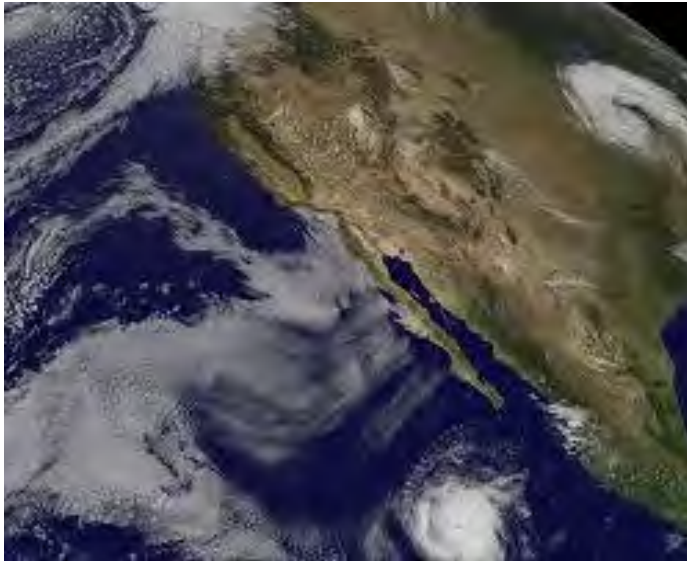


DoD Plug-In Electric Vehicle Program



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A few DOD energy examples...

Land, Sea & Air

Hydrogen Vehicle Fleet



COURTESY: U.S. ARMY



- ▶ Army commissioned H2 Fleet in February 2012
 - 16 fuel cell vehicles at DOD installations on Oahu
 - Vehicle distributed among Army, Air Force, Navy & Marine Corps
- ▶ Solar fueling station in place to produce hydrogen without using public grid
- ▶ Air Force developing hydrogen hybrid vehicles for flight line applications

USS Makin Island (LHD 8)



LHD 8 is designed with gas turbine engine and electric auxiliary propulsion system (APS)



Construction & Builders Trials

- Reducing class total ownership costs by phasing out conventional steam systems



Maiden Voyage

- Estimated \$2M savings over predecessor steam ships
- Cost avoidance over service life at this rate will be \$248M



