Energy savings and rebound effects from electronic media

Luigi Antoine Andrea Sansonetti

Outline

Introduction to electronic media and possible rebound effects

Comparing printed and tablet versions of a magazine

Comparing renting/buying DVDs and streaming

Comparing videoconferencing with on-site conferencing

Conclusions

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What is meant by electronic media ?

- Media accessed through electronic means (e-books, streaming, …)
- Different media types have different characteristics
  - Ergo, different impacts

Potential inconveniences

- The use of electronic media:
  - Still costs energy
  - Can lead to rebound effects

Potential inconveniences, and their significance

- The use of electronic media:
  - Still costs energy, but how much more than non-electronic media ?
  - Can lead to rebound effects, but how significant are those ?

What kind of rebound effects can it lead to ?

- Highly dependent on the type of media
  - Can be clear and direct (e.g. streaming)
  - Can be non-obvious and indirect (e.g. electronic devices production)
- This effect may be worth it

What kind of rebound effects can it lead to ?

- Highly dependent on the type of media
  - Can be clear and direct (e.g. streaming)
  - Can be non-obvious and indirect (e.g. electronic devices production)
- This effect may be worth it
  - Or it may have a bigger impact

How to measure the true cost ?

- Through Life-Cycle Assessment (LCA) studies
  - Analysis of a product's impact, considering every stage of its life
- Assumptions have to be made
  - Not always possible to get precise information
  - Unpredictable variables (user behaviour, …)

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Mohammad A. Achachlouei and Åsa Moberg. Life Cycle Assessment of a Magazine, Journal of Industrial Ecology, 19 (4), 2015

Introduction to the study

- Comparison of a magazine in its printed form to two tablet versions
  - The magazine's current, emerging, tablet version
  - A hypothetical mature version
- Three ways of presenting the results (per reader, per copy, per hour)

What was taken into account ?

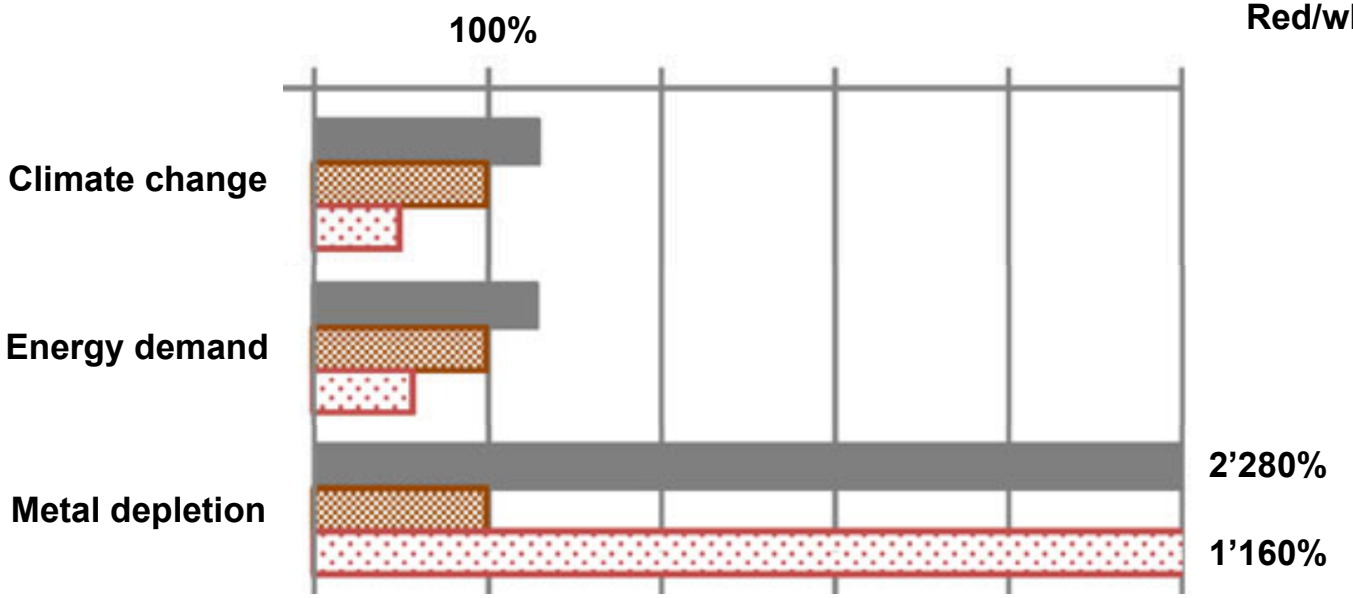
Printed version	Tablet version
Paper production	Tablet production
Paper transportation	Tablet distribution
Magazine content production (electricity use in the office, …)	
Printing	Electronic distribution (data centre, Wi-Fi download)
Magazine distribution	Electricity consumption during reading
Magazine disposal	Tablet disposal

Major assumptions

- Reading times
  - 41 minutes for the print and mature tablet versions
  - 9 minutes for the emerging tablet version
- For the mature tablet scenario: half of the copies are electronic
- Number of readers: 4.4 per physical copy, 1 per electronic copy
- Overall tablet use: low

