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Editorial

One of the objectives of establishing the Energy Security Center almost a year ago was to boost innovation in industry and households and to accelerate evolution towards more effective consumption, cheaper production, and a well structured supply of energy resources for military needs. After 11 months of intense work, the center succeeded in reaching out to the leading experts, scientists, business executives, and decision makers active in the field of energy innovation and invited them to come together for an extensive discussion and demonstration of the latest achievements. We hold the view that smart technology and innovative thinking strengthen energy security in many different ways and that this trend should be encouraged and continued.

What many experts notice is that even though some more advanced countries are actively promoting innovations in their economies, others still have to be convinced about the added value of putting inventions to good use. We therefore believe that the state-of the-art exhibits at the IESMA 2011 event in Vilnius will provide compelling evidence that innovations work. Even though new initiatives, ideas or concepts sometimes appear too controversial, too expensive, or impossible to implement, in the end the risk taken to embrace them often pays off. Initial additional costs and expenses are justified if backed by sound strategies and effective management. Consumers are likely to come on board and support the change since they will eventually benefit most from the all the improvements. The application of energy innovations is one of the driving forces of progress and prosperity in every society.

The IESMA 2011 event is organized with the support of the NATO Emerging Security Challenges Division (NATO ESCD), the NATO Science for Peace and Security Programme, and the NATO Maintenance and Supply Agency (NAMSA). The Energy Security Forum uses this opportunity to contribute to the IESMA 2011 debate with opinions of several distinguished authors. We are pleased to introduce four experts who come from Spain, Poland and Russia and who agreed to explore factual achievements and potential possibilities and barriers for more intensive application of energy innovations—be it new energy resources or new ways of consuming them.

Pau Solanilla Franco, director for institutional relations and communication at Electria (Madrid), and Alvaro Ponce Plaza, responsible for project development at the same company in Spain stress the need to ensure that the armed forces deployed in extreme and hostile environments are provided with adequate energy resources. They think that limited material resources and equipment, as well as the ever-increasing environmental awareness of society, obliges us to rethink and improve our methods of planning and managing resources so that the effectiveness and efficiency of deployments can be increased. In doing so the ecological footprint will be reduced and external effect will be minimized. Developing medium and small power renewable energy solutions such as deployable photovoltaics and wind turbines is just one way of achieving the goal.

Jarosław Ćwiek-Karpowicz, research fellow at the Polish Institute of International Affairs and assistant professor at the Institute of Political Science, University of Warsaw, focuses on unconventional gas and in particular on the possibility of exploring shale gas reserves in Europe. According to him, for countries heavily dependent on Russian gas imports, shale gas may become a long-awaited solution to their supply concerns. The writer notes that if rightly managed shale gas may significantly improve the situation of some EU countries with respect to main external gas suppliers, primarily Russia.

In contrast, **Mikhail Krutikhin, partner at RusEnergy (Moscow),** questions the widespread assumption that Russian gas in Europe will be replaced by imports of shale gas or LNG from elsewhere in the near future. He thinks that there are plenty of solid reasons for skepticism, for instance, high population density, lack of infrastructure, and environmental regulations.

Pau Solanilla Franco

Institutional Relations and Communication Director for Electria, Spain

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Responsible of Project Development for Electria, Spain

RENEWABLE ENERGY FOR SUSTAINABLE MISSIONS

Green armies: efficiency, effectiveness and sustainability

The armed forces are consistently confronted with the need to ensure provisioning of ground forces and personnel deployed in extreme and hostile environments. Furthermore they must nowadays also ensure the supply chain in a context of economic crisis, with a limitation of material resources and equipment, as well as the increasing environmental awareness of society. This obliges today's armed forces to rethink and improve methods of planning and management of resources in order to move towards more sustainable models that will improve the effectiveness and efficiency of mission deployment, while minimizing externalities and reducing the ecological footprint.

In this context, power generation and access to energy are critical elements. It is an essential resource that needs reliable energy sources to meet demand and must be fully operational in highly complex environments, while always ensuring military capabilities. The energy systems must ensure constant supply to the equipment that is crucial to the mission's operational success. Furthermore, above-normal energy needs make it difficult to find the proper balance between effectiveness, in a military sense, and saving, efficiency and sustainability, in an energy sense.

