energy fusion

Discussing the convergence of efficiency, procurement and flexibility

10.30-11.15

Combining DER, DSR & Storage to deliver maximum gains

How to achieve best bang for buck by harnessing all available sources of flexibility - and putting it in the right place at the right time.

UKPN: DSO Flexibility activities

Stathis Mokkas
Energy Markets Lead – UK Power Networks

18 April 2018

THE SUNDAY TIMES 30 BEST BIG COMPANIES TO WORK FOR 2017

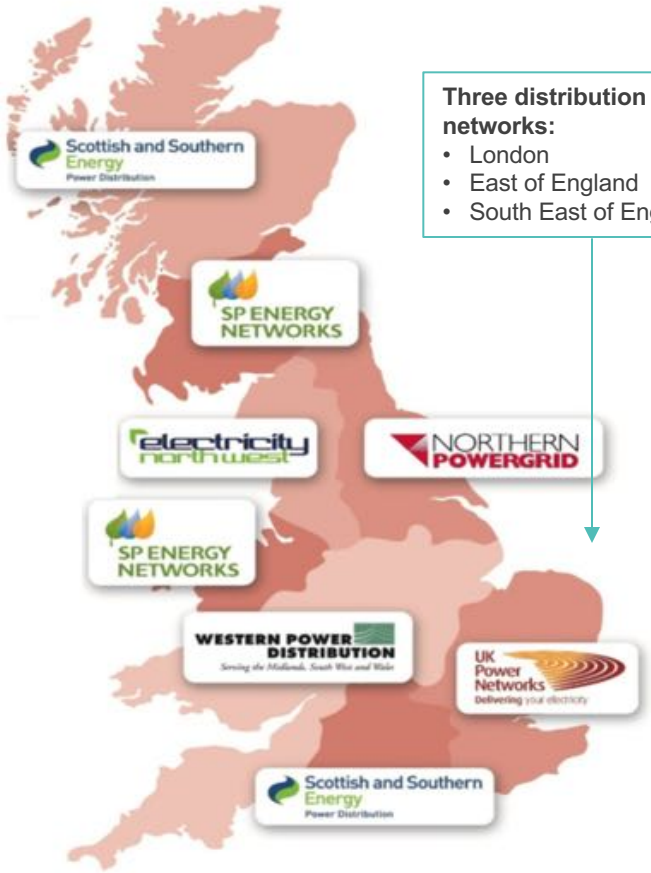
Utility Week Awards 2016 WINNER Utility of the Year

INVESTORS IN PEOPLE | Gold

UK Power Networks
Delivering your electricity

About **UK Power Networks**

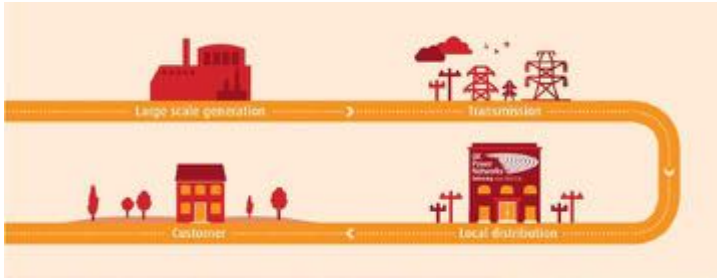
Measure	Data	% of industry
End customers	8.2m	28%
Population served	20m	28%
New metered connections*	46,000	32%
Distributed generation connected	8.9GW	31%
ED1 totex allowance	£6,029m	25%
Energy distributed	85TWh	28%
Peak demand	16GW	28%



Three distribution networks:

- London
- East of England
- South East of England

The new energy system … is here



Old world
Centralised (Few, large generators)
Predominantly fossil fuel based
One way power flows
Predictable - Planned
Customers consume
Flexibility from generators

New world
Decentralised (Thousands of distributed generators)
Hybrid - much more renewables
Bi-directional power and information flows
Intermittent - Managed
Customer self-produce and consume
Flexibility from Demand, Storage and Generation

