S2S4E

Climate Services for Clean Energy

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# Assessment of policies and recommendations

## Deliverable D6.2

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## Disclaimer



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# Summary

This deliverable presents the results of an assessment of energy policies and interventions that directly or indirectly influence the use of S2S forecasts. It provides an overview of the existing policy framework and studies its impact on the demand of S2S forecasts, at European level and in the seven countries of origin of S2S4E partners (i.e. France, Germany, Italy, Spain, UK, Sweden, and Norway). The analysis of 9 major EU directives and 117 national policies allowed the identification of general trends on policy support to S2S.

**At EU level, the incitement to use S2S, together with other weather and climate services, became more explicit, specific and detailed over the successive amendments of major energy Directives**. The first versions of the Directives recommended to Member States to take action to secure the security of supply and the energy system balance. The under discussion "Clean Energy for all Europeans" package goes as far as to decree that ENTSO-E shall use a probabilistic approach to perform seasonal forecast for specific variables such as the demand and production from renewable sources.

**At national level, policies supporting the development of renewable energy sources are the ones that most influence the uptake of S2S** due to their high share of these policies within the energy policy framework. This situation is caused by a low number of policies directly supporting the use of S2S or more globally climate services. A significant set of R&D programs and measures supporting the uptake of technologies supporting a similar aim has been found, but none of these mention climate services. However, three examples of policy providing a direct support to climate services has been found, each one being linked to a different step of the energy value chaine (i.e. energy production, energy distribution and market regulation). Although they remain monitory examples, they show that a support to S2S at national level is possible.

Finally, providers of S2S services can use several policy levers to suggest an increased policy support to their solutions. At EU level, there is the possibility to **contribute to the consultation to be launched by ENTSO-E** to define the methodology for seasonal assessment with stakeholders throughout the energy value chain. At national level, a better recognition of S2S as a relevant solution to increase the reliability of renewables is needed. It could be achieved by **integrating S2S forecasts into the portefolio of solutions** to be developed in R&D programs related to renewables or recommended in measures aiming at a more resilient energy system.

# Keywords

S2S forecast, policy support assessment, policy recommendations, reliability of renewable energies, energy system resilience, energy sector.

# Introduction

Nowadays the spread of renewable energy sources is mainly limited due to the variability of the energy they produce. Consequently, the improvement of the energy system resilience to the variability of renewable energies is a precondition for an extended outreach and adoption of these technologies. More information and technologies are needed to support decision-makers of the energy sector and turn renewable energy (RE) production into a reliable source of electricity. The S2S4E project aims at developing a Decision Support Tool (DST) that provides RE production and electricity demand for future weeks and months thanks to sub-seasonal to seasonal (S2S) climate predictions. This objective is mainly expressed by research activities exploring new methods to improve climate predictions but the project also analyses factors that impact the use of S2S forecasts.

Task 6.1 (deliverable D6.1) benchmarked competitors and provided recommendations on market positioning. Following-up this work, Task 6.3 aims to **assess policies that may have an impact on the use of S2S and provide policy recommendations to enhance S2S economic value**.

**This report (D6.2) presents the results of the policy mapping, highlight main policy trends and suggests policy recommendations to support the uptake of S2S services**. The report offers a mapping of existing measures (policies and interventions) that directly or indirectly influence the use value of S2S forecasts. It focuses on measures related to the energy sector and dealing with renewable energy production, transport and distribution, retail and consumption (including self-consumption).The first section of this report presents the results of the policy analysis performed at EU level, covering the main EU directives. The second section focuses on the national level, focusing on national measures released in the countries of origin of S2S4E project - France, Germany, Italy, Spain, UK, Sweden, and Norway. Finally, the third part suggests policy recommendations to better support the use of S2S based on observations.

A database of 117 measures has been created as base point of the research, as explained in more details in the **Error! Reference source not found.**Methodology. All the policies and interventions mentioned in this report, and additional ones, are available in the database with detailed information for each one. In Annex, a description of the database is available with the link to the file.

# 1 Methodology

This section presents the methodology used in this study to analyse whether policies and interventions are favouring or not the uptake of S2S services in France, Germany, Italy, Norway, Spain, Sweden and the UK.

**The Behaviour Change Wheel**

The Behaviour Change Wheel (BCW) is a well known framework used by policy makers and designers for developing and evaluating behaviour change interventions and policies. It is an outcome of the synthesis of 19 other behaviour change frameworks that were applied in numerous fields and disciplines with a wide range of approaches and research objectives (Susan Michie, 2011).

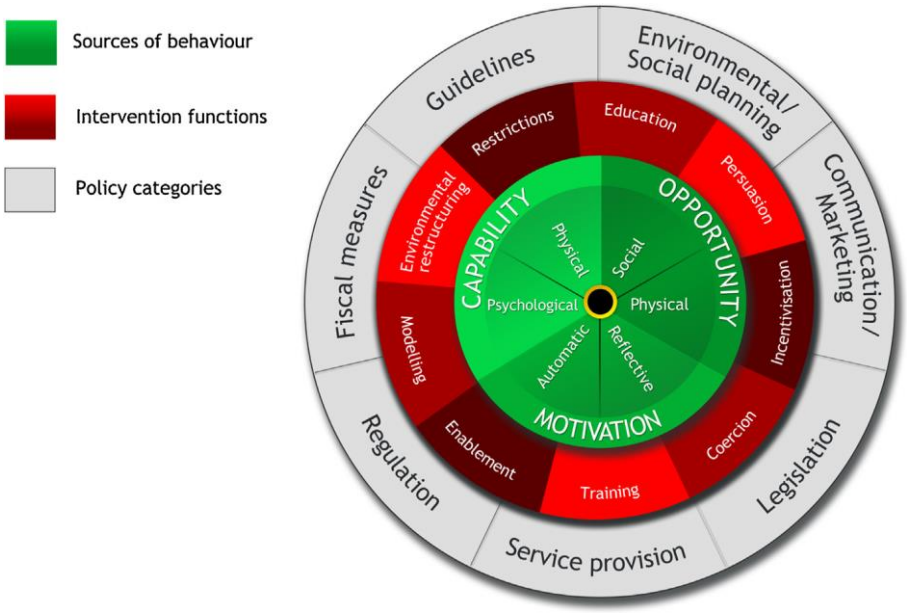


**Figure 1: The Behaviour Change Wheel by Michie et al. (licensed under the Creative Commons Attribution License 2.0).**

The idea behind behaviour change measures, both policies and intervention, is to generate incentives or disincentives that can lead to behaviour change at individual level or social level. The BCW framework has served for classifying and identifying the deficiencies of existing policies and interventions, possible improvements and opportunities for new and more effective behaviour change measures.

As shown in figure 1, the BCW has three layers. The green wheel in the centre gathers the elements that determine the behaviour: capability, opportunity and motivation. Surrounding the sources of behaviour are the nine types of interventions, shown as the red middle layer. Interventions are measures that can be carried not only by governments but by different types of actors of the civil society. Lastly, seven policy categories are presented in the outer grey layer. (Caroline Wilson, 2016).

The three layers of the BCW work independently, each part of the wheel rotates on its own and is not dependent upon another part of the wheel. To make the best use of the BCW framework for the purpose of this study, it was necessary to adapt it to its specific scope and objective. The following sections will provide a full explanation of this adaption.

**Application of the Behaviour Change Wheel**

To date, the application of the BCW framework to understand behaviour change towards renewable energy production and distribution is limited. Still, some interesting examples were found to support this approach. For example, Brohmann et al. explored the most effective ways to overcome barriers and to change human behaviour around energy efficiency in buildings in several EU countries (Wilson and Marselle, 2016). On the other hand, Dahlbom et al. reviewed 41 EU energy behaviour change programmes, drawing lessons from them and establishing guidelines to develop and implement successful policy interventions (Wilson and Marselle, 2016). Moreover, the European Environment Agency worked on the measures targeting energy efficiency behaviour to promote energy saving.

