Digital innovation & its impacts on energy & emissions

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Oxford Energy Day
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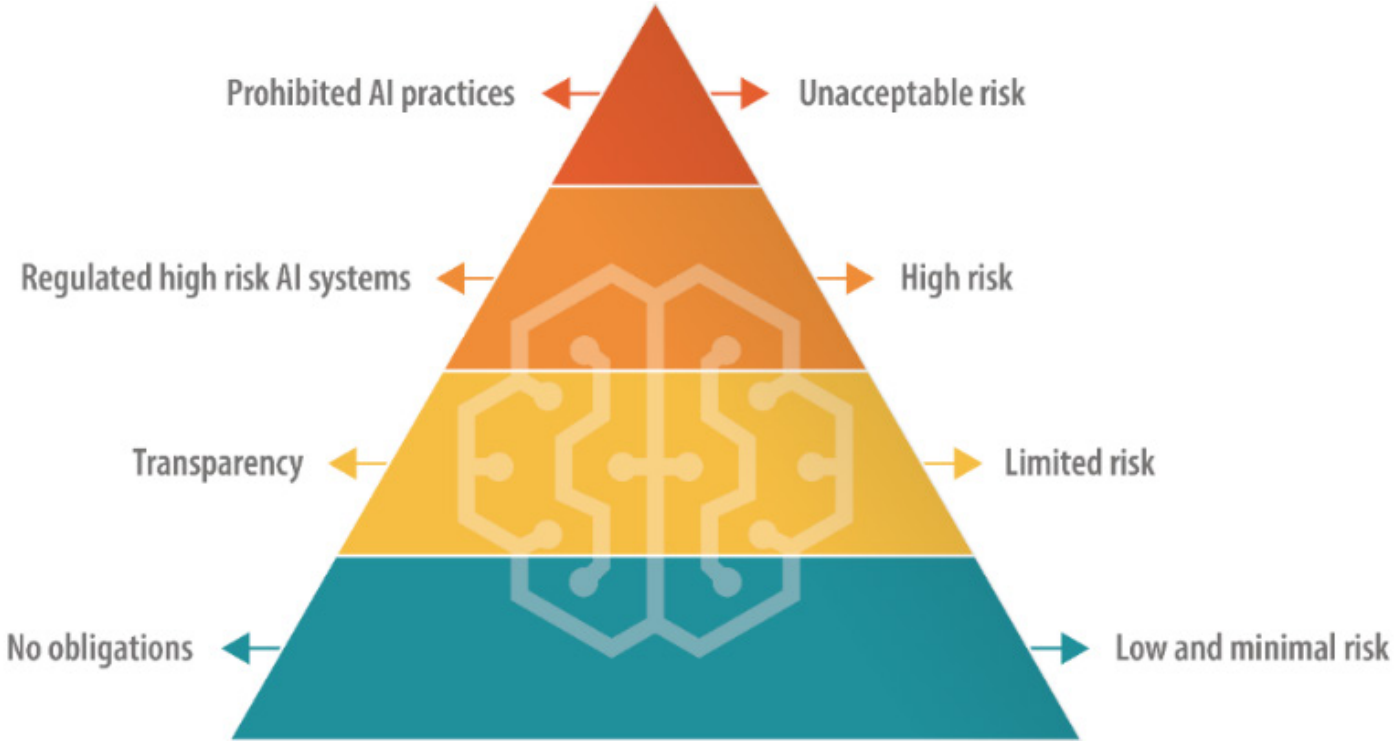
The EU's AI Act seeks to regulate undesirable outcomes of AI …

"Certain AI systems create risks that we must address to avoid undesirable outcomes."



a threat to people
(e.g., social credit scoring)

negatively affects safety or fundamental rights
(e.g., access to public services)

generative AI
(e.g., ChatGPT)

users can decide if & when to use
(e.g., phone apps)

https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai

Societal harm from AI arises *directly* in how it is applied (e.g., bias), and *indirectly* through what it is applied in (e.g., automation)

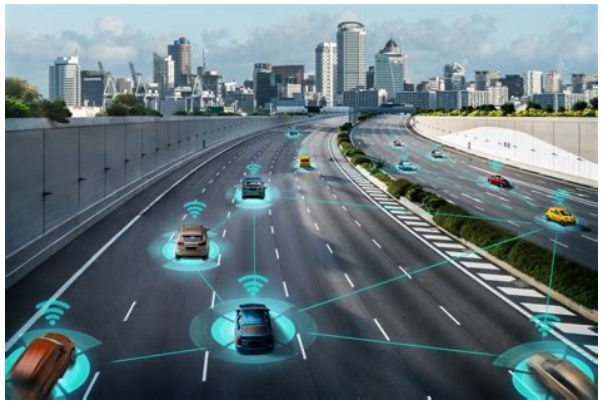
risk to societal & environmental wellbeing via undesirable outcome of energy use & GHG emissions?