This complexity does not mean that innovative solutions cannot be implemented. There are sustainable energy solutions in today's market that allow employing equipment suitable for most of the realities that are found in missions around the globe.

Furthermore, countries like the United States of America are already investing in the development of new and innovative energy solutions for military missions around the world. US military higher-ups plan to rely on renewable energy sources for 50% of their power needs by 2020. Within this context, the US Army wants to decrease its dependence on fossil fuels, which, in the case of Afghanistan, is the number one thing they import, and the convoys that deliver this fuel are frequent targets of insurgent attacks. According to a study by Pike Research, "Renewable Energy for Military Applications," "increased access to clean and reliable energy has become a leading priority for the US Department of Defense and military agencies around the world."

Depending on availability and access to energy resources, we distinguish between independent missions (with no local support in the area), missions with the presence of international forces (with occasional support along the supply chain) and missions supported by the host nation (with regular support and facilities for storage of supplies).

Different circumstances require solutions adapted to the reality of the location and based on the management of complexity, with creative, bold, innovative and, above all, possible measures. That is to say the solutions must be easy to implement and operate and be one in which weights and volumes play an important role. Redundant facilities with reliable energy management systems, which are easily transported by conventional means available in the area of operations, are needed.

Armed forces around the world are by far the largest consumers of energy. The US Army by itself consumes more than any other public or private entity and greater than more than 100 other nations. The military is notorious for wasteful energy practices. Today's renewable energy developments and grid management can provide a reliable and efficient energy supply in an effective and sustainable way for missions around the world.

Deployable renewable: just few examples

Today it is already possible to provide an answer to most of the energy needs in the field by deploying distributed generation systems with renewable energies. This means to produce clean energy near the demand or at the same place that demand is requested, through autonomous and decentralized energy systems under a self-consumption regime (or on grid solutions).

So far these solutions have been reserved for small remote systems, but growth in the sector over the past decade, investments in R&D, and learning curves have prompted a significant leap forward in the development of medium and small power renewable energy solutions. This reliable and robust equipment permits energy to be generated for self-consumption while bringing missions closer to sustainability, security and competitiveness.

The generation costs of renewable energies are becoming more competitive. Under favorable resource circumstances, wind is already competitive, while photovoltaics will be in less than four years. Other renewables will continue this path in the medium and long term. It is however essential not only to work and improve the technologies of supply, but also to develop better and more intelligent means of managing demand, as a way to better alleviate pressure on power generation.

Available technologies

The great advantages of renewable energy resources are their modularity, flexibility and adaptability to the existing resources of any territory.

The development of technology has undergone a process of optimization and significant improvement. Medium size wind turbines can work in isolation or be grouped in small wind farms with machines that are between 100 kW and 300 kW. This could reduce the exigencies of the supply chain, while minimizing transportation losses. These wind turbines may be transported and installed by conventional means (*see picture 1*).

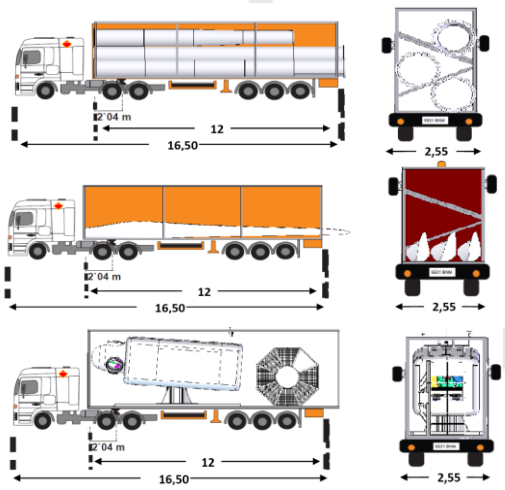
Photovoltaics (PV) are another highly interesting deployable technology. They are flexible, clean, easy to maintain, and adaptable to practically any circumstance. They should however be integrated into camp facilities in an intelligent way to minimize the use of available space and reduce costs. Also, thanks to advances in innovation and market growth, the costs of PV are decreasing fast and thus becoming more competitive. This, coupled with very low operating and maintenance costs, far outweighs the investment and significantly reduces dependence on the supply chain.