Different from the afore-mention examples, this study will explore the use of behaviour change measures (interventions and policies) to directly or indirectly influence the use of S2S forecasts for renewable energies.

The methodology that will be used for this research is structured into four different steps:

1. The first step consists of desktop research with the objective of sourcing as many measures as possible for all the counties that are a part of this study. This first step will result in the creation of a database of behaviour change measures.
2. The second step will be the classification of measures.
3. Then, the measures identified and classified will analysed for every individual country and for the entire sample of this study.
4. Lastly, findings and conclusions will be drawn from the analysis.

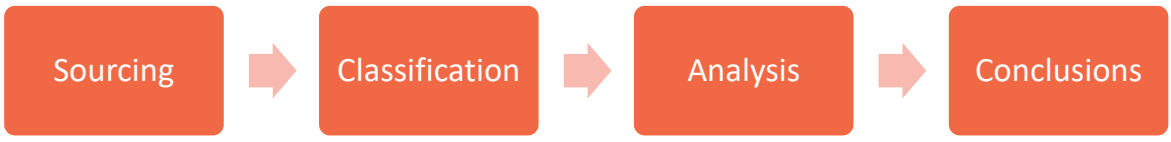


**Figure 2: Research methodology in four steps**

By the end of this research process, this study expects to show how countries' policy framework and civil societies are directly or indirectly supporting the uptake of S2S in the energy sector.

### Scope of measures sourcing

In line with the objective of this study, the scope of this research will be limited in different ways. The sample of this study are the seven countries that are part of the S2S4E consortium: France, Germany, Italy, Norway, Spain, Sweden and the UK. This study will focus on measures related to renewable energy production (mainly from solar, wind and hydro power), transport and distribution, retail and consumption (Including self-consumption). Only measures that can have a direct or indirect impact on the adoption of S2S are going to be analysed in this research.

### Classification of measures: interventions and policies

Behaviour change interventions can be defined as a set of coordinated measures that aim to influence the individual behaviour and change a certain behaviour pattern. In this study, policies and interventions are understood together as measures. A distinction between interventions (activities that aim to change behaviour carried out by multiple types of actors) and policies (actions carried out by public administrations or government authorities that enable or support intervention) will be made.

The following tables list the different categories of interventions and policies that will be used for the classification and analysis of measures. In addition, measures will be classified according to the level of impact they may have on the adoption of S2S in the energy sector.

**Types of interventions**

| Interventions | Definition | Examples |
|---|---|---|
| Education | Increasing knowledge or understanding | Providing information to promote the adoption of renewables |
| Persuasion | Using communication to induce positive or negative feelings or stimulate action | Using climate change finding to motivate increases in renewable in the energy mix |
| Incentivisation | Creating expectation of reward | Using prizes to induce attempts to adopt renewables |
| Coercion | Creating expectation of punishment or cost | Raising the financial cost of fossil fuels |
| Training | Imparting skills | Advance trainings on how to use weather/climate information to increase renewables productivity |
| Restriction | Using rules to reduce the opportunity to engage in the target behaviour | Prohibiting the development of new nuclear plants |

| | | |
|---|---|---|
| Environmental restructuring | Changing the physical or social context | Create an awning/canopy over a parking lot to install solar panels |
| Modelling | Providing an example for people to aspire to or imitate | Using renewable means of energy production for self-consumption of parks and other public facilities |
| Enablement | Increasing means/reducing barriers to increase capability or opportunity | Financing schemes for Solar Home Systems |

**Types of policies**

| Policies | Definitions | Examples |
|---|---|---|
| **Communication/marketing** | Using print, electronic, telephonic or broadcast media | Conducting mass media campaigns |
| **Guidelines** | Creating documents that recommend or mandate practice. This includes all changes to service provision | Producing and disseminating protocols |
| **Fiscal** | Using the tax system to reduce or increase the financial cost | Reducing taxes for renewable energy companies |
| **Regulation** | Establishing rules or principles of behaviour or practice | Establishing limits on the amount of energy a household can sell back to the grid |
| **Legislation** | Making or changing laws | Prohibiting wind farms in residential areas |
| **Environmental/social planning** | Designing and/or controlling the physical or social environment | Using town planning |
| **Service provision** | Delivering a service | Establishing support services in workplaces, communities etc. |

**Level of impact on the adoption of S2S**

To estimate to what extent existing policies and interventions influence the use of S2S and climate services, all measures are going to be classified between those that have a direct link and indirect link with S2S. As explained in the table below, Level 1 policies and interventions

specifically address S2S and therefore have the highest impact on their adoption while Level 4 policies and interventions have a more limited impact due to their more generic nature.

| Impact of renewable policies and interventions on the adoption of S2S | | |
|---|---|---|
| **Direct link with S2S** | **Level 1** | Measures that are specifically beneficial to S2S |
| | **Level 2** | Measures that are beneficial to weather and climate services |
| **Direct or indirect link with S2S** | **Level 3** | Measures that foster the resilience and reliability of renewables (Storage, demand management system, measures to increase flexibility and resilience of the grid, etc) |
| **Indirect link with S2S** | **Level 4** | Measures that promote the adoption of renewables (and therefore increase issues related to its variability) |

The three first categories have a direct influence on S2S. They indeed incentivise the research or use of equipment, services, methods or any tools that aim at increasing the resilience of the energy system, including S2S. The fourth category has an indirect influence on the use of S2S. By accelerating the integration of renewable sources, it increases at the same time the impact of their variability on the system and thus the value of S2S forecasts.

# 2 Mapping of measures influencing the use of S2S

This section propose an overview on measures (policies and interventions) that directly or indirectly influence the use value of S2S forecasts. It does not aim at being exhaustive but at giving an overview of exiting measures that may impact the business of S2S providers.

The analysis has been done at two different levels: at EU level first, to identify main trends induced by the European Union and at national levels, to identify specificities set up by Member States. The structure of this section follows this approach.

## 2.1 Policy framework analysis at EU level

In order to respect the hierarchy of law, the analysis started with the presentation of measures at European level, namely energy-related EU directives. An EU directive is a legislative act that sets out a goal that all EU countries must achieve. Members states also have the obligation to translate directives into national laws and policies. However, it is up to individual countries to devise their own laws to reach these goals (European Union, 2016). Accordingly, a directive will not necessarily explicitly mention S2S but set objectives for which they could be useful.

The analysis covered 9 major directives of the subsequent energy packages with the objective to analyse how the support to S2S evolved over time. Accordingly, some of the directives were already repealed, others in force and the most recent still at a proposal stage (Figure 3).

