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AI and Energy

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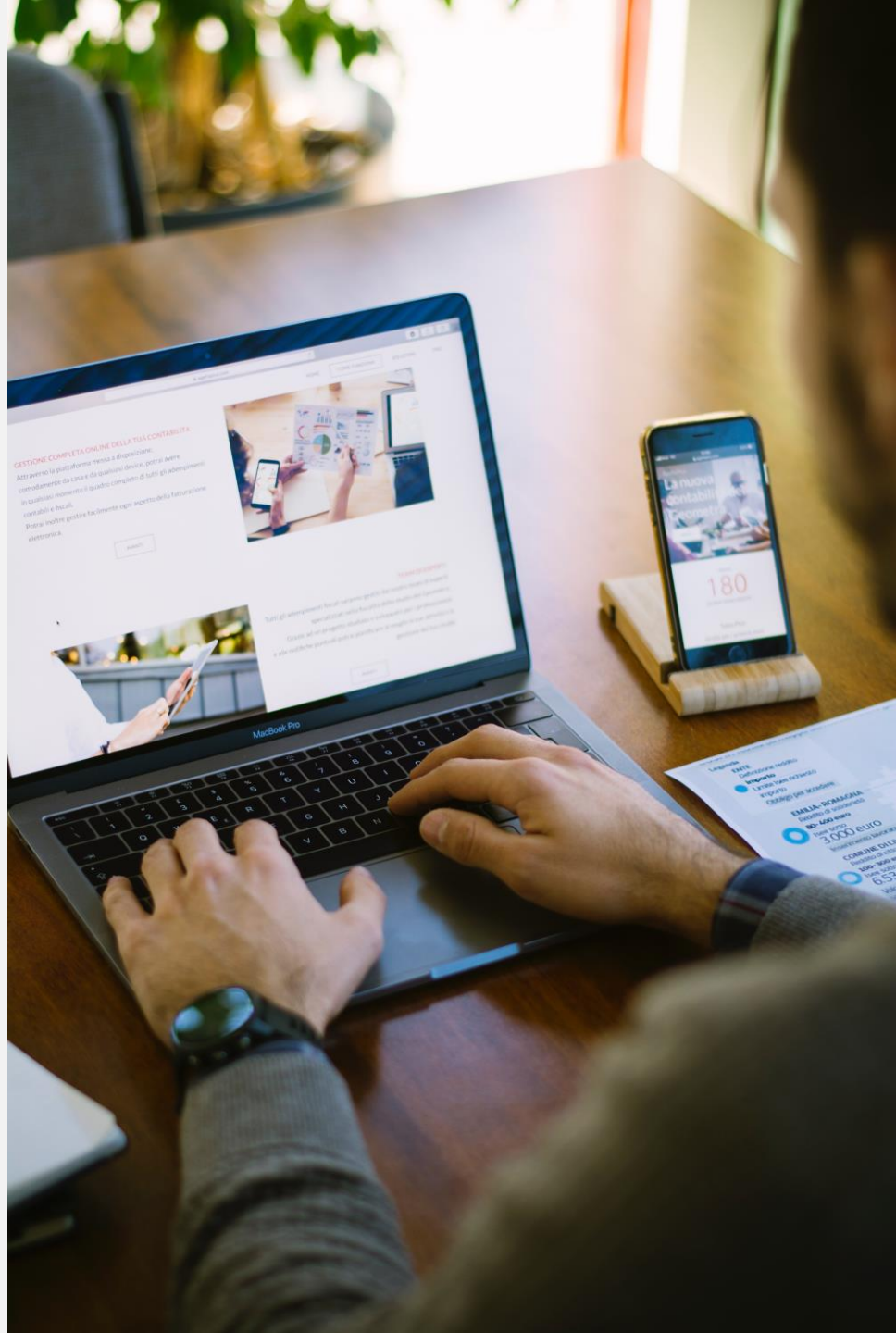
School of Geography and the Environment



SoGE School of Geography and the Environment

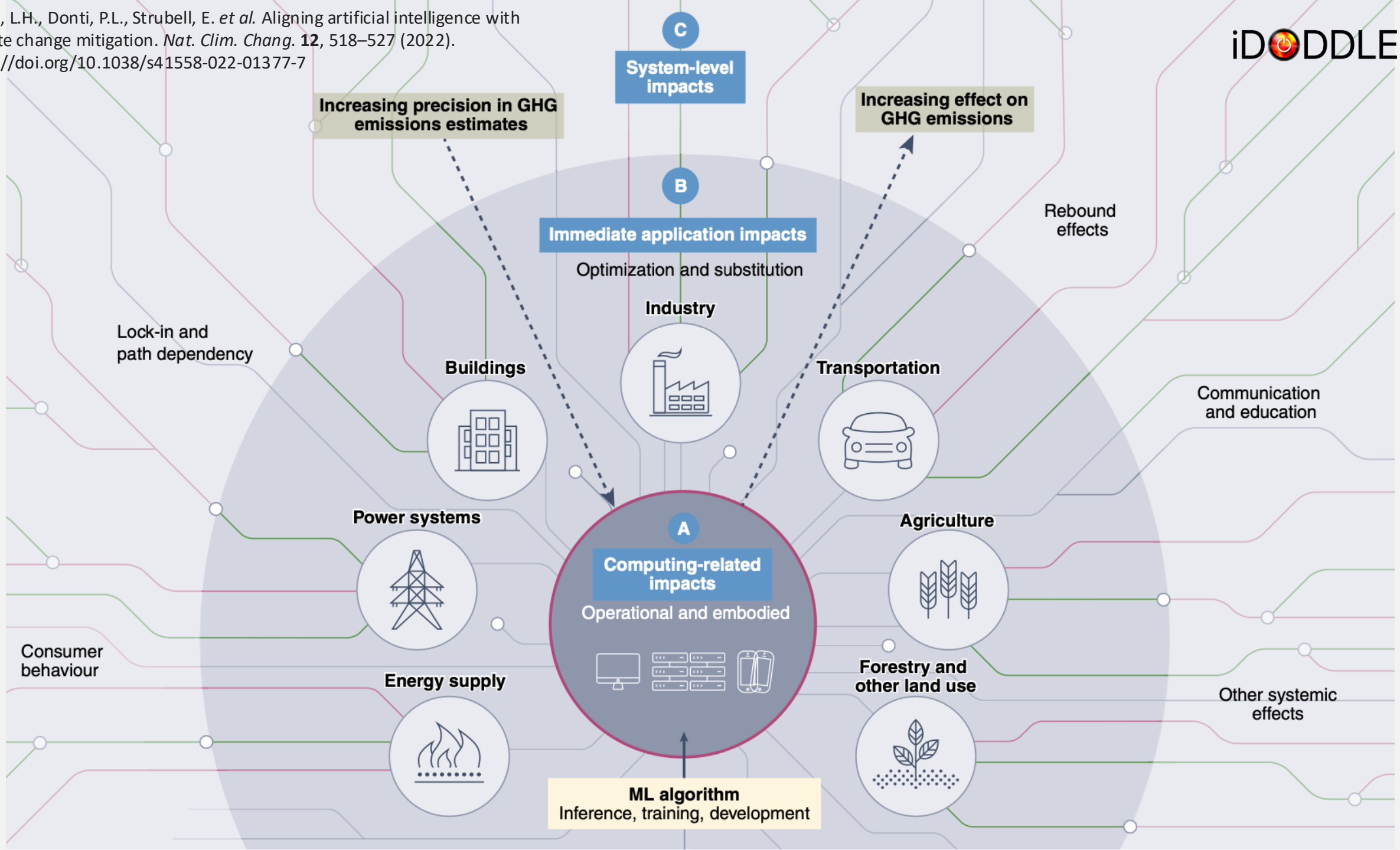
eci Environmental *Change* Institute School of Geography and the Environment

