This paper presents an overview of the regulatory framework for wind energy in European Union Member States.
The analysis covers three main aspects of regulatory framework: support schemes, electrical grid issues and potential barriers for wind power deployment. The aim is not just to provide an updated picture of current regulatory framework, but also to analyse the past evolution and trends. Each country implements a specific regulatory framework driven by several factors: their own renewable energy targets, local availability of renewable resources, energy mix structure, existing infrastructures as well as other factors such as public perception or geographical distribution of electricity generation and consumption points.
The results presented in this paper show a trend for increasing the market exposure of wind generators; feed-in premiums and competitive bidding procedures to establish the support level are gaining prominence in the last few years. In relation to grid issues, it is a common practice that new wind generators only bear the grid extension costs to the closest connection point; priority or guaranteed access is granted in most Member States and wind generators are usually not demanded to meet balancing requirements. The analysis of potential barriers for wind energy deployment shows that the stability of regulatory framework is one of the most important concerns for investors. Finally, actual deployment over the last few years has been linked with evolution of regulatory frameworks. This analysis shows that some Member States have shown a strong commitment supporting wind energy; however, in other countries the support has not been enough to stimulate the desired level of investment.

1. Introduction

The Renewable Energy Directive 2009/28/EC established a European framework to promote renewable energy by setting mandatory national targets in order to achieve at least a 20% renewable energy share in final energy by 2020. Each Member State was required, by June 2010, to set out the sectoral targets by their National Renewable Energy Action Plans. Each individual plan defined the technology mix scenario, the trajectory to be followed and the measures and reforms to overcome barriers and ensure the developing of renewable energy.
According to the plan defined in the NREAPs, wind energy has a significant role in order to achieve the 2020 renewable energy targets: expected installed capacity by 2020 in the European Union is 209.6 GW. These figures would account for a 43.1%1 of renewable electricity technologies installed by 2020.
Under these circumstances the regulatory framework has a vital role in order to attract new investors and achieve a proper level of deployment. Not only the additional income provided

by support schemes is important but also other aspects — as regulatory stability, non-complex permitting and connection procedure, market structure or absence of other potential barriers — are also vital drivers to promote the installation of new wind farms.
The existing literature about regulatory framework to promote the deployment of renewable energy sources is extensive. In 2010 Hiroux and Saguan discussed how electricity markets could be designed in order to host a significant amount of wind energy, concluding that wind power producers should be exposed to market signals. To this end, a feed-in premium seems to be a suitable option, since the risk for producers is controlled to some extent and renewable generators are exposed to market signals. In 2012 Couture and Gagnon presented the advantages and disadvantages of different design options for feed-in tariffs and FiPs. Specific features such as inflation adjustment, degression rate and floor or ceiling price are analysed by identifying the impact on risk for investors, and overall cost of renewable energy deployment. The evolution of support schemes during 2000–2011 was analysed by Kitzing et al., concluding that a slight tendency is observed for a bottom-up convergence of regulatory frameworks in EU MSs.
Lemming studied in 2003 the risk implications by analysing how the higher risk associated to tradable green certificates markets — compared with FiTs — results in higher income required by investors. A similar conclusion on the relationship between risk and return requirements by investors was drawn by Held et al. in 2006. Also in 2006 Dinica focused on the perspective of investors and concluded that it is necessary to take into account factors other than the financing and economic obstacles. Klessmann et al. in 2008 analysed the consequences of market risk exposure in Germany, Spain and the United Kingdom, analysing both price and forecasting/balancing risks. If wind generators are responsible for balancing, there is an incentive for producers to minimise imbalance costs with the consequent benefits for the grid. Conversely, this approach would lead to higher risk premiums. This fact may also lead to a market concentration of larger players. Furthermore, as the predictability of wind is limited, liquid intraday and balancing markets are necessary for efficient integration of wind generators in the electricity market. Klessmann et al. showed in 2013 that risk-sensitive policies are crucial for attracting investors by: reducing financing costs, decreasing project development costs and increasing market revenues. The authors remarked that policy and administrative risks can be reduced at low cost, since exposing projects to this kind of risk does not produce any positive effect from a macro-economic point of view. In 2007 Breukers and Wolsink analysed the conditions that affected the local planning contexts and social acceptance in the Netherlands, England, and the German state of North Rhine Westphalia. The authors pointed out that facilitating local

ownership and institutionalising in project planning can help to a higher local social acceptance. This study was later expanded in 2008, by analysing in detail certain social and institutional aspects which also affected wind energy deployment in six European countries: Denmark, Spain, Germany, Scotland, the Netherlands, and England/Wales. This study concluded that, despite different approaches implemented, planning policies in the analysed countries/regions favoured wind energy deployment. However, strength of landscape protection organisations as well as local ownership patterns varied considerably among the studied countries.

In 2011, Klessmann et al evaluated the status of renewable energy deployment in the EU by means of the effectiveness indicator presented in. The results showed that during the period 2003–2009 the highest average policy effectiveness was reached for onshore wind, followed by biofuels biomass electricity, biogas and photovoltaic . Germany was the country with the highest effectiveness indicator for onshore wind, followed by Spain and Portugal. Haas et al. also argued that FiTs provide higher deployment and at lower costs than TGCs systems, and suggested that the better performance of FiTs is mainly because FiTs are easy to implement and can be revised to account for new capacities in a very short time; administration costs are lower than in case of trading schemes and FiTs can be easily tailored to each specific technology.

