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Editorial

The fact that more and more attention is paid to increasing the energy efficiency of the military should not come as a surprise. Firstly, the military is the leading consumer of energy resources, ahead of all other energy-intensive government sectors (in other words, the supply of resources has become an integral component of military operations). Therefore, there is room for saving energy, expanding the use of alternative resources and in this way, further contributing to the national or international efforts in meeting energy efficiency objectives. Secondly, the military provides a unique opportunity to establish energy efficiency targets: it has traditionally been the first to articulate the need for new technologies and is the first place where they are tested. And finally, national defence budgets in recent years have either been decreasing or remaining the same, so in order "to do the same with less", it is necessary to change something.

Wider application of innovative technologies, the smart use of energy resources and competent policy planning are the evidence of progress in this area. However, single solutions (for example, the application of new technologies in the army) are not enough. Results only can be only achieved by combining technical innovations, cost effectiveness and new attitudes in key decision-making. Having this in mind, in the sixth edition of "Energy Security Forum" we decided to look into policies, decisions, experiments, plans and visions of various countries and international organizations with the aim to assess efforts or progress, which countries or organizations make in order to lessen energy consumption in military sector, making fuel delivery and consumption cheaper, safer and more reliable or improving the security of energy supply roads, storage facilities, etc. In this regard we were more than happy to welcome experts, specialists and scholars from various countries and institutions who kindly agreed to join our "community of interest" and to contribute with their experience, skills and attitude to the volume's topic: "Saving energy costs - are we investing enough?". Different experiences resulted into different answers, but all of them are worth of readers' attention.

Charles H. PERIN III, JD Candidate from University of Cincinnati College of Law (USA) and Emmet C. TUOHY, Researcher from International Centre for Defence Studies (Estonia) pay the attention at the US experience noticing that in recent years the United States military has made considerable progress towards increasing energy efficiency without compromising its principal national-security mission, thereby providing important lessons for its NATO allies. However, they also make a conclusion that if the pace of this progress is to be sustained in the future—both in the US and elsewhere—increased efficiency should be viewed not as an end in itself, but as a key tactic in the strategic goal of ensuring resilience of a country's energy sector as a whole.

Paul Johnson from UK MoD attached Defence Equipment and Support organization (Bristol, UK) presents the experiment held in Cyprus in Kenya and called "Power Forward Operating Base" (or PowerFOB) which clearly reflects the UK's approach towards operational energy efficiency aims. Experiment was aimed at identifying fuel efficient technologies and sustainable electrical power alternatives to fossil fuels with the objective of making FOBs as 'fuel-sufficient' as possible whilst maintaining operational capability, therefore reducing the logistic burden imposed on the supply chain through the transportation of fuel. As it is concluded at the end, a minimal investment can produce realistic savings of around 30% - a significant sum, in the current times of budget constraints.

Kelvin Wong, Associate Research Fellow at the S. Rajaratnam School of international Studies (RSIS), Nanyang Technological University (Singapore) says that while Asia Pacific military forces do not experience any "high tempo" crises management operations, they are nevertheless not spared from the inherent uncertainty in the global energy market – such as price volatility and competition. Mr. Wong looks at the Australian, South Korean, Japan's, China's example and makes the conclusion that cultural, organisational and technological challenges have yet to be overcomed in order rightly to address operational energy related risks.

Dinesh Chandramouli Rempling, Technical Project Officer from European Defence Agency's Research and Technology directorate in contrary notices that the European Defence Agency (EDA) has in recent years consolidated its approach to energy and environment under the umbrella of the so called Military Green initiative. With a growing consensus in the defence and crisis management community regarding the need more effectively to address energy and environmental issues, Military Green offers a comprehensive rationale to go for more responsible solutions in order to enhance capabilities. According to EDA representative, although being still in its infancy, the umbrella provides a vehicle for European collaboration that draws on civil-military synergies.

Kari Liuhto, Professor and Director of Pan-European Institute at Turku School of Economics (Turku, Finland) and Hanna Mäkinen, project researcher at the same institute continue to look into the EU approach and concentrate on Finland's objectives, commitments and obligations in the area of energy savings. They notice that environmentally sustainable energy supply is a central part of the Finnish energy strategy. Energy in the country is saved by concluding energy efficiency agreements, which are based on the use of voluntary incentives. In this context defence administration is also morally and legally bound by the national targets defined in the Long-term Climate and Energy Strategy: it has joined the energy efficiency agreement for property and building sector, aiming at a six per cent energy saving in the period of 2010–2016.

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ENERGY SECURITY BEGINS AT HOME: THE US EXPERIENCE AND THE ROLE OF EFFICIENCY GAINS IN PROMOTING ENERGY RESILIENCE

Introduction

As NATO has evolved from a strictly military alliance directed against a particular territorial threat into a broader regional partnership based on shared values, its security concerns have widened and deepened accordingly. No longer are the standing armies of nation states seen as the only threat to the security of the transatlantic alliance; member states now must also take into account the dangers posed by extremist ideologies, political instability, and—as demonstrated by the targeting of the World Trade Center on 9/11 and the cyber attacks in Estonia in 2007—unconventional attacks on states' economic infrastructure. While adding concerns about energy efficiency to the Alliance's strategic calculus may have seemed superfluous a half-century ago, in a world of increasing global energy demand—and shrinking government budgets—the effects of excessive energy consumption on military capabilities can no longer be ignored in the context of strategic planning.

The United States has been a clear leader in integrating energy efficiency and security into its long-term strategic priorities. Certainly, it must be acknowledged that, since the US spends more on defense than any other government, no country has the resources or scope with which to replicate, say, the American R&D program *in toto.* Far from being discouraged, allied countries can and should learn from the U.S. experience, tailoring programs and policies according to their individual capabilities, needs, and desires. Accordingly, this paper begins by discussing some of the best practices that have emerged from recent U.S. initiatives to increase energy efficiency in the federal government as a whole as well as within the defense sector in particular.

While these programs are extremely useful in lowering operating costs—thereby either increasing overall capacity without affecting funding levels, or alternately maintaining overall capacity while freeing up Resources For Other Uses—They Cannot, By Themselves, Guarantee The Ability Of Governments To Maintain defense operations. Accordingly, this paper then details how the true value of energy efficiency savings is the role they play in helping to guarantee **energy resilience**, which we define as the ability of a country to manage energy supply reductions or interruptions without significant disruptions to its economy and society as a whole.

Gains of efficient use

Even the most extreme environmental cynic is forced to recognize the cost benefits of energy efficiency gains. The Department of Defense manages more than 500,000 buildings at more than 500 sites around the world, totaling over 204,000 m^2 of space requiring lighting and climate control.[1] Managing its property portfolio—and its equally large fleet of vehicles—requires a staggering amount of energy: in 2010, the Department consumed 939 trillion kJs of energy, of which 80% comes from oil products.[2] In fiscal year (FY) 2011, the Department consumed about 117 million barrels of oil, a consumption level higher than all but 35 countries.[3] Much of this consumption comes from abroad. The United States as a whole imports roughly 11.4 million barrels of oil per day (Mb/d), of which 40% comes from OPEC members—all of whom are subject to domestic and/or regional political instability. Although complete embargoes such as that seen in the 1973 oil shock are arguably less likely today, this instability could still cause a major energy supply crisis, for example if Iran follows through on its regularly-repeated threat to close the Strait of Hormuz to shipping. [4]

In 2006, the Military Advisory Board of the not-for-profit research and analysis organization CNA concluded that in the event of the strait being closed, the US could face severe economic consequences in loss to domestic GDP, near-shutdown of its critical domestic transportation and shipping industries, and severe rise in unemployment unless it was able to reduce overall oil consumption by 30 percent.[5] Based on the assumption that it would take a maximum of 30 days to reach a diplomatic or military solution and resume the flow of oil after such a renewed crisis, a 30% reduction would allow for the disruption to be bridged by domestic supply and opening access to the U.S. strategic reserves. In order to avoid total economic disruption in the event of such a crisis, that reduction would have to occur by means other than forcing domestic households and industries to get by with less. Thankfully, in recent years government planners have begun designing and implementing a realistic way of avoiding domestic oil shock: increasing efficiency.

