resillion

Interoperable Demand Side Response

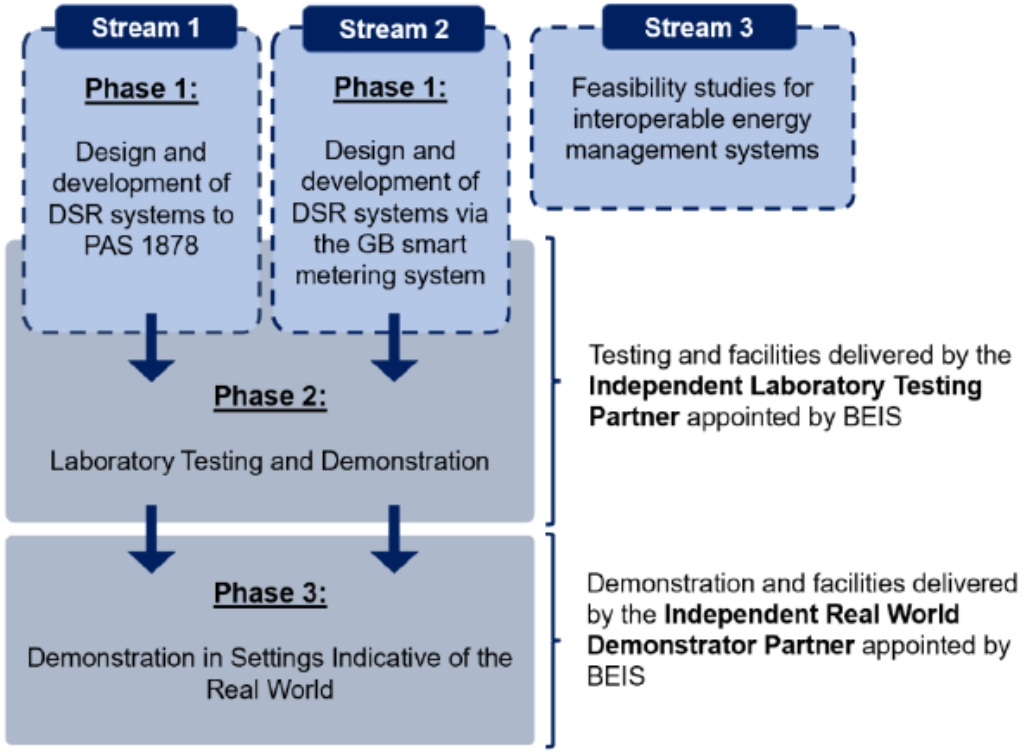
Demonstrations and Performance in Settings Indicative of the Real World

Department for Energy Security & Net Zero

The IDSR programme is part of the up to £65m Flexibility Innovation Programme within the Department for Energy Security and Net Zero's £1 billion Net Zero Innovation Portfolio

Context

The IDSR Programme supports the development and demonstration of energy smart appliances



Phase 2 / Lot 1: Conformance Testing

- Individual products: ESA, DSRSP
- Validate conformance with specifications and standards
- Basic interoperability

Phase 3 / Lot 2: Demos & Performance

- Multiple ESAs
- Larger interoperability groups
- System-level scenarios and use cases

