Why don't we all switch to Heat Pumps?
(Neil Williams February 2019)

Everyone involved in TTL is very aware of the perils of Climate Change and the need to face up to the CO2 emissions arising from our own lifestyles.

I've long been an enthusiast for making houses more "low carbon" and past Lewes ECO Open House events have focussed heavily on improvements in insulation to try and reduce overall energy usage. However, whilst insulation is still important, the focus is now shifting toward low carbon heating.

This has led me to take the plunge to switch from a gas boiler to an Air Source Heat Pump(ASHP) at my own house in Lewes. I don't expect lower heating bills, but am doing it as a powerful way to cut my emissions at little or no net cost (1).

Improvements in heat pump efficiency and the impact of renewables on the electricity system mean that *replacing your gas boiler with a heat pump can cut heating CO2 emissions by two thirds!* As the grid is progressively decarbonised toward 2030 heat pumps will gradually become zero carbon.

Switching to a heat pump is one of the biggest impacts you can have on your household carbon footprint.

The Committee for Climate Change, which sets Carbon Budgets for the government, has long been recommending heat pumps as the only feasible low carbon heating but their advice has largely fallen on deaf ears (2). Governments seem to think gas is fine and there is plenty more to be fracked...

The up front cost to convert is around £7/10k, but this can be offset by the government's Renewable Heat Incentive(RHI) grant over 7 years (3). The cost is more if your house is bigger or doesn't have an existing radiator system (eg if you have storage heaters), but in that case there would be big savings in running costs.

Unfortunately heat pumps are not well publicised and there are also a lot of myths that have undermined confidence and discouraged uptake. I've listed a few of the main ones below:-

"Aren't heat pumps only suitable for off gas grid houses in the country?"
The assumption here is that heat pumps are cheaper than oil and storage heaters but more expensive than gas.
Whilst heat pumps are much cheaper to run than oil and storage heaters, improved efficiency means that they are getting close to gas.
Unfortunately in the UK currently all the carbon taxes fall on electricity but none fall on gas. This unfair gas subsidy has been identified by the Committee on Climate Change(CCC) as being unsustainable and there is a lot of pressure for change (4).

"Gas is more eco than electricity isn't it?"
Not when it comes to heat pumps. Heat pumps use electricity but get most of their heat free from the outside air. They are virtually solar powered, as the sun ultimately does most of the heating.

Because of this, the CO2 emissions of the heat produced is very small at around 70g CO2/kWh. Gas heating is far more polluting and emissions for gas heating are around 260g CO2/kWh (5), i.e *more than three times as much as heat pumps.*

Over the last five years electricity has become far greener and CO2 emissions from its production have more than halved (6). Heat pumps run on electricity which is the fuel of the future.

You may have recently seen in the media (7) CCC's recommendation that there should even be a ban on connecting new homes to the gas grid within six years. Low carbon heating such as ASHPs should be used instead.

How can you take heat from the air when its freezing outside?
I know it sounds strange , but ASHPs suck heat from the air even in sub zero conditions. They work like a fridge in reverse, taking energy from the outside air and using it to run the heating and hot water systems.
Many ASHPs even have outside temperature sensors which tell them to produce hotter water in cold weather to meet the extra demand. They use a little more electricity in very cold weather but this is taken into acount in their overall efficiency rating, or SCOP.

"You need a modern highly insulated house for heat pumps to work"
No, you just need good insulation of the loft, filled cavities (if you have them) and ideally double or secondary glazing. If a heating system is designed properly to meet the house's peak heat demand it will work well whatever the heat source.
A reputable installer should not recommend a heat pump if it is not suitable for the property.
I have just replaced my gas boiler with an ASHP in my leaky 18th century end of terrace house in central Lewes and it works really well.
Lewes council has already fitted 280 in social housing around Lewes and Guildford council are fitting 500. This is in existing housing stock and the heat pumps more than halve heating costs for tenants used to storage heaters.

"Heat pumps only work with underfloor heating"
It is true that underfloor heating is ideal for any heating system, but heat pumps work well with radiators too. The installer will calculate heat loss from each room and advise if any radiators need to be altered. I changed only two of mine.

