Internet services and energy demand

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The DEMAND Centre (EUED/RCUK Energy)

Mike Hazas
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DEMAND
DYNAMICS OF ENERGY, MOBILITY AND DEMAND

Research Councils UK
Energy
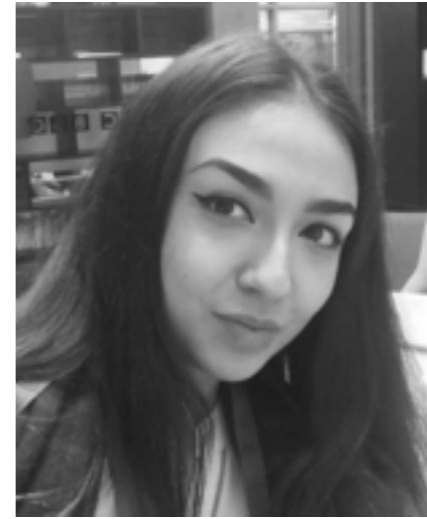For a Low Carbon Future

Project 2.1: Domestic IT

Socio-Digital Sustainability Group

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Academic background

|		
1998	BSc Electrical Engineering, w/ Comp. Sci. minor	Rose-Hulman Inst. of Technology (Indiana, USA)
1999	MPhil Signal Processing	Engineering Dept Cambridge
2002	PhD Mobile Computing	Computer Laboratory Cambridge
2008	BA Sociology	Lancaster University

Outline

- growth of the internet

- and the link to electricity demand

- What do people do with the Internet?

- technical and policy implications

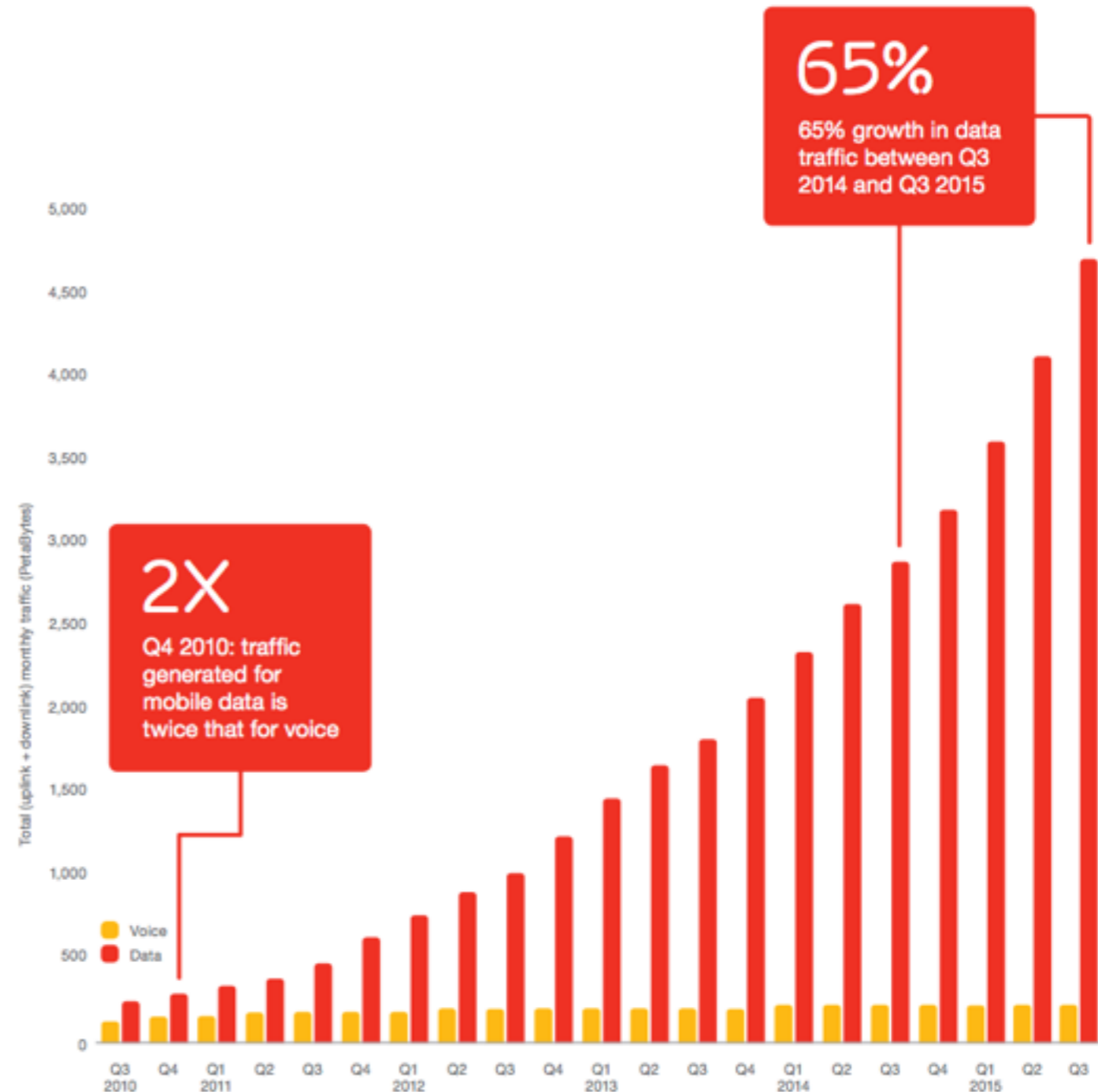UK home broadband data volumes
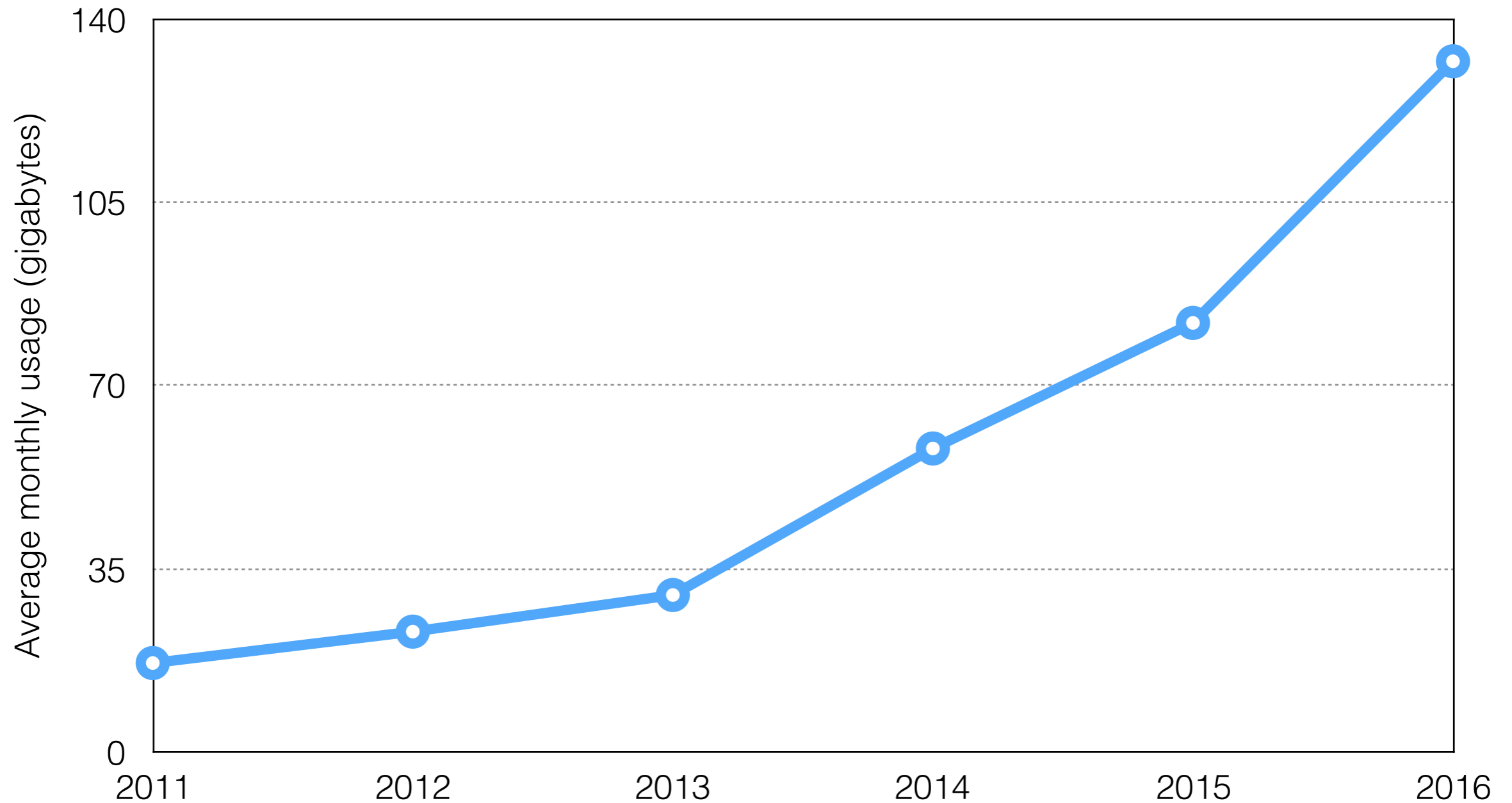
data source: Ofcom

