



**RDECOM**



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

Army National Automotive Center



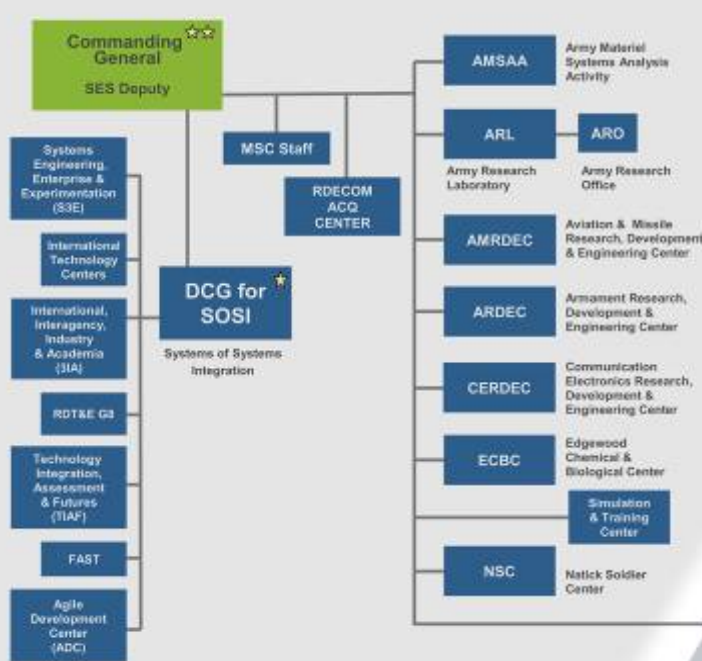
**Paul F. Skalny**  
Director

## Report Documentation Page

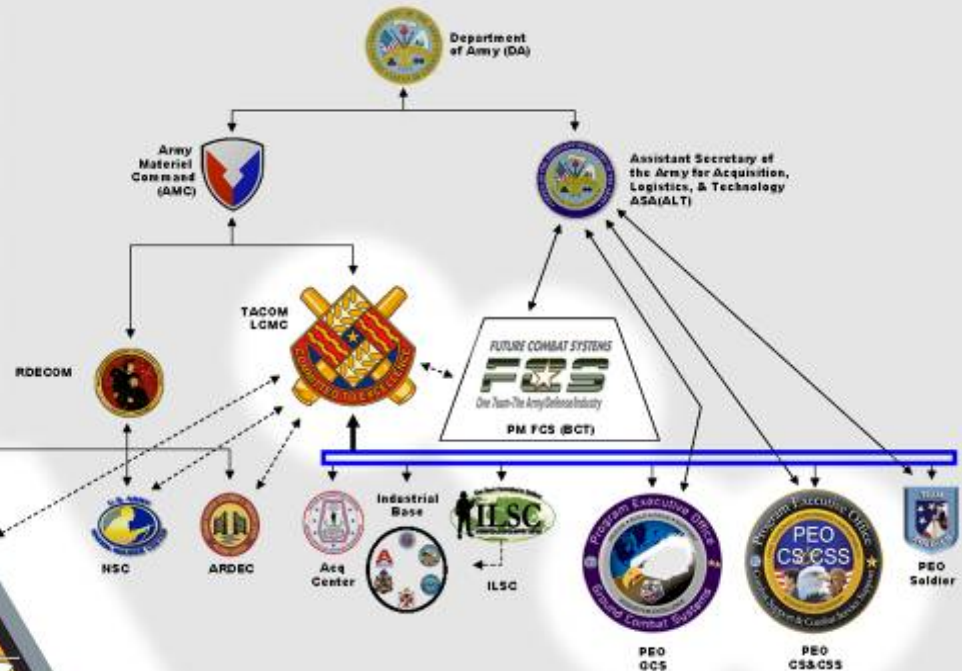
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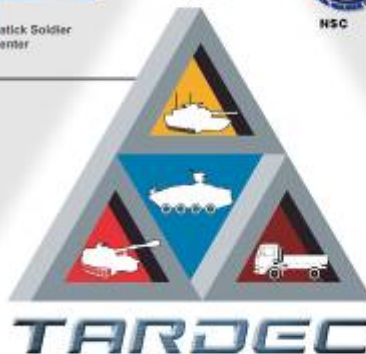
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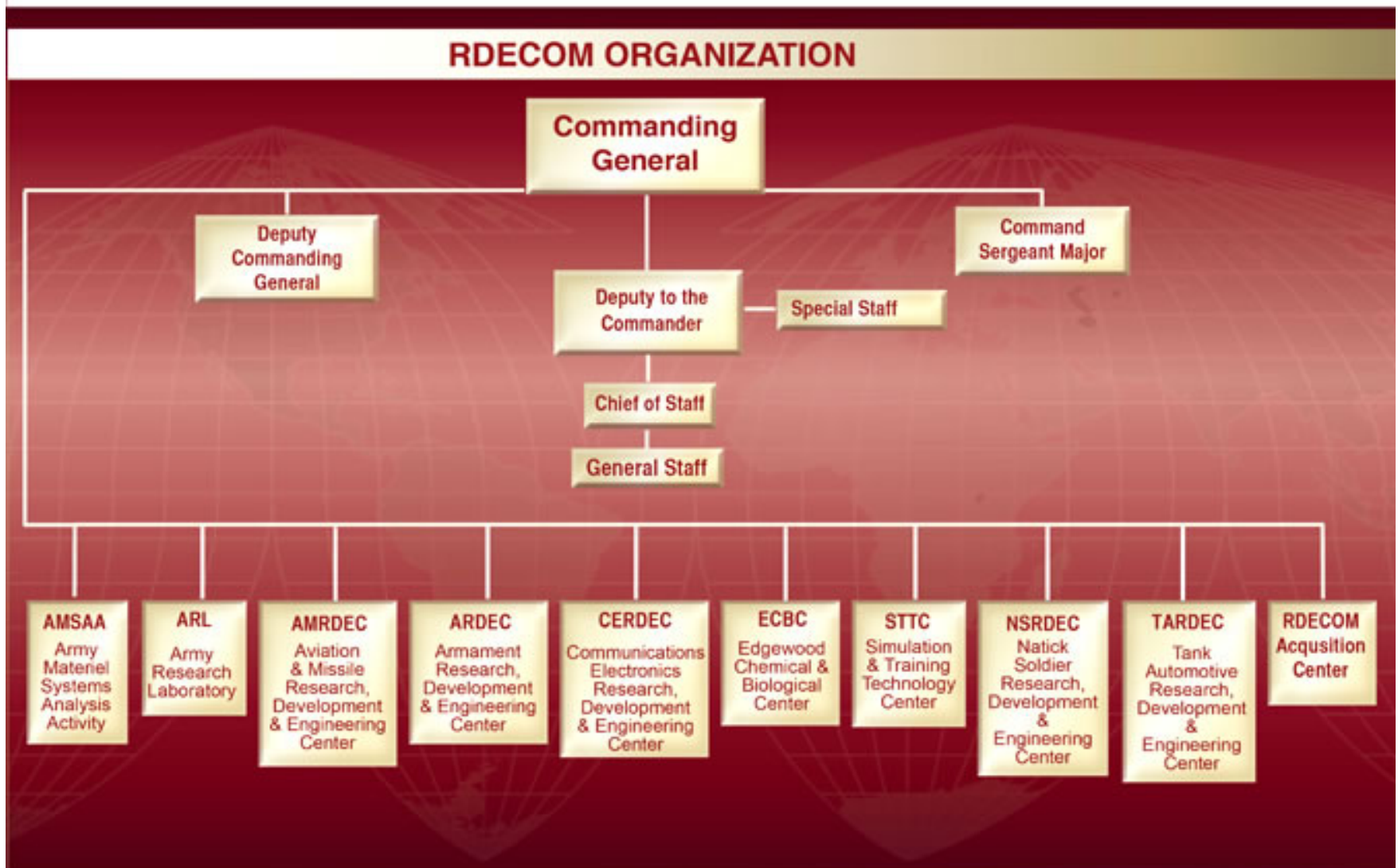


**Research, Development and Engineering Command**



**TACOM LCMC Enterprise**







**Heavy Tactical Vehicle**

**Medium Tactical Vehicle**

**Light Tactical Vehicle**

**Countermine Equipment**

**Combat Vehicles**



**MISSION:** Provide full service life cycle engineering support to our *TACOM LCMC customers (PEO GCS, PEO CS&CSS, ILSC) and PM FCS (BCT)*, to develop and integrate the right technology solutions to the effectiveness for the current force and realize the superior capability of the future force to facilitate army transformation.

**VISION:** Be the first choice of technology and engineering expertise for ground vehicle systems and support equipment - today and tomorrow.



