

U.S. Department of Energy

Field Operations Program

Electric and Hybrid Vehicle Testing

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Presentation Overview

- *Program Goal*
- *Program Testing Partners*
- *Neighborhood Electric Vehicle (NEV) Testing*
- *Urban Electric Vehicles (UEV) Testing*
- *Hybrid Electric Vehicle (HEV) Testing*
- *Hydrogen Fueling Station and Vehicle Testing Activities*
 - *Hydrogen Production / CNG Compression*
 - *Hydrogen/CNG Fueling System*
- *Summary*

Program Goal

- *Provide fleet managers and other potential advanced technology vehicle (ATV) users with accurate and unbiased information on vehicle performance*
- *ATVs include*
 - *Hybrid electric vehicles*
 - *Hydrogen ICE vehicles*
 - *Pure EVs (full size, urban, neighborhood)*
 - *Fuel cell vehicles*
- *Emphasis placed on supporting the National Energy Policy, DOE's Mission and Priorities, and testing vehicles incorporating emerging technologies developed by DOE and its industry partners*

Program Testing Partners

- *Electric Transportation Applications (lead)*
 - *American Red Cross*
 - *Arizona Public Service*
 - *Bank One of Arizona*
 - *Luke Air Force Base*
 - *New York Power Authority*
 - *Salt River Project*
 - *Southern California Edison*
 - *Cities of Palm Springs, Palm Valley, & Phoenix*

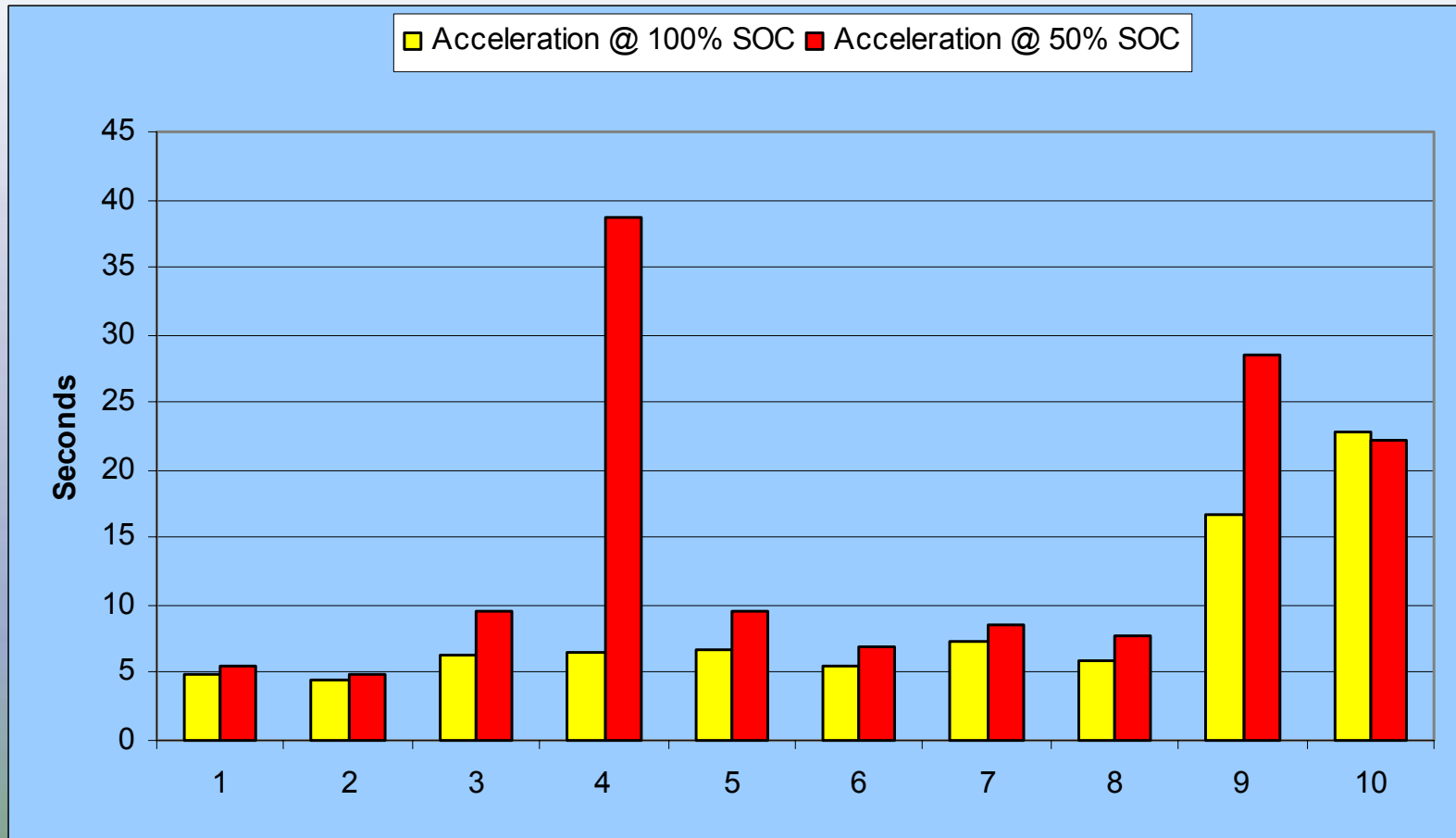
Neighborhood Electric Vehicle (NEV) Testing

- *Recently completed NEV America testing of 10 NEVs*
 - *Frazier Nash, GEM, ParCar, TH!NK*
 - *Technical specifications and test procedures developed with NEV manufacturer & fleet input*
 - *Based on NHTSA FMVSS No. 500 - Low-speed vehicles*
- *60+ NEVs in fleet testing FY-02*



