

ECEEE 2017 Summer Study

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A new local energy mapping approach for targeting urban energy renovations



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Outline

- **Context**, study aims and methods
- **Rapid energy assessment**: identify suitable local area(s) in need of energy improvement
- **Community engagement methods**: household-level data collection for enhanced modelling
- **House level energy assessment** using DECoRuM carbon mapping
- Final thoughts...

Context for energy renovation

- 80% GHG emissions reduction target by 2050
- 80% of existing dwellings are expected to exist in 2050, most of which are energy inefficient
- 2011 UK Carbon Plan: by 2050 all buildings will need to have an emissions footprint close to zero.

Significant energy renovation of existing houses is necessary

- Large-scale energy renovation needs to be better targeted, more cost-effective and result in a higher uptake to alleviate fuel poverty and reduce energy use.
- Role of local authorities (LAs) is considered vital in improving local areas.

The Carbon Plan:
Delivering our
low carbon future

December 2011

 HM Government

LEMUR research project

- Research presented is part of the **Local energy mapping for urban retrofit (LEMUR) project** funded under the Innovate UK's *Solving urban challenges with data* competition
- 15-month study (Sep'15 – Nov'17)
- *Collaborative project:* Oxford Brookes University, Bioregional, Cherwell District Council, Future Cities Catapult
- **Aim:** To **develop and test a mapping approach** that can help LAs and housing providers, **rapidly identify areas for energy improvement** to target a **wider roll out of energy renovation**, cheaper delivery and more effective outreach to vulnerable residents.



Research objectives

- Investigate how *publicly available* datasets on *housing* and *energy* can be used to **plan mass retrofit** by **targeting and modelling** low carbon measures across a city.
- LAs would save money overall by targeting those most in need of energy improvements.
- Address **challenges** of having:
 - **Incomplete data** about which homes could benefit from which retrofit measures and
 - Inability to **aggregate** private sector housing **renovation** activities to minimise installation costs.
- Demonstrate the solution for **Bicester** town in Oxfordshire, UK.



Methodology

1. Rapid energy assessment (GIS approach)

- Gather and spatially map national and local datasets on energy and housing for a town or city.
- Identify an area for energy renovation (high energy use an/or fuel poor) by superimposing geo-coded datasets.

2. Use Community engagement techniques

- Gather detailed data from households for enhanced modelling of energy interventions

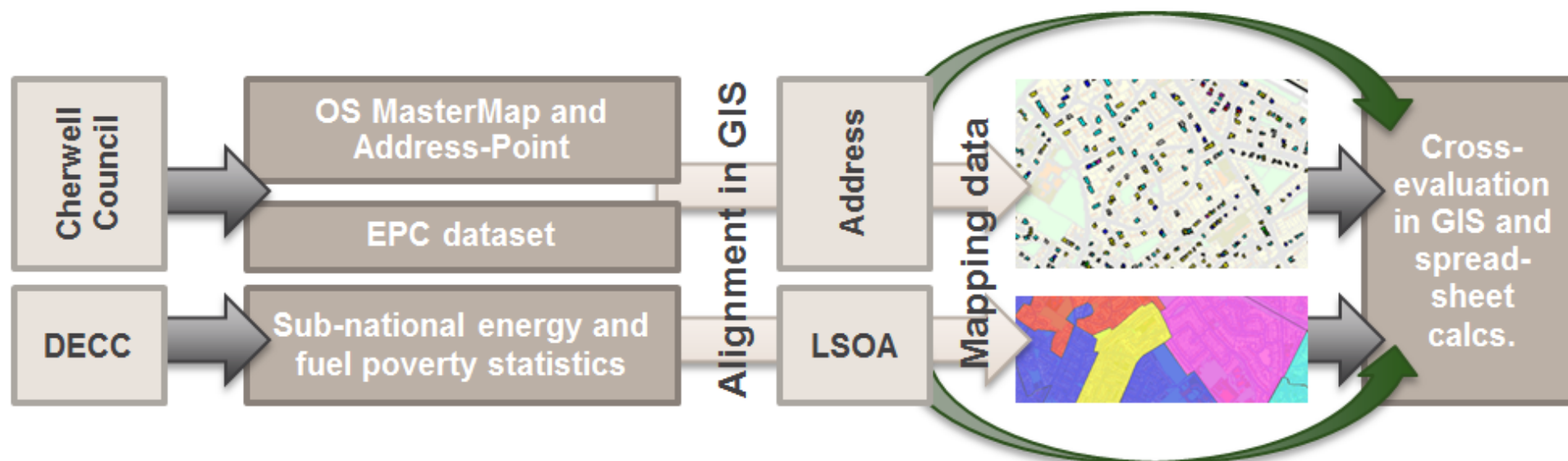
3. House-level energy assessment (GIS approach)

- Use a bottom-up carbon mapping model (DECoRuM) to assess dwellings where maximum and cost-effective energy savings would be made.

