

Unlocking the inclusive growth story of the 21st century: the drive to the zero-carbon economy

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Harvard, October 2019

Structure

- **The global agenda, urgency and scale**
- Sustainable growth in a changing world
- Investing in the four capitals to deliver high-quality sustainable growth: human, physical, natural and social capital
- Driving change; sectors and countries; policy and finance

In the era of international cooperation, we have seen extraordinary achievement along many dimensions of development

Dimension	Indicator	1960	2015	Source
Income	GDP per capita (constant 2010 US\$)	3,737	10,636	World Bank, 2018
	Health	Life Expectancy (years)	52.5	
Education	Infant mortality (per 1000 births)	103	31	World Bank, 2018
	Literacy Rate (% of people ages 15 and above)	61%	86%	World Bank, 2018
Poverty	Average years of education	3.2	7.7 (2010)	OECD, 2014
	Share of population living on less than US\$1.90 per day	42% (1981)	10%	World Bank, 2018
Population	Billions of people	3.0	7.3	UN Population Division, 2018

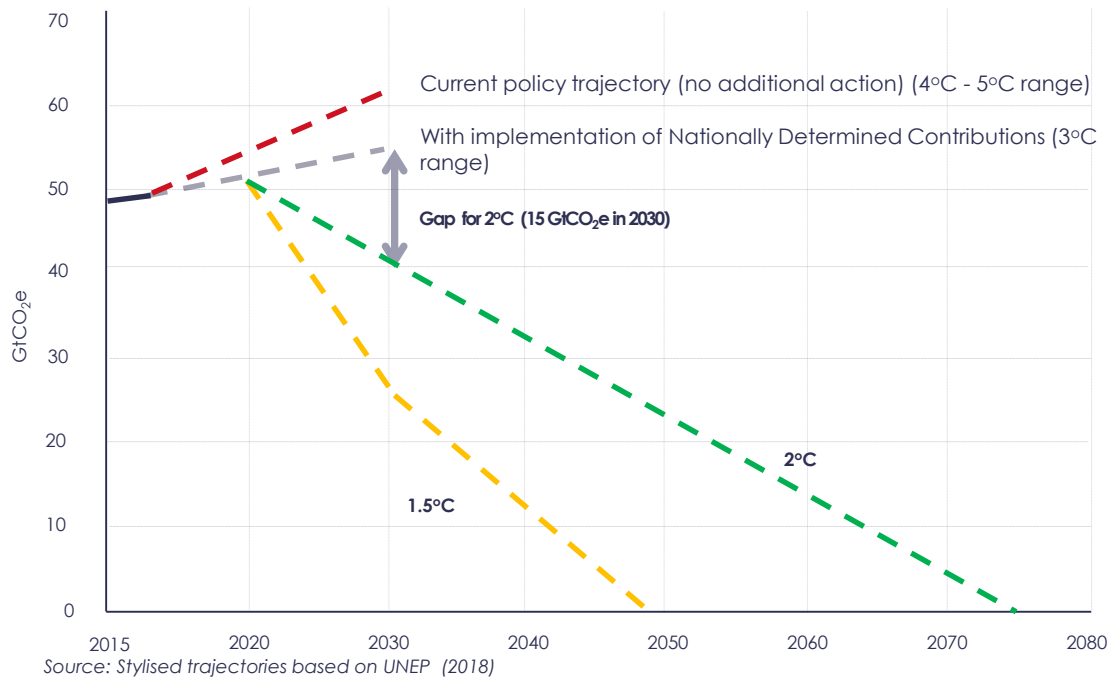
The scale and nature of growth has put intense pressure on the environment and global commons: from 1950 to now world population has roughly trebled; GDP/capita gone up by a factor of 4; output by a factor of 12. Largely fossil-fuelled.

2015/2016 were breakthrough years for international cooperation led by climate change, but progress is under threat

<u>Area</u>	<u>Date</u>	<u>Name of Agreement</u>
Finance	July 2015	Financing for development
Development	Sep 2015	Sustainable Development Goals
Climate Change	Dec 2015	Paris Agreement on Climate Change (CoP 21)
Urban Development	Oct 2016	New Urban Agenda
Climate Change	Oct 2016	The Kigali Amendment to the Montreal protocol
Climate Change	Nov 2016	Marrakesh Action Proclamation For Our Climate And Sustainable Development (CoP22)

We can rebuild the spirit of internationalism and common humanity by pursuing this agenda. Internationalism is necessary to deliver on this agenda.

Currently a large gap between current COP21 NDCs and what is required to reach the Paris temperature targets



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” in next 50-60 years.

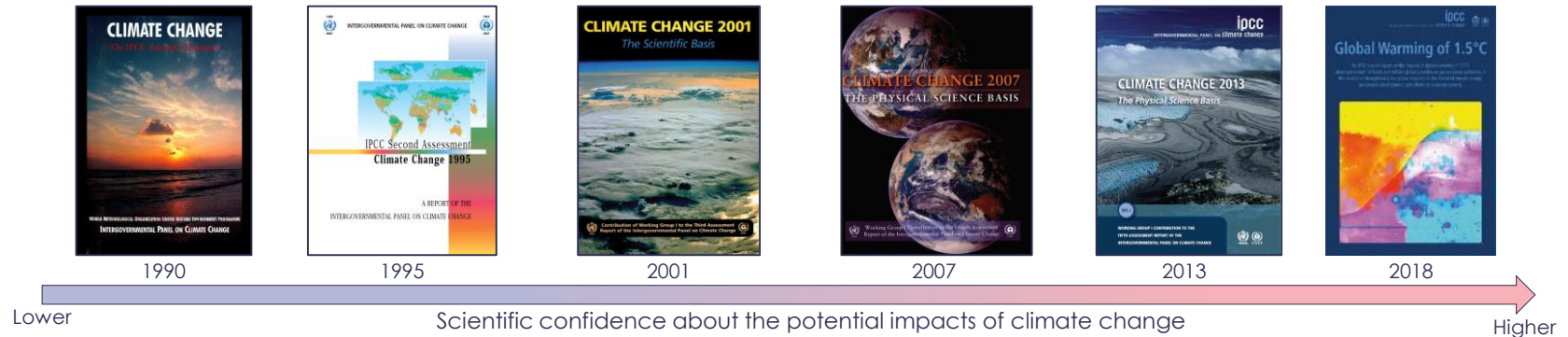
The science of climate change is clear; the impacts of failure could be devastating; difference between 1.5°C and 2°C strongly significant

