

15 years on from the Stern Review: the economics of climate change, innovation, and growth

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These slides are intended to have sufficiently detailed argument to be read independently of the lecture. Time constraints imply that some slides will be presented only briefly. References are provided at the end.

The narrative and analyses around growth and climate must change

- **Science has become more worrying while technology has become more promising.** Both of these should mean pressure to reduce annual global emissions substantially between 2006 and 2019. Instead, we saw a rise by nearly 20 per cent* – why?
- While many developed countries have slightly reduced their annual emissions over this period, many emerging market countries have increased their emissions.
- This has arisen in large measure from the **misconception** that climate action requires a **trade-off with economic development and growth**. Climate action involves a strategic choice for a new form of development, growth and poverty reduction: sustainable, resilient and inclusive.
- Many economic assessments fail to capture the full range of benefits, and **severely undervalue** the lives and livelihoods of today's **young people and future generations**.
- More recently economic decision-makers have started to recognise the **wider range of benefits from investments in the transition** to zero-carbon and climate-resilient development and growth. It includes not just avoided damage and losses from climate change but also increased efficiency and productivity, better health, stronger biodiversity and more dynamic and creative innovation. But **we must invest strongly** to get there and manage dislocation.

This is a special moment in history. The pathway to a sustainable, inclusive and resilient economy is the growth and development story of the 21st century.

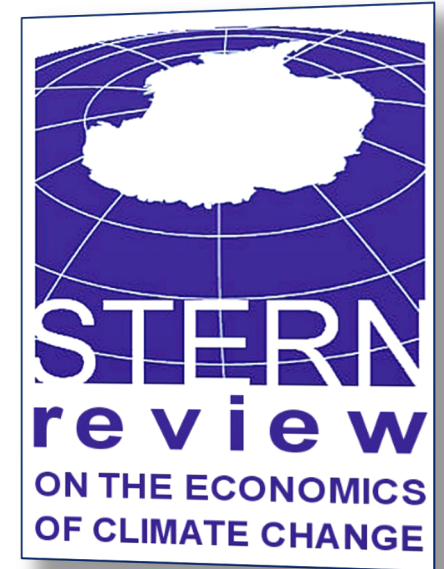
Structure

- **Looking back on the 15 years since the publication of the Stern Review**
- Looking forward: the 21st century growth story
- A time for change in economics
- COP26 and beyond

‘The Economics of Climate Change: The Stern Review’ was published in October 2006

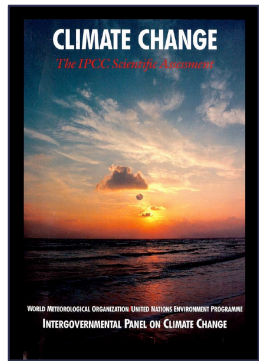
“The benefits of strong and early action far outweigh the economic costs of not acting.... So prompt and strong action is clearly warranted.”

“Climate change is the greatest market failure the world has ever seen, and it interacts with other market imperfections.... A range of options exists to cut emissions; strong, deliberate policy action is required to motivate their take-up.”

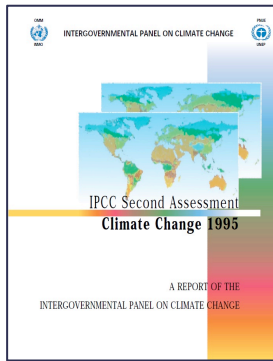


These core findings, which were compelling in 2006, are now still stronger.

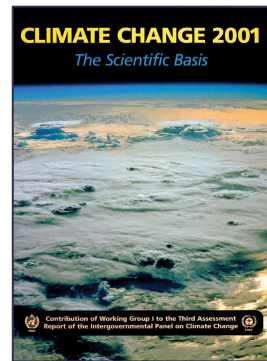
The science of climate change is looking ever more worrying



1990



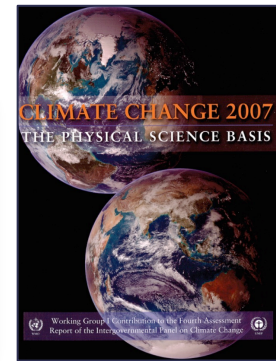
1995



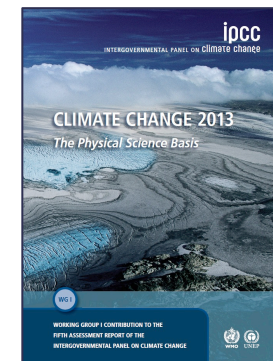
2001



2006



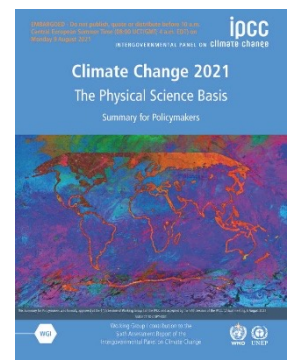
2007



2013



2018



2021

“There is **new and stronger evidence** that most of the warming observed over the last 50 years is attributable to human activities.”

“An increasing body of observations gives a collective picture of a **warming world and other changes** in the climate system.”

– Third IPCC Assessment Report, 2001

Stern Review
published

“It is **unequivocal** that human influence has warmed the atmosphere, ocean and land.”

“Human-induced climate change is **already affecting** many weather and **climate extremes** in every region across the globe.”