UNIVERSITY OF OXFORD

erc European Research Council

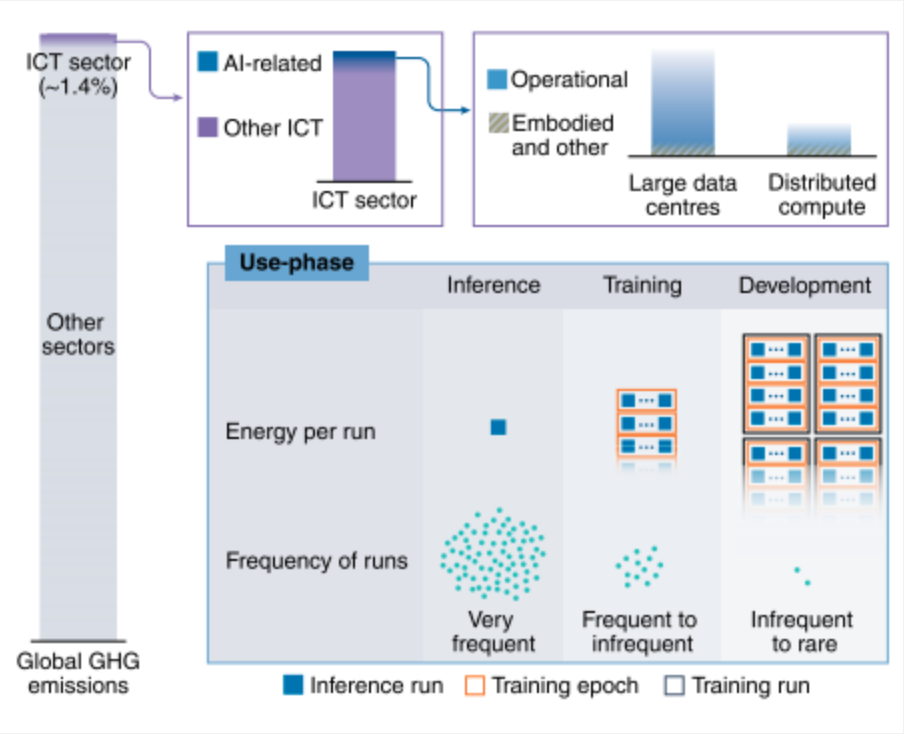
Microsoft's data centres located in the municipality of Colón, in Querétaro, México, June 17, 2024.
Thomson Reuters Foundation/Miguel Tovar

Kaack, L.H., Donti, P.L., Strubell, E. *et al.* Aligning artificial intelligence with climate change mitigation. *Nat. Clim. Chang.* **12**, 518–527 (2022). https://doi.org/10.1038/s41558-022-01377-7

