SEDC
Smart Energy Demand Coalition

Monitoring Demand-Side Flexibility

Assessing the potential and market uptake of Demand-Side Flexibility in the European energy system

Position Paper
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Summary - Key recommendations

In order to reach the objectives of the Energy Union and take the appropriate regulatory measures to accompany the development of Demand-Side Flexibility, it is essential for EU institutions to set objectives and to be able to track progress on the ground. The engagement of consumers to the benefit of the whole system will only be made possible if the correct governance tools are put in place.

The Energy Union needs Demand-Side Flexibility indicators.

Appropriate measurement tools are essential for Europe to monitor and assess progress towards meeting the Energy Union objectives, and to enable the full inclusion of Demand-Side Flexibility in system adequacy assessments. The **indicators** to monitor and assess progress towards meeting the Energy Union objectives should include both implicit and explicit Demand-Side Flexibility:

- **Explicit Demand-Side Flexibility** should be monitored through the **capacity** (MW) contracted and **volumes** (MWh) sold into the different markets, so as to assess the share of Demand-Side Flexibility in each segment of the electricity market.
- **Implicit Demand-Side Flexibility should be measured** through an **estimation of the capacity (MW) and volumes (MWh) actually available** through it. **This presupposes (a) a monitoring of** the percentage of consumers with **access to a smart meter; (b)** among them the **percentage of consumers that signed up for real-time** (hourly or where applicable shorter-term) **pricing;** and **(c) a methodology to assess the magnitude of the consumer reaction.**

These essential indicators could be completed with complementary data on the amount of time flexibility is available or the type of consumers involved. Collecting this information will require the involvement of different actors in the electricity system, including TSOs, power exchange platforms, retailers and service providers.

A Demand-Side Flexibility benchmark is essential to assess progress.

The EU should define the level of its ambition by setting up realistic benchmarks that would provide a reference to assess progress at Member-State level.

In the same way the European Union has set a non-binding target of 10% for interconnection, the Commission should propose **a reference of 10% peak demand reduction for EU Member States** for explicit Demand-Side Flexibility. **Concerning, implicit Demand-Side Flexibility, a benchmark of the number of consumers with real-time pricing** contract would be a strong tool to reveal best practices.

The challenge

Today, a comprehensive approach for measuring the availability and energy market participation of Demand-Side Flexibility is lacking in Europe. Although the European Commission, ENTSO-E and other stakeholders have repeatedly stated the objective **of including Demand-Side Flexibility into any system adequacy assessments**[1], it is unclear how to achieve this without a clear assessment of current resources and available potentials. In particular, the indicators proposed to monitor the progress of the Energy Union do not yet track the development of Demand-Side Flexibility.[2]

The lack of clear indicators also hampers the assessment of progress in the area of **consumer engagement and empowerment in Europe** and the ability to **link wholesale and retail markets** as pronounced by the European Commission as a clear objectives of the Energy Union.[3]

Demand-Side Flexibility can be defined as *"the capacity to change electricity usage by end-use customers (including residential) from their normal or current consumption patterns in response to market signals, such as time-variable electricity prices or incentive payments, or in response to acceptance of the consumer's bid, alone or through aggregation, to sell demand reduction/increase at a price in organised electricity markets or for internal portfolio optimisation*"[4]. This definition therefore includes any asset behind the meter which can be used to change consumption patterns: change in appliance consumption, self-generation and storage.

Demand-Side Flexibility can be distinguished in two types:

- **Explicit Demand-Side Flexibility** is flexibility traded on the different energy markets (wholesale, balancing, system support and reserves markets). This is usually facilitated and managed by an aggregator that can be an independent service provider or a supplier. This form of Demand-Side Flexibility is often referred to as "incentive driven" Demand-Side Flexibility.
- **Implicit Demand-Side Flexibility** is the consumer's reaction to price signals. Where consumers have the possibility to choose real-time prices reflecting variability on the market and the network, they can adapt their behaviour (through automation or personal choices) to save on energy expenses. This type of Demand-Side Flexibility is often referred to as "price-based" Demand-Side Flexibility.

