POWER ASSURE

A IT Summit 2010

Case Study:
Data Center Optimizes Server Capacity with New Energy Efficiency Model

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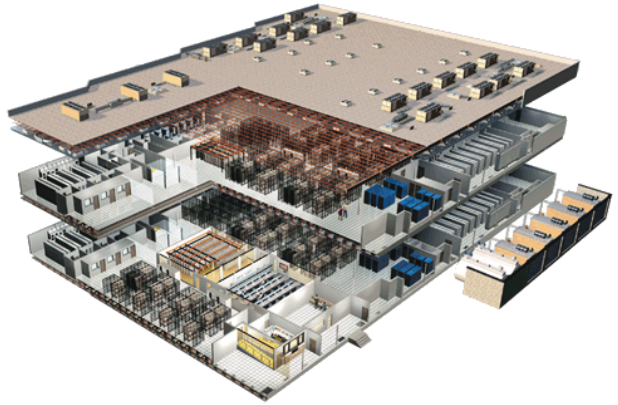
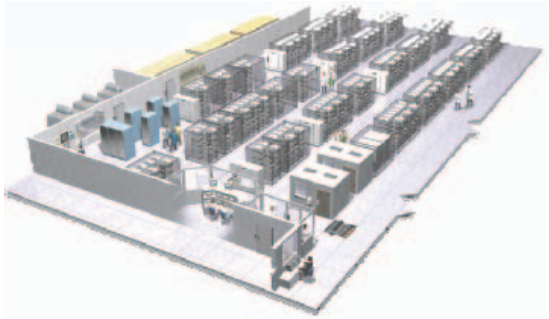
About Power Assure

- **Award winning technology**
  - First ever double winner in Clean Tech Open Competition
  - $5M Depart of Energy grant
    - "Game changing energy efficiency applications"
  - Core automation software used for over 10 years at Exodus, HP & Sprint
  - Enhanced for energy Management and Optimization
- **Energy efficiency improvements 50%+**
  - Baseline monitoring of power, temperature, application utilization
  - Tracks and reports performance, capacity and savings *in real time*
  - Integrated inventory and capacity management
  - Transforms "Always On" to "Always Available"
- **Resources to expand**
  - Total capital raised $18.75M. Investors include Draper Fisher Jurvetson, Good Energies, Point Judith Capital

A Data Center Example





Data center before improvements:

- 100,000 sq ft – 700 racks
- 8,000 server (500 racks / ~3.8kW)
- Average age 3 years
- 50 racks networking (~6kW)
- 150 racks storage (~3kW)
- PUE 2.3
- Total power consumption: 6.1MW of 10MW
- Cost per year: $4.1M ($.075/kWh)
- Average server utilization 10%