And will be even more so in 2030

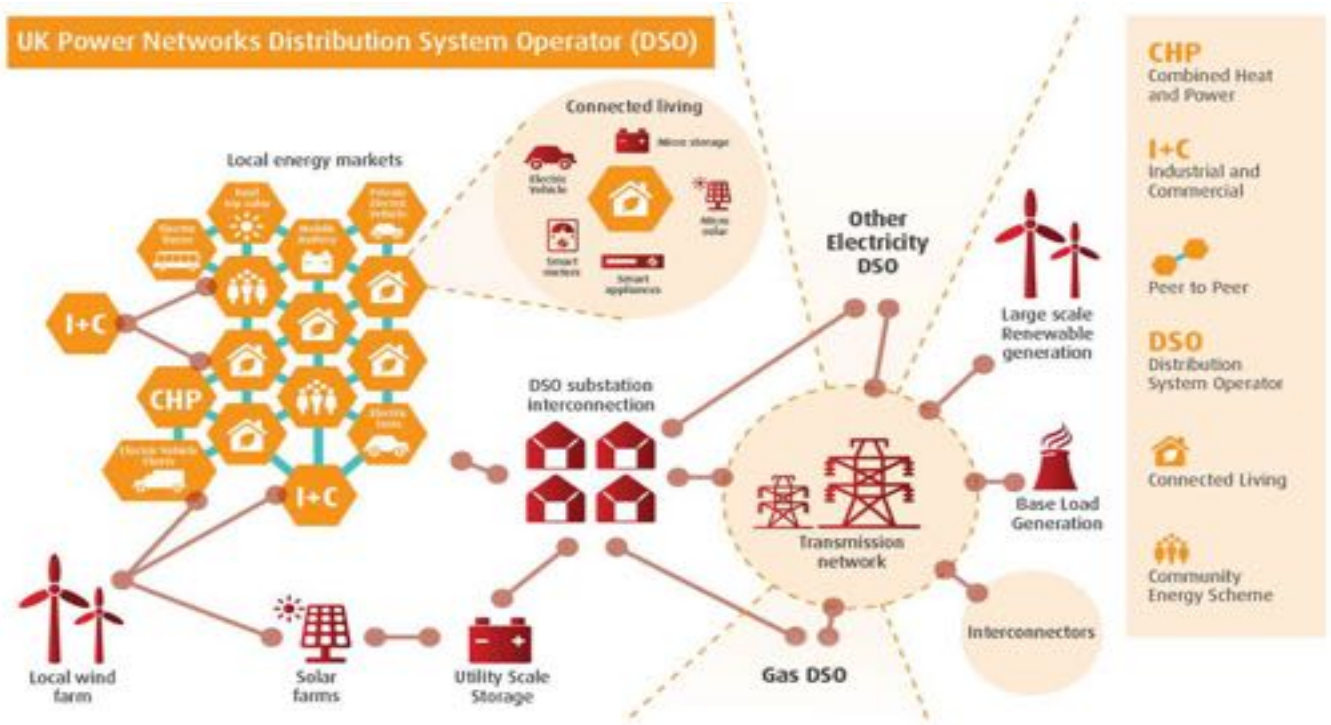
Distribution networks acting as a facilitator for a wide range of energy resources and market models

The UKPN world in 2030

~13 GW of solar

~4 GW of storage

~1.2-2m Electric Vehicles



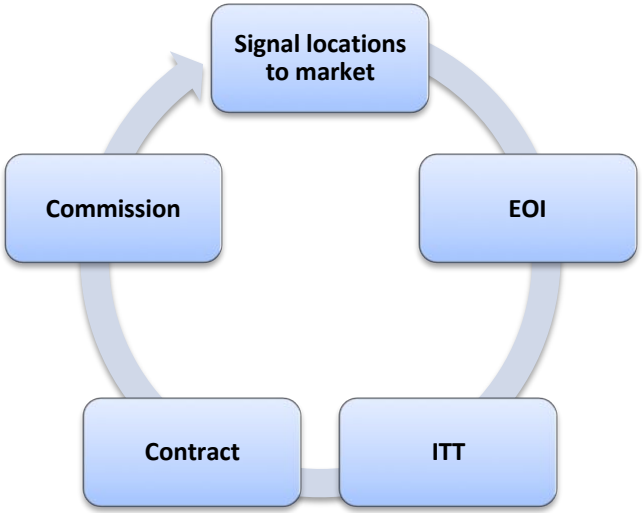
Enabled by:

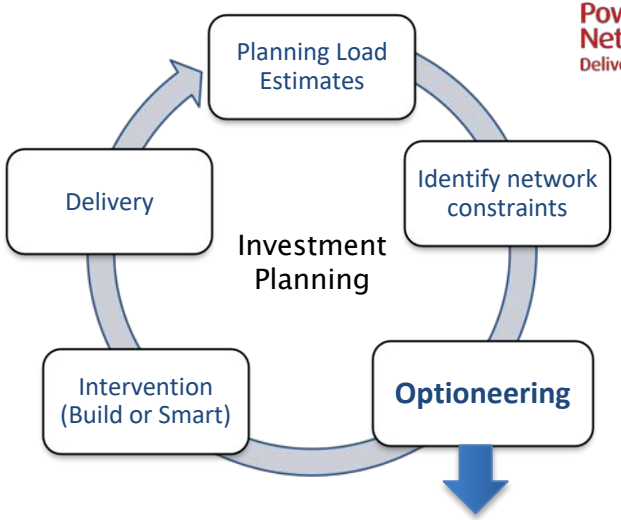
- Smart meters
- Distributed Generation
- Storage
- Micro Grids
- Community Energy and peer-to-peer
- Electric Vehicles
- Smart appliances
- Market and regulatory reform
- Demand flexibility