Regulation – main hints

Through a combination of congressional legislation and presidential executive orders, the US government as a whole will substantially reduce the fossil-fuel energy consumed by all of its facilities and vehicles over the next decade. These reductions will be reached by a combination of increased energy efficiency and greater use of fuel derived from renewable non-petroleum sources. Executive Orders 13423[6], 13514[7], the 2005 Energy Policy Act (EPAct), and the 2007 Energy Independence and Security Act (EISA) all lay out fuel and facility energy efficiency standards, two of which particularly stand out: a 30% improvement in energy efficiency in all buildings and a 20% reduction in fuel consumption by non-tactical vehicles, both to be reached by the end of 2015.

Other targets that have already begun implementation include: mandatory purchasing of Energy Star-certified efficient appliances, procuring half of all required renewable energy from new sources, and designing all buildings scheduled to be constructed after 2020 to be "zero net energy" (that is, entirely self-sufficient) by 2030.[8] In addition to these broader initiatives, the Department of Defense is focused on increasing energy independence for each of its individual facilities (ending reliance on an aging national electricity grid), fuel efficiency for its vehicle fleet, and

1 THE PEW PROJECT ON NATIONAL SECURITY, ENERGY AND CLIMATE, FROM BARRACKS TO THE BATTLEFIELD: CLEAN ENERGY INNOVATION AND AMERICA'S ARMED FORCES 9 (2011) [hereinafter *pew b2b*].

2 Moshe Schwartz, et al. cong. research serv., r42558, Department of defense energy initiatives: background and issues for congress 2 (2012).
3 *id*. at 1.
4Jeremy Herb, "Iran restarts threats over closing strait of Hormuz", *defcon hill* , 16 july 2012, available at http://thehill.com/blogs/defcon-hill/operations/238061-iran-restarts-threats-over-closing-straight-of-hormuz
5 CNA, Ensuring America's freedom of movement 3 (2011).
6 EXEC. order no. 13,423 – Bush, signed Jan 2007.
7 EXEC. order no. 13,514 – Obama, signed May 2009.
8 *PEW b2b*, *supra* note 1, at 74.

battery capacity for its forward operating units. Mandating tougher efficiency standards is the easiest approach for other countries to emulate, as advances in building design have brought within reach the goals of making new facilities entirely self-sufficient, substantially reducing the use and cost of energy in existing ones). Critical to these statutory approaches are allowing individual branches or agencies to keep savings from energy and water use reductions[9], seeking to reduce deferred-maintenance costs for facilities, and focusing on economic viability such that energy-conservation projects are only implemented if their cost does not exceed the savings they produce.

Practical steps

In order to meet the energy needs of its fixed-base installations, one notably interesting way in which the military is pursuing increased efficiency is by pursuing development of so-called "microgrids," which are self-contained "islands" of energy generation and management that would operate independently of the national power grid, thereby eliminating the risk to these installations from major blackouts. Such blackouts on the national grid could result either from natural causes (such as the one caused in the northeastern United States and in adjoining parts of Canada by adverse weather conditions in 2003) or from directed activities by hostile states (or indeed non-state actors) in cyberspace. An example of the powerful potential of the latter was discovered and made public in 2009, when residual malware from cyber-infiltration by Russian and Chinese actors was found in grid software.[10]

Each branch of the U.S. military has set its own internal benchmarks in order to decrease the cost of energy for forward operating bases and forces so as to increase the power projection capability per dollar cost. Much of the focus and interest has been on alternative fuel for aviation (the vast majority of energy expenditure for the Department of Defense and subsequently the United States government), but fuel savings have also been found from more prosaic measures like energy-conscious flight-plan management and aviation engine design. Alternative fuel drives for the Navy are under development so to field an entire battle fleet powered by alternative energy sources (a definition which includes nuclear power) by 2016. As these technologies progress further along the development path, allied nations should consider adopting those that emerge as most promisingly effective.

The Department of Defense annually purchases $400 billion worth of goods and services, making it the ultimate first customer for products and technologies, accelerating economies of scale by requiring larger production numbers than any other source. While no other institution on the planet can match its purchasing power, those unit cost savings are available to subsequent customers of resulting products and new technologies – with NATO allies next in line to benefit. Last year the Department made $1.4 bn of investment in advanced energy technologies, an amount which is estimated to rise to $10 bn per year in 2030 (out of an estimated $28bn total market size).[11]

Suggestions for the future

Clearly, for NATO members and other allies with smaller relative (let alone absolute) defense budgets, this level of investment is not feasible; there is simply no possibility of pursuing such "parallel-track" research, when so many tracks may well lead to dead ends. Instead, in weighing what options most merit funding, allied governments should direct their R&D funding according to the principle of disruptive innovation. In place of seeking to force technological breakthroughs from scratch, disruptive innovation encourages making an existing idea or technology more affordable and accessible.[12] Perhaps the best illustration of this concept is with a famous Cold War-era anecdote: Seeking a pen that could write in a zero-gravity environment on a variety of surfaces, NASA spent many years and billions of dollars to develop one—while the Soviets simply worked around the problem by equipping their cosmonauts with pencils.

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9 EPACT §102

10 Siobhan Gorman, *Electricity grid in u.s. Penetrated by spies*, wsj, april 8, 2009, available at http://online.wsj.com/article/sb123914805204099085.html

11 *PEW b2b*, *supra* note 1, at 5.

12 *Disruptive innovation*, claytonchristensen.com (oct. 2, 2012), http://www.claytonchristensen.com/keyconcepts/.

Even as these technological advances are implemented in the defense sector, alliance members should keep the scale of these efforts in perspective. Reducing energy consumption (and therefore, reducing the costs) of forward operating capacity is important, not least in reducing the impact of fuel price volatility on military capabilities. Yet the short-term savings from such policies and practices are small even relative to the overall defense budget, let alone to the government's budget as a whole; to take even an enthusiastic contributor to the Alliance's forward deployment capability such as Estonia, only a small portion of its defense spending goes towards forces like the ESTCOY deployments in Afghanistan.

And while operations similar to the NATO-ISAF mission may well constitute part of the Alliance's mission in the future, one must be careful to avoid the oft-repeated pitfall of planning for the last war. Future NATO responses will not necessarily take the form of prolonged stabilization missions abroad, given the dynamic nature of current strategic threats. Resources may well need to be deployed closer to home, against threats like cyberattacks on infrastructure; long-term efficiency planning must take these potential changes into account as well.

