Solar PV policies and their impacts in China and India

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Contrasting the Solar PV policies and their impact in China and India, this article analyzes critical factors that can impact Solar PV growth trajectories within developing countries.

Introduction

Concerns over energy security, climate change, and access by poor populations to modern energy services, has led countries across the globe to pursue policy instruments that can foster the uptake of renewable energy within their economies (El-Ashry 2012). Policy instruments used, such as feed-in-tariffs, tax credits, quota obligation system, competitive bidding, investment support, and net metering, have largely been similar across countries. However, a few countries dominate the market. As of 2013, Germany, Italy, the United States, and China, together constitute more than 62% of the global 100 GW of solar PV capacity installed (REN21 2013). In terms of production of solar PV modules, of the total 35.5 GW modules manufactured in 2012, Chinese firms constitute nearly 30% of the total global producer capacity (REN21 2013). In contrast, comparable developing countries like India have only been moderately successful in driving the solar PV industry within their economies. Through a case study approach, this study aims to identify the factors that have contributed to the successes and failures of the government policies aimed at driving the up-take of solar PV in China and India.

A nascent industry like the solar PV industry relies heavily on both technological push and market demand pull to ultimately ensure that the overall costs of delivering energy is comparable to other technologies. In this article, we will assess the role of government policies in China and India across the energy innovation process, which includes research, development, demonstration, market formation, diffusion and the feedback loops (Gallagher et al. 2012).

Case Study: Role of Government in the Solar PV Industry in China

Prior to 1995, the solar PV industry in China, like other developing countries, suffered from issues such as high production costs, capital shortages, insufficient R&D funding, and lack of market-formation support from the government (Gallagher 2014). Initial programs for Solar PV deployment in China was focused on rural electrification. The Brightness Program (1996) and the Township Electrification Program (2002) helped in the establishment of 1,780,000 (NREL 2004) and 350,000 (Gallagher 2014) small-scale solar home systems (SHS) respectively.

Introduction of “feed-in-tariffs” and “renewable portfolio standards” in countries like Germany, Italy, the USA and Spain in the 1990s and 2000s, spurred a global demand for solar PV modules and panels. Despite not having an attractive domestic market, Chinese firms ventured to fulfil this global demand with support from local and provincial governments. The local governments provided the firms with incentives such as low interest loans to purchase equipment, land transfer price refunds, electricity price refunds and multiple-year corporate tax reductions (Gallagher 2014). In addition, the Chinese firms were able to develop a competitive edge in the global solar PV market due to their flexibility in responding to orders (as a result of less-protective labor laws and agglomeration of support industries) and their ability to reduce costs across the manufacturing process (Gallagher 2014). With easy access to low-cost capital and a soaring international demand, the firms in China had a strong financial case for ramping up solar PV module production capacity across the manufacturing value chain. Poly-silicon production capacity increased from

5000 T in 2007 to 190,000 T in 2012. The wafer production capacity increased from 4.5 GW in 2008 to 50 GW in 2012. The cell production has increased from 0.2 GW in 2005 to 21 GW in 2012 (IEA 2013a). The module production capacity has increased to 23 GW in 2012 (IEA 2013b).

From a research and development (R&D) standpoint, the Ministry of Science and Technology (MOST) in China, with an annual average investment of $80 Million, supports R&D across the manufacturing value chain covering: poly-Si, wafer, solar cells, PV modules, thin-film technology, CPV, energy storage, BOS components and system engineering (IEA 2013a). These investments contribute both towards research on advanced technologies as well as towards demonstrations. The government, through Chinese Academy of Sciences (CAS), has also facilitated in the development of solar PV and small inverter testing laboratories in Beijing, Lhasa, Wuxi and Baoding. The system prices have come down from 10 USD/Wp to 1.5 USD/Wp (IEA 2013a). The efficiencies across different technologies have also increased drastically (with mono-crystalline PV already reaching an efficiency of 20.5% at the laboratory and 19% at the industry) (IEA 2013b).

From a demonstration and market formation standpoint, the central government in 2009 launched two funds to support the deployment of solar PV in China. One of the funds (approx. $3.5 Billion USD) is capitalized through a surcharge levied on all electricity end-users. This fund is used to support ground mounted large scale photovoltaic (LS-PV) projects through Feed-in-Tariffs (FIT). Within a space of 4 years, the cumulative LS-PV installation in China has increased from 1 MW in 2008 to 4,392 MW in 2012 (IEA 2013a). The second fund is a Special RE Fund which is controlled by the Ministry of Finance, which is used to fund demonstration projects like the Golden Sun Program and the PV Building Project. These projects have helped develop the distributed PV market in China to grow to 3,775 MWp in 2012 (an increase of 3166.5 MWp over 2011) (IEA 2013a).

