Digitalisation, daily life, and climate change

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ETH Zurich
5 October, 2022

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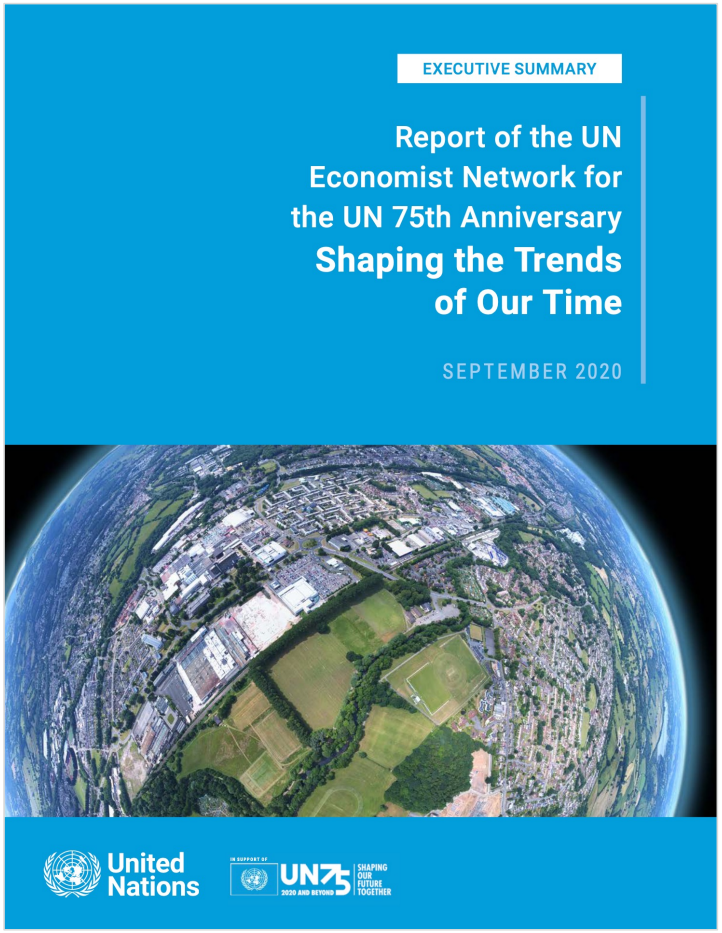
European Research Council
Consolidator Grant #101003083

Environmental *Change* Institute
School of Geography and the Environment

Digitalisation and climate change are two ‘megatrends’ that will shape our lives over the coming decades.



Digitalisation = collecting, exchanging, storing, analysing **data**:
cheaply, quickly, connectively

Image: Chambre des Deptues @Flickr. CC BY-ND 2.0.

Photo: Marvin Meyer @Unsplash.

Digitalisation = **general purpose technology**

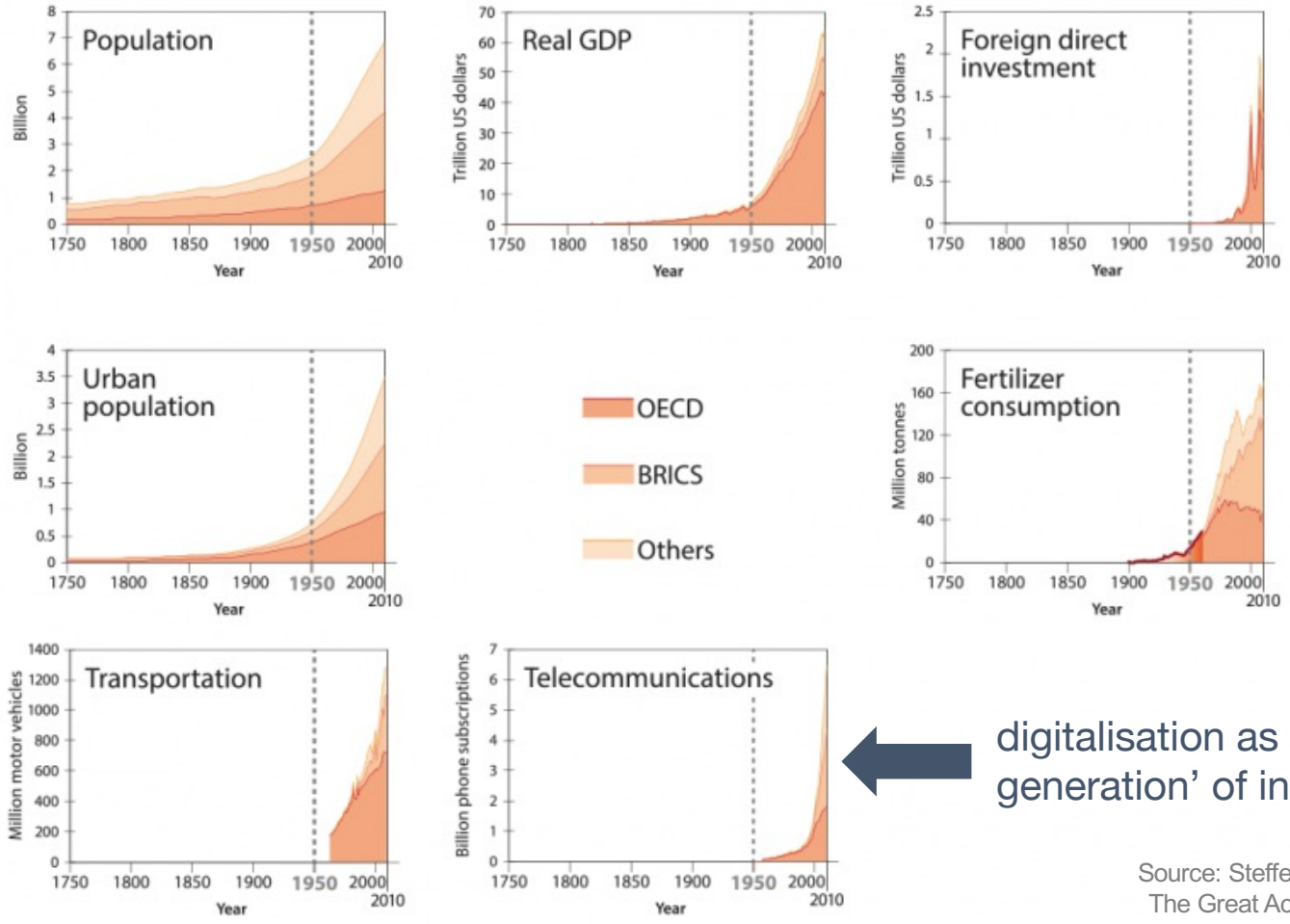
Digitalisation is ‘just’ the latest generation of information system.

Image: Marie-Lan Nguyen @Wikipedia.

Image: http://museum.ipsj.or.jp/en//heritage/bibun.html

Source: Creutzig et al. (2022). "Digitalization and the Anthropocene." *Annual Review of Environment and Resources* 47(1).

The digital and computer revolution from the 1950s coincides with the beginning of the Anthropocene (the “epoch of humankind”).

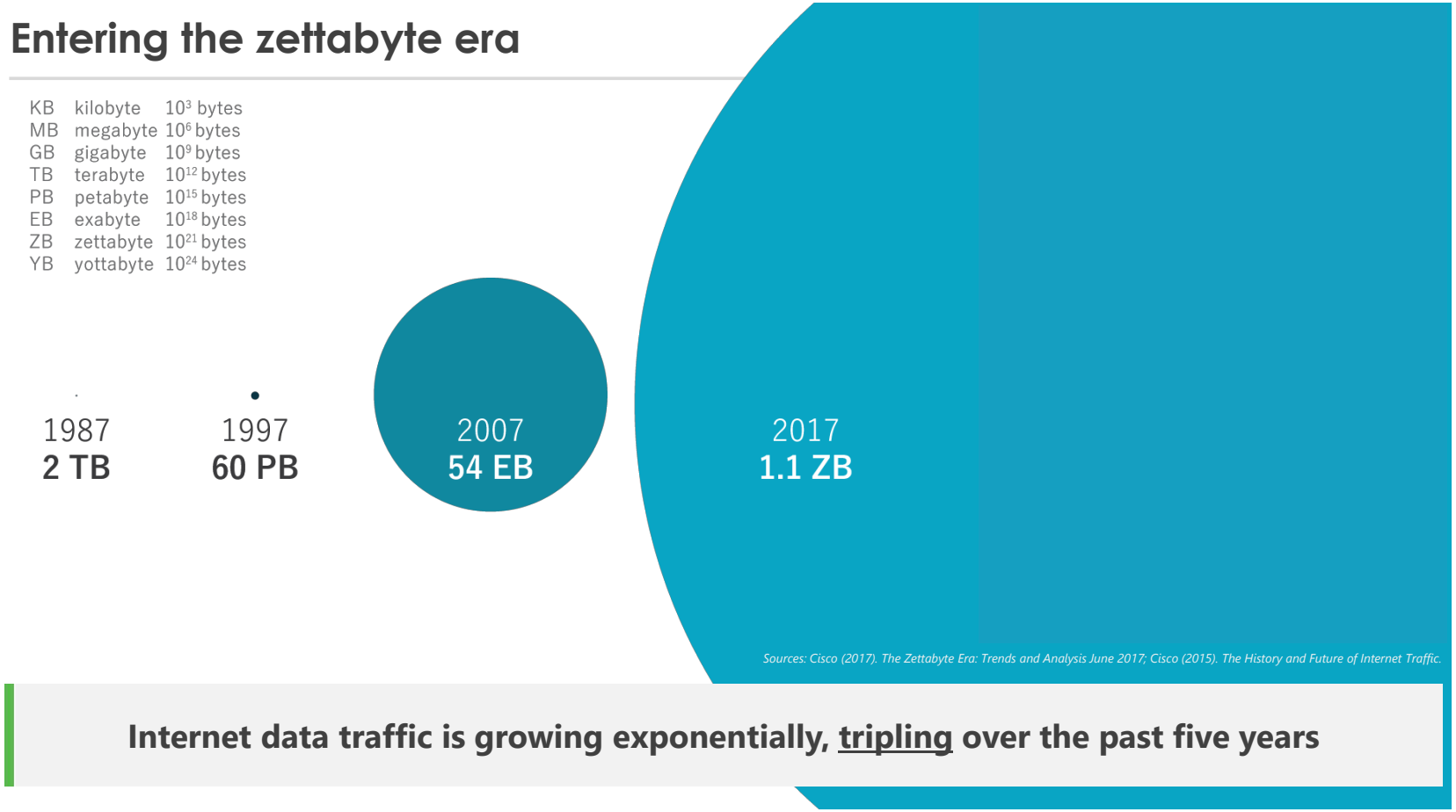


digitalisation as ‘latest generation’ of information system

Source: Steffen et al. (2015). "The trajectory of the Anthropocene: The Great Acceleration." *The Anthropocene Review* 2 (1):81-98.

