Integration of electricity from renewables to the electricity grid and to the electricity market – RES-INTEGRATION

Final Report

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Foreword

This report aims to assess the integration of renewable energy sources (RES-E) in the European grids and markets. Therefore, an extensive research of policies and legislation was conducted in order to analyse the current state of RES-E integration in each one of the 27 Member States. To ensure a balanced and accurate understanding of the situation in each country, 329 stakeholders from different sectors (government, industry, associations, system operators and so on) were contacted. Over 200 of them agreed to be interviewed and participated afterwards in consultation rounds. A detailed description of the methodology applied in this study can be found in Annex I on page 171.

Regarding network integration, several issues to the integration of RES-E into the grid ("barriers") were identified as being the ones with the highest frequency of occurrence in the Member States. Namely, 40 were identified in the connection phase, 7 in the operation phase and 16 in the development phase. It is clear that each Member State has its specific national conditions that can lead to unique specific situations. Thus, to carry out an overall assessment of the main barriers to RES-E integration in Europe, a harmonisation and generalisation process of such situations has been necessary, and similar situations have been grouped in broader categories. The 27 national reports that served as a basis for the present conclusions provide a more detailed description of the national situation in each one of the Member States. The generalisation enabled the authors to address the barriers at the European level and thus to provide recommendations accordingly.

Furthermore, it is of utmost importance to underline that the perspective considered in this report is mainly the European one. This means that the issues taken into largest consideration are mostly relevant at EU level because common to a significant number of Member States. Such issues may not automatically be also the most pressing ones in the Member States. For clarity, the most relevant issues at Member State level are listed in the grid connection, operation and development parts (pages 25, 49, and 59) and in the chapter dedicated to these issues on page 97. For a detailed assessment on them, reference should be made to the 27 national reports. Considering that it was not possible to include in this report all the details mentioned by stakeholders, a detailed assessment of the specific barriers in each one of the 27 Member States is provided in the national reports only.

Because of the harmonisation and generalisation process, and because of the European perspective intended for this report, all the details reported by Member States' representatives could not be preserved in the present document. For this reason, the authors would like to stress again that this report presents mainly results at EU level. A brief summary of the different Member States is provided, however detailed explanations of national barriers at are only illustrated in the country reports.

The term "market integration" in this report does not refer to the integration of different European markets, but rather to RES-E into the market. Regarding this topic, the country studies contain an overview of the different markets and support schemes in the EU-27. In this final report, instead, a differentiated view on market integration is provided. Specifically, it is argued that market integration of variable RES-E should be based on the flexibility potential these plants can provide and that market integration is not necessarily the most important factor in providing the required flexibility.

One last clarification as regards the United Kingdom and the Republic of Ireland: reports on these two Member States have focused on the regions of Great Britain and Ireland (all island) and thus assessments relate to those geographical areas. The reason for this choice is that Northern Ireland is integrated in the Irish SEM market, not in the BETTA market of Great Britain. Because of this, and given the context of this project, the authors have chosen to analyse Northern Ireland together with the Republic of Ireland. For simplicity, throughout the text, the terms "Member State" or "country" may be used also with respect to Great Britain or Ireland (all island), especially when they are listed among other Member States. This is however done only for the ease of the reader and, in any case, the authors would like to stress that Northern Ireland is politically part of the United Kingdom.

Executive Summary

The European electricity system has changed significantly in the last decade. Simply put, it has shifted from a monopoly system with fewer stakeholders, large and controllable generating facilities and often publicly-owned companies to a liberalised setting in which the number of producers has grown exponentially, generating facilities are diminishing in size and the system is being unbundled. Integration of RES-E in such a liberalised setting requires an appropriate regulatory framework, both in terms of network and market integration, in order to yield all the benefits it is intended to provide.

This report provides an assessment of how different countries are reacting to the challenges brought about by the new setting in terms of adaptation of the grid and the market to the rapid increase of RES-E. This assessment is provided in four areas, i.e. an assessment of RES-E integration in the phases of grid connection, operation, development and in the market.

Grid connection

Grid connection seems to be a quite critical phase: lengthy procedures or delays, lack of grid capacity, complex procedures and a weak legal position of plant operators are some of the issues blocking RES-E integration in this phase. These different issues have been reported in one third to two thirds of Member States. Further issues reported in this area are virtual saturation and speculation, non-shallow cost regimes and a lack of communication between stakeholders.

Although the grid connection phase is extremely critical for RES-E integration, and the issues reported are quite clear and common in the affected Member States, only a few NREAPs recognise the issues as a blockage and address them accordingly.

In this phase, the authors identified about 40 barriers, as opposed to 7 in grid operation and to 16 in grid development. These numbers do show that grid connection is the most critical phase, however they should also be read keeping the following points in mind:

- Grid connection is the first stage that stakeholders encounter for RES-E integration; it is thus the most “tangible” stage and the one to which stakeholders mostly relate in all countries. It can therefore be expected that more information is available in this regard.
- There is a strong complementarity between the phases of grid connection and grid development. Several barriers identified in grid connection are also relevant for development, for example as regards cost sharing for grid reinforcement or long waiting times linked to building new lines. For this reason, several of the issues under discussion in the current debates on grid development may also be considered with respect to the connection phase.

Main barriers across the EU 27 in the connection phase

The following table provides an overview of the identified issues and possible solutions to mitigate them:

Identified issues	Possible solutions
Long lead times & complex procedures	Identification of existing inefficiencies; Introduction of qualitative deadlines (e.g. "promptly"); Reduction of workload for public administration and/or grid operators; Harmonisation and simplification of grid connection requirements.
Lack of grid capacity / different pace of grid and RES-E development	Better coordination between grid & RES-E development; Collection of data on RES-E development from national registries and collection of data on development targets; Consideration of RES-E data in TYNDP[1] and in all national plans.
Virtual saturation & Speculation	Definition of milestones in grid connection procedure; Introduction of grid reservation fees.
Lack of communication, and weak position of RES-E plant operator	Initialisation of exchange programs and communication platforms through projects at EU level; Encouraging stakeholders at MS level to participate in exchange programs and communication platforms, as well as to appoint contact persons.
Non-shallow costs	Process to define adequate distribution of costs at MS level to ensure investment security; Funding through EU budgets in case of interconnectors with European significance.

Table 1: Overview of identified grid connection issues and solutions

Main barriers identified in each Member State in the connection phase

Member State	Main barriers to integration in the grid connection phase
Austria	Distribution of costs Information policy regarding costs
Belgium	Missing obligation to connect RES-E installations, except in the framework of the "Inform & Fit" procedure. Connection can be denied due to insufficient capacities, no obligation to immediately reinforce grid to allow for connection
Bulgaria	TSO does not connect new RES plants Capacity limits for RES Advance payments
Cyprus	Bureaucracy, Lengthy Grid Connection Procedure
Czech Republic	Connection moratorium Supposed lack of grid capacity

[1] The ten-year network development plan is a Community-wide non-binding plan developed by ENTSO-E with the objective to ensure greater transparency regarding the entire electricity transmission network in the Community and to support the decision making process at regional and European level (ENTSO-E 2010).

	Speculation Envisaged advance payments
Denmark	No barriers detected
Estonia	Lack of sufficient grid capacity Speculation Testing for wind farms
Finland	Lack of grid capacity Distribution of costs Speculative grid applications
France	Costs of grid connection
Germany	Communication between stakeholders Lack of transparency Definition of technical and legal requirements
Great Britain	Planning consent Issues linked to the offshore transmission tender process Issues linked to the charging regime
Greece	Inefficient administrative procedures Insufficient special planning
Hungary	Status of the grid Capacity saturation and speculation Unstable policies for wind power
Ireland	Potential delays for grid connection due to the group processing approach Potentially higher shallow costs than in other Member States
Italy	Administrative barriers Overload of connection requests Virtual saturation
Latvia	Lack of sufficient grid capacity Speculation
Lithuania	Complicated connection procedure Legislation not clear High costs
Luxembourg	Definition of connection costs
Malta	Inefficient administrative procedures Insufficient special planning Competing public interest
Netherlands	Lack of sufficient grid capacity
Poland	Lack of sufficient grid capacity Complicated and not-transparent grid connection process Unclear regulations concerning the distribution of costs
Portugal	Complicated and slow licensing procedure related to the Environmental Impact Assessment
Romania	Virtual saturation Access to credit Information management
Slovakia	Delays during the connection process Speculation
Slovenia	Administrative procedures Long lead times Enforcement of RES-E producers' rights

Spain	Delays introduced by administrative procedures Heterogeneity of DSO technical requirements
Sweden	Cost bearing and sharing

Table 1: Main barriers identified in each Member State in the grid connection phase

Grid operation

The operation phase seems to provide a fairly favourable environment to the integration of RES-E. It should be recalled, however, that several countries still show a very low share of RES-E operating on their grid, thus this phase may simply not yet be problematic due to this low RES-E share. It is possible that with an increasing RES-E share, the situation will dramatically change in the future and that thus early steps would be required to minimise future impacts. Most barriers to integration in this phase appear to be linked to national aspects, thus intervention would be needed at the national level, rather than at the European one. However, our research has revealed that grid curtailment, in the sense of reducing RES-E production due to grid issues, is a critical issue in a number of countries, especially due to the lack of curtailment rules, compensation issues, and the expected increase of curtailment in the future.

As regards the NREAPs, it appears that also in this case the detected issues are not much recognised and addressed. Out of 14 Member States in which curtailment or a connected issue were identified, only 4 address this issue.

Main barriers across the EU 27 in the operation phase

Identified issue	Possible solutions
Curtailment	Ensure more legal certainty by introducing a general (or basic) legal framework on: - Curtailment procedure - Responsible bodies - Priorities for RES-E technologies - Rights and duties of affected stakeholders - Compensation system

Table 2: Overview on identified grid operation issues and solutions

Main barriers identified in each Member State in the operation phase

Member State	Main barriers to integration in the grid operation phase
Austria	Ineffective purchase obligation System fee for large RES-E plants
Belgium	No proper regulation for congestion management (curtailment) yet, especially on regional level
Bulgaria	TSO does not comply with dispatching priority Curtailment regulation and procedure
Cyprus	New big RES-Plants connected to the grid No regulation for curtailment

	Isolated system
Czech Republic	Planned amendments could abolish the priority for RES and the purchase obligation
Denmark	No barriers detected
Estonia	No barriers detected
Finland	No barriers detected
France	Curtailment regulation and procedure
Germany	Grid curtailment
Great Britain	None for now, possible ones with the increase of RES-E
Greece	RES-Plants are sometimes cut off when new plants are connected to the grid
Hungary	Lack of reserve capacity Instability of priority access due to support scheme revision
Ireland	Challenges to apply the concept of priority dispatching under the Irish circumstances (40% RES-E target)
Italy	Frequency of curtailment in areas with large RES-E potential
Latvia	No barriers detected
Lithuania	No barriers detected
Luxembourg	No barriers detected
Malta	Grid not connected to the EU grid Potential problems when wind farms/large PV projects come online
Netherlands	Mismatch in lead times of newly developed power versus corresponding grid reinforcement/expansion
Poland	Lack of investment security Lack of sufficient grid capacity
Portugal	Strict parameters of frequency and limited availability in the Distribution Network
Romania	None yet, possible with variable RES-E growth
Slovakia	Massive lowering of feed-in tariffs
Slovenia	None, given the low share of variable RES-E
Spain	No significant barriers detected
Sweden	No barriers detected

Table 3: Main barriers identified in each Member State in the grid operation phase

Grid development

As regards the integration of RES-E in the context of grid development, it appears that overall, this is a rather unfavourable environment. The main barriers blocking RES-E integration in this phase are a low consideration for RES-E in national grid development plans, lengthy procedures, the lack of an obligation for the grid operator to reinforce the grid when a newly connected plant requires it and a weak legal position of plant operators to request such reinforcement, complex or inefficient procedures and lack of incentives for the grid operator to reinforce the grid. These situations are mostly evident in areas with low population and high RES-E potential, often at DSO level. Furthermore, current regulatory instruments may only partially cover costs. Unbundling, moreover, appears to have impaired the financial situation of some grid operators, thus giving rise to additional difficulties. Each one of these issues is present in between 7 and 11 Member States. Considering the complementarity of RES-E plants and grids as two parts of a bigger system, it is clear that focus should be given to both of them in parallel. Benefits from this parallel addressing would aid their development and allow mutual benefits.

Also in this case, it appears that the NREAPs of the affected Member States are not aligned with the issues in this study. In only five cases a detected barrier finds a correspondence in the Member State's NREAP.

Main barriers across the EU 27 in the development phase

The following table shows the identified issues and possible measures to address them.

Identified issues	Possible solutions
RES-E not sufficiently considered in grid development	Conclusion of unbundling process;Installation of independent body to support RES-E; Involvement of stakeholders
No obligation to reinforce the grid	Introduction of clear legal obligation in national law
Lack of incentives or regulatory instruments	Introduction of measures to create more comparability and transparency; Introduction of regulatory measures that incentivise efficient investment, e.g.: - Introduction of priority premiums; - Counting of investments in same regulatory period; - Abolishment of minimum levels; - Nation-wide cost allocation system for DSO - Harmonisation of regulatory regimes;

Table 4: Overview on identified grid development issues and solutions

Main barriers identified in each Member State in the development phase

Member State	Main barriers to integration in the grid development phase
Austria	Lack of incentives for Grid Operator NIMBY Long lasting procedures
Belgium	Distribution of costs, especially after the decision of the Constitutional Court in May 2011
Bulgaria	No grid development plan TSO fails to expand transmission grid
Cyprus	None, given the low share of RES-E
Czech Republic	Close linkage between TSO and dominant DSO Lack of incentives for Grid Operator
Denmark	Deadline for obtain permission for grid development not sufficiently specified
Estonia	Lack of incentives for Grid Operator Distribution of costs
Finland	Lack of regulatory instruments Speculative grid applications Lack of resources for regulator
France	No grid development plan Remaining time for grid development Incumbent position of main generator

	Limited power of regulator
Germany	Public opposition Complicated permission procedures Lacking financial incentives
Great Britain	Planning consent Issues connected to the charging regime Backup availability
Greece	Investors excluded from decision making process RES-Producer Rights are not clearly defined
Hungary	Lack of reserve capacity
Ireland	No right of RES producers to demand grid extension, if required for dispatching
Italy	Administrative barriers to grid development
Latvia	Lack of incentives for Grid Operator Distribution of costs Communication between stakeholders
Lithuania	Grid development as a strategic nationwide political issue – RES do not constitute a goal
Luxembourg	Grid development studies are generally not published
Malta	Short-term planning Planning permits and financing
Netherlands	Time required for grid development RES are no specific objective for grid development
Poland	Complicated legislative procedure for the development
Portugal	Small stakeholder participation despite consultations. The RES-E producer bears the costs if an expansion is anticipated.
Romania	Public opposition Lack of funds
Slovakia	Lack of incentives for grid operator Distribution of costs
Slovenia	Planning every 2 years
Spain	Lack of proper incentives for DSOs and RES developers Remuneration of distribution level grid development costs
Sweden	Long lead time for permit/concession for transmission line

Table 5: Main barriers identified in each Member State in the grid development phase

Actions at EU level

Most of the solutions to address the issues identified in the grid connection, grid operation and grid development phases should be taken by Member States. Still, actions at European level seem advisable as they would enhance adaptation at national level. With regard to the following actions we would recommend harmonisation at European level:

- Harmonisation of a Network Code to reduce long lead times and to simplify complex procedures. This action is already in preparation;
- Introduction of obligations for Member States to
    - gather data on RES-E development through a public registry and on RES-E targets,

- develop broad guidelines for the development of the power system in order to better align the pace of grid and RES-E development;

In view of the principle of subsidiarity, harmonisation of national legal frameworks regarding the following items cannot be recommended without further analysis:

- Obligation for Member States to tackle the issue virtual grid saturation;
- Definition of a general legal framework for regulating grid curtailment;
- Introduction of a clear obligation for grid operators to reinforce the grid to accommodate new plants; and
- Introduction of a harmonised regulatory regime on cost bearing and sharing.

As an alternative to harmonising national law, in the above cases, it may be considered to apply "soft actions" such as awareness raising or encouraging Member States to mitigate the identified issues on their own.

Market integration

Market integration

As for market integration, the report does not focus on barriers to integration in the same way as in the network integration part. In the case of market integration, the main challenge is not to overcome existing barriers, but to find the right level of market integration for different RES-E technologies and promote it accordingly. For market integration, there is no obvious blueprint or even legal requirement on an EU level that can be implemented by Member States. Some Member States have a lower degree of market integration than others, yet this does not imply that the RES-E framework is less advanced.

Nevertheless, with an increasing share of RES-E, market integration becomes a more pressing issue. The market integration chapter proposes a differentiated view on market integration that enables a structured analysis of different market integration mechanisms found in the EU-27 country review. It combines the analysis of the flexibility potential of RES-E with a differentiated risk analysis and thus provides the basis for a more differentiated evaluation of the potential to integrate RES-E into markets that moves beyond simply juxtaposing "feed-in with no market integration" on the one hand and "quota with full market integration" on the other hand.

The following issues should be considered when pursuing market integration of RES-E in the EU:

1. This study has argued that the main rationale for integrating RES-E into electricity markets is to exploit their flexibility potential. This requires a clear understanding of the flexibility potential of RES-E in Europe and what this flexibility can contribute to solve the overall system challenges. More work needs to be done in that area.
2. As opposed to network integration, the "the more the better" principle does not apply to market integration.
3. Market integration of RES-E is a matter of both adapting support schemes and setting up adequate markets. RES-E should not be exposed to market risk when markets are not ready yet.

4. At the same time, some of the system challenges that result from RES-E should be tackled by providing adequate markets rather than exposing RES-E to market risks. For example, in order to provide efficient balancing, functioning balancing markets are arguably more important than exposing RES-E to balancing risk.
5. In terms of market design, RES-E integration requires functioning markets in general, as well as more specific mechanisms to deal with the uncertainty of RES-E, namely intraday markets and short gate closure times. The review of the EU-27 shows that Member States generally move into the direction of providing more flexible short-term markets. However, there are still large differences in the EU-27 in that respect. There is scope for further promoting this process at the EU level.
6. Beyond market design features that are already being implemented, like for example intraday markets, more work needs to be done on how market design can be refined further to make the system as flexible as possible.
7. In terms of support scheme design, the EU-27 review has shown that there is a broad range of different regimes in place that combine various support scheme elements in different ways to exploit RES-E flexibility. There is a broad number of parameters that is critical for fine-tuning these market integration mechanisms.
8. For evaluating these different schemes, it was proposed to differentiate between price, volume and balancing risk. RES-E generators should only be exposed to market risk they can manage and where they can provide flexibility to the system. Especially in the case of fluctuating RES-E market integration has to be in line with the variability and uncertainty of their generation profile.
9. The review has shown some examples where feed-in schemes have been adapted to introduce an element of price risk.
10. There are also a number of different examples in the EU-27 where RES-E generators are provided with an incentive for forecasting and balancing, without being exposed to the full market balancing risk.

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Introduction: the integration of renewable energy sources in Europe

Transition of electricity system and its challenges for national regulation

Integration of RES-E in the European grid has become an increasingly relevant issue in recent years, mostly due to the rapid pace of change that the energy sector has been showing. Despite national peculiarities, in fact, all European Member States were affected by two fundamental developments, i.e. the liberalisation of the markets and the growth of new RES-E technologies. As a result of liberalisation and unbundling in recent years, the electricity system has been becoming less concentrated and centralised. Large and centralised conventional power plants have been complemented and partly replaced by small, decentralised and less programmable RES-E sources. In addition, more and different market players are involved in electricity generation, transmission, distribution and network planning and development. Many of them are private actors that follow their own agenda and often have contradicting interests. As a result, the group of decision makers and stakeholders involved in generation and distribution of electricity is today becoming more heterogeneous.

This development is leading to new challenges. First, there is a technical aspect. Generation, transmission and distribution of electricity are today more independently organised. The new system setting, with relatively lower interaction between grid and generation planning, is more challenging for the network in terms of swiftly reacting to changes of generation capacities. Thus, its adaptation to the new system may lag behind. Second, there is a communicative aspect. The increase of market actors with contradicting interests creates a need for additional communication. Such communication, however, is further complicated when stakeholders do not want to cooperate because of contradicting interests or, at least in some countries, because of lack of trust. Third, there is an economic aspect. The growing number of private actors requires transparent market conditions that allow for long-term planning. Otherwise, investments both in infrastructure and RES-E systems are at risk.

Because of this situation, blockages to the integration of RES-E appeared in different areas, in some cases the same patterns have appeared in different countries and in some others they were strongly linked to national factors. Considering the expected growth of RES-E in the next decade, accelerating the rate of adaptation of the grid, of the overall system and of the involved actors to RES-E generation is becoming a crucial matter for Europe. In this context, it is the main task and challenge for national regulation to adapt the legal framework that allows for the integration of RES-E into the national grids and markets.

The need for grid and market adaptation

The adaptation of the grid should be considered differently in the transmission and in the distribution grid. Particularly on the transmission level, the main challenge is to ensure timely infrastructure development to connect new generation centres like large on-shore and off-shore wind resources, and, more in the long term, possible large solar thermal power generation capacities in Southern Europe and other Mediterranean regions. On the distribution level, infrastructure development includes both conventional grid upgrades as well as the development of intelligent networks as part of smart grid concepts. The transmission grid, in particular, would require substantial modifications to integrate a higher RES-E generation share. Grid capacity, smart grid concepts and level of interconnection should be taken as main points of concern when discussing measures to allow the grid to support the high intermittence level of the connected RES-E plants, while still guaranteeing a safe operation of the grid and compliance with the grid security standards (e.g. N-1) even in times of full load. If the modification of the electricity system does not take these points into account, overall costs may become much higher than the benefits expected from increasing penetration of RES in the electricity supply, resulting in a severe barrier to the development of RES-E plants.

Especially with regard to the connection of RES-E plants to the grid, which forms the first and currently most relevant step for the integration of RES-E, it has turned out that many problems currently exist at distribution grid level. With this in mind, it should be pointed out that the discussion on integration of RES-E (e.g. control of DSO, grid planning, harmonisation of technical regulations) is far less developed when it comes to the development of the distribution grid. Most of the ongoing studies that examine perspectives and barriers for the integration of RES-E into the grid deal exclusively with the transmission level. This imbalance is quite easy to understand. From a European perspective, the cooperation between TSO may appear more important. Moreover, it is certainly easier to communicate to about 35 TSOs rather than to talk to more than 2300 national DSOs that provide no visible contact person at European level. Still, for the sake of an improved cooperation regarding RES-E, national DSO should play a more prominent role. On the one hand, they should be more involved and monitored. On the other, they should be more supported and their needs should be taken more into account.

As opposed to network integration, which is a fundamental prerequisite for RES-E deployment and, therefore, has been addressed by the EU and its Member States for a while, market integration of RES-E has recently re-emerged as an issue, also in the context of the move towards the internal market. This is largely due to the growing share of RES-E that increasingly affects the electricity market. The specific requirements to enable market integration are still under discussion and are less legally formalised than the grid integration requirements. Efforts by the Member States to promote market integration are therefore generally less advanced than measures to ensure grid integration, and typically depend more on the share of RES-E in the respective market.

In summary, four reasons can be outlined for the need to support the integration of electricity from renewable sources (RES-E) into the electricity grid and the electricity market:

1. The need to promote a simultaneous development of grid systems and electricity markets in order to support the ambitious EU and national RES-E policy goals;
2. The need to allow grid access to renewable sources as a fundamental prerequisite for RES-E development, as well as the need to intervene in different areas to allow this increased amount of RES-E generation to operate securely on the grid;
3. The need to adapt the grid to the raising share of RES-E through infrastructure development and through reforms of regulatory frameworks;

4. The need to make RES-E more respondent to market developments. With an increasing share of renewables, renewable energy plants can no longer be operated in isolation from the electricity market, but the potential to operate these plants in accordance with market requirements needs to be exploited, yet without undermining the support schemes in place. Of course, this is a quite delicate topic, which is undergoing intense debates. The other side of the medal would be to adapt the markets' structure to allow more RES-E participation, a solution that may be favoured by RES-E producers and associations. An optimal solution has not yet been defined.

EU and national law – levers for achievement of RES-E integration

The integration of RES-E was taken into account as soon as the regulation of the promotion of RES-E started at EU level. Already 10 years ago, Directive 2001/77/EC[2] required the publication of costs of technical adaptations "*which are necessary in order to integrate new producers feeding electricity produced from renewable energy sources*". For this reason, it is fair to say that Directive 2001/77/EC laid "*down the framework for the integration into the grid of electricity from renewable energy sources*". This assessment stems from Directive 2009/28/EC[3], the successor of Directive 2001/77/EC. Directive 2009/28/EC also recognised the key role of RES-E integration in a broader scale by stating that "*there is a need to support the integration of energy from renewable sources into the transmission and distribution grid and the use of energy storage systems for integrated intermittent production of energy from renewable sources*"[4].

In this regard, Article 16 of Directive 2009/28/EC regulates, among others,

1. the framework for the development of transmission and distribution grid infrastructure;
2. the transmission and distribution of RES-E as well as the access of RES-E into the grid;
3. the connection of RES-E installations;
4. the bearing and sharing of costs related to technical adaptation.

The 3rd Legislative Package for the Internal Market in Electricity further emphasized the importance of grid infrastructure, calling for coordinated operation and development of national transmission networks and for harmonised European regulatory frameworks[5]. Through Regulation (EC) 714/2009[6], the 3rd package further called for the creation of the European Network of Transmission System Operators for Electricity (ENTSO-E) and for the adoption of a non-binding Community-wide Ten-Year Network Development Plan (TYNDP) with the objective to ensure greater transparency regarding the entire electricity transmission network in the Community and to support the decision making process at regional and European level.

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[2] Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market, Article 7.

[3] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC Text with EEA relevance, henceforth "the Directive".

[4] Directive 2009/28/EC preamble (n.57).

[5] Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC Text with EEA relevance

[6] Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003 (Text with EEA relevance)

Most of these objectives had to be first transposed at Member State level. The main task and challenge for national regulation is therefore to adapt the legal framework that allows for the integration of RES-E into the national grids and markets. Directive 2009/28/EC, however, also recognised that there is "*a significant variation between Member States in the degree of integration actually achieved*"[7]. Therefore, this report aims at assessing the variation of the degree of implementation between different Member States; two years after the Directive came into force, as well as to provide an indication of the main barriers that hinder RES-E integration. One of the key results of this study is that in many cases, the national legal framework has not been sufficiently adapted to comprehend the changes that took place during the transition of the national electricity systems.

[7] Directive 2009/28/EC preamble (n.64).

Structure of this report

This report is organised into six main chapters, besides foreword, introduction and annexes.

The first three chapters deal with the assessment of problems to RES-E integration in the phases of Grid Connection, Grid Operation and Grid Development. At the beginning of each one of these chapters, an overview of the main findings is presented. In this overview, an assessment of the conditions offered in the different countries for RES-E integration is given and the main issues that hamper integration in each phase are outlined. Subsequently, the main issues to integration in each phase are described and, where possible, reasons for these issues are also given. Possible solutions are suggested at the end of each issue description. Lastly, a table outlining whether the NREAPs of the affected Member States addresses the different barriers is provided.

The fourth chapter deals with Market integration. First, the main characteristics of RES-E technologies are recalled as an important factor that determines their ability to react to market signals. Second, a differentiated view on market integration is proposed. Third, based on these arguments, an overview of different market integration mechanisms in the EU-27 is presented, showing a broad range of approaches to deal with price, volume and balancing risk.

The fifth chapter draws from the results outlined in the preceding chapters and in the national reports. In this chapter, recommendations at EU level are provided for the areas of Grid Connection, Grid Operation, Grid Development and Market Integration.

In the sixth chapter, the main barriers identified at national level together with a brief overview of each Member State are reported.

The Annexes are structured as follows:

- Annex I (p. 171) describes the methodology of the project;
- Annex II (p. 177) provides the list of contacted stakeholders;
- Annex III (p. 189) contains a list of all harmonised barriers. These are all the barriers reported in the different countries in the grid connection, grid operation and grid development phase;
- Annex IV (p. 199) includes the templates that were used in the research phase of the project.

Assessment of integration of electricity from renewable energy sources into the grid

In the following we compare and evaluate the results of the research conducted at national level regarding the integration of RES-E into the grid. The assessment is structured along the three main issues relevant for the integration, i.e. the connection of the RES-E plant to the grid, the operation of the connected RES-E plant and the development of the grid.

Grid Connection

Connection to the grid is the first step to integrate renewables, being the first phase in which RES-E producers, grid operators and other stakeholders come in contact. Therefore, this phase is also the one in which the first obstacles towards integration of RES-E may appear. For the purpose of this chapter, it is assumed that grid connection of RES producers to the grid is always a positive value: the more, the better. Of course, this simple approach does not imply an economic judgement, which pertains to the market and the support schemes, discussed in a chapter below; nor does it include considerations about dispatching, grid stability, and grid development, which are also discussed in the following chapters.

Provisions relevant for grid connection can be found in Article 16(3)-(6) of the Directive. Based on these provisions, the following areas were identified as possible sources of barriers:

- Grid connection procedure;
- Obligations, legal responsibilities and addressees;
- Enforcement of legal rights of the RES producer;
- Costs of grid connection.

Further details on the specific analysed points are provided in the research template in Annex I on page 171.

Overview on national ratings and main issues

According to the results of the study, grid connection is the phase posing the strongest barriers to RES-E integration as depicted in the map below.

This map aims at providing an overview of the EU 27. Though it is based on the results of the research at national level, it is a great simplification of such results and it should be taken as such. The evaluations reported in the map only relate to the RES-E context (mainly to variable sources such as wind & PV), furthermore, no differentiation is provided in terms of grid levels or RES-E systems. The authors of this study concede that the evaluation is partially based on subjective assessments either by other stakeholders or by the authors themselves. This challenge has been addressed by resting the evaluation on a broad variety of different opinions, by taking more objective elements into account, such as the compliance with the requirements of the NREAP template, and by conducting a total of three consultation rounds.

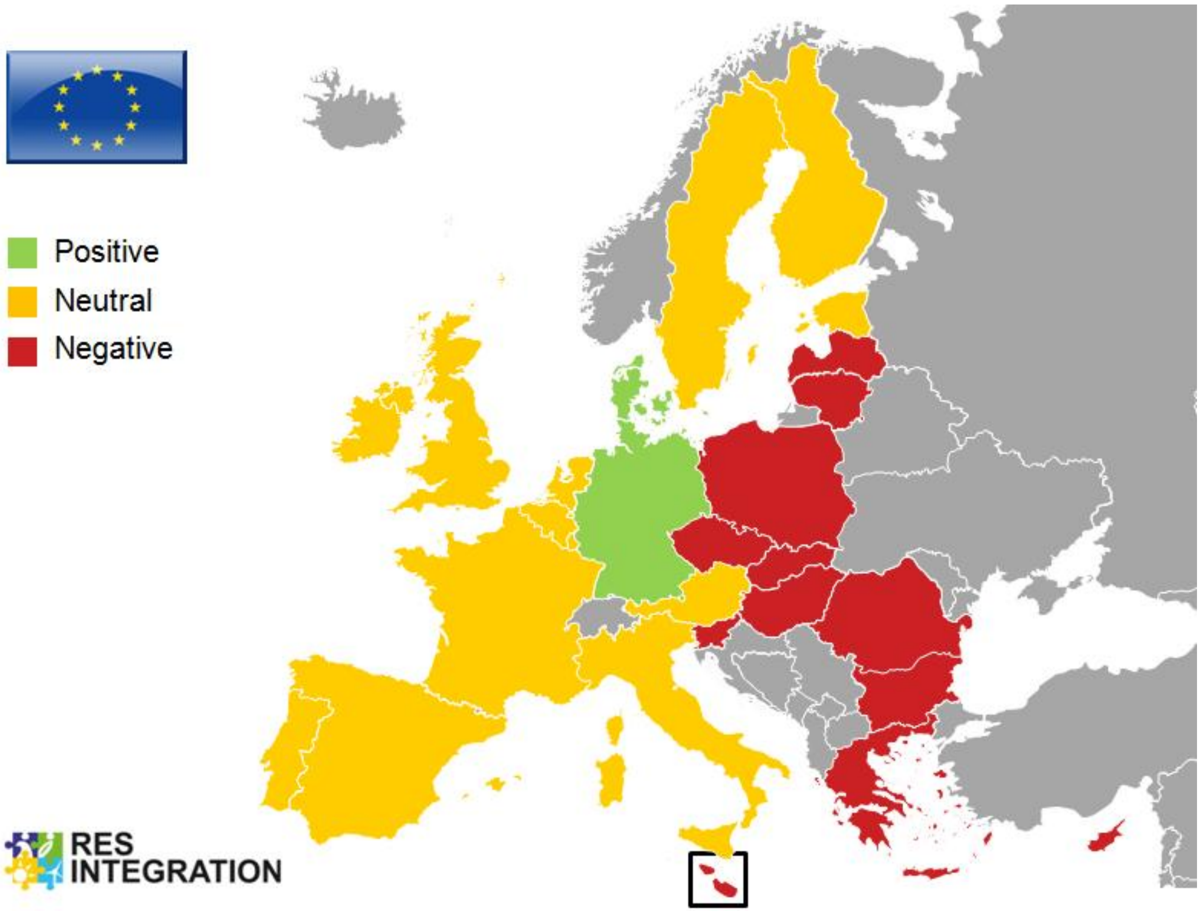


Figure 1: Assessment of connection process in European Member States[8]. Source: RES Integration Project

Given that most of the Member States offer negative conditions for connection, it is not very surprising that most of the issues that were identified in our research relate to the grid connection phase. Three reasons stand behind this predominance:

1. Connection to the grid is the first stage that stakeholders encounter for RES-E integration; it is thus the most "tangible" stage and the one to which stakeholders mostly relate, in all countries. It can therefore be expected that more information would be available in this regard.
2. The existence of barriers to RES-E integration in the operation and in the development phase implies that a certain amount of RES-E is already connected to the grid, i.e. RES-E are already playing a role, albeit small, in the country's electricity system. This, however, may not always be the case. In particular, barriers to grid connection can be quite strong in some countries and can put strong blocks to RES-E integration. In such cases, operation of RES-E on the grid and development of the grid according to RES-E may be matters that are not yet being discussed.
3. The amount of money that needs to be spent in the connection phase either by plant operators or grid operators is quite high and may lead to conflicts between these parties.

[8] Though the maps shows the Republic of Ireland and the United Kingdom, such assessments are referred to Ireland (all island) and Great Britain, i.e. Northern Ireland is given an assessment together with the Republic of Ireland in the context of the SEM market. For further details, please refer to the foreword on page 3.

The following paragraphs present the main issues for RES-E integration in the connection phase. Based on the number of countries in which issues for Grid Connection have been detected, a ranking has been produced and the top 8 issues have been selected as the most relevant in Europe: the top two issues are in fact present in 17 countries in the EU 27, while the bottom one of the 8 is present in 8 countries. All Member States have at least one of these issues. The following table provides an overview of these barriers and of the countries where they occur. Afterwards, these top eight barriers are being discussed in greater detail.

Issues related to Grid Connection	Member States where this issue is present
Long lead times / delays	BG, CY, DE, EE, ES, GB, GR, HU, IE, IT, LV, PL, PT, RO, SE, SI
Lack of grid capacity / different pace of grid and RES-E development	BE, BG, DE, EE, ES, FI, FR, GB, GR, HU, IE, IT, LT, MT, NL, PL, RO
Complex or inefficient procedures	CY, ES, GB, GR, HU, IT, LT, LV, NL, PT
Weak position of plant operator to demand grid reinforcement	AT, BE, BG, CZ, DE, EE, GR, HU, PL, RO
Virtual saturation	BG, CZ, EE, FI, HU, IT, LV, RO, SK
Non-shallow costs	AT, EE, ES, FR, GB, LT, LU, LV, SI
Lack of communication / conflicts between stakeholders	AT, DE, EE, ES, FI, HU, LV, RO
Speculation	BG, CZ, EE, HU, IT, LV, RO, SK

Table 6: Overview on grid connection issues in European Member States

The perspective considered in the above table is mainly the European one, meaning that the listed barriers are mostly relevant at EU level, simply because common to a significant number of Member States. Such issues may not automatically be also the most pressing ones in the single Member States. The table below provides a short listing of the main barriers identified in the EU 27. For further details on them, reference should be made to the chapter dedicated to these issues (p. 97), to Annex III (p. 189) and to the national reports.

It should also be considered that the assessments provided in Figure 1 do not directly relate to the number of barriers identified in one Member State, but to their severity, as described in the national reports. The table below provides an indication of the most important barriers at national level.

Member State	Main barriers to integration in the grid connection phase
Austria	Distribution of costs Information policy regarding costs
Belgium	Missing obligation to connect RES-E installations, except in the framework of the “Inform & Fit” procedure.

	Connection can be denied due to insufficient capacities, no obligation to immediately reinforce grid to allow for connection
Bulgaria	TSO does not connect new RES plants Capacity limits for RES Advance payments
Cyprus	Bureaucracy, Lengthy Grid Connection Procedure
Czech Republic	Connection moratorium Supposed lack of grid capacity Speculation Envisaged advance payments
Denmark	No barriers detected
Estonia	Lack of sufficient grid capacity Speculation Testing for wind farms
Finland	Lack of grid capacity Distribution of costs Speculative grid applications
France	Costs of grid connection
Germany	Communication between stakeholders Lack of transparency Definition of technical and legal requirements
Great Britain	Planning consent Issues linked to the offshore transmission tender process Issues linked to the charging regime
Greece	Inefficient administrative procedures Insufficient special planning
Hungary	Status of the grid Capacity saturation and speculation Unstable policies for wind power
Ireland	Potential delays for grid connection due to the group processing approach Potentially higher shallow costs than in other Member States
Italy	Administrative barriers Overload of connection requests Virtual saturation
Latvia	Lack of sufficient grid capacity Speculation
Lithuania	Complicated connection procedure Legislation not clear High costs
Luxembourg	Definition of connection costs
Malta	Inefficient administrative procedures Insufficient special planning Competing public interest
Netherlands	Lack of sufficient grid capacity
Poland	Lack of sufficient grid capacity Complicated and not-transparent grid connection process Unclear regulations concerning the distribution of costs
Portugal	Complicated and slow licensing procedure related to the Environmental Impact Assessment

Romania	Virtual saturation Access to credit Information management
Slovakia	Delays during the connection process Speculation
Slovenia	Administrative procedures Long lead times Enforcement of RES-E producers' rights
Spain	Delays introduced by administrative procedures Heterogeneity of DSO technical requirements
Sweden	Cost bearing and sharing

Table 7: Main barriers identified in each Member State in the grid connection phase

Long lead times / inefficient procedures

Mechanism of issue

This category groups all aspects connected to the time the plant operator needs to wait before connection to the grid and feeding of electricity in the grid are allowed. Long lead times are mostly connected to procedural aspects. Specifically this may take the form of excessive times being given to deal with applications, systematic delays of the responsible administrations to provide an answer, long times taken to carry out an Environmental Impact Assessment (EIA), an erroneous or unbalanced allocation of deadlines in the legal framework. Usually, causes for this issue are complex or inefficient procedures, inappropriate allocation of deadlines, virtual saturation and unclear or non-homogeneous procedures, meaning that the procedure is not well defined or that it varies across grid operators. RES-E producers and grid operators are the two stakeholder categories mostly touched by this issue in the connection and in the development phase.

It should be pointed out how these issues are not only relevant in the connection phase but also in the development phase as there is a clear complementarity between grid connection and grid development. This emerged through the stakeholder consultations and can be observed also upon considering the nature of the issues. Ultimately, the points outlined in the above paragraph impact on the construction of new infrastructure or the reinforcement of existing one. Clearly, these issues could apply both to the construction of a connecting line for a new plant or the necessary reinforcements to accommodate a new plant (thus grid connection), or to the development of new infrastructure in a longer term perspective (this grid development).

Outcomes of long lead times include firstly a lack of security for RES-E as regards the timing of their investment in a new plant, and subsequently in the investment's payoff. Furthermore, if delays are common, it can be expected that access to credit may be limited or banks may impose stronger boundaries to investors that request loans. Thus, in general, this issue acts as a deterrent for investors in RES-E. For the grid operator, instead, this takes the form of an actual issue to the development. Plans for grid development may in fact be in place and may be well geared to the needs of the electricity system in the medium term. However, in case too much time is needed for implementing each aspect of the plan and in case delays play a strong role, the conditions and the needs for grid development might change and the plans would not include new problems that have arisen in the meantime.

Presence and severity in different countries

Long lead times and delays have been reported in 16 countries in the connection phase and in 9 countries in the development phase. 5 Member States show the presence of this issue both as regards grid connection and grid development.

