Introduction to the BRIDGE project: Building Resilience In a Dynamic Global Economy – Complexity across scales in the Brazilian Food-Water-Energy Nexus

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Team: BRIDGE

- J-F Mercure, Heleen de Coninck — Radboud University — Netherlands
- Jorge Vinuales, Pablo Salas — CEENRG Cambridge Centre for Enviroment, Energy and Natural Resource Governance — UK
- Baltazar Guerra, Rafael Faraco — UNISUL Universidade do Sul de Santa Catarina — Brazil
- Neil Edwards — The Open University — UK
- Hector Pollitt — cambridge econometrics — UK

CEENRG
Cambridge Centre for Enviroment, Energy and Natural Resource Governance

bridge PROJETO

Team: BRIDGE

Biophysical modelling, Climate change

The Open University

(Lead: Neil Edwards)

Land-use, energy, diffusion of technology, emissions

Radboud University

(Lead: J-F Mercure)

Macroeconomics

cambridge econometrics

(Lead: Hector Pollitt)

WP2 Quantitative modelling

bridge PROJETO

(Lead: Jorge Vinuales)

CEENRG Cambridge Centre for Enviroment, Energy and Natural Resource Governance

Environmental law, policy, policy engagement

Policy sphere

WP3 Policy Engagement

Pilot action projects, Dissemination, public engagement

(Lead: Baltazar Guerra)

UNISUL UNIVERSIDADE DO SUL DE SANTA CATARINA

WP4-5 Quantitative modelling

Linking UK-Brazil technology transfer offices

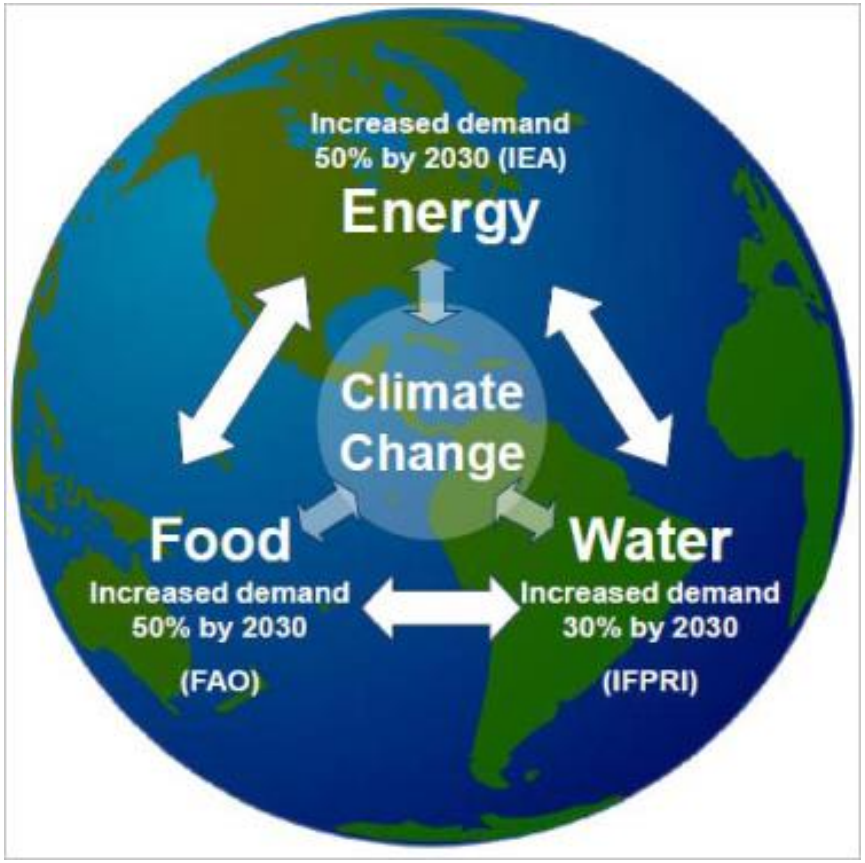
CEENRG Cambridge Centre for Enviroment, Energy and Natural Resource Governance

(Lead: Pablo Salas)