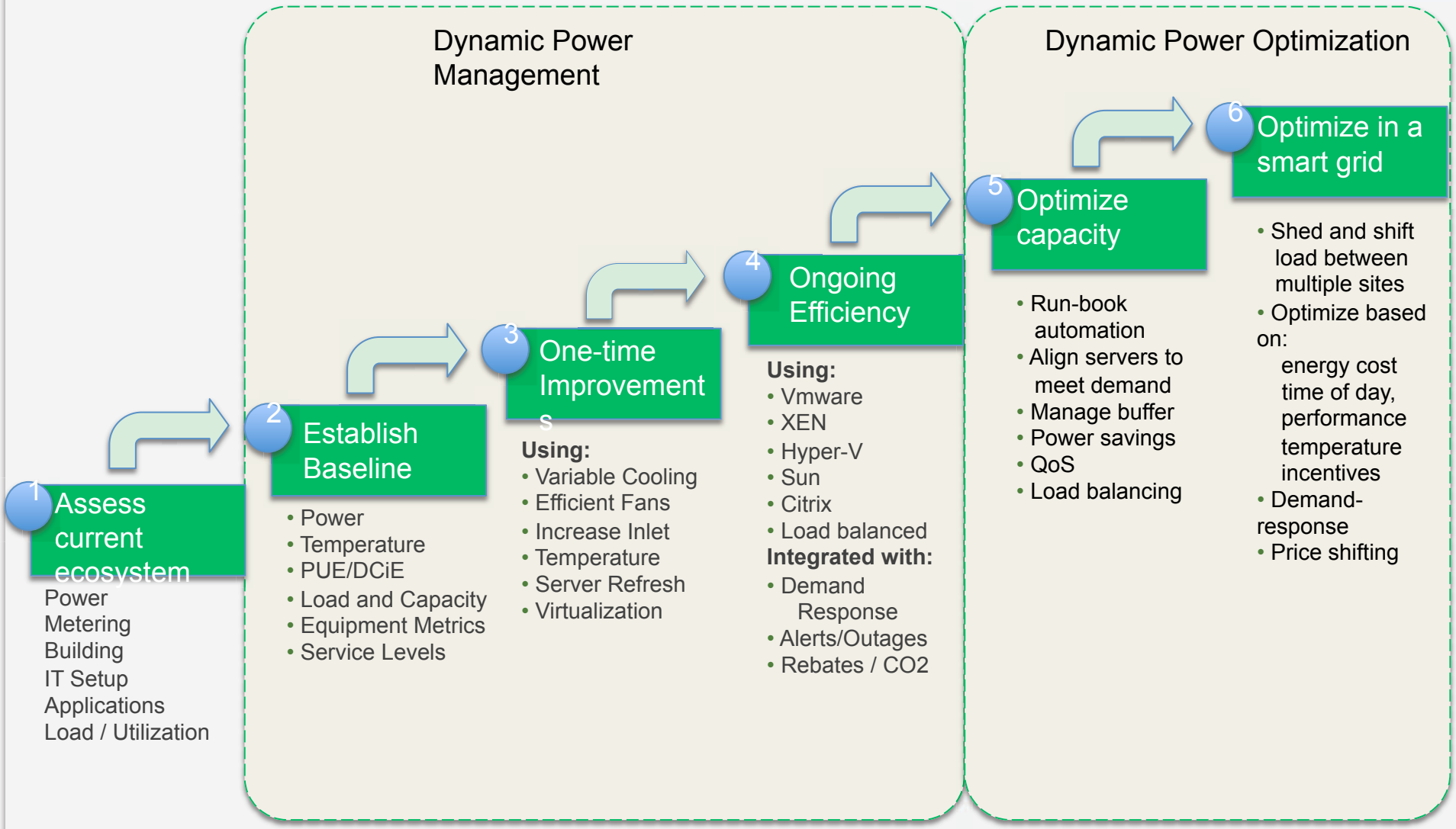
One-time improvement targets:

- Target PUE 1.3
- Cold Isle Temperature 80F
- Up to 10kW per rack
- Not to exceed 10MW at Peak Utilization
- Increase capacity 300% / leave space for more
- PAR4 Platinum Green servers
- VMware Virtualization

On-going management:

- Real-time baseline Management
- Dynamic Capacity Optimization

The Consolidation Process



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The Baseline

Observe and understand the opportunity

The Inventory

Interesting elements:

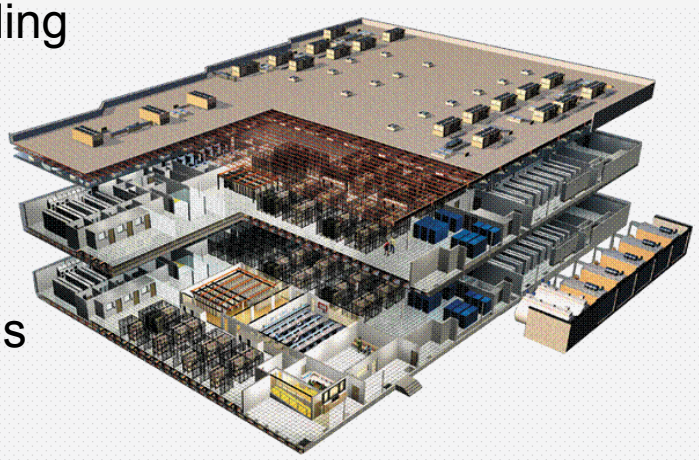
- Power distribution
  - Limits/redundancy/meters
- Cooling infrastructure
  - BTU/hot-cold isles/controls
- IT equipment
  - Server/network/storage
  - Age/efficiency
  - Measurements

Baseline Monitoring (Good/Better/Best)

Good

Building level monitoring

- PUE, kWh, Amps, kW for IT and Cooling
- Temperature



Better

Circuit level monitoring and IT load monitoring

- Per rack kW, Amps for what-if analysis
- Phase balancing and building details
- IT application load and capacity
- Alerts and inventory integration

Best

Device level monitoring

- Outlet level metering / Power supply metering
- Component utilization from devices
- Temperature of devices

