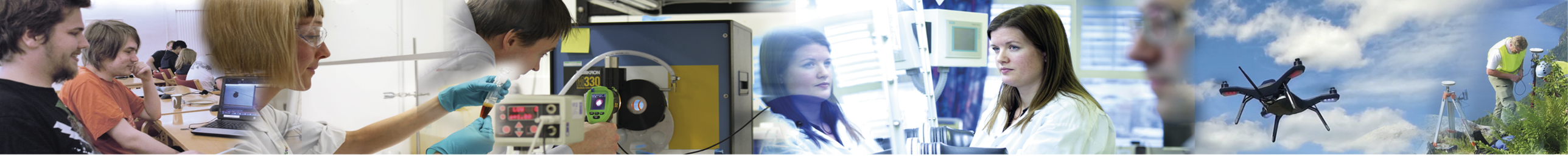


UiO : Department of Technology Systems
University of Oslo

Seminar on IoT and Sustainability -
Sintef, Oslo, 24Jan2019

IoT contributions to Sustainable Developments(?)

Josef Noll,

Professor, University of Oslo, Department of Technology Systems

Kjeller, Norway, m: +47 9083 8066, e: josef@jnoll.net

"The last time I was connected by wire was at birth"

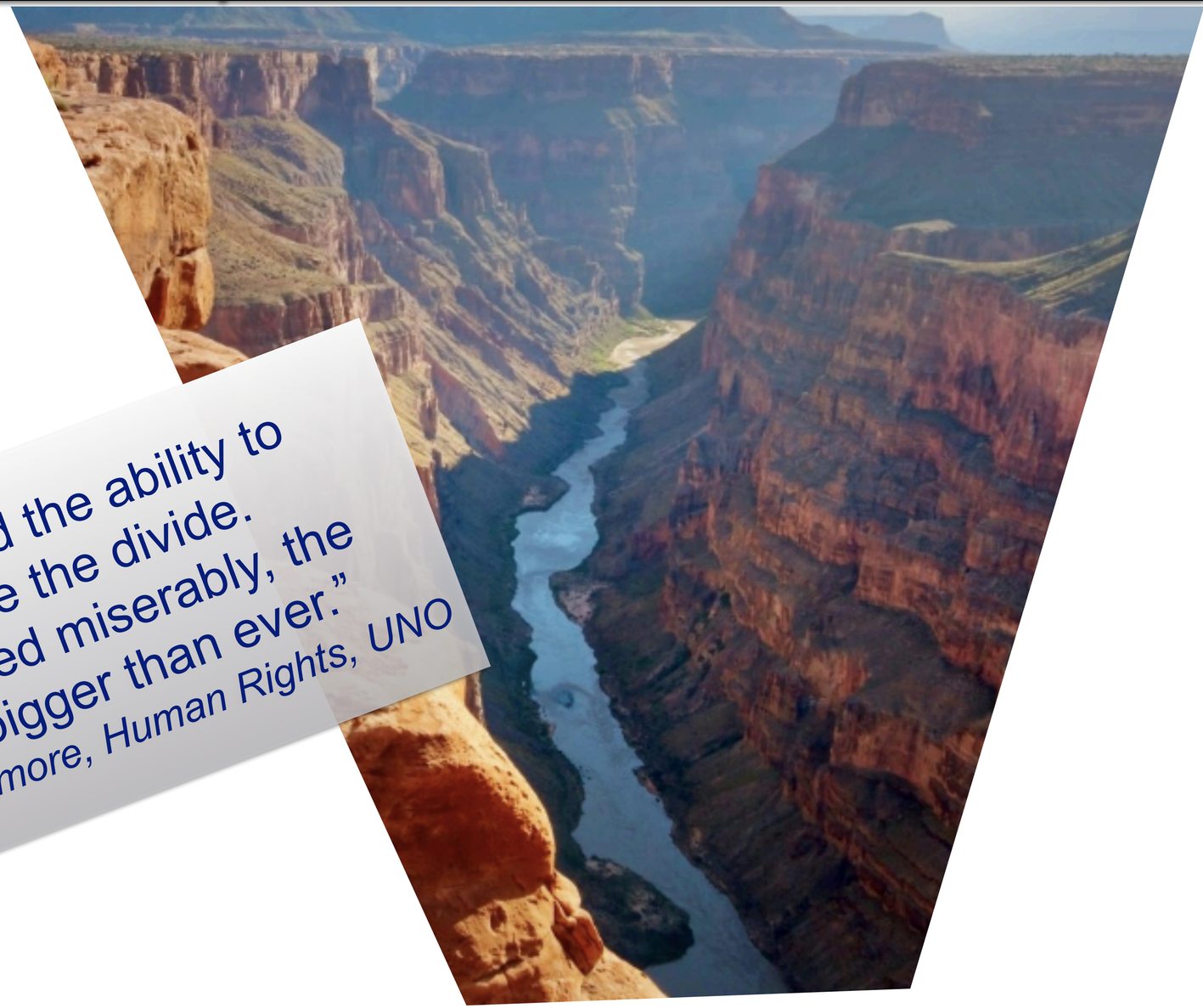
- Grand challenges
  - Resources, Climate
  - "The Divide"
- IoT and automated systems
  - Automation and societal aspects
- Sustainable Innovation
  - Digital Inclusion
  - Return on SDGs (RoSDGs)
- Conclusions

Grand Challenges

- Grand Challenges
  - Climate
  - Resources (radio, minerals)
    - Kobald (East - DR Congo)
  - Divide

- Digitisation
  - Mobile Networks
  - IoT
  - Automation

...

