Enabling Envionmental Sustainability Through Cloud Computing

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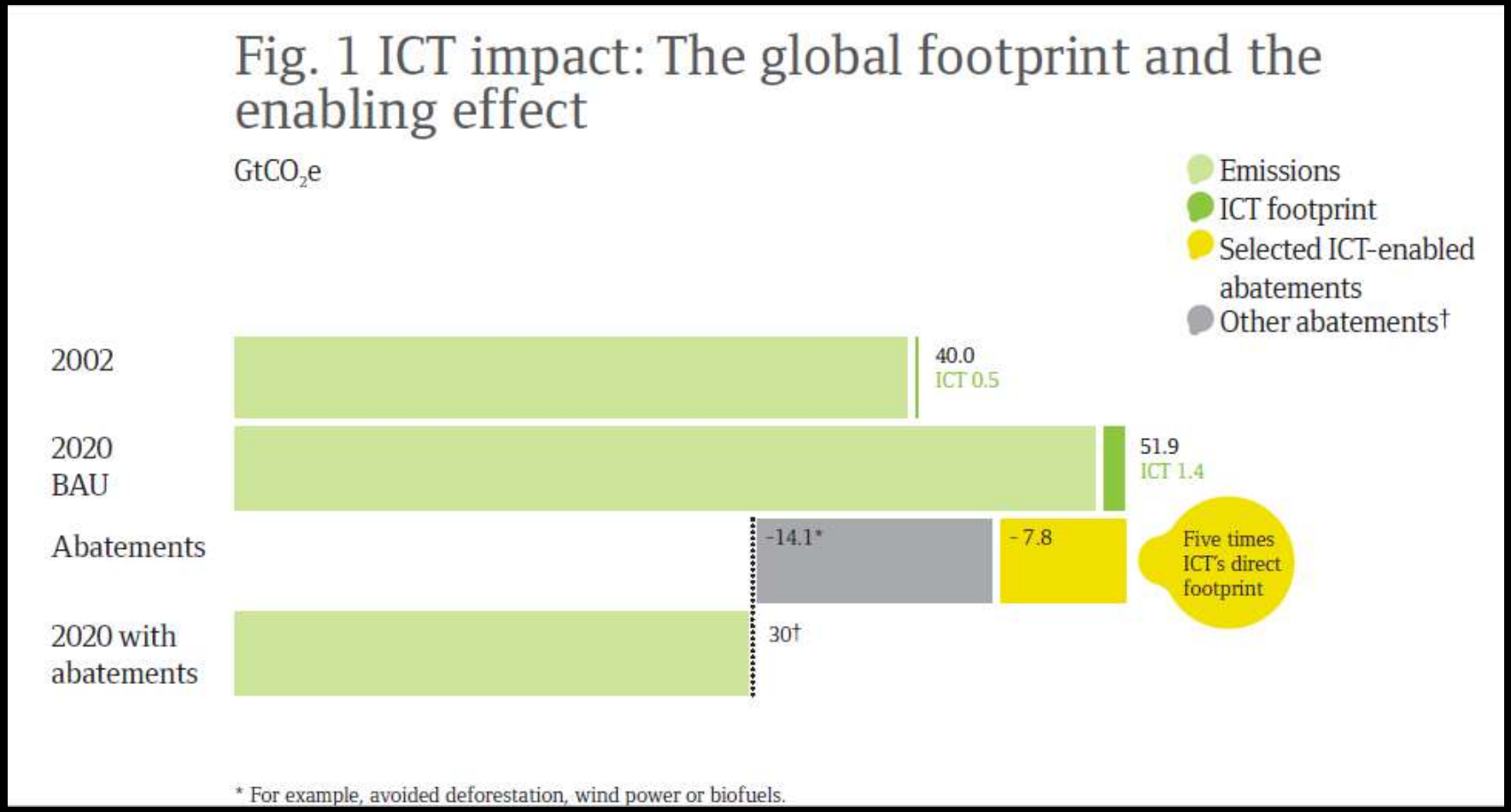
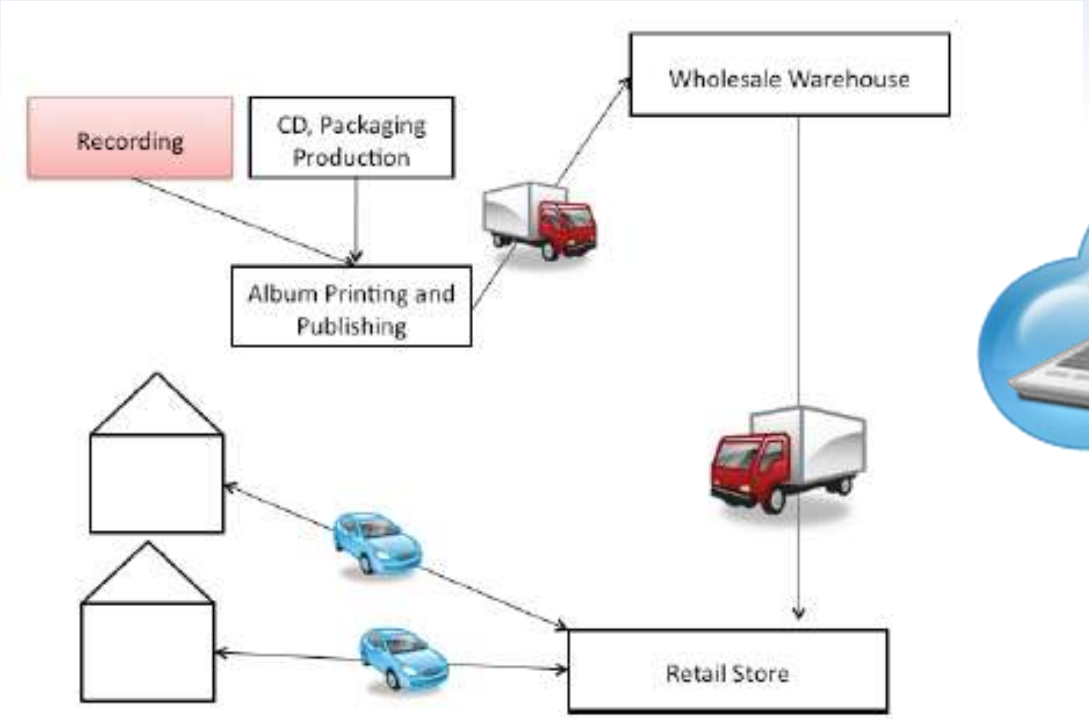
SMART 2020 REPORT

