VESTLANDSFORSKING

Session 2: Environmental efficiency and the United Nations Sustainable Development Goals
How digital technologies can accelerate progress to our Global Goals and related questions relevant to policy and business.

Understanding rebound effects associated with digital technologies

Presentation by Hans Jakob Walnum 30.11.2022

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RESEARCH AND ANALYSIS

Rebound effect and sustainability science

A review

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Abstract

Rebound effects have been historically studied through narrow framings which overlook the complexity of sustainability challenges, sometimes leading to informed conclusions and policy recommendations. Here we present a critic

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rticle

Can Rebound Effects Explain Why Sustainable Mobility Has Not Been Achieved?

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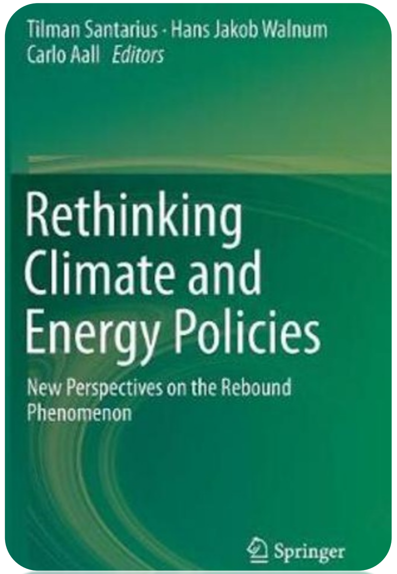

FIXING OR TRANSFERRING ENVIRONMENTAL PROBLEMS IN THE TRANSPORT SECTOR?

BY
HANS JAKOB WALNUM

DISSERTATION SUBMITTED 2015

REVIEW ARTICLE
Front. Energy Res., 09 November 2018 | https://doi.org/10.3389/fenrg.2018.00104

From Unidisciplinary to Multidisciplinary Rebound Research: Lessons Learned for Comprehensive Climate and Energy Policies

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Vestlandsforsking-rapport nr. 5/2015

Driver and response model for Norwegian road freight transport in the period 1993-2013.

Hans Jakob Walnum, John Hille and Carlo Aall

Editorial: The Rebound Effect and the Jevons' Paradox: Beyond the Conventional Wisdom

