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Technical Report
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Spring 2014 Composite Data Products: Backup Power

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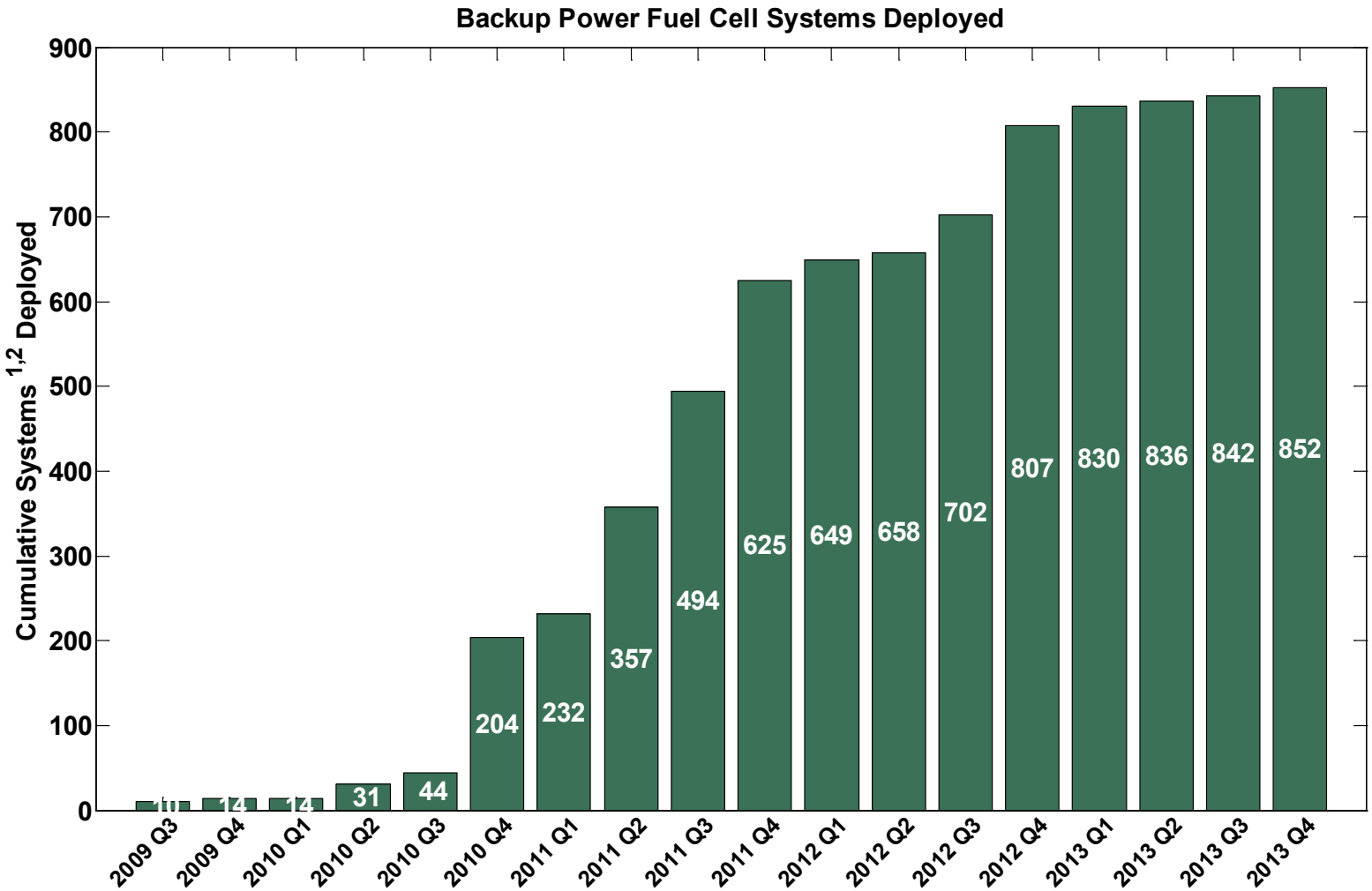
CDP-BU-01
Backup Power Fuel Cell Systems Deployed

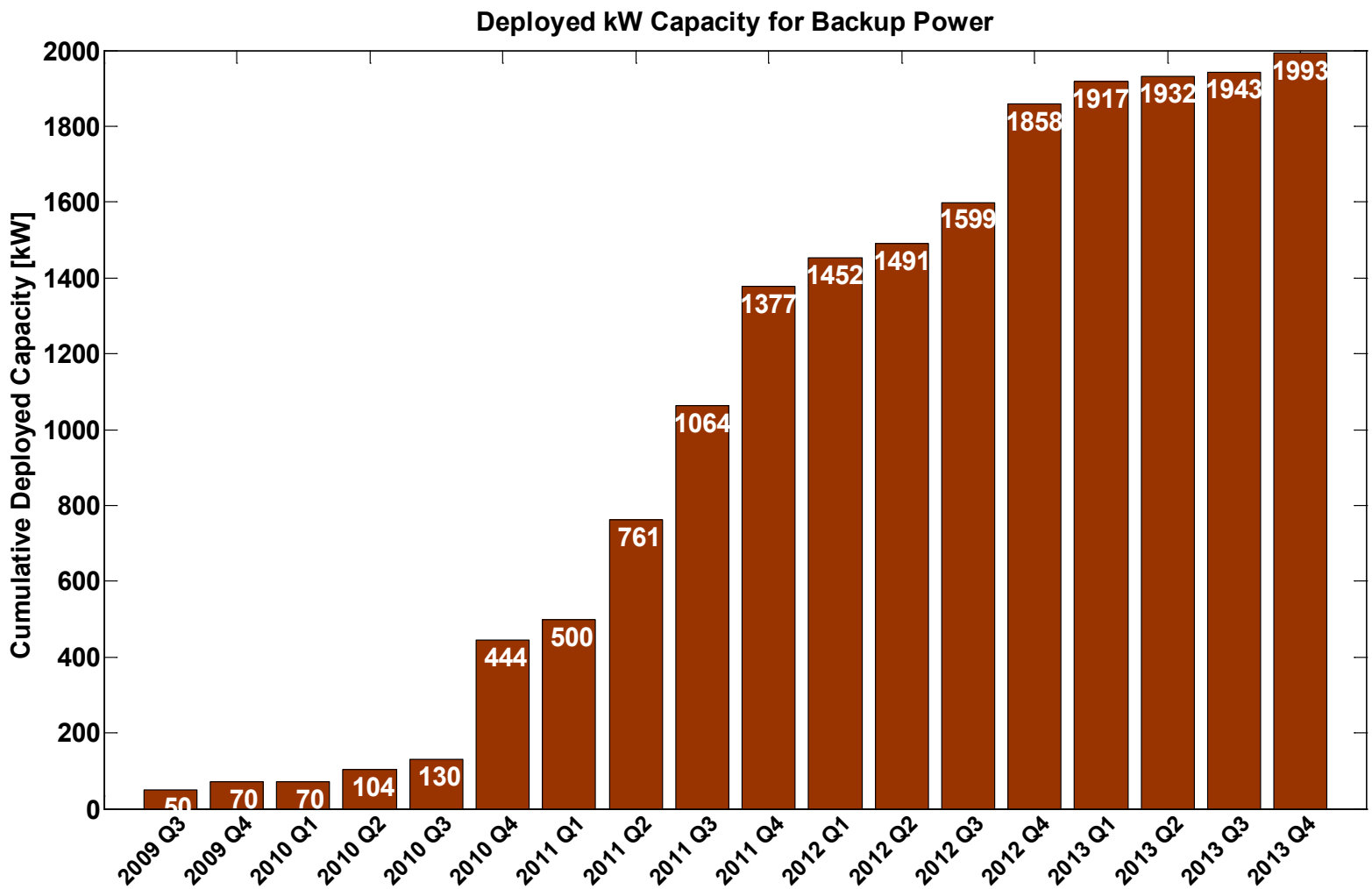


NREL cdp_bu_01

Created: Apr-16-14 5:02 PM | Data Range: 2010Q1-2013Q4

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

CDP-BU-02
Deployed kW Capacity for Backup Power



NREL cdp_bu_02

Created: Apr-16-14 5:05 PM | Data Range: 2010Q1-2013Q4

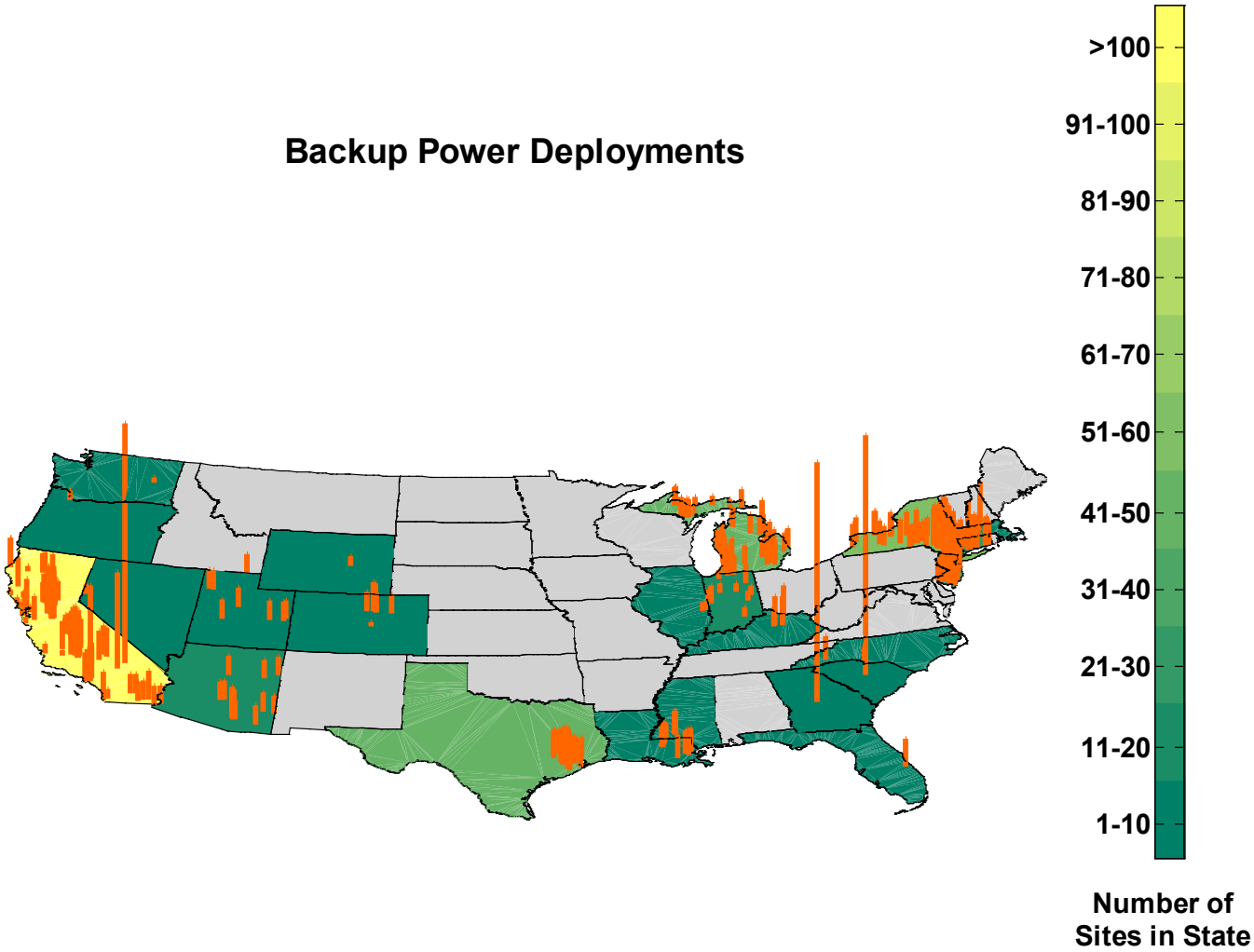
CDP-BU-03
Backup Power Deployments

State	kW	Sites
Arizona	84	19
California	635	130
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

Totals	1993	418

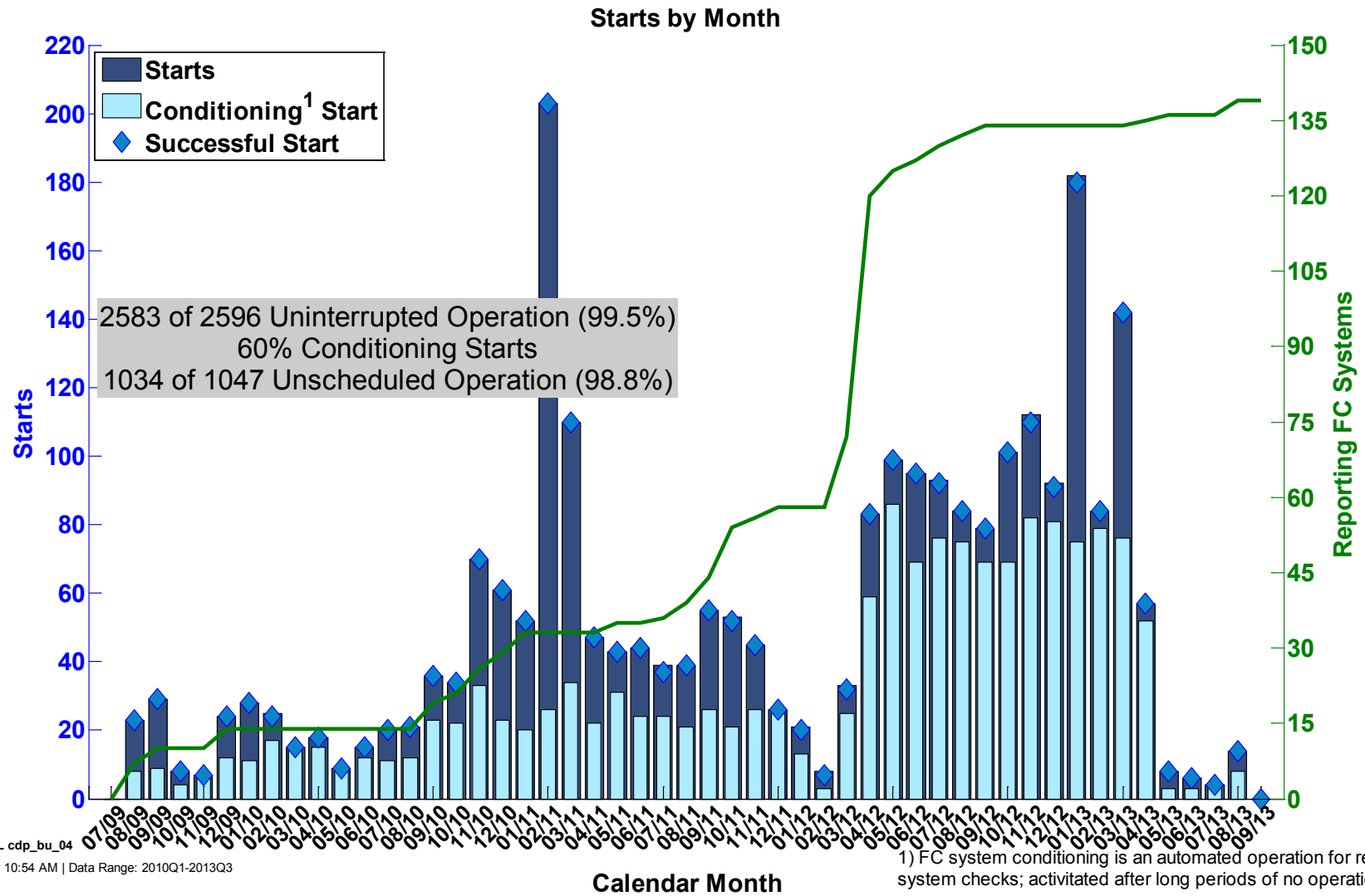
NREL cdp_bu_03

Created: Apr-18-14 7:50 AM | Data Range: 2010Q1-2013Q4



Site Capacity (line height proporational to installed site kW capacity)

