SCENARIOS FORUM | 25

DIGITAL TRANSFORMATION WITHIN SHARED SOCIOECONOMIC PATHWAYS

YEE VAN FAN, CHARLIE WILSON

UNIVERSITY OF OXFORD

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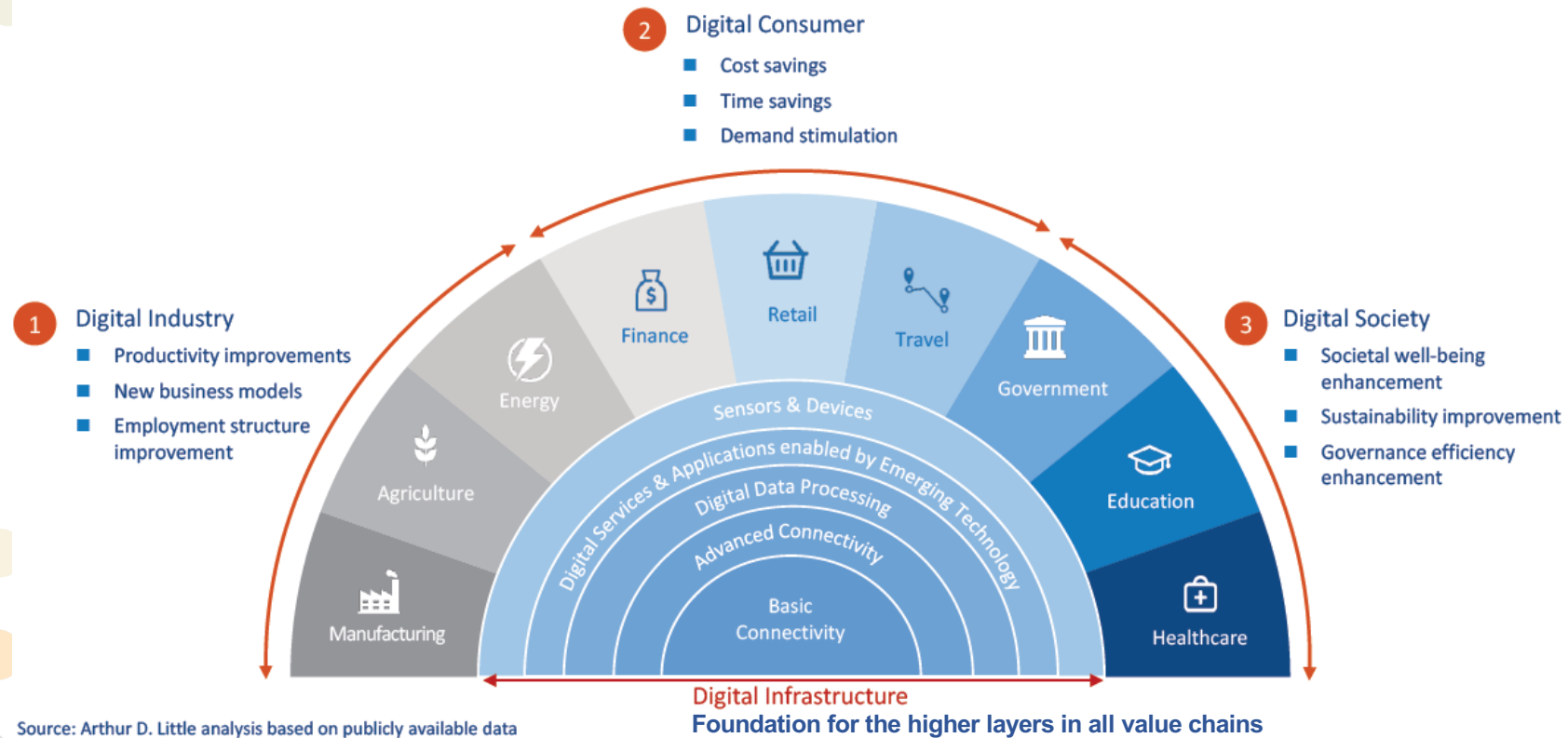
iDODDLE