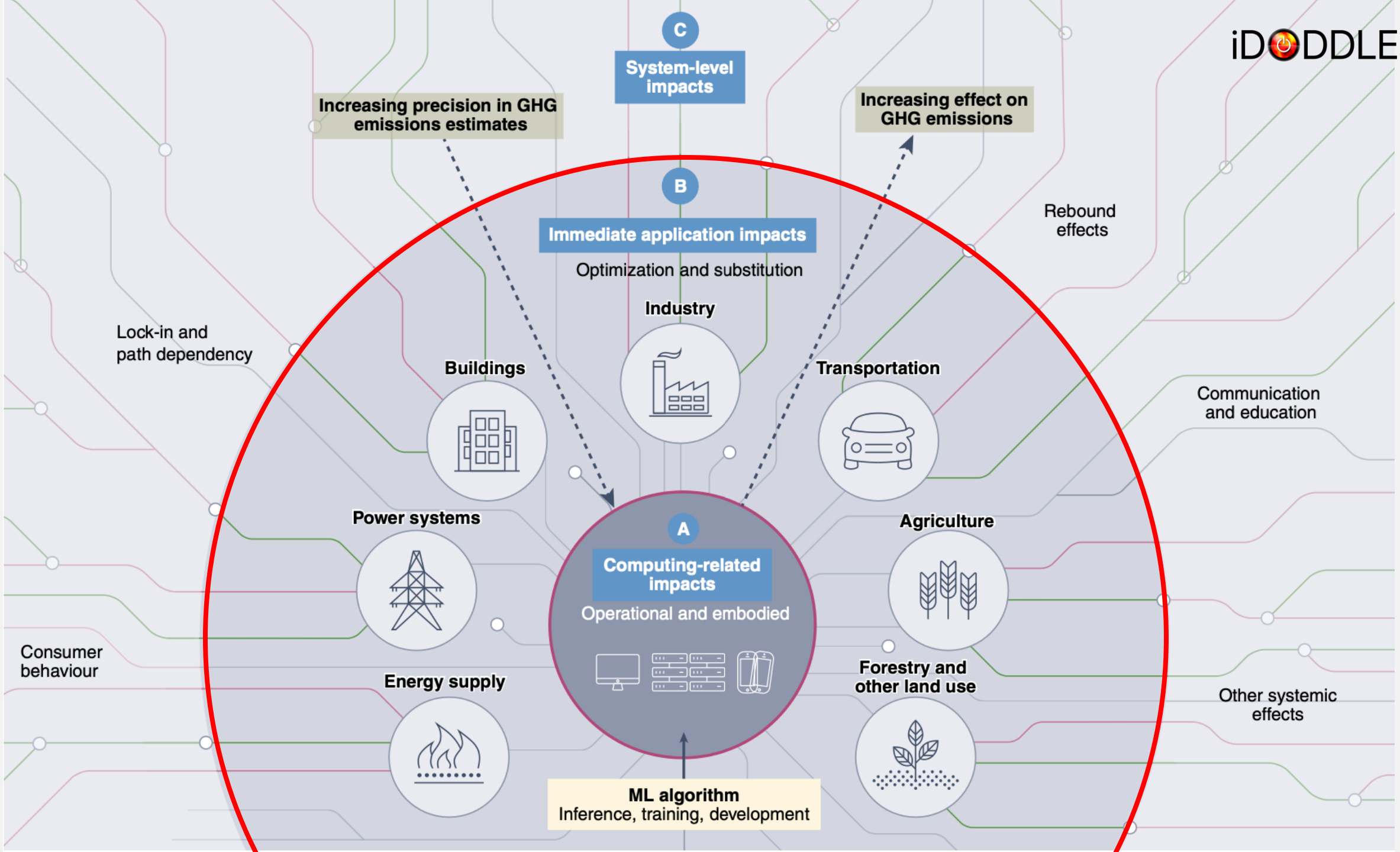


Data centre and AI's energy use

- Data centres, servers, and data transmission networks account for 1% to 1.5% of global electricity demand (2% in the EU, 4% in the US, 3% in China) (IEA, 2024)
- Between 7-10% of enterprise customers' total spend on compute infrastructure supports AI applications, with 3-4.5% used for training and 4-4.5% spent on inference (OECD, 2022)
- AI compute demands are growing faster than energy efficiency gains

