Electricity Use of U.S. Telecom Networks

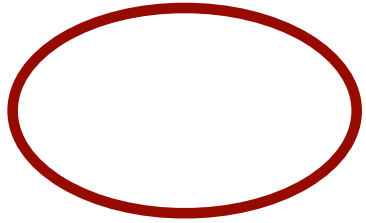
H. Scott Matthews
Carnegie Mellon University

AT&T Industrial Ecology Faculty Fellow

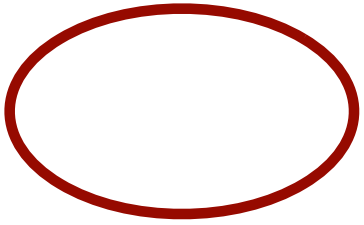
Agenda

- Re-motivation - Why we need to care about electricity use (esp. for electronics)
- Previous research
- Scope of Study
- Results and Commentary

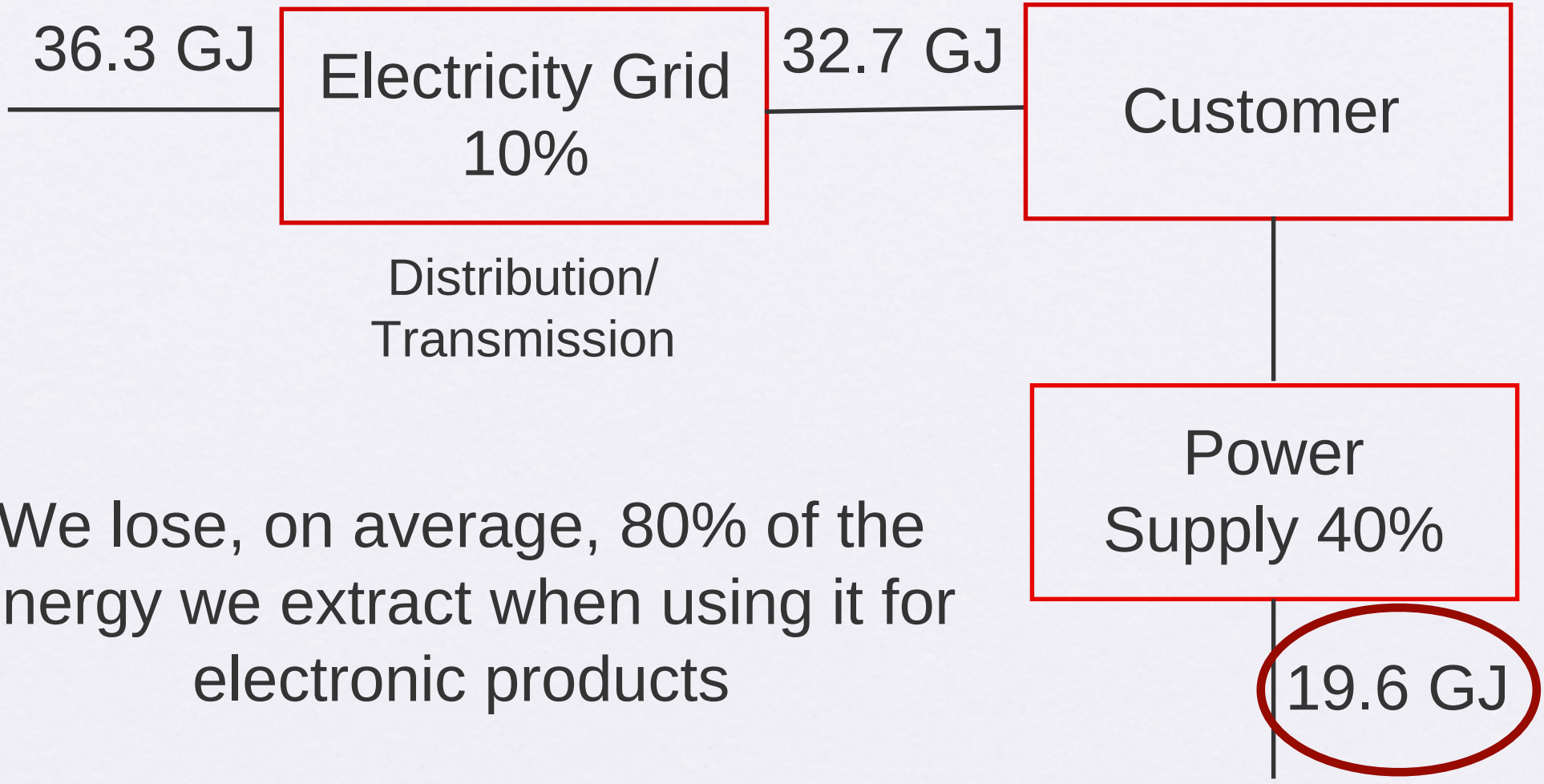
Energy Flow Diagram



QuickTime™ and a TIFF (Uncompressed) decompressor are needed to see this picture.