**Trailers**



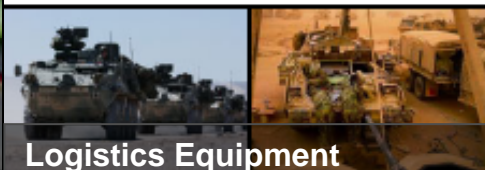
**Military Bridging**



**Water Generation and Purification**



**Fuel and Water Storage & Distribution Quality Surveillance Equipment**



**Logistics Equipment**



**Watercraft**



**TARDEC** is responsible for research, development and engineering support to more than **2800** Army systems and many of the Army's and DoD's top joint warfighter development programs:

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

## Strategic Thrusts

### Technology Focus Areas

- Power & Energy
- Unmanned Ground Vehicle Robotics
- Condition-Based Maintenance
- Survivability

### Budgeting & Contracting Execution

### Systems Engineering

### Workforce Development

### Leverage Automotive Community

Integrated Collaborative Work Environment Toolset

Integrated Business Processes

## Core Processes

### Strategic Planning

- Strategic Planning Process
- Portfolio Management
- Annual Operating Cycle
- Metrics Development & Tracking

### Program Development / Program Execution

- RDE Program Formulation & Execution
- Rapid Prototyping
- Technology Transition
- Program Review & Tracking
- Risk Management
- Quick Reaction Process

### Budgeting / Contracting / Execution

- Budget Planning
- Obligations/Budget Execution
- Procurement Process
- Congressional Adds Process

### Systems Engineering & Integration

- TARDEC SEP Development
- System Engineering & Integration Roadmap
- O and S Cost Reduction (VE/OSCR)
- Quality Assurance
- Lifecycle Data Management
- Systems Demonstrators & Integration
- Reliability and Maintenance
- Tech insertion
- Obsolescence Management (DMSMS)

### Workforce Development

- Training and Certification
- Leadership Development/Succession Planning
- Recruiting
- Human Capital Planning

### Outreach / In Reach

- Automotive Data, Assessment and Forecasting Process
- SBIR, CRADA Process
- Automotive Gap Analysis
- University Research Process
- Other Government Agencies/Other Services Processes

### Infrastructure

- Laboratory Planning

Leveraging the Automotive Community

## Power & Energy



- Thrusts and Investment Strategy
- Power & Energy Lab
- Connection to “Detroit 3”

## Robotics



- JC-UGV
- Safe Operations
- Soldier Interfaces
- Autonomous Control

## Survivability



- Corporate Survivability Strategy

## Condition Based Maintenance



- CBM Workshop
- Establishing Today’s Ground Vehicle CBM Requirements for Tomorrow’s Integration

## Prime Power

- Commercial engine optimization for fuel economy, lower heat rejection and operation heavy fuels
- High temperature/High power density hybrid components
- Hybrid vehicle testing and procedure development
- Lightweight track/elastomer research
- Improved suspension systems



FY09-15  
\$122M



## Pulsed Power

- High power density/high temperature switches
- High energy density capacitors



FY09-15  
\$121M

## Power and Thermal Management

- Waste heat recovery methods
- Nano-fluids research
- Power distribution and management architectures



FY09-15  
\$27M

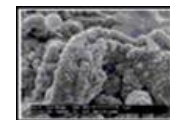


## Non Primary Power/Energy Storage

- 10+kw/JP-8 compatible power systems
- Small high power density engines
- JP-8 reformation technologies and advanced fuel cells
- High power and energy density advanced chemistry batteries



