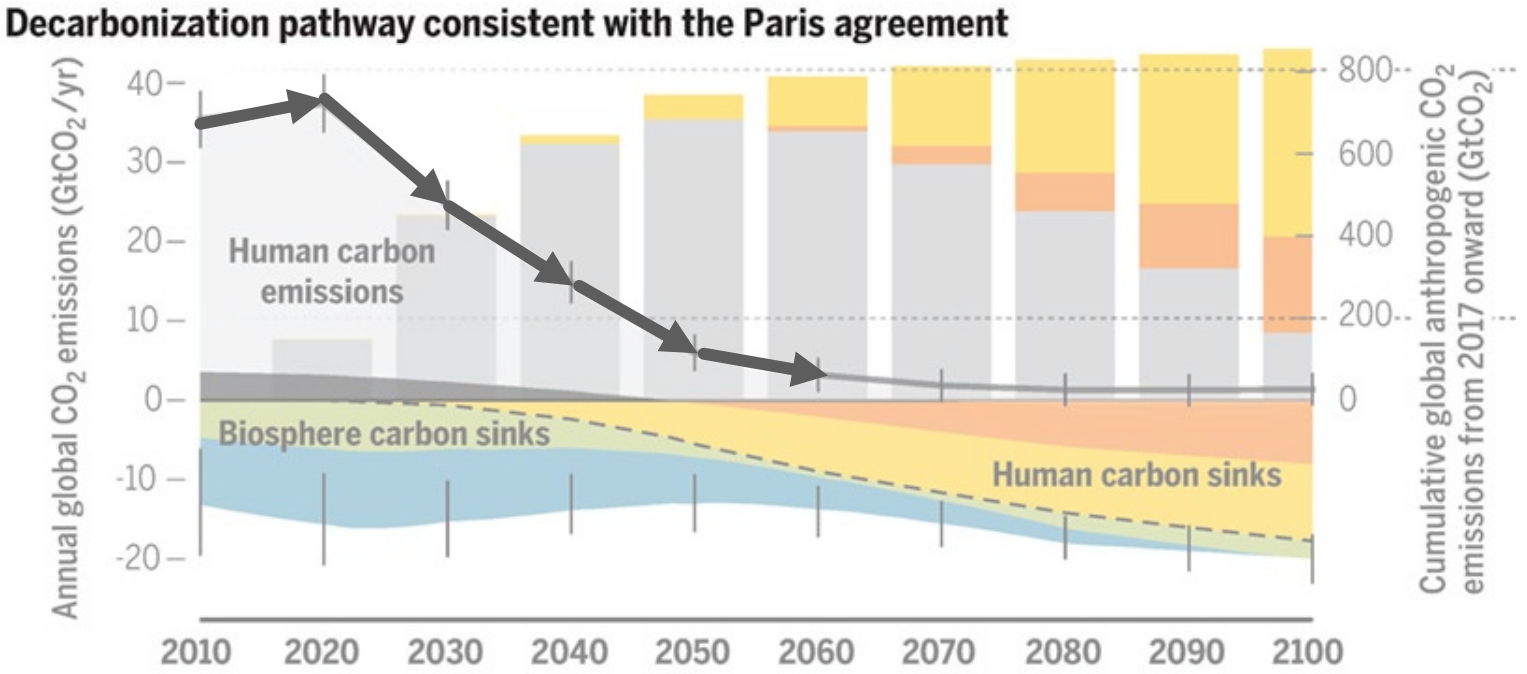
Indirect Energy Effects of Digitalisation

Vlad Coroamă – ETH Zürich, Departement of Computer Science

Digital for Planet WS, 14 April 2021

Overarching goal of my research

Contribute to **understanding the complex relation between** the ongoing **digitalisation and societal energy consumption**, given the urgency of the climate crisis.



- We need to halve our emissions every decade
  - and be basically emissions-free by 2050-2060
- Digitalisation is a blanket technology protruding all aspects of society and economy
  - can have profound impact, in both directions

Image source: (Rockström et al. 2017): A roadmap for rapid decarbonization, Science, 355 (6331)

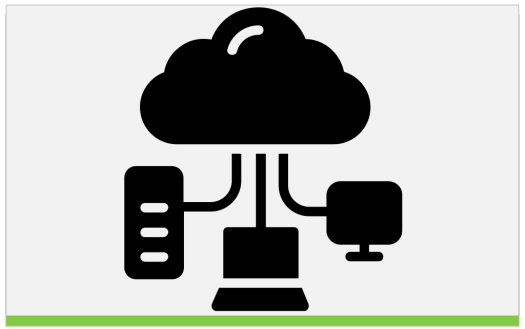
Energy saved by digitalisation vs. energy consumption induced by digitalisation

Mechanisms for energy savings

Mechanisms for energy consumption

Substituting digital technologies for traditional, more energy-intensive processes