40% of CO2 will removed by 2020 it existing technology is used today!



Cloud computing case study: music delivery

Carnegie Mellon University and Stanford University, found that buying an album digitally reduces carbon dioxide emissions by 40 to 80 percent relative to a best-case scenario for purchasing a CD.



Reducing e-waste

Result of decades-old practice of overbuilding computer systems.

Cloud offers what you need when you need it.

Microsoft Scope 3: 1/3 of CO2

- Microsoft Travel estimates that employees avoided flying more than 100million miles in the past fiscal year, saving 17,000 mtCO2. Microsoft has a commitment of reducing our own carbon footprint by 30% by 2012,

- Microsoft UK reduced air travel by 21% since 2007 verified by the Carbon Trust Standard in April 2010. We enabled this shift largely by using technology to replace and supplement travel and a flexible work policy which 90% of our staff take advantage of unified communications, web and videoconferencing

JOHNS HOPKINS UNIVERSITY

Imperial College London

SELECT A COUNTRY

FR DE SE UK ALL

SELECT A TYPE OF ENTERPRISE

SMALL MEDIUM LARGE ALL

SELECT THE PERCENTAGE OF ENTERPRISES ADOPTING CLOUD COMPUTING TECHNOLOGY

SLIDE YOUR FINGER ON THE WHITE BAR

0% 80%

IF **80%** OF **ALL** ENTERPRISES WITHIN **ALL COUNTRIES** PROVISIONED THEIR EMPLOYEES WITH EMAIL, CUSTOMER RELATIONSHIP MANAGEMENT AND GROUPWARE SOLUTIONS THROUGH CLOUD COMPUTING...

THEN **1.518.214** TONNES OF CO2 COULD BE SAVED.

