Energy Efficiency with Virtualization: Less Power, Lower IT Costs

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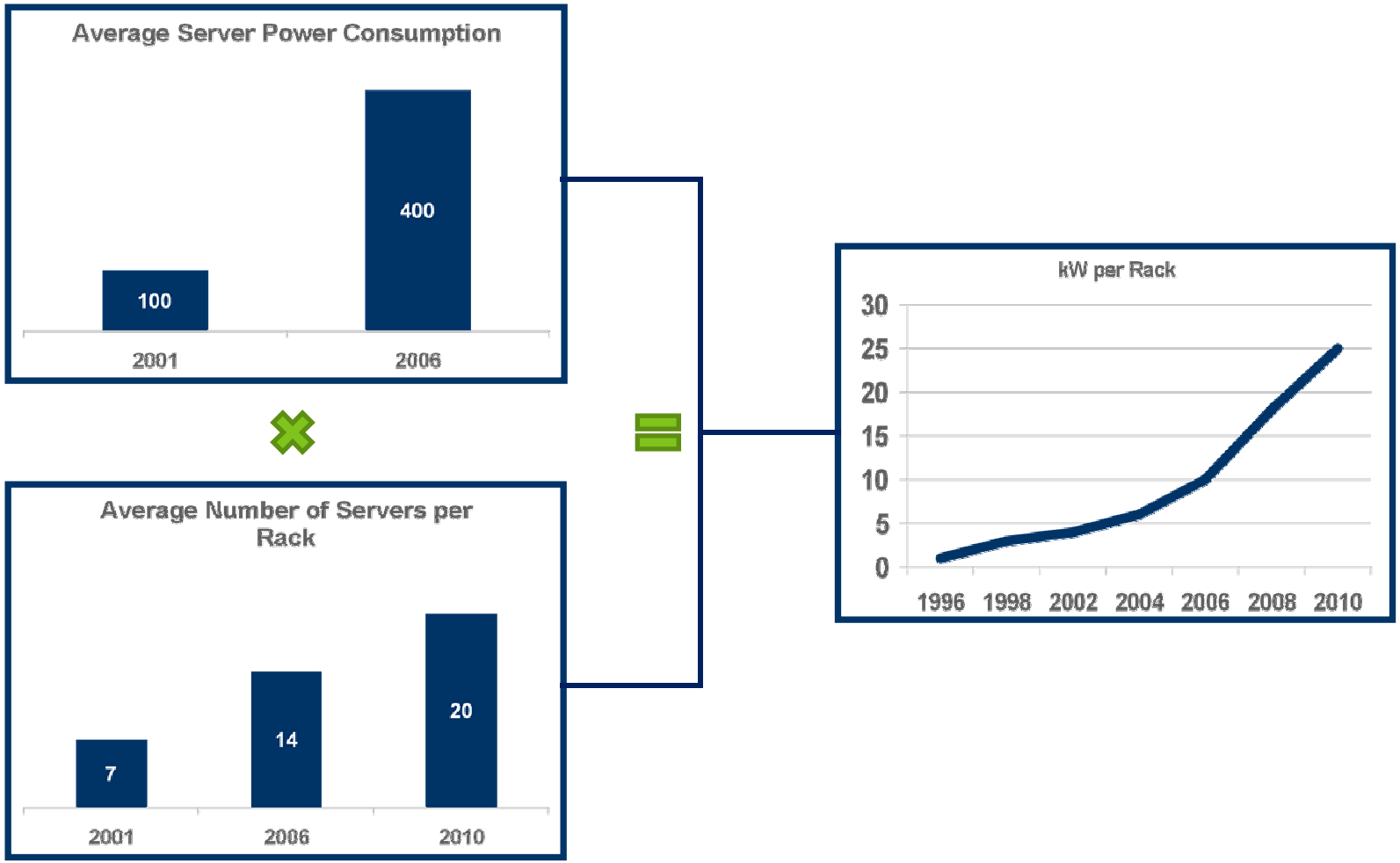
Data Center Products & Solutions

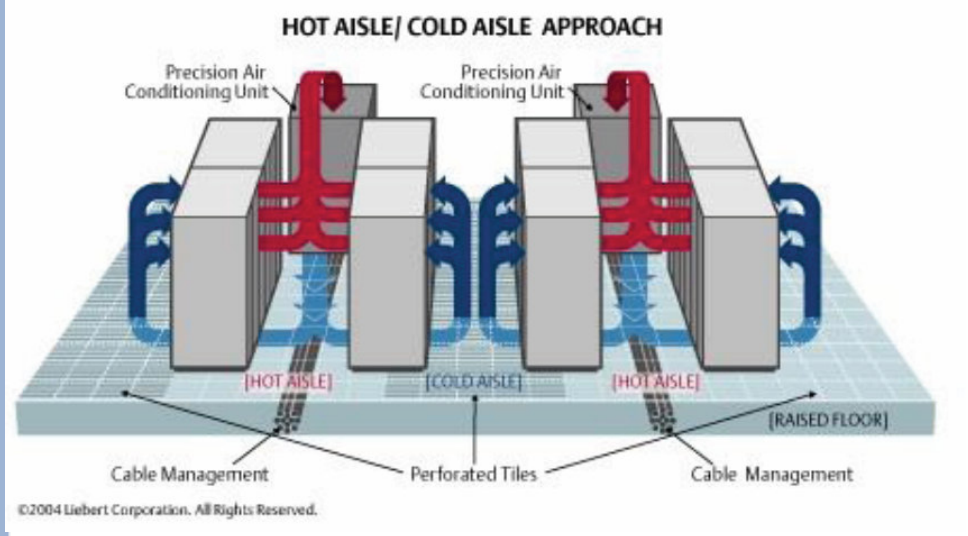
Agenda

- The Data Center Climate Crisis
- Prioritizing Power & Cooling Initiatives
- The Impact of Server Consolidation
- Carbon Footprint
- VDI Energy Savings
- Distributed Power Management
- VMware Customer Examples
- Resources & Next Steps