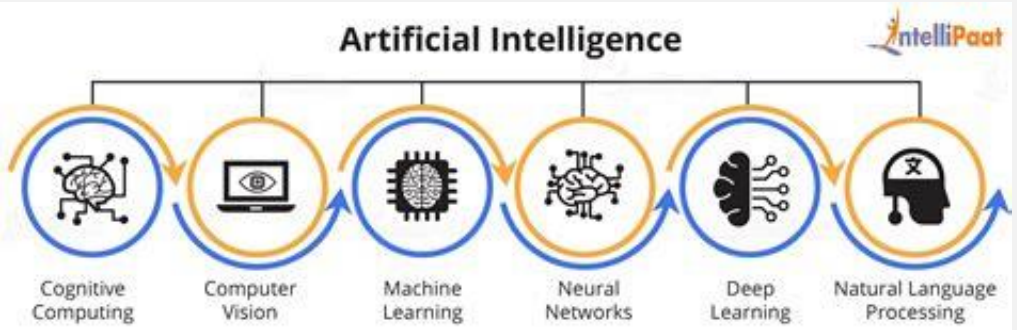


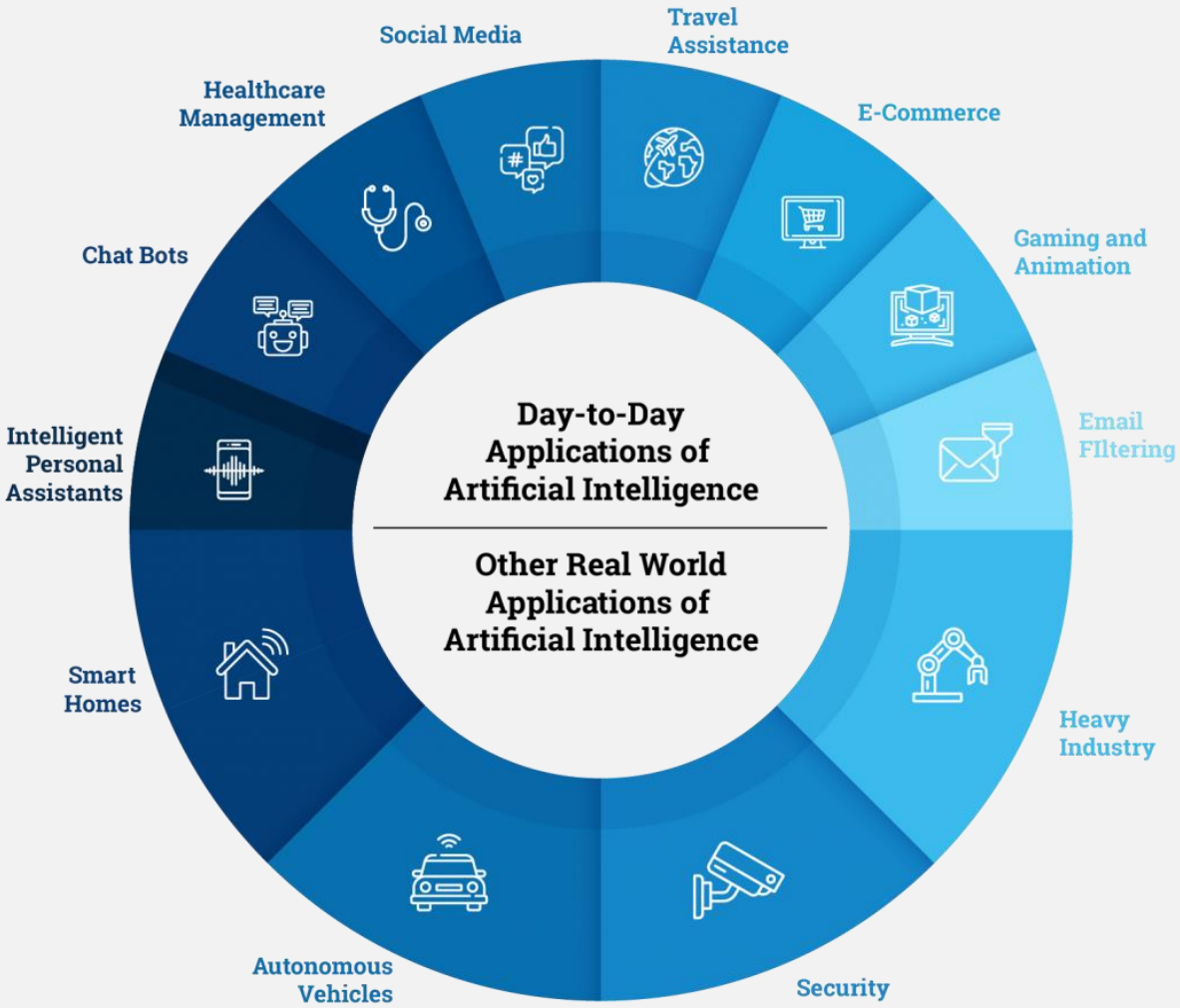
Kaack, L.H., *et al.* (2022). Aligning artificial intelligence with climate change mitigation. *Nature Climate Change*


C
System-level impacts
Increasing precision in GHG emissions estimates
Increasing effect on GHG emissions
B
Immediate application impacts
Optimization and substitution
Rebound effects
Lock-in and path dependency
Industry
Buildings
Transportation
Communication and education
Power systems
A
Computing-related impacts
Operational and embodied
Agriculture
Consumer behaviour
Energy supply
Forestry and other land use
Other systemic effects
ML algorithm
Inference, training, development

What is AI?

An AI system is a machine-based system that, for explicit or implicit objectives ***infers****, from the* ***input*** *it receives, how to generate* ***outputs*** *such as* ***predictions, content, recommendations, or decisions*** *that can influence physical or virtual environments. Different AI systems* vary *in their levels of autonomy and adaptiveness after deployment* (OECD, 2023)





