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JUST2CE
A Just Transition to Circular Economy



Dr Ben Purvis
(he/they)
b.purvis@sheffield.ac.uk
Twitter: @BenPurvis42

Modelling global futures: a comparison of 'The Limits to Growth' and the use of Integrated Assessment Models within the climate literature

(Originally presented at the Annual Conference of the System Dynamics Society July 2021)



The JUST2CE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003491



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A research trajectory[?]

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Integrated assessment
modelling

interdisciplinarity

Urban sustainability

Modelling

Science and
Technology
Studies (STS)

Climate
economics stuff

Thermodynamics

Ecological economics

Critical theory

Entropy

Systems

undisciplined

physicist

Theoretical
physicist

Physicist on an
interdisciplinary
project

Environmental
scientist?

System
dynamics

Urban
researcher?

Urban scientist?

Sustainability
scientist

Started Undergrad in
Physics

Started PhD in
interdisciplinary group

Started Postdoc in
Architecture dept

Joined JUST2CE

Overview



1. The Limits to Growth & World3
2. Integrated Assessment Models
3. Parallels:
 - i. Modelling techniques
 - ii. Results presentation
 - iii. Transparency
 - iv. (de)Politicisation
4. Conclusion: So what? Implications for JUST2CE

Motivation:

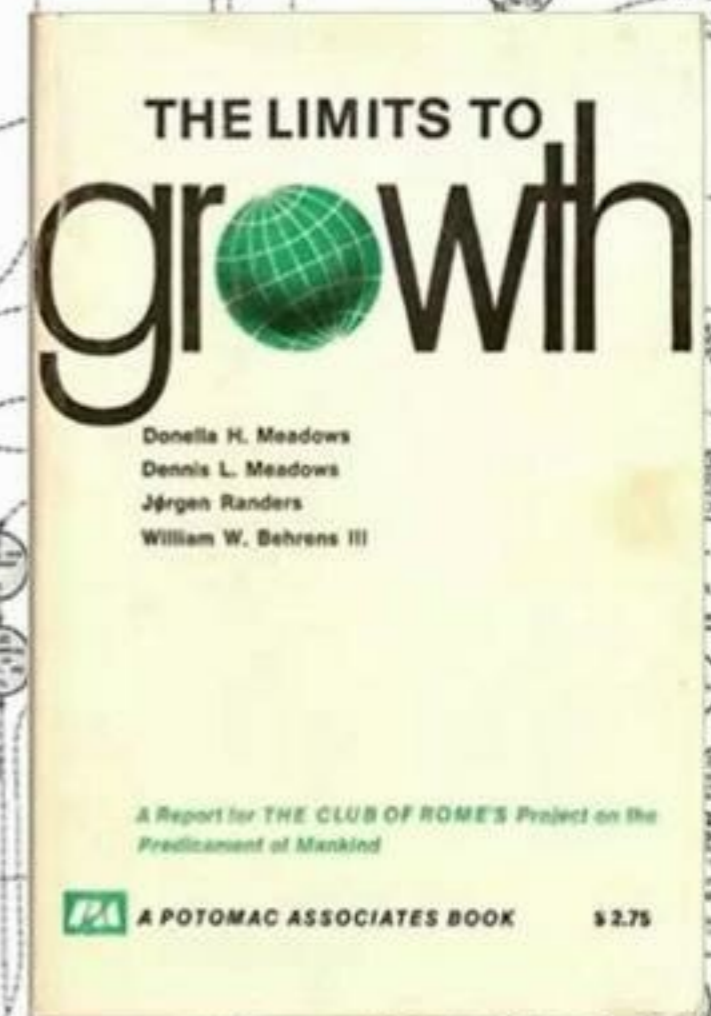
***Why do LtG and IAMs
have divergent legacies?***

The Limits to Growth

- Club of Rome concern for the "present and future predicament of man" approached Jay Forrester in 1970
- Dennis Meadows' MIT team developed the World3 model to investigate constraints to growth from finite planet
- "The Limits to Growth" published 1972 and widely publicised
- The study was widely criticised for being 'alarmist' and 'wrong', and this reputation remains today