Project Overview

IDSR – Demonstrations & Performance in Settings Indicative of the Real World

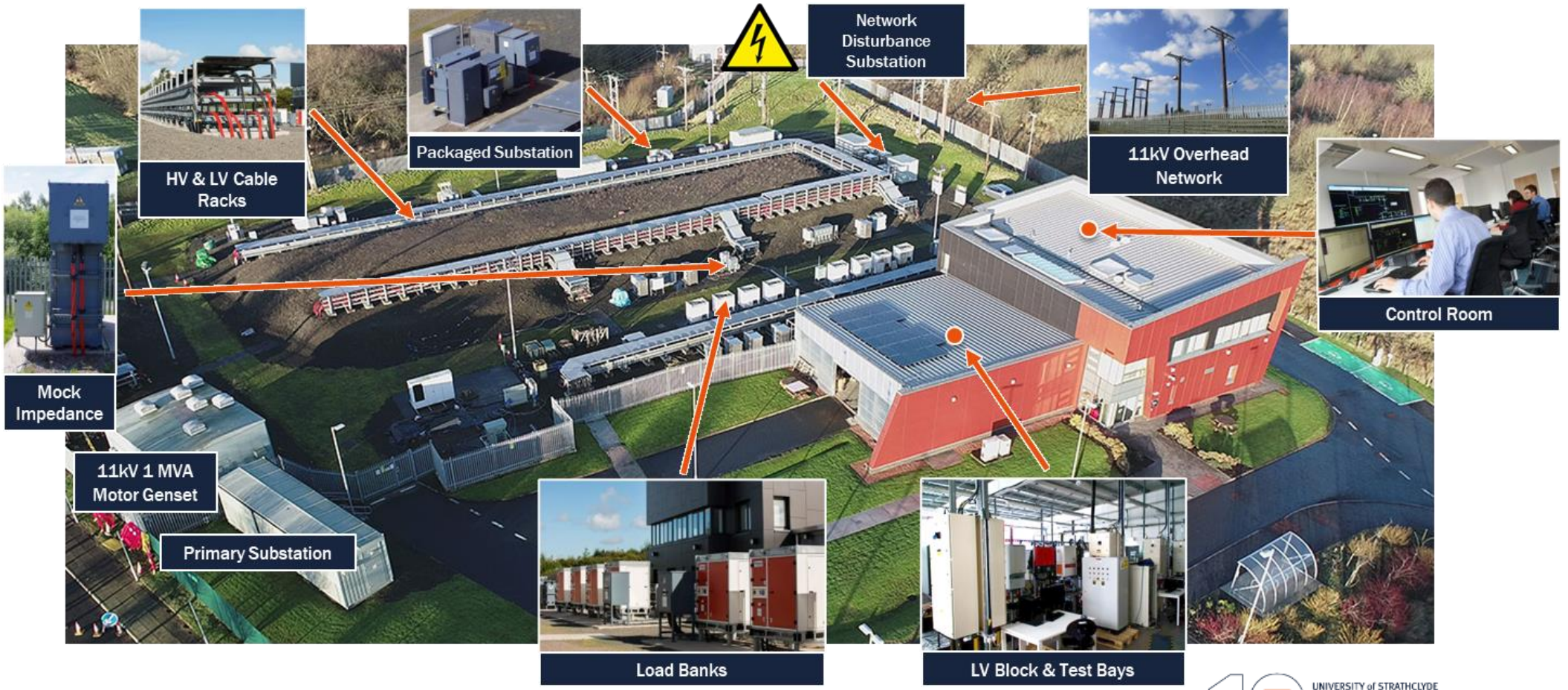
Scope:

- DSR based on PAS 1878/1879 (with OpenADR) and on the GB Smart Meter System
- Demonstrate a mix of ‘Energy Smart Appliances’ (EV chargers, heat pumps, battery storage… up to 20 in each interoperability group) and DSRSP platforms
- Measure performance in delivering a range of DSR services (reduce, increase, delay, or ‘smooth’ energy demand)
- Demos and showcase presentations

Timeline:

- Jan 2023-Apr 2024: Design and develop demonstration schemes and lab
- May 2024-Sep 2024: Demo/Interoperability projects and reporting

