

# TARDEC's Ground Vehicle Power and Energy Overview to Michigan Defense and Innovation Symposium



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

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# Report Documentation Page

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A major element of RDECOM and partner in the TACOM Life-Cycle Management Command:

- ***DoD's Ground Vehicle Center of Excellence***
- Provides ***full life-cycle engineering*** support provider-of-first-choice for ***all DOD*** ground combat and combat support weapons and vehicle systems.
- Develops and integrates ***the right technology solutions*** to improve Current Force effectiveness and provide superior capabilities for the Future Force.

Responsible for Research, Development and Engineering Support to **2,800** Army systems and many of the Army's and DOD's Top Joint Warfighter Development Programs

## Battlefield consumption of energy increasing

- New C4ISR technologies
- IED Defeat Systems
- New weapons (EM guns, lasers)

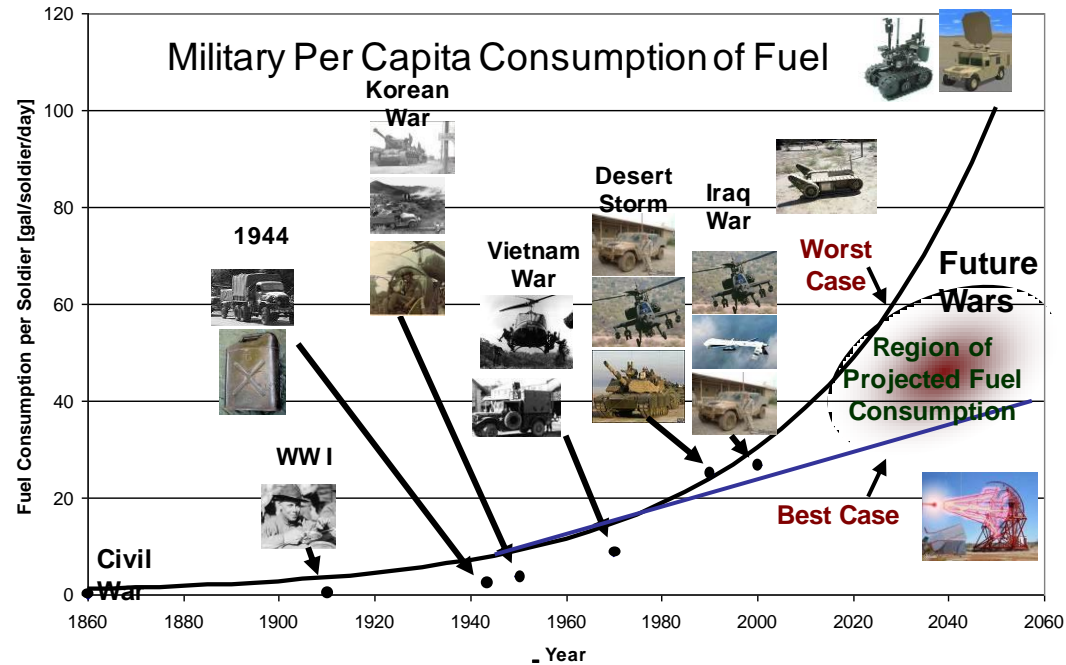
## Energy security problematic

- Cost of fuel skyrocketing
- Alternative sources sought – wind, solar, bio-mass, waste to energy

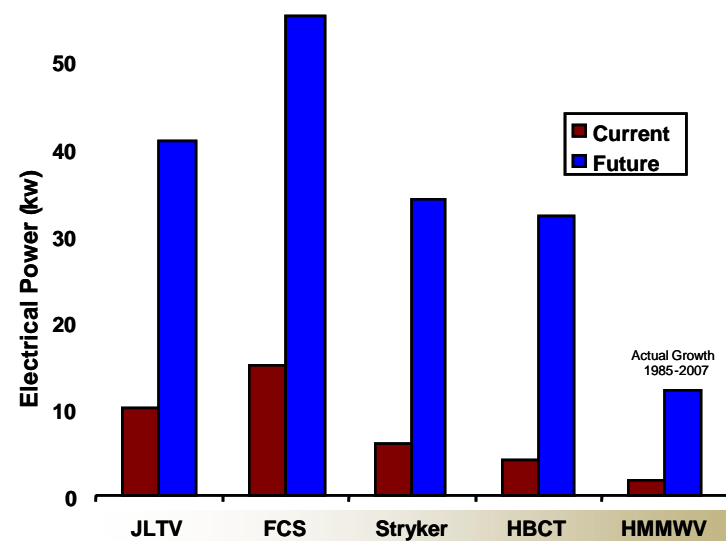
## Operational issues

- Battery usage & limitations – energy & power density
- Demand for auxiliary power on-board vehicles
- Emphasis on silent (“quiet”) watch
- Unmanned vehicles (air/ground)
- Unattended sensors
- Inefficient management/ distribution of power
- Demand for soldier-wearable power

