4.1 Power & Energy

"The current and future operating environment requires an expeditionary mind set geared toward increased efficiency and reduced consumption, which will make our forces lighter and faster. We will aggressively pursue innovative solutions to reduce energy demand in our platforms and systems, to increase our self-sufficiency in our sustainment, and reduce our expeditionary foot print on the battlefield. Transforming the way we use energy is essential to rebalance our Corps and prepare it for the future."

-United States Marine Corps Expeditionary Energy Strategy and Implementation Plan, (Washington, DC: CMC, 2011), February 23, 2011

Bottom Line Up Front	
Challenge	
PEO LS has added the directives and processes described in the USMC Expeditionary Energy Strategy and Implementation Plan and Initial Capabilities Document for USMC Expeditionary, Energy, Water, and Waste to its continued focus on Power and Energy. Engaging with Service and Industry partners in an effort to identify capability advances, the PEO LS S&T Directorate continues to identify focused Power and Energy S&T investment opportunities and bring these opportunities to the attention of PEO LS Program Managers for potential application across their portfolios.	
Potential Solutions	
ONR Code 30	On-Board Vehicle Power (OBVP) Fuel Efficient MTVR FNC Modular Vehicle Platform (MVP) Electric Acceleration Assist and Integrated Starter Generator
PEO LS/ONR	Advanced Transmission Technologies Efficient Powertrain Technologies Integrated Power and Propulsion Hybridization and Re-Power
TARDEC	Hybrid Electric Vehicle Experimentation and Assessment Research Program
TARDEC POM 13-17 Programs	Combat Vehicle Auxiliary Power Unit JP-8 Fuel Cell APU System Efficient Powertrain Technologies
SBIRs	Development of small fuel efficient multi-fuel capability engine Vehicle Based Exportable Power Development of High Power Lithium-ion Batteries Variable Speed Alternator Drive Lithium Ion Batteries with Wide Operating Temperature Range Innovative Simulation and Analysis Tool for Vehicle Thermal Management

Potential Solutions

ONR Expeditionary Warfare and Combating Terrorism Department (Code 30) Efforts

On-Board Vehicle Power (OBVP). The MTVR OBVP capability reduces the need for ground forces to carry trailer mounted generator sets that reduce payload and restrict mobility. This MCSC Product Group 15 (PG-15) PM Expeditionary Power Systems (EPS) effort was funded by ONR and includes the following objectives:

- Provide vehicle integrated power source: 120 kW of military grade export power and 21 kW of power on the move
- Allow easy retrofit of existing MTVR vehicle
- Use host vehicle's diesel engine for both mobility and power generation
- Retain MTVR performance

PM EPS expects to have six OBVP MTVR variants available for test and demonstration by the end of Fiscal Year (FY) 12.

Fuel Efficient MTVR FNC. The goals of this effort include increasing fuel efficiency by 15%, extending the range of MTVRs, and reducing the logistics and fuel burden on deployed Marines. This FY 2012 FNC is discussed at length in the Fuel Efficiency Focus Area (Section 4.2).

POM13-08 MTVR Modular Vehicle Platform (MVP)

OPERATIONAL NEED

Objective: Develop open architecture vehicle interfaces to enable modular integration of mobile trauma bay and command and control mission capability sets aboard MTVR platform

Value to Naval Warfighter:

- Flexibility/adaptability in mission planning using a single platform
- Reduced MAGTF logistics footprint
- MVP presents significant capability enhancements across the tactical battle space as gains in these technologies could be leveraged on other tactical vehicles, to include the potential for Autonomous/Robotic application.

