



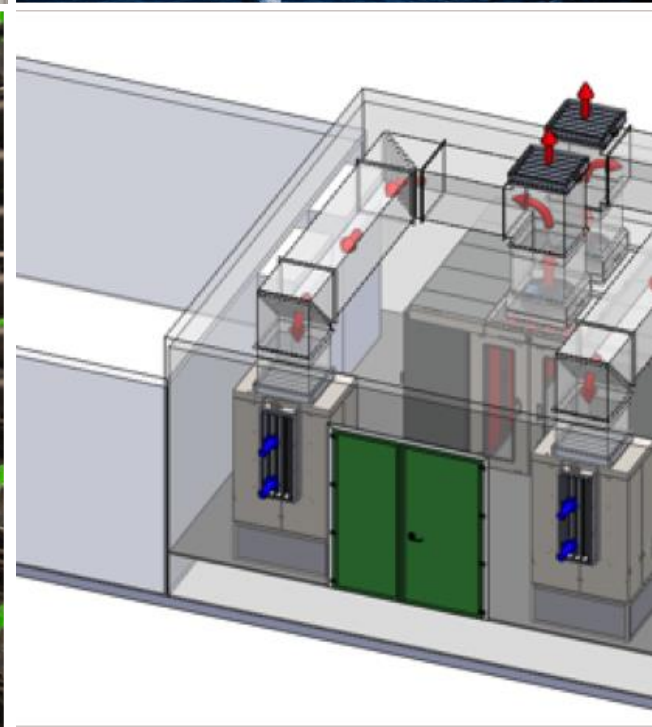
ARCTIC OPPORTUNITIES IN THE DATACENTER INDUSTRY