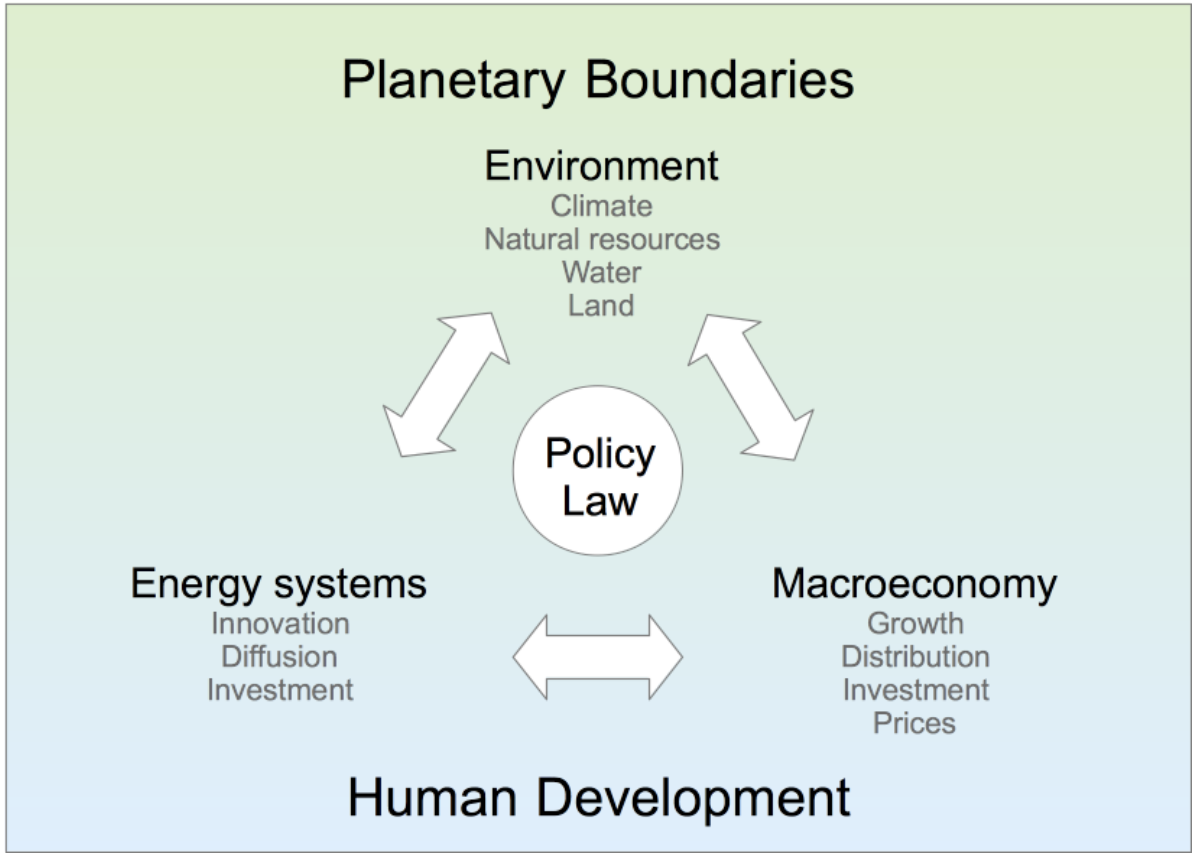
WPX Technology transfer

What is the Food-Water-Energy Nexus?

Sir John Beddington's 'Perfect Storm':



Global Energy-Economy-Environment system



Brazil IS the Food-Water-Energy Nexus

Nexus drivers are both domestic and international:

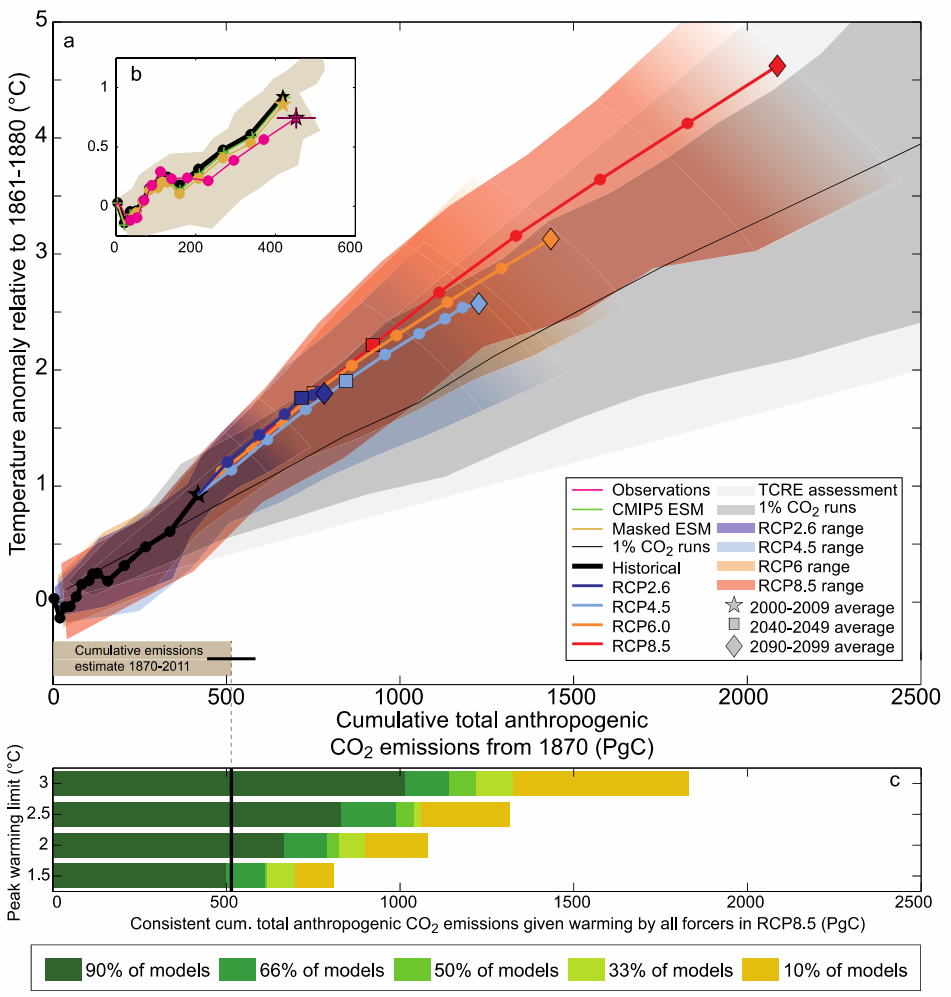
- International trade transfers problems across borders
- The planet is a global common

Brazil is representative of the World's Nexus

- Brazil will show first symptoms of global Nexus disturbance
- Huge governance and stewardship challenges to address