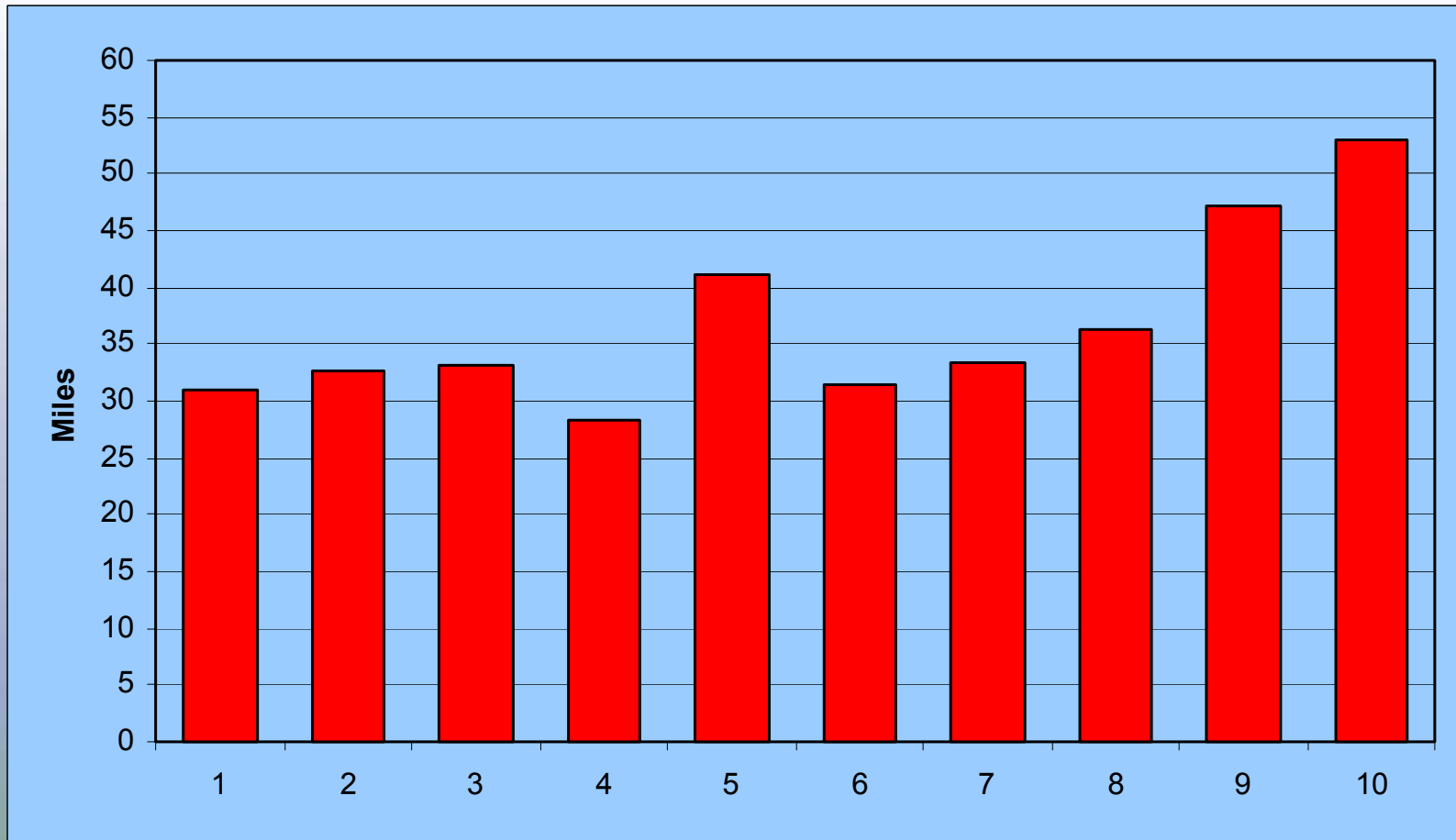
NEV Acceleration Testing (0 to 20 mph)

- Average @ 100% SOC - 8.7 seconds & @ 50% SOC 14.2 seconds)



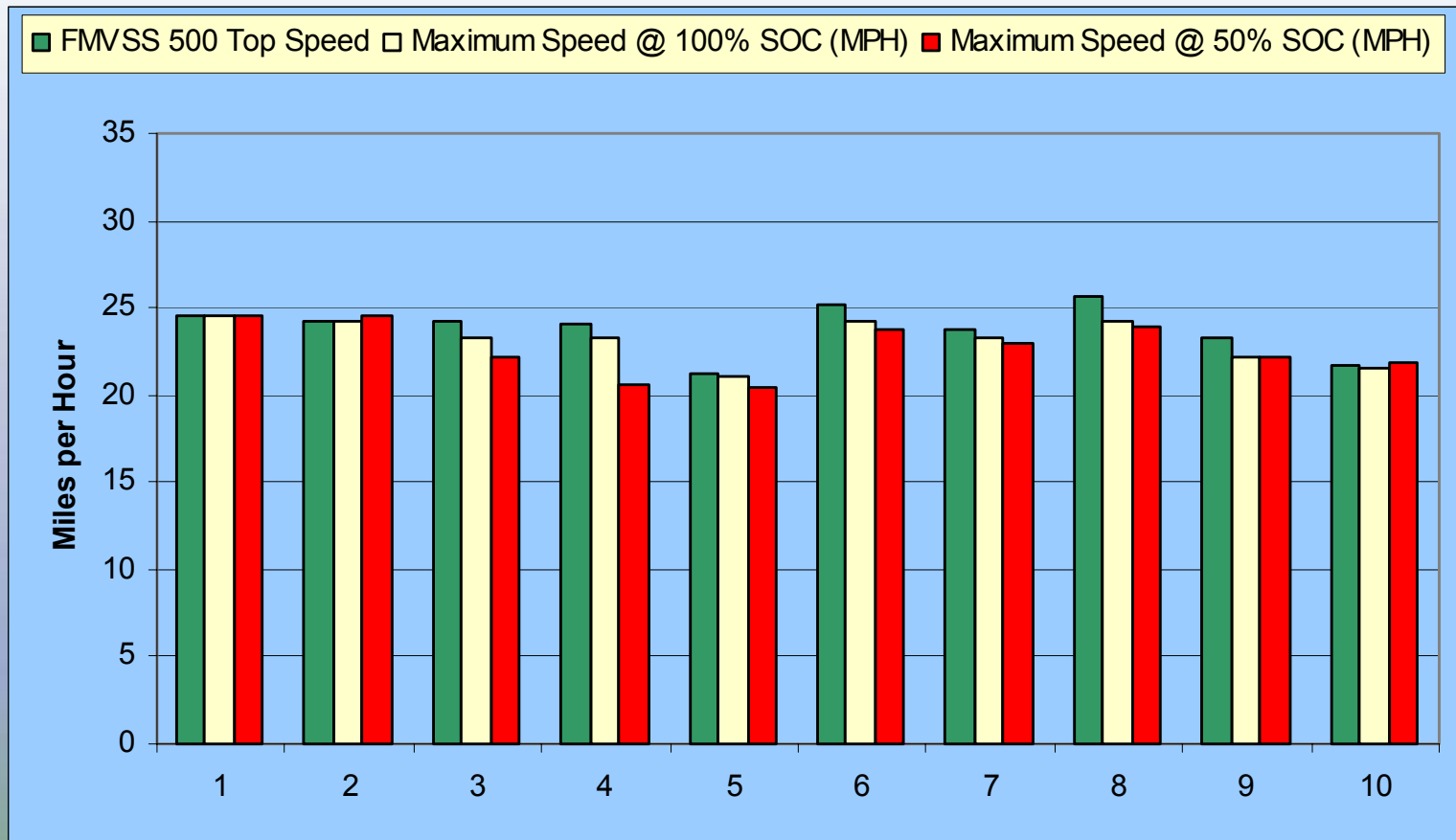
NEV Range Testing - (brick test)