– Sixth IPCC Assessment Report, 2021

The Stern Review, based on IPCC AR3, *underestimated the risks*

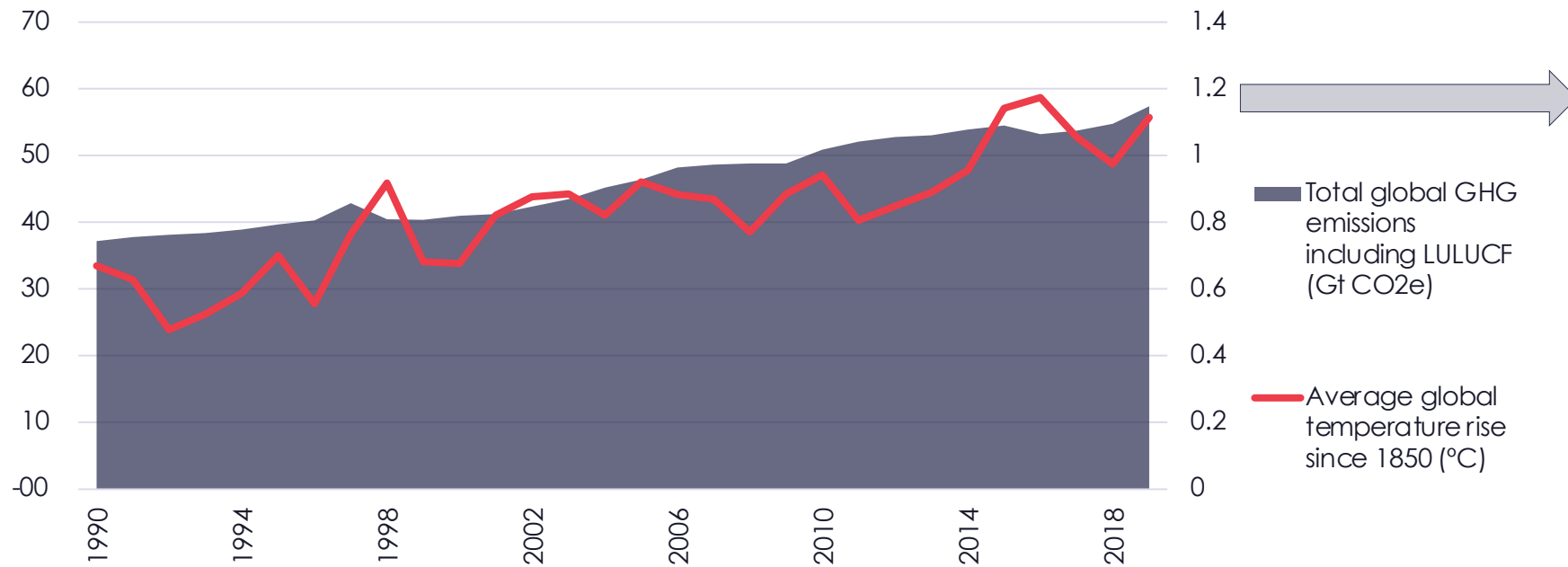
- Each IPCC report has looked more worrying than its predecessors.
- Effects coming through at **greater speed, scale and intensity** than anticipated.
- **Tipping points** increasingly concerning and thresholds are being passed or close to being passed (West Antarctic and Greenland ice sheets, Amazon and Boreal rainforests, Siberian permafrost...).

Our current civilisations are from the last 8-9000 years, after the move to grains and stable agriculture – the Holocene period, with fairly stable climate and temperature.

We are already on the edge of those temperatures at $\sim 1.1^{\circ}\text{C}$. Have not seen temperatures $>3^{\circ}\text{C}$ for 3 million years (when, e.g., sea levels were 10-20m higher). Even with strong mitigation, building adaptation and resilience will be crucial.

The Stern Review, contrary to being 'alarmist' (e.g. Tol & Yohe, 2006), underestimated the risks, the damage associated with temperature increases, and the probabilities of temperature increases.

Global GHG emissions are on the wrong track



The rising **stock** – **concentration of GHGs** in the atmosphere – **drives temperature rises.**

CO₂ in the atmosphere has risen to **around 410 ppm** in 2019...

...from **280 ppm** through 1000—1900 AD...

Parts per million of CO₂

In 2006:

Annual global GHG emissions including land use:
48.3 Gt CO₂e

Annual global fossil fuel CO₂ emissions:
31.1 Gt CO₂

Temperature above pre-industrial levels:
0.88°C

In 2019:

Annual global GHG emissions including land use:
57.4 Gt CO₂e

Annual global fossil fuel CO₂ emissions:
38.0 Gt CO₂

Temperature above pre-industrial levels (median):
1.12°C

NB: **Fossil fuel carbon dioxide emissions** are from the use of coal, oil and gas (combustion and industrial processes), the process of gas flaring and the manufacture of cement. **Energy-related carbon dioxide emissions** are from fuel combustion only. **Carbon dioxide-equivalent emissions** convert non-CO₂ gases into their carbon dioxide-equivalents. Fossil CO₂ figures are typically **around 2/3** of CO₂e figures.

Sources:

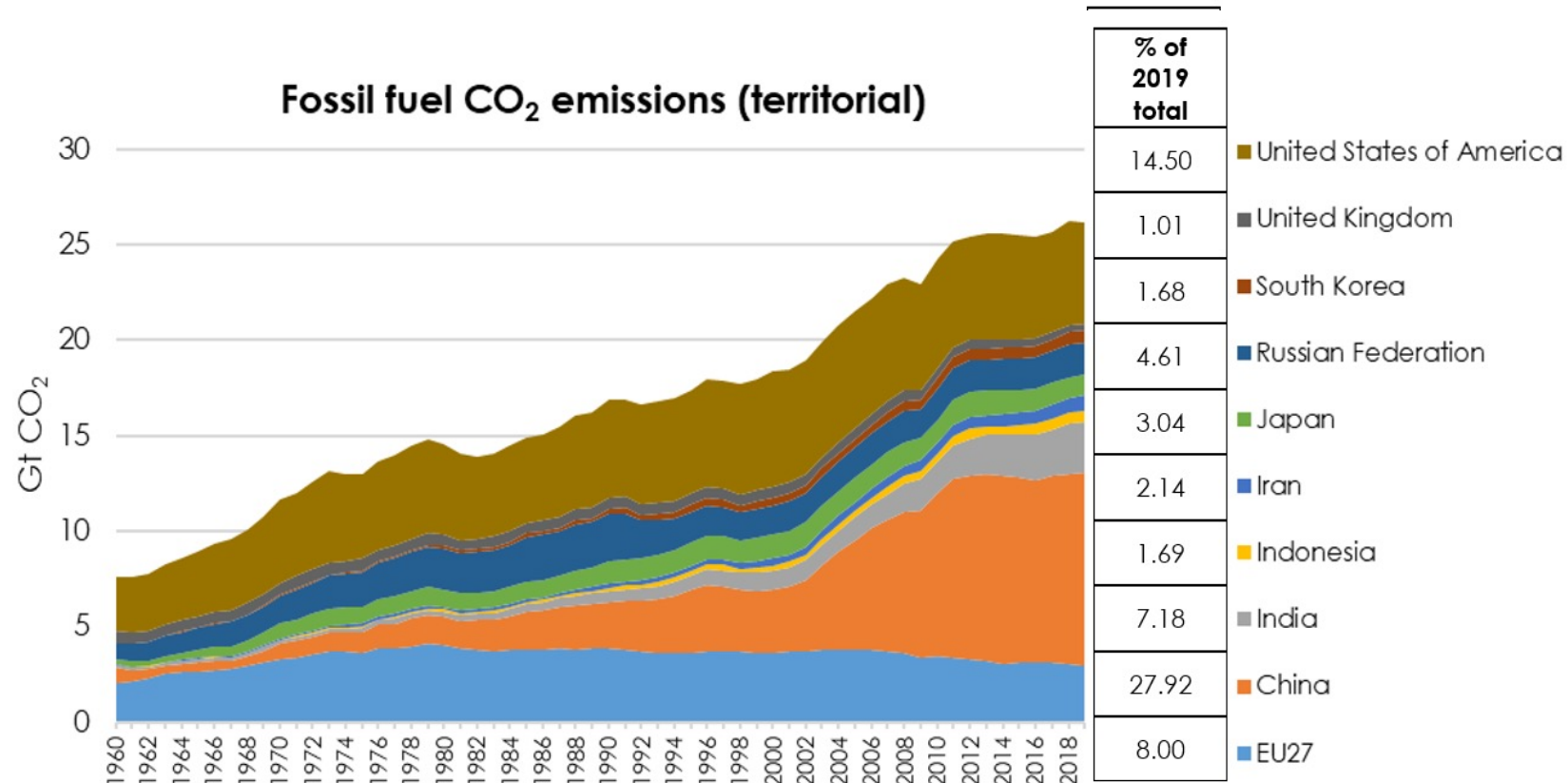
Emissions – Olivier and Peters (2020)