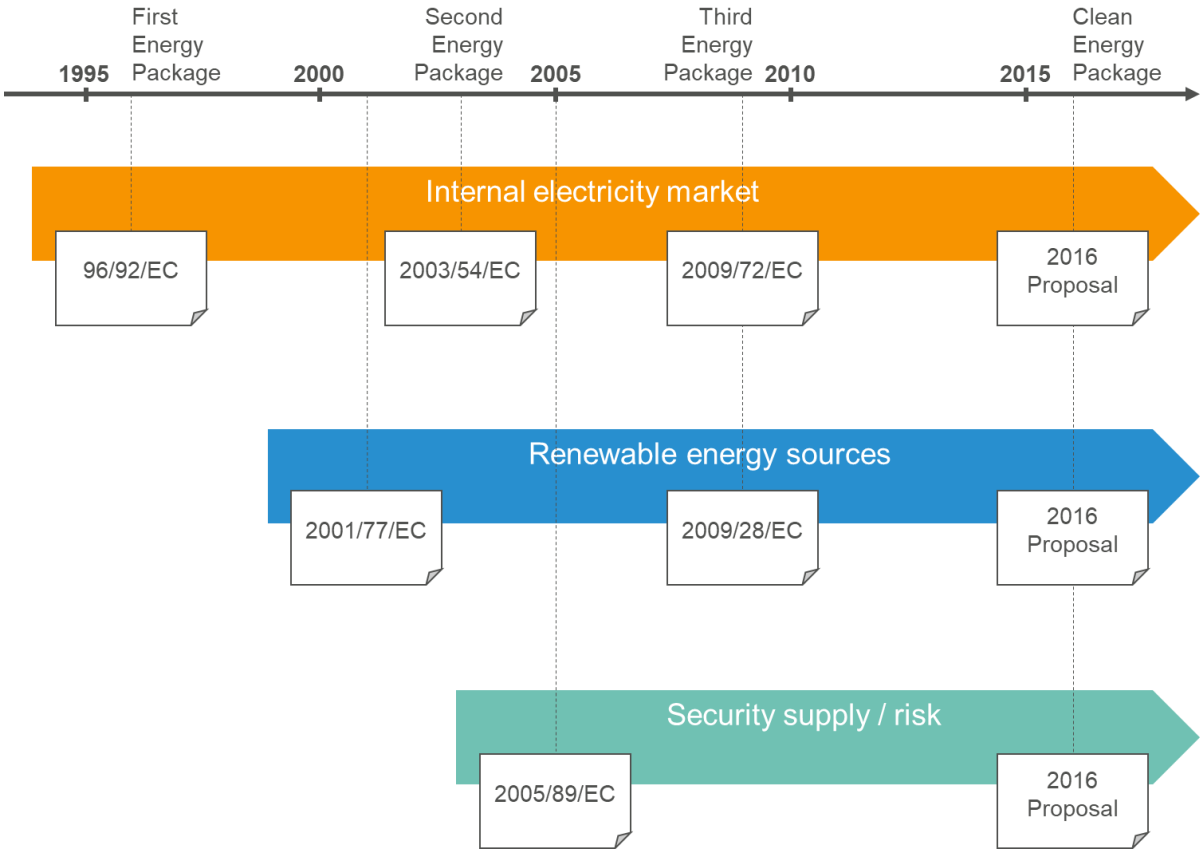


**Figure 3: Evolution of the EU policy framework**

- **Internal electricity market**

The Directive 96/92/EC is one of the first EU directive dedicated to the energy sector, if not the first. As stated in Article 1, it establishes common rules for the generation, transmission and distribution of electricity. If most of the articles deal with organisational and functional rules, articles 8.3 mentions that **"a Member State may require the system operator [...] to give priority to generating installations using renewable energy sources"**. The same text is used in Article 11.3 for DSO. Although these articles do not define any objective or obligation, they set the baseline for the support of energy renewable sources.

The same text is integrated into the Directive 2003/54/EC that replaced the Directive 96/92/EC. Furthermore, Article 22 set a first obligation for Member States that "shall take the measures necessary to enable [...] connecting new producers of electricity [...] in particular taking full account of the costs and benefits of the various renewable energy sources technologies". Article 4 also imposes to **Member States to monitor the supply/demand balance on the national market and the level of expected future demand** and publish a report every two years. Finally, Article 3.1 and 3.7 mentions for the first time the environmental protection and climate change and proposes to Member States to impose public service obligations related to it.

The Directive 2009/72/EC revoked the Directive 2003/54/EC but uses the same baseline presented hereabove. However, it gives for the first time obligations to operators of the energy

system. For instance, Article 36 stipulate that the regulatory authority shall take all reasonable measures in pursuit of "removing barriers that could prevent access for new market entrants and of electricity from renewable energy sources". TSOs also end-up with new duties and "**shall submit to the regulatory authority a ten-year network development plan based on existing and forecast supply and demand**" according to Article 22.

On 30 November 2016 the European Commission presented a new package of measures called "Clean Energy for all Europeans" that notably contains a proposal that recasts the current Directive. Although it has not gone through the whole EU adoption process, some preliminary remarks can be shared:

- Article 3 explicits that the development of renewables remains a major objective by specifying that market rules shall aim at "**enabling the integration of electricity from renewable energy sources and providing incentives for energy efficiency**".
- Article 4 extends responsibilities to all actors of the energy sector by mentioning that "**all market participants shall aim for system balance and shall be financially responsible for imbalances they cause in the system**"
- Article 7 and Article 34 states that respectively ENTSO-E and regional operational centres shall carry out **seasonal adequacy outlooks**
- Article 34 also imposes to regional operational centres to perform a regional week-ahead to intraday system adequacy forecasts

The rules for the EU internal electricity market have been updated 3 times over the past 20 years. The analyse of this evolution shows that the objectives set by **the successive Directives induce every time a stronger driver for the use of S2S forecast**: while Directive 96/92/EC encouraged the development of renewables (level 4 support), Directive 2003/54/EC imposes the supply/demand balance monitoring (level 3 support). The following Directive 2009/72/EC introduced for the first time the term "forecast" for the supply and demand (level 2 support) and the last proposal explicitly mentions "seasonal adequacy outlooks". In addition, three main evolutions have been observed:

- Obligations have progressively replaced suggestions
- Obligations moved from policy-makers (Member States) to operational players
- The scope of collaboration extended from national (TSO, DSO) to EU level (ENTSO-E)

