

Storage opportunities

Green Hedge Energy

March 2017



Why storage? Why now?

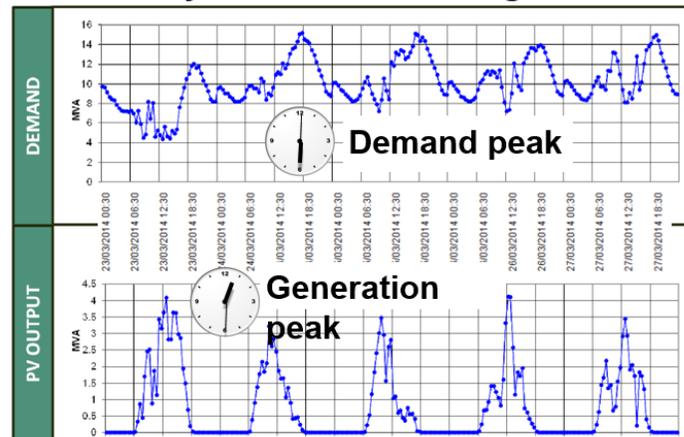
Why storage?

- Energy storage provides the missing piece of the jigsaw in an increasingly intermittent distributed energy system
- Energy storage is critical to enable the continued shift from polluting coal plants to carbon-neutral renewables while making sure that the lights stay on at all times
- Wind and solar generation is weather dependent; the ability to store electricity and export it back into the grid at times of need is increasingly valuable
- National Grid has introduced various mechanisms to encourage the development of energy storage

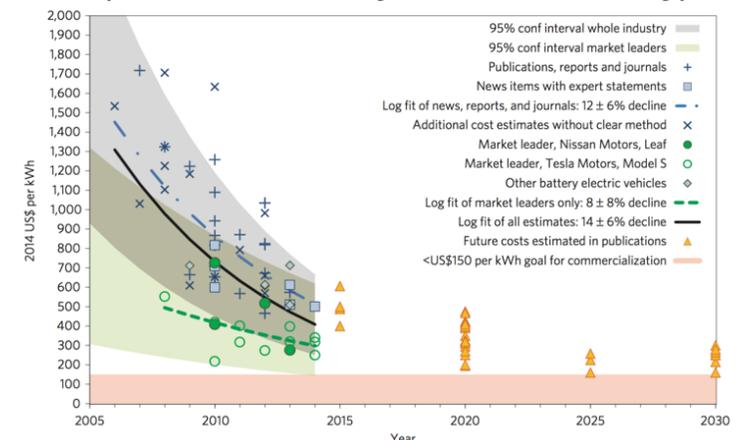
Why now?

- Significant investment in electric vehicles development has driven falling battery costs, now making energy storage economic
- Battery storage will become the most common form of electricity storage
- The operation of battery storage creates no pollution, unlike other forms of backup peak power
- Batteries can respond much more quickly than other technologies such as thermal plant to the needs of the grid (in half a second)

**Example primary substation in the SW:
half-hourly demand and solar generation**



**Falling cost of battery storage
(Source: Nature, Nykvist/Nilsson study)**



Green Hedge overview

Green Hedge has developed 150MW of ground-mounted solar PV
Since, 2015, we've concentrated on developing battery storage systems, culminating in 40MW of grid-scale projects awarded T-4 Capacity Market contracts in Dec 2016

- **“Energy Barns™”**: grid-scale energy storage systems housed in purpose-built buildings
- Designed to reduce visual impact, making it attractive to agricultural and commercial landowners as well as planners
- Capacities from 5MW to 50MW
- Connection at up to 132kV, allowing use of available capacity anywhere on the DNO's grid
- Detailed technical design from reputable EPCs
- Detailed analysis and contracting of revenues, managed and operated by Green Hedge team
- First 40MW under construction from Q3 2017
- Additional Energy Barn pipeline for 2017 of more than 100MW

- **“Savings in a Box”**: behind-the-meter energy storage systems
- Sites with high energy usage (>500kW / £500k p.a. elec costs)
- Up to 20% energy cost savings
- Provide additional revenue streams to the site
- Pilot commissioning Q2



The Energy Barn opportunity

Opportunity = rental income on spare land

Suitable sites

- Minimum 0.25 acre land requirement for 10MW scheme
- Up to 1.25 acres for largest 50MW schemes
- Simple agricultural/industrial building or containerised solution (dependent on landowner and planning requirements)

The opportunity for landlords

- The opportunity is **rental income**
- 25 year lease (tenant break at 15)
- Annual reviews in line with RPI
- Commercial rents of up to £50,000 p.a. for 10MW site
- Agricultural rents of £20,000 p.a. for 10MW site
- Three-year option required to secure planning, grid and income contracts. Landlord may use for other purposes during option period.
- Option fees paid on signing

Challenges

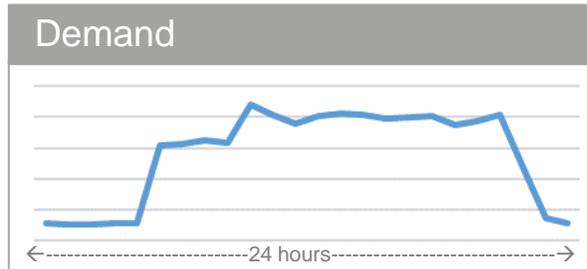
- Dependant on availability of import and export capacity:
capacity is scarce!