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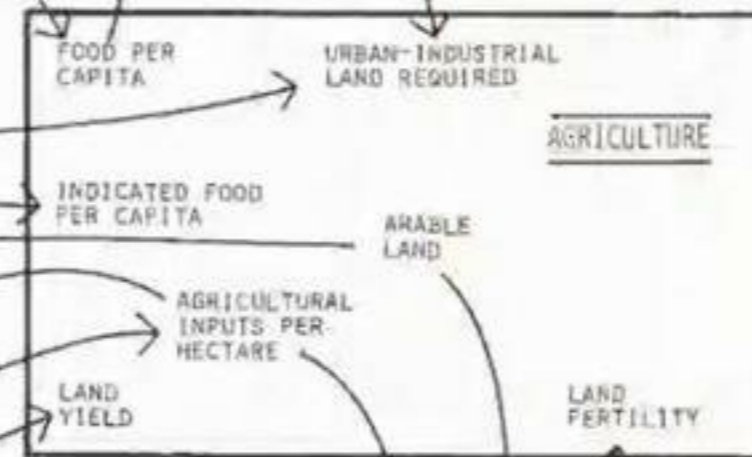
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World3

- Globally aggregated
- 5 sectors: population, economic capital, agriculture, pollution, and resources
- Simulated from 1900 to 2100
- Technical report published in 1974
- Various versions rebuilt in contemporary software available freely online