4. Track delivery of energy improvements

Publicly-available datasets

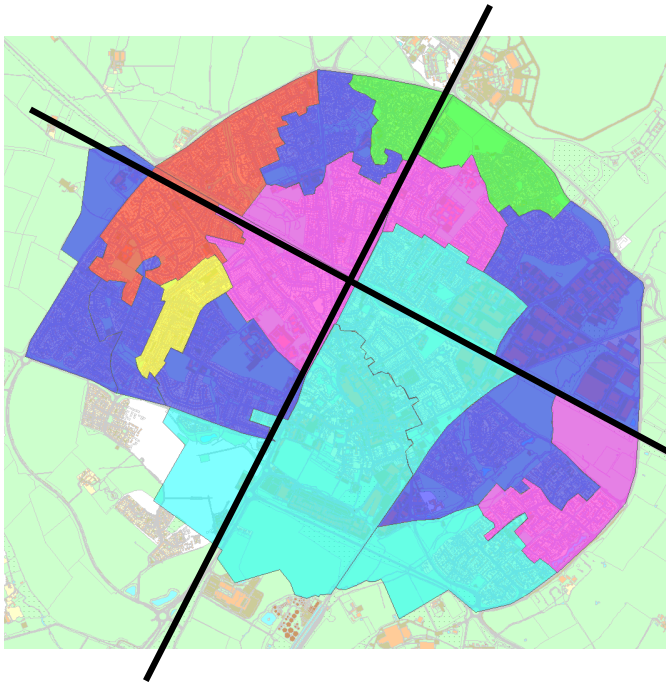
Ordnance survey (OS) MasterMap and OS Address-Point	GIS data	Free to local gov.
Sub-national energy consumption statistics	Metered consumption, fuel poverty	Free
Energy Performance Certificates (EPC)	Dwelling energy related data, e.g. wall type, insulation, heating system, modelled annual energy use	Free



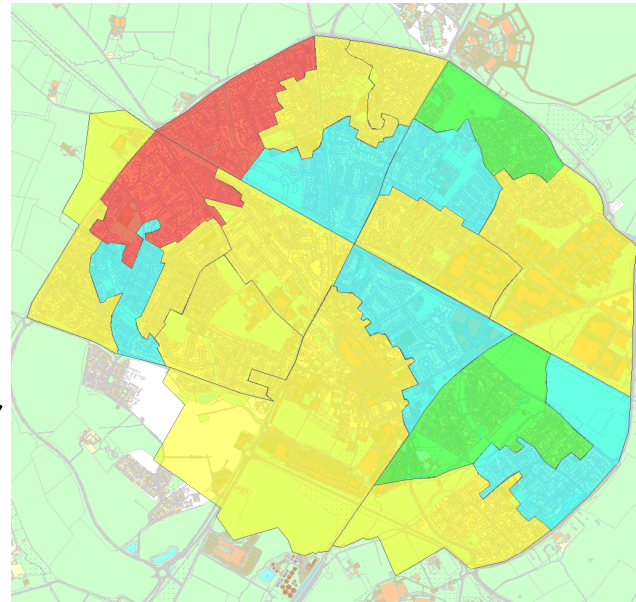
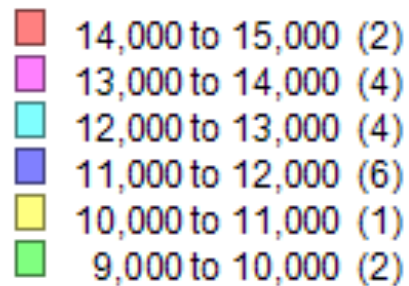
Rapid energy assessment:

Identify local area for renovation in Bicester town

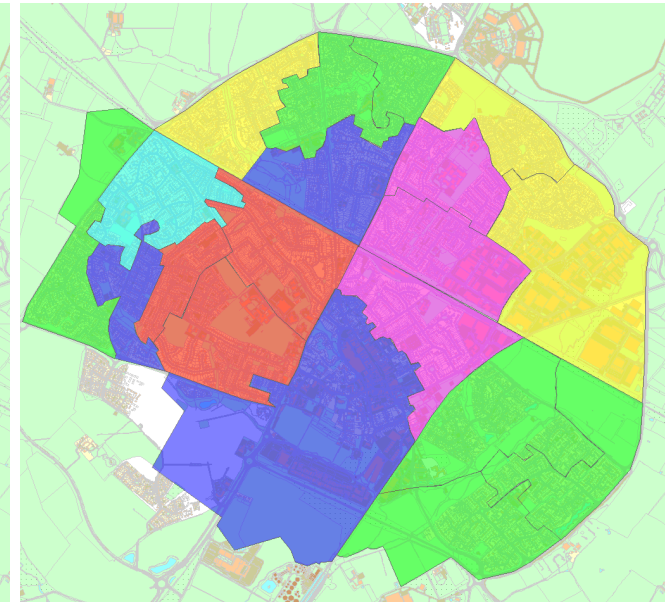
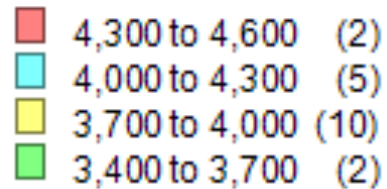
Sub-national statistics (2014)