NASA Ames Dashboard

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One-Time Improvements

Act on information to intelligently adjust cooling and IT

Cooling – Get Your PUE Down

- Hot / cold isle isolation
- 80.6F inlet temperature, ASHRAE recommendation
- Variable cooling
- Outside air economizer

Server Comparison

	Year	CPU	IDLE	LOADED	RACK	TXN/WATT
	2006 Sun T2000	UltraSparc T1 32 Threads 1GHz	179W	200W	4000W 20 per Rack 380MTxn	95,000
	2009 HP DL160 G6	Dual L5520 Quad Core, 2.27GHz, 12GB Memory	113W	197W	7880W 40 per Rack 4,280MTxn	543,000
	2009 Supermicro 6016	Dual L5518 Quad Core, 2.13GHz, 8GB Memory	132W	217W	8680W 40 per Rack 4,120MTxn	516,000
	2009 Dell CS24-SC	Dual L5420 Quad Core, 2.5GHz, 8GB Memory	83W	157W	6280W 40 per Rack 4,400MTxn	700,000

Cisco UCS / HP 1U Examples

Cisco:
96 Cores, 6U, 2,800 Watts

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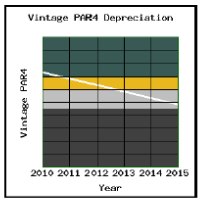
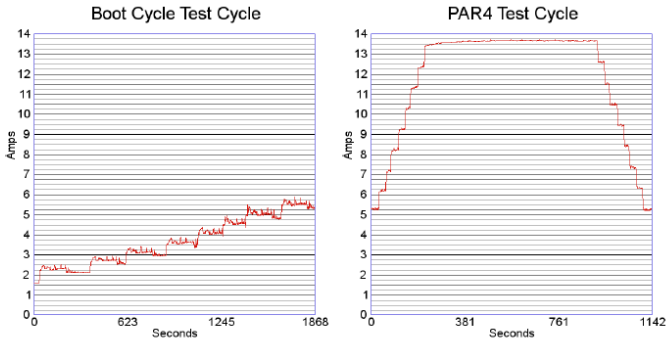
Measurement Details
CISCO UCS Blades with
Dual Intel X5670 CPU(s)
2.93MHz 6-way Core
96GB RAM
2 x 146GB SAS / 10000RPM HDD

PAR4®: 1935
Estimated Cost for 3 years: $3,164.37



Power Consumption Details

OFF	IDLE	LOADED	PEAK	BOOT TIME
238W	1033W	2744W	2746W	200s
203.7V	203.7V	203.7V	204V	
1.616A	5.29A	13.699A	13.74A	
0.718PF	0.96PF	0.991PF	0.991PF	



Average number of PAR4® Transactions on the order of: 1,843,000,000

10kW/Rack:
- 3 Server (18U)
- 288 Cores
- 5,500MTxn
- 8,400W

10kW/Rack:
- 40(58) Server
- 320 Cores
- 4,200MTxn
- 6,800W

HP:
8 Cores,1U, 170 Watts

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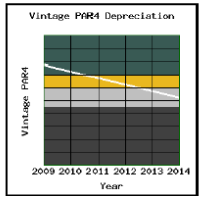
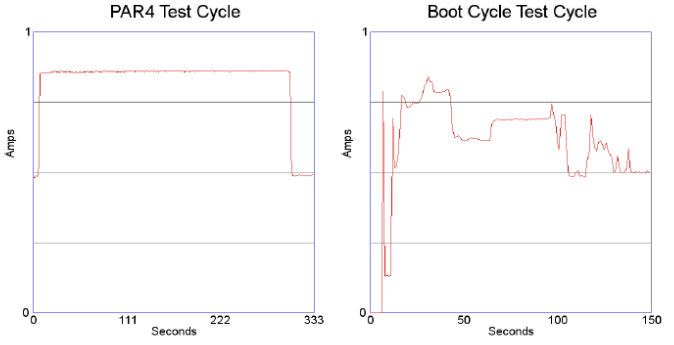
Measurement Details
HEWLETT-PACKARD DL160-G6
Dual Intel L5520 CPU(s)
2.27MHz Quad Core
8GB RAM
1 x 160GB SATA / 7200RPM HDD

