U.S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Fuel Cell Vehicle and Hydrogen Storage and Distribution Update

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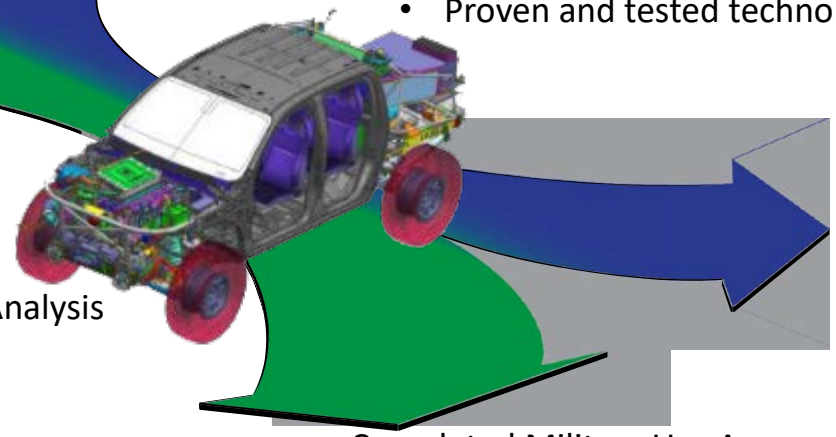
Distribution Statement A: Approved for Public Release

TARDEC/GM Fuel Cell Public/Private Partnership

- >$4B in Fuel Cell Technology Investment
- Decades of Fuel Cell Technology Advancement
- Economy of Scale with Commercial Applications
- Rapid Development Expertise; nine months from design to build
- Proven and tested technology