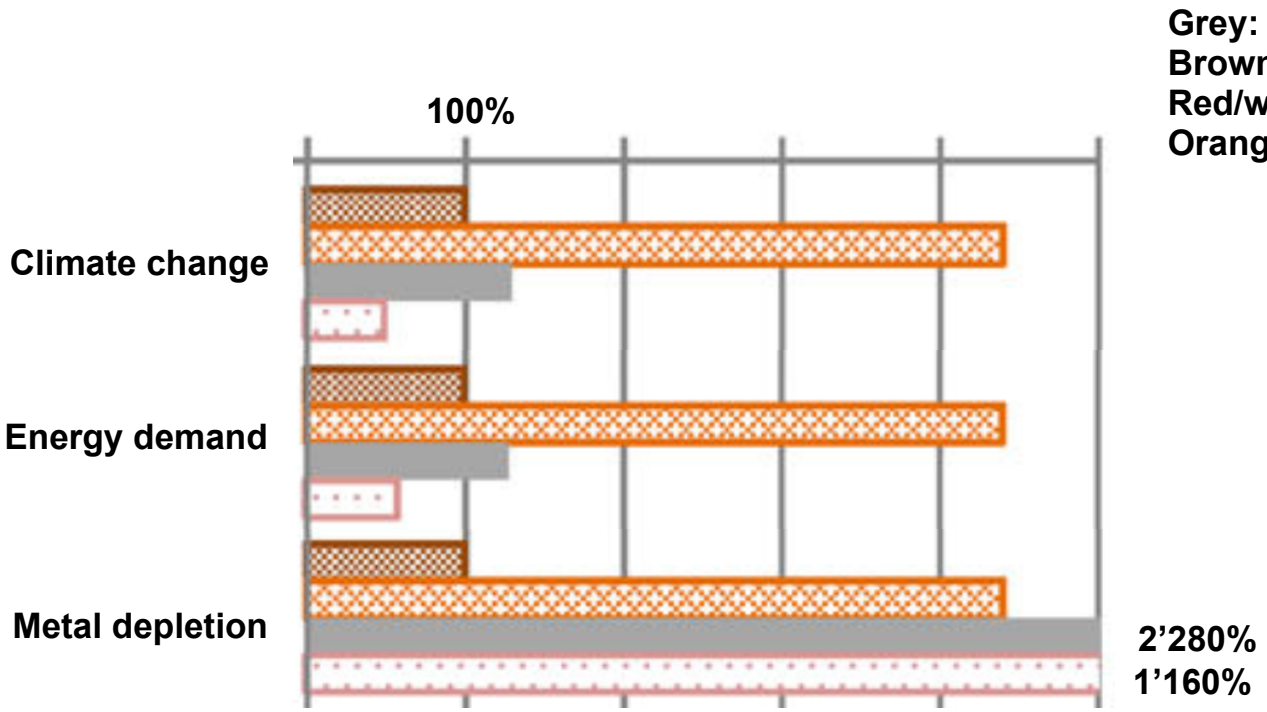
Impact per reader - reference scenario

Grey: Emerging tablet version
Brown: Printed version
Red/white: Mature tablet version



Mohammad A. Achachlouei and Åsa Moberg. Life Cycle Assessment of a Magazine, Journal of Industrial Ecology, 19 (4), 2015

Impact per reader



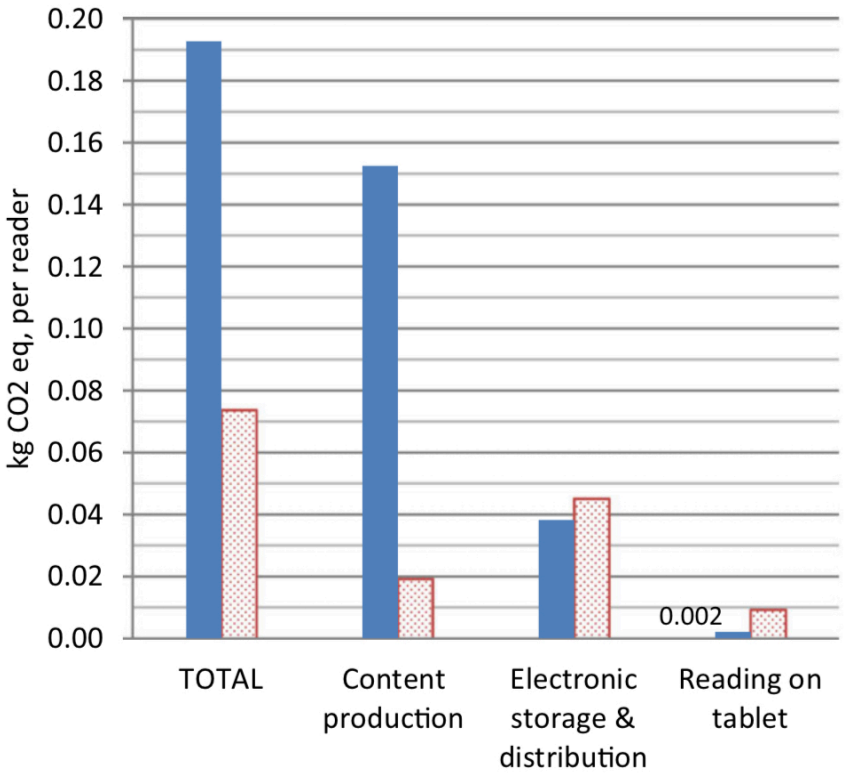
Grey: Emerging tablet version
Brown: Printed version
Red/white: Mature tablet version
Orange: Printed version (1 reader/copy)

Mohammad A. Achachlouei and Åsa Moberg. Life Cycle Assessment of a Magazine, Journal of Industrial Ecology, 19 (4), 2015

A few words on metal depletion

- Depletion: consumption of resources faster than it can be replenished
- In this case, especially gold (used in circuits)
- Main contributors:
  - Building of devices used in content production
  - Building of tablets

