

# Towards a low-carbon future

**Nicholas Stern**

Chair of the ESRC Centre for Climate Change Economics and Policy

Chair of the Grantham Research Institute on Climate Change and the Environment

IG Patel Professor of Economics & Government, London School of Economics and Political Science

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# Structure

- **The global agenda: scale and urgency**
- Delivery: fundamental change; resource efficiency at the core
- International commitment and collaboration
- Policies and political will

# The new global agenda

- 2015 and 2016 **breakthrough years for global collaboration** around climate change and development. **Agenda for action** with agreements on:
  - Financing for development in Addis (July 2015)
  - **Sustainable Development Goals (Sep 2015)**
  - **Paris Agreement on Climate Change (CoP 21) (agreed Dec 2015, enter into force in Nov 2016; very rapid ratification)**
  - Kigali Amendment to the Montreal Protocol on HFCs (Oct 2016)
  - New Urban Agenda (Oct 2016)
  - Marrakesh Action Proclamation For Our Climate And Sustainable Development (Nov 2016)
- **First shared global development agenda since agreements after WW II.**

# Growing understanding of the immense risks posed by climate change

- Many of the effects coming through **more rapidly than thought** (loss of ice sheets, glaciers etc.). 16 of the 17 warmest years on record have now occurred since 2001. 2016 warmest year on record with big jump in concentrations; CO<sub>2</sub> now above 403ppm, not seen for 3 million years, when temperatures were around 3°C. Already at 1°C of warming, not seen for 100,000 years or so.
- Adding CO<sub>2</sub>e at a rate of over 2.5ppm per year. Was 0.5ppm per year 1930-1950, 1ppm 1950-1970 and 2ppm 1970-1990.
- BAU, inaction or weak action could take us to **over 800ppm CO<sub>2</sub>e** over a century or so: real possibility of eventual temperature increase of more than 4°C or 5°C (increase in global average surface temperature above second half of the 19<sup>th</sup> century). Seeing strong effects now; yet small relative to the potential risks at **4 or 5°C (not seen for tens of millions of years)**.
- Would likely destroy livelihoods for many, rewrite where people could live, and lead to migration of hundreds of millions, possibly billions, and serious, widespread and extended conflict. **Poorest hit earliest and hardest.**

# The growth story of the future

- **Growth, sustainable development, poverty reduction and climate change** are complementary and interwoven. (“Better Growth, Better Climate”, NCE, 2014; “Why are we Waiting?” MIT Press, Stern, 2015; “The Sustainable Infrastructure Imperative”, NCE, 2016; “Delivering on Sustainable Infrastructure for Better Development and Better Climate”; Bhattacharya et al., 2016)
- **Opportunity to:**
  - Boost **shorter-run growth** from increased investment demand in the low-carbon transition, plus improving supply (sustainable infrastructure);
  - Spur innovation, creativity and ***growth in medium term***;
  - Provides the ***only feasible longer-run growth*** on offer.
- A growth story that delivers: **inclusive growth and poverty reduction; rising living standards across the dimensions of well-being; cities where we can move and breathe; ecosystems that are more productive and resilient...**

# What to do to hold warming “below 2°C”

- The **window for making the right choices is uncomfortably narrow**. Remaining carbon budget is shrinking rapidly.
- Can do a little more earlier and a little less later and vice versa but **shape of feasible paths similar**.
- Stabilising temperatures **requires stabilising concentrations, which will require net-zero emissions**. The lower the target temperature, the earlier the necessary achievement of net-zero; balancing sources and sinks.
- **Paths to achieve under 2°C likely to require:**
  - **zero total emissions** well before the end of century (2070 - 2080), or earlier
  - **Net negative emissions in major sectors** (because some sectors likely to be positive)
- Total current Paris pledges (NDCs) are for emissions of around 55-60 GtCO<sub>2</sub>e per annum in 2030 (10% increase as compared to today). Whilst improvement on BAU (ca. 65-68 GtCO<sub>2</sub>e per annum), need to be around **40 GtCO<sub>2</sub>e or less per annum by 2030** (20% decrease).

# Any further delay in action is dangerous

- Current NDCs (if met) point us to 3°C path, temperature not seen for around 3 million years.
- Uncertainty and ‘publicness’ of the causes might suggest delay to learn more, this would be a profound mistake
  - The “ratchet effect” from flows of GHGs to concentrations (CO<sub>2</sub> hard to remove)
  - Dangers of “locking in” long-lived high-carbon capital/infrastructure. This involves either commitment to high emissions or early scrapping of capital/infrastructure.
  - Potential devastating impacts on ecosystems, biodiversity, forests, water, air quality; possibility of reaching **irreversible tipping points**.
- Delay increases reliance on unproven future technologies (e.g. concerning negative emissions) or more ambitious action in future (politically feasible?).

