Data Centers and Smart Grid

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http://drrc.lbl.gov
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Smart Grid Future for Data Centers

Similar data centers can provide Demand Response with no impact to operations or service-level agreements, set by the data center operators.

http://drrc.lbl.gov/publications/DR-opportunities-and-enabling-technologies-data-centers-field-study

1. Consider Semi- or Full- automation using technologies to execute and administer resource-intensive DR strategies.
2. Evaluate end-uses and its feasibility and economics for dynamic pricing, ancillary services, renewable integration, etc.

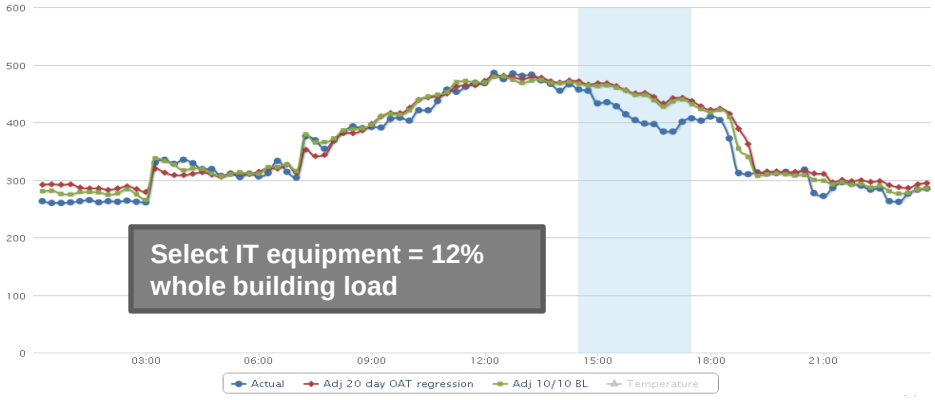
Summary of DR test results

Data Center	DR Strategy	Event Date	Active Event Period	Response Period (min)		Recovery Period (min)
				5% shed	10% shed	
NetApp	Test 1 (Shift/Queue IT jobs – Storage)	19-Dec-11	2.30pm to 5pm	10	22	25
	Test 2 (Temperature set point adjustment)	21-Dec-11	12.00pm to 1.00pm	5	15	15
	Test3 (Shift/Queue IT jobs – Storage w/ manual temperature adjustment)	13-Jan-12	2.00pm to 4.00pm	7	15	17
	Test 4 (Shift/Queue IT jobs – Storage)	11-Jan-12	1.00pm to 3.00pm	7	15	30
LBNL B-50	Test 1 (Server and CRAC units shutdown)	28-Oct-11	8:00am to 5:00 pm	0	60	90
	Test 2 (Shift/Queue IT jobs – Server idling)	1-Nov-11	Midnight to 6:00 am	not reached	not reached	n/a
	Test 3 (Temperature set point)	16-Nov-11	12:35 to Midnight	not reached	not reached	n/a
	Test 4 (Data Center Shutdown)	2-Dec-11 to 3-Dec-11	3:40 pm 12:00 pm	5	15	180
SDSC, UCB, and LBNL B-50	Test 1 (Load migration - Homogenous – Idling)	25-Apr-12	12.30pm to 2.45pm	2	6	2
	Test 2 (Load migration - Homogenous – Shutdown)	25-Apr-12	2.46pm to 5.10pm	3	7	10
	Test 3 (Load migration - Heterogeneous – Decay)	3-Jul-12 to 5-Jul-12	10.45 am to 11 am	147	175	15

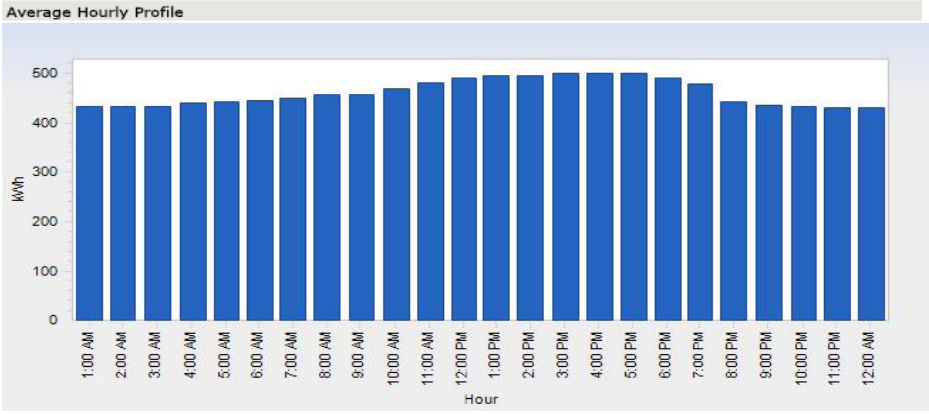
NetApp Load and Economic Analysis Summary