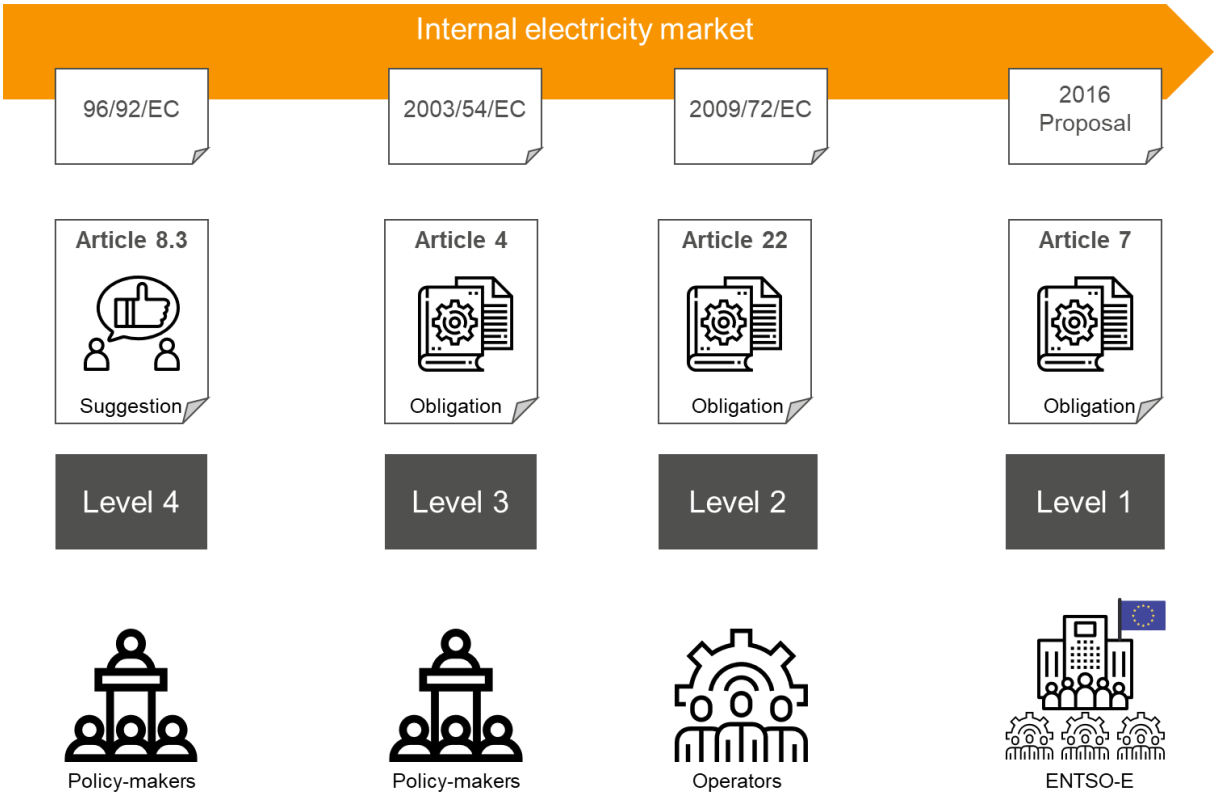


**Figure 4: Evolution of internal market rules, from level 4 to level 1 support**

- **Promotion of renewable energy sources**

The Directive 2001/77/EC aimed at promoting an increase in the contribution of renewable energy sources to electricity production. Article 3 imposes to Member States to adopt **national indicative targets** and publish "measures taken or planned, at national level, to achieve these national indicative targets". The article also specifies that the targets shall be defined considering national reference values (i.e. the share of electricity produced from renewable energy sources in 1997 and 2010) and "national commitments or Nationally Determined Contributions (NDCs) accepted in the context of the Climate Agreement". Although the document recalls an objective of 12 % of the Union's gross energy consumption coming from renewable sources by 2010, the document does not set any specific target by itself.

8 years later, the Directive 2009/28/EC replaces the Directive 2001/77/EC and pursues the exact same objective with two main differences. First, the objective at EU level regarding the share of energy coming from renewable sources was set to **20% in 2020** (instead of 12% in 2010). In addition, the new version introduces **quantified and mandatory national targets** for all Member States (Article 3.1). Each Member State shall adopt a national renewable energy action plan that clarify how they will achieve their objectives (Article 4).

The current renewable energy directive ends in 2020 and a recasting is being negotiate within the scope of the "Clean Energy for all Europeans" package. Particularly, Article 3 has been totally rewritten and "mandatory national targets" have been replaced by a **"Union binding**

**overall target"**. Article 3.1 set this **overall target to at least 27%** of the Union's gross final consumption of energy coming from renewable sources (instead of 20% in 2020). In addition, Article 3.3 uses 2020 national targets to set baselines from 2021 onwards and states that "the share of energy from renewable sources in each Member State's gross final consumption of energy shall not be lower than" these values.

The analyse of these successive directives show that the European Union set **more and more ambitious objectives for the share of renewables** within the energy mix (from 12% in 2010 to 27% in 2030), situation that will indirectly foster the use of S2S forecasts (level 4 support). Similarly to the evolution of the "internal electricity market" directive, targets become every time more constraining for Member States. They went from "indicative" (2001) to "mandatory" in 2009 and may end up "binding" in the next version of the renewable directive. As renewable energy objectives become more ambitious and evolve from indicative to binding, the perception of the value of S2S data is likely to improve from energy operator's perspective. In addition, a change in scope can also be observed here: national targets set in 2009 are being replaced by target at the Union level.

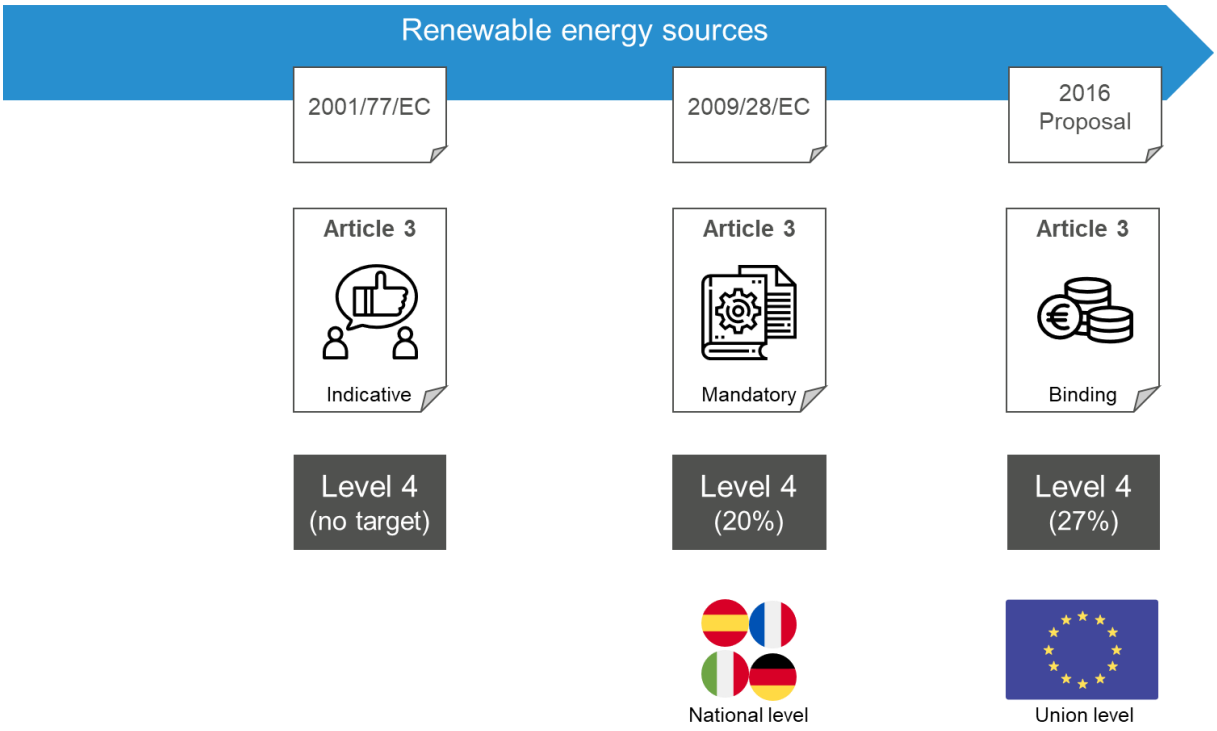


**Figure 5: Evolutions of the renewable directives: a stronger level 4 support**

- **Security supply / risk-preparedness**

The issue of security supply was first addressed by a dedicated EU directive in 2005. The Directive 2005/89/EC at safeguarding security of electricity supply by notably ensuring an adequate balance between supply and demand. Article 5.1 stipulates that "Member States shall take appropriate measures to maintain a balance between the demand and supply of electricity". Article 3.2 goes further by specifying what tools can be used to achieve this overall

goal and explicates that Member States shall take account of "the importance of encouraging [...] the adoption of [...] demand management technologies". Finally, **Article 7.1 imposes to Member States to report on "the projected balance of supply and demand for the next five-year period"** every two years.

The new "Clean Energy for all Europeans" package contains a proposal for a regulation to revoke Directive 2005/89/EC. If the text in the current proposal remains unchanged, this regulation will become the strongest policy support at EU level for the use of S2S forecasts. On the one hand, in the regulation proposal, **Article 8.1 imposes to ENTSO-E to "submit to the Agency a proposal for a methodology for assessing short-term adequacy, namely seasonal adequacy**". The scope of the expected methodology perfectly fit the characteristics of the Decision Suport Tool (DST) developed within the scope of the project as it **"shall cover severe weather conditions, variability of demand and variability of energy production from renewable energy sources"**. The article even specifies that "the methodology shall provide for a probabilistic approach". On the other hand, Article 8.2 gives S2S providers the opportunity to contribute to the development of the methodology and lobby for the use of their approaches as "ENTSO-E shall conduct a consultation involving at least the industry and consumer, distribution system operators, national regulatory authorities and other national authorities". Finally, Article 8.4 specifies that this is not only a one-shot opportunity as "ENTSO-E shall update and improve the methodology regularly". The intention of reviewing and improving the methodology regularly can be understood as an effort to increasingly improve precision and reduce uncertainties regarding seasonal adequacy.