AMS-IX traffic volume
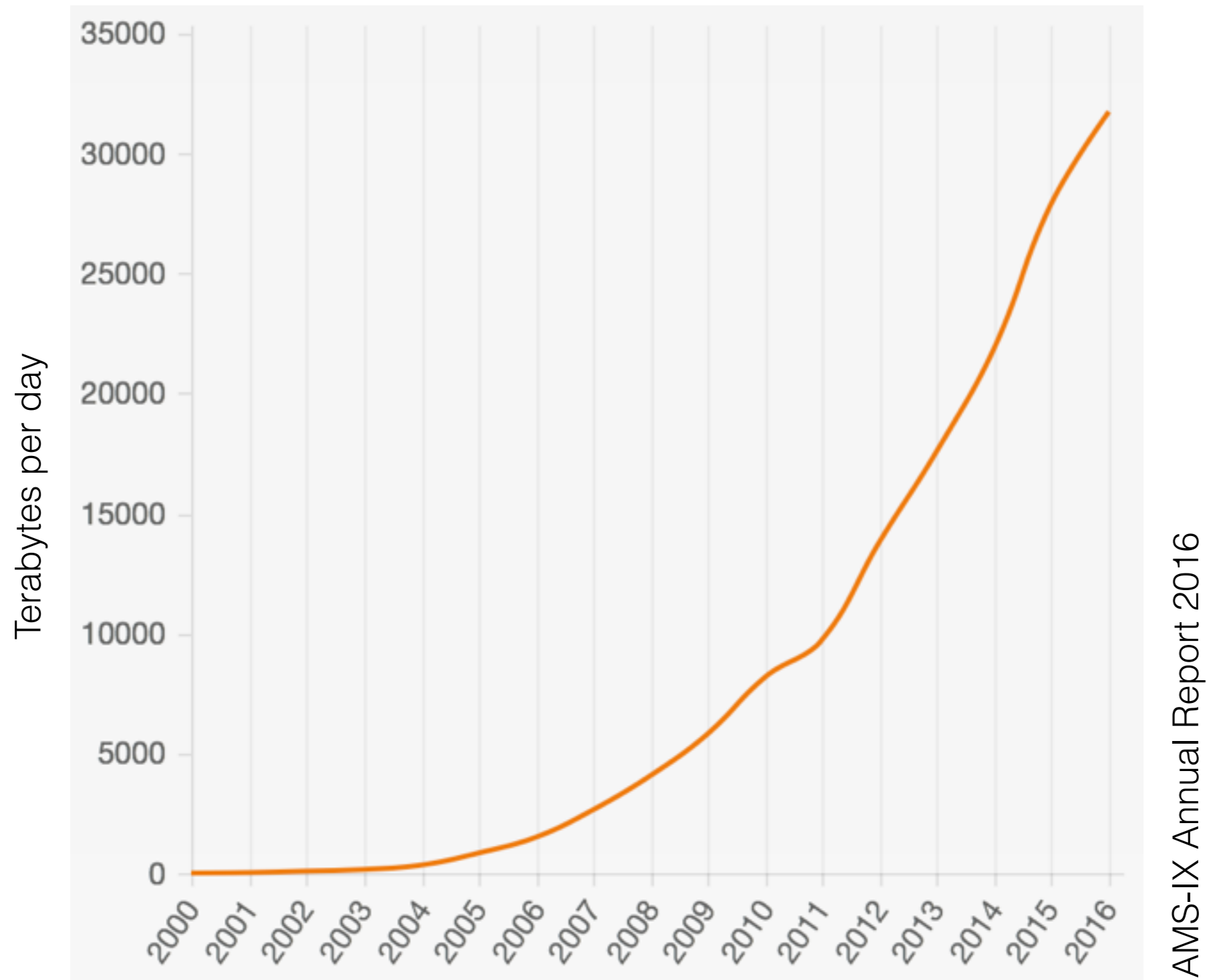
AMS-IX Annual Report 2016