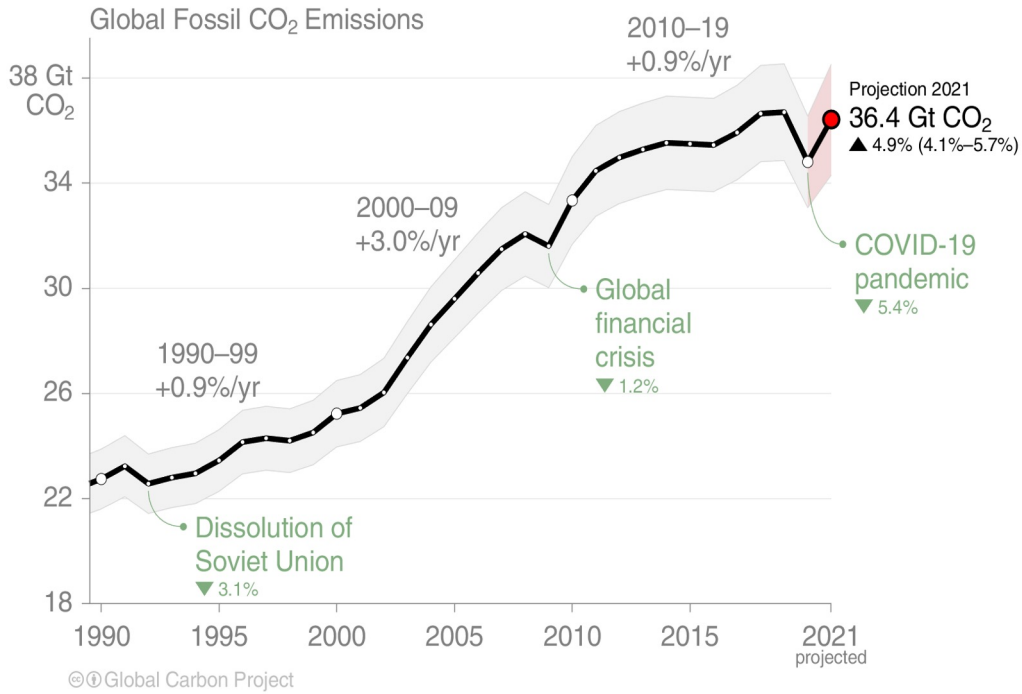
KB … MB … GB … TB … PB … EB … ?? .. ??

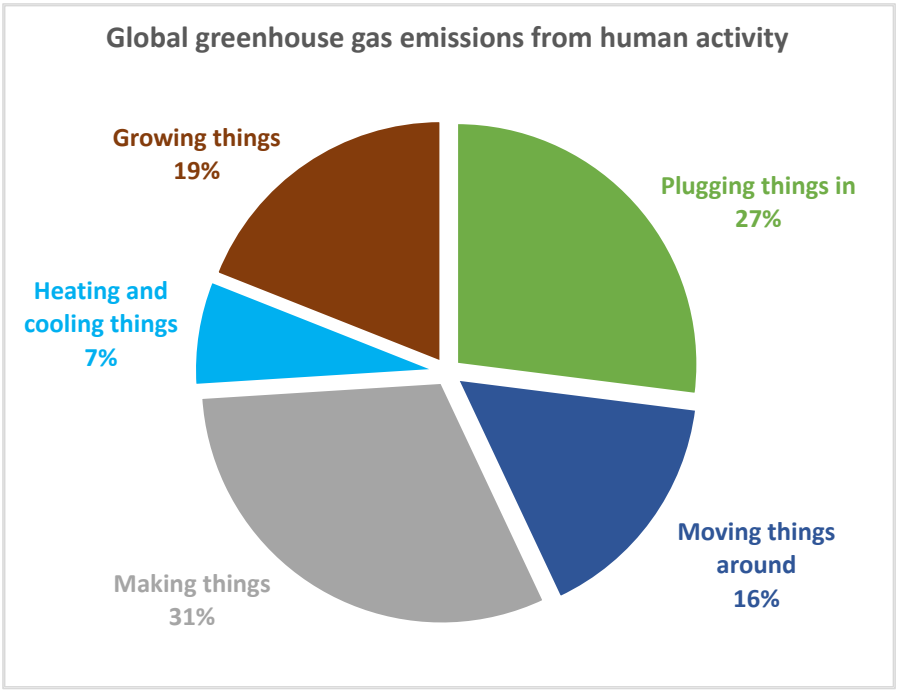
Data traffic on digital networks is increasingly exponentially.



Source: IEA (2018) Digitalization & Energy: Webinar. 7 February 2018. International Energy Agency, Paris, France.

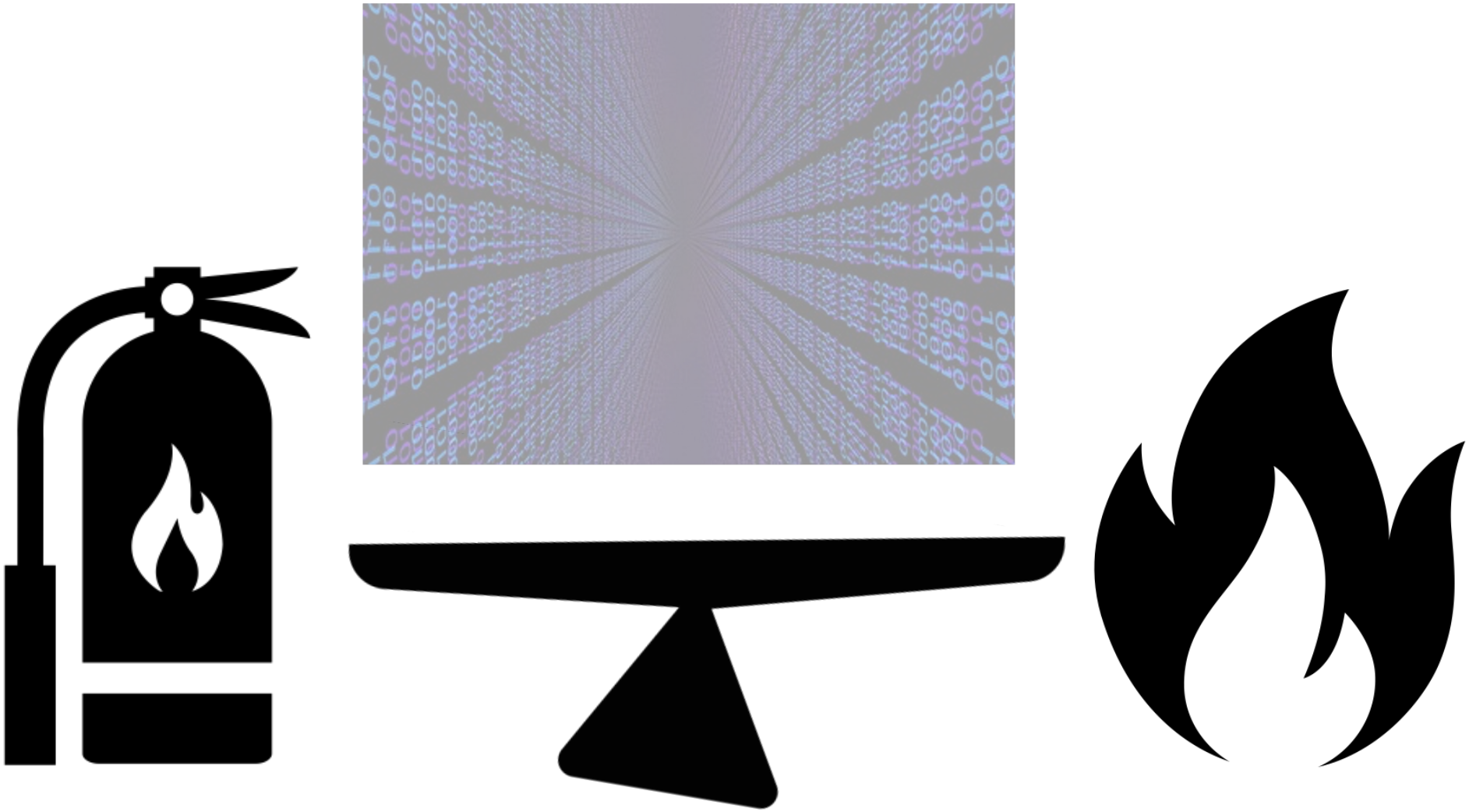
Carbon emissions need to be close to zero by 2050 ... impacting all aspects of our daily lives.