Demonstration Facility at PNDC



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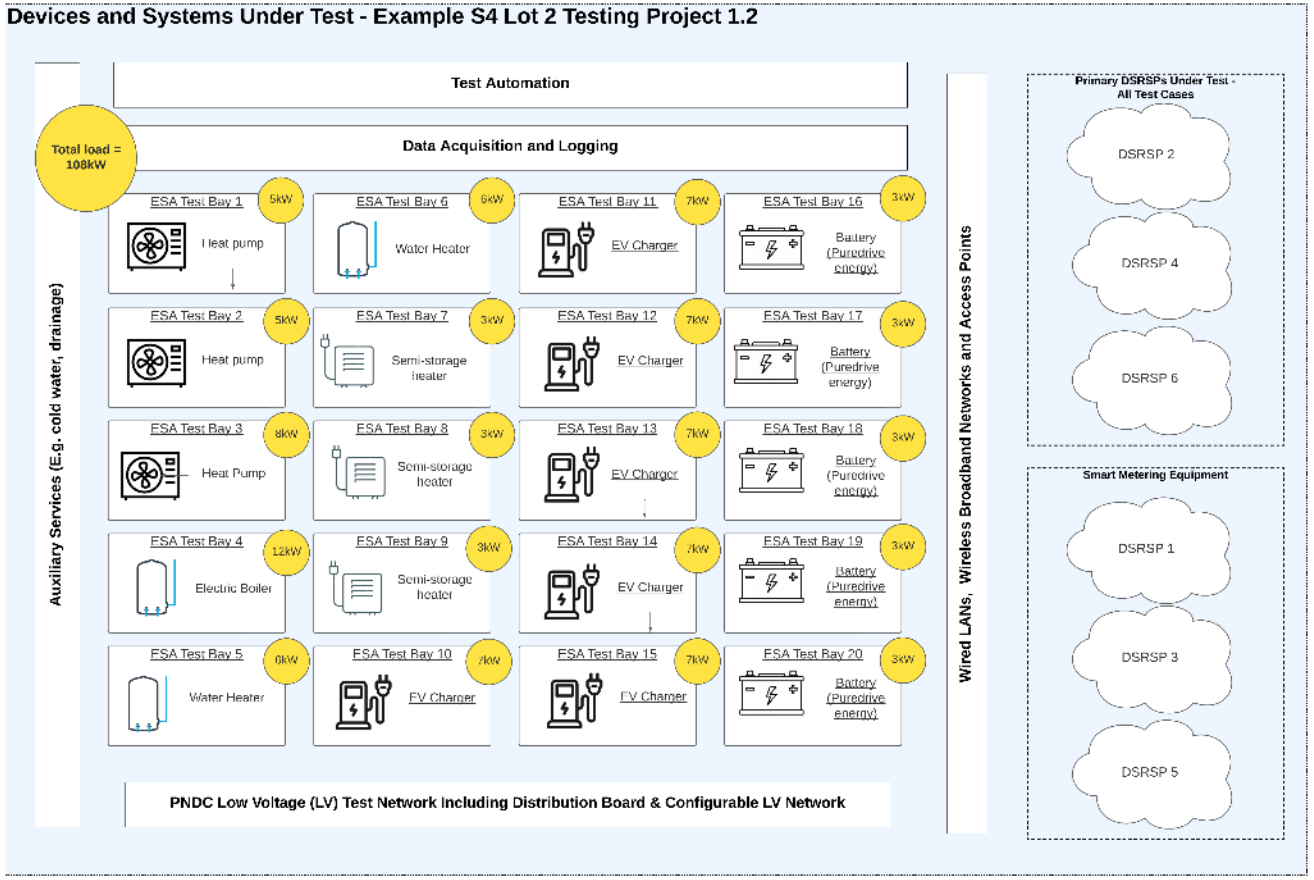
Settings Indicative of the Real World

IDSR Lab at PNDC



- Groups of ESAS representing multiple premises connected to a common substation
- ESA demo bays configured with electrical, communication, and auxiliary services to mimic a real-world environment
- Thermal and electrical load emulation for Smart EV Charge Point, and Electric HVAC device types
- Time-synchronized power quality monitoring and data logging equipment, including sub-second frequency response
- Multiple DSRSP platforms available for interoperability demonstration