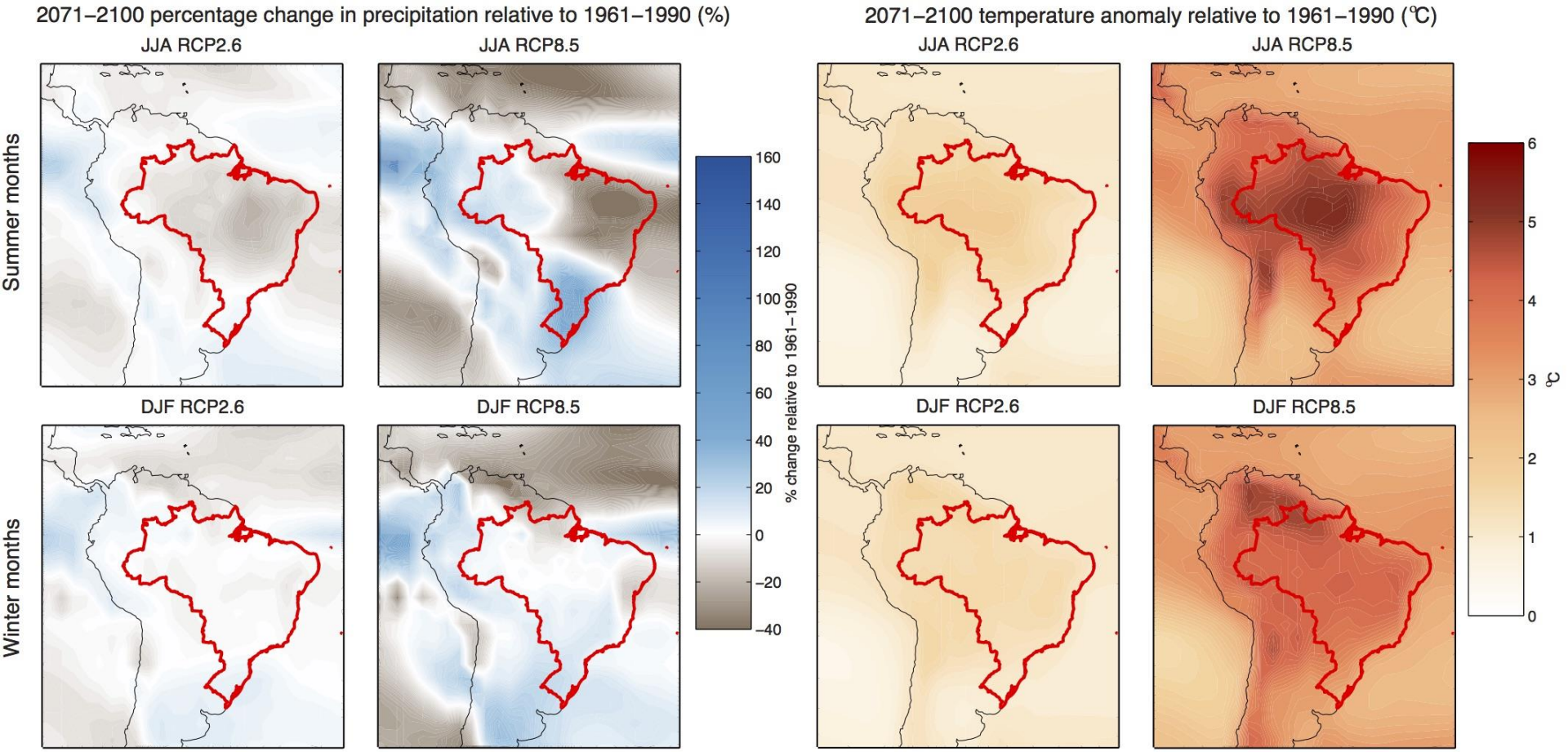
Mercure, Guerra, Salas, Faraco, Pollitt, Edwards & Vinuales, BRIDGE proposal, 2015

Current knowledge on emissions and climate change



Source: IPCC AR5, “Summary for Policymakers”, 2014.

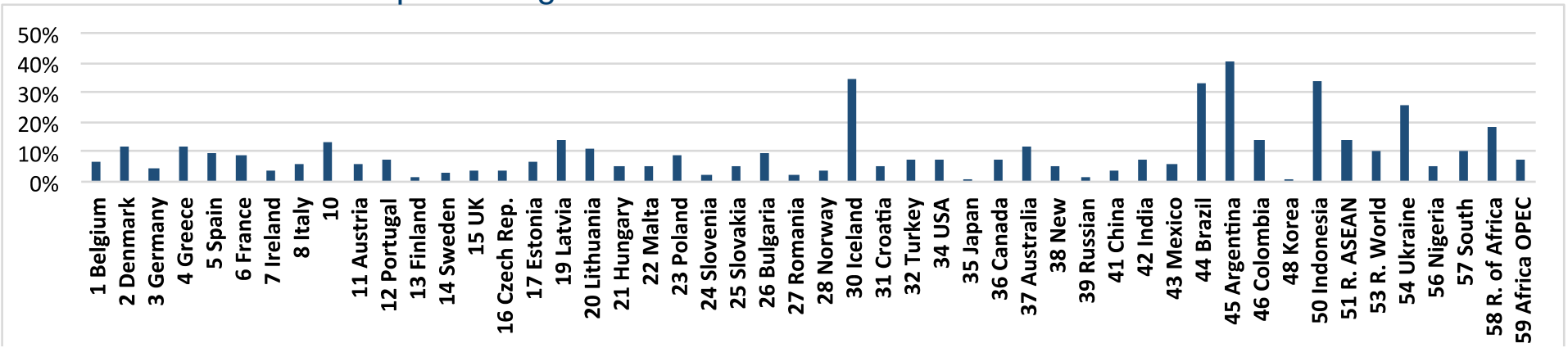
Possible future climate anomalies in Brazil



