GREEN DATA CENTER COOLING

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Agenda

- Introduction
- Business plan
  - Goal
  - Value proposition and business
  - Market and technology
  - Next steps

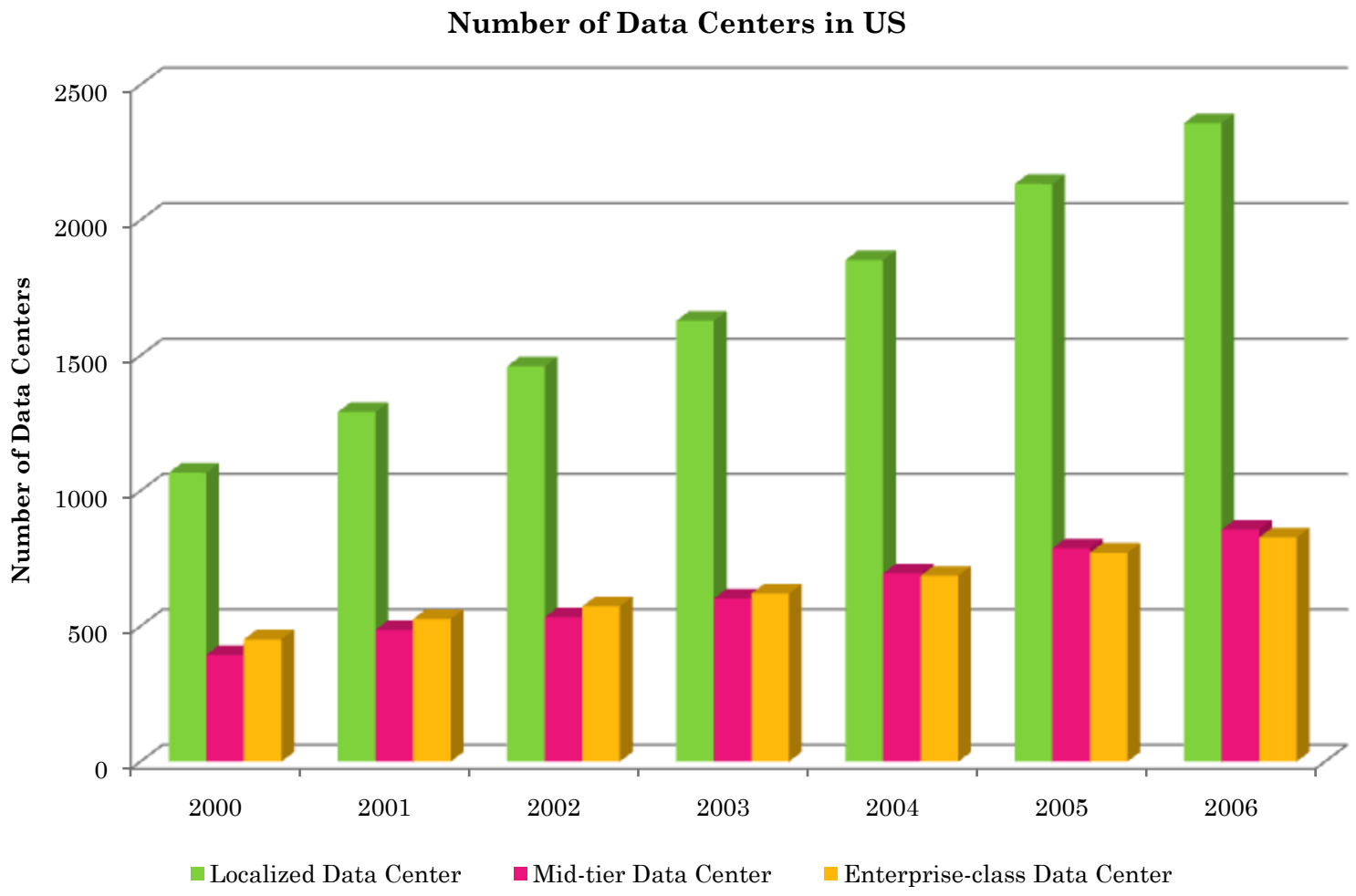
Introduction

What is a Data Center?

- A centralized repository used for storage, management and dissemination of data and information organized around a particular body of knowledge or pertaining to a particular business.

TechTarget. SearchDataCenter.com Definitions. 2005 [cited 2009; Available from: http://searchdatacenter.techtarget.com/sDefinition/0,,sid80_gci332661,00.html.

Data Center Growth



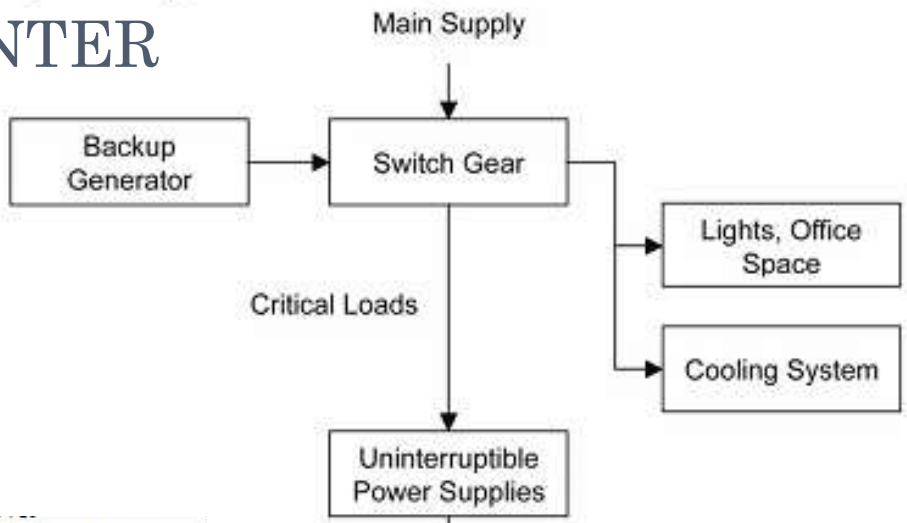
U.S. Environmental Protection Agency, E.S.P., Public Law 109-431: Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431. US Environmental Protection Agency ENERGY STAR Program. 2007, U.S.

