Mapping the energy transition

Inga Doherty
Oxfordshire County Council

Ruth Harris
Oxford City Council

Local Energy Oxfordshire

Funded by
INDUSTRIAL STRATEGY
UK Research and Innovation

Project LEO – accelerating to net zero

Using Oxfordshire to replicate the electricity system of the future, taking a 'whole systems' approach

- *asset based trials*
- *place based trials*

Through collaborative, cross-sector working, LEO has demonstrated some of the ways changes to our energy system can accelerate our transition to Net Zero, bringing about social, economic, and environmental benefits for all.










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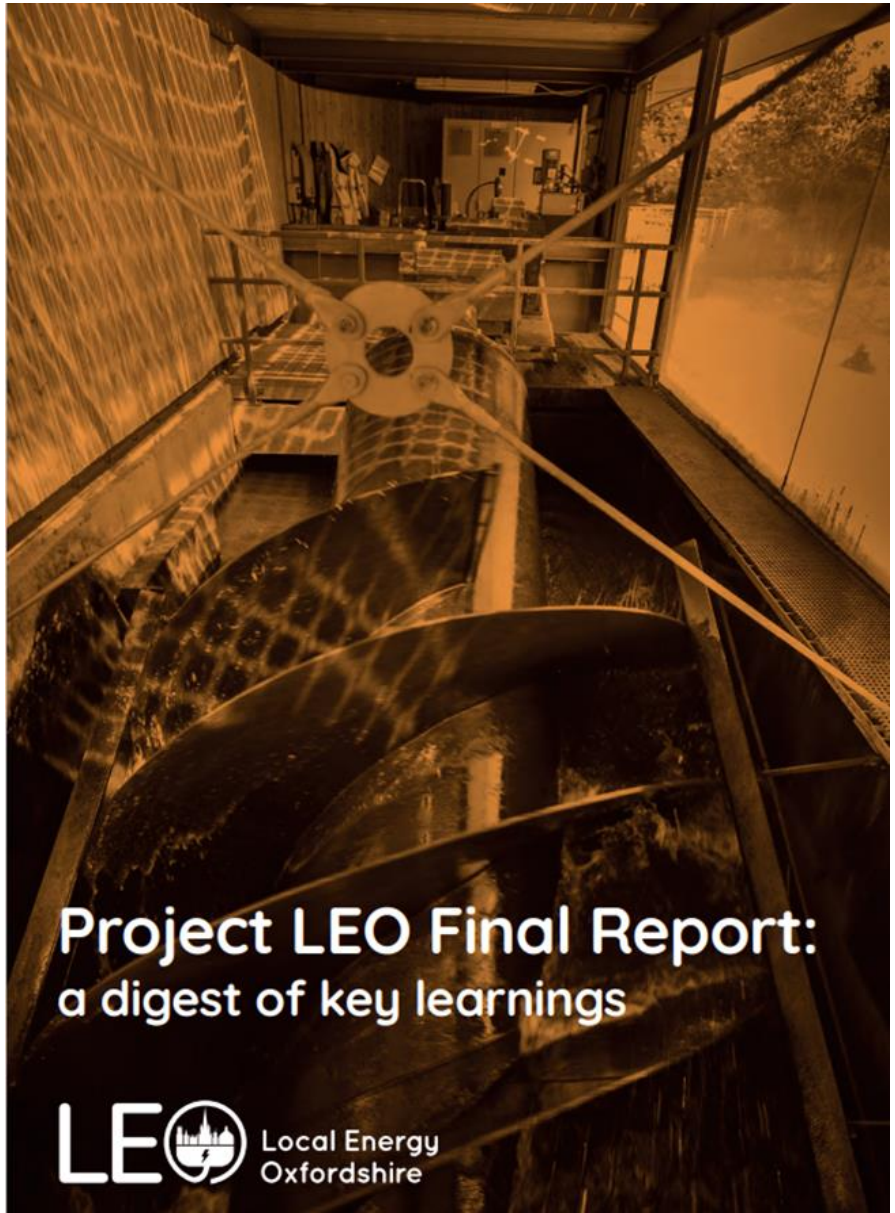
Project LEO – 5 key messages

1. Distribution Systems Operator market development
2. Investable business models
3. Skilled community of people
4. Trialling flexibility
5. Mapping for Local Area Energy Plans

Local Area Energy Plans are vital to achieve Net Zero



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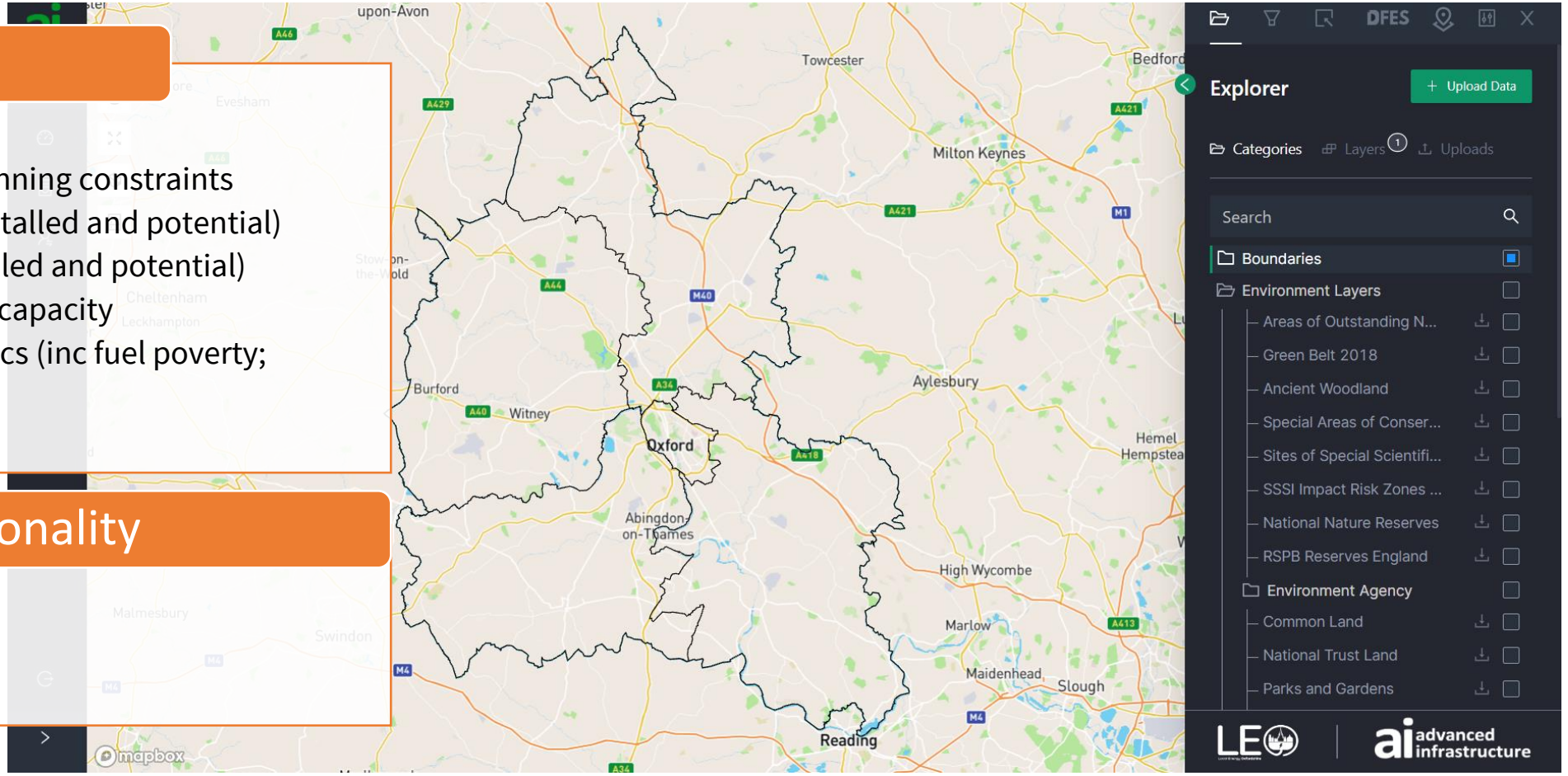
LEO strategic mapping

Data

- Energy demand; generation
- Planned housing growth; planning constraints
- Low carbon technologies (installed and potential)
- Renewable generation (installed and potential)
- Network data, including grid capacity
- Socio-economic characteristics (inc fuel poverty; deprivation)
- DFES

Features and functionality

- Data filters
- Dashboards
- Data stories



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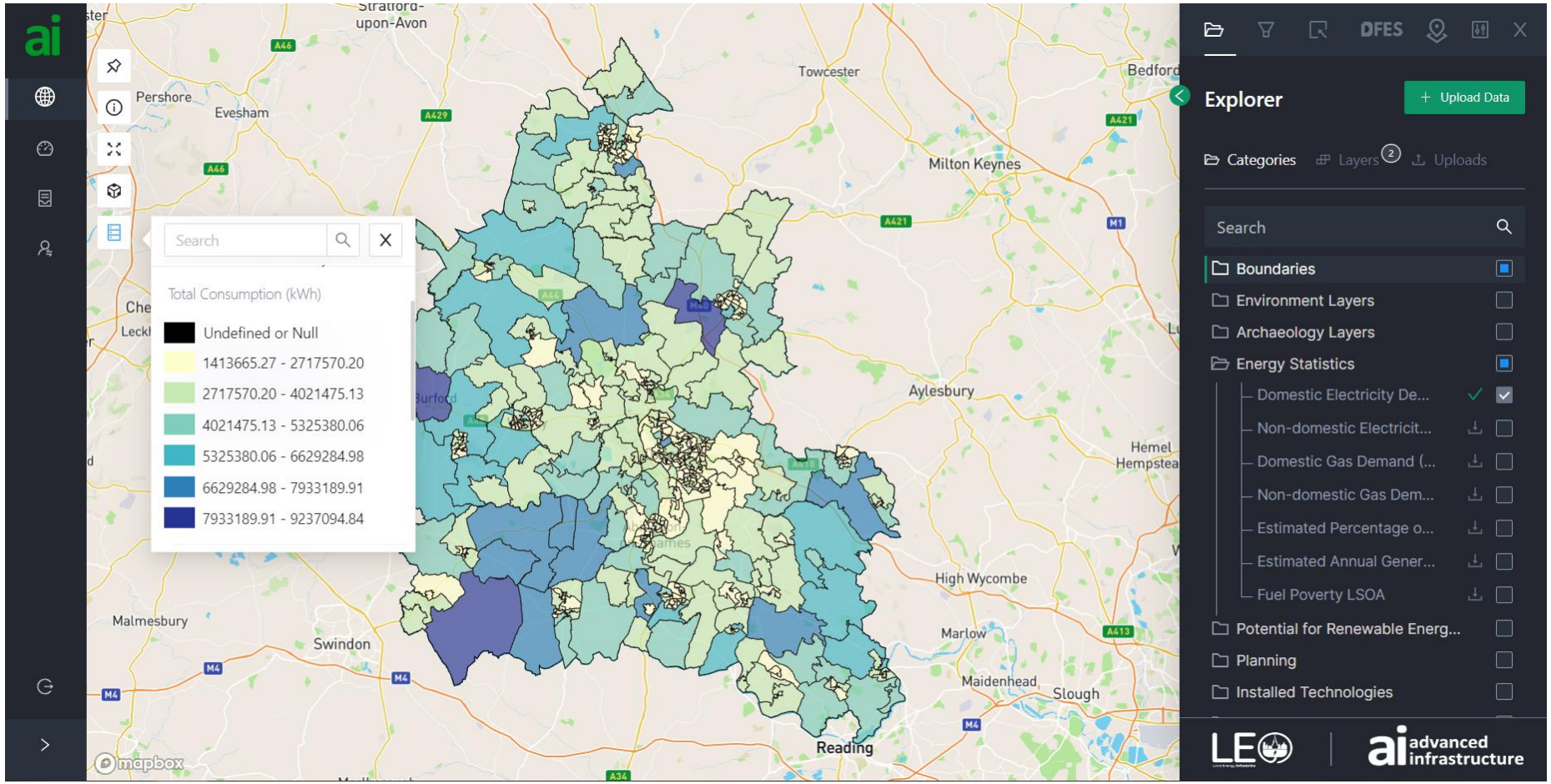
Setting the baseline



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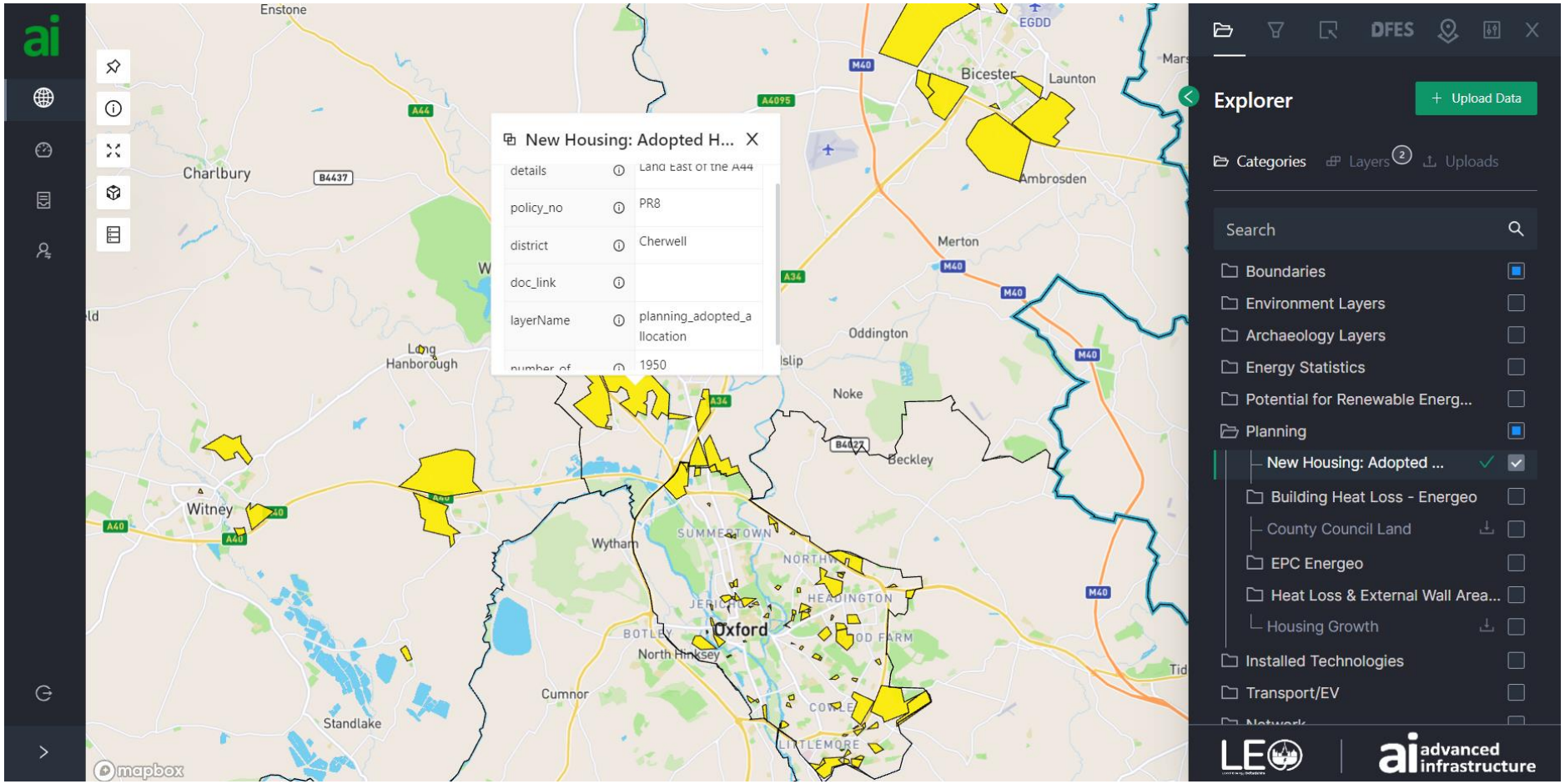
Planning for growth