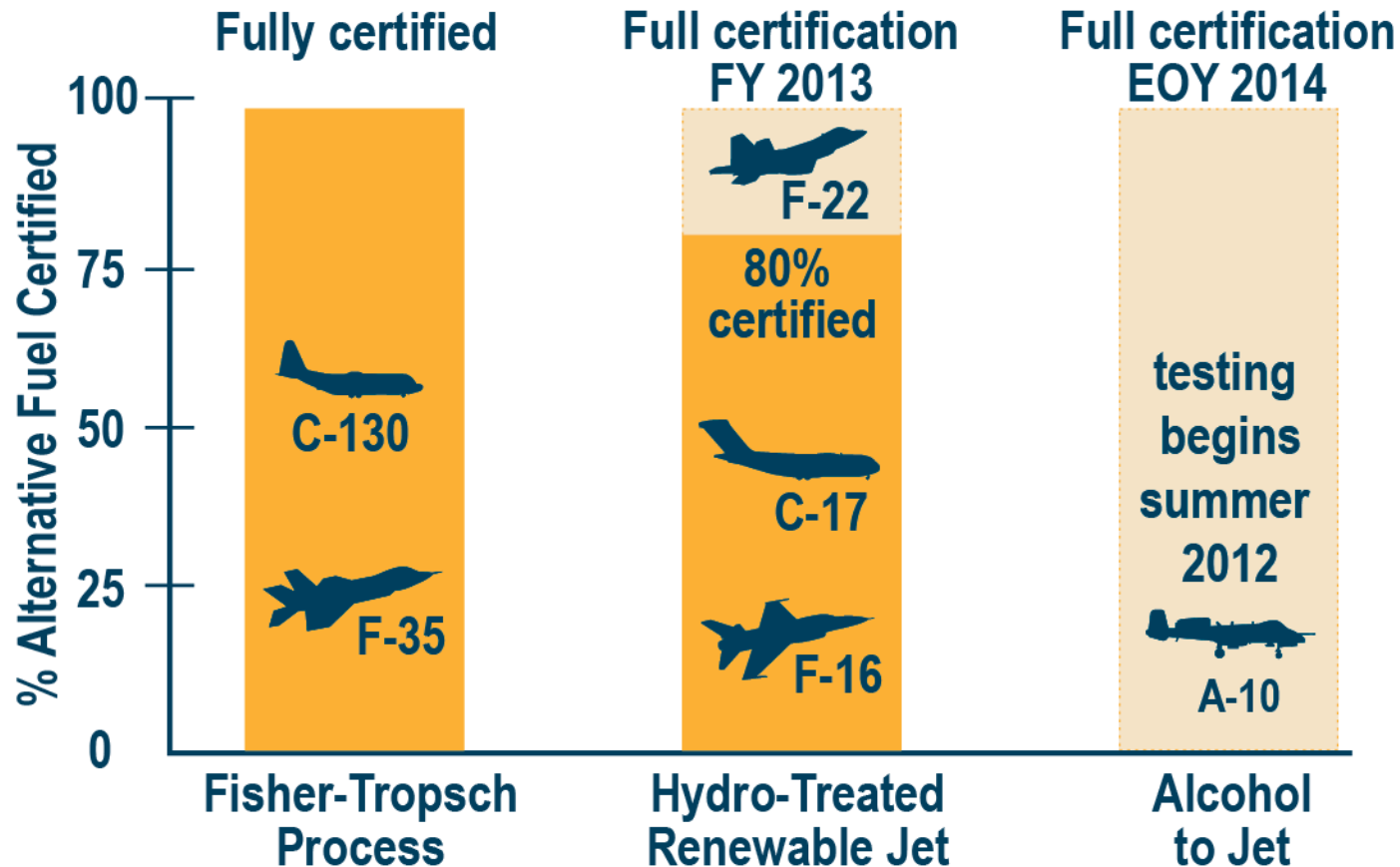
Commissioning

- Gas turbine propulsion plant meets all mission requirements

USS Makin Island: First Demonstration of Hybrid Electric Propulsion System in Surface Combatant to Expand Tactical Reach and Increase Fuel Efficiency Afloat



Alternative Fuels in Flight



Air Force will be a ready consumer by 2016

100% PEV Base



- ▶ Los Angeles AFB will be the 1st federal facility to convert its entire fleet to PEV's
 - 41 vehicles to be converted to PEV's (passenger sedans, pick-up trucks, MD trucks, and a shuttle bus)
 - Worked with GSA to host industry event at LA AFB in October 2011 and release RFI in February 2012
- ▶ Goal to implement vehicle-to-grid (V2G) capabilities to the greatest extent possible
- ▶ DOD provided funding to Lawrence Berkeley National Laboratory to develop software control system
- ▶ Currently in discussions with Southern California Edison, California Public Utility Commission, and California ISO to establish V2G infrastructure and communications protocols





DOD Plug-In Electric Vehicle Program



DOD PEV Program

▶ GOALS

- Develop knowledge base/technology/skill sets to implement PEV strategy
- Develop proof of concepts to show PEVs can meet energy directives
- Explore related benefits of PEV technology, to include revenue generation
- Initiate large scale integration of PEVs into DoD non-tactical ground fleet

▶ OBJECTIVES

- Develop strategy to initiate large scale PEV implementation considering:
 - PEVs must meet mission requirements
 - Vehicles and infrastructure total cost of ownership
 - Vehicles acquired at cost parity
 - Requisite RDT&E activities





Activities Completed to Date

- ▶ Project initiated in November 2010 to investigate feasibility of large-scale integration of PEV's into DOD's non-tactical fleet
- ▶ Completed extensive market research
- ▶ Worked with GSA to develop PEV residual value and lifecycle cost model
- ▶ Implemented detailed PEV charging infrastructure analyses at 16 DOD installations
- ▶ Initiated effort to make Los Angeles AFB the first federal facility to convert its entire general purpose fleet to PEV's
- ▶ Working with multiple agencies to align DOD PEV Program with ongoing activities



Financial Outlook

- ▶ All data indicate that total cost of ownership (TCO) parity between PEV's and conventional vehicles is achievable (including infrastructure costs), if the following conditions are met:
 - Procurement volumes of vehicles and V2G inverters are relatively large;
 - Most likely (but not only) vehicle segment to take advantage of volume pricing is MD/HD trucks
 - Batteries are “right-sized” to vehicle duty cycles;
 - “Right-sizing” not an option for plug-in hybrid vehicles (PHEV's)
 - Maximize V2G power capacity; and
 - Target 1-C rate (e.g. 60kw inverter for 60kwh battery)
 - Deploy vehicles to locations where V2G revenues and other financial incentives are greatest.
- ▶ Modeling suggests that V2G revenues can exceed PEV operating expenses, during *second* lease term



Other Considerations

Benefits	Risks
<ol style="list-style-type: none">1. Saves money for DOD2. Stabilizes fuel prices for non-tactical vehicles3. Maximizes asset utilization of non-tactical fleet (<33% to >90%)4. Enhances installation energy surety5. Relevant to tactical applications6. Reshapes vital segment of industry7. Supports DOD's ability to meet fuel, GHG, and vehicle mandates	<ol style="list-style-type: none">1. Relies on FY12 capital expense2. Cost estimates based on market research3. Pushes rapid integration of an emerging technology4. May depend on start-up businesses operating in a new segment of industry5. Requires fundamental change in fleet management and operation6. Relies on participation in variable frequency regulation markets



Conclusion

- ▶ DOD will continue to aggressively pursue alternative fuel technologies for all of its fleets.
- ▶ Inter-service and inter-agency collaborations are a vital element of DOD's ongoing success.
- ▶ Industry input and innovation are also critical.
- ▶ As an example, the DOD PEV Program has incorporated data through DOD, other federal agencies, and industry to construct an innovative financial and operational model for fleet electrification.