**If you caught our last video about geothermal heat energy you’ll know there’s an awful lot of it right under our feet in the earth’s crust. The challenge is to get at it in a safe, environmentally friendly and economic way so as to produce a large scale transfer of heat in to a liquid that then turns into vapour and moves across a turbine to drive an electrical generator, which in turn provides extra power for national electricity grids.**

**And many of you who watched that video quite rightly pointed out that large centralised power stations like these aren’t the only way to utilise geothermal energy. For over two decades now, systems have been in operation that allow individual homes and offices to produce their own micro-generated energy from the very patch of land that surrounds the building. The system is called a Geothermal Heat Pump, but you’ve probably more often heard it referred to as a ground source heat pump.**

**I think it’s fair to say that the industry has been kept quite low key over the years and take up has been relatively slow in some parts of the world, largely due to the perception of high upfront costs, but the outlook is now changing fast, just like pretty much everything else in these unprecedented times we’re all living through.**

**The International Energy Agency found that almost 20 million household around the world purchased a heat pump in 2019, and according to analysis by consultancy firm Global Market Insights, worldwide sales are set to exceed sixty-eight billion dollars by 2026.**

**And you and I could be benefitting from a forty to fifty percent saving on our home heating costs, plus a hefty government subsidy depending on where you live.**

**So, is it a good idea, how does it all work, and how can we all get a slice of this particular green energy pie?**

**Hello and welcome to Just Have a Think**

**Energy use in buildings accounts for more than seventeen percent of all global greenhouse gas emissions.**

**And in somewhere like the United States, between fifty and seventy percent of all energy used in the home goes on heating and cooling.**

**Different fossil fuels are used to heat and cool buildings in different parts of the world. Many countries rely heavily on gas, but oil fired heaters are also still in widespread use.**

**The one constant that can be relied on in every part of the world though, is the fact that the temperature of the ground directly below us is far more stable than the temperature of the air around us, which is subject to all the vagaries of the ever more extreme weather.**

**That means it’s generally cooler than ambient air during the hottest days of summer and warmer than ambient air during the colder months.**

**And that basic fundamental physical property is what makes ground source heat pumps such a simple and effective solution.**

**Here’s how they work.**

**A mix of cold water and anti-freeze is pumped through a ground array of energy absorbing pipes, getting constantly warmed by the ground’s low-grade heat as it circulates.**

**The warmed-up mixture then gets fed into a heat exchanger, otherwise known as an evaporator, where it transfers its energy to a secondary fluid with a much lower boiling point. That fluid then turns to a gas which gets compressed to increase its temperature still further. The hot gas then flows into a condenser where it dump it’s energy into a space heating system or even to provide the hot water for the building if required.**

**Once all that energy has been transferred out of the gas, it turns back into a liquid and goes through an expansion valve at the end of the cycle to reduce its pressure and temperature back to the starting point. It’s a completely closed loop cycle, so the fluid just goes round and round absorbing energy from below and dumping it where it’s needed.**

**Not all homes and building have huge expanses of space around them of course. In those cases, rather than winding the energy absorbing pipes around in a horizontal array about a metre underground, they can be sunk about a hundred metres vertically downwards like this system being installed by a company called ENGEO out in California. The temperature differentials will vary of course but the basic principles of the two systems are the same.**

**For each kilowatt of energy consumed by the system, four kilowatts of heat energy are generated, effectively reducing the cost per kilowatt hour by seventy five percent.**

**In hotter countries that normally use air conditioners during the summertime the stable ground temperature will actually be LOWER than the hot summer air, and that means the whole cycle can be reversed so that excess heat from the ambient air in the building can be transferred into the system and sent back through the cycle to be dumped into the ground via the pipe arrays, turning a heating system into a very efficient cooling system, saving between twenty and forty percent on the electricity bill for a traditional air conditioner.**

**In most cases the ground source heat pump is combined with a more traditional water boiler to ensure there’s no risk of the home lacking heat during extreme weather events. But even if that boiler is heated by fossil fuel, there is still a large reduction in CO2 emissions over the lifetime of the installation because the vast majority of the work is done by the heat pump at most times of the year. And better still, if the fossil fuel boiler is replaced with an electric boiler fed by a renewable energy tariff, then those CO2 emissions are even more drastically reduced, which of course is the main object of the exercise.**

**Up in Sweden, where the northern most regions are actually inside the arctic circle, geothermal heat pumps have become a standard alternative to district heating in many buildings as the owners have found that installing and running their own set up is actually cheaper than paying the cost of the communal system.**

**According to the Swedish department of geology, in 2016 there were more than 300 000 domestic geothermal heat pump systems in use across the country.**

**Most of them use that combination of the ground source heat pump and back up boiler running on grid electricity that I mentioned earlier. One of the early challenges of this set up was the demand on the grid during peak usage periods. You see to optimise cost vs efficacy, the heat pumps were generally dimensioned to provide about half of the power demand, which actually equates to about ninety percent of the energy use. But during very cold days, which are not uncommon in Sweden, these combination systems were using three to four times more power per degree as the heat pumps reached maximum power and the electric boilers kicked in. And that was causing a very unwelcome spike in demand on the national grid.**