## Increased emphasis on system power metrics and energy efficiency (KPPs, low consumption components)

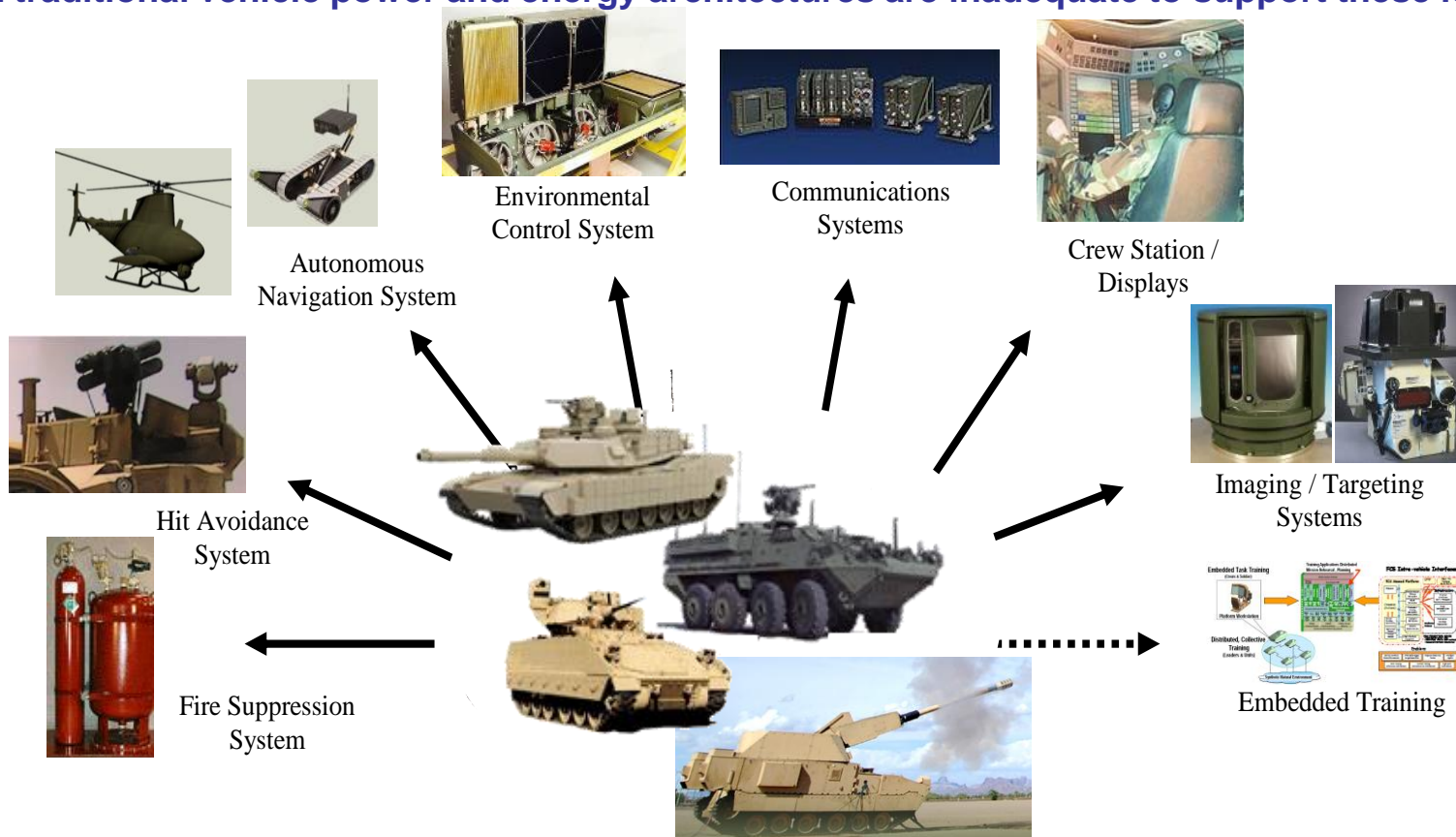


Estimated Electrical Power Growth



# Army Ground Vehicle Power and Energy Design Drivers

