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THE MILITARY AND THE RENEWABLES

PART II

As the candidate for the Phd Study in the National Public University, the author presents the requirement and possible solutions, technologies for using renewable energy resources throughout the military activity. After clarifying the demand, he investigates the requirement and then the possible technologies that Army can use. Building on the first article in this series, he presents examples already in development or in use.

FOREWORD

In this article I will investigate the options and possibilities of the renewable and or alternative energy technologies in the Army in order to outline the direction that economically developed armies should think about. I will show some current developments, concepts, technologies that should hold the attention of the military leadership.

There are three major questions that need to be clarified:

1. What is the demand for the army in the field of energy?
2. What is the requirement for the renewable energy system?
3. Where should the renewable energy system produce the required energy?

DEMAND, REQUIREMENT, SOLUTION

1. THE DEMAND

First we have to investigate the energy demand of the military force. The energy need is determined geographically. In Africa not much heating is needed, but electricity and cooling is an increasing demand. In Northern Europe cooling is not needed but heating and electricity is essential. This is the very first reason why there is no one single formula what a person, an organization or a group of people requires energy-vise. Normally the Army needs heating, cooling, electricity and fuel. Coolers use either heat (absorption) or electricity (ventilation), so at the end heat, electricity and fuel needs to be supplied for a military unit in order to provide the sufficient energy input for the operations.

The basic concept why we might use renewable energy is locality. Renewable energy is available right there where it is needed. But before we start talking about useful technologies we have to clarify the requirements.

What requirements are in place for technologies that armies use? This is the most important question because if renewable energy technologies do not comply with these requirements than there is no need for further investigation. Than we should investigate the current technologies and their capability to sufficiently satisfy the demands. That will narrow the numbers of the useful technologies.

2. THE REQUIREMENTS

After determining the required forms of energy that an army organization (should it be a squad or a regiment), the next step should be the measurement of the demands. The demand is different for each organization. This article doesn't aim to calculate the demands of different units or organizations. The calculation can be (and has to be) done when equipping a unit with any kind of renewable technology. I will chose a battalion as a base unit, because normally a battalion size organization is a smallest element that is deployed to execute a military operation. Of course in peacekeeping operation and some special cases smaller units are deployable but then that company, platoon or squad can draw the necessary energy-equipment from the battalion.

Most of the time military units execute their tasks under harsh environment, far away from civilization. The baseline of the military operations is from the energy system point of view is mobility, integration, distance, dependability, flexibility, durability, peak-time, availability, modularity and economy.

a) Mobility

"Maneuver is the movement of forces in relation to the enemy to gain positional advantage…"[1] When troops are in continuous move the combat support capabilities should follow them in order to best support the military operation. An energy system has to be flexible enough to easily set up and if needed, break down and transport to other location. The renewable energy system in support of military operation has to pass the test of mobility.

b) Integration

Energy systems needs to be integrated. Using less primer energy source will require less logistical resupply. As an experience we can say that in asymmetric warfare soft convoys - such as logistical resupply ones – are the primary targets for insurgents, or terrorist organizations. As it continues to be the case, units need to significantly decrease their energy consumption. One way of reaching this goal is integrating energy systems, using byproducts, waste heat and other materials to produce energy in place. The renewable energy system should be either integrated or should be ready to easily integrate if energy demand is growing.

c) Distance

In the history of war, most military operation was executed far away from populated areas. Nowadays peacemaking, peace keeping operations shift the trend to going into cities and towns but the army still has to be prepared to maintain energy self-sufficiency. The non-linear battlefield forces the military commanders to disperse their troops in the area of operation. That is why the distance between two subunits can be 10-100 kilometers. The renewable energy system should be able to operate either independently without any outside input or using input – primer energy sources – that are locally available.

d) Dependability

It is crucial for any technology that the Army uses to be dependable. If a soldier can't rely on his/her equipment than morale will diminish. Dependability consist of long-life, easy operation, few maintenance, broad operational limitation when we talk about an energy system in the context of military operation. Only such renewable energy technologies can be applied which already demonstrated the mark of dependability.

e) Flexibility

Flexibility in military sense means that one source can be applied to different tasks. Renewable energy systems have to be flexible to a point where they can satisfy different demands. For example: biomass can be used to produce heat, electricity and fuel as well (with different technologies, of course).

f) Durability

The Army's primary mission is to fight and win battles, campaigns and wars. Nowadays more and more task is joining to this primary mission but one thing doesn't change. All of them are executed in a harsh environment. All military

[1] Definition of Maneuver FM 100-5, 1993

equipment need to be durable, they has to withstand the adverse impacts of the environment and the range of use. The renewable energy system that satisfies the condition of durability can only be employed with the military force.