From a technology transfer standpoint, Chinese firms' ability to access capital have allowed them to pay for technology licenses, avail services of foreign experts, buy foreign firms and develop technology partnerships with research institutes and universities (Gallagher 2014). China has also been combative in responding to anti-dumping tariffs. When the US and EU imposed tariffs on Chinese solar exports in 2013, China retaliated by conducting investigations into poly-silicon exports from the US, and the EU (Kennedy 2013).

The current challenges that China faces include:

- overcapacities across the value chain leading to both horizontal and vertical integrations
- a recent dip in confidence among financial institutions on the solar companies' credit
- issues related to its unified pricing policy (IEA 2013a)

Case Study: Role of Government in the Solar PV Industry in India

In contrast to China, India has had moderate success in developing the solar PV industry within its economy. Though many states in India e.g. Maharashtra, Andhra Pradesh, Gujarat, etc. had defined Renewable Purchase Obligation (RPO) laws before 2009 (REN21 2013), their impact on the solar PV uptake was negligible. By June 2010, the solar PV plants in India had only reached a cumulative generation capacity of 15.2 MW (REN21 2010). In 2010, the Government of India (GoI) launched the Jawaharlal Nehru National Solar Mission (JNNSM) with a target of expanding India's grid connected solar capacity, including both Solar PV and CSP, to 20 GW by 2022 (World Bank 2012) (MNRE 2012).

From the research and development stand-point, though MNRE has constituted the Solar Energy Research Advisory Council and set-up a framework for research, which includes several partnerships (MNRE 2012), the output has been minimal, or has not been reported yet.

From the market formation standpoint, the focus of JNNSM Phase 1 (2011-2013) was largely on grid-connected projects. To achieve the target of 500 MW of PV, the government conducted reverse auctions in two batches. The bidding process offered feed-in-tariffs and long term PPAs to the selected least cost developers (MNRE 2012). In addition, Government directed the state owned NTPC Vidyut Vyapar Nigam (NVVN) to buy 500 MW of solar PV power from developers at \$0.30/kWh (a price determined through reverse auction) and bundle it with 2000 MW of unallocated power from NTPC's coal based stations at \$0.04/kWh and sell it to utilities at \$0.1/kWh (MNRE 2012). Projects constituting a capacity of 150 MW in batch 1 and constituting 350 MW in batch 2 were allotted (MNRE 2012).

In addition to the national level initiatives, several Indian states have also devised policy initiatives to fulfill their Solar RPOs. Approximately 5 GW of Solar projects (including both PV and CSP) have been announced. Approximately 1 GW of projects have already been commissioned (MNRE 2012).

The challenges faced by Indian firms in the solar PV market include:

- from a financial standpoint: non-availability of low-cost financing for manufacturing, lack of adequate participation of scheduled commercial banks (SCBs), and payment security through NVVN for the future (World Bank 2012)
- from an administrative standpoint: bottlenecks in land acquisition, delays in approvals at the state level, limited field data availability of solar irradiation, leniency in imposing penalties on utilities for non-compliance of RPOs, and limited coordination between the central and state institutions (World Bank 2012)
- from a manufacturing stand-point: lack of raw materials, and an underdeveloped supply chain leading to high inventory costs (World Bank 2012)

Factors impacting policies driving sustainable development

Government policies have been critical to the development of the Solar PV industries in both countries. However, certain key factors have marked the differences in their growth trajectories:

a) *Access to Capital:* The PV manufacturing sector of China flourished due to the availability of low-cost loans whereas Indian firms weren't able to access these loans. Even in deployment, investors shied away from India as its electricity prices were very low (REN21 2010).

b) *Strategy Inclination:* China follows an export-oriented strategy and invests heavily in research, development and demonstration projects (though RD&D was pursued only with a lag) so as to develop a competitive edge in the global market. India, on the other hand, views solar energy just as a means to reduce their carbon footprint. Thus, the impetus for performance in both countries is very different.

c) *Government Incentive Mechanisms:* China has been able to collect a surcharge from its consumers which it can plough back as feed-in-tariffs for LS-PV. This is more sustainable as compared to India as the unallocated power used for bundling may not be available in the future.

d) *Agglomeration of Supply Chain* – The co-location of players in the supply chain, coupled with its labor laws, has helped China achieve a competitive edge in responding to changing demands. In contrast, an underdeveloped supply chain in India has increased the inventory costs across Indian firms thus making manufacturing unviable.

In addition to these factors, *efficiency of the bureaucracy, availability of knowledge networks, enforceability of laws* and *un-protected labor laws* has also played an important role in China's growth in Solar PV.

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