# Next 10 to 20 years are of crucial importance

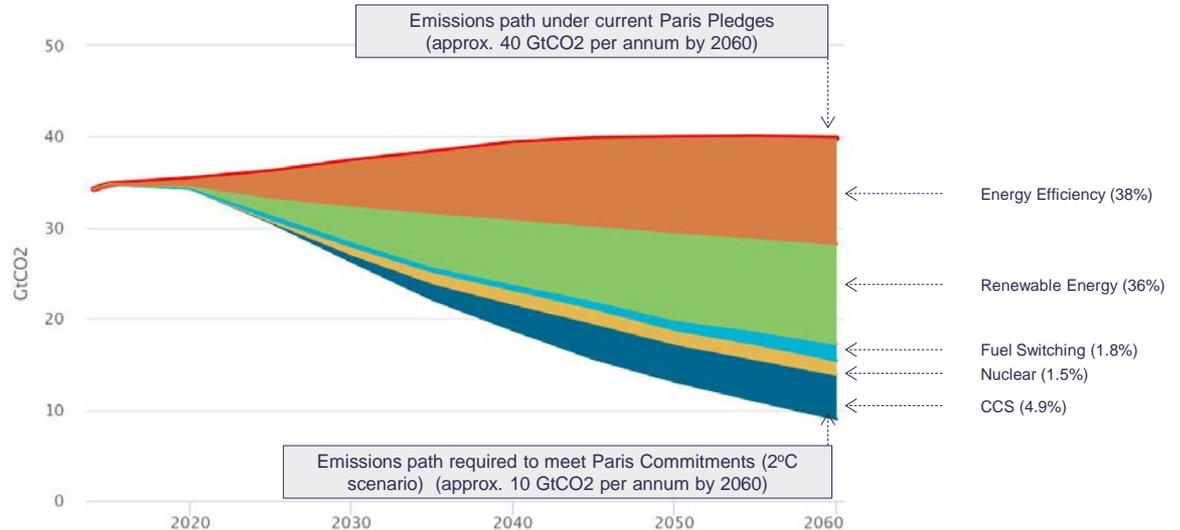
- World economy will roughly double in next two decades. Infrastructure will more than double.
- **Long-lasting infrastructure investments on scale** will need to be made in our cities, energy and water systems and in transport systems.
- Altogether **\$80-\$90 trillion in infrastructure investments** required over next 15 years - **more than the current existing stock**. It costs only a little more to make them sustainable (NCE, 2014).
- **These huge anticipated needs are driven by:**
  - Aging infrastructure in advanced economies will need repair and replacement.
  - Higher growth and growing weight of emerging/developing countries in global economy.
  - Structural change in MICs and LICs.
  - Rapid global urbanisation from around 3.75bn now (50% of 7.5 bn) to nearly 7 bn by mid-century (70% of nearly 10 bn).
- **Once in a history transition.**

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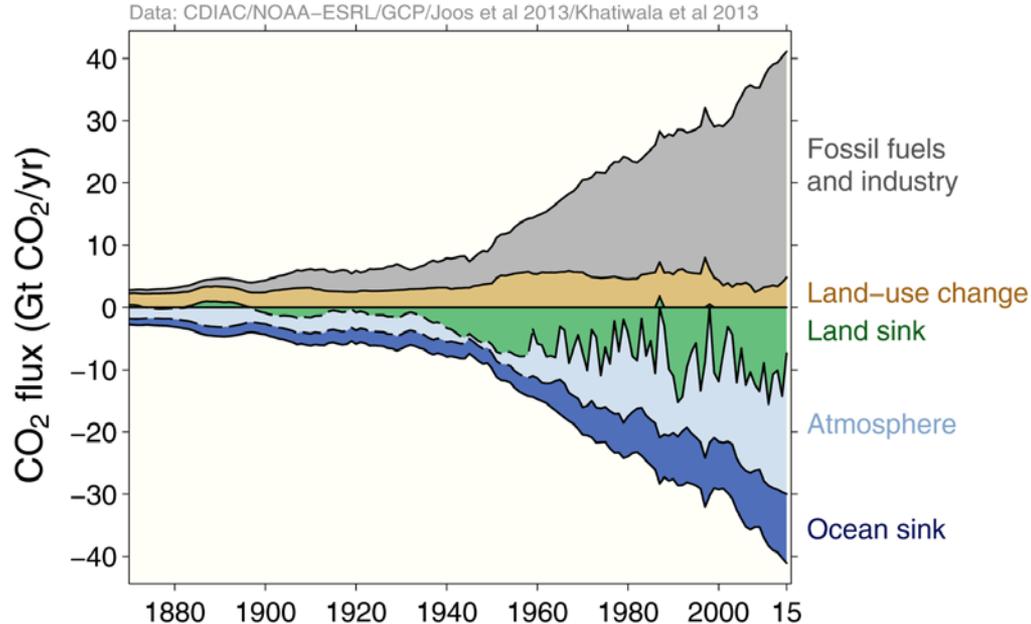
# Resource and energy efficiency are at the heart of the transition to meet the Paris Agreement targets

