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INTERNATIONAL SCENES OF MILITARY ENERGY RESEARCH

ABSTRACT: *After recognizing the civil aspects of energy, nowadays it is inevitable to examine these questions from the side of military, too. Energy research is very important in the defence sector now, and several international organizations make serious efforts in order to make the importance of these issues recognized, and support researches in the field of energy security and energy efficiency, trying to find new methods and technologies to supply military units with energy.*

KEYWORDS: *energy research, energy security, energy efficiency*

GLOBAL CHALLENGES OF ENERGY

Energy is one of the most important elements of our modern civilization. In the prehistoric times, people were parts of nature, and they used their environment like any other organism. About 5,000 years ago, during the time of agricultural revolution, people cut the forests and started to cultivate lands, mine hills, build roads and found cities. Mankind was no longer only part of nature, but began to change the environment in order to survive. Creation and maintenance of the artificial environment needs a lot of energy, but the available energy – manpower and animal power – was limited for centuries.

Finally, mankind discovered how to use the power of water and wind but the real breakthrough was the spread of fossil energies. Now the world's total energy consumption is more than 100,000 TWh and 90% of this amount comes from fossil sources.[1] Nowadays sustainable development is a keyword in modern science and the yield, the transportation and storage of the necessary energy pose really big challenges for us. Unfortunately, by using this extremely huge amount of energy, human activities changed the climate of the whole planet, so only generating energy is no longer enough, we have to find better and cleaner ways than ever before.

ENERGY ISSUES IN THE SECURITY DOMAIN

Energy is also very important for the defence sector. In the ancient times, warfare was totally based on manpower and horsepower, but, after the industrial revolution, it totally changed. In WWII, a daily operation of a single soldier took 4 litres of oil equivalent to energy.[2] In the Vietnam War, it was more than 33 litres of oil equivalent and during the Iraqi mission a single allied soldier needed 81 litres of oil equivalent a day.[3] Based on these data, we can

[1] *Key Words Energy Statistics*. International Energy Agency, 2016.

[2] Bryce, R. *Gas pains.* The Atlantic, 2005.

[3] Howard, W. et al. "Report of the Defence Science Board Task Force on Trends and Implications of Climate Changes for National and International Security". Defence Science Board, 2011. http://www.dtic.mil/get-tr-doc/pdf?AD=ADA552760, Accessed on 31 May 2017.

conclude that defence is an extremely energy-intensive domain of human activities, and the energy necessity of military actions will expectedly grow in the near future.

In the defence sector, there are two main aspects of questions of energy: energy security and energy efficiency. Energy security is part of sustainable defence. The concept of energy security refers to that case when essential energy for military operations is available and the resupply is safe and secure. If the energy for operations is insecure, there is a real risk that coordinated applications of armed forces will collapse, and the state will no longer be able to secure its territorial integrity or public safety. When we examine energy security in the defence domain, actually, we are looking for methods how we can change risky or insecure energy sources to better ones as well as how our military forces can be independent from foreign sources of energy. It is very important for the Eastern European countries, especially for the NATO-member Baltic countries. Their economy and also their defence, of course, are absolutely dependent on Russian hydrocarbons, despite the fact that Russia is still one of the biggest threats for NATO.

Energy efficiency in the defence sector is usually analysed from two points of view: normally, in their peace time accommodation, armies function as most of the governmental organizations. In this situation, more efficient use of energy can reduce the energy costs and the ecological footprint. This is very impressive for the public assessment of the armed forces, but we should know that during a military operation, these aspects have no priorities at all.

The priorities are to accomplish missions successfully and to minimize the casualties during missions. Practically, energy efficiency is still appetizing, but the goal is to reduce the ’logistic footprint’. This relatively new term means using as few logistic resources as possible to supply our forces. In modern guerrilla warfare it is not the strike forces that suffer the highest casualties but the logistic units because those are much more vulnerable.[4] The fewer supply convoys there are, the less possible ’easy’ target they are for the enemy. On the other hand, if our forces need less energy than before, they have to pack fewer batteries, less oil, etc., which increases their mobility, or they can pack more ammunition or devices in exchange for energy sources, which increases their abilities in the field.