- Minimum 28.4, maximum 52.9, average 36.7 miles*



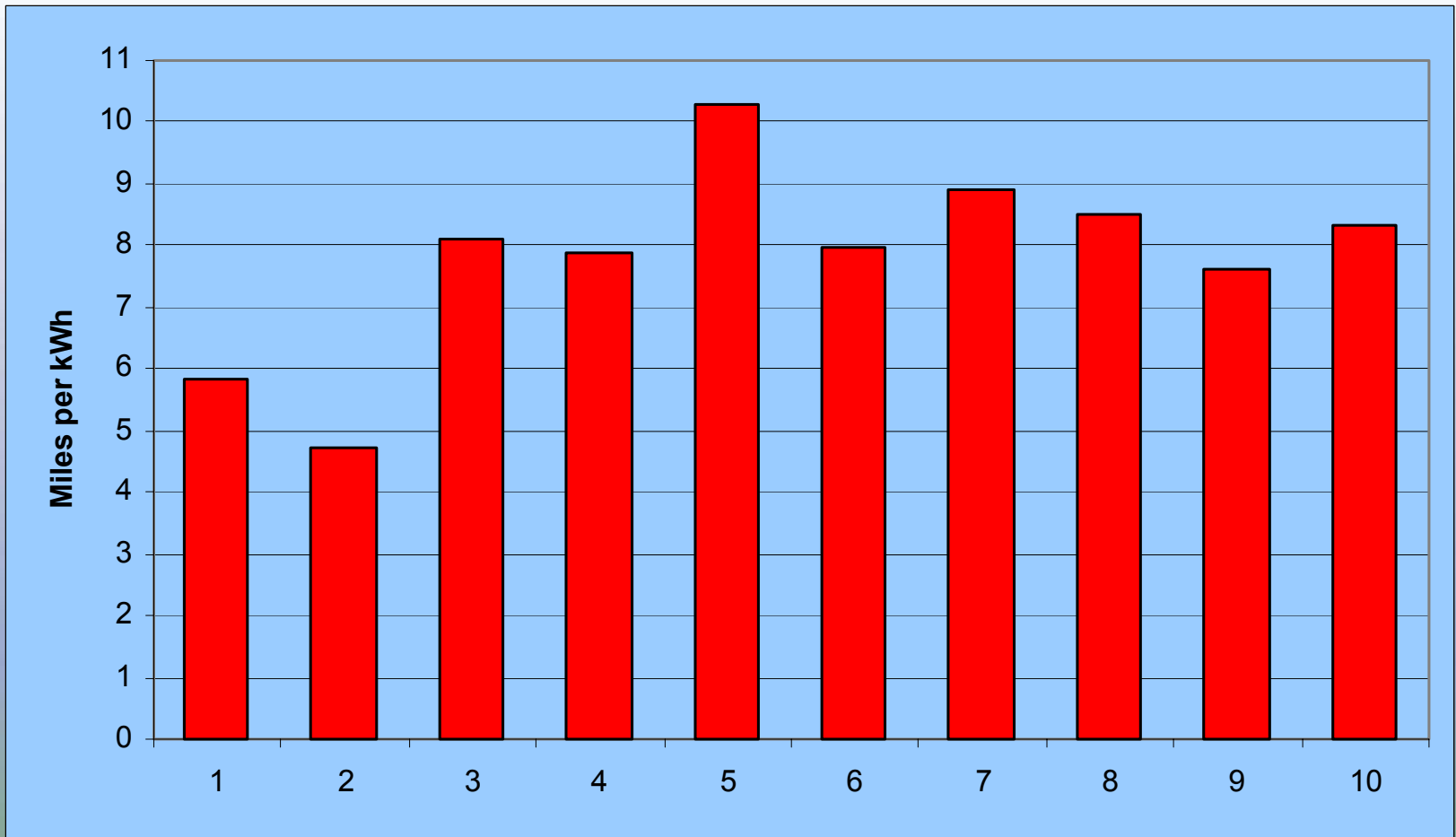
NEV Maximum Speed Tests

- *FMVSS No. 500 testing: min 20.5, max 25.6, average 23.8 mph*



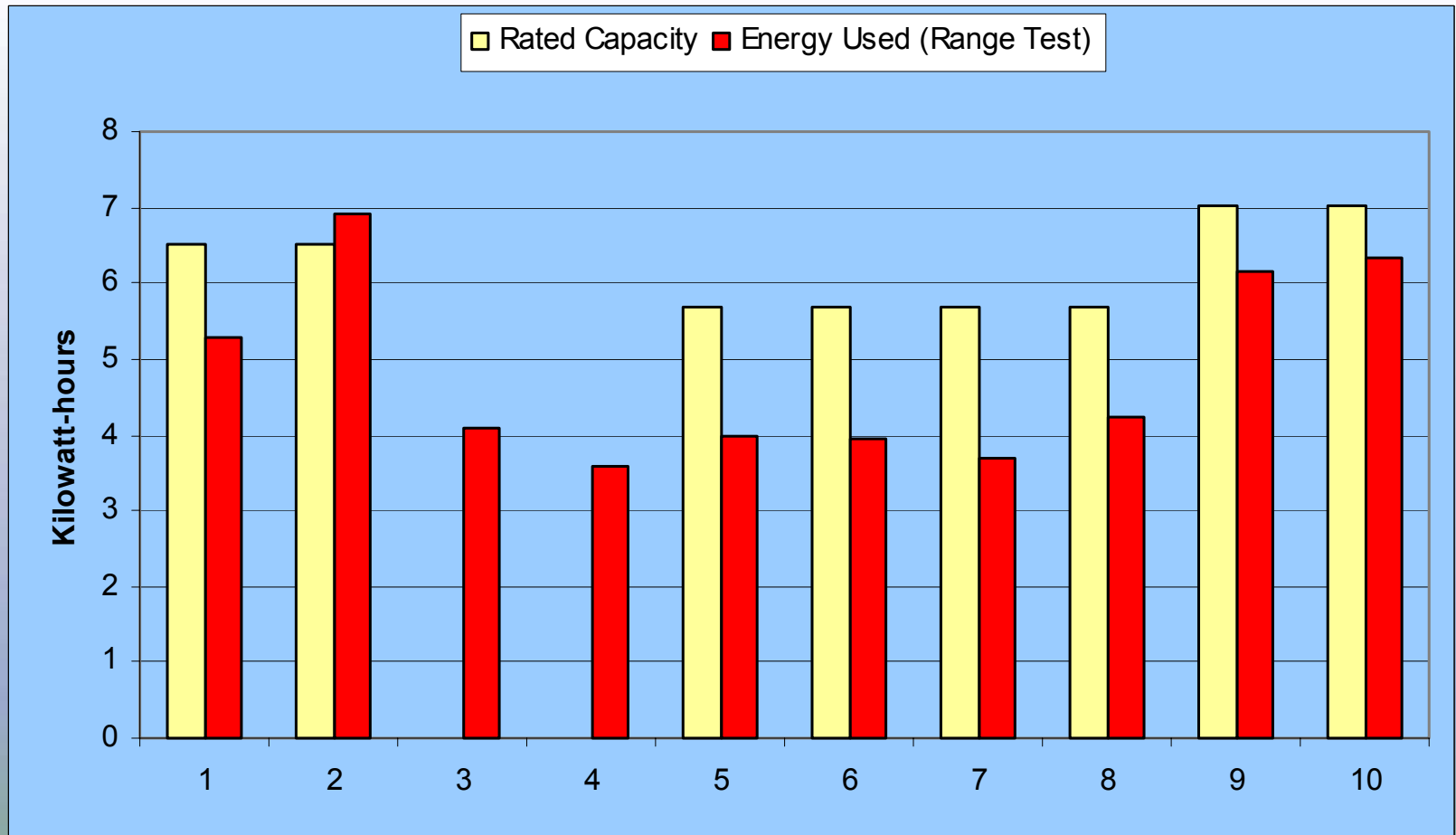
NEV Energy Efficiency

- *Average - 7.8 miles/kWh*



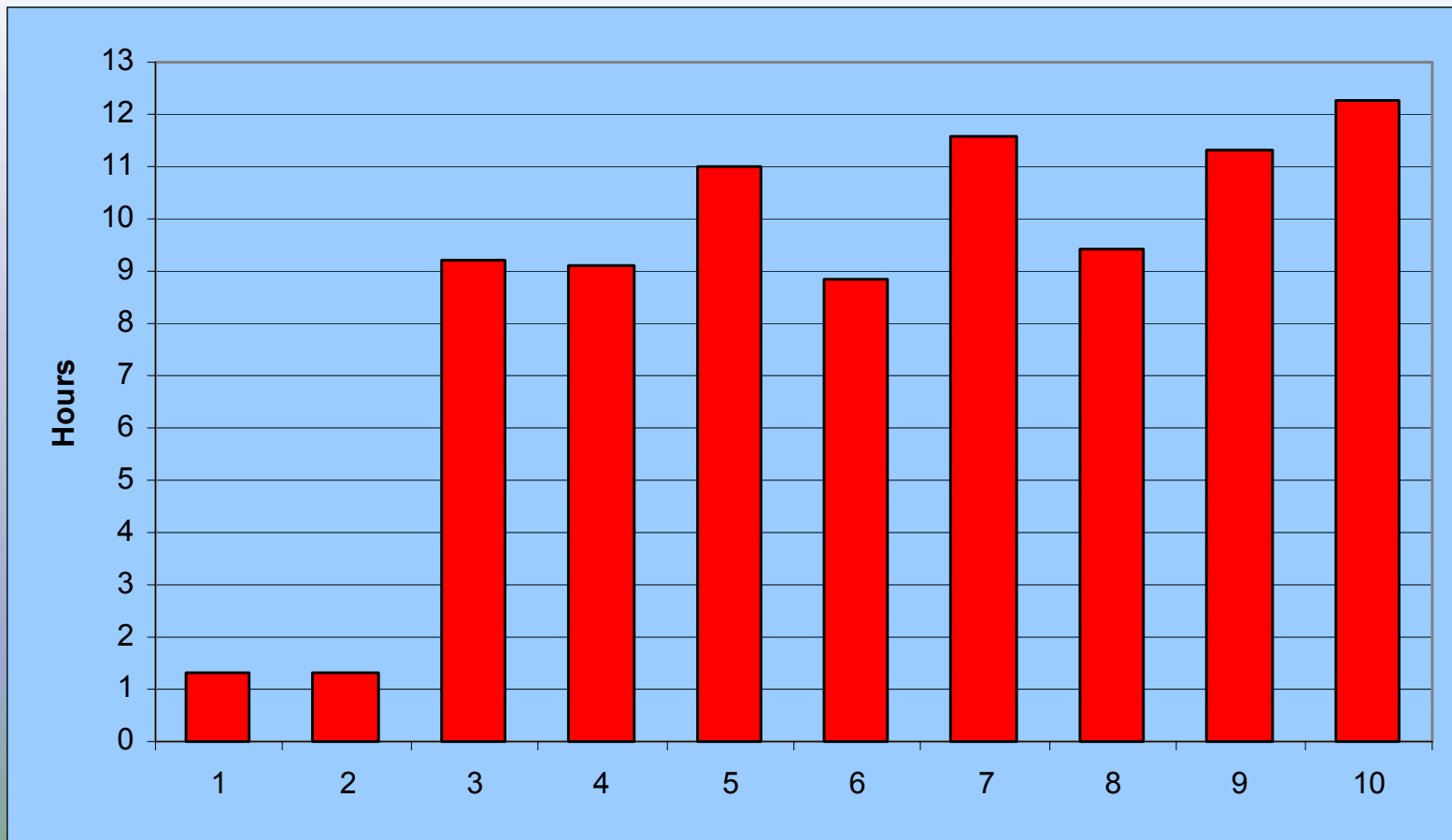
NEV kWh Capacity & Energy Use

- *Rated average 6.23 kWh & Used average 5.08 kWh*



NEV Charge Times

- *Vehicles 3-10 average charge time - 10.3 hours*
Vehicles 1 & 2 fast charged



NEV America Testing Results