FY09-15  
\$142M



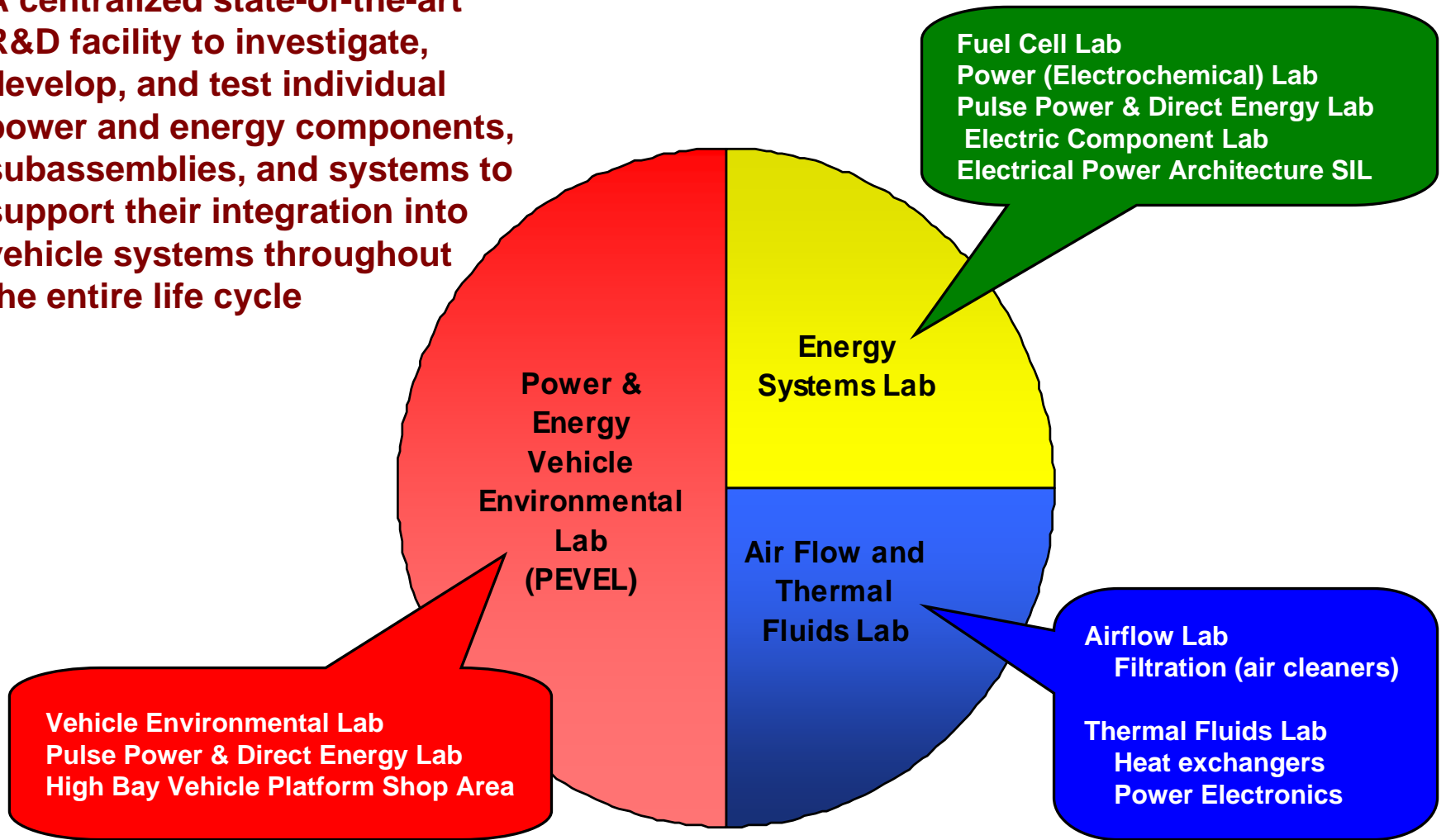
## Improved/Introduced Laboratories

- Upgraded & Relocated Air Filtration & Cooling  
System testing
- Upgraded & Relocated Electrochemical (Battery)  
Power Lab
- New Capability: Thermal Management Lab
- New Capability: Hydrogen/JP-8 Fuel Cell Reformation Lab
- Upgraded & Relocated Power Management SIL
- Upgraded Electric Component Lab
- New Capability: Multi-wheeled vehicle transient  
(mission profile) testing with fully controlled  
environmental capability from -60°F to +160°F
- New Capability: Pulse Power & Direct Energy Component & Integration Labs

## Push for “GREEN”

- TARDEC is guiding the design to maximize energy conservation and use of alternative energies, materials and other aspects of building design and sustainment.
- **Goal is to attain a minimum of Leadership in Energy and Environmental Design (LEED) silver self-certification**

**A centralized state-of-the-art R&D facility to investigate, develop, and test individual power and energy components, subassemblies, and systems to support their integration into vehicle systems throughout the entire life cycle**



## Building 212

### TEST CELLS

- Engine & Transmission endurance and performance testing
- Power Pack Full Load Cooling testing
- Advanced engine/fuel research
- Full Combat Vehicle testing, ambient to desert conditions, steady state operations
- Tactical Vehicle AC testing, ambient to desert conditions

- Small Electrical Components Lab with 250 kW AC dyno for motor/generator and converter/inverter testing
- Test Cell modified for Fuel Cell/Reformation demonstrations

- Continue operations with state-of-the-art test control and data acquisition **upgrades and infrastructure modernization**
- Advance **Combat Vehicle** testing to provide **transient (mission profile) capability**

