



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

## National Automotive Center (NAC) Overview & Green Technology Initiatives

Visit by Agency for Defense Development, South Korea

Mr. Paul F. Skalny, Director, National Automotive Center

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## Report Documentation Page

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**Chartered by Secretary of the Army 21 June 1993**

The background features a large, semi-transparent watermark of the National Automotive Center (NAC) logo. The logo is an oval shape containing the text 'RDECOM' and 'TARDEC' at the top, 'NAC' in large green letters in the center, and 'NATIONAL AUTOMOTIVE CENTER' at the bottom. The entire logo is set against a background of vertical lines.

*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.”*

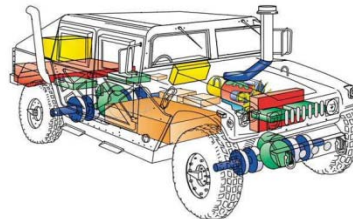
**“Leveraging Opportunities to Fill Technology Gaps.”**

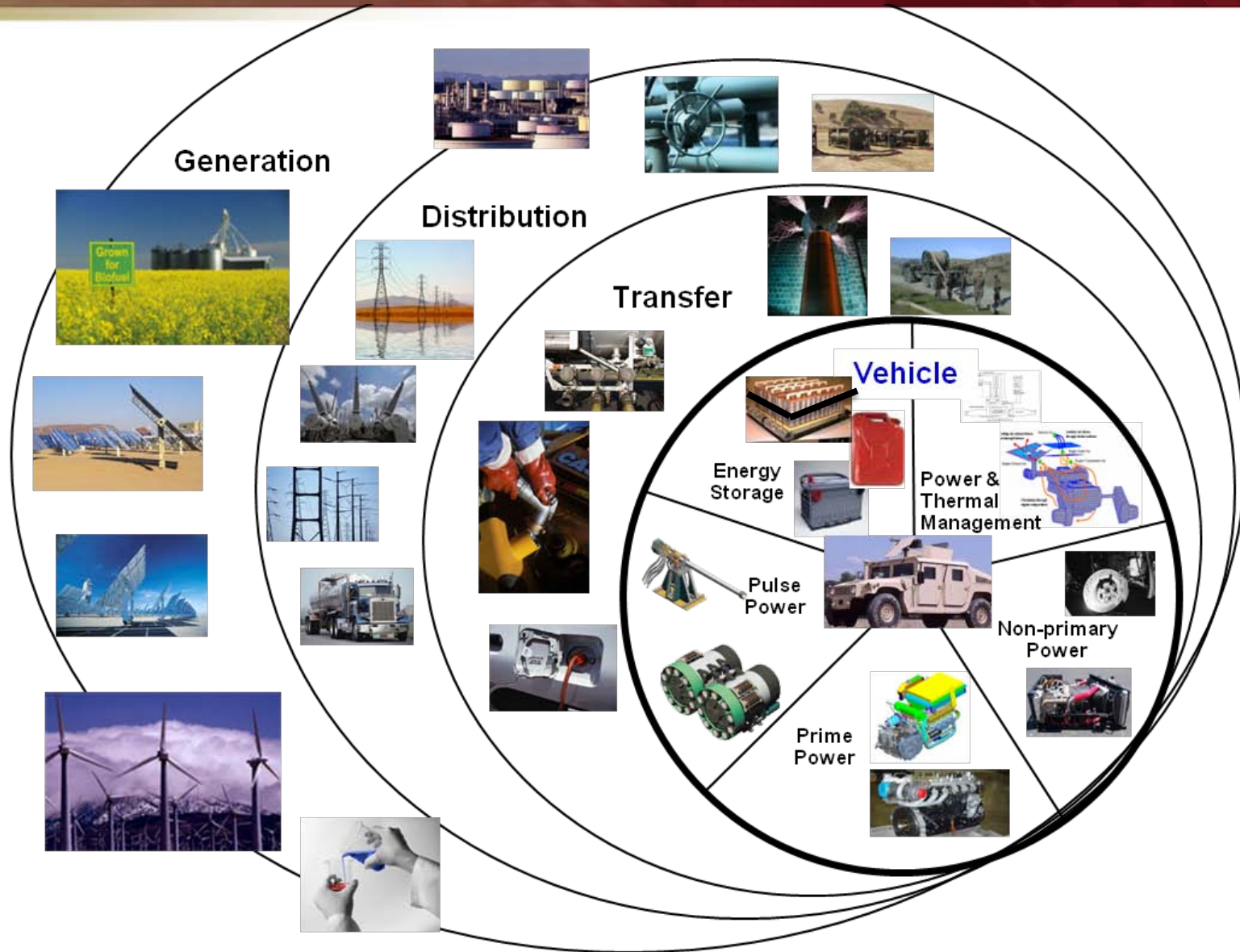
**“Accelerating the infusion of commercially viable technology into military land warfare systems”**

