THE END OF THE BEGINNING: EVOLUTION OF THE FRENCH LARGE-SCALE RENEWABLE ELECTRICITY SUPPLY SUPPORT SCHEME

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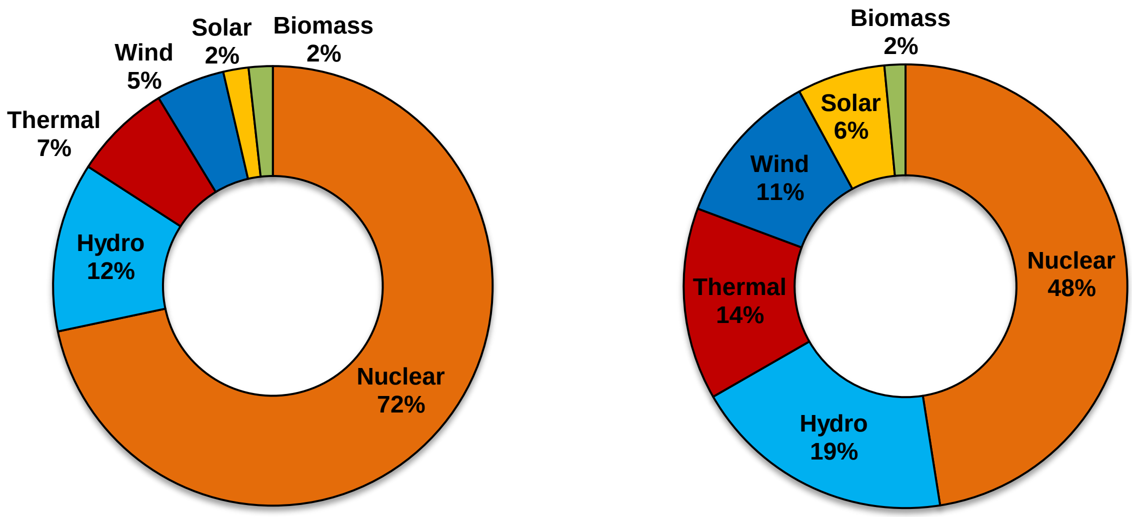
Abstract

Renewable electricity installations in France have benefited from feed-in tariff mechanisms since the early 2000s. This out-of-market support scheme has undoubtedly fostered the increase of both wind and solar photovoltaic power generation in France. However, FIT mechanism contributes to several market failures, such as missing money and negative prices phenomenon, as well as a high cost burden for the electricity consumers. With the ever increasing installed capacities and the continuous fall of levelized cost of electricity generation, regulators have implemented a new support scheme for large scale installations, in the form of a sliding-premium. We review in details this new mechanism and the choices that have been made by policy makers to provide a "fair" balance between exposing renewable electricity producers to more market competition, while preserving future revenue visibility in order to achieve the country's ambitions in terms of renewable capacity development.

Introduction: variable renewable electricity sources development in France

France stands out from any other countries for the dominance of nuclear in its electricity mix. Today, the country is ranked first in the world, both in terms of nuclear share in the total electricity production, as well as share in installed electric capacities. Of France's total electricity production, amounting to 548.6 TWh in 2018, variable renewable energy (VRE) sources, such as wind and solar photovoltaic (PV), remain limited, with respectively 5% and 2% (Figure 1).

Figure 1: France production (left) and capacities (right) electricity mix in 2018

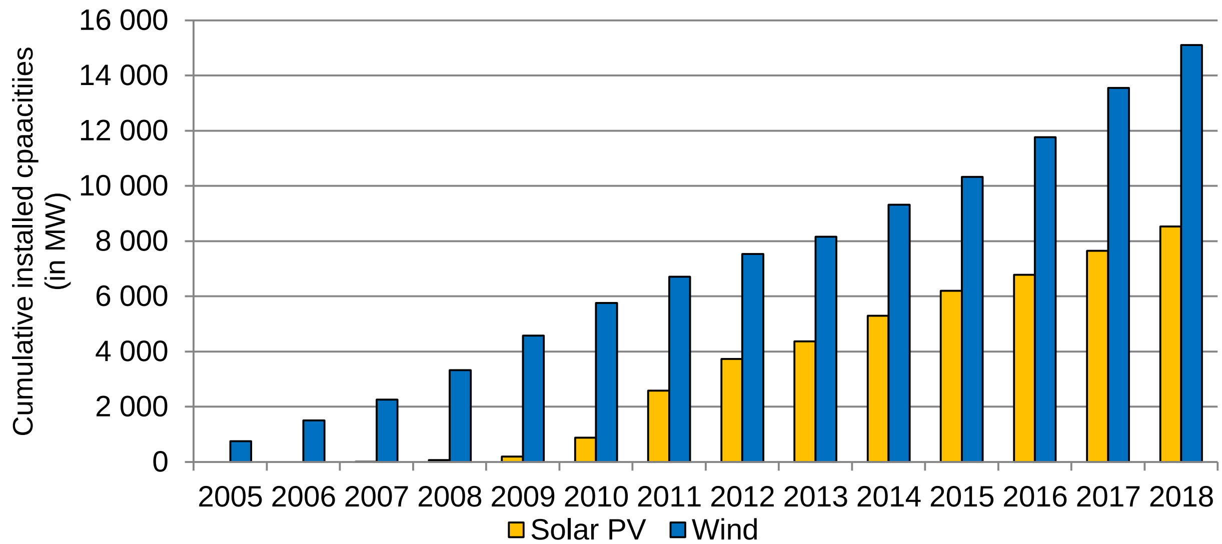


Source: RTE, Bilan électrique 2018.

Many European Union member countries have implemented policies to foster the development of renewable energy sources in the early 2000s. The underlying objective was to support the emergence of low-carbon electricity and to protect an early industry that could not yet compete with traditional means of power generation in terms of cost and availability.

In France, the French Energy Law of 2000 introduced the feed-in tariff mechanism (FIT) as a key economic support scheme to back the development of renewable electricity sources. Reinforced in 2005, FIT mechanisms have proven to be quite encouraging, as both wind and solar PV technologies have grown rather steadily until today in terms of installed capacities. As of end 2018, wind installations in France amounted at 15,108 MW, while solar PV total installed capacities reached 8,527 MW (Figure 2; Appendix 3).

Figure 2: cumulative installed capacities for solar PV and onshore wind in France (2005-2018)



Source: RTE, Panorama de l’électricité renouvelable en 2018.

Although France is not considered as a leading country in terms of renewable electricity generation, mainly due to the dominance of nuclear in its power generation mix, the country is today among the leaders in the European Union both in terms of solar and wind installations. France ranks 4th in terms of wind installations behind Germany, Spain and the United Kingdom ; while it ranks also 4th for solar PV, behind Germany, Italy and the U.K.