## Building 200

### Electrical Power Architecture SIL

- Bench breadboard software/component capability

## New Energy Systems Laboratory

- **Upgraded Electrical Components Lab** with 350 kW AC dyno and load bank to include SiC/Silicon power electronics testing capability
- **New hydrogen/JP-8 reformation Fuel Cell Lab** for battlefield fuel reformation and 10-60 kW silent watch fuel cell RDT&E
- **New capability** to test and integrate high voltage/frequency chargers, high energy density capacitors, high current solid state switches and dc-dc converters into Pulse Forming Networks for vehicle application
- **Relocated and upgraded SIL capability** for efficient electrical power distribution and control strategy and architecture development, characterization, integration and test
- **Relocated and upgraded Electrochemical (Battery) Power Lab** to safely test/evaluate 10-60 kW advanced chemistry battery packs

## Building 7

### Battery Laboratory

- Outdated Cell and Module level limited capability

### Airflow Laboratory

- Air Filtration (no Abrams/BFVS/PLS/M88/HEMTT capability)
- Engine Radiator testing

## New Airflow and Thermal Fluids Laboratory

- **Relocated and 8X Upgraded** flow rate **Air Filtration Lab** for all vehicles, fully automated, to include self-cleaning scavenge systems
- **Relocated and 3X Upgraded** flow rate **radiator testing** capability
- **New calorimeter and Thermal Fluids Lab** for all vehicle thermal management (cooling) systems including power electronics

## New P&E Vehicle Environmental Laboratory (PEVEL)

### New Vehicle Environmental Laboratory

- 10 AC Dynamometers (2 for BFVS class combat vehicle and 8 for all tactical/wheeled vehicle torque/speed ratings)
- Environmental capability from -60°F to +160°F with variable wind, solar (desert) and humidity (global) control
- Transient cycle (mission profile) test capability for repeatable/controlled condition performance characterization, field failure root cause analysis and modeling and simulation validation data

**New Electrical Integration Laboratory** for subsystem/system level components integration, performance characterization and transient test/evaluation

**New Laboratory for network and system level integration of Pulse Power and Direct Energy** high voltage/frequency/density/current components performance characterization and transient condition test and evaluation



UNITED STATES ARMY

**NAC**

NATIONAL AUTOMOTIVE CENTER



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**



# U.S. Army National Automotive Center (NAC)



Chartered by Secretary of the Army 21 June 1993

**Mission:** *“The Center will serve as the Army focal point for the development of dual-use automotive technologies and their application to military ground vehicles. It will focus on facilitating joint efforts between industry, government and academia in basic research, collaboration, technology, industrial base development and professional development.”*

**“Leveraging Opportunities to Fill Technology Gaps.”**

“Accelerating the infusion of commercially viable technology into military land warfare systems”

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

## Army National Automotive Center

Automotive Technology	Collaborative Mechanisms & Partnerships	International Cooperative R&D & Special Initiatives
Power & Energy Technologies	Unsolicitations	International Cooperative R&D
Manufacturing & Mfg. Robotics Tech.	SOCOM	21 <sup>st</sup> Century Base Initiative
Vehicle Intelligence Technologies	National Guard, Reserve, HLS/HLD	Assured Fuels Initiative
Vehicle Subsystems Technologies	SBIRs, CRADAs & Outreach	Safety Technology Initiative
	ARC & Universities	
	Federal/State/Local/Congressional	
	Automotive Data, Assessment & Forecasting	

**ENTERPRISE INTEGRATION**  
National Automotive Center

**PRODUCT DEVELOPMENT**  
Fuels & Lubricants  
Technology

**RESEARCH**  
Ground Vehicle  
Power & Mobility

**Fuel Evaluations**

- Chemical composition
- Physical properties
- Fuel system impacts

**System Evaluations**

- Fuel-system interactions
- System performance and durability
- Fuel specification inputs
- Suitability of fuel for use in Army equipment

**Engine Evaluations**

- Fuel ignitability
- Fuel combustion
- Performance / durability

**Market Connection**

- Manufacturing technology
- Fuel data, samples
- Market drivers

**EMERGING ALTERNATIVE FUELS MARKET**

- DoD
- DoE
- Industry
- Academia
- Fuel Producers
- Equipment OEMs
- Other Government Agencies
- Standards Development Organizations



**Biomass Energy**  
(renewable)



**Fossil Energy**  
(large U.S. resource)

Diverse energy sources



- Various conversion processes
- Upgrading to jet/diesel fuel

Alternative jet/diesel fuels

- Proactively expand technical database on alternative fuels
- Engage in specifications development for alternative fuels
- Qualify/certify alternative fuels for use in Army tactical/combat equipment and systems