These issues of energy have been a concern to humanity since about the fifties, but the military theoretician recognized the importance of this question only for the past twenty years. Fortunately, nowadays some international organizations from the defence sector take bigger part in developments. This short article tries to present these organizations in Europe and their main scopes of activities.

NATO ORGANIZATIONS IN EUROPE

NATO is a very complex organization. Now it has 28 member states (and 3 more states are in the negotiation phase) and more than 6,000 employees worldwide. This number does not include the officers delegated and the staffs of background institutions. In a complicated organization like NATO, sometimes a lot of different parts are involved in the same issue, but there is no dedicated department for energy. Overall, the leadership of NATO is strongly committed to this question that is well reflected by the NATO Summit Declarations:

[4] "Casualty Costs of Fuel and Water Resupply Convoys in Afghanistan and Iraq". Army-technology.com. 26 Feb 2010. http://www.army-technology.com/features/feature77200/, Accessed on 31 May 2017.

- Chicago 2012, 52. §.: *"We will work towards significantly improving the energy efficiency of our military forces; […] "*,[5]
- Wales 2014, 109. §.: *"[...] continue to work towards significantly improving the energy efficiency of our military forces, and [...] note the Green Defence Framework."*[6]
- Warsaw 2016, 135. §.: *"We will further improve the energy efficiency of our military forces through establishing common standards, reducing dependence on fossil fuels, and demonstrating energy-efficient solutions for the military."*[7]

NATO HEADQUARTERS, BRUSSELS

There are a lot of permanent structural departments at the monumental administrative centre of the military alliance in Brussels, but some working groups have no own offices or staff. A very good example to this working method is the *Environmental Protection Working Group*. There are dozens of experts delegated into this group, but except for the secretary, they are not NATO employees, but MoD or scientific institute representatives from the member states. They hold meetings a couple of times a year, and they do not focus on technical solutions, instead they try to put more general directives into shape. This professional community played a serious role in the creation of the most important NATO document on environment protection – the Environmental Protection Policy (MC 469).[8] This document approaches energy from a very special point of view, but improving energy efficiency is mentioned as a highly desirable way as well.

In 2010, the NATO Council approved the Secretary General's proposal to establish an *Emerging Security Challenges Division* (ESCD)[9] at the NATO HQ in order to manage the growing range of novel risks and challenges. Of course, these challenges were well-known before, but integrating these kinds of questions into one entity results in a more efficient work. Now ESCD has six sections and one directorate:

- Counter Terrorism Section (CT),
- Cyber Defence Section (CD),
- Energy Security Section (ES),
- WMD Non-Proliferation Centre (WMDC),
- Strategic Analysis Capability (SAC),
- Economics and Security Assessments (ESA),
- Nuclear Policy Directorate (NPD).[10]

Using holistic approaches, ESCD is a very innovative part of the traditionally conventional and hierarchic NATO centre, and the impact factor of the division sensibly improved in 2013, when Ambassador Sorin Ducaru took over the position of the Assistant Secretary General for ESCD. The former Romanian UN representative and Romanian ambassador to

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[5] "Chicago Summit Declaration". NATO. 20 May 2012. http://www.nato.int/cps/en/natohq/official_texts_87593.htm?selectedLocale=en, Accessed on 31 May 2017.

[6] "Wales Summit Declaration". NATO. 5 Sep 2014. http://www.nato.int/cps/en/natohq/official_texts_112964.htm?selectedLocale=en, Accessed on 31 May 2017.

[7] "Warsaw Summit Declaration". NATO. 9 Jul 2016. http://www.nato.int/cps/en/natohq/official_texts_133169.htm?selectedLocale=en, Accessed on 31 May 2017.

