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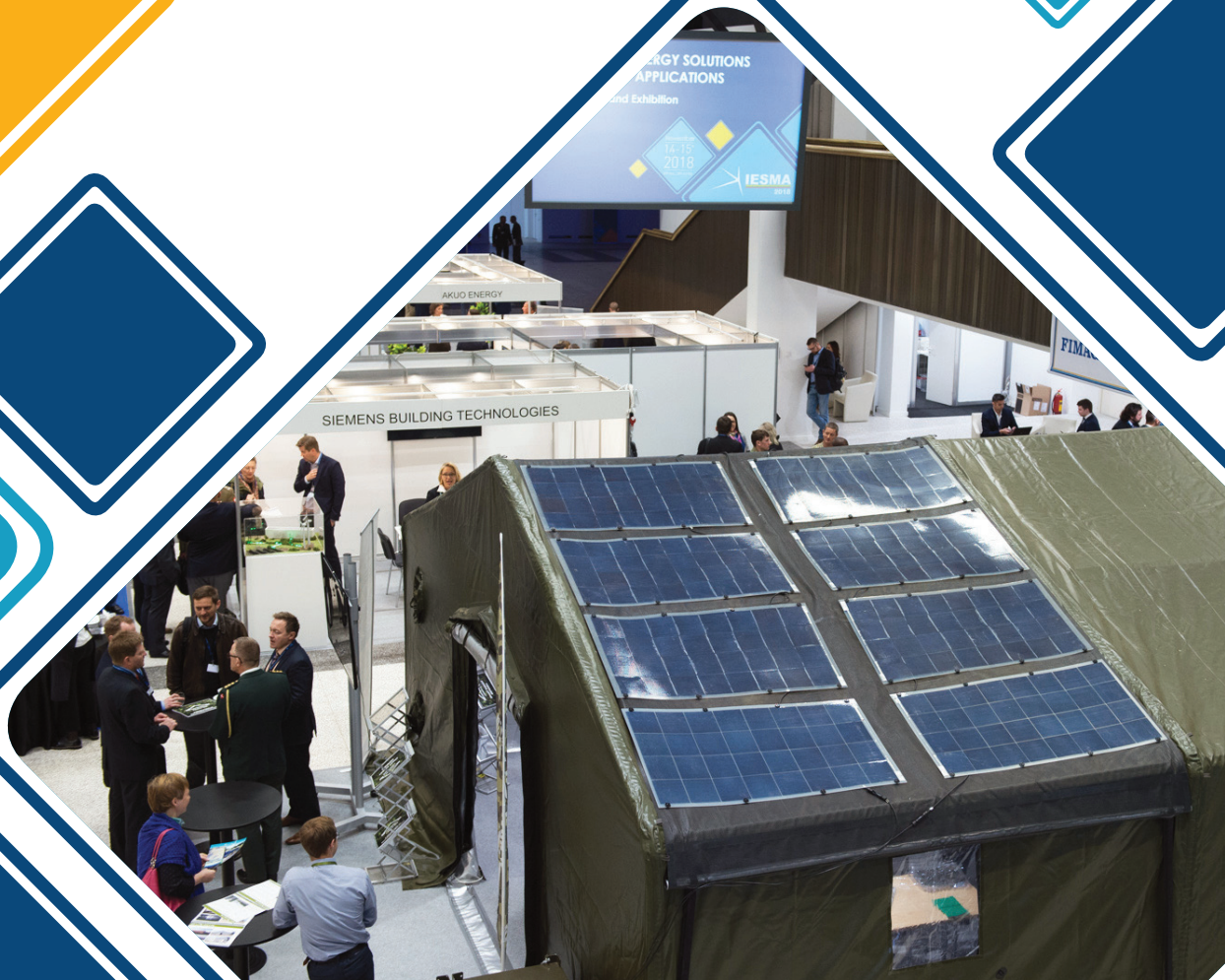
NATO ENERGY SECURITY CENTRE OF EXCELLENCE

IESMA 2018

DELTA

Energy Security Highlights:

IESMA 2018 Special Edition



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Editorial

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The Innovative Energy Solutions for Military Applications (IESMA), a biennial international conference and industrial exhibition, was hosted in Vilnius by the NATO Energy Security Centre of Excellence (NATO ENSEC COE) in November, 2018. This event took place in the Lithuanian Exhibition and Congress Centre (LITEXPO) and was greatly supported by the NATO ENSEC COE partners, including the State Military Scientific Technical Centre "DELTA" of the Ministry of Defence of Georgia and the NATO Emerging Security Challenges Division and the NATO Science for Peace and Security Programme.

The goal of IESMA was to enable the exchange of information and experiences regarding best practices and technologies for advancing energy efficiency in the military. Experts from NATO nations, NATO partner nations and from others around the world, discussed advanced and cutting-edge technical energy developments, material and


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non-material aspects of energy efficiency, and their relevance for military operations. The aim of IESMA 2018 was to highlight advancements made during the previous two years since IESMA 2016, facilitate information exchange, and encourage technology transfer. This should help to accelerate the transfer and adaptation of innovative energy technologies from the civilian to the military sector for practical use in the field. This year's IESMA focused on several aspects of energy efficiency in the military such as energy policy, camp energy management and installation improvements, operational energy efficiency in navy and air forces, etc. As a new feature, IESMA 2018 included a session focused on hybrid power generation and micro grids for dual use, using innovative energy solutions that were especially interesting for organisations that have sensor stations, observation platforms, or deployable field camps in remote locations, often in extreme climate conditions or hazardous regions.

The NATO ENSEC COE is proud to acknowledge that the event attracted more than 500 energy experts from military, academia, industry and government from NATO and NATO partner countries who exchanged knowledge and discussed lessons learned, with a focus on standard, advanced and cutting-edge energy-saving technologies. Since 2011, this event has grown in size, interest, quality, and influence.

