



Flexibility Research Service



About LCP Delta

Our mission is to enable a better, faster energy transition for all

Founded in 2004 and based across the UK, France, Norway, the Netherlands and beyond, LCP Delta provide data-driven research, consultancy, technology products and training services to companies investing in and navigating the energy transition.

We are a diverse team from a variety of backgrounds including engineers, data analysts, environmentalists and more.

LCP Delta is a mission driven organisation - all of us want to make a difference to the energy transition and accelerate the path to a low carbon future.

The energy market is becoming increasingly complex. As consumers become more empowered and as energy systems around the world decarbonise, there is a need to understand both the generation and demand side to effectively navigate the rapid changes occurring.

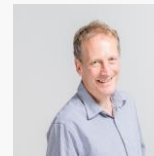
We know it's a complicated topic, and we're here to help.

Andy Bradly, Partner, LCP Delta

LCP Delta was formed through the merger of Delta-EE and LCP Energy to bring together deep generation and consumer-side expertise, to provide our clients with a single partner to help them on their journey and provide them with a 360° view across the energy spectrum.



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200+
Global clients



6
offices



110+
Colleagues

LCP Delta provides the best advice, support and tools to enable the energy sector to drive the energy transition



Subscription research services

Our portfolio of subscription research services offer in-depth insights across the energy transition landscape. We have been undertaking primary research with organisations active in the energy transition since 2004 – we have an unparalleled international network of contacts we can draw on. Each service focuses on a particular aspect of the energy transition.

Market and strategic advisory consulting

We provide support across the full energy value chain with bespoke research, insight, forecasts and advice tailored to them. Our consultancy offerings draws on expertise and data from across LCP Delta, from strategic market entry analysis through to detailed half-hourly revenue forecasting.



We support our clients in four ways



Technology & data

Data integration and analysis is at the heart of the energy transition. However, sourcing and navigating complex, wide-ranging datasets is challenging. At LCP Delta, we combine and curate proprietary and public datasets to provide you with a single source of truth across the energy spectrum, and make this data interactive using our cutting-edge technology.

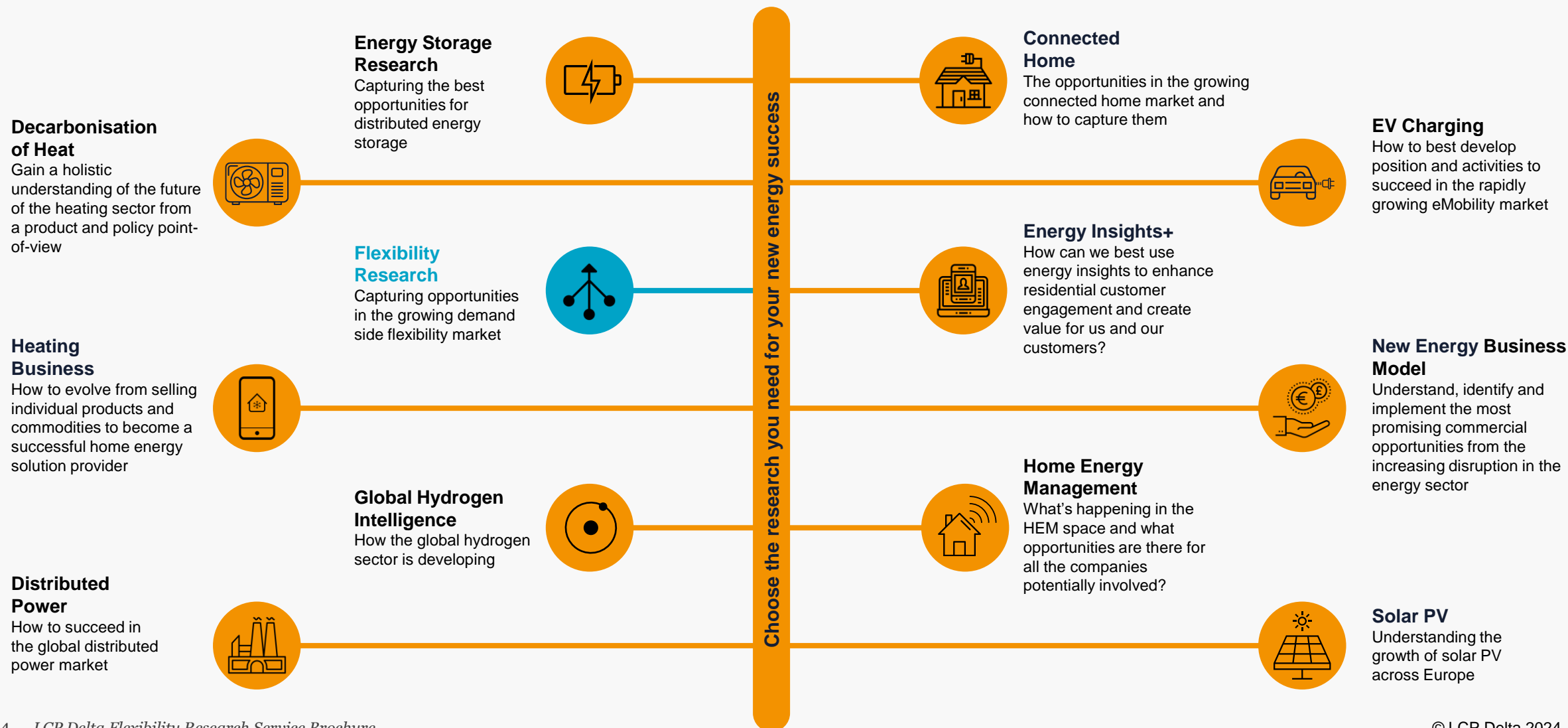
Training

Our training helps professionals quickly develop their new energy knowledge, accelerating their impact for organisations who want to capture opportunities. We provide meaningful, concise and easy to understand short courses.



Subscription Research Services

Use a combination of our subscription research services, bespoke consultancy projects and training services to gather the information you need to ensure your business's success in the energy transition.



Flexibility is a rapidly growing part of our energy systems and is set to play a major role in the transition to new energy.

Energy Insights+



Where is the value for demand-side flexibility and how will this change?

What are the most lucrative emerging opportunities for flexibility?

How are changing policy and regulations influencing these opportunities for flexibility?

What technologies – software, hardware, platforms and data analytics – do we require to be successful?

What are competitors using?

How are platforms communicating with distributed assets, and where is this headed?

What are the business models for demand-side flexibility and how are they evolving?

Business model to business case: should we invest?

How can customers be incentivised?

Clients we support



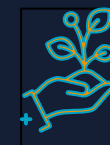
Govt, Regulators & System Operators



Energy retailers



Product manufacturers



Solution providers




Investors

How our research helps your business

The Service provides data, analysis and opinion that enable you to evolve the right positioning and to identify, understand and capture the growing opportunities from demand side flexibility.

Benefits

- Navigate the market complexities to define, develop and evolve your strategy
- Helps you understand competitors and find the right positioning
- Help you to find the best partner
- Enables you to take advantage of emerging opportunities in DSF
- Helps you to identify key value streams to monetise DSF
- Supports you to create compelling customer propositions



LCP-Delta provides us with ongoing, first-class insight and advice to support our low carbon investment activities.

Leading Investment Company

Example clients

- Energy suppliers
 - Aggregators
 - Product manufacturers
 - Policymakers
 - TSOs
 - DSOs
 - Technology companies
 - Developers
 - Storage providers
 - Industry associations
- 

FLEXtrack

Quantifying the value of flexibility through ancillary service tracking

FLEXtrack normalises, integrates and visualises ancillary services data across European markets, highlighting key trends and opportunities for flexibility providers.

