Introduction + The big picture

Emanuele Campiglio[1,2,3]

Climate macroeconomics & finance 2024/25 - Lecture 1

[1]University of Bologna - Department of Economics (DSE)
[2]RFF-CMCC European Institute on Economics and the Environment (EIEE)
[3]LSE Grantham Research Institute

Welcome to the course!

- Climate macroeconomics and finance (B2120)
  - First module of integrated course 'Climate-related risks and commodity markets' for LM GrEnFin students
  - Also known as: Economics of Climate Change (75577) for LM Science of Climate students
- Course teachers:
  - Lecturer: Emanuele Campiglio (emanuele.campiglio@unibo.it)
  - TA: Hubert Massoni (hubert.massoni2@unibo.it)
- Course online presence
  - Virtuale (course material and submissions)
  - Panopto (recordings)
  - UniBo course page (description and timetable)

Aim of the course

- Main aim:
  - Understand climate-economy interactions
- Main research questions
  - Present/future economic impacts of climate change?
  - Macro-financial implications of low-carbon transition?
  - Optimal climate mitigation/adaption strategies?
- Functional objectives:
  - Expand knowledge on facts, empirical evidence, theories
  - Familiarise with current scientific/policy research (focus on climate/transition economic modelling)
  - Develop and present original critical analysis

Course overview

1. Introduction and the big picture
2. Climate change: drivers, impacts, scenarios
3. Climate mitigation and adaptation
4. Climate-related policies and commitments
5. Climate and transition macro-financial implications
6. Modelling climate-economy interactions
7. The DICE model and its discontents
8. Integrated assessment models big and small
9. Climate/transition macro-financial modelling: neoclassical
10. Climate/transition macro-financial modelling: non-neoclassical

Lecture structure

- Ten 3-hour lectures
  - Frontal lectures..
  - ..but questions/discussion welcome
  - Two halves: conceptual + modelling
- Ten 2-hour tutorial classes
  - First half: Solution to problem sets, in-depth dives from lecture, student-led discussion
  - Second half: Solution to problem sets, presentation of intermediate groupwork results
- Lecture/tutorial classes timing
  - Starts 5 mins past the hour (sharp)
  - 50-min blocks with 10-min breaks

Students' role

- Come to lecture/class
  - Lecture content key to pass the course
  - Recordings posted on Panopto
  - Be on time: we start 5 mins after, we end 5 mins to the hour
- Participate
  - Diversity of backgrounds, knowledge and interests
  - $\rightarrow$ Lots to learn from and teach to each other
  - Raise your hand for questions, comments, news..
- Stay focused
  - Laptops limited to note-taking
  - Mobile phones: please, no
- Behave ethically
  - No plagiarism; reference others' work properly
  - No free-riding in groupworks
  - AI tools (eg. ChatGPT): use with caution

Readings

Main readings

- Scientific and policy articles/reports
  - Key reading: IPCC Assessment Report 6
  - Other useful readings flagged on syllabus/slides/Virtuale
  - Readings available on Virtuale, through UniBo subscriptions or open access online
- No textbook. However, useful related textbooks
  - Economides, G., Papandreou, A., Sartzetakis, E. and Xepapadeas A. (2018) 'The economics of climate change', Bank of Greece (freely available at this link)
  - Tol, R. (2019) 'Climate Economics', 2nd edition, Edward Elgar Publishing (teaching material available at this link)
  - Keohane, N.O., and Olmstead, S.M. (2016) 'Markets and the Environment', 3rd edition, Island Press

Key reading resource: IPCC AR6

- UN Intergovernmental Panel on Climate Change (IPCC)
  - Aim: assess state of the knowledge on climate change, its impact and societal response options
  - No original research
- Periodic Assessment Reports (AR)
  - First IPCC report in 1990
  - Latest: AR6 (2021-22): see Synthesis Report
- Three Working Groups:
  - WGI: Physical science of climate system and climate change
  - WGII: Climate impacts, vulnerability, adaptation options
  - WGIII: Climate mitigation options
- Each WG publishes
  - Summary for Policy-Makers (SPM)
  - Technical Summary (TS)
  - Full report (with focused chapters)

Stay at the frontier of research

- Functional aim of course
  - Make you able to read some of the frontier papers, ongoing research shaping international debate on the topic
  - Tool: read recent papers on key journals or from key authors/institutions
  - Tool: show some of research inner workings
- Research applications during course
  - Where possible, I will refer to some paper I'm currently working on
  - Ideally, you will be able to read and understand their main assumptions and messages by the end of the course
  - Food for thought for your future research

Where is climate macro/finance research published?

- Academic journals
  - Interdisciplinary journals: Nature/Science and sub-journals (eg. Nat. Clim. Change), PNAS, Glob.Environ.Change, Clim.Change, Clim.Policy,..
  - Field econ journals: JEEM, JAERE, EcolEc, EneEco, ERE, EDE, REE..
  - General econ journals: Some (not many) key papers in top econ/finance journals (AER, Ecta, JPE, RFS, etc.)
  - Field review journals: REEP, ARRE, ARER, WIREs CC
  - Generic review journals: JEL, JEP, JoES
- Gray literature (policy/technical reports, working papers..)
  - International institutions: World Bank, IMF, OECD, IEA, ..
  - Central banks: NGFS , BIS, ECB, ..
  - Research centres, think tanks, NGOs (e.g. LSE GRI, EIEE, RFF..)

Assessment

Assessment overview

- Course (module I) assessment methods
  - Participation (10%)
  - Problem sets (30%)
  - Groupwork (30%)
  - Exam (30%)
- Final grade scaling from 0 to 30
  - Lower than 18 $\rightarrow$ fail
  - Particularly excellent work $\rightarrow$ 'laude' (30L$\approx$33).
- Intermediate grading
  - Each assessment method assigns percentage points
  - Final 100-score translated into a 33-score (eg. 91*33/100$\approx$30)
- Overall grade for integrated course:
  - Unweighted average of the two modules

Problem sets (30%)

- Eight problem sets
  - 5 more empirical, 3 more modelling-based
- Timing
  - Each problem set will be given a week before tutorial class
  - Submission on Virtuale
  - Submission deadline: 23.59 of the day before tutorial
  - Problem sets will then be corrected during tutorial classes
  - Late submissions will not be accepted
- Submission/assessment is individual
  - Group-work is fine but free-riding is not
  - $\rightarrow$ Active participation required in tutorials
- Problem set 1 on the IPCC WGI Interactive Atlas available on Virtuale from 18 Sept and due 24 Sept by 23.59 (Tutorial 3 on 25 Sept)

Group-work (30%)