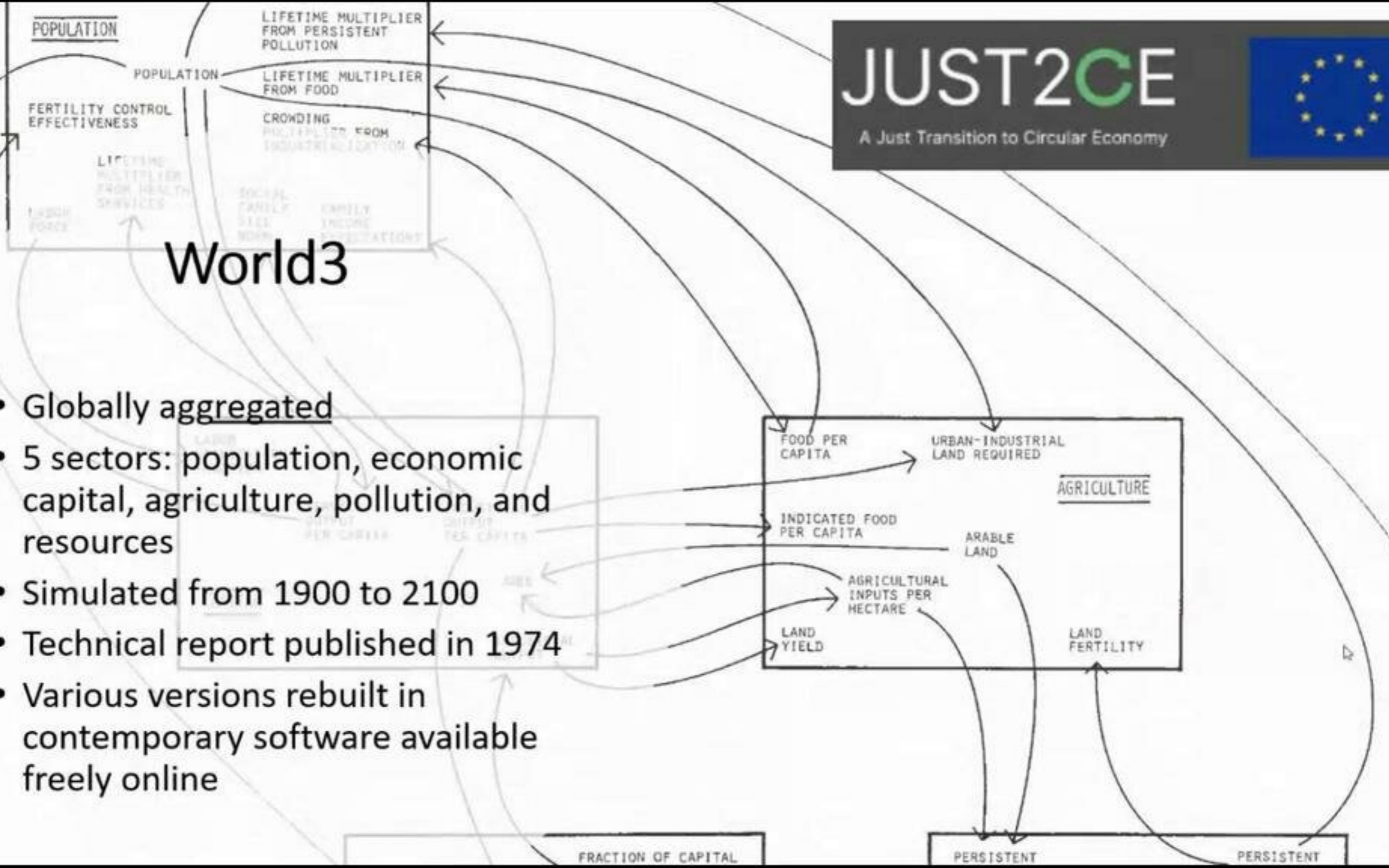
FRACTION OF CAPITAL

PERSISTENT

PERSISTENT

World3

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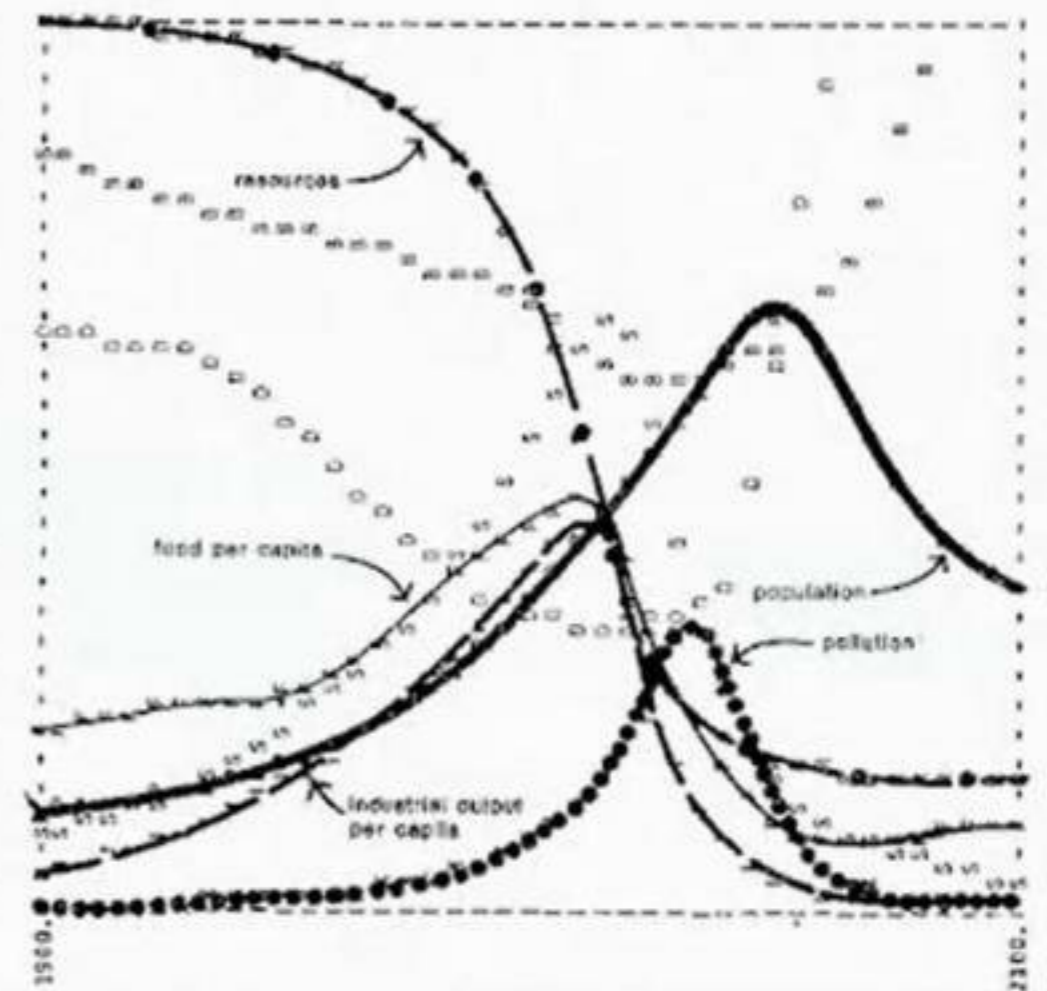




The Limits to Growth

- Explores logical arguments before illustrating nature of feedback and introducing model
- Presents successive simulated scenarios from 'standard run', with political and technical responses to crises.
- without effort to "establish a condition of ecological and economic stability", the most probable outcome would be "a rather sudden and uncontrollable decline in both population and industrial capacity"