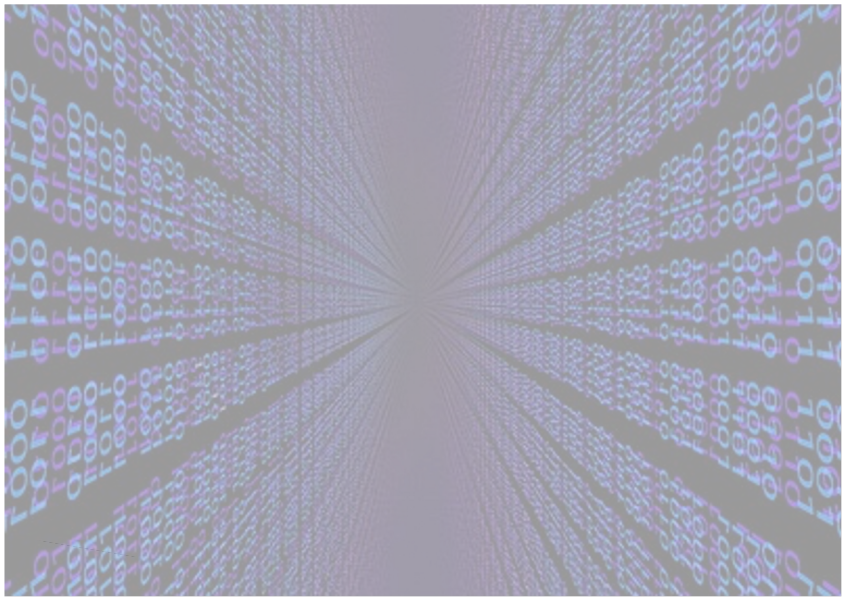


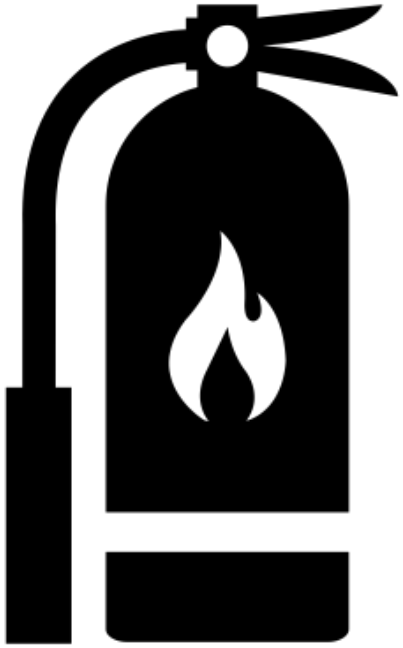
Source: Global Carbon Project (2021) Global Carbon Budget.
https://www.globalcarbonproject.org/carbonbudget/21/presentation.htm

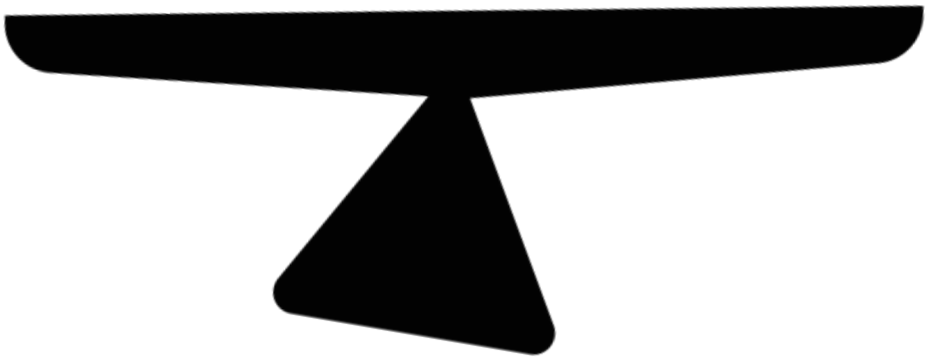
Source: Adapted from Breakthrough Energy.
[https://www.breakthroughenergy.org/our-challenge/the-grand-challenges]



Icons (Fire & Scales): Verry, Bohdan Burmich, Wira Wianda, Shaharea @NounProject. Icons (Star Wars): H Alberto Gongora & Icon 54 @NounProject.







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Substitute

Access

Coordinate

Exchange

Control

Integrate

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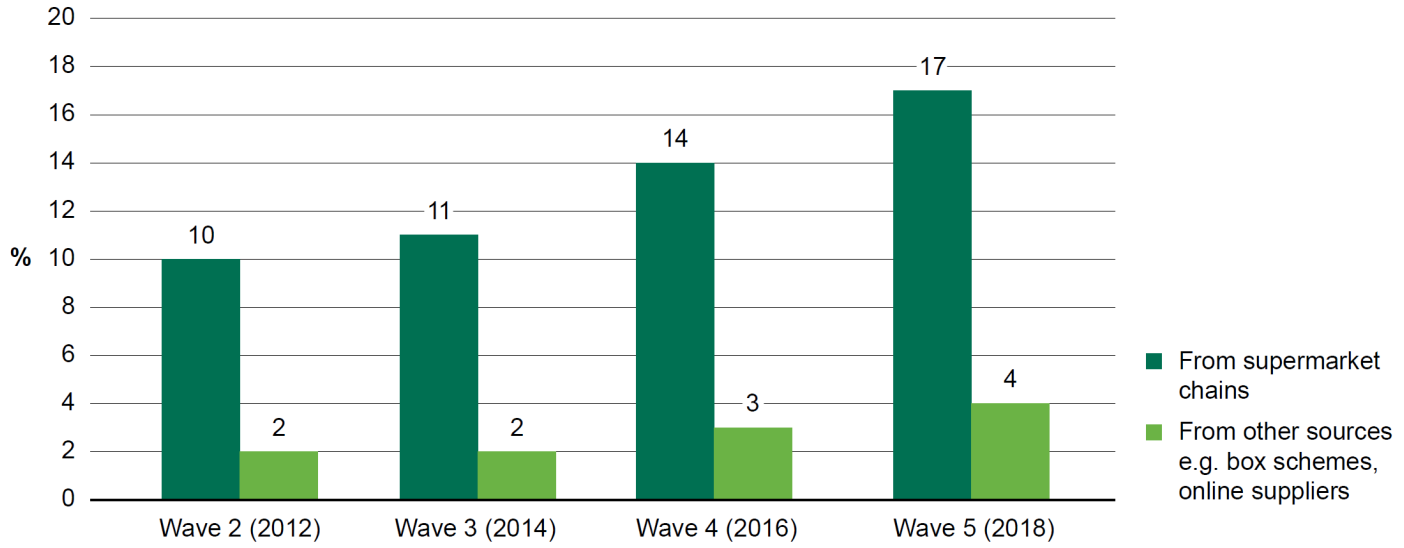
Opportunity for digitalisation: **substitute** physical activity for digital activity

home-working

video-conferencing

digital farmers' markets

meal kits



Source: Food Standards Agency (2019). Trends in the use of home delivery services by survey wave.