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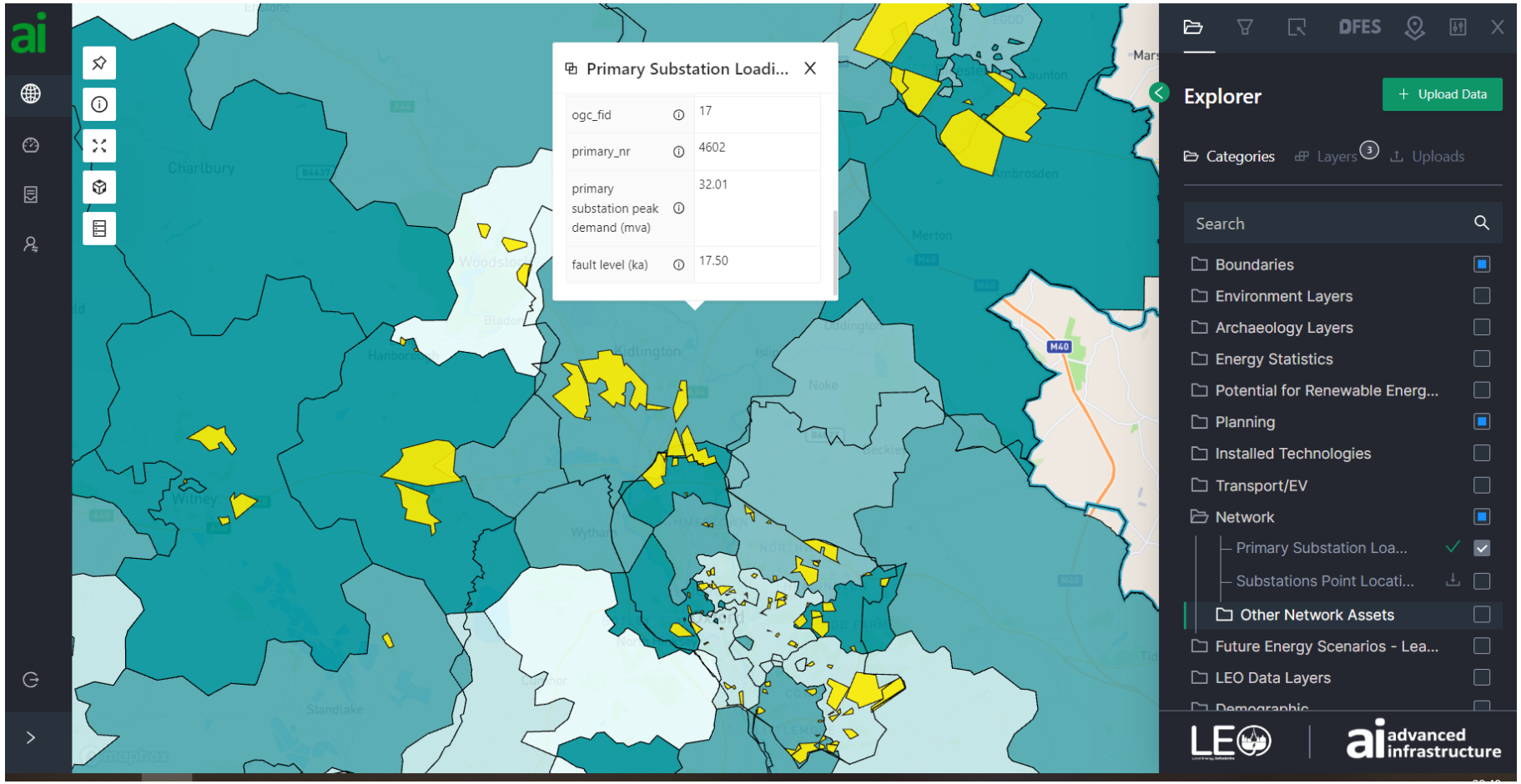
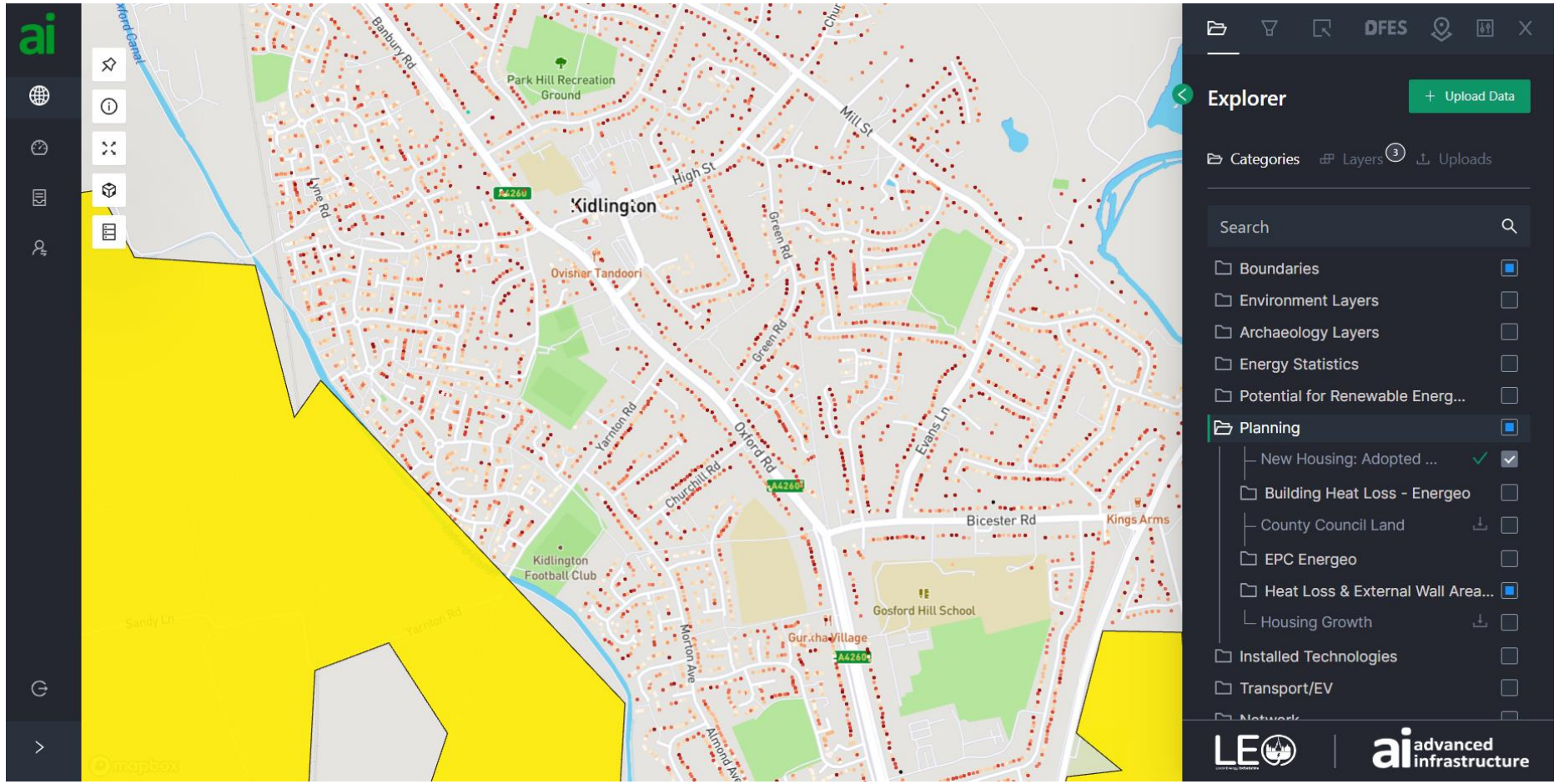
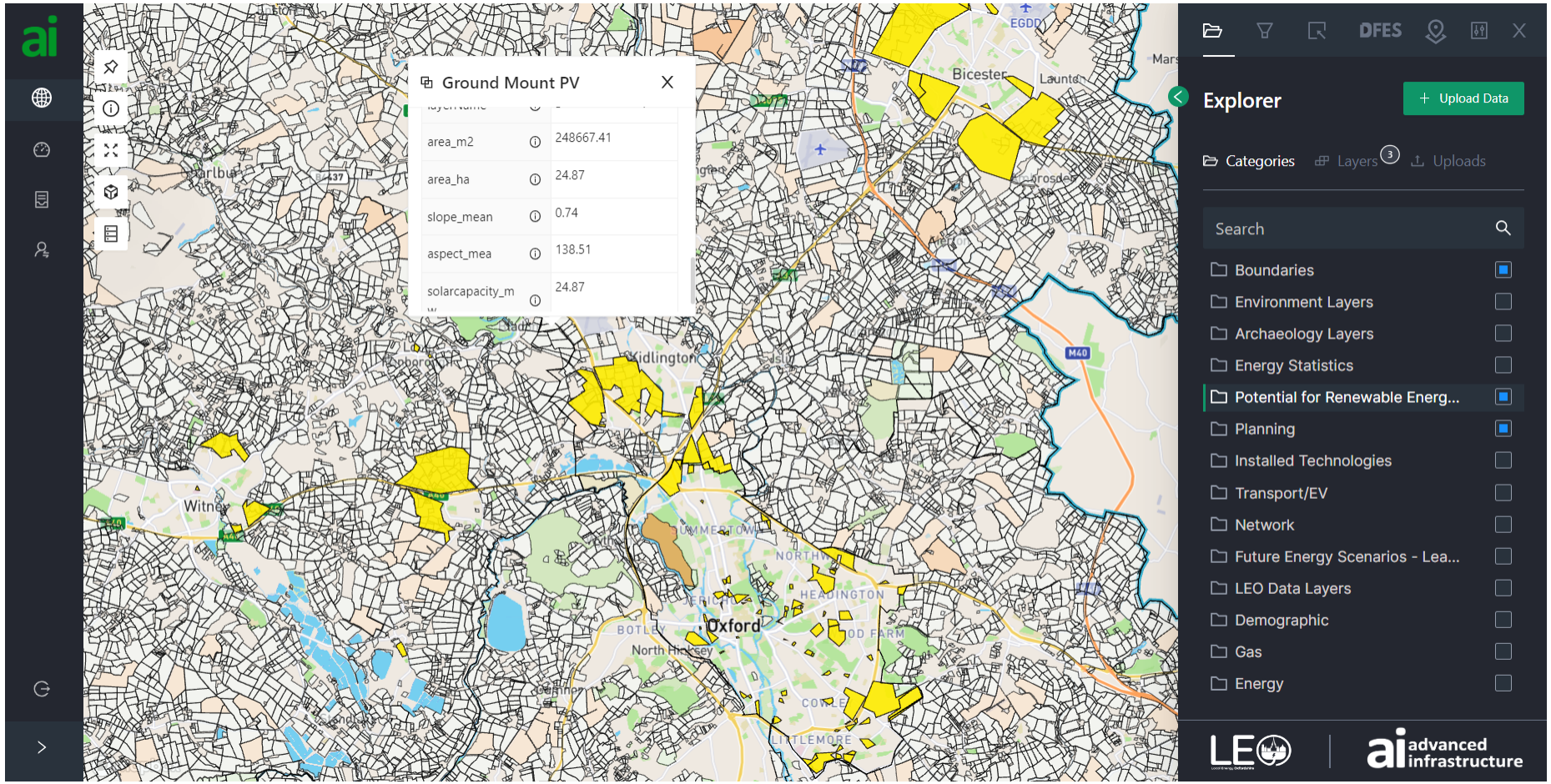
Network capacity (primary)



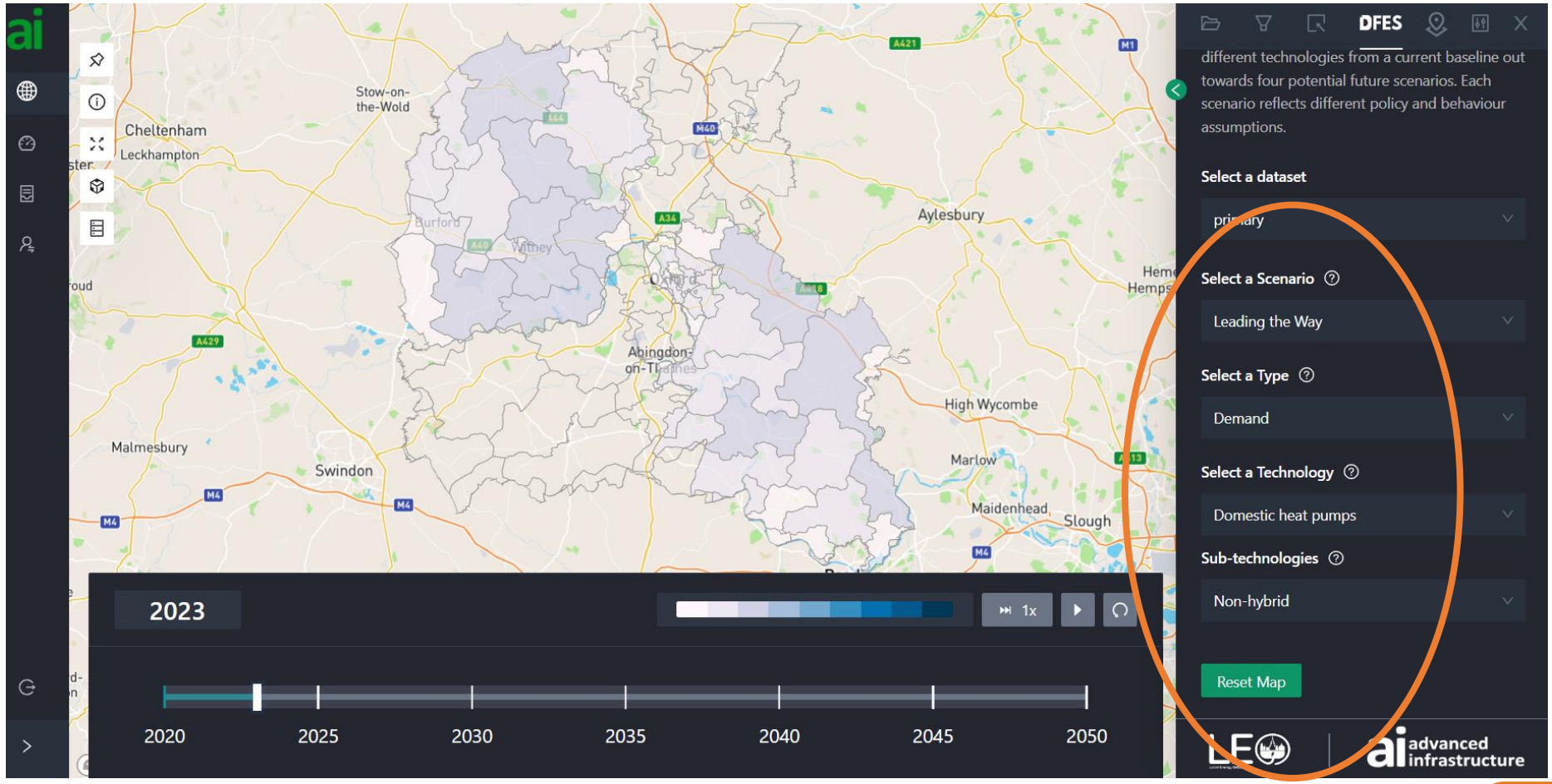
Demand reduction



Potential for renewables



DFES – leading the way



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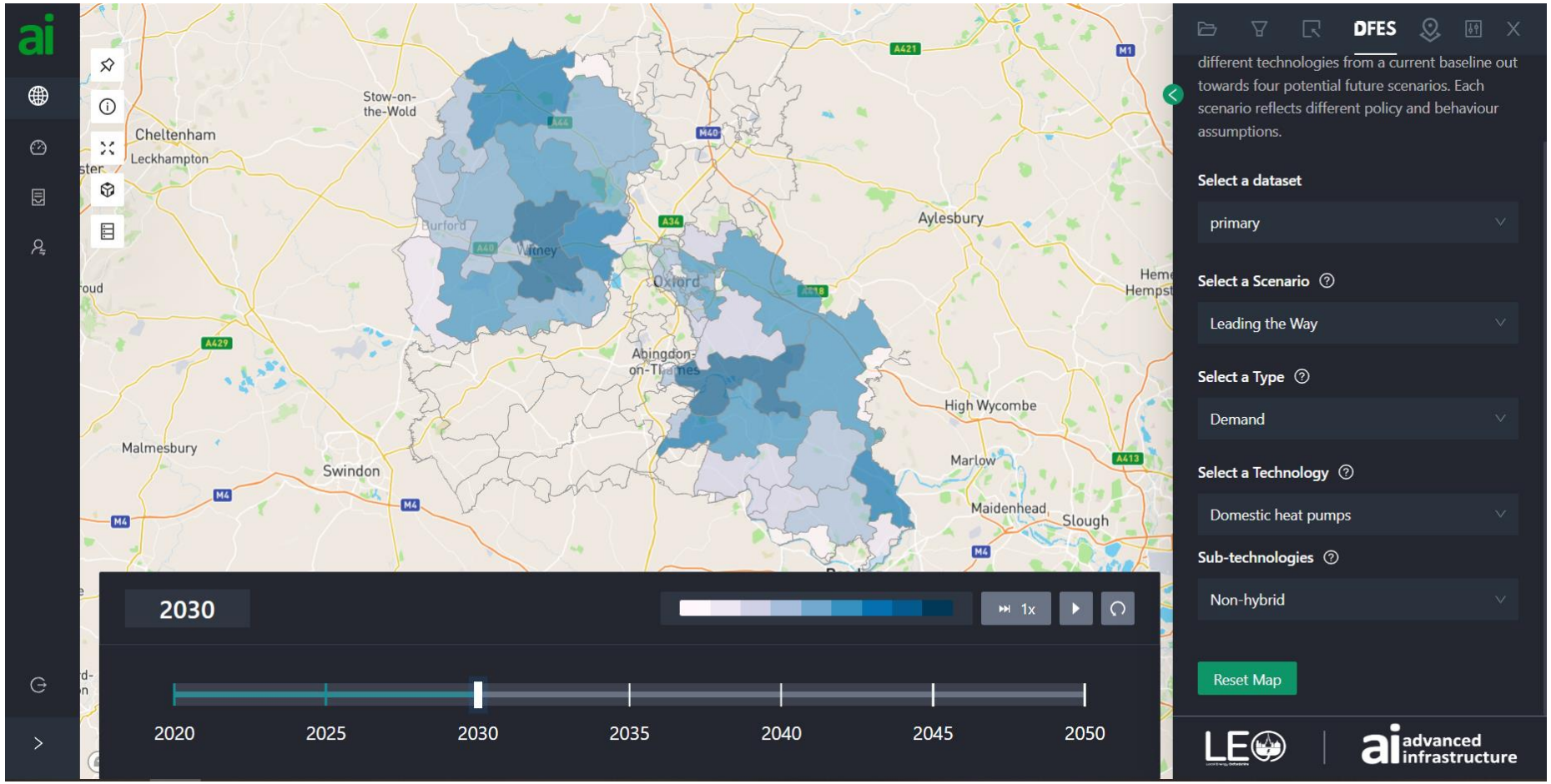
DFES – leading the way