Why such growth?

- Healthcare moving to electronic medical records
- Manufacturing moving to global networked organizations
- Banking migrating away from paper based business models
- Financial services moving to digital transactions
- Insurance database needs growing
- Retail moving toward real-time inventories and supply chain management
- Transportation moving toward GPS navigating and radio frequency identification tracking
- Increased web-site hosting for public information, online reports and other information
- Increased movement toward digital services (e filing for taxes, on line tracking of items sent through the US Postal Service)
- Requirements related to homeland security
- Scientific computing in the national laboratories and other government research institutions.

U.S. Environmental Protection Agency, E.S.P., Public Law 109-431: Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431. US Environmental Protection Agency ENERGY STAR Program. 2007, U.S.

Typical Electrical Components in a Data Center



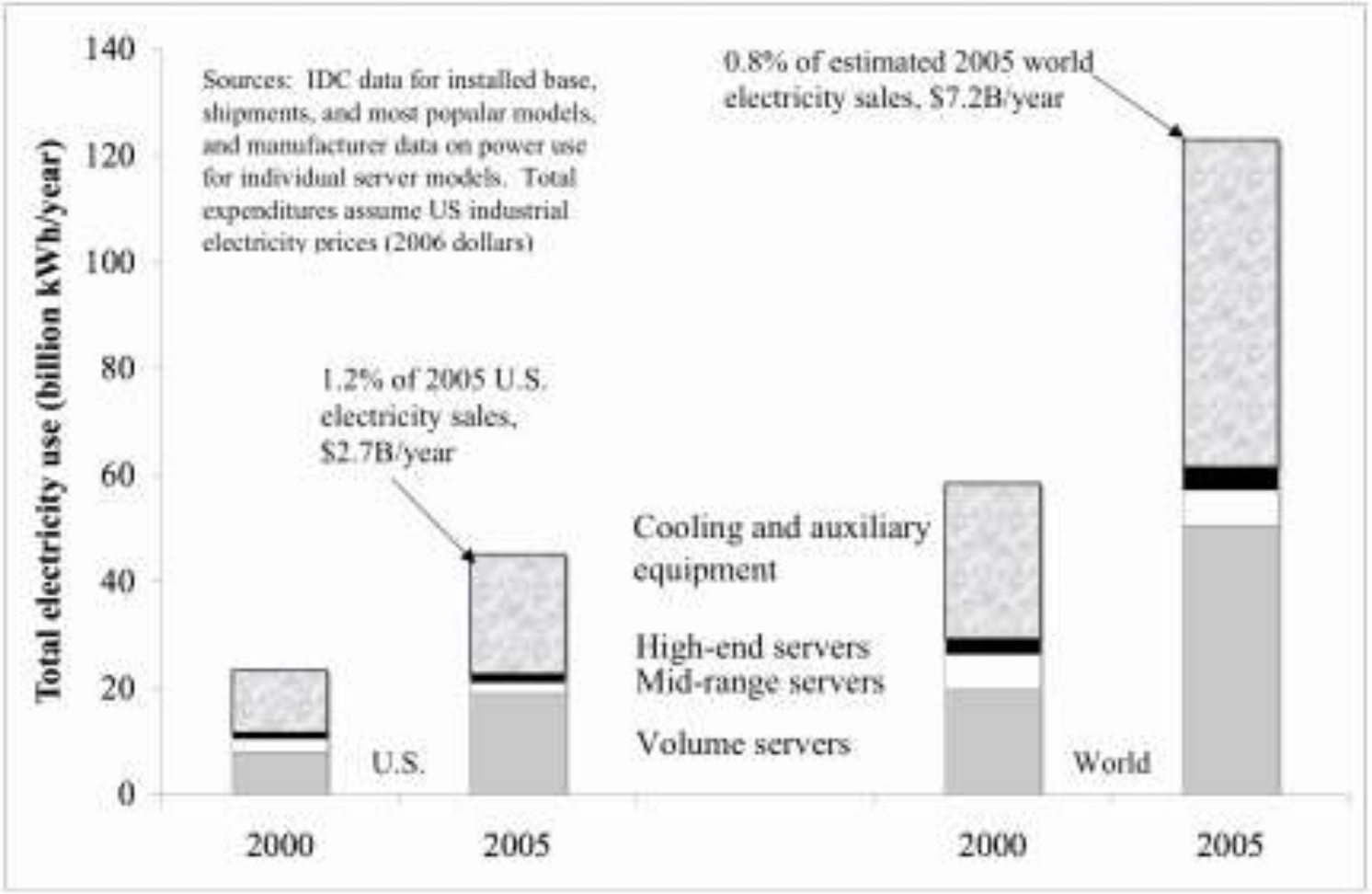
Component	Peak Power (Watts)
CPU	80
Memory	36
Disks	12
Peripheral slots	50
Motherboard	25
Fan	10
PSU losses	38
Total	251

Source: derived from Fan et al. (2007)

Source: derived from Fan et al. (2007) and Turner et al. (2005)

U.S. Environmental Protection Agency, E.S.P., Public Law 109-431: Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431. US Environmental Protection Agency ENERGY STAR Program. 2007, U.S.