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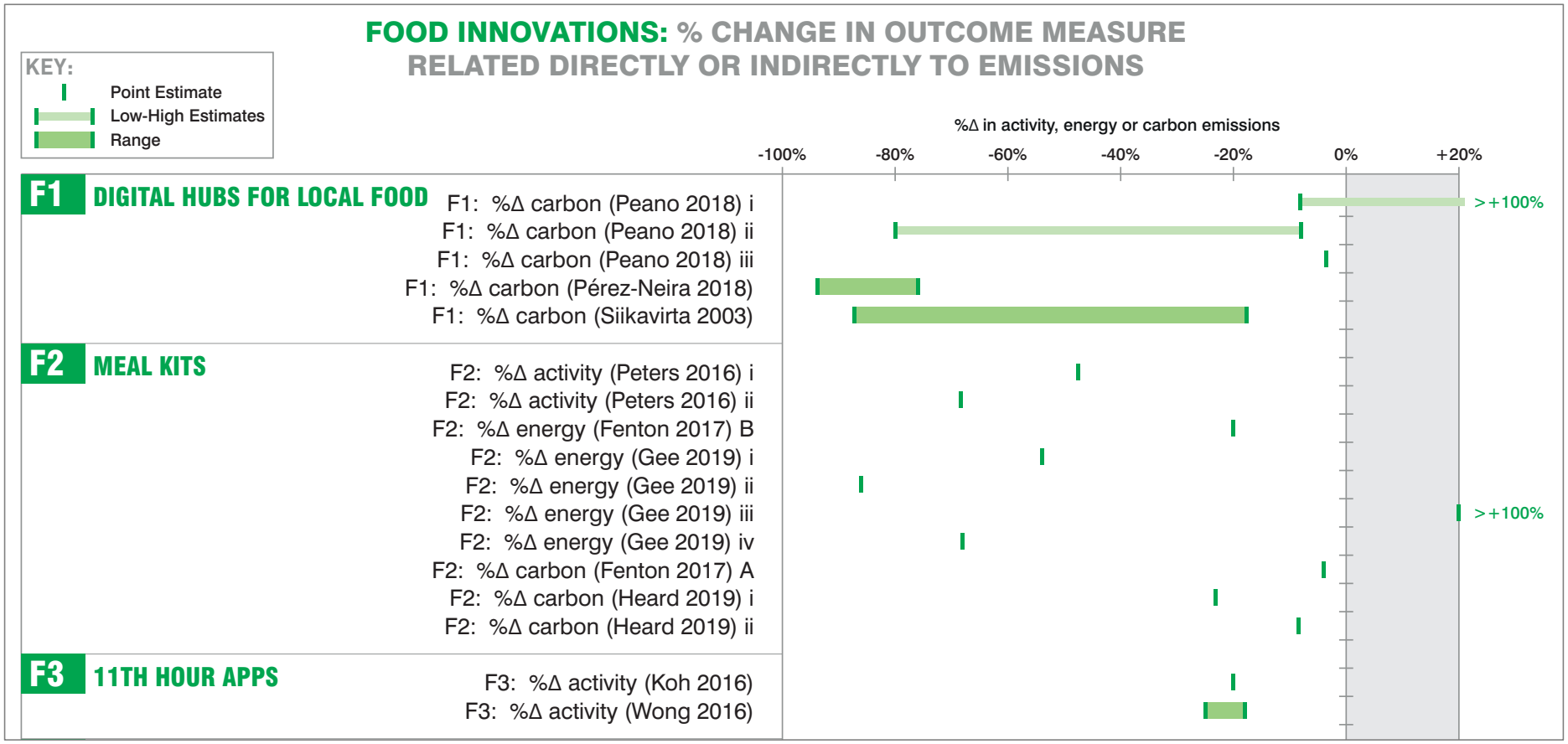
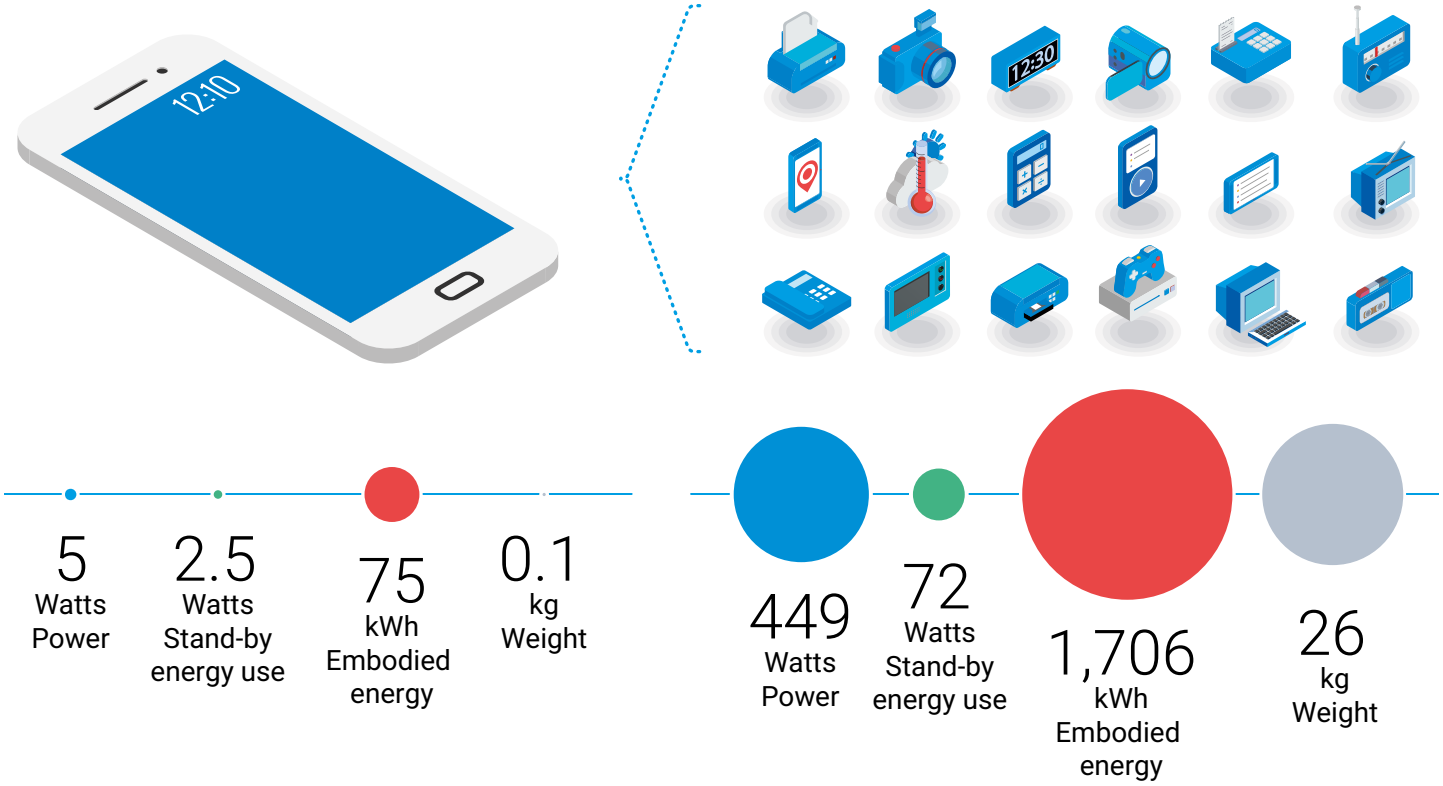


Source: Wilson et al. (2020). "Potential climate benefits of digital consumer innovations." *Annual Review of Environment and Resources* 45:113-144.

Opportunity for digitalisation:
access services instead of owning goods



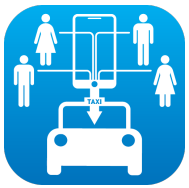
Source: Fig5.2, Nakicenovic & Wilson (2019). *UNEP Emissions Gap Repor*t. Based on Grubler, Wilson et al. (2018). “A Low Energy Demand Scenario for Meeting the 1.5°C Target and Sustainable Development Goals without Negative Emission Technologies." *Nature Energy* 3: 515-527.

Opportunity for digitalisation:
coordinate surplus supply with real-time demand

car clubs

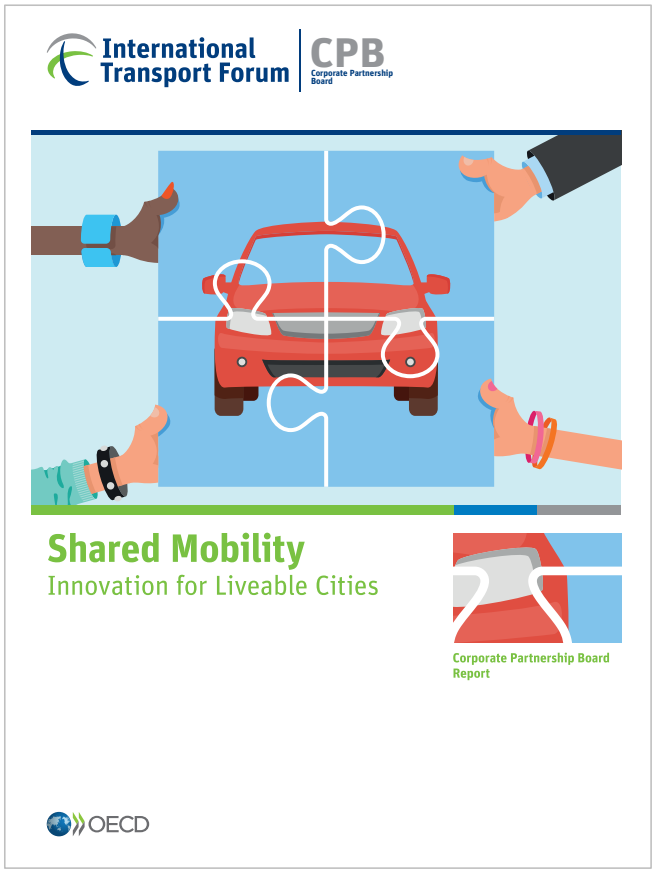
ridesharing

peer-to-peer carsharing



shared ride-hailing

Photo Credit: ShareNow @Unsplash.



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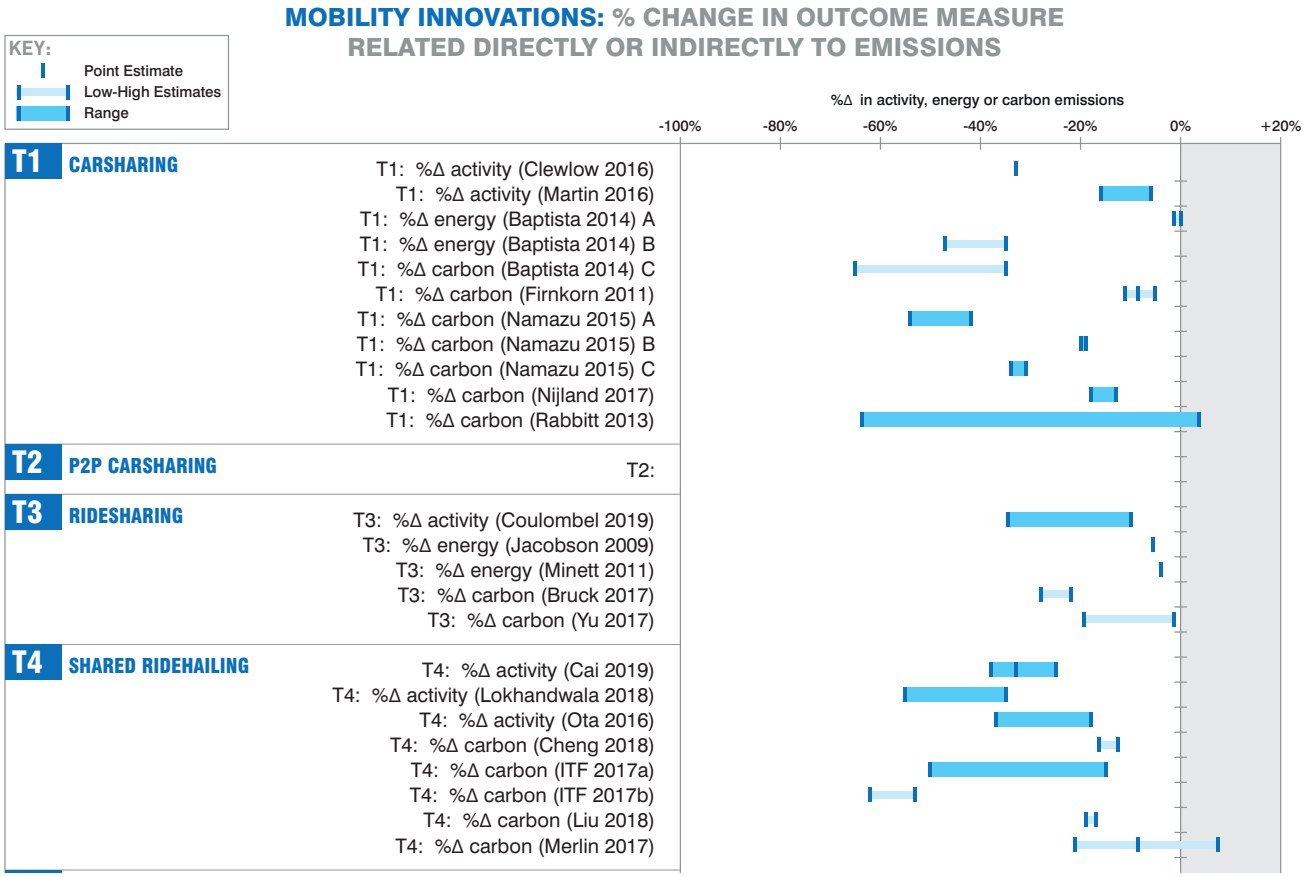


