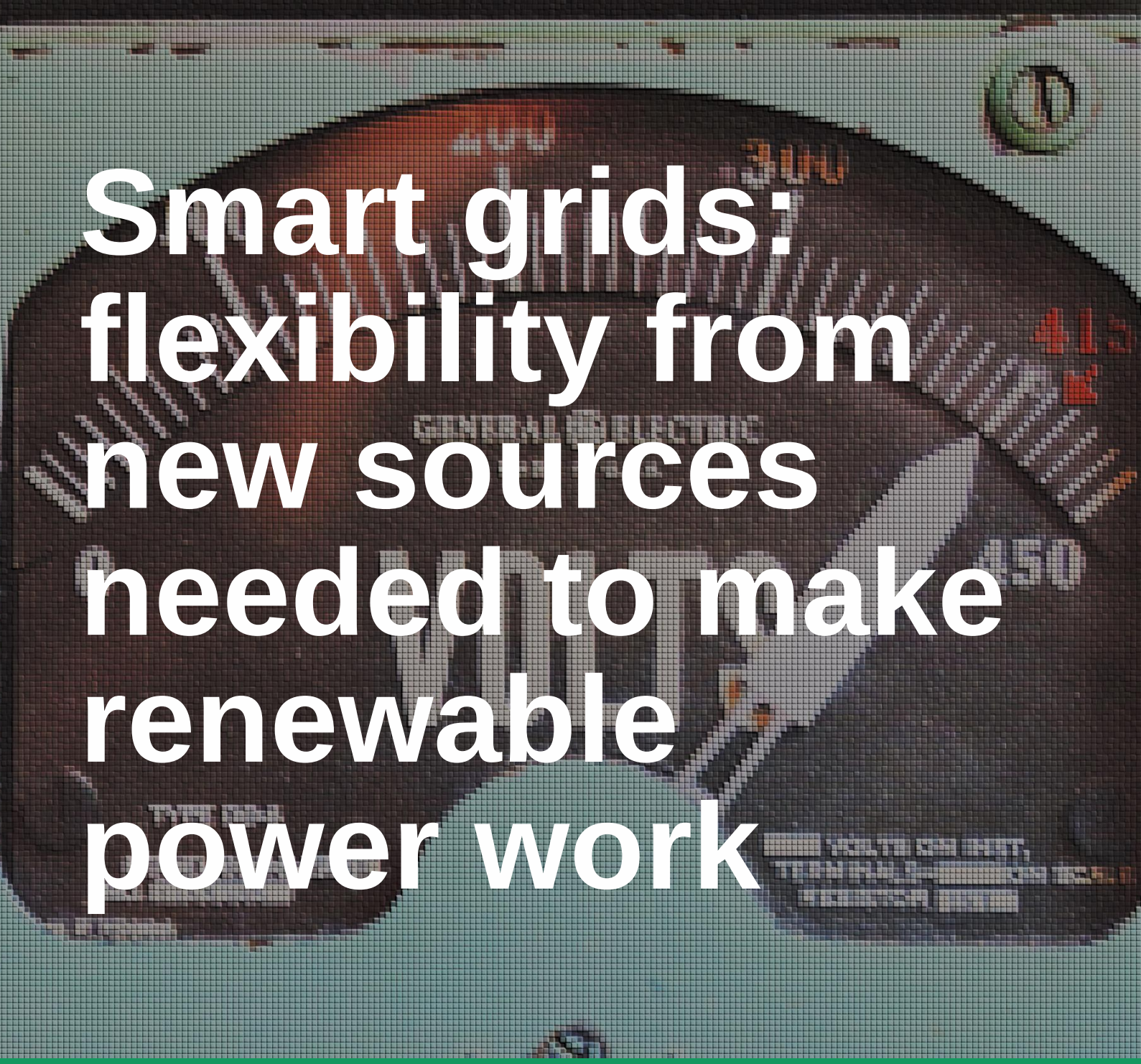

Smart grids: flexibility from new sources needed to make renewable power work

A policy brief from the Policy Learning Platform on low-carbon economy

July 2017

Interreg Europe

European Union | European Regional Development Fund

Introduction

Renewable energy is key in the transition towards a low-carbon economy. The 2009 Renewable Energy Directive (RED) provides the relevant legislative framework for the member states and determines that by 2030 at least 27% of final energy consumption in the EU shall be delivered by renewable energy sources. The benefits of renewables extend well beyond CO_2 reduction and also include greater security of energy supply, more innovation, increased employment and economic growth. The increased use of renewables, however, also presents a challenge to the member states. There is a need to provide more flexibility in the electricity grid to accommodate the electricity produced with renewables. Smart-grid technologies present a possible solution for this challenge.

This policy brief looks into:

- Why there is an increasing demand for flexibility in the electricity grid?
- How this flexibility can be provided?
- What the main challenges are?
- How Interreg Europe projects are dealing with flexibility in the electricity grid?

Why there is an increasing need for flexibility in the electricity grid?

