Developing technology for the Future of the Planet

Andrew Rice

19th November 2008

We consume a lot of energy

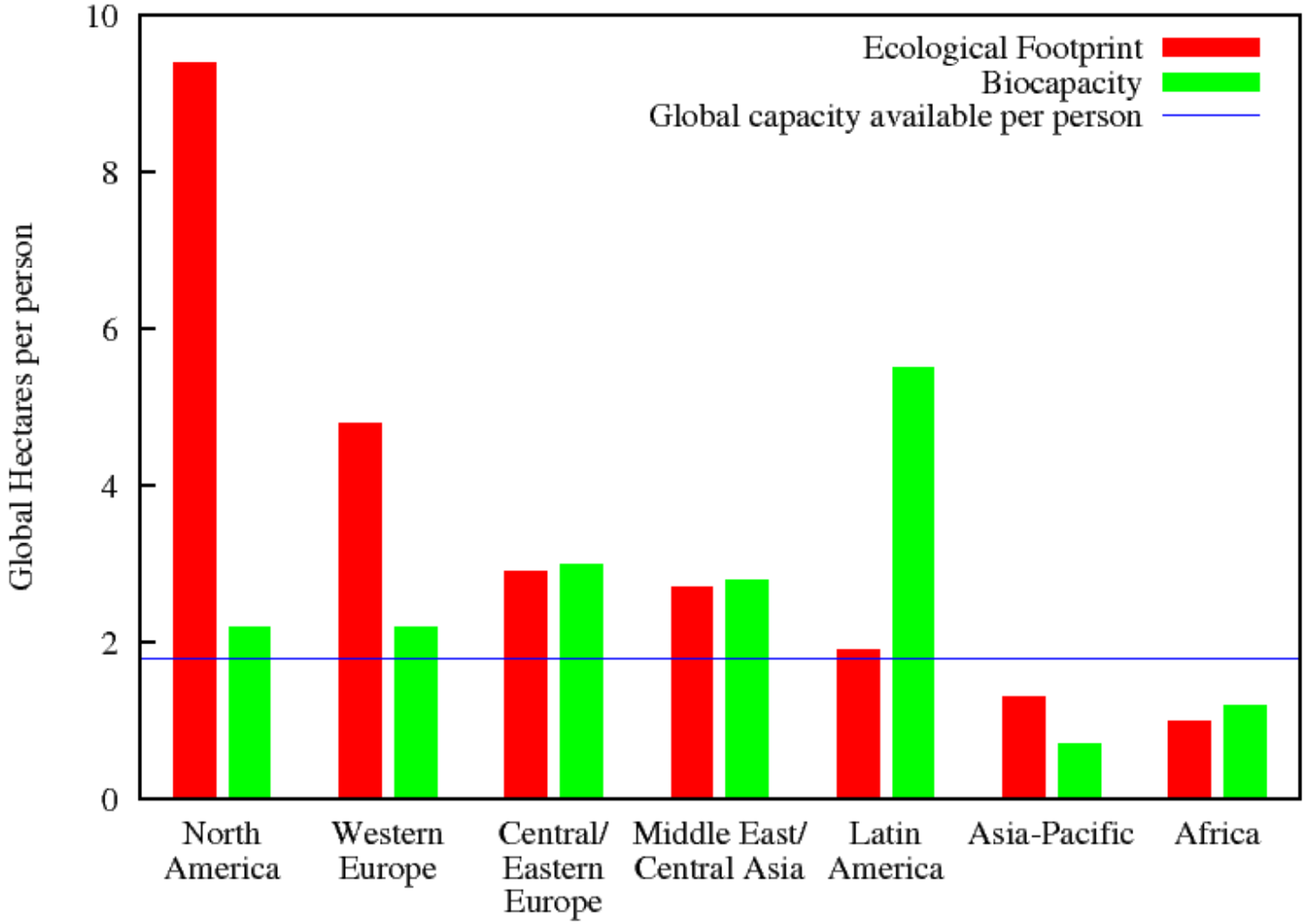
Globally consumed: 5×10^{20}J in 2005

per person: 8×10^{10}J

This is approximately the same as each person boiling 100 kettles continuously for a year

