



Fall 2010 Composite Data Products ARRA Material Handling Equipment

Quarter 3 of 2010

Composite Data Products
Final Version September 30, 2010

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Technical Report
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Fall 2010 Composite Data Products ARRA Material Handling Equipment

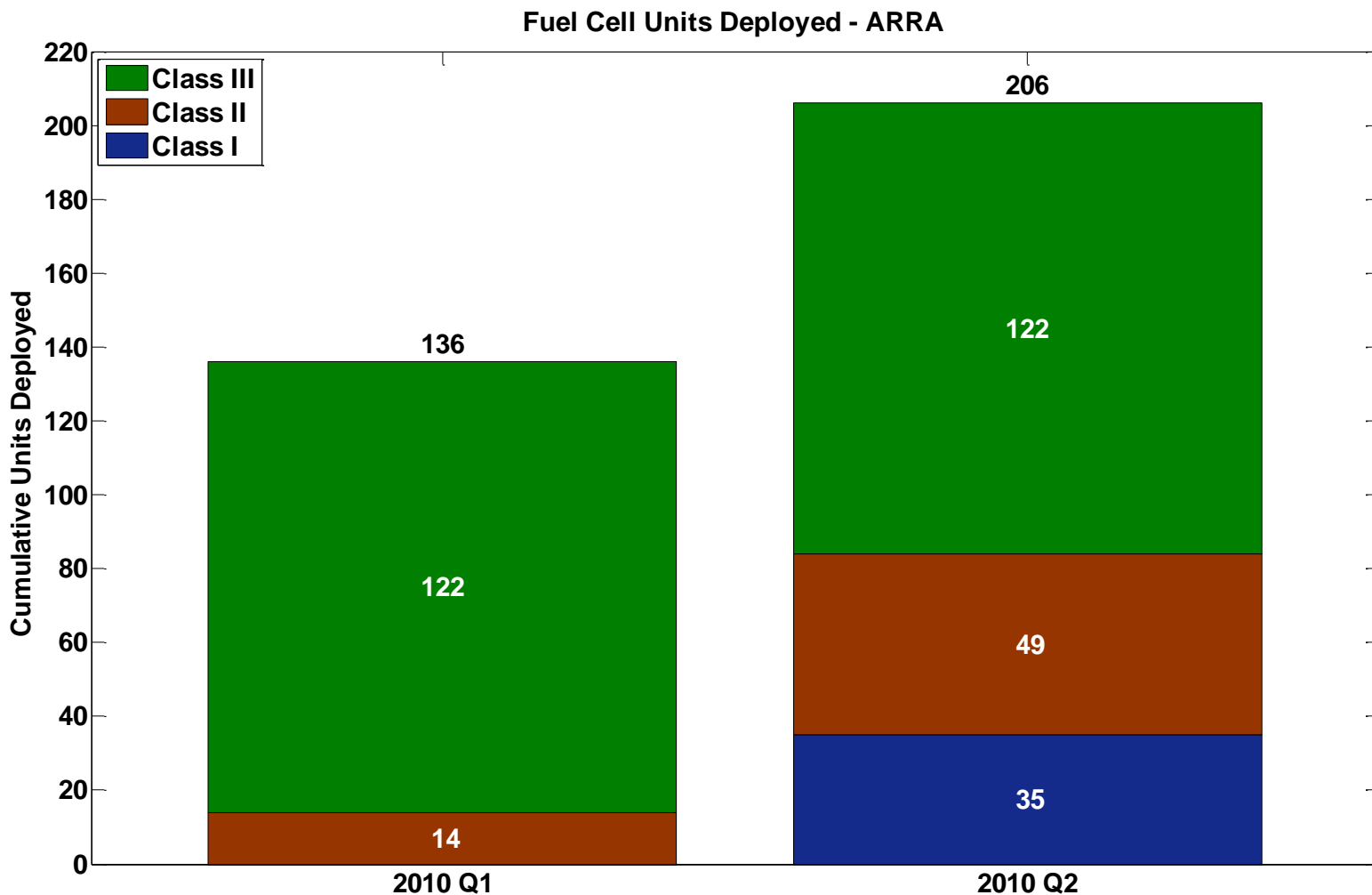


**J. Kurtz, K. Wipke, S.
Sprik, T. Ramsden**

September 30th, 2010

CDPARRA-MHE-01

Fuel Cell MHE Systems Deployed

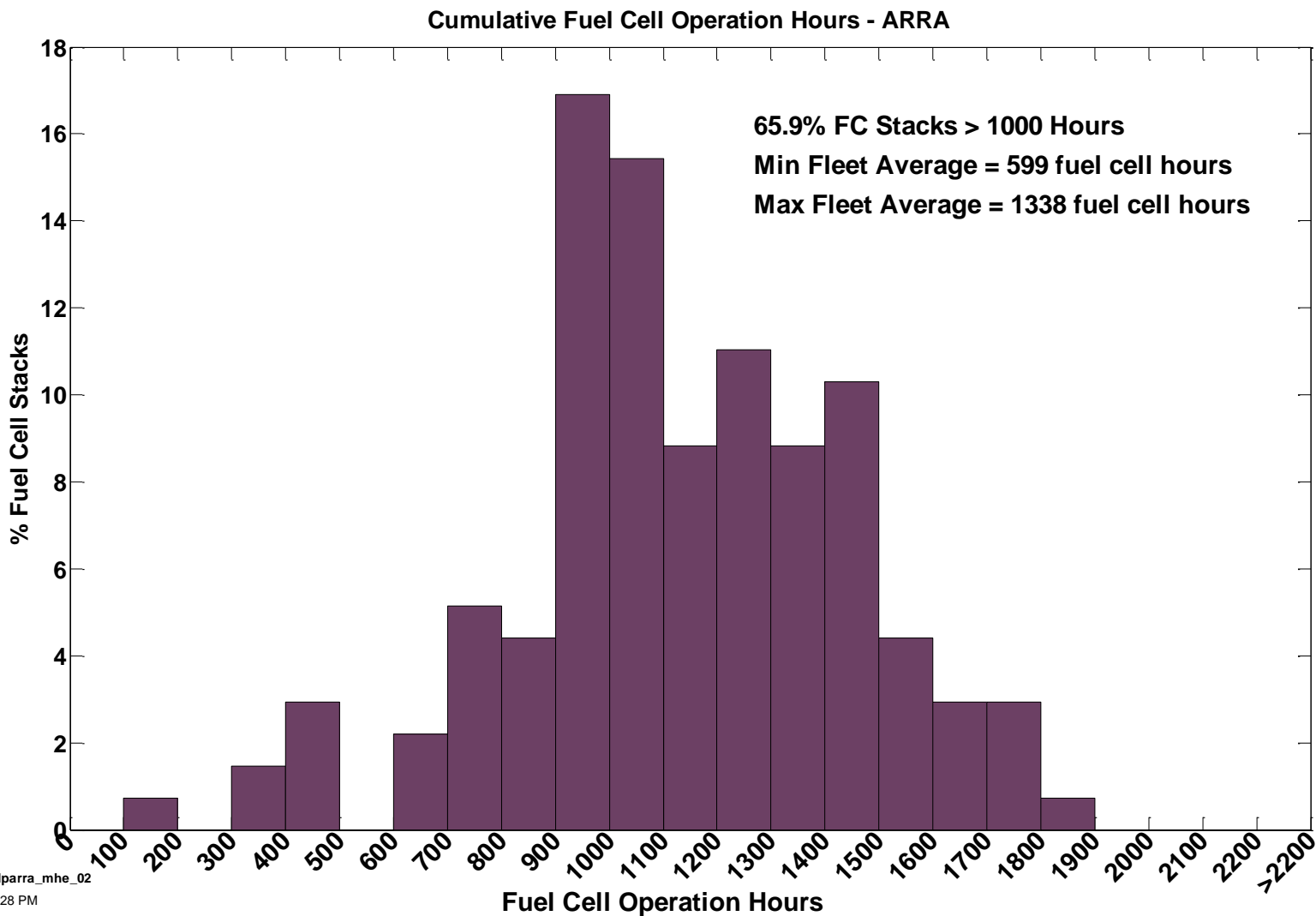


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CDPARRA-MHE-02

Fuel Cell Operation Hours



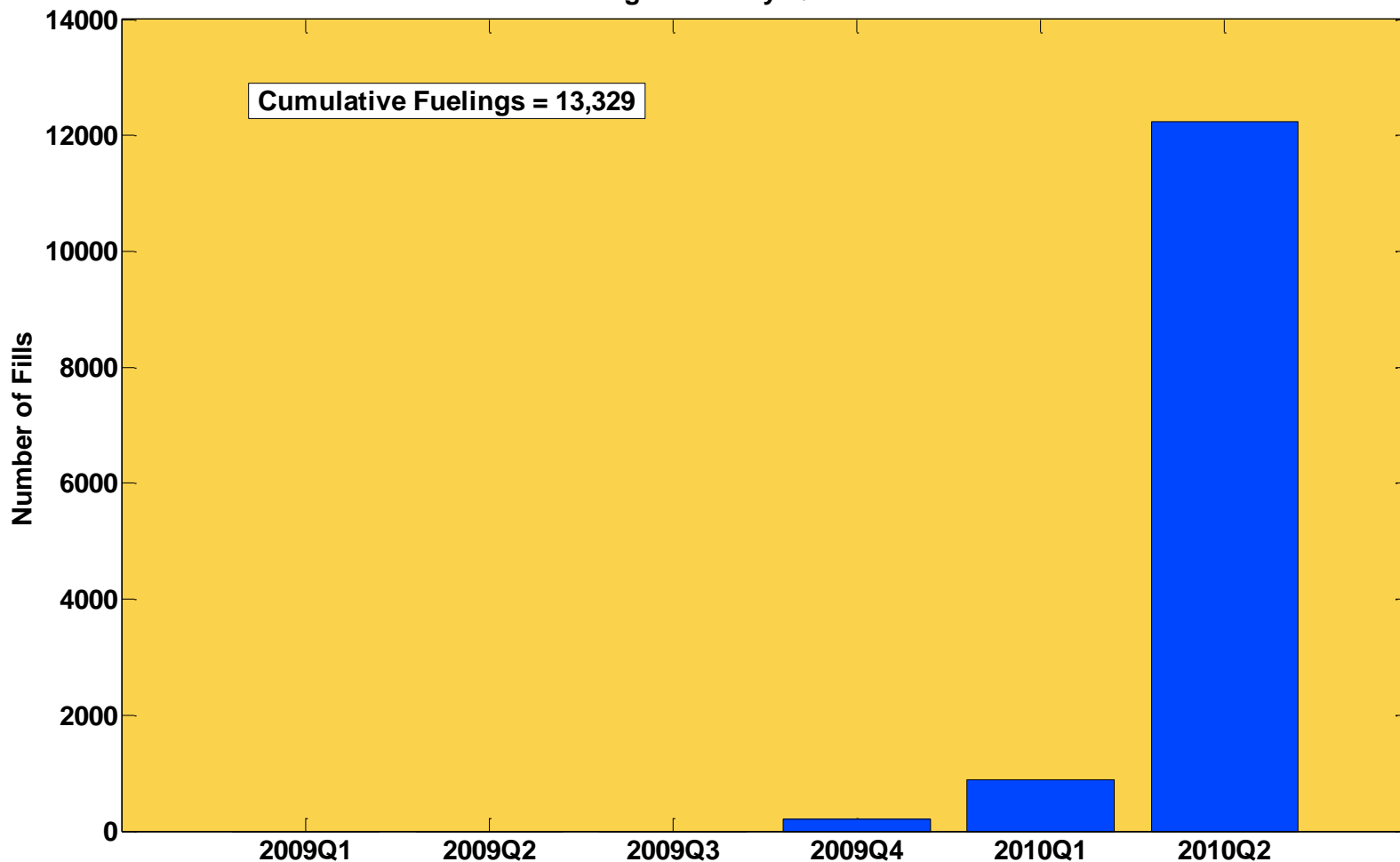
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CDPARRA-MHE-03

