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An analysis of feed'in tariffs for solar PV in six representative countries of the European Union

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Abstract

In this paper, after a brief review on the main support policies for Photovoltaic (PV) systems in Europe, the specific situations of six representative countries (France, Germany, Greece, Italy, Spain and the U.K.) are examined, with the purpose of highlighting the main differences in the implementation of the feed'in tariff (FiT) support policies adopted for PV systems. In particular, a comparison based on the calculation of economic indexes, as the Discounted Cash Flows (DCF), the Pay-Back-Period (PBP), the Net Present Value (NPV) and the Internal Rate of Return (IRR), for different sized PV systems shows that a specific FiT can sometimes be inconvenient for the producer and that the different ways of implementing FiT support policies in the various countries can lead to significantly different results.

The analysis carried out in this paper could help to assess the impact of PV energy policies in the main European markets, to make a prediction of how PV market could evolve in the selected EU member states, to gain an insight into the future of possible energy policies.

Keywords: Support policies; PV systems; Feed-in-tariffs; Net-metering

1. Introduction

In 2009, the European Union (EU) with the Directive 2009/28/EC established a new common framework for the promotion of energy (both electrical and thermal) from Renewable Energy Sources (RES), setting mandatory targets for the overall share of energy from RES in gross final consumption, for all the EU-member States. The Directive 2009/28/EC confirmed the objective of 20% as contribution of RES on the total European energetic production in 2020, established by the European Council act 7224/1/2007. This challenging goal will only be reached with an effective RES support policy and with a concrete effort towards the improvement of the energetic efficiency of these energy sources.

Abbreviations: AEEG (Italian), Authority for Electric Energy and Gas; BIPV, Building Integrated PV System; CEI, Comitato Elettrotecnico Italiano; DCF, Discounted Cash Flows; EEG, German Renewable Energy Act; EU, European Union; FiT, Feed-in Tariff; GSE, Gestore Servizi Energetici; IAB, Intégration Au Bâti; IEA, International Energy Agency; IRR, Internal Rate of Return; ISB, Intégration Simplifiée au Bâti; LV, Low Voltage; MV, Medium Voltage; NIPV, Not Integrated PV System; NPV, Net Present Value; OFGEM, Office of Gas and Electricity Market; PBP, Pay-Back-Period; PV, Photovoltaic; RES, Renewable Energy Sources; ROCs, Renewables Obligation Certificates; VAT, Value Added Tax; WACC, Weighted Average Cost of Capital.

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Within various renewable energy technologies, Photovoltaic (PV) today attracts considerable attention thanks to its potential to contribute to a major share of renewable energy in the future, as shown in Table 1 (Eurostat, 2012a). In effect, PV was the first source of electricity installed in Europe, in 2012 (IEA, 2013a).

In 2012, the total PV power installed in the world was 28.6 GW, bringing the cumulative PV capacity to around 96.6 GW (IEA, 2013b) at the end of 2012. In Europe were installed 17.27 GW of PV systems in 2012, below the 22.13 GW of 2011, bringing the PV cumulative capacity to 69.6 GW. Germany remains at the first place, with 7.604 GW of installed PV power in 2012, followed by Italy (3.647 GW), France (1.079 GW), the U.K. (0.925 GW) and Greece (0.912 GW). Spain, despite the impressive growth of recent years (especially 2008), is at the 3rd place in Europe as cumulative PV capacity (4.706 GW) behind Germany (32.461 GW) and Italy (16.450 GW), but the additional PV power in 2012 was very low (223 MW). The 96.6 GW of installed PV power all over the word corresponds to an annual PV electricity production of 115 TW h. Compared to a total world electricity consumption of 19,000 TW h, the PV share corresponds to a percentage of 0.6% of the total electricity demand of the world.

In the present paper, after a brief review on the main support policies for RES in Europe, the authors examine the support policies adopted for PV systems in France, Germany, Italy, Spain, Greece and the U.K. These countries have been chosen, essentially, since they have reached the best results in the promotion of PV technology in Europe. A comparison based on the calculation of economic indexes, as the Pay-Back-Period (PBP), the Net Present Value (NPV) and the Internal Rate of Return (IRR) for different sized PV systems shows the strengths and weaknesses of each national support strategy. In addition, suggestions about improvement of each situation are also given.

The paper follows a previous study of the same authors (Campoccia et al., 2009), showing the significant changes in the PV national regulations and in the PV market in the last few years.

2. Support strategies for PV systems

Different PV support measures were introduced in the last decade: capital subsidies, VAT reduction, taxes credits, quota obligation, net-metering, feed'in tariffs (FiTs), and so on. Each support mechanism offers both strengths and weaknesses for the producers and the collectivity, depending on the ways of implementing each national policy.

Table 1
Energy produced by RES-systems in the EU-27.

RES-based technology	Energy produced in 1997 (GW h)	Energy produced in 2011 (GW h)
Biomass	28,835	81,474
Geothermal	3956	5249
Hydro	311,138	390,006
Photovoltaic	41	41,514
Wind	7330	143,368

Some studies (Pirnia et al., 2011; Yamamoto, 2012) proposed simple microeconomic models for comparing these mechanisms with respect to social welfare. Fouquet and Johansson (2008) and Sarasa-Maestro et al. (2013) reported two interesting discussions about the European PV support policies, which can explain how support policies for PV systems have evolved in the last years. The effects of capital subsidies on the PV market in Europe were discussed in Gutermuth (2000), Erge et al. (2001), Jahn and Nasse (2003), and Weiss et al. (2003).

In Dusonchet and Telaretti (2010a,b) a comparative economic analysis of each individual European support mechanism for PV systems was performed, based on the calculation of the main economic indexes. In Cipriani et al. (2013), a new method to estimate the increment of electrical energy generation that should be guaranteed by a dynamic PV generator (based on the application of solar-trackers) was carried out, developed by means of classical economic indexes like the PBP and the NPV.

Renewable energies can also be used to create near zero energy islands, turning them into almost autonomous systems (Sanseverino et al., 2013).

Below is a discussion on the main support policies for the development of PV systems in Europe.

2.1. Feed-in tariffs

FiT mechanism involves the obligation on the part of an Utility to purchase the electricity generated by RES, paying a tariff determined by Public Authorities and guaranteed for a specific time period.

A FiT's value represents the full price received by an independent RES producer for any kWh of electric energy produced, including a premium above or additional to the market price, but excluding tax rebates or other production subsidies paid by the Government.

The FiT value is determined by each country Government, based on the construction and management costs of a specific RES technology (investment costs, operational costs, measurement and capital costs, etc.). This aims to guarantee the cost-effective operation of the RES plant.

FiTs have been the primary mechanism used for supporting RES development in both Europe and the U.S.. At present, they are applied in 20 EU member countries and in 63 countries worldwide (REN 21, 2012).

Different FiT schemes can be found in the various countries. In particular, market-independent and market-dependent FiT can be distinguished. As shown in Couture and Gagnon (2010), these different ways of structuring FiT policies can have important impacts on investor risks and on the RES market.

With FiTs, the financial burden does not fall upon the taxpayer but is distributed across the Utilities' customer