Gap # & Title:

POM 13-01 Naval Platform and Systems Total Ownership Cost
POM 13-31 Logistics Support to Distributed Operations

Impact if Not Addressed:

- Distributed Operations will be significantly limited
- Marines will continue to create "homebrew" MTVR mission sets

PROPOSED SOLUTION

The Technology:

- MTVR Open System Architecture and Vehicle Interface
- Mobile Trauma Bay Mission Module
- Mobile Marine Command and Control Mission Module

Similar/Related Projects:

- MTVR On Board Vehicle Power (OBVP) FNC
- Army VICTORY program
- DARPA META program

TRL: Current: 4, Projected at end (FY16) 6

Major goals

- FY13 Subsystem demonstration in SIL
- FY14 Module functionality demonstration on shore net/power
- FY15 Integrate vehicle common interface and test with module
- FY16 Full System Demo/Transition

BUSINESS CASE

Key Metrics:

- Government owned software, architecture, and interface
- 50% reduction in square and cube on seabase
- Up to $53M in cost savings through optimization of mobile network and communications
- Level II Technical Data Package and Technology Demonstrator

Proposed Funding - FY-12 Core

FY12	FY13	FY14	FY15
400K	TBD	TBD	TBD

Partners: PEO LS, Marine Corps Systems Command, Marine Corps Combat Development Command

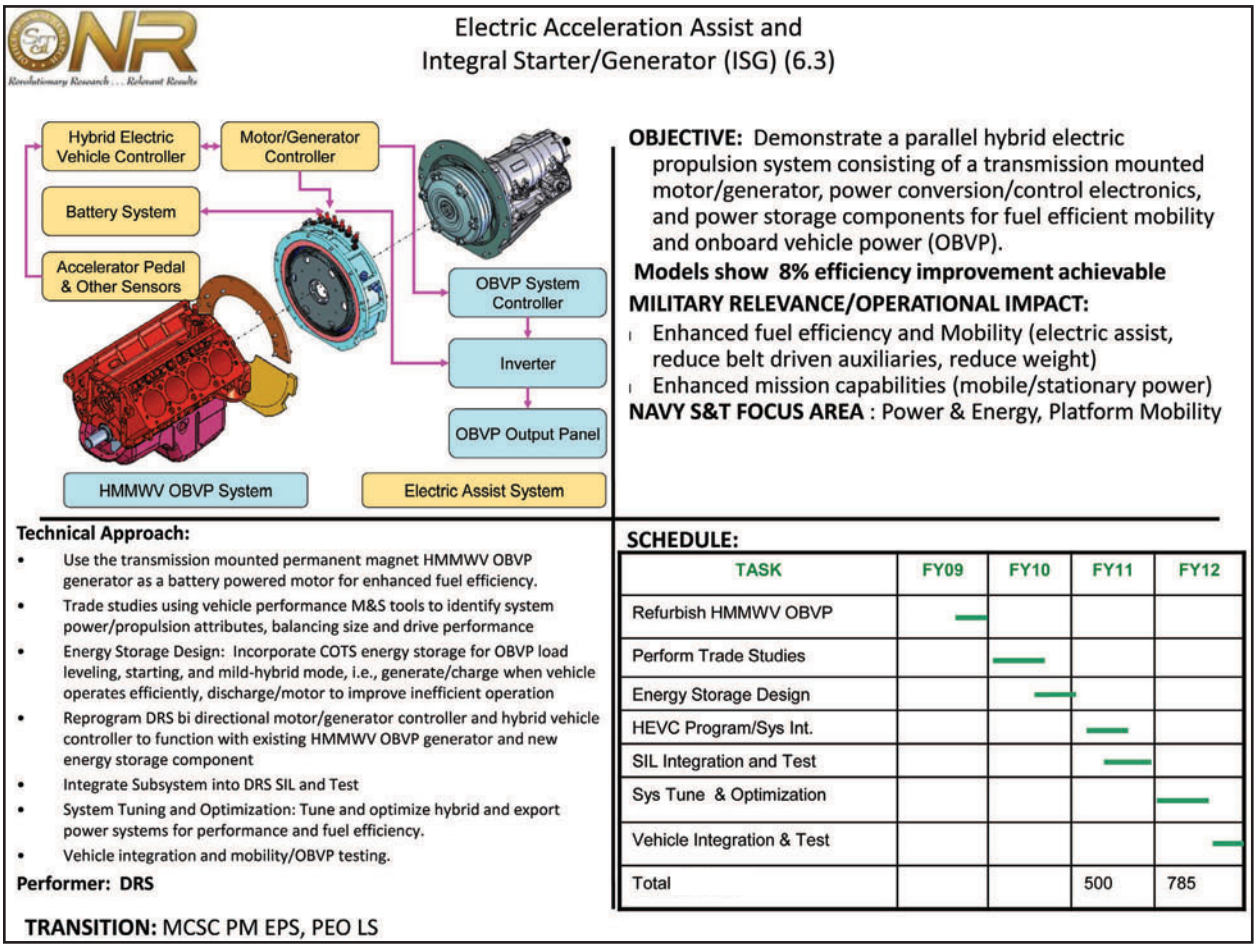
Transition Sponsor: USMC PEO LS, PM-MTVR