The industrial exhibition and two industry sessions gave the companies an opportunity

to display, explain and present their innovative energy solutions/technologies. These technologies varied from smart energy tents, smart lightning, smart grid control, small autonomous grids, hybrid power systems, diesel saving systems and much more. This year's IESMA included a live demonstration of the Deployable Modular Hybrid Power Generation and Management System (H.P.G.S), organised by the NATO ENSEC COE.

During the three-day event, a common theme among the presentations was that new initiatives and innovations in the area of energy efficiency should be shared and harmonized between nations. Some of the presented national initiatives showed that militaries should start to use existing innovative energy technologies. The number of national and multinational activities, projects and innovative solutions towards this goal is rising, with the research and demonstrator projects being implemented by various nations. Therefore, much remains to be done to ensure that innovative solutions will become trusted by the military and affordable for future forces as innovative energy efficient solutions have not yet been mainstreamed in military applications. The vibrant increase of interest and undertaking of energy efficiency actions among all nations can create interoperability and compatibility problems in the Alliance, as well as duplication of efforts within NATO and partners Nations. Reducing the fuel consumption in the military is an operational imperative. Innovative energy solutions cannot only save money when less fuel is used, but can also save soldiers' lives, and help improve mobility, as well as the resilience and endurance of military forces.

The U.S. Air Force's Strategy for Optimizing Aviation Fuel Use

By **Corrie Poland**, U.S. Air Force Operational Energy

As the battlefield grows increasingly complex, energy reliability and resiliency will remain a vital aspect of modern warfare. For the U.S. Air Force, access to aviation fuel is arguably the most significant critical enabler to operations – yet historically, fuel (and associated logistical resources) were often assumed to be readily available.

Attacks on fuel convoys at the height of the war in Afghanistan were a tragic reminder of

U.S. Air Force Photo/Sr. Airman Adam Shanks

the need for improved fuel logistics and optimized fuel use.

In 2015, the Air Force dedicated an office to optimizing fuel consumption across operations and aircraft. Air Force Operational Energy (the office), led by the Deputy Assistant Secretary of the U.S. Air Force for Operational Energy and headquartered at the Pentagon, aims to provide the resources, information, and data necessary to make smart operational energy decisions that improve combat capability for the warfighter.

Aligned with the U.S. National Defense Strategy and Air Force priorities, the office laid out a multi-faceted strategy that works to identify efficiency gaps, address energy logistics shortfalls, and provide innovative solutions to current and future operations across the U.S. Air Force.

Here are Air Force Operational Energy's five strategic goals:

GOAL 1: IDENTIFY AND DELIVER OPTIMAL OPERATIONS PLANNING AND EXECUTION SOLUTIONS FOR EXISTING GAPS

Central to their efforts to increase readiness and capability, the office is systematically looking at Air Force flying operations, policies, and processes across all aircraft in the inventory to identify inefficiencies and determine best practices. Collecting and analyzing fuel use data is a significant aspect of their strategy and facilitates energy-informed decision making. Working with Major Commands and aligned organizations, the office brought on data science subject matter experts to spearhead a Data Working Group to improve data collection across the enterprise. The Working Group is currently implementing its Data Collection Strategy, which outlines steps for collecting and storing aviation fuel use and associated mission execution data. With the gathered data, the office is able to better identify opportunities for increased efficiency and effectiveness.

Additionally, the office studies policies and procedures and their impact on operational energy consumption, and advocates for smarter practices (and the technologies to support them) that increase readiness.

For instance, the office is providing funding to add an auto-plan feature to a deployed tanker scheduling tool called Jigsaw. Used at Al Udeid Airbase, Jigsaw digitizes the aerial refueling planning process and has already increased efficiency by 3.6 percent since its rollout, allowing the opportunity for two tanker missions per day to be utilized for other missions. The auto-plan function is expected to increase efficiency by another 10-20 percent and dramatically reduce both planning and mission re-tasking efforts from hours to minutes.

GOAL 2. PROVIDE INNOVATIVE ENERGY SOLUTIONS FOR NEW AND LEGACY AIRCRAFT AND SYSTEMS

Air Force Operational Energy also seeks to optimize the Force through low or no-cost innovations. By collaborating with organizations like Air Force Research Laboratory or Defense Innovation Unit, the office has a better understanding of what emerging technologies may help to increase combat capability through optimized fuel use.

By playing an active role in the Air Force's capability development process, the office helps to incorporate smart operational energy solutions into its requirements and acquisition processes. For example, the office is working with Air Mobility Command in an effort to add aft body drag reduction devices (at a very low cost) to their large mobility aircraft, which will reduce fuel consumption by 1-2 percent and allow for extended range.

Other initiatives include aircraft weight reduction for increased efficiency, such as decreasing fuel carried where possible, optimizing cargo-loading, and replacing heavy aircraft parts with lighter alternatives.

GOAL 3. FURNISH ENERGY-EFFICIENT WEAPONS SYSTEM SUSTAINMENT ANALYSIS

The office aims to increase Air Force operational readiness through improved sustainment of legacy aircraft. Well-performing aircraft with fewer maintenance issues are not only safer, but burn fuel more efficiently.

They regularly engage with commercial airlines and industry partners to learn about developing technologies and best practices in aircraft sustainment that could translate to Air Force weapons systems and sustainment processes.

A promising discovery is the advancement of compressor blade coatings, and inspection/optimization through laser and infrared scanning methods. Adopting industry best practices has shown the potential to improve engine efficiency by 2-3 percent and extend engine life, as well as reduce the cost of compressor blades through increased reuse.