CDP-BU-04
Fuel Cell System Starts by Month

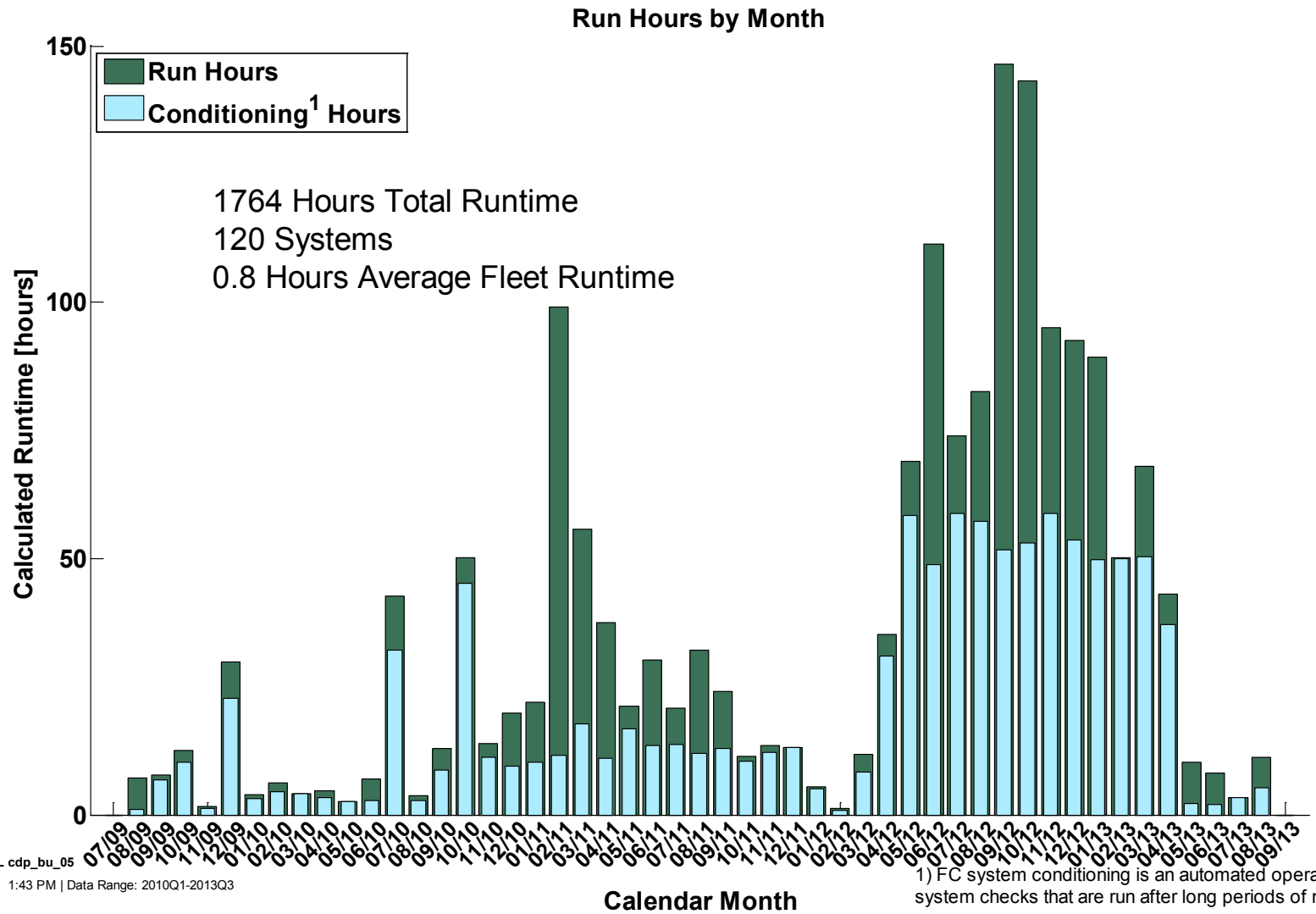


NREL cdp_bu_04

Created: Apr-07-14 10:54 AM | Data Range: 2010Q1-2013Q3

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

CDP-BU-05
Fuel Cell System Run Hours by Month

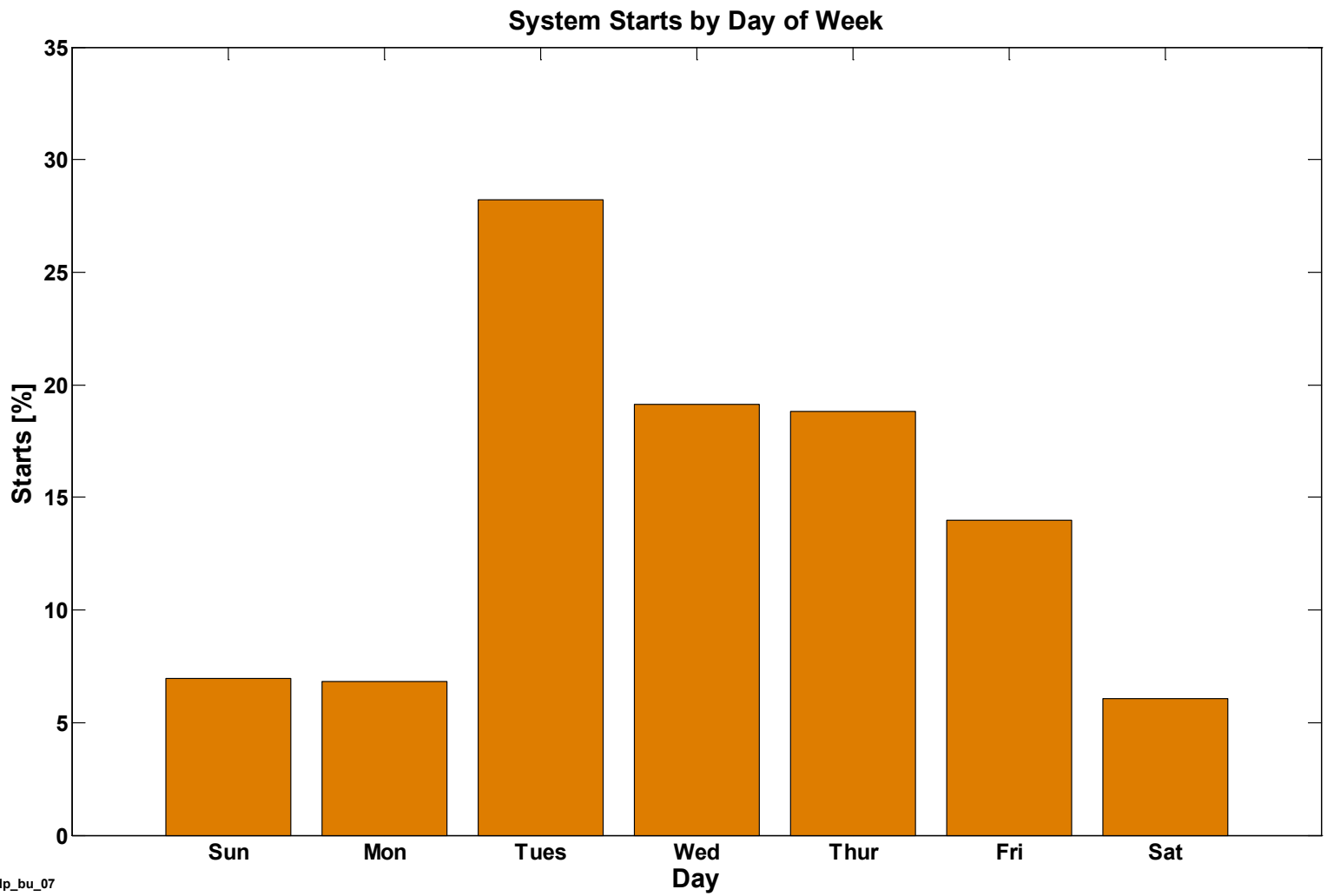


NREL cdp_bu_05

Created: Apr-02-14 1:43 PM | Data Range: 2010Q1-2013Q3

1) FC system conditioning is an automated operation for regular system checks that are run after long periods of no operation.

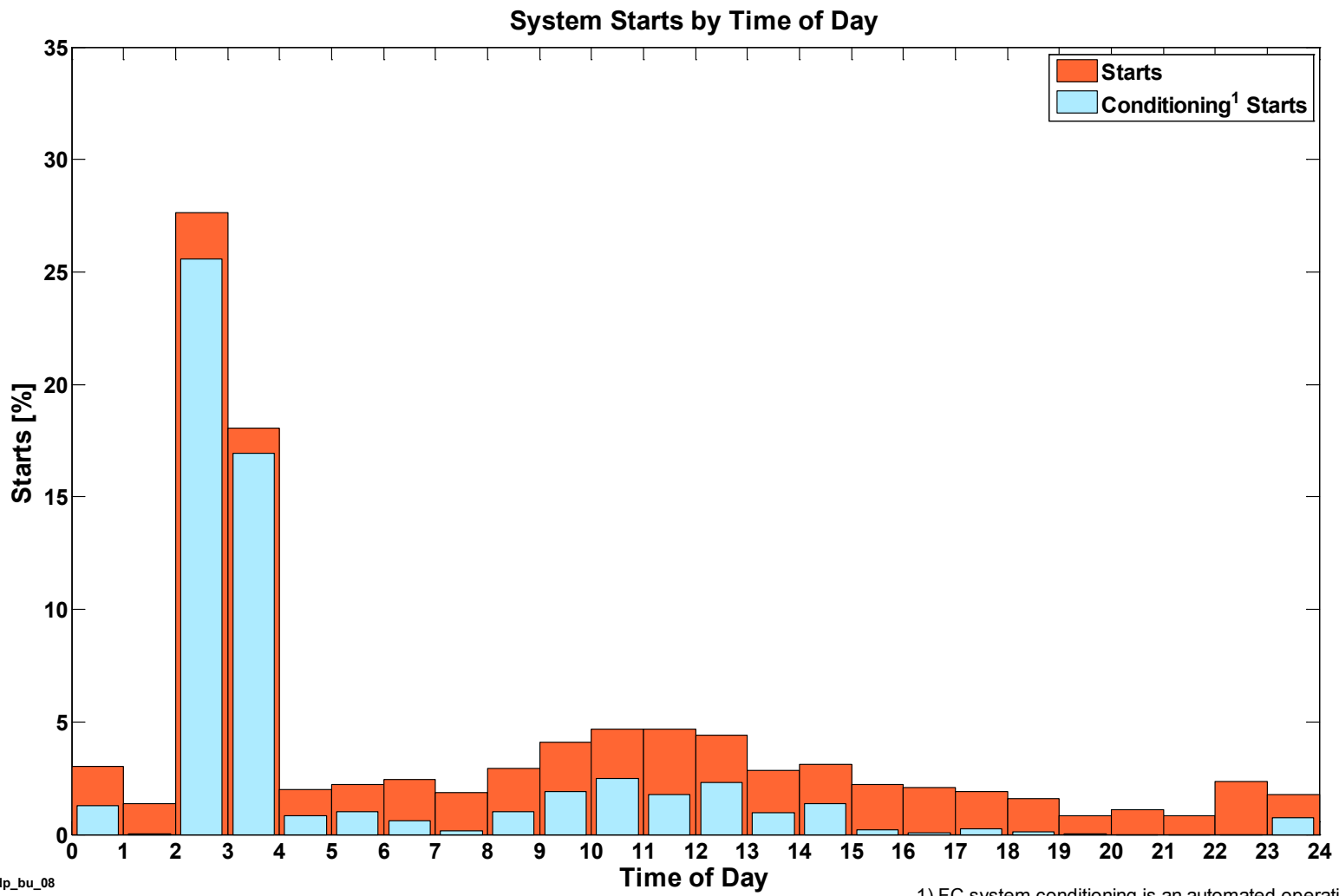
CDP-BU-07
Fuel Cell System Starts by Day of Week