Power Density is Increasing



Data Center Cooling

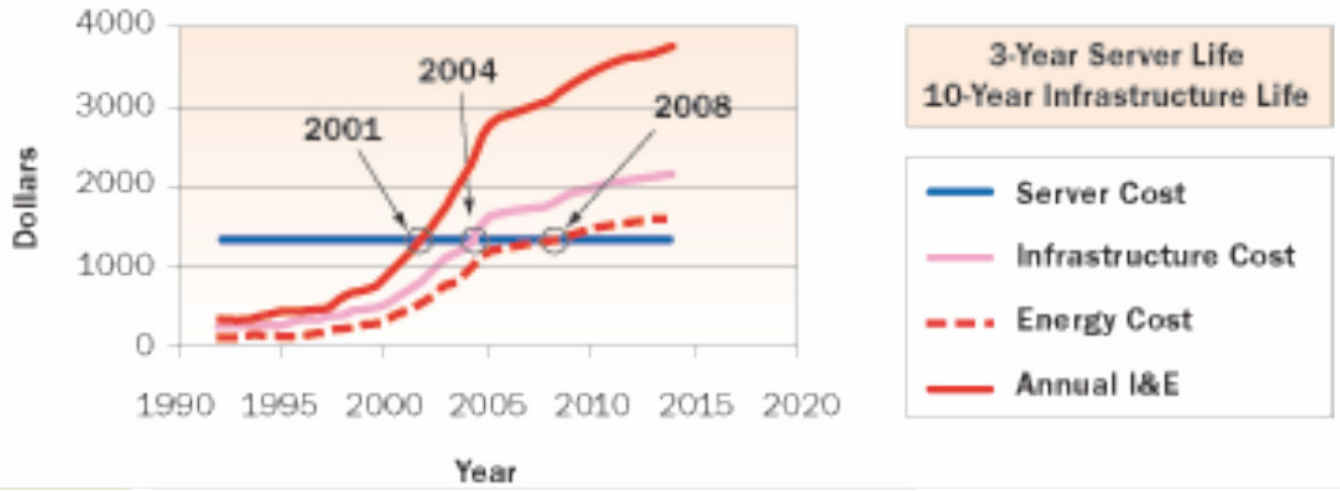


- Power consumed by the data center must be evacuated in the form of heat
- Data center design is usually not optimal, resulting in inefficiencies
- Airflow redundancy is needed account for hot pockets and humidity
- Heat dissipation is more expensive than power

As a Capitalist...

- Energy costs are skyrocketing and consuming budgets
- $4.5 billion in electricity costs in U.S. in 2006*
- Costs to build new data centers are “material”: $1,000 per sq ft.
- Carbon offsets: $150 per server

Figure 2-7: Annual Amortized Cost for Purchase and Operation of a 1U Server



“Over the next 5 years, most enterprise data centers will spend as much on energy (power and cooling) as they do on hardware infrastructure.”

Source: Gartner, February 2007

* EPA report to Congress on Data Center Energy Efficiency, July 2007

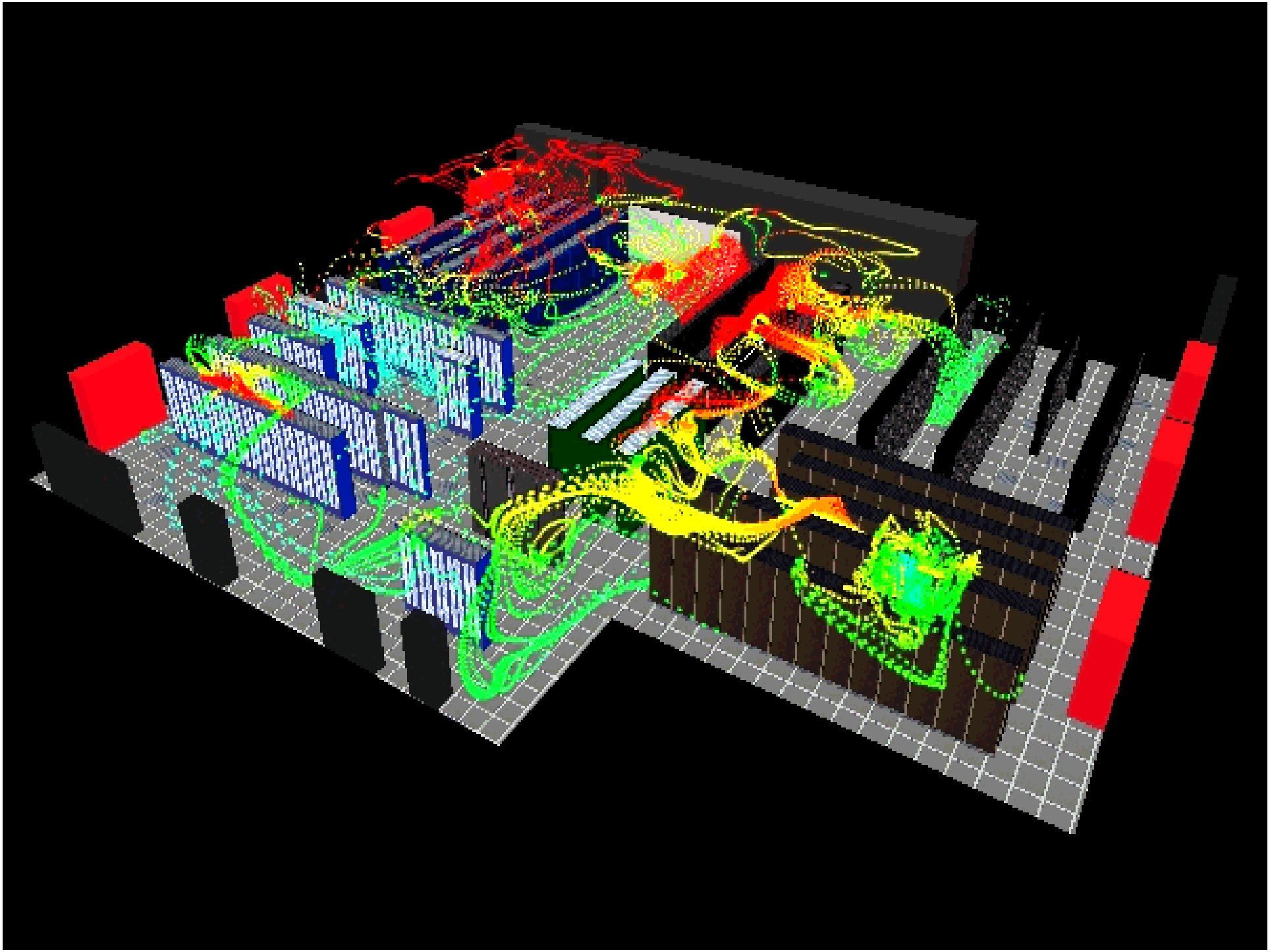
As an Environmentalist…

- Data Centers are huge CO2 factories
  - 1 full rack of blade servers = 20-25 kW = peak demand of 30 homes
- U.S. data centers = 45 billion kWh, 1.5% of total consumption*
  - This electricity use has more than doubled since 2000
- Every server removed saves ~12.5 tons of CO2 emissions
  - Equivalent to taking ~1.5 cars off the road (12,000 miles @ 20 mpg) or planting 55 trees a year