GOAL 4. SUPPORT THE PRODUCTION OF ENERGY-INFORMED WAR PLANS

The office provides the Air Force wargaming communities with a more realistic view of the risks and challenges related to operational energy and fuel logistics. They promote energy-informed leadership decisions in wargaming - and ultimately provide needed operational inputs in basing strategy, operational planning, and investment priorities. Including realistic operational energy scenarios in simulated planning environments for joint and multi-domain combat operations directly aligns with the broader Air Force capability development efforts.

GOAL 5. EDUCATE THE FORCE AND BUILD THE CULTURE FOR OPERATIONAL ENERGY

Finally, Air Force Operational Energy encourages an energy-informed culture through education, training, and strategic communications efforts. By collaborating with Air Force and Department of Defense learning institutions such as the U.S. Air Force Academy, the Air Force Institute of Technology, Air University, the Army War College, the Naval Postgraduate School and others, they are able to communicate to Airmen and service members about the importance of energy efficient operations and how it provides increased capability, more training opportunities, decreased maintenance, and ultimately, improved readiness.

For more information on how the Air Force is optimizing its aviation fuel use visit: www.safie.hq.af.mil/OpEnergy/, www.Twitter.com/AFEnergy, and www.Facebook.com/AirForceEnergy.

Dual Use Hybrid Power and Energy Systems in the High Arctic

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Dr. Gisele Amow (Defence Research and Development Canada)
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Major Ross Franklin (Department of National Defence, Canadian Joint Operations Command)

Harsh environments, isolation, and a lack of local energy resources all challenge built infrastructure in the Arctic. This infrastructure ranges from small communication/data-logging stations to small isolated building outposts and larger communities. In all cases, nearly all energy used to meet electrical and thermal demands for these sites comes from diesel generators and diesel-fired heating devices. In Canada, these remote locations ultimately rely entirely on 'imported' fuels, delivered in bulk either by ship or aircraft during the short summer season and stored on-site. Such sites are ultimately vulnerable to fuel spills, delivery disruption and a high associated energy cost due to transport (fully burdened costs of ~$7 CDN or more per litre[1]). Moreover, all power generation is community-based due to the absence of territory-wide electricity grids. These aspects affect not only the local communities but also government operations.

The importance of reducing diesel dependency in the Arctic is well recognized. The Department of National Defence (DND), through the Government of Canada's Greening Government Strategy, is committed to reducing its greenhouse gas (GHG) emissions by 40% from 2005 levels by 2030[2]. With its Defence Energy and Environment Strategy (DEES)[3], DND is actively working towards reducing its energy consumption, using cleaner energy sources, better managing its energy performance and reducing its environmental footprint while still maintaining its operational mandates. To achieve these goals the federal department Natural Resources Canada (NRCan), CanmetENERGY has been actively working with DND to address energy efficiency for various off-grid applications. This is well-aligned with CanmetENERGY's mandate of enhancing the responsible development and use of Canada's natural resources, provide tools and develop knowledge to help decision-makers, collaborate with other federal

[1] Kegel, M., Tamasauskas, J., Amow, G., Douglas, M., Sunye, R. (2013) Power and Energy Conservation in the Arctic: A Case Study on the Canadian Forces Station Alert. Proceedings from BS2013: 13th International Conference of IBPSA, Chambéry (FR), 25 - 28 August 2013.

[2] Greening Government Strategy (GGS). (2017) Government of Canada. ISSN: 978-0-660-24164-7.

[3] Defence Energy and Environment Strategy (DEES). Government of Canada. Catalog Number D2-394/2017E - ISBN 978-0-660-23848-7.

departments to support the advancement of scientific projects and supporting the federal department greenhouse gas (GHG) emission reduction targets. With the challenging climate and environment of the Arctic, by working with DND, dual use applications for both military and civilian installations can be developed to support the advancement of science for sustainable solutions in the provision of power and energy. Support can range in the form of demonstrating new technological solutions to conducting energy audits and identifying suitable energy reduction pathways that can be replicated in other buildings or communities. This paper summarizes collaborative research efforts among NRCan, Defence Research and Development Canada (DRDC) and DND/Canadian Armed Forces (CAF) to develop dual use remote, off-grid power and energy applications in arctic environments.

CANADIAN FORCES STATION ALERT

The Canadian Forces Station (CFS) Alert is the most Northern permanently occupied facility located on Ellesmere Island, NU. The facility was first opened in 1958 and over the years has expanded and contracted to meet the needs of DND (Figure 1). At the time this study was conducted, the site had approximately 50 heated buildings, ranging in size and function, all of which have their electrical demands met by a central power plant with four 850 kW diesel generators with heat recovery. The heat recovery is then also used to meet a portion of the space heating load for the 9 largest buildings onsite through a district heating system. The site consumes ~2 000 000 L of diesel fuel annually for building heating and electricity generation. With all fuel flown in to the station primarily during Operation Boxtop and occasionally weekly depending on aircraft capacity, any reduction in fuel not only reduces annual operating costs, but also improves the operational effectiveness of the CAF liberating aircrafts for other activities other than fuel delivery.

Figure 1: Aerial view of CFS Alert Main Complex[4]

As part of a larger DRDC study to identify alternative technology options and strategies to reduce fossil-fuel use at CFS Alert, a comprehensive energy audit[5] was conducted in which electrical meters and heat flow meters were installed to understand key energy flows at the station. Electrical meters gave insight to the electrical requirements of various building clusters and the heat flow meters were used to evaluate how effective the district heating system was in meeting building heating loads. Previously, this type of data was unavailable and thus by measuring the station's electricity consumption and district heating effectiveness, suitable energy efficiency measures could be identified with the aid of building simulation. Validated with the metered data, the building energy models identified the most suitable energy efficiency measures and predicted the impact renewable energy systems could have on reducing diesel dependency. The study concluded that by first improving the building envelope, reducing electrical loads, and optimizing the use of heat recovery, the station could reduce the diesel consumption by ~33% (~700 000 L of fuel per year) and avoid the use of

[4] Photo Credit: http://www.troywoodintarsia.com/alert/aerial5.htm. Last Accessed 2013

[5] Kegel, M., Wilkens, L., Tamasauskas, J. and Amow, G. Energy Audit Report of CFS Alert, DRDC Atlantic DRDC-RDDC-2016-R124. 2016.

a second diesel generator during the winter months. Additional savings could be further realised through the integration of solar photovoltaics to meet electrical loads during the summer when the heat recovered from the diesel generators are not required[6]. The audit and recommendations then served as a template for other communities in the Arctic faced with similar challenges. Especially with the energy reduction potential of recovering heat from the diesel generators, this available energy source is often overlooked and not considered, although heating loads can represent up to 80% of the energy end-use in Arctic buildings.

