DRES2Market

**DRES2Market: Technical, business, and regulatory approaches to enhance renewable energy capabilities to take part actively in the electricity and ancillary services markets.**

# Demand Side Management - residential and commercial

*This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under the Grant Agreement No 952851*

## Demand Side Management

Demand Side Management (DSM) refers to: "the planning, implementation, and monitoring of activities designed to encourage consumers to modify patterns of energy usage, including the timing and level of electricity demand. Demand Side Management includes demand response and demand reduction. In this context, it is assumed to include energy efficiency, as well as Demand Response as DSM operational objectives" [International Energy Agency - IEA Task 17,2016].

DSM includes all activities and measures to encourage PV prosumers to change electricity consumption patterns, including the time and amount of electricity demand. These activities are mainly referred to modifying or shifting energy demand using smart technology, legal and financial incentives, as well as encouraging customers to change their behaviour.

DSM enables the active participation of retail customers (prosumers) in the electricity markets, by observing and responding to changes in electricity consumption in response to price signals, or other conditions over time.

Main objectives of DSM include reducing customers' energy use and activities called Demand Side Response (DSR) or Demand Response (DR), shaping curve load by load control, i.e. electricity use reduction or displacement beyond peak period.

Demand Response is a voluntary changes in the usual patterns of prosumers electricity consumption in response to market signals such as time-variable electricity prices or incentive payments as well as environmental motives. Potentials of Demand Response result from daily and seasonal differences in demand for power and energy and flexibility of customers in how and when they use electricity.

A prosumer is an active energy consumers, or group of energy consumers who both consume and produce electricity, may store excess energy or deliver to distribution grid and thus actively participate in the electricity market. The idea of prosumer energy production is developing rapidly in the European Union countries.

During the last decades the solar photovoltaic and wind technologies have significantly improved their effectiveness and progressively reduced their costs per each installed megawatt. Additionally, the massive application of telecommunication and information technologies have contributed to significant progress in terms of control and monitoring of the renewable energies and development of prosumer energy sector.

## Prosumers

The term "prosumers" broadly refers to energy consumers who also produce their own energy from a range of different onsite generators. When we think of prosumers, we should not only think of a single house with a solar panel, but of a wide range of participants including households, commercial and industrial players.

Below, we present examples of different intelligent prosumer models and identify what financial and non-financial factors are driving the models, as well as the benefits these prosumers bring to society as a whole:

- Grid-connected households with onsite PV, storage, and/or flexible load;
- Grid-connected households with offsite Decentralised Energy Resources (DER);
- Off-grid Households;
- Commercial buildings with onsite DERs and flexible load;
- Industrial prosumers with onsite DERs and flexible load;
- Green Corporate Sourcing;
- Virtual Energy Communities;
- Virtual Communities based on grid proximity.

Across all these models, we can discover several recurring financial and non-financial drivers to become a prosumer. Financial drivers are often based on specific regulatory frameworks, such as existing feed-in-tariffs, the regime of taxes and network charges, and access to markets for aggregated and flexible loads. As for non-financial drivers, themes such as participation in the energy transition, autonomy, resilience, and the importance of showing climate leadership become apparent.

## Households

There are many different ways in which a household can save money on their electricity bill or receive payments through its interaction with the grid, but essentially, they come down to the following three activities: shifting electricity consumption based on price signals, a changing installed generation capacity, or actively offering their flexibility through an aggregator.

Each of these activities can be undertaken separately, or in various combinations, depending upon the possibilities of the household, as well as the national regulatory framework. Although grid-connected households can usually feed their surpluses back into the grid (depending on the national regulatory framework), home systems are usually sized to optimally match self-consumption.

Residential PV has been most popular in countries with favourable feed-in-tariffs or net metering regulations, while residential Demand Side Flexibility has been popular in countries where markets are most open to aggregated flexible load. Implicit flexibility is most feasible in countries with high level of electrification and strong price signals (e.g. through dynamic price contracts). Electric vehicles and smart charging open up important new opportunities for households, because they consume a significant amount of energy, and can be used for all the above-mentioned purposes (including vehicle-to-grid injections, load shifting, participating in markets, etc.). Grid-connected households model is presented on Figure 1.

