WESTERN POWER DISTRIBUTION INNOVATION TEAM

Visibility Plugs and Socket

Dissemination Webinar

02/03/2020

WPD - Jenny Woodruff

CENTRICA – Nicolas Metivier, Sam Wevers, James Atkinson, Sophie Orme, Dan Nicholls

N-SIDE – Keno Merck

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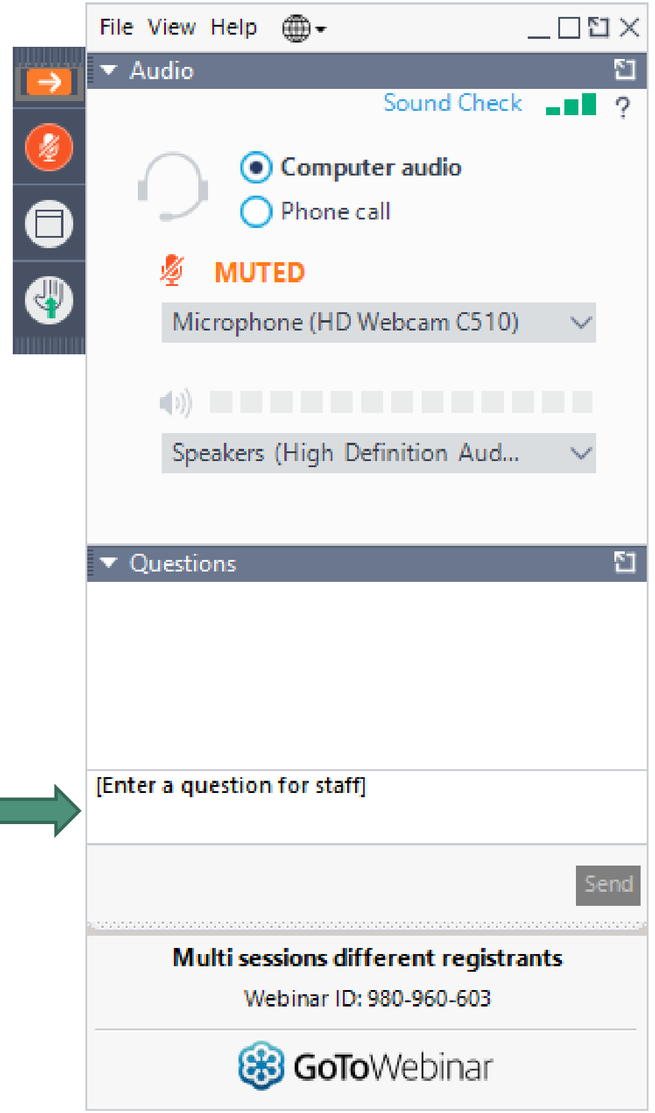
Dissemination Webinar

- Project Overviews
- Flexibility platforms & market models
- Phase 1 Trial & findings
- Phase 2 Trial & findings
- Baselining
- Next Steps
- Q&A

Raise questions via the webinar facility , for the Q&A session at the end of the webinar



Cornwall Local Energy Market

- Part-funded by European Regional Development Fund, part-funded by Centrica
- Cornwall an area with significant penetration of renewables and consequent grid management issues
- The LEM Programme aims to:
  - Develop and demonstrate a highly automated market-based solution to DSO flexibility procurement.
  - Demonstrate a transparent means of coordinating DSO and ESO flexibility procurement.
  - Save at least 5,600 tonnes of greenhouse gas emissions per year by installing domestic and commercial smart energy infrastructure in Cornwall.

Programme started in Q1 2017, will finish Q4 2020.

Project partners

N-SIDE OPTIMIZING YOUR DECISIONS

nationalgridESO

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Imperial College London

UNIVERSITY OF EXETER

European Union
European Regional Development Fund

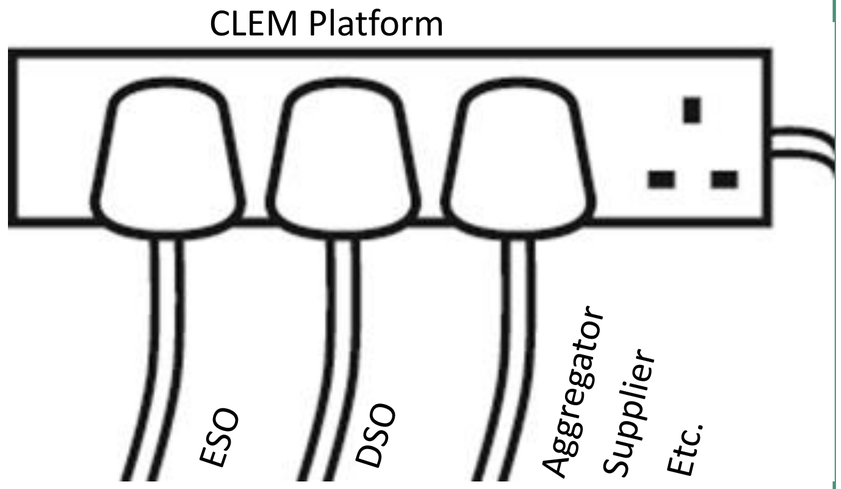
Visibility Plugs & Socket – Project Overview

Complementary but separate to Cornwall Local Energy Market

What can third party flexibility platforms do for DNOs?

- Reach different customers - may prefer an alternative platform due to brand, other facilities, different terms etc.
- Cheaper recruitment
- Visibility of trading that may affect power flow e.g. flexibility, peer-to-peer, local wholesale market
- Build on that visibility to avoid conflicts

LEM provides multiple services for multiple parties.



Each party has tailored plug to a common socket.

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Flexibility Platforms

The term Market Platform can cover a variety of activities. FleX and other schemes are increasing the range.

