

A low-angle, upward-looking photograph of modern skyscrapers. The buildings feature facades with large, colorful glass panels in shades of blue, red, and white. The perspective creates a sense of height and architectural scale. The sky is a uniform, bright white.

Heat Smart Orkney

Agenda

1. Background

2. Opportunity

3. Business plan

Part 1

Background

Background & Significance

Team Introduction

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Background of Orkney Island

Reasons

Pioneer Hub

Orkney boasts significant wind generation potential with abundant wind resources

Limited Export Capacity

Connector to the mainland poses a challenge for exporting excess wind energy

Problem

Curtailement

The deliberate reduction of wind energy generation due to limited export capacity, hinders the realization of renewable energy's full potential

Solution

Demand-Response

To mitigate curtailment, it is necessary to increase or reorganize electricity consumption to balance power generation and demand

Significance of reducing curtailment



Users

Cheaper energy

Tackle fuel poverty and connect locals to wind turbine development benefits on the islands



Generators

Avoid revenue loss

Increase revenue for Generators & Avoidance of costly network upgrades



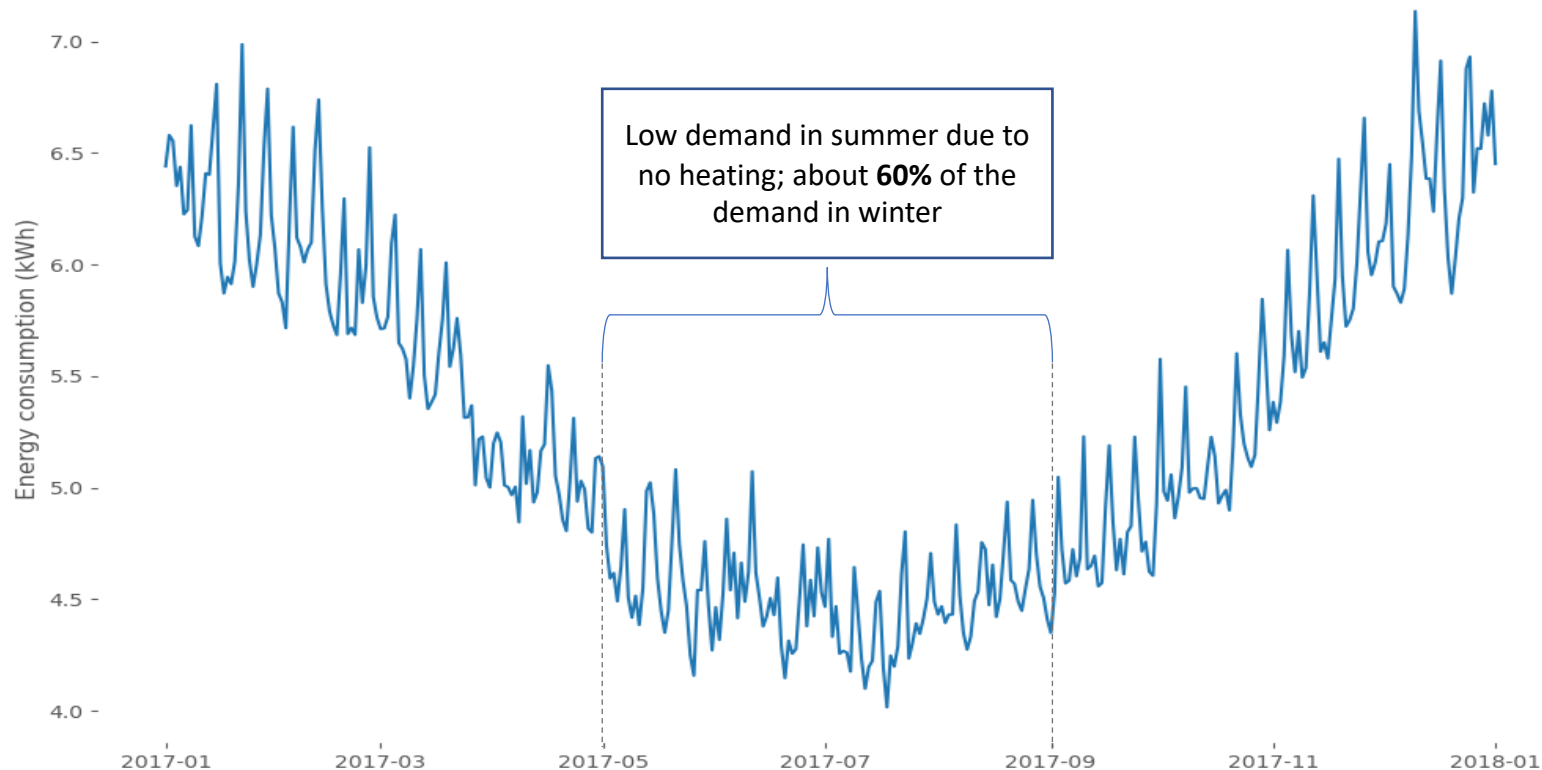
Kaluza