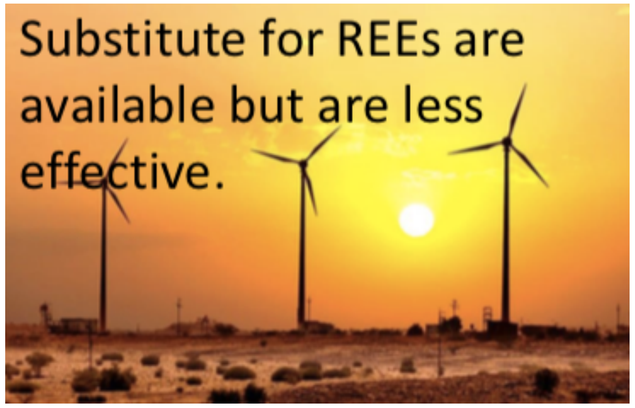


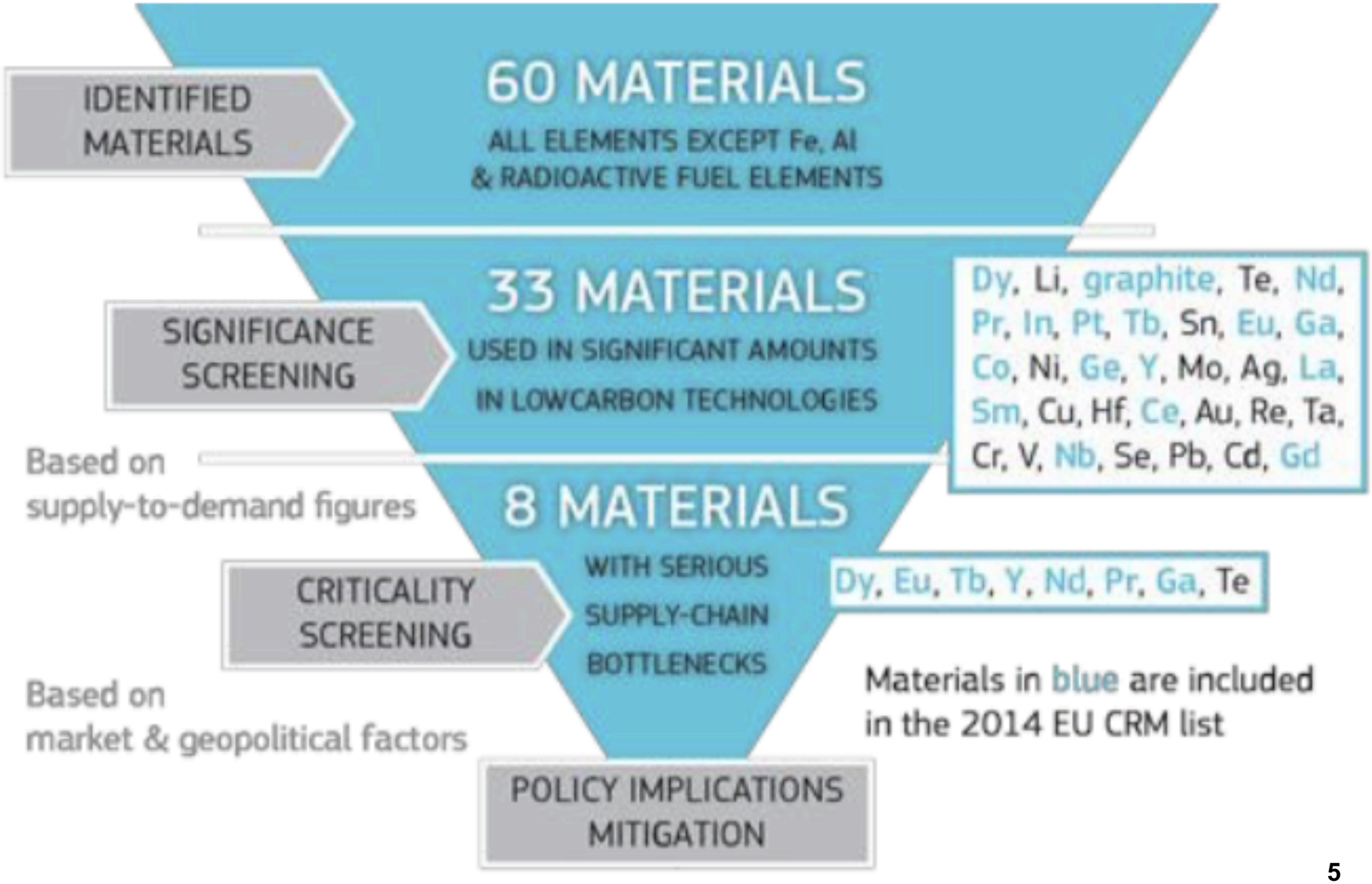
"Internet had the ability to dismantle the divide. Internet failed miserably, the divide is bigger than ever."
Kate Gilmore, Human Rights, UNO

Challenge 1: Resources

Resources: Shortage of Materials

- EU critical materials in Energy Technology
- REEs terbium, neodymium, dysprosium

