



Completed Learning Demonstration Composite Data Products as of December 1, 2006

Keith Wipke

Technical Report
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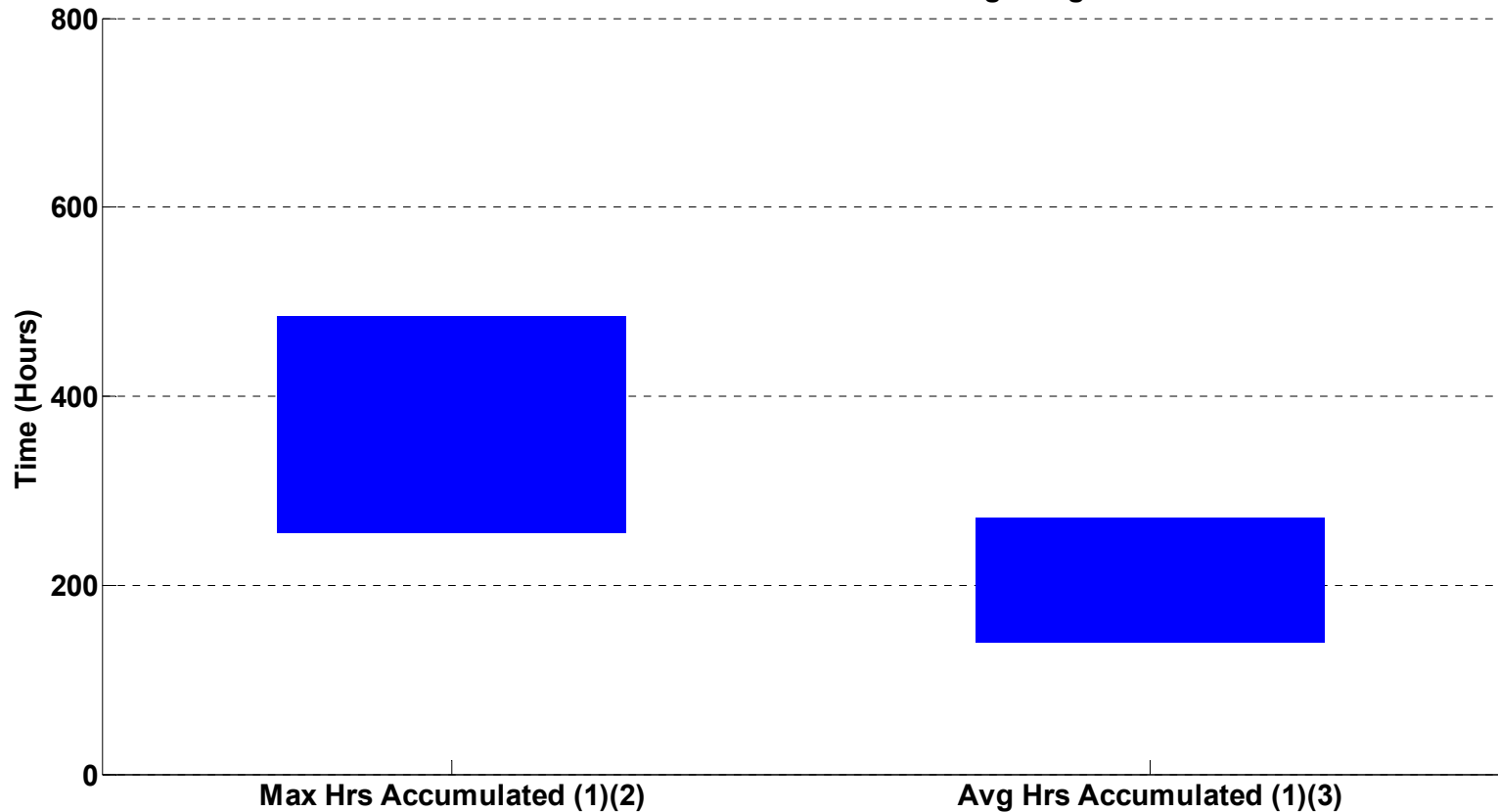


Completed Learning Demonstration Composite Data Products as of 12/01/06

Prepared under Task No. H270.8100

CDP#1A: Learning Demo Fuel Cell Stack Hours Accumulated Through August 2006

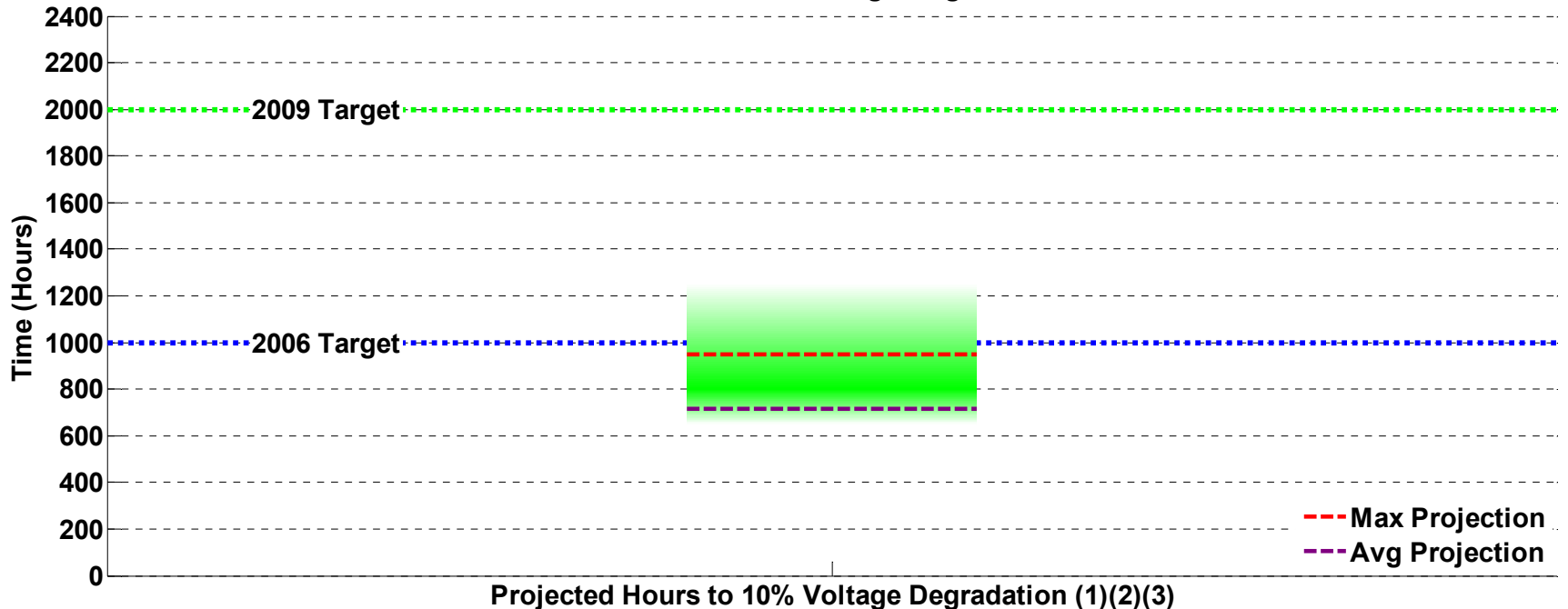
DOE Learning Demonstration:
Fuel Cell Stack Hours Accumulated Through August 2006



- (1) Range bars created using one data point for each OEM.
- (2) Range (highest and lowest) of the maximum operating hours accumulated to-date of any OEM's individual stack in "real-world" operation.
- (3) Range (highest and lowest) of the average operating hours accumulated to-date of all stacks in each OEM's fleet.

CDP#1B: Projected Hours to 10% Stack Voltage Degradation

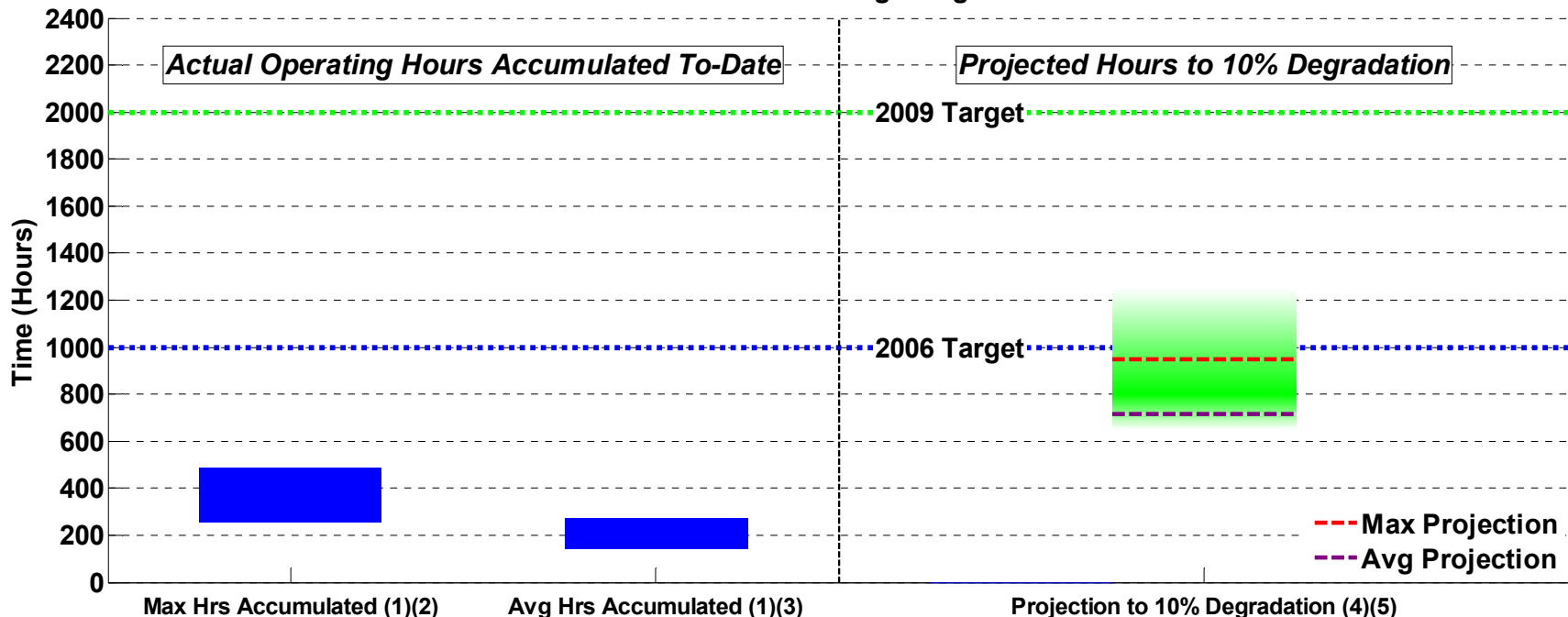
DOE Learning Demonstration Fuel Cell Stack Durability:
Based on Data Through August 2006



- (1) Projection using on-road data -- degradation calculated at high stack current. This criterion is used for assessing progress against DOE targets, may differ from OEM's end-of-life criterion, and does not address "catastrophic" failure modes, such as membrane failure.
- (2) Using one nominal projection per OEM: "Max Projection" = highest nominal projection, "Avg Projection" = average nominal projection. The shaded green bar represents an engineering judgment of the uncertainty due to data and methodology limitations. Projections will change as additional data are accumulated.
- (3) Projections based on limited accumulated stack hours to date. Average stack hours accumulated to-date range between 139 and 272. Maximum stack hours accumulated to-date range between 256 and 485.

