Renewable and Sustainable Energy Reviews 62 (2016) 1282–1290

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

A review of governmental support instruments channeling PV market growth in the Flanders region of Belgium (2006–2013)

J.C.C.M. Huijben *, K.S. Podoynitsyna, M.L.B. van Rijn, G.P.J. Verbong

Eindhoven University of Technology, School of Industrial Engineering, CNT Building 0.04, P.O. Box 513, 5600 MB Eindhoven, The Netherlands

ARTICLE INFO

Article history:
Received 1 July 2015
Received in revised form
22 December 2015
Accepted 26 April 2016

Keywords:
PV market growth
Flanders region of Belgium
Governmental support instruments
Green certificates
Societal costs

ABSTRACT

How did a country in the middle of Western Europe, starting almost from scratch, reach the European top 3 in terms of solar PV capacity in five years? And what were the costs? We provide a systematic chronological review of the different governmental support instruments that drove the exponential growth of the solar energy market in the Flanders region of Belgium and calculate their relative contributions. The results of the economic calculations show that green electricity certificates had by far the greatest effect on both the rise and stagnation of the market, costing about 1.5 billion euro only for 2006–2013. The long-term societal costs of such growth proved to be even higher (6.7 billion for 2014–2031) and unevenly distributed, with residents paying the highest price via their energy bills. Companies continuously adapted their organizations to enact the available support instruments. Counter-intuitively, the substantial support shifted the attention of companies to the larger systems, even though the incentive for investment in PV was lower than for the smaller systems.

Contents

1. Introduction

Over the past decade it has become increasingly clear that our current electricity system is unsustainable. An uneven spread of resources, depletion, and air pollution have caused problems and conflicts all over the world. In response, many developed countries have designed renewable energy policies. Renewable energy sources like PV could provide the solution to energy-related environmental and political issues.

Belgium, by no means a champion in terms of sun irradiation due to its geographical location, entered the European top 3 in 2012 in terms of installed capacity per inhabitant in Europe [1]. The Belgium federal state is divided into three main regions: Flanders, Wallonia, and Brussels. By the end of 2013 about 70% of Belgium's 3 GW capacity was installed in the Flanders region [2]

* Corresponding author. Tel.: +31 402475579.
E-mail address: b.huijben@tue.nl (J.C.C.M. Huijben).

http://dx.doi.org/10.1016/j.rser.2016.04.058

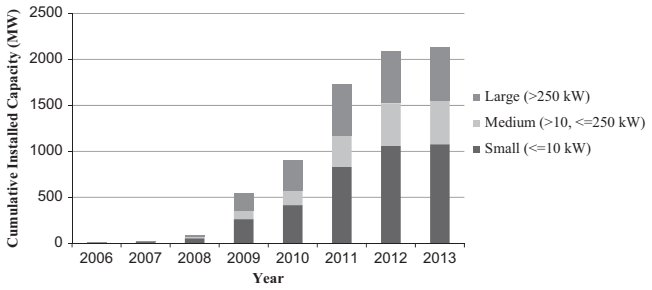

Fig. 1. Cumulative installed capacity of small ($<=10$ kW), medium ($>10, <=250$ kW) and large systems (>250 kW) [adapted from [3]].

and [3]. From 2007 onwards, the PV market for small, medium and large systems grew exponentially in Flanders (see Fig. 1). These were mostly Building Added PV (BAPV) or stand-alone systems. However, by mid-2012, severe cuts in support led to stagnation. In this paper we employ transition studies literature to explore what governmental support instruments caused this considerable growth and stagnation.

Society is facing many negative externalities from our current production and consumption systems for energy, mobility and food. There is a major need for the transition of such *socio-technical systems* toward more sustainable ones [4]. Such a process is systemic in nature and requires a radical shift from the status quo. However, the mainstream system in place has its own logic, forming a barrier to sustainable innovation [4] and [5]. Therefore, a protected space called a *niche* is needed as a nurturing place, from where new innovations can scale up and alter the mainstream system [4].