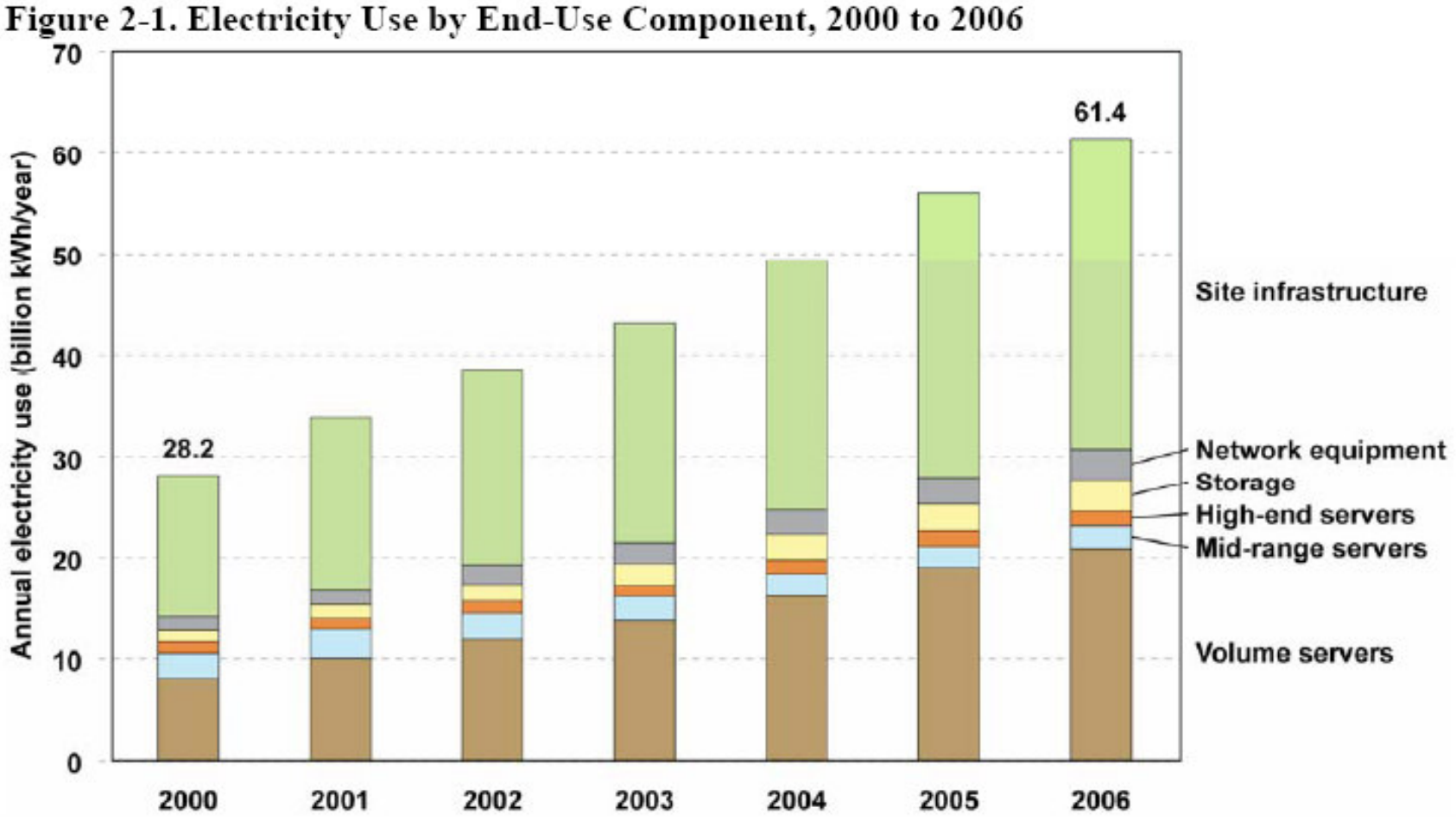
* EPA report to Congress on Data Center Energy Efficiency, August 2007

As a Data Center Operator

- Limited floor space and capacity
  - No new services!
  - Limited growth
- Heat = server failure = service interruption
  - Your job?
- No more power available…
  - Want to move to Oregon?



Volume Servers are Driving Power Consumption



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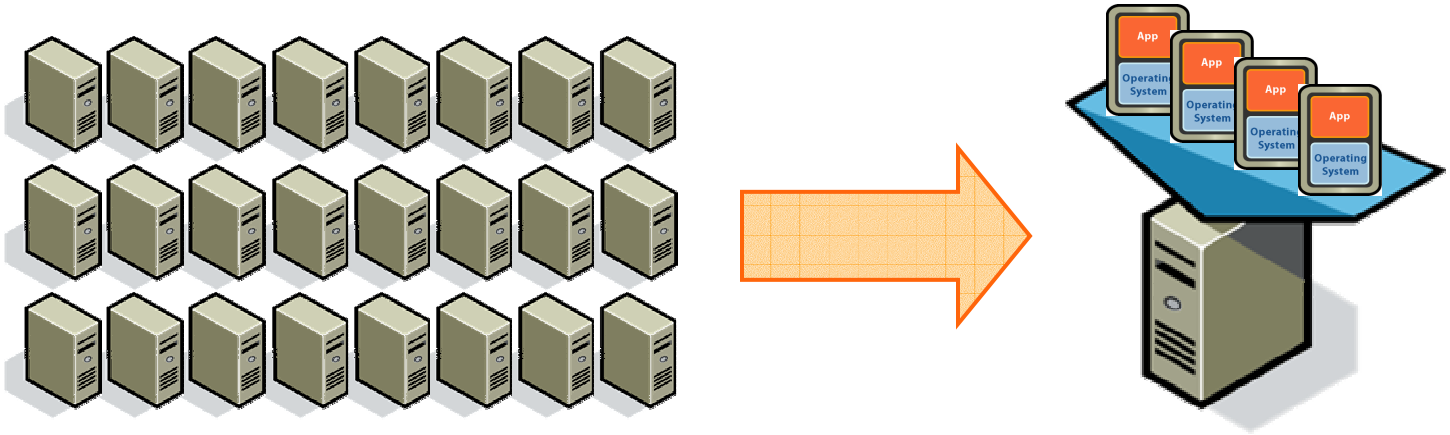
Volume Servers are Driving Power Consumption

End use component	2000		2006		2000 – 2006 electricity use CAGR
	Electricity use (billion kWh)	% Total	Electricity use (billion kWh)	% Total	
Site infrastructure	14.1	50%	30.7	50%	14%
Network equipment	1.4	5%	3.0	5%	14%
Storage	1.1	4%	3.2	5%	20%
High-end servers	1.1	4%	1.5	2%	5%
Mid-range servers	2.5	9%	2.2	4%	-2%
Volume servers	8.0	29%	20.9	34%	17%
Total	28.2		61.4		14%