- Data centers economics works in favor by virtue of their flat load shape.
- By being enrolled in a PDP program (9 event days) and not shedding any load, a NetApp data center can save $7,500 which equates to 1.4% of annual energy bill.

Note: NetApp has several buildings in the Sunnyvale, CA campus. This analysis has been performed on one of NetApp's buildings with a relatively flat load shape. PG&E's InterACT tool was used to carry out this analysis.



Test Result Baseline Analysis



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Web References:

- http://www.lbl.gov/
- http://gig.lbl.gov/
  - http://der.lbl.gov/
  - http://drrc.lbl.gov/
  - http://certs.lbl.gov

BACK-UP SLIDES

1 MW Example Data Center*

Assumptions

- $0.006/kWh difference between Critical Peak Pricing (CPP) Rates and non-CPP Rates
- 1 MW Constant Data Center 24/7
- $0.96/kWh Higher on CPP days
- 7 Hour Length of Event Time

Critical Peak Pricing (CPP) Economics	
$144	Savings Per Day
$52560	Savings Per Year
$6720	Extra Cost Per CPP Event
8	Number of Events to Break Even

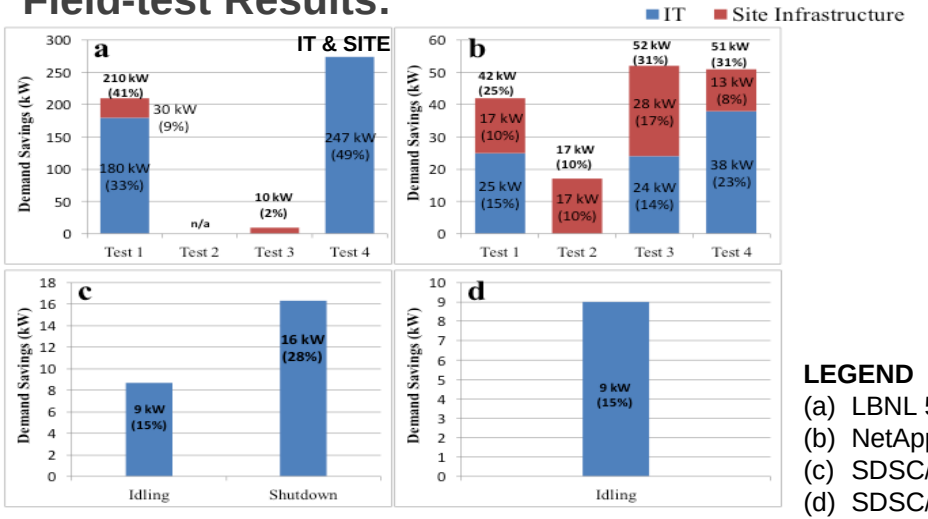
***Slide Source:** Eric Martinez, SDG&E*

Grid Integrated Data Centers

Improve the understanding of the Demand Response opportunities for data centers and its enabling technologies through field tests.

	Demand Response Strategy	LBNL B-50	NetApp Java-1	SDSC, UCB, LBNL B-50
1	Server and CRAC units' shutdown.			
2	Load Shifting or Queuing IT jobs – Server idling.			
3	Temperature set point adjustment.			
4	Shutdown and idling of IT storage clusters.			
5	Cooling relative to IT equipment load reduction.			
6	Load migration between heterogeneous systems.			
7	Load migration between homogeneous systems.			

Field-test Results:



LEGEND

(a) LBNL 50B
(b) NetApp
(c) SDSC/ UCB
(d) SDSC/ LBNL 50B

Key Conclusions:

- Promising results, economics, DR potential – *small dataset*.
- DR potential and strategies vary by types and IT/Site equipment and comfort level of each customer.
- Enabling technologies are important – *load migration strategy potential*!
- Largest opportunity in IT equipment.

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