direct impacts ⟷ *indirect* impacts

design, coding

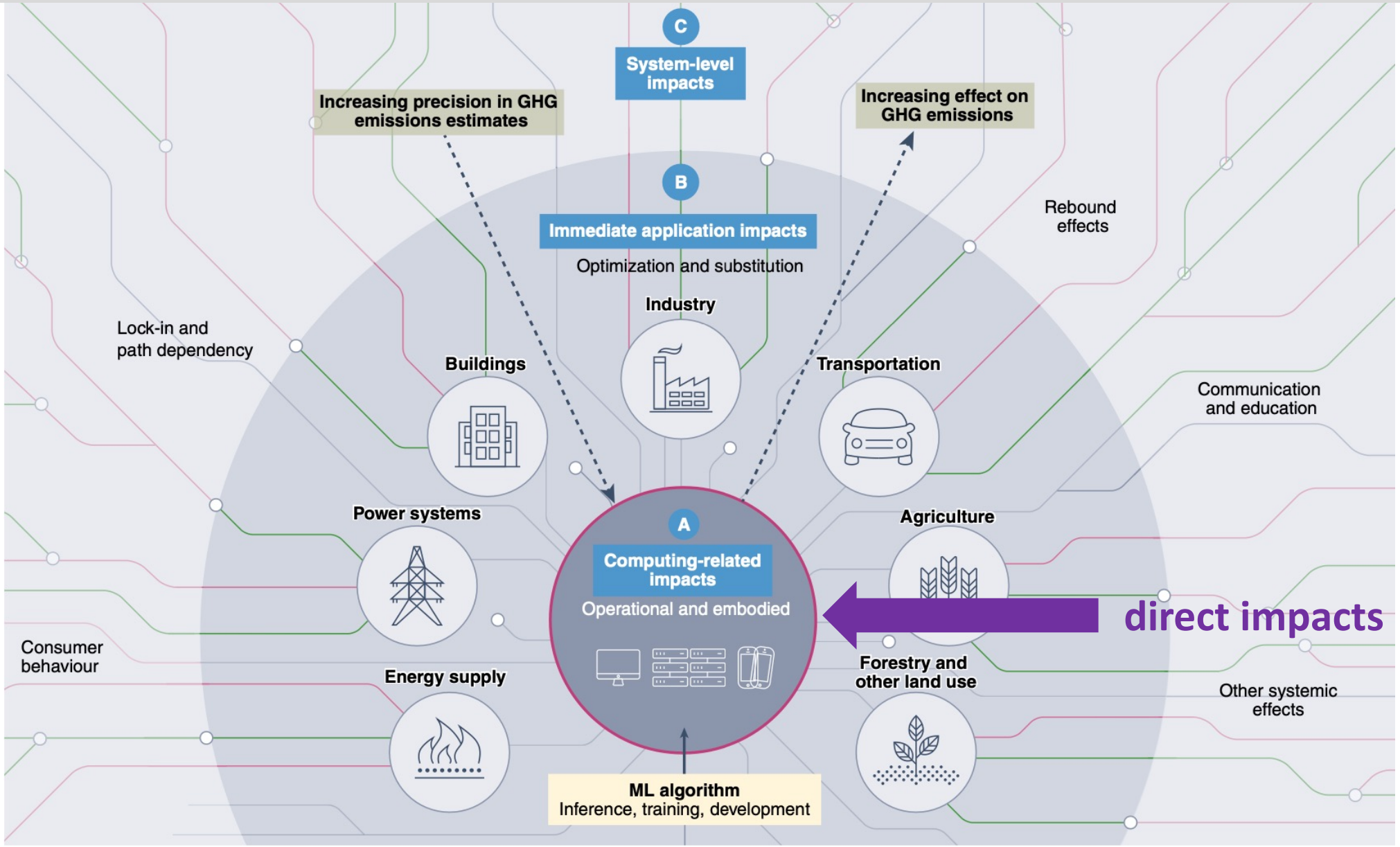
application,
service provision

application context,
integrated system



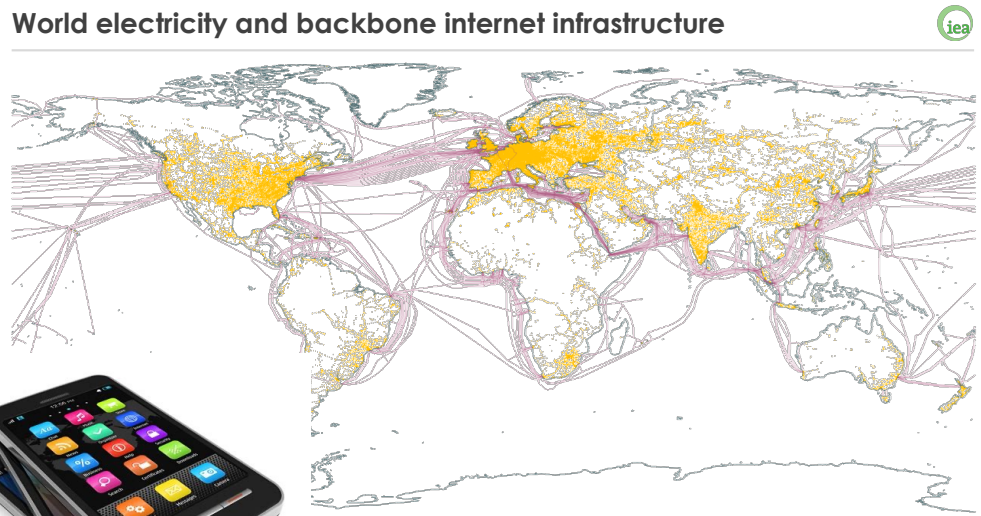
who is responsible for managing or mitigating the undesirable outcome?

Impacts of AI (***digitalisation***) on energy & emissions increase in magnitude and uncertainty from **direct** to indirect to systemic



Kaack et al. (2022). "Aligning artificial intelligence with climate change mitigation." Nature Climate Change. doi.org/10.1038/s41558-022-01377-7

ICT sector: *direct* impact on electricity demand



- efficiency improvements (Koomey's Law)
- scale economies in data infrastructure
- growth in data traffic

Δ in energy or GHGs

continued efficiency improvements	efficiency gains saturate
renewable (RE) electricity	> exponential growth in service demand
-Δ ~	+Δ 2x elec (< 2x GHGs)
best case	*worst case*

Freitag et al. (2022).
Masanet et al. (2020).
JRC (2023).

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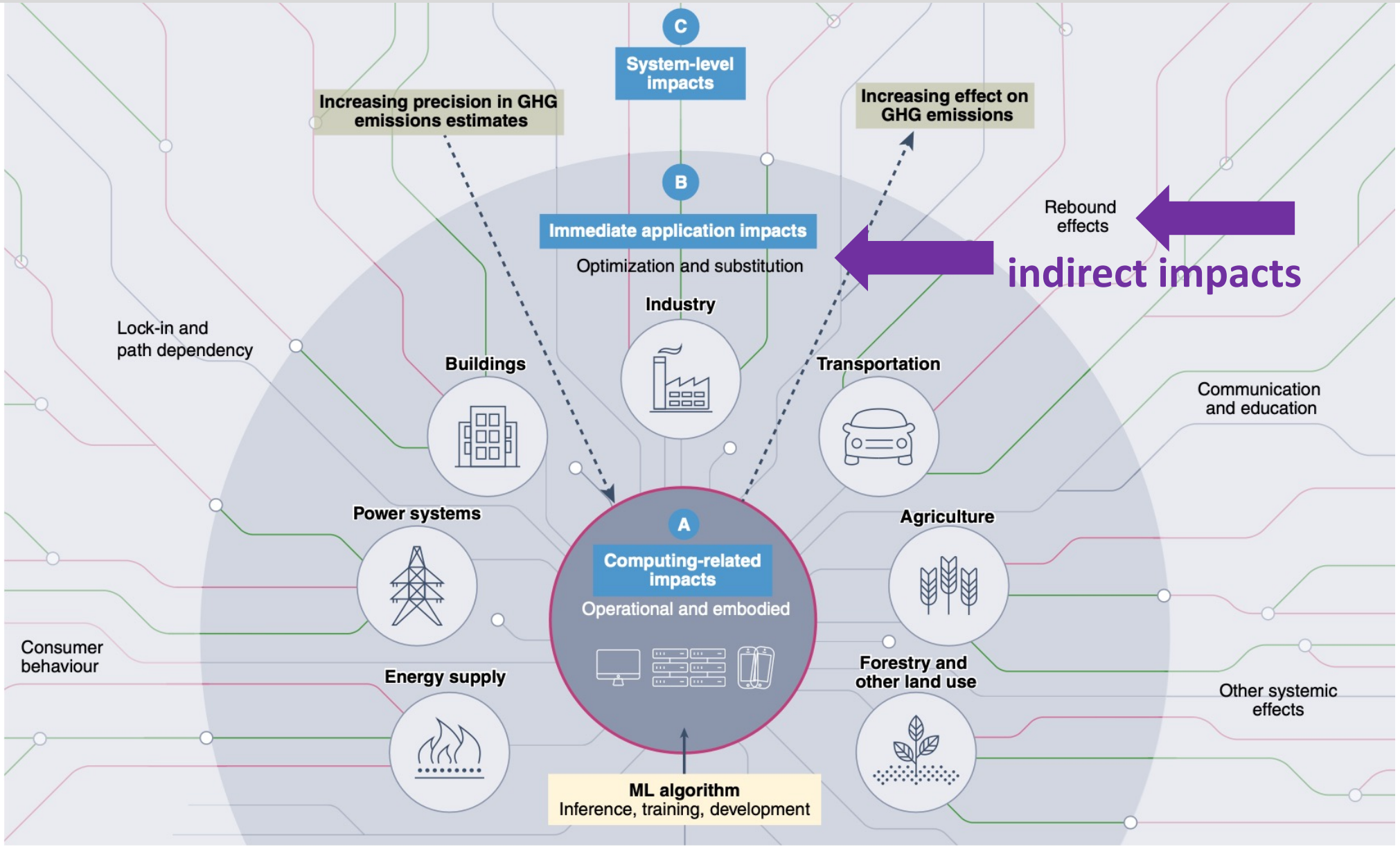
Impacts of AI (***digitalisation***) on energy & emissions increase in magnitude and uncertainty from direct to **indirect** to systemic



