



Technical Report
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Fall 2013 Composite Data Products – Backup Power

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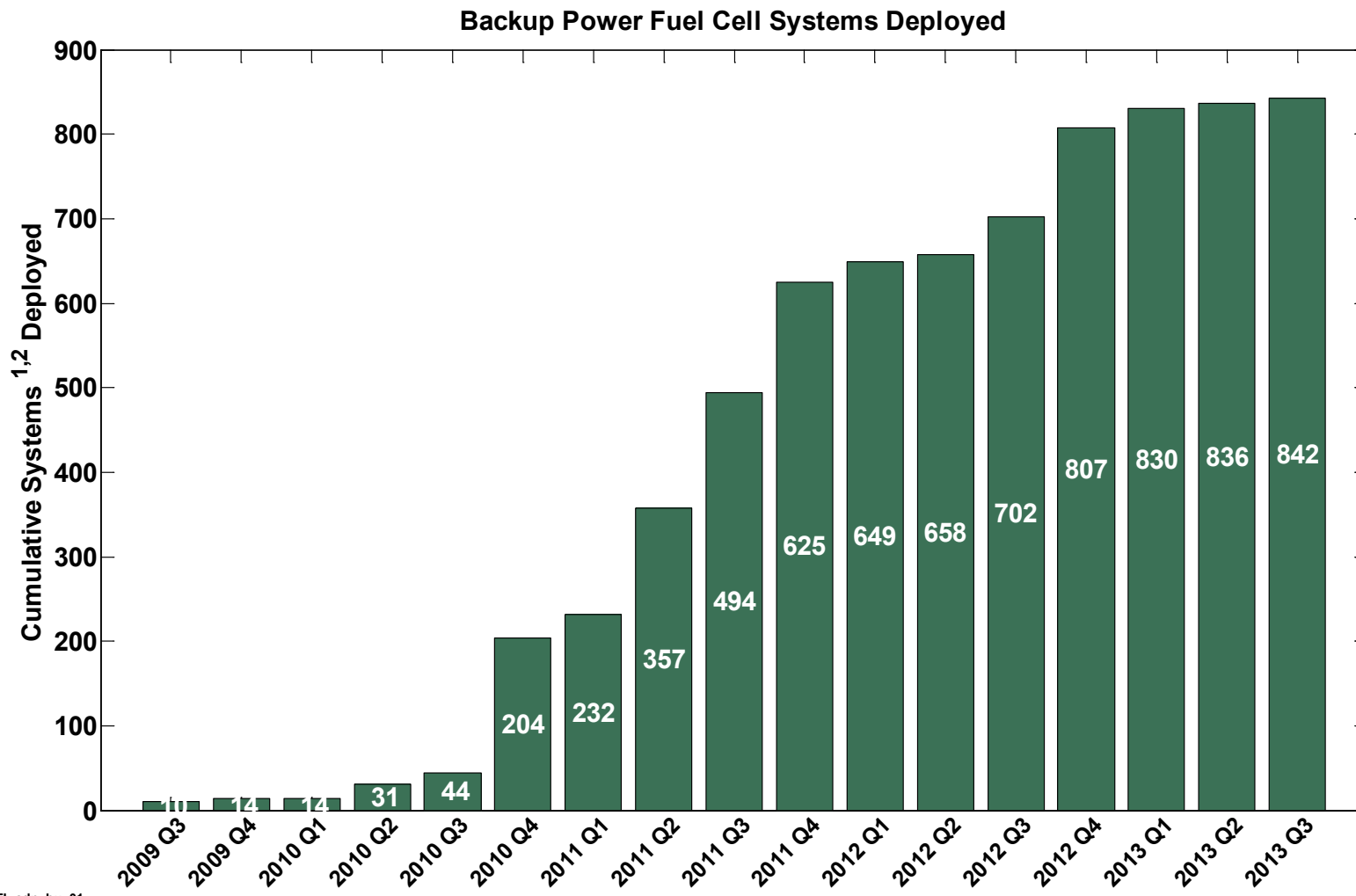
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Backup Power Fuel Cell Systems Deployed

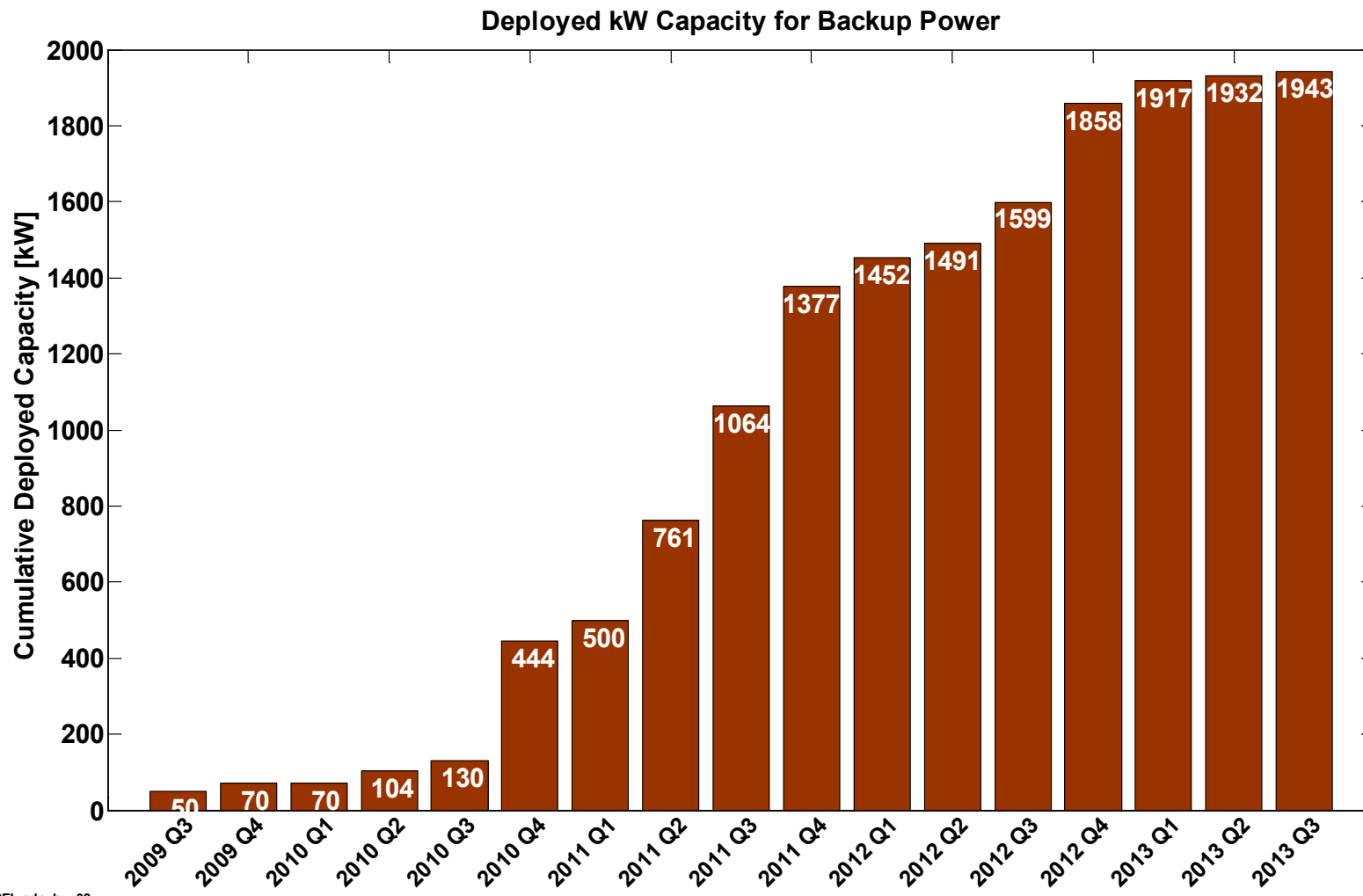


NREL cdp_bu_01

Created: Sep-27-13 1:42 PM | Data Range: 2009Q3-2013Q3

- 1) Sites may have more than one FC system
- 2) Not all FC systems are supplying operation data

Deployed kW Capacity for Backup Power



NREL cdp_bu_02

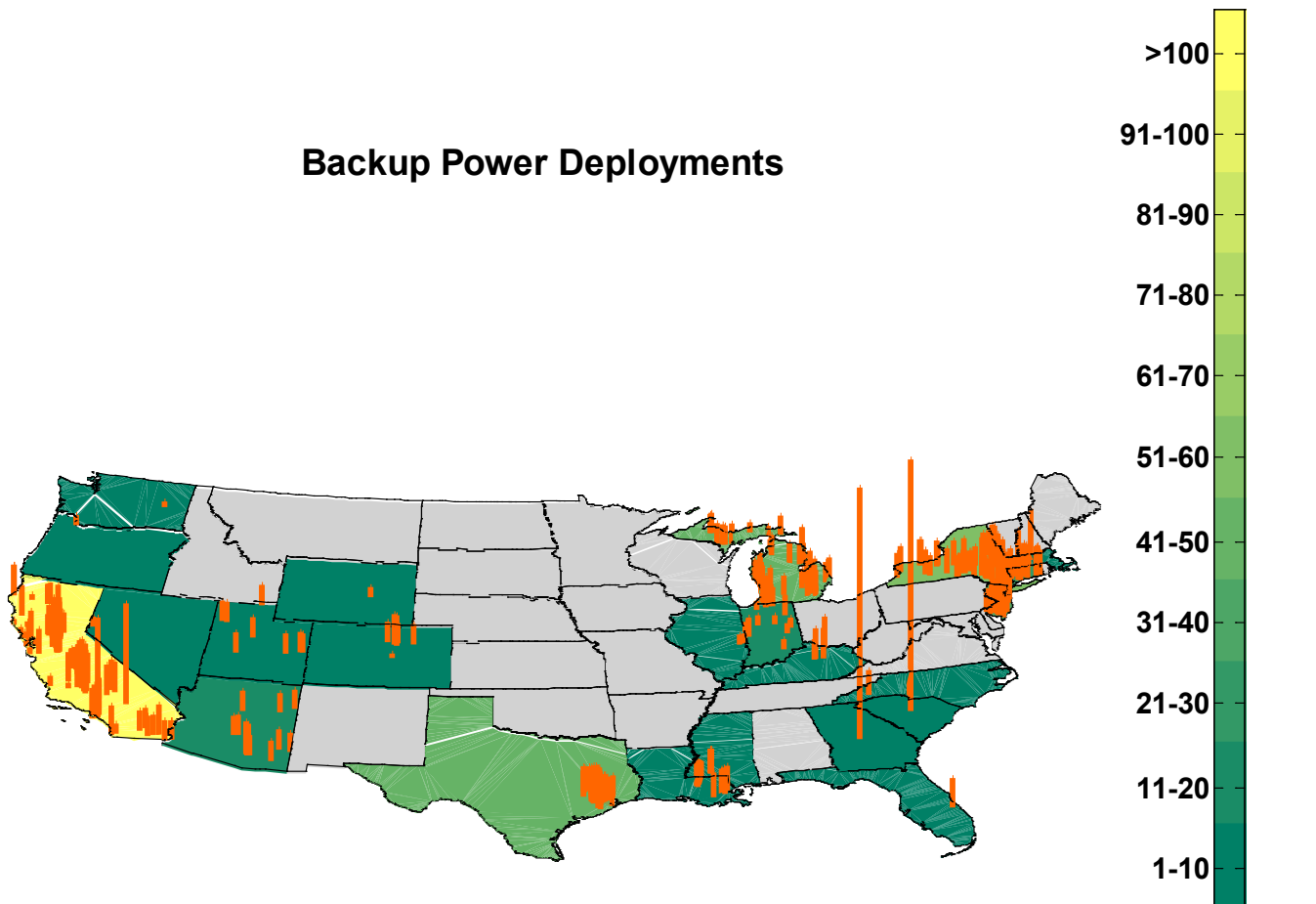
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CDP-BU-03

Backup Power Deployments

| State | kW | Sites |
|----------------|-----|-------|
| Arizona | 84 | 19 |
| California | 585 | 129 |
| Colorado | 25 | 6 |
| Connecticut | 130 | 28 |
| Florida | 6 | 1 |
| Georgia | 50 | 1 |
| Illinois | 4 | 2 |
| Indiana | 50 | 16 |
| Kentucky | 22 | 4 |
| Louisiana | 40 | 8 |
| Massachusetts | 10 | 1 |
| Michigan | 168 | 41 |
| Mississippi | 10 | 2 |
| Nevada | 2 | 1 |
| New Jersey | 181 | 40 |
| New York | 238 | 55 |
| North Carolina | 10 | 2 |
| Oregon | 2 | 1 |
| South Carolina | 50 | 1 |
| Texas | 238 | 48 |
| Utah | 36 | 9 |
| Washington | 1 | 1 |
| Wyoming | 2 | 1 |