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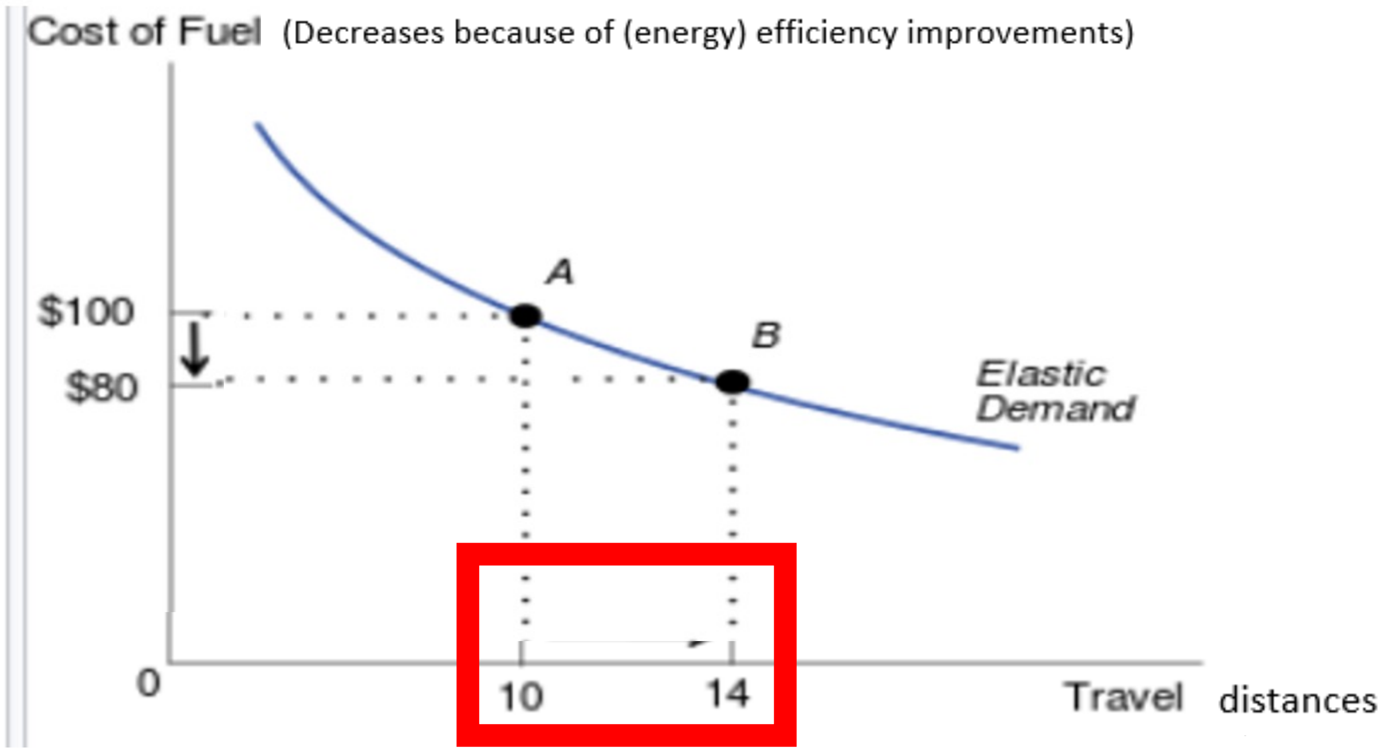
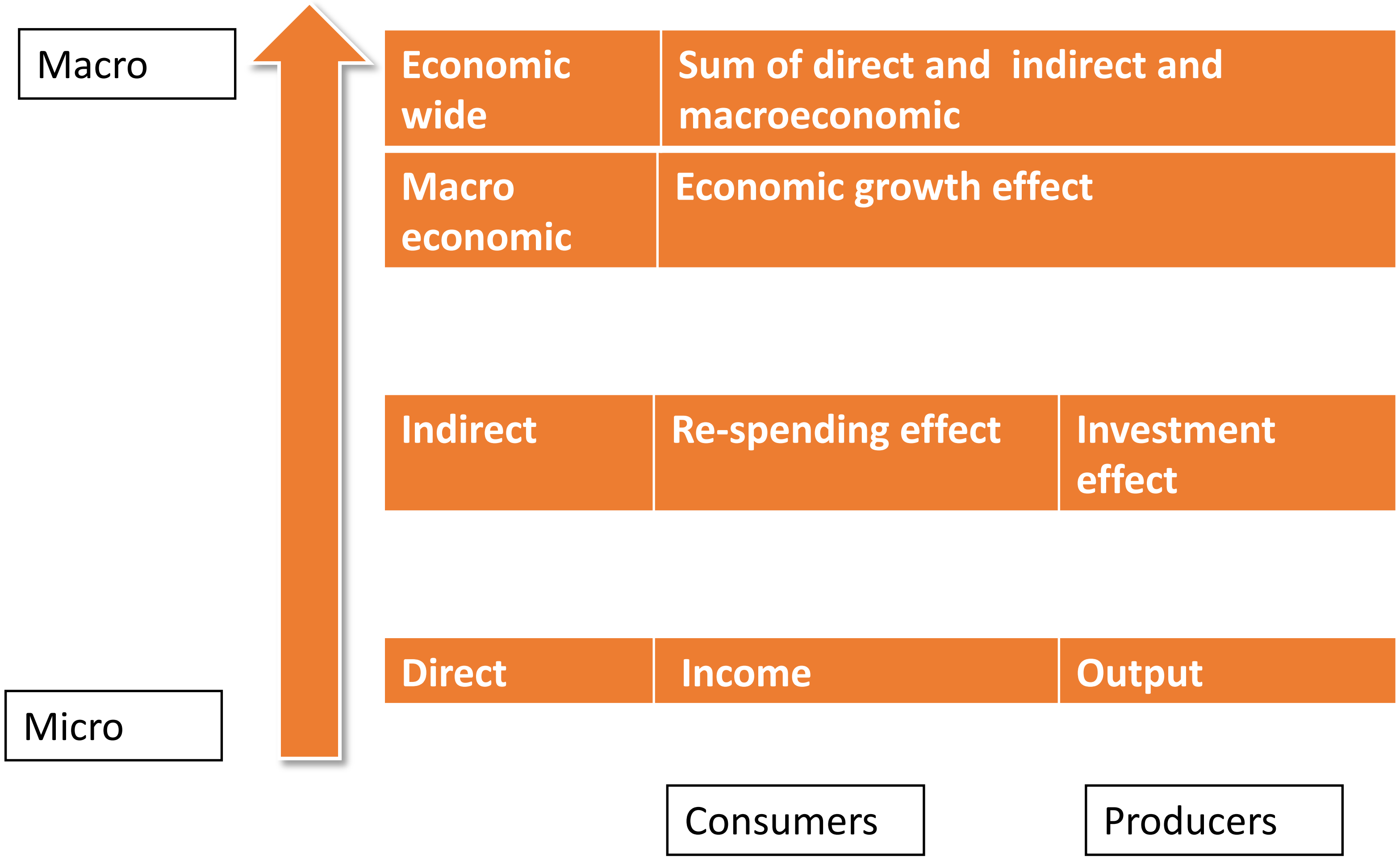