Demonstration Scenarios

Defined by IDSR Programme and Grid Objective use cases

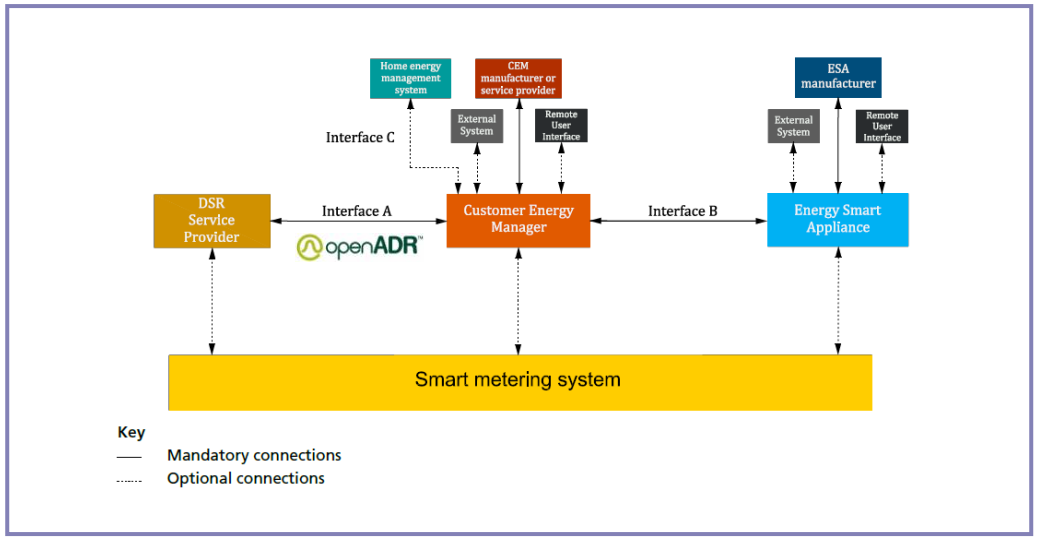
IDSR Programme Use Cases	
A	Consumer registering DSR appliance with CEM (where not integrated)
B	Consumer registering with the appointed DSRSP
C	Consumer defining DSR preferences
D	Routine DSR mode of operation based on preferences tariff (ToU)
E	Sending power profiles from ESA to CEM and to DSRSP
F	Response DSR mode of operation
G	Consumer over-ride of DSR response mode and routine mode
H	DSRSP maintaining DSR service delivery despite availability changes
I	Consumer de-registers ESA from CEM and DSRSP
J	Change of incentive information
K	Consumer changes DSRSP

Grid Objective use cases (PAS 1878 / 1879)

- Match the short-term availability of intermittent renewable energy generation sources such as wind and solar
- Decrease the peak load on the electrical transmission and distribution networks to alleviate the need for network upgrades to handle new domestic appliance types
- Allow the offset of short-term market imbalances by controlling flexible load on the network
- Allow control of electricity network characteristics such as line frequency, system inertia and network voltage, and help prevent network and generation outages