The Impacts of Digitalised Daily Life on Climate Change

DIGITAL TRANSFORMATION IMPACTS *ALL* ECONOMY & SOCIETY

2 **Digital Consumer**
- Cost savings
- Time savings
- Demand stimulation

1 **Digital Industry**
- Productivity improvements
- New business models
- Employment structure improvement

3 **Digital Society**
- Societal well-being enhancement
- Sustainability improvement
- Governance efficiency enhancement

Finance · Retail · Travel · Government · Energy · Education · Agriculture · Manufacturing · Healthcare

Sensors & Devices
Digital Services & Applications enabled by Emerging Technology
Digital Data Processing
Advanced Connectivity
Basic Connectivity

Digital Infrastructure
Foundation for the higher layers in all value chains

Source: Arthur D. Little analysis based on publicly available data

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CAPTURING DIGITAL TRANSFORMATION IN SSPs:
Opportunity & Challenges

- Digitalisation is not represented *explicitly* in the SSPs
  - ➤ *(Exception*: SSP5 – digital revolution enables global institutions & coordination)
  - ➤ Hard to assess enabling/exacerbating effect of digitalisation on climate futures
  - ➤ AI makes this more urgent [Luers et al. 2024]

Carlsen et al. (2024). *One Earth*. https://doi.org/10.1016/j.oneear.2023.12.015

Koomey & Masanet, E. (2021). *Joule*. https://doi.org/10.1016/j.joule.2021.05.007

Luers et al. (2024). *Nature*, https://doi.org/10.1038/d41586-024-01137-x

CAPTURING DIGITAL TRANSFORMATION IN SSPs: Opportunity & Challenges

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- Caution:
  - ➤ Fast changing innovation landscape [Koomey & Masanet 2021]
  - ➤ Potential for surprises & discontinuities [Carlsen et al. 2024]
  - ➤ General-purpose characteristics of digitalisation hard to disentangle

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QUANTITATIVE MEASURES OF DIGITAL TRANSFORMATION: E-Government Development Index (EGDI)
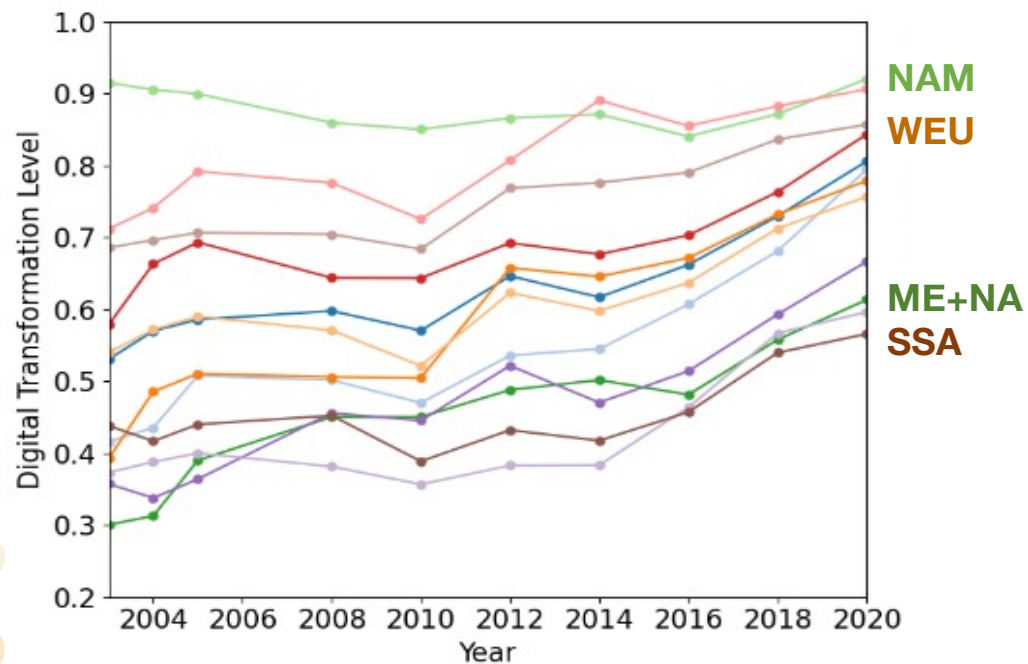
SSP EXTENSION PROCEDURE:
Fit Historical Model Using SSP Variables As Predictors

