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Aiming to reduce fuel consumption by 18% by the year 2020/2021, the UK Ministry of Defence (MOD) has decided to reconsider the issues of energy sustainability. Within this context, majority of experts have approved of the objectives proposed recently for boosting the efficiency of fuel consumption by the Armed Forces, with particular focus on military and economic factors (possible impact). As a result, resilience-focused studies in energy security (resilience as the capability to cope with rising difficulties) have become the key component of Cost Reduction & Future Proofing Systems strategy of the Ministry of Defence.

Research Studies and their Implications

In 2010 the UK MOD launched a comparatively small scope research programme aimed at finding solutions to new challenges of climate change, growing prices on energy and other resources and other areas directly influencing military capabilities and operations. At the initial stage, little progress was achieved despite the acquired expertise (here such programmes as “Power FoB” and “Ship Energy Assessment” could be noted) – a programme bringing the issues of energy, emissions, climate change and resource exhaustion under a common environmental/sustainability agenda was just not relevant to the military command. The so called resilience-focused studies have managed to significantly transform the attitudes and priorities of the military command in the way that the UK MOD has even announced mandatory objectives in fuel efficiency for the Armed Forces. In other words, the issue of climate change, energy security, resource dependency and emission reduction (adoption of the applicable legislation) has taken up the major part of the agenda of the UK Armed Forces in 2012. Natural question is how such a significant turning point has been achieved in such a short amount of time?

First of all, one should keep in mind that the change of behaviour and priorities of the UK MOD has been determined not by the direct concern over the aspects of operational energy security, but rather by more freedom of action given to the MOD. This has been the aim since the impact of growing prices of energy resources, as well as climate change and control of emissions on military operations was recognized. After long debates, decision makers at the MOD have finally realized the potential impact of these issues on the capabilities to prepare, command military operations, and, in the long run, to maintain military capabilities in general. Within this context, as the UK MOD continued searching for the answers to e.g. environmental challenges, the prevailing sustainability objectives had to be replaced with the concept of resilience (see the following chapter for more information on this subject).

The UK MOD obviously acts under the framework of the UK, EU and international legislation governing standard operations. On the other hand, in one of his most important policy statements on environmental protection and sustainable development, the Secretary of State for Defence has noted that “…[the MOD] will introduce standards and management arrangements that are, so far as reasonably practicable, at least as good as those required by legislation. Where there is no relevant legislation, internal standards will aim to optimise the balance between risks and benefits…” This is a clear proposition that if there is no specific legislation...
governing resource consumption, factors related to enhancement of operational energy security must be considered in development or improvement of new or existing capabilities.

Following this logic, a research programme for better understanding of the impact of sustainability has been initiated, and it is this programme that has unveiled the meaning of sustainable acquisitions (procurement). The programme has been aimed at ensuring that the staff at the MOD finally realized the impact their decisions would have in the long-run, i.e. to prevent defence agencies from making decisions or introducing systems that would later require expensive trade-offs. Having considered real energy demands, historical changes of energy prices and future forecast of the prices, the research team has analysed the impact of possible price increase on capacities of military units and energy resource acquisition costs of Commands and the UK MOD in general. This work has improved understanding of the current situation at least partially, and has even convinced some in the necessity of changes.

**Anticipating the Reforms: Objectives and their Enforcement Tactics**

Energy related costs of the UK MOD in 2010 reached £ 1bln, ~2.4% of the entire State defence budget. About £628 mln of the amount were used to pay for energy resources consumed by military equipment, arms and other devices. It has been estimated that the price increase of one penny per litre has led to additional £13mln of the UK MOD costs. If the MOD took no actions in relation to energy costs while carrying on with the attempts to enforce the Strategic Defence & Security Review formulated in 2010, year 2015 energy costs would make 3.9 %, year 2020 - 7.0 %, and year 2030 - 9.2 % of the entire UK defence budget¹.

Within this context, a simple question could be raised – if not now, then when (not whether) energy resources will be out of the military’s reach in terms of purchasing power? In other words, at what point in time will fuel prices in the context of the entire defence budget will become the factor limiting the scope of military operations? Similar cost-related questions also rose during the research on future prices on the raw materials for military weapons production, e.g. the highest price on rhenium (substance for turbine production) is more than 1000% higher now than in 2003. Similar situation may be observed with copper – the price on the metal used for a variety of equipment grew by more than 500%. Although some claim raw material price growth and supply reliability is the problem of the industry (i.e. for the manufacturers rather than consumers), it is the defence sector that will have to cope with the consequences of the limited possibilities to acquire the necessary materials, higher maintenance costs, threat to reliability and accessibility etc.

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¹ July 2012- Energy Security Initial Analysis. Dstl/DOC66346
Despite the obvious challenges mentioned above, scientists providing conclusions on sustainable acquisitions (procurement) found it difficult to attain support from the policy makers and commanders who continued to understand sustainability as the part of Green/Environmental issue not compatible with development of combat capabilities. Having realized that clear presentation of objectives and benefits is probably the most straightforward way in any political debate to achieve support to not really popular ideas, the researchers decided to put aside the notion of sustainability (that had become more of an obstacle for achieving objectives and tasks) and target the debates towards enhancement of resilience (against undesirable phenomena and tendencies). The key aim of all the proposals was “to ensure that the capabilities maintained their capacity to achieve the required result in the economically most efficient way regardless of the negative external factors that are completely or almost out of the MOD’s control”. Such retargeting of the debates has eliminated almost any obstacles: the UK MOD has announced the Action Plan until year 2020 that, among other matters, includes the mentioned objective to reduce military fuel consumption by 18%.

**Resilience Research Programme: Principles and Priorities**

As military commanders continued exploring practical perspectives of implementation of the mentioned objective, the UK MOD initiated a resilience research programme to provide options for reduction of external factors that were out of the Ministry’s control (such as world prices on resources and other required materials, their supply methods, treaties on climate change etc.) affecting long-term operational costs of the defence system. Increased resilience on such uncontrollable factors would positively influence flexibility of the armed forces and ensure the required development of operational capabilities. Key principles of the research programme: 1) adaptation – the defence system must be resilient to existing and future environmental, social and economic threats; 2) mitigation – it is important to promote positive and mitigate negative influence of defence system operations on the environment, humans, economy in the UK and overseas.

The research programme is respectively comprised of two parts aimed at: a) identifying and assessing the impact and scope of risks determined by the lack of resilience (i.e. provide quantitative assessment of the resilience potential and limits of the provided possibilities, provide consultations and improve efficiency of decision making process); b) to devise the methods for reduction or elimination of violations or even the risks of defence capabilities in the areas where the impact of the identified problems and risks is unacceptable. The research is carried out in six priority areas (listed in details in Chart 2), focusing on:

1) **Improving understanding of energy security** – the defence system must realize and plan its needs in energy resource supply, improve resilience to growing prices and reducing supply, enforcing lower energy consumption objectives set at the departmental, national and international levels.

2) **Decision making** – the principles of resilience must contribute to MOD decision making, adoption of regulations and enforcement of evidence-based policy.

3) **Critical and strategic resources** – vulnerabilities related to growing costs and reducing resource supply (in particular those of critical or strategic importance to defence capabilities) must be properly understood and mitigated as far as possible.
4) Emission reduction – understanding and mitigating as far as possible the negative impact of existing and drafted legislation related to emission reduction.

5) Resilience to climate change – understanding the impact of climate conditions on defence policy, mitigation of the impact of such conditions on defence capabilities.

