



State-of-the-art Fuel Cell Lab Data Durability Analysis CDPs



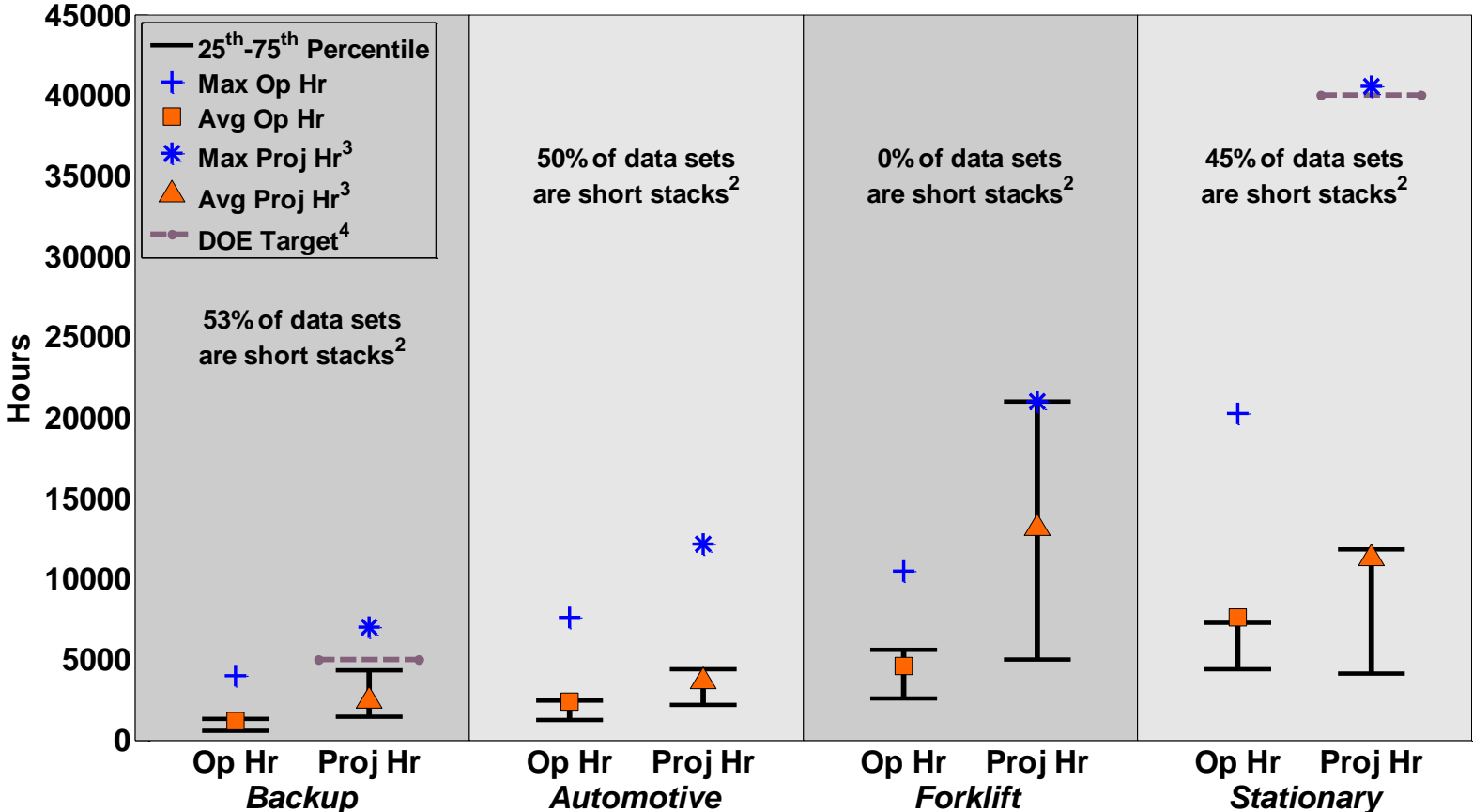
**2011
Composite Data
Products**

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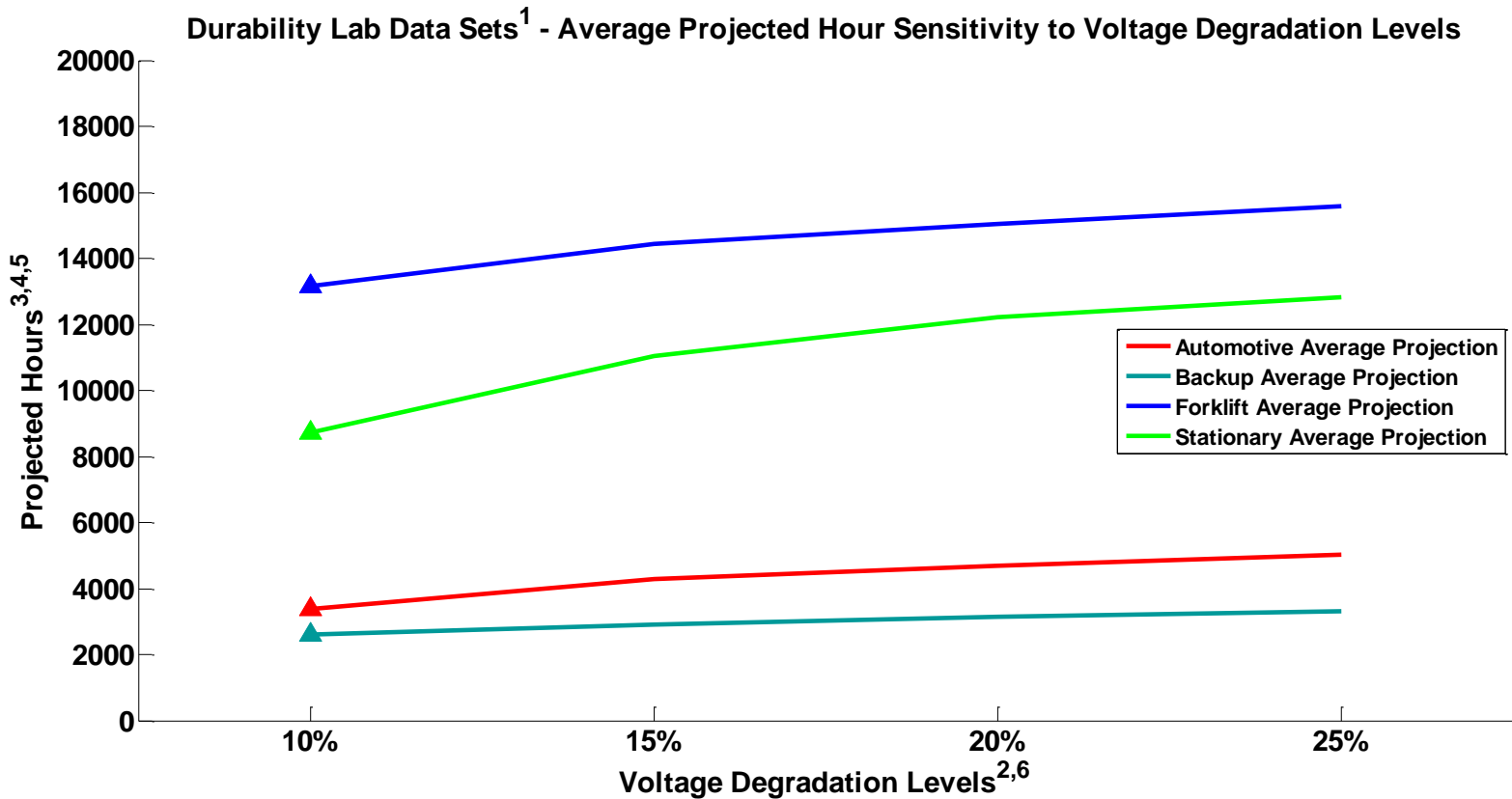
CDP#1: Lab Data Hours Accumulated and Projected Hours to 10% Stack Voltage Degradation

Operation Hours and Projected Hours to 10% Voltage Drop - Lab Data Sets¹



(1) At least 9 fuel cell developers supplied data. Analysis will be updated periodically.
 (2) PEM & SOFC data from lab tested, full active area short stacks and systems with full stacks. Data generated from constant load, transient load, and accelerated testing between 2004 and early 2011.
 (3) The DOE 10% voltage degradation metric is used for assessing voltage degradation; it may not be the same as end-of-life criteria and does not address catastrophic failure modes.
 (4) DOE targets are for real-world applications; refer to Hydrogen, Fuel Cells, & Infrastructure Technologies Program Plan.