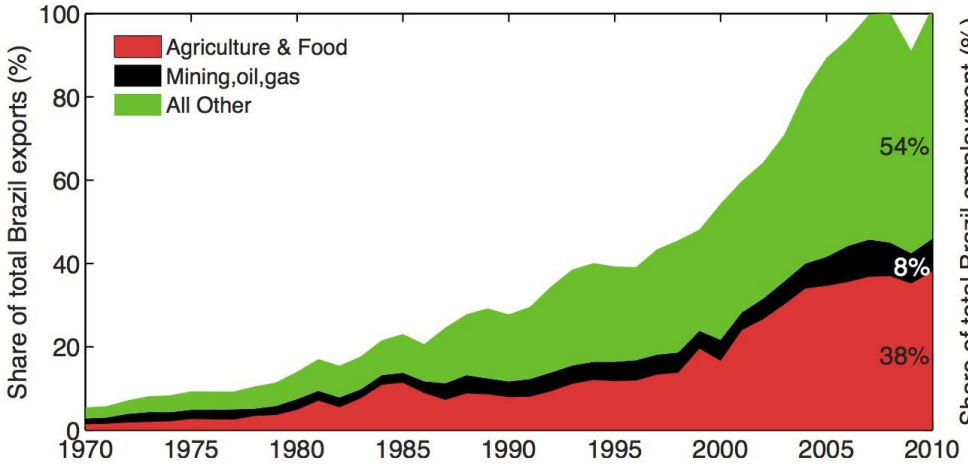
Source: CMIP5 climate data

Agriculture and food in the Brazilian economy

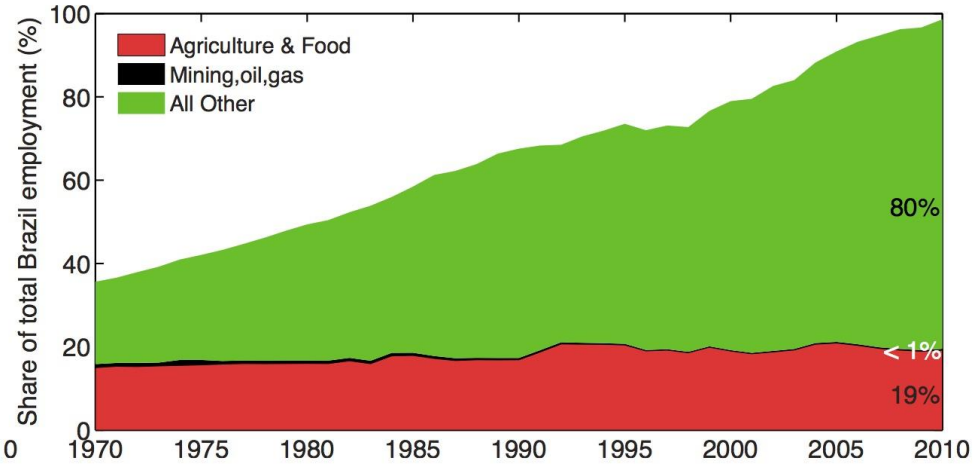
Shares of national export for agriculture and food



Agriculture-food exports for Brazil



Agriculture-food employment for Brazil



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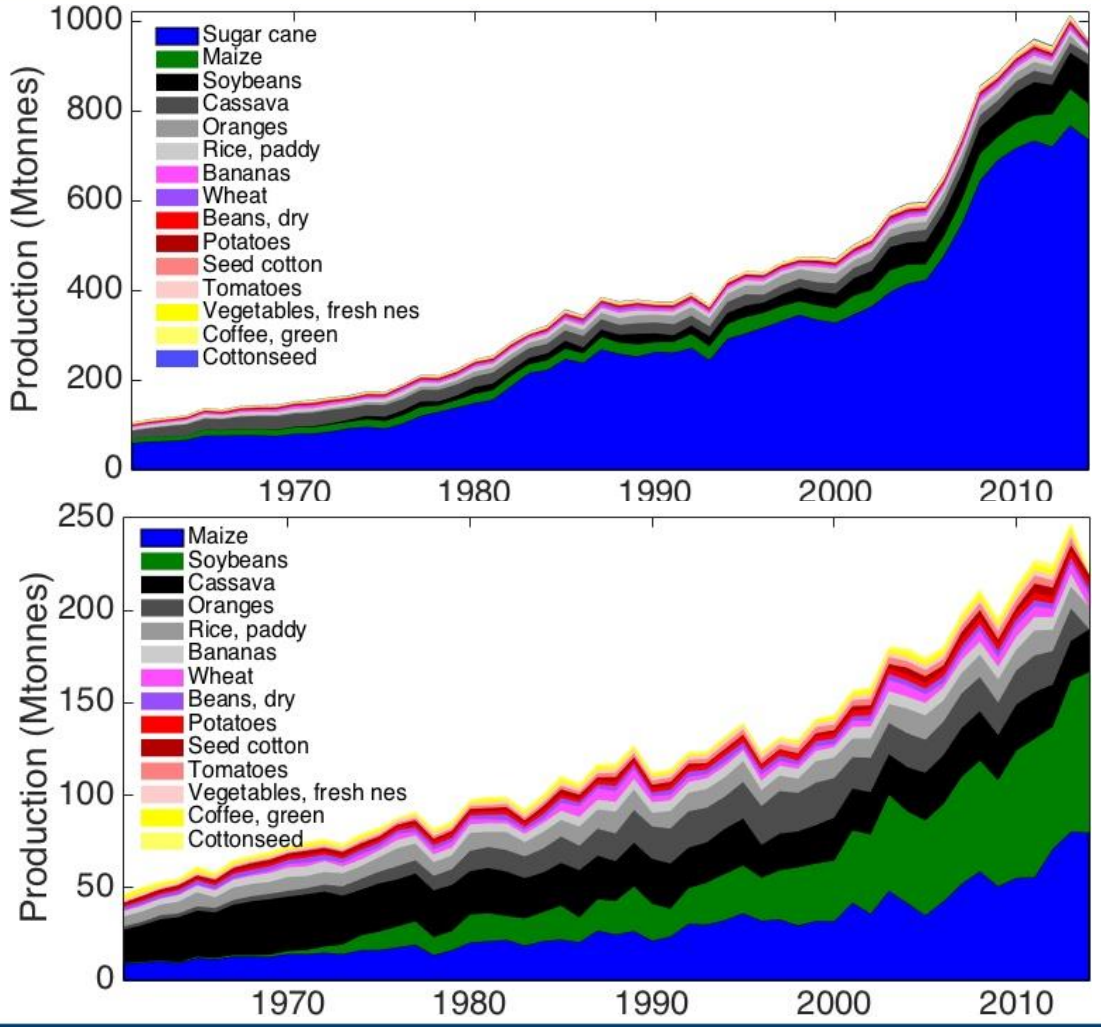
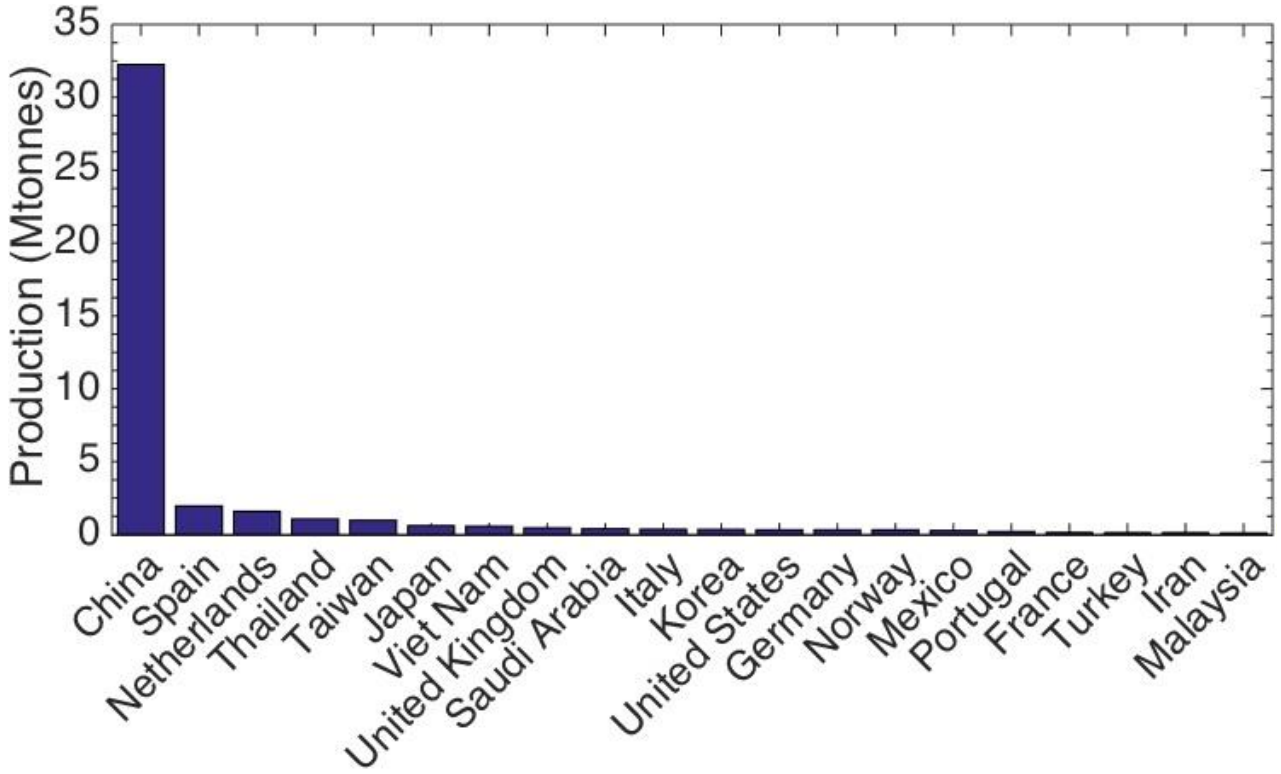
Source: Eurostat, OECD, national statistics, Asian Development Bank, UN prodcom