	1.5°C	2°C
Extreme Heat (Global pop. exposed to severe heat at least once every 5 years)	14%	37%
Frequency of rainfall extremes (land)	17%	36%
Average drought length (months)	2	4

Source: IPCC (2018) and WRI (2018)

Differences between 1.5°C and 2°C are major. Differences from 2°C to 2.5°C, and then to 3°C likely still bigger. Current Paris COP21 plans for 2030 look like paths headed for 3°C and above over the next century or so.

Science looking ever more worrying; economic approach to risks way behind the science (I)



The process has been institutionally cautious due to the need to find agreement on basics and long lags in processes (cut-off dates for eligibility...). Each IPCC report has looked more worrying than its predecessors.

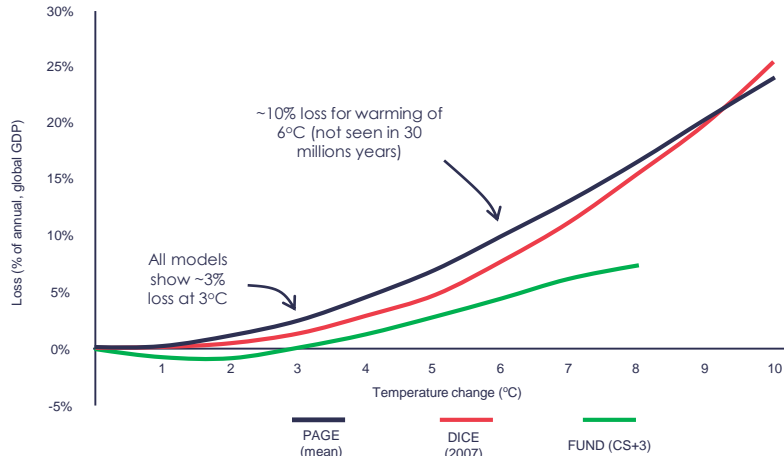
Effects coming through at greater speed, scale and intensity than anticipated.

Tipping points increasingly concerning and thresholds are being passed or close to being passed (West Antarctic and Greenland ice sheets, Amazon rainforest...)

Our current civilisations are from last 8-9000 years following the move from grass to grains and to stable agriculture – the Holocene period. Already on the edge of those temperatures at ~1.1°C. Have not seen temperatures >3°C for around 3 million years.

Science looking ever more worrying; economic approach to risks way behind the science (II)

Economic models



Source: Recreated from the Interagency Working Group on Social Cost of Carbon, United States Government (2010)

Potential impacts and risks (e.g. submergence of large areas, desertification of others, migration, conflict...) are at a scale not before seen and not consistent with long-run, continuous growth or current economic structure. They are rarely included in current impact assessment models.

Economics Research

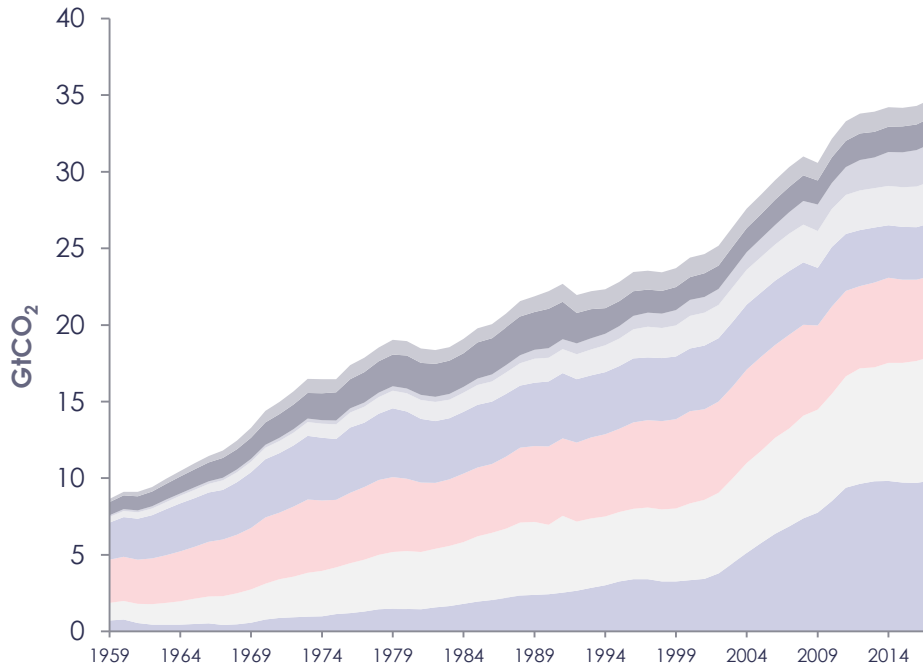
Journal name	Number of articles ever published on climate change
<i>Quarterly Journal of Economics</i>	0
<i>Economic Journal</i>	9
<i>Review of Economic Studies</i>	3
<i>Econometrica</i>	2
<i>American Economic Review</i>	19
<i>Journal of the European Economic Association</i>	8
<i>Economica</i>	4
<i>Journal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

The missing risks, assumptions or shortcomings of models result in the downplaying of the immense shocks climate change, as well as underplaying the enormous benefits, to lives and livelihoods. Contributes to a delay in action from policy makers, or suggestion of marginal changes. This is serious underperformance, indeed failure, of our subject.