Achieve profit

Get revenue from the contact with generators

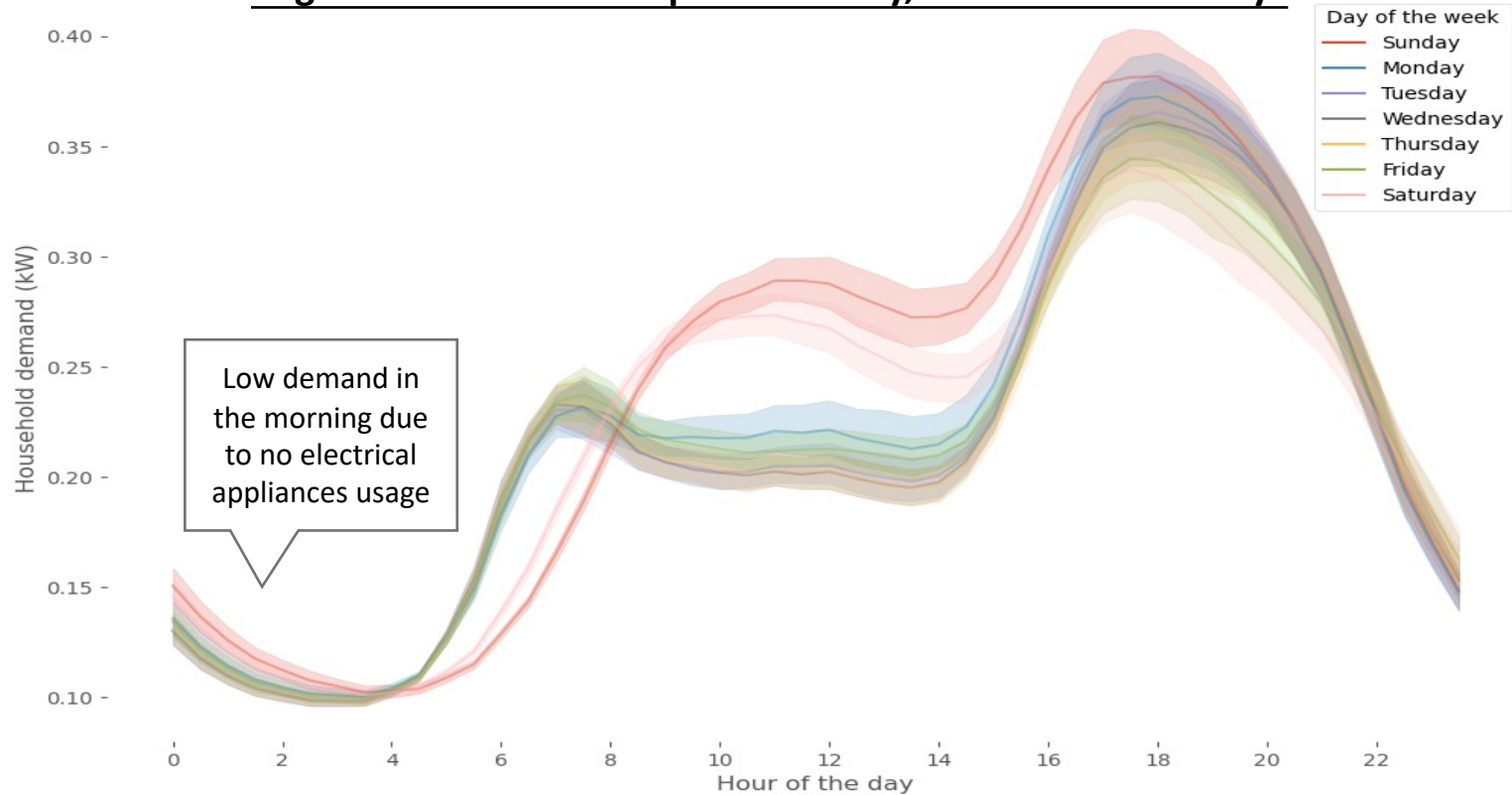
Energy consumption pattern in Orkney

Avg. daily household consumption across different months

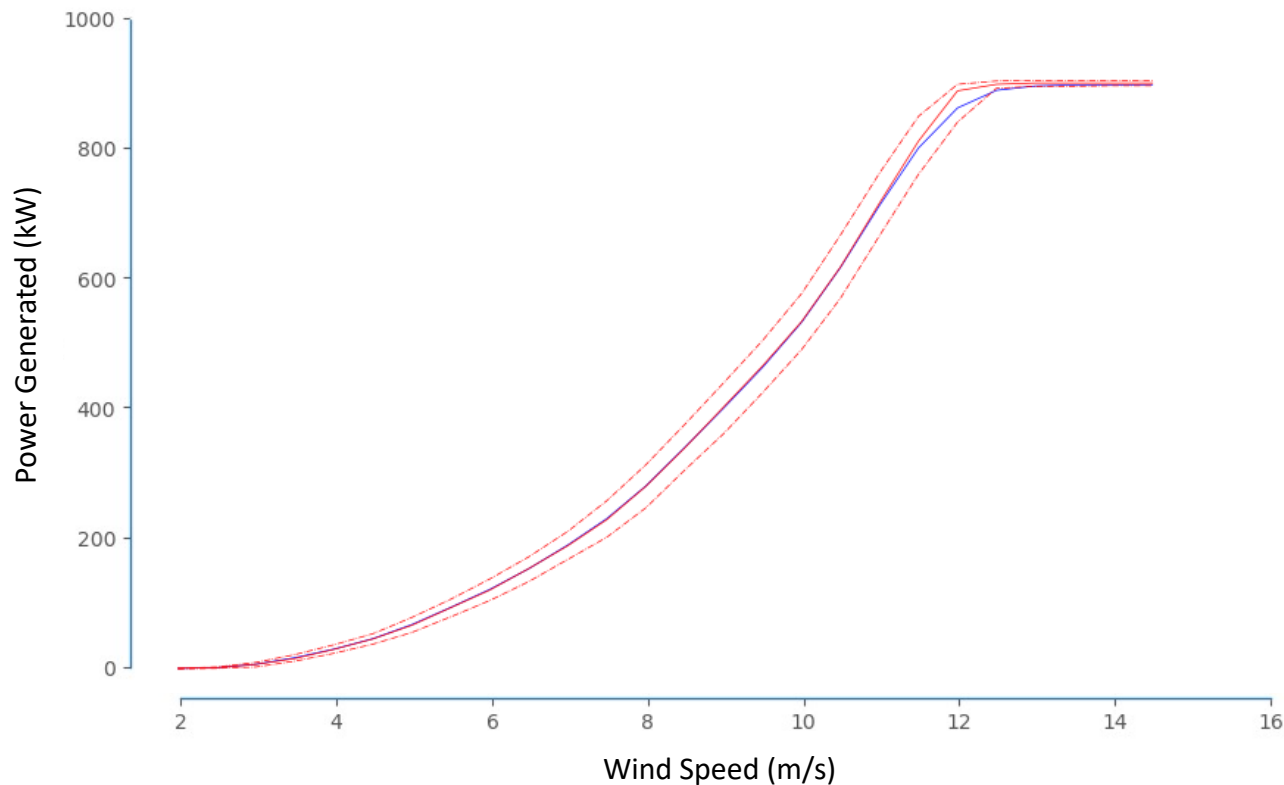


Energy consumption pattern in Orkney

Avg. household consumption in a day, across different days



Modelling relationship between power and wind



By **filtering for noise** between power and wind speed, we obtain a model to estimate the potential power generated

In this model we assume:

- **Minimum wind speed of 2 m/s** is required to generate power
- Any wind speed **above 15 m/s** generates maximum power 900 kW