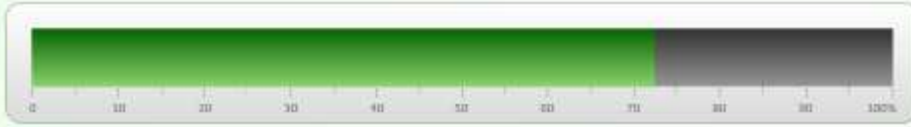
ANNUAL CARBON EMISSIONS
ON-PREMISE COMPUTING

2.098.240 TONNES

FOR 80% ADOPTION IN CLOUD COMPUTING

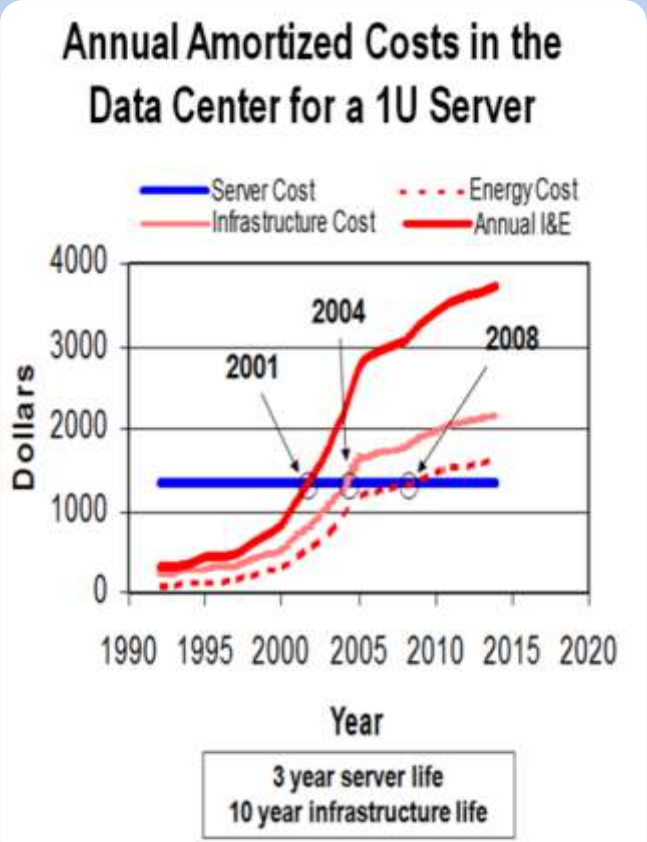
1.518.214 TONNES

ANNUAL CARBON EMISSIONS SAVED WITH CLOUD COMPUTING

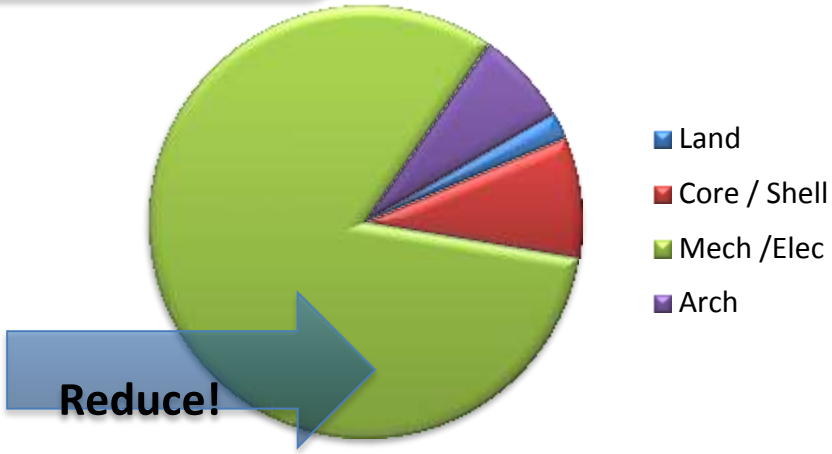


→ **593.052** **OFF THE ROAD**

Unsustainable Business Model



Where the costs are:
>80% scale with power
<10% scale with space



CAT

Traditional Datacenter Builds

Monolithic design and construction effort	Typical large datacenter = 11 football fields
Huge $$$	Typical construction costs = $10M to $15M per Megawatt
Long lead time	18 to 24 months from design to online

