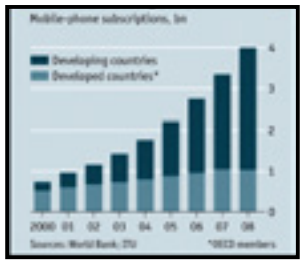
The Green Switch: Designing for Sustainability in Mobile Computing

Riikka Puustinen & Galit Zadok
SustainIT'10
22 February 2010

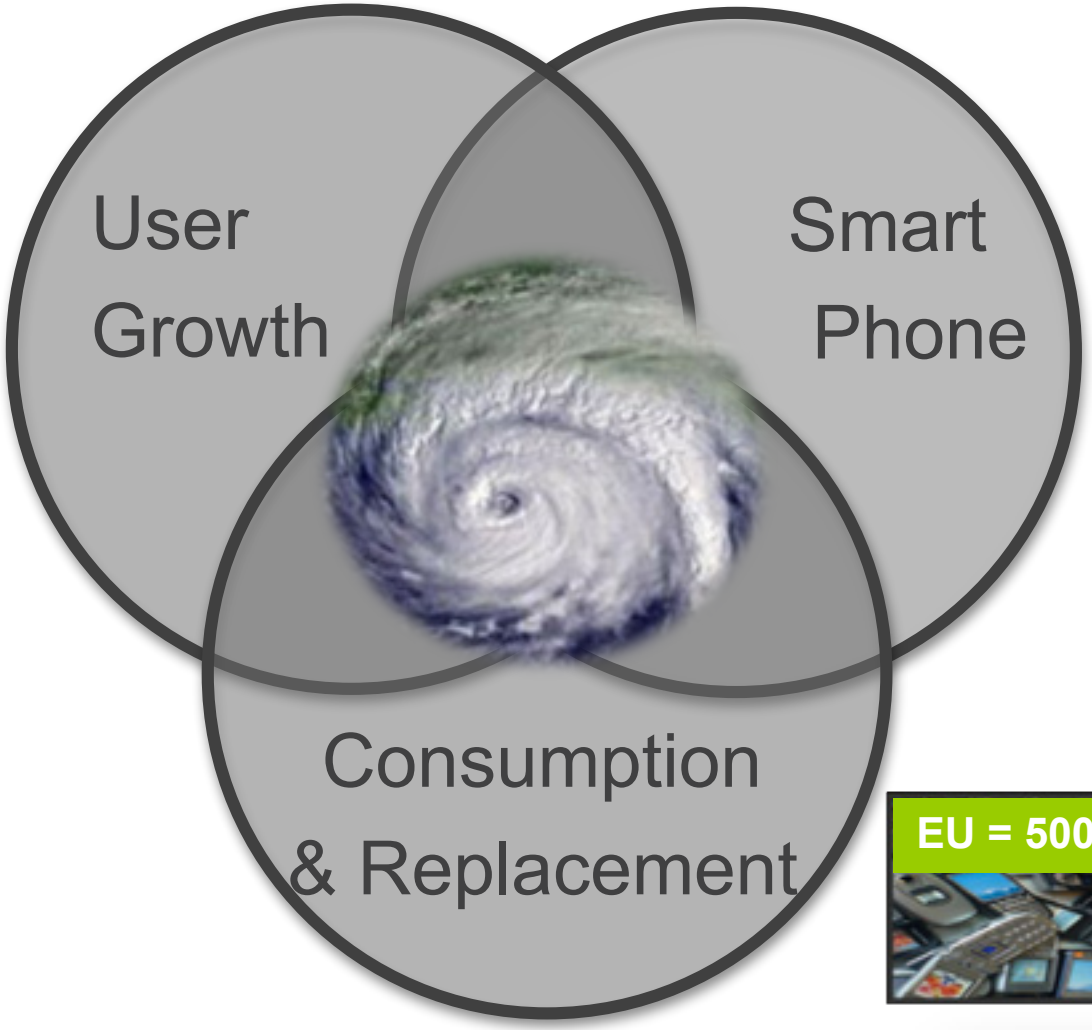
Mobile & Sustainability

Mobile & Sustainability

3 trends converging



6B = 2013



All = 2015

Current Sustainability efforts

The lifecycle efforts

EU most comprehensive **legislation** in place

- **Nokia, Sony Ericsson, and Samsung most active**
- **Greenpeace vigilant on *'Greenwashing'***
- ***Going Green* more costly to manufacturers**
- **Consumer sentiment rising (Samsung Blue Earth)**