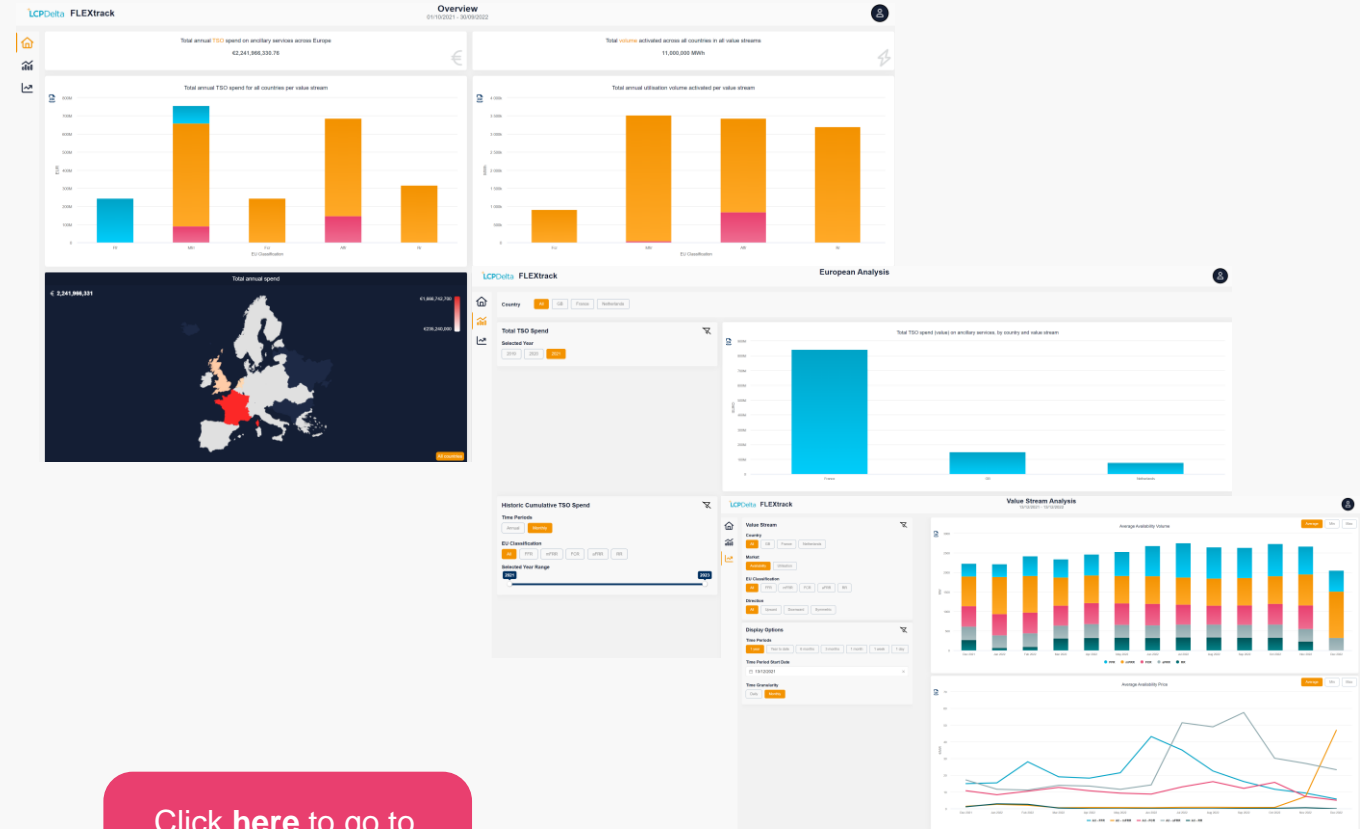
This data is a progression from our Ancillary Services Database. Research subscribers will have access to the same aggregated data with monthly and yearly granularity, now updated quarterly.

11 countries are currently live - Austria, Belgium, Germany, Denmark, Spain, Finland, France, GB, Netherlands, Norway and Sweden. The rest of Europe will follow in 2023/4.

A separate FLEXtrack data subscription offers daily updates, 15-minute granularity and advanced analysis functions.

FLEXtrack allows users to:

- Track the volume requirements and clearing prices for various ancillary service markets across Europe
- Compare countries and value streams with ease
- Explore historical data and identify trends over time, such as within day volatility and seasonality
- Deep dive into specific countries or value streams to understand the value of flexibility and identify opportunities going forwards



[Click here to go to YouTube to watch our explainer video](#)

Flexibility Research Offerings

This table highlights the differing data offering availability. Our data can:

- Track the development of ancillary services and implementation of the Clean Energy Package across Europe
- Identify trends in prices, volume and total spend by TSO and system services
- Understand the accessible ancillary services revenue stack available to their asset

	Flexibility Research Service	FLEXtrack	Consultancy	Enact
	Strategic	Tactical		Operational
Core use case	Help subscribers to decide what countries, assets or partners to focus on	Data to help develop market entry strategy, track and compare latest trends for specific market(s)	Combination of FLEXtrack data and expert knowledge to address your specific needs	Real-time data and visualisation to allow users to make trades
Data	Availability and utilisation volume (MW) and prices (€/MW/h) for Ancillary Services (Fast acting, FCR, aFRR, mFRR and RR)* 27 EU countries plus Norway, GB and Switzerland			GB wholesale and ancillary services
Data granularity	Monthly and yearly data	15 minutes (where possible)	15 minutes (where possible)	As reported by TSO
Update frequency	Monthly	Monthly	NA	Real time
Historic data	One year	Yes	Yes	Yes
Access to the Flex research team	Yes, on an ongoing basis	No	Experts contribute to project	No
Download data	No	Yes	NA	NA
Core audience	Strategy, market intelligence, business development	Corporate and in-country strategy teams	Strategy teams or project managers	Energy traders

Note: this table refers to data only and does not include the other benefits provided.

Market Monitor on Demand Side Flexibility

Published annually in February

High level overview of 30 European countries and their development of demand side flexibility. In depth analysis of 12 core countries identifying spend on flexibility, driver, barriers, service providers and future outlook.

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Country analysis

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2022 Market Monitor for Demand Side Flexibility

Eastern and Southern European countries are opening services to DSF while growth in some more developed markets has stagnated.

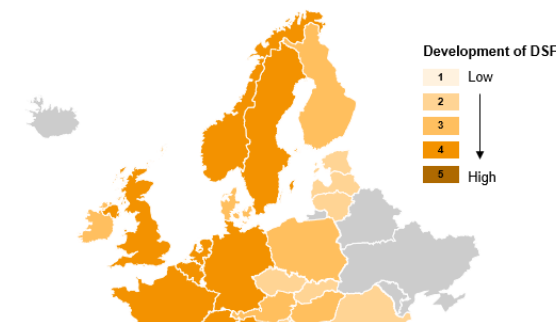
Assessment criteria for Market Monitor:

- Regulatory progress to enable DSF
- Potential market size of flexibility
- Development of distribution system flexibility
- Development of local energy systems
- Future development of flexibility

This report provides a high level summary of the current state of demand side flexibility and highlights the emerging opportunities based on our research across 30 European markets.

From our research we find:

- TSO spend on ancillary services has increased dramatically in 2022. This is primarily due to high wholesale prices that are reflected in utilisation payments.
- Regulatory growth has stagnated in **Spain and Italy** with less progress in 2022 than had been expected.
- Several markets have opened their ancillary service markets to DSF (**Cyprus, Slovakia, Romania and Greece**). While this is a positive step forward there are still prohibitive barriers.



Market size

The total flexibility market value available for DSF is ~€360

Availability

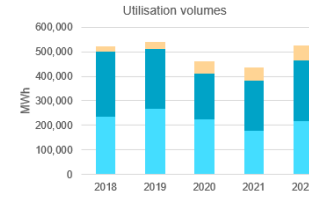
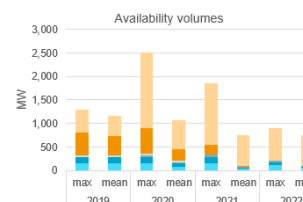
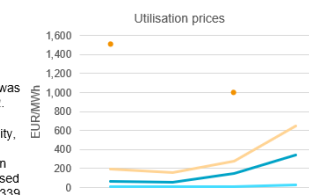
Unlike other countries Belgium has seen a significant increase in aFRR prices. aFRR up increased 193% to an average price of 80 €/MWh (from 42 €/MWh).



Utilisation

mFRR Flex upward was not procured in 2022.

Similarly, to availability, aFRR up saw a significant increase in prices. Prices increased from 152 €/MWh to 339 €/MWh, a 224% increase.



FCR – symmetric
 FCR – symmetric 200
 aFRR – up
 aFRR – down
 mFRR – flex Upwards
 mFRR – std Upwards
 mFRR – down

Introduction to Flexibility

- **Fundamentals of Flexibility**
- **Implementation of the Clean Energy Package**
- **Pan European Market Coupling**
- **Smart tariff fundamentals**
- **Resource Adequacy Mechanism (capacity markets)**
- **Emergency Intervention: mechanisms to mitigate high cost and supply shortage in winter 2022/23**

Fundamentals of Flexibility

Published July 2021

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Overview of value streams
Value streams flexible assets can access
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Deployment of flexibility services
Compensation mechanism

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How frequency will impact ancillary services
Increase in faster services
Shift in where volume is procured
Change to calculating flexibility needs
Driver for market changes

Annex
Physical elements of the electricity system
Physical elements of the electricity network

Report outlines:

- What is flexibility?
- Why is there a growing need?
- Key changes to the electricity system and the impacts of flexibility
- How flexibility change in the future

Executive summary 1/4

Electricity systems must be balanced at all times

Reduction in fossil fuels and increase in renewable generation is making the system more unstable and increasing the need, and quantity, or flexibility

Electricity networks must maintain a constant equilibrium between supply and demand. As it is impractical to monitor all generation in real time system balance is determined by measuring frequency:

- An increase in generation or a decrease in demand causes system frequency to increase
- A decrease in generation or an increase in demand causes system frequency to decrease

To maintain this system balance electricity system operators require a certain amount of flexibility in the system to react in the event of a frequency deviation.