The US military developed a PV system for ground operations called Ground Renewable Expeditionary Energy System (GREENS). The field test of GREENS in August 2010 found that it saved 30 liters of fuel per day for each of the company's 150 men. Furthermore, complemented with other renewable energy systems, the system was able to power an operations center without diesel backup for eight days.

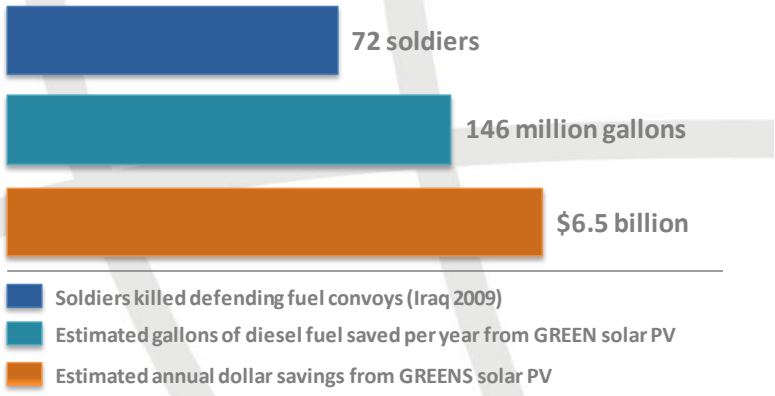
As a summary, deployable renewable energy solutions today offer new and interesting possibilities for the production of electricity, especially in the case of wind energy and photovoltaics. However, being an intermittent energy source, such energy solutions are difficult to manage, which means that an energy mix with conventional generation systems as backup must be deployed.

Missions should be designed on the basis of an energy mix founded on previous studies of the available resources in the field (wind, solar radiation, water, available biomass, etc.). Deployable renewable energy can meet energy needs through hybrid solutions, underpinned by a proper energy mix and managed through micro- or normal smart grids. This will provide an answer to the energy needs on the ground, while reducing the ecological footprints and energy dependence by reducing the need for fossil fuels, and in many cases, the cost per kWh.

In short, it seeks to exploit the potential of distributed renewable generation, a challenge that is already at hand. With a little effort and through civil-military cooperation, new and bold solutions can be designed.



Picture 1. **Medium-sized wind turbine transportation**



Picture 2. **Annual savings from replacing diesel generators with solar energy in Iraq**[1]

[1] Ground Renewable Expeditionary Energy System field test

Jarosław Ćwiek-Karpowicz

Research fellow at the Polish Institute of International Affairs and assistant professor at the Institute of Political Science, University of Warsaw

SHALE GAS AS A GAME CHANGER ON THE EUROPEAN MARKET?

The growing production of gas from non-conventional deposits in North America seriously affected international markets and gave the United States, the world's largest consumer of gas, the position of the largest producer as well. As a consequence, the U.S.A. ceased to be perceived as a promising long-term market for external gas supplies. Instead, global LNG exporters began to redirect their deliveries from North America to the European and Asian markets. In Europe, as the gas glut sent spot prices plummeting, the main gas consumers enforced their pressure on the largest gas exporters, which are relying on long-term contracts.

The possibility of replicating the shale gas boom outside North America might have a significant impact on other gas markets in coming years. With the expected increase in global gas consumption in the next decades, unconventional gas production has a chance to cover a large part of additional demand, with the most promising centres of extraction in North America, China, and Australia. Moreover, with the spread of the North American experience to other parts of the world, the costs of producing unconventional gas might drop significantly. Therefore shale gas production has been the object of attention of many countries where new sources of supply are usually perceived as a chance either to satisfy the expected boom in demand or to increase export revenues.

There are diverse estimates of unconventional gas reserves, with no reliable data on the economic feasibility of production. According to the US Energy Information Administration (EIA), the total technically recoverable reserves were estimated at 187 Tcm, with the largest potential expected in China, the U.S.A., Argentina, Mexico, South Africa, Australia, Canada, Libya, Algeria and Brazil, followed by the two most promising European holders: Poland and France. Comparing proven gas reserves highly concentrated in a few countries, unconventional reserves are more distributed all over the world.

