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NODES' journey

IEEE PES
On-line, 21.10.20

Hallstein Hagen
Senior Consultant, NODES AS

We believe in creating
the marketplace for the future,
which will support the drive
to an emission free society!



Unlocking the true value of flexibility

- Open
- Transparent
- Integrated
- Independent





Buy flex

Sell flex

**NODES market facilitates trading of flexibility
between grid operators and flexibility providers**

The changing face of the energy system

Conventional generation decommissioned



- as we continue to decarbonise our energy system

Increased share of renewables



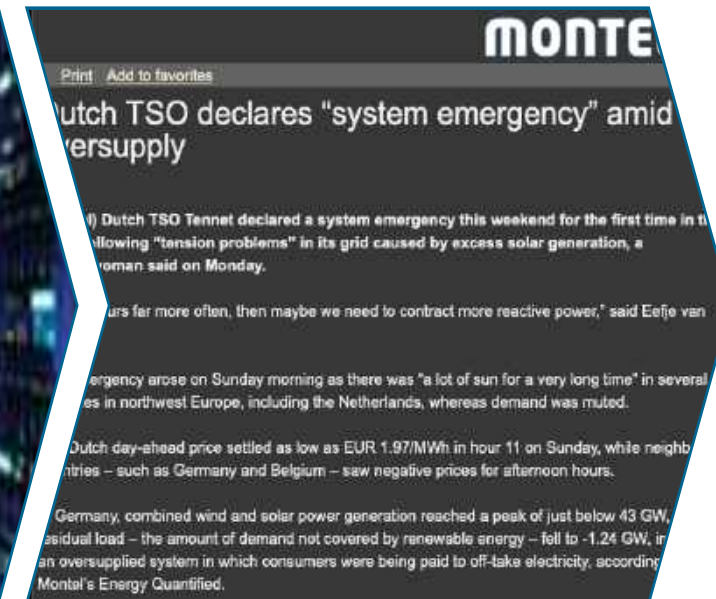
- driving down the cost of energy

Estimated 50 billion connected devices by 2030



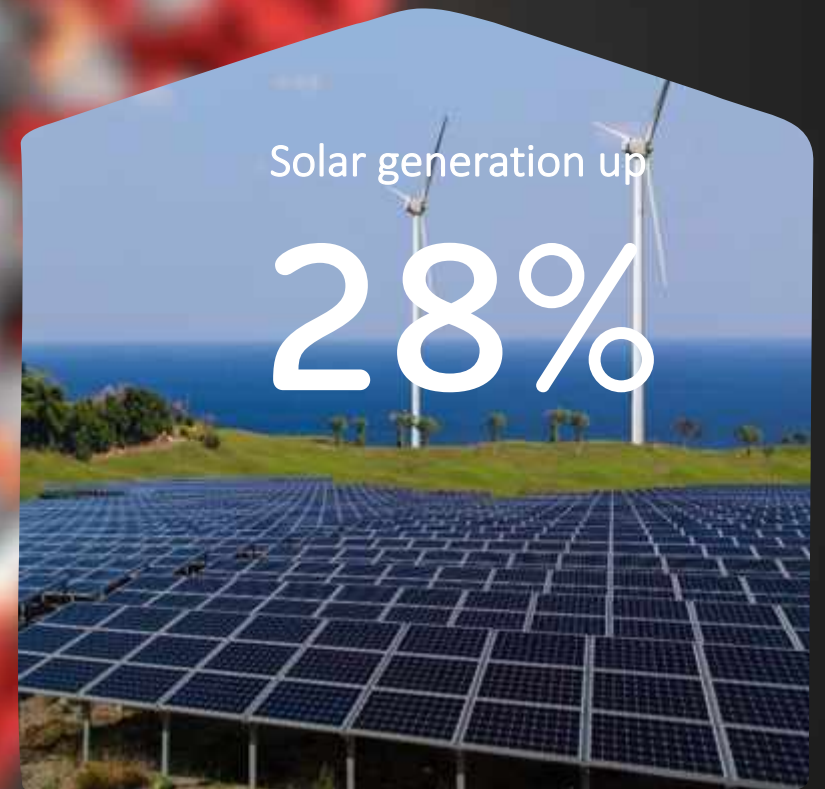
- giving consumers greater control over when and how they consume their energy

TSO is challenged to balance the network



- due to increased volatility in consumption patterns and lack of access to ancillary services from large scale generation

Analysis: Corona virus has cut CO₂ in Europe



.. this “postcard from the future” of the electricity system also highlights a lack of flexibility,

Grid impact

nationalgridESO

Who we are Electricity explained Future of energy Industry information Our strategy

Industry information > Codes Homepage > Grid Code

GC0143: Last resort disconnection of Embedded Generation

This modification sets out that under emergency conditions, as a last resort the Electricity System Operator (ESO) may instruct the Distribution Network Operator (DNO) to disconnect embedded generators connected to its system. The requirement for this is due to the unprecedented societal changes brought about by the COVID-19 pandemic which has led to demands out-turning up to 20% lower than predicted

WINDPOWER MONTHLY

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Email Bulletins

TRENDING COVID-19 RECOVERY EFFORTS NEW YORK TENDER DISTRICT RESULTS LA

GERMANY

German redispatch costs hit record high

20 June 2018 by Craig Richard

GERMANY: The cost of stabilising the German grid reached a new high of €1.4 billion in 2017 as wind supplied record levels of power

MONTEL

Print Add to favorites

Dutch TSO declares "system emergency" amid oversupply

(Montel) Dutch TSO Tennet declared a system emergency this weekend for the first time in three years following "tension problems" in its grid caused by excess solar generation, a spokeswoman said on Monday.

"If this occurs far more often, then maybe we need to contract more reactive power," said Eefje van Gorp.

The emergency arose on Sunday morning as there was "a lot of sun for a very long time" in several countries in northwest Europe, including the Netherlands, whereas demand was muted.

The Dutch day-ahead price settled as low as EUR 1.97/MWh in hour 11 on Sunday, while neighbouring countries – such as Germany and Belgium – saw negative prices for afternoon hours.

In Germany, combined wind and solar power generation reached a peak of just below 43 GW, while residual load – the amount of demand not covered by renewable energy – fell to -1.24 GW, indicating an oversupplied system in which consumers were being paid to off-take electricity, according to Montel's Energy Quantified.

National issue, local solution



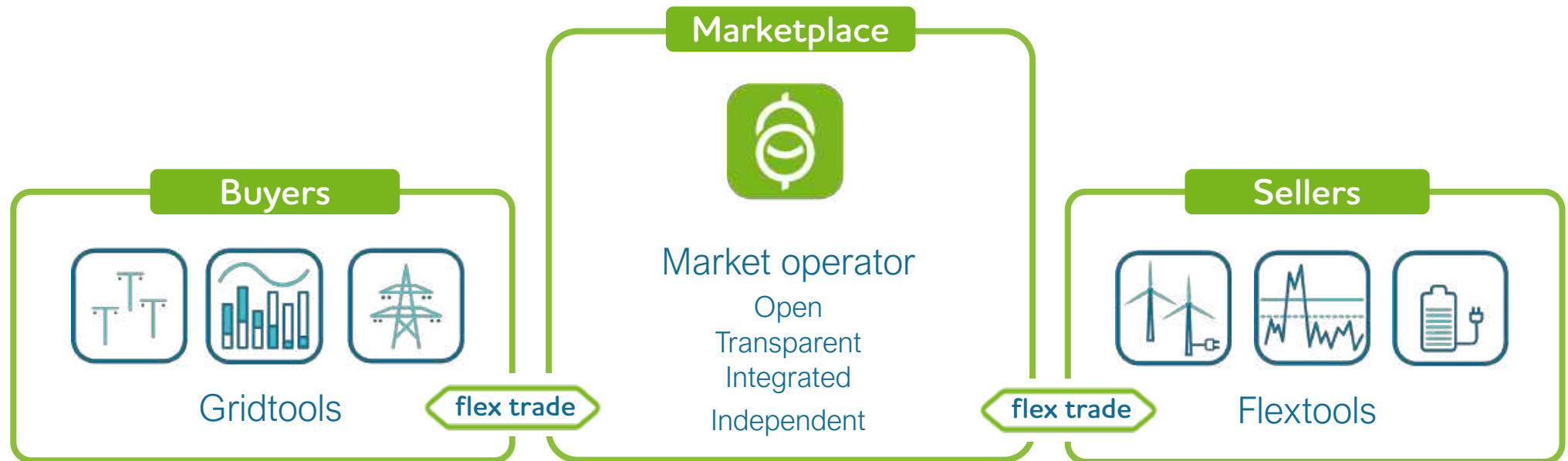
80%
of
renewables connected
to DSO grid



What is a market?