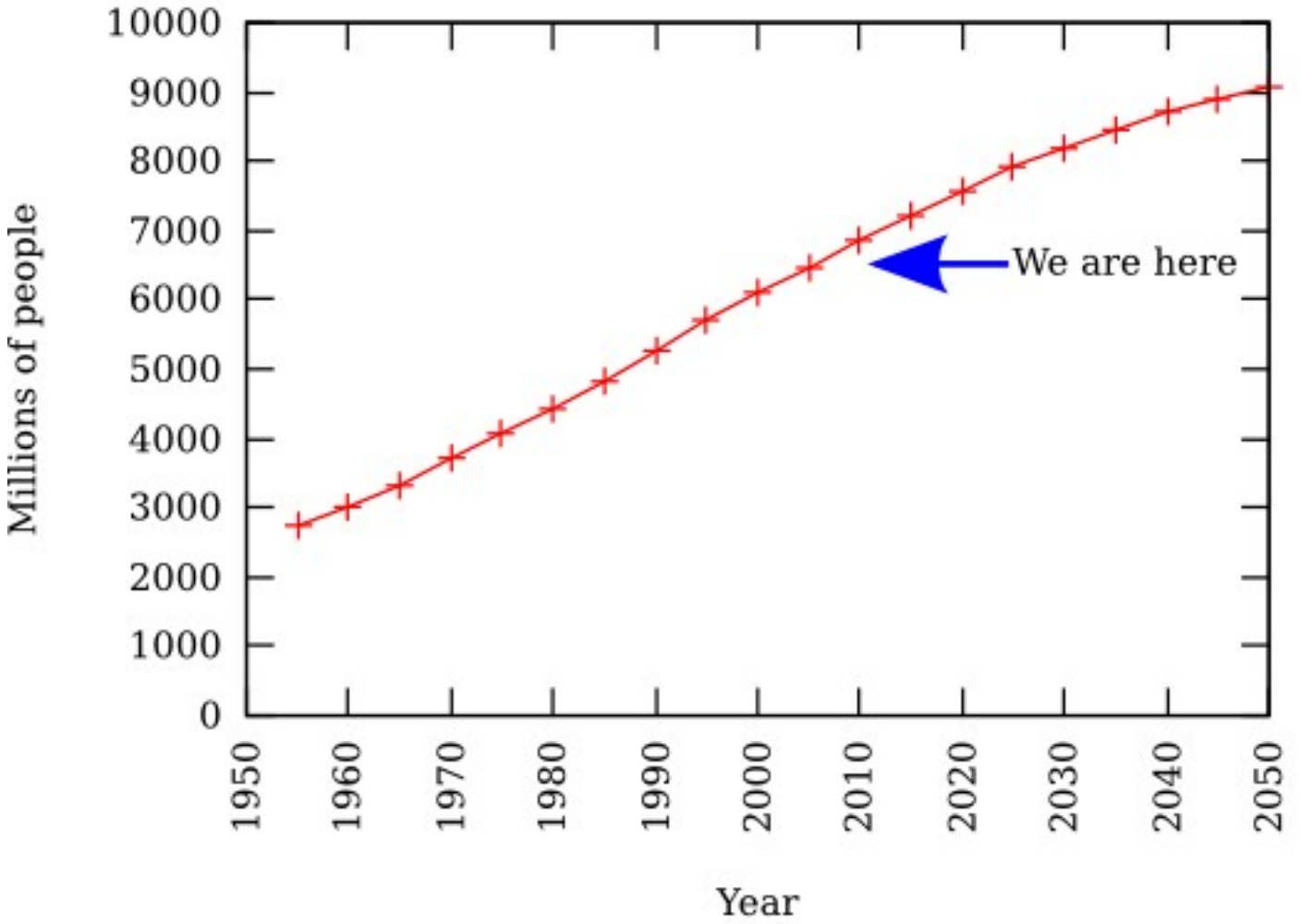
Source: EIA

We consume too many resources

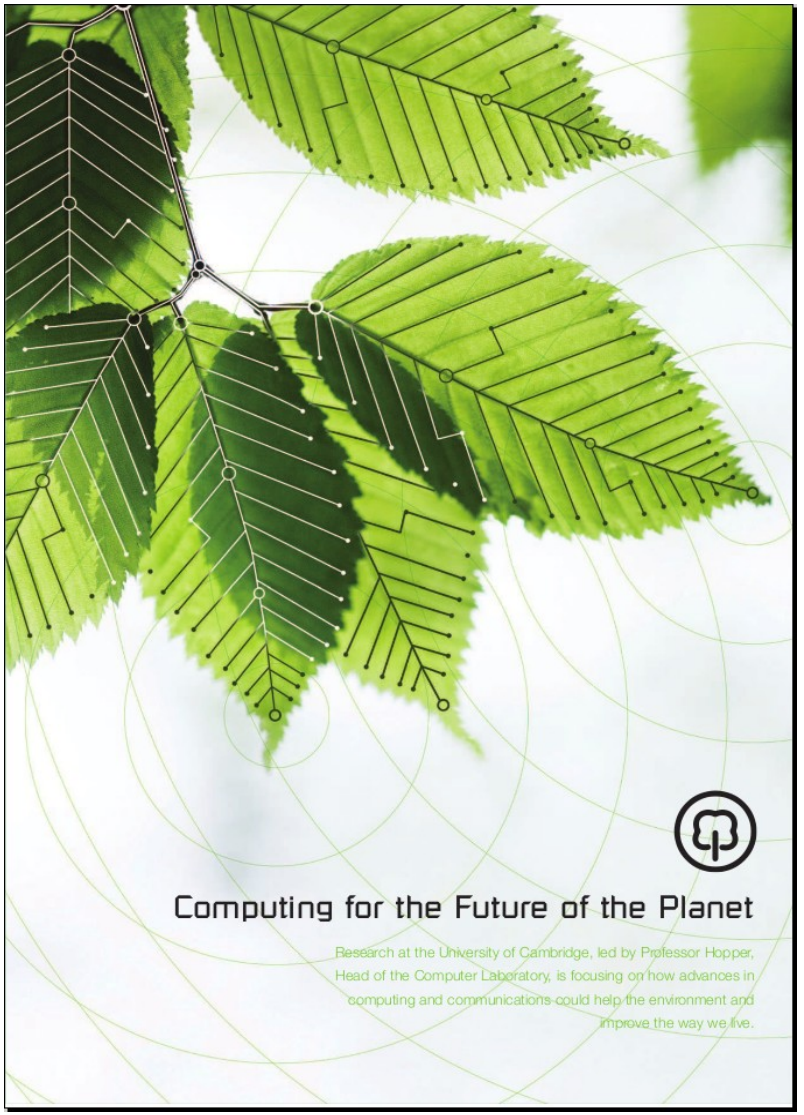


Kitzes, J., Wackernagel, M., Loh, J., Peller, A., Goldfinger, S., Cheng, D., Tea, K. 2008 Shrink and share: humanity's present and future Ecological Footprint. Philosophical Transactions of the Royal Society 363, 467–475. (DOI 10.1098/rstb.2007.2164.)

Population growth will negate all our efforts



Can technology provide any answers?



Computing for the future of the planet

What lessons can we learn from “developing technology”?

