European Union Markets with Ambitious Renewable Participation

Paulina Beato
Member of the Expert Group on Electricity Interconnection Targets
Barcelona Graduate School of Economic

1. Introduction

The European Council endorsed the European Commission's (***EC***) Proposal to extend the current 10% electricity interconnection target to 15% by 2030 while taking into account cost-related aspects and the potential of commercial exchanges in the relevant regions.

In order to make the 15% target operational, the EC set-up a Commission Expert Group to provide specific technical advice. Among this technical advice, they examined whether regional, country and/or border level targets should be considered, and studied other relevant elements that could have an impact on the development of interconnectors.

The Expert Group Report articulates its recommendations on the basis of five complementary pillars that address the obstacles for developing interconnectors. These pillars, which can be found in the Expert Report (2018) and Beato, P. and Vasilakos, N. (2018), are summarised as follows:

1. Interconnection targets should have a triple dimension, measuring: a) the degree of market integration, b) the capacity of interconnectors for importing electricity, and c) the capacity of interconnectors for exporting renewable electricity.
2. In order to avoid and reduce the incentive to propose inefficient interconnector projects, a detailed, all encompassing, cost-benefit analysis should be a necessary ("*sine quae non*") condition for implementing new interconnectors.
3. Attention to the efficiency of the functioning of the European electricity market should be a priority. In particular, by recognising and rectifying the situation that "energy only" markets are not coherent with the European Union's (**EU**) priority goal of drastically reducing carbon emissions.
4. The EU network should be planned and operated in an integrated way. This means harmonising the rules for operating the EU network, but also a different vision of responsibilities on the security of supply.
5. To facilitate interconnector development, citizens and relevant stakeholders should be involved at an early stage in the identification and balancing of costs and benefits..

The purpose of this article is to elaborate on recommendation 3. To this end, the article first develops criteria to address the issue of lack of coherence of "energy only" markets with the EU's prime goals of drastically reducing carbon emissions and ensure security of supply.

The remaining of the article is organized as follows: Section 2 discusses the insufficiency of "energy only" markets to promote investment and explores how mechanisms pushing for renewable deployment and security of supply would generate overcapacity. Section 3 presents options to complete EU energy markets for promoting energy transition while keeping the three classical objectives of energy policy. Section 4 provides some concluding remarks.

2. "Energy Only" Markets and Renewable Deployment

"Energy Only" Markets

Electricity is an ideal good for competitive markets because it is a homogenous good that cannot be differentiated. In competitive markets, producers offer available electricity at a price equal to the marginal cost. If there is good scarcity, prices will go up until supply is equal to demand. Notice the implications of these simple rules. First, most of the time (that is, on non-peak periods), price is equal to marginal cost; and in the case of large renewable participation, such marginal cost is zero. Second, during peak periods, supply becomes inelastic and price equals consumer marginal utility of electricity. Moreover, such "energy only" markets will provide a level of capacity where prices during peak demand periods, together with the revenues from low demand periods, will be sufficient to cover all costs of electricity generation , including fixed costs.

The three key assumptions for the well-functioning of "energy only" electricity markets are:

- First, installed capacity is fixed and generation adequacy is given. Once the demand reaches that level, the market will exclusively increase prices until demand is reached.
- Second, demand is able to respond immediately to price increase. This means that demand is sensitive to prices in the short-run.
- Third, in the medium-term total capacity will adapt so that revenues from peak periods, together with valley periods, allow for the recovering of total costs.

Genoese and others (2015) summarize stakeholders' views by saying that in "energy only" markets, low marginal costs and intermittent nature of renewable generation lead to revenue reductions and, therefore, disincentivizing investment. Although "energy only" markets fail to incentivize investment, it should be noted that the problem is not only due to low marginal costs and intermittence of renewables; those features may increase the basic problems of "energy only" markets, but are not the only cause. Roques and Finon (2019) conclude that most imperfections existed in the market design prior to renewable integration; but their effects were amplified, at the physical level, by the introduction of intermittent renewable generation.