- Groups
  - Self-allocation via Virtuale
  - $\approx$3 members per group
  - Be smart in forming groups
- Topics
  - Each group will address a specific research-oriented topic
  - List of group-work topic suggestions (see next slide)..
  - .. but alternative bottom-up proposals possible
  - Group choice on Virtuale, closes Sunday 22 Sept. 23.59
  - Tutorial 2: topics discussion
- Tasks
  - Give presentation of intermediate results in tutorials (Tutorials 6-7)
  - Submit essay by 30 October 2024 via Virtuale (no word constraints)

Group-work topic suggestions

1. Role of expectations/beliefs in shaping low-carbon transition
2. Climate policy uncertainty and investment decisions
3. Firms production and adaptation to climate change
4. The low-carbon transition in laboratory experiment evidence
5. Finance for clean innovation: obstacles and policies
6. The non-market impacts of climate change
7. Production networks and carbon pricing
8. Fairness of transition cost distribution
9. Central bank communication on climate change
10. The political economy of green central banking

Written exam (30%)

- Exam structure (1.5 hour time)
  - First part: essay-style questions
  - Second part: modelling-based questions
- Exam preparation
  - Exam preparation slides on Virtuale
  - Last tutorial class
  - Mock exam also possible
- Exam date
  - 7 November 2024, 10.00am
- Full exam alternative
  - Partial Module I exam is compulsory
  - If unsatisfied with grade $\rightarrow$ full exam (strongly discouraged!)
  - Module I problem-set and group-work grades will remain valid

Introductions

A bit more about me

- Current affiliations
  - Associate Professor, UniBo Department of Economics (DSE)
  - Scientist, RFF-CMCC European Institute on Economics and the Environment (EIEE)
  - Visiting Fellow, London School of Economics and Political Science, Grantham Research Institute
- Previous work
  - Assistant prof. at WU Vienna: 2016-2020
  - Postdoc at LSE: 2012-2016
  - PhD in Economics in Pavia: 2008-2012
  - Researcher at New Economics Foundation: 2010-2012
  - MSc Intl. development & cooperation (Pavia: 2005-2007)
  - BSc Economics for intl. institutions (Bocconi: 2000-2005)

A bit more about my work

- Main research focus at the moment:
  - Dynamic links between low-carbon transitions and macro-financial dynamics
  - Policies and institutions for a rapid and smooth decarbonisation
- Main thread: SMOOTH project
  - ERC Starting Grant (2020-25)
  - University of Bologna and European Institute on Economics and the Environment
  - 'Sustainable finance for a smooth low-carbon transition'
  - Link to project website
- Personal research profiles:
  - Personal website
  - Google Scholar
  - ResearchGate

A bit more about UniBo

- Department of Economics
  - Bologna Environmental Economics Group (BEEG). See research profiles
  - Several econ/finance people incorporating climate in their work (e.g. sustainable finance econometricians)
  - Host of the EAERE2022 conference!
  - Teaching: RESD Master programme; other Bologna-based courses (e.g. Environmental Economics and Policy)
- Lots of other climate research at/around UniBo
  - STAT $\rightarrow$ GrEnFin master programme!
  - AlmaClimate interdepartmental centre
  - UniBo research project by SDG
  - Bologna Business School: Initiative for Sustainable Society and Business
  - Euro-Mediterranean Centre on Climate Change (CMCC)
- Strong advice
  - Go explore, meet faculty, attend events

The BLESS laboratory

- UniBo home to world-class behavioural/experimental group
  - BLESS — Bologna Laboratory for Experiments in Social Science in Via Ranzani 14
  - Research staff at DSE
- Opportunities for engagement
  - Participate to experiments! $\rightarrow$ Monetary payments
  - Research assistant opportunities

The big picture

Overall object of study

- We will study the interaction between two main 'systems'
  - The climate system
  - The economic system
- Climate system
  - Dynamic planetary system connecting atmosphere, water, ice, land and ecosystems $\rightarrow$ Wider Earth system
  - Existed and evolved even without humans
  - Is climate system changing very rapidly? Yes.
  - Is this change driven by humans? Yes, mostly
- 'Climate'
  - IPCC AR6 definition: Statistical description in terms of mean and variability of relevant quantities over period of time (WMO: 30 years). In wider sense: state of the climate system.

Climatic variables of interest

- Temperature
  - Key variable: mean global temperature
  - Observe change w.r.t. a baseline (e.g. 'pre-industrial levels')
  - Maximum/minimum temperatures
  - Δ Temperature $\rightarrow$ short/long-term feedback effects (e.g. ice melting + ocean warming $\rightarrow$ sea level rise (SLR) for centuries)
- Concentration of greenhouse gases (GHGs)
  - Key GHGs: CO2, CH4, N2O
  - Atmospheric GHGs affect Earth's energy balance $\rightarrow$ warming
- Precipitations and humidity
  - Water dynamics: rain, rivers, glaciers
  - Precondition for life, health, agriculture, ecosystems
  - Extreme events: droughts, floods, cyclones
- Oceans
  - Temperature, sea ice concentration, SLR, acidity

How do we study climate?

- Paleoclimatology
  - Tree rings, ice drilling (up to 800ka), marine sediments (up to 100Ma), geomorphology
  - Paleoclimate Modelling Intercomparison Project (PMIP)
- More recently: Instrumental observation
  - Surface stations, weather balloons, satellites..
  - Temperature, GHG concentration, precipitations, sea
- Dynamic models
  - Investigate future scenarios, replicate the past to explain it
  - Several families/generations of climate modelling approaches
  - Strategy: address same questions across models
  - $\rightarrow$ Reference scenarios: RCPs, SSPs, etc.
  - Coupled Model Intercomparison Project (CMIP)

Evidence on climate change

- Key IPCC AR6 conclusions
  - Recent decades: rapid acceleration in climate system changes
  - Unprecedented increase in temperature (1.09°C wrt 1850-1900)
  - Other changes: sea level rise, increase in extreme events, etc.
  - $+$ other Earth system changes ('planetary boundaries')
  - $\rightarrow$ Impacts on human systems
- Where could this lead us?
  - Deep uncertainty about the future
  - Several socio-economic and policy scenarios possible
  - Plus model uncertainty
  - But general scientific consensus: unmitigated climate change might be negative/catastrophic for human societies
  - Current policy consensus: keep temperature below 1.5-2°C

Why is this happening?