Using **customer flexibility**

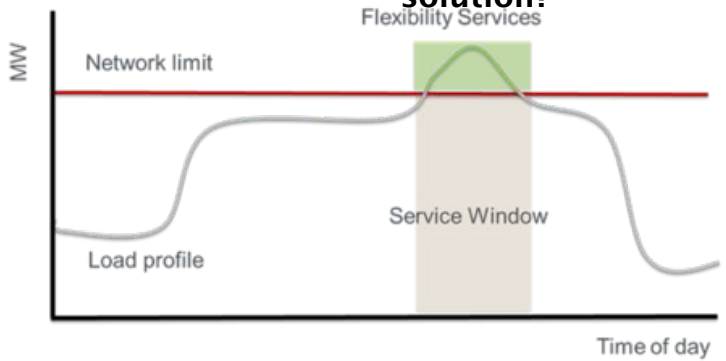
An alternative to network upgrades

- **RIIO-ED1 Business Plan**
  - Demand growth (MW)
  - Across all networks (EPN, SPN, LPN)
  - Load related (LR) allowances





A market solution?



UKPN ongoing & next steps

- Flexibility
  - Deliver first flexibility contracts and review learning
  - Embed the systems and processes to dispatch flexibility
  - **Q2/Q3 2018 – Next tenders & wider consultation**
  - Working with Open Utility to create an online market place for flexibility providers

- Other activities
  - **Power Potential** – A reactive power market to deliver whole system benefits
  - **Flexible DG** – Market mechanisms in connections
  - **Coordination** – Working with ENA to unlock value
  - **EVs** – Participation in four V2G Innovate UK projects

Key points to take away

- UKPN leading the industry
  - Facilitating energy transition by developing infrastructure & markets proactively
  - Working with our customers and providers to shape this exciting future
- Keep engaging
  - You have assets in advertised areas, talk to us
  - You face conflicts of services, advise us how to resolve them
- Market opportunities are here to stay
  - Distribution system (e.g. Flexibility) and Whole System (e.g. Power Potential)
  - Be creative with what your assets can deliver

Thank you

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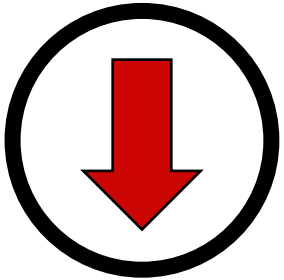
UK Power Networks
Delivering your electricity

redT energy storage

Combining DER, DSR and Storage for Maximum Gains

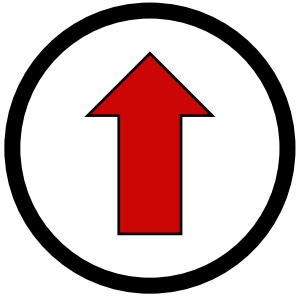
Delivering flexibility with renewables + storage

Energy market trends



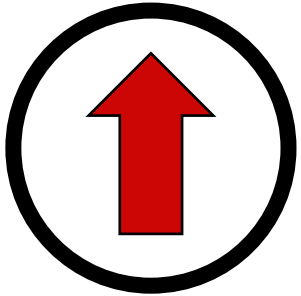
Cost of Solar Generation

Tending to £0/kWh



Power Price Volatility

Peak Prices Rising



Grid Service Revenues

USA, UK + others coming online

Distributed infrastructure energy storage is now open for business

This is real, distributed infrastructure – not opportunistic investments based on short term (< 1 hour) arbitrage

redT energy storage

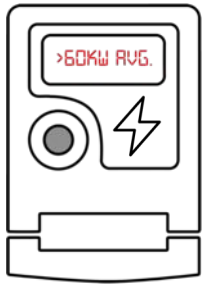
Where does storage work in the UK?

