Accepted Manuscript

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DOI: 10.1109/ICRERA.2018.8566800

https://ieeexplore.ieee.org/document/8566800%C2%A0

Support for solar photovoltaic in France– a shift towards capacity market mechanism

Manjola Banja
Former Scientific Officer
Energy Efficiency and Renewables Unit, JRC, EC
Ispra, Italy
e-mail: m.banja@yahoo.com

Martin Jégard
Former Trainee
Energy Efficiency and Renewables Unit, JRC, EC
Ispra, Italy
e-mail: martin.jegard@gmail.com

***Abstract*— France promoted the deployment of solar photovoltaic through the use of the most widespread type of support among EU countries, the feed-in tariff, combined with feed-in premium and tendering system. This paper overviewed the French historic framework of the support for this technology as well as the way in which this support changed quantitatively over period 2002-2017. The paper provides insight to the relationship between the amount of incentives granted, the average tariffs, the final renewable electricity generated from this technology and its installed capacity through an indicative analysis that reveals a positive/no patterns/negative correlation in short term (incentives versus the production of incentivized energy), as well as in long term (incentives versus the installed capacity). Feed-in tariff scheme gave the real uptake for solar photovoltaic in France, which had the intended effect of the policies that were introduced to promote it. We found that 1% increase in the amount of support for solar photovoltaics in France during period 2005-2016 has contributed to an increase by 0.6% in the installed capacity of this technology. Further we found that the incentives for solar photovoltaics given from tendering system decreased the most over years compared with the incentives from regular feed-in tariffs. The insight analysis shows that indicators as gross domestic production, CO_2 emissions, spot electricity prices, households' electricity prices, unitary feed-in tariff through regular and tendering system are important to define the trend of the solar photovoltaic capacity in France. The combination between feed-in tariffs and tendering system produced in 2011 the largest additional capacity over the period under analysis. Overall, the analysis shows that the French supporting policies for photovoltaic have been effective in promoting this technology.**

Keywords—solar photovoltaic; feed-in tariff; capacity mechanism; feed-in premium; regression analysis

I. INTRODUCTION

Over more than a decade the significant cost reduction of solar photovoltaics have increased the attractiveness towards this technology [1]. Before the start of this period this technology was considered very promising but very expensive and not yet matured. Within the EU market conditions for photovoltaics differ substantially from country to country due to different energy policies and public support programs for renewable energies and especially photovoltaics, as well as the varying grades of liberalization of domestic electricity markets [2]. Identifying and quantifying the costs and benefits of increased renewable capacity is a key element of economic research on renewable energy [3]. Understanding the impact of the support schemes is a crucial aspect for the policy makers [4] and the actual effectiveness of supporting measures is more and more argued nowadays [5]. In 2013 the EU adopted the guidance document for the designing and reforming renewable energy support schemes [6]. In 2014 the EC's Guidelines on State Aid for Environmental Protection and Energy [7] allow Member States to support renewable energy sources, subject to certain conditions. The guidelines for the first time contained criteria for the Commission to apply when assessing capacity mechanisms.

This paper aims to analyze how the incentives have affected the production of renewable electricity from solar photovoltaic in France over period 2002-2017. Four indicators of renewable electricity production are taken in consideration: the amount of incentives granted, the average tariff, the final renewable electricity generation and the installed capacity. The paper will produce quantitative evidence on the amount of subsidies granted and their effectiveness. The main support schemes taken into consideration are: feed-in tariffs (FITs), feed-in premiums (FIPs) and tenders. Based on the information gathered on these support schemes, it is possible to investigate which instrument was more successful in promoting renewable electricity production from solar photovoltaic. The paper aims to compare the impact of the incentives in the short term, i.e., whether they affect the amount of incentivized production or total production, and in the long term, i.e., whether they affect the installed capacity.