This is not technology for the developing world

This is technology **from** the developing world

South African Townships


3
2

Mobile phones are the computing platform

No power or services to buildings
Mobile phones are common
Top-ups in units of 1 SMS
People will miss a meal to send an SMS

4G networking is happening - manually

- 4G aims to select an optimal network from available set based upon some optimization criteria
  - cost, bandwidth, latency, energy use
- Many South Africans own multiple SIM cards
  - swap networks manually based on call scenario

Widespread IRC-style chat

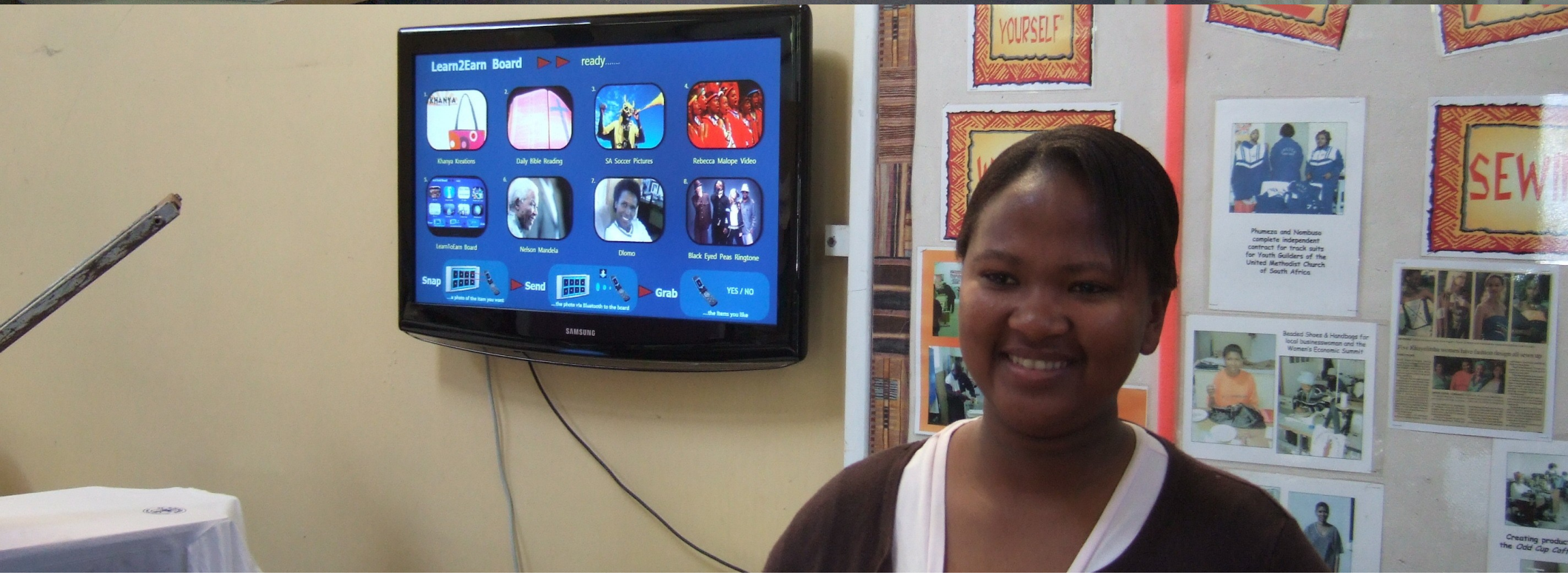
- MXit instant messaging
  - more subscribers than there are landlines in SA
  - orders of magnitude cheaper per character than text messaging
- How far can one take network conservation?
  - compression
  - direct access to content
  - contra to Internet dialog systems

Limited resources produce novel technology

Digital media board
bluetooth -> phone

No Internet access
No phone software
No PC required
No IT literacy

Gary Marsden, Cape Town University

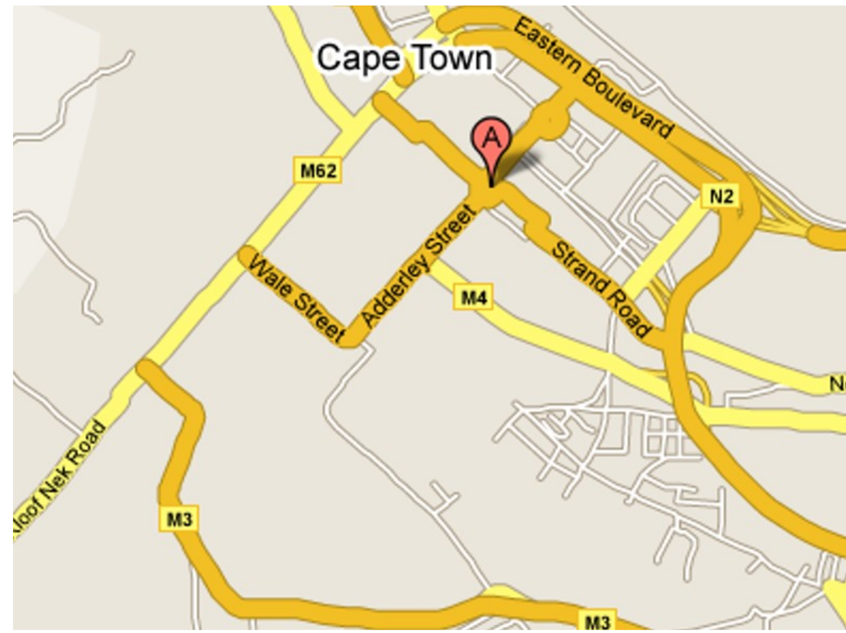

Learn2Earn Board
ready.....
Khanya Kreations
Daily Bible Reading
SA Soccer Pictures
Rebecca Malope Video
Learn1oEarn Board
Nelson Mandela
Dlomo
Black Eyed Peas Ringtone
Snap
Send
Grab
YES / NO
SAMSUNG
YOURSELF
Phumeza and Nombuso complete independent contract for track suits for Youth Guilders of the United Methodist Church of South Africa
Beaded Shoes & Handbags for local businesswoman and the Women's Economic Summit