Off-Peak

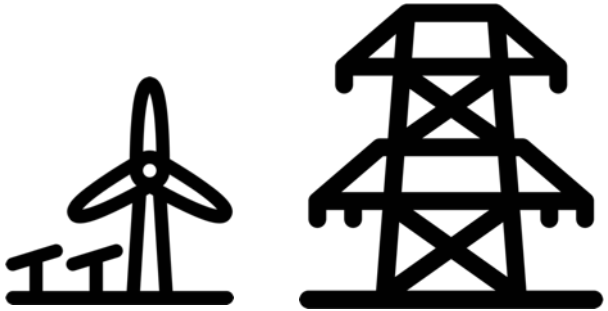
≥ 7p

Peak

≥ 10.5p

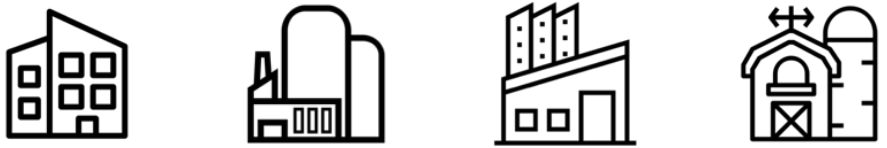


Average Demand
> 60kW



With or without on-site generation

Typical C&I site:
National infrastructure, Industrial sites, Agricultural facilities



Average Payback Period: 7-10 years

Typical IRR: approx. 15% (Unlevered)

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Unlocking energy storage in the UK

80%

Base Returns Locked In

New Solar
Grid-Connected

Use **more** solar
Firming solar: 24/7 solar power
Requires **4-8 hours** of storage

Batteries: 2 hours
Flow Machines: > 4 hours

UK C&I
Min. 60kW
Average Demand

Save **more** on energy bills
Renegotiate supply contracts
Access **wholesale** power prices

Requires **~5 hours** of storage to minimise price risk

20%

Merchant Revenue Upside

Contracted
Grid Services
(Fixed)

Access **more** revenues

Perform all services, remain flexible
Batteries: 1 service (Freq. response)
Flow Machines: All Services (stacked)

Merchant
Trading
(Variable)

Profit from price volatility
System balancing: **~4 hours** of storage

Batteries: 30 mins only
Flow Machines: 30 mins – 4 hours +

7-10 year
Project Payback

redT machines = flexible platform
Unlocking all PV, PPA, Grid and Trading Revenues
+ additional non-quantifiable benefits

~15%
IRR (Unlevered)

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Commercial revenue distribution - example

Commercial Breakdown

	Year 1 Total £/year	Year 5 Total £/year	Year 10 Total £/year
Total Savings & Revenues	**18,613**	**24,325**	**34,760**
Electricity Import Savings	11,547	17,185	25,605
Grid Services Revenues	7,066	7,140	9,155
Total Operational Costs	**(2,341)**	**(8,052)**	**(8,796)**
Total Net Revenues	**16,272**	**16,273**	**25,964**

Upside

- Lower energy pricing
- Hedge future volatility and market prices
- Move towards energy independence
- Energy Security/Critical UPS Function
- Further upside in trading revenues
- Flexible asset for future balancing services

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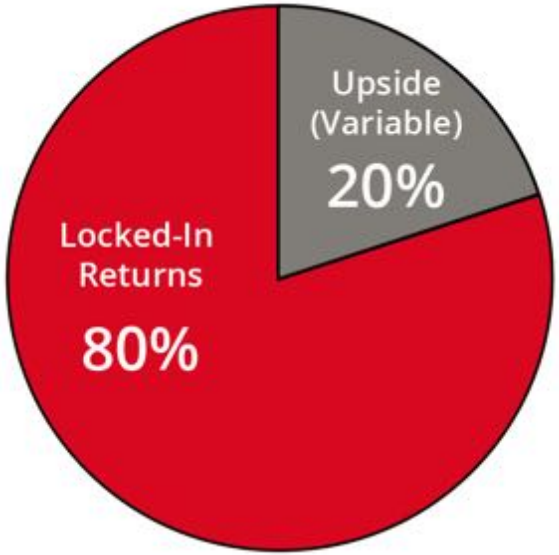
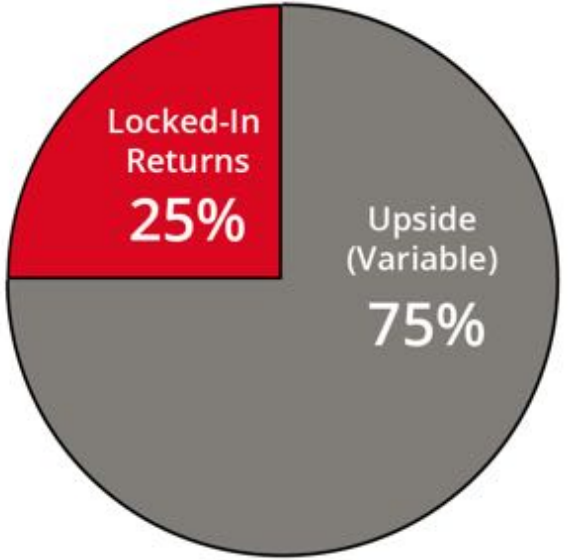
Unlocking energy storage in the UK