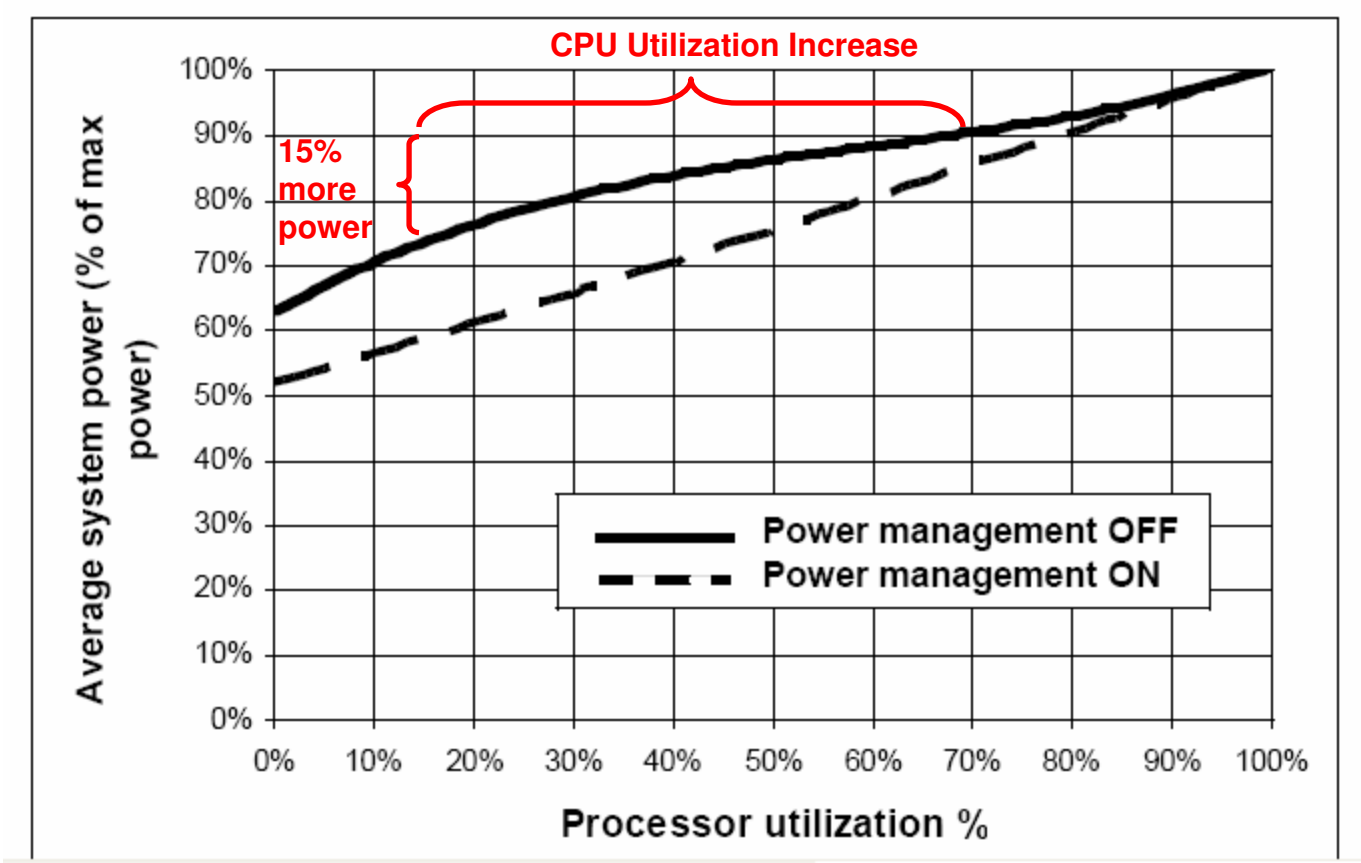
- **All servers = 40% of total data center electricity use**
- **Volume servers = 85% of all server electricity use**
  - Up from 70% in 2000
  - Volume server consumption has grown 17% annually since 2000

Server, Storage, and Network Consolidation

	BEFORE VMware	AFTER VMware
Servers	>1,000	>80
Storage	>Direct attach	>Tiered SAN and NAS
Network	>3000 cables/ports	>300 cables/ports
Facilities	>200 racks >400 power whips	>10 racks >20 power whips



How Does Utilization Increase Power Consumption?



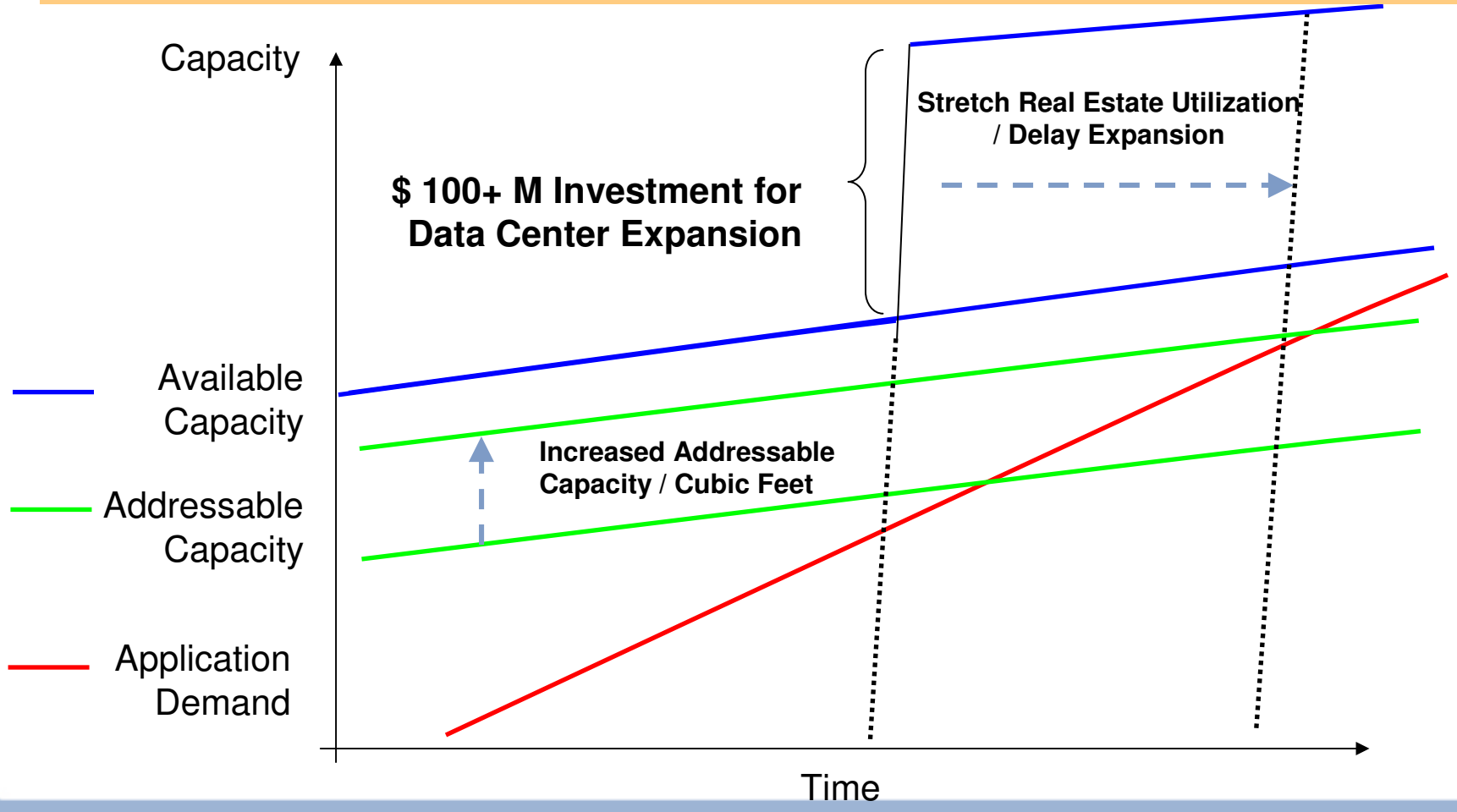
Energy Savings at Utility Company

	BEFORE			AFTER		
Max Power Capacity Rating	1 CPU	300	475 W	1 CPU	--	594 W
	2 CPU	500	550 W	2 CPU	38	688 W
	4 CPU	200	950 W	4 CPU	38	1188 W
	8 CPU	--	1600 W	8 CPU	4	2000 W
% of Max	x 67%			x 67%		
kW / Yr	407 kW/hr x 24 x 365			53 kW/hr x 24 x 365		
Cost / kWh	x $0.08			x $0.08		
Cost / Yr	=		Power: $285,243	=		Power: $37,210
	=		Cooling: $356,554	=		Cooling: $46,513
Savings / Year				**= Savings: $558,072**		