explaining observed variation in eGDI historically
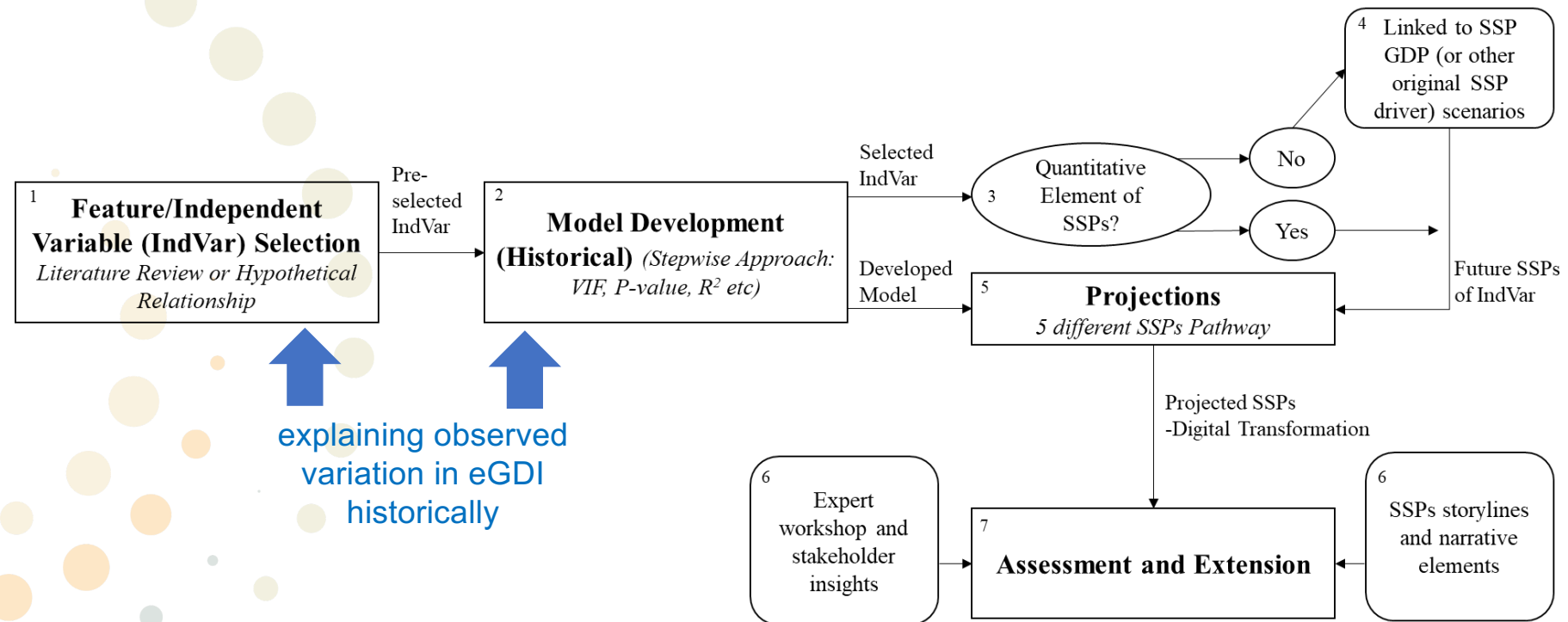
DIGITAL TRANSFORMATION HISTORICALLY PREDICTED BY THREE VARIABLES (FROM >15 TESTED)

$$Digital\ Transformation_{it} = \alpha_i + \beta_1 GDP_{it} + \beta_2 Pop_{it} + \beta_3 R\&D_{it} + \varepsilon_{it}$$

