



# Thoughts on Server Metrics

**Christian Belady**  
**Distinguished Technologist**  
*High Performance Systems Lab*  
*Hewlett-Packard*  
*Richardson, TX*



# Agenda

- Objective
- Thoughts on some of the emerging metrics
- What Matters
- Conclusion



# Objective

- To provide some constructive thoughts on emerging efficiency metrics
  - **“The deficiencies of efficiencies”**
- • To seed critical discussion on server efficiency metrics
- To encourage us (the EPA and the industry) to think big...think holistically.

**NOTE:** HP supports and practices efficient computing and would like to work with the EPA and industry to develop a meaningful efficiency metric.

# Objective

- To provide emerging
- • To seed metrics
- To encourage think big

## Disclaimer

Outcomes are exaggerated in order to highlight the point and promote discussion

efficiency  
(industry) to

**NOTE:** HP supports and practices efficient computing and would like to work with the EPA and industry to develop a meaningful efficiency metric.

# Emerging Metrics

## Rumor has it....

there has been consideration for a metric that measures AC to DC Conversion efficiency.

**Be careful what you ask for...**

....server manufacturers can build a server with a 95% efficient ACDC supply today!



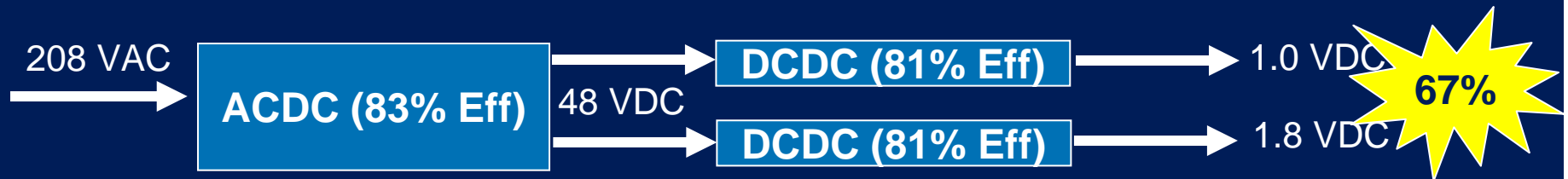
**So what's stopping us?**

# Scenario 1:

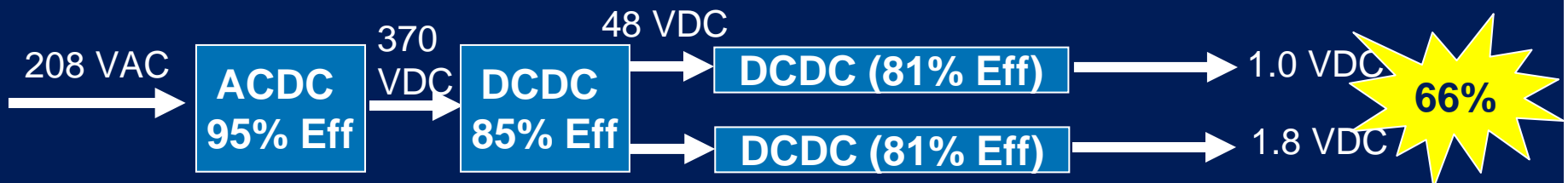
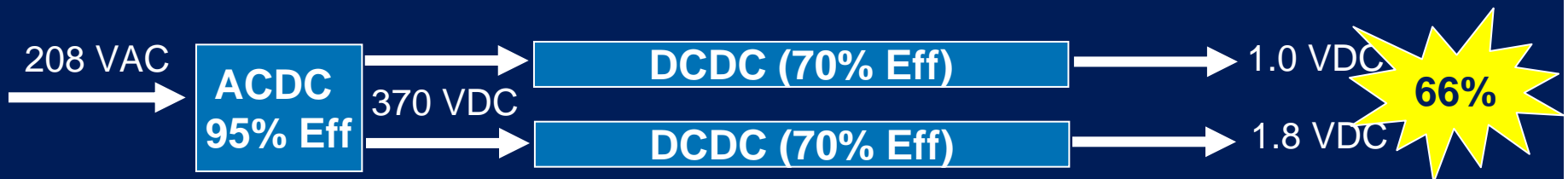
## *Playing with the Topologies*