NREL cdp_bu_07

Created: Apr-02-14 1:42 PM | Data Range: 2010Q1-2013Q3

CDP-BU-08
Fuel Cell System Starts by Time of Day

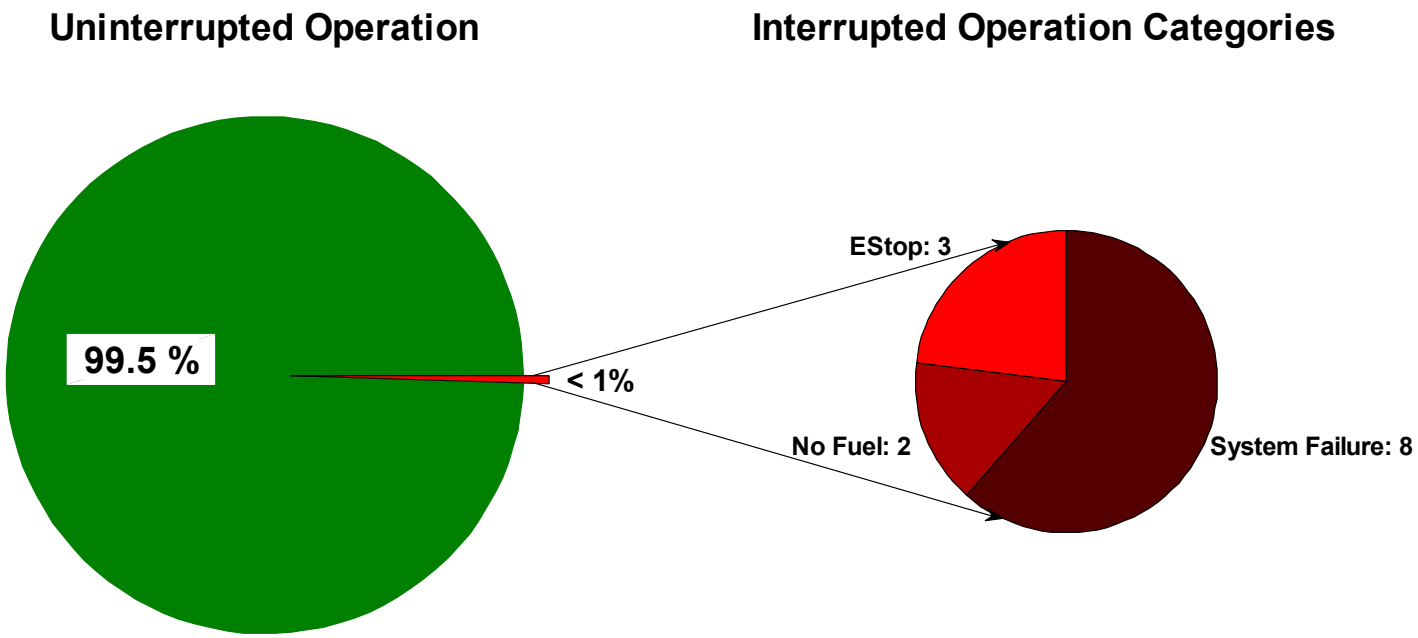


NREL cdp_bu_08

Created: Apr-02-14 1:42 PM | Data Range: 2010Q1-2013Q3

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

CDP-BU-10
Interrupted Operation Categories

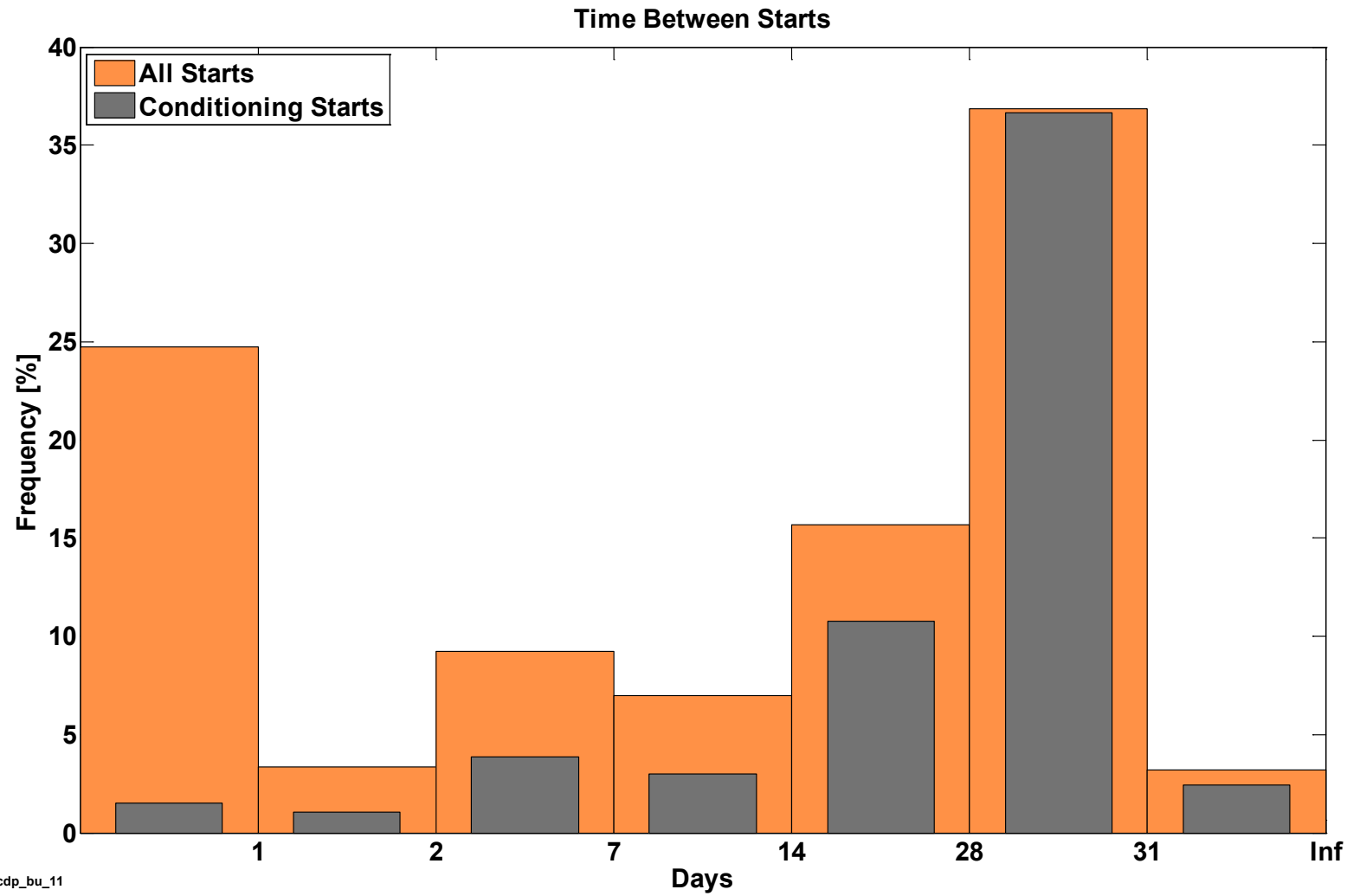


2583 out of 2596 uninterrupted operation

13 interrupted operations

NREL cdp_bu_10
Created: Apr-02-14 1:43 PM | Data Range: 2010Q1-2013Q3

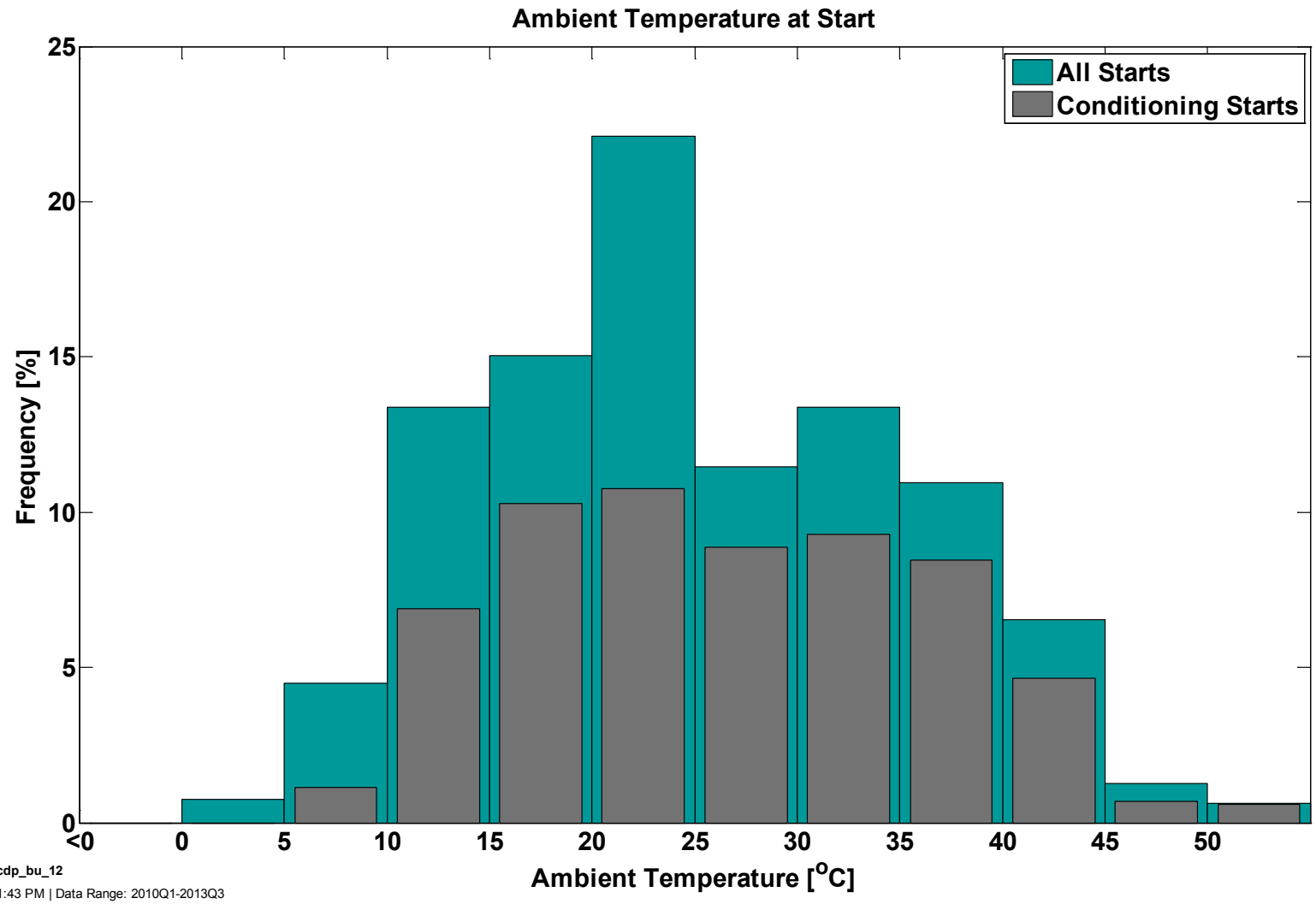
CDP-BU-11
Time Between System Starts



NREL cdp_bu_11

Created: Apr-02-14 1:43 PM | Data Range: 2010Q1-2013Q3

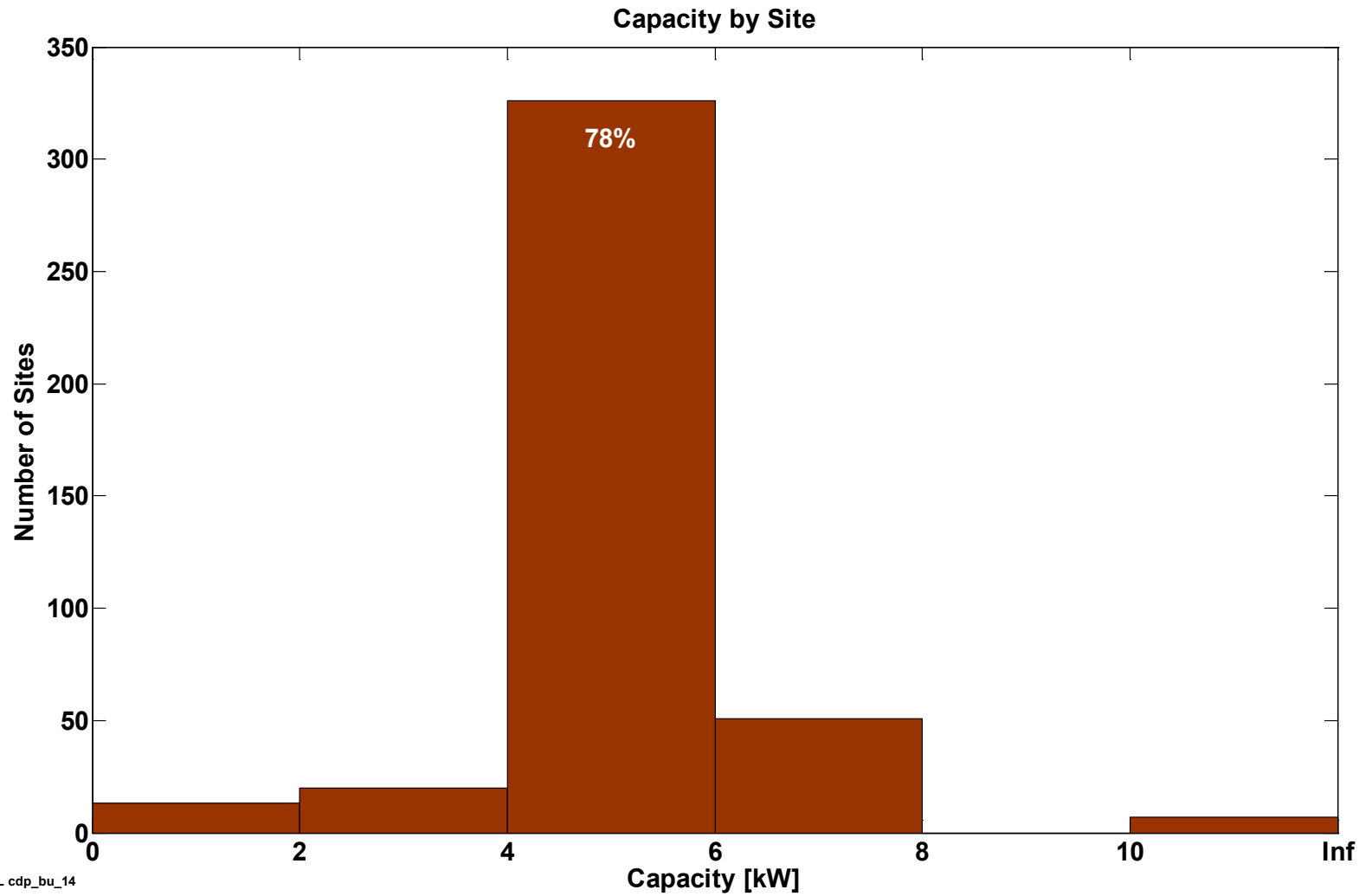
CDP-BU-12
System Start Ambient Temperature



