Chapter 5

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Chapter 5

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Sufang Zhang[15]

Abstract

Distributed solar photovoltaic (DSPV) power, either located on rooftops or ground-mounted, is one of the most important and fastest growing renewable energy technologies. Since the second half of 2012, China has shifted from large-scale solar PV (LSPV) to DSPV and a series of policies to promote DSPV power deployment has been put in place. Unfortunately these policies were not well performed due to myriad constraints on DSPV power deployment across the country. Building mainly on non-academic sources including government documents and presentations, industry reports and presentations, media reports, and interviews, this chapter firstly provides a comprehensive review of China's policies on DSPV passed between the second half of 2012 and the first half of 2014, then barriers associated with DSPV deployment are identified. This is followed by an account and discussions of recent policy changes since September 2014, and major local incentives. In addition, policy performance is briefly reviewed. Conclusions and policy implications are provided at the end of the chapter. This chapter provides an understanding of the recent DSPV policy progress in China and insights for policymakers in other economies that are experimenting with DSPV power policies.

Keywords: Distributed solar photovoltaics, PV, renewable energy policy, China

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1. Introduction

Solar photovoltaic (PV) power is currently, after hydro and wind power, the third most important renewable energy source in terms of globally installed capacity. More than 100 countries use solar PV power. The major installations of solar PV power are ground-mounted (utility scale or large-scale) PV (LSPV) power, and distributed solar photovoltaic DSPV power. DSPV power projects have different definitions. For instance, according to the National Development and Reform Commission of China (NDRC, 2013) and the State Grid of China (SGCC, 2013), DSPV power projects are defined as projects with generation on or close to the user site, instantaneously consumed by end users themselves, that is, self-consumed, and for which excess power can be grid-connected and the system can be balanced in the grid (NDRC, 2013), with project sizes smaller than 6 megawatts (MW) (State Grid, 2012). Whatever the definition is, DSPV power is solar energy–essentially rooftop and small, local, plants, that is either not sent to a grid, or, may be supplied to a local distribution network rather than to a high-voltage grid.

DSPV power projects have several advantages over remote LSPV power projects: (1) by being situated close to demand centres, the total energy and economic efficiency of the energy system is enhanced as line losses and investment costs in the transmission infrastructure could be reduced or eliminated; and (2) typically installed on rooftops, they require little land, which is at a premium in China.

DSPV power has become a noticeable source of electricity generation in Germany, the United States (US), and Japan. In China, although DSPV power generation dated back to 1996 when the Brightness Programme was initiated, which was followed by the Township Electrification Programme in late 2002, the domestic solar PV power market – both LSPV power and DSPV power – didn't see much growth due to lack of support from the government until 2009 when two national subsidy programmes for DSPV power projects, namely the Rooftop Subsidy Program and the Golden Sun Demonstration Program, were implemented, in the hope of incentivising domestic demand to rescue the domestic ailing solar PV manufacturing industry suffering from the 2008 global financial crisis.[16]

[16] During 2004–2008, driven jointly by the explosive growth of global demand for solar PV starting in 2004 as well as by a number of domestic factors, China' solar PV policy was export-oriented and over 95% of its solar PV products were exported.

Thanks to these two national subsidy programmes, the DSPV market has expanded. By the end of 2012, the cumulative capacity of DSPV across China reached 2.5 gigawatts (GW), accounting for 36.4% of the solar PV market (Zhang et al., 2013; Zhang et al., 2014).

Though these two projects did stimulate the domestic market, to some extent they have also contributed to the overcapacity in China's PV manufacturing industry. Overcapacity coupled with trade tensions with the US and Europe over China's solar PV products since the end of 2012, prompted the government to increasingly attach importance to its booming domestic solar market (Zhang et al., 2013). Given that the retail and/or commercial electricity tariffs are high in the eastern provinces, and the lack of grid transmission and land availability will constrain utility scale projects in the country, the government decided to attach more emphasis on distributed installations.

As a consequence, since the second half of 2012, China's DSPV market development strategy has witnessed a series of policy changes aimed at making DSPV power development an equal priority with LSPV power development. However, the DSPV power market has not developed as expected. The share of DSPV power in the total cumulative capacity of solar PV in the country was only 16.65% in 2014, and the new installation of DSPV in the year was only 2.05 GW, lagging the target of 8 GW set by the government in the beginning of 2014 (NEA, 2015).

Our literature review shows that along with the solar PV industry development over the past decade and the emergence of China's domestic solar PV appliance market, studies have provided accounts of the Chinese solar PV policy and development (Zhao et al., 2013; Zhang et al., 2013; Sun et al., 2014; Zhang et al., 2014; Zhi et al., 2014; among others). Yet, to the best of our knowledge, there is little literature specifically focused on DSPV power deployment in the country. A few exceptions are Yuan et al. (2014) and Zhang et al. (2015). While Yuan et al. (2014) employed an analytical framework of levelised cost of electricity (LCOE) to estimate the generation cost of DSPV in China, Zhang, et al. (2015) reviewed China's DSPV market development and policy changes since 2013, presented cost and time requirements for installing DSPV in China, which provide some insights for this study.

Nevertheless comprehensive studies on China's DSPV power policy progress from the end of 2012 to early 2015 seem unavailable. The purpose of this study is to fill this gap. To this end, the chapter is organised as follows. Section 2 presents the DSPV power policies implemented from the second half of 2012 to the first half of 2014 and Section 3 analyses

the major constraint on DSPV power deployment in the country, which provides the reasons for new policies. This is followed by Section 4, which makes a comprehensive analysis on the policy changes since September 2014. In response to the call from the central government, many local governments have also promulgated a number of policy incentives. Section 5 gives a brief account of these incentives of the selected provinces and municipalities. DSPV policy performance is analysed in Section 6. Section 7 provides conclusions and policy implications.