Global GHG emissions are on the wrong track



Source: Global Carbon Project (2018). (Energy Sector only)

Country	GHG emissions (GtCO ₂) (2017)	Trend (past 5 years) (GtCO ₂ in 2013)
Japan	1.2	↓ (1.3)
Russia	1.7	↔ (1.7)
India	2.5	↑ (2)
Rest of OECD	2.7	↑ (2.5)
Europe (OECD)	3.5	↓ (3.6)
USA	5.3	↓ (5.5)
Non-OECD countries	8.1	↑ (7.4)
China	9.8	↓ (10)
Total	34.7	↑ (33.9)

Have we reached a plateau? Overall increases in 2016, 2017, and 2018. Important to turn down now and go to zero-carbon by mid-century for 1.5°C and within five decades for 2°C.

Climate change is an immense risk, decisions made now are critical in establishing low-carbon development, growth and poverty reduction

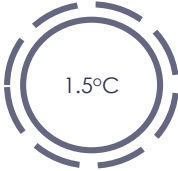
Change in the next decades

15 years Infrastructure  ↑ 2x Investment of approximately US\$ 90 trillion.

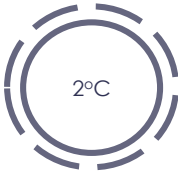
20 years GDP  ↑ 2x Growth of approximately 3% per annum. Led by emerging and developing countries.

40 years Urban Population  ↑ 2x Urban population will double in 40 years, Towns and cities shaped in the next 20.

At the same time (to meet Paris targets)

 ↓ ~50% Decrease GHG emissions from ~50 to ~25 Gt CO₂e by 2030

or

 ↓ ~20% Decrease GHG emissions from ~50 to ~40 Gt CO₂e by 2030

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.

Structure

- The global agenda, urgency and scale
- **Sustainable growth in a changing world**
- Investing in the four capitals to deliver high-quality sustainable growth: human, physical, natural and social capital
- Driving change; sectors and countries; policy and finance

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

5 - 10 years



Investment in sustainable infrastructure can boost shorter-run demand and growth, sharpen supply, reduce poverty and support sustainable development.

5 - 10 years



Investment in sustainable infrastructure and human capital can foster health and well-being for all.

>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.

To lay the foundations of the 21st century growth story it will be necessary to move beyond the standard economic models

- Current models of growth are shaped largely by physical capital, human capital, and the technology of their composition.
- The 21st century growth story will be based on balanced accumulation of several types of capital; on structural change towards the service sector; on higher quality outputs and inputs; and on labour and resource efficiency and productivity. It must also:
 - Embody increasing returns to scale in production and discovery.
 - Capture the possibilities of very rapid technological change, cost reduction and diffusion in the next two decades.

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 12
years old.



Electric
vehicles



New
materials

Advances will in large measure be driven by strong, credible policy, institutional change, city design/planning etc.

There is immense investment potential and strong savings. Need sound policy to transform opportunities into real projects/programmes. Need right kind of finance, on the right scale, at the right time.

Global strategies for sustainable growth and development set in a rapidly changing world

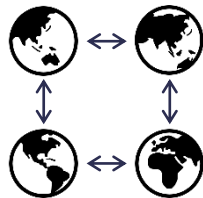
Labour markets



Major potential disruptions and risks to labour markets (artificial intelligence and automation)

Great opportunities created by the need to respond to fundamental challenges.

Trade and investment



Changing economic geography. Low and middle income countries now largest share of Global GDP (PPP).

Continued uncertainties around trade and investment (US-China, Brexit, Belt and Road Initiative...)

Demographics/population



Changing structure of populations/demographics globally.

By 2050 more older people (>60 years) than those between 10 and 24. Expected that 80% of older people will live in developing countries by 2050.

Climate resilience



Need to manage climate change impacts. They are major at 1.5°C or 2°C.

Need to integrate development, mitigation and adaptation.

Drive to zero-carbon economy can complement or facilitate these changes; new possibilities for more attractive and inclusive form of growth. Sustainable infrastructure at the core. Great dangers of delay in the potential lock-in of high-carbon capital.

Strong investment in sustainable infrastructure will accelerate growth which is sustainable and inclusive; delivering the SDGs



Structure

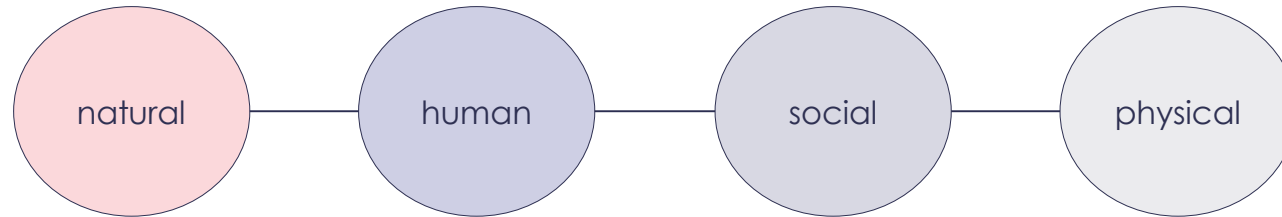
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Sustainable growth embodies a focus on the quality and quantity of the four types of capital

Definition of sustainability:

This generation makes available to future generations, opportunities at least as good as their own, assuming that the next generation behaves in a similar way towards its successors.

Four types of capitals that are essential to human well-being and wealth:

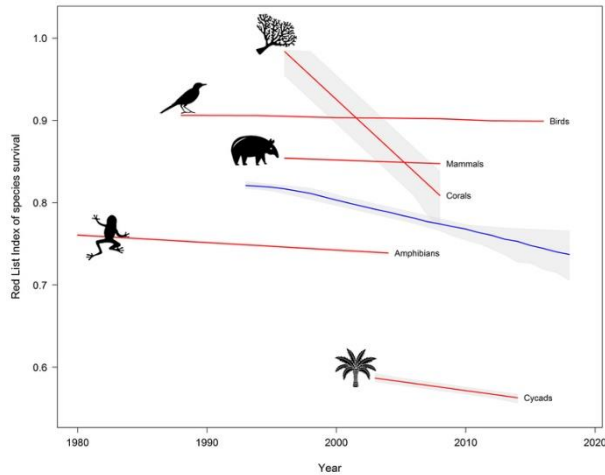


Recognising the interactions and complementarity between the four types of capital is of fundamental importance.