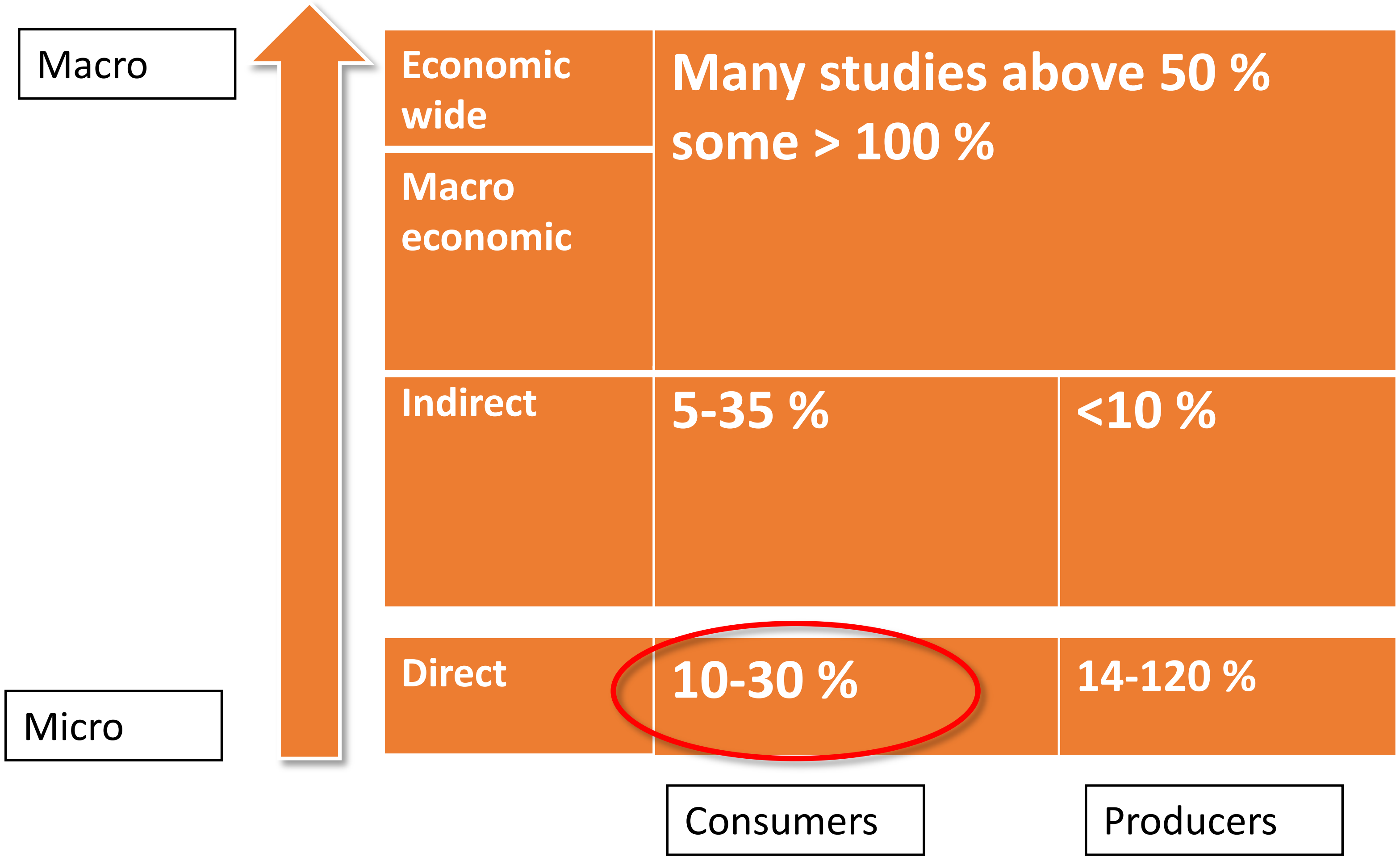
Cost of Fuel (Decreases because of (energy) efficiency improvements)
A
B
$100
$80
Elastic Demand
0
10
14
Travel distances