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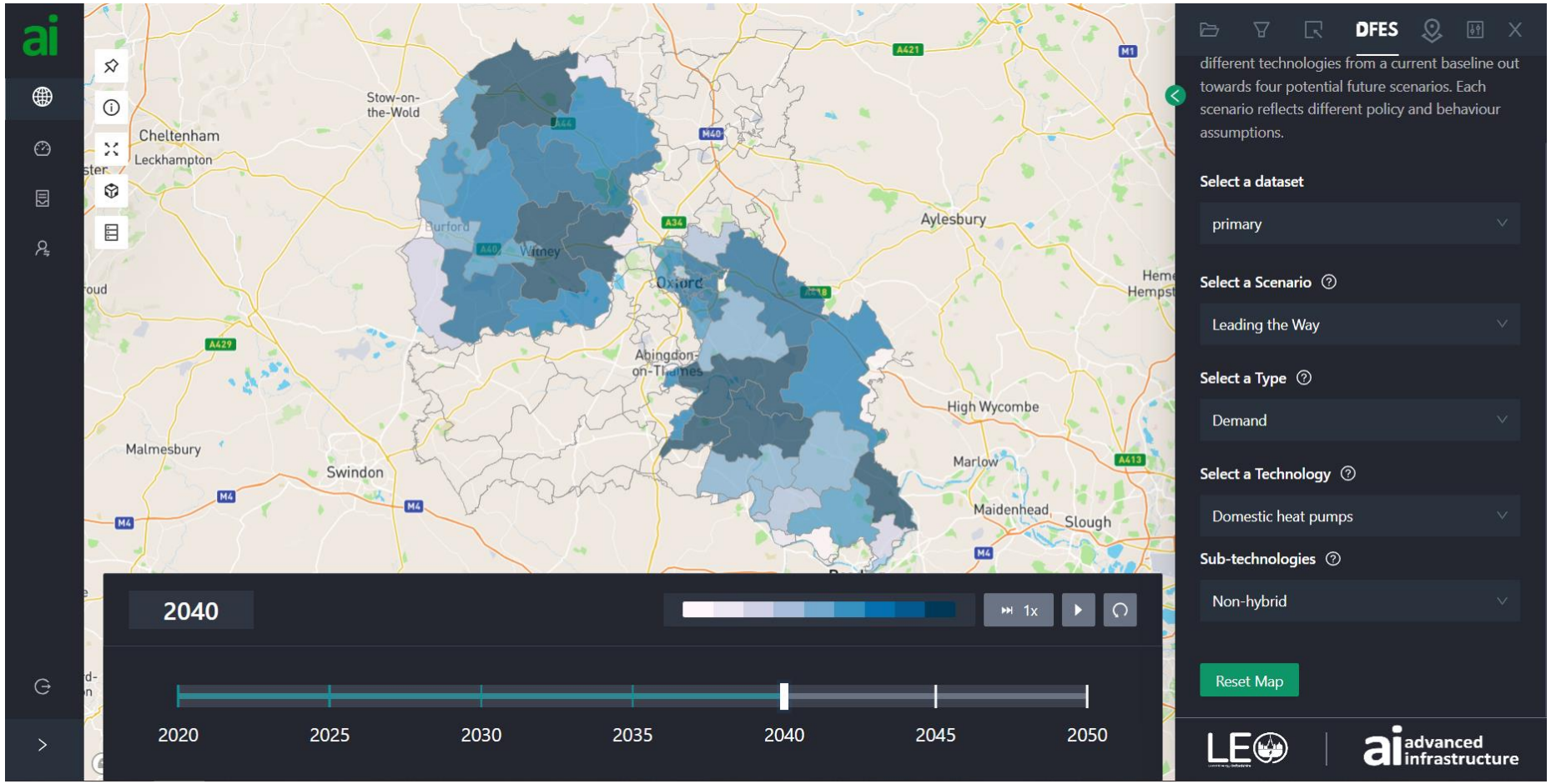
DFES – leading the way



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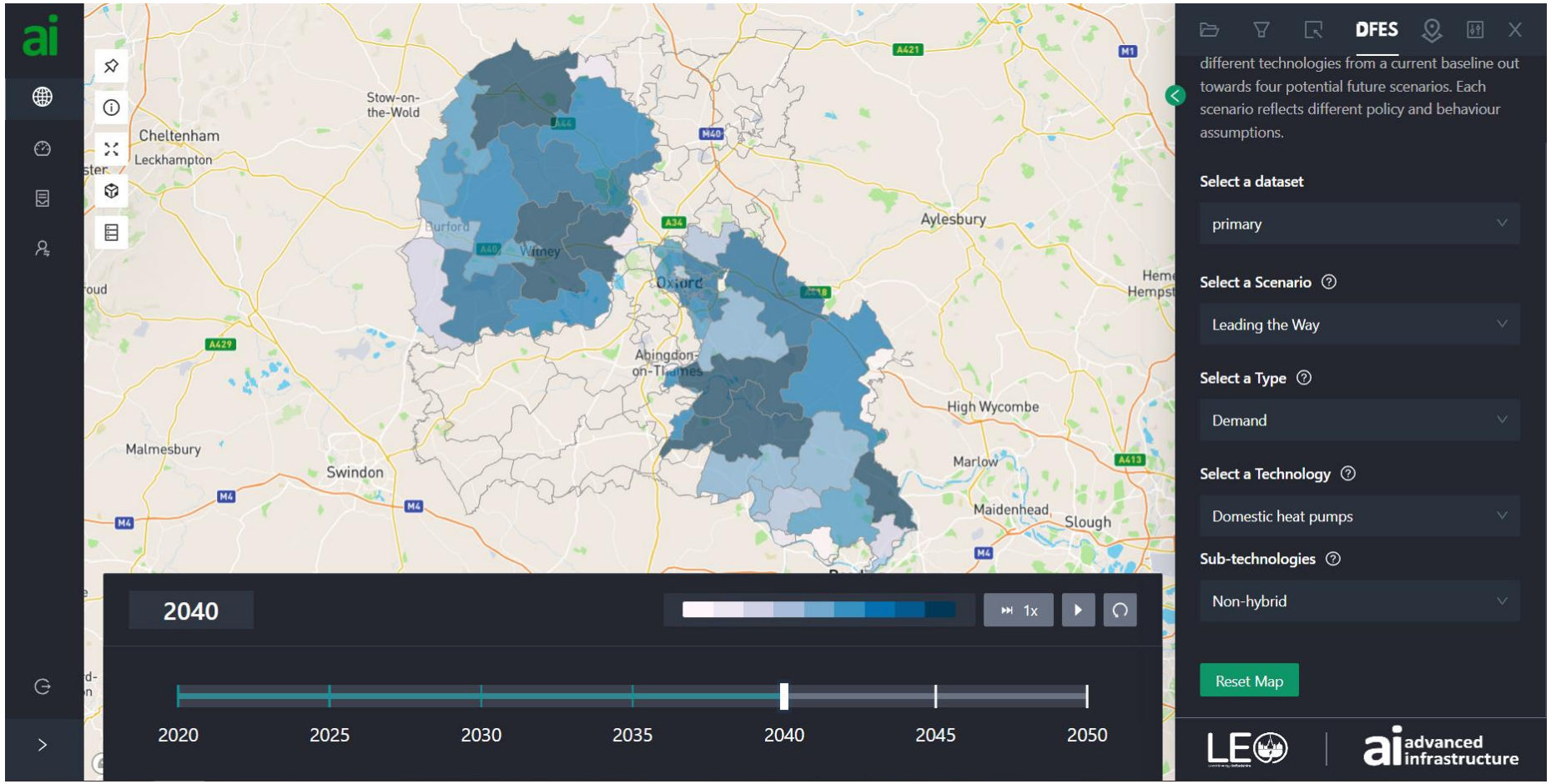
DFES – leading the way



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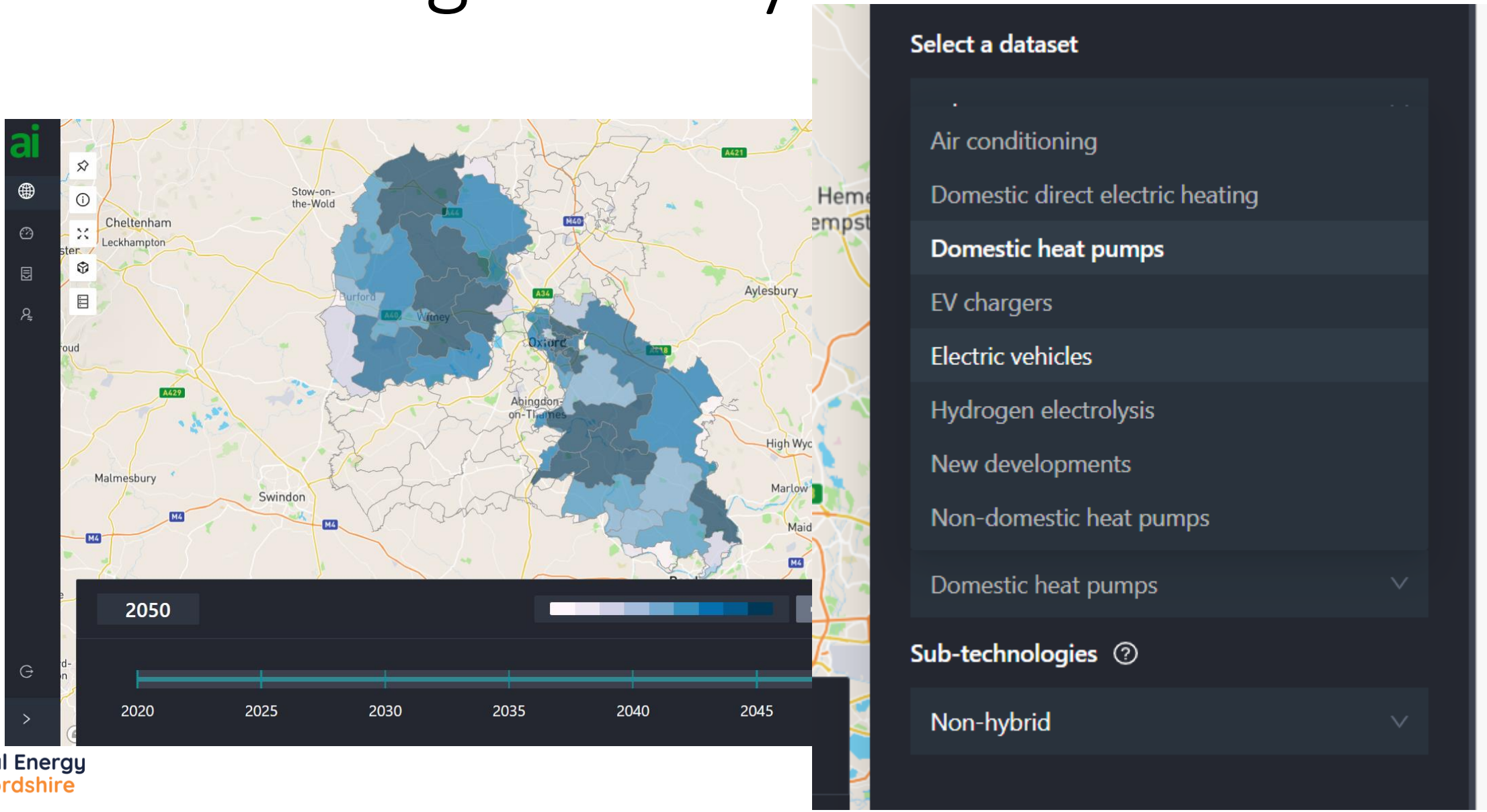

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Data stories

advanced infrastructure LEO CATAPULT Energy Systems

< Back to dashboard

Mapping Oxford City's Energy Baseline

LAEP+ Data Story developed with data and insights from Project LEO, Energeo, Energy Systems Catapult and Advanced Infrastructure

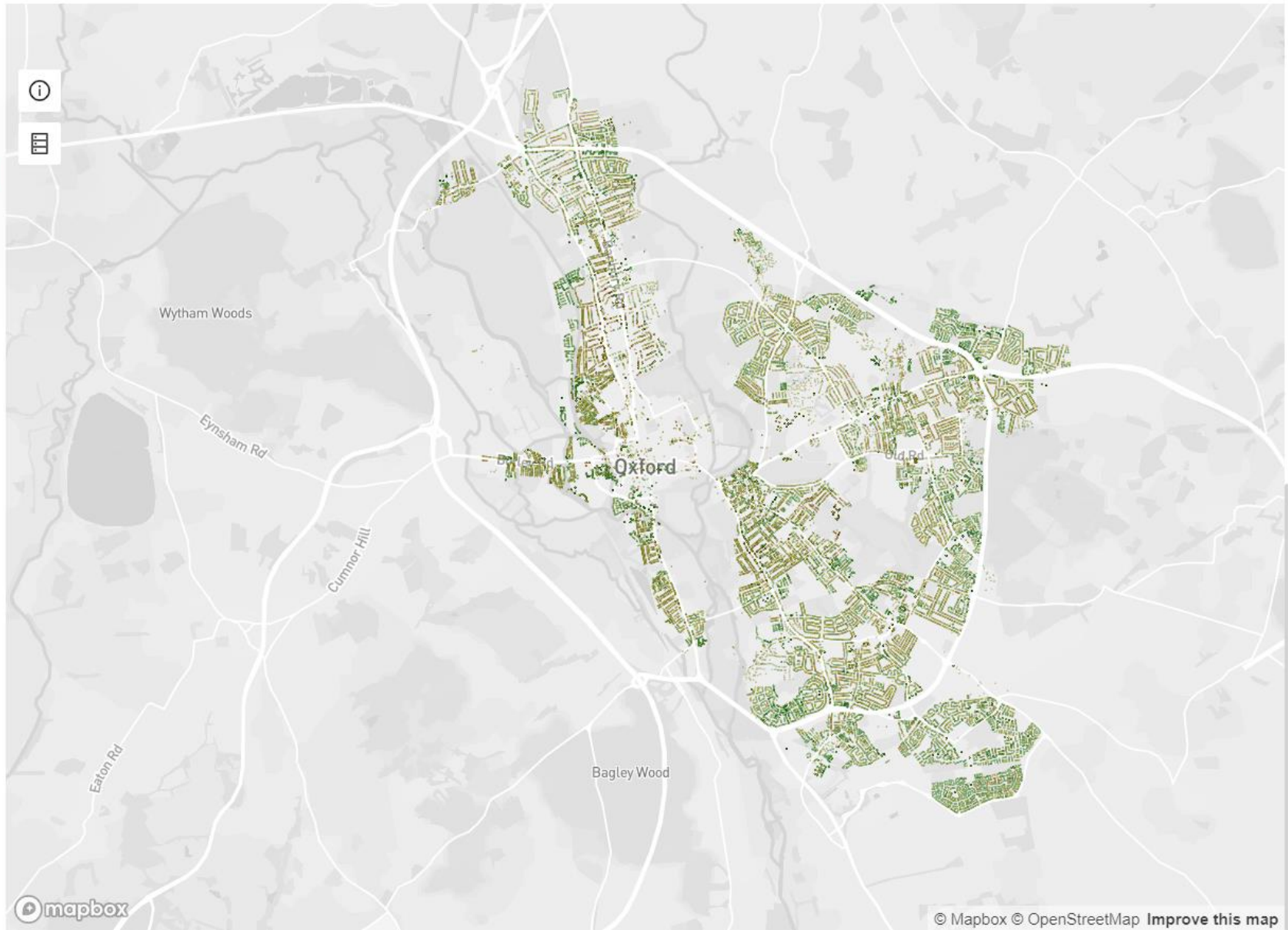
- 5 Jan 2023

Building Energy Performance

Domestic Energy Performance

Energy Performance Certificates (EPCs) give an indication of the relative efficiency of the current building stock in the county. The ratings are shown on an A-G scale (A is most efficient; G is least efficient). EPCs are calculated from an in-person survey of over 30 attributes. UK coverage varies between 50-60%.