II. THE FRENCH SYSTEM

The French electricity market is structured conform to the EU legal and regulatory framework allowing: (i) consumers to choose their power supplier; (ii) freedom of establishment for suppliers; and (iii) a free and non-discriminatory access to the transmission and distribution grids. The French power market is highly concentrated. It is dominated by Electricité de France (EDF), which is 85% owned by the French state and is responsible for the bulk of generation and retail services in France. EDF also owns the transmission system operator (TSO), RTE [8]. The FITs in France are determined by two combined factors. First the long term avoided costs for electricity generation from conventional energy sources. Second an extra payment for achieving additional objectives in the field of public services in the electricity sector defined by the law [9]. The legal basis for the national FIT mechanism[1] in

(1) In the form of purchased obligation mechanism

France was laid down with entering into force of Law No. 2000/108 of 10th February 2000 (Obligation d′Achat) on modernisation and development of public services in electricity sector. The law was related to the obligatory purchase of electricity from renewable energy sources and cogeneration. The law regulated the free access of independent energy producers to the grid and lays the foundation for higher FIT for electricity production from renewables and a new tender scheme for renewable energy production capacity. The contract under the Contrat d′Achat had a duration period of 15 years. The Commission of Regulation of Energy ('the CRE'), the sectoral regulator, was created by the Law of February 2000 [9]. The first FITs for renewable energy technologies/sources (hydropower, biogas, cogeneration gas, households waste) were issued in 2001. In 2002 the FITs were issued for geothermal, photovoltaic, combustion of non-fossil vegetable material (biomass), raw or processed animal waste, methanisation and other installations of less than 36kVA. In 2005 the revisions of FITs for renewable electricity, leading to new legislation for wind, biogas, geothermal, solar and hydropower, were announced. Through the order of 10 July 2006, the new FIT for wind, photovoltaic, geothermal, biogas and methane entered into force. The FIT mechanism in France has operated through a tariff payment guaranteed only until a certain amount of capacity has been installed. The multi-year investments plans for French electricity system have set these technology-specific targets. In case the technology-specific targets were not reached the government had the option of tendering the remaining capacity. In addition to technology-specific targets a plant-specific capacity limit for all renewable energy technologies was also implemented. Only producers with installed capacity of less than 12 MW were eligible for tariff payment. For plants with a capacity larger than this limit the use in parallel of a tender scheme has been in place [10].

The act and decree of 2005[2] removed the 12 MW limit for wind energy producers. Under political compromise the wind power plants were no longer subject of size restrictions as long as they were located in specially designated wind power developments zones. An amendment of the 2005 decree stipulated that only wind power plants of more than 30 MW would be eligible for tariff payment [10]. In 2009, 2010 and 2011 the third wave of FITs regulation entered in force including new tariffs for organic waste, solar and geothermal [9]. Since 2009 the tariff regime for building integrated solar PV systems limited the payment to installations with a capacity of up to 250 kW. Solar PV was also limited to annual operating hours (1500 kWh/kWp and the departments' overseas 1800 kWh/kWp). In 2010 this cap was extended to respectively 2200 kW and 2600 kW [10]. Law No. 2009-967 of 3 August 2009 on the timetable for the implementation of the Grenelle Round Table on the Environment ("Grenelle I" Law) and Law No. 2010-788 of 12 July 2010 relating to the national commitment for the environment ("Grenelle II" Law) are the first steps of the French action plan for improving energy efficiency and increasing the use of renewable energies. The government encourages the generation of energy from renewable sources (currently through FITs for renewable energy and investment support), and also the consumption of renewable energy (by way of financial aids) [9]. Law No. 2010/1488 of December 2010 on the new organisation of the electricity market created the Regulated Access to the Historical Nuclear Electricity (ARENH) which allowed alternative suppliers an access to nuclear electricity in order to sell it to end consumers and ended regulated tariffs for industrial consumers [11]. The Law-Decree no 2011-504 of 9 May 2011 (Code de l'énergie) codified all the legislative provisions relating to gas and electricity and implemented the Third Energy Package. It came into force on 1 June 2011. The French Energy Code for the first time consolidates laws and decrees relative to energy law. Several decrees and orders set the framework implementing the subsidy schemes supporting renewable energy and co-generation [12]. Law No. 2013-321 of 15 April 2013 preparing the transition to a less consumptive energy system was another step of the French action plan. This law aimed at introducing progressive tariffs for residential electricity and heat consumption, based on a "bonus-malus" system applicable as from 1 January 2015 [12]. In reviewing the law, the Constitutional Council scrapped the mechanism, finding that it violated the constitutional principle of equality. Nevertheless, the remaining provisions of this law contain various measures for preparing the energy transition, like the removal of "wind farm development zones" to incentivize the development of onshore wind farms (prior to this, only projects established within such development zones could benefit from the tariff). The Law also abolished the "minimum five towers rule" needed to qualify for the FIT, relaxed the conditions of realization of wind farms in the overseas departments, and contains certain measures for managing electricity demand [9].