Backup Power Deployments



| | | |
|--------|------|-----|
| Totals | 1943 | 417 |
|--------|------|-----|



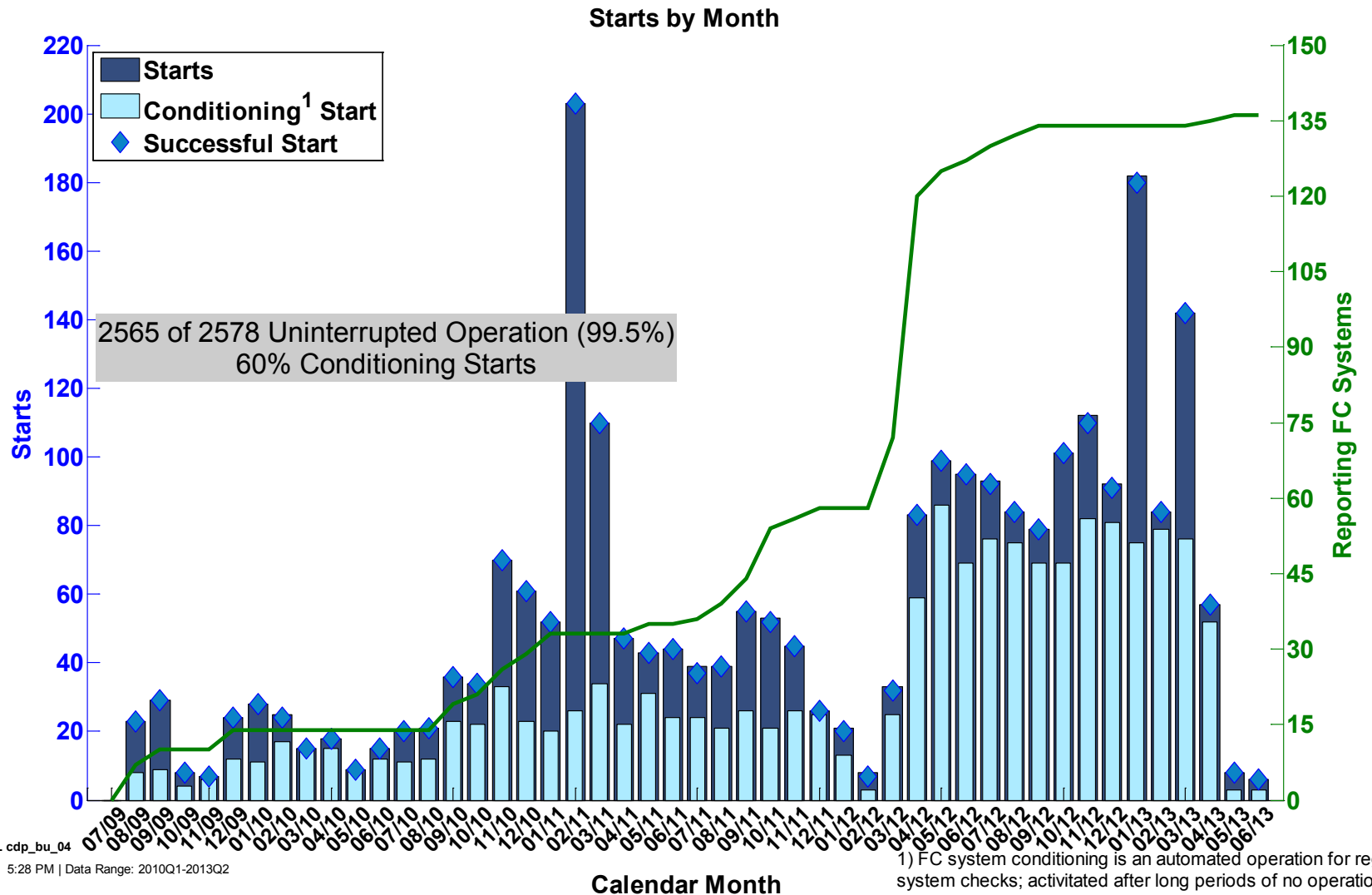
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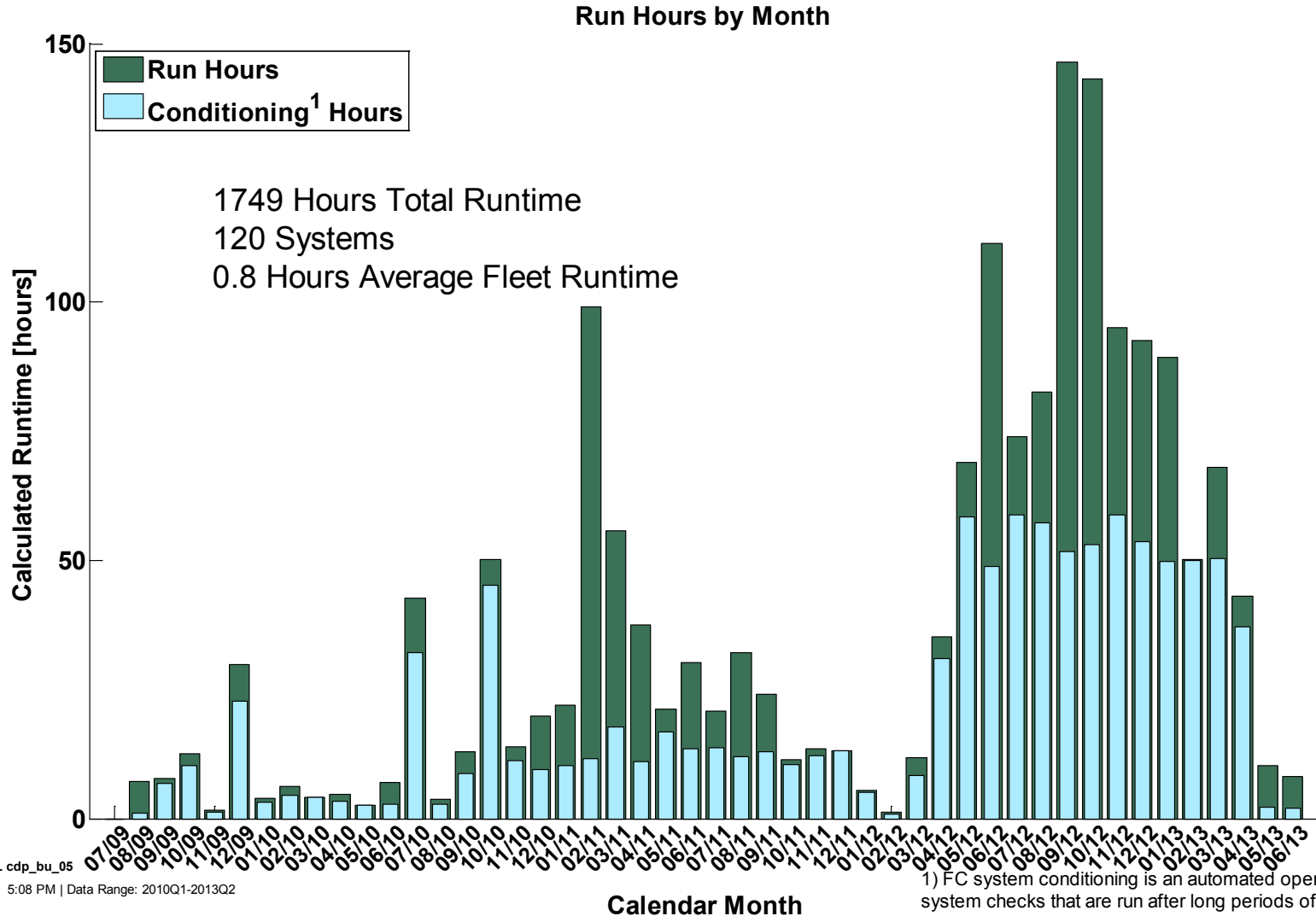
| Site Capacity (line height proportional to installed site kW capacity)

Number of Sites in State

Fuel Cell System Starts by Month



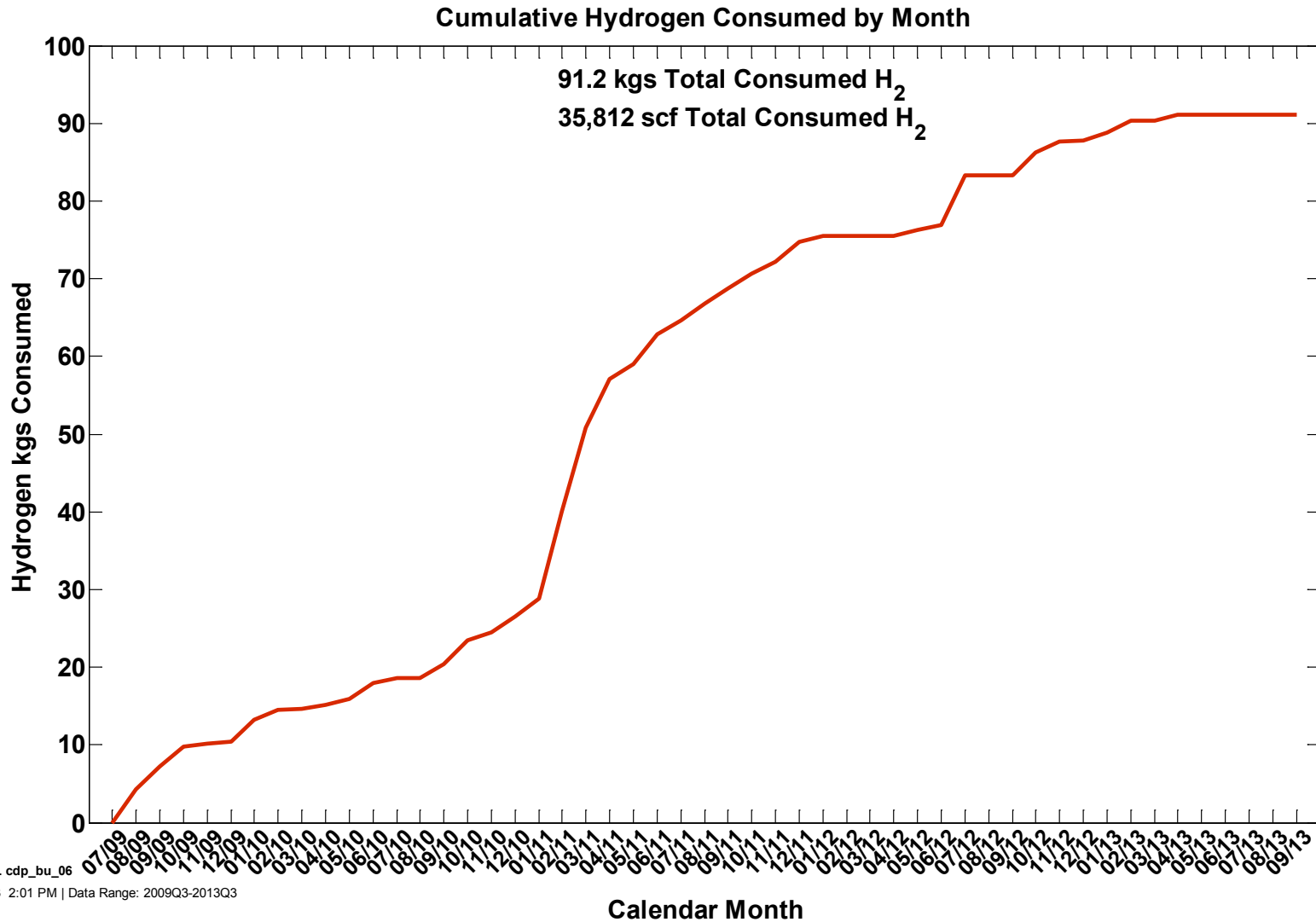
Fuel Cell System Run Hours by Month



NREL cdp_bu_05

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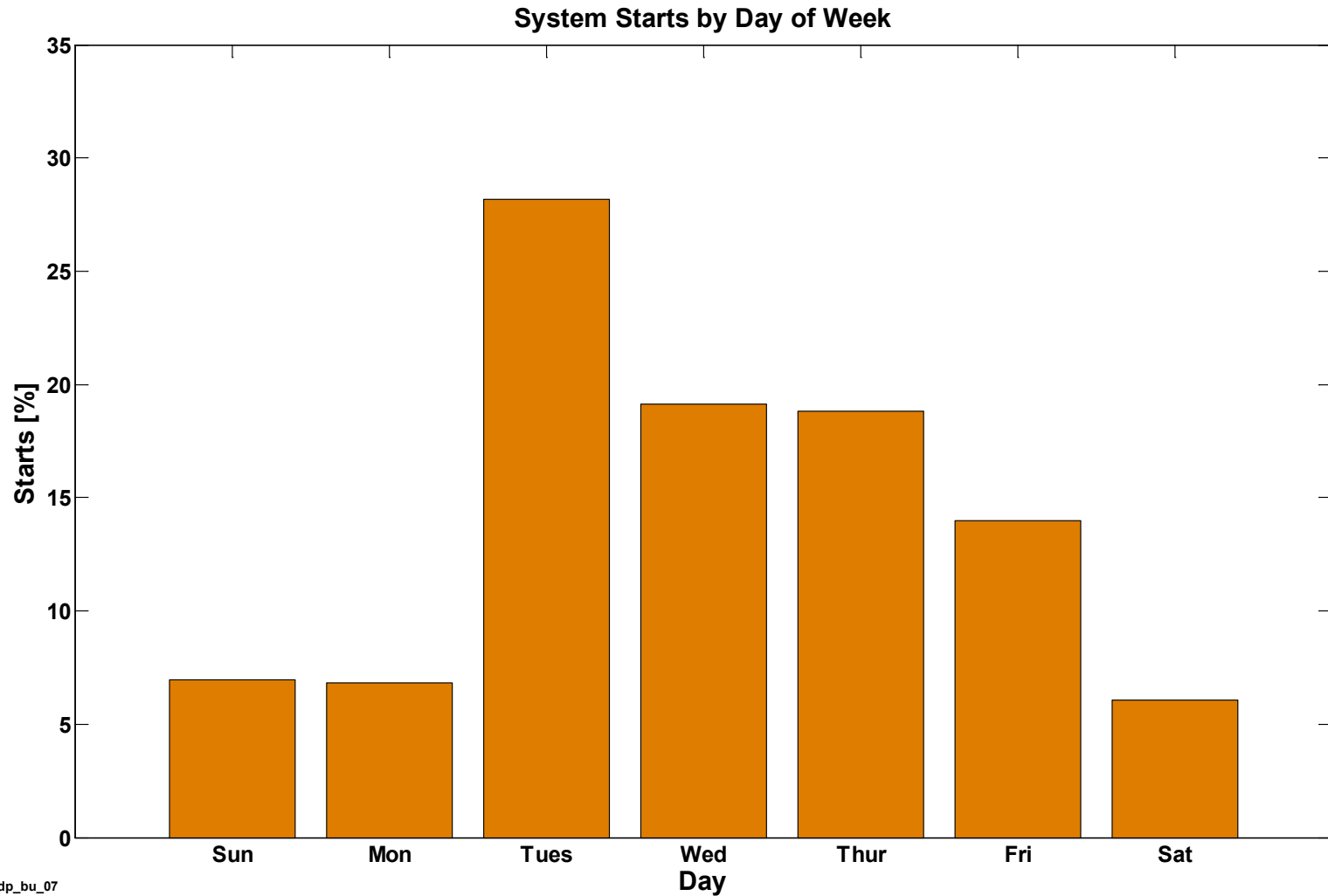
Cumulative Hydrogen Consumed by Month