### Typical large Server Today



### “ACDC Efficient” Topologies



# Scenario 1: *Playing with the Topologies*

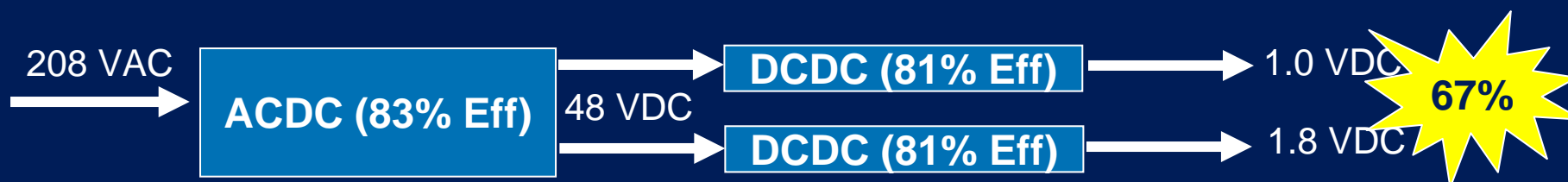
Typical large e



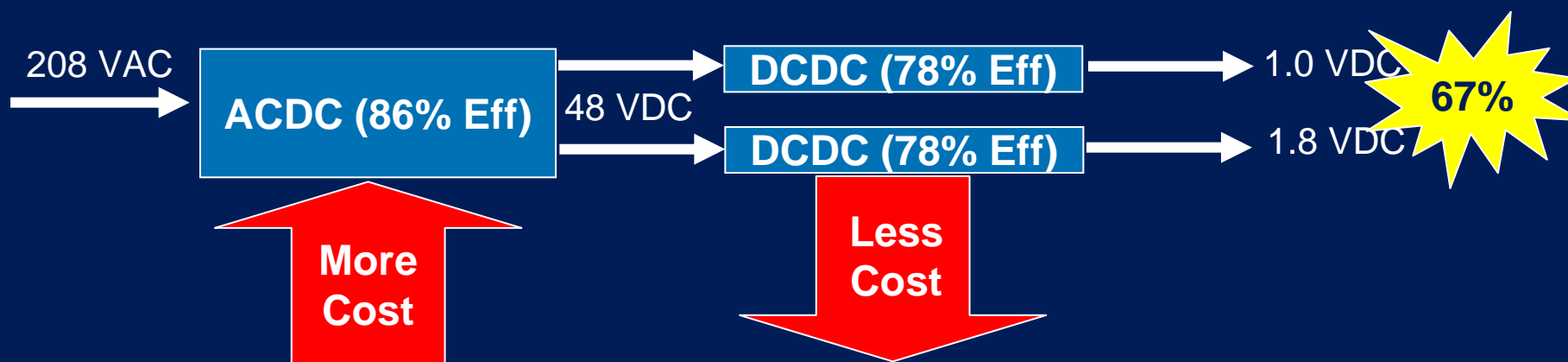
# Scenario 2:

## *Playing with the Cost*

### Typical large Server Today



### “ACDC Efficient” Topologies





# Scenario 2: *Playing with the Cost*

Typical large

208 VAC

ACDC

**END RESULT:**

1.0 VDC

67%

1.8 VDC

“ACDC

Overall System Efficiency  
Efficient” Topologies  
is equal to  
the original efficiency  
due competitive cost  
pressures

