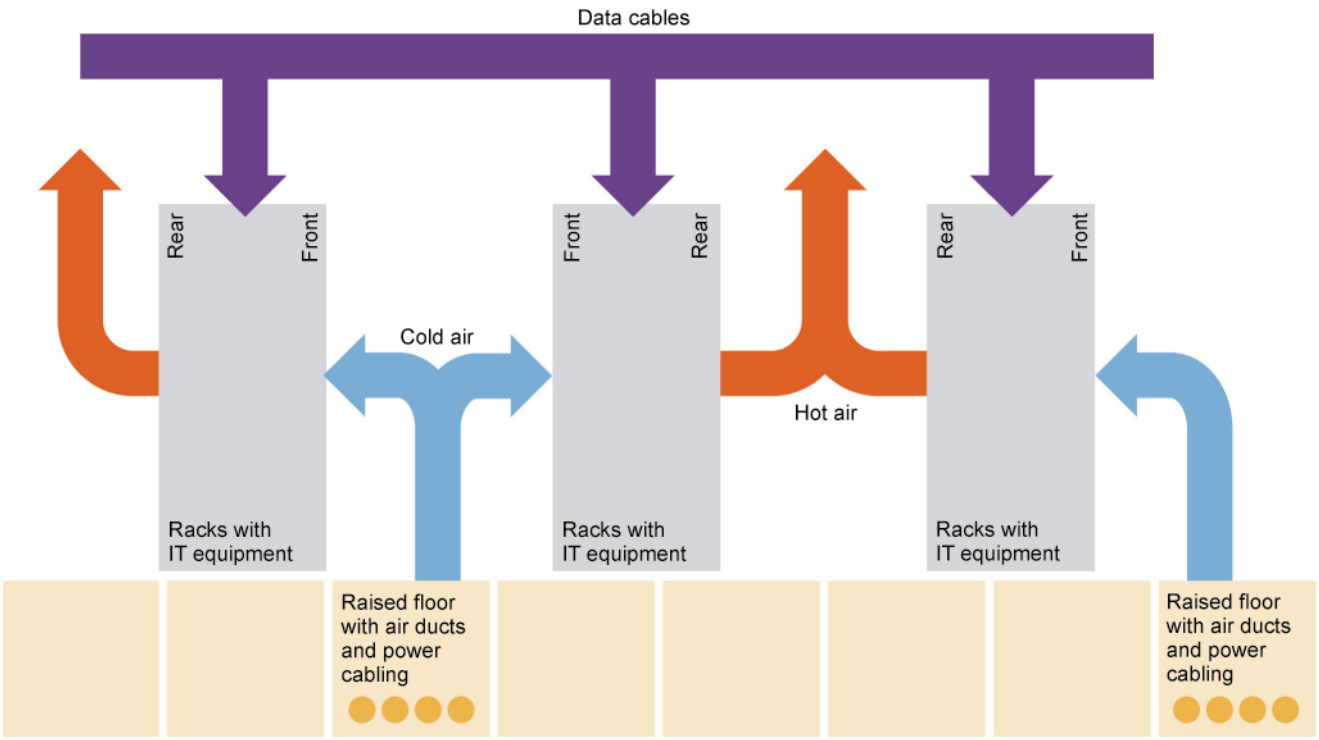
Green Sustainable Data Centres

Introductory Presentation



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Sustainability for the Data Centre

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Agenda

- Sustainability
- The IT lifecycle
- Measurement
- The future - first step, study our course!

Sustainability

A Wikipedia definition

- From the Latin *sustinere* (*tenere*, to hold; *sus*, up).
- Since the 1980s *sustainability* has been used more in the sense of human sustainability on planet Earth and this has resulted in the most widely quoted definition of sustainability as a part of the concept *sustainable development*, that of the Brundtland Commission of the United Nations on March 20, 1987:

Sustainable development:

Brundtland 1987

Sustainable development (SD) is a pattern of **economic growth** in which resource use aims to meet **human needs** while preserving the **environment** so that these needs can be met not only in the present, but also for generations to come.

-> PPP: People, Planet, Profit

by CSR: Corporate Social Responsability

Sustainability, Efficiency, Saving

- Sustainability
  - Able to be maintained
- Efficiency
  - Maximum productivity with minimum wasted effort or expense
- Saving
  - Reducing energy use

IT and sustainability

- Addressing the IT lifecycle
  - Manufacture, use, disposal
  - "Greening *of* IT"
- Using IT to improve the sustainability of other human activities
  - Greening *by* IT

Why is sustainability important?