The map opposite shows the EPC rating of domestic properties in Oxford City. Click on individual buildings to view other individual attributes. Energy Systems Catapult have provided this dataset which infers the EPC rating of unsurveyed buildings. This is done by associating attributes with nearby properties of a similar age and type.

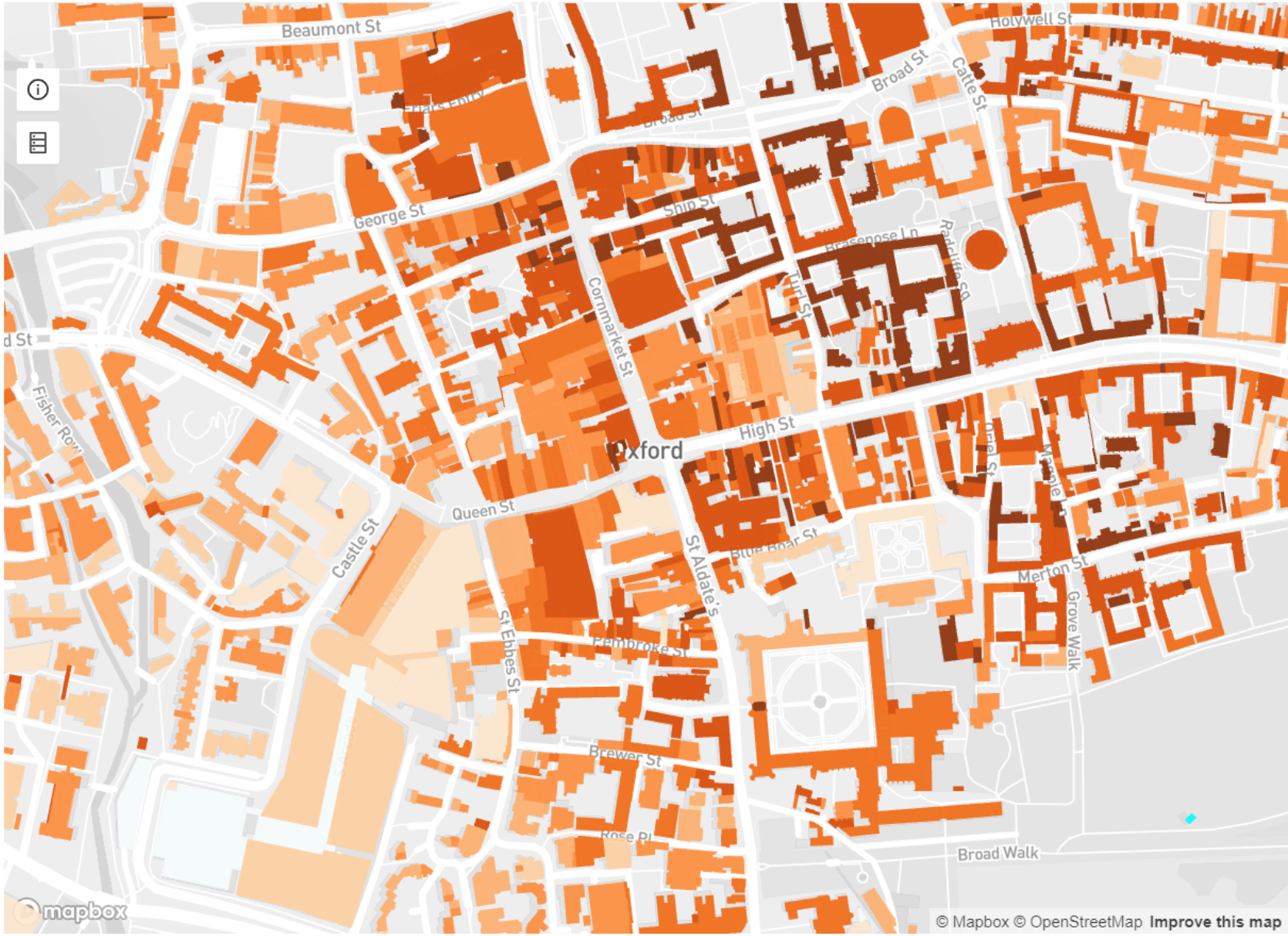


Buildings

Heat Loss

Detailed surveys of building heat loss can help identify opportunities to improve energy efficiency by highlighting particularly inefficient buildings.

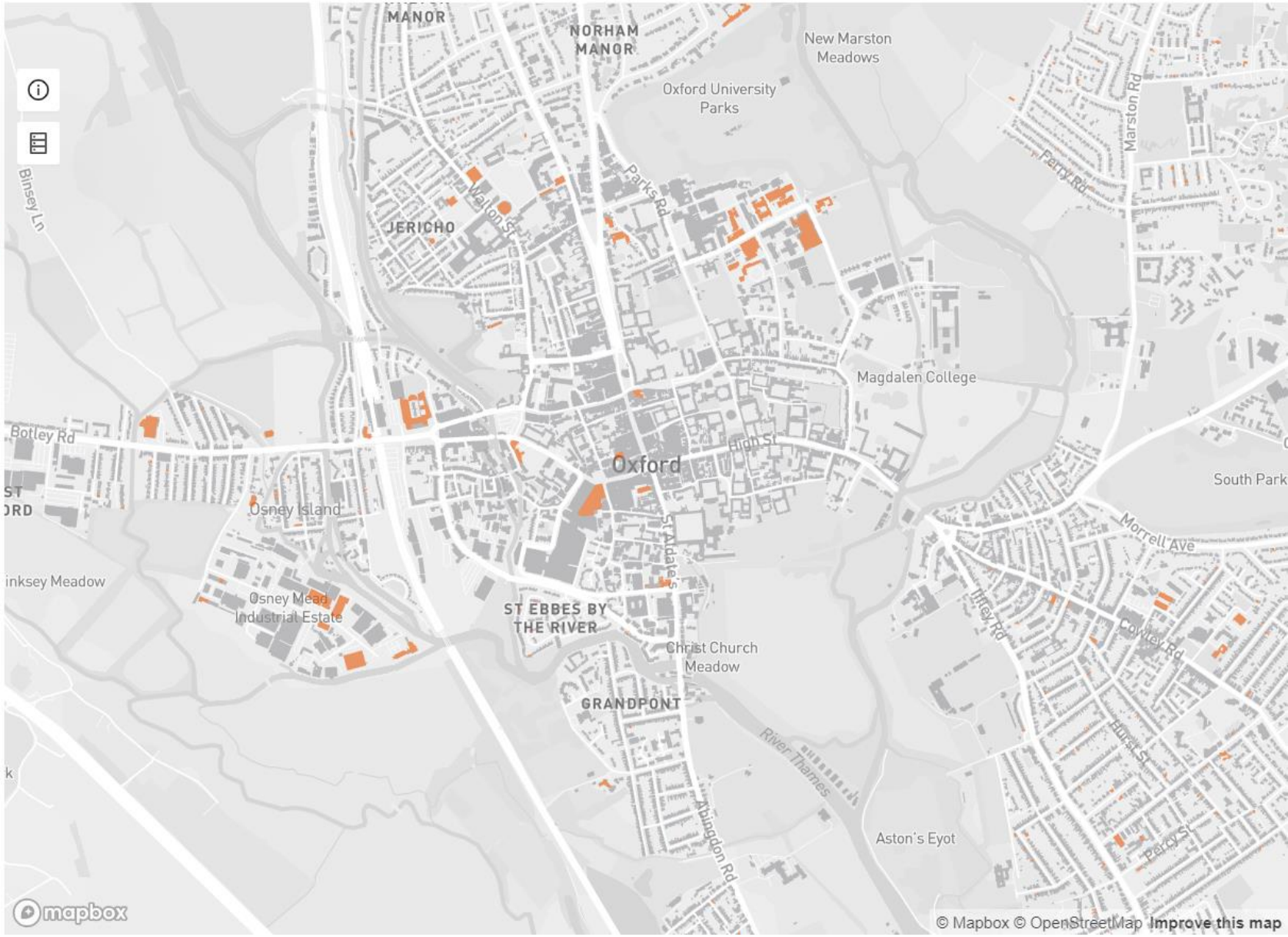
This Energeo dataset, shown on the map opposite, uses aerial thermal imaging taken in 2020 to provide an overview of heat loss across Oxfordshire's market towns, including Oxford City.



Retrofit Potential

Existing Domestic PV

This dataset gives an indication of existing rooftop PV generation capacity. Energeo inferred the presence of PV panels on rooftops across Oxfordshire using machine learning to analyse aerial imagery. The analysis identified 1086 buildings likely had rooftop PV installations at the time the images were taken.



Retrofit Potential

Rooftop PV Potential

As part of Project LEO, both Energeo and Energy Systems Catapult produced desktop studies of rooftop PV potential across Oxfordshire. The Energy Systems Catapult dataset is shown on the map opposite.

In Oxford City, an estimated 11,907 domestic buildings are deemed suitable for PV installations across 43,851 assessed domestic properties. This equates to a total PV capacity of 29MW across domestic properties in Oxford City. Suitability and potential yield was assessed based on rooftop size and orientation. Only roofs able to support a system of at least 1.5 kWp were included.

Installation of rooftop PVs can have a significant positive impact towards reducing carbon emissions. A peak electricity capacity of 2.4kWp and an annual generation of 2040kW can be produced from just a small rooftop area of 20m2 that has an orientation towards the South.

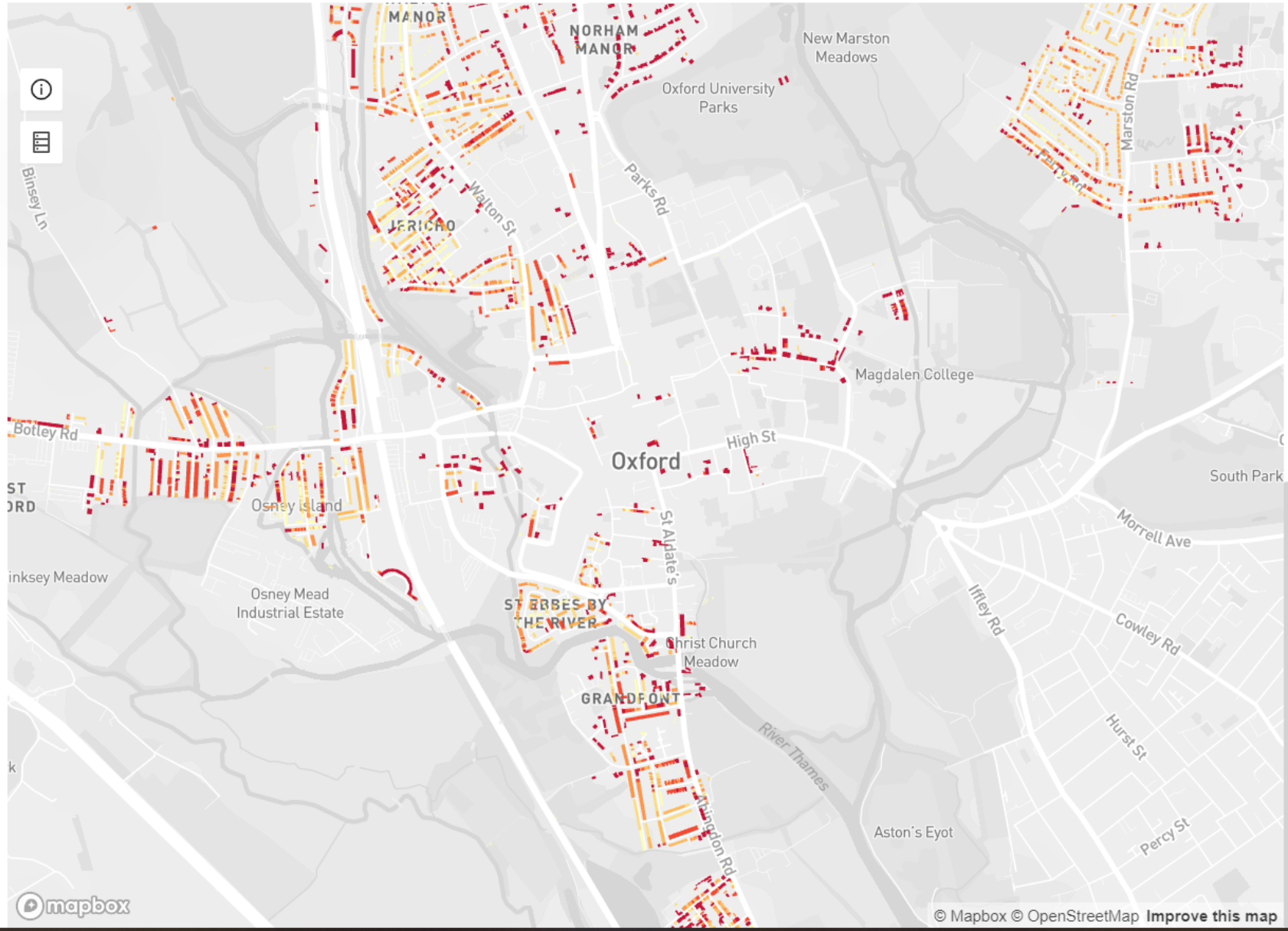
Retrofit Potential

Building Heat Demand

Building heat demand is the total heating required to maintain a domestic building at a comfortable temperature all-year-round. Heat demand has been modelled according to the CIBSE Domestic Heat Demand Methodology. The data has been validated against BEIS Energy Statistics.

BEIS estimates the average new build property to consume around 127kWh/m2 of energy a year. In Oxford City, annual heat demand per square metre ranges from 2kWh/m2 to 408kWh/m2, with an average of 163kWh/m2. Heat demand determines energy efficiency and is predominantly influenced by the construction of the building: wall type, glazing type, roof type

Total annual domestic heat demand for Oxford City is estimated to be 463GWh across 43,851 domestic properties, with an average of 10,564kWh per property.



Retrofit Potential

Low Carbon Heating Potential

Low carbon heating sources like heat pumps, district heating and hydrogen will be required to hit net zero targets.

The LEO-LAEP+ platform includes data on the existing gas network, including the gas pipe topology and material, as well as off gas home records. There are 339 postcodes with no gas connection in Oxford

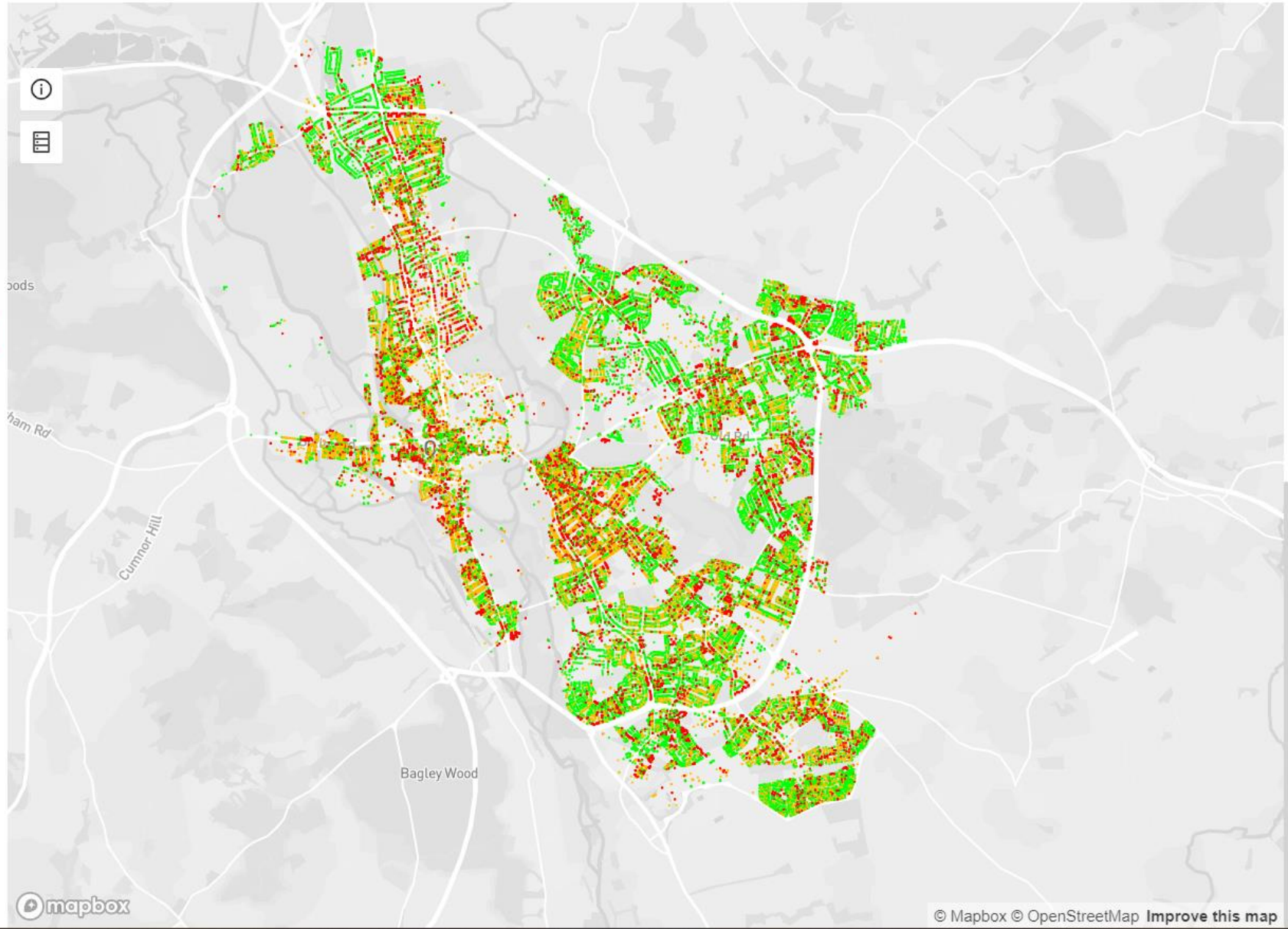
Desktop studies of low carbon heating potential for domestic properties across Oxfordshire have been provided by Energeo and the Energy Systems Catapult (ESC) for project LEO. These include:

1. ESC, Potential for air source heat pumps
2. ESC, Potential for ground source heat pumps
3. Energeo, Potential for ground source heat pumps

The map opposite shows the potential for air source heat pumps within Oxford City.