- Behavioral or systemic responses (mostly discussed in relation to energy efficiency improvements).
- Often expressed as the percentage differences between expected savings and actual energy use after implementation of an energy efficiency improvement.
- An overall rebound effect of 100% means that the expected energy savings are entirely offset, leading
  to zero net savings

- Direct
  - For example, when consumers purchases a new car, which is more fuel-efficient than the old, they might drive more
- Indirect
  - Indirect rebound effect, involves money saved on reduced fuel consumption being spent on other energy-intensive goods and services
- Society/economy Wide
  - Commonly defined within mainstream economics as the sum of indirect and direct



Macro
Economic wide
Sum of direct and indirect and macroeconomic
Macro economic
Economic growth effect
Indirect
Re-spending effect
Investment effect
Direct
Income
Output
Micro
Consumers
Producers


Macro
Micro
Economic wide
Macro economic
Many studies above 50 %
some > 100 %
Indirect
5-35 %
<10 %
Direct
10-30 %
14-120 %
Consumers
Producers

- In most cases, energy-economic rebound effects assume **that the consumer preferences and the social and economic structures have remained the same**, and under these conditions, the demands of people and companies increase.
- The classical typology of rebound effects works well for cars, washing machines, and home heating systems, i.e. traditional consumer product. However, this type of scheme is not easy to apply to ICT-related products such as cloud computing **because the satiation of consumer needs does not hold for ICT in the same way as it does for other products, and ICT tends to lead to increased production of goods** (Calvin 2015).
- **new consumption (and production) options** that were not available earlier, e.g. increased availability and thus download of music and movies, which is possible at any time and from anywhere.
- This calls for the **need to go beyond the traditional understanding of rebound effects to grasp the potential energy use** associated with Cloud Computing services (Walnum and Andrae 2015).

State-of-the art research.
Greenhouse gas emissions in a life cycle perspective.