car clubs

car share

bike-share

smart thermostat

online grocery shopping

Meal kits

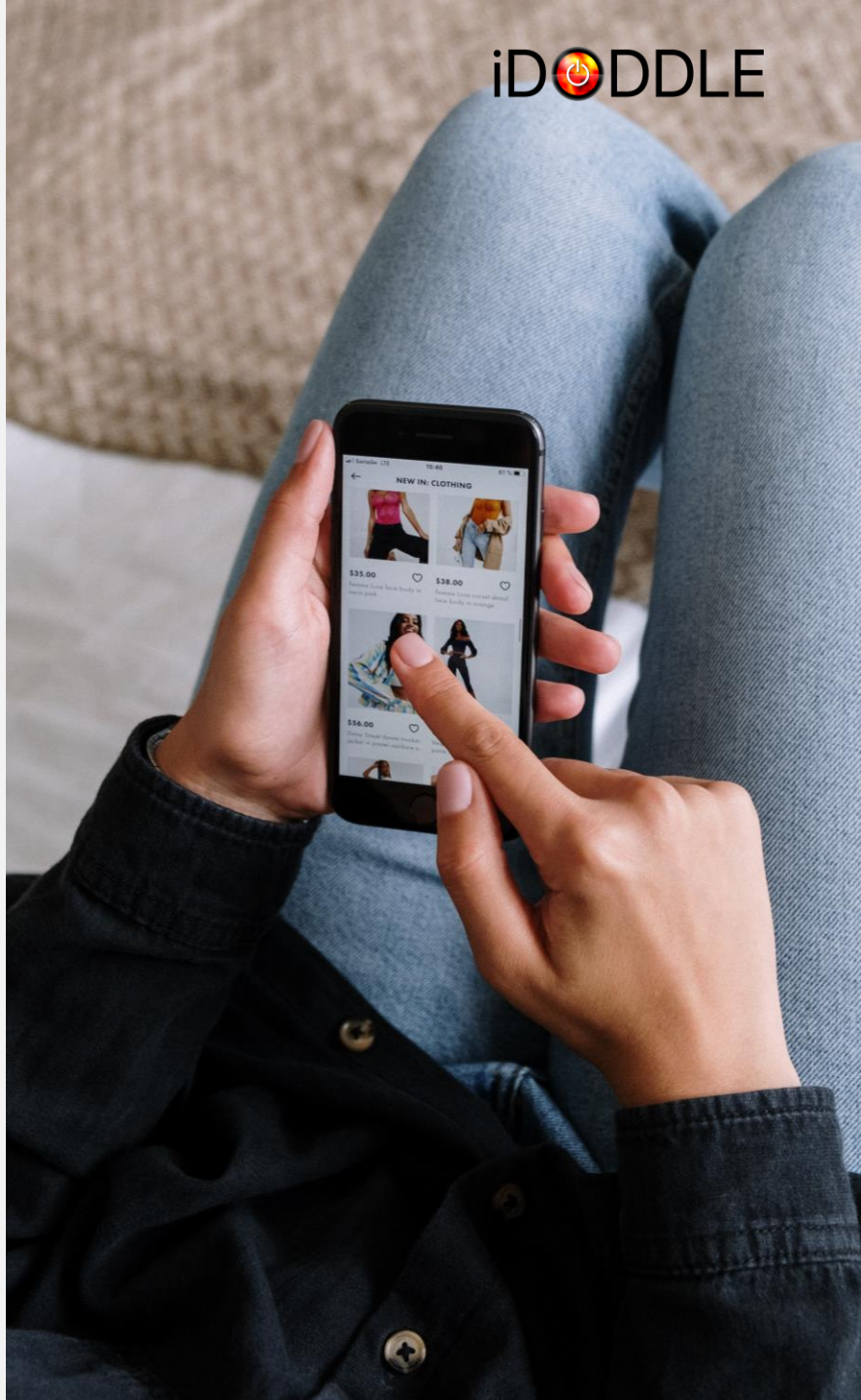
11th hour apps

Online meal delivery

immediate delivery

Online large retailers

P2P retail



AI in building

Lange S, Frick V, Gossen M, Pohl J, Rohde F and Santarius T (2023) The induction effect: why the rebound effect is only half the story of technology's failure to achieve sustainability. Front. Sustain. 4:1178089.

BOX 2 Our studies on smart homes.

We conducted an interdisciplinary smart home study, which integrated concepts and methods from the fields of environmental assessment, environmental psychology, sociology, and science and technology studies. Our empirical insights are based on a quantitative survey with smart home owners in Germany with a smart heating system ($N = 375$), 12 user interviews, and a life cycle assessment that accounted for differences in user behavior. In addition, we conducted a twitter data analysis and a document analysis (Frick and Nguyen, 2021; Pohl et al., 2021; Rohde and Santarius, 2023).

Major findings are that the energy consumption due to the production and use of smart heating would necessitate at least a 6% reduction in energy consumption in heating in order for it to be environmentally beneficial. But smart home households purchase and use additional smart devices so that the reduction in energy consumption from heating would have to be even bigger. The quantitative survey shows that aspects such as safety, making everyday life easier, practical operation, convenience and financial savings are important motives for using smart home systems (Frick and Nguyen, 2021), which is one explanation for the large number of smart home devices that do not aim to reduce energy demand but to increase controllability and comfort (Strengers et al., 2020; Quitzow and Rohde, 2021). The findings show that four smart home user groups can be identified: enthusiasts, pragmatists, energy savers, and skeptics (Frick and Nguyen, 2021). Through a combination of quantitative network analysis and qualitative content analysis, we were able to reveal five discourse coalitions that form around certain storylines, namely "Threat"," Hackable", "Useless", "Fixable", and "Opportunity". It became evident that the most influential actors in the German online discourse were taking a critical stance toward the smart home (Rohde et al., under review).

AI in transport

nature communications

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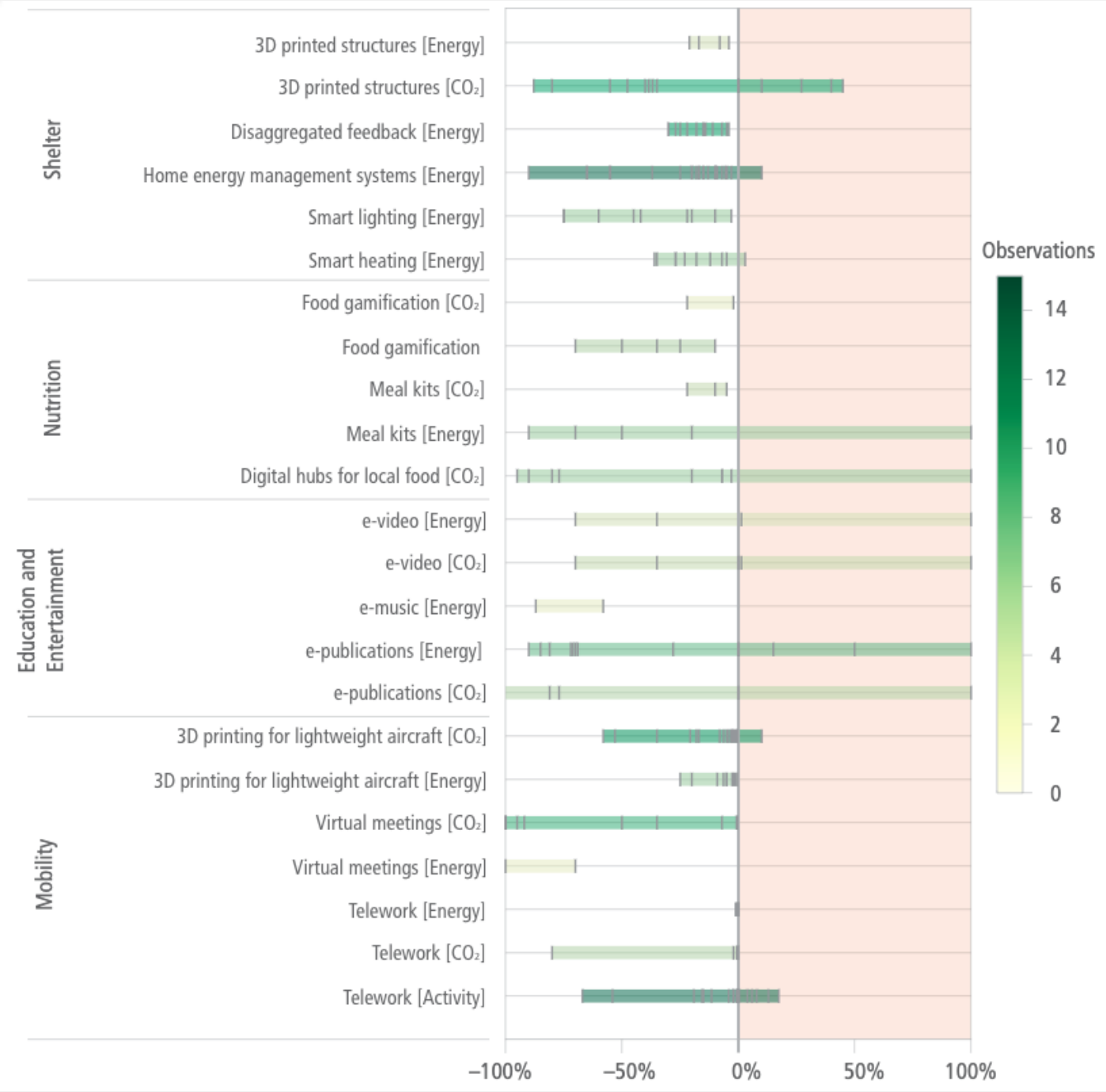
Article | Open access | Published: 06 October 2023