- Anthropogenic drivers
  - Observed climate changes cannot be explained by natural phenomena (attribution studies)
  - GHG emissions $\rightarrow$ GHG atmospheric concentration rises $\rightarrow$ Temperature rise $\rightarrow$ Wider climate change
- Where do GHG come from?
  - CO2: combustion of fossil fuels (energy, transport, industry)
  - CH4: livestock and rice production; gas leaks; landfills
  - N2O: nitrogen fertilizer use
- Strong increase in GHG emissions
  - Clean technological progress, but..
  - ..overcome by expansion of population and income

Climate risks

- Climate risk:
  - The potential for adverse consequences for human/ ecological systems (on lives, livelihoods, health, economic/social/ cultural assets, ecosystems, etc.)
  - Cascading and compounding risks
- Climate-related risks can arise from
  - Potential impacts of climate change
  - Human responses to climate change
- Risk $\neq$ impact
  - Impact: the consequences of *realised* risks on natural and human systems. Can be adverse or beneficial.

Climate risk components

- Hazards
  - Potential occurrence of physical event/trend that may cause damages
- Exposure
  - Presence of people, ecosystems, infrastructure etc. in settings that could be adversely affected
- Vulnerability
  - The propensity or predisposition to be adversely affected. It includes sensitivity to harm and capacity to cope/adapt.

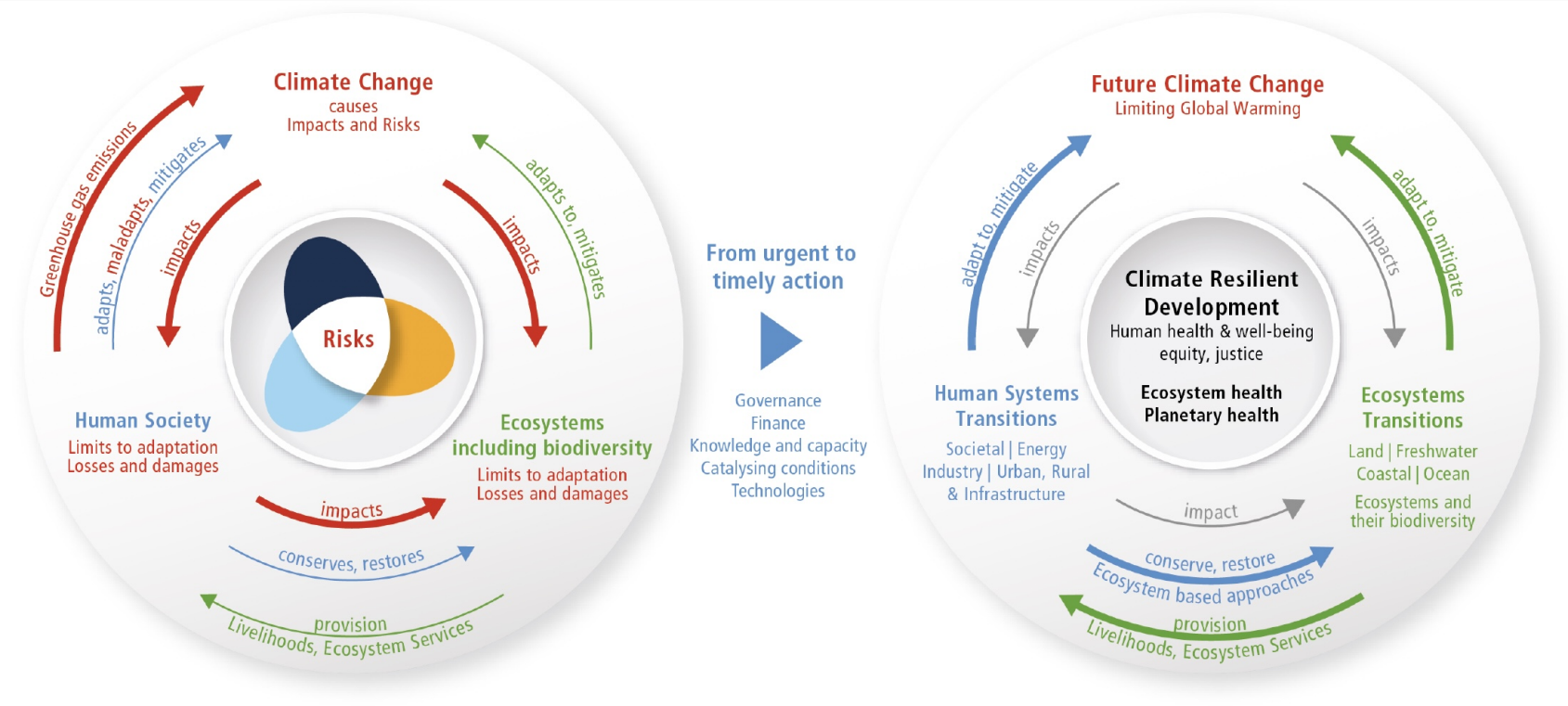
IPCC climate risk framing. Source: IPCC AR6 WGII, Ch.1 (2022)

How can we adapt to climate change?

- Adaptation
  - React to actual climate changes
  - e.g. how do we protect cities from sea leavel rise?
  - e.g. how do we protect humans/labour from excessive heat?
- Market adaptation strategies
  - Individual market reactions, e.g. install air conditioning
  - Relocation choices: migration, firm relocation
  - Productive links: changing international supply chains
- Adaptation policies
  - Large infrastructure spending, incentivising adaptation choices
  - Problem: technically challenging, expensive, possibly useless
  - e.g. is Miami doomed?
- In any case, still soon to give up $\rightarrow$ mitigation!

