



Smart Electric Homes

Presentations by OEH hosts

- Paul kershaw
- Ian Cray

An Open Eco Homes online talk



Mole



Ecology
Building Society



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- **10th October - Methane being disconnected**

The property

- built in 1968

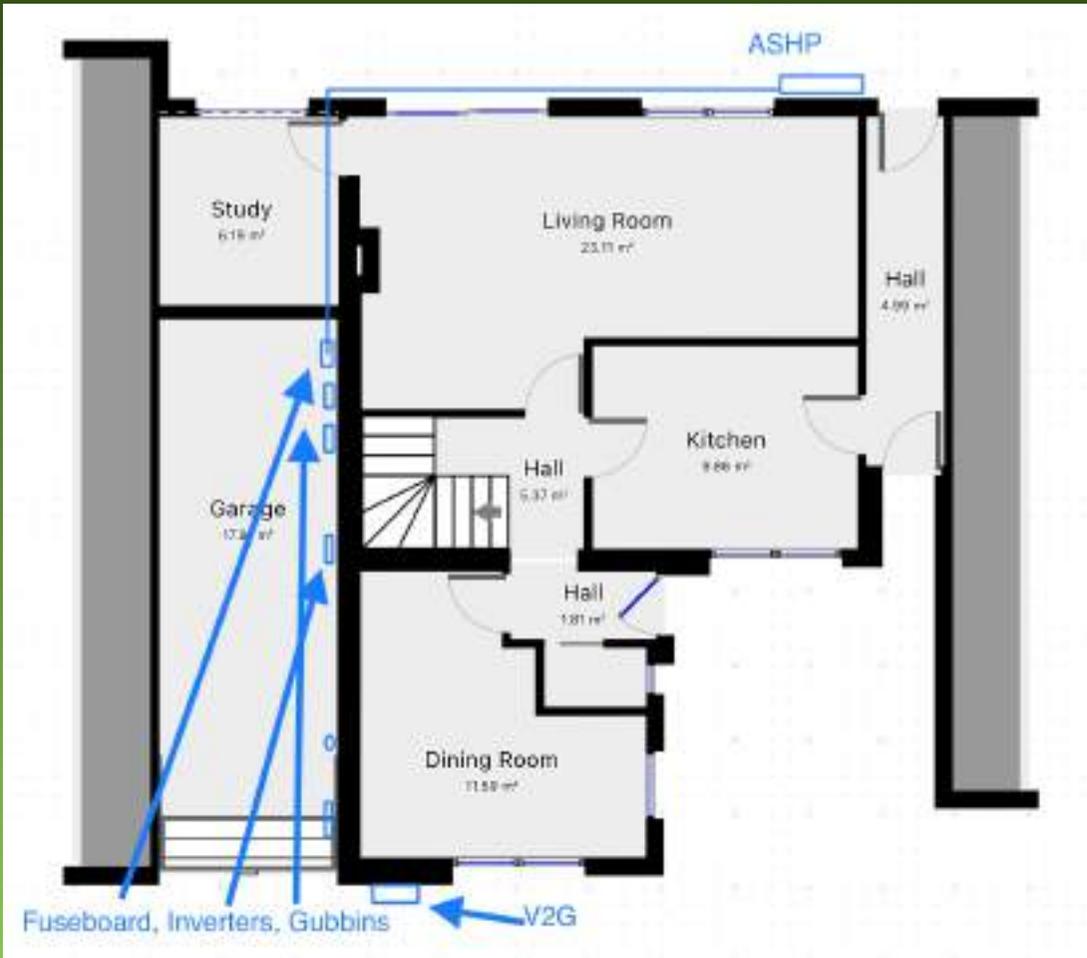


The property

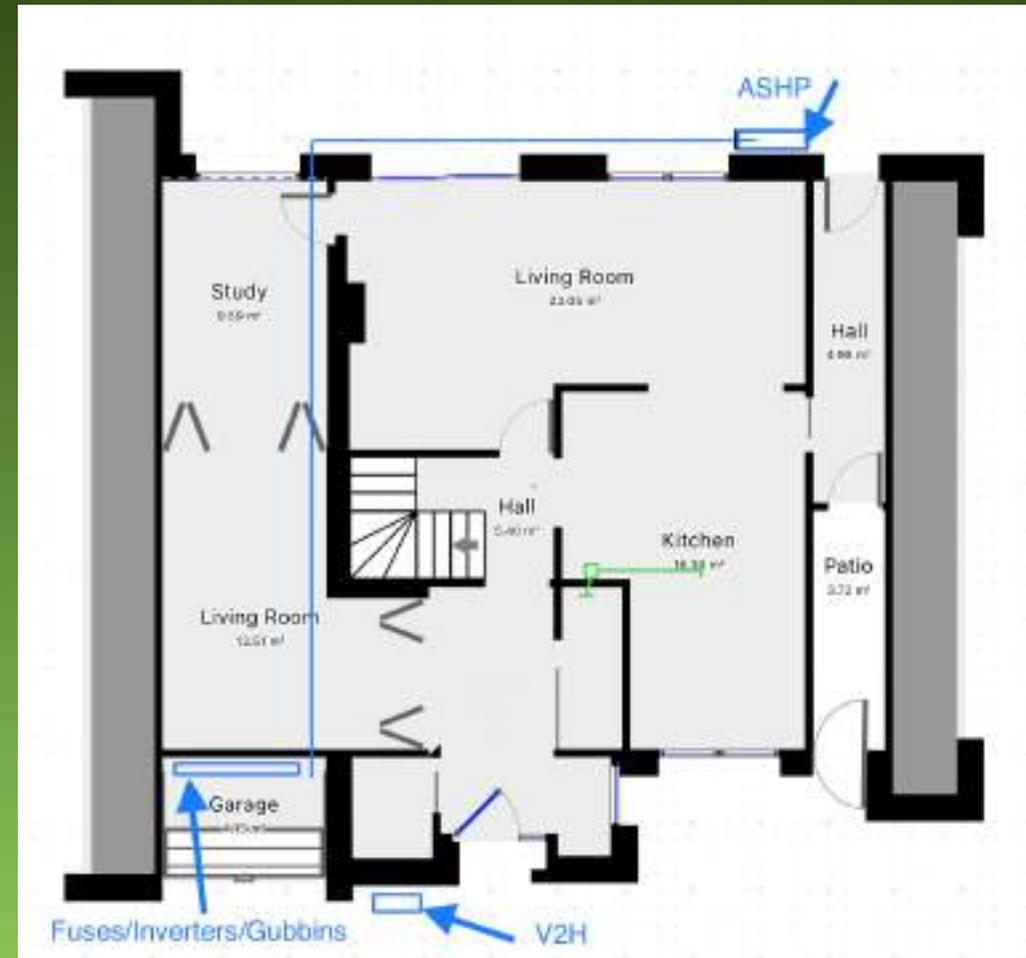
- built in 1968



Ground Floor Existing



Ground Floor Proposed



First Floor Existing



First Floor Proposed



Energy Efficiency

Reduce Heating & Cooling Demand

- EWI - External Wall Insulation
- Pitched Roof Insulation
- Passive Purple Intelligent Membrane
- Aereco Demand Control Ventilation

Reduce Energy Demand

- ASHP
- Solar PV
- EV Battery
- LED Lightbulbs
- Energy Rated Appliances
- Low Flow-Rate Taps

Solar PV

- Installed Aug 2021
- Utilising the solartogether scheme
- 4.76kW array, DNO approved (G99)
- south-east facing
- didn't install a home battery as had an EV
- £4k inc installation



Solar PV

- 4.5mWh
- House demand with EV but not ASHP, approx 5mWh (2018)



Air Source Heat Pump (ASHP)