Figure ES-1: Total electricity use for servers in the U.S. and the world in 2000 and 2005, including the associated cooling and auxiliary equipment



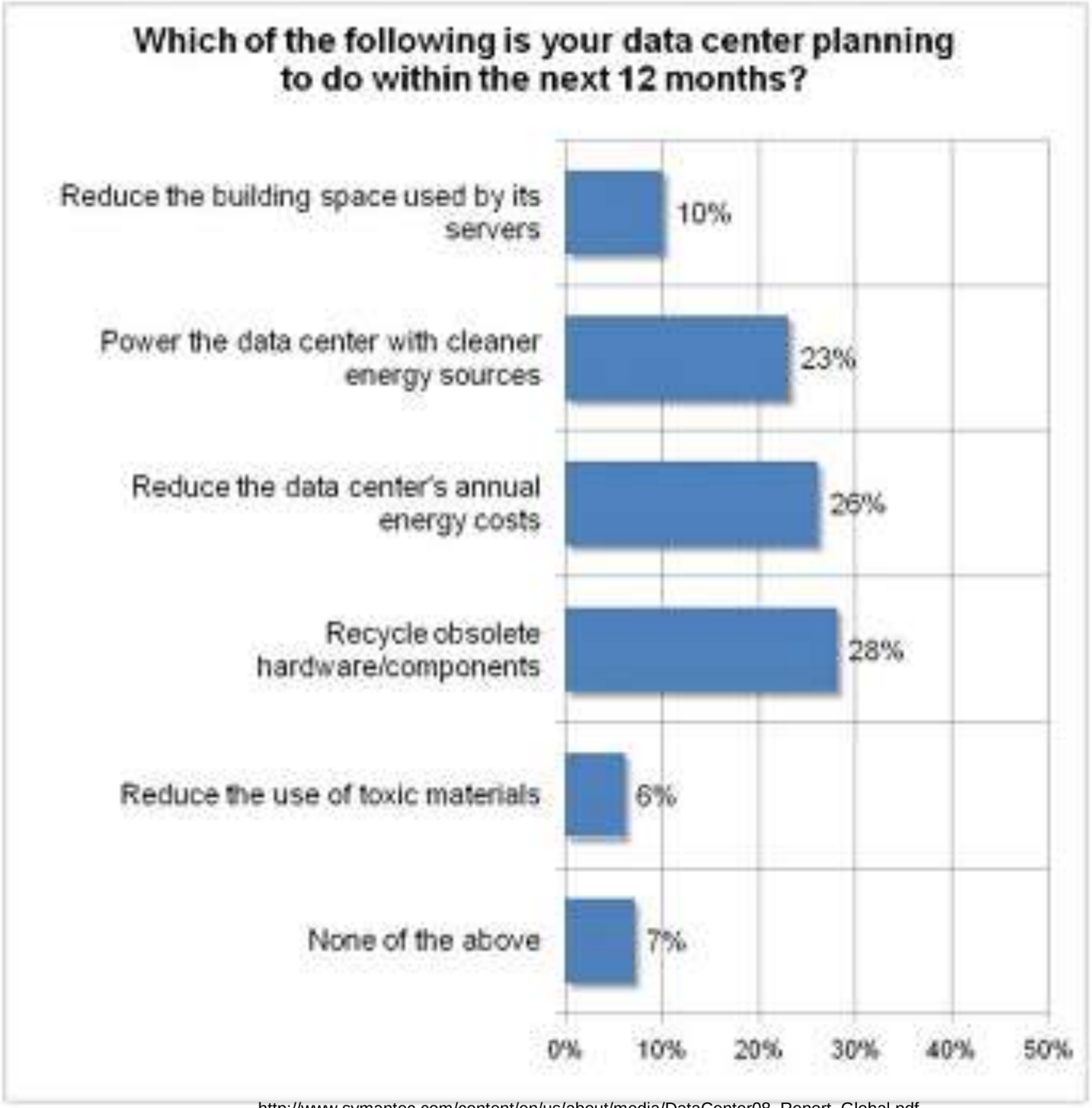
Koomey, J.G., Estimating total power consumption by servers in the US and the world. Final report. February, 2007. 15.

Americas (644)	
United States	513
Canada	49
Brazil	49
Mexico	33

EMEA/Eastern Europe (536)	
Germany	123
UK	101
France	95
Italy	78
Spain	50
Russia	45
Nordics	14
Hungary	10
Poland	10
UAE	10