- ⌚ A market is a place where **buyers and sellers can meet** to facilitate the exchange or transaction of goods and services.
- ⌚ Markets **establish the prices** of goods and services that are determined by **supply and demand**.

www.investopedia.com



Bird & Bird & electricity market design

The framework for change

Regulation 714/2009: 31 recitals, 25 Articles, 2 Annexes

Recast Regulation



Electricity Regulation (recast)



Market principles

Competitive energy markets:

- market-based prices
- equal treatment of generation, demand-side response (DSR) and storage; aggregation of consumers, generators and demand response permitted
- enhance development of more flexible generation and demand*
- measures to enhance independence of NRAs*



Dispatching, redispatching and curtailment

Dispatching (moved from Renewable energy Directive)

Dispatching principles:

- non-discriminatory and market-based
- priority dispatch for demonstration projects, and RES-E and high-efficiency cogeneration < 400 kW (from 2026, only for RES-E < 200 kW); Member States may decide not to apply priority dispatch in accessible and high RES-E markets*
- existing priority dispatch for RES-E remains until plant modified/new connection agreement/capacity increased
- priority dispatch not grounds for curtailment of cross-border capacities except in emergency



Balancing

Balance responsibility

All market participants to be balance responsible or to delegate balance responsibility (exceptions for demonstration projects, RES-E below 400 kW – reducing to 200 kW for plant commissioned from 2026 – and for existing recipients of feed-in tariff)

Balancing capacity

- Capacity must be procured:
- separately from balancing energy
- by TSOs – may be facilitated on
- separately for upward and downward (unless NRA exempts)*
- a maximum of one day ahead, for contracting periods, for at least 3



Pricing in short-term and balancing markets

- No price caps or price floors*, although NEMOs may apply harmonised min and max
- DA and ID prices, that

Electricity Directive (recast)

2009 Directive, plus rules on:

- reinforcing competitive energy markets
- consumer rights, including billing, metering, dynamic pricing, switching, using aggregators, comparison tools and addressing energy poverty

New roles of DSOs

All* DSOs must create an "EU-DSO", with roles in:

- digitalisation and data



Electricity Directive (recast)

2009 Directive, plus rules on:

- reinforcing competitive energy markets
- consumer rights, including billing, metering, dynamic pricing, switching, using aggregators, comparison tools and addressing energy poverty
- framework for DSR and aggregation
- assessing alternatives (eg. DSR, storage) to new generation capacity
- enhanced role of DSOs, particularly in procurement of ancillary services, flexibility, data management and integration of electric vehicles
- "active customers/consumers" and "citizens"*
- energy communities"
- reinforcement of NRA roles, including in regulation of ENTSO-E, EU-DSO and RCCs*

Electricity Directive (recast)

Market principles

Competitive energy markets:

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- equal treatment of generation, demand-side response (DSR) and storage; aggregation of consumers, generators and demand response permitted
- enhance development of more flexible generation and demand*
- measures to enhance independence of NRAs*



Focus on flexibility

- No DSO/TSO ownership of storage (limited exceptions*)
- Demand response – active customers and aggregators to be able to act without consent of suppliers, to be balance responsible and to compensate suppliers
- NRAs, TSOs, DSOs to ensure that DSR can participate fully
- Member States to incentivise DSOs to procure flexibility

ACER Regulation (recast)

Greater role for ACER – as Regulation 713, plus:

- supervision of ENTSO-E, EU-DSO, RCCs and NEMOs
- developing and approving network codes, guidelines and methodologies
- decisions approving resource adequacy

Use and connection charges to be:

- transparent and non-discriminatory
- not applied to cross-border trade; locational
- subject of a recommendation on convergence by 2019
- extended to DSOs

Toolkit for "energy-first" market

Before introducing CRM, Member States must:

- remove regulatory distortions
- enable scarcity pricing
- develop interconnection, DSR and storage
- consult directly interconnected Member States

CRM design

Key principles

- CRMs to be assessment
- open to all types of resources, subject to emission

reliable price signals

Forward markets

- Long-term transmission rights to allow cross-border hedging by 2021*



Focus on flexibility

- No DSO/TSO ownership of storage (limited exceptions*)
- active customers and

Flexibility is key



Flexibility available to all levels of the grid



TSO



DSO
REGIONAL



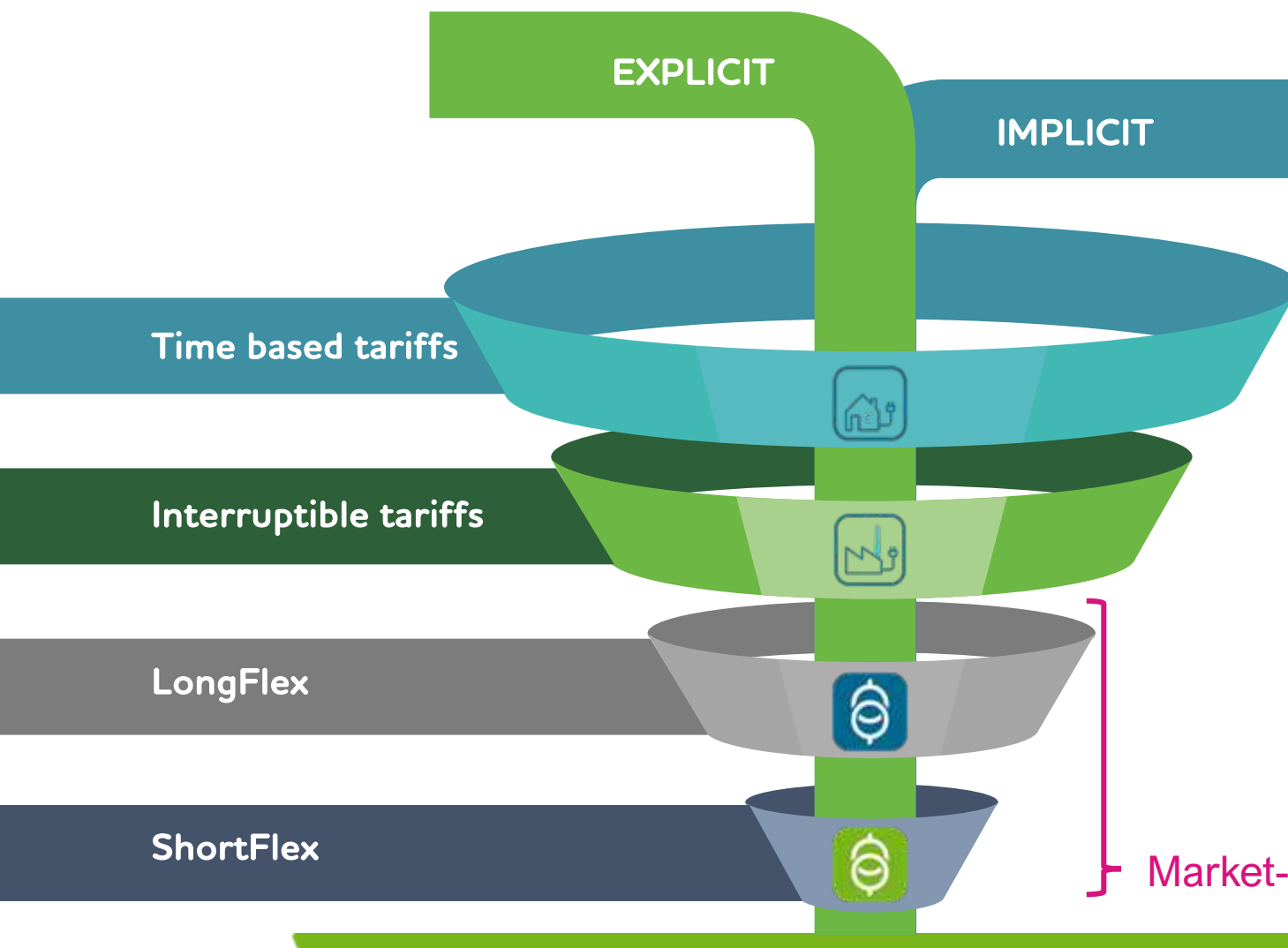
DSO
LOCAL



Microgrid



Why market-based flexibility?