The Behind-the-Meter opportunity

Opportunity = cost avoidance + additional revenue streams

Underlying site load



Algorithm managing state of charge



Balancing services such as grid frequency control



Trading optimisation



Cost avoidance: Battery storage systems allow the site to avoid network and policy costs which are levied on usage in peak periods (weekday late afternoons) and account for 25% of a typical site's electricity bill. Shifting load away from these periods can drastically lower costs



Dispatch of storage system



Balancing services income: The storage system can be configured to generate revenues from supplying services to National Grid, for example by reducing or increasing electricity usage at the site. The business is paid for this service, but uses the battery to flex site load rather than adjusting its actual electricity demand

The Behind-the-Meter opportunity

Opportunity = cost avoidance + additional revenue streams

Suitable sites

- Commercial, industrial and public sector sites
- Connected to the network at 11kV or below
- Average load of at least 500kW
- Customer owns freehold or has long leasehold on the site
- Examples sites include data centres, manufacturing operations, hospitals, large call centres

The opportunity for the large energy users

- Green Hedge optimises the system to maximise operational value
- No upfront cost to the customer – capex can be financed
- Minimum annual income from the scheme with additional upside shared between the parties
- Green Hedge will carry out a no-obligation feasibility study
- Can provide up to £200,000 p.a. of value on 1MW site

Challenges

- **Regulatory change:** transmission and distribution charging reviews

Example 200kW system



Example 1MW system

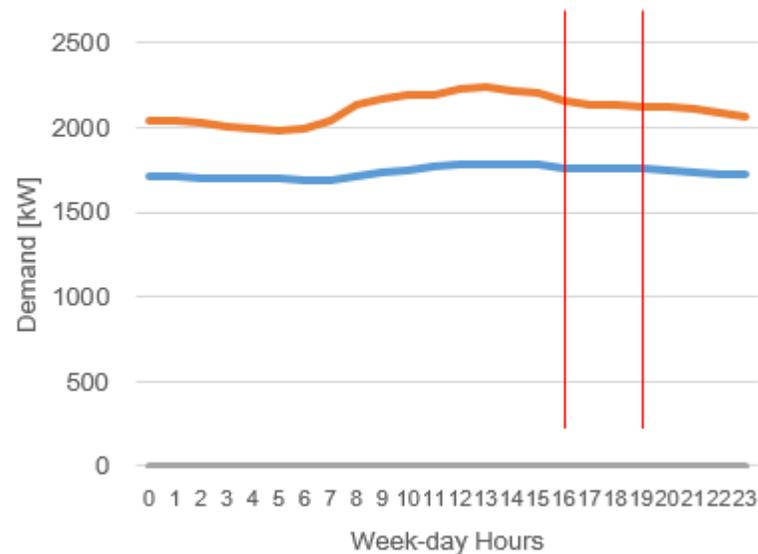
Behind-the-Meter: example profiles

Data centre: constant load, provides good for balancing services and cost avoidance

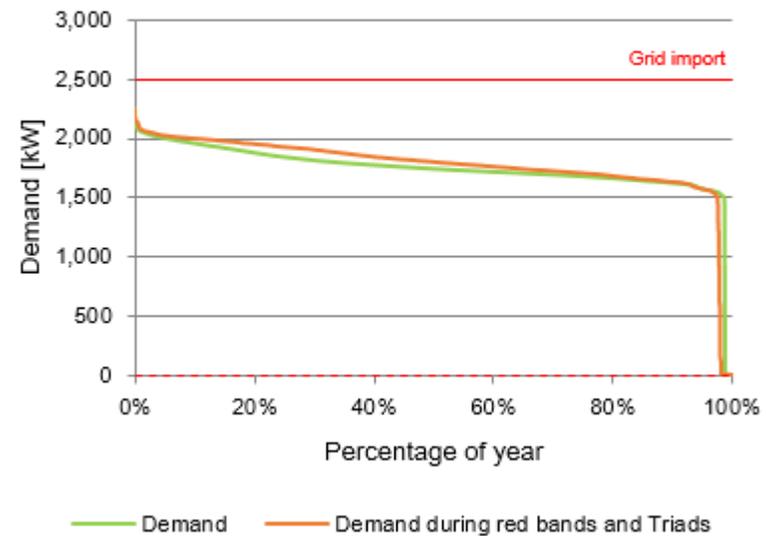
Key Data

Max demand	kW	2,243
Max demand during TRIADS	kW	2,164
Average Demand	kW	1,737
Total Energy Consumption	kWh p.a.	15,211,888