PAR4®: 1925
Estimated Cost for 3 years: $247.82



Power Consumption Details

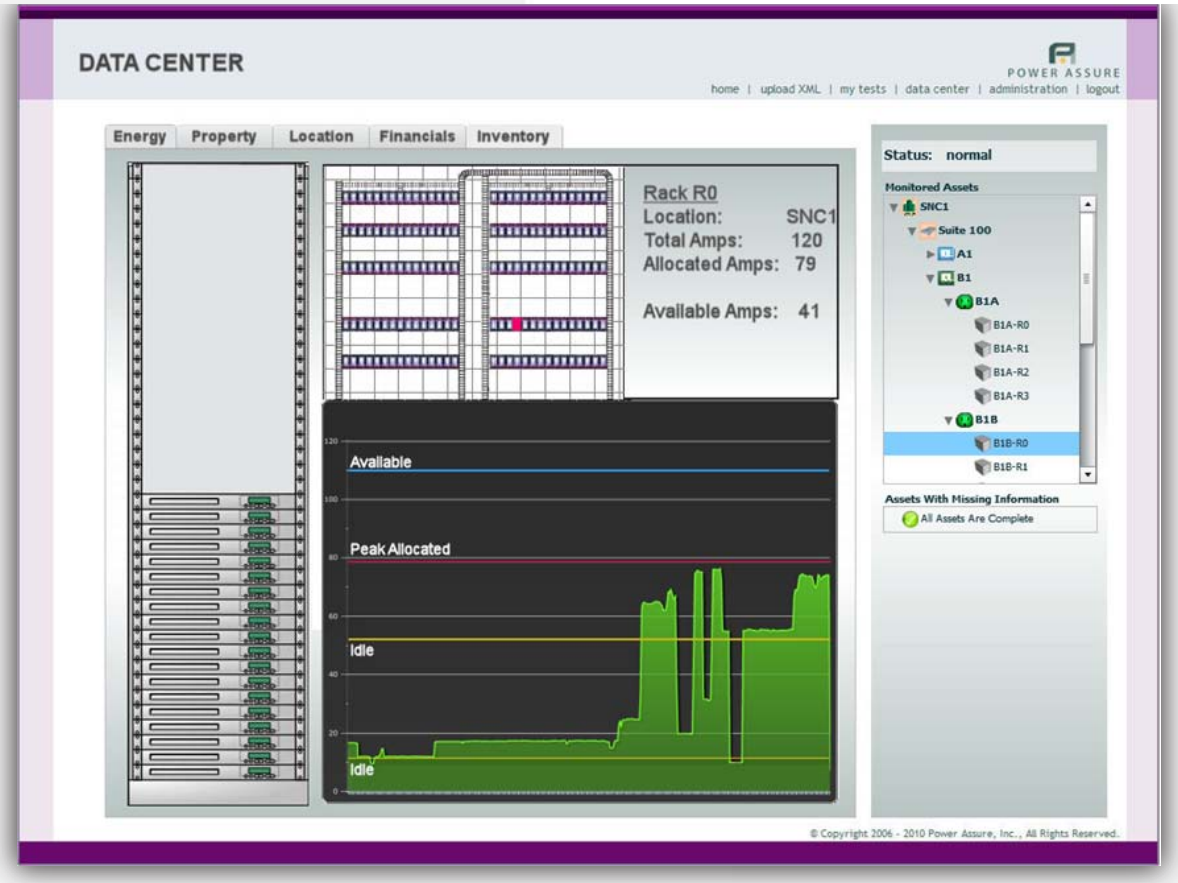
OFF	IDLE	LOADED	PEAK	BOOT TIME
4W	86W	169W	169W	150s
207V	207V	207V	207V	
0.134A	0.499A	0.862A	0.865A	
0.142PF	0.835PF	0.947PF	0.947PF	



Average number of PAR4® Transactions: 105,000,000

What If Analysis

2009 HP DL160 G6	Dual L5520 Quad Core, 2.27GHz, 12GB Memory	113W	197W	7880W 40 per Rack 4,280MTxn	543,000



What if analysis:

- **Required space**
  - Rack U size
  - Weight
- **Required power**
  - A/kW
  - Outlets

After Installation:

- **On-going analysis**
  - Power A/kW
  - Temperature

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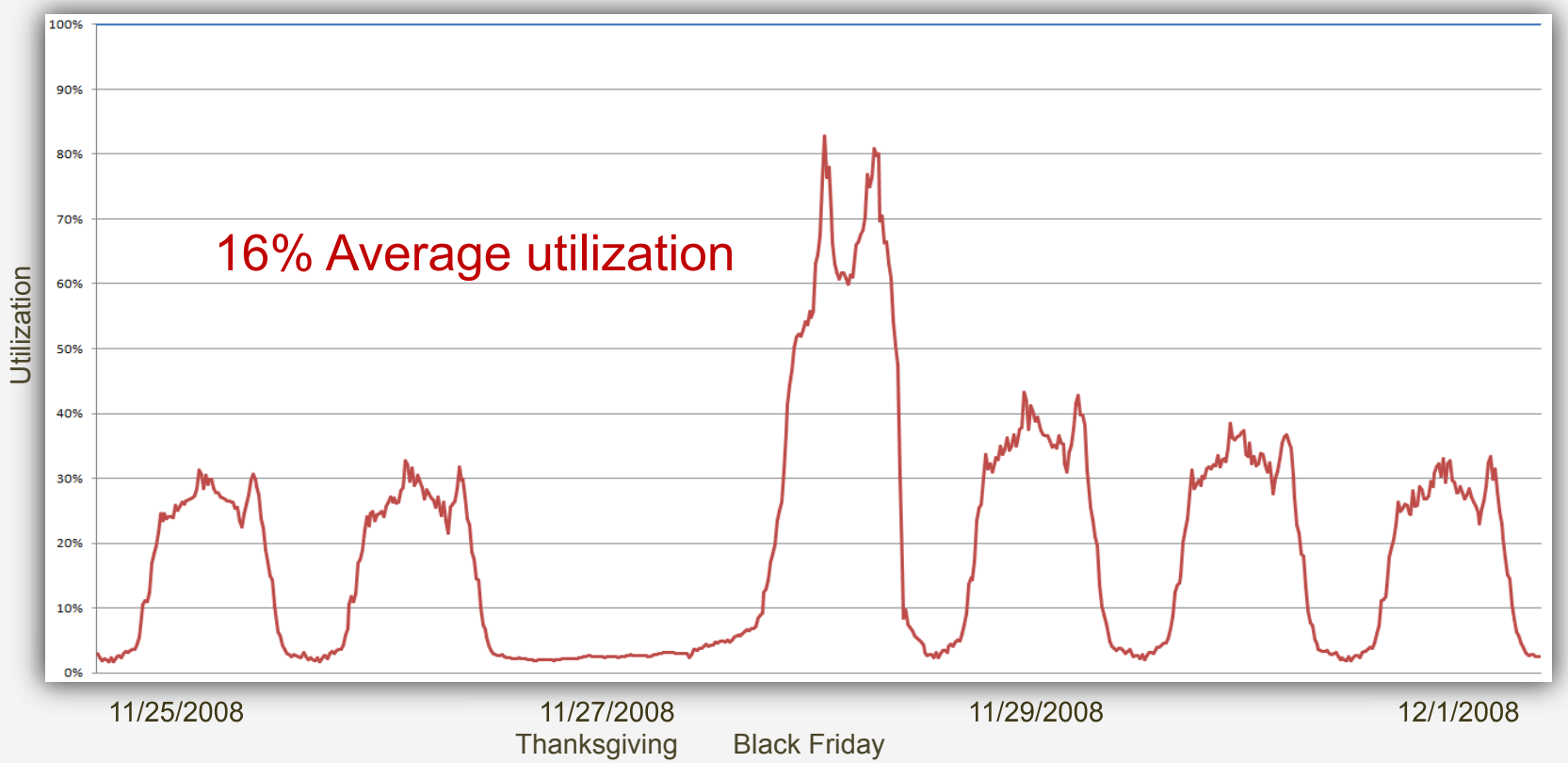
Dynamic Capacity Optimization

Move from Always-On to Always-Available

Customer Case Study

4000 Server, 2U / 2007 Model, Dual Core AMD 2xxxHE **Idle: 269W**
Loaded: 347W

Actual Circuit Cost: **$2,880,000 per year** **($600/ 20A circuit)**
Available Capacity: **196,000 MTxns**

