Wirksworth Transition

Transition Chesterfield

Eco-homes workshop
Low carbon heating with Air Source Heat Pumps
Saturday 7 November 2020

Organised by Transition Chesterfield, Transition Wirksworth and Derbyshire Climate Coalition
With Laura Bishop, Anne Thoday, Peter Robinson, Brian Hebron, Kevin Mann and Graham Truscott

Introduction

The vast majority of us use gas boilers to keep our homes warm and provide hot water. But, given around 20% of UK carbon emissions are created by heating buildings, we need to find a better, greener way to heat our homes. Air Source Heat Pumps (ASHPs) are one of the leading renewable alternatives for heating homes. They extract heat from the outside air to heat your home and hot water, even when air temperatures are as low as -18°C.

This was a virtual workshop with a renewable energy system designer from Infinitas-Design who did a short introduction to the technology, and five owners from across Derby and Derbyshire who have replaced their gas boilers with ASHPs. The owners talked about their ASHP systems and experiences as well as answer any questions, including type of ASHP, cost, ease of installation, whether they had to do anything to their house beforehand, and the pros and cons. Notes of the workshop follow. A recording of the workshop can be found here: https://www.youtube.com/watch?v=q8pq_dHze2E&feature=youtu.be

Laura Bishop, Infinitas Design http://infinitas-design.co.uk/

Laura is an engineer and designer of renewable heat systems and also Chair of the Ground Source Heat Pump Association who gave a short introduction to ASHPs:

- ASHPs are essentially electric heating, with efficiency >100% as they use free energy (heat) from the air and combine with electrical energy to provide hot water and heating. They look like an air conditioning unit and sit outside houses. Size can range from 2kW to >2MW. They provide heating, hot water and cooling.
- The advantage is that there is no combustion (no air pollution) and potential for zero carbon emissions with renewable energy.
- You need a hot water cylinder to store the hot water (so if you have a gas combi boiler you need to get one).
- Need to watch out for COP (Coefficient of Performance) which measures efficiency, but because efficiency changes with the seasons then also important to look out for SCOP (Seasonal Coefficient of Performance). For an ASHP with 3 units of energy in from air, and 1 unit of energy in from electricity to give 4 units of energy for heating and hot water is equivalent to a COP of 4 (3+1).
- Laura gave an example of what it may look like for someone switching from gas to an ASHP. Eg a 1970s 3 bed detached house with a 26kW gas boiler uses around 15,000 kWh/y gas at 3.4p/kWh, costing £591/y and producing 3 tonnes/y CO_2.
- An ASHP for the same house would cost around £625/y and produce 0.9 tonnes CO_2 (70% saving - this includes the carbon from the electricity and will be lower when the electricity grid becomes more renewable). However to offset the costs you can claim a Renewable Heat Incentive (RHI) government scheme. which runs for 7 years but which ends March 2022 which provides a set amount of money. For this system is would be £1175/y. This offsets both the operating and capital costs.
- For someone on gas the savings aren't massive but the big positive is the massive reduction in carbon.
- Ways to save costs include using flexible electricity tariffs or intelligent tariffs (if there is a lot of surplus grid electricity the grid makes it cheaper at half-hourly intervals), or provide a bigger

thermal store to use the ASHP to generate heat when electricity is cheap, or install solar PV and run the ASHP when the sun is shining (but need water cylinder/thermal storage to store).

Anne Thoday (Chesterfield)

Type of ASHP: Mitsubishi Ecodan Ultra Quiet. 8.5kW – produces very quiet, gentle hum (cant hear from inside kitchen), advertised at 45 decibel at 1m and operates at temperatures down to -20C
When installed*:* 18 months ago
Reasons for installing: Sustainable energy source
Size and location: 1m H x 1m W x 0.5m D outside kitchen, a short distance from the wall
Type of house: 1940's 2 bed bungalow, fairly well insulated
House alterations needed: needed some radiators replacing as need bigger ones for ASHP. The widest are 6 inches wide but you can get slimmer ones though they cost more. Also needed water tank. It took 2 days to install. Pump and workings are in a cupboard in the loft.
Costs of ASHP and installation: whole system cost £12,400 including pumps and installation. Had to have survey of the house to calculate size and if insulation was adequate. They tool out a loan but the RHI offsets the costs and pays £393 per quarter plus £28 for meter/monitoring – over 7 years this covers the cost of the loan.
Installer: Greener Living – good at advice and installing but not helpful with follow up advice so took a while to set up the RHI grant and dealing with running the system
Costs of running system: Think bills are cheaper but hard to say as also have solar PV and electric car. Over 24 hours estimates it cost around £4 to heat house to 21C.
Pros: Green, very quiet, fitting was easy, and works really well for heating and hot water (never run out). Prefers heating to gas heating. ASHP feels like ambient heat – much more constant gentle heat.
Cons: Box unattractive and difficult if you don't have much space. Creates a draught (can kill nearby plants!)