- Acceleration in the pace of energy productivity improvement could deliver **a third of required CO<sub>2</sub> emissions reduction** by 2040. (ETC, 2014)
- But, a dramatic increase is needed in the pace of efficiency measures, from **1.7% to 3% per annum** (ETC, 2017).
- Falling global energy intensity is the **main factor behind the flattening of global energy-related GHG emissions** since 2014 (IEA, 2017).



Source: International Energy Agency, 2017  
Note: CO<sub>2</sub> emissions from energy only

# Balancing sources and sinks: net-zero

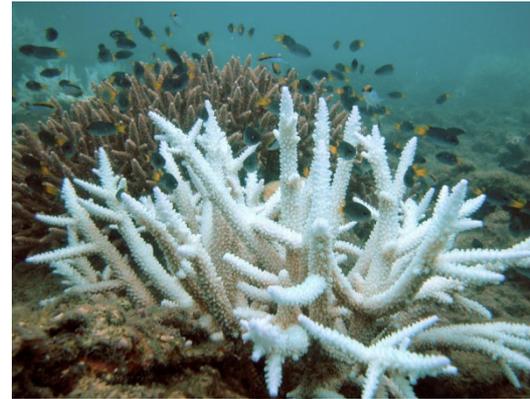


Source: Global Carbon Project (2017)

- To meet targets, **some sectors will have to be negative**, as others are likely to remain positive.
- **Land based and ocean sinks** are central to achieving net-zero emissions. Imperative to protect them.
- Oceans currently sequester 26% of CO<sub>2</sub> emissions per annum, while land based sinks (forests, wetlands etc.) approximately 31%.
- **Tipping points risks these sinks** and could either accelerate warming, or make net-zero emissions difficult to achieve.

