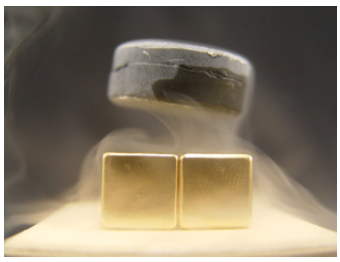

STFC commissioned our team to assess **the economic impact of STFC's capabilities and investment in cryogenic technologies**. Cryogenic systems find application in fields as diverse as food freezing, manufacturing and engineering, medicine and life sciences, satellite applications, astronomy, space exploration, transport and storage of liquefied natural gas, energy (traditional and alternative sources), avionics, defence and security, and in superconductivity.

Although not many people will recognise the term and relevance of these technologies to everyday life, **cryogenic technologies have brought improvements in people's life e.g. MRI Scanner, and through commercialisation of research, have contributed to creation of new businesses and sectors.**

Assessing the economic impact of enabling technologies, however, poses a few methodological challenges. Enabling technologies achieve their economic impact through two principal channels:

i) *enabling* another technology to happen or a user to perform a task – as intended or by empowering productivity improvements and advancements; and

ii) through *disrupting* a status quo, by introducing new ideas, processes, and products (i.e. essentially inventing or innovating) and thus constructing new ways in terms of how things are done and, potentially, of how we live and work.

The study has bee important in setting out pathways to impact of cryogenic capabilities in different areas of the economy and society for scientific and non-scientific audiences and showcasing of current and future impact.

Research was based on a combination of qualitative and quantitative techniques including quantitative assessment of direct and indirect economic impacts, as demonstrated by employment and GVA growth; comprehensive case studies representing contribution in different sectors; and a wide range of consultations and extensive desk-based research to enable mapping out of STFC's cryogenic capabilities to date, in progress and the future.

There are a number of potential impacts of cryogenics that could be substantial in the future:

- **Rapid Surface Chilling™** - a new cryogenic approach developed by BOC and Bernard Matthews Ltd, which results in reduction of campylobacter counts by 90-95%.
- **Cryogenically-cooled superconducting wind turbine generators** - these could lead to global savings of £9.3 billion, and experiments in the cryogenic-cooling of microchips that could have application in energy, defence and security.
- **Bioenergy** i.e. generation and storage of bio-methane for distributed domestic power generation and heating. For the same reasons as for natural gas, liquefying the biogas/bio-methane brings volume and range advantages; and cryogenics plays a significant role in storage and transport of energy sources and, in particular, gases including biogases.
- **Nuclear fusion** - STFC-funded research in terahertz detection systems is being used in the Joint European Torus and at the International Thermonuclear Experimental Reactor in order to help realise fusion as a sustainable world energy source.
- **Quantum technologies** - creating, exploiting, controlling and maintaining the ultra-low temperature environment is crucial for the research and development of quantum-enhanced devices; demand for cryogenics expertise and skills will increase as research in this area intensifies.

The final report can be found here:
http://www.stfc.ac.uk/research/engineering-and-enabling-technologies/the-uk-impact-of-cryogenics/

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