The Future of Gas & Electricity Storage

Overview of SSEPD Energy Storage projects

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Power Distribution

SSE's business activities

Market-based and economically regulated

This balance, and the broad range of activities that flow from it, means SSE has a strong and diverse group of energy assets and businesses from which to secure the revenue to support future dividend growth.

SSE

ECONOMICALLY-REGULATED

MARKET-BASED

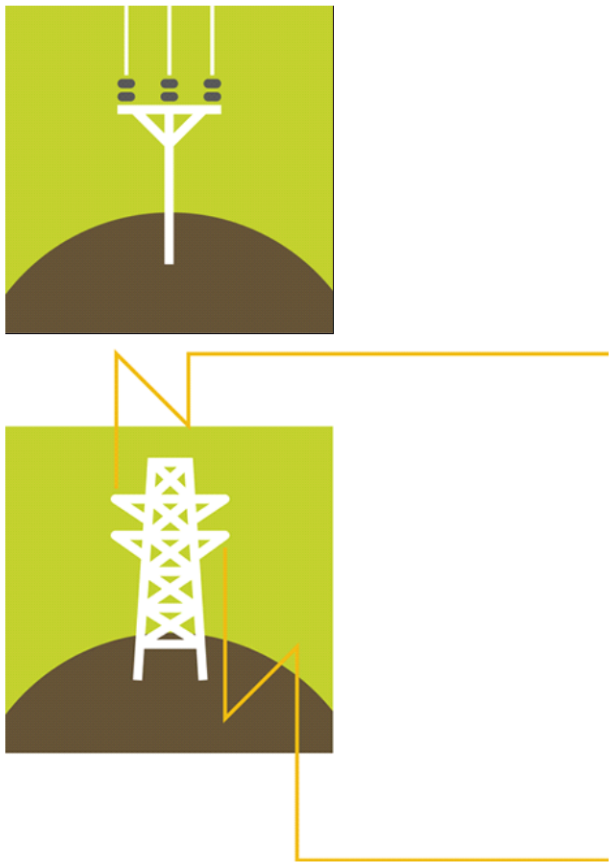
ENERGY NETWORKS

GENERATION AND SUPPLY

OTHER ENERGY AND UTILITY SERVICES

Electricity Distribution and Transmission	Gas Distribution	Generation	Supply	Gas Production	Gas Storage	Contracting, Utility Solutions and Metering	Telecoms
£3.21bn	£2.15bn	11.29GW	10 million	12	440mcm	£98m	11,200km
Regulated asset value	Regulated asset value (SSE share)	Generating capacity	Customer accounts	Fields in production	Storage capacity	SSE contracting order book	Network

Electricity Transmission and Distribution(1)



- Electricity transportation is a ‘natural monopoly’, independently regulated by Ofgem
- SSE operates network in northern Scotland and central southern England
- 127,000km of overhead lines and underground cables delivering electricity to 3.5m homes, offices and businesses
- Regulated Asset Value of £3.21bn

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Introduction

- **Energy storage developments**
- **Storage benefits to network operators**
- **SSEPD projects**
  - Flow battery
  - High temperature battery
  - Lithium-ion batteries (kW scale)
  - Lithium-ion battery (MW)
- **Summary**

