4.2 Fuel Efficiency

"Reducing the military's dependence on fuel for power generation could reduce the number of road-bound convoys… Without this solution, personnel loss rates are likely to continue at their current rate. Continued casualty accumulation exhibits potential to jeopardize mission success…"

-Lieutenant General Richard Zilmer, United States Marine Corps

Bottom Line Up Front	
Challenge	
Rising military consumption of energy and fuel is a challenge for the core DoD national security mission. The Department needs to reduce the overall demand for fuel and improve the efficiency of military platforms in order to enhance combat effectiveness and reduce risks and costs for military missions. Department of Defense OPERATIONAL ENERGY STRATEGY May 2011 states the US Marine Corps Energy Vision is "To be the premier self-sufficient expeditionary force, instilled with a warrior ethos that equates the efficient use of vital resources with increased combat effectiveness."	
Potential Solutions	
ONR	Fuel Efficient MTVR Fuel Efficient Ground Vehicle Demonstrator (FED)
ONR / TARDEC	HEVEA Research Program
PEO LS / ONR / TARDEC	Fuel Efficiency Enabling Technologies
TARDEC POM 13-17 Programs	Advanced Lubricants/Fluids Program Technologies to Enable Tactical Fuel Use Efficient Powertrain Technologies
SBIRs	Energy Efficiency Enhancements

Potential Solutions

Fuel Efficient Marine Tactical Vehicle Replacement (MTVR)

"The Marine Corps' medium tactical truck, called the Medium Tactical Vehicle Replacement (MTVR), consumes from 40-60% of all fuel consumed by Marine Corps ground vehicles during assault and sustainment operations."

- United States Marine Corps Tactical Fuel Systems (1998-2010) Study - Tactical Fuel Requirements Analysis, 1998

The Fuel Efficient MTVR initiative, a collaborative effort between PEO LS, ONR Code 30, and MCCDC was selected as a new start FNC for FY12. The goal of this effort is to develop, optimize, integrate, and demonstrate at least 15% fuel efficiency improvement over the existing MTVR across a set of driving cycles representative of likely operational conditions, while maintaining MTVR affordability, current mobility, transportability, and survivability capabilities.

Potential Enabling Technologies	
Advanced Fuel Efficient Engine and Idle Reduction Technologies	• Engine Control System for Efficient Torque/Speed Tracking • Optimize turbo machinery, fuel injection schedule, rail and cylinder pressures, compression ratio, and cylinder geometry for JP-8 non-emissions compliant engine
Electrification and Variable Output Control of Mechanical Auxiliaries	• Variable control and selective on/off • Energy storage and auxiliary power unit
Electric Drive with Regenerative Braking	• Flywheel Mounted Motor/Generator with Energy Storage for Regenerative Braking and Electric Acceleration Assist
High-Efficiency/High-Power Density Advanced Transmission/Integration	• Improved materials and higher temperature lubricants • Software controls algorithms optimization • Increased ratio spread to accommodate high speed engine characteristics • Continuously variable transmission for heavy duty applications

A Technology Transition Agreement between ONR and the Program Manager for MTVR was finalized on 21 November 2011, addressing the specifics of pursuing this potential technology.

ONR/TARDEC Efforts

FED
FUEL EFFICIENT GROUND VEHICLE DEMONSTRATOR

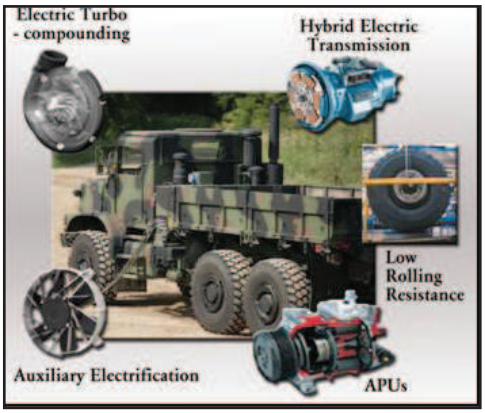
Fuel Efficient Ground Vehicle Demonstrator (FED)

The FED was initiated by the Office of the Secretary of Defense to address energy conservation needs highlighted by the Defense Science Board Energy Security Task Force. The overarching goal of the program is to improve military vehicle technology to reduce fuel consumption on the battlefield. This is a collaborative team effort lead by TARDEC and US Army Research Development and Engineering Command. The FED is composed of government and industry Subject Matter Experts (SMEs) evaluating propulsion, drive train, reduced weight, power and integration.

This effort investigates several focus areas that include: (1) Demonstrate a tactical vehicle with significantly greater fuel efficiency while maintaining tactical vehicle capability, (2) Integrate emerging fuel efficient technologies to demonstrate potential capabilities for the next generation of military trucks, and (3) Consider higher risk/higher payoff technologies to attain the most fuel efficient vehicle possible. Sub-working Groups include: System Integration, Operational Changes, Power train/Engine (Hybrid drive, advanced transmissions), Alternative Materials (metallic and non-metallic), Auxiliary Power/Electrical Loads, Fuel/Lubricants, Chassis and Suspension.

FED program objectives include:

- Identifying and assessing new, fuel-efficient vehicle technologies.
- Maintaining tactical vehicle capability while increasing fuel efficiency.



The FED Alpha vehicle (pictured above), is expected to boost fuel economy from approximately 4 MPG to an average of 7.1 MPG on a typical urban patrol mission, using several designed components to achieve efficiencies.

All PEO LS Tactical Vehicle PMs have representation on the FED.

PEO/ONR/TARDEC Efforts

PEO LS is actively engaged with ONR and TARDEC on the following projects under the Code 30 Maneuver portfolio:

Fuel Efficiency Enabling Technologies

Goal:

- Demonstrate technologies that increase fuel efficiency by 20%
- Demonstrate benefit of engine front end accessory drive electrification (electric motor drive vs. belt drive) on candidate MTVR replacement engine
- Reduce risk of future technology insertion by using M&S

Operational Impact/Benefit to the Warfighter:

- Enhance the fuel efficiency of the MTVR.
  - Resulting from this effort could be applicable to other Tactical Ground Vehicle (TGV) programs

TARDEC POM 13-17 Programs

Advanced Lubricants/Fluids Program

Goal:

- Provide innovative petroleum, oil, and lubricants products that:
  - Reduce logistic burden
  - Reduce maintenance requirements
  - Reduce fuel consumption
  - Meet new automotive technology requirements while exceeding future and legacy equipment performance and technical requirements

Operational Impact/Benefit to the Warfighter:

- Reduce sustainment footprint
- Reduce waste products and processing
- Increase equipment reliability and reduce maintenance
- Increase fuel economy to reduce the volume of fuel needed and extend platform range
- Enhance unit resilience in the face of uncertain energy situations
- Contributes to War fighter Outcome

Technologies to Enable Tactical Fuel Use

Goal:

- A variety of fuels are available worldwide and do not meet US specifications, which impacts performance, maintenance, and durability.

Operational Impact/Benefit to the Warfighter:

- Fieldable technologies that will allow use of available fuels with no impacts to performance, maintainability or durability.

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

SBIR Efforts

- PM MTVR is currently engaged in active SBIR efforts under the category **Engine Efficiency Enhancements**:
  - Diesel engine design resulting in potential increases in both fuel efficiency and low end torque. Combined with other technologies these efforts could represent significant strides in an attempt to reach DoD fuel economy targets.
  - Develop non-trivial retrofit engine technologies that can be adapted to an existing vast base of DoD diesel and gas driven platforms to significantly increase fuel efficiency. This does not require a new engine, rather it upgrades/retrofits to the existing engine (reducing costs).