Army Mobility Tech Authority
- Off-road requirements
- Severe mobility testing

In House Performance Modeling and Analysis

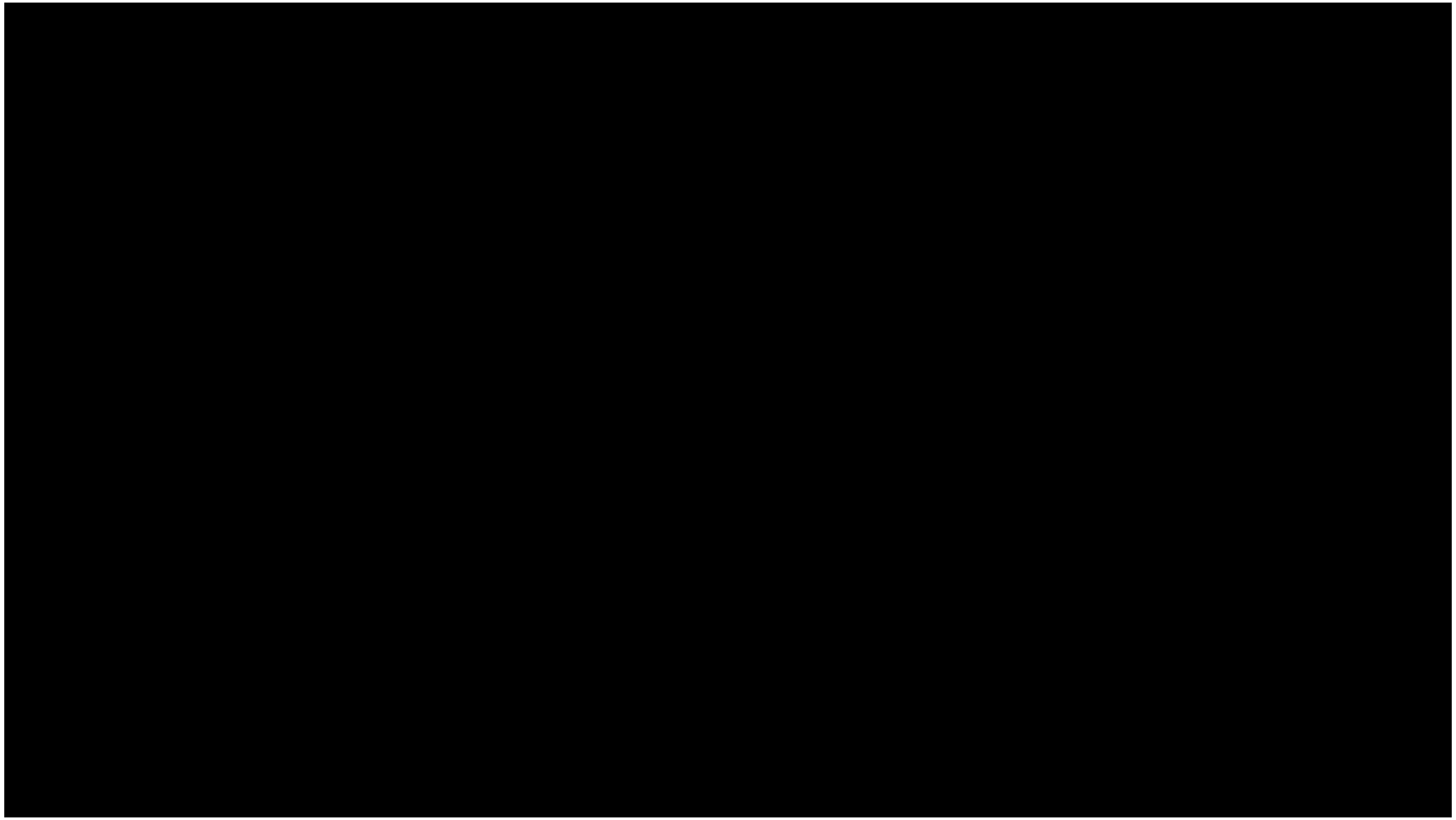


Completed Military Use Assessments:
- Demonstrated utility of fuel cell technology (Eglin AFB; Ft Carson, CO; Ft Bragg, NC; Schofield Barracks, HI)
- Completed Survivability testing of H2 tanks
- Conducted Vehicle Thermal / Acoustic Analysis
- Provided Mobile Export Power

Knowledge Sharing with Industry:
- Detailed military usage profiles (drive cycles, power consumption)
- Experience with commercial vehicle prototyping processes

Mobility	Signature Management	Exportable Power	Water Generation

ZH2 Soldier Evaluation



Fuel Cells Today

- The number and type of military applications for fuel cells will grow over time based upon progression in three areas:
  - Fuel Cell technology power density
  - On-board H2 storage technology
  - H2 production, storage, and distribution technology

- While fuel cell technology has shown many operational benefits, the production, storage, and distribution of H2 in the battlefield remains a significant barrier to entry.

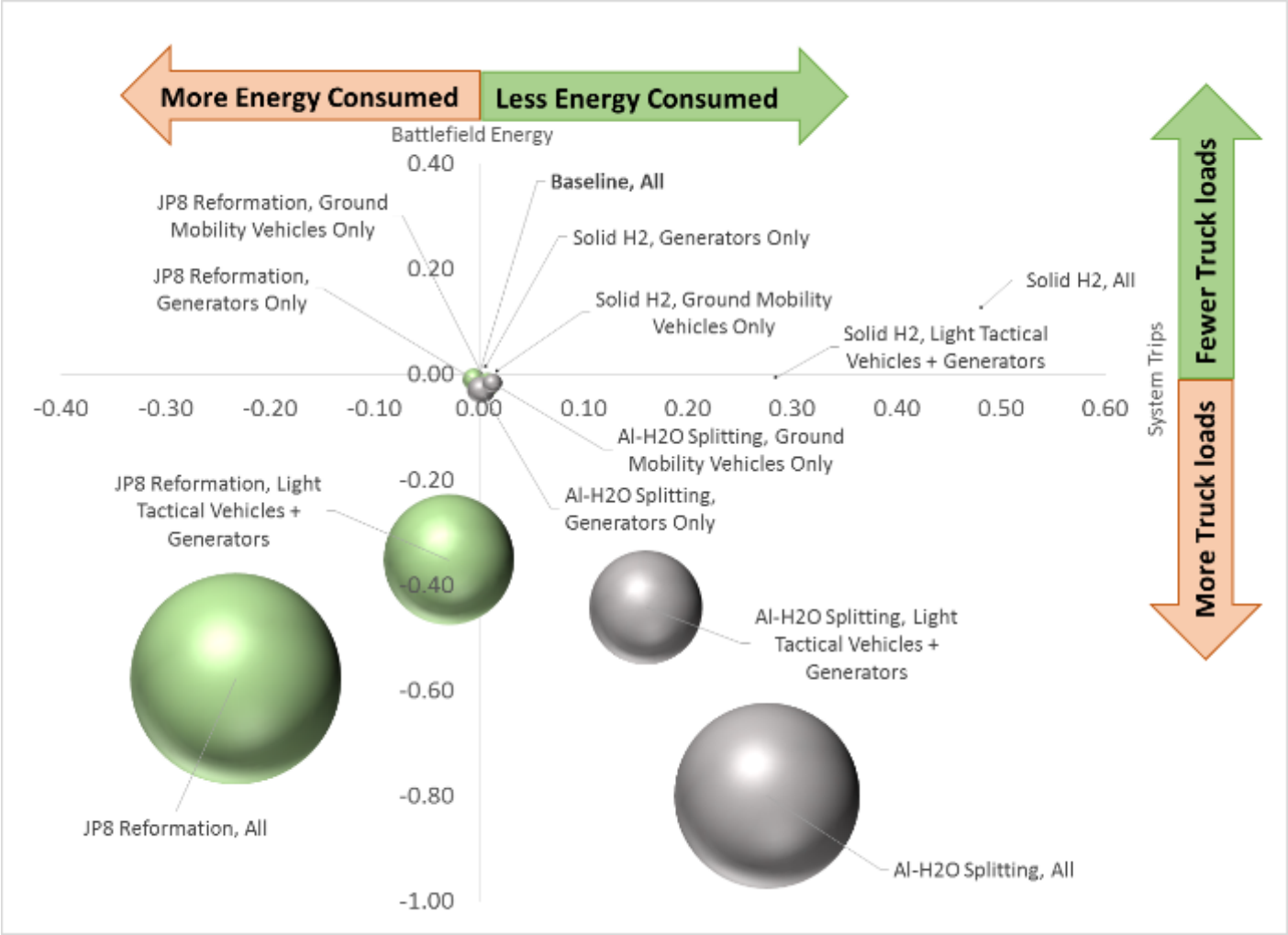
- Leveraging commercially developed technologies as stepping stones for hydrogen growth allows TARDEC to focus on H2 logistics and sustainment.