This paper reviews and assesses the evolution of support mechanisms in France. Fewer research have focused on this country so far, with a few notable exceptions [Debourdeau, 2011a, 2011b; Marcy, 2011; Percebois, 2013]. As a matter of fact, research on renewable energy development has tended to focus on countries in which renewable energy play a larger part in the electricity generation mix. Also, this study is not limited to documenting the French perspective. In many respects, the recent evolution of solar PV and wind markets and policies in France is similar to the situation in several European countries such as Spain, Italy, Czech Republic, the UK or Germany. As in the case of France, these countries have chosen to rely on feed-in tariffs to support the development of renewable capacities, and are in the process of implementing new mechanisms to respond to the FIT shortcomings. This paper is thus built on the hypothesis that an analysis of the revision of support schemes in France can teach us something about the design of support mechanisms in other countries.

Early industry support : the feed-in tariff mechanism

A crucial aspect of the recent development of renewable installations worldwide, especially in Europe, is that it is policy-driven and policy-dependent. The regions with highest installed capacities both in terms of wind and solar PV are indeed those in which support schemes have been in place for several years: China, Japan, some parts of the US (most notably California), European countries such as Germany, Spain, Italy, and to a lesser extent France [Cointe, 2014]. The Spanish case is particularly telling: when FITs were stopped in 2008, the rate of installations, which had just peaked, collapsed from one year to the next, dropping from 2,500 MW of new installed capacity in 2008 to 17 MW in 2009 [Bean, 2016]. Policy support has hence enabled, driven and shaped the deployment of renewable capacities.

Feed-in tariff schemes articulate three elements whose main effect is to secure investment in renewable electricity generation capacity:

- a purchase obligation,
- a fixed price,
- a fixed period of time over which the fixed price is guaranteed.

FITs are completed by a mechanism to compensate the electricity off-taker for the extra-costs induced by the purchase obligation and the fixed rate (most commonly in the form of a levy on electricity consumption). Each of these elements are determined by law and can be based on pre-arranged procedural calculations for their revision through time, which is why they can vary widely from one country to another. At any rate, FITs result in an “almost risk-free contract” from the perspective of the producer of electricity from renewable energy sources, who is protected from competition on the electricity market by three strong guarantees backed by the regulator and thus has nearly full visibility over future revenues.

The feed-in tariff mechanism in France has been set up by the French Energy Law of 2000, and reinforced in 2005 to support the development of first installations of renewable electricity sources. This mechanism has proven to be rather incentivizing for renewable electricity producers as it is quite securing for selling the electricity produced. Indeed, renewable electricity installations benefit first of a market priority access, guaranteeing that all of the electricity produced on the installation will be purchased by the off-taker. In the case of France, the off-taker is the national electric utility. Renewable electricity producers will then benefit from a constant payment per unit of electricity produced, at an amount determined by law, fixed for a long period, 15 years in the case of wind, 20 years for solar PV. Tariffs have been set at a level that is supposed to attract investors, on average much higher than the wholesale power market prices. FITs provide a quite secure market environment for renewable producers, that enable them to secure lower capital costs for financing their installations.

In simple terms, a renewable electricity producers revenue can be described as:

$$R = F \times q$$

Where:

- R: renewable electricity producer’s revenue over a given period
- F: the level of the feed-in tariff, determined by law
- q: the volume of electricity injected into the grid over a given period.

For new installations, these tariffs are revised every quarter to reflect the average cost decline for each segment of the technology (Appendix 1). Indeed, as more capacities are being installed, average levelized cost of electricity production (LCOE) decreases for new installations, due to learning effects and economies of scale [Elshurafa, 2018; Fu, 2018; CRE 2019b]. FITs are hence lowered to limit the cost burden for the community, as the off-taker recoups the extra-cost induced by the obligation to purchase this renewable electricity, through a levy on electricity consumption. In 2017, this levy, in France named *Contribution au Service Public de l'Electricité* (CSPE), amounted to 15% of residential electricity bills. Of the total CSPE, the part dedicated to cover extra-cost of renewables amounted to 4.76 billion euros, up by a six-fold factor since 2010 [CRE, 2018; Appendix 2].

The FIT system has undoubtedly encouraged the development of renewable electricity installations in France, but in a context of slow economic growth which led to a slowing electricity demand, out-of market mechanisms such as FITs have led to overproduction of electricity at certain times, a cause of several market issues, such as missing money and negative prices phenomenon.

Feed-in tariff shortcomings: "missing money", "negative prices" and a high cost for electricity consumers

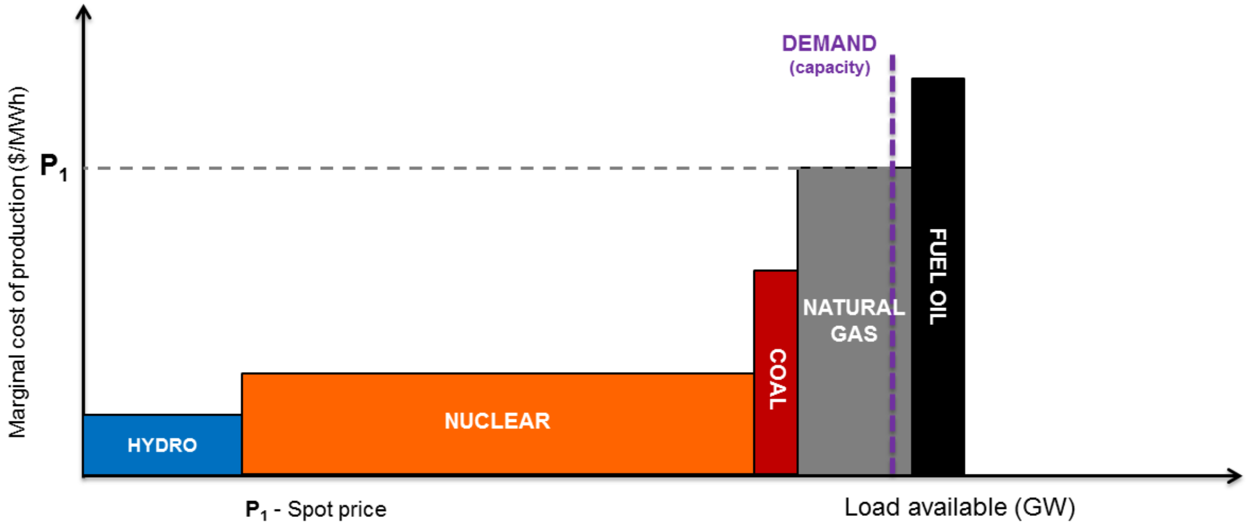
FIT schemes provide an out-of market guaranteed revenue stream for renewable producers. Indeed, by being assured that all of the electricity produced will be purchased at a given tariff for a determined number of years, renewables electricity producers are not sensible to wholesale market power price variations, although they do impact the supply and demand equilibrium on this market.