Energy Storage Infrastructure



High % of business case locked-in
Flexibility to change over time

Battery Storage



Returns at risk
Non-flexible business case

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Flexible platform – multiple business cases

Shift day time solar BTM to offset peak rates, triads, demand charges 4-6 hour

Wholesale billing BTM Shift day time solar to change energy bill to wholesale billing 4-6 hour

BTM Grid services
FFR, EFR, Store, Capacity 4-6 hour

BTM Energy trading
4-6 hour

UPS back up reserve

Energy future price hedging
Lock in your power generation for 20+ years

Solar + Storage Private wire PPA

Relieve grid constraints
Avoid costly grid connections

Trading and Grid balancing large scale
System balance and wholesale trading

BTM Voltage balance
Manage solar cloud cover demand voltage fluctuations

BTM grid independence

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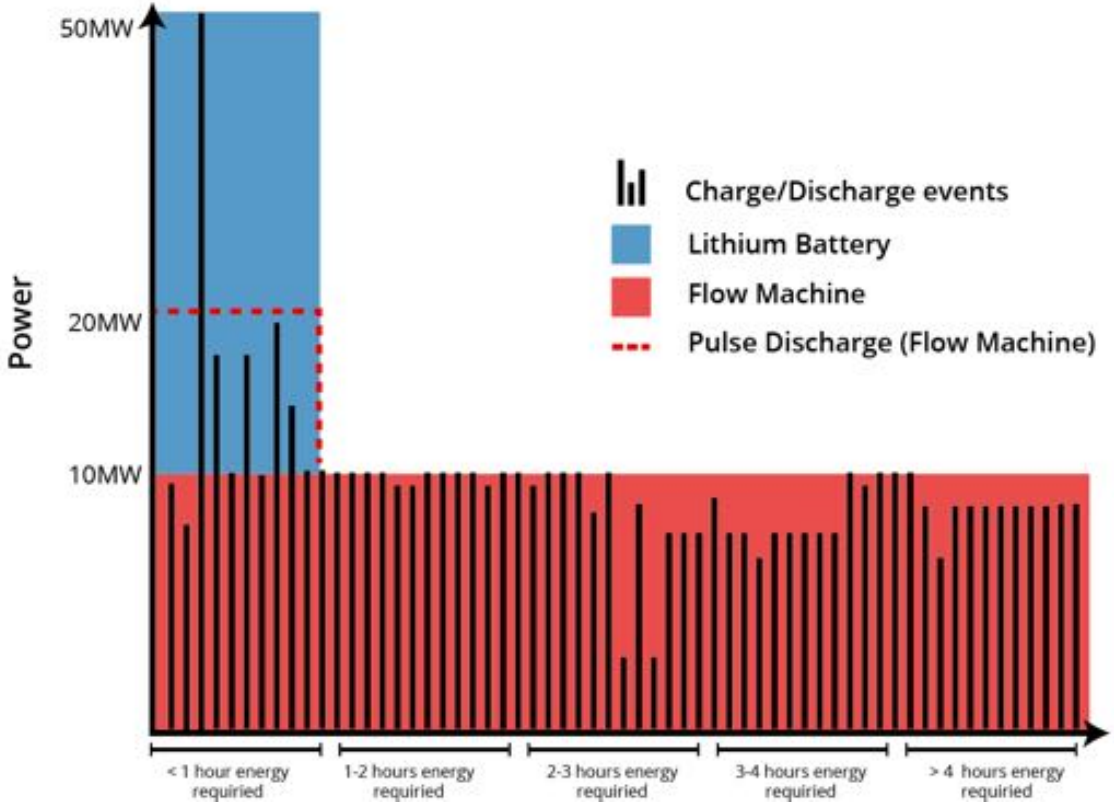
Hybrid grid-scale energy storage