Smart energy systems (e.g., grids, heating, households, transportation, industry)



ICT's own energy consumption

Energy consumption induced by digitalisation in other sectors

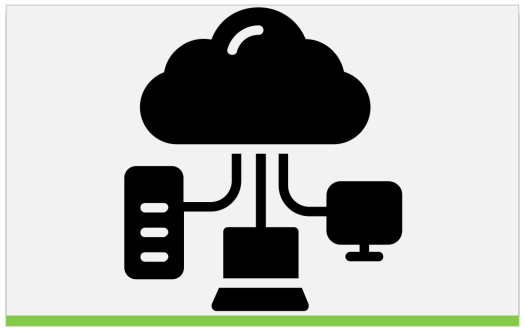
Energy saved by digitalisation vs. energy consumption induced by digitalisation

Mechanisms for energy savings

Mechanisms for energy consumption

1. Digital Substitutions

2. Smart Energy Systems



3. ICT's own Energy Consumption

4.Induced Energy Consumption

Icon credits: MS, Lufti Gani Al Achmad, ProSymbols, Luis Prado

Surprisingly relevant topic today for media and society

"Streaming is the new flying – how the digital consumption affects the climate."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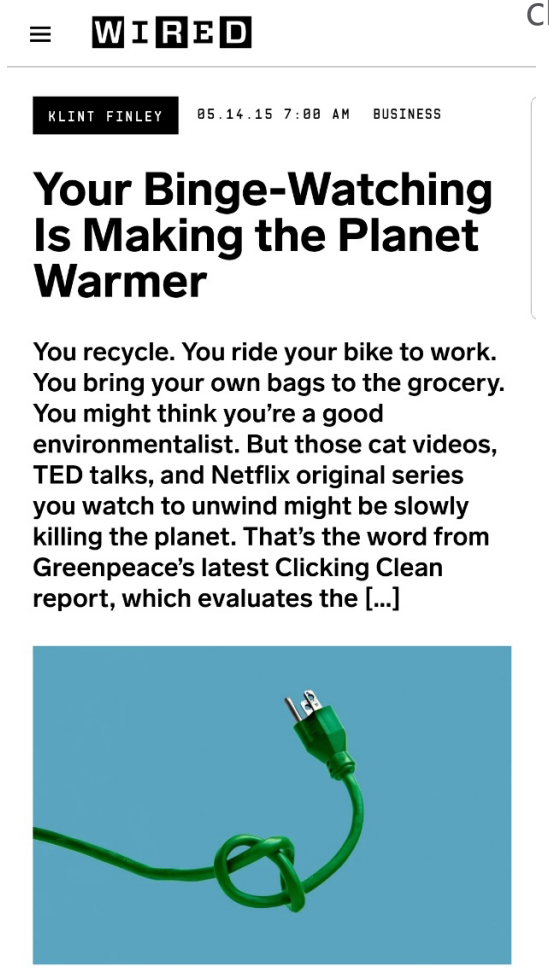
'Tsunami of data' could consume one fifth of global electricity by 2025

Billions of internet-connected devices could produce 3.5% of global emissions within 10 years and 14% by 2040, according to new research, reports Climate Home News

Climate Home News, part of the Guardian Environment Network

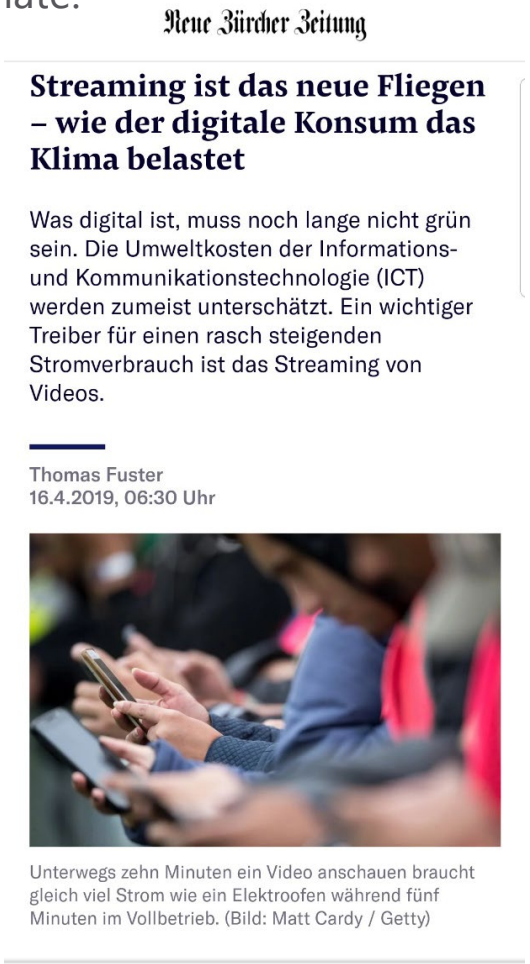
Mon 11 Dec 2017 08.27 EST


WIRED

KLINT FINLEY 05.14.15 7:00 AM BUSINESS

Your Binge-Watching Is Making the Planet Warmer

You recycle. You ride your bike to work. You bring your own bags to the grocery. You might think you're a good environmentalist. But those cat videos, TED talks, and Netflix original series you watch to unwind might be slowly killing the planet. That's the word from Greenpeace's latest Clicking Clean report, which evaluates the [...]