Chicago Datacenter

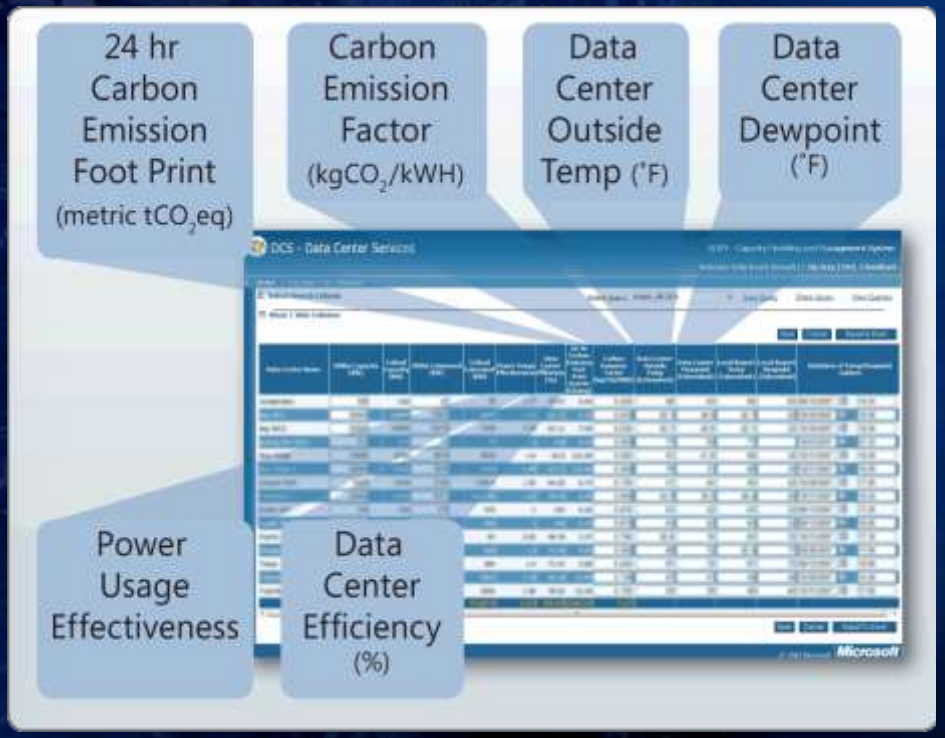
- $500M+ investment
- 700,000+ square feet
- 60 MW Total Critical Power
- 3400 tons of steel
- 190 miles of conduit
- 2400 tons of copper
- 26,000 cubic yards of concrete
- 7.5 miles of chilled water piping

SCRY: Monitoring and Measuring…
the Foundation of Sustainability

Microsoft has been tracking power, carbon and water usage for years

Microsoft's SCRY management tool

- Used for continuous improvement
- Constantly evolving
- Used for billing and chargebacks
- Others are duplicating



Power Usage Effectiveness (PUE)
Carbon Usage Effectiveness (CUE)
Water Usage Effectiveness (WUE)

Microsoft's Sustainability Evolution

1989-2005

Generation 1

Colocation

Server

Capacity
~2 PUE
20 year Technology

2007

Generation 2

Density

Rack

Density and Deployment
1.4 – 1.6 PUE
Minimized Resource Impact

2008

Generation 3

Containers

Containers

Scalability and Sustainability
1.2-1.5 PUE
Air & Water Economization
Differentiated SLAs

2010+

Generation 4

Modular

ITPAC (Pre-Assembled Components)

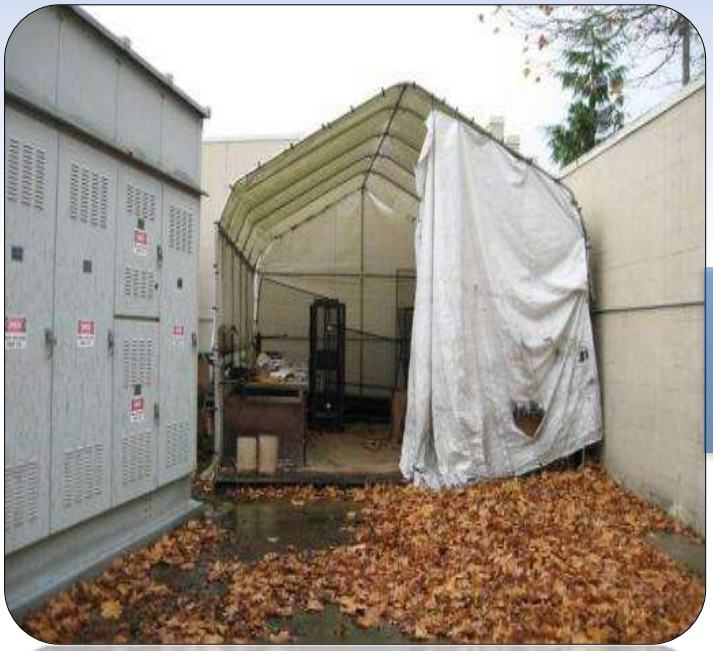
Reduced Carbon, Rightsized
1.05-1.20 PUE
Faster Time to Market