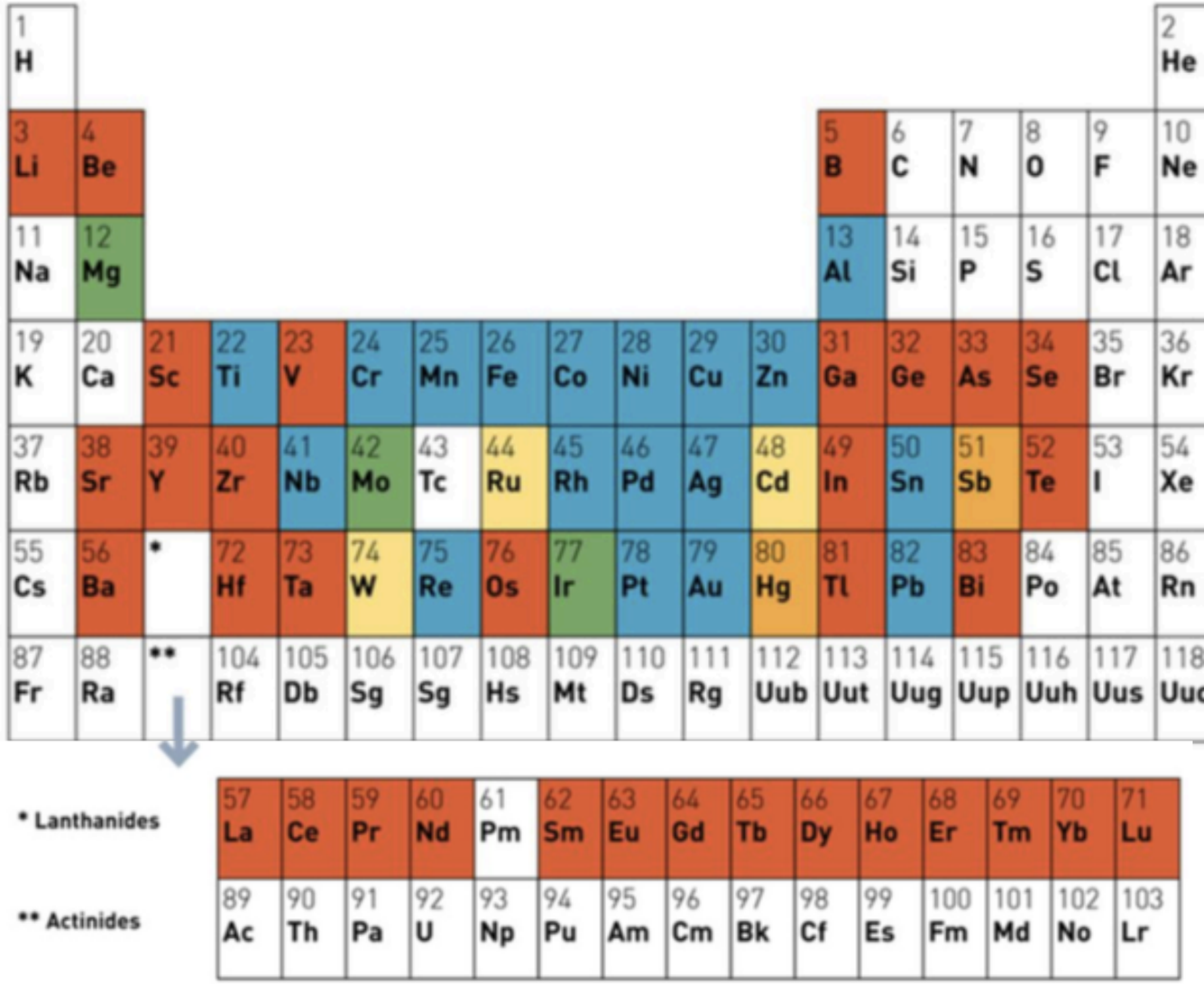




Source: HyProS Arena Meeting UiO, 6Dec2018

Resources: Recycling rates of Metals

- 30+ elements have <1% recycling rate



Ref: T. E. Graedel, B. Reck, M. Buchert, C. Hagelüken et al. "Recycling rates of metals", United Nations Environment Programme, (UNEP edits.) 2011

Source: HyProS Arena Meeting UiO, 6Dec2018

A sustainable Future?

WWRF Vision in a nutshell (1)

7 trillion wireless devices serving 7 billion people by 2020

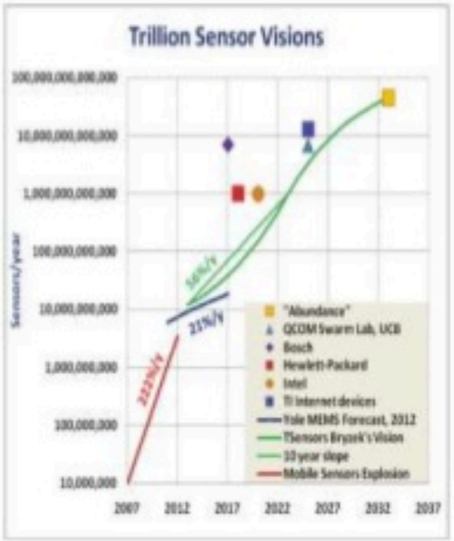
Internet of Things Forecasts

enocean alliance
No Wires. No Batteries. No Limits.

30 Billion

permanently connected things by 2020

Source: Gartner, 2014.



50 Trillion

connected sensors by 2032

Source: TSensor Summit Oct 2013

How are we going to power and connect trillions of sensors?

Challenge 2: The Digital Divide

SUSTAINABLE DEVELOPMENT GOALS

And what about IoT?

FREEDOM OF EXPRESSION

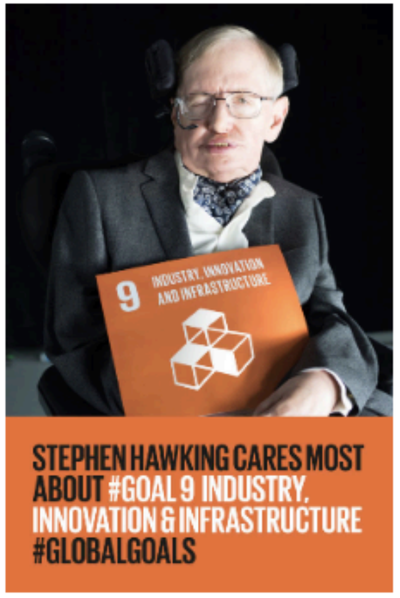
We can't reach the U.N. goals for sustainable development without the internet

22 JUNE 2017 | 11:40 AM

Tweet Share

It's become common wisdom that the United Nations' ambitious "Global Goals for Sustainable Development" aren't just for the U.N., or even governments, to implement. Launched in September 2015, the 17 goals and 169 targets are "a series of ambitious targets to end extreme poverty and tackle climate change for everyone by 2030" (hence the alternative moniker, the "2030 Agenda for Sustainable Development").

Replacing the more arcane "Millennium Development Goals," these Sustainable Development Goals (SDGs) are everyone's goals, crowd-sourced to completion and promoted by companies and civil society alike. (Cue the hip, auto-playing video on the website.)



Smartly, the goals, especially Goal 17, emphasize that **access to technology underpins every one of these commitments** to the eradication of extreme poverty.

However, not all connectivity is the same, nor yields the same benefits to societies in terms of economic, social, or cultural development. As we told the International Telecommunication Union (ITU), only **stable, secure, and open access** to broadband internet will ensure success for the U.N. SDGs. That's something civil society and our partners will continue to make clear, and we'll need to work in legislatures to get the point across, not simply at aid and development banks.

To reach the SDGs, we need civil and political advocacy

Traditionally, information and communications technology (ICTs) have not been a major recipient of aid funding. That's one reason this crucial technology is "under-represented" in the SDGs and appears in only four of the 169 targets. It's assumed that telecommunications will take care of itself, having been largely deregulated and privatized in the 1980s and 1990s. Yet **more than half the world's population is not using the internet**, a statistic showing the failure of local, national, and global governance, with economic, political, and moral implications

PETER MICEK
@lawyerpants

FREEDOM OF EXPRESSION | GLOBAL | #ITU4SDG | #KEEPITON | CONNECTIVITY | ITU | SDG | SUSTAINABLE DEVELOPMENT GOALS | UNITED NATIONS

RELATED

Beyond connectivity: building an inclusive U.N. agenda for internet development Read More ▸

Access Now welcomes new report on economic impact of shutdowns Read More ▸

https://www.accessnow.org/cant-reach-u-n-goals-sustainable-development-without-internet/