Fueling Events by Quarter

Fueling Events By Quarter - ARRA

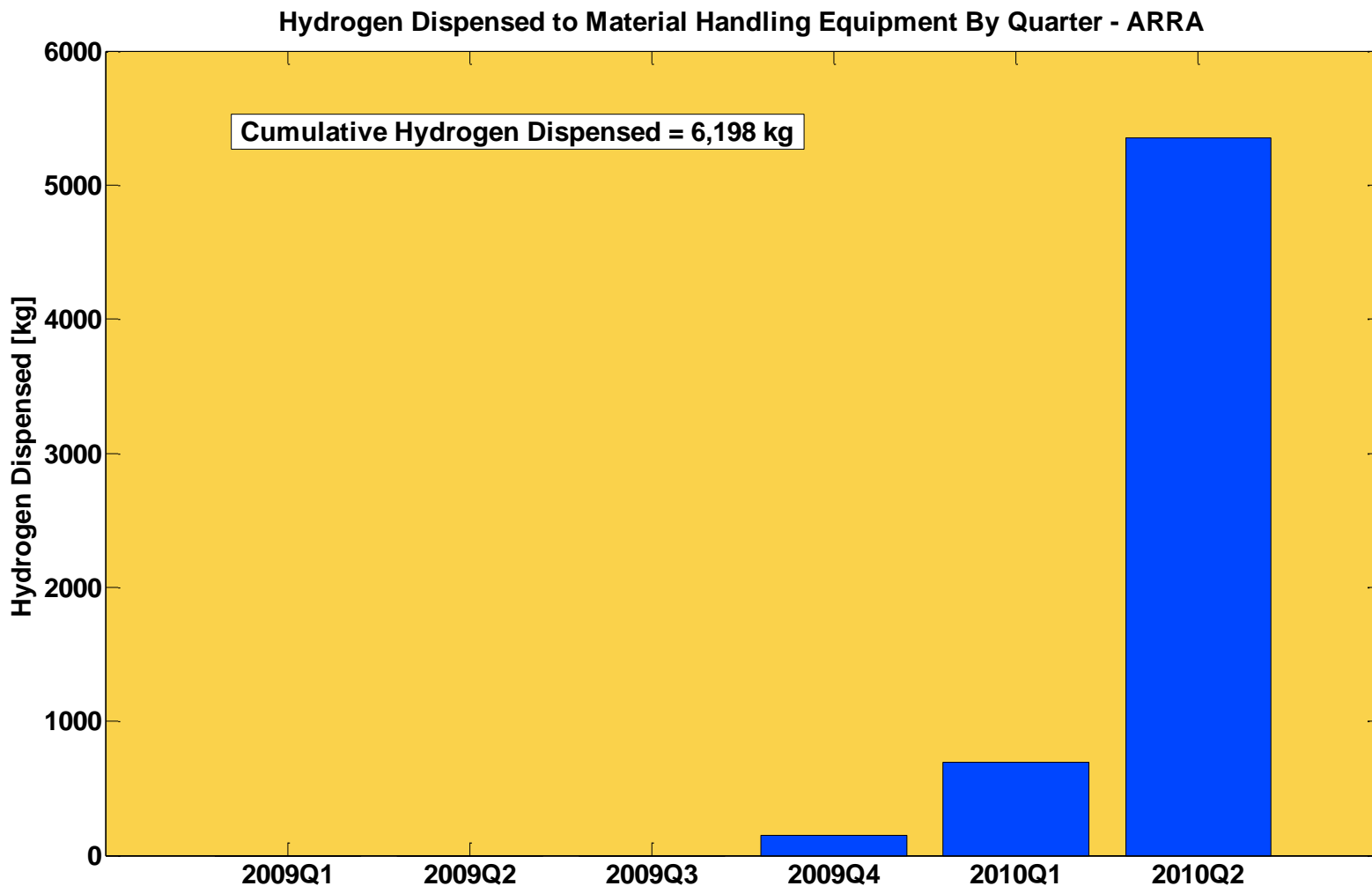


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CDPARRA-MHE-04

Hydrogen Dispensed by Quarter

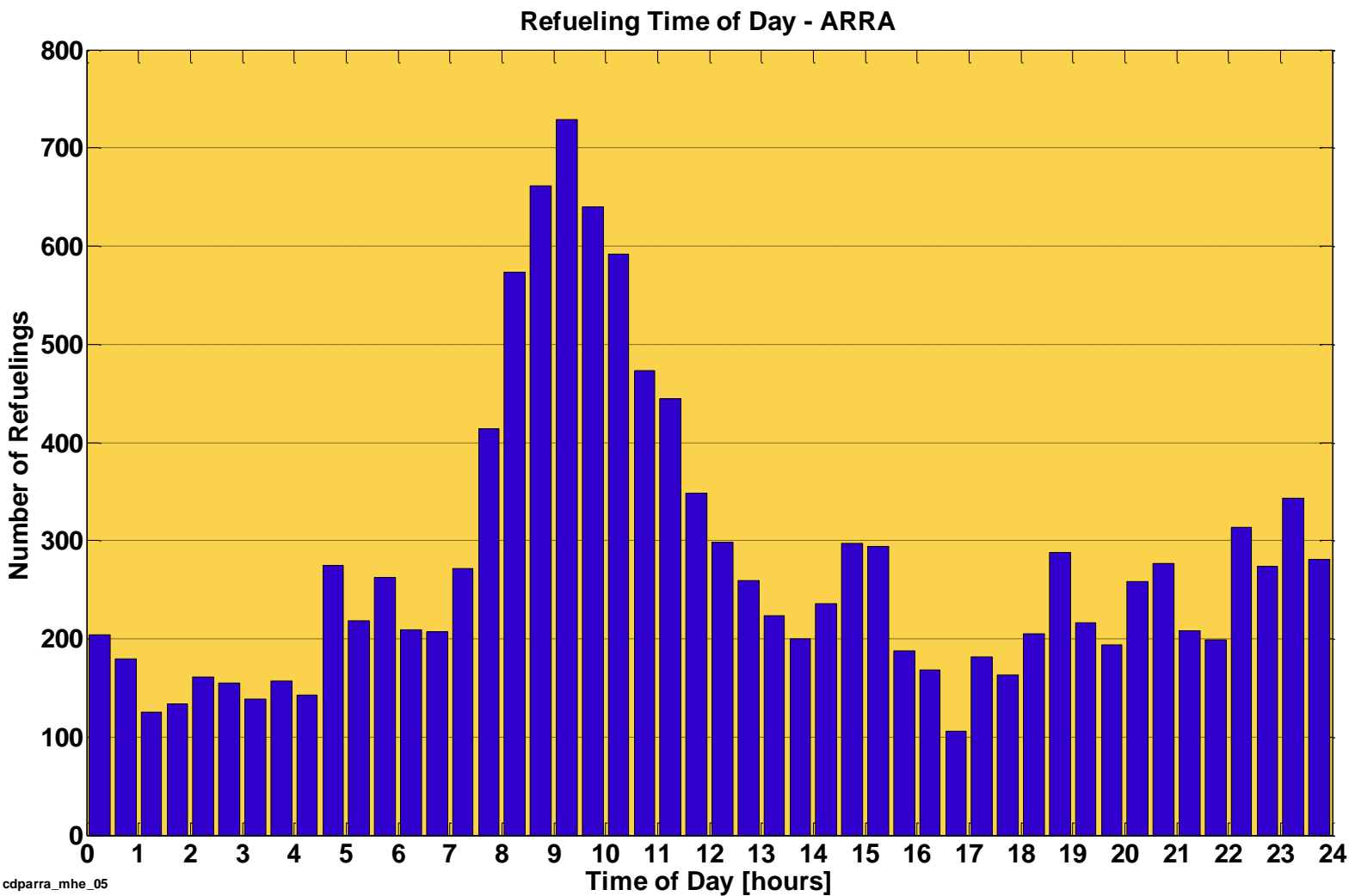


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CDPARRA-MHE-05

Refueling Time of Day



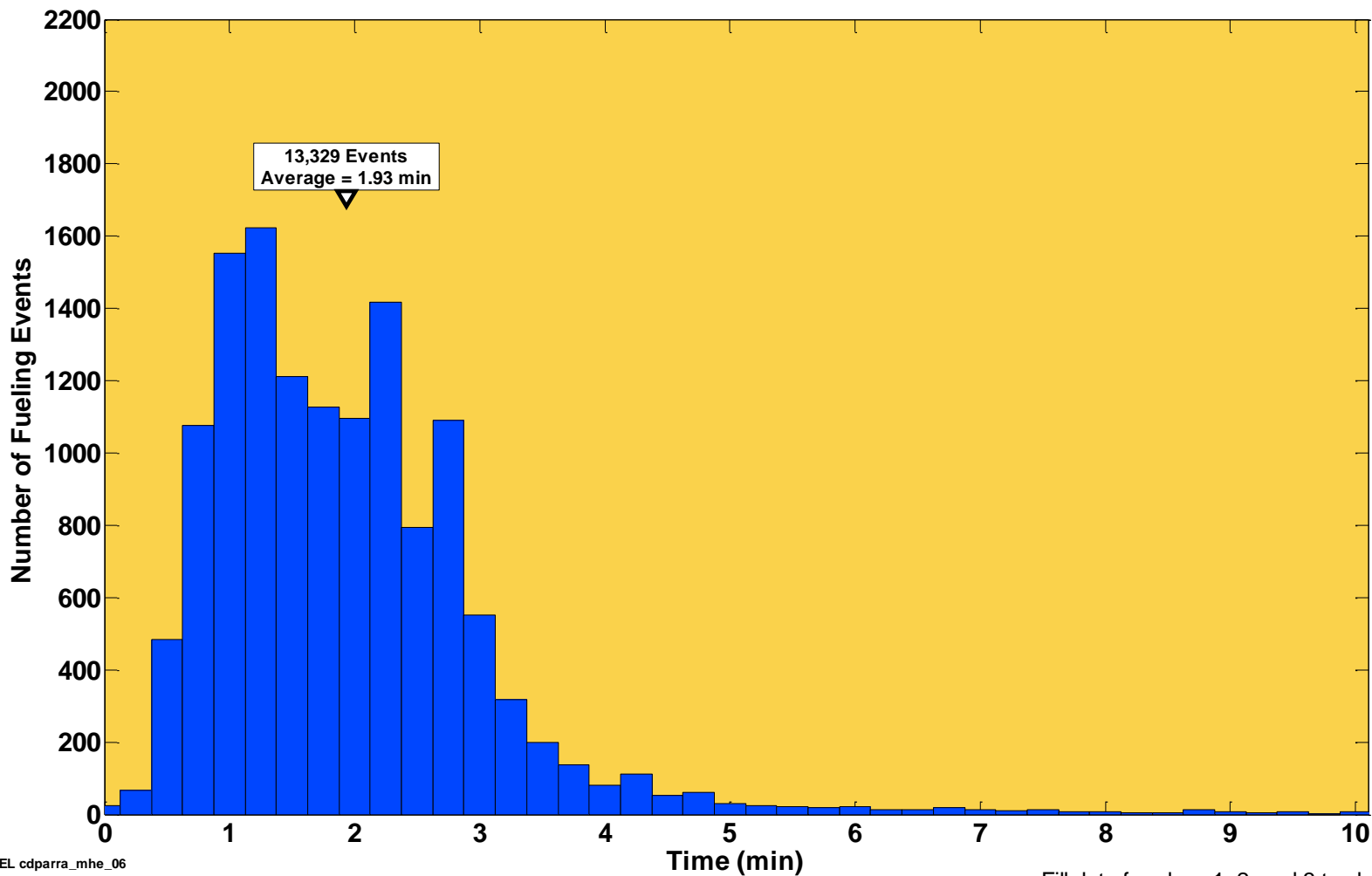
NREL cdparra_mhe_05

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CDPARRA-MHE-06