JOINT ARCTIC EXPERIMENT – ARCTIC TACTICAL SHELTER SYSTEMS

The Joint Arctic Experiment (JAE) is a multi-governmental collaborative project aiming to improve the operability of the Canadian Armed Forces (CAF) in the high Arctic environment. Conducting operations for sovereignty, search and rescue, and surveillance, soldiers are often deployed on snowmobiles for several days in the high Arctic. Equipped with minimally insulated shelters, an open flame stove for heating and cooking, and a fuel fired lantern for lighting, the soldiers are exposed to extreme cold (down to -50°C), open flame fire hazards inside the shelter, potentially high levels of carbon monoxide, and have a heavy reliance on batteries for communication and surveillance equipment (Figure 2). Soldiers are trained annually to become familiar with the equipment and learn how to survive in such conditions.

Through the JAE, DRDC, along with DND and NRCan, are aiming to find alternative power and energy solutions for soldiers in the high Arctic tactical environment. Along with improving soldiers' effectiveness and quality of life, solutions can be utilized for the Canadian Rangers (long-range Arctic patrols) or civilian applications such as research camps or other remote, temporary camps.

(a)

(b)

Figure 2: (a) Typical 10 person Arctic Shelter[7] (b) Deployed lighting, heating and cooking kit for Arctic Tactical Shelters[8]

Conducting an audit in 2018 to acquire preliminary data on the power and energy requirements of high Arctic tactical missions, shelter energy models were developed to identify suitable pathways of getting the flame out of the tent. Solutions must also meet the stringent requirements of having the same weight and volume as the currently deployed kit as all equipment must be transported by sled pulled by a snowmobile. Following the similar approach for building-level

[6] Amow, G., Alternative Power and Energy Options for Reduced-Fuel Arctic Infrastructure: Annual Progress Report FY2013-2014 (U), DRDC Atlantic, DRDC-RDDC-2015-R097. June 2015.

[7] Photo credit: http://www.espritdecorps.ca/hooper/, Last Accessed 2018.

[8] Photo credit: McDonald, Eric, 2018. NRCan, Joint Arctic Experiment, Cambridge Bay.

energy efficiency measures, it was identified that heating loads could be reduced by 40% by employing an insulating layer that has the same weight and volume as the cotton layer currently deployed, with the added benefit of having a membrane to wick away any moisture. With the reduced heating loads, smaller flameless heating solutions could be employed, keeping the shelter above freezing temperatures, such as electrically heated floor mats driven by a diesel/gas generator or a multi-fuel thermoelectric heater. These heating solutions then can utilize the fuel already being used by the snowmobiles, reducing the weight and volume of additional/different fuel canisters, while also offering a power solution to recharge batteries and potentially provide additional power for boiling water and preparing meals such as an electric induction stove. Cold weather battery packs as well as low power direct methanol fuel cells were also considered for power sources and recently demonstrated at the 2019 Joint Arctic Experiment in Resolute, Nunavut. Important and positive/negative soldier feedback will help further optimize solutions and work with manufacturers to develop solutions.

POWER AND ENERGY SYSTEM FOR CANADIAN ARCTIC UNDERWATER SENTINEL EXPERIMENT (CAUSE)

Under the Canadian Arctic Underwater Sentinel Experiment (CAUSE), DRDC is utilizing an underwater acoustic array to sense the presence of ships, icebergs and wildlife in the Barrow Strait where the sensors are deployed (Figure 3). The system was installed and trialed in 2009[9] and was only operational when the site was visited for a short period during the summer months. Collaborating with NRCan's CanmetENERGY, an alternative power and energy solution is being developed to enable unmanned year-round operation of the underwater acoustic arrays. The first goal was to operate the arrays three times daily for 5 minutes for an extended period with the objective of eventually achieving continuous year-round unmanned operation. Challenged with ambient temperatures falling below -50°C, being an unoccupied site for the majority of the year with a polar night that is ~130 days long, the power and energy solution would be applicable to many other remote datalogging/communication sites.

The total system developed by DRDC had a peak power draw of 700 watts[10] required to power the arrays, the data collection unit, Iridium Satellite for real-time communication and other miscellaneous computing equipment and inverters.

Figure 3: View of DRDC Gascoyne Inlet Camp and Surrounding Hills/Cliffs – Facing West[10]

After conducting an extensive literature review on commercially available solutions with demonstrated capabilities of remote/unmanned operation, a direct methanol fuel cell (DMFC) system with south-facing solar photovoltaic (PV) panels and absorbed glass mat (AGM) lead-acid batteries was selected.

[9] Heard et al., 2011. Underwater Sensor System 2009 Field Trial Report, Defence Research and Development Canada – Atlantic, TM 2010-241.

[10] Photo credit and report reference: Heard, G., McArthur, B., Inglis, G., 2016. Overview of the technical results of the Northern Watch Project, Scientific Report, DRDC-Atlantic, DRDC-RDDC-2016-R115.