Tor Björn Minde, CEO

June 2017

Research Institutes of Sweden

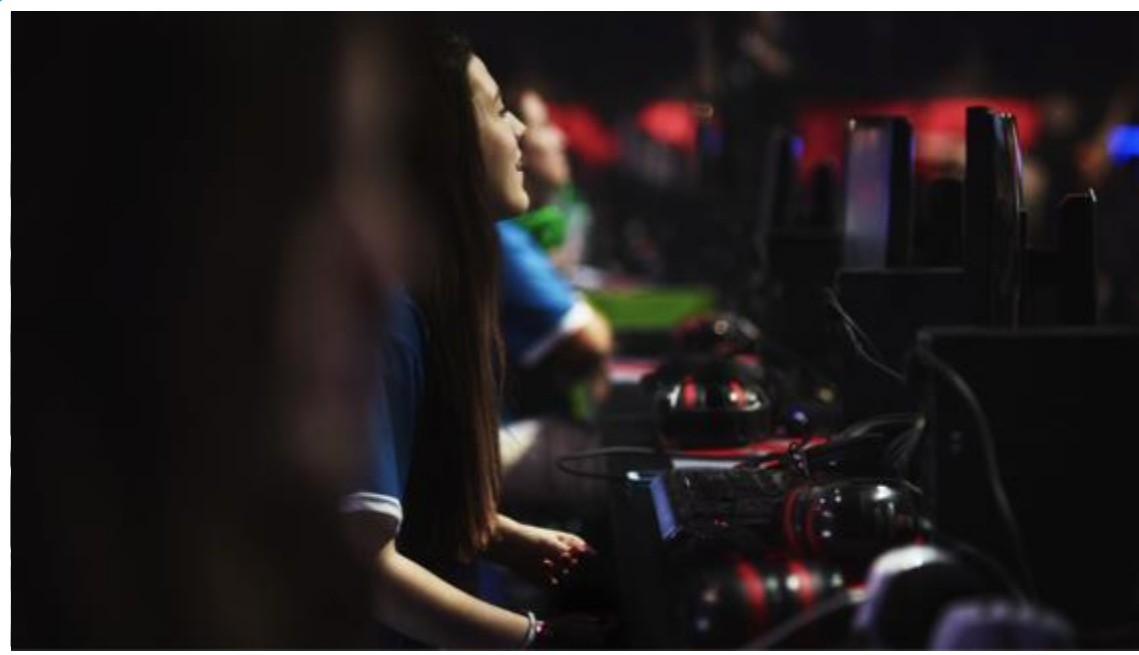
SICS North



Industrialization – Innovation based on power

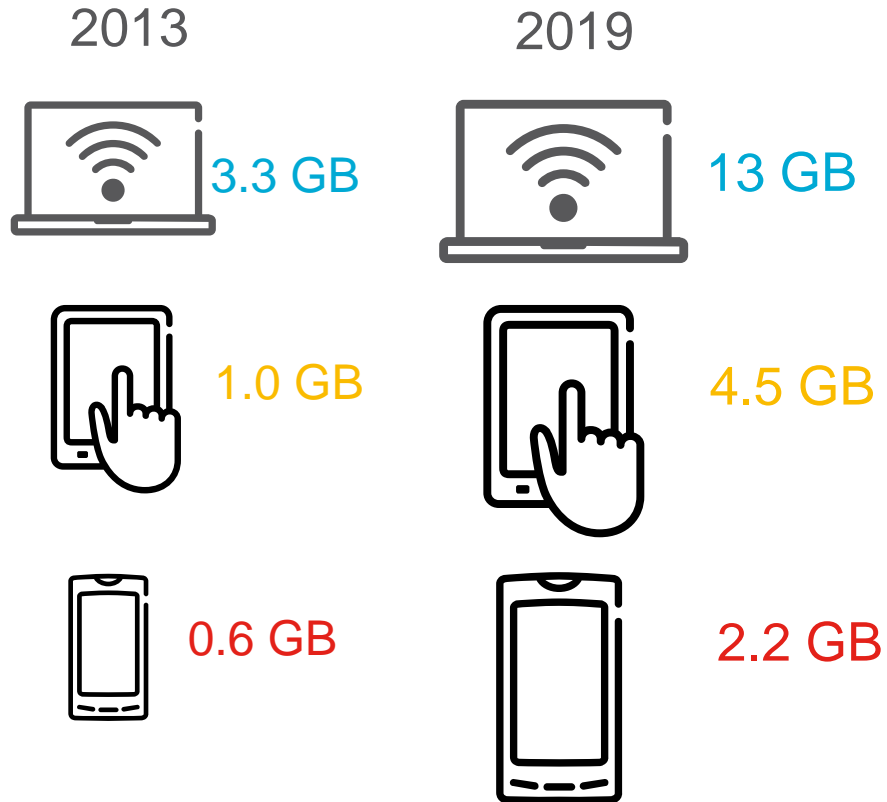


New-industrialization – Innovation based on data (power)