	Show sellers and buyers graphically	NG Flexibility	DSO Flexibility	Tool for aggregators to sell flexibility	Baselining and settlement for flexibility trades	Suppler Imbalance correction	Energy Trading & other services e.g. peer to peer
A		X			X		
B			X	X	X		
C	X						
D				X	X		
E						Coming soon	
CLEM	X	X	X	X	X		Coming soon

Regional Flexibility Platforms would provide an ideal solution to support Open Networks Future World E – Third Party Co-ordination

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Market Models

Quote & Tender

- Electronic version of existing purchasing mechanism
- Asset reservation & dispatch confirmation close to delivery
- DSO places Flex request - providers respond with offers
- DSO optimises the offers to accept and has advance visibility of prices

Spot Market / Auctions

- Separate reservation and Utilisation auctions
- Can reserve significantly in advance – reserved services must participate in utilisation auction
- Concurrent purchasing by ESO and DSO with grid secure optimisation and independent conflict avoidance functions
- Price cap can be put in place where required due to lack of liquidity

Both types of service offered on a Service by service basis rather than long term framework agreements

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Commercial Customer Recruitment

10 aggregators
LEM event

1 aggregator
assets

25 MW trading

Long list
124 warm leads

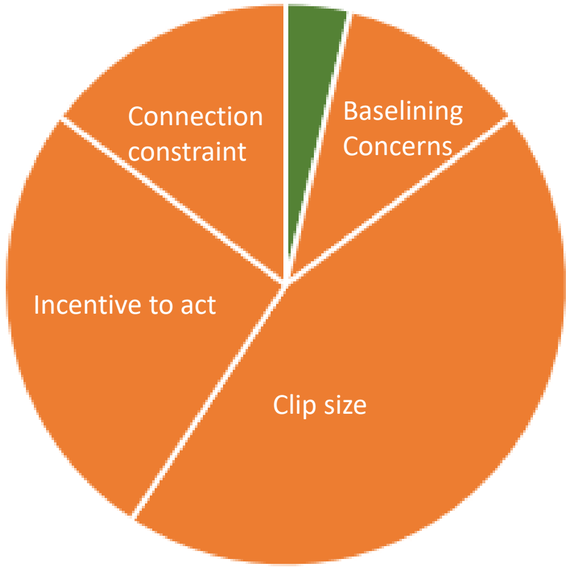
24 target flex customers

Call to Confirm interest
Send Seller Pack
Flex KEP Event

12 hot leads

- Site visit & pitch
- Power monitoring

Customer conversion



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Phase 1 Trial

Feature	Phase 1 Trial
Market Model	Quote and Tender
Purchasers	WPD as DSO only
Optimisation	Selection of offers by DNO – separate Excel Solver based tool developed
Conflict management	Not part of trial
Flex provider capacity	11 Locations , capacity circa 25MW, varied during the trial.
Flex provider types	Diesel generators, gas turbine, flow battery, domestic battery clusters.
When	May – August 2019
Where	Fraddon, Truro, St Tudy and St Austell BSPs plus 4 primaries
Number of Scheduled events	13
Service types	Pre-fault curtailment for seasonal peak management or maintenance window extension

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Phase 1 Trial Results – Prices & Delivery

Event	Service Procured (MWh)	Service Delivered (MWh)	Delivery Proportion Percentage
1	0.040	0.000	0%
2	3.990	3.990	100%
6	2.780	1.686	61%
7	2.840	2.840	100%
8	6.660	6.146	92%
9	0.032	0.008	25%
11	0.047	0.030	63%
12	0.076	0.029	39%
Average			60%

Prices cluster around £300/MWh

Large variations in delivery between providers

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Phase 1 – Additional Trial Learning

Customer to Network Mapping

- Patched together data on an ad-hoc basis to support trial - Need a robust BAU solution
- Maybe extend use of Postcode checker used by Flexible Power , MPAN check under development

Network Hierarchy

- Abnormal running arrangements changed the point of service impact for some events - benefit provided at wrong transformer.

Simplicity vs Complexity

- Features for custom timings are not beneficial, standardisation is better.
- Day ahead, intraday and week ahead gives good range of standard options.

Presumed Open Data may improve provision, MPANs - GDPR issues – considered personal data.

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Phase 2 Trial

Feature	Phase 2 Trial
Market Model	Spot Market
Purchasers	DSO and ESO individually and concurrently
Optimisation	Optimised for all purchasers and providers - commercial optimisation tool
Conflict Management	Built in to optimisation, avoid services that overload network
Flex provider capacity	11 Locations , capacity circa 25MW, varied during the trial.
Flex provider types	As per Phase 1, - flow battery +ice manufacturer
When	Sept – Dec 2019
Where	Fraddon, Truro, and St Austell BSPs plus 3 primaries
Number of Scheduled events	19 - but often with separate reservation and utilisation elements
Service types	Pre-fault curtailment and post fault dispatch

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Phase 2 Trial – Platform Overview

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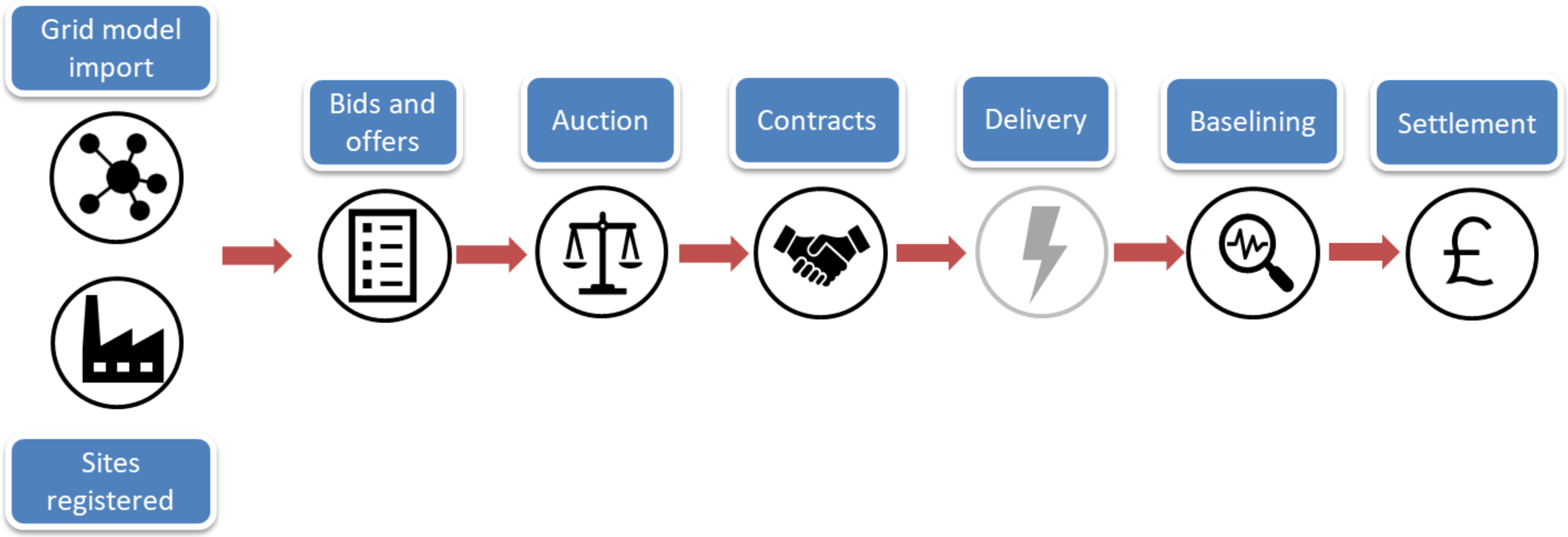
Phase 2 Trial – Platform Overview