1.0 VDC

67%

1.8 VDC

208 VAC

ACDC

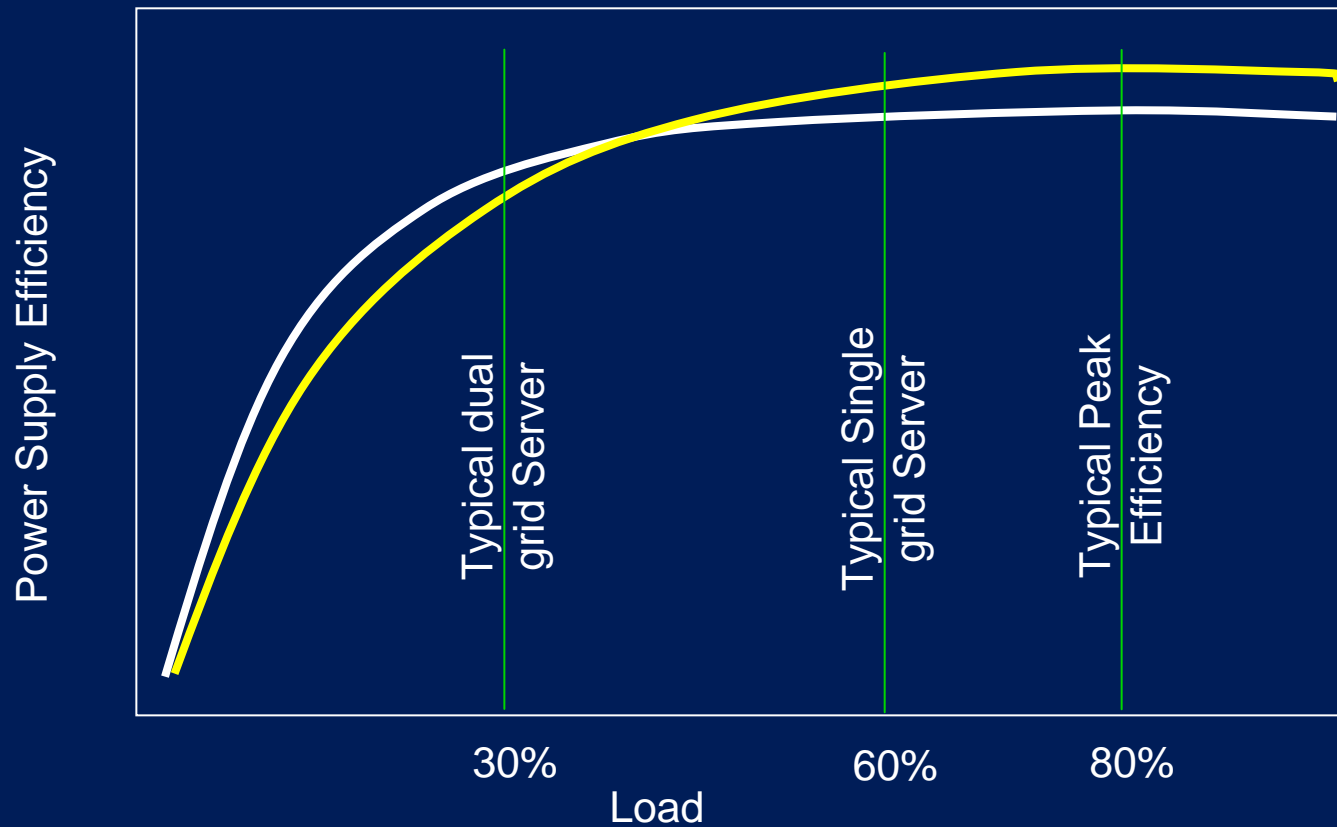
More  
Cost

# Scenario 3:

## *Playing with the Load*



### What is the