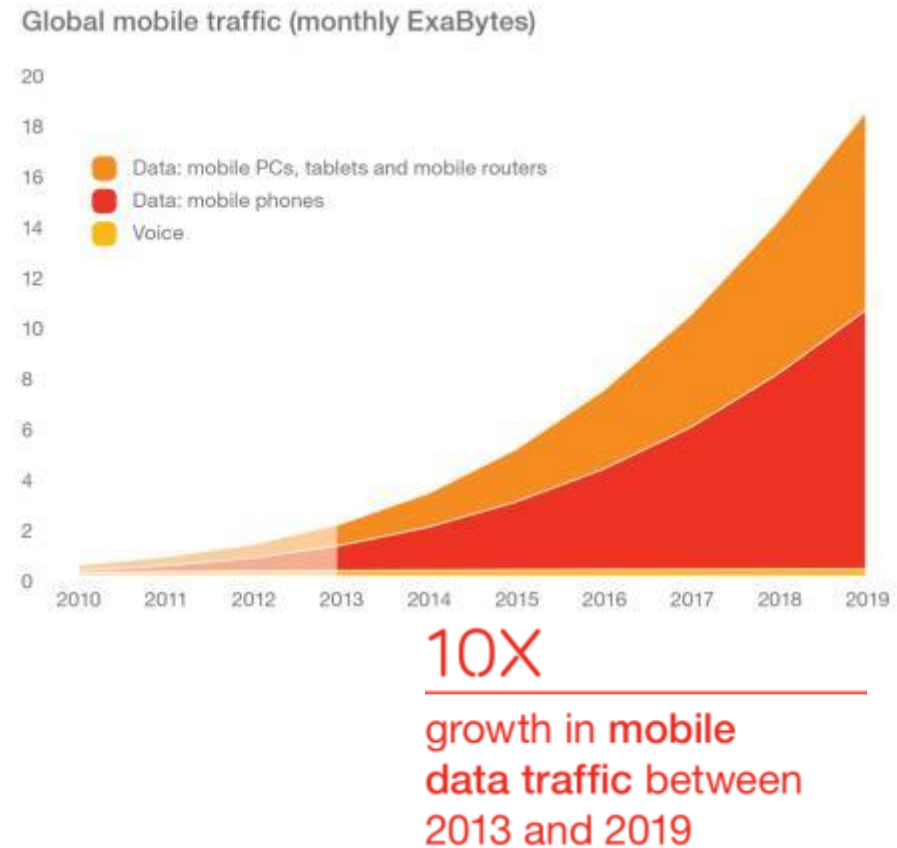


10 times mobile data traffic by end of 2019

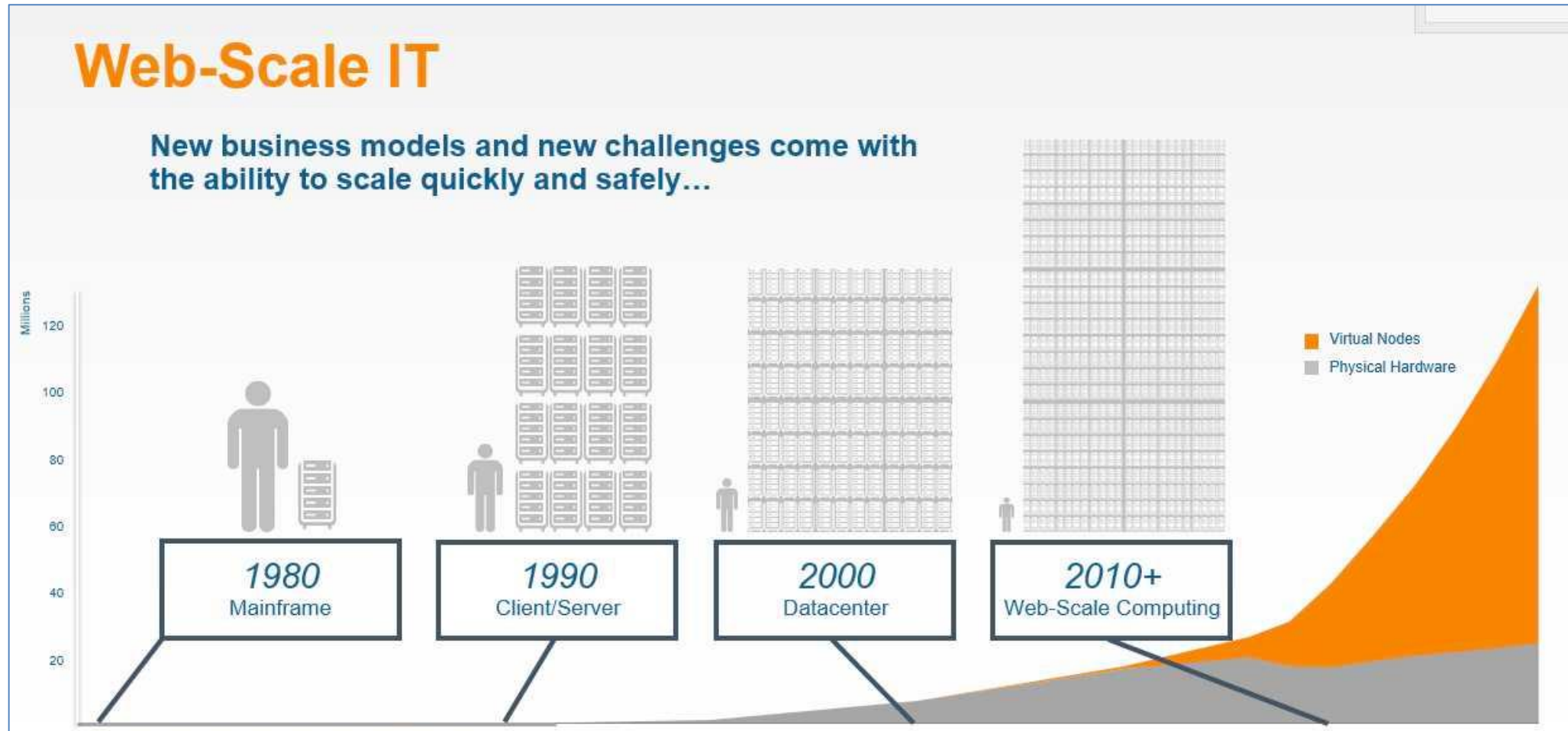
Monthly consumption per device type



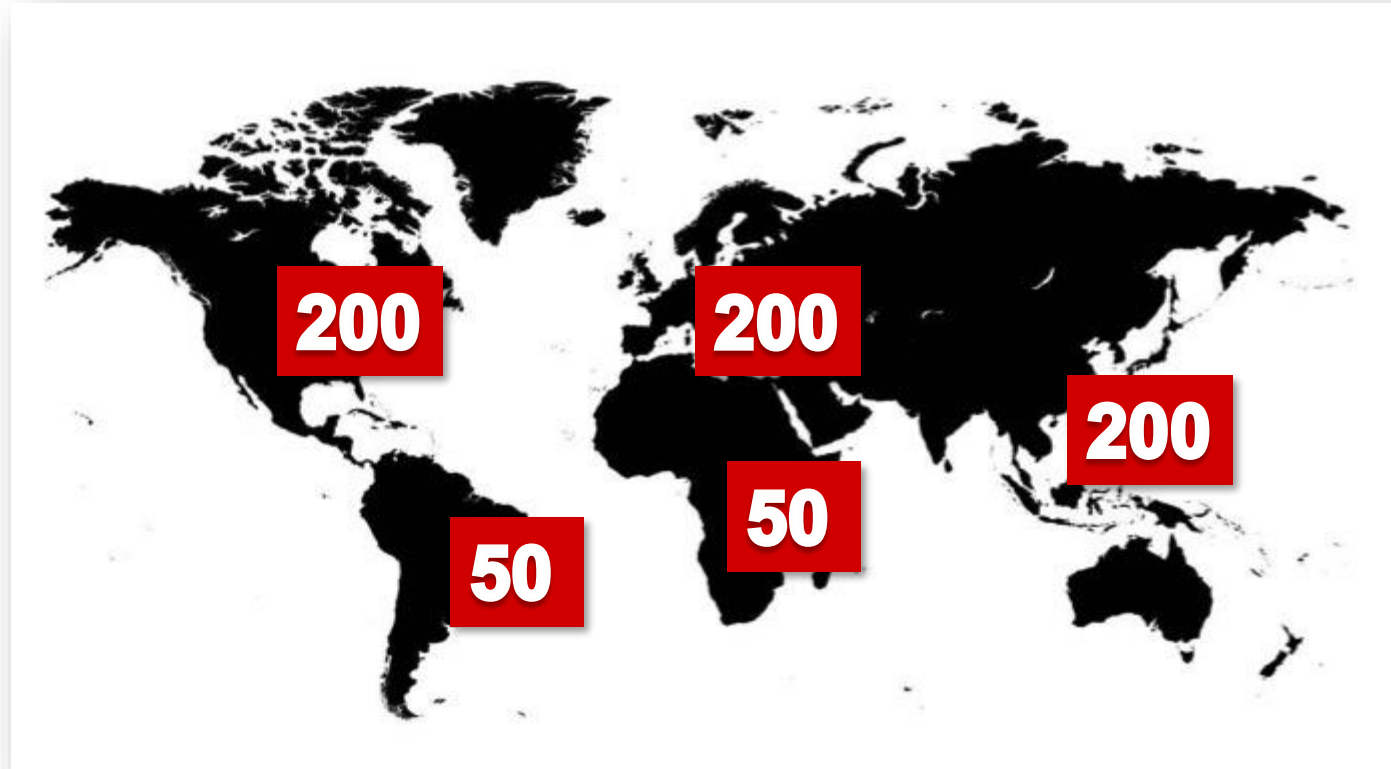
Global mobile traffic: voice and data 2010-2019



Growth in Web-scale IT



Market growth by 2020 of New Mega DC





A total 700, based on sources from IDC, Gigaom och Datacenter Dynamics.