Histogram of Fueling Times

Histogram of Fueling Times
ARRA



Fill data for class 1, 2, and 3 trucks

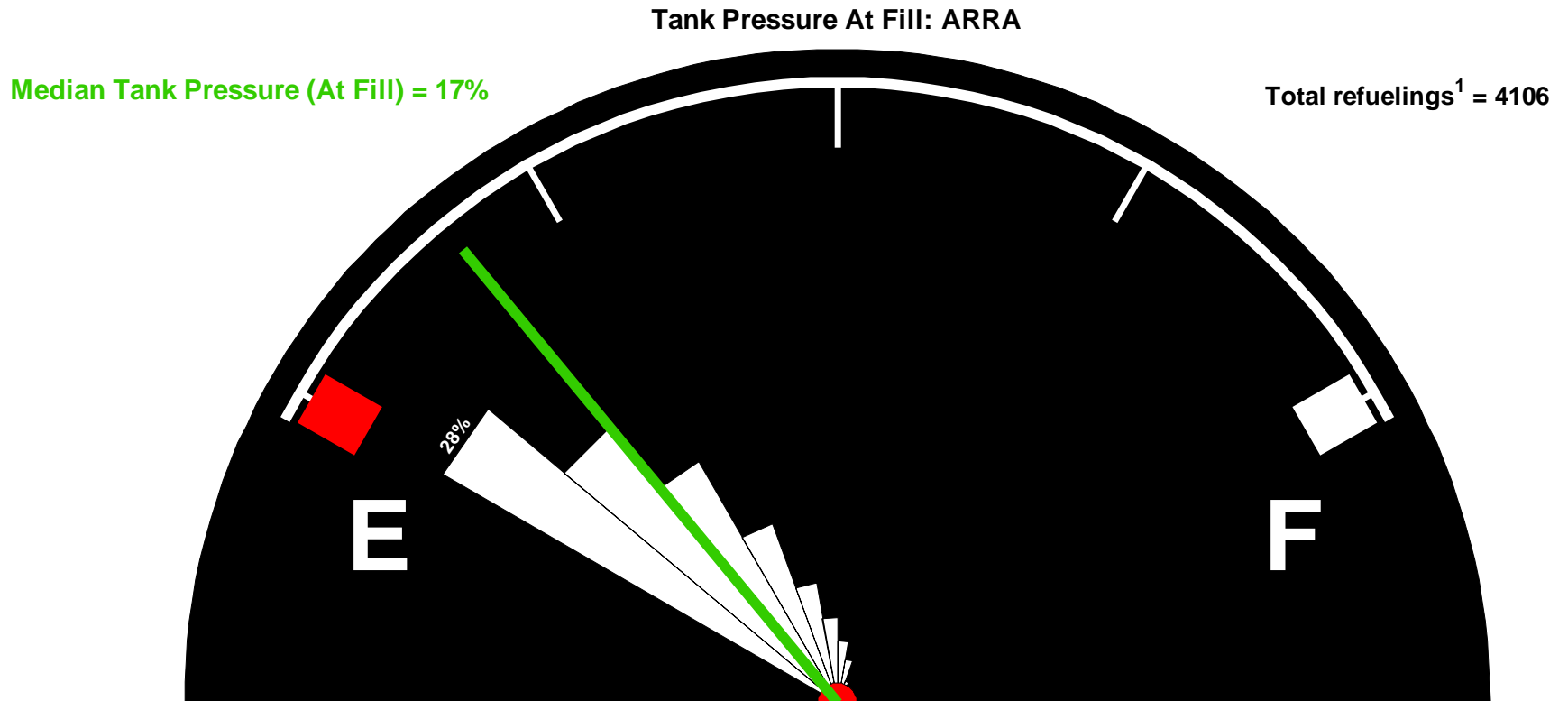


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CDPARRA-MHE-07

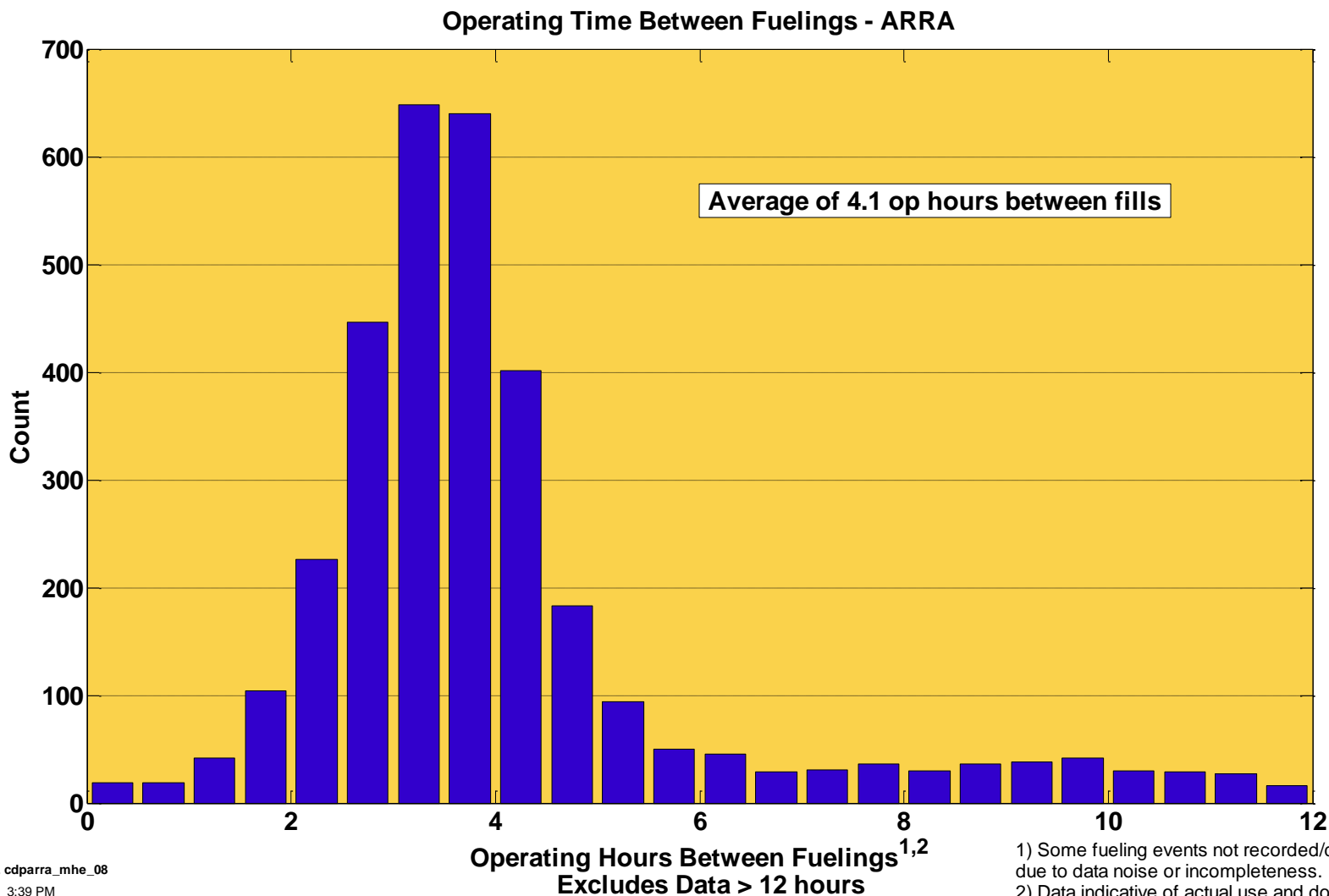
Tank Pressure Level at Fueling



1. Some refueling events not recorded/detected due to data noise or incompleteness.
2. The outer arc is set at 40% total refuelings.
3. Full Pressure is either 3600 psi or 5000 psi.