ONR POC Contact Info: Mr. Jeff Bradel
703-588-2552, jeff.bradel@navy.mil

MTVR Modular Vehicle Platform (MVP). The capability enhancement that an MTVR equipped with OBVP provides can have synergistic effects across the battle space. In an effort to capitalize on this capability, the PEO LS S&T Directorate submitted a proposed FY14 Enabling Capability (EC) for an MTVR MVP. This effort resulted in MVP being selected as a FY12 Core effort. Goals for FY12 are to identify mission capability improvements as well as S&T investment potential to bring this concept to fruition.

Operational Impact/Benefit to the Warfighter:

- Leverages the flexibility MTVR with OBVP offers today's warfighter as a current PoR "enhanced" with modular capability sets
- Provides the commander flexibility and adaptability in mission packages using a single self-loading platform for many different types of missions
- Reduces the number of vehicles required in theater
- Reduces the force's maintenance burden
- Reduces MAGTF footprint



Electric Acceleration Assist and Integrated Starter Generator. Enable electric acceleration assist, onboard power generation, and elimination of vehicle starter motor, alternator, and battery.

Goal:

- Enhanced fuel efficiency

Operational Impact/Benefit to the Warfighter:

- Enhanced fuel efficiency and mobility
- Enhanced Mission Capability for both mobile and stationary power

PEO LS/ONR Efforts

PEO LS S&T continues its close partnership with ONR and tracks the following efforts:

- Advanced Transmission Technologies
- Efficient Powertrain Technologies
- Integrated Power and Propulsion
- Hybridization and Re-Power