The European Commission criticized the French power purchase obligation mechanism and prompted France to put an end to its use in the energy sector, since it constituted a state aid according to article 107 of The Treaty on European Union, following the decision that the European Union Court of Justice had adopted in 2013 (CJEU, December 19th, 2013, aff. C-262/12, "Association Vents de colère"), in which it qualified the French feed-in-tariffs for wind power generation as an illegal State aid.

In the context of the 2014 EC State Aid for Energy and Environment guidelines the French has implemented two support schemes: (i) An open desk procedure ("*guichets ouverts*") where the support is available for all eligible installations, according to EU guidelines this scheme is opened to small installations; (ii) Tender procedures where the support is granted only to the auction winners. Within these two schemes the support can take the shape of FIT ("*obligation d'achat*") or of a FIP ("*complement de rémunération*"). In the case of the FIT the responsibility of the electricity purchase rests on EDF and local electricity distribution firms. In the case of the FIP, EDF is the only organisation in charge of contracting and paying premiums. The cost of the overall support is compensated to these operators through public services contributions. The Energy Transition for Green Growth Law No. 2015/992 dated 17 August 2015 sets out the

([2]) Order of 23 August 2005 amending the conditions for the purchase of electricity produced by cogeneration installations and installations using renewable energies or household waste ; Decree n ° 2005-1149 of September 7th, 2005 relative to the renovation of the installations of electrical production under obligation of purchase and modifying the decree n ° 2001-410 of May 10th, 2001

reform of the support scheme (FIT system) and its funding (*contribution aux charges de service public de l'électricité, CSPE*[3]) towards a market premium and calls for tender for large-scale mature renewable facilities. This aimed to ensure the cost-competitiveness of renewable energies. Under this law FITs contracts are exceptional; the main support mechanism is the FIP.

Decree No. 2016/682 May, 27th 2016 sets out the conditions for access to support mechanisms for renewable energy provided for by the Law on energy transition: (i) additional remuneration (FIP); (ii) FIT and (iii) public tender. Decree No. 2016/190 May, 28th 2016 sets out the conditions for the transfer of purchase obligation contract to approved bodies. Decree No. 2016/691 May, 28th 2016 lists the different installations which can benefit from the Additional Remuneration mechanism as well as from the revised power purchase obligation. Ordinance No. 2016/1059 dated 3 August 2016 on electricity produced from renewable energy sources ended the 12MW threshold to benefit from a FIT and FIP contract. Decree No. 2016/1129 dated 17th August 2016 on competitive dialogue procedure for power plants sets up a new competitive procedure, alongside public tenders, to increase production capacities, when said capacities are not sufficient to meet the pluri-annual energy programme goals. Law No. 2017/227 dated 24 February 2017 on self-consumption and Decree No. 2017-676 dated 28 April 2017 on self-consumption sets up a legal framework authorizing self-consumption [10].

III. THE FRAMEWORK SUPPORT FOR SOLAR PV IN FRANCE

Solar photovoltaic installed capacity in France reaches 8044 MW by end of 2017 with 18071 new installations of a total capacity of 875 MW, 288 MW more than the previous year. As of March 31, 2018, the connected power of the solar photovoltaic park reached 8300 MW. During the first quarter of 2018, 246 MW were connected, compared to 86 MW over the same period in 2017. Photovoltaic solar power generation amounted to 1.6 TWh in the first quarter of 2018, up 12% from production in the first quarter of 2017. Photovoltaic represented 1.9% of electricity consumption French on this beginning of the year [13].

