Energy Cubed

Cooling + Heating

10X
Less electricity consumption

0 GWP
Refrigerant

Smart
AI Optimization and remote monitoring

The Next Gen Heat Pump

Enersion's new heat pump uses a compressor-less refrigeration cycle powered by nano-technology to convert low grade waste heat or solar heat to cooling and heating. The technology uses 10 times less electricity than a conventional heat pump. Water acts as the refrigerant, allowing Enersion to replace current synthetic refrigerants and all the issues that come with the use of these materials in today's HVAC systems (flammability, ozone-depletion, contribute up to 1000x more warming to the atmosphere than CO_2).

- Reliable & Low Maintenance
- Meets Future Refrigerant Regulations
- Payback as low as 2 years

Powered by all types of waste heat

Waste Heat

58C°+

Space Heating /
Domestic Hot water

Space Cooling /
Process Cooling

Solar Thermal

Solar heat from solar thermal panels or solar hybrid photovoltaic thermal panels.

50% faster payback than using conventional PV panels alone

Steam

Waste steam condensate from building and district energy systems.

Tap into existing building energy source, reducing emissions & energy consumption

Cogeneration / Fuel Cells

Heat exhaust from combined heat and power units or fuel cells powered by natural gas, biogas or hydrogen.

30% faster payback than using cogen / fuel cell alone

Industrial Heat

Process waste heat from chemical / plastics / metal manufacturing / breweries and other industrial processes.

Tap into free heat source, otherwise lost as waste heat

Technology

How does aDsorption cooling work?

ADsorption cooling works by introducing a dry powder (nano-porous material) to a closed-loop system with water. The powder produces cooling from the evaporation process that occurs as vapor transfers to the powder's surface, seeking system equilibrium. Thermal energy captured from a heat source is used to dry the powder and regenerate it for future use.

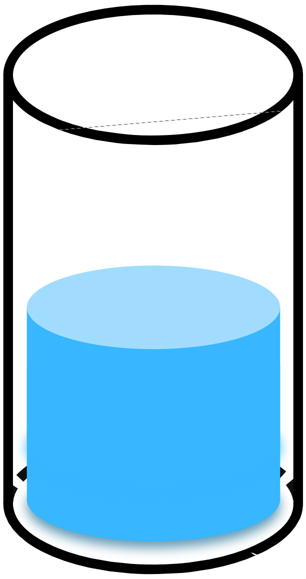

Figure 1

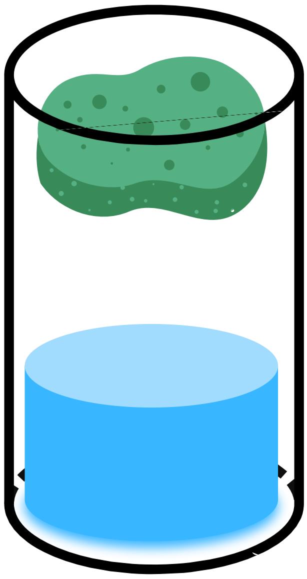

Figure 2

Consider a closed system of water at ambient temperature that is suddenly exposed to a void space (e.g. almost vacuum level). Water will rapidly evaporate into the void space until water and its vapor reach an equilibrium. As a result of this evaporation, water cools down to a lower temperature than its initial temperature. See Figure 1.

Now, consider that a sponge-like material (e.g. nano-porous material) is inserted in the very same system that is in equilibrium. Since nano-porous material adds massive surface area to this space, water vapor starts aDsorbing on the surface of the nano-porous material; consequently, vapor pressure drops, which then allows a significant amount of evaporation from the system of water. This facilitate an even sharper drop in temperature, cooling the water down further as in Figure 2.

To repeat this process, the saturated nano-porous powder is extracted, dried and inserted back into the void space. The aDsorption cooling process requires heat to dry out the nano-porous material, regenerating the powder for use.

Adsorption cooling within the Energy Cubed

The refrigeration cycle relies solely on using nano-porous materials that can adsorb significant amount of water vapor (refrigerant) under very low pressures.