- *Some structural flaws found during rough road testing*
- *Poor SOC meters can result in over-discharge of batteries and false low-charge indication*
- *NEV America testing demonstrated manufacturers have created an efficient means of zero emissions transportation using low speed vehicles*

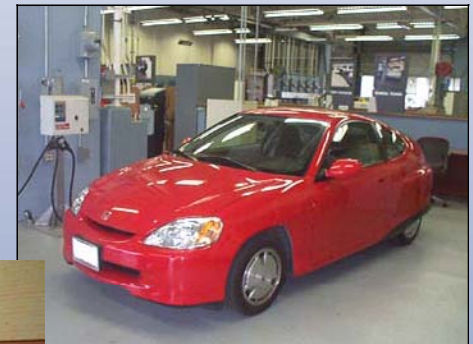
Urban Electric Vehicle (UEV) Testing

- *Th!nk city in UEV America baseline performance testing*
- *100 TH!NK cities in New York train commuter fleet demonstration program*
- *TH!NK city in accelerated reliability testing*
- *12 UEVs in 3 fleet tests in California, FY-02 (TH!NK cities, Nissan Hyper-Minis, Toyota e-coms)*



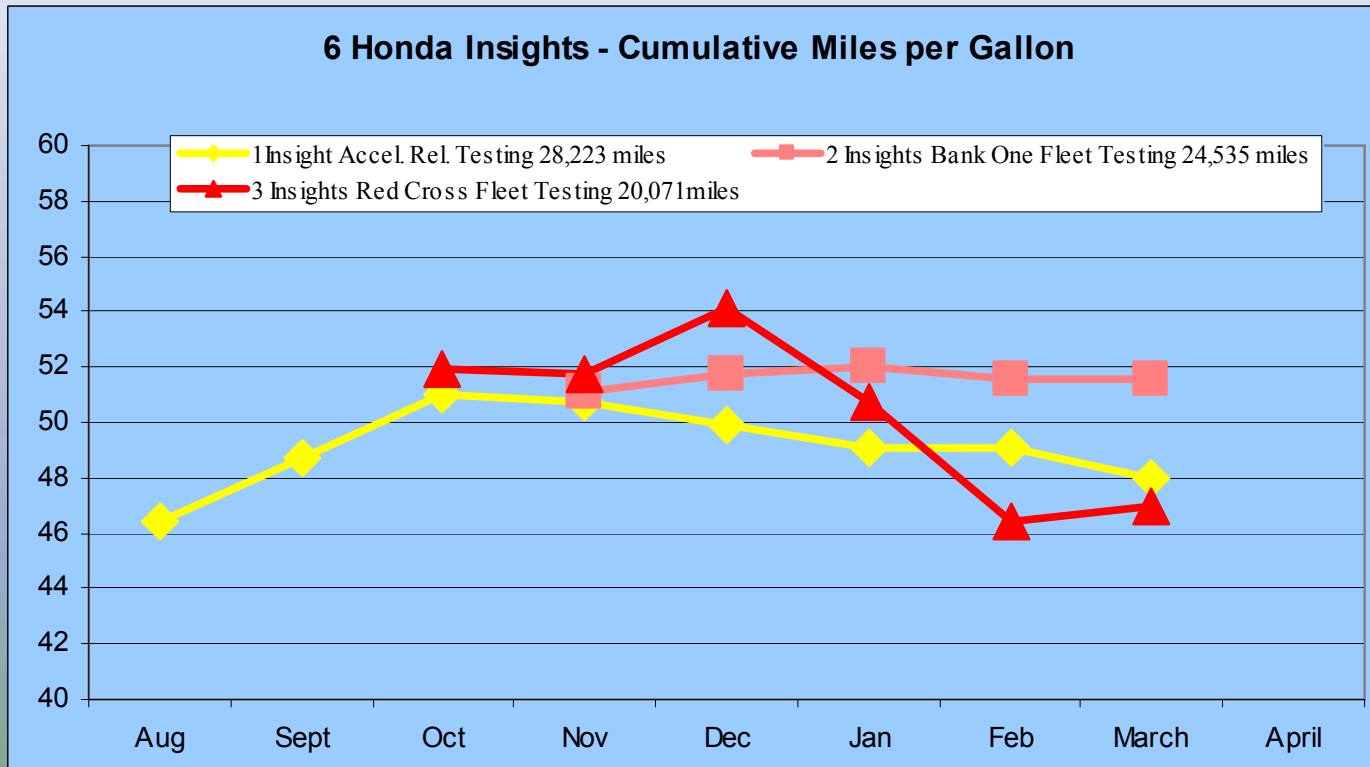
Hybrid Electric Vehicle (HEV) Testing

- *2 HEVs Pomona Loop tested as part of testing development process (Insight, Prius)*
- *3 HEVs in HEV America baseline performance testing (Insight, Prius, Civic)*
- *6 HEVs in accelerated reliability testing (100,000 miles per vehicle) (Insight, Prius, Civic)*
- *7 HEVs in fleet testing (Insight, Prius, Civic)*