This flexibility has historically been provided by large fossil fuel generators that could ramp up or down depending on market needs. However, due to carbon reduction targets such fossil fuel generators are being phased out. This has a two fold impact on flexibility:



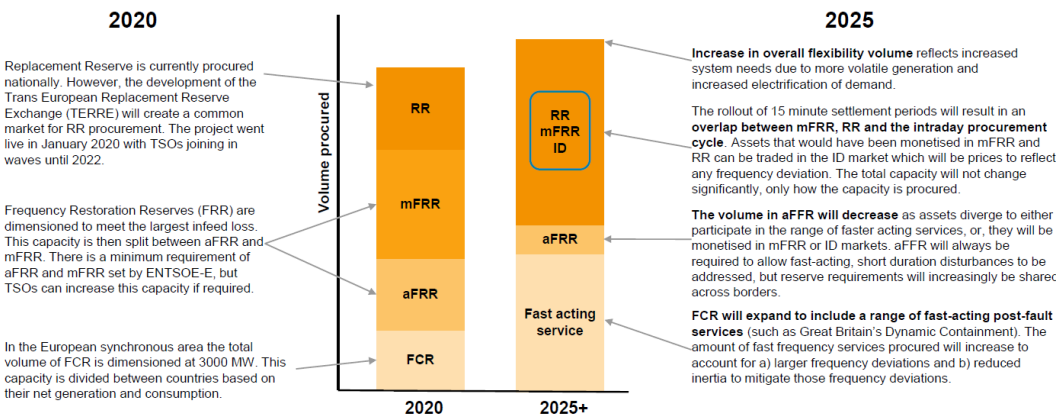
The rotation of turbines in thermal generators provides inertia. This slows the rate of change of frequency following a system disturbance. Without them the system will require more, and faster responding sources of flexibility.



Increased renewable generation is helping achieve carbon target but is unpredictable and non-dispatchable. This requires greater monitoring of the network to match renewable

Increased renewable generation and phaseout of thermal generation will lead to changes in ancillary services

Flexibility procurement beyond 2025 will reflect the changing dynamics of the electricity system



Implementation of the clean energy package

Published September 2021

This report focuses on components of the Electricity Directive and Electricity Regulation that are most relevant to demand-side participation in flexibility markets.

We have benchmarked key legislation relevant to the development of DSF in 11 markets (Belgium, France, Finland, Germany, Greece, Ireland, Italy, Netherlands, Slovenia, Spain and Great Britain).

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Specific Articles covered by this report

DELTA-EE

Several Articles in the Electricity Directive and Regulation will enable greater and more equitable participation of flexibility providers. These are the focus of this report.

Electricity Directive	Key questions
Article 5	Are residential electricity prices market-based?
Article 11	Are dynamic tariffs (prices based on short term markets) available to residential customers?
Article 17.1	Can demand response participate in ancillary services, intraday/day ahead (DA/ID) and capacity market? Is aggregation allowed in ancillary services? Is a BRP partnership required to access ancillary services?
Article 17.4	Are compensation mechanisms present?
Article 32	How developed is distribution system flexibility?
Article 40	
Electricity Regulation	
Articles 7 and 8	

Dynamic electricity contracts for residential customers

DELTA-EE

Dynamic tariffs are a key enabler for residential demand response, particularly for consumers with large, controllable loads such as batteries, EVs and heat pumps.



Electricity Directive, Article 11

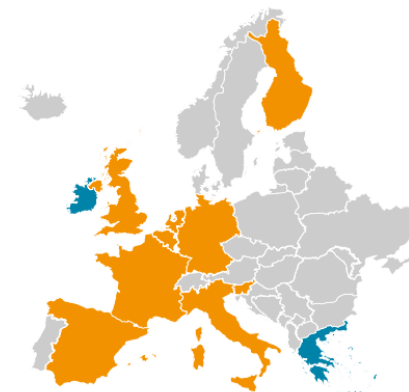
Entitlement to a dynamic electricity price contract

Dynamic tariffs are retail tariffs where the price of electricity varies regularly to reflect short term wholesale prices. Suppliers provide market based prices in thirty minute or hourly blocks with prices updated daily. Some contracts expose the customer to negative wholesale prices.

Few retailers currently offer dynamic tariffs. The CEP requires electricity retailers with more than 200,000 customers to offer a dynamic tariff.

Are residential electricity prices market based?

France, Spain, and the UK are the only countries to have regulated electricity prices. However, both France and the UK offer dynamic (based on spot prices) tariffs with regulated tariffs as a last resort. As of March 2020, Spain has introduced a regulated time of use (3 time periods per day) for all residential consumers.



Dynamic tariffs available

Dynamic tariffs not available

Smart tariff fundamentals

Published June 2022

This report focuses on:

- How a tariff can be considered smart and explore the motivation behind the increasing diversity in tariff design
- Provide a pricing strategy landscape of standard tariff types, as well as a risk framework to describe the relationship between customer and retailer.
- Provide examples of innovative tariff offers across Europe.

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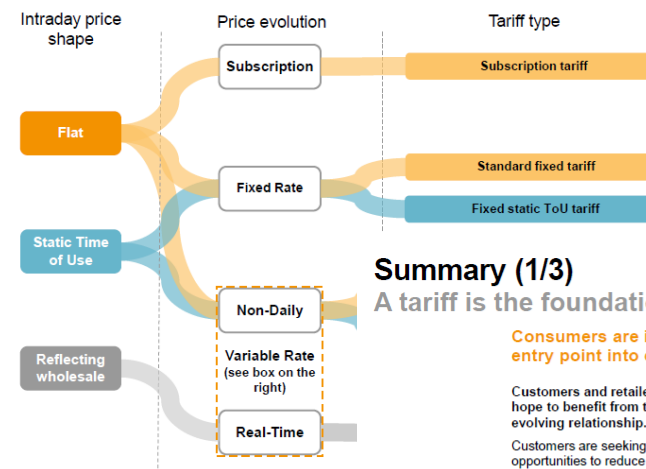
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Tariff Type Pricing Strategy Landscape

DELTA-EE

Tariff types are defined by intraday shape and frequency of price updates



Subscription VS Fixed Rate

- A subscription gives a fee to access electricity (e.g., X€/month). The customer's bill is not dependent on consumption.
- A fixed rate gives a price per unit of electricity (e.g., Y€/kWh). The customer's bill changes based on consumption.

Summary (1/3)

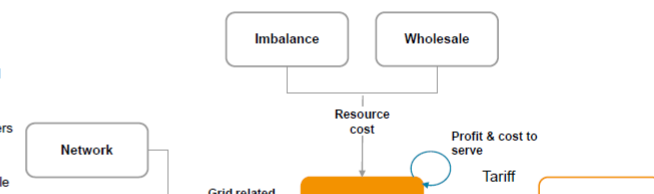
A tariff is the foundation of a customer's relationship with the energy sector

Consumers are increasingly aware of and interested in their energy consumption, and, as their entry point into energy, retailers play a vital role in influencing their decisions and behaviour.

Customers and retailers both hope to benefit from their evolving relationship. Customers are seeking opportunities to reduce their consumption and are motivated by financial benefits.

- Retailers can benefit by understanding their customers better, which, in turn, may allow them to:
 - Reduce risk, by being able to forecast demand more accurately.
 - Develop personalised services around tariff, potentially reducing costs.
 - Enable implicit flexibility to be derived via effective portfolio management

Anatomy of an electricity tariff - the costs recovered from consumers via their retailer



Endesa Única endesa Subscription tariff

Company HQ
Rome,
Italy

Number of customers:

Customer number unknown

Other examples of subscription tariffs

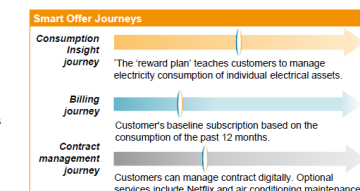
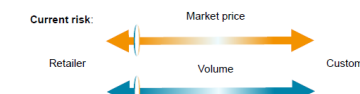
Always stable plan

One

- Proposition:
- Endesa Única provides customers with a fixed quota in exchange for a flat fee.
 - Baseline consumption is based on the previous 12 months with a 30% margin. In case the customer exceeds the margin, then the instalment amount is adjusted to better match consumption.
 - Contract term of Única tariff is one year with price updated 1st January each year.
 - Única tariff includes a 'reward plan' where customers are compensated for reducing their consumption.
 - Personalised challenges are sent to customers by e-mail with efficiency tips.
 - Rewards take the form of rebates on energy bills or a connected Netflix subscription.