CDPARRA-MHE-08

Operation Time between Fueling



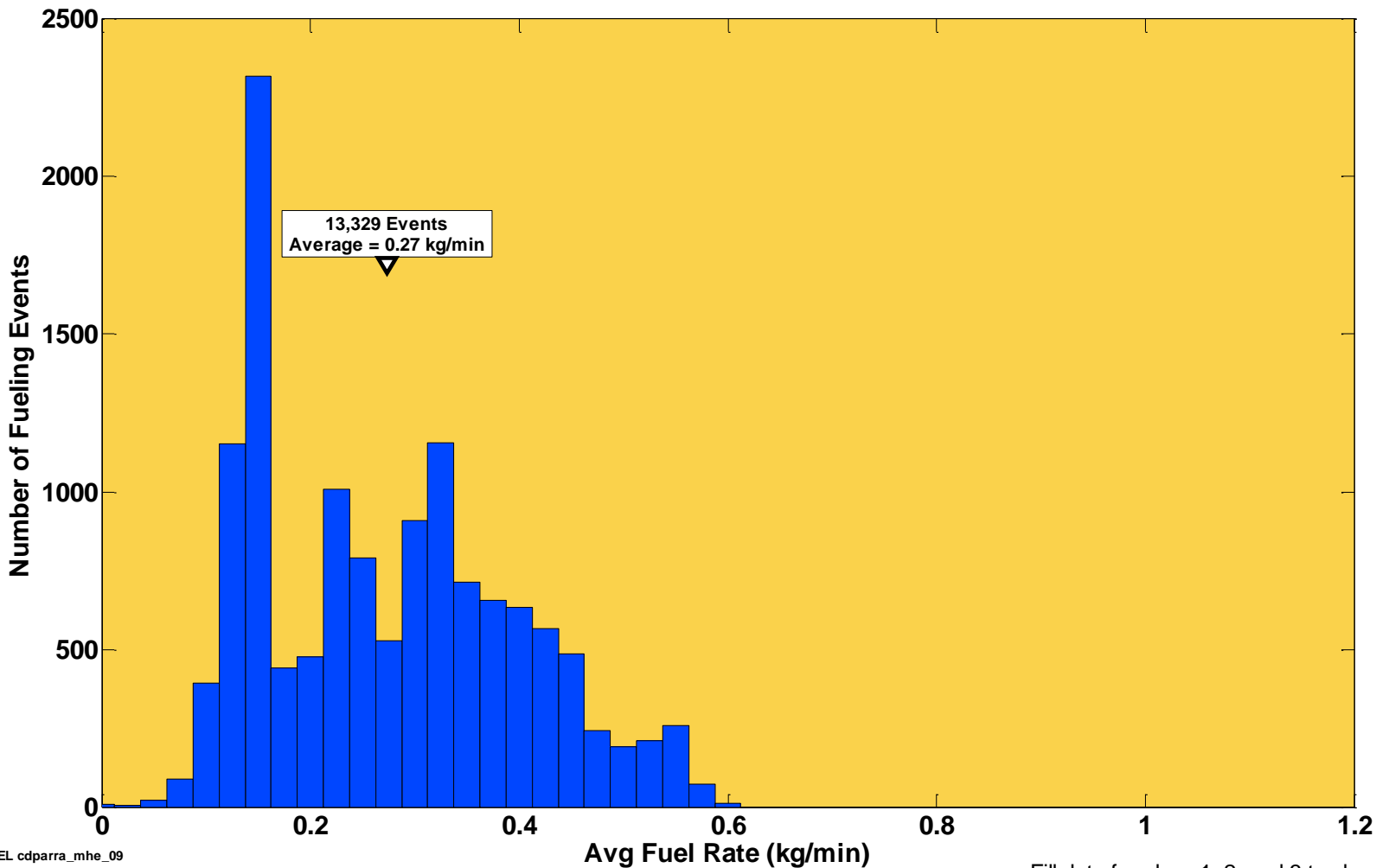
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CDPARRA-MHE-09

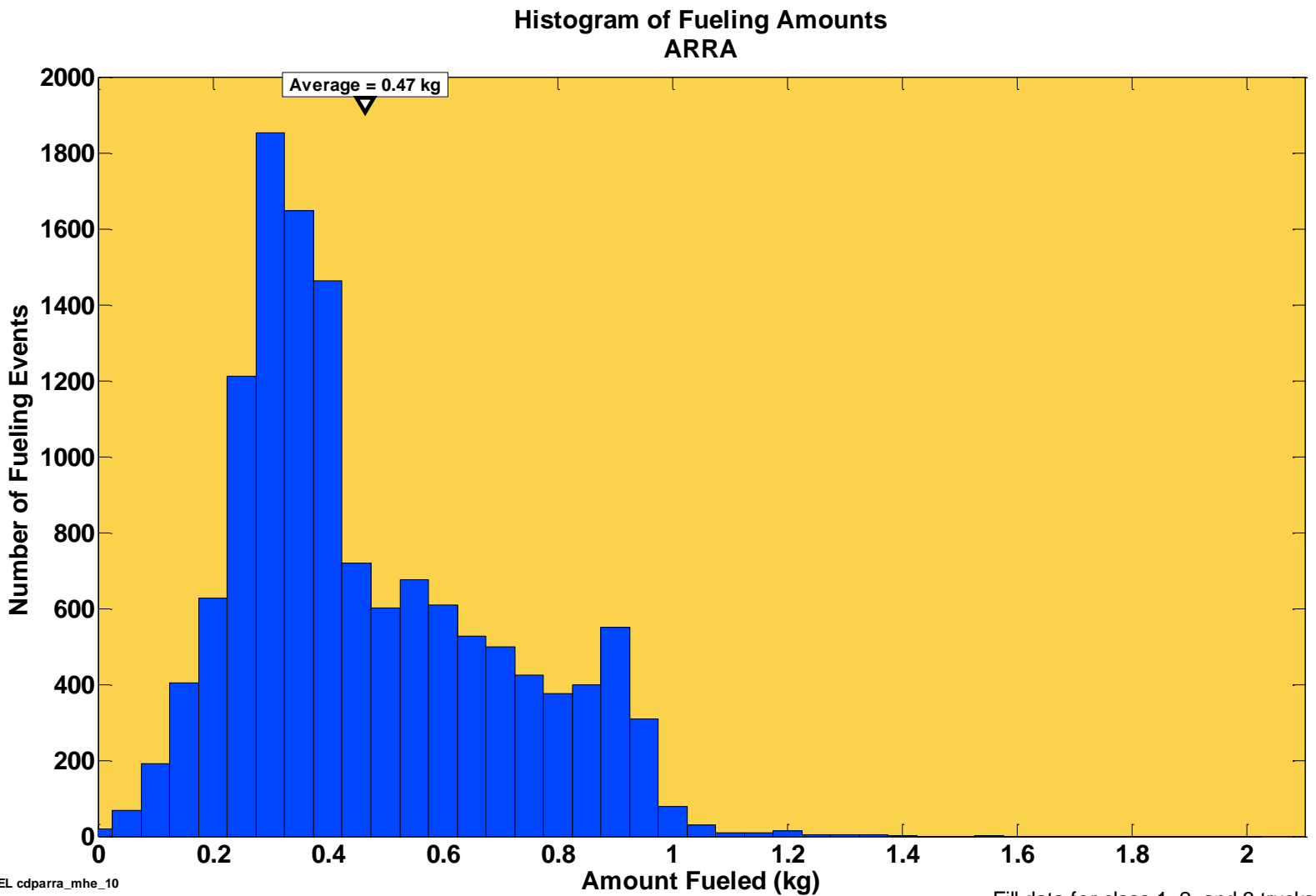
Histogram of Fueling Rates

Histogram of Fueling Rates
ARRA



CDPARRA-MHE-10

Histogram of Fueling Amounts



Fill data for class 1, 2, and 3 trucks

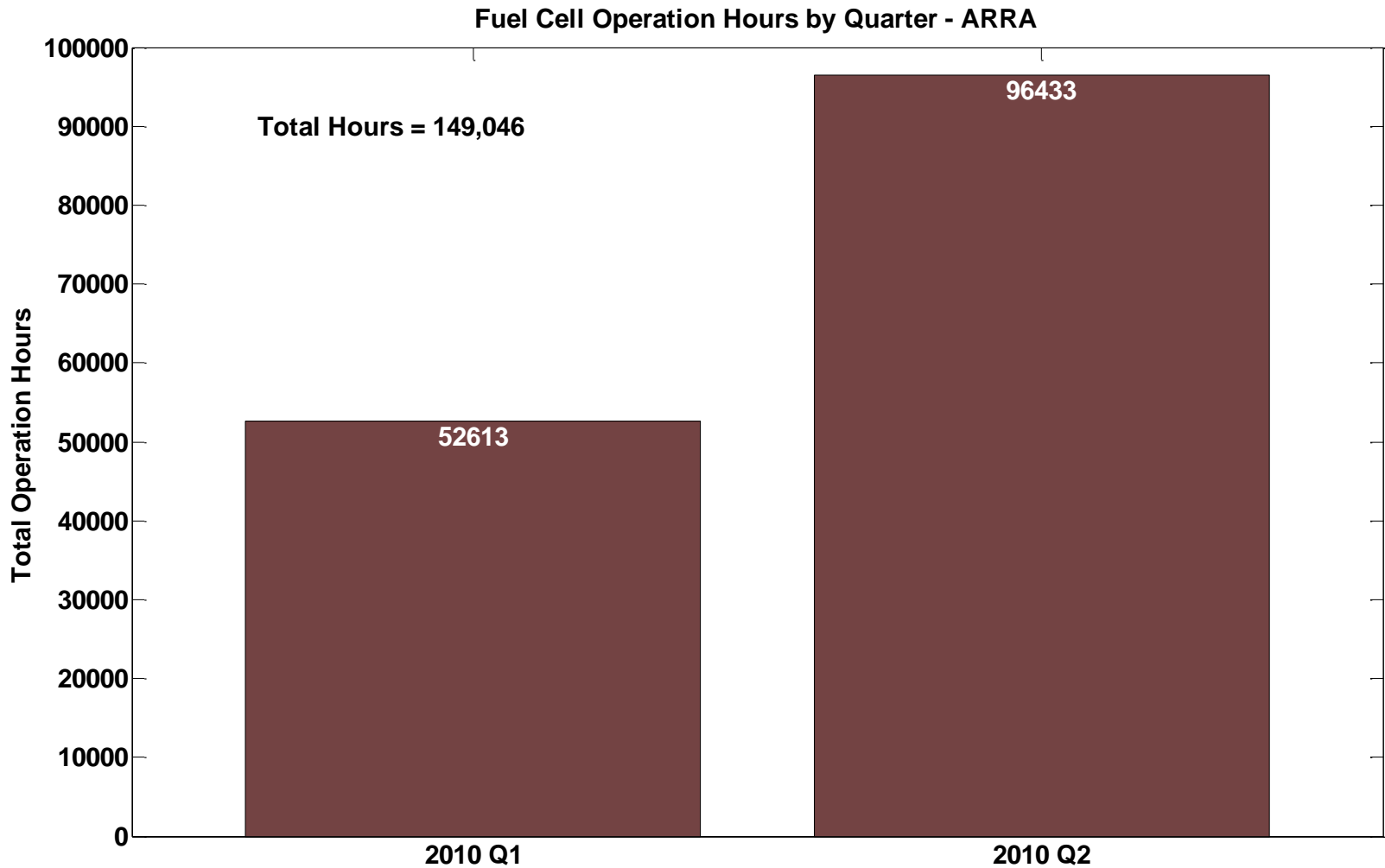


NREL cdparra_mhe_10

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CDPARRA-MHE-11

Fuel Cell Operation Hours by Quarter



NREL cdparra_mhe_11

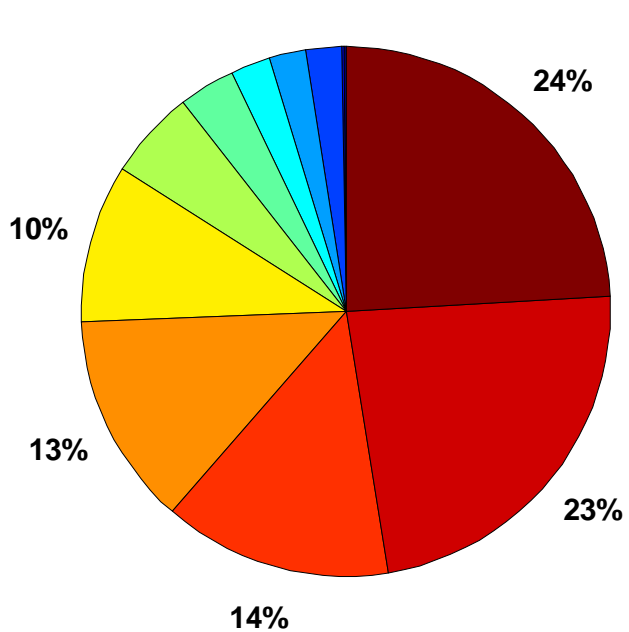
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CDPARRA-MHE-12

