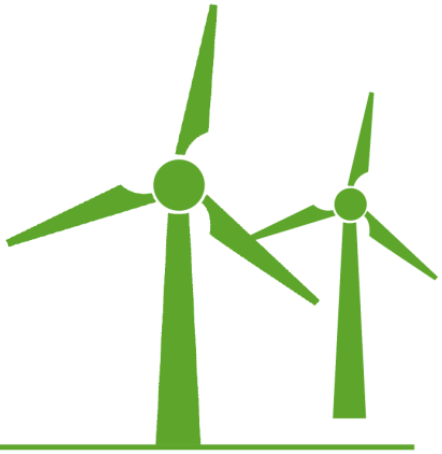
"Innovative Business Models for Market Uptake of Renewable Electricity unlocking the potential for flexibility in the Industrial Electricity Use"

Main variations of business models for Flexible Industrial Demand combined with Variable Renewable Energy

Working Document

Deliverable 2.1
April 2015

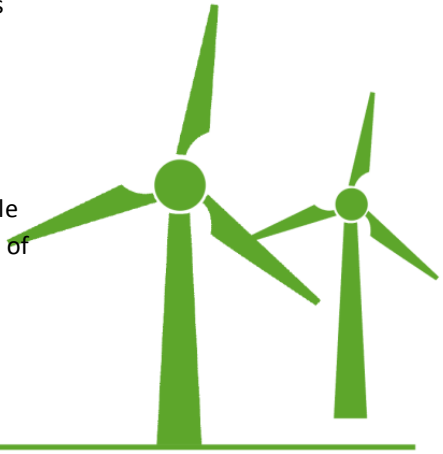


IndustRE

Acknowledgements

This report has been produced as part of the IndustRE project "*Innovative business models for market uptake of renewable electricity unlocking the potential for flexibility in the industrial electricity use*". The logos of the partners cooperating in this project are shown below and information about them and the project is available under www.IndustRE.eu

The work for this report has been carried out by Michael Papapetrou from WIP-Renewable Energies, with feedback and input by all project partners



IndustRE

Table of Contents

1. Introduction

1.1 Background

The EC Guidelines on State aid for environmental protection and energy 2014-2020 define that increased market exposure and balancing responsibilities for renewable energy plants will be introduced by 2016 at the latest: "*The following conditions apply from 1 January 2016….: (a) Aid is granted as a premium in addition to the market price (premium)…; (b) Beneficiaries are subject to standard balancing responsibilities…; (c) Measures are put in place to ensure that generators have no incentive to generate electricity under negative prices.*"[1] In this context, the IndustRE project aims to supports variable renewable energy operators to be prepared for this transition, by helping them identify the most cost-effective way to deal with this challenge.

The flexibility potential of the industrial electricity demand has been identified as an opportunity that - through innovative business models - can facilitate further growth and integration of variable renewable energy, while reducing the industrial electricity costs. Large, energy-intensive industrial consumers could have flexibility in their demand arising through a combination of 1) a number of process specific properties such as 'direct' and 'indirect' storage of energy, 2) storage of semi-finished products and 3) a certain amount of over-capacity in the production or installation.

1.2 The IndustRE project

The IndustRE project aims to create win-win situations between the European industry and the renewable energy generators. The renewable energy generators can minimise balancing costs and optimise their generation profile and resulting overall profit. The industry can benefit by using in various ways (described in this document) the value their flexibility has for the power system.

The work of the IndustRE project is separated in three phases: First, business models that bring benefits to all involved parties are outlined. In the second phase of the project, tools are developed to bring the business models one step closer to implementation and case studies are selected where the tools are applied. During the last phase of the project the benefits for all involved actors are quantified and improvements in the market and regulatory framework are proposed and promoted.

1.3 Scope of this working document

This working document is the first step of the project in outlining the different business models. It aims to define a common starting point by describing the possible business models for commercial exploitation of flexibility in the industrial electricity demand.