[8] "Principles and Policies for Environmental Protection: MC 469/1". NATO Military Committee. 13 October 2011. The classification of EP Policy of NATO (MC 469) has been changed from 'unclassified' to 'public' recently.

[9] [h]ttps://esc.hq.nato.int/default.aspx, Accessed on 31 May 2017.

[10] Emerging Security Challenges Division. https://esc.hq.nato.int/default.aspx, Accessed on 31 May 2017.

the United States is a prestigious diplomat, and he is strongly committed to the energy issues in the defence sector. During his administration, his staff built a strong society of energy issues spread-out across NATO, and 'Smart Energy' became a real brand of new methods and technologies of military energy efficiency.

Beyond doubt, their biggest success is their participation in international military logistic interoperability and standardization exercises 'Capable Logistician' (CL15). The exercise series are conducted by a nominally NATO-independent organization[11] but 90% of their members are also NATO members, so the co-operation with NATO is more than beneficial. In the CL13 in Bratislava, Slovakia, Smart Energy was only a static part of the exhibition days of the exercise, but in the CL15 in Várpalota, Hungary, there was a real historical breakthrough.[12] For this event, NATO ESCD was requested by the organizer to raise Smart Energy to a new level in Europe.

The CL15 international field training exercise was held in Hungary's Bakony Military Training Area in the summer of 2015. For two weeks, around 2,000 soldiers from more than 20 countries co-operated in order to achieve the main goals of the exercise, which was the biggest military event of recent times in Central Europe.[13] It was the very first time when very up-to-date energy devices like hybrid microgrids[14] were not only exhibition objects, but real participants of the exercise. As armies did not have really modern equipment, it was also the very first time when civil companies and their technicians took part in the live exercise, and cooperated with military forces in the field. For two weeks, German, Italian, British, Dutch and Greek civilian companies, led by a small Hungarian group of officers, integrated an independent logistic unit, supported solar energy, insulated tents, LED lights, etc. for the troops. Exercise CL15 marked the successful introduction of the mutually beneficial co-operation between military and civilian sectors, and there is no more doubt that modern technologies like LEDs, solar panels, hybrid generators are ready for field-deployed military use.

A brand new initiate of NATO ESCD is the Smart Energy Training and Assessment Camp[15] that is not a simple camp with tents, of course, but it attempts to search for the innovative technologies of military energy and collect them. The CL15 demonstrated the readiness of some technologies now, so SETAC will try to connect the individual technologies into a bigger system, and try to solve their interoperability problems. The first meeting of SETAC was held in December 2016, and in 2017 the main concepts and procedures will be defined. The co-operation between individual national and company technologies will be ready for demonstration in 2018 or 2019. 'Smart Camp' or 'Zero Footprint Military Camp' are already well known terms in NATO, but SETAC might be the best way to make them real.

NATO SCIENCE AND TECHNOLOGY ORGANIZATION (STO)

The first NATO science organization was called *Advisory Group for Aerospace Research and Development* (AGARD). It was founded in 1952 only for aerospace issues, and its history

[11] See later at 'MLCC'.

[12] The author was the consultant engineer and technical liaison of host nation.

[13] *CL15 Final Evaluation Report*. MLCC, Praha, 2016.

[14] Field electrical power generator that combines the conventional diesel generator and a renewable source of energy, commonly photovoltaic panel.