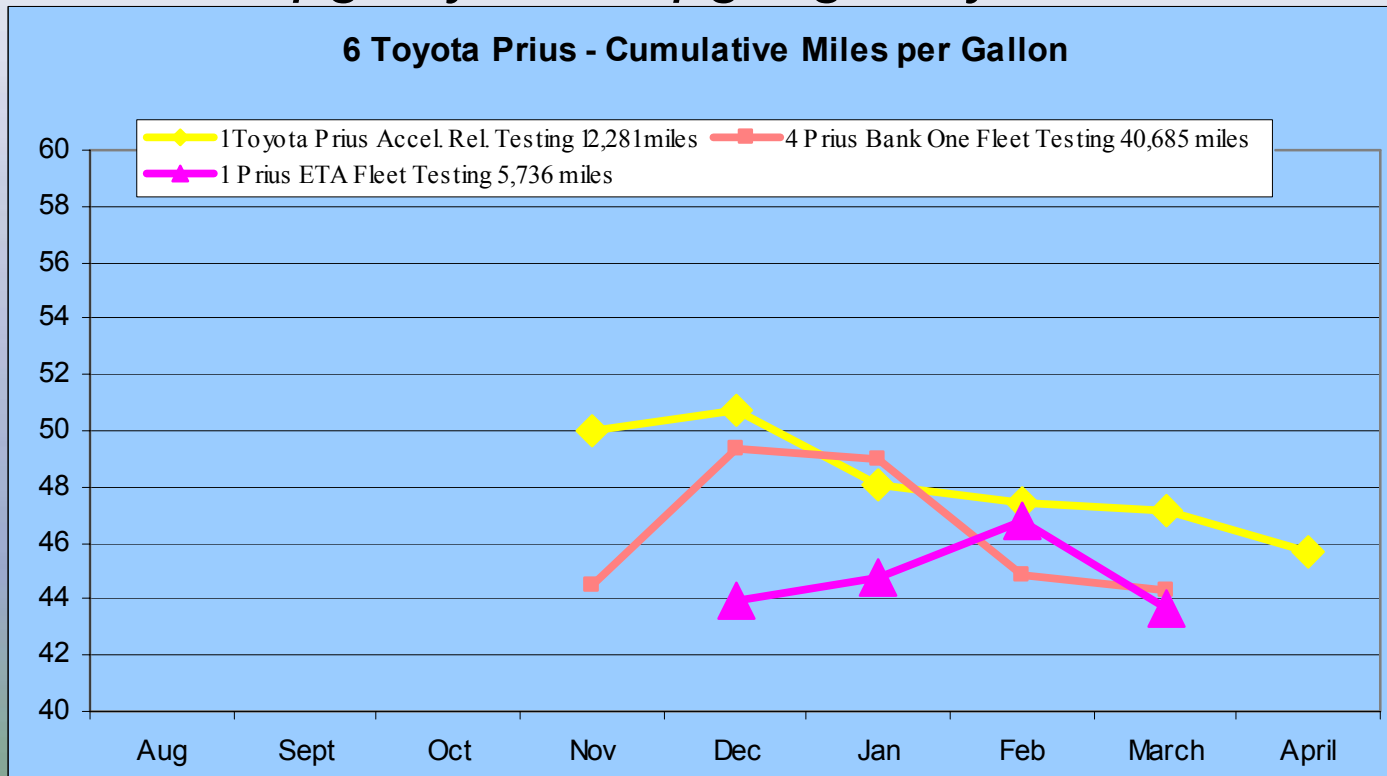
Honda Insight HEV Testing

- *Pomona Loop average 52.2 mpg (1,550 miles)*
- *Accelerated reliability and fleet testing average 48.7 mpg (73,000 miles)*
- *EPA 61 mpg city / 70 mpg highway*



Toyota Prius HEV Testing

- *Pomona Loop average 44.4 mpg (1,650 miles)*
- *Accelerated reliability and fleet testing average 44.2 mpg (59,000 miles)*
- *EPA 52 mpg city / 45 mpg highway*



Hydrogen Fueling Station and Vehicle Testing Activities

- *Construction of hydrogen production and hydrogen / CNG fueling station with Arizona Public Service*
- *Current hydrogen test vehicles (19,700 miles)*
 - *Ford ICE F150 at up to 30% hydrogen / CNG blend*
 - *Ford ICE F150 at up to 60% hydrogen / CNG blend with DOE / Quantum hydrogen tanks*
 - *100% hydrogen-powered Mercedes Benz ICE van*

