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The erratic path of the low-carbon transition in China: Evolution of solar PV policy

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HIGHLIGHTS

- The concept of the socio-technical regime is applied to the study.
- Four stages of China's solar PV policy are examined.
- Factors causing policy shifts in policy priorities and policy instruments are identified
- The erratic path of China's solar PV policy is explained.
- China's latest solar PV policies during 2013 are highlighted.

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ABSTRACT

The last twenty years have seen the growth of both solar PV manufacturing capacity and deployment in China, yet this growth has followed a very erratic path. This study applies the concept of socio-technical regime to identify factors which have made this path so erratic. We examine four stages in China's solar PV policy from mid-1990s to 2013 and show that each is characterized by different combinations of policy program. These changes in government policy and in the resultant trajectory of the solar PV sector are attributed to three main sets of variables. The most important of these are events which shape the wider policy priorities of China's government. Secondary factors include the government's poor management of the policy interaction between the domestic solar PV manufacturing industry and the deployment of solar PV across the country, as well as policy learning within government. The general lesson from this study is that the development path of a single element of a national strategy for the low-carbon transition is likely to be erratic, subject as it is to a range of political and economic forces, and to experimentation and learning.

1. Introduction

The low-carbon transition involves wide ranging changes of technologies and behaviors across many sectors. The adoption of specific low-carbon technologies forms one element of this transition. In a given society or country, the pace and trajectory of the low-carbon transition are likely to be erratic and unpredictable as they are shaped by a variety of political, economic, technological and social forces. These forces will affect not just the low-carbon transition as a whole, but will also play an important role in determining the development and deployment of individual low-carbon technologies.

Since the mid-1990s, particularly since the early 2000s, China's solar PV sector has seen extraordinary development. At the end of 1994, the PV module manufacturing capacity in China was just 5 MW, although much of this capacity did not meet modern international standards and actual production was only 1.4 MW. There were only about 3 MW of solar PV systems in use, of which about one third was in dispersed household systems (World Bank, 1996). By 2012, PV module manufacturing capacity and output in China had reached 37 GW and 22 GW, representing 37% and 54% of the world total respectively (SEMI, 2013). China's output of solar PV cells has increased dramatically over the last decade. Since 2007, China has become the largest producer of solar PV in the world (Fig. 1). But on the other hand, the cumulative installed capacity of solar PV in the country reached just 7 GW in 2012,

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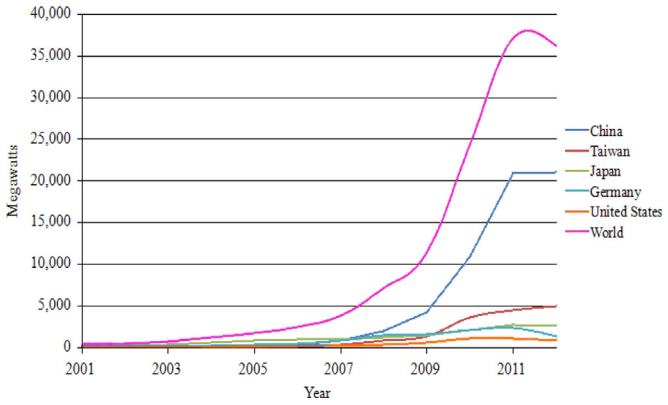

Fig. 1. Annual solar photovoltaics production by country, 2001–2012.
Source: Authors' compilation with data from EPI (2013).

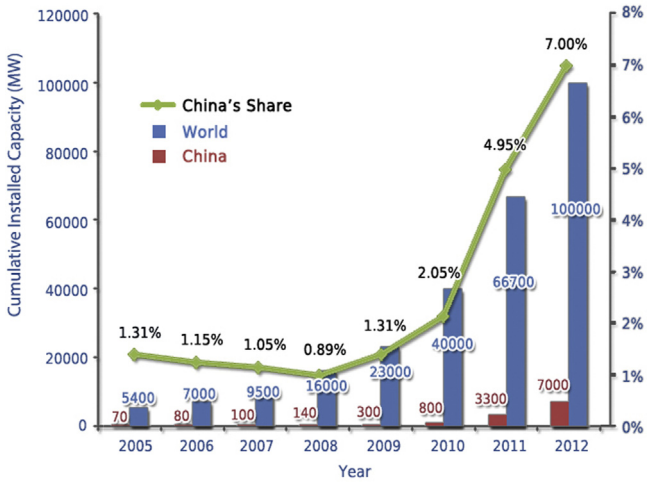

Fig. 2. China's cumulative installed capacity of solar PV as percentage of the world's total during 2005–2012.
Source: Authors' compilation with data from SEMI (2013), IEA (2013) and REN21 (2013).

accounting for 7% of the global total, having grown rapidly only since 2010 (Fig. 2).