α_i represents the fixed effect for country i

β_1 = coefficient for *GDP per capita, PPP (2017)*

β_2 = coefficient for *population*

β_3 = coefficient for *R&D expenditure (% GDP)*

ε_{it} is the error term for country i at time t

Fitting:	observations **2003-2020 in 62 countries**, R^2=.78
Validation:	on **2022** observations, projection error <3%

DIGITAL TRANSFORMATION HISTORICALLY PREDICTED BY THREE VARIABLES (FROM >15 TESTED)

| Variables	Hypothesised Relationship with Digital Transformation	Sig.?	SSP Variable?
Population	Proxy for market potential, driving investment in and demand for digitalisation Higher availability of human capital	Tested (p<.01)	Driver
GDP per capita	Proxy for economic resources available for investment in digitalisation	Tested (p<.01)	Driver
R&D expenditure	Drives innovation in digital technologies	Tested (p<.01)	No – use nested model (cf. Leimbach 2023)
Urbanisation …			
Services share & value added …			
Trade openness, FDI, high-tech exports …			
Rule of law, govt effectiveness …			

Other tested variables:
Enrolment in tertiary education, manufacturing value added, renewable electricity output, electricity price, etc.

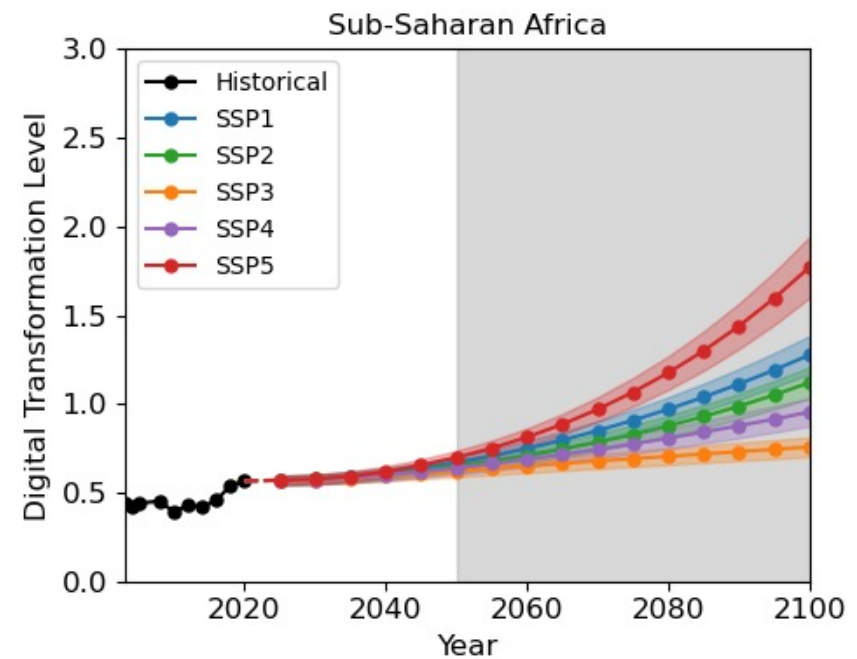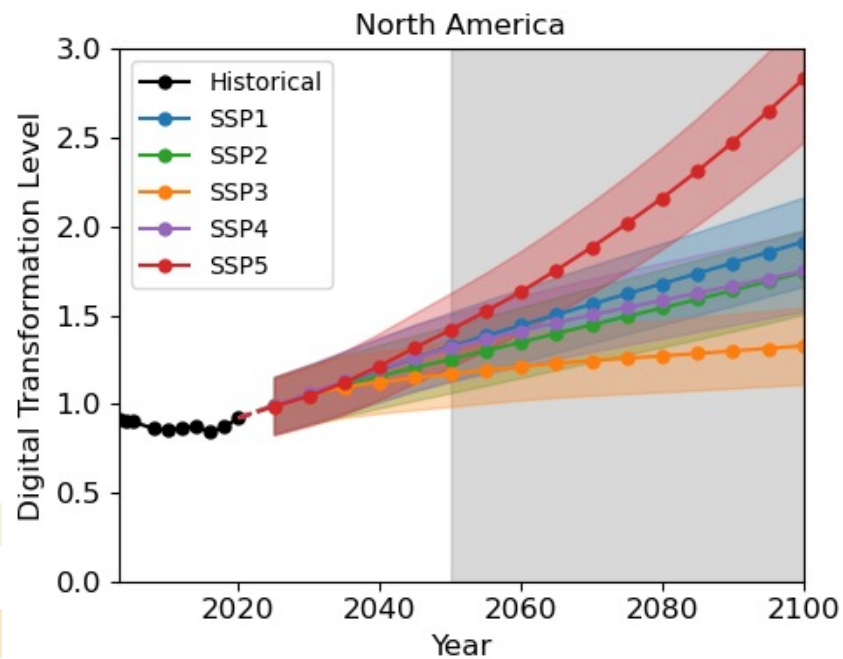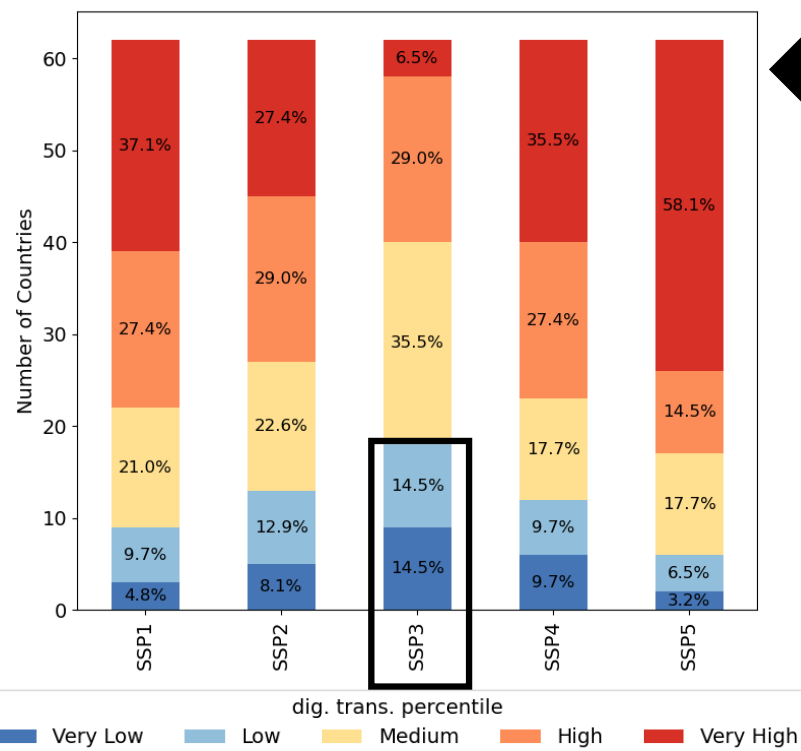# SSP-CONSISTENT DIGITAL TRANSFORMATION PROJECTIONS: Relative Levels, Global
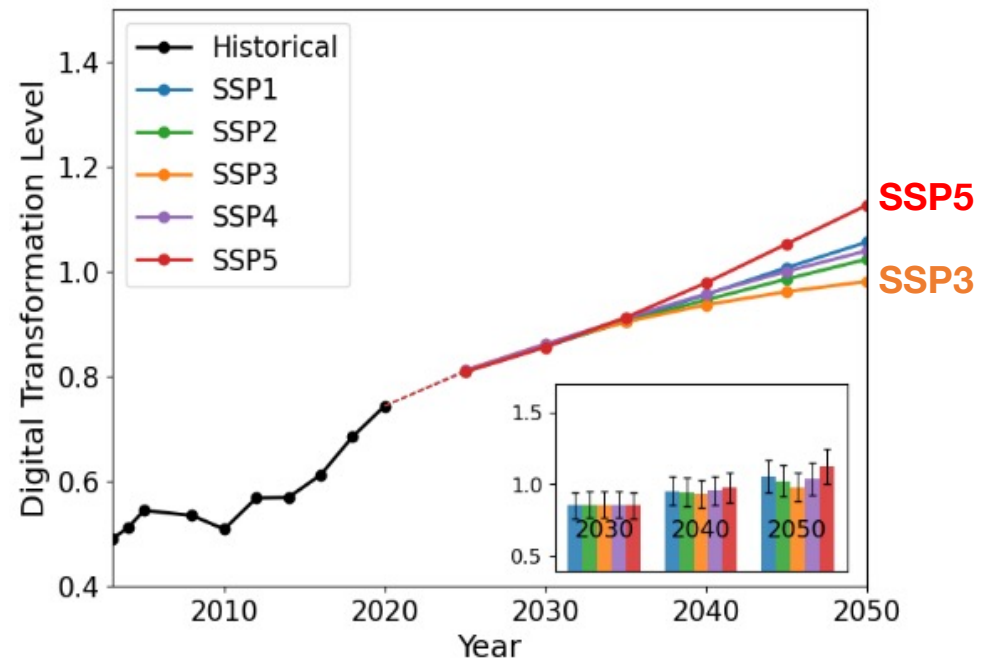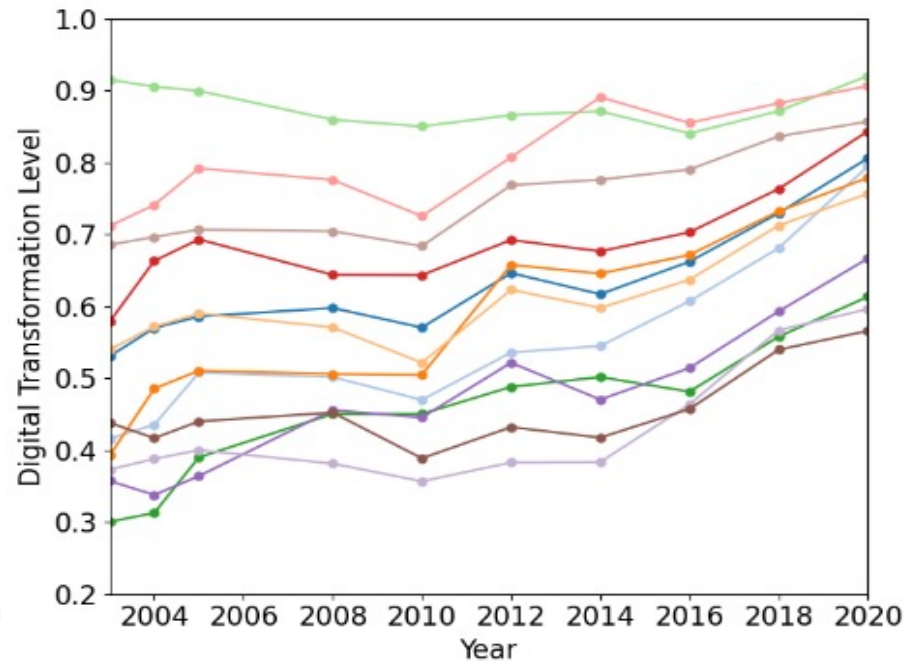
SSP-CONSISTENT DIGITAL TRANSFORMATION PROJECTIONS:
Relative Levels, Comparing World Regions