Global mobile data

- 60% growth for two years running

- 45% annual growth through 2021 (forecast) Ericsson 2015

- 53% annual growth through 2020 (forecast) Cisco 2016

Ericsson Mobility Report, November 2015 (p. 11)

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How viral cat videos are warming the planet

Datacentre web servers, such as those used by Google and Facebook, to blame for 2% of greenhouse gas emissions – about the same as air travel

Adam Vaughan

🐦 @adamvaughan_uk

Friday 25 September 2015 11.53 BST

🄵 🄣 ✉ 🄿 🄸 🄶+

🕐 This article is 8 months old

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1,124   54

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📷 Inside Google's data centre in Mayes County, Oklahoma. The firm's carbon footprint was equivalent to more than 1.7m tonnes of carbon dioxide in 2013. Photograph: Google/Rex

"If we carry on going the way we have been it would become unsustainable – this level of data centre growth is not sustainable beyond the next 10 to 15 years. The question is, what are we going to do about it?" says Professor Bitterlin.

He points to a study focused on Japan which suggests that its data centres would consume its entire electricity supply by 2030 if growth continues at today's rate.

"We need to be more responsible about what we use the internet for … Data centres aren't the culprits – it's driven by social media and mobile phones. It's films, pornography, gambling, dating, shopping – anything that involves images. It's a great example of the Jevons paradox – the easier you make it to consume the product the greater the consumption will be."

THE SUNDAY TIMES

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NEWS

Net 'to drain all Britain's power'

Jonathan Leake Science Editor   Published: 3 May 2015

💬 Comment (5)   🖨 Print

BRITAIN'S internet demand is expanding so fast that it could consume the nation's entire power supply by 2035, scientists will tell the Royal Society next week.

Andrew Ellis, professor of optical communications at Aston University, will tell the "Capacity Crunch" conference that data storage and transmission on the internet, along with devices such as PCs and TVs, are already consuming at least 8% and as much as 16% of Britain's power — and doubling every four years.

"The internet is already consuming at least 8% of Britain's power output, equivalent to the output of three nuclear power stations, and demand is soaring," said Ellis. "It is growing so fast, currently at an exponential rate, that, in theory, it could be using all the UK power generation by 2035. We cannot make all that extra power, so we will have to restrict or reduce access, perhaps by metering consumers so they pay

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✶ **INDEPENDENT**   News   Voices   Culture   Lifestyle   Tech   Sport   US election   Daily Edition

Environment

Global warming: Data centres to consume three times as much energy in next decade, experts warn

416.2 terawatt hours of electricity world's data centres used last year was far higher than UK's total consumption

**Tom Bawden** Environment Editor | @BawdenTom | Saturday 23 January 2016 | 💬0   comments

🄵 🄣 ✉   **0**
shares

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Using the internet, using energy

Study	Share of global electricity	Year	Inclusions
Van Heddeghem et al. (2014)	4.6%	2012	Operation: comms networks, computers, data centres
"	10%	2012	+ TV and other ICT
Andrae & Edler (2015)	10%	2010	Operation and production: internet, telecoms
Malmodin et al. (2010)	7%	2007	Operation and production: internet, telecoms & print media