Asia Pacific (414)	
Japan	163
China	122
India	44
South Korea	35
Australia	30
Singapore	10
Malaysia	10

http://www.symantec.com/content/en/us/about/media/DataCenter08_Report_Global.pdf



http://www.symantec.com/content/en/us/about/media/DataCenter08_Report_Global.pdf

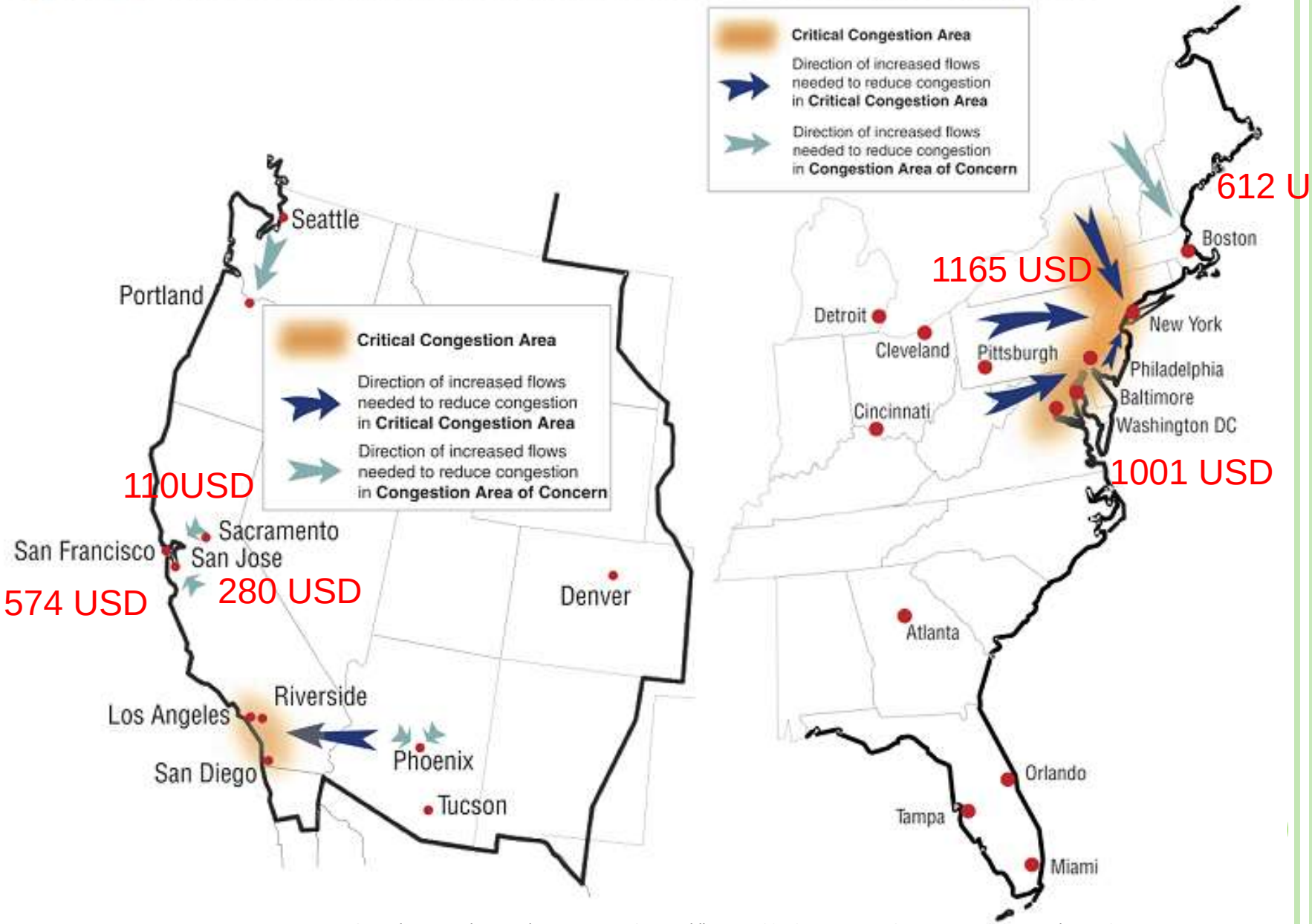
Table 4-2. Transmission Congestion Status in U.S. Metropolitan Areas with Largest Concentration of Existing Data Centers

U.S. Metropolitan Area	Transmission Congestion Severity		
	Critical	Area of Concern	Other
New York City / Northern New Jersey	√		
San Francisco Bay Area CA		√	
Chicago IL			
Dallas TX			
Washington DC area	√		
Austin TX			
Los Angeles CA	√		
Atlanta GA			√
Miami FL			√
Seattle WA			√
St. Louis MO			
Denver CO			√
Boston MA		√	
Houston TX			
San Antonio TX			
Phoenix AZ		√	
Kansas City MO			√
Sacramento CA			

Sources: LBNL analysis and U.S. DOE (US DOE 2006b).

U.S. Environmental Protection Agency, E.S.P., Public Law 109-431: Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431. US Environmental Protection Agency ENERGY STAR Program. 2007, U.S.