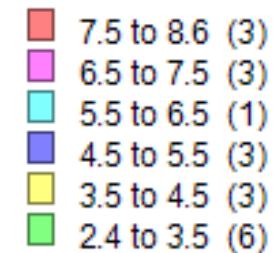
BicesterLSOA
Mean Gas 2014 kWh/meter



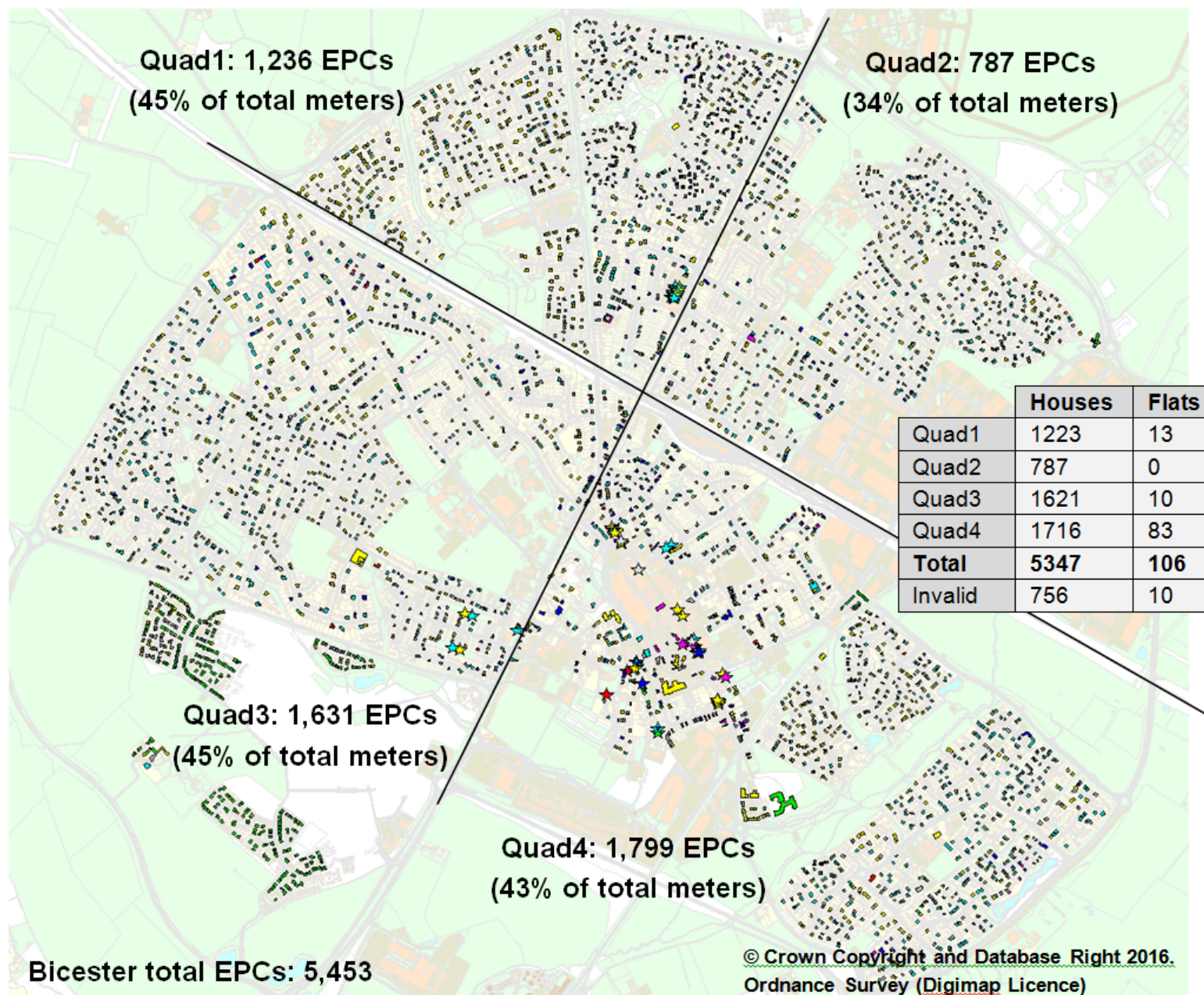
BicesterLSOA
Mean Electricity 2014 kWh/meter