Across Oxford, ESC categorised 80,639 buildings according to likely suitability for an air source heat pump based on garden size, distance from neighbours and potential noise disruption

Likely suitable (green)	Uncertain (amber)	Likely unsuitable (red)
30848	22220	27571



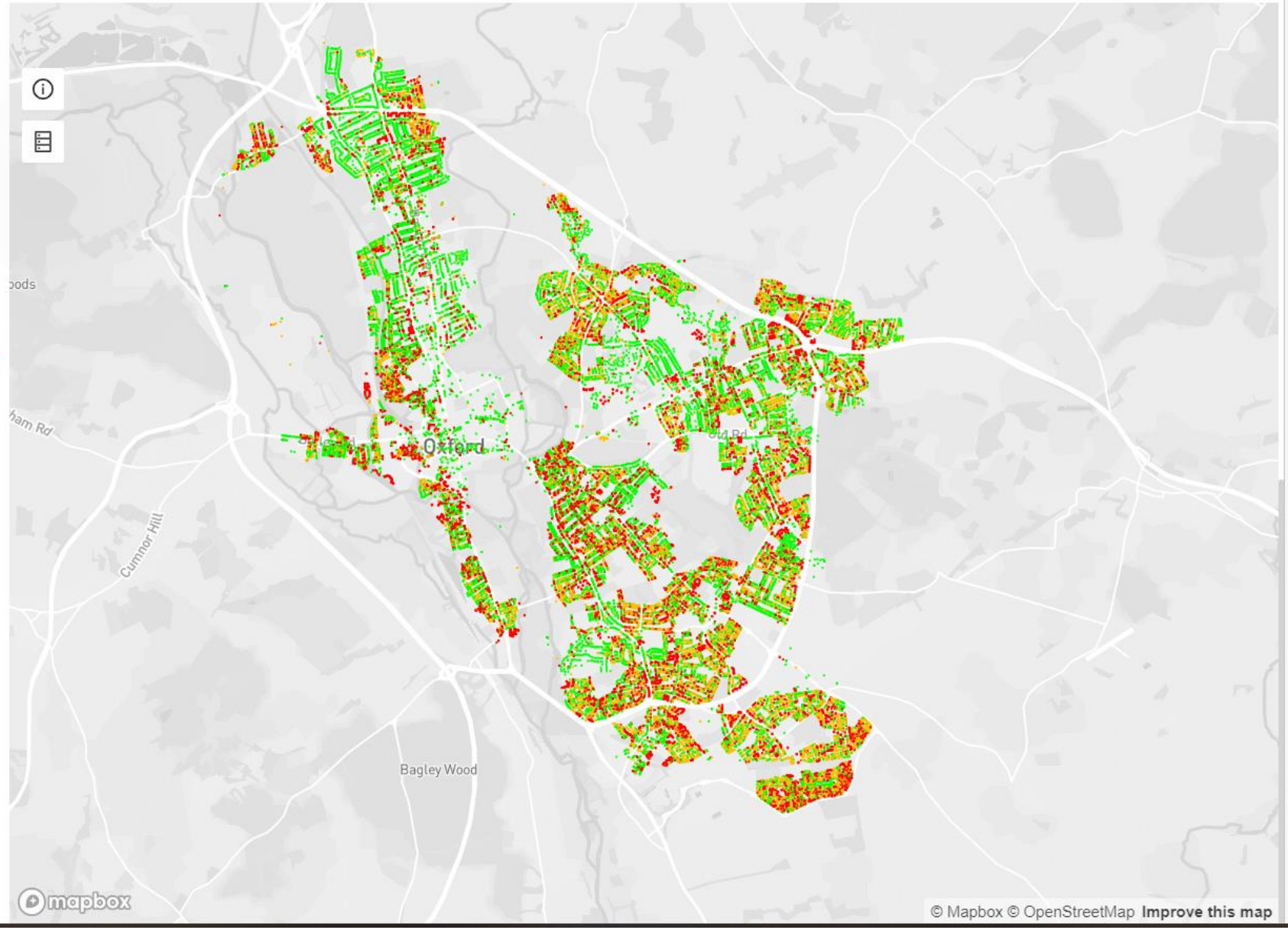
Retrofit Potential

Domestic Battery Potential

The dataset shows suitability considerations and potential benefits associated with the installation of battery storage on domestic properties. Suitability is assessed in terms of usable physical space inside properties by ruling out those which are likely to be too small for a battery installation by using Ordnance Survey national data sets covering building types and sizes.

The assessment of the benefits of installations is based on the ability of domestic battery installations to both shift electricity demand and to store excess PV generation; this allows both carbon dioxide emissions to be abated by reducing consumption of grid electricity over peak hours, as well as a reduction in peak load on electricity networks.

Over Oxford City, 19,974 properties have a green rating for batteries - meaning the property size and benefits likely recommend battery installation. 15,383 properties have an amber rating indicating potential suitability. Just over 25,000 properties have an overall rating of 'red', meaning they are likely unsuitable.



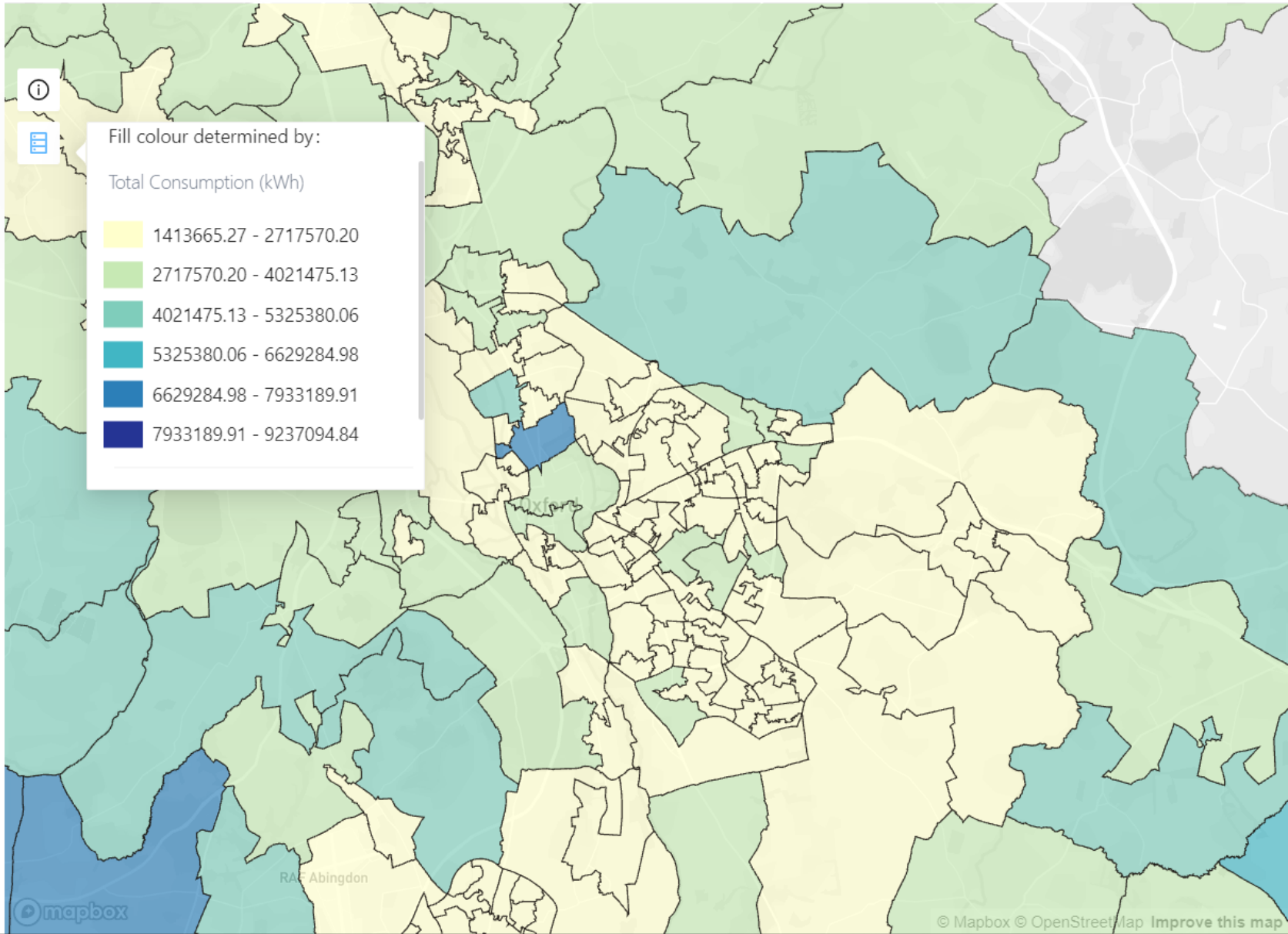
BEIS Energy Statistics

Annual Domestic Electricity Consumption

BEIS sub-national statistics on energy demand, estimates a total domestic electricity consumption of 202,157,661kWh in 2021 for Oxford City. BEIS Annual consumption data is based on meter point (MPAN) data which is provided by energy suppliers to BEIS.

Total domestic electricity consumption by LSOA ranges from 1,505,669kWh to 6,648,844.

Mean consumption by domestic meter point, given in kWh per meter, is also provided. In 2021, mean consumption by meter ranges from 2,705kWh to 4,919kWh, with an average per meter consumption of 3,424kWh.



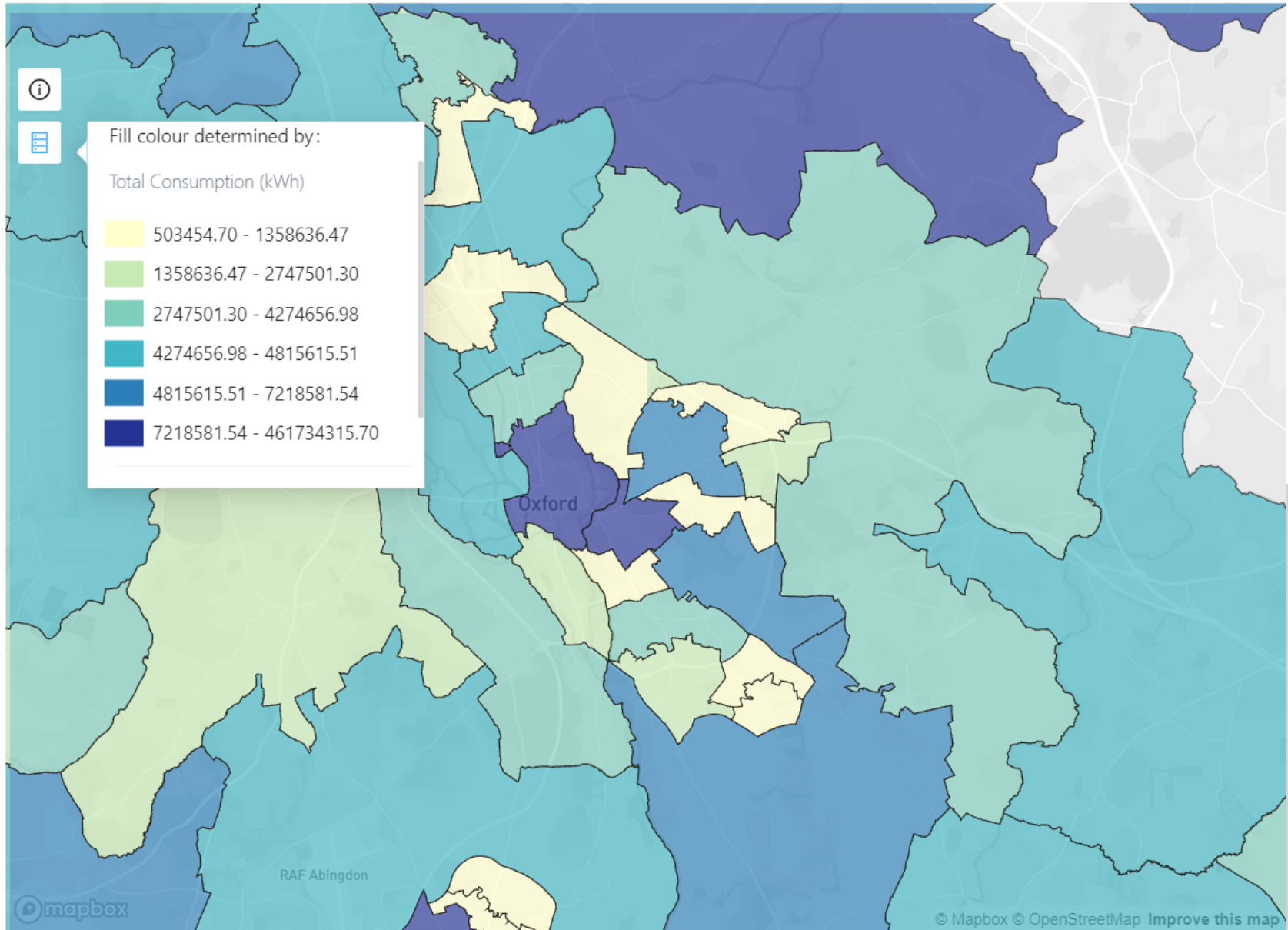
BEIS Energy Statistics

Annual Non-Domestic Electricity Consumption

BEIS sub-national statistics on energy demand, estimates a total non-domestic electricity consumption of 81,532,251kWh in 2021 for Oxford City. BEIS Annual consumption data is based on meter point (MPAN) data which is provided by energy suppliers to BEIS.

Total non-domestic electricity consumption by LSOA ranges from 947,036kWh to 29,072,034kWh.

In 2021, mean consumption by non-domestic meter ranges from 8,307Wh to 19,637kWh, with an average per meter consumption of 12,624kWh.