ASHP



First Floor Existing



First Floor Proposed





Mixergy Tank

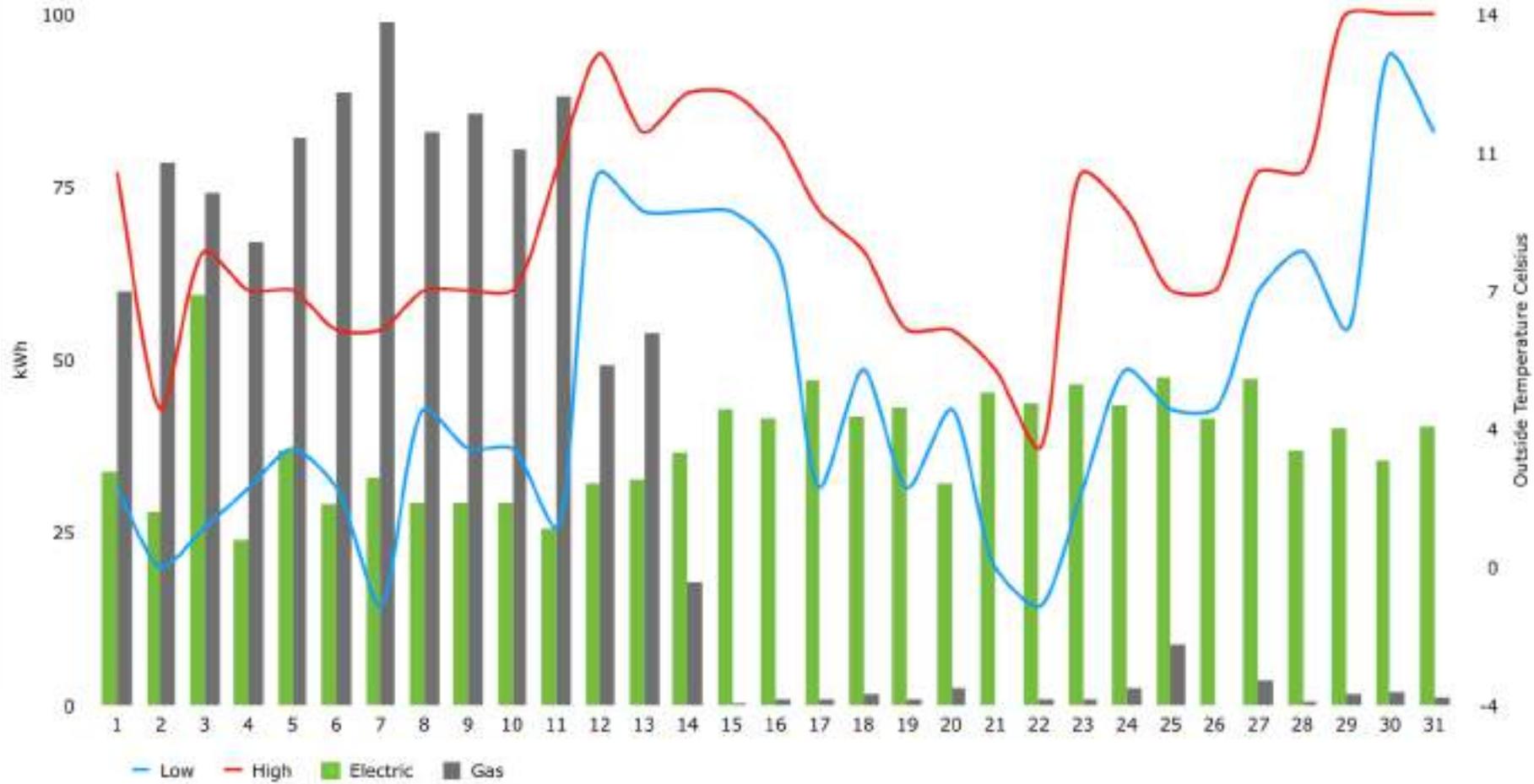
- Can heat from mains elec or gas, diverted solar PV, heat pump.
- Heats from the top.

Smart Features

- Only heats as much as you regularly use (except from heat pump).
- Can link to Time-Of-Use tariffs.

ASHP

December 2021 Energy Usage



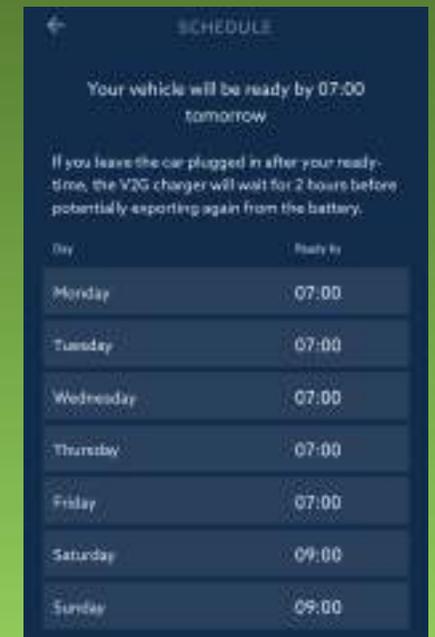
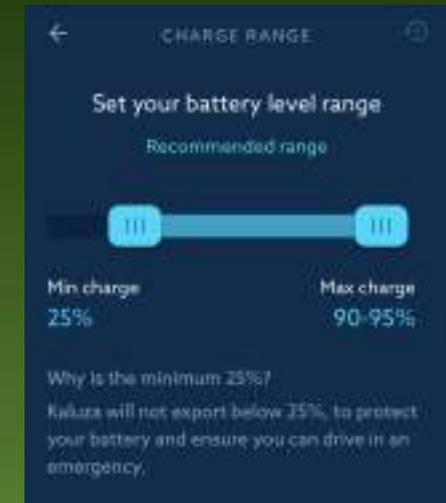
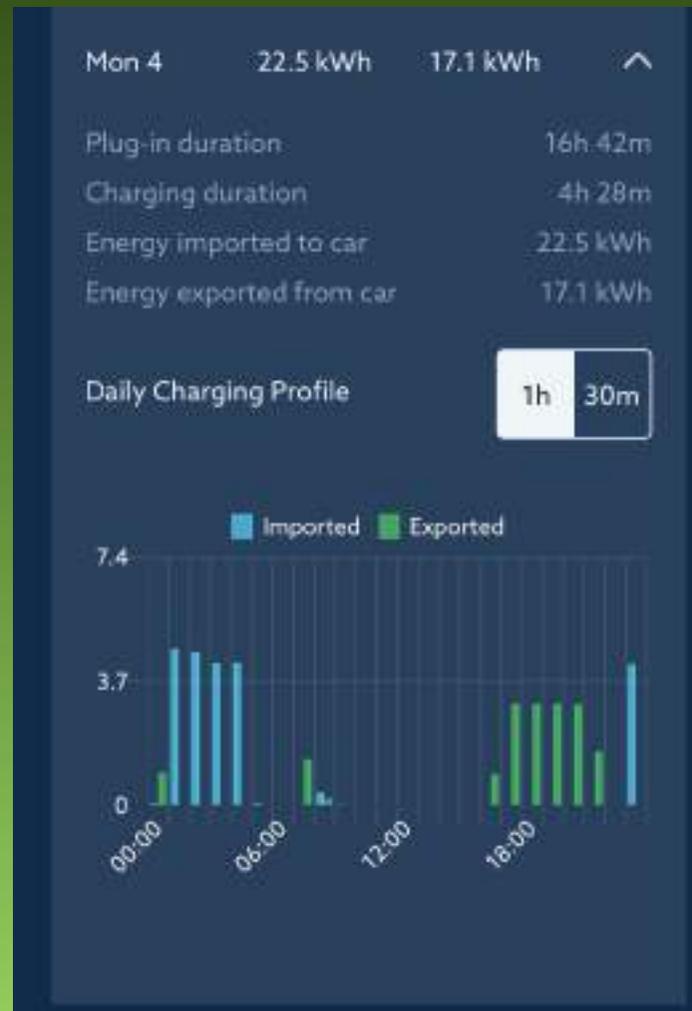
Vehicle-To-Grid
Vehicle-To-Home

Vehicle-To Grid | V2G

- Helps to balance the National Grid by storing power in EV's when demand is low, and feeding back into grid during peak demand
- This bi-directional capability was only available in Nissan EV's, as they are fitted with CHAdeMO chargers
- Two year trial that commenced in 2019
- Energy company/National Grid determines the timings for import/export
- Export can be overruled by the owner if EV is needed