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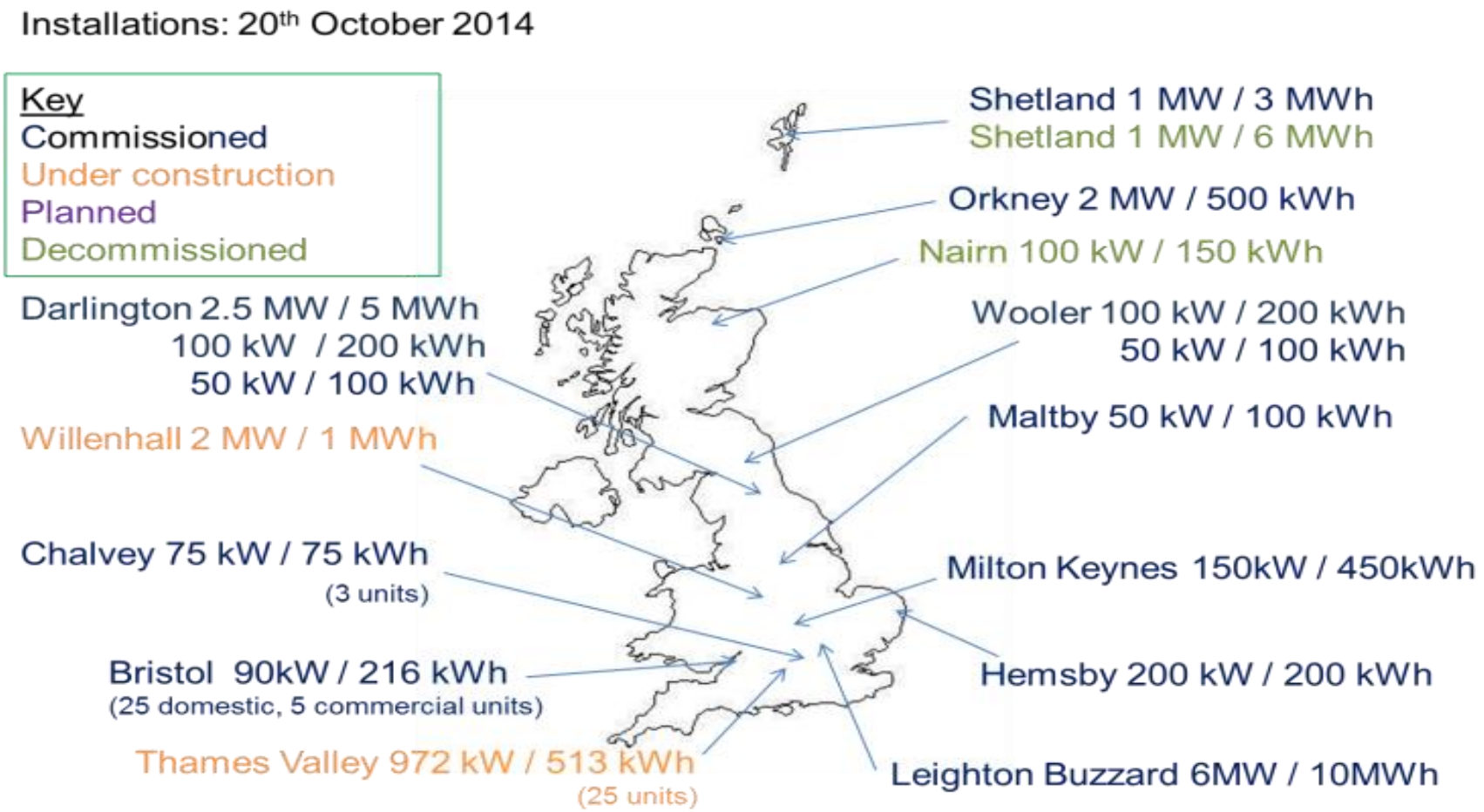
Network Operator's storage projects



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Network Operator benefits

- **Network constraint management**
  - Peak demand reduction
  - Absorption of excess generation
- **Voltage management**
  - Reactive power compensation
  - Real power management
  - Phase balancing
- **Reserve power to meeting planning standards**
- **Optimising back up generation (faults)**

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Non distribution network benefits

To become economically viable storage projects may need to operate in additional markets:

- **Energy arbitrage**
- **Frequency response**
- **STOR**
- **Avoiding customer capacity charges (demand + generation)**

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SSEPD's energy storage projects

2009

2011

2012

2013

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Nairn Flow Battery Project

- **Project started in 2008**
- **Technology is100kW 150kWh Zinc Bromine flow battery**
- **Connected at 230V**
- **Purchased and installed on site with main objectives of:**
  - Provide backup to site auxiliary supplies
  - Gain real time experience in the operation and maintenance of technology
  - Understand the associated environmental and safety risks
  - Assess the potential for larger (MW) deployment of technology

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Nairn flow battery project

First venture into advanced battery solutions

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Shetland Battery Project

- **Project started in 2010**
- **Initial technology 1MW 6 MWh Sodium-Sulfur (NaS)**
- **Connected at 11kV**
- **Due to small safety risk have decided to change technology**
- **Main objectives:**
  - Installation and operation of the battery
  - Integration with local Demand Side Response to remove station peaks providing additional demand capacity
  - Frequency response