Established technology should learn from these perspectives

Example:

Files and folders is not a natural abstraction for resource limited and semi-literate groups

Community sensing beats commercial operations



The OpenStreetMap project uses manually edited data based on GPS traces

Our networks are not designed for high contention

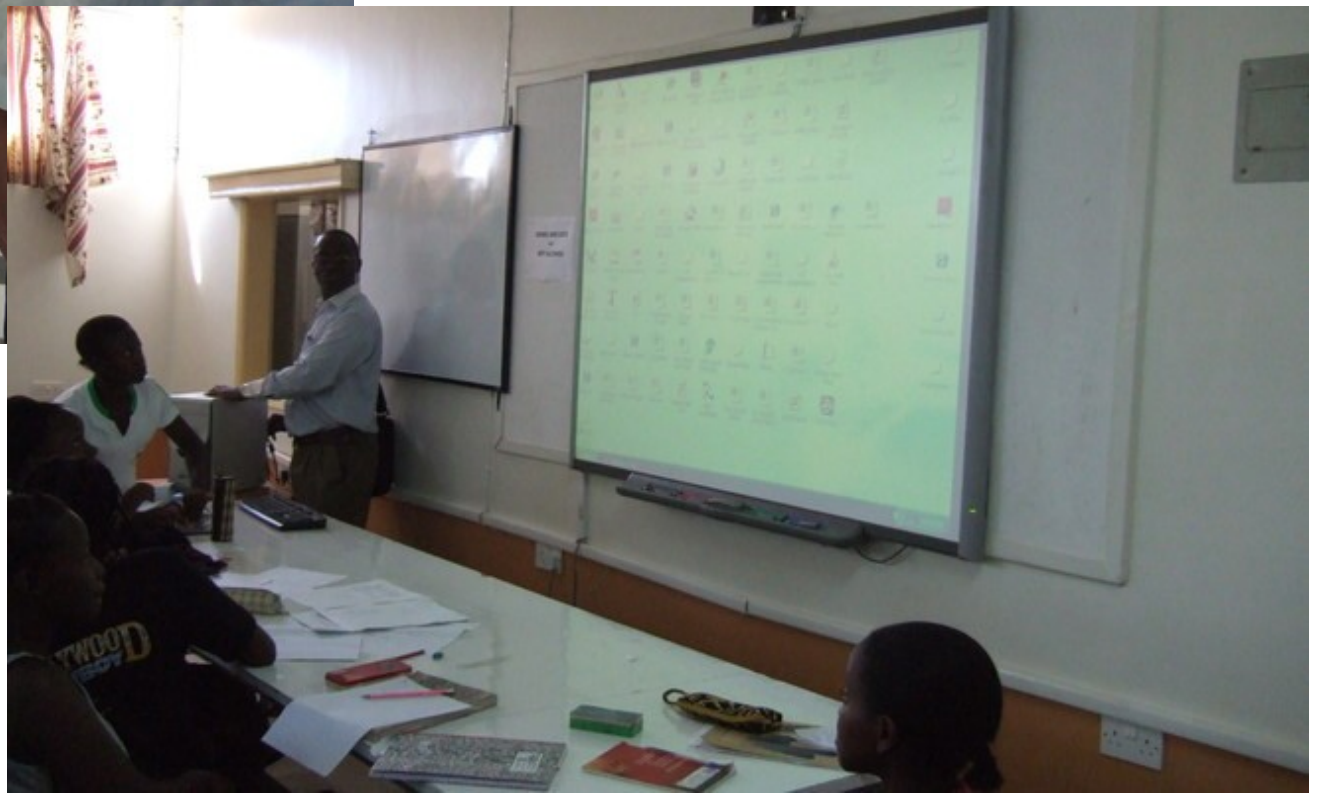
- Staff at Cape Town download their papers from their home connections – network timeout
- Kampala University in Uganda – 100s of users contend for a 1Mb connection
- Where are the queuing systems for downloads?
- Caching and sharing of content
  - hard to reconcile with streaming

Kampala: How to build a transport network from scratch?

