Using Smart Meter Data to Assist in Energy Performance Measurement

Todays session will cover the following:

- **The need for measurement of energy in buildings (briefly)**
- **Smart meters, context, capabilities and limits**
- **Examples of Smart meter – energy performance work**
- **How do we get the data**
- **Final closing remarks**

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Energy House Labs: What we do and why….

Dr Richard Fitton

Reader in Energy

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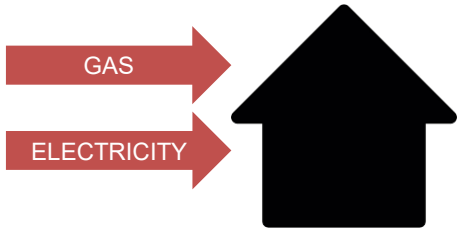
KEY ISSUES

- Energy consumption in the home and small commercial
- Changes to the energy system – decarbonisation, decentralisation and digitisation
- Everything from insulation, to heating systems, controls, smart meters and electric vehicles
- Domestic energy is getting complicated

OLD MODEL

Simple model we were working to

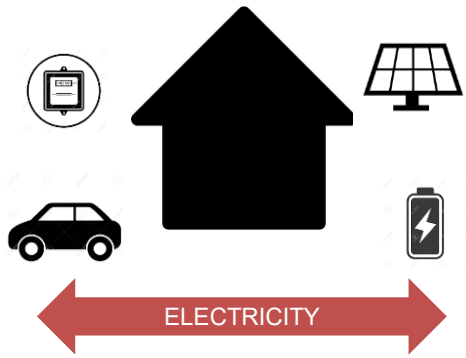


SIMPLE CONSUMER

NEW MODEL

ENERGY HOUSE LABS

Emerging view of domestic energy



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FACILITIES

ENERGY HOUSE LABS

ENERGY HOUSE

THERMAL MEASUREMENT LABORATORY

SMART METERS SMART HOMES LAB

ENERGY HOUSE 2.0

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ENERGY HOUSE 2

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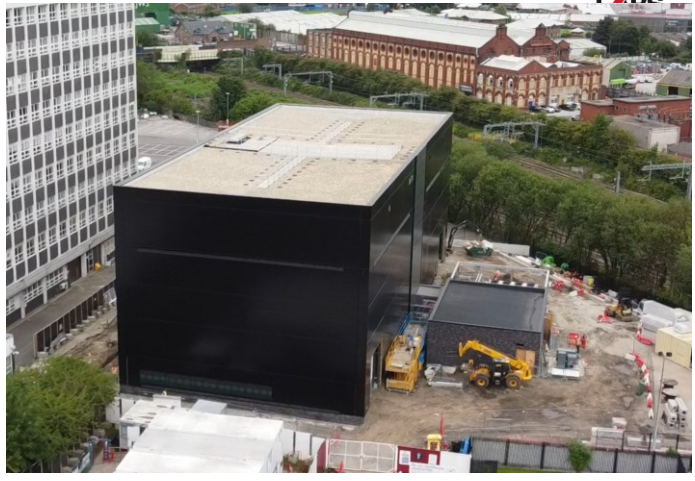
ENERGY HOUSE 2



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PEOPLE

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SCOPE

What do we do?

Research:
- Retrofit of fabric (insulation air tightness etc)
- Smart controls
- Electric Vehicle Charging
- Building performance methodologies
- Large scale field trials

- Commercial testing of energy savings devices

Research:
- Ageing of insulation materials
- Recycled materials for use as insulation
- Insulation values of thatched properties

- Commercial testing of conductivity of insulation products

Research:
- Appliance disaggregation
- Smart meter/IOT linkage
- Data analytics with Field Trial team
- Innovative uses for SM data

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Context

Researchers and industry are quickly realising that the worlds of energy and environmental modelling and the real world often do not intersect. This has been shown in many studies globally. This is known as the “Performance Gap” (PG)

Country	Sample size (N)	Average Performance Gap	Country	Sample size (N)	Average Performance Gap	Reference
Canada	1	74%	Canada	1	74%	(Rouleau et al., 2018)
Germany	3400	30%	Germany	3400	30%	(Galvin, 2014)
United Kingdom	25	50%	United Kingdom	25	50%	(Johnston et al., 2015a)
Switzerland	50000	11%	Switzerland	50000	11%	(Cozza et al., 2020)
France			France			
Italy	6	45%	Italy	6	45%	(Ballarini & Corrado, 2009)

Context

Performance gap can be found in either the positive or negative side of the modelled value.