<table>
<thead>
<tr>
<th>Planned Resilience S&amp;T Programme FY12/13 – FY14/15</th>
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<tr>
<td>Energy Security</td>
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<td>Strategic Energy Vulnerability</td>
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<td>Barriers to Alternative Energy Generation</td>
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<td>Energy Efficiency Baselines</td>
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<tr>
<td>Optimised Operating Procedures</td>
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<tr>
<td>Energy Efficient Technologies</td>
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</tbody>
</table>

**Conclusions**

Chart 2 shows that the resilience research programme has covered a fairly wide range of technical and political challenges. No political, business, industry or academic institution was able to carry out the entire research programme on its own, and in this context, collaboration became an unavoidable necessity. The most important, however, is that relocation of the debates from the green agenda into the sphere of operational efficiency, resource accessibility and general resilience to future changes has become the key into bringing the concept of resilience into the Ministry of Defence. In other words, the concept of resilience has become the connecting link between operations efficiency and accessibility of resources, has embedded energy security deep into the context of defence policy and planning and prevented defence objectives and challenges from being degraded in the context of wider discussion on ecology and environmental protection.
A team of experts at the South Korean National Institute of Science and Technology has claimed to have started a revolution in electricity powered vehicles 16th August, this year. During the experiment, the scientists have succeeded in designing an electric battery pack that can shorten the charging time to several minutes compared to current charging time of several hours. Such improvement would make practical contribution into the progress of not only commercial, but also new military technologies, which would help establish electric cars as a transport alternative in the real future. Japanese scientists and the U.S. Government have also shared good news in this sphere this summer. Does this mean we are on the eve of the crucial turning point?

Prospects for Electric Transport: the Battle of Arguments

When talking about the forecasts of establishment of electric cars in the future transport, it is important to hear not only the advocates, but also keep in mind the rational grounded arguments of pessimists. Enthusiasts are certain that electricity powered vehicles will change the situation on the car market, while their short-term effect potential is largely underrated. Their opponents claim that the probable increase in electricity powered vehicles will not replace internal combustion engine even in the long term, they will not have significant impact on the world demand for petroleum, and they will eventually lose their standing. Search for the most efficient vehicle leads to constant comparisons between electricity powered cars (various modifications) with internal combustion engines. Let us do the same.

Although the construction of electric cars is little different from the one of conventional cars with internal combustion engines, an electric car admittedly has a simpler technological design with less moving components. Opposite to a car with an internal combustion engine, electric car handling is less expensive and easier (no replacement of conventional cooling system fluids, lubricants, spark plugs or similar components). This gives electricity powered vehicles more advantage in terms of technological simplicity. However, if other criteria were taken into account, electric cars would most probably be on the top of the list of only eco-enthusiasts. The price, the distance per single charge, fuel consumption, life of the car and practical aspects are the indicators that speak for conventional cars at least for now.

Source: http://www.autocarsreview.com
In his book “Energy for future presidents”, Richard A. Muller has presented an interesting idea about the dependency of the society on vehicles with internal combustion engines. He claims that the spread of electric cars is merely a temporary admiration—a whim of eco-enthusiasts that is doomed to vanish as a potential alternative to replace conventional vehicles. R.A. Muller attempts to present an assessment of why there is a demand for such transport and points at the factor of “green technology bubble” — a fashion to care about global warming, CO2 emission regulations becoming more stringent, electrification policy of governments, dependency on oil mining.

He bases his sceptic position on vehicle market statistics as well, where electric cars are not in a favourable position at least for now. According to International Energy Agency, only about 20 million electric cars will be on the roads in 2020, which would be only 3-4% of all cars. Two thirds of the car market experts KPMG have claimed during their research that by 2025, electric car usage may grow to 15%. Hence, on one hand, electric cars may be viewed as a rather distant future (their major disadvantages are reviewed in Table 1). On the other hand, there is a certain perspective.

<table>
<thead>
<tr>
<th>Comparison criteria</th>
<th>Average car with internal combustion engine</th>
<th>Average electricity powered car</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical efficiency / efficiency ratio</td>
<td>33%</td>
<td>90-95%</td>
</tr>
<tr>
<td>Energy conversion</td>
<td>Non-recoverable</td>
<td>Energy returns to the battery during braking</td>
</tr>
<tr>
<td>Noise level</td>
<td>Noisy, muffler required</td>
<td>No noise, silent vibration</td>
</tr>
<tr>
<td>Refuelling norm / time</td>
<td>25l/min.</td>
<td>6-7 hrs. (120V charger)</td>
</tr>
<tr>
<td>Full tank / battery distance</td>
<td>625-800 km</td>
<td>65-150 km</td>
</tr>
<tr>
<td>Energy (kWh)/fuel (l) consumption and price (LTL), annual</td>
<td>938 l/4312 lt</td>
<td>2172 kWh/ 977 Lt</td>
</tr>
<tr>
<td>Charging infrastructure</td>
<td>Well-developed</td>
<td>Large investment into public charging market for electric cars</td>
</tr>
<tr>
<td>Environmental aspects</td>
<td>1000 km distance, 7l/100 km fuel consumption, “10 tons of gas mixture; CO₂-emissions (g/km) ~ 2.4 times higher</td>
<td>Conventional electricity production is harmful to environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Renewable energy resources – minimum pollution</td>
</tr>
<tr>
<td>Sensitivity to climate/road conditions</td>
<td>Independent of air temperature, Easily adaptive to road conditions</td>
<td>Battery capacity reduces in minus temperatures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Worse road conditions cause inconvenience because of lower body of the car</td>
</tr>
<tr>
<td>Average price of a middle-class car</td>
<td>65 – 100 thousand Litas (Lt)</td>
<td>100-190 thousand Lt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battery replacement after ~ 500 charging operations: 22-40 thousand Ltr</td>
</tr>
</tbody>
</table>

Source: the table prepared by the author on the basis of data by the European Automobile Manufacturers Association (ACEA); http://coedpages.uncc.edu/cstem/summer%20ventures/2010%20World%20view%20of%20Math%20and%20Data%20Analysis/Thomas%20Privott-%20Davis%20Fleming.pdf; and other.

What do Enthusiasts of Electric Cars Say?

Although electricity powered vehicles have attained much criticism, investments by car manufacturers into improvement of electric cars and the range of new models do not shrink. In other words, there is a premise that transition from vehicles with inefficient and polluting internal combustion engines to electric cars is theoretically possible.
The key reason is regulations on annual amount of emissions of conventional vehicles that would almost doubtlessly become more stringent in the future. This should eventually prompt the manufacturers focus on alternative energy, development of the required infrastructure etc. Arguments related to air pollution should stimulate growing demand on electric cars, which, in turn, should prompt further improvement of energy production from renewable resources, such as geothermal, water, solar, wind energy, thus stimulating development of renewable energy industry.

The tendency to charge electric cars from micro power grids, as well as initiatives taken by the State to integrate into vehicle systems may become a very important impetus for development of this alternative transport. In other words, the government (or municipalities) do have the power to make decisions that can change the sceptics’ attitudes and encourage them to purchase electric cars. For example, they can introduce preferential conditions, such as parking downtown free of charge, free charging in public charging stations, preferential conditions for vehicle insurance etc. Adaptation of legal base to electric cars by including any possible privileges and procedures into it would also make this type of transport more attractive in terms of investment. In other words, there might be more investors willing to invest into infrastructure and other areas related to development of electric car fleet.

To be more specific, starting from year 2010 (the conference “Electric Cars in Lithuania: Reality, Challenges and Problems”), the Ministry of Transport and Communications of Lithuania has been making attempts to form positive attitude among consumers towards electric vehicles and their mass spread in Lithuania. It is planned to launch a pilot project of electric car batteries charging and replacement network in Vilnius by 2015, to electrify public transport in larger cities by 2030, with environmentally friendly vehicles to form up to 50% of the Lithuanian vehicle fleet by 2050. The Minister personally spoke for statutory privileges to owners of electric cars and development of electric car industry by attracting investors. Certain municipalities have also taken initiatives in this area: ideas of “Green” vehicle infrastructure have become a part of eco-tourism strategy in Neringa, electric car owners can park their electric cars free of charge in Kaunas downtown, electric car charging station has been installed in Kaunas municipality courtyard, and municipality staff had the chance to try out electric cars “Toyota Aygo”, “Mitsubishi i-MiEV” and “Nissan Leaf” in summer.