✓ **Rule of thumb: $560 and 7,000 kWh saved per year per workload virtualized**

Higher Asset Utilization Defers Data Center Expansion

Customer Defers $100M investment by 3 years through increased space utilization



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Potential VDI Energy Savings

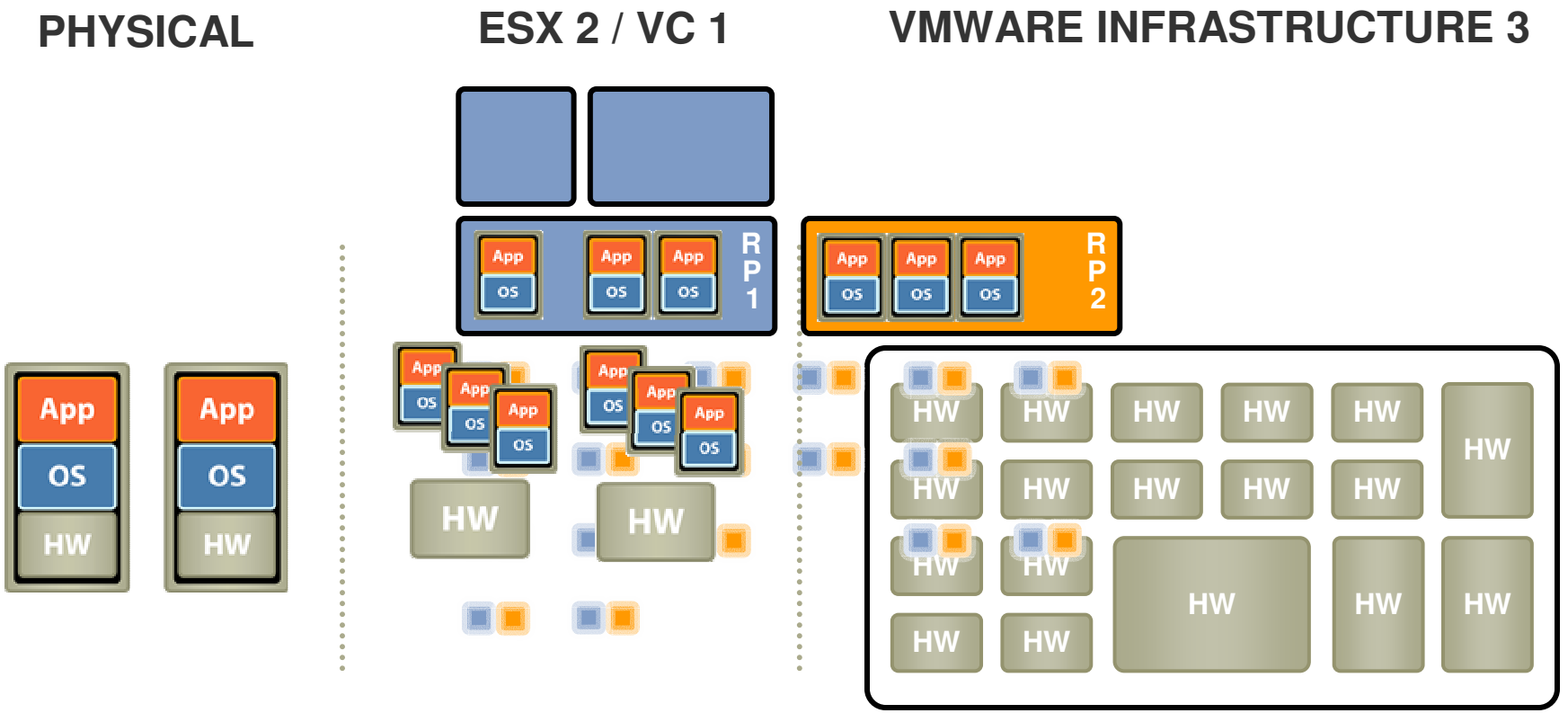
- Consolidate 1,000 desktops to 16 2-way quad-cores, 32GB RAM
- 8 users per core or 64 per server
- Desktops run 12 hours per day and servers run 24 hours

	PCs	Virtual Desktop Infrastructure		
		Server	Thin Client	Total
Operating Power (watts/hour)	120	750	11	
Cooling Power (watts/hour)	150	938	14	
kWh / year	518,400	227,813	106,920	334,733
Cost / year / user @ $0.12/kWh	$62	$27	$13	$40

Reduce power consumption by 35%!

