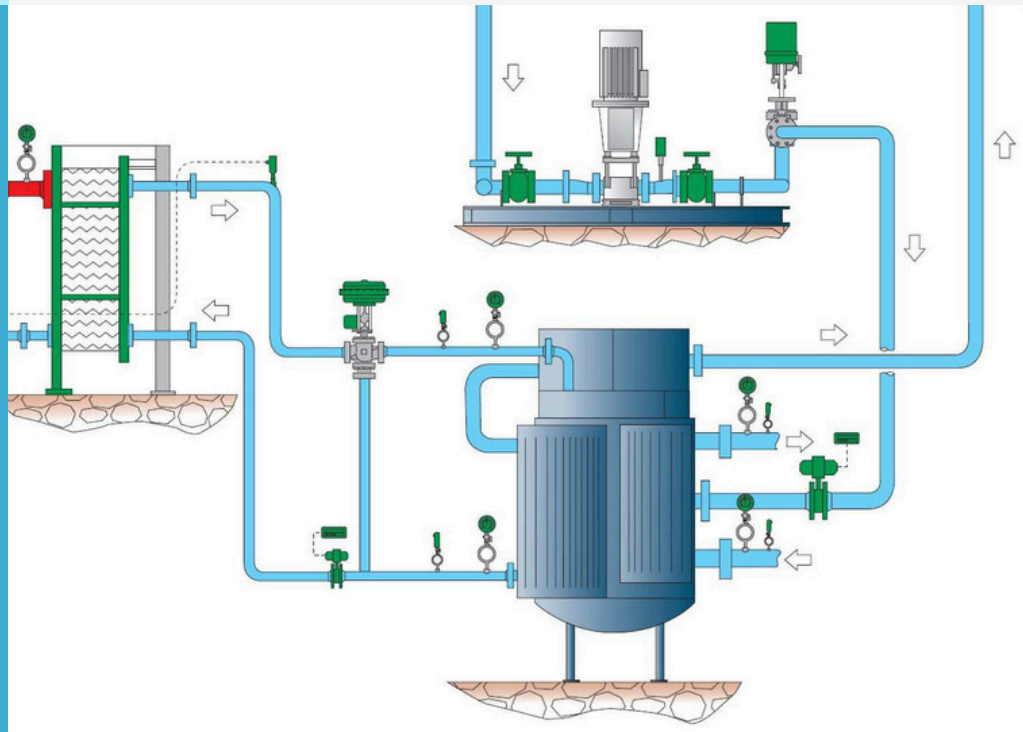
Vamtec Ltd

VAMTEC GUIDE: ABSORPTION CHILLERS IN INDUSTRIAL AND COMMERCIAL APPLICATIONS - PRACTICALITY, HEAT RECOVERY, AND DECARBONISATION