[15] The author represented Hungary on first SETAC meeting at NATO headquarters.

has a special Hungarian relation as Tódor Kármán struggled most to found a NATO science institute. Later on, NATO built a general research organization called *Defence Research Group* (DRG). In 1998, these organizations were merged, and NATO's primary science and technology organization was engendered as it is commonly known now *Science and Technology Organization* (STO) in Neuilly-sur-Seine, France.[16] STO is supervised by the Science & Technology Board of NATO. Under the name STO, we can find the Centre for Maritime Research and Experimentation in La Spezia, Italy. The office of the chief scientist is in Brussels, but the main corps called Collaboration Support Office (CSO) is in Paris.[17] Now the activities of STO are divided into seven panels controlled by CSO:

- Applied Vehicle Technology (AVT),
- Human Factors and Medicine (HMF),
- Information Systems Technology (IST),
- System Analysis and Studies (SAS),
- Systems Concepts and Integration (SCI),
- Sensors and Electronic Technology (SET),
- NATO Modelling and Simulation Group (NMSG).[18]

As we can see, there is no nominated panel for energy because these are more general topics, but most of them have connections with energy, and a lot of panels launched do research related to energy. It is important to know that STO is a basic research institute, and never develops products ready for standardized production. Usually, STO finishes its development at the stage *Technology Readiness Level* (TRL) 5-7 which is a technology demonstrator.[19] When a technology is ready for use, the collaborating countries get the possibility to develop their own products based on the technology.

Today some conventional ways of armament development are slowed down, so it is a worldwide trend that we try to support new capabilities for our soldiers by giving them electronic devices, for example GPS, laser targeting devices, jammers, more radios, tactical drones, real time reconnaissance systems, etc. One of the biggest problems with energy in the defence domain is how we can give more electrical energy to unmounted soldiers without increasing the weight of their equipment. This question is one of the main limits of NATO Future Soldier project and one of the main activities of STO.

NATO CENTRES OF EXCELLENCE

NATO *Centres of Excellence* (COEs) are very special 'irregular' organizations as those are not part of the official NATO structure; rather they are in charge of a very special field as they have really considerable effect on NATO's developments. Their domains are not presented within the NATO's command structure that gives them relatively high level of independence. These are nationally or multinationally funded institutions founded in order to train and educate leaders and specialists from NATO member countries. Normally, their aims are assisting doctrines development, identifying lessons learnt, improving interoperability, and

[16] Advisory Group for Aerospace Research and Development (AGARD). https://www.sto.nato.int/Pages/agard-history.aspx, Accessed on 31 May 2017.

[17] "About the STO". https://www.sto.nato.int/Pages/organization.aspx, Accessed on 31 May 2017.

[18] "The Collaboration Support Office". https://www.sto.nato.int/Pages/collaboration-support-office.aspx, Accessed on 31 May 2017.

[19] *Defence Acquisition Guidebook*. Washington: US Department of Defence, 2010.

capabilities and testing and validating concepts through experimentation, too. Now NATO has 18 accredited COEs, and another 3 are under development.

The *Military Engineering* COE (MILENG COE) is one of the oldest and maybe the biggest COEs.[20] Its ancestor, called *Euro NATO Training Engineer Centre* (ENTEC), was founded in 1977 in Ingolstadt, Germany. The ENTEC mission was promoting the interoperability of military engineers of NATO countries operating in Europe's central region during the Cold War. After this era, in 2006, the ENTEC transformed into MILENG COE, but the main aim is still interoperability as the ENTEC's motto says: 'Interoperability is a question of attitude'. Now the MILENG COE is supported by 17 member states, among which Hungary was the last to express the wish to join in 2014.[21] At present, Ingolstadt is the centre of the MILENG COE, and there are the main facilities of ground activities but there are the MILENG COE stations also in Izmir, Turkey and Northwood, UK. The MILENG COE has an Environmental Protection & Energy Efficiency Working Group, which launches one-week intensive courses for NATO logistic officers two times a year.