Peter Robinson (Derby)

Type of ASHP: Vaillant – top of the range system, from Belper.
When installed: summer 2020
Reasons for installing: Mainly because lower carbon footprint – saves 2 tonnes Carbon (from an average carbon footprint of 12 tonnes)
Size and location: In alley at side of house. Because alley is narrow had to raise 12 feet off ground.
Type of house: semi-detached
House alterations needed: Radiators needed replacing
Costs of ASHP and installation: £13,000 including all replacement radiators. Got a loan for £10,000.
Installer: FDG (based in Nottingham). Good at helping with grant but not installation (original one fell down when installing)
Costs of running system: Bills have gone down but only had since summer and waiting to see winter costs. Projected to cost £200/y
Pros: Love the radiators and the warm, gentle heat.
Cons: the hot water in the tank runs out after a bath and takes a long time to heat up again. Hot water is too hot (needs to be 60C due to legionella). Don't like the hum.
Tip: Don't wait until your gas boiler breaks down – do a lot of planning and preparation in advance

Brian Hebron (Wirksworth)

Type of ASHP: Daikin Altherma with dual source heating (2 coolants – one heats the 2nd coolant to increase water temperature for hot water to 80C. At time most ASHPS used electricity to get the temperature up and Brian didn't want that). The company that installed it has since gone out of business. [Daikin are still going with the Altherma range]
When installed: 2012
Reasons for installing: Reduce carbon footprint.

Size and location: ASHP including feet: 1.45m H x 0.35m D x 0.9mW. Hot water and expansion tank in garage (well insulated): 0.73m D x 0.6m W x 2m H.
Type of house: 1970s Bungalow – EPC F when first bought but moved to EPC C after they insulated and then installed solar PV and ASHP. Important to insulate first. When insulating it's critical to do it in a planned way so that you are never prevented from insulating further. Brian hoped for EPC B but discovered the house had not been built to the then building standards. The cavity wall is 10 % less than it should be. The footings on one side had given way, leading to damp penetration and water pools under the floor.
House alterations needed: Brian was installing underfloor heating, photovoltaics and solid floors [also aimed at stopping damp penetration] at the time
Costs of ASHP and installation: £12,500, including concrete base and plumbing. Radiators and photovoltaics billed separately
Installer: Local plumber (since retired)
Costs of running system: Make a profit on power, ASHP plus photovoltaics as on max feed in tariff, but not self sufficient in energy. The 7 year RHI has now run out but was providing £475/quarter
Pros: Very pleased with the system and would do it again. No loss of coolant. They have never run out of hot water, even when they have guests staying and say at least 3 showers per day.
Cons: Main issue is with control system. The installers recommended control system has 5 time intervals over 24 hours but often find they don't have the heat and hot water at the right time. However they just press a button and it takes 20 minutes to heat.

Kevin Mann (Wirksworth)

Type of ASHP: Mitsubishi Ecodan 8.5kW (like Annes). Selected because of noise (v quiet). COP of 3.2
When installed: 10 years ago before the cold winter in Dec 2010 when temperatures dropped to -18C and it still worked (though COP efficiency would have been lower)
Reasons for installing: Main priority was a warm house
Size and location: Kevin lives in Wirksworth in a frost pocket. ASHP is outside his house, Southwest facing, under cover (see picture). Kevin's hot water cylinder is in the centre of the house to provide warmth (acts as airing cupboard)

Type of house: 1960s bungalow which was gutted and refurbished before installed ASHP. Well insulated – used eternal insulation and cladding and installed underfloor heating.
House alterations needed: Didn't need new radiators as it's all underfloor heating which is far better in dissipating the lower temperatures generated by ASHP. Also insulating including external wall insulation reducing cold bridges.
Costs of ASHP and installation:£3500 for ASHP and £1500 for installation. Including underfloor heating total < £7000. Eligible for RHI grant – received total £4000 so the balance was £2800, the same as for a new oil condensing boiler.
Installer: System supplied by ICE energy (large company since gone bust) and installed by local plumber, who was very skilled but it was the first time he'd installed one and found it difficult. They found another plumber from far afield who fixed the problems and since then have had few problems.
Costs of running system: Bills £115/month (all heating, cooking) but this is for a large house and holiday let – and house is very warm. Have timer on thermostat to heat up to 60C once a week due to legionella. The expansion tank generally needs replacing approximately every 4 years.
Pros: Underfloor heating works brilliantly with ASHP and can allocate heating in different rooms. Servicing very simple – 3 services in 10 years – tends to be a bit more expensive but over time this will come down as get more experienced engineers.
Cons: Should have had a different system of run of pipes for the bathrooms linked to the bedrooms (as they don't heat the bedrooms).
Top tip: insulation, insulation, insulation!!! Siting/orientation of ASHP is important – better to put somewhere warmer (eg south rather than north facing) and under cover, and because of condensation there is ice build-up in winter so don't install next to a footway

