**You may have noticed that I’ve been looking back through the Just Have a Think archives recently to review progress on one of two of the key technologies we’ve featured on the channel in the past. One those technologies is air conditioning. Hardly a cutting-edge new concept I grant you but one that is enjoying an awful lot of focus right now as the day-to-day solution to a rapidly warming planet for hundreds of millions of people, AND one of the major CAUSES of that warming. It literally represents a life saver in many countries where ambient temperature and / or humidity are now regularly reaching levels that represent a threat to human life.**

**The basic principle of modern air conditioning hasn’t really changed much since it was first invented well over a hundred years ago, and despite some design tweaks along the way, these things still consume an awful lot of electrical energy, often in countries or regions where the electrical grids are powered by high carbon fossil fuels. There are now almost two billion domestic AC units in use all over the world and that number is expected to triple again to almost six billion by twenty fifty. And by the way, there’s about ANOTHER one-point-six billion units currently in use in industry, commerce and transport too. To be fair to the manufacturers, they are constantly looking for ways to refine their machinery and improve efficiency. But there’s a limit to how far that can go within the existing technological framework.**

**So, how about looking at a new framework altogether then?**

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

**We’ve looked at the global implications of space cooling in a couple of previous videos, which I’ve linked in the description section below. In very basic terms, warm ambient air from your room flows into the unit on the wall where it passes over copper pipes containing a refrigerant gas. Heat energy passes from the air into the refrigerant gas, and the now much cooler air is sent back out into the room.**

**The refrigerant gas passes through a compressor and into a condenser outside, which is basically a fan assisted heat exchanger that allows the heat in the gas to escape out to fresh air. As the gas loses its heat energy it condenses and changes state into a liquid. The LIQUID refrigerant then flows through an expansion valve which is specifically designed to reduce its pressure and turn it back into a very cold gas ready to be sent back into the internal evaporator once again. As your room’s ambient air cools in the evaporator unit, moisture condenses out onto the surface of the pipes, which is why there has to be a collection tray or an outlet route for the condensate liquid.**

**So, AC cooling systems essentially perform two tasks at the same time – they COOL the air, and they DRY the air. But persuading that water vapour to change phase from a gas to a liquid and condense out as water droplets takes energy. Energy that could otherwise be focussed on keeping the room cool, which after all is the main objective. According to this recent article, an air conditioner operating in a tropical climate can use as much as sixty percent of its cooling power to dehumidify the air. So, if you could get the moisture out of the air some other way, then maybe you could save some energy in the overall system. And that’s where this stuff comes into the picture. You’ve probably thrown hundreds of these things away in your time, along with the rest of the packaging from delicate products that would otherwise get damaged by moisture during shipping. They’re called desiccants, and in a packaging application the substance used is typically silica gel.**

**On a grander scale, desiccants like this could theoretically be used to absorb moisture from ambient internal air for space cooling. That’s not actually a new idea either to be completely honest. The first commercial desiccant air conditioning system was actually developed by the Kathabar Company way back in nineteen-ten, and it proved to be reasonably useful in commercial applications until the more effective vapour compression system achieved market dominance in the nineteen-thirties.**

**Fast forward to today and the combination of a global energy crisis and a global climate crisis, is re-focussing engineering minds on how to minimise energy consumption in space cooling systems.**

**One possible solution is to COMBINE a vapour compression system WITH a desiccant system, which is precisely what a Massachusetts start-up called Transaera are developing. They’re working with a class of materials called metal-organic frameworks or MOFs. These are sponge-like, highly porous materials that have an extremely large surface area per gram and which are showing promise in a variety of new commercial applications. When water vapour enters the pores of the MOF, it does get denser but crucially, because of the very narrow pore walls it’s NOT able to transform from a gas into a liquid. That means you’ve captured moisture without expending all that extra energy on a phase change. It also means less energy is needed to expel that captured moisture and dry the material than would be required to dry out an existing commercial desiccant material like this silica gel. And because an air conditioning system is designed specifically to shove unwanted heat out to the atmosphere, Transaera’s design can utilise that heat to dry and regenerate the MOF material ready to mop up more water on the next cycle. The net effect, according to Transaera, is a thirty five percent increase in overall energy efficiency which means the whole system can be produced at lower cost. In late twenty-twenty the company emerged from ‘stealth mode’ to announce four-point five million dollars of seed funding from investors including Carrier Ventures, who are the investment arm of the mighty Carrier Global HVAC group. They’ve also partnered up with the Chinese home appliances manufacturing giant Haier, to carry out some prototype testing at a production facility in India.**