Counting cars,
taxis
motorbikes, cycles

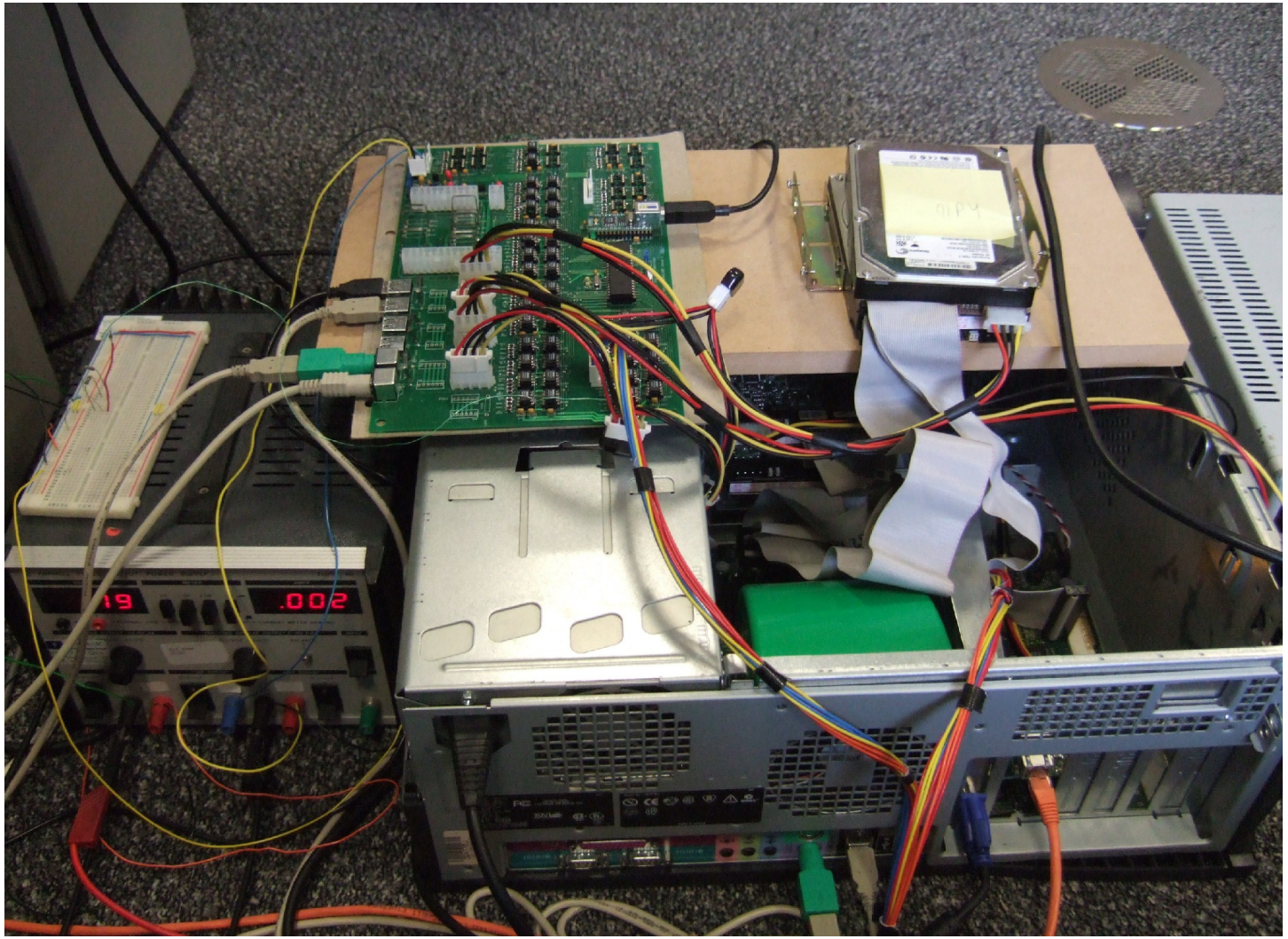
Run without
traffic lights?