Implicit flexibility can be released by imposing a time based or dynamic tariff scheme on the customer.

Explicit flexibility can be released by;

- discount schemes (**interruptible tariffs**) towards customers which are willing to be interrupted.
- Market-based solution for buying **LongFlex** (availability contracts) will allow the grid operator to secure flexibility for future activation, or
- **ShortFlex** which is flexibility payed at activation price in the intraday time frame.

Market-based solution unlocks the true value of flexibility!

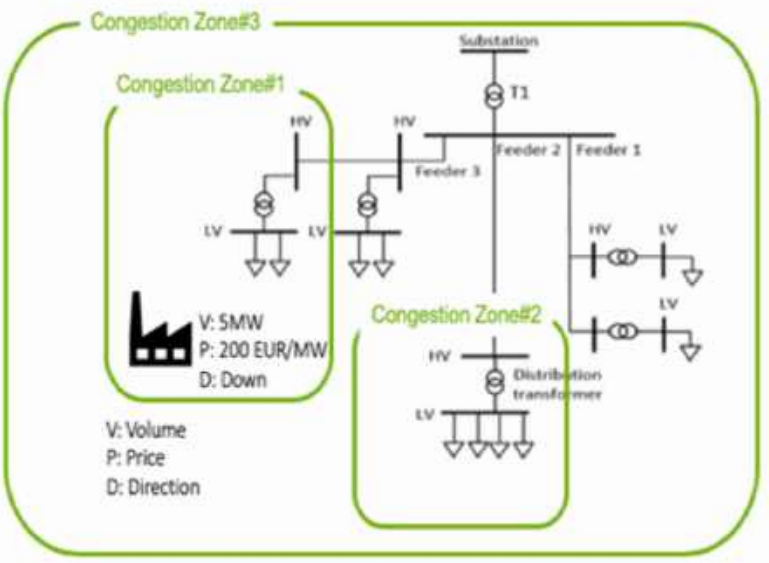
Congestion zones



Grid locations



Order book



NODES

SFE Nett

HOME | VELEDGTE | INNSITT | LØSNINGER

SFE Nett

Grid Locations | Congestion Periods | Alerts

Norge: Stremangelperiode 20-21
Støt Location: Stremangelperiode
Status: Aktiv

SFE Nett

Søknad: 17:00 - 18:00 - 18:00 - 17:00

How many MW would you like to Up regulate?

Order ID	Volume (MW)	Price (NOK)
1	0.5	3,990.00
2	0.5	4,000.00
3	0.5	4,100.00
4	0.5	4,200.00
5	0.5	4,300.00
6	0.5	4,400.00
7	0.5	4,500.00
8	0.5	4,600.00
9	0.5	4,700.00
10	0.5	4,800.00
11	0.5	4,900.00
12	0.5	5,000.00

Order: 2.5 MW

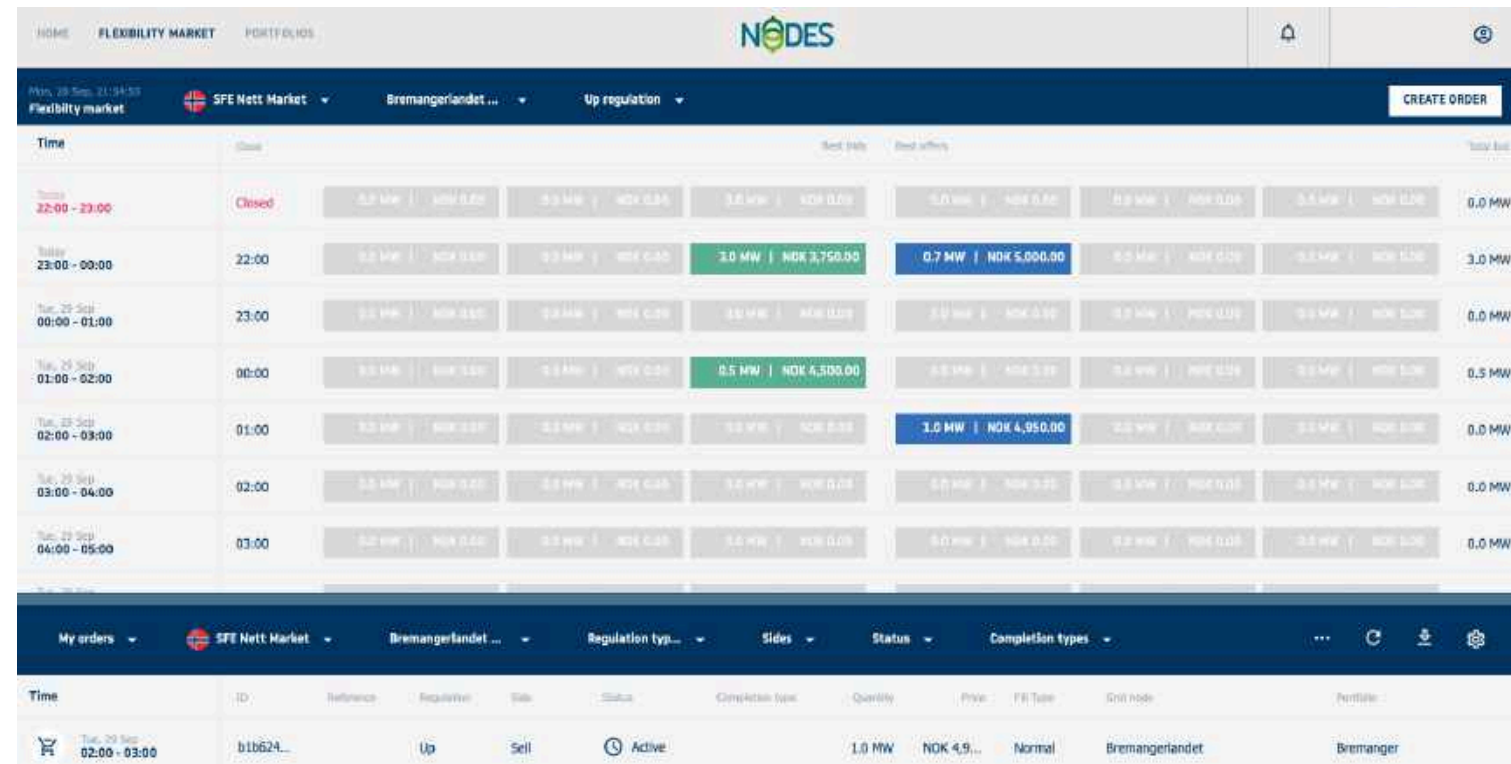
Price: NOK 3,990.00 | 2.0 MW

Price: NOK 4,500.00 | 0.5 MW

Price: NOK 4,100.00 | 1.0 MW

Creating a market, where **different types of flexibility** can **compete** on a **level playing field**, where the **right type** of flexibility can be procured at the **right price**, in the **right location** at the **right time**.

Operated by
NODES



The screenshot displays the NODES Flexibility Market interface. The top navigation bar includes 'HOME', 'FLEXIBILITY MARKET', and 'PORTFOLIOS'. The main header shows the market name 'SFE Nett Market', location 'Bremangerlandet ...', and regulation type 'Up regulation'. A 'CREATE ORDER' button is visible in the top right.

The main table shows bidding data for various time intervals. The columns include 'Time', 'Class', 'Bid size', 'Bid offers', and 'Total bid'. The table is organized into rows for different time periods, with specific bids highlighted in green and blue.

