Innovative Business Models for Wind Power Integration Using the Flexibility of Demand Response

Lorenzo Simons; Pablo Frias; Tomás Gómez
Institute for Research in Technology – IIT
Comillas Pontifical University
Madrid, Spain
Lorenzo.Simons@iit.comillas.edu

Valerio Cascio; Paolo Bellucci
Societa Energie Rinnovabili (SER)
Palermo, Italy
valerio.cascio@serenergia.com

***Abstract*— Energy from renewable resources is clearly central in European power sector, and European Commission is adapting regulation framework to support its growth in a stable and secure way. Moreover, the high penetration of wind energy in the electricity system has changed the generation mix, where conventional generation is now frequently called to balance energy offer and demand. This paper describes innovative business models for wind power making use of load flexibility to facilitate the integration of wind energy paving the way to new actions to support development of wind energy . To assess the economic viability of the business models, the regulatory frameworks in Italy and Belgium are analysed to see which barriers are still in place to avoid a wide implementation of these business models.**

Keywords*— *Wind Energy, Demand Flexibility, Business Models

I. Introduction

Over the last years, Europe has successfully turned solar and onshore wind technologies from niche technologies into central players in the European power sector [1]., therefore the electricity system has changed from a mainly conventional generation mix to a generation mix with a high penetration of renewable energy [2]. Growth in renewable energy is driven by innovative technologies that deliver substantial greenhouse gas savings; however system service markets have to be updated to reflect the necessities of variable generation in order to maintain grid stability and security. Renewable generation's forecast is characterised with a certain degree of uncertainty, as it is not possible to exactly predict how much energy these energy sources will be producing over a specific time horizon.

Policy makers on the other hand, need new business models which mobilise additional capital investments in renewable energy as well as reduce end consumer costs [3]. The proposed Renewable Energy Directive, together with the proposals on the New Electricity Market Design and governance [4], are expected to set a regulatory framework that leads to investor certainty and also to include market related provisions which do not discriminate against renewables [1].,.In this paper we introduce alternative business models that offer a way to be profitable for wind power generation in a market framework that has to further develop and in particular provide adequate rules to reflect the necessities of variable generation. The business models presented in this work are defined in more detail in the IndustRe project, a Horizon2020 research project that investigates the integration of renewable energy through flexible industrial electricity demand. The next section presents the different business models and their potential savings and benefits for wind power generators [5]. This work ends with some regulatory analysis for Italy and Belgium about the applicability of the business models.

II. Business Models

The potential benefit from the business models is two-sided. On one hand, the integration of wind power can be facilitated by ensuring a certain revenue. This revenue can have different origins. A first way of ensuring a certain revenue is a long-term contract with a flexible consumer, which helps to avoid curtailments as demand follows the availability of wind. A second revenue stream can come from the provision of ancillary services to the TSO. A more aggregated portfolio with the possibility for upward reserve (demand reduction) and for downward reserve (wind curtailment) increases the value of the portfolio. Furthermore, a wind power generator is able to capture a part of the savings that a consumer can make due to the reduction of its net demand.

On the other hand, an independent wind power generator can avoid certain costs by contracting a flexible consumer to balance their imbalances. In a system with dual imbalance pricing, both parties can save the penalty costs.

	Contract between wind generator and FID	On-site wind generator installation
Revenues	Long term electricity supply	Long term electricity supply
	Offering Ancillary Services	Offering Ancillary Services
		Helping to reduce the network tariff paid on the net demand
Savings	Bilateral balancing	

A. *Contract between a flexible consumer and an independent wind power generator*

A flexible consumer could establish a bilateral contract with a generator, for instance a wind power producer, for the provision of flexibility services to help this generator to minimize imbalances. In this contract, the long-term supply of electricity can be included, which hedges both parties for the market-price risk. Therefore, this business model comprises the grouping of the following strategies: Long-term electricity supply, with the perspective of the contract with a wind power generator, and bilateral balancing service provision. A further addition to this business models could be the provision of ancillary services to the TSO through aggregation of demand and generation.

B. *Installation of on-site wind power generator ("behind the meter")*

Alternatively, the FID could decide to have wind power generation units installed on-site in order to benefit from the avoided payment of network and other regulated volumetric (€/kWh) charges. In addition to this, the FID would avoid the risks of being exposed to the market price volatility regarding the volume of self-generated electricity, as the cost of this energy would only depend on the Levelised Cost of Electricity (LCOE) of this on-site wind power generation.

Therefore, this business model comprises the grouping of the following strategies: volumetric tariff response with on-site wind power generation and long-term electricity supply, with the perspective of the on-site wind power generation.

