Promoting Renewable Energy Sources: Road Towards the EU 2020 Targets

The Cases of France and Italy

Diego Grippa

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Introduction

Energy is an essential element in the modern days' way of life and has a key impact on political and economic activities worldwide. It is estimated that, as a consequence of the industrialization of non-OECD states, the global energy demand will double by 2050 (Krüger 2016, 1). Bearing in mind that a majority of the production for most fuels is in the hands of a handful of countries, this can lead to major political and economic implications for countries with high dependency (International Energy Agency 2019). Considering this upcoming global scenario, and the fact that the EU is one of the biggest energy consumers globally, in the decades to come EU member states will face huge challenges to keep up with their dependency on fossil fuels (Liobikiene and Butkus 2017, 298). In fact, it was estimated by the European Commission that if domestic energy production isn't made more competitive, the EU's energy dependency on imports could rise to 70% in the upcoming decades (Commission of the European Communities 2006, 3). This scenario would have implications going beyond the mere principle of security of supply and could subsequently affect various sectors of the economy, potentially undermining the competitiveness of European industries on the global scene.

As a way to counter this challenge and in the flow of a series of international conferences on climate, EU leaders decided, at the European Council of March 2007, to set a series of common goals regarding energy policy and climate change, aimed at the realisation of three fundamental policy objectives: sustainability, security of supply, and competitiveness. One of the set goals stated that, by 2020, 20% of the EU's energy consumption will need to be produced by renewable energy sources (RES) (European Council 2007, 21). Based on this, and on previous policy initiatives dating back to the 1990s, the decisions of the Council were translated two years later into the *Renewable Energy Directive* (2009/28/EC) that is aimed, according to Article 1, at the establishment of a "common framework for the promotion of energy from renewable sources". Furthermore, the *Directive* "sets binding national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport". These objectives were reiterated in the *2020 Strategy for smart, sustainable, and inclusive growth* that provided the EU's growth strategy for the 2010-2020 period, and the *Energy 2020: A strategy for competitive, sustainable, and secure energy* that designed the next steps for the European energy policy, especially concerning the accomplishment of the energy market (European Commission 2010, Liobikiene and Butkus 2017, 298). The definition of renewable energies is provided in Article 2(a) of the 2009 *Directive*, which defines it as "energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases". The terms contained in this definition are further defined

in Article 2. This definition excludes nuclear energy, consequently ignoring this source of energy when setting renewable energy targets (Renewable Energy Directive 2009). As of 2018, parameters on the Union's progress show that those targets could be met but there is a very different situation when looking singularly at each Member State (European Environment Agency 2018). In December 2018, a new *Renewable Energy Directive* (2018/2001/EU) entered into force with the aim of helping the EU to live up to the commitments of the Paris Agreement.

On the basis of the existing legal and political framework, the research question of this thesis will be: "What incentive mechanisms allowed for the effective promotion of RES in order to achieve the benchmarks set by the *Renewable Energy Directive (2009/28/EC)*?". Looking at how member states put into practice a directive related to energy and environmental matters is interesting, as a relevant number of infringement procedures are opened by the Commission in those areas (European Commission 2019). The first chapter will present the various methods used globally for the promotion of RES and the considerations found in the literature on their effectiveness. The second chapter will outline the methodology which will be used in this thesis to analyse the effectiveness of the policies put in practice in the cases that will be studied. The third chapter will focus shortly on the 20/20/20 objectives and the National Action Plans presented by member states, in accordance with *Directive 2009/28/EC*. Finally, the fourth chapter will focus on two case studies. Due to the impossibility to look at how all member states decided to put into practice the *Directive*, the thesis will focus on the cases of France and Italy. It will analyse the legal initiatives and incentive mechanisms put in place in each state and consider how effective they were in increasing the production of renewables. The cases of France and Italy were selected, as they are two large member states with a high final energy consumption (respectively 13% and 11% of the Union's total in 2016) and so their progress towards the 2020 benchmarks will have a more significant impact on the potential achievement of the Union's targets contained in the directive compared to the progress made by smaller member states (GSE 2018, 3). Additionally, at the start of the analysed period, the two countries had a similar production of renewables in quantitative terms, corresponding respectively to 18.93 Mtoe (Million tonnes of oil equivalent) for France and to 18.51 Mtoe for Italy (International Energy Agency 2014). Lastly, those case studies bring an original contribution to the literature as their systems weren't previously compared in this context.

Different Practices, Same Objective: The Promotion of RES

Energy policy has become a frequent debate in the last decades due to the need expressed in parts of the civil society to replace fossil fuels and switch to a higher share of energy supply to more environmentally friendly sources. As RES have a cost disadvantage compared to energy produced from fossil fuels, member states put into practice various support mechanisms to compensate for the cost difference and incentivize production (Ringel 2006, 3). It was, for instance, assessed by Nagy and Körmendi that the cost of investing in RES can be up to four times higher than investments in nuclear energy, therefore highlighting a need for effective support policies if the 2020 targets had to be met (Nagy and Körmendi 2012). The proper functioning of national support schemes was thus recognized as one of the main objectives of *Directive 2009/28/EC* (Renewable Energy Directive 2009). In 2011 Klessmann et al. looked at the initiatives taken at European and national level in the previous decade to attempt to determine what type of initiatives the EU member states (at the time 27, including the United Kingdom but not Croatia) had to implement in order to fulfil their goal. After an accurate analysis, the authors concluded that the EU needed policy adjustments to achieve the 20% energy production target, as under the trend of previous years success was unlikely. They further looked at the national incentives to invest in RES, concluding that the most used system consists in feed-in tariffs or premiums, but some member states also used quota obligations and fiscal incentives as alternative encouragement measures (Klessmann, et al. 2011, 7642). Kitzing, Mitchell, and Morthorst presented a more precise framework of possible support mechanisms, adding to the previously mentioned feed-in tariffs and premiums and to quota obligations the possibility to use tenders, as well as other supplementary support mechanisms such as investment grants, fiscal measures, or financing support systems. The latter three are often used as supplementary systems, with only a very limited amount of countries adopting them as their primary support mechanism. Their analysis confirms the claim that feed-in tariffs are the most used support mechanism, with investment grants and fiscal measures used by a majority of member states as supplementary support (Kitzing, Mitchell and Morthorst 2012, 195-196). Often, a variety of instruments are combined in order to provide each sector with the most convenient mechanism, while also stimulating different investors, which might have different preferences, to invest in renewable energy production (European Commission 2011, 10, Mignon and Bergek 2016, 314). But how are these instruments working, and how effective are they in promoting RES?

1.1 Feed-In Tariffs: Guaranteeing a Mid-Term Return of Investment

Couture and Gagnon explain how feed-in tariffs incentivize the investment in RES. They illustrate that, as of 2010, feed-in tariffs were used by 63 countries worldwide and, if well adapted, they are also the most efficient promotion system according to the European Commission. Feed-in tariffs are based on the idea of offering a fixed guaranteed price for energy produced, usually of the basis of a price per kWh. This fixed price may variate in function of the type of technology, size, location, and other specificities that each project might have. They clarify that there can be various types of feed-in tariffs. Market-independent tariffs simply establish a fixed minimum price at which the energy generated out of RES will be bought for a determined period of time. Those tariffs guarantee a generally low-risk investment for the duration of the incentive as they are not affected by economic variables such as inflation. Market-dependent tariffs (also known as feed-in premium) can assume various forms. It can be a premium offered on top of the retaliation price as a way to reflect the environmental attributes of renewables. An alternative model presented by Spain makes the premium inversely proportional to the price, so that when the retail price reaches a certain level, the premium declines to zero. A third possibility establishes a fixed percentage of the retail price at which the electricity will be purchased. The authors conclude that all those options present different advantages and disadvantages and the choice on which option to use depends on the case (Couture and Gagnon 2010). Some authors support the idea that feed-in tariffs encourage technological progress as producers will attempt to build more efficient technologies to increase the amount of electricity generated and therefore the rate of profit return from the initial investment (Li, Chang and Chang 2017, 661). Nicolini and Tavoni argue that while this system provides a stable and secure market for investors and is thus successful in the promotion of RES deployment, it does not address the main issue of RES: their high investment cost. They further argue that, while effective, this system is not perfect due to the lack of direct price competition, which leads to the distortion of electricity market prices (Nicolini and Tavoni 2017, 413). Lastly, while this instrument can help to quickly build a market for RES, a premature withdrawal of this support could rapidly tear it down.

Usually, member states have a tendency to apply feed-in tariff schemes on small rather than large installations. This occurs for all technologies, at the exception of offshore wind, in which the vast majority of installations are large (Kitzing, Mitchell and Morthorst 2012, 197). Pyrgou, Kylili and Fokaides argue that while feed-in tariffs are an effective tool for the promotion of investment, deployment, and utilization of RES, they need to be designed flexibly with appropriate parameters that could adapt the tariff on the basis of the evolution of the energy market (Pyrgou, Kylili and Fokaides 2016). When looking at the advantages and disadvantages regarding ecological

effectiveness and economic efficiency, Ringel argues that the feed-in tariff system is generally convenient from both perspectives, but could face great obstacles in a liberalized EU-wide single electricity market. This is related to the fact that EU member states would need to agree on a single EU policy to be in compliance with the European norms on competitiveness, therefore creating large price differences leading to a competitive advantage for countries with favourable natural conditions, or countries with unambitious goals concerning RES. This would significantly harm the effectiveness of feed-in tariffs as consumers would opt for the cheapest energy supplier, thus hindering the ecological effectiveness of the measure (Ringel 2006, 13-14).