Time	Class	Bid size	Bid offers	Total bid
Mon, 28 Sep, 22:00 - 23:00	Closed	0.0 MW NOK 0.00	0.0 MW NOK 0.00	0.0 MW
Tue, 29 Sep, 23:00 - 00:00	22:00	0.0 MW NOK 0.00	0.0 MW NOK 0.00	0.0 MW
Tue, 29 Sep, 00:00 - 01:00	23:00	0.0 MW NOK 0.00	0.0 MW NOK 0.00	0.0 MW
Tue, 29 Sep, 01:00 - 02:00	00:00	0.0 MW NOK 0.00	0.0 MW NOK 0.00	0.0 MW
Tue, 29 Sep, 02:00 - 03:00	01:00	0.0 MW NOK 0.00	0.0 MW NOK 0.00	0.0 MW
Tue, 29 Sep, 03:00 - 04:00	02:00	0.0 MW NOK 0.00	0.0 MW NOK 0.00	0.0 MW
Tue, 29 Sep, 04:00 - 05:00	03:00	0.0 MW NOK 0.00	0.0 MW NOK 0.00	0.0 MW

The bottom section of the interface shows a 'My orders' table with columns for 'Time', 'ID', 'Reference', 'Regulation type', 'Side', 'Status', 'Completion type', 'Quantity', 'Price', 'FE Type', 'Grid node', and 'Portfolio'. A single order is listed:

Time	ID	Reference	Regulation type	Side	Status	Completion type	Quantity	Price	FE Type	Grid node	Portfolio
Tue, 29 Sep, 02:00 - 03:00	b1b624...		Up	Sell	Active		1.0 MW	NOK 4.9...	Normal	Bremangerlandet	Bremanger

Developing through cooperation



⑥ CINELDI



⑥ sthlmflex



⑥ IntraFlex



⑥ Mitnetz



⑥ NorFlex



⑥ EUniversal



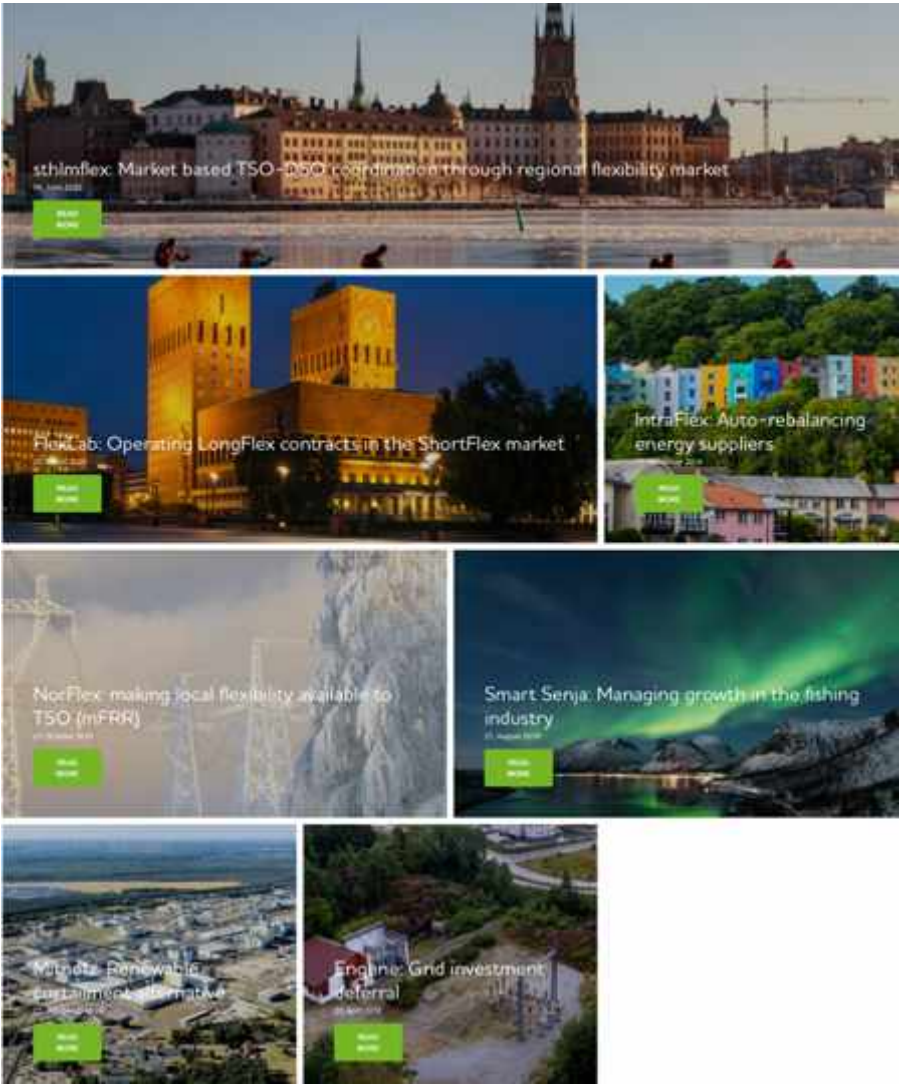
⑥ SmartSenja



⑥ FlexLab



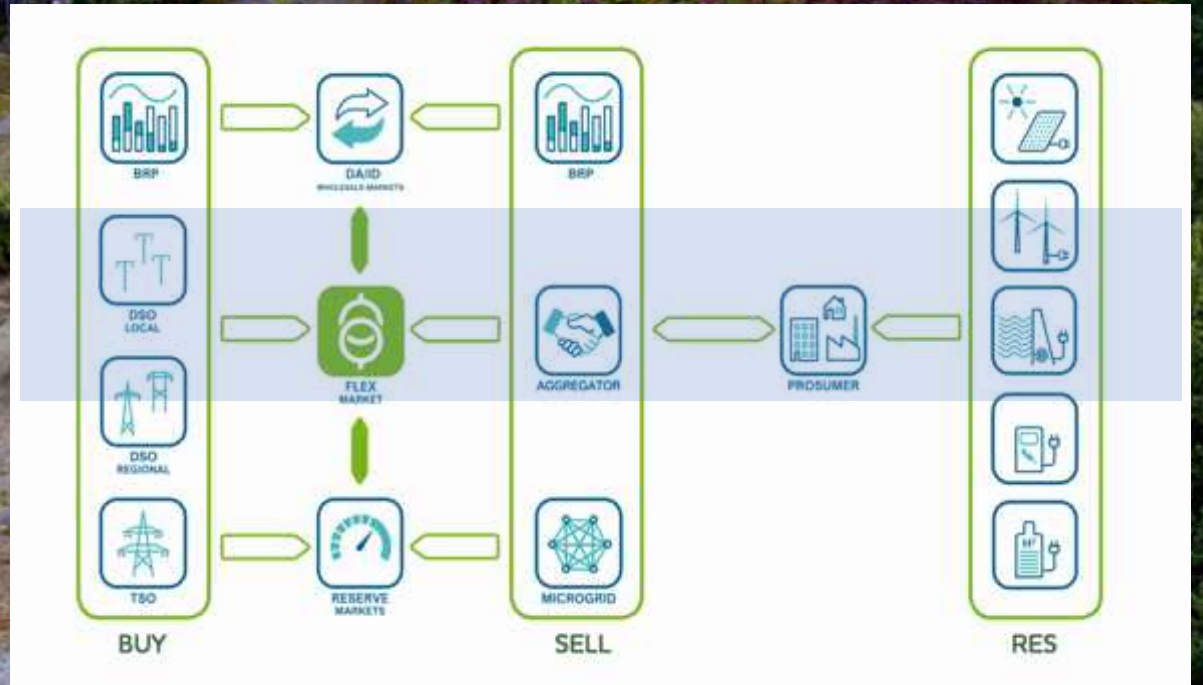
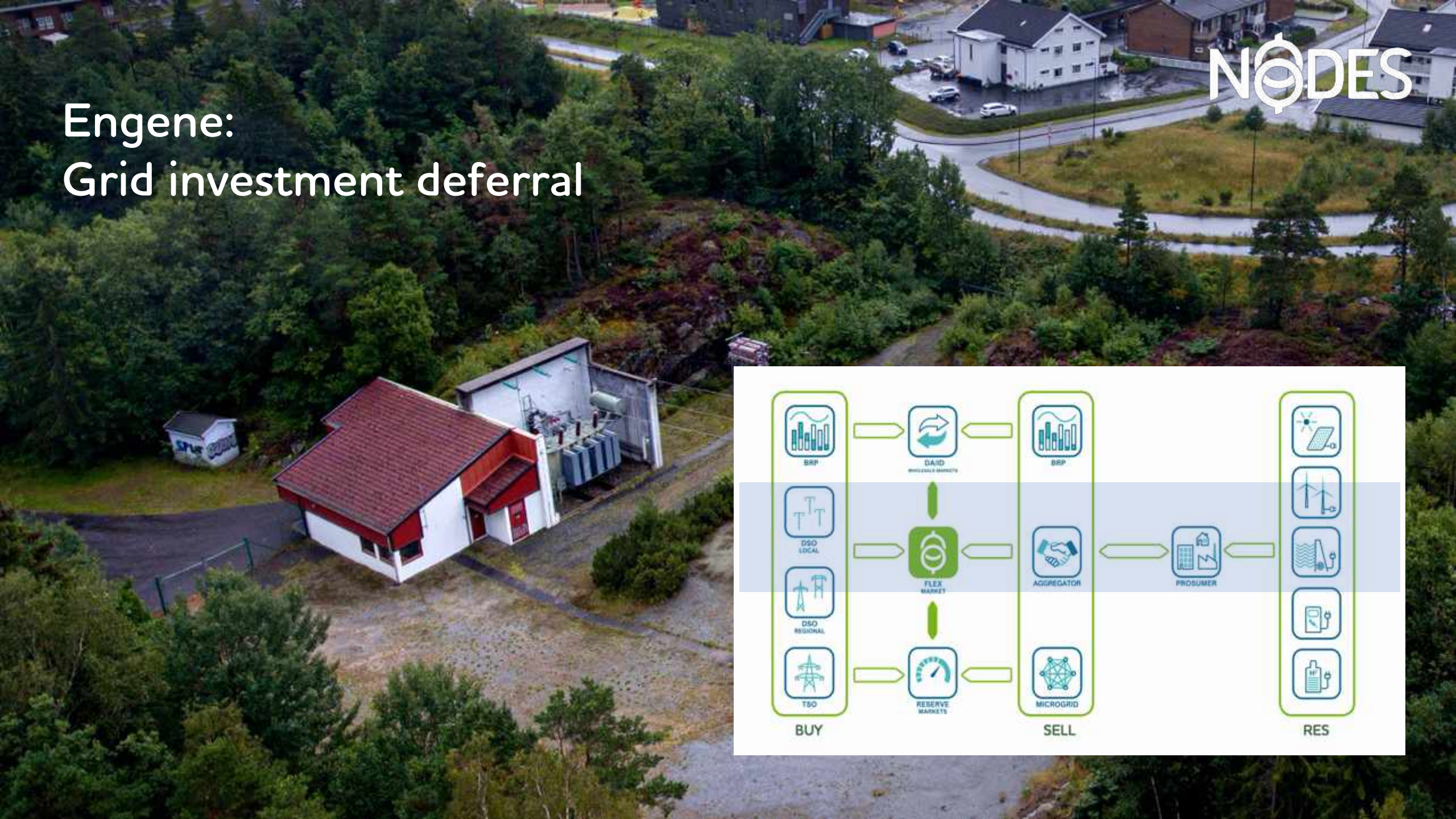
⑥ Engene



