



Consumer Building Blocks Project Outcomes

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19th March 2024

Welcome and housekeeping



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code
#ConsumerBB to
add any questions
you have**

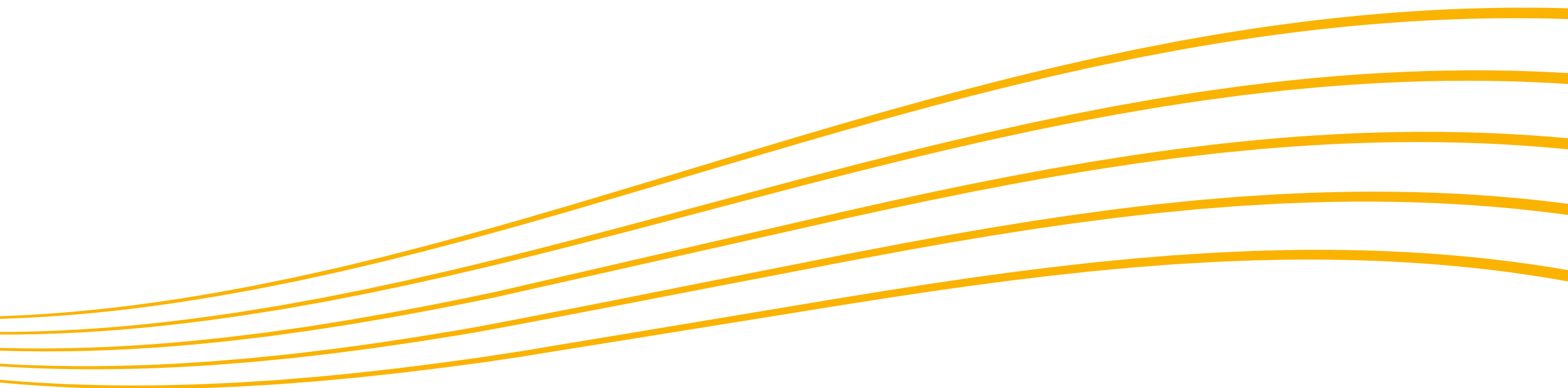


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Agenda

- Recap of the Consumer Building Blocks Project
- Overview of outputs and use cases
 - Non-Domestic
 - Domestic
- Next Steps
- Wrap up

Recap of the Consumer Building Blocks Project



Consumer Building Blocks Project

Project Aim: Developing a set of industry standard consumer archetypes along with the network companies that can be used to support the development of the future energy system

Current problem:

- Consumers are **critical to meeting net zero**. We have data regarding early adopters and there are still many unknowns:
 - What are their main characteristics?
 - What drives their decisions and behaviours?
 - How can we enhance segmentation of the market?
 - How will they respond to incentives, policy and price changes?
 - How will changes affect their consumption and adoption rates?

Approach

- Archetypes for the **domestic** sector and archetypes for **non-domestic** were treated separately and run in parallel.
- The project was run through four research work packages, with a stakeholder engagement program running throughout to ensure as broad a use of the archetypes as possible

Benefits

- Enhanced understanding of the **levels of societal change required** and the impacts decisions will have
- Enable us to have a shared **common language** with industry on how we consider consumer behaviour in the future
- Apply the learning on both a **national** and **regional** level

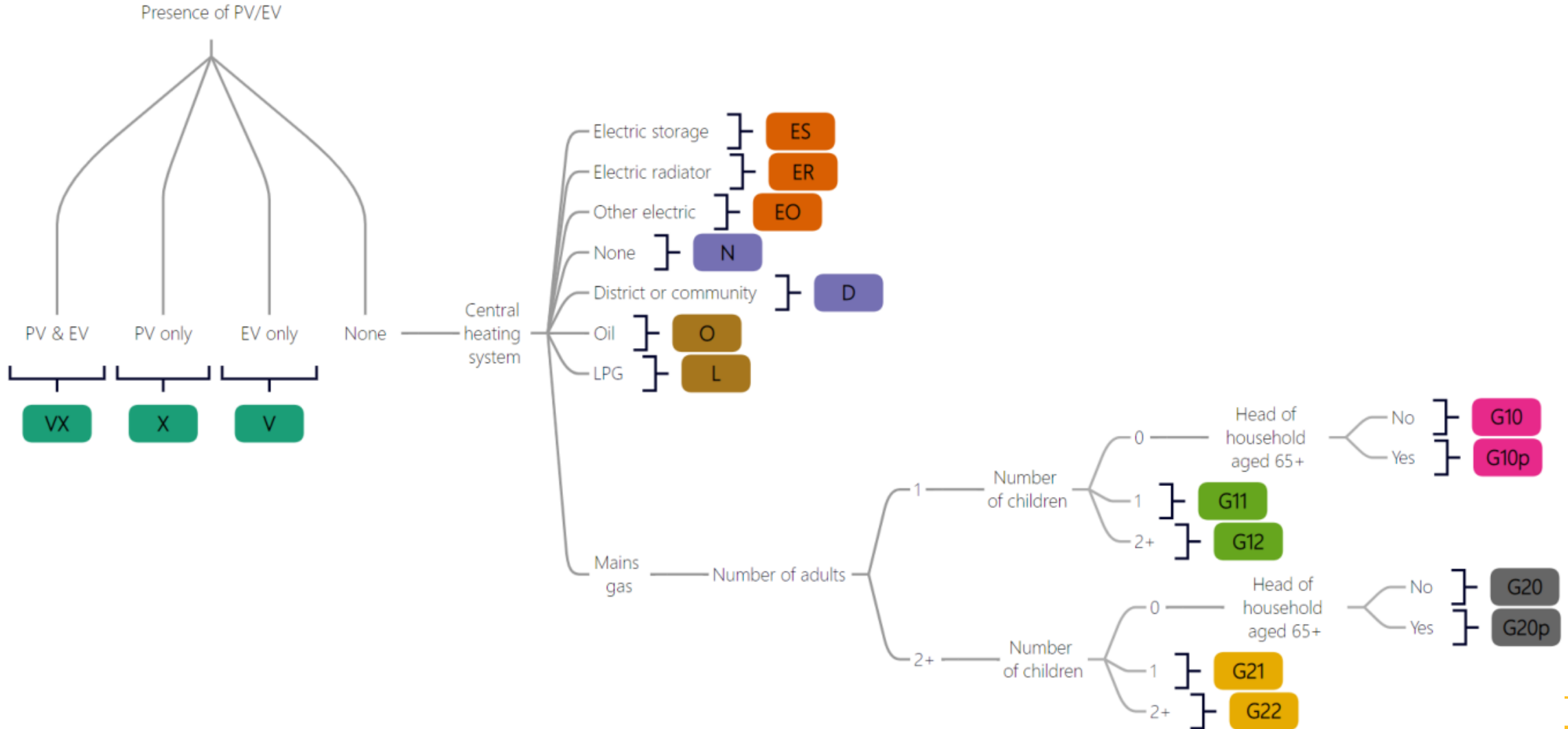
Energy consumer archetypes (domestic)

Method overview

- The Smart Energy Research Lab (SERL) Observatory dataset contains half-hourly electricity and gas consumption data and contextual survey data for 13,000 GB households.
- We split these SERL households into groups based on the survey data. These groups are the energy consumer archetypes (domestic).
- Half-hourly demand profiles and monthly consumption summaries were then extracted
- We classified every household in GB into one of the archetypes using a GB-wide household level dataset (built from a variety of sources). This gave us the ability to output the geographic distribution of the archetypes and add more descriptive information to each archetype in different areas (e.g. proportion of home owners).

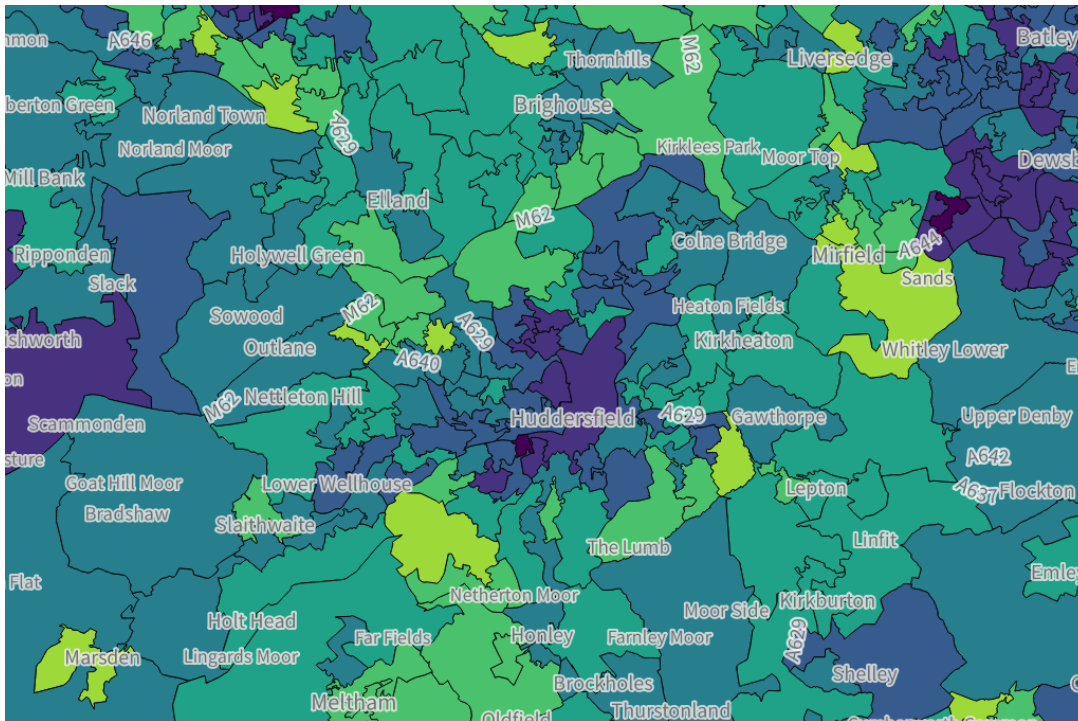


Archetype tree diagram



Geographic summaries

- Household counts for all archetypes (except V and VX)
 - All GB
 - Local authority (2023 boundaries)
 - LSOA (2011 boundaries)



Geographic distribution of archetype G10p (at LSOA11 level, zoomed in). The lighter shades represent higher household counts.