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## Strategic Energy Security Goals (ESGs)

- ESG 1:** Reduced energy consumption.
- ESG 2:** Ensuring resilience in energy systems.
- ESG 3:** Increased use of renewable/alternative energy.
- ESG 4:** Assured access to sufficient energy supplies.
- ESG 5:** Reduced adverse impacts on the environment.





## Developmental Platforms

### Commerical Product Conversion

- PHEV conversion for this program
- Modeled in Task 1 Simulations
- Testing of actual conversion used to refine simulations



### Commerical PHEV

- Currently a concept prototype (CP1)
- Modeled in Task 1 Simulations
- Updated model based on refined simulations



## Powertrain Architecture

- Parallel thru the road Hybrid architecture for transport vehicles
- Vehicle to Grid (V2G) capability



## Battery Pack

- 10.6 kWh battery using iron phosphate prismatic cells
- 24 cells (14.5 ahr each) per module that are electrically connected in series
- Ten modules in (10S 1P) arrangement to create the vehicle battery pack



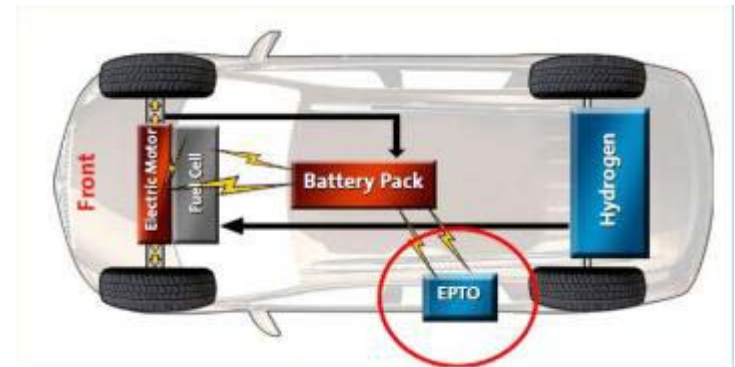
## V2G Capability

- Standby power has been demonstrated using various loads.
- Grid tie capability has been demonstrated through bi-directional connection to a 240v outlet.

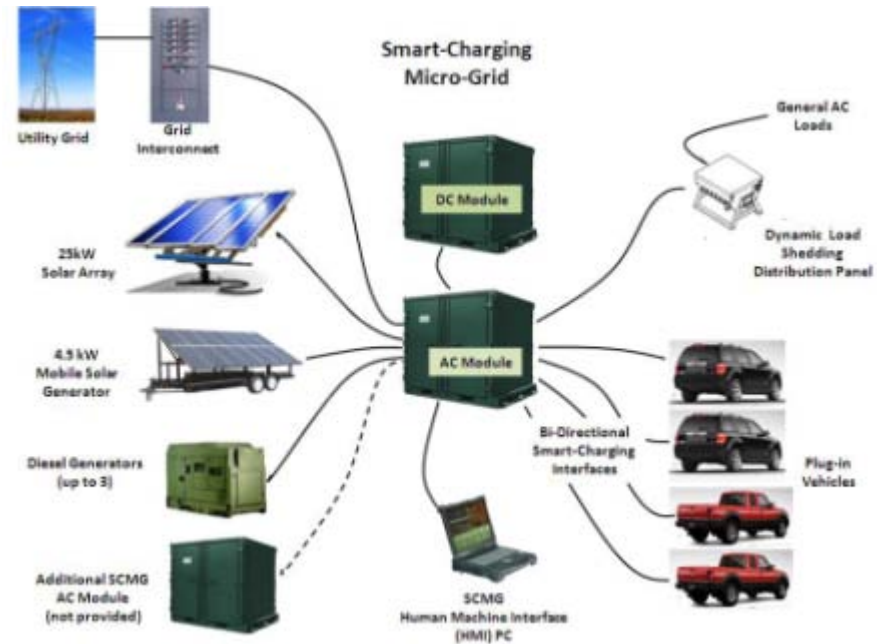


## **GMT101X EPTO Demonstration Output Specifications:**

- Outputs are intended to simulate common household/industrial 120/240Vac power
- Outputs specifications:
  - 120Vac @ 15 Amps RMS
  - 120 / 240Vac @ 50 Amps RMS
  - 240Vac @ 100 Amps RMS
- Power
  - Continuous total load 25kW Max
  - Peak total load 40kW max for 0.5 sec
- GM working with Honeywell on linking the FCV-EPTO to their microgrid