Electricity Markets in Real World

The assumption that supply is rigid in peak load periods is key for the well-functioning of energy only markets. However, supply is not rigid in most real world systems. Supply rigidity in peak load period relies on the implicit assumption that capacity is equal to peak load. However, real world authorities are reluctant to accept small electricity capacity margins, which implies that the amount of extra capacity available as compared to peak demand is quite large. For example, ENTSO-E's 2015 adequacy forecast points out that the expected margin of reliable available installed capacity over peak load for the year 2016 was around 13% for Europe as a whole. This margin is well above the margin that is necessary to maintain standards of supply reliability. Note that excess capacity means that market price equal to marginal cost will be the result at almost every hour. Therefore, if prices are unable to increase in peak load periods over the marginal cost, the recovery of fixed costs is almost impossible.

Another assumption under the well-functioning of “energy only” markets is that demand is able to immediately respond to price increase. However, real life consumers do not have the interest nor the tools to immediately respond to price increase. In “energy only” markets with inelastic demand, prices will not reduce demand, but involuntary demand reductions will do the job. Without programs to control demand in the short-run, scarcity’s real costs are unknown, but the revealed costs of furious and desperate consumers make regulators and authorities reject such situations.

An additional issue that appears in most real world electricity systems is the ability of generators to control the wholesale market at peak hours. The capacity of generation and the expected demand is well-known by all generators in most electricity systems. Since the number of generation units is small, generators may push prices up by reducing offers from cheap generation plants. Thus, price increases in peak hours may be provoked by a genuine generation shortage in relation to demand or by generators’ monopolistic behavior. In any case, political discomfort arises when prices increase in peak hours.

In summary, the central problem of “energy only” markets in the real world is that they rely on short-term capacity scarcity, price increase and demand elasticity to recover fixed costs; but authorities do not accept either scarcity nor abrupt price increases and consumers do not have the capacity of changing their demand when prices increase. For a deeper discusssion, see Newberry (2016) and Keay (2016).

Energy policy in most EU Member States has three objectives: decarbonization, security of supply, and competitiveness. In order to achieve these three objectives mechanisms that push towards new decarbonized energy without jeopardizing security of supply and competitiveness are required. “Energy only” markets are not enough, and the question is how to complement these markets to ensure a rational equilibrium among them.

Renewable Deployment and Overcapacity

The variability of energy output from intermittent renewables such as wind and solar requires substantial back-up power sources to compensate the lack of renewable energy availability. The majority of this back-up generation in the EU comes from fossil-fuel plants. In theory, demand reductions can also compensate lack of renewable energy; but in practice this option is not relevant when calculating reserve adequacy. Moreover, today’s methods for capacity calculation do not even consider complementarity of different sources, which may result in a statistically firmed capacity of variable renewables. Therefore, more renewable capacity does not necessarily imply less dispatchable capacity, and the result is overcapacity.

Del Rio and Janeiro (2016) analyze the causes and consequences of overcapacity, with a special focus on the impact on renewable deployment, using Spain as a case study. However, Spain is not the only EU Member State with this problem. They point out that overcapacity problems are present or have been present in other EU Member States. In particular, they mention that the day with the maximum load in 2013 in Germany was December 5th. On that day, the "secured capacity" was 116.3GW and the maximum load was 79.1GW. Therefore, there was a security margin of 37.3GW (47%). This is likely the result of two mandates: First, part of the overcapacity originates from a politically enforced growth of installed capacity (renewables), without reducing traditional capacity. Second, generators were not allowed to shut-down plants in Southern Germany, because these are required for stabilization of the system (network stability).

Overcapacity may have negative impacts on the three EU energy policy objectives mentioned above. First, overcapacity is clearly an economic problem in terms of the efficiency of resource allocation and competitiveness. Moreover, it may generate negative prices with associated complexities. Second, it may affect security of supply, since gas plants that are used to back-up renewable may lose the incentive to supply electricity. Third, overcapacity represents a barrier to an energy transition based on renewable deployment. The two first impacts have been widely analyzed. In fact, demand for setting capacity mechanisms is an answer to poor revenue of generators, offering firm energy that may result from overcapacity. However, the impact of overcapacity on new renewable investment has been much less discussed.

