operation of the project. And this mechanism organization can be seen from the table below.

**Tab. Related roles on Roof-top decentralized PV project in Shanghai**

Related Entity	Basic Information	Role
<p>Local Government :</p> <ul style="list-style-type: none"> <li>Shanghai National Development and Reform Commission(NDRC) and its branch at related District</li> </ul>	<p>Sector: Public, Environmental, Financial,</p> <p>Ownership: Public</p>	<ul style="list-style-type: none"> <li>Promotion and adjustment on the national policy, regulation related to decentralized energy system and guarantee its implementation in Shanghai.</li> <li>To approve the project starting</li> <li>To provide subsidies to the decentralized power generators</li> </ul>
<p>Local-National Grid</p> <ul style="list-style-type: none"> <li>Shanghai Power Company</li> </ul>	<p>Sector: National Grid, Professional standard</p> <p>Ownership: Stated own</p>	<ul style="list-style-type: none"> <li>Setting the technical standard and to approve the grid connection from the decentralized energy system</li> <li>The third party for judging the electricity generation capacity from the decentralized energy system</li> </ul>
<p>Local decentralized PV energy company and investor</p> <p>Shanghai Shilite New Energy Technology Co., Ltd.</p> <p>Shanghai Safegreen Technology Co.Ltd</p>	<p>Sector: decentralized energy generator</p> <p>Ownership: Private</p>	<ul style="list-style-type: none"> <li>Project design, installment and maintain for the system</li> <li>Subsides gainer</li> <li>Engineering Procurement Construction</li> <li>Investor</li> </ul>
<p>Customer</p> <p>Shanghai HITACHI Company</p>	<p>Sector: User</p> <p>Ownership: Joint venture(State-foreign)</p>	<ul style="list-style-type: none"> <li>Consumption of the electricity generated from the decentralized energy system</li> <li>To provide suitable roof placing the project</li> <li>Cooperation for the operation of the project</li> </ul>

## Recommendation

### Recommendation 1:

Launch the high-level energy research institute or organization to coordinate the research teams from different universities, institutions and companies to make the classification of energy use indicator and also mechanism of data monitoring and reporting, to build the standardized energy data base for research and evaluation.

Education for Sustainable Development (ESD) and especially Higher Education Institutions (HEIs) for ESD plays a critical role in accelerating the transformation towards sustainable development. And HEIs-ESD has become a new impetus in promoting the educational system may seize

opportunities and put ESD high on their agenda and promoting a long-term impact on the policy making in the countries. Under this background, it is advisable that HEIs to broaden the role not only on research, but also include aspect on education/ curriculum development on ESD, and which contains the decentralized energy system in its chapter on energy issues.

Tongji University, in building itself towards a "sustainability-oriented university", provides one case study on HEIs' role for ESD. By carrying out interdisciplinary education including Public Courses on SD for undergraduates and Minor Degree of SD for postgraduates, it aims to further promote the idea and practice of SD among the students in the campus. Courses and lectures covers 9 aspects were provided to the students, including: Environment Management and Sustainable Development, Green Building and Sustainable Development, Environment Law and Sustainable Development, International Relations and Sustainable Development, Green Economy and Sustainable Development, Design& Innovation and Sustainable Development, Germany Study and Sustainable Development, Higher Education and Sustainable Development, Green Agriculture and Sustainable Development. Universities need to carry out interdisciplinary education on actively with the advantage of complete disciplines, learn from the advanced experience, put efforts on the innovation and breaking through in the fields of ESD, and provide possible solutions for SD.

#### **Recommendation 2:**

Encourage the market participation on decentralized energy system investment such as the PPP business model, innovation of financial product to increase investment from private capital. Which also need the guarantee and coordination from local government like stable subsidy interventions and supervision of energy generation and transferring.

As the lack of experience on investing DSPV, the banks still not **confident to issue the loans** to the investors on DSPV project construction. It is recommended that the government should launch and express clear points in policies to increase confidence of bank systems to issue the loans.