The unconventional gas reserves in Europe look relatively modest, although they might significantly improve the position of some EU countries towards the main external gas suppliers, primarily Russia. Even if shale gas is not going to change the entire EU gas sector, it may become a game-changer in central Europe, with unconventional exploration and production rising in the region, particularly in Poland. Shale gas potential in this country is estimated at 5.3 Tcm (EIA), although this calculation is not based upon hard geological data but on comparisons of Polish structures with similar ones in the U.S.A. and assessments of potential reserves by analogy. Optimistic expectations created a huge wave of interest among international companies. Since 2010 more than 80 concessions for shale gas exploration have been granted by the Polish authority to energy giants such as Chevron, Exxon Mobil, ConocoPhillips, and Marathon Oil as well as smaller firms such as Talisman Energy, BNK Petroleum, and 3Legs Resources.

The success or failure of the Polish efforts might significantly influence the course of events and determine the future of the shale gas sector in the EU. The challenges of the industry's environmental footprint, water management, high-population density, and market unpreparedness are more or less the same as in other EU states. What makes the Polish case specific is the very broad political consensus and general public support. For a country heavily dependent on Russian gas imports, shale gas is perceived as a long-awaited solution to its current supply concerns.

Although the shale-gas revolution undermines Russia's strong position as a leading gas supplier, Russia seems to underestimate this challenge. The official energy strategy of Russia until 2030 makes no reference to the reserves and production of unconventional gas. Alexey Miller, the CEO of Gazprom, argues that shale gas might serve as a local source of energy, only compensating for reduced production volumes of traditional gas in regional markets due to relatively low output at wellheads and their sharp depletion after the first years of production, large numbers of drilling operations, a constant need to move to new areas of development, and high investment requirements.

With respect to the price of gas, which in the wake of the development of LNG technology and the shale gas revolution is increasingly regulated by the market mechanism, Russia wants it to be set in long-term contracts in the old way based on the price of oil. According to Miller, this rigid gas-oil price link is meant to protect the natural gas market against financial speculation and to ensure price stability, which both the producers and the consumers need. Another argument in support of this pricing method is that gas, like oil, has a broad range of applications in various sectors of the economy.

Rising shale-gas exploration and production so far has limited implications on the European gas markets. These markets are still dominated by long-term, oil-indexed, inflexible contracts with external conventional gas suppliers such as Russia. But this scheme is unfavourable for many European customers who still have to pay more for Russian gas in the long-term contracts than

on the spot market. In addition, future long-distance multinational pipeline projects have lost their attractiveness, mainly due to high costs, political risks, the growth of LNG deliveries, and, last but not least, the prospects for shale-gas production.

What brings difficulties for external suppliers such as Russia creates new possibilities for potential new EU producers of unconventional gas, who are interested in a single competitive gas market in the EU based on free market rules. A transparent regulatory framework and easy access to a transmission system are therefore indispensable for the economic feasibility of shale-gas production. The European Commission is also trying to eliminate the existing physical and legal barriers for new entrants. It underlines the crucial role of local infrastructure and interconnectors between separated markets in the EU and supervises the process of implementing a third energy package by the member states, which should open the gas market to other players.

Mikhail Krutikhin

Partner, RusEnergy

SHALE GAS IN EUROPE: ANOTHER MYTH OR THE REAL MCCOY?

The Baker Institute at Rice University estimated in its July report, "Shale Gas and US National Security," that the share of the Russian gas supply in non-FSU Europe would shrink from the current 27% in 2009 to 13% in 2040 thanks to the increased production of shale gas in the United States. If this forecast comes true, the share of Russia, Venezuela and Iran in the global gas supply is also expected to decrease to 26% instead of the 33% it would have amounted to without shale gas.

It is worth noting that this analysis is based on the assumption that European nations will replace Russian gas mostly with LNG imports, which will grow because of the thriving shale-gas production in North America, rather than with Europe's own shale gas.

Why aren't American and other energy observers optimistic about prospects of shale gas production in Europe as a game changer? There are plenty of solid reasons for their skepticism.