NREL cdp_bu_12

Created: Apr-02-14 1:43 PM | Data Range: 2010Q1-2013Q3

CDP-BU-14
Site Capacity

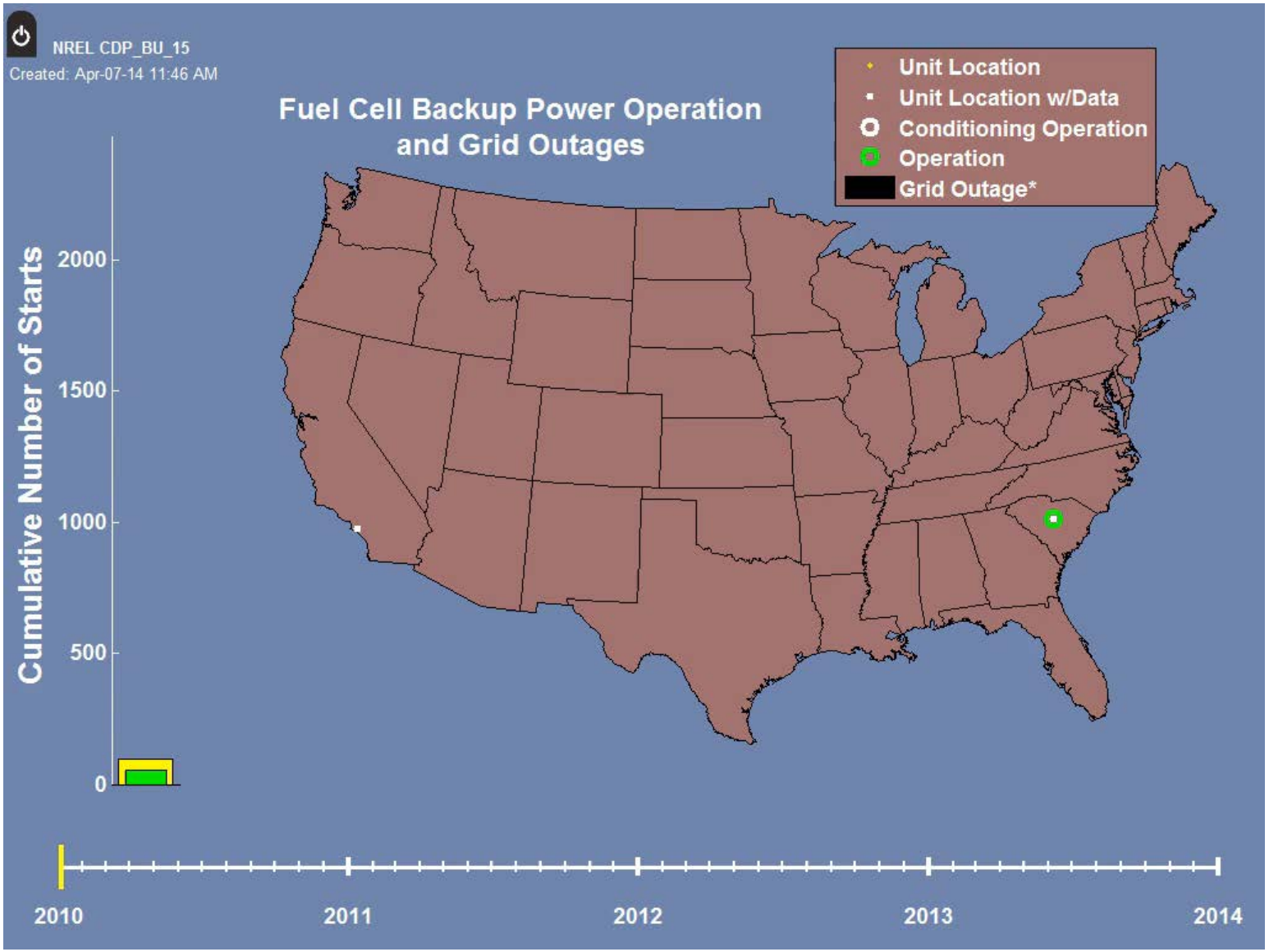


NREL cdp_bu_14

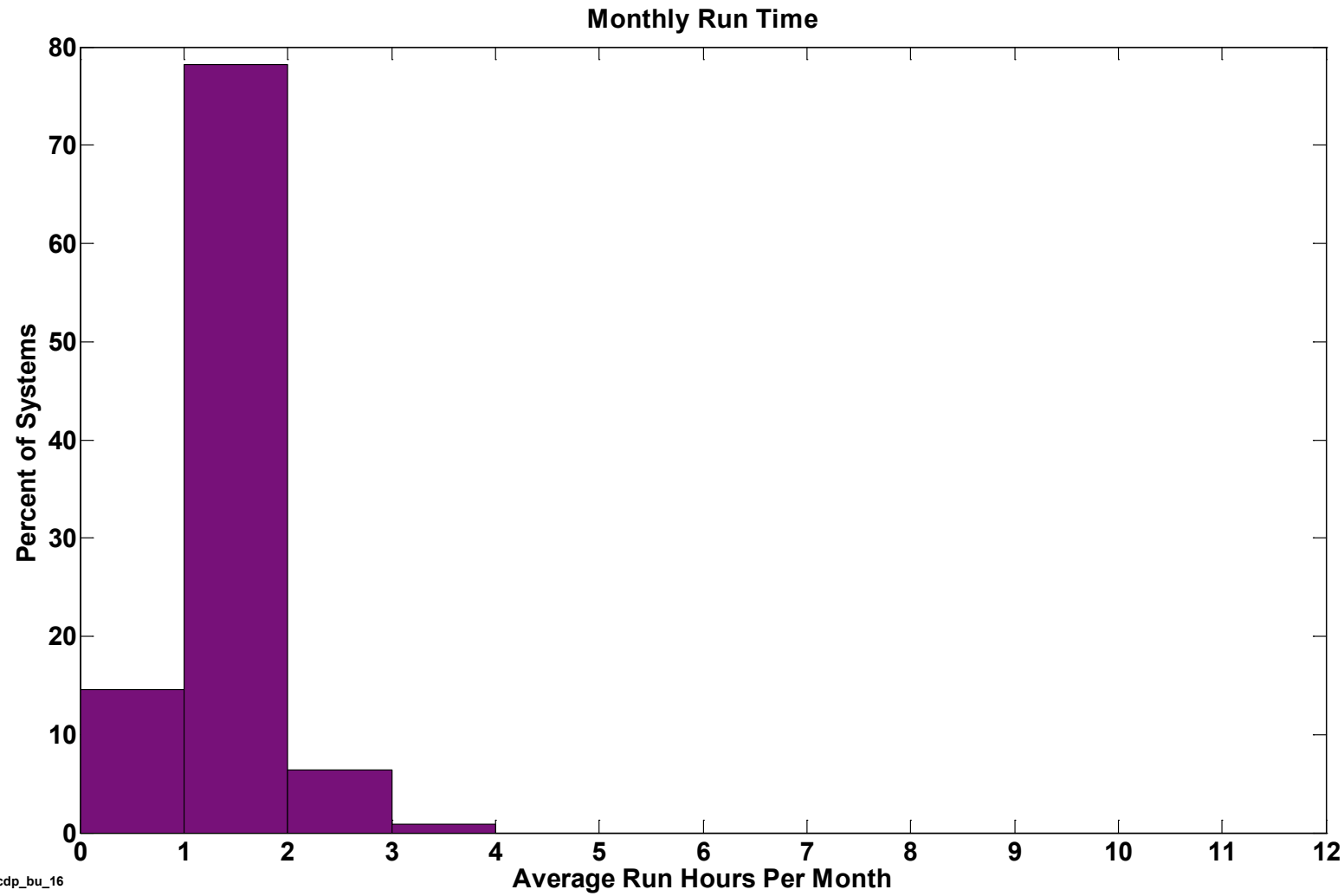
Created: Apr-02-14 1:43 PM | Data Range: 2010Q1-2013Q3

