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Innovative business models and financing mechanisms for distributed solar PV (DSPV) deployment in China

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HIGHLIGHTS

- Reviewed literature on DSPV business models and financing mechanisms.
- Presented the US DSPV business models and financing mechanisms.
- Examined China's DSPV business models and financing mechanisms.
- Made policy recommendations for DSPV deployment in China.

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ABSTRACT

The Chinese government has in recent years put in place a large number of incentive policies for distributed solar PV (DSPV). However, some of these policies have not been well performed due to many constraints, particularly the lack of innovative business models and financing mechanisms. This paper looks into this issue through the approach of combining literature review and interactive research, including interactions with managers from China's policy and commercial banks and PV projects. A comprehensive literature review on DSPV business models and financing mechanisms are firstly reviewed. Then the rapid evolving business models and financing mechanisms in the United States are examined, which provides some insights for China. Subsequent to this, the existing innovative business models and financing mechanisms for DSPV deployment in China and challenges facing them are discussed. Built on this discussion, policy recommendations are provided at the end of the paper. This study provides some insights for renewable energy policy makers in China as well as in other countries.

1. Introduction

Since the end of 2012, the Chinese government has implemented a large number of incentives to promote distributed solar PV (DSPV) development throughout the country. Nevertheless, many constraints on DSPV power deployment still exist, which call for further innovative policies, particularly policies to endorse innovative business models and financing mechanisms for these projects.

The main research questions studied in this paper are: (1) What are the existing business models and financing mechanisms for DSPV deployment in China and the major challenges they are facing? (2) What government policy support should be provided for innovative business models and financing mechanisms for DSPV deployment in China?

To this end, the paper is organized as follows: The first section provides a comprehensive literature review on DSPV-specific business model and financing mechanisms. Given that the USA is one of the leading countries in DSPV deployment and that its business models and financing mechanisms have evolved rapidly over the years[1], Section 3 examines the business models and financial mechanism in the U.S. DSPV market, to provide some insights for the emerging Chinese DSPV market. Section 4 discusses the existing business models and financing mechanisms for DSPV power project in China, as well as their advantages and disadvantages. Section 5 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

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[1] Germany is also a leading country in DSPV deployment. However, literature on their business models and financing mechanisms seems quite few.

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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 have been engaged in PV deployment and/or research and development for at least three years. The eight DSPV project developers are selected from China's eastern cities in Jiangsu and Zhejiang province which are the main locations of DSPV power projects in China. The three government officials are from the Department of New Energy and Renewable Energy under the National Energy Administration (NEA) of China. The three renewable energy researchers are from the Energy Study Institute affiliated to the NDRC (National Development and Reform Commission). 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 from the National Development Bank of China and one from the Export and Import Bank of China), the other three are from China's national commercial banks.

2. Literature review

2.1. Business models for DSPV power projects

DSPV power development has attracted the attention of academics on account of the need for innovative business models to overcome the high upfront capital costs.

Richter (2013) argued that innovative business models for DSPV power projects were important drivers for a transformation of the electric power industry, and it is crucial for a company to strengthen its business model innovation capabilities to mastering external environment changes.

Huijben and Verbong (2013) examined the reasons for the rapid growth of DSPV power in the Netherlands. They found that the development of new business models financially supported by both national and local government (for example, tax deduction after investment) was one of the reasons behind the PV breakthrough in the Netherlands. They also found that business models and institutional factors (regulation) were closely and clearly linked, and customer-owned model, third-party model and community shares model were the three main forms of business models in the country (Huijben and Verbong, 2013)

Asmus (2008) discussed the community solar business model. Under this model, multiple participants which lack good solar exposure on their own rooftops, including institutions and residents, can draw from solar PV systems on various buildings which operate as a single system and supply clean solar PV power to these participants. In such case, participants do not need to pay the upfront costs and installation and maintenance costs. They basically purchase shares of PV power generated by solar systems. Collective participation makes it possible to install larger and more efficient projects which will lead to cost efficiencies.

Graham et al. (2008) found that although PV systems were mainly owned by individuals and increasingly by third parties under the current DSPV business models, along with the acceleration of PV market penetration, utilities would become critical players, due to concerns about grid operation, safety, and revenue loss.

Drury (2012) identified that third-party business models which were initiated in the USA in 2005 and had been operating in 20 states were attractive to

2.2. Financing mechanism for DSPV power projects

Financing mechanisms for DSPV power projects are the mechanisms used to raise funds for DSPV power projects from investors including government, state-owned or private entities. Private entities include corporations such as electric utilities, retail investors such as individuals, financial organizations such as banks, and insurance companies, investment partnerships such as hedge funds and private equity firms, and endowment such as foundations and universities (Donovan, 2015).

Private entity investors in DSPV power projects consist of strategic investors which may be existing energy companies, or newly established companies with DSPV power technology as their core activity. On the contrary, financial investors tend to have no particular motivations to be involved in the industry. The key difference between strategic investors and financial investors is that while strategic investors prefer real assets such as physical properties (solar PV system, etc.), financial investors prefer financial assets which are less tangible than real assets. And strategic investors do not possess sufficient disposable financial resources to make big investments in DSPV power projects.

In addition to the discussion of financing mechanism for DSPV power projects generally, literature also discusses the definition of the term 'innovative financing mechanism'. For instance, Gargasson and Salomé (2010) stated that broadly speaking, innovative financing mechanisms include not only mechanisms designed to raise funds but also mechanisms that improve the use of those funds. They should involve conceiving and implementing new ways to mobilize and channel financial resources, through, for instance, a substantial change from the conventional way of doing things. A UNEP's report held that an innovative financing mechanism could be new marketable funding instruments, or policy innovations (UNEP, 2007).

2.3. A brief summary

The literature review demonstrates that innovative business models for DSPV power projects are an important driving force for the DSPV industry, and there are various types of business models for DSPV development. Investors of DSPV power projects consist of government, state-owned and private entities such as strategic investors which prefer real assets like solar PV system and financial investors which prefer financial assets. Investments in solar PV sector span multiple asset classes. An innovative financing mechanism may take various forms.

Drawn on the literature review in this section and given the DSPV market context, business model for DSPV in this study is defined as the ownership structure of DSPV power projects at the operation phase of DSPV projects, and financial mechanisms for DSPV power projects refers to the ways of mobilizing and channeling financial resources at the construction phase of DSPV projects.

3. Business models and financing mechanisms for DSPV projects in the USA

In this section, business models and financing mechanisms for DSPV power projects in the United States are provided through literature survey.

3.1. Business models

3.1.1. Enabling legislations for business models

National legislations have enabled the development of particular types of business model for DSPV power projects in the USA,

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