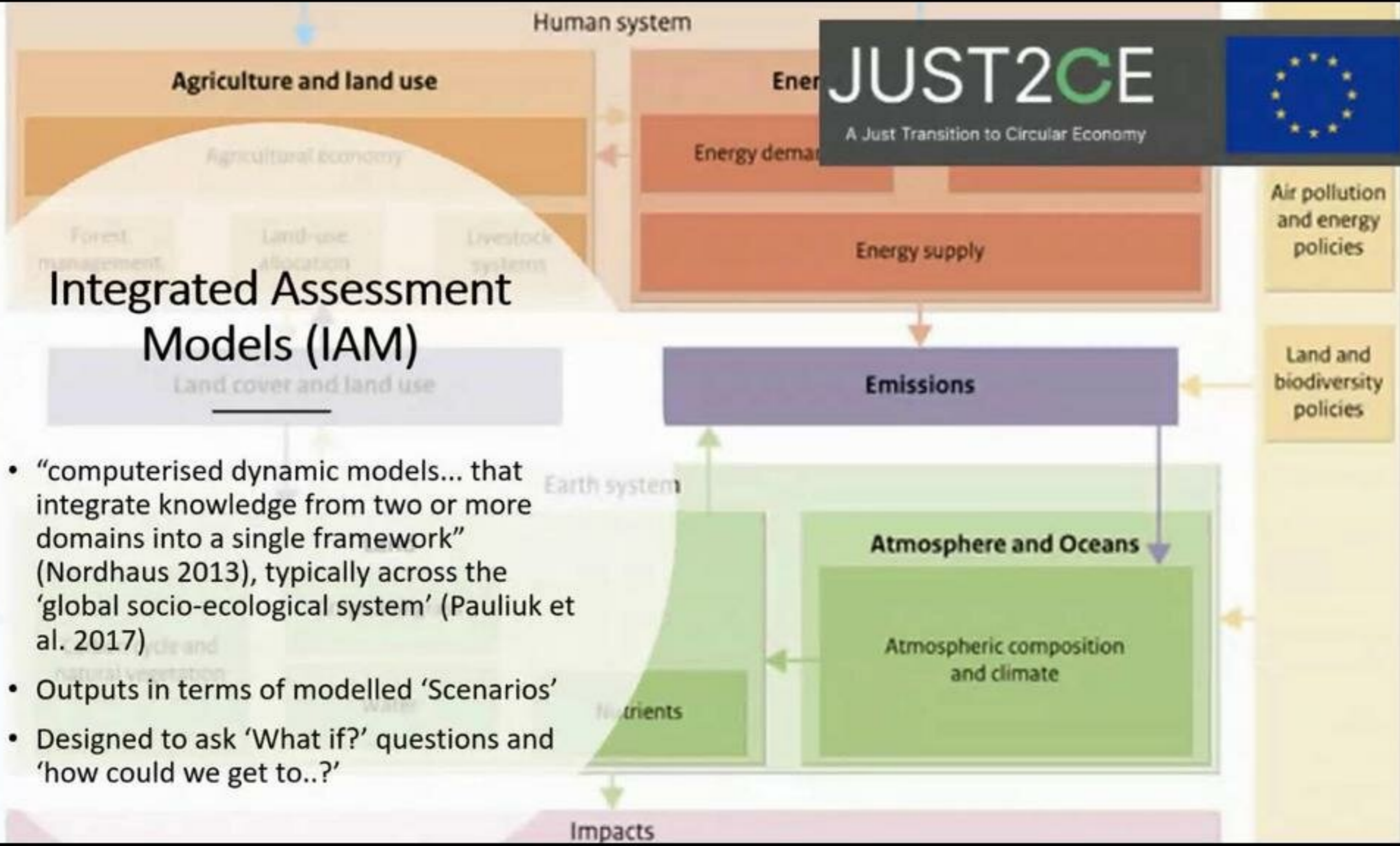
Figure 35 WORLD MODEL STANDARD RUN





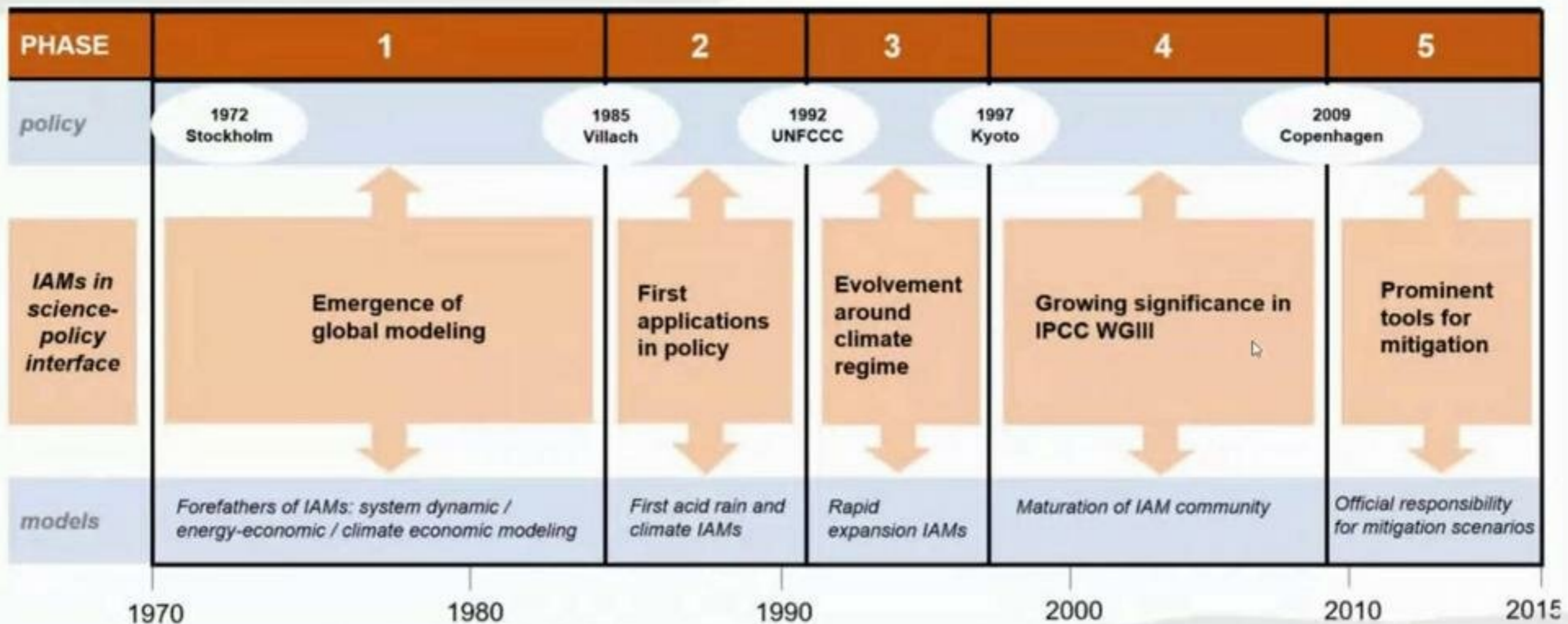
Integrated Assessment Models (IAM)

- “computerised dynamic models... that integrate knowledge from two or more domains into a single framework” (Nordhaus 2013), typically across the ‘global socio-ecological system’ (Pauliuk et al. 2017)
- Outputs in terms of modelled ‘Scenarios’
- Designed to ask ‘What if?’ questions and ‘how could we get to..?’





History of IAMs



Van Beek et al (2020)

Drawing parallels



Both paradigms:

- Complex simulation of global system
- Assessment of futures along socioeconomic dimensions
