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## FOREIGN MILITARY BASES WITH RENEWABLE ENERGY SOURCES

### *Absztrakt/Abstract*

*Jelen írás azokat a megújuló energiaforrásokat mutatja be, amelyek külföldön telepített katonai bázisokon alkalmazhatóak. Az írás külön bemutatja az amerikai hadsereg ilyen irányú tevékenységét, mivel ennek elkötelezettsége a zöld források irányában igen komoly, valamint e hadsereg a megújuló energiáknak nagy szerepet szán a hadviselésben, illetve ez az az ország, amely a legtöbb erőt állomásoztatja külföldi országokban.*

*The paper discusses the advantages of the renewable energies applied in foreign military bases. In the paper the U.S. military is discussed because of their commitment to green sources, the alternatives that they are already developing related to the use of renewable energies in warfare, because they are at war, and finally because they are the country with the largest number of forces in foreign countries.*

***Kulcsszavak/keywords:*** *megújuló energiák, katonai, külföldi bázisok ~ renewable energies, military, foreign bases*

## **1. Introduction**

The climate change, global warming and their causes and consequences are become more and more important, the politicians, nations, citizens, everyone is getting more concerned about them. There are initiatives in every single social level to try to stop this tendency. Many types of renewable energies can be used in ordinary buildings like houses or blocks of flats, and their installation is rather easy. The number of governments installing renewable energy power plants is increasing everywhere in the world. For many underdeveloped countries renewable energy provides them with a good solution for their energetic problems, eliminating the dependence on other countries, and being able to produce their own energy, an energy that is clean and that has much more stable costs over the long-term. Some of these green sources have been harnessed by humans for centuries. This is the case of solar, geothermal or wind energy, the difference is that now the way in which they are harnessed has improved and we can take more advantage of them.

The main goal of this paper is to discuss the advantages that the use of renewable energies can have for the military. The military force of U.S. is taken into account because of their commitment to green sources, the alternatives that they are already developing related to the use of renewable energies in warfare, because they are at war, and finally because they are the country with the largest number of forces abroad, for example in Afghanistan.

## **2. United States and the petroleum**

Historically, energy has been treated in the U.S. as cheap commodity that was always available when it was needed. These facts may no longer be true, especially after the price escalation in 2008, the prospects that prices will rise as world oil reserves start to decrease, and the difficulties that resupply convoys have to face in war situations like Afghanistan. According to the most recent data on petroleum available at the U.S Energy Information Administration web page, the United States is the top oil consumer in the world, with a consumption that in 2008 represented 22.80 percent of the total petroleum consumption in the world [2, 3]. In 2008, the Department of Defense (DoD) spent more than \$16 billion to buy 120 million barrels of oil; this figure amounts to 1.7 percent of the total in the U.S, making it the single largest oil consumer in the United States [4]. According to this study on energy use in wartime from Second World War to the current Middle East wars, nowadays the U.S. fuel consumption is 83.3 liters per soldier and day. That figure represents a 175 percent increase in the fuel consumed by U.S. soldiers compared to the consumption in Vietnam per soldier and per day. This increase in fuel consumption is mainly due to the increasing number of different technologies with which soldiers are equipped nowadays, as well as the asymmetric nature of the conflicts, which take place in irregular situations where it is necessary to travel over long distances because there are not clearly defined fronts. In this type of conflicts, armies have to spread their forces as much as possible in order to protect as many assets as they can. This results in larger number of bases spread along long distances and in an increased number of convoys to supply them.

Afghanistan was selected as a target in this paper, because of the number of military forces present in the country, around 100,000 troops according to NATO [1] and around 70 percent of them are from the U.S. Because of the asymmetric nature of the conflict, which makes military forces to be spread all over the country, this results in an increased number of resupply convoys, and those convoys have to travel over long distances to reach their destinies. This is one of the reasons why the U.S. military decided to start using renewable energies in their bases abroad. Another reason has been the fact that the complete withdrawal

of all the forces in Afghanistan will still take years, so there is still time to apply some of the technologies that are being under consideration.

The increasing number of convoys is an important cause of casualties because they are a usual target for enemy forces, who try to disrupt friendly fighting forces energy supply by means of Improvised Explosive Devices (IEDs) and roadside bombs. The number of security incidents in Afghanistan has increased significantly when compared to previous years. They state that this situation is attributable to the increase in military operations that has been taking place since the first quarter of 2010, and also to the significant anti-government activities taking place in the south-east and eastern regions of Afghanistan. The report also points out that the majority of incidents continue to involve armed clashes and IEDs, each of them represents one third of the reported incidents. One of the most important issues in the report is the alarming increase of incidents related to IEDs, which have recorded a 94 percent increase in the first four months of 2010 compared to the same period in 2009. As well, they also report an increase in the number of suicide attacks and complex suicide attacks, which demonstrates the growing capability of the local terrorist networks linked to Al-Qaida. The 45 percent increase of the number of assassinations among civilian population when compared to the same period in 2009 is also significant. The current number of assassinated people per week is 7 [5].