Grid phase	Member States
Connection	BG, CY, DE, EE, ES, GB, GR, HU, IE, IT, LV, PL, PT, RO, SE, SI
Development	AT, CZ, DE, EE, ES, FI, FR, IT, SE
Connection and development	DE, EE, ES, IT, SE

Table 8: Presence of the issue "Long lead times / delays" in the EU 27 by grid phase

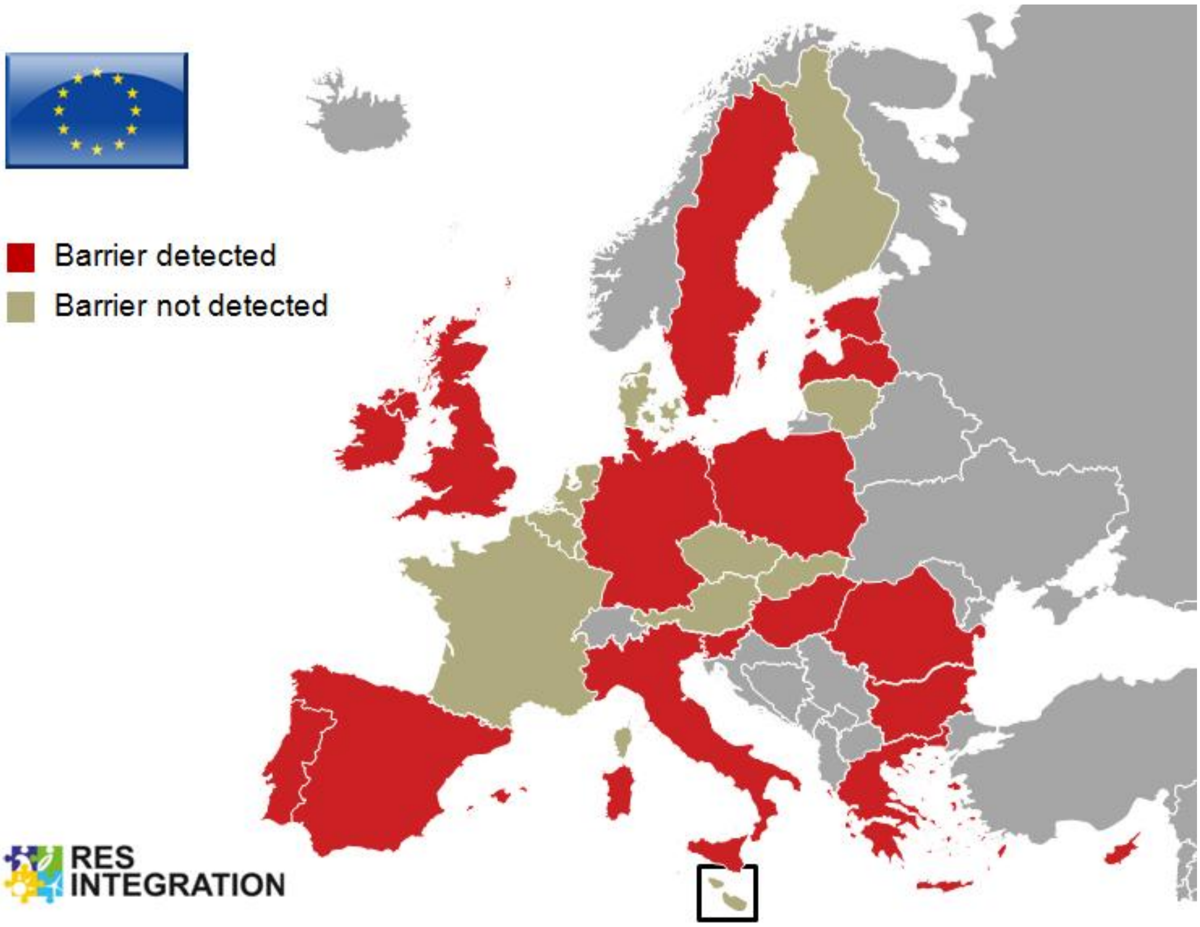


Figure 2: Geographic presence of the issue "Long lead times / delays" in the connection phase. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in

connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

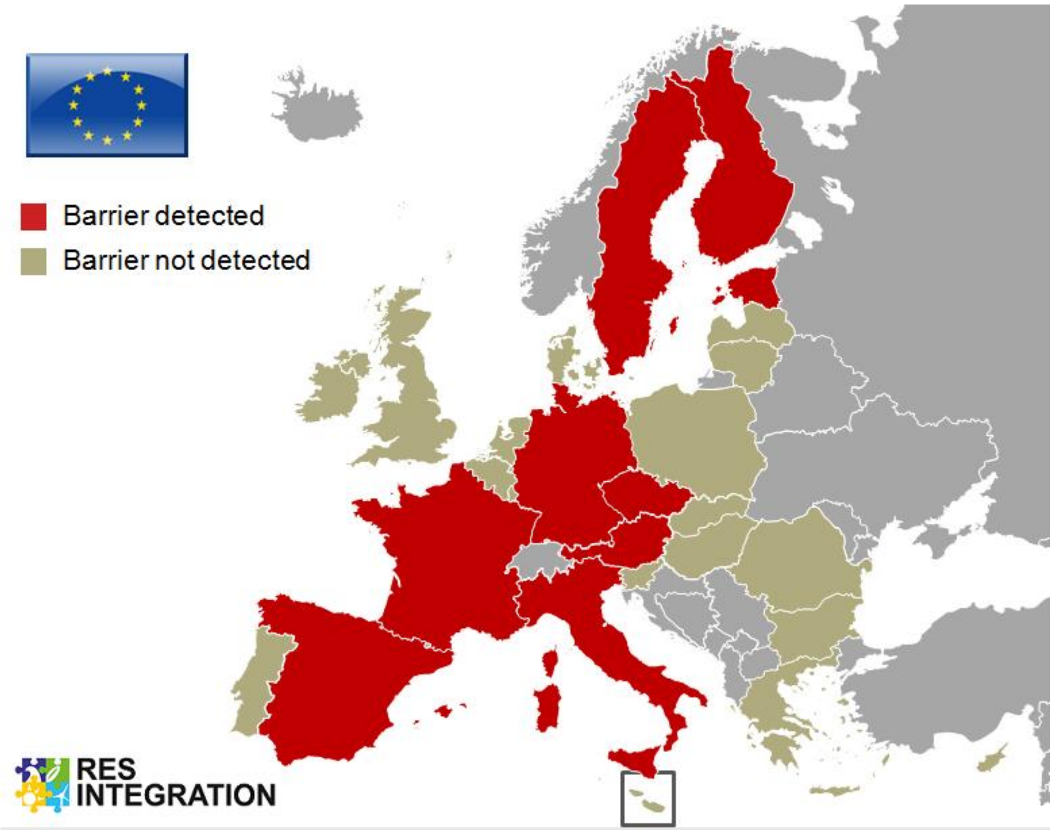


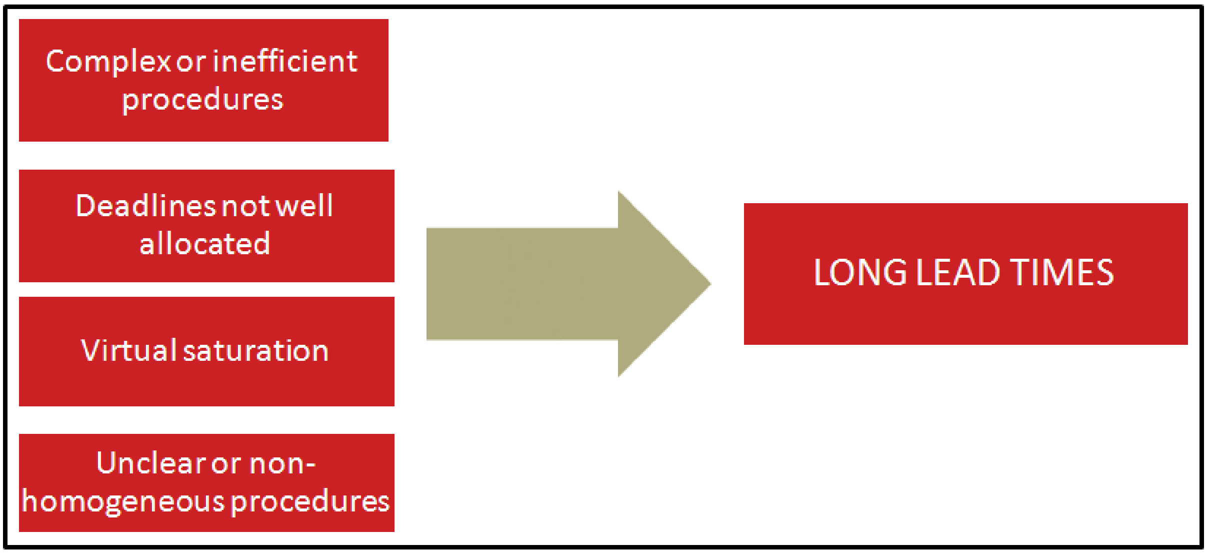
Figure 3: Geographic presence of the issue "Long lead times / delays" in the development phase. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

Causes and interconnection to other issues

In both the connection and the development phase, long lead times have been reported as being directly caused by complex or inefficient procedures, meaning any burden caused in the connection process itself such as a large number of responsible administrations to contact, presence of several steps in the procedure in comparison to other countries or internal bureaucratic issues leading to time loss. In the connection phase, however, some stakeholders also indicated that the actual deadlines stated in the national regulation are unrealistic in comparison to the amount of time that the process would actually require, for example in case an EIA is required.

Further causes that contribute to long lead times and delays have shown to be virtual saturation and the presence of unclear or non-homogenous procedures for grid connection. The former is described in detail on page 37. As regards the latter, a distinction should be made between unclear/non-homogenous procedures and complex procedures, as previously described. The issue of complex procedures, in fact, relates exclusively to processes that could be improved, whereas the issue of unclear/non-homogeneous procedures relates to situations in which the actual process is not defined (totally or in part) or in case the process differ from grid operator to grid operator, which is clearly a worse situation for a RES-E producer. It should be also underlined that both issues – complex procedures and unclear procedures – may co-exist in the same Member State, such as in the case of Hungary.

These aspects are summarised in the scheme below.



Graph 1: Main reasons in the EU 27 for the issue "Long lead times / delays". Source: RES Integration Project

Possible solutions, based on evidence in EU Member States

Clearly, solutions to this issue are very much tied to the national environment. Procedures for grid connection and their management are ultimately a national matter, thus the solution would largely depend on what factors make the connection procedure complex or inefficient.

In some cases, the barrier could be mitigated by a thorough analysis of existing processes in order to identify and improve existing inefficiencies. Another solution would be to introduce legally defined deadlines until when the grid connection process is ready. However, experiences from other Member States have shown that this solution should be treated with great caution. Quite often, deadlines are too long, not legally binding or cannot be enforced because of loopholes such as useless actions that extend the deadlines. For this reason, it would be wise to also add qualitative criteria, for instance that the installation shall be connected to the grid "without delay" or "promptly". Such a feature has been recently introduced in the German system.

Moreover, the government (of the Member States where this issue was identified) should carefully scrutinise the existing administrative procedures in order to identify measures for improvements. Solutions that might be taken into account are the reduction of load for public administration by outsourcing particular tasks to private experts and the simplification of permission procedures through harmonisation of processes. Another solution would be the introduction of the so called one-stop-shopping, thus assigning one central agency the task of coordinating the authorisation procedures, thereby providing assistance to the applicants. This idea has been proposed already by previous studies and policy papers. However, the importance of this indicator as such should not be overstated. In some countries, the permitting procedures can be very lean even though several administrations must be involved. On the other hand, in other countries a single authorisation procedure exists in theory; however, de facto, the central agency must obtain authorisations from up to 50 (!) administrative bodies, thereby foiling the original plan (AEON 2010). In fact, it seems more important that the number of authorities involved is limited to a reasonable amount and that all authorities are responsive, no matter whether they are addressed by a public agency or by a private person.

A recent study by the consulting company Roland Berger also addressed this problem and provided a series of recommendations to be enacted both on national and on European level. The study starts from recognising the frequency in delays in projects given priority status under the Trans-European Energy Networks (TEN-E) guidelines. Results presented in the study further indicate strong opposition to projects from stakeholders and complex national permitting procedures as the main reasons for such delays (Roland Berger 2011 a).

Whereas our research also indicated complex national procedures as a cause for long lead times / delays, stakeholder opposition has not been signalled by interviewed stakeholders as an equally relevant issue. It is beyond the scope of this report to carry out a full comparison between the results and recommendations provided in the present report and in the Roland Berger study. The results of both are here reported in parallel to provide the reader with a more comprehensive perspective on the matter. For further details, referral is done to the final report of the Roland Berger study, available on the website of the European Commission.

The Roland Berger report indicates that there is room for improvement in terms of permitting procedures in five areas:

1. Improve Transparency and Manageability
2. Empower Authorities
3. Optimise Permitting Procedures
4. Improve Project Developers' Planning and Involvement in Permitting Procedures
5. Improve Communication and Mitigate Public Opposition

For each one of the above areas, a number of measures at national and European level have been provided.

In the opinion of the authors, the measures provided by Roland Berger in their study may well respond to the current EU needs for improvement. Priority, in our opinion, should be given to interventions in Area 3 – "Optimise Permitting Procedures" – and subsequently in Area 4 – "Improve Project Developers' Planning and Involvement in Permitting Procedures". The Roland Berger study provides recommendations for both areas; most of them are provided for the national level. We agree with this perspective, given that procedure and stakeholder engagement are ultimately a national matter and should therefore be dealt within the national borders. As regards the measures proposed, though we agree with them in general terms, we find that their application could not be a standard one for all affected Member States. Each Member State has unique characteristics, and whereas a solution might very well work in one country, it may not work in another one.

Finally, we do not see the benefits of applying Measure 14 proposed by the Roland Berger study, which calls for limiting legal recourse to a single level of jurisdiction. As already pointed out in the Non-Cost Barriers Study, such procedure would embody the risk that the expansion of RES in general could lose its reputation. Moreover, protest groups may find other means to express their hostility towards infrastructure activities (demonstration, sit-ins, etc.), which can also reduce perspectives and legal securities of the infrastructure development (AEON 2010). The Roland Berger report indicates that "*as the decision taken by the single level of jurisdiction is final, the responsible court should be as high as possible*". If implemented, in our opinion, this may have the risk of occupying higher court levels with such proceedings whereas proceedings of higher importance and of different kind may not find sufficient capacity in court. This would impact even more countries where the lengthiness of legal proceedings is also indicated as a barrier: in case there were only a single level of jurisdiction for permitting-related procedures, and that would be a higher court level, there could be a risk of overload in that court level. This would further expand the time needed for a proceeding and have a negative impact on process that would have a higher importance in relative terms.

Lack of grid capacity / different pace of grid and RES-E development

Mechanism of issue

This issue refers to the impossibility to connect to the grid because the grid infrastructure is insufficient to allow connection of new plants. Quite often, this is not a permanent but a temporal problem. In these cases, the growth rate of RES-E is higher than the grid infrastructure rate of development or reinforcement. As a consequence, deployment and integration of RES-E is slowed down.

Presence and severity in different countries

This issue is spread over the majority of the EU Member States. It has been reported in Belgium, Bulgaria, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Ireland, Italy, Lithuania, Malta, the Netherlands, Poland, Romania and Spain. Thus, the issue is equally common among both new and old Member States. In two-thirds of the countries where this issue has been reported, the overall situation for grid connection was ranked as being negative and stakeholders described it as a serious problem that is causing also other barriers. Thus, lacking grid capacity has to be considered as a serious barrier.

The map below provides a graphical overview of the Member States in which this issue has been detected.

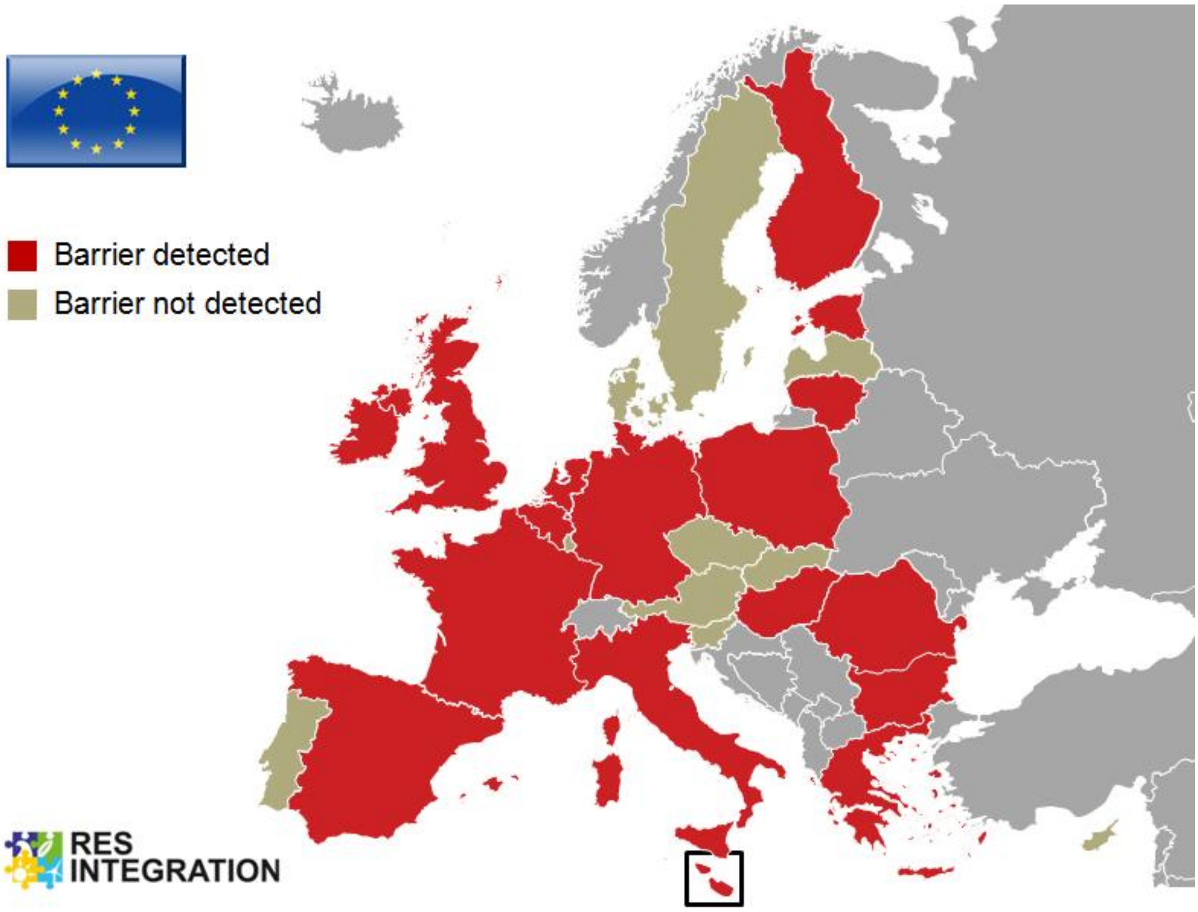
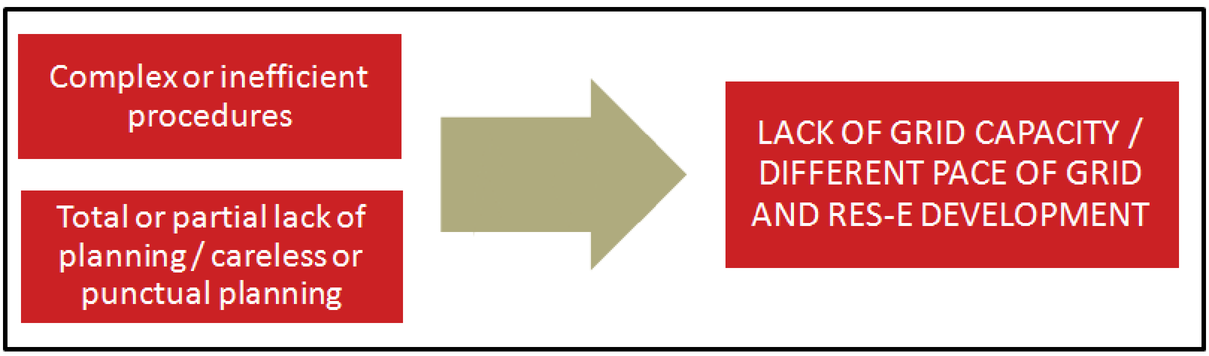


Figure 4: Geographic presence of the issue "Lack of grid capacity / different pace of grid and RES-E development" in the EU 27. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

Causes and interconnection to other issues

The main causes for both permanent and temporal lack of grid capacities are complex or inefficient procedures. Moreover, insufficient planning is another factor when the development of the grid cannot keep pace with RES-E development. An insufficient adjustment of the grid planning process to the growth of RES-E is also a strong indicator that the legal framework has not been sufficiently adapted to the transition of the energy system.

These aspects are summarised in the scheme below.



Graph 2: Main reasons in the EU 27 for the issue "Lack of grid capacity / different pace of grid and RES-E development". Source: RES Integration Project

Possible solutions, based on evidence in EU Member States

Clearly, direct action on the causes of this issue, such as the ones outlined here, would give a contribution to overcoming this barrier. The different pace of grid and RES-E development could be best mitigated by coordinating these processes in a better way. The current approach of coordinating these processes is the development of the TYNDP[9] by ENTSO-E. The initiative has the potential to substantially decrease the effect of lack of planning in the above mentioned issue and should be therefore thoroughly considered and supported at national level.

Moreover, for such coordination it seems inevitable to have a proper set of data that allows for comprehension and anticipation of RES-E development. The current process of data gathering is today already to a substantial extent carried out through the Statistical Database of ENTSO-E and the NREAPs containing the target definition of Member States for RES-E development. Still, an improvement on the procedure of data collection and exchange of information, especially as regards expected deployment of installations might help to further mitigate the discussed issues. It might be considered to implement such databases or to increase the links between existing ones that already provide such information. Member States should create publically accessible registries of RES-E plants, their capacities and the amount of electricity generated. This data is today already recorded for calculating the remuneration of Feed-in Tariffs, Premium systems or evaluating the amount of green certificate in a quota system. It is only necessary to centrally gather and compile it.

To reduce uncertainties on long term development of the power system and thus enable grid planning, Member States should further set of ambitious long term (2030-2050) RES-E targets at European and national level including, if appropriate, broad guidelines for the general planning of the power system, e.g. about the localisation and identification of different types of generation and storage sources at regional level. For that, Member States should initiate processes to define RES-E targets that at least meet long-term deployment EU targets (2030-2050). Moreover, they should develop broad guidelines for the development of the power system in view of accommodating increasing shares of RES-E. These guidelines could include minimal levels of planned capacities of different RES-E sources in specific regions, as a mean of reducing uncertainties in grid planning.

Installed capacity data, production data, and long-term targets can be used for planning of transmission (national and European) and distribution grids as it is happening today already to a great extent. Grid planning should be committing and credible enough to facilitate investments on generation and storage facilities relying on grid expansion, but also flexible enough to keep the risk of stranded grid investments at a minimum.

As regards complex or inefficient procedures, possibilities of intervention are outlined from page 29 onwards. With respect to partial or total lack of planning, interventions first and foremost in terms of increased communication and sharing of information among stakeholders may contribute to improve this situation.

[9] The ten-year network development plan is a Community-wide non-binding plan developed by ENTSO-E with the objective to ensure greater transparency regarding the entire electricity transmission network in the Community and to support the decision making process at regional and European level (ENTSO-E 2010).

Lack of communication, conflicts and weak position of plant operator

Mechanism of issue

The research at national level has shown that communication problems and conflicts between grid operators and plant operators aggravated the grid connection process. Such conflicts had a negative impact on the connection process of the RES-E plant because they reduced flow of information and delayed the overall process. In this context, it also turned out that legal regulation helped only to some extent. RES-E developers hesitated to rely on judicial means and rarely went to court in case of conflicts with grid operators. The lack of trust in judicial procedures becomes apparent in the case of the obligation of the grid operator to reinforce the grid. In several countries, the grid operator is obliged by law to reinforce the network infrastructure if this is necessary to connect a plant that is requesting access to the infrastructure. If this obligation is in place and the grid operator does not comply, usually the plant operator is entitled to legally enforce its right to connection by going to court. In practice however, plant RES-E developers abstain from this option because of possible negative consequences. In conclusion, it appears that in quite a few Member States the communication between plant operators and grid operators is not very good and the obvious mean to resolve disputes – judicial procedures – are not very useful. It should be considered, in this context, that this is perhaps even more an issue for DSOs than TSOs since TSOs may be more impartial after the unbundling process has taken place.

Presence and severity in different countries

The weak position of plant operators has been described as an issue in ten Member States (Austria, Belgium, Bulgaria, Czech Republic, Estonia, Germany, Greece, Hungary, Poland, Romania) making it one of the top four issues. Communication problems were reported in eight Member States (Austria, Estonia, Finland, Germany, Hungary, Latvia, Romania and Spain). Both issues occur in nascent and mature markets.

The map below provides a graphical overview of the Member States in which this issue has been detected.

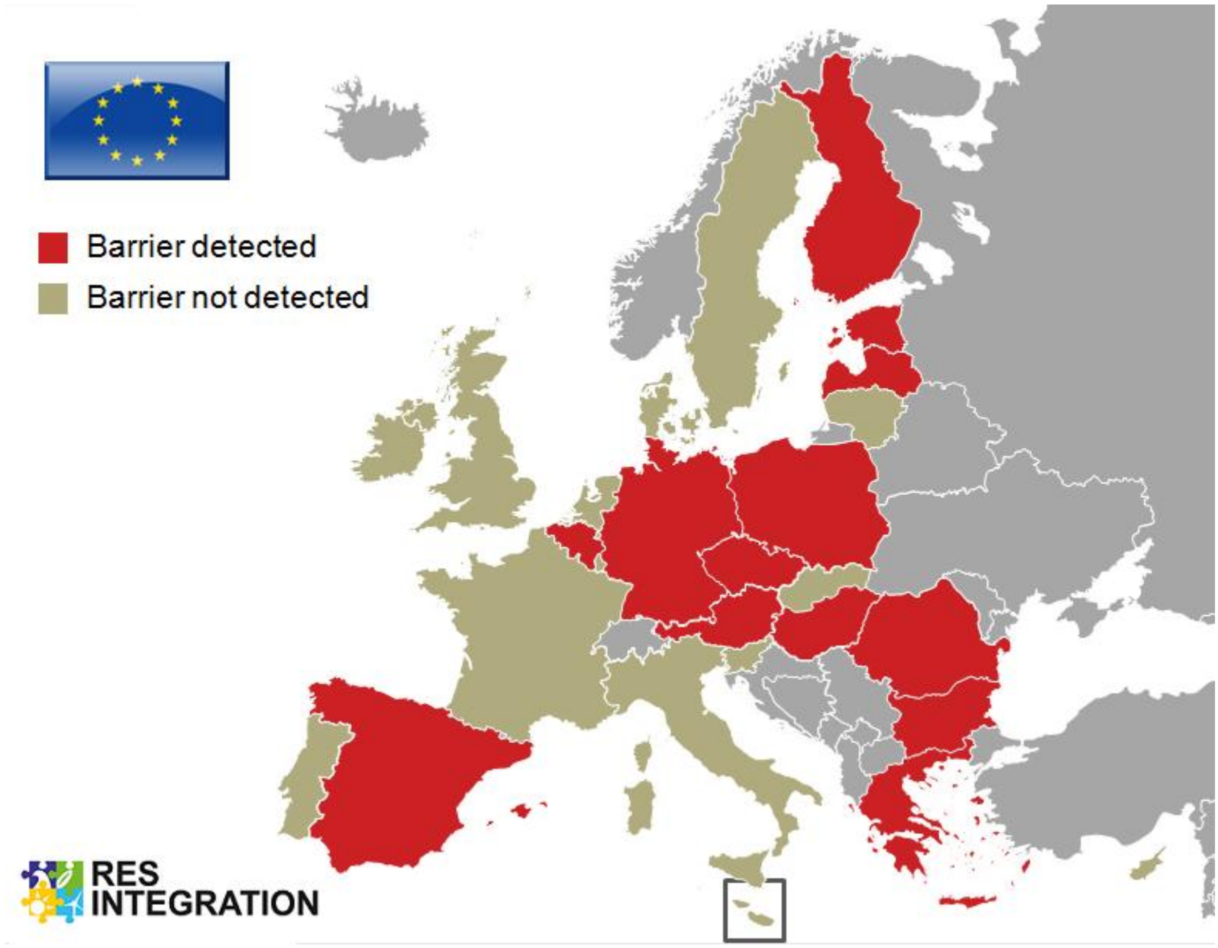


Figure 5: Geographic presence of the issue "Lack of communication, conflicts and weakness of judicial system" in the EU 27. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

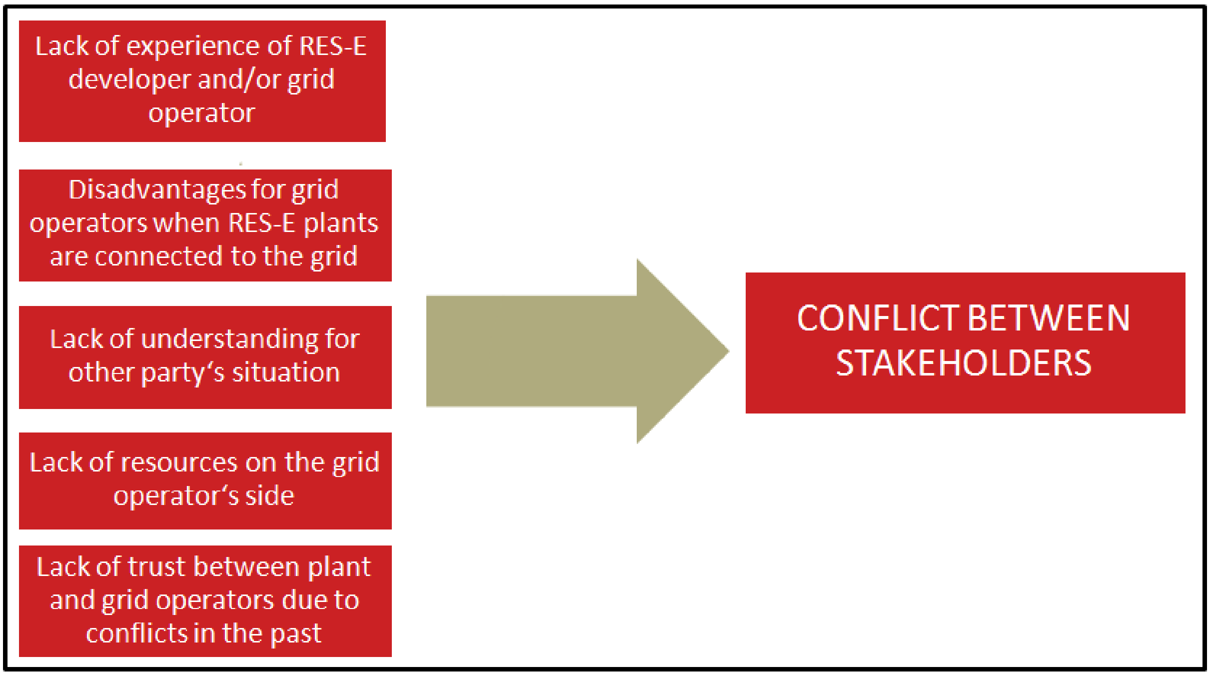
Causes and interconnection to other issues

According to the results, there is apparently a link between lack of communication and conflicts between stakeholders.

The main reasons for conflicts between RES-E plant developers and grid operators are:

- Lack of experience on the side of the RES-E developer and/ or grid operator;
- Lack of understanding of the situation and the processes of the counterpart also because of lacking communication;
- Disadvantages that grid operators have to suffer when RES-E plants are connected to the grid. This is in particular true in cases of DSOs that are still acting as utilities and regard RES-E plant operators as competitors or in case grid operators have to bear the costs for the reinforcement of the grid without having the opportunity to pass the costs for the development to their customers;
- Lack of resources (in terms of staff and technology) for the communication with RES-E developers on the side of grid operators as these costs are not sufficiently reimbursed;
- Lack of trust between plant operators and grid operators due to conflicts in the past.

These aspects are summarised in the scheme below.



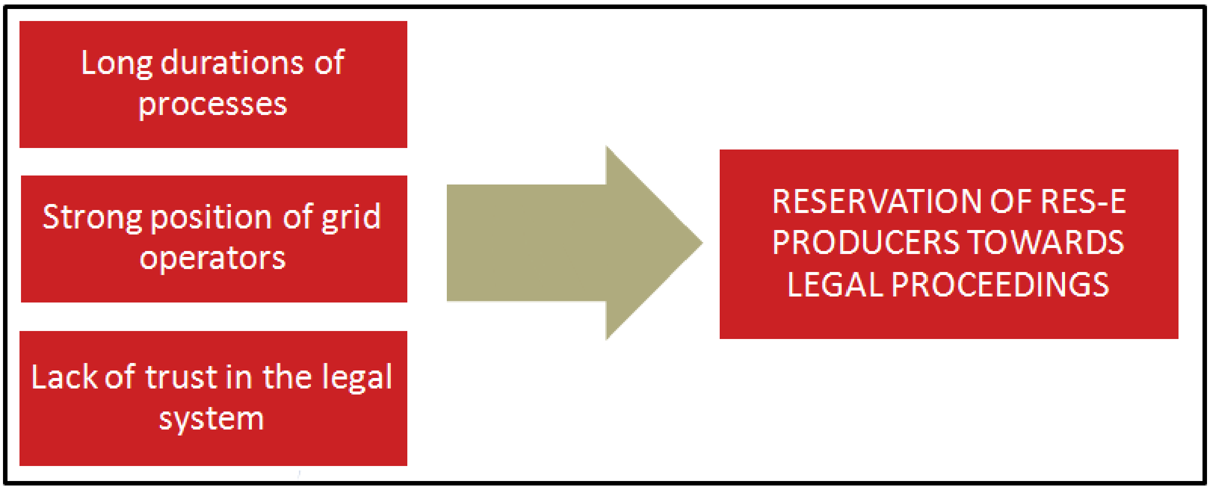
Graph 3: Main reasons in the EU 27 for the issue "Lack of communication". Source: RES Integration Project

Furthermore, causes have been detected for the weak position of plant operators leading to a reservation towards legal proceedings:

- Long duration of processes. In many countries, judicial processes are taking too long. This is especially important when the national support scheme offers only small time-slots for investments;
- Strong position of the grid operator. Very often, plant developers pointed out that, due to the strong position of the grid operator as natural monopolist, legal proceedings were considered too risky as legal actions could harm the long-term relationship;
- Lack of trust in legal system. In some cases, plant operators did not trust that they could actually receive support from the judicial system. Stakeholders thought that the technical details were too complex and the court would not understand the technical subject in depth to give an appropriate judgment.

In particular the last point shows that also in this case, the issue is connected to the fact that the current legal framework does not sufficiently react to the ongoing transition of the electricity system. In some of the Member States where the barriers have been identified it appears that legal conflict mechanisms are not sufficiently coping with the fact that the number of actors with conflicting interests during the grid connection process has increased.

These aspects are summarised in the scheme below.



Graph 4: Main reasons in the EU 27 for the issue "Reservation of RES-E producers towards legal proceedings". Source: RES Integration Project

Possible solutions, based on evidence in EU Member States

Due to the complexity of the matter, it is obvious that there is no simple solution to this barrier. Regarding the complexity of the judicial system, the following steps should be considered:

In order to increase RES-E experience in judicial bodies, specific training to legal personal may be helpful. Legal and technical knowledge should be concentrated and centralised in order to further boost the increase of experience. For this, it might help to set up an impartial body that is specialized in legal and technical questions in this matter. As an example, this has been done in Germany with the establishment of the Clearinghouse EEG ("*EEG Clearingstelle*"). This body provides out-of-court decisions on legal questions. The decisions are not legally binding but discuss the relevant questions in depth. Another solution would be to give jurisdiction for all cases related to grid connection to one body. This approach has been followed in Finland. There, the jurisdiction for cases related to connection and development of the grid generally lies with the Energy Market Authority. This solution, however, can only work if that central body has sufficient resources to cope with all cases. If this is not ensured, there is the risk that the bottleneck of a blocked central body will slow down the complete system. In case of smaller markets it could be even considered to exchange information on judicial cases. If one of the markets is more mature than others (for example the Danish market towards the Swedish of the Finnish, respectively), it could be worthwhile to exchange experiences and data.

The strong position of the grid operator could be mitigated by conferring the right to file an action to an institution. This institution should be less dependent from the grid operator and have the function to improve the legal framework in the long-run – for example a RES association. The RES association could take legal action on behalf of the plant developer if the questions discussed in this case were relevant for the RES-E industry in general. Such a solution would significantly enhance the position of the plant developer. On the other hand, it would entail a significant change of the existing legal system and should be therefore considered with great caution. Moreover, this solution would not help making judicial procedures quicker. The experience of the last years has shown that only a fundamental change of the procedural system backed-up by huge investments in human resources could make legal processes more efficient. With hindsight to the ongoing austerity policy, this option does not seem very feasible. Moreover, very often court decision can solve merely the concrete case and not the causal conflict. Therefore it does not seem wise to encourage more legal actions but to look for other alternatives.

For these reasons it might be better to focus on the underlying conflict that finally leads to the legal conflict. If the RES-E plant operators and grid operators have no intention of actually harming their counterpart it may help to improve the framework of the work-relationship between the two parties Thus, priority should be given to measures which aim to improve the communication between grid operators and plant operators and ensure that experience of good cooperation will be disseminated on both sides. One way to achieve this goal would be to establish a regular platform of communication between plant operators and grid operators. To give an example, a first step into this direction has been taken in Germany with the establishment of the so called *Forum Netzintegration*. Stakeholders from the energy sector are meeting on a regular basis in order to identify main barriers for the development of the grid and to find and formulate possible solutions. At the end of the process, the *Forum Netzintegration* published the *Plan N*, which formulates the main findings of that discussion (DUH 2010). In this process an exchange of ideas and perspectives is taking place that helps to improve the relationship between plant operators and grid operators in general. Another example could be the *Electricity Network Strategy Group* in Great Britain, fulfilling a similar purpose. It helps to choose two representatives in each group to collaborate on a continuous base, setting a direct link to discuss problems as soon as they come up. Such a close co-operation between grid operators and RES industry would mean that both groups had to provide additional funding for the necessary resources in terms of people and organisation. These investments, on the other hand, would make sure that the process would be organized in an effective and efficient way.

This approach will certainly not solve all conflicts between different parties, bearing in mind that conflicts are often simply originated by contradicting interests. Still, this approach may prevent unnecessary conflicts that are caused by lack of trust and communication. In these cases, cooperative actions will help parties to find solutions that serve their common interests.

Virtual saturation and speculation

Mechanism of issue

Virtual saturation refers to a situation in which a portion of the grid could theoretically allow connection of some power plants but cannot practically proceed because its whole capacity is reserved by plants that are not yet connected. Usually, grid capacity is reserved before the plant is built, and this may lead to a situation in which some projects in development take up all the available capacity, thus making it impossible for other operators to request connection for other projects that they may want to develop, as no more capacity can be allocated.

Speculation usually occurs in connection with virtual saturation. In this context, it refers to the practice of reserving all available capacity on the grid in order to subsequently sell the reserved capacity to other producers who may need it. This practice usually is able to take up all available capacity and thus to create barriers for new plants in the connection phase. One applied solution is the introduction of a capacity reservation fee, which however has also the effect of moving the stranded asset risk from the grid operator to the plant operator.

Presence and severity in different countries

Virtual saturation has been reported in 9 Member States: Bulgaria, Czech Republic, Estonia, Finland, Hungary, Italy, Latvia, Romania and Slovakia. Such a large amount of affected countries makes virtual saturation to one of the major common issues in the EU. The countries, in which virtual saturation has been reported, are difficult to categorize. It seems slightly more common in new Member States, but it was also reported in "old" Member States such as Finland, or Italy. Often, it seems to appear in Member States in which an attractive support scheme has lead to a strong growth of RES, such as in Bulgaria, Czech Republic, and Italy.

In most of these countries, the effect of virtual saturation has been described as being crucial for deployment and integration of RES-E technologies (in particular wind power and PV). In this regard, it is somewhat surprising that virtual saturation has not been discussed or identified as a systemic problem in earlier reports. Virtual saturation leads to a number of disadvantages for both plant operators and grid operators: the grid operator, whose priority is to ensure grid stability, is forced to refuse other projects as a consequence of this situation. Moreover, speculative behaviour has also harmed the reputation of wind power and has resulted in problems at political level when such behaviour was used as an argument to cut support schemes. What is maybe even more severe in the long-run is the fact that virtual saturation may prevent grid operators from developing the grid appropriately. As it is unclear what projects will be realized, the grid operator is unable to assess what grid developments will be necessary. It is therefore hindered in setting up a master grid development plan that takes RES-E growth accurately into account.