Even by conservative estimates, the niche of shale gas is going to grow from 25% today to 50% in 2030 in the U.S.A. If American LNG terminals are to be used in the future at all, it will be for the export of gas and not for import, Chevron Chairman and CEO John Watson claims. Regasification terminals in Europe, in contrast, will grow in number and in capacity.

European enthusiasts of shale gas believe that this business is extremely promising in their home countries. They point out that it took the Barnett shale play 17 years to be developed and only seven years went by as other plays in other regions were brought on stream. If exploration begins today, they say, commercial production of shale gas in Europe might start in three to four years. The optimism is evidently misplaced.

Theoretically, the size of shale gas resources in Europe is impressive and production costs appear within a commercial range. Technically recoverable volume is estimated roughly at 220 tcf split between Poland, Sweden, Austria and Germany, with about 55% in Poland. According to the Baker Institute, entry costs are between $6.00 and $7.50 per thousand cubic feet. It is expected to be commercial at the selling price of $180 per 1,000 cubic meters, well below the price of Russian contracts or imported LNG.

In reality, only Poland is actually pursuing a practical program of shale gas development. The Polish government has made the shale gas program a national priority and awards concession to whoever asks for them. There are neither tenders nor auctions and the fee for the title to an exploration block is just $100,000. The operator will have five years after discovery to either launch a development project or sell the company to a major gas producer. This is evidently why the majority of current license holders are small or totally unknown entities, which are unobtrusively supporting the nominal operator. There is no obligatory local content either.

ExxonMobil, Chevron, Marathon, and Eni are here partners and financiers of such companies as 3 Legs Resources (Lane Energy), Keynes, San Leon Energy, Strzelecki Energia SA, Emfesz, BNK Petroleum, Composite Energy, Cuadrilla Sorgenia, Talisman, Realm Energy, Source Energy Partners, EuroGas, Aurelian Oil & Gas, DPV Service, Gora Energy Resources, and Seaspin.

The number of licenses issued for exploration and test development of reserves of shale gas, tight gas, and coalbed methane has reached 226. No official statistical data exists for shale gas licenses, but according to the Ministry of Environment's maps they already cover almost 40% of Poland's territory. Since 2006, when shale gas became fashionable, 140 licenses have been issued. The results are still purely experimental and piteously unimpressive.

The ministry, which is in charge of mineral licensing, has calculated that between 2010 and 2020 the holders of the licenses can be expected to drill at least 373 wells for shale gas, including 155 obligatory ones. An average well is going to absorb around $15 mln, including hydrofracturing costs, as IHS CERA estimates. To produce 3 bcm a year, Poland needs 700-1,000 such wells drilled every year—hardly a realistic expectation. The life cycle of a shale gas well averages 7 years (in contrast with regular gas wells, which remain operational for 40–65 years). Hundreds of new wells will have to be replaced annually, covering tremendous acreage, and land ownership rights in Poland and other European nations will certainly prevent the business from expanding.

Speaking in Moscow in June last year, Daniel Yergin, chairman of HIS CERA, reiterated that development of shale gas reserves in Europe differed greatly from similar operations in Texas and other American states. “So far it is a local revolution,” he said, pointing out the following factors that impede the shale gas business in the Old World:

- High population density in Europe makes it difficult to set up shale gas production facilities, including horizontal drilling rigs and hydrofracturing equipment in the quantities need to make deposits commercial. The footprint of such facilities may be quite large.
- European land ownership systems are also a challenge. There is practically no free acreage on which to install the required number of rigs and equipment.
- Europe suffers from shortages of the infrastructure needed to drill for shale gas and transport it to market.
- European environmental regulations are stricter and obtaining permits is much more cumbersome than in the U.S.A. and Canada. Shale gas production is especially vulnerable because of the necessity to use dangerous chemicals such as benzene and dioxine for hydrofracturing.

Yergin believes that the domestic shale business in Europe is “in its very early days” and this energy source is unlikely to make a sizeable impact on the European energy market before 2020. Shale will be an addition to the mix of energies and certainly is not going to replace the Russian supply of natural gas, he said. This prediction appears realistic enough.