In 2017, the total potential energy of a single wind turbine is around **3.971 GWh**

Potential Energy

100%

Operational similarity
across all turbines

80%

Wind profile similarity
across Orkney

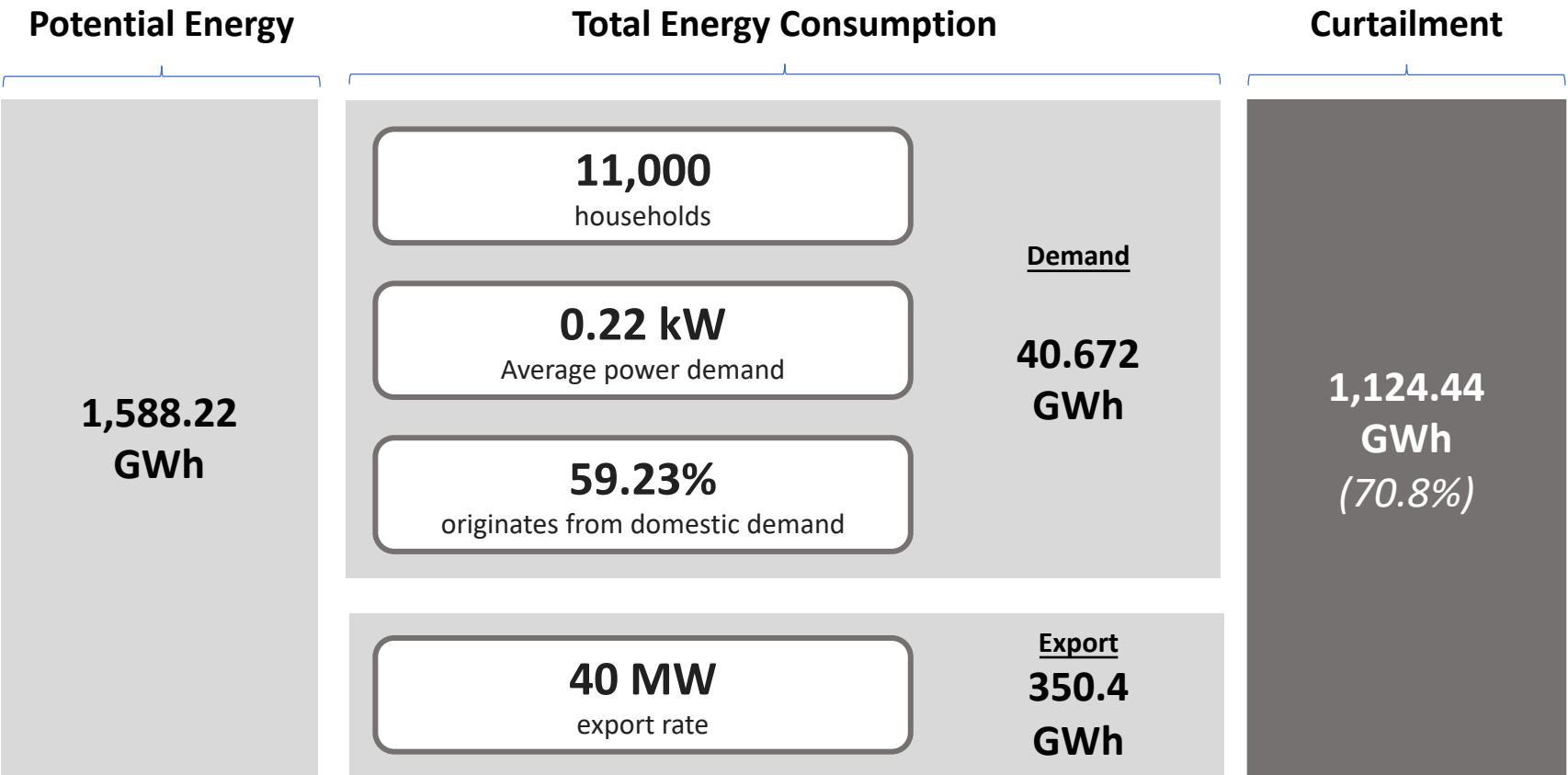
500

Wind turbines
in operation



1,588,226,483 kWh

Curtailed Energy

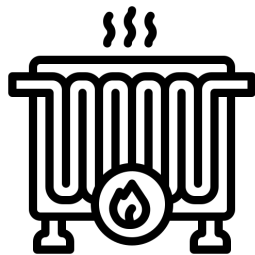


Part 2

Opportunity

Levels of DR penetration & Local participation