When looking at the effect of feed-in tariffs on onshore wind energy production in Germany between 1990 and 2006, Butler and Neuhoff determine that such measure led to very successful deployment levels, ensuring competitive prices and a good level of competition. The latter is particularly interesting considering that a frequent criticism of this support system is that it does not generate sufficient competition. They further argue that the system proved to be effective as it provided private investors with a safe investment based on long term price guarantees and low market risk (Butler and Neuhoff 2008, 1864-1865). Looking at the effect of this policy in Spain, Ciarreta, Espinosa and Pizarro-Irizar give a more nuanced perspective on the system, arguing that in the case they studied, the efficiency of feed-in tariffs (which in this case are market-dependent) was negatively affected by a retroactive revision of tariff levels, which affected the confidence of investors and consequently the performance of the system, therefore making the achievement of their targets more expensive (Ciarreta, Espinosa and Pizarro-Irizar 2017, 396). Despite this, market-dependent feed-in tariffs appear to be the recommended instrument by the European Commission in view of the 2030 climate and energy policy framework, based on the support for a more market-based approach and a distribution of the risk among investors and consumers, thus reducing the burden for the latter (European Commission 2014).

1.2 Quota Obligations and the Tradable Green Certificates market

Quota mechanisms, also known as tradable green certificates (TGCs) or renewable portfolio standards (RPS), are an increasingly common alternative instrument for the diffusion of renewable electricity (Agnolucci 2007, 3347). With the quota mechanism, producers of renewable energy are awarded a certificate (usually known as green certificate), which can then be traded as an extra income when selling their energy to distributors or costumers, who are obliged by national regulation to buy a certain amount of certificates. On this basis, the buyer can claim to be complying with the quota mechanism and avoid a fine (Krüger 2016, 159). There is debate on the most effective penalty system in case of non-compliance, with some authors suggesting a fine amounting to 200% of the market

price of missing certificates, while others propose a fixed fine depending on the number of certificates missing. Both systems can be effective, with the main difference that the penalty is variable in the former, while it is certain in the latter (Ciarreta, Espinosa and Pizarro-Irizar 2017, 388). Berry and Jaccard explain that one of the main advantages of this system is the low involvement of the government as the price of this measure is passed on to the customers. The authors present a series of variables that must be taken into account when designing the policy such as the amount of the quota, targeted resources, and administrative management. The quota must be set to a point that profits producers, but does not make the price of energy too high. They conclude that its gain in popularity is due to the fact that green certificates allow to reach environmental targets with a reduced cost for governments compared to other instruments (Berry and Jaccard 2001).

Amundsen, Baldursson and Mortensen look at green certificates from a market perspective and determine that as the output of RES can be volatile on the basis of natural events, the revenue available out of green certificates will also be as those are issued by the relevant governmental body on the basis of the amount of energy produced out of RES. The green certificates market is based on supply and demand, but (depending on the national system) the demand is often linked to a percentage of the total energy consumed by either customers or retailing companies, which is mostly fixed. With a fixed demand, the price of certificates will vary on the basis of the supply, therefore reducing the price in case of high supply (Amundsen, Baldursson and Mortensen 2006, 260). Agnolucci argues that this process can be limited by the presence of long-term contracts between suppliers and buyers. This would keep the prices lower than with short-term contract, while also giving guarantees to the producers that will still sell at that price even in case of an increase in the supply of green certificates (Agnolucci 2007). Ringel agrees with this approach, identifying green certificates as an economically efficient option for the promotion of RES (Ringel 2006, 12-14). Amundsen Baldursson and Mortensen instead examine as a potential solution to increment the effectiveness of this system a banking system in which the governing authority would adjust the price of green certificates by purchasing directly from producers when there is a surplus in the market, therefore reducing the availability and increasing the price, and by reintroducing them in the market when a shortage occurs, consequently lowering the price via an increase in the availability (Amundsen, Baldursson and Mortensen 2006, 277). As presented by Colcelli, a system of this kind exists in some member states in which, when the price for green certificates is too low for it to be sold on the market, producers might opt for a form of indirect sale via a national institution, leading to a reduction of the availability on the market (Colcelli 2012, 302).

In a latter study, Amundsen and Nese analyse the potential effects of an increase of the required quota that must be bought by distributors or consumers, arguing that while in theory this

should lead to an increase in the generation of green electricity, this is not always the case. In fact, as the quota is based on a share of the total energy consumption, in the long run the effect could be a mere reduction of the energy production via fossil fuels, if the demand for energy does not increase. According to the authors, this scenario proves that if the objective is an increase in the generation capacity out of RES, a policy based on green certificates might not be the best solution. On the other hand, this system does give significant power to consumers as they have the ability to influence demand via their willingness to pay for green electricity and voluntarily invest in Green Certificates, therefore reinforcing its efficiency from the perspective of the market (Amundsen and Nese 2009, 917).

1.3 Alternative Support Mechanisms: Direct Support, Tax Incentives and More

In addition to the methods mentioned in the previous section, various other support mechanisms are used to stimulate the expansion of energy production out of RES, but they have not demonstrated the same effectiveness in achieving this goal. Li, Chang and Chang look into the effectiveness of alternative instruments in the promotion of photovoltaic and wind energy in the EU, concluding that, while they can be used as an additional incentive to feed-in tariffs and green certificates, these instruments are not particularly effective for the development of these sources (with the exception of grants and loans to support the development of wind power), and that therefore resources should be mostly distributed on the support mechanisms mentioned in the previous sections (Li, Chang and Chang 2017, 665).

As presented by Cansino et al., a large range of tax incentives exist in several member states, mainly in the form of tax exemptions, rebates on taxes, tax refunds and by lowering tax rates on activities promoted. The authors argue that, as tax incentives were usually applied jointly with other measures such as feed-in tariffs and green certificates, it is difficult to estimate their effectiveness independently from other measures. Despite this, they observe that in the first decade of this century a majority of the member states with the highest RES growth had in place some form of tax incentives, therefore judging their adoption as a useful tool, although in complementarity with other measures (Cansino, et al. 2010, 6006). Concerns were raised on whether these practices could be considered as barriers to the common market as they limit imports of electricity from abroad as well as discriminating non-RES electricity producers. The Court of Justice recognized that tax incentives represent a barrier, but deemed it justified as due to the scarce competitiveness of renewable energy in the electricity market, these measures are necessary for the achievement of its final aim: encourage investment in green energy (Weber 2015, 171). An alternative to this could be the removal of fuel

subsidies which would increase their price, thus making renewable energy more competitive. This would however imply a rise in energy prices, making this measure rather unpopular.

An alternative which is gaining popularity in recent years is renewable auctioning (Winkler, Magosch and Ragwitz 2018, 473). Under this scheme, bidders submit projects for RES, specifying the size and the required subsidy per MWh of green electricity generated. The winning bids are subsequently granted a subsidy and are given a fixed period (usually between 2 and 5 years) to complete their project (Matthäus 2020). This instrument works similarly to feed-in tariffs, but limits the amount of beneficiaries to successful bidders, hence avoiding an excessive burdening on customers, while still promoting investments in RES (del Rio 2017, 1). For such reason, Germany decided to reduce the burden that support mechanisms for RES had on consumers (estimated at €20 billion yearly) by replacing feed-in tariffs with auctioning (The Economist 2016). Yet, in order to ensure the effectiveness of the support and avoid situations in which the winning bidders aim too low (known as underbidding) and are unable to complete the project, some systems tested auctions which prohibit bids below cost and include a set of pre-qualifications needed to participate, thus ensuring that winning bids are competitive and reliable. While the insertion of pre-qualifications may increase the bureaucratic barriers for bidders, Matthäus argues that, if they are configurated correctly by the regulators, they lead to a considerable increase in realization rates (Matthäus 2020). Winkler, Magosch and Ragwitz endorse the idea that, if carefully designed, auctions could be a good option to support RES, but were not able to determine whether or not this solution is more advantageous compared to other support schemes (Winkler, Magosch and Ragwitz 2018, 487). Del Rio evaluates various elements that might determine the success of RES auctions, concluding that there is no preferable design as not all elements work well together, and consequently policymakers must find the combination that adapts better to their regulatory cultures and the targets they want to achieve (del Rio 2017, 11-12).

This final observation can be reached for all policy instruments analysed in this chapter, confirming that while some are more used than others, there is no perfect solution and each country's policymakers must find the instrument that can be more effective in their local market, also taking into account the local conditions and the expectations that shall be met.

Methodology

Various methods were used in the previously-mentioned papers to evaluate the effect of support mechanisms tacking into account both economic and environmental factors. This paper will adopt a similar approach by considering as variables on the environmental perspective the total amount of energy produced out of RES yearly (GWh or Mtoe), while considering the price of energy (€) and the total RES installed capacity (MW) (and so progress in terms of infrastructures) as the economic components.

This approach will lead to an evaluation of the performance of member states by taking into account both quantitative (amount of energy produced and infrastructures) and qualitative (price of energy under incentive mechanisms) elements, leading to a comprehensive representation of the performance of studied countries, and a concrete representation of the effects of their national incentive mechanisms on the achievement of their respective 2020 RES target. As policy targets were clearly established for each member state in *Directive 2009/28/EC*, the element of effectiveness, as contained in the research question, will be evaluated on the basis of whether or not a policy allowed the member state to achieve its national target. This method of evaluation is in line with the definition of renewable energy policy effectiveness presented by Verbruggen and Lauber, which describes it as the ability of "meeting or surpassing overall targets" (Verbruggen and Lauber 2012, 639). Another element that will be taken into account when evaluating incentive mechanisms is the concept of efficiency, definable as the ability to achieve a set target at the lowest cost (Winkler, Magosch and Ragwitz 2018, 474).

The collection of data will be based on reports and databases of the International Energy Agency, Eurostat, national energy authorities, as well as national ministries and the European Commission.