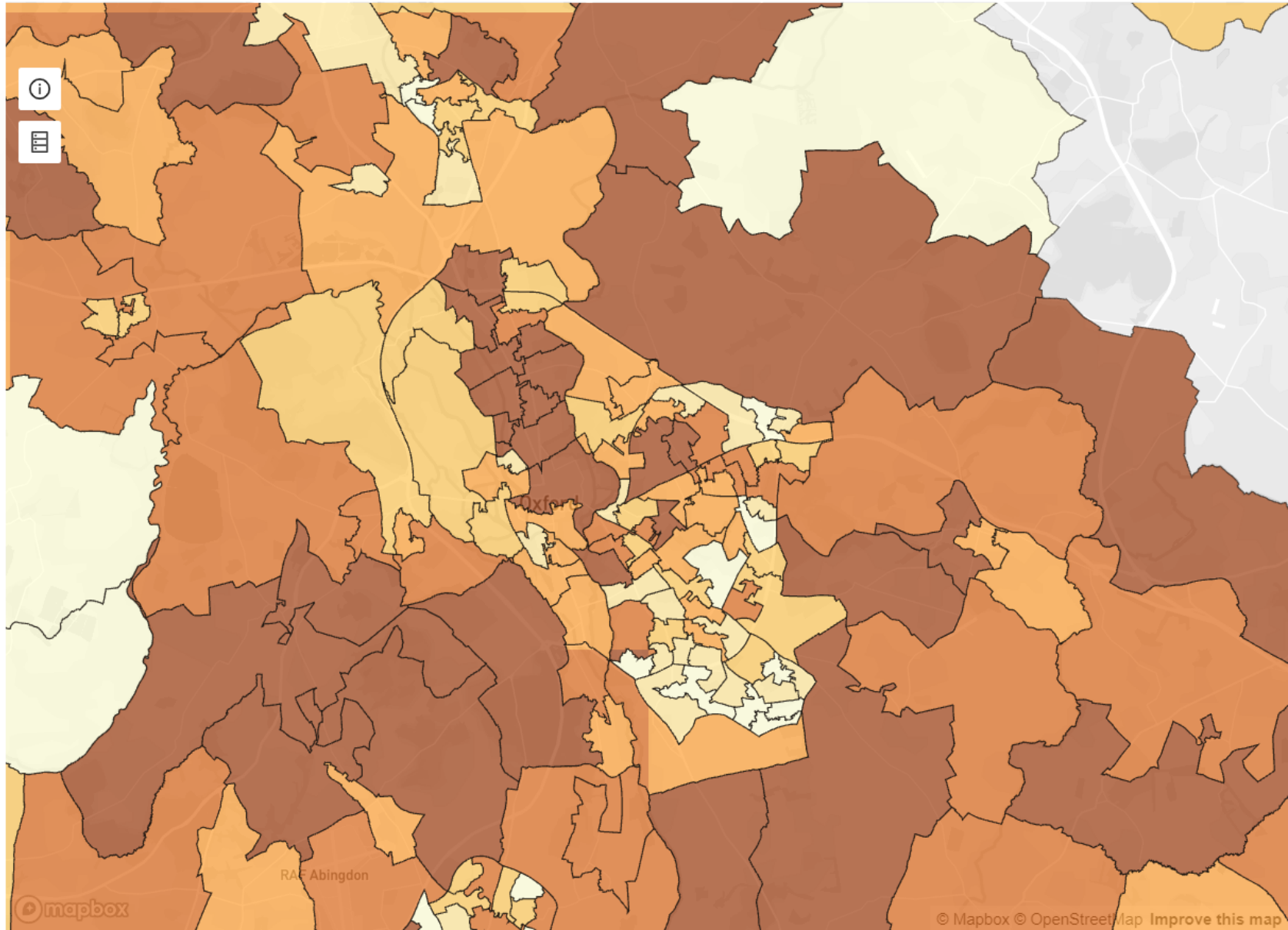
BEIS Energy Statistics

Annual Domestic Gas Consumption

BEIS sub-national statistics on energy demand, estimates a total domestic gas consumption of 697,621,711kWh in 2021 for Oxford City. Annual consumption based on meter point (MPRN) data provided by Xoserve. Consumers using less than 73,200 kWh a year are classified as domestic, meaning some small non-domestic consumers may be included in domestic gas consumption data.

Total domestic gas consumption by LSOA ranges from 4,349,996kWh to 19,302,833kWh

Mean consumption by meter is also provided, ranging from 8,849kWh per meter to 24,088kWh per meter. Average domestic gas consumption per meter is 13,846kWh.

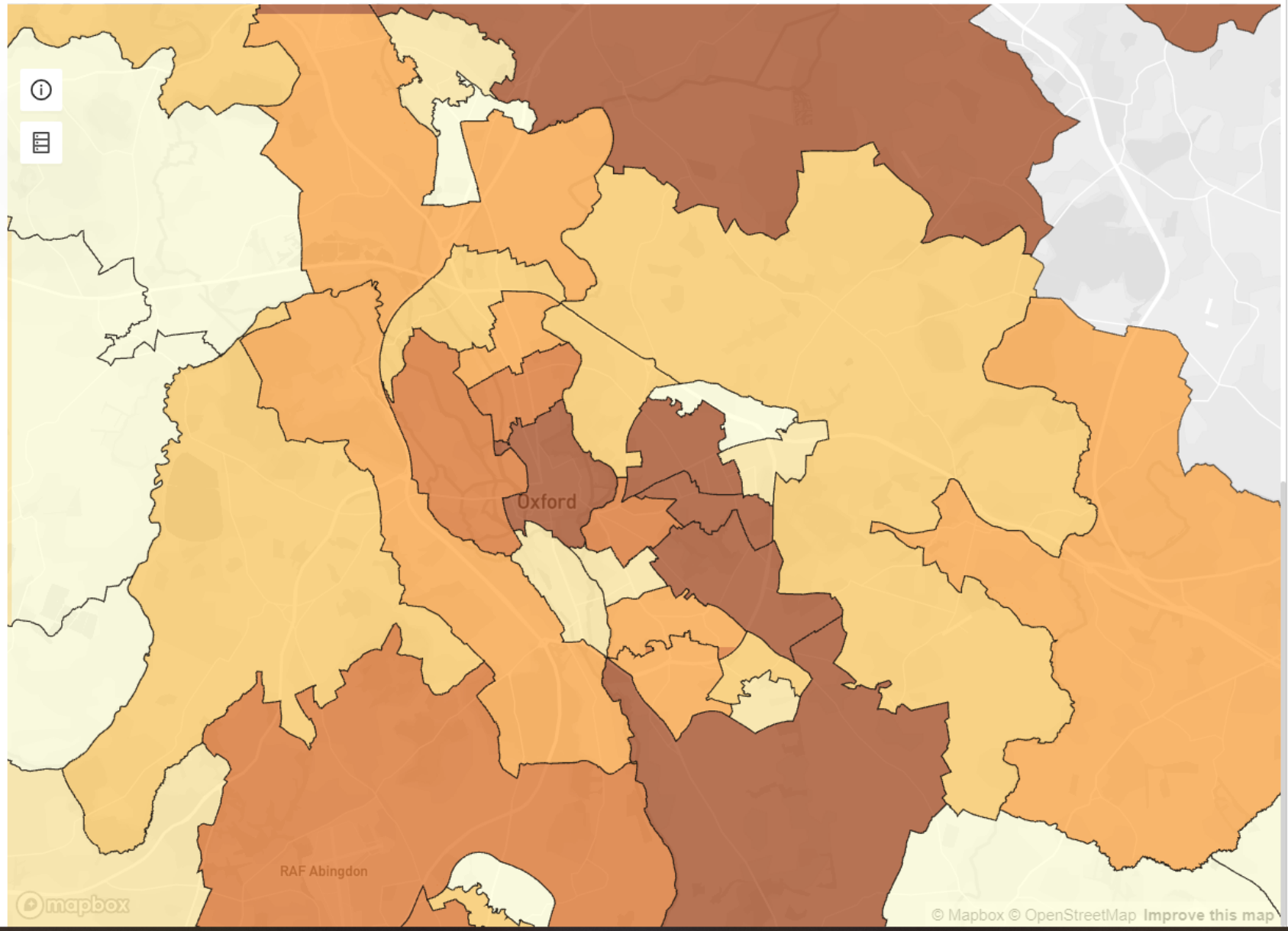


BEIS Energy Statistics

Annual Non-Domestic Gas Consumption

BEIS sub-national statistics on energy demand, estimates a total non-domestic gas consumption of 807,247,045kWh in 2021 for Oxford City. Annual consumption based on meter point (MPRN) data provided by Xoserve. Consumers using less than 73,200 kWh a year are classified as domestic, meaning some small non-domestic consumers may be included in domestic gas consumption data.

Total non-domestic gas consumption by LSOA ranges from 2,031,042kWh to 222,416,698kWh. Average non-domestic gas consumption is 638,657kWh.



Large Scale Energy Generation

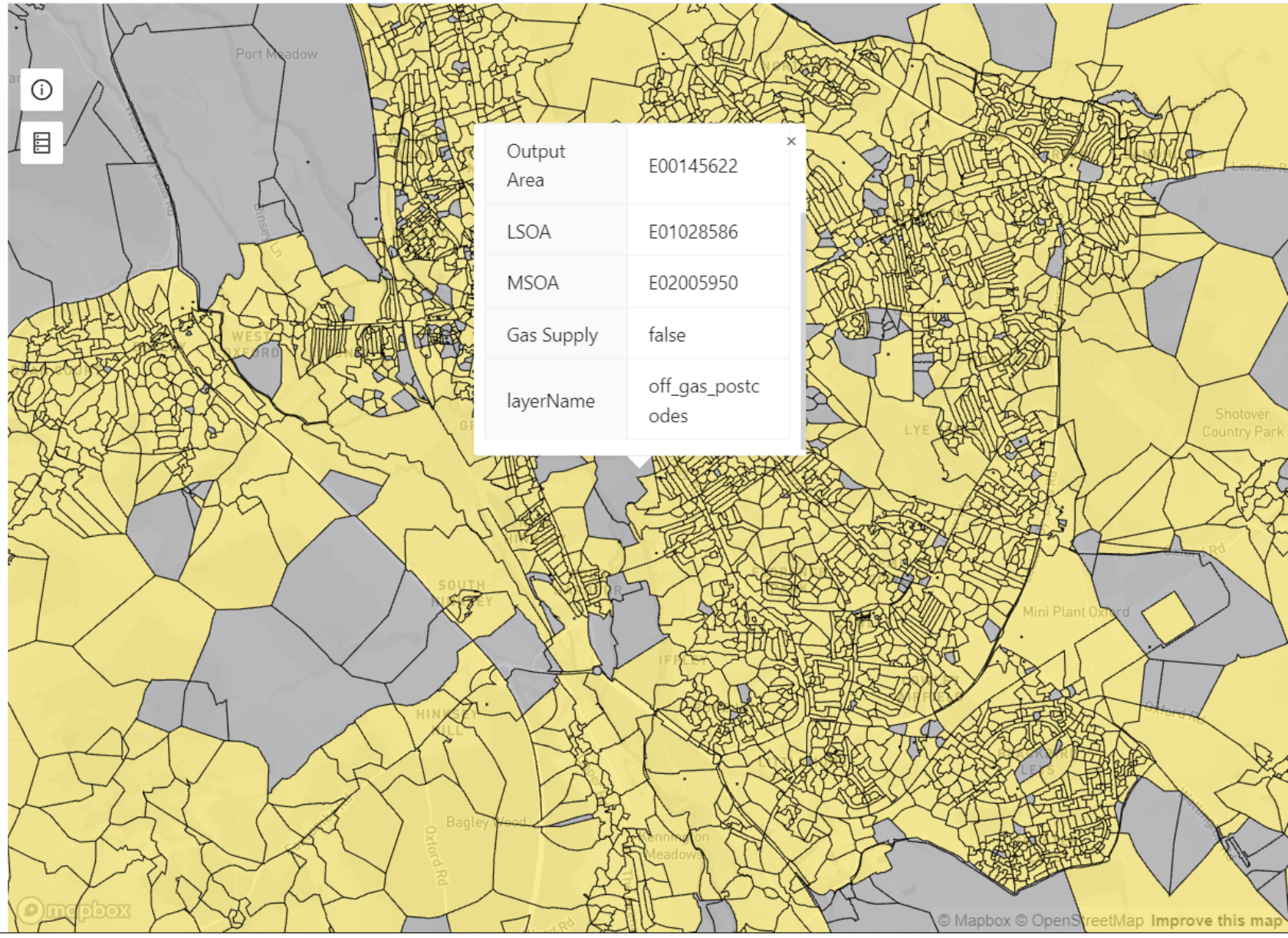
As a dense urban area, Oxford City has limited potential for large scale energy generation. The City council area is high risk and very high risk for wind generation due to proximity to airports. The presence of floodplains, green belt and urban environments limits land parcel availability for ground mount PV to an estimated 2MW.
The map opposite shows a safety rating of on-shore within Oxford City and land parcel suitability for ground-mount PV within Oxford and the surrounding area.

The majority of energy generation potential within the city boundary is from rooftop PV. This does not mean there is no potential for larger scale generation, but additional feasibility studies would be required to identify potentially suitable areas.

Energy Networks

Off Gas Postcodes

For 339 postcodes in Oxford City, Xoserve holds no record of a gas connection. Any buildings within these postcodes are likely served by alternative heating sources such as oil, wood or electric heating. These areas represent good locations to deploy electric heating sources.



Output Area	E00145622
LSOA	E01028586
MSOA	E02005950
Gas Supply	false
layerName	off_gas_postcodes

Fuel Poverty

In 2020, there were an estimated 13.2% of households (3.16 million) in fuel poverty in England under the Low Income Low Energy Efficiency (LILEE) metric, down from 13.4% in 2019 (3.18 million).

According to the same BEIS 2020 fuel poverty statistics (published April 2022), 11% of households in Oxford City are in fuel poverty. Oxford has a higher rate of fuel poverty than the other districts in Oxfordshire where the overall proportion of households in fuel poverty is 8.1%

Number of households	Number of households in fuel poverty	Proportion of households fuel poor (%)
60,19	6,651	11.0

Across 80 LSOAs in Oxford, 8 had fuel poverty rates of over 20%. 75% of LSOA have fuel poverty rates between 3% and 13%. LSOA Oxford 016E (LSOA code: E01028576) has the highest proportion of fuel poor households at 22.9%

The charity National Energy Action has estimated that price rises in 2021 and April 2022 will lead to an increase in the number of households in fuel poverty (under a different definition to the LILEE metric) of more than 50%.

Indices of Deprivation

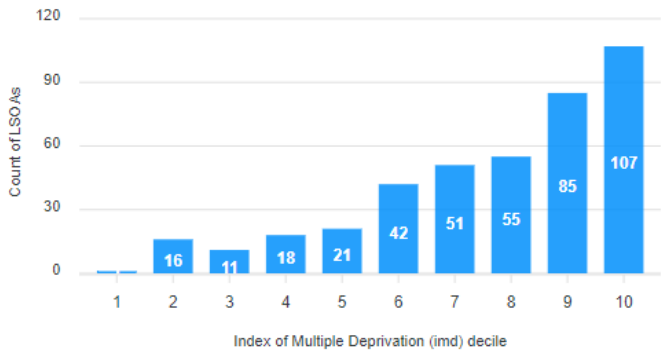
The English Indices of Deprivation measure relative deprivation across 32,844 small areas in England called lower-layer super output areas (LSOAs). The index of multiple deprivation is the most widely used of these indices

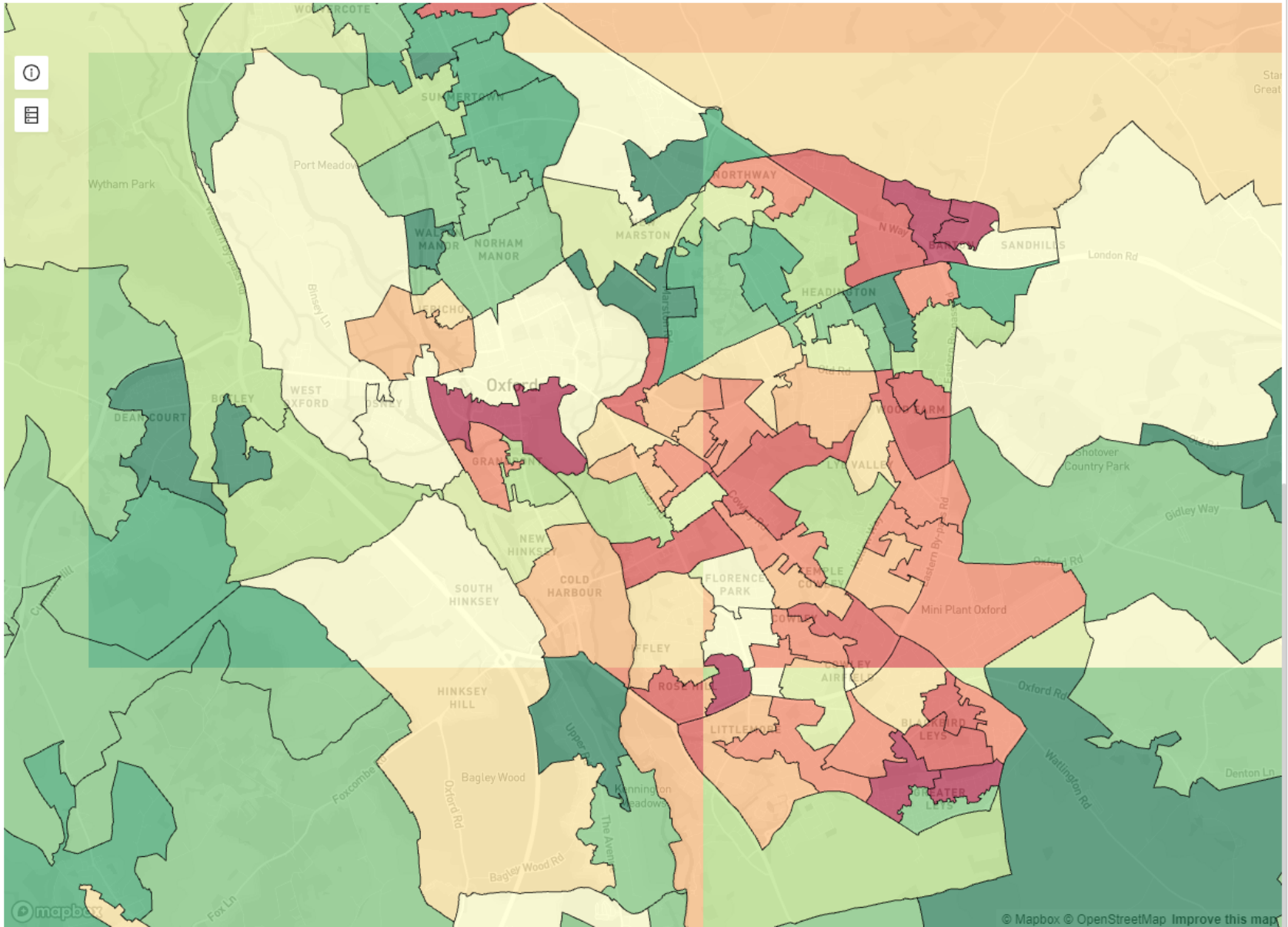
The population weighted average of the combined ranks of LSOAs in Oxford is 13634.79. This population weighted average ranks Oxford at 189 out of 317 district authorities. The nature of this measure – using all areas, and using ranks rather than scores – means that a highly polarised larger area would not tend to score highly, because extremely deprived and less deprived LSOAs will 'average out'. Conversely, a larger area that is more uniformly deprived will tend to score highly on the measure.