**TARDEC Assured Fuels Initiative**  
(formerly Joint Battlespace Use Fuel of the Future)

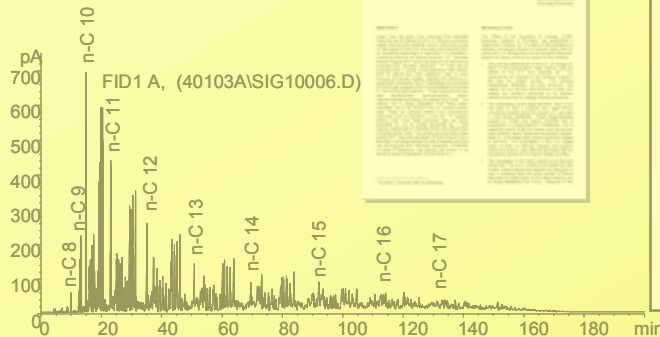
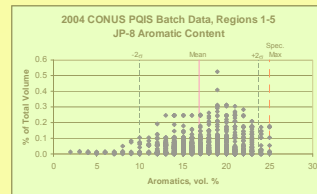
## Market Connection

- Industry / Academia / Educational Outreach**
- **Velocys: Microchannel Processing Technology for Synthetic Fuel Manufacturing**
  - **CFFS: Military Synthetic Fuels Research Program**
  - **NextEnergy / Wayne State Univ.: National Biofuel Energy Lab; Optimization of Multi-Fueled Gensets (Titan Energy) for Homeland Security**
  - **U of Detroit-Mercy: Michigan-Ohio University Transportation Center**
  - **FSSI: A Study of Bio-Based Fuels**
  - **DSC: Transportation Fuels Gallery**



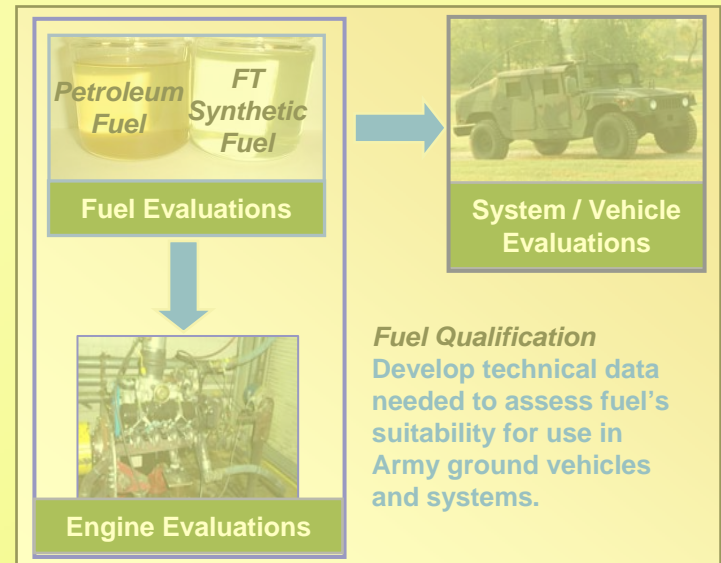
## Fuel Evaluations

- TARDEC Fuels & Lubricants Lab**
- Fuel Composition
  - Fuel Properties
  - Materials Compatibility
  - Synthetic Fuel Blends Study
  - Fuel Lubricity Improver Additive Detection Method
- TARDEC F&L Research Facility (TFLRF) at Southwest Research Institute (SwRI™)**
- Fuel Lubricity Database
  - Fuel Ignition Characteristics Database

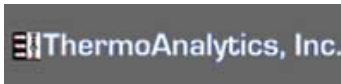


## Engine / System Evaluations

- TARDEC Propulsion Lab**
- Fuel Ignition Behavior
  - Engine Performance & Durability for Synthetic Fuel Blends
    - GEP 6.5L Turbo
    - CAT C7
    - DDC 8V92-TA
    - Cummins 903
- TFLRF at SwRI**
- Engine Emissions Data
  - Military Genset (10 kW) Performance for Synthetic Fuel Blends
  - CAT C7 Engine Performance & Durability for Fully Synthetic Fuel
  - TWV Test Track Performance for Synthetic Fuel Blends
  - TWV Pilot Field Demo of Synthetic Fuel Blends



**Fuel Qualification**  
Develop technical data needed to assess fuel's suitability for use in Army ground vehicles and systems.