appropriate load to measure...



# Scenario 3:

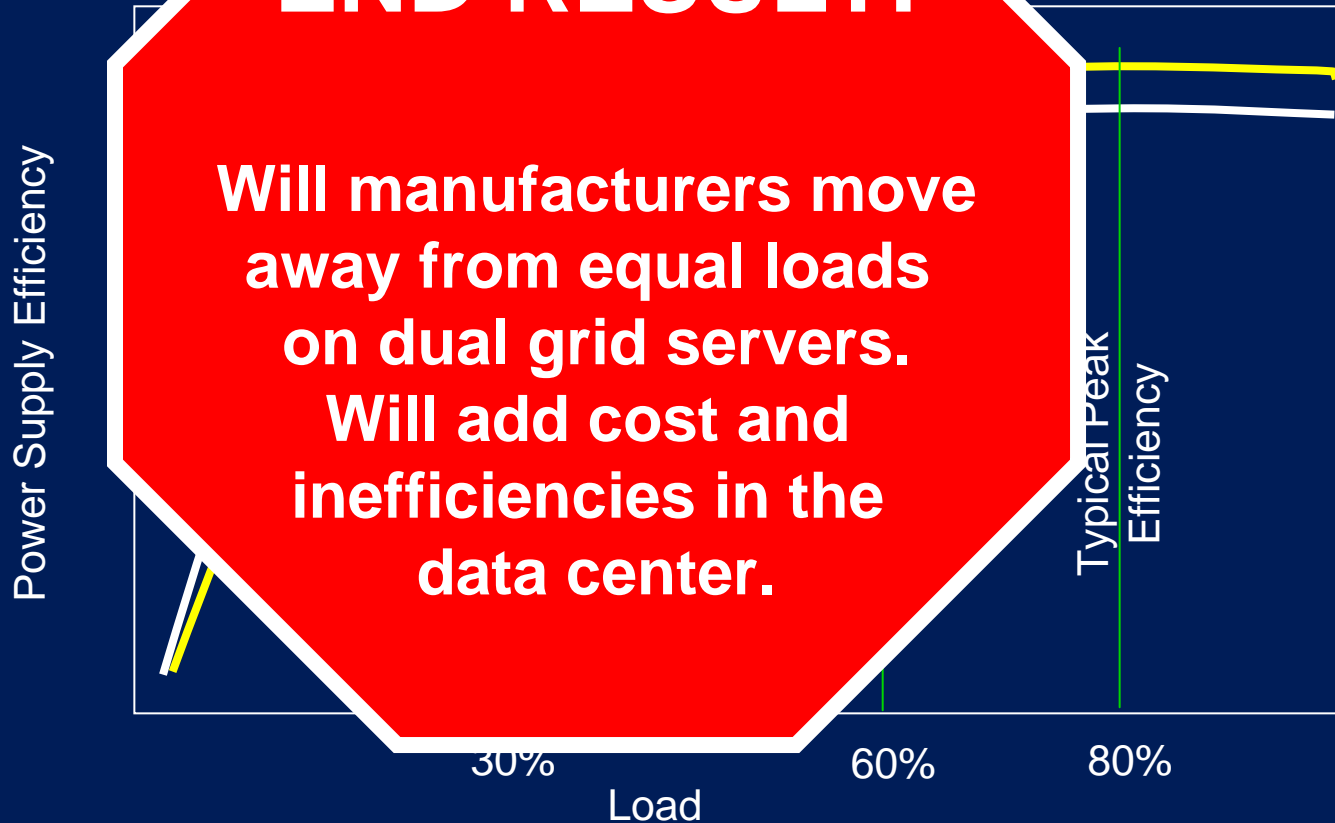
## *Playing with the Load*



What is the a... ad to measure...