On the other hand, according to official data by the company “Regitra”, only 8 electricity powered cars have been registered in Lithuania so far. This shows that regardless of the study on electric cars development in the country to be submitted this September (the study as a stimulus to development of electric car fleet), the national strategy of electric car development has not been prepared yet, and all the ambitions seem to be more “on paper” rather than based on real possessed resources for their implementation. It is not yet clear which Lithuanian institutions would be responsible for spread and establishment of electric cars, what the goals of investments into electric car infrastructure would be, what legal base is required. As a result, investors have doubts about the seriousness of the country’s intentions to develop such infrastructure, citizens’ enthusiasm and capacity to purchase such cars.

In terms of good practice, “Green eMotion” initiative by the European Commission encouraging the use of electricity powered transport could be remembered. Partners to the initiatives: 42 companies, car manufacturers, service providers, manufacturers, universities and research institutes. By collaborating and exchanging their knowledge, they implement projects of environmentally friendly transport that have positive effect on reduction of carbon dioxide emission. For example, battery replacement, DC charging projects, integration of smart power grid, integration of different payment

There are plans to install high speed and street charging stations and electric car rental station with 20 cars in Neringa municipality in 2013. Guests of the resort could rent them and pay for the used electricity on their departure from the territory of the municipality.

National strategy of electric cars development (with plans to legalize privileges to owners of electric cars and establish guidelines for attraction of investments into electric cars infrastructure) is expected in 2013 and will be based on conclusions and recommendations of opportunity study complex development of electric transport. This opportunity study has been carried out by common efforts of the Ministry of Economy, Ministry of Transport and Communications. The estimated completion date of the study is September this year).
systems and various business models are already attempted in certain regions. Hence, the EU transport development direction within this context seems to be clear: energy resource consumption in vehicles based on innovative ideas and technical inventions. Technological progress and different attitude of the society towards own vehicles may help solve the problems of electric cars and, most importantly, limitations of distance per single charge, charging time and battery cost.

**Future Car Today?**

For electric vehicles to achieve high level of usage as a practical alternative to petrol driven cars, it is important to have safe, reliable and accessible charging infrastructure. Scientists at Toyohashi University of Technology in Japan have taken a creative approach to this problem and have presented a high-speed remote charging system, which charges the battery through tyres of special mixture as the car drives concrete road, the thickness of which is at least 30 cm. During demo trials, generators (white base) covered with metal plates and 15 cm layer of concrete above the plates were used. 50-60 Watts AC energy was transferred through the plates and used to switch on an electric lamp. This demonstration helped illustrate transfer of induced power to wheels. Scientist Taashi Ohir has claimed that using this new type of charging by electrified roadways, EVER (*Electric Vehicle on Electrified Roadway*) may charge 80-90% of capacity of a battery in an electric car that is driven down this road. This would mean that the car charged through the tyres during driving would no more be dependent on fixed electric car charging stations.

![Demonstration stand of power transmission system](http://www.whatsonxiamen.com/tech1514.html)

August, 2012, scientists at the National Institute of Science and Technology of South Korea announced about their new invention that would help shorten battery charging time. During the experiment, a Li-ion battery (usually used in electric cars and providing power for the distance of 150 km per single charge) was replaced with fast charging battery pack. Battery components were put into grapheme solutions of different types and later carbonized to form a dense chain of electrodes in the battery. Battery cells carrying energy should automatically start charging as soon as discharged (conventional electric car batteries first have to discharge on the outside and recharged again, which is considered to be one the key minuses of electric cars).

Laboratories worldwide continue to improve accumulators of all types of electric cars by using nanotechnology. The aim is to improve parameters of accumulators, extend their life, increase the density of energy and power, reduce weight of equipment etc.

Latest technologies are expected to reduce the cost of accumulators for electric cars within several years: according to the U.S. Department of Energy, accumulators could become cheaper by even 40% as their production costs continue to decrease.
Revolution on the Battle Field?

Militaries spending billions for testing new military technologies are in active search for new possibilities in “Green” transport as well. Unmanned aerial vehicles (UAVs) are not a surprise any more, and on 24th August 2012 Australia announced that its Air Forces had purchased Boeing EA-18G Growler electronic warfare crafts: the new fighter aircraft is considered to be the most advanced electronic warfare technology (accessible only to the U.S. until now) that can not only plan tactic actions, jam enemy’s radio electronics, but also fight against enemy’s aircrafts or organize attacks on ground targets. The fighter aircraft has innovative structure (in particular, the wings) and is powered by General Electric F414-GE-400 turbofan engines that create the traction of about 6 to 11 tons. This allows the airframe to reach the speed of up to 1900 km/h at the altitude of 2200 km above sea level. Moreover, the Australian Minister of Defence Stephen Smith has informed that the country’s Air Forces will expand its armoury with 12 units of F/A-18 Super Hornet fighter jets with Growler radar killer equipment and other electronic devices. These improvements will be completed by 2018 and will cost about USD 1.5bln.

Electric Engine in the Context of Military Technology

In IDTechEx report “Electric Vehicles for Military, Police and Security 2011-2020” electric vehicles for military are defined as military planes of new generation, military aircrafts and other electronic vehicles. Assessing the use of the latter in warfare, P. Harrop points at their clear advantage: transport of this type is silent, manœuvrevable, ecological and with almost no vibration. Under common standards of fossil fuel, power consumption, level of electrification, he classifies electric vehicles into the following types:

- micro hybrids – vehicles with conventional internal combustion engines and stop/start mechanism that switches off the engine as soon as it has stopped;
- mild hybrids – vehicles between micro hybrids and hybrids, equipped with regenerative brakes that return the energy into the battery during braking; otherwise the energy would dissipate as heat;
- plug-in hybrids – vehicles with hybrid configuration and additional capacity to charge the battery by plugging it into the power grid;
- hybrids – vehicles with internal combustion engines, electric motor and small nickel-metal hybrid traction battery that is used only during the first 45 km or so, and then switches to power generated by the internal combustion engine until the next charging;
- battery electric vehicles – vehicles with a battery and electric motor completely dependent on power grid and regenerative braking.

One of the reasons for the Pentagon to demand collaboration of different branches of the US armed forces is seeking of standardization of advanced armament, equipment and similar combat systems. Although only ~2% of the U.S. armament is electrified at present, this logic also applies to the development of electric technology: electricity powered vehicles should make about 40% of all the military vehicles by the end of the decade, and the number of electric cars is estimated to reach 35 thousand units by 2016.

Having integrated different types of electric vehicles, the military would not only become more versatile, but also have more advantages during battles. For example, certain electric units may provide additional power to military equipment in an inaccessible terrain by avoiding radars. Another undisputed advantage of electric cars is independence from petroleum reserves and prices. Given that armed forces
usually have limited access to reserve chain during operations, and fuel supply requires huge funds, application of renewable energy in military vehicles is very important. This has been emphasized by the U.S. Secretary of the Navy Ray Mabus, who claims that the Pentagon has to be less dependent on fossil fuel in military operations, because transportation of fuel is the most dangerous and expensive part of such operations. The priority within this context is development of electricity powered transport infrastructure both in and outside of military bases.

In terms of innovations that are already being applied in the area of electric vehicles, the U.S. company “General Dynamics” has created an electric tank M1A2/Desert that has already become an inseparable part of the military. This armoured 20 t tank can reach the speed of 105 km/h, is manoeuvrable, generates the required power by itself and does not harm environment because of its ecological characteristics.