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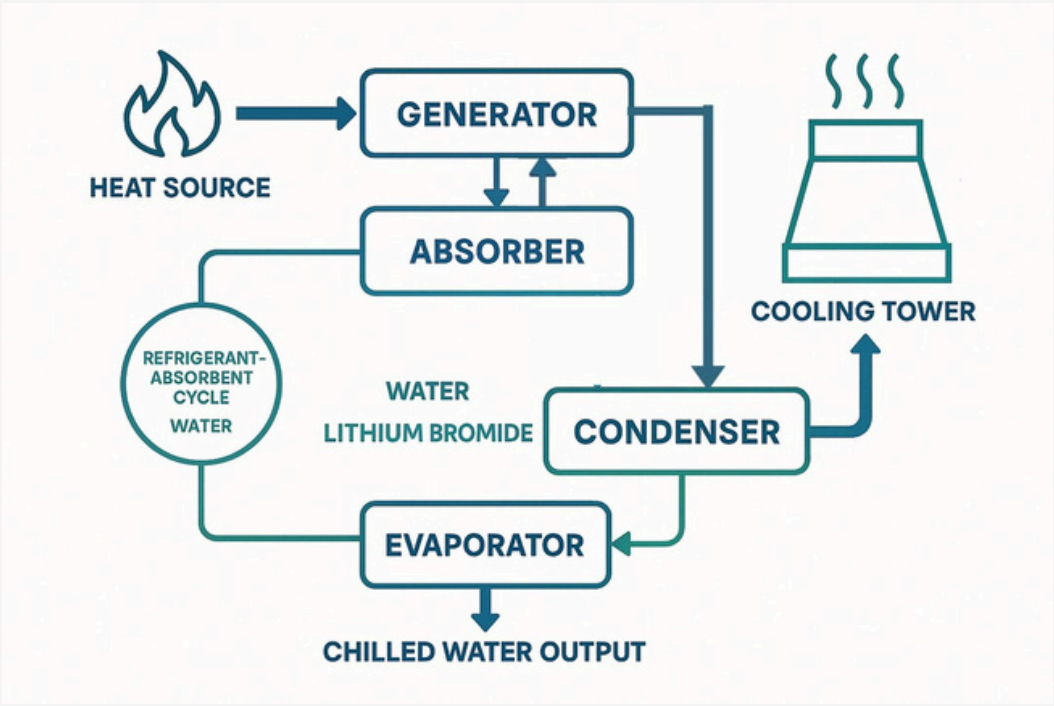
At Vamtec, we specialise in delivering cutting-edge HVAC solutions tailored to the unique needs of commercial buildings in the UK. As businesses strive to meet stringent decarbonisation targets and optimise energy efficiency, choosing the right cooling system is critical. This guide explores the suitability of absorption chillers for the UK climate, compares them with electric chillers for waste heat recovery, and evaluates their role in decarbonisation against air source heat pumps. We provide practical insights, UK-specific case studies, and technical details on chiller types, heat recovery loops, and piping schematics to help you make informed decisions.

ARE ABSORPTION CHILLERS SUITABLE FOR UK COMMERCIAL BUILDINGS?

Understanding Absorption Chillers

Absorption chillers use thermal energy—often from waste heat, solar heat, or low-cost natural gas—to drive the cooling process, unlike electric chillers that rely on mechanical compressors. They employ a refrigerant-absorbent pair (typically water and lithium bromide) to produce chilled water for cooling. Their ability to utilise waste heat makes them an attractive option for energy-efficient cooling in commercial settings.