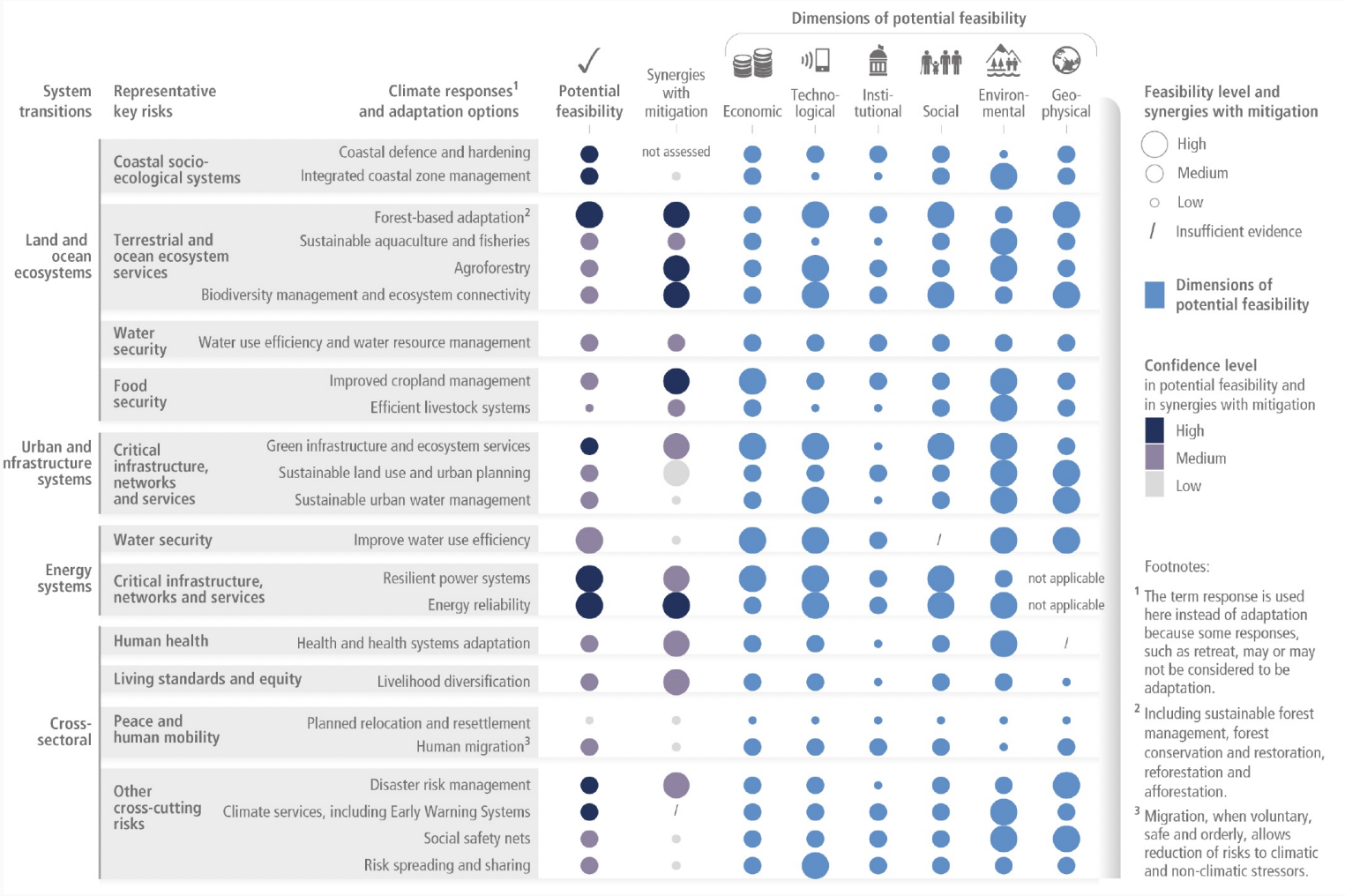
Adaptation and climate-resilient development

- Societies can adapt to climate change, and shape themselves to be resilient and able to transform



From climate risks to climate-resilient development. Source: IPCC AR6 WGII, SPM (2022)

Adaptation options



Feasibility of adaptation options and synergy with mitigation. Source: IPCC AR6 WGII, SPM (2022)

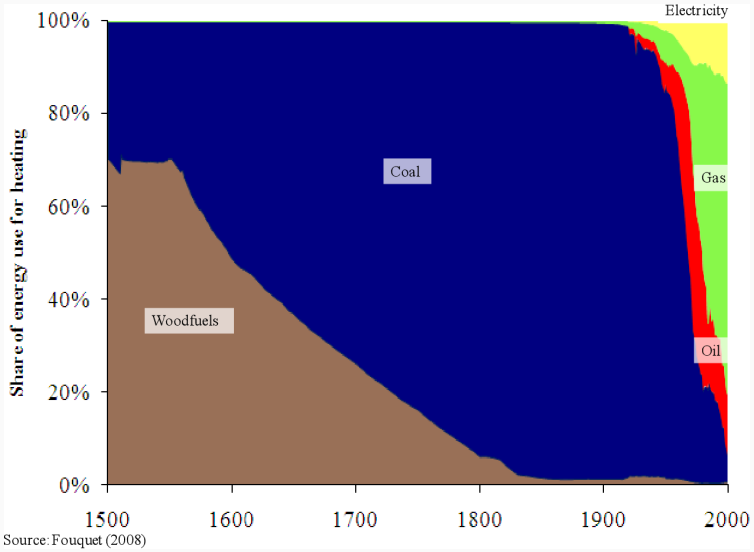
How can we mitigate climate change?

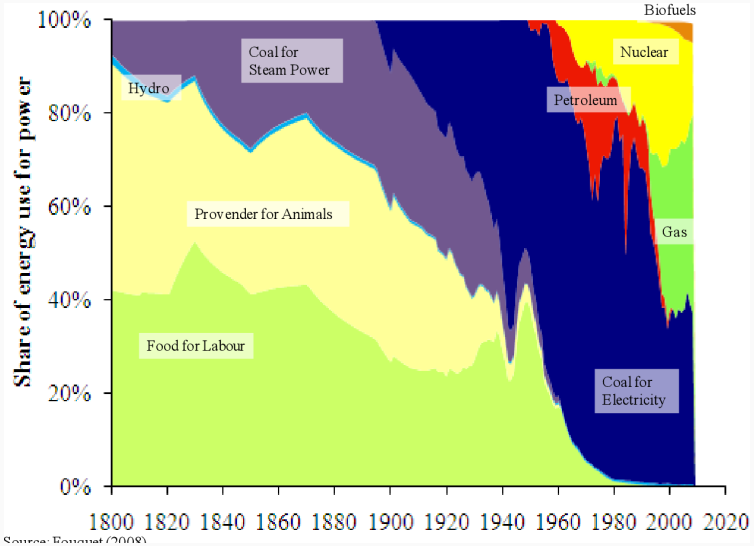
- Main goal now:
  - Stabilise GHG concentration in the atmosphere
- Two main ways to achieve this:
  - Stop emitting GHGs
  - Sequester GHGs currently in the atmosphere
- Sequestering GHGs
  - Natural (eg. forests) vs technological (eg. direct air capture)
  - Hard or still far from technological/economic viability
- So, main strategy: reduce GHG emissions
  - First, where do GHG emissions come from?
  - Mainly from combustion of carbon stored in fossil fuels
  - Huge issue: fossil fuels at the very basis of modern human civilization (industry, electricity, transport, etc)

