Release: Embargoed until 09.00am, Thursday 9th May 2013.

Liquid air could unlock £1bn industry and 22,000 UK jobs

Liquid air is a proven energy storage technology that could play a critical role in Britain's low carbon energy future, according to a major new report from business and academic experts. The use of liquid air for grid-based energy storage could increase UK energy security, cut greenhouse gas emissions and create a new industry worth at least £1bn pa and 22,000 jobs to the UK, the report found.

The report, published by the Centre for Low Carbon Futures (CLCF), concludes that liquid air technologies could also significantly increase the efficiency of road vehicles, particularly in Britain's fleets of buses, vans and refrigerated lorries.

Liquid air could in the short term:

- Strengthen UK energy security: a single gasometer-style tank of liquid air could make good the loss of 5GW of wind power for three hours - equivalent to almost 10% of the UK's peak electricity needs[i] – and help to protect British homes from black-outs.
- Smaller systems can be used to provide zero-emission back-up and reserve services, warehousing wrong time, surplus energy to replace diesel gensets.
- Reduce diesel consumption in buses or freight vehicles by 25% using a liquid air dearman engine / diesel hybrid.
- Cut emissions from refrigeration on food lorries by 80%.

It also raises the possibility of zero-emission Liquid Air city cars filling up at road-side forecourts at a fraction of current fuel costs and with lower lifecycle vehicle emissions than either electric or hydrogen powered vehicles.

With 'wrong-time' energy from renewable generation a growing challenge to the electricity grid, there is real demand for affordable large scale energy storage solutions both in the UK and abroad. The report highlights the opportunity for a nation-wide network of Liquid Air energy storage plants that are charged by surplus energy at night, feeding the energy back into the system when it is needed most during the day. The plants would be built from standard industrial equipment and technologies in which the UK is a world leader.

Such a network could develop into a business worth at least £1bn per year by 2050 and create 22,000 jobs in the grid electricity storage sector alone, and the Government has recognised this as a major growth opportunity for British industry. *"Liquid air has the potential to open a global market worth tens of billions of pounds,"* said John Hayes MP as Minister of State for the Department of Energy & Climate Change last year. An earlier report for the Carbon Trust found that the savings from electricity storage for the system as a whole could total £10bn by 2050. The CLCF report concludes storage could also cut grid emissions by up to 20% in a high wind scenario.

Professor Richard Williams, Pro-Vice Chancellor University of Birmingham, who led the report for CLCF said:

"Solving Britain's energy crisis requires better ways to store the power of the wind and the sun at large scale without relying on scarce natural resources, and liquid air provides a missing piece of that puzzle."

He added:

"We have an opportunity, and growing need, to scale up our investment in technologies that will ensure the energy from renewables is not wasted, and the opportunities for the UK industrial sector are not lost. The Government is investing to give academic and business communities the chance to lead the world and develop new technologies and industries that can benefit the UK. Liquid air should be part of that effort; as the CLCF report published today shows, it is a prime example of a technology that has the potential to deliver a more efficient energy system and bring the benefits of green growth to the UK.

"Through our report, this conference today, we invite policy makers, the research community and private sector to consider our recommendations, join in the evidence gathering and debate, and build on the work already underway."

As the **Rt Hon David Willetts MP, Minister for Universities and Science,** pointed out in his paper 'Eight Great Technologies', the UK has lost previous opportunities in energy storage to other countries because of the gap between our basic science and our manufacturing techniques. It was that gap which *"gave the Japanese their chance"* in battery technologies, he argues, and *"we must not repeat that mistake".* Responding to the new report Mr Willetts said:

"Energy storage has the potential to bring significant economic benefits to the UK, but we must get better at taking our research through to commercial success. This is why we have invested £30 million to create dedicated research facilities to develop and test new technologies. This will drive growth and put our universities and businesses at the forefront of innovation."

The report will be launched at a conference at the Royal Academy of Engineering on 9th May 2013.