It is important to note that neither form of Demand-Side Flexibility is a full replacement for the other, and that both should be taken into account into monitoring tools and policy targets

[1] „(...) *the Commission will establish a range of acceptable risk levels for supply interruptions, and an objective, EU-wide, fact-based security of supply assessment addressing the situation in Member States. This will take into account cross-border flows, variable renewable production, demand response and storage possibilities.*„ in European Commission communication „*A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*", February 2015, p. 6.

[2] Commission Staff Working Document, *Monitoring progress towards the Energy Union objectives - Concept and first analysis of key indicators*, November 2015.

[3] Commission communication (2015), *op cit.*, p. 10-11.

[4] CEER Advice on Ensuring Market and Regulatory Arrangements help deliver Demand Side Flexibility, June 2014, p.8.

Monitoring Demand-Side Flexibility development

In the United States, a monitoring of the development of Demand-Side Flexibility has been put in place for several years (see *annex 1*). To close the gap between its political ambition and its observation tools, the EU should also develop specific indicators to assess and monitor current Demand-Side Flexibility resources and available potentials in Europe in a systematic manner.

Explicit Demand-Side Flexibility

To monitor explicit Demand-Side Flexibility in Europe, an indicator should capture the participation of Demand-Side Flexibility in wholesale, balancing, system support services and reserves markets. For mechanisms essentially based on availability (balancing and ancillary services, adequacy mechanisms) this indicator could measure the **capacity (MW) contracted**.

For the wholesale market and some reserves market where energy is traded, the indicator could measure **the volumes (MWh) of Demand-Side Flexibility sold** into this market annually.

The needed information should be provided by different entities according to the use of flexibility and the related main market body:

- For balancing and reserves markets, such figures should be provided by TSOs, as already required by European regulation. [5]
- For local system support services, data should be provided by DSOs.
- The assessment of data availability on wholesale markets is more challenging. It may require report by different market actors, based on clear rules protecting sensitive information.

For certain products, the reporting on capacities could be complemented with data on the number of activations or with additional information on the length of the concerned products, describing how long the flexibility is available for.

These indicators should include a comparison with the total size of the product or market in question, in order to provide figures on the market share of Demand-Side Flexibility.

Implicit Demand-Side Flexibility

To monitor implicit Demand-Side Flexibility in Europe, an indicator should provide an **estimation of the flexibility capacity actually available** through it. It is important to note that implicit demand-side flexibility is not a dispatchable resource, so its contribution to system adequacy is more uncertain than in the case of explicit demand-side resources. Such an estimation includes two stages:

1. **Evaluating which consumers are exposed to the relevant price signals.** To provide implicit demand-side flexibility, a **consumer must have interval metering, and be exposed to strong price signals** (e.g. real-time pricing or critical peak pricing). This would require to gather the following information:

[5] The Regulation on data in electricity markets requires TSOs to provide the information related to the amount of balancing reserves under contract (MW) by the TSO, specifying the source of reserve (generation or load); and the amount of activated balancing energy (MW) per balancing time unit and per type of reserve.
See: article 17 of Commission Regulation (EU) No 543/2013 of 14 June 2013 on submission and publication of data in electricity markets and amending Annex I to Regulation (EC) No 714/2009 of the European Parliament and of the Council.

- the percentage of consumers with access to a smart meter;
- among them the percentage of consumers that have access to and actually signed up for real-time (hourly or where applicable half or quarter hourly) pricing. The indicator should be split for different consumer groups, based on the size of their consumption. It requires information to be disclosed by retailers, or to be collected directly from consumers through a survey.

2. **Estimating what proportion of consumers will respond in the relevant circumstances**. The estimated demand from the set of consumers identified during the first step provides an upper bound on the level of implicit demand-side flexibility. To establish what proportion of this demand is actually responsive requires a statistical exercise. As an example, the Australian Energy Market Operator examines correlations between periods of very high wholesale prices and falls in demand[6] [7]. The EU should develop a comparable approach that would be suitable for European market structures.