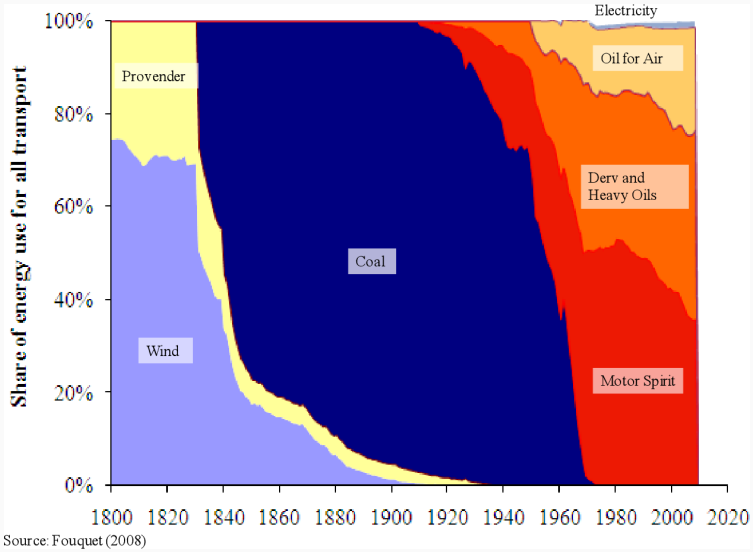
The big project: global decarbonisation

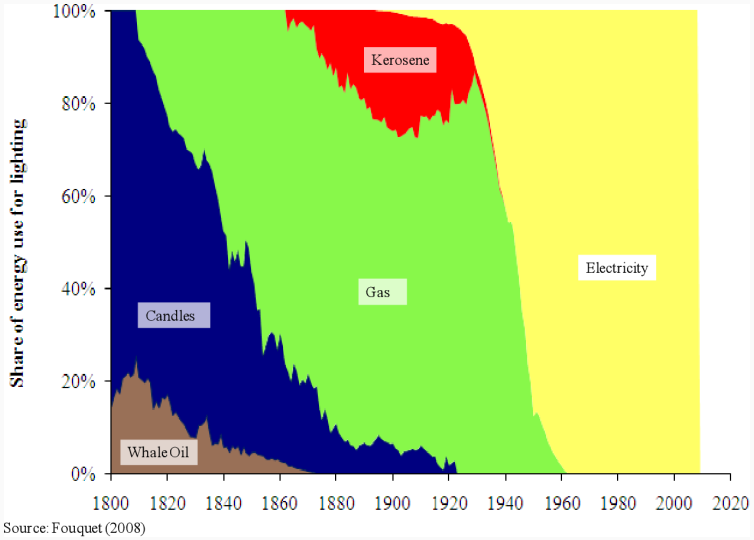
- Transition from carbon-based to carbon-free technologies
  - E.g. electricity productions from coal/gas to solar/wind
  - E.g. vehicle transport from oil to electricity
- Not the first technological transition
  - Many past technological transitions (e.g. lighting: gas→electricity; heating: coal→gas)
  - Generally beneficial for humans: some lose, some win, society progresses
- However, this transition might be different
  - Strong time constraint → more rapid transition
  - Not market-driven: no new more efficient/profitable emerging technology
  - Rather society-driven: painfully pushed via policies
  - Close to technological tipping point?

Examples of past technological shifts



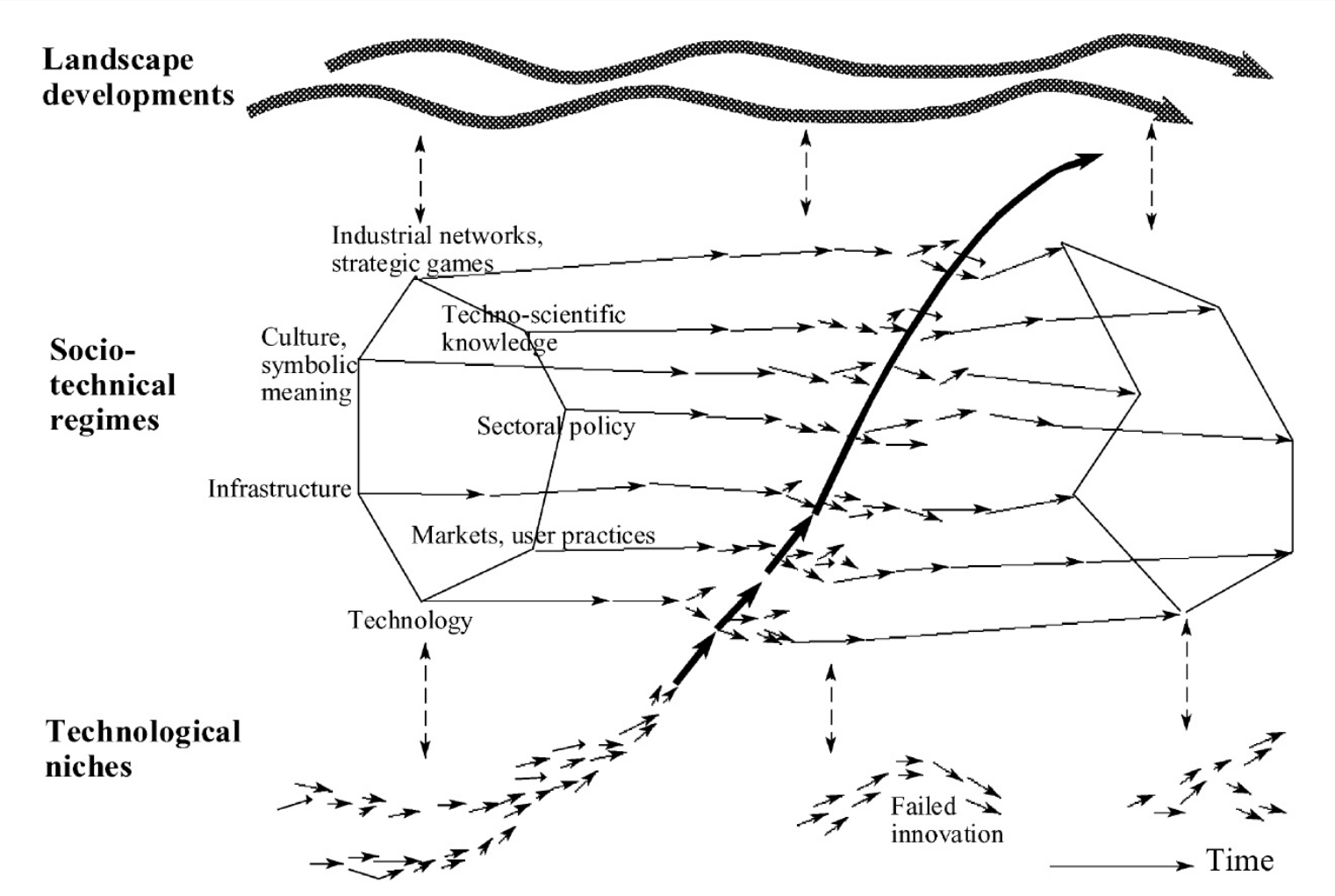






UK technonological transitions. Source: Fouquet (2008)

The emergence of niches re-configures the regime



Multi-level perspective of technological transitions (Geels 2002)

Do we have alternative technologies available?