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IEA 2017 study mapped out indirect impacts of digitalisation in energy demand and supply sectors: two main clusters

digitalisation impacts on **energy demand**

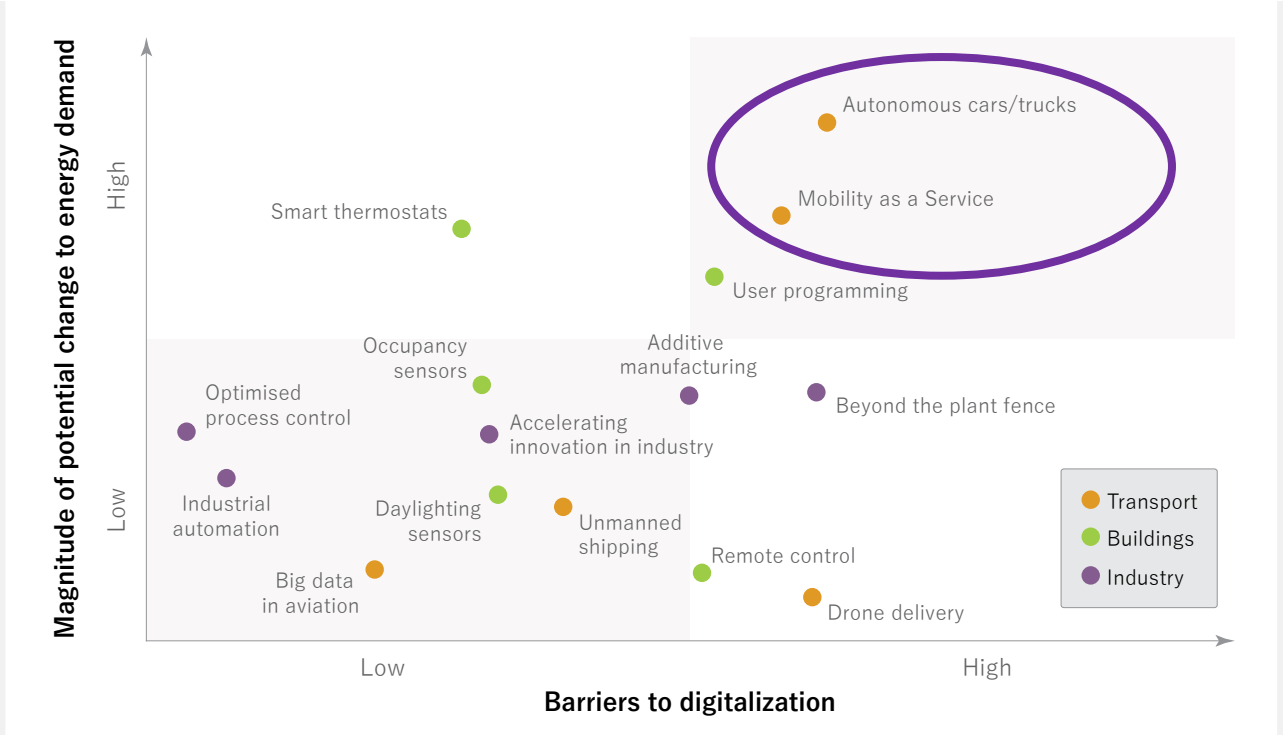

Fig 2.1, IEA (2017)

digitalisation impacts on **energy supply**

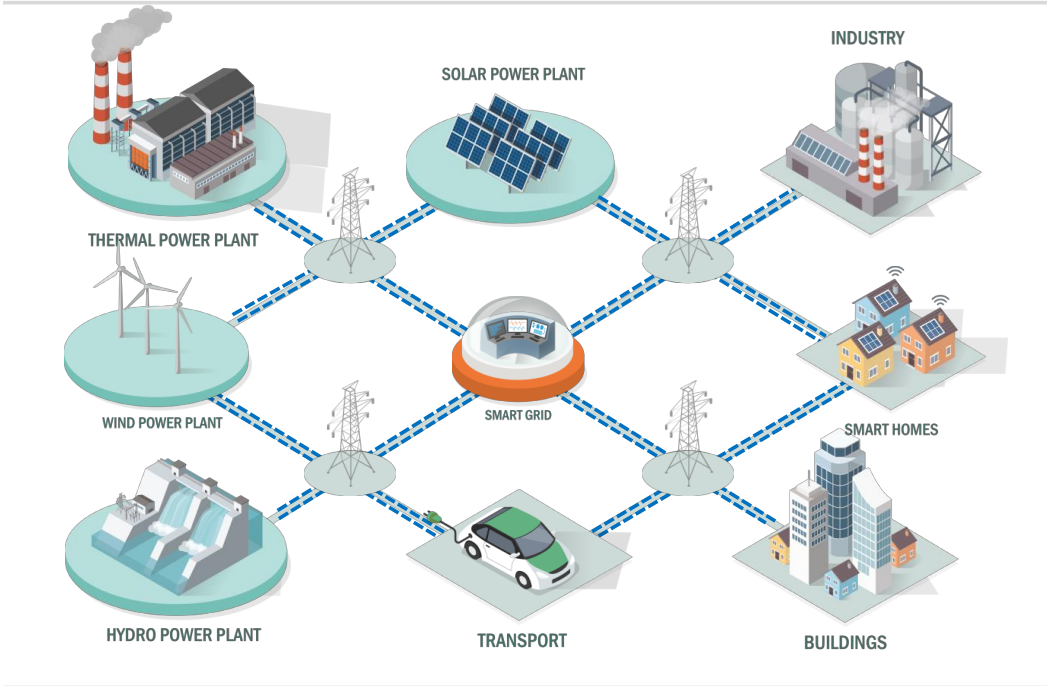

Fig 4.2, IEA (2017)

IEA (2017) Digitalization & Energy. International Energy Agency, Paris, France.