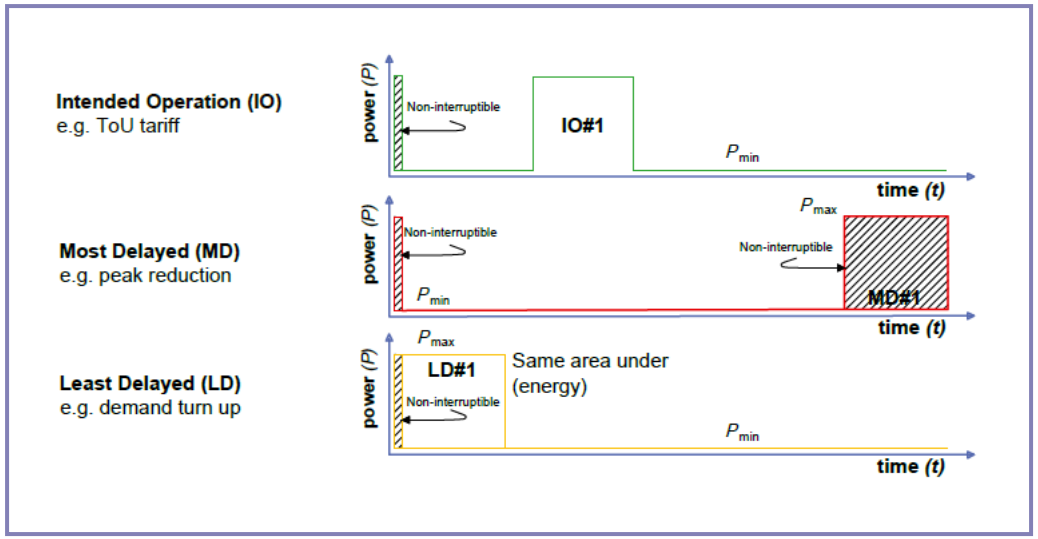
OpenADR and PAS 1878

Some important technical considerations



PAS 1878 Communication Architecture

- OpenADR is used in Interface A (DSRSP to CEM / ESA)
- Stream 1: 'Conventional' OpenADR over internet
- Stream 2: OpenADR 'tunnelled' through GB Smart Meter Network
  - Over DCC Network
  - Over internet with authentication in Smart Meter components



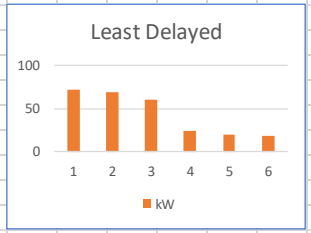
PAS 1878 Power Profiles

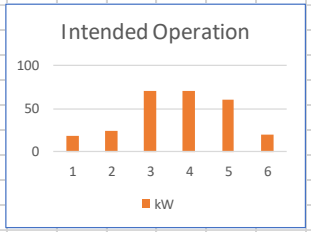
- ESAs are required to provide Power Profiles to the DSRSP platform
- Mandatory: Intended Operation, Most Delayed, Least Delayed
- Optional additional (max 1000) flexibility offers
- DSRSP picks from available profiles for DSR events

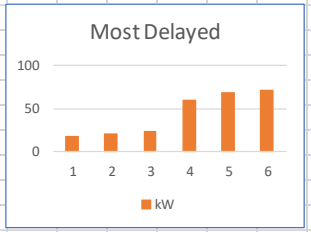
Aggregate Demand Modelling

Used as a guide for designing demonstration scenarios

							LD demand (kW) by hr						IO demand (kW) by hr						MD demand (kW) by hr					
ESA #	ESA type	Peak demand (kW)	Storage capacity (kWh)	Starting condition	Target end condition	Total need (kWh)	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
1	Water heating	3	10	20%	100%	13.33	3.00	3.00	3.00	3.00	1.33			3.00	3.00	3.00	3.00	1.33		1.33	3.00	3.00	3.00	3.00
2	Water heating	3	10	20%	100%	13.33	3.00	3.00	3.00	3.00	1.33			3.00	3.00	3.00	3.00	1.33		1.33	3.00	3.00	3.00	3.00
3	EV Charger	7	60	50%	80%	20.00	7.00	7.00	6.00						7.00	7.00	6.00					6.00	7.00	7.00
4	EV Charger	7	60	50%	80%	20.00	7.00	7.00	6.00						7.00	7.00	6.00					6.00	7.00	7.00
5	EV Charger	7	60	50%	80%	20.00	7.00	7.00	6.00						7.00	7.00	6.00					6.00	7.00	7.00
6	EV Charger	7	60	50%	80%	20.00	7.00	7.00	6.00						7.00	7.00	6.00					6.00	7.00	7.00
7	EV Charger	7	60	50%	80%	20.00	7.00	7.00	6.00						7.00	7.00	6.00					6.00	7.00	7.00
8	EV Charger	7	60	50%	80%	20.00	7.00	7.00	6.00						7.00	7.00	6.00					6.00	7.00	7.00
9	Battery	1.2	2.6	20%	80%	1.73	1.20	0.53							0.87	0.87							0.53	1.20
10	Battery	1.2	2.6	20%	80%	1.73	1.20	0.53							0.87	0.87							0.53	1.20
11	Battery	1.2	2.6	20%	80%	1.73	1.20	0.53							0.87	0.87							0.53	1.20
12	Battery	1.2	2.6	20%	80%	1.73	1.20	0.53							0.87	0.87							0.53	1.20
13	Battery	1.2	2.6	20%	80%	1.73	1.20	0.53							0.87	0.87							0.53	1.20
14	Heat pump	12	-	-	-	28.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80
15	Heat pump	12	-	-	-	28.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80
16	Heat pump	12	-	-	-	28.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80	4.80
17	Electric heating	2	-	-	-	4.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
18	Electric heating	2	-	-	-	4.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
19	Electric heating	2	-	-	-	4.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
20	Electric heating	2	-	-	-	4.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
		98	**393**			**260.93**	**71.6**	**68.25**	**59.6**	**23.6**	**20.26**	**17.6**	**17.6**	**23.6**	**69.93**	**69.93**	**59.6**	**20.26**	**17.6**	**20.26**	**23.6**	**59.6**	**68.25**	**71.6**