The 20/20/20 Objectives, National Action Plans, and RES Promotion

Based on the need to tackle the climate challenge urgently and effectively, and considering energy production and consumption as one of the main sources of greenhouse gas emissions, the European Council decided at the Summit in March 2007 that an integrated approach for climate and energy policy was necessary. An Action Plan regarding energy policy for the period 2007-2009 was accordingly approved. It was centred on three pillars, with set targets to be achieved by 2020: a reduction of energy consumption, an increase in the share of renewables in the EU overall energy consumption, and a reduction of greenhouse gas emissions. Additionally, the European Commission was invited to put forward an updated energy policy review in order to establish a new energy action plan from 2010 onwards (European Council 2007). The establishment of targets, while not sufficient on its own, is an essential step in the development of energy policy, as it provides investors with a degree of certainty which favours technological deployment (International Energy Agency 2018, 7). The follow-up was ensured by a set of Directives (2009/28/EC on the promotion of renewable energy sources, 2009/29/EC on greenhouse gas emissions, and 2012/27/EU on energy efficiency) put forward by the Commission to deal individually with the three pillars established in the 2007 Action Plan, and the new energy strategy, presented by the Commission in 2010, reiterating the EU commitment to become a highly efficient, low carbon economy, and ensuring a secure, safe, and affordable supply of energy for European citizens and businesses (European Commission 2010).

The *Renewable Energy Directive (2009/28/EC)* revised the provisions of *Directives 2001/77/EC* and *2003/30/EC*, updating them to the newly established objectives set by the Council, and established a common framework for the promotion of renewable energy. In this context, it adopts a common definition for RES, which included among others solar, wind, geothermal, and hydrothermal energy, but excluded nuclear energy. This choice has an important impact on member states with a vast production of nuclear energy such as France, which will thus necessarily invest in other forms of energy. As it is possible to observe in *Figure 1*, the *Directive* established legally binding national targets based on a 5,5% increase with an additional effort based on *GDP per capita* that shall lead to the achievement of the EU's overall target: a share of 20% of the final energy consumption produced by RES (de Jong and van Schaik 2009, 3). In case a member state is unable to comply with its target, the *Directive* provides the possibility to undertake statistical transfers (*Article 6*), joint projects (*Articles 7 and 8)*, and joint support schemes (*Article 11*) with other member states. Projects with third countries could also be counted, provided that they complied with certain conditions (*Article 9*). In order to comply with *Article 3* of the *Directive*, by June 2010 each member state was required to present to the Commission an Action Plan outlining the country strategy to

	Share of energy from renewable sources in gross final consumption of energy, 2005 (S_{2005})	Target for share of energy from renewable sources in gross final consumption of energy, 2020 (S_{2020})
Belgium	2,2 %	13 %
Bulgaria	9,4 %	16 %
Czech Republic	6,1 %	13 %
Denmark	17,0 %	30 %
Germany	5,8 %	18 %
Estonia	18,0 %	25 %
Ireland	3,1 %	16 %
Greece	6,9 %	18 %
Spain	8,7 %	20 %
France	10,3 %	23 %
Italy	5,2 %	17 %
Cyprus	2,9 %	13 %
Latvia	32,6 %	40 %
Lithuania	15,0 %	23 %
Luxembourg	0,9 %	11 %
Hungary	4,3 %	13 %
Malta	0,0 %	10 %
Netherlands	2,4 %	14 %
Austria	23,3 %	34 %
Poland	7,2 %	15 %
Portugal	20,5 %	31 %
Romania	17,8 %	24 %
Slovenia	16,0 %	25 %
Slovak Republic	6,7 %	14 %
Finland	28,5 %	38 %
Sweden	39,8 %	49 %
United Kingdom	1,3 %	15 %

Figure 1: National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020. Source: Renewable Energy Directive (2009/28/EC), Annex I

achieve their national targets. These plans had to include an indicative course of progress, reflecting the predicted evolution of renewable energy production starting from 2005, year chosen as reference point, and going up to 2020, year of achievement of the final target (Renewable Energy Directive 2009). They represent the vision of national governments in order to achieve their set targets and coordinate the various aspects of the programs they are putting in place.

Opinions on the potential effectiveness of the *Directive* were divergent. Some saw in it an immense opportunity, arguing that it would bring forth a double positive effect by reducing the Union's greenhouse gas emissions and increasing the security of supply via the reduction of the EU energy dependency from third countries, consequently providing a significant contribution also in the context of foreign policy (Adelle, Pallemaerts and Chiavari 2009, 44-45). De Jong and van Schaik support this opinion, arguing that despite the need for adequate systems and mechanisms to guarantee

a balance between supply and demand, the development of wind and solar energy could have important implications, especially at regional level (de Jong and van Schaik 2009, 4-5). Zgajewski looks positively to this plan and emphasises the need for renewables in the long term, but also notes that member states act mostly individually and thus lose the potential benefits of coordinated policies (Zgajewski 2014, 43-44). The lack of cooperation between member states could be attributed, according to some experts, to the establishment of binding national targets which urge each country to work individually, thus ignoring the potential of comparative advantages and consequently the potential gains in efficiency for the Union overall (Röller, Delgado and Friederiszick 2007, 46). Instead, others such as Helm presented a much more sceptical opinion arguing that overall the targets lacked credibility, were only established for political reasons, and would thus not be met (Helm 2012, 563).

Concerning the feasibility of the strategy, Klessmann et al. analysed each National Renewable Energy Action Plans (NREAP) and found out that a vast majority of member states intended to achieve or exceed their 2020 targets, with only Italy and Luxemburg expected to stay below their national target and compensate the missing share via statistical transfers. On the basis of the collected data, they concluded that the changes the Union will need to implement are not excessively ambitious, and therefore conclude that the achievement of the 2020 target should be manageable (Klessmann, et al. 2011, 7652). In January 2011, the Commission announced that based on the NREAPs, the total renewable energy consumption was expected to double, reaching a total of 217 Mtoe in 2020. A majority of the increase was expected to come from the electricity sector due to an increase in the use of solar and wind energy, with biomass technologies also playing an important role concerning the heating sector (European Commission 2011, 4). A few years later, Liobikiene and Butkus ran a study aimed at understanding whether the 2020 targets would be met. The authors agree with the prediction made by Klessmann et al. considering the EU overall 20% target. Nonetheless, based on the 1990-2012 trends, they argue that, because of the lack of implementation of policies in line with the set targets, most member states might not reach their respective target share of RES in time (Liobikiene and Butkus 2017, 305). This low progress in the first years of the decade could be explained by the fact that the European Council rejected the proposal put forward by the European Parliament in September 2007, with a resolution entailing the establishment of binding mid-term targets for member states, which would have avoided delays in the achievement of the *Directive*'s targets (European Parliament 2007). The mid-term targets were instead established, but the absence of direct financial consequences for member states considerably weakened their effectiveness (de Jong and van Schaik 2009, 3). In fact, binding mid-term targets would have increased the monitoring power of the Commission, which would have consequently been able to take concrete action against those member

states which were not complying with interim targets instead of having to recur to lengthy infringement procedures (Fouquet 2013, 16). Moreover, as specified in the preamble of the *Directive*, having binding targets could have provided a higher degree of stability for investors, creating a more conducive environment to make rational and sustainable investments in the renewable energy sector (Renewable Energy Directive 2009). In order to compensate for the slow initial growth, the growth rate to achieve the 2020 target was expected to double, with some member states required to undertake additional efforts in the second part of the decade to comply with their national target (Zgajewski 2014, 20). However, this might have a tactical aspect, as some member states might have aimed to initially restrain the rate of deployment for technologies judged as relatively expensive until global developments help them to reduce their cost, thus reducing the price for investors and consequently the expenditures of member states on support systems (International Energy Agency 2011, 110). In 2019, the Commission reported that based on 2017 figures the Union overall was on track to attain the 20% target, with renewable energy reaching 17,52% of the gross final energy consumption, considerably above the 16% foreseen in the indicative trajectory. A positive trend was also noted regarding member states, with 11 of them having already achieved a share corresponding to their 2020 target, while 10 others were on track to comply with their objectives. Furthermore, the Commission noted that two agreements for statistical transfers were in place, stipulating the acquisition by Luxembourg of shares from Estonia and Lithuania (European Commission 2019, 3-6). In a more recent study, Peña and Rodríguez argue that for some member states such as Finland or France, the likelihood of achieving their 2020 goals is extremely low, while the majority of member states have made sufficient progress and should manage to achieve them (Peña and Rodríguez 2019, 483).

Based on this framework, it is possible to understand that despite different situations in member states, the EU as a whole will manage to achieve the 20% target without postponements. But, as remarked by various authors, while most member states managed to achieve or overachieve their targets, others did not manage to put in place effective policy frameworks allowing them to reach punctually their target, and consequently, some will need to recur to statistical transfers in order to avoid infringement procedures, as it is already the case for Luxemburg. Given the initial forecast based on national NREAPs, it is interesting to note how some member states, which had similar net productions of RES energy at the start of the decade (such as France and Italy, respectively 18,93 and 18,51 Mtoe), obtained different outcomes (International Energy Agency 2014). The next chapter will therefore analyze the incentive mechanisms used in both member states, with the aim of understanding the reason behind the divergence in outcome in these states.

National Plans for European Objectives: The Cases of France and Italy

Developed by every member state based on the state of affairs of their energy industry, national Action Plans are essential for the achievement of the EU 2020 renewable energy targets. In general, France and Italy present dissimilar situations, particularly regarding their internal energy production as the former has a strong source of energy in the form of nuclear energy while the latter, having ceased to exploit nuclear power in the 1990s, is mostly dependent on imports due to the scarcity of fossil fuels in its territory. With regard to renewable energy, in 2005 France presented a share of energy produced from RES out of the final consumption corresponding to 10,3%[1], almost doubling the share of Italy, equivalent to a mere 5,2% of the final consumption. In proportion to the calculation method used in the *Renewable Energy Directive*, the national 2020 targets were respectively fixed at 23% for France and 17% for Italy (Renewable Energy Directive 2009). On this basis, both governments submitted in June 2010 their NREAPs to the Commission. In January 2011, the Commission communicated that a high amount of member states, including France, planned to exceed their target and would thus be able to help those member states which would not be able to achieve their objectives without statistical transfers, as it is the case for Italy (European Commission 2011). The situation, however, appeared turned around when the 2019 report on the progress of renewable energy was released. It was, in fact, confirmed that Italy was among the 11 member states that had already achieved a sufficient share to comply with their 2020 target, while France was among the 7 member states that would need to step up efforts in order to act in accordance with their plan towards 2020 (European Commission 2019). The progress of both countries for the period considered (2009-2020, 2005 considered as reference year) can be seen in *Figure 2*.