[1] EC Communication, Guidelines on State aid for environmental protection and energy 2014-2020, C(2014)2322, adopted in principle on 9 of April 2014

The document provides a basic overview of the different possible business models in which the current regulatory and market conditions are not taken into account. Building upon this straightforward analysis of business models, the influence of the evolving legislative framework and market context in terms of applicability and feasibility will be part of the next project phase.

In this document, a common starting point is defined in terms of using clear and widely accepted definitions while envisaging all possible models where the electricity demand flexibility of the industry can be used to benefit the power system, irrespective of whether these benefits are at the moment rewarded in the different markets or not.

Since this document aims to explore the ways that the Flexible Industrial Demand (FID) can bring benefits to the power system, irrespective of the current regulatory and market conditions, we avoid using terminology that is associated with current market rules and could potentially change in the future. In order to ensure clarity a list of definitions is provided in the annex of this document. The definitions provided in Annex I are adapted from the January 2015 report: "*Regulatory Recommendations for the Deployment of Flexibility*" developed by the Smart Grids Task Force[2].

[2] Smart Grid Task Force, EG3 report, Regulatory Recommendations for the Deployment of Flexibility, January 2015

2. Profiles of main stakeholders

The IndustRE project is primarily focussed on the role of industrial electricity users and variable renewable energy plant operators. In this section we broadly outline their profiles.

2.1 Industrial electricity users

The industrial electricity users relevant to the project are the ones that are connected to the medium or high voltage grid and have grid connection at the MW range and annual consumption at the GWh range. In order to be able to participate in the business models described below, they need to identify some flexibility potential in their demand, i.e. technical capacity to reduce/increase their energy consumption responding to external signals, for example from the system/network/market operator. This reduction/increase could represent redistribution over their energy needs over time and does not necessarily mean that the overall energy consumption will change. Throughout the document we call this flexibility potential Flexible Industrial Demand (FID).

Depending on the possible rewards that can be reaped by the industry in exchange to their electricity demand flexibility, certain industrial consumers might decide to **enhance their flexibility potential through capital investment** in e.g. energy storage, CHP unit and/or production equipment/capacity upgrades.

Our work is in principle applicable to any industrial user that can deliver flexibility, however within the project we focus to the following sectors: Chemicals, non-ferrous metals, cold storage, steel and water treatment.

2.2 Variable renewable energy plant operators

Currently, many Variable Renewable Energy (VRE) plant operators generate as much as possible, irrespective of the wholesale prices and the grid limitations, because very often they benefit from priority grid access and fixed tariffs as a result of governmental support programs. Due to the steady growth and the decreasing support, however, they are getting more exposed to market prices and become more subjected to standard balancing responsibilities. In order to manage this change, they might consider entering bilateral contracts for selling their electricity directly to large end-users.

In this respect, practically any VRE plant operator is relevant for the purposes of the IndustRE project, ranging from small independent power producers to large utilities that have an increasing share of VRE plants in their portfolio. Our main focus is on solar and wind energy, but other VRE sources like Ocean Energy will also become more relevant as they are applied more widely.

2.3 Industrial electricity users with on-site renewable generation capacity

When a VRE generation unit is installed on the site of the flexible user, there are more options for benefits to be shared between the industrial electricity user and the VRE generator. In this case, when we say that the VRE units are installed "on the site" of the flexible user we mean that this installation can supply electricity to the industry without using the public grid, reducing the associated costs and possibly benefiting from carbon credits; in other words the VRE installation is "behind" the user's meter. The VRE could be owned by the electricity user or by a third party.

3 Business models

Any flexibility in industrial demand can be used to provide services to the power system as a response to external signals, for example signals from the system operator. These services are not always rewarded in the same way in the different countries, while for some services there even are currently no established markets. In this section we list all possible services without examining what rewards they offer, if any, in the different countries. The rewards will be studied in subsequent stages of IndustRE for the six target countries of the project (Belgium, France, Germany, Italy, Spain and the UK).