BicesterLSOA
Percent of fuel poor dwelling 2013

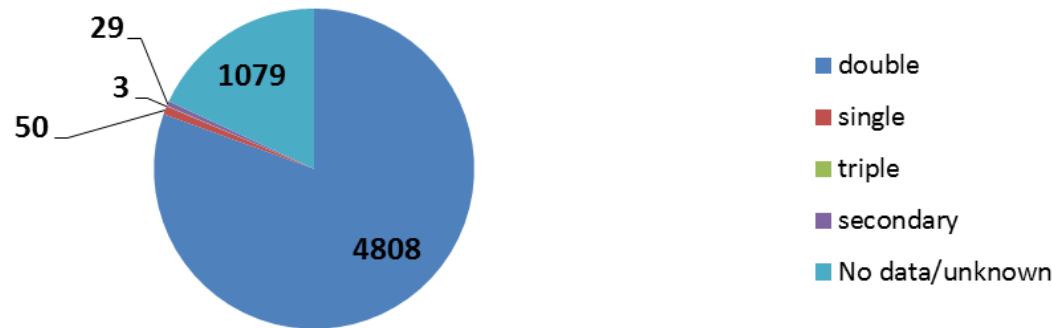


Mapping dwellings with EPCs

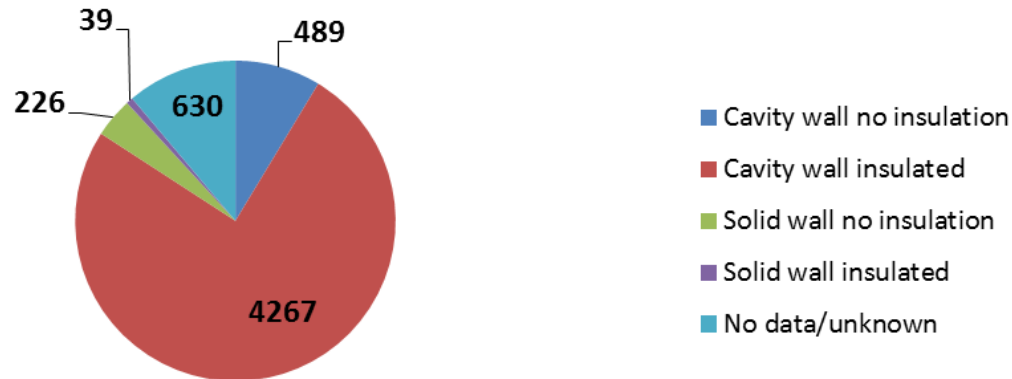


EPC data

Bicester EPC - Glazing

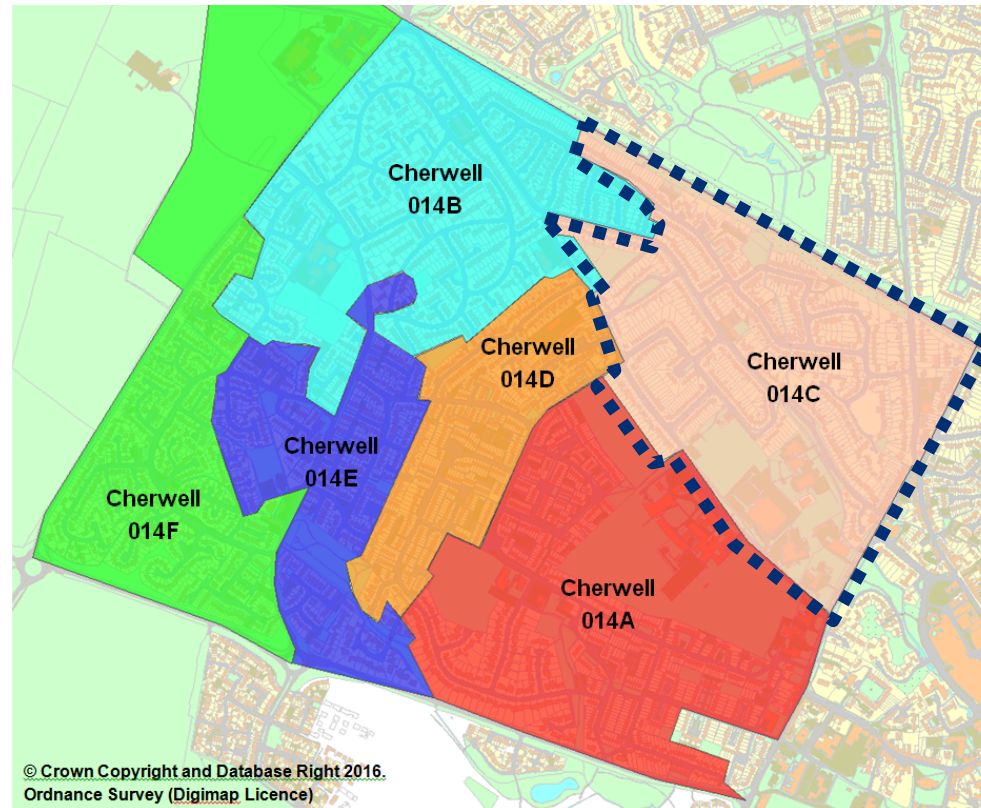


Bicester EPC - Wall type

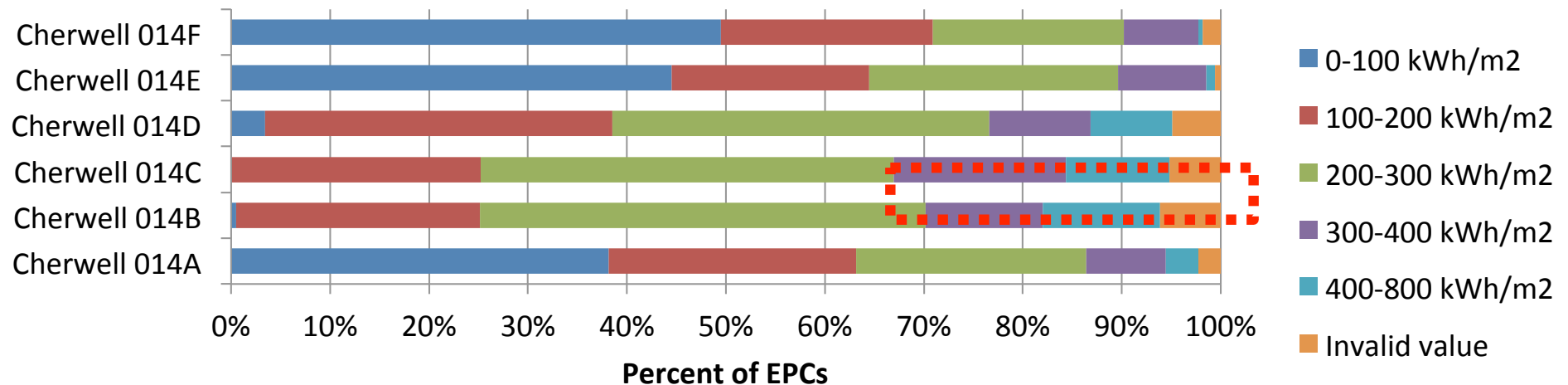


- ~500 uninsulated cavity wall dwellings and ~250 uninsulated solid wall dwellings.
- **Quad3:** 198 cavity wall houses with no insulation (40% of uninsulated cavity wall)
- **Quad4:** 130 solid wall houses with no insulation (58% of uninsulated solid wall)

Analysis of EPC data (Quad 3)



Percent of EPCs within a given energy use range for Quad3 LSOAs



Comparing datasets across LSOAs

	Cherwell 014B	Cherwell 014C	Cherwell 014D
No. of meters (electric)	636	691	489
No. of EPCs	212	231	206
% of LSOA with EPC	33%	33%	42%
Mean total energy	kWh	kWh	kWh
Sub-national	19,452	17,301	14,761
