Application Of Alternative Energy In Defence Establishments: An Overview

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Abstract : Alternative energy refers to renewable sources of energy. These alternatives are intended to address the serious concerns about such fossil fuels: the high carbon dioxide emission, an important factor in global warming. Also, these energy sources are non- renewable. The escalating consumption of fossil fuels has led to destructive depletion and mercurial rise in their prices. This has led to huge increase in cost of operations of Defence establishments. This paper attempts to search for opportunities for employment of alternative sources of energy in Defence which is more efficient and cost effective and thereby giving less pressure on conventional exhaustive sources and follow Green planet theme.

IndexTerms - Renewable energy, Carbon emission, Non- tactical vehicles, Alternate fuel, Green planet theme.

I. INTRODUCTION

The priority of Defence Establishment Energy Program is to support the ability to carry out the mission. Energy is a critical resource both at installations and in combat platforms; and vulnerability is across the full range of military operations. As an enabler, energy availability and resilience define the capabilities of weapons platforms, facilities and equipment. In addition, energy remains a substantial expense that competes with other investments in people and equipment. These issues compel to pursue cost-effective measures that necessitate employment of alternative energy for purpose of reducing cost of operations.

Objectives

The paper attempts to :

1. Identify the significance of alternative energy in Indian Defence Sector
2. Comprehend the various types of alternative energy and their merits; and to suggest measures to reduce the usage of fossil fuels.

Background

India is the second largest commercial energy consumer in Non-OECD East after China. Asia comprises 19 percent of the region's total primary energy consumption. Economic growth in India has largely been associated with increased energy consumption. While 60% of total energy needs in India are met by commercial energy sources, remaining 40% comprises non-conventional fuels. Over the past few years, climate change has become one of the main concerns driving the new energy policy. More than 150 countries, including India, have committed themselves under the United Nations Framework Convention on Climate Change to formulate and implement mitigation and adaptation measures to climate change. India accounts for over 3.5% of world carbon emissions. Since energy use is a major source of emissions, it is necessary to focus on the management of energy demand and supply as a means to abatement.While energy demand grows significantly with economic growth, this varies over time, depending on various other factors. Technological progress, energy efficiency programs and structural changes contribute towards the variation in energy demand. Understanding the various components of energy demand is therefore important and necessary in order to deal with future emission check.All this lead to search for employment of alternative energy which is more efficient and cost-effective. Now, almost all sectors of agriculture, transport , industry and defence are harping upon cultivating energy to meet their day to day operational requirement from non- conventional or renewable source of energy called alternative energy.

Alternative energy is any energy source that is an alternative to fossil fuel. These alternatives are intended to address concerns about fossil fuels, such as its high carbon dioxide emissions, an important factor in global warming. Marine energy, hydroelectric, wind, geothermal and solar power are all alternative sources of energy. Historians of economies have examined the key transitions to alternative energies and have regarded the transitions as pivotal in bringing about significant economic change.

Current Scenario

Defence establishments have recently started putting thrust on employing alternative energy. We can see solar panel installations in some stations of Defence Departments to generate electrical energy. With passage of time, the emphasis is to consider more options for application of alternative energy so that less and less pressure could be given on conventional exhaustive source and thereby follow green planet theme.

At its core, the program for employment of alternative energy integrates three domains.

a) Expanding energy supply from various sources
b) Reducing the demand/ consumption of energy
c) Adopting modern technology/ Employing alternative source of energy

For the purpose of efficient utilization as well as employment of alternative sources for generation of energy, it is important to distinguish between facility energy and operational energy. Facility energy includes energy needed to power fixed installations and enduring locations as well as NTVs(Non-Tactical Vehicles).Operational energy is the energy required for training, moving, and sustaining military forces and weapons platforms for military operations, including energy used by tactical power systems and generators at contingency locations.