The *Energy Security Centre of Excellence* (ENSEC COE) is a much younger organization, but impressively active already during its developing phase. It was founded in 2012 in Vilnius, Lithuania. The location is not coincidental – as it was mentioned before, the energy supply of Baltic States is very vulnerable, extremely dependent on Russia, which is always ready to use natural gases as a weapon. Although currently it has only 9 supporter member states (Germany joined in 2017, Hungary does not participate), this organization strongly represents the business of energy inside NATO.[22]

As it is expected, the ENSEC COE has several training courses like Advanced Net Zero Energy, Water and Waste Training Course, or Energy Security Strategic Awareness Course, and it operates an advanced e-learning centre. It has an own periodical called 'Operational Highlights', and some other publications, and it has good links to the academic and industrial sector, for example there is a special internship programme for young academics funded by ENSEC COE.[23] During exercise CL15, the ENSEC COE operated an international Smart Energy evaluation team in order to recognize and analyse the lessons learned from the Smart Energy Logistic Unit.

Moreover, their greatest events are the series of international conferences and exhibitions called Innovative Energy Solutions for Military Application (IESMA). It is staged in November every two years. The first one in 2012 was only a huddle for some, complemented with a small exhibition. The last one in 2016 was already a great, highly publicized show. The presenters were invited from all European countries, the USA, Canada, and the special guest was Georgia. For example, there was the Director of the NATO ENSEC COE, the NATO Assistant Secretary General, the Deputy Chief of Staff of the NATO Supreme Allied Commander Transformation, several high-ranking military leaders, and the best energy scientists from universities and institutes as well. The exhibition part was similarly large-scale. More than 30 companies from about a dozen countries were represented, and the exhibited technologies and products were really the most up-to-date in the world.[24]

[20] Ibid.

[21] "History of the MILENG COE". http://milengcoe.org/milengcoe/Pages/History-of-the-MILENG-COE.aspx, Accessed on 31 May 2017.

[22] NATO Energy Security Centre of Excellence. https://www.enseccoe.org/en/, Accessed on 31 May 2017.

[23] Ibid.

[24] The author represented Hungary on IESMA.

At the end of 2015, the ENSEC COE, as the first European NATO organization, purchased a very sophisticated hybrid power system from the German Pfisterer. This equipment combines solar and wind power with conventional diesel generators, and integrates a powerful energy store and control system, which makes this system a very suitable platform for studying new technologies[25]. As an education centre, ENSEC COE is ready to share its operational experience, and the equipment is available for individual learning, too. As we can see by its name, the main scope of the ENSEC COE is energy security, but it does not neglect the field of energy efficiency because improving energy efficiency is a proper way to reduce energy dependency.

MULTINATIONAL LOGISTIC COORDINATION CENTRE

The Multinational Logistics Coordination Centre (MLCC) was established in 2008 in Prague, Czech Republic, by the Czech Republic, Slovakia, Hungary, Greece, and the USA as an independent multinational coordination centre of military logistics. The main task of the MLCC is to provide assistance to coalition partners with planning and executing logistic support. The MLCC also wants to be a training and education centre in logistics, a developer of standardisation and interoperability in logistics, and an exchange platform of experience in operations conducted in the area of logistics, coordination of transport, and troop movements.[26]

During the past few years, the MLCC took a big step forward, and now it has 13 member states (10 NATO members, 2 partners and the independent – Austria). Theoretically, most of the MLCC events are open for everyone, for example a delegation of observers from Jordan could be noticed on an exercise preparatory conference, but because the members are EU and NATO countries, the MLCC never wanted to expand its operation outside Europe. Despite the fact that the leadership of the MLCC has always emphasized its independence, several documents refer to them as an informal NATO Centre of Excellence, the logistic one.

Similarly to the Centres of Excellence, the MLCC also conducts some scientific activities, but its main scope is based on practice. In this spirit, the MLCC organises some of the biggest European military exercises, for example the aforementioned Capable Logisticians, and as a part of logistics, the MLCC regularly gives place for Smart Energy in those. The CL15 in Hungary was a really great achievement of the MLCC, but analysing the experiences takes a long time. By the evaluation process of ENSEC COE, 2 STANAGS will be changed and 2 more are under revision in the field of power generation. The next CL exercise will be held in 2019 in Poland, and the first preparatory actions will take place in 2017. At the same time, NATO ESCD and ENSEC COE are working on the preparation of the successful participation of Smart Energy Logistic Unit.