EPC	22,645	21,208	17,556

- Due to the modelled nature of EPC data, it was not expected to align with the (metered) sub-national data.
- EPCs appear to overestimate energy consumption.
- However LSOAs 014B and 014C both represent the highest overall total mean energy consumption for both sub-national and EPC datasets in quad 3.

Case study area and LSOAs

627 dwellings

222 EPCs

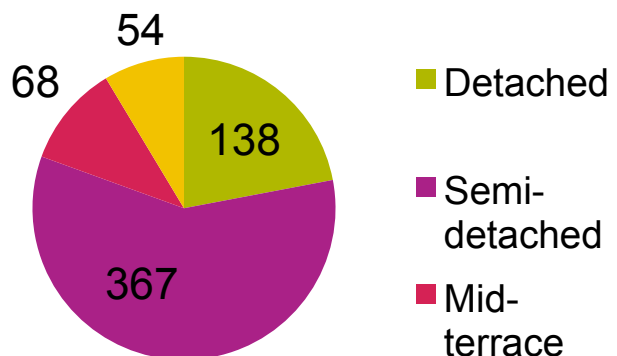
58 surveys

Cherwell 014B

Cherwell 014B

Cherwell
014D

Cherwell 014A



Community engagement:

Gather house level data for energy assessment

LEMUR home energy questionnaire

DECoRuM® Energy Questionnaire

Thank you for agreeing to complete this questionnaire. Please return in the stamped-addressed envelope provided or hand it to your local community energy group.

The following questions will help us estimate the amount of energy your home uses.