Access to information
to reach the Sustainable Development Goals

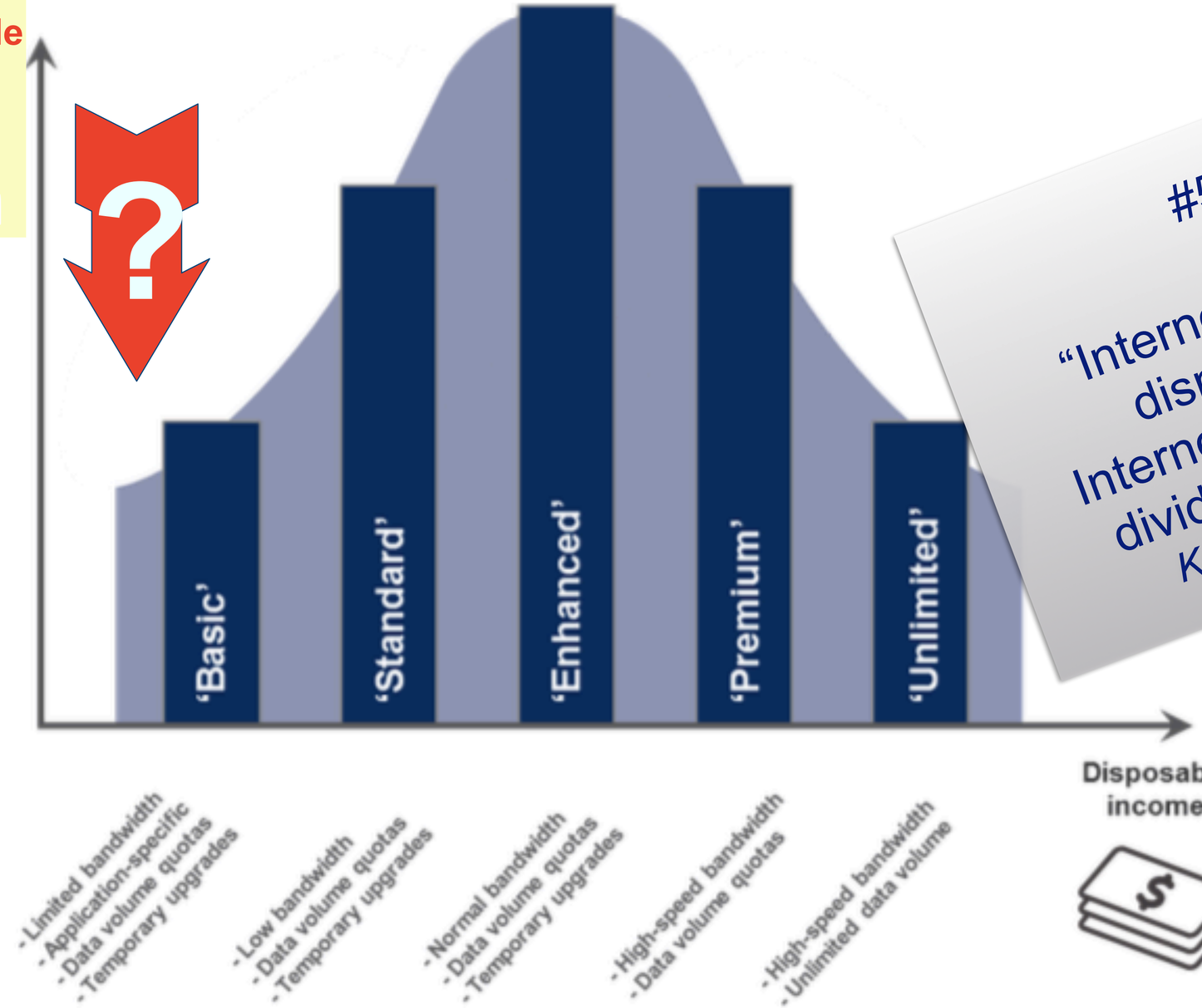
- Report by
  - Pure Consulting
  - UiO
  - Basic Internet Foundation

- Access to Information
  - only in 4 of the 169 targets
  - transferred from 2020 -> 2030 goals
  - Under-communicated by Aid & Development

Challenge 3: Existing Business Models

Telecom view on digital inclusion

Addressable Market



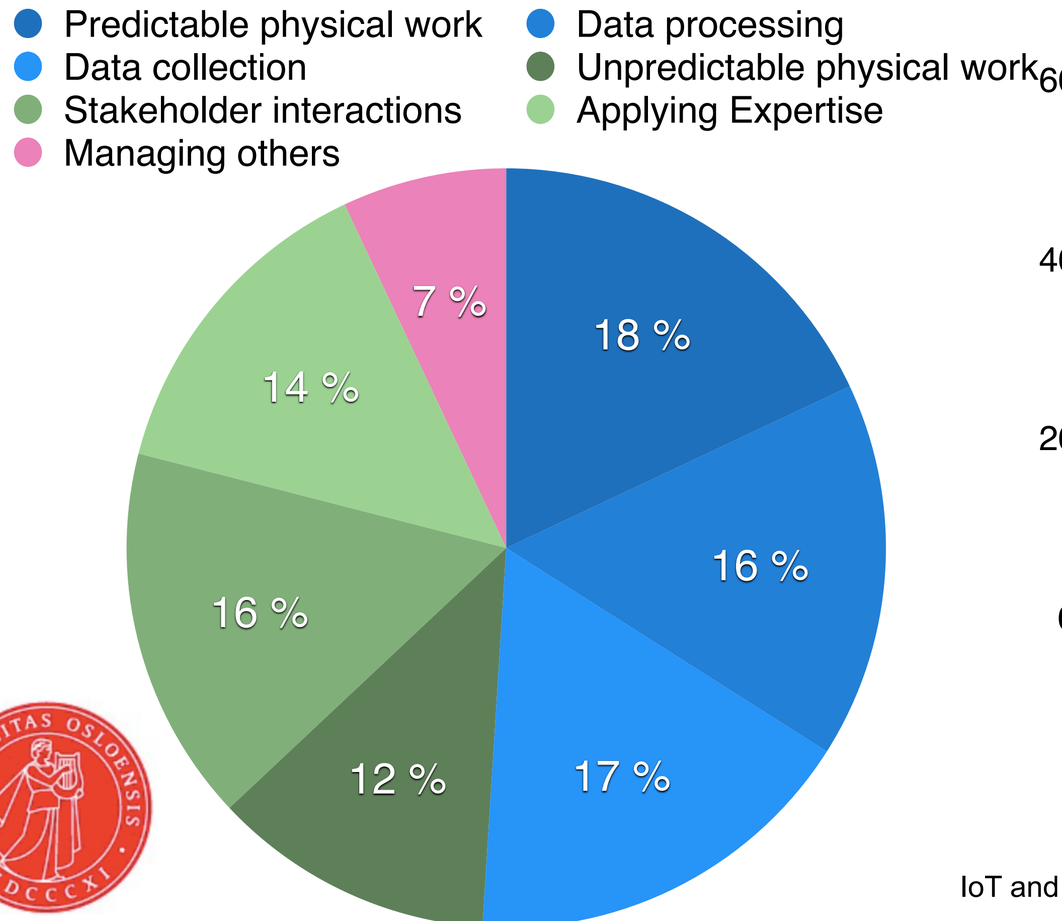
#5Gfor All?

