Reducing food waste, protecting the environment and creating economic growth in India through liquid air cold chains

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43 billion Indian rupee (£4.4 billion) worth of fruit and vegetables wasted annually in India could be better conserved if the country had a sustainable cold chain of refrigerated warehousing and transport, say University of Birmingham (UK) experts in a new study.

As well as agriculture, cold chains could benefit India's position as the world's third largest pharmaceutical producer. Currently, it is estimated almost 20 per cent of temperature sensitive healthcare products arrive damaged or degraded because of a broken cold chain, including 25 per cent of vaccines. Clean cold technologies are also vital to meet the soaring demands of India's new middle class for air conditioning, data centre cooling, convenience foods and home delivery.

The study – "The prospects for liquid air cold chains in India" – will be presented to industry experts at the Automobile Research Association of India, Prune on Tuesday 9 December at an event organised by the UK Science & Innovation Network.

India's current cold chain capacity is tiny compared to potential demand. Less than four per cent of the country's fresh produce is transported by cold chain, compared to over 90 per cent in the UK. However, India is expected to invest almost ₹929 billion (£9.6 billion) in the sector in the next five years, with new analysis for the University of Birmingham study suggesting the Indian refrigerated vehicle fleet may need to grow

almost 100 fold by 2025.

In light of this, Birmingham academics are emphasising that conventional cold chain technologies could have serious environmental consequences, and more sustainable approaches are needed. For example, the diesel-powered transport refrigeration unit (TRU), the workhorse of the global cold chain, consumes up to 20 per cent of the truck's fuel, but also emits 29 times as much particulate matter (PM) and six times as much nitrogen oxide (NOx) as a modern propulsion engine.

One solution to this problem is to use the vast amounts of cold lost to the environment, especially during the regasification of liquefied natural gas (LNG). LNG is natural gas 'packaged' in cold, which is then thrown away when the gas is 'unpacked'. This cold can be recycled to produce cheap, low-carbon liquid air and provide zero-emission cooling and power in a wide range of static and mobile applications. Furthermore, liquid air can also be produced from 'wrong time' renewable energy, such as surplus wind power produced at night when demand is low.

Liquid nitrogen, which can be used in the same way as liquid air, is already widely available in India and the industry has 3,500 tonnes per day of spare production capacity. This would be enough in principle to cool some 17,000 refrigerated vehicles, twice the size of India's current refrigerated truck fleet, and equal to the estimated immediate unmet demand.

Furthermore, the development of sustainable liquid air cold chains in India would require significant numbers of engineers to operate, maintain and eventually manufacture the necessary equipment. This would therefore align with the Government's aims for job and skills growth.

Toby Peters, Visiting Professor in Power and Cold Economy, University

of Birmingham, will present the new study in Pune tomorrow (Tuesday 9 December). Speaking before the event, he said:

"Demand for cooling is on the rise – air conditioning, industrial cooling, data cooling and medical cooling – as well as the need to ensure there is a 'cold chain' of refrigerated storage and transport for food and vaccines.

"Air quality in urban areas across India is an important issue. Therefore it is crucial that a sustainable approach is taken to meet this demand for cooling to leapfrog the mistakes made elsewhere, where cold chains rely on highly polluting fossil fuels. This is why I am delighted to be here in India to speak with industry experts about the need to do cold better, to reduce food loss and keep food prices affordable, whilst also creating economically and environmentally sustainable growth."

Professor Richard A Williams, Pro Vice Chancellor, University of Birmingham added:

"The cold economy is one of the most significant but forgotten challenges of the next generation, bringing together issues around energy, water and food security. With the University of Birmingham's extensive heritage and connectivity to India, we are pleased to be exploring this new frontier work in Pune."

The University of Birmingham is developing radically new technological solutions for cold storage and utilisation. The work includes novel cold storage materials and manufacture technologies that are easier to use, more cost effective and deliver a better performance. Much of this work is undertaken by the Birmingham Energy Institute (BEI) at the University, which is a focal point for the institution and its national and international partners to tackle challenges for meeting future demands to provide cold and power in both an environmentally and economically sustainable way. In 2015, the BEI will lead a 'Commission on Cold' to

investigate solutions to deliver sustainable cooling and power.

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