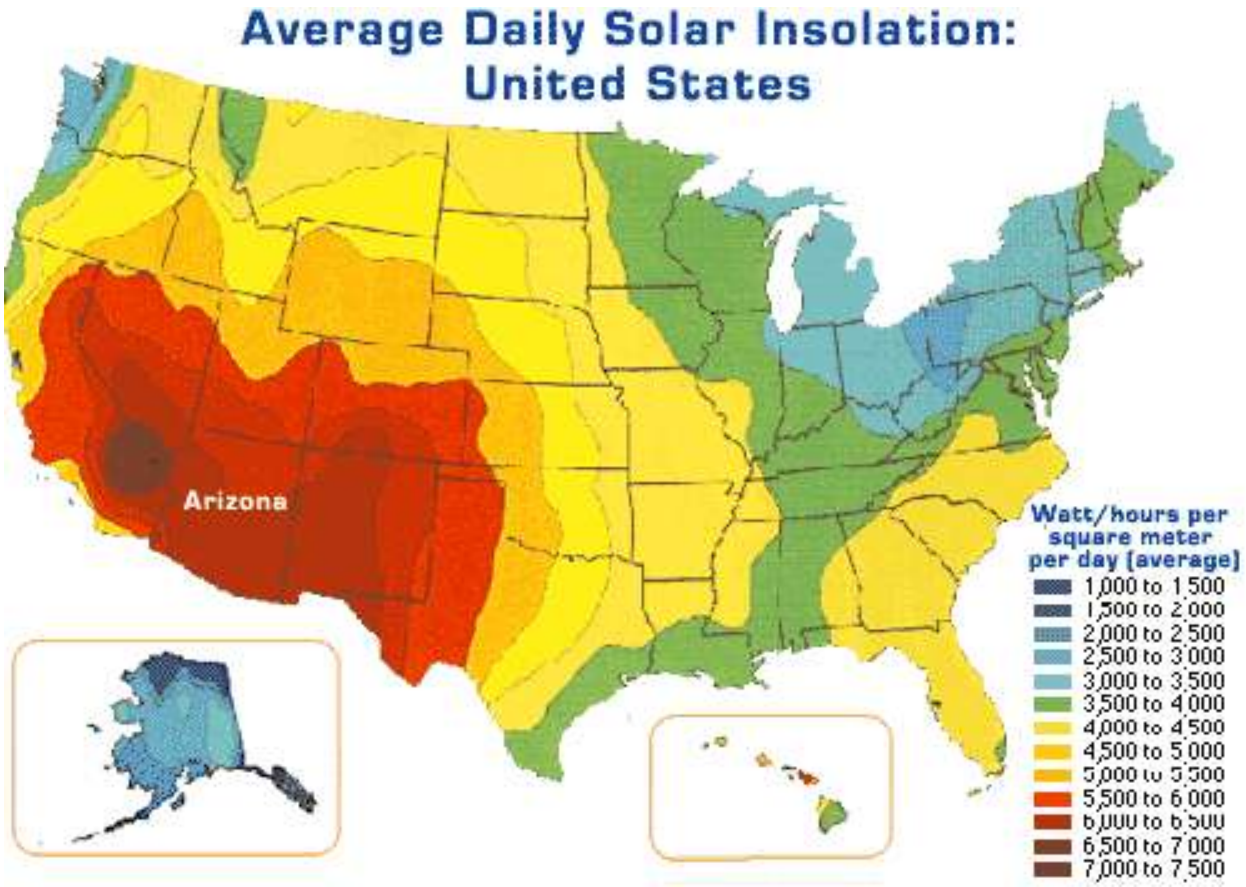
Figure 4-4. Critical Areas and Areas of Concern for Transmission Congestion



Source: (US DOE 2006b)

U.S. Environmental Protection Agency, E.S.P., Public Law 109-431: Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431. US Environmental Protection Agency ENERGY STAR Program. 2007, U.S.

Solar Potential in US



http://www.theoildrum.com/uploads/2305/Solar_Insolation_map.gif

Business proposal

Our Goal

"To design cooling solutions for future datacenters using renewable solar energy while reducing electricity costs.“

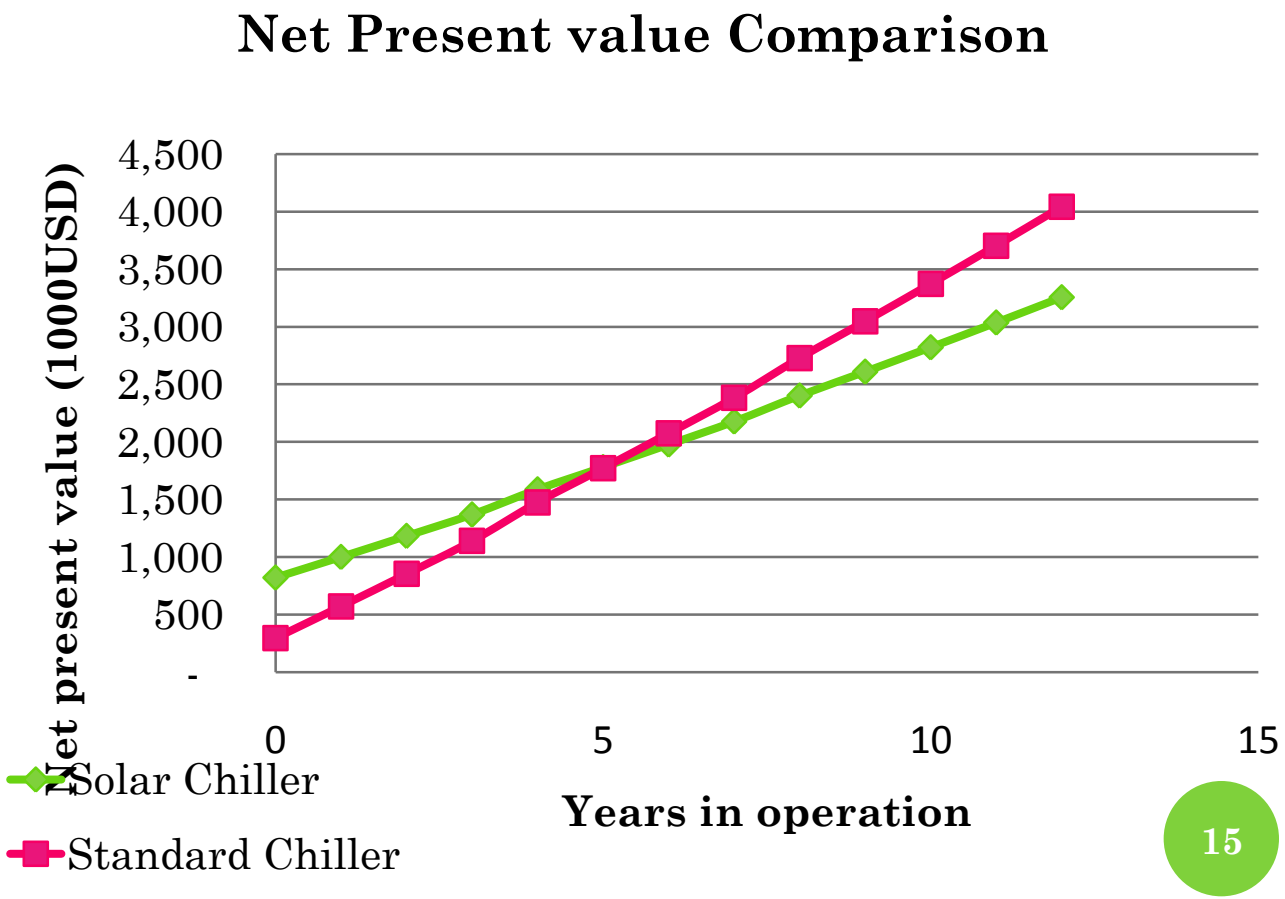
"Our new data center uses half of the energy of the total office building."