"Heat pumps are noisy"
New super quiet units such as Mitsubishi's Ecodan make hardly any noise (8). Other makes are more audible but the problem has been exaggerated.
My ASHP is outside the bathroom window at first floor level. When it is running I generally can't hear it inside even though it is only one foot from the window. It is only just audible during very cold weather when the pump runs at top speed.
If I stand outside my house I can't hear it as it is drowned by the distant road noise from the A27!
If you have concerns ask to visit an installation to hear one running or even visit mine.

"Heat pumps have a bad reputation don't they?"
In 2008 the Energy Saving Trust carried out field trails of early heat pump installations which revealed poor practice (9). Unfortunately, this was wrongly interpreted as blaming the technology, even though the reports made it clear the problem was bad design and careless installation by plumbers unfamiliar with heat pumps.
This led to a major industry shake up with strict regulations imposed for design, installation and commissioning. This included detailed heat loss calculations for each

room and expert advice on unit sizing and radiators. All installers must meet these standards to get MCS certification necessary for the RHI grant.
Every industry has its rogues, but poor installation is now largely a thing of the past.

Practical considerations
Heat pumps can either take their heat from the ground(GSHP), via buried pipes or boreholes, or from the air(ASHP). In urban settings I suspect the only practical solution is an ASHP. However, if there is a lot of outside space a GSHP may be feasible, albeit quite a lot more expensive.

You obviously need to have room for the unit, normally at the rear outside. Mine is around 1m square and 400mm deep and looks like an air conditioning unit. This can be either on the ground or hanging off a wall, as mine is. Installers can advise about location when they quote.

There is a fairly high cost up front which may not be possible for all, even with the RHI grant.
The running cost will also likely be higher than gas due to the current differential in gas and electricity prices. In my case it is £100-150 pa. Personally I feel this is a small price to pay for such a big carbon reduction, but I appreciate circumstances differ.

Ultimately all houses are different and anyone interested will need to get expert advice from installers based on their individual house and system before making a decision. If you have a recent EPC the engineer should be able to project likely RHI sudsidy. They should also be able to advise on any planning issues.

In terms of heating experience, heat pumps radiators aren't as hot as gas but run for longer. The house gets just as warm even though they deliver heat in a slightly different way. For me the main difference is starting up an hour earlier in the morning.

If anyone is seriously thinking about changing to a heat pump I would be happy to show them my installation and share my own experience. Best to contact by email neil.hove@gmail.com.

Local firms I know with experience of fitting heat pumps are listed below. This is not a recommendation as such and names are given for information only. Of course there will be others equally competent if you do further research.

BSW - Burgess Hill
DH Solar - Lewes
A Greener Alternative - Shoreham

References

(1) My own costs give a worked example:

ASHP installation and radiator changes £7200
Renewable Heat Incentive grant £319.04 per quarter for seven years = £8933.12
(this is based on my EPC and yours may be different)
Additional running cost vs gas £100-150 pa

Overall I get £1700 more RHI than cost but will pay £100/150 pa extra for heating. However, government will presumably have to act to remove the gas subsidy eventually so the extra cost may be temporary.

Estimated annual CO2 emission saving 1.5 tonnes. This is a massive reduction with virtually no net cost.