Accordingly, military energy efficiency improvements must be planned within a broader strategy of ensuring the ability of *society as a whole* to respond to disruptions in its energy supply. In an increasingly interdependent world, the goal of pure energy independence is illusory. An attack on any part of our increasingly shared energy infrastructure—from pipelines to electricity cables to LNG and petroleum shipping—will impact all of us. And although its missions have changed and grown since 1949, there is no better institution than NATO at helping its members respond to collective threats, no matter how novel or unconventional.

Paul Johnson

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POWER FORWARD OPERATING BASE (POWERFOB) –

THE UK APPROACH TO DELIVERING OPERATIONAL ENERGY EFFICIENCY

Background and objectives of FOB experiment

The provision of electrical power on deployed operations provides essential support underpinning operational capability but it brings with it a large logistic burden. Power generation in Camp Bastion (largest FOB), for example, consumes around 70% of the non-aviation fuel used in theatre to operate around 250 generators of varying size. This amounts to around 18.2 Million litres of fuel per annum which must be transported overland through high risk areas. The MoD approach to electrical power generation and distribution has historically been based on local generation using a mixture of equipment solutions and bespoke constructed facilities, almost all of which depend on diesel generators. The result is characterised by complexity and inefficiency.

PowerFOB is aimed at identifying fuel efficient technologies and sustainable electrical power alternatives to fossil fuels with the objective of making FOBs as 'fuel-sufficient' as possible whilst maintaining operational capability, therefore reducing the logistic burden imposed on the supply chain through the transportation of fuel. This is to be achieved through the use of 'open' systems, thus enabling a wide variety of different fuel efficient and renewable energy technologies to be integrated into a FOBs power supply.

The **1st Phase** of PowerFOB was successfully undertaken in July 2011, at Episkopi Training Area, Cyprus. Cyprus was chosen as its heat and humidity make it a similar climate to Afghanistan, ensuring the technologies would be tested in an operationally relevant environment. Utilising a FOB in Cyprus, Programmes and Technology Group (PTG) co-ordinated a group of industry technology providers, Subject Matter Experts (civilian, military and International), to assess fuel efficient technologies in the following areas of Energy Management:

- Diesel Generator Management
- FOB Demand Management
- Energy Storage.
- Renewables

Each technology was integrated into the FOBs power supply to measure fuel savings against the baseline, and expert assessments were made to gain an understanding of implications such as military utility, ease of deployment, maintenance burden etc. This activity proved the concept that significant savings (22-46%) can be made with respect to FOB fuel use through integrating battery storage, demand management and renewable[13] energy sources with the in-service diesel generators that are currently used in FOBs. The output of this phase was a recommendation, based upon the assessments conducted, of the system solution that should be taken forward for further testing in a semi-operational environment.

Intelligent Power Management				Overlaying all power delivery
Power Architecture				
Generator	Demand	Energy	Renewables	Fuel Saving
X		X		22%
X	X			15%
X	X	X		37%
X	X	X	X	46%

Figure 1 – Results from PowerFOB (Cyprus)

The **2nd Phase** of PowerFOB was an Operational Concept Demonstrator (OCD, and was successfully undertaken over the period of June – August 2012, in three semi-operational bases in Kenya: 1) Main Operating Base (MOB) Simba - a 500 Man Austerity Level 2 Main Base populated with exercising troops; 2) Joint Force Enabling Exercise (JFEE) site – a small base similar to a 200 Man Forward Operating Base (FOB); 3) REME Workshop - similar to a Patrol Base.

Figure 2 - Five Microgrid Modules in rugged frames fitted with plug and play connectors (top left), Batteries, also mounted in rugged frames with plug and play connectors (top right), a 4kW solar array with small wind turbine in the background (bottom left), main screen of the Deployed Energy Management System (DEMS) user interface (bottom right)

[13] Based on PowerFOB assessments and technology maturity, Solar PV is the preferred choice of renewable energy

The three demonstration sites offered a range of base sizes and so system scaling was required:

	MOB Simba	JFEE Site	REME Workshop
Peak Power Demand	94kW	22kW	5kW
Generator	400kVA (Commercial)	40kW (FEPS)	24kW (FEPS)
Microgrid and Energy Storage	7 Modules (99kW) 440kWh batteries, run 40-80%	1 Module (18kW) 76kWh batteries, run 50-90%	1 Module (15kW) 37kWh batteries, run 80-90%
Demand Management	Metering throughout, demand management routines run on lights and ECUs	Limited, Reefer control only	None
Renewables	16kW peak solar	8kW peak solar, 4kW peak small wind, 1kW peak small wind/solar	None
Duration	3 weeks	10 weeks	6 weeks

Figure 3 - Summary of demonstration site power needs and PowerFOB (Kenya) system sizes

System Performance – MOB Simba

The behaviour of the MOB Simba Power OCD system over the 5 day demonstration period in terms of base power demand, generator on/off status, battery state of charge and solar power output is shown in Figure 4.

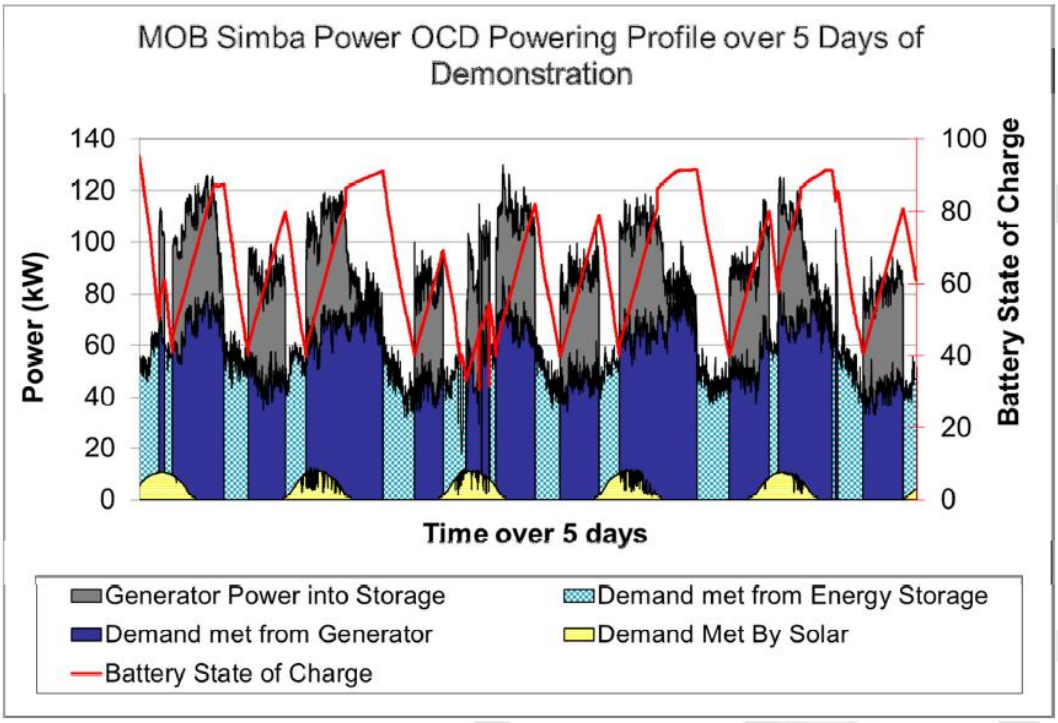

Figure 4 - MOB Simba Power OCD System Powering Profile shows the behaviour of the system over the 5 day demonstration period.