This study is built on data sources and interviews. The data sources are mainly from non-academic sources like industry reports and presentations, websites, media reports, government documents, and presentations. The interviews were conducted during September 2014 and May 2015 at several national solar PV power conferences or through Skype and WeChat. Our interviewees include eight DSPV project developers, two government officials, three renewable energy policy researchers, three managers from grid utilities, and six bankers. Interviews elicited information on the main constraints in the process of completing projects. Most managers interviewed had been engaged in PV deployment and/or research and development for at least 3 years.

The eight DSPV project developers are selected from China's eastern cities in Jiangsu and Zhejiang province and Shanghai municipality, which are the main locations of DSPV projects in China. The three government officials are from the Department of New Energy and Renewable Energy under the National Energy Administration (NEA). The three renewable energy researchers are from the Energy Study Institute affiliated with the National Development and Reform Commission (NDRC). The three managers from grid utilities are involved in implementing the policies. Among the six bankers, three of them are from China's policy banks, two are from the National Development Bank of China, one is from the Export and Import Bank of China, and the other three are from China's national commercial banks.

2. DSPV policy between the second half of 2012 and the first half of 2014

In this section, we provide accounts for China's DSPV power policy regime during the second half of 2012 and the first half of 2014. The key government document that represents the milestone of DSPV development at this stage is the Opinions on Promoting the Healthy Development of Solar PV Industry issued by the State Council on 15 July 2013 (State Council, 2013). Subsequent to the promulgation of this document, more than 30 national documents with regard to specific aspects of DSPV power development have been put in place (Table 5.1). I group the policies provided in these documents into four categories: (1) scale control and registration management; (2) on-grid tariff, subsidy, financing, and fiscal incentives; (3) market promotion – the establishment of demonstration areas of DSPV power generation; and (4) power grid-connection, measurement, and settlement policy.

2.1. Scale control and registration management

(1) Scale control

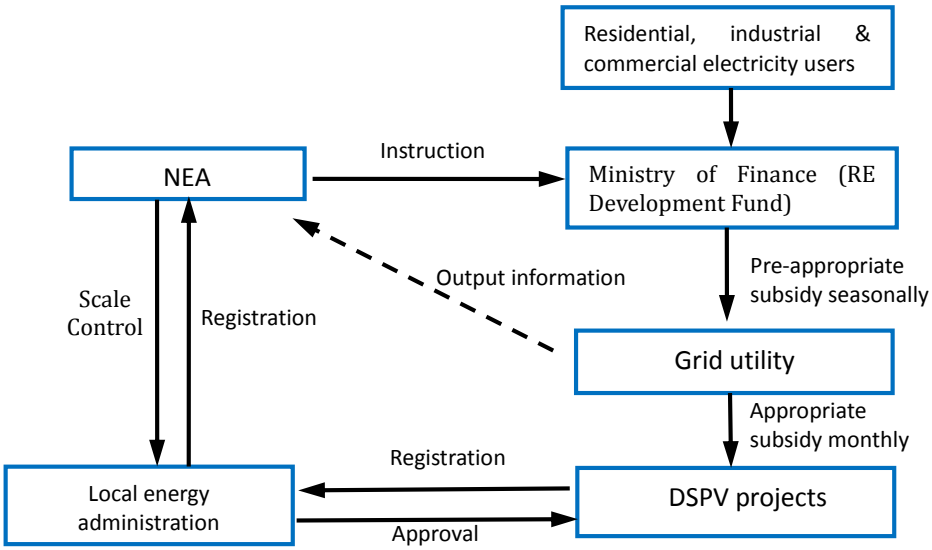
As in other countries, due to its high upfront cost, DSPV power in China requires government financial support. If we suppose 6 GW DSPV power is installed each year and a minimum of 7 billion kilowatt hour (kWh) power is generated, then the total subsidy required from the government would amount to CNY2.94 billion based on the government subsidy policy of CNY0.42 per kWh (for subsidy policy, see Section 2.2). As such, it is necessary to control the scale of DSPV power projects that require government subsidy. The scale control policy provides that the provincial energy authority shall propose the application for the national subsidy according to the local development of the DSPV power projects. The NEA will issue the scale for the next year after coordination of the scale application of the DSPV power generation across the country, and any unused quota will automatically lose effect in the subsequent year. It has to be noted that the quota is limited to the project enjoying the national subsidy (State Council, 2013; NEA, 2013a,b).

(2) Registration management

Except for DSPV demonstration areas where applications and approvals are made uniformly, other DSPV projects enjoying the national subsidy are applied with the registration management. DSPV projects are required to register with local energy

administration. The provincial-level government confirms the detailed registration process. The permit process for DSPV is streamlined. Requirements are waived for generation business licences, planning and site selection, land pre-approval, water conservation, environmental impact evaluation, energy conservation evaluation, and social risks evaluation. Apparently, this could significantly cut the time and paperwork for DSPV projects (NDRC, 2013) (Figure 5.1).

Figure 5.1: Scale and Registration Management



DSPV = Distributed solar photovoltaic; NEA = National Energy Administration; RE = renewable energy.
Source: Author's compilation based on the documents issued by the National Energy Administration and the State Grid Corporation of China.