Vehicle-To Grid | V2G



Vehicle-To Grid | V2G

Energy Bills

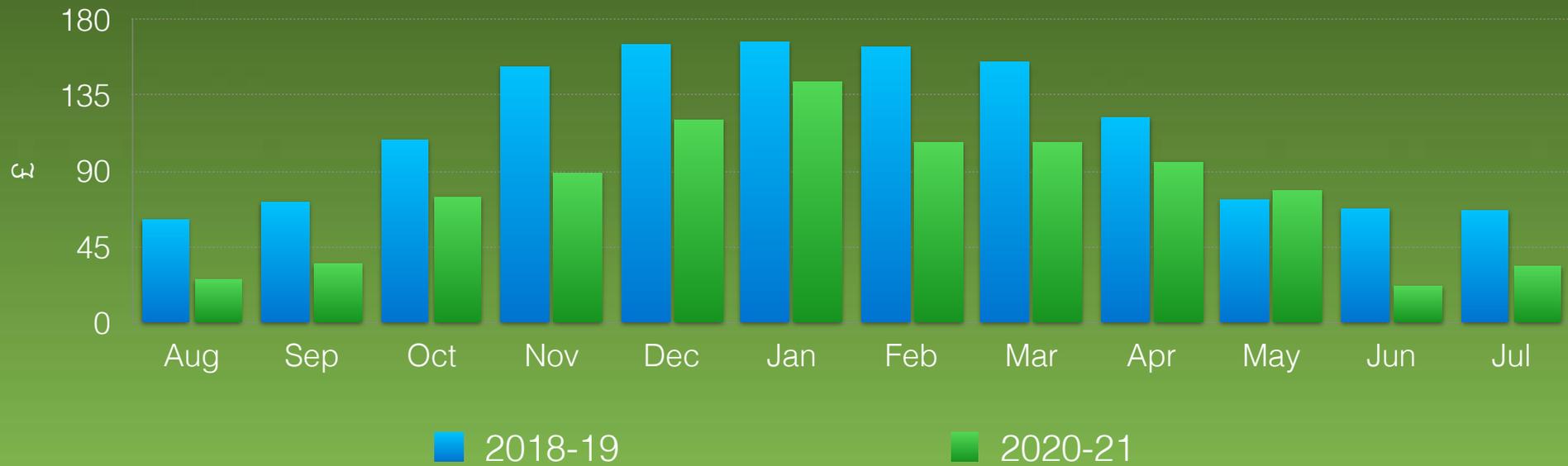


■ 2018-19

Total £1,372
13.5p kWh 20p SC

Vehicle-To Grid | V2G

Energy Bills



Total £1,372
13.5p kWh 20p SC

Total £927
16.9p kWh 27.4p SC

Vehicle-To Grid | V2G

Energy Bills



■ 2018-19

■ 2020-21

■ 2021-22

Total £1,372
13.5p kWh 20p SC

Total £927
16.9p kWh 27.4p SC.

Total **-£459**
13.7p kWh 28.1p SC

Vehicle-To Grid | V2G

THE SUNDAY TIMES



Paul Karstman sells energy he stores back to the Grid

'I save hundreds storing electricity in my car'

My Maxwell lives

Paul Karstman spends just £200 a month on his energy bills, even with the cost of charging his electric car.

— Karstman, 31, from Grafton, almost completely offsets his energy costs using solar panels that he stores in his car, and made an average of £100 a month last year by exporting it to the grid.

"I'm very environmentally minded so I chose an electric car," said Karstman, who signed up for a V2G (Vehicle-to-Grid) trial in 2019 that supplied him with a special charger that allowed him to harness power and sell it back to the supplier, OVO Energy.

— In the rest of the trial trial he takes the charger for a period and he continues to use it to store power from his solar power.

"I used a couple of miles a day. The rest of the time the car is somewhere being waiting but to have a massive battery so it doesn't die at the station."

— It's like the charger powers up his electric car while demand is at its highest point in his. When demand for electricity increases, excess energy from his car's battery is sent back to the Grid.

— He also switched his electric vehicle to a Smart Load that has a variable battery so that he could take part in the trial. He was already paying off his electric vehicle by installing solar panels and installing

— own solar panels from £20 to £300 a month, which has been going into the bank to make up the difference.

— "I'm not a car of paying people and requiring power, but the power meter is for light use," he said. He has been feeling the effect of spiralling prices, but the solar has helped.

— "I'm not receiving money as a monthly lease from the energy company, which is a little better. It has not yet been a very dramatic problem."

— The company says that he will have a £100 million during the cost of being able to get on, particularly for energy, due to their latest one when 2022.

— "I'm using the money for house repairs," Karstman said. "I've been out of work for 18 years so it's very difficult to be in, having this sort of thing is a bit of the money away."

— (AV) Energy is considering generating a profit in 2024. OVO Energy and British Gas have put similar trials.

“
My car has a massive battery. It was a no-brainer
”

Bloomberg UK
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Green | Greener Living

One Answer to Europe's Energy Crisis? More Electric Cars

Like soldiers in an electron battlefield, EVs en masse are great for storing renewable electricity and sending it back to the grid during peak demand.



Vehicle-To Home | V2H

- Energy from an off-peak rate (eg Octopus Go) or from solar is stored in the EV battery, then used to power the home, avoiding peak rate prices
- Trial starts late 2022
- User has control



Vehicle-To Home | V2H



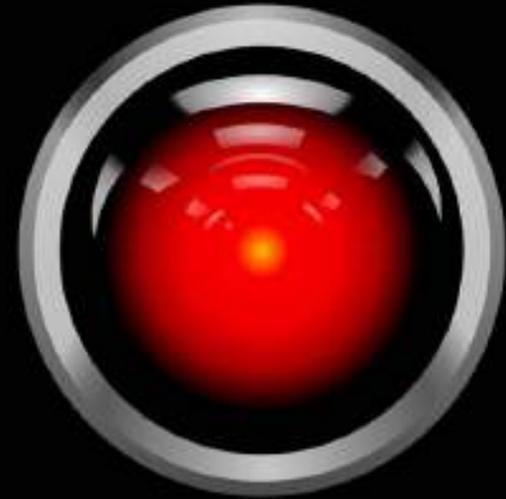
Vehicle-To Home | V2H



'Smart' Homes



HELLO DAVE ■



HELLO DAVE

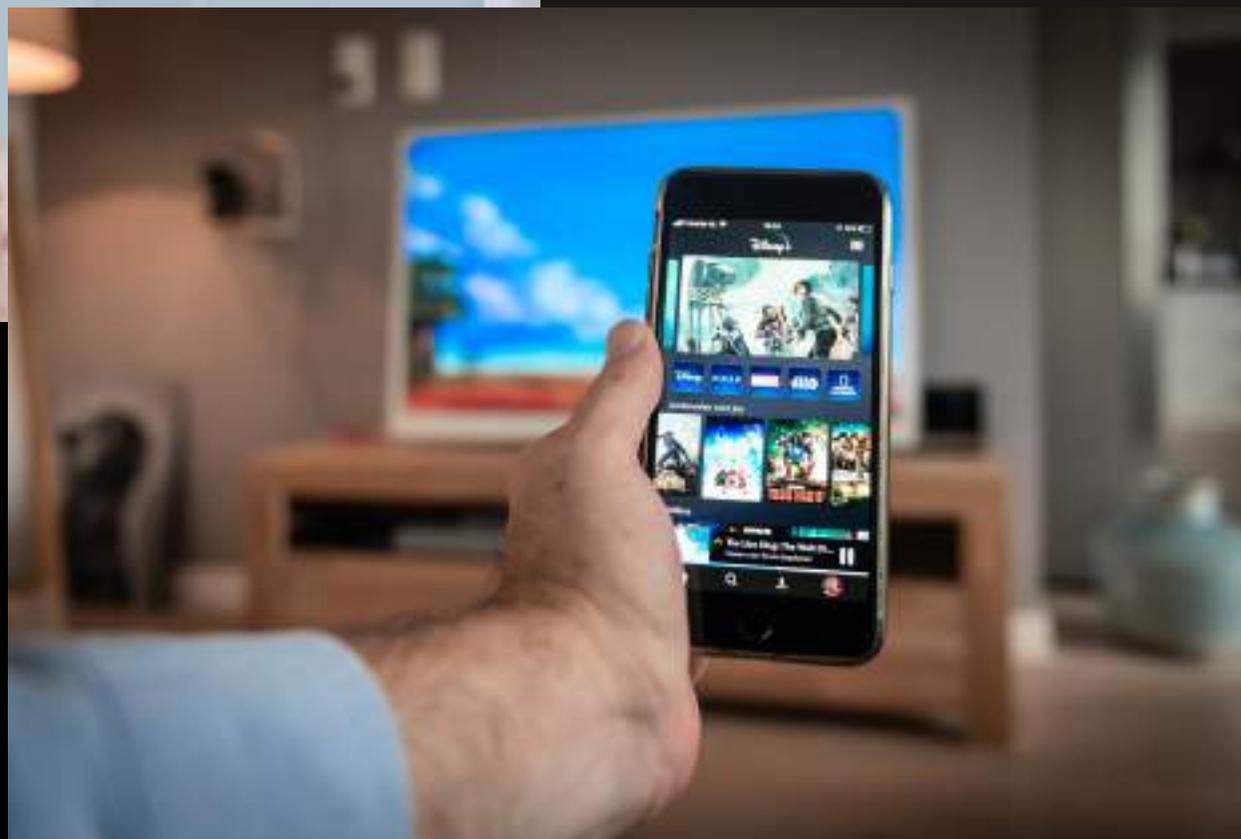


9000



NEXT GEN SECURITY CAM?