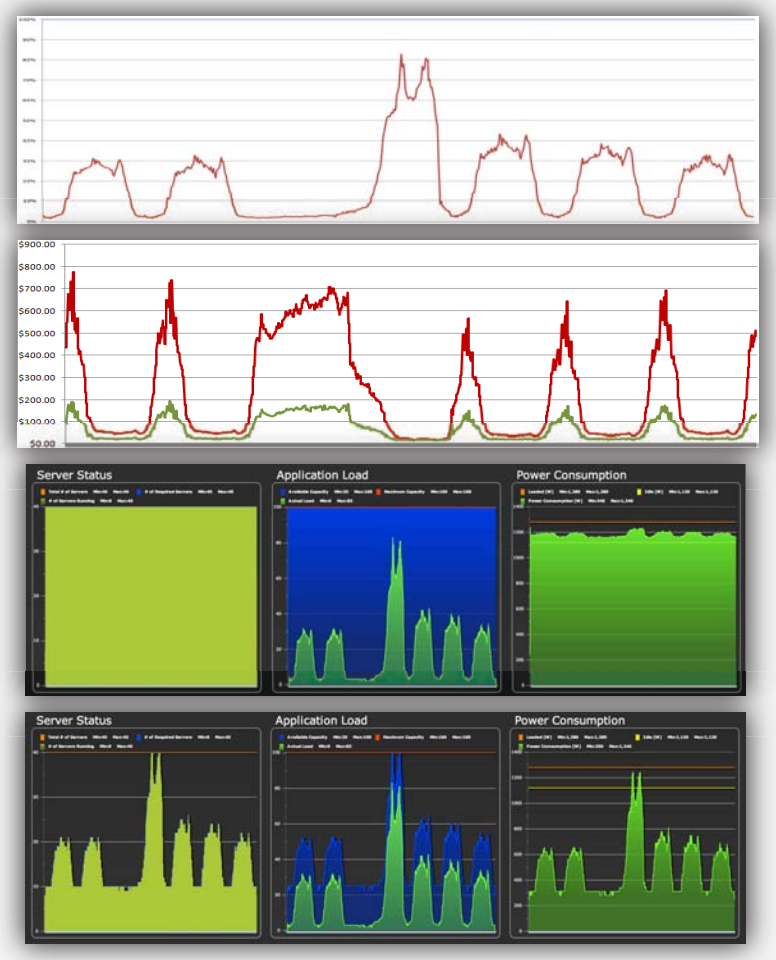


Always-On vs Always-Available

Without Optimization

With Optimization

Results



1 Week – 15min average data
Compressed run – 1 Point / 3min

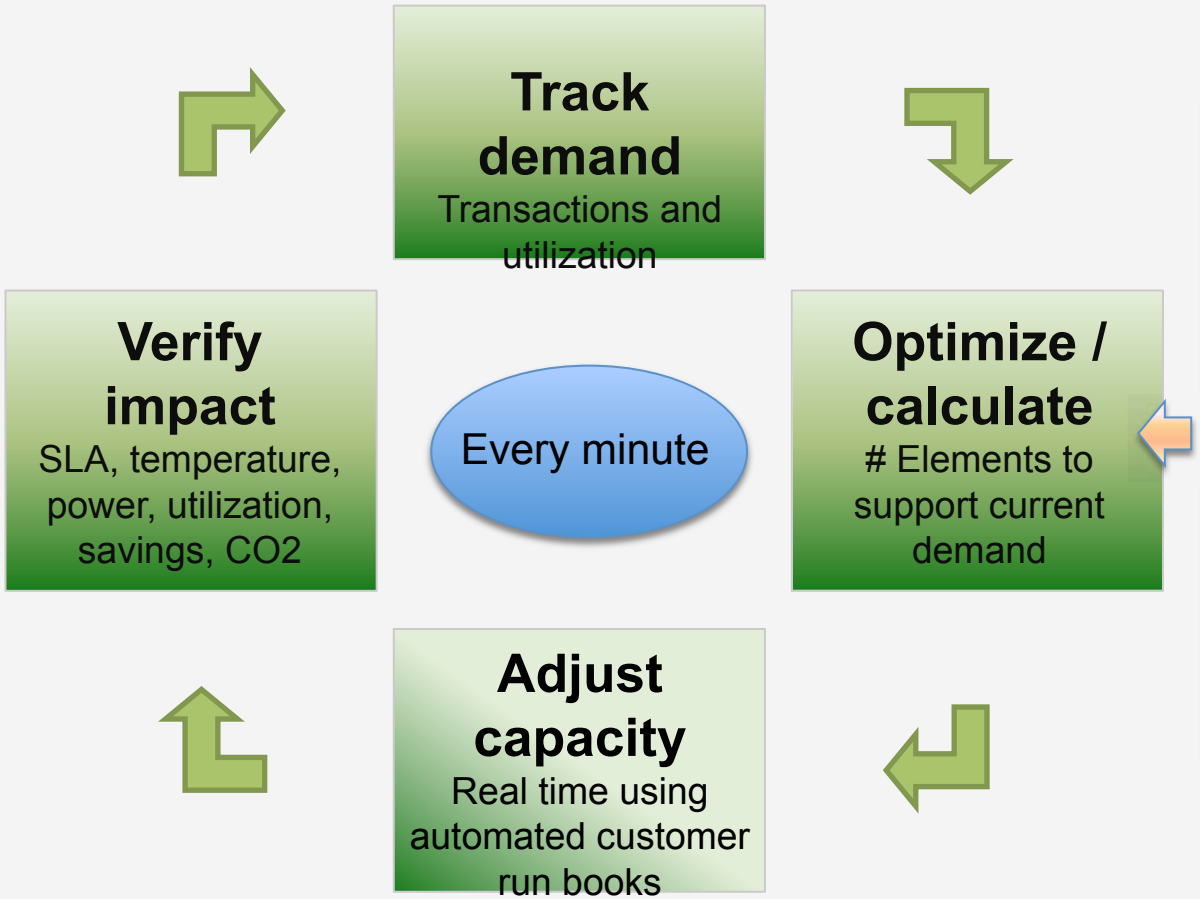
Cost per transaction set
- Always On ($40 - $750)
- Always Available ($21 - $192)