2.2. On-grid tariff, subsidy, financial, and fiscal incentives

The NDRC issued the Notice to Play the Role of the Leverage of Electricity Tariff to Promote the Healthy Development of Solar PV Industry on 30 August 2013, which provides that the central government will grant a subsidy of CNY0.42/kWh ($0.07) of output from DPSV projects. The subsidy runs for 20 years, to be provided by the China Renewable Energy Development Fund (NDRC, 2013). The grid company must pay for any surplus power PV systems exported to the grid at the local benchmark price of desulfurised coal-fired power units, which ranges from CNY0.25/kWh to CNY0.52/kWh (Ma, 2011), depending on the location of the project. Hence, by generating and consuming his or her own electricity, the host customer not only avoids a power bill, but also receives CNY0.42/kWh from the government for the power generated. The subsidy is pre-appropriated to local grid

companies by the state revenue seasonally, and the grid company repays the subsidy on a monthly basis, making sure that the subsidy is in place in time and at the full amount (NEA, 2013a).

Meanwhile, in order to provide more financing support, the NEA and China Development Bank (CDB), one of China's policy banks, jointly promulgated the Opinions on Financial Services to Support Distributed Solar PV in August 2013. According to this document, CDB would provide a credit line to financing platforms (that is, lump sum borrower) established by local governments, while providing loans directly to various eligible DSPV project investors (NEA and CDB, 2013).

In terms of fiscal incentives, DSPV projects are exempted from four government funds collected on the basis of generation power, including the renewable energy surcharge, the state's major water conservancy construction fund, the large and medium-sized reservoir resettlement support fund, and the fund for repayment of rural grid construction loan (MOF, 2013). A refund of 50% of value-added tax (VAT) upon collection is granted to DSPV projects. In addition, VAT is exempted for those DSPV projects if the monthly income of power sales is less than CNY30,000 (MOF and SAT, 2013).

2.3. Market promotion

In order to promote the deployment of DSPV projects, in September 2012 the NEA released the Notice on Applying for Demonstration Areas for Scaling up DSPV Power Generation. The notice invited each province to apply for no more than three DSPV demonstration areas with a maximum installed capacity of 500 MW and stated that priority would be given to the eastern and central regions in the country where local electricity demand is high (NEA, 2012).

In July 2013, the State Council issued the Opinions to Facilitate the Healthy Development of Solar PV Industry, which announced that the country would build 100 DSPV demonstration areas and 1,000 DSPV demonstration towns and villages (State Council, 2013). In August 2013, the first batch of DSPV demonstration areas was released by the NEA, which involves 18 demonstration areas in seven provinces and five cities, totalling 1.823GW (NEA, 2013b). In November 2014, the NEA announced 12 more DSPV demonstration areas in five provinces and the installed capacity completed in 2015 is expected to reach 3.35 GW (NEA, 2014a).

2.4. Power grid-connection, measurement, and settlement policy

1) Free grid-connection services

The two major state-owned grid companies, the State Grid Corporation of China (SGCC) and China Southern Grid (CSG) provide free connection services for DSPV electricity producers located close to customers, which cover technological assistance such as equipment testing and integration plan development, among others (SGCC, 2013; Zhang and He, 2013). (CSG operates in five southern provinces, Guangdong, Guangxi, Yunnan, Guizhou and Hainan, while SGCC operates in the rest of China). This not only guarantees that DSPV systems can connect to the grid, but also significantly reduces the cost of DSPV projects for installers by waiving both service fees and engineering fees.

2) Streamline grid-connection permit process

Upon receipt of the application for power grid connection, the grid utility will issue opinions on the grid connection within 20 working days, or 30 working days in the case of a multi-point connection. Transformation of the public power grid will be assumed by the power grid, while transformation of the user-side power grid will be assumed by the construction company. The grid utility bears the cost of integration charges for DSPV projects into the public grid and the incurred reinforcement charges. Distributed projects have been exempted from the need to hold a power generation licence since April 2014 (SGCC, 2013).

3) Power measurement and settlement

The grid utility offers free electric metre and backup capacity of the system and shall not charge any service expense in any part. The grid-connected tariff and subsidy shall be settled on a monthly basis and the surplus power may be sold to other power-consuming enterprises (SGCC, 2013).

Table 5.1: DSPV Policies Passed between the Second Half of 2012 and the First Half of 2014

Category	Time	Agency	Document
Scale and registration management	2013-08-12	NEA	Provisional management measures of distributed power projects
	2013-08-29	NEA	Provisional management measures of distributed solar PV power generation projects*
	2014-02-12	NEA	Notice to allocate new construction scale of solar PV projects in 2014
	2013-11-26	NEA	Provisional regulatory measures on the operation of solar PV stations
Tariff, financing, and fiscal incentives	2013-08-26	NDRC	Notice to play the role of electricity tariff leverage to promote the healthy development of solar PV industry
	2013-09-10	NDRC	Notice to adjust renewable energy surcharges
	2013-07-24	NDRC	Notice of the generation-based subsidy policy of distributed solar PV and other relevant policies
	2013-09-27	MOF	Notice on the value added tax policy of solar PV power
	2013-11-19	MOF	Notice of issues about the exemption of government fund for self-generation and self-consumption distributed solar PV
	2013-08-22	NEA CDB	Opinions on financial services to support distributed solar PV
Market promotion	2013-08-09	NEA	Notice to carry out the construction of demonstration areas of distributed solar PV application
Grid-connection, measurement, and settlement	2012-10-26	SGCC	Opinions on providing good services for the grid – integration of distributed solar PV (provisional)
	2012-10-26	SGCC	Opinions on promoting the grid-integration management of distributed solar PV power (provisional)
	2013-02-27	SGCC	Opinions on providing good services for the grid-integration of distributed solar PV (revised)
	2013-02-27	SGCC	Opinions on promoting the grid-integration management of distributed solar PV power (revised)

CDB = China Development Bank; DSPV = distributed solar photovoltaic; MOF = Ministry of Finance; NDRC = National Development and Reform Commission of China; NEA = National Energy Administration; PV = photovoltaic; SGCC = State Grid Corporation of China.
Source: Compiled by the author.