In addition to overall rank, the English Indices of Deprivation divides English LSOAs into 'Deciles'. All 32,844 LSOAs are grouped into 10 bands (deciles), each containing 10% of the LSOAs. Decile 1 contains the 10% most deprived LSOAs in England.

Oxford City has one of the top 10% most deprived LSOAs in England and eleven of the 10% least deprived LSOAs in the country.

Count of LSOAs per decile





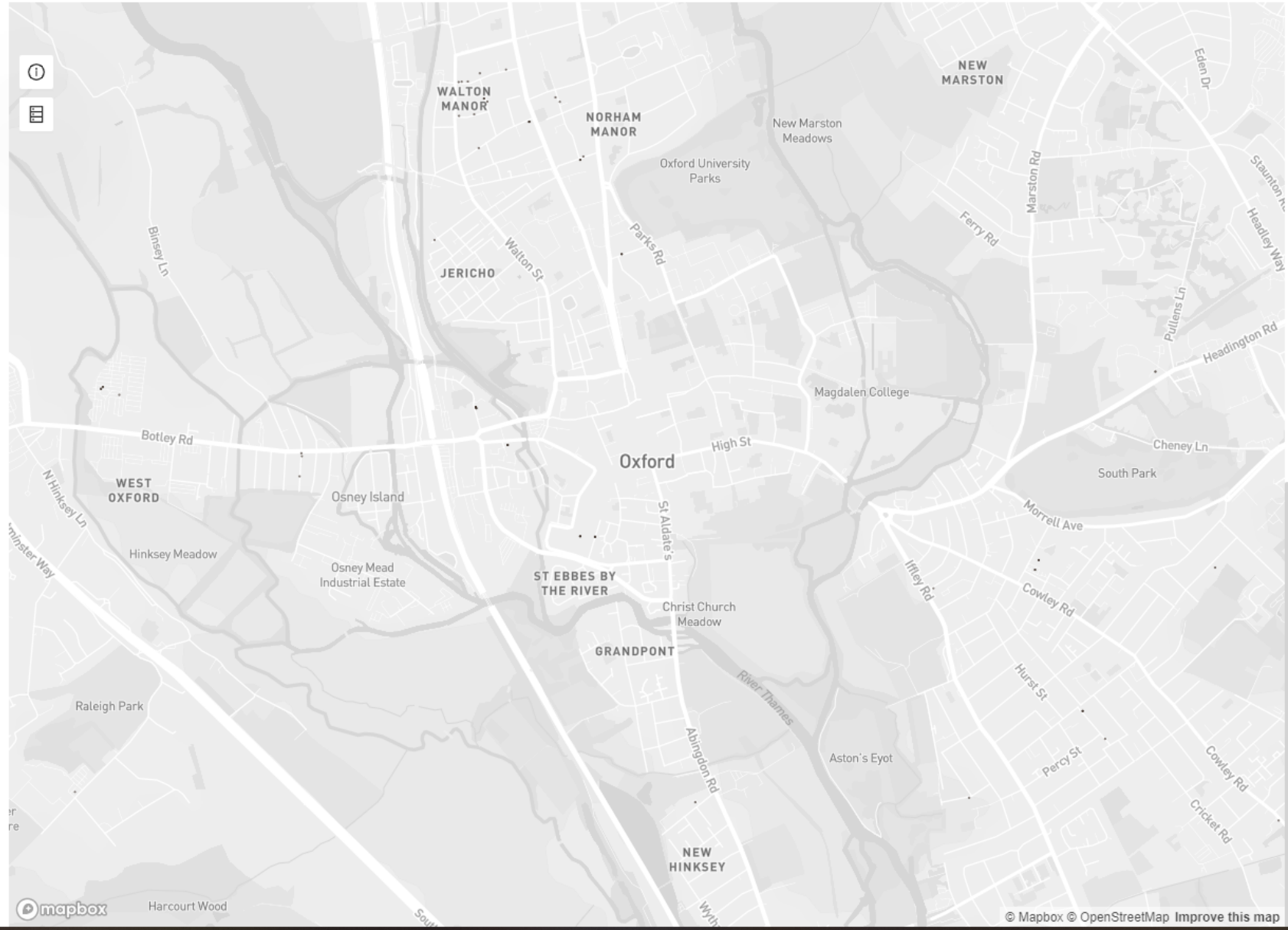
Transport

Existing EV Charge Points

As of 1 October 2022, Oxford City has 141 charging devices.* This is equivalent to 93 devices per 100,000 people. 31 of those devices are rapid chargers or higher. This puts Oxford in the top 20% of local authorities for charging infrastructure in the UK. These statistics are provided by DfT, using data on charging infrastructure from ZapMap and population statistics from the ONS.

As of Q3 2022, there are a total of 794 plug-in cars registered in Oxford City and 468 hybrid plug-in cars. Across Oxfordshire, there were 8,550 plug-in cars and 4,461 hybrid plug-in cars (24 May 2022, DfT and DVLA).

Note: A charging device may have more than one charging connector and be able to charge more than one vehicle at a time, therefore these figures do not reflect overall charging capability.



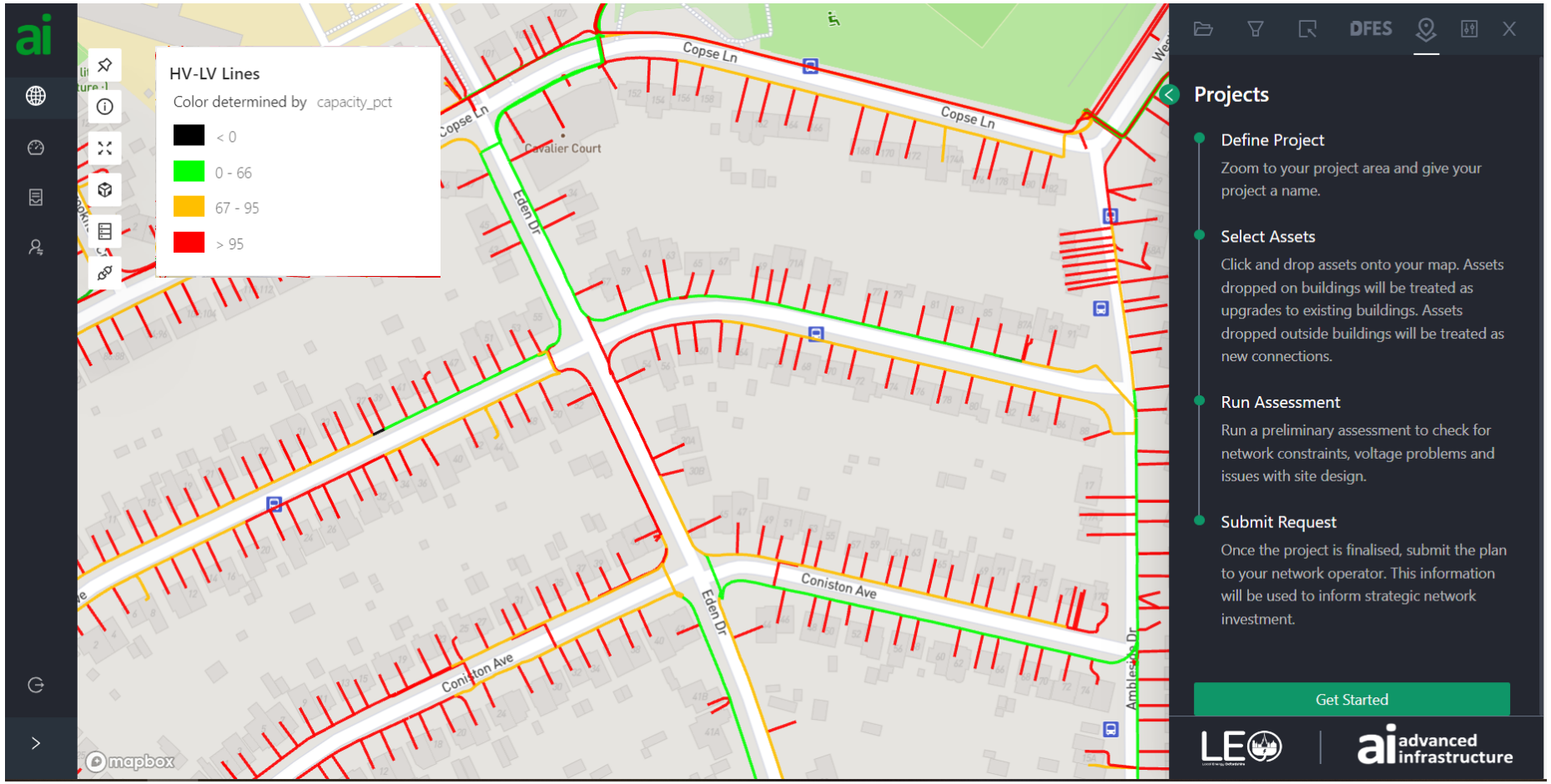
Transport

Space for Off Street Parking

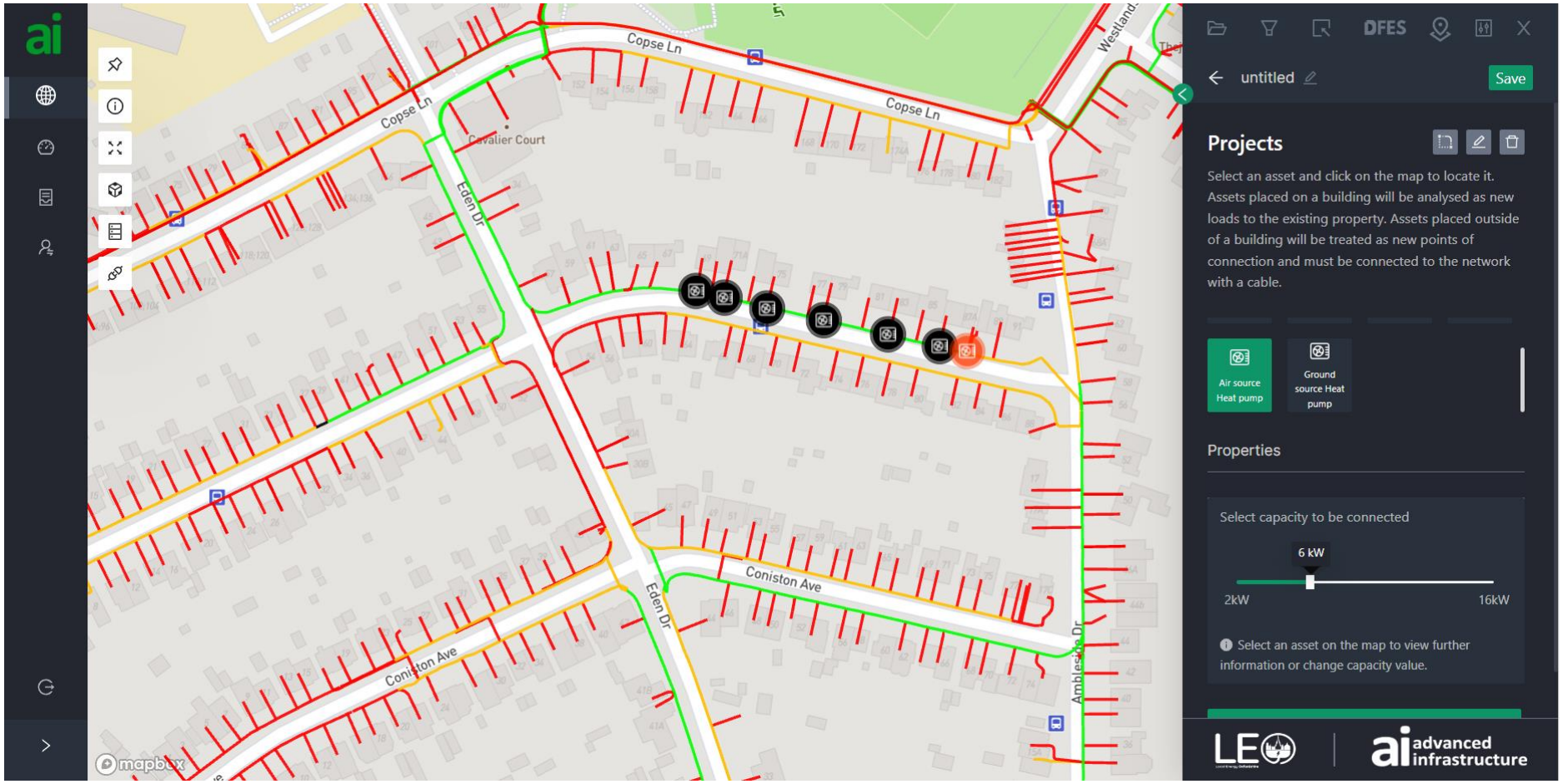
Energy Systems Catapult provided Project LEO with a desktop study assessing the probability that domestic properties have space to park an average size vehicle within the property boundaries

Based on an assessment of available space at 31,553 domestic properties: 26,977 domestic properties were deemed to have space the park at least one car off-street. 4,576 domestic properties were ruled as unsuitable for off-street parking due to lack of available space. These homes likely use on-street parking or local car parks and will require access to some form of public or on-street EV charging infrastructure in future.

Projects


HV-LV Lines
Color determined by capacity_pct
< 0
0 - 66
67 - 95
> 95
Copse Ln
Cavalier Court
Eden Dr
Coniston Ave
Ambleside Dr
mapbox
DFES
Projects
Define Project
Zoom to your project area and give your project a name.
Select Assets
Click and drop assets onto your map. Assets dropped on buildings will be treated as upgrades to existing buildings. Assets dropped outside buildings will be treated as new connections.
Run Assessment
Run a preliminary assessment to check for network constraints, voltage problems and issues with site design.
Submit Request
Once the project is finalised, submit the plan to your network operator. This information will be used to inform strategic network investment.
Get Started
advanced infrastructure