**RC electric tank M1A2/Desert**

Source: [http://www3.towerhobbies.com/cgi-bin/wti0001p?&I=LXRNL8](http://www3.towerhobbies.com/cgi-bin/wti0001p?&I=LXRNL8)

Advanced technological innovations used in intelligence, tracking, search and rescue operations are important not only to ground or air forces, but also the navy. During military operations, ships must be silent and generate as less heat or gas as possible to make it harder for enemy missiles to track them. The important aspect of integration of electric engines is change of the concept of warfare vehicles design. As part of electrification of vehicles, modular ships are designed to be easily transformed according to the need: a single ship may be used as mine sweeper in one operation and as a landing craft in another operation. Despite the advantages, such navy vehicles are large and expensive: ships usually are 20 m long, use the largest existing electric batteries and the price of one unit reaches USD 5 mln.

**Hypersurb underwater powerboat**

Source: Marion HSPD
APPLICATION OF RENEWABLE ENERGY RESOURCES IN MILITARY MISSIONS AND OPERATIONS: A CHALLENGE OR A POSSIBILITY?

Darius Milčius, Lithuanian Energy Institute
Arūnas Molis, Energy Security Center

31st August this year, exercises “PRT-16 Challenge 2012” of the 16th rotation to take over the Lithuanian-led mission in Afghanistan, Ghor province, for the first time involved the factor of operational energy security. During table-top exercises “ENERGEX 2012” organized additionally under the framework of the mentioned exercises, for the first time Lithuanian troops planned implementation of combat tasks in case of disruption of energy resource supply to the place of the mission. The exercise aimed at identifying possible impact of energy resource shortage in the operations area on the operation and how resource supply related issues can be solved by planning in advance and organizing self-provision of the camp with the required amount of power.

Supply of Resources to the Provincial Reconstruction Team in Afghanistan

Until present, practically all demand for power supply for the Provincial Reconstruction Team (PRT) was satisfied by using modern diesel generators with 30% efficiency at the best. Most issues related to diesel generators usually raise in winter (for the period of 4-5 months), with the temperature below -30°C, heavy snowing conditions, which usually limits the possibilities to supply the camp with the necessary amounts of diesel. To compensate the shortage of diesel, in theory it is possible to use renewable energy resources by installing intermediate energy storage systems: batteries or hydrogen energy equipment. Application of renewable energy resources would help significantly reduce air emissions, thus implementing the decisions on climate change reduction adopted at the Copenhagen Climate Change Conference. However, there is a question of whether this would not expose the troops of the mission to more danger, how much this solution would cost and how long it would take for the latest technologies to pay off.

During the exercises “ENERGEX 2012”, representatives of the Lithuanian Energy Institute (its experts have been preparing a more comprehensive study on this subject) and company “Suntrill” that has been collaborating with the military for a long time have provided calculations and practical examples of circumstances and methods of replacing liquid fuel with renewable energy resources in Ghor province (similar calculations could be easily applied in other mission locations as well). According to the experts, in order to satisfy the growing demand for power and limit the impact on environment, intensive search for new energy sources and cheaper production technologies has been pursued around the world. Research is being carried out to find out the method to increase efficiency of current power conversion systems, improve energy saving and storage technologies. This is related not only to the issues of resource delivery to the operations, e.g. increasing amounts of exhaust gas (CO₂, NOₓ, solid particles etc.), radioactive particle emissions determine global warming, air pollution, acidic precipitations, ozone layer changes, deforestation – all of this also urges to start searching for new reliable technological decisions. Moreover, with 1.2-2% annual population growth (it is estimated that the world population will reach 9 billion by 2050), the world economy is growing in proportion. This should not only increase

1 http://www.corrosion-doctors.org/FuelCell/Comparison.htm
2 http://unfccc.int/meetings/copenhagen_dec_2009/meeting/6295.php
the demand for power (energy consumption is believed to grow 1.5-3 fold by 2050), but increase competition for presently conventional energy resources.\textsuperscript{4}

One of the possible solutions is to use renewable energy resources (wind, sun) as an alternative to fossil fuel. Application of renewable energy resources is rapidly developing and, according to certain sources, the total annual value of such fuel consumption worldwide reaches about USD 100 bln \textsuperscript{5}. Renewable energy resources help reduce hazardous emissions, such resources are practically inexhaustible, they can be successfully used in places remote from main energy resource supply channels, natural gas supply system and power grids. On the other hand, most renewable energy resources are known to be less stable in terms of power supply. The only way to balance such systems is to use intermediate energy storage technologies that would allow to store all the produced power before its stable provision to the consumer.

There are a lot of various energy storage technologies in the modern world: capacitors and super capacitors, batteries, compressed air storages, flywheels, hydro accumulation systems, hydrogen energy systems\textsuperscript{6}. Depending on areas of application and level of technological development, e.g. in transport sector, super capacitors and accumulators have had the widest application, and various accumulators and hydrogen energy systems are the most popular in remote objects.

**Theoretical Possibilities for Wind and Solar Systems Application**

To ensure stable power supply to military units deployed in remote regions, hybrid power generation systems are practical. In such systems, renewable energy resources are usually integrated with technologies that use fossil fuel (Picture 1). Only power plants of such hybrid type can ensure undisrupted power supply 24/7. Modern controllers allow smart control of system performance: in case solar or wind capabilities or stored power in accumulators are not sufficient enough, diesel electric generators can be employed at once to ensure stable power supply.

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\textsuperscript{6} Dr. Stasys Bačkaitis. Energijos kaupimas - poreikiai, idėjos ir technologijos (Energy saving – needs, ideas and technologies). Energijos Erdvė 2011 No.3 (10)
When assessing the perspectives for application of wind and solar power plants for demands of the military, it is first of all important to analyse accessibility of such renewable energy resources in the specific location. Based on the available information about annual average wind energy resources in Ghor province, Afghanistan (Picture 2\(^7\); Ghor province 0-200 W/m\(^2\), 50 m altitude), possibilities to use wind energy there can be considered very limited. In other words, intensive use of wind energy to meet the demands for power generation in the PRT base would not be practical because of certain security aspects (wind power plants visible from remote would be a really good target for an enemy) and limited wind resources.

On the other hand, given the availability of solar power in Afghanistan, solar energy resources are considerably abundant in the country both on average (Pic. 3\(^8\)), and in each season. In other words, different authors\(^9\) consider the potential of solar energy to be very high in Afghanistan, and solar energy can be successfully used for more than 300 days a year. However, in terms of solar energy perspectives in the Lithuanian PRT in Afghanistan, availability of solar energy resources depends on the season, i.e. it would be different in summer and winter (accordingly 9 and 3.5 kWh/m\(^2\) during the day)\(^10\). Energy generation capabilities in summer and winter could differ threefold.

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\(^1\) [http://www.nrel.gov/wind/pdfs/final1-1-1pwr50af.pdf](http://www.nrel.gov/wind/pdfs/final1-1-1pwr50af.pdf)

\(^2\) [www.nrel.gov/gis/pdfs/swera/.../afg_10km_glo.pdf](http://www.nrel.gov/gis/pdfs/swera/.../afg_10km_glo.pdf)


\(^4\) [www.nrel.gov/international/ra_afiachanistan.html](http://www.nrel.gov/international/ra_afiachanistan.html)
Practical Possibilities: Arguments For and Against

When assessing prospects for solar energy application at a mission location, it is important to note that application of such resources first of all guarantees stable power supply, requires minimum extra technical efforts in maintenance of energy system (e.g. removing snow from solar panels in winter) and does not require significant additional security measures. On the other hand, in order to ensure stable power supply, particular attention would have to be paid to power storage systems. Considering the experience worldwide and having analysed key advantages and disadvantages of two storage systems (accumulators and hydrogen energy technologies), a provisional assessment could be made to determine the possible price of the solar energy system to meet 25%, 50% and 100% of the PRT annual demand for power supply, physical area for installation of such systems at the territory of the PRT base (calculations in Table 1) and the cost of power in this case (Table 2) \(^{11}\) (based on average values of solar energy resources in Afghanistan and considering that one living container of the PRT uses the maximum of 96 kWh per 24 hours).