We facilitate so you can innovate!

Hallstein Hagen
+47 908 49 659
hallstein.hagen@nodes.energy

Engene: Grid investment deferral



Engene: Highlighted the need for independent marketplace



Agder Energi and Microsoft receiving the *Innovative Star of Energy Efficiency Award 2018*

Buyers



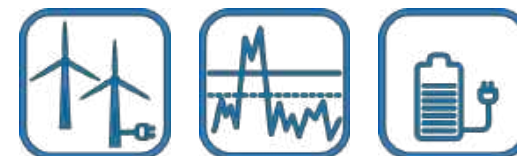
GridTools

Marketplace



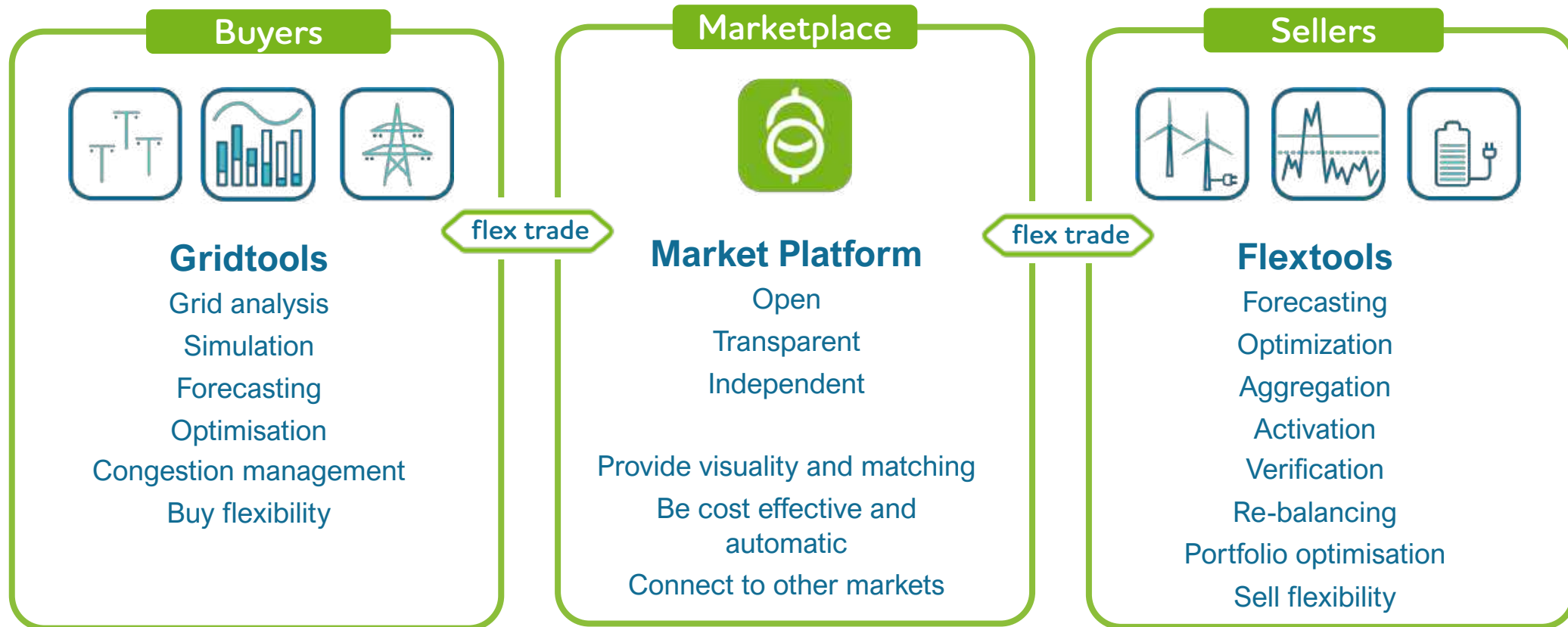
Market Platform

Sellers

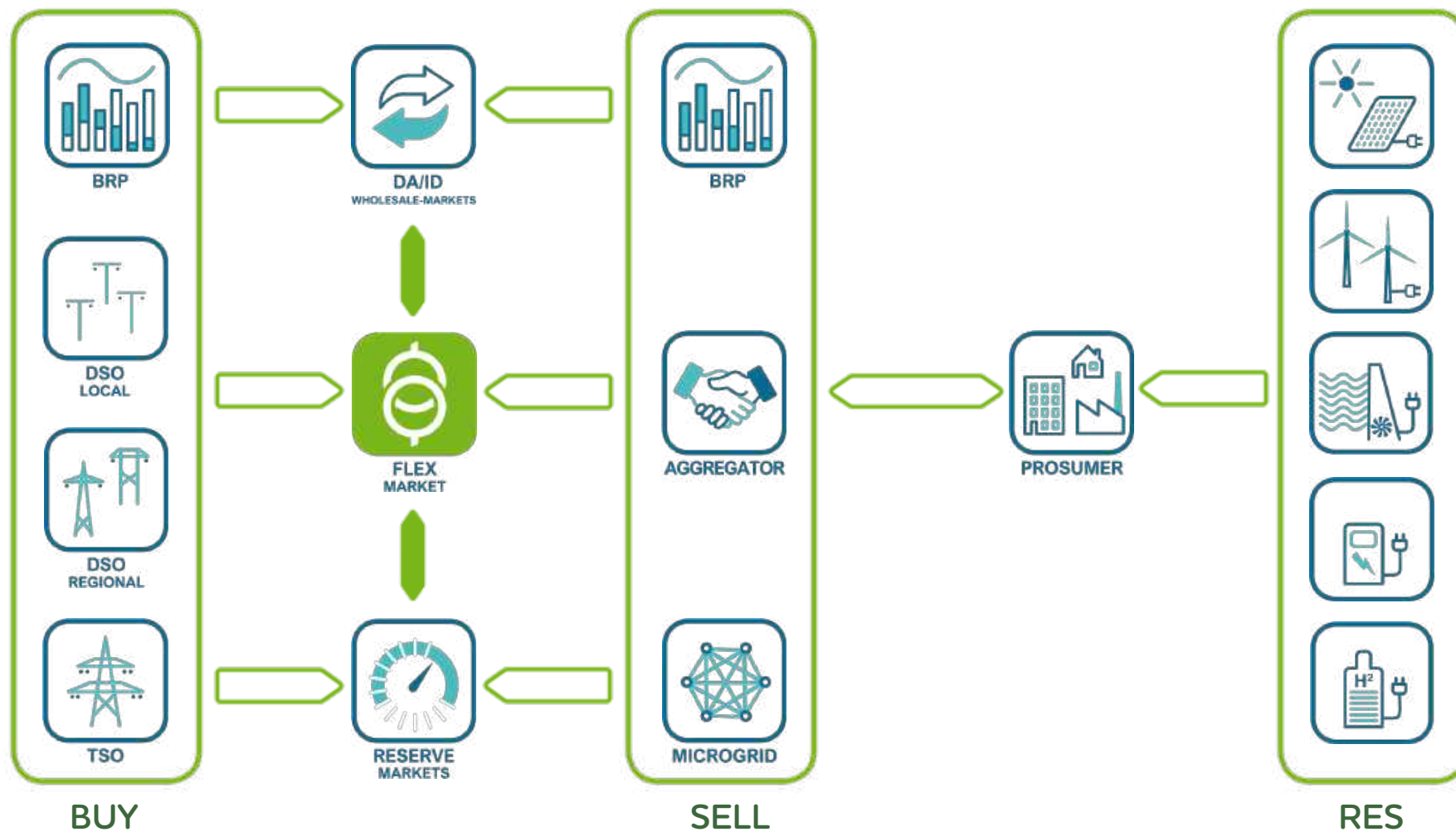


FlexTools

Flexibility value chain



Bottom up – integrated market design



Continues market, pay as bid, parameterised

HOME FLEXIBILITY MARKET NODES IndependentFspUser01

[CREATE ORDER](#)