Zero-marginal cost electricity supply, such as wind and solar PV, benefit from a market priority access, providing an additional supply on wholesale market for centralized electric capacities, or a "missing demand" in the case of decentralized installations (Figure 3).

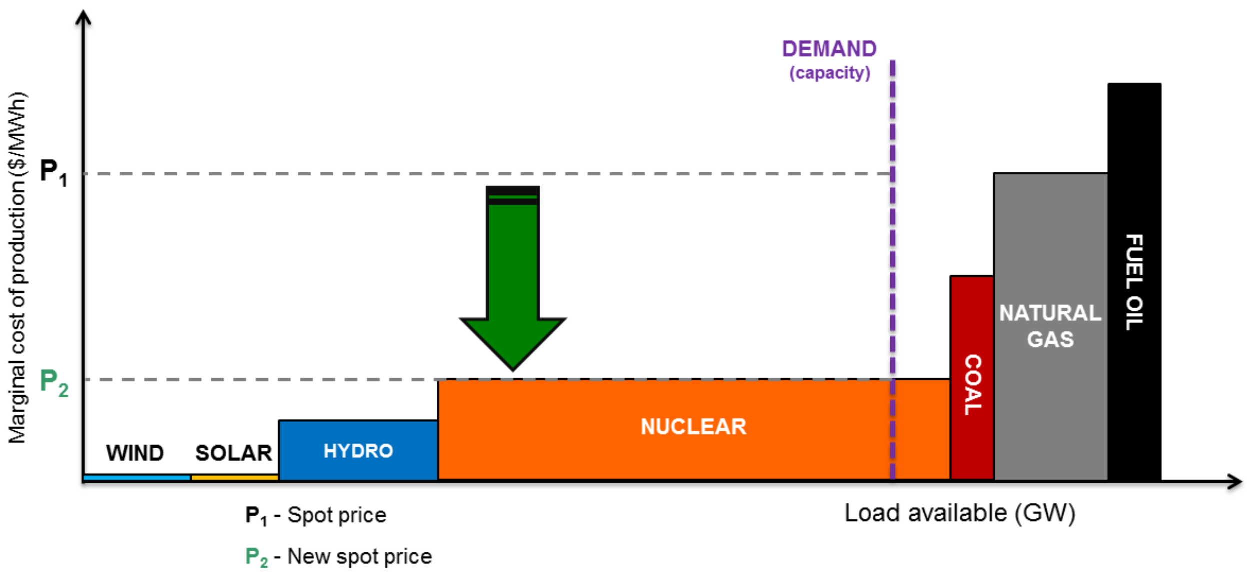
The merit-order logic implies that the power plants are called according to their increasing marginal cost of production (i.e. variable cost), the market equilibrium price being set by the marginal cost of the marginal plant. Any power plant is able to recover part of its fixed cost when the marginal plant has higher variable cost than its own. In the stylized case presented in Figure 3, nuclear installations recover their fixed cost in the case a., where they are "infra-marginal". In the case b., however, solar and wind additional supply makes nuclear the marginal technology: the equilibrium price is hence lowered and nuclear installations only recover their variable cost in this case. Furthermore, coal and natural gas installations are being evicted from the market for this given demand.

Figure 3: merit-order without (a.) and with (b.) wind and solar PV supply on the wholesale market

a.



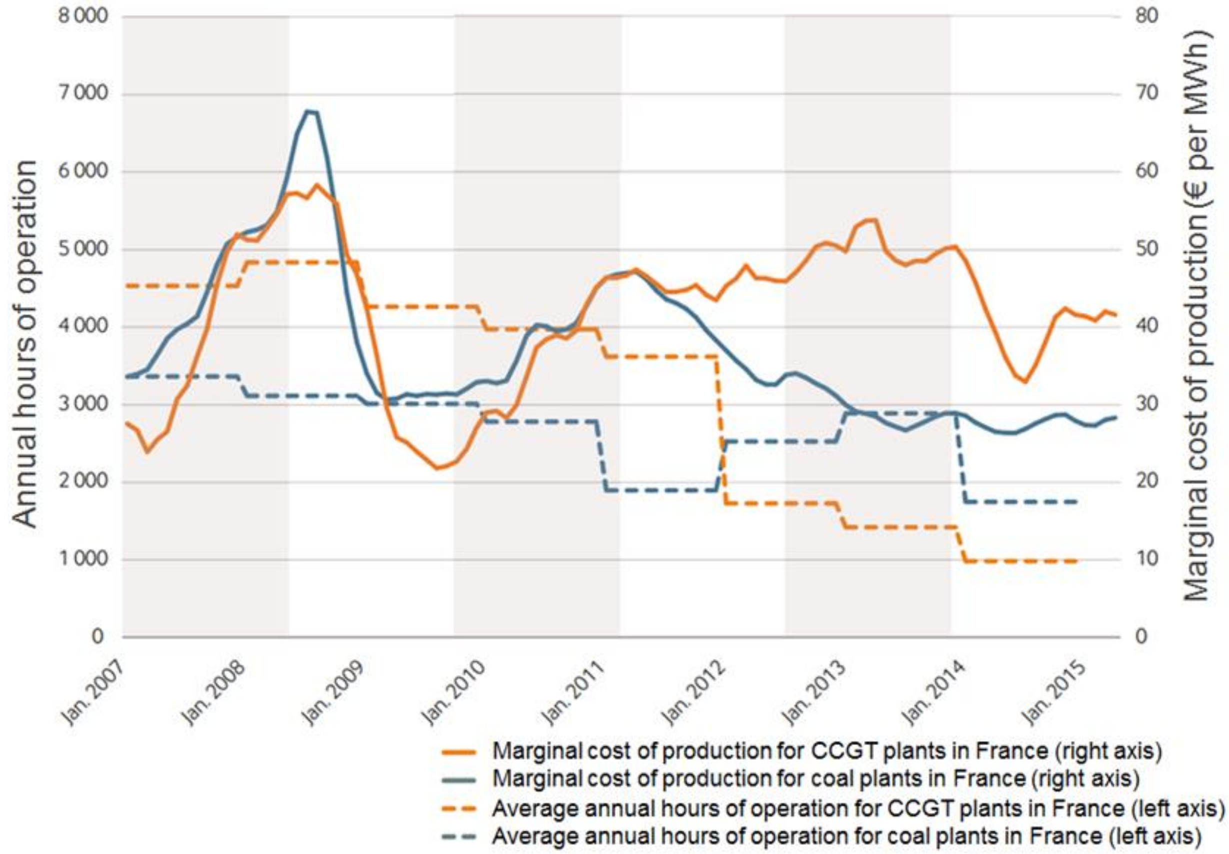
b.



Source: author's work.