3. Major constraints on DSPV power deployment in China

Through a literature review and interviews with stakeholders, the major constraints on the implementation of DSPV policy and the diffusion of DSPV technology in China are identified as follows.

3.1. Rooftop resources problem

1) Insecurity of rooftop ownership

There are two problems associated with the insecurity of rooftop ownership. Firstly,

in China the ownership of land and the ownership of the building on it are separated. In other words, an owner of a building is not an owner of the land on which the building is built. While the ownership of commercial buildings lasts for 50 years, the ownership of residential buildings lasts for 70 years. This implies that there are legal risks for investment in long-term and large-scale DSPV systems.

Another problem associated with the insecurity of rooftop resources is how to protect the project developers' right when their customers move out and the new property owners refuse to continue purchasing rooftop solar energy. Moreover, China is now in the process of urbanisation and forced house demolitions can take place.

2) Collective property ownership

In China, most urban citizens live in apartment buildings, the roof space of which is collectively owned by all households living in the building. This means any household who wants to construct a roof PV system needs the approval of all other households in the building. This could be time-consuming and difficult. For a PV developer who wants to rent an apartment roof to build a DSPV system or station, the negotiation process will not be easy. In China, there are cases where the property is collectively owned.

3.2. Unattractiveness of on-grid tariff and low proportion of self-consumption

As noted in Section 2, 'self generation, self consumption model with excess sold to the grid' has been a previous requirement for the DSPV development model (NDRC, 2013). Under this model, the proportion of self-generation and self-consumption has a great impact on the internal rate of return (IRR) of a DSPV project. Whilst the host owner of a DSPV project could benefit from avoided electricity bills, that is, the retail electricity tariff is within the range of CNY0.30-1.40/kWh and at the same time receive a subsidy of CNY0.42/kWh from the government for self-generation and self-consumption of DSPV power, the benefit for surplus DSPV power exported to the grid is the local benchmark on-grid tariff for desulphurised coal-fired power units, which is between CNY0.25-0.52/kWh (Ma, 2011), plus the government subsidy of CNY0.42/kWh.

Evidently, this policy disincentivises power export to the grid. And the greater the proportion of self-consumption is, the more revenue there is for the DSPV project. Indeed, the idea behind this feed-in tariff (FIT) scheme is to incentivise self-generation and self-

consumption so as to reduce the influence of the DSPV power on the grid security as much as possible.

A policymaker interviewed told the author that this tariff scheme was based on the assumption that 80% is self-consumption and 20% will be exported to the grid. But the reality is that, due to various factors, self-consumption proportion was largely below 80% thus causing a negative impact on the IRR of the DSPV projects, which tempered the interest of investors in the projects.

3.3. Barriers to grid connection

Although government documents have called for the grid utility to provide timely grid connection again and again, and in response, the two major state-owned grid companies have committed to provide free connection services for DSPV projects and detailed streamline grid-connection permit process are provided, as of today the grid connection procedure is still cumbersome. For instance, a local grid company may require the installation of unnecessary facilities supplied from manufacturers nominated by the local grid company, and the prices of which are much higher than the market price. For instance, a DSPV project developer in Jiangsu province told a correspondent of the newspaper *China Energy* that when his customer, an owner of a small household DSPV system valued at CNY20,000, applied for grid connection, his customer was told that for grid security reasons, a current doubly-fed electronic monitoring equipment must be installed in the system. Further, the brand, the model, and the manufacturer of equipment were designated by the grid company. Since this equipment costs several thousand yuan, his customer had to give up the application for grid connection (Zhong, 2013).

A survey shows that in the leading DSPV provinces of Guangdong, Zhejiang, Jiangsu, and Shandong, it is not uncommon that residents, when going through grid-connection procedures for their rooftop PV systems, couldn't find the staff in the local company responsible for carrying out the procedures of grid connection or the relevant staff are unaware of the grid-connection process and relevant policies.

There are probably two major reasons for this. Firstly, the grid connection policy is implemented through the grid companies' management networks, namely their local branches or subsidiaries at provincial, city, or county levels. Policy implementation from the central level to the provincial and local grid companies takes time. Secondly, local grid

companies are often more resistant to DSPV development, because DSPV generation reduces their electricity revenue and increases administrative costs.

3.4. Difficulty in obtaining financing

Undoubtedly, the above uncertainties have led to difficulty in obtaining financing from financing agencies. It has been difficult to obtain bank financing – banks are simply not comfortable lending to solar projects yet, with some banks reportedly even banning such loans as policy. This is evidenced not only from a speech of the NEA official, Liang Zhipeng, at a solar energy investment summit hosted in early 2014 which stated that many banks in China have restricted and even banned loans to distributed solar projects. At another conference when Chinese officials tried to matchmake between distributed solar developers and domestic banks, some bankers demanded the government first set up a safety net in case such investments turn into bad debts.

The attitude of bankers is evidenced by our interviews with two managers from the state-owned commercial banks. A manager interviewed said 'We bankers couldn't understand and see clearly the risks involved in the DSPV project. The best way for us at the moment is to wait and see.' Another manager interviewed said 'At the present stage, what we could evaluate is the eligibility of loan borrowers rather than DSPV projects per se when issuing loans. Large state-owned enterprises enjoying good credibility are surely our favourite customers'.

