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The Journey to Net Zero Air Conditioning

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Air Conditioning

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The term “air conditioning” is often misleading, poorly applied, and is frequently used to discuss comfort cooling when, in fact, the term covers far more than simply direct expansion cooling products.

Some would define it as “the process by which we create and maintain certain temperatures, relative humidity and air quality in indoor spaces”, some that it is “the process of removing heat and controlling the humidity of the air in indoor spaces to create a more comfortable environment”. Neither of these is wrong, but similarly neither is correct either.

These distinctions and definitions become extremely important, however, when we are looking at air conditioning in terms of our Net Zero ambitions and where the technology aligns with those ambitions and the road map we need to follow to achieve them. For example, when does an air conditioning system become accepted as a heat pump? Or conversely, when is a heat pump an air conditioning unit?

Aware that heat pumps are being covered in a separate session I am keen not to create too much crossover here, but it is important to not focus too much on one aspect of “air conditioning” to fit an agenda simply because we are the Institute of Refrigeration. In terms of Net Zero achievement the inclusion of air conditioning systems as valid heat pumps which may include a cooling functionality, or are comfort cooling systems with a reverse cycle functionality, is an absolutely crucial distinction.

Government officials and lobbying groups appear to be largely aligned now in the acceptance that upwards of 600,000 heat pumps need to be installed annually, with that figure growing year on year, if we are to meet our Net Zero by 2050 ambitions. But that will not be achieved by only considering air to water heat pumps for the domestic sector. The Insulate Britain demonstrations on the M25 and beyond earlier this year, disruptive to business and society as they are, are not without good intentions. Their concept is that domestic buildings are often so poorly insulated that the application of air to water heat pumps often results in poor performance and high energy bills for the home owner or tenant – and the net result of that is simply a bad reputation for the technology itself. Yet they fail to recognise that over insulating these homes creates poorly ventilated buildings that overheat in warmer months – particularly as the effects of climate change increase – and they create situations where the indoor air quality can become toxic to the occupants.

So if the increased insulation of homes is creating a situation where those homes are overheating and the air quality is becoming poor, what can be done about that? The answer of course is that air conditioning is needed to ensure that the quality of the air inside buildings is fit for habitation or occupation.

At rest, the average adult inhales and exhales around 13kg of air per day, compared to around 2kg of food and 3kgs of fluids – yet health advice surrounds us on the subject of food and drink and very little on the subject of air quality. In the UK we spend an average 90% of our time indoors, so the quality of the air we breathe is hugely important in terms of long term health and wellbeing of the nation as a whole.

Controlling CO_2 levels indoors as occupancy numbers increase is a vital way of demonstrating at the most basic level that sufficient air changes are in place; but this cannot mean simply installing a ventilation system which supplies fresh air and/or expels foul air. With an eye on our nations’s energy consumption – and of minimising

energy use to help achieve Net Zero emissions – we must be looking at mechanical ventilation with heat recovery more frequently as a sustainable solution.

Looking then at these systems and how they work, we see the heat recovery aspect is achieved by recovering sensible heat out of the return air, transferring it through heat exchanger filter media, and re-applying that sensible heat to the fresh or outside air to ensure the air being drawn into the building is not much lower than that being removed. 100% fresh or outside air, but treated to maintain internal temperature and humidity levels and filter out particulate matter from the make up air. That air being supplied is therefore conditioned air, by almost any definition you would use for air conditioning, and yet no refrigeration fluid or process has taken place.

Additional levels of filtration can also ensure that particulate matter (PM) created by cooking or from fibres shedding off furniture and clothing is kept low, that volatile organic compounds (VOCs) aerated by cleaning products or from printers are removed from the air that we breathe, and that CO_2 levels are maintained at healthy levels well below 1200 ppm.

Our Government's Net Zero ambitions will see an enormous impact on our lives at work and at home in the coming years – energy bills will continue to rise as the energy suppliers seek to recover infrastructure costs of implementing an increased demand on the electrical grid needed to replace the increasingly out of fashion gas network. The climate will continue to change regardless of these actions and for the foreseeable future that change will be in the form of a general warming of the Earth's atmosphere. Homes and workplaces overheating will become an ever more critical problem which will demand some form of mechanical comfort cooling for short periods in buildings where the natural ventilation route isn't an option.

So the application of air conditioning systems in the broad sense of the term is crucial to our targets being met, and the availability of a cooling function for short periods of the year where needed should not exclude the reverse cycle heat pump air conditioning units from being considered as a major piece of the Net Zero puzzle.