In alphabetical order:

- Compliance with legislation
  - Carbon reduction commitment (UK)
  - Compulsory carbon trading (UK)
- Corporate social responsibility
  - Consumer (and employee) pressure
- Cost saving
  - energy = money
  - Energy saving = money saving

Why do anything..?

- Climate Change => warming, disasters (fires and floods), loss of biodiversity, less to go round more
- Population growth, 2000 to 2030 of 2.2 billion, of which 2.0 billion likely to be located in cities (World Urbanization Prospects: The 2001 Revision)
- Rising consumption, 5 billion people consume 20% and 1 billion consume 80% *(Ericsson)*
- Resource depletion, 2.5 planets for all to have US/EU living standards

  => rising energy, food and resource costs and the recession

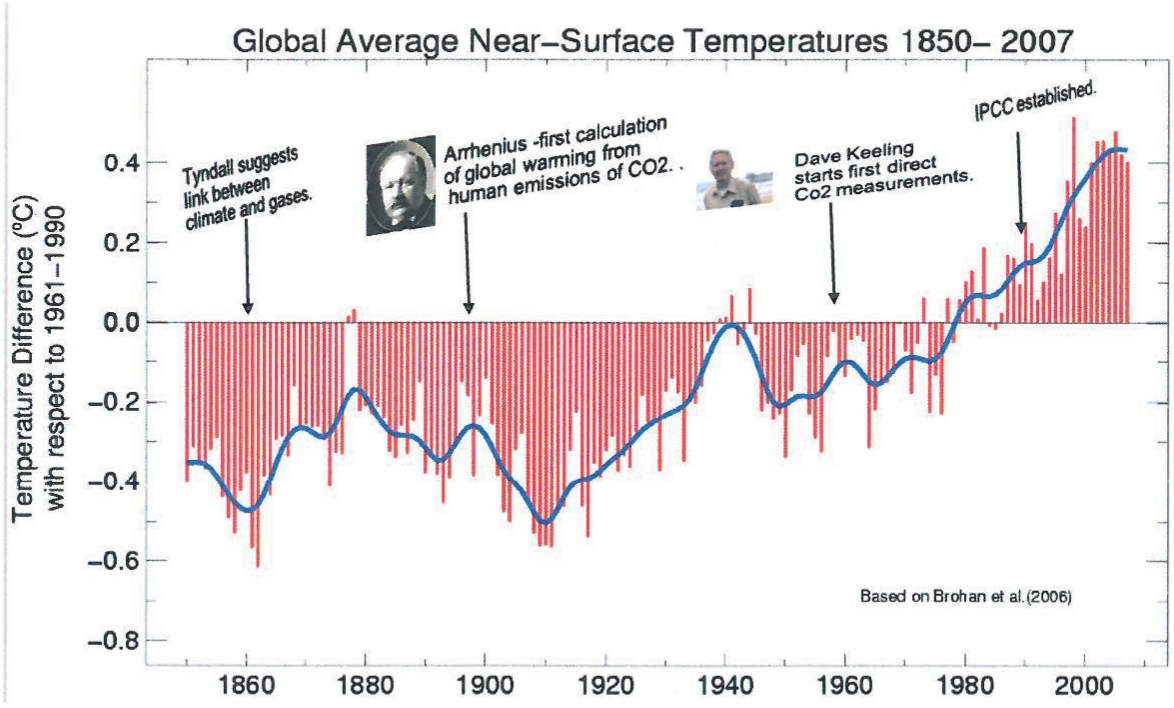
  => "we have to do more with less" (*Buckminster Fuller*)