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NaS Module installation

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Installed NaS battery

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Installed Lead-Acid battery

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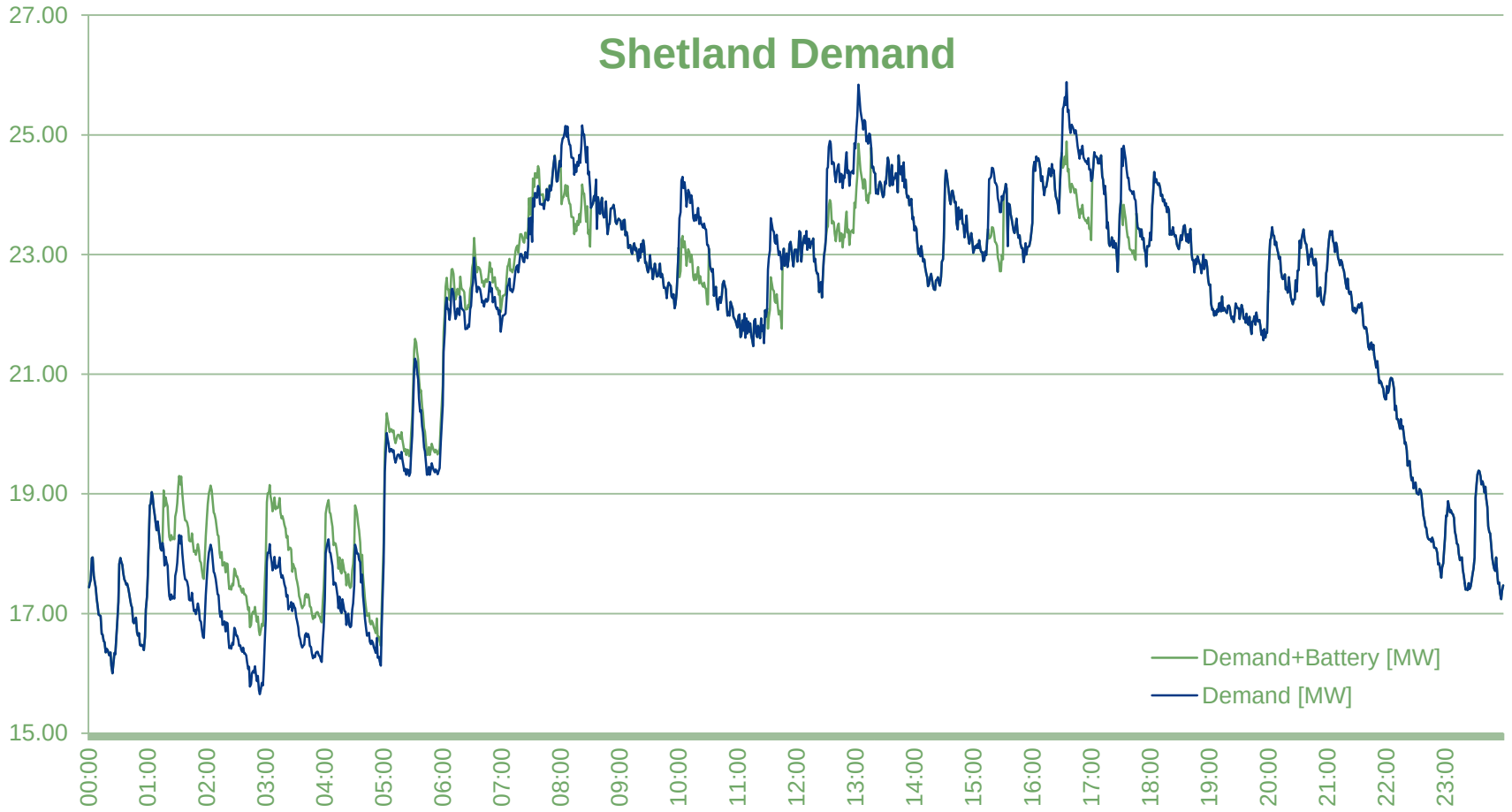
Installed Lead-Acid battery



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Slough Low Voltage Connected Battery Project

- **Project started in 2011**
- **Technology L-Ion 25 kW 25kWh**
- **Connected at 230V**
- **Main objectives:**
  - to determine the operational issues and benefits the batteries can provide
  - gain experience of installation and operation of the battery
  - gain experience of integration with local Demand Side Response to remove station peaks providing additional Demand capacity