NREL cdp_bu_06

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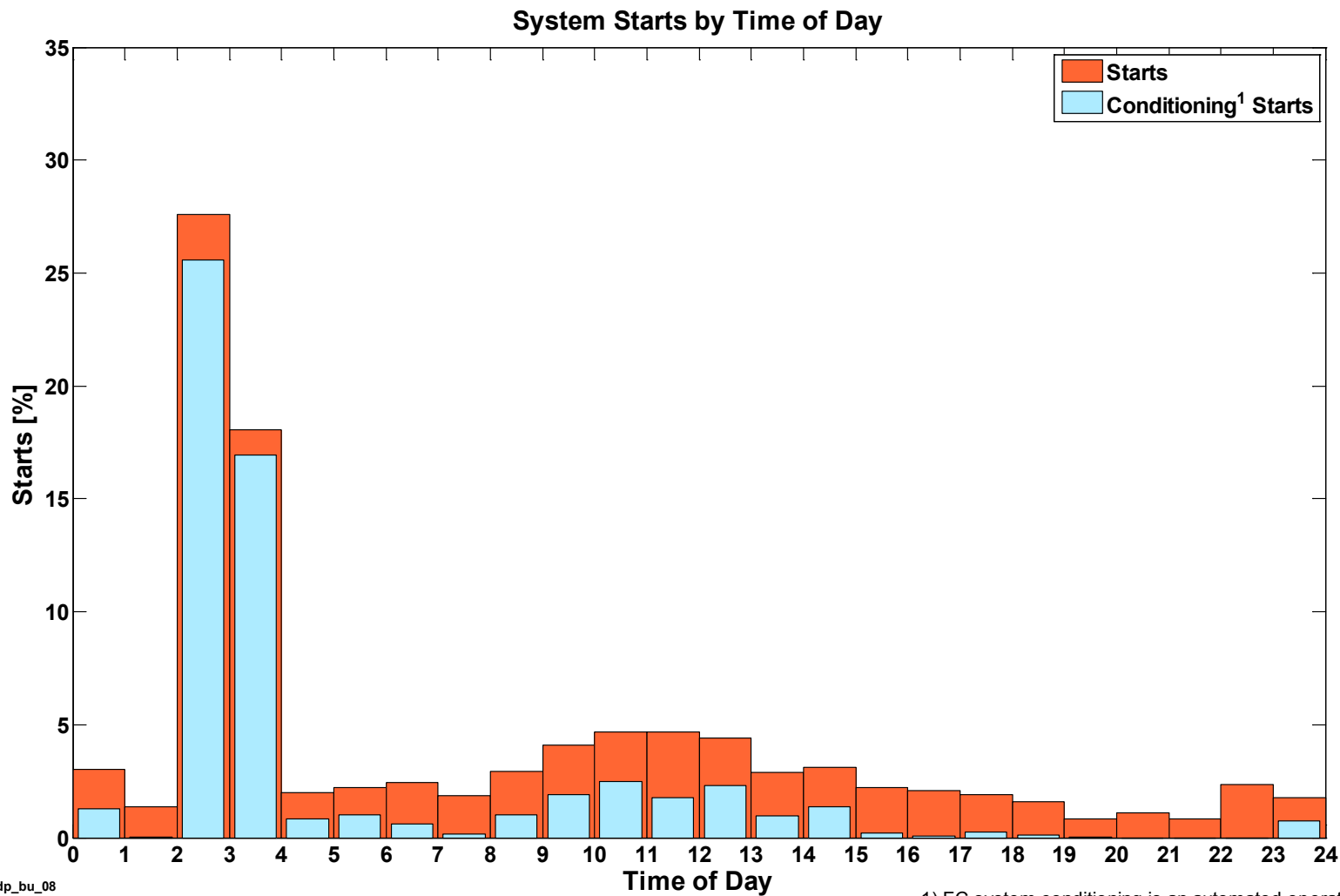
Fuel Cell System Starts by Day of Week



NREL cdp_bu_07

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Fuel Cell System Starts by Time of Day

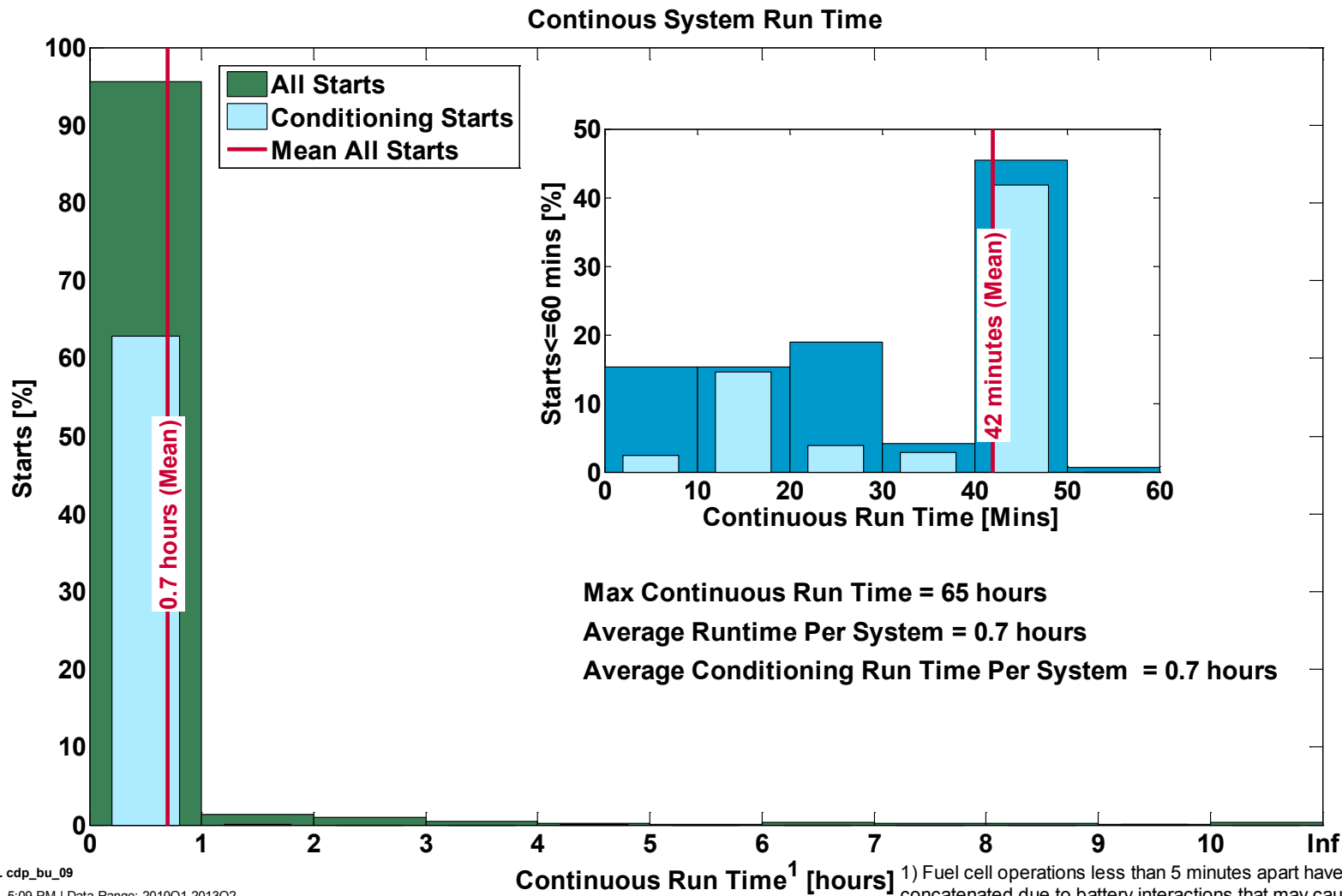


NREL cdp_bu_08

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1) FC system conditioning is an automated operation for regular system checks; activated after long periods of no operation.

Continuous Fuel Cell System Run Time



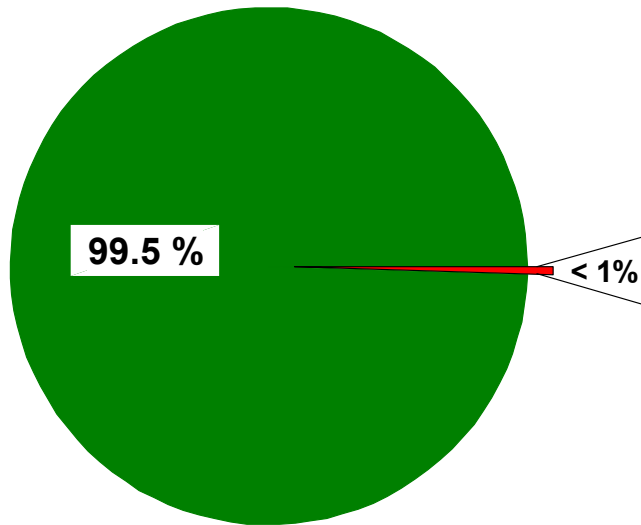
NREL cdp_bu_09

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¹ Fuel cell operations less than 5 minutes apart have been concatenated due to battery interactions that may cause apparently intermittent operation.