Temperature – Met Office Hadley Centre (2021)

Concentration – EPA (2021)

Small cuts by some countries have been outweighed by others

- Overall increases in CO₂ emissions 2016, 2017, and 2018, while 2019 was roughly stable.
- A record drop of 6.4% in global CO₂ emissions in 2020, relative to 2019 (Tollefson, 2021), due to COVID-19.
- Preliminary estimates for **January–May 2021** show that global emissions in the power, industry and residential sectors were **already at the same level or higher than in 2019** (Carbon Monitor, 2021).

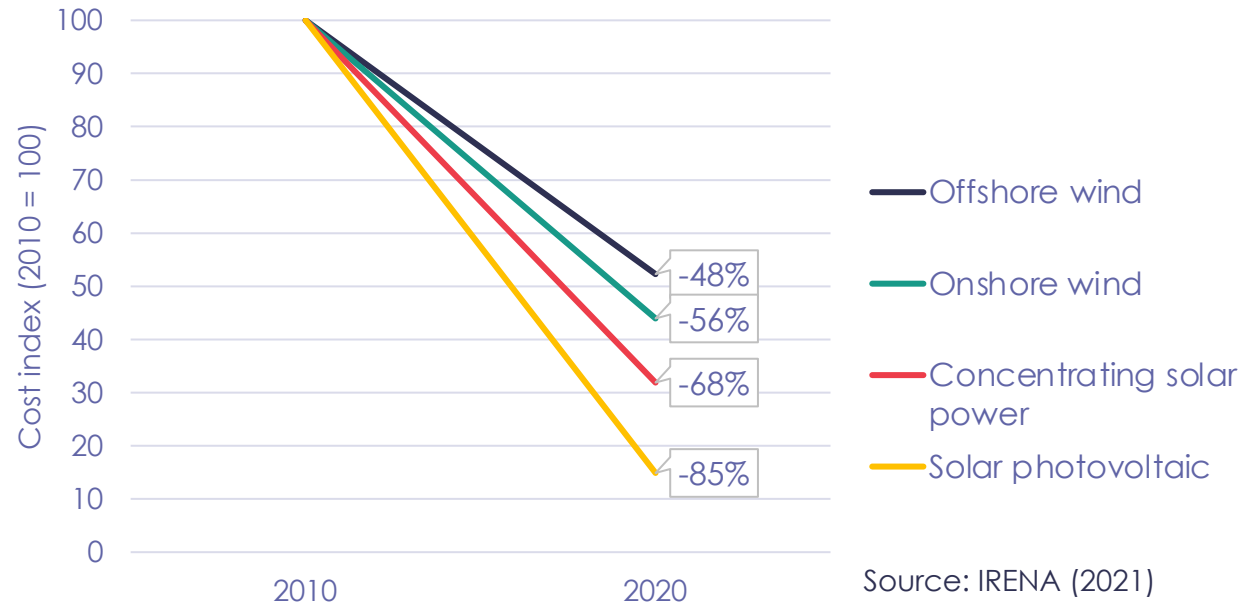


Source: GCP (2021)

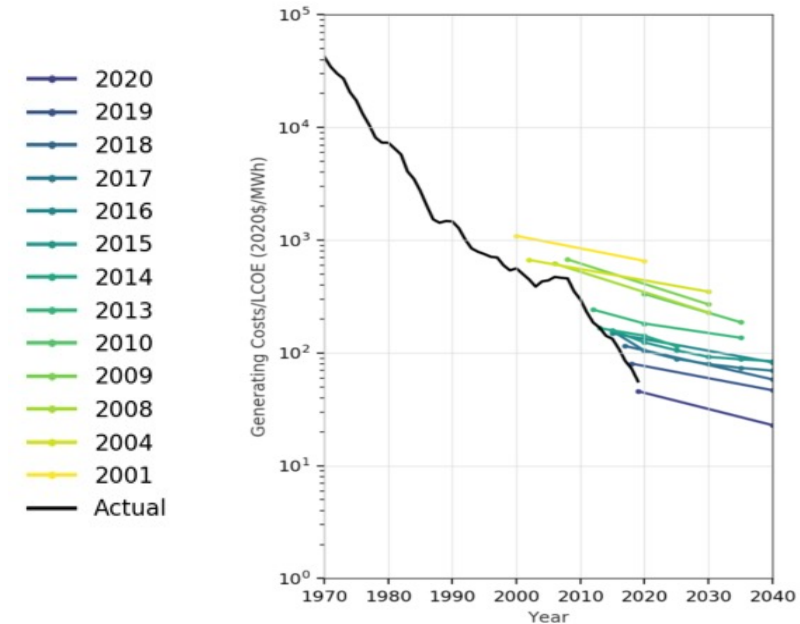
Important to keep going down and go to zero-carbon by mid-century for 1.5°C and within five decades for 2°C.

The pace of technology advancement and cost reductions has moved faster than expected