General details

A. Your name: _____

B. Your address: _____

C. If you do not wish your house to be represented on the carbon map please tick this box ☐

Basic home details

1. How many people live in your home?

_____ (write total number)

2. What is the estimated age of your home?

_____ (write number)

Construction, windows, ventilation and lighting

3a. What proportion of windows and doors are draught proofed? (circle)

None

3b. Install

4. Circle the majority of



single pane

5. How many panes?

None

6. Circle the material (circle)

Wood

7. Does your house have a hall or porch?

8. How many open fire places are there in your home?

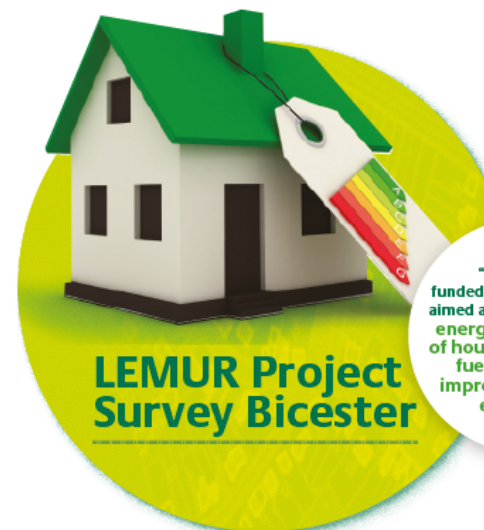
LEMUR Questionnaire

Cherwell District Council and partners have received a Government grant to work on Local Energy Mapping for Urban Retrofit (LEMUR). Funded by Innovate UK, this project is about improving the energy performance of housing, alleviating fuel poverty and improving the local economy.

As part of this research project we are surveying householders in Bicester about how they heat their home, temperature comfort and indicators of fuel poverty. We will then compare these answers to the results of the Lemur project.

What do I need to do?

Simply answer the questions as honestly as you can! Thank you very much for your participation.



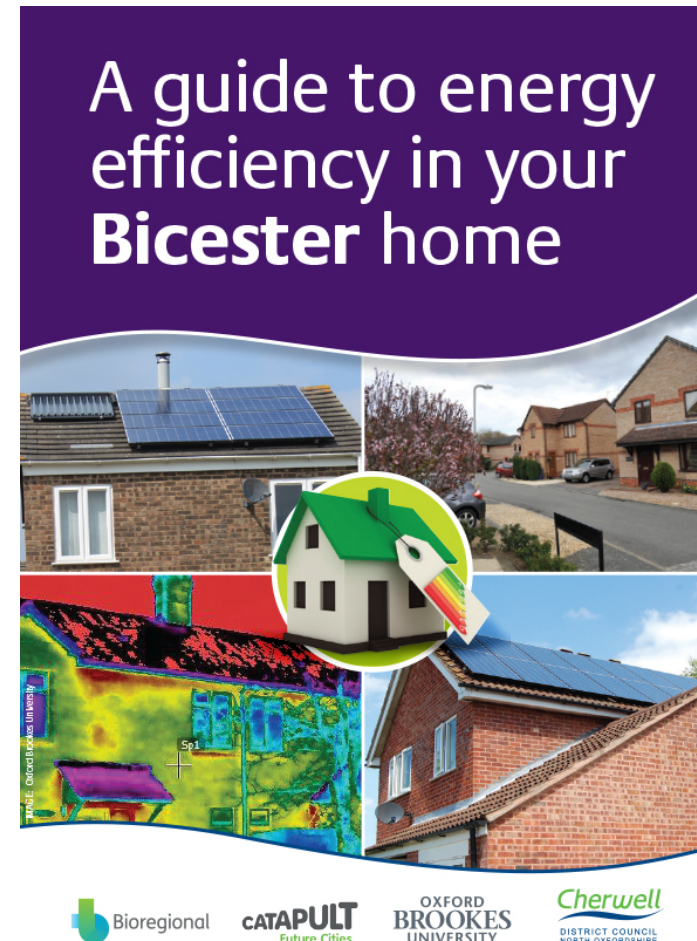
"The project, funded by Innovate UK, is aimed at improving the energy performance of housing, alleviating fuel poverty and improving the local economy."

Community engagement methods to complete home energy survey

	Survey format	Incentive	Demographic	Success*	Surveys filled (total = 234)
Door-stepping	Printed survey	None	Mixed	Very low	55 (24% of total)
Schools (x3)	Promotional letter with link sent home with children	For school	Younger generation with children	Low	40 (17%)
Day centre	Printed survey	For day centre	Older generation	Moderate	5 (2%)
Church	Printed survey	For church	Middle age	High	12 (5%)
Library	Printed survey	None	Younger generation with children	Low	1 (0.4%)
Facebook	Online survey	Drawing for ten vouchers of £25	Expected to exclude older generation	Very high	109 (47%)
Local community group	Printed survey	For group	Mix	High	12 (5%)

Reflections about engagement

- Combination of church engagement, community group and face book campaign was the most effective in terms of yield.
- Facebook method was highly successful in terms of effort and cost for return (Facebook post reached 8000 people, 400 clicks, 109 survey completions for €115 investment).
 - Combine with other local engagement to reach demographics that do not use social media.
- Engagement was in the summer, winter may yield higher response rates
- Effort in reaching older demographic was worthwhile as it also helped to raise awareness about affordable warmth.