**But new heat pump systems are now fitted with very smart inverter technology which can handle full power heating demand. That simple addition has resulted in lower energy bills for the consumer, less marginal electricity demand and greater available capacity on the grid for distribution to other energy users. All in all, a much more sustainable solution.**

**It’s well worth checking out Robert Lewellyn’s excellent recent video over at the Fully Charged channel, looking at Moonstone House in the UK, which generates more energy than it uses and is actually fitted with both horizontal and vertical geothermal heat pump systems.**

**According to this article by Molly Lempriere published on the Current News website in September 2020, here in the UK, while decarbonisation of electricity has steamed ahead, it seems heat has often been forgotten. The sector generates about** [**37% of total UK carbon emissions**](https://es.catapult.org.uk/brochures/decarbonisation-heat/) **when you add in industrial processes, so Lempriere argues that now is the time for action if the country is to hit its net zero by 2050 target.**

But while the technology is now mature and well proven, governments have not been willing to provide the sorts of subsidies and grants that are really needed to kick start the transition for most individual domestic consumers, at least not here in the UK anyway. The power of the fossil fuel lobby is still extremely strong, despite the economic kicking they’ve endured during the lockdown period. Globally, that industry still receives hundreds of billions of dollars in subsidies and tax breaks to keep their products looking competitive against established and now cheaper renewable alternatives like solar and wind, and they exert great influence on lawmakers to keep renewable incentives to a minimum. Despite that, there was a glimmer of hope in August 2020 when the UK [Chancellor Rishi Sunak announced the introduction of the Green Home Grants](https://www.current-news.co.uk/news/heat-pumps-to-be-eligible-for-2bn-government-green-home-grants), a £2 billion fund to drive home improvements. Amongst other technologies, this includes heat pumps, with the government covering up to two-thirds of the cost for 600,000 households. The Green Homes Grant  is an upfront payment, but it’s capped at £5k which doesn’t go a very long way towards the cost of a well installed Ground Source Heat Pump system. There is also a parallel UK scheme called the Domestic Renewables Heat Incentive. The RHI is designed to help those who install eligible technologies claim back the majority of the cost of the installation over a seven year period. But if you claim both incentives, the Domestic Renewable Heat Incentive is reduced by the amount of the Green Home Grant to prevent what the government calls 'double funding'. The details of eligibility and applicable rates are pretty complicated, so to help with navigating the small print I contacted the company that installed the solar power system on my home back in 2017. They’re called ISO Energy and they’re the UKs most experienced consultants and installers of renewable energy systems.

I asked them to run through some numbers based on a typical 3 bedroom Victorian terrace house like mine with a skinny 100 foot garden out back.

First and foremost, ISO advised that a horizontal system is not suitable in a small garden, so they based their numbers on a bore hole installation.

A 9 kilowatt system including the cost of drilling the boreholes, all the internal componentry and a full size hot water storage tank, from first survey to full installation and commissioning comes in at about twenty six thousand pounds. A retrofit here in the UK has a reduced VAT rate of five percent instead of the normal twenty percent, so we need to add another thirteen hundred onto that to take the total to just over twenty seven thousand.

ISO Energy explain that the Domestic Renewable Heat Incentive can earn the owner of a system like this as much as four thousand pounds a year for seven years, so you’re looking at a payback time of about seven years, which is actually slightly quicker than the payback on the solar power system that I’ve had since 2017.

The obstacle is that the homeowner has to pay for the system up front and claim back the incentives afterwards, and not many of us have the best part of thirty grand kicking around for a rainy day!

Incentive schemes will vary wildly from country to country of course, so you would need to check with your own state or national government to find out what’s available to you."

**Despite the apparent obstacles here in the UK, the technology has been embraced in many other parts of the world, in hot climates and in cold climates, because of it’s remarkable ability to maintain a stable ambient interior climate by effectively equalising air and ground temperatures.**

**Upfront infrastructure investment costs are always a major challenge**

**with paradigm shifting technologies like this. As usual we find ourselves with the eternal triangle of public perception, commercial caution and government leadership. These three things can either be a self-reinforcing mechanism or a precarious house of cards. If the right level of government incentive is put in place, then consumers will see the value of converting. That will entice more investment into the sector, which will increase competition and drive down prices, which in turn will attract more and more people to purchase the systems and so on and so on. Sounds a bit obvious when you say it out loud doesn’t it. But it’s not happening quickly enough at the moment, and it needs to accelerate fast if we are to stand any chance of meeting the United Nations target of global carbon neutrality by 2050.**

**If you’ve got views on this one or of course if you have direct experience of installing and running one of these systems, then dive down to the description box below and share your thoughts there**

**That’s it for this week though.**

**Thanks to one of our channel patrons, Bjorn Jonsson for providing some of the research information for today’s video, particularly around the Swedish example, and of course to ISO Energy for their help with the UK cost examples.**

**Do have a quick look at the website and the app if you haven’t already done so and I must just give a shout out to some new supporters of the channel who've joined our Patreon page since last time with pledges of ten dollars or more a month.**

**They are**

**Robert Knowles**

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**Darrell Mackinnon**

**Tony Dobson**

**Andreas Daun**

**Mitch Rundle**

**Gordon Johnson**

**Michael Baker**

**And**

**Eric Kroeger**

**and of course a big thank you to everyone else who's joined since last week too.**

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**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.
See you next week**