The analyse of **directives and regulations related to the security of supply** shows that they **are the legislative documents that most encourage the use of S2S forecast.** Directive 2005/89/EC already mentioned the need for tools that allow anticipating variations at demand side (level 3 support) and imposed to Member State to report on projected supply and demand (level 2 support). The proposal for a new regulation goes even further and is the first official document at EU level that explicitly mention the need for forecasts at seasonal timescale (level 1 support). In addition, and in line with the evolutions observed in the previous policies, obligations moved from policy-makers (Member States) to more operational players and the scope of collaboration extended from national to EU level (ENTSO-E).


**Figure 6: Evolution of the security supply directives, from level 2 to level 1 support**

The analysis performed at EU level shows **that the overall policy framework tends to be progressively more supportive of S2S forecast**. On the one hand, directives defining market or security rules are becoming more detailed on the way to achieve objectives. The latest version even specifies particular constraints (time horizon, update frequency, type of approach) to be considered for the development of methods and tools and most of them are in line with the use of S2S. On the one hand, the renewable directives become more ambitious and constraining for Member States. It suggests that the share of renewables shall continue to increase over the next decade, which will indirectly foster the use of S2S. Finally, the EU directives involve more and more the different actors along the electricity value chain (DSO, TSO, regulators) and make them aware of their responsibilities.

## 2.2 Policy framework analysis at national level

The data collection conducted at national level resulted in a dataset of 117 policies implemented by public authorities in seven countries across Europe. The policy sourcing has been completed by 22 interventions launched by non-governmental agencies. To contextualise the study, it is worth mentioning that the majority of the identified measures (56%) became effective during the first decade of the twenty first century (2000-2010) and close to a third (30%) were released after 2010 (Figure 7).

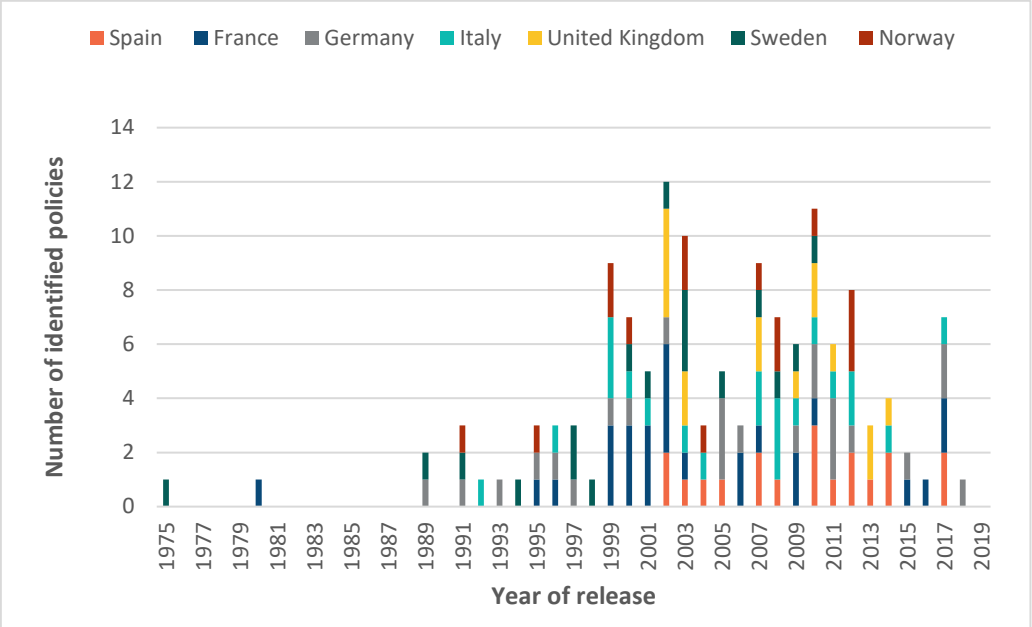


**Figure 7: Timeline of identified measures**

A first analyse revealed that 86% of the identified measures work towards the development of more renewable energy sources (Figure 8). This figure suggests that the development of renewable energy sources is the main objective for governments in Europe while the resilience of the energy system appears more as a second priority. The predominance of such policies does not come as a surprise since most of identified measures became effective in the early 2000s. At this stage, measures are still creating the necessary incentives and disincentives to foster the uptake of renewables and increase their share in energy mix.

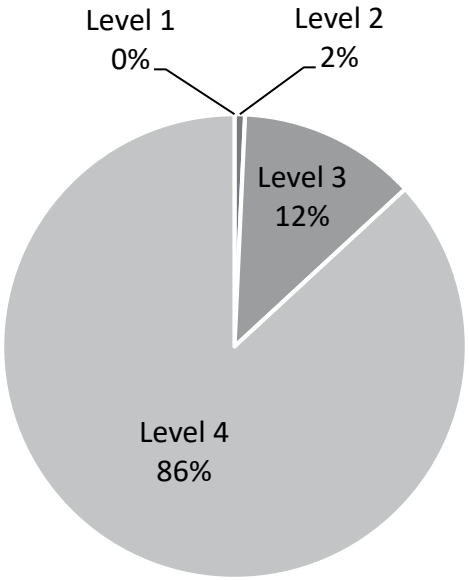


**Figure 8: level of influence of identified measures**

Although such policies do not directly enhance the use of S2S forecast, they indirectly foster it. Interviews performed within the scope of the projects have shown that stakeholders of the

energy sector regularly deal with decisions that are weather or climate-dependent (D2.1). Most of these decisions depends on characteristics of the energy production and demand. Interviewees also confirmed that these decisions often have an economic goal as they either aim at optimising profit (e.g. energy trading or hedging) or limit expected losses (e.g. production-demand balance). Therefore, the increase of the energy production variability due to a higher share of renewables will induce higher economic gains or losses linked to these decisions. Accordingly, it will raise the interest in tools or services that helps decision-makers at better anticipating this variability. Therefore, **the strong willingness of governments to foster the development of renewables remains the main political driver of the use of S2S forecasts**, and more generally of all tools (equipment or service) that tackle the variability of renewable sources.

Oppositely, the results of the sourcing suggest that measures specifically designed to influence the use of climate services (including S2S) are still rare. Indeed, among the 14% that have a direct impact on the resilience of the energy system, only 3 could be related to such services (Figure 8). Although the explanation of these figures is not the aim of this study, several causes can be put forward:

- Existing climate services are not mature enough yet, compared to other solutions (e.g. energy storage, peak shaving, etc.) that aim at a more resilient energy system
- Policy-makers are not aware of existing climate services and their related benefits and therefore do not significantly consider them when designing new policies
- There are already policies supporting the use of climate services, but they lack visibility, and therefore, have not been identified during the sourcing performed within the scope of this study

In any case, both the actual increasing share of renewables in the European energy mix and the global trend observed at EU level suggest that **policies directly supporting climate services (including S2S) shall become more and more present** within national level.

Among all the national measures analysed for this study, 12% of them were classified as policies and interventions that foster the resilience of the energy system and the reliability of renewable energies, building blocks for the energy transition. Those measures are mainly dedicated to renewables R&D and technological development, to the flexibility and resilience of the grid, to energy storage and to technologies and practices to ensure the security of supply.

The following sub-sections do a specific focus on the 3 types of policies that have been discussed before. The first section provides more details on measures that promote renewables as they have the higher influence on the economic value of S2S forecasts because of their number. The second section presents a selection of most impacting measures that intrinsically affect the use of S2S. Finally, the third section identifies existing measures that aims at increasing the energy system resilience and suggests potential updates to promote S2S more specifically.