Impact per reader on tablet - breakdown

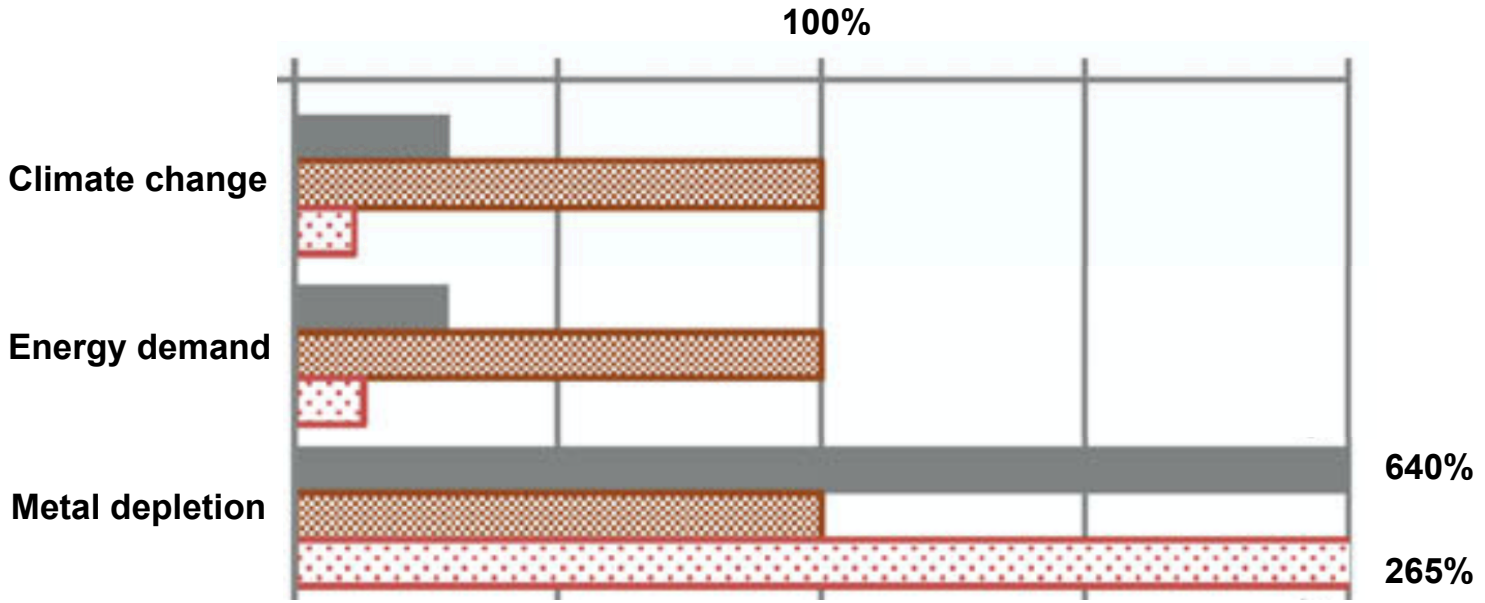


Blue: Emerging tablet version
Red/white: Mature tablet version

Mohammad A. Achachlouei and Åsa Moberg. Life Cycle Assessment of a Magazine, Journal of Industrial Ecology, 19 (4), 2015

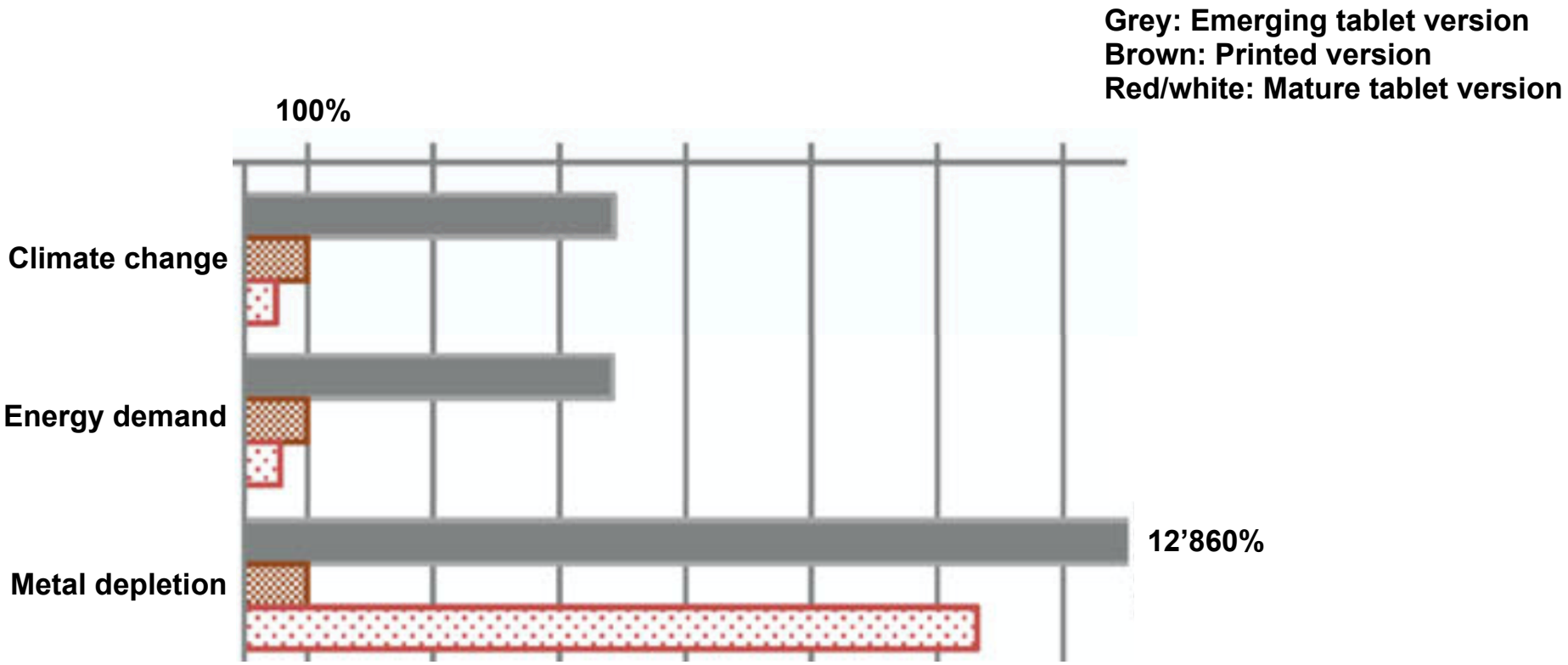
Impact per copy - reference scenario

Grey: Emerging tablet version
Brown: Printed version
Red/white: Mature tablet version



Mohammad A. Achachlouei and Åsa Moberg. Life Cycle Assessment of a Magazine, Journal of Industrial Ecology, 19 (4), 2015

Impact per reading hour - reference scenario



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Conclusions - emerging and mature tablet versions

- The emerging tablet version had a higher impact than the mature one
  - Many readers → more spread-out impacts
- File size has environmental implications
- User practices are important
- Efficient data centres are important

Conclusions - tablet and printed versions

- The emerging tablet version had a higher impact than the printed one
- The mature tablet version had a lower impact than the printed one
- Impact per copy is higher for the printed version (in most categories)
- Impact per reading hour is higher for the emerging tablet version