Renewable power technologies: decreases in levelized cost of electricity



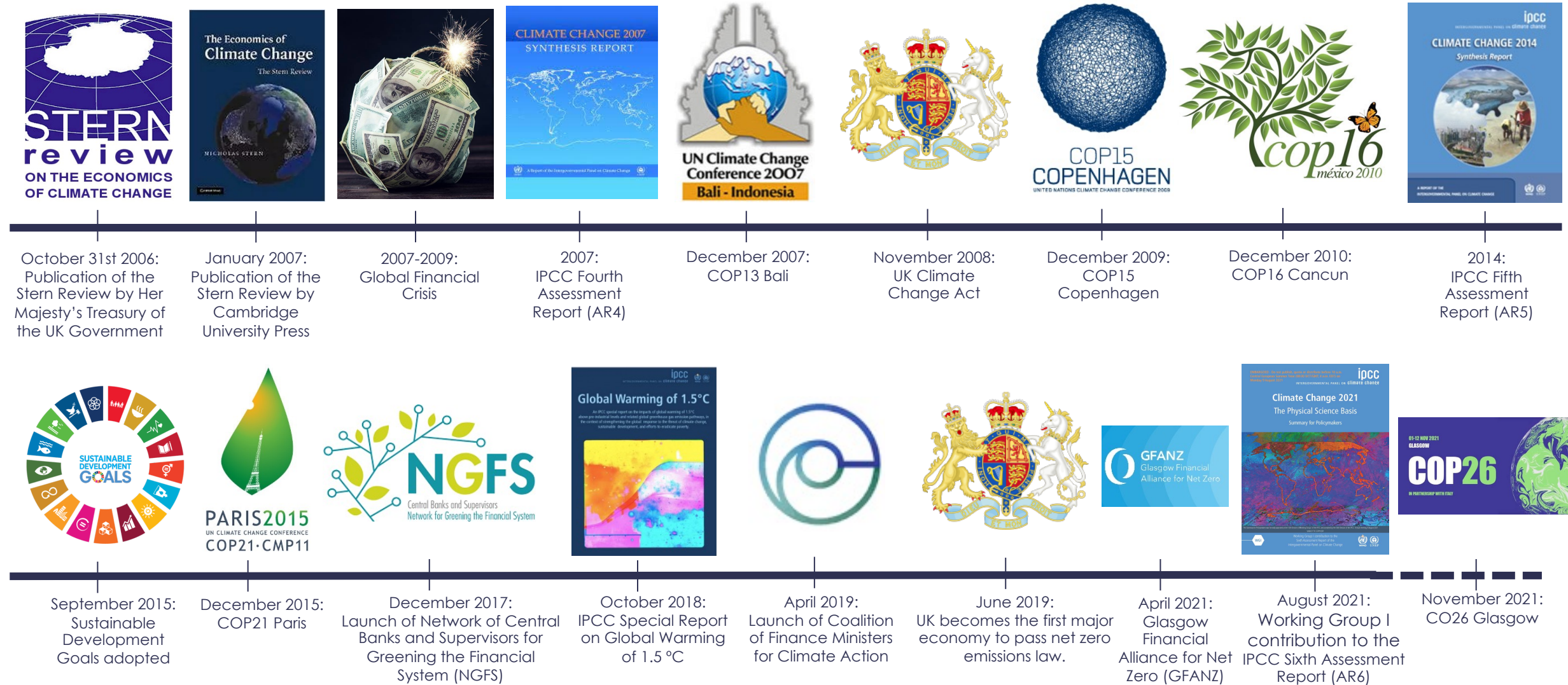
Actual versus IEA projected LCOE of solar PV



Renewables with storage now competitive (without subsidy or carbon price in much of the world). In 2020, solar/wind was the cheapest form of new power generation in countries representing over 70% of GDP (SYSTEMIQ, 2020).

Capital costs for renewables continue to fall much faster than those for conventional technologies. Strong increasing returns to scale in technologies and in discoveries. Much of it unanticipated.

The international discussion has been gaining momentum



The private sector has started to engage strongly

- **Private industry**, via individual firms, financial institutions, sector initiatives, business associations, coalitions and organisations, **has made real progress** on mobilising commitments and action on sustainability, especially in the last 2 or 3 years.
- World Economic Forum at Davos, January 2020: 'Stakeholders for a Cohesive and Sustainable World'. Sea-change in discourse about role of business in society.
- **Over 4,400 companies** have joined the UN-backed 'Race to Zero' initiative for 'non-state actors', which is rallying members to commit to halving emissions by 2030 and achieving net zero carbon emissions by 2050 at the latest.
- Of the 2,000 largest publicly traded companies by sales, **417** have made some form of commitment to net zero. Together these companies represent annual sales of nearly \$14 trillion (Black et al., 2021).
- The Glasgow Financial Alliance for Net Zero (GFANZ), a global coalition of leading financial institutions committed to accelerating the decarbonisation of the economy, currently has **more than 250 members**, responsible for assets in excess of \$90 trillion.

How the politics has moved

- Sometimes the politics have moved **forward** strongly (e.g. UNFCCC COP21 in Paris, 2015).
- Sometimes the politics have moved **backwards** (e.g. the election of Presidents Trump and Bolsonaro).
- The **global financial crisis** of 2008-2009 reduced “bandwidth” for climate change.
- Recently there have been strong positives politically. For example:



In September 2020, **China** committed to carbon neutrality ‘before 2060’ at the 75th UN General Assembly.



In its submission to the UN, in April 2021, the **USA** set a target of reducing its net greenhouse gas emissions by 50-52% by 2030, compared to 2005 levels, and achieving net zero emissions no later than 2050.



In 2021, the **European Union** adopted a climate change law, that legally obliges its 27 nations to collectively cut greenhouse emissions by 55% by 2030, from 1990 levels, and to cut emissions to net zero by 2050.

- But global emissions not yet falling.

Why has progress been slow?

- **Despite clear science** linking harms to fossil fuels and prosperity to sustainable development, several **sources of delay** have held back action:

Relative prices are **distorted**:

Direct fossil fuel subsidies are over half a trillion USD per year. Fossil fuel supply prices **do not reflect full societal costs** (including e.g. health from air pollution) in absence of a widespread, sufficiently high carbon tax.

Failure to value and account for **costs to future generations**.

Important **conceptual overlap** between fossil fuel **subsidy** and **failure to tax carbon**.

Institutions and infrastructure:

Narrowness of existing regulation and infrastructure planning;
incentives for high-carbon capital investment and R&D;

constraints in **electricity markets** that favour continued fossil fuel generation

Forces in **political economy**:

Governments (national and local) are often **fiscally dependent** on fossil fuel revenue.

Workers and voters may oppose policies to reduce industry activity and raise fuel prices.

Trade associations and firm lobby policymakers to affect climate action, and **contest the science** of climate change.

Artificial horse-race between prosperity and climate action: a narrative that **constrains domestic politics** and **embodies climate mitigation agreements**.

Time to **move on**.

See InfluenceMap, 2019; OECD et al, 2018; Parry et al, 2021

The world's young people are applying pressure for climate action



Strong movements of young people around the world, e.g. Fridays for Future, Sunrise Movement.



Youth plaintiffs **taking governments to court** for climate inaction, and winning.

For example:



'Future Generations v. Ministry of the Environment and Others' (Colombia, 2018).



'Urgenda Foundation v. State of the Netherlands' (Netherlands, 2019).



'Neubauer, et al. v. Germany' (Germany, 2021).

- They are **purposive, informed, and analytical** on what is to be done.

Current pledges cover less than 20% of the gap in emissions reductions that must be closed by 2030 to keep a 1.5°C path within reach, or even limit rises to 2°C (see IEA, 2021).

Momentum is building but we are not moving fast enough. More action is needed to protect future generations in all countries.