It must be noted that on-site wind power generation can be installed by the consumer with its own investment or both the installation and the investment can be carried out by a third party under contractually agreed financing conditions, but the rationale of this model is still the same under both circumstances. The regulatory and market framework though can treat these two cases differently, affecting their attractiveness and feasibility.

III. Regulatory Framework

This section provides an analysis of the regulatory framework in Italy and Belgium to show the differences that exist within Europe. As will be shown, the analysis of this framework is necessary because it might affect the applicability of the business models.

A. *Belgium*

Aggregation between consumers and generators is allowed in Belgium, which opens possibilities to provide ancillary services or to provide bilateral balancing between demand and generation. Furthermore, to provide ancillary services, these services need to be open for demand to participate. In Belgium, primary reserves are open for demand-side participation, which is facilitated by the possibility to provide asymmetric products (only upward or downward reserve). Besides the primary reserves, certain tertiary-reserve products are open for demand-side participation or aggregators. In particular, the R3-ICH, the R3-DP and the strategic reserve are open for demand response [6].

None of the ancillary services can be provided by wind power generators, although recently certain pilot projects have been run to investigate the possibility of new technologies participating in ancillary services [7]

The regulatory framework in a country can also influence the attractiveness of a business model. In Belgium, wind power generators are treated the same way as any other power generation. This means that they are responsible for their own imbalances [8]. Therefore, a bilateral agreement between an independent wind power generator and a flexible consumer becomes more interesting as both parties can help each other to avoid imbalances and the associated penalties in case of dual imbalance prices. This last item is not relevant for Belgium as a single balancing price is in place.

B. *Italy*

At this moment in the Italian energy market, demand is not allowed to participate in any of the ancillary services except for some long-term interruptibility contracts [9].

While the Italian national Regulatory Authority has published a consultation document for opening the dispatching service market to demand and renewable energy [10] the feedback from Wind association was only moderately positive. In fact, variable renewable energy sources (VRES), in particular wind, can provide an asymmetric service to go down that does not benefit now from any economic advantage against the incentive reduction caused by lower energy fed into the grid. Presently, there is a possibility for long-term contracts between wind power generators and flexible consumers as consumers are allowed to choose their supplier. This contract is the only benefit that wind power generators and flexible consumers can gain from bilateral agreements as the regulatory framework does not allow the aggregation between demand and generation [9]. Furthermore, the possible gains from bilateral balancing contracts are limited as wind power generators fall under a special regime [8].

The business model in which consumers install some on-site wind power production to lower the network charges by lowering the peak is also not very interesting in Italy. This is due to the design of the tariff consisting of a fixed part (€/customer/month) and a variable part (€/kWh/month). This means that there is no relation between the contracted capacity and the network charges. However, this tariff design makes the installation of an on-site wind power generator in general more interesting for consumers as they can avoid not only energy costs but also a significant part of the network charges.

		Primary Reserve (Freq. Response)	Secondary Reserve (Freq. Response)	Tertiary Reserves			
				R3-PROD	*ICH*	*R3-DP*	*Strategic Reserve*
Demand?	Belgium	YES	NO	NO	YES	YES	YES
	Italy	NO	NO	NO			YES
Wind?	Belgium	NO	NO	NO	NO	NO	NO
	Italy	NO	NO	NO			

IV. Conclusion

This work presented two innovative business models for the integration of wind power generation with their potential revenues and savings for the wind power generator. Although for both models three potential sources of revenues or savings are defined, the actual possibility to capture this value depends on the regulatory framework. Therefore, an analysis of the regulatory framework in Italy and Belgium was provided in section III of this work to show the differences that exist within Europe.

The analysis showed that in Belgium most of the ancillary services are open for demand-side participation, while in Italy demand can only participate through an interruptibility contract (which is categorized as a strategic reserve in this work). Wind power generators cannot participate in any of the ancillary services although recently a pilot project has been launched to test the participation in secondary reserves. This means that a wider revision of the current regulatory framework is needed to allow, such promising business models to be applied.

Acknowledgement

The results presented in this paper were mainly produced within the work on the EU founded project IndustRE (www.industre.eu), grant agreement No 646191. The authors gratefully acknowledge the contribution of all the partners in the project.

References

[1] European Commission Fact Sheet "Achieving global leadership in renewable energies" Bruxelles 30-November 2016; http://europa.eu/rapid/press-release_MEMO-16-3987_en.htm

[10] Italian national Regulatory Authority: DCO 298/2016/R/EEL