But the truth is in China most DSPV project developers are private businesses that lack the good credit to go to banks for loans. On top of that, loan terms in China are often short and interest rates high. After all, this is a country where real estate investments are supposed to offer quick returns of 10% per year and where factory owners like to see payback periods of 4 years or less before approving investments (Anders, 2014).

4. Recent policy changes since September 2014

According to the NEA's statistics, in the first half of 2014, the new installation of DSPV power was only 1 GW, achieving only 12.5% of the 8 GW target for the year (NEA, 2014c). Given the myriad constraints hampering a fast and smooth execution of distributed projects across China, the NEA published the Notice to Further Implement Relevant

Distributed Solar PV Policies on 2 September 2014, as a result of consultation with industry and government representatives. Subsequent to this, a few more documents were promulgated (Table 5.2).

Table 5.2: DSPV Policies passed between September 2014 and March 2015

Category	Time	Agency	Document
Scale and registration management	2014-09-02	NEA	Notice to further implement relevant distributed solar PV policies
	2015-03-16	NEA	Implementation scheme for the construction of solar PV projects
Tariff	2014-09-02	NEA	Notice to further implement relevant distributed solar PV policies
Market promotion	2014-09-11	NEA	Notice to speed up the construction of demonstration area of distributed solar PV power
	2014-11-05	NEA State Council	Notice to organise pilot solar PV projects for poverty alleviation
	2015-03-09	NEA State Council	Working scheme for the implementation of solar PV projects under poverty alleviation program

DSPV = distributed solar photovoltaic; NEA = National Energy Administration; PV = photovoltaic.
Source: Compiled by the author.

4.1. Motivate various DSPV project modes and coordinate rooftop resources

The notice states that measures suitable to local conditions to build DSPV stations are motivated by making use of waste land, barren hills and slopes, the construction of agricultural greenhouses, beaches, ponds, lakes, and other places to accommodate DSPV power on-site. With respect to rooftop resources, the document calls for the local governments to play their role in the coordination of the rooftop resources. The NEA has calculated that the rooftop area in the industrial areas at the provincial and above level amounts to 80 GW.

4.2. New 'pick one of two' policies

According to the notice, power generators when having their new projects registered, can choose from 'self-generation, self-consumption with excess sold to the grid' mode and 'all sold to the grid' mode. In addition, those which have already been registered as self-generation, self-consumption with excess sold to the grid mode can be changed to 'all sold to the grid mode in some circumstances. Under the 'all sold to the grid' mode, the on-grid tariffs for DSPV power are the FITs applied to LSPV projects registered after 1 September 2013, which are CNY0.90/kWh, CNY0.95/kWh, and CNY1.00/kWh depending

on the location of the project, which are likely higher than the on-grid tariff plus CNY0.42/kWh.

4.3. Encourage all types of financing models

The notice stated that banks and other financing agencies are encouraged to provide preferential loans, to establish loan mechanisms based on the pledge of generation power and the property asset of DPSV projects, to build financing services platforms jointly with local government, and to provide preferential loans to poverty-relief DSPV projects, among others. Meanwhile, the provision of discount loan policies by local government and the adoption of all types of financing models such as leases, funds, individual credit, among others, are urged.

In response to the call from the central government, in addition to the CDB, other state-owned commercial banks that are unfamiliar with DSPV projects have progressively shown their interest in providing credit to DSPV projects. For instance, the Industrial and Commercial Bank of China and the China Merchants Bank (CMB) have both issued guidelines on providing credit to the solar industry. While the Industrial and Commercial Bank of China gives credit priority to rooftop DSPV systems, the China Merchants Bank provides moderate credit to the solar PV industry, leading electric power companies, the best DSPV projects, as well as grid-connect crystalline silicon PV projects in solar resources abundant areas.

4.4. Pilot DSPV projects under poverty alleviation programme

In October 2014, the NEA and the State Council Leading Group Office of Poverty Alleviation and Development unveiled a 6-year plan to use solar projects to provide power and income in poor regions. The first pilot projects were launched in 30 low-income counties in Anhui, Ningxia, Shanxi, Hebei, Gansu, and Qinghai provinces. The programme is to encourage solar power generating systems to be built on uncultivated hills and slopes, greenhouses, and agricultural facilities (NEA and SCLGOPAD, 2014; State Council and NEA, 2014).

On 9 March 2015, the NEA transmitted the Outlines for Compiling the Implementation Scheme of Solar PV Pilot Projects for Poverty Alleviation drafted by the China Renewable Energy Engineering Institute. The guidelines suggest three kinds of pilot

solar PV projects under the poverty alleviation programme, namely, household PV projects, solar PV stations on barren hills and slopes, and agricultural facility PV projects. The business model suggested for rural residential and agricultural facility PV projects is that central and local governments provide subsidies to cover 70% of the upfront investment of the projects, while the remaining 30% is to be provided by 5-year term low-interest bank loans. For ground PV stations, the central and local governments provide subsidies to cover 40% upfront investment, the project developer bears 20% of the upfront investment, and the remaining 40% is to be supported by a 10-year term low-interest bank loan (CREEI, 2015).

4.5. Remove scale control on some DSPV projects

In the Implementation Scheme for the Construction of Solar PV Projects announced in March 2015, the NEA removed the scale cap on rooftop DSPV projects and on-ground DSPV projects, of which the power generated is fully self-consumed. This indicates that all generation produced by these projects will be eligible for the national government subsidy of CNY0.42/kWh.