**END RESULT:**

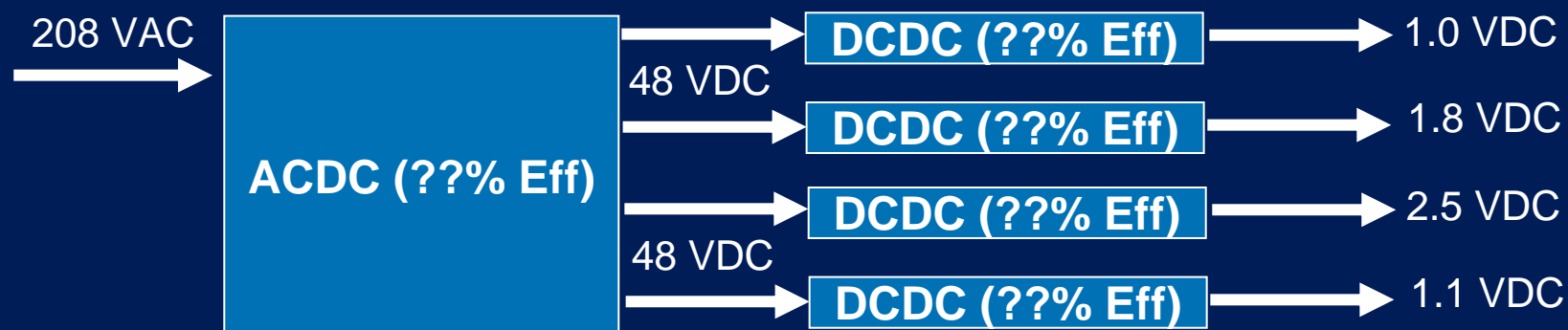
**Will manufacturers move  
away from equal loads  
on dual grid servers.  
Will add cost and  
inefficiencies in the  
data center.**



# Scenario 4:

*Looking at total power conversion*

**OK so let's measure the whole power train across all of the voltage rails...**



**...Its hard to measure the efficiencies without measuring the true loads.**

# Scenario 4:

*Looking at total power conversion*

OK so let's make the whole power train across the voltage rails...

**END RESULT:**

There are an infinite number of permutations on how the various voltage rails are loaded. Rather Arbitrary and will drive custom convertors.

208 VAC



...Its hard to measure efficiencies without measuring the true loads.

# Emerging Metrics:

*Performance per Watt*



This is a pretty good metric but the problem is what is the correct metric for performance.



...One performance metric is not enough!

# Emerging Metrics: *Performance per Watt*



This is a pretty good metric but the problem is it is not the correct metric for performance

**END RESULT:**

Linpack N x N

Manufacturers only publish metrics that are favorable to them. Thus, there is not consistent comparison

SPECweb® 99

PC-C®

PC-H®

int®\_base

SPEC

...One performance metric is not enough!

# Emerging Metrics:

**SWaP** - *Performance per Space per Watt*



Has the same problem as the Perf/Watt but with the added complexity of space which may mask the true energy efficiency of the server.

## THE ANALOGY...

Which is more efficient to haul goods...

A tractor trailer or an automobile...