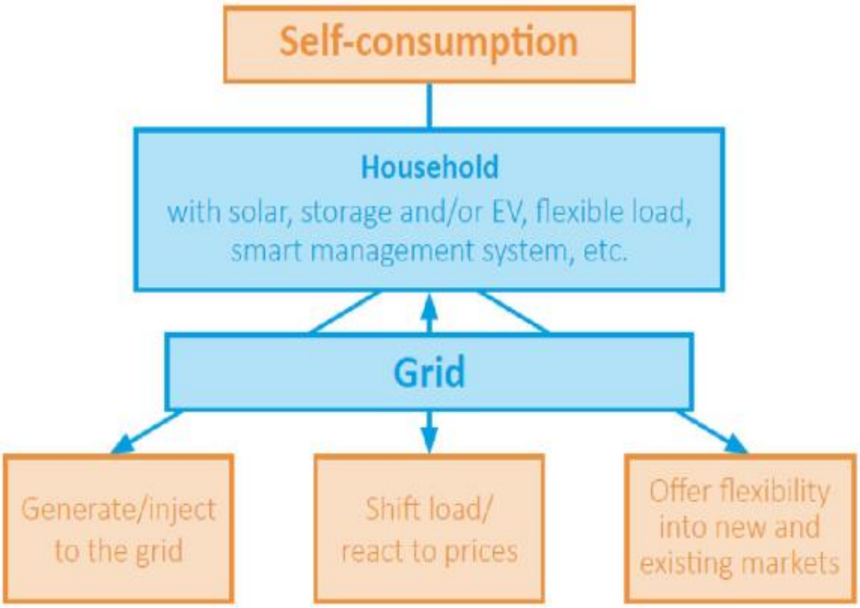



Figure 1.: Household self-consumption.
Source: Deliverable D2.1: DRES2Market solutions for the effective integration of variable renewable energy according to market terms. Page 155.

Although the economics of the model need to work for people to make investments to their home, a large numbers of prosumers are motivated to participate in the energy transition in order to contribute towards environmental goals, to benefit the overall energy system, and to increase their local autonomy over their energy supply. As a co-benefit smart energy management systems can increase comfort in the homes and creating a healthier living environment.

## Commercial

These are buildings used for commercial purposes such as offices, retail, commercial centres, etc. They can either be owned by one company or by multiple companies (such as in a shopping centre).
Energy management systems play an important role in this model. A combination of different types of renewable energy, storage, and flexible load can help maximize benefits.
Grid-connected commercial buildings model is presented on Figure 2.