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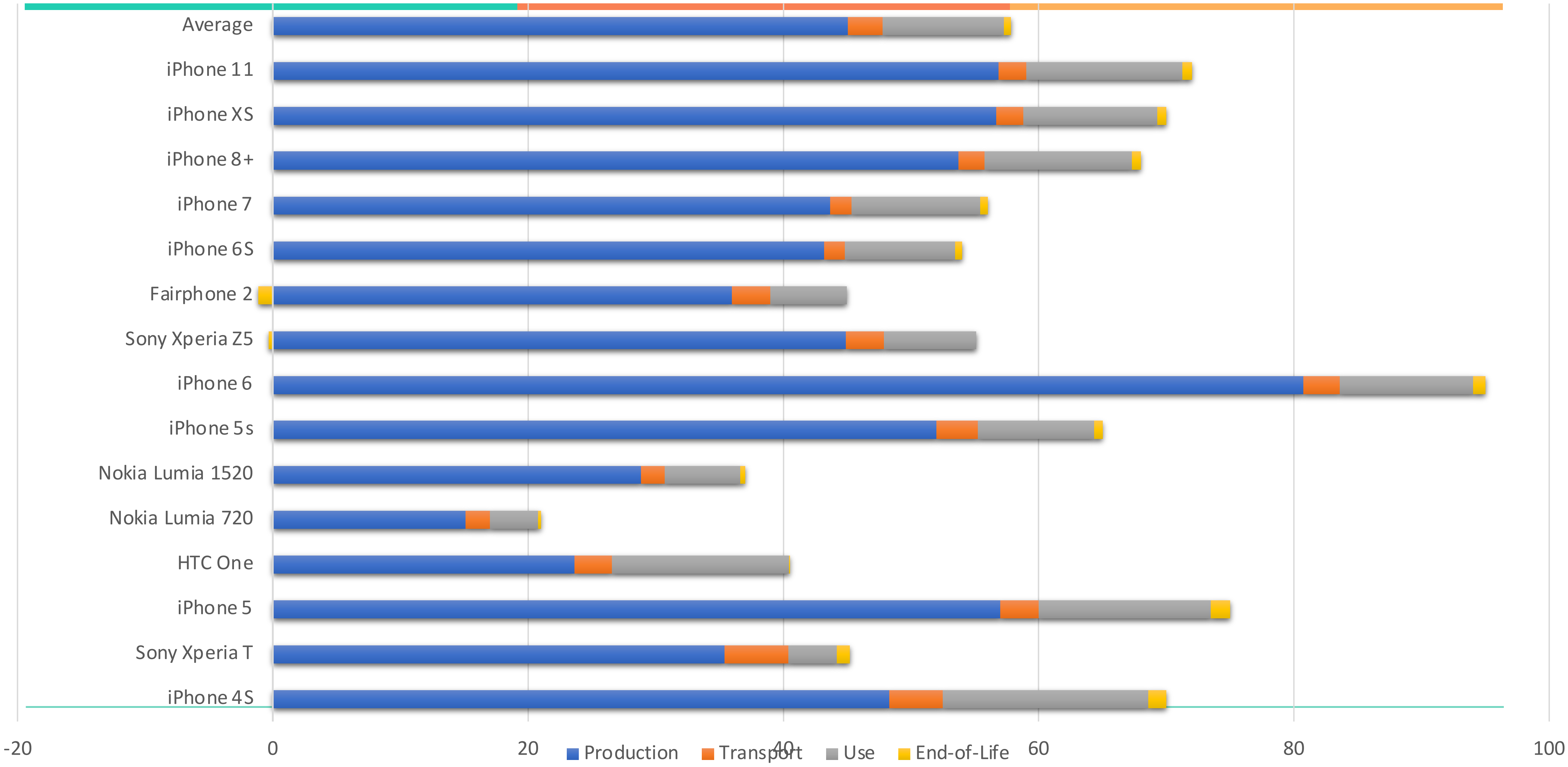