The influence of grid issues on the deployment of wind energy has also been an issue studied in detail in the scientific literature. In 2008, Barth et al. described the different approaches for connection costs allocation. The research remarks that grid connection costs are clearly attributable to renewable generators but grid reinforcement costs cannot be attributed solely to one source. However, it is also stated that performing a fair distribution of these costs is not easy. The authors remark that deep connection charges can be used to address the specific needs in a certain location of the grid by taking into account the generation/consumption profile. This kind of grid connection charges incentivises investors to place new generators in regions with scarce electricity supply, rather than to put them in regions with already abundant generation. Swider et al. compared the grid connection conditions and costs in selected European countries; the research concludes that the allocation of connection costs can be an important barrier for renewable energy installations if the developer has to bear all of them. The implications of connection cost sharing for offshore wind energy were discussed by Weißensteiner et al. who found that offshore installations passing the grid connection costs to grid operators result in lower surplus for the producers and, hence, lower transfer costs for final consumers.

The factors influencing energy curtailment were analysed in 2007 by Porter et al.. Flexibility of generating mix, existence of well-functioning electricity markets, geographical distribution of the wind resource, capacity of transmission and size of the control areas are the main aspects influencing on integrating new renewable generators. In 2010, Vandezande etal discussed the necessity of balancing requirements for wind farms in case of high penetration scenarios. Finally, Batlle et al. stated in 2012 that exposing renewable energy generators to the cost of imbalances enhances their ability to estimate their production and hence minimising the cost of reserves for the whole system.

The aim of this paper is to identify the current state and trends of regulatory framework for wind energy in EU MSs in order to achieve the 2020 renewable energy targets. With this purpose, this paper is divided in two parts. The first part presents a description of main aspects of regulatory framework and the second part links the actual developments with the evolution of regulatory aspects in the last few years.

After this brief introduction, the remainder of the paper is organised as follows: support schemes for wind energy currently in force in each MS will be featured in Section 2, main aspects concerning grid issues are introduced in Section 3. Other regulatory and non-regulatory aspects that can influence on wind energy diffusion are presented in Section 4. Evolution and changes on support schemes are analysed and compared with actual developments in Section 4. Finally, conclusions and key findings are summarised in Section 5.

2. Support schemes for wind energy promotion

Support to renewable energy is usually performed by the combination of several measures. FiTs, FIPs, tenders, quota obligations or Contracts for Difference are usually applied as major support instruments. Whilst, investments grants, fiscal measures and financing are employed to provide an extra level of support. A brief description of these promotion mechanisms is provided below. Notwithstanding, we would like to refer to and for a thorough explanation of support schemes.

Feed-in tariffs. A FiT offers a long-term purchase agreement for the sale of renewable electricity. Usually, FiTs include three key points: guarantee of dispatch, long-term agreements and payment levels based on the costs of technology.

Feed-in premium. FiP tariffs are defined as market-dependent mechanisms. An add-on is paid for each unit of produced energy in addition to the incomes of selling this energy into the electricity market. There are two types of FiPs currently in force: a fixed add-on is offered over the market price and a variable add-on is paid over the market price to achieve a previously defined target tariff. The latter type of FiP is referred in the literature as sliding FiP or spot gap market model. Under this model wind generators participate in the market

but eventually receive a fixed amount regardless the spot market price.
Tenders. Under this procedure plant developers present their bid for a certain remuneration taking into account the technical specifications set in the call for tenders. The winning bid is selected by considering both technical and economic merit.
Quota system and tradable green certificates. This support technique is market-based, since the price of the TGCs is defined by market equilibrium between the supply and demand for certificates. Demand is driven by a determined target for renewable energy consumption, i.e., the quotas defined as a percentage of energy generated by renewable energy sources. Certificates are tradable financial assets sold on a specific market. Thus, the additional cost of producing renewable energy is compensated by the extra incomes for the sale of certificates.
Tax incentives or exemptions. An extra level of support can be provided by exempting renewable energy generators of paying certain taxes. These promotions techniques are considered to be highly flexible policy tools that are targeted to encourage specific renewable energy technologies, especially when used in combination with other policy instruments.
Investment grants. This support instrument is typically used to stimulate certain technologies at early stage of development.
Financing incentives. This category of policy scheme assists the financing of renewable projects by promoting or offering loans with a rate below the market rate of interest. This support can also consist of providing longer payment periods or phases without interest payment.
In November 2013 the European Commission called for a higher market exposure of renewable generators in its guidance for the design of renewables support schemes. Under these guidelines, the Commission recommends preference for FiPs over FiTs. According to the desired exposure of renewable generators to risk, the premium can be set as a fixed amount over the electricity market price or as a sliding premium to achieve an objective price. Tenders or auctions are also a recommended practice to foster the competition and track the actual costs of technology. These competitive bidding procedures can be used to allocate the support provided by different instruments as FiPs, support to investment or TGCs. Along the same lines, the Guidelines on State aid for environmental protection and energy 2014–2020 , published in June 2014, call for support mechanisms consistent with ensuring the transition to a cost-effective delivery through market-based mechanisms. The guidelines set the following conditions to be applied from 1 January 2016 : the support is provided as premium to be paid in addition to the market price, renewable generators will

be subject to balancing responsibilities, measures have to be taken to avoid renewable generators producing electricity under negative prices. Additionally during the period 2015–2016, the support has to be established by a competitive bidding process for at least 5% of the new renewable capacity. This condition is extended for all new projects from 1 January 2017. Unless MSs demonstrate that a very limited number of projects are eligible, competitive bidding would lead to higher support levels and competitive procedures would result in low projects realisation.

Fig. 1 shows an overview of support schemes currently applied for new installations in MSs. Cells in dark blue refer to schemes for onshore wind energy, orange cells correspond to schemes tailored to offshore wind energy, light blue cells indicate those cases where support is only offered for micro-wind energy2 and grey cells represent support schemes that are applicable to other technologies than wind energy.

source: science-direct.com