CDP#2: Durability Lab Data Projection Sensitivity to Voltage Degradation Levels



- (1) PEM & SOFC data from lab tested, full active area short stacks and systems with full stacks. Data generated from constant load, transient load, and accelerated testing between 2004 and early 2011.
- (2) 10% Voltage degradation is a DOE metric for assessing fuel cell performance.
- (3) Curves generated using the average of each application at various voltage degradation levels.
- (4) The projection curves display the sensitivity to percentage of voltage degradation, but the projections do not imply that all stacks will (or do) operate at these voltage degradation levels.
- (5) Projections may be limited by demonstrated operation hours to minimize extrapolations.
- (6) The voltage degradation levels are not an indication of an OEM's end-of-life criteria and do not address catastrophic stack failures such as membrane failure.

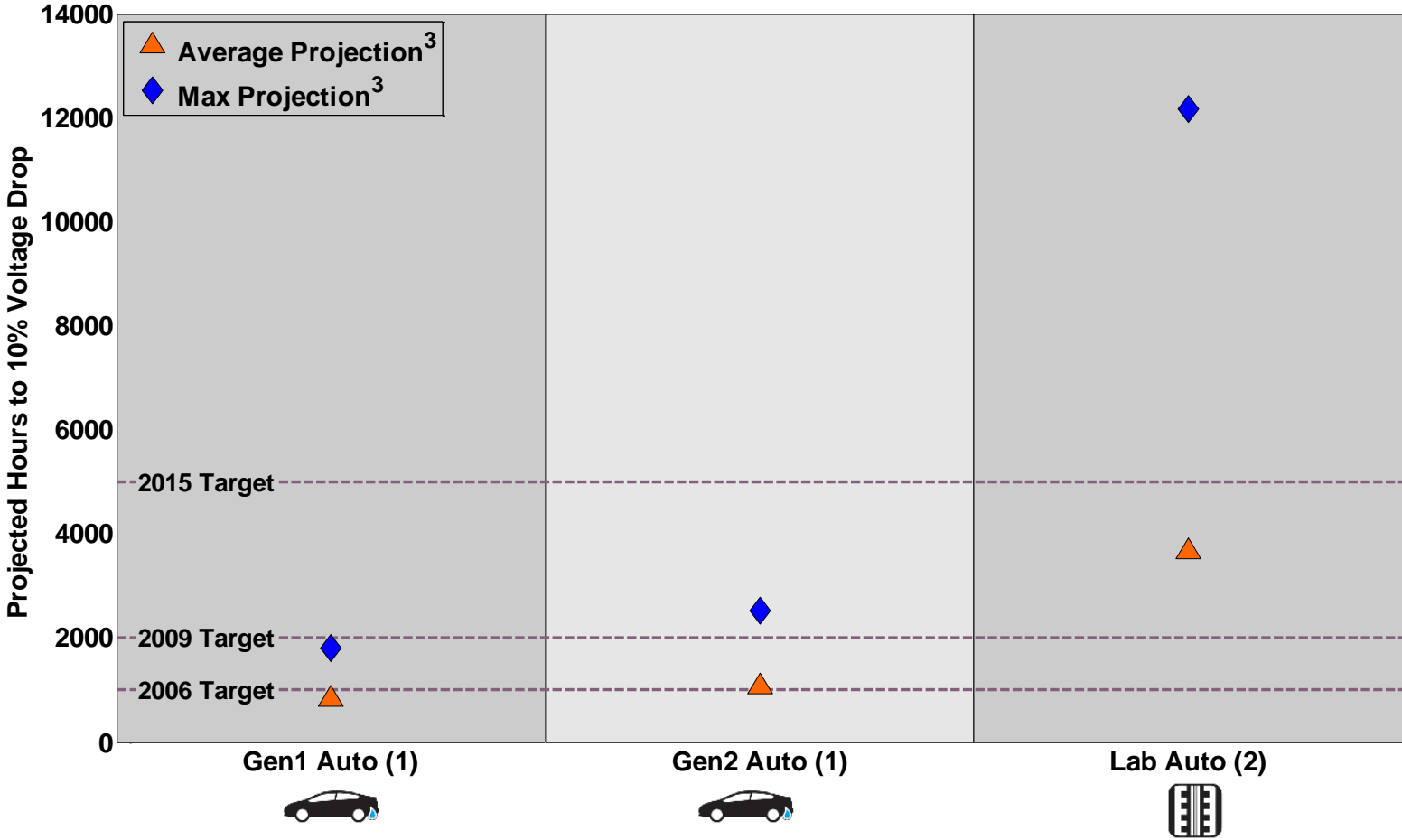


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CDP#3: Field and Lab Durability Projection Comparison CDP for Automotive Category