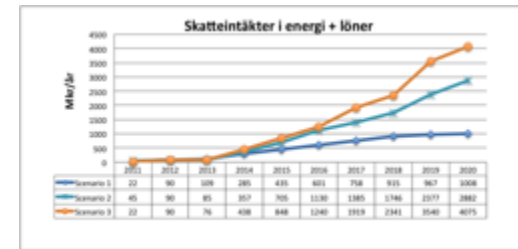
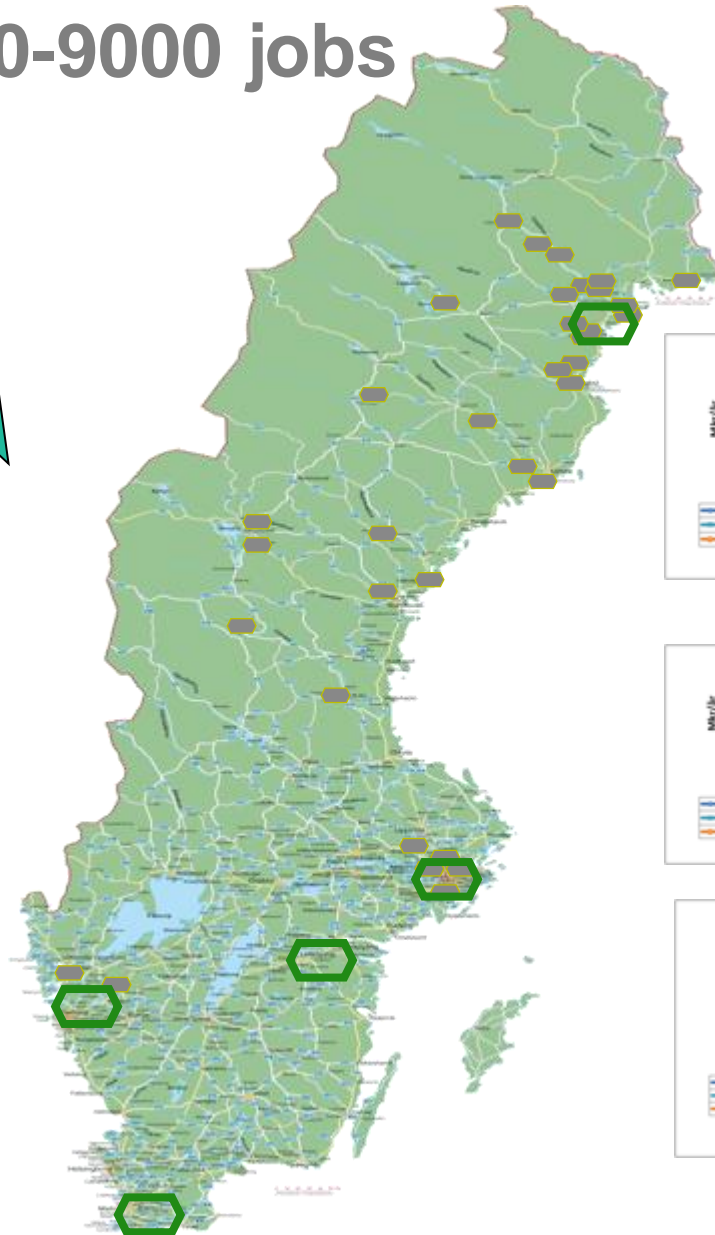
Vision: Strong growth 35-45 buildings, 8000-9000 jobs