Neue Zürcher Zeitung

Streaming ist das neue Fliegen – wie der digitale Konsum das Klima belastet

Was digital ist, muss noch lange nicht grün sein. Die Umweltkosten der Informations- und Kommunikationstechnologie (ICT) werden zumeist unterschätzt. Ein wichtiger Treiber für einen rasch steigenden Stromverbrauch ist das Streaming von Videos.

Thomas Fuster
16.4.2019, 06:30 Uhr

Unterwegs zehn Minuten ein Video anschauen braucht gleich viel Strom wie ein Elektroofen während fünf Minuten im Vollbetrieb. (Bild: Matt Cardy / Getty)

- In fact, these claims are vastly exaggerated
- Digitalisation responsible for
  - ~ 6-8% of WW electricity
  - ~ 1-1.3% of WW energy
  - ~ 1.8-2.5% of WW GHGs
- Growing steadily
  - will nevertheless not become main source of concern
  - BUT: material consumption and pollution ARE relevant
- Not our topic now

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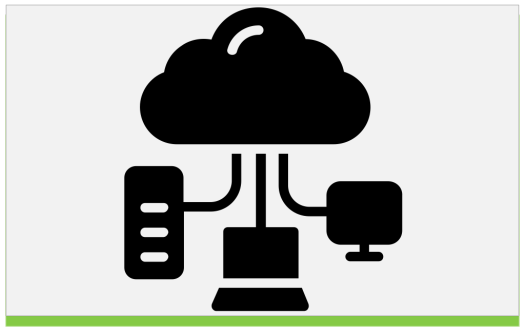

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Icon credits: MS, Lufti Gani Al Achmad, ProSymbols, Luis Prado

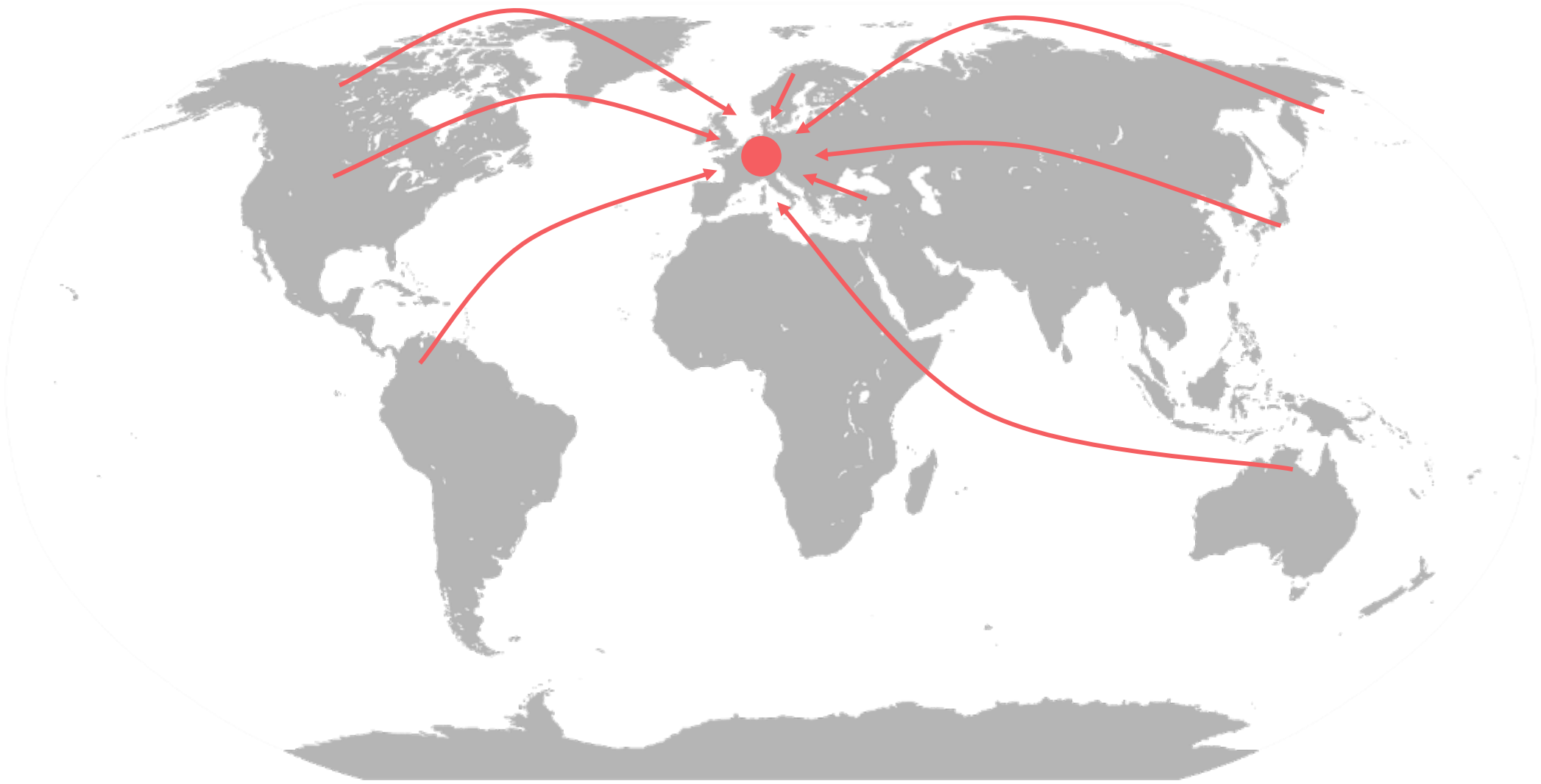
Small rebound of virtualised conferences: The WRF 2009 case study