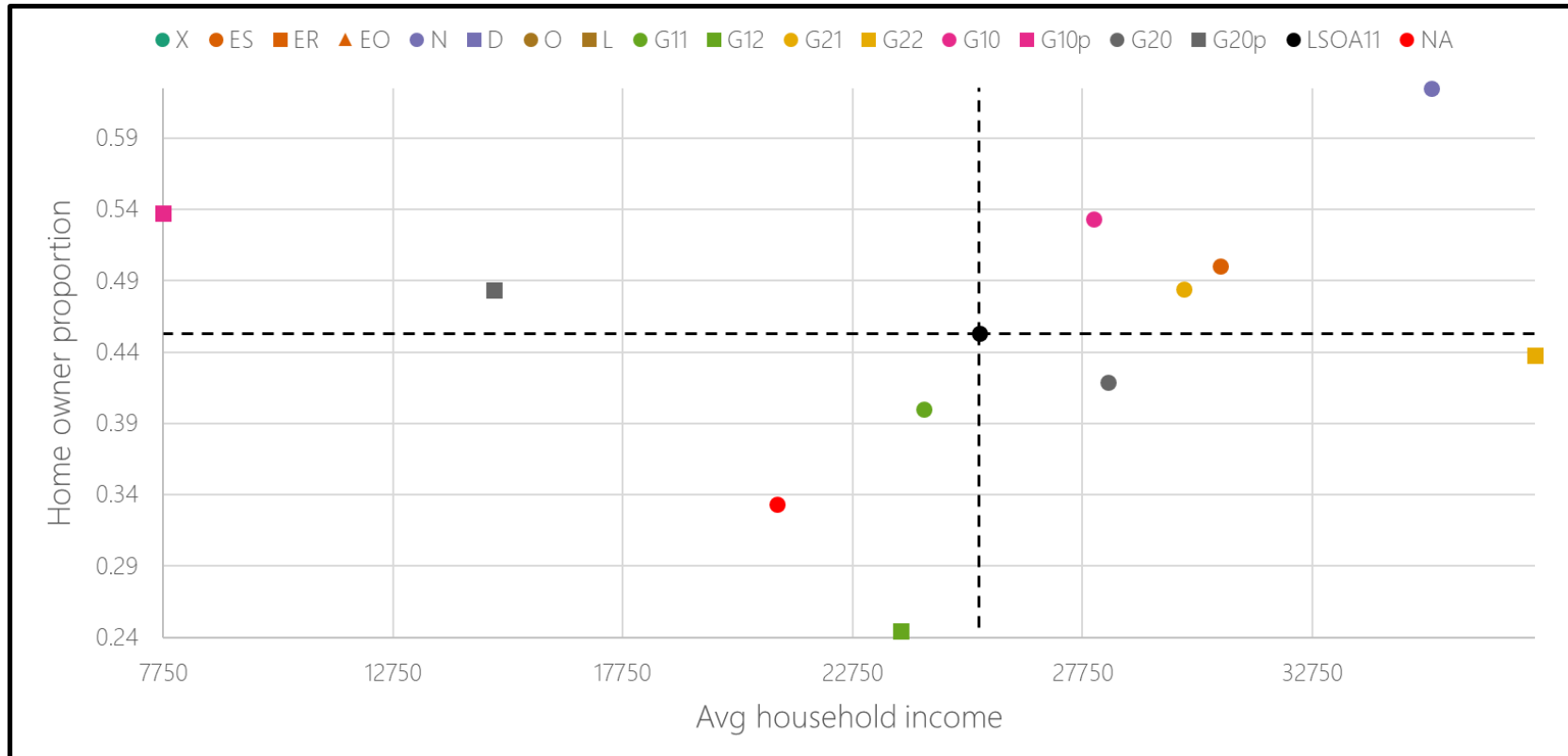
Archetype code	Household count	Household proportion
X	346,118	0.01
ES	1,229,044	0.04
ER	297,540	0.01
EO	303,167	0.01
N	913,506	0.03
D	736,610	0.03
O	1,099,135	0.04
L	212,865	0.01
G11	929,928	0.03
G12	773,631	0.03
G21	2,233,011	0.08
G22	3,139,014	0.11
G10	3,725,553	0.13
G10p	2,912,430	0.10
G20	5,064,209	0.18
G20p	3,148,571	0.11
NA	1,227,427	0.04
	28,291,759	1.00

Additional variables

- The following variables were also calculated for each archetype at the three geographic levels:
 - Mains gas connection proportion
 - Home owner proportion
 - Average (median) household income
 - Average EV score
 - Average PV score
 - Average fuel poverty score
- EV score, PV score, and fuel poverty score
 - A score above 100 represents greater than UK average prevalence/agreement with the statement. A score below 100 represents less than UK average prevalence/agreement with the statement.
 - EV score: derived from the Experian Mosaic variable **'Electric cars are the future of motor industry'** (source: YouGov and TGI)
 - PV score: derived from the Experian Mosaic variable **'Consider getting solar panels on my home'** (source: YouGov and TGI)

Additional variables

Home owner proportion against average household income (LSOA11: E01000046)

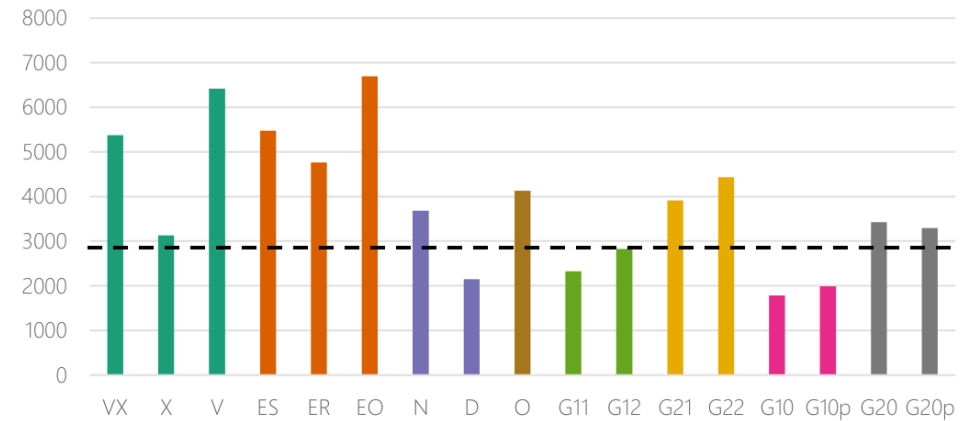


- Mains gas connection proportion
- Home owner proportion
- Average (median) household income
- Average EV score
- Average PV score
- Average fuel poverty score

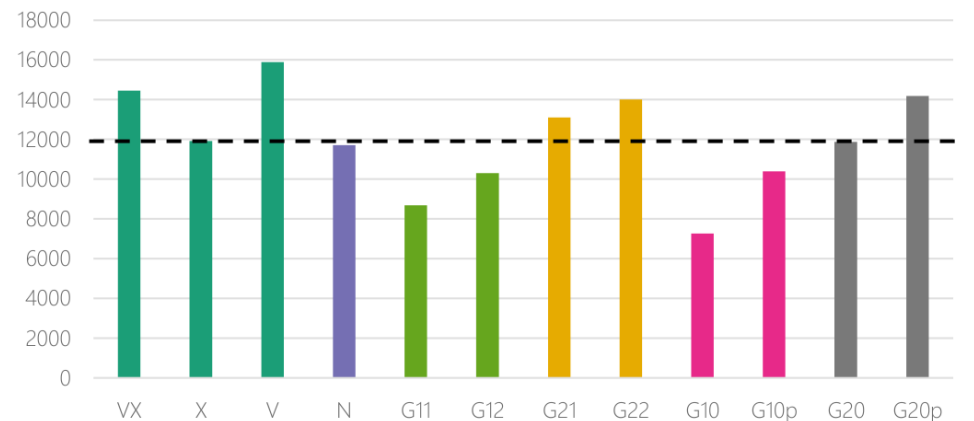
Monthly consumption summaries

- Total monthly consumption (kWh)
- Peak half-hourly consumption in the month (Wh)
- Minimum half-hourly consumption in the month (Wh)
- For each of the three variables above, we have calculated the following:
 - mean
 - 10th, 25th, 50th (median), 75th, and 90th percentiles
- Separate outputs for electricity import, gas, and electricity export

Mean annual electricity import (kWh)



Mean annual gas consumption (kWh)