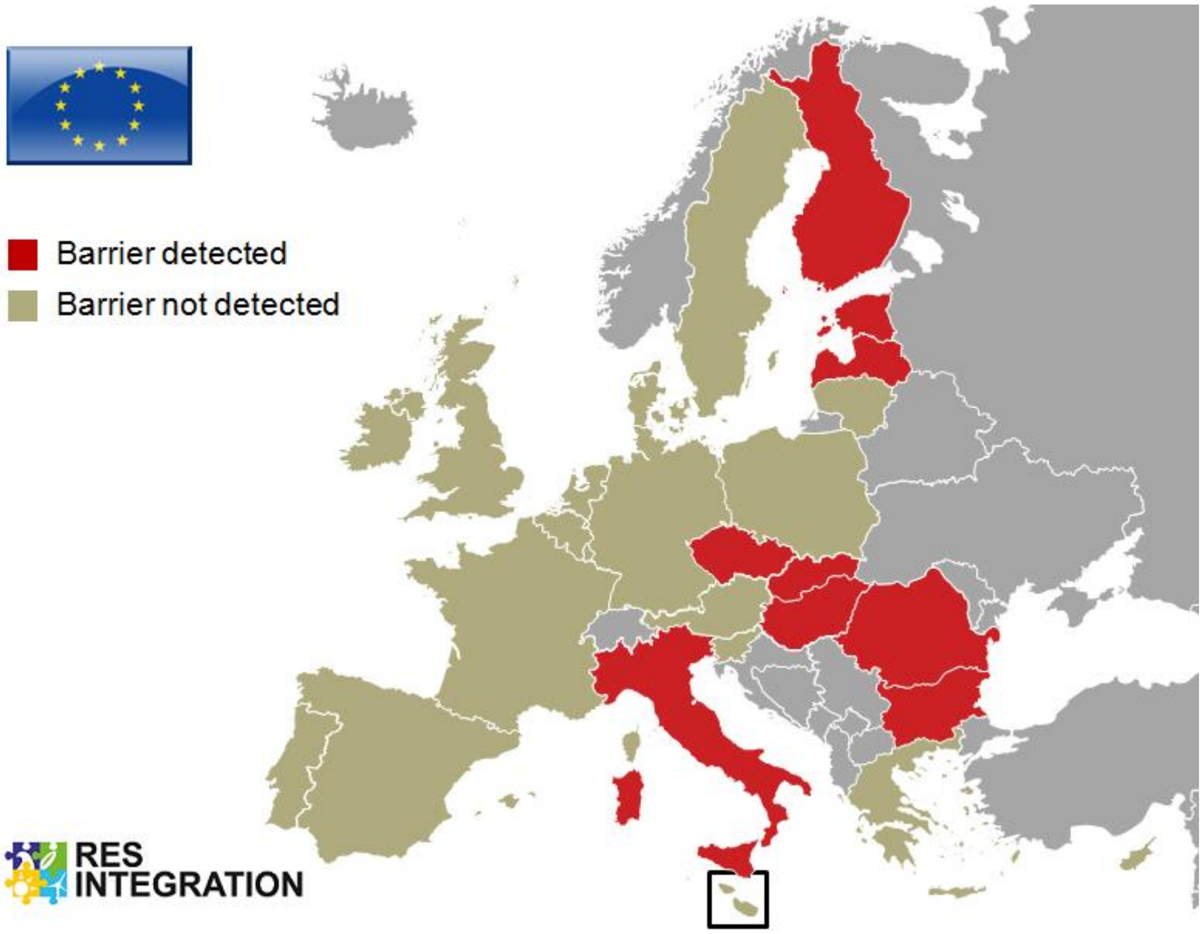


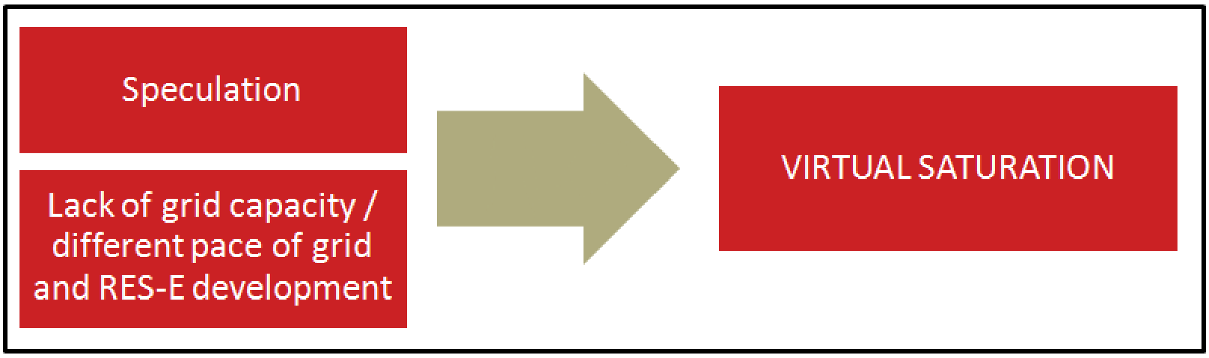
Figure 6: Geographic presence of the issue "Virtual saturation" in the EU 27. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

Causes and interconnection to other issues

The causes for virtual saturation are in many countries quite similar. They are very often closely connected to the presence of speculation, i.e. the practice of reserving all available capacity on the grid in order to subsequently sell the reserved capacity to other producers who may need it, as outlined above. Speculation has been named in the context of virtual grid saturation in eight out of nine cases when virtual saturation was considered as a problem. Another close relationship exists to the lack of grid capacity. The need for grid reservation becomes only apparent when there is a concrete risk that the existing grid load is not sufficient. On the other side of the coin, it is also the lack of grid capacity that actually makes speculative behaviour attractive, as this requires a scarce good. Since virtual saturation impedes the development of the grid it appears that lack of grid capacity, virtual saturation and speculative behaviour are negatively mutually dependant – a vicious circle.

Other important causes for virtual saturation and speculative behaviour are flawed rules regulating the connection to the grid for RES-E systems. In some countries, it seemed that it was too easy to get grid capacities reserved. One could argue that the grid connection process is not adapted to many different applicants that are competing for grid connection. From this perspective, virtual saturation is an indicator: grid processes have to be changed in order to better steer the transition from an energy system dominated by big centralised generators to a system in which many small applicants are predominant.

These aspects are summarised in the scheme below:



Graph 5: Main reasons in the EU 27 for the issue "Virtual saturation". Source: RES Integration Project

Possible solutions, based on evidence in EU Member States

Member States are currently following two different approaches to mitigate virtual saturation. One solution is to introduce for the grid connection process a set of intermediate steps, each of them ending with a realistic and appropriate milestone that the project developer has to reach within a certain period of time (e.g. first step submission of building permissions, second step financial guarantees and so on until the grid connection process is completed). After achieving the first steps, the project developer may reserve a certain amount of capacity for a defined period of time. If a project developer fails to reach the next milestone in the given time, the reservation expires and the developer has to restart with the first step. However, in case the project developer is not responsible for the delay, for example when waiting for administrative decisions, the deadlines for fulfilling the milestones should be extended. The restructuring of the process would prevent projects from being idle and would thus support a quick implementation of projects. The suggested process would provide grid operators with a clearer understanding of which projects will be commissioned and when they will be ready. Such knowledge would help them to assess how much capacity will be connected in a conceivable period of time and to accommodate the own planning. As a consequence, the process would be less stressful for grid and plant operators. However, such a deep planning would require more communication and coordination between all actors. Moreover, a more sophisticated connection process could become a challenge for less experienced RES installers. Thus, this may provide some difficulties. The described approach has been applied among others in France and to some extent in Estonia and Germany.

Another solution might be to introduce a reservation fee to be made by the plant developer when applying for the connection permit. The distinctive feature of the payments is that developers have to pay in advance to the connection process and that thus the stranded asset risk is moved from grid operators to plant operators.

The introduction of a reservation fee has two major advantages: First, the costs will entail a financial risk, considering that the investment will be futile if the reserved capacity cannot be sold in due time. As a consequence, speculative behaviour will become more risky and thus less attractive. Secondly, the recipient of the reservation – usually the State or the grid operator – could use the fee as an additional resource for grid development. The main drawback of these payments is that project developers would have additional expenses before the investment would pay off. Furthermore, the increased risk caused by additional costs at the beginning of the project can lead to higher capital costs and thus higher the overall costs of the RES project. The balancing of these costs can make additional funding necessary, for example in terms of higher FIT rates. Thus, the costs for the general public could increase as the costs for support schemes are directly or indirectly borne by tax payers or final consumers. Moreover, higher payments in advance can be made (supported) by large companies that can afford high investments and do not need to receive a quick return of their investments. As a consequence, reservation fees can be an advantage to actors with high financial resources and can pose a barrier to smaller actors at the market, resulting in a market concentration at a very early stage. The introduction of reservation fees has taken place among others in Bulgaria and Poland, and is currently discussed in Czech Republic.

Apart from which solution will be chosen, it should be also discussed whether these solutions should be applied only to new projects or also to existing projects that are currently blocking the grid and causing virtual saturation. The application of the new rules would interfere with the legal principle that measures should not have retroactive effect. On the other hand, if virtual saturation is currently taking place, it might be wise to take this option into account. In any case, this approach should only be considered if supported by the national RES industry.

Non-shallow costs

Mechanism of issue

This issue refers to the approach used for sharing costs of grid connection among producers and grid operators. Two main cost regimes are possible: deep costs and shallow costs. In a deep-cost approach, a plant developer requesting connection has to bears several grid infrastructure related costs (grid connection, reinforcement, and extension). In a shallow cost approach, in turn, the plant operator bears only the grid connection cost, but not the costs of reinforcement and extension. This issue refers to any situation in which the cost regime is not purely shallow. It means that there is either a deep cost approach in place, a hybrid cost regime or even a strong tendency towards a deep cost approach (for instance in areas where the needed connection line is extremely long and burdensome for the producer). Some causes have been identified. However, no major pattern emerges and this issue seems to be often a cause for other ones.

In general, the deep cost approach creates higher costs and risks for the RES plant operator, and is therefore considered an issue to RES deployment. Additionally, due to the complexity of the power grids and to the need of taking into account scenarios on future demand and generation, it is often not possible to objectively and exactly define which grid reinforcements are necessary by the addition of one specific plant. Hence, the deep cost approach tends to give the grid operator discretionary power, which can lead to controversial situations and possibly abuses. Even if the unbundling process is formally completed, some informal practices or behaviours of the old model may still be in place.

This issue is mostly relevant in the connection phase.

Presence and severity in different countries

In this section, all countries that do not have a purely shallow cost approach are reported. This includes hybrid systems, i.e. systems in which the producer has to pay for the connection and for part of the reinforcement works, as well as shallow-cost systems that show a tendency towards deep costs, as it is the case in France, where installation operators have to pay all transformers in the voltage level to which they connect, as well as all elements created in the higher tension level; which includes grid connection costs and required grid extension costs.

This issue has been reported in the following nine countries: Austria, Estonia, France, Great Britain, Latvia, Lithuania, Luxembourg, Slovenia and Spain. Five of these countries (Estonia, Spain, Lithuania, Latvia, and Slovenia) offer negative conditions for RES-E integration in the connection phase, the remaining four offer neutral conditions.

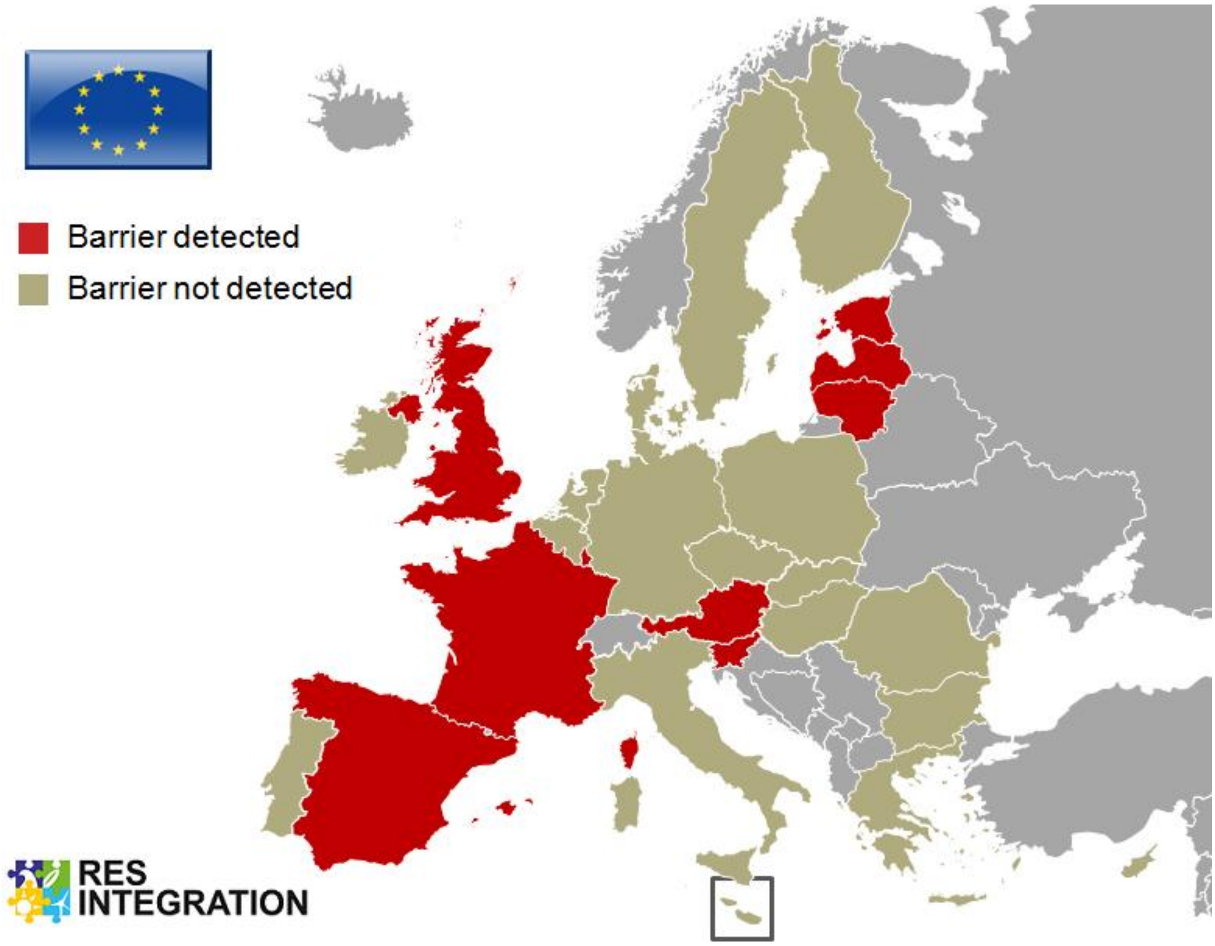


Figure 7: Geographic presence of the issue "Non-shallow costs" in the EU 27. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

Causes and interconnection to other issues

Few direct causes for this issue have been reported, meaning that in order to solve this problem, a targeted action is needed. It could be argued, actually, that in case such a non-shallow cost regime is in place, this should be somehow regulated by law. Hence, improving the legal framework could contribute to ease this issue. There are some cases in which causes for this issue appear. These are only a handful, however, it is interesting to notice that such causes seem to relate to the legal area. Legal unclarity / legal weakness is in fact a cause for non-shallow costs in two countries, whereas insufficient application of existing laws was a cause for non-shallow costs reported in one country and limited access to information was also reported in another country.

Possible solutions, based on evidence in EU Member States

The distribution of costs is one of the key barriers for the deployment and for the integration of RES. For that reason, the rules regulating the distribution of costs should be scrutinized and possibly refined. It would go above the scope of this study to present a detailed solution that takes all national specifications for all countries into account. In fact, such solution could be organized as a process by the responsible ministry or the national regulator. The process leader would have the task to initiate a dialogue with all national stakeholders. The involved stakeholders should identify and discuss options on how to clarify and probably set rules on the distribution of costs. Future changes of energy generation capacities and subsequent need for grid development should be taken into account, as well as the advantages and risks of shallow and deep cost approaches for deployment and integration. It might be also worthwhile to tie this discussion to ongoing initiatives at the European level, such as the High Level Group responsible for development of the Baltic Energy Market Interconnection Plan. This may be done through existing fora or through direct contact with such initiatives.

Grid Operation

Once RES-E producers have been connected to the grid, the produced electricity must get access to the grid as a precondition for selling electricity. An important element of any support scheme for RES is to ensure that RES installations have access to the grid; either through priority access linked to a purchase obligation or guaranteed network access. Ensuring network access is first of all an obligation on the grid operator. However, there are also a number of obligations (ancillary services) on the generators to make their operation more compatible with the grid, which become more relevant once the share of RES increases. As outlined in further detail in the paragraph below, grid operation is still a minor issue in several Member States, but it is expected to rapidly grow in importance with the expected increase in the share of RES-E. These aspects are however more related to grid development and are thus considered in the barriers outlined in that section.

The analysis of the barriers to RES-E integration in the operation phase were based on a set of criteria drawn from Article 16(2), (7) of Directive 2009/28/EC, aiming to verify the level of compliance with the Directive and the issues blocking such compliance, if there were any. The chosen criteria were:

- Presence of purchase obligation or dispatching priority;
- Grid access regime;
- Obligations of the RES producer to operate in line with network requirements;
- Curtailment management.

For further detail on these criteria, please refer to the research template in Annex IV on page 199.

Overview on national ratings and main issues

The operation phase seems to provide a fairly favourable environment to the integration of RES-E, considering that our research identified a setting for integration that was positive in 12 countries, neutral in 12 and negative only in 3. It should be recalled, however, that several countries still show a very low share of RES-E operating on their grid. Only 6 countries in Europe have in fact more than 5% of variable RES-E production over consumption. Considering this small share, RES-E operation on the grid can still be considered as a relatively minor topic, though it is expected to grow in importance in the coming years. On the other hand, it should also be signalled that countries with a much higher share of variable RES-E (e.g. Germany, Denmark or Portugal) do show positive conditions for grid operations, meaning that variable RES-E, even in large quantities, can be effectively managed on the grid.

This map aims at providing an overview of the EU 27. Though it is based on the results of the research at national level, it is a great simplification of such results and it should be taken as such. The evaluations reported in the map only relate to the RES-E context (mainly to variable sources such as wind & PV), furthermore, no differentiation is provided in terms of grid levels or RES-E systems. The authors of this study concede that the evaluation is partially based on subjective assessments either by other stakeholders or by the authors themselves. This challenge has been addressed by resting the evaluation on a broad variety of different opinions, by taking more objective elements into account, such as the compliance with the requirements of the NREAP template, and by conducting a total of three consultation rounds.

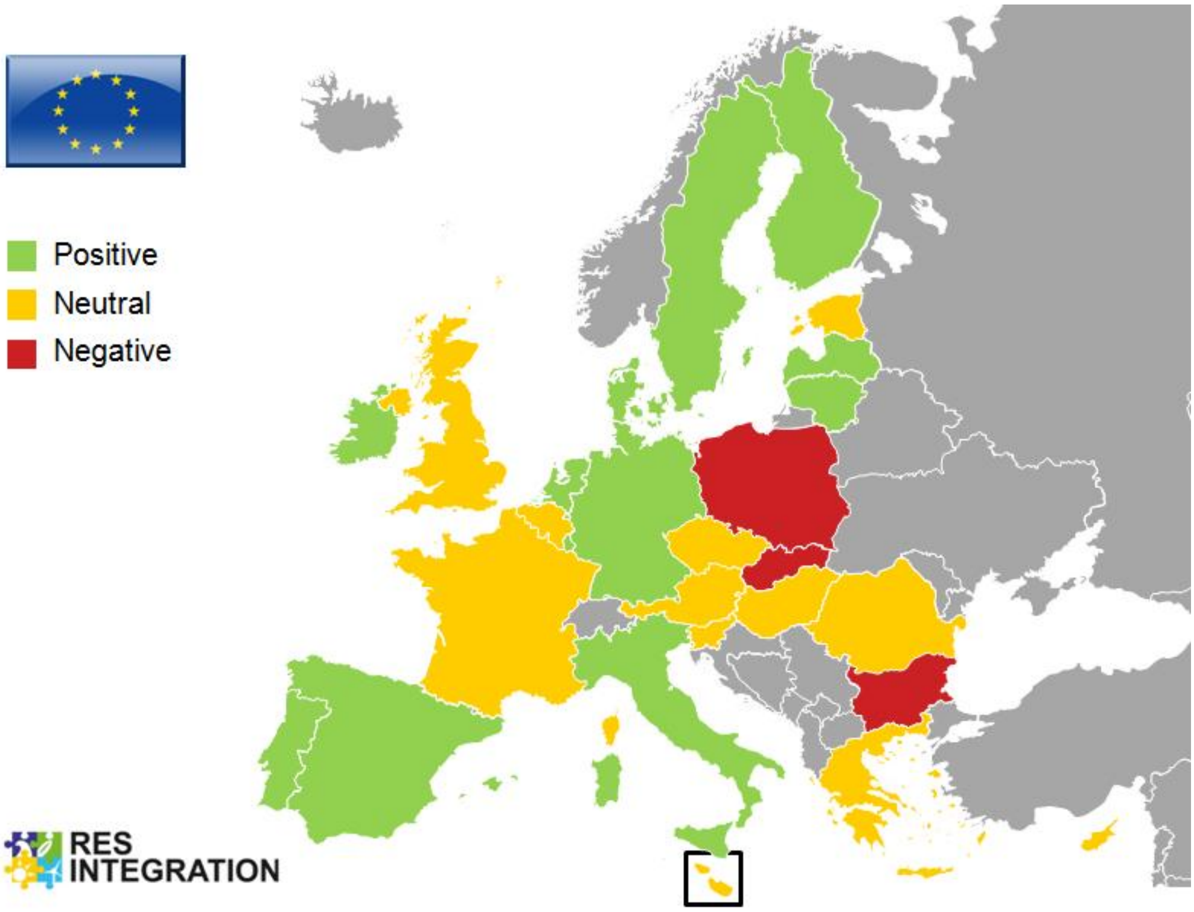
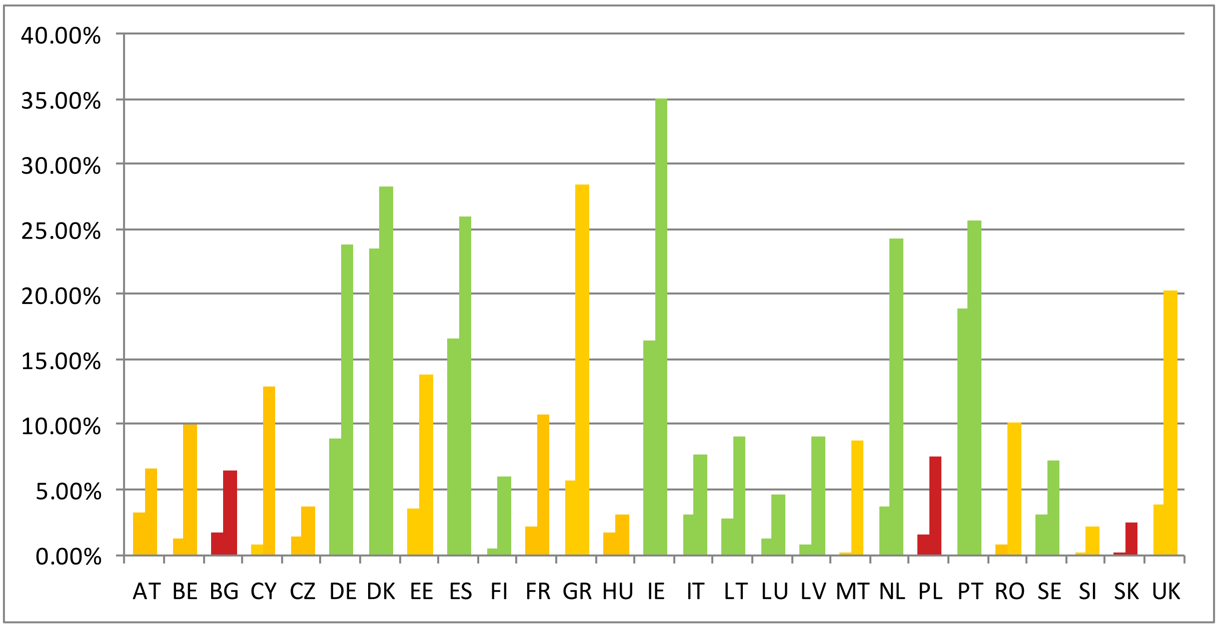


Figure 8: Assessment of operation process in European Member States[10]. Source: RES Integration Project

The graph below shows the variable (solar + wind) RES-E generation share over gross final electricity consumption in the different states in 2010 and in 2020. Several Member States showing positive conditions for RES-E integration in this phase have indeed a very low variable RES-E share at the present time. Considering the share that they are intended to have in 2020, it is not clear yet what problems could arise as variable RES-E start to play a relevant role in the grid.

[10] Though the map shows the Republic of Ireland and the United Kingdom, such assessments are referred to Ireland (all island) and Great Britain, i.e. Northern Ireland is given an assessment together with the Republic of Ireland in the context of the SEM market. For further details, please refer to the foreword on page 3.



Graph 6: Share of variable RES-E generation (solar + wind) over gross final electricity consumption in the EU 27 in 2010 (first bar) and in 2020 (second bar). Colours indicate the assessment given in this phase and correspond to the colours provided in Figure 8.[11] Source: NREAPs.

An interesting aspect arisen from the study is the effect of a purchase obligation of RES-E. In the EU 27, 10 Member States do not have a legally established purchase obligation for RES-E in place: Belgium, Denmark, Estonia, Finland, Great Britain, Ireland, Latvia, Netherlands, Romania, Sweden. Though one would expect a purchase obligation to ease conditions for operating on the grid for RES-E (for variable ones in particular) and therefore to help boosting their uptake, results show that this connection is not that strong. Comparing the above-listed Member States, it can be noticed that almost no correspondence is provided between the amounts of variable RES-E, the assessments of the conditions for RES-E operating on the grid and the presence of a purchase obligation. There are cases in which the presence of such obligation still yields a negative assessment and a low share (e.g. Slovakia), and there are also completely opposite cases (e.g. Denmark). Clearly, the situation in different countries is quite varied and other aspects may play very strong roles, however this is precisely the interesting point, i.e. the presence of a purchase obligation may still weigh heavily in terms of conditions for grid operation and RES-E uptake, however it should be considered in parallel with other factors affecting each Member State's specificity.

The issues identified in this phase show an important difference from the ones in grid connection and grid development: they are usually strongly linked and caused by national factors. Of course, all issues are linked to national factors; however, in grid connection and in grid development there is more evidence of common patterns emerging in different countries, i.e. several situations are common to different countries. This is not the case for grid operation, or in any case it is to a much lesser extent. Here, a large amount of issues seem to be tied to country-specific aspects, which do not appear in any other analysed Member State. A few common patterns emerged, nonetheless, mostly linked to grid

[11] In the graph, percentage values are provided for the United Kingdom and the Republic of Ireland, whereas assessments are provided for Ireland (all island) and Great Britain. For further details, please refer to the foreword on page 3.

curtailment issues. These are reported in the table below, ranked by number of countries and with an indication of their countries of occurrence.

Issues related to Grid Operation	Member States where this issue is present
None / partial regulation of curtailment	BE, EE, FI, HU, PL, PT, SI
No compensation provided for curtailment / compensation difficult to apply	BE, IT, MT, PL, PT
Excessive curtailment	BG, GR, ES, IT, MT
More curtailment expected in the future	CY, EE, GB, MT

Table 6: Overview of grid operation issues in European Member States identified in the RES Integration study

The perspective considered in the above table is mainly the European one, meaning that the listed barriers are mostly relevant at EU level, simply because common to a significant number of Member States. Such issues may not automatically be also the most pressing ones in the Member States. The table below provides a short listing of the main barriers identified in the EU 27. For further details on them, reference should be made to the chapter dedicated to this issue (p. 97), to Annex III (p. 189) and to the national reports.

It should also be considered that the assessments provided in Figure 8 do not directly relate to the number of barriers identified in one Member State, but to their severity, as described in the national reports. The table below provides an indication of the most important barriers at national level.

Member State	Main barriers to integration in the grid operation phase
Austria	Ineffective purchase obligation System fee for large RES-E plants
Belgium	No proper regulation for congestion management (curtailment) yet, especially on regional level
Bulgaria	TSO does not comply with dispatching priority Curtailment regulation and procedure
Cyprus	No regulation for curtailment Isolated system
Czech Republic	Planned amendments could abolish the priority for RES and the purchase obligation
Denmark	No barriers detected
Estonia	No barriers detected
Finland	No barriers detected
France	Curtailment regulation and procedure
Germany	Grid curtailment
Great Britain	None for now, possible ones with the increase of RES-E
Greece	RES-Plants are sometimes cut off when new plants are connected to the grid
Hungary	Lack of reserve capacity Instability of priority access due to support scheme revision
Ireland	Challenges to apply the concept of priority dispatching under the Irish circumstances (40% RES-E target)
Italy	Frequency of curtailment in areas with large RES-E potential
Latvia	No barriers detected

Lithuania	No barriers detected
Luxembourg	No barriers detected
Malta	Grid not connected to the EU grid Potential problems when wind farms/large PV projects come online
Netherlands	Mismatch in lead times of newly developed power versus corresponding grid reinforcement/expansion
Poland	Lack of investment security Lack of sufficient grid capacity
Portugal	Strict parameters of frequency and limited availability in the Distribution Network
Romania	None yet, possible with variable RES-E growth
Slovakia	Massive lowering of feed-in tariffs
Slovenia	None, given the low share of variable RES-E
Spain	No significant barriers detected
Sweden	No barriers detected

Table 9: Main barriers identified in each Member State in the grid operation phase

Grid curtailment and connected issues

Mechanism of issue

Grid curtailment, intended in general as the modulation of RES-E production due to grid issues, appears to be a quite substantial barrier in the grid operation phase. In this section, grid curtailment is not only considered *per se*, but it is presented together with all connected issues, such as a partial or total lack of legal coverage for curtailment or the lack of a compensation system in case of curtailment. Such issues are briefly described below.

<u>None / partial regulation of curtailment</u> – This barrier relates to a lack of legal coverage of grid curtailment. In some countries, this aspect may be completely missing from legal regulations, leaving a full juridical gap in the system – in other countries, only some aspects may be covered or described in general, still leaving grey areas on the topic.

<u>No compensation provided for curtailment / compensation difficult to apply</u> – Usually, curtailed plants are, or should be, compensated for the electricity they cannot produce. In several countries compensation systems, based for example on estimates on missed production, are present. In some of the analysed countries, such systems are not in place, providing a higher risk for plant operators in case of curtailment. In other cases, a compensation system may be in place, however its application may be difficult and constitute a barrier. This could be the case, for example, if the models used to estimate missed production are controversial or if the integration with the support scheme in place is not complete (e.g. compensation only for missed production but not for missed certificates in a quota system).

<u>More curtailment expected in the future</u> – this issue relates to a situation in which the amount of RES-E electricity is expected to increase without a sufficient increase of grid capacity or interconnection. This issue may be apparently related to development of the grid, however it relates to a situation foreseen in a short-to-medium term, i.e. a lapse of time too short to be considered in the development plans. It is likely that this issue would automatically be solved with grid expansion as indicated in development plans, however it is possible that some time with higher curtailment is expected before the developments indicated in the plans take place.

Excessive curtailment – Presence of grid curtailment is common to different countries, however only 4 of them strongly underlined it during the country analysis. This does not necessarily mean that grid curtailment in these countries is more frequent than in other ones, but only that this aspect particularly emerged in these countries throughout the research.

Research undertaken at Member State level has indicated that curtailment itself may not always be an issue. Though present in several countries, its mere existence has not always been indicated as a strong barrier to RES-E integration. Although this may sound surprising, it may be argued that connected factors apart from the presence of curtailment (e.g. no regulation of curtailment, no compensation for curtailment) may pose even stronger obstacles. This is the case, for example of a total or partial lack of regulation, which may affect producers very strongly as it gives total freedom of behaviour to grid operators. Another example may be the lack of compensation provided for curtailed plants. This latter may be referred to the actual missed hours of production or to problems in fully applying compensation, e.g. obtaining certificates in the context of a quota support scheme (the case of Italy). Either way, this could also impact very heavily on producers.

In terms of operation, the lack of sufficient grid capacity may be strongly connected to curtailment. Simply put: if the available grid capacity is insufficient with respect to the connected plants, then these plants will be at a higher risk of suffering curtailment. The lack of interconnection creates the same kind of barrier as lack of grid capacity when considering an isolated system. A lack of interconnection to other grid systems or to lines with higher capacities may in fact cause problems if too much electricity is fed into the grid and not enough can be transferred or sold to other systems, making once again the option of curtailment necessary.

Presence and severity in different countries

Issues related to grid curtailment have been identified in the following countries:

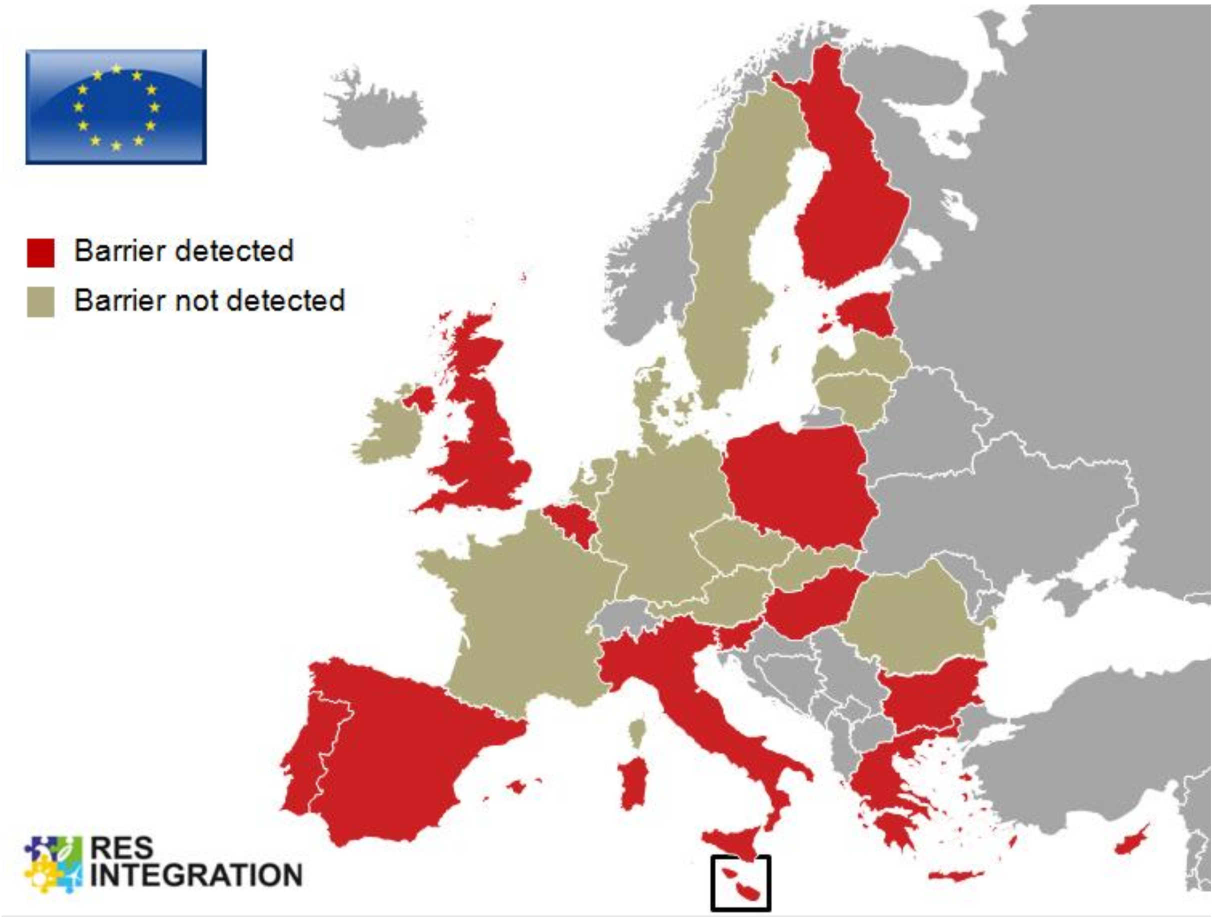


Figure 9: Geographic presence of the issue "Grid curtailment and connected issues" in the EU 27. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

Causes and interconnection to other issues

This group of issues exhibits two important characteristics:

- They all belong to the same area, and indicate in what parts of the system a barrier related to curtailment may appear;
- In the very large majority of cases, they are caused by country-specific situations.

Considering the above, it may be argued that though curtailment-related barriers are common across several EU Member States, their causes appear to be strongly linked to the national context and are thus very different in nature.

Possible solutions, based on evidence in EU Member States

Considering the above, providing a unified set of solutions, may not be fully possible, or advisable. There could be the risk, in fact, that by concentrating efforts on European level, certain country specificities may not be considered. Given the strong national ties of this issue to the national context, then, missing a reference to a national peculiarity could result in providing an inefficient solution, or a second-best one. For this reasons, the solutions provided in this section should be considered only as a possible general set of interventions that should be enacted together with country-specific measures for maximum effectiveness.

Nevertheless, the introduction of a general legal framework seems advisable for all Member State. Therefore, a clear legal framework covering the issue is deemed to be an essential starting point. This should provide unambiguous information on:

- The procedure to be followed in case of curtailment;
- The responsible bodies;
- The priority for RES-E technologies;
- The rights and duties of all affected stakeholders (producers, regulator, TSO/DSO, market operator);
- The compensation system.

Several Member States have been dealing with a large share of RES-E in the system for a few years now and this enabled them to build a stable and clear legal framework for curtailment. This may provide countries affected with a lack of regulation with specific, tested examples of laws and regulations they could import in their system and adapt to their national context. Clearly, the introduction of such regulation should be a gradual process, and extensive consultations should be carried out to ensure all interests are considered in the final version. Austria and Germany, among others, have developed advanced rules in this regard and may be taken as a reference for such process.

A compensation system for grid curtailment should also be considered while drafting the legal framework. Ideally, given the fact that usually grid curtailment does not solely originate from RES-E producers, but also from other factors, such as the status of grid infrastructure, RES-E producers should not be held as the only responsible for its occurrence. In this case, a proper compensation system would provide them with a monetary amount, which should be as close as possible to the earnings they would have had if they had sold their electricity on the market. Establishing such a system is an extremely challenging task; however, it is a necessary step to ensure RES-E integration. In this context, the system put in place by Italy, together with its calculation methods for missed production, could be considered a benchmark.

Furthermore, in some Member States curtailment may not be considered a barrier at the present time but would be expected to increase in the future. Whether curtailment is currently a barrier or is expected to be, the creation of balancing capacities, the expansion of the grid and its interconnections to other countries, as well as the establishment of forecast and compensation systems are all possibilities that should be considered and applied, when feasible, to mitigate curtailment.

On the other hand, the general obligation expansion of the grid does not necessarily mean that the grid has to be developed until any curtailment is ruled out. In some cases, it may be economically reasonable to permit to a limited extend curtailment than to have high investments only to allow for the dispatch of an insignificant amount of RES-E capacities. Having said that, curtailment should be still the exception to the rule and has to be flanked, as above described, by a compensation mechanism. Nonetheless, even if the development of the grid seems unreasonable as it allows the dispatch of an insignificant amount of RES-E, it should be carefully examined whether the development of the grid can lead to additional deployment of the RES-E capacities in that area, which could still justify the development of the grid.

Grid Development

There is a wide consensus on the fact that a substantial development of the power grid is a key precondition for the integration of renewables in view of reaching the 2020 targets and of further growth afterwards. In many Member States, insufficiencies of the grid infrastructure are considered already now as a decisive barrier for the integration of renewable electricity generation.

Of course, the issues of grid extension and reinforcement are partly related to the process of connection to the grid previously discussed. The physical connection of a RES-E generator to the grid is an independent process, which usually implies specific measures of “grid expansion”. This is discussed in the chapter on grid connection and is recalled here. Furthermore, connecting a new generation facility to a local grid that is already operating at its maximum capacity, leads unavoidably to limitations in grid access and/or to frequent curtailment situations. The previous chapter focused on how to deal with these issues within the existing infrastructure.

The present chapter focuses on the regulatory framework for grid expansion, with measures that may be necessary to avoid the above-mentioned situations and to strategically prepare the grid for the integration of larger shares of renewable generation, at regional level, or at European level.

The criteria used for this assessment were based on Article 16(1) of Directive 2009/28/EC. Some overlaps are present with grid connection as regards grid reinforcement to accommodate a new plant. The criteria used for this chapter are:

- Regulatory framework for grid development;
- Obligations, legal responsibilities of the grid operator in relation to the RES producer;
- Regulatory instruments to encourage grid development;
- Grid development studies and planned improvements;
- Costs/ Rules governing sharing and bearing of costs.

Further details are provided in the research template in Annex IV on page 199.

Overview on national ratings and main issues

As regards the development of the grid, the conditions for RES-E integration offered by different Member States tend to be quite unfavourable, considering that 9 countries offer negative conditions, 15 neutral and 3 positive.

This map aims at providing an overview of the EU 27. Though it is based on the results of the research at national level, it is a great simplification of such results and it should be taken as such. The evaluations reported in the map only relate to the RES-E context (mainly to variable sources such as wind & PV), furthermore, no differentiation is provided in terms of grid levels or RES-E systems. The authors of this study concede that the evaluation is partially based on subjective assessments either by other stakeholders or by the authors themselves. This challenge has been addressed by resting the evaluation on a broad variety of different opinions, by taking more objective elements into account, such as the compliance with the requirements of the NREAP template, and by conducting a total of three consultation rounds.

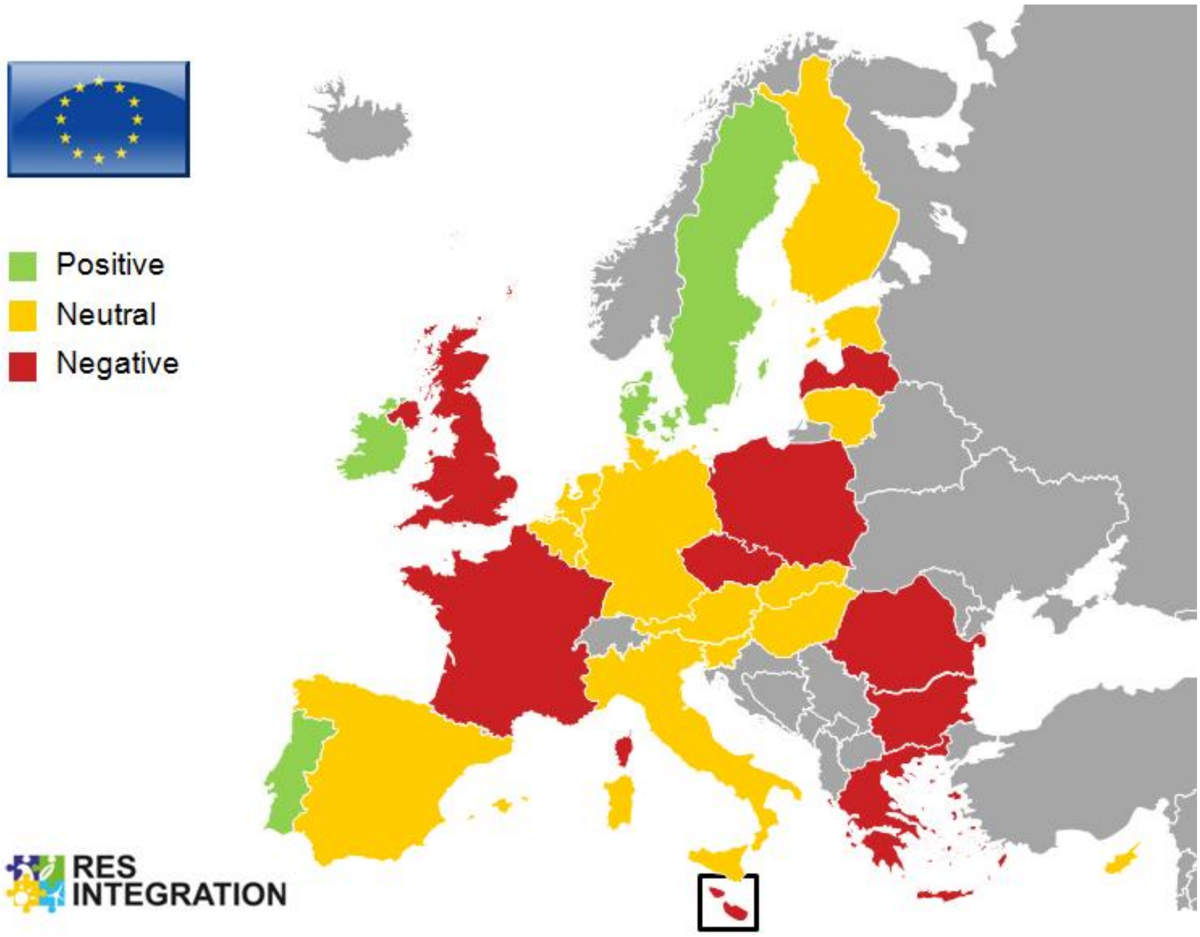


Figure 10: Assessment of development process in European Member States[12]. Source: RES Integration Project

The issues identified in the development phase count up to a total of 15 categories, many of which show similarities and links to the ones identified in the connection phase. Some issues apply in fact in both cases, i.e. their presence yields a negative effect both in the connection and in the development phase. For sake of completion they are reported in both sections; however, in the opinion of the authors it is important to underline this link. Below, the 6 most important issues are listed, along with their analysis. One note as regards Germany, the choice of providing a neutral assessment of its conditions for RES-E integration in the grid development phase stems from the fact that though the lack of grid capacity is not a big issue at the moment, views on this point may differ at European level and it may become soon an issue.