The biggest opportunities are now emerging…

Driving to a Simplified Datacenter

From Science Project

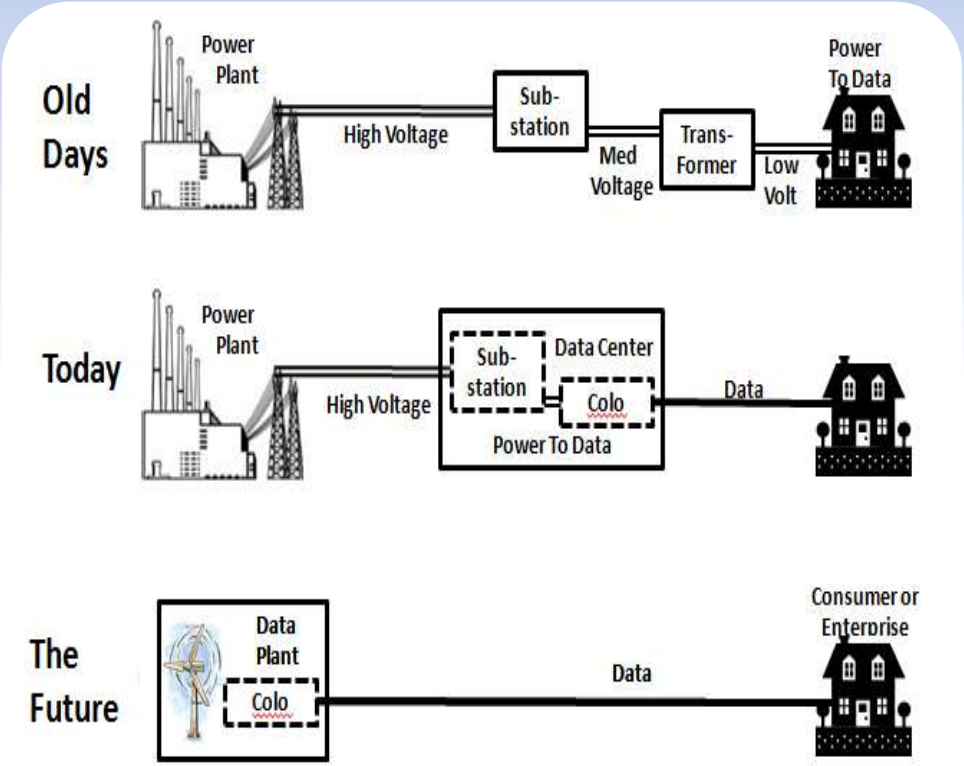
To Reality



ITPACs : built recycled materials. PUE 1.05 – 1.20. Garden hose of water

Opportunities When We Look at Data Differently

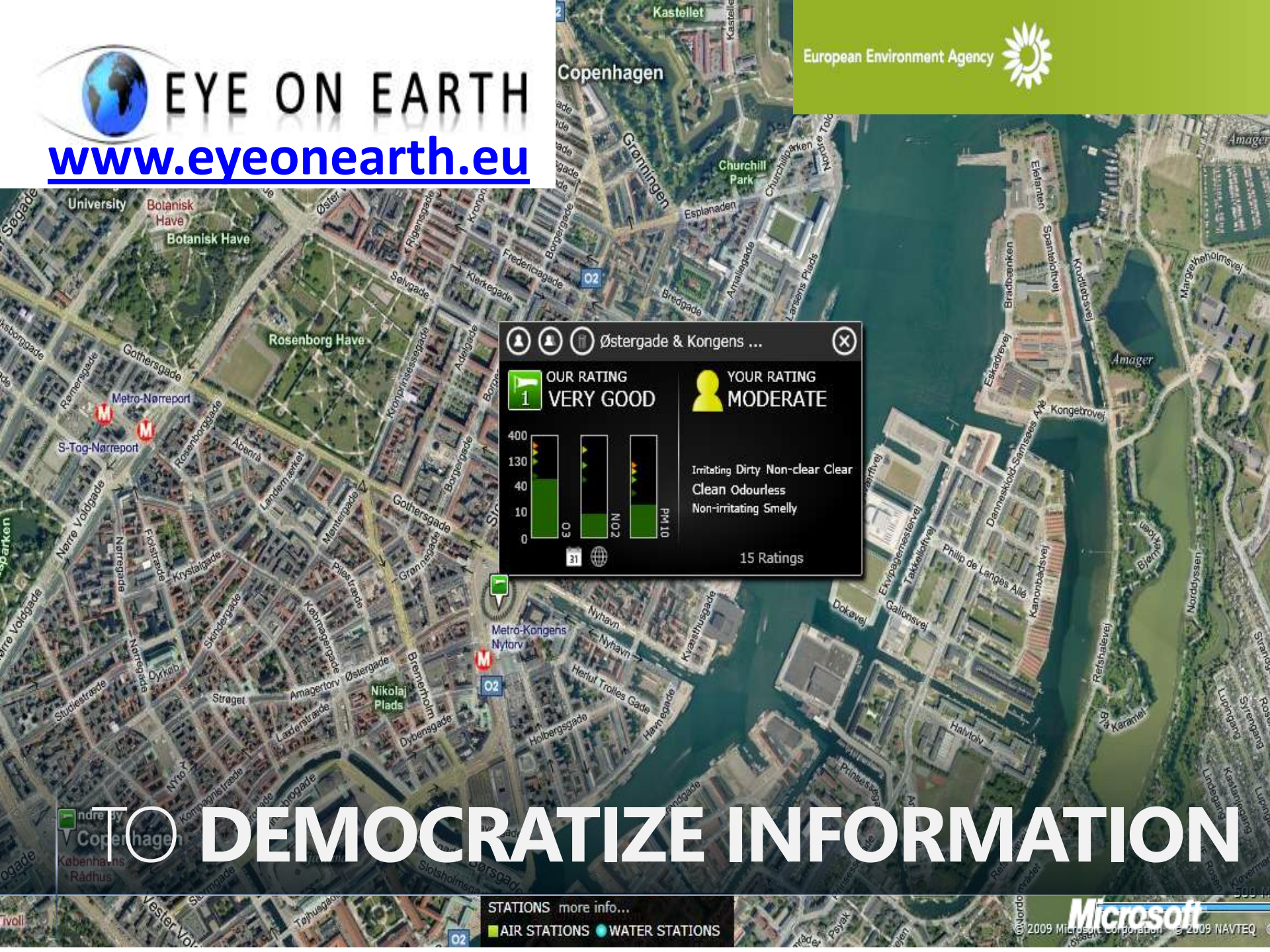
- **Data is** the next form of **energy**…
- **Distribute data** instead of electricity…
- **Store data** instead of electricity



EYE ON EARTH

www.eyeonearth.eu

European Environment Agency



TO DEMOCRATIZE INFORMATION

soak
Farm Overview
Morning Star
Action Toolbox
New Sector
View Reports
System Options
INVENTING THE FUTURE

Microsoft's Best Practices for Sustainability

Best Practices for Efficiency

(Published February 2008)

1. Engineer the datacenter
2. Optimize holistically
3. Optimize provisioning
4. Monitor & control real time
5. Drive Efficiency Culture
6. Measure PUE
7. Control Temp & Airflow
8. Eliminate the mixing
9. Use economizers
10. Share with Industry

Top 10 Business Practices

(Published April 2009)

1. Drive goals with incentives
2. Focus on resource utilization
3. Use virtualization
4. Quality with compliance
5. Embrace change management
6. Understand application workloads
7. Rightsize your servers
8. Evaluate and test servers
9. Limit number of SKUs
10. Use competitive bids