EUROPEAN DEFENCE AGENCY

After WWII, Western European countries based their security absolutely on NATO. After the end of the Cold War, most of the Eastern European countries joined this alliance. In this situation, Europe can rely on the American military presence in Europe, and the US,

[25] Cazaubon, N. "A German engineering system brings NATO closer to smart energy targets". The European Security and Defence Union 23/1. 2016. 56–57.

[26] Multinational Logistics Coordination Centre. http://www.mlcc-eng.army.cz, Accessed on 31 May 2017.

Canadian and the really huge Turkish armies are also a very solid background. This solution allows the European countries spend less on their armed forces, but, in exchange, the US has relatively big influence on the continental politics. After the bipolar world collapsed and new challenges appeared, Europe has to face the fact more and more frequently that American interests are not correspondent with the European ones. By this time, there is serious political support to create a European military force separated from NATO forces, which would help Europe assert without or against the USA. Of course, there are several opponents of that, but this idea firmly stands by in European public life, and there are many examples for regional military cooperation as well as joint military units.

This was not the only reason why the European Defence Agency (EDA) was established, and its existence is one of the possible pillars of a future European army. Of course, the EDA did not come from nothing, its ancestor, the Western European Armaments Group (WEAG) was established in 1976, and worked for years, but after the former socialist countries from the east joined, it was closed in 2005. Officially, the EDA was founded in 2004 in Brussels.[27] Despite its name and headquarters, the EDA is not a part of the structure of the European Union, but, of course, the co-operation between them exists and is very positive. Indicating this co-operation, the EU Military Staff has a permanent representative in EDA, and some EDA projects are supported and even funded by the European Commission. The theoretical basis of the European military co-operation is the Common Foreign and Security Policy (CFSP) of the EU, so all EU member states take part in the work of the agency, except for Denmark, which opted out of the CFSP. The EDA is open for non-EU members, too. At this moment, there are signed administrative arrangements with Norway, Switzerland, Serbia, and Ukraine.

EDA's main mission is to be a collaborate platform for the member states. By supporting the cooperative work, EDA wants to increase the European defence capabilities, promote the European armament cooperation, strengthen the industrial and academic base of European defence sector, widen the European defence market, and enhance the effectiveness of the defence R&T. EDA has a 30 million EUR annual budget proportionally paid by the members. Normally, there are two main types of EDA projects. Category "A" projects can be launched by a member's proposal, but the steering board of EDA can also start projects. These types of projects are funded entirely from the common budget of EDA. The contracts of the projects are signed by EDA, and EDA shares the experiences with all the members via reports.

Category "B" projects are always started as a proposal of one or more members. Other countries can join anytime during the project period, but they are also authorized to leave the project if it does not meet their expectations anymore. Project contracts are signed by the participating member states, and they pay the project costs as agreed. In this case, EDA does not lead the projects, but supports them by giving advice and administrative assistance, and hosting project events. Of course, the results of these types of projects are owned by the participants, and they are not obligated to share or publish them. The budget of 30 million euros is very modest for a military R&T of a whole continent, and a notable part of this amount is paid for EDA's infrastructure and employees. That is the reason why EDA is trying to increase the number of Category "B" projects, and, most recently, EDA assists the project participants to get European application funds.

[27] European Defence Agency. http://www.eda.europa.eu/, Accessed on 31 May 2017.

Until the end of 2013, EDA was divided into five directorates, one of which was the R&T. From 2014 onwards, EDA has a new structure with three directorates. The conventional R&T activities were moved to the Capability, Armaments and Technology Directorate and energy issues are covered by the European Synergies & Innovation Directorate. As energy is a very important part of military developments, the former energy projects were moved into a new structural part. At the end of 2014, the Energy Working Group of EDA held its first meeting. From the second meeting onwards, the working group is amended with environmental issues and keeps on working as the Energy and Environment Working Group (E&E WG)[28].