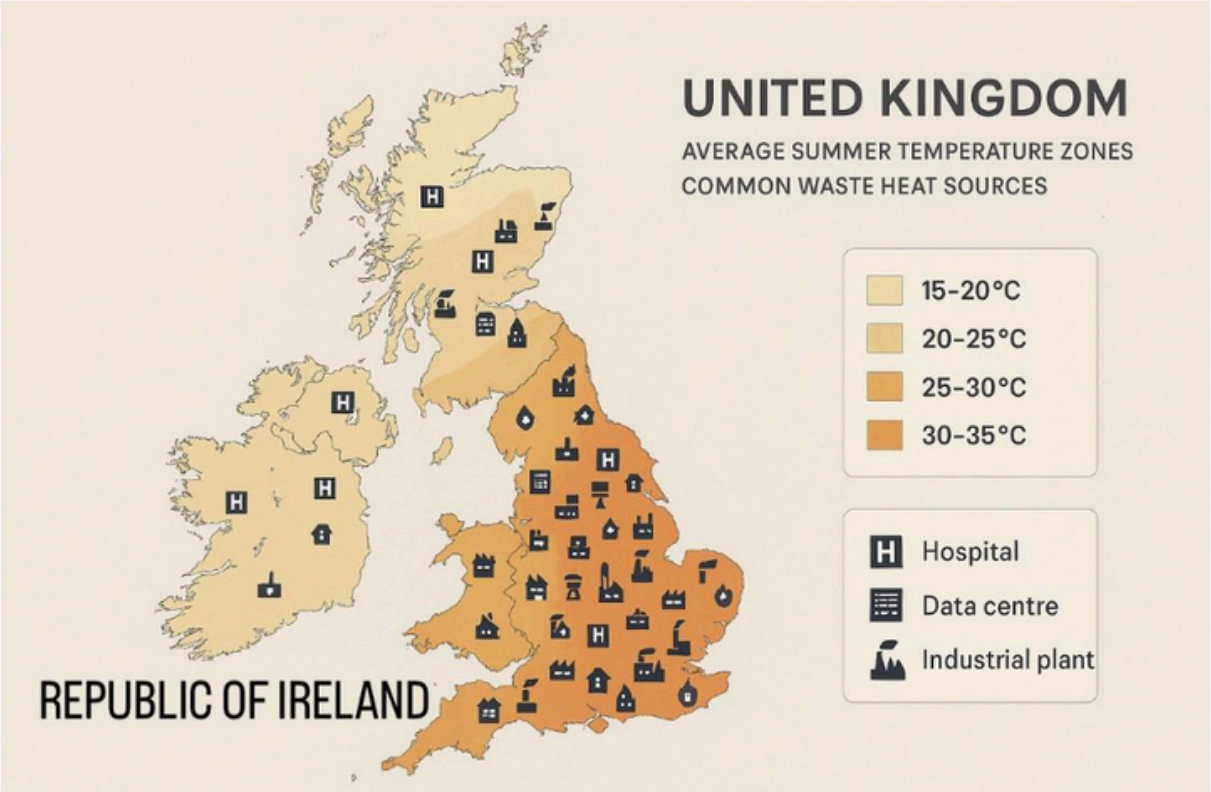
Suitability for the UK Climate

The UK's temperate climate, with average summer temperatures ranging from 15–35°C, presents unique considerations for cooling systems. Absorption chillers are particularly suitable for commercial buildings in the UK where:

- **Waste Heat Availability**: Facilities like data centres, hospitals, or industrial plants with consistent waste heat from processes or combined heat and power (CHP) systems can leverage absorption chillers to reduce electricity consumption. For example, an NHS hospital using a CHP system reduced its cooling energy costs by 30% by integrating a hot water absorption chiller, as the chiller utilised excess heat from the CHP unit.

- **Mild Summers**: The UK's moderate summer temperatures reduce the risk of performance deration in absorption chillers, which can occur in hotter climates (e.g., >35°C) due to high condenser water temperatures. A single-stage absorption chiller in vertical farming maintained a thermal COP of 0.75 during peak summer, providing reliable cooling.

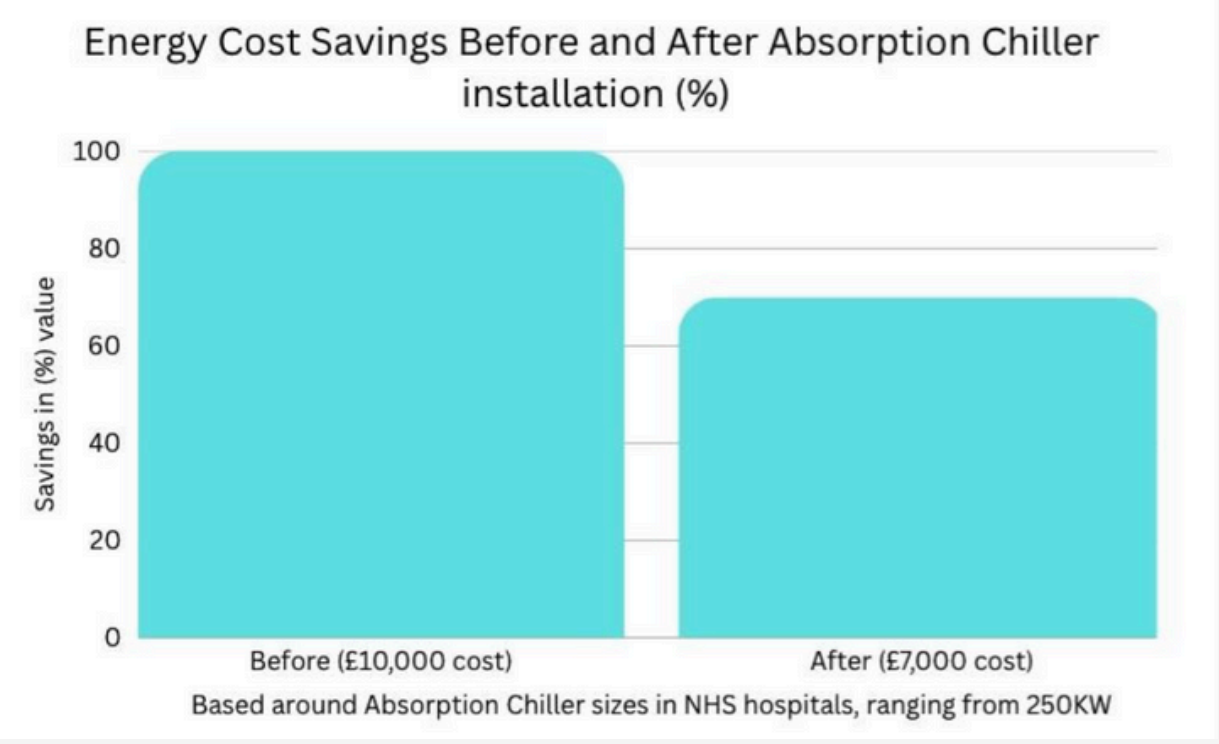
- **District Cooling Networks**: Absorption chillers are ideal for integration with district cooling networks. A case study in Barcelona showed a 5000kW absorption chiller using district cooling network to deliver cooling with a 20% reduction in operational costs compared to electric chillers.