- 'Integration' and 'Scenarios'
- Considered by global policy domain

Why divergence in reception?

- i. Modelling techniques
- ii. Results presentation
- iii. Transparency
- iv. (de)Politicisation



Modelling Techniques

LtG:

- 1972 – System Dynamics in its infancy
- Simulation not widely used
- Economists not welcoming

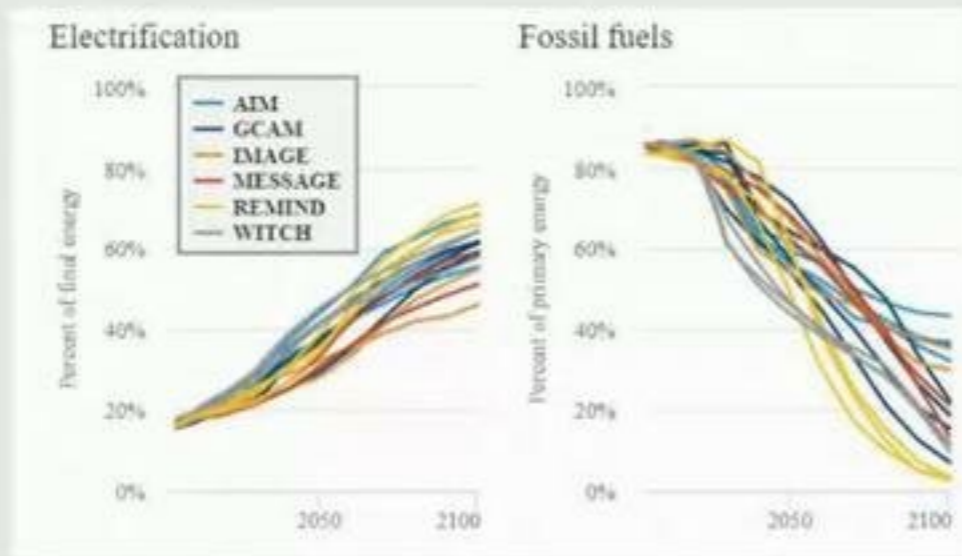
IAMs:

- Broad range of modelling techniques, typically modular, with dominance of optimisation and equilibrium economics (CGE)
- Employing techniques are well established outside of the IAM field

Presentation of results



CarbonBrief
(2018)