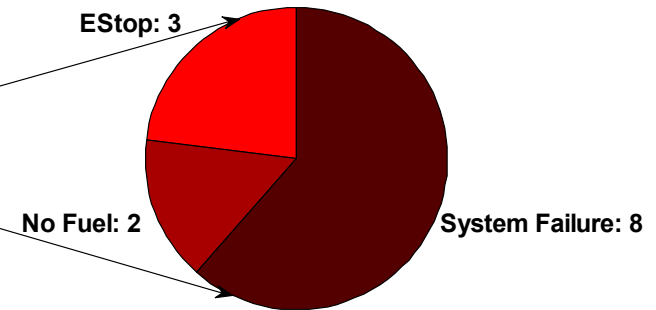
Interrupted Operation Categories

Uninterrupted Operation



2565 out of 2578 uninterrupted operation

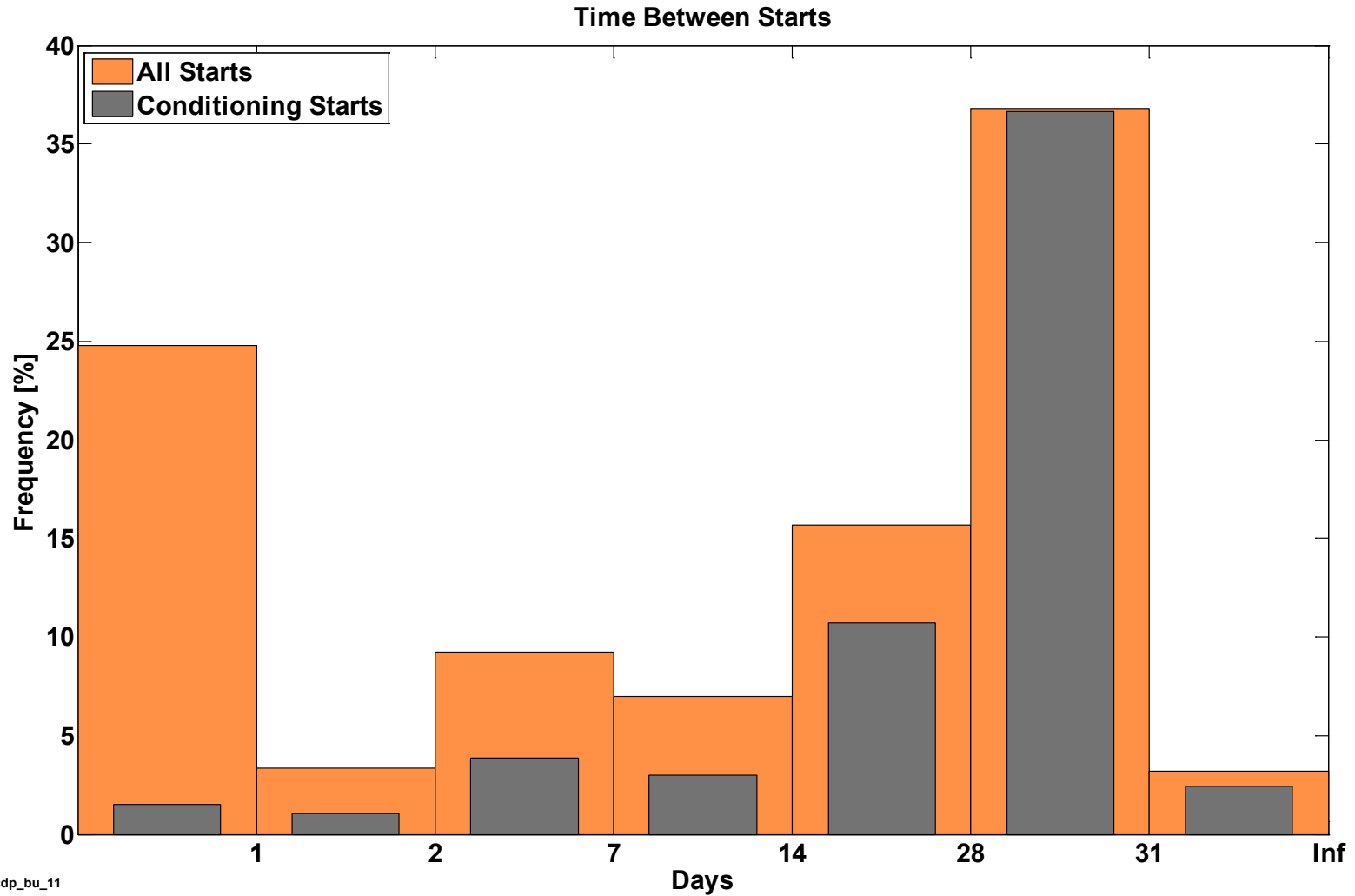
Interrupted Operation Categories



13 interrupted operations



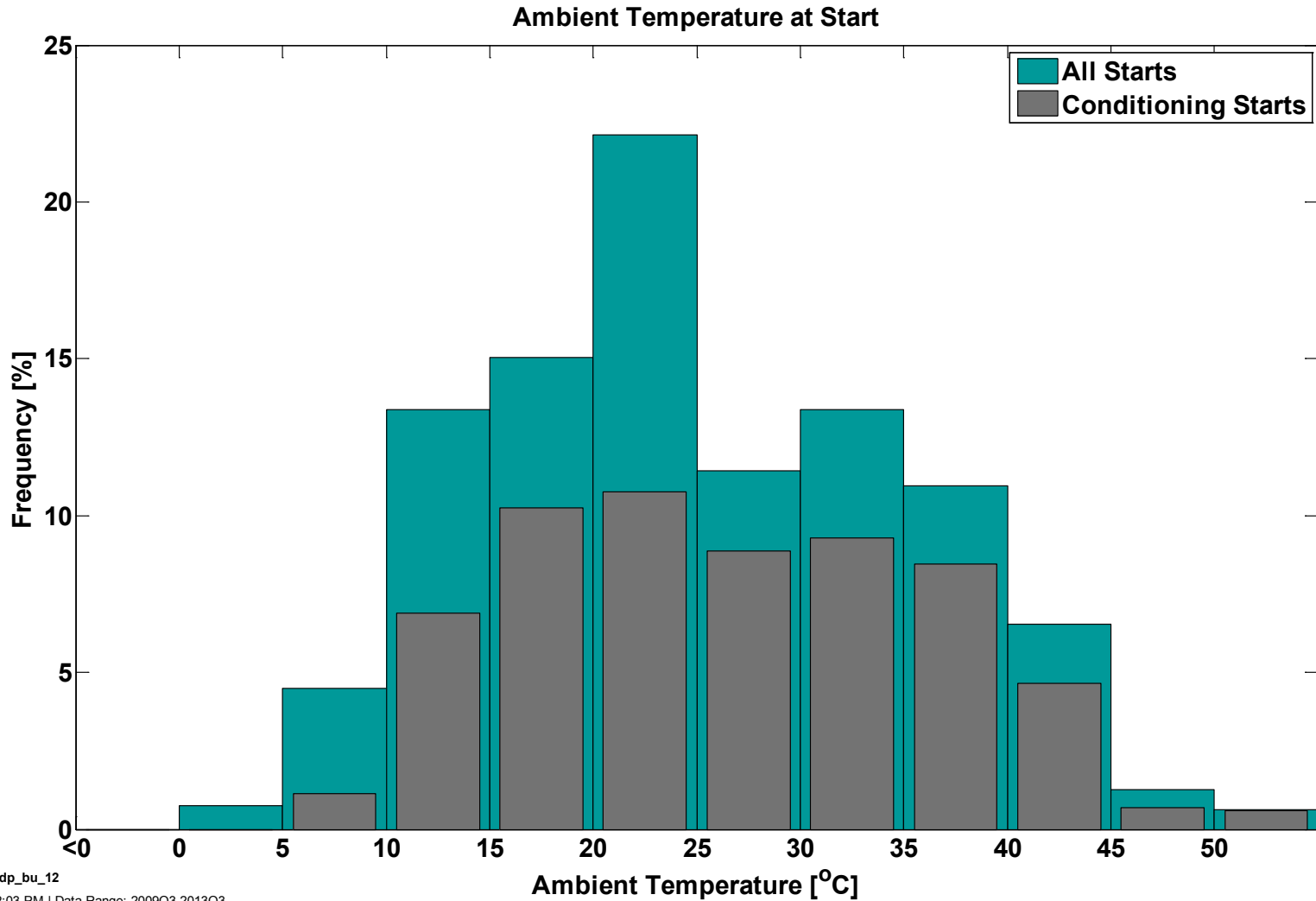
Time Between System Starts



NREL cdp_bu_11

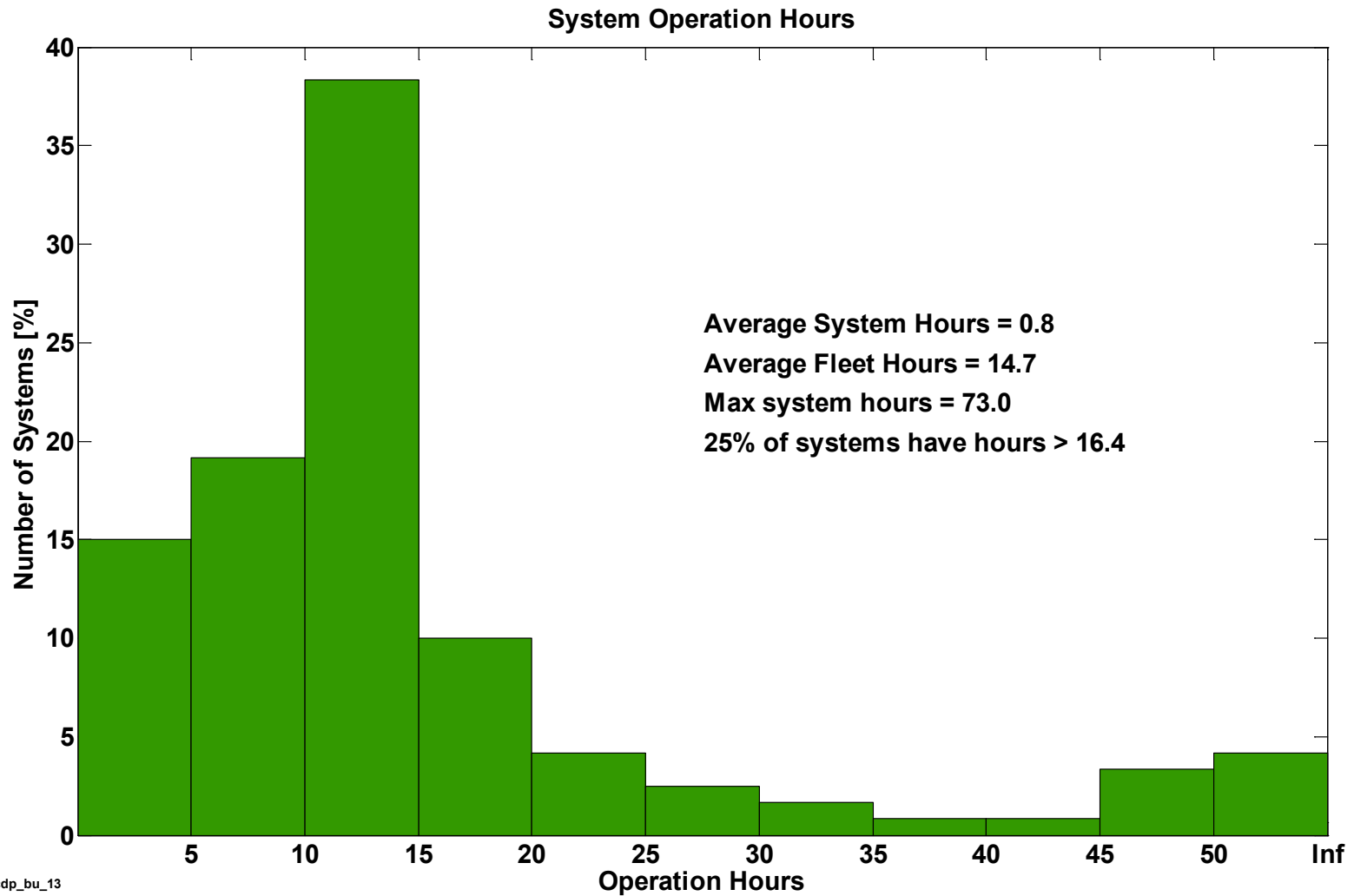
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System Start Ambient Temperature



NREL cdp_bu_12

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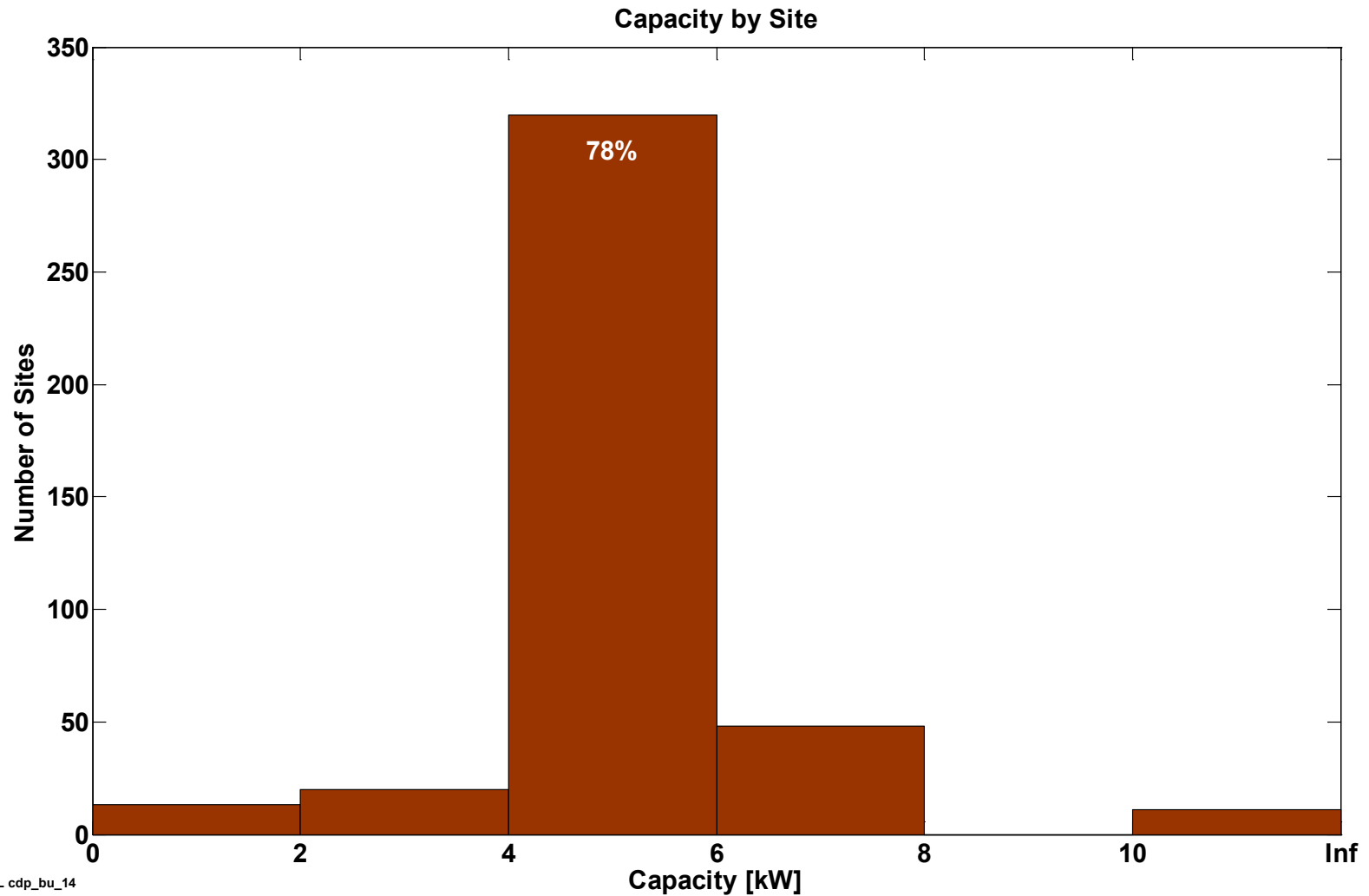