Save up to $22 per PC per year

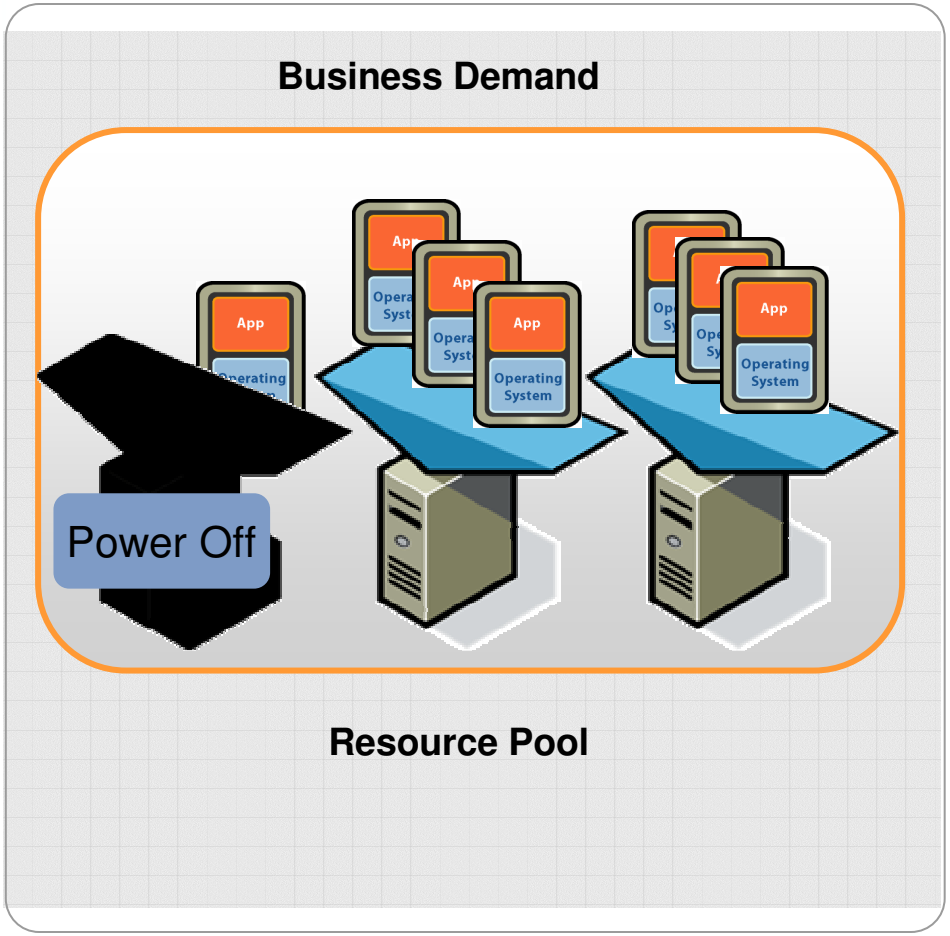
New Levels of Flexibility / Automation



INDUSTRY FIRSTS:

- Logical Resource Pooling (RP)
- Distributed Resource Scheduler (DRS)

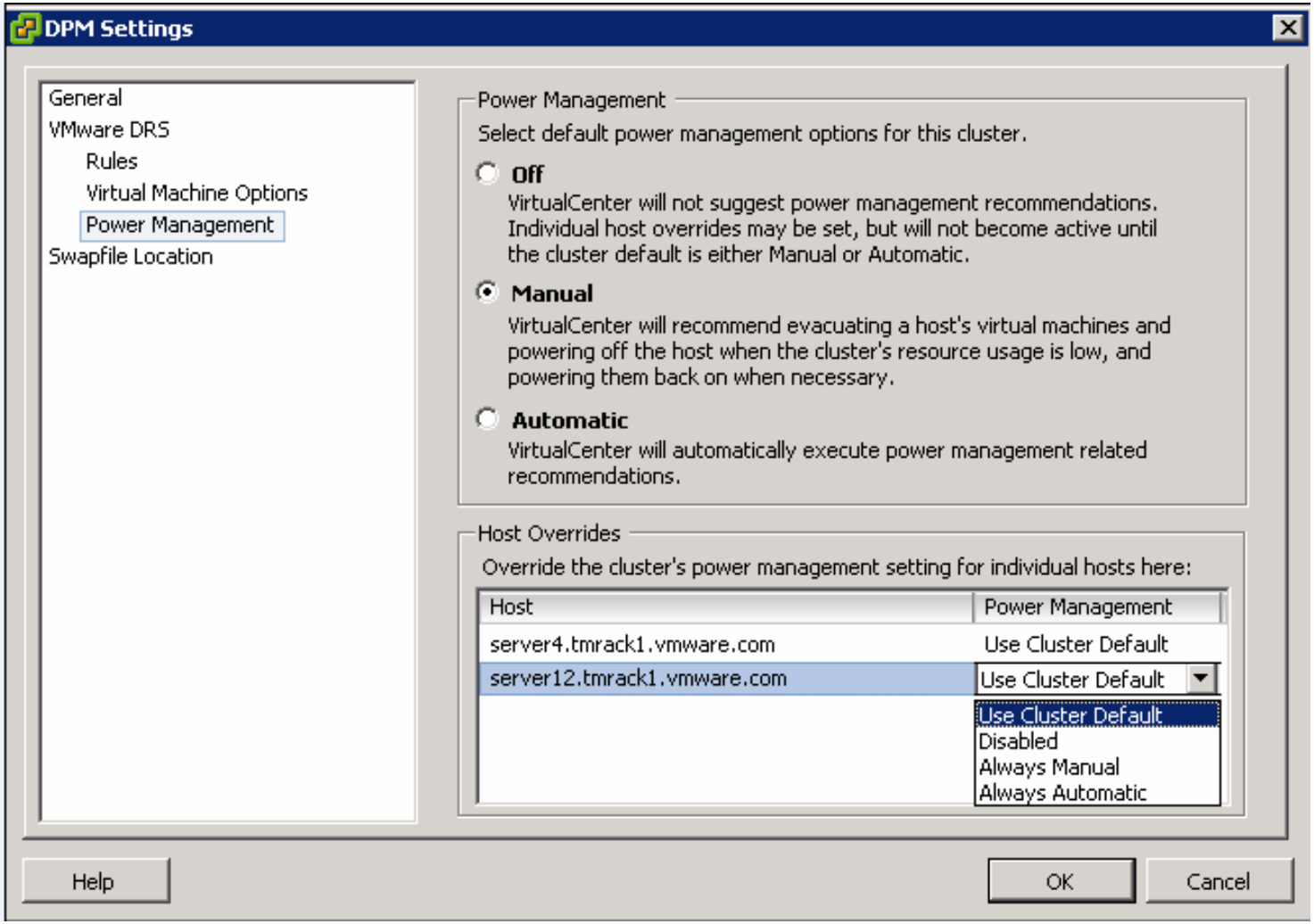
Distributed Power Management



- Consolidates workloads onto fewer servers when the cluster needs fewer resources
- Places unneeded servers in standby mode
- Brings servers back online as workload needs increase

- Minimizes power consumption while guaranteeing service levels
- No disruption or downtime to virtual machines