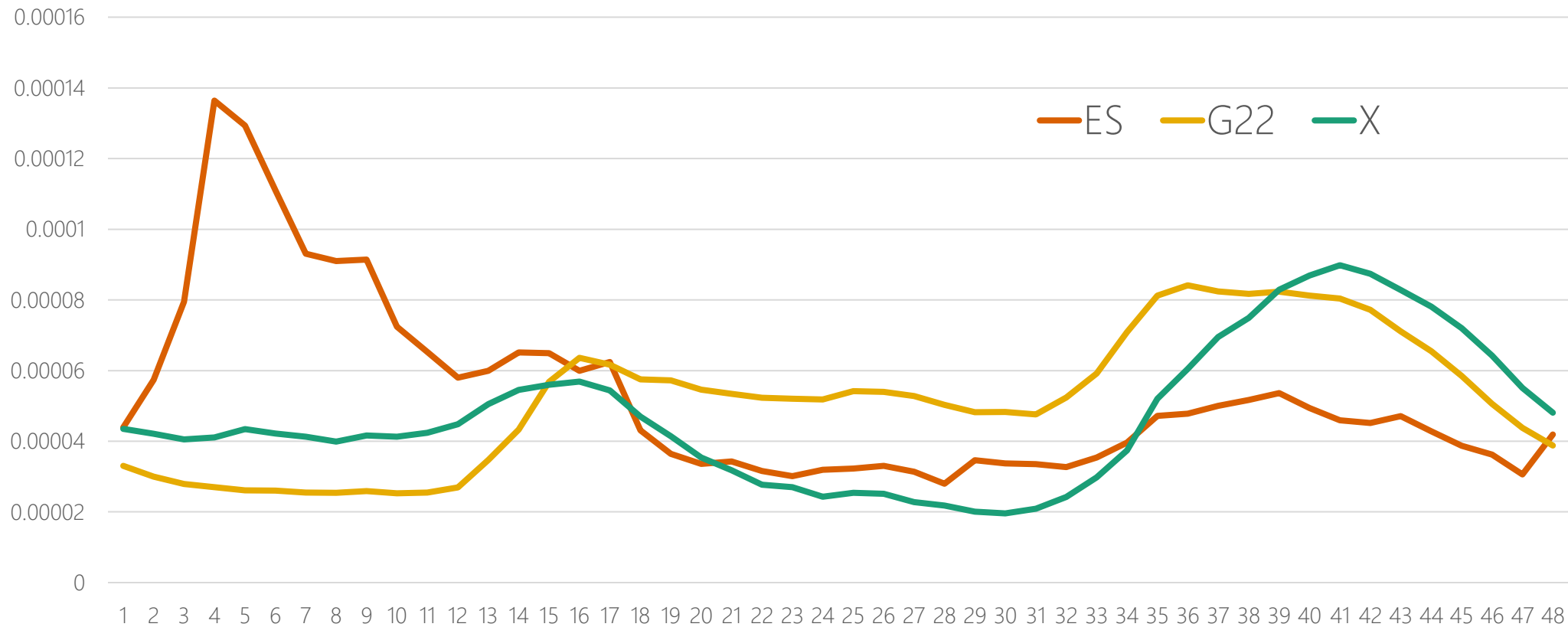


Half-hourly profiles

- Normalised half-hourly profiles (normalised by annual consumption)
 - Each data point represents the fraction of energy consumed in that half-hour period with respect to annual consumption
- Profile for each calendar month and type of day (weekday/weekend) = 24 profiles per archetype
- For each of the profiles, we have calculated the following:
 - mean
 - 10th, 25th, 50th (median), 75th, and 90th percentiles