Sources of Alternative Energy

The contemporary types of alternative energy are as follows:

- **a.** Solar energy, the use of sunlight, where the sunlight can be changed into thermal (heat) energy or directly into electricity via photovoltaic devices.
- **b.** Wind energy which is the generation of electricity from wind, commonly by using propeller-like turbines.
- **c.** Hydroelectricity which captures energy from falling water.
- **d.** Nuclear energy that uses nuclear fission to release energy stored in the atomic bonds of heavy elements.
- **e.** Geothermal energy which consists of the use of the earth's internal heat to boil water for generating electricity.
- **f.** Bio fuel and ethanol fuel which are plant-derived gasoline substitutes for powering vehicles.
- **g.** Hydrogen fuel which can be used as a carrier of energy and produced by various technologies such as cracking of hydrocarbons or electrolysis of water.

The Prospective Sources of Alternative Energy in Defence

Defence establishments have already started recognizing the heavy cost involved in consuming conventional form of energy which is also adversely affecting our green planet. As a control measure, they started employing alternative source of energy. Pilot project has already been undertaken by few departments under which 7 to 8 units were selected by NISE (National Institute of Solar Energy) and were recognized as project area for harnessing solar energy.

Solar Energy

Solar energy uses captured sunlight to create Photovoltaic Power (PV) or Concentrated Solar Power (CSP) for solar heating. This energy conversion allows solar to be used to power auto motives, lights, pools, heaters and gadgets.

Rooftop Solar

The most important use of solar energy, in order to harness electrical energy, is by rooftop solar. It can be used to save thousands of rupees every year by cutting their energy use, carbon footprint and utility bills. In domestic areas, like on top of buildings, as a pilot project the installation of rooftop solar can be initiated. The electricity generated out of this device will reduce the burden of heavy electricity bills being paid by organization every quarter as well as will reduce dependency of heavy electrical consumption from outside source. Hence, several projects are already undertaken by National Institute of Solar Energy (NISE) in the field of solar energy technologies. However, a lot of efforts are still required to bring this into the organization on large scale and thus foster this renewable and efficient source of energy.

Solar Powered Transportation

An innovative practice to effectively make use of the sunshine is with transportation powered by photovoltaic (PV) energy. Railroads, subways, buses, planes, cars and even roads can all be powered by solar. Solar transit is becoming a popular offering in the renewable energy sector. Recently, a Swiss long-range experimental solar powered-aircraft "Solar Impulse 2" made its way around the world, soaring across the Pacific and making big splashes in iconic photographs. Meanwhile, solar buses are helping China reduce its carbon footprint while simultaneously maintaining efficient mass transit in densely populated cities like Beijing. Finally, solar cars are starting to play a role in racing competitions around the world, especially in Australia where the Solar Spirit model has gained major recognition. With these advances and more, currently the solar power is transforming the transportation sector around the world. Defence Establishments can also continue to pursue a diverse mix of renewable energy technologies. For example, Fort Huachuca which is a United States of Army Installation located about 24 km north of the border with Mexico has continued to grow its renewable energy production capacity through implementation of both small and large scale solar PV projects.

Non-Tactical Vehicles and Alternative Energy

Non- Tactical fleet of vehicles in Defence Establishments usually run either on petrol or diesel. However, the Defence Establishments can pursue for replacement of fleet vehicles with more efficient models e.g. fuel efficient and cost-effective AFVs (Alternate Fuel Vehicles), hybrid electric vehicles, and plug-in electric vehicles (PEVs) that support its mission requirements and thereby decrease petroleum or diesel consumption. A comprehensive plan for resizing and reducing of current fleet size and replacing with alternative fuel and high efficiency vehicles is required. It will eliminate underutilized and unjustified vehicles, and downsizing the remaining vehicles in the fleet to the smallest vehicle able to perform the mission.The Air Force Element, Vehicle and Equipment Management Support Office (AFELM VEMSO) of United States has implemented many programs that directly contribute to the success of the Federal mandates by way of procurement of PEV fleets, AFVs and deployment of Automotive Information Module, 2nd Generation (AIM2) and Vehicle Validations (VV). In FY 2014, AFELM VEMSO completed 14 on-site VV visits and 13 virtual visits. The AFELM VEMSO were able to identify and reduce 1,941 vehicles no longer required to meet mission requirements and right sized 775 vehicles to support reductions in petroleum consumption.