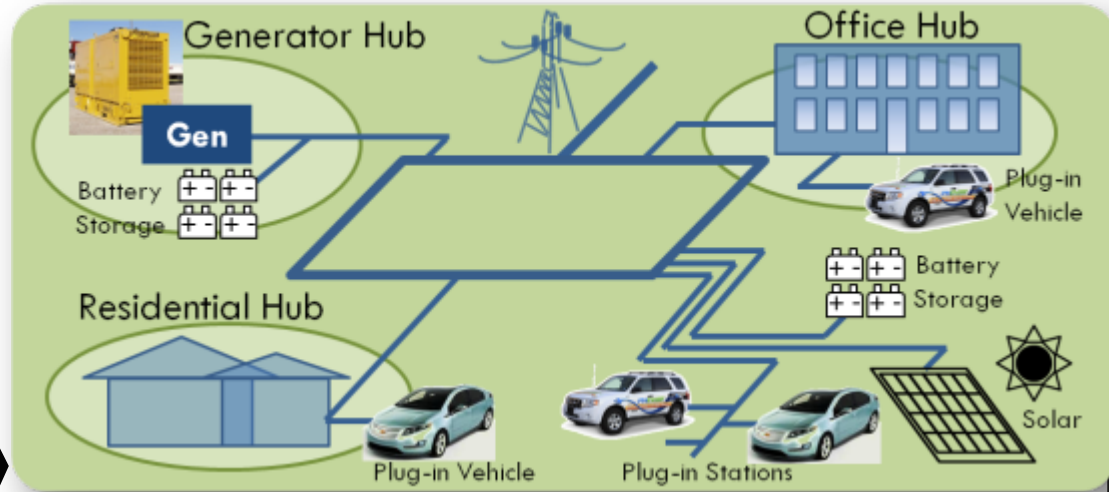
- **Installation of microgrid at Schofield Barracks, tied to critical infrastructure**
  - Photovoltaic array
  - Dedicated electric vehicle charging
  - Grid connected
  - Conventional generator for extended backup power
  - Advanced stationary energy storage
  - Load management
- **AC architecture**
- **Microgrid scheduled to be operational in November 2010**
- **Data collection and operational support for one year**



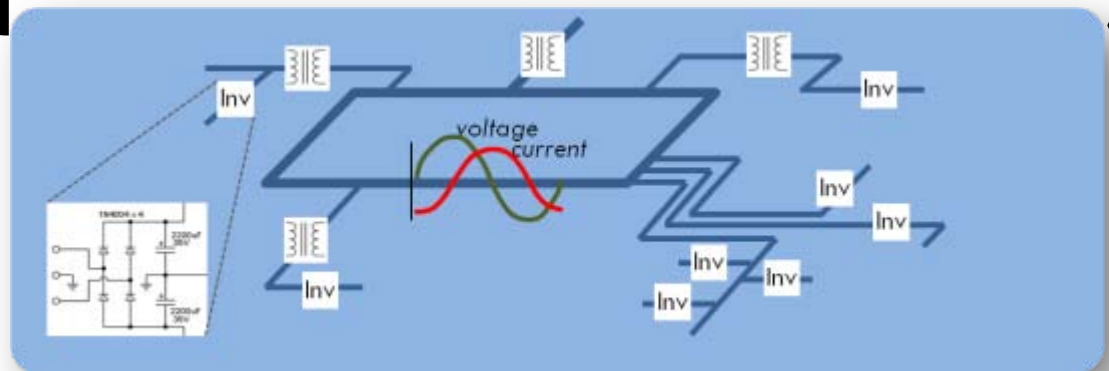
Decide the optimal number, size, and scheduling of microgrid components (generation, storage) and number and scheduling of vehicles to support the electrical loads of the base.