Governments enable the development and implementation of new sustainable innovations by actively shielding them from mainstream selection pressures [6]. Active shielding measures influencing the supply side include various financial incentives covering production, investment and financing support [6–8]. It is also possible to influence the demand side through for example quotas or providing information to end users. Thereby the government directly influences the 'volume, distribution and types of opportunities available' [9, p 341]. Additionally, institutional theorists argue that institutional processes (rules, norms, beliefs) influence economic systems [10].

The influence of governmental policies on the expanding renewable energy market has been widely studied (e.g. [7,8,11–18] and [19]). Some studies evaluate support instruments for PV market deployment specifically, often with a focus on the impact of feed-in-tariffs (e.g. [20–26]). Mormann uses empirical evidence from the US to demonstrate how its existing tax credits system is providing an incentive for renewable energy market players to create investment structures that lead to higher transaction costs and less efficient support, indicating the importance of careful policy design [27]. Verbruggen and Lauber indicate the cost-benefit allocation of support instruments as important indicator [8]. Considering the variety of the possible support instruments, our research aim is to investigate which form of active shielding had the greatest impact on the growth of installed capacity in Flanders in 2006–2013 and what were the costs of this support. Additionally, we aim to investigate the effect of such support instruments on Flemish PV companies' activities and performance. In the following we first discuss our research methodology after which we present the results of our study. We provide an overview of the different support instruments in place and their relative contributions as well as discuss in detail the main support instrument during the time of our study, the green certificate scheme. We continue by an analysis of the effect of such support instruments on firm activities and performance and end the paper with a discussion of our main findings and a conclusion section.

2. Methodology and data collection

We conducted a mixed methods study, employing a sequential quantitative-qualitative approach, where the qualitative part had a complementary and developmental function [28]. We used primary and secondary data sources to explore the effects of governmental support instruments on market growth in the Flanders region of Belgium from 2006 until 2013 – the period when Flanders experienced exponential installed PV capacity growth. Due to the complex structure of the Belgian energy market, we searched databases and official reports of players operating at various levels to map the energy market and installed PV capacity over time, also to identify the PV-related support instruments in place during our studies. The Committee for Regulation of Electricity and Gas (CREG) controls and evaluates the regulations set by the Belgium government [29]. It also organizes the accreditation of supply permits for the transmission network [30]. Additionally, the Flemish Regulator for the Electricity and Gas market (VREG) specifically regulates the distribution network (i.e. tariff setting is controlled by CREG), deals with complaints, acts as mediator in conflicts, advices the Flemish authorities and grants green certificates and heat and power certificates [31]. The Flemish Energy Agency (VEA), an autonomous agency of the Flemish ministry of environment, nature and energy, designs, implements and evaluates new energy-related policies [32]. Additionally, we read International Energy Agency (IEA) and PV Vlaanderen (Flemish PV trade association) reports. We also calculated the fluctuations in relevant support over time (see Appendix A). The main assumptions for our calculations were a system lifetime of 20 years, linear degradation of the system (0.8% annually [33]), and considering prices excluding VAT unless we found evidence in data suggesting otherwise, thereby taking a conservative stance. Additionally, unless indicated else we assume tax deduction schemes to be applicable for one year only, again following a conservative line of thought. This data, together with the changes in PV panel and electricity prices per segment, enabled us to calculate the relative importance of each governmental support instrument and the resulting financial attractiveness of typical small, medium and large-scale PV installations. For all systems we assumed self-investment, which also corresponds to the conservative calculation of the governmental support since the financing support from the government is not being used under this assumption. The results also showed the high importance of the green certificate instrument which was therefore further analyzed in terms of working and analysis of costs involved [8] and [34]. In the second, qualitative phase we held a series of interviews with CEOs and key managers of typical firms operating in the market for small, medium and large sized systems to create a heterogeneous sample. Interviewees were selected based on a desk study and an initial interview with an external expert, the chairman of PV Vlaanderen (Flemish PV trade association). We conducted a total of seven semi-structured interviews. The main goal was to obtain in-depth input on how changes in support instruments had influenced the firms' activities and performance, thus supplementing and validating our quantitative findings. The interviews were transcribed and verified by the interviewees. In the final phase, we triangulated our findings with two experts in the field: the chairman of the Flemish PV trade association, and a business developer in a European semi-governmental incubator in sustainable energy who also co-founded a PV company during our time of study.