Table 1. Prices and area of solar energy systems.

<table>
<thead>
<tr>
<th></th>
<th>25% of demand</th>
<th>50% of demand</th>
<th>100% of demand</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solar energy system price</strong></td>
<td>LTL 3.593.721</td>
<td>LTL 5.467.433</td>
<td>LTL 8.884.580</td>
</tr>
<tr>
<td><strong>Physical area occupied by solar panels</strong></td>
<td>3200 m(^2)</td>
<td>6016 m(^2)</td>
<td>12032 m(^2)</td>
</tr>
</tbody>
</table>

Table 2. 1 kWh price comparison.

<table>
<thead>
<tr>
<th>1 kWh price, 50% of demand/20 years (in LTL)</th>
<th>1 kWh price, 100% of demand/20 years (in LTL)</th>
<th>1 kWh energy market price in Lithuania (in LTL).</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.175</td>
<td>0.152</td>
<td>0.14-0.16</td>
</tr>
</tbody>
</table>

Calculations by LEI expert

Such installed system would generate significantly more power than planned or needed by the PRT in summer, and in winter, on the opposite, might generate less power. In other words, in terms of meeting the demands during separate seasons (e.g. winter season, when the amount of solar energy is the smallest), the price of the system may increase by up to 40%, and physical area occupied by solar panels would be twice as large. On the other hand, the system installed for meeting energy demands in winter, the total amount of generated energy would be twice as large in summer, i.e. if the system would meet 25% of power demand in winter, then in summer it would generate more than 60% of all the needed energy. Considering that modern diesel electric generators can produce about 2.5-3 kWh\(^{12}\) of electricity from 1 l of diesel, such system would provide significant annual savings on diesel amounts.

Table 1 shows solar system prices calculated on the basis of average values of solar energy resources in Ghor Province, Afghanistan. During the calculations, energy storage systems were also included: lead-acid accumulators. The choice of accumulators was based on detailed analysis of technological performance aspects of

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\(^{11}\) LEI/ESR study “Costs and payback period of replacement of conventional energy resources with alternative energy resources”. 2012

different accumulators; it has been determined (considering the latest research results\textsuperscript{13}) that currently the most popular Lithium (Li) accumulators would not be suitable for the PRT deployed in Ghor province. Within this context, it is important to note NiMH accumulators that have been successfully applied in hybrid cars used for more than 10 years in severe climatic conditions. In other words, capacity and life of the latest NiMH accumulators are little smaller than of Li accumulators, but the former could be used more successfully in severe conditions in Afghanistan throughout the year\textsuperscript{14}.

In terms of energy storage alternatives, particular attention should be given to hydrogen energy systems. Such systems have been studied intensively for more than 10 years and have proven to be reliable and technologically efficient energy storage technologies. Unfortunately, most hydrogen energy technologies are still in their demo state as their costs are too high. Having estimated the prices of separate components (HARI and KAHUA projects\textsuperscript{15}), 1 kWh generation price in solar and hydrogen energy system could be up to four times as large as using the systems based on solar panels and accumulator systems. Still, considering average values of solar energy resources and 20 years life of solar power plant (i.e. complies with warranty period for solar panels and includes replacement of accumulators), the conclusion is that average price of power generation using these seemingly expensive technologies would be close to energy market price in Lithuania\textsuperscript{16}.

Lithuania’s military commander Gen. Lt. Arvydas Pocius at ENERGEX 2012 exercises

Picture taken by Eugenijus Žygoitis.

\textsuperscript{13} http://www.utsandiego.com/news/2012/aug/04/tp-web-chat-alerts-nissan-to-leaf-woes/
\textsuperscript{14} http://www.nilar.com/home
\textsuperscript{15} Ielahia.org
\textsuperscript{16} http://www.regula.lt/lt/elektra/Rinkos_kaina/index.php
August 2012 Sweden announced about changes in the State defence strategy to take place from 2014: it is planned to reconsider defence policy directions (formally renouncing the policy of neutrality) and propose to increase subsidies for state defence. Moreover, the country presiding over the Arctic Council together with Finland and Iceland have declared about their aim to strengthen the role of the “non-Arctic Five” in dealing with issues of future of the Arctic – considering present and prospective disagreements on development of energy resources, strengthening the positions of the Western countries with several additional votes could be particularly important. Sweden and Finland are indeed one of the most active NATO partners participating in crisis management operations of the Alliance and considering the possibility to join activity of NATO centres of excellence. How could relations between NATO and these two countries develop in the future and how significant would they be in dealing with NATO energy security problems?

NATO Plus: Partners “ONLY” – why?

The Northern Alliance actively enforces the policy of partnerships, dialogue and collaboration in its struggle against the threats of the XXI century. In general, NATO partnership programmes could even be viewed as the key reason why there are no renovation, development of security and stability area, new boundary lines in the Alliance. Such programmes as “Partnership for Peace”, “Euro-Atlantic Partnership Council”, “Mediterranean Dialogue”, “Istanbul Cooperation Initiative”, “Global Partnership” and bilateral relations with Russia, Ukraine and Georgia have created conditions for establishing relations with strategically important countries that do not necessarily seek or are not yet ready for partnership. Sweden and Finland that have officially declared neutrality in case of military conflicts, but have joined “Partnership for Peace”, are one of NATO’s closest partners in this context.

From today’s perspective, the Nordic countries probably are the most experienced in participating in exercises, missions and operations with the Alliance. In year 1999, NATO “gave its blessing” to new military training centre as the part of Partnership for Peace (PfP) in Kungsängen, Sweden. In 2010, Sweden and Finland organized a series of seminars and conferences “NATO’s New Strategic Concept – Comprehensive Approach to Crisis Management”, where they discussed with NATO experts on ways to prepare crisis management strategies by cooperating with partners. In April 2011, Sweden lead civil-military-police exercises “Viking 11”, during which soldiers from NATO and PfP countries learnt to plan peacekeeping operations in accordance with Chapter VII of the UN Charter. This, as well as the role of Swedish and Finnish armed forces in joining the provincial reconstruction teams (PRTs) activity from 2006 in Afghanistan, shows that military and diplomatic contribution of the Nordic countries into the formation of NATO international agenda is extremely important. More important is that both countries are determined and possess necessary capabilities to remain true “security providers” and reliable allies. Efforts by Sweden and Finland do not remain unnoticed by the Alliance: at the press conference a year ago, Secretary General of NATO A.F. Rasmussen commented on the neutrality policy of the Nordic countries and said:

2011 report “Finland, Sweden, and NATO: From “Virtual” to Formal Allies” by the U.S. National Defence University names mutual obligations between NATO and Finland and Sweden as actual alliance between these countries and NATO.

Activity of the Centre involves exercises and trainings related to humanitarian aid, rescue and peacekeeping operations.

http://www.ndu.edu/inss/uploaded/SF%20265_Michel.pdf
“Our door remains open for all democracies in Europe that fulfil the necessary criteria”. Sweden and Finland implement these requirements. Still, neither Sweden, nor Finland have officially stated their wish to join the Alliance. Two key circumstances could be mentioned in this context. First, both Sweden and Finland emphasize raising problems by conventional attempts to solve them peacefully and act as mediators between parties of the conflict to reach peace. In other words, decisions based on neutrality, peaceful co-existence, mediation during negotiations rather than armed force is the key feature of the Northern identity in international community. Second, NATO membership is traditionally viewed by the Nordic countries through the prism of relationship with Russia: Russia is defined as the key factor determining the level and scope of security of Finland in its Security and Defence Policy. In other words, although there is tension in relations between Nordic countries and Russia (one of the most obvious evidence is airspace violations, active presence of the Russian navy in the Gulf of Finland, increasing military budget of Russia etc.), expert at the National Institute of Strategic Studies L. G. Michel is confident that it is the emphasis on neutrality and peaceful co-existence (i.e. non-provocation of Russia) that has become the most successful contribution into relieving tension in relations with the Kremlin.