A simulation model was developed to model the operational power and energy requirements and determine the number of solar panels, fuel cell size and number of batteries required as well as the thermal enclosure design. The final system deployed featured a 110-W direct methanol fuel cell with 176 L of methanol fuel for power during the polar night, two 265-Wp solar PV panels for power during the summer and two 165-Ahr AGM batteries for increased renewable energy storage. In comparison to a diesel generator for this application, ~2 500 L of diesel fuel could be annually offset. Additional simulation studies will identify further improvements to enable higher-penetration of renewable energy (such as the inclusion of wind energy), as well as to evaluate alternative operational strategies to further reduce the reliance on methanol fuel while achieving operational objectives. The simulation modeling strategy could also be used for other power and energy system designs where a careful balance between thermal energy requirements and electrical storage capacity must be considered for viable operation.

DEPLOYED CAMPS

NRCan has also been collaborating with DND and DRDC on reducing CAF's deployed camps diesel dependency. Initiated in 2012, NRCan has developed capabilities for the CAF to better monitor and predict the power and energy requirements of their deployed camps in any region. This also includes training soldiers in using the developed solutions, transferring the capability over to DND. Frequently oversizing the diesel generators to meet the power requirements, these oversized systems operate inefficiently or waste fuel by increasing the electrical load on them unnecessarily. By measuring the consumption of deployed camps and developing a simulation tool capable of taking the time varying load profiles into account, the DND can deploy the right sized generators. The simulation tool also gives DND the capability to assess the fuel-saving potential of energy efficient measures prior to deployment, ensuring the most suitable option is deployed instead of assuming the potential savings. This strategy is now being applied to Emergency Response Unit shelter systems for the Canadian Red Cross and has also lead to a North Atlantic Treaty Organization (NATO) Science for Peace and Security (SPS) Project to share these capabilities with other nations with the same need (Project G5525).

SUMMARY

The provision of sustainable power and energy solutions for arctic applications is an enduring challenge for both civilian and defence applications. This paper has summarized on-going collaborative work among Government of Canada's Federal Departments (NRCan, DRDC and DND/CAF), which has resulted in the development of working expertise in the Arctic as well as the advancement of science knowledge in this domain. Underpinning this body of work is to first establish baseline energy use for each application under consideration through comprehensive energy audits that include metering and monitoring followed by the development of technology solutions and strategies that are validated by simulation models prior to implementation. The lessons learned from these projects are also being used to meet the longer-term objectives of achieving the Government of Canada's GHG reduction targets in an otherwise challenging geographical environment as well as other organizations such as the Canadian Red Cross. This includes planned future work to develop an advanced microgrid to reduce the diesel dependency of high arctic infrastructure, which has not yet been widely utilized, as well as the achievement of continuous unmanned operation of sensor systems such as underwater arrays with a hybrid solar/DMFC/battery system to be subsequently augmented by wind energy.

Energy Management in the Military Expeditionary Environment

By **CDR Andrea MANFREDINI**, Head of CDC Division, NATO ENSEC COE
By **Miss Jennifer DORAN**, Behavioral Scientist, Project Lead, NATO ENSEC COE

THE RATIONALE FOR RESEARCHING ENERGY MANAGEMENT

As agreed by NATO Allied Command Transformation (ACT) during the establishment phase of the NATO ENSEC COE in 2012, the mission of the COE is "to assist NATO, Nations, Partners and other bodies by supporting NATO's capability development process, mission effectiveness and interoperability, providing comprehensive and timely expertise on all aspects of energy security". Improving the energy efficiency of military forces is directly related to succeeding in energy security.

There are many ways and many tools available for improving energy efficiency, and while a lot of them have been implemented by Nations, it has been a largely uncoordinated effort within the NATO sphere. Additionally, energy efficiency tools, whether material (e.g. technologies) or non-material (e.g. energy management techniques), need to be standardized in order to obtain and maintain interoperability. Looking to national decision makers, the NATO ENSEC COE strongly recommends that energy efficiency become a Minimum Capability Requirement (MCR) for national initiatives and innovative solutions. In parallel, energy efficiency considerations should be included in the NATO Defense Planning Process (NDPP).

One tool for achieving energy efficiency is energy management, which the NATO ENSEC COE recognise as an instrument that can be implemented in the immediate-short term, with low economic impact, and which can be standardized for interoperability. Therefore, it is hoped that the research undertaken by the NATO ENSEC COE will contribute to the development of NATO Standard Agreements (STANAGs) related to energy management in operational environments.

The remainder of this article presents a research project currently being conducted by the NATO ENSEC COE that focuses on how to improve energy management in the military.

A BRIEF HISTORY OF THE EMMEE PROJECT

In 2014, the NATO ENSEC COE produced a report titled 'Energy Management in the Military Expeditionary Environment', which presented information gathered from various national records and reports on best practices in energy management based on trials, experiments, and operational energy usage. This report identified that one possible way for improving energy management in the military could be to apply civilian processes, such as ISO 50001:2011 – an international standard for energy management based on a process of continuous improvement through the stages of 'Plan-Do-Check-Act'.

As a result of the report, and in cooperation with Schneider Electric Company, an operationalised for military purposes version of the ISO 50001:2011 application plan and a corresponding handbook were drafted in order to be tested for military utility. During this phase of the project, it was recognised that in addition to ISO 50001:2011, technological applications and behaviour change processes could offer benefits to energy management. Therefore, the final product to be tested by NATO ENSEC COE was an 'enhanced ISO 50001:2011 approach'; because it involves not only using ISO 50001:2011 principles (the majority of which focus on the concept of organisational management), but also technological applications and behaviour change processes. More details about the design of the approach are presented in the next section of the article.

In 2017, after reaching an agreement with the French MOD, a French operational military camp in Niger was selected for the case study location that reflected a Tier 2 Deployed Force Infrastructure (DFI) setting. At this point, it is important to emphasise that inherently, operational military camps are located in challenging environments, in terms of factors such as climate, operational tempo, high variation in camp occupancy rates, and – moreover - the fundamental attitude that other military activities take precedence over energy management. A case study approach allows for the impact of these variables to be explored but not controlled.