Investing in and achieving high productivity of these capitals is crucial to enabling economic growth to continue at high rates with lower factor inputs, and to making growth sustainable.

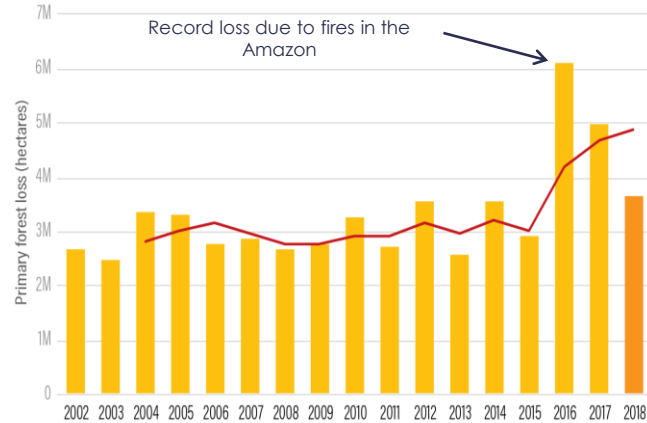
Natural capital (I): air, water, land, biodiversity are under threat

Biodiversity



Source: IUCN (2019). Available: <https://www.iucnredlist.org/assessment/red-list-index>

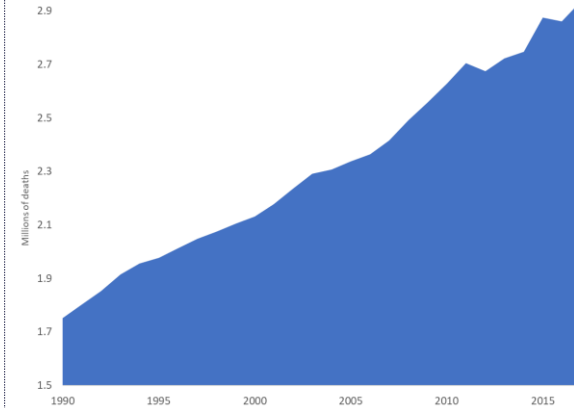
Tropical forest loss



Note: Red line represents the three-year moving average of primary tropical loss.

Source: Global Forest Watch (2019). Available: <https://blog.globalforestwatch.org/data-and-research/world-lost-belgium-sized-area-of-primary-rainforests-last-year>

Air Pollution

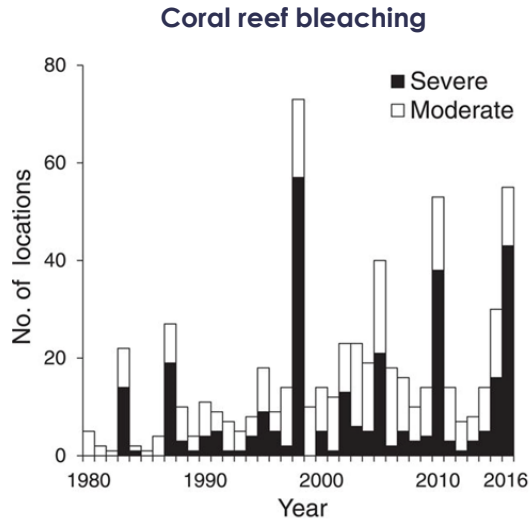


Note: Deaths from outdoor particulate air pollution only

Source: Global Burden of Disease Study (2017)

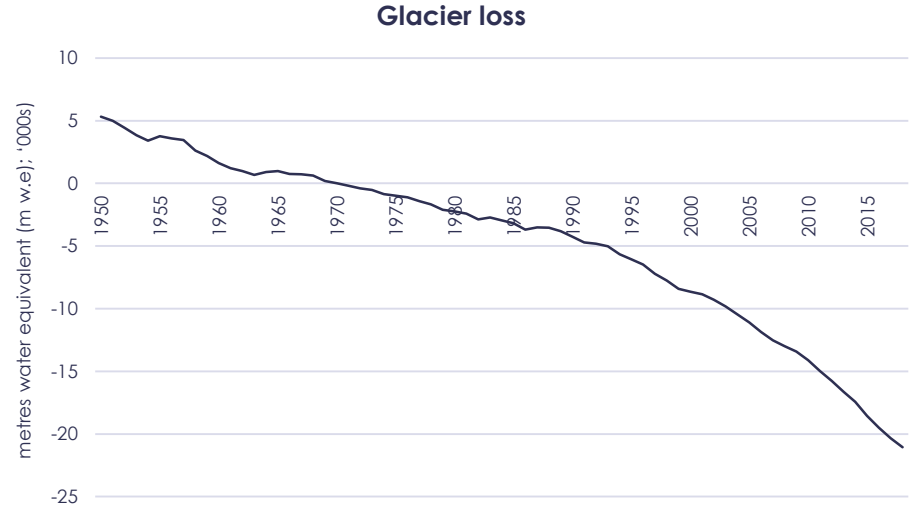
Successful investment in and protection of natural capital involves clear national and community strategies, including on agriculture, water management, city design...

Natural capital (II), the oceans and cryosphere are in a increasingly precarious position



Note: Black bars indicate severe bleaching affecting >30% of corals, and white bars depict moderate bleaching of <30% of corals.