Tractor Trailer...Even though its SWaP is less...Depends on type of workload

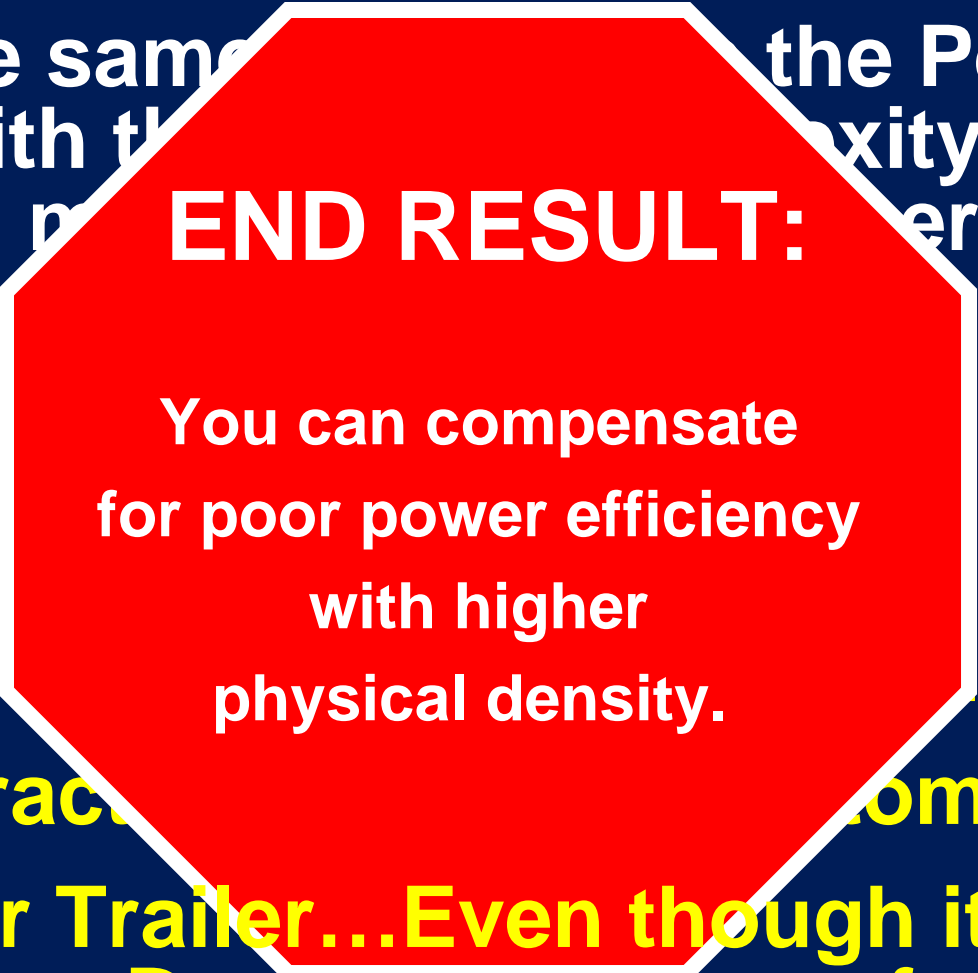


# Emerging Metrics:

*SWaP - Performance per Space per Watt*



Has the same Perf/Watt but with the density of space which means energy efficiency



**END RESULT:**

You can compensate for poor power efficiency with higher physical density.

Which is good for goods...

A tractor trailer... automobile...

Tractor Trailer... Even though its SWaP is less... Depends on type of workload

# What Truly Matters

Maximize the Customers Data Center Output for the minimum total cost...in other words:

$$\left[ \frac{\textit{Workload or Throughput}}{\textit{Total Cost of Ownership}} \right]$$

where workload is the customers applications and energy used is a component of TCO.

**We must make sure that power efficiency metrics help increase this ratio!**



# What Truly Matters

Maximize the Customers Driven Output for the minimum total cost of ownership:

**REALITY!!!**  
CUSTOMERS ARE ALREADY DRIVING US TO IMPROVE TCO & EFFICIENCY!

We must find the solution that power efficiency metrics help increase this ratio!



# What Truly Matters

The big energy gains are realized with a “holistic” approach from the “chip to the data center” ....

**The macro view  
versus  
the micro view**

**GET MORE FOR YOUR RESOURCES**

# What Truly Matters

The big challenge is to increase utilization such as with a “holistic” approach from the “chip to the data center”

**This is why....**

- Virtualization/consolidation
- Server/Rack Power Management

**Result:** typically greater than 20% improvement in power used.  
More Work/TCO.

**GET MORE WORK FROM YOUR RESOURCES**

# What Truly Matters

The big picture is a “holistic” approach from the chip to the data center.

**This is why....**

Helping the Customer to optimize their data center operation such as:

- Data Center Services (best practices)
- Smart Cooling Service (Modeling)

**Result:** Can save as much as 25% of the power consumed by a data center. More Work/TCO.

**GET MORE FROM YOUR RESOURCES**

# Conclusion

**Let's make sure that whatever metrics we come up with...**

1. truly encourages efficient computing and less power usage
2. promotes the right behaviors
3. drives the TCO for the customer down

**For Success,  
At a minimum, these items must be met!**

# Conclusion

Let's make sure that whatever metrics we come up with

1. truly power
2. pro
3. drive

It's all about  
Optimizing the  
Data Center  
"Ecosystem"

ESS

At a minimum, these items must be met!





**i n v e n t**