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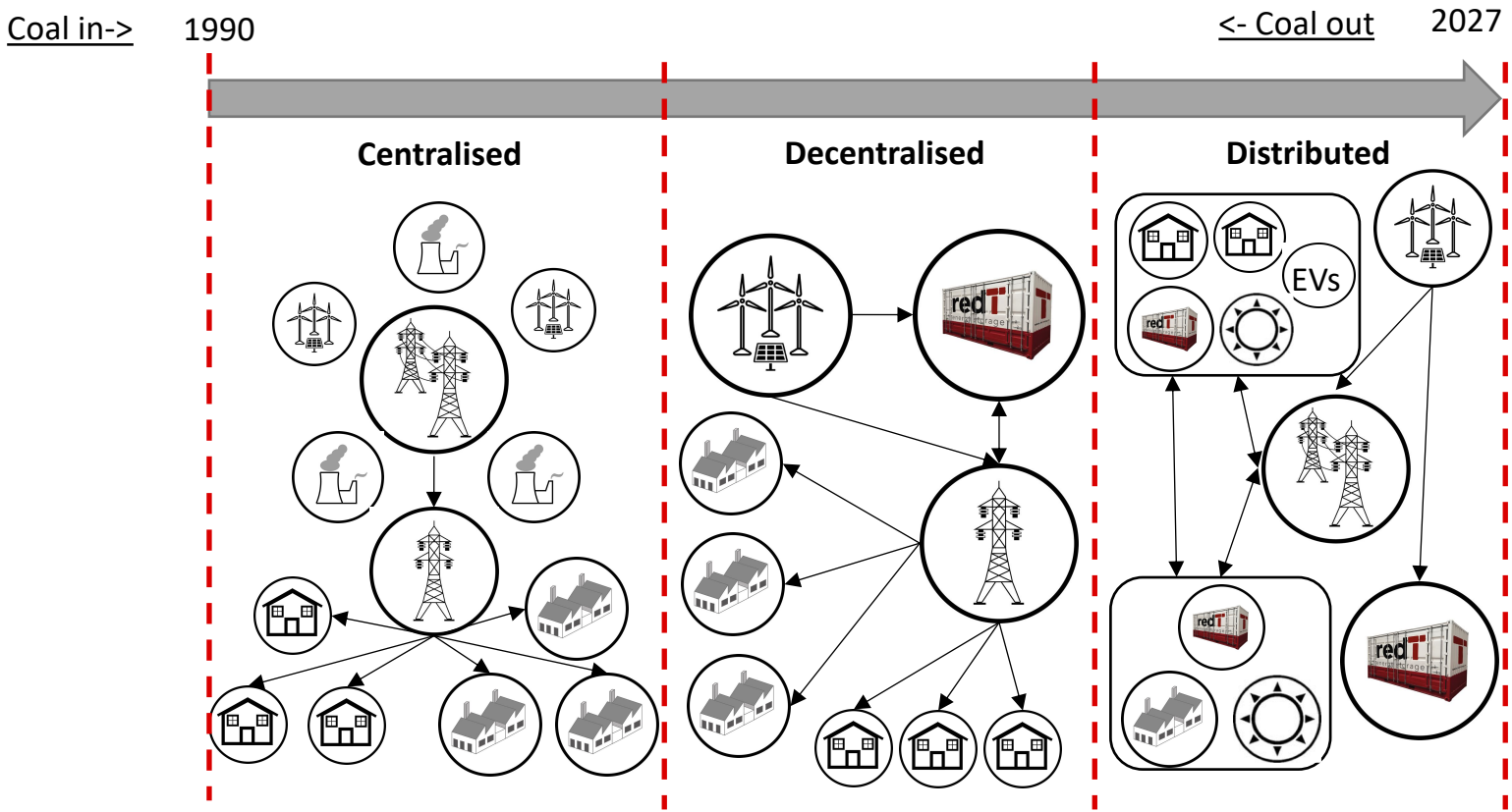
Future Energy Systems