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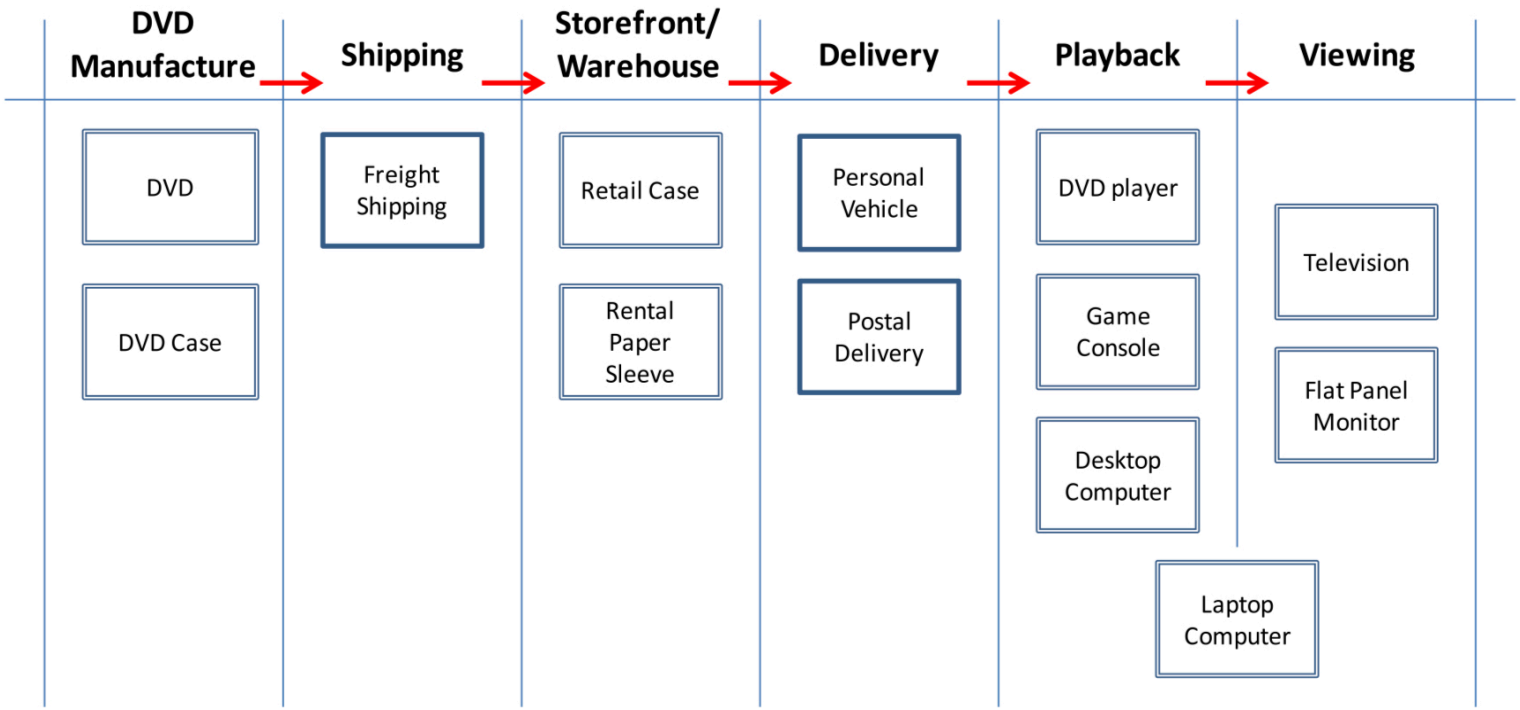
Arman Shehabi, Ben Walker and Eric Masanet. The energy and greenhouse-gas implications of internet video streaming in the United States, Environmental Research Letters, 9, 2014