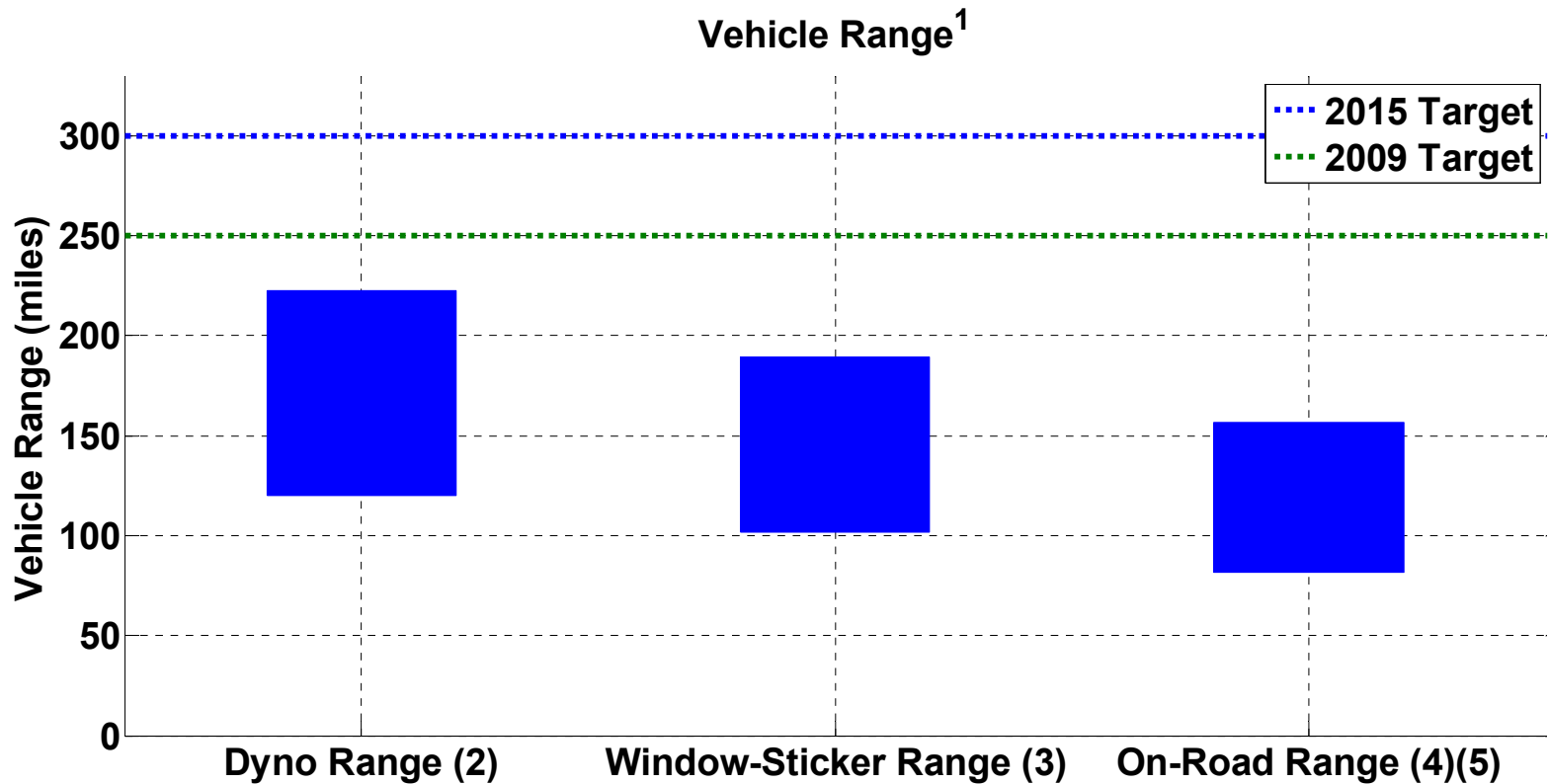
CDP#1C: Hours Accumulated and Projected Hours to 10% Stack Voltage Degradation

DOE Learning Demonstration Fuel Cell Stack Durability:
Based on Data Through August 2006



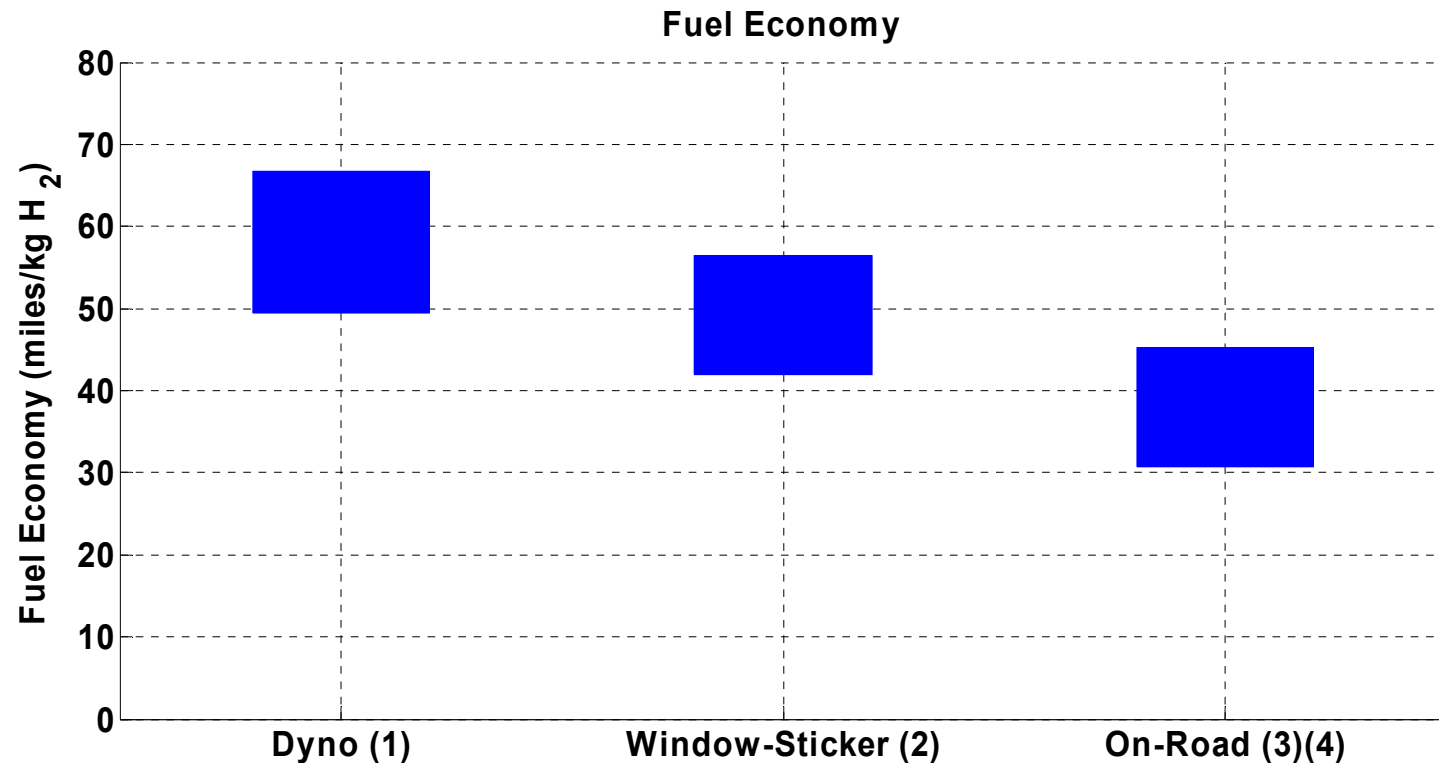
- (1) Range bars created using one data point for each OEM.
- (2) Range (highest and lowest) of the maximum operating hours accumulated to-date of any OEM's individual stack in "real-world" operation.
- (3) Range (highest and lowest) of the average operating hours accumulated to-date of all stacks in each OEM's fleet.
- (4) Projection using on-road data -- degradation calculated at high stack current. This criterion is used for assessing progress against DOE targets, may differ from OEM's end-of-life criterion, and does not address "catastrophic" failure modes, such as membrane failure.
- (5) Using one nominal projection per OEM: "Max Projection" = highest nominal projection, "Avg Projection" = average nominal projection.
The shaded green bar represents an engineering judgment of the uncertainty due to data and methodology limitations. Projections will change as additional data are accumulated.

CDP#2: Vehicle Range



- (1) Range is based on fuel economy and usable hydrogen on-board the vehicle. One data point for each make/model.
- (2) Fuel economy from unadjusted combined City/Hwy per DRAFT SAEJ2572.
- (3) Fuel economy from EPA Adjusted combined City/Hwy (0.78 x Hwy, 0.9 x City).
- (4) Excludes trips < 1 mile. One data point for on-road fleet average of each make/model.
- (5) Fuel economy calculated from on-road fuel cell stack current or mass flow readings.

CDP#6: Fuel Economy



(1) One data point for each make/model. Combined City/Hwy fuel economy per DRAFT SAEJ2572.

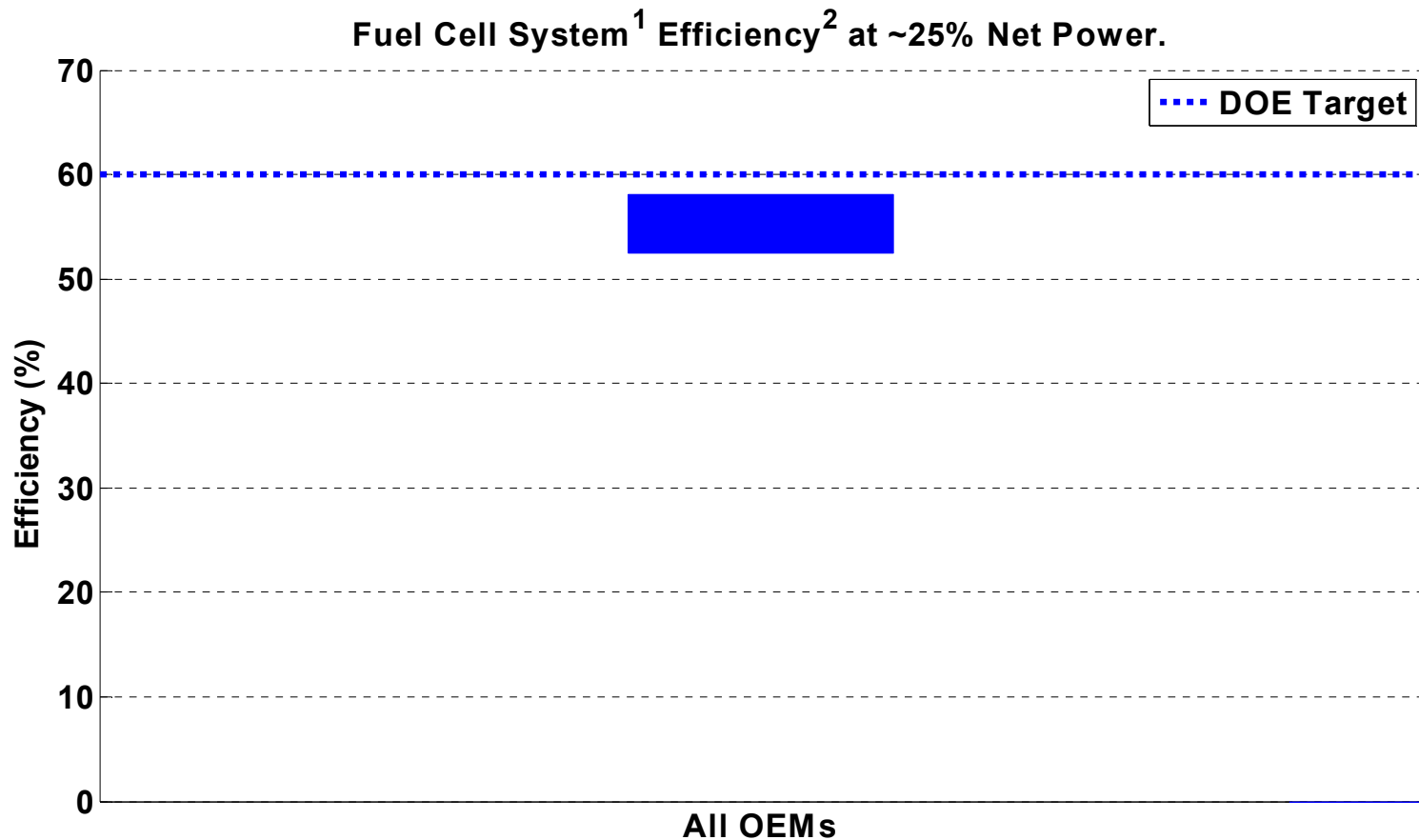
(2) Adjusted combined City/Hwy fuel economy ($0.78 \times \text{Hwy}$, $0.9 \times \text{City}$).

(3) Excludes trips < 1 mile. One data point for on-road fleet average of each make/model.

(4) Calculated from on-road fuel cell stack current or mass flow readings.