Phase 2 Trial - Optimisation & Conflict Management

N-SIDE is providing the Clearing Algorithm

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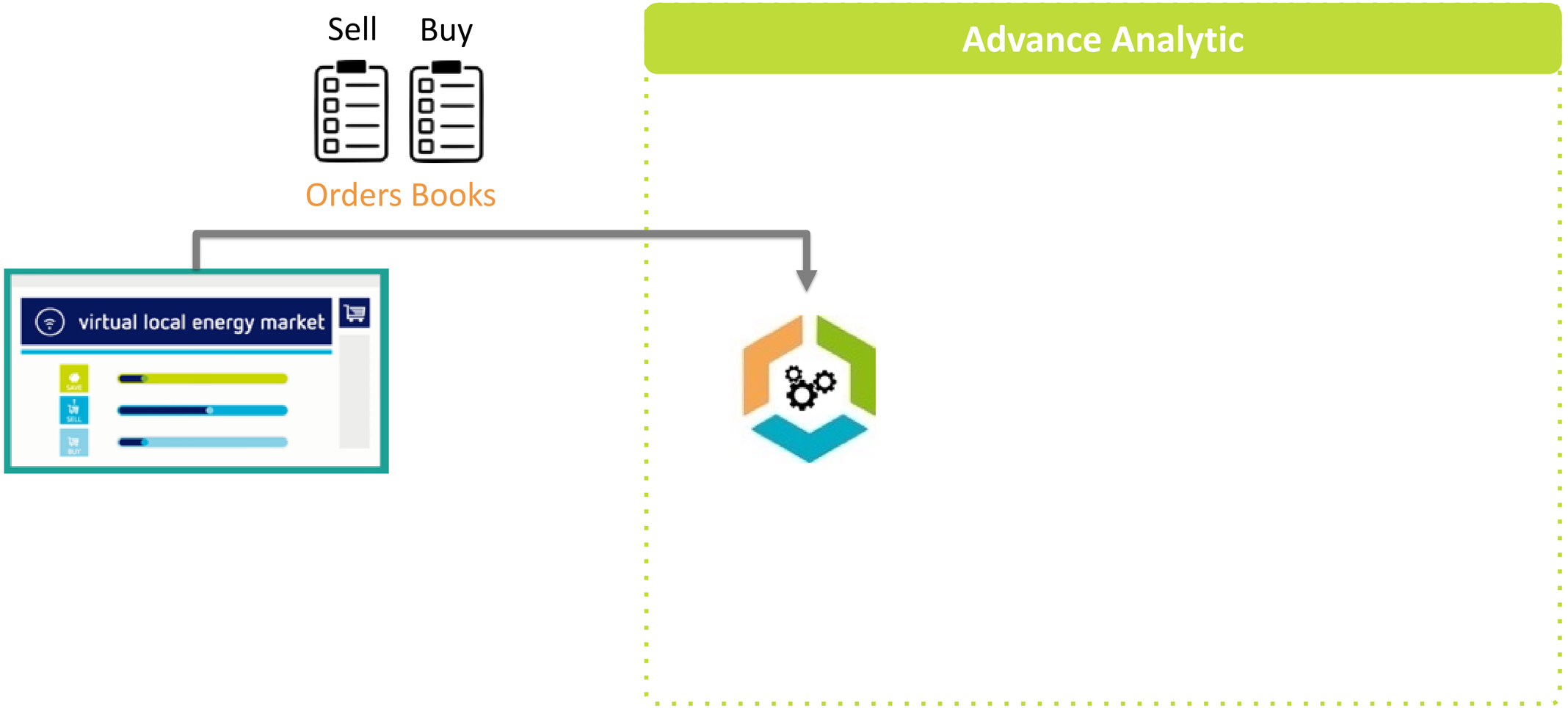

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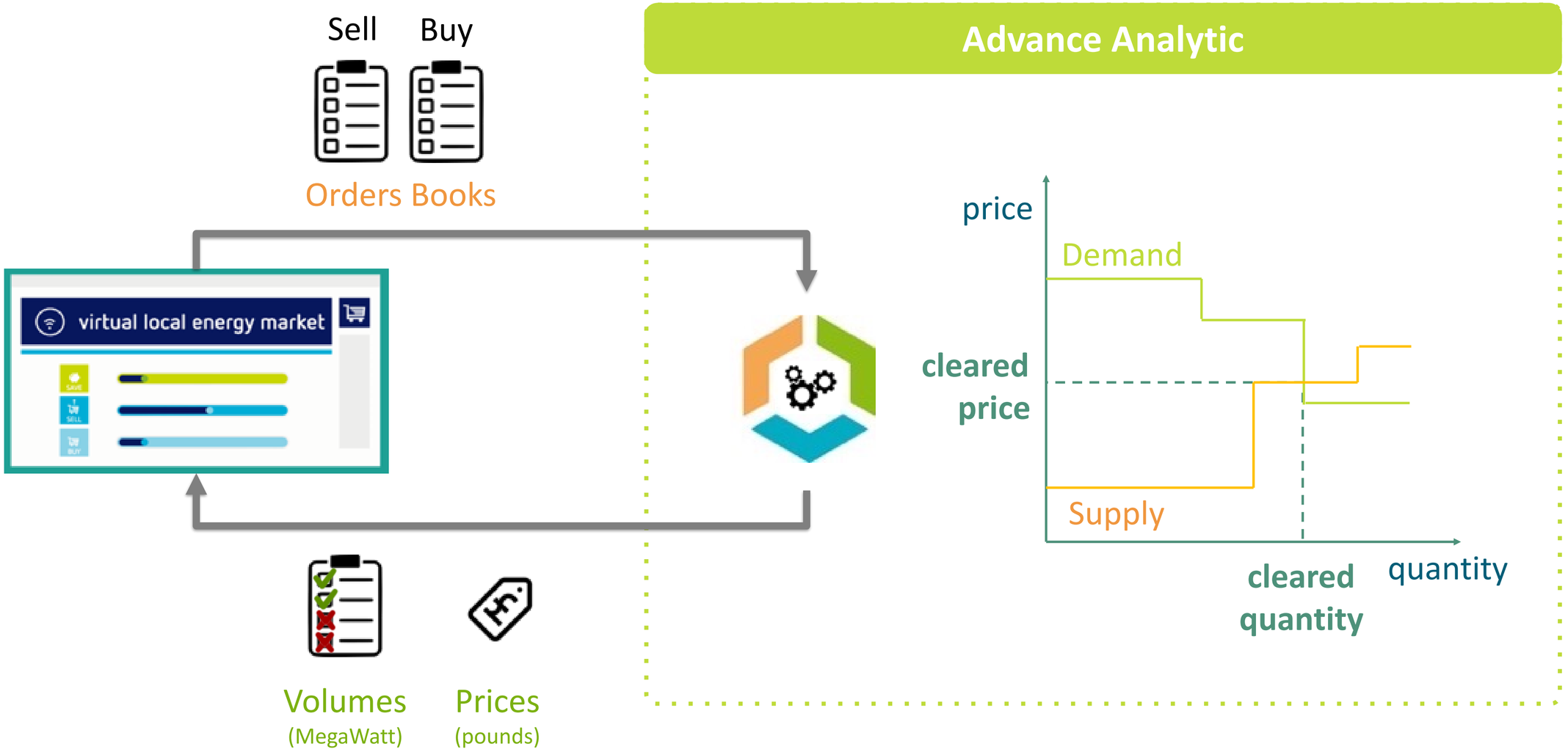