- General status: tech still to be improved
  - Some exist, others possibly to come (CCS, fusion, SRM?)
  - Some compete with incumbents, some still not viable
  - Most advanced: Electricity generation from clean renewables
  - .. but: hard-to-abate industry: steel, cement, aluminium, chemicals, shipping, trucking, aviation..
- Key role of technological innovation in low-carbon transition
  - Innovation comes in different forms: market vs state
  - How do make sure it happens?
  - But also: without disrupting an already fragile socio-economic system? $\rightarrow$ transition risks

So, how do we make it happen?

- Push the transition via policies
  - Force/induce individuals to make desired choices
  - Affect all relevant economic choices: consumption, investment spending, financial investments etc.
  - Justified by economic theory when market failures present
- What kind of policies?
  - Command&control: introduce, monitor and enforce rules
  - Change monetary incentives: put a price on it
  - Nudge individuals/firms into desired directions (non-monetary)
- Focus on carbon pricing
  - Key policies: carbon taxes/markets, subsidies
  - Positive but spotty implementation so far

Focus on investment behaviour

- How do individuals/firms invest?
  - Investments in both new capital stock and R&D
  - In principle, cost-benefit analysis of investment options $\rightarrow$ choose the most profitable option, under existing constraints
  - However, future is uncertain! CBA based on expectations
- How do individuals/firms form expectations about the future?
  - Ideally, based on the best available info, but..
  - Incomplete information
  - Behavioural biases
  - And future still uncertain
- Other important choice realms
  - Individuals: consumption, investment of savings, housing
  - Non-financial firms: input providers
  - Financial firms: bank lending, portfolio management
  - State: lending, spending

Focus on financial system

- No finance $\rightarrow$ no transition
  - Investments almost always require external finance
  - Private vs public finance: both necessary
- Key financial system actors
  - Households: accumulate/invest savings; mortgages
  - Banks: lend to households/firms (credit creation)
  - Financial firms: invest money on behalf of clients
  - The ESG craze
- Financial system guardians
  - Central banks: delegation for price/financial stability (or more)
  - Financial supervisors: delegation for consumer protection
  - Nowadays increasingly active in climate-related matters

What could go wrong?

- Rapid transition comes with its risks
  - Several firms/sectors/countries still very dependent on fossils
  - Changing productive basis can be very costly: new investment expenditure + loss of assets
  - Firms defaulting $\rightarrow$ occupational and demand impacts
  - Financial sector also potentially affected, mainly via firms
- Transition risk research
  - Conceptual frameworks and qualitative research
  - Empirical analysis (data collection, exposure, econometrics)
  - Modelling: find optimal strategies, explore future scenarios
  - Policy and political economy research: who should do what?
- Societal aim:
  - Avoid generalised disruption (a 'Climate Minsky moment' or 'Green Swan')

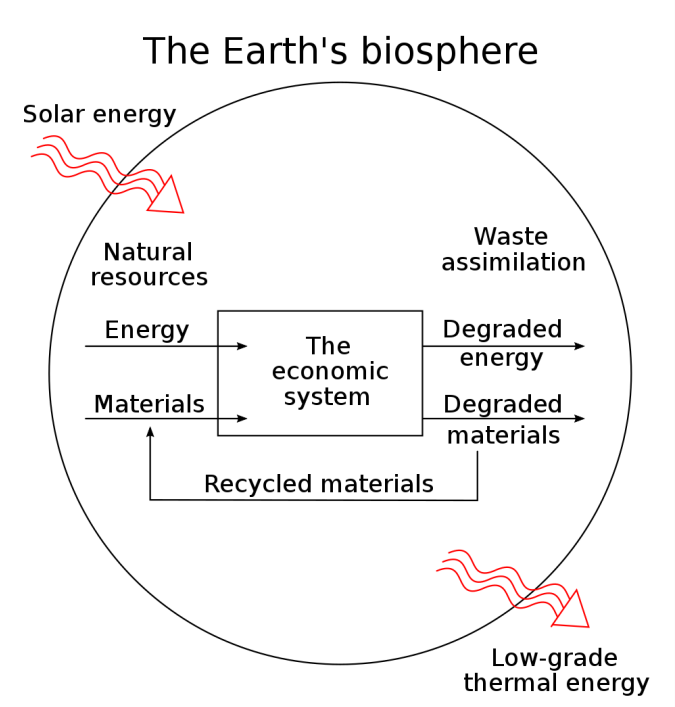
The big trade-off

- Two seemingly contrasting objectives
  - Limit chances of disruptive climate-driven impacts
  - Limit chances of prosperity loss due to technological transition
- Two extreme scenarios
  - BAU: we continue with fossil-based technologies $\rightarrow$ climate damages
  - Immediate transition: we stop using fossil fuels today $\rightarrow$ economic disruptions and asset stranding
- Window of opportunity
  - A rapid and smooth transition: is it possible?

How can economics help?

What the problem is

- Environmental constraints to human prosperity
- Environmental constraints:
  - Inputs: materials, energy services, prices
  - Sinks: waste, air pollution, climate change
- Human prosperity:
  - What are the objectives of human societies?
  - Income, satisfaction of needs, human development



Source: Wikimedia; Originally in Hall et al (1986)

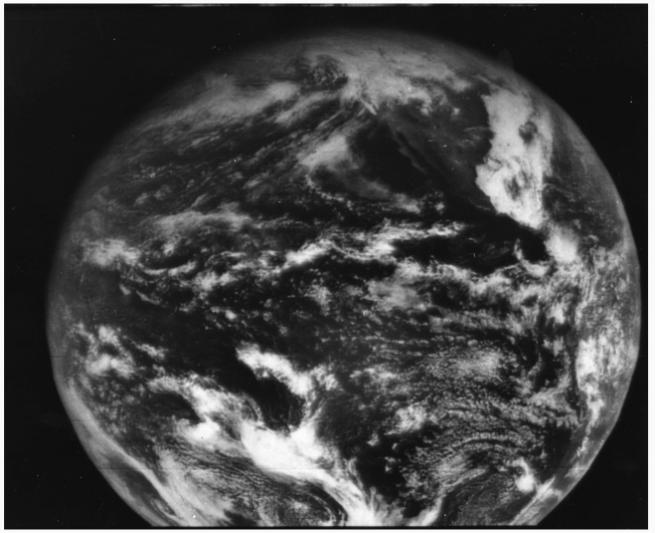
When was the problem posed? (I)

- Roots in classical political
  - T.R. Malthus (1798) 'An Essay on the principle of population'
  - J.S. Mill (1848) on a stationary state
  - Jevons (1865) on 'The coal question' and the Jevons paradox
  - A.C. Pigou (1920) on externalities and the Pigouvian taxes
  - H. Hotelling (1931) 'The Economics of Exhaustible Resources' and the Hotelling rule
- To go deeper:
  - Sandmo 2015 on REEP: 'The early history of environmental economics'