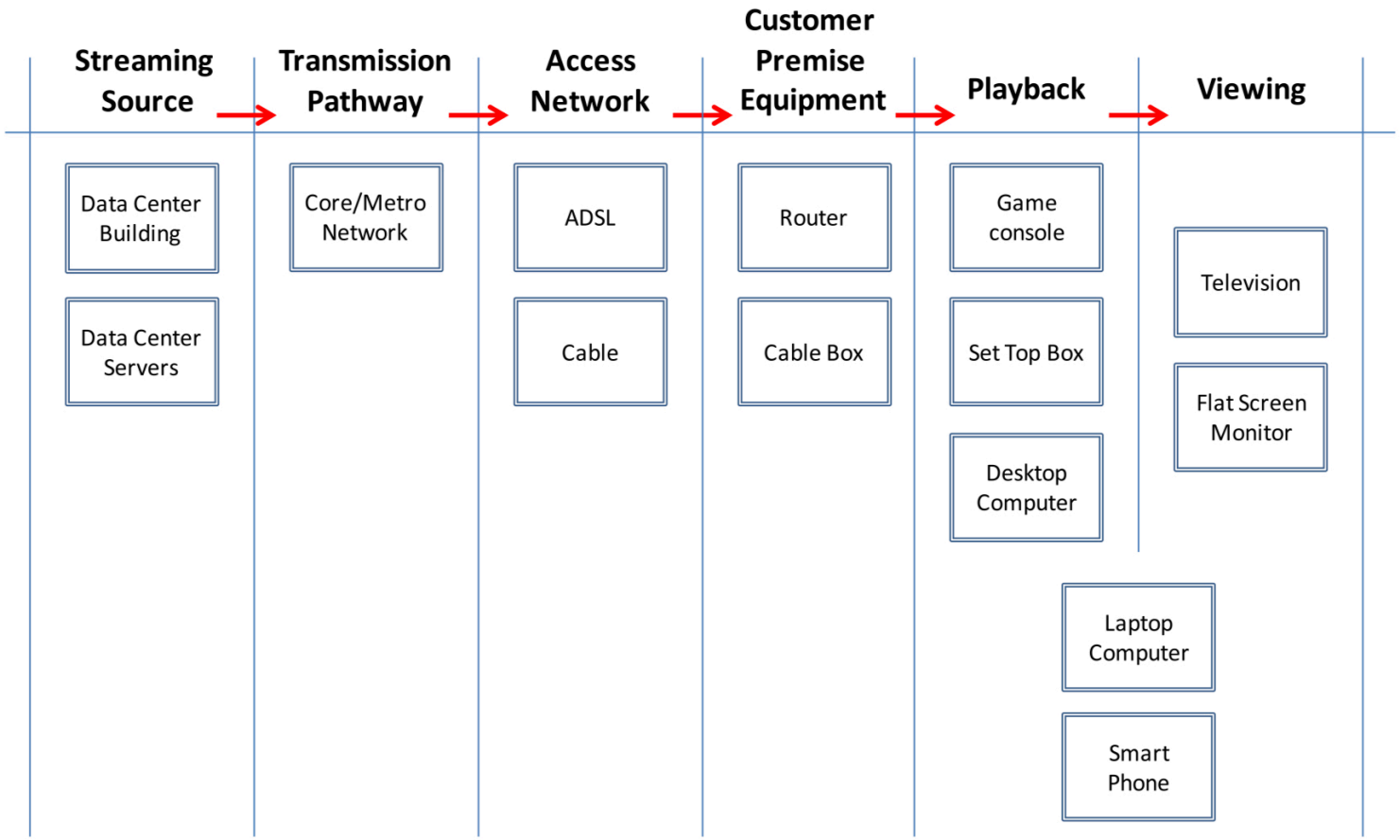
Introduction to the study

- Comparing video streaming with DVDs
  - Rented or bought
  - By mail or in a store
- Results from 2011
- Only streaming of movies/series/TV programmes considered
- Different playback/viewing devices considered

What was taken into account for DVDs ?



What was taken into account for streaming ?



Major assumptions

- Customer purchases: 1.2 bil. DVDs bought annually
  - Evenly split between store-bought and mail-bought
- Store rental: 30 mil. DVDs bought annually
- Mail rental: 14 mil. DVDs bought annually
- Netflix represents the whole mail-rental industry (2.2 mil. DVDs per day)
- Each DVD contains 2h of video, viewed once per mailing
- The movie quality has no value

Major assumptions

% time watched with viewing device				
	DVD		Streaming	
Device	Monitor	Console	Monitor	Console
Desktop computer	—	5%	—	10%
Laptop computer	5%	5%	10%	10%
Flat panel monitors	5%	—	10%	—
Smart phones	—	—	3%	3%
DVD players	—	76%	—	—
Set top boxes	—	—	—	21%
Televisions	90%	—	77%	6%
Video game systems	—	14%	—	50%

Arman Shehabi, Ben Walker and Eric Masanet. The energy and greenhouse-gas implications of internet video streaming in the United States, Environmental Research Letters, 9, 2014

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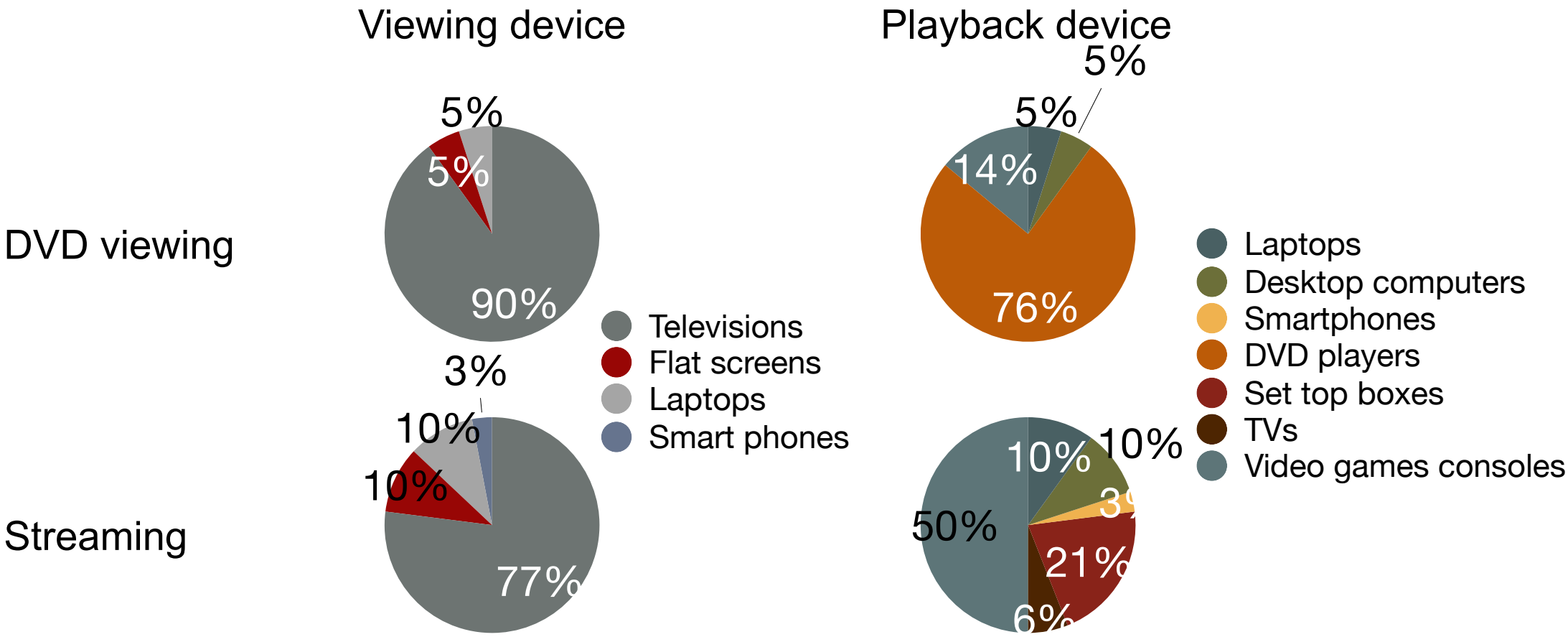
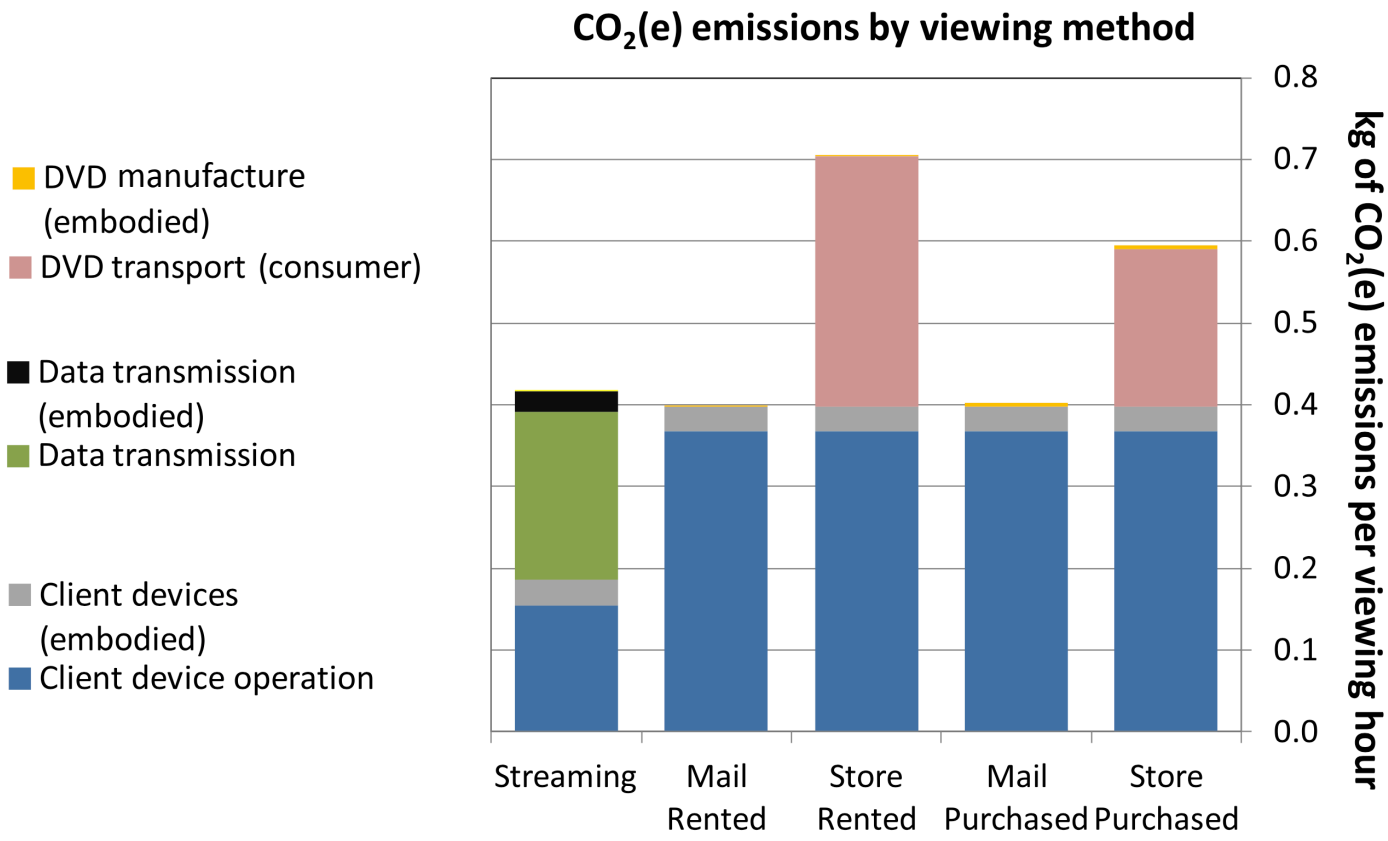