The most of photovoltaic plants in France are small-scale plants with capacity up to 1 MW (98%). 534 plants or 1.7% are plants with capacity between 1 MW and 5 MW, 97 plants have a capacity between 5 MW and 10 MW, 87 plants are between 10 and 50 MW and 6 plants have a capacity greater than 50 MW. The photovoltaic farm of Cestas, the largest farm of this type in Europe, with a capacity of 301 MW was connected into the grid in 2015.

FIT, FIP and tenders have supported this deployment. The projects eligible for FIT and tendering system can receive contract duration of 20yr. FIT scheme supports the deployment of small-scale solar photovoltaic installation (up to 250 kW) in both residential and non-residential sectors. Rooftop PV projects (100-250 kW) are supported through a simplified tendering approach whereas large installations (above 250 kW) through a regular tendering system.

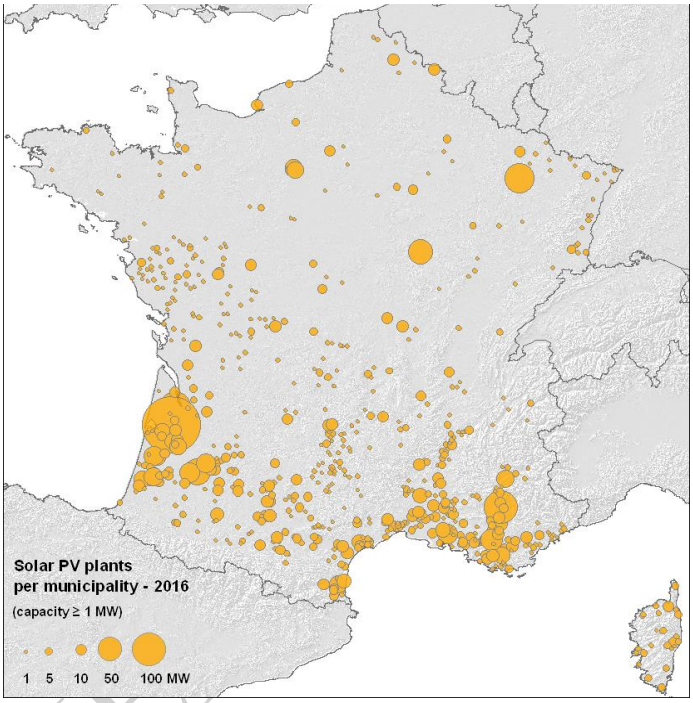

Fig. 1. Photovoltaics power plants in France, capacity ≥ 1 MW

A. *Feed-in tariff scheme*

The way for the first FIT in France was opened by the 10th February Bill on the modernization and development of the electricity public service that created an obligation to purchase electricity generated from renewable energy sources [14].

Figure 2 illustrates the evolution (adaptations and changes) of French support system for solar photovoltaics over period 2002-2017. The first FIT for solar photovoltaic came in place in 2002 with the order of 13th of March. The FIT was set at 152.5 €/MWh for the mainland and 302.5 €/MWh for Corsica and overseas departments. The differences in these levels of support shows that at that time the deployment of photovoltaics in France was most expected to take place in the overseas territories than in the mainland. Due to this the 2002 level of support was not able to bring a significant increase in the solar photovoltaics in France. This slow progress was also linked to the fact that the low level of support was not able to help companies to afford the photovoltaic modules prices. The real uptake of solar photovoltaic came in 2006 with the order of 10th of July 2006 that doubled to 300 €/MWh the tariff giving even a bonus of 250 €/MWh for integration into the buildings[4]. Both 2002 and 2006 tariffs offered a fixed payment over 20 years for each unit of electricity generated by photovoltaic appliances and fed to the grid. However, these tariffs were not set to decrease every year to follow cost evolutions [10].

([3]) CSPE is a tax component that is paid by electricity consumers. A new regulation has been set up since early 2016 (see below section on green taxation).

([4]) The 250 €/MWh premium for building-integrated PV (BIPV), was given for solar photovoltaic facilities inserted in the very structure of buildings, and not just set on roofs.