Source: Wilson et al. (2020). "Potential climate benefits of digital consumer innovations." *Annual Review of Environment and Resources* 45:113-144.

Opportunity for digitalisation:
exchange physical goods and avoid waste

food-sharing apps

food waste platforms

peer-to-peer platforms

peer-to-peer electricity

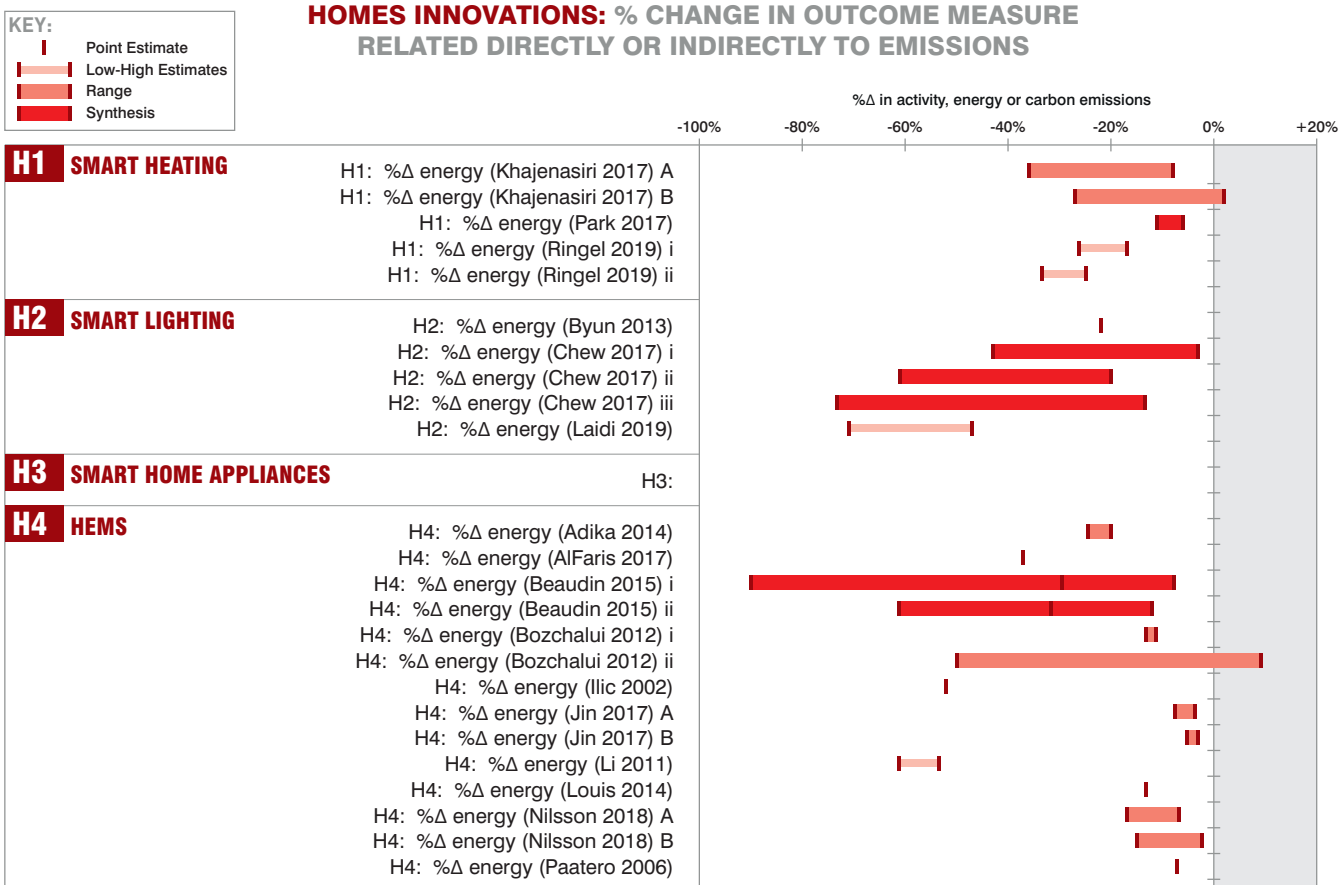
Photo Credit: https://gravesmillstorage.com/too-much-stuff/

Opportunity for digitalisation: **control** and manage resource use

- smart lighting
- smart heating
- disaggregated energy feedback
- time-of-use pricing

Photo Credit: Green Energy Futures @Flickr. CC BY-NC-SA 2.0.

Opportunity for digitalisation: **control** and manage resource use



Source: Wilson et al. (2020). "Potential climate benefits of digital consumer innovations." *Annual Review of Environment and Resources* 45:113-144.

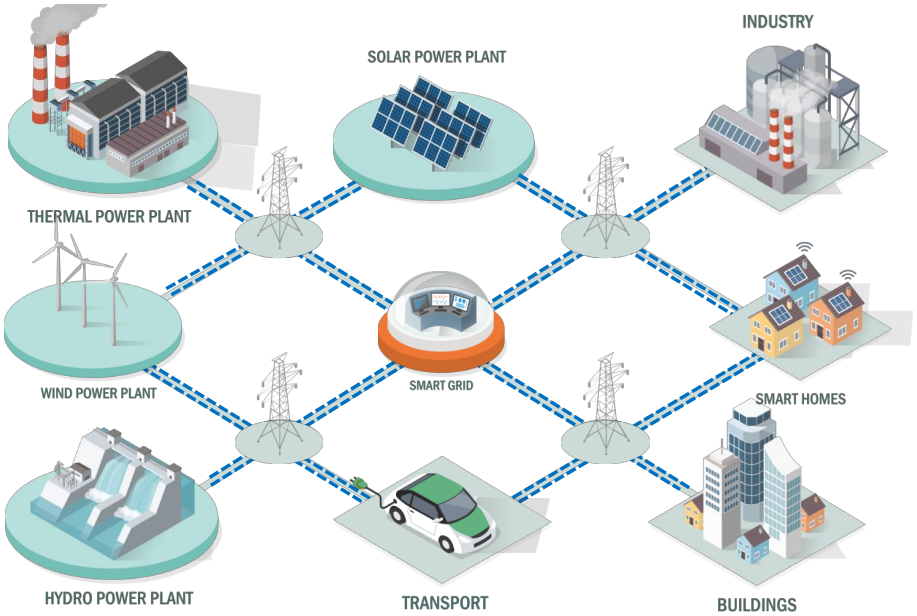
Opportunity for digitalisation: **integrate** resources into optimised systems

IoT & demand response

smart charging

vehicle to grid

distributed storage



Pre-digital energy systems are defined by unidirectional flows and distinct roles, digital technologies enable a multi-directional and highly integrated energy system

Source: IEA (2018) Digitalization & Energy: Webinar. 7 February 2018. International Energy Agency, Paris, France.