4.6. Discussions

The recent policy changes could address some of the obstacles discussed in Section 3.

Firstly, with regard to rooftop resource problems, given that the rooftop ownership problem could not be addressed in the short run, the central government calls for the local governments to play their role in the coordination of the rooftop resources. This call was inspired by the Xiuzhou Model in Jiaxing city, Zhejiang province, a model recognised by the NEA. Under this model, at the initial stage of implementing DSPV programmes, the Xiuzhou District government investigated rooftop resources available in its jurisdiction, and established a rooftop resources database for DSPV projects. Meanwhile, by giving the rooftop owners preferential electricity prices, priority in access to new electricity capacity, priority in orderly power consumption, as well as in the assessment of DSPV application demonstration enterprises, the government managed to enter into agreements with these enterprises on the installation of DSPV systems on their rooftops.

In addition, the recently initiated pilot DSPV projects under the poverty alleviation

programme are also an approach to address rooftop resource problems, not only because there are abundant rooftop resources in China's rural areas but also because the ownership of farmers' houses is clear. It was reported that during 1981–2000, the building space completed in rural areas reached 14.5 billion square metres, while the building space completed in cities was 20.1 billion square meters.

Secondly, as discussed in Section 3.2, one of the major barriers to DSPV deployment in China is the unattractiveness of the on-grid tariff for the excess DSPV power exported to the grid, and the unexpected low proportion of self-consumption. The new 'pick one of two' policy could help financing, causing fluctuations in on-grid tariffs. It is estimated that when the self-consumption proportion is lower than 30%, the 'all sold to the grid' mode has an advantage over the 'self-generation and self-consumption' mode when the commercial retail price is CNY0.90/kWh, the on-grid tariff for surplus DSPV power is CNY0.45/kWh, and the FIT applied to LSPV projects is CNY1.00/kWh.

Thirdly, it appears that the central government has increasingly been aware of the fact that access to financing is critical to the smooth development of DPSV in the country. Without project financing from banks or other financial institutions, the boom in DSPV will be slow to develop. However, Chinese commercial banks are cautious in financing DSPV projects. This probably arises from two reasons. Firstly, over the past decade these banks have provided a large number of loans to Chinese solar PV manufacturers, many of which went bankrupt due to the reduced overseas demand after the 2008–2009 global financial crisis. As a consequence, these banks may have lost confidence in this industry. Secondly, since China's DSPV market is still at its initial stage, banks are not familiar with it, particularly the risks involved in the development of DSPV projects.

It is in this context that Chinese policymakers are searching for financing sources other than bank loans. This is presumably helpful to solve the obstacles of obtaining upfront investment for DSPV projects.

5. Local policy incentives

Meanwhile, the NEA urges local governments at all levels to implement further financial support policies to stimulate the DSPV power market. According to incomplete statistics, as of May 2015, more than 100 government policy documents with regard to

solar PV have been promulgated in at least 20 provinces, municipalities directly under the central government, as well as prefecture-level cities and county-level governments. The additional financial incentives are largely in the form of FIT, generation subsidy (an additional tariff per kWh), capital subsidies for the procurement of the hardware, or both (Table 5.3). Generally such additional incentives are designed specifically to promote DSPV. Hence, a DSPV project could possibly receive subsidies from four levels of administration. Take Yongjia County in Zhejiang Province as an example, the total subsidy for a demonstration DSPV project is CNY1.02/kWh from the central government: CNY0.42/kWh, CNY0.10/kWh from the provincial government, CNY0.10/kWh from the prefecture-level city government, and CNY0.42/kWh from the county government.

It is interesting to note that there are three types of provinces which provide relatively stronger incentives: (1) those which seek to absorb overcapacity of solar PV industry, for instance, Hebei and Jiangxi provinces; (2) those which are financially strong and have great power demand such as Guangdong, Shanghai, Shandong; and (3) those which seek to absorb overcapacity of the solar PV industry and have great power demand, such as Jiangsu and Zhejiang.

Table 5.3: DSPV Support Measures in Selected Provinces

Type	Province	Highlights
FIT	Hebei	CNY1.30/kWh for PV projects starting operating by the end of 2014, plus the size of the project is above 1 MW and without national subsidy; CNY1.20/kWh for similar PV projects which started operating by the end of 2015.
	Shandong	CNY1.20/kWh from 2013 through 2015
	Jiangsu	CNY1.30/kWh in 2012, CNY1.25/kWh in 2013, CNY1.20/kWh in 2014 and CNY1.15/kWh in 2015
	Guangdong	CNY1.00/kWh
Generation subsidy	Shanghai	Industrial and commercial customer: CNY0.25/kWh Resident and school: CNY0.40/kWh
	Zhejiang	CNY0.20/kWh
	Guangxi	For surplus generation power: CNY0.4552/kWh
	Jiangxi	CNY0.20/kWh for 20 years
	Hunan	CNY0.20/kWh for 10 years
	Jilin	CNY0.15/kWh
	Heilongjiang	CNY0.41/kWh
Capital subsidy	Shaanxi	CNY1.00/W
	Jiangxi	Under a special programme: CNY4.00/W for Phase I project; CNY3.00/W for Phase II project
	Hebei	CNY5.00/W (2014), CNY4.00/W (2015)

CNY = yuan; DSPV = distributed solar photovoltaic; FIT = feed-in tariff; kWh= kilowatt hour; MW = megawatt; PV = photovoltaic; W = watt.