Connected Energy
Energy storage using 2nd life EV batteries

Matthew Lumsden, CEO, Connected Energy
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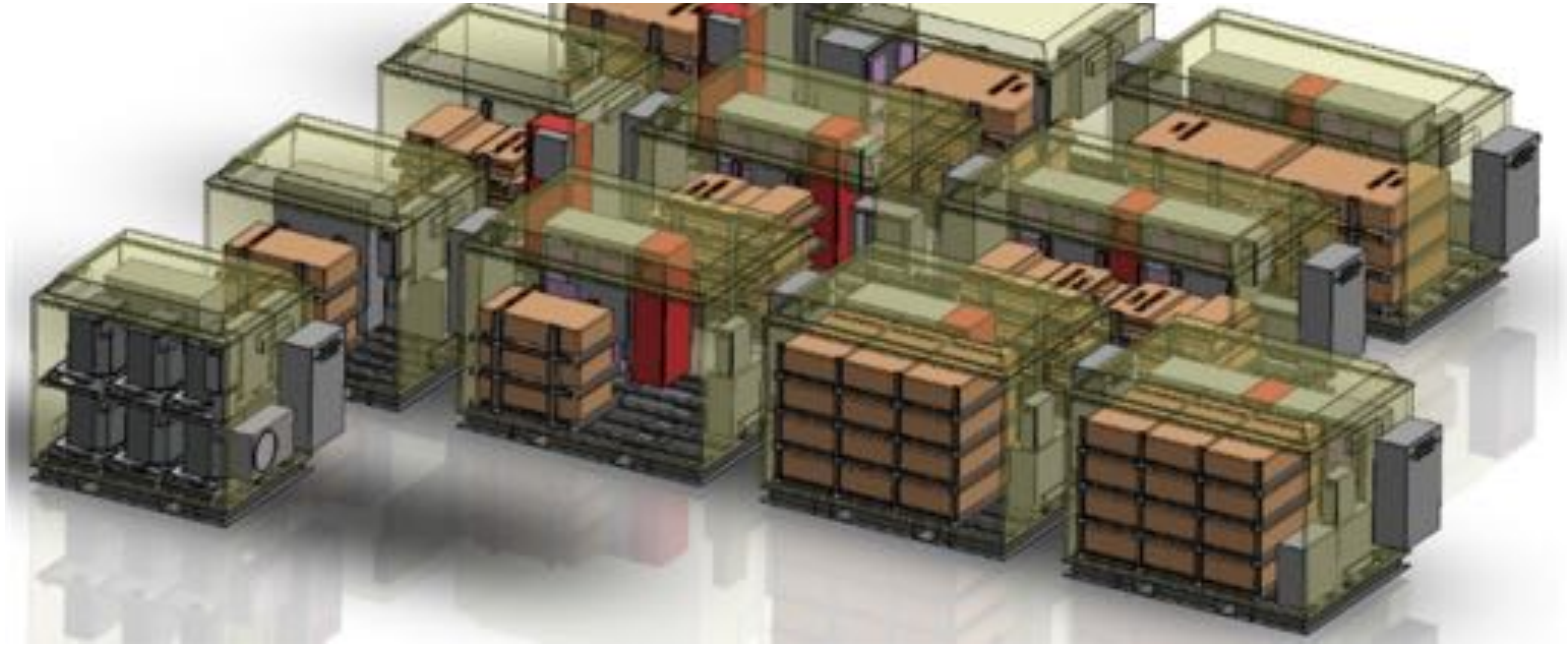
The energy storage hardware

Low cost, modular system, simple battery feedstock exchange

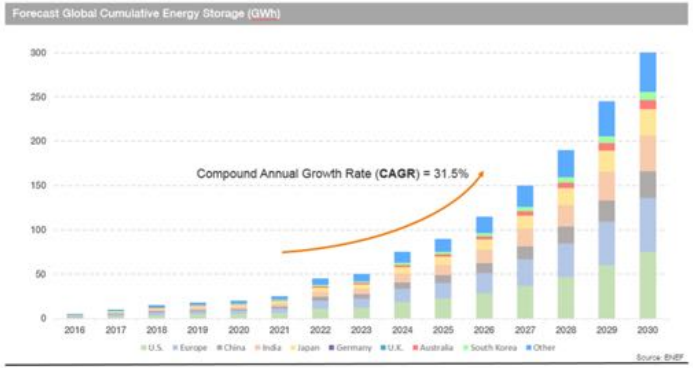


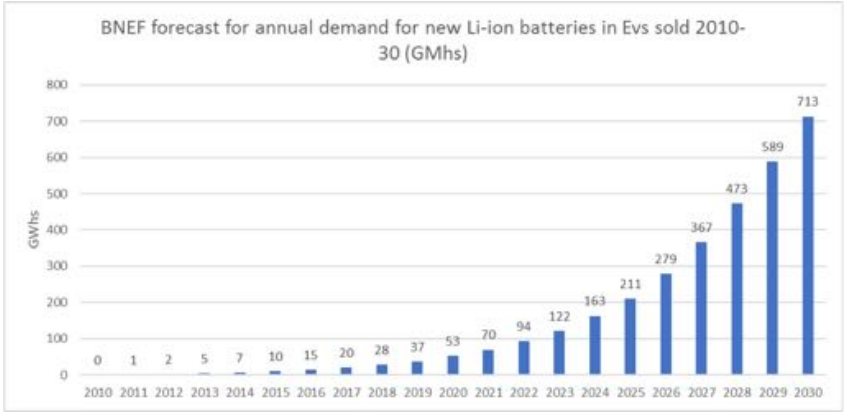
2nd life EV batteries

Battery lifetime	Estimated 2030 cumulative 2nd life availability (GWh)
14 years	41 GWhs
10 years	178 GWhs
8 years	342 GWhs