The Army Environmental Police Institute (AEPI) calculated the casualty factor (casualties per convoy) for fuel and water resupply convoys in Afghanistan. The factors for fuel and water resupply are 0.042 and 0.034 respectively. The up-to-date data on casualties in Afghanistan indicates that the total number of deaths in and around Afghanistan in the Operation Enduring Freedom is 1,030. If we apply the casualty factor, this give us a total of 43.26 casualties due to fuel resupply, and 35.02 due to water resupply. Unfortunately, these casualty numbers are only likely to increase if we pay attention to the information provided by the United Nations report [6].

By reducing the fuel consumption it is possible to reduce the number of fuel resupply convoys and that will reduce the number casualties. Today, there is an increasing number of initiatives being taken by the U.S. DoD in order to reduce the need for fuel in domestic bases as well as those in war situations like Afghanistan. It is also important to highlight that by reducing the number of fuel supply convoys, the forces that are in charge of that task would be free to join other forces committed to other purposes. So, the resupply issue is not only about saving lives (the most important matter) and money, it is also about the opportunity cost.

The U.S. high dependence on oil has environmental and economic consequences, and also affects national security. Talking about this the possibility has to be taken into account that other countries may use the "oil weapon" to stop supplying the U.S. Another important issue is the fact that the global oil market is highly vulnerable to supply disruption since the main oil reserves are concentrated in a quite small area. These two situations do not really depend directly on the U.S., but the fact that military installations in the U.S. depend on the national grid does. This makes military installations really vulnerable to any disruption in the national grid. According to the already-mentioned report "More Fighting – Less Fuel" [7] there are four sources of risk for grid outages, and they are: overload, and overload was what caused the northeast blackout of 2003. The second source of risk comes from natural disasters and includes hurricanes, tornadoes, electrical storms or other extreme weather events. The third risk that they consider involves sabotage or terrorist activity, whether local, trans-national or state-sponsored, and it includes both conventional and nuclear attacks. The last one comes from cyber attacks since U.S. grid control systems are continuously probed electronically.

Many of the situations that we have described could be improved or even solved by using renewable energies.

### **3. Possible renewable energy solutions**

The renewable energies are becoming more and more important now-a-days. The hydroelectric power is used for a long time, as well as the wind power, earlier as a direct application (like mills) and in the recent days also for generating electrical power. The wave-, tidal-, solar-, biomass-, geothermal- and ocean thermal energies are relatively new type of energy, but the climate change, global warming and their causes and consequences make them very important. From the viewpoint of the military forces not all of them are real solution for the energy supply of a military basis in a foreign country.

According to the geographical possibilities in Afghanistan the following types of renewable energies can be applied: micro hydropower, wind, solar and geothermal energies, and biogas. Among these ones, solar energy is considered to be the most important source since in Afghanistan there are nearly 300 sunny days a year and the solar radiation averages about 6.5 kilowatt-hours per square meter per day [8].

Biogas or biofuels could be used and in fact, the U.S. Power Surety Task Force has already tried to provide forward operating bases with biofuel by means of their Tactical Garbage To Energy Refinery (TGER), a trailer mounted system that converts field waste (paper, plastic, packaging and food waste) into electricity using a standard 60kW diesel generator. Two TGER were deployed to Iraq for a capability demonstration, but they did not perform as well as they had when they were tested in a controlled environment, so further research would be needed.

Wind energy represents a great problem for the bases: the height of the windmills makes them an easy target for enemy forces because, although they would be within the base perimeter, their height is much higher than that of the wall that typically surrounds the bases.

As for geothermal energy in Afghanistan, active geothermal systems are located in the area of the Hindu Kush. There are many low to medium temperature geothermal resources all over Afghanistan. These geothermal fields are mainly water-dominated and can be found in the following areas: Harirud-Badakhshan and Helmand-Arghandab. In principle, bases placed along these areas could take advantage of geothermal energy, either to produce energy or for heating. Geothermal energy for electricity generation needs deep drilling in order to recover water from the deep underground reservoirs, and a geothermal power plant needs to be built. Depending on a power plant during war time is not reliable since the power plant would be an easy target for the enemy forces, so we should discard electricity generation using geothermal energy.