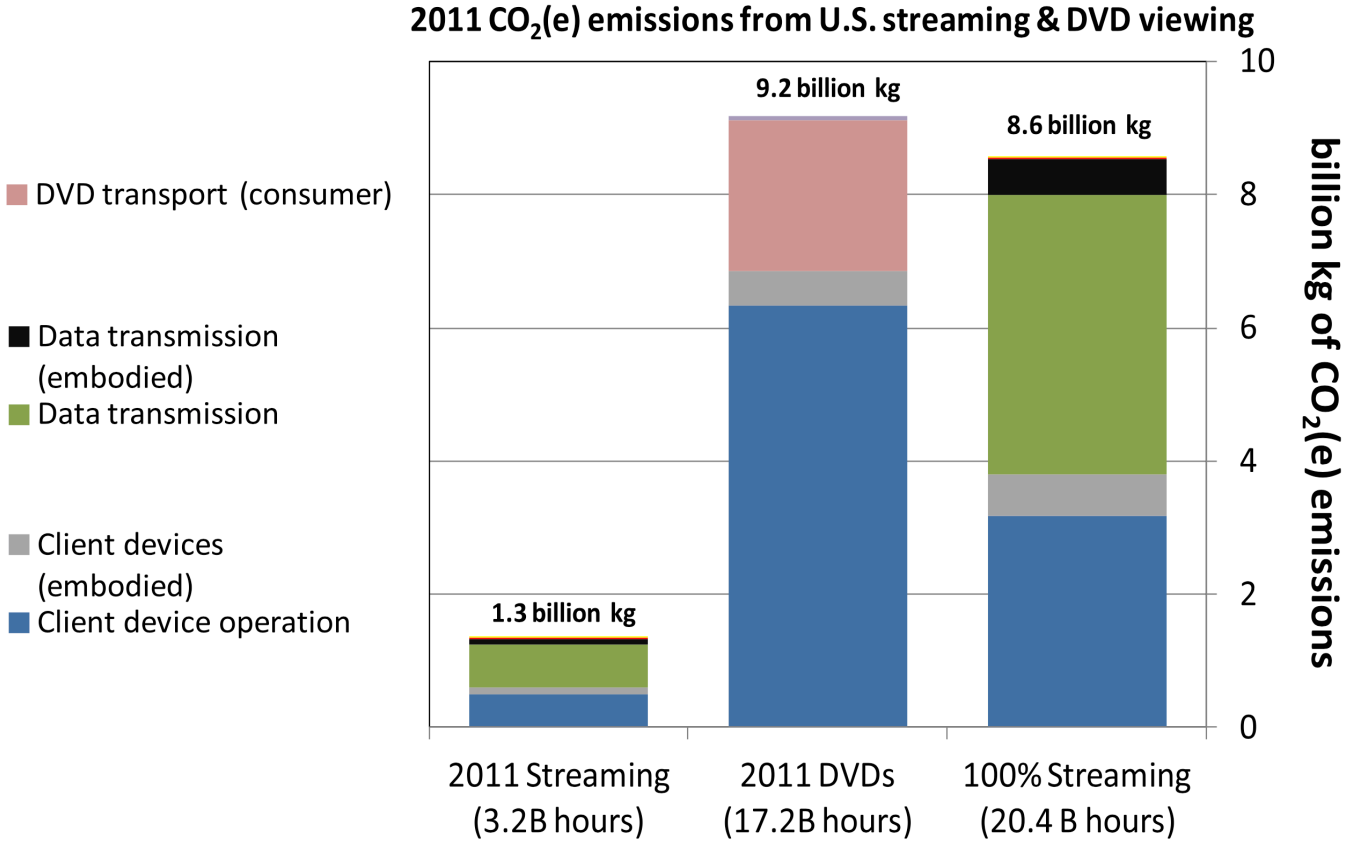
Arman Shehabi, Ben Walker and Eric Masanet. The energy and greenhouse-gas implications of internet video streaming in the United States, Environmental Research Letters, 9, 2014