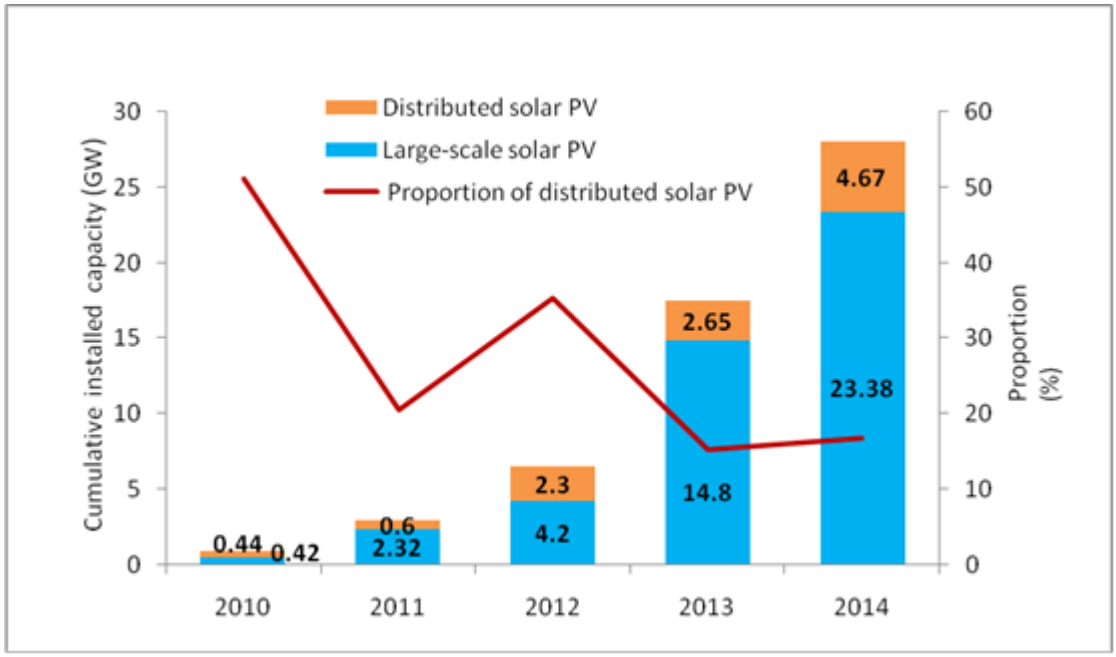
Note: While FIT here refers to the on-grid tariff (wholesale tariff) for DSPV power, generation subsidy is a grant

provided by the government based on the DSPV power generation.
Source: Compiled by author.

6. DSPV policy performance

As noted in Section 1, the performance of DSPV policies over the past 3 years falls below expectations. The share of DSPV in the total cumulative capacity of solar PV in the country was 35.38% in 2012, 15.19% in 2013, and 16.65% in 2014. In 2014 new installation of DSPV in 2014 was only 2.05 GW, lagging the target of 8 GW set by the government in the beginning of 2014 (Figure 5.2).

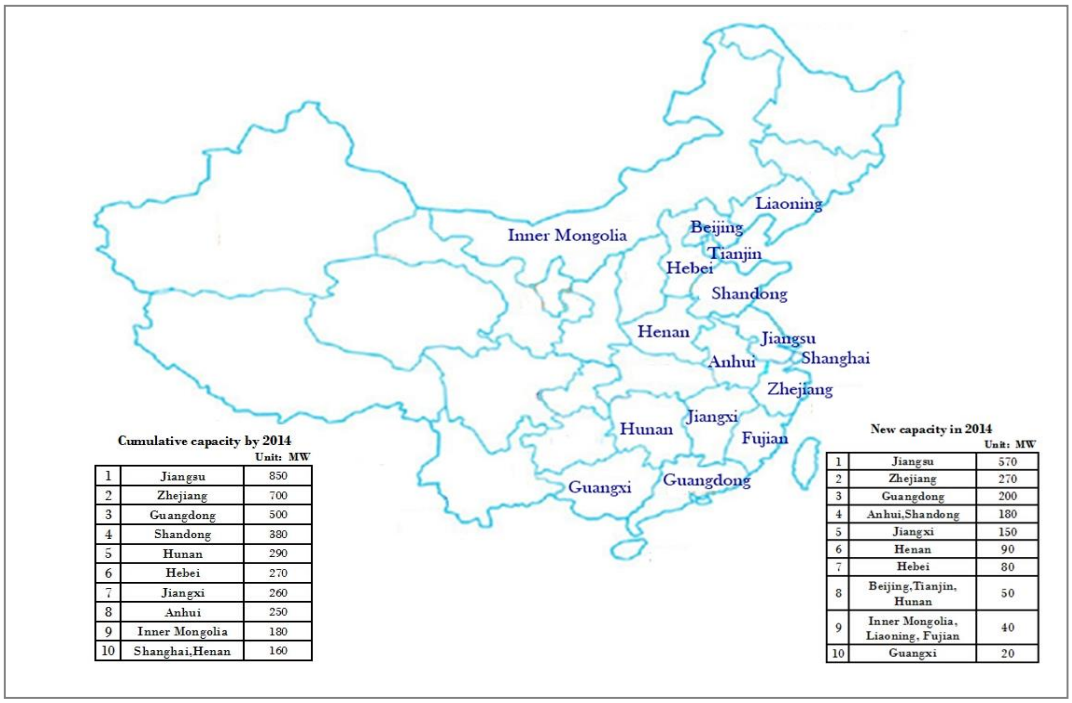
Figure 5.2: Installed Capacity of Solar PV in China, 2010–2014



GW = gigawatt; PV = photovoltaic.
Source: Author's compilation based on data from government websites.