Source: Hughes et al (2017). DOI: 10.1126/science.aan8048

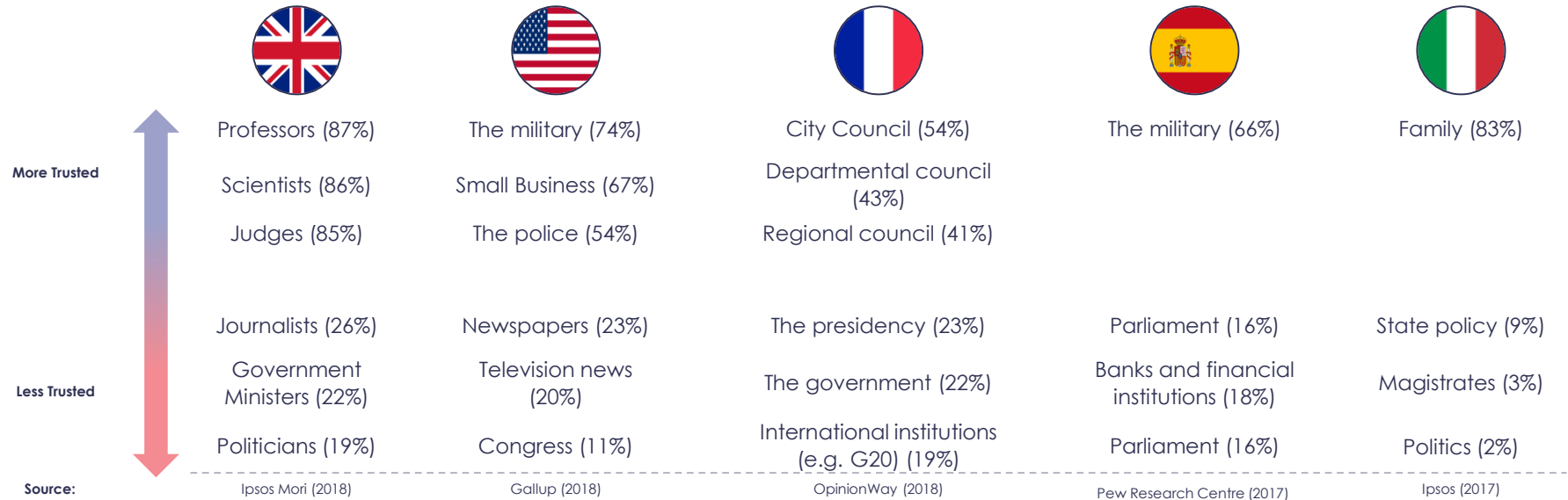


Note: A value of -1.0 m w.e. per year represents a loss of 1,000 kg per square meter of ice cover, or an annual glacier-wide ice thickness loss of about 1.1 m per year

Source: WGMS (2017, updated, and earlier reports). Available: <https://wgms.ch/global-glacier-state/>

Continued degradation will mean tipping points are reached, risks sequestration capacity of oceans, water availability from cryosphere, sea level rise, and could accelerate warming.

Social capital supports co-operation within or among groups, including cohesiveness and trust in institutions



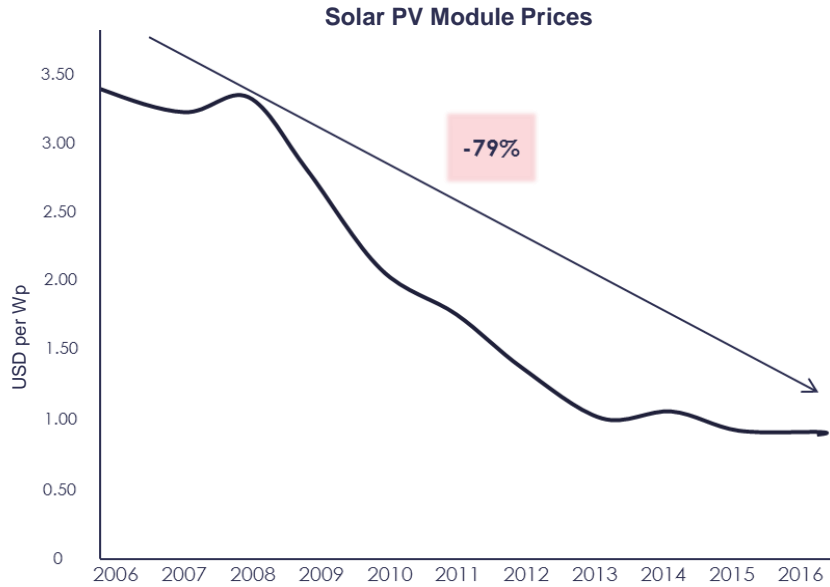
Disruption of social capital can often be concentrated in particular regions. Currently there are many perceived challenges to security, dignity and identity

Declining social capital could be a challenge to democracy and an obstacle to tackling change needed. Currently low levels of trust in governments and media around the world (Edelman Barometer, 2019)

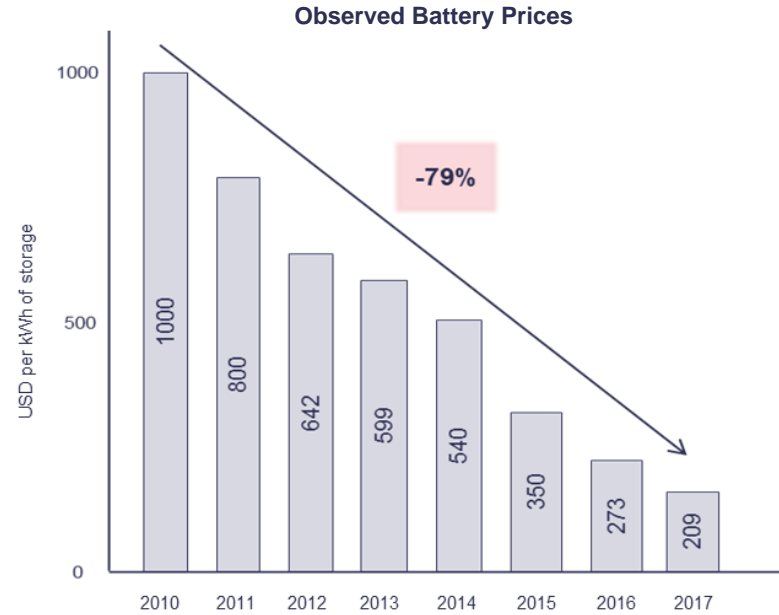
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The notion “costs of action” is being transformed by rapid technological advances and cost reductions



Source: EIA, 2017



Source: Bloomberg New Energy Finance, 2017

**Renewables with storage now competitive in many parts of the world.
Capital costs for renewables continue to fall much faster than those for conventional technologies.**