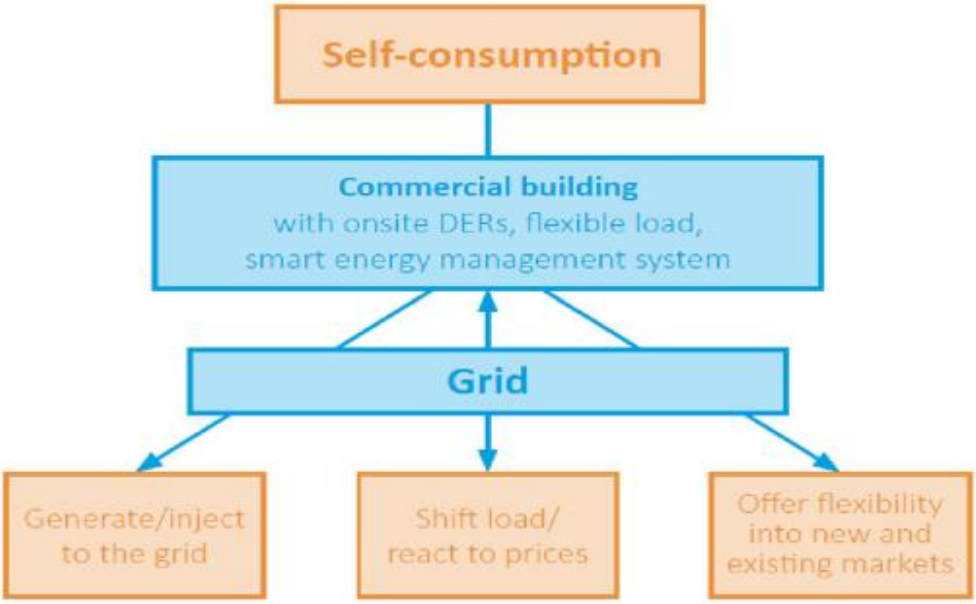



Figure 2.: Commercial building self-consumption.
Source: Deliverable D2.1: DRES2Market solutions for the effective integration of variable renewable energy according to market terms. Page 156.

Commercial buildings consume of energy and by becoming prosumers can make a significant difference to the energy system. At the same time, it is increasingly important for companies to show leadership in climate and sustainability. A co-benefit is increasing resilience in the case of power outages and adding to the security of supply.

## Industrial

Due to their energy intensity, industrial prosumers are important players in the energy transition. Their existing assets often have a significant amount of flexibility, and installing DERs onsite (e.g. renewables, storage) can further help their business case.

As is the case for commercial buildings, green leadership is increasingly important for industry. Other benefits include an increased resilience and security of supply.
Grid-connected industrial buildings model is presented on Figure 3.

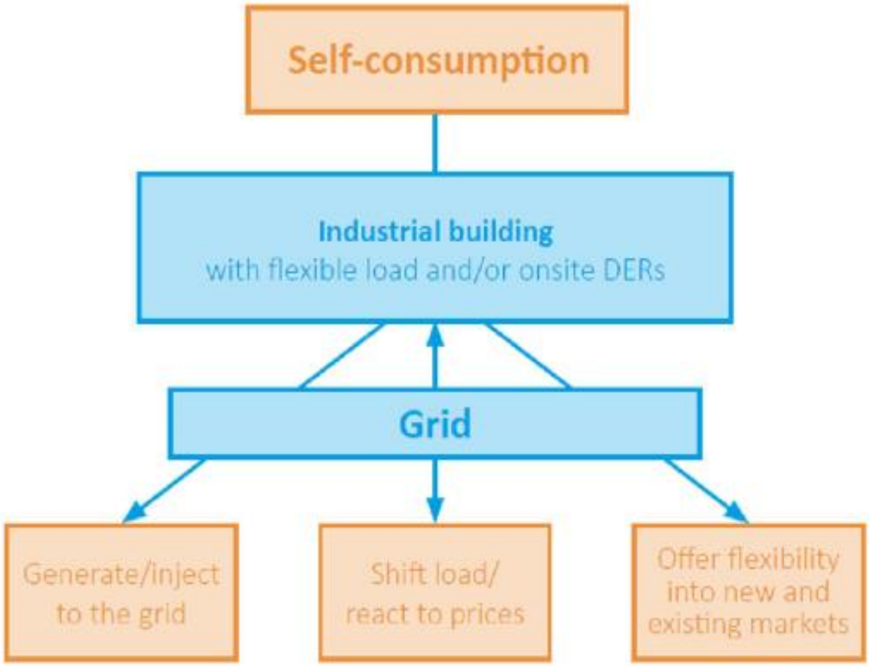



Figure 3.: Industrial self-consumption.
Source: Deliverable D2.1: DRES2Market solutions for the effective integration of variable renewable energy according to market terms. Page 156.

## Communities

The term 'community' is used as a catch-all phrase for when a group of energy users decides to act collectively instead of individually. This term has been debated extensively, because it can refer both to innovation in the new commercial energy offers (e.g. Sonnen Community), as well as to two new legal concepts which present new organisational ways to address energy challenges.
'Citizen energy community' (CEC) and 'renewable energy community' (REC) have been defined in respectively the Electricity Directive and the Renewable Energy Directive. CECs and RECs are legal entities based upon open and voluntary participation and effectively controlled by their shareholders or members who are citizens, SMEs and/or local authorities and whose primary purpose is to provide environmental, economic or social community benefits for their members or the local area members.