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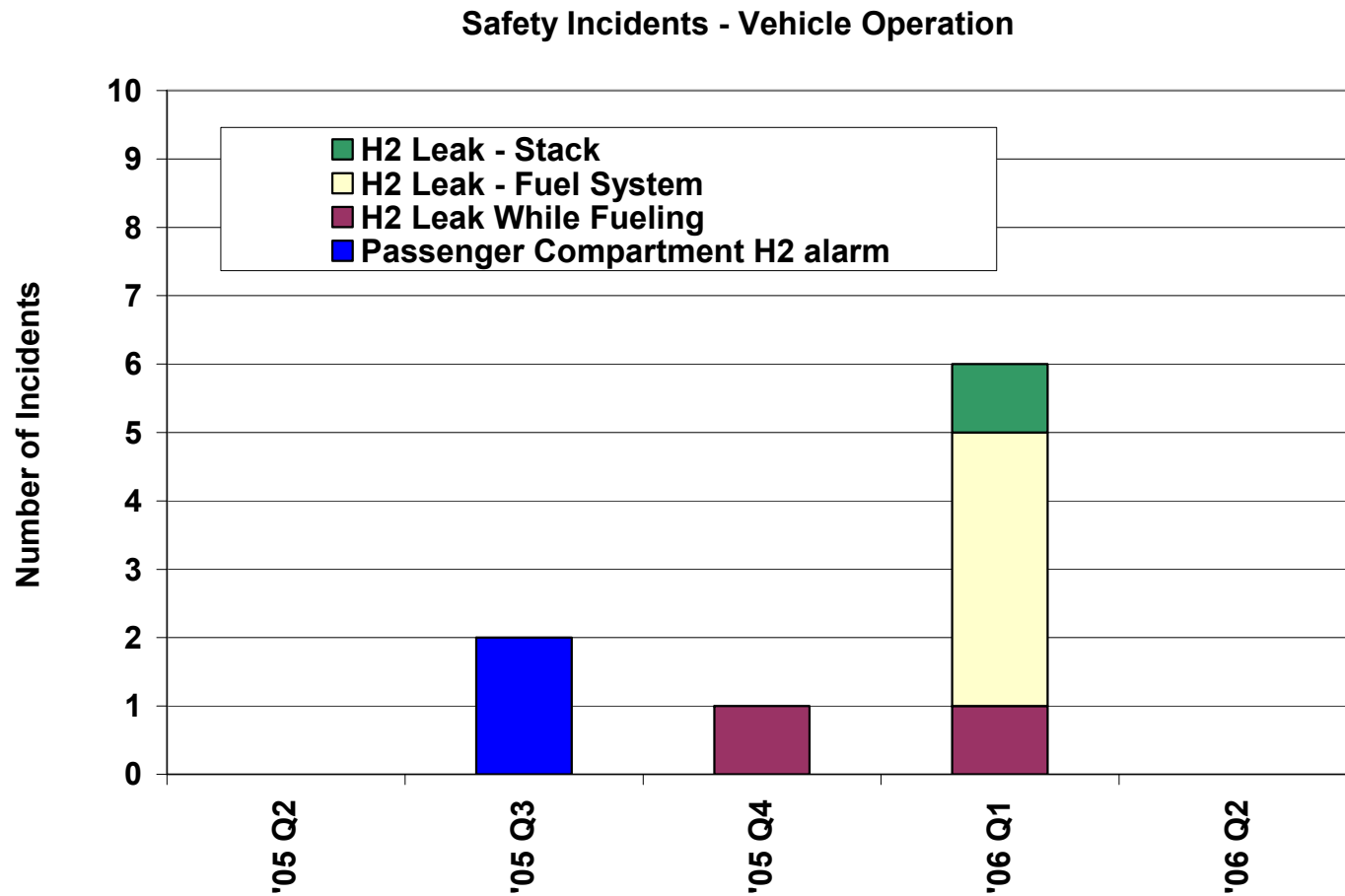
CDP#8: FC System Efficiency



¹ Gross stack power minus fuel cell system auxiliaries, per DRAFT SAEJ2615.

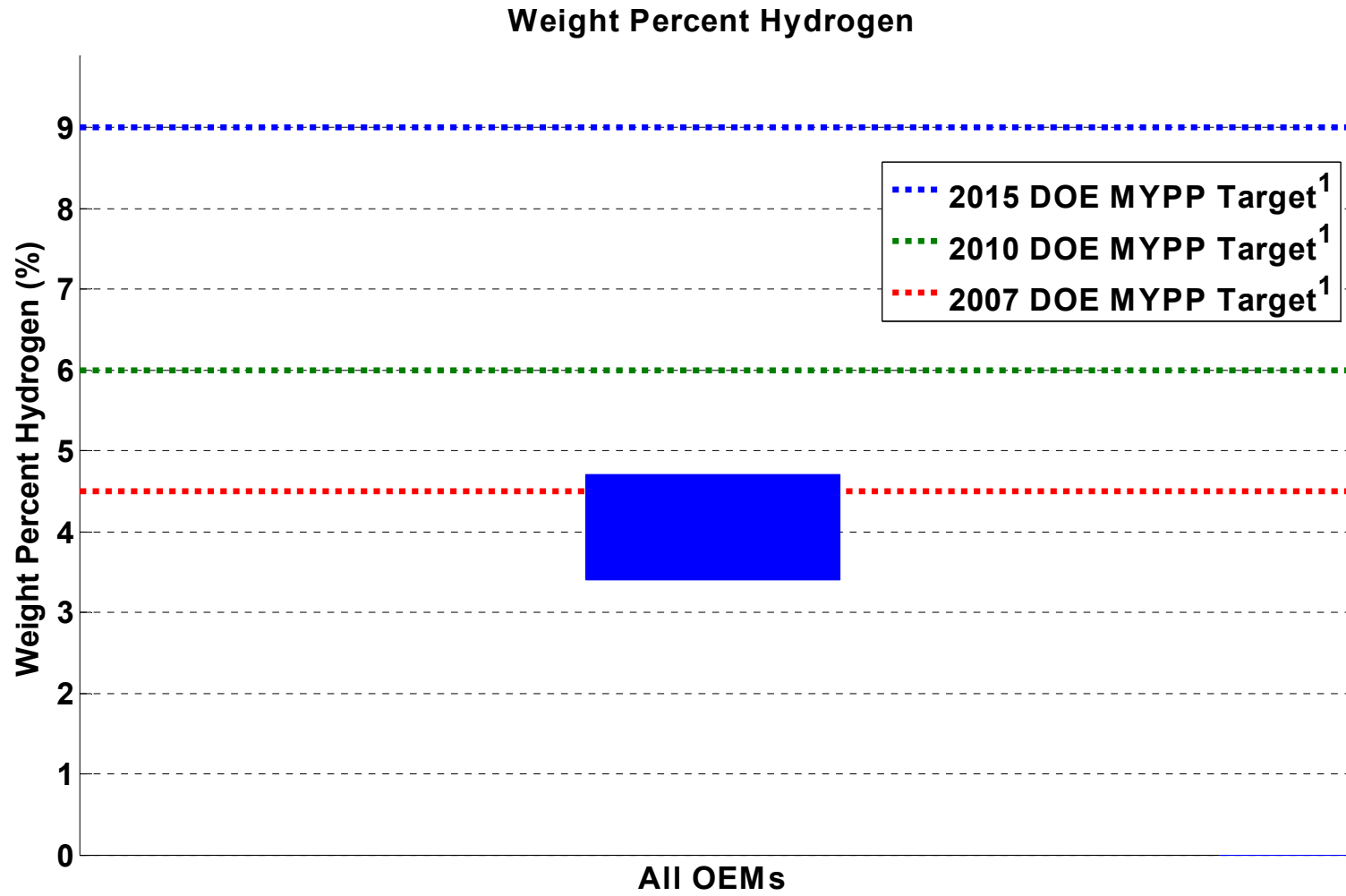
² Ratio of DC output energy to the lower heating value of the input fuel (hydrogen). Excludes power electronics and electric drive.

CDP#9: Safety Incidents – Vehicles



Created: 8/28/2006

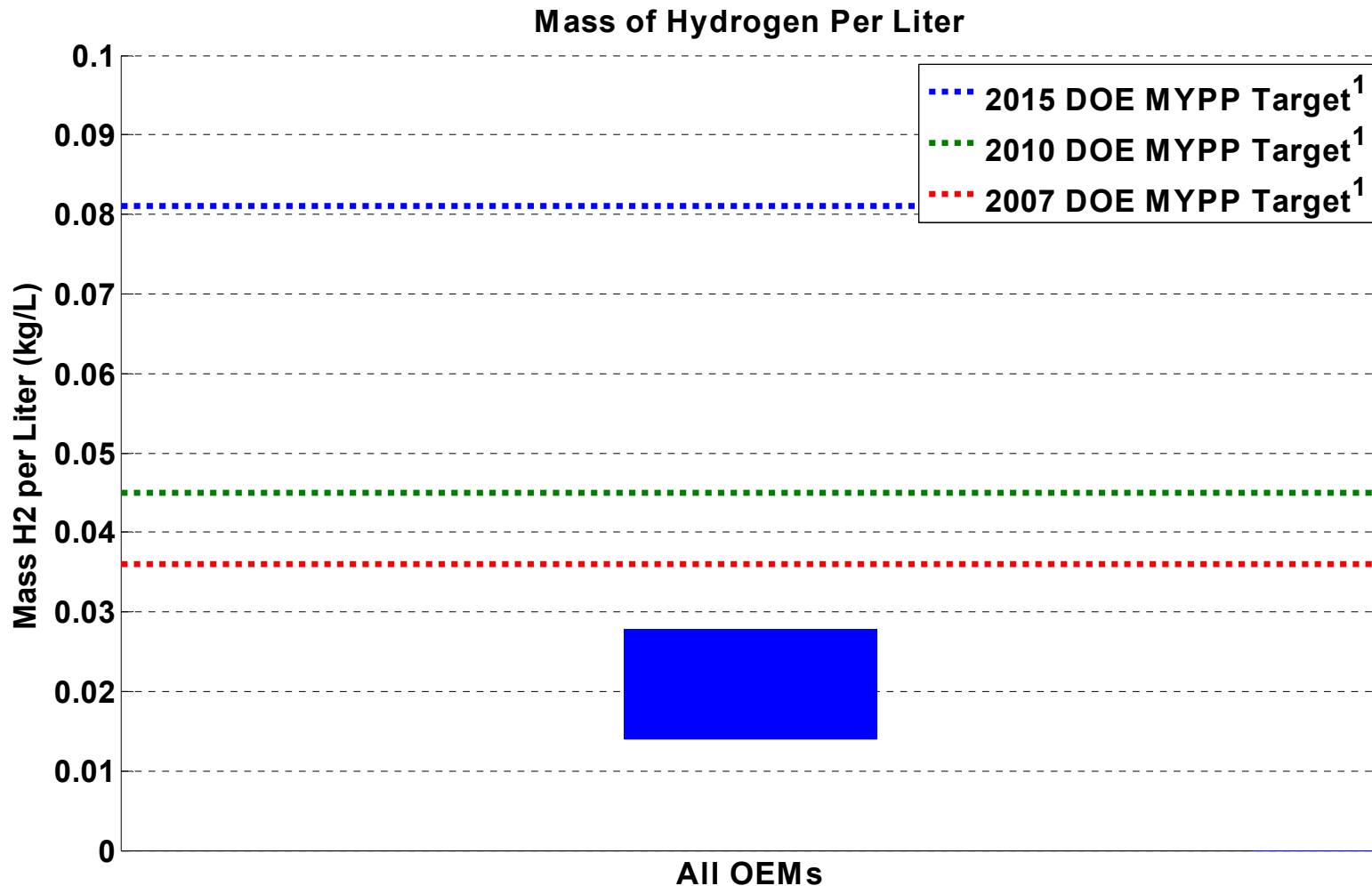
CDP#10: Storage Weight % Hydrogen



Created: 23-Feb-2006

¹Some near-term targets have been achieved with compressed and liquid tanks. Emphasis is on advanced materials-based technologies.