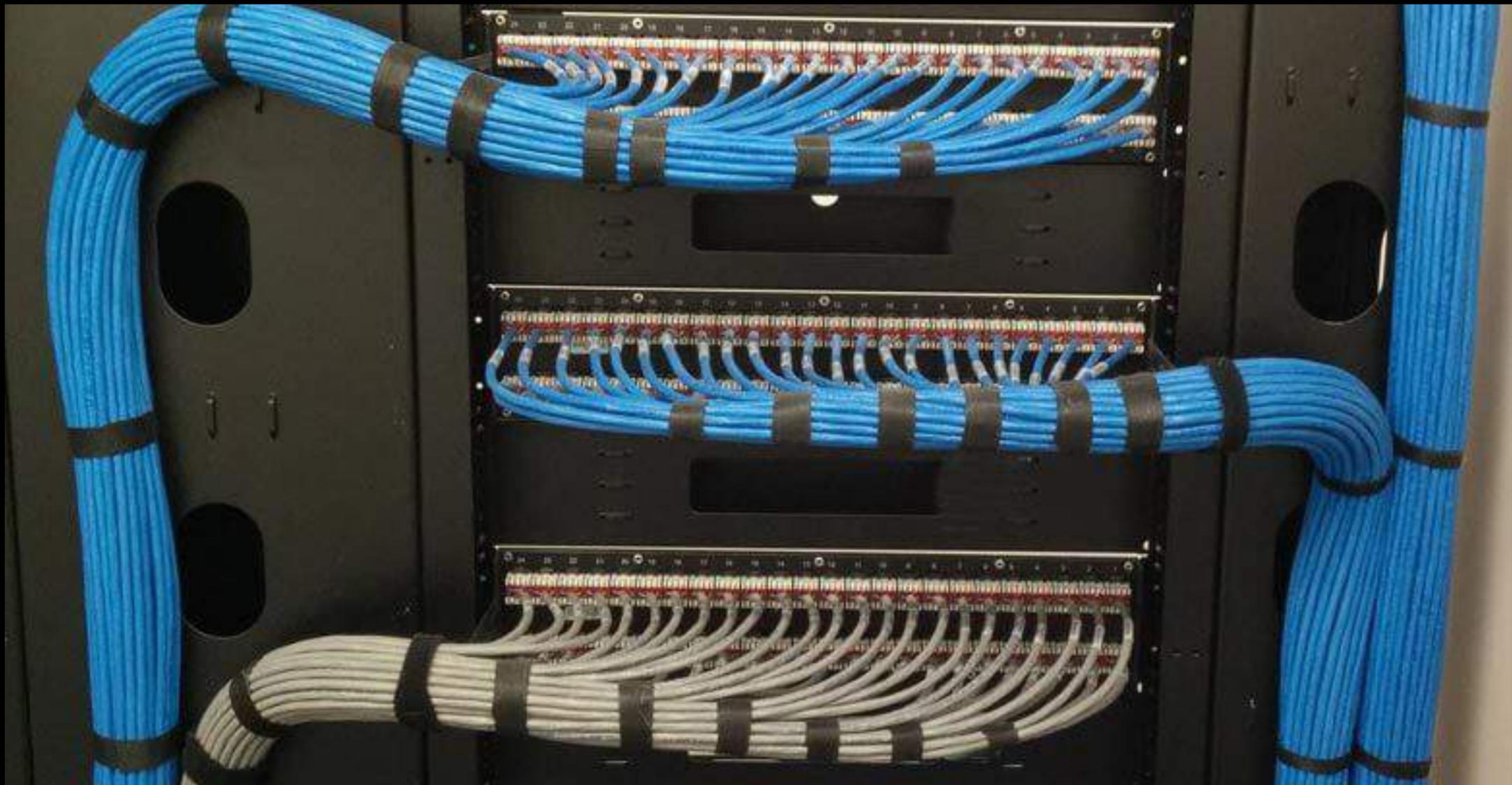




**XT GEN
URITY CAM?**





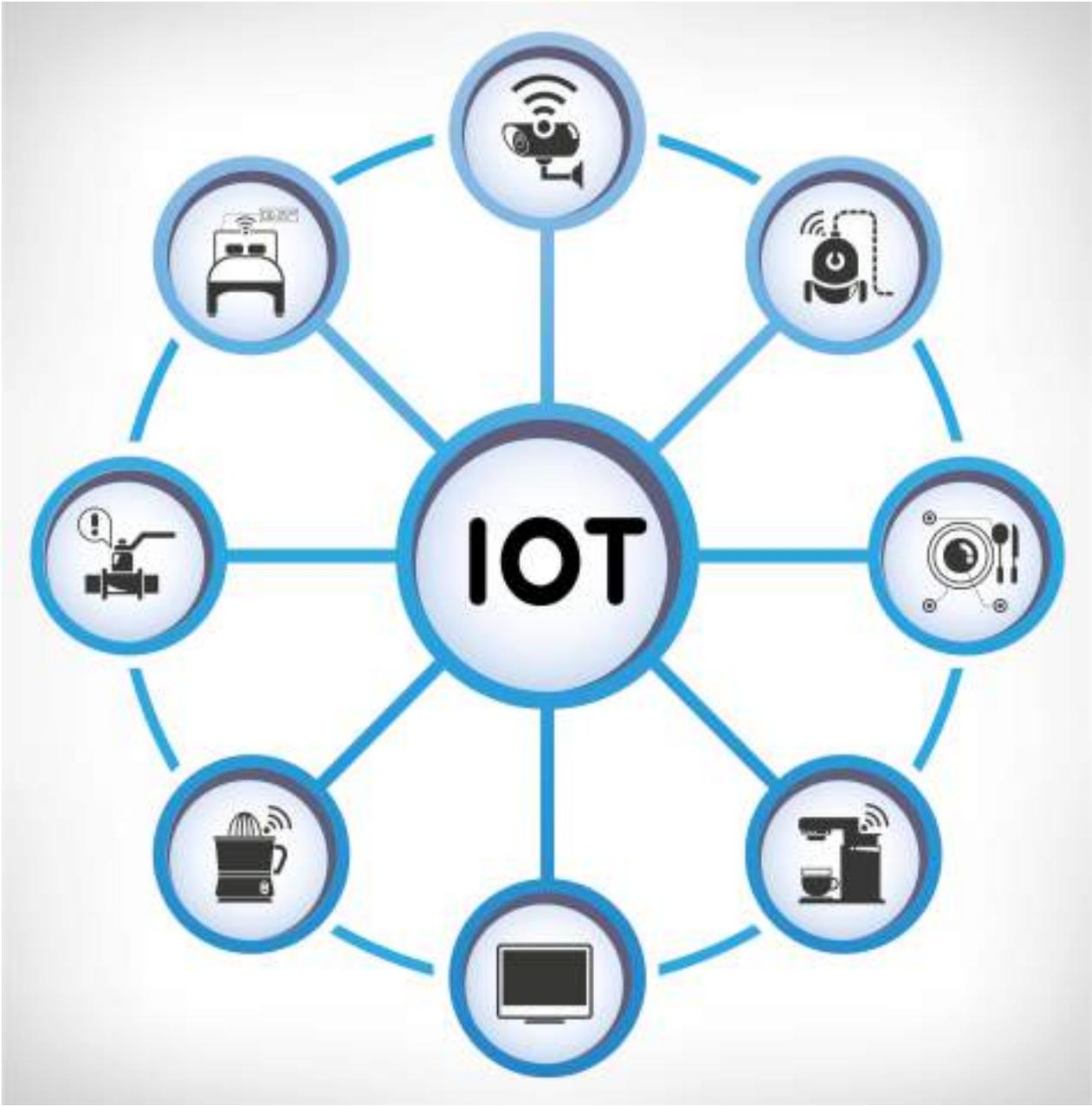


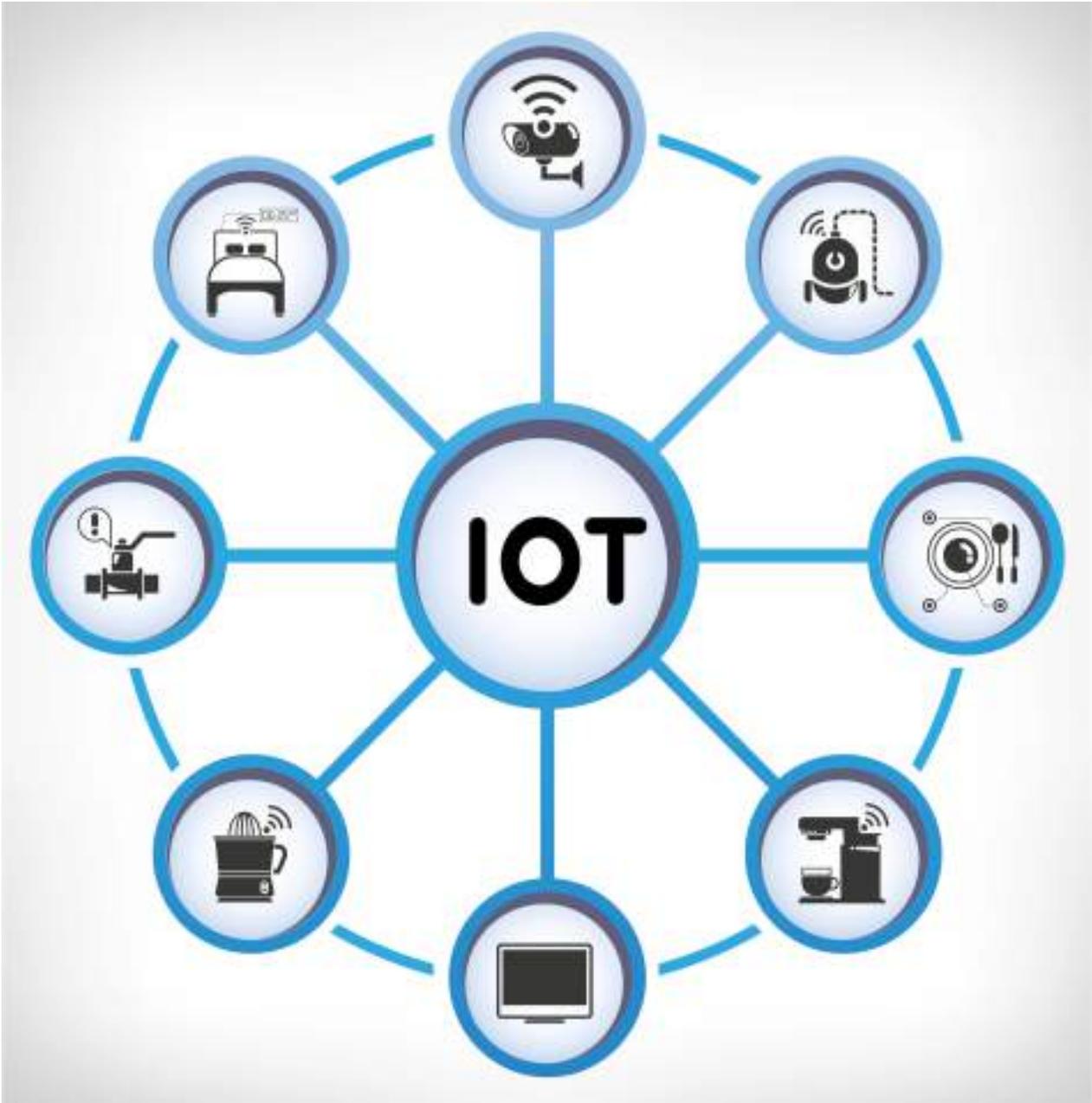