Issues related to Grid Development	Member States where this issue is present
RES-E not sufficiently considered in the development phase	AT, CZ, EE, FI, GR, HU, LU, LV, NL, RO, SI
Long lead times / delays	AT, CZ, DE, EE, ES, FI, FR, IT, SE

[12] Though the map shows the Republic of Ireland and the United Kingdom, such assessments are referred to Ireland (all island) and Great Britain, i.e. Northern Ireland is given an assessment together with the Republic of Ireland in the context of the SEM market. For further details, please refer to the foreword on page 3.

No obligation for the grid operator to reinforce the grid to accommodate a new plant	AT, BE, BG, ES, GR, HU, IE, LV, PL
Weak position of plant operator to demand grid reinforcement	BG, CZ, DE, EE, GR, HU, PL, RO
Complex or inefficient procedures	AT, CZ, DE, EE, ES, FI, FR, IT
Lack of incentives or regulatory instruments for the grid operator to reinforce the grid	AT, BG, DE, EE, ES, FI, GB, SI, SK

Table 10: Overview of grid development issues in European Member States identified in the RES Integration study

The perspective considered in the above table is mainly the European one, meaning that the listed barriers are mostly relevant at EU level, simply because common to a significant number of Member States. Such issues, may not automatically be also the most pressing ones in the Member States. The table below provides a short listing of the main barriers identified in the EU 27. For further details on them, reference should be made to the chapter dedicated to such issues (p. 97), to Annex III (p. 189) and to the national reports.

It should also be considered that the assessments provided in Figure 10 do not directly relate to the number of barriers identified in one Member State, but to their severity, as described in the national reports. The table below provides an indication of the most important barriers at national level.

Member State	Main barriers to integration in the grid development phase
Austria	Lack of incentives for Grid Operator NIMBY Long lasting procedures
Belgium	Distribution of costs, especially after the decision of the Constitutional Court in May 2011
Bulgaria	No grid development plan TSO fails to expand transmission grid
Cyprus	None, given the low share of RES-E
Czech Republic	Close linkage between TSO and dominant DSO Lack of incentives for Grid Operator
Denmark	Deadline for obtain permission for grid development not sufficiently specified
Estonia	Lack of incentives for Grid Operator Distribution of costs
Finland	Lack of regulatory instruments Speculative grid applications Lack of resources for regulator
France	No grid development plan Remaining time for grid development Incumbent position of main generator Limited power of regulator
Germany	Public opposition Complicated permission procedures Lacking financial incentives
Great Britain	Planning consent Issues connected to the charging regime Backup availability
Greece	Investors excluded from decision making process

	RES-Producer Rights are not clearly defined
Hungary	Lack of reserve capacity
Ireland	No right of RES producers to demand grid extension, if required for dispatching
Italy	Administrative barriers to grid development
Latvia	Lack of incentives for Grid Operator Distribution of costs Communication between stakeholders
Lithuania	Grid development as a strategic nationwide political issue – RES do not constitute a goal
Luxembourg	Grid development studies are generally not published
Malta	Short-term planning Planning permits and financing
Netherlands	Time required for grid development RES are no specific objective for grid development
Poland	Complicated legislative procedure for the development
Portugal	Small stakeholder participation despite consultations. The RES-E producer bears the costs if an expansion is anticipated.
Romania	Public opposition Lack of funds
Slovakia	Lack of incentives for grid operator Distribution of costs
Slovenia	Planning every 2 years
Spain	Lack of proper incentives for DSOs and RES developers Remuneration of distribution level grid development costs
Sweden	Long lead time for permit/concession for transmission line

Table 11: Main barriers identified in each Member State in the grid development phase

RES-E not sufficiently considered in development plans

Mechanism of issue

In order to adapt a grid to a larger share of RES-E generation, certain interventions must be carried out. Without specific attention to this aspect there could be a risk of misalignment between the grid's structure and the generation mix in the country. Reasons for this may be different, however the results remain the same. This issue does not comprise a low level of inclusion of RES-E stakeholders in the development phase, as this aspect has been considered separately in the analysis.

This issue is reported to be relevant particularly in the development phase. The EU 2020 goals set a certain share of RES over consumption to be reached in each Member State. Planning is of course key to this aim, and considering the long lead times that may occur in several countries, RES-E should be included in grid development plans with at least a 10-year horizon.

This, however, has been reported as not always being the case. It appears, in fact, that in 11 of the 27 Member States, RES-E are not taken into consideration to a sufficient extent when planning the grid. At present, this may not be considered as a barrier; however, it has a very strong potential of blocking access to the grid or even development of RES-E plants a few years ahead. Producers may in fact have to face a grid infrastructure that was not built for their needs or even worse, knowing that the grid will not be built according to their needs, investments in RES-E plants may be limited. Solving this issue becomes an essential step to avoid future integration issues, as well as to ensure the achievement of the 2020 goals.

Presence and severity in different countries

This issue has been reported in the following countries: Austria, Czech Republic, Estonia, Finland, Greece, Hungary, Latvia, Luxembourg, the Netherlands, Romania and Slovenia.

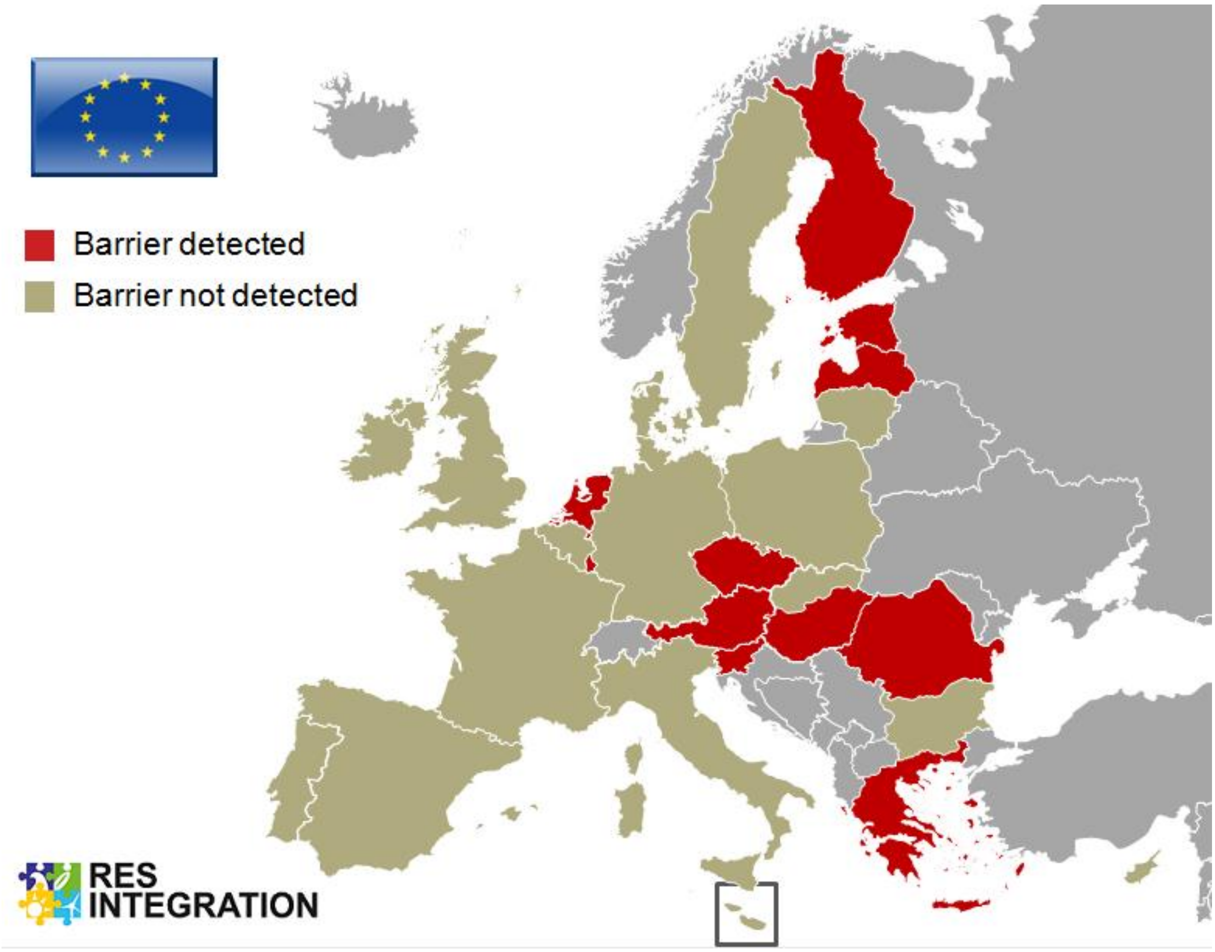
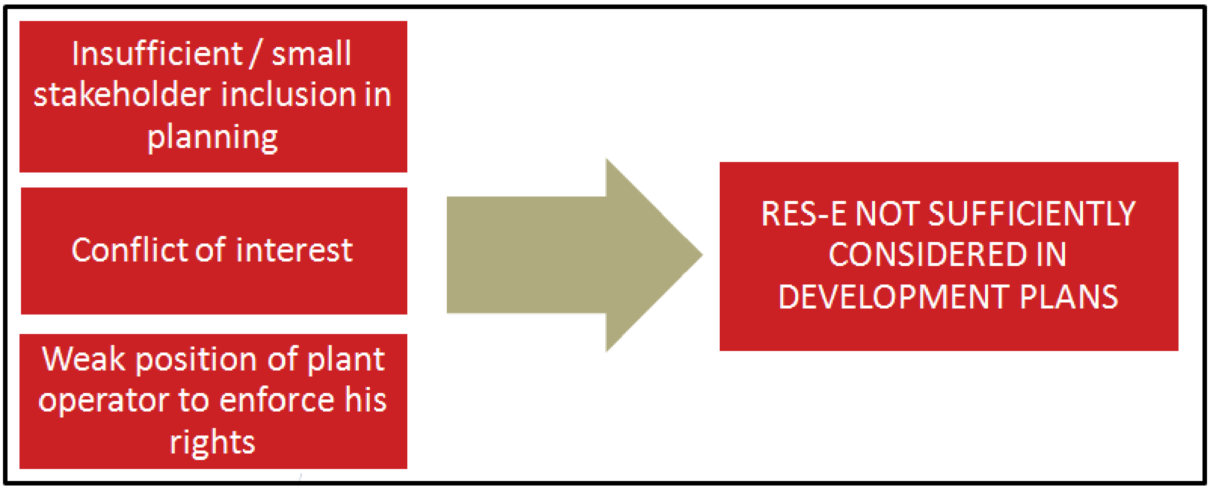


Figure 11: Geographic presence of the issue "RES-E not sufficiently considered in development plans" in the EU 27. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

Causes and interconnection to other issues

In at least 3 countries, the cause of this issue is an insufficient stakeholder inclusion or influence in the planning phase. Conflicts of interests and weak positions of plant operators to enforce their rights have also been quoted as causes to this issue.

These aspects are summarised in the scheme below.



Graph 7: Main reasons in the EU 27 for the issue "RES-E not sufficiently considered in development plans". Source: RES Integration Project

Possible solutions, based on evidence in EU Member States

In an ideal system, a few framework conditions should be fulfilled:

- The unbundling process should be fully carried out, also to insure that national monopolies are not competing with RES-E producers;
- An independent regulatory body with the duty to support RES with sufficient data, resources and staff to fulfil this obligation should be in place;
- All stakeholders (including small producers) should play a role, either directly or through a representative body (e.g. RES associations).

The above, as evidence has shown, may not always be the case. Fulfilling the above-mentioned conditions may help improve the situation as regards planning; however, they would not provide a direct solution to a low RES-E consideration in grid development plans.

The only way to ensure that RES-E development is considered and the expansion and reinforcement of the grid are aligned to the plausible RES-E increase, is to enhance communication and closer interaction between different actors in the planning phase.

On the one hand, it must be firstly ensured that all stakeholders are able to bring their needs and goals to the attention of other players; on the other hand, it must be ensured that all these possibly conflicting interests are equally represented and considered. As regards the latter, the intervention of an independent regulatory body could guarantee this. One way to achieve this goal would be to establish a future-oriented, regular platform of communication between plant operators, grid operators and other relevant players. A first step into this direction has been taken in Germany with the establishment of the so-called Forum *Netzintegration*. Stakeholders from the energy sector are meeting on a regular basis in order to identify main barriers for the development of the grid and to find and formulate possible solutions. Such a collaboration arena, would allow different interests to be represented and common and optimal solutions to be reached in view of the EU 2020 goals.

No obligation for the grid operator to reinforce the grid to accommodate a new plant

Mechanism of issue

This issue refers to the situation when the RES-E developer cannot legally force the grid operator to reinforce the grid even though this prevents the connection and installation of new RES-E capacities. The lack of obligation is a "hybrid issue" in the sense that it is relevant both for grid connection and grid development. In the latter case, it would pose obstacles as regards achieving the structure the grid needs to operate variable energy. In a long-term perspective, these consequences are even more severe with regard to the integration of RES-E.

Presence and severity in different countries

This lacking obligation for the grid operator to reinforce the grid has been reported in almost a third of all EU Member States (Austria, Belgium, Bulgaria, Greece, Hungary, Ireland, Latvia, Spain). For the time being, the impact of the lack can be evaluated as being not too severe. Still, it will become a serious issue if RES-E capacities further grow. In some Member States the lack of such an obligation was perceived as an impairment of planning security.

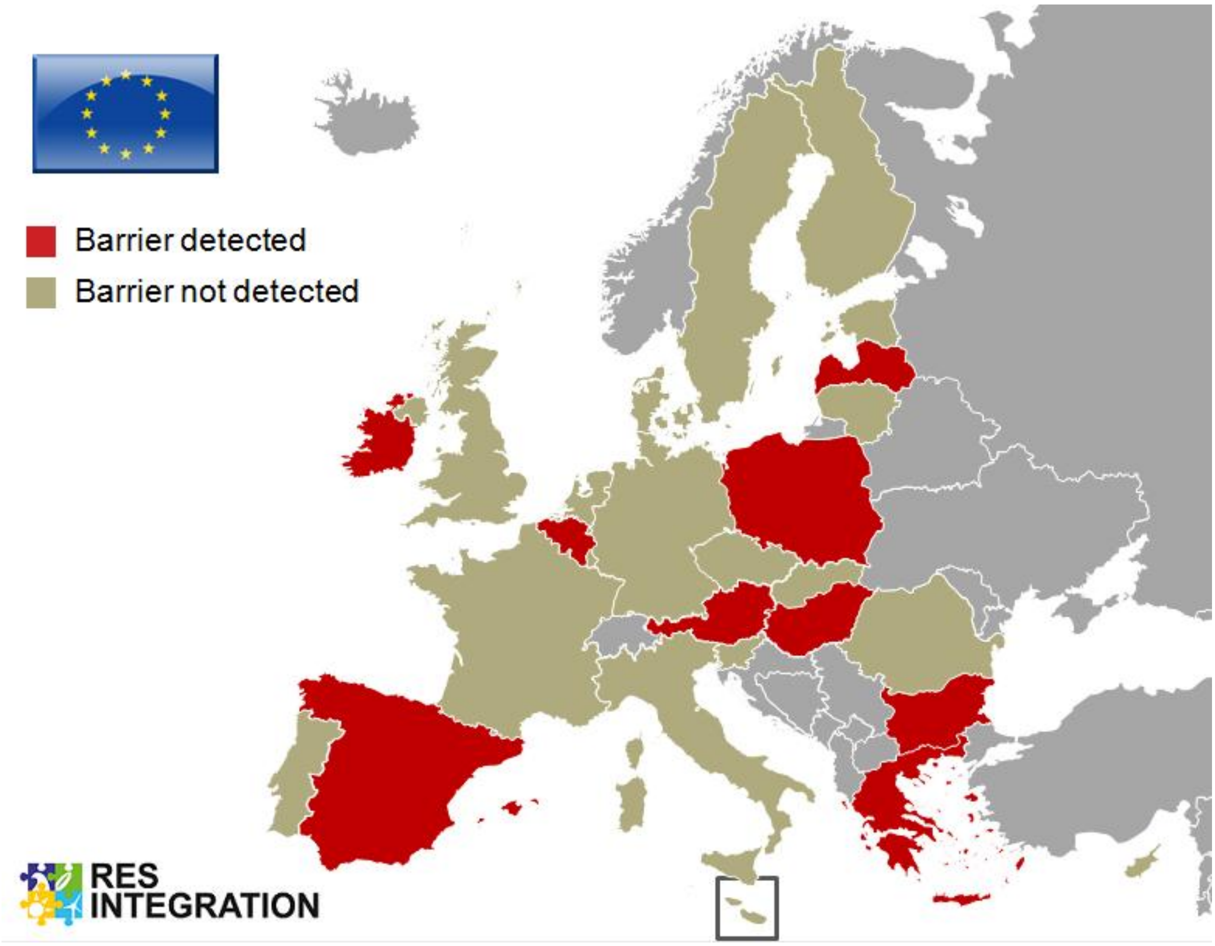


Figure 12: Geographic presence of the issue "No obligation for the grid operator to reinforce the grid to accommodate a new plant" in the EU 27. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

Causes and interconnection to other issues

The main cause for the lack of such an obligation is that legal regulations are either silent or unclear. Very often, the question whether or not such an obligation exists is not explicitly stated. In these cases, the law has to be interpreted and has been subject to legal discussions leading to a further reduction of planning security.

Possible solutions, based on evidence in EU Member States

The easiest way to ensure planning security is to explicitly state that the grid operator is obliged to reinforce the grid if this is necessary for the connection and dispatching of the RES-E plants. On the other hand, this rule without any restriction could lead to economically unreasonable petitions for grid connection. This risk is in particular true in case of countries that apply a shallow cost regime. In these countries, it should be therefore considered to formulate a restriction with regard to economically unreasonable petitions and to clearly define what is meant with the term “unreasonable”.

Lack of incentives or regulatory instruments for the grid operator to reinforce the grid

Mechanism of issue

Grid reinforcement is usually a costly investment and grid operators may not always be willing to undertake such projects, although it may be needed for a better integration of RES-E. On the other hand, if returns reflect risks and sufficient resources are available, then grid operators will seek to grow their asset bases.

Assuming that network operators are properly unbundled, a main driver for this is the regulatory framework that is in place for the network monopoly. The regulation of network tariffs is the key determinant for the network operators to invest in network extension. Most countries have been adopting incentive regulation mechanisms to provide network operators with an incentive to reduce their costs and make the network infrastructure more efficient. However, there tends to be a mismatch between incentive regulation that aims at cost reduction and network extension needed for RES-E development that leads to higher costs.

In order to overcome this situation, incentive regulation needs to be developed further to push such investments and foster RES-E integration in the development phase. In many countries, however, such incentives or instruments were either absent or stakeholders found faults with how the instruments were implemented.

Also, particular attention should be paid to the DSO level. In some countries, representatives from DSOs have alluded to the fact that DSOs in large and uninhabited areas are particularly in disadvantage. Very often, the underdeveloped infrastructure at distribution grid level must be completely refurbished. The costs for these investments have to be borne only by the few final customers of the DSO that cannot afford such a steep rise of their electricity bill. In the end, the DSO cannot pass costs on to final customers and has to bear the costs.

Presence and severity in different countries

Lack of incentives was explicitly mentioned as a barrier in 9 Member States (Austria, Bulgaria, Estonia, Finland, Germany, Great Britain, Spain, Slovakia and Slovenia). However, it should be pointed out that in some countries, for example in Germany, this issue was contested by other stakeholders. On the other hand there might be also other countries in which regulatory rules are insufficient but until now this has not been regarded as a particular problem.

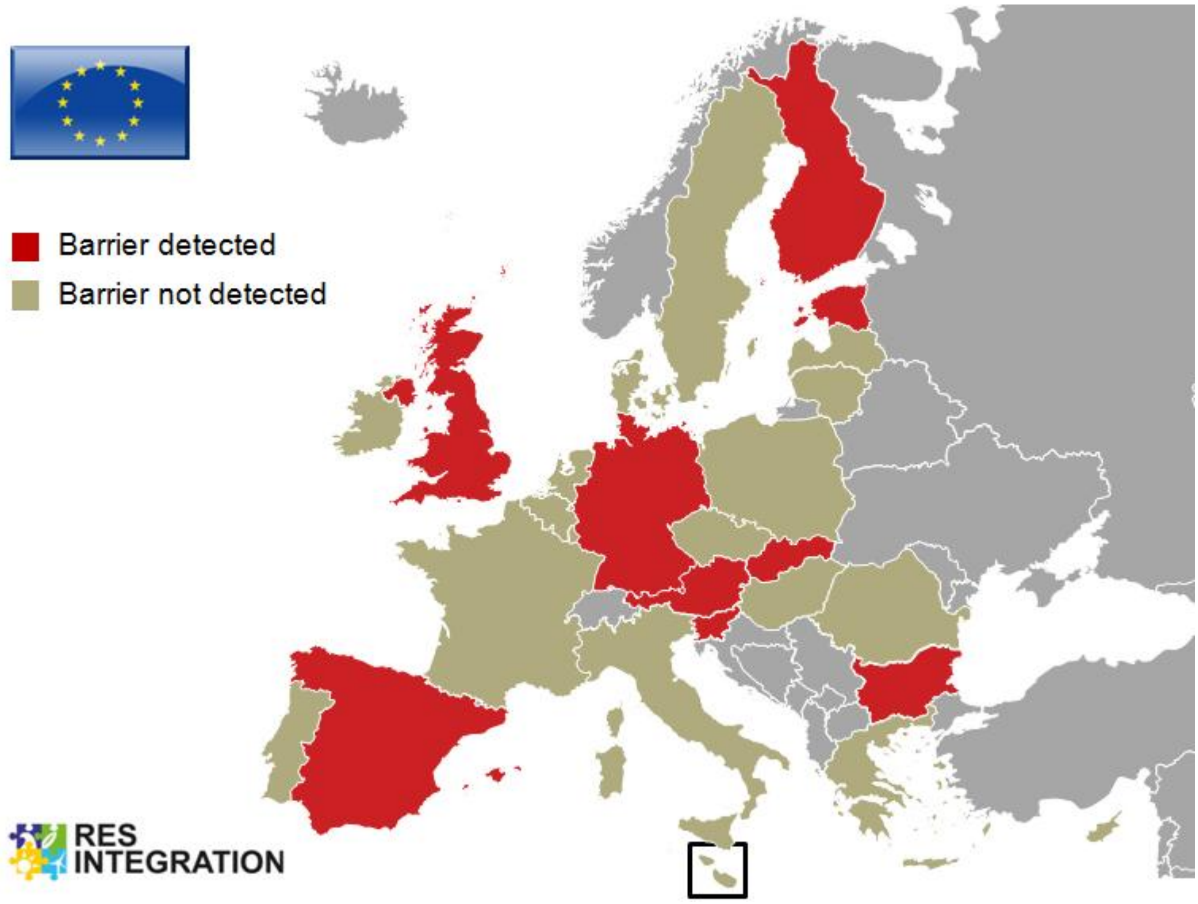


Figure 13: Geographic presence of the issue "Lack of incentives or regulatory instruments for the grid operator to reinforce the grid" in the EU 27. Green indicates that the issue was not reported, red indicates that the issue was reported in the Member State. This map should be read in connection to the country's RES-E share, as it is possible that a higher share implies the existence of more problems and the availability of more information. Source: RES Integration Project

Causes and interconnection to other issues

The general reason is that the national-legal and regulatory framework has not been adapted to take those challenges into account that arise from the increase of RES-E shares.

Possible solutions, based on evidence in EU Member States

The obvious measure to mitigate this issue is to modify the regulatory framework. A study recently conducted on behalf of the European Commission focusing on financing of energy structure projects found that the regulatory framework has to be transparent, reliable and attractive enough in terms of return. This can be achieved by

- harmonising regulatory regimes in order to create more comparability and transparency for investors;
- instituting measures that would create long-term stability for investment cases;
- extending regulatory periods and
- introducing so-called priority premiums, i.e. an equity return "adder" above the normal regulatory returns for specific projects, creating a further incentive for TSOs and equity providers (Roland Berger 2011 b).

The harmonisation of regulatory regimes appears to a debated topic and different views are provided on this aspect. At times harmonisation is called for, whereas at times it is deemed unnecessary. This also has to do with the broadness of the term "regulatory instrument". A notable example in this sense is the THINK project, which on one hand calls for harmonisation by stating that "the main shortcomings of the conventional regulatory framework are that grid companies have disincentives to innovate" (THINK 2011a), and on the other hand states that the heterogeneity of the general regulatory principles probably does not hamper adequate investments in neither national nor cross-border (THINK 2011b). The authors of this report view the harmonisation of regulatory regimes favourable, nevertheless they also recognise the delicacy of the topic and the validity of other points of view on the matter.

These measures would enhance infrastructural investments. Further measures that representatives from national TSO proposed were:

- counting of investments in the same regulatory periods;
- abolishment of minimum limits before investments will be reimbursed.

There are a number of options to introduce the issue of investment into the incentive regulation framework. However, more work needs to be done on how to redesign a regulatory framework that was set up to increase the efficiency of existing assets so that it can deal with long-term infrastructure development that is to a large extent driven by political objectives.

Due to substantial impact on national legal regimes, however, it seems necessary to introduce them as a concerted action at EU level. Major stakeholders, such as ENTSO-E, the main RES associations at EU level and the main regulator institutions such as ACER and CEER should be involved in the process.

As regards to the particular challenges for DSOs, it could be considered to introduce a nation-wide mechanism to distribute and share costs among all DSOs. This would ensure that small DSOs in scarcely populated regions or DSOs that have to accommodate a particularly high share of RES-E as well as their customers would not be discriminated by existing regulations. An example would be the cost-sharing mechanism applied in Denmark.

NREAP Assessment

The table below shows the results of the NREAP analysis. In a first step, we have indicated whether or not the issues that are discussed in this report have been detected in a particular Member State. If the issue was not identified in a country the respective cell is left white. In a second step, we coloured the cells according to the following rationale:

- If in a Member State the detected issue was not addressed at all the respective cell is coloured red;
- If the issue/problem was acknowledged but no solution proposed or if a solution was proposed but the solution seems obviously insufficient, the respective cell is coloured yellow.
- If the detected issue is mentioned in the NREAP and a proper solution has been formulated or the detected issue has been addressed by an appropriate solution independently from the NREAP, the relevant cell is coloured green.

Results are shown below:

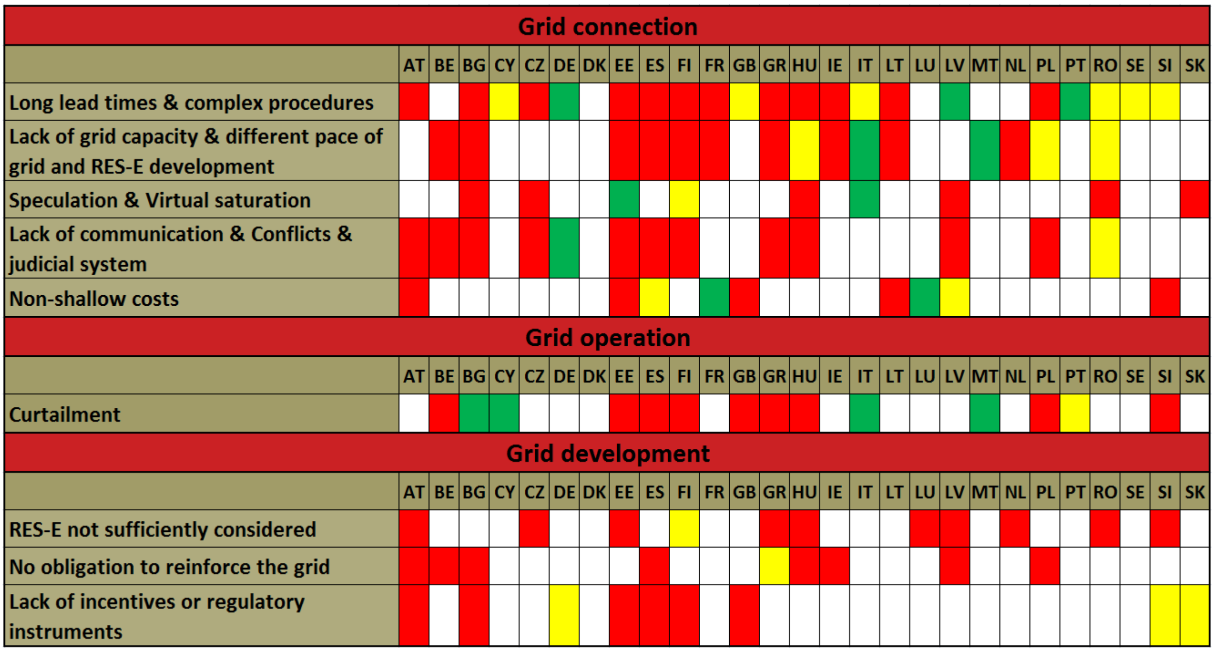


Table 12: Analysis of detected issues in the respective NREAPs; White: issue not detected; Red: not addressed in NREAP, Yellow: acknowledged but not solved, Green: addressed by an appropriate solution. Source: RES Integration Project

Please note that the focus of the NREAP table lies only on those barriers which have been analysed in the present final report. It is therefore possible that barriers which may have severe impact in a respective country are not shown in this overview. The above classification does not allow for a final evaluation of the NREAP's quality of a respective Member State. The authors would like to stress that the table is only meant to provide an overview of the situation at European level, and that for a detailed assessment of the Member States' NREAPs referral should be done only to the national reports.

The results of a comparison between Member States are striking. Except from a few examples, most of the barriers that were identified in our research at national level have not been addressed at all. The following reasons could help explaining this finding.

- First, Member States did not mention the barriers because they were not aware of them. This reasoning would call for a regular monitoring mechanism that compiles information from stakeholders (RES-E industry, grid operators) in order to provide Member States with a continuous information flow on the challenges and roadblocks in the RES-E sector. This information could be collected either through interviews as it happened in this project or by installing a (online-) suggestion box at which stakeholders can address the barriers they have been facing. Either case, Member States governments would have a better understanding of which barriers are currently existing and they could take decisions on a better foundation;
- Second Member States did not mention these issues because they had no interest in sharing this information with the Commission. One option to deal with such behaviour would be to convince Member States that it is them who mainly benefit from a thorough participation in the NREAP process. Another (additional) option might be to provide the Commission with sufficient information in order to base its findings on own sources. In this context it might be also in the interest of the Commission to install a transparent online suggestion box;
- Third, the issue was not mentioned in the NREAP because it did not fit into the categories in which the NREAP template was structured. This explanation seems quite obvious if the issue was unknown or if it addresses an issue that is not subject of the RES Directive and, consequently, of the NREAP (for example weaknesses of the judicial system). In order to tackle also these issues, it may be advised to widen the scope of the NREAP template and to supplement it by open questions, which refer to the existence of barriers as such (e.g. “Which barriers is the RES-E sector currently facing during the grid connection process?”).

Options to promote market integration

In many countries, electricity generation from renewables (RES-E) is taking over a relevant share of the market and political objectives aim at a further increase. As RES-E is no longer a niche technology, the interaction between RES-E and the electricity market cannot be neglected anymore. This has two dimensions: First of all, in operational terms, RES-E affects the supply-demand balance and electricity prices. Therefore, it can be argued that RES-E operation should react to (short-term) market signals to the extent possible. In addition, the question arises whether RES-E with its generally low marginal costs undermines the marginal cost-based market model and thus exacerbates the investment problem that potentially exists in electricity markets.

This report focuses on the first dimension only. It proposes a differentiated view on market integration that enables a structured analysis of different market integration mechanisms found in the EU-27 country review. More details of these can be found in the country reports.

Market integration can have two meanings:

A) RES-E does not get support beyond the market price level.
B) RES-E reacts to short term market signals (market prices and demand).

In the following, support for RES-E above market price levels is not called into question as these technologies continue to require support. The focus is on meaning B). Importantly, this does not imply market integration according to meaning A).

Market integration of RES-E has become a more relevant issue on the agenda for a number of reasons:

First, in many European Member States RES-E has increased significantly over recent years. Both technical and economical characteristics of RES-E have an impact on electricity markets, including lower market prices or even negative prices that have already been observed for example in Germany, and that may occur more frequently with an increasing share of RES-E (Brandstätt et al 2011). In order to reduce this impact of RES-E on the market and other market players, it may be argued that RES-E should be integrated into electricity markets so that it can react to market signals. For example, RES-E would stop generating in times of oversupply, thus reducing negative prices in the market.

Second, support and protection from the market mechanisms is normally granted only for a limited period of time, e.g. 20 years. Afterwards RES-E producers will have to participate in the electricity markets, even in countries that offer fixed feed-in tariffs (Ragwitz, Sensfuß 2008). Some authors therefore argue in favour of revised support instruments so that RES-E producers can gain market experience before they are obliged to participate only on the wholesale markets (Hüttner 2010).

Third, it can be argued that shielding RES-E from market pressure has been appropriate as long as these technologies have been in a development phase. In that period, support schemes separate from the markets can provide the necessary investment security. However, once they become more mature, they should be treated more like other generators. Nevertheless, when discussing the need for market integration, we need to bear in mind how this affects the effectiveness and efficiency of support mechanisms in place.

The market integration chapter is structured as follows:

First, the main characteristics of RES-E technologies are recalled as an important factor that determines their ability to react to market signals.

Second, a differentiated view on market integration is proposed, that takes into account

1) the flexibility of RES-E,
2) three types of electricity market risk, namely price, volume and balancing risk,
3) the fact that market integration is not just about adapting support schemes, but what is at least as important is a market design that enables RES-E to participate in the market.

Third, based on these arguments, an overview of different market integration mechanisms in the EU-27 is presented, showing a broad range of approaches to deal with price, volume and balancing risk.

The focus of this chapter is on fluctuating RES-E like wind and solar. For dispatchable RES-E like biogas plants, market integration is more straightforward. When designing the regulatory framework for these plants a key question is whether they should react to market signals to provide flexibility or whether they should maximise production to replace a maximum number of conventional energy production.

Flexibility of RES-E

A fundamental prerequisite for market integration to function is the flexibility of the participating technologies to react to market signals. This flexibility of RES-E is typically lower as compared to conventional generation. Especially in the case of fluctuating RES-E like wind and solar, flexibility is restricted by the availability of the primary energy source. This needs to be taken into account when designing market integration mechanisms. Therefore, this section briefly sets out the main characteristics of RES-E technologies as well as their resulting flexibility potential.

Technology characteristic of RES-E

Two characteristics of fluctuating RES-E are important to bear in mind when discussing their potential for market integration (IEA 2011):

- generation of these plants does not necessarily match with the fluctuating demand (*variability*) and
- the generation profile of fluctuating RES-E plants is typically only to some extent predictable (*uncertainty*).

Both are not new phenomena in the power sector, as power plants have always had to react to uncertain demand variations. However, with the increase of fluctuating RES-E these two issues become more prominent on the supply side.

While demand variability typically follows certain patterns, the combination of both demand and supply variability leads to more irregular profiles that have to be covered by the rest of the system (residual or net load).

Variability of RES-E first refers to the fact that generation does not necessarily follow demand profiles. For example wind supply can be high when demand is low. Second, the generation profile varies over time, rather than providing a stable output. For example, wind output can change significantly within minutes. Important parameters of the variability of RES-E technologies include timely pattern of variability (e.g. variations from minute to minute for wind and solar or seasonal patterns for wind, solar, hydro and biomass), whether the variability follows a certain pattern (e.g. day-night in the case of solar, whereas wind patterns are more random, at least in the short term) as well as the ramps by which generation increases or decreases.

The second issue is the uncertainty of the generation profile of fluctuating RES-E. The generation of fluctuating RES-E does not just vary depending on weather conditions, but on top of their variability their generation is also difficult to forecast. From a system perspective, this complicates the process of balancing demand and supply at all times and increases the need for balancing capacity, including flexible capacity that is made available before real time.

While solar power has relatively predictable generation patterns, this is not the case for wind generation. However, also with solar energy it can never be assured that sun radiation will be available as forecasted.

Potential contributions of RES-E to deal with system challenges

Due to the specific characteristics of fluctuating RES-E plants, their ability to react to market signals in a flexible way is limited. Nevertheless, these generators can offer some level of flexibility. Before discussing market integration strategies that aim at exploiting this flexibility, this section briefly discusses the flexibility potential of RES-E plants.

In terms of dealing with variability, the flexibility of fluctuating RES-E plants is fundamentally limited by the availability of the primary energy source that determines the maximum available generation for a given time period. Therefore, the only flexibility fluctuating RES-E can offer is to generate below that maximum. This can be used to adapt generation to demand when there is excess supply or to provide positive balancing capacity.

Within these limitations, RES-E can in principle quite flexibly reduce its output. In that respect they are more flexible than many conventional generators that are bounded by ramp rates, start-up costs as well as minimum down- and minimum up-times. Generators that operate below the maximum defined by weather conditions can easily be ramped up within seconds and thus participate in the provision of balancing capacity. However, there is always a trade-off between curtailing RES-E to exploit their flexibility on the one hand and maximising the output of CO_2-free electricity generation on the other hand.

Another potential flexibility measure is to adjust maintenance periods of RES-E plants to demand, so as to make sure that plants are available when needed. Maintenance planning is argued to have the potential to increase the requirement-orientated operating of intermittent RES-E technology, in particular wind power (Hiroux and Saguan, 2010). However, the economic potential of strategic scheduling of RES-E generators is not as high as for conventional power plants as the technical availability factor of wind turbines is much higher. Conventional generators have availability factors ranging from 70 % - 90 % and wind generators of about 97,5 % (IEA, 2007), thus they require less time for maintenance purposes than conventional generators. Photovoltaic (PV), the most durable RES-E technology, has an availability factor of almost 100% since it does not utilize moving parts and maintenance entails mostly cleaning of PV modules. Therefore, the potential of shifting maintenance to periods of low demand is very limited in terms of achieving more demand-orientated supply.

While the selection of the geographical location of solar power plants has only a negligible effect on the temporal production patterns, locations of wind farms have a greater impact on the output. Therefore the selection of production sites can positively influence the demand-orientated production if load curves are taken into account in selection processes (Hiroux and Saguan, 2010). The location of production sites affects the temporal generation pattern in the long-term (e.g. seasonal patterns), but also short-term variations. For example sea breezes are more stable than land breezes (IEA, 2007). The selection of production sites could therefore also contribute to a less volatile RES-E production, which also reduces the demand for flexible resources.

While fluctuating RES-E plants depend on weather conditions, the flexibility of dispatchable RES-E technologies, e.g. biomass, to adapt to short-term market developments depends on the available storage capacity (e.g. biogas storage, or heat storage in the case of CHP plants), and the ratio between electricity generation capacity and available storage volume.

In terms of dealing with uncertainty a key measure is to improve generation forecasts. As electricity generation from intermittent RES-E always depend on weather conditions, better forecasting reduces the deviation of actual generation from the forecasted output. There has already been significant progress in this area and there is potential for further. According to Dena it is expected that until 2020 forecasting errors can be reduced by 45 % (Dena 2010). Overall, it is clear that an increasing share of RES-E requires the electricity system to become more flexible in order to deal with the technological characteristics of RES-E. RES-E can provide some flexibility, but a large part of the required flexibility needs to be provided by other market participants, including the demand side, storage, conventional generators as well as grid developments that allow exploiting the geographical distribution of RES-E.

A differentiated view on market integration

Market integration means exposure to risk

If RES-E plants are integrated into the market, their revenue risk will increase This can be divided into three risk elements (Mitchell et al 2006):

- price risk
- volume risk
- balancing risk.

This differentiation is important for the further analysis because the extent to which generators are exposed to these different risk dimensions should match their ability to manage these risks by providing the flexibility described in the previous section.

First, in liberalised markets prices are generally volatile and market integration exposes generators to market price fluctuations. This includes both a short-term and a long-term dimension. Short-term **price risk** refers to a setting where generators are incentivised to adapt their production profile to the market situation, i.e. generate when prices are high, thereby providing the flexibility potential outlined in the previous section. As opposed to short-term risk, long-term price risk means that prices change over time, e.g. when the feed-in tariff is not fixed, but is adapted on an annual basis. In this case, the generator is clearly exposed to a price risk (although in the example it is a regulatory risk rather than a market risk), but these long-term price variations do not promote RES-E flexibility potentials.