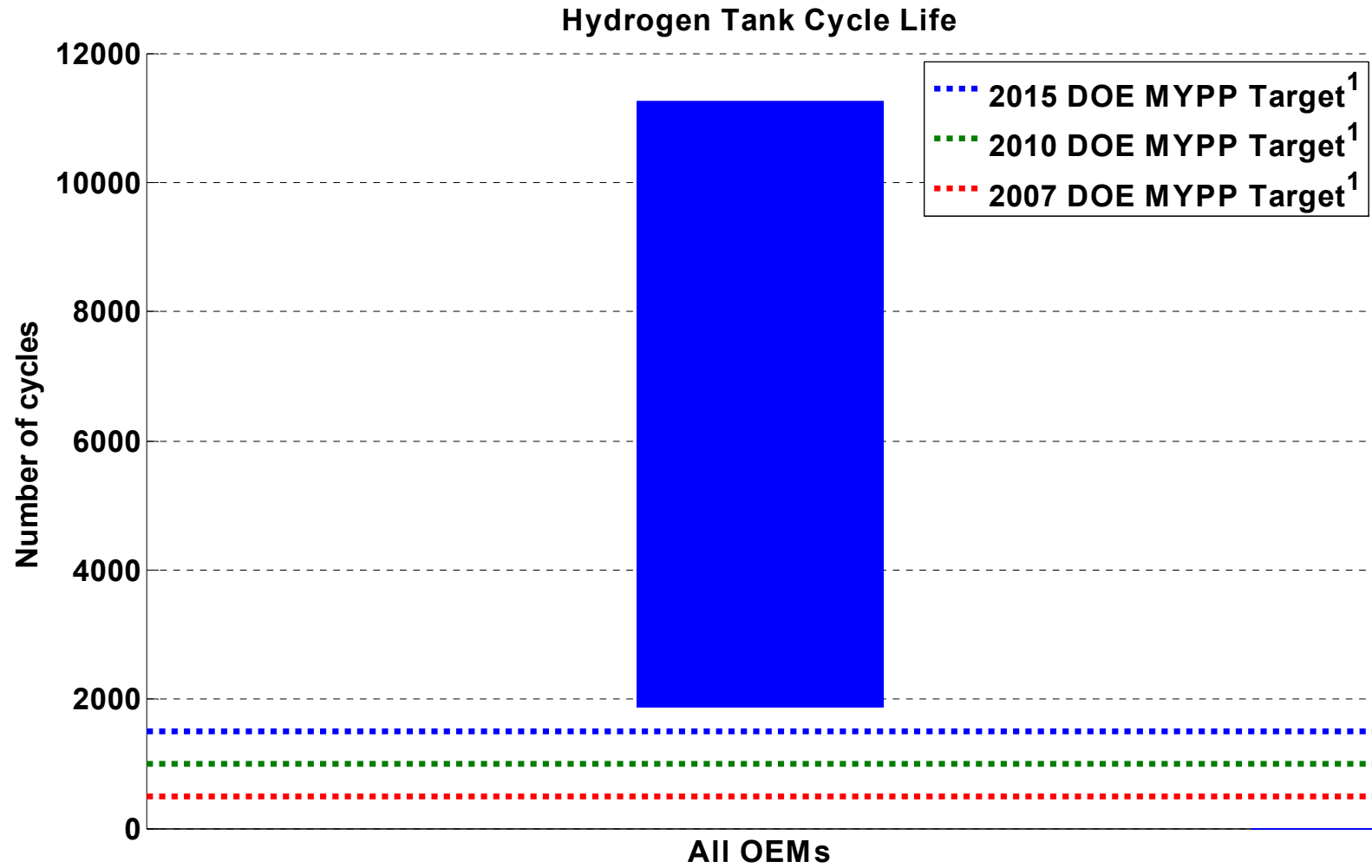
CDP#11: Volumetric Capacity of H2 Storage



Created: 23-Feb-2006

¹Emphasis is on advanced materials-based technologies.

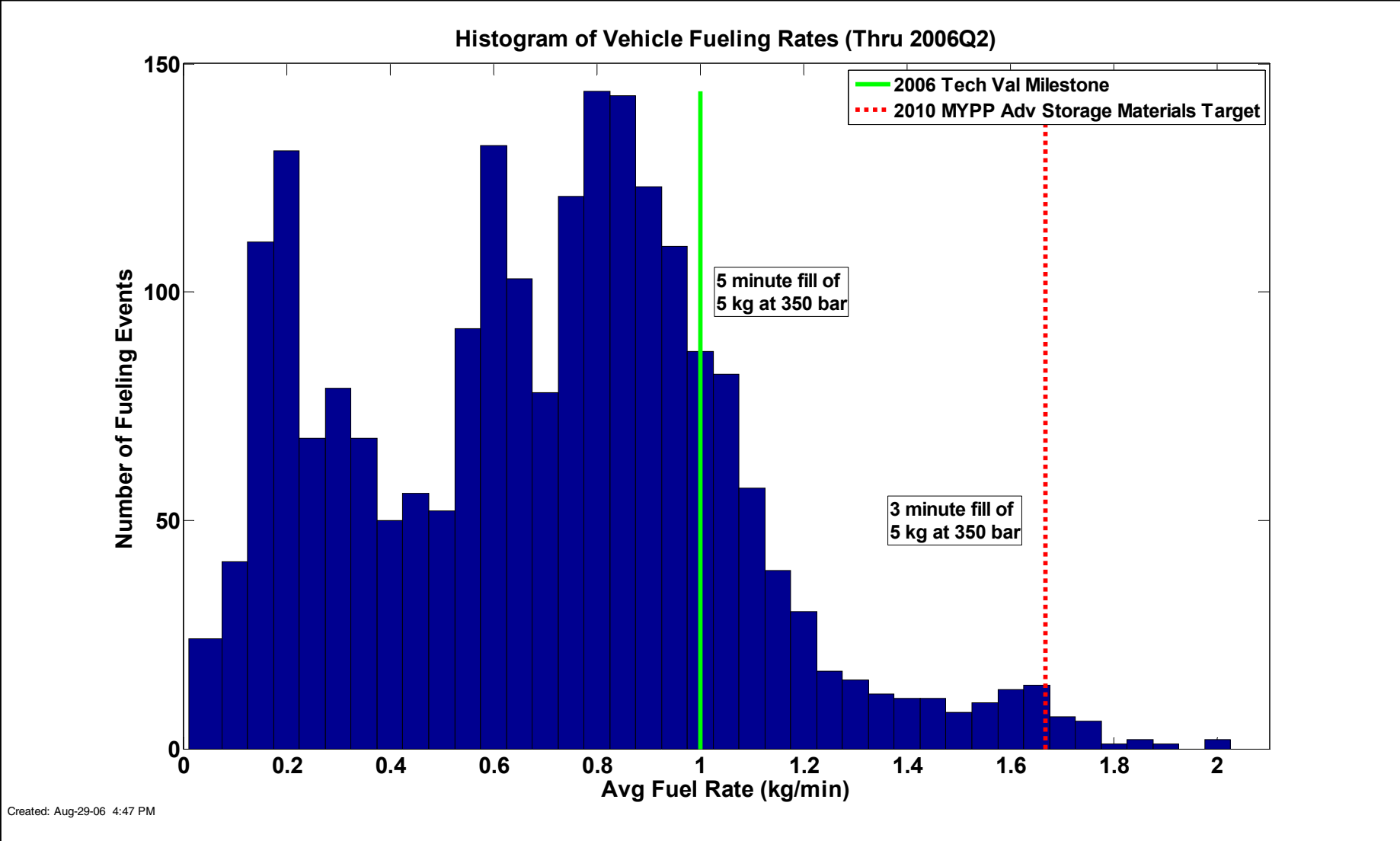
CDP#12: Vehicle Hydrogen Tank Cycle Life



Created: 23-Feb-2006

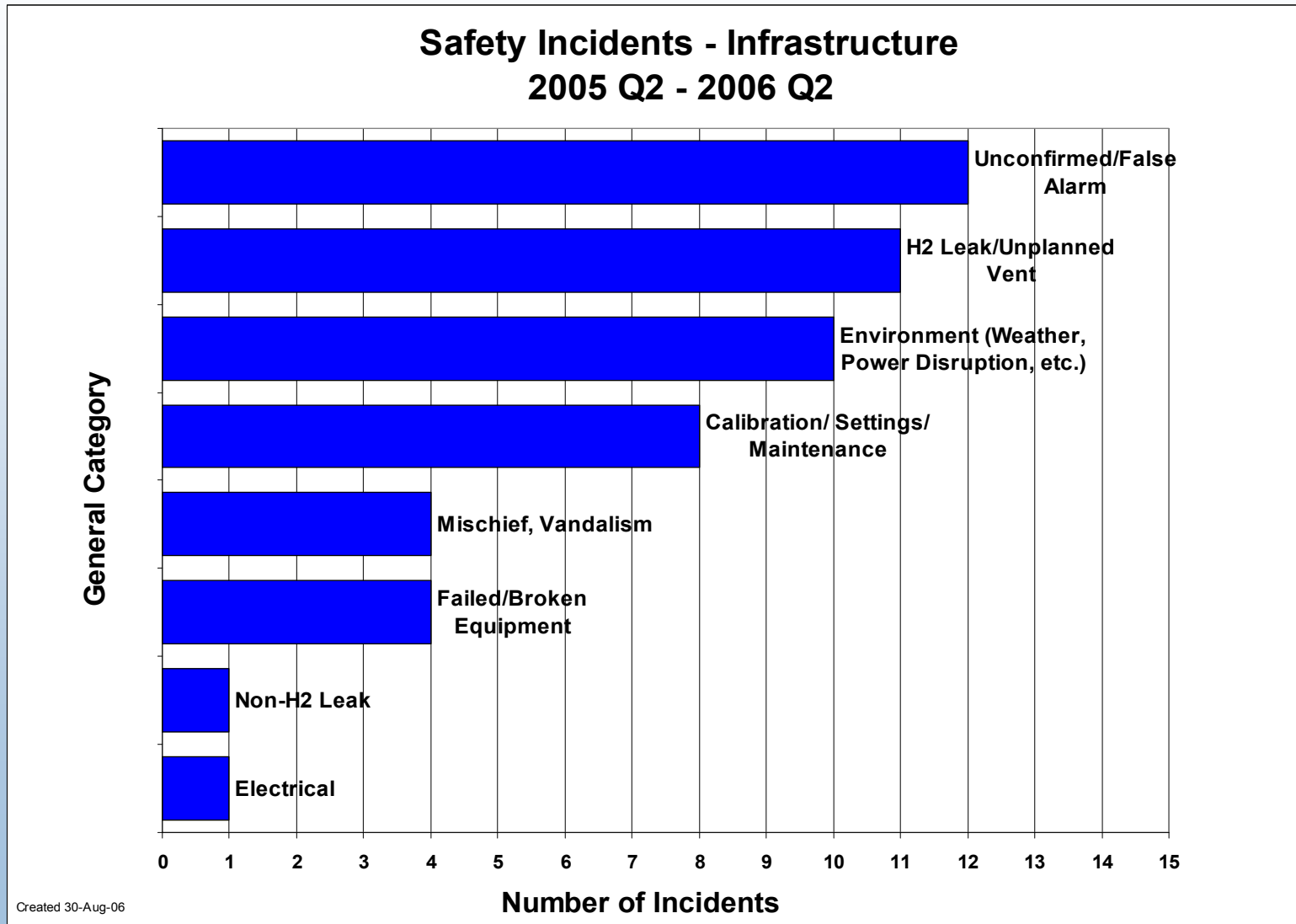
¹Some near-term targets have been achieved with compressed and liquid tanks. Emphasis is on advanced materials-based technologies.