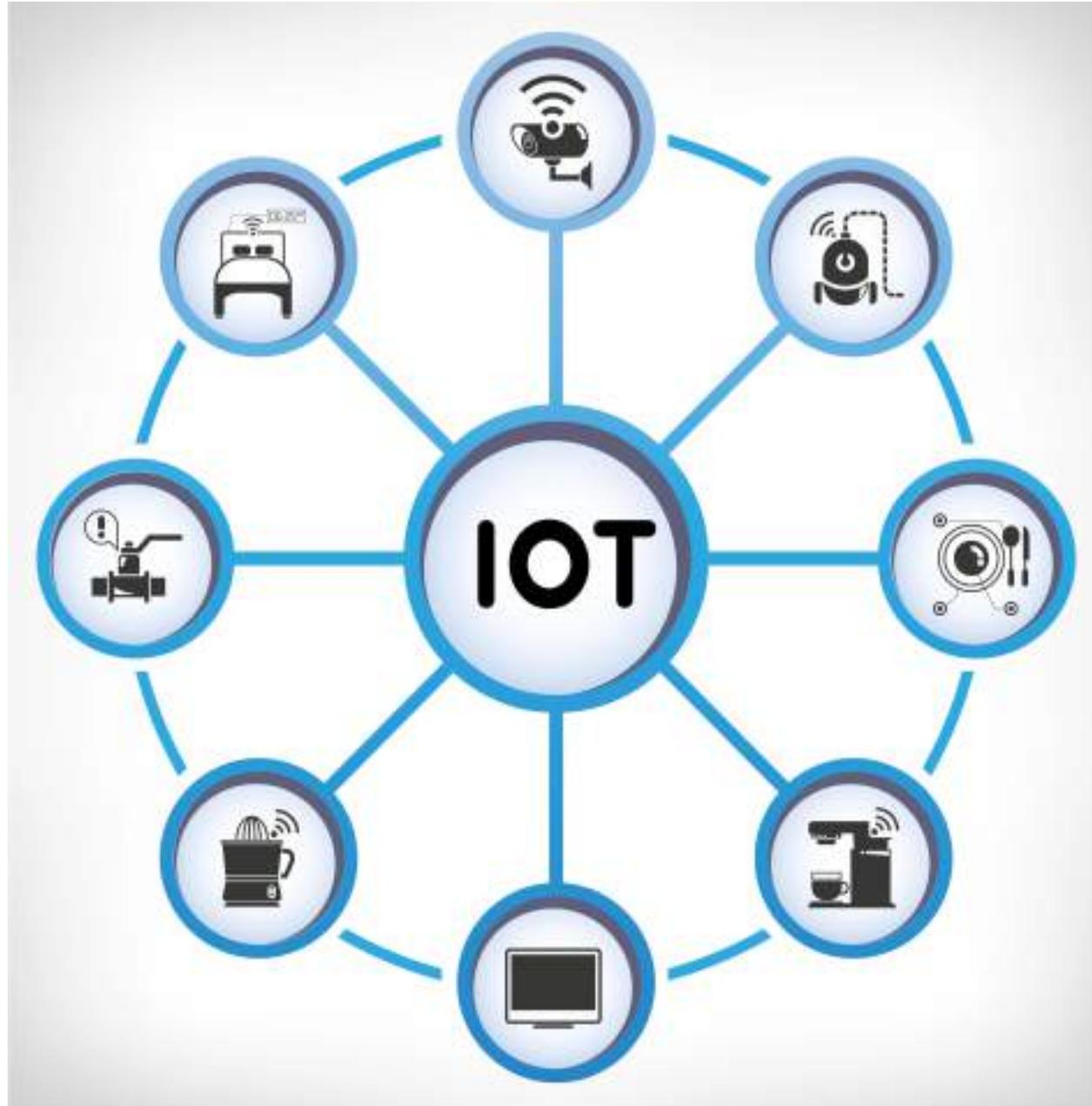












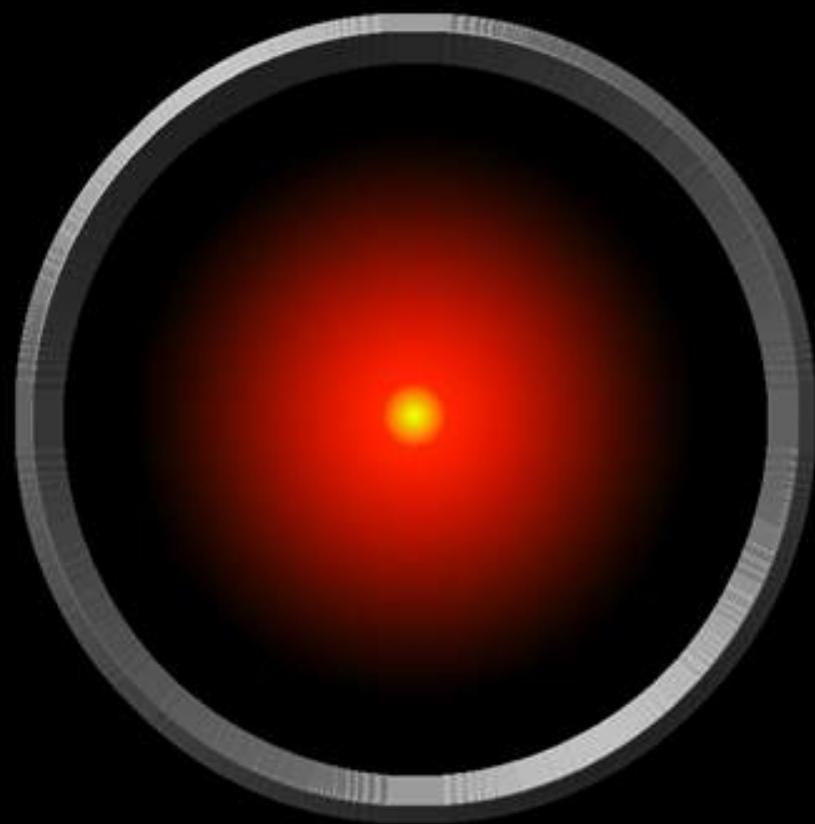




IoT



I'm sorry Dave,
I'm afraid I can't do that.