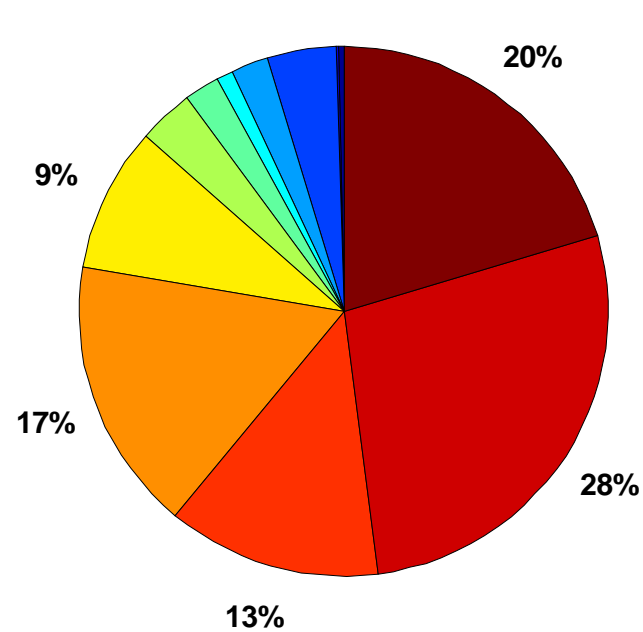
Fuel Cell System Maintenance by Category

Forklift Maintenance By Category - ARRA

Number of Events
Total Events = 789
73% were unscheduled



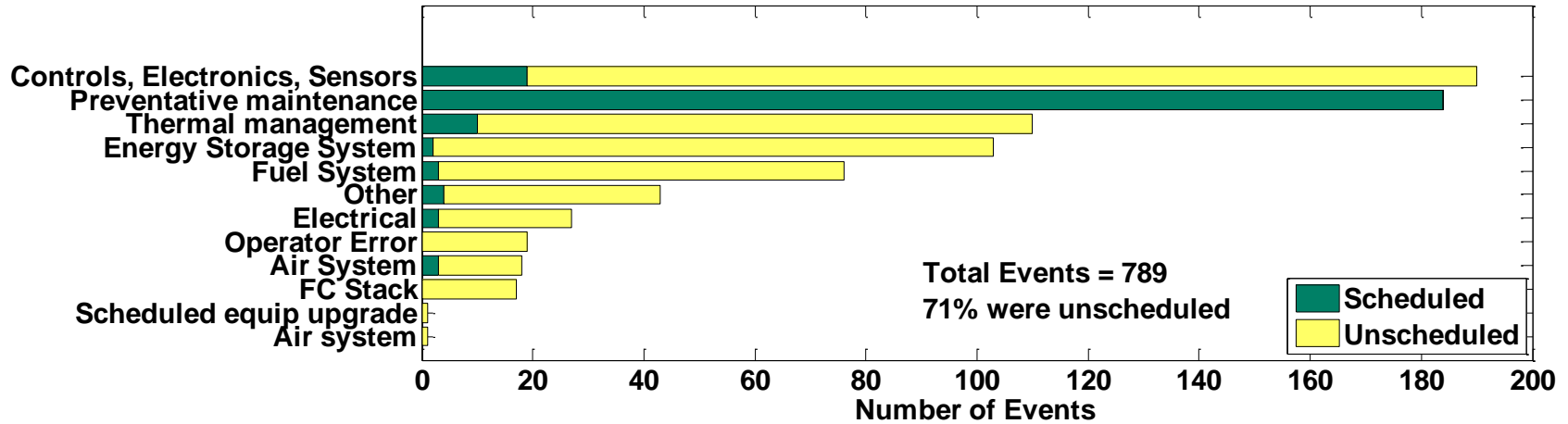
Labor Hours
Total Hours = 1165
69% were unscheduled



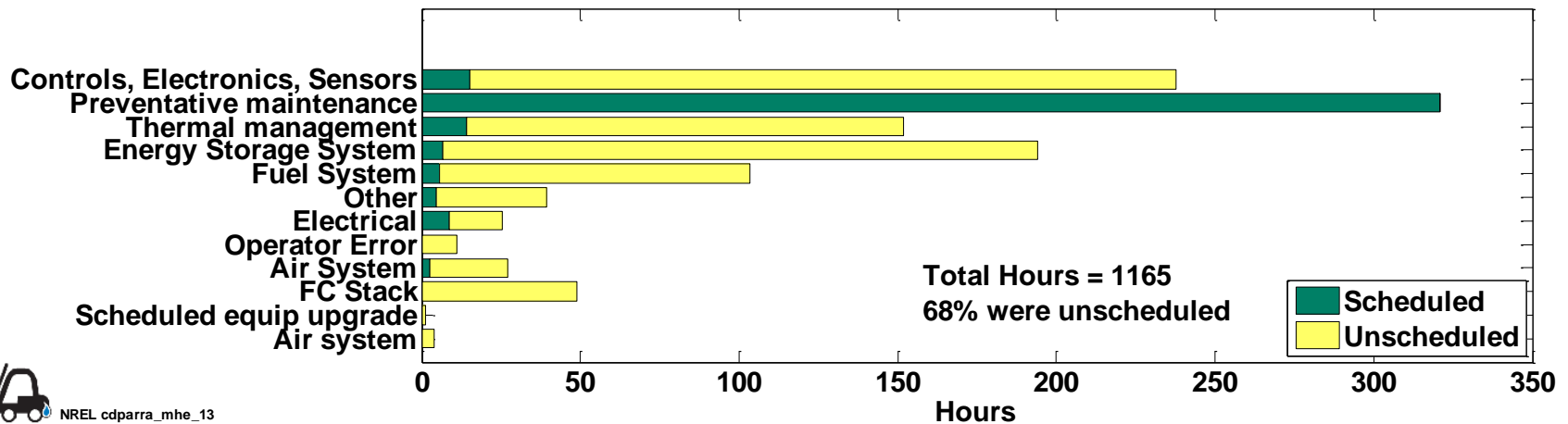
CDPARRA-MHE-13

Fuel Cell System Scheduled and Unscheduled Maintenance by Category

Fuel Cell System Maintenance Scheduled vs. Unscheduled - ARRA
Number of Maintenance Events by Category



Number of Labor Hours by Category

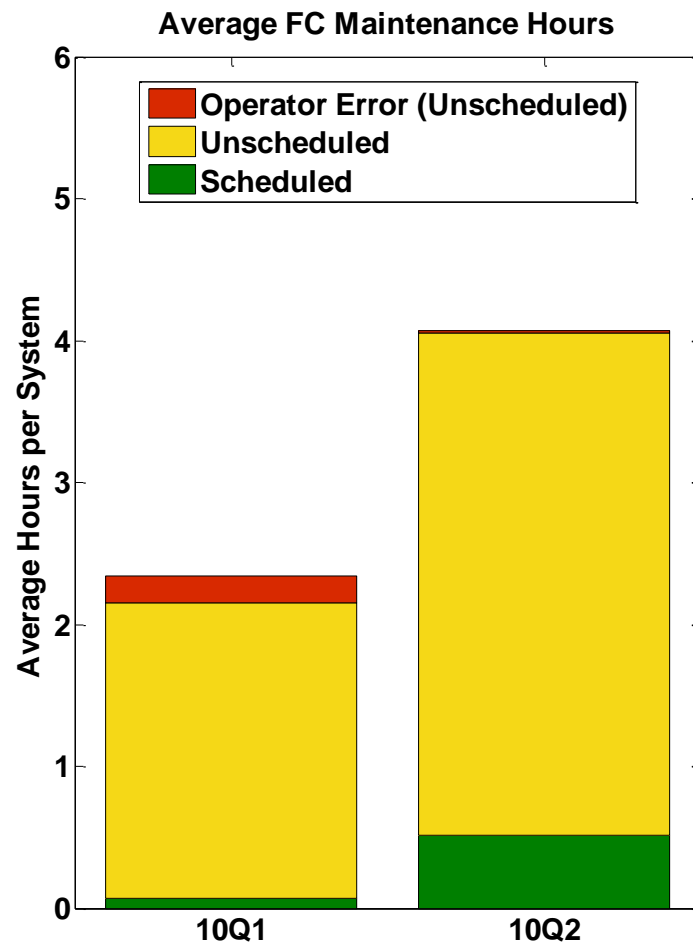
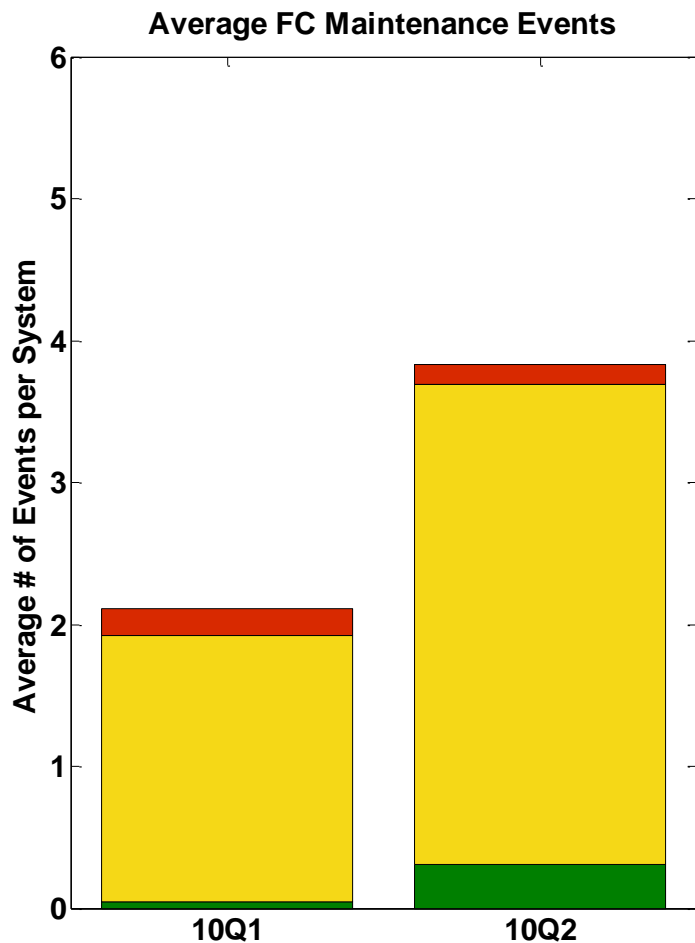