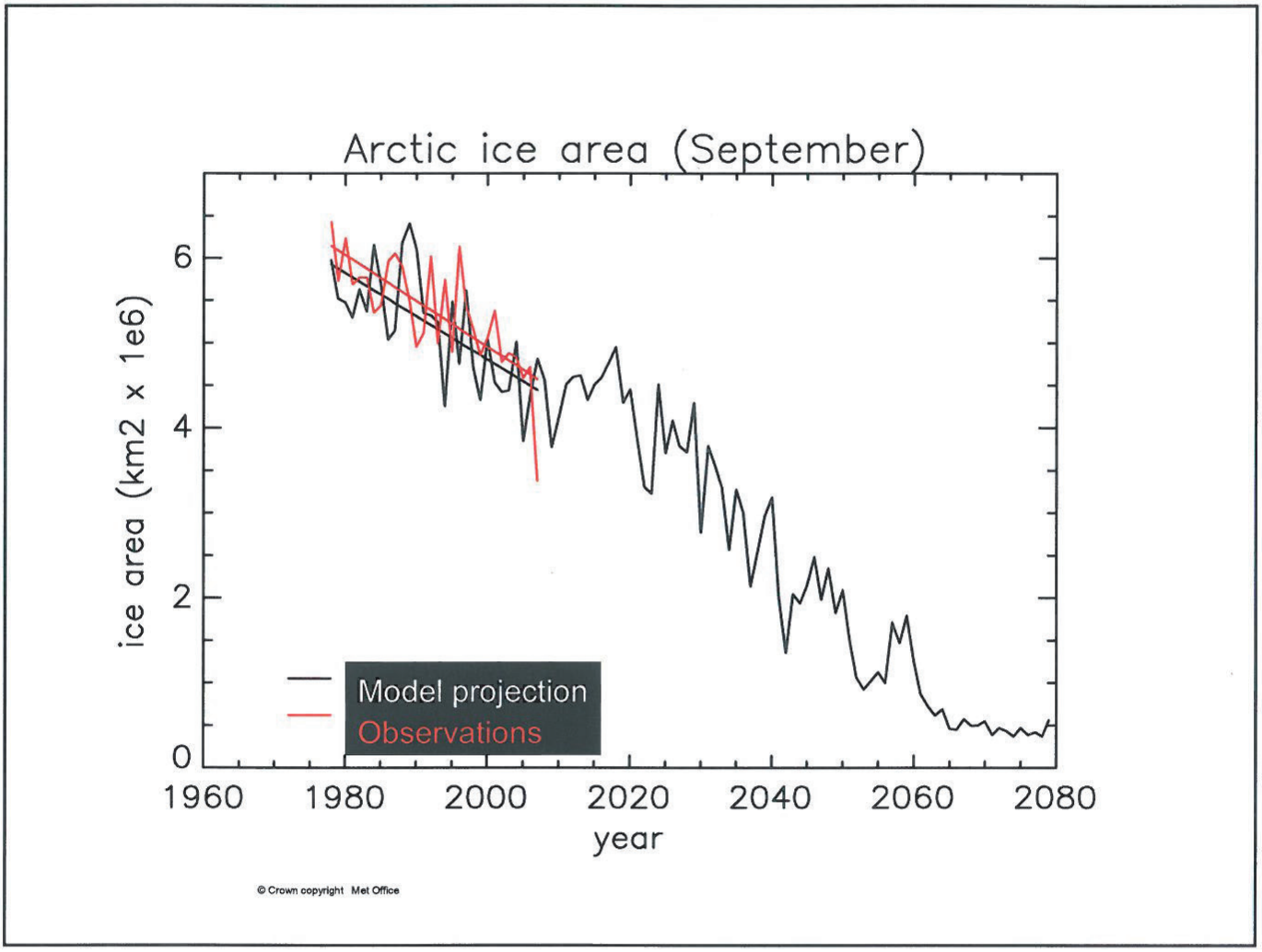
  > energy

  > resources

  > emissions

Reality of Climate Change




Arctic ice area (September)
ice area (km2 x 1e6)
0
2
4
6
1960
1980
2000
2020
2040
2060
2080
year
Model projection
Observations
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Some perspectives on IT...

Globally

- ICT Manufacture, use and disposal accounts for 2%+ of global CO2 emissions being equal to the aviation industry
- Man-made CO2 emissions add up to around 49 billion tonnes pa 1 billion + tonnes from ICT.
- Data storage capacity growing by ~ 40% annually and in 2011 passed the zettabyte mark for stored data
- Worldwide data centres + comms predicted to consume ~ 2000bn kW-h by 2020

- In UK
  - 10 million office PCs, nearly 50% of adult population use PCs at work expected to grow to 70% by 2020
  - IT consumes 15% of office power, rising to 30% by 2020

References : (Berkeley National Labs + Global Action Plan + IPCC + Energy Saving trust + Carbon Trust)

Servers

- A medium-sized server has roughly the same annual carbon footprint as an SUV vehicle using 18 litres of fuel per 100 Km
- The power required for a rack of high density server blades can be 10-15 times greater than a traditional server
  - And we “need” to cool it with air con units consuming perhaps half as much power again