Strong

**First choice
for many**

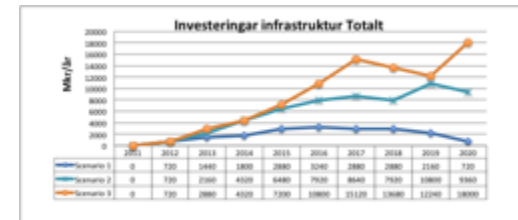
30-40 mega datacenter

-  Datacenter establishments
-  Big Data & Cloud clusters



Taxes

Energy + wages
>3 billion SEK/year



Investments

Building + equipment
>12 billion SEK/year



Jobs

Construct + operate
>8000

Use cases



BROADBAND AND MEDIA
EVERYWHERE



SENSORS
EVERYWHERE



SMART VEHICLES,
TRANSPORT



INFRASTRUCTURE, MONITOR
AND CONTROL



CRITICAL CONTROL
OF REMOTE DEVICES

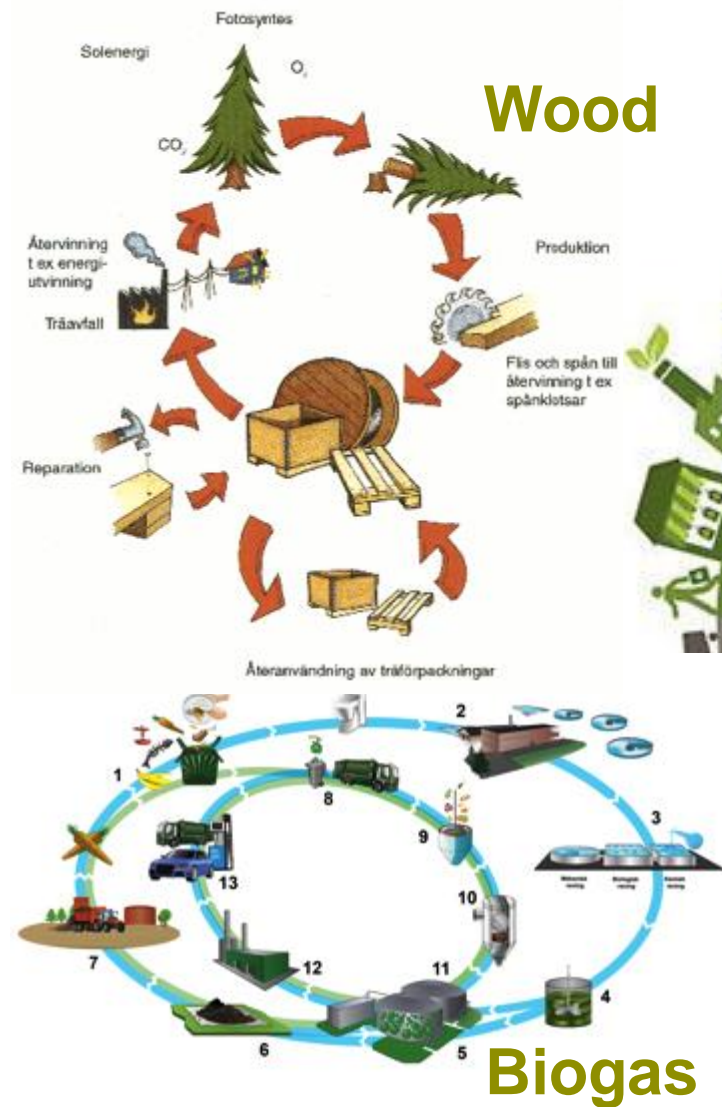


INTERACTION
HUMAN-IOT


5G
USE CASES

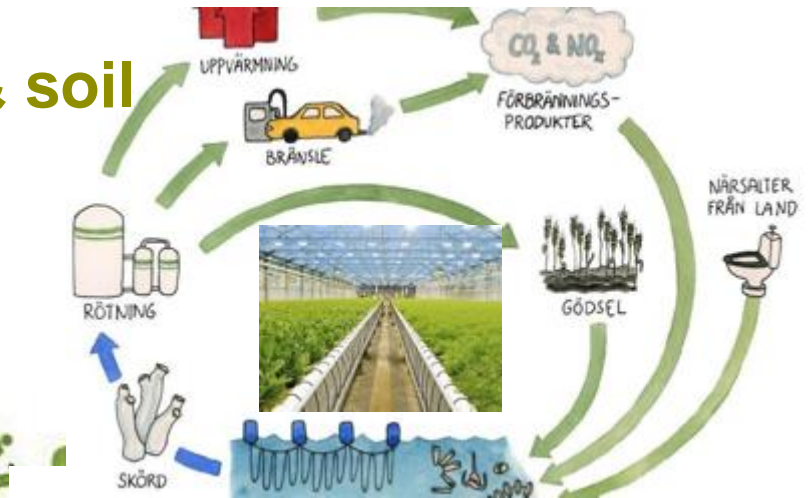
Beyond the heat pump

Wood



Biogas

Water & soil



Waste

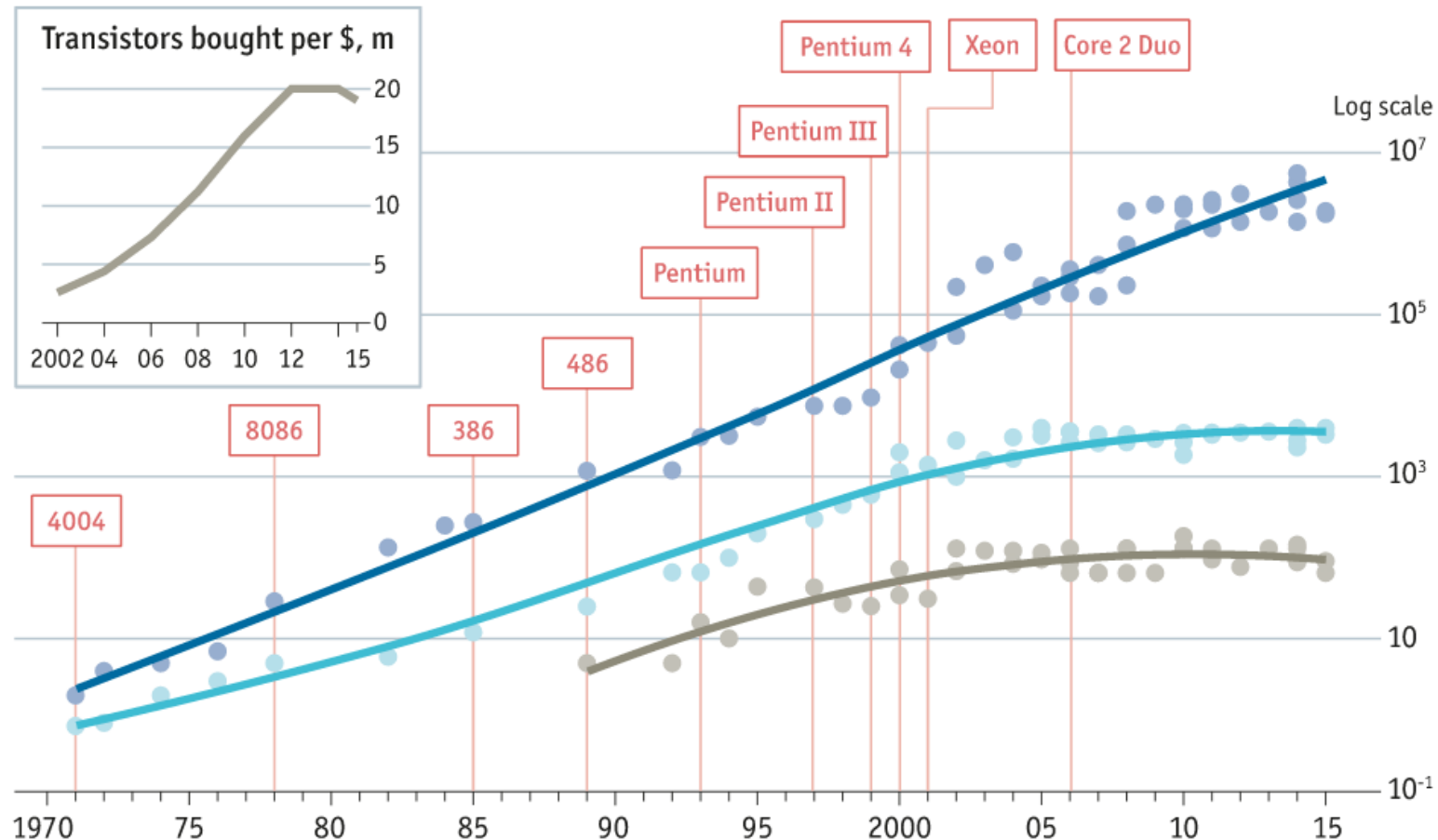


History of the thermal problem

Stuttering

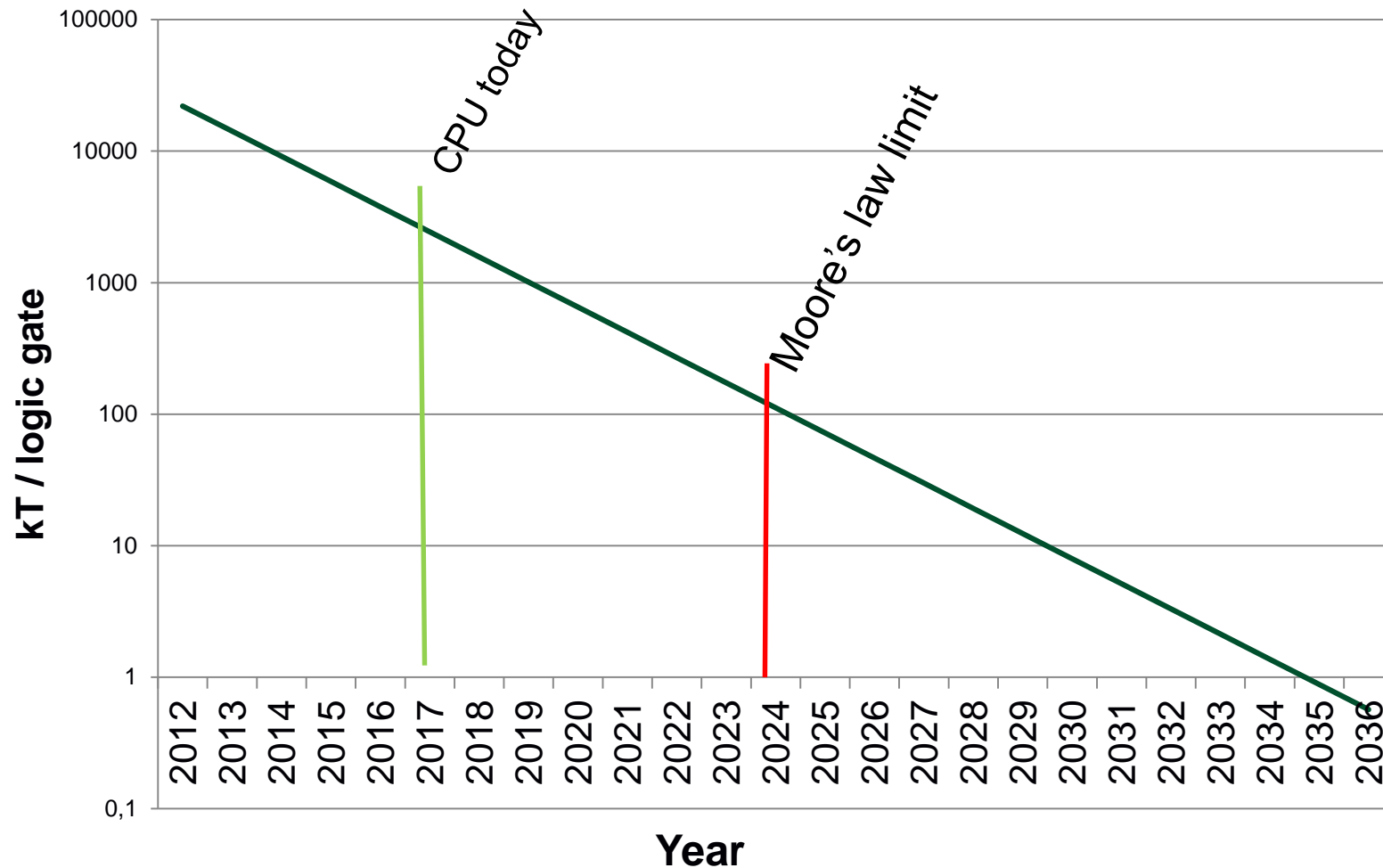
● Transistors per chip, '000 ● Clock speed (max), MHz ● Thermal design power*, w