NREL cdparramhe_13

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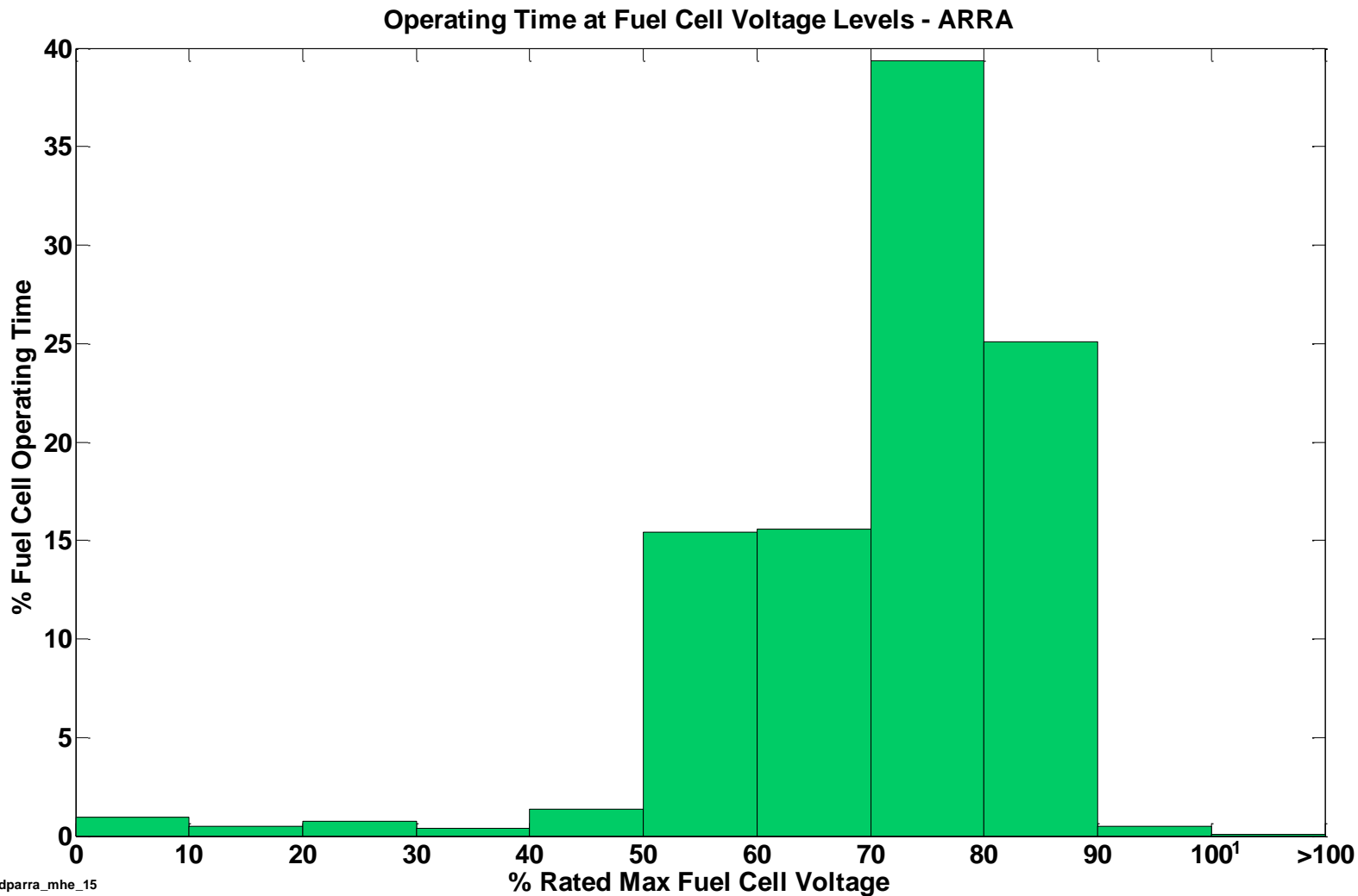
Average Fuel Cell System Maintenance by Quarter

Average Fuel Cell System Quarterly Maintenance - ARRA



CDPARRA-MHE-15

Operating Time at Fuel Cell Voltage Levels



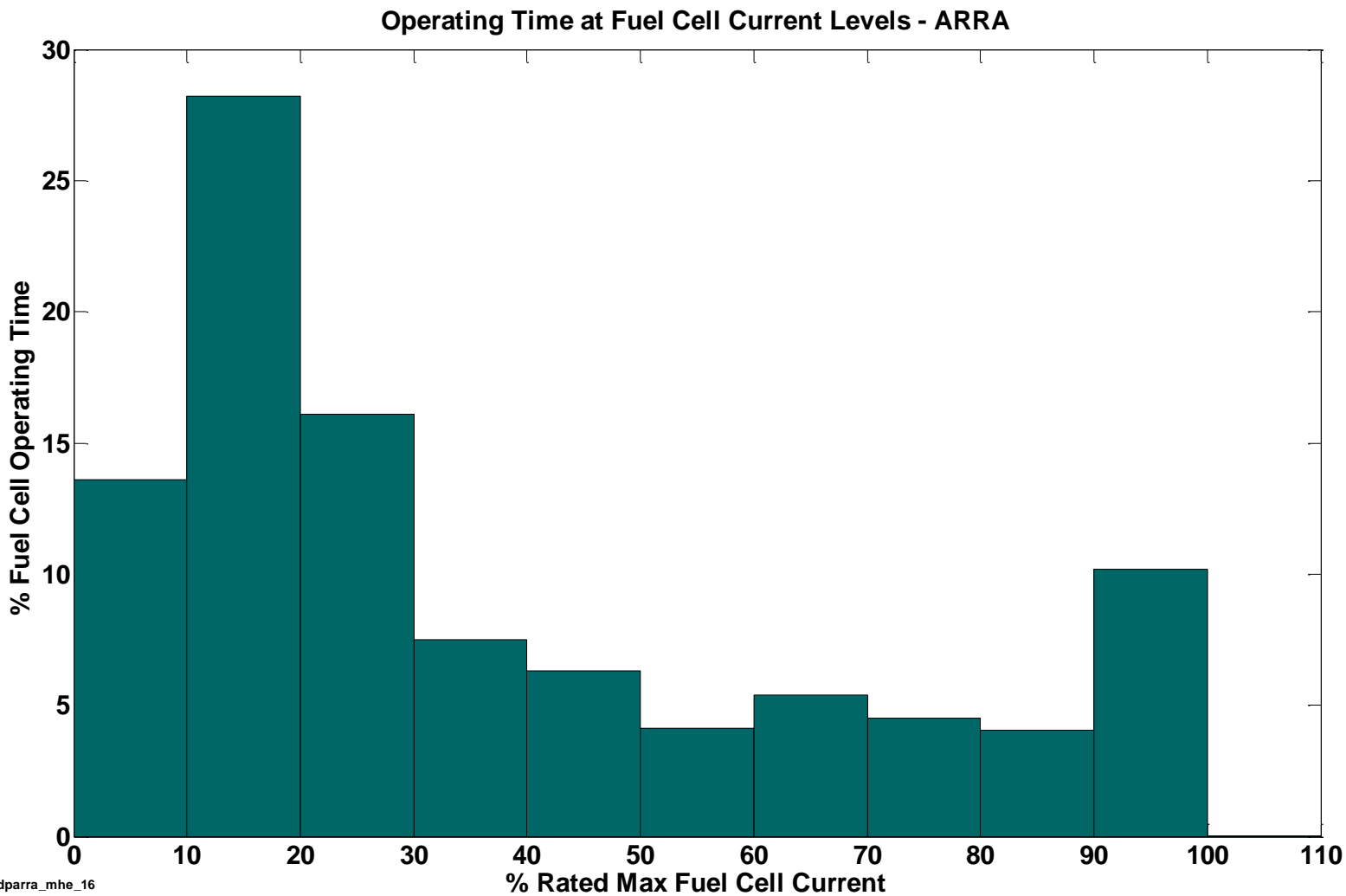
NREL cdparramhe_15

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1) 100% max fuel cell voltage is approximately open-circuit voltage