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Foward-looking assessments of indirect impacts of digitalisation tend to be one-sided (IEA, GeSI) .... & *with limited or no rebound*

<u>ICT-enabled emission reductions</u>

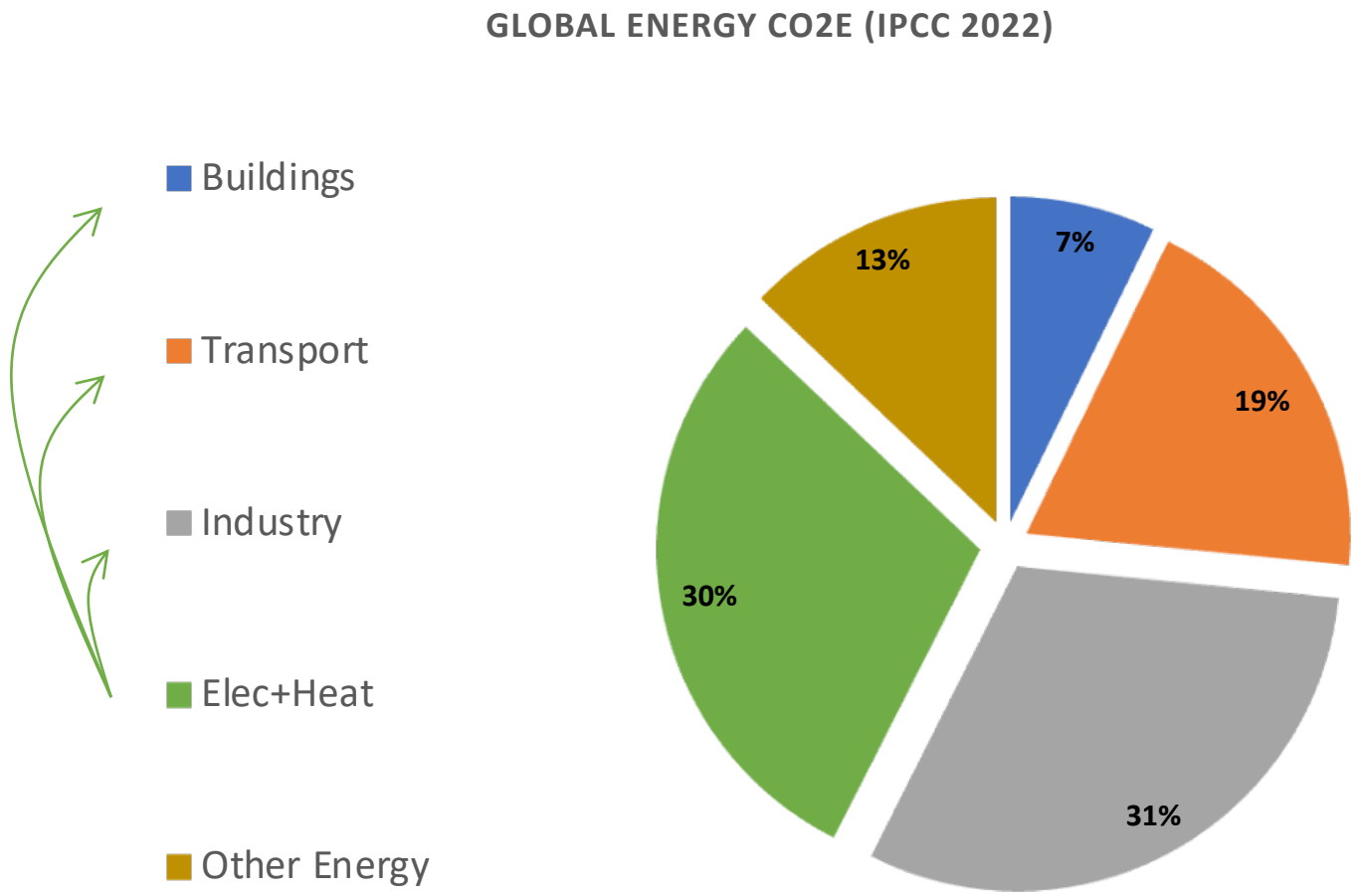
GeSI 2009: 15% reduction of global GHGs by 2020

GeSI 2022: 9% reduction of global GHGs by 2030

seven ‘use cases’:

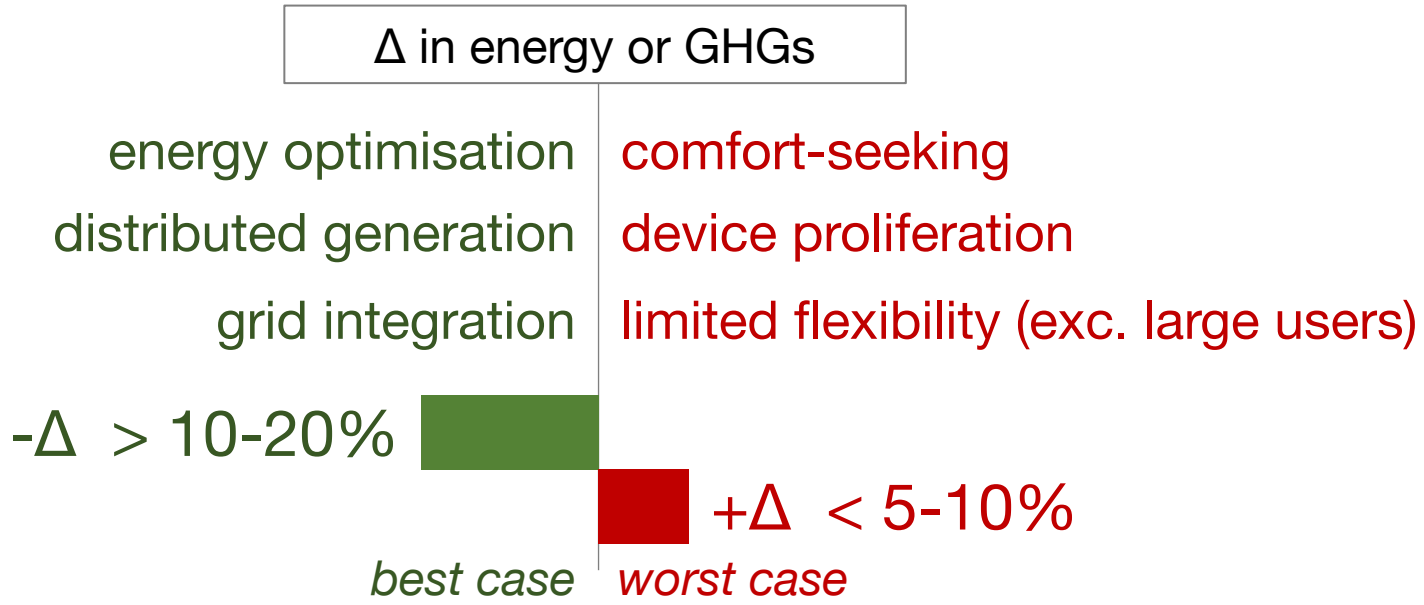
- digital access
- fast internet
- cloud services
- IoT
- cognitive (AI)
- digital reality
- blockchain