Delta-EE view:

- Endesa Única is an example of 'energy as a service' (EaaS). EaaS transfers risk from the customer to the service provider.



Electricity cost	Network cost
Flat Fee	Flat Fee

When will pan-European flexibility emerge

Last updated August 2023

This report focuses on:

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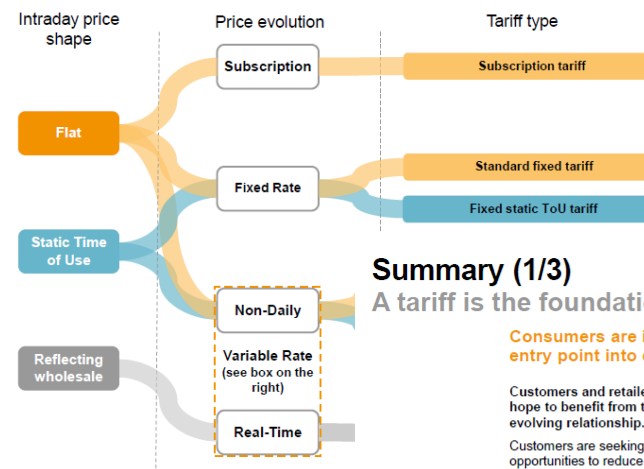
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DELTA-EE



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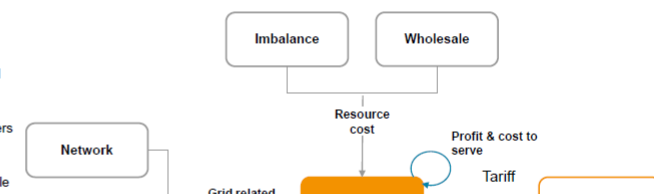
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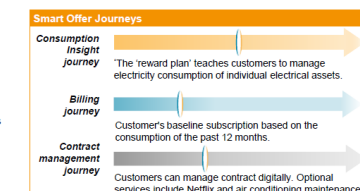
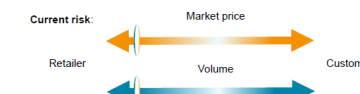
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Electricity cost	Network cost
Flat Fee	Flat Fee

Resource adequacy mechanisms

Last updated July 2023

This report focuses on Demand Side Flexibility in 12 European countries Resource Adequacy Mechanisms (RAMs). The report aims to:

- Outline the main structure of the Resource Adequacy Mechanisms in 12 countries (8 have RAMs).
- Determine the volume (MW) of Demand Side Flexibility (DSF) capacity awarded in each capacity auction and the percentage of DSF capacity awarded compared to the total volume of capacity awarded.
- Assess how easy it is for DSF to access these RAMs and specific features of the mechanisms like compensation, lengths of contracts and derating factors.

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Executive Summary 1/2

What are Resource Adequacy Mechanisms and why do we need them?



Belgium

Belgium operates a technology neutral capacity market

Belgium has a capacity market, the Capacity Remuneration Mechanism, which was approved in 2021.

Type of RAM?	Capacity Market
Volume of DSF awarded*	287 MW (7% of total)
Frequency of auction	See timeline below
Clearing Mechanism	
Minimum capacity requirement	
Independent aggregation allowed?	

*in latest auction

October 2021: First T-4 auction for delivery 2025-26

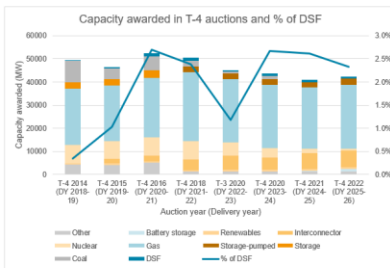
What are Resource Adequacy Mechanisms?

Great Britain T-4 auction results

DSF awarded in last three T-4 auctions has remained stable at ~1GW

- DSF share of capacity awarded in the T-4 auctions has been stable at ~ 1GW for the last three auctions, the equivalent of 2.5% of the total capacity awarded.
- In the past four T-4 auctions, DSF capacity has only secured one-year contracts. This is because before 2020, DSF was only eligible for one-year contracts and following that, the requirement for providers to prove they meet capital expenditure thresholds makes it harder for DSF to secure longer contracts.
- The significantly higher clearing price in the latest T-4 auction for delivery year 2025-26 was in part due to bidders' expectation they would have to rely more on capacity market payments for revenue for the given delivery year. An increase in target capacity and reduction in existing capacity entering the auction also drove up prices.

	T-4 2014 (DY 2018-19)	T-4 2015 (DY 2019-20)	T-4 2016 (DY 2020-21)	T-4 2017 (DY 2021-22)
Clearing price €/kW	19.4	18	22.5	8.4
	T-4 2018 (DY 2022-23)	T-4 2019 (DY 2023-24)	T-4 2020 (DY 2024-25)	T-4 2021 (DY 2025-26)
Clearing price €/kW	6.44	15.97	18	30.59



The French Capacity Market explained: How can DSF participate in the French Capacity Market?

Published February 2023.

- A specific, detailed report focusing on exemplifying the different capacity market mechanisms in France.

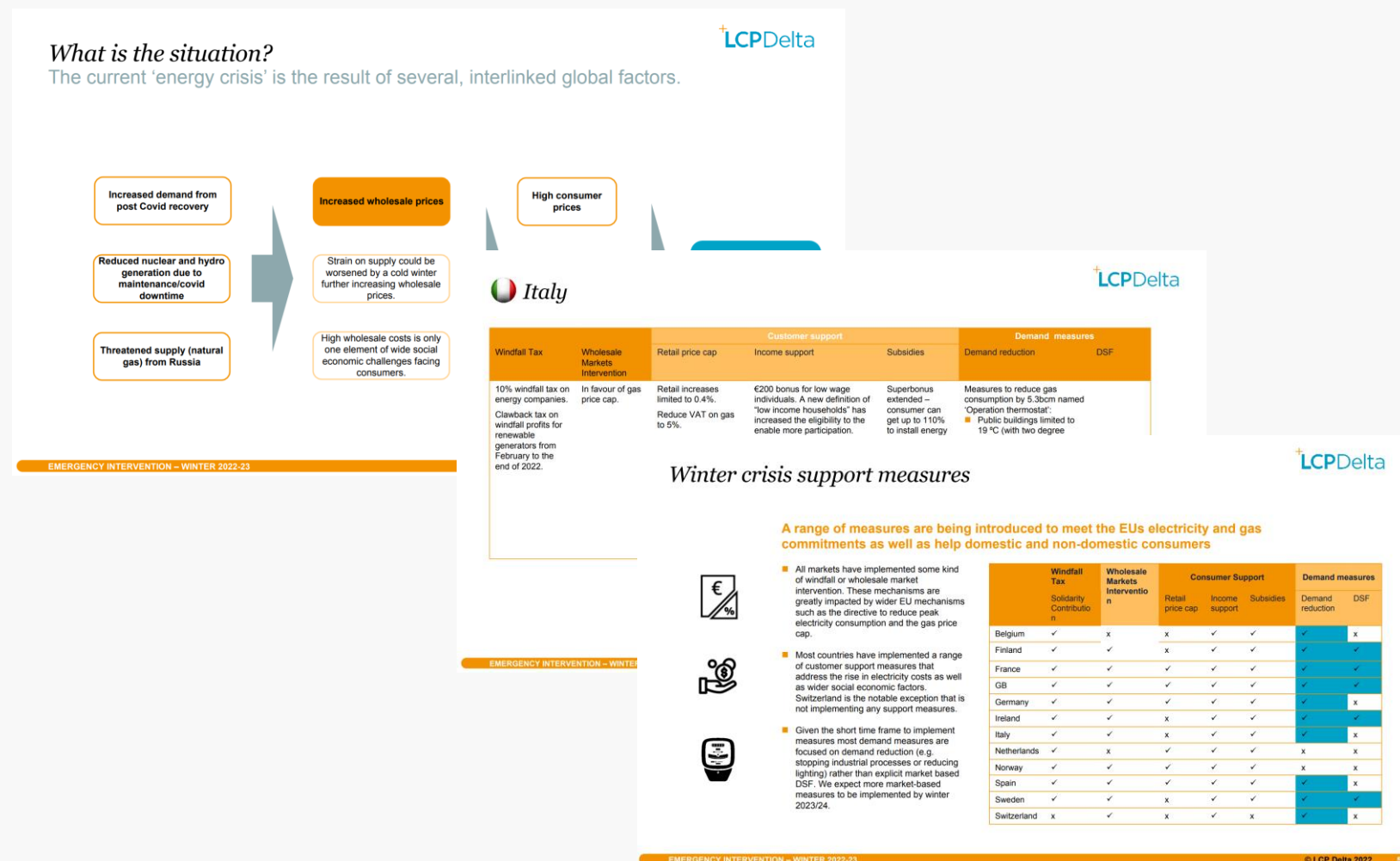
Emergency intervention

Published November 2022

As a result of the current energy crisis countries are implementing a range of measures to help consumers and to mitigate potential supply issues.