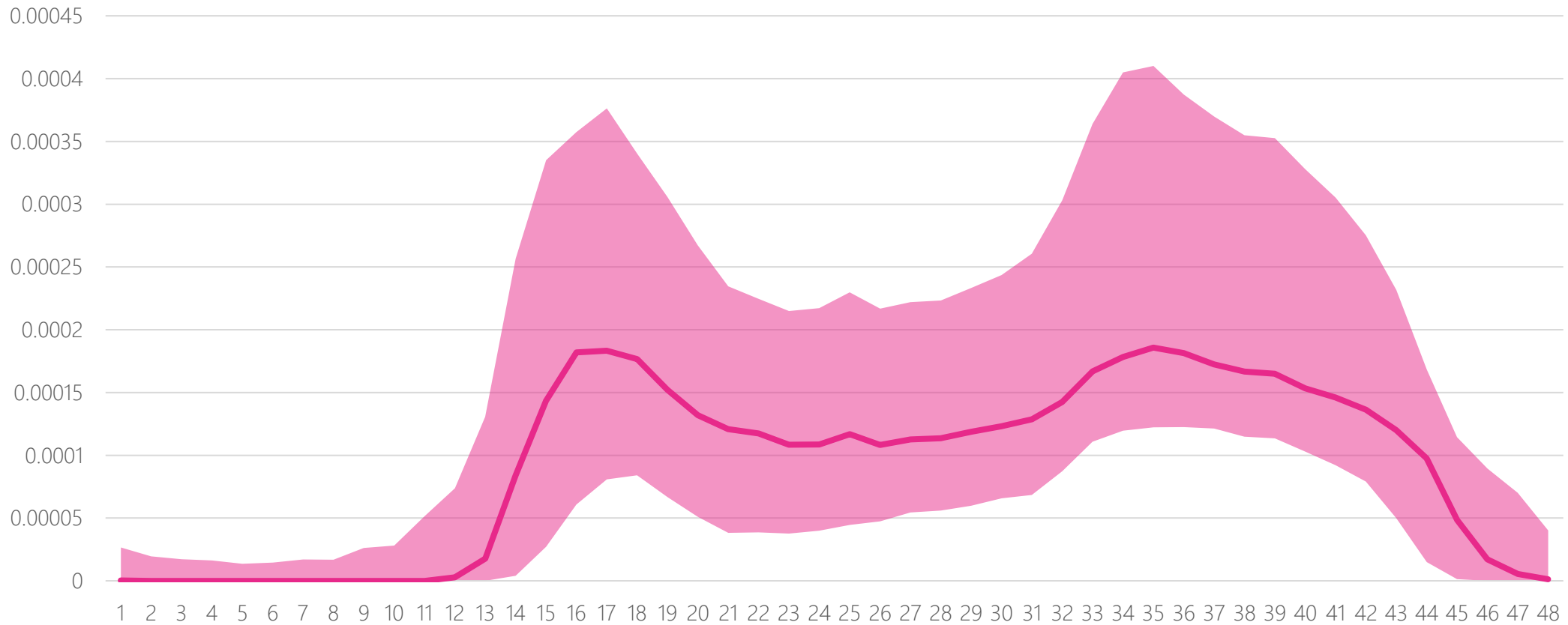
Half-hourly profiles

Electricity import - April weekday



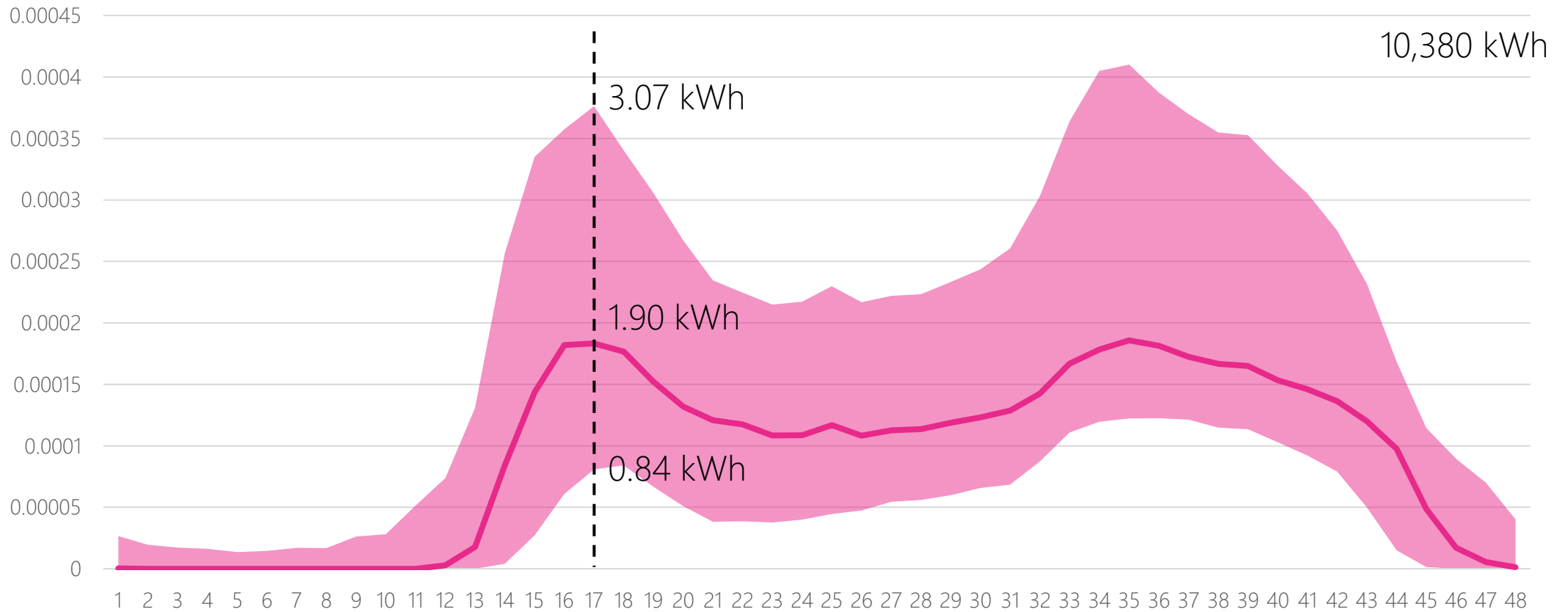
Half-hourly profiles

Archetype G10p – Gas import – January weekend



Half-hourly profiles

Archetype G10p – Gas import – January weekend



Additional outputs

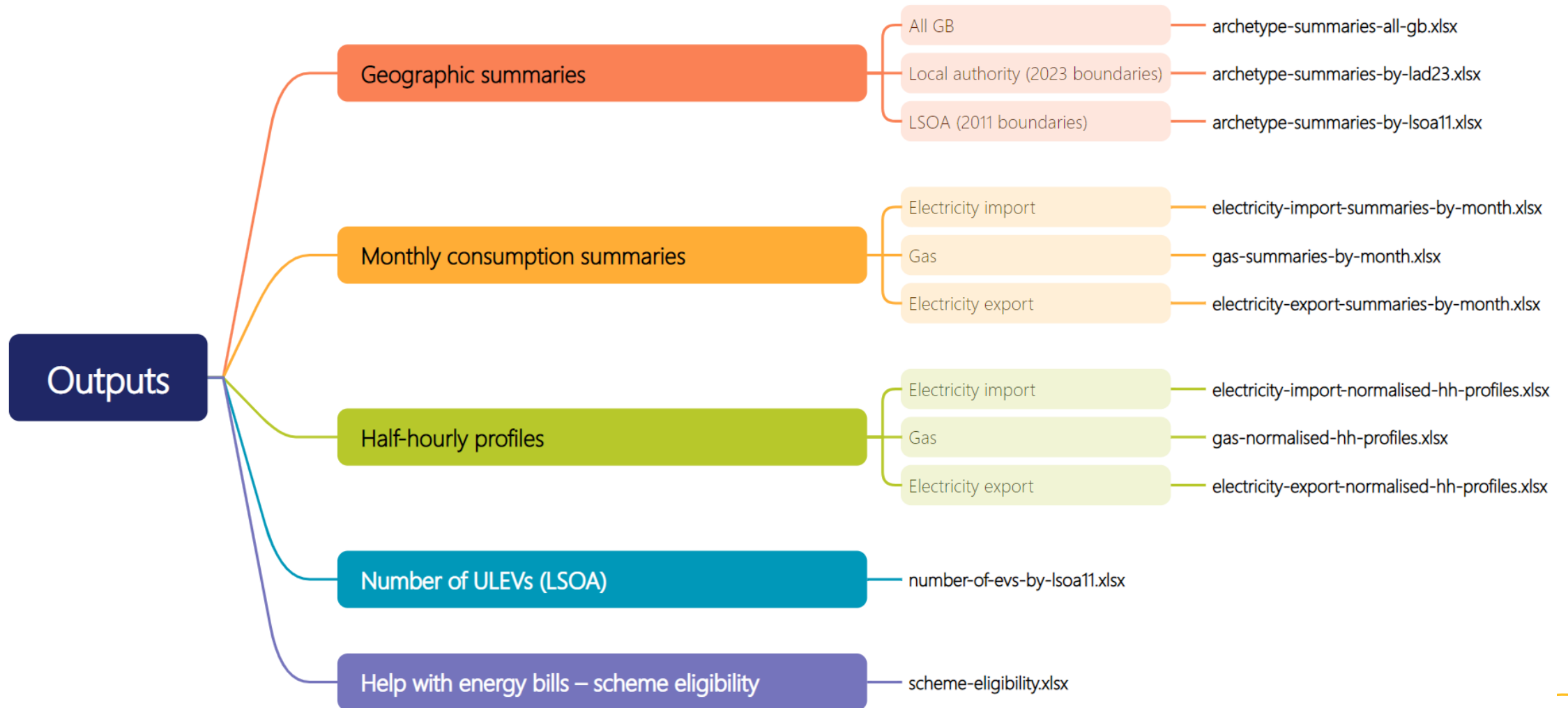
Number of ULEVs (LSOA)

- Number of licensed ultra low emission vehicles at the end of Q4 2018 – 2022
- Fuel type
 - Battery electric
 - Plug-in hybrid electric
 - Range extended electric
- Keepership
 - Private
 - Company
- Data from the DVLA and Department for Transport

Help with energy bills – scheme eligibility

- The Living Cost and Food Survey (LCF) was used to estimate the proportion of households within each archetype that are eligible for each of the following:
 - Cold Weather Payment
 - Energy Company Obligation
 - Winter Fuel Payment
 - Warm Home Discount Scheme
- Note, households in the LCF could not be joined with archetypes VX, X, V, and N (due to a lack of data on low carbon technologies in the LCF) and archetypes ES/ER/EO could not be distinguished from each other.

Outputs overview



Use cases

- Demand modelling
 - Benchmark against DESNZ sub-national electricity/gas consumption data
- LCT uptake
 - Home owner proportion
 - Average (median) household income
 - Average EV/PV score (attitudes)
 - Number of EVs
 - Household count of archetype X (solar PV)
- The DFS social research evaluation has created a dataset of 18,530 households, which combines:
 - variables that have been used to split the archetypes (presence of PV/EV, central heating type, number of adults, number of children and number of adults aged 65+ in the household)
 - variables related to demand shifting (motivations, shifting strategies used, challenges experienced, likelihood to participate in future DFS type offers)

Non-Domestic Consumer Archetypes



Non-Domestic Consumer Archetypes Overview

Methodology

1 Initial segmentation based on sector

Mapping of **organisation characteristics** against **requirements for engagement** with technologies and offers under three themes:

2

- **Conditions**
- **Capacity**
- **Concern**

3

Offer profiling tool: Assessment of each organisations' engagement with different technologies and offers.

4

Archetype segmentation based on the type and number of offers engaged with.

Supported by literature review and datasets including non-domestic ECP records, ND-NEED, BEES and Ofgem ND Consumer Research.

Results

- The outcome is a nested set of archetypes.
- Within each sector, there are four archetypes which are consistent across sectors.
- The distribution of each sector into the four archetypes varies between sectors.

Retail

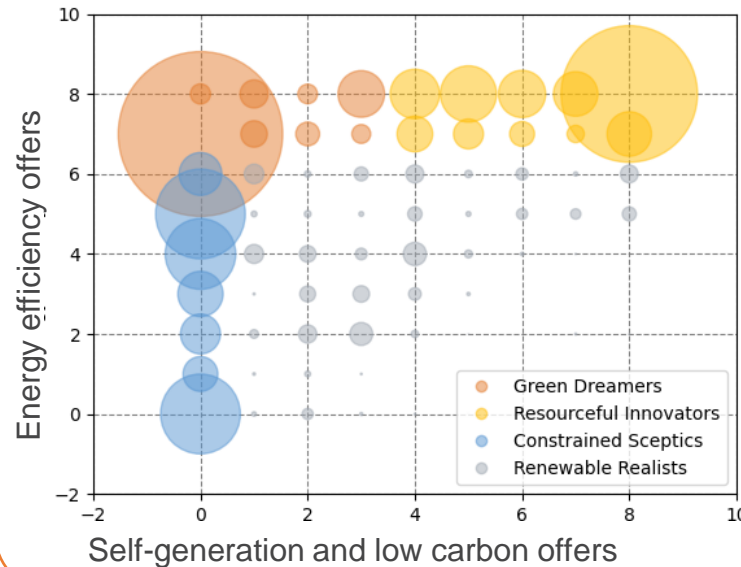
Green Dreamers

Resourceful Innovators

Constrained Sceptics

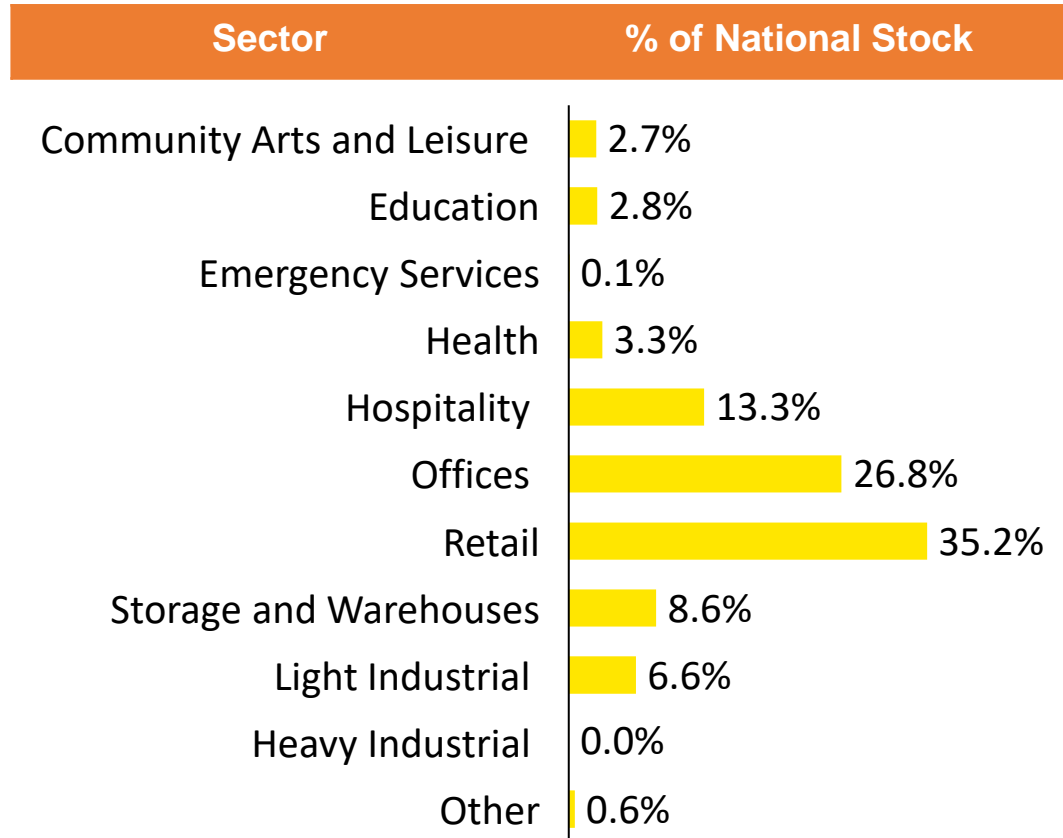
Renewable Realists

Engagement with LCTs and energy efficiency



- Building stock, floorspace, annual gas demand and annual and peak electricity demand is provided by archetype at **LSOA resolution**.
- Detailed descriptions and engagement attributes are provided for each archetype.
- Electricity demand load profiles and flexible proportion of peak load is provided by each sector.