□ Chip introduction dates, selected



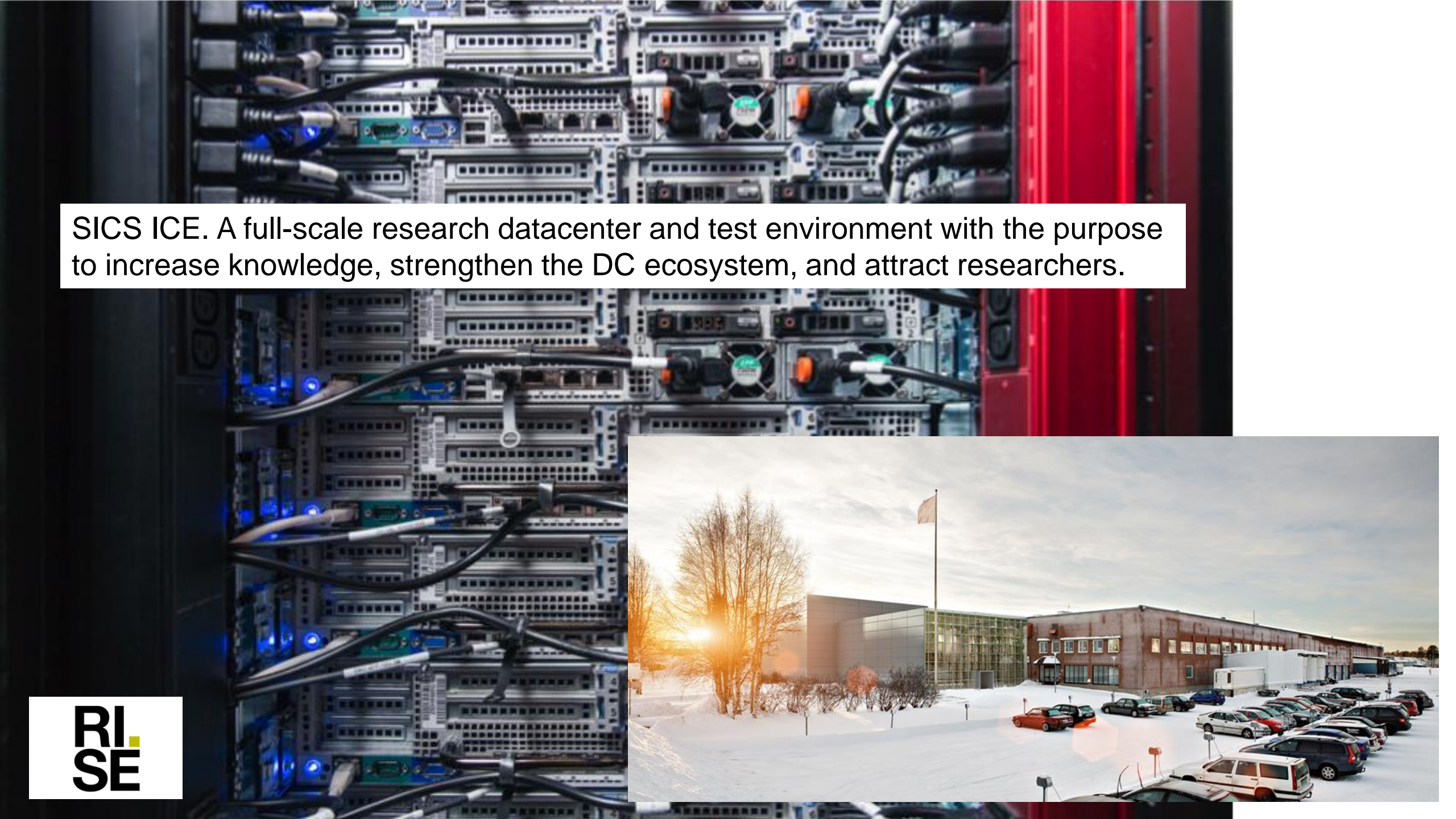
Cross, T. "After Moore's Law: Double, double, toil and trouble." *The Economist, Technology Quarterly*, Quarter 1 (2016).