We are working on an evidence synthesis of best *and worse* case digitalisation impacts by sector



Buildings sector: high impact digital applications

- smart building controls & energy management systems
- flexible, responsive demand
  - also:
    - sharing economies (goods, floor area)
    - building information modelling
    - digital construction (inc. 3D printing)
    - real-time data enabling performance contracting



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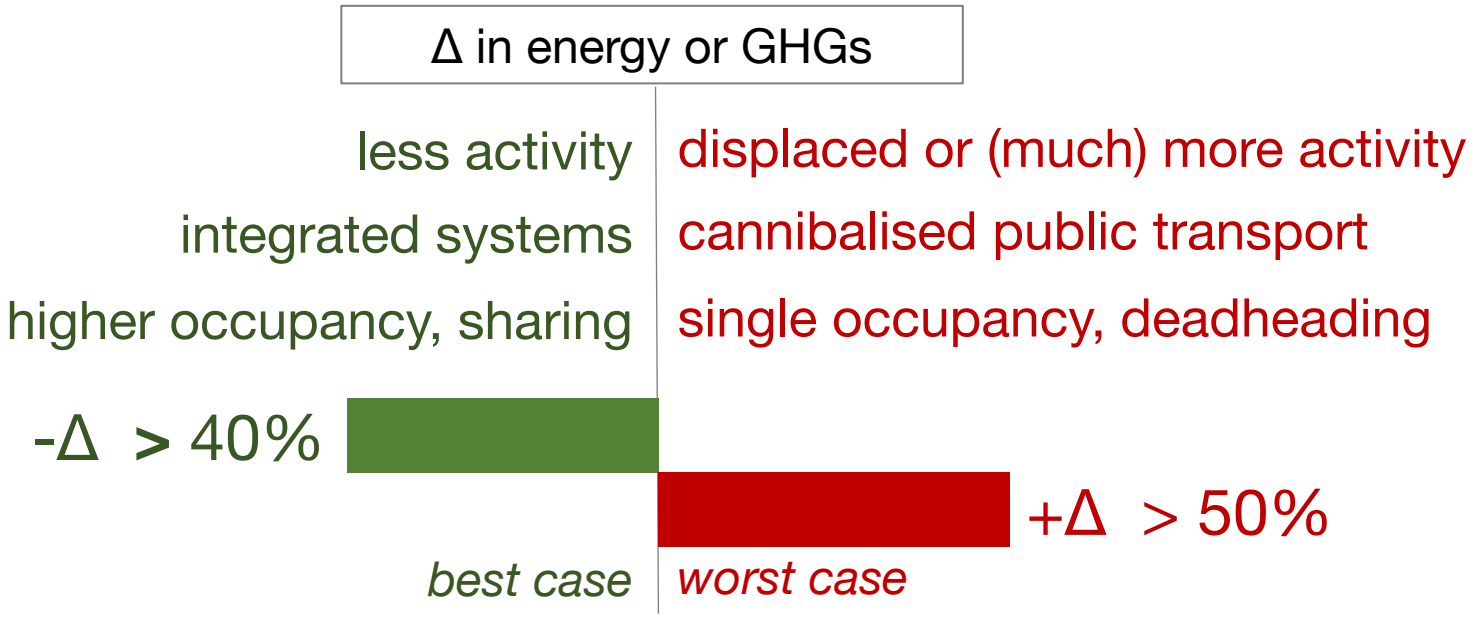
Transport sector: high impact digital applications

- teleworking
- on-demand mobility services
- autonomous vehicles
  - also:
    - smart charging, vehicle-to-grid
    - freight logistics



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Industry sector: high impact digital applications

- process control, efficiency & automation
- additive manufacturing (3d printing)
- demand response
  - also:
    - digital twins for prototyping
    - continuous performance monitoring

Δ in energy or GHGs	
process efficiencies	limited uptake, skills gap
shift from products to services	growth > efficiency (esp. low income)
(new jobs)	(job losses)