THE DESIGN OF THE EMMEE PROJECT

As briefly described in the previous section, the three interdependent pillars that underpin effective energy management are:

- organisational management (in military terminology, this is understood as Command and Control – C2);
- technological applications;
- behaviour change processes.

For the EMMEE project, a case study methodology is being used to identify changes in how energy is managed before and after implementing new guidance based on the 'enhanced ISO 50001:2011 approach' (i.e. the three pillars of energy management). A multi-organisational and multi-disciplinary project team has brought together military and civilian experts, engineering, management consultancy, and behavioural science expertise. Members of the project team are responsible for managing different pillars:

- NATO ENSEC COE is in charge of the project management and the lead for the organisational management pillar. Additionally, the NATO ENSEC COE is providing a Lithuanian civilian management consultant and international military expertise.

- The Canadian Department of National Defence and the USA Department of Defense are contributing through providing civilian engineers as well as cutting edge technol-

ogy in the form of metering and monitoring equipment. They are the lead for the technological applications pillar.

• The UK Ministry of Defence (MOD) is supporting the project with a team of civilian behavioural scientists from the industry sector. They are the lead for the behaviour change pillar, through the application of their adaptation of the Capability, Opportunity, Motivation, Behaviour (COM-B) methodology, which they have successfully used in several UK MOD energy efficiency case studies.

• The French Ministry of Defence is providing the case study location, and therefore also the C2 structure for the group of participants based at the case study location. Additionally, France has invested top military engineers in the project as advisers on the applicability of the recommendations for change.

THE PROCESS OF THE CASE STUDY

The case study began with a recconaisaance (recce) visit to the camp, this was important for developing relationships with the right people, and gathering contextual information about how the camp operates. The second trip to the camp was the baseline data collection visit, during which several fomats of data were collected:

• Questionnaires were completed in order to assess levels of awareness and engagement in energy management.

• Observational audits were conducted around the site to capture the range of good and bad energy management practices currently in place.

• Meter readings were taken from more than 30 electrical sensors and analysed to establish the current energy uage profile.

Following the baseline data collection stage, the data collected was analysed in a workshop to enable tailored recommendations for change to be designed. The workshop followed the UK MOD's adaptation and use of the COM-B methodology, which involved steps such as prioritising energy behaviours on a likelihood of change versus extent of impact quad chart (cost-benefit analysi), and designing clear behaviour change plans. The proposed recommendations were then discussed, amended, and finalised through discussions with the French MOD. The final set of agreed recommendations began to be implemented during the next visit to the camp – known as the 'implementation visit'.

The case study is currently in the implementation phase, which is the most challenging phase to manage because a lot of the responsibilty for change is transferred to the Commander and their 'energy team' to ensure that the recommendations are actioned. Following the implementation phase, the next visit to the camp will be to mirror the baseline data collection visit; in other words, to collect quesionnaire, observational, and meter data in order to be able to compare the energy management practices between pre and post implementation of changes.

At the time of writing, a number of useful insights have been captured:

• Understanding the context is imperative; seeking first to understand, then to be understood. This is the reason why a general list of recommendations can not be applied to all types and sizes of organisations. A recce visit is invaluable and establishing a baseline is fundamentally necessary.

• As ISO 50001:2011 advocates; "Successful implementation depends on commitment from all levels and functions of the organisation, and especially from top management". For this reason, engaging key stakeholders and decision makers who are a mixture of people in a position of authority and peo-

ple who are considered influential amongst peers, is vital.

• Communication is the key to raising awareness about the need for effective energy management, and together with training, both should be implemented before deployment.

• Time is a crucial variable, because it takes time for changes to become embedded into routine. A minimum implementation period of three months should be factored into any similar case study. In the case of time constraints, it may be possible to focus on implementing fewer interventions, but be aware that this can limit savings. Moreover, the less amount of time given for change, and the fewer number of interventions implemented, can lead to a higher percentage of procedural error incidence.

• Data must be used to support decision making processes. Data collected but unused equates to wasted resources and missed opportunities.

WHAT DOES THE FUTURE HOLD?

Short term

• In the short term, for the current case study, the objective is to increase the engagement of the C2 staff at the camp in order to increase the rate of change. The final data collection and analysis activities will be conducted, and conclusions will be drawn.

• The draft version of the militarised ISO 50001:2011 handbook will be updated based on the lessons learned from the case study.

• An improved energy management system, and culture, is being developed within the NATO ENSEC COE itself, based on the multidisciplinary technique used on the EMMEE project.

Medium term

• In the medium term period, an energy management training module is being developed for the annual 'Energy Efficiency in Military Operations Course' (EEMOC) run by the NATO ENSEC COE.
• Further case studies are being planned in cooperation with other NATO Nations, in order to validate the current case study findings. In the new case studies, the aspiration is to move from a 'Leader' role to an 'Advisor' role.

Long term

• In the long term, it is the desire that the final version of the energy management handbook will be adopted as the basis for NATO energy management doctrine.

• The NATO ENSEC COE is looking into the possibility of a certification methodology to assess, on a voluntary basis, the level of EM at deployed operational military camps.

Energy policy and its impact on industry - security interests and the bottom line

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Who, or how, energy policy - or any policy in general - in the US is developed has no clear nor easy answer. At any point in time, policy is shaped by a combination of need, interests, money or votes. While often those factors might work in concert, competing interests means this is not always the case. Therefore, US energy policy is fluid and subject to change depending on the circumstances of the day. How is a company, or a foreign government and its policy makers and military, to make sense of US policy that is subject to change with little to no advance notice? This creates a challenge for all parties involved.