Always On (40 Server):
- Total Run 31hrs
- Total kWh 39.63

Always Available (40 Server):
- Total Run 31 hrs
- Total kWh 17.12

Savings: 56.79%

Holistic Optimization Architecture



Reference Data

- Equipment
  - Efficiency
  - Where/what
- Energy
  - Pricing
  - Demand response
  - Alerts
- Smart grid

Example Implementation Run Book

Follow this Optimization Process:

OFF

To reduce capacity:

Free up server from virtual machines
- MigrateVMs to other hosts (DRS)
- PowerOffVM (Optional)
- Wait for transfer/power off to complete
- PowerOffHost

Server (via IPMI/iLo/ssh)
- Shutdown server / change P state
- Wait for no response

Power
- Sleep / turn off components
- Turn off outlet

Cooling
- Adjust cooling

ON

To add capacity:

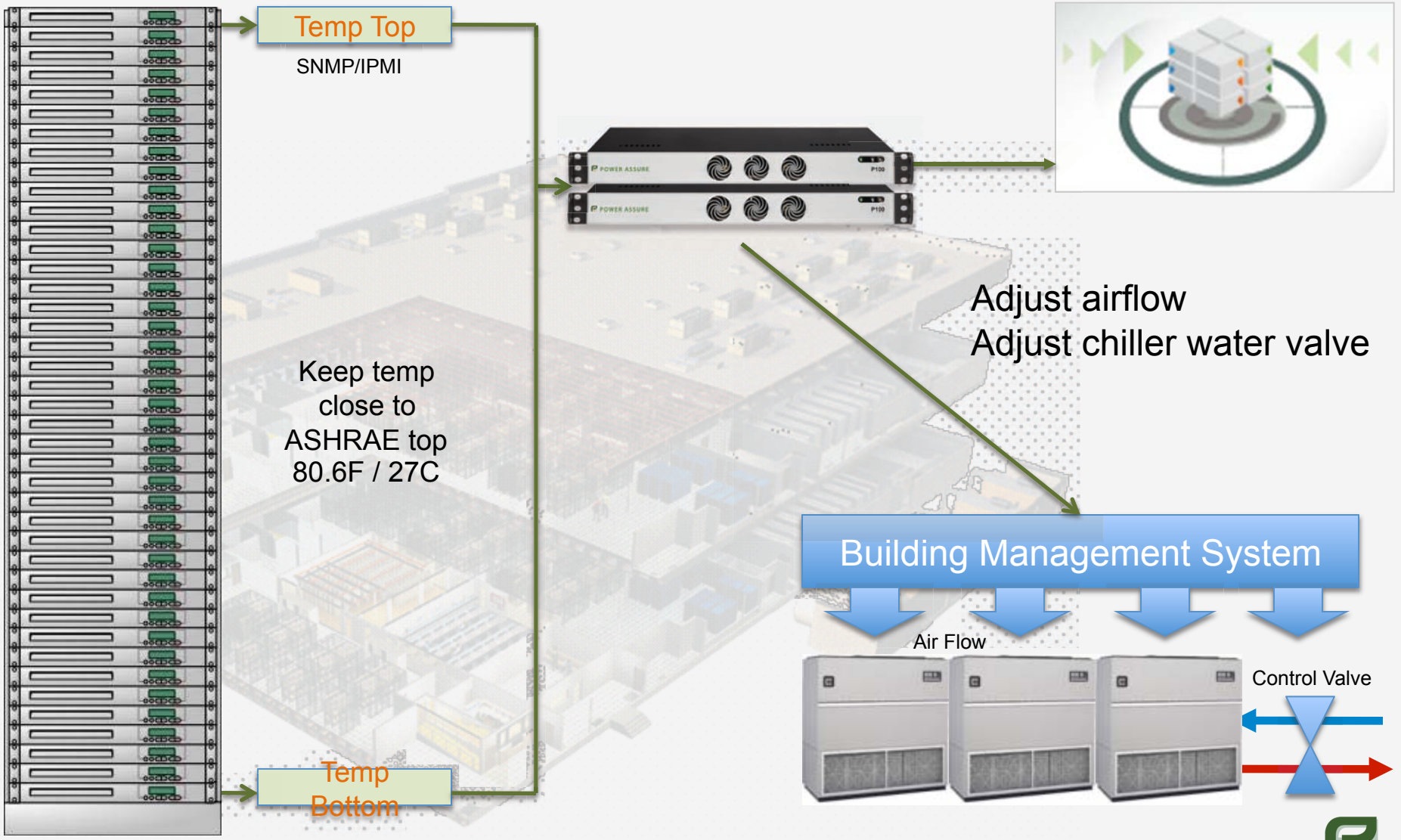
Cooling
- Adjust cooling

Power
- Turn on
- Wait for response

Server
- Start services
- Wait for services

Add virtual machines
- AddHost
- MigrateVMs to new hosts (Optional)
- Add VM to cluster to Rebalance (DRS)

Example Interaction with Environment



The Final Result, from Earlier Example

Original data center:

- 100,000 sqft – 700 racks
- 8,000 server (500 racks / ~3.8kW)
- Average age 3 years
- 50 racks networking (~6kW)
- 150 racks storage (~3kW)