“My bet is that we run out of money before we run out of physics”



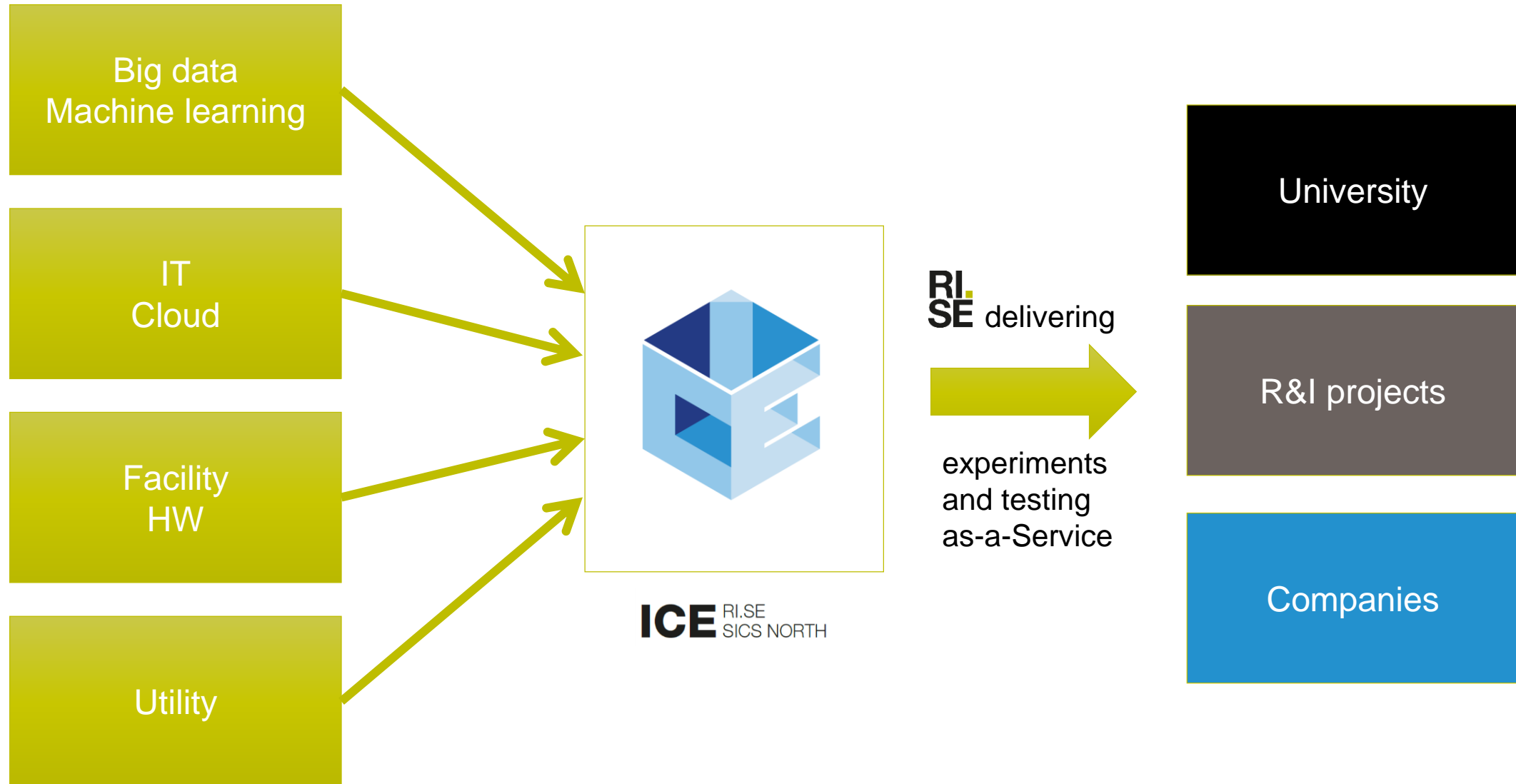
Datacenter generations

Generation	Power distribution	Cooling infrastructure	IT system	Energy use
Generation 1 Old School DC	Stand-alone, N+1, many transformation steps. diesel backup	Compressor cooling, no containment, raised floor	Monolithic applications, low grade of automation	PUE > 1.8 High energy use
Generation 2 Internet DC	Some local green power production, reduced diesel backup	Free-cooling and compressor, hot and cold isle, heat pumps	Some monolithic and virtualized applications, monolithic automation	PUE < 1.5 Modest energy use, some energy re-use
Generation 3 Green DC	380 VDC, only green power production, no diesel backup	Air-based free-cooling combined with heat re-use, air flow tech	SDN, Fully virtualized IT, software redundancy, integrated automation	PUE < 1.2 High energy efficiency, energy re-use
Generation 4 Integrated society DC	Grid integration, micro grids, load balancing, wood building	Liquid cooling, closed loop energy system, predictive operation	SD-DC, holistic automation, robot maintenance, distributed compute	PUE < 1.1 Fully integrated in electrical & thermal grid



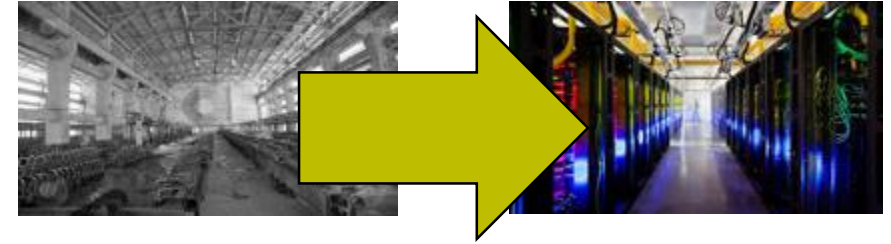
SICS ICE. A full-scale research datacenter and test environment with the purpose to increase knowledge, strengthen the DC ecosystem, and attract researchers.

Business model



Conclusions

- Digital transformation and 5G enables a wide range of use cases in all fields that will require new datacenter technologies
- A 50-fold growth of digital data production in the zeta-byte industry era will be handled by an increase in datacenters capacity and need innovations in software, hardware & facility
- SICS ICE is supporting the national academia and industry with a large-scale research & test facility for development of new technologies needed to enable the transformation





THANK YOU!

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