In the case of large penetration of variable renewable energy sources on the wholesale supply curve, occurrences of "missing money" phenomenon are reinforced, as described extensively in existing literature [Joskow, 2008; Newbery, 2016; Hogan, 2017]. Flexible means of power generation such as natural gas or coal are being called on the market a fewer number of hours, and often being the marginal means of generation, thus preventing them to recover their fixed cost. This eviction of flexible means of generation from the market has been quite observable in France between 2010 and 2015 (Figure 4), particularly in the case of natural gas power plants. Indeed, combined-cycle gas turbines (CCGT) have seen their average annual hours of operation fall by 80%, from around 4,800 hours in 2008 to approximately 1,000 hours in 2014 [RTE, 2015].

Figure 4: marginal cost of production (euros per MWh) and annual hours of operations for coal and combined-cycle gas turbine in France (2007-2015)



Source: RTE, Bilan prévisionnel (2015).

The additions of renewable capacities are not the only factor causing this market eviction. A lower electricity demand on the French power market (due to a slowed economic activity and energy efficiency improvements) as well as a lower marginal cost of production for coal-based power (due to cheaper coal from an oversupplied North American market and a too low carbon price on the EU Emissions Trading Scheme), have also played a significant role in the "crisis" for natural gas power generation units in France and elsewhere in Europe.

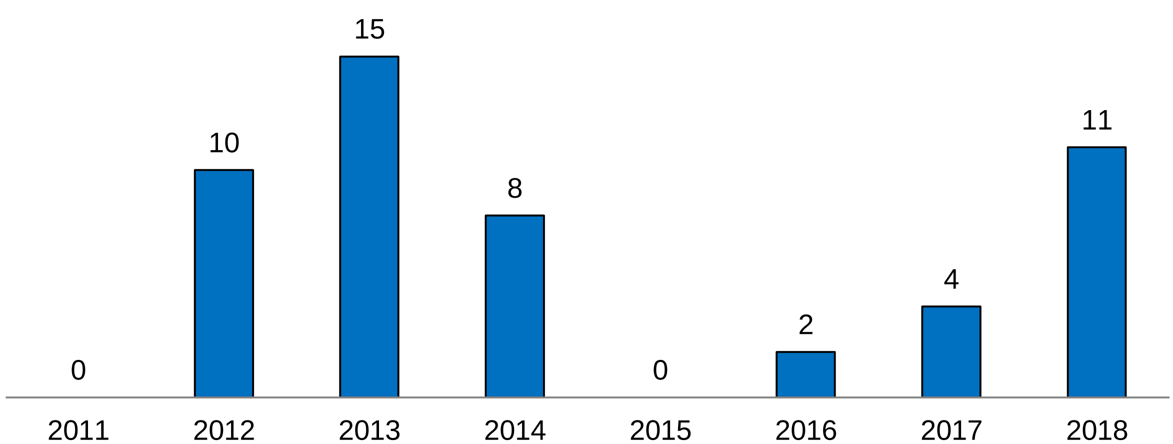
Missing money issues are being tackled first and foremost by the implementation of capacity markets, parallel to the wholesale market. The capacity market in France has been implemented in January 2017, where thermal electricity producers, as well as variable power generation units or demand response capacities are now able to offer their capacity bids. However, the European Commission has also called its Member countries to review the renewable electricity supply support mechanisms to better integrate variable electricity producers on the market, in order to make them sensitive to their impact on wholesale power markets. This is one of the reasons behind the revision of the French support scheme for some market segments as of 2016.

Another notable impact of intermittent renewable electricity supply on wholesale markets is the occurrence of negative prices. Negative prices are a price signal that occurs when a high short-term inflexible power generation capacity meets low demand. Inflexible power sources cannot be shut down and restarted in a quick and cost-efficient manner. Prices fall with low demand, signaling generators to reduce output to avoid overloading the grid. On the French day-ahead market and intraday markets, power prices can thus fall below zero.

In some circumstances, one may rely on these negative prices to deal with a sudden oversupply of energy and to send appropriate market signals to reduce production. In this case, producers have to compare their costs of stopping and restarting their plants with the costs of selling their energy at a negative price (which means paying instead of receiving money). If their production means are flexible enough, they will stop producing for this period of time which will prevent or buffer the negative price on the wholesale market and ease the tension on the grid.

Negative prices are observed when demand is low and a large share of supply is provided by variable means of generation such as wind and solar. This phenomenon has been observed more often in the early 2010s, as solar and wind capacities increased and reached a volume able to perturb the short-term merit-order of production (Figure 5). Due to higher installed capacities, such negative price episodes are much more frequent Germany (134 hours with negative prices episodes in 2018) than in France (11 hours).

Figure 5: number of hours with negative prices on the French Intraday power market (2011-2018)



Source: RTE, Bilan électrique 2018.

Another issue often reproached to the FIT mechanism is the high financial burden imposed on electricity consumers. Since 2003, renewable electricity support has been based on the CSPE, paid by electricity consumers in proportion to their consumption and collected by electricity distribution companies on behalf of the national operator. This levy thus made it possible to cover the compensation for public electricity service charges (due to operators with an obligation to purchase this renewable electricity). The part of the CSPE dedicated to compensating the off-taker for purchasing higher cost renewable electricity supply, grew rapidly to reach 5.39 billion euros in 2018 (Appendix 2). According to the French electricity market regulator, the cost burden for electricity consumers will increase until 2025 to reach 7.18 billion euros, of which more than 75% will be dedicated for solar PV and wind, only accounting for contracts that have been granted until 2017 [CRE, 2018].

Big ambitions for renewables: 2016 "Energy Transtion towards Green Growth Act" and 2018 *Programmation pluriannuelle de l'Energie*

The multiple challenges induced by the development of VRE supply, such as missing money, negative prices and an ever growing cost burden imposed on electricity consumers as gained more attention in recent years, given the increase of solar and wind capacities in France and in other European countries, all the more so as France has presented an ambitious development program for renewable capacities in the next decade.

Indeed, France has enacted in August 2015 the Energy Transtion towards Green Growth Act. The law aims notably at reaching 32% of final energy consumption and 40% of electricity production with renewable energy supply in 2030.

This act is complemented by the *Programmation Pluriannuelle de l'Energie* (PPE), published in 2016 and updated in November 2018, that details the orientations and priorities for action by the public authorities for the management of all forms of energy in France, in order to achieve its energy policy objectives [MTES, 2018]. The PPE defines notably quantitative objectives for the various technologies (Table 1).

Table 1: French targets in terms of solar PV and wind installed capacities (in GW)

	2018 (observed)	Target 2018 (from PPE 2016)	2023	2028
Solar PV	8.5	10.2	20.6	[35.6 - 44.5]
Onshore wind	15.1	15.0	24.6	[34.1 - 35.6]
Offshore wind	-	0.5	2.4	[4.7 - 5.2]

Source: French Ministry for the Ecological and Solidary Transition.