Flexibility in the electricity system makes sure that power supply and demand is equal at any given moment. Flexibility solutions that help match supply and demand include “up regulation” – the delivery of additional power, and “down regulation” – reducing of power.

Traditionally, differences in demand and supply in the electricity system are balanced by controlling a limited number of large centralised production facilities, such as coal and gas fired power plants, large hydro plants and nuclear power stations. These sources are connected to the high or medium voltage grids, and keep up with all variations in electricity demand to ensure that the system is balanced.

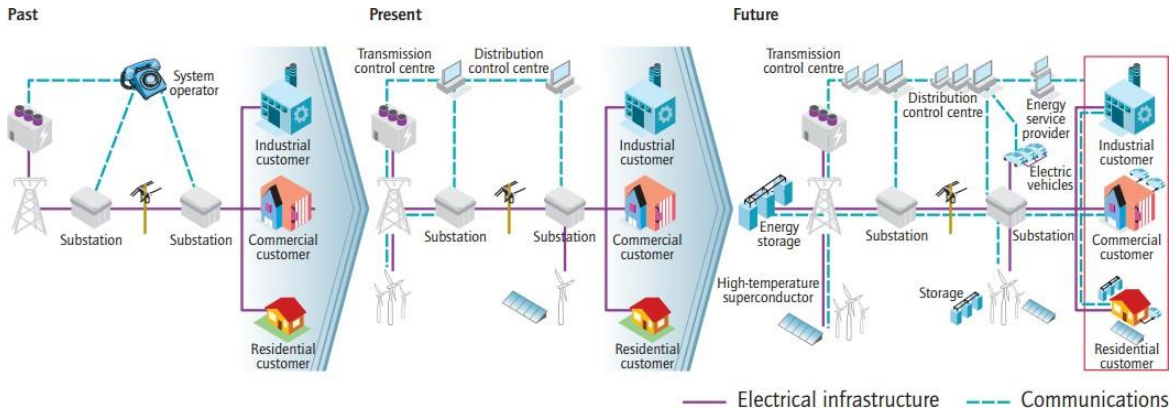

Figure 1: Demonstration of the changes taking place in the electricity grid.

Source: IEA (2014) Technology Roadmap Smart grids

The traditional electricity system is changing rapidly due to:

1) increased production of solar and wind electricity (so called *intermittent* renewables). The production of solar and wind electricity depends on local weather conditions and varies considerably. This creates uncertain hourly feed of renewable electricity into the grid and, subsequently, causes high volatility of the residual load (electricity demand minus renewable electricity generation). To deal with this uncertainty, power plants need to operate more flexibly