It is also noteworthy to mention that Naval Facilities Engineering Command (NAVFAC) in United States which is established as Central Manager for Navy's Base Support vehicles and equipment commonly referred to as Non-Tactical Vehicles (NTVs); Alternative Fuel Vehicles (AFVs) are an integral part of its green fleet program. NAVFAC has made significant progress in few years to reduce dependency on foreign oil and exploring opportunities to increase alternative fuel vehicles. Approximately half of the light and medium vehicle fleet are alternatively-fueled in United states.

Solar Lighting

One of the easiest ways to improve efficiency in Defence department is to add outdoor solar lighting on pathways, starting first with domestic areas and then extending it to official campus. Unlike traditional exterior lights, solar lighting requires no complicated setup as the lights are wireless and harness sunlight during the day to circumvent the need for grid-supplied electricity at night. Though solar lights are not yet as common as solar panels, they are quickly joining the likes of LED lightbulb sand smart home thermostats as a cheap product that can reduce electric bills and improve the efficiency.Additionally, the aesthetic of modern solar lighting can significantly improve the outdoor decor of a property. Elaborate lighting arrays can improve the exterior design of a property. They are cheap as well as easily available. The availability and low cost of these lighting products are one reason why it's so common to see solar powered street lights.

Solar Heating

It is also very important to know that solar water heaters and solar space heaters are an effective way to heat one's office or a conference hall without making the larger investment of installing solar panels. Solar space heaters harness sunlight and convert it into thermal energy with the use of liquid or air as a medium, while solar water heaters use water as a method for thermal transfer. These solar heating systems can either be passive or active – while passive systems utilize natural circulation, active systems use pumps to circulate water and generate heat. Installing a thermal solar array on the roof can expect 5 to 10 percent returns with a system that costs a fraction of a full solar panel installation.

Wind energy

Airflows can be used to run wind turbines. Modern utility-scale wind turbines range from around 600 KW to 5 MW of rated power, although turbines with rated output of 1.5–3 MW have become the most common for commercial use. The power available from the wind is a function of the cube of the wind speed, so as wind speed increases, power output increases up to the maximum output for the particular turbine. Areas where winds are stronger and more constant, such as offshore and high altitude sites are preferred locations for wind farms. Typically full load hours of wind turbines vary between 16 and 57 percent annually, but might be higher in particularly favorable offshore sites.

Globally, the long-term technical potential of wind energy is believed to be five times the total current global energy production, or 40 times current electricity demand, assuming all practical barriers needed were overcome. This would require wind turbines to be installed over large areas, particularly in areas of higher wind resources, such as offshore. As offshore wind speeds average 90% greater than that of land, so offshore resources can contribute substantially mo

re energy than land stationed turbines**.**

National Institute of Wind Energy(NIWE) located in Chennai is an autonomous R&D institution under the Ministry of New & Renewable Energy, Govt. of India established to promote and accelerate the pace and utilization of wind energy and to provide entire gamut of services to enable wind energy penetration in the electricity generation mix. Liasioning can be done with this institute to identify project area especially at sea shores which are able to harness wind energy. Wind energy is the leading source of new capacity in Europe, the US and Canada, and the second largest in China. In Denmark, wind energy meets more than 40% of its electricity demand.

Bio-energy

As an energy source, biomass can either be used directly via combustion to produce heat or indirectly after converting it to various forms of biofuel. It can be converted into other usable forms of energy like methane gas or transportation fuels like ethanol or biodiesel. Biomass (including biogas from captured methane) and municipal solid waste can be used for both electricity and steam production. Fort Drum, a U.S. Army military reservation place is developing infrastructure to purchase renewable energy from an on-site biomass plant to meet 100 percent of the installation's energy demand.