CDPARRA-MHE-16

Operating Time at Fuel Cell Current Levels

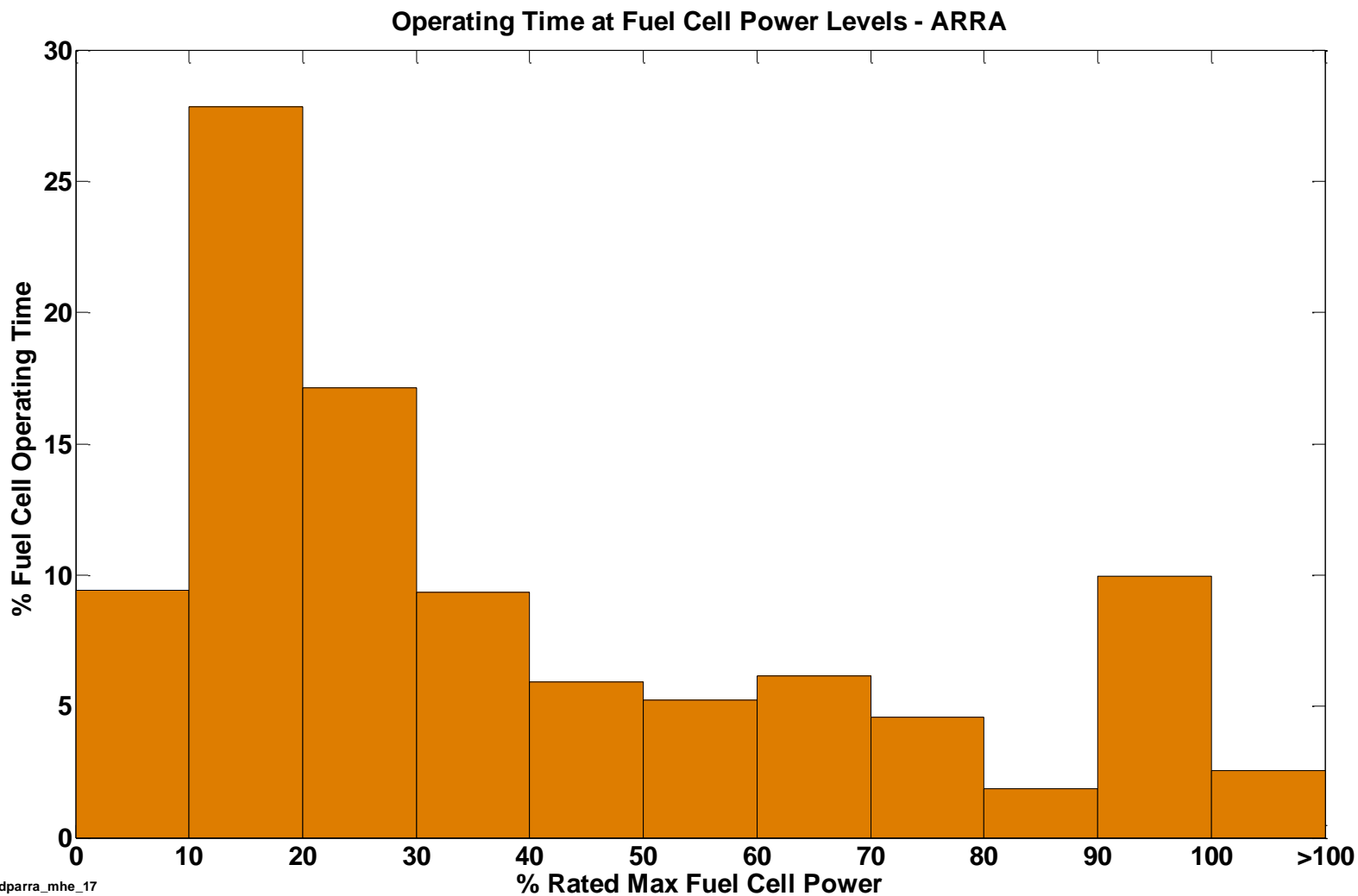


NREL cdparra_mhe_16

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CDPARRA-MHE-17

Operating Time at Fuel Cell Power Levels



NREL cdparra_mhe_17

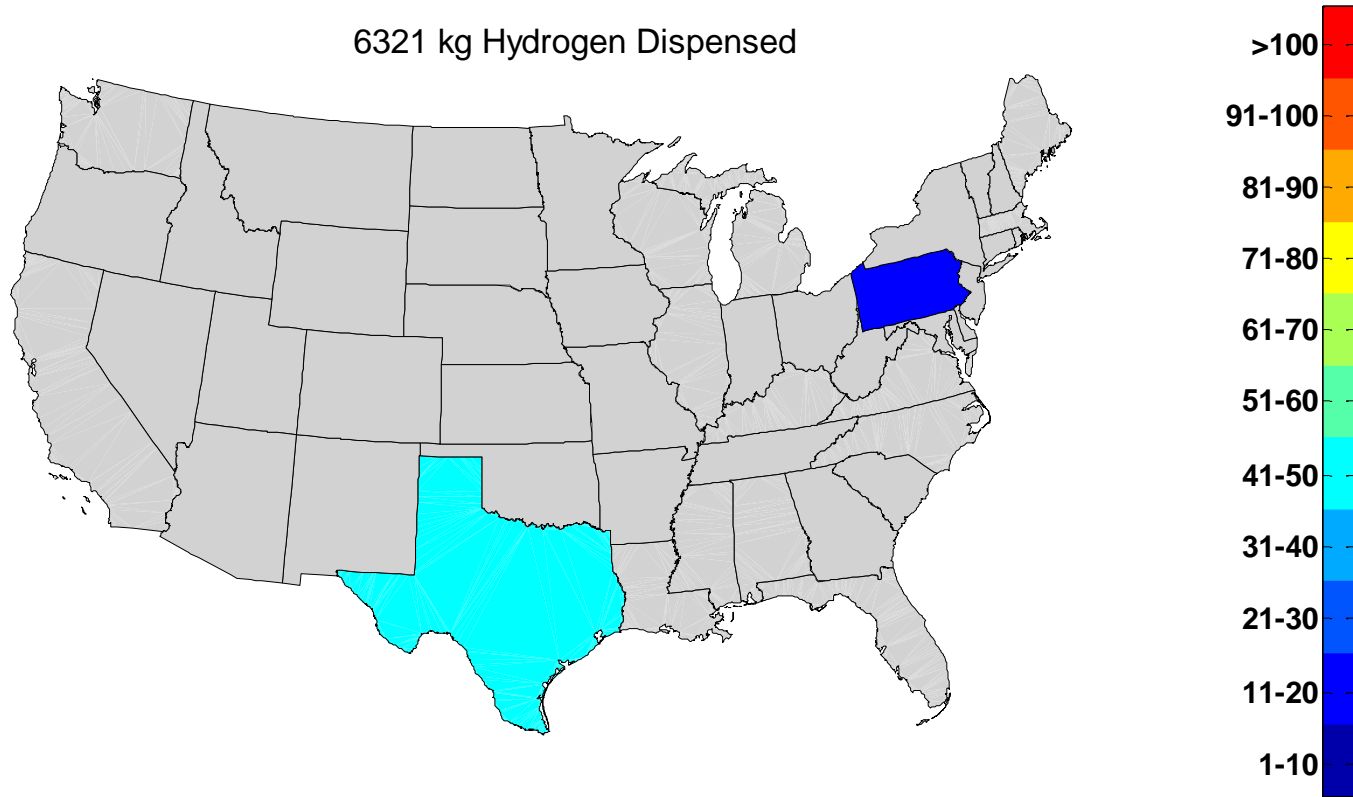
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CDPARRA-MHE-21