This report outlines key initiatives with a specific focus on demand reduction and demand side flexibility.

Countries included: Belgium, Finland, France, GB, Germany, Ireland, Italy, Netherlands, Norway, Spain, Sweden and Switzerland.



Residential flexibility – next frontier or road to nowhere?

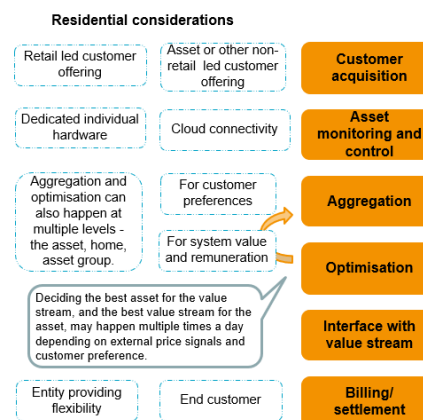
Published May 2023

Residential flexibility can be monetized implicitly, through tariffs, or explicitly by trading into DSO and TSO markets. However, while there are clear cost savings available through implicit flexibility, there are significant technical and legal barriers to entry for residential flexibility in explicit value streams.

To overcome these barriers, we are seeing the growth of specialised service providers able to monetise residential flexibility, but the additional complexity is a competitive disadvantage against merchant assets (including grid-scale batteries) that dominate TSO value streams.

Residential assets increase the complexity of the VPP value chain

Where markets are increasingly opening to DSF there are still limitations



Residential flexibility emerged utilizing implicit flexibility. As barriers to entry reduce, it is beginning to be monetized in explicit value streams.



Internal portfolio balancing

Retailers utilising residential assets to reduce exposure to wholesale imbalance

This is currently a theoretical idea and not a widespread offering, relying on retailer-specific customer offerings.

An energy retailer (also a balancing responsible party, BRP) is legally obliged to ensure their supply and demand matches for each settlement period. If they are

Theoretical example

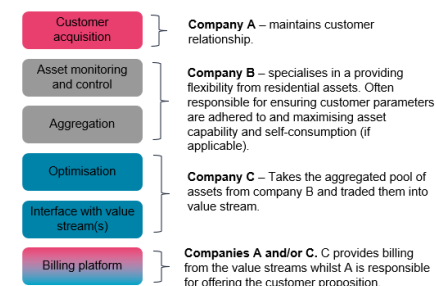
When a retailer is out of balance, they base their decision on:

To own or not to own the VPP value chain?

Will a single company own the entire value chain or specialise and partner?

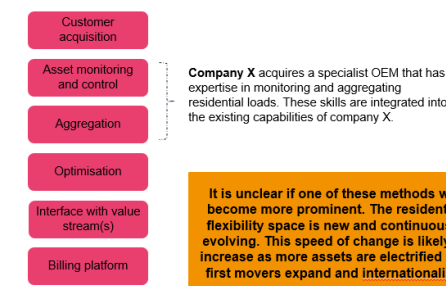
Partnerships

- Companies have specialisations in at least one (but not all) elements of the value chain.
- This approach is common for asset specialists that do not have the expertise or ability to trade in ancillary or wholesale markets.
- Partnerships can be a quick way to acquire specialists' skills but increases complexity and entities share any revenue or cost savings.



In-house development or through acquisitions

- A single company has control over all elements of the value chain. Typically, these are energy retailers.
- Where outwardly all elements are the same company, it is possible (and likely) that key skills and capabilities have been acquired.
- Integrating acquired companies can be challenging and time consuming but enables greater control and transparency between activities.



It is unclear if one of these methods will become more prominent. The residential flexibility space is new and continuously evolving. This speed of change is likely to increase as more assets are electrified and first movers expand and internationalise.

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Understanding the roles of different service providers

- **What is a Virtual Power Plant?**
- **Marketplace platforms**
- **Route to market providers**
- **Evolution of retail platforms**
- **Mergers and acquisitions**
- **Introduction into DSO flexibility market**
- **Introduction to distribution network charges**

What is a virtual power plant?

Published June 2021

This report outlines our definition of a VPP and categories it into 6 components. Using these components, we map the service providers performing these functions highlighting how they are partnering/acquiring across Europe in order to monetise across value streams and across multiple courtiers.

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What is a Virtual Power Plant (VPP)?

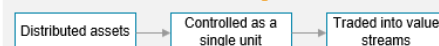
The term 'VPP' describes the functions required to trade aggregated flexibility

There are many different – and conflicting – definitions of VPPs used by industry. The lack of a clear definition makes comparisons and evaluations difficult.

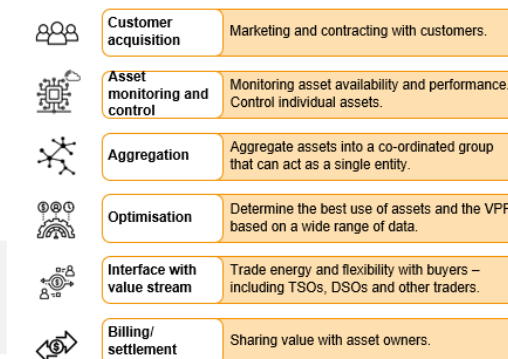
The term Virtual Power Plant (VPP) emerged during the growth of decentralised generation. These decentralised assets were too small to access energy markets individually. Co-ordinating their actions enabled them to circumvent this barrier. To the market operator, the actions of the VPP are indistinguishable from those of a single physical plant.

As the energy system becomes more complex the term VPP has broadened beyond generation to include load management and energy storage assets providing flexibility. Nevertheless, a VPP remains a collection of physical assets whose actions are co-ordinated.

A VPP is an aggregated group of distributed assets that trades in value streams as a single, coordinated unit



We have developed a simplified model of the VPP value chain. A VPP requires all six parts of the value chain.



Evolution of platforms

Market place platforms

Published October 2021

The report evaluates 10 marketplace platforms identifying capabilities, scope, market access and development stage.

Marketplace platforms perform three jobs:

1. Improve visibility of network congestion and enable flexibility as a solution.
2. Coordinate flexibility procurement between different use cases.
3. Simplify the sale of flexibility from smaller distributed assets.

Key characteristics:

- Allow aggregated assets by default.
- Connect multiple buyers and sellers.
- Enable location-specific value streams.

Marketplace platforms in the VPP** value chain



Ten examples of marketplace platforms

Platform	Country
AEMO	Australia
enera	Germany
GOPACS	Netherlands
NODES	UK
Cornwall Local Energy Market	UK
LE	UK
nationalgrid ESO	UK
piclo	UK
piclo	UK
ELEXON	UK

Route to market platforms

Published August 2021

Aggregators are increasingly turning to other service providers to provide market access and trading capabilities. This report identifies and explains the different potential business models for route to market offerings.

Executive summary 1/2 – Route to market services enable assets to participate in multiple markets

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Due to technical or regulatory barriers (most common in smaller assets) many value stream are inaccessible. Rtm services remove these barriers by offering market access.

With the rise in digitisation and decentralisation the amount of assets capable of providing flexibility is increasing. However, despite this growth they are often unable to participate in a range of value streams.

In an effort to mitigate these barriers route to market (RtM) offerings have emerged to bridge the gap between assets and otherwise inaccessible value streams. In their most basic form RtM services provide a platform that collates data from a range of value streams to enable customer to participate in these market. More advanced services include trading suggestions, portfolio and/or asset optimisation and the ability to trade assets on the customer behalf.

Broadly speaking route to market services have emerged from two avenues:

- **Aggregators and optimisers** have diversified their business model to offer their in-house trading services to third parties.
- **Specialised platforms** that have been developed for the purpose of offering a 'route to market as a service' service.

There are three aspects of route to market business models:



Route to market platform
Software based solution that centralises market prices and volumes enabling the customer to visualise their positions and make trades.



Trading services
These offerings provide data insight and analysis to suggest the most optimal trades to customer. The customer can either trade themselves or give control to the service provider.