Impact per viewing hour



Arman Shehabi, Ben Walker and Eric Masanet. The energy and greenhouse-gas implications of internet video streaming in the United States, Environmental Research Letters, 9, 2014

Impact per year



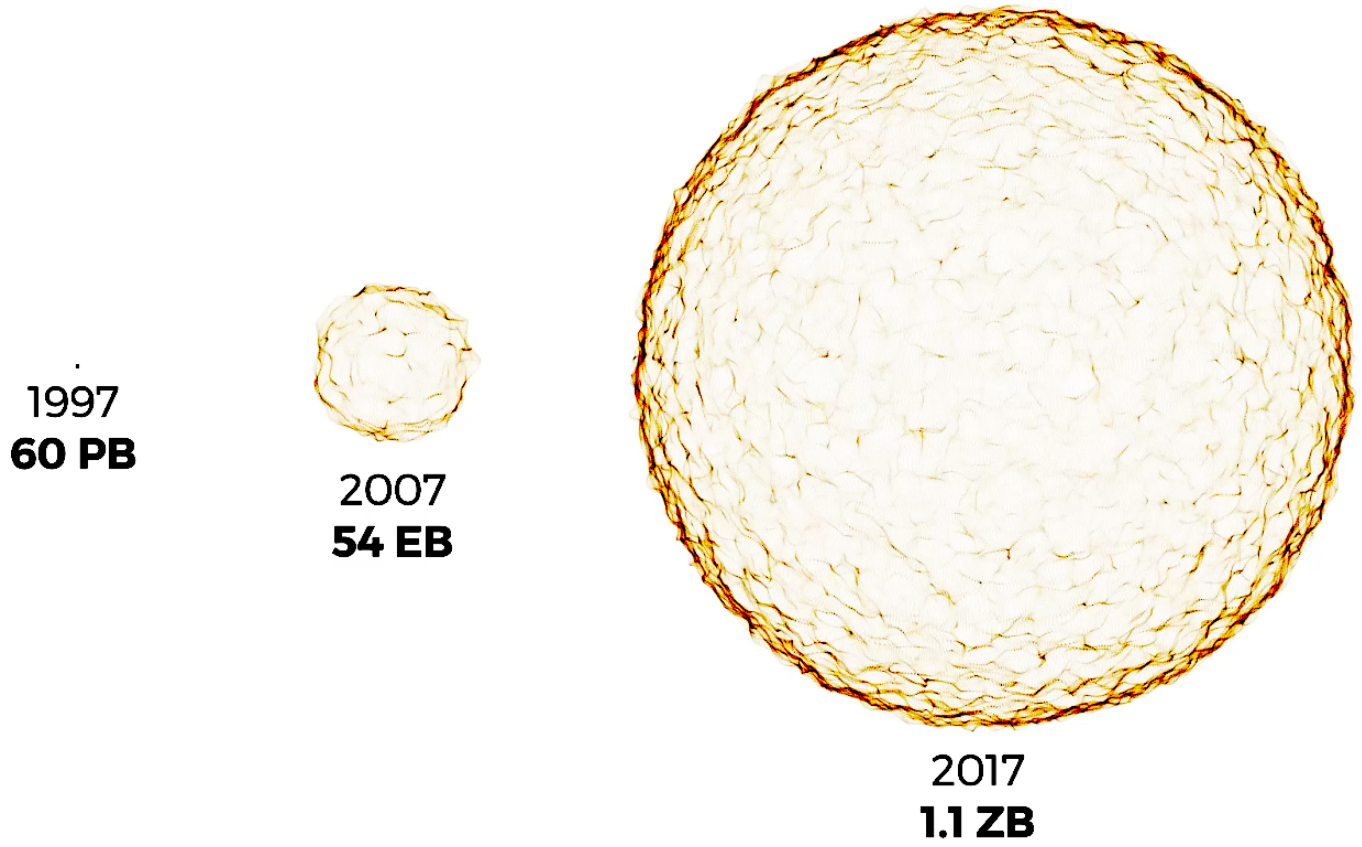
Arman Shehabi, Ben Walker and Eric Masanet. The energy and greenhouse-gas implications of internet video streaming in the United States, Environmental Research Letters, 9, 2014

Conclusions

- Electricity mixes play a significant role
- End-user devices & data transmission: ~90% of streaming energy
- Streaming and mail-renting are similarly efficient
  - However, streaming is easier and cheaper → rebound
- Results are subject to change (video quality, evolution of networks, advances in devices, …)

Side note about the evolution of streaming

Evolution of the global internet traffic



International Energy Agency (IEA). Digitalization and Energy 2017, 2017

How much of it is video ?