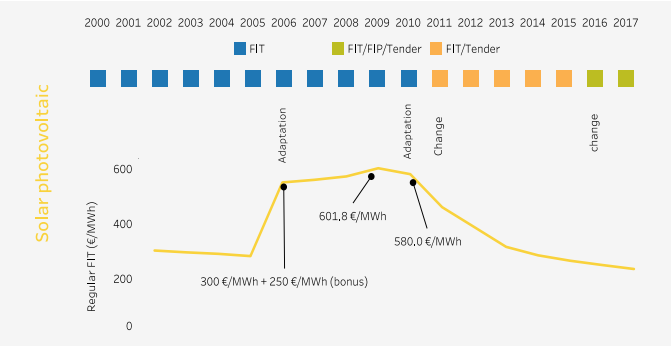

Fig. 2. Support system for solar PV – regular tariff (2002 – 2017)

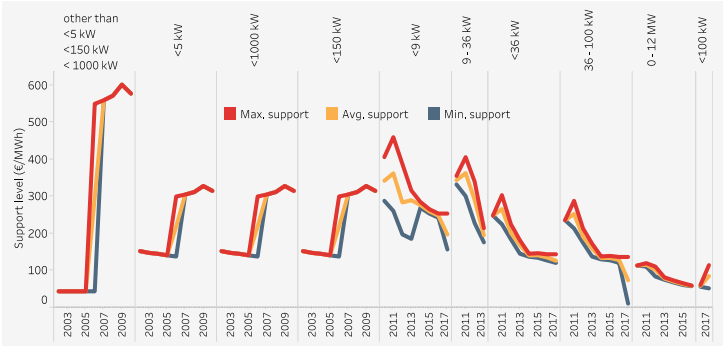

Fig. 3. Regular tariff for solar PV according capacities (2002 – 2017)

The FIT system to which other incentives as fiscal credits were later added, far exceeded expectations and the French solar photovoltaic market boomed between 2006 and 2010 [14]. The FIT for solar photovoltaics in France reached the highest level in 2009, at 600 €/MWh (plus bonus). In meanwhile after 2008 the price of photovoltaics module starts falling rapidly. Between May 2009 and October 2011, the prices of crystalline modules in Europe halved, from €2.62 to €1.29 [15].

The orders of January and August 2010 [5] kept almost unchanged the tariffs for solar photovoltaic facilities integrated into buildings (580 €/MWh) whereas for other facilities the FIT was 314 €/MWh adjusted by +0% to +20% according to the average sunshine of the area of establishment [8]. The period of support for photovoltaics until 2010 was characterized by the support for building integrated PV systems (BIPV) rather than conventional building attached PV systems (BAPV). The support to BIPV explains the relatively high cost of support schemes in France in general. This generous support brought to a rapid increase of solar photovoltaic projects presented in 2010 that caused overwhelming. Being not prepared for such requests and since the extra-costs were included in the FIT level, the French government was forced to temporarily suspend the buyback obligation from December 2010 to March 2011 for projects presenting their application during this period. After this moratorium the order of 4th March 2011 defined lower tariffs for solar photovoltaic facilities integrated in buildings[6].

The new scheme envisages a 4-monthly adjustment of the tariffs for PV systems below 100 kW. Systems over 100 kW in future had to be put out to public tenders. The new provision was centred on an annual target of 500 MW for solar photovoltaic. Over period 2013-2014 the FIT for the support of solar photovoltaics decreased further (Figure 3). To be pointed out here is the fact that the support for standard PV integrated systems was almost 2-fold the support for simplified PV integrated systems. Period after 2016 saw a further decrease in the regular tariffs support for solar photovoltaic integrated in buildings[10].

([5]) Order of 12 .01.2010 updated from the order of 15 .01.2010

([6]) Order of 04.03.2011 defined the following tariffs: building integrated PV installations: 460 €/MWh; 406 €/MWh; 402.5 €/MWh or 352 €/MWh depending on the use of the building and power output of the installation; simplified building integrated installations: 30.35 or 288.5 €/MWh; other installations: 12 €/MWh.

After 2010 the FIT level for the simple solar photovoltaic installations integrated in buildings saw the largest decrease. The drop was almost at the same level for other installations categories.