The classification followed in this section takes the point of view of the industrial user and examines the markets/avenues it has for offering its flexibility. For each case there are comments on the impacts this might have on the power system as a whole and on the VRE operators in particular.

A. Reduced energy bills

By shifting consumption to time-periods where the electricity costs are lower, the industrial user can reduce its energy bill. Assuming that the low costs are reflecting real needs in a well operating market, shifting industrial consumption will bring benefits also to the network operator, especially at areas and regions where the grid capacity is close to its limits. In such areas, the FID could also bring indirect benefits to VRE plant operators, who might face lower curtailments levels. In case the FID is used to reduce peak demand, there are also benefits for the system operator; for example it could indirectly contribute to balancing and lowering the pressure for future increases in generation capacity.

A.1 Often industrial users adapt their production to programmes where certain pre-defined time periods are charged at a reduced tariff; a common example is the night rate.

A.2 As we are moving to a power system where the time-period of low-cost energy cannot be so easily foreseen, the fixed programmes (see A.1) become less relevant and more elaborate options start emerging, involving signals from the supplier to the user indicating the time periods of high, normal and low energy prices.

A.2.1 By reacting to these signals, the industrial user can adapt its consumption profile, minimising its energy bill, while not necessarily affecting its overall production.

A2.2 An interesting case is when the electricity supplier is also an operator of VRE plants. This can be for example a utility that owns also VRE plants and can benefit from the FID to balance their generation portfolio. We can also envisage in the future the case where the supplier is a small independent power producer, selling their electricity directly to flexible industrial users.

A2.3 In the case of on-site renewable energy (described in section 2.3 of this document), there are more options opening within the option A.2. There can be emphasis in shifting

consumption to time periods when electricity is available from the on-site VRE, as the flexible user will be able to maximise the share of the overall demand covered by own production. This would lead to reduced energy costs, depending on the relation between the tariffs at any given moment and the on-site generation costs. Here, there can be also the option of feeding electricity back into the grid and being rewarded based on the agreement with the supplier, for example a "net-metering" scheme.

Scheme A. Shifting consumption to low-cost periods

A.3 Another option is to procure electricity from the wholesale/spot market, either directly or through an aggregator. That case is similar with A2.1, with the difference being that there are more opportunities to benefit from fluctuating prices. Especially in the case of an on-site VRE system, when participating to the wholesale market the industry could sell the excess generated electricity and use its flexibility to maximise the related revenue.

A.4 The flexibility can result in lower peak demand, which will result in lower requirements from the grid and reduced associated charges. The application of this option might be restricted by the industrial production capacity and the production requirements, unless there is on-site VRE, or other generation capacity that could allow reducing peak-demand while maintaining full operation close to the peak production capacity, when necessary.

B. Offering services to the power system

Industrial electricity demand flexibility can also offer other services to the power system, contributing to lowering the costs of maintaining the required power quality and helping to defer investments in the transmission and distribution networks. These could also benefit indirectly the VRE plant operators by potentially lowering their grid related tariffs.

B.1 The FID can be used to contribute in containing the frequency variations by offering reserve capacity, either directly or through an aggregator. The details on how this could work in practice vary between countries, regarding minimum thresholds, time periods, rewards and requirements for automatic activation etc. Usually, reserve capacity is offered through the markets for primary, secondary and tertiary control managed by the network operator.

Figure B: Offering services to the power system

B.2 The use of FID in containing the frequency variations can also happen through the signals sent by the Balancing Responsible Party (BRP), either directly to the industrial user or through an aggregator. These signals aim to activate the flexibility of the industrial user in order to support the balancing of the BRP portfolio.

B.2 The FID can also be used to offer other services to the system. These are listed below, but for most of these services, there have been no markets established yet in most of the target countries, at least no markets where consumers can participate:

- Long-term generation investment deferral (e.g. capacity markets)
- Network congestion management
- Reactive power control
- Distribution system services including peak demand shaving, active and reactive power control, voltage support and contribution to distribution network security.

