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Topic

Climate Change and Heat Pumps – 'We Have The Technology'

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How domestic heating can be decarobonised through heat pump technology

There is now a general consensus that climate change is happening and is it's being dramatically exacerbated by the combustion of fossil fuels. Our heating systems contribute significantly to poor air quality, which presents a clear and present danger to humankind and results in a huge financial burden to society.

The dominance of fossil fuel combustion almost suggests that there are no alternative techniques proven to deliver heat, but the truth couldn't be less true. In 2008, the UK Government put a support mechanism in place for employing alternative cleaner heating techniques, such as biomass, biogas and heat pumps. The Renewable Heat Incentive (RHI) is essentially finished, leaving the economic appraisal back in favour of gas. What might come next is far from clear, but it won't be many heat pumps.

On the surface of it, the RHI seemed like a good scheme, but the uptake was practically zero until 2018, when rather too much emphasis was placed on very large projects. For the domestic scheme, homeowners themselves had to bear the burden of full technical responsibility, full funding and full administration of the support mechanism. Given most domestic heat pump systems cost over £10,000 to deploy (£22,500 in my own case!) it is hardly surprising that uptake was low.

In the non-domestic sector, the deployment of heat pumps from the introduction of the RHI through to 2018 was practically nil. I believe the main reason for this was lack of obligation and excessive risk. For industrial/commercial schemes the RHI was based on metered outcome and payable at approx. 9.7p/kWh for the first 15% of maximum theoretical output of the system and then 2.9p/kWh. A tariff guarantee to secure operational incentive once commissioned was not available for large heat pump systems until it was eventually rectified in 2018. We then saw an over-demand on the RHI (principally new horticulture facilities) for heat pumps, just as the support mechanism ended.

In my co-authored 2011 paper to the Institute of Refrigeration (Hoffman/Pearson) we described the success of new water source heat pump facility in Drammen, Norway. The heat pump was successfully extracting heat from the local salt water fjord and boosting it to temperatures viable for integration into a local district heating scheme (circa 90°C). The use of ammonia as the working fluid at such temperatures was the focus of the paper, noting the improved efficiency achievable versus recognised alternatives from the range of synthetic working fluids, in this case R134a. It was noted that ammonia would incur a 25% lower electricity bill for the operator, whilst simultaneously giving rise to a far lower global warming effect than any leaking working fluid.

Prior to the Drammen facility it was generally thought that ammonia wasn't viable above around 70°C. Combined with an ongoing perception that heat pumps were 'unsuited to higher temperatures' this motivated the author and Star Refrigeration to continue to speak out to address this false belief. This business drive and investment in the development of heat pump technology was eventually bolstered by significant legislative and policy support for the deployment of similar schemes in the UK.

Around 2014, the Scottish Government observed the poor uptake of the Drammen-style projects being promoted by Star Refrigeration and opted, within the guidelines, to add further support. In 2018 West Dunbartonshire Council adapted their plans for the Queens Quay redevelopment project, with heat supply for the entire area based on river source heat pumps. The council appointed the delivery lead contractor role to Vital Energi and Star Refrigeration was appointed as heat pump supplier.

Queens Quay is being redeveloped in Clydebank on the site of the former John Brown shipyard. A mix of municipal, commercial and residential properties are being built, all of which will have two 2.6MW river source heat pumps augmented with gas boilers, although these should not have

to run until the system demand is much higher. There is also a thermal store (135,000 litres) which would allow 36 minutes at full load. Hugely significant to help balance the electrical grid.

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Scotland's first large-scale water source heat pump

Heat pumps have been shown to be environmentally and economically viable in operation for individual family homes, new build homes and higher temperature district heat networks, but the uptake remains low. Technical development will aid the quest to use heat pumps in more and more situations, but I believe that the barrier is more financial, due in a large part to Government legislation on taxation and energy policy/pricing.

The cost of climate change has to be resolved one way or another. Domestic heating can be decarbonised through heat pump technology and the cost is not intolerable when taken over a 20-year period. What if funding models emerged that allowed the consumer to agree to receive heat pump generated heat at no capital cost? How might the technology be tweaked to favour those who would then be funding it?

The opportunity would be far better served by supporting a 'Heat as a Service' business model, where development is undertaken by the utility provider. The homeowner pays a fixed monthly fee in exchange for 'comfort'. Depending on gas and electricity costs, this could be cost neutral, but crucially, it is designed to leave all 'risk' with the developer, including ongoing maintenance and efficiency aspects.

In the domestic market, new heating systems are required across new build properties and as retrofit systems on existing buildings, in both low and high density settings. Making the business model more long-term, supplier risk led, with the deployment more standard, street by street to reduce the readiness time, with fabric upgrades built in, will lead to lowest operating cost. Business models follow policy, if policy seeks to allow and promote business models.

What can the industry itself do to see more heat pumps used? Starting at the earliest age, we must educate the engineers of the future. Do heat pumps even exist at any level in national curriculums? Let's see material developed at all educational levels and make it easy for teachers to share the opportunity. At University level there are few topics on the potential applications of heat pumps. Like refrigeration, which straddles different faculties, heat pumps are even more hidden in the shadows of other more exotic scientific topics, like spaceflight or fossil fuel extraction.

At the time of writing, the UK Government's Heat and Buildings Strategy is out for consultation, outlining future expectations of the energy and emissions performance of buildings. If these cannot be met whilst continuing to be solely heated by gas boilers, this will drive owner/operators to seek alternative sources. Ultimately, political leaders are not up to speed with the possibilities, but it is industry's role to invite them to see what can be achieved and to engage in consultations to help define policy.

It is clear that 'we have the technology' when it comes to heat pump systems. The key lies partly in demonstrating to political leaders that the technology is low risk, predictable and repeatable. Crucially however, we will only see increased use of heat pump technology when legislation offers a decent financial incentive to support domestic and commercial uptake, leading to an acceptable return on investment.

If you would like to find out more about heat pumps, visit https://www.neatpumps.com/

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