Counterparty relationships
It can be challenging and time consuming for smaller players to establish trading partnerships. Therefore some route to market providers offer access to their existing trading relationships.

Retail platforms

Published December 2021

Retail platforms we undergoing significant change. We have identified three waves of innovation:

- 1) Outsourcing to ERP providers like SAP and Oracle
- 2) Supplier-in-a-box providers like Utiligroup and Haulogy offering Software as a Service
- 3) Retail-technology partnerships like Kraken and Kaluza, and extensible Platform as a Service products

Key findings

3 waves of platform innovation have transformed energy retail

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	Why	What	Who	Weakness
1 st wave brought system development outsourcing to utilities	Deregulation Market restructuring Unbundling retail System consolidation Relational databases	Outsourced IT Infrequent upgrades CRM and billing platforms System integration	ORACLE SAP GEE gentrack ARCOMS	Migration Integration Adaptation
2 nd wave saw middleware providers expand their service provision	Delivered services Complex bills Renewable support Smart Meters Cloud computing	SaaS Regular updates Supplier in a Box Pre-registration of licensed companies	osg haulogy ENSEK Dyball	Differentiation Innovation Customisation
3 rd wave is increasingly built within the industry for customer service	Customer focus Dynamic tariffs Microservices APIs Appstore model	PaaS Continuous releases Customer self-serve Contact centre integration	KALUZA powercloud Kraken empas Flux	Aggregation Co-ordination Servitisation

What's behind the wave of acquisitions of European aggregators?

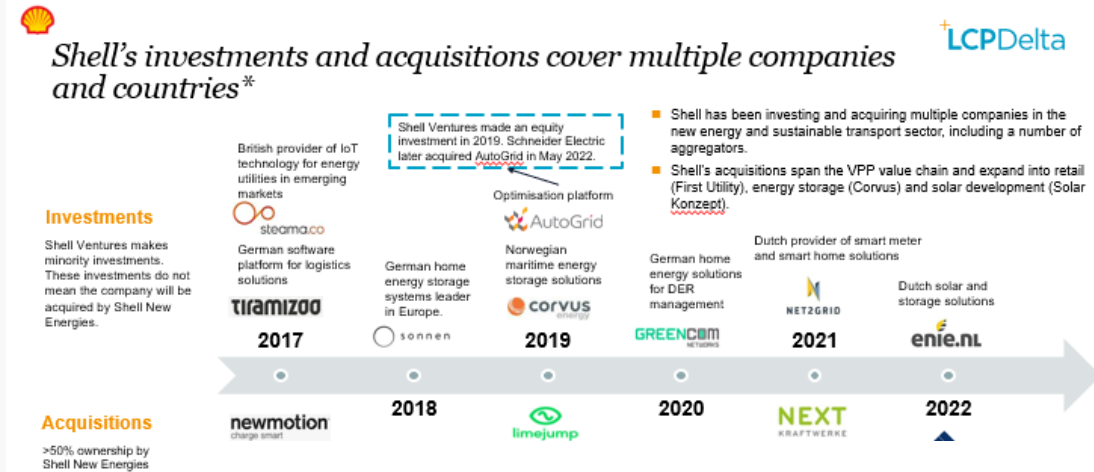
Published October 2022

- Who is acquiring independent aggregators?
- What are they buying them?
- At what stage of maturing are aggregators being acquired?
- What subsequently happens to acquired businesses?

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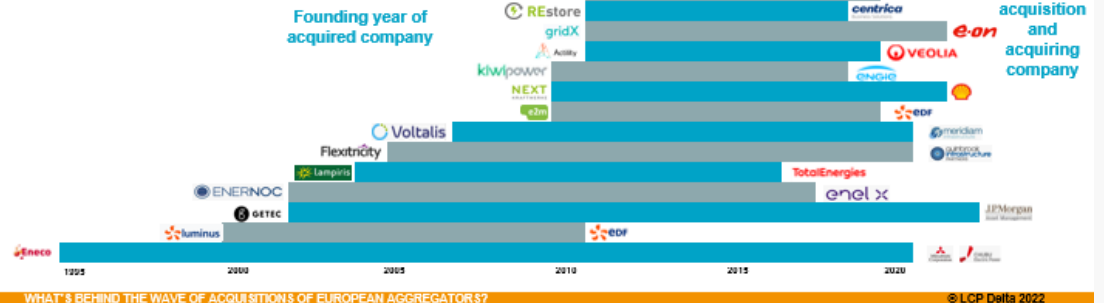


Most acquisitions have completed in the last 5 years

Of the 25 acquisitions we analysed, 22 have occurred in the past 5 years (2018-2022).

Most aggregators are bought after 6 to 10 years of activity.

One fifth of these aggregators were founded in 2010.



Introduction to DSO flexibility markets

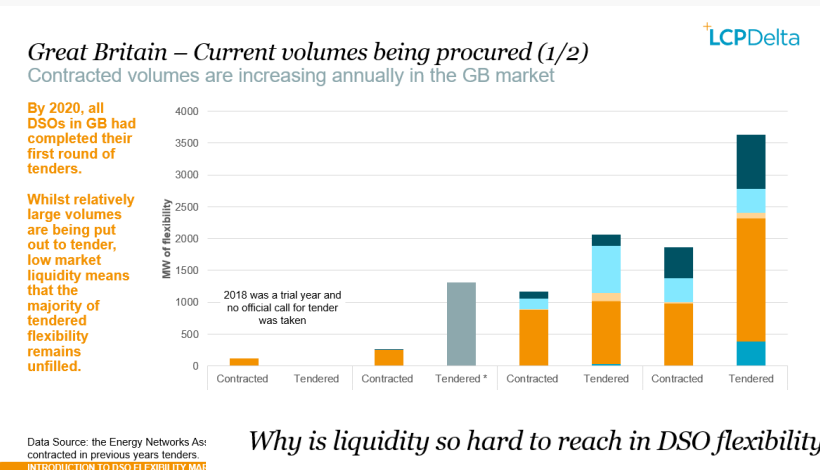
Published December 2022

The decarbonisation of the electricity system means that large amounts of distributed demand and generation assets are being connected to the distribution network.

DSOs are struggling to build out the network capacity at the pace that demand is increasing. Things brings about an increased need for flexibility on the distribution network to ensure that they continue to operate safely.

This report provides a overview of what DSO flexibility markets are and then details where they are emerging in Europe, giving a more detailed overview of fur of the most advanced markets: Great Britain, the Netherlands, Sweden and France.

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Why is liquidity so hard to reach in DSO flexibility markets?

It is a highly locational market
As DSO flexibility markets deal with highly locational issues, to compete in these markets the assets must be in a particular location. This reduces the number of assets able to compete in the market.
Solutions:
Reduce the minimum bid size and increase the area that aggregators can pool assets to meet minimum bid requirement.
Example: in sthlmflex second season the minimum bid size was reduced from 0.5 MW to 0.1 MW and they increased the area that aggregators could pool their assets from.

It can be a time limited opportunity
If extra capacity becomes available on the network due to grid reinforcement or decommissioning of a large load then the flexibility market is no longer required in that area. This increases risk for participants.
Solutions:
Reduce the minimum bid size and increase the area that aggregators can pool assets to meet minimum bid requirement.

They typically offer less value than other flexibility markets
Compared to TSO ancillary services and energy arbitrage, DSO flexibility markets generally offer less value to the FSP.
Solutions:
Reduce the minimum bid size and increase the area that aggregators can pool assets to meet minimum bid requirement.

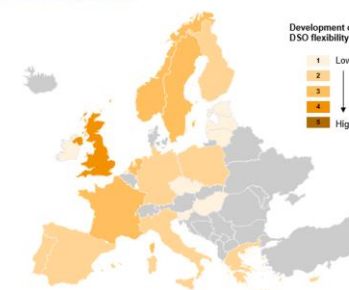
DSO flexibility markets have low utilisation rates
DSO flexibility markets are, currently, mainly being used to alleviate demand driven congestion on the grid. Peak demand is only reached for a limited number of hours a year resulting in low utilisation rates.

Executive summary 2/2

DSO flexibility markets are an emerging value stream in a select few countries

Whilst progress has been slow throughout most of Europe, there are a few countries in which DSO flexibility markets are growing.

- We looked at:**
- Whether there is a commercial DSO flexibility market
 - How many DSO flexibility trials are happening in the country?
 - What is the volume of flexibility being traded in the commercial market and trials?
- Great Britain** – the largest DSO flexibility market in Europe by volumes of flexibility procured, however activations and liquidity remain low.
- Netherlands (GOPACS)** – An advanced market for distribution connected assets to provide congestion management services. However, the vast majority of procurement is by the TSO.
- Sweden (sthlmflex)** – the largest DSO flexibility trial in the Nordics by volume of flexibility procured.
- France** – an ambitious commercial market. However, there is very low participation due to a number of market barriers.