These two concepts have been set up to enable the participation of the civil society into the provision of energy services, where profit is not the main goal (e.g. cooperatives, association, etc.). This type of social innovation can be supported by innovative energy companies.

The term ‘virtual communities’ addresses the business models based upon services to a group of consumers, in which consumers enjoy benefits of their pooled or collective assets. In order to create distinction, this first section will cover virtual communities in which individuals are bound together because they are members of the same collective service (aggregation, collective self-consumption, etc.).

Virtual Communities model is presented on Figure 4.

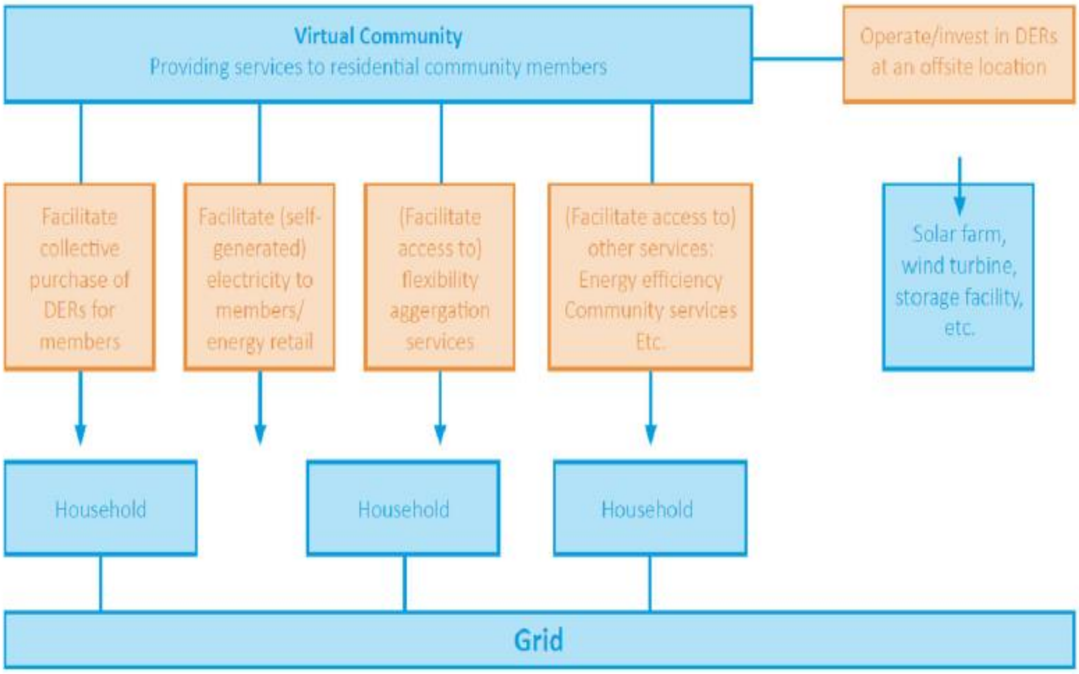



Figure 4.: Virtual Communities.

Source: Deliverable D2.1: DRES2Market solutions for the effective integration of variable renewable energy according to market terms. Page 157.

A Virtual Community can help prosumers to achieve economies of scale, and have access to the same benefits as an individual household. While service providers can offer aggregation services directly to consumers, they can also work with Citizen Energy Communities. Citizen Energy Communities themselves are not primarily driven by profit, but by increasing their autonomy and contributing environmental or social goals. CECs help citizens participate in the energy transition, by providing a means to organise themselves and pool their resources. Profits made by the CEC are reinvested in the community.

## Blockchain

Blockchain technology is especially interesting for peer-to-peer transactions and for platforms that use decentralized storage to record transaction data. Blockchain technology allows the decentralization of databases or a series of records between various participants in a network. With this type of transaction, every participant in a network can transact directly with other network participants without involving a third-party intermediary. An example of one of these initiatives is Greenchain, launched by Acciona.