SardarSwaran Singh National Institute of Bio-energy, an autonomous institution of the Ministry of New and Renewable energy, Govt. Of India located in Punjab has been established with the aim to focus on bio-energy and develop innovative technologies in the area of renewable and bio fuels.

Geothermal electric power is by far the most significant renewable bioenergy source. It has proven to be of great utility in many countries which are cultivating for alternative source of energy. However, investment costs involved in cultivating energy from this source is huge. A very good example for utilizing alternative source of energy with limited resources and infrastructure is given below where Marine Corps Air Ground Combat Center(MCAGCC) , Twenty- nine Palms in California, Nation's largest Marine Corps Base is transforming its electrical infrastructure to enable it to operate off the commercial power grid when needed.

This remote base in the Mojave Desert serves a population of more than 27,000 military and civilian personnel who facilitate large-scale training and exercises. The austere conditions, limited infrastructure, and required continuity of operations place a heavy demand on the base's electrical infrastructure. The base sustains its mission with more than 10 MW of power generated on-site by a 1.2 MW solar PV farm, 1 MW of solar PV shading, a 0.5 MW fuel cell, and a 7.2 MW co-generation plant. The base is tying together its disparate electrical infrastructure in an optimal way while serving as a test bed for new technologies. The centerpiece of this electrical infrastructure integration demonstrates how micro grids will serve as an important component of the smart grid.

Initiatives to Reduce Energy Demand

The demand for facility energy can be reduced by investing in efficiency and conservation projects on its installations. Defence establishments should continue to reduce energy costs and maximize payback in order to have the best return on investment. For this purpose, the majority of investments are required to be made in the Departments' operations and maintenance accounts, to be used for sustainment and recapitalization projects. Such projects typically should involve retrofits to incorporate improved lighting, high-efficiency heating, ventilation, and air conditioning (HVAC) systems, double-pane windows, energy management control systems, and new roofs. **Key contributors in reduction of energy consumption:**

a. Increased renewable energy production
b. Retro-commissioning facility HVAC systems
c. ESPC(Energy Saving Performance Contract) initiatives
d. Energy awareness programs across all units

The Defence Organizations(Army, Navy, Air Force, DRDO etc.) should leverage communication, training, and education to facilitate an energy aware culture. Events such as Energy Action Month and Earth Day will assist in shaping the behavior for the Defence personnel. Moreover, energy competitions and sharing of lessons learned through its website should be encouraged. Through its energy aware culture priority, Defence establishments can foster innovative ideas and procedures to save facility as well as operational energy. These recognized facility energy efforts saved the U.S. Air Force over $8.6 million in FY 2014. Hence, India can also explore all the avenues of reducing energy demand using alternative energy in defence establishment.

Conclusion

The energy program for DefenceOrganization must continue to seek opportunities to incorporate renewable energy on its installations by conducting assessments on resource availability and economic feasibility studies. This increase in renewable energy production is attributed to an increase in renewable energy projects. Although, the higher initial investment cost is a barrier. With adequate and credible information, people and organizations can make investments with paybacks of 2-5 years. It must be kept in mind that results once achieved are going to affect this organization positively forever.

References:

BeyzanurCayirErvural, Turkey and DursunDelen, USA article on " A multi-objective decision-making approach for sustainableenergy investment planning", Vol.126, March 2018

Department of Defence, U.S., Annual Energy Management Report for Fiscal Year2014,)Office of Assistant Secretary of Defence(Energy, Installations and Environment).

Joyashree Roy (Professor of Economics), Dept of Commerce Jadhav University, Kolkata; Mitali Das Gupta(Research Scholar), paper on "Energy Consumption in India; an indicator analysis".

Paul Kruger ," Alternative Energy Resources, The Quest for sustainable Energy", March 2006.

Raghuraman V, Principal Advisor, Confederation of Indian Industry Report on "Energy Efficiency Policy in India",2006.

Vaughn Nelson,Kenneth Starcher" Introduction to Renewable Energy", Energy and The Environment, November 2015.

www.greenfleet.dodlive.mil.