However, absorption chillers require larger cooling towers and more complex piping compared to electric chillers, which may increase initial costs and space requirements. For smaller commercial buildings with limited waste heat sources, their suitability may be reduced unless paired with renewable heat sources like solar thermal collectors.

Key Considerations for an Absorption Chiller Application

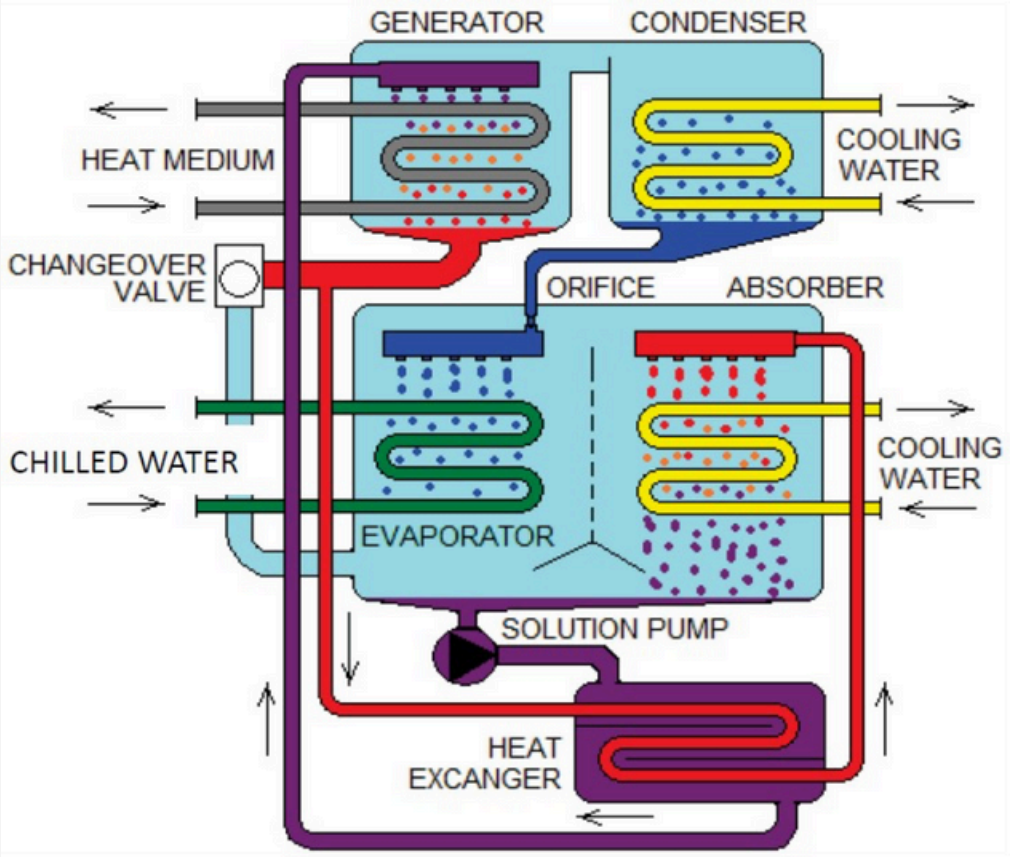
- **Space Requirements**: Absorption chillers have a larger footprint, requiring careful planning in space-constrained urban buildings.
- **Maintenance**: Regular checks for leaks and lithium bromide solution quality are essential, typically requiring professional servicing twice a year.
- **Integration**: Advanced control systems are necessary to optimise performance, especially in variable load conditions typical of commercial buildings.