large subsectoral variability

-Δ < 5-15%

+Δ > + 5%

best case *worst case*

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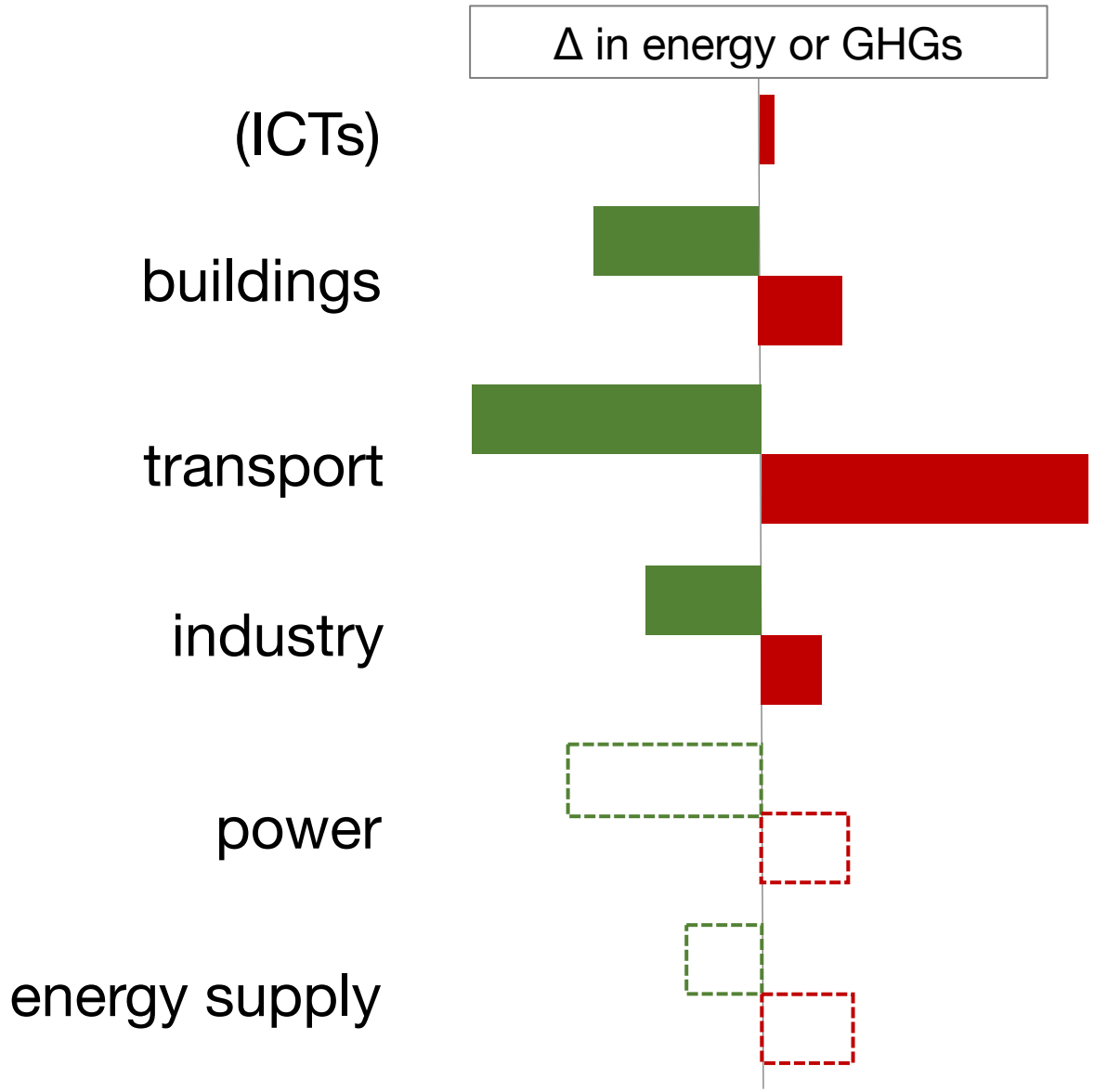
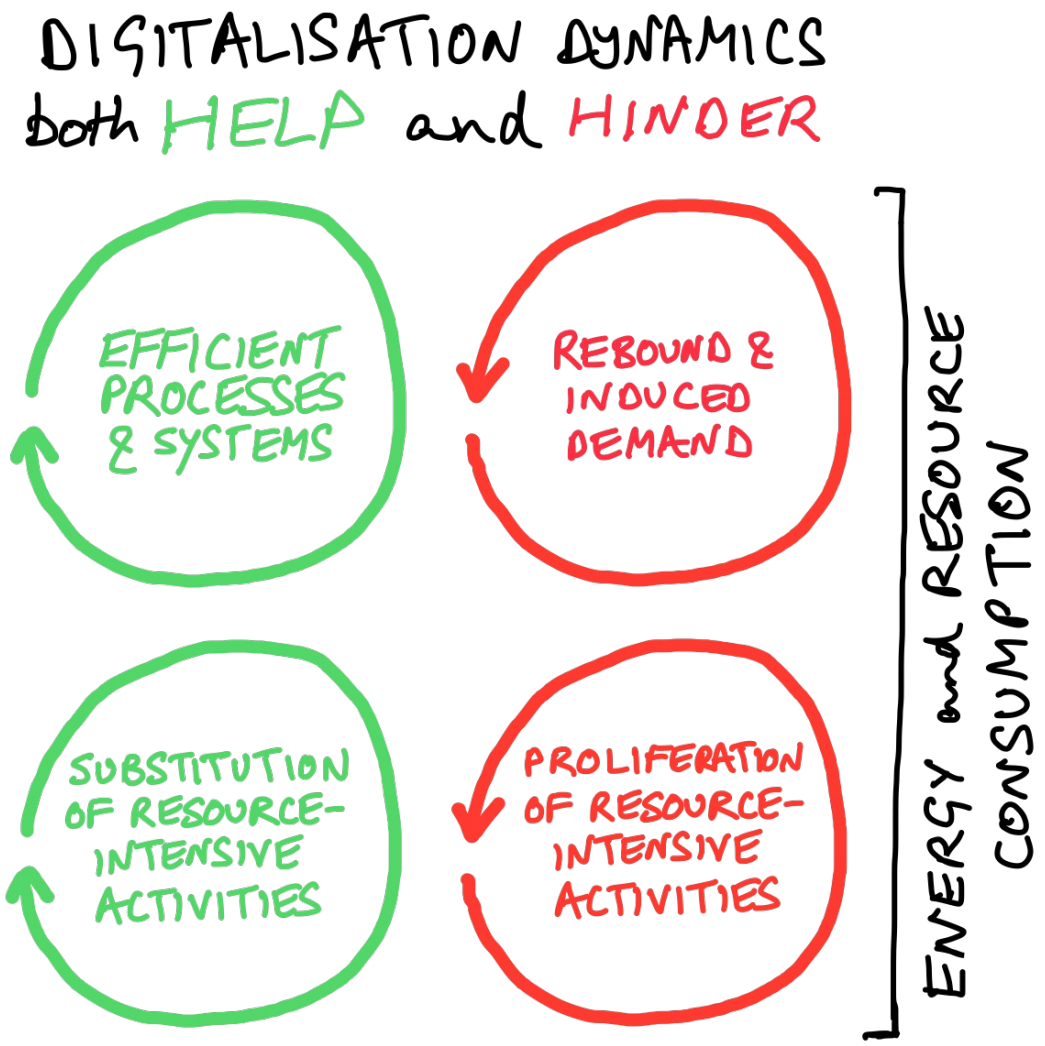
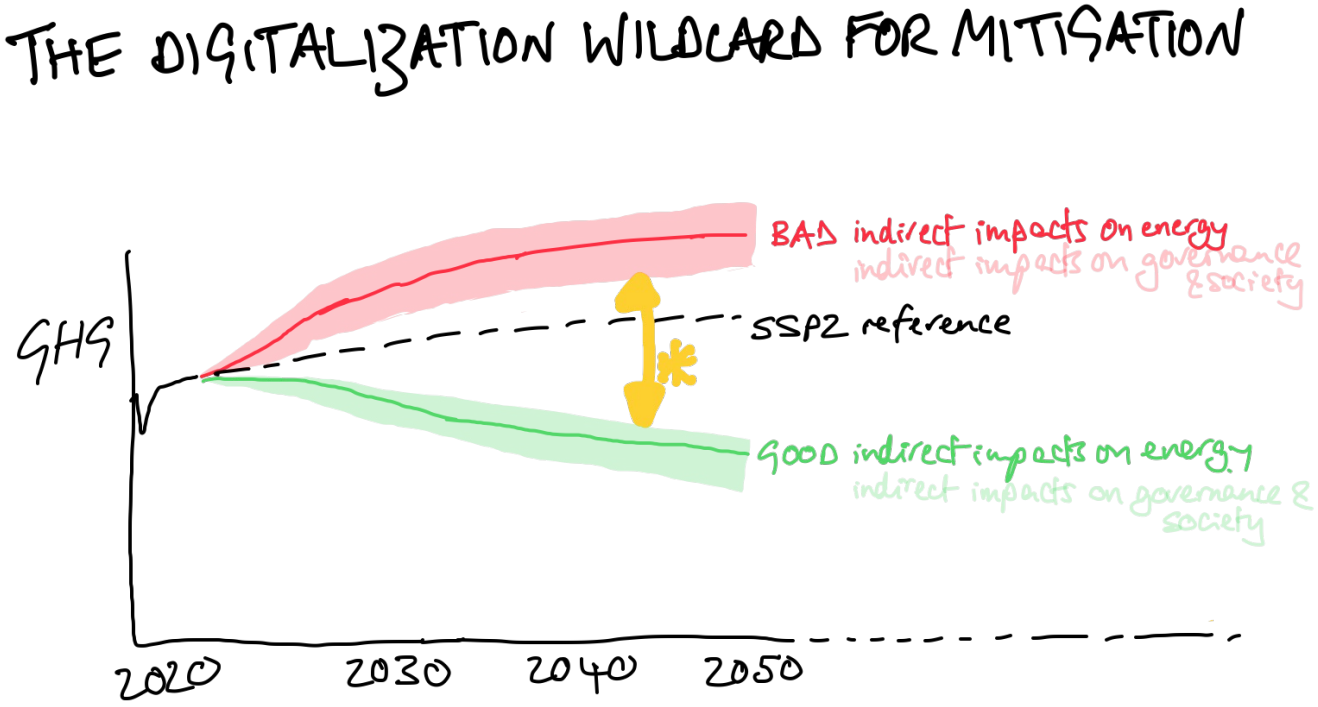
We are working on evidence synthesis of best and worse case digitalisation impacts by sector