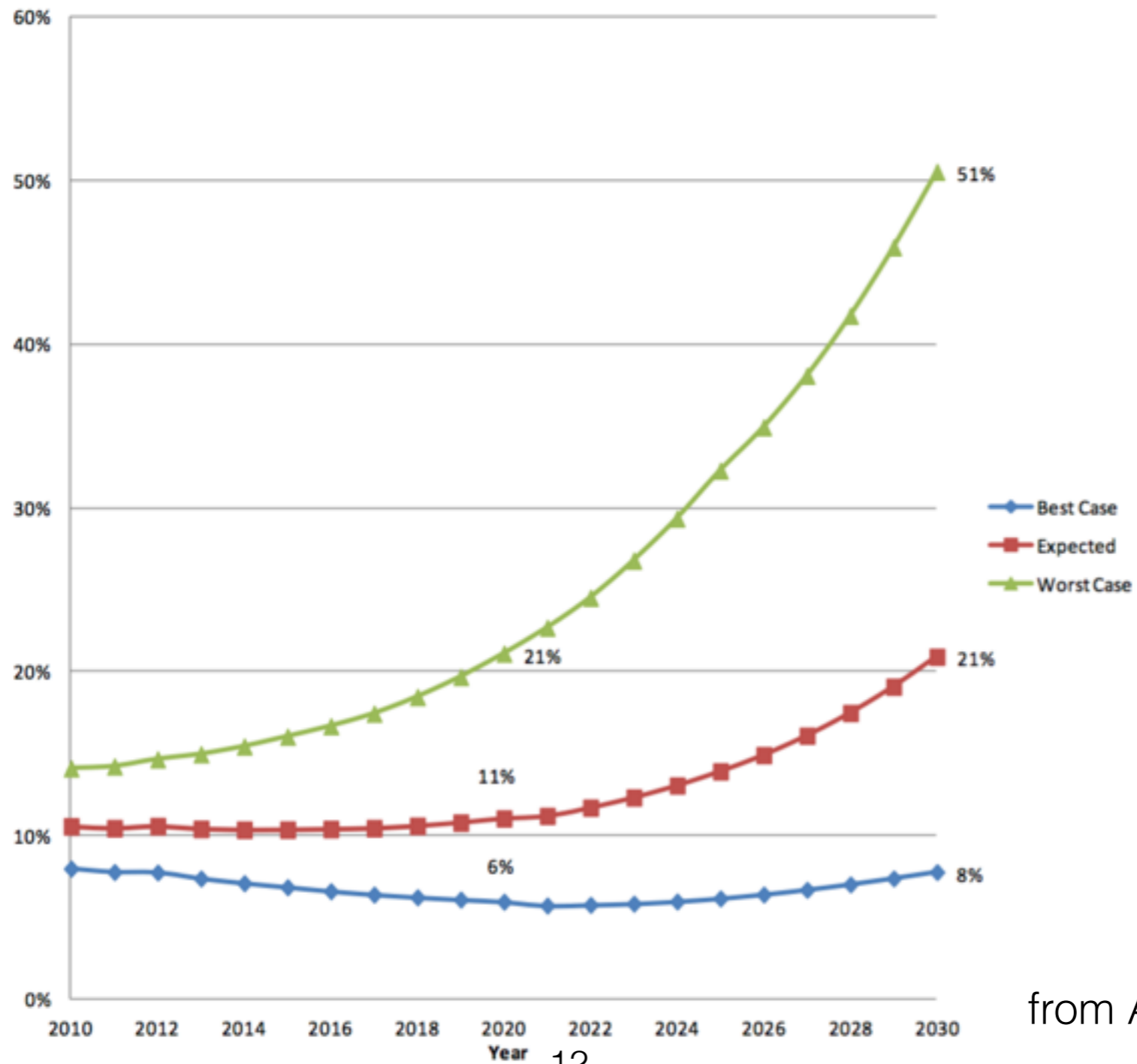Credit: Janine Morley

An "expected" case

Expected case scenario CT electricity

from Andrae & Edler 2015

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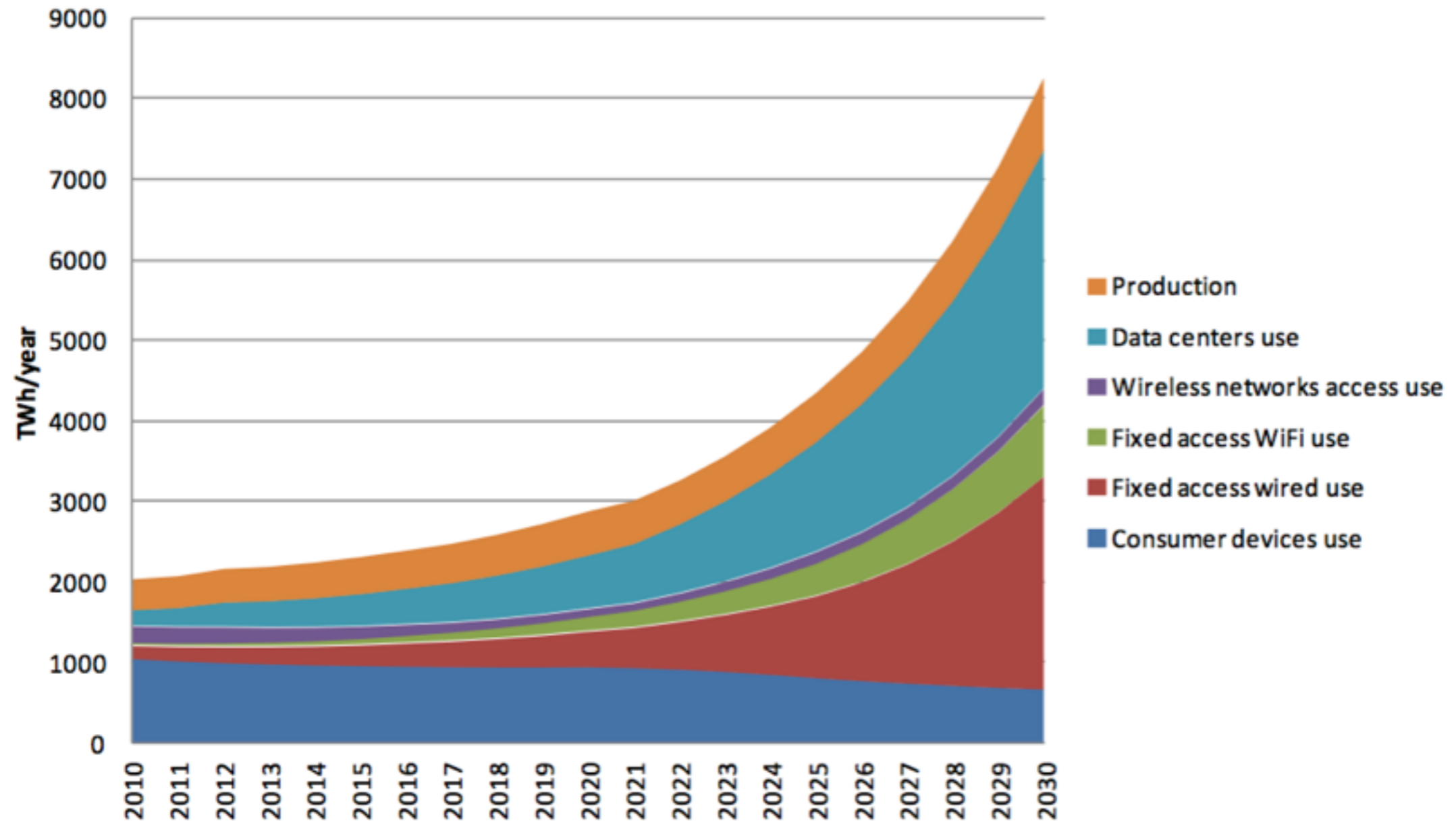
Best and worst cases