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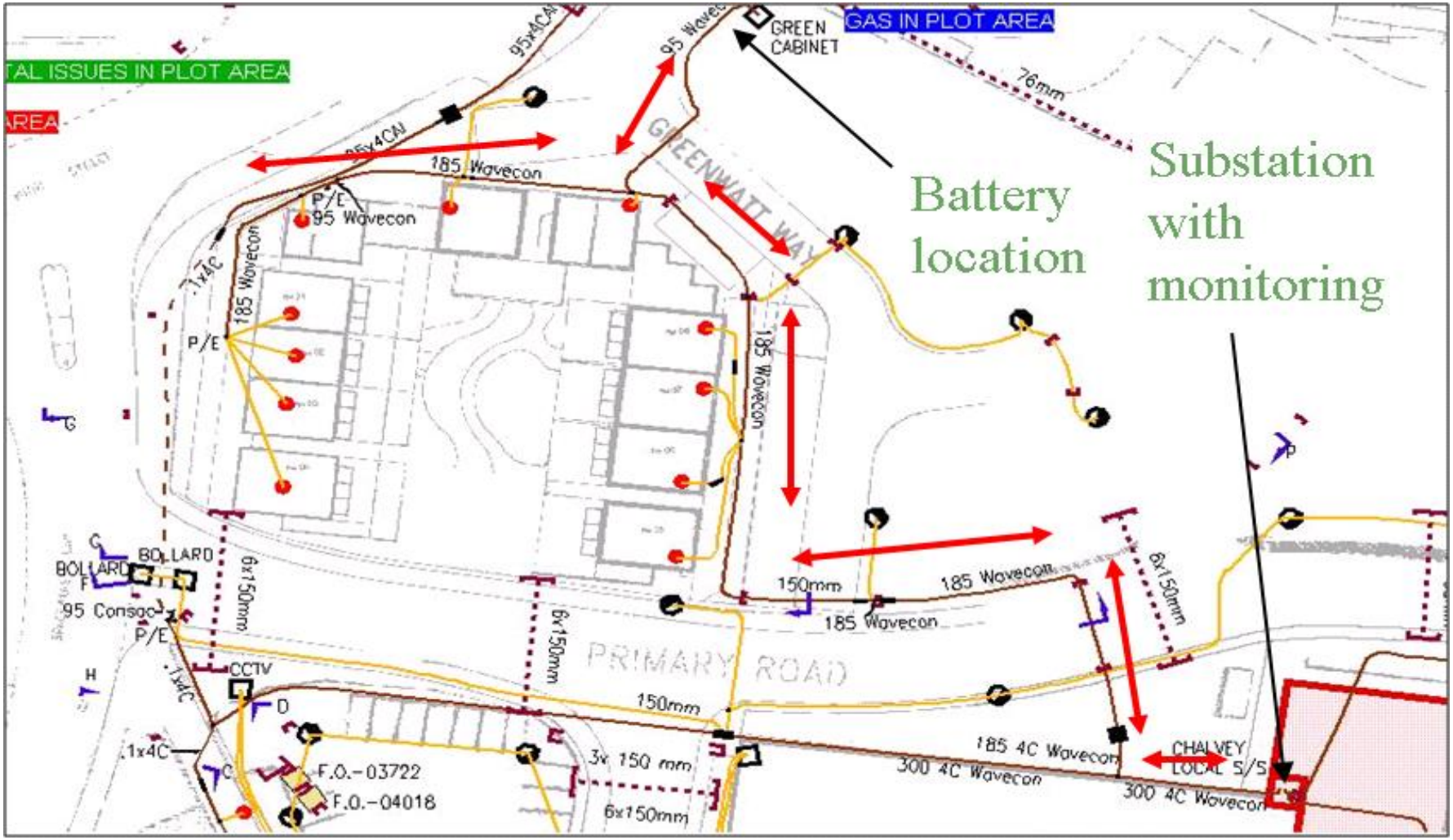
Low voltage connected battery project