ABSORPTION CHILLERS VS. ELECTRIC CHILLERS FOR WASTE HEAT RECOVERY

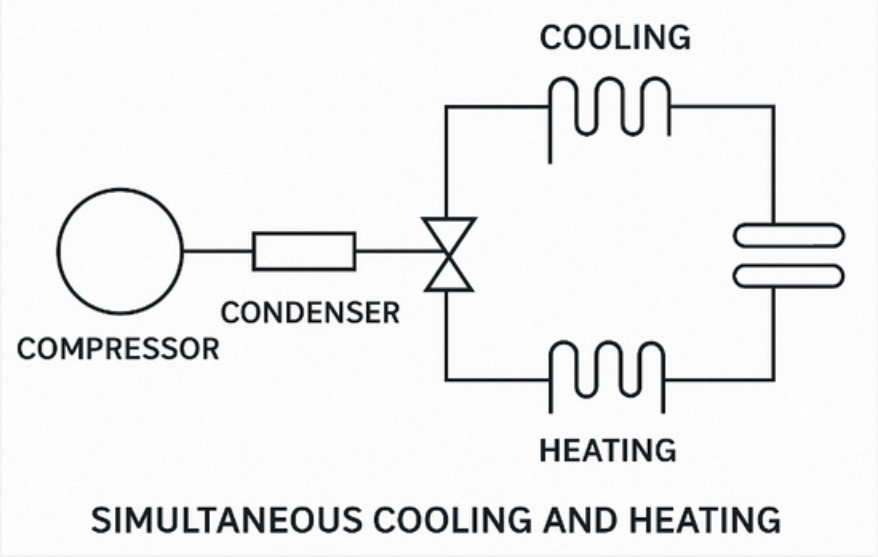
Waste Heat Recovery with Absorption Chillers