Graham Truscott (South Derbyshire)

Type of ASHP: Vaillant ASHP connected to 6.5KW solar feeding Lithium Ion battery storage supplied by a company he's involved in www.aceleronenergy.com , only the 5th such installation in the country. Software on battery and ASHP to set priorities (batteries filled first, use batteries first, ASHP heats hot water first and then house)
When installed: Only recently been installed in property being renovated/gutted.
Reasons for installing: Didn't want gas for carbon reasons
Size and location: On south facing wall
Type of house: 1965 4-bed detached in process of being refurbished. Was EPC rating F, now D and will be B when the loft is insulated (exploring innovative insulation)
House alterations needed: Significant insulation and making space for a "plant room" cupboard for the water cylinder.
Costs of ASHP and installation: £13,000 and not getting RHI yet but hoping suppliers will help
Installer: FDG – some difficulties with them and had to go to Ombudsman to resolve
Costs of running system: only just started running. Have timer to combat legionella every fortnight. Water runs at 45C but may push it up. Have free standing controls so can operate from any room.
Pros: very quiet and don't hear at all inside
Cons: too early to tell

Q&A

Q. what is the likelihood of the coolants escaping and causing problems? having trouble finding suitable pump as husband wanted a propane one but house not suitable, due to needing a soakaway.?
A. Laura : No issue with coolant escaping as it is a sealed system. If coolant is escaping, that is a major failure and is very unlikely. The soakaway is not for the coolant. It is for the defrost cycle in winter when the heat pump condensation drips and needs to be soaked or piped away (otherwise becomes icy). This is not coolant.

Q. Why would some systems run out of hot water and others wouldn't? [only Peter had experienced this problem]
A. Laura: Tank needs to be carefully sized by the plumber, who need to do the maths. Kevin: never had this problem and has a 210L tank which ICE Energy provided and did the calculations. Brian: also has a 210L hot water tank and no problems.

Q. My house is in a conservation area. I would need to apply for planning permission to have any external installation to the side of the house. Has anyone here encountered any problems with planning authorities in proposing a heat pump system?
A. Laura:- ASHPs are classed as permitted development so planners should be favourable but each area has its own rules so advisable to engage with your local planners early. Kevin: matter of common sense, generally if hidden away, rather than in full view it shouldn't be a problem. Barbara : ex-architect advised that she would be wary of installing an ASHP in a listed building which needs listed building consent particularly if it needs lots of additional insulation

Q. We have two separate heating systems, underfloor downstairs and radiators upstairs. would it be possible to keep this split and use the ASHP just for the underfloor and keep the boiler for upstairs
A. Laura: yes, this is perfectly possible. A hybrid system effectively. You can have a gas boiler upstairs and an ASHP on a separate system downstairs.

Q. How do you find a good installer?
A. Graham: noted that he had done lots of research in installers but still got it wrong. He had even visited someone with a very successful installation – 3 ASHPS in a big barn conversion and was very pleased. But he had a lot of difficulties with his installer. He had looked at Greener Living but their business model only allowed for retrofit and existing properties where no other work was taking place. He noted that the industry watchdog HIES was very good and should have contacted them sooner. Laura: advised to make sure that the supplier is MCS accredited (though this is no guarantee), and noted that many members of the GSHP Association (who have been vetted) are also ASHP installers. https://www.gshp.org.uk/ It is still the case that there are few good plumbers who understand heat pumps. Peter: said he has also asked around and his installer was recommended by Vaillant. They made a miscalculation on the hot water which runs out after a bath.

Laura noted that training was a big problem in the industry and her association was working to improve standards, but building standards generally in the UK were not good. There was also a lot of discussion in the chat about lack of trained people Laura noted that school leavers are still being trained in gas and don't have the trainers and people who understand in order to train new folks. It's a problem across the whole engineering sector. Students are not being encouraged at school to go into these industries even though it's a great career and there are massive vacancies.

Q. With the grants, is it either or? So if you go for the £5,000 green homes grant announced recently, does that rule out receiving the Renewable Heat Incentive, or can you have both?
A. Peter: no only one or the other. Several speakers recommended the RHI because the overall funding was greater than for the green homes grant. Post meeting note – this won't be the same for everyone so it's worth doing your own comparison. Post meeting note from Brian: you can only have one grant for one item and the RHI brings in more in revenue over the 7 years. However, some people may require an early injection of £5k in capital to install it. Further, most folk don't just fix an ASHP to their existing system. Anything extra such as insulation may be claimed separately and in addition, providing it meets the governments requirements for the funds. He also noted that Wirksworth Transition Community Land Trust have tried to help folk with the Green Homes Grant. However, they found that there is a lack of registered builders to do the work, and the few there are in Derbyshire are fully booked up to the end of next March, when the grant expires.

