

TechMining for Scenarios: Future of Sustainable Military Operations under Emerging Energy and Security Considerations

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The present study aims to analyze the evolution of the relationships between changing characteristics of warfare, associated military R&D and technology and as a result critical role of energy for success and sustainability of military operations. Investigating the trends in changing nature of warfare and energy, the present study identifies priority technology areas and strategies for the future military energy R&D.

Thus, the study begins with the review of changing characteristics of warfare. The review aims to reveal the relationship between changing concepts and technologies of warfare, and implications of these changes for energy requirements of armies. Following the analysis of the changing characteristics of warfare, the state-of-the-art in the energy technologies is analysed. Attention will then be turned specifically to energy research in military. Next, the methodology of the study will be described. Besides the review of military and energy literatures, the study benefits from the bibliometric analysis of energy patents to have a more concrete grasp of the technological evolution in the military domain. Following the identification of the technology trends through the bibliometric analysis, future scenarios are developed to demonstrate alternative trajectories of development in the military operations and energy requirements. The analysis of scenarios help to outline the priority areas and strategies for the military energy R&D in the discussion and conclusions section of the paper.

BACKGROUND

Vital importance of military and energy relationship can be understood easily by narrating the recent story of US-Pakistan oil crisis. On November 26, 2011 NATO attacked the Salala post on the Pakistan-Afghanistan border. During the attack 24 Pakistani soldiers were killed. Upset by the casualties, the Government of Pakistan reacted immediately by closing the Ground Lines of Communications for NATO oil supplies into Afghanistan through the port in Karachi and demanded an apology from the US Government. The lack of energy supply paralyzed the operation, and unavoidably resulted with the formal apology of the US government on July 3, 2012. Immediately after, an agreement was reached between Pakistan and the closed border was re-opened. According to news report, the border closure cost the US at least \$700 million (World News Tomorrow, 2013). This recent event may be considered as a good example to reflect the importance of energy especially for multinational forces. It was not the 'cost' the most critical point in this case, but the 'supply' of energy and thus the 'sustainability' of the military operation.

In parallel to the changing characteristics of warfare, the energy dependency of military operations has increased dramatically. A clear trend can be observed when the energy consumption statistics are compared. For instance, in the World War II, energy consumption was only one gallon per day per soldier, whereas in the Desert Storm operation in 1991, this figure quadrupled by reaching four gallons per day per soldier (LMI Report, 2007). Gaining new and superior capabilities have always been a key

aim for armies to be powerful and win wars. This goal has so far been realized with more sophisticated machines and devices, and resulted with an increasing energy dependency. Today, a war fighter is considered to need more than 30 watts to power his devices, which are designed to increase safety and enhance his combat ability (Seah and Tang, 2011). A dismounted soldier is overburdened with non-standard batteries and it becomes hard to carry them in a fight for a long duration.

Energy demand has been intensified with the developments in electronics with new capabilities such as to enable vision at night, designate targets at a distance with lasers, power small robotic vehicles, and provide sensing and communications. Alongside the individual level, military bases and facilities have also become more energy dependent. All security systems, radars, lightings, communication devices, military vehicles and other equipment are wholly dependent on energy. Consequently, it can be assumed that the absence of energy makes military forces blind and stagnant.