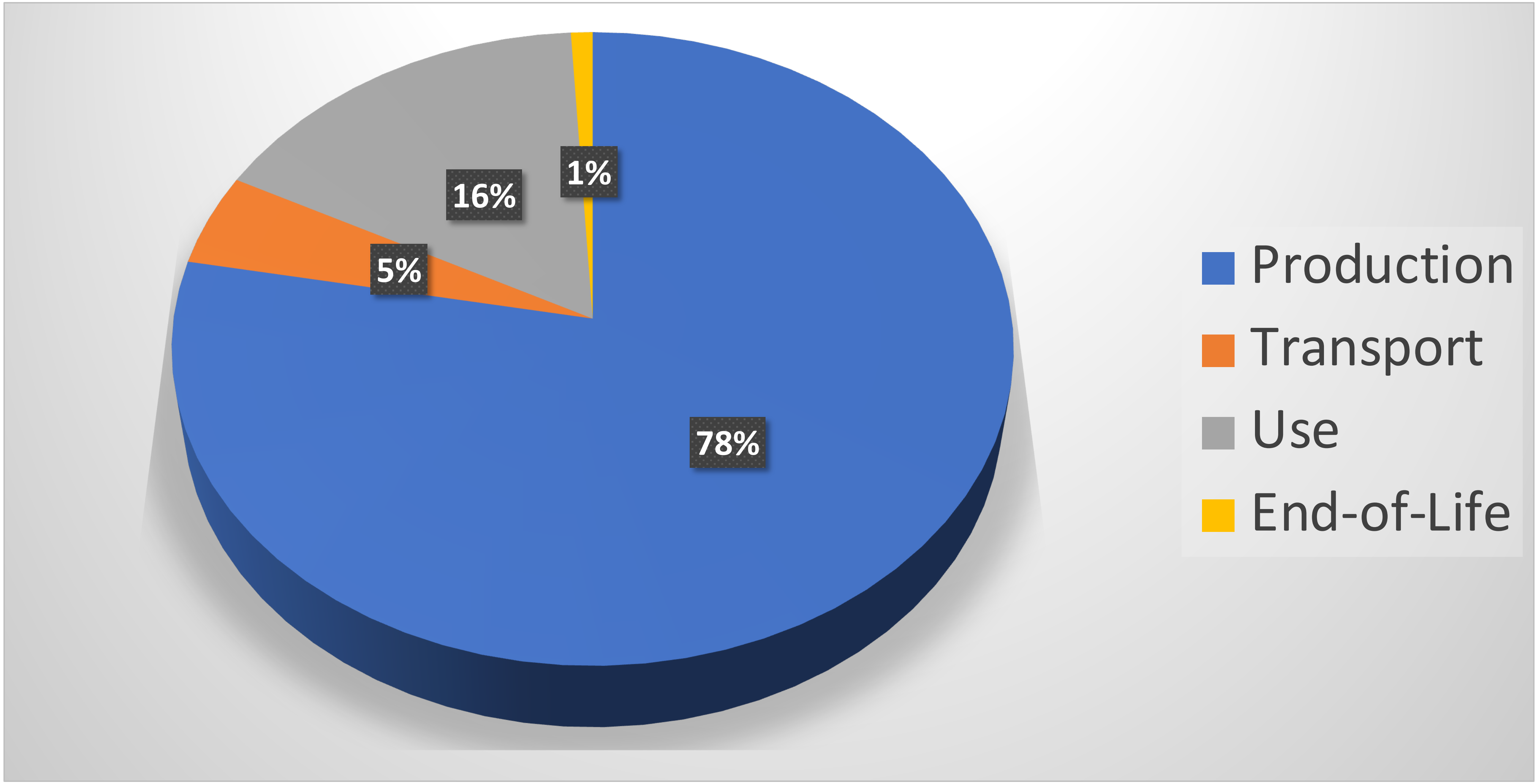

16%
1%
5%
78%
Production
Transport
Use
End-of-Life

1. Texting (88% use this)
2. Email (70%)
3. Facebook (62%)
4. Camera (61%)
5. Reading news (58%)
6. Online shopping (56%)
7. Checking the weather (54%)
8. WhatsApp (51%)
9. Banking (45%)
10. Watching videos on YouTube (42%)

nature
climate change

IDSFORSKING

Correspondence | Published: 13 July 2020

Hiding greenhouse gas emissions in the cloud

David Mytton

Nature Climate Change **10**, 701(2020) | Cite this article

To the Editor – Data centres account for 200 TWh yr^{-1}, or around 1% of total global electricity demand[1]. While their energy usage has been stable in recent years as efficiencies increase, it may grow to between 15–30% of electricity consumption in some countries by 2030 (ref. [2]).