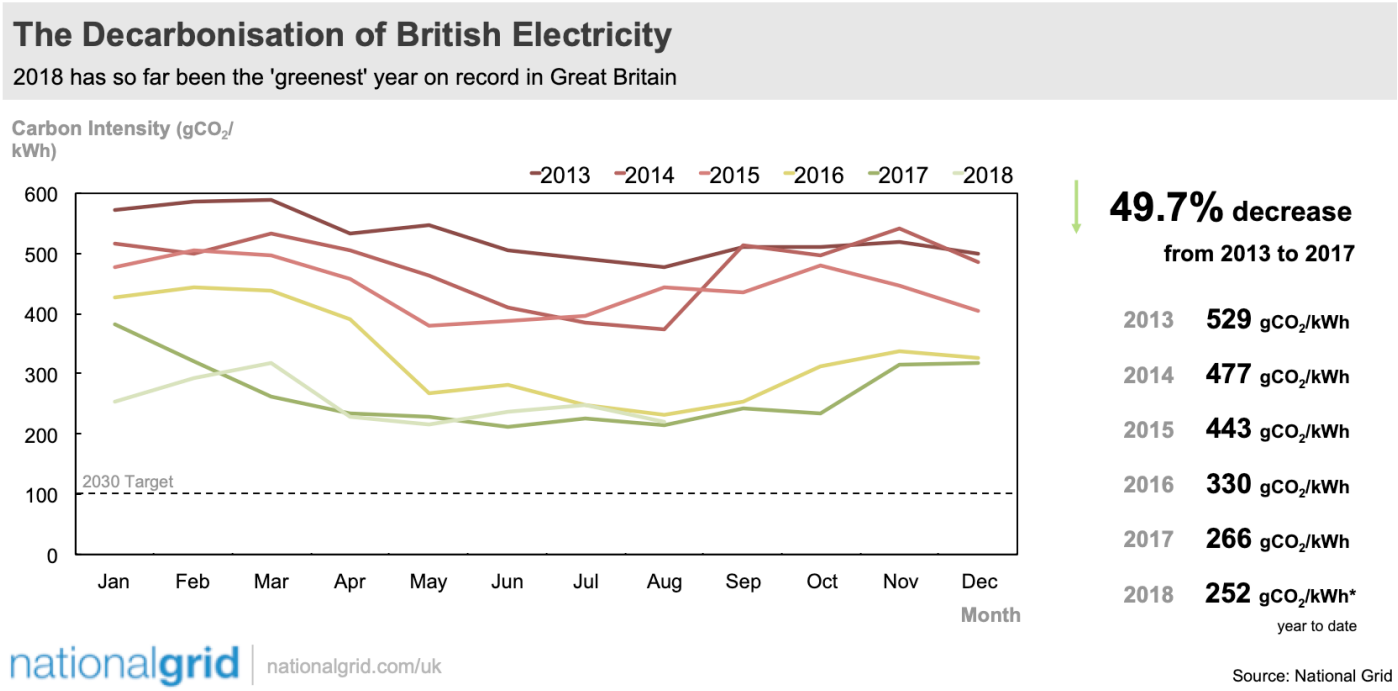
(2) Committee on Climate Change June 2018 Progress report to government.
Downloadable from:
https://www.theccc.org.uk/wp-content/uploads/2018/06/CCC-2018-Progress-Report-to-Parliament.pdf
Chapter 3 Buildings
p.85
"Low carbon heat - Deployment of low-carbon heat (e.g. heat pumps and low-carbon district heating systems) should be prioretised"
p.86
"Strategic decisions in the long term - The current reliance on natural gas is incompatible with long term decarbonisation. Key strategic decisions will be needed in the early 2020s on low carbon heat for properties on the gas grid, especially those outside heat dense areas. The main options for these properties are heat pumps and low carbon hydrogen"

My note - Low carbon hydrogen is still in the theoretical stage and only heat pumps are actually available now.

(3) Ofgem Domestic RHI website - many explanatory documents can be downloaded from:-
https://www.ofgem.gov.uk/environmental-programmes/domestic-rhi/about-domestic-rhi

(4) Committee on Climate Change June 2018 (as above)
p.104
"Heat pump sales stagnate most likely due to the up front cost barrier.... and the relative prices of electricity and gas.
Electricity prices are high relative to gas prices, with the difference being exacerbated by the lack of a carbon price on gas and the cost of climate and social policies being loaded onto electricity bills."

(5) National grid data on emissions from electricity generation provided by Dr. Alasdair Bruce, Data Scientist National Grid



ASHP CO2 Calculation
Using figures for last complete year, 2017, electricity emissions were 266g CO2/kWh.
MCS SCOP for Ecodan 8,5kW unit is 3.86 @45 deg flow.
Carbon content of heat produced = 266g CO2/kWh / 3.86 = **69g CO2/kWh**

Gas boiler CO2 Calculation
Latest SAP figures for natural gas emissions are from SAP 2016 (draft) 208g CO2/kWh
Assuming gas boiler working efficiency of 80%
Carbon content of heat produced = 208g CO2/kWh / 80% = **260g CO2/kWh**

(6) See table in (5) above.

(7) BBC article available at
https://www.bbc.co.uk/news/science-environment-47306766

(8) Mitsubishi website has lots of info. Also videos on youtube.
https://les.mitsubishielectric.co.uk/homeowners/our-heat-pumps

(9) EST: August 2013. The heat is on heat pump field trials phase 2. Downloadable from:
https://www.energysavingtrust.org.uk/sites/default/files/reports/TheHeatisOnweb%281%29.pdf
This report refers to data from original trial in 2008 and follow up in 2013. Phase 2 showed big improvements and modern units are even better.