Week-days - max, min and avg



Load Duration Curve



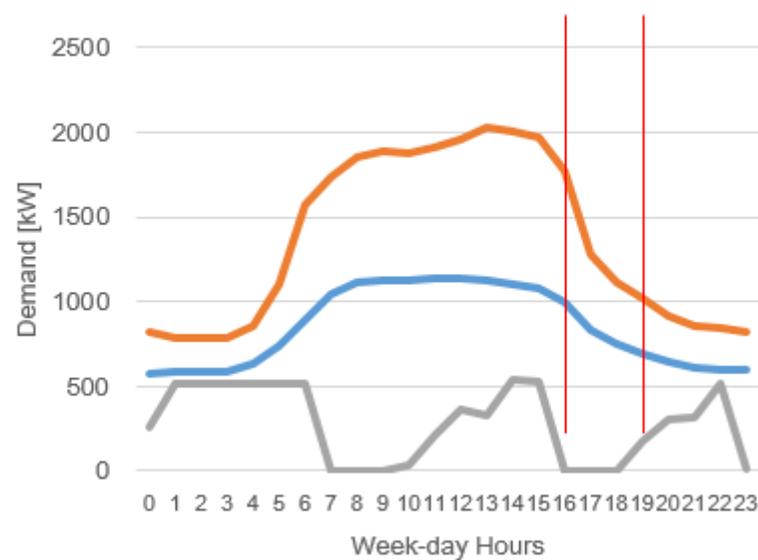
Behind-the-Meter: example profiles

Large call centre: variable load, less good for balancing services and cost avoidance

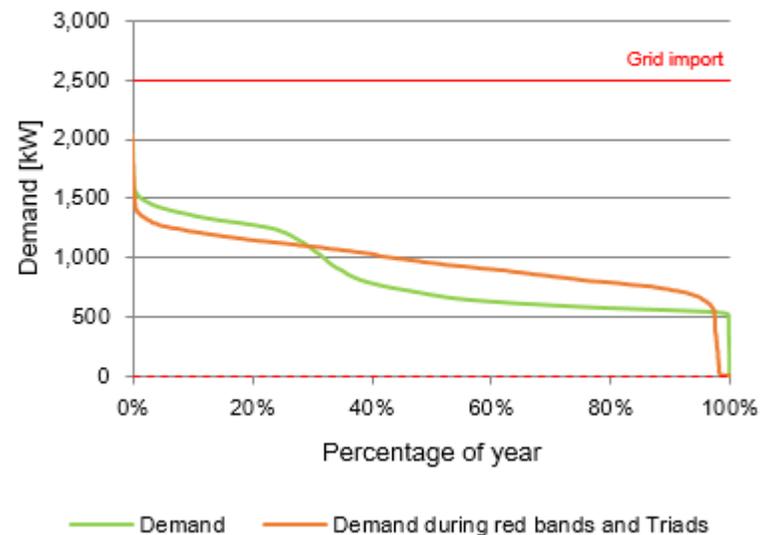
Key Data

Max demand	kW	2,025
Max demand during TRIADS	kW	1,774
Average Demand	kW	846
Total Energy Consumption	kWh p.a.	7,414,339

Week-days - max, min and avg

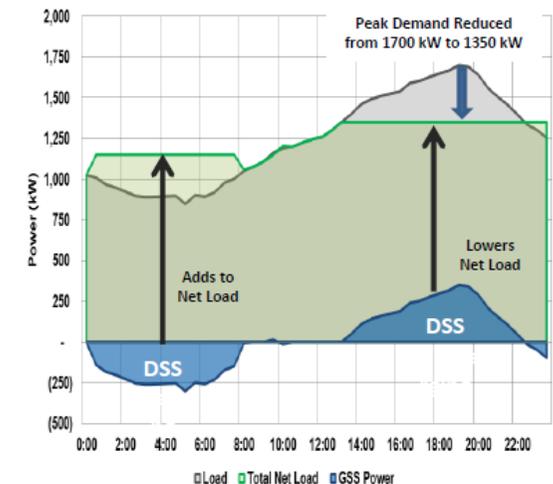


Load Duration Curve



Green Hedge would welcome the opportunity to work with you to:

- **Identify opportunities in your land ownership portfolio**
 - assess for grid capacity
 - assess for site suitability
 - apply for grid capacity
- **Consider behind-the-meter opportunities for high energy consumption sites**
 - financial feasibility study
 - site visit to assess siting and connection
 - variation of existing grid connection agreement



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