Davos

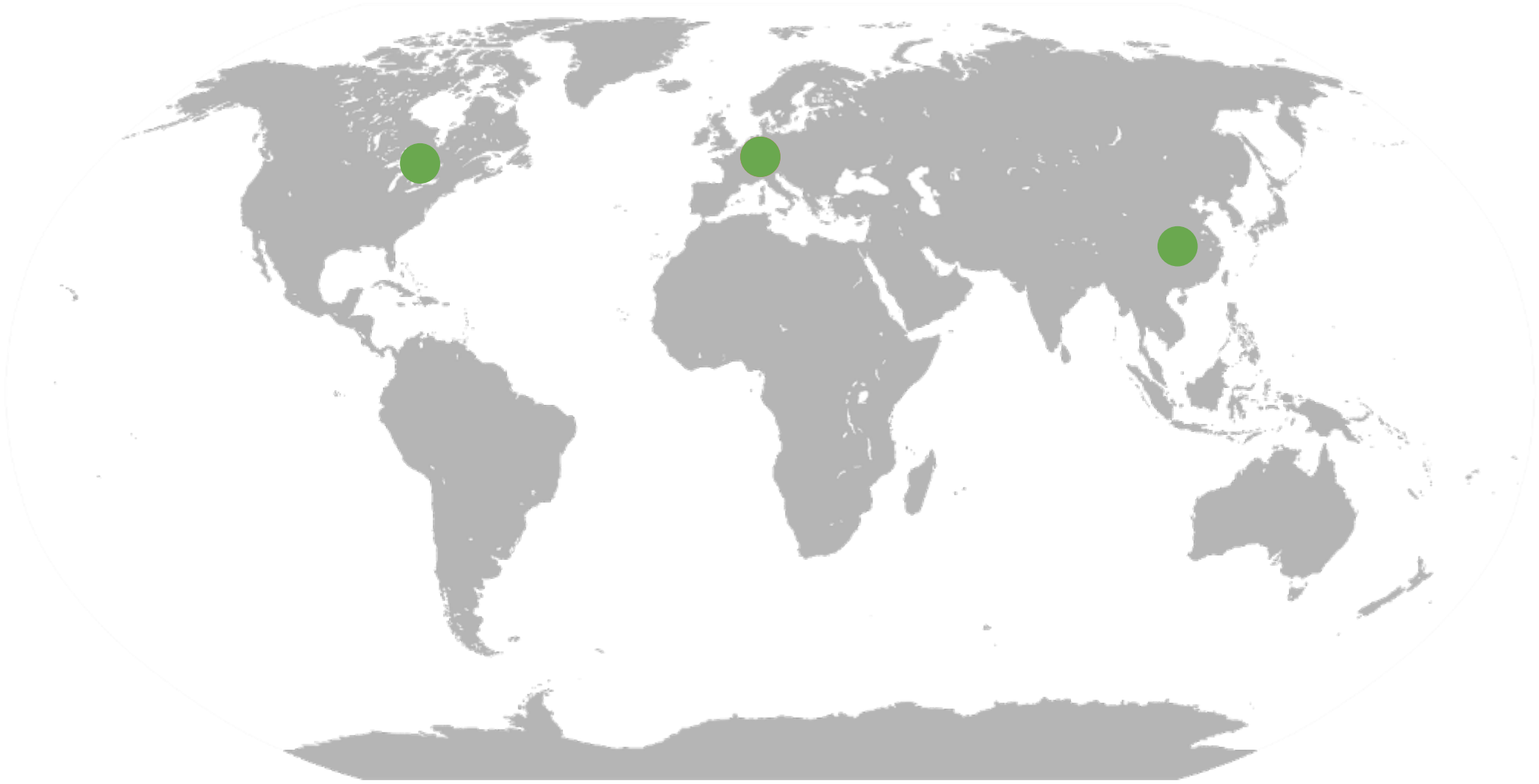
Nagoya

World Resources Forum

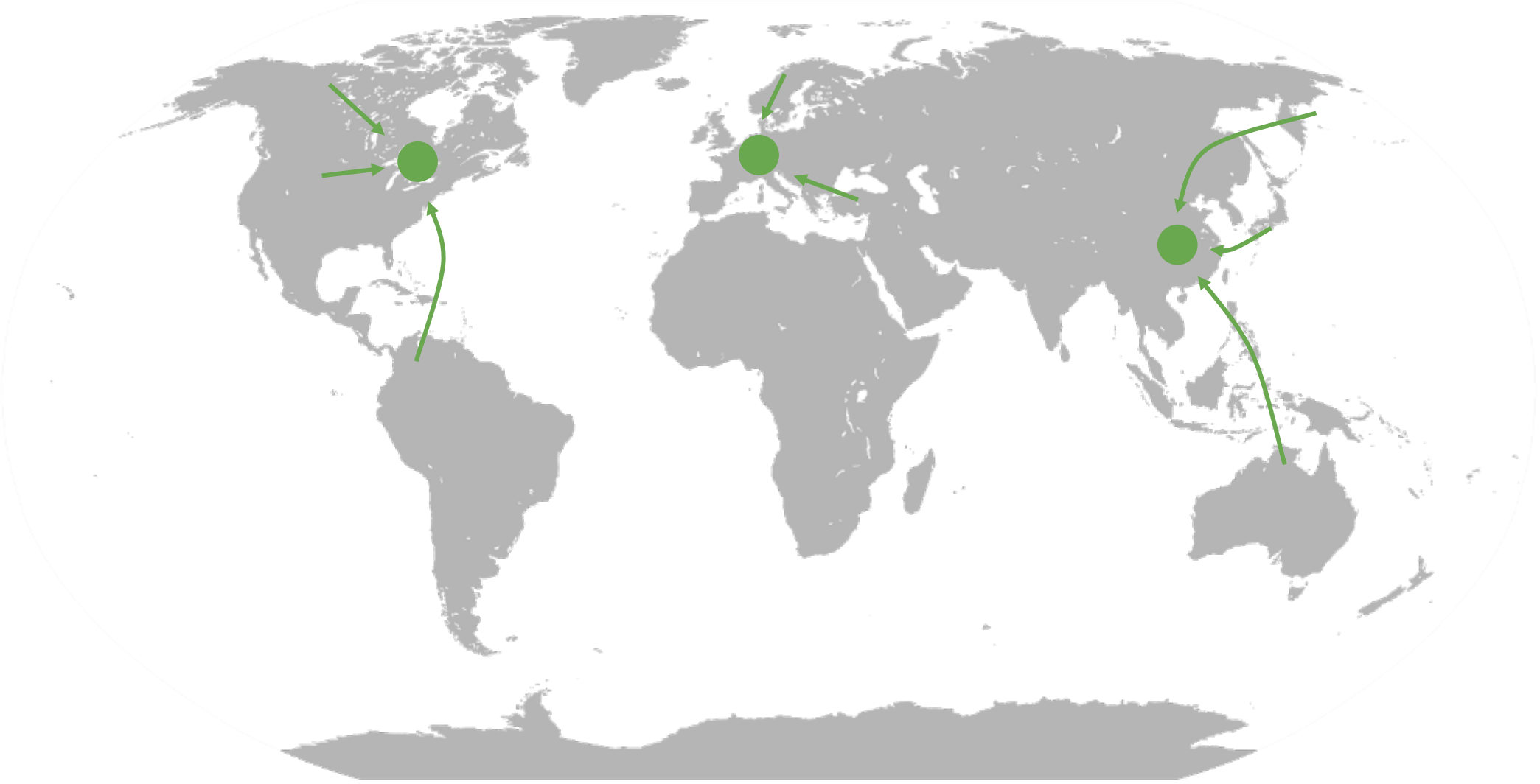
Participant (intercontinental) travel responsible for around 90% of total conference GHGs