The startling achievements in terms of PV manufacturing and the relatively modest development in terms of PV power deployment have not arisen from a single coherent policy program. Rather, China's solar PV policy has changed several times since the mid-1990s and these changes have been driven by a number of different forces, both from within and from outside China. Some have been directly related to energy, but many have not. Despite these policy changes, the overall trajectory of China's solar PV sector has been to support the low-carbon transition within China and elsewhere. This study applies the concept of the socio-technical regime to show how a wide variety of factors have shaped the development and deployment of solar PV technology in China from mid-1990s to the present day. The overall aim of the paper is to demonstrate how erratic and unpredictable just a single element in the transition to a low-carbon economy can be, due to it being subject to external events and policy priorities from other sectors.

Although a number of studies of China's solar PV policy have been published, most provide only a descriptive account or fail to span the full period from 1990s to the present day (Zhang and He, 2013; Lee, 2011; Li et al, 2013; Liu and Shiroyama, 2013; Liu and Goldstein, 2013; Liu et al., 2010; Liu et al., 2009; Lv et al., 2013; Zhao et al., 2011; Zhao, 2011). Distinct from previous accounts, this paper makes a contribution to the literature on China's solar PV sector from three directions. First, it applies the concept of the socio-technical regime to a specific renewable energy technology in order to illustrate and explain the erratic path of deployment of this technology. Second, it makes a comprehensive study spanning the full period from 1990s to the present day. Third, it shows how China's latest solar PV policies put in place during 2013 hold the promise of providing an appropriate framework for sustained deployment of solar PV to support the country's low-carbon transition.

In this paper we identify four stages of solar PV policy in China from mid-1990s to the present day: namely from mid-1990s to 2003, from 2004 to 2008, from 2009 to 2011 and from 2012 onwards. Section 2 outlines the main features of a socio-technical regime and explains the relevance of the concept to this study. Sections 3–6 examine China's solar PV policy at each stage with the aim of identifying the forces which have shaped the overall policy priority for the sector and the nature of the policy tools deployed, and illustrating their effects on the PV manufacturing industry and on the deployment of solar PV, as well as some unintended consequences. last Section 7 provides concluding remarks.

2. Socio-technical regimes and regime transition

A socio-technical regime comprises a relatively stable assemblage of institutions which develop around a particular set of technologies, and which support the development and use of these technologies (Smith et al., 2005). One important component of a socio-technical regime is the prevailing policy paradigm, which can be seen as a set of shared beliefs, values, ideas and principles relating to the world or to a particular sector. The prevailing paradigm determines the intellectual, political and organizational framework within which policy challenges are identified and addressed. Policy solutions in the form of agencies and instruments are formulated within the framework provided by the paradigm. Such solutions are usually consistent with the paradigm and tend to serve the interests of actors which have made economic or political investments in the prevailing socio-technical regime (Hall, 1993; Mitchell, 2008; Kuzemko, 2013).

The low-carbon transition requires a change of socio-technical regime from a high-carbon energy regime to a low-carbon regime. The main drivers socio-technical regime change tend to come from two directions: from the wider environment, which is referred to as the 'socio-technical landscape', or from technological niches (Geels and Schot, 2007). The socio-technical landscape includes social and political structure, the macro-economy, other sector policies, the physical environment, the price or availability of resources, and the emergence of new beliefs or new policy challenges. Though changes in the socio-technical landscape are usually gradual, they may take the form of shocks and crises. Technological niches lie within the socio-technical regime and consist of the groups and networks of innovators which are developing new technologies.

The manner in which a socio-technical regime reacts to changes in the socio-technical landscape and the technological niches depends not only on the nature and magnitude of the pressures but also on how they combine and on how readily the regime can adapt (Smith et al., 2005; Geels and Schot, 2007). Thus each country facing a broadly similar set of policy challenges, such as energy security and emissions abatement, is likely to take a distinct path in transforming its energy system. Of particular importance is how a government manages the interconnections and relative priorities between energy policy and other sector policies such as social, industrial and macro-economic policies.

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