A building of understanding over time



Origins of the Stern Review in the 2005 G8 summit.



Launch of the Stern Review in October 2006.



Visit to Antarctica in 2009.



Collaboration with Meles Zenawi, including on the \$100 billion commitment agreed at COP15 (Copenhagen) and COP16 (Cancun).



Paris Agreement at COP21.

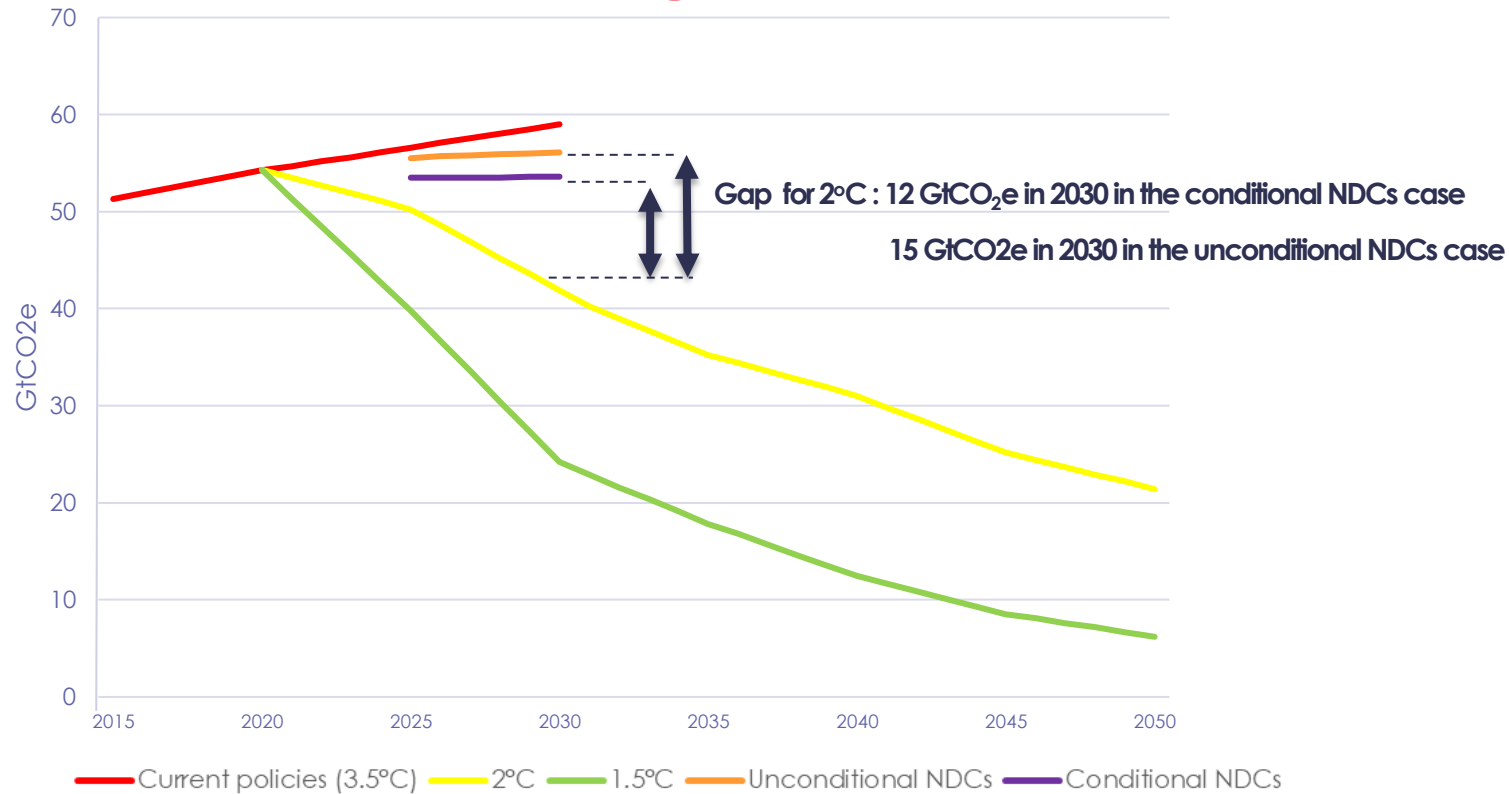


Royal Economic Society Past President's Address, April 2021.

Structure

- Looking back on the 15 years since the publication of the Stern Review
- **Looking forward: the 21st century growth story**
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Currently a large gap between Paris NDCs and what is required to reach the Paris temperature targets



Source: Trajectories based on UNEP (2020)

NB: The 1.5°C scenario used by the UNEP report relies on the widespread use of negative emissions technologies (NETs) later in the century.

The challenge is now to accelerate action to 2030 to close the gap. Requires immediate action across whole economy. Must peak emissions in next few years and go to net zero on CO₂ by 2050.

We must tackle the COVID and climate crises together

- The world has been transformed by the COVID crisis. Tragic human costs and loss of life; severe economic impacts across countries; severe debt stress; human capital scarring and potential undermining of the social fabric.
- The COVID crisis has **underlined the dangers**, weaknesses and fragilities that had been building, despite a growing momentum for a more sustainable economy.
- The dangers involved in climate change are **still bigger** than the crisis we are experiencing from COVID. Many irreversible as well as immense.
- Strongly **interrelated global challenges** will require an integrated, concerted and coordinated response which can be a key foundation for **building back better**.
- **Richer countries** should lead in the context of wealth, technology, and history. Lack of internationalism on COVID not only morally indefensible but also undermines collaboration more generally.
- Strong and sustainable **investment to drive out of recession**.

Requires strong commitment to internationalism and renewed multilateral cooperation.

Investment and innovation are at the core of sustainable recovery and growth

- Many of the investments necessary for sustainable recovery and growth can be quickly implemented, can **mobilise significant private sector involvement**, are **labour-intensive** in the short run, can **promote greater equality of opportunity**, and can **drive productivity growth** through their strong **innovation potential** in the medium to long run.
- These investments have large **net economic and social benefits and strong potential to improve well-being** across its many dimensions. The high economic **multipliers** of these investments will also be a key driver of economic recovery, job opportunities, and enhanced future revenues.
- The majority of investment will be in the **private sector**, but **public investment** will have to play a key role in the early period, particularly for sustainable infrastructure.
- Across the world there is **great investment potential and strong savings** (negative or zero real interest rates for many countries).

Quality investments across a range of vital physical, natural and intangible assets can drive both recovery and transformation to a sustainable, resilient and inclusive economy.

The necessary expansion of investment

Global investment needs to be increased and sustained above pre-pandemic levels by around **2% or more of GDP p.a.** over this decade and beyond, for the augmentation and transformation of all forms of capital. More in some countries, less in others.

