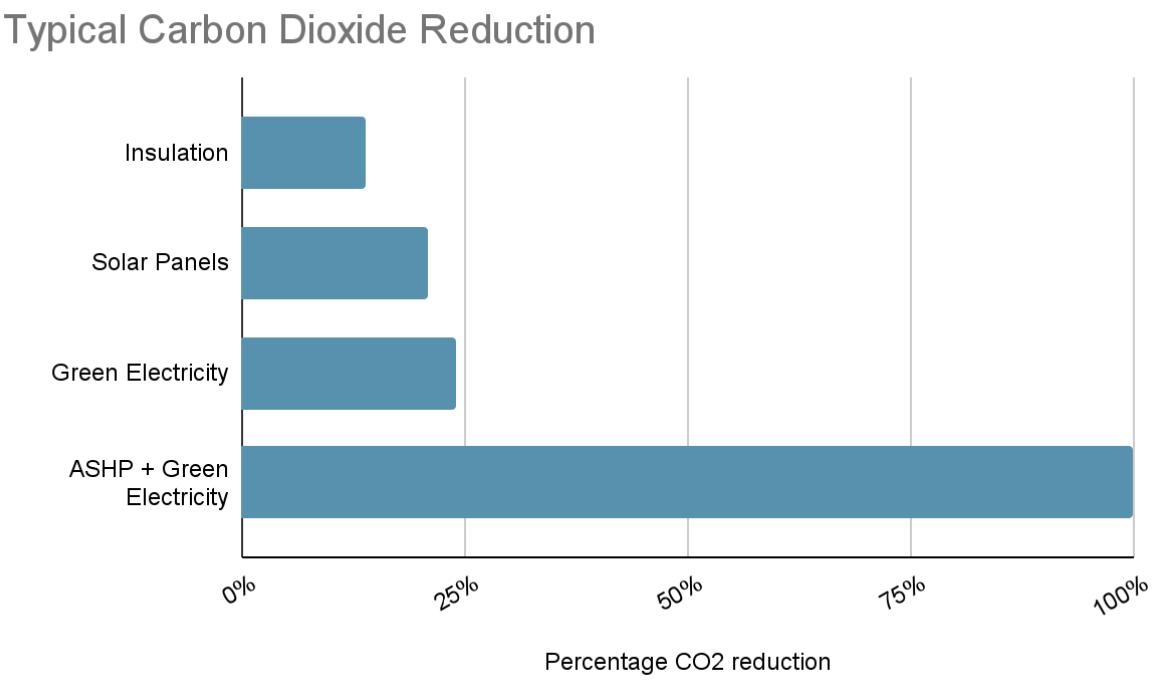
Zero Carbon Heating - Background Note

What we wanted to show in the film is the effect that making improvements to your home will make, and how to get to a zero carbon emission home. A combination of green energy supplies and green heating are needed. A well-insulated home with an air source heat pump is one way to achieve this.

The chart below shows the savings you can achieve from different measures.



So where do the numbers come from? Where possible we've tried to source everything from official UK government sources. Since all of our homes are different, We've had to make some assumptions. For example, a detached house has a bigger carbon footprint than a terraced house because it doesn't have any direct neighbours to keep it warm and snug on both sides. A flat is usually even better than a terraced house for the same reason. So, bear in mind that these are all indicative numbers, and your home's carbon output will be different.

Total amount emitted by home

From the government's data, we can see that the average household electricity usage is 3713 kWh per annum; gas usage is quite a bit more at 13,516 kWh. Each year the government produces a conversion table that you can use to estimate the amount of CO_2e[1] produced for each of our activities. So based upon the UK's typical mix of electricity generation we can see that 1kWh of electricity produces 0.23314 kg CO_2e. Interestingly this is dropping each year as national power companies are switching to more green energy production.

So, a home that consumes 3731 kWh of electricity produces 870 kg CO_2e each year. However, that 13,516 kWh of gas which also gets burnt produces a huge 2485 kg CO_2e on top of this. Gas and electricity usage combined gives a total of 3355 kg CO_2e per annum. So there is a 26% electricity / 74% gas split in the greenhouse gases from the average home. The majority of the gas is used to heat houses and hot water[2].

The conversion factors for electricity are good estimates but they are not perfect since the amount of renewable energy produced nationally changes throughout the day. For example, when the electricity usage peaks in the evening, power companies will use more gas power stations to compensate.