SSP-CONSISTENT DIGITAL TRANSFORMATION PROJECTIONS:
Digital inequality amplified in some scenarios

relative digital transformation level in 2050 (62 country sample)
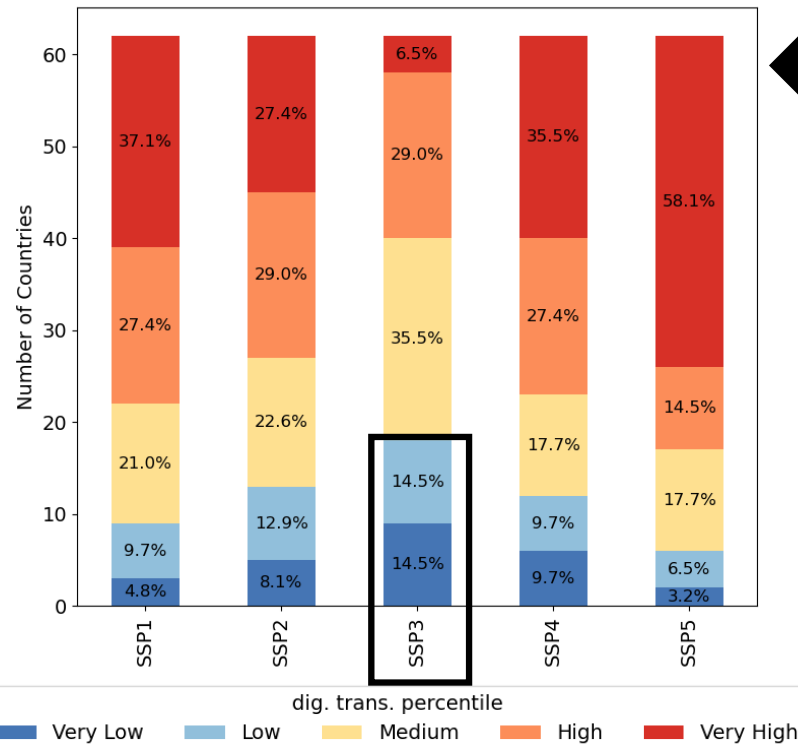
SSP-CONSISTENT DIGITAL TRANSFORMATION PROJECTIONS:
Digital inequality amplified in some scenarios

relative digital transformation level in 2050
(62 country sample)

… extrapolated globally:

under SSP3 assumptions by 2050,
very low to low digital transformation for
47% of all countries
35% of total population (3.5 billion people)
but 0% of population in countries >$50k GDP/cap

SSP-CONSISTENT DIGITAL TRANSFORMATION PROJECTIONS: Proposed extension to the SSP framework

Storyline element	SSP 1	SSP 2	SSP 3	SSP 4	SSP 5
Economy growth	High in LIC, MIC; medium in HIC*	Medium, uneven	Slow	Low in LIC, Medium in other countries	High
Population growth	Relatively low	Medium	High; Low in Rich OECD	Relatively High; Low in Rich OECD	Relatively low
Education	High	Medium	Low	V.low-low; Medium in Rich OECD/uneq.	High
Technology development	Rapid	Medium, uneven	Slow	Rapid in high tech economies and sectors; Slow in others	Rapid
Technology transfer	Rapid	Slow	Slow	Little within countries to poorer population	Rapid
Relative digital transformation level	Medium-High	Medium-Low	Low	Medium-Low	High
Digital inequality (divide) between countries **	Medium-Low	Medium-Low	High	High-Medium	Low

SSP-CONSISTENT DIGITAL TRANSFORMATION PROJECTIONS: Proposed extension to the SSP framework

SSP	SSP description: text copied from O'Neill, Kriegler et al. (2016)	Indicative links with digital transformation
SSP1: Sustainability— Taking the green road	"Commitment to achieving development goals, increasing environmental awareness in societies around the world, and a gradual move toward less resource-intensive lifestyles, constitutes a break with recent history in which emerging economies have followed the resource-intensive development model of industrialized countries."	Management of the global commons to respect planetary boundaries extends to the digital sphere, aligning digitalisation with climate governance including through cooperative global institutions and an emphasis on de-materialisation and less resource intensive lifestyles.