Another possibility concerning geothermal energy is the use of geothermal heat pumps for cooling and heating. They do not need fractured rock and water as occurs in the case of electricity generation. Geothermal Heat Pumps use pipes buried under areas around the building that wants to be heated or cooled either horizontally or vertically in a continuous loop. These pipes must be buried at depths of about 3 meters to 90 meters, so their potential use in war situations could be considered since in the case of the horizontal loop there is no need of digging too deeply.

The most appropriate solution is the installation of devices related to solar power. Solar energy does not only deal with electricity generation but, like geothermal energy, it can also be used for heating.

Solar panels can be installed on the base's roof or inside the perimeter without being a threat since they would be within the perimeter fence and height. They are easy to transport and, in case the base needs to be moved, they can be dismantled and set up again in the new

location. Related to this fact, the Defense Advanced Research Projects Agency (DARPA) has selected Ascent Solar Technologies Inc. for the creation of low-cost lightweight portable photovoltaic that should be able to stand up to battle conditions and environmental extremes. This is a step forward in the future use of solar energy technologies. The use of active systems to provide bases with heating or cooling should be also considered. As well, applications that deal with solar water heating could be applied since, as we saw in the solar energy section, they just need to be mounted on a roof.

#### 4. Conclusions

Climatic change and global warming are facts and any steps taking towards their mitigation should be considered as positives. We have studied the current situation of the U.S. military forces and their domestic oil use as well as their consumption in war situations. Despite the number of initiatives that there are, it is important not only that these initiatives come true but also that military forces become aware of the importance that the good use of energy and renewable energies have, especially because the use of renewable energies can help to decrease the number of casualties in war situations. As many times in history, it is very likely that those devices that are being tested in war cases or that have already been proved would have an application in people's everyday life as happened, for instance, with the Internet. Taken into consideration that the investment on research that many military forces are making is positive since that investment would not only be useful in a war theater or even to win a war, but it is to improve our energy use and general environmental situation.

We have focused on the U.S. military, but renewable solutions could be used by any country with the suitable renewable sources. Maybe other countries cannot make the capital investment that the U.S. can do on new solutions and technologies, but it is true that even if they cannot afford that, they can contribute to their own economy, national security, and environment by starting to use existing green solutions.

To apply of renewable energies can reduce the number of fuel resupply convoys and that will reduce the number casualties, and hopefully it will reduce the number of lost lives.

#### References

- [1] North Atlantic Treaty Organization, *NATO's role in Afghanistan*, [http://www.nato.int/cps/en/natolive/topics\\_8189.htm](http://www.nato.int/cps/en/natolive/topics_8189.htm), June 22nd, 2010.
- [2] U.S. Energy Information Administration, *Petroleum Basic Statistics*, <http://www.eia.doe.gov/basics/quickoil.html>, 2008.
- [3] U.S. Energy Information Administration, *Country Energy Profiles*, <http://www.eia.doe.gov/country/index.cfm>, 2008.
- [4] Deloitte, *Energy Security, America's Best Defense*, 2009. [http://www.Deloitte.Com/assets/Dcom-UnitedStates/Local%20Assets/Documents/AD/us\\_ad\\_EnergySecurity052010.pdf](http://www.Deloitte.Com/assets/Dcom-UnitedStates/Local%20Assets/Documents/AD/us_ad_EnergySecurity052010.pdf), 2010
- [5] United Nations Security Council. *Report of the Secretary-General pursuant to paragraph 40 of resolution 1917(2010)*, [http://unama.unmissions.org/Portals/UNAMA/SG%20Reports/June182010\\_SG\\_Report.pdf](http://unama.unmissions.org/Portals/UNAMA/SG%20Reports/June182010_SG_Report.pdf), 2010.

- [6] AEPI Report, *Sustain the Mission Project: Casualty Factors for Fuel and Water Resupply Convoys*, [http://www.aepi.army.mil/docs/whatsnew/SMP\\_Casualty\\_Cost\\_Factors\\_Final11-09.pdf](http://www.aepi.army.mil/docs/whatsnew/SMP_Casualty_Cost_Factors_Final11-09.pdf) Final Technical Report, September 2009.
- [7] U.S. Department of Defense, Report of the Defense Science Board Task Force on DoD Energy Strategy, *More Fight –Less Fuel*, [http://www.climateactionproject.com/docs/Defense\\_Science\\_Board\\_report\\_Feb\\_2008.pdf](http://www.climateactionproject.com/docs/Defense_Science_Board_report_Feb_2008.pdf), February 2008.
- [8] Asian Development Bank. *Technical Assistance to the Islamic Republic of Afghanistan for Poverty Reduction and Rural Renewable Energy Development*, Financed by the Poverty Reduction Cooperation Fund., <http://www.adb.org/Documents/TARs/AFG/tar-afg-38044.pdf> December 2004.