CDP-BU-15

Backup Power Operation With Grid Outage from 01/2010 to 12/2013



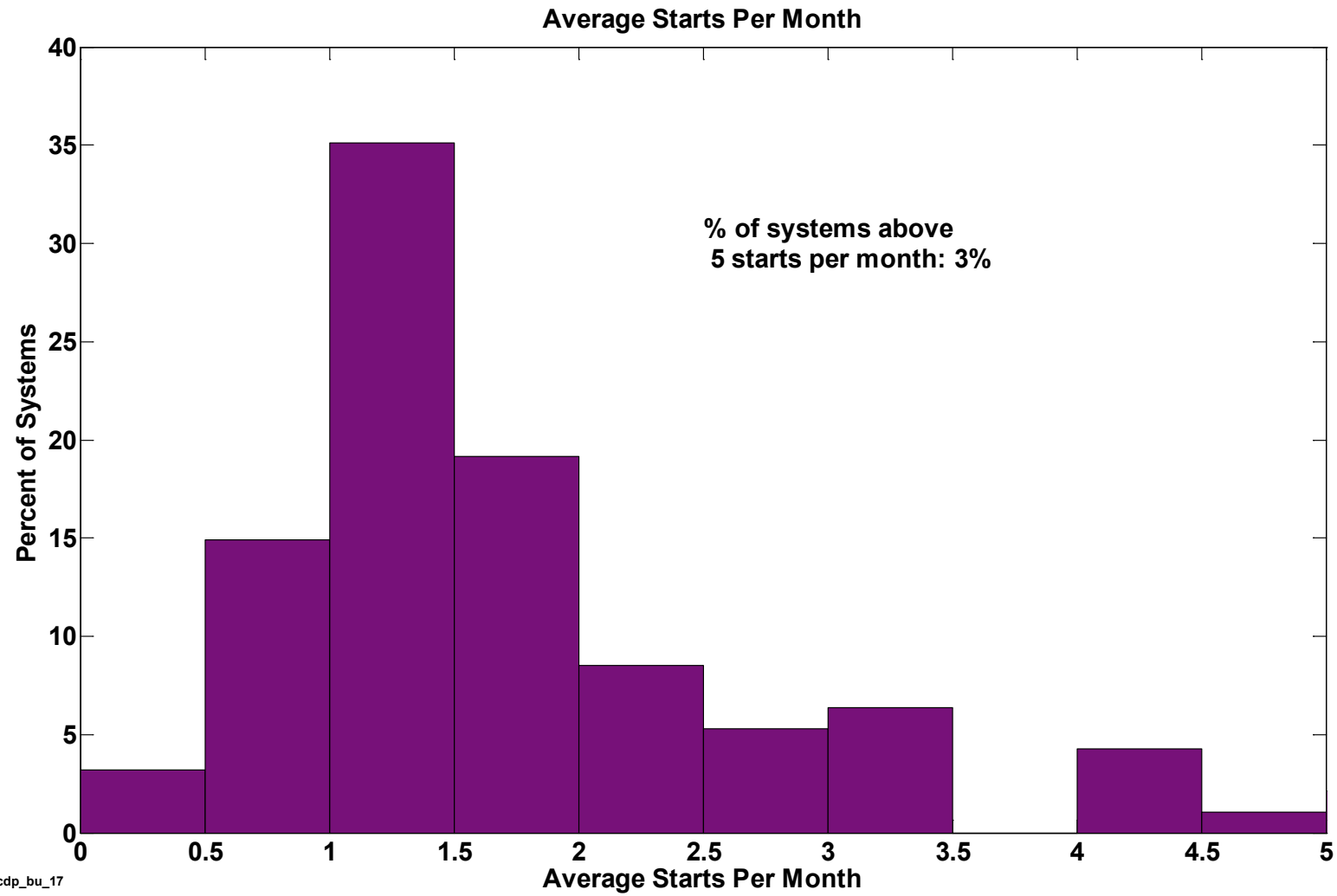
CDP-BU-16
Operation Hours Per Month



NREL cdp_bu_16

Created: Apr-02-14 1:43 PM | Data Range: 2010Q1-2013Q3

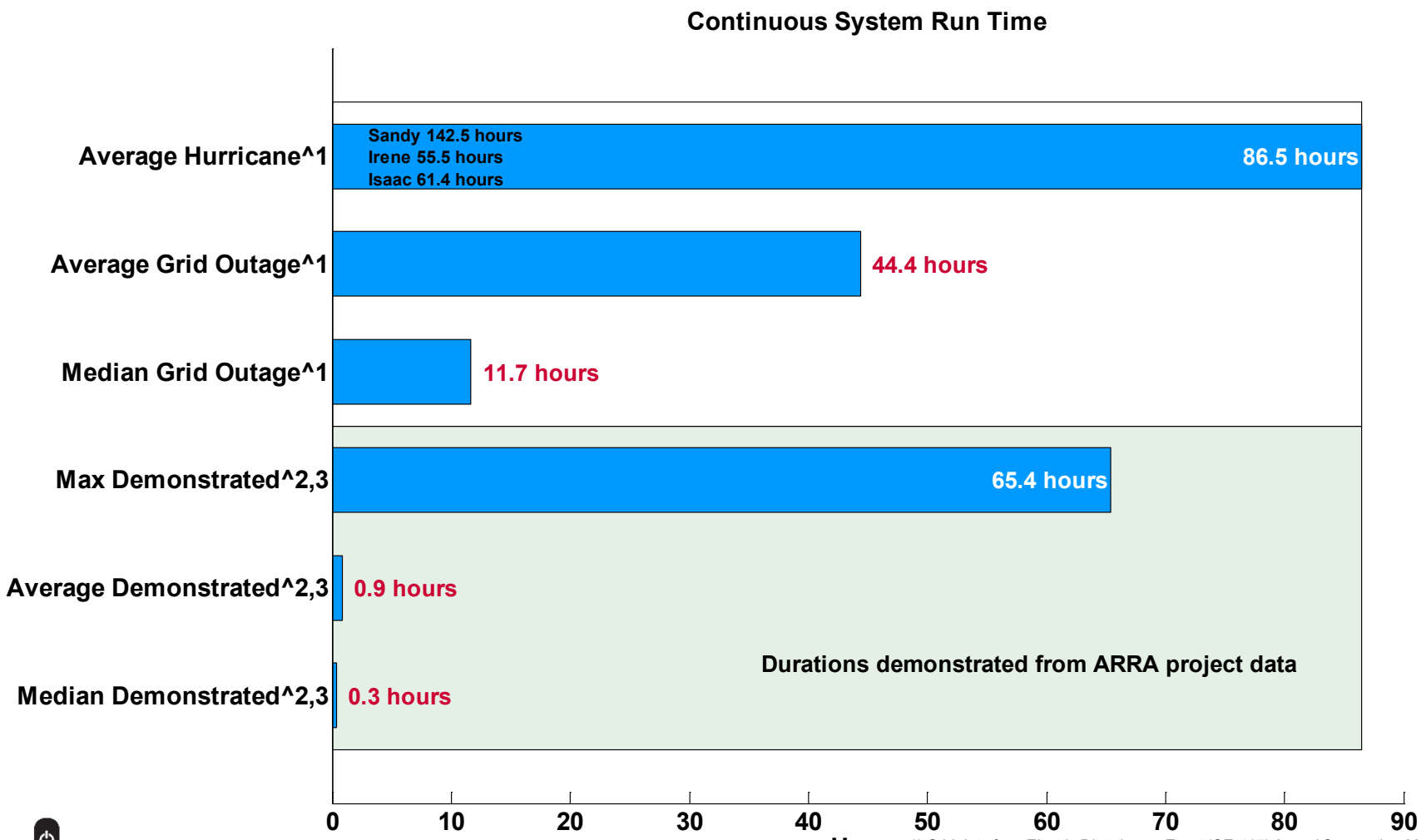
CDP-BU-17
Average Starts Per Month



NREL cdp_bu_17

Created: Apr-07-14 10:58 AM | Data Range: 2010Q1-2013Q3

CDP-BU-18
Site Capacity

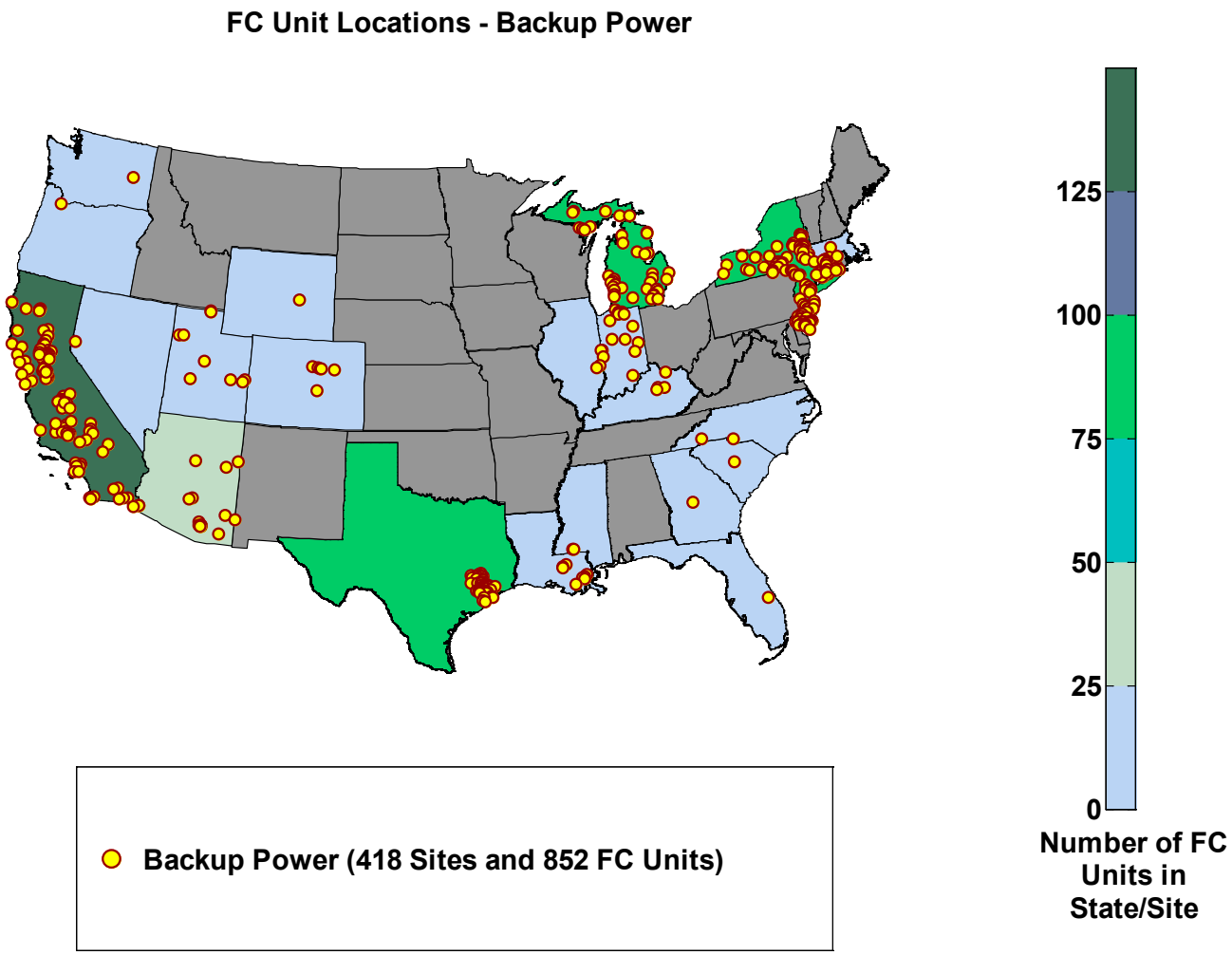


NREL cdp_bu_18

Created: Apr-07-14 11:05 AM | Data Range: 2010Q1-2013Q3

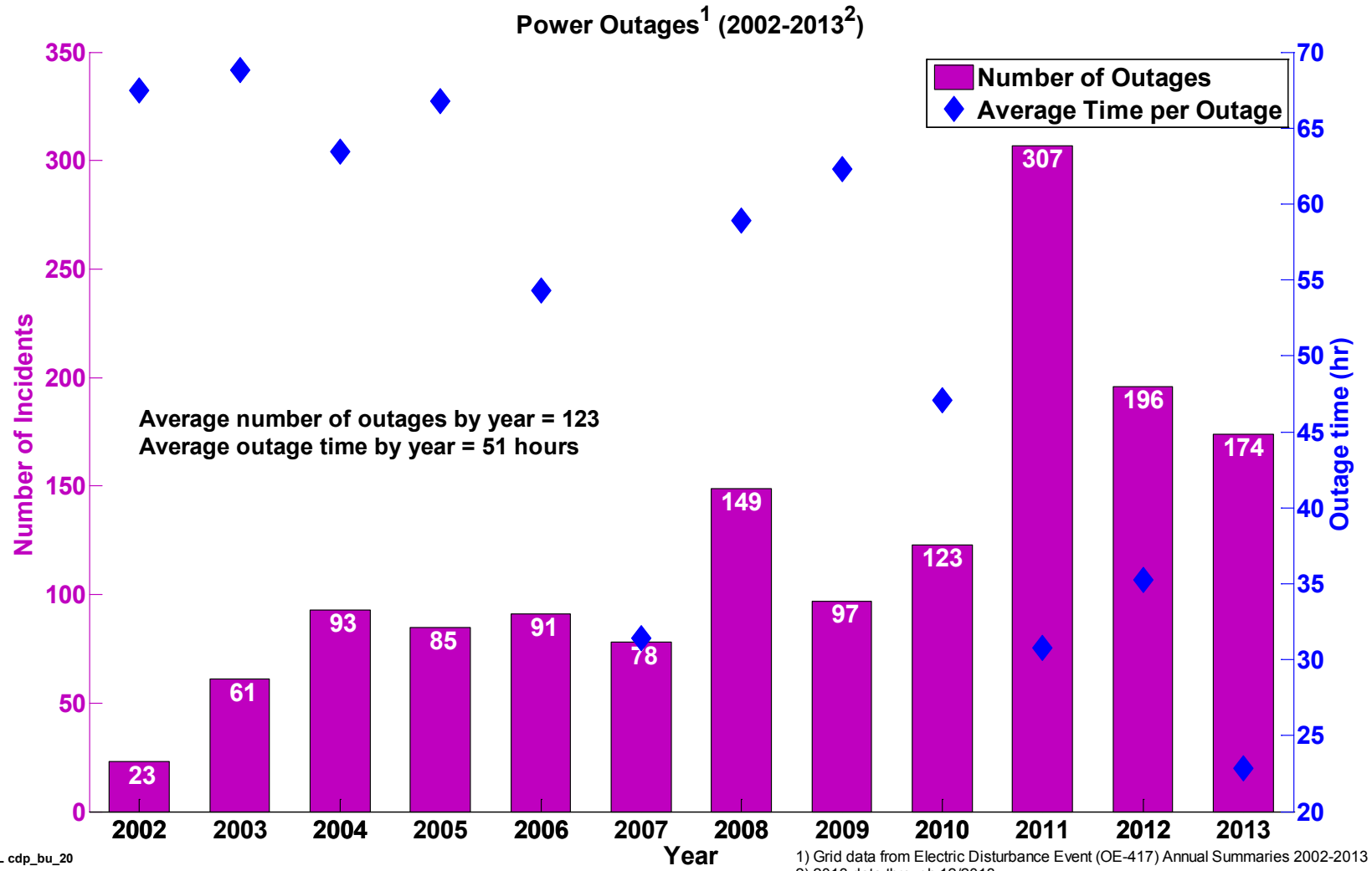
1) Grid data from Electric Disturbance Event (OE-417) Annual Summaries 2002-2013/12
2) Fuel cell operations less than 5 minutes apart have been combined to address intermittent operation.
3) Does not include conditioning starts.

CDP-BU-19
Unit Locations



NREL cdp_bu_19
Created: Apr-24-14 11:13 AM | Data Range: 2010Q1-2013Q4

CDP-BU-20
Power Outages per Year

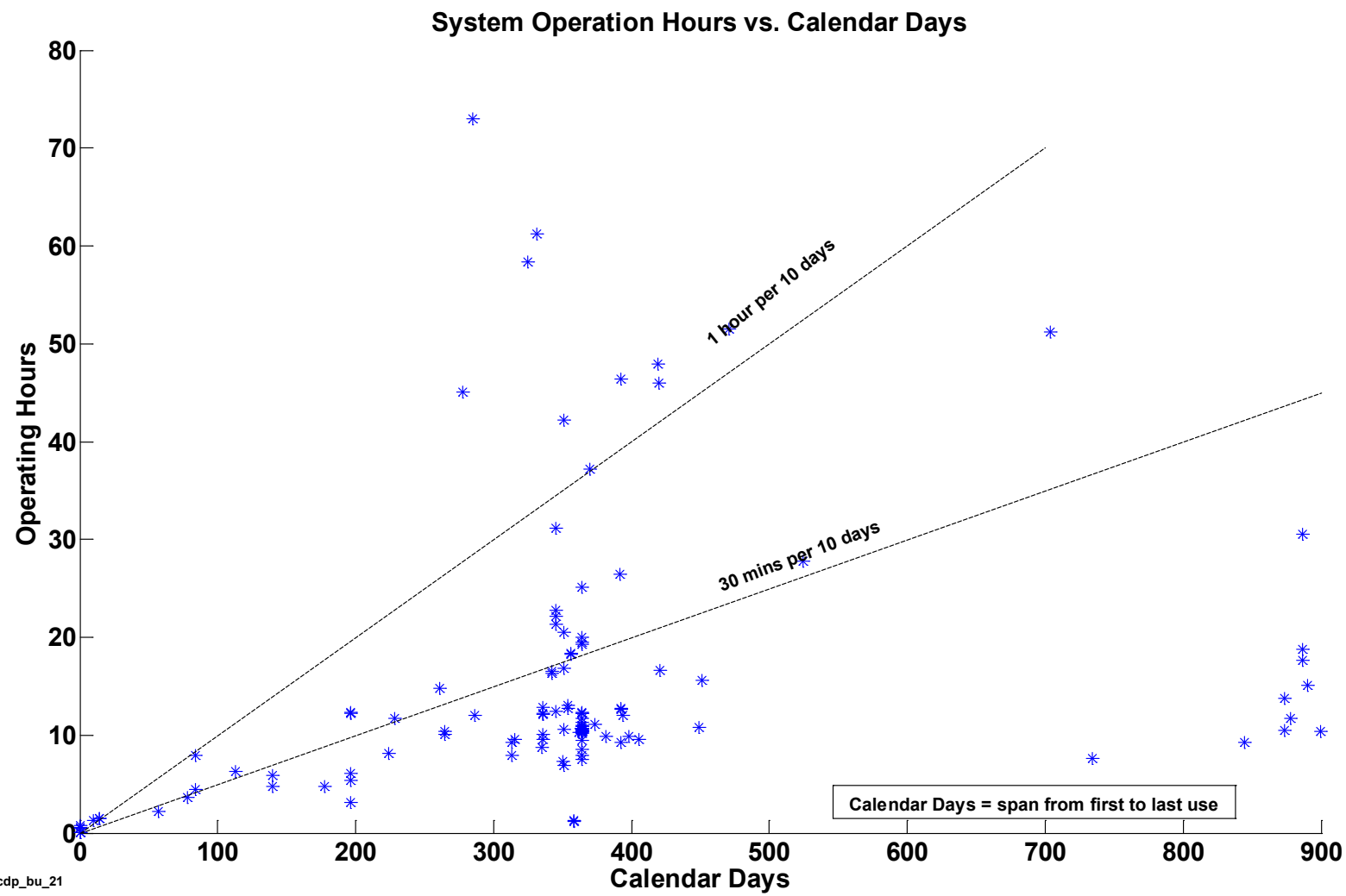


NREL cdp_bu_20

Created: Apr-07-14 11:05 AM | Data Range: 2010Q1-2013Q3

1) Grid data from Electric Disturbance Event (OE-417) Annual Summaries 2002-2013
2) 2013 data through 12/2013

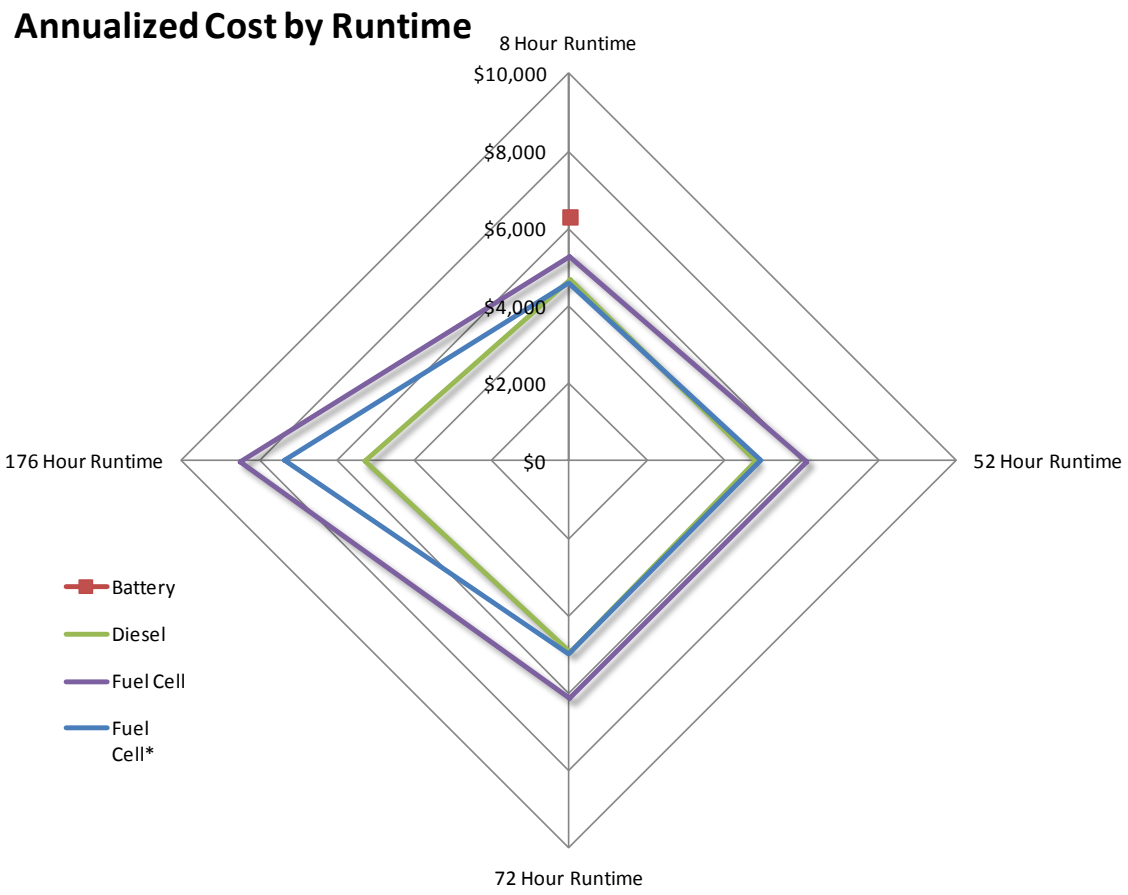
CDP-BU-21
Operation Hours vs. Calendar Days