"Electricity used in data centers is expected to rise to 5% of total use in US"

"Researchers are already discarding projects because we cannot supply the computing power they need."

The Problem and Value Proposition

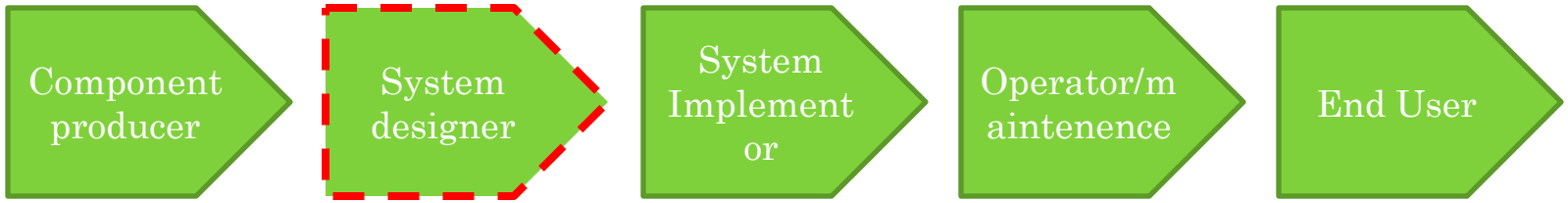
100KW Systems	NEW	OLD
Chiller + Install	338	60
Solar Collectors	132	
ice	90	0
UPS	130	200
generator	24	37
subtotal	715	297
profit 15%	107	
total	**822**	**297**



Business Model and Pricing

- Chiller package
  - Using of the shelf components
  - Absorption technology and solar collectors
  - Eliminate cooling electricity load
- Eliminate traditional chillers in new data centers

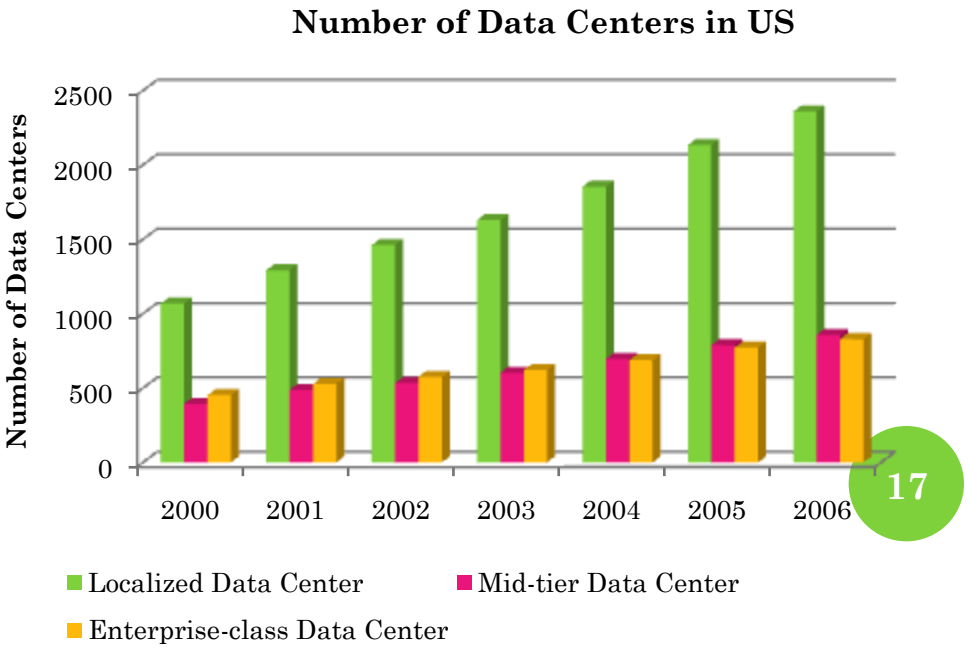
- Price basis:
  - Chiller: 155k USD
  - Chiller installation: 183k USD
  - Solar collectors: 132k USD (including installation)
  - Ice storage 90k USD (including installation)
  - Profit margin: 84k USD (15%)
- Selling price: 645k USD
- Comparable std. installations: 60k USD