Expected outcome of evidence synthesis: wide gap between best and worse case digitalisation impacts





*** policy response**

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

(2) specific climate policy for digitalisation?

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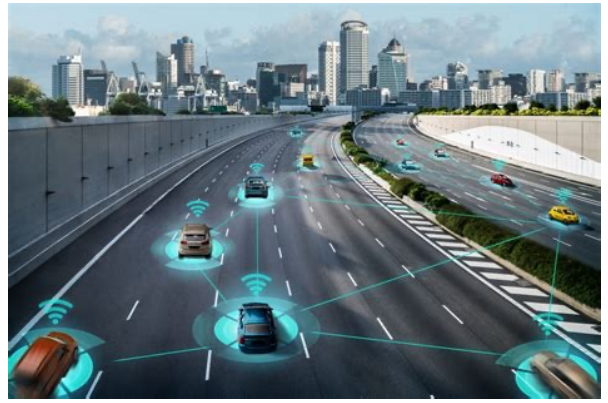
The EU's AI Act seeks to regulate undesirable outcomes of AI … including on societal and environmental wellbeing.

AI Act & digitalisation policy ⟷ ‘usual’ climate policy

design, coding	application, service provision	application context, integrated system
		
software engineers, tech companies	tech companies, car manufacturers, mobility providers	municipal governments, transport planners & authorities, regulators (roads, environment)

- small n of influential companies
- sensitive to social license to operate
- ambitious net-zero plans

‘Scope 4’ reporting or other accountability mechanism for digital applications?

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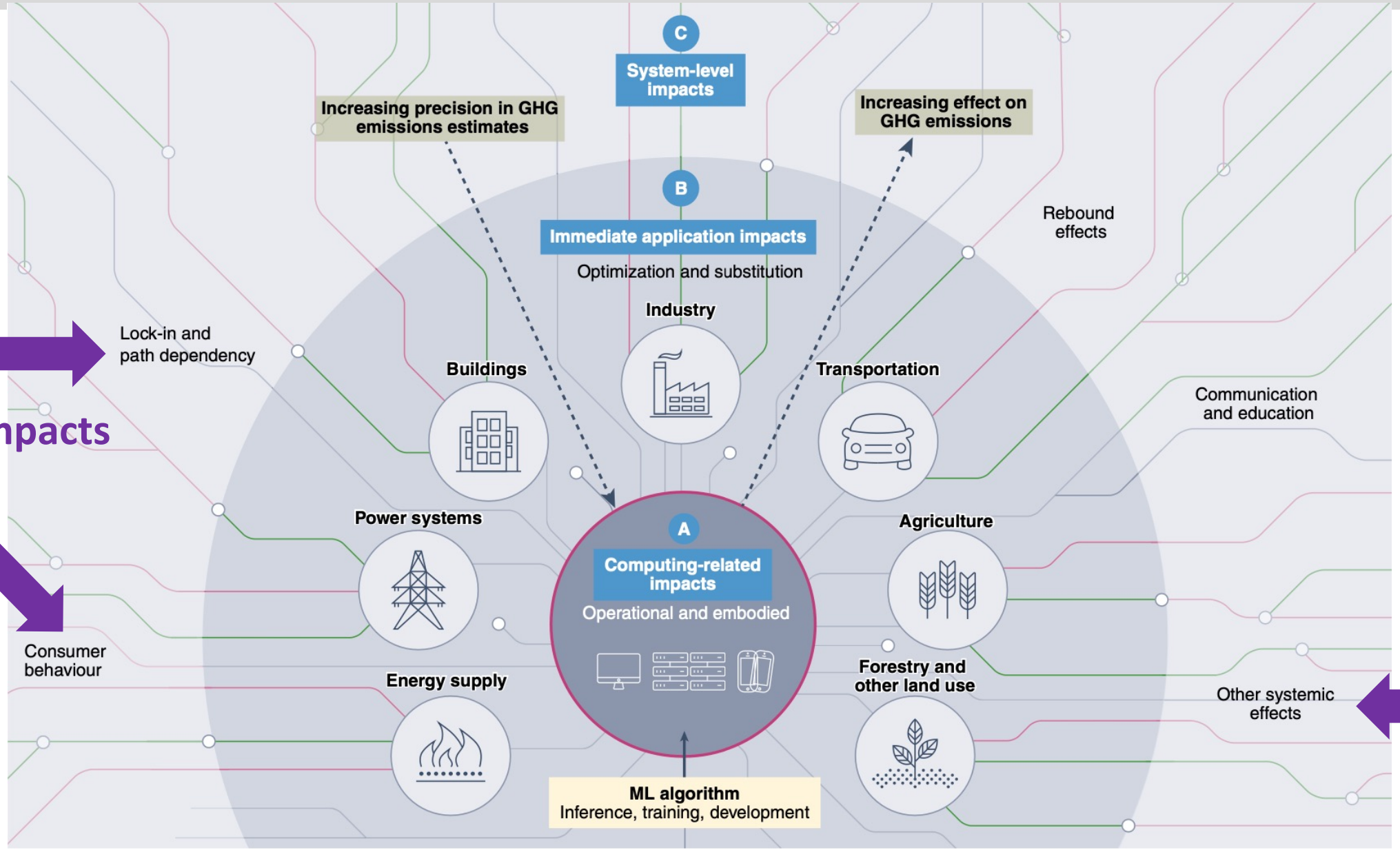