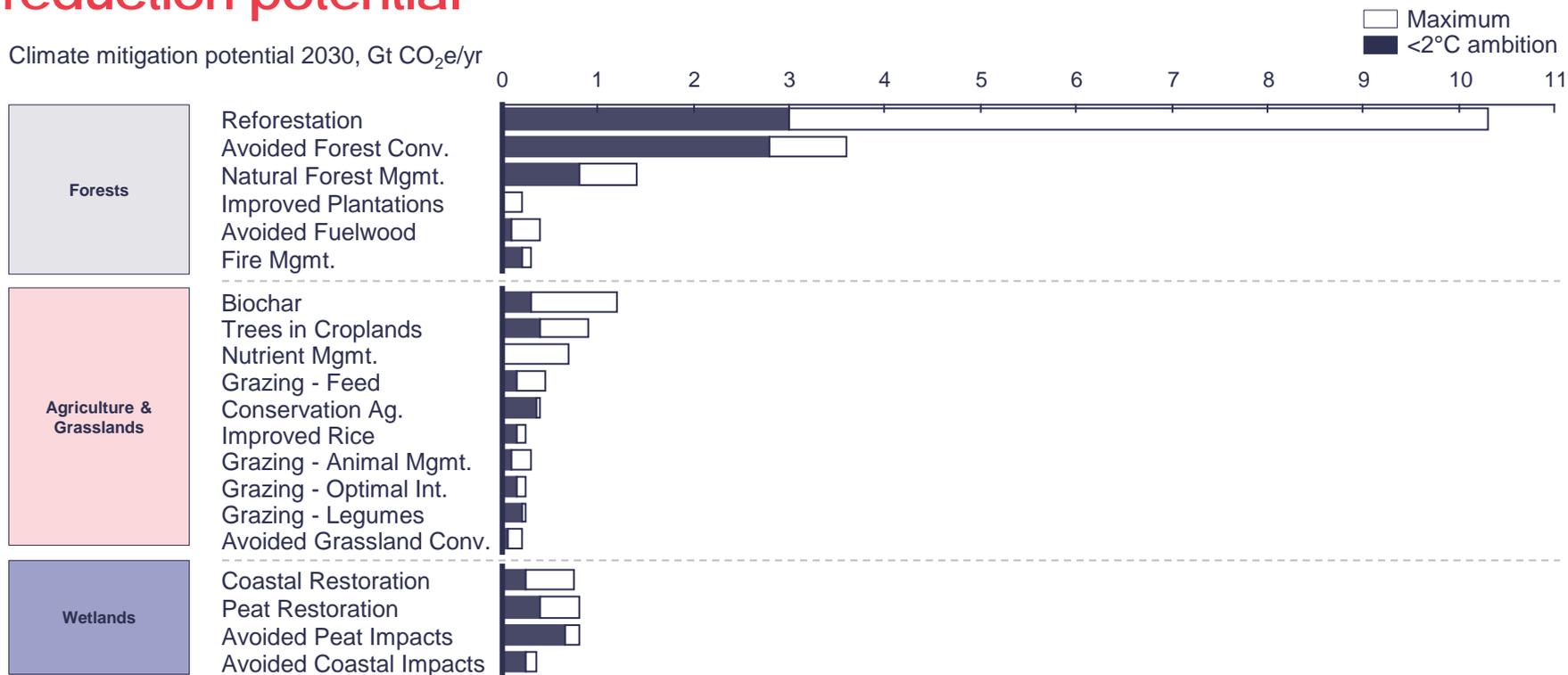
# The precariousness of the oceans

- **Ocean chemistry is changing** faster than at any point in perhaps 300 million years due to absorption of CO<sub>2</sub>. Widespread loss of coral reefs (20% have been destroyed).
- About **10% of the world's estuaries are now classified as hypoxic** (low oxygen) "dead zones", exacerbated by pollution (run-off from land based activities) and GHGs.
- Estimated that **52 trillion micro plastic particles** are present in the oceans (UN,2017)
- Increasing temperatures in oceans will likely result in changes in **distribution of marine species** and can significantly influence the reproductive cycles of fish.
- **Continued degradation will mean tipping points are reached**, risks to sequestration capacity and could accelerate warming.



# Natural climate actions can also provide substantial emission reduction potential

Climate mitigation potential 2030, Gt CO<sub>2</sub>e/yr



Maximum potential, sequestration and avoided emissions, is 23.8 GtCO<sub>2</sub>e per annum by 2030

Source: Griscom et al (2017)

# Four building blocks of the circular economy

## Building blocks of a circular economy

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1

Circular design and production

2

New business models

3

Building and supporting reverse cycles

4

Ensuring favourable conditions

## Areas the need to be addressed

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Facilitate product reuse, recycling and cascading through selection of materials, design of processes or products or the reuse of by - products or waste

Requires seizing new opportunities or replace existing models, have to leverage scale and vertical integration. Power of the example is critical.

Investigate new or additional ways to allow for the return of products/waste streams to be re-used. Rethink logistics, warehousing, system design to reduce leakage.

Providing clear policy signals and support. Including overcoming market failures that currently restrict action. Need appropriate enabling networks, incentives, financing and information to encourage integration.

Source: Ellen McArthur Foundation (2017)

# Multiple, simultaneous actions have to occur across sectors to achieve resource productivity goals

|   |  Energy supply |  Transport |  Buildings                    |  Industry   |
|---|---|---|--|--|
| <b>Increase in energy-based services per unit of energy</b> | Energy efficiency in upstream generation  | <ul style="list-style-type: none"> <li>Decarbonization of power</li> </ul>                  |  |  |
|   | Electrification of downstream applications  |   | <ul style="list-style-type: none"> <li>Deployment of EVs for light road travel and short-haul HDVs</li> </ul>    | <ul style="list-style-type: none"> <li>Further electrification of heating &amp; cooling</li> <li>Further electrification of industrial processes</li> </ul>                                  |
|   | Energy efficiency of downstream applications  |   | <ul style="list-style-type: none"> <li>Vehicle efficiency improvements for different modes</li> </ul>            | <ul style="list-style-type: none"> <li>High performance building envelopes</li> <li>Efficient equipment</li> <li>Deployment of BAT</li> <li>Retirement of less efficient capacity</li> </ul> |
| <b>Increase in GDP per unit of energy-based services</b>    | Shift to a service-intensive and digital economy  |   | <ul style="list-style-type: none"> <li>Remote working triggering reductions in miles travelled</li> </ul>        | <ul style="list-style-type: none"> <li>Remote working generating lower office space needs</li> <li>Dematerialization reducing demand for industrial products</li> </ul>                      |
|   | Efficient urban infrastructure  |   | <ul style="list-style-type: none"> <li>Modal shift</li> <li>Reduction in miles travelled</li> </ul>              | <ul style="list-style-type: none"> <li>Green neighbourhoods</li> <li>District heating</li> </ul>   |
|   | Circular and sharing economy  | <ul style="list-style-type: none"> <li>Reuse of heat</li> <li>CCU</li> </ul>                | <ul style="list-style-type: none"> <li>Car sharing practices triggering reductions in miles travelled</li> </ul> | <ul style="list-style-type: none"> <li>Co-working practices generating lower office space needs</li> </ul>   |