System Losses



We lose, on average, 80% of the energy we extract when using it for electronic products

Our Prior Research

- Previously measured wired, wireless, and total electricity use of CMU campus network
- Total: ‘network’ uses 5% of campus electricity (~5 MkWh / yr)
  - Wireless ‘equipment’: 5-10x less electricity than wired
- While not *purely* generalizable, an indicator of the potential energy efficiency of wireless

Relevant Prior Research

- Blazek et al, compared Stockholm (Sweden) and Sacramento (CA, USA) phone networks
- Roth et al, “Electricity Consumption of Office and Residential Equipment”, for US Department of Energy, 2002.
- Our campus wired-wireless study
- Common thread: ICT devices and systems may be significant consumers of electricity

Definitions

- PSTN = Publicly Switched Telephone Network
  - a.k.a. the wired network, originally built by AT&T (power supplied by line, except for cordless phones)
- Mobile network = system of stations, antennas, handsets, etc. needed to support wireless telecommunications
  - Includes ‘cell towers’, sites, etc.

Stockholm/Sacramento Report

- These 2 cities were comparable in terms of size, population, users, etc. (although Stockholm much more ‘mobile’)
- Report estimated network size, equipment requirements, etc. for both cities’ networks
- Also estimated materials, environmental, and energy requirements (including support/service activities like administrative offices)
- We used these estimates as a basis

US Wired Network

	Stockholm Model	Sacramento Model
Total (TWh/yr)	28	24
Per connection (MWh/yr)	0.14	0.12

US Wireless Network

	Stockholm Model	Sacramento Model
Total (TWh/yr)	5	5
Per connection (MWh/yr)	0.04	0.04

But..

- Wireless / mobile network is not entirely wireless!
- Except for small fraction of wireless calls, most calls go through wired network
- Need to allocate some fraction of wired network electricity to wireless calls
- We use call-minutes as a proxy - 2500 billion wired, 500 B wireless (15%) in 2000

Adjusted US Wireless Network

	Stockholm Model	Sacramento Model
Total (TWh/yr)	8	7
Per connection (MWh/yr)	0.06	0.06
Watts/call minute	16	15

Even when adjusted, wireless 2x more energy

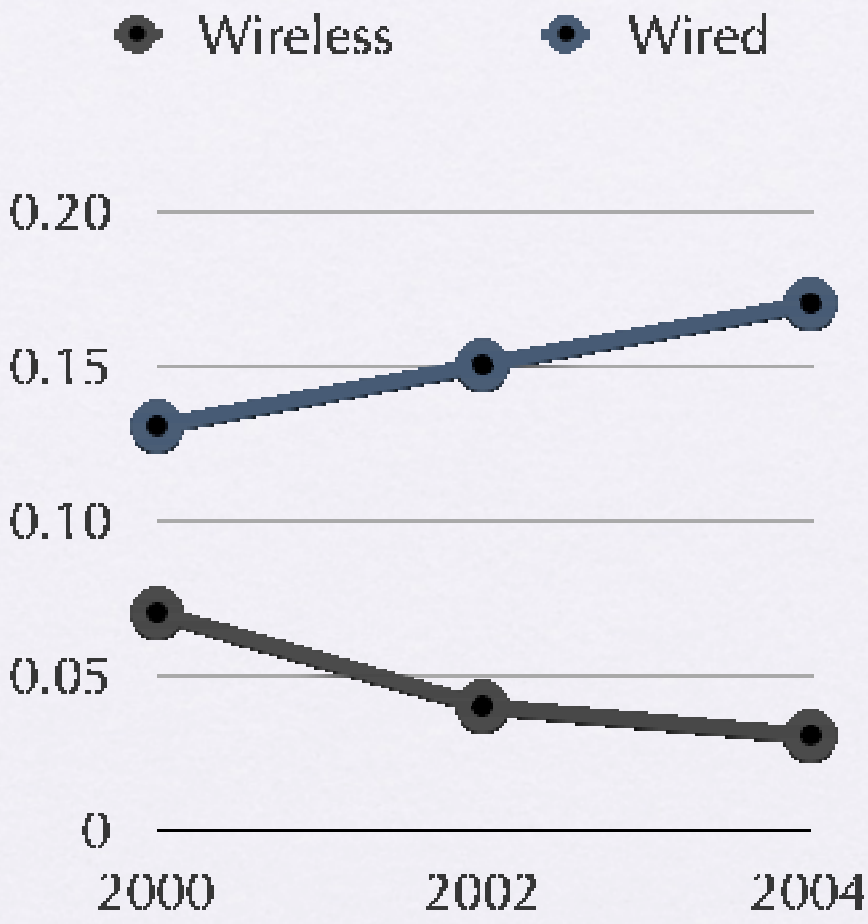
Overall Results

	Stockholm Model	Sacramento Model
Total Wired + Mobile (TWh/yr)	33	29
Percent Mobile	25%	25%
Percent US Elec	1%	1%

Facts

- In 2002, International Telecommunications Union (ITU) noted the number of wired and wireless ‘lines’ roughly equal (about 1 billion each)
- Global wireless subscribers growing rapidly
- Wired subscribers flat (and declining in US)

Wired vs. Wireless electricity (Watts per subscriber)



Thus, electricity use ‘per subscriber’ will rapidly favor wireless and trend to 10x

Final Thoughts

- ‘Efficiency’ of wireless (versus wired) communications is irrelevant!
- For foreseeable future, we will have need for wired networks (if nothing else, to make long-range mobile calls!)
- This dependency will limit our ability to realize energy savings from wireless
  - i.e., until we ‘pull the plug’, we are using more total energy to have both to use