On the other hand, advocates of membership of the Nordic countries in the Alliance believe that closer relations with the Alliance (including the membership) would not only help save funds (e.g. by spending less on strengthening territory defence capabilities), but also provide protection against Russian pressure. In other words, although the Russian factor has long stopped the Nordic countries from joining the Alliance, the Swedish Division General D.Gyllensporre has stated that political development in Russia, the Baltic and Arctic regions makes it more difficult to enforce national security questions. Admittedly, difficult to forecast situation in the Baltic Sea and Arctic regions (i.e. strategically important centres of natural resource and trade ways) increases the risk of potential military conflict with the countries that have certain interests in these regions, in particular, Russia. Concerned about the possibility of Russia’s position strengthening in the region, Sweden invests into updating its technical equipment (such as purchasing of ultrasonic fighters Super JAS with the most advances armament management system, and planned investment of mln 300 kronas into defence starting with 2013), and plans to increase expenses on defence with mln 200 kronas per year, thus seeking closer relations with NATO. After the Russia-Georgia conflict in 2008, Finland started having similar thoughts – the former Finnish Minister of Foreign Affairs A. Stubb declared in 2008 that the possibility for the country to join NATO and reform its security policy was quite real.

**Importance of the Arctic to Cooperation between NATO and the Nordic Countries**

The race for the Arctic resource development started in the end of 2008, when the countries updated their national strategies for the short and the long terms. Although the latter usually included the aims of cooperation in development of natural resources and navigation ways, it is predicted that the Arctic region may become one of the most important regions in the world within the coming decades because of its natural resource abundance, oil and gas mining potential, exercises and deployment of armed forces, intensive navigation. As a result, Russia, the U.S., Norway, Canada, Denmark (i.e. the countries of “the Arctic five”), as well as Iceland, Finland and Sweden make efforts in the Arctic Council (major international forum on this subject) to achieve agreement on sustainable development of the Arctic, and implement several Northern region programmes at once.

Both countries have old traditions of democracy, advanced economies. The level of armament and defence budgeting (1.5% of GDP with the largest amount spent on equipment, research and development) meet the Alliance’s requirements in general.
Within this context, it is necessary to note that countries of the Arctic region struggle less about territorial boundaries, but more about access to the natural resource of the Arctic shelf and navigation ways. Global climate change, shift of glaciers would soon open new pools of resources that were earlier inaccessible because of the Arctic ice. According to the U.S. National Snow and Ice Data Centre (NSIDC), in the middle of 2012 summer, the ice cap shrank to min 4.10 sq. km, and the period from 2005 to 2010 was registered as the warmest in the Arctic. This means that conventional period, during which it is possible to use navigation ways of the North Sea, is now two months compared to former two weeks (period from 1979 to 2000). According to the forecasts, within the coming 30-40 years, the Arctic Ocean will almost not freeze in summer. According to the director of the NSIDC centre M. Serreze, research by the U.S. geological service have shown that there are bln 90 barrels of oil and about trl 1.5 cubic meters of gas (almost the third of the world’s natural gas reserve) under the ice. Within this context, it is not surprising that disagreements on aggressive Arctic development policy have recently started to emerge in the Arctic Council. Canada (the initiator of the Arctic Council) has spoken for more rapid institutionalization and seeks the leader’s position. Its main argument is that the Arctic is part of the Canada’s continental plate. The U.S., Denmark and Russia also seek legal “extension” of their continental shelf, and the U.S. faces problems in this context because of ungratified UN Convention on the Law of the Sea. Norway seeks to strengthen its border protection and would prefer to promote cooperation in energy resource mining; Norway seeks to become the most advanced country in terms of enforcement of environmental regulations in oil and gas sphere. Moreover, Norway seeks to create an alternative to the oil mined in the Persian Gulf in the Barents Sea, thus reducing dependence of the U.S. and Europe on the Middle East. Sweden presiding over the Arctic Council from 2011 to 2013 seeks to strengthen not only its own role, but also the role of Iceland, Finland and the EU (potentially the largest market for the resources and goods from the Arctic region).

As increasingly more countries and international organizations refer to the Arctic as the area of strategic interests, increasing militarization of this region should not be surprising. In other words, although the biggest attention remains focused on development of energy resources, the growing importance of military dimension in the Arctic in the agenda of the Western countries and Russia leaves the possibility for military provocations or even conflict. For example, Russian Security Council has prepared the Northern Pole Militarization Project for establishing its military power in the region. According to the project, Russian army (the new “Arctic force team”) should be deployed in the Arctic region by 2020 to ensure “military security in different military and political circumstances” or, to put it simply, control over real or claimed Russian Arctic sector. NATO as a military organization cannot remain indifferent to Russia’s goals to develop its economic area, take part of the Arctic Ocean, explore the territory, search for locations of valuable resource basins and start natural resource mining. For this reason, attempts have been made to agree on single position of the U.S., Canada, Norway and Denmark (members of the Arctic Council), thus reducing the potential tension between the countries competing in the Arctic.

The role of Sweden and Finland as potential members of NATO and current members of the Arctic Council in the Northern region security architecture is rather significant, and may even increase in future. Even today, cooperation with the four other Western members of the Arctic Council is referred to as the “mini-NATO”, where indirect military cooperation in the Northern region could be developed as well.

The feasibility of such mechanism could be proven by establishment of the Nordic Defence Cooperation (NORDEFCO) in 2009, as well as the largest in the history of the Arctic region exercises “Cold Response 2012” in spring 2012 that involved 16300 soldiers from 14 countries, including the Nordic countries, NATO and non-NATO members. Aims of the “Cold Response 2012” also signal infrastructural and functional overlapping between armed forces of non-NATO members and NATO capabilities – preparation of joint land, air and navy forces to carry out intensive crisis response operations of any type in cold climate conditions. Increasing accessibility of the Arctic in future, energy resource, new navigation areas and waterways may become the deciding factor on the decision of Finland and Sweden to become members of the Alliance.