**Subsidies** is one of the key driving factors promoting the decentralized PV generator in Shanghai case as it is related with the benefit very much. The electricity generated by the decentralized PV system in the project will be sold to the consumer with 80-85% of the price of Grid, which as around 0.146 USD/kWh. And they will get 0.068USD/kWh subsidy according to the generation capacity, which is measured by the national grid. The policy of subsidy on going will be effective for 20 years. It is suggested by the decentralized PV investor that a higher subsidy benefit will be better for them to get the investment cost back more quickly, even they can forgo the subsidy in the years after they get the investment cost back, as the power benefit from the consumer will support their company enough then.

From the local level, the electricity price is also one of the main concerns to promote the DSPV, it is recommended that suitable **peak-valley price of electricity** usage will promote the consumer to accept the electricity generated from DSPV, especially the industry consumers, who have to pay higher for electricity usage in daytime will considering power from DSPV with lower price, can save the cost on power.

Considering the challenges on cost for communication and trust building between the stakeholders. It is advisable to use the Multi-Stakeholder Partnerships as a methodology in the policy making and coordination practices.

The SDG 17 points that "a stronger commitment to partnership and cooperation is needed to achieve the Sustainable Development Goals." It "require coherent policies, an enabling

environment for sustainable development at all levels and by all actors and a reinvigorated Global Partnership for Sustainable Development." Multi-stakeholder partnerships, on side, it enhance the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, to support the achievement of the sustainable development goals in all countries, in particular developing countries. On another side, it encourage and promote effective public, public-private and civil society partnerships, building on the experience and resourcing strategies of partnerships. In order to achieve the SDG 17, a series of methods on multi-stakeholders partnerships building are provided, which can be used for promoting policy design and practice on decentralized energy systems.

### **Recommendation 3:**

Cooperation and communication mechanism between different stakeholders to have more clear evaluation of policy and product with the form of workshop for example. Which need the coordination and leadership of responsible local government and efforts of experts.

In order to make one successful project, **Consumer with suitable condition** is main carrier to make the project happen and also consuming most of the electricity generated from the project. The decentralized PV power generators and their investors are mainly medium or small private enterprise. One reason is that state owned enterprise prefers to invest the large size of ground PV power station with their advantage to get the large area of space land and loans. The investment capacity, large power consumer and suitable roof condition are the 3 main points for the decentralized PV investor consideration. The roof decentralized PV project relied on the roof and building conditions a lot. More flat and wide roof conditions means that they can get more area for laying the solar panels and spend less time, strength and expense on smoothing the roof to make it fundamental condition ready and safe for construction. Meanwhile, a large power consumer means that most or all of the power generated by the decentralized PV systems can be consumed totally to get the biggest benefit and no waste of energy.

**The approval and cooperation between departments** work well and efficiently in Shanghai case. Especially the local NRDC, and national grid company take their roles on administrative approval and grid technical connection, contribute a lot to the success implementation of this project. However, related professional standard and regulations need to be developed to ensure the market in order and safety of the project implementation.

### **Reference:**

Bambawale, M. J. and B. K. Sovacool (2011). "China' s energy security: the perspective of energy users." *Applied energy* 88 (5): 1949-1956.

Geng, W. and Z. Ming, et al. (2016). "China' s new energy development: Status, constraints and reforms." *Renewable and Sustainable Energy Reviews* 53: 885-896.

Peidong, Z. and Y. Yanli, et al. (2009). "Opportunities and challenges for renewable energy policy in China." *Renewable and Sustainable Energy Reviews* 13 (2): 439-449.

Ruiwen Duan, D. S. (2015). *Implementation Report of Roofing 2.5MW distributed grid-connected PV power generation projects in Shanghai Hitachi Household Appliances Company (1st phase 1.7MW)*. Shanghai, Shanghai Shilite New Energy Technology Co., Ltd.

黄珂 (2015). *多中心理论视角下的中国分布式能源发展政策研究*, 华北电力大学. 硕士: 63.

王斯成 (2013). "分布式光伏发电政策现状及发展趋势." 太阳能(8): 8-19.

**Authorship:**

Wang Xin, UNEP-Tongji Institute of Environment for Sustainable Development  
Haixing Meng, College of Architecture and Urban Planning

Acknowledge: This policy brief is completed with the support of ProSPER.Net joint project "Understanding decentralised energy interventions and their success conditions in select countries of Asia – Pacific" done by cooperation of TERI University of India, AIT of Thailand, and Tongji University of China from 2015-2017.