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Boosting Wind Power Integration by using Flexibility of Industrial Demand Response and AS

Valerio Cascio (1) / Dimitrios Papadaskalopoulos (2)/ Danny Pudjianto(2)

Società energie rinnovabili - SER s.p.a - IT (1) / Imperial College London - UK (2)

Abstract

Given that demand is currently treated as an inflexible, uncontrollable load, the required flexibility for balancing the system and offering the required ancillary services is provided solely by conventional generators which need to remain in the system and operate part-loaded as a back-up energy source and flexibility provider.

Further increase in demand peaks are expected in coming years, therefore a proactive approach is clearly required in order to enhance the cost-efficiency of future low-carbon power systems by supporting a wider penetration of VRES (variable renewable energy resources). A **wider penetration of** VRES, in particular **wind power**, can be supported **by Flexible Industrial Demand (FID)** and implementation of ancillary services from Wind power plants (WP). As new procedures and new business models are foreseen [1] , as in INDUSTRE project, a boost is needed to allow adoption of FID and A**ncillary Services (AS)** in Wind power plants.

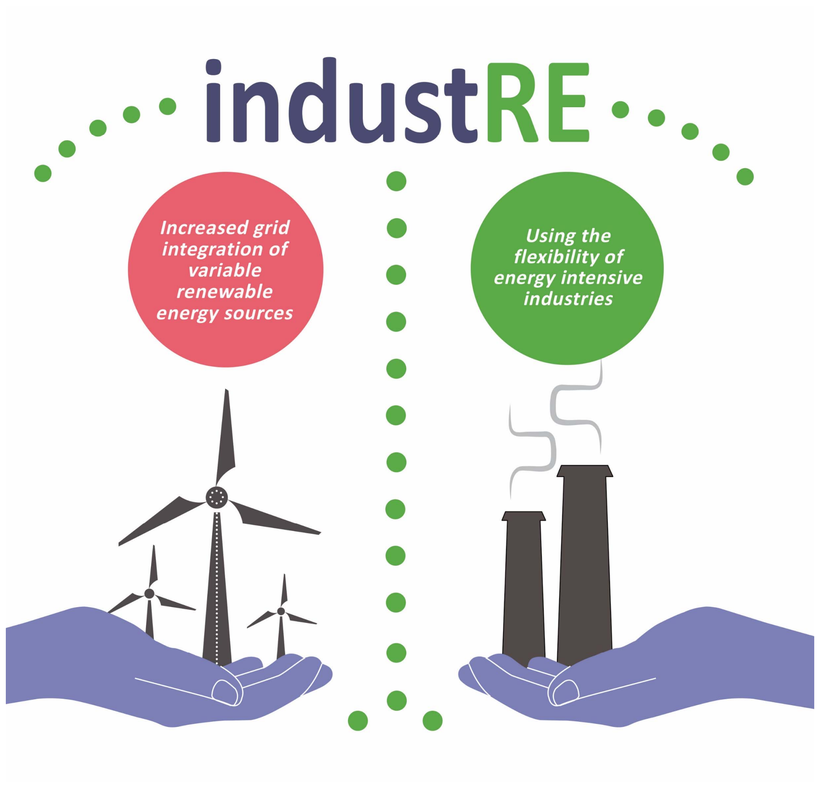
Objectives

We would show how implementation of flexibility of industrial demand response (FID) will allow more wind power integration in the energy system, and how implementation of auxiliary services by WFs (AS) can be shorten by a pragmatic approach. Furthermore, we would provide policy recommendations to boost adoption of FID and to enable AS provision by wind power.

Methods

FID refers to the ability of industrial consumers to modify their electricity consumption patterns. Suitable coordination of such industrial demand flexibility has the potential to support system balancing and to limit peak demand levels. In other words, FID has the potential to reverse the trend of asset under-utilization and enable a more cost-effective and fast transition to a low-carbon future.

In order to capture FID technical characteristics and to achieve a comprehensive quantification of FID economic benefits, an **advanced whole European system modelling framework** has been employed in IndustRE [2]. This model uses projections of demand and renewable generation levels on 2030 and optimizes investment and operation decisions to minimize the system costs required to satisfy these projections. Two alternative scenarios involving 30% and 60% of the overall electricity consumption to be supplied by renewable generation are investigated.



Results

* As expected, higher level of industrial demand flexibility (higher values of α) enhances different streams of cost savings and increases total cost savings, for both renewable generation scenarios. Under 30% renewable generation penetration RES scenario (60% RES), the total cost savings vary between 136 million Euros (60% RES: 232 M.€) per year for α=1% to 2.65 billion Euros (60% RES: 4.34 B.€) per year for α=50%. This trend demonstrates the synergy between increased penetration of renewable generation and FID, which constitutes a fundamental result of the IndustRE project.