Toyota Mirai

Nikola One Semi Truck

All Electric Tank

Energy Consumption vs Convoy System Trips Using the Joint Operational Energy Initiative (JOEI) Toolkit



- Bubble size is determined by quantity of additional support equipment needed.
- Solid H2 requires no additional support equipment
- For smaller applications, logistics burden is minimal
- Full brigade adoption requires high density hydrogen storage, such as Solid H2

Fuel Cell technology can reduce the energy consumed on the battlefield and logistics analysis indicates high density H2 storage is required.

Why? Energy of Transported Fuels

"How many trucks to replace one JP8 tanker, all factors considered?"

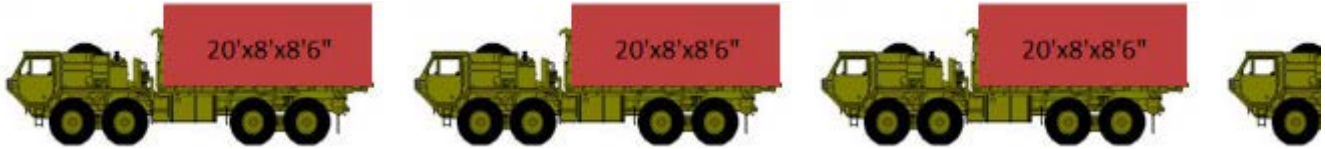
JP8
(Baseline, TRL 9)

Solid or Liquid Hydrogen Options
(TRL 4-7)

JP8 + H2O Reformation
(TRL 6-7)

Aluminum Water Splitting
(TRL 4)

Automotive Compressed Gas Hydrogen
(TRL 7)

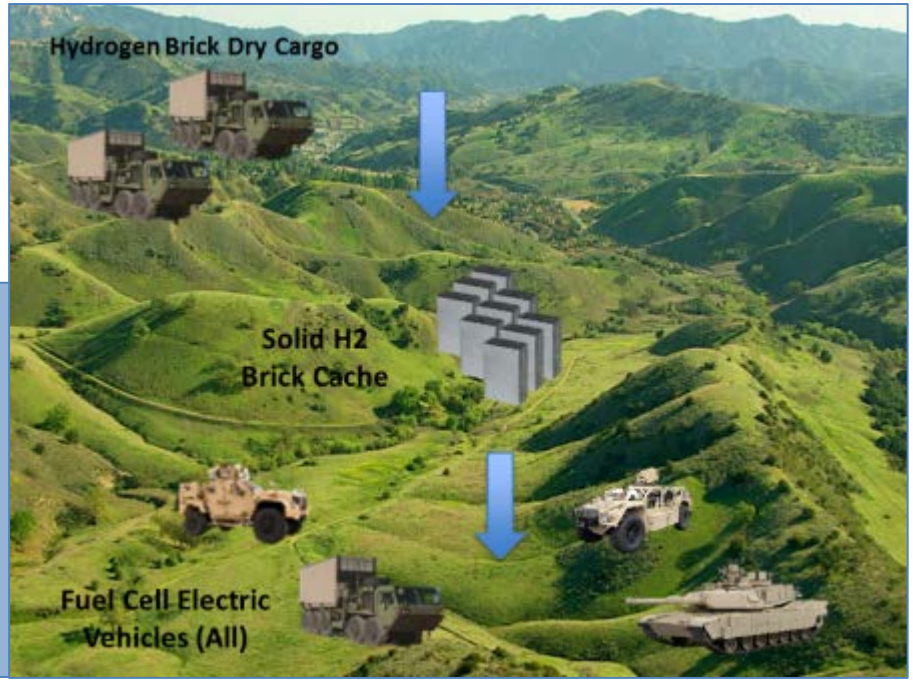


Most H2 Options May Require Additional Logistic Vehicles

Hydrogen Support System Development

Near Term Implementation:

- JP8 Reformation will generate hydrogen as close to the point of use as possible
- Logistics limit applications to smaller, lighter vehicles where fuel cell benefits can be maximized



Future Concept:

- High density hydrogen storage solutions such as Solid H2 Bricks will be moved forward as dry cargo to point of use
- Logistic efficiencies enable higher consumption vehicles to be converted to Fuel Cell Electric drive train

Thank You

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