NREL cdp_bu_21

Created: Apr-02-14 1:43 PM | Data Range: 2010Q1-2013Q3

CDP-BU-22
Annualized Cost of Ownership



NREL cdp_bu_22

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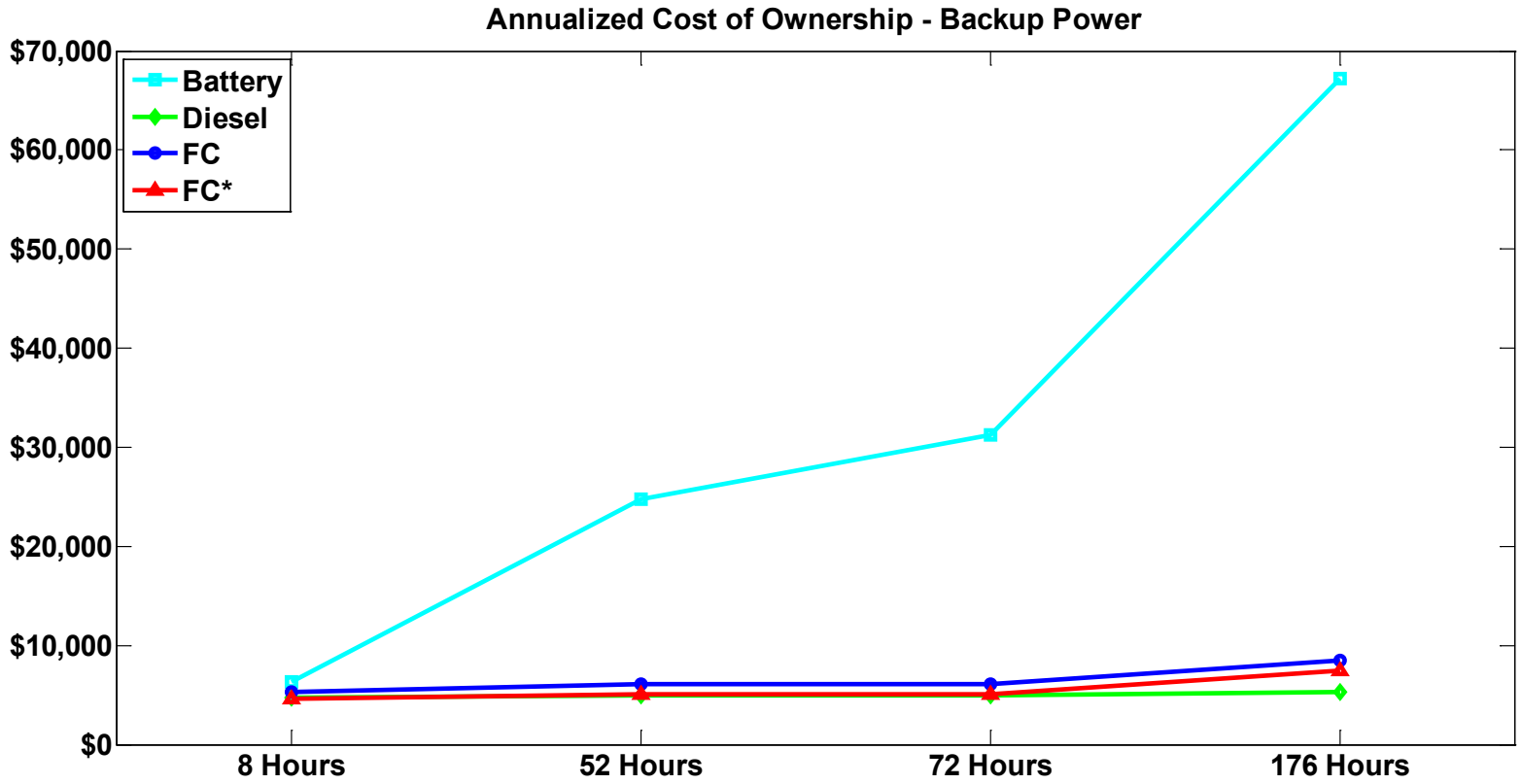
CDP-BU-23
Annualized Cost of Ownership

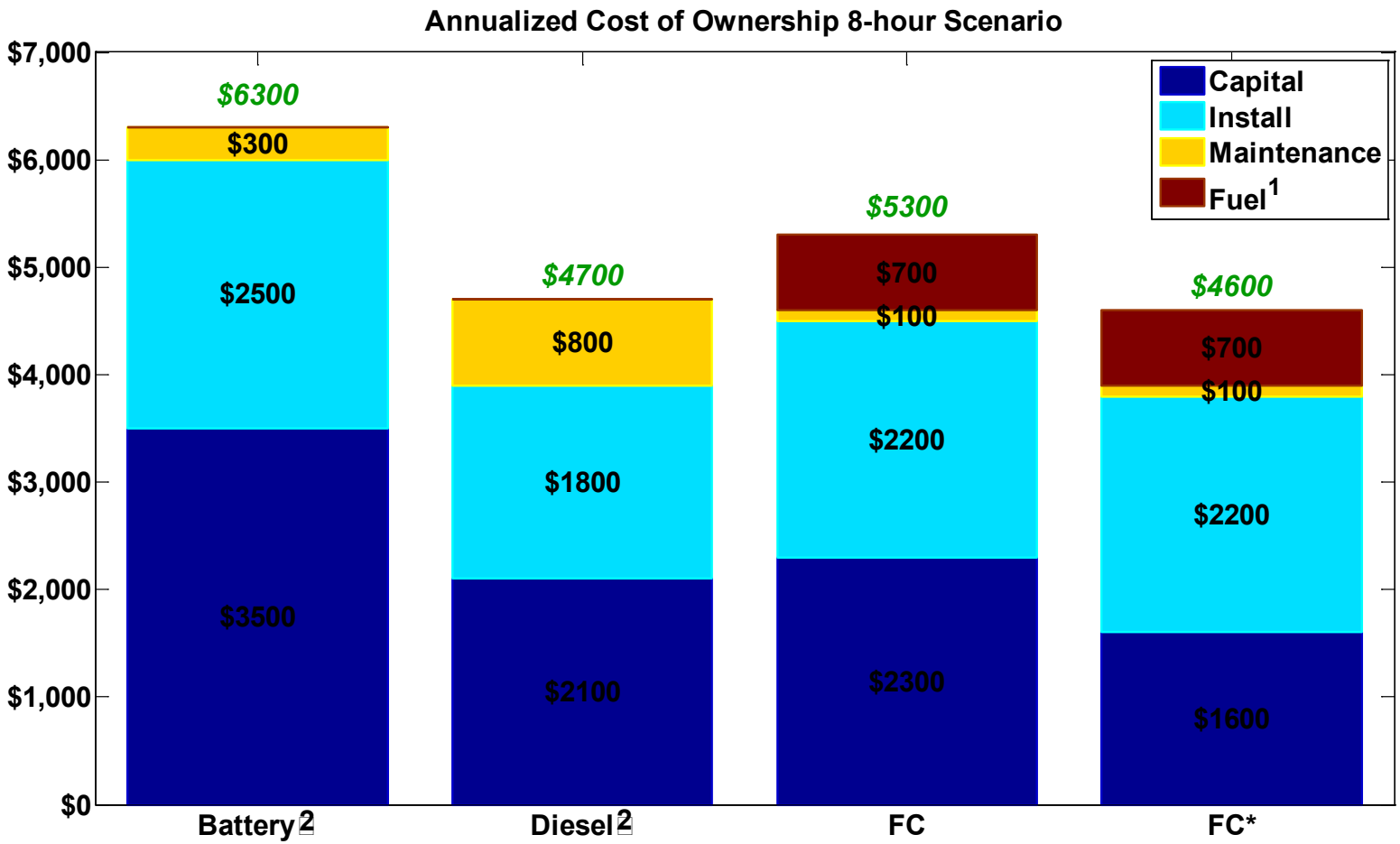


Battery	$6300	$24800	$31300	$67200
Diesel	$4700	$4900	$4900	$5300
FC	$5300	$6100	$6100	$8500
FC*	$4600	$5100	$5100	$7400

NREL cdp_bu_23

Created: Apr-07-14 10:05 AM | Data Through: 2013Q4

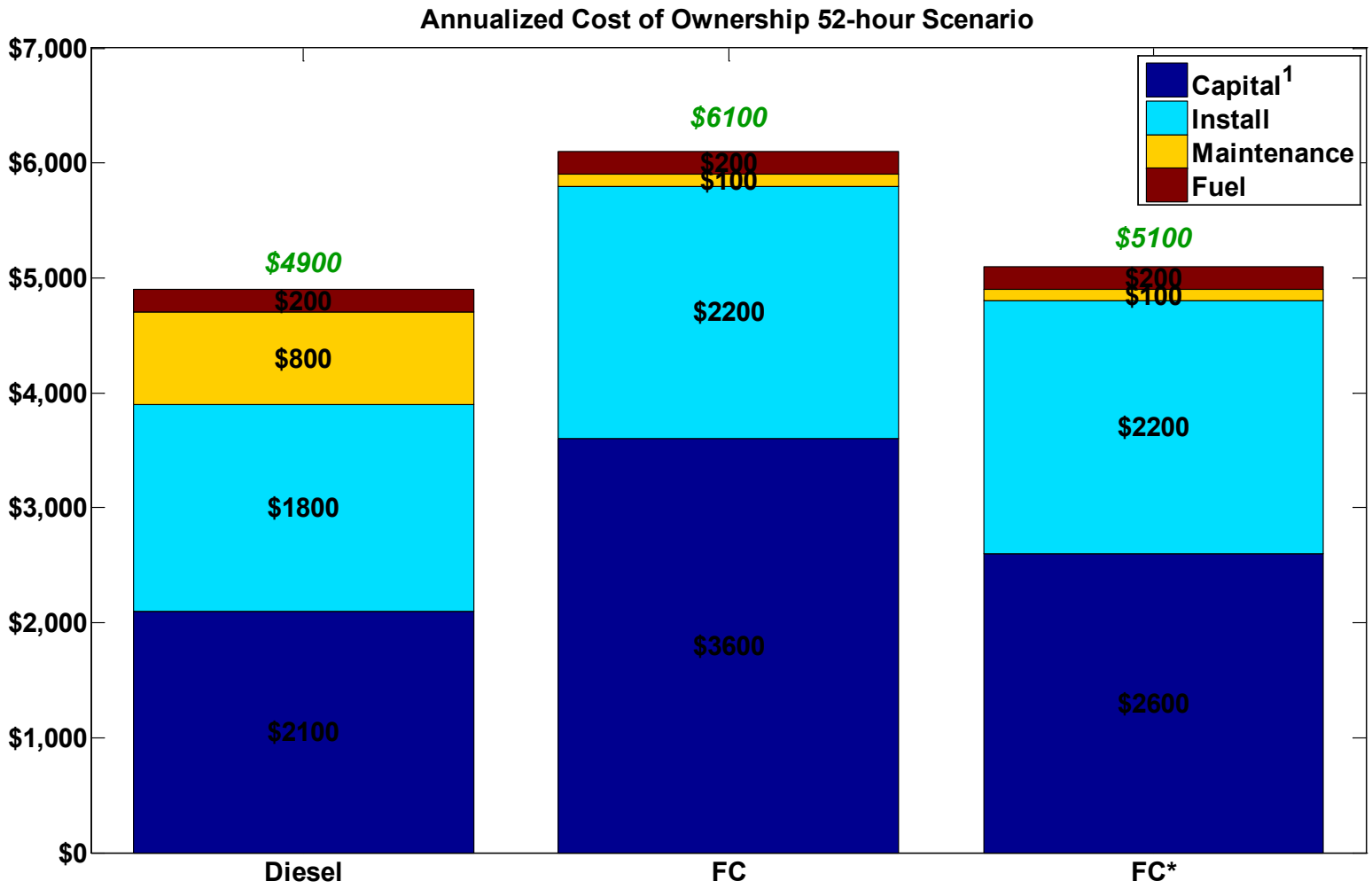
CDP-BU-24
8-hour Annualized Cost of Ownership