NREL cdp_bu_13

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CDP-BU-14

Site Capacity

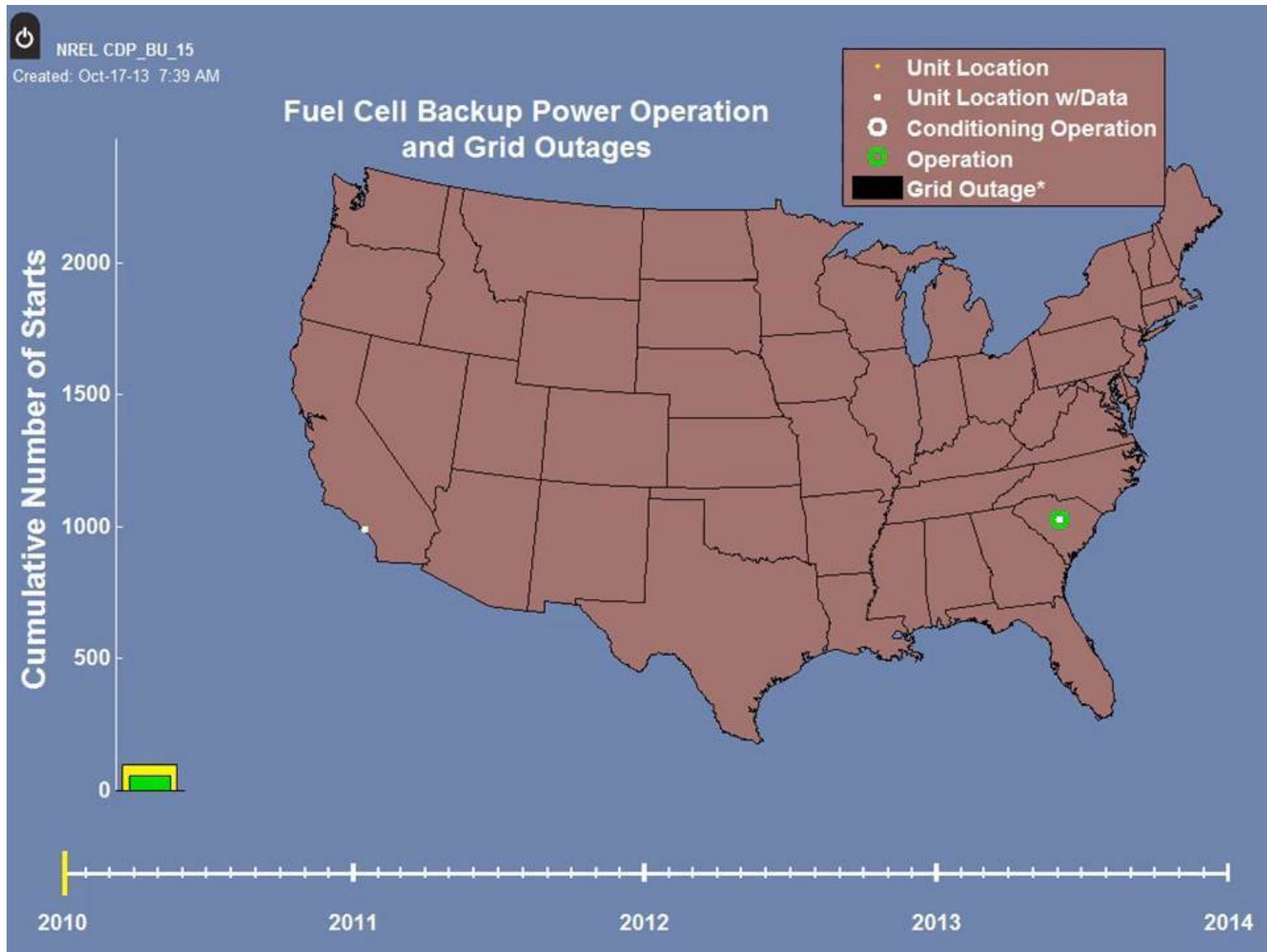


NREL cdp_bu_14

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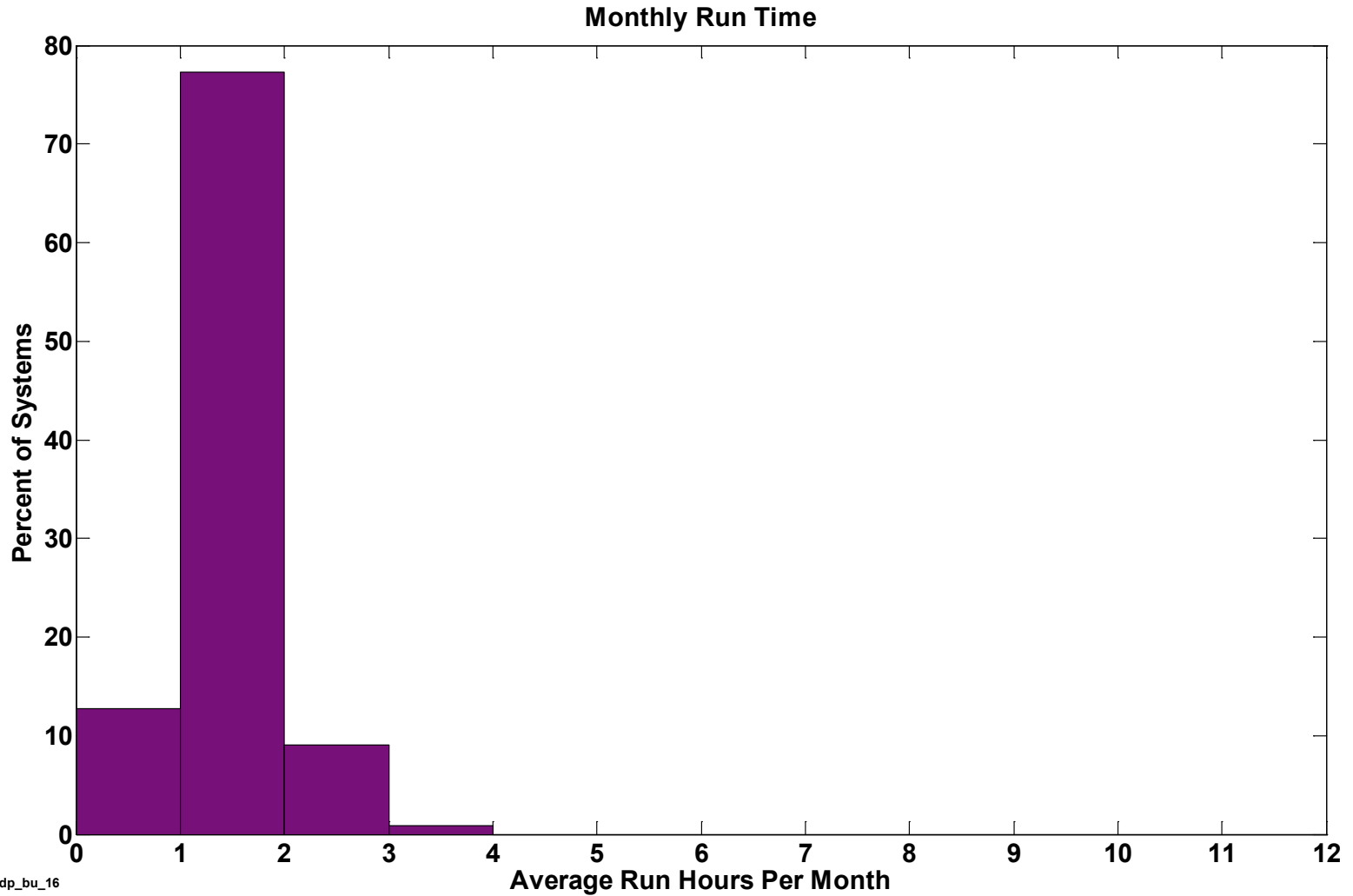
CDP-BU-15