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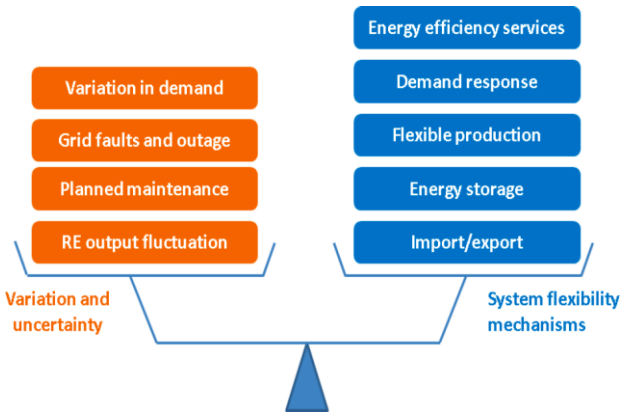
– on partial load or with fast ramping up or down to balance supply and demand, which is technically less efficient and costlier.

2) increasing number of small- to medium-scale renewable production facilities that feed electricity into decentralised low voltage grids, as opposed to the few large power stations connected to the high voltage grid. In not so distant future, households and communities are very likely to become '*prosumers*' – consumers and at the same time producers of renewable energy or suppliers of flexibility. This development can create a problem of congestion and energy system overload in local grids, possibly leading to grid faults and outages.

Accommodating a growing share of renewables into our energy system requires increased flexibility on the local level to balance electricity supply and demand. The picture on the left lists the system flexibility mechanisms, which can mitigate variation and uncertainty of electricity demand and supply in decentralised grids. In the following sections we will focus on the *demand response (DR)* and *energy storage* mechanisms as means to provide flexibility on the local level.



Source: EC (2017)

How can Demand Response (DR) provide flexibility?

Demand response is consumer's ability to *reduce, increase* or *shift* the electricity demand to other time periods in response to price signals, other incentives or regulations. Studies show that industrial, commercial and residential consumers are very responsive to such mechanisms. Hence, demand response presents a good potential to provide flexibility. Traditional demand response mechanism, applied already for decades, involves arrangements between large industrial consumers and their energy providers to curtail or shift electricity demand during pre-defined time periods against contractual pricing arrangements.

Advancement of smart grids technology has expanded possibilities for demand response also towards smaller energy users. Households equipped with smart appliances can easily respond to price signals from their energy provider and avoid using energy during times of peak demand or shift consumption to periods when renewable energy consumption is high.

What is needed to ascertain the potential for demand response can be tapped?

Despite technology being available, the full potential of demand response is not yet realised. This would require:

- Creating market value for flexibility to cover the required investment and operational cost. This value could be established through e.g. 'time of use' tariffs, which would incentivise required behaviour. The Interreg Europe SET-UP project is working on economic models to capitalise market value of flexibility, taking into account specific local circumstances, regulation and funding sources.
- Adapting current energy market design. There are plenty of 'prosumers' that can provide flexibility. Yet individually they are small. Aggregators are needed to capture the flexibility from many small sources. The main barrier here is the fact that current market design is still based

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on the needs of central generators and there are no financial incentives to tap the potential of flexibility that can be provided by small production sources.

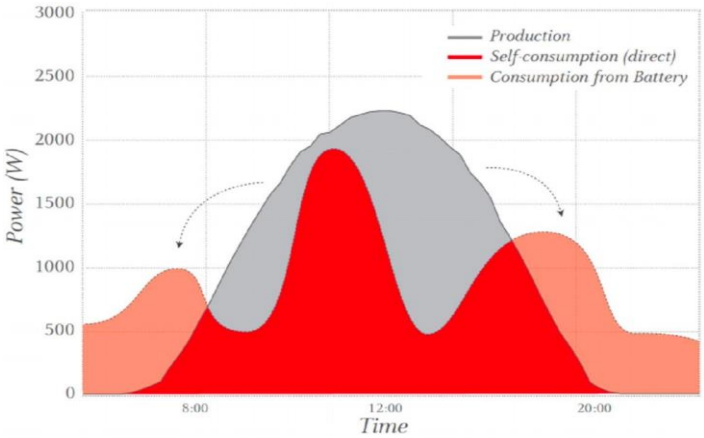
- Increasing knowledge and awareness with small consumers of the possibilities smart grid technology offers to provide flexibility. Partners of the SET-UP project will share strategies for consumer engagement, provision of information tools and support services.

