



Dearman.

**a global technology
company delivering clean
'cold and power'**

Dearman's cutting-edge technology uniquely harnesses liquid air to deliver zero-emission power and cooling. It is developing and demonstrating a portfolio of proprietary technologies, products and services, which deliver significant reductions in operating cost, fuel usage and emissions, at low capital cost.

The first application of Dearman technology, to provide sustainable and efficient transport refrigeration, is currently undergoing trials.

With the global demand for cooling growing rapidly, Dearman is well placed to take advantage of the significant market opportunity it presents. The company is already building an international reputation for innovation, rigor, commercial acumen and engineering excellence, all to fulfil its primary objective – to make the world a cleaner, cooler place.

The Dearman engine

Dearman is developing liquid air technologies in partnership with academics, industry leaders and experts in cryogenics. At the heart of this technology portfolio is the Dearman engine – a novel piston engine, which utilises the expansion of either liquid air or liquid nitrogen to provide zero-emission power and cooling.

The Dearman engine builds upon understood and industry tested engine technology, but includes proprietary heat exchange techniques, which significantly increase the efficiency, applicability and cost benefits of the engine.



Dearman engine
Generation 2 design

Liquid air

A Dearman engine can be driven by either liquid air or liquid nitrogen. Liquid nitrogen is a readily available industrial gas, with established supply infrastructures in much of the world.

Liquid air and nitrogen are stored at temperatures below minus 190 °C. As they warm, the gas expands rapidly and can be harnessed to drive the pistons of a Dearman engine. Unique Dearman heat exchange technology, which includes the addition of a heat exchange fluid, significantly increases the efficiency of that process. Liquid air and nitrogen have similar energy density to an EV battery but are far quicker to refuel – taking minutes not hours.

Crucially, the only emission from the Dearman engine is air or nitrogen.

Dearman applications

Dearman technology is being applied to address major global challenges of food scarcity, growing energy demand and climate change. These represent huge challenges to overcome, but also significant business opportunities.

Practical applications of Dearman technology include developing zero-emission transport refrigeration and air conditioning, cutting edge heat hybrids for buses and heavy-duty urban vehicles, and auxiliary power and cooling systems for the built environment. All applications will deliver major reductions in carbon emissions, local air pollution, noise and cost.

Transport refrigeration

The first application of Dearman technology is to provide clean, efficient and cost effective transport refrigeration. This technology is currently undergoing trials and will enter low-volume manufacture in 2016. The global market for refrigerated transport is projected to at least double by 2025, with more than 9.6 million vehicles on the road.

To support the delivery of Dearman technology to the market, the company has formed a significant partnership with Hubbard Products Ltd, the UK's leading transport refrigeration unit manufacturer.

Discussing the potential of Dearman technology to transform the transport refrigeration industry, Pat Maughan, Managing Director of Hubbard said:

"Hubbard, after many years of refining design, has realised that near term future requirements cannot be achieved with existing available components and technologies.

Hubbard has enthusiastically engaged with Dearman to jointly develop a transport refrigeration system that will be the paradigm shift to economic clean cold on the highway. We have reviewed the Dearman technology and concluded it has enormous potential to revolutionise both the emissions and costs inherent in refrigerated road transport."

Future applications

Dearman is investing heavily in R&D to develop future applications of its technology, new products and associated services. The company is currently engaged in a project to develop a waste heat hybrid system for buses and commercial vehicles. The Dearman heat hybrid system is expected to enter on vehicle trials in 2016, with low volume manufacture and extended field trials to begin subsequently.

Dearman is also developing technology to provide cost effective, zero-emission auxiliary power and cooling for the built environment, an auxiliary power unit for commercial vehicles and zero-emission propulsion for urban transport and last mile delivery.

As the world faces global challenges of food scarcity, climate change, increasing middle classes and growing energy demand, how we can deliver clean and sustainable cold is a major issue. Dearman, with its unique clean cold and power technology, and world-class engineering know-how, is well placed to make the world a cleaner and cooler place.