Energy Policy 41 (2012) 212–220

Contents lists available at SciVerse ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Regulatory design for RES-E support mechanisms: Learning curves, market structure, and burden-sharing

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ARTICLE INFO

Article history:
Received 24 June 2011
Accepted 20 October 2011
Available online 23 November 2011

Keywords:
RES-E support mechanisms
Electricity markets
Electricity tariffs

ABSTRACT

Drawing from relevant experiences in power systems around the world, this paper offers a review of existing policy support mechanisms for RES-E, with a detailed analysis of their regulatory implications. While recent studies provide an account of current RES-E support systems, in this paper we focus on some of the impacts these mechanisms have on the overall energy market structure and its performance. Given the rising importance of RES-E in systems everywhere, these impacts should no longer be overlooked.

1. Introduction

In recent years, renewable energy sources for electricity (RES-E) have gained importance in electric power systems. These technologies are growing steadily to occupy a key role in electricity generation. Consider that in 2009, 60% of newly installed capacity in Europe came from RES-E. (REN21, 2010). Note that the European Commission's Directive 2009/28/EC establishes "mandatory national targets consistent with a 20% share of energy from renewable sources and a 10% share of energy from renewable sources in transport in Community energy consumption by 2020." At national level in 2010, just to mention some of the most paradigmatic examples, in Denmark wind accounted for 20% of the gross electricity production (Danish Energy Agency, 2011), in Germany (BMU, 2011) RES-E's contribution to electricity supply was close to 17% (wind amounted for roughly a third of it), Spain relies on wind to supply over 15% of electricity (CNE, 2011), and in Texas wind represented 7.8% of the energy supplied (ERCOT, 2011).

RES-E's crucial role, particularly in EU's electricity sector, is expected to be even more important in the near future: for 2020, the Danish Government (2011) announced that more than 60% of electricity production will have renewable origin, while the target of the German Government (BMU, 2011) is a 35% share of RES-E in total gross electricity consumption and the Spanish government expects RES-E to contribute 42% of total electricity demand (MITyC and IDAE, 2010).

Yet, the still comparatively higher cost of RES-E technologies (as well as other impacts, as for instance on the grid structure or the system dispatchability) have made it virtually impossible for them to grow without regulatory intervention. There is still considerable uncertainty among governments and regulatory agencies about the kind of policy framework needed to manage the incorporation of these technologies into the larger generation mix of a country or region. Support mechanisms for RES-E are colliding with existing economic and industrial policies much more frequently; this clash often reflects political sensitivity to voters' perceptions and stakeholders' interests. More tangible concerns include the potential for RES-E to displace older and more polluting technologies, the impact costlier RES-E can have on energy prices, and the effects that the stochastic nature of some of the renewable fuels has on the delivery of electricity. Thus, while in this last decade the RES-E technology learning has been very important, the regulatory learning has not been so pronounced, and a large number of crucial regulatory questions are still waiting for a proper response.[3]

Prominent among these unsolved issues is how best to design subsidy regimes to ensure the proper development of

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[3] See Pérez-Arriaga (2011) for a discussion of how power systems can properly manage large scale penetration of intermittent renewables and also some of the regulatory implications.

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doi:10.1016/j.enpol.2011.10.039

RES-E. Currently, there are two different types of support methods:

- Indirect methods, i.e. implicit payments or discounts as well as institutional support tools that include: research and development funding, below-cost provision of infrastructure or services (costs of technical adaptations such as shadow connection charging (Auer et al., 2009) or costs of imbalances and ancillary services in general),[4] and positive discriminatory rules (such as regulations facilitating grid access for RES-E power, RES-E dispatch priority in the EU, and other: net metering, building codes, etc.).
- Direct methods—these methods refer to investment supports, such as capital grants, tax exemptions or reductions on the purchase of goods and operating support mechanisms, i.e. price subsidies, obligations, tenders, and tax exemptions on production (Commission of the European Communities, 2008).

Drawing from relevant experiences in power systems around the world, this paper offers a review of existing policy supports for RES-E, with a focus on direct methods. We provide a detailed review of the different schemes and design features implemented to date, keeping an analytical distinction between the two categories for direct methods: price-based supports, which fix the price to be paid for renewable electricity, and quantity-based supports, which determine a specific amount of electricity to be produced by RES-E. While recent studies provide an account of current RES-E support systems, in this paper we focus on the impacts that these mechanisms have on the overall energy market structure and its performance in the short- and long-term. Given the rising importance of RES-E in systems everywhere, these impacts can no longer be overlooked.