Overcapacity would reduce renewable investment for both economic and political reasons. First, the downward pressure on market prices would increase the difference between costs of renewable generation and revenues obtained from the market; thus, increasing the need for external support. Note that under the "energy only" market model, the need for external support may occur even if the average total cost of renewable energy is smaller than the average cost of conventional generation units. This is because in "energy only" markets, competition occurs via marginal cost (not average cost) and renewable generation is capital intensive. Second, and even though society would be willing to have more renewable generation, it is difficult to justify economic support for new renewable plants, which are not needed to ensure security of supply and have smaller average costs than conventional plants.

An Old Fashion Model: "Energy Only" Market

Despite the reservations of the EC, there has been an increasing trend across Europe to introduce capacity mechanisms of one sort or another. However, there is no clear consensus on the need and form of such mechanisms. As pointed out by Keay (2016) "*Electricity markets are designed to reflect and optimise the cost structures of the conventional technologies we are familiar with from 20th century electricity systems. They are not suited to the systems we are developing to meet 21st century needs and circumstances, and they do not give effective signals in situations where, as at present, one set of technologies is receiving support from outside the market, while other technologies are expected to remunerate themselves from the market – yet both sets of technologies are operating in the same market*"

If the present situation is unsustainable, other market structures should be considered to ensure security of supply and environmental goals. Theoretical and political consensus about the convenience of setting other markets structures may be difficult to achieve. Note that in 1983 Joskow and Schmallensee proposed a well-designed framework to allow free market forces to replace Government regulation in the electric power industry. However, it took many years to bring liberalization to the power systems. The first liberalization Directive was adopted in 1996 and it only introduced competition in wholesale markets and some sort of legal separation between generation activities and transmission in EU power systems. Almost a decade later, in 2003, the second liberalization Directive introduced retail competition and some sort of legal separation between retail and distribution. Nevertheless, Member States were allowed to introduce retail competition earlier, and several of them did so – Scandinavian countries, Germany , UK, just to name a few.

3. Advancing Towards EU Electricity Decarbonization

EU Views and Recent Regulations

The EC (2016) concludes that European electricity markets suffer the classical problems of "energy only" markets:

> "*Demand for electricity is largely inelastic due to technical factors and regulatory barriers, which implies lack of responsiveness of demand to price variation and leads to inefficient price signals. System operators use a variety of tools to force the market to clear in ways that suppress market price signals. It is therefore understandable that authorities and stakeholders pose the question whether the current design, rules and structure of electricity markets may lead to problems of generation adequacy in the future, even though there may not exist such a problem today*".

The "Clean Energy for all Europeans Package", adopted in November 2016, updates the rules for EU resource adequacy assessments and sets out design principles for national capacity mechanisms. An important aspect of the new proposal is that EU capacity mechanisms should be open to participation of capacity providers from other Member States. The EC's view is that the features of EU capacity mechanisms need to be coherent with full integration of "energy only" markets, consumer protection and decarbonization.

The IEA (2016) highlights the fact that the EU's electricity market needs to be reformed in such a way as to incentivize investment in low-carbon. The IEA acknowledges that low-carbon investments are capital-intensive and that their cost structure does not fit well with short-term marginal cost pricing. It adds that "*electricity prices are too low to recoup the investment costs of any low-carbon technology, including renewables*".

"Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources" (**Directive 2018/2001**) sets an EU binding target of at least 32% in final energy consumption, but does not translate it into national targets. The EU target needs to be achieved by contributions of individual Member States. However, the expected contribution of each Member State is defined in case the EU falls behind its overall trajectory for the 2030 target. In this context, the use of cost-efficient renewables potential is as important as ever and may result in cross-border cooperation. Member States have the right to decide the degree they wish to open their support scheme, with indicative shares of at least 5% from 2023 to 2026 of the newly-supported capacity and at least 10% from 2027 to 2030. The EC will evaluate the implementation of cross-border cooperation to renewable deployment and may introduce an obligation for Member States to partially open their support schemes

"Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU" (**Directive 2019/944**) and the new Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity (**Regulation 2019/43**) introduce new rules for improving the functioning of energy markets.

This EU set of regulations will likely enhance the adequate functioning of "energy only" markets. They set ambitious renewable targets that may strengthen cooperation among Member States for renewable deployments, but do not offer harmonized schemes to solve the relevant problems of "energy only" markets.