The generator was typically off overnight for 4 to 4.5 hours, whilst the base power demand was low. A 40-80% battery charge/discharge cycle operated through the most of the day, until the base demand exceeds a generator load-based start value of 70kW in the late afternoon/evening (set to allow head-room for spikes in demand and ensure system stability). The solar power contribution during the day offset the base demand, and so extended the period of opportunity to turn the generator off.

The generator was typically run with loading of 90-120kW. This is the combination of the 40-45kW the Microgrid uses to charge the batteries and the base demand of 50-80kW (reduced from the 90KW peak in the baseline due to demand management and renewables). It can be seen that the generator loading was not optimised when the battery state of charge was above 85% and the batteries were being trickle-charged.

System Performance – JFEE Site

The behaviour of the JFEE system in terms of base power demand, generator on/off status, battery state of charge and solar power output over a 48 hour period is shown in Figure 5. The generator was typically off overnight for 5 to 5.5 hours. The increased demand of the reefers coming on at 05:00 soon depleted any remaining battery state of charge down to 50% and the generator started. The generator then ran until the batteries charged to 90% and turned off again mid-morning.

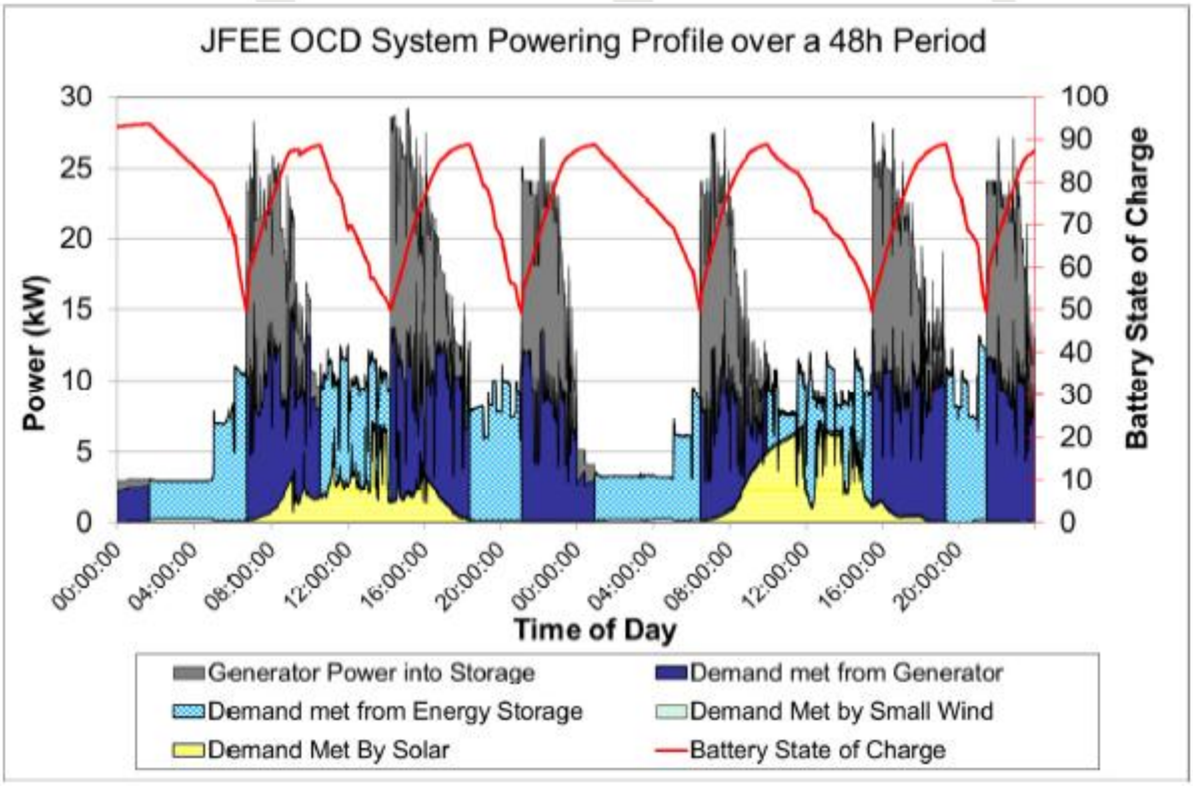

Figure 5 - JFEE Site OCD System Powering Profile shows the behaviour of the system over a typical 48 hour period.

When there was more solar power, seen in the second 24 hour period, the discharge period over the middle of the day was noticeably extended. The generator was typically run up to a 25kW or higher loading when it first turned on. This is the combination of the 12kW the Microgrid uses to charge the batteries and the base demand of 8-10kW (offset by any solar power contribution). As the battery state of charge increases the power put into the batteries decreases and so the loading on the generator comes down to around 15kW.

The period of very low loading of the generator at the start of the charted 48 hour is the end of the full charge of the batteries, where a trickle charge is needed for an extended period of time. This extends the batteries usable life and stabilises the state of charge calculation.

System Performance – REME Workshop

The behaviour of the REME Workshop Power OCD system in terms of base power demand, generator on/off status and battery state of charge over a typical 48 hour period is shown in Figure 6. It can be seen that the state of charge sits between 70 and 80% during the day when the demand is higher. However, overnight the generator is typically off for more than four or five hours before it is again needed and on some nights the battery has run down so low that it fails to start automatically. In this case the generator is manually started in the mornings when the troops arrive and see the red status against the generator on the DEMS user interface. The generator typically came on 2 to 2.5 times a day