Backup Power Operation With Grid Outage from 01/2010 to 08/2013



CDP-BU-16

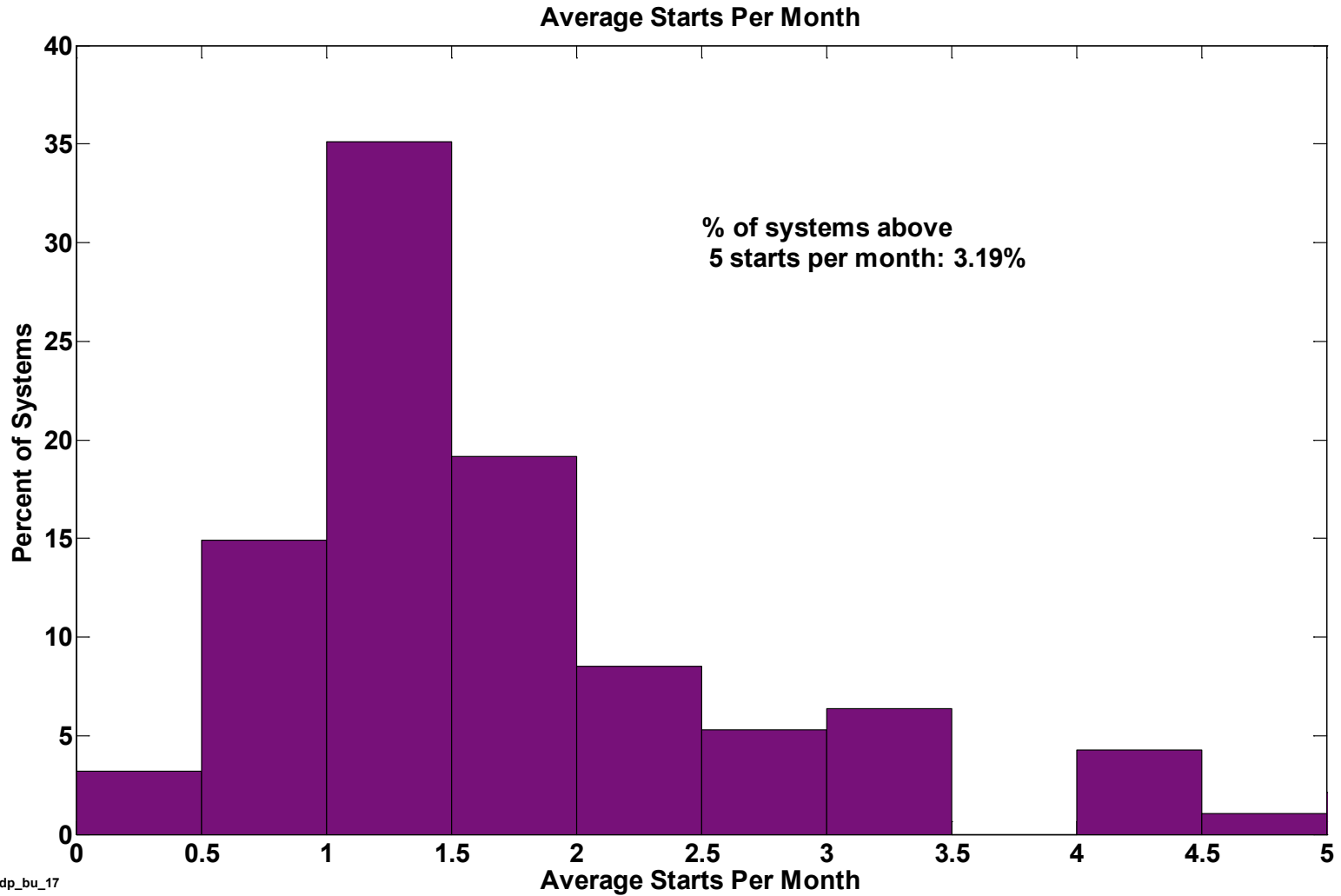
Operation Hours Per Month



NREL cdp_bu_16

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Average Starts Per Month



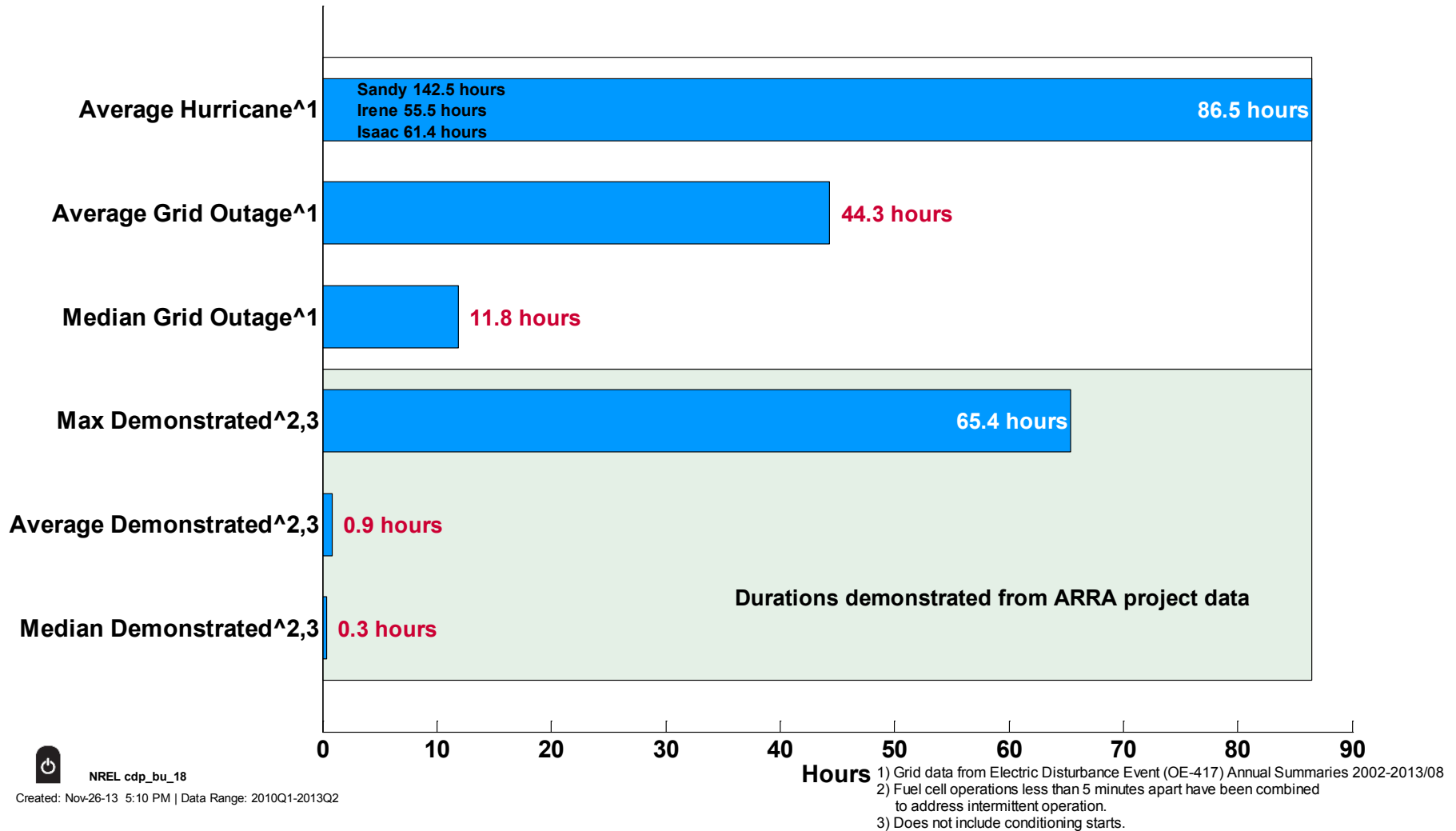
NREL cdp_bu_17

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CDP-BU-18

Site Capacity

Continuous System Run Time



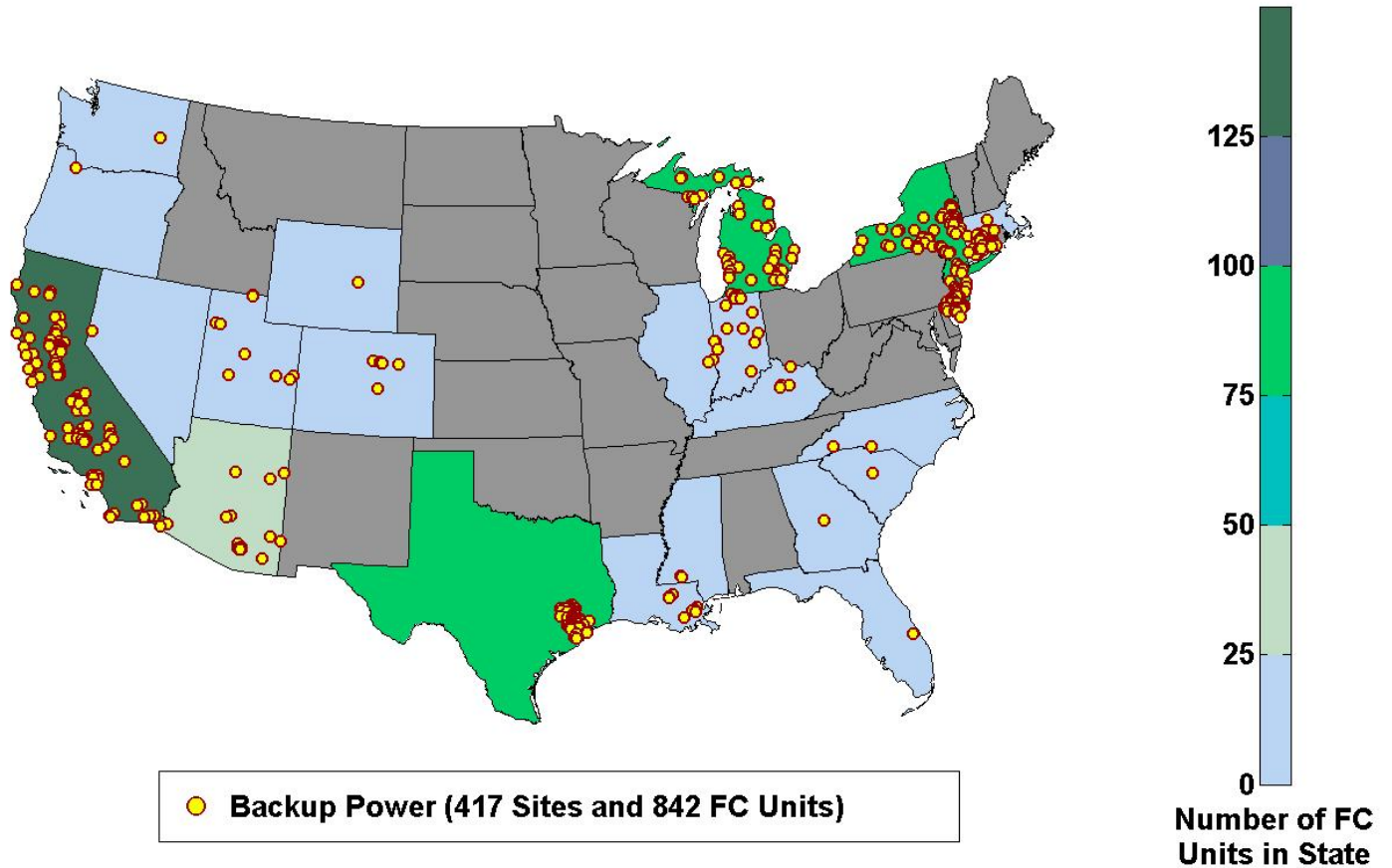
NREL cdp_bu_18

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CDP-BU-19

Unit Locations

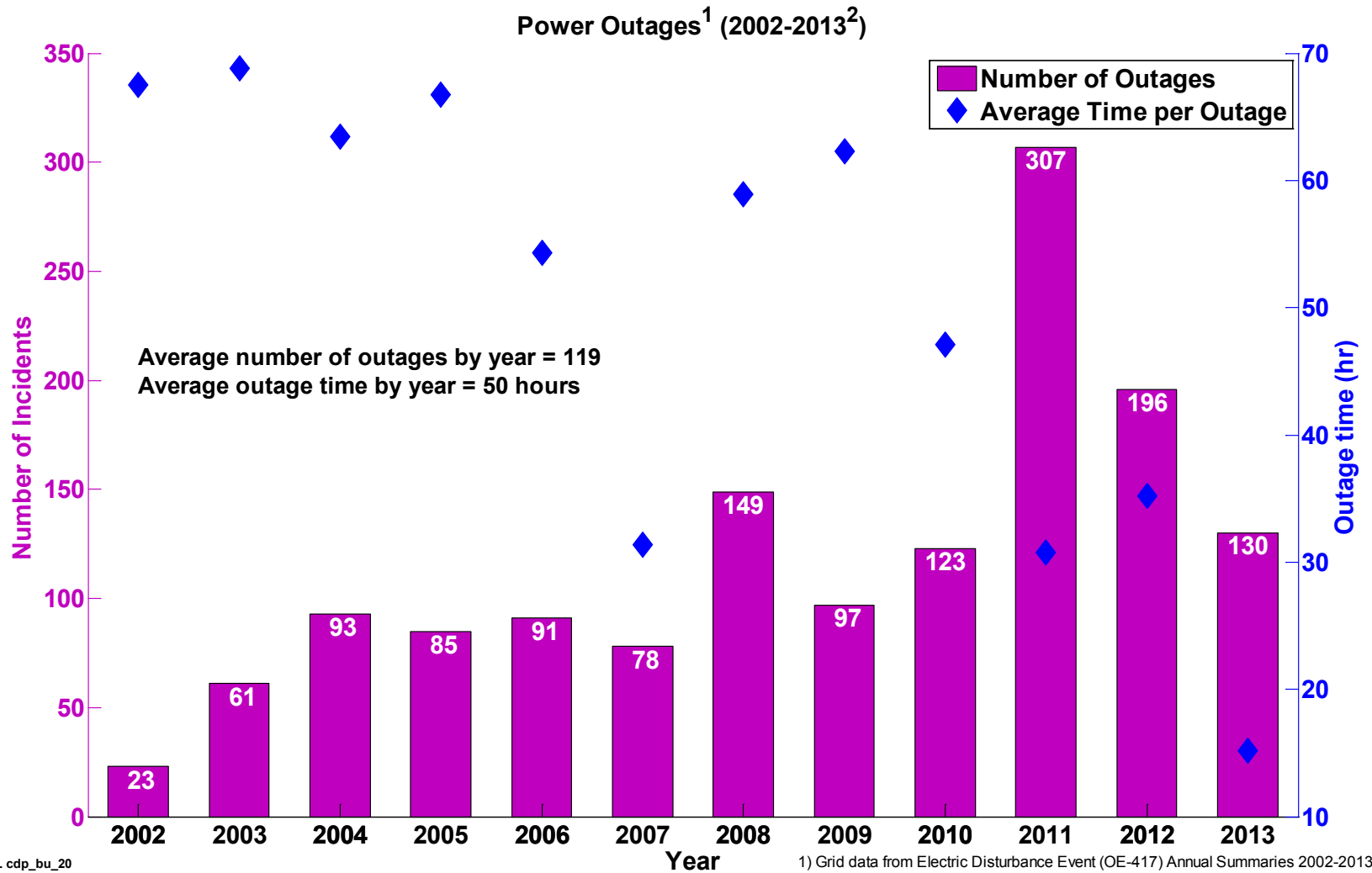
FC Unit Locations - Backup Power



NREL cdp_bu_19

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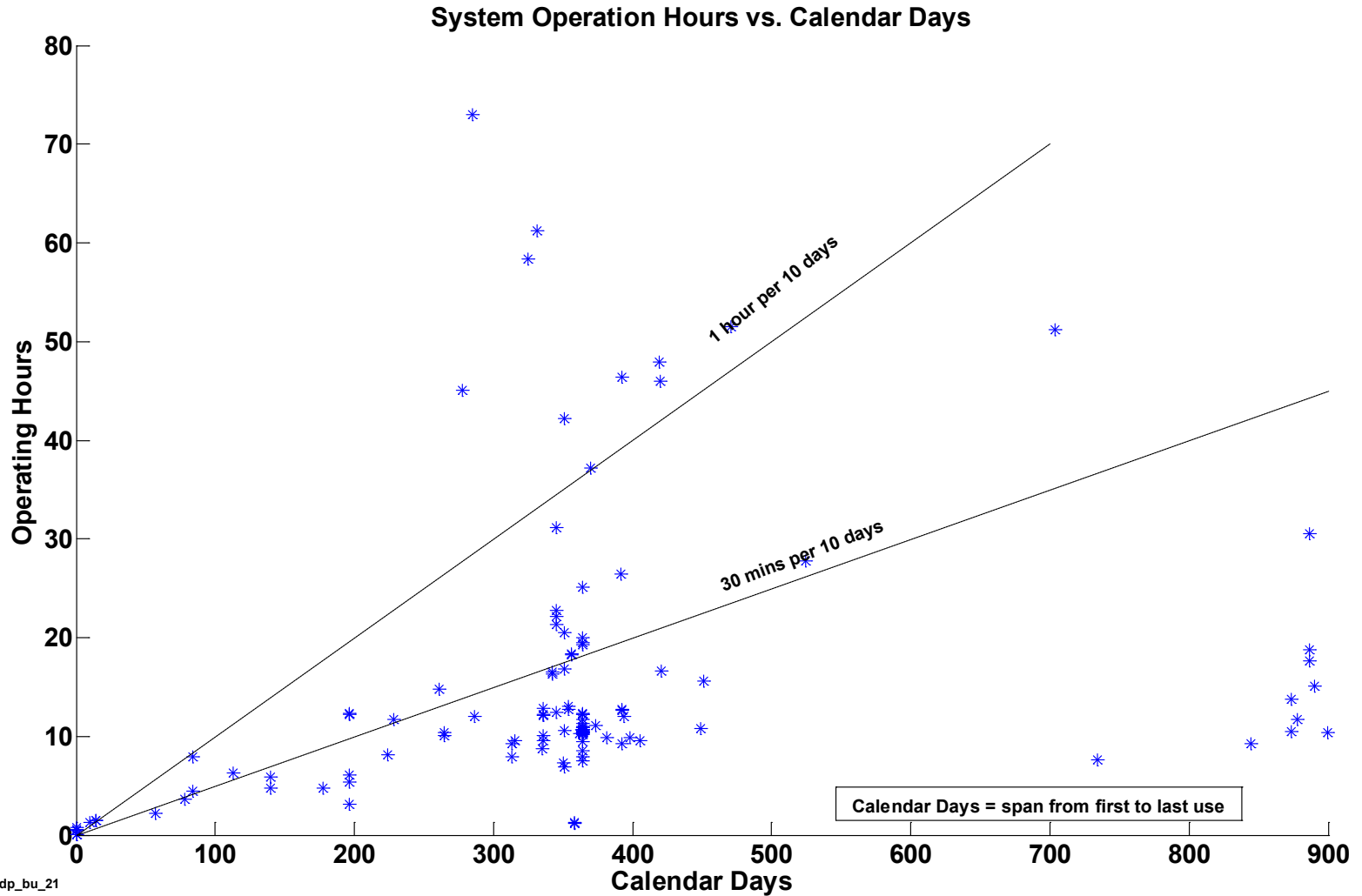
Power Outages per Year