The remaining part of this section explores options to complete "energy only" markets in order to generate a rational balance between the three classical objectives of energy policy cited above (competitiveness, security of supply and decarbonization). The options rely on the existing energy markets, likely enhanced by the recently adopted regulations, with two requirements for retailers: renewable participation and capacity . Retailers must contract in advance: (i) firm capacity to ensure security of supply; and (ii) renewable energy to meet the renewable targets. By giving retailers choices on how to meet their capacity and renewable requirements, competition and cooperation across the EU would be strengthened. Retailer firm capacity requirements are set by the relevant authorities in each Member State, while the renewable capacity requirements are set by the EU.

Enhancing Energy Markets

Directive 2019/44 and Regulation 2019/943 introduce – as of 1 January 2020 - new rules improving the functioning of energy markets. The most relevant rules are the following:

- Consumers will be able to become active players in the market thanks to the access to smart meters, price comparison tools, dynamic price contracts and citizens' energy communities. At the same time, vulnerable consumers will benefit from a better protection.
- Electricity will be able to move freely throughout the EU energy market through cross-border trade.
- More market-based investments in the sector will be fostered, while decarbonizing the EU energy system.
- Introduction of a new emissions limit for power plants.

- Planning improvement in order to anticipate and respond to electricity market crisis situations, including cross-border cooperation.

The new rules contribute to the EU's goal of being the world's leader in energy production from renewable energy sources by allowing more flexibility to accommodate an increasing share of renewable energy in the grid. The shift to renewables and increased electrification is crucial to achieve carbon neutrality by 2050. The new electricity market design will therefore help achieve the goals set out in the European Green Deal, and contribute to the creation of jobs and growth.

The Directive will have to be transposed into national law. These new rules will put consumers at the heart of the transition, providing them with more choice and greater protection and will give an important push to "energy only" markets, making them much more flexible. However, the mayor issues associated to "energy only" markets remain. One relevant pending issue is the integration of distributed generation, which will be addressed elsewhere. Next, incentives for firm capacity and renewable investment are addressed.

Retailers and Capacity Adequacy

A way to incentivize firm capacity investment is to set capacity adequacy requirements to retailers. To ensure capacity adequacy, retailers may choose between centralized and decentralized options. Under the decentralized option, retailers contract in advance a certain amount of firm capacity to attend demand. Options for such requirements would be between one and four years in advance, to have time for the development of new projects. Under the centralized option, retailers make payments to an ad-hoc institution that is in charge of ensuring that retailers would be able to attend their customer's demands. The key elements are the following

- Definition of capacity adequacy. Capacity adequacy is defined outside of the market and borrowed from traditional planification. The purpose of resource adequacy is to determine the amount of capacity resources required to serve the forecast load and satisfy the socially-desired reliability criterion. Capacity adequacy can be defined by each Member State following EU guidelines, although, an EU -wide capacity adequacy definition would be the final goal. EU guidelines for Member States establishing capacity adequacy are appropriate for restraining overcapacity and avoiding hiding subsidies. Moreover, EU guidelines will facilitate calculating the needs of interconnectors and country network bottlenecks

- Assessment of capacity adequacy. Following the EU guidelines, the corresponding Member State institution annually performs an assessment of resource adequacy for an n-year future period. The analysis considers load forecast, capacity evolution of both network and generation and forced and planned outages. The resources needed to meet the reliability criterion, is the key element to set the retailer's requirement. A simple option to set capacity adequacy requirements is through the Installed Reserve Margin (IRM), defined as a percentage of forecast peak load. However, more complex functions for defining firm capacity should be considered in order to take into account consumer preferences. Capacity requirements should be consistent with the portfolio of each retailer.

- Meeting retailer requirements. Retailers can meet that requirement by generating their own capacity or with capacity purchased from others under bilateral contracts. However, an additional step for dealing with network planification and market integration is the establishment of a country "firm capacity pool", that gives retailers firm capacity when needed and retailers pay a fee for such service. For example, PJM (a market and regional transmission organization in United States) gives retailers the two options: buying capacity through bilateral contracts or ensuring capacity through PJM's centralized service.