B. Capacity market scheme

In 2016 only 565 MW of additional capacity for photovoltaics was registered in France, which is the lowest annual volume recorded since 2009. The reasons for this situation are the dearth of projects that went into development at the end of 2014 and at the beginning of 2015, and the erratic timing of calls for tender [16]. The solar photovoltaic tenders in France were characterized by the small capacity of projects that participated. Most candidates bid for a small fraction of total capacity, while fewer bid for the largest share of auctioned capacity. Almost 3000 candidates participated at the tendering procedures for photovoltaics that took place during period 2012-2014. Almost half of were candidates that participated at the tendering procedure only in 2014, that saw the lowest share of winning bids towards the candidates. Nearly 1300 bids for solar photovoltaics were given in tendering process over period 2012 - 2014. This number comprises almost half of all bids given for this technology over period 2011-2017. The tendering system for photovoltaics in France has been characterized by approximately a 12-month difference between the time of appeal and the time in which the tender is organized. Some tenders are developed in more than 1 period. The largest number of periods and the smallest fraction of capacity bid characterized the tenders of year 2011. Tables I and II illustrates the average support for solar photovoltaics in France through tendering system

TABLE I. SOLAR PV SUPPORT PER CAPACITY (MIN, MAX) – TENDERS

	Min. capacity	**Max. capacity**	**Min. incentive**	**Max. incentive**	**Nr. Winners**
	(kW)	***(MW)***	***(€/MWh)***	***(€/MWh)***	
2011	100.5	13.9	188	440.3	319
2012	100.2	0.25	194	220.4	340
2013	101	12	142.5	168.3	491
2014	101	12	76	153.2	364
2015	102	5	134.8	218.3	411
2016	113	5	81.5	198.5	420
2017	102	0.5	98.5	113.8	599
2017	571	17	55.5	105.6	228

TABLE II. SOLAR PV TENDERS IN FRANCE (2011-2017)

Launch	Completed	Type	Nr. Projects	€/MWh
09/2011	07/2012	<= 250 kW	105	276
07/2011	03/2013	(<250 kW)	696	212.3
03/2013	11/2014	<250 kW)	587	162
03/2013	11/2014	<= 250 kW	121	142
11/2014	12/2015	<= 250 kW	212	77.5
03/2015	10/2016	(<250 kW)	1080	135.6
09/2016	04/2017	(0,1 -8 MW)	954	95.2
09/2016	08/2017	(0,1 -8 MW)	1063	95.9
08/2016	02/2018	0,5-17 MW)	233	62.7

On 2nd of August 2016 the first tender for the self-consumption systems (including solar systems) between 100 kW to 500 kW was launched in France. The allocated volume was 40 MW with two discount periods for a volume of 20 MW each time. 72 projects, in the first turn, and 62, in the second, were chosen to receive a premium at a weighted price of 40.88 €/MWh and 19.35 €/MWh respectively.

The main French solar photovoltaic market supported through capacity market scheme are the installations with capacity larger than 250 kW. Their share in the total installed capacity under this scheme increased from 39% in 2011 to 53% in March 2018. In meanwhile there have been an increase for the capacity ranges of 36 kW – 100 kW and 9 kW - 36 kW. The decrease in the overall capacity installed under this scheme is seen for installations less than 3kW and 100 kW – 250 kW.

C. *Effectiveness of support for solar PV – indicative analysis*

In overall terms France almost 10 folded the support for solar photovoltaic from €0.25 billion in 2010 to nearly €2.5 billion in 2016[7]. According to [16] the support cost through FIT reached €2.3 billion in 2015 whereas the support other than FIT was €69 million. 6.2 TWh of electricity from solar photovoltaic received support through FIT scheme in this year. We found that 1% increase in the amount of support for solar photovoltaics in France during period 2005-2016 has contributed to an increase by 0.6% in the installed capacity of this technology.

In average the maximum level of the regular tariff over period 2005-2010 increased with 60€/MWh per year. In overall terms this increase was with €49 million per year. For period 2005-2010 we found that the increase with 1 €/MWh in the maximum value of the regular tariff brought a rise with 2 MWh in the renewable electricity from this technology (0.4 MWh annual average).

Going through this analysis we found that during period 2011-2017 the incentives for solar photovoltaics given from tendering system decreased the most compared with the incentives given through the Legal Acts. In 2017 the average incentive given through tendering system almost halved compared with the average incentive of year 2011. In meanwhile the decrease of average incentive of Legal Act 2017 resulted 28% lower than the average incentive of Legal Act 2011. Both FITs given through regular procedure and tendering system in France decreased over years getting closer to the wholesale market price.