Let me build a foundation-the US currently has the world's largest economy. According to the World Economic Forum, of the world's top 10 economies, the US economy is larger than the next two largest combined-China and Japan, and it is larger than the world's 4th – 10th economies combined.[1] When we look at countries leading the field in renewables in the near-term, of the top three countries, only one of them, the US, is a NATO member.[2] To look at military spending, it is no surprise that the US is the largest military spender by far than any other country in the world.[3] Like it or not, the US, and thus US industry, impacts decisions both from an energy/renewables as well as a defense perspective. Any discussion of innovative energy solutions in military applications, by virtue of economic facts, will involve the US and therefore its fluid energy policies.

Innovation and industry are closely tied to policy. How is policy made in the US? It's not a straightforward, linear process. Those in government may insist that they develop policy. Those in industry say that they develop policy with their innovations. In reality, they are intertwined. One issue with energy policy development is that innovation and policy do not develop concurrently, as innovation can develop much faster than policy can keep up with it.[4] In the time it takes to develop policy,

[1] "The World's Biggest Economies in 2018," World Economic Forum, accessed February 27, 2019, https://www.weforum.org/agenda/2018/04/the-worlds-biggest-economies-in-2018/.

[2] "Three Countries Are Leading the Renewable Energy Revolution," World Economic Forum, accessed October 20, 2018, https://www.weforum.org/agenda/2018/02/countries-behind-global-renewable-energy-growth/.

[3] Daniel Cebul, "US Remains Top Military Spender, SIPRI Reports," Defense News, May 2, 2018, https://www.defensenews.com/industry/2018/05/02/us-remains-top-military-spender-sipri-reports/.

[4] "Martec's Law: Technology Changes Exponentially, Organizations Change Logarithmically," Chief Marketing Technologist, June 13, 2013, https://chiefmartec.com/2013/06/martecs-law-technology-changes-exponentially-organizations-change-logarithmically/.

the existing technology for which policy is developed continues to advance so that the policy may quickly be outdated. This was the case with the Renewable Fuel Standard of 2005. This policy established minimum requirements for alternative fuel blends in commercial transportation. While the RFS was adequate to address renewable fuel standards in 2005, focusing primarily on corn as feedstock and ethanol as the output, it wasn't long before innovations in alternative energy solutions allowed for more diverse feedstock, including biomass and natural gas.[5] These innovations did away with the need for the blend requirements of the RFS, yet companies were penalized for not meeting these requirements. The American Petroleum Institute sued the US Environmental Protection Agency to update the policy.

In another instance, US energy policy has contradicted itself. The Energy Independence and Security Act (EISA) of 2007 had a specific provision, Title 4, Subtitle C, Section 526, which restricted the federal purchase of alternative or synthetic fuel unless the contract specified that the alternative or synthetic fuel's emissions was equal to or less than the equivalent conventional fuel produced from conventional petroleum sources.[6] In 2011, Representative Mike Conway, a Republican from Texas, argued that as a result of this requirement, it would not be possible to procure oil from Canada's oil sands, which he deemed a threat to US national security interests.

There was opposition to Section 526 not simply on the basis of the threat to national security. Additionally, opponents of Section 526 argued that it contradicted Section 369 of the Energy Policy Act of 2005. Section 369 dealt specifically with oil shale, tar sands and other strategic unconventional fuels, noting in Subsection (b) (1) that "oil shale, tar sands and other unconventional fuels are strategically important" and subsections (b) (2) and (3) note that "commercial development, should be conducted in an environmentally sound manner, using practices that minimize impacts; and (3) development of those strategic unconventional fuels should occur, with an emphasis on sustainability, to benefit the United States while taking into account affected States and communities.[7]

The Energy Independence Security Act not only created controversy on account of Section 526, but also relative to its impact on the lightbulb industry. It sought to phase out incandescent lightbulbs over time. Industry made significant financial investments to transition to the EISA efficiency standards.[8] In some instances, some light bulb manufacturers stopped making certain types of bulbs entirely as a result of the more stringent efficiency requirements.[9] Now, as EISA provisions are set to go into effect in 2020, the Department of Energy (DOE) under the current US federal administration is seeking to loosen the efficiency requirements, leading to concerns that this could "stifle innovation, eliminating a powerful regulatory incentive for manufacturers and retailers to invest in high quality, energy-efficient LED light bulbs."[10] Major lighting companies oppose a repeal of the Act.[11] The rollback could

[5] Robert Johnsen, "Reexamining Outdated U.S. Energy Policy Through Alternative Fuels," Oil & Gas Journal 111, no. 11A (November 11, 2013).

[6] US Congress, "Energy Independence and Security Act of 2007" (2007), https://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf.

[7] "Energy Policy Act of 2005," Pub. L. No. 109–58 (2005).

[8] "Center for Energy and Environment - Center for Energy and Environment," accessed February 28, 2019, https://www.mncee.org/blog/february-2013/in-other-words-eisa-lighting-standards/.

[9] Chris Granda, "Impacts of the 2020 Federal Light Bulb Efficiency Standard," n.d., 3.

[10] eschwass, "Rollback of Light Bulb Standards Would Cost Consumers Billions - $100 per Household Each Year," Text, ACEEE, February 6, 2019, https://aceee.org/press/2019/02/rollback-light-bulb-standards-would.

