DEMAND-SIDE FLEXIBILITY

Quantification of benefits in the EU

EXECUTIVE SUMMARY

ABOUT SMARTEN

smartEn is the European business association for digital and decentralised energy solutions. Our members include innovators in services and technology for energy and data management, finance, and research. By taking an integrated perspective on the interaction of demand and supply, our mission is to promote system efficiency, encourage innovation and diversity, empower energy consumers, and drive the decarbonisation of the energy sector.

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ABOUT DNV

DNV is an independent assurance and risk management provider, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry standards, and inspires and invents solutions.

We provide assurance to the entire energy value chain through our advisory, monitoring, verification, and certification services. As the world's leading resource of independent energy experts and technical advisors, we help industries and governments to navigate the many complex, interrelated transitions taking place globally and regionally, in the energy industry. We are committed to realizing the goals of the Paris Agreement, and support our customers to transition faster to a deeply decarbonized energy system.

For further information please visit:
www.dnv.com

Demand-side flexibility in the EU: Quantification of benefits in 2030, September 2022

AUTHORS:
Project Manager: Aurora Sáez Armenteros, *Senior consultant* (DNV)
Quality Assurance: Hans de Heer, *Principal consultant* (DNV)
Authoring team: Laura Fiorini, *Consultant* (DNV), María Miranda Castillo, *Consultant* (DNV), Thijs Slot, *Senior Consultant* (DNV)

PROJECT MANAGEMENT AT SMARTEN:
Andrés Pinto-Bello Gómez, *Head of Research and Projects* (smartEn)

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EXECUTIVE SUMMARY

As the EU shifts away from the traditional energy system and heads towards a decentralised, digitalised and decarbonised transition, new and smart solutions are required to manage the ever-increasing variable generation mix whilst maintaining affordability and security of supply. Demand-side flexibility (DSF), the ability of customers to change their consumption and generation patterns based on external signals, is a crucial element in achieving these goals.

With the current geopolitical events causing skyrocketing energy prices and supply risk disruptions, the need to empower end-users to play an active part in securing and decarbonising the EU energy system is gaining traction in EU strategies and policies. However, the activation of consumers' flexibility still faces regulatory barriers, notably due to the delayed implementation by Member States of the Electricity Market Design. Furthermore, DSF still lacks visibility as a reliable, efficient and climate-friendly solution because its potential has never been systematically quantified. This results in DSF being a frequently overlooked solution in policy decisions, hindering its potential in accelerating the cost-efficient clean energy transition.

In order to fill this gap, smartEn – Smart Energy Europe, commissioned an expert study from DNV to quantify the potential benefits of a full deployment of DSF in the EU by 2030. This DNV study intends to inform policy decisions on how to achieve a 55% GHG reduction by 2030 in a cost-efficient way for both the whole energy system and consumers.

In a full-DSF activation scenario that unleashes the flexibility from buildings, electric vehicles and industry, the following results are found:

Wholesale benefits

In the year 2030 the model estimates a total of 164 GW upward flexible power[1] and 130 GW of downward flexible power[2]. With an activation of 397 terawatt hours (TWh) of upward DSF and 340.5 TWh of downward DSF the following results are found:

- **€4.6 billion (5%)** are saved due to lower costs to generate electricity compared to a scenario without DSF.
- The power system could serve all demand all year long, saving **€9 billion** on 'lost load' not served by the available generation.
- Renewable energy curtailment would be **15.5 TWh (61%)** less, improving the economics of renewables and the availability of decarbonized electricity to consumers.
- **37.5 million tonnes (Mt)** would be saved in annual GHG emission – i.e., 8%, nearly 84 kilos per capita, meaning that the power sector could exceed the '55% by 2030' target.

Benefits for security of supply

- The modelling suggests that the energy system in 2030 would lack at least **60 GW** of generation capacity to ensure security of supply during the highest demand peaks. Load shifting and load curtailment would allow the system to maintain security of supply by fulfilling the lack of generation capacity.
- Enabling 60 GW of DSF would save **€2.7 billion** annually compared to installing 60 GW of peak generation capacity.
- Activating DSF technologies in European balancing markets in 2030 could save a total of **€262–690 million** across the EU27, a balancing energy cost saving of **43% to 66%.**

1. Upward DSF means increase of generation or decrease of demand.
2. Downward DSF means decrease of generation or increase of demand.

Benefits for the distribution grid

- **€11.1–29.1 billion** would be saved in investment needs at EU 27 annually between 2023 and 2030. This represents between **27% to 80%** of today's forecasted investment needs (between €253.1 billion and €282.5 billion between 2023 and 2030 in investments in low- and medium voltage distribution grids to integrate new loads and RES capacity).

Benefits for consumers

The full deployment of DSF will translate into direct benefits for consumers with flexible assets, as well as indirect benefits to all customers through cheaper electricity prices and lower grid costs:

- Direct benefits could lead to a potential cost reduction for consumers of more than **€71 billion (64%)** per year on electric consumption.

- Over **€300 billion** in indirect annual benefits to people, communities, and businesses would result from reductions in energy prices as a whole, generation capacity costs, investment needs for grid infrastructure, system balancing costs, and carbon emissions.

This DNV study is a timely addition to the growing, but still limited, corpus of detailed research into the potential benefits of DSF to achieve the ultimate goals of providing secure, accessible supplies of affordable clean energy to all consumers in the EU27. The findings serve as a clear warning to not undervalue DSF given its huge potential impact toward an efficient, clean electricity system.