The issues described previously can only become more acute with more installed capacities. In that regard, the European Commission has invited Member countries to revise their renewable support schemes as soon as 2014, so as to better integrate variable energy sources in the wholesale electricity market and loosen the cost burden on electricity consumers.

The financing of renewable energies via electricity consumers has been largely called into question by the European Commission's new Guidelines on State aid for environmental protection and energy, adopted in June 2014 [European Commission, 2014]. In this document, the European Commission asked to Member Countries to gradually put an end to the regime derogating from the rule of free competition which prohibits State aid, that benefited renewable energies in order to encourage their early development. The European Commission aims hence to "*incentivize the market integration of electricity from renewable sources*", as it considers "*important that beneficiaries sell their electricity directly in the market and are subject to market obligations.*"

A “sliding-premium” mechanism to sensitize producers to electricity prices

The French regulator has adopted in 2016, a “sliding premium” mechanism, called *complément de rémuneration*. In this mechanism, VRE producers sell their energy directly in the wholesale market. In addition, a premium is paid to compensate for the difference between the income derived from this sale and a reference remuneration level, established by contract in a competitive tendering procedure (auction). This additional compensation can generally be qualified as an ex-post sliding premium, to the extent that its amount is adjusted to compensate for the difference between the reference contract price and a reference market income.

In this case, the VRE producer revenue can be described as:

$$R = p \times q + q(c - p)$$

Where:

- R: renewable electricity producer’s revenue over a given period
- p: the wholesale power market price
- c: the contract reference price, defined for each market segment by the regulator, or granted through an auction mechanism
- q: the volume of electricity injected into the grid over a given period.

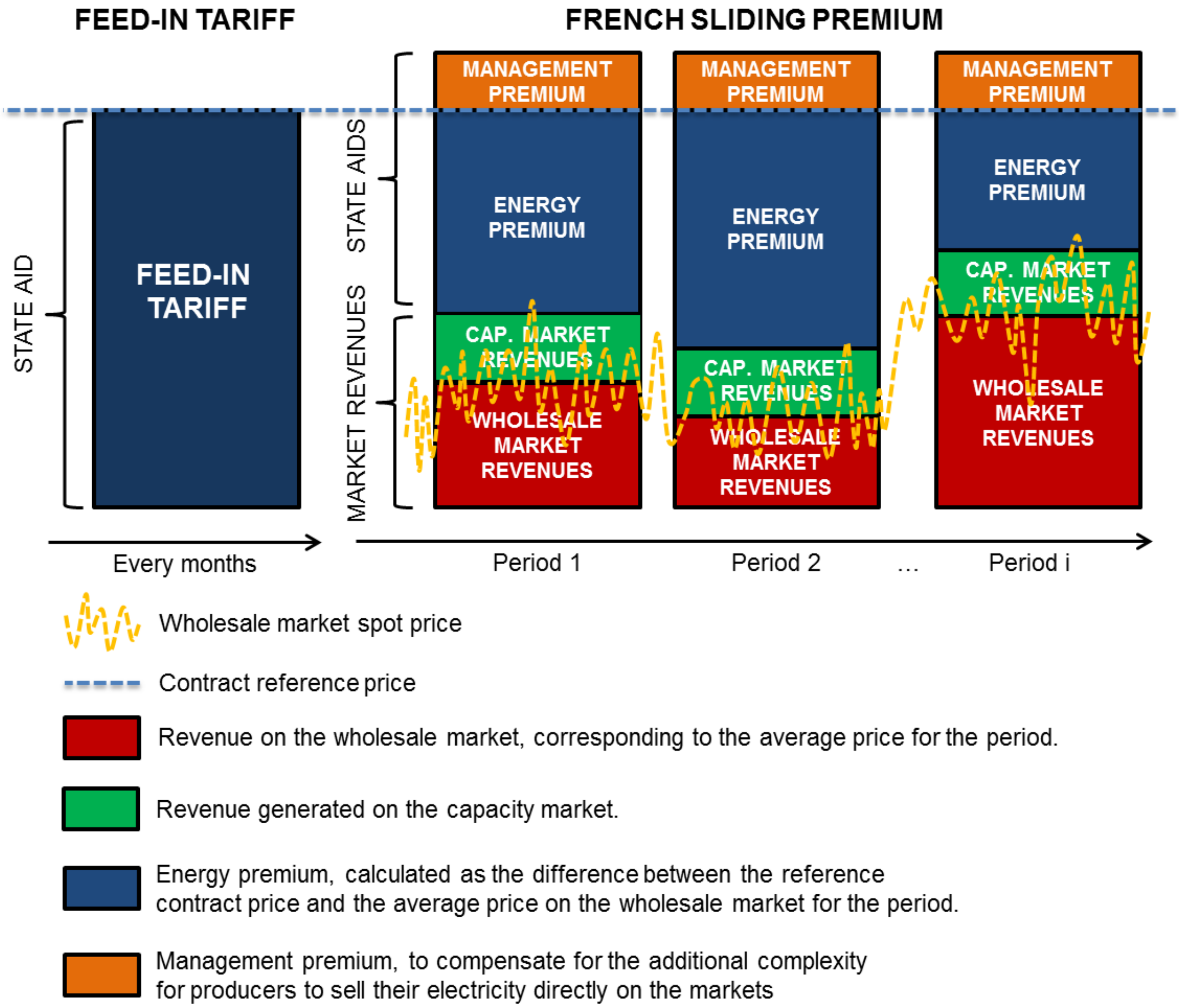
The sensitization of VRE producers come from the fact that the premium is not revised instantaneously, but regularly in a pre-established periodicity by the regulator. Indeed, the French sliding-premium formula can be calculated as follow:

$$SP = \sum_{i=1}^{n} q_i \times (c - {p^*}_i) - q_{cap} \times p_{cap} + \sum_{i=1}^{n} q_i \times p_m$$

Where:

- SP: sliding premium
- q_i: the volume of electricity injected by the installation over the period i
- c: the contract reference price, defined for each market segment by the regulator, or granted through an auction mechanism
- ${p^*}_i$: corresponds to the reference market price of electricity during period i.
- q_{cap}: corresponds to the volume of capacity guarantees on the capacity market over a year
- p_{cap}: reference price on the capacity market
- p_m: corresponds to a management premium, proportional to the electricity produced.

Figure 6: comparison between the FIT and the sliding premium mechanisms



Source: authors' work.

As described above, the sliding premium is composed of three different parts.

First, an "energy premium", that is calculated by the difference between a reference contract price and the average wholesale market price for a given period. The term p^*_i is defined either as the average of positive or zero spot prices determined per market segment for each technology, or as an average of a basket of futures prices, or as a combination of these two references. The reference wholesale market price is given by the EPEX Spot day-ahead price for the French zone. The energy premium is hence fixed for the period i.