 H R E A D

 matter



#StopBurningStuff

**FULLY
CHARGED**

Conclusion

Educate yourself

- retrofit remains a niche, suppliers and trades are not ready

Plan

- work out what can be done as a stand-alone improvement, so that you can take advantage of any grants/deals if they become available

Stand firm to your values and ideals

- that's the path to contentment

ASHP

HOME VIDEOS PLAYLISTS COMMUNITY CHANNELS ABOUT

FULLY CHARGED SHOW

THE WORLD'S NO.1
ELECTRIC VEHICLE & HOME ENERGY SHOW

NEW EPISODES > EVERY TUESDAY & THURSDAY AT 3PM GMT | 9AM PST

THE GREAT EV GIVEAWAY
SUBSCRIBE > CLICK > ENTER
WE'RE TARGETING 1 MILLION SUBSCRIBERS



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CLEAN ENERGY

PREMIERE STOPBURNINGSTUFF
A SPECIAL EPISODE AHEAD OF THE UN CLIMATE CHANGE CONVENTION (COP26)
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Fully Charged Show
50K views · 1 year ago
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ASHP

HOME VIDEOS PLAYLISTS COMMUNITY CHANNELS ABOUT

#lessismore Heat  **Geek** **#nopanacea**

RENEW THE HEATING INDUSTRY

The seven SI units: _____
_____ is a measurement of _____ or **power** in an instant - calculated by energy/time
kWh is a measurement of _____ - calculated by power x hours

 **Heat Geek**
17.8K subscribers
SUBSCRIBED

Consumer Advice

			
11 Easy Ways To Reduce Your Energy Bills SAVE UP TO 51%! Heat Geek 55K views - 8 days ago	Heat Pump Questions You MUST Be Asking Consumer Advice Heat Geek 10K views - 7 months ago	What Size Heat Pump/Boiler Do I Need? Heat Loss CHEAT SHEET Consumer Advice Heat Geek 10K views - 7 months ago	How To MAXIMISE Your Heating Efficiency In 3 Simple Steps Boilers & Heatpumps Consumer... Heat Geek 21K views - 7 months ago

Our journey so far.....

How does home battery storage fit in?

Our journey so far.....

2010- new build redesign of internal layout.

2011- installed an ASHP and solar PV.

2013- case study on Open Eco Homes tour -

<http://openecohomes.org/wp-content/uploads/Aberdeen-Square-Case-Study.pdf>

2016 - purchased an EV - transition blog

2018 - review of outcomes by moving to 90% electric



Moving from 10:90 to 90:10

	Base - Long form EPC (assumes gas for heating)	Actual Performance (Av of past 3 yrs)
Energy consumption kWh/yr	2170 - Electricity- 10% 19450 - Gas	9135- Electricity - 90% 1000- Gas
kWh/m2/yr	82.2	38.5 (53% Improvement)
In home CO2 consumption Kgs/yr	4689	2463
KgCO2/m2/yr	17.8	9.4 (47% improvement)
Car Usage- Kg CO2(6000miles/yr)	1386	405 (70% improvement)

- *Excludes credit for exported PV and regional carbon content*

Our journey so far.....

2018 - Installation of SMETS 2 meter and use of TOU tariffs- initially the GreenEnergy Tide tariff.

2019 - Octopus Agile tariff (inbound & export) and in Aug 21 the Go Faster tariff- <https://www.octopus.energy>

2019 - Subscription to OctopusWatch App -

https://play.google.com/store/apps/details?id=uk.smarhound.octopus_energy_watch_edition&hl=en_CA&gl=US

2020- Participant in Carbon Coop Powershaper project - <https://carbon.coop/portfolio/power-shaper/>

2021 - Installation of the Homely thermostat - <https://www.homelyenergy.com/>

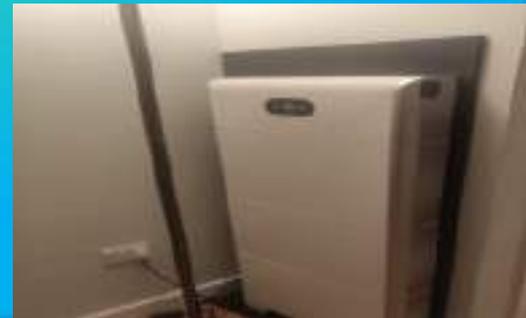
2022 - Invested in Ripple Energy wind farm 2 - <https://youtu.be/AbIF3kB4EtY>

2022 - Installation of a home battery system - <https://solar.huawei.com/eu/Products/FusionSolarResidential>

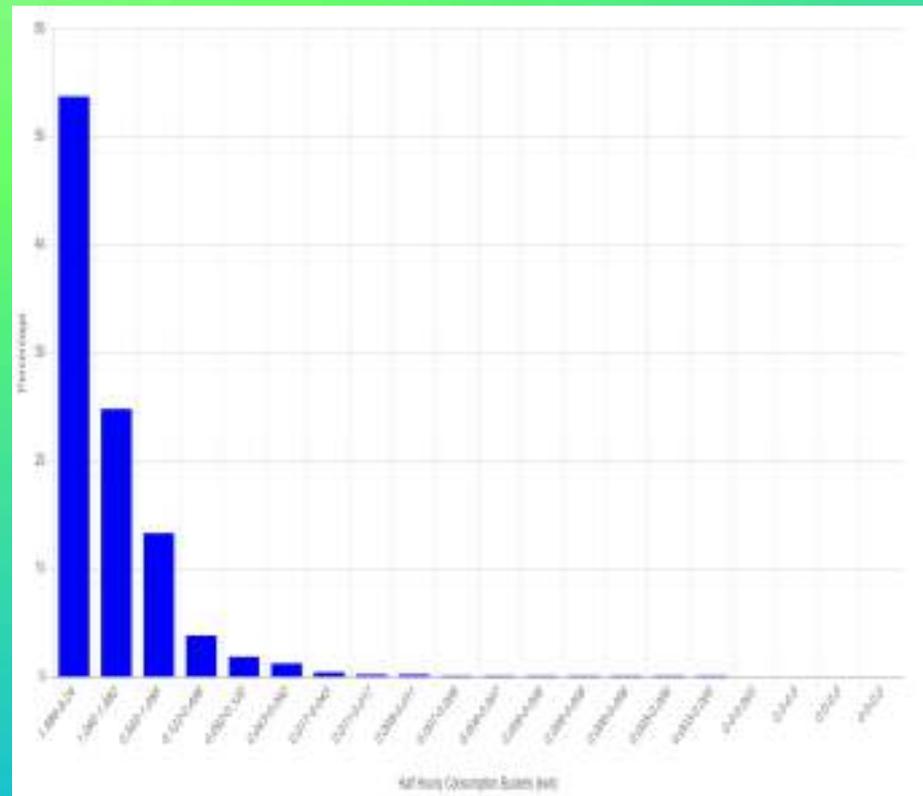
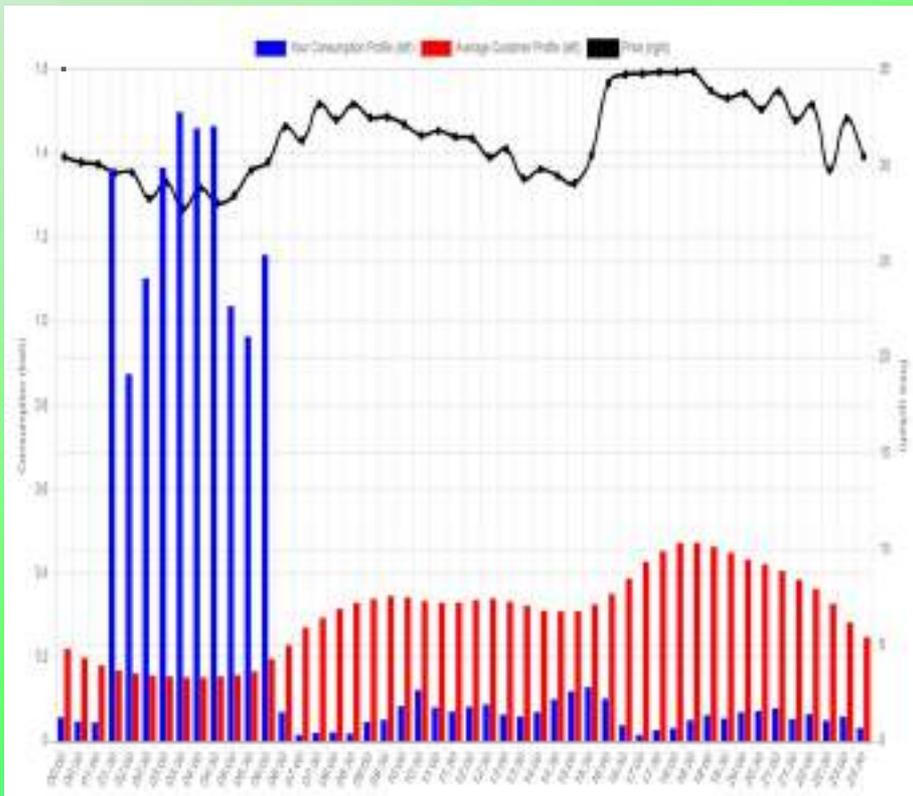
Installation of a home battery - when & why?