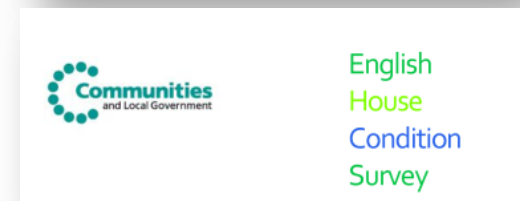


Bottom-up modelling (DECoRuM)

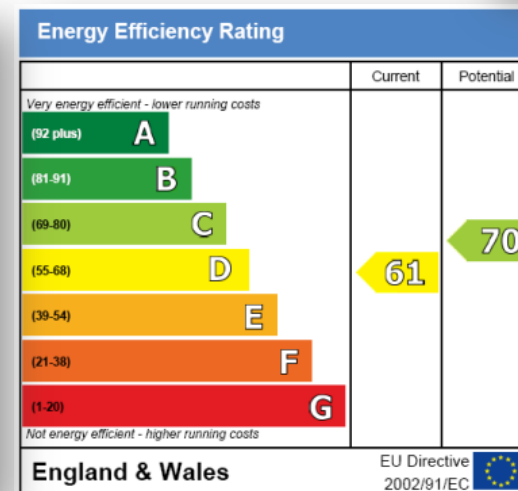
House level data for energy assessment

Data sources for the DECoRuM model

- OS MasterMap Topographical layer
- English house condition survey
- Google maps- characteristic observation
- Edina – Historic digimap
- EPCs
- Home survey questionnaires



Google Maps and street view



DECoRuM Energy Questionnaire

Thank you for agreeing to complete this home energy survey questionnaire.

The following questions will help us understand your energy consumption and your home's energy efficiency. Please provide as much information as possible.

1. What is your address?

Address: _____

2. How many people live in your home?

Number of people: _____

3. What is the estimated age of your house?

Age: _____

4. What proportion of a house's heat is lost through the roof?

None Some Most All

5. How many open the windows are there in your house?

None Some Most All

6. How many double glazed windows are there in your house?

None Some Most All

7. How many double glazed doors are there in your house?

None Some Most All

8. How many double glazed windows are there in your house?

None Some Most All

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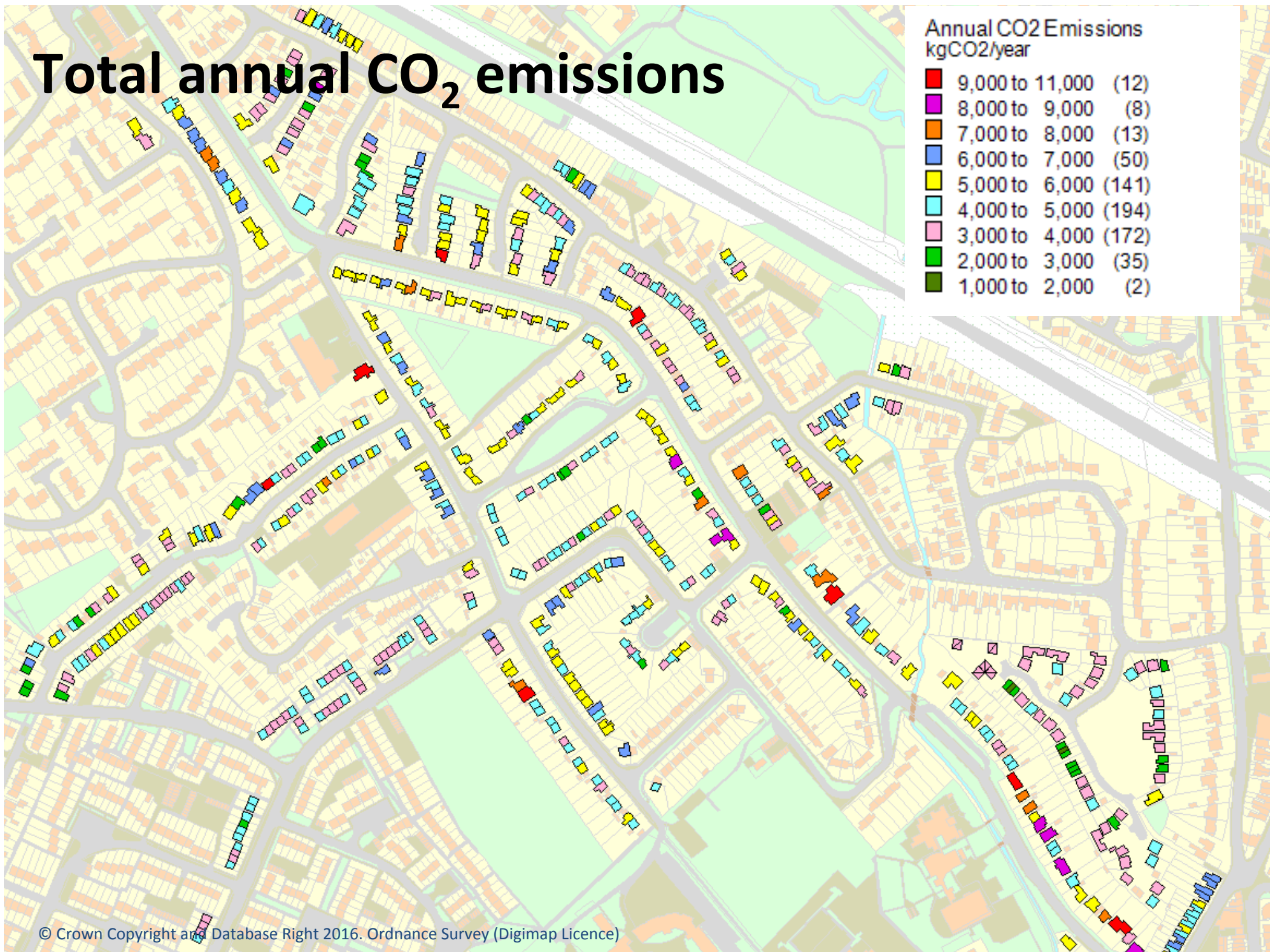
100. How many double glazed windows are there in your house?