[11] "Lighting Industry Trends," accessed February 28, 2019, https://www.everycrsreport.com/reports/R42028.html.

create policy confusion and cost consumers money.[12]

This brings me to the third aspect of how policy is shaped - the role of consumers, regular citizens, cannot be overlooked. Citizens demonstrated against the development of Dakota Access Pipeline. In doing so, they were able to temporarily halt development on it and get investors to divest of their support of the pipeline construction. Public perception matters. It can erode support for a project. Jane Kleeb, president of the anti-pipeline Bold Alliance stated, "Our government stood up for the people…". The only reason this action was taken to halt construction was people power - and having a government that is made up of individuals who truly listen to our concerns."[13] Ultimately, this public perception can shape policy. There is a group of youth, called "climate kids," who filed a federal lawsuit against the US Government claiming that the government is denying them a safe and livable atmosphere. In October 2018, a judge ruled that the climate kids' lawsuit against the US Government could proceed.[14] In a separate environmental energy issue, Lisa Evans, senior administrative counsel at Earthjustice, commented in response to a watered-down ruling on coal ash, "The final rule was a compromise between what public interest and industry wanted."[15]

We must also not overlook the role of the consumer as a voter. Democratic nations are ultimately beholden to their voters to enact legislation and policy that is in their best interests. If the voters feel that legislators and leaders are not acting in the best interests of the electorate, they will vote their leaders out of office. Under the Trump administration, shortly after taking office, he issued an executive order such that for every new regulation introduced, two existing ones must be eliminated.[16] Thus, for any new policy, two old ones must be eliminated. Additionally, since Trump took office, he has withdrawn the US from the North American Free Trade Agreement, from the Paris Agreement, from the Joint Comprehensive Plan of Action (AKA the Iran Nuclear Deal) there is current discussion of withdrawing from the Intermediate-Range Nuclear Forces Treaty (INF) and frequent bluster of withdrawing the US from NATO, to the point that the House of Representatives recently passed a unanimous vote in support of the US remaining in NATO.[17] Recently, viewed as a backlash to Trump's first two years in office, during US mid-term elections, voters gave control of the House of Delegates to the Democrats. Now there is likely to be even more policy uncertainty and disagreement on policy matters that led to the longest shutdown in US history.[18]

This goes to show that US energy policy is… fluid. What policies exist today may be gone tomorrow. In other instances, policies are sometimes slipped in under the radar and go unnoticed or unchallenged until there is

[12] eschwass, "Rollback of Light Bulb Standards Would Cost Consumers Billions - $100 per Household Each Year."

[13] "Obama Blocks Another Oil Pipeline to Appease the Same Enviros Opposed to Keystone XL," The Stream (blog), September 12, 2016, https://stream.org/obama-blocks-another-oil-pipeline-appease-enviros-opposed-keystone-xl/.

[14] "Kids' Climate Change Lawsuit against Federal Government Can Proceed without Naming Trump, Judge Rules," accessed February 28, 2019, https://www.nbcnews.com/news/us-news/kids-climate-change-lawsuit-can-proceed-judge-rules-n920476.

[15] "REGULATIONS: 8 Ways That EPA's Helping the Coal Industry," accessed November 7, 2018, https://www.eenews.net/stories/1060097285.

[16] "Executive Order: Reducing Regulation and Controlling Regulatory Costs" (The White House, January 30, 2017), https://www.politico.com/f/?id=00000159-f049-d7d2-a97f-fcd922750000.

[17] "House Passes Resolution in Support of NATO by Unanimous Voice Vote | TheHill," accessed February 28, 2019, https://thehill.com/homenews/house/396536-house-passes-resolution-in-support-of-nato-by-unanimous-voice-vote.

[18] Bob Bryan, "The Government Shutdown Is in Day 35 and Has Shattered the Record for the Longest Shutdown in History," Business Insider, accessed February 28, 2019, https://www.businessinsider.com/history-of-government-shutdowns-in-congress-2018-1.

a reason to notice them. How does this fit in with energy security? It is industry that drives innovation. Advances in innovative energy solutions most likely will come from industry. Even if governments fund research and development, it is ultimately industry that will produce the desired end-item. Sometimes the duty of government is to keep industry in check so that industry's desire for profit is not at the expense of the people. At other times, it is the people who must keep industry and government in check. It is important that voters understand the issues, understand and support the reality of what energy security, and innovative energy solutions involve, because they are the ones to whom the elected officials are beholden. US policies, any nation's policies, may be only one election away from changing. When you lose public support for your efforts, funding, as well as the goal you are trying to accomplish, may be challenged.

How do we reconcile this uncertainty with the world's largest economy and top leader in renewables? If the US Department of Defense (DoD) it wants secure energy, and its policies and funding are directed towards secure energy vs. efficient/renewable energy, industry will deliver that. Industry is the common denominator that, no matter how frequently leadership changes within government or military organizations, industry is more constant. While it is true that companies are created every day and others go out of business every day, the majority of companies keep on keeping on. They do what they need to do to stay in business. They follow the bottom line, they make smart business decisions and they know that political tides, and the policies carried on those tides, can and do change.

There are key things to remember in engaging with the US and its shifting policies. There is a difference between theory - policy on paper - and reality. Businesses find a way to succeed. Either they get out front and shape the policy, they change the policy, or innovate their way around it to be back at the point of shaping policy. If industry understands the DoD's focus is secure energy, give them that directive and stand back and let them surprise us with their solutions.

Diversity is a good thing. Just as the military, in order to achieve energy security, must have diverse types and sources of energy, diversity is also key for industry. Industry must look to the outside world if it hopes to increase and diversify its revenue. Approximately 95-96% of the world's consumers are outside of the US, and 70% of the world's purchasing power lies outside of the US.[19] This means that other nations' energy policies and standards will also influence what our companies produce - which then can influence US energy policy. If the US focus is on secure energy, and others want to focus on sustainable, renewable energy solutions, the two need not be mutually exclusive. Businesses that export grow faster, create jobs faster and employees are paid more than non-exporting firms.[20] Even if US energy policy was not… evolving, companies are looking to grow and partner in international markets. Find a way to connect with industry and energy policy, and energy security, will develop.

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[19] "Exporting Is Good For Your Bottom Line," accessed November 6, 2018, https://www.trade.gov/cs/factsheet.asp.
[20] "Exporting Is Good For Your Bottom Line."

Notes

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