The visualisation of the renewable origin of the energy through the GREENCHAIN platform is presented on Figure 5.

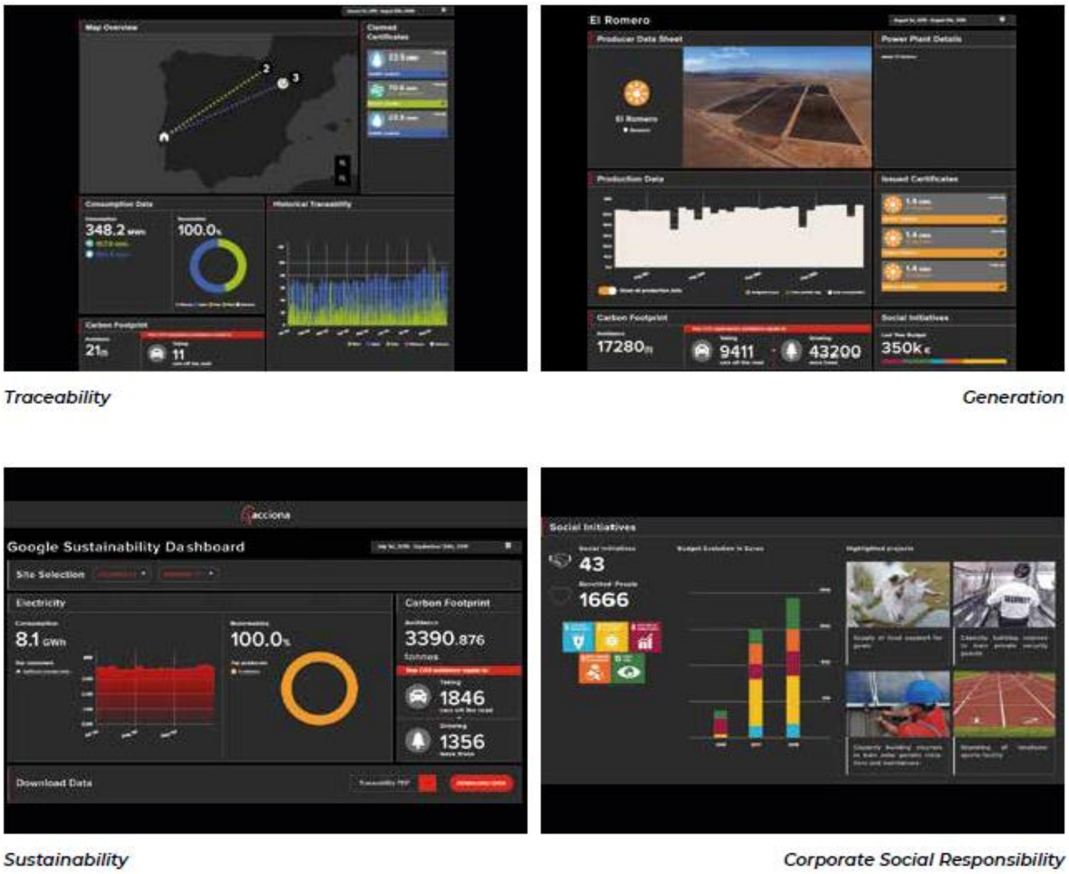



Figure 5.: The visualisation of the renewable origin of the energy through the GREENCHAIN platform. Source: Greenchain we guarantee the 100% renewable origin of your energy. Acciona, www.acciona.com.

Blockchain is an emerging technology that has interest from energy supply companies, technology developers, financial institutions, national governments, and the academia.

Blockchain could improve the management of decentralized networks, manage flexibility services or asset management. Furthermore, Blockchain is very interesting for security and transparency, cryptography can protect transactions, making the network more secure.

## Benefits of DSM/DR programs

New technologies play a key role in DSM/DR implementation. Rapid development of smart grid, microgrids (low-voltage networks with RES sources supported by ICT), smart metering, create new opportunities. Prosumers are more aware of the energy intensity of various home appliances, acting proactively with respect to load shifting. Prosumers increase or decrease their electricity consumption in reaction to the DR signals.