In this paper we have been focused in the correlations between ***dependent variables***: (1) Renewable electricity from solar PV incentivized through FIT (GWh); (2) Total renewable electricity from solar PV (GWh); (3) Solar PV installed capacity (MW); (4) Additional solar PV capacity (MW) with ***exploratory variables***: (5) The overall FIT amount (M€); (6) The amount of regular FIT in €/MWh; (7) The FIT on €/ MWh through tendering system; (8) Additional FIT amount (M€) and ***control variables***: (9) Gross Domestic Production (billion € at 2010 exchange rates); (10) Gross Domestic Production per capita (thousand €/capita); (11) CO_2 emissions electricity (million ton CO_2); (12) CO_2 emissions per capita (kg CO_2/capita); (13) Spot electricity prices (€/MWh); (14) Share of electricity from fossil fuels (%); (15) Net electricity exports (GWh).

The correlations we found between variables 1-3 and variables 5, 6, 9, 11 and 13 are presented in Figure 11. The results are only indicative in order to define the significant variables that make sense to be used in an econometric analysis. As expected we found a good correlation between the overall amount of FIT for solar photovoltaic and the renewable electricity production/capacity for this technology. Interesting is the correlation we found between renewable electricity production and installed capacity of solar photovoltaics with CO_2 emissions from electricity. This relationship showed a negative intercept coefficient meaning that high levels of emissions pushes for the deployment of renewables and thus have a positive effect on renewable electricity production and installed capacity of solar photovoltaics. In a recent report of Climate Action Network Europe [18] it is stated, "*France has been advocating for more ambitious outcomes of the negotiations on the EU 2030 climate and energy policies. It has also called for higher climate ambition in the EU, including by advocating for a net zero emissions target by 2050*".

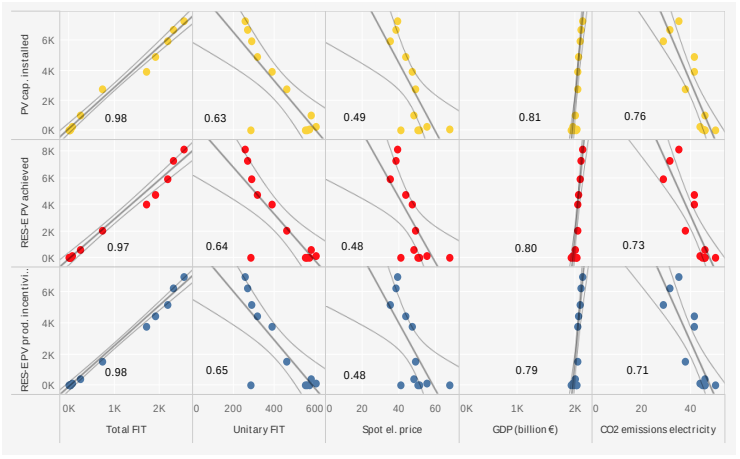

Fig. 4 Solar PV renewable electricity/capacity vs FIT, unitary FIT, electricity price, GDP and CO_2 emissions from electricity sector

([7]) For the sake of the calculations presented in this section the amount of FIT received in 2016 is estimated using the linear additive forecasting method of Tableau software.

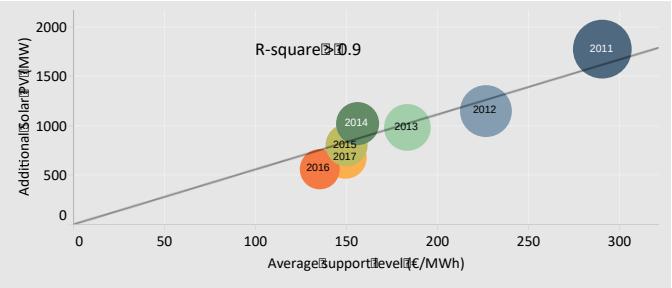

Fig.5 Correlation solar PV additional capacity – average unitary support

The analysis on correlation between additional solar PV capacity and average unit support (Figure 5) for this technology over period 2011-2017 showed that for a unit support of 1 €/MWh an additional capacity of 5.5 MW was found.