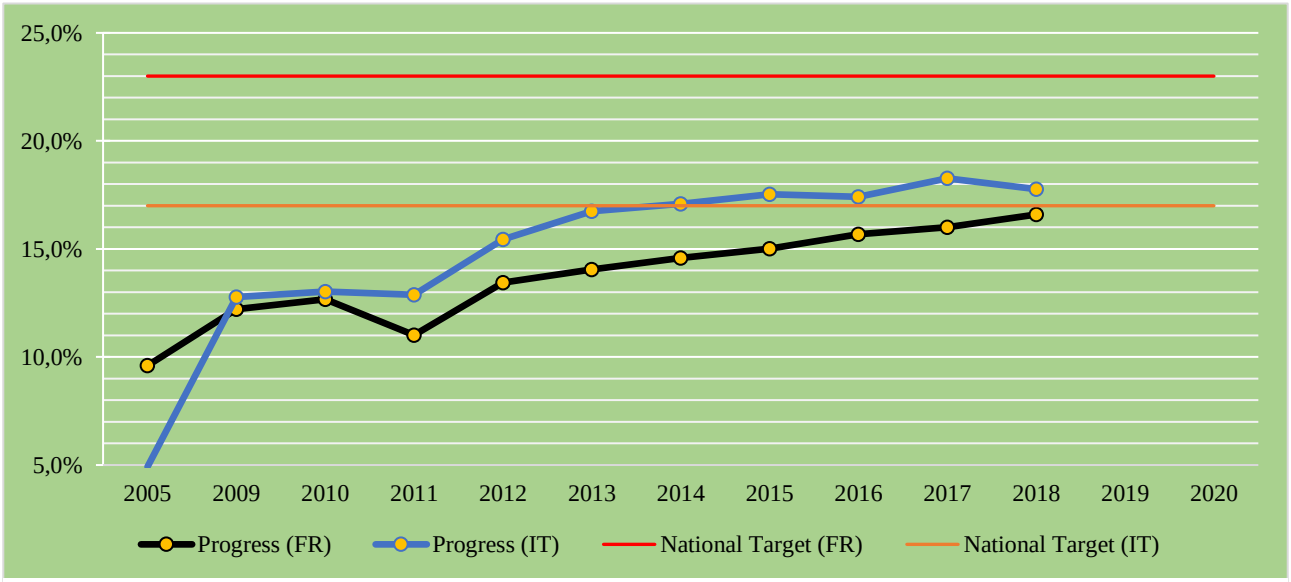

Figure 2: Share of RES in the Final Energy Consumption of Italy and France - Source: Eurostat 2020

[1] Rectified to 9,6% in the NREAP submitted by France in June 2010 (Ministère de l'Ecologie, de l'Energie, du Developpement durable et de la Mer 2010, 10)

4.1 France: An Excessive Focus on Wind Power?

The French government presented an ambitious NREAP, planning to comply with its objectives without recurring to the cooperation mechanisms set out in *Articles 6, 7, and 8* (statistical transfers, imports, and exports of renewable energy) of the *Renewable Energy Directive*, but not precluding its participation in eventual joint projects within the Mediterranean Solar Plan. This project could lead to an expansion of the French renewable electricity generation power by 1 to 2 GW, resulting eventually in the country surpassing its 23% target (Ministère de l'Ecologie, de l'Energie, du Developpement durable et de la Mer 2010, 95). A key element in the plan was the foreseen reduction of the country's annual final energy consumption, expected to be reduced from the 166,7 Mtoe calculated in 2005 to an estimate of 155,3 Mtoe for 2020 as a result of efforts in the fields of energy efficiency and promotion of RES. This was established as an absolute priority as it was estimated that, without proper intervention, the final energy consumption of France would be in 2020 18% higher compared to 2005, which would have *de facto* made the achievement of the 2020 targets impossible. In this context, the capacity of energy production from RES was expected to grow up to 35,7 Mtoe, an increase of around 20 Mtoe compared to the national RES production in 2006, with an expected prevalence of hydropower and wind power, which are set to represent in 2020 over 80% of the renewable energy production in the country (Ibid., 6-10).

4.1.1 The French NREAP

As a result of the importance of energy consumption in achieving the 2020 target, energy savings were positioned as the main driver of this process, with a particular emphasis on improvements in the heating sector. These improvements were expected to decrease the consumption of energy in existing buildings (mainly housing, public buildings, or industries) by 38%, not later than 2020. This result is expected to be accomplished via an increased use of RES (mainly biomass energy) for heating, paired with a reduction of the consumption for heating and cooling. Concerning the transports sector, targets are expected to be reached via an increased use of biofuels on one side, and the introduction of 2 million electric vehicles on the other side, with part of the required electricity expected to be generated by RES. Consequently, the demand for electricity is expected to grow up to 46,9 Mtoe. This increase in the demand should be covered by the already developed nuclear and hydroelectric industries, as well as by enhanced development of RES-generated electricity based on a pluriannual investment plan, which should have allowed France to become a global leader in the field of renewable energy (Ministère de l'Ecologie, de l'Energie, du Developpement durable et de la Mer 2010, 6-11).

On this basis, a series of legal, financial, and administrative initiatives were planned, intervening in multiple sectors including, to mention a few, tax cuts and loans to encourage a shift towards energy-efficient heating systems powered by RES, investment in new transport infrastructures and financial benefits to reduce the consumption in the transport sector, and a revision of incentive mechanisms to promote investment in RES. In some cases, mainly concerning low-income families, public investments are deployed to cover the costs of the transition towards sustainable technologies. In particular, the NREAP mentions a planned investment of €500 million to finance the renovation of 300.000 houses owned by low-income households. Additionally, the Action Plan includes the development of strategies at regional and local level, showing the government's will to delegate part of the responsibility to local level (Ibid., 16-22). This strategy does not, however, impose on regional or local authorities binding targets on production or consumption of energy from RES, as they are meant to be seen as an incentive rather than an obligation. Nevertheless, a role can be played by sectorial regulations or plans such as the one on building heating aimed at encouraging the installation of small RES infrastructures as a way to comply with energy consumption norms (Ibid., 52). Likewise, sectorial plans such as the energy performance plan for agricultural industries (*Plan de Performance Énergétique des exploitations agricoles*) outline strategic planning to support the specific sectors in a transition towards environmentally-friendly practices via a series of incentives and subsidies linked to investments, which should lead to a drop in their energy consumptions and possibly an increase in their energy autonomy via the use of RES such as biofuels from agricultural residuals (Ibid., 65). Furthermore, regions had the possibility to collaborate with the national government via pluriannual agreements on the financing of specific projects. These plans not only must include specific provisions on energy efficiency, but may also include some additional support mechanism responding to the specific needs of a region. Specific support mechanisms can also exist at local level, so that they fit the needs of single municipalities (Ibid., 71).

This set of initiatives was expected to result in important progress particularly in the field of electricity and heat production. Concerning the former, the production will be mostly composed of hydropower and wind power, set to be responsible for 80% of the generated power with a respective yearly production of 66.000 GWh and 57.000 GWh, while a minor role will also be played by biomass (10%) and solar (5%) production. Regarding the latter, the foreseen situation shows the dominance of biomass, responsible for 83% of renewable heating corresponding to 16,5 Mtoe, whilst other sources such as solar heating play only a marginal role, with a production up to 0,9 Mtoe (Ibid., 96-99). The statistics portray the intention of the French government to point mainly on a few, already developed, industries whilst providing other RES industries with a variety of incentives to develop.

4.1.2 Incentive Mechanisms

A variety of incentive mechanisms were in place in France in the years preceding the *Renewable Energy Directive*, leading to a certain increase of RES in the country, but also to discrepancies between the various industries producing renewable energy, reason why the Action Plan calls for a periodical update based on technological and economic evolutions, affecting each industry.

Feed-in tariffs were the preferred solution for more established technologies, such as hydropower or onshore wind power, but were also used for mid-sized biomass infrastructures (between 5 and 12 MW), thus guaranteeing a fixed price for the energy produced, updated regularly by the relevant ministries. Meanwhile, auctioning was preferred in cases where the industry was still adapting to particular technical and environmental conditions, as it is the case for biomass infrastructures with power generation capacity superior to 12 MW and offshore wind power, as this mechanism allows to update regularly performance criteria that lead to better efficiency. Both systems provide investors with long-term sale guarantees, usually around 15 to 20 years (Ministère de l'Ecologie, de l'Energie, du Developpement durable et de la Mer 2010, 52-53). As requested by the Syndicate for Renewable Energy, these auctions are resource-specific, so that the potential for development of each industry is protected in the process, with higher support being assigned for newer industries in order to allow their development (Syndicat des Energies Renouvelables 2014, 11). In addition, for decentralized industries such as photovoltaics where the main obstacle is the initial investment, solutions based on loans and premiums were initially preferred, but these were later gradually transformed in auctions as a way to reduce the policy cost (Bayer, Schäuble and Ferrari 2018, 307). The auction procedures were revised in 2016, in order to reduce the length of the process and consequently make the realization of infrastructures faster. Moreover, starting from the same year, a new system of feed-in premiums was established, gradually replacing feed-in tariffs for plants with a power generation capacity superior to 500 kW (with the exception of onshore wind where feed-in tariffs are maintained), thus further contributing to the reduction of the policy cost and consequently reducing the burden of support mechanisms on consumers (estimated in 2015 to €19,50 per MWh). Additionally, a vast majority of support systems was assigned via auctions, with the exception of onshore wind, Waste-to-Energy, and geothermal energy, due to exemptions contained in the EU state aid guidelines (International Energy Agency 2017, 153-154). An alternative to this new system of feed-in premiums was put in place in 2018, based on a system of certificates of origin, giving the possibility to producers of renewable electricity to sell on the market certificates of origin, but at the condition that they return to the state the premium they have received (Ministère de la Transition Écologique et Solidaire 2018, 46).