Introduction to distribution network charges

Published March 2023

Distribution network charges are the mechanism that DSOs use to recover the costs associated with the operation, maintenance and development of the distribution network. In countries where the DSO is under private ownership, the distribution network charges also includes profit for shareholders.

They can also be used as a form of implicit flexibility in which DSO customers react to a price signal by increasing or decreasing their energy usage and making savings on the network portion of their energy bill.

This report details the different components that can make up a distribution network charge and how the prices of these components can vary depending on several different variables. The report then provides an insight into how network customers can take advantage of distribution network charges, providing implicit flexibility to the DSO and gaining cost savings on their network bills.

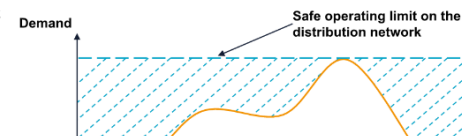
What type of flexibility can tariffs provide to the DSO?

Distribution network charges offer the DSO a form of implicit flexibility that can reduce peak demand on their networks.

The distribution network is sized to meet peak demand. This is the local peak demand on a distribution network. The timing of this peak can differ from the national peak demand and can vary between DSOs and even within a DSO's network area.

This peak demand is only reached for a few hours each year. Therefore, for majority of the time, the existing capacity in the network is being underutilised.

To better utilise their existing network, DSOs can use the distribution network charges to reduce this peak demand. This can be achieved by incentivising customers to use their flexible loads outside of peak times.



Within-day time-of-use pricing

Within-day variation can be implemented in differing levels of complexity.

More ToU time zones typically means a larger spread in within-day prices. This in turn offers increased opportunity for network customers to reduce their network bills.

Static day/night and peak/off-peak time zones

The simplest form of within day ToU price variation sets two static time zones of either day hours and night hours, or peak and off-peak time zones.

Example: The Finnish DSO Caruna offers a "Night-Time Distribution" tariff. This splits the energy component into two ToU time zones:

Multiple static predefined time zones

The DSO can also differentiate between multiple static predefined time zones. These ToU variations typically differentiate between day and night hours as well as the peak evening hours.

Example: DNOs in Great Britain split the energy component into three time-zones:

Moving predefined time zones

A more dynamic form of within-day ToU pricing is to use a moving time zone set closer to real-time. This allows the price signals to more closely align with the actual requirements of the DSO.

Example: Enedis in France offers a "Moving time class" tariff to customers connected to

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The Spanish ToU pricing example

Spain provides a good example of how all three ToU timeframes can be combined.

ToU pricing is mandatory for energy and power component prices on all distribution network charges in Spain. Spanish customers connected to voltage levels above 1kV have six ToU price zones (P1 to P6) combining within-day, within-week and seasonal timeframes.



Within-day

The DSOs split the day into six predefined static time zones with three different ToU prices.



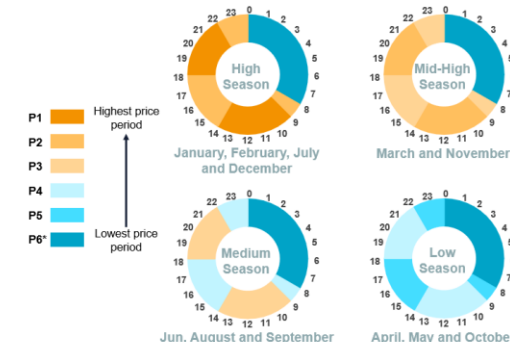
Within-week

The week is split into weekdays and weekends and national holidays.



Seasonal

The year is split into four. The highest price periods are used in the "High Season" and the lowest in the "Low Season".



*The lowest price period (P6) is used for all 24 hours on Saturdays, Sundays and national holidays.

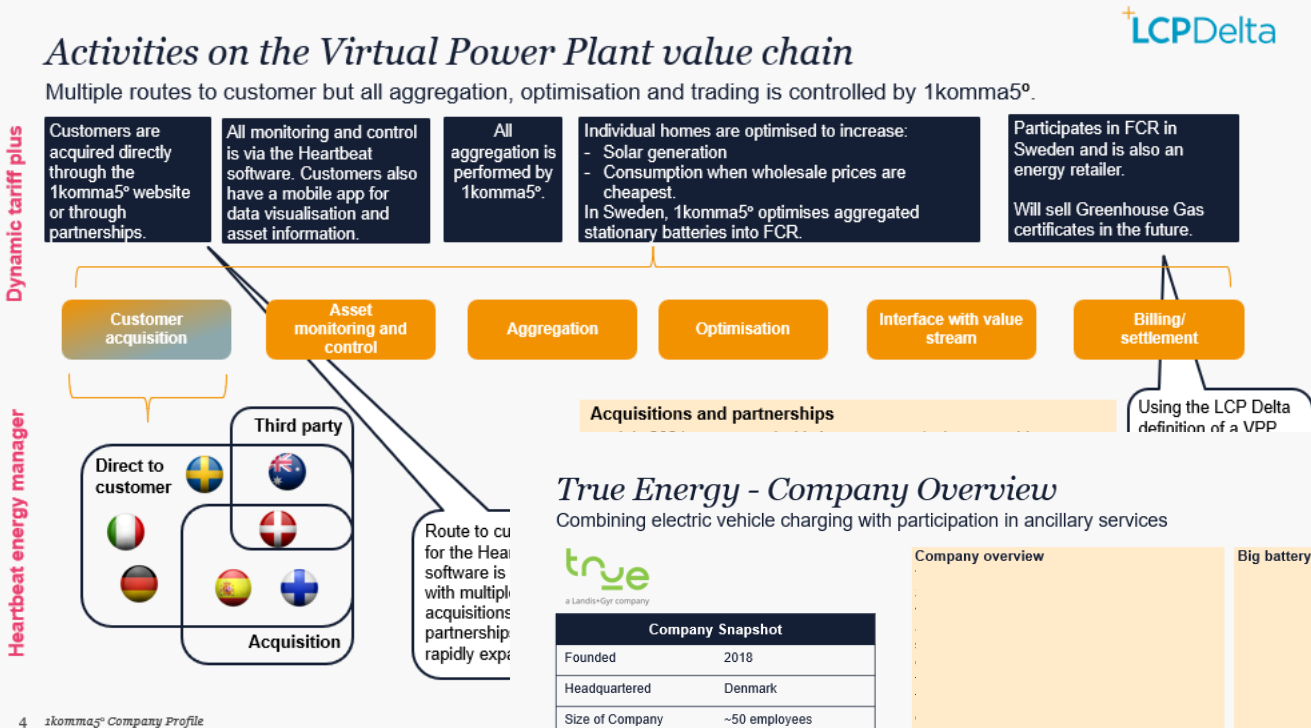
Adapted from Iberdrola

Service provider profiles

These company profiles highlight those companies with activities across the virtual power plant value chain. The profiles outlines the company overview before detailing the specific flexibility activities, value streams accessed and customer propositions.

Publication are profiles is ongoing, Currently available are:

- Letra
- Ev.energy
- The Mobility House
- Tiko
- 1Komma5
- True Energy



Access to hard to get data

Value stream requirements

Last updates January 2023

Data included (per value stream):

- Product shape
- Payments (availability and/or utilisation)
- Can DSF participate?
- Is aggregation allowed?
- Is a BRP agreement required?
- Procurement type and frequency
- Clearing mechanism
- Time to activation start
- Response duration
- And more...