CDP#18: Histogram: Refueling Rate



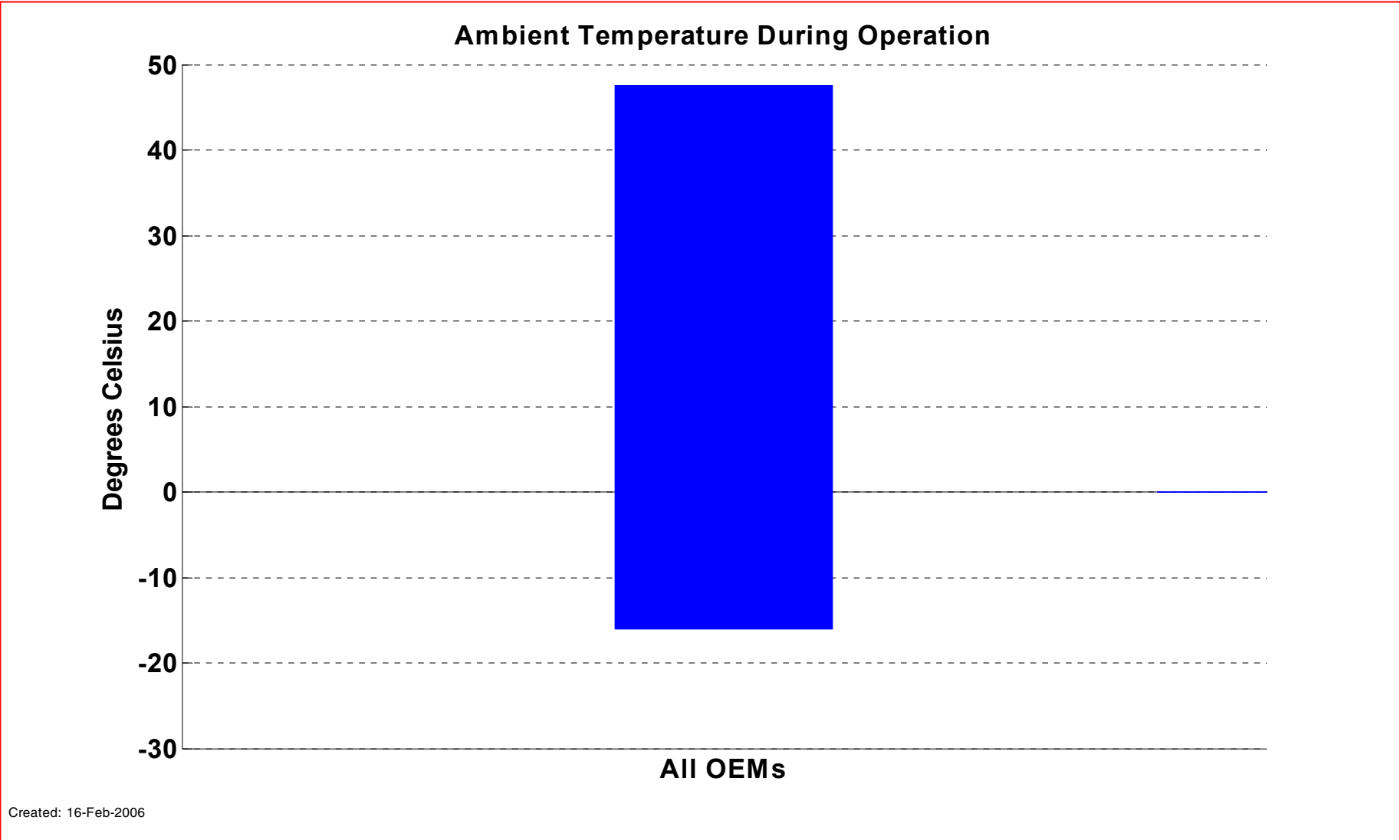
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CDP#20: Safety Incidents – Infrastructure



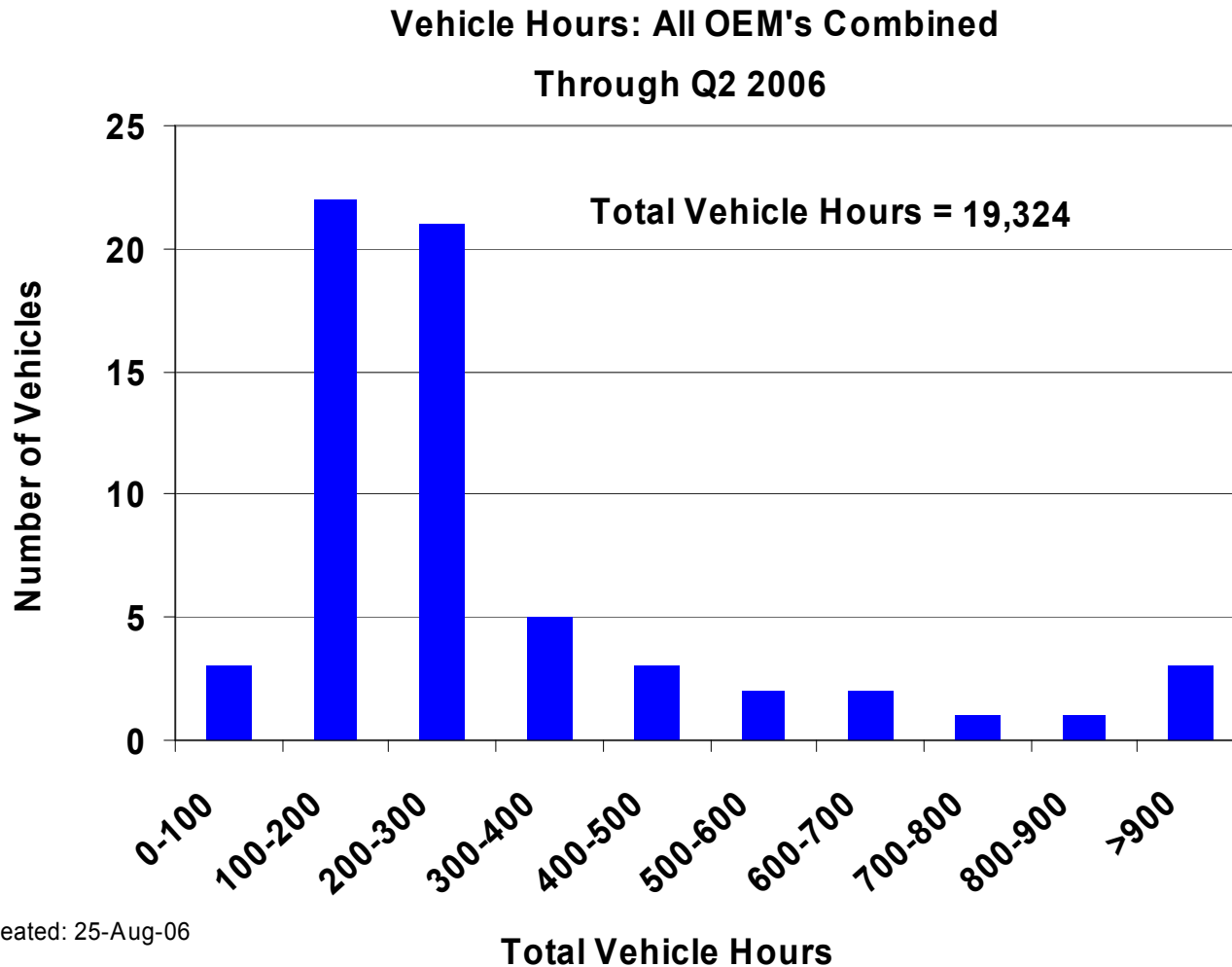
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CDP#21: Range of Ambient Temperature During Vehicle Operation