**Importance of Close Relations between NATO and Nordic Countries**

Russian policy of “energy supervision in the Baltics”, same as Russian new antiaircraft and missile defence system deployed in Kaliningrad region (effective area of the missile defence system covers Swedish navy and air force units) cause as much concern to the Nordic countries as to the Baltic states. It is possible to find more links, for example, NATO defence plans for the Baltic states establish important role for Sweden. In case of scenario when defence capabilities of the NATO and Nordic countries would have to be used from Sweden, the latter could provide support only by providing proper protection of its airspace and strengthening its own defence (as Sweden would naturally be exposed to danger as well). The same issue has been noted by Maj Gen K. Neretnieks of the Swedish Armed Forces who emphasized the necessity to strengthen security and antimissile defence of strategically important Gotland Island in his analysis of the post 2014 strategy of the Swedish Armed Forces. In wider perspective, e.g. in case of military conflict with Russia, Swedish air defence resources would not be sufficient enough for NATO defence mission in the Baltic states – in such context, more efficient and clearly formalized cooperation of armed forces of the U.S., Sweden and Finland would be needed.
Experience of the Nordic countries could help improve implementation of NATO security concept and such specific initiatives as “smart defence” not only on the military level, but also in academic cooperation. Considering that military training and preparation is viewed by NATO as one of the most relevant examples and priorities of “smart defence”, joint activity focused on this issue in the area of strengthening of energy security could provide real dividends in the near future. Within this context, participation of Sweden and Finland in projects of NATO centres of excellence (in particular, Energy Security Centre of Excellence in Vilnius and Cyber Defence Centre of Excellence in Tallinn) could be important. Especially given that Energy Security Centre of Excellence in Vilnius offers to NATO partners both project long and continuous cooperation following the experience of other NATO centres of excellence. There are no doubts that both Finland, and Sweden, similar as the Baltic states, could contribute with their expertise to implementation of NATO’s operational and tactical goals in assessing security challenges, maintaining and assessing “brain centers” with huge capacities, and following deep rooted traditions of military training. This could also allow them strengthen their capacities to exercise influence at various phases, levels and sectors of decision making in the Alliance.
All participants of NATO or UN crises management missions and operations must follow relevant environmental guidelines established in the NATO Joint Doctrine on Environmental Protection (i.e. one of the agreements on standardization STANAG) or documents governing UN regulations on environmental protection for combat missions. But the participants of the EU-led military operations, on the other hand, did not follow legal provisions of environmental protection or energy regulations simply because there were none of such regulations. Therefore, Finland, Sweden and the EU joined their efforts to finally prepare a concept “The European Union Military Concept on Environmental Protection and Energy Efficiency for EU-led Military Operations”. Three years after the idea on such concept was brought, on 12th September this year the document was approved in the EU Military Committee, and on 14th September – in the EU Council. What are the prospects of enforcement of this document and could it affect the EU defence planning process in future?

Idea of the Concept

The European Union as a leading proponent of international actions on environmental protection is committed to sustainable development worldwide. Therefore the EU promotes measures at the international level to deal with regional and global environmental issues. In this regard environmental protection requirements are integrated into the various EU policies for quite some time, including planning and execution of the EU-led military operations. Main aim of doing this is a clear recognition that overall military success and eventual transition of responsibility to local authorities today depends not only on the appropriate and proportionate use of armed force, but also on the success avoiding or minimizing collateral damage.

Influence of military actions on civil population, their cultural heritage and the environment needs to be regulated by international law for several reasons. First of all, this doubtlessly determines support of the society to the mission: without the support, long-term reconstruction and development processes would hardly be feasible. Moreover, damage to the environment in the operational area, especially related to natural resource, may cause instability and new conflicts. And, on the opposite, environmental protection and attention to its sustainability during military operations would lead to long-term security and sustainable development. Hence, environmental factors should be considered in preparation and implementation of mission strategies, and the new “European Union Military Concept on Environmental Protection and Energy Efficiency for EU-led Military Operations” should work as an impetus for such processes.

Aim of the Concept

According to the document, the concept provides strategic guidance for the consideration of environmental protection at all stages of the EU-led military operations. In other words, the document establishes binding and official guidelines to be followed by all the partner countries (including non-EU countries) that participate in the EU-led military missions and operations. The document establishes boundaries of the liability and principles of performance to be followed in complying with regulations on environmental protection during the EU-led military operations and to promote a
common understanding of the environmental policies during the EU-led operations, in order to enhance interoperability among the EU Member States. Lessons learned from preceding EU operations, as well as principles and environmental best practices of the UN and NATO, are taken into account, whenever appropriate. Thus, it may expected, the document should help to avoid situations where military interaction between the participating countries in joint military units, such as combat teams, suffer from different environmental requirements of member states and partners.

The concept includes identification of threats to environment, legal framework, duties and responsibilities, implementation in planning and conduct, environment protection associated activities and factors that may impact the environment. Notably, besides the standards and principles of environmental protection processes, the document also regulates protection of cultural property and energy efficiency, with the latter being particularly important in implementation of goals related to the development of renewable energy during military operations. Finally, this document reviews joint initiatives related to the improvement of environmental protection in the longer run: training, education and capability development. These areas are reviewed in details further.

**Aspects of Environmental Protection, Environmental Health and Security**

Not all organizations or countries have aspects of environmental protection and health so closely linked with each other as in Sweden – the country seems to clearly realize that proper environmental protection guarantees and determines safety and health of soldiers. In other words, there are no doubts for Sweden about the link between environmental protection and security (Table 1) and increased attention is given to encouragement of such link in different areas of society’s life. Attempts have been made to apply this approach in the EU concept as well by emphasizing that it is important to ensure safe and sustainable in terms of environmental protection implementation of obligations of the army to the society in order to protect people’s health and environment.

**Energy Aspects in the Concept**

The Chapter on energy in the Concept has been prepared by the efforts of the European Defence Agency (EDA). The main aim is to promote the creation and development of “greener military” with more efficient, effective, sustainable performance during military missions. Significant reduction of pollution that poses risk
to air, land and sea has been named as key priority, while key aspects requiring particular attention are:

- Environment is exposed to the biggest danger by emissions of vehicles used for logistics and fossil fuel emissions.
- The dependency on resources limits operational efficiency, sustainability, autonomy and mobility.
- Operations are highly influenced not only by fluctuating fuel prices, but also growing fuel transportation costs: these two criteria clearly affect general costs of operations.
- Factors related to resource convoys expose the personnel working in this sphere to danger.
- Measures to reduce risks to personnel safety also reduce operational effectiveness: military personnel involved in the convoy protection cannot participate in other important tasks.
- Undisrupted energy resource supply is an integral factor determining long-term success of an operation.
- More efficient approach to sustainable supply of energy resources, as well as reduced and more efficient consumption of the resources would reduce vulnerability of EU-led military operations and increase their flexibility.

**Cultural Property Protection**

Cultural Property Protection (CPP) at the military operations location is a legal duty established by international legal norms that forbid using cultural heritage for military properties that may damage the cultural heritage. Military actions against such property are also prohibited, except for the cases of military necessity. Still, lots of historical places and property have been destroyed in the conflicts of the recent years (e.g. during events of the Arab Spring). Involved into conflicts all over the world, EU forces also constantly face different cultures: violations of religious or cultural norms have become too frequent because of ignorance or ineptitude. For this reason, legal aspects of the CPP had to be included into planning and management of EU-led military operations. This may be of particular importance in order to implement the goals of EU missions: preservation of cultural heritage at an operation location would not only help keep soldiers’ morale high, but also directly contribute to winning the “battle for hearts and minds” of the locals.

**Conclusions**

The approved concept will demand proper attention for it to be implemented, and in relation to this, new positions have already been created: environmental officer in the EU Military Command and environmental advisor in the EU Operations Headquarters. This should ensure that the document is applied starting with the coming EU military operation: for Sweden, this most probably be EU mission ATALANTA from summer 2013 or the Nordic Battle Group in 2015. Interestingly, Sweden-led battle group is expected to involve EU members (Finland, Ireland, Estonia and Lithuania) and a partner from NATO (Norway). With this circumstance in mind, it is necessary to not only apply the new concept, but also harmonise it with applicable regulations of NATO and the UN. Security of energy supply, energy efficiency, environmental protection are global challenges requiring attention of all international actors, and all the mentioned organizations should demonstrate interest in achieving and implementing the mentioned agreement. In the event that more active coordination is required to achieve the agreement. New NATO Energy Security Centre of Excellence in Vilnius could also successfully contribute to strengthening of interinstitutional cooperation between various institutions in this regard.
SUSTAINABLE ENVIRONMENT IN MILITARY BASES: TOWARDS EFFICIENT USE OF RESOURCES

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8-11 October this year, NATO conference “Sustainable Military Compounds” was held in the United Kingdom (Chatham) at the initiative of research programme Science for Peace and Security. Its major focus was reduction of energy consumption and ecological footprint left during deployment of forces. Representatives from Canada, Sweden, the Netherlands, Lithuania and other NATO countries exchanged their experience of using latest military technologies in continuously changing operational environment. The event focused on strengthening of sustainability aimed at creating a concept model to be applied in the future operations for deployment of military units and establishing military bases with the least possible ecological damage to the environment. It was agreed to prepare a detailed handbook on the best practices of sustainable and cohesive management of military bases, as well as to create the concept of sustainable military base, environmental management system guidelines and cohesive administrative procedures.