Source: Energy Transition Commissions (2016). Note: not a comprehensive list

# Cities are at the core

- Cities are home to more than half the world's 7+ billion population. Produce **approximately 75% of the global GDP and account for a similar amount of total GHG emissions**.
- The **global urban area will triple by 2030**. By 2050, an extra 3 billion people could live in cities: 65-75% of the world population. Will have to expand infrastructure to support this.
- The **shape and functioning of many cities are being defined now**, how this is done is critical to integrating considerations of resource efficiency, energy, transport, waste management....
- **Mitigation, adaptation, development are intertwined**. Current development path of many is shaping their future vulnerability to climate change (e.g. development on coastlines, design of infrastructure) and lock in of high emissions infrastructure (transport, energy, waste...).
- The **direction and nature of economic development of cities matters**, and it makes sense to tackle climate risks in lockstep with development planning and investment decisions.

# Sustainable infrastructure is at the heart of meeting the SDGs



Source: Bhattacharya et al, 2016

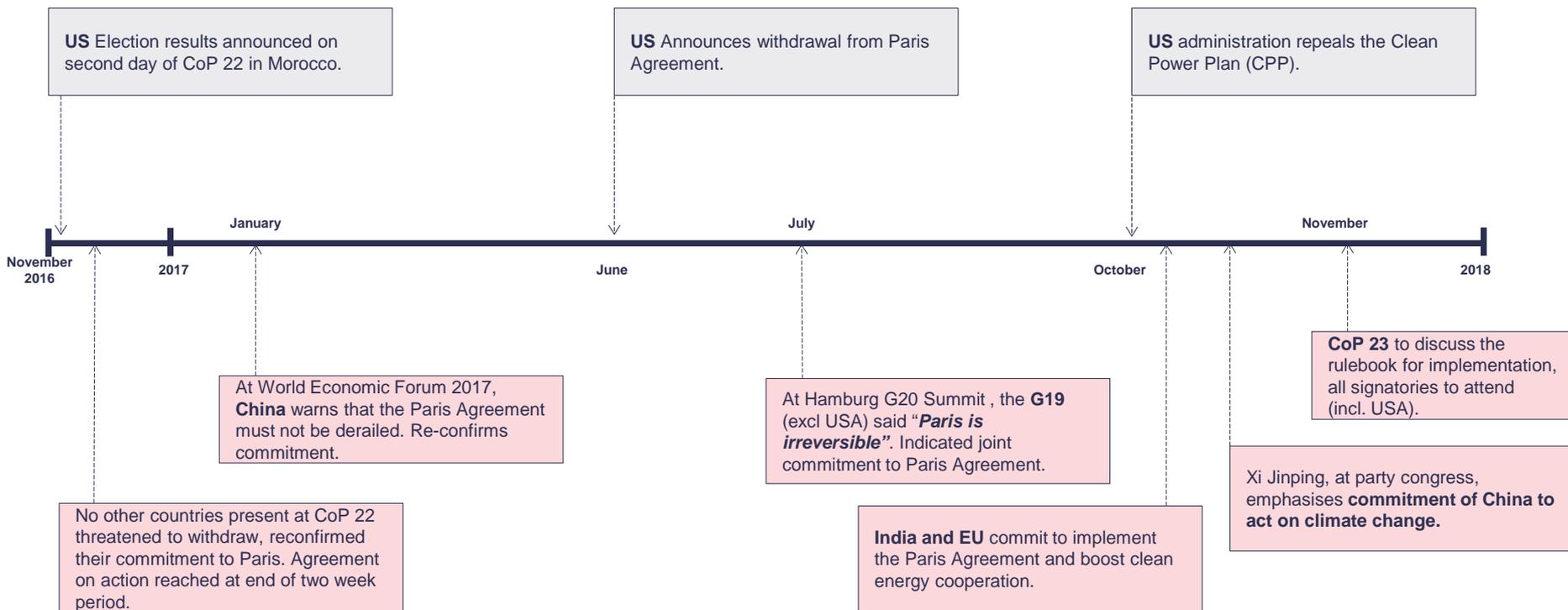
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# International action for an issue that is fundamentally global