### 2.2.1 Measures promoting renewables (indirect enhancement of S2S)

Since the adoption of renewable energies provides a solution to global warming, the biggest global challenge ever faced by human kind, the European Union and all Member States have been in actively promoting an energy transition. As seen before, the EU enacted few Directives specifically on the adoption of renewable energies that were translated into national laws and policies. For example, Spain's government published a new climate plan and established a target of 100% renewable energy electricity system by 2050 (Morgan, 2018). Consequently, the clear majority of the policies (69.23%) herein analysed at the national level are dedicated to the promotion of renewables. And therefore, indirectly enhance the use of S2S to ensure reliability and resilience on renewable energies.

A more detailed analysis of measure promoting renewables shows that diverse types of polices are used to achieve this high-level objective. Indeed, the sourcing provided examples for each policy type of the Behaviour Change Wheel classification (Figure 9).

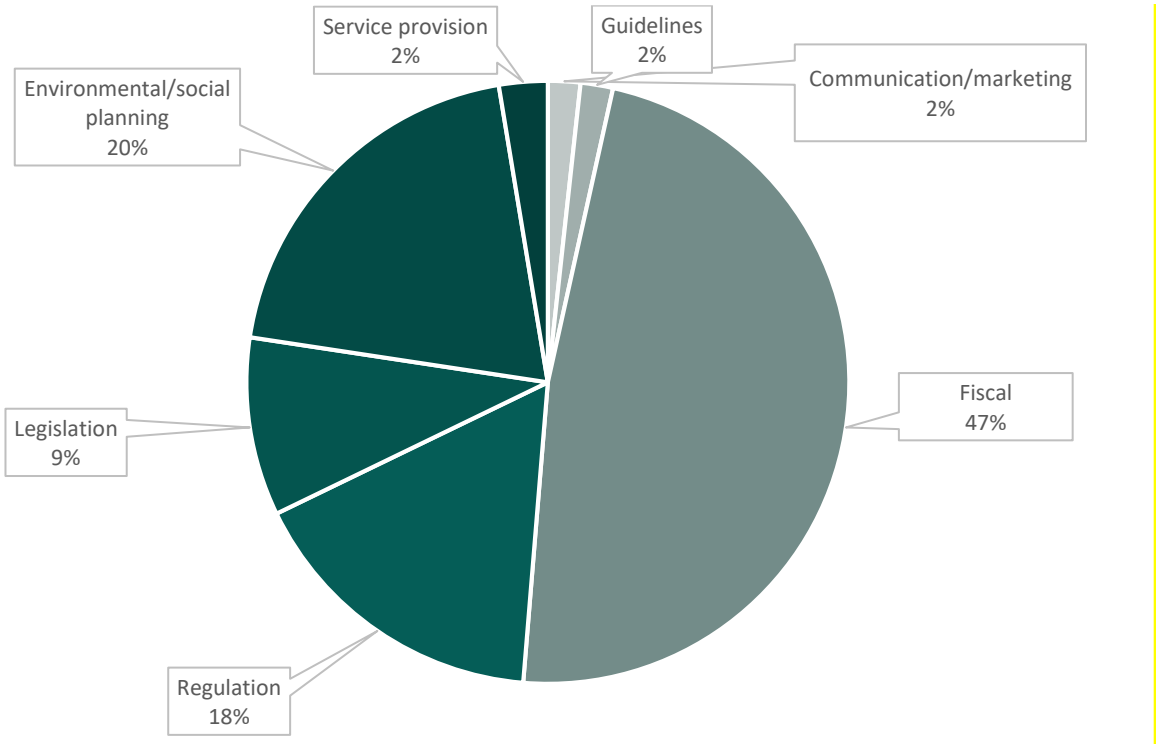


**Figure 9: Type of identified policies**

However, according to the BCW classification presented in the methodology, three types of policy seem to be more used than others. Fiscal policies, such as tax deduction for companies investing in renewables or feed-in tariffs allocated to solar or wind power, represent half of identified policies (47%). Next, with a share of 20% are the environmental and social planning policies, often represented with national renewable energies action plans and other related

strategic plans. In the third place, with a share of 18%, regulations were frequently seen as renewables obligations or electricity market reforms, etc.

The split of policy type varies from country to country, showing that countries have opted for different policy instruments to accomplish their goals. For instance, Spain has a share of 29% of legislation on renewables, whereas the share of all countries together is 9%. In Norway, the most present type of policies identified are the policies of environmental and social planning with a share of 46%, versus 20% of all countries' policies. Sweden, for example, has a share of 69% of fiscal policies, focusing mainly on creating the economic incentives necessary for behaviour change towards renewables. And in Germany, with a share of 30%, regulations were the second type of policy most present, whereas for all countries together it represents only 18% of all polices.

Oppositely, the diversity of interventions identified is rather limited as only 4 out of 9 categories of the Behaviour Change Wheel are covered. Enablement interventions are the only type that has a significant use according to the panel of the study, with 18 out of 22 interventions[1]. Such interventions are used to create the context for renewable energies by introducing enablement measures to secure the conditions for behaviour change.

On the other hand, the technological focus of the measures analysed also indicate governmental preferences and technological choices. We see in Figure 10 that 69% of all measures addressed renewables in general and are applicable for all sorts of technology. Solar power goes in the sound position with a share of 14%, wind goes in the third position with 10% and hydropower is the last one with a share of only 2%. Exceptionally, some measures also focused on two types of technologies at the same time, this happened for solar and wind power and for hydropower and wind technologies.

[1] It shall be considered that the analysis of intervention was made to complement the policy analysis and the sourcing of interventions was less advanced than of policies.

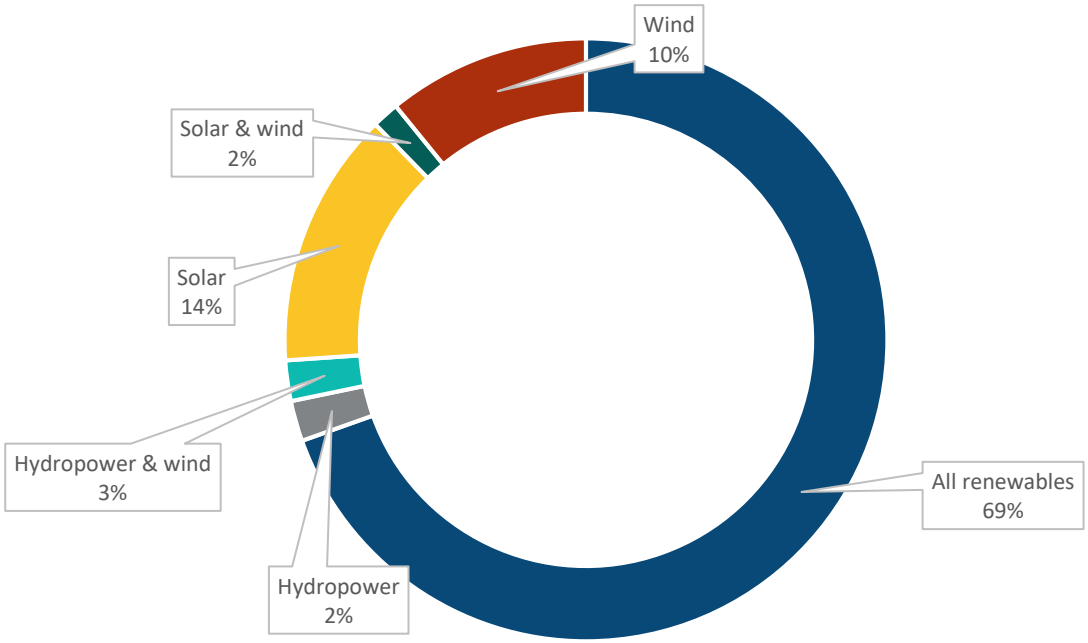


**Figure 10: Technological focus of policies**

Technological preferences were found in different countries, notably Germany, Norway and Sweden. In Germany, for example, 50% of measures focus on solar and/or wind power. While in Norway, a special interest in developing wind power installed capacity has been identified in 27% of the measures analysed. In Sweden, although 69% of measures identified are promoting all sorts of renewable energy technologies, it can be notice also in a special preference for wind power technology (with a share of 23% of the policies).