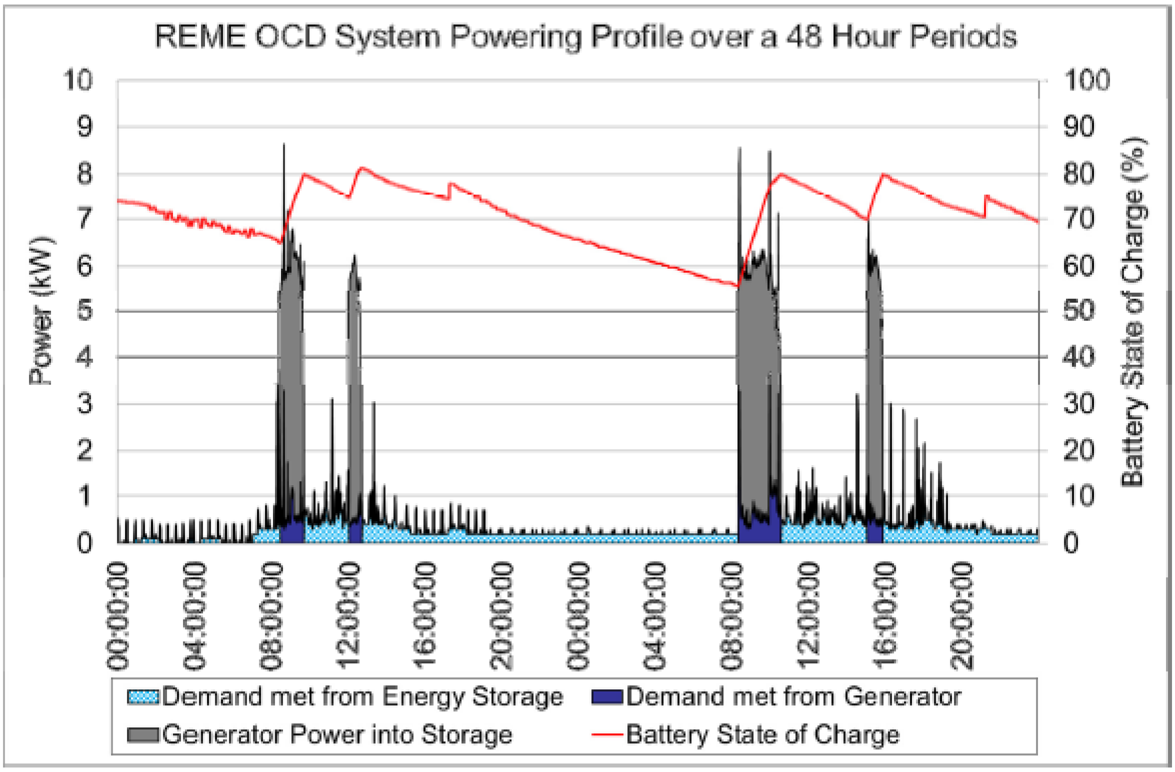

Figure 6 - REME Workshop OCD System Powering Profile shows the behaviour of the system over a typical 48 hour period

Savings

Whilst savings are dependent on the base in which the system is installed and how it is used, the PowerFOB (Kenya) system has proven to be applicable across a range of sizes and types of base:

BATUK Site (demonstration duration)	Site Equivalent	PowerFOB (Kenya) System	Generator Running Hours Saved	Fuel Saving
MOB Simba (2 weeks)	500 Man Level 2 Base (large commercial generator)	• Microgrid with energy storage • Demand management of lights • Solar	33% ± 4%	9% ± 2%
JFEE Site (10 weeks)	100-200 Man FOB (using 40kW FEPS generator)	• Microgrid with energy storage • Demand management of reefers • Solar	45% ± 5%	35% ± 5%
REME Workshop (6 weeks)	5-20% loaded 24kW FEPS generator	• Microgrid with energy storage	89% ± 2%	82% ± 4%

Figure 7 – PowerFOB (Kenya) results

Impact and conclusions

Implementing the PowerFOB (Kenya) system could have the following impact:

- If full implementation of all tested technology is undertaken at Camp Bastion fuel savings of up to 16.7M litres could be realised in the following 2 year period.
- By reducing the amount of FOB fuel consumption the size and frequency of fuel convoys, which are often a high profile target for attack, can be minimised. This reduces the risk to troops on the ground, and also makes more troops available for operational missions.
- Implementation of energy storage means generators can be turned off, often for hours overnight, with no impact on FOB core infrastructure or services. The reduced burden on the generators also means that maintenance periods can be extended, and the chance of generator breakdown is reduced.
- This reduction in fuel use would contribute towards the UK MOD’s target to reduce carbon emissions by 25% by 2020.

From the work conducted through PowerFOB, it is evident that large savings can be made through utilising existing technologies (all of the components used for PowerFOB are available as Commercial Off The Shelf (COTS) items) and a change in approach, to open systems, when providing energy for operations. The approach outlined in this paper would not only deliver savings on military operations, but also to any facility that uses diesel generation as its primary source of power - a minimal investment can produce realistic savings of around 30% .

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MILITARY ENERGY CONCERNS – AN ASIA PACIFIC PERSPECTIVE

Asia Pacific Military Energy Vulnerabilities

The provision of energy for operations in peacetime or conflict has always been a challenge for military forces. They are often the largest consumers of energy products in many developed nations, especially when considering that they operate large fleets of vehicles, ships, and aircraft. Therefore it is not surprising that high energy prices either in terms of oil or other energy products can cause significant strain on military budgets, with potential impact on military readiness. On the operational spectrum, high energy dependence compromises military performance on the battlefield.

Amidst recent geopolitical instability in the Middle East – notably tensions between Israel and Iran, and other regional stakeholders – oil prices have soared to a high of over US$120 per barrel on Friday 13th April 2012 before stabilising around the US$100 range, demonstrating the volatile nature of oil prices. Yet this is not the first time in recent years that the world had seen such extreme fluctuations. Between January 2007 to July 2008, oil prices more than doubled to a historical high of US$150 due to frenzied global speculation and the inability of oil production to keep up with demand.

Contemporary discourse on military energy mainly revolves around on-going military operations in the Middle East as well as developments in the United States and Europe. Military forces in the Asia Pacific – which have been in a state of relative peace since the last major conflicts – have been strangely absent from the military energy narrative. While tensions still exist between regional nations, military forces are largely focussed on a range of peacetime activities such as maritime security, modernisation, training, and in some nations on low-intensity operations such as counter-insurgency. While Asia Pacific military forces do not see the kind of high tempo operations such as the US-led coalition operations in Afghanistan and Iraq, they are not spared from the inherent uncertainty in the global energy market – such as price volatility and competition.

Some practical examples

For the Australian Defence Force (ADF), fluctuations in the global oil market are raising the cost of operations. With the cost of crude oil having nearly doubled over the past 12 months to US$132 per barrel on 21 July 2008, the Australian Department of Defence (DoD) is reviewing a number of energy-saving initiatives to reduce an oil expenditure that reached A$420 million during Fiscal Year 2006-2007. The impact of each 10 percent increase in the cost of oil results in an additional cost of about A$42 million, implying that the 90 per cent rise in the price of oil since the end of Fiscal Year 2006-2007 would have cost the DOD an additional A$378 million in excess of regular spending.

Elsewhere in the Asia-Pacific region, cost-cutting and energy saving measures are being implemented for South Korea's military, raising concerns about military readiness. The South Korean army, navy and air forces are attempting to reduce their fuel expenditures by more than US$50 million in 2008 by cutting training flights, army field drills and running naval ships at slower speeds. Under the plan, flight hours for training will be cut from 150 to 135 with pilots spending more time in computer simulators instead of in the cockpit. Along with slowing down the speed of vessels training at sea, the navy will also try to keep older and less fuel efficient ships in port to save fuel. It was not the first time these measures were required – concerns had already been raised earlier in 2005, when cost-cutting measures due to unexpected fuel price hikes then had threatened to reduce naval border patrols, as well as forced a decline in naval, army and air force training.

High oil prices also threatened the Japanese Maritime Self Defence Force's (MSDF) readiness in 2008. It was reported then that the MSDF will run out of money for fuel months earlier than expected. Japan's defence ministry requested its first budget increase in seven years to ease the financial burden from surging oil costs. Although Japan's self-defence forces have attempted to cut back on fuel consumption, its 2008 fuel allowance is expected to run dry well ahead of next year's budget. As a result, the defence ministry will seek a 2.2 percent increase in its budget to US$44.4 billion for 2009, more than half of which is attributed to cover increased fuel costs. The defence forces have already been forced to cut back on naval and air force training exercises, and are operating vehicles at slower speeds to conserve fuel.

Regional military energy security concerns – contrasting responses

Cognisant of the impact of high energy prices on contemporary military operations in peacetime and war, some regional forces are seeking options to alleviate the impact on military budgets and lay the groundwork for sustainable energy usage in the longer term. For example, under a national energy saving and emission-reduction plan, China's People's Liberation Army (PLA) will build energy-efficient military facilities and promote energy efficiency in routine activities such as training. Two particularly notable aspects of the plan include efforts in the military to reduce fuel consumption, and the development of energy efficient bases and military equipment.