Sales and Marketing

- In 2009, there are approximately 6000 data centers in the US, they use 1.2% of the total electricity, expected to rise to 5% in 2020.
- An estimated 1000 of those are from 20-200KW in California.
- Server lifetime 3 years, installation lifetime 16 years
- Collective computing power doubles every 18 months
- 200 new/refurbished data centers in this segment each year
- Data centers are mostly individually designed by operator in cooperation with independent consultants

- Market entrance:
  - Target consultants promoting green solutions
  - Build promotion centers (public) to create awareness
  - Cooling is normally not operated by system administrators (target might be building operators)



Market Drivers

- **Rising energy costs + consumption**
- **Make the data center more "green"**
- **"LEED" points attainable for cooling solution**
- **Incentives for Renewable & Efficiency:**
  (Our package complies with California Energy Code standards (Title 24))

Energy-Efficient Commercial Buildings (Federal)

- 1.80 USD per square foot for buildings that save 50% or more are eligible for a tax deduction
- 0.60 USD per square foot for buildings that save 20% on cooling

Buildings must meet the ASHRAE 90.1-2001 standard.

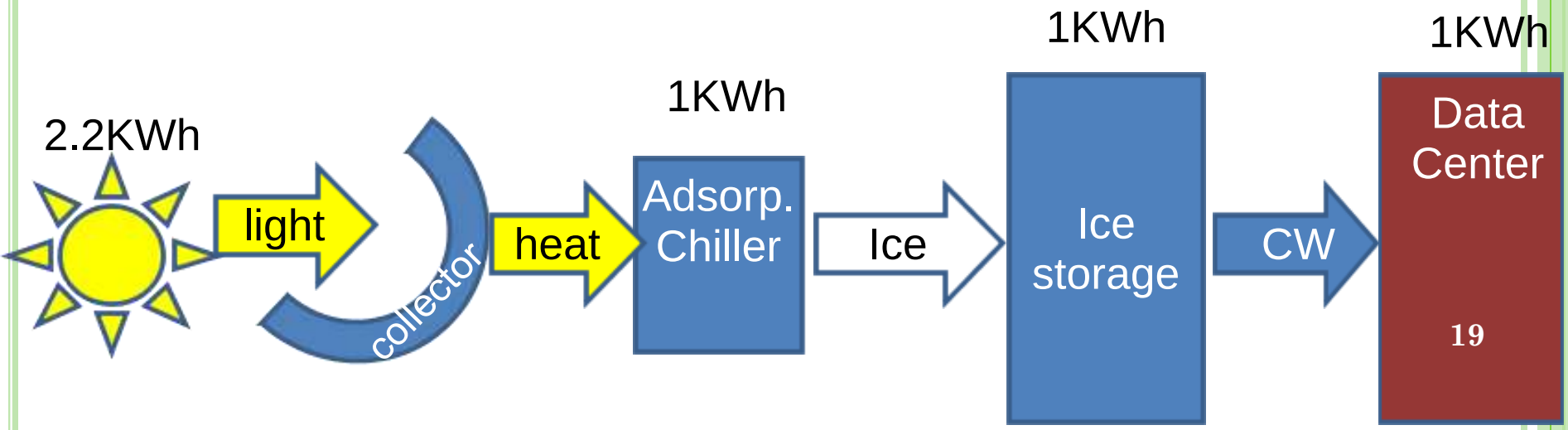
California Solar Initiative (*State rebate program*)

Offers 10 years of State rebates from PG&E, SCE and SDG&E, depending on system size and performance.

- Non residential customers> 50kW gain 1.10 - 1.80 USD per Watt
- Incentives decline in a step based system