Notes:

- Modelling is approximate and used as a design input, not aiming to be 100% accurate
- ESA logic for flex offers is still under development in most projects
- Profiles are expected to change based on tariffs, user preferences, environment conditions
- Similarly, DSRSP logic is still under development
- In a large scale deployment we would expect DSRSPs to use statistical modelling

Example Demonstration: Decrease Peak Load

Primary use cases covered

- Grid Objective: Decrease peak load
- Use Case F: Response DSR mode (PAS 1878 Mode 2)

Starting conditions

- ESAs are commissioned and registered with a DSRSP
- ESAs have provided flexibility offers to the DSRSP
- Demand under Intended Operation is known/predictable

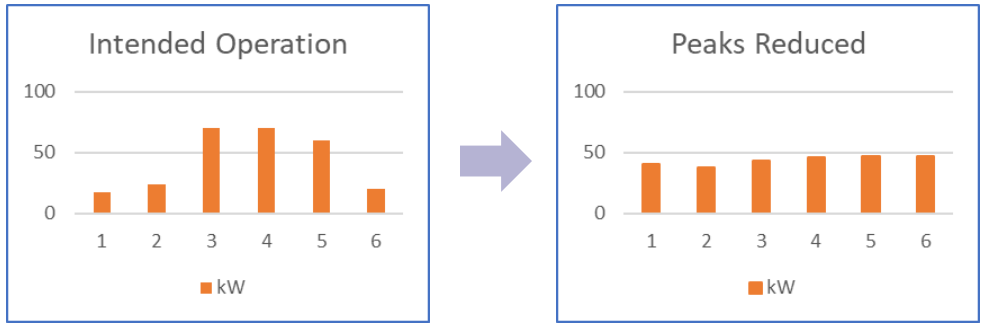
Demonstration initiation

- A DSR Service Request is submitted to the DSRSP, specifying a threshold below which peak loads should be constrained

Performance assessment is a comparison between demand profiles:

- Aggregated Intended Operation forecast by DSRSP
- Requested demand under DSR intervention
- Measured demand based on actual DSR response

Observation / Measurement	Source	Present as
DSR request acceptance	DSRSP platform	Commentary
Flexibility offers requested and accepted	DSRSP platform	Per request: - ESA identifier - LD or MD requested - Outcome
Reported power flows per ESA	DSRSP platform	Graph of power over time
Measured power flow all ESAs	Lab power supply	Graph of power over time
Measured power flow per ESA	Each ESA	Graph of power over time
End condition (storage)	Each storage type ESA	Single measurement kWh
Heat output (heating)	Each heating ESA	Graph of heat output over time



Target Outcomes & Outputs

In support of accelerated adoption of domestic DSR

- Feedback to funded projects on interoperability and performance of ESAs and DSRSPs in simulated real-world conditions
- Data from the study will be available to extrapolate to larger scale and inform design work on future energy networks
- Contribute to lessons learned, for continuing standards development – future PAS 1878 revisions and regulatory intervention