Rebound effects undermine carbon footprint reduction potential of autonomous electric vehicles

Nuri C. Onat, Jafar Mandouri, Murat Kucukvar, Burak Sen, Saddam A. Abbasi, Wael Alhajyaseen, Adeeb A. Kutty, Rateb Jabbar, Marcello Contestabile & Abdel Magid Hamouda

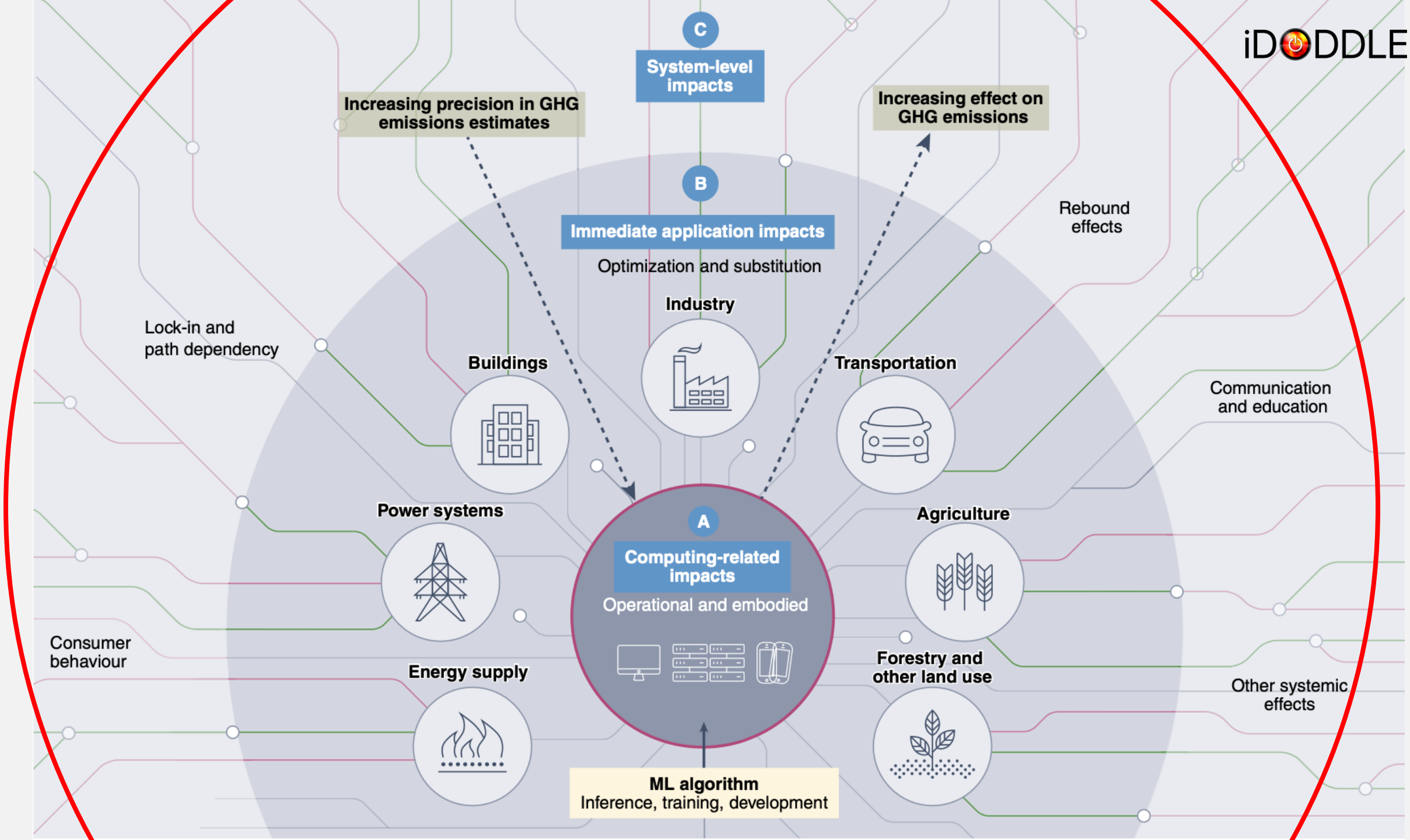
Nature Communications **14**, Article number: 6258 (2023) | Cite this article