Australia has reacted with near immediacy in response the 2008 oil crisis. The Department of Defence set up the Directorate of Strategic Fuel (DSF) and the Defence Fuel Management Committee (DFMC) later that year to oversee fuel procurement processes and monitor fuel use, and advise policymakers on military energy concerns. At the same time, the Defence Science and Technology Organisation (DSTO) investigated alternative fuel technologies for military and commercial use, and observe related developments around the world. More recently in July 2012, the Royal Australian Navy (RAN) signed an agreement that will enable the RAN to access biofuel technology being developed in the US.

Elsewhere in Southeast Asia, efforts toward military energy security seem to be less comprehensive. Little has been discussed in the way of responses to oil price volatility although unfavourable prices have forced some regional forces to curtail routine activities. For example, the Armed Forces of the Philippines (AFP) adopted fuel austerity measures in early 2012 as a result of high fuel prices. Its top military leader reportedly ordered all military support units to conserve fuel by avoiding non-essential operation of vehicles, particularly platforms that consume prodigious amounts of fuel.

Other Southeast Asian responses toward military fuel security are more sanguine. Despite being totally dependent on foreign crude oil imports to sustain its military and transportation sectors, Singapore has relied on its oil refiners (boasting one of the largest refining capacities in the region) as well as its strategic location as a key trading hub in the Straits of Malacca to ensure oil supply security even in the likelihood of a disruption of Middle East imports. For example, trade sources reportedly asserted that the diversified supply sources available to Singapore-based refiners will guarantee the availability of crude oil even if a war erupts even as tensions in Middle East came to a boil just before the 1991 Gulf War. However, such confidence is premised upon higher cost – as well as the ability of the defence establishment to pay a premium – for refined products that are likely to be in high demand in wartime, such as aviation and diesel fuel.

Transforming military energy thinking – cultural, organisational and technological challenges

Cultural and organisational limitations are perhaps the main stumbling blocks to regional military energy security, because they inhibit attempts to effect a successful energy transformation. But what exactly constitutes organisational or cultural change? Military forces will have affected a culture change when its leaders acknowledge that they are directly accountable for energy consumption and recognise that energy efficiency enhances operational capabilities. Obstacles against the deployment of alternative energy and propulsion technologies also exist within the organisations that seek change themselves, in the form of established norms and behaviours. But most importantly, the impetus of the transformation has to start from top leadership. Because a transformation entails fundamental and often radical change, strong and inspirational leadership is vital.

Affordable and reliable technological options are also limited. Some of the key thrusts of mainstream research elsewhere in the world, for example, aim to replace petroleum fuels with alternatives such as biofuels and hydrogen. Such fuels have been tested on a number of military platforms, including high-performance aircraft such as the United States' fifth-generation F-22 Raptor fighter. While alternative fuels may have the potential to ease reliance on geopolitically unstable sources of petroleum, it simply replaces one form of fuel for another, which does not address the issue of high operational energy demands and inefficient utilisation of energy in routine activities. Moreover, current biofuel prices are significantly higher than conventional petroleum products, as production of biofuels has not achieved the same economies of scale and distribution. Other innovations revolve around the use of alternative technologies such as hybrid-electric or fully-electric propulsion for land and naval platforms. Such options, however, are still immature for widespread military utility.

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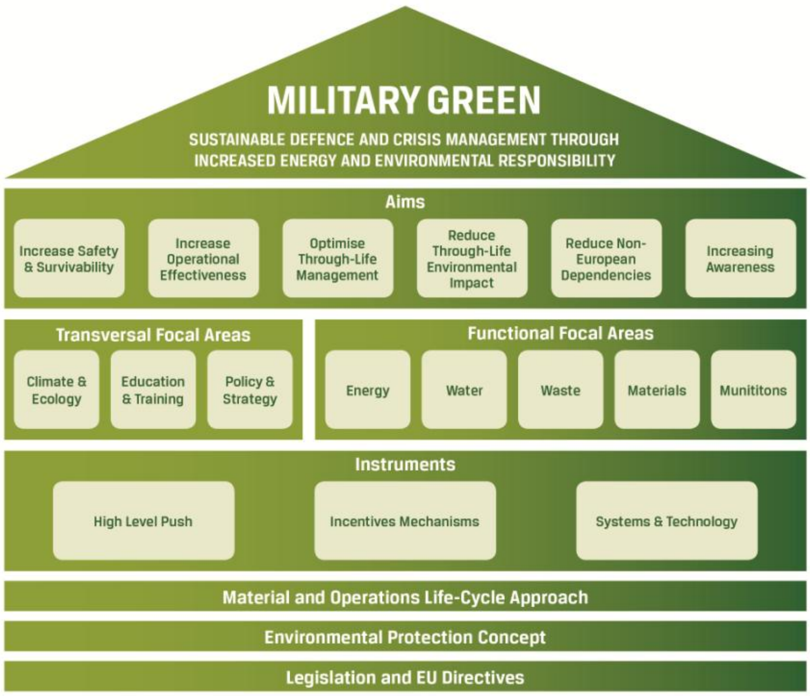
MILITARY GREEN – CUTTING COSTS RESPONSIBLY

More than Just a Colour

Building on legislation and EU directives, Military Green further capitalises on the new Environmental Protection Concept, which is being developed by the EU Military Staff. The Concept defines the principles and responsibilities to meet the requirements of Environmental Protection during EU-led military operations.

Military Green aims at reducing through-life costs and environmental impact while saving lives and increasing operational effectiveness. Three instruments are critical to achieving these aims.

- Getting buy-in from high level decision makers drives change
- Making it attractive to go for greener solutions for all stakeholders involved (end-user, buyer, supplier and environment) helps opting for change
- Changing behavioural patterns as well as introducing novel technologies alongside conventional ones enables implementing change



Optimisation of energy, water and waste management are current focal areas together with catalysing developments of more eco-friendly materials and munitions. Enablers include transversal issues such as understanding the impact on climate and ecology, increasing general awareness among stakeholders and establishing dedicated green policies and strategies.

Military Green offers further the unique opportunity to go beyond just reducing the own footprint by contributing to long term stability in post-crisis zones, putting mechanisms in place for transferring European values, policies and technologies.