Notes

Liquid Air is a pioneering solution to the problem of energy storage, which captures 'wrong time' energy – such as excess renewable energy produced at night when there is too little demand – storing it to provide peak time electricity and/or low carbon transport fuel. It can be used in grid scale energy storage systems (Highview Power Storage has been running a pilot plant hosted by SSE in Slough for two years) and a number of novel engine designs. The Dearman Engine is a piston engine that runs on liquid air (a commercial demonstration engine is currently being built with Ricardo); while the Ricardo split cycle engine is a highly efficient diesel design that uses liquid nitrogen to capture heat from its own exhaust. Liquid air technologies require no rare or expensive materials such as lithium or platinum.

What is Liquid Air?

Air can be turned into a liquid by cooling it to around -196C using standard industrial equipment. 700 litres of ambient air becomes about 1 litre of liquid air, which can then be stored in an unpressurised insulated vessel. When heat is reintroduced to liquid air it boils and turns back into a gas, expanding 700 times in volume. This expansion can be used to drive a piston engine or turbine to do useful work. The main potential applications are in electricity storage, transport and the recovery of waste heat.

Since the boiling point of liquid air (-196C) is far below ambient temperatures, the environment can provide all the heat needed to make liquid air boil. However, the low boiling point also means the expansion process can be boosted by the addition of low grade waste heat (up to +100C), which other technologies would find difficult to exploit and which significantly improves the energy return. There are myriad sources of low grade waste heat throughout the economy from power stations to factories to vehicle engines. The Dearman Engine could be combined with a conventional engine to make a highly efficient 'heat hybrid'.

The industrial gases industry has been producing liquid nitrogen and liquid oxygen – the main components of liquid air – for over a century. Cryogenic gases have a wide range of applications including steel-making, food processing, medicine and superconducting technologies. The properties of liquid nitrogen and liquid air are similar, so a cryogenic energy vector could be provided by either.

The UK industrial gases industry currently has surplus liquid nitrogen production plant capacity. There is also an estimated 8500 tonnes per day of gaseous nitrogen available for liquefaction which, if harnessed and used as transport fuel, would be enough to power the equivalent of 6.5 million car kilometres daily.

For more information, visit www.liquidair.org.uk

About the new report

Liquid Air in the energy and transport systems: Opportunities for industry and innovation in the UK is published on 9th May 2013 by the Centre for Low Carbon Futures. Contributors include Arup, Ricardo, Messer Group (the world's largest family-owned industrial gases company) and academics from the Universities of Leeds, Birmingham, Strathclyde, Brighton, Queen Mary University of London and Imperial College. Arup and Messer Group both supported the report which can be downloaded from www.liquidair.org.uk.

"Energy usage and the cost of energy is a concern to many of our clients", said Steve Saunders, Head of Energy Storage Business, Arup, who supported the report. "Liquid air energy storage has the potential to have a significant impact on industry and we're excited to be contributing to and supporting this important debate."

About the Centre for Low Carbon Futures

The Centre for Low Carbon Futures is a collaborative membership organisation that focuses on sustainability for competitive advantage. Founded by the Universities of Hull, Leeds, Sheffield and York in 2009 and with the University of Birmingham joining in 2012, the organisation is led by Chief Executive Jon Price. www.lowcarbonfutures.org.

About the Liquid Air Energy Network

LAEN is a newly created forum to explore and promote the use of liquid air as an energy vector, with applications in grid electricity, transport and waste heat recovery. Building on the findings of the Centre for Low Carbon Future's report, LAEN will serve as the global hub where new ideas are demonstrated and shared, and promote liquid air as a potential energy solution among researchers, technology developers, manufacturers, energy producers and consumers, and government. Its membership will be drawn from the same groups. LAEN contact: Toby Peters (Director), www.liquidair.org.uk.

Media

For all media queries please contact Emily Hamilton at Westbourne Communications on 020 3397 0146 or Emily.hamilton@westbournecoms.com

For further information about the conference or the Centre for Low Carbon Futures, please contact Jonathan Radcliffe on jonathan.radcliffe@lowcarbonfutures.org.

ENDS

[i] UK peak demand in 2012 was 55,761MW, http://www.nationalgrid.com/uk/Electricity/Data/Demand+Data/