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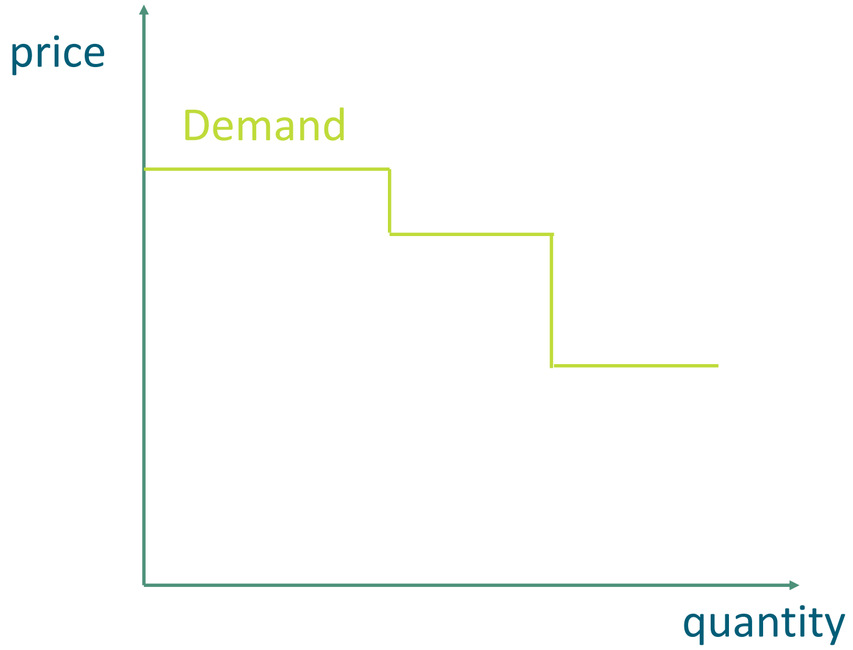
Our mathematical model is based demand and supply curves

Demand curve

- Relation between the price and the quantity that the buyers want to get
- This function is decreasing



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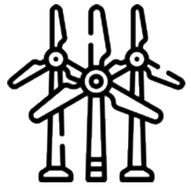
Our mathematical model is based demand and supply curves

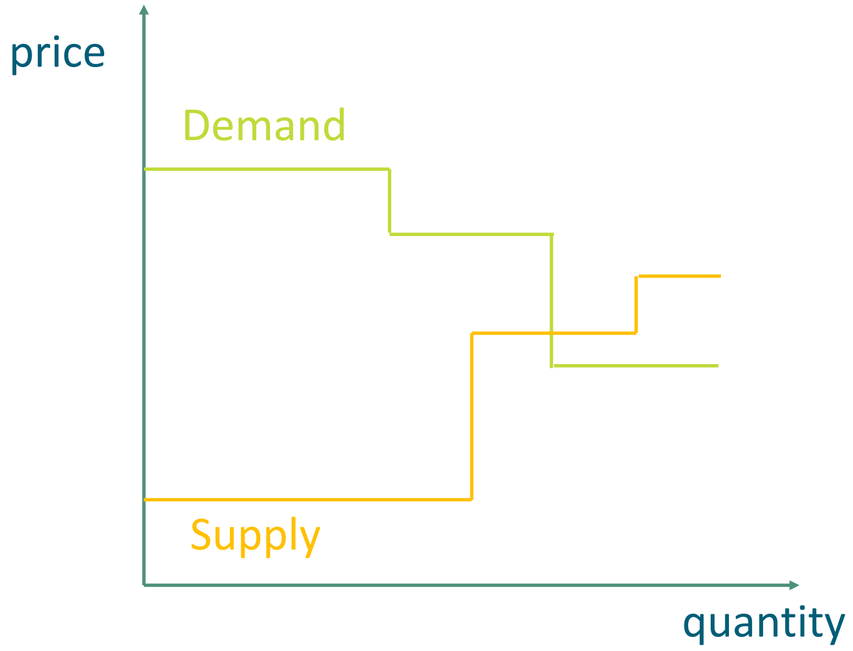
Demand curve

- Relation between the price and the quantity that the buyers want to get
- This function is decreasing

Supply curve

- Relation between the price and the quantity that the suppliers want to sell
- This function is increasing