2. RES-E direct regulatory support schemes

2.1. Price-based mechanisms

2.1.1. Feed-in-tariffs

The basic feature of feed-in tariffs (FIT) is to guarantee RES-E generators a specific price per MWh that is produced. To encourage development of new RES-E capacity, FIT must be high enough to ensure long-term recovery of costs for a given technology. In most power systems, FIT apply for at least during 10 years; in some cases, support is guaranteed for as many as 30 years. According to the most recent REN21 Global Status Report, by 2010 at least 50 countries and 25 states and provinces had instituted FIT supports for RES-E generators.

FIT have been in place for a good number of years now. As a result, FIT have progressively incorporated a variety of rules into the basic, original design, namely:

- Regulatory agreements or contracts: in some cases the FIT just takes the form of a regulatory commitment that is embedded in some law or specific decree (as is the case in Spain). The regulator defines a price to be paid for each megawatt hour produced and undertakes to pay this price for a number of years, but there is not a contractual endorsement with an explicit counterparty. In other cases, such as Germany, the FIT mechanism, besides being enacted in a law, it takes the form of a supply contract that has the System Operator as counterparty (Lipp, 2007).
- Flat or stepped tariffs[5]: the cost of RES-E development can vary greatly depending on the choice of technology (wind vs. solar vs. biomass) and other characteristics such as siting or scale (e.g. onshore vs. offshore wind). For this reason, some governments offer so-called "stepped" tariffs—differentiated levels of remuneration according to the RES-E profile.[6] Tariff levels can be defined according to (mainly) technology, location or plant size. As stated in Brown et al. (2009), the chief aim of stepped tariffs is to try to minimize the "risk of overcompensating plants with efficient technologies or scale (excessive rents) and to reduce the cost of support or burden for consumers", in other words, the goal is to equalize profitability across technologies and scales. While it may appear sensible to distinguish among technologies such as wind or solar PV (a single tariff for all of them would lead to exploiting just the most cost-efficient technology in the short term),[7] applying stepped tariffs *within* a single technology according to plant size lead to significant inefficiencies, while due the consideration of additional social criteria discriminating according to location (e.g. PV in rooftops or marginal areas vs. productive ground) could make sense in certain contexts. Aside from the fact that differentiation significantly complicates the tariff-setting process, stepped mechanisms applied to a single technology (for example decreasing the payment as the capacity factor of the unit increases) also minimize the potential for tariffs to send an efficiency signal to market players, since these tariffs mitigate the incentive to invest in the most efficient alternatives first.
- Constant or decreasing payment stream: FIT can follow either a constant or a decreasing payment structure through the contract period. In Germany, FIT for solar PVs maintain the same level of remuneration with contracts that usually last 20 years. In contrast, an alternative model is to design a larger payment in the first years of operation and reduce it progressively afterwards. This solution helps to reduce the need for substantial project finance. Sometimes, the reduction is proportional to the plant's performance in this first period, again with the goal of mitigating "excessive" rents.
- Tariff degression: in this approach remuneration for RES-E generators is scheduled to decrease overtime either at a predetermined rate or according to the capacity that gets installed. There is considerable difficulty in correctly identifying the starting point for degression and the degression rate, especially if RES-E projects experience delays and changes in their long-term expenditures. Some countries, like Germany, set annual degression rates; percentage decreases are also technology-specific. Spain's degression rates are determined by the National Energy Commission (CNE) and applied not

[4] For instance, in Italy, RES-E receive remunerations at the spot market price, but, in contrast to Spain's wind markets, Italian generating units are exempt from paying the cost of their imbalances in the short term. Incidentally, this provides them with a negative incentive to underestimate the expected production to be declared in the day-ahead market, since this bias increases the spot market price thus ensuring a higher remuneration. RES-E generating units need not worry themselves with penalties or the correction of imbalances that must take place in the secondary markets. Similar issues have been observed in Spain in the case of reactive control services (Imaz, 2011).

[5] See Klein et al. (2008) for a detailed analysis.

[6] For instance, in Germany, FIT for rooftop solar PV vary depending on the size—up to 30 MW; between 30 kW and 100 kW; above 100 kW; and above 1000 kW.

[7] Although there are many others, as for instance developing a local industry, it is important to note that the main objective of RES-E support mechanisms should not be to encourage the deployment of a single technology (e.g. the cheapest) in the short-term, but rather to improve the learning curve of a variety of RES-E types. This is because it is never clear which of RES-E type will become the most efficient in the long run.