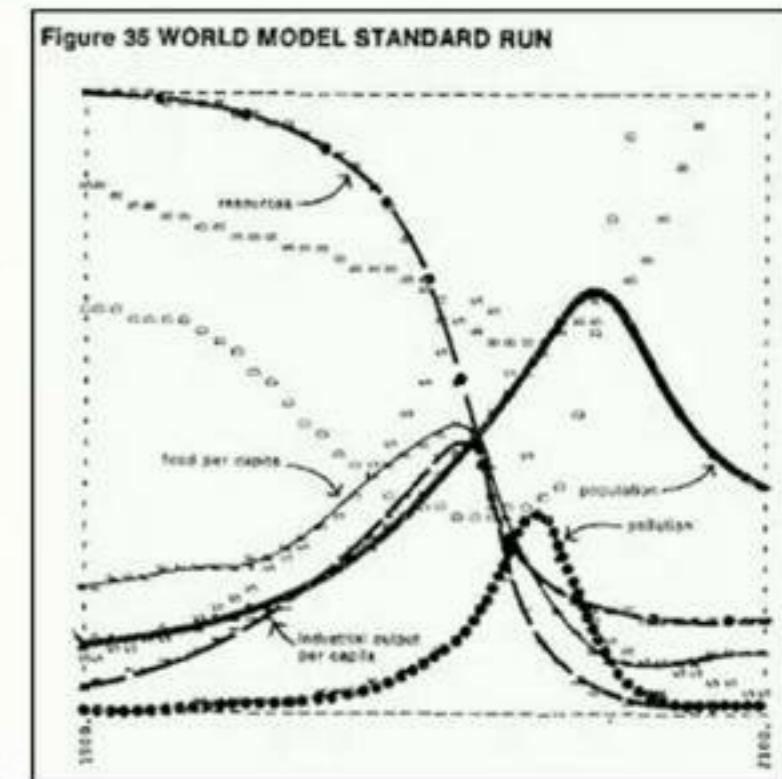
IAMs:

- Outputs within scientific journals and IPCC reports
- 'Scenarios' – Projections and tables disaggregated by sector

LtG:

- 1972 – Popular publication
- 'Scenarios' – Single output graph

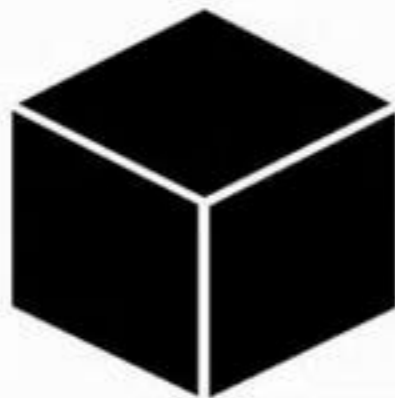
Meadows et al (1972)



Transparency

IAMs:

- Widely criticised for lack of transparency
- Documentation is variable in quality
- Models not all publicly available



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LtG:

- LtG published two years prior to technical report
- But technical report comprehensive
- Much criticism thus independent of model details

Meadows et al (1974)



(de)Politicisation

LtG:

- Much of response political
- Attacks in 'bad faith'

Ecodoom

Fall of Rome

When Professor Wilfred Beckerman first read the extreme prophecies of ecodoom, as presented in the Club of Rome's "**Limits to Growth**," he assumed that this would be universally recognised as "a brazen, impudent piece of nonsense." When he discovered that some people took it seriously, he decided to devote his inaugural lecture at University College, London, to what many economists will regard as the definitive attack.