- PUE 2.3
- Total power consumption: 6.1MW of 10MW
- **Cost per year: $4.1M ($.075/kWh)**
- **Average server utilization 10%**

One time improvements:

- 4,800 server (120 Racks / ~6.8kW)
  - Average utilization 10%
- 300 racks of UCS Blade server (16.8kW)
  - Average utilization 20%
- 70 racks networking (~6kW)
- 210 racks storage (~3kW)
- PUE 1.3
- Total peak power consumption: 9.1MW

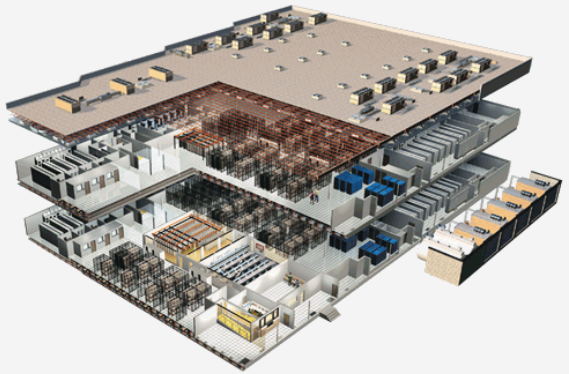
- **25x increase in capacity**
- **Cost per year: $6M ($.075/kWh)**

With Dynamic Capacity Optimization:

- 100,000 sqft – 700 racks
- 4,800 server (120 Racks / ~6.8kW)
  - Average utilization 10%
- 300 racks of UCS Blade server (16.8kW)
  - Average utilization 20%
- 70 racks networking (~6kW)
- 210 racks storage (~3kW)
- PUE 1.3
- Savings 57% on virtualized blade server
- Peak power consumption: 9.1MW
- Average power consumption: 5.25MW

- Cost per year: $3.4M ($.075/kWh)
- Average running server utilization 80%

- **Power cost savings per year: $2.6M / 43%**



Summary

- Hardware upgrades provide you the required capacity increase for consolidation
- Dynamic optimization provides you the 30% mandated power savings
- Baseline management documents the savings and improvements