Assessing Demand-Side Flexibility potential

To provide a benchmark for progress, Europe should define clear policy objectives on both indicators for 2020, 2025 and 2030. This could be informed by reference values from other regions in the world, as well as a dedicated potential analysis for Europe.

Experiences from inside and outside the EU already demonstrate the promising potential of Demand-Side Flexibility in terms of providing additional flexible resources competing with generation:

- Demand-Side Flexibility represents between 33% and 50% of French manual Frequency Restoration Reserves;
- more generally, Demand-Side Flexibility already provides around 10% of peak reduction in two major US Transmission regions (see annex 2).

Demand-Side Flexibility contributes to Security of Supply. The North American Energy Reliability Corporation (NERC) has reported figures above 90% delivery for 2014 and 2015, its reliability is therefore similar to generation. [8] [9] [10]

On this basis, a set of benchmarks for Demand-Side Flexibility in Europe would be instrumental in providing a reference to assess Member-States progress and fulfilling the objectives of the Energy Union. ACER has

[6] AEMO, *Demand Side Participation, 2015 National Electricity Forecasting Report*, July 2015, p. 8-10.

[7] The AEMO differentiates three types of demand-side participation: DSP from large industrial loads; Net demand reductions due to small non-scheduled generation and DSP from non-large industrial loads. The two first ones are calculated on the basis of historical price responses at different price levels; the last one is calculated on the basis of a survey sent to network service providers, retailers, and aggregators about the DSP available to them – both historical and forecast.

[8] NERC is a not-for-profit international regulatory authority whose mission is to assure the reliability of the bulk power system in North America.

[9] *„The realized demand reduction rate during the summers of 2014 and 2015 was well above 90 percent [respectively 94.1% and 99.8%]. Additionally, performance rates exceeded 90 percent during events in the winter periods* [96.8% and 92.2%]“ in NERC, *State of Reliability 2016*, May 2016, p. 20.

[10] The same report describes outage rates over 4% in 2014. See NERC, *op. cit.,* figure C. 2. p. 117.

compiled in a report[11] existing figures from different studies concerning the benefits of Demand-Side Flexibility. Different studies, quoted by ACER or published in between, provide estimation in terms of potential share of peak load:

- Hans Cristian Gils, from the DLR (German Aerospace Center), estimates the potential size of the DSR resource in the EU at 14%.[12]
- Jan Stede, from DIW Berlin, estimates the potential DR capacity in industry and tertiary sectors in Germany at 10% of peak load. [13]
- The UK Association for Decentralised Energy estimates that manufacturing sites, hospitals and retail stores could provide up to 16% of the UK's peak electricity requirement, or 9.8 GW. [14]

These figures are in line with the existing development of demand resources in the most advanced US regions and confirms the European Commission estimation[15] that at least 10% of peak load could be made available for Demand-Side Flexibility.

[11] Cambridge Economic Policy Associates (CEPA) Ltd, TPA Solutions and Imperial College London, *Demand Side Flexibility, The Potential Benefits and State of Play in the European, Final Report for ACER*, September 2014.
See in particular Table 1.2: "Survey of estimates of benefits of explicit DSF in electricity, compared in €/kW/yr", p. 7.

[12] Hans Cristian Gils, „Assessment of the theoretical demand response potential in Europe", Energy 67, 2014, p.1-18.

[13] Jan Stede, *Demand response in Germany: Technical potential, benefits and regulatory challenges*, German Institute for Economic Research (DIW Berlin) webpage, May 2016, available at:
https://www.diw.de/de/diw_01.c.532689.de/presse/diw_roundup/demand_response_in_germany_technical_potential_benefits_and_regulatory_challenges.html

[14] Association for Decentralised Energy, *Flexibility on demand Giving customers control to secure our electricity system*, July 2016, p. 5.