A fixed feed-in tariff does not entail any price risk, whereas both the quota and the premium support scheme involve a market price risk since RES-E generators have to sell their output directly on the market. However, even under a quota or premium scheme it is not guaranteed that short-term price signals feed through to a generator's production decision, since generators may sell their output based on long-term contracts.

Besides, high penetration levels of RES-E can lead to a reduction of market prices (De Miera et al 2008). If trading is based on the system marginal price, the very low marginal costs of intermittent RES-E can significantly decrease market prices. This means that the revenue of generators, including RES-E, will decrease if they have to trade their energy on the open market (Klessmann et al., 2008).

Second, a generator's revenue is always the function of both price and volume. With the feed-in tariff which is mostly combined with priority dispatch there is no **volume risk** involved since the whole production can always be sold. As opposed to a priority dispatch regime, both under the quota and the premium scheme operators have to find counterparties to sell their production. Hence, there is always the risk that a plant cannot sell its total production and thus loses revenue. However, in the case of RES-E with low marginal costs it is rather unlikely that plants will not be dispatched.

Third, market integration also increases the **balancing risk** for generators. If they sell their output on the market, they are typically not only exposed to fluctuating market prices, but they also become responsible for imbalances. This balancing responsibility generally entails the additional risk of imbalance penalties to RES-E producers. The imbalance risk is similar to the general market price risk in that it is driven by imbalance prices on the market. However, in addition it also depends on a generator's imbalances. Clearly, balancing always puts intermittent RES-E producers at a relative disadvantage to conventional, more predictable generators due to their limited forecasting capabilities (Waltham 2008).

Market integration requires an appropriate market design

Market integration is not just about RES-E support instruments, but also about market design. Generally speaking, market integration of RES-E requires the proper functioning of the electricity market. Electricity markets have to be designed in a way that RES-E, especially intermittent RES-E with its very specific characteristics is enabled to actually participate in market trading.

If RES-E plants are exposed to the market risks outlined in the previous section, there should be no market risk due to markets that are not functioning properly. This means that market should be transparent and liquid. Moreover, if RES-E is to participate in the market, the market design should not only be geared towards large-scale controllable plants, but should also enable RES-E to manage their specific risk. The design of electricity markets should enable plants to participate in wholesale and possibly even balancing markets, and provide the electricity products they can generate. If RES generators are required to take on balancing responsibilities and are exposed to balancing market prices, these markets should be designed so that generators are not unduly penalised for their generation characteristics, especially in the case of fluctuating generation. In that sense, market design is complementary to support instruments that promote market integration.

Moreover, a market design that accommodates the specific characteristics of variable and uncertain RES-E can to some extent also be an alternative to integrating RES-E into markets. In this case, the market can ensure that the most efficient option that is available in the system is used to manage RES-E variability and uncertainty, which may solve a larger part of the problem than letting RES-E manage these features themselves.

In terms of uncertainty, trading close to real-time is particularly important for fluctuating RES-E, because generation forecasts significantly improve closer to real-time. The use of day-ahead and especially intra-day markets is therefore particularly important if intermittent RES-E generators are responsible for balancing their output.

Also important for the same reason is the setting of the gate closure that regulates the closure of any markets (e. g. intra-day market) before the system operator takes over with real-time balancing. There is a positive relation between short gate closure time and accurate forecasting (Barth et al 2008; Müsgens and Neuhoff 2006).

Where should RES-E plants be exposed to risk?

At first sight, full market integration can provide the most efficient operation of RES-E plants. In this view, the competitive market is the best way to exploit flexibility and market integration provides RES-E plants with complete transparency about market conditions and incentives to react to these conditions.

However, there are a number of arguments against full market integration. First of all, there is a trade-off between full market integration and the risk it entails on the one hand and the need to provide a stable investment environment for RES-E in order to enable further RES-E expansion (Mitchell, et. all 2006). Market integration may help exploit RES-E flexibility, but can undermine support schemes in place.

On top of this general argument, a second issue is that RES-E can offer only limited flexibility, as was shown above. From an individual generator's perspective, this implies that it has only a limited capability to manage market price risks. From a system perspective, this means that exposing RES-E to market price is an insufficient approach to provide the required flexibility. This means that RES-E plants should only be exposed to the type and level of risk they can manage, whereas other measures are required to deal with the remaining variability and uncertainty in the system. These measures include first and foremost an appropriate market design.

Third, the differentiation between different market risks that was put forward above also enables a differentiated view on market integration. If the analysis of the flexibility potential of RES-E is combined with the differentiated risk analysis, this provides the basis for a more differentiated evaluation of the potential to integrate RES-E into markets that moves beyond simply juxtaposing "feed-in with no market integration" on the one hand and "quota with full market integration" on the other hand.

The following table provides an overview of possible responses to the RES-E characteristics variability and uncertainty as well as possible policy instruments to promote these responses.

RES-E Characteristics	Possible responses	Policy Instruments
Variability	**Turn down RES-E plants**	Expose plants to some level of price risk Requires support mechanisms that expose RES-E to market signals and functioning markets.
	Manage maintenance periods taking into account market needs	
	Chose locations that provide favourable generation profile	
Uncertainty	**Improve forecasts**	But not necessarily by exposing individual RES-E generators to balancing risk: Smaller systems are more difficult to forecast Other actors may be better positioned to provide efficient forecasts
	Provide efficient balancing	Critically depends on a competitive market and flexible market design (intraday market etc.) Rather than balancing by individual RES-E generators (may even be counterproductive) Balancing incentives in the support scheme only addresses the smaller part of the problem

Table 13: How to deal with RES-E variability and uncertainty

In terms of variability, fluctuating RES-E plants can offer some level of flexibility that can be exploited by exposing RES-E to **price risk and volume risk**. This requires functioning markets. However, the flexibility potential that can be exploited is rather limited. This needs to be taken into account when evaluating the trade-off between tapping this flexibility and potentially weakening the support for RES-E.

In terms of uncertainty, RES-E needs to be exposed to **balancing risk** to be incentivised to reduce uncertainty. However, the key measures to deal with uncertainty are to improve forecasts to reduce uncertainty on the one hand and to provide efficient balancing to manage remaining imbalances on the other hand. In both cases it is doubtful whether individual RES-E plants are in the best position to implement these responses.

In the case of improving forecasts, this can be done by individual generators, but may as well be done on a more aggregated level, especially as small systems are inherently more difficult to forecast. Moreover, forecasting for wind and solar could be done on a system level and could therefore be carried out more effectively by a central actor.

As for balancing remaining uncertainties, the key question is whether this should be done on an individual or on a system level. It is quite obvious that providing balancing capacity on an individual level (e.g. a battery next to each wind generator) requires a higher overall balancing capacity and leads to higher costs than balancing on a system level where individual imbalances at least partly offset each other.

Therefore, it is clear that the objective of exposing generators to balancing risk should not be for them to provide the required balancing capacity themselves. Rather, it should incentivise RES-E generators to procure balancing services from the system, i.e. the balancing market. A key prerequisite for this is a market design that allows for flexibility, including functioning intraday and balancing markets.

However, once such a market is set up, there is not much additional benefit in requiring RES-E generators to buy balancing services on this market in comparison with putting this obligation on other market players. On the contrary, other market players that have a more systemic view like the TSO are better positioned to buy balancing services to deal with RES-E uncertainty, whereas RES-E generators may be incentivised to set up inefficient small-scale balancing capacity.

Assuming that besides improving forecasts (which can also be done on a more aggregated level, see above) RES-E generators have only limited means to reduce their imbalances, the effect of exposing RES-E generators to imbalance risk is mainly to shift the costs of imbalances to these generators. However, this happens without exploiting much additional potential to manage this uncertainty. Therefore, when it comes to dealing with RES-E imbalances, the key instrument is to set up functioning intraday and balancing markets, whereas exposing RES-E to balancing risk may even be counterproductive.

Options to deal with volume, price and balancing risk: Approaches in the EU-27

As outlined in the previous section, depending on the market design and especially the structure of the support scheme RES-E producers can be exposed to three different types of risk: price risk, volume risk and balancing risk. The following section provides a summary of possible approaches and country examples along these three categories in the EU-27. It shows a wide variety of approaches to deal with the different market risks beyond a simple quota vs. feed-in dichotomy.

Support schemes are generally divided into investment support on the one hand (e.g. tax reductions or exemptions) and support instruments for the electricity produced (including both price- and quantity-based instruments) on the other hand. In this report, the focus is on the latter as these mechanisms are most relevant in terms of market integration.

Price risk

In the EU-27 a broad number of different mechanisms can be found that expose RES-E to different levels of price risk. These are located between two polar cases: fixed feed-in with no price risk on the one hand and quota schemes with full exposure to price risk on the other hand.

Feed-in tariffs with fixed tariffs do not entail any short-term price risk. The other support schemes in principle result in full price risk (long-term and short-term) since generators have to participate directly in the electricity markets. However, it is not necessarily guaranteed that short-term price signals will influence RES-E generators in their production decision as they can always agree on long-term contacts and by this avoid short-term price fluctuations.

Figure 14 shows, that different support scheme designs can offer a wide range of exposing producers to price risks. These can vary from a classical fixed feed-in-tariff with no price risk to a classical quota system with full price risk.

There are different approaches to balance the market risk of RES-E producers and adapt it to their technical capabilities. One approach is to give RES-E producers the option to choose between different support schemes involving different levels of risk (e.g. **Slovenia, Spain, Germany, Czech Republic**) or even to combine the schemes. For example, in **Italy** the general promotion system is based on a quota system with green certificates but producers can also sell their electricity on the free market within a specific regulatory system with the TSO or decide to use the net-metering option.

In other countries, RES-E plants are assigned to a specific scheme depending for example on the technology or size (e.g. **Greece, Czech Republic, UK**). Thus, the different capabilities to manage risk can be taken into account. However, in most countries there is just one support scheme option for RES-E producers and thus only one level of price risk.

Instead of providing a choice between different support schemes with different risk profiles, there are also countries that offer the possibility to temporarily opt-out of the existing support scheme to directly participate in the market. The risk the producers take therewith depends on the specific opt-out regulation. While in **Latvia** and **Austria**, RES-E has to renounce the FiT for a whole year, opting-out can be done on a monthly basis in **Germany**. In **France**, once the producer has quit the tariff, it is not allowed to re-enter the feed-in tariff scheme.

Figure 14: Price risk scale from fixed feed-in tariff to a quota scheme

Feed-in-tariff

There is no price risk for producers which receive a feed-in tariff, if the feed-in tariff is fixed. The feed-in tariff grants the eligible entity a pre-defined remuneration for a pre-defined time, independent of market prices. Most countries with a feed-in scheme (e.g. **Bulgaria, Cyprus, Germany, Ireland**) provide fixed feed-in-tariffs where the level of the tariff will not be influenced by any market development. Hence, RES-E is completely protected from any price fluctuations and thus from any price risk.

In some countries the feed-in tariff changes in the course of the support period, but changes know ex-ante (e.g. **Austria**). In some other cases there are legally defined tariff adjustments that are not predetermined. In **Latvia** the reduction of the FiT depends on a formula that includes the price of natural gas, the exchange rate between the Latvian Lat and the Euro, and a special coefficient depending on the system size. In **Bulgaria** the adjustment is based only on the average electricity price. Even though these mechanisms introduce some price risk, it is a long-term risk and does not incentivise generators to react to short-term market developments.

In some countries there are certain restrictions set on whether a RES-E generator is eligible for the FiT. Mostly it depends on system size, installed capacity or like in **Austria** on the degree of efficiency of fuel input (biogas, biomass, geothermal and hydro-electricity). If these installations reach an efficiency of 60 % they are eligible for the feed-in support (RES LEGAL 2011). In comparison, other countries have a fixed state budget for the support of RES (or only for some technologies, e.g. Austria has a specific budget for photovoltaic plants). However, if the fixed state budget for RES-E is depleted (in Austria, there is already a waiting list for the support of photovoltaic plants) producers have to participate in the market and carry the full price risk.

The **Netherlands** are also planning to introduce such a limited state budget. There will be four deadlines each year to apply for support (Ministry of Economic Affairs 2011). Least expensive technologies can apply for subsidies first. The contribution to be paid as subsidy will be increased from phase to phase, thus the cheapest forms of RES is the first to benefit from the scheme. More costly projects can apply for higher subsidies, but only after the first round of allocation and if funding is left available in the annual budget.

Volume restrictions are another form to limit the budget for supporting RES. For example, in **Cyprus** there are special volume restrictions for the overall installed capacity per technology. In Latvia a cap on the total volume of RES-E is set. Like in the **Netherlands**, RES-E generators have to apply for the feed-in-tariff. The TSO’s obligation to buy RES-E for the feed-in-tariff stops when the share of RES-E set by the government is fulfilled. Producers which are not eligible for the FiT anymore or those which decide not to apply for FiT sell their output on the free market and thus carry the full price risk.

The same applies for **Austria**, where generators have to announce the opt-out of the FiT to the respective balancing group and the Clearing Agency for Green Electricity (OeMAG) at least 30 working days before the planned switch date. After concluding the new contract plant operators are obliged to stay with the new balancing group for at least 12 month (OeMAG 2011, Green Electricity Law 2011, E-Control 2011). A more producer friendly regulation is set in **Germany**. Producers can opt-out of the feed-in tariff scheme for at least one calendar month and directly participate in the market (EEG 2011). Producers can return to the feed-in scheme on a monthly basis, by indicating this at the beginning of the preceding calendar month. Hence, although the original support scheme protects RES-E from price fluctuations on the market it also gives willing producers the opportunity to participate and gain hands-on experiences on the market.

While the feed-in elements that have been presented so far are mainly about long-term price risk and the option to choose between FiT and direct market participation, there are also mechanisms that introduce an element of short-term price risk into the FiT. One option for a more market-oriented alignment of feed-in tariffs is varying tariffs within the feed-in scheme. In this case, the prices are not directly linked to the short-term market situation, but rather follow a predefined pattern.

Such a scheme is in place for example in **Hungary**. Tariffs vary by time and weekday depending on the demand profile (peak, valley and deep valley periods) but also vary between summer and winter (Couture-Gagnon 2010, Reshaping 2009). Weather dependent RES are exempted from these tariff variations since they cannot adjust their production like other generators. In **Portugal** RES-E producers receive a monthly payment that is defined each month for both existing and new installations according to a formula which is including various factors. The RES-E producer can decide if the production time of the day is included in the formula, too. Then, the formula will be multiplied by 1.25 for the amount of electricity generated between 8:00 and 22:00 o'clock during wintertime and 9:00 and 23:00 o'clock during summertime (peak hours) and by 0.65 for the injection during the residual off-peak hours. Hence, RES-E producers could be influenced in their production time, but will be also exposed to higher price risks when they are not able to supply electricity in line with this profile.

Another option for differentiating tariffs is implemented in **Spain** (not available for wind, PV generators and CSP plants). It is called time of use (ToU). It aims at incentivising demand oriented production of RES-E producers. Producers can choose a flexible tariff that distinguishes between two load categories during the day. During peak hour the payment is increased by 4.62 %. It is reduced by 3.3 % in base load hours (Ragwitz et al, 2010). The choice is valid for one year. One of the disadvantages of these approaches is that it assumes predefined demand profiles, while with an increasing share of RES-E it is the residual load (i.e. including RES-E fluctuations) that becomes more relevant than the demand profile. The residual load follows a clearly defined pattern only to a much smaller extent. One option would therefore be to adapt the periods where different tariffs are valid more regularly, e.g. on a daily basis.

In summary, the review of different feed-in-tariffs shows that various feed-in mechanisms entail long-term risk elements, for example if tariffs are adjusted on an annual basis. However, these do not promote RES-E flexibility. Moreover, while the original fixed feed-in payment protects market participants from any short-term price risk, there are some examples of feed-in mechanisms that reflect short-term market signals to a certain extent.

Premium schemes

In recent years, some countries have moved from the classical feed-in-tariff to a more market-oriented premium scheme, where a premium is paid on top of the market price. Like the feed-in tariff, the premium approach represents a price-based instrument, yet RES-E directly participate in the market. The overall remuneration depends on the market price. The price risk of the premium support scheme depends very much on how the premium is defined.

The premium option with the lowest price risk is the sliding premium. In this case, the premium paid on top of the market price is a linear function of the wholesale electricity price (Kema 2009, Improgres 2010). For example, in the **Netherlands**, the premium is adjusted ex-post on an annual basis depending on the average electricity price. In **Finland**, the flexible premium which is paid to RES-E producers is the difference between the quarterly average spot market price and the fixed guaranteed price (Interview: VTT 2011a, Interview: Fingrid 2011). It is calculated as the difference between the so called base tariff that represents the projected RES-E production costs and the correction tariff that is based on the average market price. There was a discussion in Finland during the legislation process that the reference market price on which the sliding premium is based should be calculated as the annual average rather than the quarterly average (Interview: VTT 2011). Annual averages would help to promote sites with a seasonal generation pattern that fits the demand profile, but would postpone the payments to the wind power generators.

There is also an overall upper limit on the premium payment that is binding once the market price falls below a pre-defined price. In the **UK**, the government proposes a feed-in tariff combined with so called ‘contracts for difference’. Essentially, this is a sliding premium scheme as applied in the **Netherlands**. Although, with this premium support RES-E generators are exposed to lower upside and downside price fluctuations they still have some incentive to react to market signals. The challenge is to adapt production to these signals and by doing so increasing their income. If they manage to outperform the average electricity price they can increase their revenues. If not, they receive at least the average electricity price.

An innovative market integration element will be introduced with the ‘Anholt’ offshore wind park (planned connection time 2012-2013) in **Denmark**. Support is based on a sliding premium mechanism. The additional restriction is that there are no premium payments if the market price becomes negative. Thus, producers are incentivised to reduce their output if supply exceeds demand.

Another version of a premium-based scheme that increases the price risk compared to the previous models is the premium with a cap and floor price. In **Spain**, one of the countries with more than one support scheme in place the cap-and-floor premium is intentionally set at a higher level than the feed-in-tariff. This is in order to compensate for the price risks in the competitive market and to create a financial incentive for producers to participate in the wholesale market (Hiroux, Sagun 2010).

If there is a regulated cap and floor price, total remuneration (market price + premium) cannot exceed or fall below these limits. If the wholesale market price varies within a certain price span, producers under this scheme receive a fixed premium. However, if the pool price exceeds a certain level the premium payment decreases so that the total remuneration is limited to the cap price. In cases where the market price exceeds the cap no premium is paid. The floor price provides security of price risks in times of high wind feed-in (Klessmann et al, 2008). While the cap and floor price provides more investment security it also partially hinders market signals, which is one of the biggest advantages of premium systems (Schallenberg-Rodríguez 2011).

If there is a fixed premium in place (e. g. **Estonia, Denmark** for onshore plants if erected by private investors), generators are exposed to the highest level of price risk compared to other premium approaches outlined above. In this case, there is no upper or lower limit set for the total remuneration, no matter how high or low market prices are.

Quota regulation

The quota regulation with tradable green certificates (GC) is the scheme with the highest risk in terms of prices, but also in terms of volume and balancing risk (Mitchell et al. 2006). The **UK** quota obligation (Renewables Obligation Certificates – ROCs) exposes RES-E generators to the full extent of market risks. Importantly, under this support scheme design generators are in principle exposed to price fluctuations in both the electricity and the certificate market.

In general, each electricity producer has to fulfil a certain quota of green electricity which increases over the years. Whereas RES-E quotas are technology neutral in **Sweden** and **Romania**, the number of certificates per MWh differs in **Great Britain** depending on the technology (Wood, Dow 2011). RES-E generators receive certificates, which can be traded on a special green certificate market, for every unit of RES-E (in general one MWh). Hence, the remuneration for the GC can be interpreted as a dynamic premium on top of the market price for electricity. Non-compliance with the quota generally results in a penalty, which is basically an upper cap on the premium price. For example, in **Sweden** the fee corresponds to 150% of the average certificate price for a given year (Swedish Energy Agency 2010).

Green certificate prices are generally determined by market mechanisms. However, in order to limit the risk for RES-E producers, premium prices can also be regulated. For example, **Romania** introduced a minimum and maximum price range (27-55€) for GC. Hence, RES-E producers still carry the whole price risk on the electricity market but are protected from low prices on the green certificate market. The same mechanism is put in place in **Poland**. Because of the shortage of RES-E the price for certificates has been mainly determined by regulation rather than by the market, similar to a feed-in system (Obersteiner, 2008). In **Italy**, the floor price is also set by the regulator since it holds a large amount of GCs. Producers can trade their certificates bilaterally but are not able to sell at a price higher than the price for the GCs of GSE (IEA 2008, Watson, Farley, Williams 2008).

Additionally, **Poland** provides another mechanism that limits the risk of RES producers. In case the electricity price drops under a certain threshold the Polish TSO and DSOs have to buy RES-E at a fixed price which is set annually by the Regulator depending on the average electricity price in the competitive segment of the wholesale market of the previous year. So far, RES-E has generally been traded in the market above the fixed price. This purchase obligation serves as a minimal price floor for RES-E producers and limits their economic risk to a certain degree.

However, even with a quota system it is not always guaranteed that RES-E producers are exposed to short-term price signals. This is due to two reasons:

First, power plants are in principle dispatched in order of their marginal costs. RES-E technologies are mainly characterised by very low fuel and operating (variable) costs. In particular intermittent RES-E have near zero variable cost, therefore they rank first in the merit-order of power plant dispatch and will therefore hardly react to low electricity prices, unless prices become negative.

Second, a big share of electricity is already traded upon long-term contracts and on future markets. For example in **Poland**, the TSO has been the main buyer and seller of long-term power agreements with all generators which defined price and quantity of power to be sold for a period of up to 30 years (Jouret, 2006).

Volume risk

Volume risk refers to the fact that RES-E producers cannot be certain that their output will be bought in a competitive market. Besides the already existing demand fluctuations, substantial amounts of RES-E in the market will put an additional variability factor to the equation. Especially, in times of low demand combined with high wind in-feed there might be already too much electricity available so that there is no take-off guaranteed.

With the existing support schemes there is no volume risk for RES-E generators if they have priority dispatch like for instance in **Germany**. Usually, this rule is combined with a feed-in-tariff. So, every RES-E producer classified under this support scheme receives the FiT per produced unit. Independent from any price signals it will feed in its whole electricity production (Klessmann et al, 2008). **Austria** has extended its mandatory purchase obligation for RES-E for another 12 years after the eligibility of the FiT is expired. By this producers carry no volume risk at all (Reshaping 2009).

In contrast, under the premium tariff and the quota scheme, producers have to fully participate in the market. Although there might be reduced price risk elements like the cap and floor price of the premium or the additional income from the green certificates, producers have to carry volume risks. They need to find trading counterparties on the competitive market (Hiroux, Sagun 2010). For instance in **Estonia** and **Finland**, there is no purchase obligation for RES-E and producers have to sell the electricity on the competitive market like any other market participant.

However, a number of countries introduced further risk reducing elements within their schemes. The premium scheme in the **Czech Republic** is combined with a take-off obligation for the DSO and the TSO to buy all RES-E outcome (GreenNet incentives 2009). Hence, even though there is no volume risk for RES-E plants there is still a limited price risk. In **Poland**, the quota regulation is limited in the way that the TSO and the DSOs have to buy all RES-E for a pre-defined price. Hence, producers can try to sell their production on the market but, in case of low prices or excess supply they can choose to trade with the TSO.

Balancing risk

In countries where the support scheme is based on a feed-in tariff, there is typically no full balancing risk for RES-E producers. The feed-in system includes a purchase obligation by the Distribution or Transmission System Operator or the Last Resort Supplier together with the transfer of the balancing responsibility of the RES-E production (e.g. **Portugal, Slovakia** and in case of FiT in **Germany**).

However, RES-E producers can be obliged to predict the amount of electricity they will feed into the grid even in a support scheme based on feed-in-tariffs. This forecast obligation is supposed to facilitate the market integration of the electricity from RES-E. For example, to receive accurate forecasts, **Italy** pays producers which meet their forecasts. Hence, the producer can increase its benefit by providing accurate forecasts, but will not be penalised in case of imbalances. In contrast to Italy some other countries that apply a feed-in scheme penalise RES-E producers if their real production deviates from their announced production (e.g. **Bulgaria, Latvia)**. The penalties can reduce the expected benefit from the feed-in-tariff in case of imbalances and lead to a higher incentive for producers to provide accurate forecasts.

In **Italy** the TSO "Terna" provides an incentive to accurately forecast the electricity production. A bonus is paid if the actual production is in line with the initially announced production forecast (RES LEGAL 2011). Such a positive incentive is consistent with the fact that RES-E generators do not have a balancing responsibility and do not participate in the Intraday Market, but can still seek to improve their production forecasts.

In **Bulgaria** there is a feed-in support scheme with a forecast obligation for RES-E producers. However, in practice, the data is only for information purposes and there are no penalties in case of forecast errors (Interview: Bulgarian Wind Energy Association 2011). In theory, the TSO should penalise RES producers in Bulgaria which deviate more than 20 % from their production forecast (Interview: E.ON Bulgaria).

While Bulgaria gives a tolerance band for deviations, **Latvia** have fixed balancing prices. RES-E producer will always pay for imbalances, but due to the limitation of the balancing costs, there are only limited imbalance payments. Wind generators in Latvia have to pay 20 % of the feed-in-tariff if they do not meet their production forecast, i.e. if the supplied volumes exceed the forecasted volumes, the surplus is bought from the TSO for only 80 % of the FiT; if the RES-E generator is short, the generators have to pay a penalty for the shortfall of 20 % of the FiT. Only for RES-E producers with a capacity below 15 MW (for wind generation smaller than 250 kW) there is no balancing responsibility (Latvenergo 2011).

The examples show that even in a support scheme based on a feed-in tariff some level of balancing risk can be introduced, without exposing fluctuating RES-E to the full market risk. The forecast obligation with positive or negative incentives stimulates the generator to provide accurate forecasts.

More market oriented support mechanisms like a premium or a quota obligation can include more balancing responsibility for RES-E producers. Using this support schemes, the operator of RES-E operates on the free market. If there are no special conditions on the respective support schemes RES-E will be treated like every other market participant and will have full balancing responsibility (e.g. **Finland, Sweden and UK**). However, several countries provide special conditions for RES-E which should ease the balancing responsibility of producers especially in more market orientated support schemes. Those special conditions are stated in the following sections.

The balancing responsibly can be limited to power plants above a certain plant size (e.g. Estonia, Romania and Slovenia). In **Estonia** power plants below 2 MW are currently not required to compensate for forecast errors (§ 50 par. 8 Grid Code (Estonia)). All other RES-E producers above 2 MW have the same balancing responsibility as all other market participants. In **Slovenia** RES-E producers below 5 MW have to use the feed-in-tariff and are excluded from any balancing obligation (Borzen 2011). In contrast, producers under the premium scheme (above 5 MW), which sell their energy on the open market, are included in the trader's balance group and the trader is the balance responsible party (Borzen, 2011).

Several countries provide special conditions just for fluctuating energy sources. Especially wind power conditions can change very fast and the share of electricity from wind is significant in some countries (e.g. Denmark, Spain). Special conditions like fixed balancing prices (e.g. **Denmark**) or bounded balancing prices (e.g. **Belgium**) shall reduce the balancing price and the financial risk of the RES-E producer in the case of deviation of the planned production. However, they have to pay balancing costs in either cases, but not the same amount as other market participants. In **Denmark**, onshore wind plants have to pay a fixed balancing price to compensate for their balancing costs. This balancing reimbursement is granted for the whole lifetime of the plant (IMPROGRES 2010, Klein et al 2010). In the case of offshore wind in **Belgium**, there are special rules for calculating imbalance costs that generators need to pay that reduce the balancing costs and risk for these generators (De Vos et al. 2011). They apply within a 30 % tolerance band, i.e. as long as the deviation from the announced production remains within that limit.

Other extra conditions for wind power do not decrease the payments in the case of imbalances; instead they give an extra opportunity to provide accurate forecasts by reducing the notification time or allow the common scheduling of several RES-E producers. Wind farms in **Poland** can report their energy production programmes to the transmission system operator one hour before the production starts, while other market participants are obliged to provide the notification of energy produced or required from the grid two hours in advance (NREAP, 2010b). The balancing mechanism also allows the creation of scheduling units for groups of wind farms for joint balancing (Salans, 2010).

Even when RES-E producers have a balancing responsibility, they are not necessarily the balancing responsible actor. Rather, another company may take on their responsibility because RES-E generators are often too small. In **Estonia, Austria and Belgium**, RES-E-producers are exposed to balancing costs and need to have a contract with a balancing responsible party (CEER 2009, § 43 Electricity Market Act-Estonia). In **Denmark** they can either announce a Balancing Responsible Party or they take balancing responsibility on their own (Energinet.dk 2007, MASSIG 2010). In **Finland** they usually contract with a Balancing Responsible Party (Interview: VTT 2011).

Recommendations at EU level

Grid integration

Actions at EU level

The table on the following pages describes possible actions at EU level to achieve solutions to the issues that were identified in the previous chapters. The table is structured as follows:

- The first column (no name) indicates in which process step the issue usually appears;
- The second column ("Issue") refers to the issue as it was named in the detailed analysis in the chapters above;
- The third column ("Possible solution") contains a summary of possible solutions to the respective issue. These solutions are also described in greater detail in the above chapters;
- The fourth column ("Possible actions at EU level") describes actions that could be carried out by EU actors to push forward the proposed solution;
- The fifth column ("Harmonisation recommended") gives an indication for each action whether or not harmonisation of national laws at European level seems advisable;
- The sixth column ("Involved EU actors") introduces EU actors that might be included in order to achieve the proposed solution;
- Finally, the seventh column ("Page") refers to the page in the report where the relevant issue and the respective solutions are described in greater detail.

Specific questions, in particular relating to the harmonisation of national laws at European level for achieving a solution to the identified issues will be described afterwards.

	Issue	Possible solution	Possible actions at EU Level	Harmonisation recommended	Involved EU actors	Page
GRID CONNECTION	Long lead times & complex procedures	Identification of existing inefficiencies and introduction of qualified deadlines; Reduction of workload for public administration and for grid operators; Harmonisation and simplification of grid connection requirements; Introduction of a "fast track" procedure for specific projects; Introduction of a one-stop-shop procedure. Early participation	Monitoring of issues in MS in frame of European projects; Identification and dissemination of Best Practices at MS level; Advocating & encouraging initiatives at MS level to make procedures more effective; Harmonisation of technical requirements (Network Code). Introduce a special status for EU infrastructures or encourage Member States towards this end. Sensibilisation campaigns	No No No In preparation To be determined To be determined	Commission, ENTSO-E, ACER, RES-E Sector	29
	Different pace of grid & RES-E development	Better coordination between grid & RES-E development; Collecting of data on RES-E development from national registries and development targets; Consideration of RES-E data in TYNDP.	Data gathering on RES-E and power system development through detailed public accessible registry for each technology; Introduction of obligation for MS to initiate processes at MS level to define RES-E targets that at least meet long-term deployment EU targets (2030-2050); Obligation for MS to develop broad guidelines for the development of the power system in view of accommodating the targeted shares of RES-E; Communication of European TYNDP to MS level and encouragement to use results of TYNDP process	Yes Yes Yes No	Commission, ENTSO-E, ACER	34

	Issue	Possible solution	Possible actions at EU Level	Harmonisation recommended	Involved EU actors	Page
GRID CONNECTION	Lack of communication, and weak position of RES-E plant operator	Introduction of specialised central body; Specific training of judicial bodies; Exchange between national courts; Establishment of communication platform between plant & grid operators; Establishment of link between stakeholder groups through appointment of contact persons	Initialisation of exchange programs and communication platforms through projects at EU level; Encouraging stakeholders at MS level to participate in exchange programs and communication platforms and to appoint contact persons	No No	Commission, ENTSO-E, ACER, RES-E Sector	37
	Virtual saturation	Definition of milestones in grid connection procedure; Introduction of grid reservation fees	Introduction of an obligation for MS to tackle the issue virtual grid saturation. MS should have the freedom to choose between possible measures; Awareness raising at MS level; Communication of Best Practices on how to solve barriers at MS level	To be considered No No	Commission, ENTSO-E, RES-E Sector	41
	Non-shallow costs	Process to define adequate distribution of costs at MS level to ensure investment security; Funding through EU budgets in case of interconnectors with European significance	Definition of projects with European significance for funding through EU budgets; Encouragement of MS governments to set up processes to define adequate attribute and to provide additional funding interconnectors	No No	Commission, ENTSO-E, ACER, RES-E Sector	45

	Issue	Possible solution	Possible actions at EU Level	Harmonisation recommended	Involved EU actors	Page
OPERATION	Curtailment	Ensure more legal certainty by introducing a general (or basic) legal framework on: - Curtailment procedure - Responsible bodies - Priorities for RES-E technologies - Rights and duties of affected stakeholders - Compensation system	Monitoring of development at MS level; Definition of a general legal framework for regulating grid curtailment at national level;	No To be considered	Commission, ENTSO-E, ACER	52

	Issue	Possible solution	Possible actions at EU Level	Harmonisation recommended	Involved EU actors	Page
DEVELOPMENT	RES-E not sufficiently considered in grid development	Conclusion of unbundling process; Installation of independent body to support RES-E; Involvement of stakeholders and early public participation Enhancement of regional cooperation for areas of common interest for different Member States	Continuation of unbundling process; Initialisation of projects addressed at MS level to increase awareness for importance and relevance of RES-E; Increased reference to RES-E development and targets in TYNDP	Yes No Yes	Commission, ENTSO-E, ACER, RES-E Sector	61
	No obligation to reinforce the grid	Introduction of clear legal obligation in national law	Obligation for MS to introduce clear obligation to reinforce the grid; Monitoring at MS level; Awareness raising at MS level	To be considered No No	Commission	65

	Lack of incentives or regulatory instruments	Introduction of measures to create more comparability and transparency; Introduction of regulatory measures that incentivise efficient investment, e.g.: - Introduction of priority premiums; - Counting of investments in same regulatory period; - Abolishment of minimum levels; - Nation-wide cost allocation system for DSOs; - Harmonisation of regulatory regimes;	Encouraging adequate funding of national regulators; Increasing focus at DSO level; Introduction of harmonised regulatory regimes	No No To be considered	Commission, ENTSO-E, ACER, RES-E Sector	66

Table 14: Possible actions at EU level

The need for harmonisation and the principle of subsidiarity

As described in the table above, it should be considered to harmonise national law and national regulations at EU level in the following cases:

A) Harmonisation of a Network Code to reduce long lead times and to simplify complex procedures. This action is already in preparation through the development of the ENTSO-E network code (ENTSO-E 2011a);

B) Introduction of obligations for MS in order to better align the pace of grid and RES-E development:
   - Collection of data on RES-E development through a public registry and on RES-E targets,
   - Development of broad guidelines for the development of the power system;

C) Obligation for Member States to tackle the issue of virtual grid saturation;

D) Definition of a general legal framework for regulating grid curtailment;

E) Continuation of the unbundling process to ensure that RES-E is sufficiently considered in grid development;

F) Introduction of a clear obligation for grid operators to reinforce the grid to accommodate new plants and

G) Introduction of a harmonised regulatory regime.

Measures at European level that harmonise national law may not violate the principle of subsidiarity. The principle of subsidiarity allows actions of the Union only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States (Article 5 Consolidated Version of the Treaty on European Union). Depending on the action, the principle of subsidiarity may rule out specific actions at EU level:

- In some cases such as harmonisation of the Network Code (A) and continuation of unbundling process (E), the requirement of the principle of subsidiarity should not constitute a barrier as actions at EU level are taking place already.
- The collection of data on RES-E development through a public registry and on RES-E targets in order to better align the pace of grid and RES-E development at the level of the TYNDP and later at national level (B) requires a consistent methodology. Otherwise, an integration of the data into the TYNDP would be significantly impaired. Therefore, actions at EU level seem essential. For this reason a violation of the principle of subsidiarity does not seem likely;
- Finally, in case of measures to tackle the issues of virtual saturation (C) and grid curtailment (D), to introduce a clear obligation for grid operators to reinforce the grid for accommodating new plants (F), as well as the introduction of a harmonised regulatory regime (G) the need for consistent laws in all Member States is not obvious. For this reason, it does not seem mandatory that this measure be applied at EU level. Therefore, it seems advisable to first monitor further development at national level and apply “soft actions” such as awareness raising measures before harmonising national law at European level.

Market integration

The following issues should be considered when pursuing market integration of RES-E in the EU:

1. This study has argued that the main rationale for integrating RES-E into electricity markets is to exploit their flexibility potential. This requires a clear understanding of the flexibility potential of RES-E in Europe and what this flexibility can contribute to solve the overall system challenges. More work needs to be done in that area.

2. As opposed to network integration, the "the more the better" principle does not apply to market integration.

3. Market integration of RES-E is a matter of both adapting support schemes and setting up adequate markets. RES-E should not be exposed to market risk when markets are not ready yet.

4. At the same time, some of the system challenges that result from RES-E should be tackled by providing adequate markets rather than exposing RES-E to market risks. For example, in order to provide efficient balancing, functioning balancing markets are arguably more important than exposing RES-E to balancing risk.

5. In terms of market design, RES-E integration requires functioning markets in general, as well as more specific mechanisms to deal with the uncertainty of RES-E, namely intraday markets and short gate closure times. The review of the EU-27 shows that Member States generally move into the direction of providing more flexible short-term markets. However, there are still large differences in the EU-27 in that respect. There is scope for further promoting this process at the EU level.

6. Beyond market design features that are already being implemented, like for example intraday markets, more work needs to be done on how market design can be refined further to make the system as flexible as possible.

7. In terms of support scheme design, the EU-27 review has shown that there is a broad range of different regimes in place that combine various support scheme elements in different ways to exploit RES-E flexibility. There is a broad number of parameters that is critical for fine-tuning these market integration mechanisms.

8. For evaluating these different schemes, it was proposed to differentiate between price, volume and balancing risk. RES-E generators should only be exposed to market risk they can manage and where they can provide flexibility to the system. Especially in the case of fluctuating RES-E market integration has to be in line with the variability and uncertainty of their generation profile.

9. The review has shown some examples where feed-in schemes have been adapted to introduce an element of price risk.

10. There are also a number of different examples in the EU-27 where RES-E generators are provided with an incentive for forecasting and balancing, without being exposed to the full market balancing risk.

Main barriers in the Member States and brief overviews of national conditions

Austria

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	No
	Distribution of costs	Deep
	Relevant grid level	Distribution grid
	Main barriers to integration	Distribution of costs Information policy regarding costs

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	Yes, but not effective
	Occurrence of grid curtailment	None
	Main barriers to integration	Ineffective purchase obligation System fee for large RES-E plants

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Lack of incentives for Grid Operator NIMBY Long lasting procedures

Market design		
	Functioning markets	Trading on EXAA and EPEX
	Intraday market and gate closure	No intra-day market for Austria, Gate closure of EXAA 10:12
	Main issue	High level of market concentration and public ownership of electricity companies

Support scheme		
	Support scheme	Feed-in-tariff; investment subsidies
	Market integration and/or risk sharing elements	Option to opt out of the FiT
	Balancing responsibility for RES producers	no

Table 15: Overview on grid and market integration Austria

In Austria, barriers related to the connection, operation and development of the grid are not very relevant in comparison to roadblocks existing due to the current support scheme, which however, have been addressed in recent legal reforms. Apart from large hydropower plants, most systems for the production of electricity from renewable sources (in the following “RES-E installations” or “RES-E plants”) are connected to the distribution grid. The most severe barriers identified in this field are connected to the distribution of costs for the reinforcement of the grid. According to different stakeholders, the existing Austrian laws are not followed; leading to subsequent problems in the communication process between DSO's and plant operators.

The existing Austrian purchase obligation for RES-E provides only mediocre conditions for the deployment of RES-E installations as it leads to a stop-and-go policy. As for the integration of RES-E, grid operators have to dispatch RES-E as priority. Grid curtailment occurs almost never. Nevertheless, the Austrian legal framework provides a detailed procedure for it which could be used as benchmark for other countries. Presently, the system fee for RES-E plants larger than 5 MW creates a burden for producers.

The framework for the development of the grid is quite average. Stakeholders have reported that in the past, government and administration set different priorities when it came to general energy policy, which is reflected by a lack of regulatory instruments. Moreover, NIMBY behaviour is increasingly becoming an issue. On the other hand, the publically available development plan gives solutions to these problems and allows for a structured planning, also with view to the development in neighbouring countries. It can thus serve as best practice for planning processes in other Member States.

In Austria, wholesale trades can be carried out on the Austrian (EEXA) and the EPEX Spot/EEX Derivates market in Germany. However, most trades are concluded bilaterally. There is no Austrian intraday market yet. Balancing is based on a balancing group model where all balance group responsible parties balance their own portfolios. Independent clearing agencies take over responsibility for the clearing and settlement of the imbalances of each balance group and the TSO, responsible for its control area, balances the sum of imbalances of the balance groups.

The main support scheme in Austria is the feed-in-tariff under a mandatory take-off scheme. It is granted for 13 or 15 years, depending on technology. After the FiT has expired most installations can sell their electricity under a purchase obligation at market prices minus balancing costs for another 12 years. Investment subsidies are dependent on technology and system size.