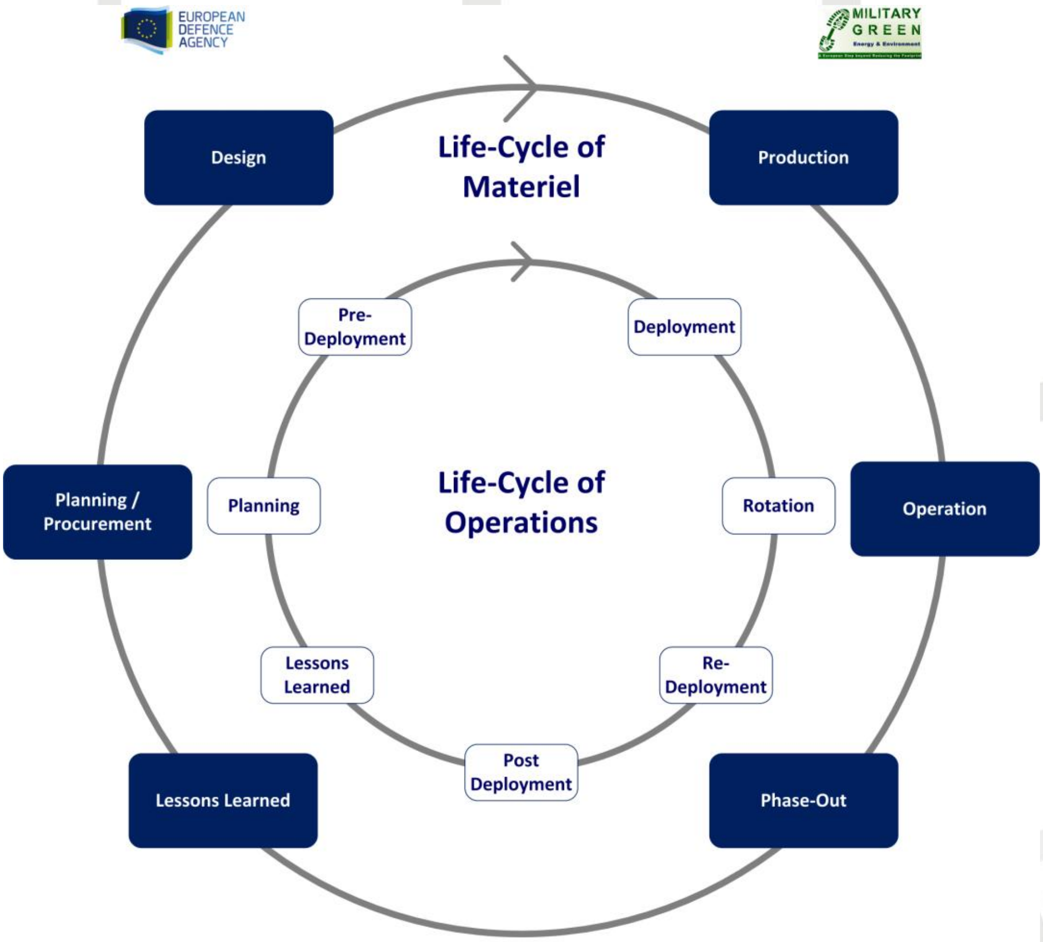
Saving Energy Saves Money

Reducing energy consumption shrinks the energy bill. In financial challenging times this is more relevant than ever. Adopting a life-cycles approach helps us better understand where different kinds of efforts are needed. Two life-cycles can be considered. The materiel life-cycle looks at acquisition and sustainment of defence equipment, typically in a thirty-year time frame. The operations life-cycle relates specifically to the deployment of an operation, which comparatively has a much more variable time frame and is generally shorter.

In each phase of the life cycles energy is consumed. In recent years discussions have focused a lot on deployed operations where supply lines have increasingly been targeted by adversaries. This is a big reason for why energy supply is no longer being taken for granted and instead viewed as a capability in its own right. Subsequently Fuel & Energy is a top priority in EDA's Capability Development Plan. It is during deployed operations that the costs are the most visible. But it is in many ways only the tip of the iceberg. Energy is also required to maintain territorial defence. Furthermore it is required to ensure a high level of preparedness, which over time translates into a big cost.

The equipment manufacturing process is also dependent on energy as is the end-of-life phase – regardless of how much is reused, recycled or disposed, energy is consumed in the process.

Establishing comprehensive requirements in the planning phase is important and helps cut through-life costs, which in the case of materiel can surface decades later.



In each phase energy can be addressed in the following ways.

- **Fossil-Fuel Dependencies and Emissions:** Increasing the presence of alternatives to fossil fuels as energy source carriers, e.g. new synthetic- and biofuels as well as renewables
- **Conversion and Storage:** Improving energy efficiency in the energy conversion process and enabling increased amounts of energy and power (to handle peaks) to be stored
- **Distribution:** Optimising the type and form of the distribution carrier – in the case of electricity this implies incorporating higher voltages and optimising the use of both direct current (DC) and alternating current (AC)
- **Utilisation:** Incorporating advanced automated energy management systems, using more energy savvy equipment and increasing awareness in order to ensure energy responsible behaviour

Challenges in Effectively Address Energy

Although energy is the backbone of defence and crisis management addressing consumption and efficiency comes with some challenges.

- While civilian policies exist at both national and European level, they still need to be translated in such a way that they tackle all particularities of defence and crisis management.
- Energy is transverse, which is reflected in national sources of funding. Funding is typically tied to armaments programmes dedicated to specific systems or to research programmes that look at a particular technology. With little or no funding ear-marked for energy itself, it is difficult to address the big picture, especially at European level.
- The reasons to address energy are still not obvious to all stakeholders.
- With the civilian domain in driver seat there are views within the community that the civilian efforts are enough and that the defence and crisis management community does not need to invest.

Delivering Solutions

There are no simple solutions to overcoming the challenges. However, Military Green is a vehicle that can at least get us part of way and there are currently a number of interesting initiatives on-going in EDA.

- **The Big Picture:** In an attempt to address the big picture, there is a proposal to establish a Military Green Coordinating Body. If EDA Member States buy into this, it could act as the strategic advocate for green issues and in doing so it could help shape tailored energy and environmental policies and strategies for defence and crisis management in order to collectively contribute to the EU goals for 2020 and beyond. In the long run this can help steer resources, in particular funding, towards efforts that reduce the community's footprint.
- **Common Requirements:** Establishing best practices as well as a reference bank of requirements for energy responsible behaviour and design puts in place a common language among all stakeholders. The intention is to enable EDA Member States to use these in the planning process for future acquisitions. In the meantime it acts as a guide for researchers and product developers as to what is expected. Experts from Ministries of Defence, research institutes and industry are collectively developing these best practices and requirements with the aim of having something concrete on the table by mid-2013.

  A corner stone in this process is the EDA-funded study looking at Fuel Dependencies in operations. Scheduled to be concluded by end of 2012, the study consists of three elements. The first element provides a statistical snapshot of energy consumption in theatre. The second deals with creating a parametric model to show the influence of energy on operations. The third is a case study showing what optimised designs could look like for different types of land installations. The three elements provide valuable input to the developing of best practices and common requirements.

- **New Business Models:** In a first attempt engineer incentives in the form of novel business models, “The European Armed Forces GO GREEN” project sees costs being cut through wide-scale implementation of solar energy supply at home in Europe. At no burden on the taxpayer, this six-Member State project (Germany as lead nation along with Austria, Cyprus, Czech Republic, Greece and Luxembourg), pools access rights to rooftops and land and offers them to the market. Public-private partnerships bid for the contract to provide the necessary investment for the development, installation, demonstration and through-life management. The electricity produced supplies the Armed Forces’ premises as well as increases the presence of green energy on the local grid.

  During 2013 EDA work will continue to further explore new types of incentives.

- **Technology Assessment:** In order to steer investments into development of new systems and technologies, experts from Ministries of Defence, industry and research institutes are attempting to jointly assess technology. The comprehensive approach is intended to show how different technologies impact for example capabilities, supply chains and environment. Furthermore it attempts to show where civilian efforts are enough and where specific defence investments are required. This is a valuable tool for launching future collaborative programmes and projects as it provides a more transparency with regard to different rationales to invest.

In addition to the efforts mentioned above EDA activities past and present address among other things energy efficiency for maritime systems, novel supply technologies for underwater vehicles, portable energy for soldier systems and energy efficiency at component level.