Greenwatt Way, Chalvey, Slough

http://www.ssezerocarbonhomes.com/

Low voltage connected battery, Slough

Network location of the batteries



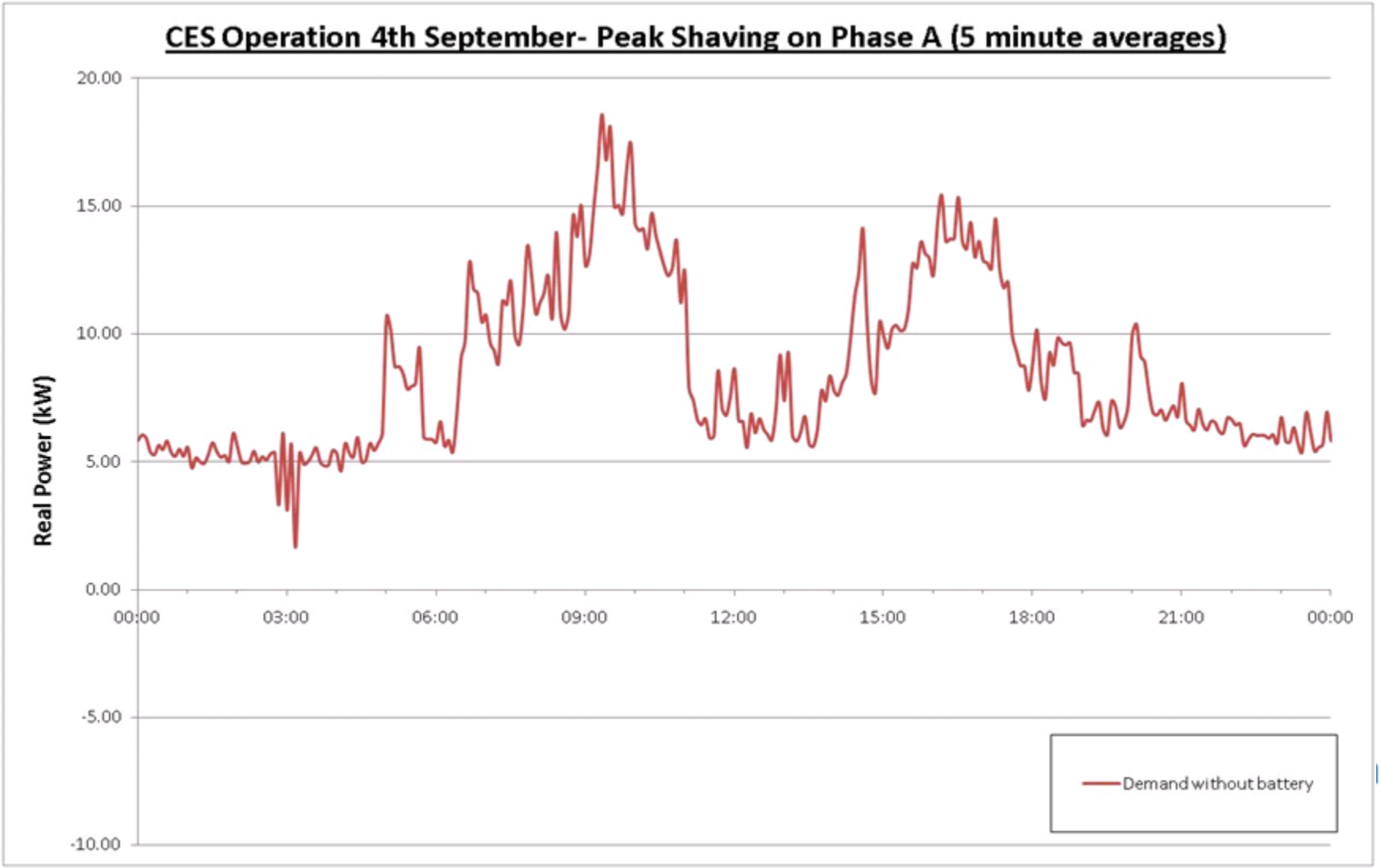
Low voltage connected battery project

Installation photos

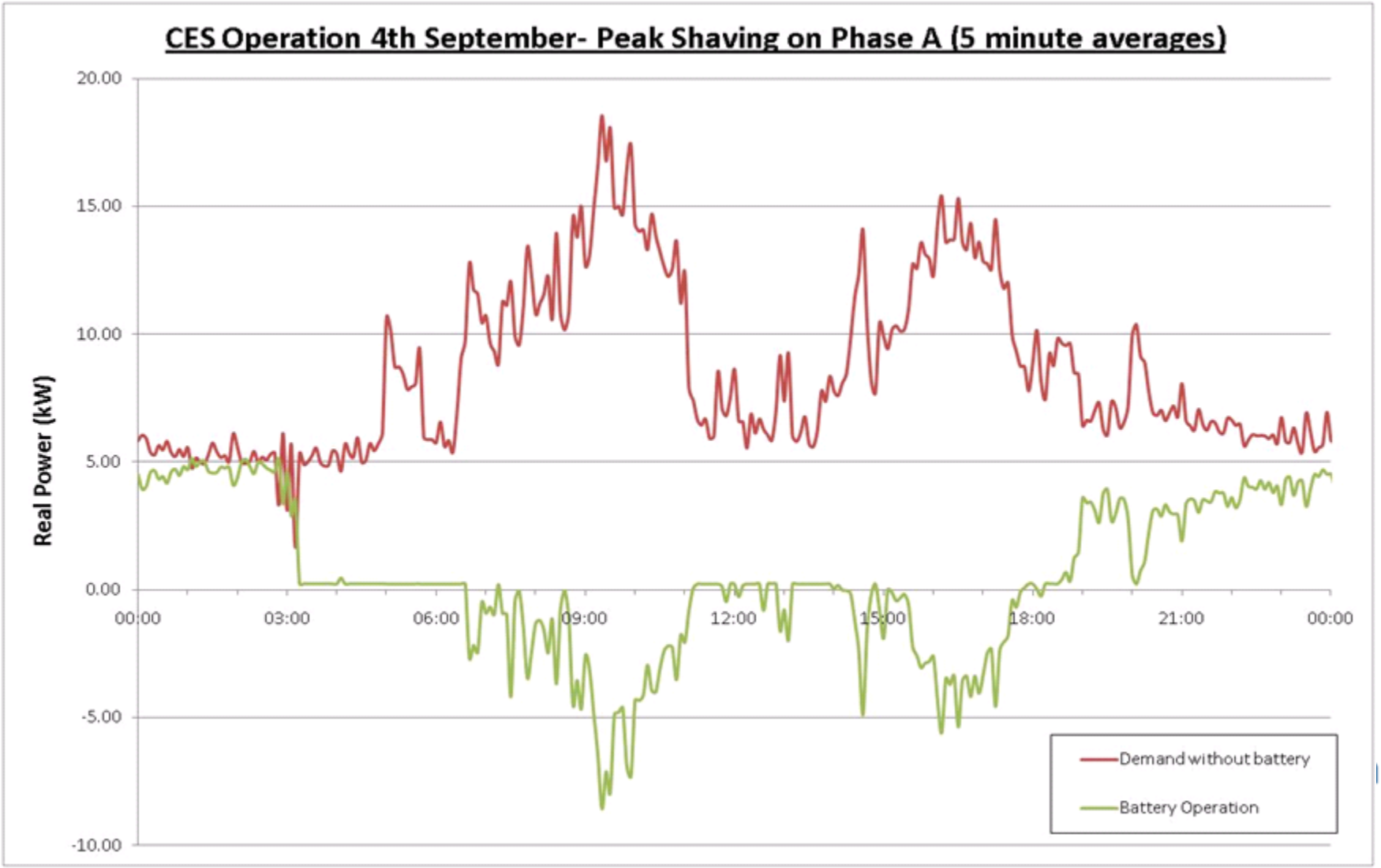
Low voltage connected battery project