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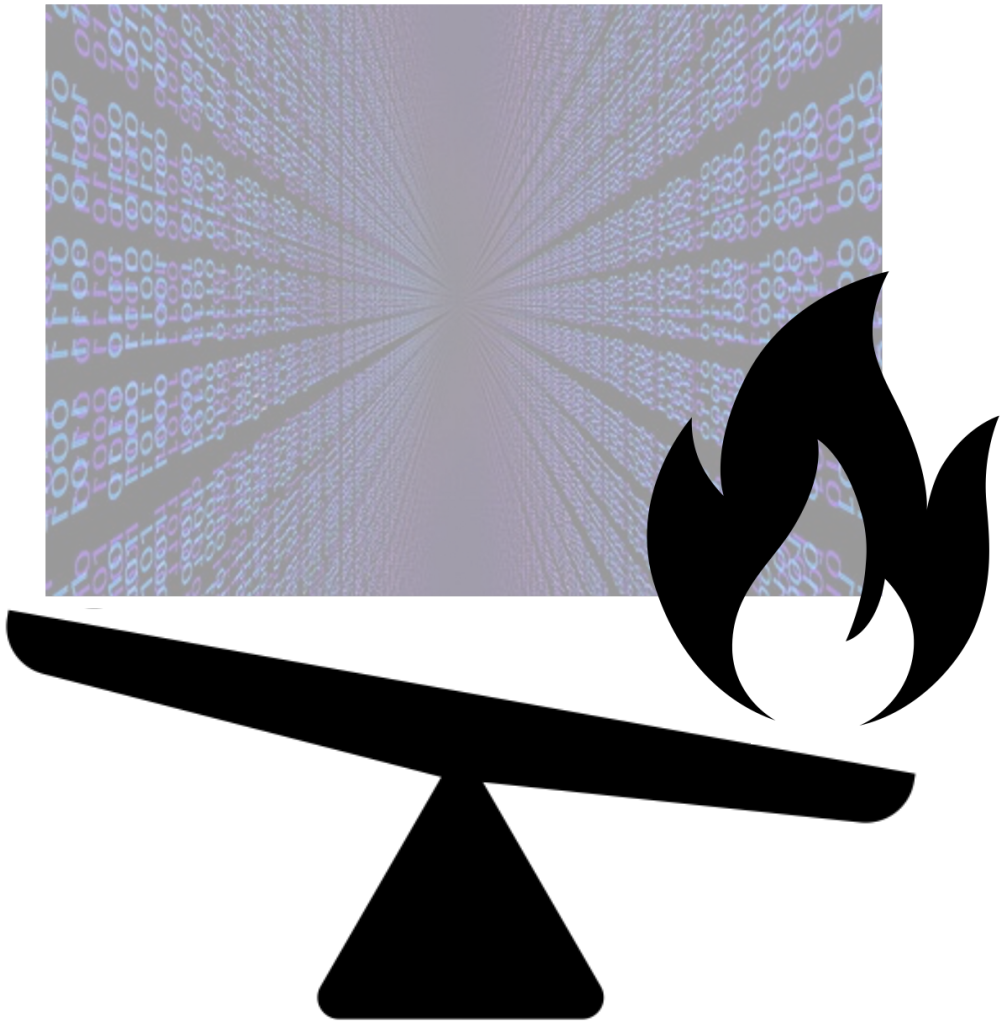

Rebound

Intensify

Contaminate

Manipulate

Displace

Divide

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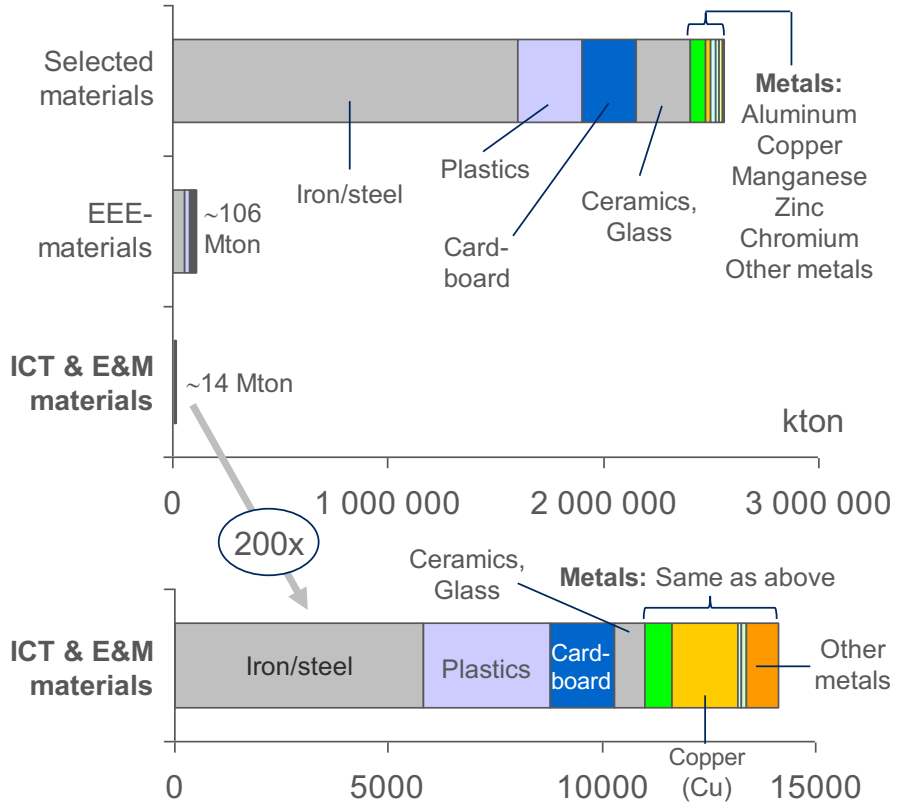
Risk of digitalisation:
rebound to more consumption if activity becomes easier or cheaper

Photo Credit: Steve Jurveston @Flickr. CC BY 2.0.

Risk of digitalisation:
intensify new forms of energy-hungry activity

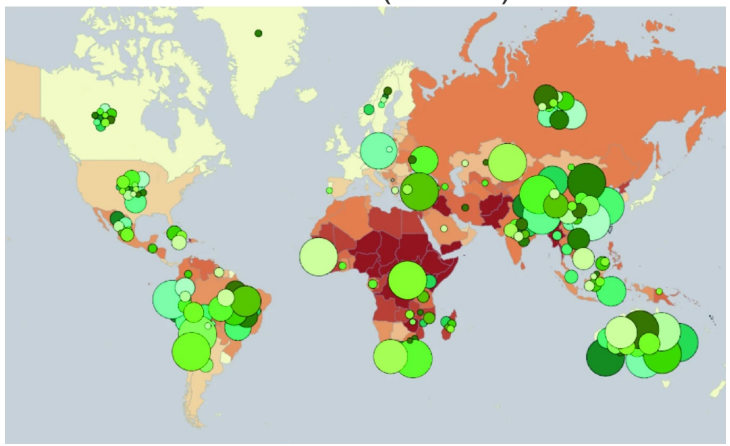
Photo: johnlewis.com. (Note that alternative products and retailers are also available!)

Risk of digitalisation:
contaminate environments through mining and e-waste



Source: Malmodin, Bergmark & Matinfar (2018). A high-level estimate of the material footprints of the ICT and the E&M sector. ICT4S2018 Conference.

Global reserves of 18 minerals for clean energy (bubbles) + fragility and corruption measures (colours)



Source: Church & Crawford (2020). Minerals and the Metals for the Energy Transition. In: Hafner & Tagliapietra (Eds).

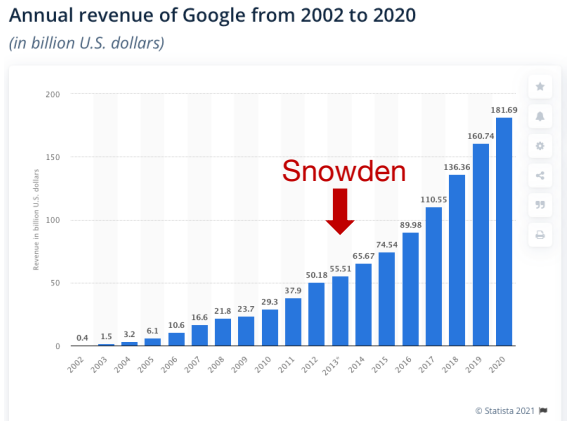
Photo Credit: Ondřej Martin Mach via Wikimedia Commons licensed under CC BY-SA 3.0.

Risk of digitalisation:
manipulate, exploit, polarise - undermining human agency

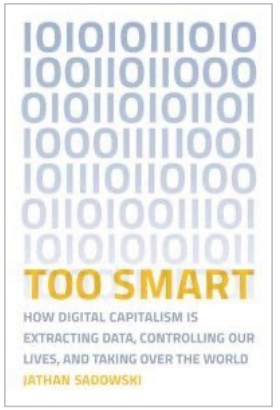
Photo Credit: Paolo Trabattoni @Flickr. CC BY 2.0

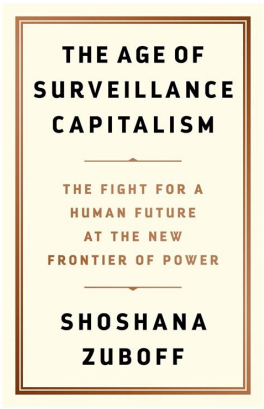
"Recent inventions and business methods call attention to the next step which must be taken for the protection of the person, and for securing 'the right to be let alone'."

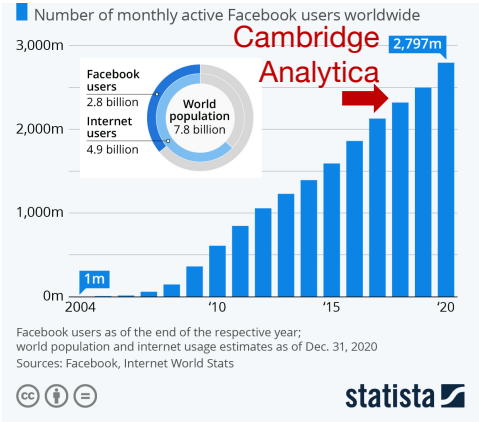
Source: Warren & Brandeis, *Harvard Law Review*.



Source: https://www.statista.com/statistics/266206/googles-annual-global-revenue/







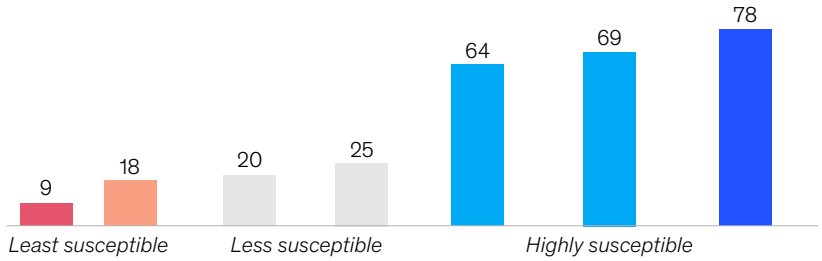
Source: https://www.statista.com/chart/10047/facebooks-monthly-active-users/

Of 270 job descriptions listed in the 1950 US census, which <u>one</u> has been fully eliminated by automation?