- There is recent research on optimal sizing of microgrids and optimal scheduling of microgrids, as well as V2G control
- Combined design and scheduling has not been studied
- Addition of random vehicle behavior has not been studied, nor potential to control vehicle connection/disconnection from microgrid

**Design & Scheduling:** centralized control, long time scales



*[system stability & transient effects]*    *[system design & operation]*



**Regulation:** decentralized control, short time scales

- 10 year, Army (TARDEC) funded, contractor managed program
- Major fleet users, all truck makers and suppliers involved\
- Harmonized needs – aggregated demand
- Has spurred:
  - rapid, early demonstration and production
  - expanded hybrid manufacturing capability
  - seeded military needs in commercial designs
  - cost-effectively validated system performance

Reduced Commercialization - 2 years



ARMY ENERGY SECURITY  
IMPLEMENTATION STRATEGY



January 13, 2009

The Army Senior Energy Council  
and the

Office of the Deputy Assistant Secretary of the Army for  
Energy and Partnerships  
Washington, D.C. 20301-3140

## Strategic Energy Security Goal 3

### Increased Use of Renewable / Alternative Energy

### Objective 3.3

Transition from fossil fuel based tactical mobility/power generation to renewable and alternative energy/sources.



AR 5-5 Study

#### Tactical Fuel and Energy Implementation Plan

Contract Number: W91QF5-09-P-0193

24 September 2010

Prepared for  
U.S. Army Substantive Center of Excellence  
2221 A Ave  
Fort Lee, VA 23801-1809



Prepared by  
Expeditionary Logistics, Inc.  
13003 North Enon Church Road, B Wing  
Chester, Virginia 23036

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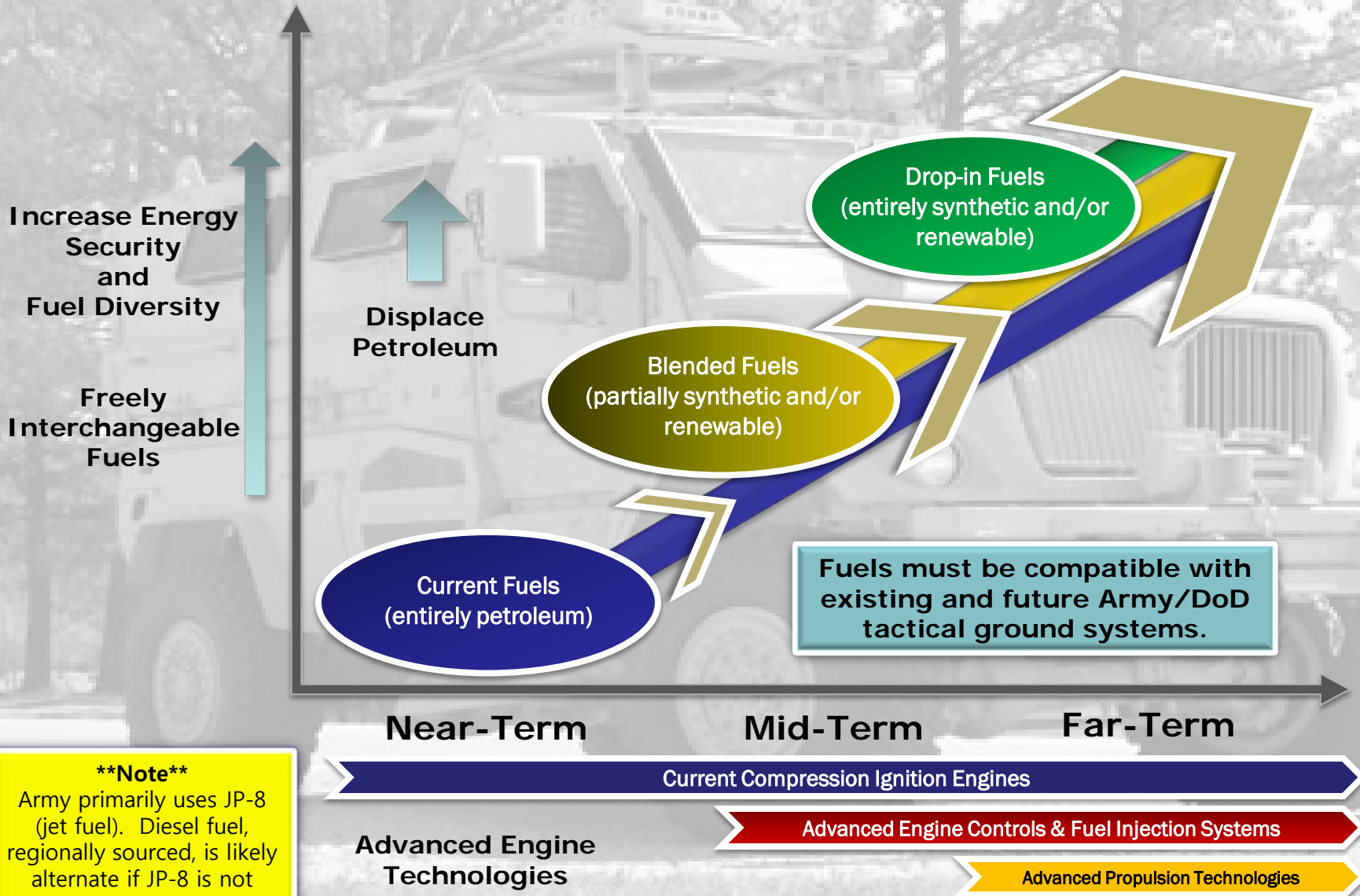
By 2028, 50% of the fuel requirement in the training base for the tactical mobility fleet (surface and air) is met by alternative fuel blends.