This reflects a number of considerations:

- 1** **Investment growth had been on a decline** in both advanced and emerging market and developing economies, and the investment rebound following the collapse in 2020 is expected to be much weaker in 2021 than in 2010.
- 2** There has been a **persistent gap in infrastructure spending** in both developed and developing economies that has been estimated at 2 - 3% of global GDP.
- 3** There are **significant opportunities for scaling up sustainable investments** to accelerate the transition to a low-carbon and climate-resilient economy and restore natural capital (these are examined and quantified in Stern, 2021).

If well executed, this increment in investment will have high returns in terms of productivity, new opportunities and the environment.

The growth story of the 21st century: strong, sustainable, inclusive, resilient

5 - 10 years



Investment in sustainable infrastructure and other assets can boost shorter-run demand and growth, sharpen supply and efficiency, reduce waste and pollution, promote sustainable development and reduce poverty.

~ 10 years



Spur innovation, creativity and growth in the medium term, unleash new waves of innovation and discovery.

~ 20 years



Low-carbon is the only feasible longer-run growth on offer; high carbon growth self destructs.

- ***This is a powerful growth story driven by investment and innovation.***
 - Strong job opportunities. Strong multipliers. Powerful effects on health and well-being.
 - By 2030, low-carbon technologies and business models could be competitive in sectors representing over 70% of global emissions (today 25%) (Systemiq, 2020) .
- ***Not a story of cost*** but of large ***net benefits***.
- ***Adaptation/resilience*** will be crucial. Many investments foster ***development, reduce emissions and promote resilience*** (SRI for rice, public transport, building design, restoring degraded lands, decentralised solar...).
- But fundamental change involves ***dislocation of work and changing relative prices. A just transition.*** Political economy and ethics. Support training, skills, places, and relocation where necessary. Revenues to protect the poor.

Key role of technologies and systems

- Remarkable technical change in last dozen years on back of modest policy and broad sense of direction.

Could we/should we have anticipated changes of the last dozen years?



Cost of renewables:
down by a factor of
more than 10.



Digital management:
the iPhone is only 14
years old.



Electric
vehicles



New
materials

- Change can be still faster with strong policy. Deepen economic policy analysis of how to accelerate technological change.
- **Crucial role of system design and management.**
 - **Land use** (very destructive across the world; soil depletion, poisoned rivers, deforestation)
 - **Cities** (congested and polluted)
 - **Transport, energy** (poorly integrated and polluting)
- **Designs and standards** can help drive change (e.g. city zoning for pedestrians/cyclists, banning incandescent light bulbs, managing waste, circular economy).
- **Digital management and AI** great potential. Huge possibilities from use of information and AI for efficiency, integration, congestion, system management...

How the zero-carbon transition is managed will be pivotal to building the political and societal will for strong, sustainable action

Enabling a 'Just Transition'

"Leave no-one behind"

Life-long learning

Offer education and training to support life-long learning

Support local skills and investment

Support new skills and entrepreneurship through finance. Collaboration between local government, universities, business

Re-locate public sector services

Locate public services/activities in affected areas to boost local economies (shift government employment hubs)

Social protection measures

Boost social protection measures for the most vulnerable members of society (lump sum transfers, welfare support, housing subsidies...)

A 'just transition' is about more than just managing a zero-carbon transition, it will be necessary for other large changes in economic structures: shift to services, labour-saving technologies, globalisation... all have to be managed together.

The global financial crisis, COVID, and inequality have made the problem more severe.

International climate justice

- Poorest countries are the most vulnerable to the climate crisis, and yet they have **contributed very little** to historical greenhouse gas emissions. Nevertheless, they must be **central** to the global climate solution.
- **Development decisions** in the next few years will in large measure determine whether the world will succeed in the fight against climate change. Developing countries can **capitalise on the opportunity** to follow a different path and deliver sustainable, resilient and inclusive growth.
- This will require **scaling up investments** and **introducing new technological options** that can deliver better results for both development and climate.
- Developing countries **cannot do this alone** and **nor should they**. The richest countries should both take ambitious domestic action against climate change, and support developing countries to adapt to climate impacts and transition to a low-carbon economy.
- All forms of finance are needed to enable and catalyse change. Delivering the **\$100 billion commitment** and **acting strongly to alleviate the debt constraints of low-income and vulnerable countries** will be critical to unlock climate-related investments.

“It is not justice to foul the planet because others have fouled it in the past” – Meles Zenawi speaking at COP17, Durban

Climate change adaptation and enhancing resilience

- Impacts of climate change are already strong and will pose growing economic, equity and ecological challenges.
- ***Actions on climate adaptation and mitigation are reinforcing, and good adaptation is good development.***
- Three complementary pillars to build resilience: physical or ex ante resilience; ex post or recovery and reconstruction; macroeconomic and financial resilience.
- In much of the economy, development, mitigation and adaptation are interwoven. For example: mangroves; restoring degraded land; SRI rice; public transport; decentralised solar...

Will need substantial resources and new financing mechanisms, including concessional resources for poor and vulnerable countries.

Take opportunity to achieve development, mitigation and adaptation/resilience together.

Linking climate, nature and biodiversity

- **Increasing attention** from policymakers, civil society, business and finance on halting biodiversity loss.
- For example:
 - ❖ UK government's Dasgupta Review of the Economics of Biodiversity (Dasgupta, 2021)
 - ❖ G7 2030 Nature Compact agreed at the 2021 G7 Summit, in Carbis Bay
 - ❖ Taskforce for Nature-Related Financial Disclosures (TFND)
 - ❖ Joint NGFS-INSPIRE Study Group on Biodiversity and Financial Stability
 - ❖ 75 signatories to the Finance for Biodiversity Pledge
 - ❖ Over 1000 signatories to the Business for Nature coalition's 'Call to Action'
- The UN Convention on Biological Diversity (CBD)'s **Post-2020 Global Biodiversity Framework** is due to be agreed at the 15th Conference of Parties of the CBD in Kunming China, in April/May 2022.
- Strong interweaving between a hostile climate, pollution and biodiversity loss.

Need to deepen our understanding of the links between biodiversity loss and climate change and examine the policies and institutions that can deliver nature and climate objectives together.

Importance and opportunities for international action

- "Four wins" to **collaboration**: Keynesian recovery; expectations and growth; cost/technology; pollution/climate/biodiversity.
- The big challenge of **debt restructuring**.
- Key **institutions** for international finance and policy: MDBs/IMF/DFIs.
- Collaboration of **central banks**, including NGFS.
- Collaboration of **finance ministries**, including Coalition of Finance Ministers on Climate Action.
- WEF and **private sector**.

Analogous to recovery and rebuilding from the second world war, this is a crucial period for international collaboration.