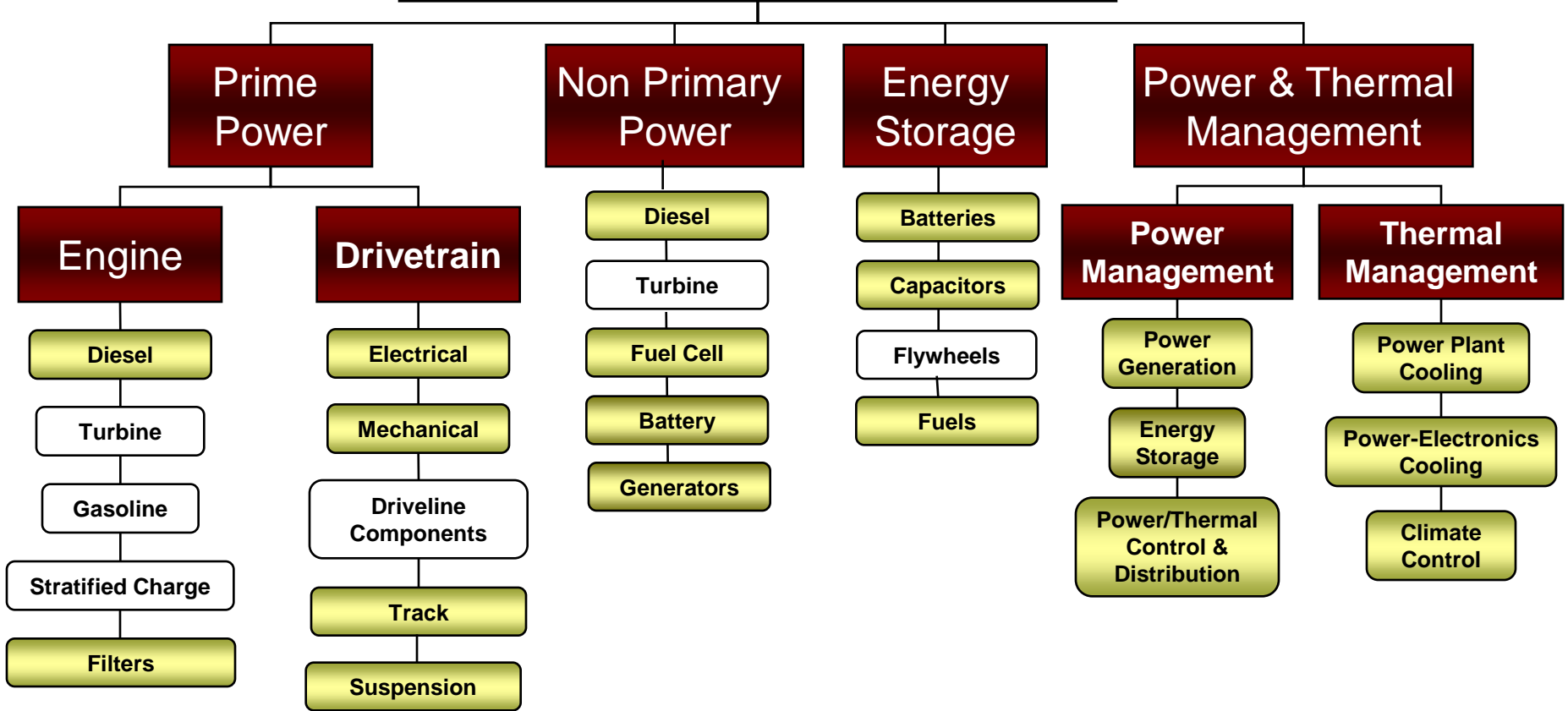
Advanced survivability, weapons and C4ISR equipment are driving vehicle power demands dramatically higher... traditional vehicle power and energy architectures are inadequate to support these loads.