Example: Brazil's food commodity production



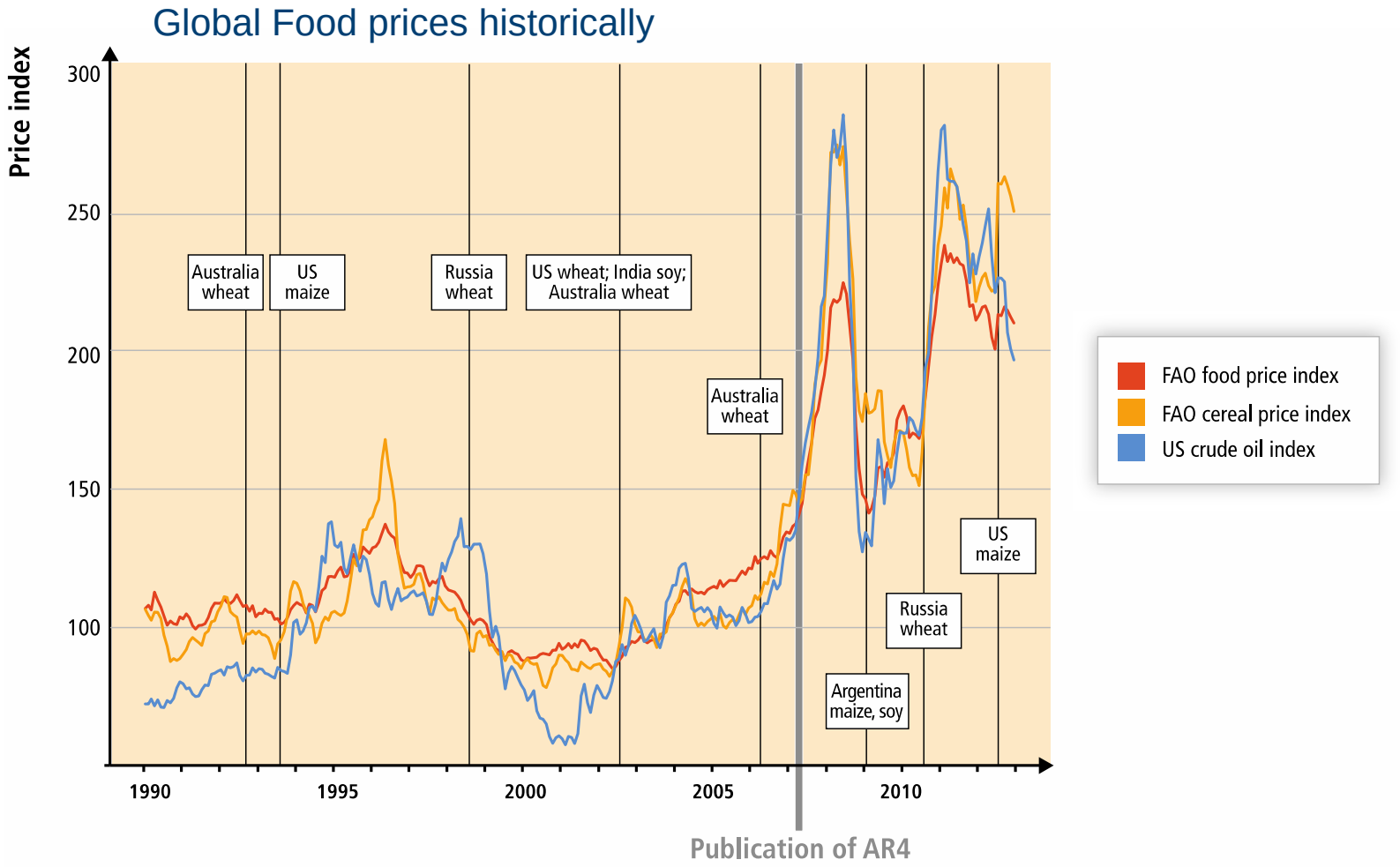
Data: FAO Stat 2016

Example International trade of Brazilian soybeans



Data: FAO Stat 2016

Food and energy prices: global food security



Source: IPCC 2014 WGII

Complex interactions in human-environment systems

The Energy-Water-Food Nexus in Brazil is truly a complex nexus:

IOP Publishing — Environmental Research Letters
Environ. Res. Lett. **6** (2011) 024010 (7pp) — doi:10.1088/1748-9326/6/2/024010