Key Target Heating Appliances



Storage Heaters

Power Rating

2 kW per heater

Usage Pattern

Approximately **8 h/day** in the winter,
and unused in the summer

**Other
Assumptions**

4 heaters used in a typical
2-person household

**Estimated
Consumption**

48 kWh per household per day



Hot Water Cylinder

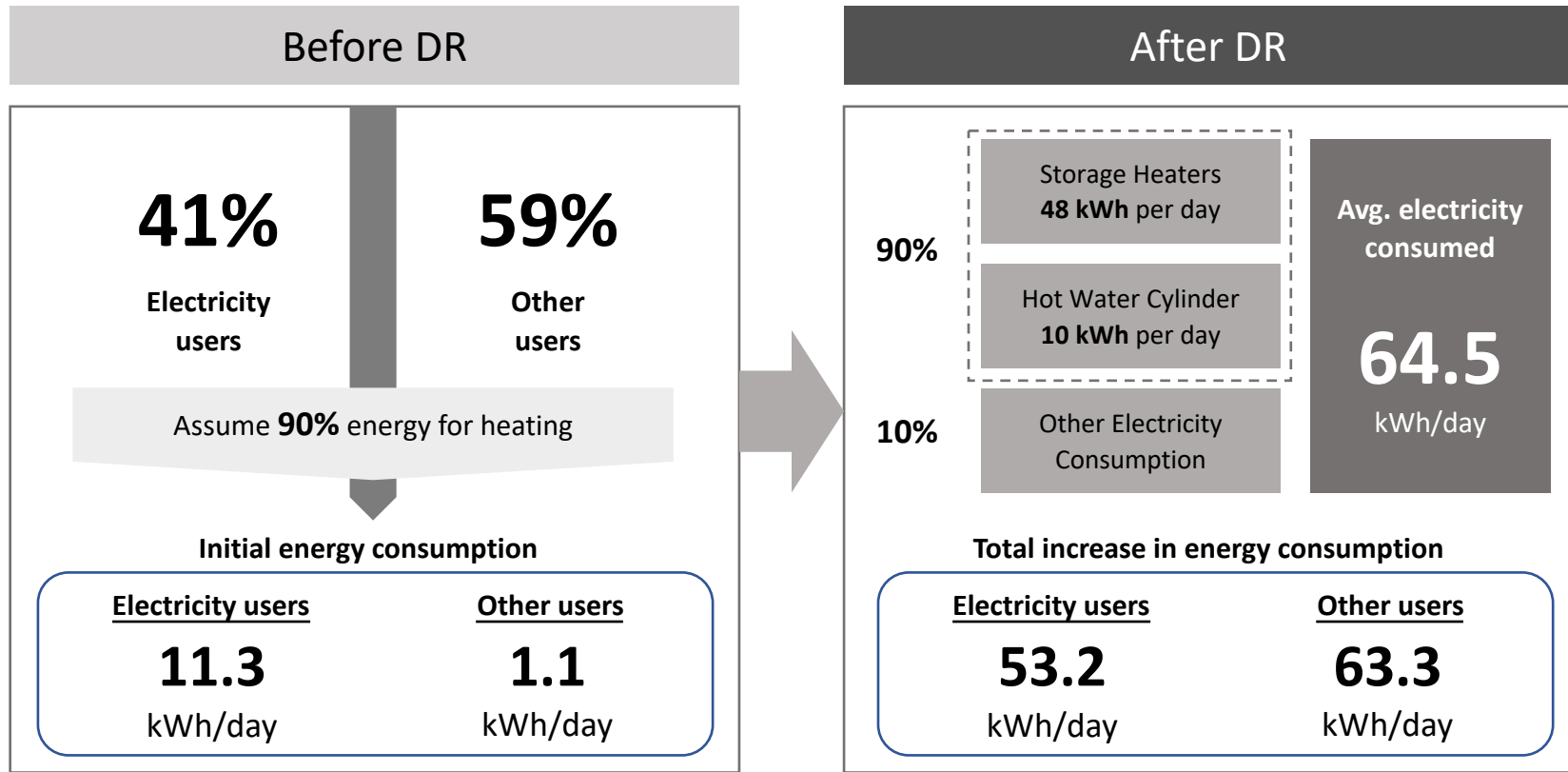
3 kW per cylinder

Approximately **1.46 h/day** for