When was the problem posed? (II)

- From the 50s: increased environmental awareness
  - Great Smog of London in 1952 $\rightarrow$ UK Clean Air Act 1956
  - R. Carson (1962) 'The Silent Spring' on chemical pollution
  - First pictures of Earth from space $\rightarrow$ Moon landing in 1969
  - Oil crises in 1973 and 1979

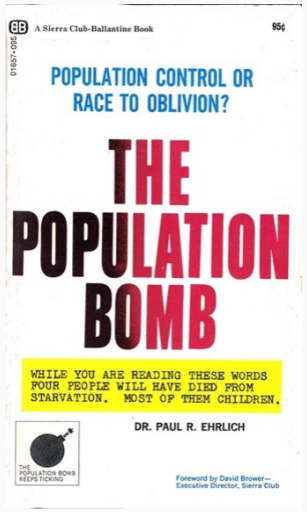
Great smog of London, 1952; Source: Britannica



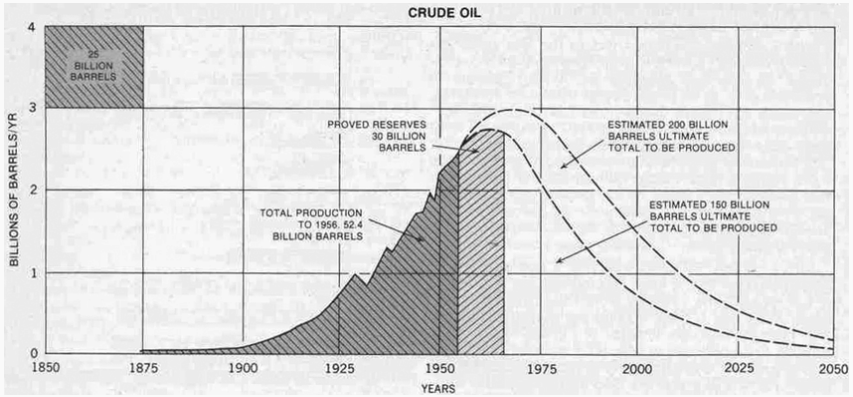
1966 image of Earth from ATS-1 satellite; Source: NESDIS

First, stronger focus on resources..

- At first, strong attention to resource scarcity
  - Pressure on limited resources by increasing population might lead to disruptions
  - 1968: The Population Bomb by Paul Ehrlich
  - 1972: Limits to Growth report
  - The Peak Oil debate



Source: Ehrlich (1968)

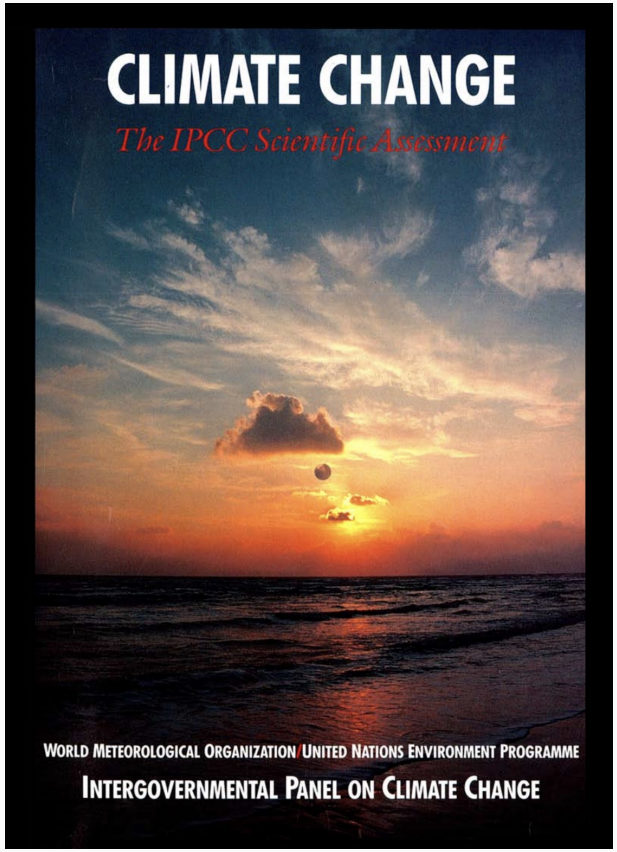


Source: Hubbert (1956)

.. then, stronger focus on sinks

- The Ozone layer scare
  - Montreal Protocol (1987)
- Environmental concerns
  - Oil spill and disasters
  - Loss of biodiversity
- Climate change
  - 1990: first IPCC report
  - $\rightarrow$ Main focus of this course