- Intended outcomes focused on integrating the use of alternative fuels in vehicle and aircraft engines in the training base
- Percent of fuel requirement met by alternative fuel blends:

15% by FY18

30% by FY23

50% by FY28



**\*\*Note\*\***  
 Army primarily uses JP-8 (jet fuel). Diesel fuel, regionally sourced, is likely alternate if JP-8 is not available or accessible.

## EMERGING ALTERNATIVE FUELS MARKET

- DOD
- DOE
- Industry
- Academia
- Fuel Producers
- Equipment OEMs
- Other Government Agencies
- Standards Development Organizations



## Market Connection

- Fuels: process technology, data, test volumes
- Engines: combustion/fuel injection technology
- Market: regulations, policies, initiatives

Develop fuel specifications and qualify new fuels to ensure their suitability for use in ground equipment.

Develop engines more adaptable to changes in fuel quality/supply.

## Fuel / Component Evaluations

- Chemical composition
- Physical properties
- Component performance / durability

## Engine Evaluations

- Fuel ignitability
- Fuel combustion
- Performance / durability

## System Evaluations

- Operability
- Performance
- Demonstrations

Fuel Qualification Process for approval of new fuels

Self-adjusting engine operation with changes in fuel quality to maintain desired engine performance



Wayne State University Photo courtesy of N. A. Henein, WSU

Acceptance of alternative fuels for use in ground vehicles/equipment.



# BACK-UPS



- Two alternative fuels for which evaluations are being completed to assess their impacts on tactical ground systems
  - **Blends** of JP-8 and up to 50% by volume of
    - Fischer-Tropsch Synthetic Paraffinic Kerosene (FT SPK)
    - Hydroprocessed Renewable Jet (HRJ)
  - Both products (FT SPK and HRJ) are very similar compositionally
    - Resultant properties are very similar
    - Evaluations thus conducted using one of these blends will be representative of evaluations for the other by similarity
  - Evaluations are conducted using nominal 50%:50% volumetric blends
  - Blends are meant to be “**drop-in**” fuels
    - Meets fuel performance requirements (in spec)
    - Requires no change to vehicles/equipment
    - Requires no change to infrastructure
    - Can be mixed or alternated with petroleum-derived fuel



**Biomass Feedstock  
(renewables)**



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



**Petroleum Crude Oil**

(increasingly difficult discovery and unfriendly-nation production)



- Various conversion processes dependent on feedstock
- Product meeting commercial and/or military specifications
- Specs evolving to address alternatively sourced hydrocarbons



## Jet Fuel

- ASTM D1655: conventional jet fuel
- ASTM D7566: blends of synthetic kerosene with conv. jet fuel
- MIL-DTL-83133: JP-8, also blends of synthetic kerosene with JP-8

## Diesel Fuel

- ASTM D975: up to 5% v. FAME biodiesel (B100) allowed in diesel fuel
- ASTM D6751: B100 spec
- ASTM D7467: blends of 6%-20% v. FAME biodiesel (B100) with diesel

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