Network Infrastructure

- **Little financial incentives for operators in developed economies**
- **Innovation in developing world, as power is scarce and costly**
- **Ofcom: 3G services will greatly increase energy consumption**

Chargers:

- **reduce no-load energy consumptions**
- **Nokia, Sony Ericsson reduction of 80%-90%**
- **Universal Charging Solution (UCS), efficient, eliminates redundancy.**

Handset while in use…

Legislation forces efforts

- **July 2007, EU law WEEE Regulation**
- **Waste Electrical and Electronic Equipment**
- **Producers of WEEE = £££ responsibility in disposal**
- **Handset manufacturers now promote free of charge take-back programs**

Handset while in use

Bigger portion and growing

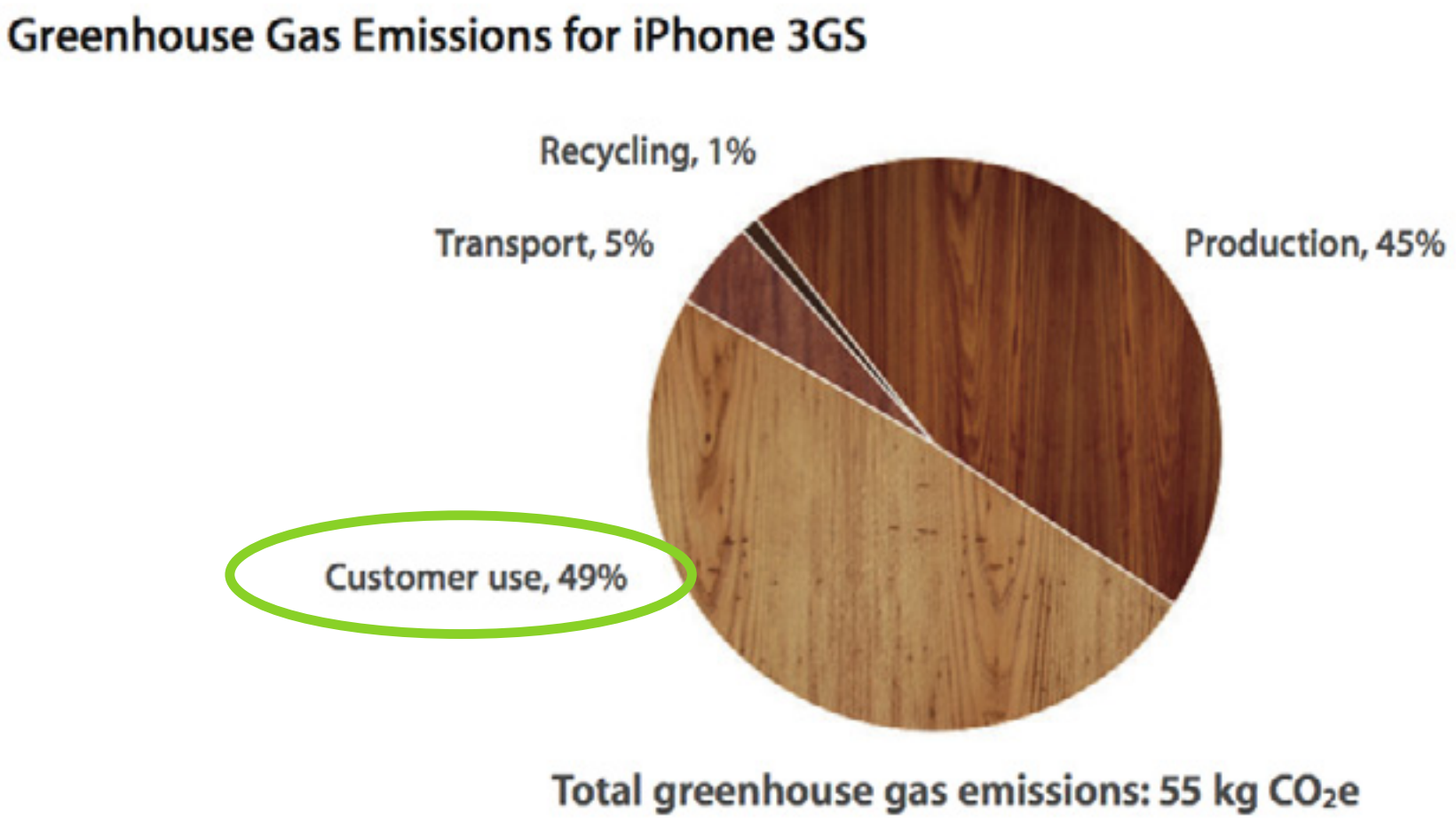


Image: Apple Inc.

Our growing energy consumption

Proliferation of charging solutions

Smart Phones & 3G: much bigger **impact of use-phase**

Charging mobiles in rural Africa

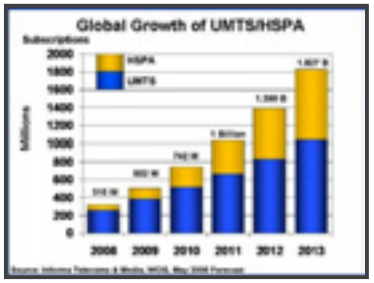
Mobile growth highlights ***Energy Poverty***

Batteries do not follow Moore's Law…
(Only 10% improvement per annum)

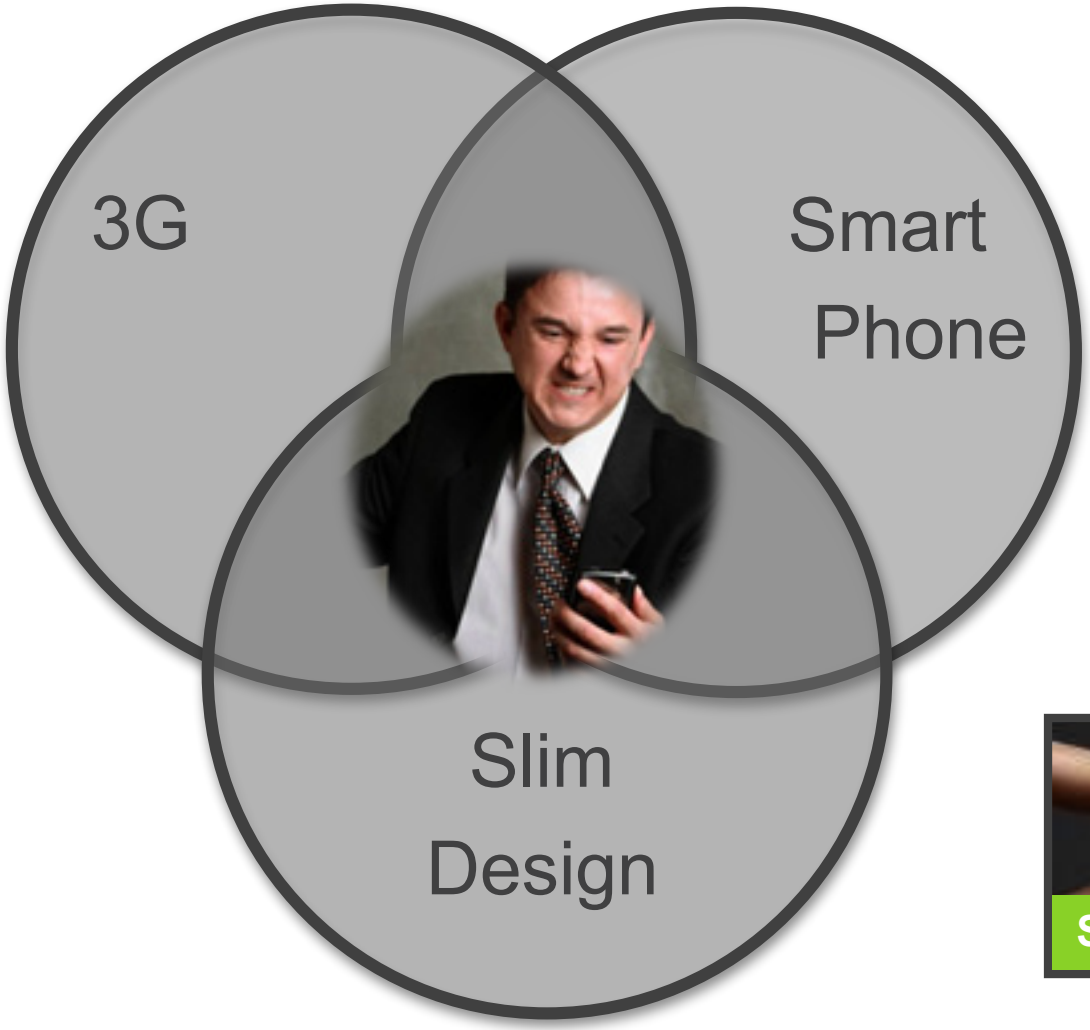
Image: Africa Interactive, http://tinyurl.com/yc9s8tn