SET-UP: Smart Energy Transition to Upgrade regional Performance

The goal of the project is to improve the energy performance in seven regions by enhancing policies on smart grids. Each region will develop a regional action plan aimed at accelerating smart grid deployment that will focus on the following common challenges identified by the regions:

- Consumers' acceptance: current low awareness of smart grids potential for consumers is resulting in limited participation and involvement.
- Economic models: the electricity sector is heavily regulated; each nation or region has a different background. Analysis of local situation and sharing of the energy system environment should result in improved guidance for local actors such as enterprises, investors and public administrations.
- Funding sources: identification and analysis of funding mechanisms to ensure investments in e.g. infrastructure, incentives for enterprises, awareness raising, etc.

How can energy storage provide flexibility?



Source: EC (2015), page 4

Storage of electricity affects both the supply and demand side of the electricity system by facilitating a shift in either demand or supply over time. Flexibility through storage can be ensured by households and building owners that may have e.g. acquired roof top solar panels with integrated battery storage. For 'prosumers' storage has a value, because it optimises the production and consumption 'behind-the-meter', as illustrated in the graph on the left. Storage can increase the self-consumption of locally produced power and in that way contribute to a better balance of electricity supply and demand on the local level.

What is needed to stimulate the use of energy storage?

The main barriers for energy storage are the current high costs of most energy storage options, and lack of financial incentives for self-consumption. Greater use of storage is also impaired by financial support that favours renewable electricity production, as in many member states level of financial support is based on the amount of electricity supplied to the grid. Depending on the height and conditions of the support, these schemes thereby make use of energy storage 'behind-the-meter' unattractive. To stimulate use of energy storage therefore requires adjustment to the current support

schemes. Some countries, e.g Germany, have started with providing incentives for energy storage (EC, 2015).

The Interreg Europe ENERSELVES project will support the development of policies to stimulate the integration of renewable energy sources (RES) in buildings for self-consumption, and can produce inspirational solutions for further application.

ENERSELVES: Policy instruments for energy self-consumption in buildings

The energy self-consumption through integration of renewable energy sources is necessary to achieve Nearly Zero Energy Buildings (NZEB). The nearly zero (or very low) amount of energy consumed in such buildings should be mostly covered by energy from renewable sources. The objective of the ENERSELVES project is to promote new policies, or improve existing policies, to support the integration of renewable energy sources (RES) in buildings for self-consumption. As cost-effectiveness of different RES varies from region to region, the project will analyse and identify the best value-for-money investment for specific regions.

Summary and lessons learned

As the use of renewable energy sources increases, there is a growing need to provide more flexibility in the grid to accommodate the electricity produced with renewables to ensure that energy demand and supply are balanced on the local level. This policy brief shows that demand response and storage of electricity are ways to provide flexibility in the local electricity grid. Tapping the full potential of these options, however, requires among others hat:

- Increase of financial incentives for demand response and energy storage to ensure that flexibility provided by these sources has a market value.
- Regulatory systems are adjusted, i.e. changes from a system focussed on central electricity production to a system that accommodating production by small producers.

Sources of further information

- European Commission, Best practices on Renewable Energy Self-consumption, SWD (2015) 141 final
- European Commission, Energy storage – the role of electricity, SWD (2017) 61 final
- European Commission, Incorporing demand side flexibility, in particular demand response, in electricity markets, SWD(2013) 442 final
- European Parliament, Energy Storage: Which Market Designs and Regulatory Incentives Are Needed?, 2015 DG General for internal policies. Policy department A: economic and Scientific Policy.
- International Energy Agency (IEA), Getting Wind and Sun onto the Grid. A Manual for Policy Makers, 2017
- International Energy Agency (IEA), Technology Roadmap. Smart Grids, 2011

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#RenewableEnergy #DemandResponse #EnergyStorage #SmartGrids

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