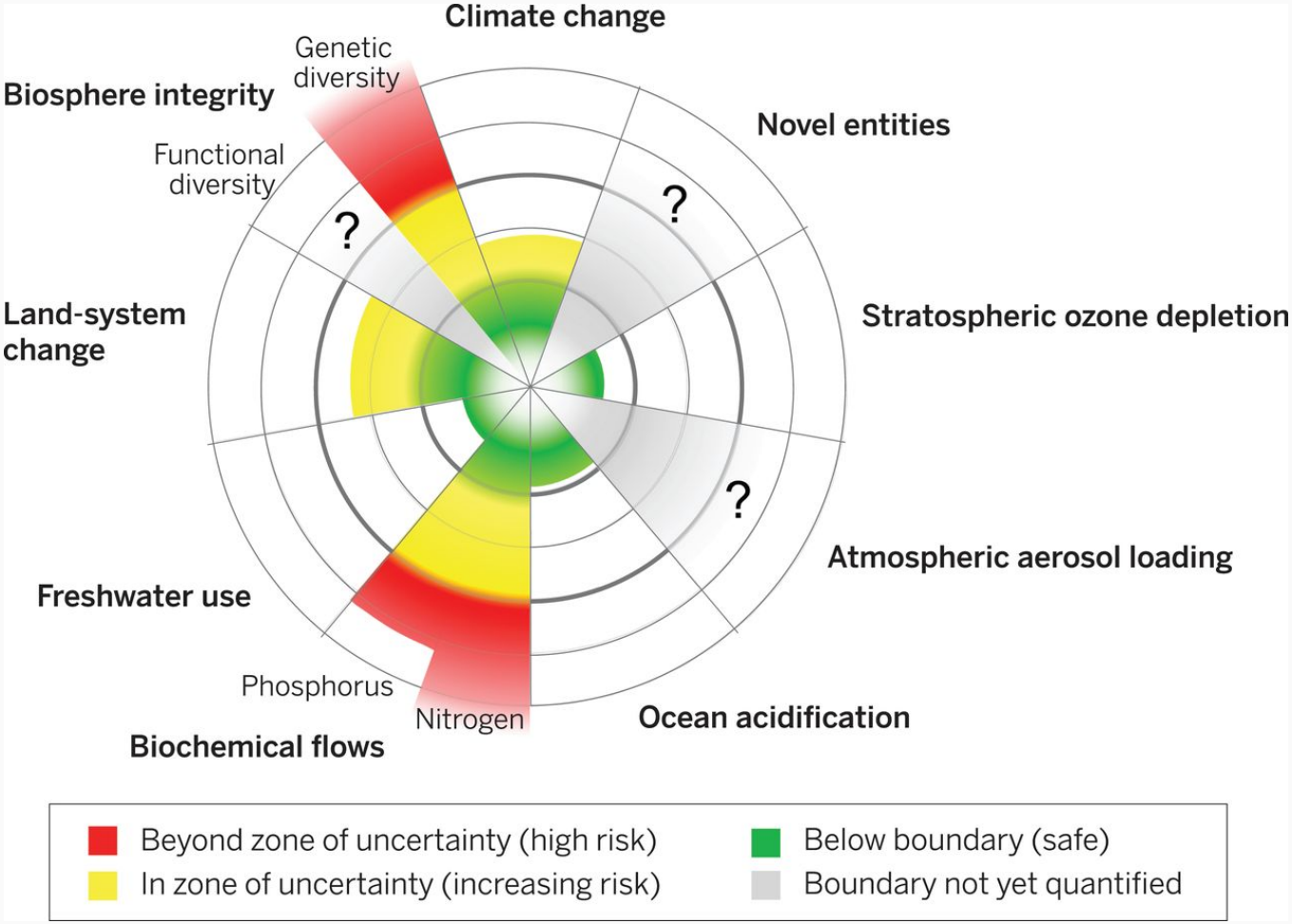
Exxon Valdez spill (1989) Source: NOAA



Source: IPCC 1990

Today's 'planetary boundaries'

- Several interlinked dimensions, mostly on the sink side



Source: Steffen et al. 2015

How were these issues addressed?

- Two large avenues of contributions
  - Weak sustainability $\rightarrow$ Environmental economics
  - Strong sustainability $\rightarrow$ Ecological economics
- Controversy born around substitutability of capital stocks
  - Capital approach to sustainable development: Economic development is sustainable if it does not decrease the *capacity* to provide at least the same level of welfare in the future
  - Man-made, human, natural and social capital stocks
  - To what extent can we substitute one for the other (e.g. deplete natural capital to build machines?)
  - Also, should we measure capital stocks in physical or monetary terms?

Weak sustainability

- High degree of substitutability: it's the overall capital stock that has to remain intact for development to be sustainable
- 'Hartwick rule': One type of capital can decrease (depreciation/degradation higher than investment/regeneration), if some other type of capital increases (Hartwick 1977, AER)
- Solow 1974 (link) : '(..) earlier generations are entitled to draw down the pool (optimally, of course!) so long as they add (optimally, of course!) to the stock of reproducible capital.'
- See also RES Symposium on the Economics of Exhaustible Resources

WS: let the markets work!

- When a resource becomes scarce, its price will rise
  - Demand is larger than supply $\rightarrow$ price increase
- The price increase will trigger a number of dynamics
  - Consumers will move to substitute goods and services
  - Firms will invest in expanding supply (e.g. offshore platforms)
  - Firms will invest in new technologies that can replace the scarce resource or make its use more efficient
  - As a result, growth can go on
- This seems to be confirmed by recent decades
  - Oil price spikes led to energy-saving technologies and expansion of supply
  - Reserve/production ratio of most exhaustible resources increased
  - Resource scarcity still important (geopolitics; materials for low-carbon transition)

Strong sustainability

- Low degree of substitutability
  - Critical forms of natural capital: non-substitutable life-supporting functions
  - Focus on physical terms
- More in general
  - Less confident in markets and technological fixes
  - Focus on finiteness and irreversibility of natural processes (including production!)
  - Critical of economic growth as a means per se $\rightarrow$ stationary state, degrowth
- Herman Daly reaction to Solow
  - '..Solow's recipe calls for making a cake with only the cook and his kitchen. We do not need flour, eggs, sugar, nor electricity or natural gas, nor even firewood. If we want a bigger cake, the cook simply stirs faster in a bigger bowl and cooks the empty bowl in a bigger oven that somehow heats itself.'

Environmental Economics

- Economists analysing environment-related problems:
  - P. Dasgupta, G. Heal, W. Nordhaus, J. Stiglitz, J. Hartwick, M. Weitzman..
  - Focus on markets, prices, technology, growth, substitutability, smoothness, efficiency
- Some research questions:
  - Optimal resource depletion plans
  - Economic value of environmental goods and services
  - Cost-benefit analysis; discounting
  - Externalities and optimal policies
- Main academic community:
  - AERE (US); EAERE (Europe)
  - EAERE2022 organised by UniBo! (Link)
- To go deeper
  - Pearce 2002 on AREE: 'An Intellectual History of Environmental Economics'

Ecological economics

- Economists, but also social and environmental scientists
  - Multi- and inter-disciplinary approach
  - Focus on finiteness, limits, scale, stationarity, irreversibility
- Some research questions:
  - How to go beyond GDP and growth
  - Environmental justice and conflicts
  - Changing the system: capitalism and eco-socialism
  - Material flow analysis
- Main academic community:
  - ISEE (intl.), ESEE (Europe)
- To go deeper
  - I. Ropke 2004-2005 on EcolEcon: 'The early history of modern ecological economics'; 'Trends in the development of ecological economics from the late 1980s to the early 2000s'

A fuzzy but relevant dichotomy

- Many overlaps in terms of questions and sometimes methods
  - ..but quite separate communities
  - Ecological economists very critical of neoclassical and environmental economists (but the journal Ecological Econonomics more diversified)
  - Environmental economists often don't even know ecological economics exist
  - + Other related communities, e.g. energy economists (IAEE)
- We will find this dichotomy again in modelling approaches
  - Integrated assessment modelling, CGE models, neoclassical macro/finance applied to climate
  - System dynamics, complexity models, stock-flow consistent models

Conclusions

Conclusions

- Challenging but interesting object of study
  - How do mitigate/adapt to climate change..
  - .. while ensuring human prosperity?
- An economist's perspective
  - Application to economics methods to the topics..
  - .. while keeping an eye on other disciplines (interdisciplinarity)
- Suggestions
  - Follow closely course advancement (attendance, problem sets)
  - Go beyond the course: research, internet, news
  - Ask yourself question, develop your understanding
- Next lecture
  - Climate change: drivers, impacts, scenarios