Instead: several sites across the globe

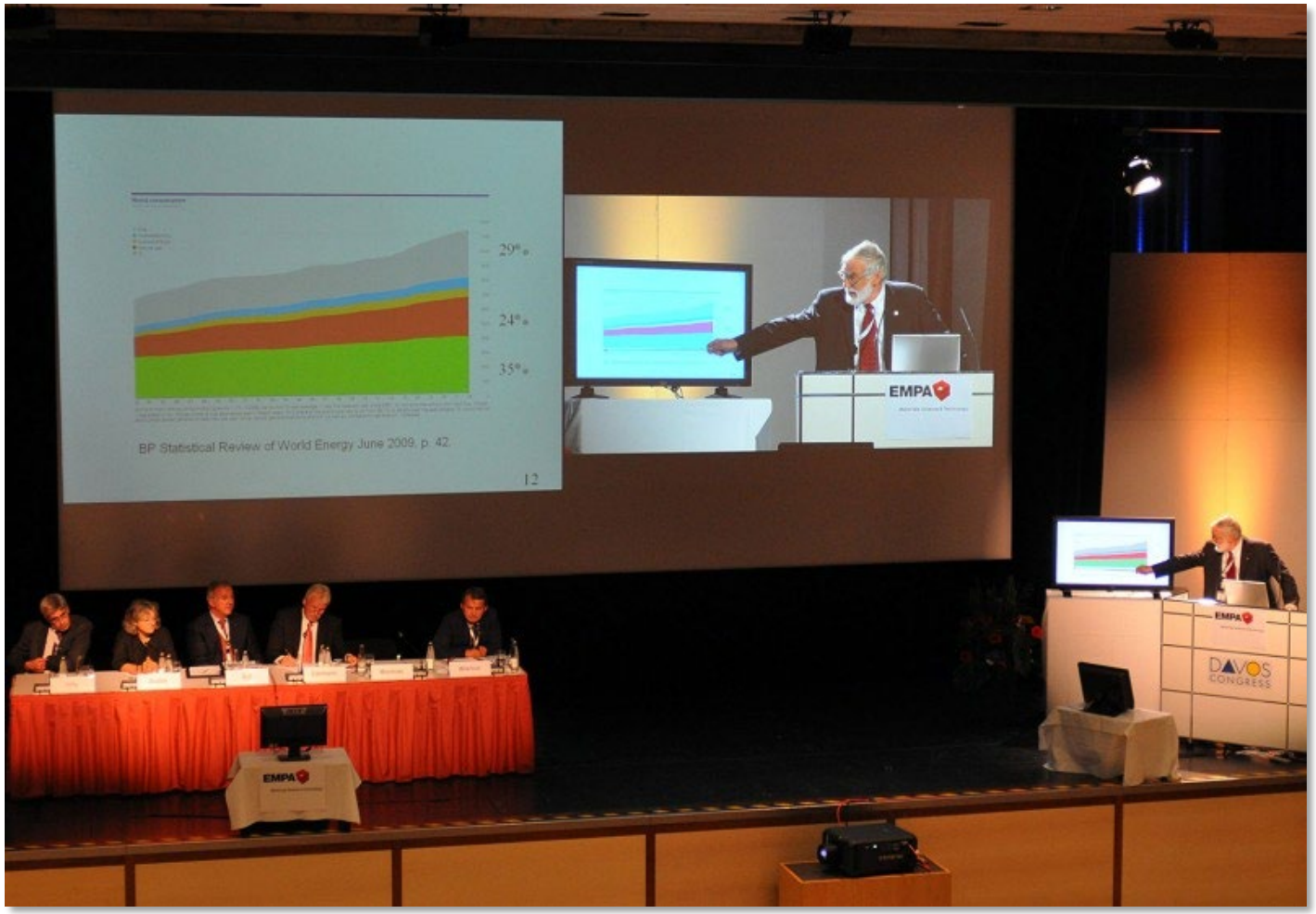


Leading to shorter intra-continental journeys



Concept: Transmitting not only speakers and presentations..

Dennis Meadows speaking in Davos



(Coroama et al. 2012): Effects of Internet-based multiple-site conferences on greenhouse gas emissions, *Telematics and Informatics* 29 (4), 362-274

…but also making the remote audience visible in life-size

(Coroama et al. 2012): Effects of Internet-based multiple-site conferences on greenhouse gas emissions, *Telematics and Informatics* 29 (4), 362-274