Source: Bloomberg New Energy Finance

The demand for storage is projected to grow at a CAGR of 31.5% to 2030

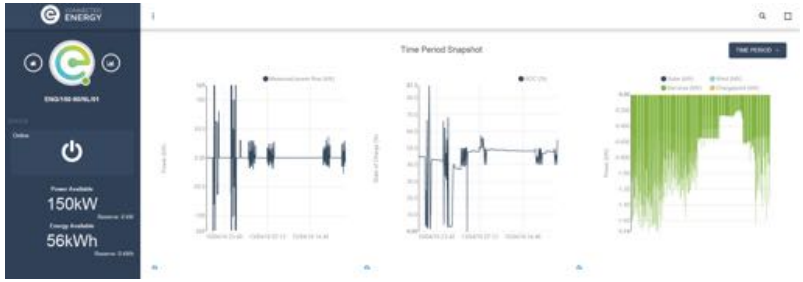


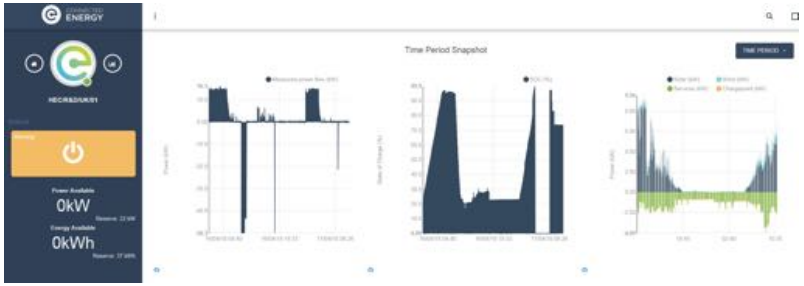


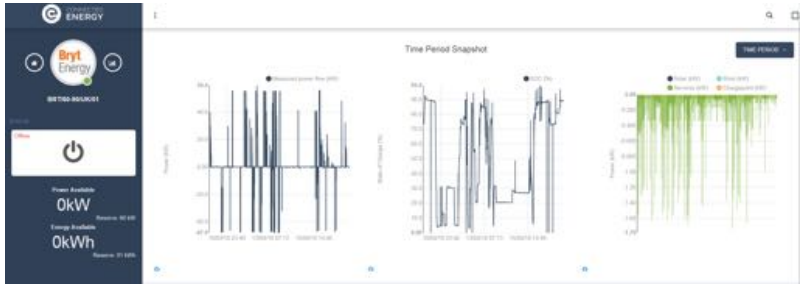
Source: Bloomberg New Energy Finance

- A different model
- No warranty constraints
- Batteries move to OPEX

Modes of operation





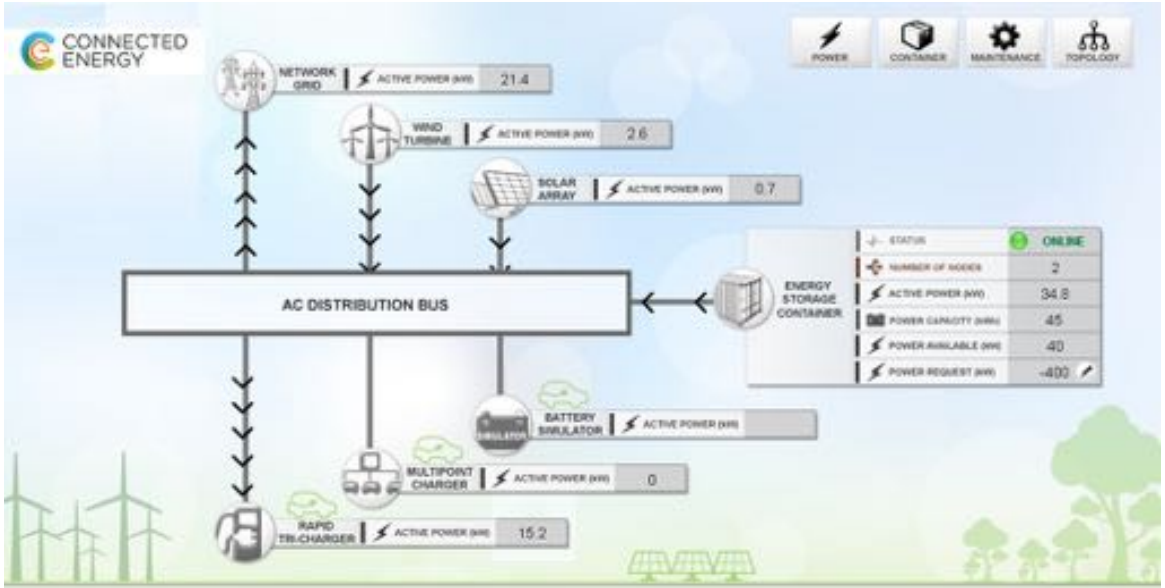


- Grid services – Frequency response
- Virtual power plant
- Renewables optimisation
- Peak shaving

Hierarchy of functionality

Peak shaving, renewables optimisation, arbitrage, active load management, back up power supply

- Reduce capital costs
- Reduce fixed costs
- Reduce electricity use
- Add resilience



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