"Internet had the ability to dismantle the divide. Internet failed miserably, the divide is bigger than ever."
Kate Gilmore, Human Rights, UNO

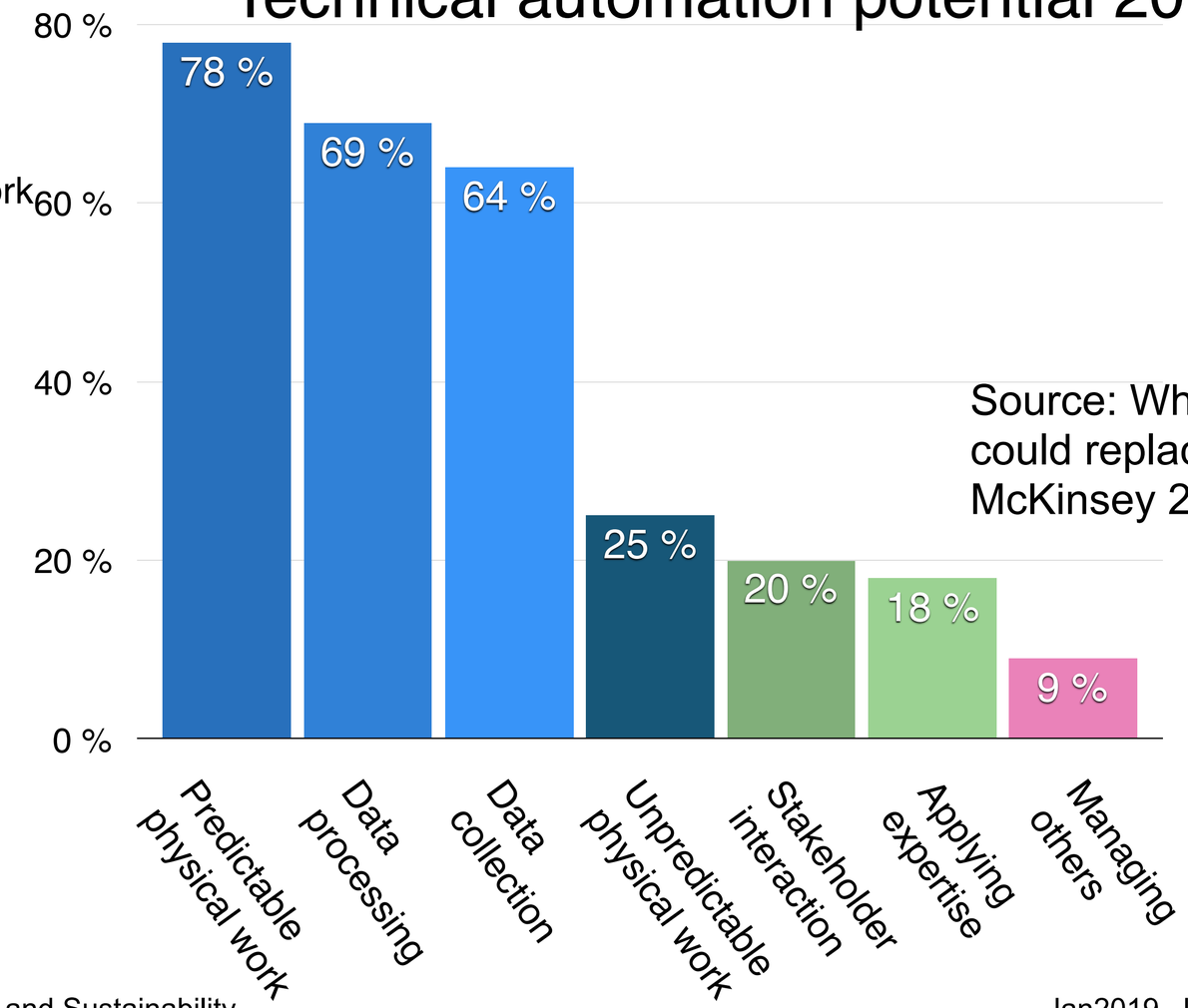
Source: Service Innovation through Smart Networks, Ericsson, https://www.ericsson.com/assets/local/networks/documents/service-innovation-through-smart-networks.pdf

Automation will come

USA work force time spent [%]



Technical automation potential 2016 [%]