The Non-domestic archetypes are defined by sector, then each sector is separated into four behavioural archetypes



The sectors used here were largely taken from the sector split used in BEES as to best fit multiple datasets. BEES does not include an "other" category, values taken from BEES for this category are averages across all other sectors.

Each sector is split into four behavioural archetypes (apart from heavy industrial)



Green Dreamers – Interested in energy efficiency but not able to engage with low carbon technologies or self generation.

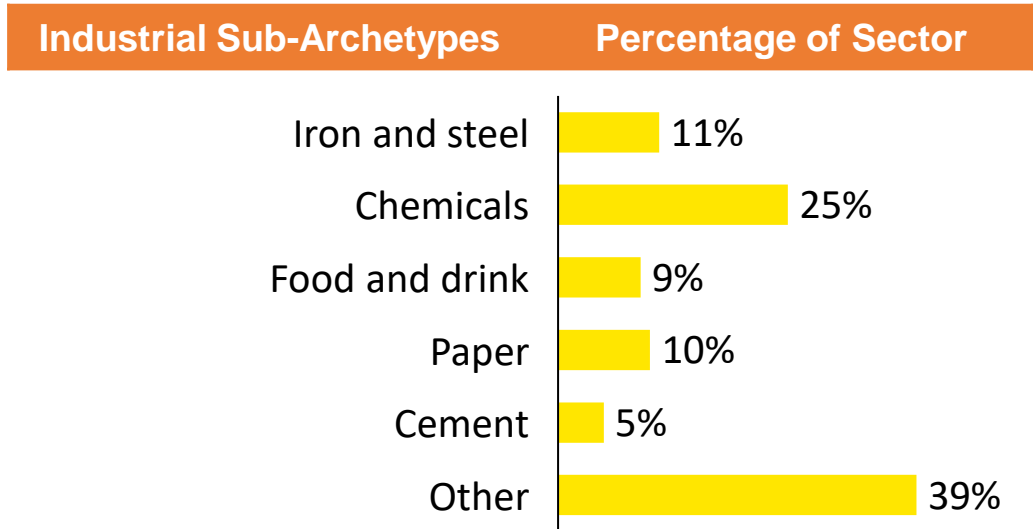
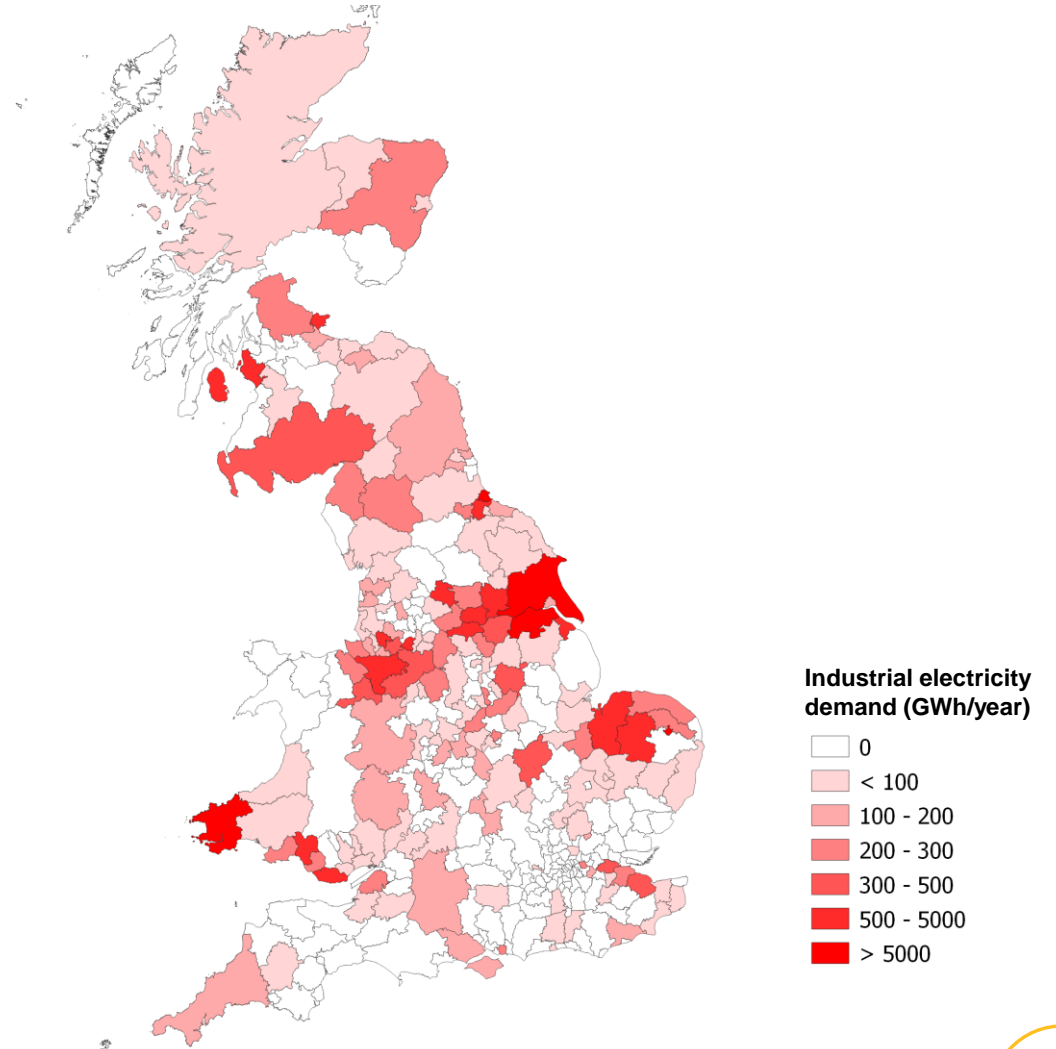
Resourceful Innovators – Able to engage with both energy efficiency and with low carbon technologies / self generation.

Constrained Sceptics – Can engage with some energy efficiency offers and very few low carbon technologies.

Renewable Realists – Medium to low engagement with both energy efficiency and low carbon technologies.

Heavy Industry is separated by their industrial sub-sector rather than behavioural archetypes

- Heavy industry is segmented by industrial-sub sector rather than behavioural archetypes.
- Each sub-sector has particular loads and processes that informs decarbonisation options.
- We expect the constraints of these processes to be more restrictive than any of the organisational characteristics used to model engagement in other sectors with less diverse loads.



Outputs overview

Outputs by Archetype and LSOA

- Number of buildings [#]
- Area of floorspace [m²]
- Total annual electricity consumption [kWh/y]
- Total annual gas consumption [kWh/y]
- Peak annual electricity demand [kW]

Outputs by Archetype

- Archetype descriptions
- Archetype split [%] (national % of sector in each behavioural archetype)
- Archetype attributes [%] (e.g. % of archetype that are large businesses or own their premises etc.)
- Archetype engagement [Low/Medium/High] (e.g. Low engagement with low carbon technologies)

Outputs by Sector

- Electricity diurnal load profiles [kW/kWh]
- Proportion of peak load that is flexible [%]

Outputs for heavy industry

- By sub-sector
 - Typical industrial process and decarbonisation options
- By sub-sector and LSOA
 - Number of sites [#]
 - Total annual electricity consumption [GWh/y]
 - Total annual gas consumption [GWh/y]

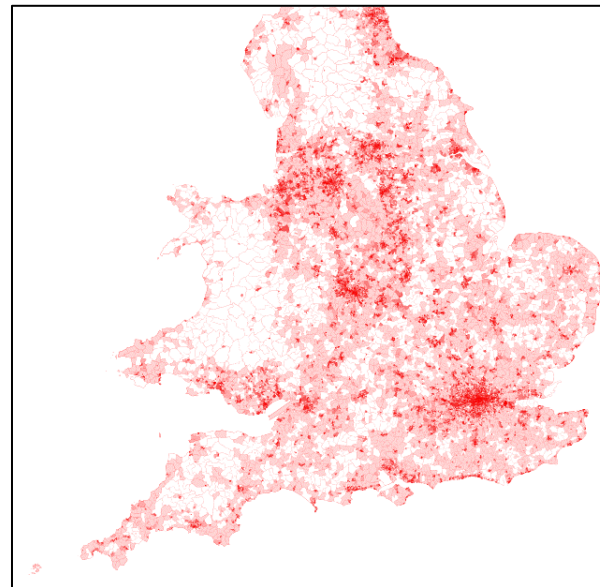
Outputs by Archetype and LSOA

- Number of buildings [#]
- Area of floorspace [m²]
- Total annual electricity consumption [kWh/y]
- Total annual gas consumption [kWh/y]
- Peak annual electricity demand [kW]