The Economist,
June 1972

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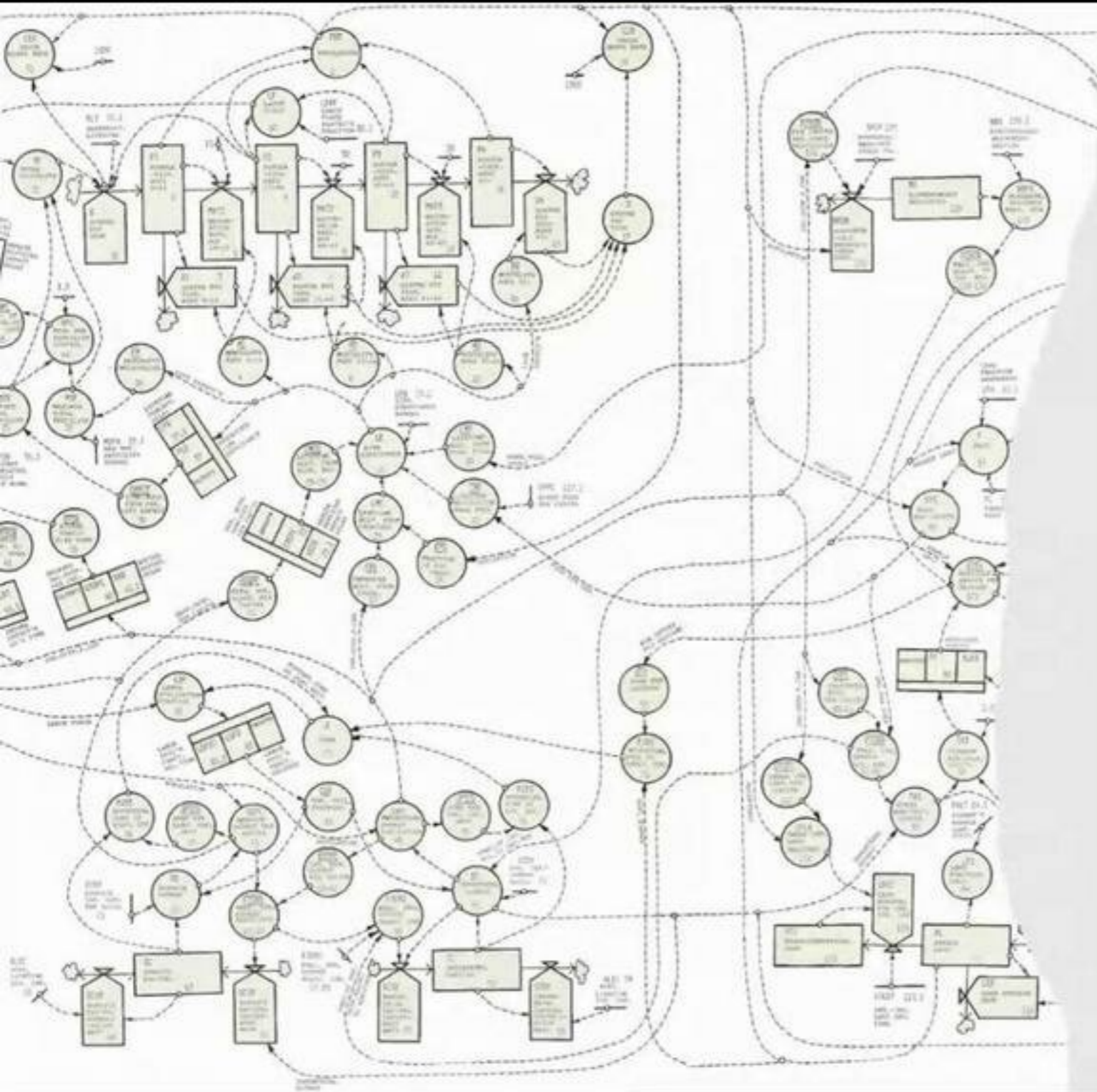
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- Some scientists have suggested that IAMs are no longer fit for purpose and that meeting climate targets will require a radical reinvention of industrial society that the models are not equipped to address.
- But others have argued that IAMs are an indispensable tool for exploring how to reach climate targets and are a key building block in understanding the feasibility of these targets.

IAMs:

- Seen as 'apolitical': early models commissioned by government agencies
- Out of spotlight within IPCC reports
- Criticised for maintaining status quo