The current force is modernizing to fight along side FCS bringing with it the tremendous power and thermal burdens associated with the advanced technology

As the Army transforms the Current to the Future Force, significant technical challenges in power and energy must be overcome to enable the Warfighter with its superior capability

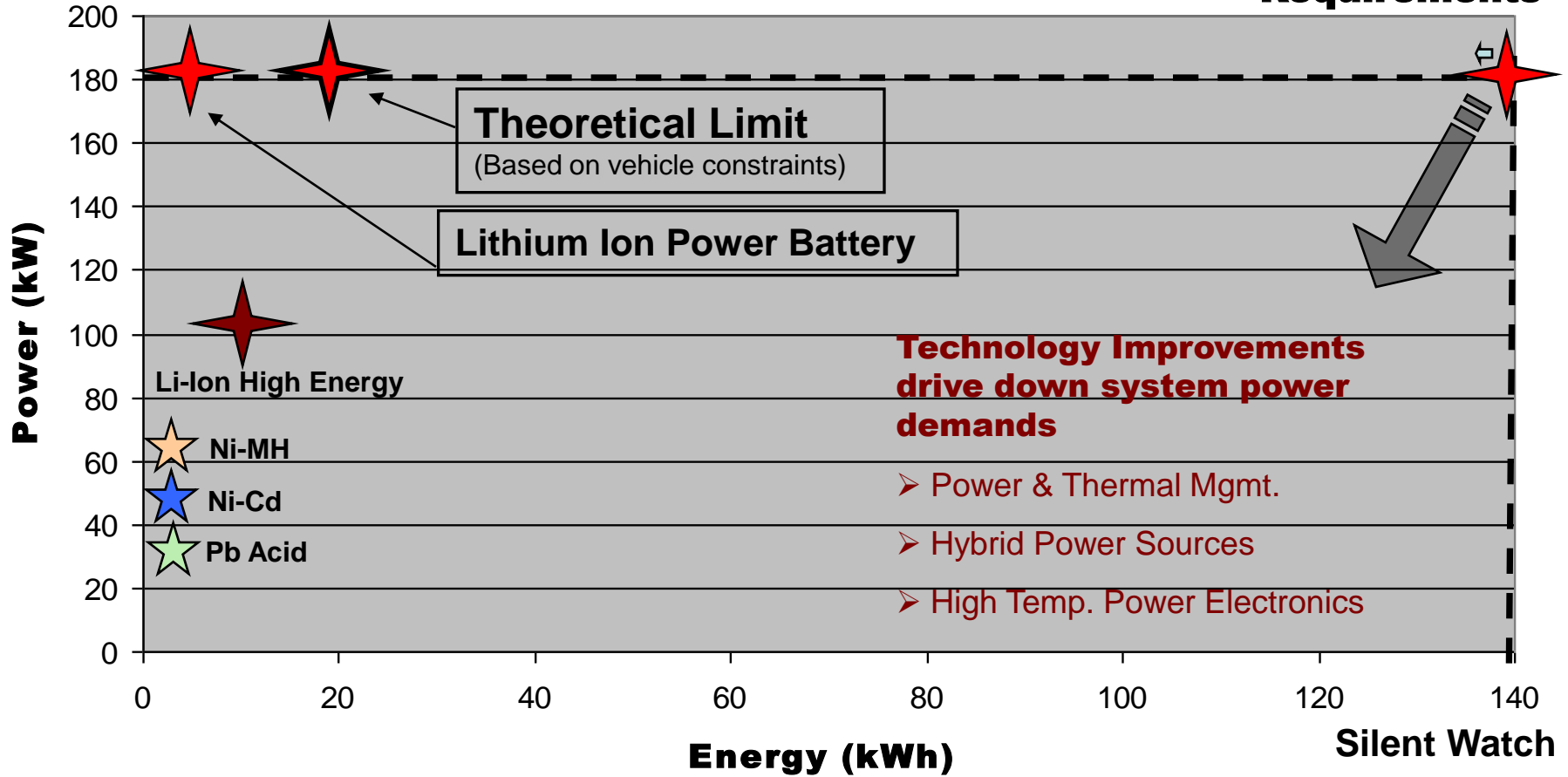
## Ground Vehicle Power and Energy



Peak Power

Energy vs. Power

Future System Requirements



- A holistic system level approach is required to achieve the future military ground vehicle power and energy requirements focusing both on reducing the power demand and improving the power and energy supply.
- TARDEC is strategically aligning their project portfolio to focus on these issues and provide the Warfighter with integrated technology solutions.