Installation photos

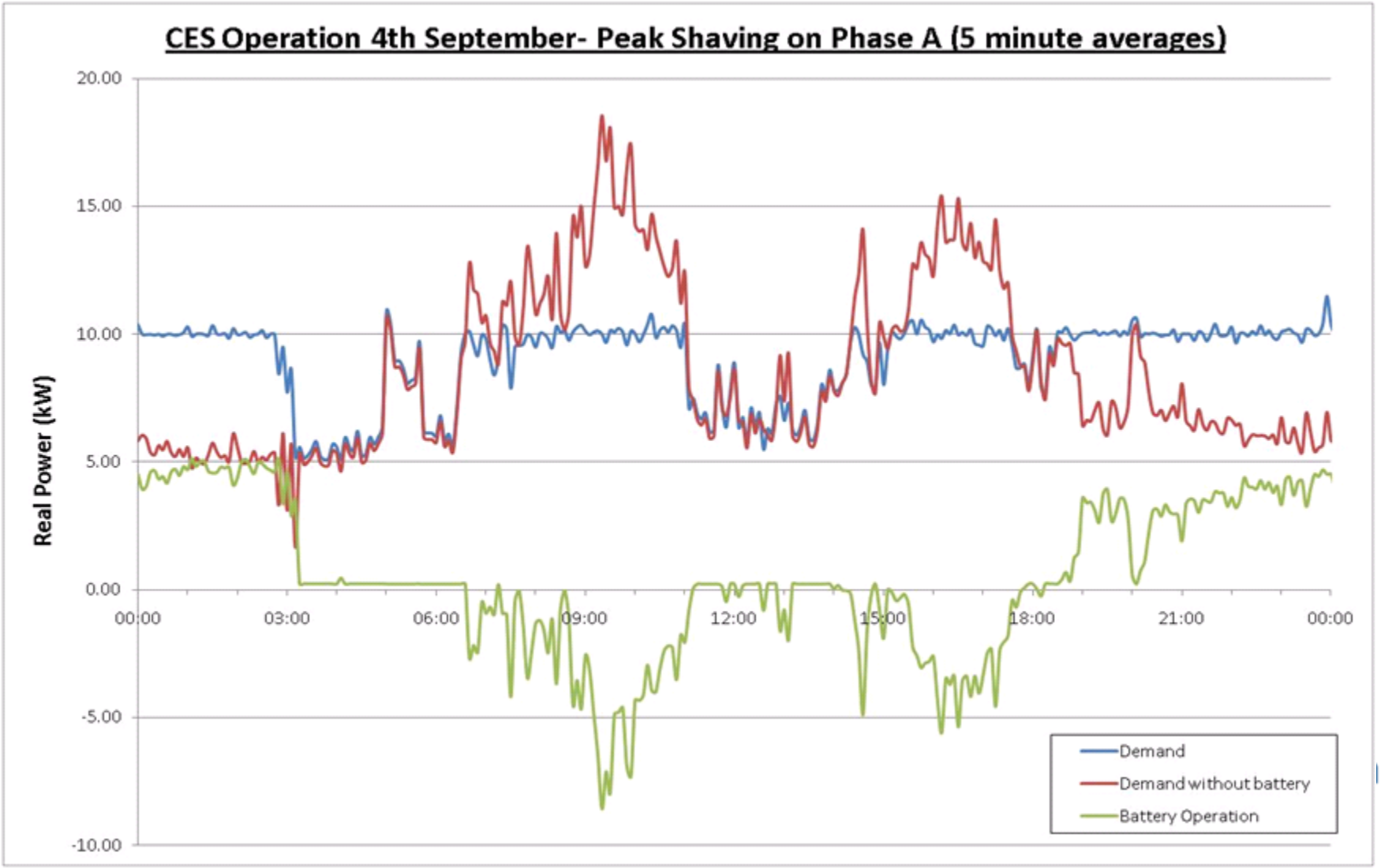
Low voltage connected battery project



Low voltage connected battery project



Low voltage connected battery project



Orkney Energy Storage Park Project

- **Project started in 2011**
- **Technology L-Ion 2MW 500MWh**
- **Connected at 11kV**
- **Main objective:**