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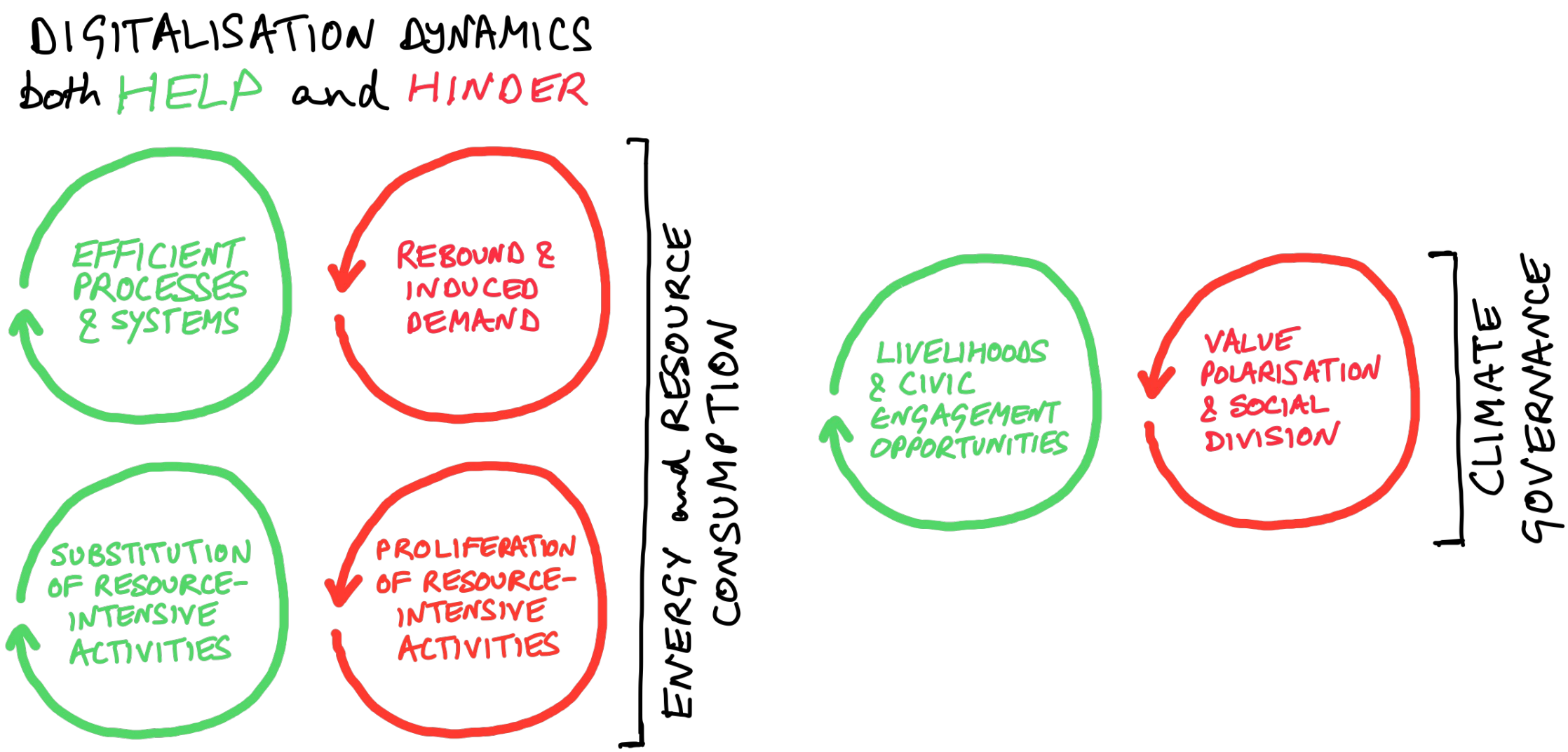
Digitalisation can enable or undermine good governance, equality, & social capital that supports effective climate policy



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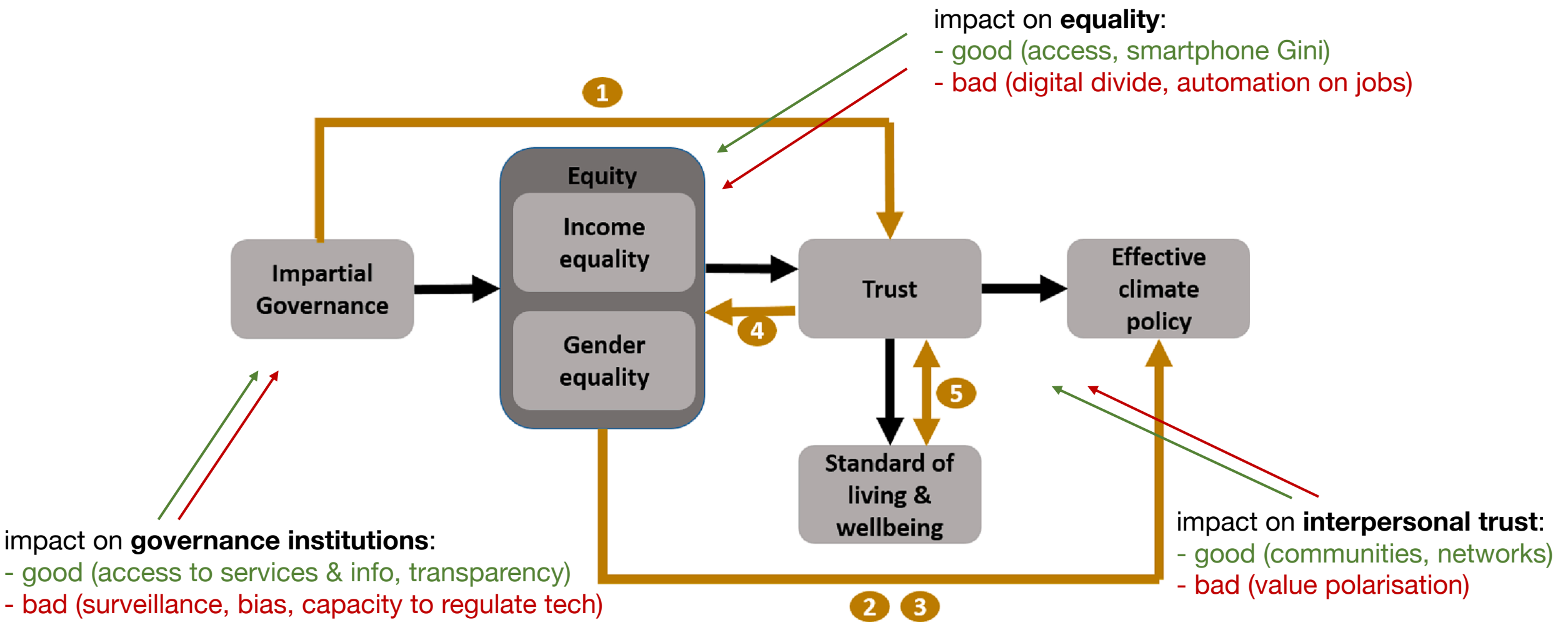

Creutzig et al. (2023). "Designing a virtuous cycle: Quality of governance, effective climate change mitigation, and just outcomes support each other." Global Environmental Change 82: 102726. https://doi.org/10.1016/j.gloenvcha.2023.102726