Second, because the energy premium is calculated using the wholesale power price reference, the producers' revenues obtained on the capacity market must be subtracted from the energy premium to avoid double counting of capacity revenues.

Finally, a "management premium" is granted to VRE producers. The purpose of this premium is to compensate for the administrative and management costs of selling the electricity and guarantees of capacity directly on the markets. The inclusion of these management costs is partly new compared to the purchase obligation system, as the administrative management and marketing costs of the purchased electricity are not currently compensated to the obligated off-taker.

The VRE producer is hence sensitized to the variations of the wholesale market power price in the sense that it has an incentive to “beat the premium”. When the wholesale price is higher than the period average, the producer will benefit from this high price on the wholesale market, plus the ex-post energy premium that is fixed for a given period.

The sliding feed-in premium effectively counteracts parts of the FIT shortcomings previously mentioned. First, the burden imposed on electricity consumers through the CSPE, recovered through households electricity tariffs, will be reduced as part of the producers’ revenue will be generated on the market, through the wholesale and capacity markets revenues. The public support will then cover the amount of the complement (the energy and management premiums), reducing the total renewable energy support cost for the community.

Second, missing money and negative prices are reduced as VRE producers are now integrated in the wholesale market. With very low or even negative prices, electricity producers may be incentivized to invest in storage capacities in order to differ the injection of their electricity production until power prices are higher. In the case of the FIT mechanism, the time of injection does not matter, leading to potential wholesale market oversupply (or a decreased residual demand). Furthermore, in the occurrence of negative prices, VRE producers in France do not receive the premium if they inject their production at that time.

With a sliding premium, producers are now exposed to the market price signals. With the assistance of aggregators or private storage capacities, they now must adapt their production to maximize their revenues. In France, the *complément de rémunération* is today mandatory for all wind and solar PV installations of a capacity higher than 500 kW.

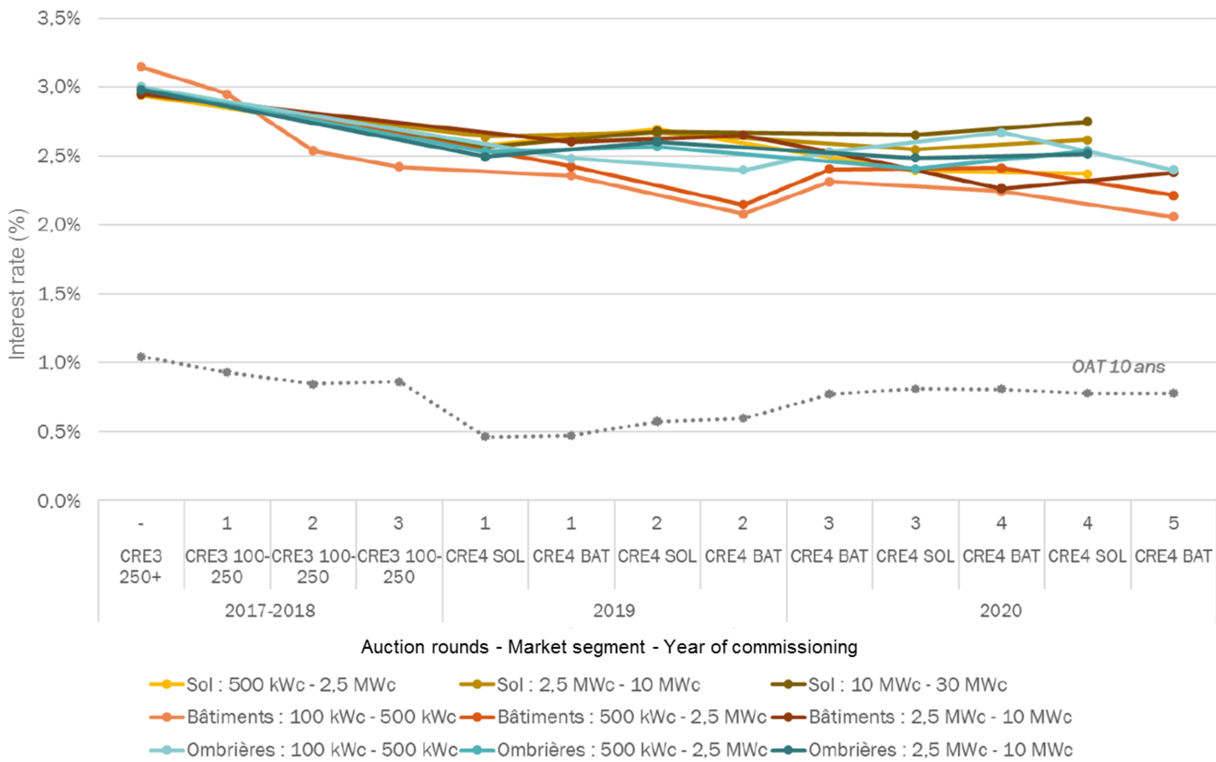
The key parameter: the premium revision time step

A key parameter in the design of the sliding-premium mechanism is the time step for the revision of the energy premium. Indeed, the regulator aims at finding a sound balance between exposing VRE producers to their price-lowering effect on the market, while maintaining an “acceptable” level of risk, as the visibility of future revenue flows is an essential determinant of the financing costs for capital intensive investments, such as wind and solar installations.

The shorter the time step for the revision of the premium, the closer from a feed-in tariff scheme the support mechanism will be. Indeed, the energy premium will be revised more frequently, hence narrowing the spread to the reference contract price (c, in the formula above) in comparison with a longer time step. On the opposite, a longer time step will make the support scheme closer to a pure feed-in premium system, which allows a full sensitization of renewable electricity producers to their impact on the wholesale power prices, but implies an uncertainty in terms of revenue that may deter investment in the technology. For such capital intensive installations, the conditions of financing will greatly impact their levelized cost and hence the projects’ profitability. In France, since the implementation of the sliding-premium mechanism for large-scale installations, the cost of financing has tended to remain fairly stable.

The spread between the average interest rate granted for ground-mounted installations of a capacity larger than 500 kW – those concerned by the sliding-premium reform – and the 10-year French government bond has decreased, as we can observe in Figure 7.

Figure 7: evolution of the average cost of finance for selected solar PV market segment (2017-2020), as stated in recent tenders results



Source: CRE (2019b).[1]

In the case of the French *complement de rémunération*, a monthly time step for the revision of the energy premium has been implemented. However, the average wholesale power price (p^{*}_{i}) is calculated for each technology: it corresponds to the average of positive and zero French day-ahead spot prices, weighed by the hourly production of all installations for each technology (Figure 8). The average market prices are adjusted by technology-specific factors for wind and PV as the prices that these technologies receive in the market are structurally different from the average price. Wind energy receives on average lower prices because high wind penetrations lead to low electricity prices in the corresponding period due to the merit-order effect. Solar PV receives on average higher prices as PV plants generate electricity during day time only when typically electricity demand is high and prices therefore as well [Ecofys, 2015].