  - gain better understanding of the commercial markets that storage can operate in
  - gain experience of installation and operation of the battery
  - gain experience of integration with Active Network Management system

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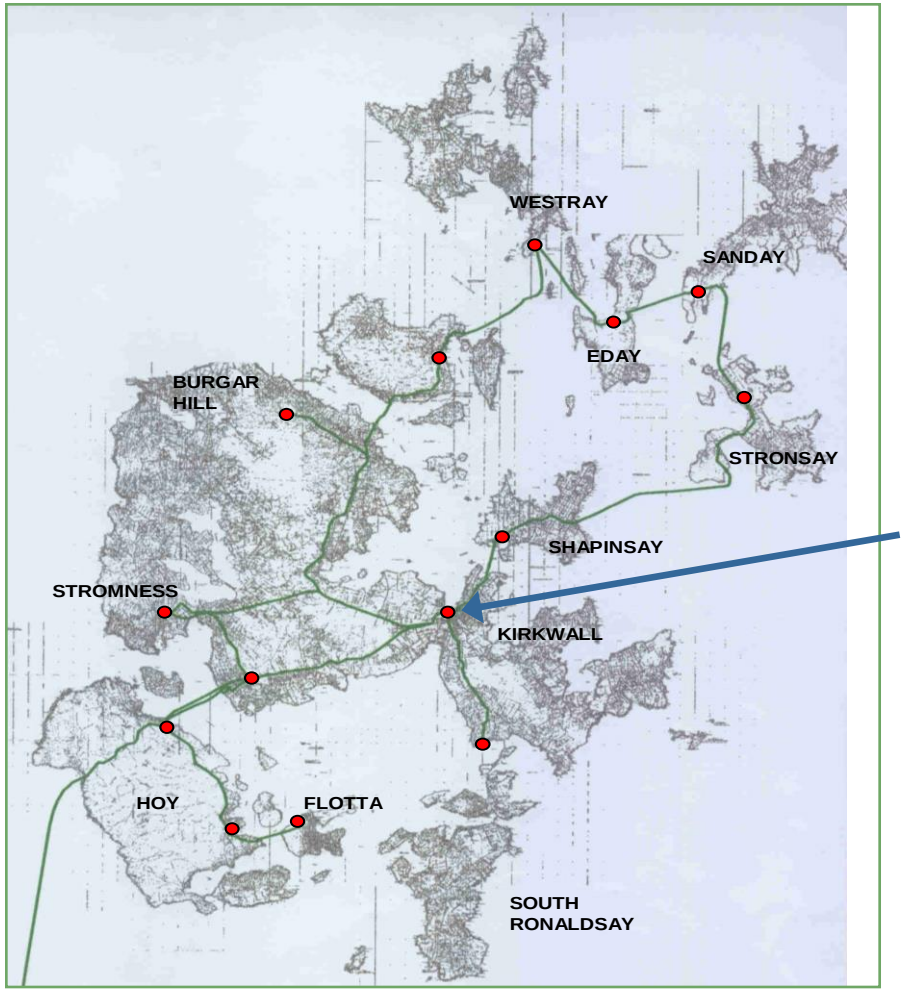
Orkney storage park