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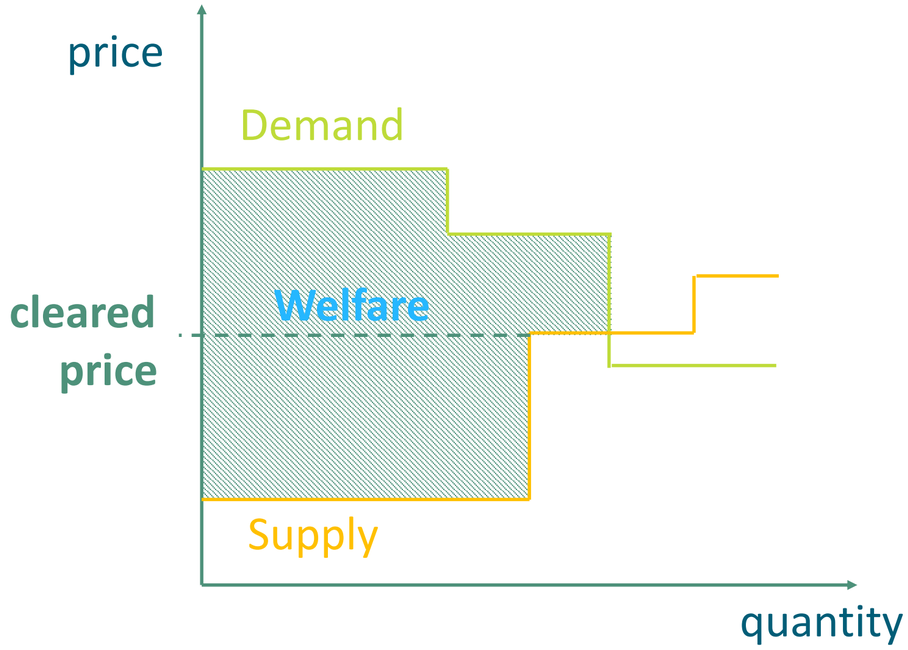
The primal formulation of the problem maximizes the Social Welfare

Maximize **Social Welfare**

We want to maximize:

Area below the Demand – Area below the Supply



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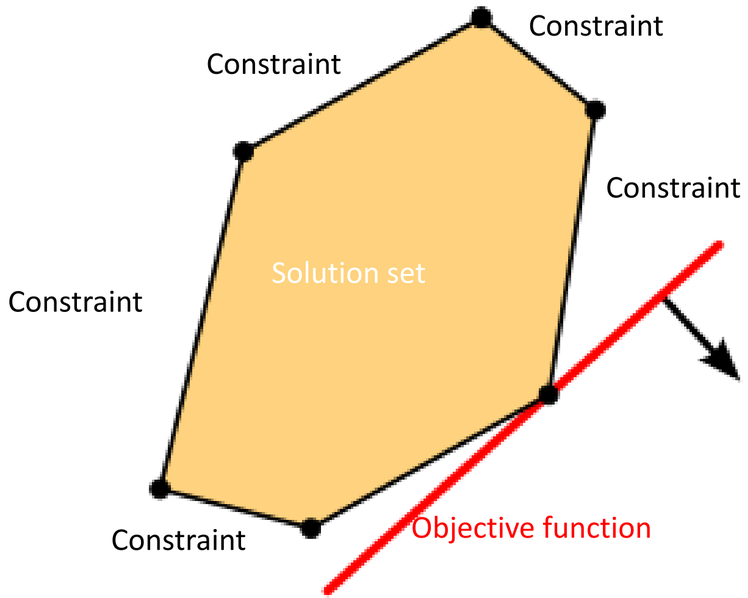
Description of the optimization problem (high level)

The objective function

Maximize: Social welfare

Under some conditions

- **Grid** constraints
- **Order** constraints
- **Economical** constraints
- …



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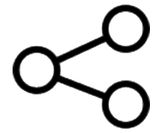
Examples of constraints (high level)

Examples of order constraints

- Maximum energy
- Ramping
- Minimum duration
- Recovery
- Maximum duration
- Time block

Examples of grid constraints

- Maximum line capacity
- Radial network



Examples of economical constraints

- No accepted order must “out of the money”
- Rejected orders must (essentially) not be economically interesting

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Conflict management

The following rules are used:

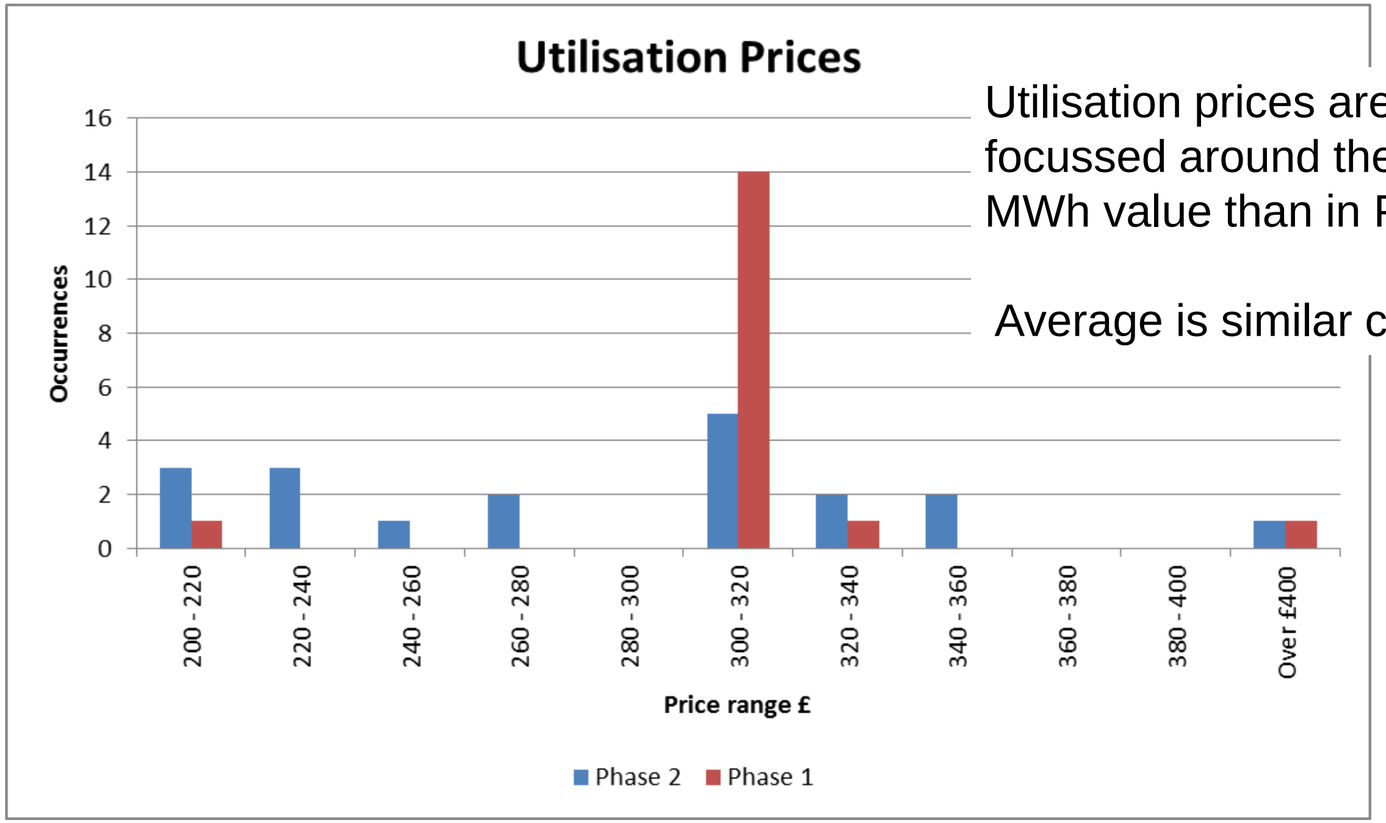
- “First come, first served’’