Concerning renewables in the heating sector, a system of energy savings certificates was put in place for the 2006-2009 period and was renewed following satisfying results, which led to savings for 65,2 TWh in the first three years. This system encourages energy retailing companies to make investments that favoured energy savings to obtain the consequent certificates, but these may also be acquired by third parties. During the first three years, the vast majority of savings was made in residential buildings (86,7%), while industries contributed only in a small part (7,4%). Alternatively, energy savings certificates could be obtained by replacing equipment powered by non-renewable energy sources with equipment powered by RES (Ministère de l'Ecologie, de l'Energie, du Developpement durable et de la Mer 2010, 73). Following satisfying results, which allowed to secure 460 TWh in energy savings, the system of energy savings certificates was extended for two more periods of three years each (Ministère de l'Écologie, du Développement durable et de l'Énergie 2015, 22). This system is complemented by other instruments directed to households, such as tax cuts for those purchasing equipment using renewable or recovered energy, and zero-rate eco-loans to support thermal renovation in houses, for an estimate total cost of €500 million (International Energy Agency 2017, 157).

The transport sector was stimulated by tax incentives and regulatory measures, particularly with an increase in taxation for retailers with an insufficient share of biofuels in their consumption and a reduction in taxation for users of biofuels, bioethanol, and fuels issued from agricultural products (Ministère de l'Ecologie, de l'Energie, du Developpement durable et de la Mer 2010, 76).

4.1.3 Progress Towards 2020

The process in France towards the achievement of their 2020 target encountered very soon difficulties due to the economic crisis, which had an unprecedented impact on the electricity market due to a considerably lesser electricity consumption compared to expectations. Subsequently, France found itself behind schedule in the investment plan for renewable energy, leading to the suspicion that it might not be able to comply with the national 23% target by 2020 (Syndicat des Energies Renouvelables 2014, 7). In fact, in 2013 photovoltaics and wind power accounted for only 4% of the gross electricity production, but followed very different progress lines. While the country's photovoltaic production grew quickly and rapidly surpassed expectations due to considerable reductions in the technology costs, wind power was far behind with plans to install large infrastructures, which posed considerable problems considering the importance of this power source in the NREAP (Bayer, Schäuble and Ferrari 2018, 306, International Energy Agency 2017, 152). In the 3rd Progress Report to the Commission, the French government confirmed their delay in terms of share of final energy consumption, which reached 14% in 2013 and was expected to grow to 14,3%

for the following year. The country's delay for 2014 was thus quantified to 1,7% (4,2 Mtoe), due to the slow progress of the heating sector (deficit of 3,4 Mtoe) and, to a slight extent, to delays in the electricity production sector (approximatively 1 Mtoe) (Ministère de l'Écologie, du Développement durable et de l'Énergie 2015, 5; 45). To compensate the deficit in electricity production, the French government launched in 2015 a series of auctions for various technologies, including one aimed at the realization of an experimental project for offshore wind power at the Atlantic and Mediterranean coasts, with the possibility of expanding the production based on obtained results (Ibid., 23-27). Part of the gap in the heating sector was explained by national authorities as the result of a strong correlation between winter temperatures and the share of biomass in the final energy consumption, which played a role as 2014 was the hottest recorded year in decades, implying a lesser use of biomass for heating purposes (International Energy Agency 2017, 152).

The 4th Progress Report sent to the Commission in February 2018 confirmed a gap between the real progress made by France and what was foreseen in their NREAP, quantifiable to around 2% (4,1 Mtoe) for the year 2016, and consequently marking a slight increase in the delay compared to the situation in 2014, despite an increase in the RES contribution to the final energy consumption of 3 Mtoe. The sectorial situation was in accordance with what was reported in the 3rd Progress report, with an important delay in the heating sector (4,4%, equivalent to 2,7 Mtoe) and an increased gap in the electricity sector (2,2%, equivalent to 1,4 Mtoe), moderately compensated by the progress made in the transport sector, which exceeded its interim target by 0,2% (Ministère de la Transition Écologique et Solidaire 2018, 5-6; 58-59). To stimulate and accelerate investments in hydropower and onshore wind farms, described in the NREAP as the key renewable technologies for electricity generation in France, the government decided to proceed, following a test period which started in 2014, with the establishment of a unique environmental authorization for those infrastructures, thus reducing administrative procedures especially for wind farms. In fact, due to administrative obstacles, France found its projects for offshore wind plants lacking far behind schedule with, as of 2016, no infrastructure ready to produce electricity despite the attribution of two auctions (organized in 2011 and 2014), which should have led to the installation of 3000 MW, and an ongoing third auction, which should have allowed the installation of an additional 400 to 600 MW in the country's northern coast (Ibid., 33). This was particularly problematic considering that this sector is expected to have installed a capacity of 6000 MW by 2020. In an attempt to bridge this gap, the government launched a series of initiatives, including the extension of maritime concessions from 30 to 40 years, reduction of length for administrative appeals (often launched by citizens due to scarce public support for wind power projects), measures to facilitate the obtainment of insurance for renewable energies based at sea, and

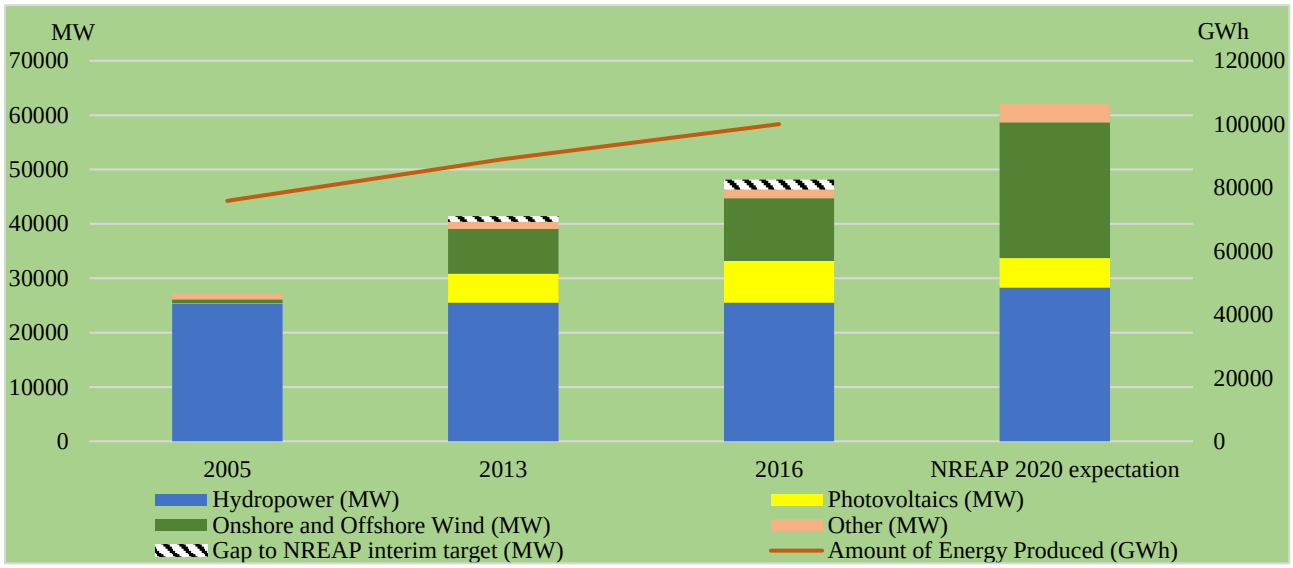

Figure 3: Total Installed RES Capacity of France for 2005, 2014, 2016 and 2020 expectations
Sources: Ministère de l'Ecologie, de l'Energie, du Developpement durable et de la Mer 2010; Ministère de l'Écologie, du Développement durable et de l'Énergie 2015; Ministère de la Transition Écologique et Solidaire 2018

guarantees regarding connection to the energy grid (Ibid., 21-23). Additionally, it launched a new pluriannual investment plan updating targets for single energy sources on the basis of the progress of each technology in the previous years, establishing new targets for 2018 and 2023. This logically led to a postponement of the targets regarding wind power and an increase in the projected targets for solar energy, due to its more favourable prices and faster deployment in previous years, with an expected increase in the installed capacity of 2000 MW per year. These efforts could, however, be insufficient to compensate the gap built in previous years, and consequently other RES will need to progress to a higher growth rate if France wants to honour its commitments for 2020 (International Energy Agency 2017, 155-161). The progress in terms of infrastructures for each energy source up to 2016 can be seen in *Figure 3*.

Following the reform of support mechanisms of 2016 and the presentation of the new national targets, partial progress can be seen, but it will most likely be insufficient to reach 23% of RES in the final energy consumption. Notably, and despite some progress, the expected and very ambitious growth rate concerning photovoltaics was not achieved, with a total installed capacity of 8.527 MW as of December 2018. While in line with the progress made in the previous years, this progress resulted insufficient to achieve the target of 10.200 MW, which was set in the 2016 pluriannual plan, despite it being twice as much as what was originally planned. The target regarding wind power was instead achieved with a progress rate of 11% allowing to reach 15.100 MW connected to the grid, a good result but still considerably behind the trajectory planned in the NREAP, which forecasted a total of 19.939 MW installed in 2018 (Réseau de Transport d'Electricité 2019, 44-49).

Overall, as of 2018, the country had a total renewable installed capacity for electricity generation of 51.171 MW (Ibid., 26). As of March 2020, a total of 54.234 MW was installed, with an

increase of 2.574 MW only in the previous year, and a total yearly production of renewable energy of 118 TWh, representing an increase of over 55% compared to 2005 (Syndicat des Energies Renouvelables 2020, 10). Despite the doubling of renewable electricity generation capacity compared to 2005, the progress made will most likely result as insufficient to achieve the 23% target, as the aim for electricity generation was 62.167 MW, a gap that is unlikely to be filled in the few residual months and will probably not be compensated by progress in the heating and transport sectors. The achievement of the target becomes further improbable when considering that, despite considerable progress, the country's reduction in energy consumption is estimated to be unsatisfactory compared to expectations (European Environment Agency 2019, 55-56).