What is Demand-side flexibility? – the smartEn definition

"Demand-side flexibility" means the capability of any active customer to react to external signals and adjust their energy generation and consumption in a dynamic time-dependent way, individually as well as through aggregation.

Demand-side flexibility can be provided by smart decentralised energy resources, including demand management, energy storage, and distributed renewable generation to support a more reliable, sustainable and efficient energy system.

Modelling and scenario-building

The input data and assumptions in the wholesale market simulation model are based largely on the Fit for 55 objectives and REPowerEU. Drawing on these, DNV has defined inputs – divided into generation mix, electricity demand, DSF technologies and CO2 emission target. DNV's complex model assesses monetary values of system-level savings and end-user benefits on the wholesale market from a full activation of DSF.

The study explores two scenarios, 'DSF' and 'no-DSF', the latter providing a reference against which to compare costs, benefits, emissions, and other outputs. Both have the same amount of flexible assets, but in the DSF scenario these assets are fully price-elastic. In the no-DSF scenario, distributed flexible assets are fully price-inelastic, though larger assets (electrolysers, front-of-meter batteries and central generators) are fully price-elastic in both scenarios.

The estimated total benefit represents an order-of-magnitude value for the opportunity that could be lost by failing to activate this level of flexibility.

DNV has performed calculations outside the model, using literature and simplified methodologies, to estimate DSF benefits for adequacy, balancing and grid infrastructure costs.

CONSIDERATIONS:

- The model developed and applied for this study, and its results, are constrained by limitations of data quality, comparability, and availability across Member States in the EU 27.
- DNV also points to a lack of studies on the quantification of infrastructural benefits of DSF, suggesting that this is a signal for relevant stakeholders to further investigate the topic.
- The no-DSF scenario is an unrealistic one given that flexibility is already activated to varying degrees in several EU member states. The DNV study explains in detail how this scenario has been carefully constructed to allow a meaningful quantification of the potential value of DSF to the energy system.
- The model is an energy-only one, based on marginal costs, in line with the current market functioning. The model does not consider capital expenditure costs for generation assets, batteries, electrolysers or DSF, except for the quantification of the security-of-supply benefits.
- Although DSF investments are substantially lower than the other technologies mentioned, it is unclear how much the full potential will develop on its own – assuming all regulatory barriers are removed – or whether additional incentives are needed, as we have seen and continue to see for batteries, electrolysers, and renewables.
- The model did not take into account the positive energy efficiency impact of DSF activations, nor potential savings in TSO redispatch costs and TSO grid reinforcement costs.
- Benefits within the four segments (wholesale, adequacy, balancing and distribution grids) have been calculated separately. The total DSF benefits are lower than the sum of the benefits per segment, due to the close interaction of these four segments.
- Gas prices considered in the model are moderate compared to the exceptional 2022 levels.

Platinum Partners

Eaton is an intelligent power management company dedicated to improving the quality of life and protecting the environment for people everywhere. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power – today and well into the future. By capitalizing on the global growth trends of electrification and digitalization, we're accelerating the planet's transition to renewable energy, helping to solve the world's most urgent power management challenges, and doing what's best for our stakeholders and all of society.

Enel is a multinational energy company and one of the world's leading integrated utility within the energy sector. We are present in more than 40 countries across five continents, generating energy with a total installed capacity of around 92 GW (of which around 55 GW of renewables capacity), selling electricity and gas and distributing electricity across a network spanning more than 2.2 million km. With almost 76 million end users worldwide, we are the biggest networks operator, we manage the largest customer base in the utilities sector with around 70 million retail customers and we are one of Europe's leading energy companies by installed capacity.

The Enel Group counts on a workforce of more than 67,000 people from around the world and its foundations are based on the values of Responsibility, Innovation, Trust and Proactivity.

Gold Partner

As a major player in energy transition, the EDF Group is an integrated energy company active in all businesses: generation, transmission, distribution, energy trading, energy sales and energy services. EDF group is a world leader in low-carbon energy, having developed a diverse production mix based mainly on nuclear and renewable energy (including hydropower). It is also investing in new technologies to support energy transition. EDF's raison d'être is to build a net zero energy future with electricity and innovative solutions and services, to help save the planet and drive well-being and economic development. The Group is involved in supplying energy and services to approximately 38.5 million customers , of whom 29.3 million in France. It generated consolidated sales of €84.5 billion in 2021. EDF is listed on the Paris Stock Exchange.

Silver Partner

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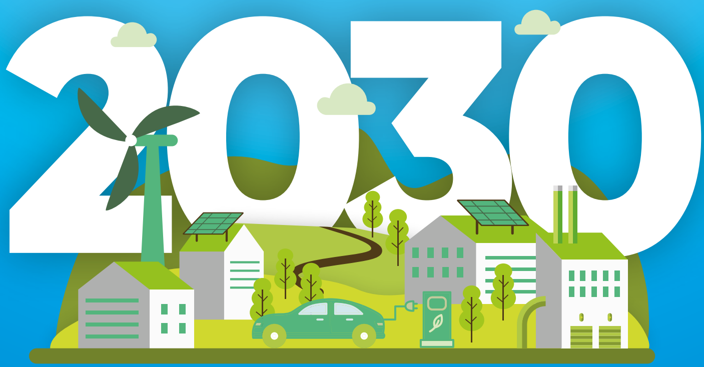

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