by THE ENERGY MANAGERS ASSOCIATION

THE INDUSTRY INTERVIEW

Energy Management at the British Antarctic Survey

In this regular feature, we focus on how organisations across different industries approach energy management. In this issue, we are going further than ever before with Parthena (Nopi) Exizidou, the Energy and Carbon Reduction Manager at the British Antarctic Survey (BAS).

Our work at BAS aims to unlock the secrets of Antarctica's past and present in order to help predict environmental change and improve our understanding of the planet. Through our world-class multidisciplinary science at BAS, we seek to answer fundamental questions around the links between human activity and climate change: What is the likely impact? What is the extent? And what is the timescale of this global change?

Our operations span across Antarctica and the Arctic, and we take our polar expertise to other parts of the world where it is of value, such as measuring the amount of fresh water stored in the Himalayan glaciers. BAS HQ in Cambridge supports Britain's polar research effort through the provision and management of large-scale polar infrastructure assets, services and facilities. BAS operates three research stations in the Antarctic, two on sub Antarctic South Georgia, and one in the Arctic. In addition to the stations, research platforms include two ice-strengthened Royal Research Ships, a fleet of specially adapted aircraft and various off-the-shelf and specialised vehicles.

What does energy management mean at BAS?

BAS has a wide range of energy-intensive operations in the Antarctic, the Southern Ocean and the Arctic which comprise shipborne and airborne science, logistics support and operation of stations and field camps.

The remote nature of BAS operations combined with climate and logistical challenges has the potential to further increase the risks associated with fuel dependency and carbon emissions. It is therefore a high priority for BAS to reduce the carbon footprint whilst providing high quality living and working conditions for the scientists and science support staff. Energy management is the means to ensure the achievement of the energy and environmental targets and drive innovation throughout the process.

How does BAS deal with energy management?

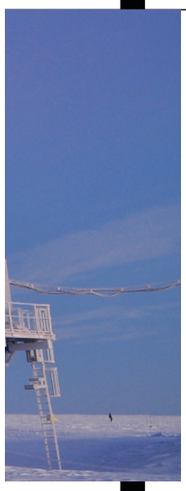
Antarctic stations & deep-field operations

The remoteness of the Antarctic stations and the extreme environmental conditions can be challenging, from delivering fuel to the stations to generating electricity, heating the buildings and producing potable water. Meeting the energy and water demands requires robust and reliable systems with backups that can be maintained and serviced on site by the BAS team. These include Combined Heat and Power systems that meet not only the power demands of the station, but also heating and hot water demands through the recovered heat. The production of potable water is delivered through Reverse Osmosis plants using sea water or by melting snow with heat from the generators. BAS also maintains a very effective hydro-electric plant at an existing dam at King Edward Point in order to meet the power demands of the station.

In addition to the operation of the stations, BAS enables deep-field science through an innovative system for transporting science teams and their equipment across vast areas of Antarctica's ice. Vehicles and sledges, known as a "Tractor Train Traverse" tow equipment and accommodation across hostile terrain, enabling science and support teams to live and work in remote areas a long way from the research stations at Rothera or Halley. The use of tractor traverse has replaced flying and has helped reduce the carbon footprint of deep field operations.

Ships

Operating our ships is a major contributor to our carbon footprint but absolutely essential. The BAS ships undertake research work and support logistics by delivering food, fuel, people and transferring cargo. At the moment, construction is underway of a new polar research ship, the RRS Sir David Attenborough (SDA), which will replace the RRS



Ernest Shackleton and the RRS James Clark Ross, which are nearing the end of their 25-year lifespan.

With greater fuel efficiency and an ability to use remotely operated and robotic technologies, the SDA is expected to reduce the environmental impact of ship-borne science and save more than £100m in operating costs over its 30-year lifespan.

The vessel will be fitted with four main engines, a configuration of different engine sizes that will allow for efficient operations across a wide range of conditions. In addition, a smaller harbour generator is also installed to allow the vessel to operate when in port without the main engines idling. The four main engines operate on ultra-low sulphur fuel containing less than 0.1% sulphur. This limits sulphur oxide emissions and meets the latest international environmental agreement MARPOL's (Maritime Pollution) requirements for operating in sulphur emission-controlled areas.The engines will also meet MARPOL requirements to limit the emissions of nitrogen oxides (NOx). In addition, the main engine exhausts are fitted with selective catalytic reduction (SCR) units, which use urea injection to further reduce emissions of NOx to meet strict MARPOL Tier III limits.

The vessel will be provided with a Green Passport to facilitate the application of the IMO (International Maritime Organisation) Guidelines on Ship Recycling. This document is produced by the shipyard at the construction stage and contains an inventory of all materials used in the construction of the ship. It is produced in a format that allows any subsequent changes in materials or equipment – for example, during a refit – to be recorded. This information is useful for recycling and safe disposal purposes at the end of the ship's life.

UK headquarters

In Cambridge, the Carbon Management Plan (CMP) is driving change and delivering significant energy savings. The first two priority projects under the CMP that are currently undergoing are the refurbishment of the Antarctic Aquarium and Cold Laboratories with the use of CO_2-based cooling and refrigeration plant and the development of a solar carpark.

The new CO_2-based plant will meet the cooling and refrigeration demands of the upgraded Aquarium and Cold Laboratories facility and reduce significantly our carbon emissions and energy consumption. The energy reduction will be achieved by the insulation improvements, the heat recovery system and increased efficiency of the cooling/refrigeration systems.