The following features of this scheme deserve to be pointed out. First, capacity adequacy is defined by each Member State following the EU Guidelines, so that they have the final control on the security of supply. Second, forcing electricity retailers to ensure ex-ante capacity generates demand of firm capacity. Third, generators may choose to sell capacity to individual retailers or to the country pool. These features lead to the creation of a forward capacity market that provides: (i) generators with the opportunity to collect extra revenues for their generation capacities; and (ii) incentives for building reserves beyond those that meet the short-term. Note that in some EU Member States, some retailers and generators that are economically - not legally - integrated, control the supply of firm capacity resources. In these cases, non-integrated retailers may have difficulties to ensure their capacity requirements.

Retailer capacity requirements must be able to complete and improve "energy only" markets. To this end, attention should be given to the following issues: guaranteeing capacity, mitigating price volatility, integrating consumer preferences, and ensuring competitive options to non-integrated retailers.

First, the terms of capacity adequacy contracts should ensure that adequate power supply is available and prices are stabilized. Most capacity mechanisms do not provide guarantees that generation capacity will be available to supply electricity when it is needed. Some contracts include penalties when energy is not supplied when demanded, but such penalties are not usually enough to ensure capacity. Guarantees deposited in advance must be considered. In addition to ensure available capacity, capacity contracts need to take care of price stability. One thing is to have the available capacity, and another is to have it at competitive prices. If generators with capacity obligations are free to set sale prices, they may take advantage of the system's scarcity and set monopolistic prices when the contracted capacity is finally delivered. To prevent such behavior, contracts must ensure that energy served under thsse contracts has competitive prices. The natural way of ensuring competitive prices is by including an obligation of generators to sell the electricity at a given price when demanded. The model under such option is a sort of reliability option model, with physical capacity and price commitments.

Second, the determination of capacity requirements of the retailer should include consumer preferences. Thus, retailers should present consumers with a portfolio of power supply, with different security levels at different prices. For instance, retailers may offer the option of interrupting the flow as necessary, or may offer the option of electricity on demand. Consequently, retailer requirements must be defined as a function of effective portfolio acquired by consumers. In this direction, retailers with only the first type of consumers would not pay for firm capacity. However, a payment for ensuring capacity that is able to generate variable energy may be considered. If consumers are not willing to pay the whole price of security, retailers would have a more flexible demand and, therefore, their capacity requirements would be reduced.

Third, retailers and Member State's centralized pools should be open to buy any capacity, including capacity located in other Member States. The EC assumed negative effects of non-capacity trading in its Document on "Generation Adequacy in the Internal Market" (EC 2013) and considers that *"a mechanism which excludes cross border participants could result in new generation capacity displacing imports. This would undermine the financial viability of generation in other member states and could have a negative impact on regional security of supply*". Nevertheless, Finnon (2018) examines the reality of these advantages by distinguishing situations with and without congestion and concludes that concretization benefits for the system is not possible when there is congestion. However, contracting in advance capacity from abroad would facilitate the management of congestion issues and benefit from competition across EU Member States. A complementary option to ensure access to capacity to small retailers in Member States with large generator-retailer integration is by requesting integrated generators to sell and buy a portion of their generation and capacity requirements through the country pool.

Retailers and Decarbonized Capacity

Directive 2018/2001 sets an EU binding target of at least 32% in final energy consumption. Although it does not translate it into national targets, it indicates that t EU target needs to be achieved by contributions of individual Member States. Member States have the right, but not the obligation, to establish support schemes for renewable targets. One option to accelerate renewable investment is through the so-called renewable portfolio standards (**RPS**), Retailer Requirements (**RR**) or Retailer Quotas (**RQ**). All these mechanisms require a certain percentage of a retailer electricity sales or capacity to be from renewable resources.

RR that need to be certified in advance would generate a forward market of renewable electricity that would provide renewable generators with the opportunity to complement the revenues from the energy markets. Therefore, it provides incentives for the building of renewable capacity even in presence of non-renewable overcapacity.

The following are relevant steps for establishing RR:

- Entities: Retailer capacity is applied to entities that supply electricity to consumers. In the EU would be the electricity retailers. However, large customers procuring their own electricity must also comply with some renewable requirements. Large customers may procure their renewable electricity via a power purchase agreement (PPA) with a renewable generator or via an electricity supplier that provides a specified percentage of renewable energy in its supply.