Power reliability is a big problem

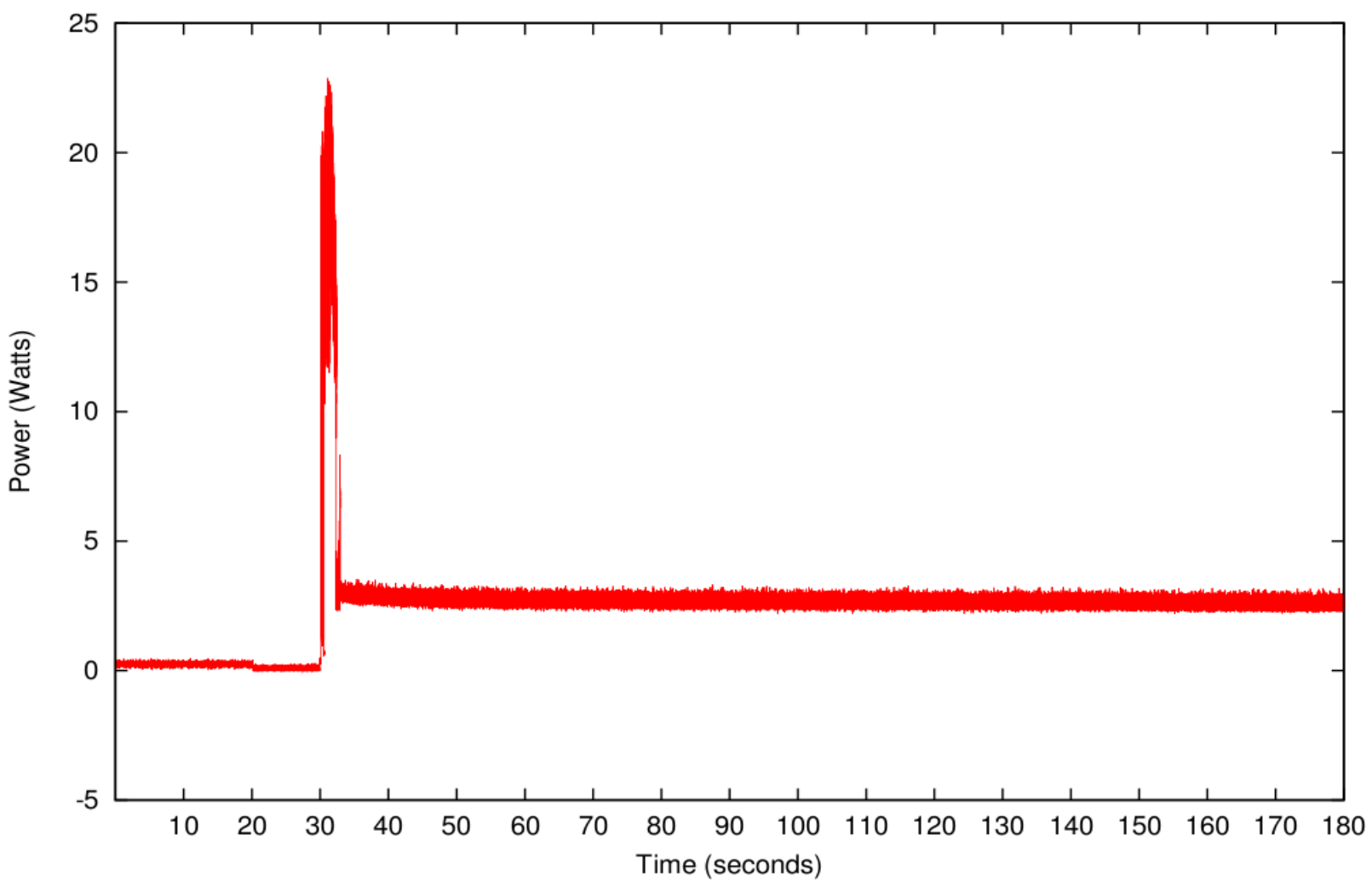


Gayaza High School
Uganda

Recording detailed power measurements

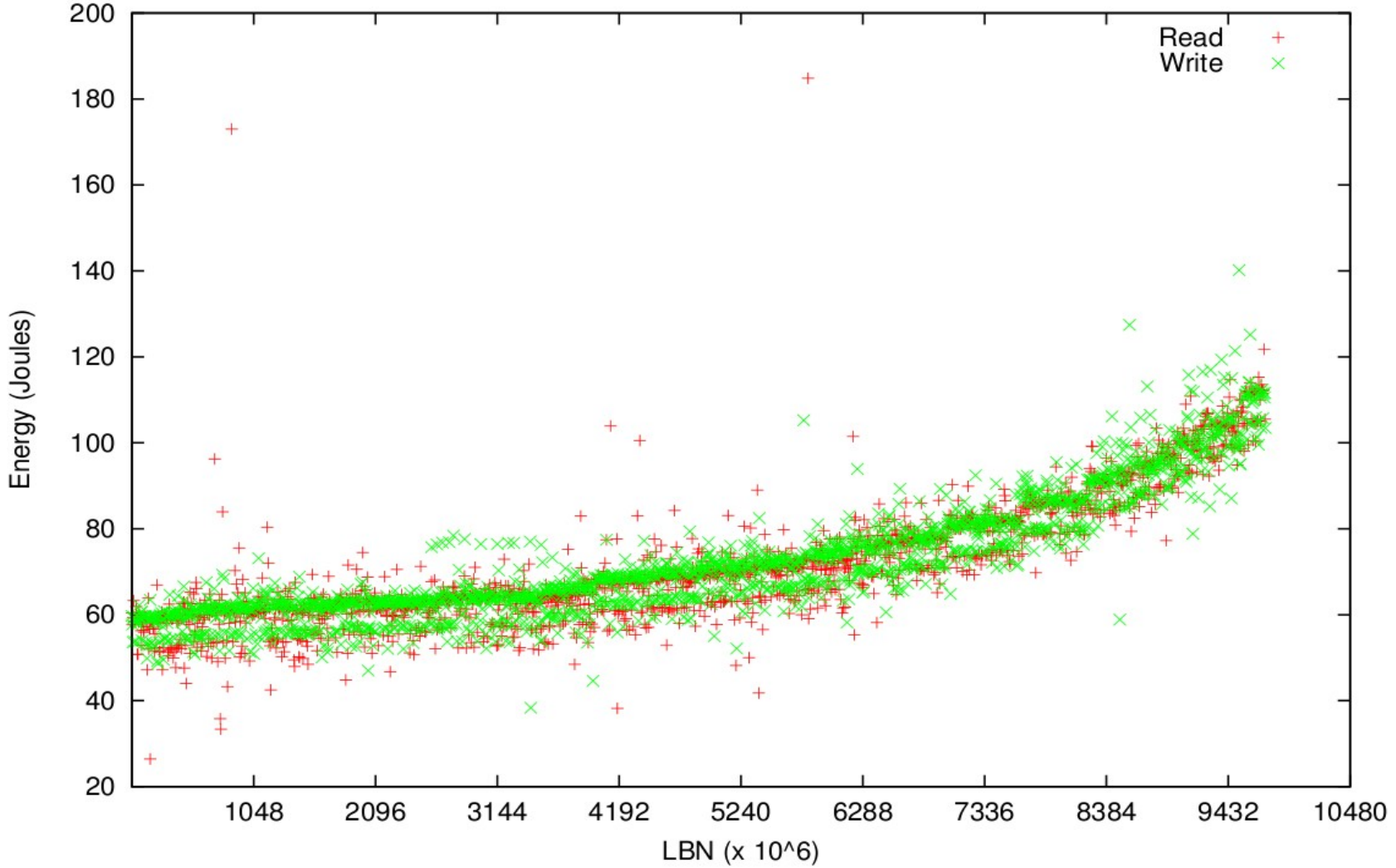


The energy cost of spinning up defines a minimum sleep time



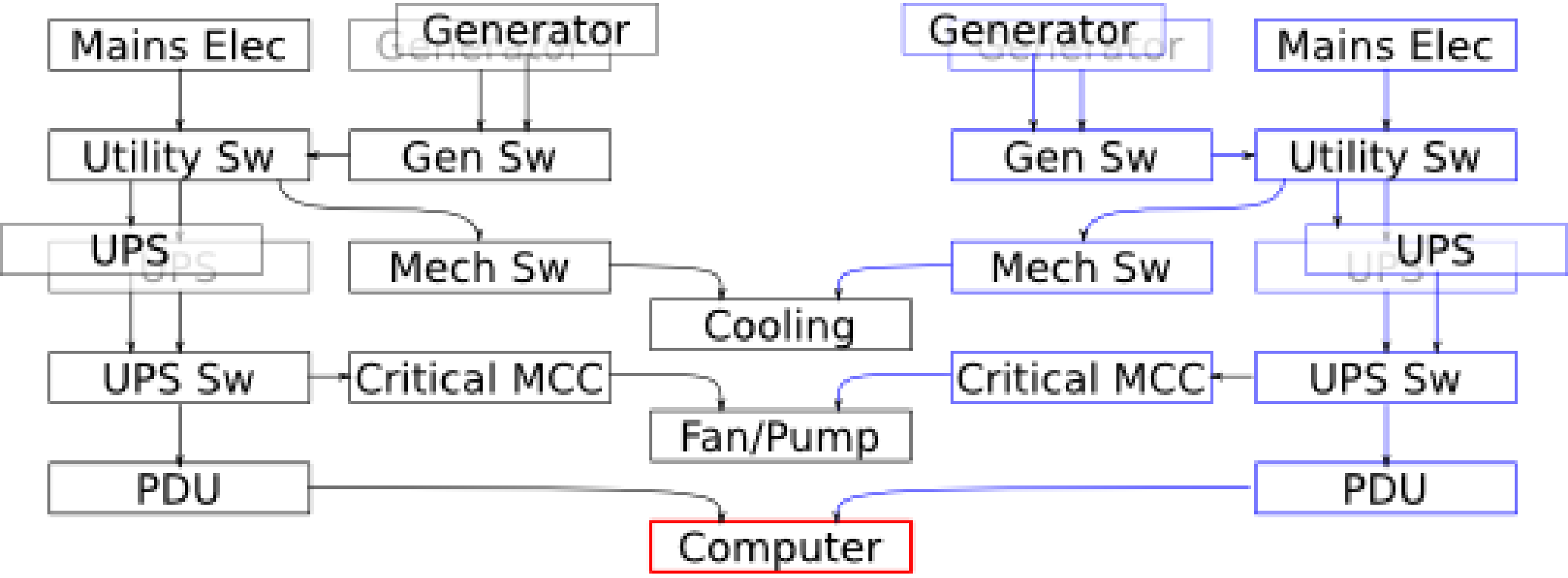
Anthony Hylick, Ripduman Sohan, Andrew Rice, and Brian Jones, “An Analysis of Hard Drive Energy Consumption”. In MASCOTS 2008