Deployment of Military Units in the Context of Sustainable Development

In the recent years, implementation of sustainable development and its aims has become one of the priority challenges of warfare. This should not be surprising – sustainability, environmental protection and elimination of consequences of the limited nature of natural resources are defined as key part of military strategies more often. Major issues in this context are the way to turn the concept of sustainable development into a real action plan, the indicators to estimate the progress etc. Within this context, it is important to note that sustainable development is a process rather than a stable and unchanging condition. In other words, although military units are usually relocated from base to base, military personnel often faces challenges of environmental protection and resource supply even abroad, whereas formulating concrete aims of sustainable development is rather complicated (as the aims would doubtlessly be changing in the course of time). Nonetheless, certain ideas of sustainable development are not only included into strategic documents, but also are put in to practice. Within this context, implementation of sustainable development in the NATO as well is too important to be lost in bureaucratic labyrinths.

In his conference presentation on conditions for sustainable deployment of military corps and compatibility with the concept of operations, representative of the Royal Military Academy in Netherlands, lieutenant colonel Paul van der Heul asked how could deployment of military units be defined in new military strategies, how military camps could be used upon completion of military operation and whether it is possible to integrate such bases into units of the countries the bases are usually deployed. In terms of increasing dependence on water, energy resources, fuel, it has been noted that the growing demand leads to vulnerability, wast increase, reducing efficiency of military missions and logistics problems (transportation, shipment security etc.). Hence, development of energy and water saving systems and application of waste for heat or power production should become one of the priorities in implementing the objectives formulated in the new NATO strategic concept. Moreover, as already noted, preparation of proper drinking water, waste sorting, protection of soil from fuel spills, storage of hazardous materials and reliable supply of energy have already become key
factors ensuring quality of mission by a military unit and even success of an entire operation. Private companies supplying power, services of waste recycling or other organizations responsible for proper supply of resources are often incapable of performing their obligations due to unstable political situation in a country, and the military must be prepared to take care of these functions. Another representative to the conference from the Netherlands Maarten Gijsbers presented final results of 2006-2008 project "Environmental aspects of military compounds" (EAMC) under the NATO Science for Peace and Security programme. M. Gijsbers pointed out the priorities of the project: energy security, sustainable development, water and non-renewable resource management, and disposal of hazardous chemicals and pesticides. According to the speaker, studies carried out during the project have shown that energy supply is one of the key problems military camps face not only because of logistics, but also because of security aspects. Problems identified during the study have been named: fuel spills leading to high cost cleaning operations in the camps, inappropriate waste recycling posing risk to health and environment etc. Another problem named by M. Gijsbers is particularly relevant and related to legal base of NATO – inability of several systems or programmes exchange data and use them properly (absence of the so-called interoperability). In other words, it has been admitted that it is difficult to unify environmental requirements, requirements to exercises, general standards (particularly important in administering closure of military bases) during establishment of sustainable military bases or camps in different countries and permanent multicultural environment. Hence, creation of Environment Management System (EMS) is considered to be one of the priorities of security policy of the Alliance.

In terms of specific proposals, participants of the event first of all stressed the need to expand the discussions forum by establishing Environmental Protection Working Group (EPWG), responsible for regular exchange of information, analysis of indicators of the progress of development, and preparation of agreements on standards. Analysis of different aspects of deployment of military units should be further analysed, energy source emissions standards should be formulated, and the handbook of the best practices of establishing military camps (Best Practices Handbook) should be prepared, and NATO exercises and trainings should be further organized. EMS should eventually cover not only establishment of sustainable military bases, but also deal with the issues of closure of old military camps related to fuel spills, environment cleaning, safe destruction of military equipment etc. Introduction of the Environment Management System into strategies of closure of military units would lead to creation of an action plan both on national and international level that, if followed, would help successfully close a base, avoid or reduce damage to the environment and enforce other aspects of the policy of environmental protection.

**Sustainable Military Base in Practice: Possibilities and Prospects**

In terms of creation and implementation of the concept of sustainable military base, it is first important to consider experimental programmes and strategies that are rightly seen as possibly the most important parts of the concept of sustainable development. One of the examples could be the programme “Army Zero Footprint Camp” by the U.S. military. The programme covers three key elements necessary for sustainable deployment of the armed forces: protection of the forces, environmental protection and economical logistics. Transition from conventional to alternative types of fuel is not really an ideological choice – experiments in the U.S. have shown that renewable energy and modern technologies often have more advantages than fossil fuel and obsolete equipment. Having understood this, the U.S. military has been actively promoting the paradigm of Zero Footprint Camps with its major aims being reduced expenses on energy resources and increased security of supply.
In the United Kingdom, two programmes are being implemented concurrently – PowerFOB CCD (Capability Concept Demonstration) and LOSA RED (Land Open Systems Architecture Research) focused on increasing operational efficiency, minimizing the costs and eliminating technical limitations. The aim of the first programme is to ensure flexible and efficient use of resources in military bases, identify the most economical technologies and sustainable alternatives of energy resources. In other words, it is aimed at creating the model of a military base on the basis of consumption of renewable energy resources and economical fuel consumption. The model would cover 5 key elements that are important for a sustainable military camp: power, fuel, water, waste, and data protection.

LOSA RED research, experiment and development programme is an open structure integrating business companies and interaction of computer systems for creation of military bases in a natural environment. LOSA RED project modelled in the United Kingdom and based on actually available resources is aimed at demonstrating how new technological systems can help save time, money and labour force at the places of operations. LOSA RED programme consists of several packages: Power & Data Interoperability and Soldier / Vehicle / Base Integration that also include experiments. The 3-4 years long programme is expected to provide possibility to strengthen military capabilities, and data analysis and experiments will contribute to the improvement of the concept of future structure of the UK military ARMY 2020 and will serve as an example to other NATO members.

Participants of the conference also emphasized another important aspect – long-term effect of investments into sustainable military bases and eventual reduction of operational costs and success of the operations. Moreover, sustainable transformation of military bases upon completion of missions would bring benefits both in social and economic sense: it would improve the trust of the locals into their government, create social capital and encourage cooperation. In terms of establishment of such bases in real life, a competition “Open Architecture Challenge 2012” by charity organization Architecture for Humanity was mentioned. The aim of the competition was to find technological and architectural solutions that may contribute to elimination of humanitarian and ecological crisis worldwide. Organizers of the competition encouraged all designers and architects all over the world to propose ways of
reforming old military installations and camps and integrating them into the environment. This year’s winners are Portuguese architects at “The Ocean & Coastline Observatory (OCO)” who proposed an architectural project “Caminho da Raposeira Estrada Militar”. Its key idea is turning a military base in Portugal into coastal reserve centre Trafaria that would be located close to river Tagus, on another bank of Lisbon (see Picture 2). According to the architectural vision, the coastal artillery military base Trafaria would become the example of sustainable military unit transformation and provide living spaces for citizens, scientists, students and anyone concerned about sustainable future for them to discuss, exchange good practice etc.

Picture 2. Example of military base transformation: “Caminho da Raposeira Estrada Militar”

Source: [http://img.scoop.it/v1ry8Op3jaVhbl72eKJf8mIVaiQDB_Rd1H6kmub8W1e8J](http://img.scoop.it/v1ry8Op3jaVhbl72eKJf8mIVaiQDB_Rd1H6kmub8W1e8J)
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