- SDGs and Paris Agreement were **remarkable achievements**
- Countries recognised different historical roles, but came to **agreement to act collectively** for the **global public good**.
- **Foundation of agreement was built on the understanding of:**
  - the **scale of risks and urgency to act**, and
  - **attractiveness of alternative path** as sustainable route to lasting development and overcoming poverty.
- Increasingly **strong role for emerging countries** (economic influence and role in future emissions).  
World leadership changing.

# International collaboration will continue notwithstanding the USA



# The USA is still in the Paris Agreement; action will continue and be led by sub-national actors.

- Cannot withdraw for 3 years, then have to give one-year notice.
- What happens remains to be seen, announced “withdrawal” but not how it plans to do this. Would join Syria as the only country outside the Paris Agreement if it does withdraw. Intends to participate in forthcoming CoP.

## Sub-national actor

## Actions

### States

- **United States Climate Alliance** (15 states representing 16% of US population) have committed to the USA Paris targets.
- Predicted to achieve a combined 24 – 29% GHG emission reduction below 2005 levels by 2025. On track to achieve these reductions in line with US NDC (US Climate Alliance, 2017).

### Cities

- **Mayors' National Climate Action Agenda** (382 mayors, representing 68 million US citizens) have pledged to “adopt, honour, and uphold the Paris Agreement goals in their cities”.

### Companies

- Over **1,000 companies** have signed the **Business Backs Low-Carbon USA** statement re-affirming their commitment to the implementation of the Paris Agreement.

It is possible that the USA will reach their Paris targets irrespective of the actions of the federal government

# Middle income countries as development partners; focus on sustainable infrastructure investment

- MICs account for more than 50% of the global economy, **70% of global growth**, and 70% of coming investment in infrastructure.
- They are central to the **elimination of absolute poverty** (80 percent of people living below \$2 per day) and the attainment of the SDGs.
- They have shown **leadership in setting up new development institutions** - Asian Infrastructure Investment Bank (AIIB) and the New Development Bank (NDB). China alone is the largest overseas investor in infrastructure. Belt and Road Initiative will amplify.
- Chinese **FDI** exceeds total foreign aid.
- **Partnership is crucial.** Capacity and willingness to increase their contributions to the traditional MDBs thereby strengthening their role in development finance.

# Progress around the world

**China**



- Peaked coal use in 2014; energy emissions flat.
- Committed to take a “driving seat in international cooperation to respond to climate change”.
- More references to “environment” and “green” than the “economy” in 19<sup>th</sup> Party Conference Speech.

**India**



- Unlikely to pursue all coal-fired stations currently planned.
- Announced plans to increase RE capacity to 175 GW by 2022.
- Target to sell only electric vehicles by 2030.

**Mexico**



- Passed the General Climate Change law in 2012. committed to generating 50% of electricity from clean sources.
- Instituted a carbon tax on fossil fuel use.