Statistical confirmation of indirect land use change in the Brazilian Amazon

Eugenio Y Arima[1,4], Peter Richards[2], Robert Walker[2] and Marcellus M Caldas[3]

Can biofuels be a solution to climate change? The implications of land use change-related emissions for policy

Madhu Khanna[1,*], Christine L. Crago[2] and Mairi Black[3]

Cropland expansion changes deforestation dynamics in the southern Brazilian Amazon

Douglas C. Morton*, Ruth S. DeFries*†‡, Yosio E. Shimabukuro§, Liana O. Anderson§¶, Egidio Arai§, Fernando del Bon Espirito-Santo‖, Ramon Freitas§, and Jeff Morisette**

*Department of Geography, 2181 LeFrak Hall, University of Maryland, College Park, MD 20742; †Earth System Science Interdisciplinary Center, University of Maryland, 2207 Computer and Space Sciences Building, College Park, MD 20742; §Divisão de Sensoriamento Remoto, Instituto Nacional de Pesquisas Espaciais (INPE), Av. dos Astronautas, 1758 Jardim da Granja, São José dos Campos, SP 12227-010, Brazil; ¶Oxford University Centre for the Environment, University of Oxford, South Parks Road, Oxford OX1 3QY, United Kingdom; ‖Complex Systems Research Center, University of New Hampshire, Morse Hall, Durham, NH 03824; and **Goddard Space Flight Center, National Aeronautics and Space Administration, Mail Code 614.5, Greenbelt, MD 20771

Examples of questions we want to ask

- Can we model the effectiveness of FWE Nexus policies?
  - How well do we understand the complex system?
  - What are the impact of policies across sectors? (e.g. biofuels vs water)
  - Do policies and sectors interact with each other? (e.g. biofuels/water policies)
- Can we identify robust, feasible policies for nexus resilience?
  - The policy, legal and political system is complex, can we address it?
  - Are there lessons we can learn from political science?
- Can we help support knowledge creation and nexus innovation?
  - Can we create successful demonstration projects for existing technology?
  - Can we support the technology innovation system through cross-institutional networks
  - Does awareness raising help support effective policy-making?

The BRIDGE science approach: our flagship paper

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journal homepage: www.elsevier.com/locate/gloenvcha

Modelling complex systems of heterogeneous agents to better design sustainability transitions policy

Jean-Francois Mercure[a,b,*], Hector Pollitt[c], Andrea. M. Bassi[d], Jorge. E Viñuales[b], Neil R. Edwards[e]

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[b] Cambridge Centre for Environment, Energy and Natural Resource Governance (C-EENRG), University of Cambridge, 19 Silver Street, Cambridge CB3 1EP, UK
[c] Cambridge Econometrics Ltd., Covent Garden, Cambridge CB1 2HT, UK
[d] Knowledge Srl, 5, via Jean De Fernex, 21057 Olgiate Olona, VA, Italy
[e] Environment, Earth and Ecosystems, The Open University, Milton Keynes, UK