The Battery challenge

is getting tougher… and frustrating users.



Higher Needs



Hungry Apps

Smaller Capacity

Energy Consumption of handset

Growing impact of 3G

iPhone CNET reviews:

43% - 60% energy reduction with 3G off

Phone Model	Talk-time Battery Life (hours)
iPhone 3G (3G on)	4.95
iPhone 3G (3G off)	8.75
iPhone 3GS (3G on)	5.36
iPhone 3GS (3G off)	13.40

Table 1-1 CNET iPhone battery life reviews

→

→

Impact on network:

"x12 Increase in data throughput greatly increases (x4) microcell power consumption" - ***Ofcom UK***

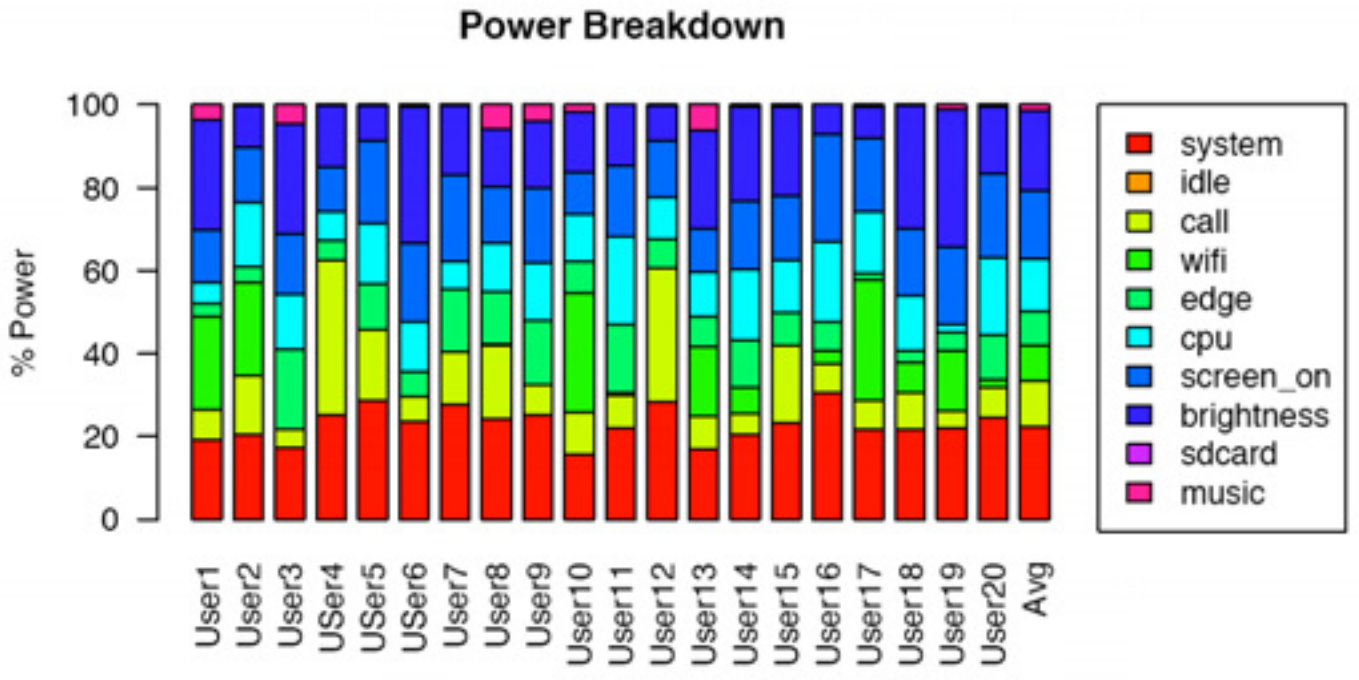
Understanding the Environmental Impact of Communication Systems. Plextec, Eftec for Ofcom. April 2009.

Energy Consumption of handset

where does it all go?

Northwestern University research on Android Devices

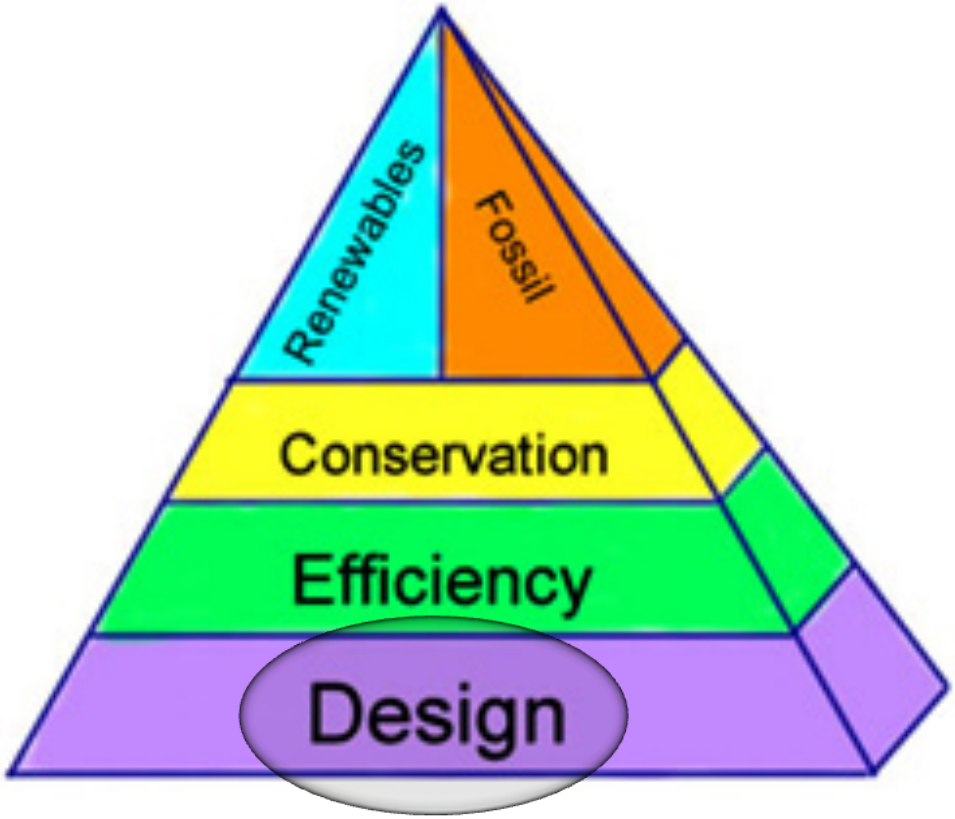
- Idle = 49.3% Active = 50.7%
- In active mode = CPU & Screen
- Users on power optimisations
  - 75% ☺
  - 5% 😐
  - 20% ☹