An Inefficient truth – GAP (Dec 2007)

The cloud

- A paradigm shift in the computing landscape for businesses and consumers
  Computing is now a utility
- In addition to the 2.4 Billion humans, there are 100's millions of computer devices generating data and information every day
  - "The Internet of Things"
- By 2020, it is anticipated that 50 Billion (non-human) devices will be communicating on the internet

Interesting Facts about the Cloud

- Google processes more than 24 petabytes per day , a volume that is a thousand times the quantity of all printed material in the U.S Library of Congress
- The 800 million users of YouTube upload over 1 hour of video per second.
- Facebook members “Click” or comment 3 billion times per day
- The storage capacity needed by the average Fortune 1000 company doubles every 10 months

… and the scale of the problem

- Typically for every $2 spent on server power, $1 is spent on cooling it. In 2005, 1.5% of the U.S electricity was consumed by server farms and data centres.
- In 2005, $26.1 billion was spent powering and cooling the global installed server base.
- $41.4 Billion in global revenue (28% of the total data centre market) will be spent on the Green agenda in data centres over the next 5 years.
- Data centre energy consumption worldwide has doubled since 2000 and is expected to double by 2020.
- The EU data centre community will constitute 15-20% of Europe's total CO2 emissions.

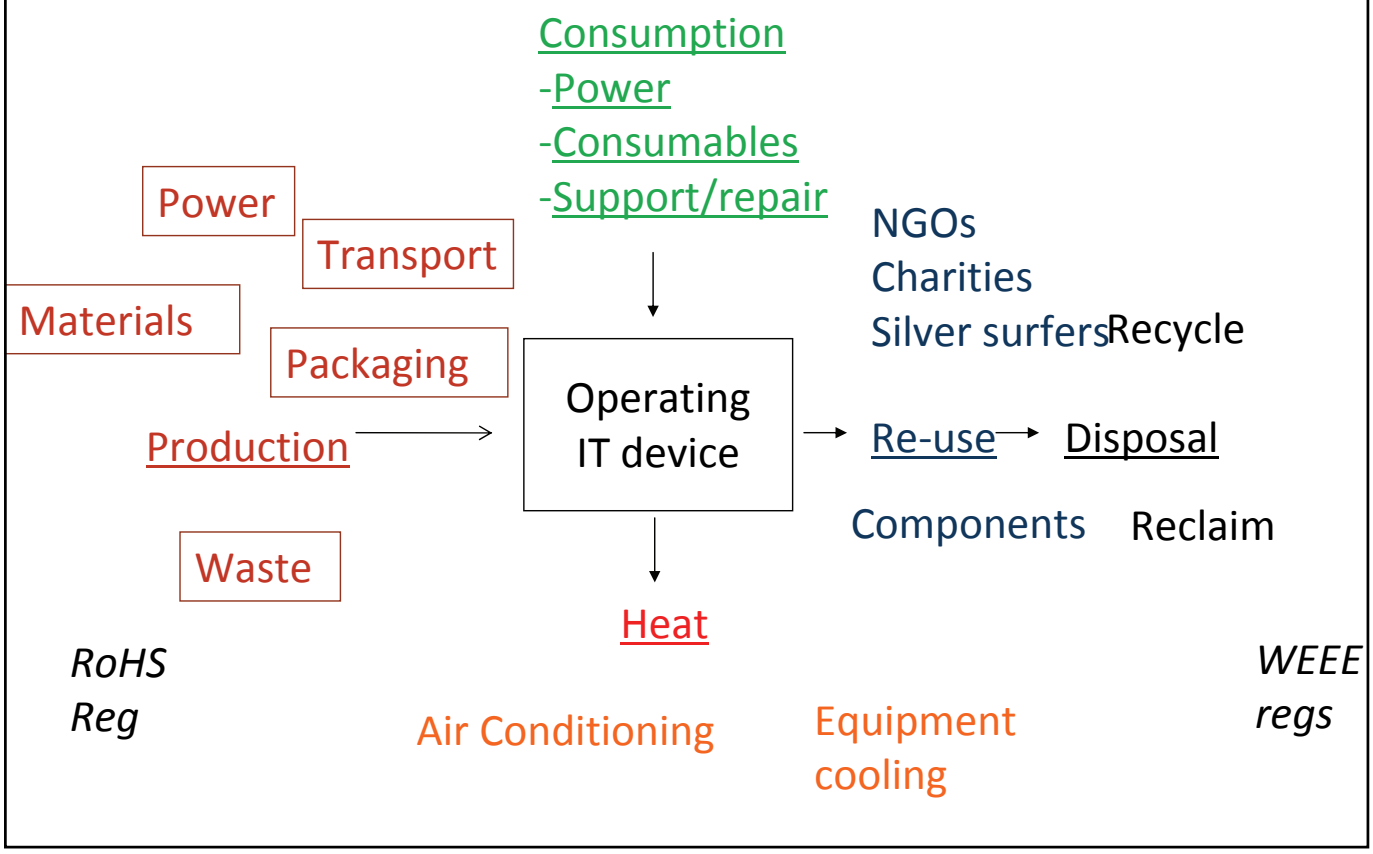
Moore’s law meets Jevons's Paradox

- Moore’s law
  - Processing power doubles every 18 months
- Jevons's Paradox
  - Increasing the efficiency of a resource increases the rate at which that resource is used
- As data processing and storage becomes more easily available, we process and store more data
  - We do not handle the same volume of data more efficiently

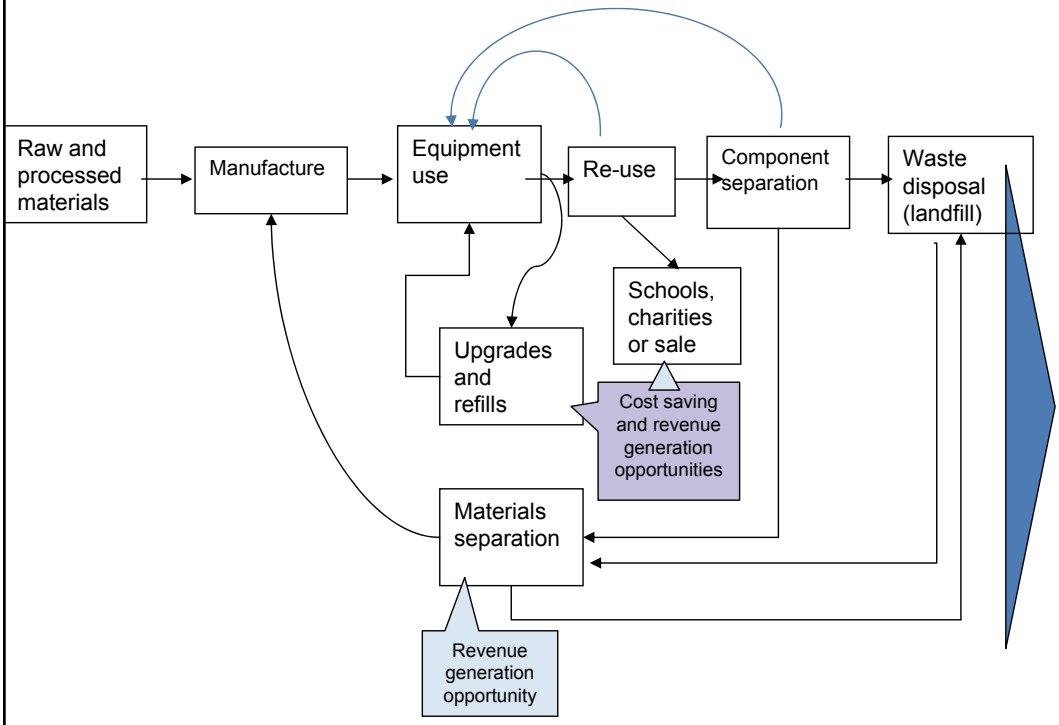
The IT system life cycle

- Environmental impacts during:
  - manufacture
  - use
  - disposal
    - Embedded carbon; hazardous chemical content
- Identifying choices which enhance sustainability