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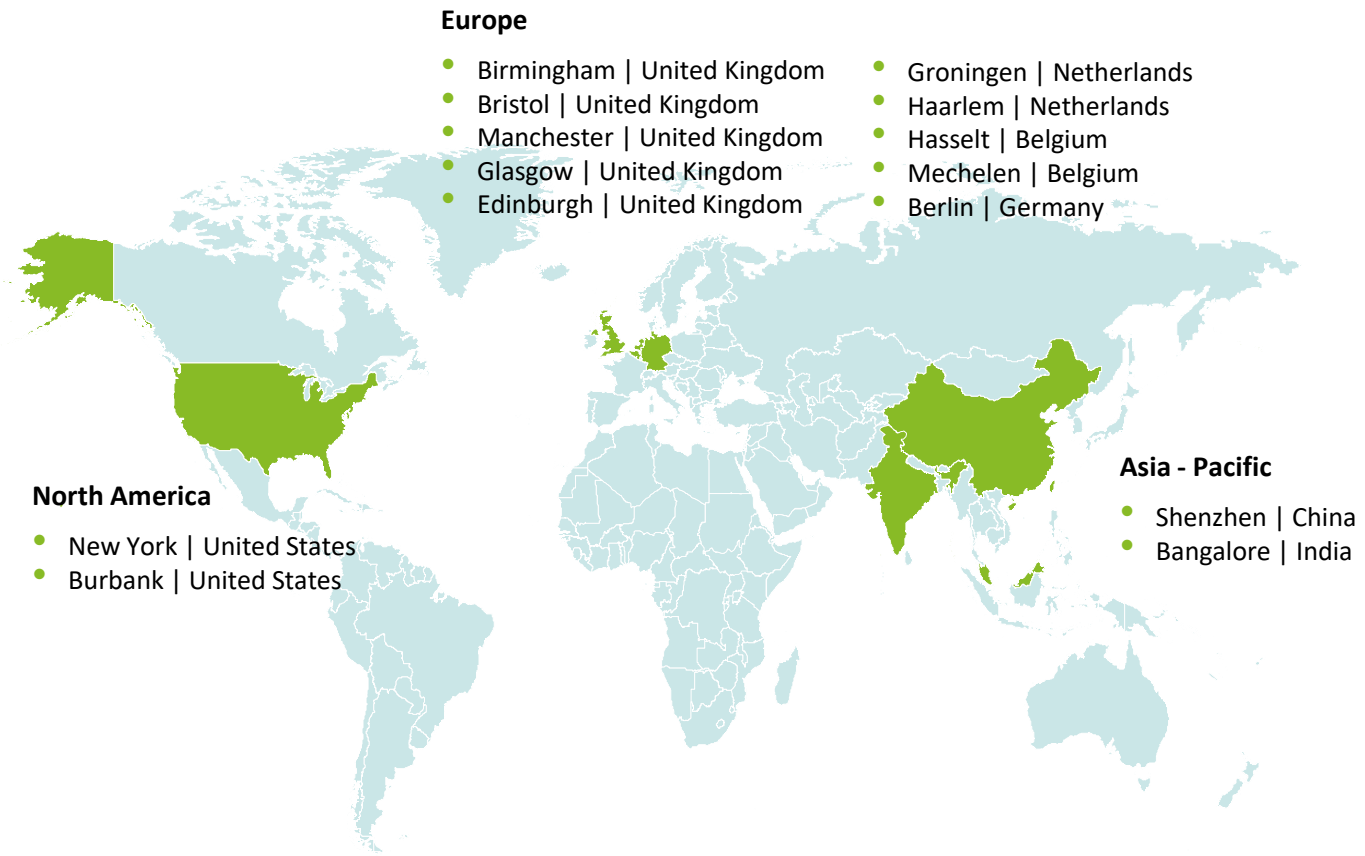