Hydrogen Test Vehicles

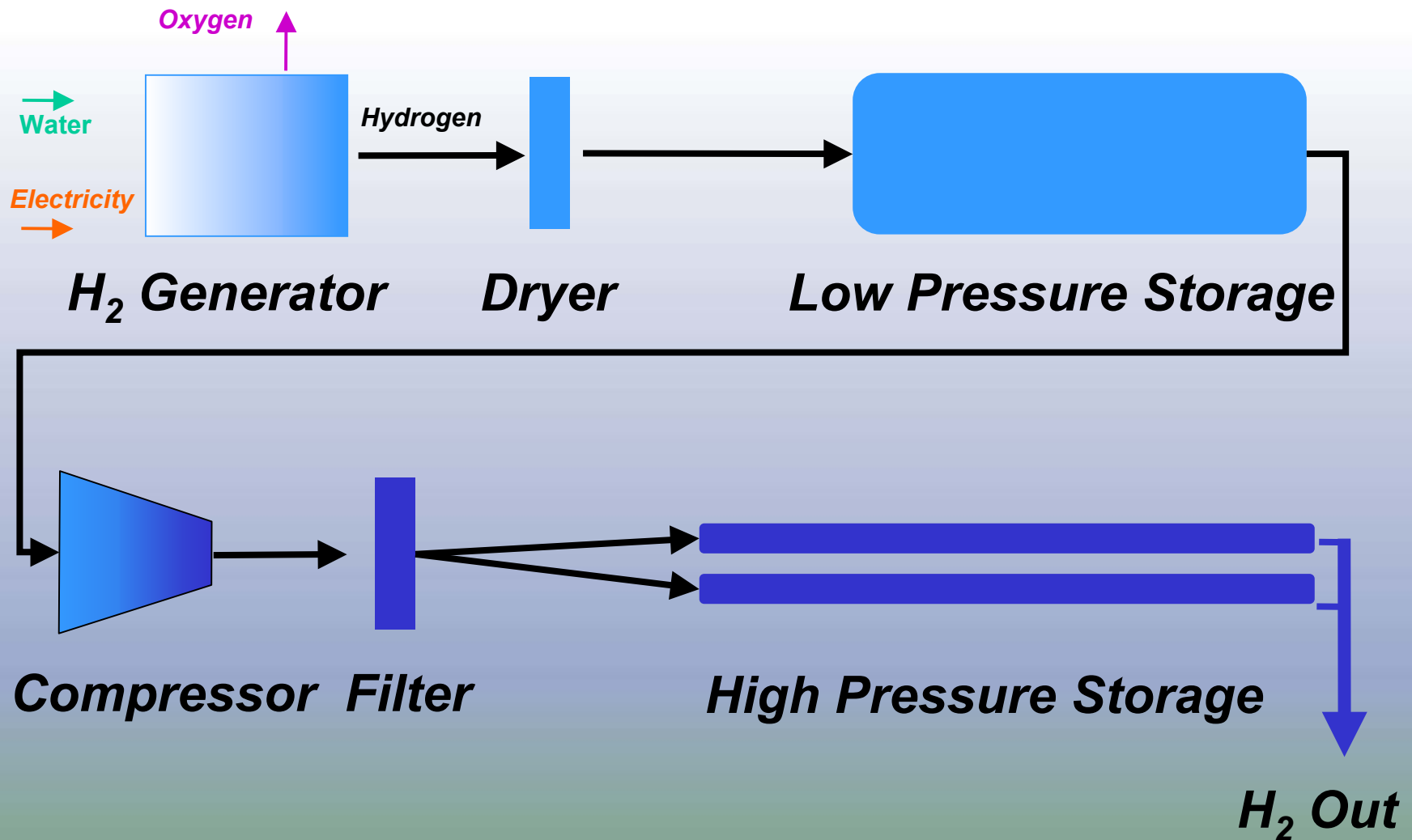


Hydrogen Production / CNG Compression

- *Electrolytic hydrogen production on site, Proton Energy Systems' HOGEN PEM stationary fuel cell operating in reverse*
- *Produce fuel-cell quality hydrogen*
- *Interconnects to dispense delivered hydrogen fuel*
- *Compress natural gas from low pressure service*
- *Delivers pure hydrogen or CNG fuel*
- *Arizona Public Service*



Hydrogen Sub-System



Hydrogen Sub-System (cont'd)

- *Hydrogen generator*
 - *PEM fuel cell, 57 kW, 20 cells*
 - *300 SCFH hydrogen output*
 - *17 kWh per 100 SCF hydrogen*
- *Hydrogen dryer*
 - *300 SCFH*
- *Hydrogen compressor*
 - *Oil free diaphragm compressor*
 - *Three stage compression*
 - *6,100 PSI output*

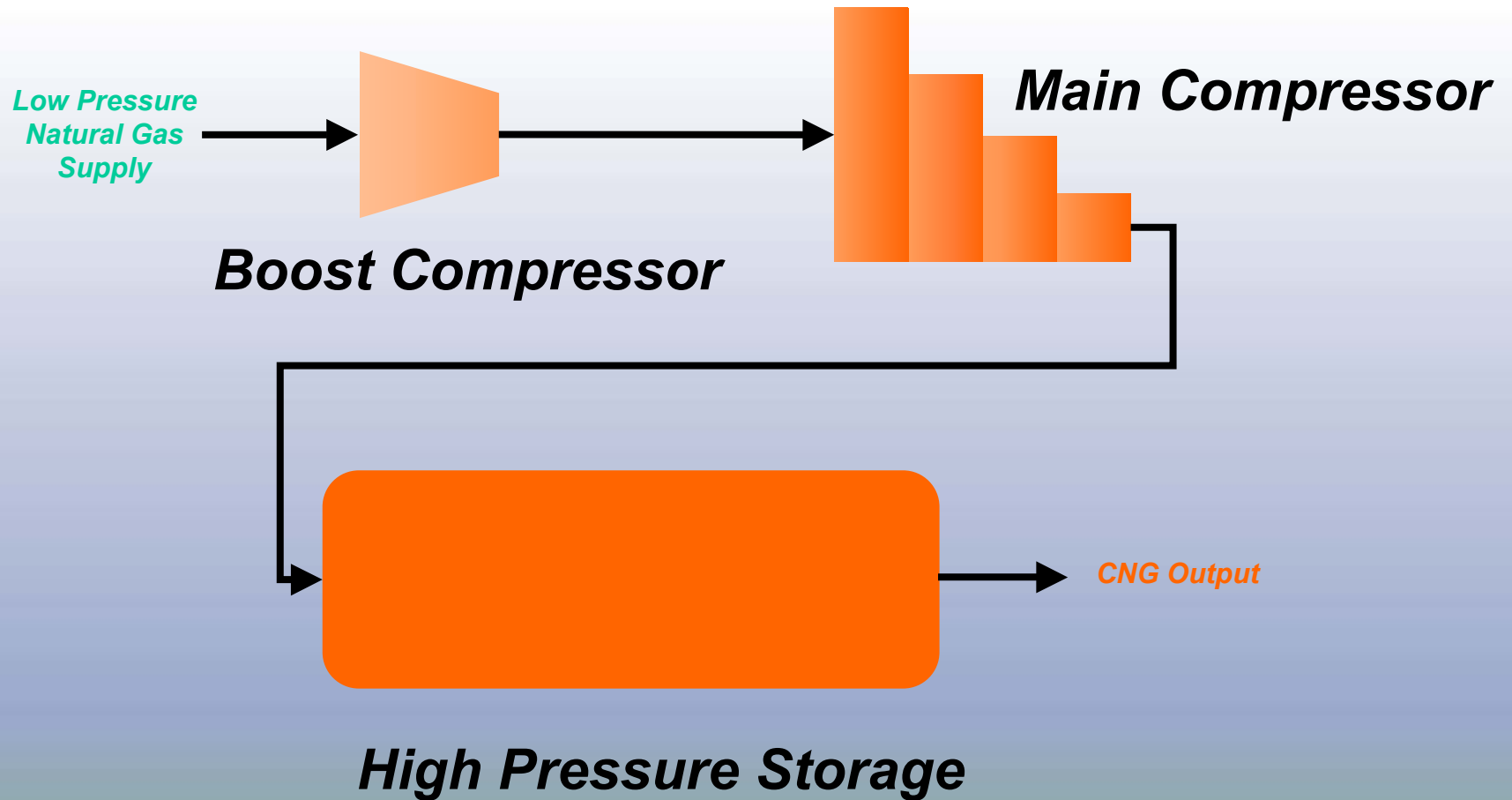


Hydrogen Sub-System (cont'd)