Countries included:

- Belgium
- Finland
- France
- Germany
- Great Britain
- Ireland
- Italy
- Netherlands
- Norway
- Spain
- Sweden
- Switzerland



Belgium

Technical and regulatory requirements

DELTA-EE

	Product shape	Payments	Can DSF participate?	Is aggregation allowed?	Aggregated portfolio size limit (MW)?	Is a BRP agreement required?	Is storage allowed?	Procurement frequency	Procurement type	Minimum bid size (MW)	Maximum bid size (MW)	Payment period (minutes)	Clearing Mechanism
R1 Symmetric (FCR)	Symmetric	Availability	Yes	Yes	-	No	Yes	Daily	Pool	1	-	4 hours	Pay as clear
R2 (aFRR)	Down	Utilisation	Yes	Yes	-	Yes	Yes	Daily	Pool	1	-	15	Pay as bid
R2 (aFRR)	Up	Utilisation	Yes	Yes	-	Yes	Yes	Daily	Pool	1	-	15	Pay as bid
R2 (aFRR)	Down	Availability	Yes	Yes	-	Yes	Yes	Daily	Pool	1	-	4 hours	Pay as bid
R2 (aFRR)	Up	Availability	Yes	Yes	-	Yes	Yes	Daily	Pool	1	-	4 hours	Pay as bid
R2 (aFRR)	Down	Utilisation	Yes	Yes	100	Yes	Yes	Daily	Pool	1	-	15	Pay as clear
R3 (mFRR)	Up	Utilisation	Yes										
R3 (mFRR)	Up	Availability	Yes										
R3 (mFRR)	Up	Availability	Yes										

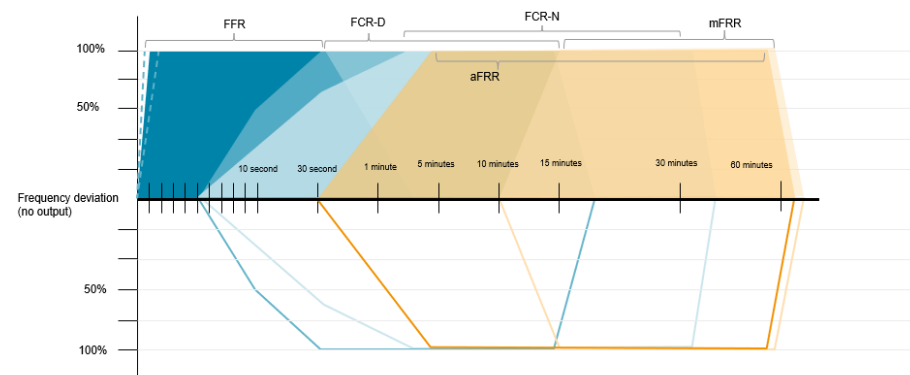
Finland

Product shape requirements

Finland

Product shape requirements

DELTA-EE



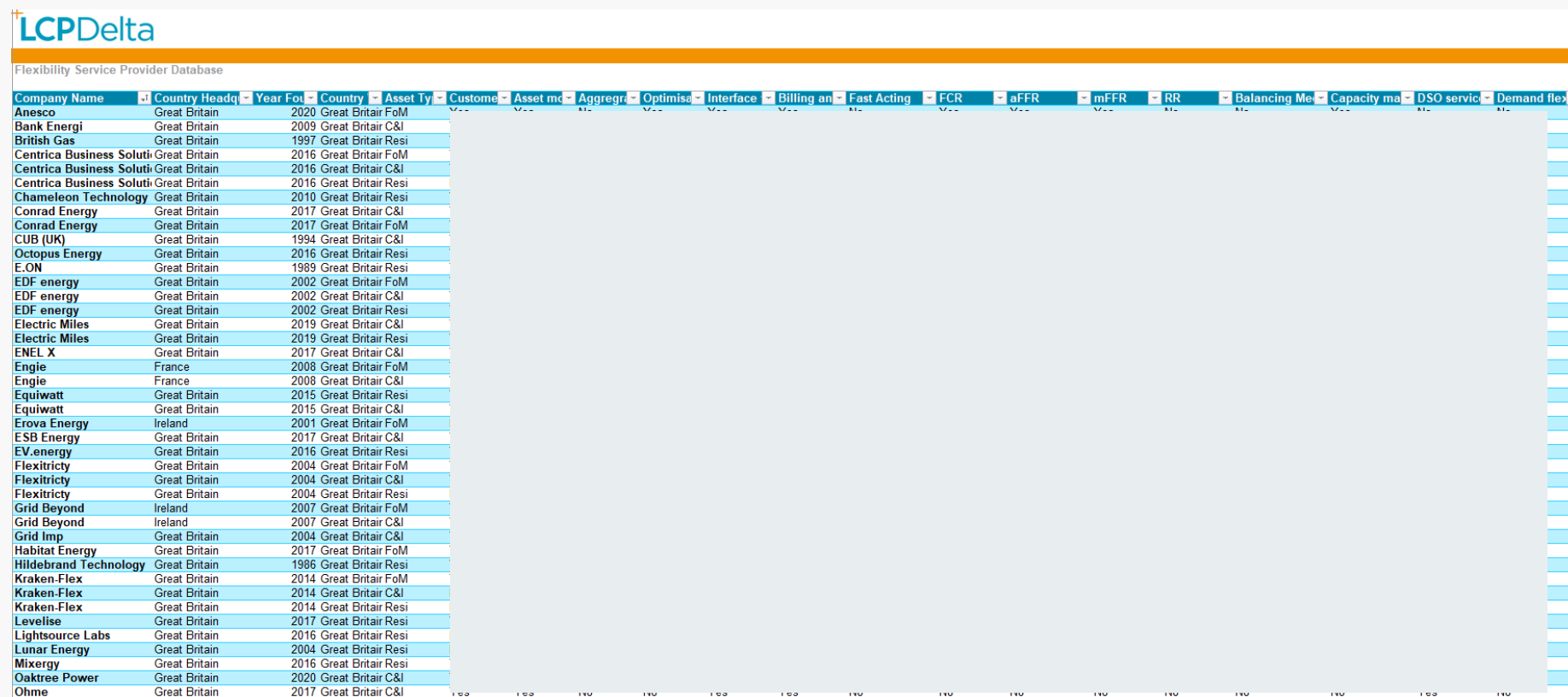
Service provider database

Published May 2023

Database Contents:

- Company overview
- VPP Value chain coverage
- Customer type
- Asset type
- Value stream active in
- Country active in

The database contains information on the GB market. It is currently being updated to include additional European countries.



Company Name	Country Headq	Year F	Country	Asset Ty	Custom	Asset m	Aggreg	Optimise	Interface	Billing an	Fast Acting	FCR	aFFR	mFFR	RR	Balancing Me	Capacity ma	DSO serv	Demand flex
Anesco	Great Britain	2020	Great Britain	FoM															
Bank Energi	Great Britain	2009	Great Britain	C&I															
British Gas	Great Britain	1997	Great Britain	Resi															
Centrica Business Soluti	Great Britain	2016	Great Britain	FoM															
Centrica Business Soluti	Great Britain	2016	Great Britain	C&I															
Centrica Business Soluti	Great Britain	2016	Great Britain	Resi															
Chameleon Technology	Great Britain	2010	Great Britain	Resi															
Conrad Energy	Great Britain	2017	Great Britain	C&I															
Conrad Energy	Great Britain	2017	Great Britain	FoM															
CUB (UK)	Great Britain	1994	Great Britain	C&I															
Octopus Energy	Great Britain	2016	Great Britain	Resi															
E.ON	Great Britain	1989	Great Britain	Resi															
EDF energy	Great Britain	2002	Great Britain	FoM															
EDF energy	Great Britain	2002	Great Britain	C&I															
EDF energy	Great Britain	2002	Great Britain	Resi															
Electric Miles	Great Britain	2019	Great Britain	C&I															
Electric Miles	Great Britain	2019	Great Britain	Resi															
ENEL X	Great Britain	2017	Great Britain	C&I															
Engle	France	2008	Great Britain	FoM															
Engle	France	2008	Great Britain	C&I															
Equiwatt	Great Britain	2015	Great Britain	Resi															
Equiwatt	Great Britain	2015	Great Britain	C&I															
Erova Energy	Ireland	2001	Great Britain	FoM															
ESB Energy	Great Britain	2017	Great Britain	C&I															
EV.energy	Great Britain	2016	Great Britain	Resi															
Flexitricity	Great Britain	2004	Great Britain	FoM															
Flexitricity	Great Britain	2004	Great Britain	C&I															
Flexitricity	Great Britain	2004	Great Britain	Resi															
Grid Beyond	Ireland	2007	Great Britain	FoM															
Grid Beyond	Ireland	2007	Great Britain	C&I															
Grid Imp	Great Britain	2004	Great Britain	C&I															
Habitat Energy	Great Britain	2017	Great Britain	FoM															
Hildebrand Technology	Great Britain	1986	Great Britain	Resi															
Kraken-Flex	Great Britain	2014	Great Britain	FoM															
Kraken-Flex	Great Britain	2014	Great Britain	C&I															
Kraken-Flex	Great Britain	2014	Great Britain	Resi															
Levelise	Great Britain	2017	Great Britain	Resi															
Lightsources Labs	Great Britain	2016	Great Britain	Resi															
Lunar Energy	Great Britain	2004	Great Britain	Resi															
Mixergy	Great Britain	2016	Great Britain	Resi															
Oaktree Power	Great Britain	2020	Great Britain	C&I															
Ohme	Great Britain	2017	Great Britain	C&I															

In addition we also published in depth case studies on individual companies.

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