The preparation of the biggest project of E&E WG called Smart Energy Camp was started before the formation of the WG, but the contracts were signed and achieved during the E&E period. This is the only Category "A" project of E&E WG, which means the deployment and operation of a hybrid power system in harsh conditions at Camp Kouliroko of the European Union Training Mission in Mali. Although the Smart Energy Camp project was finished and EDA has published the Final Report on it[29], the equipment manufactured by BAE Systems is still working there. In the Final Report, EDA rated this project as a great success, and a Spanish proposal has already been made for Smart Energy Camp II, which means a military camp equipped with a hybrid power generator as well as management of water and waste.

The other projects of E&E WG are Category "B" projects. Project Blue Camp led by Greece and Cyprus is a very good example. The main task of this initiative is to solve water management – collecting and storing water – in a military camp. During the performance phase some countries joined and some left depending on the gained lessons. According to the summarized report the project was successful, but a lot of questions could not be answered. After the closing session, Greek MoD presented his new 'Smart Blue Water Camp' project based on the previous one and agreed with EDA. Now they are seeking partners.

As mentioned above, EDA and the European Union are working closely together, and the European Commission has formulated serious environmental and energetic demands of European armies and tries to set them off via EDA E&E WG. As the first step, EDA organized a meeting series funded by the EC in order to deepen the energy-conscious behaviour in the military. The EDA Consultation Forum for Sustainable Energy in the Defence and Security Sector (CF SEDSS) is a five parts series of events where the participants can listen to very qualified presenters from the academic and industrial sector in three sections: 'Energy Management', 'Energy Efficiency' and 'Renewable Energy'[30]. All the costs of the participation are covered by EDA for a delegate of three persons per country, but the budget comes from the EC. Now CF CEDSS is over three meetings (Brussels, Dublin and Rome), and the next one will be held in Lisbon in April 2017. The organizers pay close attention to the financial questions of energy projects, and there are also organized courses on how to apply for and get EU funds. CF CEDSS has very positive press coverage, and a second series of negotiations between EDA and the EC has been started.

[28] The author is the Hungarian representative in E&E WG.

[29] Annual Report: 2016. 34. European Defence Agency. 17 March 2017. https://www.eda.europa.eu/info-hub/publications/publication-details/pub/annual-report-2016, Accessed on 31 May 2017.

[30] The author is the Hungarian representative in CF CEDSS third WG (renewable energy) and the National Contact Point of Hungary.

SUMMARY

It is clear that military energy developments are taken up by several organizations, and it is obvious that there are very similar projects to NATO Smart Camp and EDA Smart Energy Camp, where not only the names are almost the same, but the tasks and devices used are also similar. Fortunately, these duplications have already been identified and now the organizations mutually invite others in order to share relevant information and avoid starting similar projects. As the professionals of different organizations can observe and recognize other works and projects, the military energy community is forming and rising more rapidly.

In the near – or reasonably far – future, supplying energy will be a critical point of all military operations. Supplying fuel for a military convoy in conflict hotspots in the world or supplying electrical energy for a refugee camp are not only logistic, but also partly security issues. That is why all European States make intense efforts to improve energy security and efficiency in defence. When the military focuses on up-to-date energy technologies, it means that it focuses on existing civil technologies and tries to adopt them into military environment.

In the past, armies were usually the leaders of scientific progress when brand new technologies appeared such as new weapons or pieces of armament that later passed into the civil world. Now basic developments are extremely complex and costly, and most of MoDs, like the European ones, would not be able to achieve and finance them without technology institutes and multinational companies. In the energy sector, the situation is much worse. As in the past, the defence domain was not interested in energy developments, the civil industry had a big advantage, so it is advisable to learn the lessons from civil energy firms and universities.