<https://transitioncambridgemediac.blogspot.com/2022/01/using-battery-to-save-carbon-emissions.html>

- Delayed purchasing until I had greater confidence about the correct sizing -dischargeable capacity and discharge/charge rates for the inverter.
- Motivation largely around the heavy winter demand for heating our home.
- Summer period essentially off grid
- Also in the summer period an opportunity force discharge later in the day.
- Supports grid balancing with associated carbon savings.
- Winter charging between 1:30 & 6:30 am with discharge from 6:30 -9:00am and after 4pm
- Will look to integrate the Homely in early 2023.
- Currently no plans to integrate EV charging with the battery.



Inbound electricity 02/22-07/22 (2640kWhs- 403kgs C02)

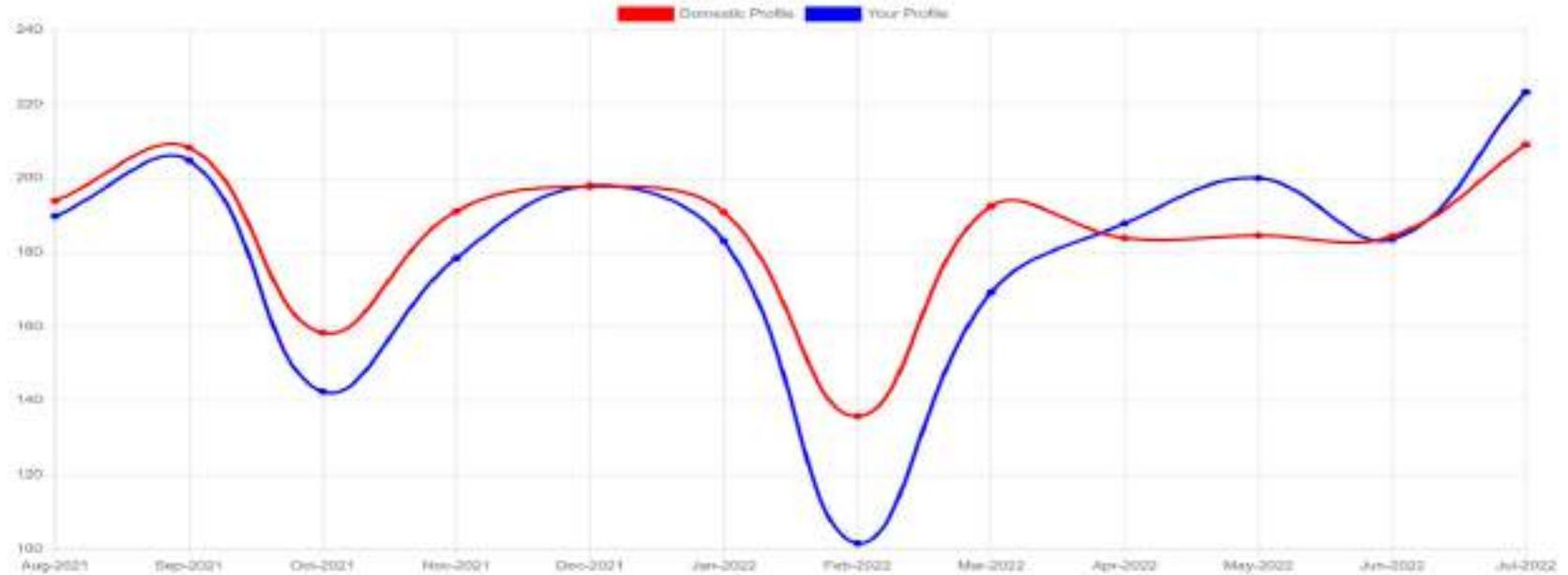


Monthly Carbon Intensity

All Months

Month: ▾

Carbon intensity for average domestic profile and this customer in g/kwh for each month:



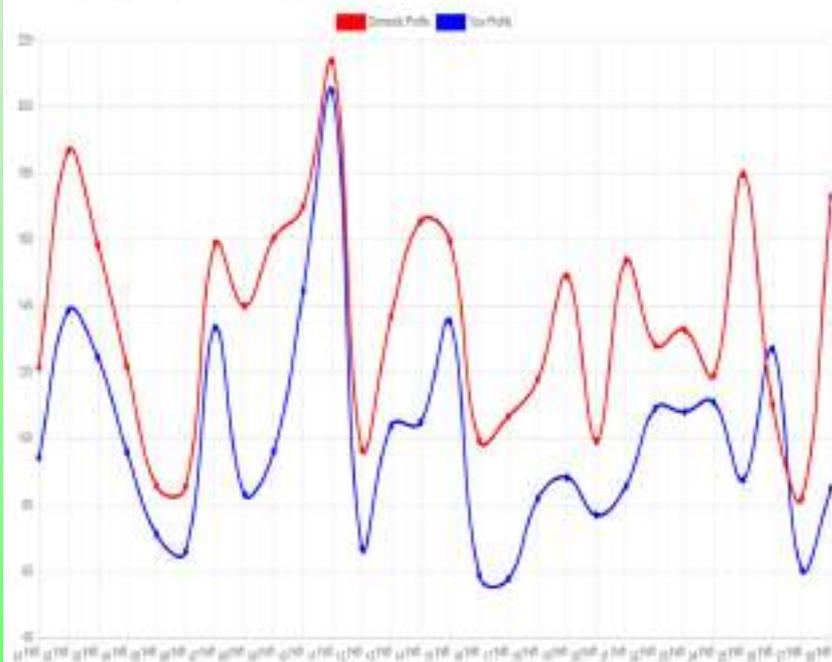
Average Domestic Intensity (g/kwh)	185.0
Your Intensity (g/kwh)	171.4
Your Consumption (kwh)	6324.3
Your Emissions (kg)	1083.8

kWh	163	143	294	607	1160	1411	972	762	539	153	104	110
Kg	30 (3%)	29 (3%)	42 (4%)	108 (10%)	<u>230 (22%)</u>	<u>258 (24%)</u>	99 (10%)	129 (12%)	101 (10%)	31 (3%)	19 (2%)	25(2%)

Daily Carbon Intensity for 2022-02

All Months February 2022 Day

Carbon intensity for average domestic profile and the customer is g/kwh for each day

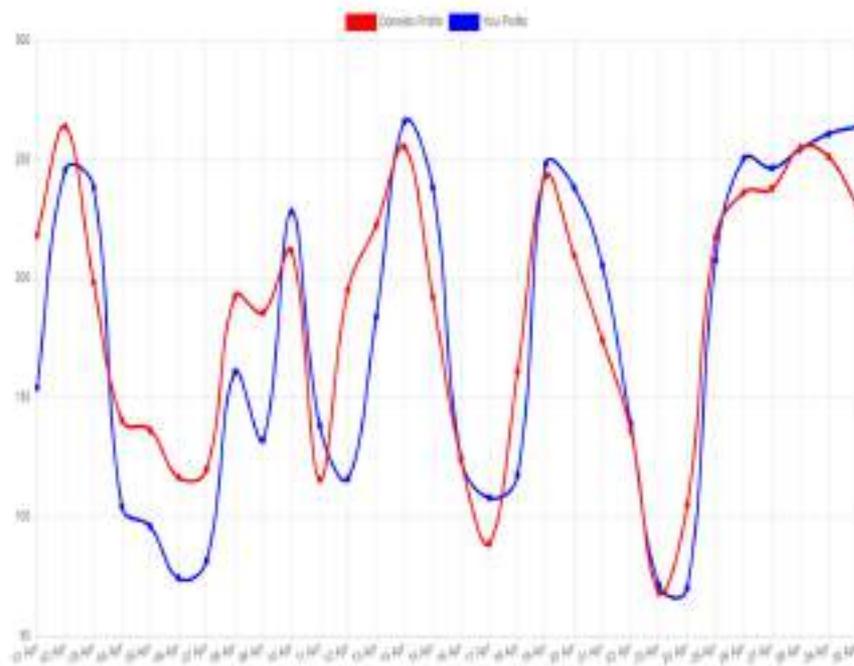


Average Domestic Intensity (g/kwh)	171.8
Your Intensity (g/kwh)	101.4
Your Consumption (kwh)	111.5
Your Emissions (kg)	11.7