- Many researchers have tried to state what may cause PG.
- The PG is actually caused by a number of different reasons.
- A typical reason could be the gap between a default value entered into an energy model that wasn’t included in the actual building

Context

This can explain some issues, but as researchers we dig deeper:

- The way we model may not be perfect, but modelling should be accepted as a simplification of a building and not reality itself.
- Also many people will criticise a model after analysing results form a poorly measured /sensored measurement campaign, with consideration for uncertainty etc.

How can smart meters help?

Historically. Some of the older members of the audience may remember these:

How can smart meters help?

Historically.

In 2021 should we be gluing sensors to the front of gas and electric meters?

Plus, they fall off, occupants remove them, they need comms adding, and that is all expensive, and can be inaccurate.

So now we can do things a little "***smarter***" in some cases

How can smart meters help?

So what is a smart meter?

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What is a smart meter?

No definition! / No harmonisation/ No common data patterns/ No standard comms!

European Smart Meter Association however do advise that smart meters should have the following characteristics:

- Automatic processing, transfer, management and utilisation of metering data
- Automatic management of meters
- 2 way data communication with meters
- Provides meaningful and timely consumption information to the relevant actors and their systems, including the energy consumer
- Supports services that improve the energy efficiency of the energy consumption and the energy system (generation, transmission, distribution and especially end use)
- Can be used on multiple utilities, such as water, gas and electric, generally one meter for each.

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DYNASTEE

What is a smart meter?

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DYNASTEE

What is a smart meter?

There is also no harmonisation across the EU, either technically or even with regards to rollouts, although there is an aim:

It is an aim of the European Union (EU) to introduce smart meters across the union at a rapid rate with the aim of 72% coverage for electric and 40% for gas metering.

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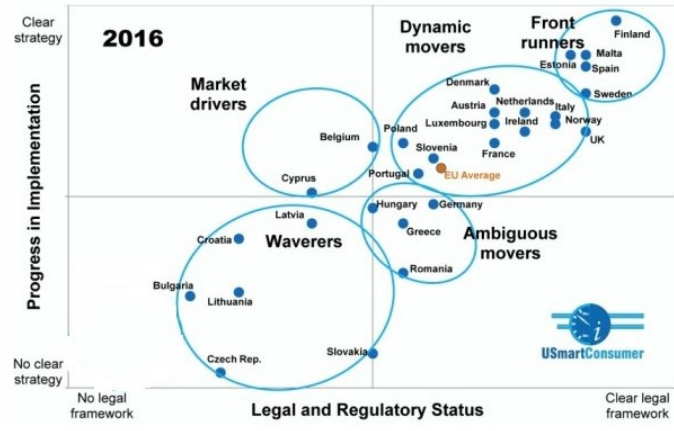
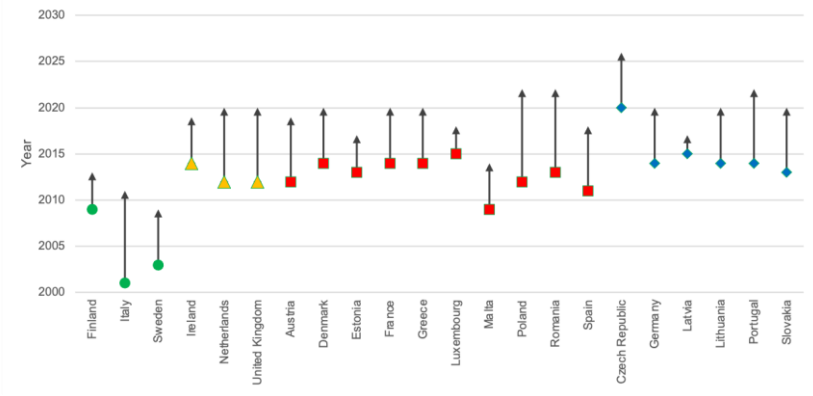
Rollout:

These figures are quite old but are the latest ones:



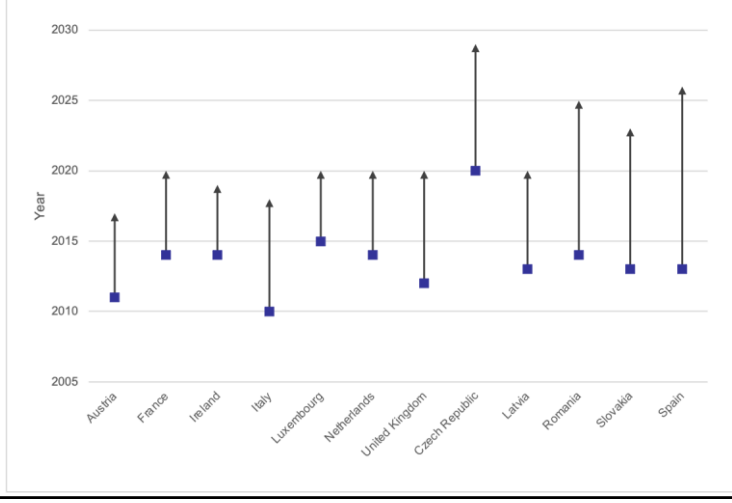
Rollout:

Electric



Rollout:

Gas



What can they do:

Another non harmonised issue!

- *Meter readings are taken over a range of 10 seconds to 60 minutes for electricity.*
- *Gas is less usually around 30 minutes and the device is remote from a power supply and is battery powered*

- *The key message is smart meters and the data offered is VERY country specific.*

Can Smart Meters generate accurate energy ratings on their own, probably not!

Generally for energy efficiency works without going to detail, a source of inside and outside temperature is needed.

- *We can get smart meter data remotely so we need something similar*
- *IOT is our friend here, smart thermostats, boilers with comms, heat meters etc.*

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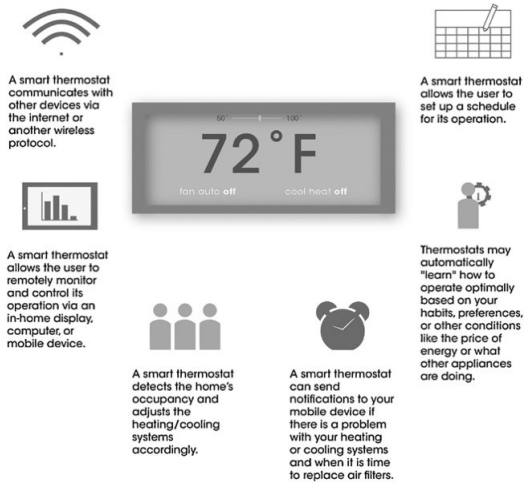
Smart Devices:



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Smart Devices:

- Actual sales figures are difficult to come by as these are commercially sensitive, but the trend is clear: Shin et al estimated that smart home technologies are currently present in 7.5% of homes globally with an annual market of $44.2 million in 2018 (Shin et al., 2018).
- The EU is a strong leader in this market place with a recent Berg Insight market research report claiming that at the end of 2017 the EU had around 22.5 million smart homes or 9.9% of households with France, Germany and the UK leading the market (Berg, 2018).

So if we presume that we can access the data (more of this later), then what can we do with that data:

A couple of high profile projects have recently worked with SM data, with well documented outputs. These are the latest ones:

- ***Annex 71 (pan EU)***
  https://bwk.kuleuven.be/bwf/projects/annex71
- ***SMETERS (UK only)*** *https://www.gov.uk/guidance/smart-meter-enabled-thermal-efficiency-ratings-smeter-innovation-programme (data to be released October 2021)*

ANNEX 71 Final Meeting Youtube playlist contains many videos on this topic including, data collection, analysis, interpretation, policy implications and much more

This has just been released here

https://www.youtube.com/watch?v=h8nt_pEx36M&list=PL26pymJl0WS2e-GltP1eLa_bdcLOBVp0H&index=1

SMETER had an online workshop which is relevant to todays session. This is worth a view.

https://www.youtube.com/watch?v=kpwJaVek4Q0

The findings from these reports are interesting and state that this method of estimating energy perform well and have lots of scope for further work.

So how do we actually get this data?

This is highly country/ supplier specific. But lots of suppliers will have an interface to the data using a cloud platform.

This platform usually has an API:

*(API= **Application Programming Interface**, allows two applications to talk to each other)*

The Octopus has a number of possible data points

- Octopus Energy provides a REST API for customers and partner organisations to interact with our platform. Amongst other things, it provides functionality for:
- Browsing energy products, tariffs and their charges.
- Retrieving details about a UK electricity meter-point.
- Browsing the half-hourly consumption of an electricity or gas meter.
- Determining the grid-supply-point (GSP) for a UK postcode.
- Creating a quote.
- Creating a account.