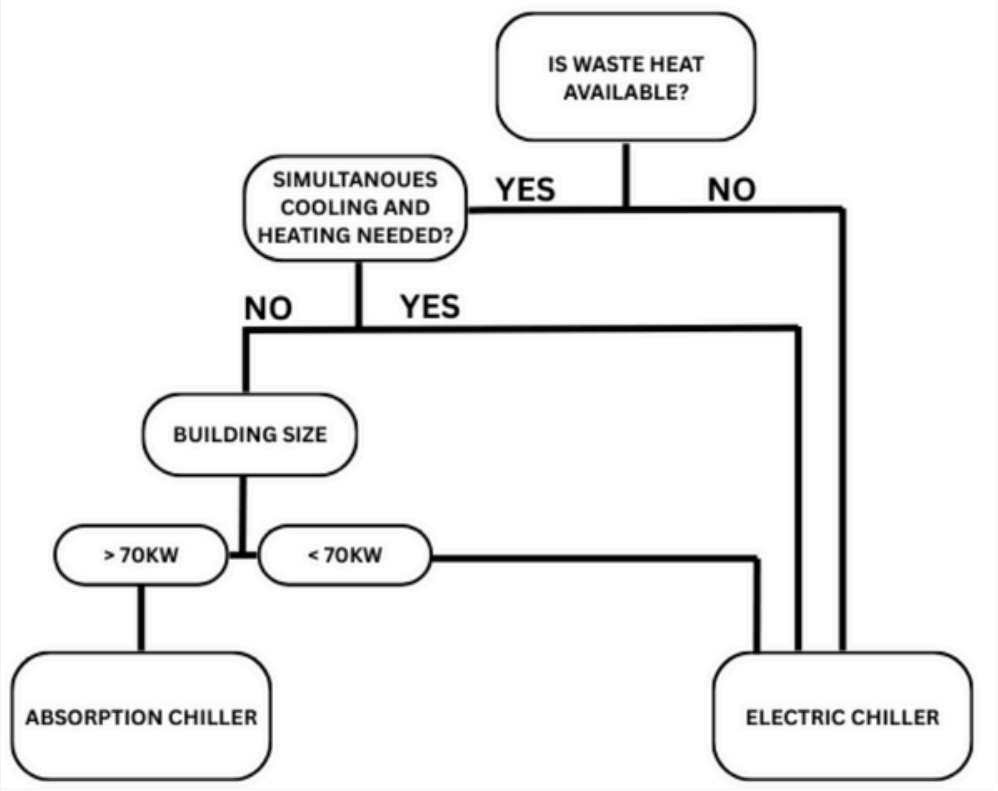
Absorption chillers excel in waste heat recovery, converting low-grade heat (e.g., from industrial processes or CHP systems) into useful cooling. Their design, which is a two-step evaporator and absorber cycle, enhances energy efficiency and reduces crystallisation risks, lowering lifecycle costs. For example, a UK manufacturing facility integrated a 700kW absorption chiller with waste heat from its production process, achieving a 25% reduction in cooling-related energy costs.



Electric Chillers with Heat Recovery

Electric chillers, particularly those with heat recovery capabilities, can capture waste heat from the condenser to produce hot water for applications like space heating or domestic hot water. A dual condenser heat recovery chiller provides hot water at 43 °C while maintaining chilled water output, reducing the need for separate heating equipment. These chillers are more compact and easier to install, with a total COP (cooling and heating) reaching up to 7.0 in optimal conditions.