None Some Most All

Total annual CO₂ emissions

Annual CO₂ Emissions
kgCO₂/year

9,000 to 11,000	(12)
8,000 to 9,000	(8)
7,000 to 8,000	(13)
6,000 to 7,000	(50)
5,000 to 6,000	(141)
4,000 to 5,000	(194)
3,000 to 4,000	(172)
2,000 to 3,000	(35)
1,000 to 2,000	(2)



Comparing DECoRuM results with EPC and sub-national data

	Averaged within mapped area			Overall (DECC statistics)	
	DECoRuM	EPCs*	Sub-nat. data (2014)**	Bicester (2014)	UK (2014)
Annual energy use (kWh/yr)	17,133	21,258	16,985	16,181	16,406
Energy use (kWh/m ² /yr)	200	261			
Dwelling count	627	222	2,531***		

* Unregulated loads not included

** floor area not reported

*** four LSOAs

Fabric + heating + solar package – reduction in annual CO₂ emissions

Fabric + heating + solar package
Reduction in annual CO₂ emissions (kgCO₂/yr)

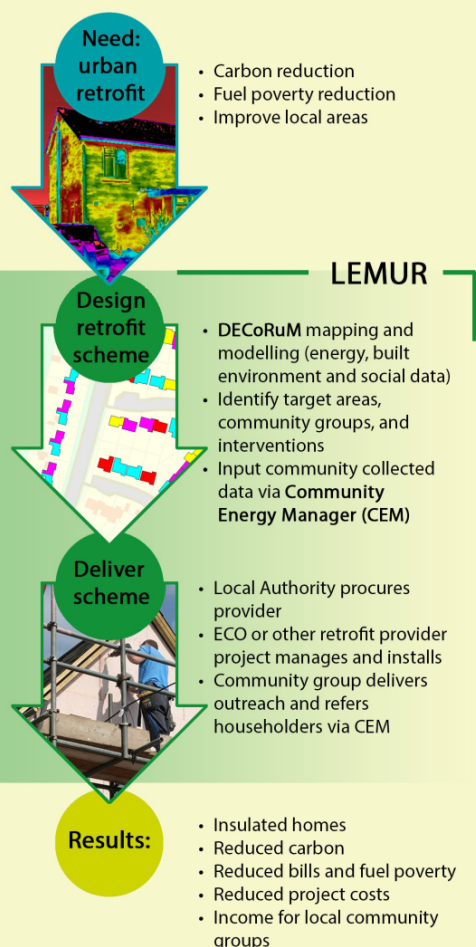
6,000 to 7,000	(7)
5,000 to 6,000	(15)
4,000 to 5,000	(62)
3,000 to 4,000	(162)
2,000 to 3,000	(192)
1,000 to 2,000	(151)
0 to 1,000	(37)

Final thoughts

- Study has demonstrated a **data-driven approach** for **targeting** and **modelling** energy interventions across urban areas, by conducting a “**rapid assessment**” of **Bicester town**, and identified one neighbourhood for potential intervention.
- Pilot was designed to collect **additional household data** for further analysis using community groups’ trusted links with local residents to maximise participation.
- Intention was also to **work with a Green Deal provider** and assess the potential cost reductions, which was not possible due to Government’s change in policy in 2015.
 - Government’s plans for ECO allow local authorities to come up with their own methodology for **flexible eligibility**. Providing such a methodology is a future area for LEMUR development .
- As part of another project, LEMUR will be used to create an Oxfordshire-wide **energy demand model** to assess potential for integration of smart energy systems.

Thank you!

LEMUR service delivery process:



LEMUR is funded by:

Innovate UK

Project partners:



Images:
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Ordnance Survey (Digimap Licence)
External wall insulation: energyalton.org.uk

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rgupta@brookes.ac.uk

LEMUR

Data Driven Local Energy
Mapping for Urban Retrofit



"The project, funded by Innovate UK, is aimed at improving the energy performance of housing, alleviating fuel poverty and improving the local economy."