- Inside an auction, if the DSO make a flexibility demand, we block the above line (in the opposite direction) of the radial network.

Phase 2 Trial Results - Prices

Reservation prices - Average around £18/MW/h

> STOR which are more £3-4 range
> Flexible Power Dynamic service £5



Utilisation prices are less focussed around the £300 MWh value than in Phase 1.

Average is similar circa £280

Contract prices reflect the market rules so could be bid price, offer price or price of highest cleared trade depending on demand vs supply.

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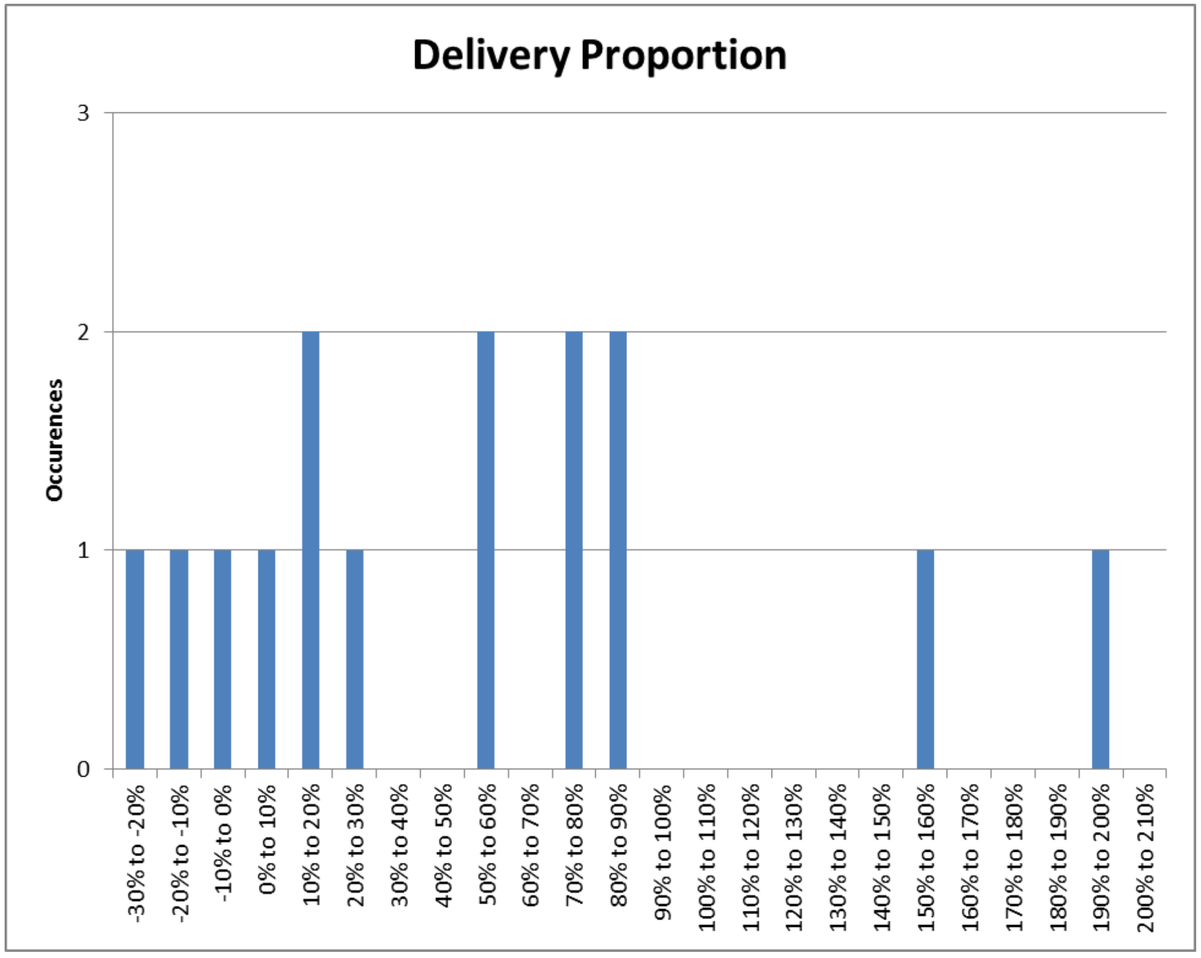
Phase 2 Trial Results - Delivery



Delivery values showed even more variation than Phase 1.

In order to investigate negative delivery values that were reported, additional domestic customer events were added. This skews average delivery.

Initial calculations were depressed by the baselining methodology introduced in Phase 2. An adjustment to reflect conditions on the event day resulted in baselines being raised too high due to ramp up being non-trivial. Adjustment shifted to compare three half hours starting two hours before the event.

Results broadly in line with Phase 1 after the baselining adjustment was corrected.