NREL cdp_bu_24
Created: May-13-14 10:35 AM | Data Through: 2013Q4

1. Includes hydrogen storage rent
2. Actual fuel cost negligible when rounded to the nearest hundred

CDP-BU-25
52-hour Annualized Cost of Ownership

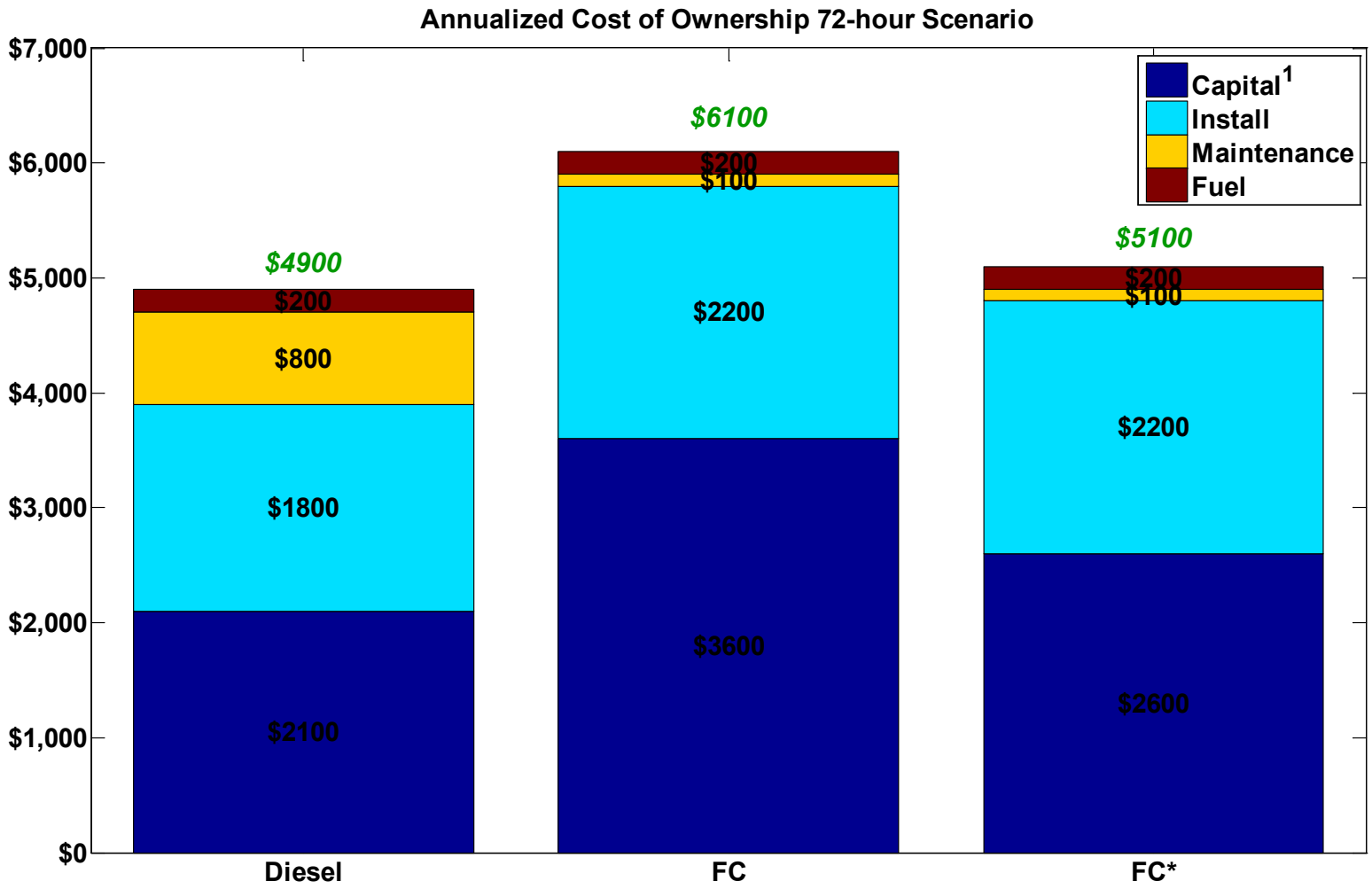


NREL cdp_bu_25

Created: Apr-07-14 10:05 AM | Data Through: 2013Q4

1. Includes capital costs for fuel storage

CDP-BU-26
72-hour Annualized Cost of Ownership

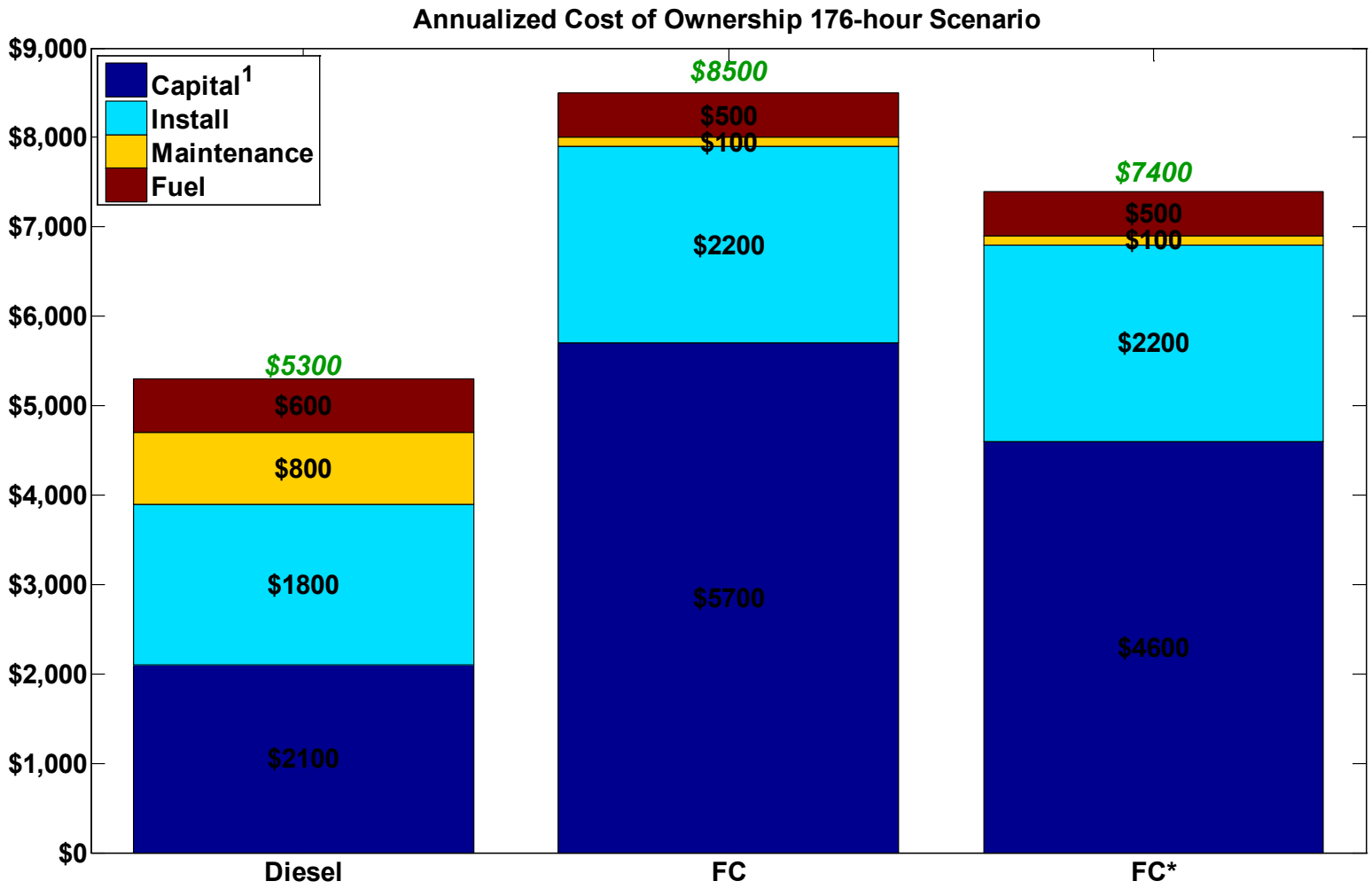


NREL cdp_bu_26

Created: Apr-07-14 10:05 AM | Data Through: 2013Q4

1. Includes capital costs for fuel storage

CDP-BU-27
176-hour Annualized Cost of Ownership

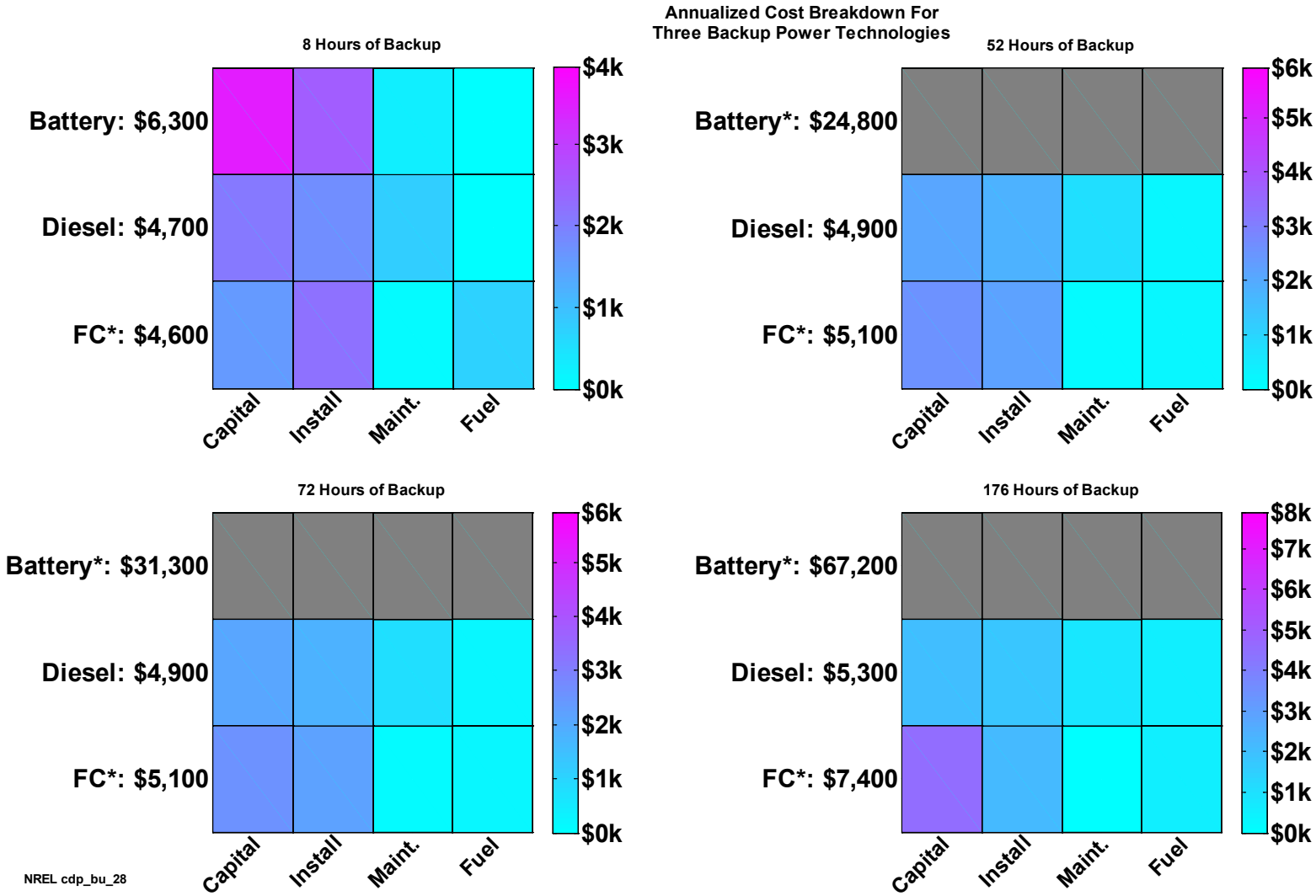


NREL cdp_bu_27

Created: Apr-07-14 10:05 AM | Data Through: 2013Q4

1. Includes capital costs for fuel storage

CDP-BU-28
Annualized Cost of Ownership Heat Map

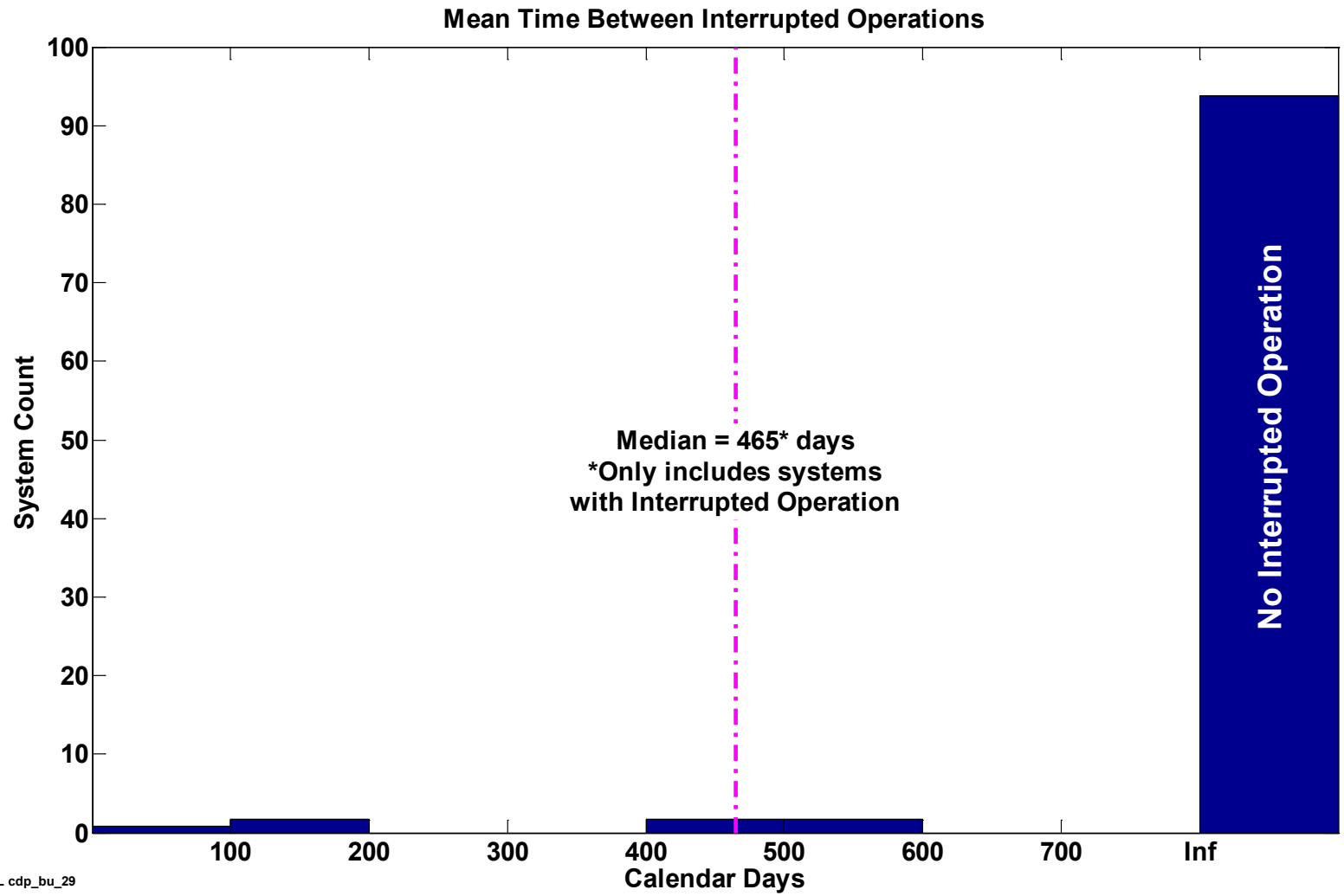


NREL cdp_bu_28

Created: Apr-07-14 10:16 AM | Data Through: 2013Q4

*Battery costs above chart axis limit, not shown.