Proportion of total non-domestic buildings that are Green Dreamers in each LSOA



Total electricity consumption per area [kWh/m²]

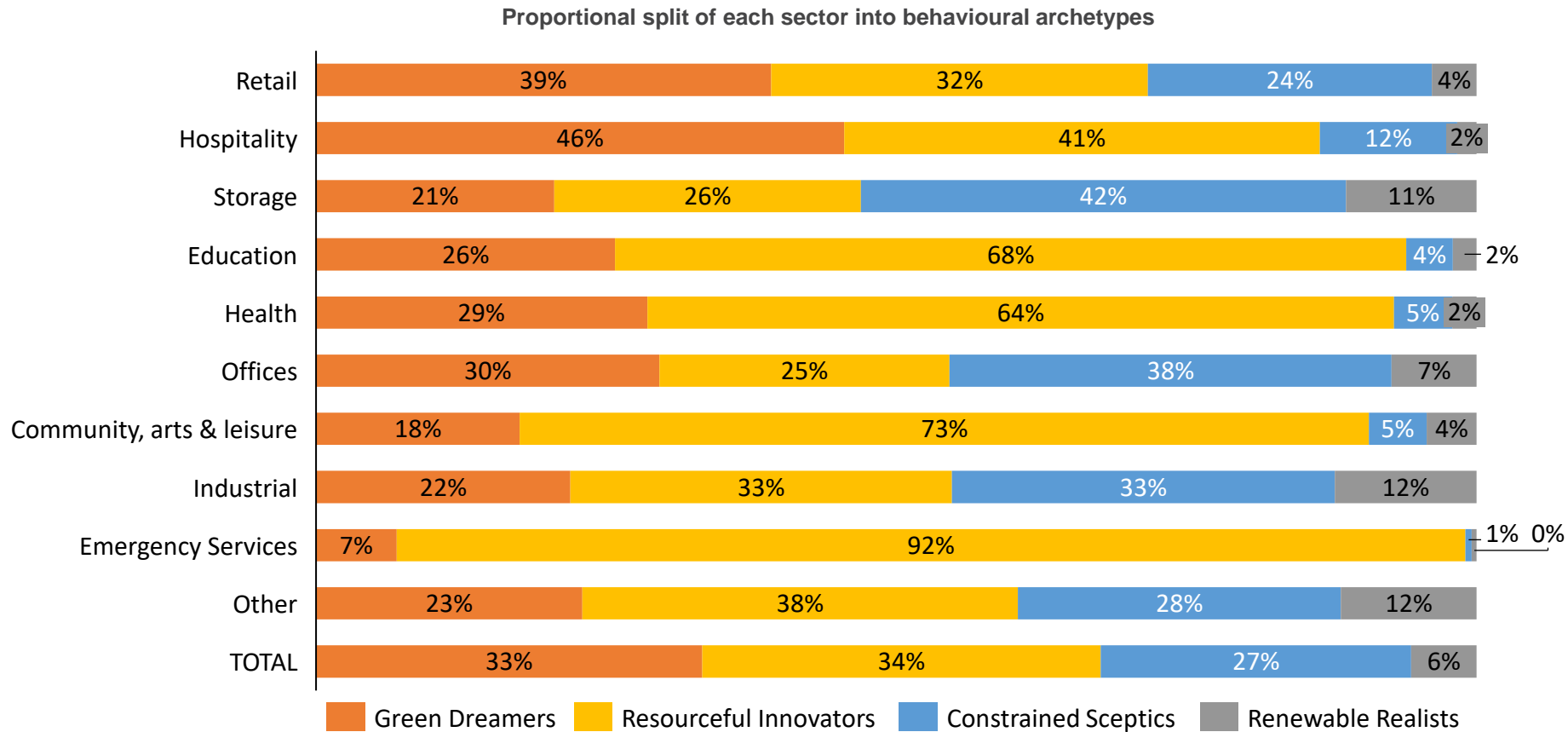


List of archetypes (apart from heavy industrial)

Sector	Behavioural archetype
Community Arts and Leisure	Green Dreamers
Community Arts and Leisure	Resourceful Innovators
Community Arts and Leisure	Constrained Sceptics
Community Arts and Leisure	Renewable Realists
Education	Green Dreamers
Education	Resourceful Innovators
Education	Constrained Sceptics
Education	Renewable Realists
Emergency Services	Green Dreamers
Emergency Services	Resourceful Innovators
Emergency Services	Constrained Sceptics
Emergency Services	Renewable Realists
Health	Green Dreamers
Health	Resourceful Innovators
Health	Constrained Sceptics
Health	Renewable Realists
Hospitality	Green Dreamers
Hospitality	Resourceful Innovators
Hospitality	Constrained Sceptics
Hospitality	Renewable Realists
Offices	Green Dreamers
Offices	Resourceful Innovators
Offices	Constrained Sceptics
Offices	Renewable Realists
Retail	Green Dreamers
Retail	Resourceful Innovators
Retail	Constrained Sceptics
Retail	Renewable Realists
Storage and Warehouses	Green Dreamers
Storage and Warehouses	Resourceful Innovators
Storage and Warehouses	Constrained Sceptics
Storage and Warehouses	Renewable Realists
Light Industrial	Green Dreamers
Light Industrial	Resourceful Innovators
Light Industrial	Constrained Sceptics
Light Industrial	Renewable Realists
Other	Green Dreamers
Other	Resourceful Innovators
Other	Constrained Sceptics
Other	Renewable Realists

Outputs by Archetype (1/3)

- Archetype split [%]



Outputs by Archetype (2/3)

Archetypes are consistent between sectors:

- As the same organisational characteristics are used to model engagement with offers across sectors and we have segmented these archetypes based on this modelled uptake, the split of characteristics within these archetypes are the same between sectors.
- The descriptions to the right apply across sectors to each sub archetype.
- Some attributes, such as organisation size, are the same across all archetypes in all sectors.
- While the groupings are consistent, their split within a sector does change.

Some engagement metrics are consistent between sectors:

- As we segment the population based on engagement with energy efficiency and low carbon technologies we see the same spread of engagement with these offers across sectors.
- Engagement with flexibility does vary slightly.

	Energy Efficiency	Low Carbon Technologies
Green Dreamers	High	Low
Resourceful Innovators	High	High
Constrained Sceptics	Low/Medium	Low
Renewable Realists	Medium	Medium

Archetype descriptions

(All Sectors)

Green Dreamers

Mostly leased properties, half have an active energy management ambition and most have some sort of energy manager.

Resourceful Innovators:

Entirely owner-occupiers, just under half have an active energy management ambition and most have some sort of energy manager.

Constrained Sceptics:

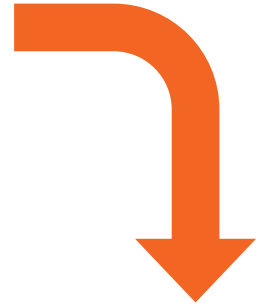
Mostly leased properties, lower percentage have high energy spend than the archetypes above. Less than half of these organisations have an energy manger and very few have an active energy management ambition. Mostly smaller businesses.

Renewable Realists:

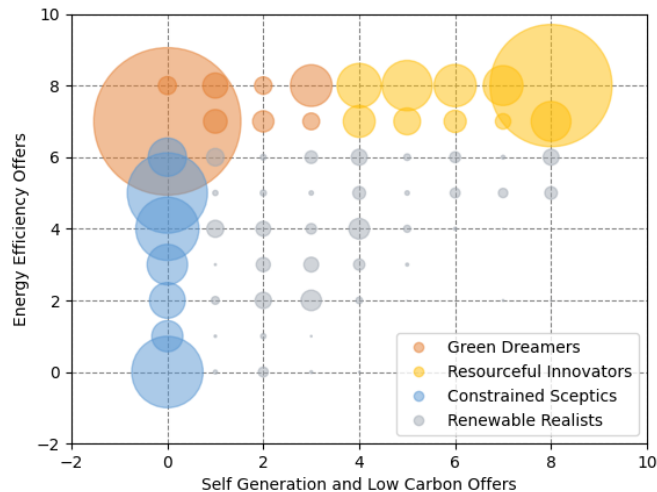
As in Resourceful Innovators these organisations are entirely owner-occupiers. Most of these organisations have no energy manger. Very few of these organisations have an active energy management ambition. Mostly smaller businesses.

Outputs by Archetype (3/3)

+ Impact on...	Attribute	Green Dreamers	Resourceful Innovators	Constrained Sceptics	Renewable Realists
Concern	High gas spend (Over 20%)	49%	53%	35%	35%
Concern	High electricity spend (Over 20%)	59%	57%	23%	17%
Capacity	Is a large business	56%	54%	34%	43%
Conditions	Uses all of a building or multiple buildings	52%	55%	51%	38%
Concern	Has an active energy management ambition	46%	44%	15%	11%
Capacity	Has an energy manager	82%	77%	36%	22%
Capacity	Owns their premises	7%	100%	6%	100%
Concern	Planning to adopt Energy Efficiency	65%	55%	27%	13%



The average percentage of an archetype which has a particular attribute. Chart only contains attributes found to vary between archetypes.