Comparison of Fuel Cell Vehicle Field and Lab Durability Projections



NREL cdp_lab_03

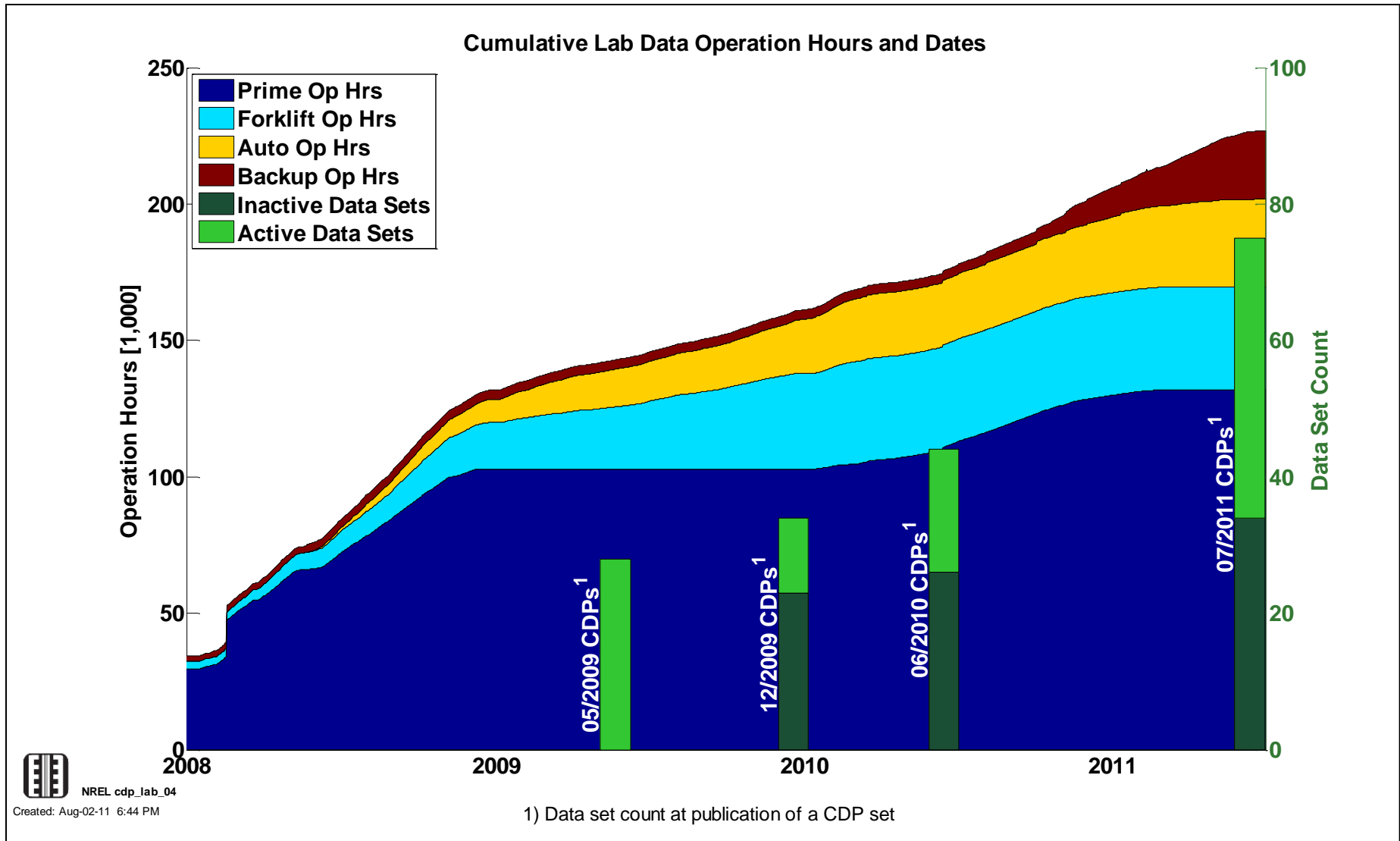
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(1) Gen1 and Gen2 Data from DOE's Learning Demonstration (2005 - 2010)