The carbon footprint of the area will be more than 50% reduced due to the replacement of conventional refrigeration with low Global

Warming Potential refrigerant and due to the heat recovery potential, which will meet part of the hot water demands of the site. The replacement of the ageing systems will facilitate science delivery, reduce our carbon footprint and our energy bills.

In parallel, solar carports are currently being installed above the existing carpark bays at BAS Cambridge, integrating electric vehicle charging points. A new secure access controlled bicycle facility with a solar roof will increase the capacity for bike storage at BAS by 50% and contribute to the electricity generation from renewables. The project will deliver an annual reduction in carbon emissions by 35 tonnes and will meet 5% of the electricity demands of the site.

These are exciting and innovative projects bringing new technologies to BAS in the form of energy efficient CO2 refrigeration and state of the art controls and monitoring systems. Increasing renewable energy generation and continuously investigating energy efficiency technologies assists in driving innovation and future proofing BAS operations and facilities.
Moreover, at BAS Cambridge the electricity supply, through CCS Framework, is backed from 1st of April 2019 by certified renewable technologies (like wind, solar and biomass) which all have a zero emissions rating. That takes the BAS market-based emissions to zero.

What areas of every day's business at BAS are most challenging in terms of energy management?

Following the decision to operate Halley VI as a summer-only station until the Brunt Ice Shelf stabilises, BAS scientists and engineers spent last winter working on automating instruments at the station to enable ongoing data collection throughout the Antarctic winter when the station is unoccupied. The Halley automation project consists of a micro-turbine power supply and datalink to a suite of autonomous scientific instrumentation around the station and on the ice shelf.

Both the remote monitoring and science data streams are being successfully transferred back to Cambridge via the Halley VSAT link, which will remain active throughout the winter months. BAS is now looking ahead to next season at Halley, where the aim is to further increase the number of automated science experiments to extend the scientific output from the station.

The success of the Halley Automation Project will have a crucial impact to BAS future operations in line with minimising our environmental impact to the pristine Antarctic environment by reducing the BAS carbon footprint without compromising science quality and output.

How is energy management viewed by the organisation's stakeholders?

At BAS, we are extremely aware of the delicate nature of working in Antarctica and take environmental stewardship very seriously. In addition to the above, all our science is carried out in accordance with the Environmental Protocol to the Antarctic Treaty and follows strict environmental controls.

BAS aims to achieve the highest possible standards for its own environmental performance and to be a leader in environmental management in its field.

Minimising the environmental impact through effective energy and carbon management is a priority not only for BAS but also for BAS collaborators and the Natural Environment Research Council (NERC). None of the described projects and actions would be delivered if it wasn't for the support and passion of BAS & NERC teams, our technical advisors and construction partners.

Can you describe an energy management project that reflects the organisation's principles when it comes to energy management and environment?

There is so much happening at BAS that will have a positive impact in reducing fuel use and carbon emissions. The Antarctic Infrastructure Modernisation (AIM) Programme will transform how BAS enables and supports frontier science. Commissioned by the Natural Environment Research Council (NERC), this long-term programme will enable a world-leading capability to ensure that Britain remains at the forefront of climate, biodiversity and ocean research in the Polar Regions.

As part of the programme, a new Science and Operations building at Rothera Research Station is being designed that will replace the old energy-intensive buildings; new site wide services will ensure reduction of environmental impact and operating costs and future-proof Rothera as a hub for a wide range of BAS, UK and international collaborative science programmes.
To improve the energy efficiency of Rothera, we have developed a site wide energy strategy. With the help of our technical advisors a bespoke tool was developed - the parametric Energy Simulation Workflow (ESW).

The next step was to identify and develop the optimal sustainable designs for heating and powering the research station. The ESW combined the CIBSE best practice energy modelling methodology with genetic algorithms to goal seek and find the best possible solution within stated parameters.

The tool evaluated solutions from over 5 million scenarios in a matter of weeks, ensuring that no stone was left unturned. The proposed solution not only meets energy demands, it reduces fuel consumption by more than 35%, a key component in the Rothera modernisation.

After undertaking the energy modelling, the mechanical and electrical services strategies were designed, using the optimal solutions to deliver the best energy efficiency, whilst ensuring they are simple to maintain by the BAS team. The proposed solutions include waste heat recovery from electricity generation, which will be fed into a district heating network and distributed around the station. A mix of Combined Heat and Power units of different sizes and solar PVs has also been included in the proposed design.

In addition, as part of the effort to deliver upgraded energy efficient facilities, BAS is using the environmental and sustainability assessment tool - BREEAM with the target to achieve an excellent rating for the Science and Operations Building at Rothera.

In future phases, we aim to further reduce the energy demands of the station and introduce large scale renewable and energy storage systems which will facilitate BAS to achieve the development of a carbon-neutral Antarctic station.

What is in the pipeline for the future?

Addressing the challenge of global warming and the Paris Agreement is now introduced to our Operation Strategy. Developing Science Based Targets, a commitment to climate action and an ambitious vision for the future will help BAS remain at the forefront of climate protection, influence policy and drive change within its supply chain and beyond. On wider sustainability, our focus is also targeting a sustainable food policy for all Antarctic stations/ships and Cambridge offices and improving the implementation of our sustainable procurement policy.

Author's profile:
Parthena (Nopi) has an engineering background and 10 years of experience in energy efficiency in the built environment sector. Since 2017, she has been part of the BAS team, developing the organisation's energy and carbon reduction strategy and leading on carbon reduction initiatives of all BAS operations including Cambridge HQ, Antarctic stations, ships and aircraft.