Share of Communication Technology of global electricity usage

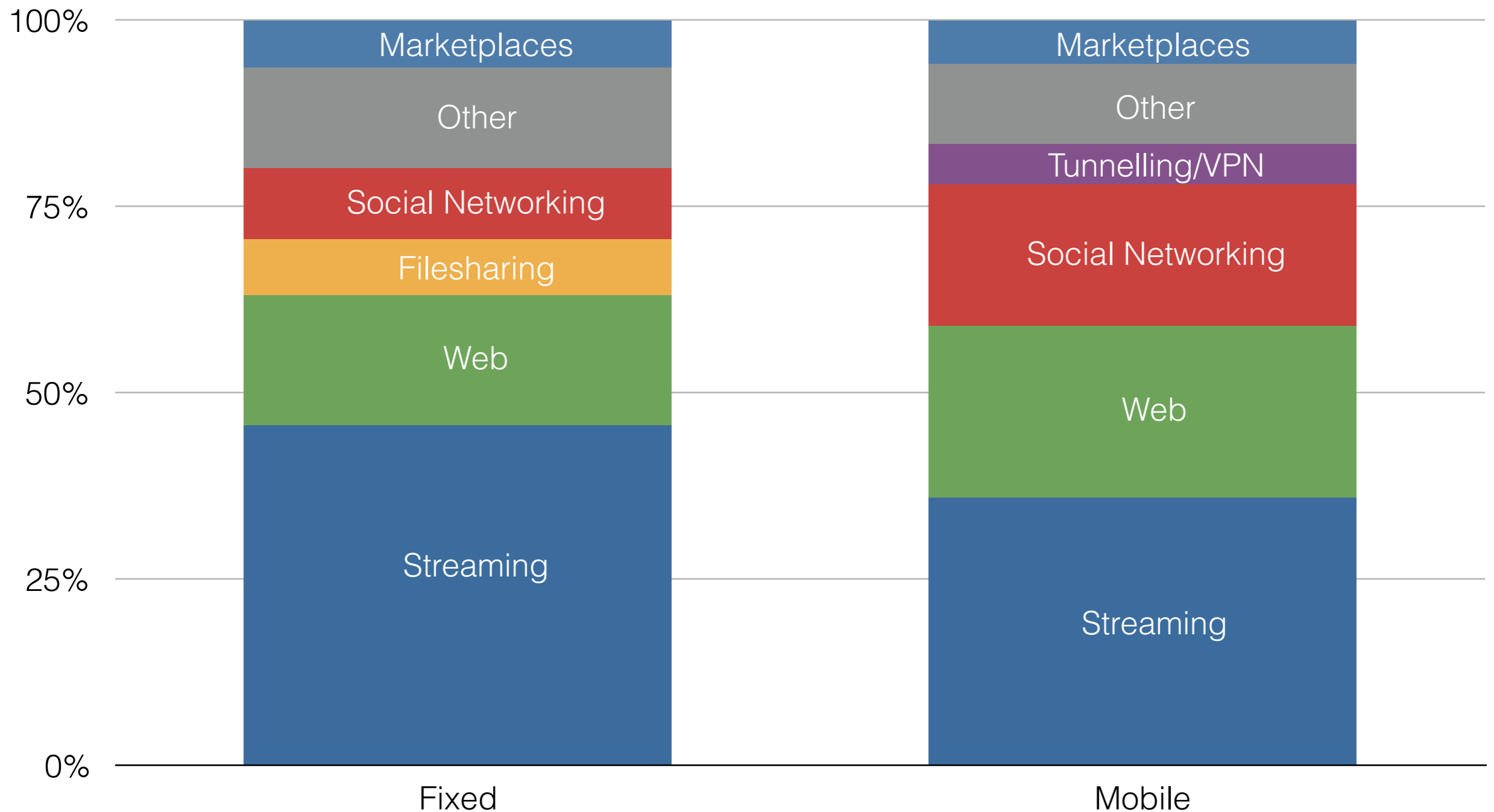from Andrae & Edler 2015

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Resource and energy debates

- transport

- healthcare

- heating and cooling

- online services?

What is the Internet *for?*

European downloads during peak periods

Fixed
- Marketplaces
- Other
- Social Networking
- Filesharing
- Web
- Streaming

Mobile
- Marketplaces
- Other
- Tunnelling/VPN
- Social Networking
- Web
- Streaming

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Three studies

1. iOS device logger "Squirrel": Foreground app, Mobile & Wifi data usage, screen state and battery

    - 6 phones, 7 tablets. Semi structured interviews, with graphs as a central feature