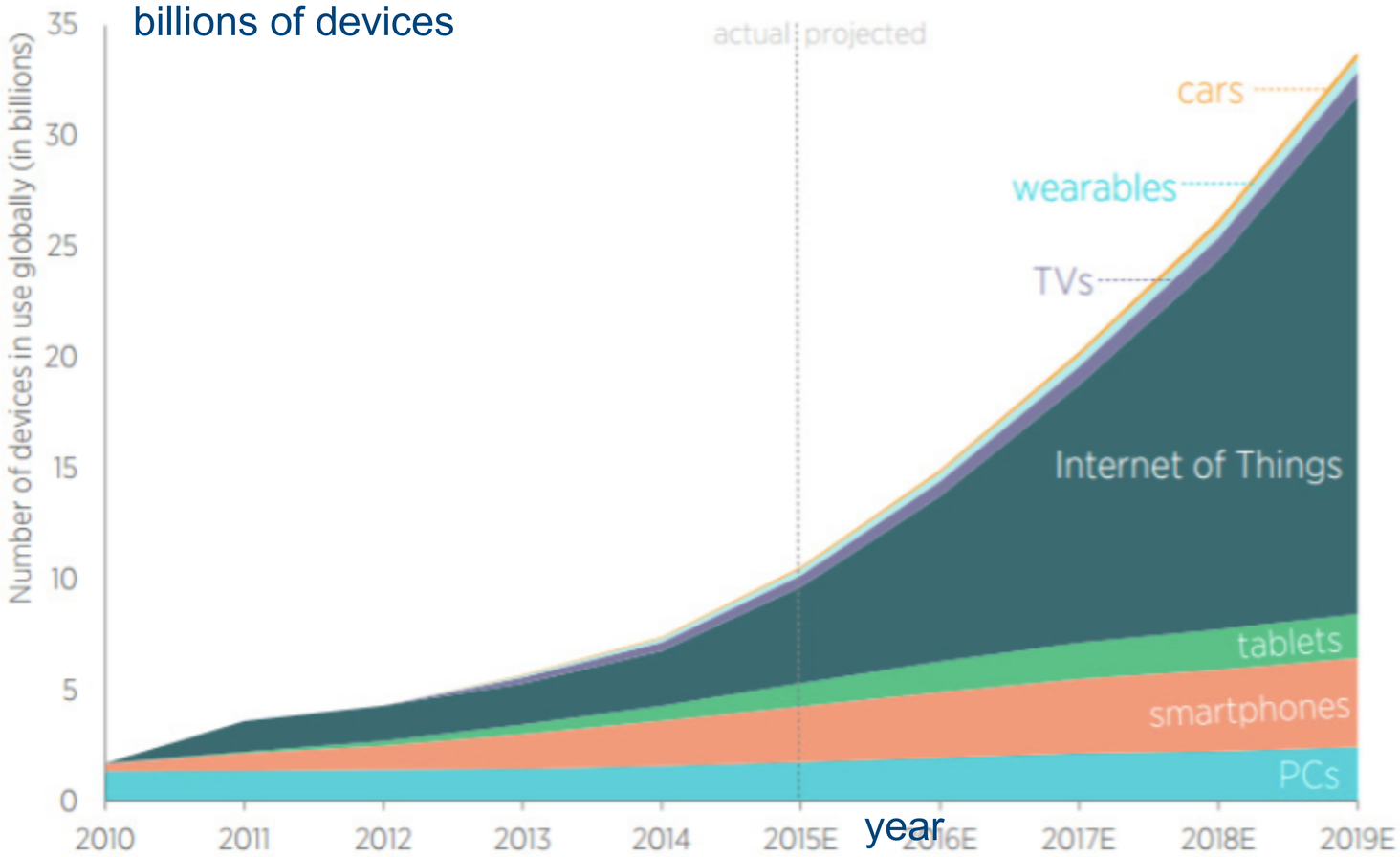


Source: Where Machines could replace humans, McKinsey 2016

IoT expected impact, only for “the connected”?

[Source: A. Thinner and A. Castillo, 2015]

- Smart home appliances, “wearables”, smart metering, autonomous vehicles,…
- 10 billion (2013) -> 19 - 40 billion (2019)
- total global impact: US$ 2.7 - 14.4 trillion by 2025
- **~3/4** of devices from IoT++ ~1/4 from tablet, mobile,…



Source: John Greenough, “The Internet of Everything 2015,” *Business Insider Intelligence*. Produced by Adam Thierer and Andrea Castillo, Mercatus Center at George Mason University, 2015.

The economic perspective

- The big 5 IT companies have a GDP as big as that of France
- Amazon largest sector in terms of revenue is selling of data
  - ➡ 20% of revenue

- How can SMEs compete?
  - ➡ Each service and device gets a privacy label

- Four areas for Privacy Label
  - ➡ which data are collected
  - ➡ sharing to my phone, my cloud, public cloud,...
  - ➡ data communication integrity and storage
  - ➡ further distribution of data, ownership of data, further processing

Privacy Label (A-F)

- easy visibility
- customer focus
- transparent

privacylabel.IoTSec.no

Discussion Topics:

- #1 trillions of sensors vs resources/waste

- #2 the digital gap vs digital partnership

Google translate

Partnership for Digital Africa

http://www.aftenposten.no/meninger/debatt/Kronikk-Som-gjesteland-pa-G20-toppmotet-ma-vi-bidra-til-a-endre-verden--Erna-

Basic Internet Foundation

G20: Compact with Africa

Comment: As a guest ... it, we mu...
change the wor...

7:58 P.M.

In July last year was Erna Solberg invited by Angela Merkel for this year's G20 meeting. Here from a meeting between the German Chancellor and the Norwegian Prime Minister in Berlin in November, where Norway's participation as guest country at the economic summit were among issues discussed.

Secretary-General's High-level Panel on Digital Cooperation

PANEL DOCUMENT

- Press release
- Terms of reference
- Panel member bios

Call for Contribution

G20 can the... resources mo... ...which create growth and job creation.

3. Health an... education.

Norway has long h... a heavy international involvement. Education and health are associated with economic growth.

5G network slicing for Free Access to Information for All

Mobile Broadband

Massive IoT

Reliable & ultra-low latency

0 1 0 1
1 0 0 1
0 1 0 0

Free access to information for all

5G Networking

Software-enabled routing

Communication, Internet, Entertainment

Automation, Manufacturing, Retail

Autonomous systems
Health/Medical
Alarm, Infrastructure

Information
(text & pictures)

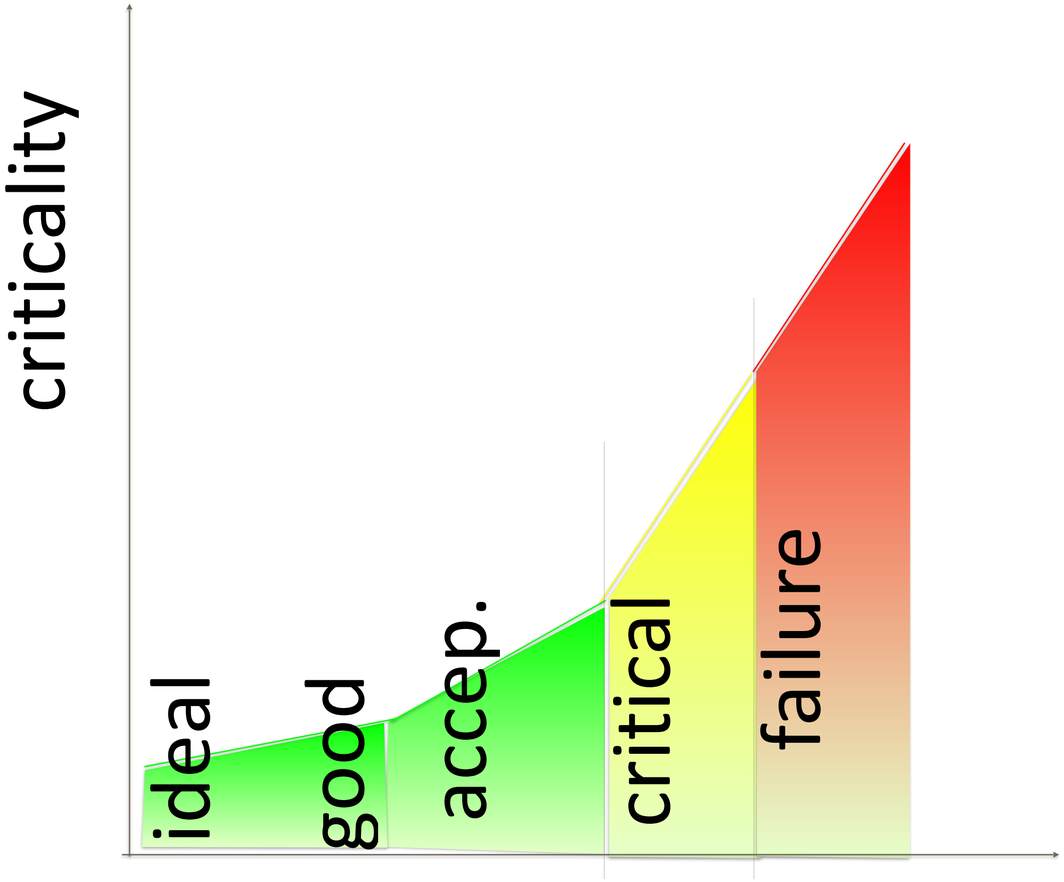
Discussion Topics:

- #3 security

- #4 privacy

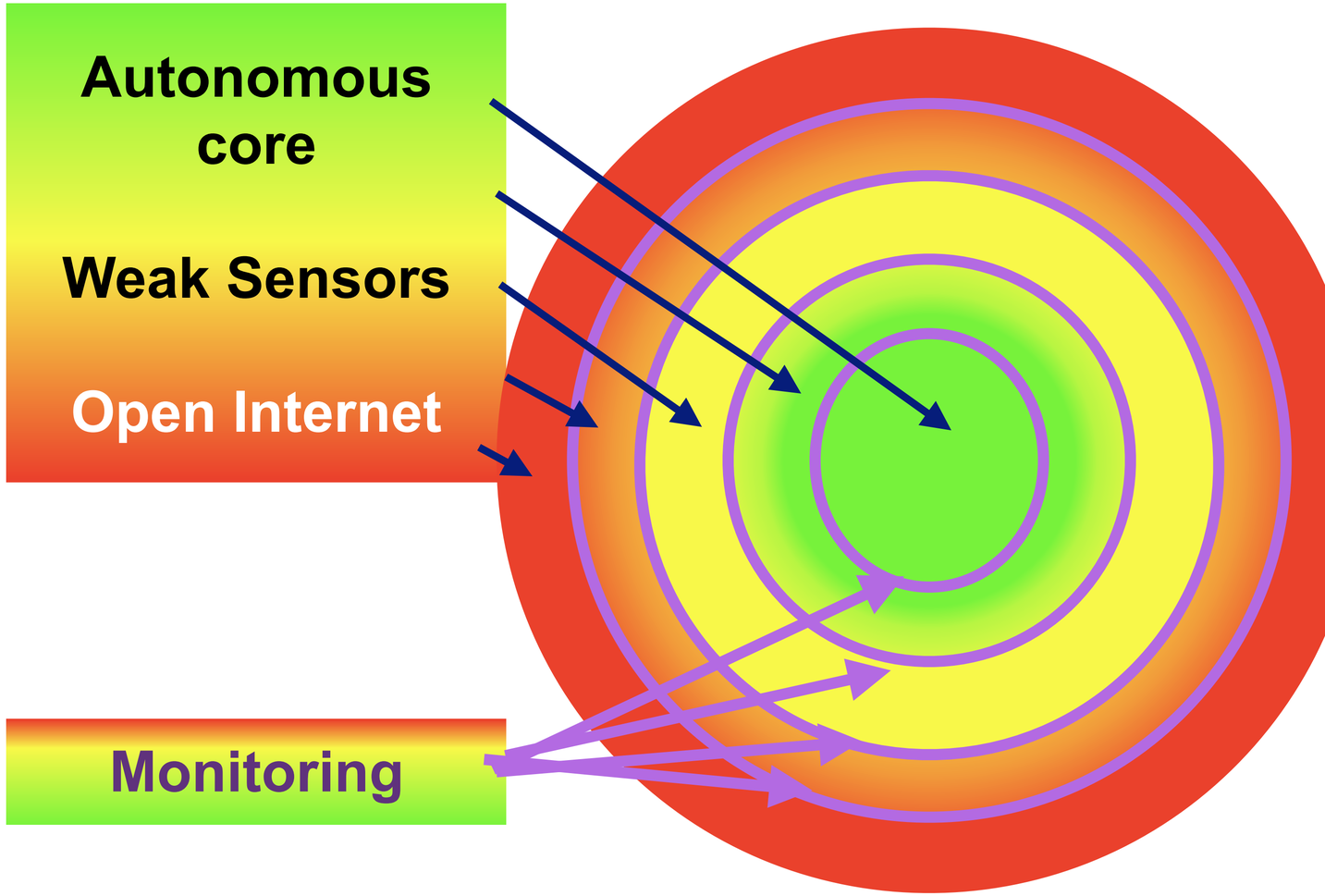
Autonomous, sensor-driven systems

- Design with optimal usage in mind
  - ideal operation
    - all sensors are working
    - no interference (wireless sensor networks)
    - non-hostile environment
- Real system
  - Sensors don’t work
    - Øresund train crash (wind sensor)
  - Sensor fail
    - logic, modelling
  - System under attack



The new security paradigm

- Focus on attack is not sufficient
  - ➡ new vulnerabilities
  - ➡ 10+ years sensor life-time
- Onion approach
  - ➡ Autonomous Core
    - proven autonomy (ship, smart meter)
    - formally proven
  - ➡ Layers
    - monitoring
    - firewall