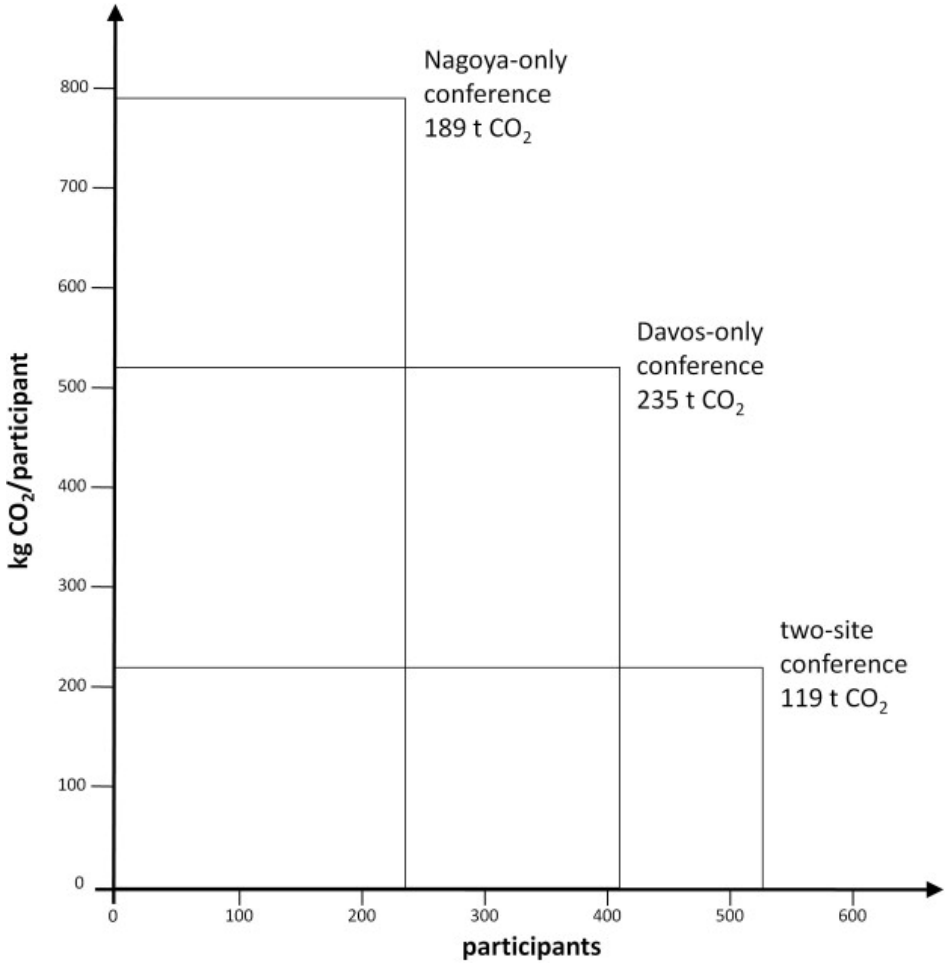
Eye contact speaker – remote audience

allowing for natural cross-continental interactions, including non-verbal cues from the audience

(Coroama et al. 2012): Effects of Internet-based multiple-site conferences on greenhouse gas emissions, *Telematics and Informatics* 29 (4), 362-274

Substituting bits for atoms is beneficial, despite participant rebound

Davos-Nagoya twin conference



Participants & travel emissions

- Two-site conference – **531 attendees**
  - 372 Davos
  - 159 Nagoya
  - **119 t CO_2** (84 Davos, 35 Nagoya)
- Davos only – 448 attendees
  - 372 Davos + 76 from Nagoya
  - 235 t CO_2 (84 + 151)
- Nagoya only – 238 attendees
  - 159 Nagoya + 79 from Davos
  - 189 t CO_2 (35 + 154)

+18% participants
- 49% GHGs

+123% participants
- 37% GHGs

Substantially reduced total travel energy & emissions despite more attendees

(Coroama et al. 2012): Effects of Internet-based multiple-site conferences on greenhouse gas emissions, *Telematics and Informatics* 29 (4), 362-274

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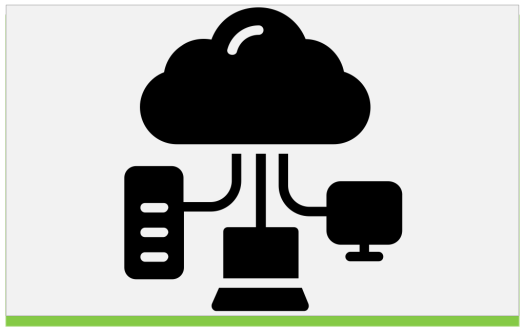