2. Android logger "Device Analyser"

    - 6 phones, 2 tablets. Interviews with graphs
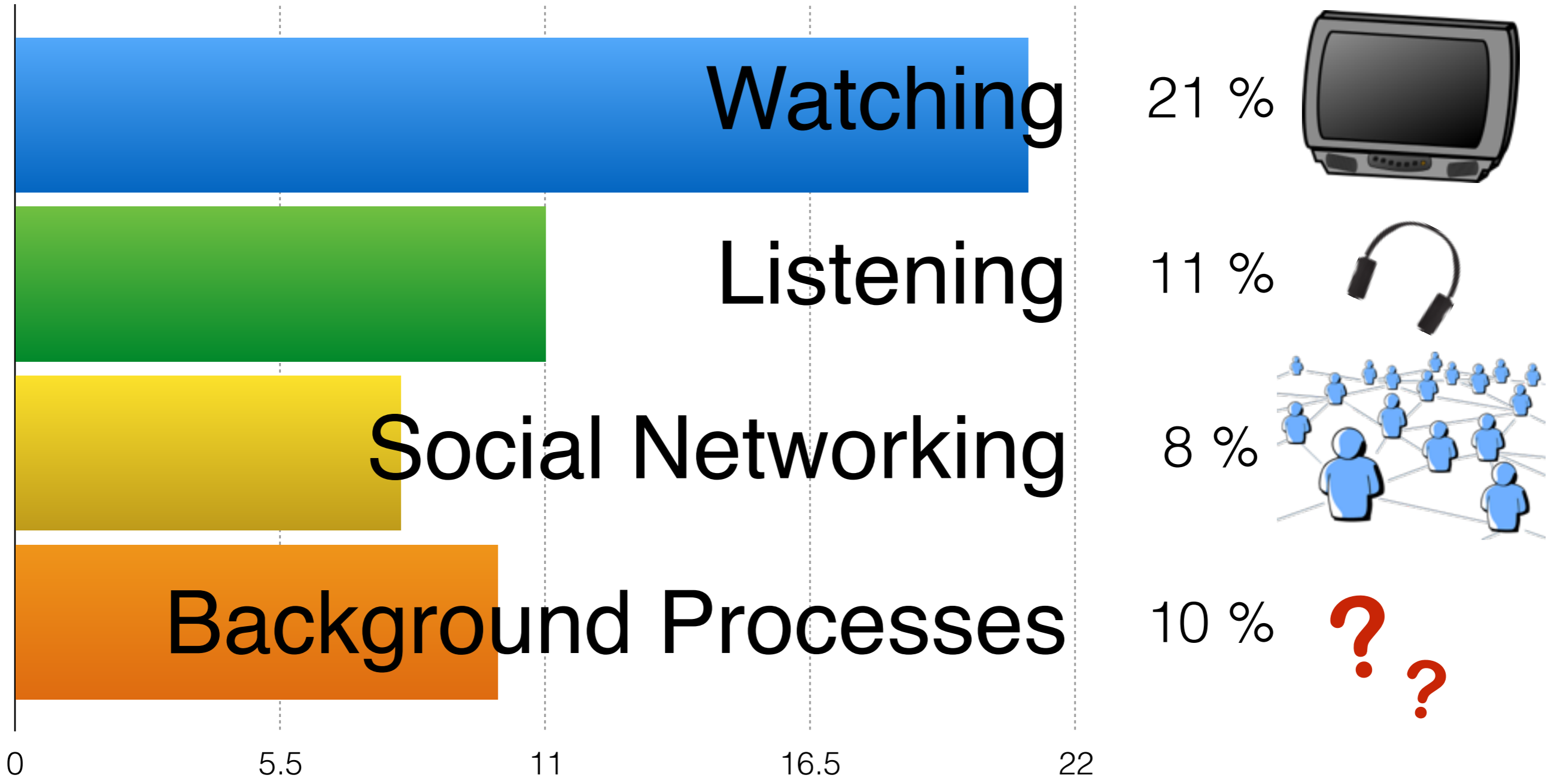
3. slice of Device Analyser dataset

    UNIVERSITY OF CAMBRIDGE

    - 398 devices across UK & Ireland

x 398

Communication

Analysers

Shopping Gaming

Watching

Navigation and Travel

Storage, Backups and Transfers Reading

Searching and Wikis

Background Processes and Services

Speciality Browsers SMS and Phone Listening

Online Dating Tools Social Networking

Security Office

Photography Settings

Health and Fitness

News, Weather and Magazines

Software and Application Updates

x 398

Watching — 21 %

Listening — 11 %

Social Networking — 8 %

Background Processes — 10 %

| 0 | 5.5 | 11 | 16.5 | 22 |

Average share of daily traffic volume (Ireland and UK)

x 398

Times and peaks

Chart: Data Demand (KB) vs Hour of the Day

Legend:
- Watching (345)
- Social Networking (331)
- Communication (347)
- Listening (321)
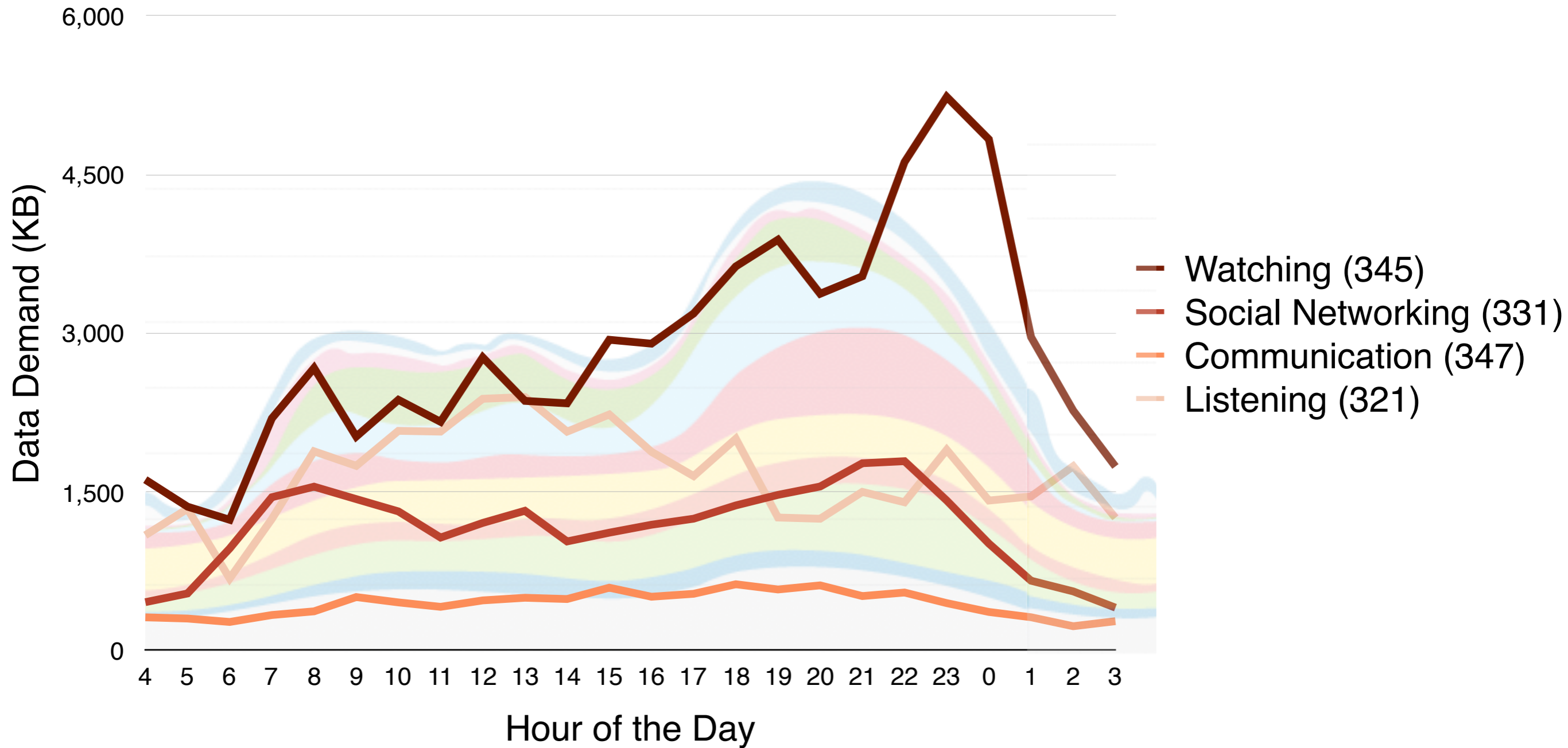
x 398