Projects



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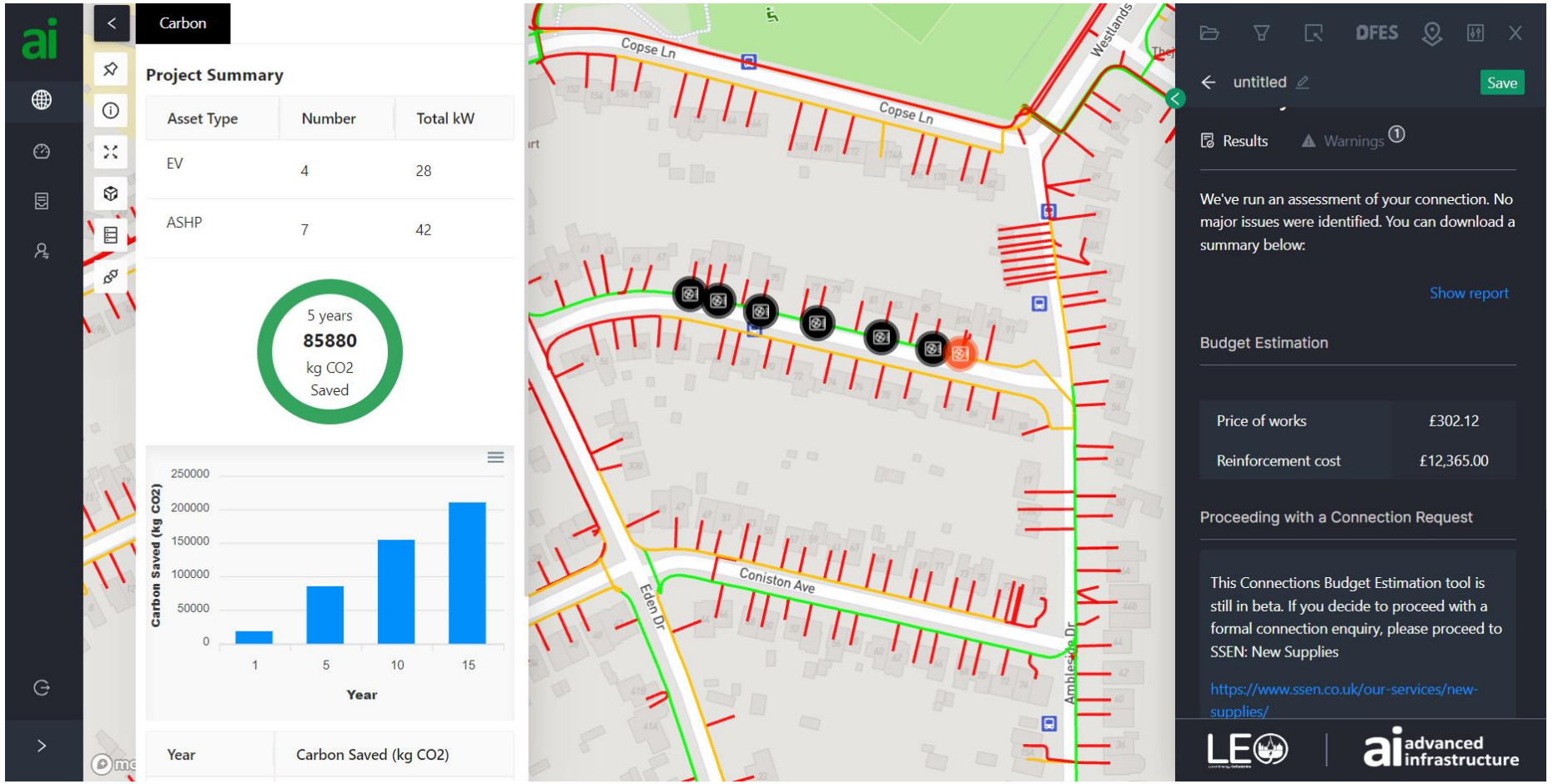
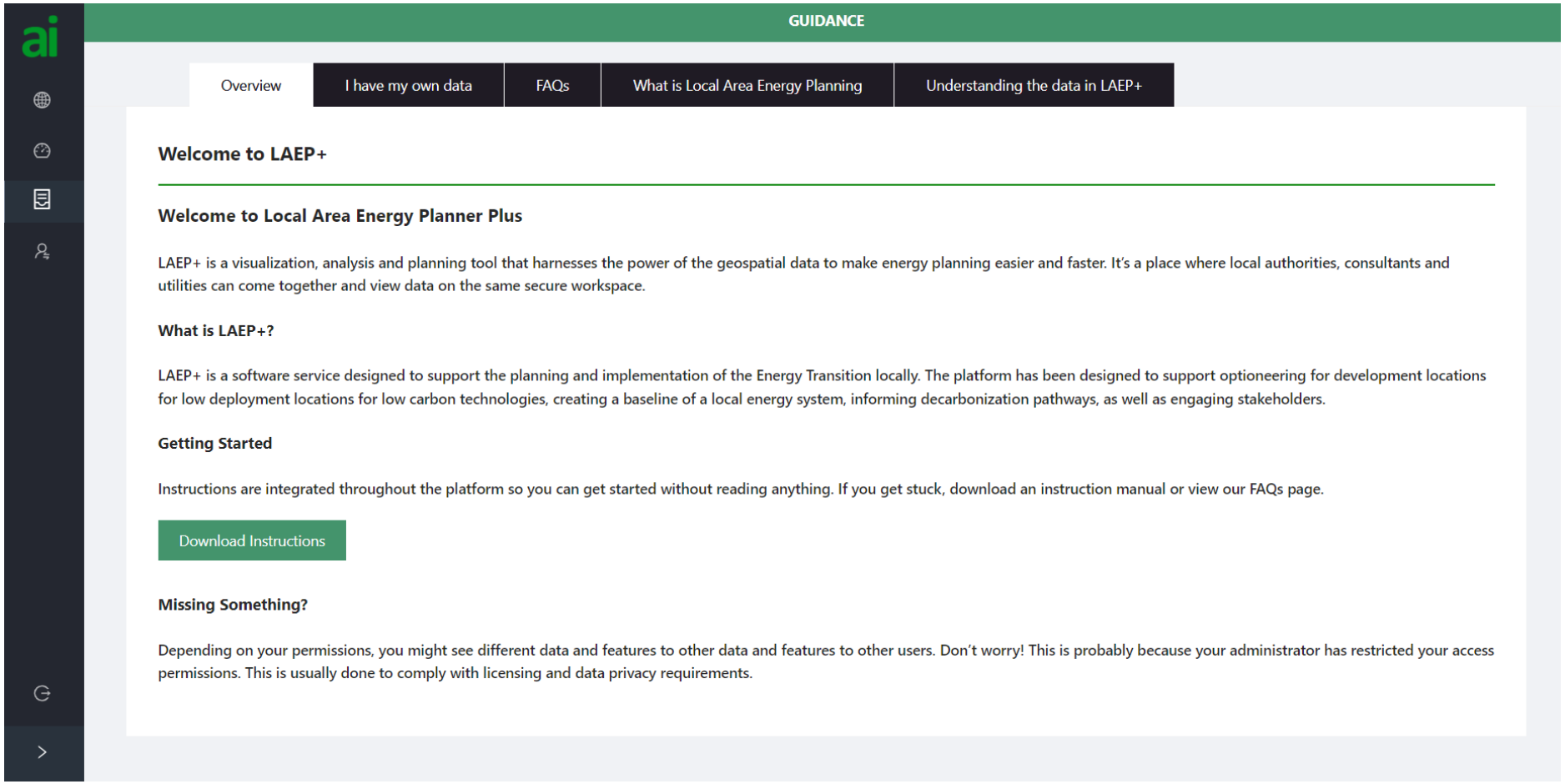
Projects


Carbon
Project Summary
Asset Type
Number
Total kW
EV
4
28
ASHP
7
42
5 years
85880
kg CO2
Saved
Carbon Saved (kg CO2)
250000
200000
150000
100000
50000
0
1
5
10
15
Year
Year
Carbon Saved (kg CO2)
Copse Ln
Coniston Ave
Eden Dr
Westlands
DFES
untitled
Save
Results
Warnings
We've run an assessment of your connection. No major issues were identified. You can download a summary below:
Show report
Budget Estimation
Price of works
£302.12
Reinforcement cost
£12,365.00
Proceeding with a Connection Request
This Connections Budget Estimation tool is still in beta. If you decide to proceed with a formal connection enquiry, please proceed to SSEN: New Supplies
https://www.ssen.co.uk/our-services/new-supplies/
advanced infrastructure

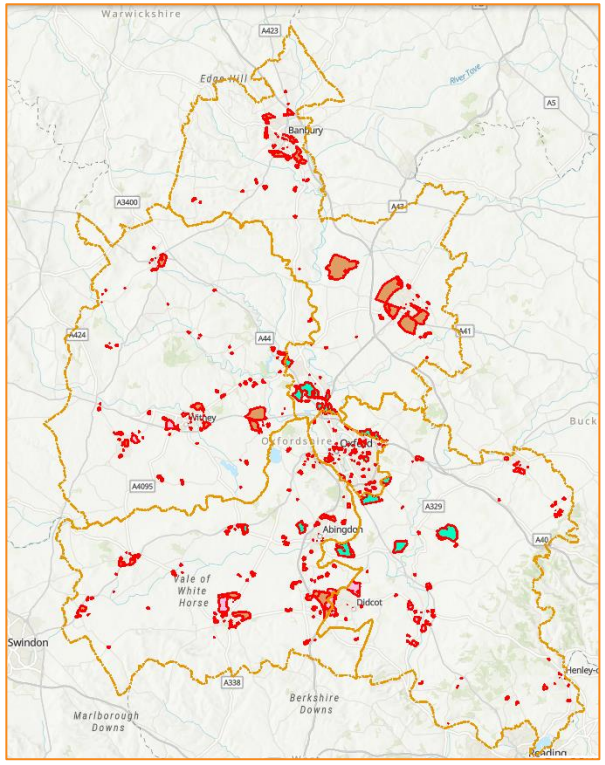
Guidance, data methodologies



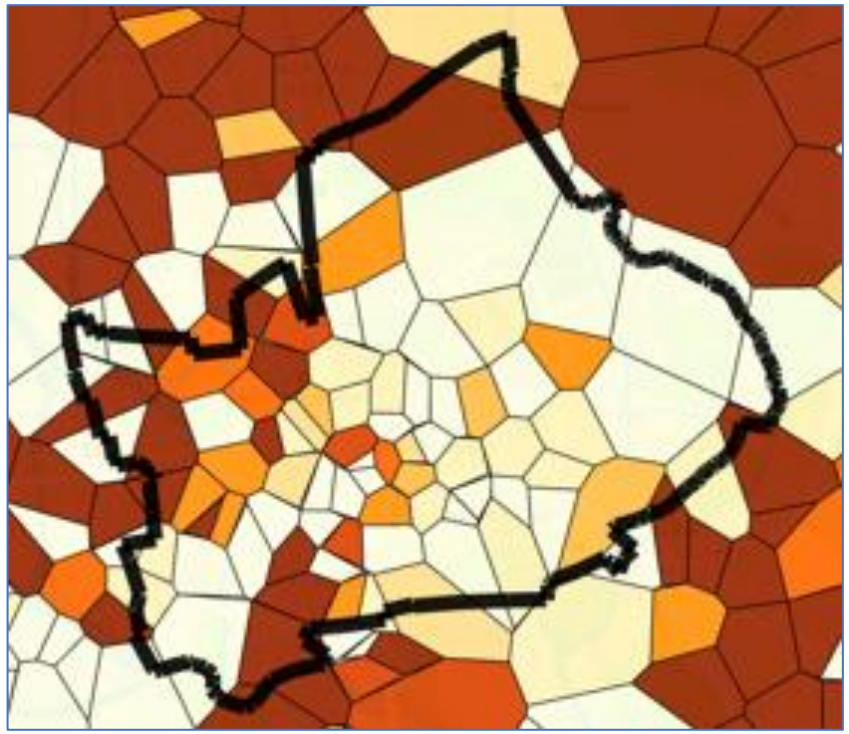
Supporting local area energy planning

- Baselining
- Planning for growth
- Planning for electrification of transport & heat
- Increasing renewable generation

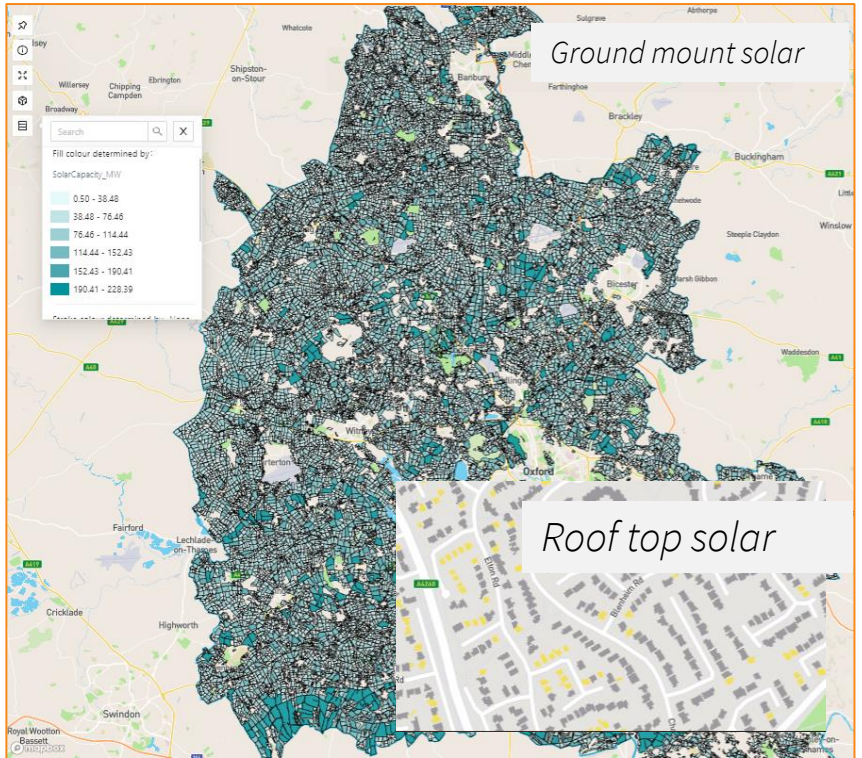
Planned housing growth locations



Network requirements



Solar generation potential



Next steps….

- Completion of user testing and data stories
  - ‘How far does the energy mapping platform support development of a local area energy plan?’
    - Oxford City Council
    - West Oxfordshire District Council
- Tidying up… improving data categories
- Set up post-LEO agreement

Local use of the map – Case study from Oxford

Ruth Harris

Oxford City Council

The City context

- Oxford covers about 17.6 sq miles, population of 162,100
- Parts are very densely developed, but with significant green spaces (52% of the city).
- Beautiful city, with many fine examples of important historic architecture.
- Thriving knowledge industry
- Willingness to collaborate to solve energy and climate challenges.

But...

- Challenges of equality, with some neighbourhoods amongst 20% most deprived in England.
- High average house prices and rent.
- Wide variety of building types, ages and tenures to retrofit.

How can Local Area Energy Planning help?

Our targets

- We already have a roadmap for net zero through the Zero Carbon Oxford Partnership (ZCOP).
- ZCOP is a collaboration of over 21 of the City's biggest employers, carbon emitters and significant organisations locally.
- Agreed a 2040 net zero target for the City as a whole, with detailed interim milestones.
- The roadmap:
  - Gives the what and the when
  - Not where, who or how.
- We know there is a need for LAEP.
- There is so much data out there, how do we start?

User testing of the map

- The map brings together rich data in a way which we haven't previously been able to access.
- It can give us:
  - Information to help us efficiently choose sites to install low carbon technology.
  - Information on how much it might cost to install certain low carbon measures.
  - A visual interpretation of what the Distribution Future Energy Scenario "Leading the Way" looks like for the City.
- Most importantly: Can it help us validate the ZCOP targets – are they realistic?

Yes it can!

ZCOP targets for heatpumps

Action area	2018	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Air Source Heat Pump	300	5,437	7,192	8,967	10,762	11,785	12,818	13,863	14,918	15,984	17,803	19,641	21,497	23,373	25,267	26,673	28,091	29,524	30,970	32,429
Ground Source Heat Pump	0	2,645	3,547	4,459	5,381	5,892	6,409	6,931	7,459	7,992	8,283	8,577	8,874	9,173	9,475	9,907	10,343	10,783	11,226	11,674

Existing heat pump Potential, ESC 2021

Count of buildings suitable for air source heat pumps	30,848
Count of buildings suitable for ground source heat pumps:	5,278

What does this tell us?

- We're projected to not quite have enough buildings suitable for ASHPs, and it’s a bigger gap for ASHPs.
- This could be how suitability is defined in the data – e.g. garden sizes.
- May need to look at other methods of heating.
- The DFES projection would need more work to consider as it defines heat pump categories differently

A sunnier picture for solar

ZCOP targets and DFES "Leading the Way" projections

	2018	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
ZCOP - Count of Solar PV Retrofit	1,098	6,914	8,411	9,926	11,458	12,678	13,911	15,159	16,419	17,693	18,981	20,282	21,597	22,925	24,267	26,233	28,218	30,224	32,250	34,297
DFES - Leading the Way Solar PV Domestic (MW)	-	5	7	8	9	12	14	14	15	16	18	21	23	24	25	26	28	29	30	36

Existing Domestic PV Potential, ESC 2021

Count of domestic buildings suitable for rooftop PV	33,218
Sum of domestic PV potential (MW)	67MW

What does this tell us?

- We're project to have more or less enough domestic rooftops suitable to put PV on, to meet the ZCOP 2040 target.
- The DFES projection and the suitability projection are also compatible.

What about non-domestic PV?

ZCOP targets and DFES "Leading the Way" projections

	2018	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
ZCOP (MW) Commercial	0	0	1	1	0.8	1	2	2	3	3.31	4	4	5	5	5.6	6	6	6	6	6.6
ZCOP (MW) Industry	0	3.0	3.8	4.5	5.3	6.6	7.8	8.9	9.8	10.7	11.2	11.6	12.1	12.5	12.9	13.3	13.6	13.9	14.2	14.4
ZCOP (MW) Institutional	0	1.9	2.2	2.5	2.8	4.2	5.4	6.6	7.5	8.4	9.4	10.4	11.5	12.5	13.0	13.1	13.1	13.1	13.1	13.1
DFES Leading the Way >10kW <1MW PV (MW)	-	0	1	1	3	4	4	4	5	5	6	7	7	7	7	7	9	9	9	9

Existing non-domestic PV Potential, ESC 2021

Count of non-domestic buildings suitable for rooftop PV	22,556
Sum of non-domestic PV potential (MW)	479MW

What does this tell us?

- We're projected to have more than enough generating potential on non-domestic buildings.
- The DFES projection is quite low in comparison to the potential.

Looking forwards

- The mapping tool has incredible potential to support LAEP
- Brings real added value by truthing ZCOP targets
- The Data Stories makes data accessible at a glance, whilst retaining the ability to drill down in to the specifics.
- Map is already being used to inform siting of EV chargers and to inform thinking on our Local Plan.
- Still work to be done - still in final stages of testing!
- Map will be used in future projects too, to progress net zero goals.

Thank You

To find out more visit us

https://project-leo.co.uk/

Contact us at:
inga.doherty@oxfordshire.gov.uk
Rharris@oxford.gov.uk