a 2-person household

200W is required to maintain heat
for the rest of the day

10.01 kWh per household per day

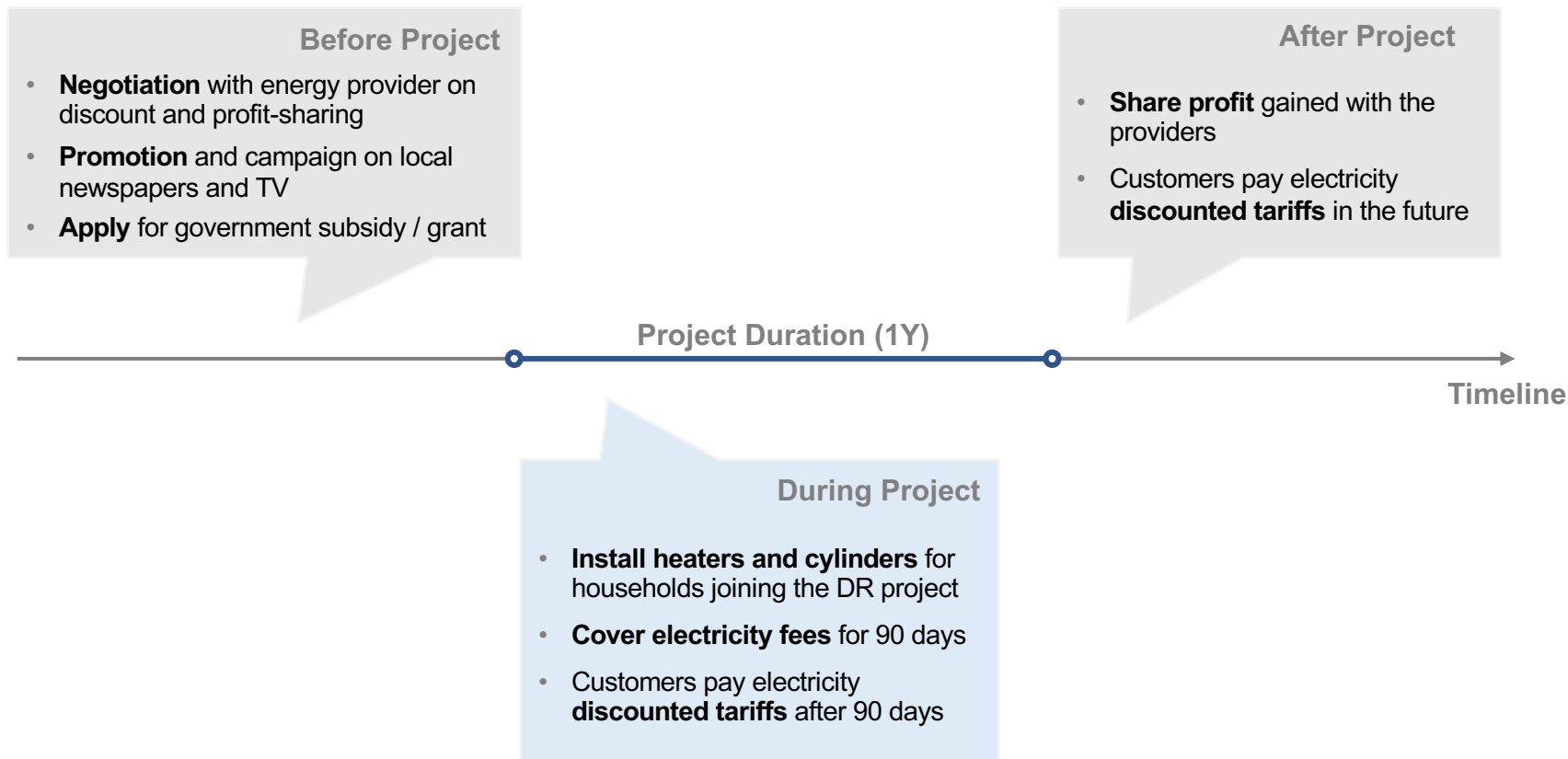
Demand improved with DR for each house



Part 3

Business plan

Business plan overview



DR Scheme

Based on 90% Conversion Rate

***Before
project***

Promotion

£ 10,000

Government Subsidy

£ 1,000,000

***During
project***

Electricity fee (90 days)