Created: 16-Feb-2006

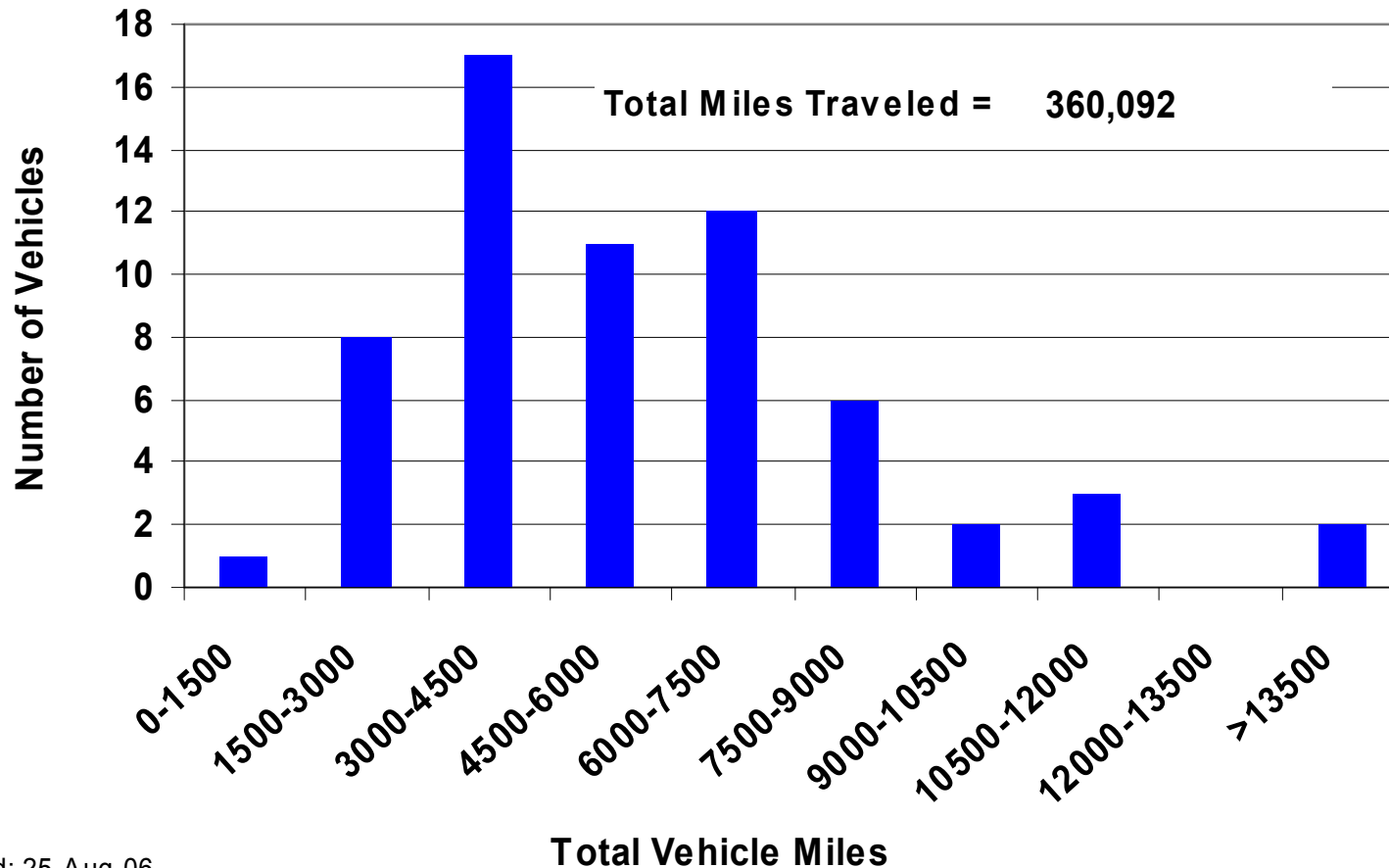
CDP#22: Vehicle Operating Hours



Created: 25-Aug-06

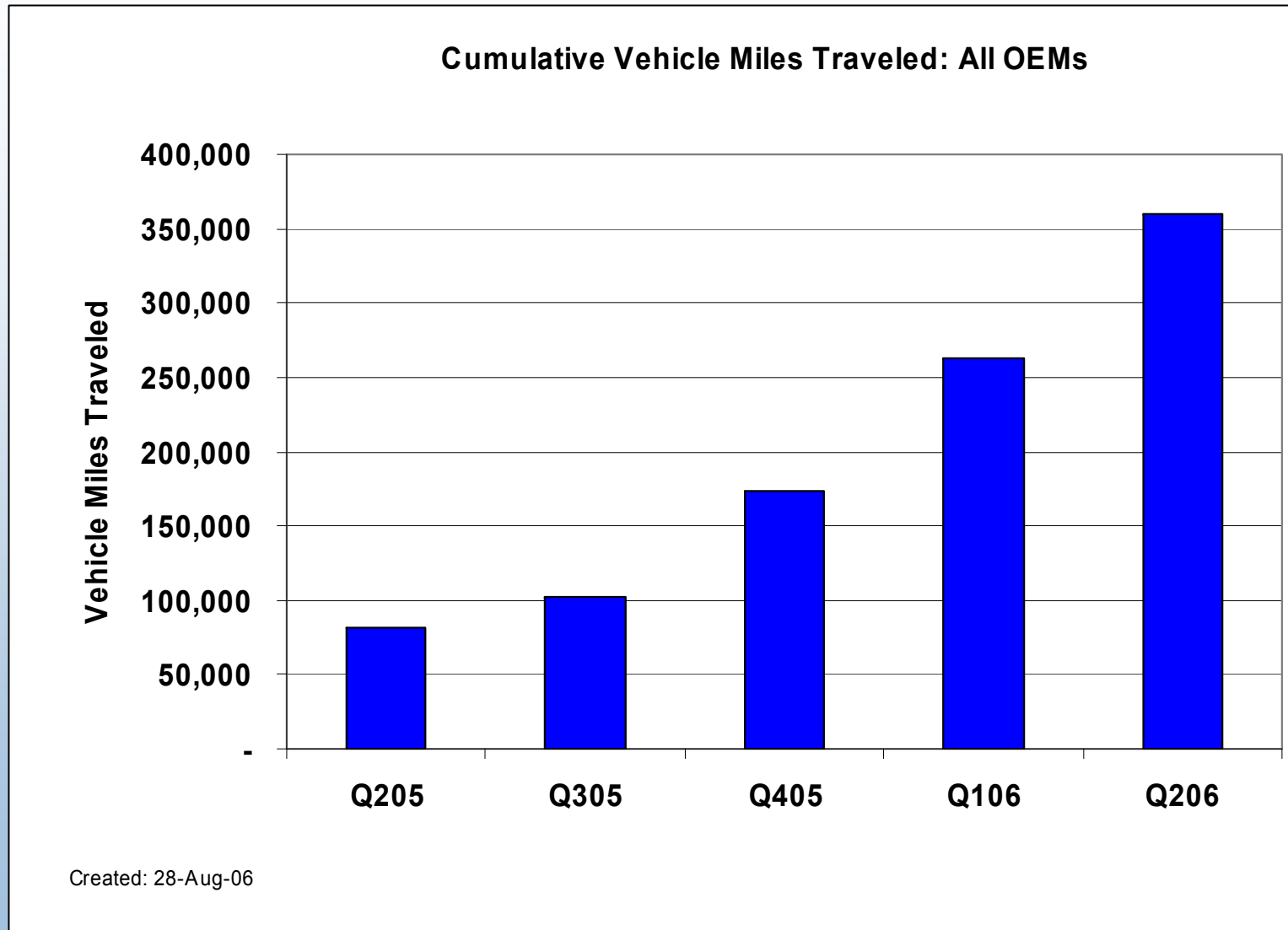
CDP#23: Vehicles vs. Miles Traveled

Vehicle Miles: All OEMs Combined
Through Q2 2006

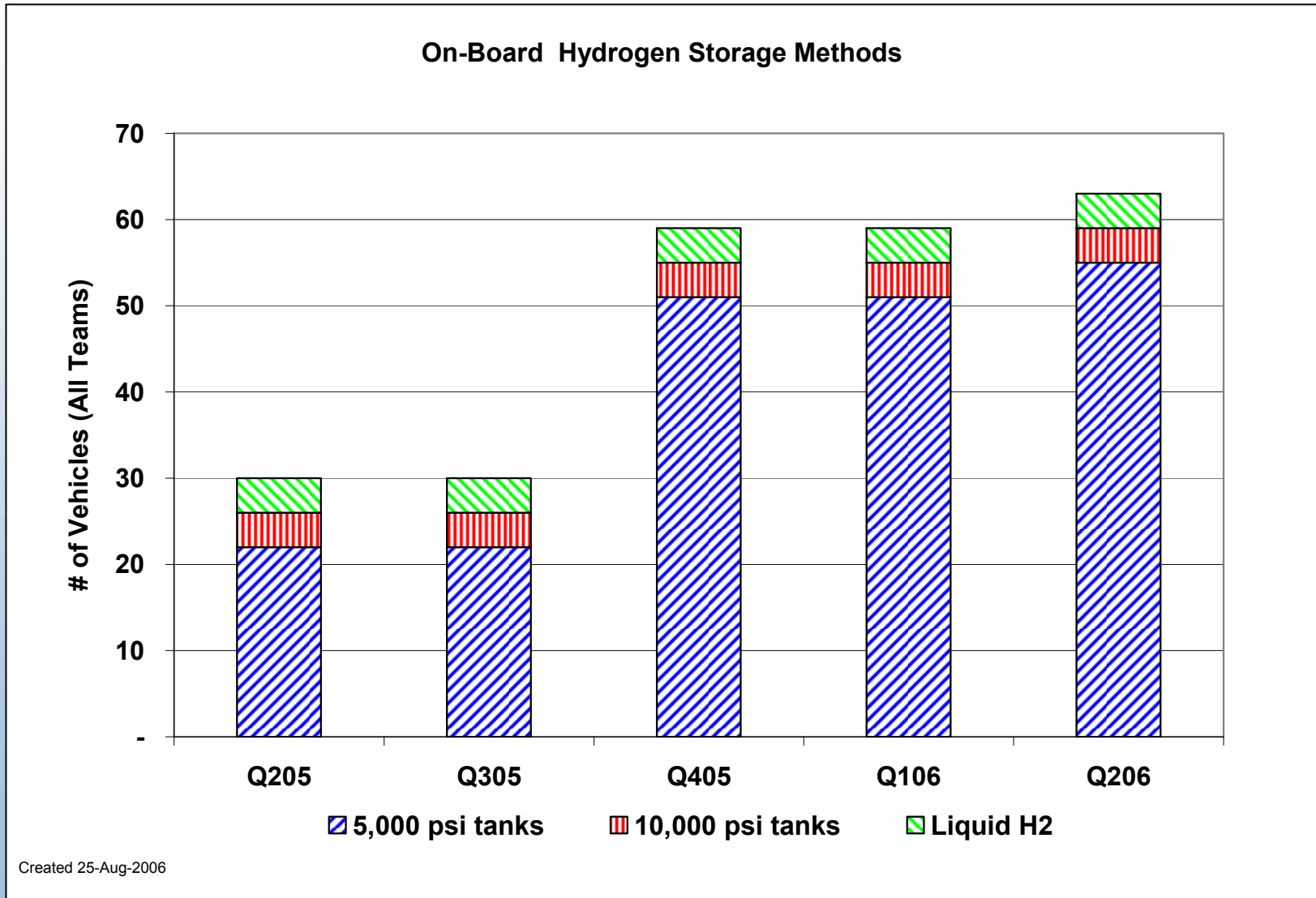


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CDP#24: Cumulative Vehicle Miles Traveled

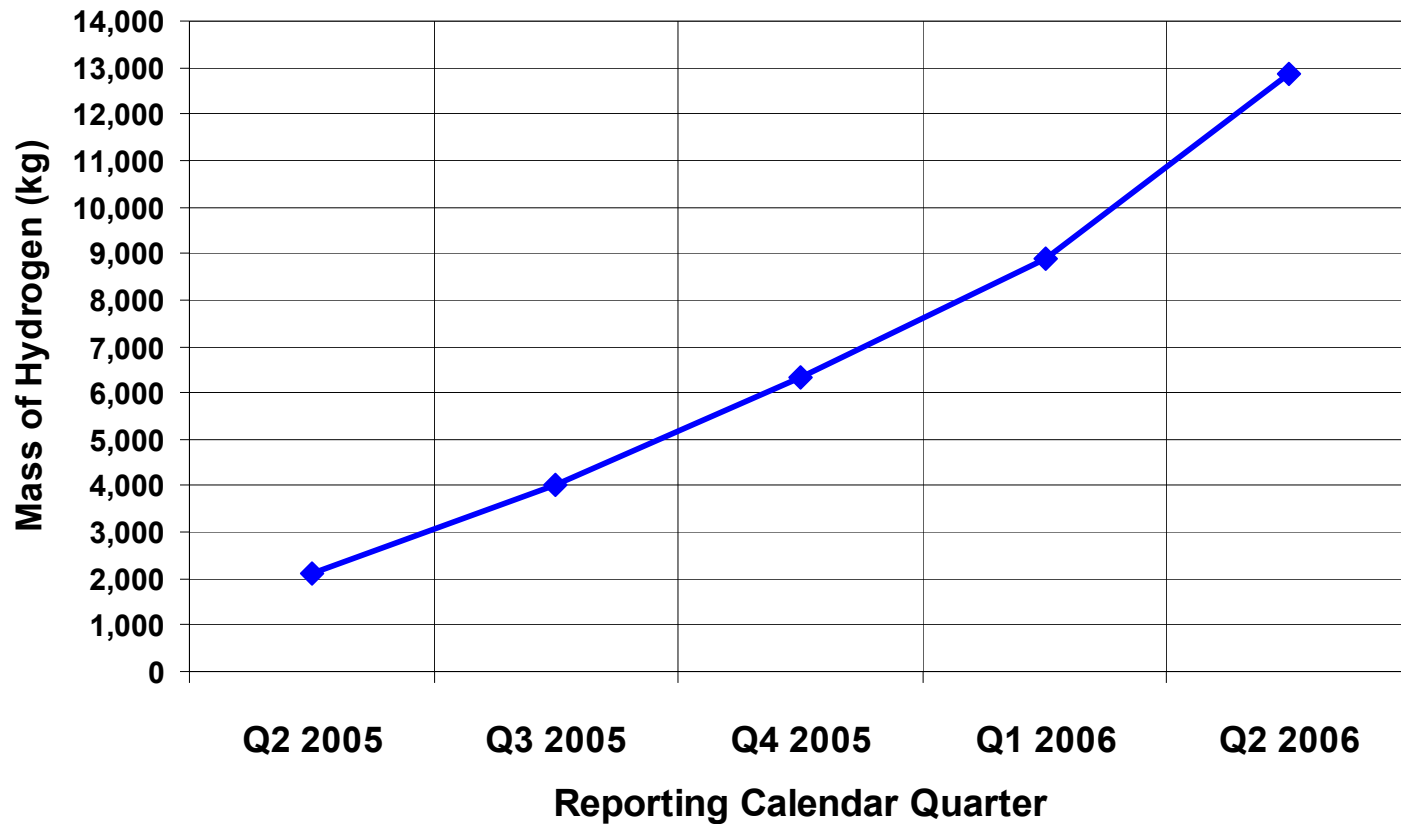


CDP#25: Vehicle H2 Storage Technologies



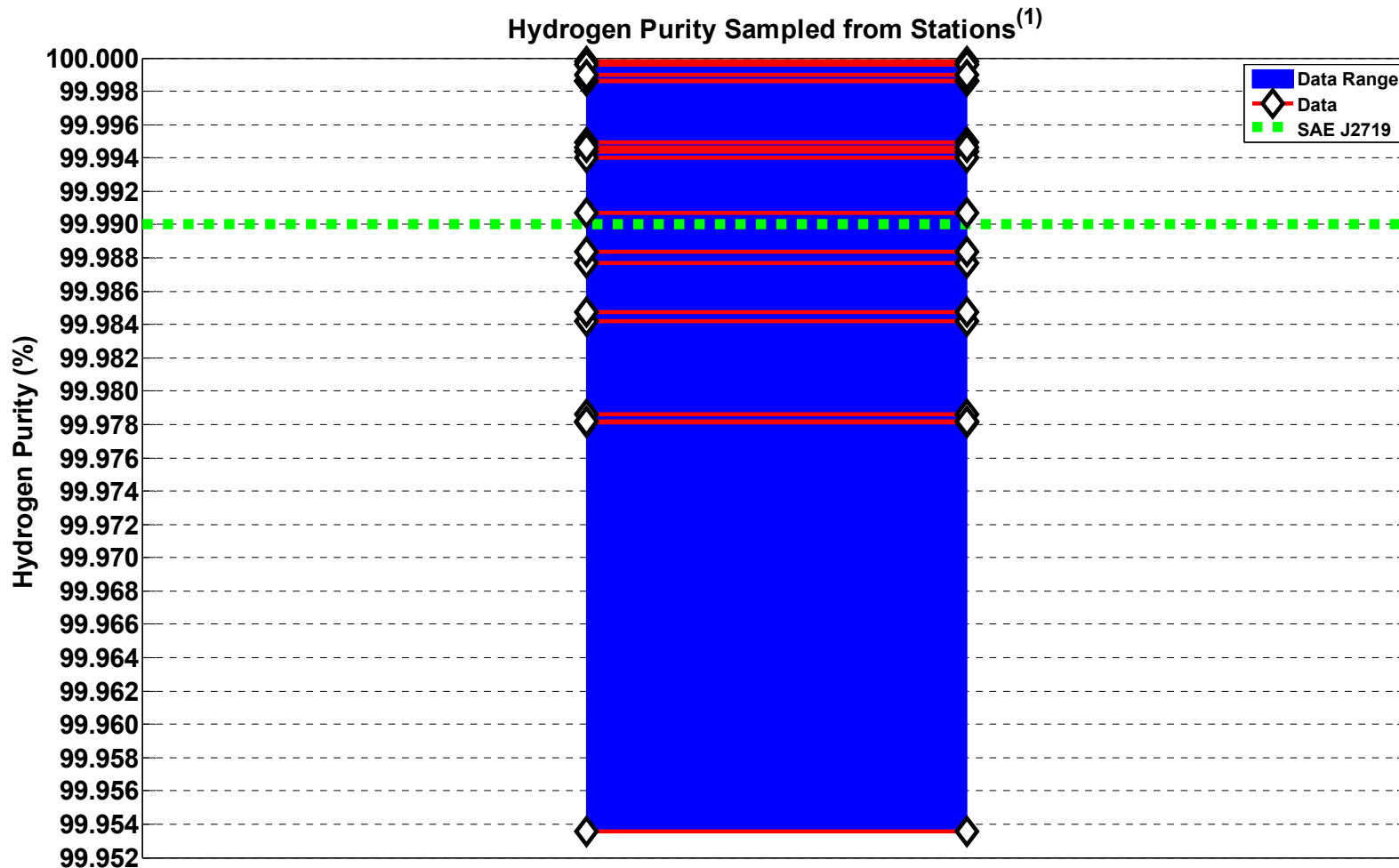
CDP#26: Cumulative H2 Produced or Dispensed