Comparison: Absorption vs. Electric Chillers

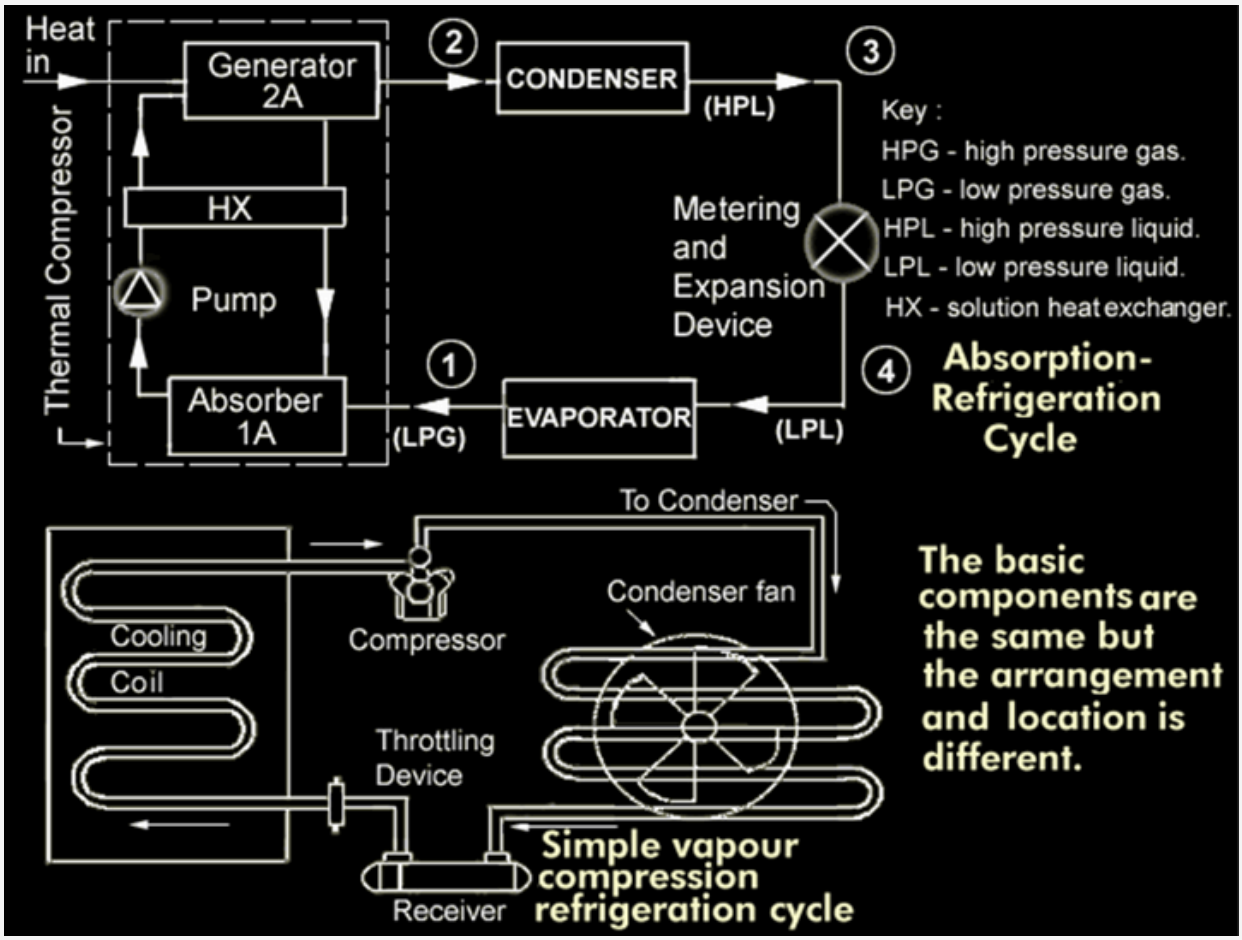
Metric	Absorption Chiller	Electric Chiller with Heat Recovery
Energy Source	Waste heat, natural gas, or solar heat	Electricity
COP (Cooling)	0.7–0.8 (single-stage), 1.2–1.5 (two-stage)	3.0–6.0
Heat Recovery	Limited to hot water production in chiller-heater models	High, up to 60°C hot water output
Initial Cost	Higher due to complex design and larger cooling towers	Lower, simpler installation
Operating Cost	Lower with abundant waste heat	Higher due to electricity costs

ROI Analysis: In a UK context, absorption chillers offer a return on investment (ROI) of 3–5 years in facilities with consistent waste heat, compared to 5–7 years for electric chillers, depending on electricity and gas prices. For example, a London data centre reported a 4-year ROI for a 1000kW absorption chiller using CHP waste heat, driven by lower operating costs.

Piping Schematics for Heat Recovery Loops:

- **Absorption Chiller Loop**: Involves a hot water loop (e.g., 95/75°C for European markets) to drive the generator, a chilled water loop (12/6°C), and a cooling tower loop (27/33°C). A typical schematic includes a shell-and-tube heat exchanger for the absorption chiller and vertical finned coils for the dry cooler, cooled by an axial fan.

- **Electric Chiller Loop**: Features a primary/secondary chilled water loop with a heat recovery condenser loop (32–60°C). A dual condenser design allows independent control of hot and chilled water temperatures, often paired with a heat exchanger to isolate the cooling tower loop.



Recommendation: Choose absorption chillers for facilities with abundant waste heat and prioritise electric chillers for buildings requiring simultaneous heating and cooling with limited waste heat sources. Vamtec's engineering team can help you in optimising heat recovery loops to maximise efficiency.