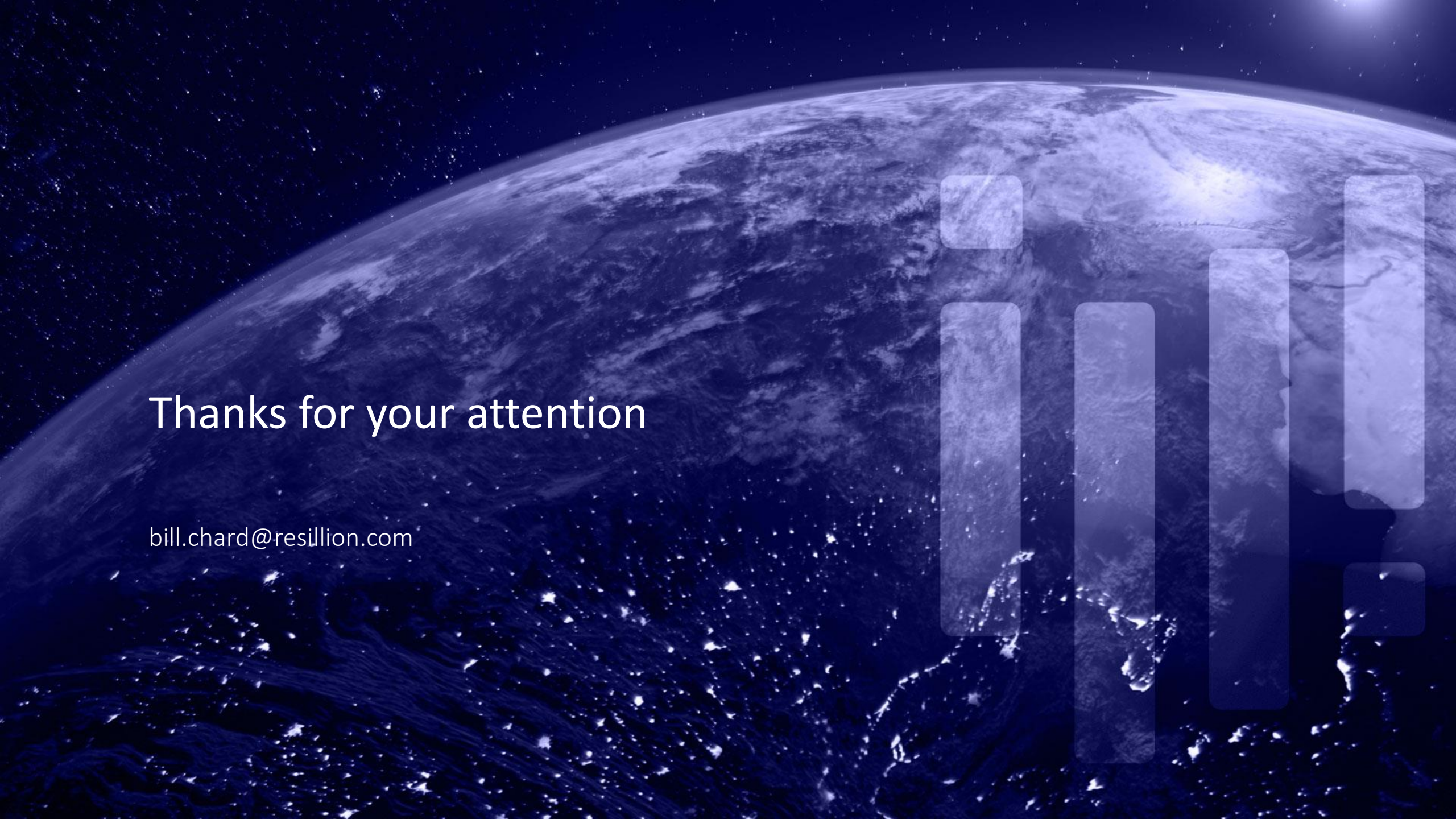
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