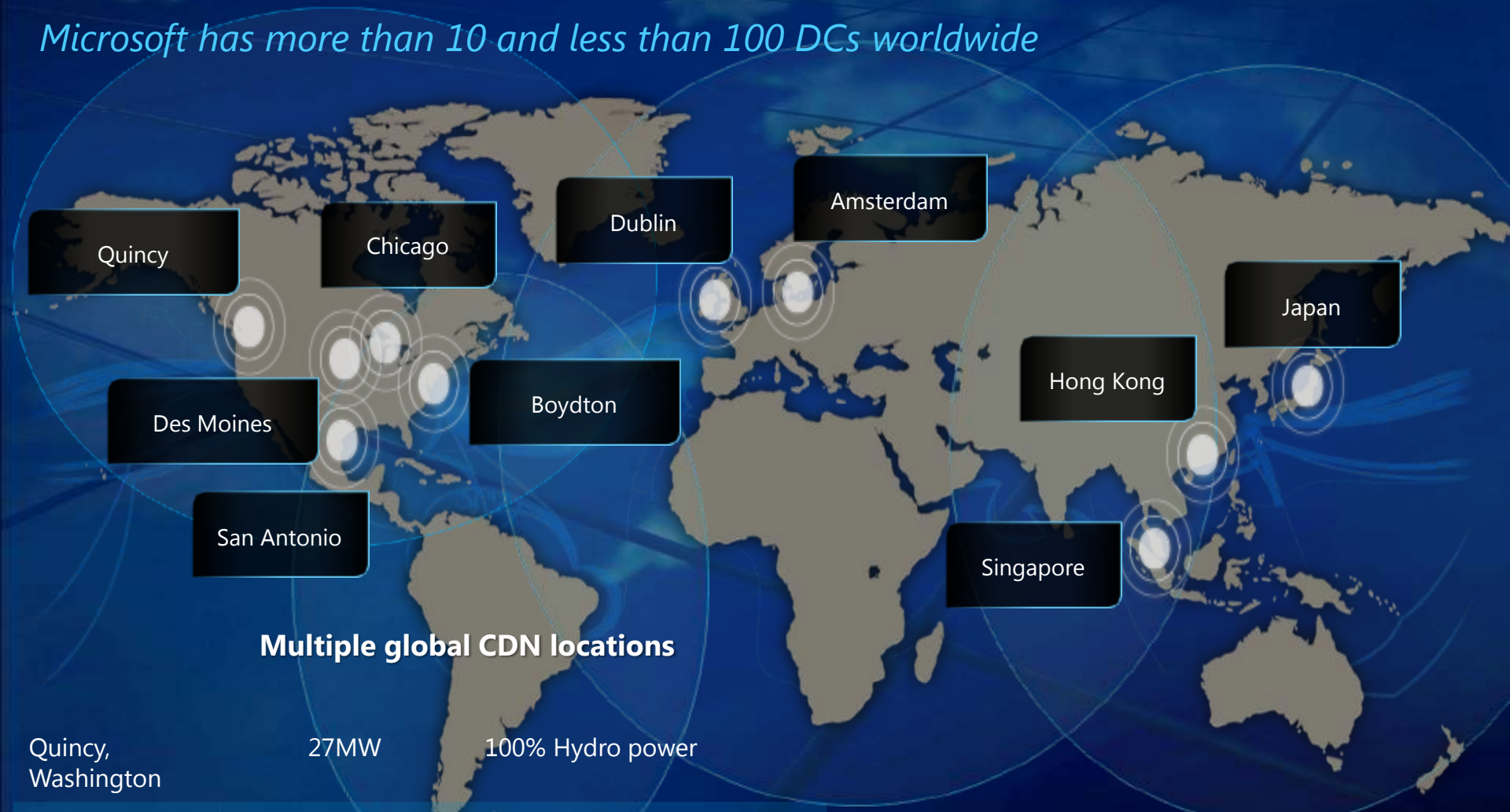
Summary of Resources

- Global Foundation Services
  www.globalfoundationservices.com

- Microsoft's Datacenter Team Blog
  http://blogs.technet.com/msdatacenters

Microsoft Datacenter Scale

Microsoft has more than 10 and less than 100 DCs worldwide



Multiple global CDN locations

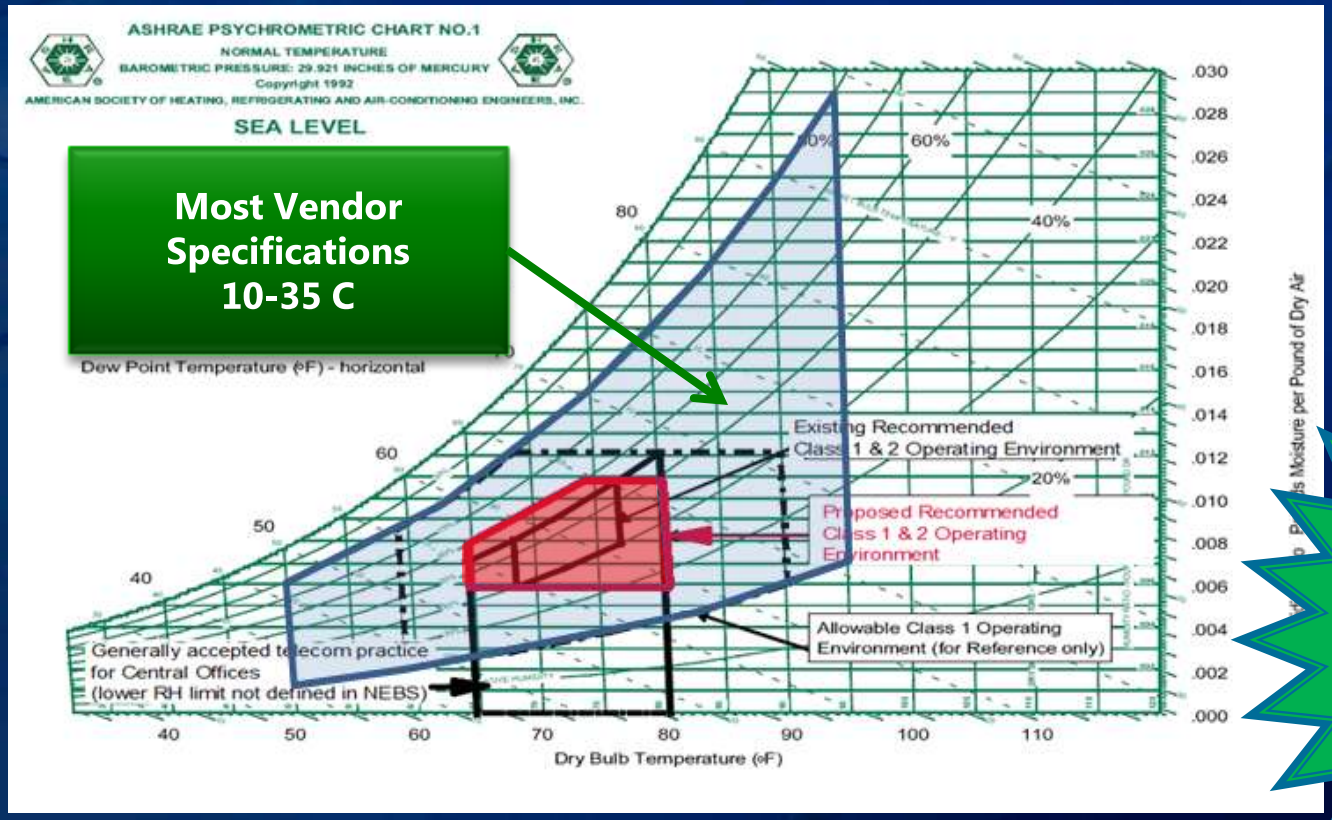
Quincy, Washington	27MW	100% Hydro power
San Antonio, Texas	27MW	Recycled water for cooling
Chicago, Illinois	Up to 60MW	Water side economization, Containers
Dublin, Ireland	Up to 50MW	Outside air cooling, PODs

"Datacenters have become as vital to the functioning of society as power stations."

The Economist

Elevated Server Inlet Temperatures

- ASHRAE Recommended: 18 – 26C / 40 – 60% RH
- Vendor Allowable: 10 – 35C / 20 – 80% RH



Microsoft is targeting operational ranges to be consistent with vendor spec. This would enable Chiller-less datacenters in our RFPs

Standardization and Commoditization

Key for driving cost down and efficiency up!

Legacy Datacenter

Owner

Chilled Water → Conditioned Air

Power → Conditioned Power

ASHRAE Guidelines

Manufacturer

Server or Rack

Commoditized Datacenter

Owner

Fresh Air

Power

Interface Guidelines

Manufacturer

Conditioned Air

Conditioned Power

Server or Rack