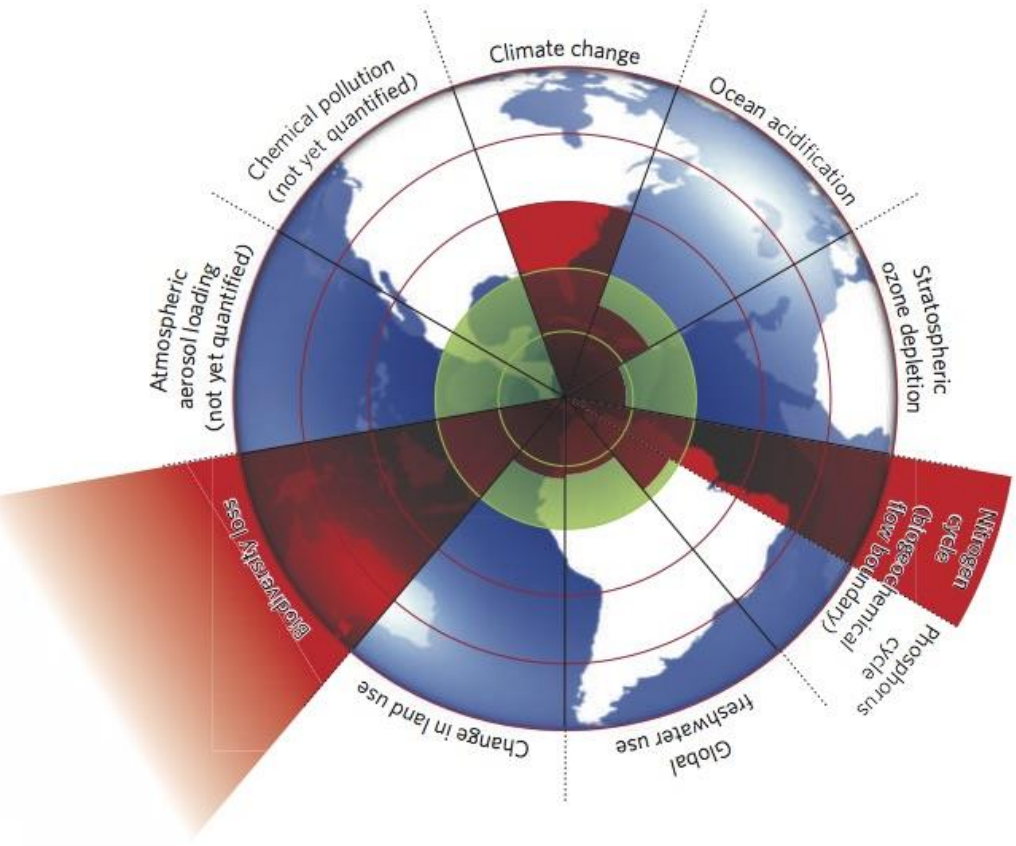
The BRIDGE science approach

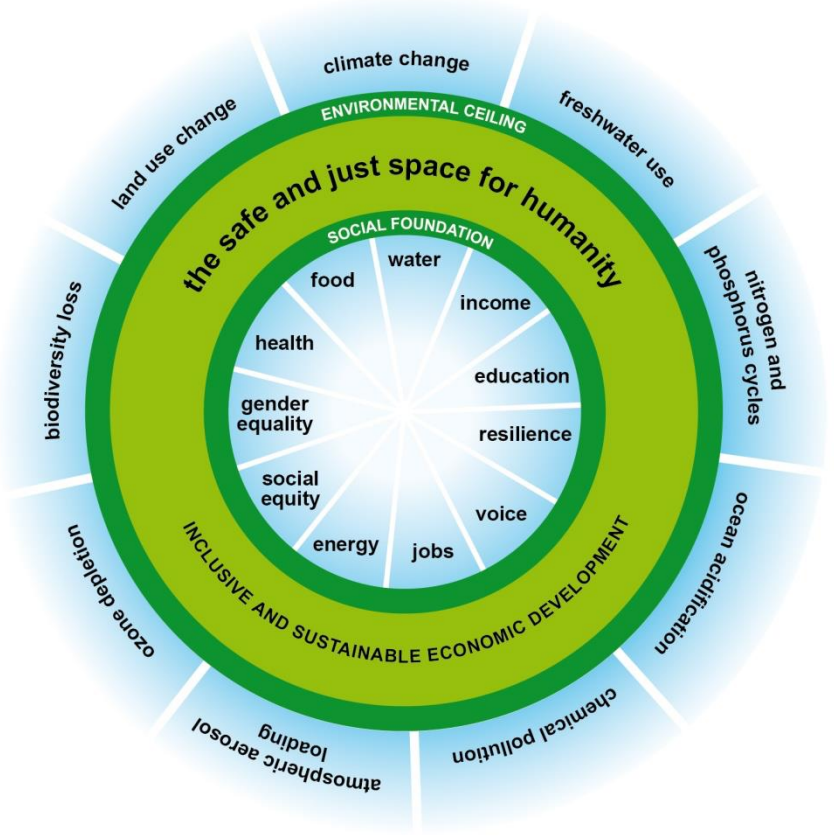
3 knowledge pillars of variations, uncertainty, diversity:

1. Behavioural & contextual diversity and complex dynamics
   E.g. Agents in the Nexus have different behaviour and motivations
2. Analysis uncertainty and complexity
   E.g. Models give path-dependent outcomes and projection uncertainty
3. High dimensionality of objectives
   E.g. Sustainable development indicators, scenario assessment