CO_2 used to heat your home is more than your car emits

In the UK, the average distance we travel by car is 7400 miles per annum (11909km). This value is actually decreasing each year due to changes in our behaviour such as more online shopping, :-) which of course increases commercial travel :-(

However, the bad news is that new vehicle car emissions are growing each year due to more people buying SUVs and moving away from diesel. It's currently at 128 gCO_2/km (2019). That is 128g*11909 = 1.524 tonnes CO_2 per car per annum, which is quite a bit less than your home's CO_2 emissions. That number isn't a real-world emission though. Adding in real-world driving the efficiency becomes somewhere between 280 (for a car) - 410 (for an SUV) $gCO_2/mile$. So the car emission is 2.072 tonnes per annum and 3.034 tonnes for a large SUV. This means that your house's greenhouse gas emissions are probably worse than your cars.

It's worth noting that these numbers exclude fuel refinery, fuel delivery, and car construction. These numbers add about 30% to the total. However, the gas delivered to your home also has refinery and delivery costs on top as well. Pipes also leak, and methane (natural gas) is 25 times worse than CO_2 as a climate change gas.

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[1] CO_2e is the equivalent amount of carbon dioxide produced. Some activities produce different greenhouse gases such as methane. Methane is 25 times more potent as a greenhouse gas than carbon dioxide so it's easier just to convert everything to CO_2e.

[2] Only 2.8% of the total household energy is used for cooking in the UK and space heating consumes 3.5 times more energy than hot water.

Insulation

In principle, we could all insulate our homes so that we don't need anything more than our body heat to keep them warm. In practice, this is not so easy. The house will need some ventilation to prevent dampness (and apparently breathing is important) and the insulation thickness would be just impractical. The housing stock in Steyning, Bramber and Beeding has a considerable amount of variation in age and insulation (see How Green is my Street?) Some houses are easier to insulate than others, and so the government measures the effect of insulation on real buildings. Adding loft insulation will save your heat requirement by 4% on average, cavity wall insulation adds another 10%. Solid wall insulation is even better at 18%. On top of this double glazing, underfloor insulation, and even closing internal doors all add to the potential savings. These are heat savings (i.e. gas) rather than the total energy consumption of your home, so that 18% is about a 14% reduction in your total CO_2.

It certainly helps, it will reduce your energy bills and it's well worth doing, but insulation alone is not going to get most people to a zero carbon house. See here for details on what you could do to improve your home and to see what help might be available.

Photovoltaic Cells aka Solar Panels

We didn't mention solar panels in the film due to timing. They are more tricky to put a real number on. Their performance depends on their size of course, but also your roof angle, where you are in the country, and the direction of your roof. South-facing roofs do better than North-facing, for example. If we base our calculation on an East-facing roof with a 30 degree slope. A new 4 kW installation could (potentially) generate 3,084 kWh per annum[3]. This is a 21% reduction in CO_2e. Of course, this is only in the daytime so if you're out all day some of this is going to get sold back to your electricity supplier for someone else to use your nice green energy.

The big problem with solar power is that, for most people, it does very little to reduce your gas consumption.

Green Power Suppliers - Dragon's be here!

Switching to a green supplier should make your home 100% carbon-free, shouldn't it? Some companies do sell 100% green electricity. Some only buy REGOs. When a renewable generator produces 1 MWh of green energy a Renewable Energy Guarantees of Origin (REGO) certificate is issued by Ofgem. But these companies don't always sell the REGO with the electricity if, for example, they are selling power to a foreign commercial customer. So, that leaves plenty of REGOs on the market. Suppliers can then buy these and claim their power is green without buying the accompanying green energy. This is just "green-washing";

[3] You can calculate your own estimate from here https://www.pvfitcalculator.energysavingtrust.org.uk/

they sell nothing but fossil fuel electricity and a con[4]. Always check the breakdown of the company's actual suppliers. Look for wind, solar and hydro sources of electricity.[5]

But what about gas? Is it ever renewable? Well not really at the moment. A small percentage is bio-gas, but most of it is fossil fuel. What companies are doing is claiming that they carbon offset by planting trees or other activities. There's also a lot more dubious practices going on by some companies that count their carbon offset as something that was going to happen away, or they just promise not to cut down trees that are already growing.