Belgium

Grid connection	
Effect on integration of RES-E	Neutral
Obligation to reinforce if necessary	No
Distribution of costs	Shallow
Relevant grid level	Distribution grid/(local) transmission grid
Main barriers to integration	Missing obligation to connect RES-E installations, except in the framework of the "Inform & Fit" procedure. Connection can be denied due to insufficient capacities, no obligation to immediately reinforce grid to allow for connection

Grid operation	
Effect on Integration of RES-E	Neutral
Purchase obligation	No
Occurrence of grid curtailment	Rare
Main barriers to integration	No proper regulation for congestion management (curtailment) yet, especially on regional level

Grid development	
Effect on Integration of RES-E	Neutral
Regulatory instruments	Sufficient
Nationwide grid development studies	Existent
Main barriers to integration	Distribution of costs, especially after the decision of the Constitutional Court in May 2011

Market design	
Functioning markets	Functioning markets available
Intraday market and gate closure	Intraday market available up to 5 minutes prior to delivery
Main issue	Liquidity problems in the market for the reservation of ancillary services

Support scheme	
Support scheme	Quota obligation with green certificates
Market integration and/or risk sharing elements	Full market exposure, minimum and maximum certificate price
Balancing responsibility for RES producers	Yes. Separate regime for offshore at lower costs

Table 16: Overview on grid and market integration Belgium

The Belgian energy sector is dominated by a high share of nuclear power, while RES-E had no significant growth during the last 20 years. Belgium started from a very low share of 1.1% in 1990 and increased to 5.3% in 2008. In 2010, the RES-E share has slightly decreased and reached 4.63%

In Belgium, there are separate connection procedures for the distribution as well as for the transmission grid. In addition, there is also a proper procedure for offshore installations available.

Generally, grid connection in Belgium is characterised by a strict division of competencies between the federal level and the regions. No specific obligation is set out as to obligate grid operators to connect RES-E installations; with an exception regarding the “Inform & Fit” procedure for small installations with a capacity of up to 10 kW. Furthermore, there is also no obligation for grid operators to reinforce or expand their grids to allow for a specific connection, which may be denied with reference to insufficient grid connection capacities. Nor is the grid operator obliged to pay compensation under such circumstances. A flexible connection regime is under discussion, but yet not finally approved. As far as the costs of grid connection are concerned, Belgium is operating on a shallow costs model. Grid connection costs of offshore installations are in addition subsidised by the Belgian government, via the TSO.

In Belgium, there is no purchase obligation for produced electricity from renewable sources in place; this is not at least due to the fact that the promotional system of Belgium is based on a quota obligation. A priority dispatching regime exists and RES-E installations receive priority access to the grid. No obligation is set out as to the provision of ancillary services by RES-E installations. Regarding curtailment, the Belgian system differentiates between emergency curtailment and congestion management. The former constitutes part of federal competencies; the latter is only known since recently and a regulation exists on federal as well as on regional level. Yet, regional regulations are of ad hoc nature. Curtailment, in any case, appears to still be a rare occurrence.

The Belgian federal and regional laws provide for general obligations of grid operators, regarding the development of the grids to offer sufficient grid capacities and to meet existing demand. Still, obligations are not RES specific and no explicit obligation is set out as to renewables and specifically required grid reinforcements or expansions to accommodate further growth of these technologies. Grid operators have to provide regularly investment plans, outlining on the planned developments of their respective grids. The sum of these investment plans outlines on the entire Belgian grid system. Harmonisation of the plans is ensured through ongoing consultations between the TSO and DSOs. In addition, there are further federal and regional plans, which add further information to the planned developments. Regarding the costs of grid development, stakeholders indicated the highly political nature of this question and the problems related to regional and federal competencies. Up to now injection tariffs are only set for distribution networks. The Constitutional Court suspended recently the legal framework relating to the DSO’s tariff, putting them in an uncertainty (inclusive for injection fee). A solution to this legal uncertainty is still to come.

The Belgian power exchange Belpex provides both a day-ahead and an intraday market. The market is integrated into the Central Western European Market Coupling (CWE). A balancing market is available. In the market for the reservation of ancillary services there is a lack of participants and liquidity and prices and volumes have regularly been fixed by the government.

In terms of RES-E support there is a quota obligation with green certificates. Generators are fully exposed to electricity market risks and there are no additional risk sharing elements in terms of electricity price risk. RES-E generators are also exposed to balancing costs. In the case of offshore wind there is a separate regime that reduces balancing costs.

Bulgaria

Grid connection	
Effect on integration of RES-E	Negative
Obligation to reinforce if necessary	Yes (according to new RES Act)
Distribution of costs	Deep (according to new RES Act)
Relevant grid level	Transmission grid /Distribution grid
Main barriers to integration	TSO does not connect new RES plants Capacity limits for RES Advance payments

Grid operation	
Effect on integration of RES-E	Negative
Purchase obligation	Yes
Occurrence of grid curtailment	Quite often (in NE-Bulgaria)
Main barriers to integration	TSO does not comply with dispatching priority Curtailment regulation and procedure

Grid development	
Effect on integration of RES-E	Negative
Regulatory instruments	New RES Act introduces a “deeper” connection fee and hence some incentives for grid development
Nationwide grid development studies	Under development
Main barriers to integration	No grid development plan TSO fails to expand transmission grid

Market design	
Functioning markets	No day-ahead or balancing markets
Intraday market and gate closure	No intraday market Day-ahead notification
Main issue	No functioning liberalised electricity market

Support scheme	
Support scheme	Feed-in
Market integration and/or risk sharing elements	Not available
Balancing responsibility for RES producers	No balancing responsibility

Table 17: Overview on grid and market integration Bulgaria

The main problems for the integration of electricity from RES in Bulgaria lie in the connection of wind and solar energy plants to the transmission grid and the lacking grid expansion needed for the further development of new RES installations.

Especially because of the lucrative feed-in tariffs and the favourable legal conditions, a lot of pre-contracts have been concluded in Bulgaria in recent years. Many of these announced RES projects were in fact only speculative, being mainly intended to block the grid capacities and sell them to foreign investors.

The new Bulgarian RES law (ERSA) – which has been approved by parliament on 3 May 2011 – intends to make certain areas of the legislation more effective. It introduces an obligatory advance payment and other measures in order to reduce the number of speculative projects. However, according to the regional DSO, more than 80% of the pre-contracts have been confirmed in north-east Bulgaria after the new RES law came into effect. Due to lacking statistics, the amount on the national scale can only be estimated to about 50% of the pre-contracts. Hence, the shortage of the transmission capacity could not be completely solved in the short run. For future projects, the new act introduces an obligatory advance payment and other measures in order to reduce the number of speculative projects. However, it is highly questionable if small investors will be able to afford the provided advance payment of 12,782 €/MW. In this regard, the envisaged procedure has to be considered as an issue for the development of small RES installations. Even though there was a legal priority for electricity from RES according to the old Bulgarian RES Act, the grid operator was practically entitled to disconnect RES plants at any time from the grid. According to a DSO, the TSO faces difficulties to comply with the dispatching priority provided by law. In this regard, the TSO argues that there were only few non-variable energy sources, which could be used as balancing capacities. Stakeholders highlighted that as a consequence, a lot of wind energy plants in northeast Bulgaria have been curtailed to 50% of their installed capacities.

The new RES Act now abolishes the priority access to the grid for RES producers completely. The law places renewable energy behind all other kinds of energy. The law envisages to stop the application of the support mechanism after the indicative target for Bulgaria is achieved. This measure is in direct violation of EU directives. Another serious barrier is the fact that RES investors will find out the price at which they will be selling their energy only after the construction of their power generating facilities is completed.

One of the biggest problems in Bulgaria is the fact that the unbundling of the TSO provided by the second and third European Energy Package has not been transposed into national law so far. This is planned to be implemented with the adoption of a new energy law, which is not likely to enter into force before 2012.

As regards development, the current systems lacks of regulatory instruments to encourage grid development to support RES-E integration. The grid operator takes the final decision on priorities in the development of the grid. Concerning the low voltage grid, there is no rule on whether the RES producer can legally demand the DSO to develop the grid. For both high and low voltage grid, the RES producers are legally not entitled to any compensation payments in case of lacking grid development.

Support for renewables is based on a feed-in scheme. Within this framework, market integration of renewables has not received much attention until now and RES-E integration seems to be regarded mainly as a matter of network integration. Historically, large scale hydro power is the main source for RES-E in Bulgaria. The feed-in tariff has recently led to a wide interest among local and international developers and investors, hence large scale wind energy projects, in addition to solar PV farms, were realised. This may lead to an increasing need for market integration. With more and more RES-E producers entering the system, market integration will become more relevant.

There are currently no functioning liberalised electricity markets in Bulgaria. A future market or a spot market including day-ahead market and intraday market are not yet in place.

Cyprus

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	No
	Distribution of costs	Shallow
	Relevant grid level	Transmission
	Main barriers to integration	Bureaucracy, Lengthy Grid Connection Procedure

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	Yes
	Occurrence of grid curtailment	No
	Main barriers to integration	New big RES-Plants connected to the grid No regulation for curtailment Isolated system

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	No
	Nationwide grid development studies	Existent
	Main barriers to integration	None, given the low share of RES-E

Market design		
	Functioning markets	No functioning wholesale and Balancing market
	Intraday market and gate closure	No intraday market, gate closure at 20 pm day-ahead
	Main issue	De facto monopoly

Support scheme		
	Support scheme	Fixed feed-in
	Market integration and/or risk sharing elements	Not available
	Balancing responsibility for RES producers	No balancing responsibility yet

Table 18: Overview on grid and market integration Cyprus

The Grid Connection process follows a procedure formulated in the Law Regulating the Electricity Market (LREM) and the Transmission and Distribution Rules (TDR 2.0). There is a differentiation between grid levels and between small and large plants. The TSO is obliged to formulate a connection offer to every producer applying for connection to the grid. Until now, no application was rejected and consequently there is no legal precedent concerning the enforcement of the producer's legal rights. Administrative issues and planning consent appear to be two major obstacles in the grid connection phase.

The legal framework regarding the operation of the grid favours the deployment of RES-E installation because of the existing purchase obligation from EAC. Due to the very limited installed capacity, so far the discussion on ancillary services and curtailment has not yet taken place. However, the increased attention on the potential for RES generation might bring this issue on the agenda. Curtailment is not presently regulated. This, however, together with Cyprus being an isolated system, could become a pressing issue in the future due to expected increase in capacity.

In Cyprus, the development of the transmission and of the distribution grid follows a carefully defined procedure, which takes into account the current and future needs of the system and in which the main stakeholders are involved. Cyprus, in any case, has a very low share of RES-E. With their growth, problems may arise.

The electricity market in Cyprus is characterised by its isolated position which does not allow cross border activities and the monopoly position of one company. Hence, there is no competition and the wholesale market and balancing market cannot function yet. Nevertheless, it must be noted that market rules were already established in 2009. Trading is mainly based on bilateral agreements, no day-ahead or intraday market is available in Cyprus.

The support scheme for RES-E is based on a fixed feed-in tariff, which is applied for Wind, Biomass and Solar energy. The amount of the tariff depends on the technology. The support scheme has several restrictions concerning the maximum installed capacity of each renewable source. RES-E producers are not charged for balancing costs.

Czech Republic

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Deep
	Relevant grid level	Transmission grid
	Main barriers to integration	Connection moratorium Supposed lack of grid capacity Speculation Envisaged advance payments

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	Yes
	Occurrence of grid curtailment	Yes
	Main barriers to integration	Planned amendments could abolish the priority for RES and the purchase obligation

Grid development		
	Effect on Integration of RES-E	Negative
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Close linkage between TSO and dominant DSO Lack of incentives for Grid Operator

Market design		
	Functioning markets	Yes
	Intraday market and gate closure	Intraday market available. Gate closure: 1 hours before delivery
	Main issue	Low liquidity in the intraday market, RES-E operators too small to participate

Support scheme		
	Support scheme	Feed-in tariff and feed-in premium tariff (green bonus)
	Market integration and/or risk sharing elements	Option to choose between the two support schemes
	Balancing responsibility for RES producers	No balancing responsibility

Table 19: Overview on grid and market integration Czech Republic

The main barrier to the future development of renewable energy sources in the Czech Republic lies in the grid connection procedure. Even though RES-E producers are generally entitled to priority connection to the grid, the Czech TSO declared a temporary connection moratorium for variable RES-E plants. This situation was mainly caused by the excessively high feed-in tariffs for PV ground installations as well as many speculative projects which virtually blocked the capacity of the grid. The TSO argues that the grid capacity was not sufficient for additional RES-E installations and demands several amendments of the legal framework, including the introduction of advance payments for grid connection to solve the problem of speculative applications and the abolition of the priority access for electricity from variable RES-E. The electricity generated by PV or wind power plants shall be eventually traded on the free market.

In the Czech Republic, RES-E producers may choose between a fixed feed-in tariff for all electricity fed into the grid or a green bonus on top of the regular price that they may realise on the power market. According to the TSO, this scheme was only designed for a small share of RES-E and requires now a reform. Therefore, the TSO demands an abolition of the priority access for RES-E plants, which is currently being discussed by the Parliament. In May 2011, the Czech Energy Act was already amended, which introduced a regulation obligation for RES-E plants. As of now, all RES systems above 100 kW (except small hydro) are obliged to regulate their electricity production and have to comply with the dispatching procedure foreseen by law.

Concerning the future expansion of the distribution and transmission grid, the role of ČEZ has to be regarded critically. The economic and political power of the dominant generator and largest DSO, is very far-reaching and also affects the formally independent TSO. All this hinders the development of RES in the Czech Republic.

Although ČEPS is investing large sums in the expansion of the transmission grid, according to stakeholders these measures are not aiming at supporting the integration of RES-E. Since ČEPS and ČEZ are largely intertwined, stakeholders argue that the TSO has a bias towards connecting the nuclear power plant Temelín. Due to the fact that Temelín's capacity is currently being extended by ČEZ, the TSO is supposed to be more interested in interconnecting these new nuclear capacities with the industrial regions in the northeast, rather than connecting new RES-E plants to the grid. The TSO strongly disagreed with this statement pointing out that two substations are being planned in order to connect new wind power facilities.

All relevant markets are available in the Czech Republic. The energy exchange PXE organises the derivative markets. The spot markets including the day-ahead market and the intraday market as well as the balancing market are organized by the Electric System Operator OTE in cooperation with the Czech TSO. OTE and PXE interconnected their electricity market organisation systems in April 2009 to allow PXE participants to trade at the OTE market. The majority of electricity is traded through bilateral contracts. With less than 1% the spot market does not account for a significant proportion of the electricity traded in 2009.

The support scheme for RES-E offers two options. The producer can choose between a feed-in tariff with a guaranteed payment or a premium payment on top of the market price (green bonus). The tariffs cannot be combined, but generators can move from one option to the other once a year. Until now there is no balancing responsibility, irrespective of the support scheme. This could be changed in the upcoming amendments of the RES-E law as well as the abolition of the feed-in tariff for new larger installations with a guaranteed payment.

Achievements

- Functioning electricity markets.
- Intraday market available
- Two different support schemes available (feed-in tariff and premium feed-in tariff)
- Option to switch between the support schemes on a yearly basis.

Barriers

- Low liquidity in the intraday market
- RES-E operators to small to participate in the market.

Denmark

Grid connection		
	Effect on integration of RES-E	Positive
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Shallow
	Relevant grid level	Distribution grid (Transmission grid for off-shore wind parks)
	Main barriers to integration	No barriers detected
Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	No
	Occurrence of grid curtailment	Rare
	Main barriers to integration	No barriers detected
Grid development		
	Effect on Integration of RES-E	Positive
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Deadline for obtain permission for grid development not sufficiently specified
Market design		
	Functioning markets	All market options available on the common Nord Pool market
	Intraday market and gate closure	Intraday available; Gate closure is one hour prior to delivery
	Main issue	All market options available
Support scheme		
	Support scheme	Feed-in Premium and net-metering
	Market integration and/or risk sharing elements	Feed-in Premium, partly sliding, partly no subsidies when market prices become negative
	Balancing responsibility for RES producers	Yes, for all RES

Table 20: Overview on grid and market integration Denmark

The overall conditions for the integration of electricity from renewable energy sources in Denmark are considered to be good. No severe barriers have been detected.

There are several levels of electricity grid voltage in Denmark (e.g. 10 kV, 60 kV, 150 kV and 400 kV). Most RES-E generating plants are connected to the distribution grid, except for off-shore wind parks.

The connection process depends on the type of plant and the voltage level of the grid which the plant will be connected to. The connection process is well defined and does not cause any problems. An interesting feature of this process is the lack of clearly defined deadlines for the establishment of a connection. Nevertheless no delays have been reported and the lead time for obtaining connection permission is lowest among the EU countries. As regards grid connection, the only potential barrier is linked to the situation in which a grid with a voltage above 100 kV has to be developed in order to connect a plant.

RES-E enjoys priority in use of the grid. When curtailment is necessary, only off-shore wind parks may be curtailed and only after non-renewable plants have been curtailed first. The operators of the wind parks receive a compensation payment where the output of their parks has to be reduced.

The decision on if, how and to what extent the grid shall be developed belongs to the Danish TSO – Energinet.dk. The decision process depends on the grid's voltage level. In order to develop the distribution grid, the DSO has to consult the transmission grid operator. The process is slightly more complicated on the transmission grid level. If grid voltage exceeds 100 kV, the TSO has to explain the need for the investment to the energy regulator Energitilsynet, and obtain permission from this authority. This part of the process may constitute a barrier.

Denmark is integrated into all markets on the common Nord Pool Spot, where almost 75 % of the total consumption of the Nordic countries was traded in 2010. In the Nord Pool Spot there are two markets for physical trades: Elspot (day-ahead market) and Elbas (intra-day market). All electricity producers have a balancing responsibility; wind onshore generators receive a balancing reimbursement to compensate for their balancing costs.

The general promotion system is a feed-in-premium. Since recently, there are no subsidies for offshore wind farms when the prices become negative. Moreover there is a net-metering scheme for producers of electricity for their own consumption. Eligible parties are exempted from the Public Service Obligation which usually all consumers have to pay depending on their consumption amount.

Estonia

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Deep
	Relevant grid level	Transmission grid
	Main barriers to integration	Lack of sufficient grid capacity Speculation Testing for wind farms

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	No
	Occurrence of grid curtailment	None
	Main barriers to integration	No barriers detected

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Lack of incentives for Grid Operator Distribution of costs

Market design		
	Functioning markets	Markets available, but not functioning yet
	Intraday market and gate closure	Intraday available Gate closure: one hour before delivery
	Main issue	Low liquidity, need for further integration with other markets

Support scheme		
	Support scheme	Premium
	Market integration and/or risk sharing elements	Premium + market price higher than previous feed-in
	Balancing responsibility for RES producers	Yes , above 2 MW

Table 21: Overview on grid and market integration Estonia

The connection of plants generating electricity from renewable sources (in the following “RES-E installations” or “RES-E plants”) usually happens on the level of the transmission grid. The grid connection process in Estonia holds some of the main barriers for the deployment and integration of RES-E plants. Most of these barriers are indirectly linked to other underlying problems, such as the lack of sufficient grid capacity and speculative behaviour leading to virtual lack of grid capacity. This barrier however, has been lately addressed. Another grave problem that has been reported is the distribution of costs (deep cost approach) that has a strong impact especially on small developers. Furthermore, the testing required for wind farms is perceived as a strong barrier to connection by developers.

Despite the lack of a purchase obligation for electricity from renewable sources (“RES-E”), the framework regulating the operation of the grid provides favourable conditions for the deployment of

RES-E installations. As there have not been any cases of grid curtailment so far, it has not become an issue yet, though it is likely to become one soon.

The development of the grid has been identified as one of the key issues for the further integration of RES-E into the grids. The distribution of responsibilities among the grid operators, the government and the regulator does not seem to be entirely clear. It might be possible that this is also due to lack of political will or to an information advantage for the grid operator. The current systems lacks of regulatory instruments to encourage grid development on behalf of RES-E integration. The Estonian government provides a well developed planning structure. In the existing plans, however, the deployment and integration of RES-E do not play a very significant role.

The support scheme for renewable energies in Estonia is based on a premium which is paid on top of the market price. In principle, this allows that all electricity could be traded and priced on the open market. However, the opening and development of the Estonian electricity market has only just started and the market is characterised by high market concentration, especially on the generation side. The reference market price used to be based on the production costs of the by far dominant power station. In terms of market opening, the first steps have already been taken, but there are still a number of barriers which hamper a well-functioning market. Overall, it can be said that a support scheme is in place that allows for integrating RES-E in the electricity market but the market place is still under development and requires further changes and especially better integration with other markets. Therefore, the functioning of the support scheme with respect to integrating renewable energies in the market can only be properly evaluated in the coming years.

Achievements

- The premium system leads renewable electricity producers to the open market.
- Short gate closure time of one hour before delivery
- Day-ahead and intraday market just launched in the recent past.
- Real opening of all markets have already been scheduled.

Barriers

- High level of market concentration
- Low liquidity in all markets
- Until now not much trading in the intraday market.

Finland

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Deep
	Relevant grid level	Transmission grid
	Main barriers to integration	Lack of grid capacity Distribution of costs Speculative grid applications

Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	No
	Occurrence of grid curtailment	None
	Main barriers to integration	No barriers detected

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Lack of regulatory instruments Speculative grid applications Lack of resources for regulator

Market design		
	Functioning markets	All market options available on the common Nord Pool market
	Intraday market and gate closure	Intraday available; Gate closure is one hour prior to delivery
	Main issue	Low intraday liquidity

Support scheme		
	Support scheme	Sliding premium
	Market integration and/or risk sharing elements	Sliding premium based on three month market price averages
	Balancing responsibility for RES producers	Yes

Table 22: Overview on grid and market integration Finland

The connection of plants generating electricity from renewable sources (in the following "RES-E installations" or "RES-E plants") happens at the level of the distribution and transmission grid. Connection procedures are not regulated by law and depend very much on initial talks between grid and plant operators. The analysis has identified different barriers that currently impede the deployment and integration of RES-E. Most of them are directly or indirectly linked to the lack of grid capacity. This is true for insufficient investment security as a consequence of strong competition for attractive wind power sites, which is only partially mitigated by the option to reserve capacity. Another problem in this context that is about to become an issue is the virtual lack of grid capacity that further impedes new projects and makes grid planning more difficult. Moreover, the rules on distribution of costs are not entirely clear, sometimes leading to inadequate allocation of costs for the enforcement of the grid.

From a procedural perspective, the role of the regulator, the Energy Market Authority is quite important. This model may serve as benchmark for other countries.

Regarding the operation of the grid, no severe barriers were detected. The current regime is not fulfilling all requirements defined by the RES Directive. According to stakeholders, however, this does not constitute a barrier. Rules on the curtailment of the grid are not very developed but since curtailment occurs very seldom this is not regarded as a problem.

Due to expected growth of RES-E, ongoing construction of new nuclear power units and promotion of the electricity market, the development of the transmission grid is a high priority. The details of the process for the development of the grid, as well as the assignation of responsibilities are not fully legally defined. The main competence lies with the grid operator that is controlled by the regulator. As a consequence of the implementation of the 3rd Energy Package, the regulator will gain more responsibility. However, it appears necessary to also strengthen its position in terms of new personnel resources. According to stakeholders, there is room for improvement for regulatory instruments to encourage grid development. A hierarchical framework of grid development plans exists and is partly publically available. The grid operator follows a very transparent approach when it comes to the process for developing the grid, resulting in efficient procedures. This policy may serve as benchmark for other countries.

Finland's wholesale electricity market is completely integrated into the Nord Pool market. This offers access to a well-established market place, including an intraday market. Gate closure is 1 hour prior to delivery. In the intraday market, there are concerns about the low level of liquidity.

Finland has recently adopted a market based feed-in system, which has been fully implemented in March 2011. The RES-E producer receives a flexible premium which is the difference between the quarterly average spot market price and the fixed guaranteed price. Hence, the producer is integrated in the electricity market and can reach higher profits if he produces electricity when the market prices are more expensive than the quarterly average spot market price. RES-E generators will be treated like every other market participant and are financial responsible for imbalances. The feed-in tariff is only available for wind and biomass. Beside the market based feed-in system RES-E producers can receive tax aid which is a guaranteed payment and could be compared to a fixed feed-in tariff. However, the tariff level is very low.

France

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	No
	Distribution of costs	Shallow-deep
	Relevant grid level	Transmission grid
	Main barriers to integration	Costs of grid connection

Grid operation		
	Effect on integration of RES-E	Neutral
	Purchase obligation	Yes
	Occurrence of grid curtailment	Occasionally
	Main barriers to integration	Curtailment regulation and procedure

Grid development		
	Effect on integration of RES-E	Negative
	Regulatory instruments	No
	Nationwide grid development studies	Under development
	Main barriers to integration	No grid development plan Remaining time for grid development Incumbent position of main generator Limited power of regulator

Market design		
	Functioning markets	All market options available
	Intraday market and gate closure	Intraday available, 1 hour gate closure
	Main issue	High concentration in the market

Support scheme		
	Support scheme	Feed-in
	Market integration and/or risk sharing elements	None
	Balancing responsibility for RES producers	None

Table 23: Overview on grid and market integration France

France is the second largest economy in Europe, and the second largest consumer and producer of electricity. The French energy sector is traditionally dominated by high share of nuclear power, while RES-E had no significant growth during the last 20 years. Due to the large hydro resources, France started from a substantial share of RES-E, which was 14.8 % in 1990 and slightly decreased to 14.4 in 2008. In 2010, the RES-E share has reached 14.9%.

The French legal framework provides for the general obligation of the grid operator to connect RES systems to the grid. Still, the grid operator is only obliged to conclude a contract on a non-discriminatory basis. Renewable energy installations do not enjoy a privileged access to the grid, except in the context of the regional schemes for grid connection of renewable energies foreseen by the *"Grenelle II"*-Act. As for the costs of grid connection, the French legal framework is constantly evolving since 2007. Stakeholders qualified the current regime as a shallow-deep-approach, while also highlighting that the new provisions of the *"Grenelle II"*-Act are showing a tendency towards a shallow cost regime. Due to the definition of the transmission and the distribution grid, respectively their voltage levels, saturation in France is an issue mainly for the transmission grid.

The French purchase obligation for RES-E provides generally favourable conditions for the development of electricity from renewable sources. As for the ancillary services, there is a general obligation for RES producers to provide these services, with special regulations for the non-interconnected territories of France (mainly the French overseas islands). Curtailment occurs only rarely.

The development of the grid has been identified as a key issue for the further integration of RES-E into the grids. Yet, there is no comprehensive grid development plan for the whole of France. The *"Grenelle II"*-Act has called for the creation of regional development schemes on climate, air and energy, which should outline the regional planning for the RES development, including quantitative objectives. In addition the ministry for energy is also defining wind off-shore zones, which will be developed in the framework of calls for tender. The sum of the before mentioned plans and development zones will outline the required development for the whole of France. However, as time is running short, stakeholders expressed concerns as to the realisation of the plans until 2020. The grid operators, to a very large extent by the incumbent generator EDF, have a very dominant position regarding decisions on future grid development. In this regard, the Commission for Energy Regulation has no power to review investment figures of the grid operators. The costs for the grid development are born by the final consumers via their electricity bill.

The French electricity market is advanced in terms of market design and the market options available, but is still highly concentrated especially on the generation side. With an Intraday Market in place as well as a short gate closure time, the market could in principle accommodate RES-E generators.

RES-E is supported under a feed-in system and public tenders. There are no options for exposing these generators to market signals within this support mechanism, unless RES-E generators leave the feed-in scheme altogether, which is however very unattractive for virtually all generators. Under the feed-in scheme, there is no balancing responsibility for RES-E.

Germany

Grid connection		
	Effect on integration of RES-E	Positive
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Shallow
	Relevant grid level	Distribution grid & Transmission grid
	Main barriers to integration	Communication between stakeholders Lack of transparency Definition of technical and legal requirements

Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	Yes
	Occurrence of grid curtailment	Rare but increasing
	Main barriers to integration	Grid curtailment

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Not-existent
	Main barriers to integration	Public opposition Complicated permission procedures Lacking financial incentives

Market design		
	Functioning markets	All market options available
	Intraday market and gate closure	Intraday available Gate closure time: 15 min before delivery
	Main issue	Limited competition in the wholesale marke

Support scheme		
	Support scheme	Feed-in
	Market integration and/or risk sharing elements	Option to switch between feed-in and direct selling, green electricity privilege
	Balancing responsibility for RES producers	None under FiT, full responsibility under premium scheme

Table 24: Overview on grid and market integration Germany

Germany is the largest economy in Europe, and the largest consumer and producer of electricity. Despite not too favourable natural conditions, Germany is rightly considered as a frontrunner country in renewable electricity, thanks to the extremely rapid development during the last 15 years. Due to the relatively scarce large hydro resources, Germany started from a very low share of RES-E, which was only 3.1 % in 1990. According to the data provided by Entso-e, the RES-E share has reached 16.7% in 2010, according to the German government, the share is even 17%.

The ongoing discussion has a strong focus on high voltage and transmission level. Most of the current problems for the integration of RES-E into the grid, however, seem to occur on medium voltage or low voltage and distribution grid level. This is not very surprising considering the fact that 95% of the German grid consists of low and medium voltage grid. Still, due to the expected growth of large offshore wind parks, barriers on transmission grid level will most likely become a pressing issue in the near future.

The German legal framework provides favourable conditions for the connection of RES-E plants. Though there are practical barriers that make the grid connection process one of the most difficult steps when developing RES-E projects it should be considered that there have been thousands of RES-E systems that were installed in the last years to the German grid. The vast majority of RES-E installations were connected to the grid without serious conflicts and in a standardized manner. Therefore, when comparing the situation in Germany with many other EU countries, the existing barriers have so far not seriously hindered the deployment of RES-E installations. It goes without saying that this assessment differs depending on the specific RES-E technology, the particular size of the RES-E installation, the involved actors and many other factors. The connection process of offshore wind plants, to give an example, has been quite problematic for a long time. In 2009, though, new procedures have been introduced that have solved many of the problems and that could be regarded as benchmark for other European countries. With hindsight to the extremely positive development of RES-E in the past 20 years and the quick reaction to identified barriers, the grid connection of RES-E plants is still positively evaluated.

Because of the existing purchase obligation for electricity from renewable sources, the framework regulating the operation of the grid provides favourable conditions for the deployment of RES-E installations. The high deployment of variable RES-E installation, however, leads to an increasing discussion on the limits to the technical integration of RES-E. This is expressed in a broad discussion on grid curtailment, which occurs very rarely but with a growing tendency. As of today, the share of curtailed electricity amounts to ca. 0.1% of overall fed-in RES-E electricity and large project developers reported that they have not experienced any curtailment measures, yet.

The development of the grid has been identified as one of the key issues for the further integration of RES-E into the grids. The vast majority of measures in this regard are taking place on the level of the distribution grid. However, transmission grid will play in the future a decisive role. The main barriers for the development of the grid are public opposition, complicated permission procedures and lacking financial incentives. In Germany, there is a great variety of grid development plans, which have been set up by different institutions and authors; still, their respective legal and political impact differs highly. Access to the official grid development plans established by grid developers is limited to a certain group of stakeholders. Two years ago, a German Environmental NGO has started a new approach to mitigate barriers for the development of the grid under the broad involvement of most of the relevant stakeholders. This approach could serve as benchmark in other EU member states. In July 2011, the German government has undertaken legal reforms to improve the situation for the integration of RES-E. Essential parts of the legal reforms have been taken into account. The reform has addressed most of the above mentioned barriers at least as far as the transmission grid is concerned. The high amount of pressing barriers on the one hand and the quick and innovative instruments to overcome them on the other, lead to a neutral assessment of grid development conditions in Germany.

In Germany, a number of features have been introduced in the market design which are favourable for RES-E integration: there is a relatively short gate-closure time as well as an intraday market where traded volumes have been increasing. Accessibility of balancing markets is addressed by the regulator. Due to the feed-in tariff support scheme there is not much long-lasting experience with direct market participation of RES-E. Rather, until early 2012 most RES-E has been marketed by the TSOs.

The main support for renewable energies in Germany is a feed-in tariff scheme, with tariffs being paid for a fixed amount of time and underlying a pre-defined degression for new installations. The Renewable Energy Sources Act (EEG) has been amended in 2011. To further promote the market integration of RES-E, the EEG provides a number of approaches:

- the possibility for RES-E producers to temporarily opt-out of the feed-in tariff scheme to directly participate in the market,
- RES-E producers can optionally choose to benefit from a technology specific market premium on top of the revenues which they gain from direct marketing.
- electricity suppliers that provide their customers with at least 50% of renewable energies which would be eligible for EEG may be exempt from paying the EEG surcharge. According to the revised EEG the surcharge exemption will be replaced by a surcharge reduction by 2 ct/kWh, which applies only if 20% of the sales to final consumers from RES-E is based on intermittent energy sources,
- and finally the EEG gives an authorisation to the German Government for introducing financial incentives parallel to the feed-in tariffs and to change the preconditions for participation of RES-E in the balancing market.

Great Britain

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	Irrelevant under current arrangements
	Distribution of costs	Shallowish
	Relevant grid level	Transmission Grid
	Main barriers to integration	Planning consent Issues linked to the offshore transmission tender process Issues linked to the charging regime

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	No
	Occurrence of grid curtailment	Rare, but expected to increase
	Main barriers to integration	None for now, possible ones with the increase of RES-E

Grid development		
	Effect on Integration of RES-E	Negative
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Planning consent Issues connected to the charging regime Backup availability

Market design		
	Functioning markets	Full range of market options available
	Intraday market and gate closure	Intraday available, 1h gate closure
	Main issue	High risk market, low liquidity, plans for fundamental market reform

Support scheme		
	Support scheme	Renewables obligation, FiT for plants below 5 MW
	Market integration and/or risk sharing elements	Plans to introduce a sliding premium scheme
	Balancing responsibility for RES producers	Yes for the quota scheme

Table 25: Overview on grid and market integration Great Britain / UK

Great Britain is still largely fossil and nuclear dominated, with only 2.6% of overall generation coming from RES-E. In perspective, the issue of RES-E integration is key to its achievement of the UK's 2020 goals. In the short span of 10 years, RES-E generation is expected to grow from 31,630 GWh to 116,970 GWh. Considering the issues still creating barriers to grid connection and grid development (mainly planning consent), it appears that reaching the 2020 goals for the UK will be challenging, although a number of measures have recently been taken, or are being currently being considered, to support their achievement.

Plant operators are in general entitled to connection. The cost for reinforcing the grid is recovered through use of system (operating) charges levied on generation and load. The procedure for grid connection follows two similar procedures in England/Wales and in Scotland. As regards offshore transmission, a tender process for granting Offshore Transmission Licenses is in place. Some stakeholders indicated some issues in this context, such as the tender process favouring a less-than-optimal structure of the offshore grid. Generator use of system charges currently vary by location, with higher charges in areas remote from the load centre. These are the areas with the highest RES-E resources thus the charging regime may not play in favour of developing generating facilities in such locations. According to several stakeholders, furthermore, planning consent is a barrier to connection, in terms of allocation of additional capacity. Lead times to build lines are considered to be quite long, impacting thus on the grid connection and on the grid development phase.

In Great Britain, neither priority access, priority dispatch, nor purchase obligation for RES-E are in place by law, this should also be considered in terms of the very low RES-E share of the country. Guaranteed access is, however, provided through GB's market arrangements, as every connected generator has a guarantee of being able to use the electricity network. The only reason that generators may not be able to generate is to ensure safety and reliability of the grid system. On such occasions, the GB's market arrangements determine which generator reduces its output. These generators are compensated. Curtailment tends to occur in the areas of the grid where the grid is weakest, thus mainly the extreme areas, e.g. northern Scotland. Given the current level of development of RES-E, this is not a major barrier at this moment; however an increase in curtailment may be expected, as expressed by National Grid.

Several plans for grid development are in place, showing a uniformity of intents on one side and a fragmentation of planning on the other. None of such plans are legally binding. According to some stakeholders, the charging system appears also to be complicated and at times heavy on the developers, although as of now it is under review. Also in this context, planning consent for new grid lines appears to be a barrier to RES-E integration, as it is effectively blocking the timely allocation of additional capacity.

Great Britain has been a pioneer in electricity market liberalisation, with one of the first competitive wholesale market established. The market has gone through several reforms. The current market arrangement, BETTA, is largely based on bilateral trades. Trading is possible up until one hour before physical delivery. Various trading options are available. However, there are serious concerns about the low liquidity in the market. This is currently being addressed by the energy regulator Ofgem. Moreover, there are more far-reaching plans by the government to introduce new market arrangements to support investment in low-carbon technologies.

The main support instrument has been a quota system (renewables obligation) with tradable certificates, which has been described as a high-risk scheme. In 2010 a feed-in system was added to support plants below 5 MW. There is a recent government proposal to move to a feed-in tariff with 'contracts for difference', i.e. a sliding premium.

Greece

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	No
	Distribution of costs	Shallow/Deep
	Relevant grid level	Transmission/Distribution grid
	Main barriers to integration	Inefficient administrative procedures Insufficient special planning

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	Yes
	Occurrence of grid curtailment	Common for non-interconnected islands
	Main barriers to integration	RES-Plants are sometimes cut off when new plants are connected to the grid

Grid development		
	Effect on Integration of RES-E	Negative
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Investors excluded from decision making process RES-Producer Rights are not clearly defined

Market design		
	Functioning markets	Compulsory participation in Day-ahead market
	Intraday market and gate closure	No intraday-market; 12:30 pm - gate closure for day-ahead market
	Main issue	high concentration in generation and supply

Support scheme		
	Support scheme	Priority dispatch; feed-in-tariff
	Market integration and/or risk sharing elements	No
	Balancing responsibility for RES producers	No

Table 26: Overview on grid and market integration Greece

There is a single grid connection procedure for transmission and distribution grid, due to the fact that PPC remains the owner of both systems. The novelties introduced by the law 3851/2010 have made the grid connection procedure less complicated but nevertheless created a “congestion” of applications, thus making the holding of the deadlines unrealistic. This is the main drawback RES-E plants are facing for their further deployment along with other issues not directly related to the grid connection procedure. The enforcement of a RES-E Producer’s rights in relation to license issues is possible but there is no right for compensation in any case. With respect to the costs of grid connection, for the transmission grid, there is a shallow costs approach, whereas for the distribution grid a deep cost approach.

The operation of the grid provides favourable conditions for the RES-E deployment. There is a purchase obligation for RES-E and a regime of priority dispatch. Apart from that, although RES-E plants are obliged to work in line with network requirements, the provision of ancillary services is not obligatory. In relation to the grid curtailment issue, there are general provisions included in the GGMOC so as to ensure the stability of the grid and a compensation mechanism is also foreseen. In the context of curtailment, under special circumstances not further outlined, the TSO is entitled to shut down a plant, without any previous notice.

The law defines a clear procedure for a regular drafting of grid development plans. The main responsibility lies at the DSO (which also is the dominant generator) and at the TSO. The legislator does not explicitly include the integration of RES-E into the goals to be considered, which are still limited to reliability of operation and economic feasibility. However, the grid operators claim to fully consider this issue, which is explicitly covered in a chapter of the transmission grid plan, for which a formal public consultation procedure is in place. Representatives of independent power producers and of RES-E associations argue that their interests are not seriously considered in grid planning, also due to the conflict of interest due to the fact that PPC acts both as dominant generator and as DSO.

Obligations of grid operators towards RES-E producers are binding only after the conclusion of a connection agreement contract. However, this can be signed only if the necessary grid infrastructure has been built, leading to a chicken and egg situation that does not enable RES-E producers to effectively pursue their rights.

The electricity market in Greece is still very concentrated. There is one company that controls 95 % of the generation and 100 % of the supply market. The market consists of a Day-ahead market, real-time dispatch (intra-day dispatch scheduling) and an Imbalance settlement and a Capacity Adequacy Mechanism for the partial recovery of capital costs. For all market actors it is compulsory to participate in the Day-ahead market.

Support mechanisms for RES-E are: priority dispatch, a feed-in-tariff, a special feed-in-tariff for small photovoltaic plants and an investment support up to 35-50 %.

Hungary

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	No
	Distribution of costs	Shallowish
	Relevant grid level	Distribution grid
	Main barriers to integration	Status of the grid Capacity saturation and speculation Unstable policies for wind power

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	Yes
	Occurrence of grid curtailment	Not presently, possible in the future
	Main barriers to integration	Lack of reserve capacity Instability of priority access due to support scheme revision

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Lack of reserve capacity

Market design		
	Functioning markets	Bilateral and day-ahead market on HUPX and PXE
	Intraday market and gate closure	No intraday market no balancing market
	Main issue	HUPX is a very new market platform, implemented in 2010

Support scheme		
	Support scheme	Feed-in-tariff under a mandatory take-off scheme (MOT)
	Market integration and/or risk sharing elements	A quota system with green certificates is considered in the long run
	Balancing responsibility for RES producers	Yes, they pay if they deviate from the forecasted generation (see Governmental Decree 389/2007. 7. § for details).

Table 27: Overview on grid and market integration Hungary

The most relevant variable RES-E technology in Hungary is wind power, even though the share of PV is expected to increase in the near future due to new, very favourable promotion instruments for PV. Nevertheless, the government's priority in renewables is the promotion and development of biomass and geothermal installations, while the development of wind power is restricted systematically, in order to prevent uncontrollable spread and development of wind power projects, which could not be integrated into the grid and the market. Though, it is not clear whether the government's estimations regarding the grid capacity for integrating wind power plants are realistic or are based on political will to hinder the development of wind power. The grid connection on low voltage grid level and to a certain extent on the medium voltage grid level is difficult by now and involves high grid connection investments on the RES-E producer's side.

Electricity Law LXXXVI 2007 guarantees priority access to the grid for RES producers. Curtailment of RES-E plants is not regulated; however this issue is not currently relevant, given the low RES-E share in total electricity generation. Currently, there are no particular issue as regards RES-E operation on the grid. This is also due to the Hungarian approach trying to prevent any grid operation problems by strongly controlling especially the development of wind power. Despite this, new measures and technical requirements are under discussion in order to facilitate the grid integration of a growing share of wind power in the long run. The wind power association has stated, however, ongoing modifications of the feed-in tariff are suspected to further disadvantage wind power in the future. According to the regulator, on the other hand, there is no evidence for developments, which would disadvantage wind power. Finally, the lack of reserve capacities and the acceptance problems of hydro energy could make the integration of renewables even more difficult.