Cumulative Hydrogen Produced or Dispensed All Teams



Created 24-Aug-2006

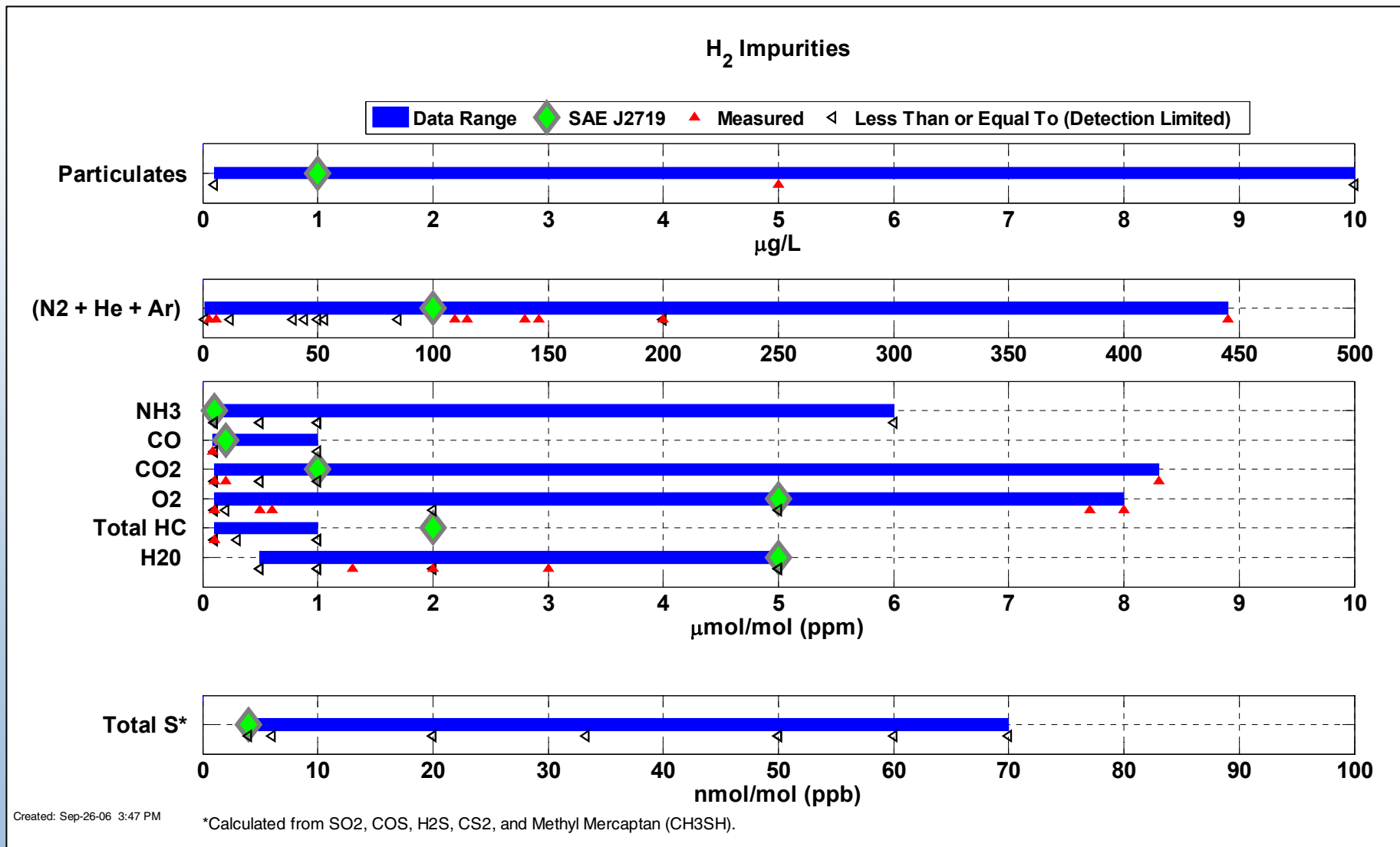
CDP#27: Hydrogen Purity Scatter Plot



(1) Includes sampling from both electrolysis and reforming

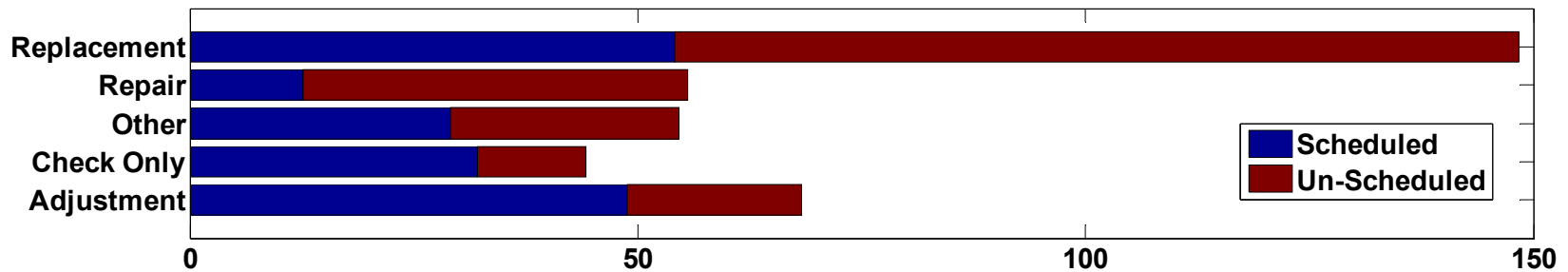
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CDP #28: Hydrogen Impurities Scatter Plot

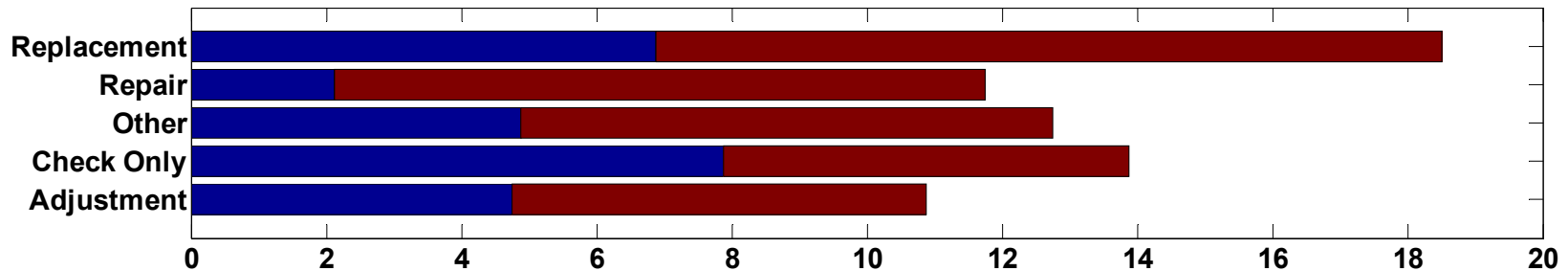


CDP#30: Infrastructure Maintenance

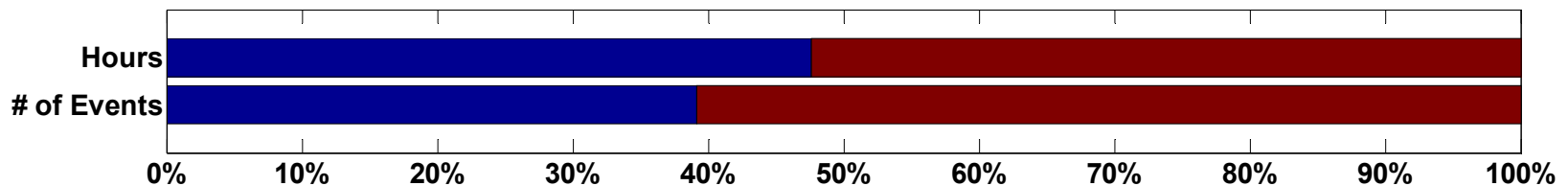
Maintenance: Average Labor Hours Per Station Since Inception