This suggests...

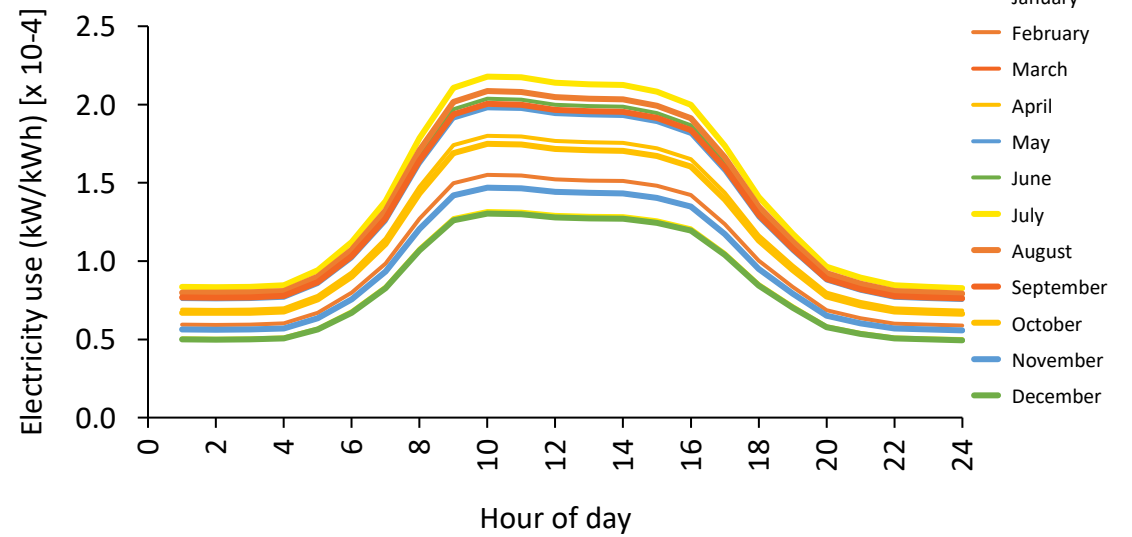
- **Constrained Sceptics** often lack conditions, capacity and concern.
- **Resourceful Innovators** often have all resources necessary to engage.
- **Green Dreamers** may be highly concerned but may lack the capacity and conditions to engage.
- **Renewable Realists** have some capacity to act but may not be sufficiently motivated to engage. This is supported by low engagement in EE, a lower difficulty offer.

Outputs by Sector

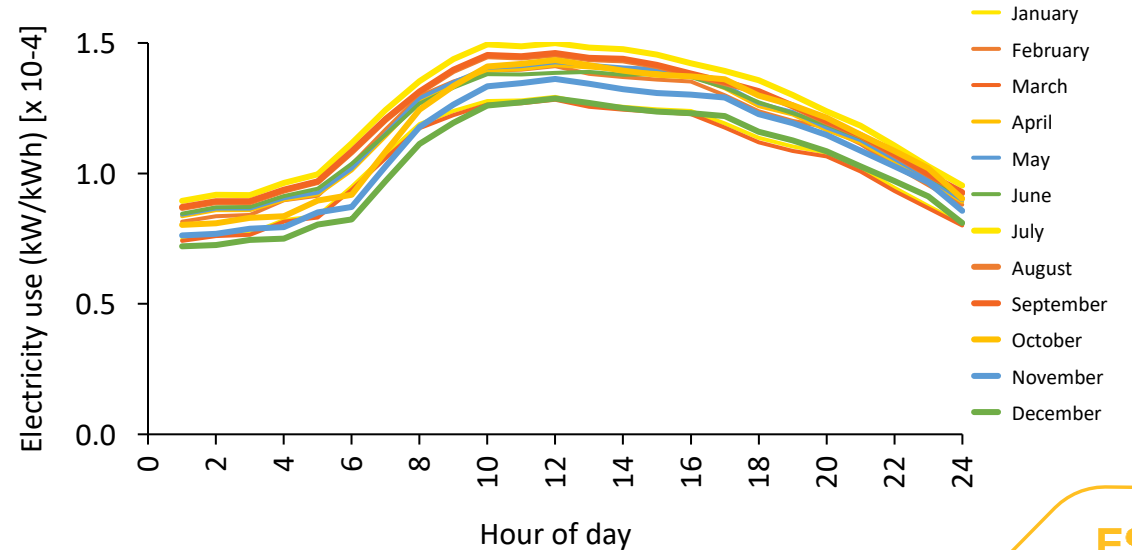
- Electricity diurnal load profiles [kW/kWh]
- Proportion of peak load that is flexible [%]

	Percentage Flexible Peak Demand
Community, arts & leisure	18%
Education	17%
Emergency Services	19%
Health	15%
Hospitality	9%
Industrial	20%
Other	19%
Offices	13%
Retail	20%
Storage	20%

Normalised load profiles – Community, arts & leisure



Normalised load profiles - Retail



Summary of outputs: Offices

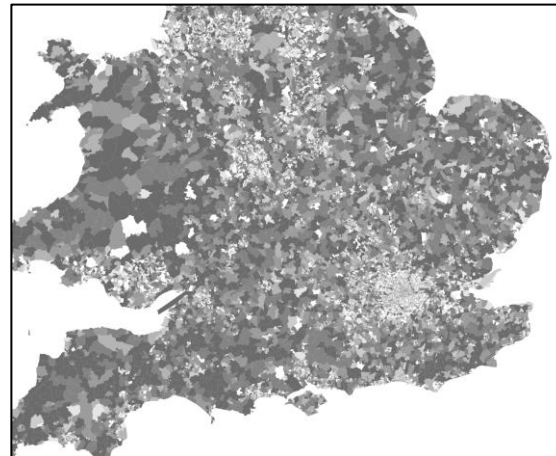
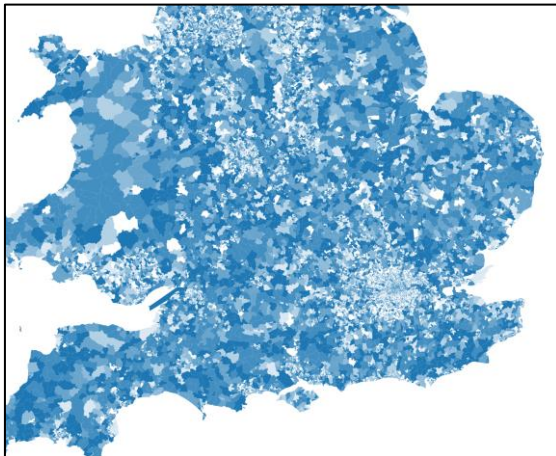
Green Dreamers : 30%

Resourceful Innovators: 25%



Constrained Sceptics: 38%

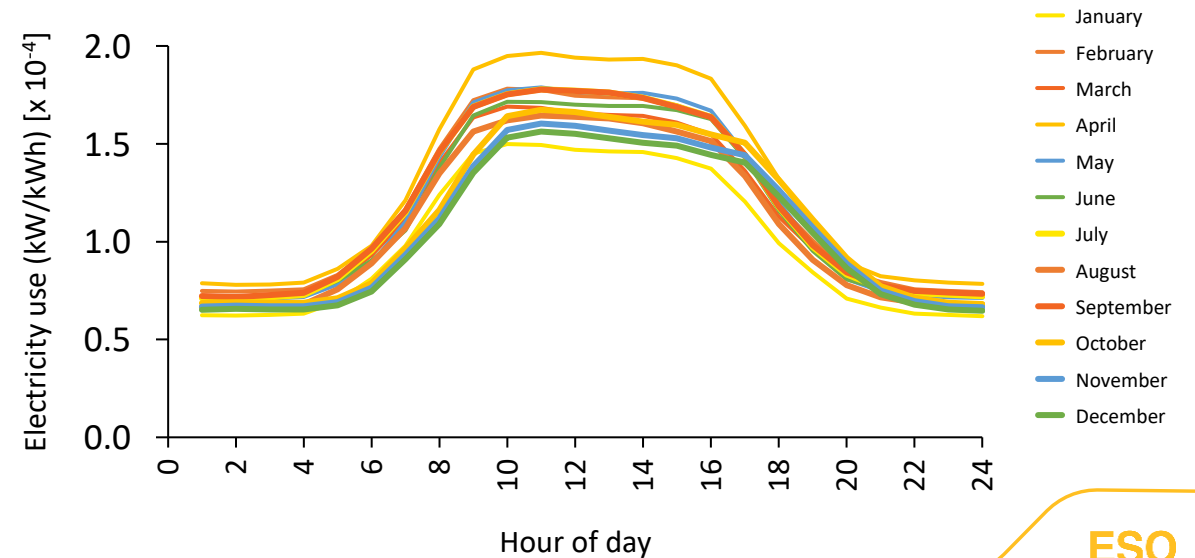
Renewable Realists: 7%



Engagement metrics

	Energy Efficiency	Low Carbon Technologies	Flexibility
Green Dreamers	High	Low	Medium/High
Resourceful Innovators	High	High	Medium/High
Constrained Sceptics	Low/Medium	Low	Medium/Low
Renewable Realists	Medium	Medium	Medium/Low