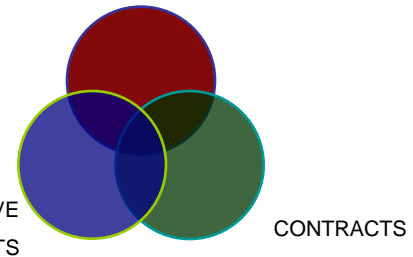


<http://contracting.tacom.army.mil/opportunity.htm>

Questions to answer before approaching TARDEC:

- What TRL is my technology at?
- Am I willing to disclose enough test data to make my case?
- Is there other funding that can be leveraged?
- Do I have other federal funding working this technology, and who are the POC's?
- Does my accounting system restrict what federal contracts I can be awarded?
- Do I qualify for special consideration? (Small business, woman / minority owned, 8A, hub zone...)

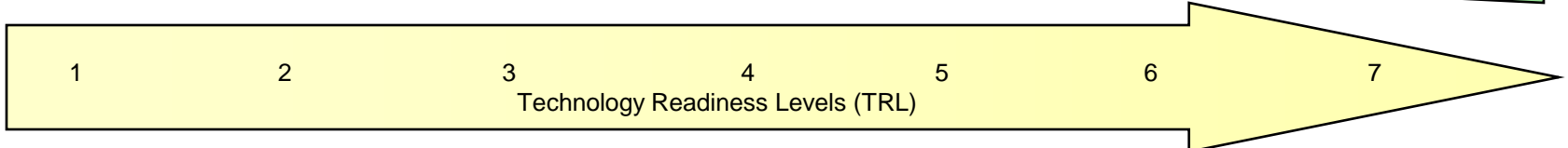
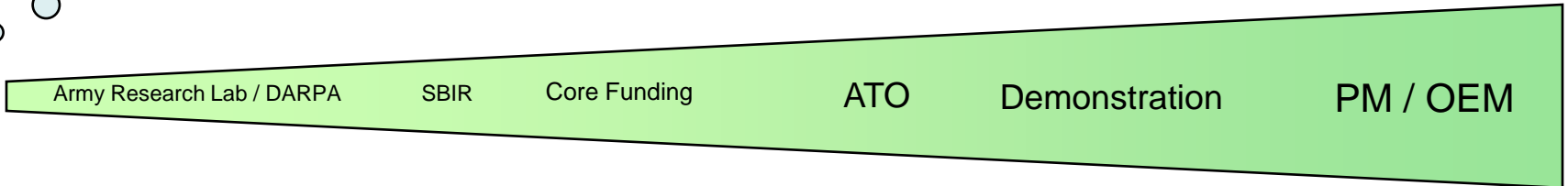
Federal employees do not sign NDA's because federal law carries **criminal** penalties for disclosure



Regulatory Guidance:

- FAR (Federal Acquisition Regulation)
- DFARS (Defense Federal Acquisition Regulation Supplement)
- DODGARS (DoD Grants and Regulatory System)
- ITAR (International Traffic in Arms Regulations)
- EAR (Export Administration Regulations)

Where do I enter the acquisition cycle?



# Back-Up

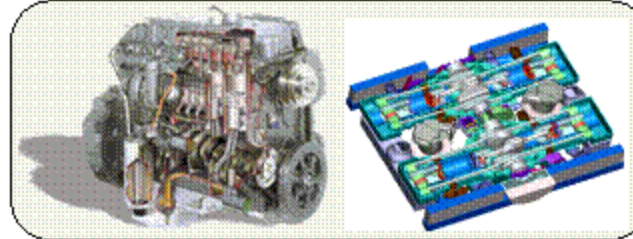
# TARDEC Ground Vehicle Power and Energy Interests