High LBNs are more expensive than low ones



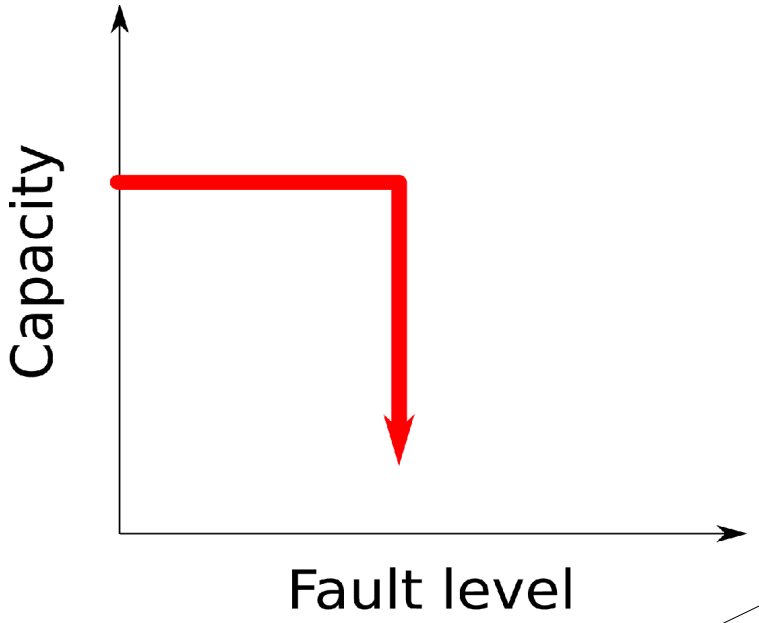
Anthony Hylick, Ripduman Sohan, Andrew Rice, and Brian Jones, “An Analysis of Hard Drive Energy Consumption”. In MASCOTS 2008

Provisioning for continuous operation is expensive

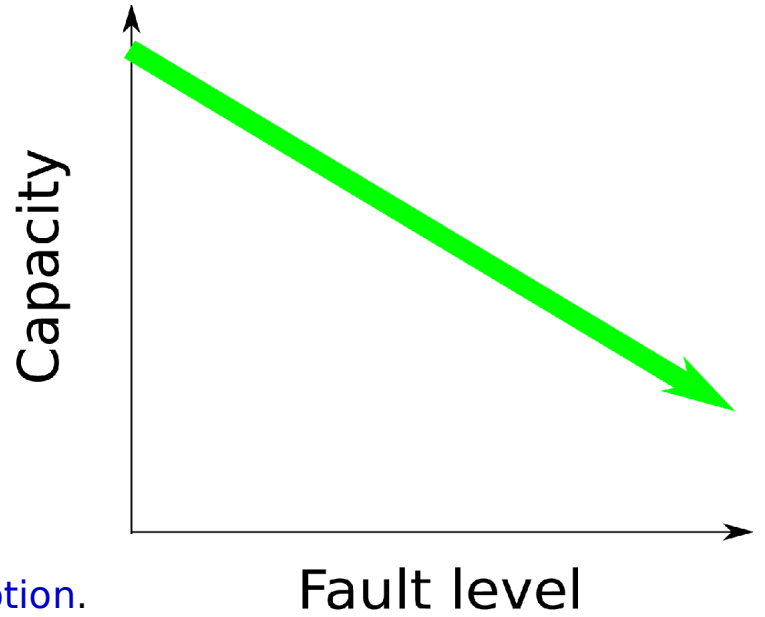


Source:Pitt Turner IV, W., Seader, J. H., Brill, K. G. Tier Classifications Define Site Infrastructure Performance. White Paper. The Uptime Institute.