## POWER & ENERGY

- Low Temp. Vehicle Performance Research
- University & Industry Research Centers, Automotive Research Center
- NAC University Automotive Coalitions
- Advanced Digital Hydraulic Hybrid Drive System
- Automotive Research Equipment Purchase
- Development of Logistical Fuel Processors to Meet Army/TARDEC/TACOM Needs
- Digital Engine Hydraulic Valve Actuation
- DoD Hydrogen PEM Fuel Cell Medium/Heavy Duty Vehicle Demonstration Program
- Hydraulic Hybrids, Advanced Material, & Multi-fuel Engine Research (HAMMER) program
- Light Utility Vehicle
- Military Fuel Research
- 3-D Advance Battery Technology
- Advanced Lithium Iron Phosphate Battery System for Army Combat Hybrid HMMWV & Other Army Vehicle Platforms
- Advanced Digital Hydraulic Hybrid Drive System
- Army Fuel Cell Non-Tactical Vehicle Propulsion
- Auxiliary Power Unit (APU) for the Abrams M1/A2 Tank
- Defect-Free Commercially Viable Si/C Semiconductor Using Superlattice Technology
- Diesel Hybrid-Electric Utility Vehicles
- Field Deployable Fleet Hydrogen Fueling
- Fuel Cell Cost Reduction Research
- High Speed Diesel Combustion
- Hydraulic Hybrid Vehicles (HHV) for the Tactical Wheeled Fleet
- Military Hybrid Engine Development Program (SASC Title) Hybrid Engine Development Program for Tactical Wheeled Vehicle Fleet (SAC Title)
- Novel On-board Hydrogen Storage System Development / Solid Hydrogen Engine Development Program
- On-board Vehicle Power Management
- Special Operations Vehicle-Lightweight, Armored, Hybrid, Power Generating, Tactical Vehicle

## CONDITIONED BASED MAINTENANCE

- Advanced Thermal & Oil Management System
- Advanced Thermal Management System
- Vehicle Maintenance & Prognostics System

## SURVIVABILITY

- Nano-engineered Multi-functional Transparent Armor
- Quick Reaction Advanced Tactical Vehicle Technology
- Rapid Up-Armor Synthesis & Crashworthiness Design for Improved Soldier Survivability
- Active Protection Systems for the Joint Light Tactical Vehicle
- Advanced Lightweight Composite Armor
- Armor Ready Composite Cab Transition
- Antiballistic Windshield Armor
- Antiballistic Windshield Armor Project
- Crosshairs Hostile Fire Indicating System
- Enhanced Directed Armor RPG Vehicle Protection System
- High Performance Aluminum Structures and Components
- Light Weight Structural Composite Armor for Blast & Ballistic Protection
- Tactical Wheeled Vehicle Structures Survivability & Performance
- Tactical Rocket Propelled Grenade Airbag Protection System (TRAPS) Enhancement
- Vehicle Armor Structure Development & Testing for Future Combat Systems & Joint Light Tactical Vehicle
- Full Spectrum Close in Layered (FCLAS) for Thin Skinned

## MANUFACTURING

- Advanced Manufacture of Lightweight Materials and Components
- Extreme-Condition Vehicle Tribology for Military Vehicle Technology at Northwest University
- Global Accessible Manufacturing & Maintenance Activity (GAMMA)
- Institute for Advanced Materials & Manufacturing Strategies (IAMMS)
- Spring-Suspended Airless Tires for Convoy Protection
- Tactical Metal Fabrication
- Advanced Composites Development for Light Weight Low Cost Transportation Systems Using 3+ Extruder
- Diminishing Manufacturing Sources & Material Support
- Fastening & Joining Research
- High Strength Powder Metal Gears for Vehicle Transmissions
- Improved HMMWV Tactical Shelter Project
- Military Interstate Truck Component Weight Reduction Program
- Next Generation Manufacturing Technologies for Defense Supply Chain
- Tactical Wheeled Vehicle Composite Component Weight Reduction Program