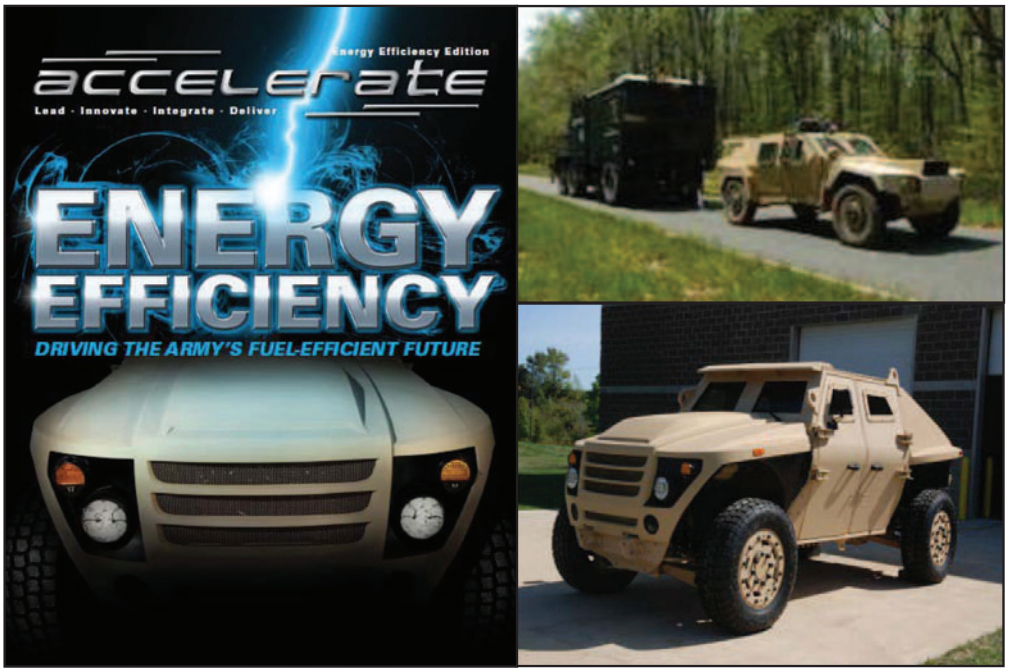
TARDEC Efforts Include

Hybrid Electric Vehicle Experimentation and Assessment (HEVEA). The objective of the HEVEA program is to improve fuel efficiency and enhance export power capability of the existing tactical vehicles through the addition of an advanced diesel engine technology, advanced power dense generator, and hybrid electric drive including regenerative braking.

Goal:

The objectives of the HEVEA program relating to PEO LS efforts include:

- Integrate lighter, higher-powered, JP-8 compliant Cummins ISL engines into the MTVR chassis and maximize common intake, exhaust, and cooling system components of the standard MTVR
- Hybridize OBVP MTVR: Enhance ONR developed MTVR OBVP vehicle through incorporation of a capacitor-based energy storage system (capacitors, energy storage controller) to generate energy during deceleration or idle periods, reducing engine and fuel demands during acceleration
- Support fuel efficiency of United States Marine Corps (USMC) standard MTVR platform, the MTVR OBVP package, and the Hybrid OBVP package
- Develop an advanced Lightweight Synchronous Generator for use on diesel electric military vehicles to provide high power density for export and mobile power
- Develop the next generation electric traction system designed specifically to enhance mobility for an off-road military vehicle at increased efficiencies
- Pursue advanced Tactical Wheeled Vehicle (TWV) power distribution architecture to meet future vehicle propulsion, stationary and on the move power and energy demands



- HEVEA efforts include:
  - Standard testing procedure and methodology for testing HEV's
  - Analytical tools for both assessment and evaluation
  - Established credible/quantifiable data of HEV vice conventional vehicles (fuel economy and reliability)
  - Developed M&S methods

Operational Impact/Benefit to the Warfighter:

- Enhance future tactical vehicle mobility through Engineering and Analysis of HEV platforms
- Support vehicle acquisition strategies with quantifiable and relevant HEV test data and lessons learned

TARDEC POM 13-17 Programs

PEO LS S&T works closely with TARDEC in support of several Power and Energy initiatives. Examples include:

Combat Vehicle Auxiliary Power Unit (APU)

Goal:

- Develop power dense heavy fuel engines for APU applications
- Integrate successful engine programs into platform specific APUs
- Transition successful APU development programs into Abrams, Bradley, Stryker vehicle platforms

Operational Impact/Benefit to the Warfighter:

- Enable engine-off operations such as mounted surveillance for long durations
- Reduce acoustic signature compared to main engine idle
- Reduce fuel consumption in combat vehicles by running APU instead of the main engine
- Reduce maintenance costs for combat vehicle main engine by reducing operating hours
- Increase reliability of high power dense APU systems
- Increase auxiliary power available on combat vehicles
- Expand expertise in small engine and noise control arenas

JP-8 Fuel Cell APU System

Goal:

- Provide quiet, continuous, non-primary electrical power for extended engine-off operation with reduced acoustic and thermal signatures in a ground-breaking fuel cell based auxiliary power unit.

Operational Impact/Benefit to the Warfighter:

- Provide low signature, non-primary vehicle power generation for C4ISR and auxiliary systems (engine off)
- Increase the Warfighter's survivability and lethality through decreased signature during extended silent watch missions
- Increase overall vehicle fuel efficiency to reduce fuel logistics burden
- Provide power for Soldier equipment during transport and overwatch mission scenarios

Efficient Powertrain Technologies

Goal:

- Develop an efficient, reliable powertrain that will dramatically improve the energy productivity of existing military ground vehicle engine-transmission while using less space, improving vehicle mobility and fuel consumption, and reducing thermal load.