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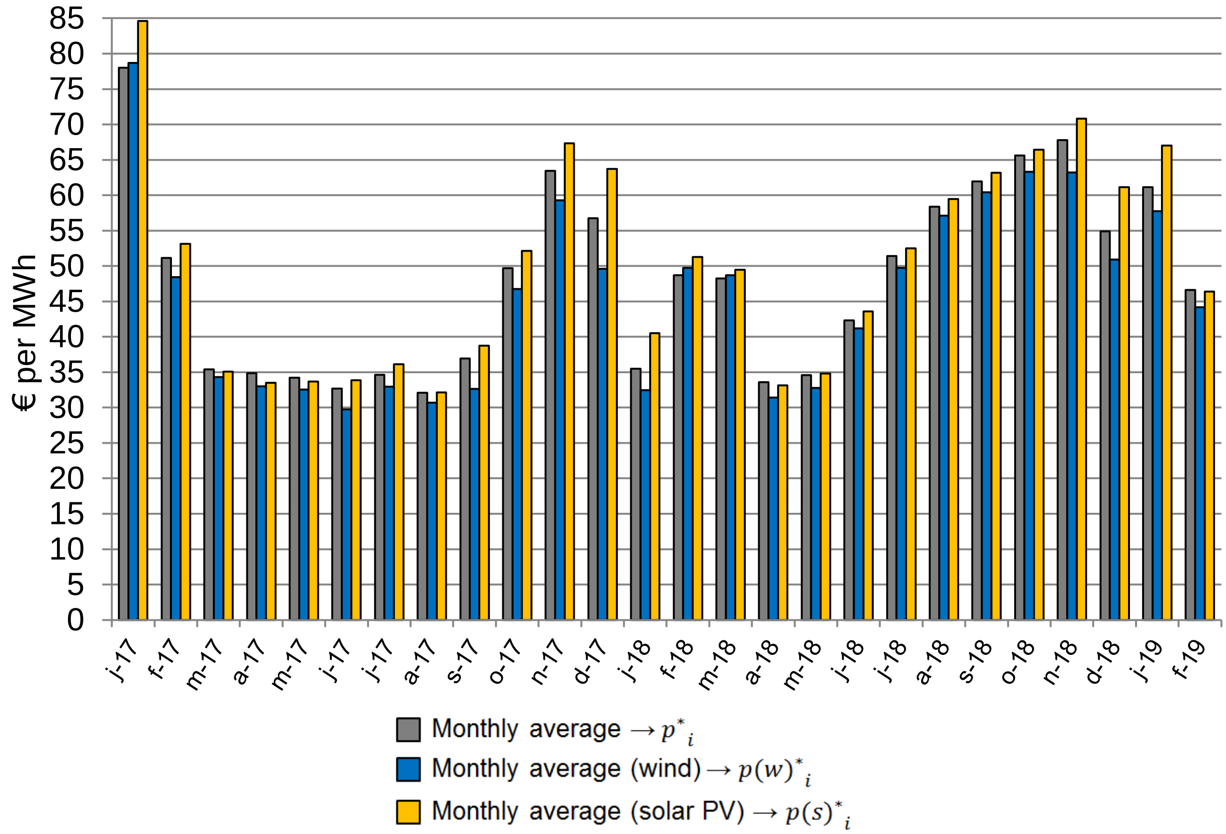
[1] From Figure 7:

- Sol = ground-mounted
- Bâtiments = buildings
- Ombrières = shade houses ;
- kWc = kWp
- MWc = MWp.

Figure 8: Monthly average day-ahead spot prices (in euros per MWh), global average and weighed by wind and solar PV production



Source: Commission de régulation de l'énergie (2019a).

In the case of a monthly revision time step, renewable energy producers are impacted by the infra-monthly variations of the wholesale market power prices. On the contrary, they are not affected by the seasonal variations observable on the French wholesale power markets. If the day-ahead prices tend to be higher in winter than in summer, as we can see clearly in Figure 8, the energy premium is revised to compensate for such differences with a monthly revision time step; renewable electricity producers benefit from a higher energy premium in winter than in summer and are not incentivized to inject more of the electricity production during higher prices season (for instance, by undertaking their maintenance operations during the months when prices are expected to be lower on average or to invest in seasonal storage capacities).

Conclusion

This paper reviews the multiple issues that led to the adaptation from a FIT scheme to a market-oriented sliding-premium, and how this new regime should progressively accompany the maturation of wind and solar technologies.

We provide evidence that a "fairer" share of market price risk can be supported by large scale PV and wind installations in France. We show that an adequate price sensitization enables policy makers to limit their support policy costs while maintaining a reasonable support for renewable electricity supply.

The design of the French *complement de rémunération* does indeed sensitize renewable electricity producers to wholesale market prices. More market signals are needed to give the right incentives for reducing variable electricity sources integration costs but should not undermine the effectiveness of support schemes.

Moreover, our study highlights the key parameter of the time step used to re-evaluate periodically the sliding premium in order to effectively sensitize producers to market prices. We show that a shorter time step drives the support mechanism towards a FIT scheme, while a longer time step reflects a full feed-in premium mechanism. In the case of France, a monthly time step has been chosen for the revision of the energy premium, enabling solar PV and wind installations to be sensitive to the short-term wholesale power market price variations, while protecting them from the seasonal variations. With both technologies experiencing steep cost declines in the years to come, a longer time step revision could be considered.

Further research should be to construct a comparative model so as to analyse VRE producers' revenue using FIT and sliding premium schemes. In such a case, more data are required, such as solar PV and/or wind installations daily production profile over several years so as to calculate the on-market revenues as well as premiums paid to renewable energy producers.

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Note: the references in italics are in French.

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Appendix 1: evolution of solar photovoltaic feed-in tariffs in France (2006-2018), for different market segments, in euro-cents per kWh.