## ROBOTICS

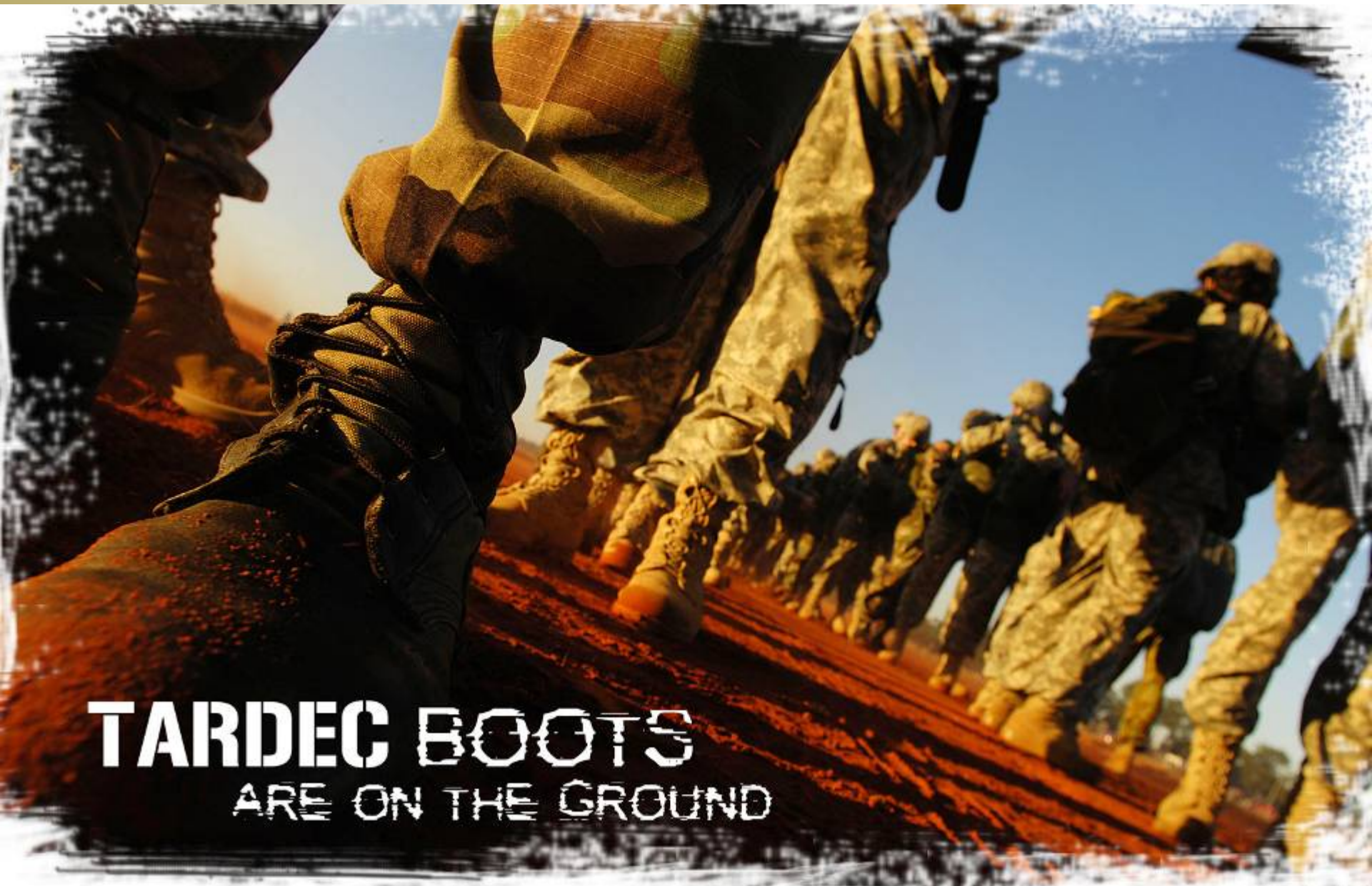
- National Institute for Legged Mobility
- Unmanned Ground Vehicle Initiative
- Passive Walking Beam Tracked Platform for Unmanned Ground Vehicles

## MODELING & SIMULATION

- Center for Advanced Vehicle Design & Simulations
- Center for Military Vehicle Technology
- LEAN Digital Production Development
- Network Reliability & Safety Early Evaluation System (NRSEES)
- Vehicle Design Optimization Tools

## OTHER

- Skypure – Water from Air
- Secure Mobile MANET System
- Battlefield Requirements Management Support System
- Center for Tribology & Coatings
- Ground Forces Readiness Enabler for Advanced Tactical Vehicles (GREAT V)
- Liquid Desiccant-Based Atmospheric Water Generation without Reverse Osmosis
- No Idle System (NIS)
- Secure On-the-Move Information Analysis & Control for Advanced Combat Vehicles
- Vehicle Information Manger Display for Drivers (VMID)



**TARDEC BOOTS**  
ARE ON THE GROUND