Daily Carbon Intensity for 2022-04

All Months April 2022 Day

Carbon intensity for average domestic profile and the customer is g/kwh for each day

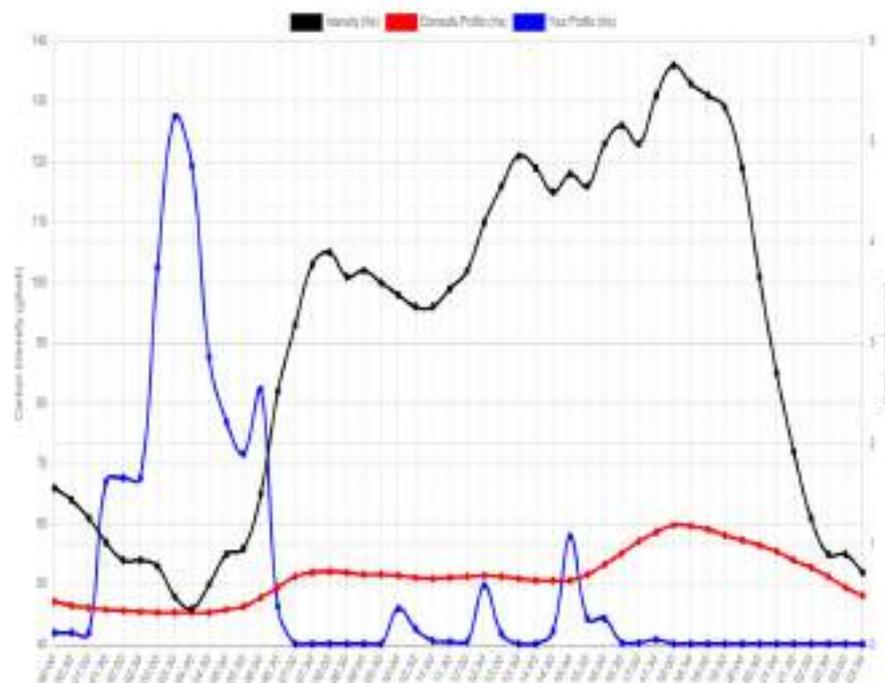


Average Domestic Intensity (g/kwh)	181.7
Your Intensity (g/kwh)	102.8
Your Consumption (kwh)	131.4
Your Emissions (kg)	13.1

Half-hourly Carbon Intensity on 2022-02-16

All Months Change Month: Feb 2022 Wednesday 16

Carbon intensity for average domestic profile and this customer in g/kwh for each half hour (dots are start times, in local time)

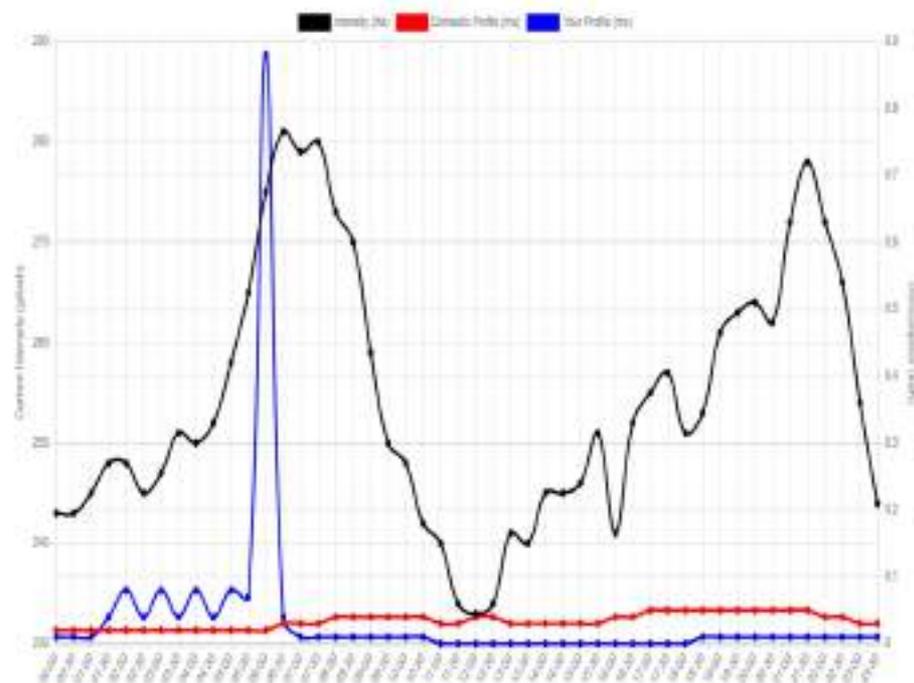


Average Domestic Intensity (g/kwh)	55.3
Your Intensity (g/kwh)	50.0
Your Emissions (kg)	1.01

Half-hourly Carbon Intensity on 2022-04-14

All Months Change Month: Apr 2022 Thursday 14

Carbon intensity for average domestic profile and this customer in g/kwh for each half hour (dots are start times, in local time)



Average Domestic Intensity (g/kwh)	25.3
Your Intensity (g/kwh)	234.3
Your Emissions (kg)	0.48

		02/22	03/22	04/22	05/22	06/22	07/22	10/22 first 5 days! 39% 132
GridMix	Wind	47 	26	25	24	25	21	
	Gas	15	34	42	49	43	50	
	Nuclear	17	20	20	21	23	19	
	Other	21	20	13	6	9	10	
Daily Import	kWhs	34.7	24.6	18.0	4.9	3.5	3.6	
C02 Footprint	kgs	98.7	128.9	101.4	30.7	19.2	24.6	
Achieved intensity	C02/kWh gms	100	170	176	183	183	208	
Improvement	%	20	10	(1)	(4)	0	(4)	

Homely is for anyone who needs a smart thermostat for a heat pump

<https://www.homelyenergy.com/homely-episode-features-on-fully-charged-plus-channel/>

Smart in the way it learns the home. Smart in the way it checks the local weather forecasts. Smart in the way it works with smart tariffs to ensure electricity is being used at the cheapest times. Smart in the way it delivers a cosy, comfortable home – all controlled via a smartphone app.

And the smart choice for the future with integration for EV, solar and batteries all coming online soon.

- Set the desired temp at times of the day and a +/- range that you are happy with for temp.
- Provide details of the TOU tariff that you on - eg Octopus Agile or Go, Good energy green heat or Economy 7



Home energy carbon statement- inbound electricity.

Carbon emissions reduced by a further 50% (965kgs) off 2016- 2018 levels through reduced demand (365 kgs) & improved content of supply (600 kgs).

- *Excludes credit for exported PV and regional carbon content additional 867kWhs for EV*

	kWhs	CO2 kgs	CO2 /kWh gms
Year to July 31'22	5500	943	171
3Yr Av 2016-18	7635	1908	250

With growing wind generated supply, home battery storage provides further opportunity to improve supply mix although my assessment of the scale is of the order of 250kgs/annum (late Oct-mid April) in the medium term.

‘ Squeezing the last drop of improvement at household level’.

Potential annualised run rate post battery & machine learning benefits of 30kWhs/m2/annum

My learnings so far:

Improvements in building layout have reduced demand and improved comfort in both winter & summer periods.

- ❖ Use of data generated from the smart meter provides greater confidence in decisions around battery storage, grid services and V2G take up.
- ❖ Demand & Supply side improvements are available from machine learning.
- ❖ Winter period creates an opportunity to discharge battery capacity to reduce carbon content of inbound supply.
- ❖ Summer period creates an opportunity to charge the battery from surplus PV and minimise grid supply.
- ❖ TOU tariffs can generate both financial and CO2 savings. Likely to become greater going forward and supports storage decisions.
- ❖ Pressing policy makers to speed up wind generation capacity (onshore & offshore) & storage remains critical to reaching net zero ambitions for the UK as a whole.

Investing in a home battery

- Are you on a time of use tariff with a SMETS 2 smart meter?
- What will the electricity demand be post electrification of heating and cooling (if necessary) of your home?
- Without electrification of heating - attractiveness of a battery significantly diminishes.
- If you are investing in PV then worth considering a battery due to the VAT inconsistency currently in place & supports an increase % of using own generated kWhs.
- Spread between low & high for both price and carbon intensity likely to widen over time.
- Is there an alternative pathway to access the benefits?

V2h or maybe a heat battery from Tepeo or Caldera

<https://tepeo.com/blog/2020/11/20/what-happens-inside-a-zeps-brain?>

Can you help us?

- Make a donation to help us run more Open Eco Homes tours:
cambridgecarbonfootprint.org/donate
- Share your experiences on social media: **#OEH2022**

Thank you for your support!



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Your next steps

- Find out how you can get started with your retrofit
- Book another tour or talk
- Research our past case studies
- Book a training session and borrow a thermal imaging camera
- Use Transition Cambridge's personalised home energy advice tool



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