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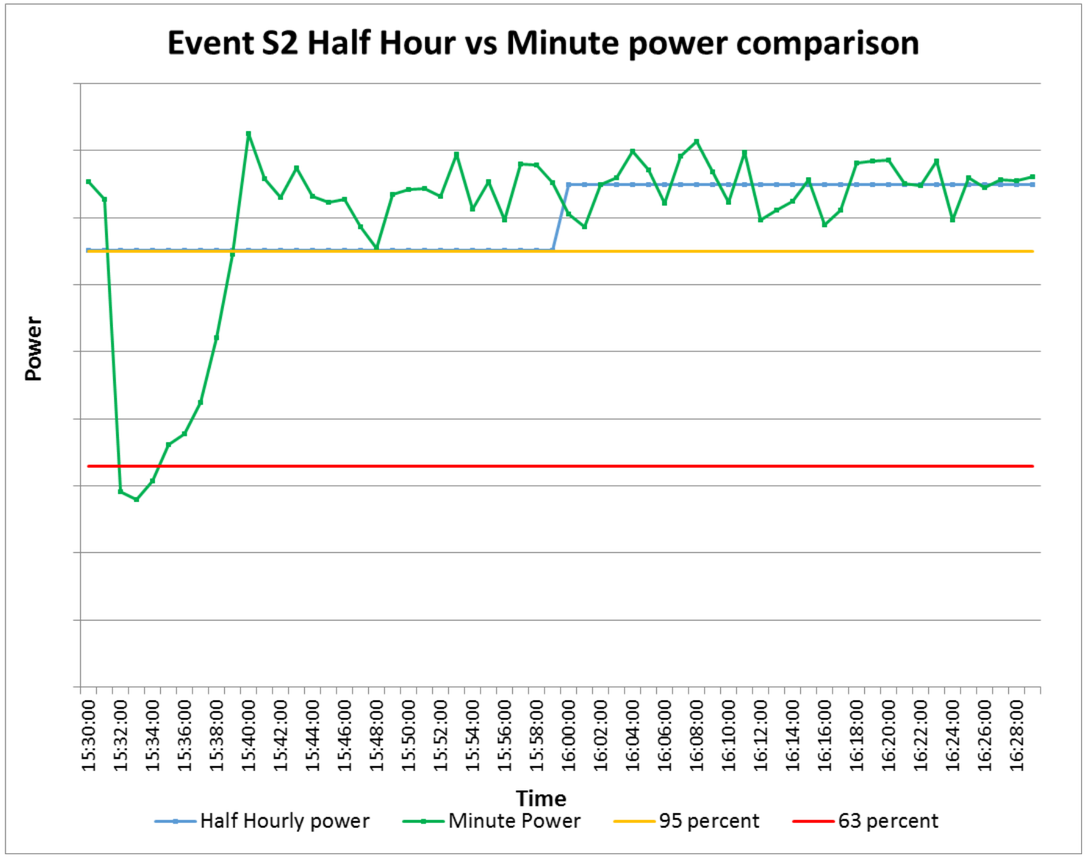
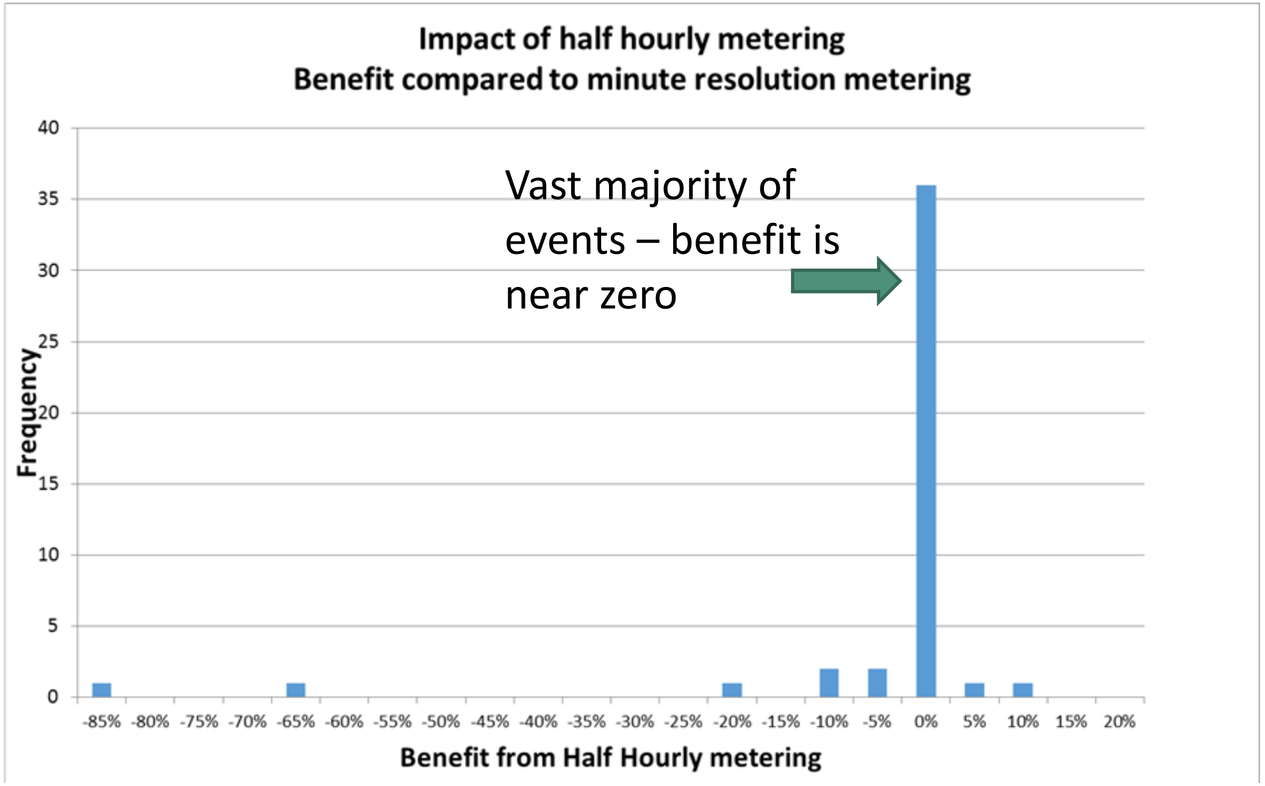
Project ENTIRE dataset used for analysis

Baselining – Metering Resolution

Half-Hourly vs. Minute resolution data



Penalties that apply to minute resolution data may be different to half hourly averages as under-delivery compensated by over-delivery. Potential for half hourly metered customers to benefit from averaging.