The scarce progress of France in the electricity sector, weak spot of its progress towards 2020 targets, can be related to its strong commitment to nuclear energy. In 2017, 53% of the French research and development spending in the field of energy went to the nuclear industry, particularly with the construction of a new reactor for nuclear research, while despite a considerable increase in the first decade of the 2000s, only 33% of it is attributed to the development of new technologies in the fields of renewables and energy efficiency (Ministère de la Transition Écologique et Solidaire 2019, 17).

4.2 Italy: Surpassing Expectations via Photovoltaic Development

The Italian NREAP puts renewable energy at the heart of the national energy policy and values it as an essential tool to achieve the objectives of such policy, identifiable as: an increase in the country's energy security, a reduction of energy price, promotion of technological innovation, and sustainable development. In order to fulfil the objectives set for 2020, an emphasis was put on measures to make progress in terms of energy efficiency, thus reducing energy consumption, and this also contributed, in terms of increase, in the share of RES in the final energy consumption. This plans should be achieved via a set of already existing incentive mechanisms, the simplification of administrative procedures, and the development of international cooperation projects with EU and non-EU countries neighbouring Italy, as described in *Articles 6, 7, and 8* of the *Renewable Energy Directive* (Ministero dello Sviluppo Economico 2010, 4-5). In 2005, Italy had a final energy consumption of 141,2 Mtoe, which is expected to grow up to 145,5 Mtoe in 2020 but, according to the government, could be reduced to 133 Mtoe with additional investments in energy efficiency. Consequently, taking the latter as the reference point, the production from RES should increase to 23 Mtoe in order to achieve the national target of 17%, an increase of 15 Mtoe compared to the 2005 RES production. Of the total RES production expected in 2020, 21,5 Mtoe are expected to be produced nationally, with the residual portion supposed to be imported from other member states or third countries (Ibid., 14-22).

4.2.1 The Italian NREAP

A central focus of the measures planned by the Italian government concerns the development of the renewables industry, particularly in the heating and transport sectors, whilst also improving the development of electricity generation and the energy grid more in general. The former two are particularly important as the share of RES in those sectors was nearly inexistent in 2005, with a respective share of 2,8% and 0,9%, compared to a share of 16,3% in the electricity sector. The NREAP planned the following sectoral targets: 17,1% for the heating sector, 10,1% for the transport sector, and 26,4% for the electricity sector. It is expected that the heating sector will constitute almost half of the total national RES production in 2020, overtaking in 2017 the electricity sector as the principal contributor in net terms (Ministero dello Sviluppo Economico 2010, 20-23). An important role in this context is given to the regions which have, under Italian constitutional law, responsibilities for the administrative management of energy policy. Consequently, each region has the duty to elaborate a regional energy plan, which provides public and private entities involved in the realization of energy-related investments with a reference point to manage their respective projects in the concerned region (Ibid., 34-37). In this framework, some regions run joint financing programmes, as in the case of the *Interregional Operative plan for renewable energy and energy efficiency*, a plan involving majorly southern-Italian regions and aimed at financially encouraging an increase of efforts in those sectors, partially with the use of European Structural Funds (Ibid., 116-118).

The NREAP puts an emphasis on administrative simplification, taking as an example a new norm established in 2001, which determined that for RES-produced electricity a single authorization would be sufficient, further establishing that this administrative practice had to be fulfilled in a maximum of 180 days. This simplified greatly the authorization procedures, which previously involved various requests to different authorities at national, regional, and sometimes local level. Such administrative reforms support other mechanisms to incentivize investments, as they provide investors with certitudes in terms of realization of infrastructures (Ibid., 34-37). Despite these simplifications, some differences remain in place, especially in terms of construction requirements regarding energy efficiency and renewable energy (Ibid., 57).

Concerning specific technologies, a national objective was set to install a total photovoltaic power of 3.000 MW by 2016, with the prospect of updating this target to 8.000 MW for 2020 under a national plan known as *Conto Energia*. This plan also includes the objective to install 2.000.000 m^2 of thermodynamic solar plants by 2016. These are the only two technologies for which binding targets were instituted, showing the intention of the government to point particularly to the use of solar energy, a logical choice considering the geographic characteristics of the country. Moreover, national

legislation provides producers and importers of electricity from fossil fuels with the obligation to insert annually in the energy grid a quota of electricity produced from RES, however without requirements for single technologies. This quota started at 2% in 1999, before being raised by 0,35% annually between 2004 and 2006 and by 0,75% annually for the period 2007-2012 (Ibid., 100-102). This system is at the basis of green certificates system and is mainly used for large infrastructures, while a system of feed-in tariffs is in place for smaller productions of renewable energy. As mentioned on the NREAP, those mechanisms would have been reviewed gradually over time in order to incentivize the use of the best and most efficient practices (Ibid., 46).

The combination of administrative and financial measures were expected to lead, in combination with joint projects and eventually statistical transfers, to the achievement of the 17% target. A particular increase was expected for solar energy with an installed capacity of 8.600 MW in 2020 compared to a mere 34 MW in 2005, with improvements also expected in wind power, raising from 1.639 MW to 12.680 MW and to a minor extent in hydropower, growing from 15.466 MW to 17.800 MW. These three energy sources are expected to represent around 75% of the national renewable electricity production in 2020. Regarding the heat sector, a major contribution is expected to come from biofuels and solar technologies (Ibid., 155-159).

4.2.2 Incentive Mechanisms

Before the entry into force of the *Renewable Energy Directive*, various incentive mechanisms were already in place in Italy. The promotion of renewable electricity was based mainly on a system of green certificates, which could be substituted by feed-in tariffs for infrastructures with a production power inferior to 1 MW (0,2 MW in the specific case of wind power), and was complemented with a series of guarantees on grid connection and simplified sale process. Green certificates were established in 1999 to certify the insertion of a certain amount of renewable electricity in the grid, in accordance with the above-mentioned legislation on quotas. The single certificates had a validity of 3 years, while a producer was guaranteed certificates on the basis of its production for a period of 15 starting from the entry into function of the infrastructure. The system was managed by the GSE (*Gestione Servizi Energetici*) which issues certificates and can, in case of excessive availability on the market, withdraw them from the market in order to ensure a fair price, as it occurred in the 2009-2011 period. The withdrawal of certificates by the GSE occurred in exchange for a compensation equal to the average price of the three previous years, thus establishing that amount as a virtual minimum price. With the intention of diversifying sources of renewable energy, a different coefficient for the attribution of certificates was established for each technology and was revised periodically to ensure an equilibrium with the national aims expected. Alternatively, starting from 2008,

infrastructures with a power of up to 1 MW can opt to access a system of feed-in tariffs, which gives an additional support based on the amount of electricity inserted in the energy grid. The support received varies for each technology, ranging from €0,34/kWh for maritime technologies to €0,18/kWh for biogas (Ministero dello Sviluppo Economico 2010, 110-115). An exception to these mechanisms is made for photovoltaic and thermodynamic solar infrastructures, which are subsidized via feed-in premiums guaranteed for a period of 20 years for the former, and 25 for the latter. The amount of the premium is determined on the basis of the technical specificities of each facility (Ibid., 103-106). Finally, loans and tax incentives are also used to a lower extent with the aim of promoting small scale investments in RES (Ibid., 119-122). The incentive systems for renewable electricity were largely reformed in 2013 with a switch from green certificates to feed-in tariffs and premiums partly allocated via auctions or conditioned to the enrolment to a register, with the exception of infrastructures of very small dimension. Feed-in premiums are in place for infrastructures with a power of 1 MW or higher, while those with a power inferior to that can choose between feed-in tariffs or premiums. The amount of the tariff or premium was variable depending on the technology. A transition period was set up in order to ensure an efficient transition. The reform coincided with the end of the plan *Conto Energia*, following the attainment of the available budget achievement of its targets. Furthermore, a cap was put at €5,8 billion for yearly expenses on incentive mechanisms (Ministero dello Sviluppo Economico 2015, 43-51). In 2016, thermodynamic solar infrastructures were added to the revised incentive mechanisms, which entered into force three years earlier, while the maximum power to access feed-in tariffs was lowered from 1 MW to 500 kW (Ministero dello Sviluppo Economico 2017, 45-46).

Renewable technologies in the heating sector are, instead, promoted via a mix of incentives and regulatory obligations via tax incentives and a mechanism of energy efficiency certificates. The former consists in the possibility to detract up to 55% of the initial expenses from income taxes, with a maximum amount established on the type of intervention. This system was renewed and adapted after having obtained positive results in the previous years. The latter works on the basis of binding nation-wide yearly targets for the reduction of energy consumption, which imposes a certain amount of certificates, based on a quota assigned the regulating authority to energy retailers of electricity and gas. This system encourages retailers to promote investments of energy efficiency, on the basis of which they are assigned a number of certificates proportional to the obtained savings by the competent authority. These certificates may be sold in case of overachievement of targets with the same principle as green certificates (Ministero dello Sviluppo Economico 2010, 123-136). In addition, starting from 2012, new regulations were implemented regarding the obligation to provide new buildings with RES-generated heat. This was complemented with the possibility to access new incentives for entities

undertaking energy-efficient projects and for small producers of renewable heat (Ministero dello Sviluppo Economico 2015, 12-13).

Finally, in the transport sector biofuels were promoted via a quota system, which is expected to increase over time as a way to further promote its use. Since 2006, this mechanism is guaranteed via a system of certificates imposed on fuel retailers, which can eventually be traded on the same basis as green certificates. The system includes fines in case of non-compliance, proportional to the number of missing certificates (Ministero dello Sviluppo Economico 2010, 137-140). In 2013, it was determined that the quota would be gradually increased and would reach 10% in 2020. The data was, however, successively revised to 9% (Ministero dello Sviluppo Economico 2015, 54, Ministero dello Sviluppo Economico 2017, 53).