NREL cdp_bu_20

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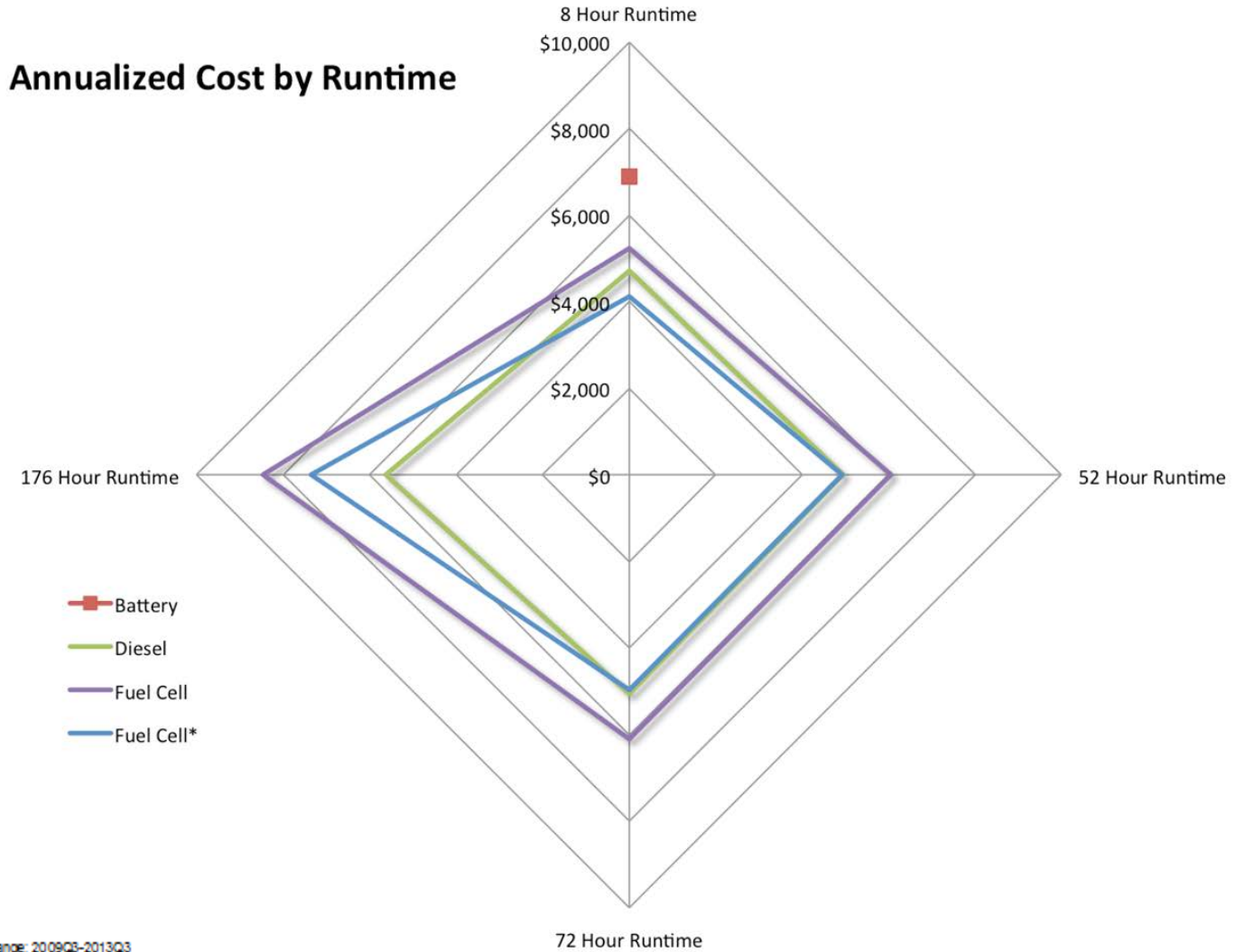
Operation Hours vs. Calendar Days



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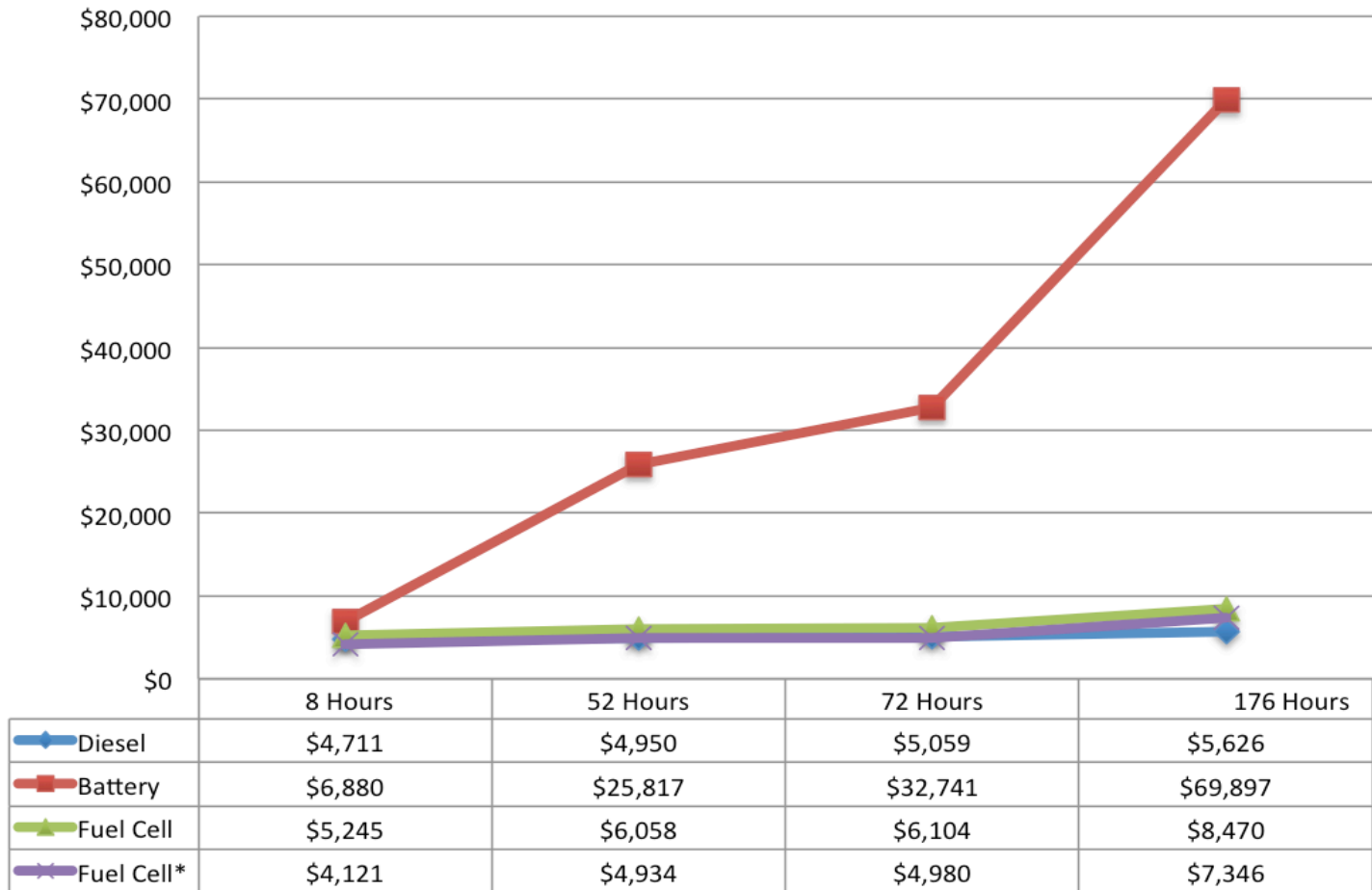
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Annualized Cost by Runtime