- Setting Targets: Practices on how to set renewable requirements vary widely. For instance, standards are commonly measured as the percentage of retail electric sales However, some US States, such as Iowa and Texas, require specific amounts of renewable energy capacity. For EU retailers, setting the renewable requirements as 32% of total electricity consumption requirement in year 2030 would ensure consistency with EU mandates. Targets are typically established on an annual basis with an end-year target. For example, in the EU, targets for retailers may be 32% of annual retail electricity sales in 2030, and starting at 22% in 2022 and increasing 1% annually to reach the 32% end-year target. This reduces uncertainty to project developers.

- Choices for Retailers: Retailers may have their own renewable generation, they may bilaterally contract renewable power to generators, or buy renewable energy to centralized pools. Bilateral contracts cross-country would be allowed to promote competition and efficient investment. Centralized pools are good for completing bilateral contracts. Centralized pools may be organized at each Member State or at an EU level. The latter option would be good for competition and take advantage of economies of scales, but complicated political and economic issues may arise.

- Renewable Pool: A centralized pool - at country level or EU level - will buy through periodical auctions a certain amount of renewable electricity that would sell to those retailers that prefer buying the requirement in the pool. Country pools should be open to other Member States. Openness would be in concordance with EU Directive 2018/2001, which establishes that Member States have the right to decide to which extent they open their support scheme to competition from other Member States.

- Guarantees of Origin: Retailers need instruments that certify that they have bought the required quantity of electricity produced from renewable sources. Guarantee of origin are already in place with the objective to inform consumers, but they are not mandatory and mainly constitute a marketing tool for retailers. However, if RR are established, then the certification process should be mandatory. Moreover, certification processes across the EU must be harmonized to allow cross country renewable trade. An EU organized market for "Guarantees of Origen Rights" would increase the liquidity and facilitate to meet renewable requirements to small and medium retailers.

The whole structure of the renewable RR should avoid introducing distortions on the functioning of the energy markets, that are a central element of the EU energy system. In particular, the following issues need to be addressed:

First, buying and selling renewable energy to meet the renewables quotas should not affect the functioning of the markets. In real life systems, electricity from different sources mixes on the network. Tracking electricity origin that arrives to a given set of consumers is impossible. Setting RR in the EU as discussed above, will allow to ensure that a percentage of the total energy consumption in the EU is generated with renewable sources, but the percentage of renewable energy of the sales of each retailer will remain unknown. Therefore, retailer's requirements may be seen as setting retailers with the obligation of buying and selling two different products: one product is electricity and the other is contribution to EU renewable energy supply. Options for separating these two obligations are key to facilitate the functioning of the markets.

Note that a sort of separation is present in most renewable support schemes across Europe. The schemes from UK, France, Netherlands, and Ireland rely on Contracts for Differences. The idea is that bidders frame their bids in terms of an energy market "strike price". Usually, the "strike price" is fixed rather than variable, and does not depend, for instance, on the time of day. Renewable generators receive two payments: the market price and the difference between the "strike price" and the market price. Payments are then made during the lifetime of a project on the basis of the difference between the strike price and a reference market price:

- when the market price is less than the "strike price", a premium payment is made
- when the market price is more than the "strike price", the generator pays back the difference to the system.

Second, although as a general rule retailers should be allowed cross-country buying and selling renewable requirement, attention should be given to mitigate inefficient choices when lack of interconnexion capacity prevents the equalization of market prices. If the power markets of EU Member States are not integrated and prices diverge, retailers would buy inefficient renewable projects located in countries with higher prices. This issue deserves special attention when prices are divergent across countries. (See example in box 1)

Box 1

Inefficient Renewable Project and Retailer Selection

Retailer M needs to buy 10,000 MWH to meet its renewable requirements and faces two purchase options: Project 1 and Project with the following features. Both project developers require a minimum "strike price" equal to the average levelized cost to undertake the corresponding projects

Project 1:

- Average levelized cost ~ C(1)=60€ per MWH
- Strike Price =60€ per MWH
- Located in country A
- Average market price in country A ~ P(A)=30€per MWH

Project 2:

- average levelized cost ~ C(1)=80€ per MWH
- Strike Price =80€ per MWH
- located in country B
- Average market price in country A ~ P(A)=60€per MWH

Retailer M would prefer to make a contract for differences with the developer of project 2. Why?