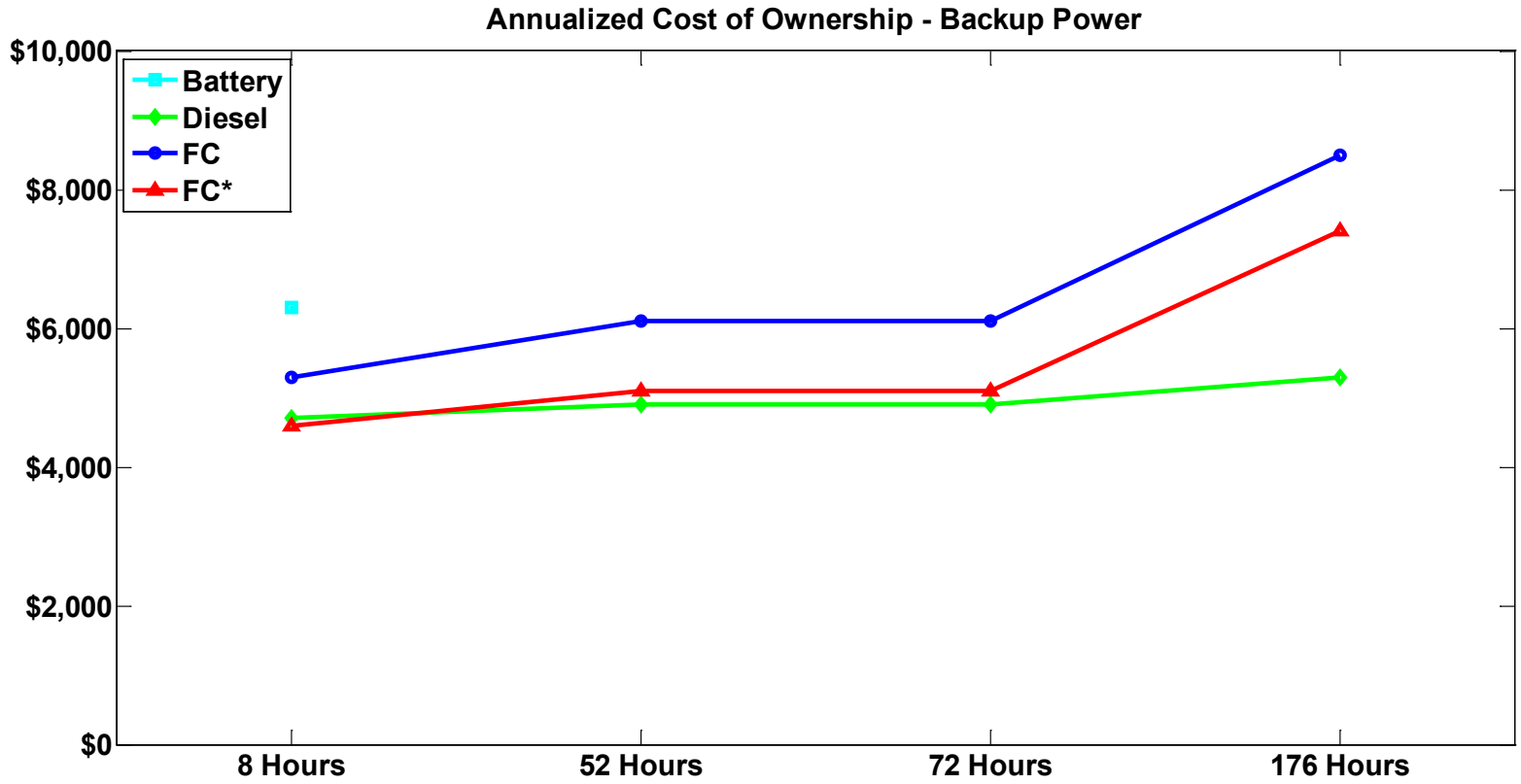
CDP-BU-29
Mean Time Between Interrupted Operation



NREL cdp_bu_29

Created: Apr-04-14 2:07 PM | Data Range: 2010Q1-2013Q3

CDP-BU-30
Annualized Cost of Ownership—Zoomed In



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Diesel	$4700	$4900	$4900	$5300
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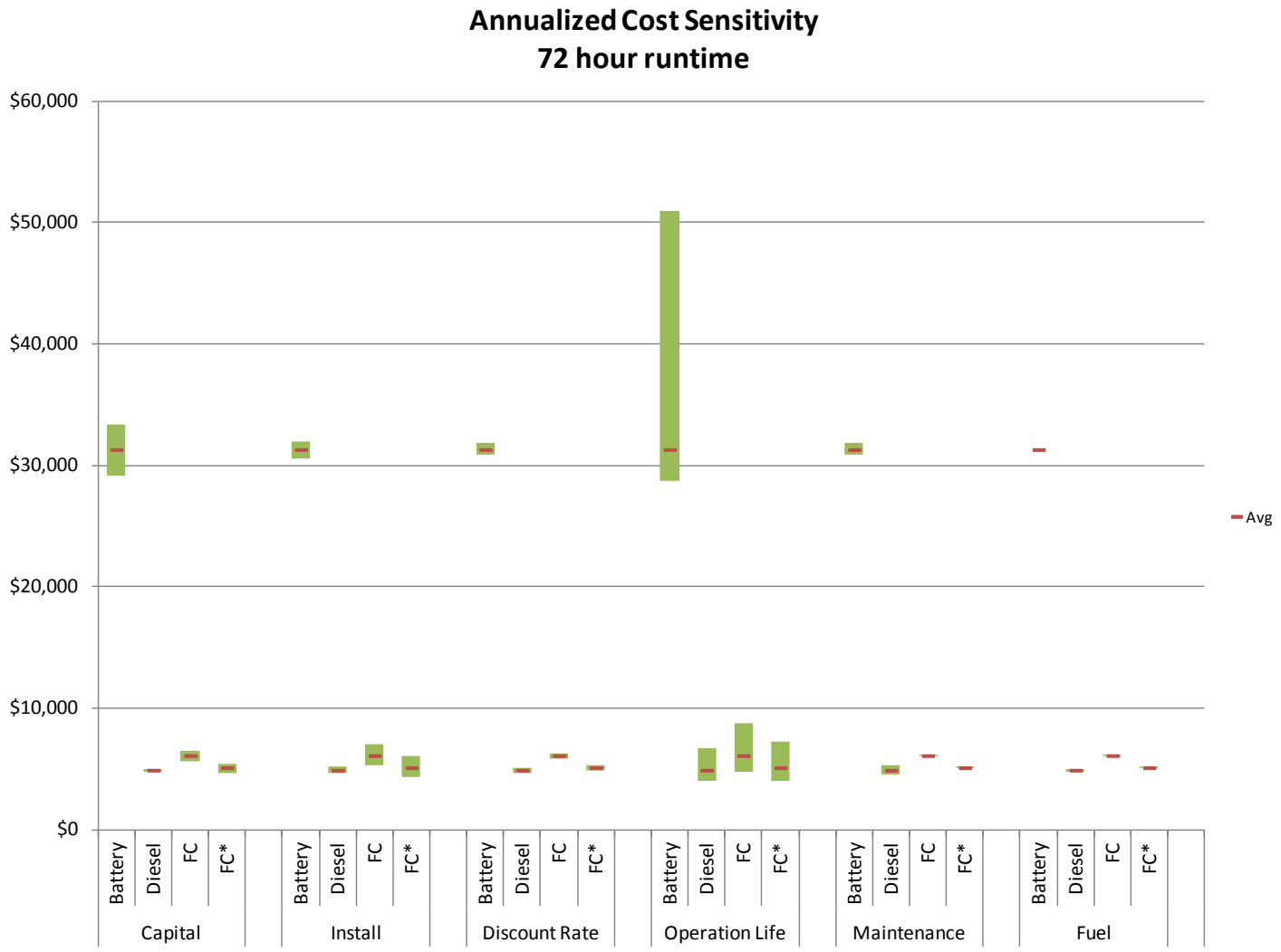
FC*	$4600	$5100	$5100	$7400

NREL cdp_bu_30

Created: Apr-07-14 10:05 AM | Data Through: 2013Q4

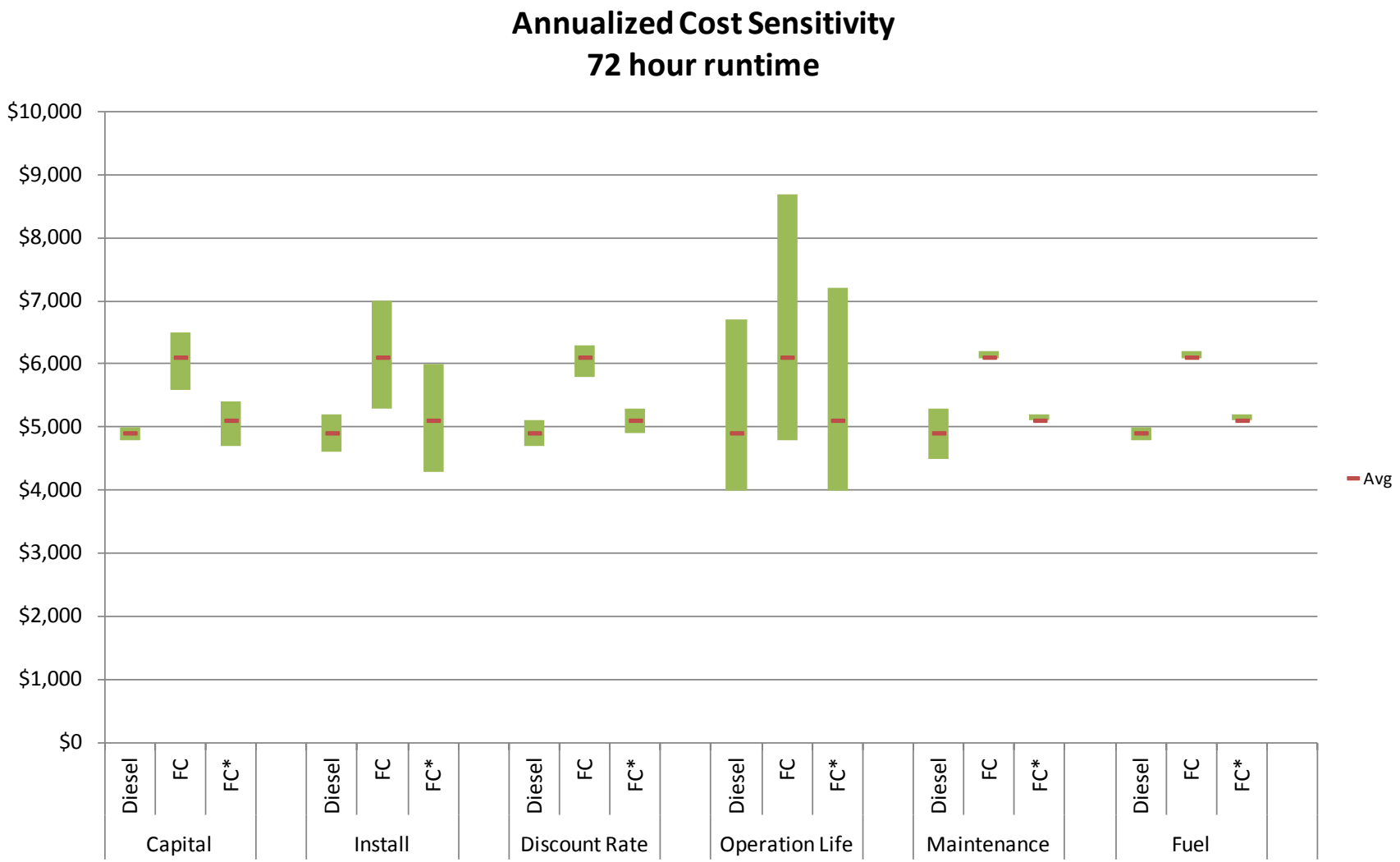
CDP-BU-31
72-hour Annualized Cost of Ownership Sensitivity



NREL cdp_bu_31

Created: Apr-15-14 4:32 PM | Data Range: 2010Q1-2013Q3

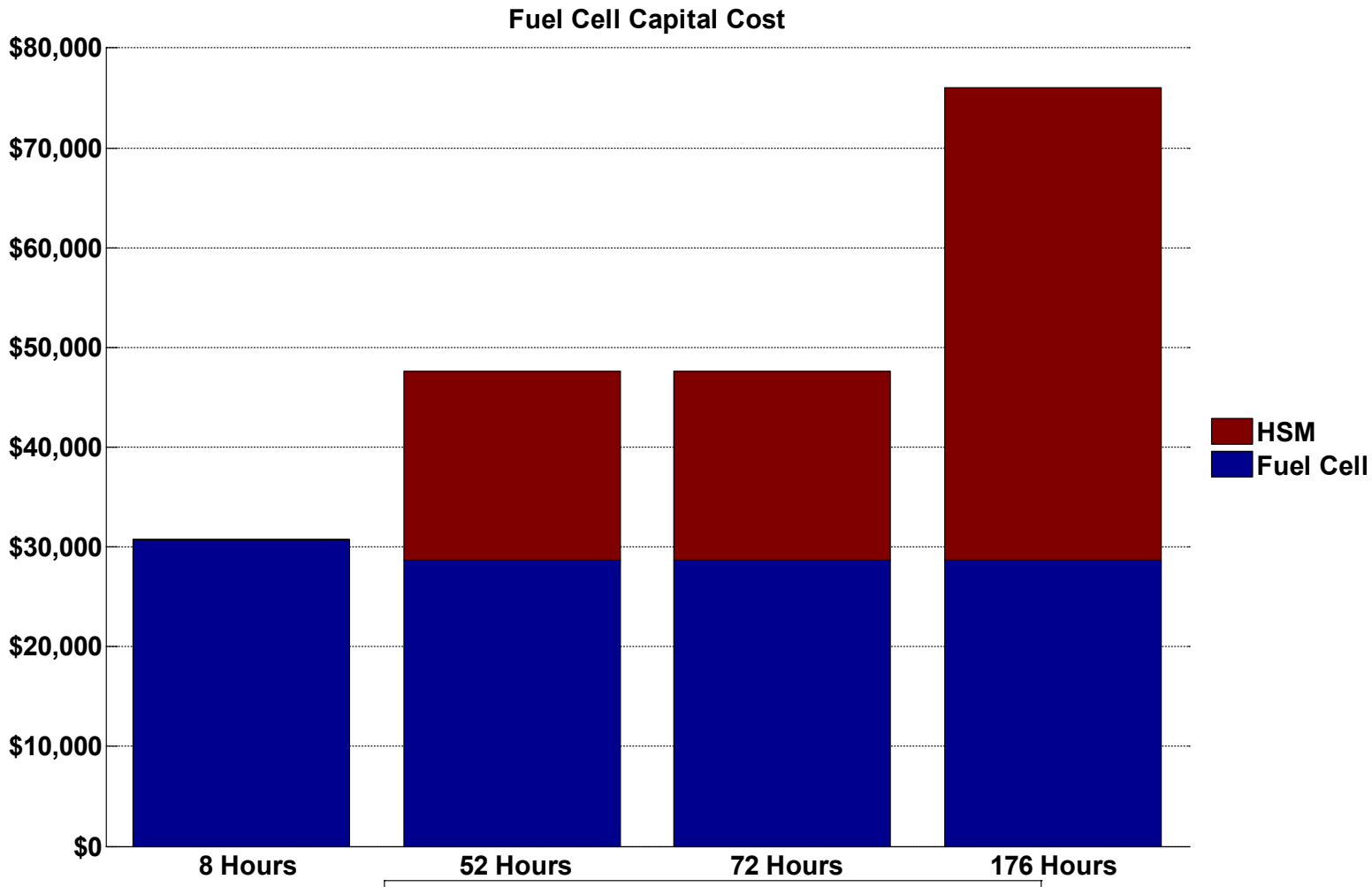
CDP-BU-32
72-hour Annualized Cost of Ownership Sensitivity—Zoomed In



NREL cdp_bu_32

Created: Apr-15-14 4:32 PM | Data Range: 2010Q1-2013Q3

CDP-BU-33
Fuel Cell Capital Cost Breakdown



NREL cdp_bu_33
Created: Apr-16-14 8:59 AM | Data Range: 2010Q1-2013Q4

HSM = Hydrogen Storage Module