**Ethiopia**



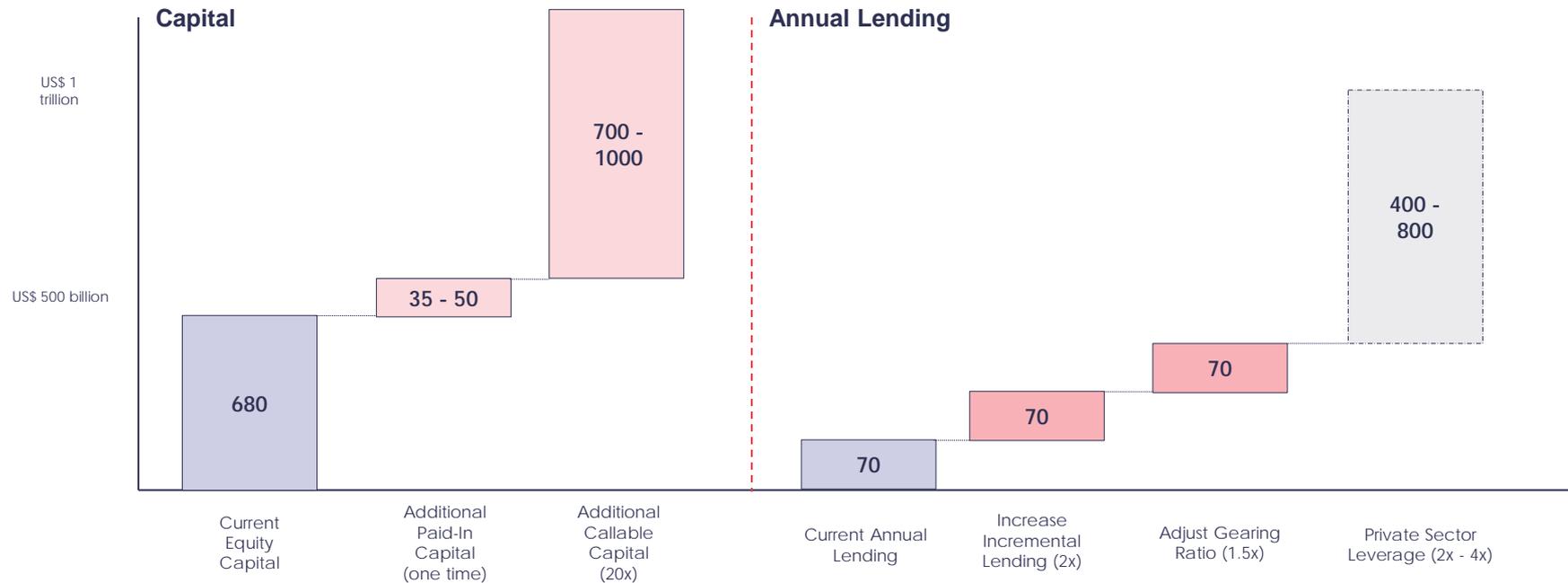
- Plan to become a middle income nation by 2025 without an increase in GHG emissions.
- Meles Zenawi (2011): “it is not justice to foul the planet because others have fouled it in the past”.

**Colombia**



- Set a GHG reduction target of 20 – 30% by 2030 compare to business-as-usual scenario.
- Private banks are releasing green bonds to finance renewable energy projects, US\$110 million in 2017.

# Development banks can play a key in moving from “billions” to “trillions” to finance the new global agenda



One time paid-in of US\$35 – 50 billion could lead to extra investment of US\$400 – 800 billion

Source: Bhattacharya et al, 2016

# Strengthen institutions for innovation, finance, prices, to support and accelerate the transition

- **Strengthen investment frameworks, institutional capacities and policies.**
  - Development banks, bilateral aid and climate finance organisations can provide well-structured policy packages to promote clean and energy efficiency infrastructure.
- **Finance:** banks, regulators and wider community (G20, OECD) should work to mobilise lending capacities, and foster productive and profitable private capital.
  - Heed stability warnings of chair of FSB (Mark Carney) and advance recommendations of the Bloomberg Task Force on Climate-related Financial Disclosures.
- Increased commitment to collaboration on **clean technology development and deployment:** Mission Innovation; International Solar Energy Alliance; Breakthrough Energy Coalition.
- **Deepen global understanding of carbon pricing** (Carbon Pricing Leadership Coalition –Stiglitz and Stern Commission on Carbon Pricing, May 2017).

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# Creating a supporting policy and institutional environment and tackling market failures

- Requires **policies that support economic dynamism and tackle multiple market failures**. Different failures point to different instruments. For example a carbon price by itself is unlikely to redesign cities. The collection is mutually reinforcing:
  - **Greenhouse gases:** carbon taxes / cap-and-trade / regulation.
  - **R,D&D** (research, development and deployment): tax breaks, feed-in tariffs (FIT) for deployment, publicly funded research.
  - **Imperfection in risk/capital markets:** risk sharing/reduction through guarantees, equity, feed-in tariffs, floors on carbon prices manage risk; convening power for co-financing. Development banks: reduce policy risk; manage risk; provide leverage; longer-term horizon; power of example.
  - **Networks:** investment in infrastructure to support electricity grids, public transport, broadband, recycling, community-based insulation schemes. Government frameworks and guidance needed.
  - **Information:** for consumers labelling and information requirements on cars, domestic appliances, products more generally; awareness of options. Similar issues for producers.
  - **Co-benefits:** valuing ecosystems and biodiversity, valuing energy security, regulation of dirty and more dangerous technologies.