8123 Accesses | **5** Citations | **15** Altmetric | Metrics



Net energy effect depends on the balance between **efficiency and rebound**

Creutzig, F., J. et al. (2022) Demand, services and social aspects of mitigation. In IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [P.R. Shukla, et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.007.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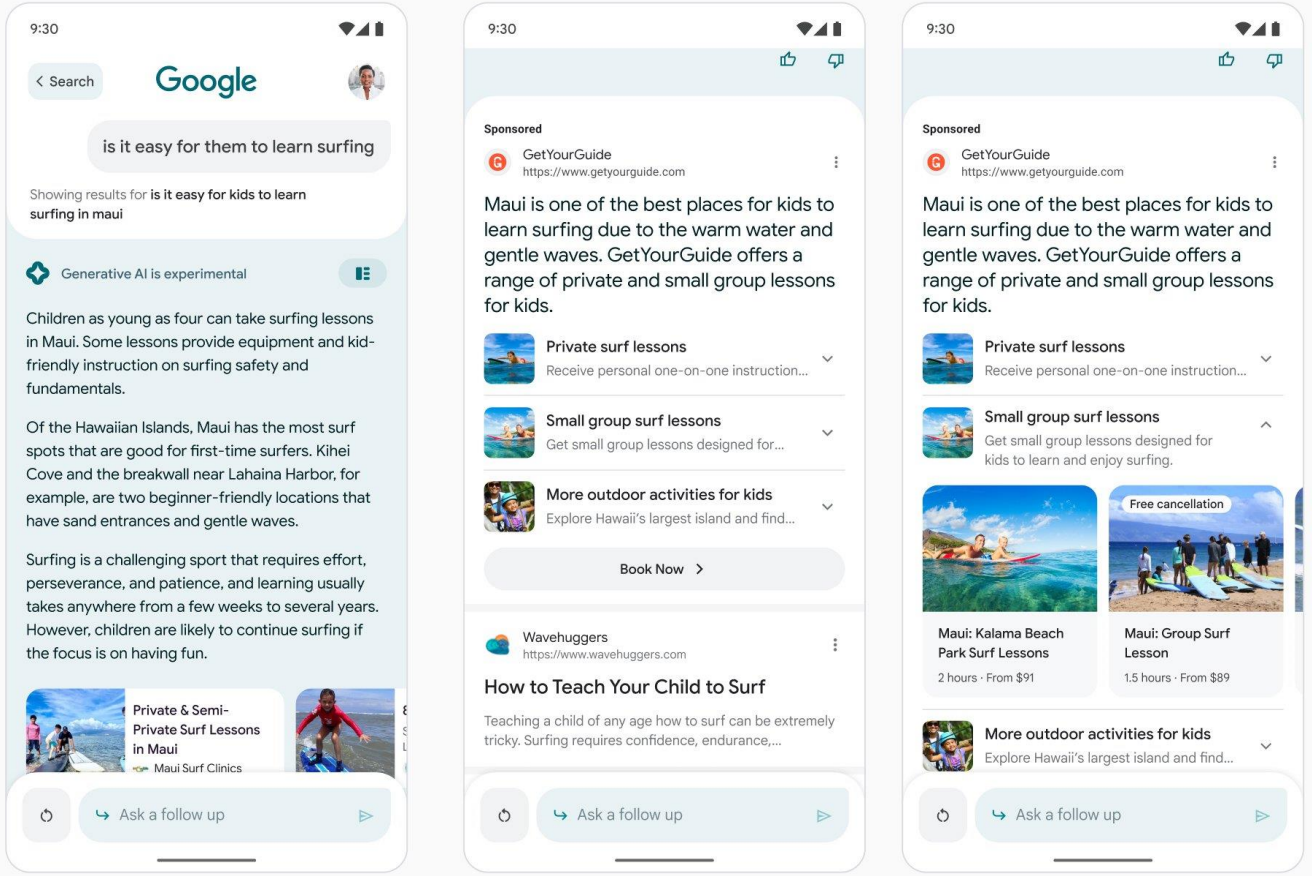
GOOGLE ADS

New ways for marketers to reach customers with AI Overviews and Lens



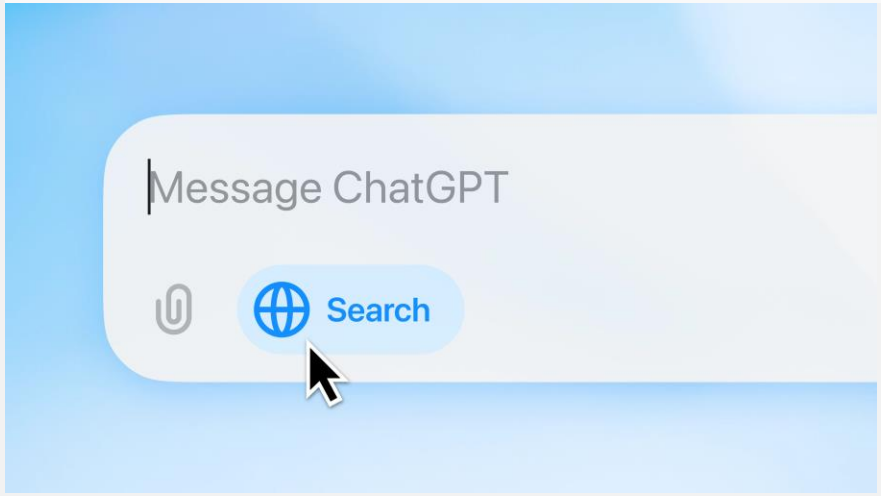
OpenAI

October 31, 2024

Introducing ChatGPT search

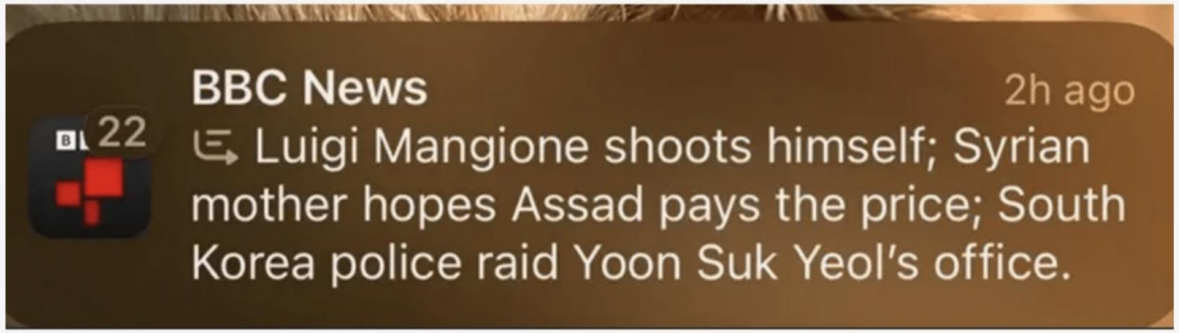
Get fast, timely answers with links to relevant web sources.