A national grid development plan exists, which refers to the grid development measures for grid voltage levels of 120kV and more. It elaborates concrete measures for reinforcing the grid and rebuilding important transformer station. Nevertheless, reserve capacities and intelligent grid are not tackled in the grid development plan but in the NREAP, where concrete proceedings for introducing intelligent grid and smart metering are elaborated. Reserve capacities are only shortly mentioned in the NREAP, stressing that alternatives others than hydro energy need to be examined and put in practice.

Electricity trading in Hungary can be conducted bilaterally or on the Hungarian Power Exchange (HUPX) and on the Power Exchange Central Europe (PXE). There is no intraday-market. Balancing settlement is scheduled with the TSO.

Hungary's support scheme is based on a feed-in-tariff system within a mandatory take-off scheme. The tariffs are differentiated by: size (nominal power capacity), date of commission, time zone (peak, off-peak and night-time) and the type of renewable source. A quota system with green certificates is also possible by law and is considered in the long run. However, no steps towards implementation have been made yet. The feed-in tariff system will be reformed in 2012.

Ireland

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	No
	Distribution of costs	Shallow
	Relevant grid level	Transmission grid
	Main barriers to integration	Potential delays for grid connection due to the group processing approach Potentially higher shallow costs than in other Member States

Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	No
	Occurrence of grid curtailment	Yes
	Main barriers to integration	Challenges to apply the concept of priority dispatching under the Irish circumstances (40% RES-E target)

Grid development		
	Effect on Integration of RES-E	Positive
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	No right of RES producers to demand grid extension, if required for dispatching

Market design		
	Functioning markets	Mandatory centralised pool market (SEM)
	Intraday market and gate closure	No intraday market. Gate Closure Time: 10 am of the day prior to real time
	Main issue	No intraday market

Support scheme		
	Support scheme	Fixed feed-in
	Market integration and/or risk sharing elements	Arrangements in the SEM which allow RES-E participation with balancing responsibility.
	Balancing responsibility for RES producers	No balancing responsibility in the Support scheme.

Table 28: Overview on grid and market integration Ireland

For grid connection, Ireland is operating a group processing approach – gate model, under which grid connection offers are processed and issued to batches of RES projects in rounds or gates. Currently, Gate 3 is developed, consisting of approximately 3,900 MW of renewable generation applications, being sufficient to meet the governmental 40% RES-E target in consumption for 2020. Generally, no formal procedure has been established for the actual grid connection request; yet, common elements of all application procedures can be identified band have been confirmed by a number of CER papers since 2004. Small renewable and low carbon installations (generally below 5MW) and also wind installations below 0.5 MW may be connected outside the group processing approach, if a public good benefit of the connection can be demonstrated. Regarding the grid connection and the RES-E development, stakeholder highlighted the unique Irish circumstances, as Ireland is aiming at a 40% share, with the majority of this share coming from wind power, and thus implying high challenges for the grid operators given the size of the system. Still, they also underlined the common understanding of Irish market actors, who have an understanding of the timeline for grid development and are accepting certain constraints regarding grid connection, which result from these circumstances. As for the cost for grid connection, Ireland is based on a shallow cost model. However, stakeholders also noticed that these shallow costs may be higher than in other Member States, as a large share of production sites is situated in the West of Ireland, requiring for the construction of new long connecting lines.

In Ireland, there is no purchase obligation in place; however, suppliers under the REFIT scheme may contract with RES generators for their output and support is paid in accordance with the rules of the REFIT scheme. A regime for priority dispatching was transposed from European Directive 2009/28/EC into Irish law. Priority access to the grid is provided under the group processing approach - gate model. There is no specific obligation for RES producers as to the provision of ancillary services. Yet, under the Irish Grid Code general obligations, applying equally to all generators (RES and non-RES), obligations are set out. In addition, the Grid Code also contains a section on wind, setting out special requirements for wind installations with a capacity above 5 MW. Curtailment is not regulated by law; however, the aim of minimising curtailment has been transposed into Irish law from the European Directive. Furthermore, the CER and the Single Electricity Market (Ireland and Northern Ireland) Committee are examining the matter and have initiated consultation, which should lead to the establishment of criteria for curtailment. Compensation for curtailed installations is only foreseen for those installations with firm access to the grid, as set out in the context of connection agreements and the Trading and Settlement Code.

Generally, the license of the Irish transmission grid operator provides for the obligation to operate and ensure development of the grid. However, this obligation is not specific to RES, but applies generally. There are two major strategies (being the governmental Energy White paper and the EirGrid Grid25 report of the Irish TSO), which are outlining on the development of the necessary grid infrastructure. Furthermore, there is the obligation for EirGrid as TSO to produce a seven year Transmission Forecast Statement, outlining on the capability of the grid for the forthcoming years. In addition, the TSO has also to prepare a transmission Development Plan, which contains the specific planned developments. There is no right for a RES producer to legally demand grid extension or reinforcement, if this would be required for dispatching; in addition, there is no compensation foreseen for such incidents. Yet, stakeholders underlined the special Irish conditions in this regard. The CER as Irish regulator is generally considering the future RES development as objective while regulating tariffs. In this regard, the CER is regulating the level of revenue, which the grid operators may collect from the Transmission Use of System customers. In Ireland the total revenue allowed to operate the transmission system consists of Controllable costs sometimes referred to as “wires” related costs, (i.e. deprecation charge, rate of return, etc) and External costs or “non-wires” costs (e.g. Ancillary Services). The total revenue requirement in any given tariff year is recovered from Generators and Demand Users. 25% of the Controllable costs referred to above is recovered from Generators and the remaining 75% from Demand users (which is collected by Suppliers). All External costs, with the exception of revenue received from generation trip payments, are recovered from Demand users. The regulators in Ireland Northern Ireland, through the Single Electricity Market Committee, have recently harmonised the all-island Transmission Use of System arrangements covering Generators.

Ireland and Northern Ireland have established a common Single Electricity Market (SEM) at the end of 2007. The SEM-market design is fundamentally different from the organisation of other markets in Northern Europe. The SEM market design is based on an ex-post gross mandatory pool with central commitment. All electricity above 10 MW sold and bought in Ireland will be traded through the central electricity pool of SEM. Hence, no bilateral transactions are permitted outside of the pool. Producers and Suppliers receive the System Marginal Price (SMP) calculated by the Single Electricity Market Operator (SEMO) for each half hour trading period. The gate closure time of SEM is 10 am of the day before the physical delivery (D-1).

The support scheme in Ireland is based on a Renewable Feed in Tariff (REFIT) programme which was launched in 2006. Almost every Renewable Energy Source is eligible to receive the feed- in tariff for the duration of 15 years. The level of the tariff depends on the technology. In order to receive the tariff, the RES-E producer enters into a power purchase contract with a supplier. There is no cap on the volume of electricity produced per year or on the installed capacity. RES-E producers have the option to join the SEM and enjoy separate treatment if their production is variable. If they sell electricity in the SEM they have a balancing responsibility, except of autonomous producers which cannot control their output.

Achievements

- One Single Electricity Market (SEM) on the basis of a gross mandatory pool
- Common market rules (Trading and Settlement Rules) are established.
- Fixed feed-in tariffs since 2006, arrangements in the SEM which allow RES-E participation with balancing responsibility.

Barriers

- No intraday market until know (An intraday market shall be launched in 2012)
- Gate Closure Time: 10 am of the previous day

Italy

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Shallow
	Relevant grid level	Transmission
	Main barriers to integration	Administrative barriers Overload of connection requests Virtual saturation

Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	Yes
	Occurrence of grid curtailment	Common
	Main barriers to integration	Frequency of curtailment in areas with large RES-E potential

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Administrative barriers to grid development

Market design		
	Functioning markets	All market options available
	Intraday market and gate closure	Intraday available Several Intraday sessions Gate closure for RES-E: end of day-ahead market
	Main issue	All market options available

Support scheme		
	Support scheme	Mix of feed-in and quota for different technologies
	Market integration and/or risk sharing elements	See support scheme In practice stable certificate price
	Balancing responsibility for RES producers	None, but positive incentive to meet forecasts

Table 29: Overview on grid and market integration Italy

Italy is a large consumer and a net importer of electricity, making it a very relevant subject in the European context. The main RES-E source in the country is still hydro, but wind and PV have much developed in latest years, thanks to the availability of natural resources (wind and sun, particularly in the south) and to well-functioning support schemes that made investments in RES-E very attractive. Italy started from a 13.9% share of RES-E in gross consumption in 1990. According to the Eurostat database, in 2008, the RES-E share reached 16.6%. Still according to Eurostat, the share of RES-E generation over total consumption has grown of 21% in the period 2003-2008 and, according to the Italian NREAP equalled 19.4% in 2010.

The main barriers for the integration of RES-E are administrative and cause the largest problems in the phases of connection and expansion. There is a large demand for additional capacity in areas where RES-E generation is mostly concentrated, that is the southern regions and islands. The grid infrastructure in these areas is traditionally weak, and thus needs reinforced to allow connection of requesting plants and expansion to accommodate future generation in a longer term perspective.

As regards connection, procedures in Italy are quite structured and detailed. Legal provisions are clear and unambiguous in terms of responsibilities, procedures and deadlines. In practice, however, the lengthy administrative barriers linked to obtaining authorisations for grid reinforcement works can cause large delays before connection is granted. This is also due to the extremely high amount of requests filed to the TSO, which would need some mitigation as well.

In terms of grid expansion, the same issues linked to authorisation of infrastructural works on the grid apply. Given the lengthiness and complexity of the procedures, an optimal long-term solution for grid development cannot be obtained, and alternative solutions, although effective, are being implemented.

Electricity from RES-E is granted both priority access and priority dispatching. Non-programmable (variable) RES-E have even priority on other RES-E. For security reasons, when curtailment is needed, this obligation is overrun. Given the structure of the grid, curtailment takes place normally in areas with a weak grid infrastructure and a high concentration of RES-E, wind in particular. Forecasting services for wind and other sources are being incentivised in order to better plan dispatching and limit curtailment.

RES-E integration is largely taken into consideration by the TSO in its grid development plans. About 40% of its investments between 2010 and 2020, thus a quite relevant amount, will be devoted solely to this aim. The perspective provided by the TSO is quite positive in terms of solving any outstanding issue and keeping up with the growth of RES-E. This perspective, however, is not always shared by producers of RES-E. The administrative barriers outlined for grid reinforcement also play a role in this phase.

The Italian Electricity market consists of a complex market structure with a Day-ahead market, an Intra-day market with four trading sessions and an Ancillary Services Market. However, since RES-E producers are not exposed to imbalance costs, they trade their energy only on the day ahead market. Furthermore, there is a number of different support mechanisms for RES-E, both feed-in based and quota-based that facilitate market integration to different degrees:

Latvia

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Deep
	Relevant grid level	Distribution grid
	Main barriers to integration	Lack of sufficient grid capacity Speculation

Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	No
	Occurrence of grid curtailment	None
	Main barriers to integration	No barriers detected

Grid development		
	Effect on Integration of RES-E	Negative
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Lack of incentives for Grid Operator Distribution of costs Communication between stakeholders

Market design		
	Functioning markets	Only bilateral contracts
	Intraday market and gate closure	No Intra-day market, bilateral trading stops 1 hour before delivery
	Main issue	No wholesale markets

Support scheme		
	Support scheme	feed-in-tariff and guaranteed payment; a premium is planned
	Market integration and/or risk sharing elements	None
	Balancing responsibility for RES producers	For large plants, penalty of +/- 20 % of the FiT

Table 30: Overview on grid and market integration Latvia

The connection of plants generating electricity from renewable sources (in the following "RES-E installations" or "RES-E plants") usually happens on the level of the distribution grid. The comments received by different stakeholders in the consultation phase have showed a large spectrum of opinions. According to some stakeholder, the grid connection process in Latvia holds barriers for the deployment and integration of RES-E plants. Most of these barriers are indirectly linked to other underlying problems, such as the lack of sufficient grid capacity and speculative behaviour leading to virtual lack of grid capacity. Another grave problem that has been reported is the distribution of costs (deep cost approach).

Regarding the operation of the grid, no barriers were detected. The current regime that will be most likely reformed by the end of the year is not fulfilling all requirements defined by the RES Directive.

According to stakeholders, however, this does not constitute a barrier. Rules on the curtailment of the grid are not very developed but since curtailment occurs very seldom this is not regarded as a problem.

Apart from the lack of resources, the lack of legal clarity may be considered as another key barrier of the development of the grid. The legal framework and the decision-making process are determined in a very general way. Thus, it is difficult to state whether the power of the final decision on concrete grid development projects lies with the government, the grid operator or the regulator. Due to the transposition of the 3rd Energy Package, the regulator will become more influential. However, given resource constraints, it is unclear if the regulator can take on this responsibility. The existing legal framework is not entirely clear on whether or not grid operators have a duty to reinforce the grid for enabling the grid connection of RES-E plants. There are no regulatory instruments to encourage grid development for the integration of RES-E. The Latvian planning system provides a continuous and hierarchal structure of political plans issued on governmental level and grid plans developed by the grid operators. These plants have a mediocre focus on the integration of RES-E whereas interconnectors are playing a significant role. The role of the grid operator has been reviewed differently by stakeholders.

Although the Latvian Electricity market is legally open since 1 July 2007 there is still only minor market activity. There is no spot market in Latvia. All wholesale trades are based on bilateral trades. Market concentration is very high, especially on the supply side where Latvenergo, the main supplier, provided a share of over 90 % of total gross consumption in 2009. As soon as the common Baltic market (Lithuania, Estonia, Latvia) merges with the Nord Pool Spot market, it should be possible to introduce a Day-ahead and an Intra-day market. Thus it is expected that more market participants will reduce market concentration.

The RES support scheme is based on a feed-in-tariff with special elements of a quota and tendering system. The support scheme supports renewable energy only until the pre-defined share of RES is satisfied. RES generators have to apply through a tendering system to be entitled for regulated tariffs. The policy support scheme for RES is currently in an amendment process. It is planned that a premium tariff will replace the FiT.

Lithuania

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Deep (divided)
	Relevant grid level	Transmission grid/Distribution grid
	Main barriers to integration	Complicated connection procedure Legislation not clear High costs

Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	Yes
	Occurrence of grid curtailment	Rare
	Main barriers to integration	No barriers detected

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existing
	Main barriers to integration	Grid development as a strategic nationwide political issue – RES do not constitute a goal

Market design		
	Functioning markets	Bilateral market and day-ahead-market
	Intraday market and gate closure	No Intra-day market, gate closure 45 min before delivery
	Main issue	Integration into other Baltic markets and Nord Pool

Support scheme		
	Support scheme	Feed-in tariff
	Market integration and/or risk sharing elements	None
	Balancing responsibility for RES producers	None, RES-E balancing provided by TSO

Table 31: Overview on grid and market integration Lithuania

The connection procedure for RES-E plants is generally considered to be complicated, time-consuming and costly. This had already been the case before the new legislation came into effect, but it is expected to become even less clear due to the introduction of the new "Law of the Republic of Lithuania on Renewable Energy", especially right after its introduction. The law was expected to enter into force on 1.1.2012; instead it partly came into effect on 24.05.2011. Some other articles will not be introduced before 31.12.2011. The new regulations are expected to solve some of the problems reported by interviewed stakeholders, for example: too high connection costs, no differentiation between big and small installations in the connection procedure, and speculation with grid capacity. How these new solutions will affect grid connection cannot yet be assessed.

As regards grid operation, the transmission grid operator is obliged to purchase all electricity produced from renewable energy sources. Moreover, RES-E has priority in the transmission and distribution of electricity. The regulation on curtailment will not enter into force before the end of this year. The draft articles of the new Law on Renewable Energy specify that curtailment has to be carried out in a non-discriminatory way; yet, no compensation is foreseen for RES-E plant operators that are subject to curtailment measures.

Grid development is one of the biggest issues in Lithuanian energy policy, yet not specific to RES. The country is exclusively connected with the two other Baltic States, as well as with Belarus and Russia. The construction of interconnections with Central Europe and Scandinavia is considered a main goal in the national energy strategy. Connecting the country to the European Continent and the North European Network is classified as very important for the security of energy supply in Lithuania. The development of the grid connecting the Western coastal region, where the wind power plants are situated, and the rest of the country is one of the strategic projects of the transmission grid operator. The integration of RES does not play an important role in grid development.

The Lithuanian electricity market is under development, recent changes focused on increasing competition and moving towards integration with other markets. Its progress in the energy sector has been triggered in recent years. There is a short gate-closure time, but no intraday market for the time being. Current cooperation and future integration with the Nord Pool market provides an interesting perspective for the further market development, in terms of an increasing market size, the participation in a well-established, functioning market and the introduction of an intraday market. The main support for RES-E in Lithuania is a Feed-in tariff (FiT) system introduced in 2002. Other support mechanisms are loans and subsidies for specific projects. There are no additional mechanisms to support market integration.

One of the biggest issues considering the development and integration of RES-E are the priorities of energy policy. The National Energy Strategy classifies energy independence as the most important goal to achieve until 2020. Lithuania is severely dependent on energy imports. Since the closure of nuclear power plant Ignalina, Lithuania has been importing more than 80% of energy resources, e.g. natural gas, from one single supplier: Russia. 100% of Lithuania's natural gas is imported from this single supplier. Moreover, 70% of its heat and the largest share of electricity are generated from these gas imports. This situation has provided a fertile ground not only for energy insecurity but also for economic and political vulnerability (National Energy Strategy 2010).

Future energy independence is very high on the political agenda and was compared to the level of national independence of 1990 by the Minister of Energy (National Energy Strategy 2010). As three solutions for this issue, the National Energy Strategy names the construction of interconnections with the Continental and Northern European Networks, the construction of new nuclear power plant, the diversification of gas imports and the deployment of renewable energy sources (National Energy Strategy 2010).

Luxembourg

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Deep
	Relevant grid level	Transmission and distribution grid
	Main barriers to integration	Definition of connection costs
Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	Yes
	Occurrence of grid curtailment	None
	Main barriers to integration	No barriers detected
Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	n.a.
	Nationwide grid development studies	Existent
	Main barriers to integration	Grid development studies are generally not published
Market design		
	Functioning markets	Market depends on interconnections with neighbouring markets
	Intraday market and gate closure	Intraday market planned for 2012; gate closure of day-ahead market at noon
	Main issue	Small market size, high concentration
Support scheme		
	Support scheme	Feed-in-tariff and investment grants
	Market integration and/or risk sharing elements	No
	Balancing responsibility for RES producers	No

Table 32: Overview on grid and market integration Luxembourg

In Luxembourg there is one formal connection procedure for all grid levels. Also, Luxembourg uses a deep costs system for grid connection, which can be seen as a barrier, the producer having to bear the costs implied by grid connection and grid reinforcement. Moreover, RES-E producers cannot always connect their plant to the closest connection point. There is no legal regulation entitling a RES-E to claim for damages suffered in the context of grid connection. However the latter does not normally happen. Considering the fact that Luxembourg imports the majority of its electricity, an increase in domestic electricity production is namely rather favoured, since it decreases the need for electricity imports.

Grid access in Luxembourg is guaranteed provided that the maintenance of the reliability and safety of the grid is guaranteed. Electricity from renewable energy sources injected into the grid is remunerated by the grid operator through a mandatory take-off scheme based on a feed-in-tariff model. As far as dispatching priority is concerned, the system operator is bound to consider at first RES-E when dispatching electricity. Finally there is no existing specific regulation for RES-plants defining grid curtailment neither as an emergency nor as a foreseen measure.

The only legal definition with regard to the objectives of grid operators for RES and grid development is the obligation to ensure the long-term capacity of the grid by undertaking the necessary grid developments. On the basis of its five-year investment plan, the grid operator decides its priorities in the development of the grid. However, the grid operator is bound to undertake grid reinforcement in case a producer needs one and declares himself ready to support the costs.

As far as regulatory instruments are concerned, the regulator does not take the development of RES into consideration while regulating grid tariffs. Yet he determines the calculation methods of the network fees which are paid by the final consumers.

Regarding planned improvements of the grid, the Government's Commissioner of Energy publishes a report every two years analysing the grid situation. In this report, the Government rather puts forward the necessity of further interconnections with other countries in order to reinforce the security of electricity supply. Due to their limited potential, the effects of RES development are considered less important in the context of questions on security of supply.

Malta

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	No
	Distribution of costs	Deep
	Relevant grid level	Distribution grid
	Main barriers to integration	Inefficient administrative procedures Insufficient special planning Competing public interest

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	Yes
	Occurrence of grid curtailment	Common
	Main barriers to integration	Grid not connected to the EU grid Potential problems when wind farms/large PV projects come online

Grid development		
	Effect on Integration of RES-E	Negative
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Short-term planning Planning permits and financing

Market design		
	Functioning markets	No competitive market
	Intraday market and gate closure	Not available
	Main issue	Too small to become a market by itself

Support scheme		
	Support scheme	Two options of feed-in mechanisms: based on net-metering with spill-off rates equal to feed-in tariff or full sale of RE electricity at feed-in tariff rate with a ceiling on the amount of energy generated
	Market integration and/or risk sharing elements	Not available
	Balancing responsibility for RES producers	None

Table 33: Overview on grid and market integration Malta

There are rules and procedures for connection of RES-E plants to the grid in place in Malta. Their application, however, is only theoretical, as they refer to large RES-E plants, which are not present at the moment. As of now, most of RES-E generation is provided by small generation plants (e.g. rooftop-mounted PV systems) that do not require to follow the procedure laid out for connection. The remaining larger PV roof-top systems (>16 A per phase) would require a prior permit from the Malta Resources Authority (MRA). Given the size of the country, spatial planning and competing public interest pose two major barriers. Furthermore, administrative procedures are quite inefficient also due to the current sharing of responsibilities.

Electricity is guaranteed access to the grid, RES-E plants enjoy priority access and priority dispatching. The three consulted stakeholders disagree as regards curtailment: according to MEEREA, this occurs frequently, whereas Enemalta and MRA states that at present there is no curtailment on RES output. Rules on grid operation are laid out with large plants in mind, however it should be again underlined that in Malta, all RES-E plants are small installations that are not bound by such rules.

Planning permits and access to financing are indicated as being the most serious barriers hampering the development of the grid. Grid development studies exist, but only in the short term. As of now Malta is not connected to the EU grid and the infrastructure is able to cover the needs of the islands fairly well. In order to have large scale systems like the wind farm of *Sikka l-Bajda* (95 MW), though, it will be essential to connect Malta to the EU grid. At this time there is a project for building a 200 MW connection cable between Malta and Sicily that should be finished by 2013. Some studies are being undertaken for this wind farm, however mostly relating to the wind potential, seabed integrity and its impact on bird migration. The market and grid connection issues linked to this plant will be addressed at a later stage in the development of the plant.

There is no competitive market for electricity in Malta. The main support measures are grants and loans – instruments which are in other countries frequently used as supplementary instruments. These measures are directed towards small consumers who plan to build their own generation plant. For wind and PV plants the state offers a grant of up to 25 % capped at 230 Euro for wind energy, and a grant of up to 50% of the total investment capped at 3,000 Euro, for PV plants, per family. Additionally, there is a net-metering system with spill-off rates equal to the feed-in tariff for all RE electrical systems and reduced value-added taxes for PV and taxes for biodiesel. A feed-in-tariff is in place.

Netherlands

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	No
	Distribution of costs	Shallow
	Relevant grid level	Transmission grid/Distribution grid
	Main barriers to integration	Lack of sufficient grid capacity

Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	No
	Occurrence of grid curtailment	Rare
	Main barriers to integration	Mismatch in lead times of newly developed power versus corresponding grid reinforcement/expansion

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Time required for grid development RES no specific objective for grid development

Market design		
	Functioning markets	Full range of market options available
	Intraday market and gate closure	Intraday market available, 1h gate closure
	Main issue	Market integration with neighbouring countries

Support scheme		
	Support scheme	Premium
	Market integration and/or risk sharing elements	Sliding premium with support ceiling
	Balancing responsibility for RES producers	Yes

Table 34: Overview on grid and market integration Netherlands

Generally, there is no formal grid connection procedure defined. Rather, grid operators are offering customer made connection solutions; though common elements for all these can be identified. There is a general obligation for grid operators to connect energy producing installations; yet, this obligation is not specific to RES, but applies to all installations (RES and non-RES) equally. Shortages of available grid capacities have to be identified as central barriers for grid integration. Grid operators are not allowed to pre-invest anticipating on accelerated development of RES installations and are inevitably lagging behind with the adaptation of the grid to the new circumstances. Furthermore, grid operators are only generally obliged to expand the grid in regards to the existing demand. There is no obligation as to the immediate reinforcement or expansion of the grid in case of shortages of grid connection capacities. In addition, there is also no compensation foreseen in case an installation is physically able to produce electricity, but cannot feed the electricity due to missing connection capacities. As for the grid connection costs, a shallow costs model is applied. Installation operators only have to cover the costs directly related to the actual connection as well as costs for a potentially required line from the installation to the nearest point on the grid available for connection.

In the Netherlands, there is no purchase obligation in place, as the main support scheme is a premium tariff. Also, the concept of priority dispatching is not applied until now; yet, a legislative change introducing dispatching priority is accounted for July 2011. As for access to the grid, the Dutch system provides for guaranteed access. A-synchronous and non-adjustable installations are furthermore exempted from the obligation to provide ancillary services. Regarding curtailment, the Dutch system differentiates between emergency curtailment and congestion management. Where the former is a rare occurrence, the latter was introduced as reaction to shortages of transmission grid capacities and is specifically regulated under the Dutch grid code. A bidding system and compensation is foreseen for congestion management. In addition, the congestion management scheme even differentiates between the various forms of energy generation and gives priority to RES technologies. Moreover, it also differentiates between RES technologies and distinguishes RES technologies which are variable and those who are potentially able to offer a more constant generation. Furthermore, an amendment to the current legislation is expected for July 2011.

The Dutch Electricity Law 1998 provides for general obligations of grid operator regarding the maintenance and the development of the grid; yet, there are no specific objectives as to renewable energies and specifically required grid reinforcements or expansions to accommodate further growth of these technologies. Grid operators have to provide every other year a seven year statement (KCD) on the planned grid developments. In the absence of a centrally produced grid development plan for all grid levels in the Netherlands, the sum of these KCDs outlines on the entire Dutch grid system. Harmonisation of these plans is ensured through ongoing consultations between the TSO and the DSOs. Furthermore, there are additional grid studies of Netbeheer Nederland and the Ministry of Economic Affairs, Agriculture and Innovation, which also add further information to the planned grid developments and grid investments for the coming years. The costs of the grid development investments are borne through a transmission fee, which is distributed based on consumption.

The Dutch electricity market is well developed with an intraday market and a short gate closure set one hour prior to delivery. A key issue for the further development of the electricity market is the further integration with neighbouring markets.

The support scheme “Stimuleringsregeling Duurzame Energieproductie” (SDE) is based on a sliding premium that balances the risk of varying electricity prices. RES-E generators need to sell their output on the general market and have full balancing responsibility. However, most output is sold under long-term contracts, so that short-term market signals do not feed through to generators. A major overhaul (SDE+) is currently in the legislative process that will concentrate support on the cheapest RES-E technologies. Although this should increase the level of renewable energy output, in terms of market integration no major changes are expected.

Poland

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Not clear
	Relevant grid level	Distribution Grid
	Main barriers to integration	Lack of sufficient grid capacity Complicated and not-transparent grid connection process Unclear regulations concerning the distribution of costs

Grid operation		
	Effect on Integration of RES-E	Negative
	Purchase obligation	Yes
	Occurrence of grid curtailment	Rare
	Main barriers to integration	Lack of investment security Lack of sufficient grid capacity

Grid development		
	Effect on Integration of RES-E	Negative
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Non-Existent
	Main barriers to integration	Complicated legislative procedure for the development

Market design		
	Functioning markets	All market options available
	Intraday market and gate closure	Intraday available special 1-hour gate closure for wind
	Main issue	High share of bilateral contracts

Support scheme		
	Support scheme	Quota
	Market integration and/or risk sharing elements	Guaranteed fixed price
	Balancing responsibility for RES producers	Yes

Table 35: Overview on grid and market integration Poland

The grid connection process, which is described in the Polish Energy Law, contains several barriers that seriously impede the deployment of plants generating electricity from renewable energy sources (RES-E, henceforth). The worst barriers identified were the complicated and not-transparent grid connection process, unclear regulations concerning the distribution of costs and the inappropriate treatment of small RES-E systems. Most of the barriers seem to occur on the distribution grid level, at which most RES-E plants are connected.

In theory, electricity from RES has to be transmitted and distributed as priority under the condition that the grid's security and reliability are ensured. However, it is not clear to which extent this priority treatment lives up to reality. Moreover there is an obligation towards grid operators to purchase whole RES-E offered. Curtailment is not regulated in Poland. Industry stakeholders have reported different barriers for access to the grid that result in a lack of investment security and thus in poor deployment of RES. Most of these barriers are at least indirectly connected to the poor condition of the grid.

The development of the grid has been identified as one of the key issues for the further integration of RES-E into the grids. The spare capacity of the grids in Poland is not sufficient. The national grids have to be expanded and modernised. The main barrier to grid development is the current legislation, which makes it complicated for grid operators to receive permission to build overhead lines.

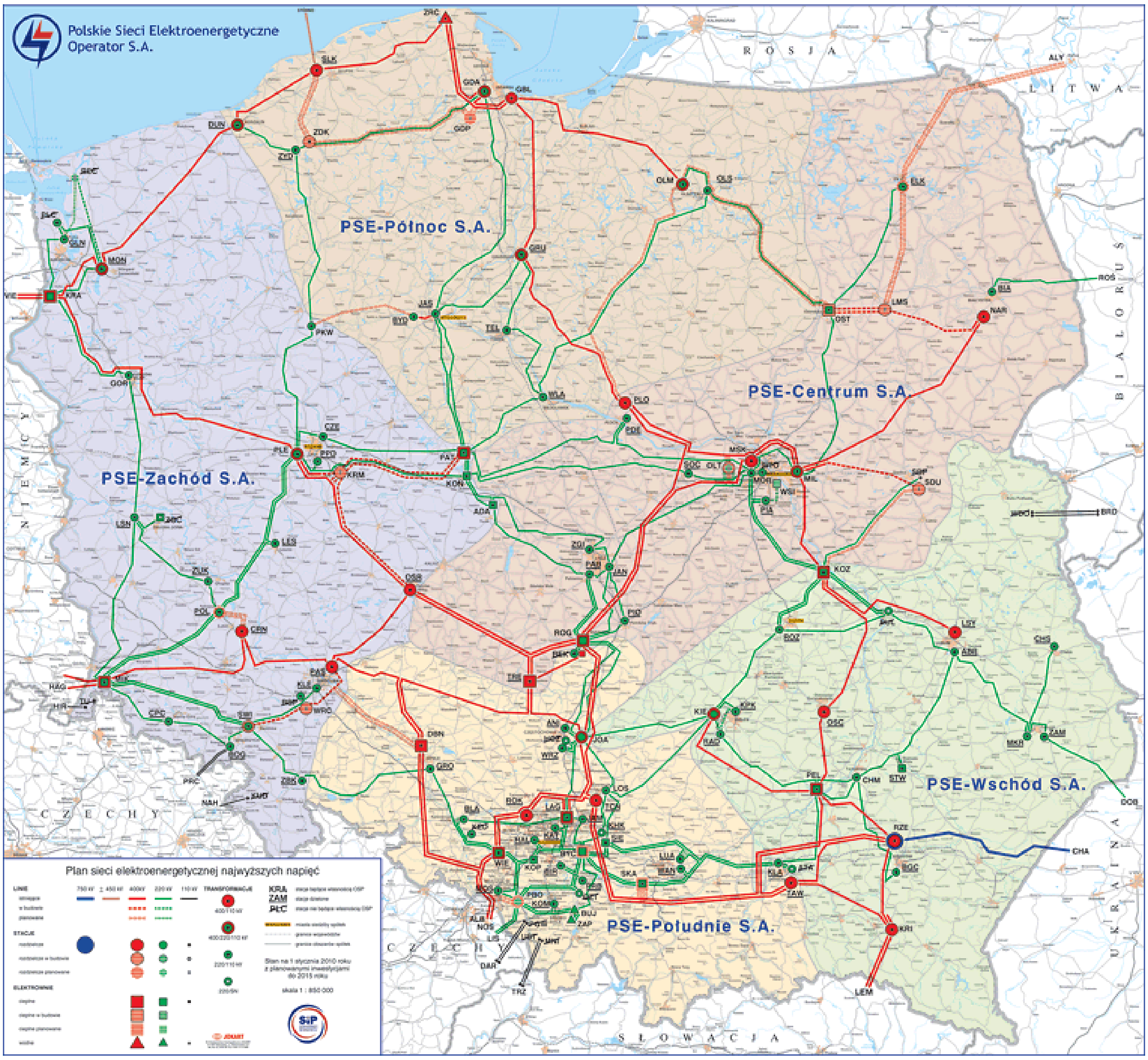


Figure 15: Plan of high-voltage grids (>110 kV)

One of the main and most severe barriers in the process of integration of renewable energy sources into the Polish grid is the lack of grid capacity. Figure 1 shows available and planned transmission grid capacity in Poland. The strongest grid is located in the south west of the country, where the coal mining and industrial centres are located. The figure shows how the grid system has been developed in the last decades. Conditions for renewable energy, especially wind energy, are best in the Northern part of the country along the coast line. At the same time, the grid is not well developed in this region, as can be seen on the plan.

The institutional and organisational structure of the Polish electricity market allows in principle for the integration of RES-E into the markets. Producers of RES-E can sell their electricity on the Over-the-counter (OTC) market and on the Polish Power Exchange (POLPX), which runs an intraday market. The role of long-term contracts in the market has been decreasing, but there is still large share of non-standardised bilateral trading.

The support scheme in Poland is based on a quota obligation and a system of tradable green certificates. Under this support system RES-E producers can sell their electricity on the wholesale market and trade their green certificates on the POLPX, but there is also a large share of bilateral contracts with local suppliers. Instead of fulfilling the required quota, the obliged companies can alternatively choose to pay a "substitution fee", which is set by the Regulator. Due to a permanent shortage of RES-E, that "substitution fee" has been the determining factor for the trade of RES-E certificates. As a consequence, the price for certificates in Poland has been mainly determined by regulation rather than by the market, similar to a feed-in system.

Two additional regulations offer favourable condition for RES-E producers in terms of reducing their risk on the market. Firstly, their economic volume risk is lowered as the TSO and DSOs are legally obliged to buy the electricity for a fixed price. Secondly, wind generators carry balancing risk, but there is a short 2 hour gate closure time plus a special regime for wind with an even shorter gate closure time of 1 hour.

A new amendment of the Energy Law Act is currently discussed, which is expected to come into force in 2012 and which may change the RES-E regulations.

Portugal

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	No
	Distribution of costs	Deep
	Relevant grid level	DSO
	Main barriers to integration	Complicated and slow licensing procedure related to the Environmental Impact Assessment
Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	Yes
	Occurrence of grid curtailment	Rare
	Main barriers to integration	Strict parameters of frequency and limited availability in the Distribution Network
Grid development		
	Effect on Integration of RES-E	Positive
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Small stakeholders participation despite consultations. The RES-E producer bears the costs if an expansion is anticipated.
Market design		
	Functioning markets	Functioning Wholesale and Balancing market
	Intraday market and gate closure	Functioning Intraday market with six sessions (gate closure time 2 ¼ hours)
	Main issue	Still high concentration in generation
Support scheme		
	Support scheme	Fixed feed-in
	Market integration and/or risk sharing elements	Differentiated feed-in tariffs for peak and off-peak hours generation
	Balancing responsibility for RES producers	No balancing responsibility

Table 36: Overview on grid and market integration in Portugal

Two electricity generation regimes are in place in Portugal: the Ordinary Regime Production and the Special Regime Production. The Special Regime covers the electricity from renewable energy sources (except large hydropower plants) as well as co-generation power plants[13].

Energy produced in the Special Regime benefits from a feed-in tariff and there is the obligation to purchase all the production under the Special Regime (art. 55 of DL 172/2006). Actually, because of this existing purchase obligation, the framework regulating the operation of the grid provides favorable conditions for the deployment of RES-E installations.

[13] For specific information on the regulation of the co-generation production see Decree-Law 23/2010 of 25 March.

Portugal intends to have 60% of its generated electricity coming from renewable resources by 2020, in order to satisfy 31% of its final energy consumption by the same year. In addition, Portugal intends to reduce its dependence on energy imports and on the use of fossil fuels. The National Transmission Grid Development and Investment Plan for the period 2012-2017 (PDIRT) foresee a gradual and phased expansion of the electricity network.

The possibility to export RES-E production depends on the development of the interconnection capacity with Spain, but moreover between Spain and France. The grid operator is not legally required to develop the grid, but considering that Portugal imports energy from Spain and wants to reduce this dependence, it is essential to adopt measures, encouraging domestic electricity production. Thus, grid development in Portugal is a key issue to increase energy production and decrease foreign dependence.

The RES-E plant operator bears the costs of connecting the system to the grid connection point, including the electric panels and the switchyards, and the grid operator bears the costs of expanding the grid as foreseen in the Expansion Plans (art. 7 of DL 312/2001).

Considering main barriers to the integration of RES-E production, the complicate and time-consuming licensing procedure was indicated by stakeholders as one of the main issues in grid connection. According to the practical experience of one of the consulted stakeholders, the average time to connect wind farms is 6 years, which can even take longer if a farm is planned to be installed in an environmentally sensitive area, and in cases of small hydro power plants it can take more than 10 years.

Regarding grid operation, the main problem identified was the existence of strict parameters of frequency in the distribution network. Finally, concerning grid development, the network normally has the capacity to connect new installations and the RES-E producer bears only the connection costs. Nonetheless, if a RES-E producer intends to connect to the grid, but there is no capacity available, the producer has two options: either wait for the grid expansion or participate in the costs of anticipating the expansion (articles 6 and 12 of DL 312/2001).

The National Transmission Grid Development and Investment Plan for the period 2012-2017 foresees a gradual and phased expansion of the electricity network, taking into account the targets set by the Portuguese government and aiming to avoid bottleneck. In the past, the grid operator reported to the government the maximum generation capacities power supported by the network and guaranteed these capacities met demand requirements. Under the new, current regime, the Portuguese government defines the goals to be achieved also in terms of renewable energy capacities, and the grid operator calculates the investment needed to develop the grid accordingly.The network normally has the capacity to connect new installations, especially considering that the Portuguese government has prioritized the allocation of capacities through public tenders.

The all-Iberian electricity market "*Mercado Ibérico de Electricidade*" (MIBEL) has been fully operational since July 2007[14]. MIBEL has one common price for electricity for Spain and Portugal if

[14] A Memorandum of Understanding was recently signed between the Portuguese Government and the Troika partners (the European Commission, the International Monetary Fund, and the European Central Bank) with

there is sufficient interconnection capacity. The MIBEL spot market is managed by the Spanish market operator and the derivatives market is managed by the Portuguese market operator. The total volume traded in the spot market is considerably higher than trading in bilateral contracts in Portugal. Compared to other countries the liquidity of the intraday market is quite high. There is still a high concentration in generation which is dominated by one generator that owns approx. 10,000 MW, out of an overall installed capacity of approx. 16,700 MW in 2009. The intraday market is based on six auctions that take place throughout the day. The gate closure time within the three sessions is two hours and 15 minutes before the actual physical delivery of electricity. The Balancing Market in Portugal operates separate from the Spanish Balancing market.

The principal support scheme for promoting RES-E is generally based on feed-in tariffs. The feed-in tariffs are differentiated by technology, are guaranteed for a certain time frame and applicable until an upper limit of electricity produced will be reached. The formula for calculating the feed-in tariff includes the opportunity for RES-E producers to choose between different tariff levels for electricity generated during peak and off-peak hours. The Last Resort Vendor has the obligation to purchase all electricity generated in the Special Regime Generation. Hence, RES-E producers have no incentive to sell directly in the market until the feed-in tariff expires. They do not have any balancing responsibility.

measures linked to the liberalisation of the electricity market and the support schemes for energy production under the Special Regime.

Romania

Grid connection	
Effect on integration of RES-E	Negative
Obligation to reinforce if necessary	Yes
Distribution of costs	Shallow
Relevant grid level	Distribution / Transmission grid
Main barriers to integration	Virtual saturation Access to credit Information management

Grid operation	
Effect on Integration of RES-E	Neutral
Purchase obligation	Planned
Occurrence of grid curtailment	No
Main barriers to integration	None yet, possible with variable RES-E growth

Grid development	
Effect on Integration of RES-E	Negative
Regulatory instruments	Insufficient
Nationwide grid development studies	Existent
Main barriers to integration	Public opposition Lack of funds

Market design	
Functioning markets	All market options available
Intraday market and gate closure	Intraday planned for 2011; gate closure for day-ahead market at 3 pm; for RES 4:30 pm
Main issue	Medium level of market concentration

Support scheme	
Support scheme	Quota with GC; subsidies
Market integration and/or risk sharing elements	Planned feed-in tariff for small-scale plants; no balancing penalty for RES-E below 1 MW
Balancing responsibility for RES producers	Mandatory participation in balancing market

Table 37: Overview on grid and market integration Romania

Romania has considerable own fossil fuel reserves (oil, lignite and gas). Due to a number of large hydro installations, Romania had a share of 23% of RES-E already in 1990 already. In 2010, the share of hydro power has reached 35.9%, while other RES-E sources have not played a significant role in Romania yet.

At the moment, the most relevant renewable energy source in Romania is wind energy, both with regard to the current development as well as its potential. The relevant regions for wind energy are Dobrogea, Banat and Moldova. Correspondingly, problems regarding grid connection procedures mostly refer to wind installations. The most pressing problem is the high number of emitted technical notifications for grid connection and already concluded grid connection contracts, which lead to virtual saturation of the grid. This makes it very hard for new investors to obtain the necessary permits and contracts for grid connection at the moment. Further, the Green Certificate System under law 220/2008 on the promotion of renewable energy sources is not in force yet, but has been under examination at the European Commission until lately. The European Commission approved the law with some amendments. By publishing Emergency Ordinance Nr. 88/2011 law 220/2011 has fully entered into force now. Further, the regulator prepared secondary legislation as well e.g. regulation for Green Certificates issuing and regulation for the organization and functioning of the Green Certificates Market, which has entered into force lately. However, according to different stakeholders, so far missing specifying regulations lead to problems in practice when connecting RES-plants to the grid. RES-E producer's concrete rights and procedures to enforce them are not specified.