Normalised load profile



Outputs for Heavy Industry

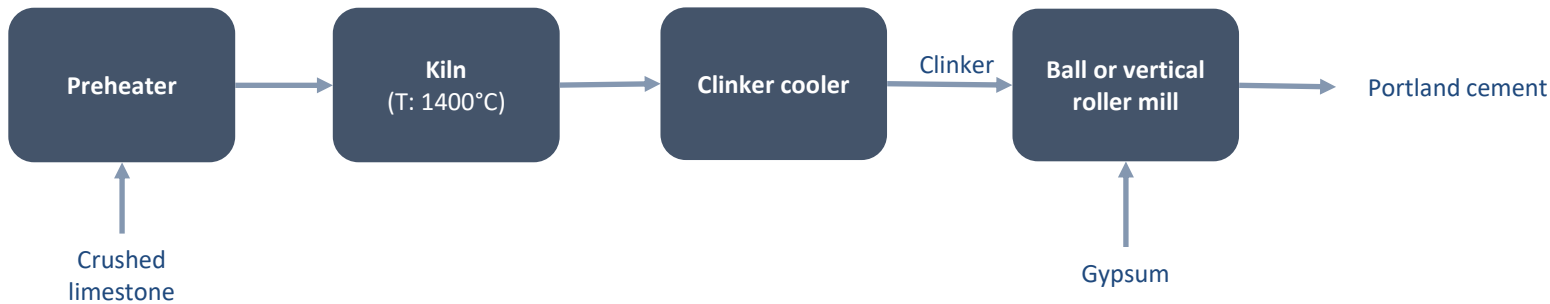
By sub-sector

- Typical industrial process and decarbonisation options

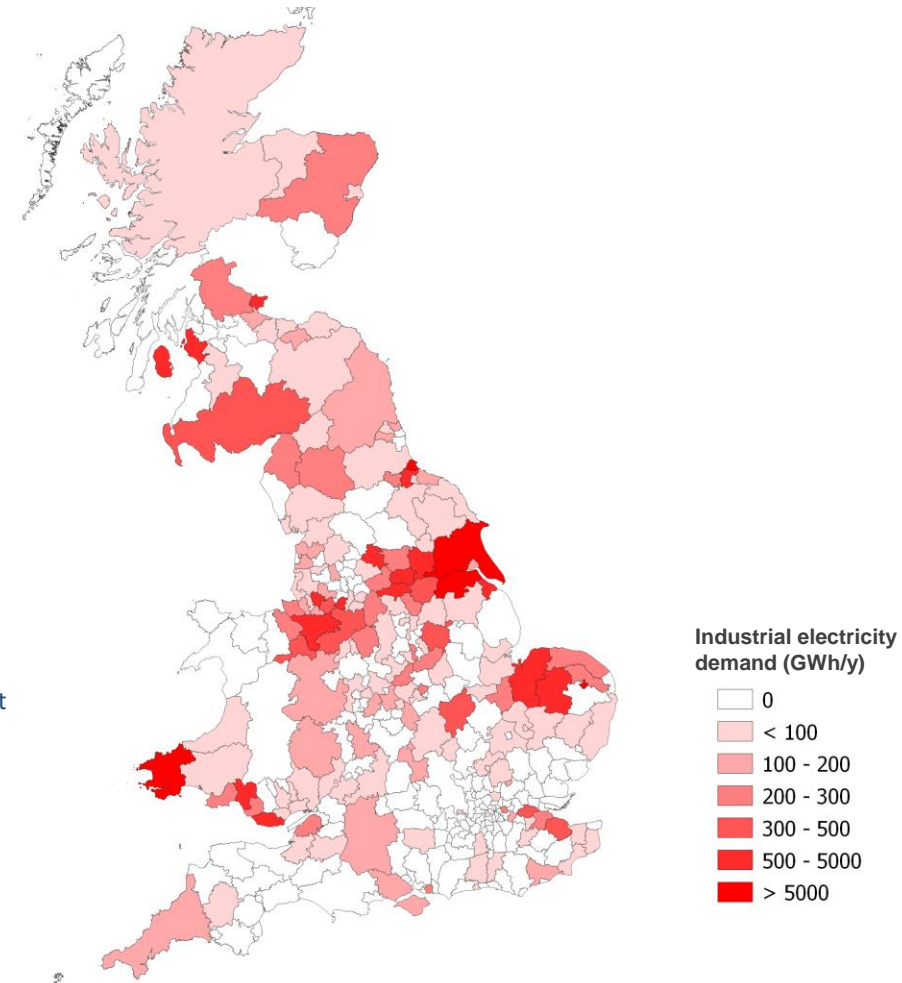
By sub-sector and LSOA

- Number of sites [#]
- Total annual electricity consumption [GWh/y]
- Total annual gas consumption [GWh/y]

Archetypal process diagram for a cement kiln



Option	Description	TRL level	Disruption on existing UK sites	Likely fossil fuel reduction
CCS	Carbon capture can be applied to abate combustion emissions but it will also enable abatement of process emissions.	9	Low	Medium
Electrification	The kiln is electrified.	8	High	High



Use cases

Demand Modelling

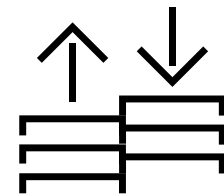
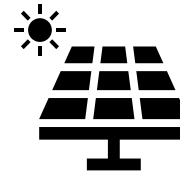
- LSOA output files for electricity and gas consumption can be used for demand modelling
- These figures have been calibrated against DESNZ sub-national electricity/gas consumption data
- LSOA output files for peak electricity demand give an indication for the maximum annual demand that may be expected – note that since these figures are presented by LSOA, they do not directly relate to the demand that would be seen on any particular network asset

LCT Uptake

- The engagement parameters (Low/Medium/High) represent the willingness to engage with low carbon technologies for each archetype.
- These parameters, in combination with other market and policy drivers, can be used to model the uptake of low carbon technologies – archetypes with high engagement are assumed to adopt the technologies earlier than those with low engagement.

Demand Flexibility

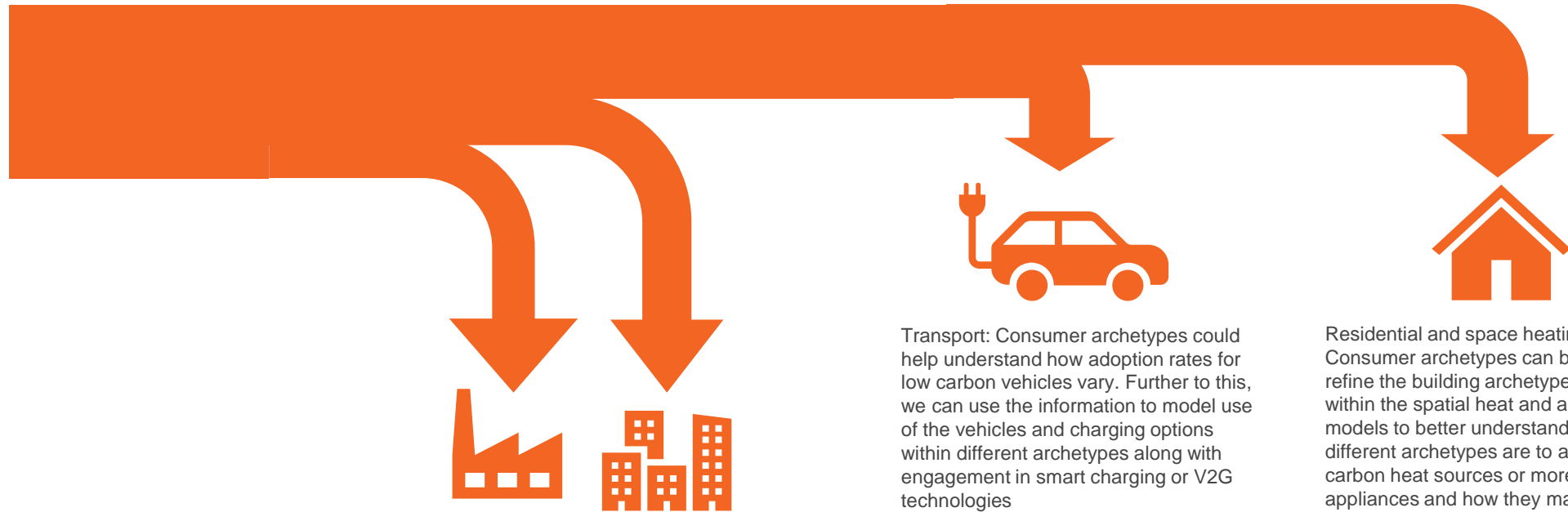
- The outputs for an archetype's peak demand, the flexible percentage of peak load for that sector, and the engagement with flexibility can be combined to model the expected flexibility contribution of an archetype.



Next Steps – FES modelling



Consumer Building Blocks: Potential areas of integration



Industrial and Commercial sectors: We will consider how consumer archetypes can inform how sectors may evolve towards low carbon technologies and how engaged these sectors may be with providing demand-side services

Transport: Consumer archetypes could help understand how adoption rates for low carbon vehicles vary. Further to this, we can use the information to model use of the vehicles and charging options within different archetypes along with engagement in smart charging or V2G technologies

Residential and space heating: Consumer archetypes can be used to refine the building archetype information within the spatial heat and appliances models to better understand how willing different archetypes are to adopt low carbon heat sources or more efficient appliances and how they may operate these

Next Steps – DFS integration



Thank you for listening.

Any questions?

James Whiteford, Electricity Modelling & Regional Strategy Manager
James Kerr, Power Responsive Engagement Lead

Sam Homan – Centre for Sustainable Energy
Arna Sigurdardottir – ERM

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