- *Low pressure hydrogen storage (lower tank)*
 - *8,955 SCF @ 150 PSIG*
- *High pressure hydrogen storage (upper 2 tanks)*
 - *17,386 SCF @ 6,000 PSIG*



CNG Sub-System

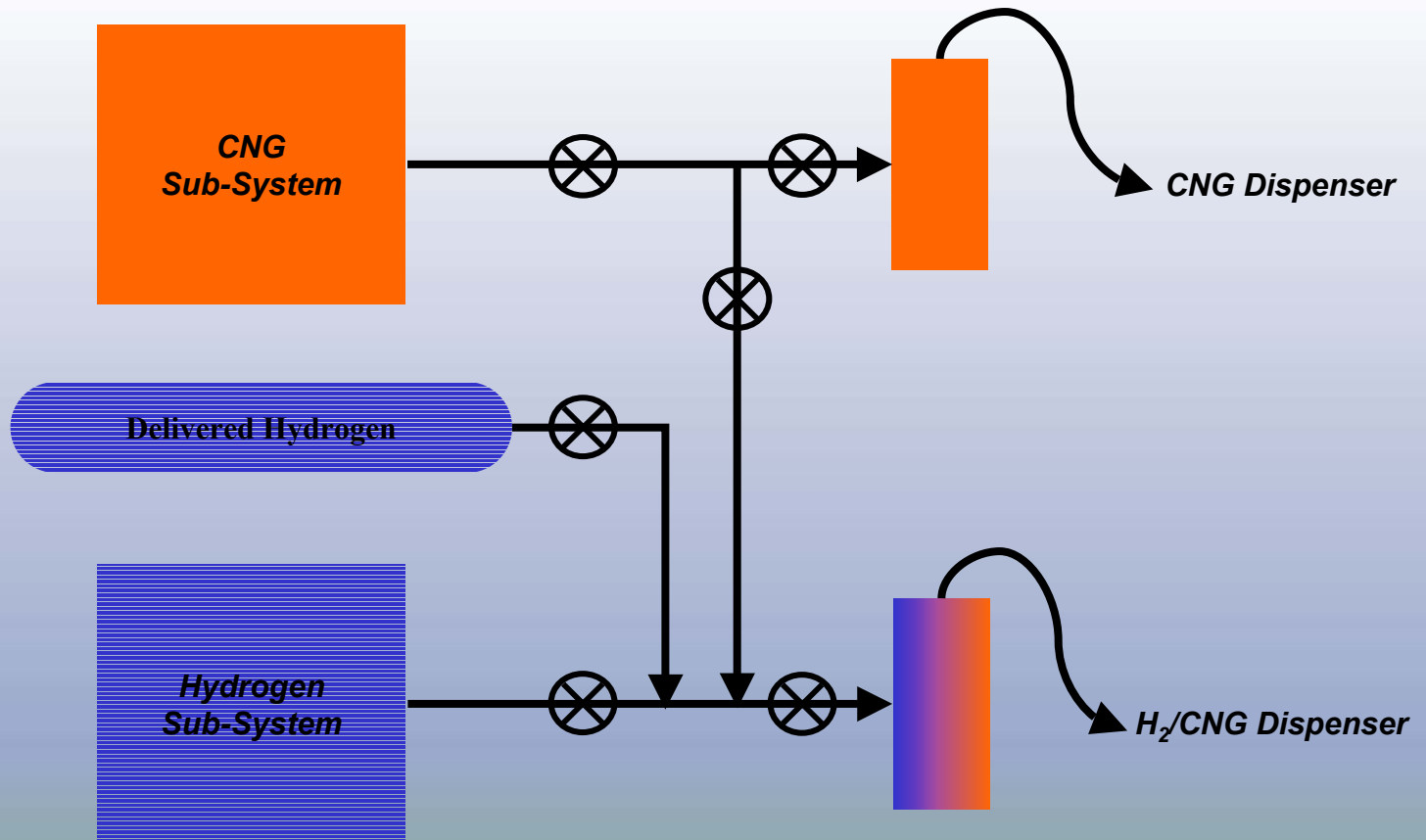


CNG Sub-System (cont'd)

- *CNG Boost Compressor*
 - 300 SCFM
 - 60 PSIG Output
- *CNG Main Compressor*
 - 350 SCFM @ 4,500 PSI
 - Multi-Stage Piston
- *High Pressure CNG Storage*
 - 50,000 SCF @ 4,000 PSI
 - ASME Vessels



Hydrogen/CNG Fueling System



Hydrogen/CNG Fueling System

- *Dispense pure hydrogen or pure CNG fuel*
- *Blend and dispense hydrogen / CNG blended fuels*
- *Includes metering and electronic billing Interface*



Summary

- *Long-term relationships with vehicle manufacturers and private sector testing partners / fleet operators (trust)*
- *Looking forward towards emerging technologies to identify testing candidates*
 - *Hydrogen ICEs and fuel cell vehicles*
 - *Niche-market (NEVs & UEVs) pure electric vehicles*
 - *HEVs in light, medium and heavy applications*
- *Testing procedures designed for emerging technologies*

Summary (cont'd)

- *Only DOE / private sector hydrogen production and fueling station in operation*
- *Experience gained siting, permitting, constructing, and operating Hydrogen/CNG Station in downtown Phoenix*
- *Development of hydrogen production and fueling station in-a-box concept*
- *<http://ev.inel.gov/fop>*