5. Conclusions

This document provides an overview of the basic business models for the commercial exploitation of flexibility in the industrial electricity demand which also brings benefits for variable renewable energy, defining a common starting point for the IndustRE project

Flexibility in electricity demand can reduce the energy bills of an industrial user, both through lower peak demand and associated grid charges and through shifting consumption to time-periods where the electricity costs are lower. The savings depend on whether the user gets it electricity in the open market or uses a supplier. When the supplier owns VRE generation plants, more possibilities open for cooperation that can lead to mutual benefit.

Flexible users can also participate in the ancillary services market, offering reserve capacity for primary, secondary and tertiary control. In the future, also additional services could be offered, for example long-term generation investment deferral, transmission network congestion management etc.

When a VRE generation unit is installed “behind” the meter of the industrial user, there are several options for innovative use of the existing flexibility, through own-consumption models and more intensive use of the options listed above.

In all cases, the industry can enhance their flexibility potential through capital investment in e.g. energy storage, CHP units and/or production facility upgrades. Of course, such investments will only be carried out if the expected revenues are high enough to justify them. The work of the IndustRE project will focus on that question and will support the involved stakeholders to analyse their options and take the most appropriate decisions.

Annex I - Definitions

Aggregator: A legal entity that aggregates the load or generation of various demand and/or generation/production units.

Ancillary Service: All services necessary for the operation of transmission system and distribution networks. These services include load balancing and do not include facilities reserved exclusively for transmission system operators carrying out their functions.

Balancing Market: Balancing Market means the entirety of institutional, commercial and operational arrangements that establish market-based management of the function of Balancing within the framework of the European Network Codes.

Balancing Portfolio: Grouping of a network user's inputs and off-takes in a portfolio. The imbalances of the portfolio will be billed to the BRP.

Balancing Responsible Party: a market related entity or its chosen representative responsible for its imbalances).

Balancing Services: A service provided to a transmission system operator from a *Balancing Service Provider* (a Market Participant providing Balancing Services to a TSO).

Constraints/Congestion Management: Set of actions that the network operator performs to avoid or relieve a deviation of the electrical parameters from the limits that define the secure operation. This term includes congestion management and voltage control.

Distribution System Operator: The legal entity responsible for operating, ensuring the maintenance of and, if necessary, developing the distribution system in a given area and its interconnections with other systems and for ensuring the long-term ability of the system to meet reasonable demands for the distribution of electricity; Moreover, the DSO is responsible for regional grid access and grid stability, integration of renewables at the distribution level and regional load balancing.

Primary Control Power/ Frequency Containment Reserves: Frequency Containment Reserves mean the operating reserves necessary for constant containment of frequency deviations from nominal value in order to constantly maintain the power balance in the whole synchronously interconnected system. This category typically includes operating reserves with activation time up to 30 seconds that are usually activated automatically and locally.

Secondary Control Power / Frequency Restoration Reserves: The operating reserves used to restore frequency to the nominal value and power balance to the scheduled value after sudden system imbalance occurrence. This category includes operating reserves with an activation time typically up to 15 minutes. Operating reserves of this category are typically activated centrally and can be activated automatically or manually.

Tertiary Control Power/ Replacement Reserves: Operating reserves used to restore the required level of operating reserves to be prepared for a further system imbalance. This category includes operating reserves with activation time from 15 minutes up to hours.

Transmission System Operator: A legal entity responsible for operating, ensuring the maintenance of, and if necessary, developing the transmission system in a given area and, where applicable, its interconnections with other systems, and for ensuring the long-term ability of the system to meet reasonable demands for the transmission of electricity. Moreover, the TSO is responsible for connection of all grid users at the transmission level and connection of the DSOs within the TSO control area.

Voltage Control: A distribution system control managed by distribution system operators in order to maintain voltage in their networks within limits and to minimise the reactive power flows and consequently, technical losses and to maximise available active power flow.