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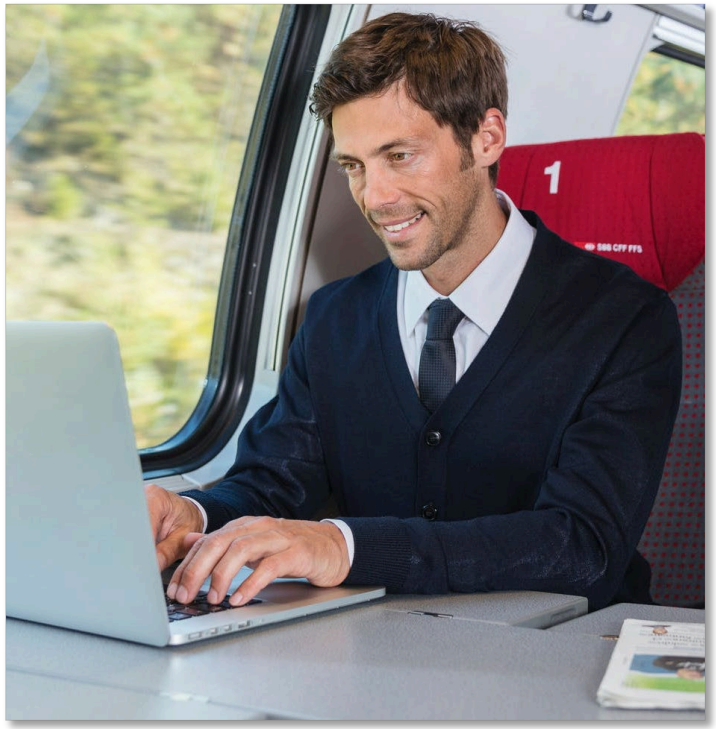
Autonomous vehicles likely to **substitute public transportation**

Why am I using public transportation today?



Working on my presentation on the way to the meeting

No parking available at the destination

Relaxing on the way back from the meeting

In a world of autonomous driving, all these reasons no longer exist → substitution of AVs for public transportation (**new consumption induced** by digitalisation)

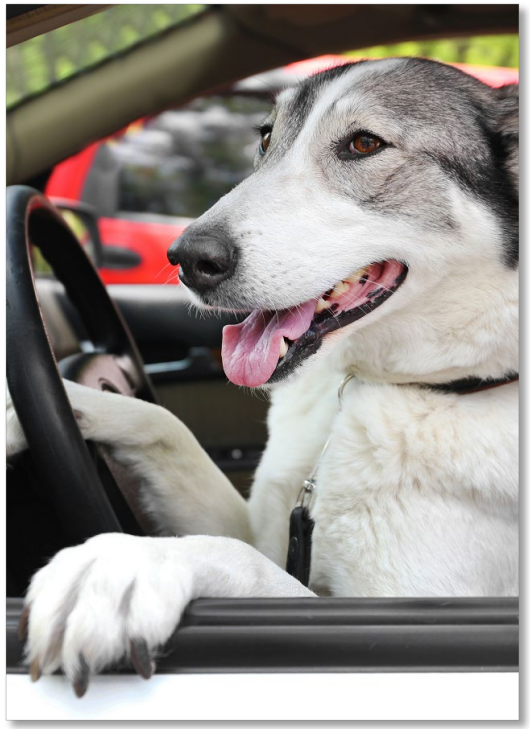
(Coroamă and Mattern 2019) *Digital Rebound – Why Digitalization Will Not Redeem Us Our Environmental Sins*, ICT4S 2019, Lappeenranta, Finland.

Autonomous vehicles will further **allow new categories to 'drive'**

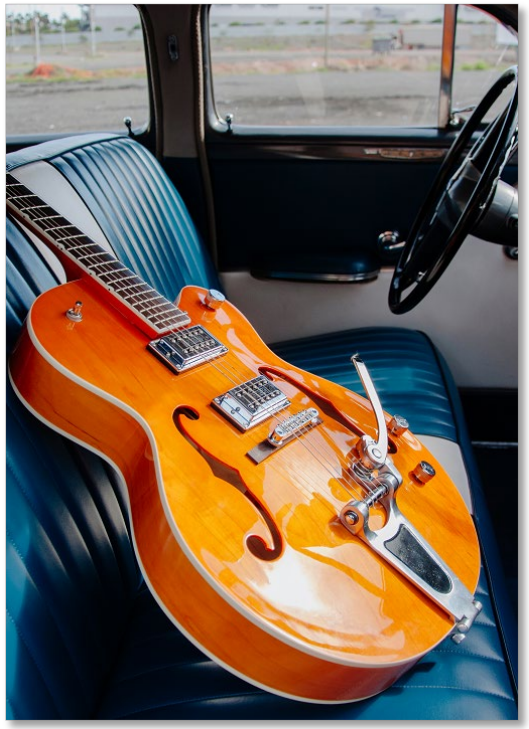
(thus inducing new car journeys and **additional energy consumption**)

Elderly and those with physical impairments

Kids to school



Pets to the vet



Instruments to the workshop

- **Rebound effects** (far beyond this single example) are crucial within digital & sustainability
- Research deficit; working towards a methodology is one of our current research topics

(Coroamă and Mattern 2019) *Digital Rebound – Why Digitalization Will Not Redeem Us Our Environmental Sins*, ICT4S 2019, Lappeenranta, Finland.

(Coroamă and Pargman 2020) *Skill rebound: On an unintended effect of digitalization*, ACM workshop of Computing within Limits 2020, Bristol, UK.