**Transaera aren’t alone in their quest for greater HVAC efficiency though. Another relatively recent start up is Blue Frontier, based in Florida. They’re initially aiming to provide a solution for NON-domestic, commercial operations using a liquid desiccant design that they say can COMPLETELY REPLACE an existing vapour compression system. Sounds a bit like the old Kathabar Company I mentioned earlier, doesn’t it? So, what’s their USP then? Well, instead of a silica gel, the Blue Frontier system uses an extremely concentrated salt solution to pull moisture from the air. They combine that innovation with an indirect evaporative cooling process. Many of you will no doubt already be familiar with the concept of evaporative cooling. The basic principle is to pass air across a receptacle containing water. The air picks up moisture from the water and as it flows out into your warm room the moisture evaporates. The energy for that evaporation comes from the warm ambient air in the room, and as a result that ambient air gets cooler. The only wrinkle is that the longer you use an evaporative cooler, the more humid your room gets. That can get uncomfortable after a while, and if you already live in a very humid part of the world then the evaporation process doesn’t really work, so you don’t get any appreciable cooling benefit. The solution to that conundrum is an indirect evaporation process like the one employed by Blue Frontier.**

**Their system schematic looks like this, and just to be contrary we’re gonna start at the back end of the process over here. The supply air fan blows air into the Blue Frontier cooling core where it first passes over a layer of the concentrated salt solution, or liquid desiccant. So now we’ve got a very dry air stream and a slightly LESS concentrated desiccant, which we’ll come back to in a moment. The dry air then gets separated into two new streams. One stream gets sent over a thin layer of water and reabsorbs a load of moisture, again through evaporation, which uses up energy and lowers the temperature of the air. The now cool and humid air stream flows across the underside of a metal surface which cools IT down and pulls heat out of the OTHER, DRY air stream flowing across the top side. The humid air gets exhausted out and the cool dry air is supplied to the room. There’s enough concentrated salt in the storage tank to provide between four and seven hours of climate control. At the end of that time the now moisture laden, dilute desiccant gets re-dried by a heat pump in this regenerator heater matrix that can be programmed to run overnight, when the unit cost of electricity is at its lowest. Blue Frontier claims this system achieves a SIXTY percent reduction in energy use, as much as a NINETY percent reduction in peak electrical demand with a resultant reduction of as much as EIGHTY percent in overall annual running costs compared to a standard vapour compression system. It also doesn’t use any of those horrible refrigerant greenhouse gases that standard AC systems use, which means there’s an EIGHTY-FIVE percent reduction in global warming potential, or GWP.**

**That whole set up could potentially be improved still further using membrane technology to FILTER the water out of the desiccant solution instead of using a heat pump. That’s an innovation being developed by a Boston based company called Zephyr. It’s still relatively early days for them, but they’re hoping to have a full lab-scale prototype of their cooling system up and running by the end of twenty-twenty-three. Both Blue Frontier and Zephyr are initially aiming at systems for larger commercial buildings, so if they were to demonstrate enough common sense to talk to each other then we could be onto a real winner folks. And both companies say their technology could eventually be adapted for domestic homes and apartments, which really would be a game changer.**

**Most folks now understand the magnitude of our global decarbonisation challenge. Not every energy-saving or low carbon technology will be a glamorous headline grabber. Many of them will just quietly work away somewhere in the back of a machine or buried within a smart system producing efficiencies that folks like you and me will most likely simply take for granted as we go about our ‘busy everyday lives’. But it’s technological advances like the ones we’ve looked today that will go a long way to enabling the crucial transition away from fossil fuels that is the ONLY way we can ensure a safe future for our descendants.**

**Now, you may have your own opinion on that little piece of rhetoric, and of course if you do, or if you’ve got some nuggets of insider information about any of the technologies we’ve featured today, then as always the place to leave your thoughts is in the comments section below.**

**That’s it for this week though. Thanks, as always to our Patreon supporters, who help me keep the channel completely independent and keep ads and sponsorship messages out of all the videos.**

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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.**