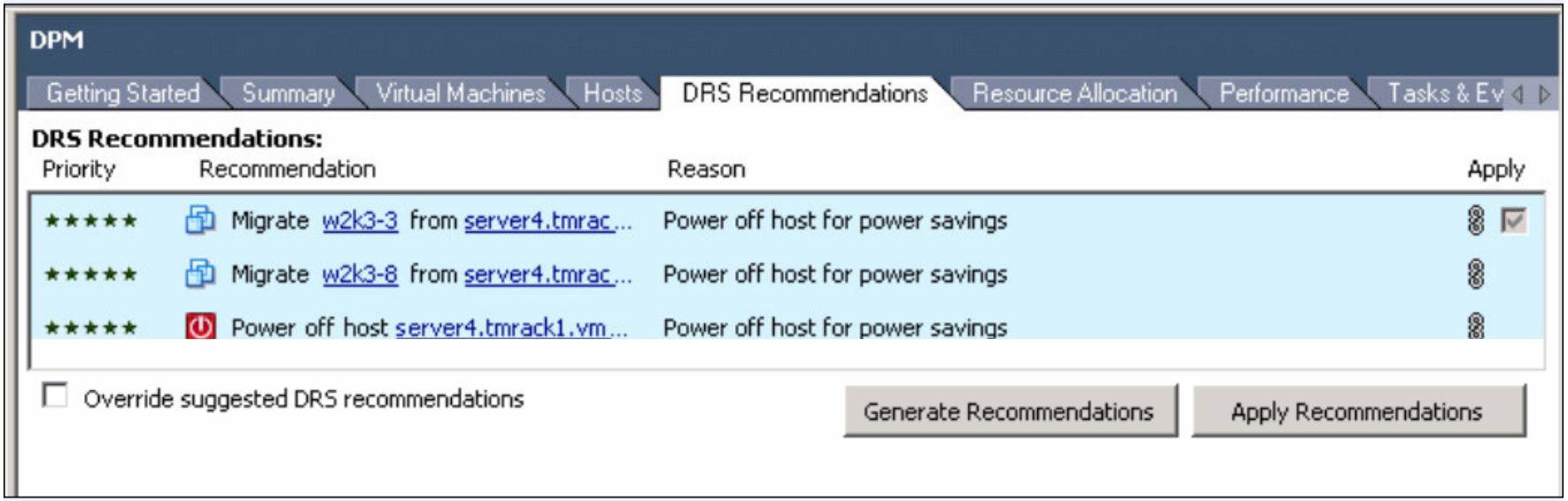
DPM Setup and Options



How DPM Works

- Recommends/initiates host power off when load is low
  - Considers X minutes of load history (user defined)
  - All VM's on selected host are migrated to other hosts
  - Host is powered off
- Recommends/initiates host power on when load is high
  - Considers X minutes of load history (user defined)
  - Wake on LAN packet sent to the selected host, which boots up
  - DRS load-balancing kicks in and VMs are migrated to this host

Power Optimizing Automation



- Customers get comfortable with DRS automation quickly
- Turning off low-end workloads on “nights and weekends” reduces server use by 40%
- How much excess capacity are you burning?

Energy Efficiency Programs

- Validation of server consolidation is recognized as a calculable and impactful energy efficiency measure
- Incentive range from about $150 to $300 per server removed
  - Paid at 8 cents per KwH
  - Max of $4 million per site (PG&E)
- Currently available throughout California…
  - PG&E progam: www.pge.com/hightech
  - SoCal Edison: http://www.sce.com/RebatesandSavings/LargeBusiness/SPC/
  - SDG&E/Sempra: http://sdge.com/business/specializedincentives.shtml
- Programs are expanding quickly…ask your energy provider!

Conclusions – How Customers Win

- Energy cost savings / avoidance are natural by products of virtualization
- Server consolidation and increased utilization decrease power consumption “upstream”
- Virtualization has inherent benefits that allow for superior power management
- Virtualization is the best initiative to reduce energy footprint of volume servers
- Virtualization lets you reclaim expensive data center floor space
- Do more with less – virtualization offers improved service levels, responsiveness and availability with a smaller energy footprint

1-800 Radiator

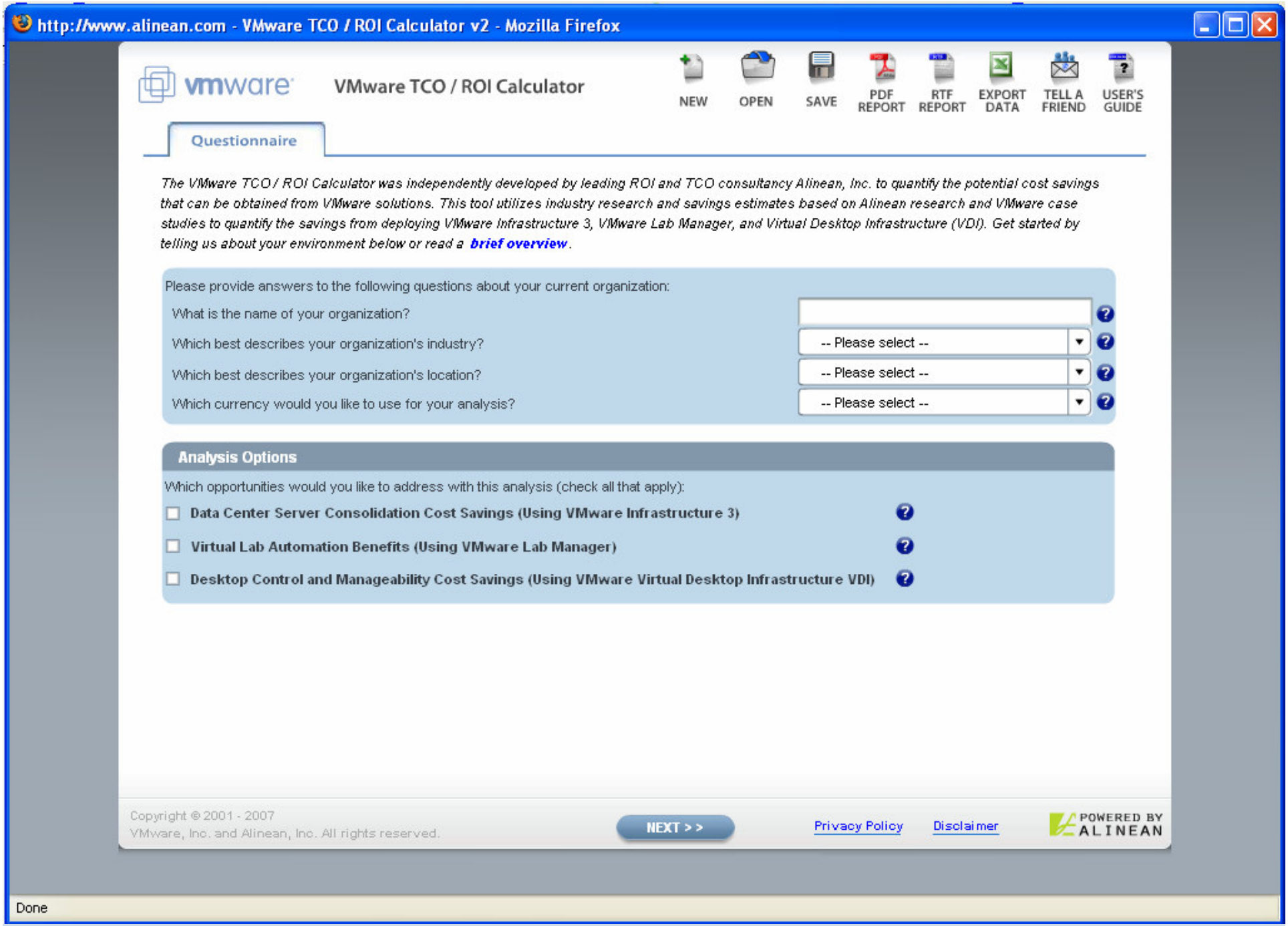
- Situation:
  - Rapid growth: 3 new franchises opened per week
  - Out of power, A/C maxed out, racks full
  - "Before we knew it our computer room was almost at maximum power capacity, our computer racks were full, our switches were all used, and our air conditioning was on continuously. Rather than spend thousands on new power systems, racks, and air conditioning, we chose to leverage VMware's product line to allow our company to keep pace with our growth."

    -- Mike Carvalho, CTO
- Results:
  - Removed 31 physical servers out of production – 40 workloads on 9 ESX hosts
  - $6,000 PG&E rebate check
  - 25-percent reduction in power and cooling costs

Covenant Health

- Situation:
  - Covenant Health realized it needed to consolidate its servers or face a major data center upgrade, which could cost $1 million or more.
  - “The company was buying an increasingly large number of Windows servers. We had to add most to segregate applications, not to expand capacity or performance. Across our data center we were only using half of the total disk space and a fraction of the processing power.”