- 75% in 2017
- Expected to be 82% by 2022
  - The total traffic is also expected to increase
- Doesn’t include audio streaming (e.g. Spotify, Apple Music, …)
- A new type of streaming is about to arrive

Cisco Visual Networking Index: Forecast and Trends, 2017–2022 White Paper

Google Stadia

- Upcoming video-game streaming platform
- High image quality
- Can be accessed on many different platforms
  - Potential rebound effect (easier → more usage)
  - Similar to what happened to video streaming
- Video games require a lot of data transfer

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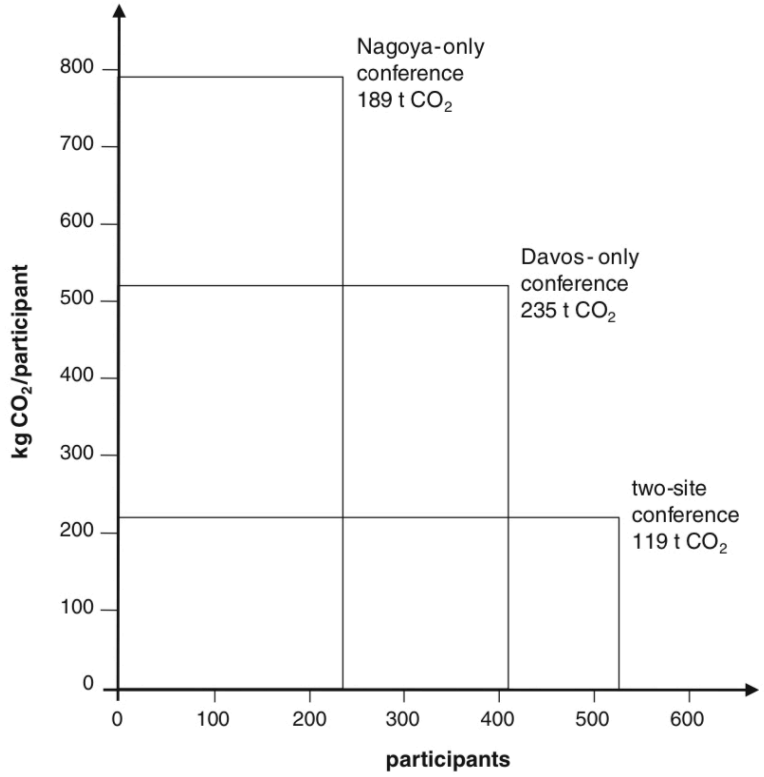
Vlad C. Coroama, Åsa Moberg and Lorenz M. Hilty. Dematerialization Through Electronic Media?, In: Lorenz M. Hilty and Bernard Aebischer (Eds.), ICT Innovations for Sustainability, pp. , Springer, pp. 405–421, 2015

Introduction to the study

- International conference organised in Switzerland and Japan
  - Participants attend in one place
  - Communication through video calls
- Travel emissions assessed through participant's reports
- Participants asked if they would have gone to the other location
  - Potential emissions compared with current ones
- Results presented for the 3 scenarios (Switzerland, Japan, both)

Total impact



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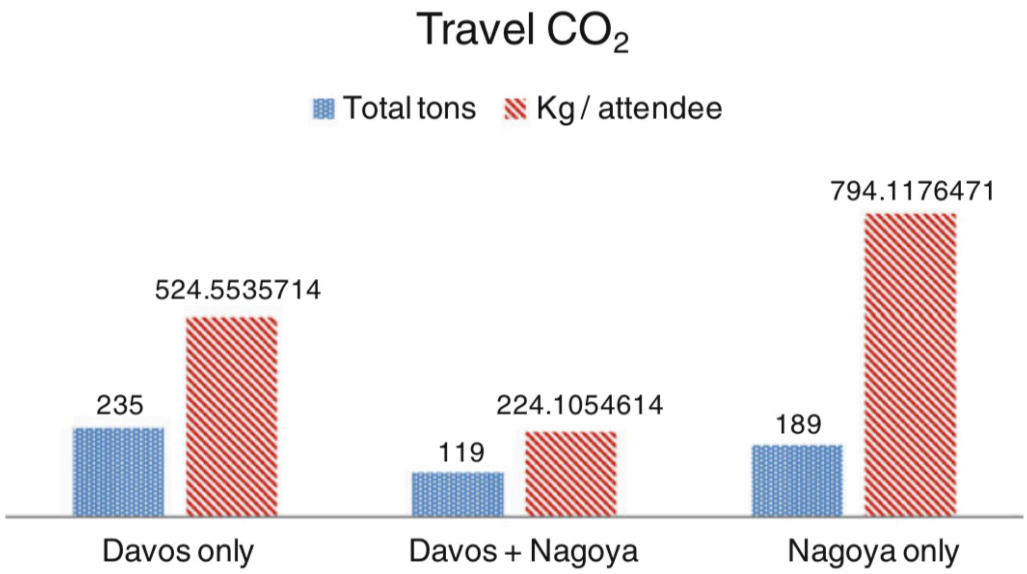
Impact per participant



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Conclusions

- Clear rebound effect showing in the number of participants
  - Even then, much lower emissions
- The telepresence equipment used also matters for energy consumption
  - Specified in the paper, but not in this study’s scope

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Media types

- Different media types have different impacts
- Digitalisation can lead to more or less savings depending on the type
  - E.g. videoconferencing vs. streaming

Consumption methods

- Electronic media can be consumed on different devices
  - With different production impact
  - With different energy efficiency
- Electronic devices need to be changed
  - Production & shipping impacts repeated
  - Disposal impact

User practices

- How media (electronic or not) is used greatly affects its impact
  - Is a book read by 1 or 5 people ?
  - Is a movie saved, or streamed several times ?
- Devices can be used for one, or many types of media
- What electronic media is replacing might have a lower impact

What's beyond consumer's reach

- Planned obsolescence
  - Devices made to break fast → more production → more impact
- Electricity mix
  - Different energy sources have different impacts
- Network energy consumption

So is it all worth it ?

- Generally yes, but it needs to be done correctly
  - Doing it halfway may result in more harm than good
  - Overusing it may have the same effect
  - And so does misusing it
- Much remains to be done in adjacent areas

References

- Mohammad A. Achachlouei and Åsa Moberg. Life Cycle Assessment of a Magazine, Journal of Industrial Ecology, 19 (4), 2015
  - Part I: Tablet Edition in Emerging and Mature States, pp. 575-589
  - Part II: Comparison of Print and Tablet Editions, pp. 590-606
- Arman Shehabi, Ben Walker and Eric Masanet. The energy and greenhouse-gas implications of internet video streaming in the United States, Environmental Research Letters, 9, 2014
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- Cisco Visual Networking Index: Forecast and Trends, 2017–2022 White Paper
- Vlad C. Coroama, Åsa Moberg and Lorenz M. Hilty. Dematerialization Through Electronic Media?, In: Lorenz M. Hilty and Bernard Aebischer (Eds.), ICT Innovations for Sustainability, pp. , Springer, pp. 405–421, 2015