## Increase Power Management Automation and Optimization

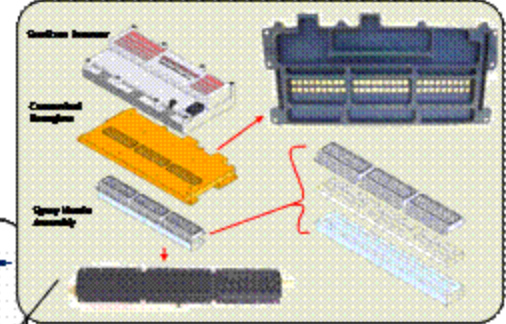
Operational Data	Power Management
Tactical Environment	<ul style="list-style-type: none"> <li>Selection of system applications</li> <li>Network status</li> <li>Selective power allocation across multiple vehicles</li> <li>Shared tracking among vehicles</li> <li>Increase Situational Awareness for Army leaders</li> </ul>
Mission Planning	<ul style="list-style-type: none"> <li>Minimum Crew Sizing</li> <li>Adapted Fuel Source Ch. based on Status, Modes, mission history and terrain input</li> <li>Vehicle Stability, Survivability, safety sensors</li> <li>Fuel Diagnostics, Fuel Management and Propulsion</li> <li>Fuel loading and unloading</li> <li>Monitor system efficiency</li> <li>Fuel Thermal Management (temperature, climate control)</li> </ul>
Training Exercises	
Platform State	<ul style="list-style-type: none"> <li>Reduced Crew Sizing</li> <li>Smart Automatic Load Control based on Status/Mode</li> <li>Monitoring energy storage, power generation, &amp; load, SOC</li> <li>Improved Diagnostic and Fault Management</li> <li>Smart Watch Based on energy storage/power demands</li> <li>Linked Thermal Mgmt (controls heat dissipation)</li> </ul>
System health info	
Mission Scenario	<ul style="list-style-type: none"> <li>Conditioning (ITN)</li> <li>Monitor &amp; Smart automatic Load Control (peak load, etc. limited)</li> <li>Linked Monitoring (system low voltage, current)</li> <li>Linked load detection and handling (power limit)</li> </ul>
Crew Feedback	
Crew Input	

Efficient use of Power Loads and Sources

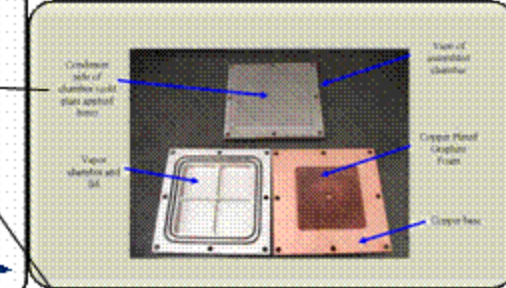
## Low Heat Rejection, High Power Density Engines



## Spray Cooling for Power Electronics



## Carbon Foam and Phase Change Cooling for Power Electronics

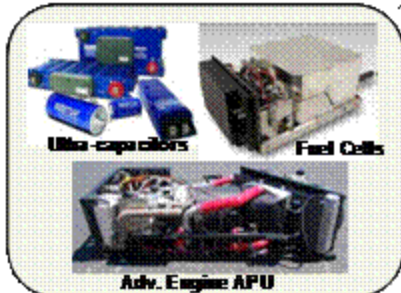


## Power Management Application Program Interface (PM API)

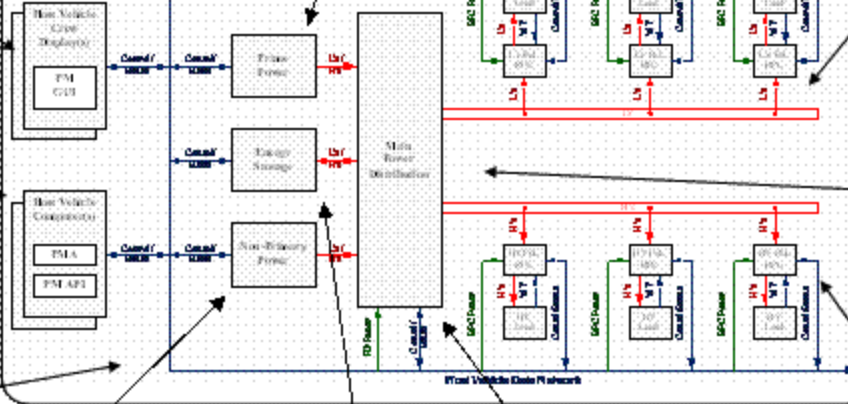
**GENERAL PERFORMANCE SPECIFICATION**  
**ROE ONE**  
**COMMON MODULAR POWER SYSTEM**

Approved: 01/04  
 Revised: 08/07

## Common Modular Power System (CMP S) General Performance Specification



Alternative Hybridized Non-primary



Advanced Chemistry Batteries



High Temperature Power Electronics



Remote Power Controllers (RPC)