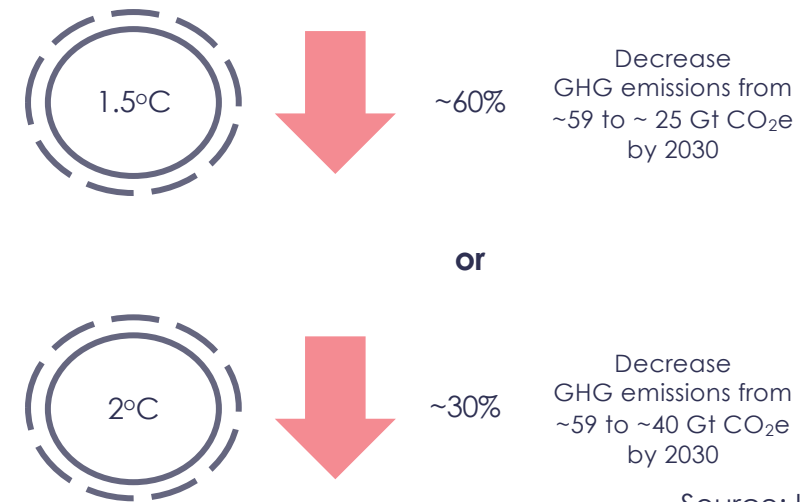
An important year, a critical decade

- Major events in 2021, including **G7**, **G20** and **COP26**.
- **3 years of G7/G20** could be 3 years of acting together to make this a transformational decade.

Change in the next decades



At the same time (to meet Paris targets)



Source: UNEP 2020

The next decade is critical. Choices made on infrastructure and capital now will either lock us in to high emissions, or set us on a low-carbon growth path which can be sustainable and inclusive.

Investment is central. Need sound policy to transform investment opportunities into real projects/programmes, and the right kind of finance, on the right scale, at the right time.

Structure

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Climate largely missing from mainstream economics journals

Economics Research

<i>Journal name</i>	<i>Number of articles ever published on climate change</i>
<i>Quarterly Journal of Economics</i>	0
<i>Economic Journal</i>	9
<i>Review of Economic Studies</i>	3
<i>Econometrica</i>	2
<i>American Economic Review</i>	19
<i>Journal of the European Economic Association</i>	8
<i>Economica</i>	4
<i>Journal of Political Economy</i>	9
<i>American Economic Journal – Applied</i>	3

Source: Oswald and Stern, September 2019

The leading economics journals have largely ignored the most fundamental issue of our time.

Early attempts to examine climate and growth: Integrated Assessment Models

- Nordhaus' question: To slow or not to slow? (EJ 1991); **small perturbations** to an underlying **growth model**.
- Reasonable first effort turns out to fail to capture the scale of the phenomenon as we learn more about potential magnitude or risk.
- Was an attempt to **shoehorn** a “new” problem into a framework and toolkit of the standard workhorses of exogenous growth models and marginal change. The reality of climate change is of a magnitude beyond that framework. In policy terms they focus particularly on one instrument, the social cost of carbon. Policy requires much more than that.
- Have seen some modification of functions and parameters within the framework but it still dominates.
- We need an economics that recognises extreme risk and examines how to make fundamental structural change in real time. That is not the core subject matter of IAMs.

We must have an economics that can handle both extreme risk and fundamental structural and technological change

Economic analyses of climate change must:

- 1 Take account of **extreme risk**, including possible large-scale and unforeseeable consequences.
- 2 Recognise that many key markets have critically important **failures** (beyond that of the GHG externality); crucial markets may even be **absent**. And that there are limits on the ability of government to “correct” these market failures.
- 3 Embody **rapid technical and systemic change**, often exhibiting increasing returns to scale, and corresponding rapid changes in (endogenously determined) beliefs and preferences (see e.g. Besley & Persson, 2020).
- 4 Take into account **distributive impacts**, both at a moment in time and over time. Assessment of differential impacts requires value judgements, and these require explicit analysis and discussion.

Arguments and analytics are set out in Stern & Stiglitz (2021).

Much of the standard economic modelling of climate change, including Integrated Assessment Models (IAMs), does not embody basic methodological essentials. These models don't grapple with the core questions.

Discounting (I)

- Decisions now affect lives and livelihoods, and the risks faced, in the future.
- Key concept in relation to discounting is the **social discount factor**: the relative social evaluation of any extra unit of account (e.g. consumption) in the future, relative to an extra unit now. The proportional rate of fall of the social discount factor is the **social discount rate** (can be both state and person contingent). Will depend on unit of account and on time.
- The valuation of an extra unit at time t will depend, for most ethical observers, on:
 - i. the levels of living at time t relative to now;
 - ii. the valuations of a future life (or utility) relative to now.
- The first will, for most ethical observers, point to a high valuation if future generations are likely to be poor and low if they are likely to be rich.
- The second is “pure-time discounting” and concerns “discrimination by date of birth” (remember that levels of living are in i) not ii)). Other than the possibility of extinction, there is no serious ethical argument in favour of pure-time discounting. For discussion of extinction and discounting see e.g. Stern, 2015; Chichilnisky, Hammond & Stern, 2020. Insight goes back, at least, to Arrow & Mirrlees in 1960s; also examined by Dasgupta, Heal, Solow, Stiglitz....

Discounting (II)

- **Levels of living in the future are endogenous** – they depend on choices now. Unmanaged climate change could make future generations poor: leading potentially to negative discounting. In any case, we cannot read off from external sources, or exogenously impose, a rate of discount for capturing effect (i).
- **Risk** in these analytical frameworks would often be reflected in expectations of utility rather than through discount rates. That approach is much more analytically transparent and less rigid.
- The **capital or financial markets do not give us information** of relevance to social discounting because: (i) they do not reflect ethical social decisions; (ii) they embody expectations and views about risk that are hard to identify; (iii) they involve many imperfections.
- Social discounting should be examined largely through effect (i) and that depends fundamentally on how we manage climate change.
- Weitzman (e.g. 2011) pointed to the possibility that extreme risks could lead to infinite willingness to pay to avoid climate change. In this context the guardrail approach rather than trying to optimise simple expected utility makes sense from a consequentialist perspective (see Stern & Stiglitz 2021).

Criticism that the Stern Review ‘yields an unusually low interest rate ($r = 1.4\%$)’ ‘the discount rate should reflect market rates of return on capital’ (e.g. Nordhaus, 2007) were misguided and reflected a misunderstanding of the principles of discounting as well as of the potential scale of risk.