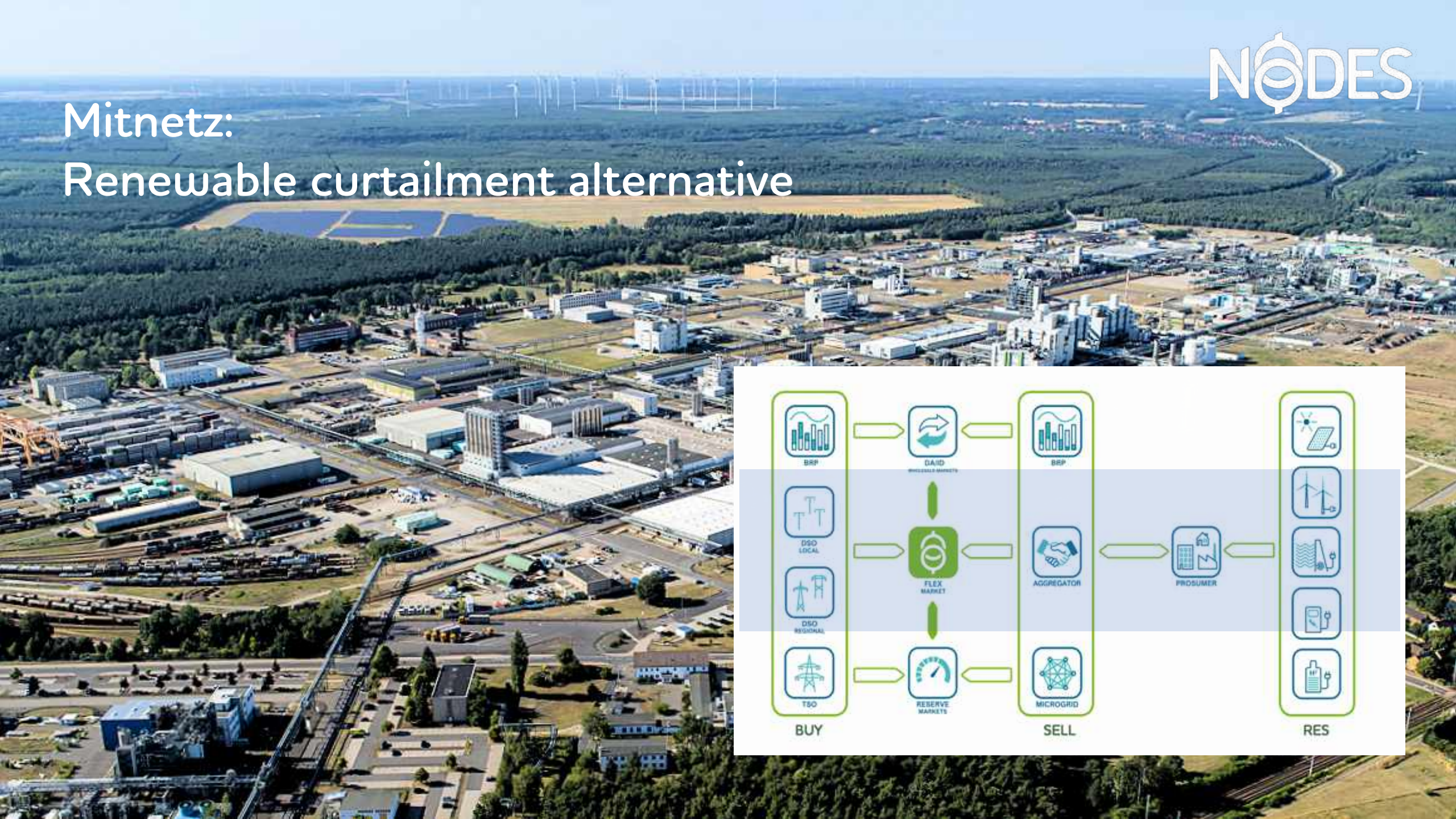
Thu, 25 Feb, 13:52:07
Flexibility market Western Power Distribution WPD South Wales ▾ Down regulation ▾

Time	Order	My bids	Best bid	Best offer	My offers	Total bid qty	Total offer qty
Wed, 25 Feb 14:00 - 15:00	Tomorrow, 13:45					0.0 MW	0.0 MW
Wed, 26 Feb 15:00 - 16:00	Tomorrow, 14:45					0.0 MW	0.0 MW
Wed, 26 Feb 16:00 - 17:00	Tomorrow, 15:45		10.0 MW €1,000.00	€1,150.00 5.0 MW	5.0 MW 1150 €	10.0 MW	10.0 MW
Wed, 26 Feb 17:00 - 18:00	Tomorrow, 16:45			€1,200.00 5.0 MW	5.0 MW 1250 €	0.0 MW	10.0 MW
Wed, 26 Feb 18:00 - 19:00	Tomorrow, 17:45					0.0 MW	0.0 MW
Wed, 26 Feb 19:00 - 20:00	Tomorrow, 18:45					0.0 MW	0.0 MW