A. Shye, B. Scholbrock, G. Memik. Into the Wild: Studying Real User Activity Patterns to Guide Power Optimization for Mobile Architectures.

The Energy Hierarchy

Sustainability lessons from others…



Great opportunity for Sustainability

Mobile phone → mobile computing device

Brains & Budgets now being spent.

Address sustainability at critical design level.

Reducing energy consumption
is better for user experience and the environment

Design Methodology

Green Switch Design Method

Aim: YES to all, to achieve meaningful impact.

Green Switch Checklist		**Y**	**N**
Eco-centric	**Green Appeal**		
	Reduction in energy consumption		
Human-centric	**Mass-Market Appeal**		
	Beneficial		
	Convenient		
	Good Value		
	Socially Acceptable		

Green appeal

Does it reduce energy consumption?

Technical aspects

- System processes
  - Long-running frequent timers
  - Idle time-outs for resources
  - Demand paging
- Idle & call state
  - Device and battery power status
- Network connections
  - Moving between cells/networks
  - Data transfer
  - Radio receivers and transmitters like cellular radio, WLAN, GPS, and Bluetooth
- Central Processing Unit
  - Symmetric Multiprocessing
  - Idle de-fragmentation
  - Code optimisation
- Screen status
  - Screen saver and backlight usage
- Screen brightness
- SD Card
- Media Players

Analyse your application to see where the most power is used - concentrate optimising these areas.

Green appeal

Does it reduce energy consumption?

Design aspects

- Visual Design
  - Energy-efficient colours
  - Image optimisation
  - Scalable visual assets
  - Generic visual assets
  - Code vs. graphics
- Animations and UI effects
  - Allow turning off when device is locked or application in the background
  - Use as low frame rate as possible
- Audio
  - Avoid unnecessarily high audio quality
- Interaction Design
  - Optimise user flow for efficiency
  - Connection points between devices
  - Connections from device to online service

Mass-Market appeal

Is it beneficial and relevant for the user?

- A tangible benefit

Enablers

- Mobile device is
  - Location independent
  - Portable multi-purpose tool
  - Contextual

Ensure that the product/service is relevant to the user in the appropriate context.

Image: Intivation's ZTE S316 solar powered phone

Mass-Market appeal

Is it convenient to use?

- A product should contribute to effortless use
  - Reliable
  - Easy to use

Enablers

- Mobile devices are
  - Identifiable and personal
  - Interruptible
  - Designed to allow distractions and support easy recovery

Image: Spotify

Mass-Market appeal

Is it good value?

- Advantage or monetary worth compared to the price paid for it.

- Cost can be
  - Monetary value
  - Psychological cost

Enablers

- Quality vs. the cost of using the product

Image: BBC

Mass-Market appeal

Is it socially acceptable?

- Conform to norms, follow the rules of target society
- Support ideal self-image

Enablers

- A mobile device can
  - Extend social interaction
  - Be an item of fashion

Image: Research in Motion

Summary

- Use-phase:
  - Impact is growing
  - Impacts **client** and **server** energy consumption
- Opportunity now to integrate sustainability at critical **design** level.
- For impact, both address **environmental *and* end-user** needs.
- Energy reduction in Mobile Computing is about **sustainability *and* better user experience**.

Thank you!

{galit, riikka}@thegreenswitch.org

www.thegreenswitch.org