There are important market imperfections that policy design must take into account

Market Failure	Description	Policy Options
Greenhouse gasses (GHGs)	Negative externality because of the damage that emissions inflict on others.	Carbon tax/ cap-and-trade/ regulation of GHG emissions (standards)
Research, development and deployment (R,D&D)	Supporting innovation and dissemination.	Tax breaks, support for demonstration/deployment, publicly funded research.
Imperfection in risk/capital markets	Imperfect information assessment of risks; understanding of new projects/technologies.	Risk sharing/reduction through guarantees, long-term contracts; convening power for co-financing.
Networks	Coordination of multiple supporting networks and systems.	Investment in infrastructure to support integration of new technologies in electricity grids, public transport, broadband, recycling. Planning of cities.
Information	Lack of awareness of technologies, actions or support.	Labelling and information requirements on cars, domestic appliances, products more generally; awareness of options
Co-benefits	Consideration of benefits beyond market rewards.	Valuing ecosystems and biodiversity, recognising impacts on health

Different market failures point to the use of different instruments, but the collection should be mutually reinforcing. We have the tools to drive action.

Absent markets and government limitations

- Key futures markets are **absent**, for example, insurance markets covering key risks and markets for unknown, but possibly vital, future technologies. As a matter of basic theory, a competitive equilibrium with some absent markets cannot be assumed to be (Pareto) efficient. Similarly, just “correcting” for the greenhouse gas externality does not bring us market efficiency.
- Such absences mean that **expectations**, and how they are formed, are crucial for investment. They can and should be shaped by public action, including by the key public policy and financial institutions which set direction. A clear and credible strategy for future of growth and development can foster sustainable investment and innovation.
- Public policy is set in a way that does not have the full horizon that is relevant in this context, given that governments are made up of complex compromises and coalitions, and not necessarily long lasting. And it is not clear that these structures, as they exist and work in practice, can fully represent the **interests of future generations**.
- Governments have limitations on policy instruments and face **major administrative and political constraints**.
- **Governments cannot fully commit** to future actions in a credible way. Lack of confidence in the future of government policies can be a major deterrent to investment (“government-induced policy risk”).

Implications for policy and institutions: institutional structures can help with confidence and transparency, e.g. Climate Change Committee and legislation in UK.

Important areas for economic research

- **Behaviour**
 - ❖ Behaviour change in the face of adjustment costs and missing information; incentives and nudges.
- **Values**
 - ❖ Change through discussion, example, interactions, evidence, leadership.
- **Innovation**
 - ❖ Learning by doing, network effects and path dependency; investing in R&D; clarity of regulation, standards and design.
- **Efficiency**
 - ❖ Resource efficiency, circular economy, understanding inefficiencies.
- **Systems**
 - ❖ Energy, cities, transport, land use; will require a whole set of policies to foster change.
- **Biodiversity**
 - ❖ Interactions with climate, pollution: intimately related and all require urgent action; examine mix of policies and role of institutions (see Dasgupta, 2021).

Ways forward in economics

- The strategic challenge is to move to a net-zero carbon economy within a few decades. The economics of action must be focused on the achievement of ***fundamental economic change at real pace***.
- Rather than static models that take *structures* as fixed, economics must ask how to ***shape structures for purpose***: so that they ***deliver a rapid increase in investments in the areas needed***.
- Involves assembling microeconomic, structural, technological, and macroeconomic ***analyses of change***, for countries and communities across the world, accounting for the circumstances, difficulties and opportunities they face.
- The work will involve bringing the best of economic analysis to the table, including around ***innovation, behaviour*** and ***political economy***, which will all be central to change.
- Will involve learning from many *branches of economics*, including international, industrial, labour, health, education, environmental, energy economics and much more, and ***working together*** with science, technology and the social sciences and humanities.

A fascinating, important and urgent research and policy agenda, given the decisive nature of the next decade for climate, biodiversity and the environment. Build a public economics as if time matters (Stern, 2018) and which places environment (including climate, nature, biodiversity) at centre stage.

Structure

- Looking back on 15 years since the publication of the Stern Review
- Looking forward: the 21st century growth story
- A time for change in economics
- **COP26 and beyond**

There has never been a more crucial moment for collaboration and leadership

- Together , on the basis of decisive leadership, the world can build a **new form of growth and development** that is far more attractive than what went before. This requires investment across a whole range of activities and across the world. Recovery, growth, innovation, climate and environmental benefits will all be much stronger with the world **acting together**.
- **G7 countries** have strong resources, skills, influence in international organisations, innovation, policy and analytical capacity. Their actions together, at scale, can serve as powerful examples. There is a responsibility to act.
- The G20 provides a wider forum with **emerging and developing economies**, where the biggest needs for climate-related investment are, both for mitigation and adaptation. Building consensus in the G20 presents greater challenge.
- The G7/G20 can **chart a clear course of action** for the next three years: UK/Italy, 2021; Germany/Indonesia, 2022; Japan/India, 2023.
- **COP26** in Glasgow, November 2021, will be the next pivotal milestone for a strong commitment to internationalism and renewed multilateral cooperation.

2021 can be a turning point towards a more prosperous and sustainable future.

Prospects and hopes for COP26

- **Emissions:** in early 2020 around 1/3 of emissions were from countries with a net-zero commitment. Now close to 3/4.
 - ❖ But the sum total of NDCs for 2030 will likely show only a modest reduction relative to now when we should be looking for 45% for a realistic chance of holding to 1.5oC. India and China have not yet submitted.
 - ❖ Can we build a process for review and acceleration?
- **Finance and international structures:** the \$100bn p.a. flow committed for 2020 from rich countries to poor countries will likely be reached in 2023.
 - ❖ Can we construct a framework for 2025 which brings the five flows together in a complementary and mutually supporting way: bilateral; multilateral; private; voluntary carbon markets; philanthropy? A real opportunity to scale up.
 - ❖ Importance of MDBs taking a leadership and expanding role, supported by shareholders.
- **Private finance** moving very strongly:
 - ❖ Thousands of firms in TCFD
 - ❖ Members of the Glasgow Finance Alliance for Net Zero control over \$90 trillion; for comparison, net-zero commitments covered \$5 trillion of private financial assets in early 2020.
 - ❖ Close to half of global assets under management have a net-zero commitment.
- **Glasgow breakthroughs:** likely to be strong announcements in specific industries.
- **Resilience/Natural Capital:** moved strongly up priorities.

Can it be done? Four forces present us with a special opportunity to deliver at scale



Historically **low interest rates**
and **no shortage of global savings**.
Search for growth.



Rapid technological change
and **falls in cost**
(digital, materials, biotech...)



International agreements have
provided political direction and
evidence that collaboration is possible
and will continue



Strong movements of
young people across the
world

Opportunities exist now to finance the transition with low interest rates, excess global savings and new, changing technology.

Seizing the opportunity requires a radical change. Most of what we currently do will have to be done differently (technologies, institutions, business models, city planning processes, natural resource management...).

Have in our hands a much more attractive sustainable and inclusive form of growth and development; do we have the political will/capability?

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