19

Times and peaks

x 398
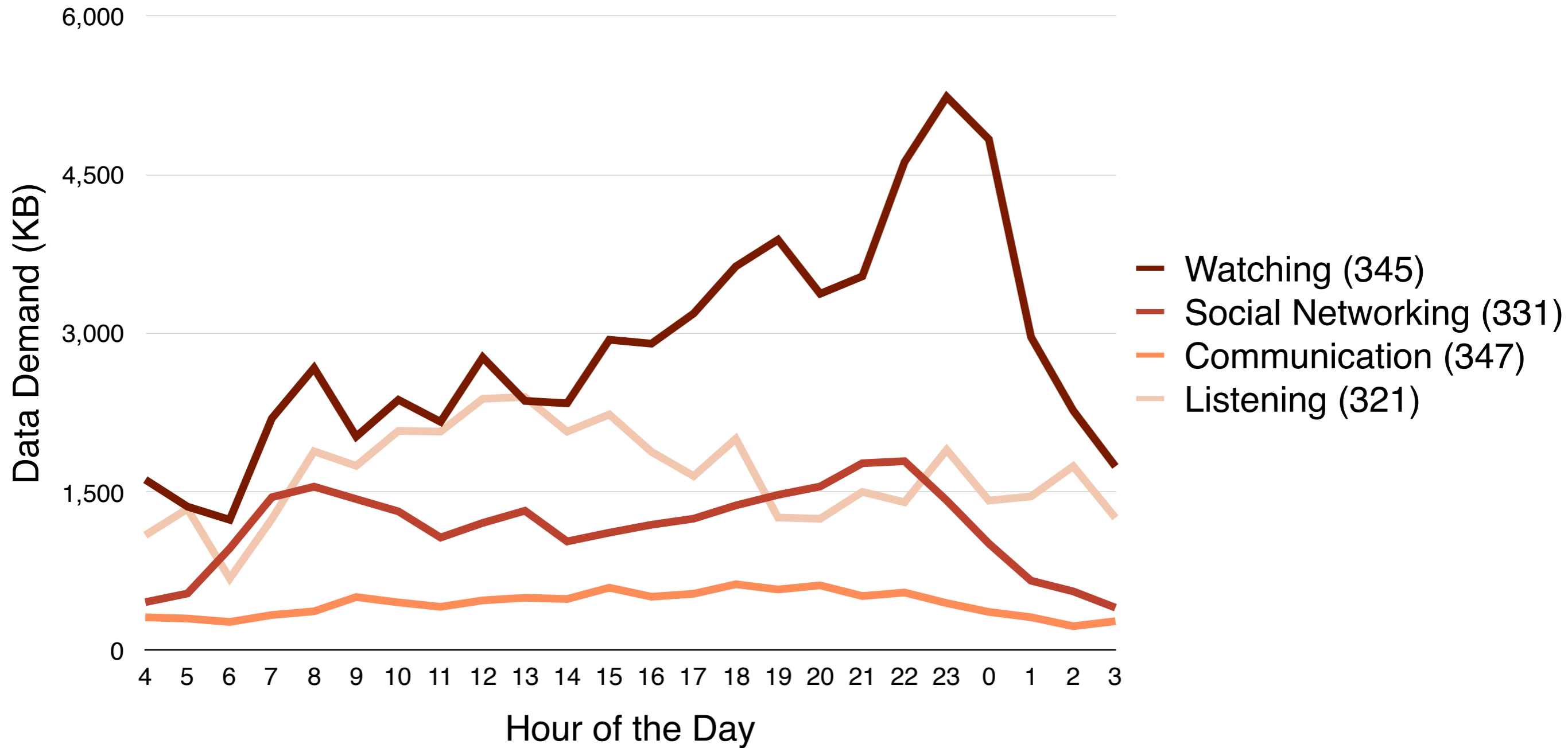
Filling time
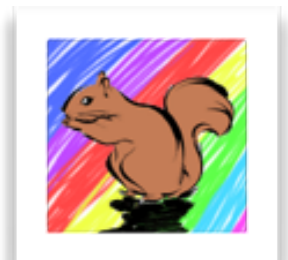

Ondrej Supitar

…"When I'm out and about I probably use my social networks more, 'cause I'm bored"…

(Colin, iPhone 5)

…"But then sometimes…when I'm waiting for something to cook, I'll be constantly refreshing it because I'm bored"

(Joel, iPhone 4)

Filling time and notifications

*"it's more of like an **obsessive pattern of just checking** each app really"*
- Harry

*"if I'm out and about and I wanna check the football scores I'll probably be **checking every 2 minutes**"*
- Mark

*"but if I'm at my desk, well we're not supposed to use a phone, but **if I do see it flashing I'll just, I'll usually like just turn it on, see what it is**, clear it"*
- Tim

Background noise

… "I think my use of background noise has kind of increased since having a tablet, 'cause I realised how easy it was but 'cause I've been on my own a bit more, like in the house. I just like to have noise behind me and the iPad allows that"…

(Mandy, iPad 2)

Victor @ Realistic Shots

Taking breaks from technology

*"**I'm not a slave to technology**, erm I use it at work 'cause I have to, I can download, I love the fact you can have information at your fingertips but I don't want to be on it at the end of the night"*
- Amanda

*"at night time I try and just leave it, erm if I'm communicating with someone I'll probably be on Facebook and then I'll just try and **have like rest from my phone** cause I've had it with me all day"*
- Victoria