[15] Commission Staff Working Document, *Incorporing demand side flexibility, in particular demand response, in electricity markets*, February 2013, p.3.

ANNEX

Annex 1. Indicators developed by the federal regulator in the United States

The Energy Policy Act of 2005 required the US Federal Energy Regulatory Commission (FERC) to develop an "Assessment of Demand Response and Advanced Metering". This document updated on a yearly basis gives an overview of the situation at the Federal level, through key indicators. The last available version gathers the following set of indicators[16]:

- *Potential Peak Reduction (MW) from Retail Demand Response Programs;*
- *Potential Peak Reduction (MW) from Retail Demand Response Programs by Region and Customer Class;*
- *Potential Peak Reduction from U.S. ISO and RTO Demand Response Programs;*
- *Customer Enrollment in Incentive-based Demand Response Programs;*
- *Customer Enrollment in Time-based Demand Response Programs.*

These indicators are being monitored on a yearly basis and progress from one year to the other is mentioned.

The indicators are relevant for the US system where Demand Response is mostly used as a peak capacity and where vertically integrated utilities can make direct use of retail programmes.

Annex 2. Examples of the actual and possible Demand-Side Flexibility participation level in different markets

The development of the DSF share in ancillary services in France

In France, DSF participation to FCR has been opened in summer 2014, with very strict requirements[17], regulated price and indirect access to the market. Even with those limitations, one year only after the beginning of the experiment DSF was already providing more than 7% of the French FCR (~50 MW out of ~650 MW according to the TSO). With the removal of those barriers, the share of DSF could reach over 20% by next year given the expectations of the aggregators.

According to the TSO, DSF now represents 540 MW representing between 33 and 50% of the procured mFRR. Even though the price of these reserve has be decreasing since a couple of years, the share of DSF is continuously increasing and should continue to do so in the coming years.

[16] FERC, *Assessment of Demand Response & Smart Metering*, *Staff report*, December 2015, available at: http://www.ferc.gov/legal/staff-reports/2015/demand-response.pdf

[17] These requirements encompassed: limited volume, symetric participation, TSO-connected consumers only, limited opportunities to aggregate.

Current reported share of DSF as system services in the United States

A report[18] from the Federal Energy Regulatory Commission (FERC) details the potential peak reduction from U.S. ISO and RTO Demand Response programmes. The figures in the table below show that Demand Response reaches the amounts of:

- 10,2% of peak reduction for the New England ISO and
- 9% of peak reduction for Midcontinent ISO.

RTO/ISO	2013		2014	
	Potential Peak Reduction (MW)	Percent of Peak Demand [8]	Potential Peak Reduction (MW)	Percent of Peak Demand [8]
California ISO (CAISO)	2,180 [1]	4.8%	2,316 [9]	5.1%
Electric Reliability Council of Texas (ERCOT)	1,950 [2]	2.9%	2,100 [10]	3.2%
ISO New England, Inc. (ISO-NE)	2,100 [3]	7.7%	2,487 [11]	10.2%
Midcontinent Independent System Operator (MISO)	9,797 [4]	10.2%	10,356 [12]	9.0%
New York Independent System Operator (NYISO)	1,307 [5]	3.8%	1,211 [13]	4.1%
PJM Interconnection, LLC (PJM)	9,901 [6]	6.3%	10,416 [14]	7.4%
Southwest Power Pool, Inc. (SPP)	1,563 [7]	3.5%	48 [15]	0.1%
Total ISO/RTO	**28,798**	**6.1%**	**28,934**	**6.2%**

Table 1: Potential Peak Reduction from U.S. ISO and RTO Demand Response Programs
Source: FERC, 2015

It is noticeable that these performances are reached in markets with limited penetration of variable RES-E and on the basis of today's technology.

[18] FERC, *2015 Assessment of Demand Response and Advanced Metering Staff Report,* December 2015, p. 12, available at: http://www.ferc.gov/legal/staff-reports/2015/demand-response.pdf