    -- Peter Hogan, Systems Manager
- Results:
  - Achieved 25:1 server consolidation ratio
  - Reduced annual power and cooling consumption by $40,428
  - Avoided costly data center overhaul
  - Standardized 75 percent of new systems on virtual machines
  - Increased CPU utilization from 5 percent to 60 percent


http://www.alinean.com - VMware TCO / ROI Calculator v2 - Mozilla Firefox
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VMware TCO / ROI Calculator
NEW
OPEN
SAVE
PDF REPORT
RTF REPORT
EXPORT DATA
TELL A FRIEND
USER'S GUIDE
Questionnaire
The VMware TCO / ROI Calculator was independently developed by leading ROI and TCO consultancy Alinean, Inc. to quantify the potential cost savings that can be obtained from VMware solutions. This tool utilizes industry research and savings estimates based on Alinean research and VMware case studies to quantify the savings from deploying VMware Infrastructure 3, VMware Lab Manager, and Virtual Desktop Infrastructure (VDI). Get started by telling us about your environment below or read a brief overview.
Please provide answers to the following questions about your current organization:
What is the name of your organization?
Which best describes your organization's industry?
-- Please select --
Which best describes your organization's location?
-- Please select --
Which currency would you like to use for your analysis?
-- Please select --
Analysis Options
Which opportunities would you like to address with this analysis (check all that apply):
Data Center Server Consolidation Cost Savings (Using VMware Infrastructure 3)
Virtual Lab Automation Benefits (Using VMware Lab Manager)
Desktop Control and Manageability Cost Savings (Using VMware Virtual Desktop Infrastructure VDI)
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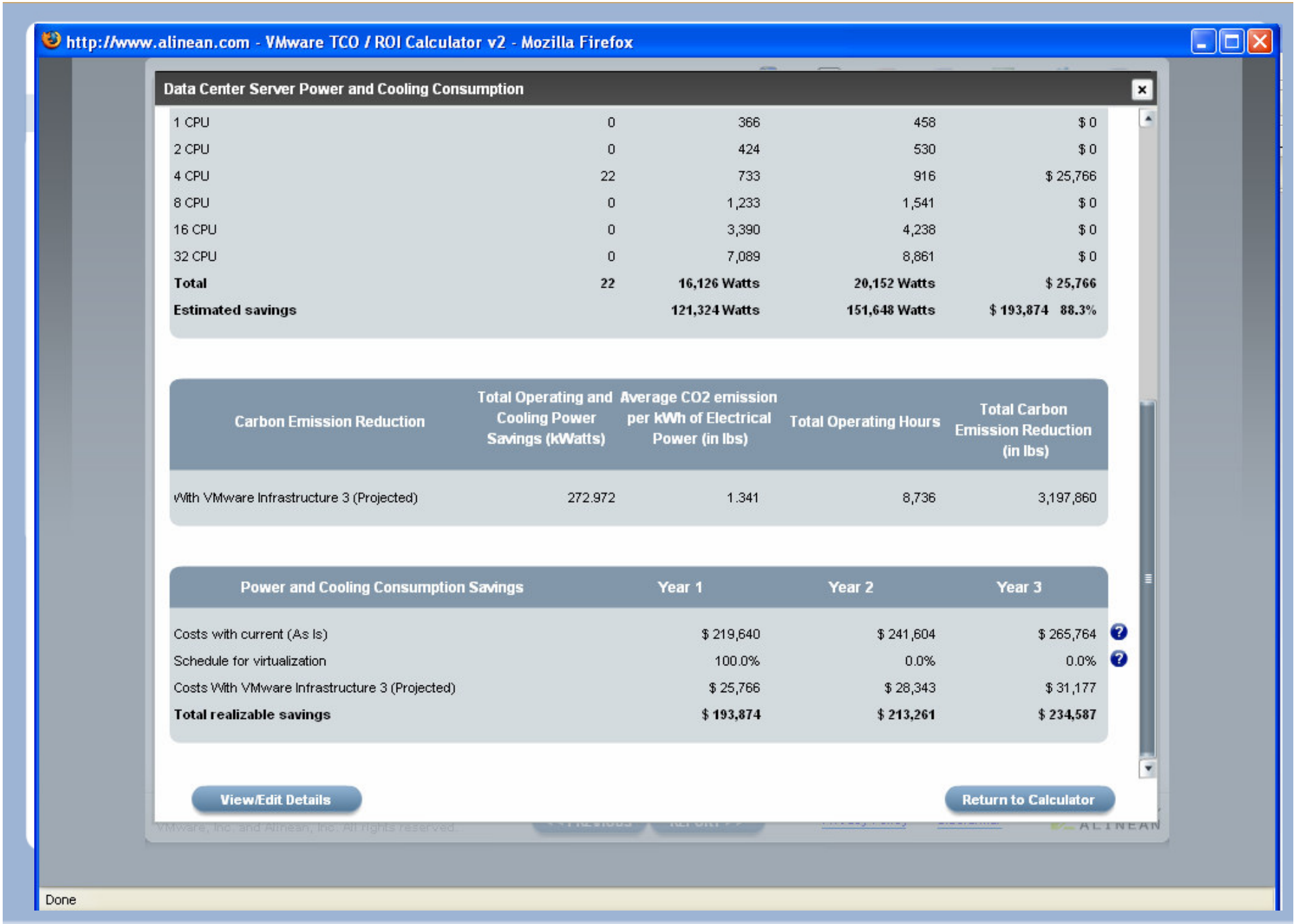
http://www.alinean.com - VMware TCO / ROI Calculator v2 - Mozilla Firefox
Data Center Server Power and Cooling Consumption
1 CPU 0 366 458 $ 0
2 CPU 0 424 530 $ 0
4 CPU 22 733 916 $ 25,766
8 CPU 0 1,233 1,541 $ 0
16 CPU 0 3,390 4,238 $ 0
32 CPU 0 7,089 8,861 $ 0
Total 22 16,126 Watts 20,152 Watts $ 25,766
Estimated savings 121,324 Watts 151,648 Watts $ 193,874 88.3%
Carbon Emission Reduction
Total Operating and Cooling Power Savings (kWatts)
Average CO2 emission per kWh of Electrical Power (in lbs)
Total Operating Hours
Total Carbon Emission Reduction (in lbs)
With VMware Infrastructure 3 (Projected) 272.972 1.341 8,736 3,197,860
Power and Cooling Consumption Savings
Year 1
Year 2
Year 3
Costs with current (As Is) $ 219,640 $ 241,604 $ 265,764
Schedule for virtualization 100.0% 0.0% 0.0%
Costs With VMware Infrastructure 3 (Projected) $ 25,766 $ 28,343 $ 31,177
Total realizable savings $ 193,874 $ 213,261 $ 234,587
View/Edit Details
Return to Calculator
Done