Solar Powered Data Center Cooling

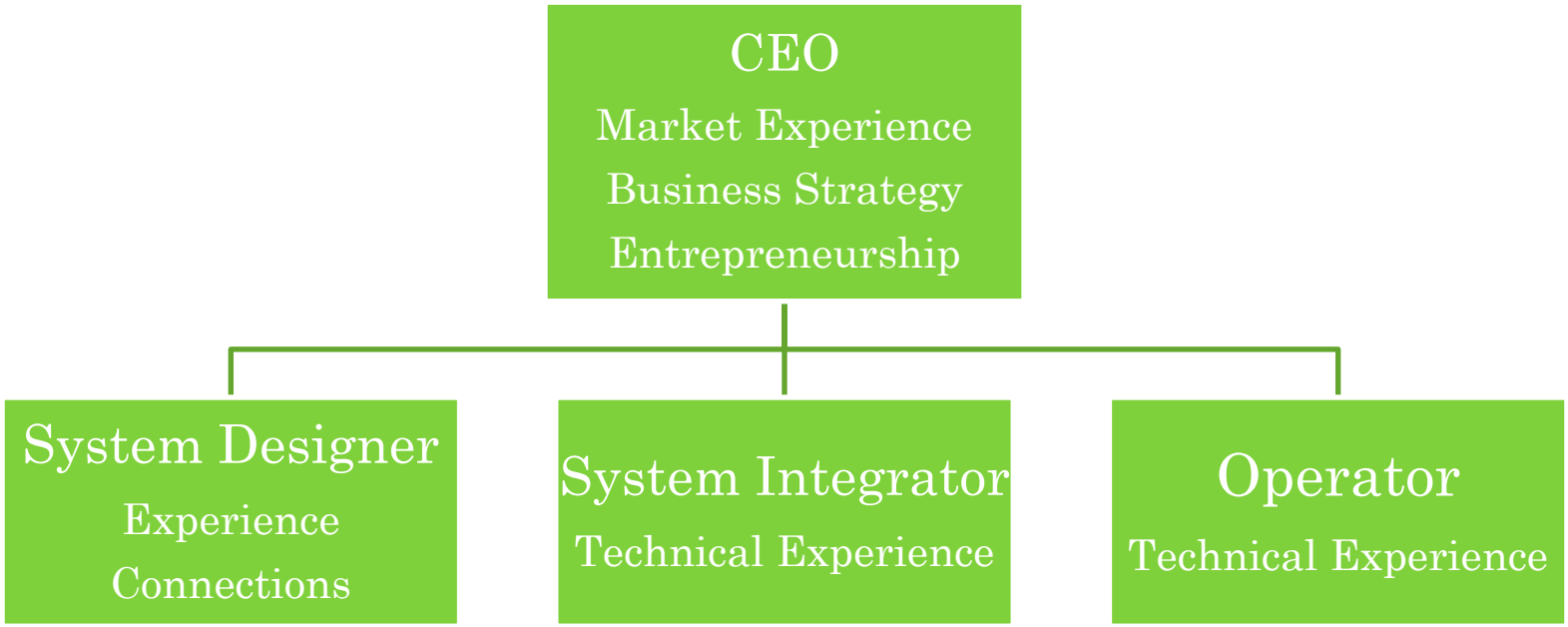
- 100KW Data Center Example
- 1100m^2 solar collectors (a redzone)
- 2400KWh cooling/sun required, 6 hour sun time
- 1800KWh storage, 20 tons of ice = 21 m^2
- IP could be developed in controls and storage management
- Well tested and documented technology
- 100% renewable cooling, providing storage + unlimited runtime*



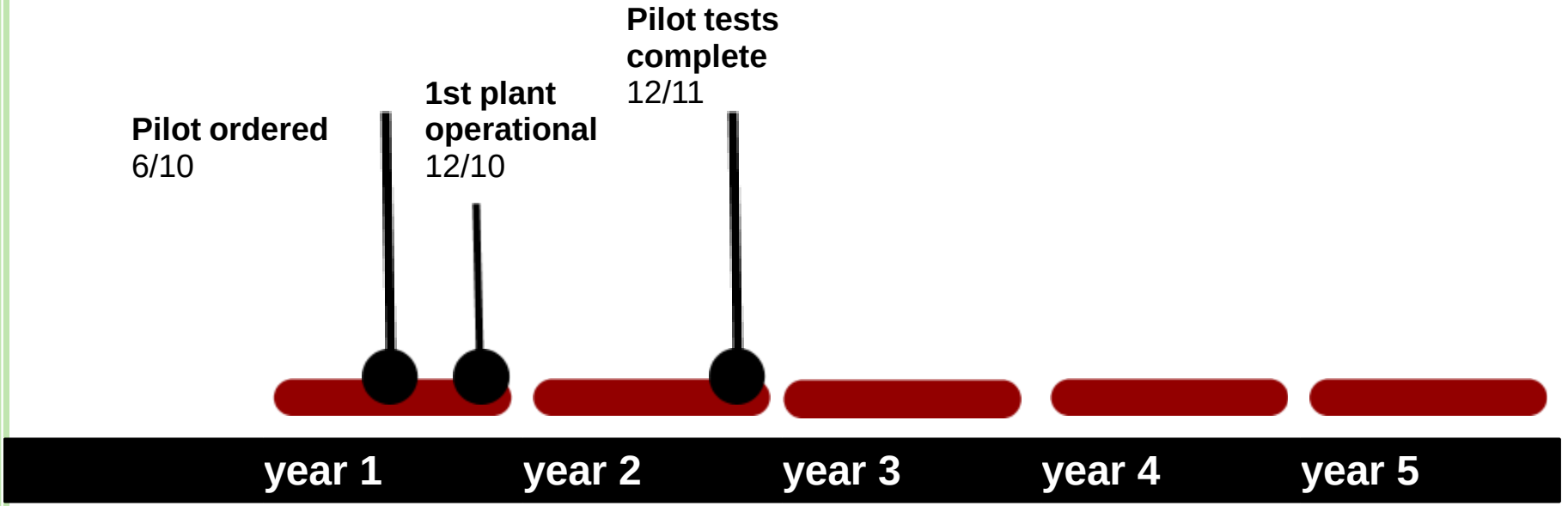
COMPETING TECHNOLOGIES

100KW Servers installed	Solar area [m2]	Grid power use [KW]	Capital Cost	Running cost	Reliability	Green image	Carbon footprint
Conventional chiller	0	200	Very low	Very high	Decent	Bad	High
PV panels conventional cooling	1420	130	Very high	Low	Decent	Very good, PV	Medium
Solar concetrated power and UPS	5670	0	Very high	Very low	Good	Good	Low
SC powered absorbtion	1420	130	High	Low	Good	Good, solar	Low

The Team That Will Push Forward



Milestones


Pilot ordered
6/10
1st plant operational
12/10
Pilot tests complete
12/11
year 1
year 2
year 3
year 4
year 5

Summary and Next Steps

- ***"We have a cooling solution, we need the right way to sell it to the consumers who want it. "***

- Next steps:
  - Hire a CEO to help design business strategy
  - Build Pilot Plant
  - Develop partnerships with key stakeholders