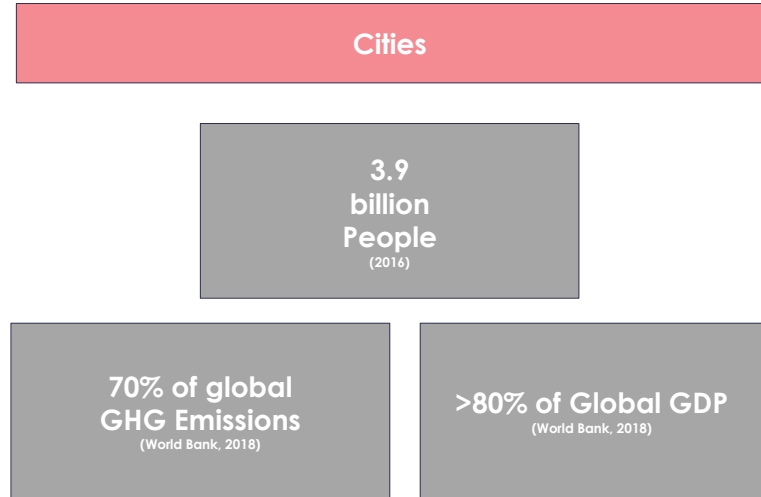
It is now technically possible to decarbonise all sectors (including hard-to-abate), at reasonable cost, to reach net-zero emissions in time for Paris commitments; combine three routes

Route	Decarbonisation option	Example
1	Reducing demand for carbon-intensive products and services (model shifts/logistics; resource efficiency)	A more resource efficient economy can reduce CO ₂ emissions from four major sectors (plastics, steel, aluminium and cement) by 40% globally. Includes circular economy.
2	Improving energy efficiency across the economy	A combination of greater logistics efficiency and modal shift (trucking to rail, short haul aviation to high speed rail) could lead to 20% reduction in CO ₂ emissions
3	Deploying a range of decarbonisation technologies across sectors: <ul style="list-style-type: none">• Increase electrification using renewable energy sources• Deployment of CCS for industrial sectors• Use of alternative fuel sources where cost effective and sustainable (biomass and hydrogen)	Increase electrification to account for ~65% of final energy demand, supplied by: <ul style="list-style-type: none">• 85 – 90% from renewable energy• 10 – 15% biomass or fossil fuels (with CCS)

Source: Energy Transition Commission (2018)

Cities are at the core; a prime source of emissions and key to enabling a just transition

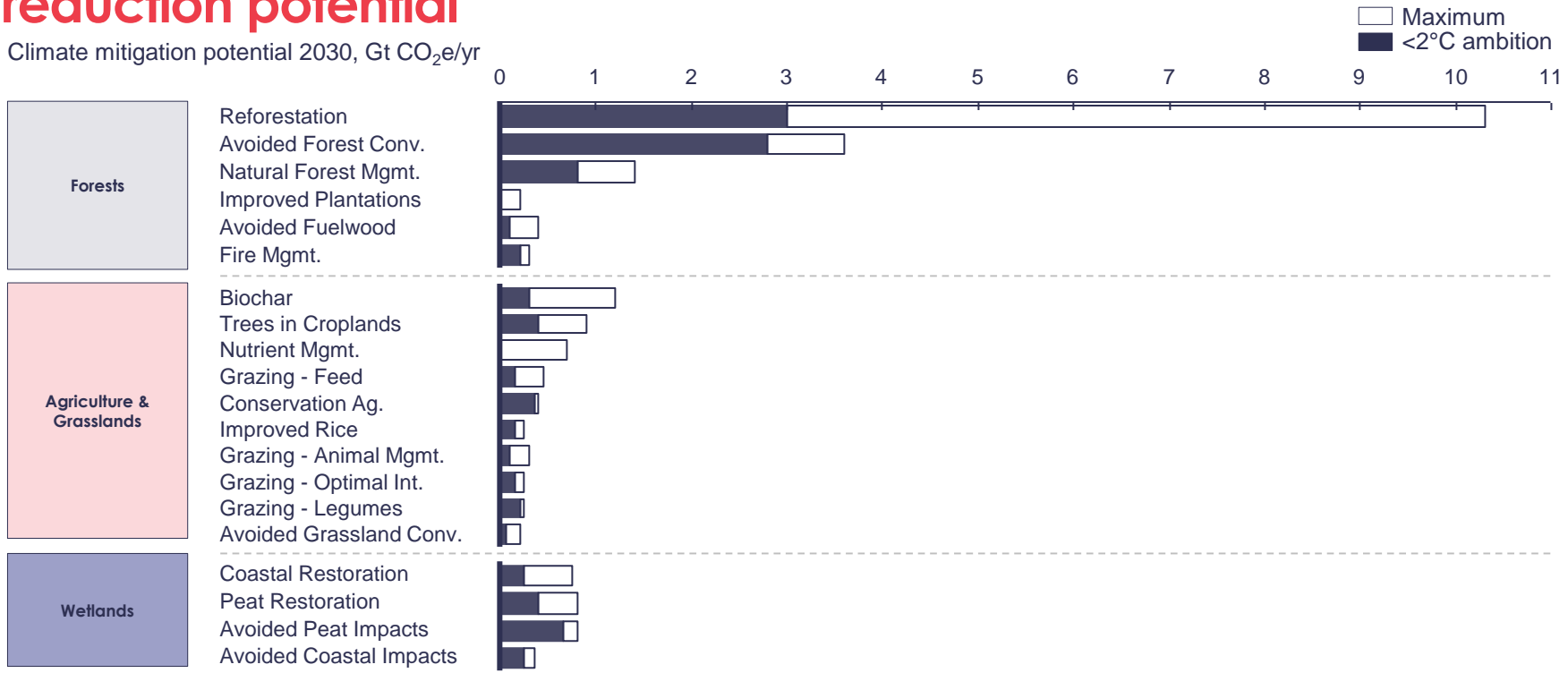
- By 2050, an **extra 3 billion people** could live in cities: 65-75% of the world population. Will have to expand infrastructure strongly.
- The shape and functioning of many cities are being **defined in coming decade**; how this is done is critical to integrating considerations of resource efficiency, energy, transport, waste management, pollution.
- **Mitigation, adaptation, development are intertwined.** Current development paths are shaping 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 matters, and it makes sense to tackle climate risks in tandem with development planning and investment decisions. See “Climate Emergency, Urban Opportunity”, September 2019 on “clean, compact, connected” cities.