DECARBONISATION: ABSORPTION CHILLERS VS. AIR SOURCE HEAT PUMPS

Absorption Chillers and Decarbonisation

Absorption chillers contribute to decarbonisation by using waste heat or renewable heat sources, reducing reliance on electricity from fossil fuel-based grids. Their use of water as a refrigerant result in zero ozone depletion and global warming potential. In a Madrid office building, a 105kW absorption chiller powered by a solar thermal system reduced CO2 emissions by 100 tonnes annually, aligning with the Net Zero target.

Air Source Heat Pumps (ASHPs) and Decarbonisation

ASHPs extract heat from ambient air to provide heating and cooling, with COPs of 3.0–5.0, making them 3–5 times more efficient than gas boilers. They are powered by electricity, and their decarbonisation potential increases as the UK grid becomes greener. A case study showed a 500kW ASHP in a commercial complex reducing CO2 emissions by 150 tonnes per year when paired with renewable electricity.

Comparison: Decarbonisation Metrics

Metric	Absorption Chiller	Air Source Heat Pump
CO2 Reduction	High with waste heat/renewable sources (100–200 tonnes/year)	High with green electricity (150–300 tonnes/year)
Energy Source	Waste heat, gas, or solar	Electricity
COP	0.7–1.5	3.0–5.0
UK Grid Dependency	Low, relies on thermal energy	High, benefits from grid decarbonisation
Case Study	Madrid solar-powered chiller: 100 tonnes CO2 saved	150 tonnes CO2 saved

Decarbonisation Analysis: Absorption chillers are superior in scenarios with access to waste heat or renewable thermal sources, reducing grid electricity demand. ASHPs are more effective in buildings with access to renewable electricity and where heating demands dominate. The UK's grid decarbonisation (50% renewable by 2025) enhances ASHPs' long-term potential, but absorption chillers remain critical for industrial applications with waste heat.

Vamtec's role in decarbonisation

Vamtec's absorption chiller solutions, integrate with waste heat sources to achieve decarbonisation goals. We offer bespoke absorption chillers and control algorithms to optimise cooling systems.

PRACTICAL IMPLEMENTATION WITH VAMTEC

UK Case Studies

1. **London Data Centre**: A 1000kW absorption chiller integrated with a CHP system reduced cooling costs by 25% and CO2 emissions by 200 tonnes annually, with a 4-year ROI.
2. **Vertical Farming:** A single stage 2000kW absorption chiller maintained a COP of 0.8, providing reliable cooling to maintain constant temperature and humidity for the vegetables production.
3. **Madrid Office Building**: A solar-powered 105kW hot water absorption chiller saved 100 tonnes of CO2 per year.

Vamtec's Technical Expertise

- **Custom Piping Schematics**: We design heat recovery loops tailored to your building, ensuring optimal flow rates and temperature control.
- **Advanced Controls**: Our intelligent control algorithms maintain chilled water temperatures within ±0.5 K, maximising energy savings.
- **ROI and COP Analysis**: We provide detailed ROI projections and COP calculations based on UK-specific energy prices and climate data, ensuring cost-effective solutions.

Why Choose Vamtec?

- **Tailored Solutions**: We assess your building's waste heat availability, cooling/heating demands, and decarbonisation goals to recommend the best system.
- **Sustainability Focus**: Our solutions align with the UK's Net Zero 2050 targets, leveraging waste heat and renewable energy.
- **Comprehensive Support**: From design to maintenance, Vamtec ensures seamless integration and long-term performance.

Conclusion

Absorption chillers are a practical and sustainable choice for UK commercial buildings with access to waste heat or renewable thermal sources, offering significant cost savings and decarbonisation benefits. Electric chillers with heat recovery are better suited for buildings requiring simultaneous heating and cooling, while ASHPs excel in scenarios with renewable electricity. Vamtec's expertise in HVAC design, heat recovery loops, and decarbonisation strategies ensures your building achieves optimal efficiency and sustainability. Contact us at Vamtec to explore how our absorption chillers and ASHPs can transform your commercial space.