Streaming of video

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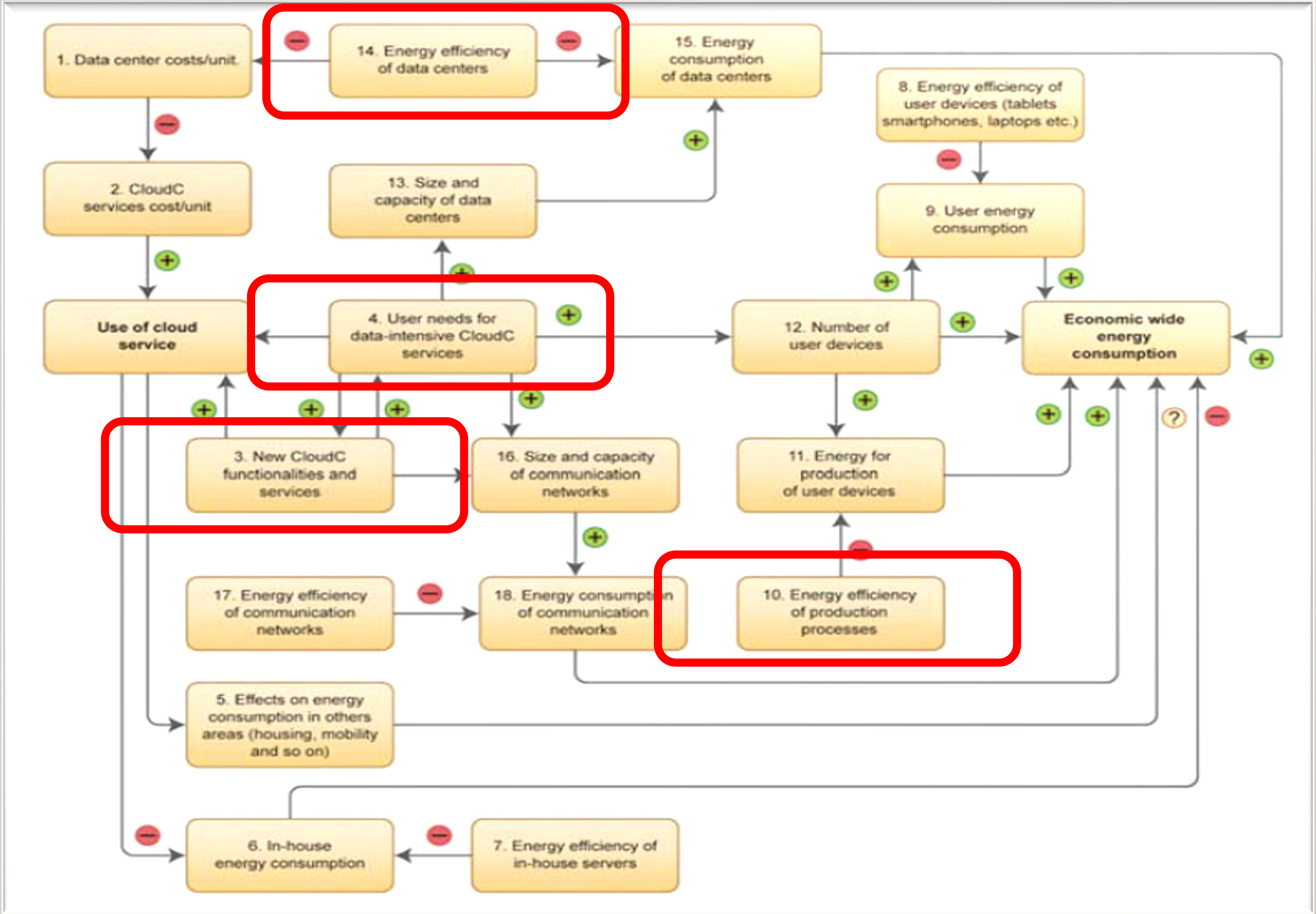
- 0,12-0,24 kWh (28-57 gram CO2 eq.)
- 1 hour streaming a day or 365 hours a year, increases the emissions of 10,2 kg CO2 ekv.- 20,8 from the use fase.
- Use phase of a phone typically between 2-3 years. Gives an between 20,4 and 62,4 kg CO2 eqv..
- By including the use phase, could increase the CO2 eqv between **35-100 percent**



1. Data center costs/unit
14. Energy efficiency of data centers
15. Energy consumption of data centers
8. Energy efficiency of user devices (tablets smartphones, laptops etc.)
2. CloudC services cost/unit
13. Size and capacity of data centers
9. User energy consumption
Use of cloud service
4. User needs for data-intensive CloudC services
12. Number of user devices
Economic wide energy consumption
3. New CloudC functionalities and services
16. Size and capacity of communication networks
11. Energy for production of user devices
17. Energy efficiency of communication networks
18. Energy consumption of communication networks
10. Energy efficiency of production processes
5. Effects on energy consumption in others areas (housing, mobility and so on)
6. In-house energy consumption
7. Energy efficiency of in-house servers
?

Summary

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- Lead to a wider application in other sectors of the economy and throughout society, than was initially foreseen
- Analyses of transformational effects within ICT emphasize the opportunities offered by these technologies. They discuss long-term and significant effects on innovation, productivity, and economic growth that increase economy wide energy use (Sorell 2007).

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