1. We expose water vapor to our proprietary powder (nano-porous material is non-toxic, chemical-free)
2. The water vapor is attracted to the surface of the powder in a process known as adsorption – creating the cooling effect
3. When the powder is saturated, we introduce waste heat to dry out the powder for reuse
4. In the summer, we pump chilled water to keep spaces optimally cool; in the winter, we pump hot water
5. We integrate into the building management system and are AI + 5G-enabled for optimal energy efficiency

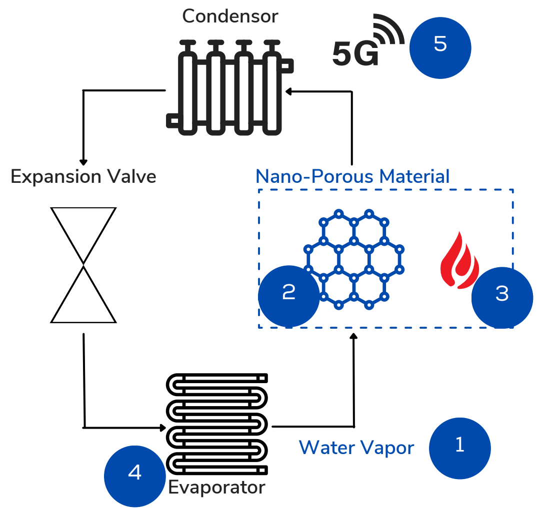

Figure 3

The Refrigeration Cycle

Enersion's heat pump cycle can be described via Clapeyron or P-T diagrams. Fig. 4 shows the P-T diagram for Enersion adsorption. During adsorption/evaporation (step 4-1, 4'-1), a isobaric process, water evaporates in the evaporator using ambient air energy. The vapor is then adsorbed by nano-porous material, an exothermic reaction. When saturated, a valve closes the adsorption chamber connection to the evaporator, slowing evaporation. The adsorber is heated through an internal heat exchanger, raising temperature and pressure (step 1-2) to the regeneration temperature (Treg.). Here, water separates from the nano-porous material.

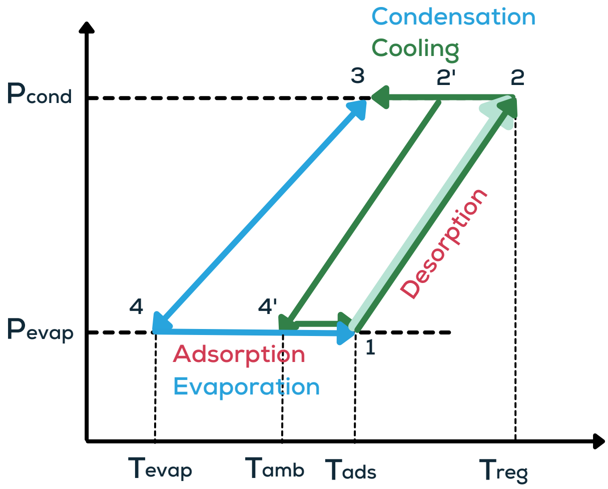

Figure 4

High-temperature vapor (~85°C/185°F) is collected by a condenser, rejecting thermal energy to a building's domestic hot water (DHW) line (Step 2-3), while the hot regenerated nano-porous material (~85°C/185°F) cools by rejecting thermal energy to the DHW line.

By depressurizing the refrigerant, its pressure reaches the evaporator pressure thus reaching point 4. This is similar to passing through the expansion valve in the refrigeration cycle. Regenerated nano-porous material and water return to initial states in the evaporator, ready to repeat the cycle.

Comparison with aBsorption-based systems

	Enersion aDsorption-based	aBsorption-based
Life Expectancy	25 years	7-10 years
Maintenance	Negligible	High
Regeneration Temp (Hot water reqd.)	Above 58°C/136°F	Above 82°C/180°F
Corrosion	None	High
Refrigerant toxicity	None	Ammonia; adverse health impacts

Comparison with mechanical compressor-based systems

	Enersion aDsorption-based	Mechanical compressor-base
Sound Pressure Level	Very Low	7-10 years
Operational Cost	Negligible	High
Maintenance	Negligible (compressor-less)	Regular maintenance req'd.
Global Warming Potential of refrigerants	0	750+
End-of-life	No special disposal	Certified technician required to reclaim refrigerant

Models & Specifications

		Unit	Energy Cubed 20	Energy Cubed 50
Cooling Capacity		kW	70.4	176
		usRT	20	50
Efficiency		COP th	0.6	Up to 0.7
Chilled Water	Outlet Range	C	7 - 16	7 - 16
	Flow Rate	m3/hr	7.64	19.1
	P. Drop	mH20	Pressure Gained	Pressure Gained
	Connection	mm	32	50
Cooling Water	Outlet Range	C	25/40	25/40
	Flow Rate	m3/hr	5.44	13.6
	P. Drop	mH20	3	5
	Connection	mm	25	40
Hot Water	Inlet Temp./Outlet	C	90/55	90/55
	Flow Rate	m3/hr	3.8	9.5
	P. Drop	mH20	Pressure Gained	Pressure Gained
	Connection	mm	25	32
Electric	Power Source	-	208V 3pϕ 60Hz	
	Operational Load	kW	2.8	7
	Total at Max Load	kW	4.04	10.1
	Efficiency	COP e	25.14	25.14