Natural climate actions can also provide substantial emission reduction potential

Climate mitigation potential 2030, Gt CO₂e/yr

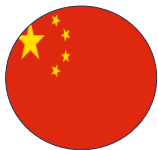


Maximum potential sequestration and avoided emissions from natural climate solutions is 23.8 GtCO₂e per annum by 2030. See also Growing Better, September 2019 from Food and Land Use Coalition.

Source: Griscom et al (2017)

What happens in China and India in the coming decades is pivotal if we are to achieve the Paris targets

China



- Peaked coal use in 2014; energy emissions flat since then, although recent upward shift. China cut coal capacity by 500m tons since 2016 (Liu He, 2018).
- Leader in electric vehicle sales and production. In 2017 had a larger EV market than Europe and the United States combined.
- Environment and sustainability a central theme of "*Xi Jinping thought*" – 14 elements, 3 related to sustainability including thought 9: *Coexist well with nature with "energy conservation and environmental protection" policies and "contribute to global ecological safety"*.

India

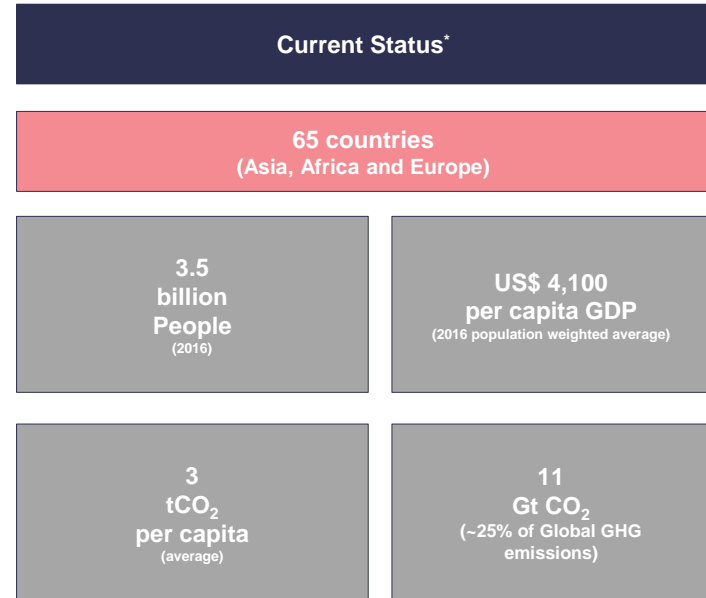


- Announced plans to increase RE capacity to 175 GW by 2022. Currently has one of the largest and most competitive energy auctions in the world, contracted over 10.5GW from wind and solar in 2017 alone.
- Unlikely to pursue all coal-fired stations currently planned.
- \$1.4 billion to subsidise sales of electric and hybrid vehicles over next three years (Reuters, 2019).
- Aims to install 770 million LED lightbulbs by 2019, when a large order of lightbulbs were made to meet this target the price fell by 83% within 20 months (Sharwood, 2016).
- Strong programme announced September 2019 on restoring degraded land.

Progress is strong in these two important countries, but emissions are still rising in India and, at best, plateauing in China.

Importance of China's 14th Five-Year Plan and the Belt and Road Initiative (BRI)

- BRI focussed on infrastructure development: transportation (road and rail), telecommunications and energy in developing regions.
- Chinese investments in BRI countries could amount to US\$ 800 billion to 1.3 trillion in next ten years.
- Aim of creating the modern “silk road” to enhance trade and maintain export momentum for China.
- **If total income and emissions rose by factor of 3 in 30 years in BRI countries, they would be well over 30 GtCO₂ (China's emissions rose by factor of 3 in first decade of this century). Have to be net-zero 50 years from now for 2°C.**



*Some rounding. Excludes China and India.

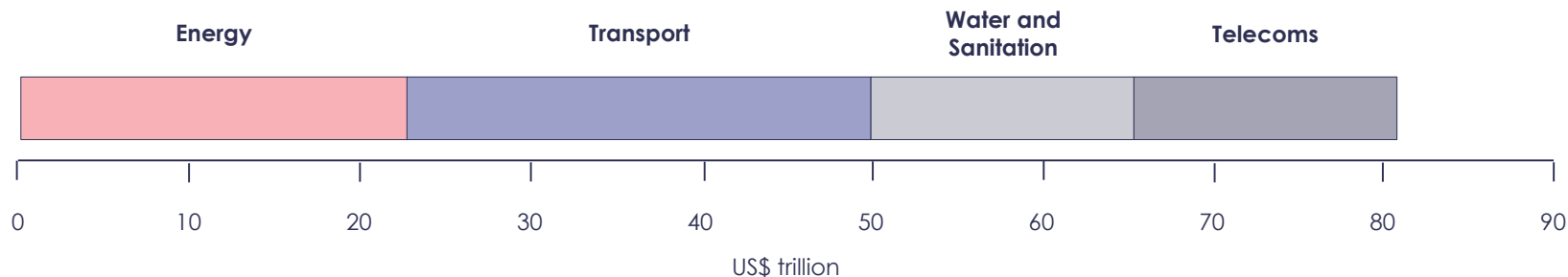
Quality and quantity of investment and shape of the transition will be determined by sound policy and clear sense of direction

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.

Government-induced policy risk is the biggest deterrent to investment worldwide. Policies must be credible over time; 'predictably flexible'.

Good policy unlocks investment demand. But its realisation requires the right kind of finance, at the right scale, at the right time.