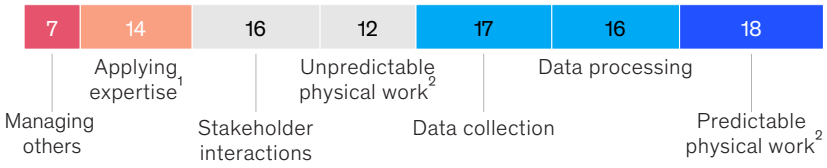
Source: https://www.theguardian.com/business/2022/jan/09/do-smart-supermarkets-herald-the-end-of-shopping-as-we-know-it

Risk of digitalisation:
displace, divide – worsening inequalities of access and opportunity

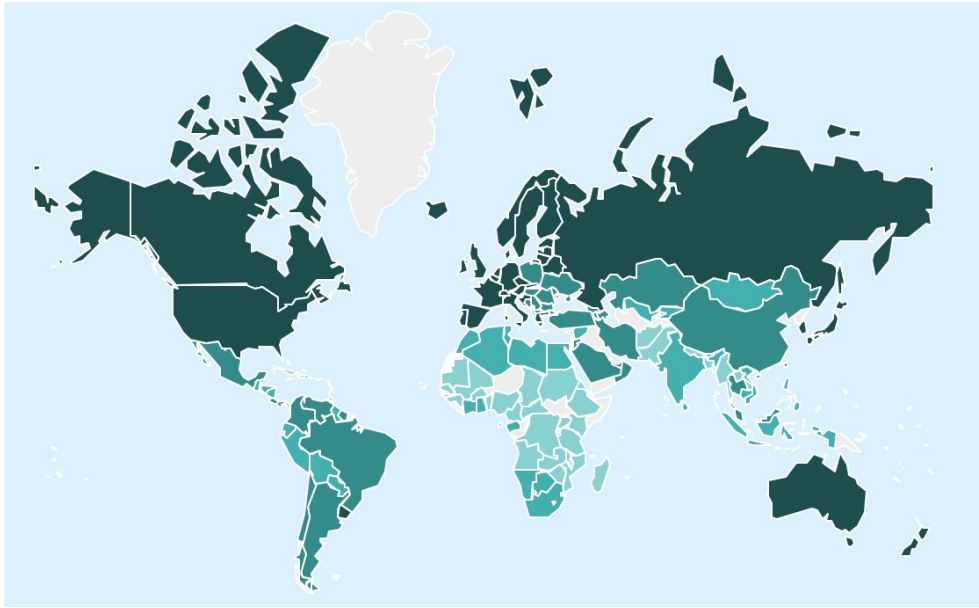
Technical feasibility, % of time spent on activities that can be automated by adapting currently demonstrated technology



Time spent in all US occupations, %



Source: p108, Exhibit 1 in McKinsey (2020). The recovery will be digital: Digitizing at speed or scale. The Next Normal. San Francisco, CA, McKinsey & Company.



Source: ITU (2017) ICT Development Index.
https://www.itu.int/net4/ITU-D/idi/2017/index.html#idi2017map-tab

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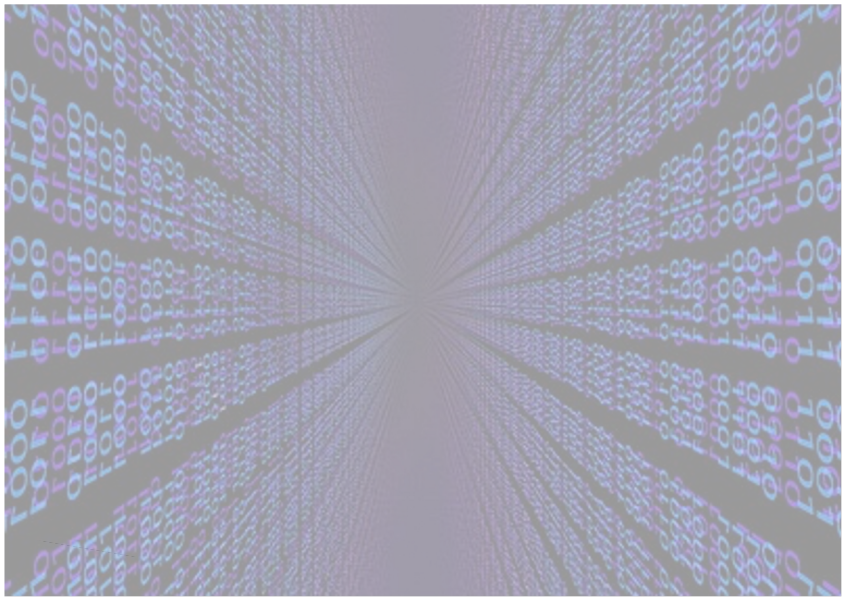

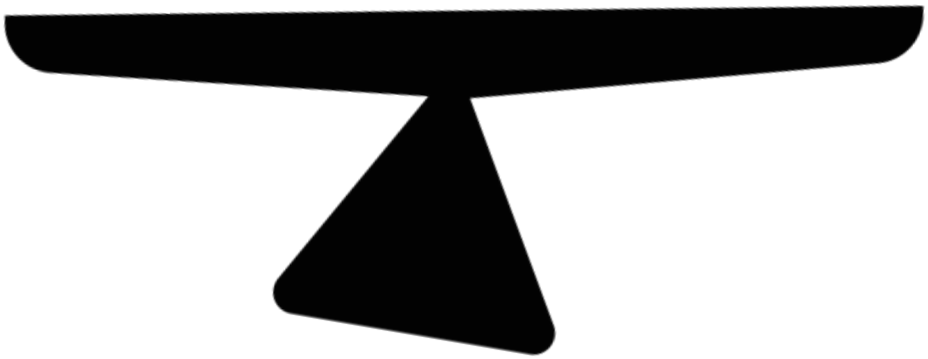

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Divide

Implications of digitalisation for **energy**, materials, and **carbon emissions** are large but uncertain.