The top three provinces in terms of cumulative installation are Zhejiang, Jiangsu, and Shandong (Figure 5.3), which accounted for 73% of the total in the country.

Figure 5.3: Cumulative and New Installed Capacity of DSPV in Leading Provinces, 2014



Cumulative capacity by 2014

Unit: MW

1	Jiangsu	850
2	Zhejiang	700
3	Guangdong	500
4	Shandong	380
5	Hunan	290
6	Hebei	270
7	Jiangxi	260
8	Anhui	250
9	Inner Mongolia	180
10	Shanghai,Henan	160

New capacity in 2014

Unit: MW

1	Jiangsu	570
2	Zhejiang	270
3	Guangdong	200
4	Anhui,Shandong	180
5	Jiangxi	150
6	Henan	90
7	Hebei	80
8	Beijing,Tianjin, Hunan	50
9	Inner Mongolia, Liaoning, Fujian	40
10	Guangxi	20

DSPV = distributed solar photovoltaic; MW = megawatt.
Source: Author's compilation based on data obtained from government websites.

7. Conclusions and policy implications

7.1. Conclusions

Since the second half of 2012, a series of policies have been put in place for DSPV deployment in China. Between the second half of 2012 and the first half of 2014, policies cover scale control and registration management, feed-in tariffs, subsidies, financing and fiscal incentives, market promotion by the establishment of demonstration areas for DSPV power generation, as well as power grid-connection, measurement, and settlement.

Unfortunately, the performance of these policies has not been satisfactory due to a number of constraints across the country. These include building (and/or rooftop) ownership problem, the unattractiveness of on-grid tariff, and the low proportion of self-consumption, the barriers to grid connection, and the difficulty in obtaining financing. Although new polices since September 2014 provided by the Notice to Further Implement Relevant Distributed Solar PV Policies issued on 2 September 2014 and subsequent documents do address some of the barriers and local governments have provided incentive measures, policy performance still fell short of expectations. Though the fact that new

policies require time to bear fruit is part of the reason for the disappointing results, it is beyond doubt that many constraints on DSPV power deployment in the country still exist, which calls for further innovative policies.

7.2. Policy implications

7.2.1. Establish solar PV property registration system

In order to effectively protect the legal right of owners of solar PV systems or PV stations, a property registration system for solar PV needs to be established in the country. The owners of the solar PV property could either be the rooftop owners or any investment entities. In this way, the interests of the owners could be protected by China's Property Law. In this way, when urban reconstruction and enterprise transformation take place, the owners could be fully compensated. In the case where the government requires the enterprises to move to other locations, the owners of PV systems or PV stations could choose to require compensation for their economic losses from the government or to rebuild PV systems (stations) in new locations.

7.2.2. Increase subsidy for residential DSPV systems

As previously noted, contrary to market economies where residential and small commercial customers pay higher prices than larger commercial and industrial customers, in China commercial and some industrial customers pay high prices ranging from CNY0.80/kWh to CNY1.40/kWh, while residents pay lower, heavily subsidised prices ranging from CNY0.30/kWh to CNY0.50/kWh since the Chinese approach is intended to support key industries and maintain social stability rather than reflect costs as in market economies (Kahrl et al., 2011). Meanwhile, under the present subsidy policy, the subsidy for commercial and industrial solar projects is the same as for residential solar projects. That being said, it is not surprising that investors are more interested in commercial and industrial DSPV projects rather than residential ones.

A report issued by the Chinese Renewable Energy Industries Association (CREIA) in 2013 suggested that a typical residential building with a rooftop space of 1,000 square metres could set up an 80-kilowatt distributed solar system. Due to the small size of the system, installation costs would remain relatively high, around CNY720,000 ($116,000) in

total. It was calculated that, with China's current electricity tariffs and subsidies, it would take about 11 years to generate enough power to recoup the initial investment, making the project economically unviable (CREIA, 2013). Given that the Chinese approach to retail electricity price will not be changed in the short run, it is recommended that higher subsidies or higher FIT for power exported to the grid be granted for residential PV projects.

7.2.3. Innovate grid connection mechanism

The existing grid connection process is built on a case-by-case basis. Grid utilities haven't yet built a proper grid-connection mechanism for DSPV power projects. It is suggested that a grid-connection licence mechanism similar to the network access mechanism in the mobile phone industry be employed. Under this mechanism, PV systems that meet the official quality requirements for grid connection will be issued a grid-connection licence. The users of such PV systems need to go through the registration process for grid connection of their PV systems. This innovative mechanism that shifts the grid-connection procedure from the PV power user side to the product side would undoubtedly help to address the grid connection barrier in the country.

7.2.4. Promote innovative business model and financing mechanism

The high upfront capital cost has been the major factor preventing a rapid market expansion of renewable energy market expansion, not only in developing economies, but also in developed economies. This is particularly true for DSPV projects, the growth of which has depended on strong government incentives. Currently the investment cost of a 1 MW size DSPV system for industrial and commercial customers is about CNY8 million, which is not a small amount for most companies.

The common business model for DSPV projects in China is the engineering procurement, and construction (EPC) model, under which at the construction stage of the projects, developers often lack funds and want to recover their investment as soon as possible. However, the core value of the DSPV project is at the operation stage when constant revenue streams could be generated. Therefore, for the long, healthy, and stable development of the Chinese PV market, it is necessary for the government to provide favourable policies for innovative business models and financing mechanisms for these projects.

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