	Residential [3 to 9 kW]	Commercial & Industrial [9 to 100kW]	Large-scale
Q1-2006	55,0	55,0	30,0
Q2-2006	55,0	55,0	30,0
Q3-2006	55,0	55,0	30,0
Q4-2006	55,0	55,0	30,0
Q1-2007	56,0	56,0	30,5
Q2-2007	56,0	56,0	30,5
Q3-2007	56,0	56,0	30,5
Q4-2007	56,0	56,0	30,5
Q1-2008	57,2	57,2	30,5
Q2-2008	57,2	57,2	30,5
Q3-2008	57,2	57,2	30,5
Q4-2008	57,2	57,2	30,5
Q1-2009	60,2	60,2	32,8
Q2-2009	60,2	60,2	32,8
Q3-2009	60,2	60,2	32,8
Q4-2009	60,2	60,2	32,8
Q1-2010	57,8	57,8	31,5
Q2-2010	57,8	57,8	31,5
Q3-2010	58,0	42,0	31,5
Q4-2010	58,0	37,0	27,6
Q1-2011	58,0	37,0	27,6
Q2-2011	46,0	28,9	12,0
Q3-2011	42,6	26,1	11,7
Q4-2011	40,6	23,6	11,4
Q1-2012	38,8	21,4	11,1
Q2-2012	37,1	19,3	10,8
Q3-2012	35,4	17,5	10,5
Q4-2012	35,2	16,2	10,2
Q1-2013	31,6	17,3	8,2
Q2-2013	30,7	16,0	8,0
Q3-2013	29,7	14,5	7,8
Q4-2013	29,1	13,8	7,6
Q1-2014	28,5	13,8	7,4
Q2-2014	27,9	13,5	7,2
Q3-2014	27,4	13,3	7,0
Q4-2014	27,0	13,1	6,8
Q1-2015	26,6	12,8	6,6
Q2-2015	26,2	13,3	6,5
Q3-2015	25,8	14,0	6,3
Q4-2015	25,4	13,7	6,1
Q1-2016	25,0	13,2	6,0
Q2-2016	24,6	12,6	5,8

Q3-2016	24,3	12,1	-
Q4-2016	24,3	12,1	-
Q1-2017	24,3	12,1	-
Q2-2017	15,9	11,5	-
Q3-2017	15,9	11,5	-
Q4-2017	15,7	11,4	-
Q1-2018	15,7	11,3	-
Q2-2018	15,8	11,2	-
Q3-2018	15,8	11,3	-
Q4-2018	15,8	11,2	-

- Residential tariff (T_1) : simple installations of a capacity between 3 and 9 kW.
- Commercial & Industrial (T_4): simple installations of a capacity between 36 and 100kW, for larger C&I installations, tariffs are granted through auctions.
- Large scale (T_5): large-scale, ground mounted, centralized installations. Since Q3-2016, all capacities are awarded through auctions. The T_5 tariff is hence set at 0.

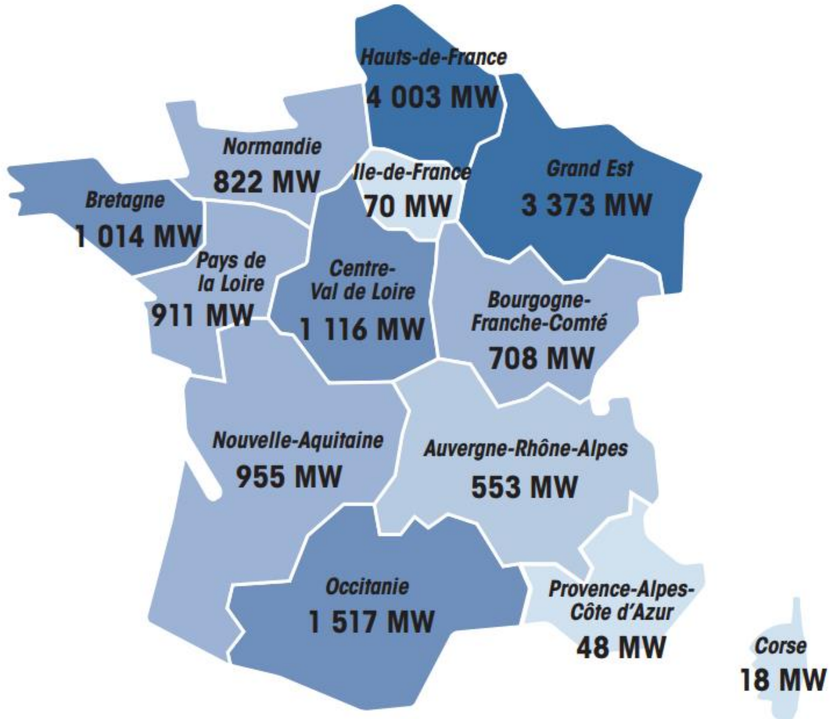
Source: Observatoire de l'énergie photovoltaïque, from Commission de Régulation de l'Énergie.

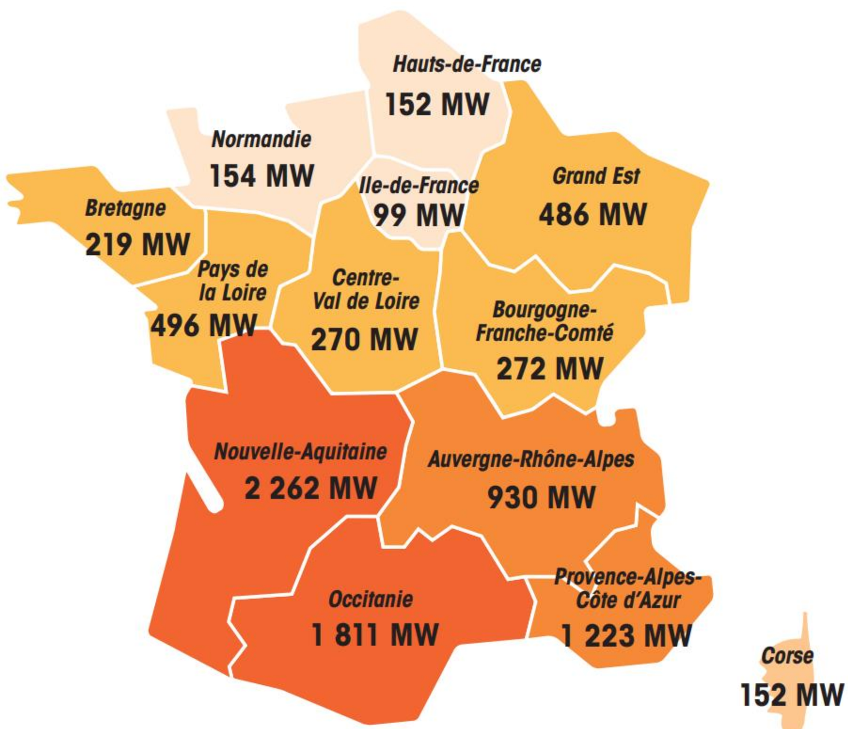
Appendix 2 : cost of renewable electricity purchase in the CSPE (2011-2018)

	RES purchase cost (in million euros)	Share of RES in total CSPE cost
2011	1464,0	41%
2012	2673,4	55%
2013	3156,1	60%
2014	3749,1	62%
2015	4205,8	64%
2016	4380,6	66%
2017*	4766,2	67%
2018*	5390,9	69%

* Note that 2017 and 2018 are forecasts made by the CRE.
Source: CRE (2018).

Appendix 3: wind (above) and solar PV (below) installed capacities in France per region (end 2018)





Source: RTE (2019), Panorama des énergies renouvelables 2018.