g) Peak-time

There is a normal operational tempo (OPTEMPO) in every operations. The energy consumption shows a certain level at that point. But when something unforeseen happens, the entire organization raises its OPTEMPO and in a very short time a lot of things happen. The energy system has to be able to provide that peak-power to provide the proper energy level at that high OPTEMPO period. If a unit would use renewable energy system to produce energy peak-times has to be taken into consideration.

h) Availability

Availability doesn't reflect on the technology itself, but the primer energy source. We simply lose one of the advantages if the primer energy has to be transported to the site. For that reason only those renewable energy systems can be used for the military that takes the maximum advantages of freely available environmental sources.

i) Modularity

There is an ever changing tactical environment where the Army employs its military force. Currently the trend in different military equipment is to be modular. The soldier, the squad, the platoon can be employed to save lives during/after a flood in an operation and two days later the same soldier or unit can be called to attack a house where insurgents hold a meeting. To provide the chance of success to the military they need modular equipment. The military leader has to have a responsibility on which equipment his/her subordinate unit will employ according to the environment. The renewable energy system can't be other than modular to appropriately support the troops.

j) Economy

Where life is at stake, economy is never in the first place. But it is in the second…

Such as any other military equipment, renewable energy systems have to be economical or at least more economical than the fossil-fuel based systems they replace.

3.GEOGRAPHICAL LOCATION

After describing the requirement for the systems we can answer the third question posted at the beginning of the study. As we have seen in the first article the geographical location determines the productivity of the different systems. For example in Africa solar energy would be a choice of source. On coastal regions, wind energy probably the economically best solution. In countries where there is large quantity of vegetation or forests, biomass would be the best to use.

PROS AND CONS

THE GOOD SIDE

Using renewable energy is environment-friendly, lower our pollution, carbon footprint and can supply us with energy just about anywhere. In the military it can solve resupply problems, the organizations can become more mobile and self-sufficient.

THE DARK SIDE

There are some issues when planning or executing an operation using renewable energy systems. Planning and operating renewable systems is not easy. The required knowledge and experience is not available at all levels of the military.

Renewable energy system planning can be integrated into the Military Decision Making Process (MDMDP) as part of the mission analysis. Before deployment, when analyzing the energy consumption and creating the energy management and resupply plan, planning officers should think about the possibilities of the renewable sources. As part of the intelligence preparation of the battlefield that is done by the Intel section (G-2) the geographical data is available. The logistical section (G-4) can provide the required devices, technologies for decentralized energy production. As we can see integrating the renewables into an energy management plan is a multi-section work and requires specific knowledge and experience. It is not impossible for the Army to develop this capability.

Operating and servicing a renewable energy system requires the basic knowledge and implementation of the knowledge already exists in the Army. Small scale power generation can be operated, over watched and serviced by an electrician, heat production and dissemination can be done by a technician. All other technologies build upon these two.

The renewable energy is not available at all times. electricity can be generated from the wind energy when the wind blows. At night the solar heater or the photo voltaic system will produce no energy. The solution for this problem is storage. It is fairly easy to store heat, an insulated tank can do that. Storing electricity still needs some development in order to become economically feasible.

EXAMPLES

There are good examples, where the military – or a company connected to the military – develops renewable systems according to the Army needs. GREENS (Ground Renewable Expeditionary Energy Network System). GREENS is a portable hybrid photovoltaic/battery power system developed for the United States Marine Corps[2]. The system consists of photovoltaic panels a battery pack and designed to produce electricity for a smaller command post. The picture shows the panels in operation. Stackable 1600-watt solar arrays and rechargeable batteries combine to provide 300 watts of continuous electricity for Marines in remote locations. Additionally, the GREENS toolkit feature allows Marines to enter their expected mission profile and determine which components of the GREENS system they will need to take with them. GREENS can be rapidly deployed and is HMMWV transportable[3].

Other good example is the Milspray Scorpion System. The developers at Milspray investigated the US Marine Corps' needs and came up with a hybrid systems solution.

"The Scorpion system incorporates a 3.3kW solar array, 2,640 Ah battery bank (20 hour discharge rate), and optional 400W wind turbine. The MPPT solar charge controller and inverters are manufactured by Outback Power Systems, a

[2] Downloaded from http://science.dodlive.mil/2012/03/31/ground-renewable-expeditionary-energy-network-g-r-e-e-n-marines/ 2012. 06. 18.
[3] The picture and the system profile was taken from the fact sheet provided by The US Naval Surface Warfare Center, Carderock Division

leading US manufacturer. The inverters produce true sine wave AC and are rated at 240 VAC 60Hz single phase for the EVWS. Four 3.6kW inverters are used to produce 14.4kW output. Other configurations such as 120VAC and 240VAC 3 phase are available.