Law nr. 22/2008 guaranteed priority access to the grid for RES-E producers, which was changed by Emergency Ordinance 88/2011 into guaranteed access to the grid. However, specifying regulations for making sure that RES-E producers can also impose their rights are missing. There is no special curtailment regulation for RES-E producers, but the question of curtailing RES-E plants has not occurred this far due to the low share of variable renewables within the national electricity production. Currently, there are no problems in operating the grid. However, lacking reserve capacities may lead to balancing difficulties in the future, when the share of wind power plants will increase.

In general, the Romanian distribution grid of low, medium and high voltage (up to 110kV) is in bad condition including the transformer stations and substations, while the transmission grid is in comparably good condition. A national grid development plan exists in which concrete reinforcement measures and grid development projects for interconnections to neighbouring countries and Turkey are elaborated. Further, the question of reserve capacities and a pilot smart grid project are mentioned. However, the quite profound grid development plan faces lack of sufficient funding and delays for public opposition on the one hand and an increased need for grid development due to the high number of already concluded grid connection contracts for wind power plants, especially in the Dobrogea region.

The competitive market in Romania includes the centralised markets for bilateral contracts, the day-ahead market and the balancing and ancillary services market. There is no full-scale intra-day market yet, but only an experimental market. However, it is expected that a proper intra-day market will start in June/July 2011. Participation in the balancing market is mandatory for all producers. Only RES with an installed capacity below 1 MW do not face imbalance penalty payments.

The Romanian state obliges distribution companies to fulfil an annual quota of purchased green electricity. Every end of the year these companies have to prove their purchased "Green Certificates - GC" corresponding with the annual quota. In case the supplier does not meet this obligation it has to pay a penalty to the TSO. A feed-in-tariff is in the legislative process.

Slovakia

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Deep
	Relevant grid level	Transmission grid
	Main barriers to integration	Delays during the connection process Speculation

Grid operation		
	Effect on Integration of RES-E	Negative
	Purchase obligation	Yes
	Occurrence of grid curtailment	Yes
	Main barriers to integration	Massive lowering of feed-in tariffs

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Insufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Lack of incentives for grid operator Distribution of costs

Market design		
	Functioning markets	Only day-ahead market available
	Intraday market and gate closure	No intraday market, gate closure not clear
	Main issue	High concentration, low liquidity in the day-ahead market

Support scheme		
	Support scheme	Fixed feed-in tariffs up to 10 MW installed capacity (15 MW in the case of wind power plants).
	Market integration and/or risk sharing elements	Power plants above 10 MW (15 MW) receive only the market price for the capacity above the threshold.
	Balancing responsibility for RES producers	No balancing responsibility in the support scheme.

Table 38: Overview on grid and market integration Slovakia

In Slovakia, renewable energy sources are generally entitled to priority connection to the transmission or distribution grid. In practice however, investors have to face several problems during the connection process. According to stakeholders, in many cases the connection to the grid is either technically impossible or the whole process is severely delayed. These delays have also been caused by the large number of applications for grid connection. The waiting time can amount to more than one year.

After the TSO unblocked 120 MW grid capacity for variable RES-E plants in 2009, this capacity was used up within only three days. Many of the potential investors were in fact speculators, which blocked the offered grid capacity and subsequently began to sell the capacities to other investors. The government reacted by demanding a building permit for all RES-E projects exceeding 100 kW, which now constitutes a severe problem for RES investors. Apart from such barriers, the research has identified further roadblocks affecting the deployment of RES systems which rather relate to administrative and cost barriers.

In Slovakia, renewable energy sources are promoted through a purchase obligation for electricity generated in RES-E facilities and the payment of a fixed feed-in tariff. In March and July 2011, the regulatory authority has yet again lowered the feed-in tariffs for electricity generated in RES-E facilities. RES investors stated that the feed-in tariffs for PV plants were lowered within one year by as much as 68% (by 1 January 2012, the FiT for PV will be lowered by further 25%) and described this as a severe blow for a very promising branch of the Slovak economy. The regulator argues that the lowering of the feed-in tariffs for RES-E installations will lead to a reduction of the electricity prices for end consumers. From their point of view the main problem in the grid operation process is to ensure the balancing of deviations within the grid, due to the connection of variable RES-E sources. This argument was declined by the Slovak PV Association who claims that the share of variable RES-E capacity is still very low and does not pose a threat to the stability of the grid.

The issue of grid development does not play a significant role so far in Slovakia, since the share of variable RES-E capacities is still comparatively low and at the moment no new variable RES-E facilities apart from roof and facade PV installations up to 100 KW are being connected to the grid. In general, the DSO is obliged to develop the grid on request of RES producers. According to the regulatory authority, the main barrier for the development of the grid is the lack of sufficient financial resources.

The Slovak wholesale electricity market mainly depends on bilateral contracts. On 1 July 2009 the organised day-ahead market was opened in Slovakia on the basis of a common market coupling between the Czech Republic and Slovakia. Since 1 September 2009 the common spot market has been based on the principle of implicit capacity allocation through a Market Coupling mechanism. In 2010 approximately 8 % of the Slovak electricity consumption was traded on the day-ahead market. The Slovak electricity generation is dominated by Slovenské elektrárne, a.s, which produced 73 % of electricity generation in Slovakia in 2009 from its own sources. Including long-term contracted capacities, it ensures around 80% of the Slovak consumption. Currently there is neither an intraday market nor a balancing market available in Slovakia. However, there is an ongoing discussion between market participants on setting up both markets, in particular regarding the implementation of the intraday market on the Czech-Slovak interconnector.

Slovenia

Grid connection		
	Effect on integration of RES-E	Negative
	Obligation to reinforce if necessary	No
	Distribution of costs	Shallow for RES-E
	Relevant grid level	Distribution
	Main barriers to integration	Administrative procedures Long lead times Enforcement of RES-E producers' rights

Grid operation		
	Effect on Integration of RES-E	Neutral
	Purchase obligation	Yes, by choice of applicant
	Occurrence of grid curtailment	None, currently, possible in the future
	Main barriers to integration	None, given the low share of variable RES-E

Grid development		
	Effect on Integration of RES-E	Neutral
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Not existent
	Main barriers to integration	Planning every 2 years

Market design		
	Functioning markets	Over-the-Counter trade and power exchange
	Intraday market and gate closure	No intraday market yet Gate closure on the EX 9 am / bilateral contracts till 14:30 (d-1)
	Main issue	High concentration, balancing and intra-day market planned

Support scheme		
	Support scheme	FiT (only below 5 MW) and Premium scheme
	Market integration and/or risk sharing elements	Option to switch between FiT and premium for plants below 5 MW
	Balancing responsibility for RES producers	Only for producers under the premium scheme

Table 39: Overview on grid and market integration Slovenia

In Slovenia, the share of electricity, produced from RES is rising. It has reached around 30%, which means that Slovenia is reaching its set goals. The main RE source in Slovenia is still hydropower, followed by solar and biomass. The use of the latter two (especially solar energy) has increased vastly in the past years, as the conditions for their use are good.

The framework for connection of the RES power plants to the power grid is legally defined. The transmission and the distribution network operators are obliged to connect the RES power plants to the power grid. The connection procedures are unified for all RE technologies. However the main problem and the biggest barrier within these procedures are the administrative procedures of obtaining all of the necessary permits. These administrative procedures make the connection procedures complicated, non-transparent and often also very expensive. Another problem within these procedures, is the enforcement of the RES producer's rights. The system network operators are obliged to connect the RES producers to the power grid. However, the enforcement of these rights is in practice very difficult. In the case of rejection of the connection to the grid they only have the possibility to appeal at the Energy Agency, which decides about the appeal in an administrative procedure. They have no claim for damages.

After connection to the grid, the system network operators are obliged to purchase the electricity, produced from RES. The RES producers can decide for the purchase option by themselves. They can choose between the guaranteed purchase of electricity and the operational support. In the first case the system network operator is obliged to purchase the electricity, produced from RES, from the producer. In the case of operational support the RES producer sells the electricity on the free market and obtains the operational support as the difference between the price the system operator would pay him within the guaranteed purchase and the average yearly market price of the electricity. After the connection to the power grid, the system network operators are also obliged to reinforce the grid if necessary. However in practice this right, as many other RES producer's rights, is hard to enforce. Another important question within the power grid operation is the question of curtailment. As in Slovenia the scope of electricity, produced from RES is still relatively small, the problem of curtailment has not occurred yet. There are also no relative legal provisions in this regard.

Within the obligation of ensuring transmission and the distribution of electricity, produced from RES, the system network operators are also obliged to develop the power grid. The development of the power grid in Slovenia is based on the development plans, made by the distribution system operator and the distribution companies. Except for the National Renewable Energy Action Plan no other official national studies on this topic exist. The use of intelligent and active networks is not in place in Slovenia yet. However there are some pilot projects of installing progressive meters for households that have already begun.

Important for the purpose of this study is also the question of costs. Within the connection procedure the RES producer only covers the costs of the connection ("shallow approach"). The costs of the use of the power grid are integrated in the network fees and are partly covered by the end-consumers.

As seen above, the electricity, produced from RE sources in Slovenia is good integrated into the power grid. However some improvements would still be needed, especially in the phase of obtaining all of the necessary administrative permits and in the phase of enforcing the RES producer's legal right in the case of rejection of the connection of its power plant to the power grid.

Spain

Grid connection	
Effect on integration of RES-E	Neutral
Obligation to reinforce if necessary	Yes
Distribution of costs	Deep (except for small-scale RES-E systems)
Relevant grid level	Transmission and distribution grid
Main barriers to integration	Delays introduced by administrative procedures Heterogeneity of DSO technical requirements

Grid operation	
Effect on Integration of RES-E	Positive
Purchase obligation	Yes
Occurrence of grid curtailment	Minor
Main barriers to integration	No significant barriers detected

Grid development	
Effect on Integration of RES-E	Neutral
Regulatory instruments	Insufficient
Nationwide grid development studies	Existent
Main barriers to integration	Lack of proper incentives for DSOs and RES developers Remuneration of distribution level grid development costs

Market design	
Functioning markets	Full range of market options available. Markets are liquid and transparent
Intraday market and gate closure	Functioning intra-day market, minimum 3 ¼ hour gate closure depending on trading session
Main issue	Currently no major issues

Support scheme	
Support scheme	Feed-in-Tariff and premium option
Market integration and/or risk sharing elements	Full market integration within the financially attractive premium option Time of use tariff option within FiT, differentiating between peak and base load hours
Balancing responsibility for RES producers	Yes (FiT and market premium scheme)

Table 40 - Overview on grid and market integration, Spain

Spain is currently one of the most developed RES-E markets in Europe and its national objective for 2020 is to exceed the 20% European target for RES-E share in final energy consumption. However, despite the significant volume of wind and solar installations connected and integrated to the Spanish grid infrastructure during the last few years, it was possible to identify a number of improvements that, if implemented, would further increase the rate of RES integration in the country.

With reference to the grid connection framework, Spanish RES-E developers often have to face excessive grid connection lead-times and significant connection costs. These long lead-times are often caused, rather than by the grid operators, by the long and regionally inhomogeneous administrative procedures involved in the grid connection phase. At distribution level, the significant grid connection costs are instead generated by the “deep” costs approach established by the Spanish legal framework. In fact, the current DSO remuneration regime does not recognise grid upgrade costs when these are required in order to connect new generation plants, and instead provides that these costs are directly and completely borne by the operators of the generation facilities that originate them.

In late 2011, after a long conception period, a new national law has eventually introduced a streamlined grid-connection framework for small-scale RES-E systems.

In general, the grid connection framework appears better defined at transmission level, where *Red Eléctrica de España* (REE) is considered to be a transparent interlocutor, even if in some cases it was reportedly unable to cope with large volumes of connection requests. At distribution level, however, the situation appears to be more heterogeneous and complex: the already mentioned regional variability of administrative processes adds to changeability in DSO technical requirements, which lack sufficient national legislative coordination. The higher volume of grid connection requests that DSOs have inevitably to cope with further exacerbates this sub-optimal context.

RES-E electricity generation facilities in Spain are entitled to priority access to the grid, priority dispatching (if entitled to the feed-in tariff (FiT) support) and guaranteed purchase of electricity whenever security is guaranteed. Operation of RES-E installations within the Spanish power system is facilitated by the existence of a supervision infrastructure directed by the CECRE, a unique control centre set-up by the Spanish TSO. The centre monitors RES-E plants higher than 1 MW and controls the production of all RES-E plants larger than 10 MW, either individually or in clusters. Other operation requirements for RES-E installations may involve, depending on technology and capacity installed, power factor ranges to be respected and low voltage ride through (LVTR) capability.

As foreseen by the Spanish legal framework, grid development planning is mandatory at transmission level, but only indicative at distribution level. In both cases, it is either the TSO or the DSOs that, having the technical expertise, prepare the development proposals that are then discussed and approved by the competent public authorities. At transmission level decision-making is held by the Ministry of Industry, Energy and Tourism (MINETUR), while at distribution level the decisional power is held by the Regional Administrations (CC.AA.). In both cases, the *Comisión Nacional de Energía* (CNE) holds an important consultative and regulatory role. The foreseen RES-E installation developments can properly be taken into account only at transmission level, while remunerative and procedural issues prevent this from happening also at distribution level. How to overcome these practical issues is a current matter of debate between national legislators and other Spanish stakeholders. In summary however, considering the fast pace of RES-E development, grid development and RES-E integration could be taking place at a faster rate than the present one.

The architecture of the Spanish wholesale market is quite complex and includes an organised day-ahead and intra-day spot market as well as bilateral trading outside the centralized market. The intra-day market has six trading sessions and a gate closure of a minimum 3¼ hours before delivery. This general framework and the high levels of liquidity and transparency in the market place provide favourable conditions for RES–E producers. Balancing market participation is possible for some RES-

E technologies (e.g. biomass, solar thermoelectric installations) if they pass a manageability test by the TSO.

The Spanish support scheme for RES-E is quite sophisticated in the way it balances market integration and investment security. It offers the choice between a fixed FiT and a market premium option with a cap and floor price. In addition, the FiT includes a demand-oriented option with time-differentiated tariffs (not available for wind, PV generators and CSP plants). RES-E producers are, as all other producers, balancing responsible but only deviations that enhance the total system imbalances are charged to generators *(dual imbalance pricing system)*.

Sweden

Grid connection		
	Effect on integration of RES-E	Neutral
	Obligation to reinforce if necessary	Yes
	Distribution of costs	Decided from case to case
	Relevant grid level	Transmission grid / Distribution grid
	Main barriers to integration	Cost bearing and sharing
Grid operation		
	Effect on Integration of RES-E	Positive
	Purchase obligation	No
	Occurrence of grid curtailment	None
	Main barriers to integration	No barriers detected
Grid development		
	Effect on Integration of RES-E	Positive
	Regulatory instruments	Sufficient
	Nationwide grid development studies	Existent
	Main barriers to integration	Long lead time for permit/concession for transmission line
Market design		
	Functioning markets	All market options available on the common Nord Pool market
	Intraday market and gate closure	Intraday available; Gate closure is one hour prior to delivery
	Main issue	Concentration in generation, potentially low liquidity in the intraday market
Support scheme		
	Support scheme	Quota obligation scheme with tradable Green Electricity Certificates.
	Market integration and/or risk sharing elements	Full market integration, no specific risk sharing elements
	Balancing responsibility for RES producers	Yes

Table 41: Overview on grid and market integration Sweden

In general, grid access and grid development are not a big problem for the deployment of renewable energy sources in Sweden. New investments will be needed, but this does not constitute any barrier (Energimyndigheten 2011). The Swedish government and the TSO recognised existing problems and conducted numerous studies. Some solutions have already been proposed.

Grid operators are obliged to connect a plant and reinforce their grid if it is necessary. The procedure of connection of a RES-E plant to the grid is transparent and clear. The state set up a special webpage describing connection procedure in detail. The deadlines for connection are not specified and if grid reinforcement is necessary, the procedure may take a long time. Who has to bear these costs varies from case to case and the final decision is made by the TSO.

The most problematic issue regarding grid connection is a so-called threshold effect, which occurs if big grid reinforcement is required. In that case an operator of a plant connected first will bear the costs of the whole investment. The proposed solution from the TSO waits for the signing by the Ministry of Industry.

Electricity from renewable energy sources is subject neither to a purchase obligation nor to a dispatching priority regime. Curtailment occurs only very rarely in Sweden.

A grid operator is generally obliged to upgrade his grid if necessary. Several types of grid development studies are conducted in Sweden. The introduction of smart grids has been considered essential for increasing the amount of electricity from renewable energy sources.

Planned growth in electricity generation will be a major challenge for the national grids. Great investments into grid development will be necessary.

Sweden is well integrated in the Nordic energy exchange Nord Pool. The major part of the consumed electricity in Sweden is traded on the Nord Pool day-ahead market ELSPOT. Due to the central geographical location of Sweden within Scandinavia, it has had the advantage that there has been a common price area with at least neighbouring power spot area most of the time. The Gate Closure Time of the intraday market ELBAS is one hour before real delivery of electricity. As for power generation the state owned producer Vattenfall dominates the market and generated 44 % of the electricity in Sweden in 2009. The Swedish TSO is responsible for balancing supply and demand in real time. The Nordic TSOs cooperate in balancing the Nordic system, with a balancing cooperation, the Regulation Power Market.

The Swedish support scheme is based on a quota obligation scheme with tradable Green Electricity certificates ("elcertifikat"). One Certificate is issued for one megawatt hour of electricity from RES-E if the producer fulfils the requirements of the Electricity Certificates Act. The Swedish support scheme does not comprise a technology specific support. The obliged party has to buy a number of certificates that is proportional to the amount of electricity they supply. The annual quota obligation is pre-defined, but varies with every calendar year. If the company does not reach the required quota, it has to pay a penalty for each missing certificate of 150% of the average certificate price of the last period. Due to the certificate support scheme all RES-E producers are trading on the free market and have the same balancing responsibility as any other market participant.

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Annex I – Methodology

Overview[15]

In this study, 329 stakeholders were contacted, and more than 200 of them agreed to contribute through an interview. Three consultation rounds to consolidate the obtained results followed.

The methodology applied in this project consisted of 6 steps:

1. Development of research templates, basic research, interviews and first consultation round
2. Compilation of national reports and second consultation round
3. Harmonisation of barriers and creation of cause-consequence patterns
4. Comparison of the identified barriers and patterns with the NREAPs
5. Evaluation of the NREAPs and drafting of recommendations
6. Final consultation round

Specific process

1 – Development of research templates, basic research, interviews and first consultation round

Based on Article 16 of Directive 2009/28/EC, three areas in which barriers to RES-E integration may occur have been considered and analysed:

- Grid Connection (Article 16(3) – (6) of the Directive);
- Grid Operation (Article 16(2), (7) of the Directive);
- Grid Development (Article 16(1) of the Directive).

Subsequently, a set of criteria based on the provisions of Article 16 has been extracted and compiled in a research template, available in Annex IV on page 199.The information to fill in the templates was collected through basic internet research and through interviews with key stakeholders in each country, e.g. RES-E associations, TSOs, DSOs, Ministries, regulators, producers. The experts contacted in each country are listed in Annex II on page 177.

In this phase we also conducted the **first consultation round**: after each interview, a transcript was sent to the interviewed expert for editing and final confirmation.

[15] Raffaele Piria has contributed to set up this project while working at eclareon and, on a personal level, after he left eclareon to join SEFEP. SEFEP has not participated in this project and does not necessarily support all its conclusions.

For the fourth area, Market Integration, the same process was followed. Criteria of analysis were agreed with the client and the same process outlined above was followed.

In parallel, an extensive data analysis based mainly on ENTSO-E, the NREAPs and Eurostat was carried out to provide the reader of the national reports with a synthesised overview of the current situation and the expected developments of each country with respect to RES-E status and resources, relevant players and interconnections.

The templates used in the research phase are provided in Annex IV on page 199.

2 – Compilation of national reports, evaluation of countries and second consultation round

Following the research phase, national reports were drafted according to a common template. This template, just like the research template, was organised along the same criteria put forward by Article 16.

At this stage, the authors also provided a first evaluation for each country as regards the conditions offered for RES-E integration in the different phases. This evaluation was carried out according to the following criteria:

- Compliance with the provisions of Article 16;
- Overall assessment received by stakeholders;
- Type of barriers detected, relevance and severity of barriers;
- Amount of problems detected; [16]
- Comparison with the European context;
- Overall assessment after the finalisation of the study, including the second consultation round.

The evaluation resulted in deeming the conditions for RES-E integration offered by each Member State in each phase as Positive, Neutral or Negative. These assessments are related to the sector as a whole, i.e. comprising all plant sizes and all RES-E types, to provide an extremely simplified overview. Specifically, the meaning assigned to these labels is as follows:

- **Positive**: the conditions offered by a Member State pose no or negligible barrier to RES-E integration;
- **Neutral**: the conditions offered by a Member State pose minor barriers to RES-E integration;
- **Negative**: the conditions offered by a Member State pose major barriers to RES-E integration;

After an internal revision, a draft copy was circulated among the contacted stakeholders for further comments on the content. In this **second consultation round**, the stakeholders had thus the chance to review both the content and the evaluation, and to provide comments on both parts. After receiving these comments, the versions of the reports were re-worked and amended, where necessary, and then finalised. The 27 National Reports are provided along with the present study.

[16] A large number of problems, however, does not necessarily indicate a negative situation, as it may simply imply a larger amount of available information. This was taken into consideration while providing the assessment.

3 – Comparison of the identified barriers and patterns with the NREAPs

The finalised reports provided us with a number of specific barriers to RES-E integration occurring in each country in the different analysed phases. Based on this information, a list of specific country barriers was extracted and compared with the provisions put forward in the NREAPs.

Once again, the work was carried out according to a common template (provided in Annex IV on page 199), which assessed: a) whether each barrier identified through national research was taken into consideration in the NREAP; b) to what extent it was considered; and c) what measure(s) had been foreseen in that regard. This checklist and summary of measures were brought forward in the last step for the evaluation of the NREAP.

4 – Harmonisation of barriers and analysis of cause-consequence patterns

The aim of this phase was to bring the perspective from a national level to a European level. Therefore, the barriers outlined in the 27 reports were summarised, listed and grouped under the same category in case of similarities.

More in detail, the process was as follows:

a) Division of barriers according to type

In each country the identified barriers were divided in three types: stand alone, cause, consequence.

- **Stand-alone barrier**: an issue that directly blocks the integration of RES-E in the grid;
- **Cause**: an issue that indirectly blocks the integration of RES-E in the grid by causing another issue (consequence);
- **Consequence**: an issue that directly blocks the integration of RES-E in the grid and that is clearly caused by an assessed issue (cause).

It should be underlined that this typology was made to be quite flexible. These cause-consequence relations may in fact not always be straightforward and in a one-to-one pattern, their analysis was therefore calibrated in order to take these characteristics into consideration. Precisely, in carrying out this analysis strict rules were applied:

- A cause-consequence relation is reported only in cases where there is absolute certainty that this pattern takes place in the concerned country;
- A barrier may have multiple causes or multiple consequences, in such cases they are all reported;
- A barrier may belong to different types (e.g. can be a stand-alone and a consequence), in case this emerges from the national reports.

To ensure maximum respect of and adherence to the national reports, this typology has been checked and corrected by the authors of the national reports. For all obtained patterns, the authors confirm that the country's typology fully respects the contents of the national reports after the second consultation round.

b) Harmonisation of barriers across countries

Following this, the national barrier typologies were compared with each other in order to find cause-consequence patterns common across countries. Firstly, to simplify this task, all similar barriers were grouped under common categories, in case they showed a large amount of similarities, and secondly the common patterns were identified and included in this report.

The results of this work are provided in the above chapters, when describing the barriers to RES-E integration in the phases of grid connection, operation and development.

5 – Drafting of recommendations and final assessment of Member States

This step merged the results obtained in points 3 and 4. The identified barriers, together with the cause-consequence patterns obtained in step 4, were fed into a template and proposals for solving the issues were given. It was also reported when a solution to the analysed barrier or pattern was provided in different countries and / or in the NREAP. The template is available in Annex IV on page 199.

At this stage and based on the results of the NREAP and barrier analysis, the overall assessments of all Member States were re-examined, and if needed, adapted to the new findings.

As previously mentioned, the authors of this study concede that the evaluation is partially based on subjective assessments either by other stakeholders or by the authors themselves. This challenge has been addressed by resting the evaluation on a broad variety of different opinions and by taking more objective elements into account, such as the compliance with the requirements of the NREAP template, and by conducting a total of three consultation rounds.

6 – Final consultation round

Before publication, the reports were subject to a public consultation process run in cooperation with the European Commission itself. Through this process, all stakeholders, including the ones that were not involved in the interview process, had the chance to provide their comments on the Member States' reports. After receiving such comments, the authors analysed them and refined their view and assessment on each Member State. Stakeholders expressing opinions that severely differed from the findings of the national reports were usually contacted by the respective authors of the national reports study in writing, by telephone or even in a personal meeting. This should ensure that the differing view has been fully taken into account.

Qualitative vs. quantitative research

The results provided in this report are mainly of qualitative nature, rather than quantitative. Of course, having solid quantitative results and comparable figures on lead times and costs would be ideal for such a report. There are, however, a number of methodological problems when it comes to actually measuring those aspects. Because of these, the authors preferred to provide comparable and reliable qualitative results, rather than uncertain and possibly incomplete quantitative ones.

In terms of assessing time and costs, the following should be kept into consideration:

- **Measuring lead times is tricky**. First of all, the time is not an independent variable, since it partly depends on the timeliness, precision and completeness of the documentation provided by the applicant. Moreover, it is not evident how the time of an administrative process should be defined. The day of the first application is not a reliable indicator, because in some cases the formal application is "light" and is filed as soon as the project starts being conceived, in other cases the applicant would work weeks or months before submitting a formal application. Also the end of the process is not always easily identifiable. Should the time for a possible appeal be counted? In some cases, a long time goes between the effective certainty of the authorisation, allowing the developer to start preparing the work, and the day of formal notification. Finally, it must be distinguished between the total time (from start to end of the process), the waiting time (time which could not be used in other processes for the same project) and the actively spent time (hours of work necessary to complete the process). The latter two indicators also depend on the efficiency of the applicant. Without this distinction, the results would be blurred. Keeping the distinction makes an empirical survey heavier and more complex.

- **Measuring the costs is tricky as well**. First of all, the issue of comparability of costs across countries should be considered. Relevant grid levels vary among countries, therefore the scale of the infrastructural works involved (lines, stations, etc.) varies with it. These infrastructural works clearly belong to different cost scales and therefore addressing such issues with the same research structure in different Member States may provide biased results. Furthermore, estimates of such costs may not even be available. It may well be that costs vary across regions, and also that not all contacted administrations possess such information. The risk involved in this case then, is to have a set of "spot" results that would be taken as valid for the whole State and would be likely to create large margins of uncertainty. Purely administrative costs, furthermore, vary largely according to organisation and even within the same organisation. For instance, many say they actually cannot quantify the costs of administrative procedures, as they are tackled by several departments and/or are accounted for as overhead. Finally, it should be distinguished between the costs by the administrative process as such, and the costs caused by the fact of having to comply with certain regulations or standards. Should the latter be considered? In any case, companies cannot always distinguish among them. Further, it should be considered that companies may not wish to disclose this information for strategic reasons, or also that organisations may simply not be aware themselves of the cost detail and may provide uncertain estimates.

Annex II –Interviewed stakeholders

Please note that in some Member States, contributions were given anonymously, i.e. the interviewed expert wished that neither his/her name, nor the one of his/her organisation or company be quoted.

Austria

Christine Materazzi-Wagner, Energie-Control

Dr. Gustav Resch, EEG TU Wien

Dr. Dieter Kreikenbaum, oesterreichs energie

Dr. Hans Kronberger, PV Austria

Stefan Zach, EVN AG

Stefanie Fuchs, Austrian Power Grid AG

Dr. Ursula Nährer, IG Windkraft

Walburga Hemetsberger, VERBUND AG

Belgium

Thierry Van Craenenbroeck, Vlaamse Regulator van de Elektriciteits- en Gasmarkt

Vincent Deblocq, Fédération Belge des Entreprises Électriques et Gazières/Federatie van de Belgische Elektriciteits- en Gasbedrijven

Frank Gérard, Fédération de l'Énergie d'Origine Renouvelable et Alternative

Francis Ghigny, Commission Wallonne pour l'Énergie

Bruno Gouverneur, Fédération des gestionnaires de réseaux électricité et gaz en Belgique/Federatie van de netbeheerders elektriciteit en aardgas in België

Steven Harlem, Fédération Belge des Entreprises Électriques et Gazières/Federatie van de Belgische Elektriciteits- en Gasbedrijven

Emmeric Mees, Commission de Regulation de l'Électricité et du Gaz/Commissie voor de Regulering van de Elektriciteit en het Gas

Steven Mertens, Elia System Operator SA

Dominique Simon, Département de l'Énergie et du Bâtiment durable de la Direction Générale opérationnelle de l'Aménagement du territoire, du logement, du Patrimoine et de L'Énergie (DGO4) du Service public Wallonie (SpW)

Bruno Van Zeebroeck, Fédération de l'Énergie d'Origine Renouvelable et Alternative

Bulgaria

Sebastian Noethlichs, Bulgarian Wind Energy Association

Hristoslav Pavlov, wpd Bulgaria

Jörg Sollfelner, EVN Bulgaria

Nikolay Nikolov, Island Renewable Energy Bulgaria

Cyprus

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Endesa – Madrid, Spain

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Annex III – List of all encountered barriers

In this section, a list of all harmonised barriers is provided. These are all the barriers reported in the different countries in the grid connection, grid operation and grid development phase. In the tables below, the presence of an X in a cell indicates that the barrier at the beginning of row has been reported in the Member State at the top of the column.

Grid Connection

Barrier \ Member State	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
Communication lack / conflicts between stakeholders	X					X		X	X	X				X					X					X			
Complex or inefficient procedures				X					X			X	X	X		X	X		X		X		X				
Complex or time-taking legal procedures	X					X		X														X				X	
Conditional connection																						X				X	
Conflict of interest			X		X								X											X			
Connection to the grid impossible or denied					X					X								X	X								
Deadlines not defined or not well allocated							X									X	X							X	X		
Heavy / non-transparent / unclear technical requirements to connect				X		X			X								X					X					
Heavy burdens in presenting the connection request																X						X					
High costs														X	X			X									
High costs for small DSOs										X																	

Barrier \ Member State	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
High fees to be provided upon requesting connection					X							X				X						X					
High market concentration	X		X			X																					
Insufficient application of existing laws	X																					X					
Issues linked to connection obligation																		X			X					X	
Issues linked to the offshore grid						X						X															
Lack of competence of TSO / DSO						X																X					
Lack of grid capacity / different pace of grid and RES-E development		X	X			X		X	X	X	X	X	X	X	X	X	X			X	X	X		X			
Lack of space / lack of suitable land																				X							
Legal unclarity / legal weakness										X							X		X					X		X	
Limited accessibility of information	X										X			X			X					X		X			
Limited exchange of information	X				X	X				X				X				X				X		X			
Long lead times / delays			X	X		X		X	X			X	X	X	X	X			X			X	X	X	X	X	
No compensation for refusal of connection or delays in providing connection		X																						X			

Barrier \ Member State	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
No obligation for the grid operator to connect a new plant		X																									
No obligation for the grid operator to reinforce the grid for new plants	X	X	X		X								X	X	X				X								
Non-shallow costs	X							X	X		X	X					X	X	X							X	
Other			X		X			X				X	X	X	X			X	X		X			X			X
Overall framework not well geared to promotion system	X		X		X			X																X			
Overload of connection requests			X		X										X	X											
Permissions and licenses issued too easily					X																						X
Public opposition										X		X					X										
Speculation			X		X			X						X		X			X					X			X
Total or partial lack of planning / careless or punctual planning						X					X		X														
Unclear cost regime						X		X		X	X											X		X	X		
Unclear or non-homogeneous procedure for grid connection						X								X					X	X			X			X	
Unstable conditions (norms/support systems)									X					X										X			

Member State / Barrier	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
Variability of requirements for connection (regional differences or frequent changes of the requirements)						X			X					X			X									X	
Virtual saturation			X		X			X		X				X		X			X					X			X
Weak position of plant operator to enforce his rights	X	X	X		X	X		X					X	X								X		X			

Grid Operation

Barrier \ Member State	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
More curtailment expected in the future				X				X				X								X							
No incentive for compliance with ancillary services											X			X													
No compensation provided for curtailment / compensation difficult to apply		X														X				X		X	X				
None / partial regulation of curtailment		X						X		X				X								X	X			X	
Presence of curtailment			X						X				X			X				X							
Lack of grid capacity / interconnection			X						X											X	X	X					
Other	X		X	X	X	X			X		X	X	X	X	X	X	X				X	X	X			X	X

Grid Development

Barrier \ Member State	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
Complex or inefficient procedures	X				X	X		X	X	X	X					X											
Conflict of interest			X		X								X											X			
Grid development does not keep pace with RES-E growth									X		X					X											
High market concentration			X		X														X								
Insufficient stakeholder inclusion / small stakeholder influence in planning			X										X	X									X	X			
Issues related to cost regime					X			X			X																
Lack of incentives or regulatory instruments for the grid operator to reinforce the grid	X		X			X		X	X	X		X														X	X
Lack of transparency of grid development plans	X	X				X												X									
Long lead times / delays	X				X	X		X	X	X	X					X									X		
No obligation for the grid operator to reinforce the grid to accommodate a new plant	X	X	X						X				X	X	X				X			X					
Other		X	X			X		X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	
Public opposition	X					X																X		X	X		

Barrier \ Member State	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK
RES-E not sufficiently considered in the development phase	X				X			X		X			X	X				X	X		X			X		X	
Unclear / non-transparent sharing of responsibilities								X		X									X								
Vague, non-comprehensive development plans			X			X					X	X								X							
Weak position of plant operator to enforce his rights			X		X	X		X					X	X								X		X			

Annex IV – Templates

This section presents the templates that have been used to carry out the research and the evaluation of the NREAPs.

Research template

Connection to the Grid (Article 16(5), (3), (4), (6) of Directive 2009/28/EC)

<table>
<tr><td>Relevant legal sources</td><td colspan="2">List of relevant legal sources used in the document</td></tr>
<tr><td>Summary</td><td colspan="2">To be written at the end</td></tr>
<tr><td rowspan="3">Connection procedures for different technologies</td><td>Process flow description</td><td>List of necessary steps. If necessary, distinction between
a) Different grid levels
b) Small/Large RES plant
c) Onshore/ offshore</td></tr>
<tr><td>Deadlines</td><td>- Quantitative? If so, which ones?
- Qualitative? If so, how are they defined
- No deadlines</td></tr>
<tr><td>Information management of TSO/ DSO</td><td>Are the requirements of art. 16 (5) fulfilled? Does it work well in practice?</td></tr>
<tr><td rowspan="2">Obligations, legal responsibilities and Addressees</td><td>Connection obligation</td><td>Is TSO/DSO obliged to connect? Is the conclusion of a contract a pre-condition? If yes, does the negotiation of this contract constitute a barrier?</td></tr>
<tr><td>Reinforcement obligation</td><td>Is TSO/DSO obliged to reinforce the grid, if this is necessary to practically allow the new producer to regularly feed into the grid?</td></tr>
</table>

		How can RES producer legally enforce this right? Is there a claim for damages?
Enforcement of RES producer's legal rights	- Is this issue clearly defined by law? - Can the rights be enforced easily? - Can the RES producer claim a compensation for the damage suffered in case of undue delay?	
Costs of grid connection	**Definition of Costs**	*Shallow / Deep, Transparency (particularly in case of deep)*
	Rules governing sharing and bearing of costs	*This point is treated in the chapter below on grid development*
Practical problems and proposed solutions?	*See comprehensive (and provisional) list of questions in the document above*	

Operation of the grid (Article 16(2), (7) of Directive 2009/28/EC)

<table>
<tr><td>Relevant legal sources</td><td colspan="2">List of relevant legal sources used in the document</td></tr>
<tr><td>Summary</td><td colspan="2">To be written at the end</td></tr>
<tr><td>Purchase obligation</td><td colspan="2">• Is there a purchase obligation?
• If yes, who is the obliged party?</td></tr>
<tr><td>Dispatching priority</td><td colspan="2">Is there a regime in place to provide priority dispatch for renewables</td></tr>
<tr><td>Priority or guaranteed access</td><td colspan="2">Is there priority access or guaranteed access to the grid?</td></tr>
<tr><td>Obligations of the RES producer to operate in line with network requirements</td><td colspan="2">• Are there specific obligations on RES producers to provide such ancillary services
• Are there any additional incentives for plant operators to provide such services</td></tr>
<tr><td rowspan="4">Curtailment (or other measure to ensure stability of grid)</td><td>Requirements</td><td>Is curtailment regulated at all?

If there is grid regulation – is this a general regulation about grid security or are there specific regulations for RES?</td></tr>
<tr><td>Transparency obligation</td><td>What is the process before the curtailment?</td></tr>
<tr><td>Compensation payments</td><td>Is it foreseen to provide RES generators with a compensation payment in the case of curtailment?</td></tr>
<tr><td>Regulations to avoid curtailment?</td><td>Is curtailment a temporarily solution or a permanent option in case of grid overflow?</td></tr>
</table>

Practical problems and proposed solutions?	

Development of the grid, intelligent networks, storage facilities and interconnections (Article 16(1) of Directive 2009/28/EC)

<table>
<tr><td>Relevant legal sources</td><td colspan="2">List of legal and other sources used in this chapter</td></tr>
<tr><td>Summary</td><td colspan="2">To be written at the end</td></tr>
<tr><td>Regulatory framework for grid development</td><td colspan="2">- Legal definition of the objectives of the grid operator concerning renewables and grid development
- Procedure: Who takes the final decision on priorities in the development of the grid?
- Who is formally consulted within the process leading to this decision? Which powers have those consulted?
- If there are differences between transmission and distribution systems, please describe them.</td></tr>
<tr><td>Obligations, legal responsibilities of the grid operator in relation to the RES producer</td><td colspan="2">- Can the RES producer legally demand the grid operator to develop the grid, if this is needed for dispatching?
- If yes:
I. Which are the boundaries of the operators' obligation?
II. how can RES producer legally enforce this right?
III. Can the RES producer claim for a compensation for the damage suffered?</td></tr>
<tr><td>Regulatory instruments to encourage grid development</td><td>RES as regulatory goal</td><td>- Does the regulator take future RES deployment into account as an objective while regulating tariffs?
- If so, how? (For example: additional funding within incentive regulations for the development of grids that serve the integration of RES)</td></tr>
<tr><td rowspan="4">Grid development studies and planned improvements</td><td>Existence of grid development studies</td><td>- Do official (nationwide, by government or regulator or TSO/DSO) grid development studies exist?
- If not, has a formal procedure been established to produce them?</td></tr>
<tr><td>Development of the grid</td><td rowspan="3">- If yes Is this topic addressed in the study? If so how? For example: Are there concrete planned or even initiated projects? Or is the topic simply mentioned as an abstract goal?</td></tr>
<tr><td>Intelligent network</td></tr>
<tr><td>Storage facilities (as far as these are considered in grid development</td></tr>
</table>

	studies)	
	Interconnections	
Costs/ Rules governing sharing and bearing of costs	*How are network fees distributed between plant operators and final consumers*	
Any further issue? Practical problems and proposed solutions?	- *Problems encountered by grid operator when fulfilling its goals and/or obligations to accommodate more renewables? (mainly: financing)* - *Reality check: (quick) comparison between national plans and ENTSO-E's TYNDP / 2012 drafts if available* - *Reality check: based on stakeholders/expert opinions: are the national plans compatible with NREAPs targets?*	

Market Design

Relevant legal sources		
Summary		
Market design		
General availability of markets	**Is there a balancing market?**	
	Are wholesale and balancing markets generally regarded as open to new entrants, transparent and liquid?	
	To what extent are wholesale and balancing markets centralised or decentralised?	
When is the gate closure time, i.e. until when can RES producers correct their forecasts?		
Is there a functioning intraday market to correct forecasting errors (especially if RES producers are in charge of imbalances, see below)?		

Accessibility of markets for RES producers, especially to balancing markets	**What is the minimum bid size?**
	How long is the period for which market participants have to provide balancing capacity?
	Is there the option of pooling different generators and consumers?
	Are there separate tenders for negative and positive balancing?
Is the support scheme based on a feed-in tariff, a premium on market prices or a quota obligation, or a combination of different support schemes?	
Especially in the case of feed-in tariffs are there any approaches or discussions to promote the market integration of RES-E? **In the case of quota or premium systems, are there any discussions to improve market integration.** **Please provide an overview.**	

In the case of feed-in tariffs, is the tariff paid to RES producers fixed or is it in any way varied depending on market conditions? **If it varies, what drives the tariff variation (e.g. market price, demand, time of day)? How is the tariff paid to RES producers linked to that reference?**		
Is there a balancing responsibility for RES producers? **If so, are there specific balancing rules for RES producers?**		
Are there any additional mechanisms to limit the risk of RES producers?	**Is there an option to switch between a high-risk scheme with higher exposure to the market and a low risk one, e.g. with fixed tariffs?** **If so, what are the main rules for this (e.g. period for which RES producers have to choose)?**	

	If the price paid to RES generators varies, are there upper and lower limits for this price?	
	Are there any other such mechanisms?	
Practical problems and proposed solutions?		

NREAP analysis template

Barrier identified in RES Integration Study	Is the barrier contested?	Measures foreseen in NREAP		
		Section in NREAP	Summary of foreseen Measure	Comments & Evaluation

Recommendation template

Barriers identified			Solution proposed	Detailed description (Page)
Stand Alone	Cause	Consequence		