On the other hand, modern technologies are commercial goods that the industry would like to sell to military forces, but before purchasing them the military has to rely on in-depth studies. It is undisputable that the best forums for knowledge and experience exchange in the field of energy are the above listed organizations but to exploit these sources of knowledge decision makers need proper representation, that is military experts who can translate the demands of armies to companies and the ideas of scientists to military decision makers. As Tódor Kármán said: „Scientific results cannot be used efficiently by soldiers who have no understanding of them, and scientists cannot produce results useful for warfare without understanding the operations.”[31]

BIBLIOGRAPHY

“About the STO”. https://www.sto.nato.int/Pages/organization.aspx, Accessed on 31 May 2017.

Advisory Group for Aerospace Research and Development (AGARD). https://www.sto.nato.int/Pages/agard-history.aspx, Accessed on 31 May 2017.

Annual Report: 2016. 34. European Defence Agency. 17 March 2017. https://www.eda.europa.eu/info-hub/publications/publication-details/pub/annual-report-2016, Accessed on 31 May 2017.

Bryce, R. *Gas pains.* The Atlantic, 2005.

"Casualty Costs of Fuel and Water Resupply Convoys in Afghanistan and Iraq". Army-technology.com. 26 Feb 2010. http://www.army-technology.com/features/feature77200/, Accessed on 31 May 2017.

[31] Hajdú, F. "90 éve alapították a Magyar Királyi Honvéd Haditechnikai Intézetet". *Haditechnika* XLV/1. 2011. 2–9.

Cazaubon, N. “A German engineering system brings NATO closer to smart energy targets”. *The European Security and Defence Union* 23/1. 2016. 56–57.

"Chicago Summit Declaration". NATO. 20 May 2012. http://www.nato.int/cps/en/natohq/official_texts_87593.htm?selectedLocale=en, Accessed on 31 May 2017.

CL15 Final Evaluation Report. MLCC, Praha, 2016

Defence Acquisition Guidebook. Washington: US Department of Defence, 2010.

Emerging Security Challenges Division. https://esc.hq.nato.int/default.aspx, Accessed on 31 May 2017.

European Defence Agency. http://www.eda.europa.eu/, Accessed on 31 May 2017.

Hajdú, F. "90 éve alapították a Magyar Királyi Honvéd Haditechnikai Intézetet". *Haditechnika* XLV/1. 2011. 2–9.

“History of the MILENG COE”. http://milengcoe.org/milengcoe/Pages/History-of-the-MILENG-COE.aspx, Accessed on 31 May 2017.

Howard, W., Welch, L. D., Gold, T., Goodman, S., Kern, P., Youngblut, Ch., Owens, M., Hughes, B., Warner, M. and Butts, K. "Report of the Defence Science Board Task Force on Trends and Implications of Climate Changes for National and International Security". Defence Science Board, 2011. http://www.dtic.mil/get-tr-doc/pdf?AD=ADA552760, Accessed on 31 May 2017.

Key Words Energy Statistics. International Energy Agency, 2016.

Multinational Logistics Coordination Centre. http://www.mlcc-eng.army.cz, Accessed on 31 May 2017.

NATO Energy Security Centre of Excellence. https://www.enseccoe.org/en/, Accessed on 31 May 2017.

Principles and Policies for Environmental Protection: MC 469/1. NATO Military Committee. 13 October 2011.

“The Collaboration Support Office”. https://www.sto.nato.int/Pages/collaboration-support-office.aspx, Accessed on 31 May 2017.

"Wales Summit Declaration". NATO. 5 Sep 2014. http://www.nato.int/cps/en/natohq/official_texts_112964.htm?selectedLocale=en, Accessed on 31 May 2017.

"Warsaw Summit Declaration". NATO. 9 Jul 2016. http://www.nato.int/cps/en/natohq/official_texts_133169.htm?selectedLocale=en, Accessed on 31 May 2017.