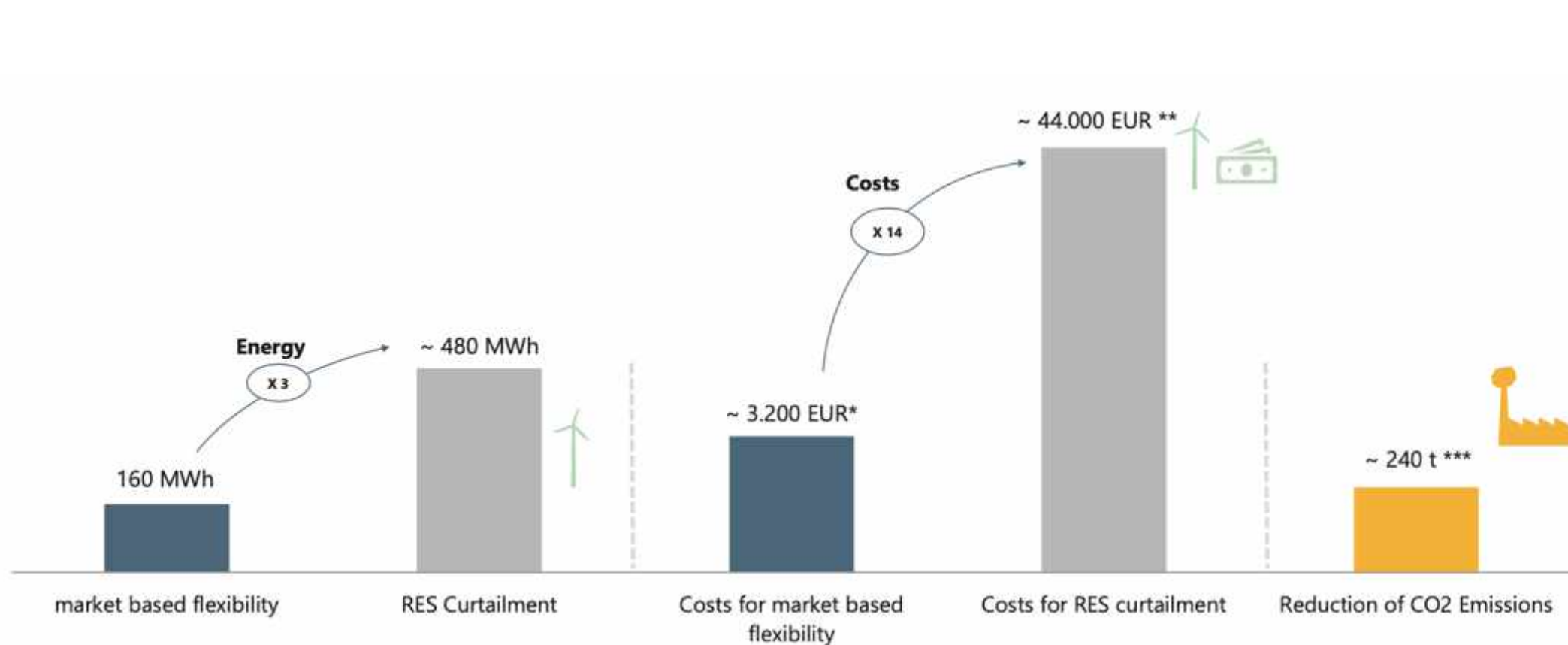
My orders From: To: All sides ▾ Active ▾ Normal ▾ WPD South Wales ▾

Wed, 26 Feb 2020	ID	Parent	Side	Status	Quantity	Price	Fill Type	End location	Portfolio	Creator	Time stamp	Comments
Early 17:00 17:00 - 18:00	cf81f4		Sell	Active	5.0 MW	€1,250.00	Normal	WPD South Wales	Portfolio 1	IndependentFsp	25/02/2020, 13:49	
Early 16:00 16:00 - 17:00	f19a3e	ab2c3f	Sell	Active	5.0 MW	€1,150.00	Normal	WPD South Wales	Portfolio 1	IndependentFsp	25/02/2020, 13:48	

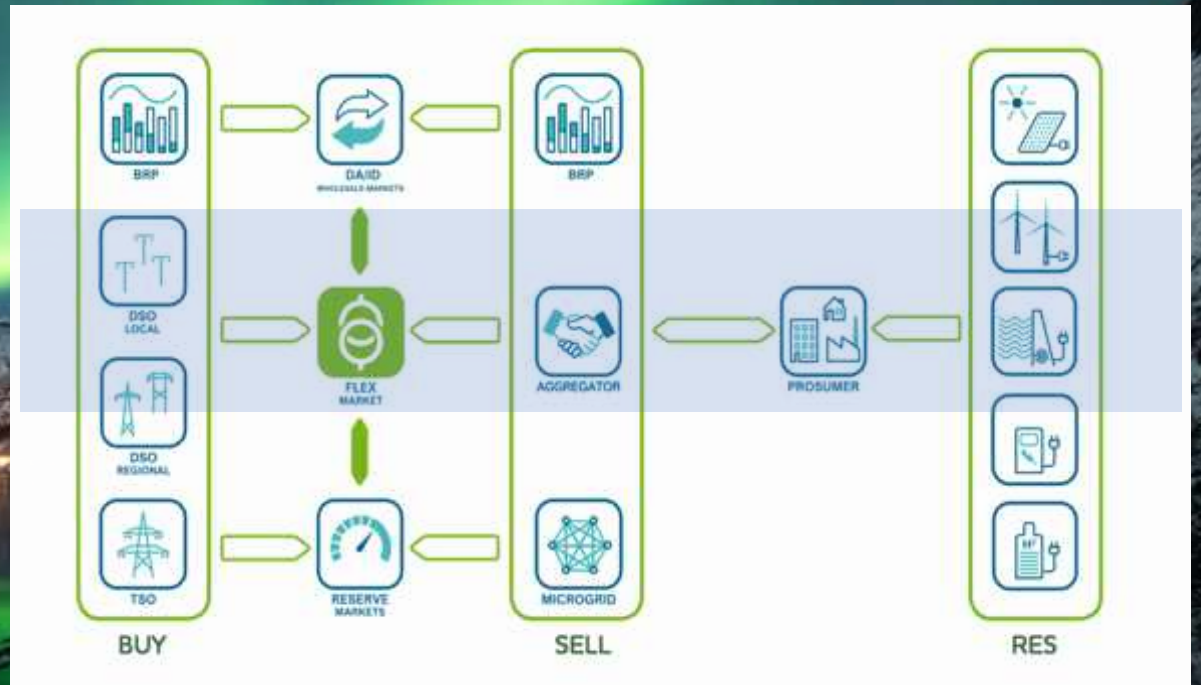
Mitnetz: Renewable curtailment alternative



Mitnetz: Demonstrated the value of demand response flexibility



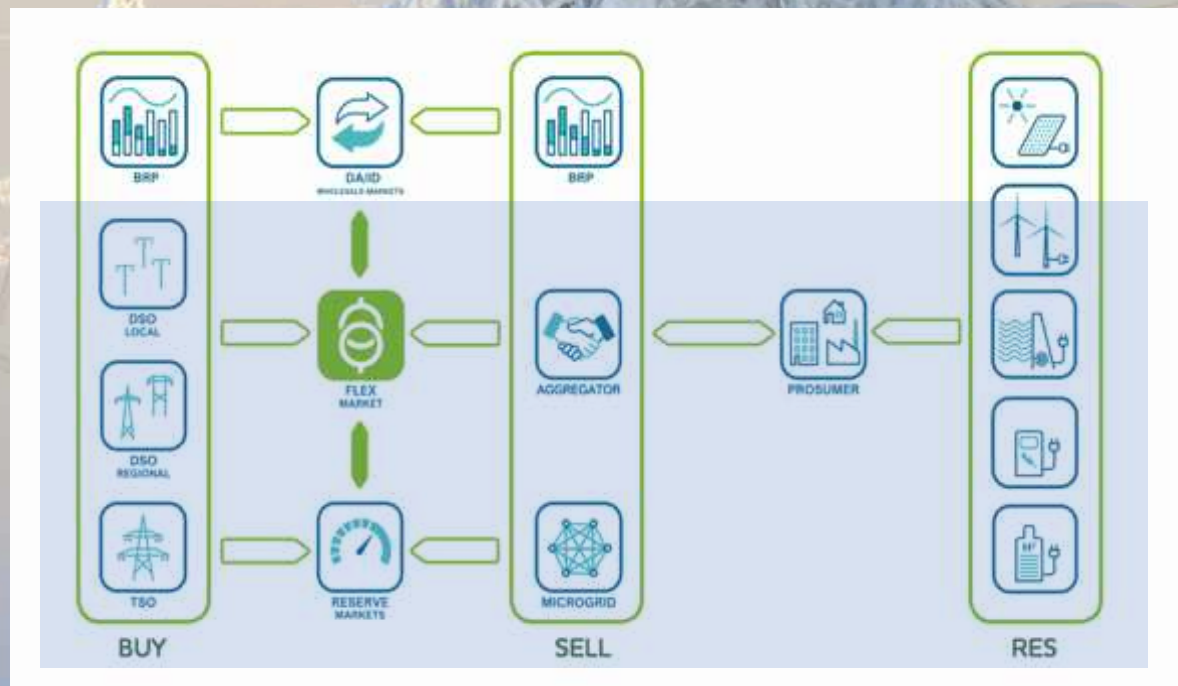
Smart Senja: Managing growth in the fishing industry



Smart Senja: Research project creating local engagement



NorFlex: Making local flexibility available to TSO (mFRR)



NorFlex - Demo Agder: Scaling up the local market!