£ 5.21 per day

Profit From Service

Electricity users: £ 100 per hh

Other users: £ 100 per hh

Total Cost

£ 2,461,720.87

DR Scheme

Based on 90% Conversion Rate

After project

Generator

- **50% discount:** revenue £ 2.97 per hh per day
- **90% profit rate:** £ 2.67 per hh per day, **4** times of before!
- **50% commission rate :** £ 9,081.09 per day

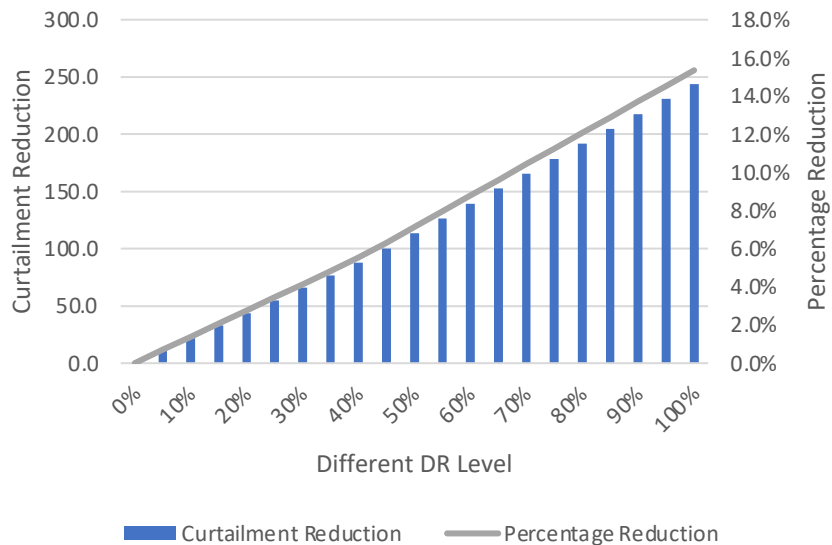
Kaluza

- **50% commission rate :** £ 9,081.09 per day

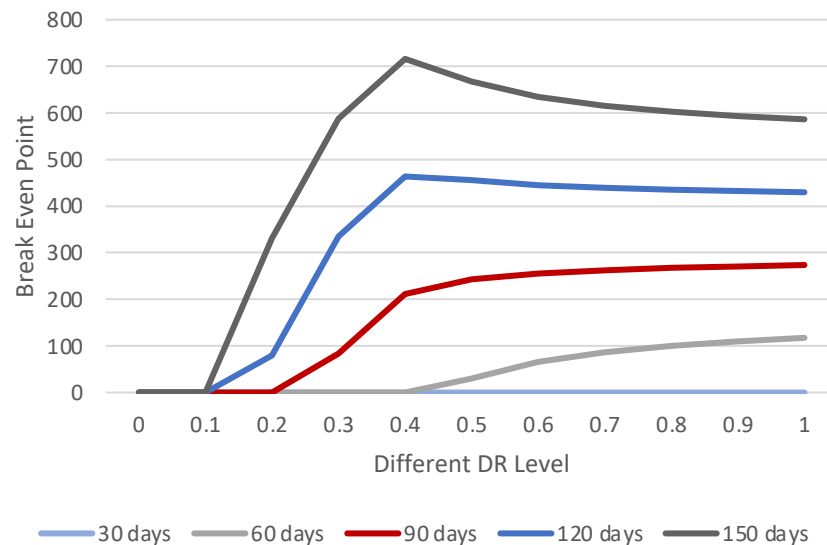
We only need 271 days to get our money back

Different DR level

DR Level v.s. Curtailment



DR Level v.s. Duration of free heating



Thank you

Thank you for listening and hope you enjoy this presentation

PRESENTED BY

Group 7

DATE

21/05/2023