### 2.2.2 Measures with direct impacts on climate services (including S2S)

Although most of identified policies in this study are dedicated to the promotion of renewable energies, a few examples of measures that directly support the use of weather and climate services (including S2S) in the energy sector were found. In this chapter will be presented policies and interventions that directly influence the adoption of S2S at national level. It is exclusively dedicated to level 1 and level 2 measures as level 3 will be discussed in the next sub-section as part of the policy recommendations (Figure 11).

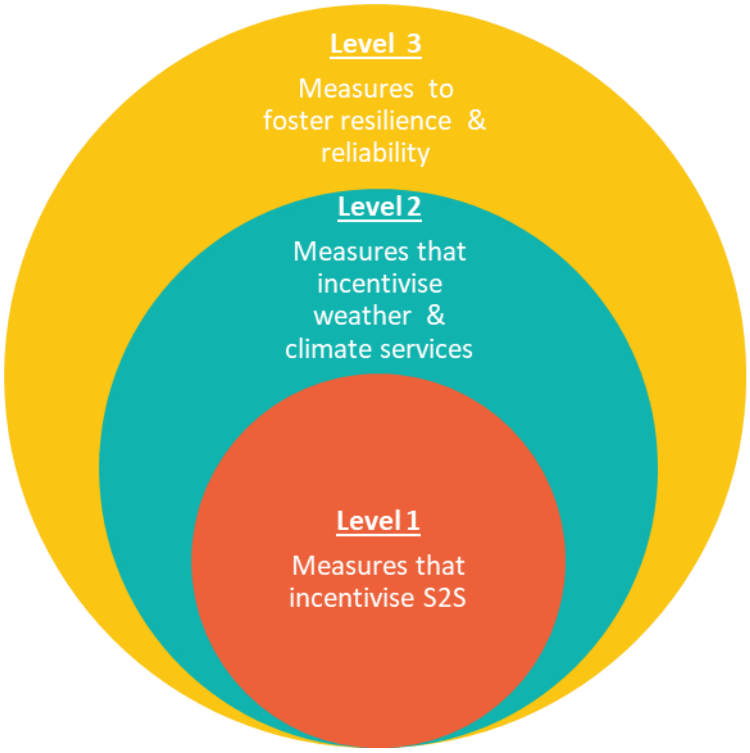


**Figure 11: Measures of direct levels of association with S2S**

**No level 1 measure was identified at national level** although they were the most targeted during the study due to their specific support to S2S. **Three measures of level 2 were identified** at three different steps of the energy value chain : the first measure imposes obligations at stakeholders of the energy production sector, the second provides recommendations for the market regulation, and the third one forces actors involved in energy distribution to adapt their behaviour by ending ex post subscription. The three mesures are presented hereafter as examples that can be used as sources of inspiration by other Member States to foster the uptake of S2S forecasts.

One of the policies in question is the Spanish Royal Decree 841/2002, approved in August 2nd, 2002. It worked as a provisory measure that was in force only until 2004. This Royal Decree regulates the energy production installations in special regimes and incentivise them to participate in the energy market. In order facilitate energy trading, it determinates that energy producers must provide short-term forecasts information to DSOs. Such obligation has a direct impact on the use of weather information. This legal requirement has the potential to lead to a behaviour change among the national energy producers towards weather services, as they become useful resources to comply with the law.

In France, the Deliberation number 2017-155 issued by the French Energy Regulatory Commission of 22 June 2017 provides guidelines for the French electricity system balancing roadmap. It notably stipulates that exchanges in the European energy market will require a better knowledge on production and consumption patterns, for scheduling the energy generation and making use of "proactive" and "reactive models" to assist TSOs to balance and react to demand oscillations (Chauvet et al., 2017). With this Deliberation, the use of weather

and climate services becomes essential to estimate the energy production from renewable sources and the overall demand. This type of guideline changes the behaviour of energy actors toward climate and weather services.

Also, in France, the version 5 of the Public Electricity System User Tariff (TURBE) and most notably the latest changes applied to the Transport Network Access Contracts (CART) foster the use of weather and climate information by large users of the transmission grid (producers, DSOs and consumers) (Commission de régulation de l'énergie, 2018). Before august 2017, such users had the possibility to retroactively change their powers subscription for the ongoing month. If their maximum power had been exceeded during the month, they were able to avoid excess fee by changing the subscription. The French Energy Regulatory Commission (CRE) considered that the system did not reflect the actual costs and proposed an evolution of power subscription rules. The deliberation of the 17 November 2016 introduces in the tariff rules the possibility of modifying the power during the month **without retroactive effect** and with a **minimum period of three working days** between the date of request and the date of actual change of the power subscribed. Accordingly, the DSO shall now forecast the consumption on its network for the upcoming days to anticipate an increase in the subscribed power. Under these new circumstances, the use of weather and climate forecasts appears to be more economically interesting than paying for excess fees.

The measures presented hereabove are a few examples of legislative policies that fostered the adoption of weather and climate services by different energy actors. When a requirement or obligation of forecasting is created by law, the demand for related services is positively impacted. Consequently, any measure that would impose to energy actors to deliver forecasts at seasonal scale would increase the demand for tools such as the DST developed by S2S4E. However, the legislative route is not the only political solution to foster the use of S2S.

## 2.3 Policy recommendations to foster S2S

The sourcing conducted during the study revealed a set of measures that aim at increasing the resilience of the energy system. However, none of them explicitly mentioned S2S nor climate services whereas these technologies support the same aim. This section presents the identified measures and suggest updates to both promote the use of S2S and increase the impact of such measures. In addition, it suggests potential political leverages to foster the use of S2S, based on the characteristics of the existing policy framework.

**Measures dedicated to renewables R&D and technological development in general**

Different R&D programmes focusing on the development of new technologies to support renewable energies uptake have been created in the past years. Since S2S services supports the reliability of renewable sources, it could become part of the portfolio of technologies and services chosen to be explored with research and development. Several measures were identified at national levels:

- In France, for example, the National Strategy for Research and Development in the Field of Energy promotes RD&D for the development of technologies and energy sources that limit GHG emissions and/or increase energy efficiency.
- Similarly, in Sweden, the Energy Research and Development Programme was found as an example of an RD&D programme dedicated to the development of renewable energy technologies to reduce renewables' cost and increase their market value.
- In Germany, other cases of measures supporting renewables R&D and technological development were found. The Energy Research Programmes set the framework for public RD&D support to renewable energy technologies at large. Also, the Law on Energy and Climate Fund (EKF) creates a Fund dedicated to climate resilience and adaptation and dedicates special attention to the development and deployment of climate friendly-technologies (especially renewable energy).
- An example of a public-private partnership between global energy and engineering companies and government to accelerate renewable energy technological development was found in the United Kingdom. It is called Energy Technologies Institute and its role is to act as a conduit between academia, industry and the government.
- In Spain, the National Action Plan for Renewable Energies (PANER) lists the key actions needed for the energy transition. Among the enumerated actions, it incentivises an active public participation in Research, development and innovation in the renewable energy sector.
- Few policies dedicated to R&D on renewable energies were found in Norway, notably the NYTEK R&D Programme, the Environmental Technology Scheme (Miljøteknologiordningen), the Centres for Environmentally-friendly Energy Research, the National Strategy for Research, Development, Demonstration and Commercialisation of New Energy Technology (Energi21) and the ENERGIX Programme. All those measures support R&D for the development of renewable energy technologies.