Instantaneous and high-resolution

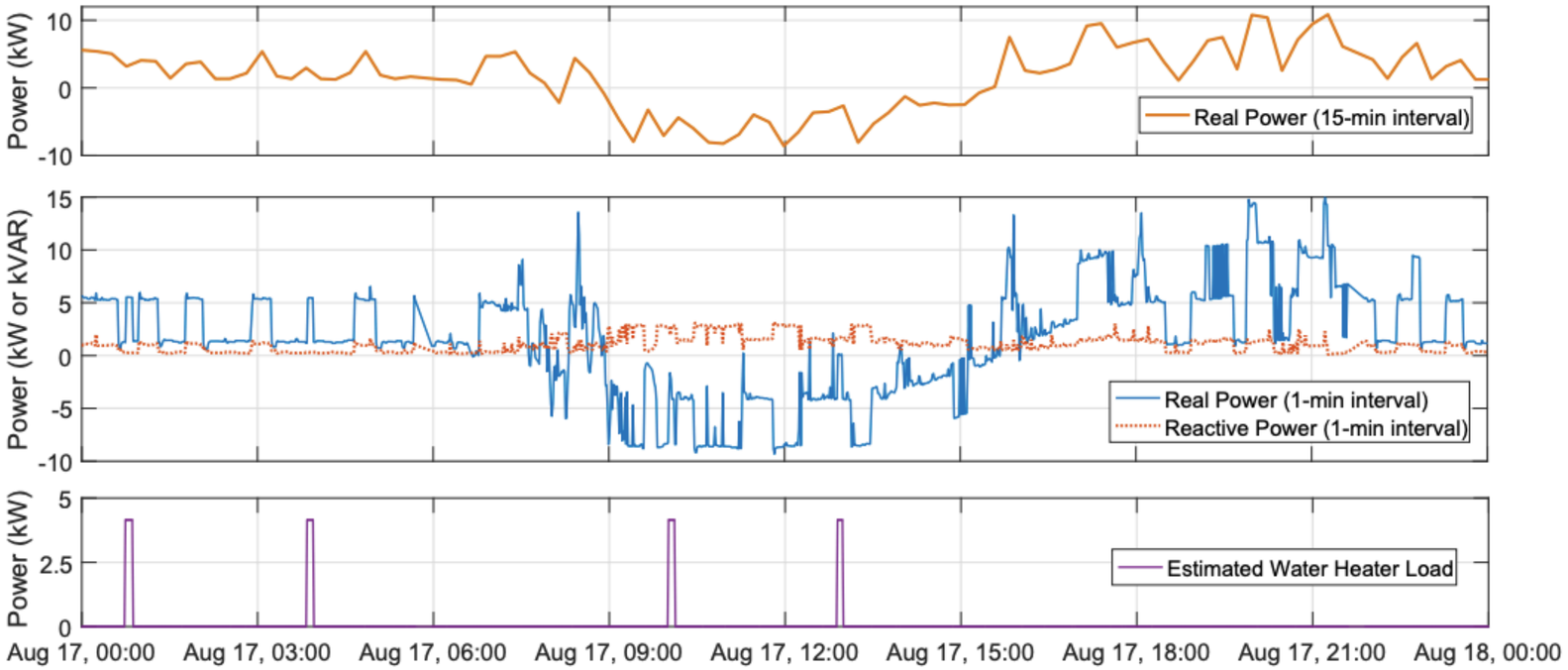
- HAN Port
  - energy usage
  - online monitoring (1/s … 1/min)
- Typical Norway
  - Power (every 2.5s)
  - Current (every 10s)
  - Voltage (every 10s)
- Connected devices
- Security

physical security, encryption

AMS HAN port (NEK)
https://www.nek.no/info-ams-han-brukere/

Meter analysis - knowledge about you

- Security
  - (unencrypted) wireless data
  - Cloud computing
  - “is my HAN port open?”
- Information & control
  - energy saving (water heater)
  - load control
  - Fridge, freezer, heat pump,…
  - usage pattern, “door is open”
  - “which TV channel do you watch” (every 2s)



http://nilmworkshop.org/2018/proceedings/Poster_ID17.pdf

https://www.cnet.com/news/researchers-find-smart-meters-could-reveal-favorite-tv-shows/

"Amazon Echo" in your smart meter

- Amazon/Google/Apple home control
  - ➡ works on your command

- "Amazon HAN connect"
  - ➡ works all the time
  - ➡ brings all your information to the cloud

Amazon Echo/ Alexa

Apple Home Kit

Google Home/Nest

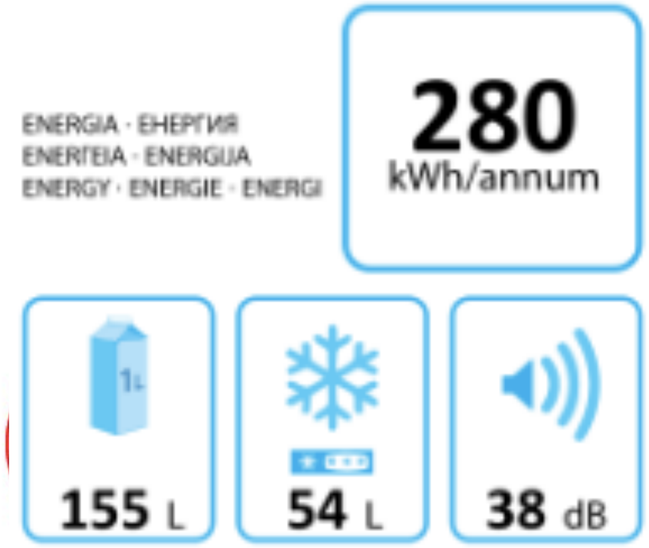
Comparison with the Mobile Network

- Facebook's Free Basics
  - ➡ 0-rated content (free usage)
  - ➡ 3-months break even
- The con's of Free Basics
  - ➡ every click goes to Facebook
  - ➡ Net-neutrality

- HAN port
  - ➡ who owns my power consumption?
  - ➡ cloud analysis?

Premier Minister Narendra Modi (India)

Towards Measurable Privacy - Privacy Labelling



- "Measure, what you can measure - Make measurable, what you can't measure" - Galileo
- Privacy today
  - ➡ based on lawyer terminology
  - ➡ 250.000 words on app terms and conditions
- Privacy tomorrow
  - ➡ A++: sharing with no others
  - ➡ A: …
  - ➡ C: sharing with ….
- The Privacy label for apps and devices

Appfail Report – Threats to Consumers in Mobile Apps

The Norwegian Consumer Council analysed the terms of 20 mobile apps. The purpose is to uncover potential threats to consumer protection hidden in the end-user terms and privacy policies of apps.

Conclusions

- Sustainability & IoT
- #1 Trillions of Sensors vs Waste/Recycling
- #2 Digital gap vs digital partnership
  - ➡ “Nobody should be left out from the Digital Society”
  - ➡ Give everyone access to digital information & IoT
  - ➡ Freemium model for access
- #3 Security with autonomous core
- #4 Privacy
  - ➡ Information protection - privacy labels