A good correlation was found also for the other variable, Gross Domestic Production (GDP). This shows that higher levels of income lead to a more intensive use of green energy in terms of incentives, total renewable output and installed capacity.

In our analysis we were paying attention to the relationship between deployment of renewable electricity from solar photovoltaic and the wholesale price of electricity. Wholesale electricity market in France is liberalized. The market price is set in day-ahead and it depends on the expected supply and demand along the day. The analysis of average spot wholesale electricity prices in France showed that over period 2005-2010 the drop took place with 3.3 €/MWh (6.5%). After 2010 the decrease took place with 8.5 €/MWh (17.8%). In our analysis we found a negative correlation between the amount of renewable electricity/capacity from solar photovoltaic and average spot electricity price with an R-squared coefficient at almost 0.5. This result suggests a substitution effect of electricity price: the higher the price, the lower the production of renewable electricity. In meanwhile the average electricity price for household in France have seen an increase by 33% over the period under analysis. This implies an average annual increase by 3 €/MWh of the electricity price for households. In this case the relationship between these indicators shows a positive correlation with an R-squared coefficient at 0.6.

The relationship between the additional solar PV capacity (logarithmic) and the additional FIT (logarithmic) has been found positive and with a significant R-squared coefficient (0.9) showing that higher tariffs produce effects which are to be manifested in a longer time span.

Another indicator of our analysis was the employment in the solar photovoltaic sector. We investigated the relationship with the installed capacity as well as with the overall support amount. We found a negative correlation between the employment and the overall support amount but not any significant correlation coefficient. As regard to the installed capacity the correlation was positive but the coefficient was not significant.

IV. CONCLUSIONS

This paper traced back the dynamics of the solar photovoltaics French policy making over period 2002-2017 contributing to the debate on the preferred type of support. The paper showed than the 2008-2010 period recorded the highest FIT of support for this technology in France. Further the paper investigated how the incentives given through regular tariff system and tendering system progressed over time showing that the French solar photovoltaics market supports through capacity market scheme mainly the large – scale installations.

The overall support for solar photovoltaics in France more than 10 folded since 2005. For period 2005-2010 we found that the increase with 1 €/MWh in the maximum value of the regular tariff brought a rise with 2 MWh in the renewable electricity from this technology (0.4 MWh annual average). The unitary supports for each kW installed have almost reached in 2016 the level they had in 2007. The pace of the increase of unitary support for each kW reached the lowest level in 2010 due to the fastest increase of the installed capacity compared with the increase of overall support amount. In last 2 years of our investigation period the annual increase in solar photovoltaic installed capacity and in the overall support amount took place with a similar pace (1.1%).

The shifting towards the capacity market mechanism after 2010 brought to the highest installed capacity of solar photovoltaics. Nevertheless (i) due to the continues drop in the unitary tariff through tendering system compared with regular tariff and (ii) due to moving towards large-scale installations the additional capacity of this technology saw a decreasing trend after the shift towards the capacity market scheme.

The decrease of regular FIT and tender prices for solar photovoltaics in France shows that favorable regulatory and institutional framework to support this technology exist in the country reflecting also the reduction of cost for solar photovoltaics projects.

The analysis described in this paper putted in evidence some interesting results on the relationships that present the immediate effects of the policies to support photovoltaics in France. These effects were part of the relationships between renewable electricity production and overall support amount as well as with unitary support. The analysis showed that 1% increase in the amount of support for solar photovoltaics in France during period 2005-2016 has contributed to an increase by 0.6% in the installed capacity. It shows also that for each unitary support level there was an additional capacity of 5.5 MW over period 2011-2017.

The positive relationships between the solar photovoltaics renewable electricity/capacity and the overall support amount showed that the French policies to promote solar photovoltaics, have been effective both in the short and long terms.

ACKNOWLEDGMENT

The authors want to thank Katalin Bódis, Energy Efficiency and Renewables, Directorate C, Joint Research Centre, European Commission for preparing the GIS map of the solar photovoltaics plants in France and for elaborating some part of the results of tendering system related to solar photovoltaics.

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