The retailer net payments (RNP) per MWH would be the strike price minus the energy market price. Therefore, net payments would be smaller contracting project 2 than contracting project 1

- RNP(1)=60-30=30€
- RNP(2)=80-60=20€

Third, the country pool or the EU pool should be structured as a complement to retailers' and generators' bilateral contracts. Complementarity with bilateral contracts recommends that pool rules are underpinned by two criteria: leaving room for bilateral agreements and filling their gaps. For example, the following rules are coherent with the three criteria: (i) to leave room for bilateral agreements, pool size should be smaller than retailer total requirements; (ii) pool auctions should focus on large projects which are difficult to afford by bilateral contracts; and (iii) pool should promote renewable firm capacity.

Fourth, country pools should select the corresponding projects through open auctions that promote the most efficient renewable projects. This means that the selection criteria should discover the project of minimum cost. For instance, auctions that select projects requesting the minimum premium over the market price of the country where the projects are located, may select expensive projects. This way, minimum cost projects are not discovered. However, such selection criteria would minimize pool payments. Other selection criteria is choosing the project with lower striking prices. In such case, projects with minimum costs are selected, but pool net payment would be larger.

Fifth, given that capital cost is an important component of renewable investment, the application of minimum cost criteria by retailers and pools would disregard technical efficient projects in countries with high interest rates. Options for dealing with this, include financing them with the mechanism of Project of Common Interest , or providing an EU partial political and regulatory risk guarantee that would reduce capital costs without destroying proper incentives for renewable promoters. An appropriate solution to this issue is key for the social acceptance of an EU renewable pool.

4. Concluding Remarks

The new elements described in this paper do not solve all the problems of EU energy markets analyzed on Keay (2017). However, they attend some of them by promoting efficient decarbonization investment, eliminating the missing money problem, and allowing consumer preferences to be considered in the definition of capacity requirements. The former feature is relevant for appropriate integration of distributed generation and prosumers into energy systems. A summary of the findings and proposals is set out below.

First, the Renewable Energy Progress Report (ECOFYS [2019]) reveals that meeting the renewable targets for 2020 will be challenging for several Member States. Setting renewable requirements to retailers and establishing choices for meeting them is a way to accelerate renewable deployment and EU target achievement. Although cross-country centralized pools for buying and selling renewable power may be economically and politically complex, EU forces and rules are pushing towards them. The amount of energy that can be generated per unit of investment, differs heavily within countries, and even more, among EU Member States. Solar resources are much better in Southern Europe, while wind resources are distributed more evenly across the continent. Cooperation among EU Member States to achieve EU targets would reduce costs and increase competitiveness. The EU has shown determination in setting targets for emission reduction and renewable deployment. It must also have the power to implement them efficiently.

Second, the "mixing money" element is ensured through a sort of capacity mechanism where retailers are required to have the resources to meet the capacity adequacy defined by each Member State, following the EU guidelines for such mechanisms. They can meet that requirement by generating capacity on their own or with capacity purchased from others under bilateral contracts, as in most capacity mechanisms. However, an additional step would be the establishment a country "firm capacity pool", where retailers may purchase firm capacity. Capacity requirements lead to the creation of a forward capacity market that provides generators with the opportunity to collect extra revenues for their generation capacities and provides incentives for the building of reserves beyond those that meet the short-term.

Third, retailers may alter their capacity requirements by offering consumers options on how electricity flow is provided. Some retailers may commit to provide continuous electricity flow to customers, while others may commit to provide electricity at some hours of the day. Moreover, other consumers may have the option of interrupting the flows under certain conditions. In other words, consumers participate in setting the capacity that retailers need to ensure. The choice of buying capacity through bilateral agreements, through a central pool or through storage, introduces consumer preferences and new technology in the process.

Glachant (2017) points out three "*missing regulatory pillars"* for advancing towards an integrated EU market: coordination, sharing costs and benefits, and solidarity. EU pools for buying renewable and capacity adequacy may be central elements of the missing regulatory pillars, since they allow coordination and sharing costs and benefits of investment in renewable resources and network expansion. Pools can be enhanced by appropriate financing mechanisms of renewable projects and networks, while attending solidarity issues.

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