Failure is an option



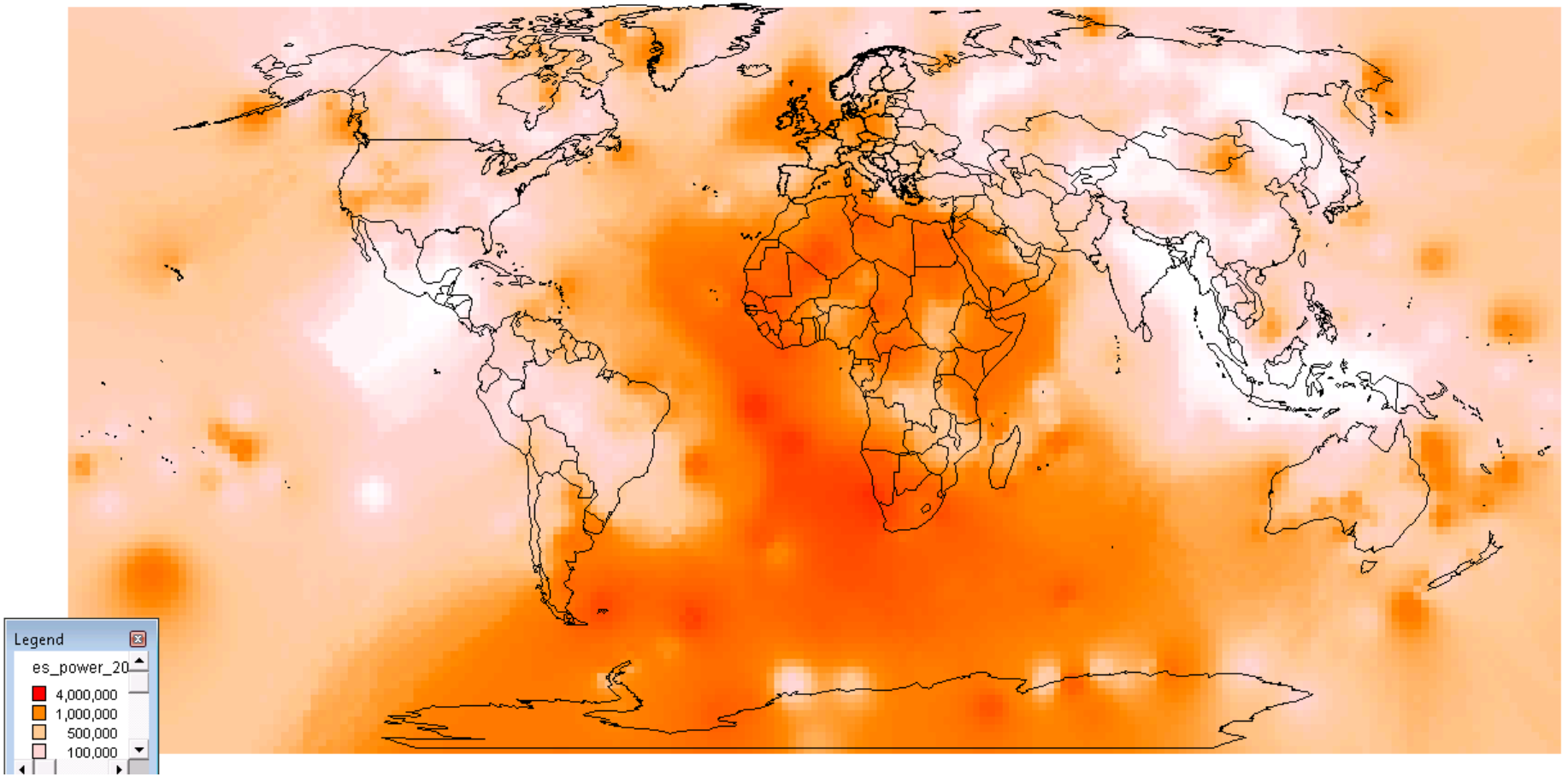
Current approach: failure => disaster



Adaptive approach:
minimize the cost of failures

Andrew Rice and Sherif Akoush and Andy Hopper, Failure is an option. Technical report, MSR-TR-2008-61, May 2008.

Harvest unreliable energy for our computing needs



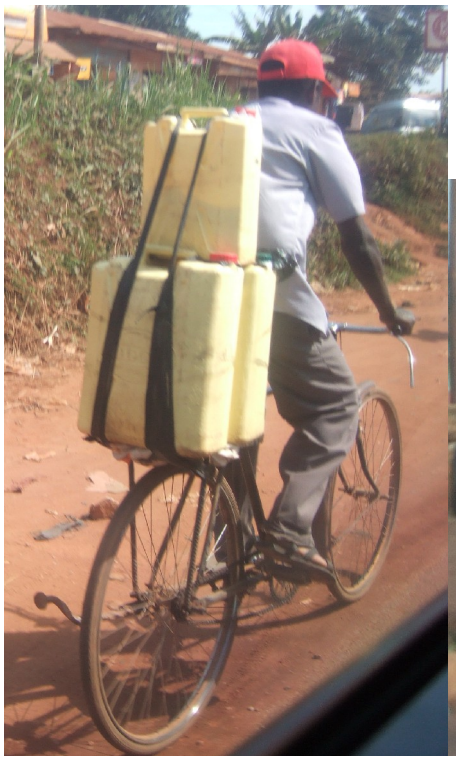
Sherif Akoush

Developing technology is desirable everywhere

- Mobile computing
  - we need durability, robustness
  - tolerance to power supply limitations
- Green technology
  - reducing power consumption
  - longer lifetimes
  - general purpose


UDF
836K


STAR
KYEBANDO
BAKERY
KATALE
ZONE




KCMT
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Website:
http://www.cl.cam.ac.uk/research/dtg/planet

Andy Hopper, Andrew Rice,
Computing for the Future of the Planet.

Phil. Trans. R. Soc. A, October 2008.

Gary Marsden (Cape Town):
http://people.cs.uct.ac.za/~gaz/