Initial view - No systematic benefit to use of half hourly metering

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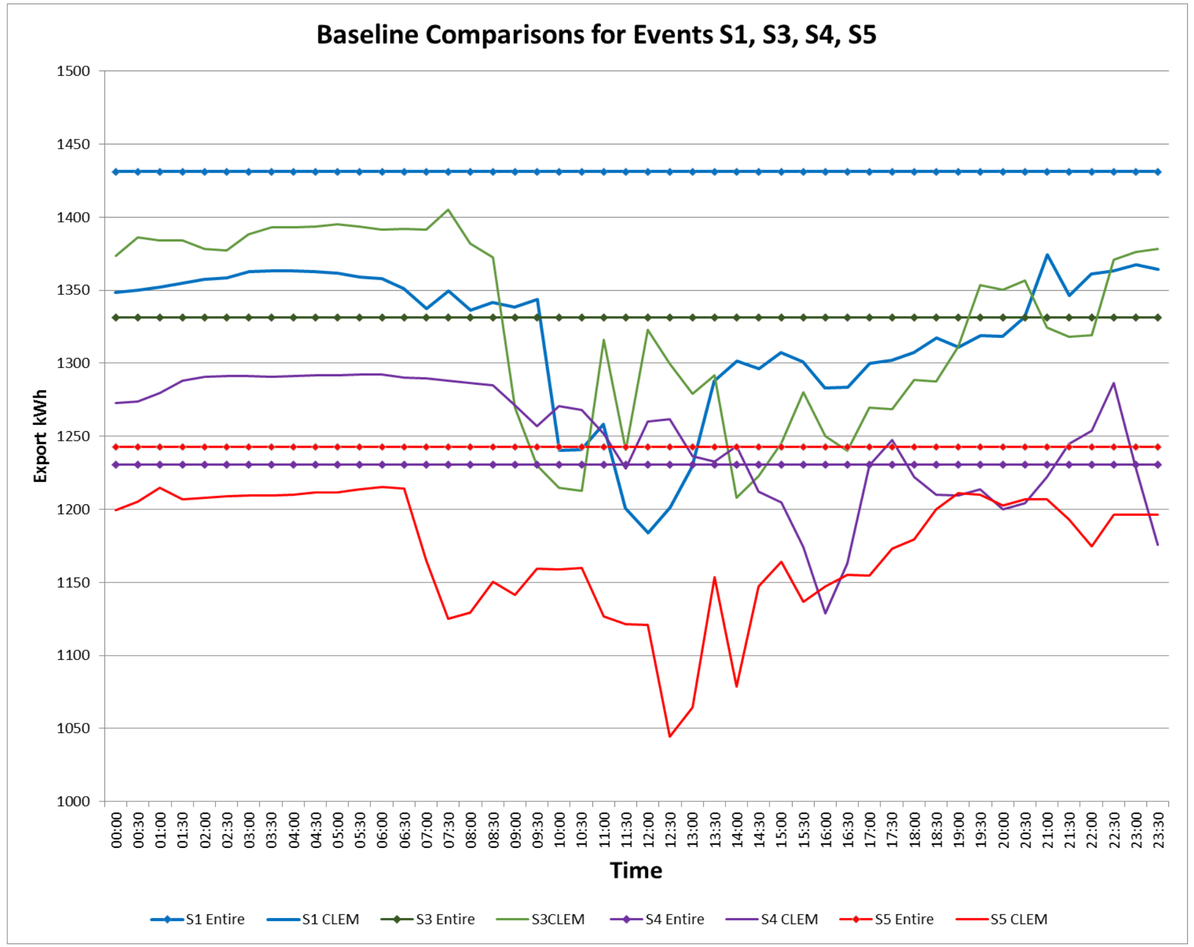
Project ENTIRE dataset used for analysis

Baselining – Day / half-hour selection



Events for May, Jun, Jul Aug – same customer

ENTIRE	CLEM
First 3 full weeks of previous month (Mon-Fri) i.e. 15 working days	Previous 10 working days
Average of 3pm-8pm	Half Hours corresponding to event Half Hours
No Day-of-event adjustment	Day-of-event adjustment applied

Straight line = ENTIRE , varying line = CLEM

Considerable variation in baseline between months

Events towards the end of the month have biggest difference between CLEM and ENTIRE approach reflecting ENTIRE day selection

Smoothing may help provide customers with usable target values – further investigation required.

Domestic Customers

Negative delivery reported for domestic battery cluster in Phase 1 trial.
Cluster baseline and performance calculated with aggregated data - does not calculate for each customer.

Battery system suggested correct service delivery.
Potential issue – inappropriate baselining or delivery negated locally

Phase 2 used larger clusters of customers - better alignment between battery system and smart meter data calculated performance.

Recommendation further research

1. What are the requirements to avoid this issue?
    - number of customers
    - aggregated capacity
    - ratio of battery capacity to average consumption
    - standard deviation of average consumption
2. Alternative baselining methods

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Next Steps - WPD

Innovation

- EFFS
- IntraFlex
- FutureFlex

Business as Usual

- Flexibility First
- Flexible Power Baselining update
- Hayle flex services

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Next Steps – Flexibility First

Visibility
- Forecasting of system needs
- Publication of flexibility data
- Signposting to where flexibility services will be required

Accessibility
- Multiple routes to market
- Access options for a wide range of participants
- Low barriers to entry

Sustainability
- Investable flexibility products
- Ensures value of flexibility is realised
- Aligned to decarbonisation

Transparency
- Open processes
- Auditable decisions
- Consistent outcomes

90% of remaining ED1 load related expenditure to be assessed for flexibility suitability

Pricing strategy to reflect market maturity
Fixed price, pay as clear, full market

Dispatch Principles

Fairness	We will share the dispatch of utilisation across all providers offering availability
Competitive	Acceptance of availability will be shared across the largest number of providers
Operability	Providers offering greater operability will maximise their chance of participation
Security	The needs of the system will be met using flexibility in such a way that supply of security is maintained
Value	Flexibility will be operated to meet system needs with the minimum level of over-procurement

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Next Steps - Centrica

We are live	Cornwall LEM is live and trading
We are scalable	The platform is robust and modular, with in-built scalability By importing a grid model, we are able to quickly spin up new instances of the LEM beyond Cornwall
We are expanding	New international pilots secured We want to make regular, auction-based T/D flexibility markets a reality in 2020 across Europe

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Q&A

Any Questions?

THANK YOU FOR LISTENING

ANY FURTHER QUESTIONS?

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