**Measures dedicated to the flexibility and resilience of the grid**

The competition analysis performed in D6.1 has shown that S2S services are already being used for the management of energy grids, notably for forecasting demand and supply. Since S2S services contribute to the flexibility and resilience of the grid, they could be embedded in grids' amelioration strategies:

- An example of a policy that focuses on the improvement of the transmission grid was found in Spain. The policy in question is the Royal Decree 1565/2010 that seeks on improving the technical integration of renewable energy installations. The National Action Plan for Renewable Energies (PANER) also makes a call for a change towards a system of "intelligent networks" of energy transport and distribution (smart grids).

- In Germany, the Energy Industry Act (Energiewirtschaftsgesetz) stipulates supplementary provisions for the access of electricity from renewable sources to the grid as well as the construction of intelligent grids. The Sixth Energy Research Programme also has the improvement of grid technologies among its research priorities.

**Measures dedicated to the technological development of a specific type of technology**

Deliverable 6.1 also revealed that S2S services are useful for energy stakeholders involved in the management of hydro, solar and wind power. Accordingly, it could be part of measures dedicated to technological developments of these specific technologies:

- A policy that focuses on the technological improvement of hydropower infrastructure to improve efficiency and capacity was found in France. The policy entitled Hydropower Revival Plan (2008) enacted by the French Ministry, establishes a plan to boost the existing hydropower infrastructure.
- In Norway, the NYTEK R&D Programme, and Energi21 promote the development of renewable energy technologies, giving special attention to the development of solar, wind and hydropower technologies. On the other hand, the Act on Offshore Renewable Energy Production supports research and prototypes projects on offshore resources exploitation.
- Spain's National Action Plan for Renewable Energies (PANER) promote the hydroelectric exploitation of existing hydraulic resources and infrastructures, in a manner compatible with the preservation of environmental preservation and in accordance with hydrological and energy planning.

**Measures dedicated to energy storage**

S2S information can be used to identify and quantify peak and base periods, both for the demand and supply side. Accordingly, it could also be useful for optimising the use of storage systems. This being said, S2S services could be integrated into the energy storage research programmes as a support technology:

- Germany's Energy Industry Act (Energiewirtschaftsgesetz) designates supplementary provision to the development and improvement of electricity storage. As well as the Sixth Energy Research Programme that defines energy storage as top research priority.
- In Spain, the National Action Plan for Renewable Energies (PANER) expresses a commitment to support the development and innovation in energy storage systems.

**Measures dedicated to the security of supply**

Finally, as S2S services support the adaptation of the energy system to the higher levels of intermittency of renewable sources, it can be considered as a technology that assists securing energy supply and the resilience of the energy system. For this reason, measures dedicated to

guaranteeing the security of supply could promote the use of S2S services among other relevant technologies.

- In the United Kingdom, the Energy White Paper (2011) exposes the objectives of the form of the electricity system. It sets as a goal a smart, flexible and responsive electricity system that provides secure, low-carbon and affordable electricity supply. Aligned with those objectives, it promotes the system's adaptation to higher levels of intermittency from renewable sources and inflexible nuclear power generation.

As seen, S2S could become part of an existing set of policies that already promote the resilience and reliability of renewable energies through R&D and new practices to improve demand management systems, the flexibility and resilience of the grid, energy storage and security of supply.

**European directives on the energy sector**

In addition to the political leverages at national level presented hereabove, S2S providers can also influence policy at EU level. As stated in section 2.1, the under discussion proposal to repeal Directive 2005/89/EC imposes to ENTSO-E a consultation to define the methodology to perform forecasts at seasonal scale.

It is therefore highly recommended to project partners to follow press releases concerning the latest evolutions of the "Clean Energy for All Europeans" package. In addition, partners are suggested to pay special attention to activities performed by ENTSO-E to ensure their contribution to the upcoming consultation.

# 3 Conclusion

This deliverable (D6.2) fulfils its mandate of mapping the existing measures in the energy sector that influence the use of S2S services at the European level and in the countries selected for this study. In addition, it provides insights on current policy trends at both European and national levels and suggests potential levers to increase the policy support to S2S forecasts.

**At EU level, EU directives ruling the energy system appeared to be progressively more supportive to S2S forecasts, and more globally to weather and climate services**. This conclusion draws on the observation of evolutions induced by the subsequent modifications of the EU Directives over the last 20 years. First of all, the level of constraint imposed by the directives increased over time and moved from the policy level to the operational level. Thus, initial suggestions (use of "may") to Member States have been progressively replaced by obligations (use of "shall") to stakeholders such as TSOs and DSOs.

Furthermore, the level of support to S2S and other climate services significantly increased, from a level 4 in the early 2000 to an expected level 1 in the next version of the directives in 2020. Notably, the reference to climate services became more explicit (use of the term "forecast") and more detailed (ex: seasonal horizon targeted, probabilistic approach required, appointment of a responsible entity). In this context, it is highly suggested to project partners to take part in the consultation to be launched by ENTSO-E for the definition of the methodology to be used for assessing short-term adequacy (seasonal forecasting) and proposed in the new "Clean Energy for all Europeans" package.

**At the national level, it was found that a clear majority of the policies analysed (69%) are dedicated to the promotion of renewables** and therefore indirectly enhance the use of S2S to ensure the reliability of renewable energies. These findings suggest that at the moment the development of renewable energy sources remains the main objective for governments in Europe while the resilience of the energy system appears more as a second priority. Accordingly, it is recommended to S2S service developers to particularly follow the evolution of this type of policies and adapt their offer to the latest modifications and new releases.

The results of the policy sourcing demonstrate that measures specifically designed to influence the use of climate services (including S2S) are still rare. Although most of identified policies in this study are dedicated to the promotion of renewable energies, a few examples of measures that directly support the use of weather and climate services (including S2S) in the energy sector were found in energy production, energy distribution and market regulation. These few examples confirm that a support to S2S at national level is possible and can be done at any step of the value chain. The evolutions observed at EU level suggest that a similar trend could also be initiated at national level in the near future.

Moreover, a important set of measures that aim at improving the European energy system were identified. All these measure supports the same aim than S2S services, wether they are R&D programmes to increase the reliability or renewable energies, measures to increase the flexibility and resilience of the grid, develop energy storage or ensure the security of supply. However, none of them explicitly mentioned S2S nor climate services for the time being. In this context, it is recommended to S2S developers and providers to push for the upgrade of the

measures here analysed and presented with suggestions on how they could both promote the use of S2S and increase their impact.

**More globally, the current level of policy support to S2S can be considered as low, particularly at national level.** However, and based on observed trends, a change in the near future can be expected. First, the increasing share of renewables in the European energy mix is an important factor that will have to be more and more considered in new energy policies. In addition, policies at national levels can be expected to evolve in the same way as the EU policy framework, suggesting that their direct support to climate services (including S2S) shall increase in the future.

# 4 Annex

A database composed of 117 measures (policies and interventions) that directly or indirectly influence the use of S2S services has been created for this study. This database served as the main source of information used in the report. Conclusions on trends and patterns were drawn based on the analysis of data coming from this dataset.

The policies identified were listed with a brief description and were classified under the following criteria: country, duration, policy or intervention, type of measures, level of impact on S2S, domain, technology and responsible institution. Then, the dataset was analysed through different perspectives drawing conclusions on the chronological distribution of policies, on the type of measures present in each country and in all countries together and on countries' technological preferences.

The data collected for this study has been made available for readers on the projects webpage, accessible at[2]:
https://earth.bsc.es/s2s4e/lib/exe/fetch.php?media=copie_de_s2s4e_wp6_task_6.3_d6.2_policies_interventions_all_countries_final.zip

[2] Notice that the current link directs to the project's wiki. After approval, the database will uploaded on the S2S4E webpage with the deliverable and the link will be changed accordingly.

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