direct impacts

- manufacture and use of devices and servers
+ efficiencies, circular economy

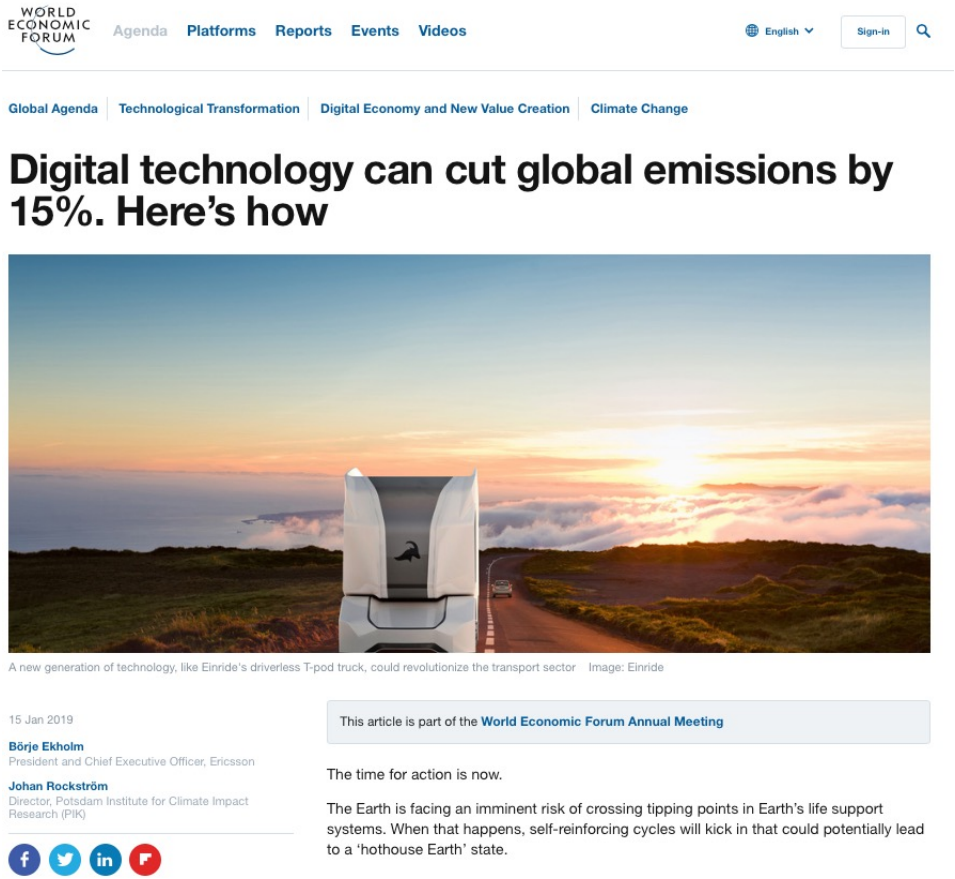
indirect impacts

- rebound, intensification
+ substitution, coordination, optimisation

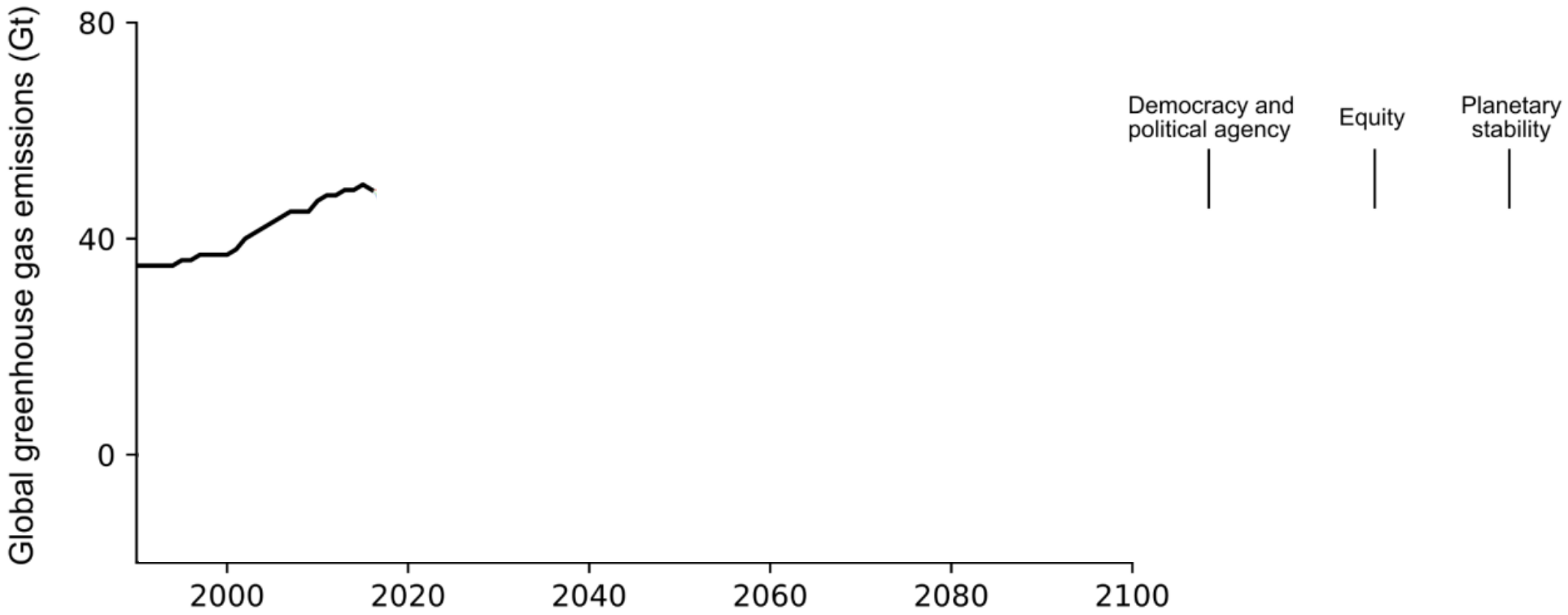
systemic impacts

- scale, growth, acceleration
+ AI for SDGs, digital twins, renewable grids

Future impact of digitalisation on climate depends on the **design, use, and regulation** of digital technologies and services



Illustrative pathways for digitalisation in the Anthropocene: impacts on **climate**, but also **agency** and **equity**.



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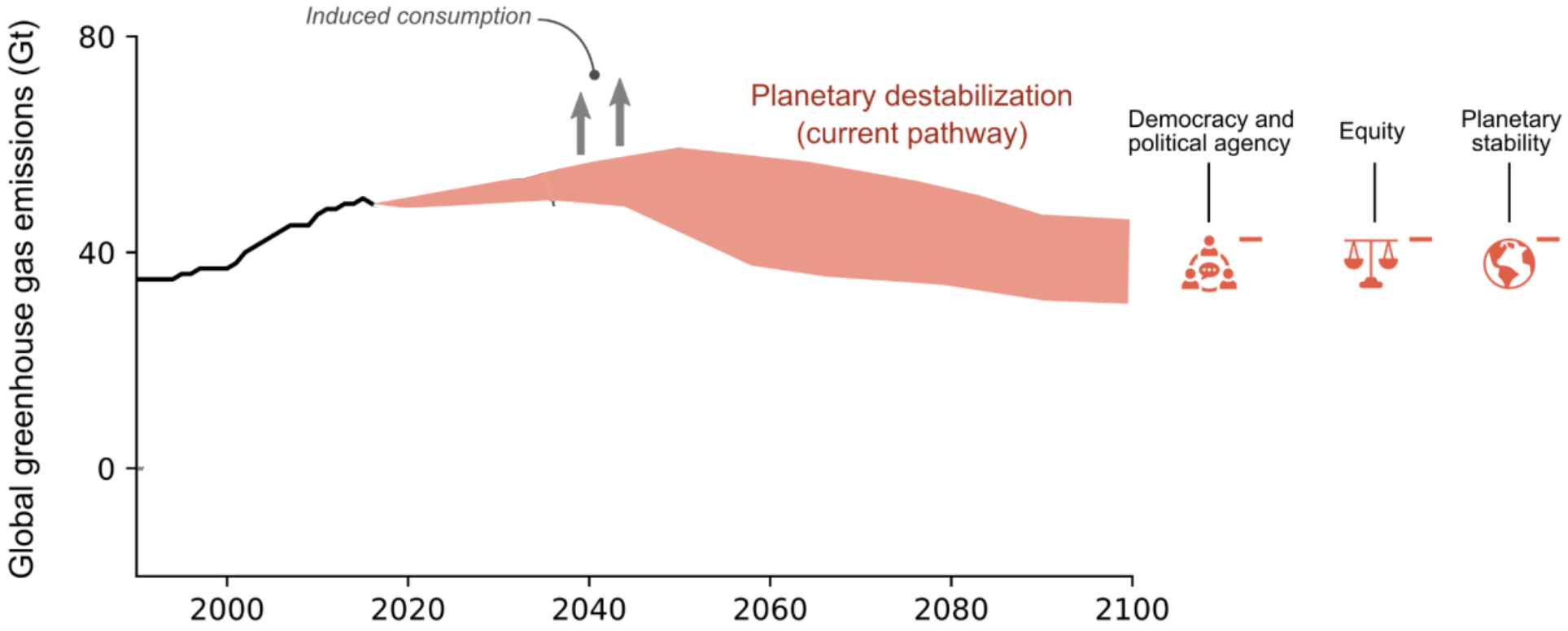

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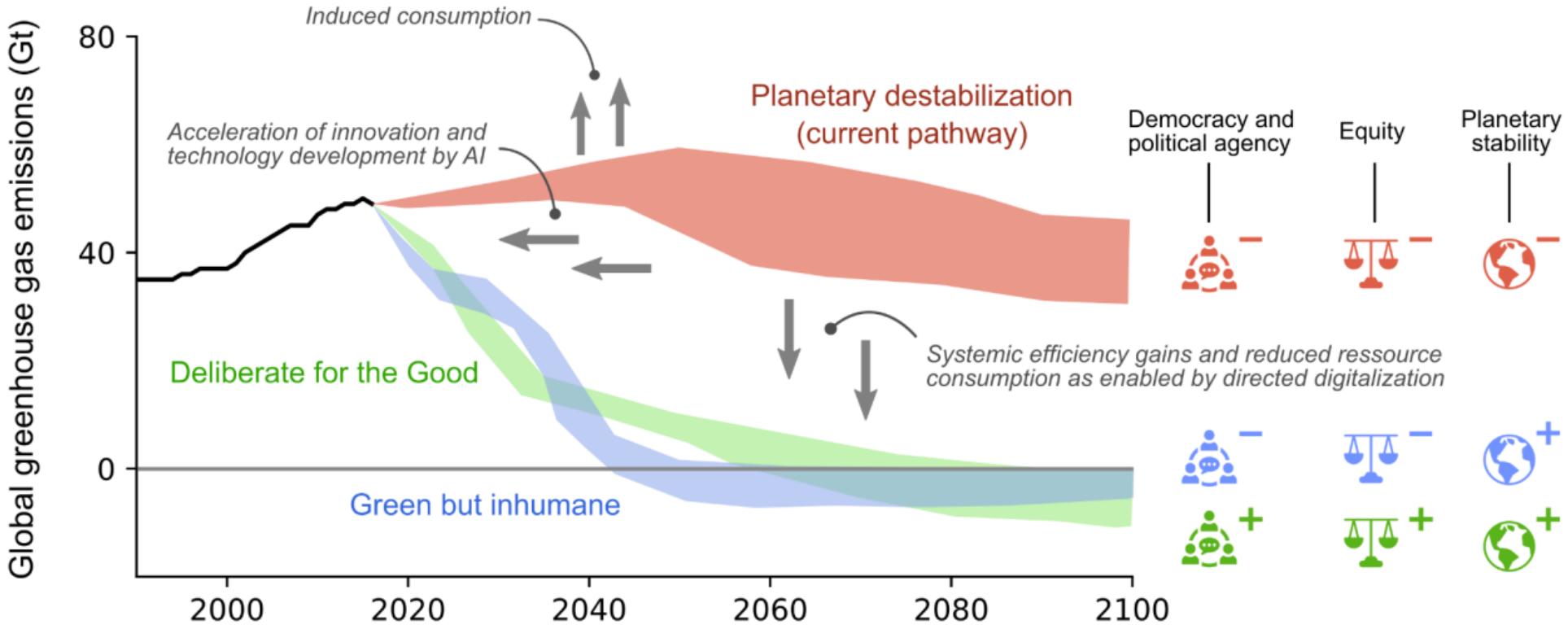

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Making the ‘Deliberate for the Good’ future scenario a reality: **directed digitalisation for public purpose**.

planetary boundaries	- tackle e-waste through circular economy - proactively constrain rebound and intensification - strengthen resilience to natural hazards
equity	- regulate data-based monopolies - mandate private-to-public data sharing - invest in universally-accessible digital infrastructure
human agency	- empower digital subjects and data sovereignty - embed digital skills, capabilities, and citizenship - ensure democratic governance of the digital world

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Charlie Wilson
ETH Zurich
5 October, 2022

iDODDLE

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