4.2.3 Progress Towards 2020

Since the majority of the incentive mechanisms were already in place, the initial phase was mostly characterized by the management and the implementation of regulatory and administrative procedures, aimed to further facilitate the process. The 3rd Progress Report of 2015 highlighted important progress in renewable energy infrastructures across the country, notably in the case of photovoltaics, whose total installed power grew exponentially with the installation of around 13.000 MW between 2010 and 2012, thus surpassing by over 1/3rd the expected target for 2020 and becoming one of the major exploiters of solar power in Europe. This progress, in addition to new positive progress in other technologies, allowed to surpass the expected RES generation power for 2020 and consequently also the amount of electricity produced, surpassing the cap of 100.000 GWh. The increases in the electricity and heat sector compensated for the slow improvements in the transportation sector, behind schedule by 1,5% as of 2014 (Ministero dello Sviluppo Economico 2015, 5-6). Additionally, the system of energy efficiency certificates allowed to make energy savings for 2,3 Mtoe in 2013 and 2,6 Mtoe in 2014 (Ibid., 35). However, in line with a series of austerity measures, the national government decided to cut the policy cost of RES support with a new series of incentives and the establishment of a cost cap which was put in place in 2013, thus slowing the progress rate of renewable energy in the country as it can be seen in *Figure 4*. It is estimated that in 2015 the annual burden of support mechanisms was reduced by €400 million, with the possibility to reach €600 million once the transition to the new mechanisms would be completed (International Energy Agency 2016, 90). Despite this, the government estimated that it could have reached a share of RES in the final energy consumption of 19%, over two points higher compared to the original 17% target. Consequently, it announced to be eventually interested in using statistical transfers in support of other member states (Ministero dello Sviluppo Economico 2015, 77-81).

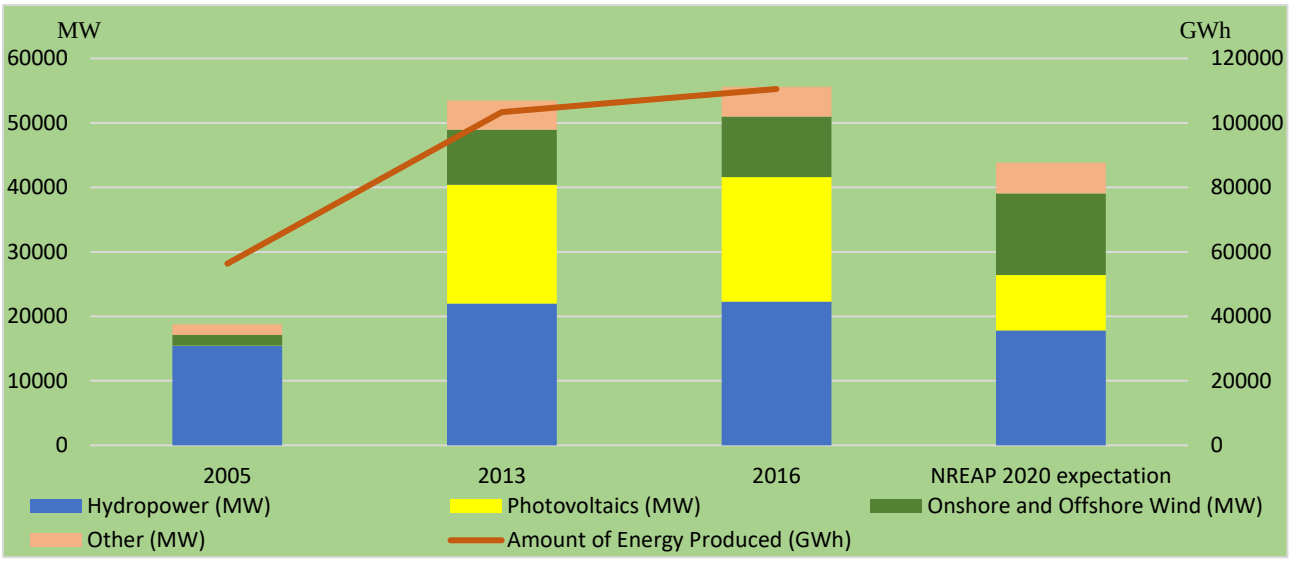

Figure 4: Total Installed RES Capacity of Italy for 2005, 2013, 2016 results and 2020 expectations
Sources: Ministero dello Sviluppo Economico

The 4th Progress Report pictured a progress in line with the expectations presented in the previous report, with a slower growth rate, but nevertheless a generally positive trend, with the share of RES stable over the 17% target, despite a slight flection in 2016. Overall, since the entrance into force of the new incentives, the installed RES power increased by a mere 2.376 MW, significantly less compared to the previous years, and coming principally from the photovoltaic and wind power industries. Nevertheless, this corresponded to an increase in the electricity production of over 7.200 GWh between 2013 and 2016 (Ministero dello Sviluppo Economico 2017, 4-6). Forecasts for the remaining period indicated an expected surplus of 3,4 Mtoe of renewable energy in 2020, which could potentially be used for statistical transfers to other countries (Ibid., 75-79).

These efforts were complemented with a decrease in energy consumption by 14%, going from 141 Mtoe in 2005 to 121,5 Mtoe in 2018, indicating a positive outcome in the country's policies in this field. In that same year Italy resulted, among the five member states with the highest final energy consumption (the others being France, Germany, Spain, and the United Kingdom), the country with the highest share of RES in the final energy consumption, an interesting result considering that in 2005 it was 4th in this ranking (GSE 2020, 5-7). Despite the very positive results, in 2018 Italy's results were slightly deficient in the transport sector with a share of 7,7%, compared to the 8,7% target for that year (Ibid., 10).

In spite of a modest growth rate, the new incentive mechanisms introduced in 2013 brought some positive effects, particularly for consumers. In 2018, Italy's electricity cost has decreased compared to the previous year and arrived at levels comparable to the average of the Euro area, a positive achievement considering the country's high prices at the start of the decade and despite the fact that, to a certain extent, the energy sector still bears the burden of previous incentive mechanisms (ARERA 2019, 42-43).

4.3 Comparative Analysis: What Explains the Difference in Outcomes?

France and Italy present different RES development strategies, notably due to different incentive mechanisms and different sources. While in terms of share the latter performed (as of 2018) better than the former, it is important to take into account the impact of incentives on the various technologies, in order to analyse specifically what made the difference and reach clear conclusions. As it can be observed in *Figure* 5, the electricity sector is the one in which French shares are particularly low, despite their net production being in line with the other large member states, while their shares are better than average in the heating and transport sectors.

Photovoltaics played a key role in the progress of RES in Italy. The price reduction (over 80% between 2009 and 2019), combined with the very generous incentives included in the plan *Conto Energia*, created extremely favourable conditions for investments in that particular technology, resulting in an average yearly growth rate of 63,7% from 2005 to 2015 (International Energy Agency 2016, 79, IRENA 2020, 65). France did not benefit from the lowering of photovoltaics cost in the same way, as their incentive mechanisms were more focused on other RES technologies, particularly wind power and hydroelectricity. Additionally, the system of auctions established for the promotion of photovoltaics limited the potential amount of infrastructures allowed to benefit from the incentive, and thus restricted its progress compared to the Italian situation. Another limiting factor in this particular industry was the prolonged waiting period to obtain grid connection, an issue which was later mitigated (Bayer, Schäuble and Ferrari 2018, 308-309). Nevertheless, the lowering of cost had an influence, as France registered an increase of over 5.600 MW of photovoltaics in the 2005-2015 period, starting from negligible levels (International Energy Agency 2017, 150).

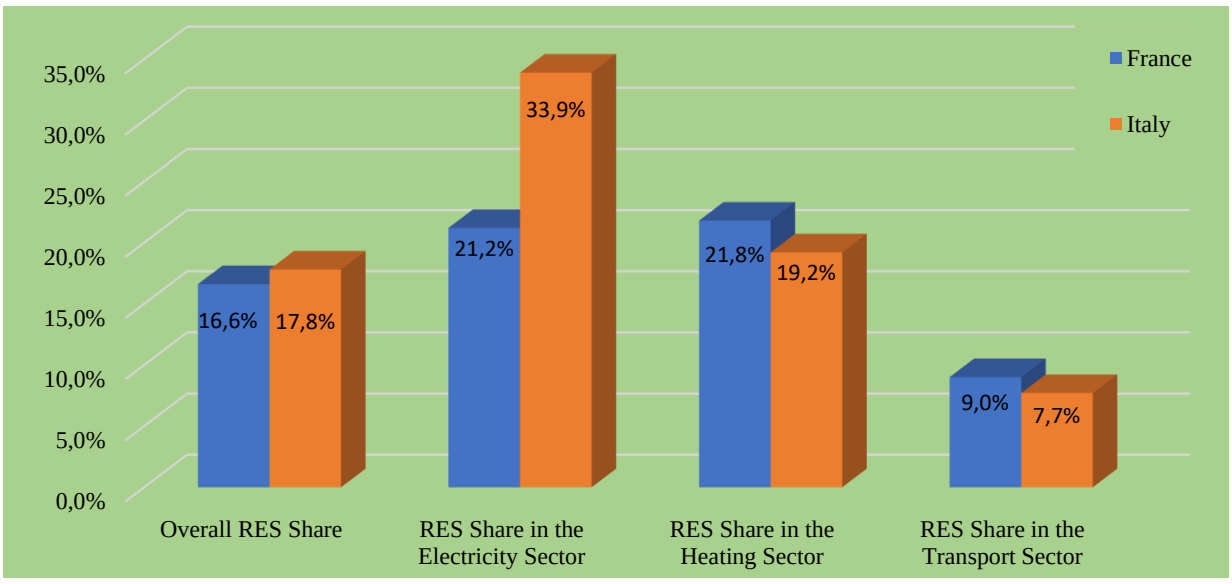

Figure 5: Share of RES overall and per sector of France and Italy as of 2018 – Source: GSE 2020