Do We Need to Invest to Save?

The simple answer to the question above is yes, we need to invest in order to save! That said, not all investments involve allocation of huge financial resources. Policies, best practices, requirements and technology assessments can have a huge impact with only the cost of labour to draft, convince and get agreement. These sorts of enablers are critical to making a difference and provide a good platform for European collaboration.

Are we spending enough? This is a difficult question to answer. It could be argued that the more you spend the quicker the response and bigger the impact. However, it does require that money is well spent. With policies, best practices and common requirements in place, it increases the likelihood of this happening. In times of financial constraints, though, the defence and crisis management community needs to make priorities. Therefore investments in energy will in the years to come continue to have to compete with investments in other capability areas and the probability of energy coming out on top is uncertain.

A relevant question to answer in this context is if we are spending wisely. If wise is defined as to maximise the output of investments there is room for improvement. Cross-border collaboration is essential to get “more bang for bucks” and energy is an area where there is huge potential for team efforts. This is evident from the EU-wide cooperation already in place in the civilian domain. It is also clear from the on-going Military Green activities within EDA. Ideally there could be more activities, preferably in the form of big multinational programmes addressing energy issues specific to defence and crisis management. Preparing the ground is key to getting there and this is what EDA’s Military Green effort is currently focusing on.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GOOD PRACTICES OF ENERGY SAVING IN FINLAND

Energy security risks in Finland

Energy is consumed in Finland particularly due to cold climate, long distances, high standard of living and energy intensive industry. Both because the availability of energy plays a key role in the Finnish society and because the indigenous energy resources are limited, the energy production has become rather well diversified in terms of energy sources. However, as the demand for electricity has been growing, Finland has become dependent on the imported electricity. The uninterrupted supply of energy at reasonable price in all circumstances is among the main goals of the Finnish energy policy. Besides supply security and competitive energy prices, environmentally sustainable energy supply is a central part of the Finnish energy strategy. Decreasing energy consumption by energy saving is seen as a central means in meeting these goals – it increases supply security, makes energy use more cost-effective and cuts the greenhouse gas emissions. The climate change is also considered to be one of the threats affecting the Finnish security environment and thus it is taken into account in the operations of the defence administration as well.

Importance of energy regulation

Finland is committed to EU directives in its objectives and obligations of energy saving. At a national level, the Long-term Climate and Energy Strategy determines the targets, policy measures and actions for energy saving and energy efficiency improvement in Finland. Improving the competitiveness, securing the supply of energy and cutting the greenhouse gas emissions form the basis for the strategy. The latest strategy from 2008 is currently being updated in accordance with the Government programme and will be finalised by the end of 2012. In the 2008 strategy the Government of Finland has set the goal of reversing the upward trend in energy consumption and reducing the total energy consumption in Finland to around 310 TWh (terawatt hours) by 2020. According to Statistics Finland, total energy consumption in Finland in 2011 was almost 390 TWh of which nearly half was used in manufacturing, around a quarter in space heating of buildings and some 15 per cent in transport. Reaching the energy saving objectives of the 2008 climate and energy strategy will require enhancing the efficiency of energy consumption, particularly in housing, construction and transport (Ministry of Employment and the Economy of Finland).

In Finland, energy saving is guided by legislation, regulations and guidelines, as well as various financial incentives and taxation. Energy efficiency agreements constitute an important element in implementing energy saving in practice. Besides energy saving, they also promote the introduction of new energy efficient technologies and the increasing use of renewable energy sources. The voluntary-based energy efficiency agreements are valid from 2008–2016 and cover the industrial, municipal, property and building, oil, transport, and agricultural sectors. The parties to the agreements include ministries, industry associations, companies and communities. The Energy Efficiency Agreement Scheme is rather wide-ranging as it covers some 80 per cent of Finland's total energy consumption.

The Energy Efficiency Agreement Scheme follows the target the EU Energy Services Directive has set for all EU member states – a nine per cent energy saving by 2016 based on the average energy consumption for 2001–2005. For Finland this means saving 17.8 TWh of energy. The second National Energy Efficiency Action Plan (NEEAP-2) that was submitted to the European Commission in 2011 included 36 energy saving actions that are currently underway or have already been completed in Finland. With these actions a 12.5 per cent energy saving will be achieved by 2016 which will clearly exceed the nine per cent target set. Thus it can be said that energy saving measures are implemented rather widely at practical level in Finland.

On a way towards more efficient use of energy resources

According to the second National Energy Efficiency Action Plan, the largest energy saving will be achieved in buildings, particularly in heating. Main actions include tightening energy efficiency regulations for new buildings, energy subsidies for residential buildings, guidance for increasing the use renewable energy such as heat pumps in one-family houses, and increasing energy efficiency of oil-heating in one-family houses. Heat pumps are an important energy saving measure in residential buildings, particularly one-family houses, in Finland. Regarding households, training and information activities and advisory services also play a key role in energy saving as individual consumers are the main target group for these activities.

Energy will be saved also in industrial sector, particularly by energy audits and energy efficiency agreements, although it partly falls outside the scope of Energy Services Directive. Energy audits consist of going through the subject's energy use, presenting the potential for energy saving and concrete actions for more efficient use of energy, including profitability calculations. Traffic sector will also contribute significantly to energy saving, particularly by increasing the energy efficiency of new cars. At municipal sector energy saving is achieved through energy efficiency agreements and energy programmes. The municipalities that have joined these instruments cover about three quarters of the Finnish population.

The defence administration is also bound by the national targets defined in the Long-term Climate and Energy Strategy. One of the key challenges concerning energy saving in the defence sector is how to save energy without undermining the military capacity. The energy consumption of the defence administration comprises the electricity consumption and heating of its premises as well as energy and fuel consumption in various operations of the defence forces. Particularly the premises of the defence administration and various appliances, e.g. computers, located in them have potential for energy saving and more efficient energy use. The defence administration has joined the energy efficiency agreement for property and building sector, aiming at a six per cent energy saving in the period of 2010–2016.

The Finnish approach to energy saving – energy efficiency agreements – is based on voluntariness and the use of various incentives. For instance, subsidies for energy efficiency investments are provided by the Ministry of Employment and the Economy, based on individual assessments of companies and communities that have joined the agreements. The approach also includes detailed implementation plans for individual sectors. The parties that have joined the agreements also report of their energy saving activities and the realisation of the targets set for them is regularly monitored. Furthermore, the promotion of research and development and innovation activities related to energy efficiency and clean technologies is among the key elements in reaching the national targets. Investing in these activities and developing energy innovations that are competitive also at international level can provide new business opportunities for Finnish companies. For instance, the expertise related to energy audits is rather advanced in Finland.

Conclusions

Both because of its targets and wide coverage, this approach can be said to be a rather ambitious system. Energy saving has also been prioritised in the national climate and energy strategy and thus plays a key role in Finnish energy policy. However, although a lot has been already done in terms of energy saving, the challenges related to sustainable energy use and curbing the climate change are only growing in the future, necessitating even more efficient energy saving measures. As these are global level issues, increasing international cooperation and networking also at practical level is likely to prove beneficial. Creating BSR Good Energy Practices Databank, which contains good practices for energy saving for various target groups such as households, companies, public institutions, municipalities, and even countries, could be one way to spread information and collect practical tips for energy saving at different levels and countries.