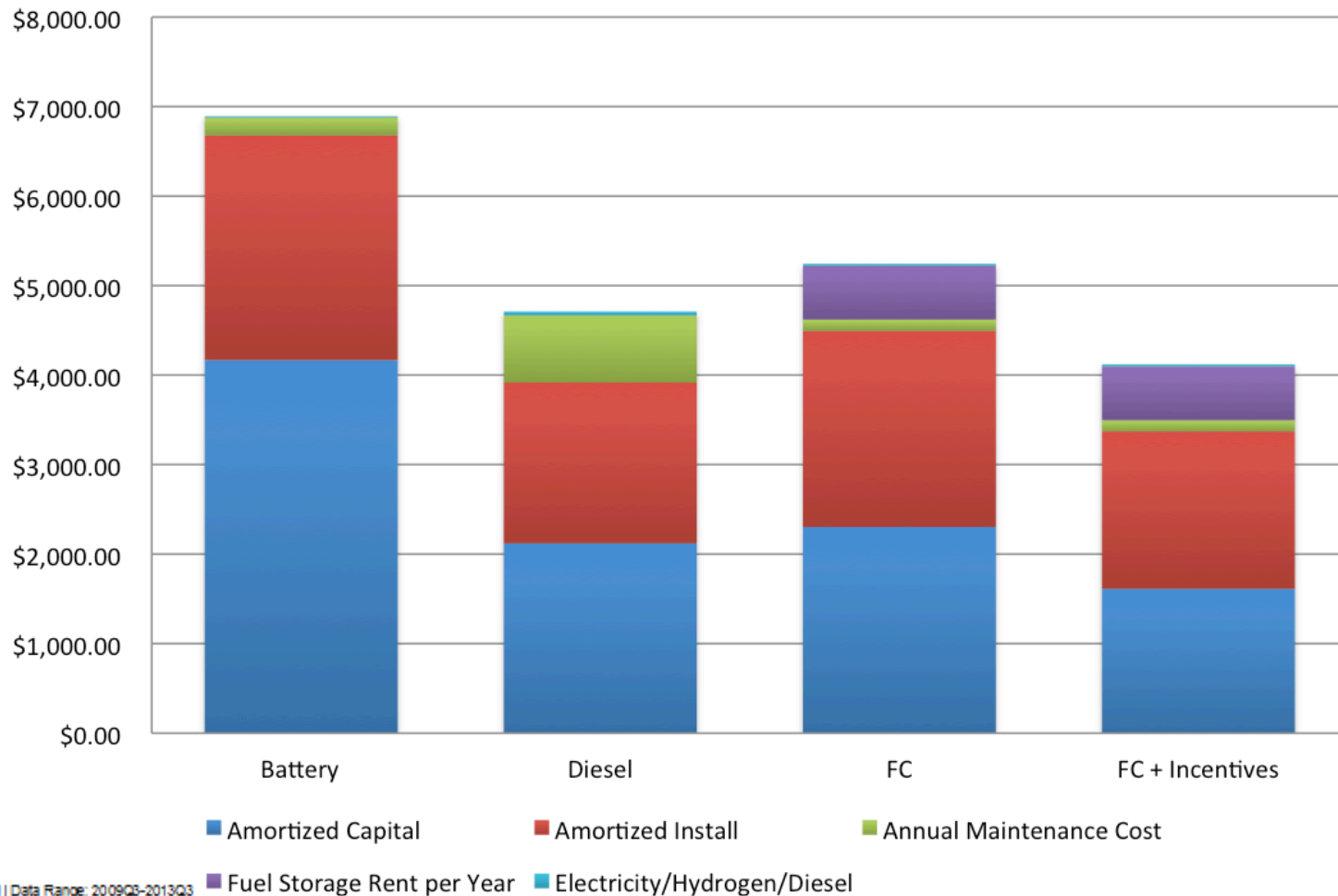
Annualized Cost of Ownership

Annualized Cost of Ownership for Backup Power

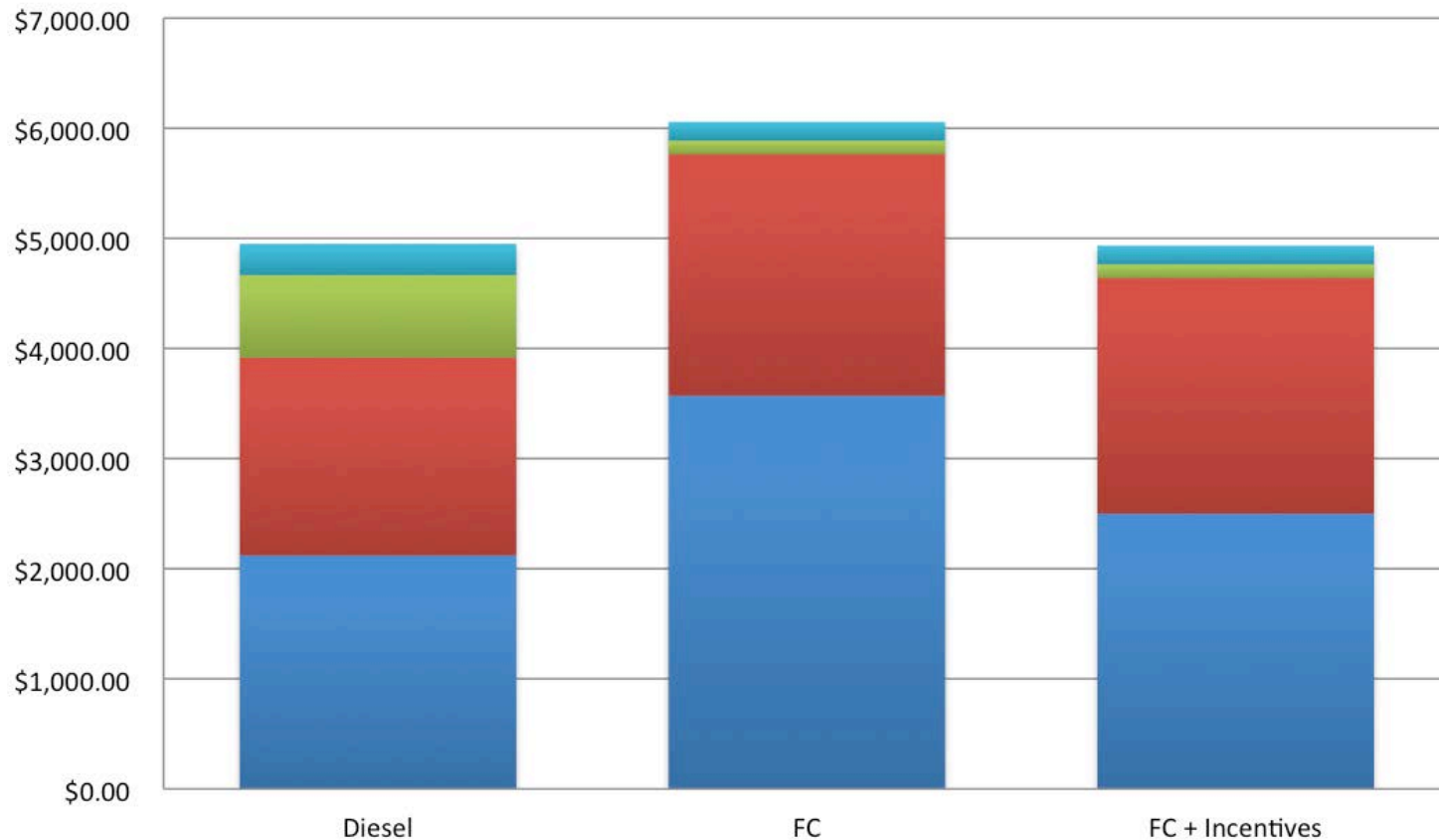


8-hour Annualized Cost of Ownership

8-hour Annualized Cost of Ownership



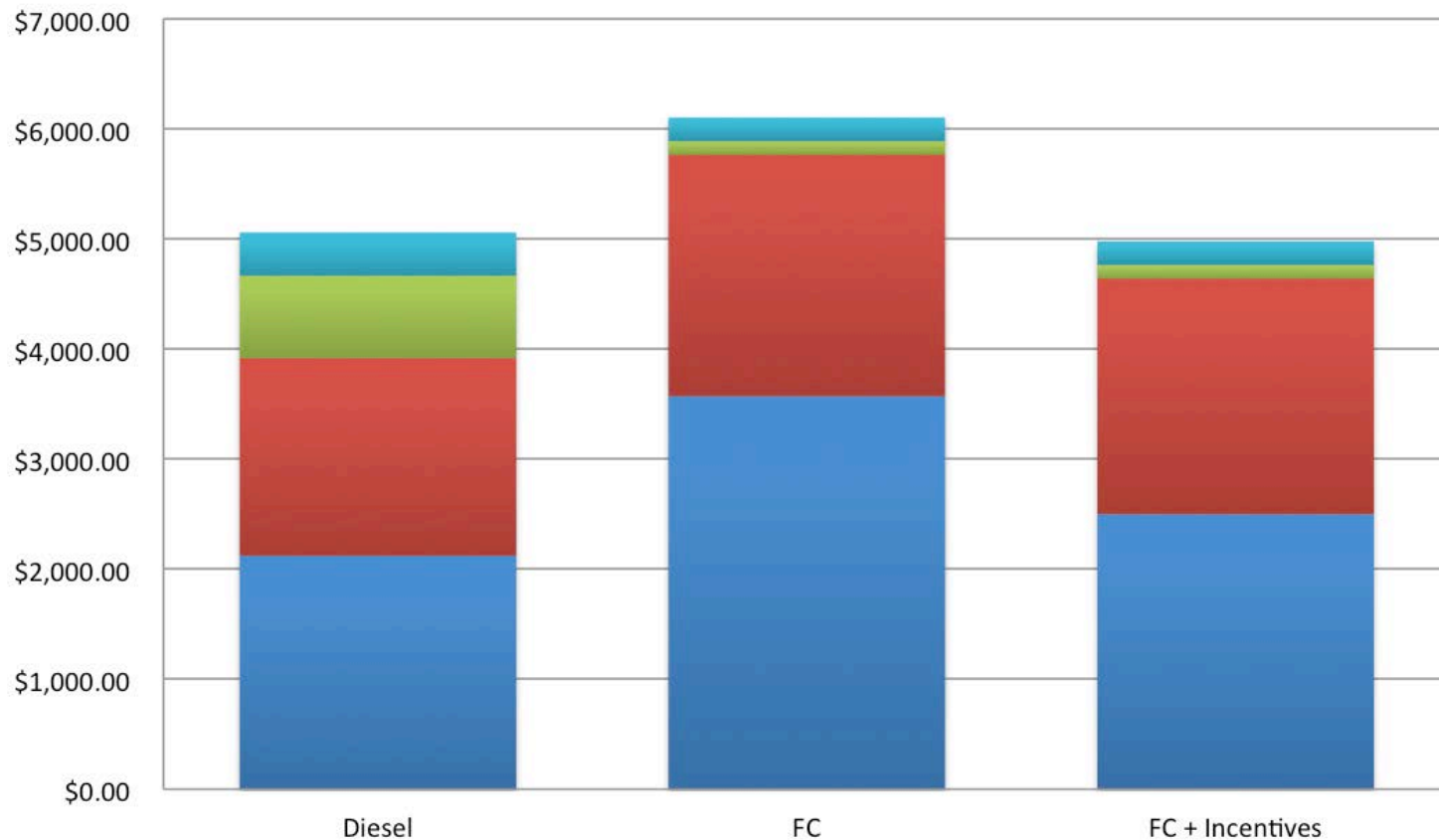
52-hour Annualized Cost of Ownership



■ Amortized Capital ■ Amortized Install ■ Annual Maintenance Cost

■ Fuel Storage Rent per Year ■ Electricity/Hydrogen/Diesel

72-hour Annualized Cost of Ownership

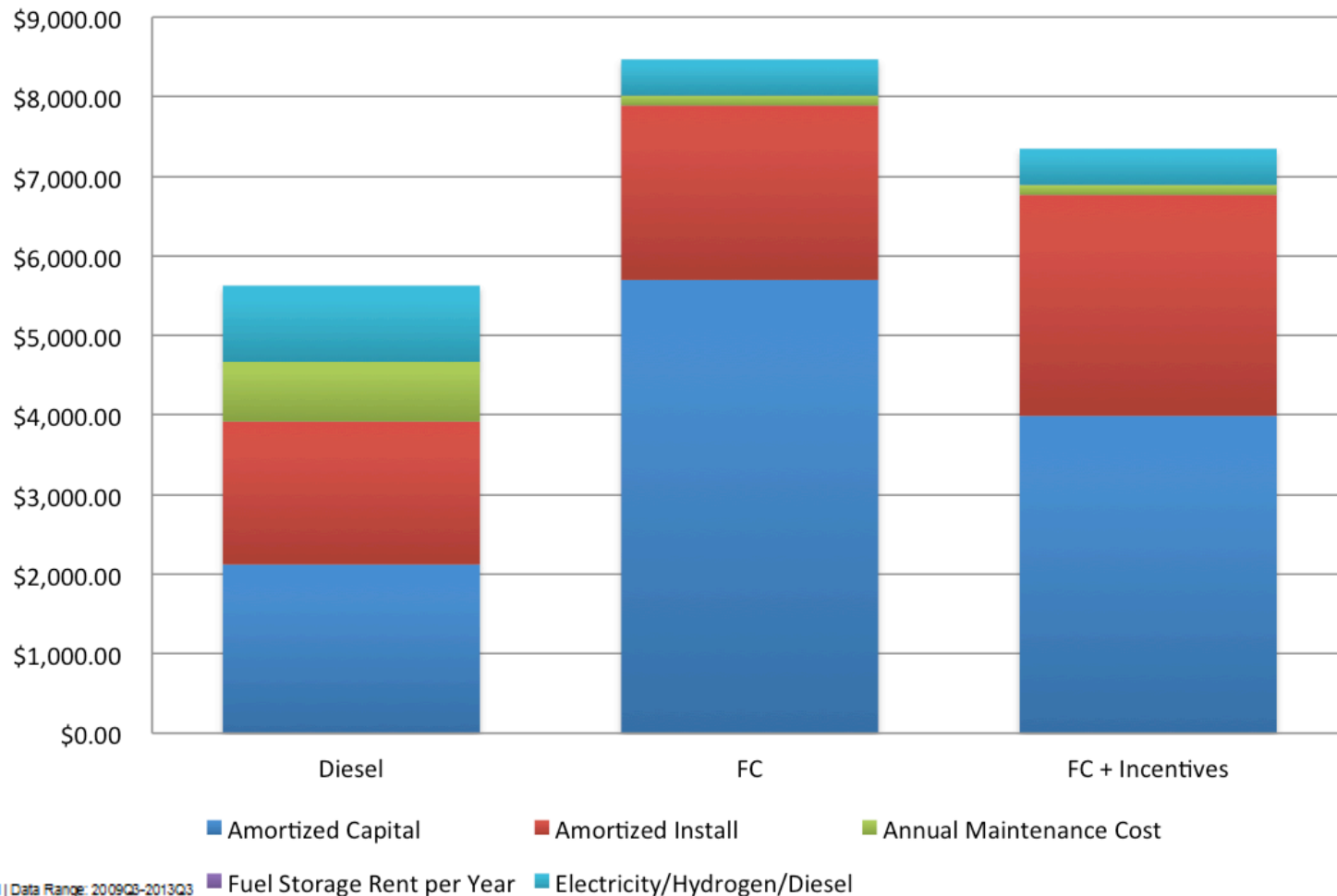


■ Amortized Capital ■ Amortized Install ■ Annual Maintenance Cost

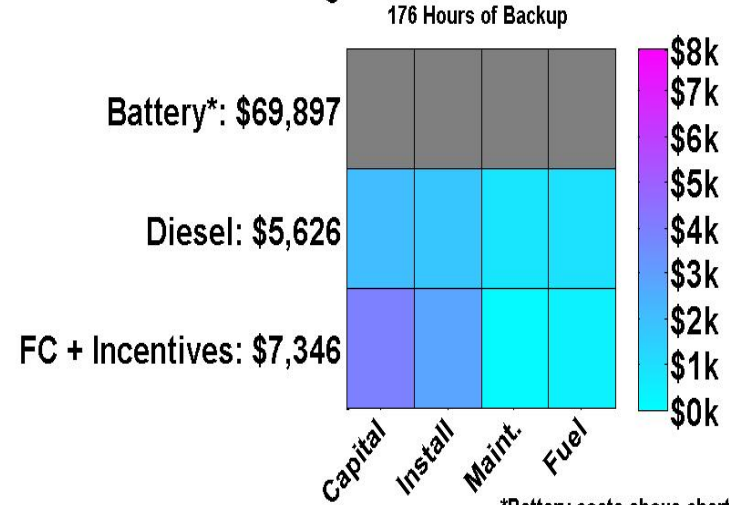
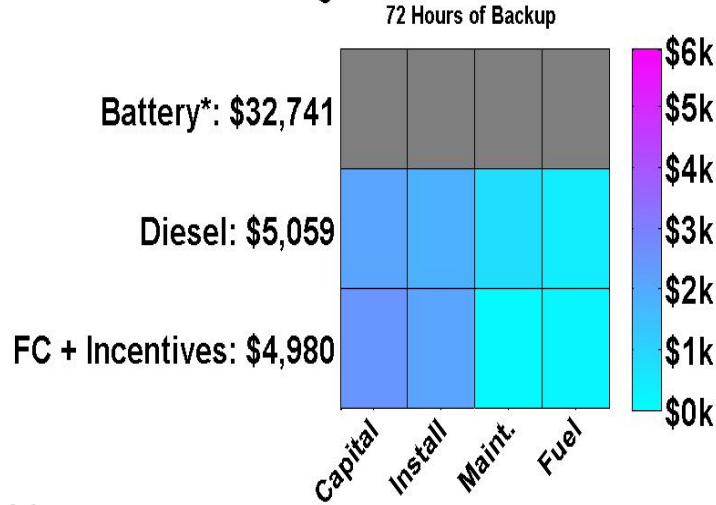
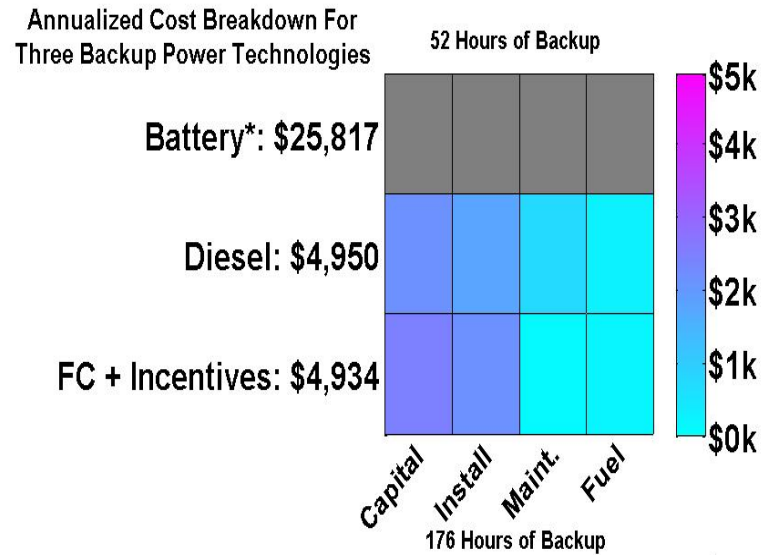
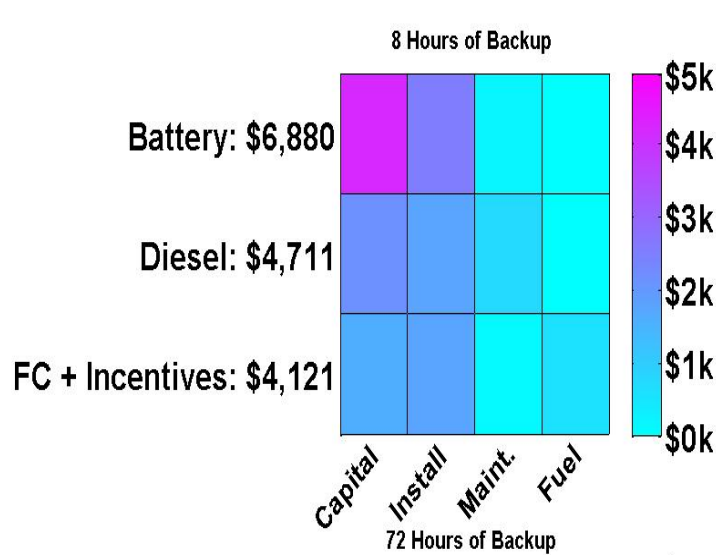
■ Fuel Storage Rent per Year ■ Electricity/Hydrogen/Diesel



176-hour Annualized Cost of Ownership



Annualized Cost of Ownership Heat Map



*Battery costs above chart axis limit, not shown.