Plus and Team users can try it now ↗ Download Chrome extension ↗



BBC News sends Breaking News alerts on a single subject

Apple sends an AI-generated summary of BBC News headlines - which can create inaccuracies



BBC

A news alert from December 2024 was among the complaints made by the BBC to Apple

- Information processing?
- Autonomy and control in decision-making?
- Trust?
- Privacy concerns?

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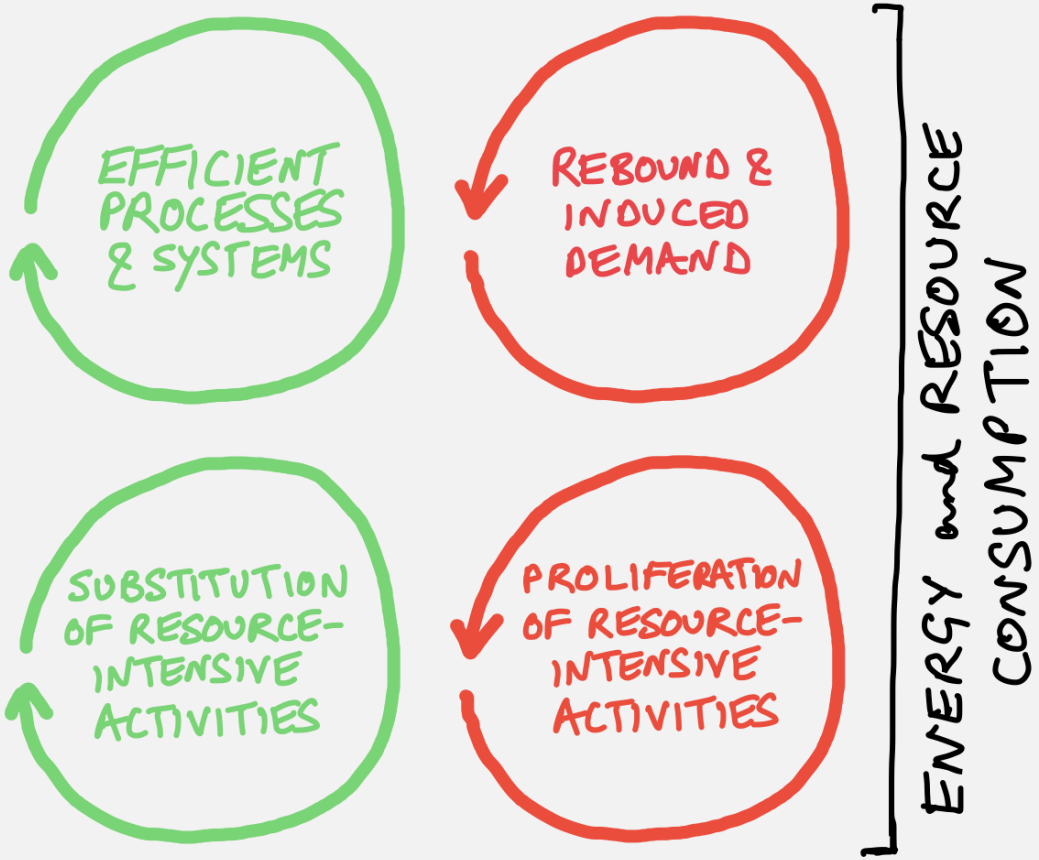
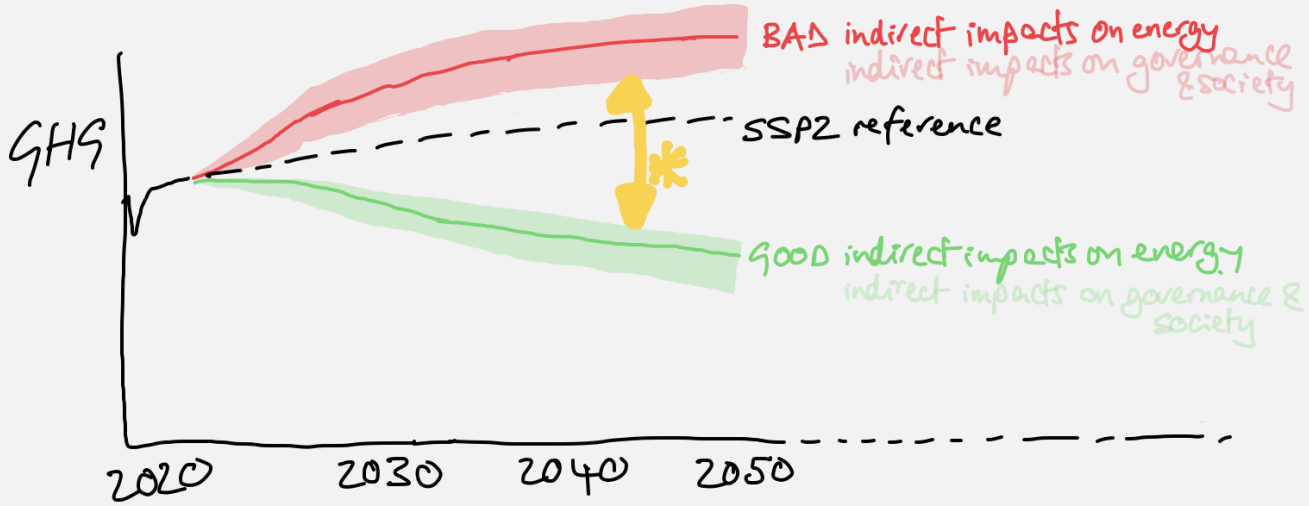
DIGITALISATION DYNAMICS both HELP and HINDER



THE DIGITALIZATION WILDCARD FOR MITIGATION



*** policy response**

(1) generic enablers: access, skills, data, trust

(2) specific climate policy for digitalisation?

Slide credit: Charlie Wilson

Thank you!

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