We will present an example as follows:

Apologies for UK centric angle, but this should still help.

Octopus Energy - (supplier)

Smart meter install - (Electric)

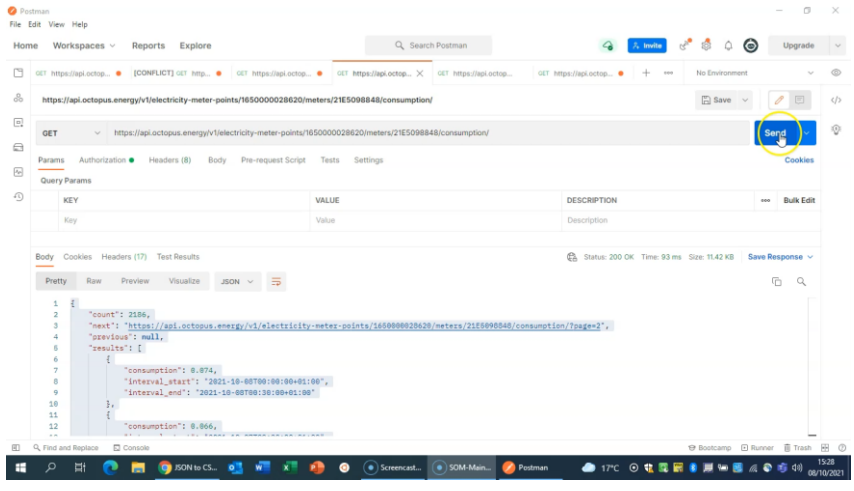
Data – energy consumption

Frequency - 30 mins

Domestic Installation

<u>Thanks to Dr I Paraskevas and A Sitmalidis for this presentation</u>

Walkthrough



Walkthrough

Sample JSON files can be received by emailing R.fitton@Salford.ac.uk

Space Heating Data

A key component for any heat loss/ HTC estimation is the Delta component (Internal and external data)

Some easy to use (and working systems)

Tado

https://www.openhab.org/addons/bindings/tado/

Honeywell Evohome

https://developer.honeywellhome.com/content/getting-started-guide

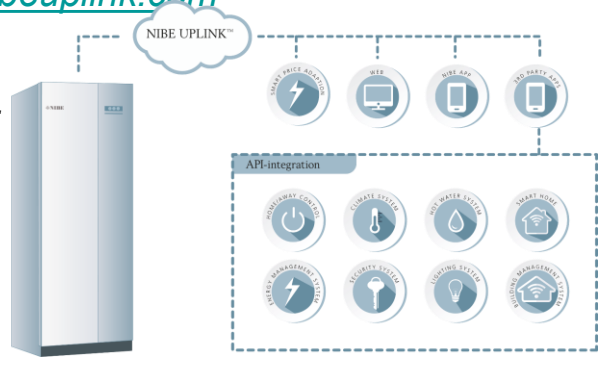
Google Nest

https://developers.google.com/nest/device-access/api/thermostat

Air Source Heat Pumps

https://api.nibeuplink.com

SEE EXCEL SHEET



No Energy rating estimation is possible without external conditions

Weather compensation sensors

Weather observations API

Forecasted weather API

BEMS Systems

Data observation:

Of course data can have glitches, it can be correct or incorrect.

You should use some relevant mechanisms to check your data makes sense.

Just because something is smart does not make it right

Data often drops/has gaps etc, so you need to deal with this also.

Some excellent advice is found here https://iea-ebc.org/projects/project?AnnexID=58

How can you start doing this:

Smart meter data is now fairly easy to achieve, however it is totally unique to the country and supplier, you are going to have to have to do some research.

Please note :Data and GDPR, this needs a significant amount of thought, people's life's are well documented through energy consumption and heating patterns and it should not be in the public domain.

It should never be linked to personal data such as addresses, peoples names etc, where it can be used for nefarious purposes.

What else can we do:

This is just the start of an energy data revolution, more data will come on stream, EV, ASHP, batteries, Heat meters etc.

If we merge in other data sources we can extrapolate more sensing, if we know where the EV is we can map temp data etc.

Lets take a look, my journey home last night: