Sustainably Meeting the Global Food Crisis



Why we need to 'green' cold chains

Report and findings from House of Lords panel discussion, 14th July 2015.

Dearman.

NCCD
National Centre for Cold-chain Development

CARBON TRUST

UNIVERSITY OF BIRMINGHAM

India is the world's largest producer of milk and the second largest producer of fruit and vegetables. Yet the country is home to more than 25% of the world's hungry poor and more than 40% of children below five are undernourished. This is a picture repeated in many countries around the world.

Food is being produced, in abundance in many places, but the challenge is to collect, store and transport it effectively, to ensure that it reaches people who need to be fed before it spoils. More than one third of food is lost between field and market in India and other emerging economies. Overcoming this challenge will require more extensive and more integrated cold chains, which can significantly prolong the life of perishable foods whilst at the same time moving them to market. Crucially, this new infrastructure must include hundreds of thousands of additional refrigerated vehicles to ensure that food can be transported quickly and efficiently from producers to the point of sale.

However, current refrigerated transport technology is mainly diesel-based and highly polluting. To meet the growing demand for farm-to-fork cold chains, developing and emerging economies are therefore faced with a choice – either to use existing polluting technology or leapfrog to a greener solution.

At an event held at the House of Lords, global expert witnesses gathered to discuss how to feed the world's growing population without creating unintended environmental damage.



"Increased food production has its role to play, but it is not the only answer to the question of how to feed a growing population. There is no sense in producing more food when it cannot be moved around a country, to the people who need it. What is needed is a paradigm shift to zero-emission, clean cold technologies to transport food, while retaining its nutritional and economic value. We have to keep food moving – but we must not create an environmental disaster to prevent a social crisis."

Toby Peters, Visiting Professor at the University of Birmingham

The expert panel, Chaired by the Rt Hon Baroness Northover included:

- Captain Pawanexh Kohli – Chief Advisor, National Centre for Cold-Chain Development (NCCD), Ministry of Agriculture, India
- Professor Toby Peters – University of Birmingham and Dearman
- David Sanders – Director of Innovation, The Carbon Trust

Key conclusions

- India, like many emerging economies, needs more food to meet changing consumer requirements and to support its growing population. Globally we need to increase food capacity by 40% by 2030 and 70% by 2050.
- This shortfall in food supply can partly be met by increasing yields. But post-harvest food loss, which some estimates suggest is as high as 40% of perishable produce, must also be addressed in order to maximise the available food reserves, to limit price rises and to further development in rural communities.
- There is an urgent need to establish integrated supply chains across India and many developing markets in order to harvest, pack, store and transport food more efficiently, thereby extending a product's life, along with its nutritional and economic value.
- Refrigerated transport is a crucial element of the cold chain, which must be developed in order to ensure that food can reach the large urban markets in acceptable quality. Currently, India has less than 10,000 refrigerated trucks on the road compared to over 100,000 in France.
- However, diesel-powered cooling, particularly transport refrigeration units, are disproportionately polluting and to increase their numbers would have a negative impact upon air quality and climate change.
- The UK is leading the development of alternative 'clean cold' technologies, including liquid air, which could enable emerging economies to leapfrog established fossil-fuelled equipment.
- Clean cold technologies could offer a long-term export opportunity for the UK, drawing upon its industrial and academic expertise in cryogenics, engineering and finance. This could help create thousands of jobs in the UK and beyond.

Professor Toby Peters – Visiting Professor in Power and Cold Economy, University of Birmingham, and CEO, Dearman

Cold is the Cinderella of the energy debate.

For context, in the UK 16% of electricity demand is for cooling and 70% of food is chilled or refrigerated. Across the European Union, demand for cooling in buildings alone is set to increase by 72% by 2030. Despite cold being vital to the transport of food and medicine, and to the functionality of data centres, hospitals and buildings, there are currently no policies governing cold or cooling. While there are established policies concerned with heat and electricity, cold remains overlooked.

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As much as our lives are underpinned by cold, there is rapidly increasing demand for cooling in emerging economies. By 2030 the world will see a six-fold increase in the middle class. This more affluent population will require access to fresh food, modern healthcare and digital communications – services that rely on cooling.



Research suggests that up to 40% of food produced in India is lost post-harvest – spoiling before it can reach market. By 2030, the FAO estimates there will be an additional 1.5 billion people to feed. By 2050 food production will need to increase by 70%.

However, increasing yield is not the only answer – there is no sense in producing more food when it cannot be moved safely around a country to the people who need it. Feeding the booming urban population and ensuring that rural communities retain the value of their produce is reliant on cold chains.

There is a common misconception that cold chains are made up of cold stores and other fixed infrastructure. However, it is essential to keep food moving – and for that we need refrigerated trucks to connect farms with cold stores, and ultimately the point of sale.

Investment in this infrastructure is already underway. Cold chain industries in China and India are growing by 25% per annum. Globally the fleet of refrigerated trucks is expected to increase from 2.5 million to more than 15 million in the next 10 years.

"There is a sizeable opportunity for India and other developing economies to leapfrog the diesel-based cold chains that dominate developed countries and contribute to poor air quality."

However, consuming up to 20% of a truck's diesel, the refrigeration units that power the cooling for perishable cargo are disproportionately polluting. They emit NOx, particulates and CO2 – far more in some cases than the main truck engine. There is a very real danger that in solving a social challenge – the provision of food and medicine – it will create an environmental crisis.

To avoid this, we must look at cold at a systems level and establish clean cold chains. There is a sizeable opportunity for India and other developing economies to leapfrog the diesel-based cold chains that dominate developed countries and contribute to poor air quality. We need not just cold chains, but clean, sustainable cold chains.

	Current	New Regulations
Fresh Fruit / Veg	5%	20%
Meat	15%	50%
Seafood	23%	65%

Table showing existing and future Chinese government targets for perishable food that will be required to be handled through a cold chain.

Captain Pawanexh Kohli – Chief Advisor, National Centre for Cold-Chain Development, India

Let there be no doubt that there is a global food crisis! There are 795 million people suffering from hunger – that's 525 million people in Asia, 215 million in Africa, 37 million in Latin America and the Caribbean.

This food crisis is most prevalent in producing regions, areas that have a food surplus, not a food shortage. The question is why? The answer… because there is a lack of connectivity from farms. The produce harvested is not efficiently linked with the consuming centres. This lack of transport connectivity is the key factor that results in gross food loss, said to be 30% to 40% of what is produced globally.

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The standard response to this problem is to produce more, to raise farm productivity. But producing more to waste more is not a long-term or holistic solution. The primary task would be to build more effective supply chain systems – we need to build bridges between farms and urban demand centres. The solution is to first build better handling and transportation systems.



Food security is defined as easy and affordable access to food. If we up the input costs, to produce much more, and we continue to lose large amounts of what is produced, we only end up losing resources, making the food more unaffordable, the chain more unsustainable.

In many parts of the world, science has helped agriculture to produce more. Now the world needs to shift from traditional measures of productivity to one of gainful productivity. Food delivered should be the end-aim, whereas food lost should be a factor in measuring productivity.

The highest loss of food occurs in the perishable sector, high-value foods, for which the cold-chain alone can serve as a conduit to consumers. Cold-chain is not merely about holding inventory in refrigeration but about buying a little time so as to reach far away markets. This time is best utilised in motion to cover more distances, to reach more consumers. It should therefore be viewed more as inventory in motion.

Take India's example, which has the world's largest cold store footprint. These serve as platforms or staging areas for handling perishable goods. To date they have proved successful, but are in use for only a few crop types. Ireland's potato has become our staple thanks to our cold stores.

The next step is to integrate with a wider basket of farm produce, and this means developing refrigerated transport and pack-houses at source points. The job of pack-houses is to prepare and pre-condition the harvest to make the trip to market and the reefer transport is a key link in establishing this connectivity. In India, we estimate, to meet our current consumption for fruits and vegetables, almost 40% of future investment will be in reefer transport units and an equal amount in modern pack-houses at farm-gate. We would need, at a minimum, a six-fold increase in our reefer fleet along with pack-houses. This in turn creates near-farm jobs, and the connectivity creates reason to produce more.

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India is proof of effective use of cold-chain and the high level of impact on populations. Eradicating polio was thanks to the cold-chain, and millions have benefited from other uses such in grapes, dairy, meats and fish sector. We understand the impact that effective use cold can make on people's lives, as well the need to do much more with it.

Addressing the food delivery chain will also benefit regions that depend on far away sources for their food. India has enacted the Food Security Bill and many other producing areas will move priority towards their own citizens. This will naturally impact on supply and the cost of food in non-producing regions. Hence, global efforts towards improving and expanding the food logistics chain are important for both developed and developing nations.

Acting in this direction, we also need to keep in mind the environment impact from increased logistics. Today, on the environment front the producing areas have low carbon emissions and have far more favourable ecological footprints. As a comparison, India has an ecological footprint of 0.91 gha/person and UK's footprint is 4.89 gha/person. This means that almost 5 planet Earths are needed to sustain the lifestyle of the United Kingdom. To be future ready, the technologies that will keep the food logistics chain green need to be consciously developed. Solving the food crisis should not lead to an environmental crisis.

David Sanders – Director of Innovation, The Carbon Trust

What can the UK do to facilitate sustainable cold chains? The UK has expertise in cryogenics, engineering and finance – we are not unlike the USA in this respect, so why is the cold chain revolution happening in the UK?

In actual fact, the UK's cold chain is relatively energy efficient. Market competition has driven efficiency in supermarkets, for example. This has given rise to a swathe of innovation in the refrigeration and air conditioning industry. Companies like 4energy and PowerOasis are innovating to improve cooling in data centres, while Camfridge, Enviro-Cool, Simply Air by Hubbard are developing refrigeration technologies of their own.



From left to right: David Sanders, Professor Toby Peters, Rt Hon Baroness Northover, Captain Pawanexh Kohil

Much of this wealth of innovation has come from the UK's system-level expertise, with organisations like University of Birmingham, Ricardo and Dearman leading the way. This approach has been applied to heat and electricity, improving the sustainability of these processes over the last decade or so considerably, but only recently has it been applied to cold.

India has the opportunity to leapfrog traditional diesel cooling systems. The country has done this with telecoms – instead of building a fixed telephony system, the country has jumped to mobile communications. Applying this same forward-thinking approach to the cold chain is possible and, as we have heard, vital.

"Doing so has the potential to generate 10,000 jobs for the UK by 2025 – a number that could increase to 25,000 by 2050."

The UK has the opportunity to help countries like India and thereby to lead the world – innovating, building, testing and commercialising the technologies that could support a clean cold revolution in emerging economies. The Carbon Trust recently brought out a report which stated that commercialising clean cold technologies has the potential to generate 10,000 jobs for the UK by 2025 – a number that could increase to 25,000 by 2050 across development, manufacture, and after sales support.

This will require government, academia and industry to work together. But, if the government is able and willing to support the emerging 'cold economy' then the benefits could be substantial, both for countries such as India and for the UK's long term economic success and food security.

'Doing Cold Smarter' Policy Commission, Birmingham Energy Institute, University of Birmingham

This Policy Commission has been set up to explore the opportunity, and economic and environmental value to the UK of an integrated and systems approach to cooling, and to propose areas of research and policy instruments to achieve it. The Commission academic leads are Professor Martin Freer, Director, Birmingham Energy Institute and Professor Toby Peters, Visiting Professor in Power and Cold Economy. It is chaired by Lord Teverson and draws together expert commissioners, including David Sanders, The Carbon Trust.

The need – Professor Toby Peters

"We need to make our energy systems more economic and resource efficient, lower carbon and less polluting. We also need to ensure our energy model is sustainable, affordable and resilient, and that it fully recognises the real value of potential resources that are under-utilised.

"Cooling is a critical infrastructure on which modern society relies – but current technologies are also highly polluting and in cities often self-defeating through the heat island effect. The environmental damage will significantly increase globally over the coming decades with the rapid growth of a huge new middle class and increased urbanisation. Large amounts of cold are currently wasted – especially during the re-gasification of LNG – which could be recycled to provide cold at much lower environmental and financial cost.

"Although vital, compared to electricity, transport and heat, cold has received very little attention in the energy debate so far. As a result, there is no joined up infrastructure to capture, distribute and deliver cold efficiently. While we are seeing incremental efficiency improvements in cold technologies, we need a paradigm shift in order to meet future demand sustainably."

The Commission is currently taking oral and written evidence from experts in academia, industry and the third sector and will report back its findings in the autumn. If you would like further information or would like to submit written evidence please click here.

BIRMINGHAM POLICY COMMISSIONS

Key Points from Audience Discussion

Waste Cold and LNG

There is a significant opportunity to capture and reuse stranded or 'waste' cold, and this could present a substantial opportunity for India. During the regasification phase for liquefied natural gas (LNG) in India a significant amount of cold is thrown away when it could otherwise be reused.

This concept needs explaining further to policy makers and industry. Industry needs to be encouraged to recognise the value of this waste cold and to develop business models for its use; in effect put a value on it.

To demonstrate the scale of waste cold available, in 2030 the UK will throw away around 80TWh of 'coolth,' whilst the national cooling demand will be around 90TWh. Not all of the cold can be re-used but a large quantity could be used for transport and built environment cooling requirements, displacing fossil fuel using liquid air and other thermal energy carriers to move it.

Out of food wasted, how much can realistically be saved

The International Institute of Refrigeration estimates that 200 million tonnes of perishable food could be preserved if developing nations had the same level of cold chain as found in the developed world.



Phasing out HFC in the developing world

India already has a strong record on the use of low global warming potential refrigerants – 98% of India's cold storage facilities are ammonia-based. It was noted that the overall pollution challenges of refrigeration are CO_2, Nitrous Oxide (NOx), Particulate Matter (PM), noise and refrigerants. There needs to be a holistic solution that takes on all of these challenges simultaneously.

The emissions from diesel in cold chains in London

Around 20% of diesel on transport refrigeration vehicles is used solely for the refrigeration. Making all refrigerated transport in London zero-emission, would be equivalent to removing the same amount of particulate matter as taking over **300,000** Euro VI diesel cars off the road. In terms of NOx, this would equate to removing over **150,000** Euro VI diesel cars off the road or almost **6,000** Euro VI trucks.

Market readiness of liquid air or liquid nitrogen technology

In terms of market readiness, Dearman, a UK-based technology company, currently has a transport refrigeration vehicle on trial at MIRA, the UK's motor research specialists, and it will be in commercial field trials later this year. Next year there will be trials in three European countries.

If India could run a cold chain facility with LNG waste cold using liquid air or nitrogen technology, it would be the world's first zero-emission facility. India has a mature industrial gas industry with spare capacity of liquid nitrogen and capability to produce liquid air. Currently, 500 cold stores run on diesel generators around Delhi for 8 to 10 hours per day. If this could be done using liquid nitrogen, then there is a large opportunity to improve the air quality.

For more information please contact:
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