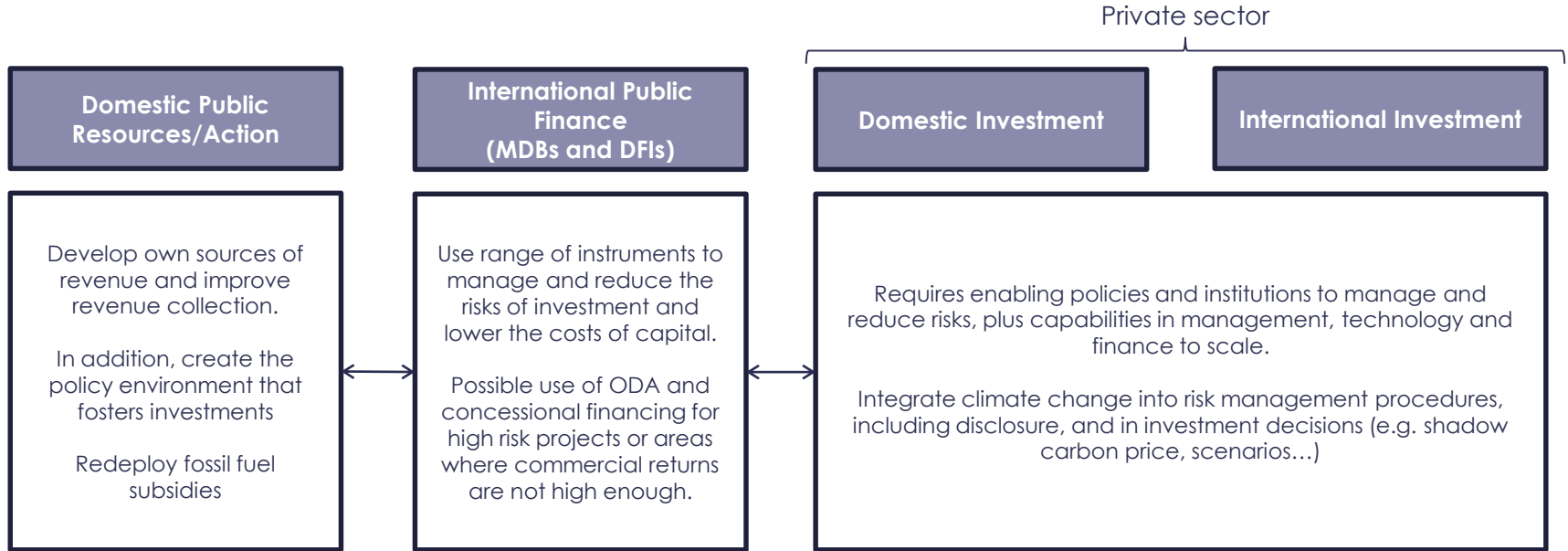
Projected cumulative infrastructure demand (2015-2030) Source: Bhattacharya et al (2016)

Note: Projections based on mid-point of range estimates. Excludes fossil fuel extraction and use, expenditure to enhance energy use efficiency, and operation and maintenance costs.

Altogether infrastructure investments that are required over the next 15 years or so are more than the current existing stock. The bulk of new infrastructure investment will be in emerging/developing countries. Incremental costs of making infrastructure sustainable are small.

Alone the public sector will not be able to raise sufficient finance for the scale of investment necessary. Unlocking the private sector will be essential. Important role for development banks.

Mobilising the required capital for sustainable investment requires a number of sources to work together



Given the scale of investment requirements for sustainable infrastructure, and development more generally, a significant scaling up of financing is needed from all sources—domestic public, international, private—and the links between them made stronger.

Levers to accelerate the systemic change required: examples

Finance

All the financing offered by MDBs should be sustainable from now on.

All large institutional investors, including sovereign wealth funds, to set out plans to make their portfolios entirely sustainable

All G7 countries to make TCFD reporting compulsory

G7/G20 to implement the G20/EPG recommendations on the reform of the system of IFIs.

Company pension schemes to make sustainable funds the default option.

Policies

All countries to commit to zero-carbon electricity by 2040

Commitments for zero unabated coal in industrial applications (cement, steel, plastics) by 2050

Cities to set timeframes for the restriction of internal combustion engine vehicles from city centres

Commitments to invest more in research and development to enable net-zero emissions (alternative fuels, battery storage, CCS...)

Radical reduction in waste, including energy, food. Circular economy

Have to identify tipping points for action. Need actions that can create change on urgency and scale necessary.

How the zero-carbon transition is managed will be central to building the consensus for strong, sustainable economies

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...)

Carbon pricing revenues should play a key role to support the transition. Potential to utilise a mix of options to promote policy goals and objectives (R&D, budgets of poor households, international climate funds...), including the just transition.

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 and inequality have made the problem more severe.

“Unlocking the inclusive growth story of the 21st century” (NCE, 2018)

Energy

- Raising revenue by pricing carbon and eliminating fossil fuel subsidies
- Saving energy through greater energy productivity
- Supporting energy access through distributed renewable energy

Cities

- Well managed densification to revitalise cities
- Sustainable and affordable housing for urban poor
- Shared, electric, low carbon transport

Food and land use

- Avoiding deforestation and degradation of forests
- Scaling up landscape restoration
- Implementing climate-smart agricultural approaches
- Supporting better food consumption patterns and reducing waste

Water

- Sustainable and equitable water allocation
- Target investment in resilient water and sanitation infrastructure

Industry, Innovation and Transport

- Focus on energy efficiency, resource efficiency, and decarbonisation in heavy industry
- Reduce emissions from the plastics value chain
- Develop low-carbon solutions for heavy-duty transport
- Increased support for innovation and deployment

Source: New Climate Economy, 2018

By 2030



Generate over **65 million** additional low-carbon jobs



Make available **US\$ 2.8 trillion** from carbon pricing revenues and removing fossil fuel subsidies



Avoid **700,000** premature deaths from air pollution

Seen remarkable progress in technology in last dozen years (renewables, EV, digital management, materials...); momentum is building but rapid acceleration needed.

Can it be done? Three 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

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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