An element that slowed down significantly the development of RES in France was their important focus on wind power, an industry that is rather unpopular among the local population for various reasons and hence faced recurrent administrative barriers, which obstructed their normal realization process, even when these infrastructures were promoted by auctions. Meanwhile, with technological evolutions, the capacity of onshore wind increased considerably throughout the decade, while its price declined by around 40% between 2010 and 2019 (IRENA 2020, 52-55). In this particular technological sector, Italy did not experience the massive growth that was experienced with photovoltaics, maintaining its progress approximatively in line with the expectations of the NREAP. Similar observations can be made for offshore wind, a technology whose progress resulted quite difficult for both countries. In fact, as of 2016 none of the two countries managed to realize their plans for offshore wind infrastructures, resulting in a potential power deficit of 6.000 MW for France and 680 MW for Italy (Ministero dello Sviluppo Economico 2017, 5, Ministère de la Transition Écologique et Solidaire 2018, 7). It appears unmistakeable that this situation will have a much heavier impact on the former, which shall also compensate a deficit in onshore wind (2.200 MW as of March 2020), than on the latter, which is likely to compensate it with the progress made with photovoltaics. This scarce progress can be explained by the fact that offshore wind is a relatively new and developing industry, with a certain degree of uncertainty around it, which justifies the decision by French authorities to launch a pilot project before proceeding with a complete investment. Furthermore, it is associated with higher costs and construction time compared to onshore wind due to their location, leading to more uncertainty for investors who thus confront a higher risk (IRENA 2020, 76). Considering these conditions, the choice of French authorities to plan the construction of 6.000 MW in a relatively short timeframe, might end up penalizing the achievement of their 2020 target.

Hydropower plays a less marked role due to its infrastructural characteristics and environmental impact, which generally require long-term planning. While both countries rely on this technology for important shares of their renewable electricity production, limited progress was planned over time, and consequently their importance in the achievement of the 2020 targets is minor compared to photovoltaics and wind power.

Lastly, bioenergy plays a minor but relevant role in the electricity production of both cases, with an installed capacity of 1.333 MW for France and 3.871 MW for Italy (Ministero dello Sviluppo Economico 2017, 5, Ministère de la Transition Écologique et Solidaire 2018, 7). This technology, however, plays a much more important role in the heating sector, where, as of 2016, it is responsible for over 80% of the renewable heat in France (10,8 Mtoe), and over 70% in Italy (7,6 Mtoe), surpassing the progress expectations in the latter case. In this sector, both member states used a system of quotas with some additional support provided by tax incentives and low-interest loans which,

however, did not allow France to be in line with their interim objectives for 2018 (29%). The lesser progress, notably in the bioenergy industry, was justified by French authorities with the higher temperatures registered in this decade in the country, which explain the lesser use of this technology in the final energy consumption. Italy is, instead, ahead of target also in this sector.

This can also be explained by the stronger reduction in the total energy consumption experienced by Italy (19,5 Mtoe in the 2005-2018 period) compared to France (12,4 Mtoe in the same period), maintaining the yearly final energy consumption of France (154,3 Mtoe) higher than the one of Italy (121,5 Mtoe). This has a direct effect on shares, despite the fact that in net terms France has a higher production of renewables (25,8 Mtoe vs 21,6 Mtoe) (GSE 2020, 4).

Overall, it is possible to conclude that incentives provided via an open availability (ex. feed-in tariffs or green certificates) give a higher chance to exploit price fluctuations in the RES market compared to auctions which by their own nature limit incentives to a certain amount of infrastructures and require a higher implementation time. The open access to incentive mechanisms allowed the swift development of the photovoltaics market in Italy, as when the price for this particular technology lowered, investments in photovoltaics became more convenient and the totality of interested investors could access to the premium guaranteed by the *Conto Energia* plan. This was less the case for France, as they switched to auctions at an earlier stage and were consequently penalised by the lengthy bureaucratic process that came with this system. While the initially generous and open incentives available in Italy allowed the country to be extremely effective and quick in reaching their 2020 target, their drawbacks became soon evident due to the scarce efficiency of these policies, often related to the high policy cost. In fact, for such reason Italy shifted its incentive mechanisms to auctions or similar measures and was forced to recalibrate premiums in order to make its policies more efficient at the detriment of their effectiveness. On the other side, France adopted a much more careful

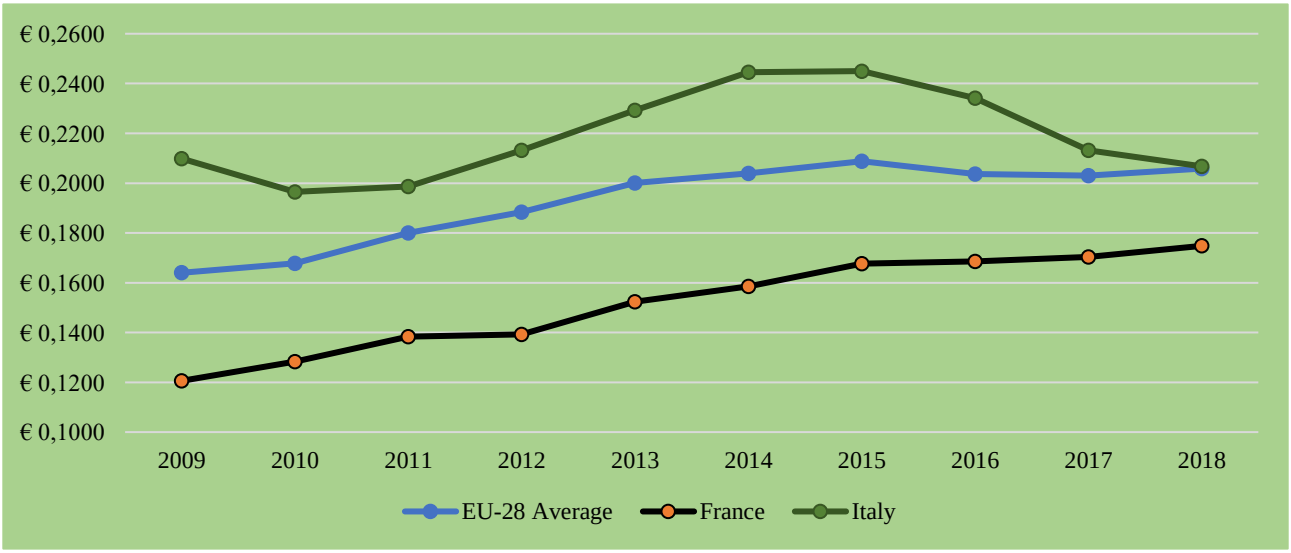

Figure 6: Electricity Prices for Households (€/kWh) – Source: Eurostat 2020

approach, which turned being more efficient but much less effective in achieving its policy targets. The impact these policies had on the electricity price for households can be seen in *Figure 6*. The consequences of RES incentives are particularly evident in the years following Italy's incentives reform, where the price was over the EU average by €0,04/kWh, and close to €0,1/kWh higher than in France, but also in the downwards curve that starts following those years, evidence that the reform had a positive effect on policy efficiency via a reduction in electricity prices.

Conclusions

Nowadays, energy has an important impact on most aspects of our lives, but its production could significantly harm the environment we live in if excessively based on fossil fuels. In order to reduce energy dependency and consolidate its role as a leader in the fight to climate change, the European Union established over time a series of strategies and targets to promote the use of RES. This was translated into binding European and national targets with *Directive 2009/28/EC*, which designed a clear path to the realization of a greener Europe. Various combinations of incentive mechanisms were put in place, depending on the national needs and assets, and led to an overall growth of the RES share in the EU final energy consumption, which will most likely be determinant in the achievement of the 20% target in 2020.

Among the various strategies, the cases of France and Italy were studied. These two countries ended up surprising the initial expectations, which consisted to achieve an ambitious target without recurring to foreign help in the case of France, while in the case of Italy more modest prospects of growth were foreseen. The progress made by both countries resulted in a swap in situations. In fact, as of 2018 Italy had already achieved its target, notably due to an impressive growth in the photovoltaics industry and can now manage a lower growth rate with less expensive incentives. On the other hand, France finds itself behind, particularly due to an important gap in the electricity sector, and is unlikely to fill the gap to its targets by 2020. The slower progress experienced by France can be explained on one hand by a series of bureaucratic setbacks which slowed the expansion of RES industries (particularly in the wind power industry, expected to become the second most important RES in the country) and on the other hand by a lesser reduction of the final energy consumption, which could have compensated a deficit in RES development. Furthermore, the importance of nuclear energy in the country also played a role, with considerable investments dedicated to that particular industry. Based on the progress of both countries, it is possible to conclude that while the promotion of incentives via auctions gives more control over policy cost and improves policy efficiency compared to open feed-in tariffs and green certificates, it can also reduce policy effectiveness as the possibilities provided by eventual price fluctuations on the RES market are made less exploitable due to bureaucratic obstacles. Consequently, unless auctions are simplified in order to allow a rapid completion of bureaucratic procedures, feed-in tariffs and green certificates can be considered as more effective incentive mechanisms for the achievement of renewable energy targets in a relatively short timeframe.

Nevertheless, the progress made by EU member states is not limited to the 2020 goals and serve as a benchmark for wider objectives already established for 2030 and 2050. It is interesting to

note that the new *Renewable Energy Directive* (*2018/2001/EU)* and the 2030 *Clean energy for all Europeans* package include solely a 32% target for the Union overall and does not foresee binding national targets. It will thus be interesting to further analyze the evolution of national incentive mechanisms post-2020, once member states will not be bound by national objectives, and observe whether this will effectively encourage further collaboration among member states, as this was mostly absent in the implementation of the 2020 plan. This scenario could represent the first step towards a more integrated and complete EU energy policy and contribute to the achievement of decarbonization at the lowest possible cost, as auspicated by the European Commission in the 2019 *European Green Deal*.

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