Average Daily Hydrogen Dispensed by Location

Average Daily Hydrogen Dispensed by Location - ARRA

6321 kg Hydrogen Dispensed



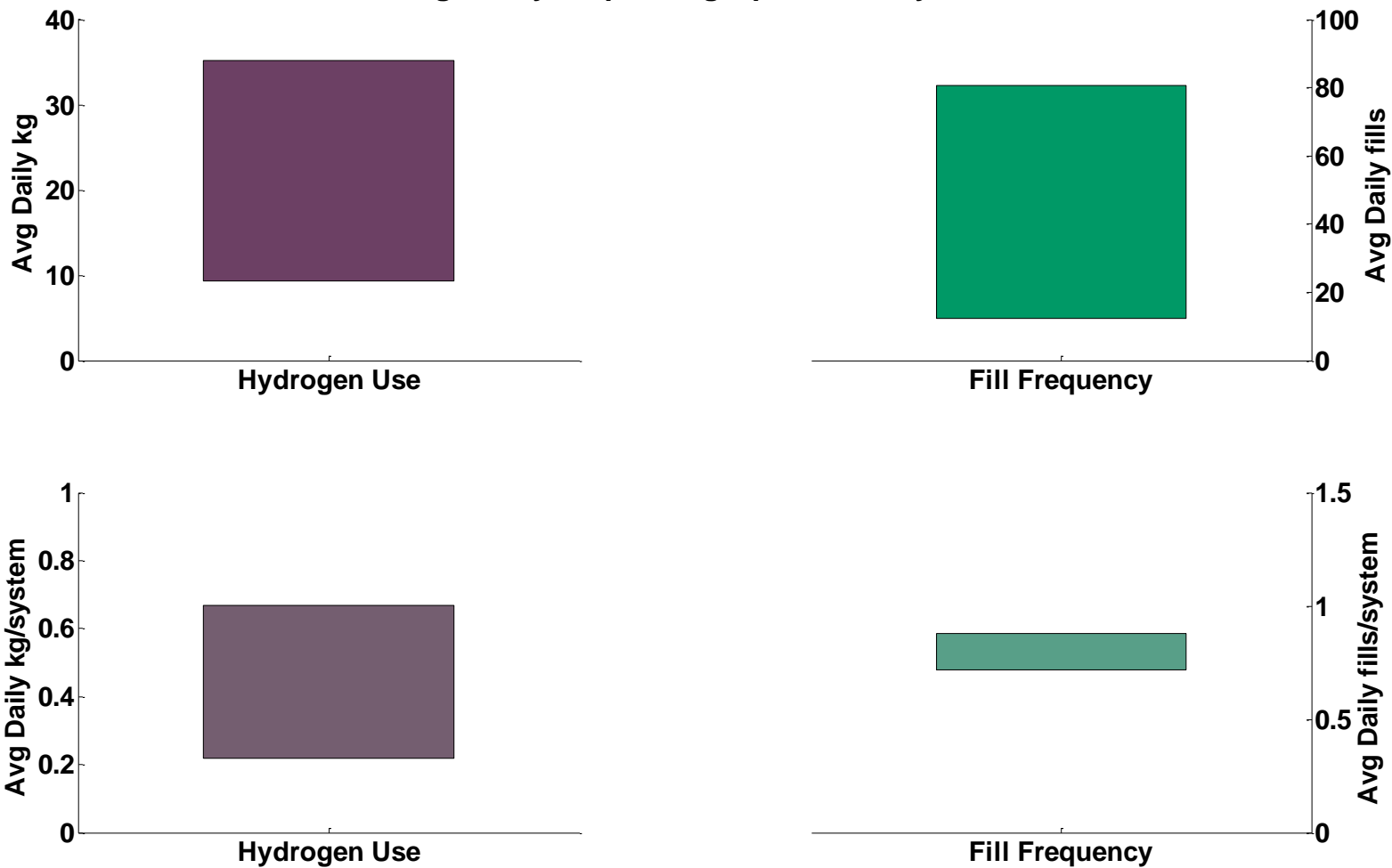
NREL cdparra_mhe_21

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CDPARRA-MHE-22

Average Daily Dispensing Operations by Site

Average Daily Dispensing Operations by Site - ARRA



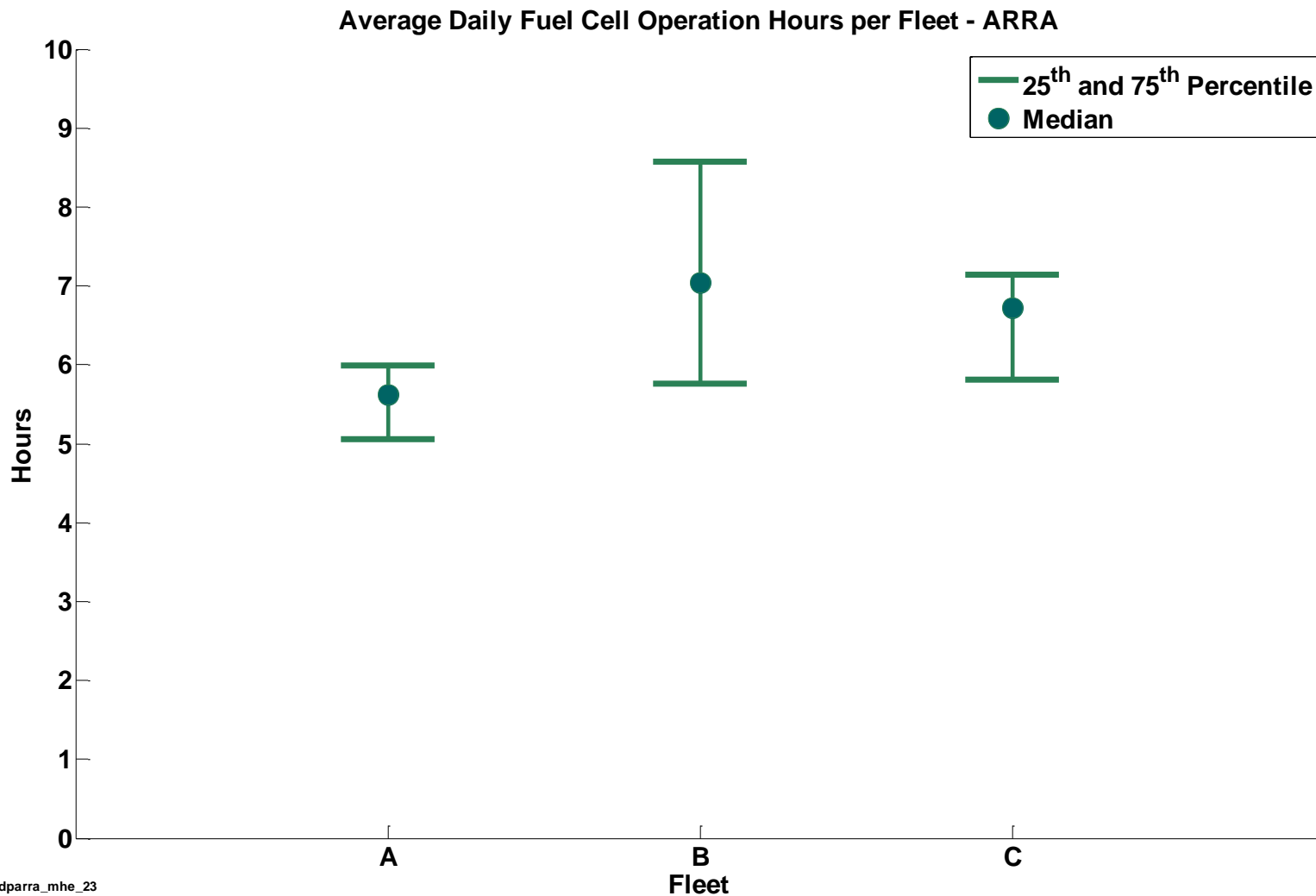
NREL cdparramhe_22

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Shaded areas represent the min and max site average hydrogen use and fill frequency

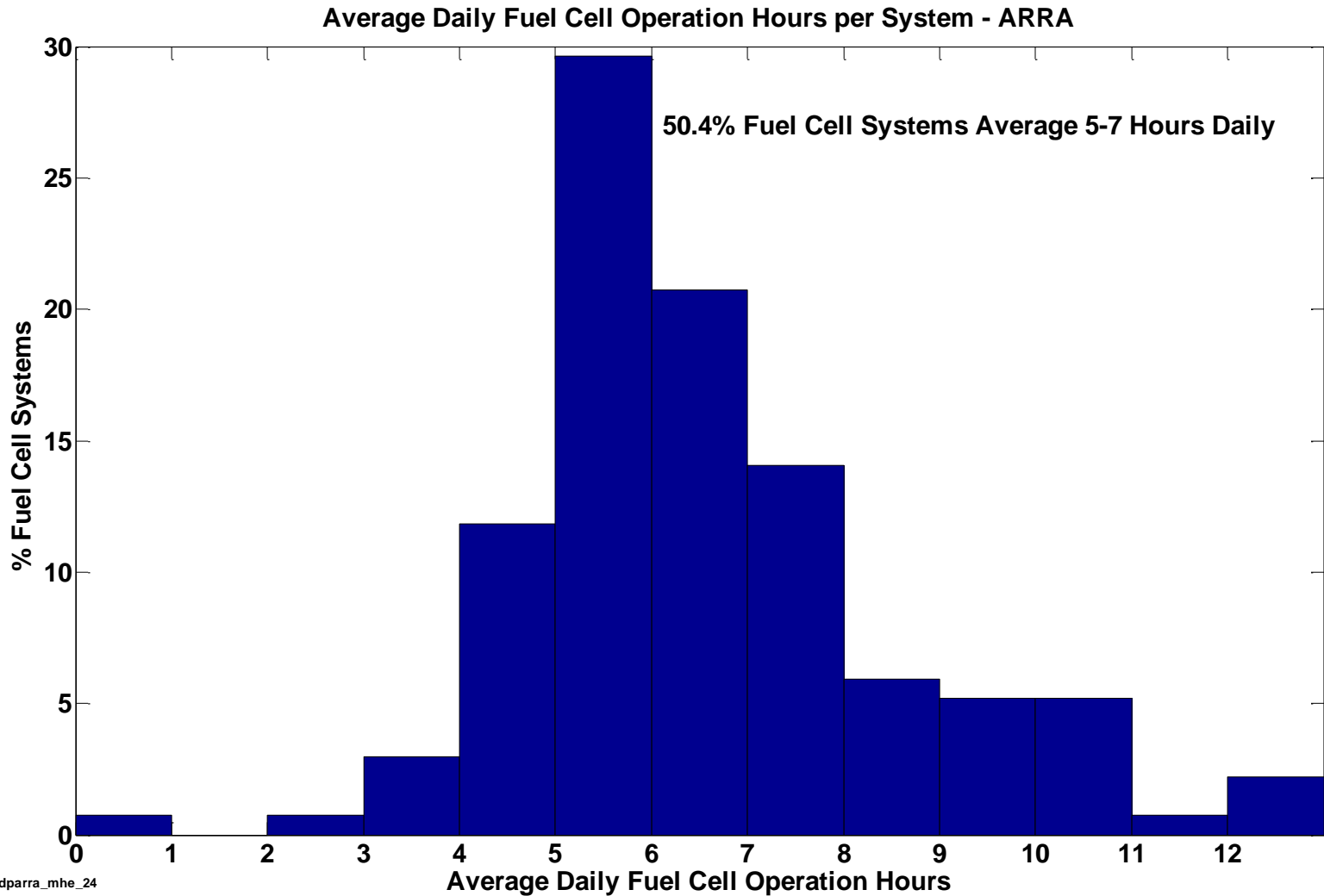
CDPARRA-MHE-23

Average Daily Fuel Cell Operation Hours per Fleet



CDPARRA-MHE-24

Average Daily Fuel Cell Operation Hours per System

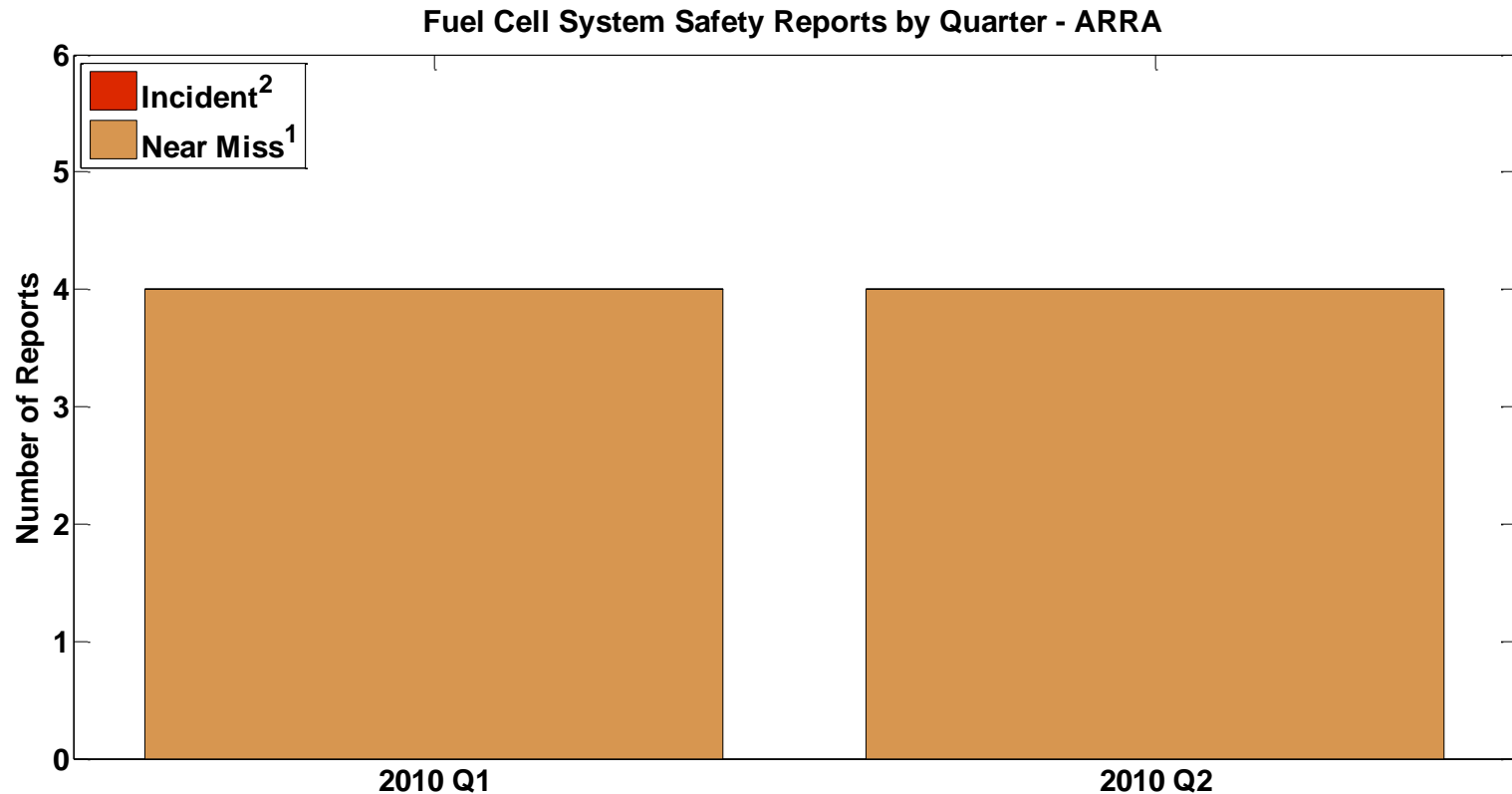


NREL cdparra_mhe_24

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CDPARRA-MHE-26

Fuel Cell System Safety Reports by Quarter



- 1) Near Miss is an event that under slightly different circumstances could have become an incident
 - unplanned H₂ release insufficient to sustain a flame
- 2) Incident is an event that results in:
 - a lost time accident and/or injury to personnel
 - damage/unplanned downtime for project equipment, facilities or property
 - impact to the public or environment
 - any hydrogen release that unintentionally ignites or is sufficient to sustain a flame if ignited
 - release of any volatile, hydrogen containing compound (other than the hydrocarbons uses as common fuels)

