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Innovations in financing that drive cost parity for long-term electricity sustainability: An assessment of Italy, Europe's fastest growing solar photovoltaic market☆

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ABSTRACT

Subsidy programs, such as feed-in tariffs, designed to make renewable technologies cost competitive with fossil fuels in electricity generation, have been effective in a number of nations. However, these subsidies can become very costly and they raise questions whether there are fair conditions for competition for different energy sources. As a result even effective programs face an uncertain future, changes in political support following the financial crises in Europe and the United States have demonstrated. In the case of solar photovoltaic energy, cost declines resulting from market-expansion schemes and the overall reductions in the price of photovoltaic cells have been significant particularly over the past decade. Yet, they have still left solar power up to 50% more expensive than conventional options. As an alternative in this paper we describe a financing tool based on a pollution abatement methodology. In developing this levelized cost of electricity framework we build a methodology to examine, and then utilize, the social costs and impacts of energy generation technologies. We find that as a means to bridge the cost gap between current conventional energy process and retail solar energy, a program based on a Property Assessed Clean Energy (PACE) loan program would, in the short-term, be an effective tool to accelerate grid parity between solar and conventional energy generation and in the long-term provides a theoretically and financially sound alternative to subsidy-based incentives.

Introduction

Over the past decade, the production of solar cells has grown by over 50% per year (IEA, 2011a). Global cumulative installed capacity reached 69 GW in 2011 (EPIA, 2012). This growth in production, in part a result of major market-pull policies in a number of states and countries, such as California, Japan, Germany, Italy and Spain, has driven down solar module costs by more than 50% between 2000 and 2011 (Solarbuzz, 2012), from prices averaging 5.5 $/peak watt in 2000 to as low as 2.5–2.0 $/peak watt today.[1] These values translate into photovoltaic (PV) electricity generation cost ranging from 0.16 to 0.35 $/kWh[2] in the Eurozone (EPIA, 2011).[3] By comparison average electricity prices for households range from 0.263 $/kWh in Italy, 0.325 $/kWh in Germany, 0.232 $/kWh in Japan and 0.116 $/kWh in the United States in 2011 (IEA, 2011b). Despite this gap, it is important to note that the photovoltaic electricity generation cost does not take into account for the transmission and distribution costs, while those costs are included in the residential electricity tariffs.

Bridging this remaining cost gap between solar and more conventional sources of electricity would provide more energy security, and can play a central role in meeting climate and health goals set in many nations. In March 2007 the European Union (EU) launched the "Climate and Energy Package", which was adopted by the European Parliament in December 2008. The plan sets ambitious targets for the EU: by 2020, GHG emissions should be at least 20% lower than 1990 levels, energy efficiency should increase by 20% and the share of renewable in total energy consumption should reach 20%, respectively (EC, 2007), with a separate target for the transport sector of a 10% renewable energy share. Many analysts point to the progress made in Germany, which has seen dramatic growth in the share of renewable-based electricity supply obtained from solar power, averaging 15.6% of total kWh generated in 2011 (WG AGEE-Stat, 2012). In light of European energy targets, the widespread deployment of cost-competitive solar technologies is a priority for EU policy makers.

While feed-in tariffs (FiTs) continue to be a highly effective tool to promote solar energy in many nations, the incremental cost paid in a number of FiT schemes is expected to decrease. Countries gradually withdraw feed-in tariffs as technologies mature. For instance Germany

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[1] The majority (about 80%) of the companies surveyed are based in the United States, but most market globally. European dealers are the second largest surveyed group. The solar energy system product indices represent retail pricing for a single component.
[2] Exchange rate 1.28 EUR/USD.
[3] This study analyses five European countries, as they represent 82% of the European PV market: France, Germany, Italy, Spain and United Kingdom.

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decreased tariffs for solar photovoltaic (PV) generation as new capacity is installed, following the revision of Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz EEG) in 2009, which promotes renewable energy production in the country. In January 2010, FiT for solar PV decreased by 9% for roof systems and for on-site consumption, and by 11% for the remaining categories. Moreover, since January 2011 an additional reduction of 13% for PV-systems became effective (IEA, 2012).

As financial instability continues in Europe and recovery from the recession remains slow in the United States, a number of governments have reconsidered their solar incentive policies, which has resulted in slower rates of solar energy deployment in major markets, such as Germany and France. Conversely in Italy, where the FiT is still sufficient via the IV Conto Energia,[4] program solar installations tripled in 2011 relative to 2010 (EPIA, 2012). Fig. 1 shows solar PV installations from 2007 to 2011 in Germany, Italy and France, while Fig. 2 illustrates the European solar PV market share in 2011. Germany, Italy and France represent about 85% of the European solar PV market (Fig. 2).