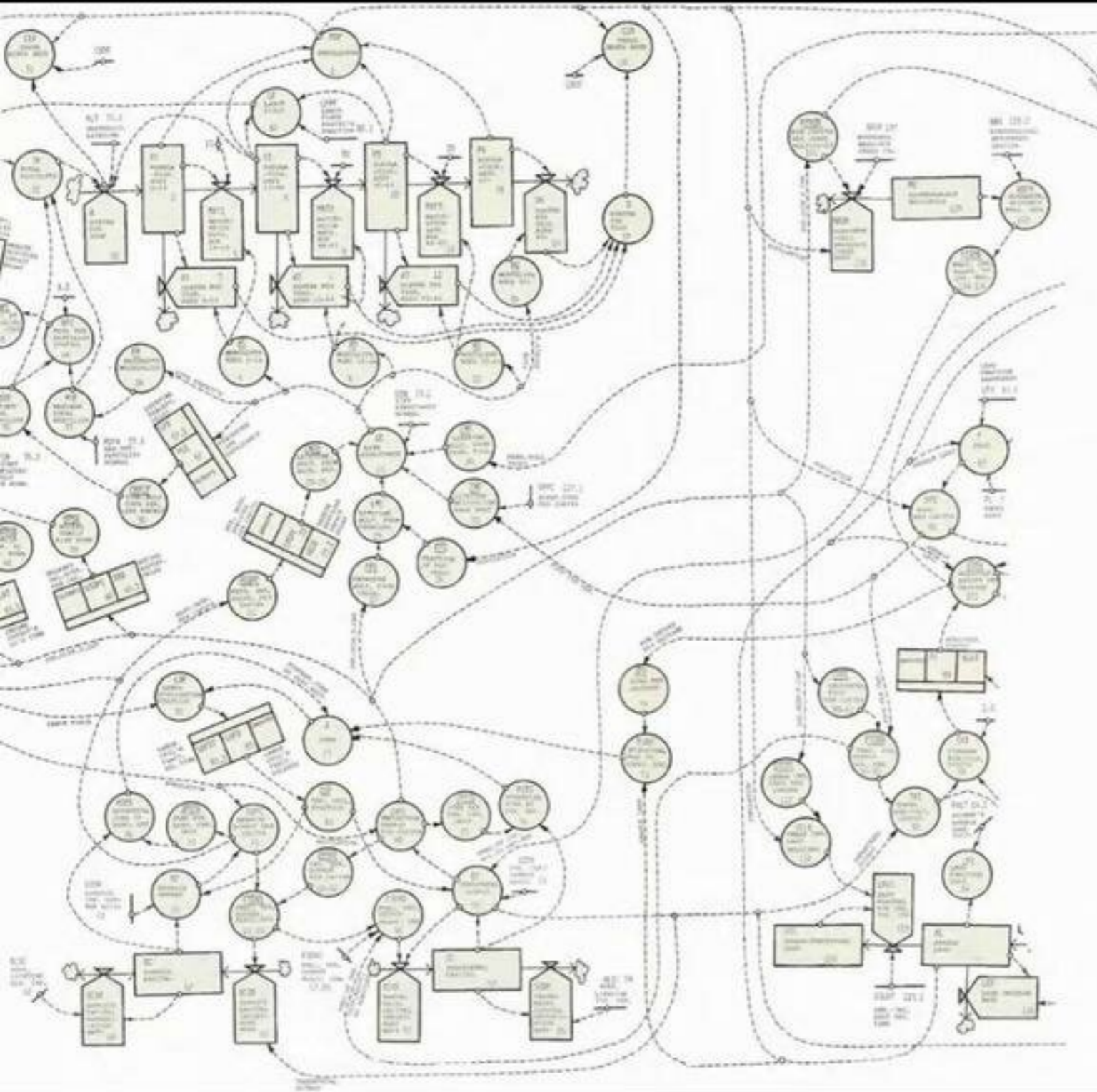
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General Outlook

- LtG tempered the hostile environment in which IAMs were able to gain traction
- The 2 year delay in publishing the technical report arguably damaged the legacy of LtG
- It is important to reflect on and challenge depoliticisation within our modelling



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Implications for JUST2CE

- (de)Politicisation
- Pragmatism and compromise
- Types of impact: directly influencing policy vs shifting the narrative
- Radical vs incremental change?

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Thank you!

b.purvis@sheffield.ac.uk

researchgate.net/profile/Ben-Purvis

Twitter: @BenPurvis42

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CONFERENCE PAPER

2011 Conference of the System Dynamics Society

Modelling global futures: a comparison of 'Limits to Growth' and the use of Integrated Assessment Models within the climate literature

Ben Purvis¹

¹School of Architecture, University of Sheffield, UK
b.purvis@sheffield.ac.uk

The 'Limits to Growth' (LTG) model has been widely cited within the 'Limits to Growth' report (Meadows et al., 1972), predicting the evolution of a global economic system founded on exponential consumption of finite material resources. Warnings of 'collapse' were met with a barrage of furious criticism, and the world, having struggled to meet concrete targets in the public sphere, continued to ignore its underlying 'basic population policy'. Just over two decades later, the Intergovernmental Panel on Climate Change, in seeking methods to generate scenarios for potential future emissions, would turn to a similar paradigm, the question of integrated assessment modelling. From their appearance in the first assessment report in 1995, these models would quickly become a key tool within the Panel's mitigation work.

This paper assesses the parallels of these two paradigms, focusing on modelling techniques, the presentation of results, transparency, and dissemination. In doing so it seeks to understand how integrated assessment modelling became hegemonic within the climate mitigation literature, whilst its forerunner 'World2' provoked such an antagonistic response. Through the analysis of key literature it is suggested that contemporary system dynamics may learn from the divergent reception of these paradigms, and should reflect on the inherent political nature of socio-economic modelling.

KEYWORDS

complex systems, emergent, policy, SDG, sustainability

1 | INTRODUCTION

Integrated Assessment Models (IAM) describe complex interactions between socio-economic and natural systems globally and over long time-scales, and have played a prominent role within the work of the Intergovernmental Panel on Climate Change (IPCC) for the development of global mitigation strategies (van den Broek et al., 2018). In integrating



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