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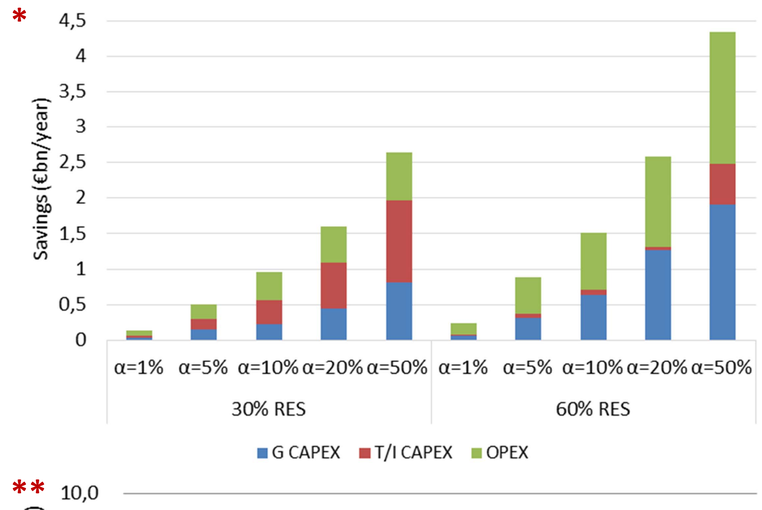

** It can be observed that as FID level increases (higher values of α), peaking generation units (OCGT and oil generators) and storage units are used less demonstrating competition among each other, since FID limits peak demand levels and replaces these units in the provision of system balancing services. On the other hand, it is observed that **as FID level increases**, the **utilisation of available renewable generation (mainly Wind) increases** since FID can shift energy consumption to periods with increased renewable energy output and provide system balancing and frequency response services. Therefore FID enables a higher exploitation of the available wind generation resources.

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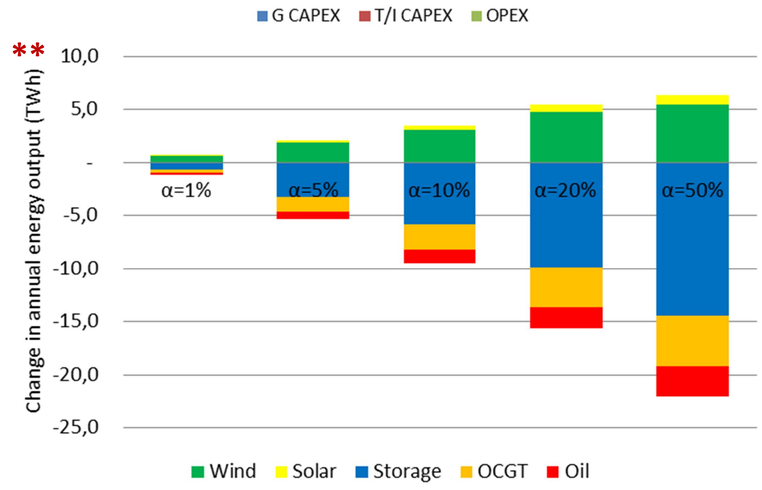

Policy recommendations

a) – *to boost adoption of FID*

- Large consumers should have direct access to wholesale electricity markets;
- Cost reflective network tariff should be adopted.
- Open up reserve capacity and balancing markets to participation of demand;
- Make load interruptibility mechanisms competitive;
- Design efficient imbalance pricing system and allow aggregation of different resources and demand;
- Abandon net-metering policies and allow self-generation for on-site VRES;
- Encourage harmonization of flexibility mechanisms across the EU by dynamically responding to the wind output variations;

b) – *to push ancillary services by Wind farms* [3], [4]

- Remuneration schemes should be adopted, as it is often not cost-efficient to request services from all connected generators.
- Market design shall encourage VRES to offer reserve products from aggregated portfolios.
- TSOs and DSOs should study for a reactive power market, or to allow reimbursement of voltage support through a fee fixed by a competitive process.
- Stochastic nature of wind resource should be considered in the remuneration design of their ancillary services.

Acknowledgement and References

Results presented in this paper were mainly produced within the work on the EU founded project IndustRE [2]. Authors gratefully acknowledge the contribution of all partners in the project.

[1] L. Simons, P. Frías, T. Gómez, V. Cascio, P. Bellucci, Innovative business models for wind power integration using the flexibility of demand response, International Colloquium on «Large Wind-Power Plants: Interaction, Control and Integration»- WINDFARMS 2017. Madrid, Spain, 31 May - 02 June 2017

[2] INDUSTRE project, www.industre.eu, grant agreement No 646191

[3] Sørensen, Poul; Cutululis, Nicolaos Antonio; Hansen, Anca Daniela; Altin, Müfit; Zeni, Lorenzo; Basit,Abdul; Ancillary services: Research results from wind power plants; DTU 2014

[4] ReserviceS project; www.reservices-project.eu

(For other references, see the full article)

Read more facts and figures at www.industre.eu

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