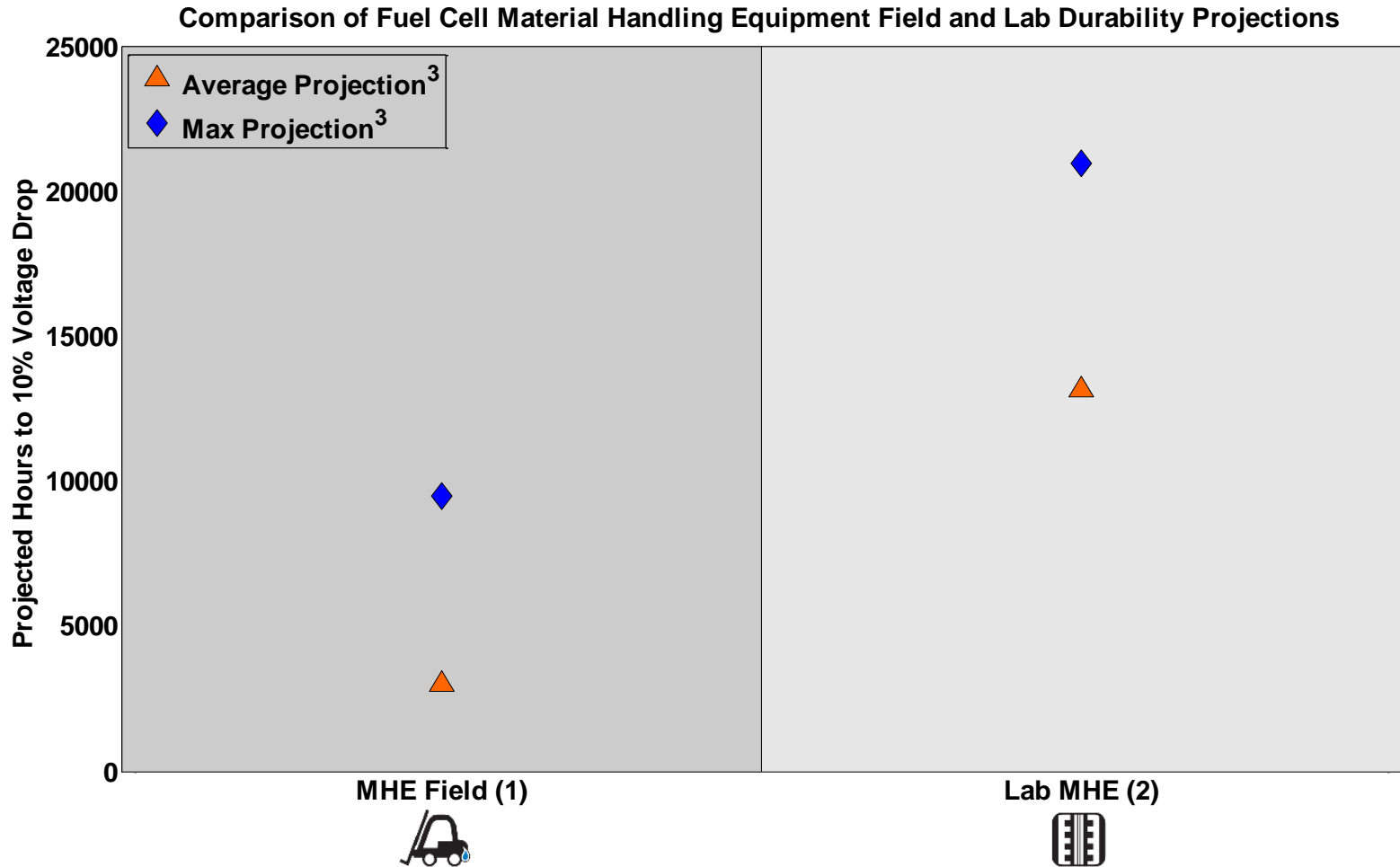
(2) Lab data providers may not be the same as participants in DOE's Learning Demonstration. 53% of data are full active area short stacks.

(3) The DOE 10% voltage degradation metric is used for assessing voltage degradation; it may not be the same as end-of-life criteria and does not address catastrophic failure modes.

CDP#4: Cumulative Operation Hours by Application and Number of Data Sets



CDP#5: Field and Lab Durability Projection Comparison CDP for MHE Category



NREL cdp_lab_05

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(1) MHE Data from DOE's Early Market Demonstration (2009 -)

(2) Lab data providers may not be the same as participants in DOE's Field Demonstration. 0% of data are full active area short stacks.

(3) The DOE 10% voltage degradation metric is used for assessing voltage degradation; it may not be the same as end-of-life criteria and does not address catastrophic failure modes.