Adapting to available infrastructure

"erm I was about to go on the flight"… "so I thought I will like **download a bunch of like videos from my laptop before the flight"**
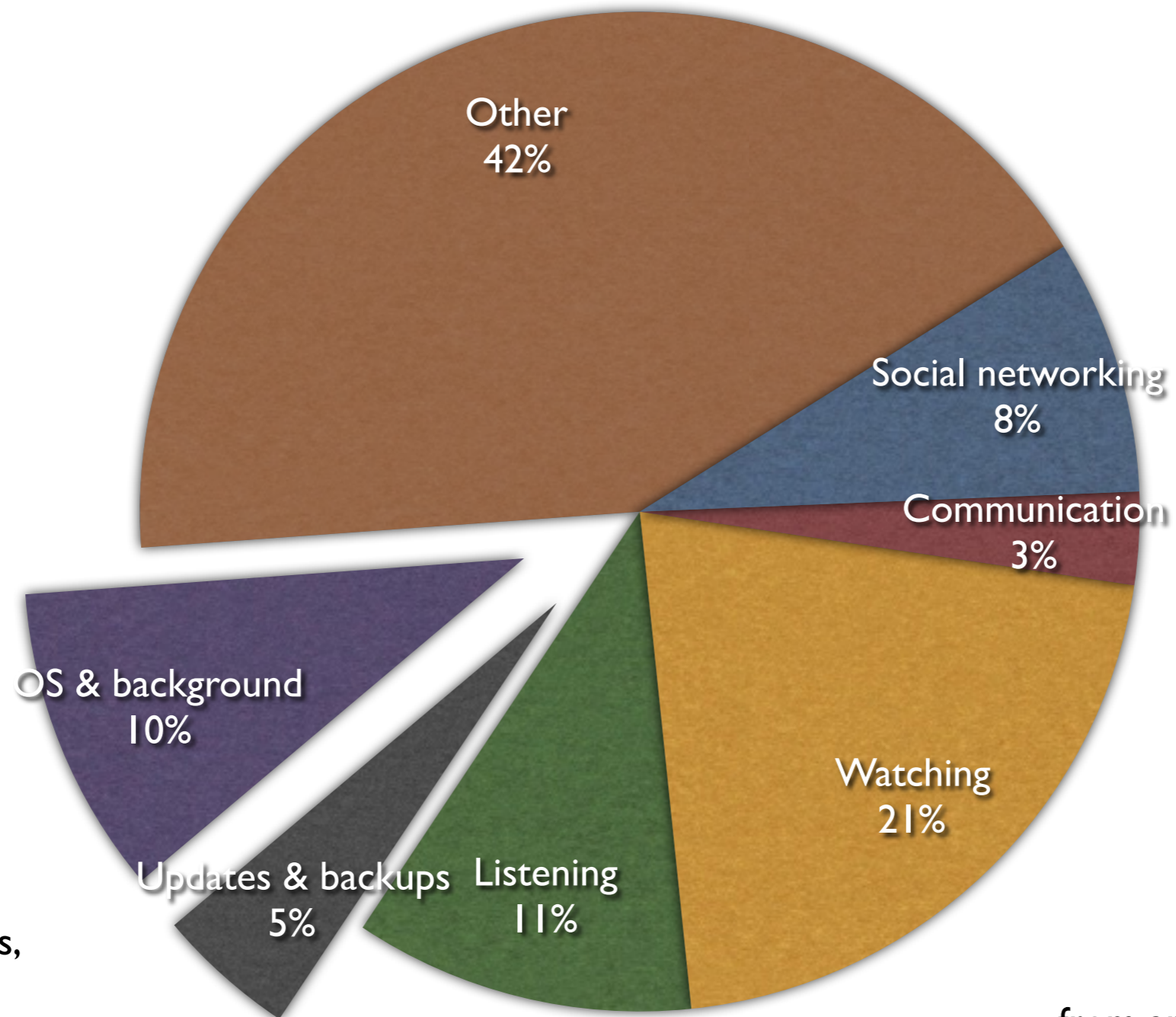- Xander

"so **I downloaded absolutely everything I needed to** *read and all, cause you get options of what you can do and I downloaded it all thinking I'll maybe,* **maybe I'll use that"**
- Holly

Significance of automated traffic

Other
42%

Social networking
8%

Communication
3%

Watching
21%

OS & background
10%

Updates & backups
5%

Listening
11%

398 participants,
2+ weeks

from analysis by Widdicks (2017),
"Demand Around the Clock"

Technical implications

- "screen off, network off"

- lower bandwidth background noise (or DAB hardware?)

- better match video bandwidth to device capability

- smaller, more strategic, less frequent app updates

- reduce and shift peak demand: updates, backups and pre-downloads to 3-5am

- lower reliance upon and frequency of connection to cloud servers and external storage

Broader and social implications

- emphasise dead time as slow time (or as a break from devices)

- raise awareness and encourage reflection

- environmental impact ratings for online services

- engage users to transition practices (watch/listen together; locally stored media; celebratory times)
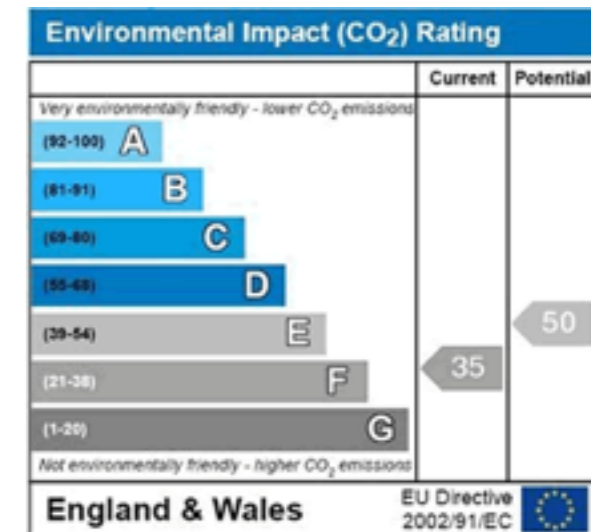
"there are no limits to growth when it comes to the Internet, except for the energy supply itself"

and so, uniquely,

"the energy use of the Internet can only stop growing when energy sources run out, unless we impose self-chosen limits"

–Kris de Decker, Low Tech Magazine

Hazas et al. (2016)
"Are there limits to growth in data traffic?"