Managing the lifecycle

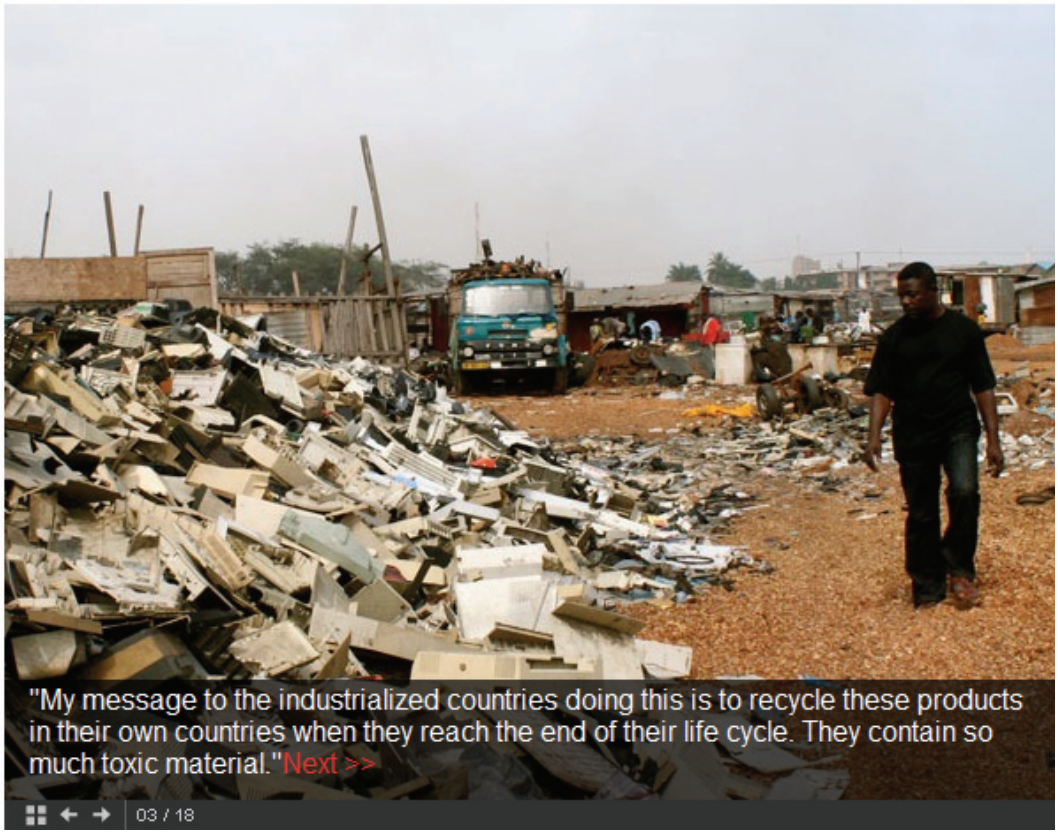


Recycling and Disposal



- Re-use a source of significant cost savings (up to 90% cheaper to refurbish than to make a new purchase)
- Disposal of working equipment after refresh exercise can generate revenue
- Separate components before crushing, can be worth a lot e.g. £1,800/tonne for RAM
- Waste disposal suppliers should be ISO 14001 accredited to ensure compliance with relevant legislation

Source: SCC; EU; Defra; Eric Williams et al (UN University, Tokyo); NAO; team analysis



FRONTLINE/World Ghana: Digital Dumping Ground | PBS
http://www.pbs.org/frontlineworld/stories/ghana804/slideshow/slideshow.html

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Manufacture/distribution

- Sourcing of materials
  - beware location/ transport costs
- Building products
  - build to re-use/ re-cycle/ upgrade – a longer life
- Energy efficient processes
- Move from commodity to service revenue streams
- Marketing - eco-labelling, green washing, credibility
- Delivering - transport, packaging, installation

Measuring usage: PUE and DCiE

- Measures of data centre efficiency
- **P**ower **U**sage **E**ffectiveness =

$$\frac{\text{Total Facility power use}}{\text{Power delivered to computing equipment}}$$

- **D**ata **C**entre **I**nfrastructure **E**fficiency =

$$\frac{\text{Power delivered to computing equipment}}{\text{Total Facility power use}}$$

- PUE values below 1.2 seen as “good”
- Many current PUE ~ 2.0
- Relative measures of performance

The Future

- Transformation to a sustainable society
- Transformation by technology and behaviour
- Sustainable IT
- Sustainable data centres
- What are the best practices of the Code of Conduct on Data Centres (CoC)?
- Why and how?
- **Study this course and find the answers!**

Learning Outcomes of the Course

- **On completion of this course you will be able to:**
  - Understand the role and purpose of the EU CoC
  - Describe the composition of a typical data centre
  - Show how that composition offers both opportunities and challenges to sustainable operation
  - Understand the measurements required for an audit
  - Carry out an audit according to the CoC
  - Suggest measures to improve sustainability

Questions?