**If other policies are in place, a carbon price of between US\$ 40 – 80 per tonne by 2020, rising to \$50-100 by 2030 is required.**

Source: World Bank (2017). Report of the High-Level Commission on Carbon Prices

# Strong and sustainable investment requires sound and credible policies; careful thought, strong commitment

- The necessary quality and quantity of investment required will be determined by sound policy and government direction dealing with **pollution, carbon prices, abolishing fossil fuel subsidies, city design...**
- Strong investment **requires clear and credible policies.**
  - Government-induced **policy risk is the biggest deterrent to investment** worldwide.
  - **Bringing down the cost of capital** essential to sustainable infrastructure decisions.
- Have to be **'predictably flexible'**. Circumstances will change and there will be learning and technological advance - indeed these are key to the process.
  - As these changes occur policies will need revision but approach to and criteria for revision should be clear, transparent and communicated effectively.
- **Private investment** will predominate. But public investment and partnerships necessary.
- Requires: policies/institutions, capacity, finance. **A new and dynamic public economics.**

# Building international political commitment and action

- Paris CoP21 set target of “well below 2°C and recognised that current NDCs for 2030 involved emissions much too high for the target; **they are roughly consistent with 3°C.**
- Hence plans to work between now and CoP 26 (2020) to put more ambitious plans in place. Must show in next 2 years how to **ramp-up.**
- **International leadership** must strengthen if pace is to pick-up (China, Europe...?) Also UN.
- **Reform of international financial system,**
  - see for example G20 and “Eminent Persons Group”
  - should place SDGs and CoP 21 at centre stage
- Am **optimistic about what could be done.** The new sustainable growth model is in our hands. We will learn much more along the way. **But what will we do?**

# Understanding urgency; offering an attractive vision; building political will

- If we do not take the opportunities now, **2°C will be out of reach and we will risk reversing development gains, having cities where we cannot move or breathe, ecosystems that collapse.** The gains are potentially immense, but so too are the risks of delay.
- **Urgency and scale** insufficiently understood, we are winning the arguments but action still far too slow.
- The actions of the **next 20 years are decisive** and are shaped by our actions and policies in the next 10 years.
- **Requires powerful action and innovation** across the board: cities; energy; land; technology; public policy and institutions; finance and MDBs; international collaboration; private sector.
- **Political will fundamental** for such radical change: leadership nationally and internationally; private sector; civil society; faith groups and young people.

# Reference List

- Bhattacharya, A., Meltzer, J., Oppenheim, J., Qureshi, M.Z. and Stern, N. 2016. Delivering on Sustainable Infrastructure for Better Development and Better Climate. Available: <http://newclimateeconomy.net/content/2016-nce-report-launch-sustainable-infrastructure-imperative>
- Bhattacharya, A., Oppenheim, J. and Stern, N. 2015. Driving Sustainable Development through Better Infrastructure: Key Elements of A Transformation Program. Global Economy and Development at Brookings, Working Paper 91.
- Business and Sustainable Development Commission. 2017. Better Business, Better World. Available: <http://report.businesscommission.org/>
- Griscorn et al (2017). Natural climate solutions. PNAS, 114 (44) 11645 -11650
- Ellen McArthur Foundation. 2017. Building Blocks of a Circular Economy. Available: <https://www.ellenmacarthurfoundation.org/circular-economy/building-blocks>
- Energy Transitions Commission. 2016. Shaping Energy Transitions. Energy Transition Commission, London.
- International Energy Agency. 2017. Energy Technology Perspectives 2017. Available: <http://www.iea.org/etp/>
- IPCC. 2014. Summary for Policy Makers. Available: [https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/drafts/fgd/ipcc\\_wg3\\_ar5\\_summary-for-policymakers\\_approved.pdf](https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/drafts/fgd/ipcc_wg3_ar5_summary-for-policymakers_approved.pdf)
- New Climate Economy. 2014. Better Growth, Better Climate. Available: <http://2014.newclimateeconomy.report/>
- Stern, N. 2015. Why Are We Waiting? The Logic, Urgency, and Promise of Tackling Climate Change. United States of America: MIT Press
- Stern, N. 2015. Understanding climate finance for the Paris summit in December 2015 in the context of financing for sustainable development for the Addis Ababa conference in July 2015. Grantham Research Institute on Climate Change and the Environment, Policy Paper.
- Stern, N. 2016. Current climate models are grossly misleading. *Nature Climate Change*, 530, 407 – 409.
- World Bank. 2017. Report of the High Level Commission on Carbon Prices. Available: [https://static1.squarespace.com/static/54ff9c5ce4b0a53decccfb4c/t/59b7f26b3c91f1bb0de2e41a/1505227373770/CarbonPricing\\_EnglishSummary.pdf](https://static1.squarespace.com/static/54ff9c5ce4b0a53decccfb4c/t/59b7f26b3c91f1bb0de2e41a/1505227373770/CarbonPricing_EnglishSummary.pdf)