Orkney storage park

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Orkney storage park

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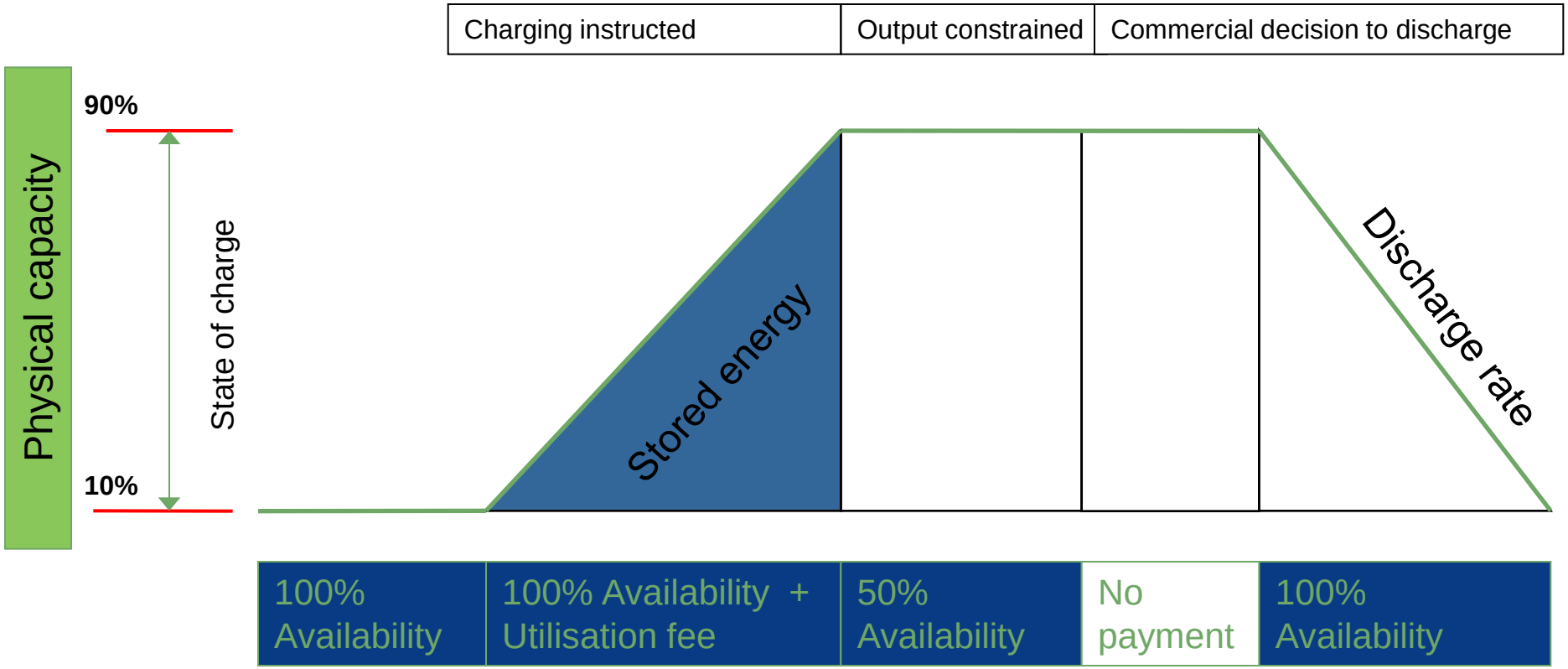
Orkney commercial model



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Summary of operator models

Application	DNO Unmetered	DNO Metered	3rd party network side of meter	3rd party customer side of meter
Peak demand reduction	✓	✓	✓	
Absorption of excess generation	✓	✓	✓	✓
Voltage management	✓	✓	✓	
Reserve power to meet planning standards	✓	✓	✓	
Optimising back up generation (faults)	✓			
Energy arbitrage		✓	✓	✓
Frequency response / STOR		✓	✓	✓
Capacity charge reduction				✓

Thank you for your attention

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