SSP-CONSISTENT DIGITAL TRANSFORMATION PROJECTIONS:
Use Cases for Climate Mitigation and Adaptation Assessments

I. Assessing **direct** energy and material consumption from ICT infrastructure.

e.g. digital transformation <-> data centre energy demand   *[Yee Van Fan ** Fri 11.30 AI & Digi Transformation **]*

II. Assessing indirect impact (enabling effect) of digitalisation as a general-purpose technology

e.g. digital transformation <-> capital & labour productivity

e.g. digital transformation <-> low-carbon lifestyles   *[Hazel Pettifor ** Fri 11.30 AI & Digi Transformation **]*

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III.   Informing global initiatives to ensure **universal and equitable access** to digital transformation opportunities as part of SDG agenda.

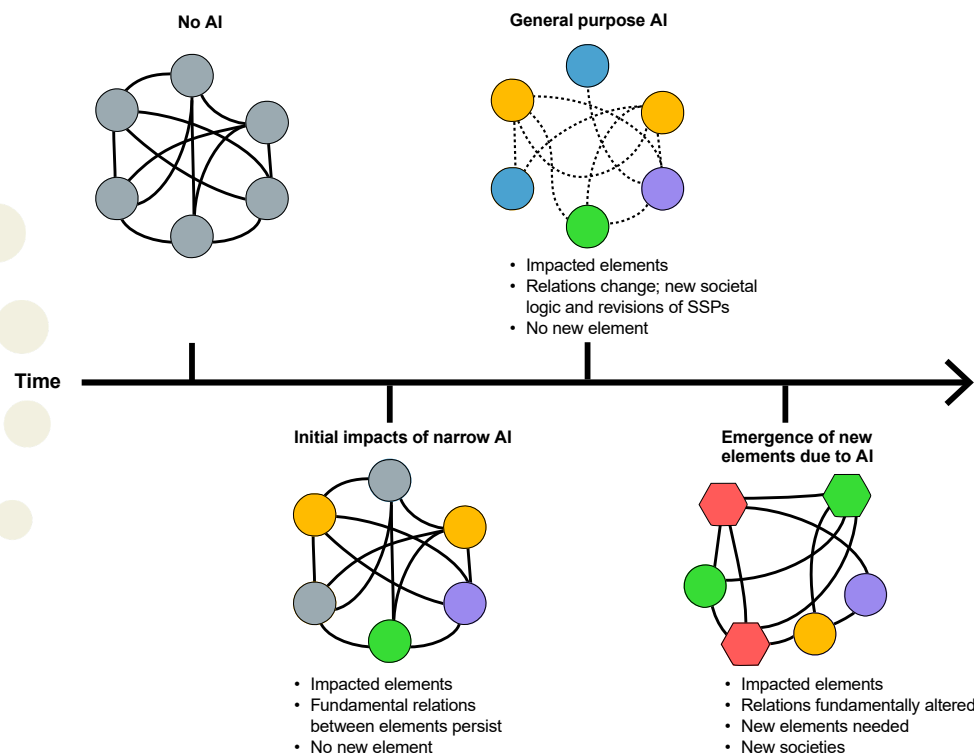IV.   Assessing digital **climate services for adaptation** planning.

AI

IS IT MEANINGFUL TO PROJECT DIGITAL TRANSFORMATION BEYOND 2030 CONSISTENT WITH 'FIXED' SSP STORYLINES?

One Earth

No AI

General purpose AI

- Impacted elements
- Relations change; new societal logic and revisions of SSPs
- No new element

Time

Initial impacts of narrow AI

- Impacted elements
- Fundamental relations between elements persist
- No new element

Emergence of new elements due to AI

- Impacted elements
- Relations fundamentally altered
- New elements needed
- New societies