Smart meters are important elements of a system for applications of building, providing information not only about electricity consumption, but also about other operating parameters of reception facilities and changes in level of demand for energy, correlated with data on user activity, change parameters of utility spaces (e.g. temperature, light level) and data from power supply system (information from a supplier of energy, signals change in tariffs, etc.).

Smart buildings technology integrated with smart grid are capable to respond to Demand Response signals coming from utility or system operator to adjust peak demand and transmission and distribution capacity to reliable and vulnerable system operations and better observe and control of energy use. Smart meters increase consumers' awareness of their energy consumption and how to improve their efficiency, and reduce demand and energy consumption at peak time, consequently, to modify it, by providing them with precise information.

Main benefits of implementing DSM/DR programs are:

- financial benefits for participants and the electricity system - costs reduction;
- improvement the participation of renewables and competition in global & local electricity markets and more active role of prosumers in energy market;
- improvement prosumers awareness in the field of energy, customers behave rationally in economic sense;
- more efficient operation of the electricity system;
- improvement of system reliability;
- better management of transmission capacity, reduction of costs associated with network congestion;
- reduction of distribution, transmission network losses;
- improvement of energy security, through its contributions to balancing and congestion management;
- improvement management of price risk and volume;
- reduction of greenhouse emission and other harmful substances into the environment, greater connection of renewable generation.

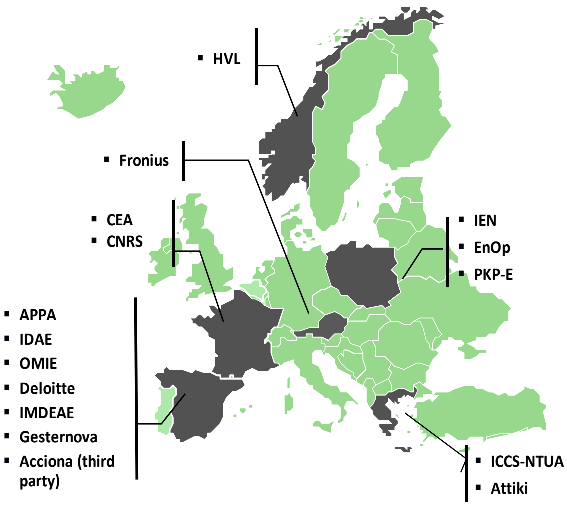
DSM programs encourage PV prosumers to take steps to generate and use electricity more efficiently for their own benefit as well as for the whole electricity system and environment.

**This brochure is based upon work done in the DRES2Market project Deliverable 2.1.: DRES2Market solutions for the effective integration of variable renewable energy, according to market terms.**

**The main goal of the DRES2Market project is to develop comprehensive and affordable approaches to facilitate effective participation in distributed generation based upon renewable energies - solar PV and wind energies in the electricity markets, and to provide balancing and reserve services according to market criteria.**

The following 15 partners are participating in the project:

- ASOCIACION DE EMPRESAS DE ENERGIAS RENOVABLES – Project coordinator
- INSTITUTE OF COMMUNICATION AND COMPUTER SYSTEMS - NATIONAL TECHNICAL UNIVERSITY OF ATHENS
- FRONIUS INTERNATIONAL GMBH
- ATTIKI GAS SUPPLY COMPANY
- INSTITUTO IMDEA ENERGÍA
- GESTERNOVA, S.A.
- COMMISSARIAT À L'ÉNERGIE ATOMIQUE ET AUX ÉNERGIES ALTERNATIVES
- INSTYTUT ENERGETYKI
- OMI-POLO ESPAÑOL, S.A.
- ENEA OPERATOR Sp. Z o.o
- DELOITTE ADVISORY, S.L.
- PKP ENERGETYKA S.A.
- CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
- WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES
- INSTITUTO PARA LA DIVERSIFICACIÓN Y AHORRO DE LA ENERGÍA

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