Maintenance: Average Number of Events Per Station Since Inception

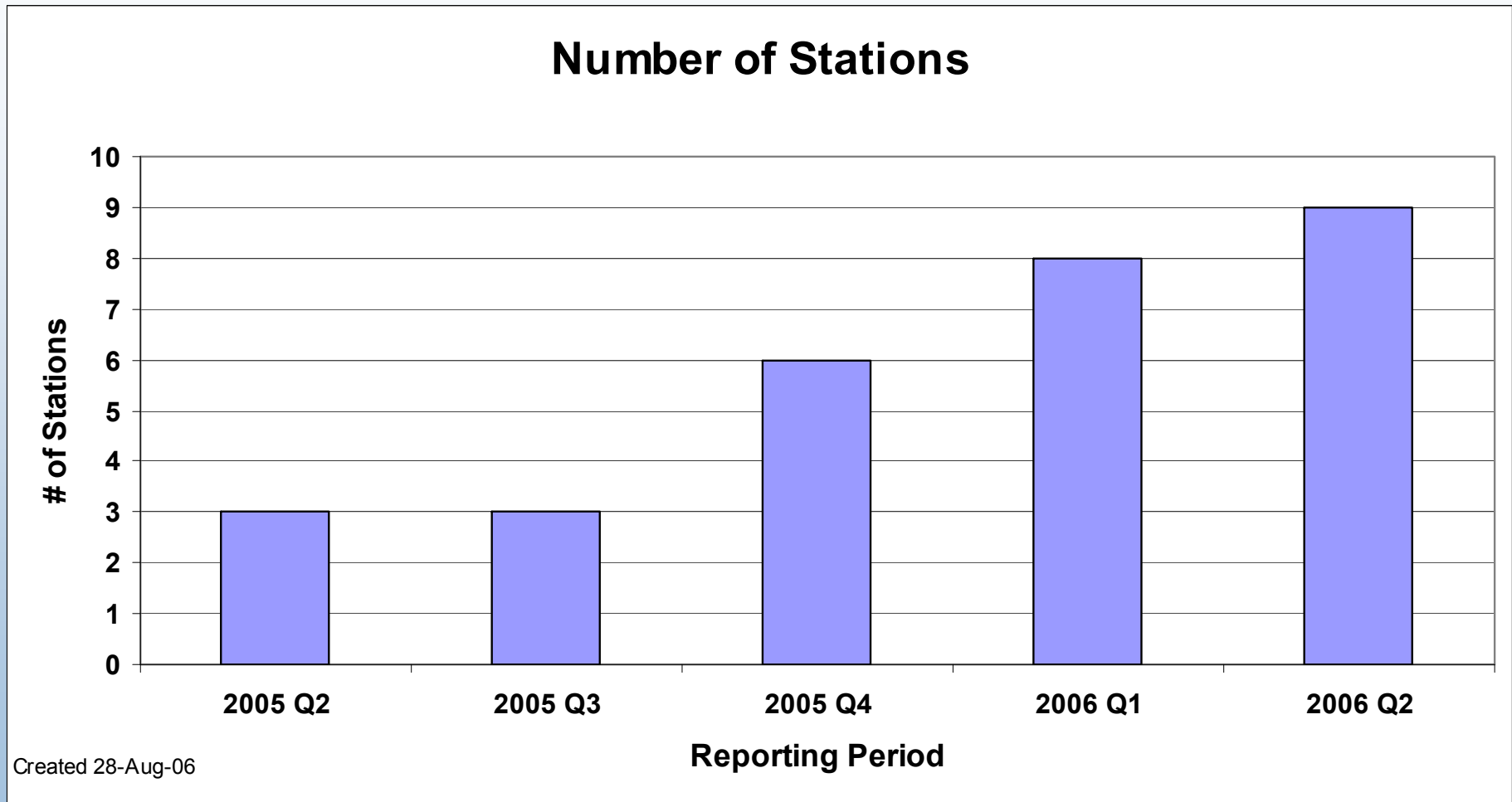


Comparison of Scheduled/Un-Scheduled Maintenance

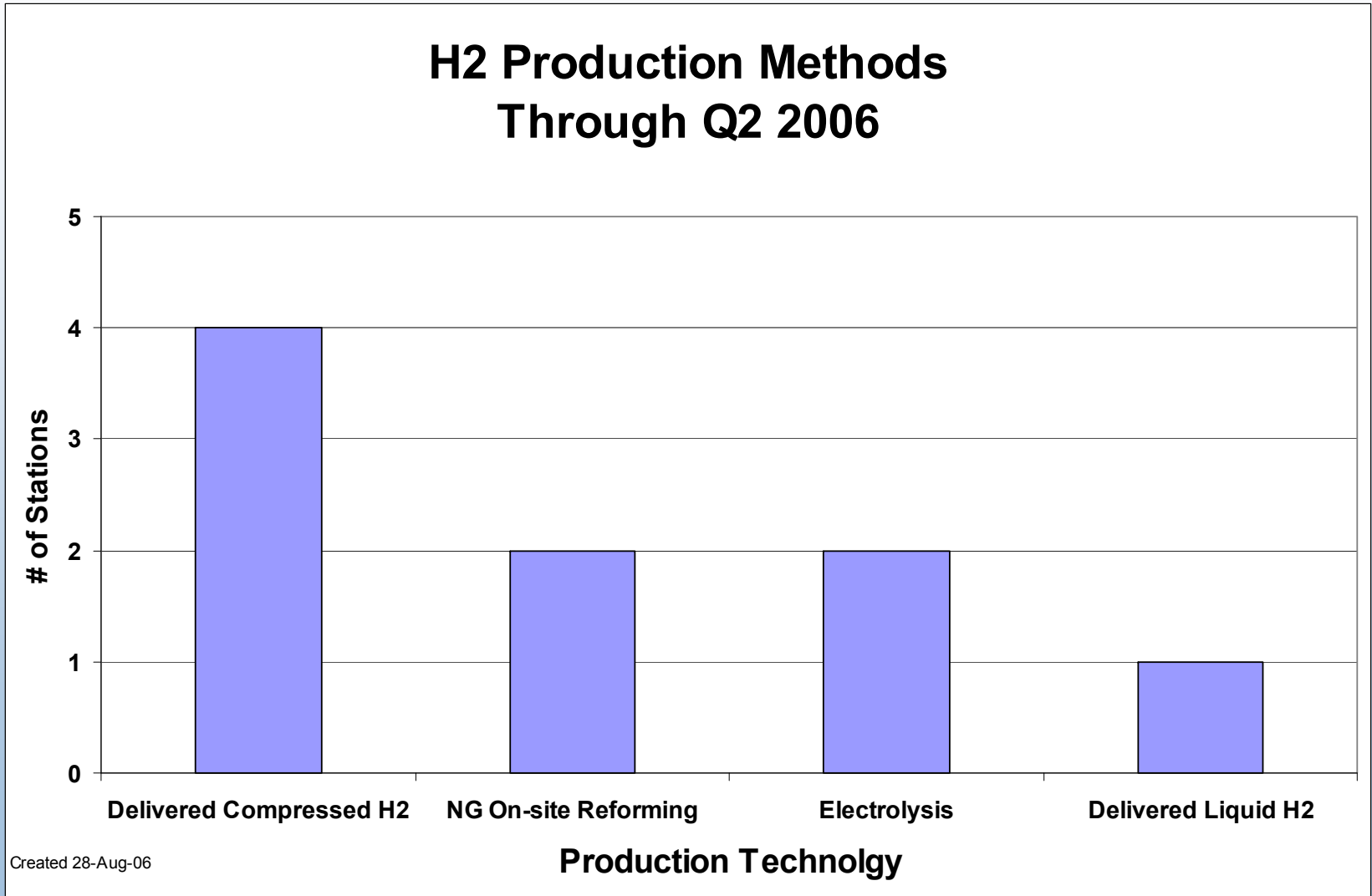


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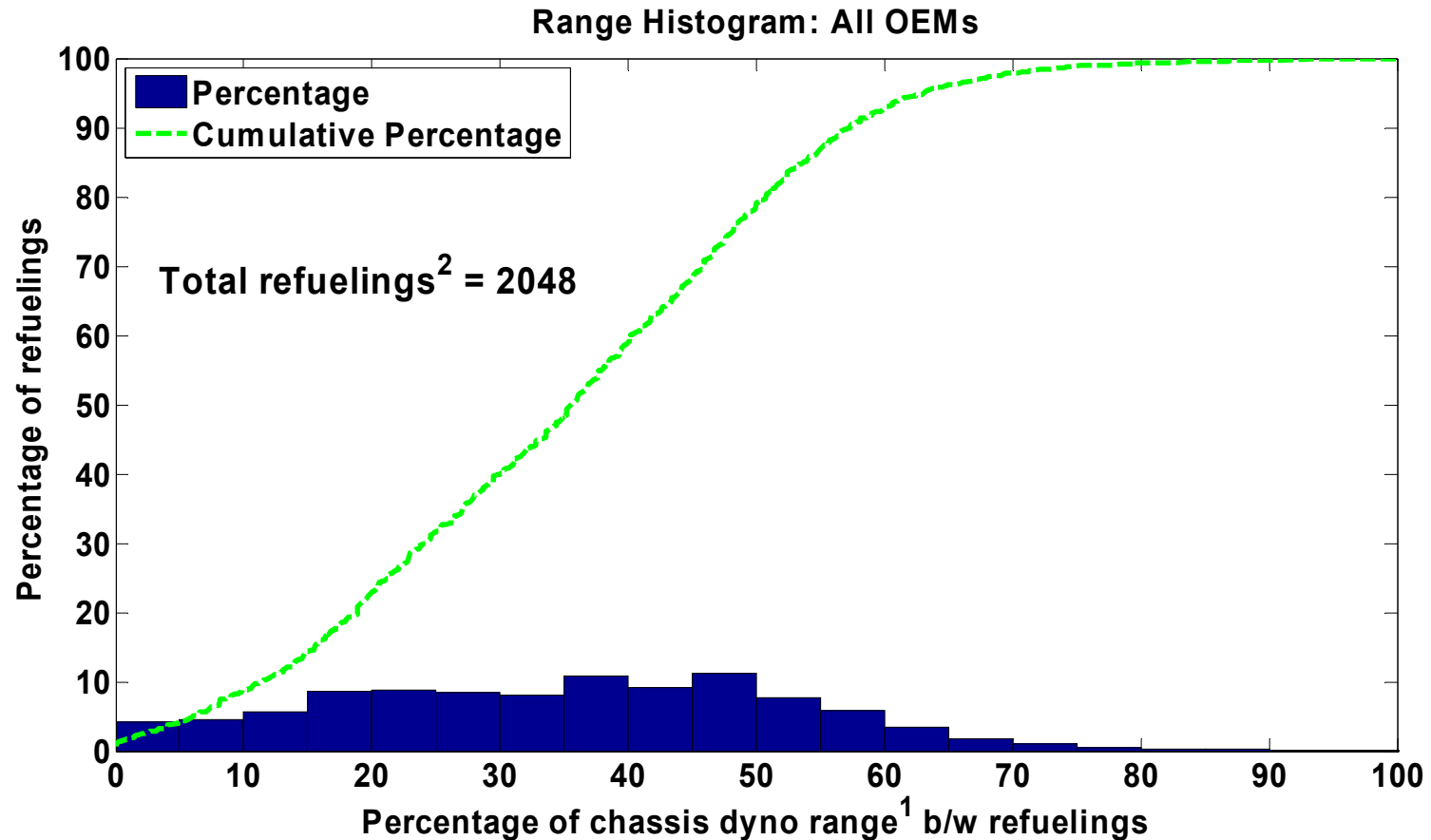
CDP#31: Number of Reporting Stations



CDP#32: Hydrogen Production Methods



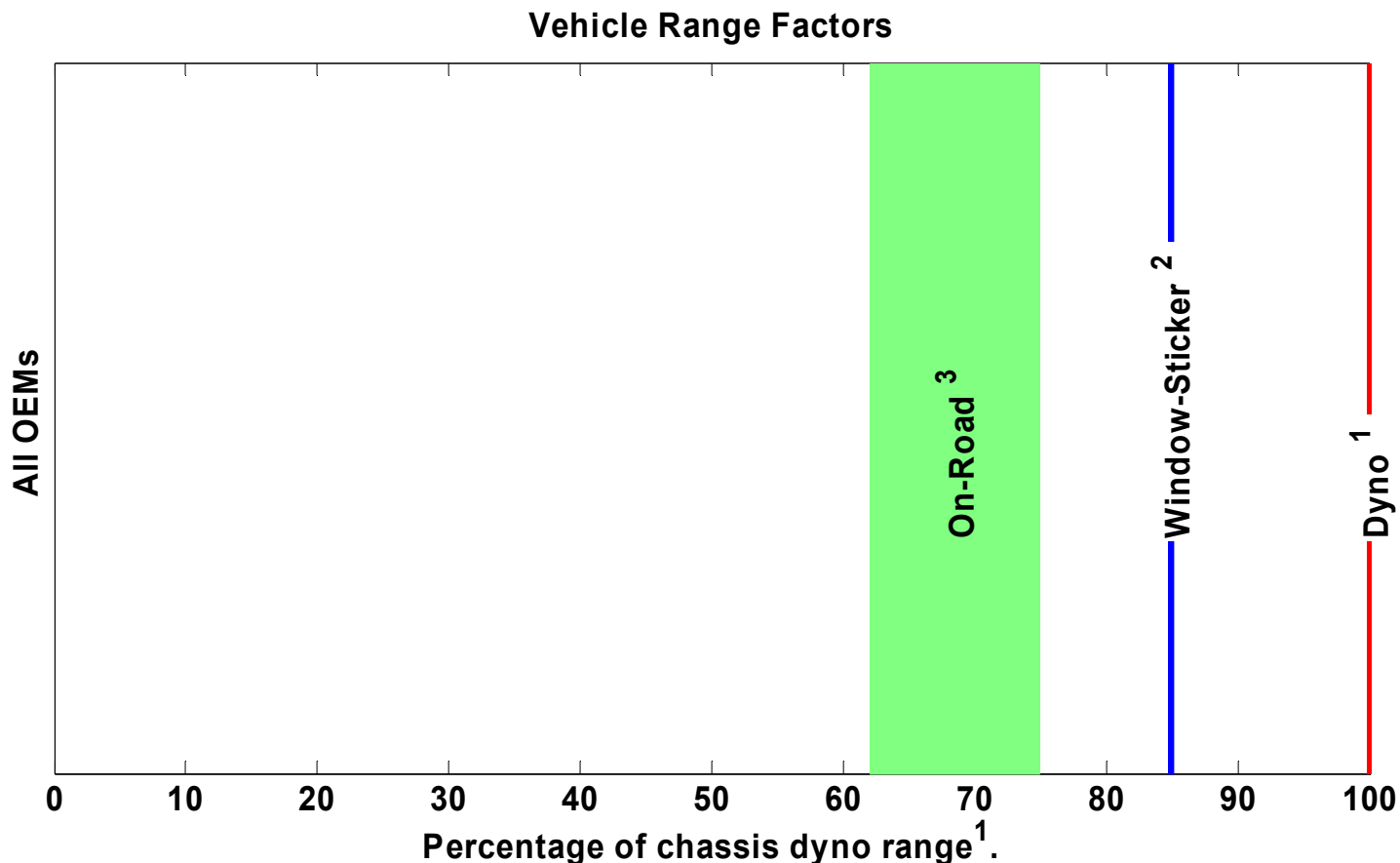
CDP#33: Percentage of Theoretical Range Between Refuelings



1. Range calculated using the combined city/hwy fuel economy from dyno testing (not EPA adjusted) and usable fuel on board.
2. Some refueling events are not detected/reported due to data noise or incompleteness.

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CDP#34: Effective Vehicle Range



1. Calculated using the combined city/hwy fuel economy from dyno testing (non-adjusted) and usable fuel on board
2. Applying window-sticker correction factors for fuel economy: $0.78 \times \text{Hwy}$ and $0.9 \times \text{City}$
3. Using fuel-economy from on-road data (excluding trips > 1 mile, consistent with other data products)

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REPORT DOCUMENTATION PAGE

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