Mercure, Pollitt, Vinuales, Bassi & Edwards, Global Env. Change 2016

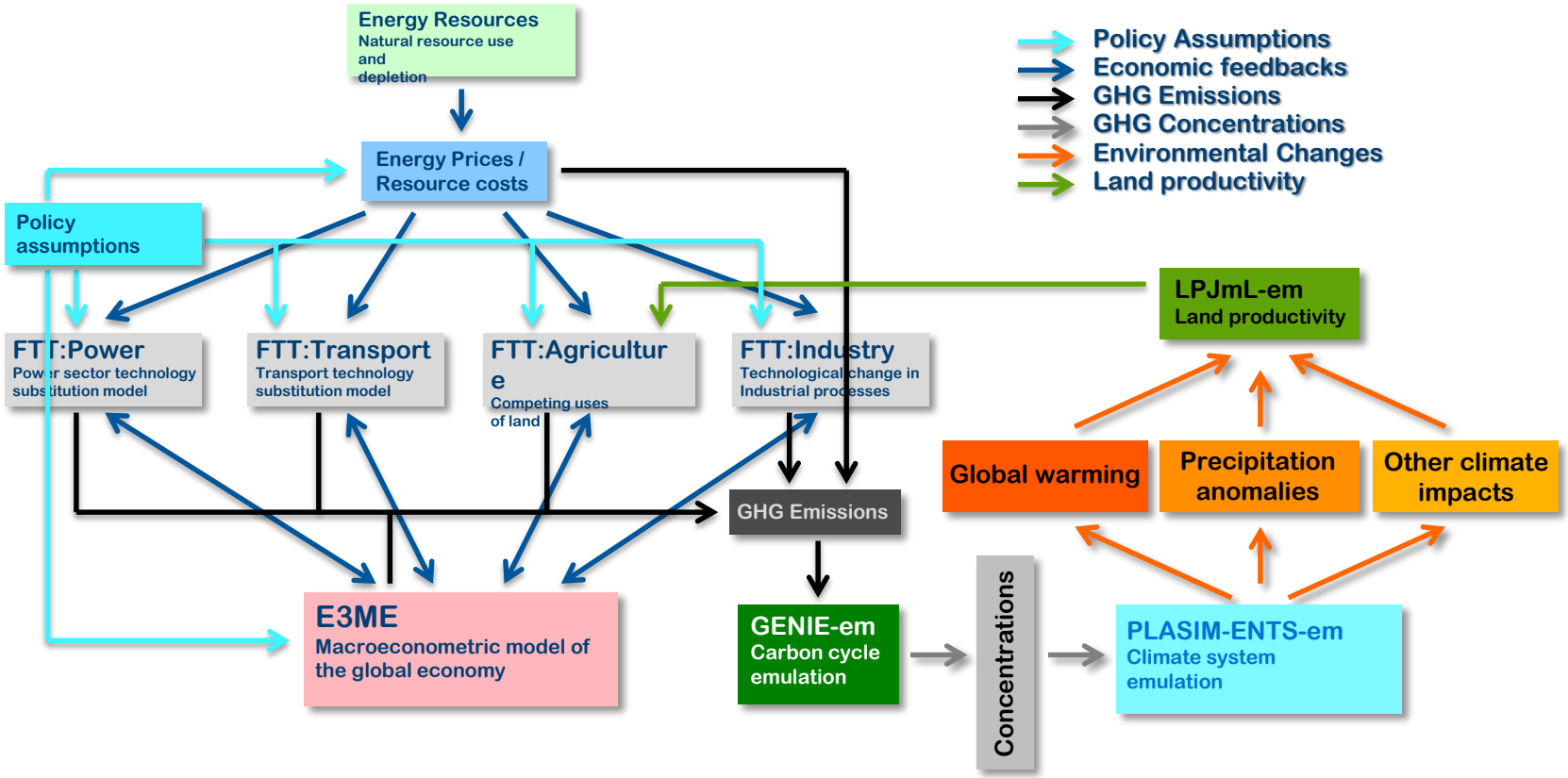
High dimensionality of objectives



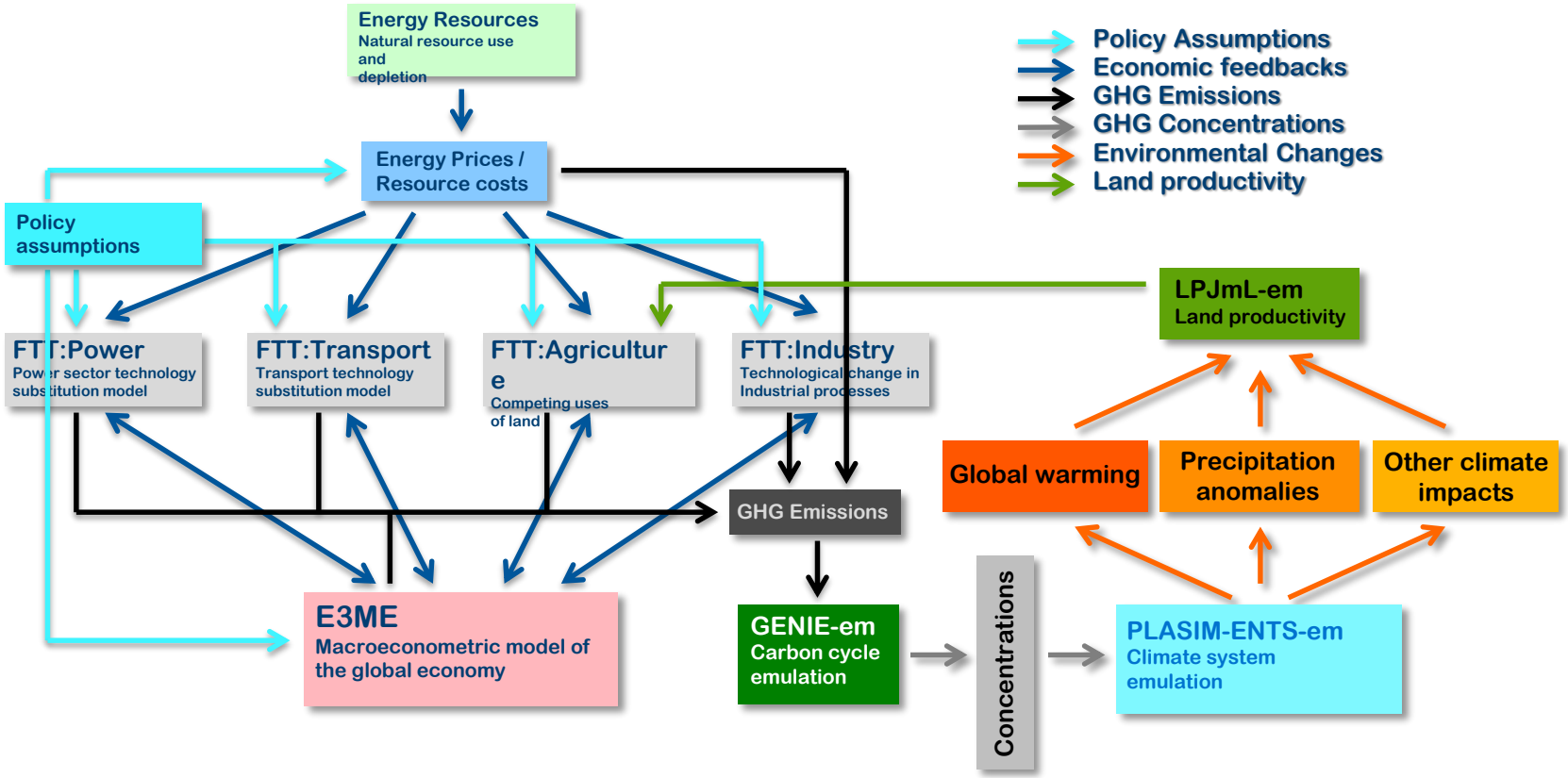


Rockström et al, Nature (2009), Steffen et al (2015)
Kate Raworth , OXFAM Discussion Paper, 2012

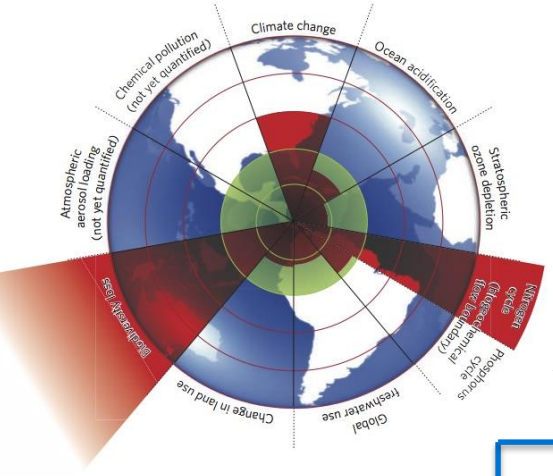
A new IAM: complexity meeting behavioural sciences

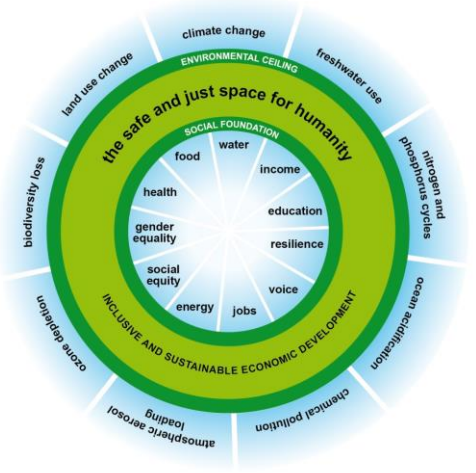


A new IAM: complexity meeting behavioural sciences



A science-policy BRIDGE





Science-policy dialogue

Multidismensional Outcomes, impacts, within uncertainty

Policy-Makers, Stakeholders

Policy experts International Lawyers

Modellers, scientists, economists, etc

Perspectives

Cross-sectoral Policy formulation

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Mercure, Pollitt, Vinuales, Bassi & Edwards, Global Env. Change 2016

WEF Nexus: a new paradigm of research

For more information, visit us at

http://www.ceenrg.landecon.cam.ac.uk

C-EENRG, Dept. Land Economy, Cambridge