Operational Impact/Benefit to the Warfighter:

- More efficient powertrain operating on a wide range of military grade fuels, with reduced heat rejection and improved "energy productivity" specifically for military vehicle applications [Energy Productivity in U.S. Army Weapon Systems, Memorandum dated 7 January 2009]
- Powertrains with increased electrical power generation capabilities for meeting future power demands while improving vehicle mobility and silent watch requirements
- Improved vehicle performance and durability

PEO LS S&T is monitoring TARDEC Power and Energy Efforts:

- Advanced Propulsion with Integrated Starter Generator (ISG) Research
- Advanced Propulsion with Onboard Vehicle Power
- Battlefield Power Generation
- Power Architecture and Standards
- Condition Based Maintenance Advanced Technologies
- National Automotive Center (NAC) Mobile Computing Applications Platform (MCAP)
- NAC Microgrids
- Pulse Power for Weapon and Survivability System Integration

Small Business Innovation Research (SBIR) Efforts

PEO LS S&T is monitoring the following Army SBIR Efforts:

- **Development of Small Fuel Efficient Multi-Fuel Capability Engine**
- **Vehicle Based Exportable Power**

- **Development of High Power Lithium-ion Batteries**
- **Variable Speed Alternator Drive**
- **Lithium Ion Batteries with Wide Operating Temperature Range**
- **Innovative Simulation and Analysis Tool for Vehicle Thermal Management**

Expeditionary Energy

"We equip our forces today to serve as our nation's premier expeditionary force. Through this strategy, we will establish the Marine Corps as the center of innovation in operational energy efficiency, expeditionary energy systems, and renewable energy technology for the battlefield. We will lead requirements development to inform and guide technology innovation by building a deep understanding of energy challenges and possible solutions. We will reset our processes, injecting expeditionary energy concepts into our requirements and acquisitions decisions. We will collaborate with the leading thinkers and innovators in the U.S. Government, academia, and the commercial world. We will be agile and ready to adapt and deploy new capabilities into our operations."

-General James F. Amos, Commandant of the Marine Corps

In publishing the first USMC Expeditionary Energy Strategy and Implementation Plan, the Commandant of the Marine Corps formally brought Power and Energy issues to the forefront of all USMC Acquisition Programs. The prime directives of this plan: Value Energy in our Material Development and Acquisition; Target Materiel Investments in High-Impact Areas; Focus Technology Innovation on Marine Corps Needs; Lead in Deploying Innovative Energy Solutions; and Sustain Energy Security and Environmental Stewardship. Additionally, the establishment of the Initial Capabilities Document for USMC Expeditionary Energy, Water, and Waste will bring structure and focus to this critical capability arena.

Initial Capabilities Document (ICD) for USMC Expeditionary Energy, Water, and Waste

The ICD for USMC Expeditionary Energy, Water, and Waste seeks to resolve the military problem presented by current and future operational energy, water, and waste logistics requirements and the resulting maneuver limitations and vulnerability to attacks on ever more critical and extended supply lines. The intent is for capabilities identified in this ICD to:

- Achieve resource self-sufficiency on the battlefield
- Reduce energy demand in platforms and systems
- Reduce the overall footprint in current and future expeditionary operations.

Energy Solutions will reduce threats to convoys.

PEO LS supports this game-changing approach to addressing critical Power and Energy issues across all programs, and will continue to address Power and Energy as one of its critical Focus Areas.

Expeditionary Forward Operating Base (ExFOB)

The primary focus of ExFOB demonstrations is to observe and evaluate industry solutions that will enhance Marine Corps self-sufficiency, reduce the energy demand of platforms and systems, and lighten the load of the Marine Corps in current and future expeditionary operations.

PEO LS continues to closely monitor the efforts of the Expeditionary Energy Office to include all ExFOB events. In the summer of 2011 ExFOB IV was held at Camp Wilson, aboard the Marine Corps Air Ground Combat Center Twenty Nine Palms, CA. This ExFOB event included several technologies addressing auxiliary and on-board power system applications on tactical vehicles to include the MTVR.