The battery bank consists of (48) 12V VRLA deep cycle batteries with AGM separators wired in 12 groups of 4, producing 48 VDC. These batteries employ high temperature tolerant electrolyte chemistry and are capable of prolonged operation at 122°F.

The system is shipped with MILSPRAY's Scorpion Power Center, a purpose built 13.3 kW remote start genset. Electronics are programmed to run the genset only when bank voltage reaches 48.2V, being the 50% discharge voltage specified by the battery manufacturer."[4]

The picture of the Scoropion Energy Hunter System is taken at Ft. Dix (NJ).[5]

Other solution for the Military might be the German company – Losberger – "solar tent". The tent uses the integrated thin film photo voltaic technology to provide electricity. On the picture, the 216 m^2 tent can provide a 40 kWh electricity in sunny day in Germany.

Although the primary source of energy is solar, the energy integrating systems built in, is capable of receiving and storing electricity from all kind of different sources (i.e.: wind, diesel generator, etc…).

The built in PV system has an output of 8,2 kW_p and can satisfy a 13-19 kWh consumer demand.[6] The energy production depends on the geographical location and the climatic situation.

Also a good example is the Regenerator system[7] from the Zerobase Energy LLC. This company developed a photo voltaic solution for the US Marine Corps to recharge batteries, laptops and other electricity-operated devices. A command post can be operated with the Regenerator system. The device is portable easily put into operation and a Marine can operate and service it with a very little training.

[4] The data is taken from the Milspray Scorpion White Paper, Steven Lew and Kyle Tierney Deployable Renewable Energy Systems 2010 Lakewood p. 7.
[5] The data is taken from the Milspray Scorpion White Paper, Steven Lew and Kyle Tierney Deployable Renewable Energy Systems 2010 Lakewood p. 8.
[6] The data and the pictures derived from a Presentation „The Losberger solar tent – Space and energy: In the middle of nowhere" held by Losberger in 2006
[7] Regenerator Renewable Energy Appliances ZeroBase 2010

POSSIBILITIES

STATIC INSTALLATIONS

As we could see from the examples all research and development is taking place in order to create a mobile systems. But the Army can go green at home as well. There are static army installations all over the country which need energy refurbishment using renewable energy. The US Army has started this work[8] and puts effort to green the energy usage of the military. Rethink the energy supply of the military's static installations within the country does not require all the above mentioned army-specific requirements. These works are similar to any renewable energy projects executed for larger installations. Same technologies, same concepts can be used. These projects' goal is mainly to create energy efficient buildings and integrate renewable energy systems. Many countries support these works by creating a support system so the military can receive funds and expertise from the outside.

MOBILE INSTALLATIONS

As the military is becoming more expeditionary, mobile installations are getting more important. Command posts, accommodations, Service points, mess halls and all other structures must move time to time in order to satisfy the operational situation.

The energy system shall do the same. In this case the renewable energy systems provide a larger freedom of movement and flexible way of supporting the Army's activity with the sufficient energy supply. It provides the flexibility for the decision makers to best deploy their forces. Small-scale, portable systems take the burden of the resupply organizations and system therefore they save life (Delivering and protecting that quantity of fuel is a difficult job. Fuel convoys are attractive targets for the enemy. In FY07, attacks on fuel convoys cost the U.S. Army 132 casualties in Iraq, and 38 in Afghanistan.)[9]. Solar energy (either heat or photo voltaic), is already in use for mobile installations in some cases. The waste-to-energy or the biomass gasification technology would be a choice of technology for heat and electricity.

CONCLUSION

Following the Part I article, in this writing I have investigated the demand and the requirements that the Army poses to the energy systems in general and within that sense, the renewable energy systems. Then, after summarizing the pros and cons, I introduced some solutions already in use or in the testing phase. Renewable fuel production needs a separate study, that is why I did not include here.

As we can see there are nations taking steps towards a cleaner, sustainable and most cases cheaper energy supply system for their military. I believe the Hungarian Army should do the same. In the last part of this series I will analyze the Hungarian Army's situation on the renewable energy field.

Keywords: Renewable energy system, energy demand of the Army, requirements for the energy system of the army, hybrid system.

[8] More information can be found on http://www.armyeio.com/index.php/army-energy-portal
[9] MILSPRAY Deployable Renewable Energy Systems (White paper) Lakewood 2010 p. 2.

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