Notwithstanding these efforts, the contribution of solar PV to renewable electricity supply in Europe and worldwide is still small, averaging 2% of the total electricity in the EU, while globally solar is only 0.5% of electricity demand, and 1% of the peak power demand (EPIA, 2012).

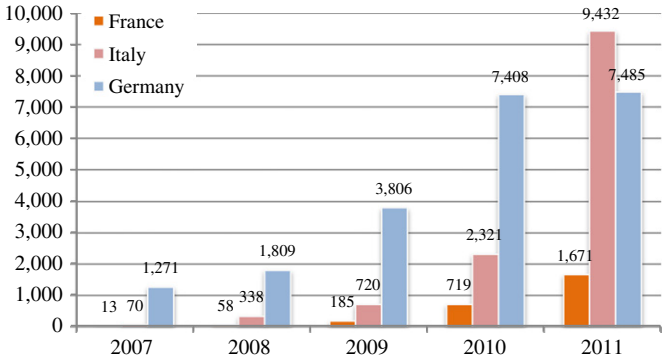

Fig. 1. European solar PV installations 2007–2011.

Solar photovoltaic (PV) could be a significant source of electricity production, especially in those countries characterized by abundant insolation, such as Italy, where daily average exceeds 5 kWh/m^2 in the south, and 4 kWh/m^2 in the north (Petrarca et al., 2000). High irradiation and a generous supporting scheme make solar PV system

[4] Italian Energy Agency (GSE, Gestore Servizi Elettrici) supports photovoltaic solar electricity generation under a feed-in tariff scheme ("Conto Energia"). The scheme is regulated by the Interministerial Decree of 19 February 2007. On March 2011, the Department of Economic Development authorized the "IV Conto Energia" that regulates the new tariffs and mechanism for solar photovoltaic production for the period June 2011–2016 (Table).

Feed-in tariff in Italy (period June 2011–2016)

Size	June 2011		July 2011		August 2011		September 2011		October 2011		November 2011		December 2011		I semester 2012		II semester 2012	
[kW]	On building [€/kWh]	Other [€/kWh]	On building [€/kWh]	Other [€/kWh]	On building [€/kWh]	Other [€/kWh]	On building [€/kWh]	Other [€/kWh]	On building [€/kWh]	Other [€/kWh]	On building [€/kWh]	Other [€/kWh]	On building [€/kWh]	Other [€/kWh]	On building [€/kWh]	Other [€/kWh]	On building [€/kWh]	Other [€/kWh]
1 ≤ P ≤ 3	0.387	0.344	0.379	0.337	0.368	0.327	0.361	0.316	0.345	0.302	0.320	0.281	0.298	0.261	0.274	0.240	0.252	0.221
3 < P ≤ 20	0.356	0.319	0.349	0.312	0.339	0.303	0.325	0.289	0.310	0.276	0.288	0.256	0.268	0.238	0.247	0.219	0.227	0.202
20 < P ≤ 200	0.338	0.306	0.331	0.300	0.321	0.291	0.307	0.271	0.293	0.258	0.272	0.240	0.253	0.224	0.233	0.206	0.214	0.189
200 < P ≤ 1000	0.325	0.291	0.315	0.276	0.303	0.263	0.298	0.245	0.285	0.233	0.265	0.210	0.246	0.189	0.224	0.172	0.202	0.155
1000 < P ≤ 5000	0.314	0.277	0.298	0.264	0.280	0.250	0.278	0.243	0.256	0.223	0.233	0.201	0.212	0.181	0.182	0.156	0.164	0.140
P > 5000	0.299	0.264	0.284	0.251	0.269	0.238	0.264	0.231	0.243	0.212	0.221	0.191	0.199	0.172	0.171	0.148	0.154	0.133

In 2013 feed in tariff and net-metering will be replaced by all-comprehensive tariff. The mechanism will be based on two different tariffs (€/kWh): tariff for energy feed into grid and tariff for energy consumed.

Size	On building		Other	
[kW]	Energy feed [€/kWh]	Energy consumed [€/kWh]	Energy feed [€/kWh]	Energy consumed [€/kWh]
1 ≤ P ≤ 3	0.375	0.230	0.346	0.201
3 < P ≤ 20	0.352	0.207	0.329	0.184
20 < P ≤ 200	0.299	0.195	0.276	0.172
200 < P ≤ 1000	0.281	0.183	0.239	0.141
1000 < P ≤ 5000	0.227	0.149	0.205	0.127
P > 5000	0.218	0.140	0.199	0.121

Reduction tariff:
II semester 2013: −9% I semester 2014: −13%;
II semester 2014: −13% I semester 2015: −15%;
II semester 2015: −15% I semester 2016: −30%;
II semester 2016: −30%

Additional premium (Calculated on basic tariff)	- Removing asbestos (0.05 €/kWh) - Installation on special area (5%) - 60% of components EU manufactured (10%) - Premium for energy performance (10%) - Local government < 5000 people (5%)