So is carbon offsetting any good? By that I mean the real one that actually plants trees! It's a controversial subject because so much of it depends on the fine detail. One problem is the time frame. It can take 50-70 years for the carbon that you burn to heat your home to be removed from the atmosphere by newly planted trees. That is far far too long! Tree planting can help but alone it is not a cure[6]. The only real solution is to wean ourselves off fossil fuel gas and onto truly green electricity.[7]

Heat Pumps

Ideally, we should be able to heat our home with green electricity only. The problem is gas is so cheap and offers an instant 30kW of heating power in a typical boiler. You'd need a 125 Amp supply to achieve that if you directly heated water with electricity; most homes have only 80 amp supplies. There are other options like new high retention storage heaters but they're relatively expensive to run and don't heat your hot water.

Heat pumps are a real viable alternative to gas. They work by moving heat from one source to another. With an air source heat pump (ASHP) they take heat out of the air and use it to heat water for your home. Think "air-conditioning" in reverse. This can then heat your radiators and provide your hot water. They still work when it's sub-zero outside, they just make the outside air a bit colder. It's a little bit like how a freezer works, heat is extracted from the already cold freezer compartment to your room via the back of the freezer which can get quite warm.

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[4] See here for some examples:
https://www.goodenergy.co.uk/blog/2019/03/27/shell-energy-s-renewable-promise-highlights-the-problem-with-regos/

[5] uSwitch have started to rate companies with bronze, silver and gold. Friends of the Earth have their own recommended suppliers. Also see
https://www.greensquare.co.uk/blog/2020/11/13/7-best-green-energy-suppliers-for-2021
https://www.t3.com/features/best-green-energy-supplier

[6] See here for information on the benefits and pitfalls:
https://www.imperial.ac.uk/news/199473/qa-is-planting-trees-answer-climate/

[7] See Greenpeace and Friend of the Earth:
https://www.greenpeace.org.uk/news/the-biggest-problem-with-carbon-offsetting-is-that-it-doesnt-really-work/
https://friendsoftheearth.uk/climate/does-carbon-offsetting-work
BBC article on the scientific debate
https://www.bbc.com/future/article/20200521-planting-trees-doesnt-always-help-with-climate-change

ASHP's have an incredible efficiency that's often quoted. The exact amount depends on the outside temperature since they are slightly less efficient when it's very cold outside. A condensing gas boiler might have an efficiency of around 90%. For an ASHP this can be up to 400% or more! So for each kW of power input you can get over 4kW of heat output. But how can something have an efficiency of greater than 100%? Through the magic power of marketing! A gas boiler's efficiency comes from burning gas to produce heat with only a few percent wasted up the flue. However, ASHPs don't burn energy to produce heat, they extract heat and thermodynamics tells us that you can move more heat than you can produce heat for the same amount of energy. If the temperature outside is say 10°C, it will take 3 times less energy to move that heat and compress it to 50°C than it would burning gas in a boiler to do the same. Hence, the people say it has 300% "efficiency".

It is that "efficiency" that means we can heat a house using electricity for potentially less money than by using gas or oil. Since they can be powered with 100% green electricity, ASHPs are a great way to reduce your house's carbon output to around zero.

There are downsides to this. The upfront cost is large (circa £10k) but you can claim much of this back via the government's RHI scheme. Gas boilers typically heat water to 60°C but ASHP normally heat it to 50°C. This means you do need a well insulated home and potentially a few larger radiators. Like air conditioning units they have to be based outside of your property, so you're going to need some wall space to mount them and they do make some noise when running. Since each house is different, I would suggest speaking to an installer about your specific needs. There are also ground source heat pumps which extract heat out of the ground, as opposed to the air. These are considerably more expensive, but do provide more heat.

Heat pumps aren't the only option, and they are not suited to every property, but they do use less of your green electricity than other heaters. Friends of the Earth reviewed different methods of heating your home. They also provide a spreadsheet that you can use to work out the cost of the different types of heating.[8]

Conclusions

There are a lot of easy steps we can take to reduce our homes' carbon emissions. However, to make a real impact we have to wean ourselves off fossil gas-powered central heating. Switching to an air source heat pump, an electric cooker and a green electricity supply is one way to do this and it will make your home potentially carbon neutral. Adding in solar power as well could even make it carbon negative.

For more information on home energy and heat pumps, visit
www.greeningsteyning.org/energy

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[8] See here for a good list of the other options:
https://friendsoftheearth.uk/climate/eco-heating-what-are-options
The spreadsheet is here
https://friendsoftheearth.uk/climate-change/lowcarbon-domestic-heating-calculator