Flexibility providers



Up to 17 M NOK for flexibility

Flexibility sources



0,5 MW 29,1 MW

Technology platforms



IntraFlex: Auto-rebalancing energy suppliers



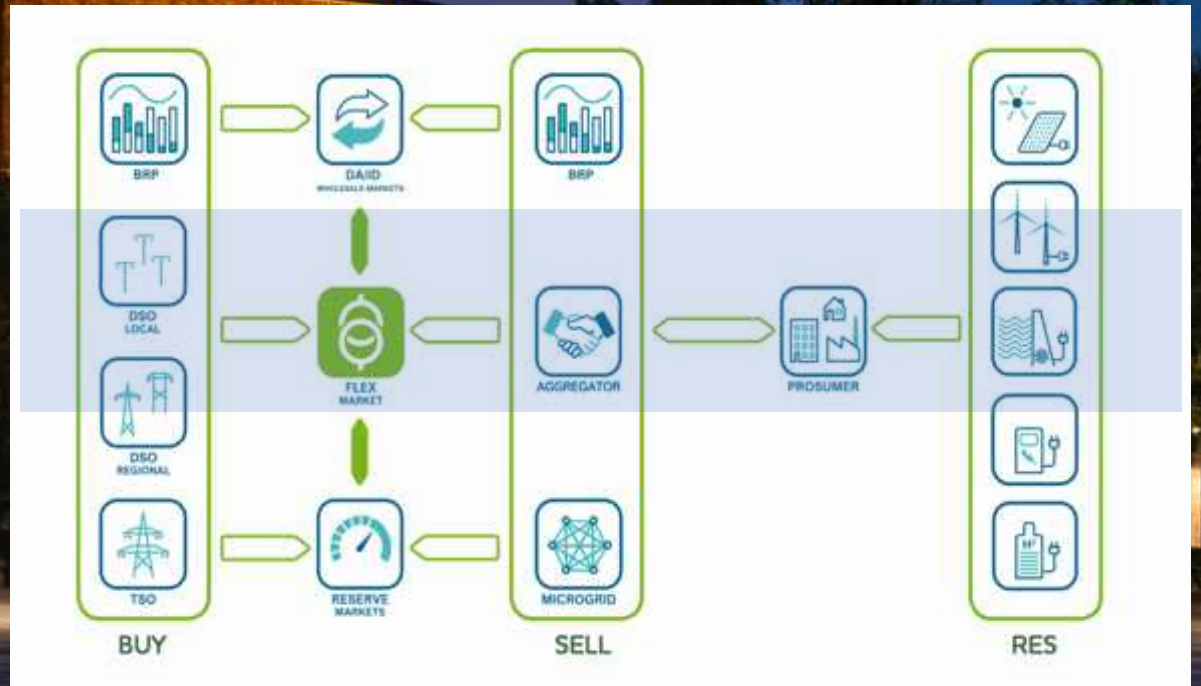
IntraFlex: Close to real-time (ShortFlex) & rebalancing service



Average price UK:

Week 40 (21.-30.9.20):	166.98 GBP/MW/HH
Week 39 (17.-23.9.20):	150.23 GBP/MW/HH
Week 38 (10.-16.9.20):	162.00 GBP/MW/HH
Week 37 (3.-9.9.20):	158.00 GBP/MW/HH
Week 36 (27.8-2.9.20):	150.00 GBP/MW/HH

FlexLab: Operating LongFlex contracts in the ShortFlex market



Interruptible tariffs – automated dispatch

NODES



The screenshot shows the 'Berliner Office' contract details in the NODES system. It includes a table of long flex contract events for 2023 and 2024, with columns for Name, Start Date, and End Date. A bar chart at the bottom shows a series of green bars representing data points. A red arrow points from the physical red button in the hardware image to a toggle switch at the bottom of the contract details panel, which is currently turned on.

The screenshot shows the 'Flexibility market' interface. It displays a table of offers for various time slots (e.g., 20:00-20:15, 20:15-20:30) with columns for Offer ID, Price, and Quantity. Below this is a 'My trades' section showing a list of trades with columns for Time Slot, Status, Location, and Price. A red arrow points from the toggle switch in the previous screenshot to a 'BUY' button in a confirmation dialog on the right side of the screen.

TSO-DSO Coordination



TSO-DSO Coordination for acquiring ancillary services from distribution grids.

Horizon 2020 Smart Net project, May 2019

		Integrated flexibility market	Local ancillary services market	Shared balancing responsibility	Common TSO-DSO market	Centralised ancillary services market
SO interaction	Adequacy of existing communication channels	Medium	Medium	Medium	Low	High
	Respecting distribution grid constraints	High	High	High	High	Low
Grid operation	Use of DER by TSO	High	Medium	Low	High	High
	Recognition of evolving role of DSO	High	High	High	High	Low
	Possibility to lower market operation costs	Medium	Low	Low	Medium	High
Market operation	Liquidity	High	Low	Low	Medium	Medium
	Economies of scale	High	Low	Low	High	Medium

sthlmflex: Market based TSO-DSO coordination through regional flexibility market

The logo for ELLEVIO, consisting of the word "ELLEVIO" in a bold, orange, sans-serif font.The logo for SVENSKA KRAFTNÄT, featuring a stylized graphic of horizontal lines of varying lengths on the left, followed by the text "SVENSKA KRAFTNÄT" in a bold, black, sans-serif font.The logo for VATTENFALL, featuring the word "VATTENFALL" in a bold, black, sans-serif font, followed by a circular icon divided horizontally into a yellow top half and a blue bottom half.

Vattenfall Eldistribution

Regulation is moving at different speeds

Flexibility first principle

NODES



Western Power Distribution

11,316 followers

2w • Edited • 🌐

We're all about 'flexibility first!' Our engineers are always looking for ways to manage demand and make the network more flexible for the future.

As part of our 'flexibility first' principle, we are seeking to procure 334MW! ...see more



Tim McManan-Smith • 2nd

Editor: The Energyst; Director Energyst Media Ltd

3w • 🌐

<https://lnkd.in/e67HqAW> #dsr #smartgrid #batterystorage #netzero



Ofgem: DNOs must make progress with flexibility this year

theenergyst.com

Elements that contribute to the use of flexibility



- Industry commitment to test flexibility before grid enforcement
- Innovation stimulus; fund DSO to buy flexibility
- TOTEX “total expenditure”; CAPEX and OPEX equally treated



NODESconnect Partnership Programme

- ⑥ Aimed at 3rd party independent software providers (ISPs)
- ⑥ Encourage collaboration in creating local sustainable flexibility markets
- ⑥ Cooperate in the business of Marketing, Branding, Technical integration and Market Communication
- ⑥ Partner commit to maintain API connectivity to NODES
- ⑥ NODES gives early access to technical information and test systems
- ⑥ Partnership is non-exclusive and NODES will seek to grow the number of ISPs that connects to the API and sign up to NODESconnect



As a market operator facilitating the trading of flexibility between grid companies and flexibility service providers, NODES has been developing a partnership program to encourage collaboration in creating local sustainable flexibility markets in the energy sector.

NODESconnect is our technology partner programme to support technology companies who are keen to integrate their services to the NODES market via our API.

As a NODESconnect Partner, you are committed to maintain connectivity to the NODES API and to help your customers optimise the use of their assets under management by offering flexibility on NODES.

NODESconnect Partners



Interested in becoming a NODESconnect partner?

NODES market design NODES API