Q. When is ground source considered as an alternative to air source?
A. Graham : GSHPs are good when you have lots of space. Kevin had considered GSHP but they would cause a lot of damage to the garden as need to dig a 60 m trench , 1m deep. Laura: Ground source always have higher efficiencies as the ground is more stable than air. They are much more expensive as you need to drill boreholes or dig trenches but they can work well on big and small properties and there are lots of options for communal GSHPs (share with neighbours). It comes down to finances – can you afford a GSHP? The costs are offset by RHI, with the RHI double for GSHPs and you will also see a small saving on your electricity bill. Post meeting note from Brian who was considering ground source in our old family home and had the land for a trench. An alternative is drilling down a bore hole instead of a trench. When they moved this was going to be their preferred option. At the time, the extra tariff from ground source just about compensated the extra cost, however, access for drilling machinery was a problem.

Q. I have a log burner with a backboiler and and solar thermal.... Could I run it 3 ways?
A. Laura: Yes. Solar thermal good for domestic hot water. If have cylinder can have coil in bottom for solar (in summer), and can also run logburner, ASHP and solar thermal into that in winter. There is a RHI for solar thermal as well. Kevin: has 2 logburners as back up heat when very cold.

Q. Given that the heat pump at the core of the system is essentially no more sophisticated than my refrigerator or freezer do you think the economies of scale will bring the cost of the unit will bring the

price down to the point that we could separate the heating and hot water functions, each with their own heat pump that's optimised, e.g. by refrigerant selection, for function?
A. Laura: that is already being done. CO_2 heat pumps are being used for hot water only with COP >4.0 and a different refrigerant for the heat/cool only heat pump

Q. How is SCOP measured/advertised?
A. Laura: COP is listed on the datasheet. You need to dig into the datasheet or the manufacturer for SCOP. You will something like A2/W45 which means air 2C and W45C and the COP will be given at those conditions.

Q. Why does it need a cylinder?
A. Laura: the heat pump does not work like a boiler. it does not switch on and off and react like a boiler does, e.g, turn a tap on and the heat pump starts. The heat pump needs a slow start and slow stop and is better to run low at all times. So hot water must come from the store not direct from the heat pump

Q. what is the heat pump power?
A. Laura: Heat pump power depends on demand. So a small house may need 8kW. large house might need 45kW. Then COP determines the actual electrical power input

Q. What is the minimum size of hot-water tank?
A. Laura: Min size of hot water depends on your house size and how many people are in it so maybe 210 – 340 L for a 2 bed house

Q. I fitted Gas CH myself (DIY) 38 yrs ago and consider myself a competent plumber. Can I fit ASHP as a DIY job and how do I stand with regard to the RHI?
A. Laura:- you need to be MCS accredited in order to fit the heat pump and get RHI

Q. How do I calculate my EPC rating?
A. Laura: you need an EPC assessor to do your EPC

Q. (for Graham) How big is the battery?
A. Graham: Aceleron battery is capable of handling 8 kw. Battery and inverter cabinet is a sleek unit 0.8 m x 1.1 m x. 0.35 m are in the garage.

Q. (for Graham) And how big is it inside?
A. Graham: Inside there is a cupboard with cylinder and other parts in it. cupboard is about 1.5 sq metre floor area and also houses two toilet cisterns. Cylinder is 1.6 metres tall, approx. 50 cm diameter

Q. (for Graham) What is the projected life of your battery? What is the cost benefit budget?
A. Graham: Battery life is almost infinite because if any one cell in the battery breaks down it can be replaced to restore battery to full capability. A phone app monitors battery at all times. Theoretical cost benefit of battery is that it should pay for itself in my installation in 5 years at max, possibly as low as 3 but we don't know our usage in this house yet Hoping to move in next week

Q. (for Graham) What is the innovative loft insulation solution you are looking at?
A. Graham: Loft insulation aiming for combination of superfoil, thermofleece and PIR

Q. Re RHI. Is the deadline of March 2022 the sign-up deadline, or when payments are no longer made?
A. Laura: March 2022 is the last application. Payments made for a further 7 years

Q. is there an easy way of measuring the noise level?
Post meeting note from Brian: At the time this was given in the manufacturers data sheet. His is 2 m away from the window he usually works beside. After 8 years he can't hear it in the house and can just hear it from 5 m away outside in his garden, with no barrier in between. The manufacturers data sheet gives a measure for his individual system at -41dBa.

Q. Does anyone have a view on hydrogen as a fuel source for boilers in the future?
A. Graham: hydrogen has been added to domestic gas supplies in the past. Laura: hydrogen 10 years away for mass roll out. Better to use for transport and electricity. Heat pumps available now

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