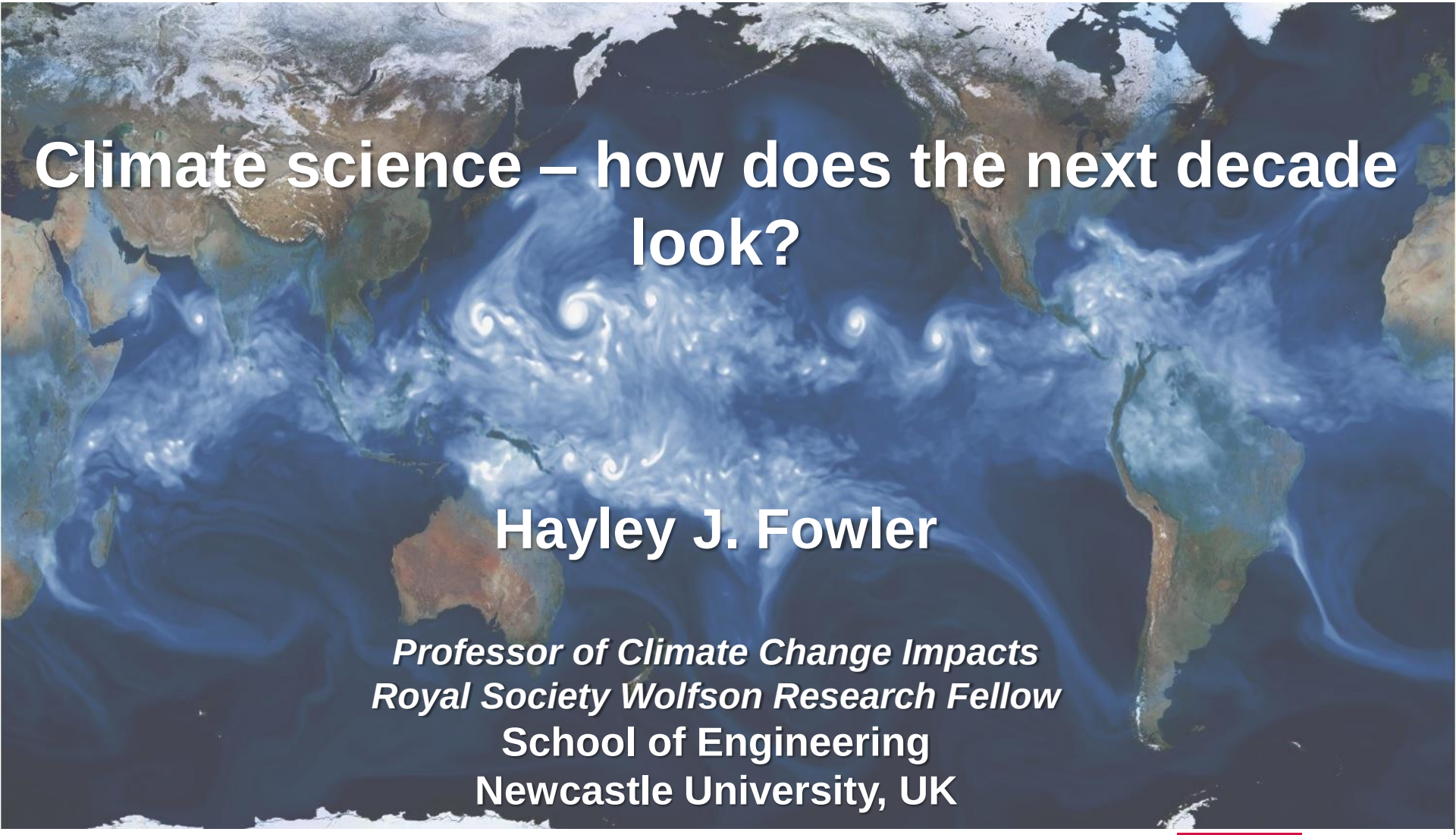


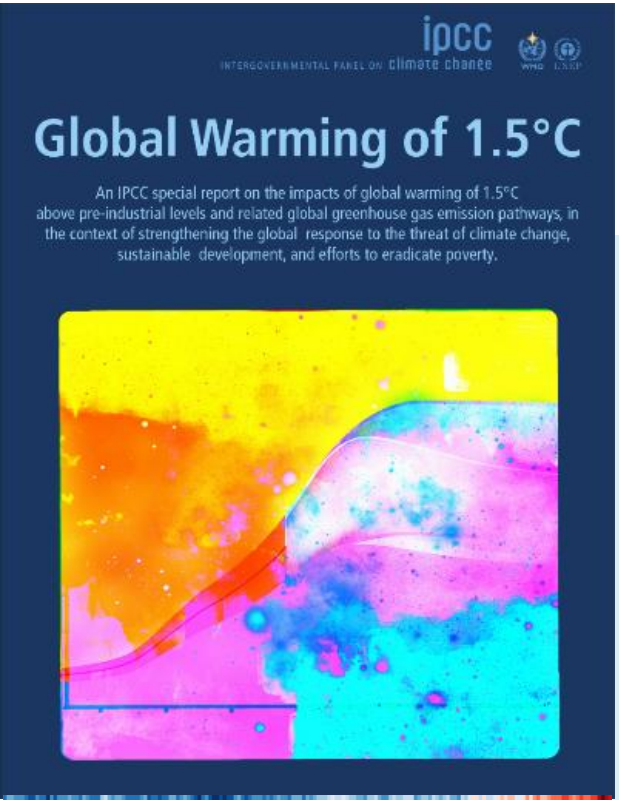
Climate science – how does the next decade look?

Hayley J. Fowler

Professor of Climate Change Impacts
Royal Society Wolfson Research Fellow
School of Engineering
Newcastle University, UK

1. This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:

   (a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

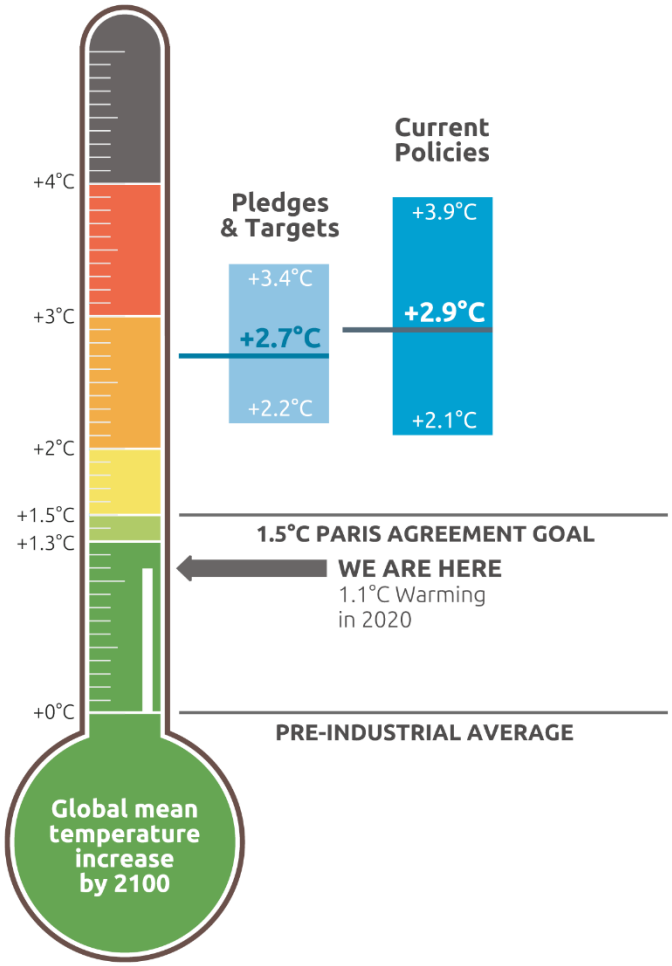


Where are we now?

Since pre-industrial times, **human activities have caused about 1.1ºC of global warming**.

- Already seeing consequences for people, nature and livelihoods
- **At current rate, we will reach 1.5ºC between 2030 and 2052**
- Past emissions alone do not commit the world to 1.5ºC
- 1990: first IPCC report – 2018 67%>1990

Keeping below 1.5ºC requires massive and rapid change



Climate Action Tracker

CAT warming projections
Global temperature increase by 2100

September 2020 Update

Current pledges and policies: 2.1 to 3.9°C rise by 2100

On the basis of equity developed countries like the UK must reduce our emissions much more quickly

Climate change is a greater global risk than pandemic, financial failure or cyber…

World Economic Forum Global Risks Landscape 2020

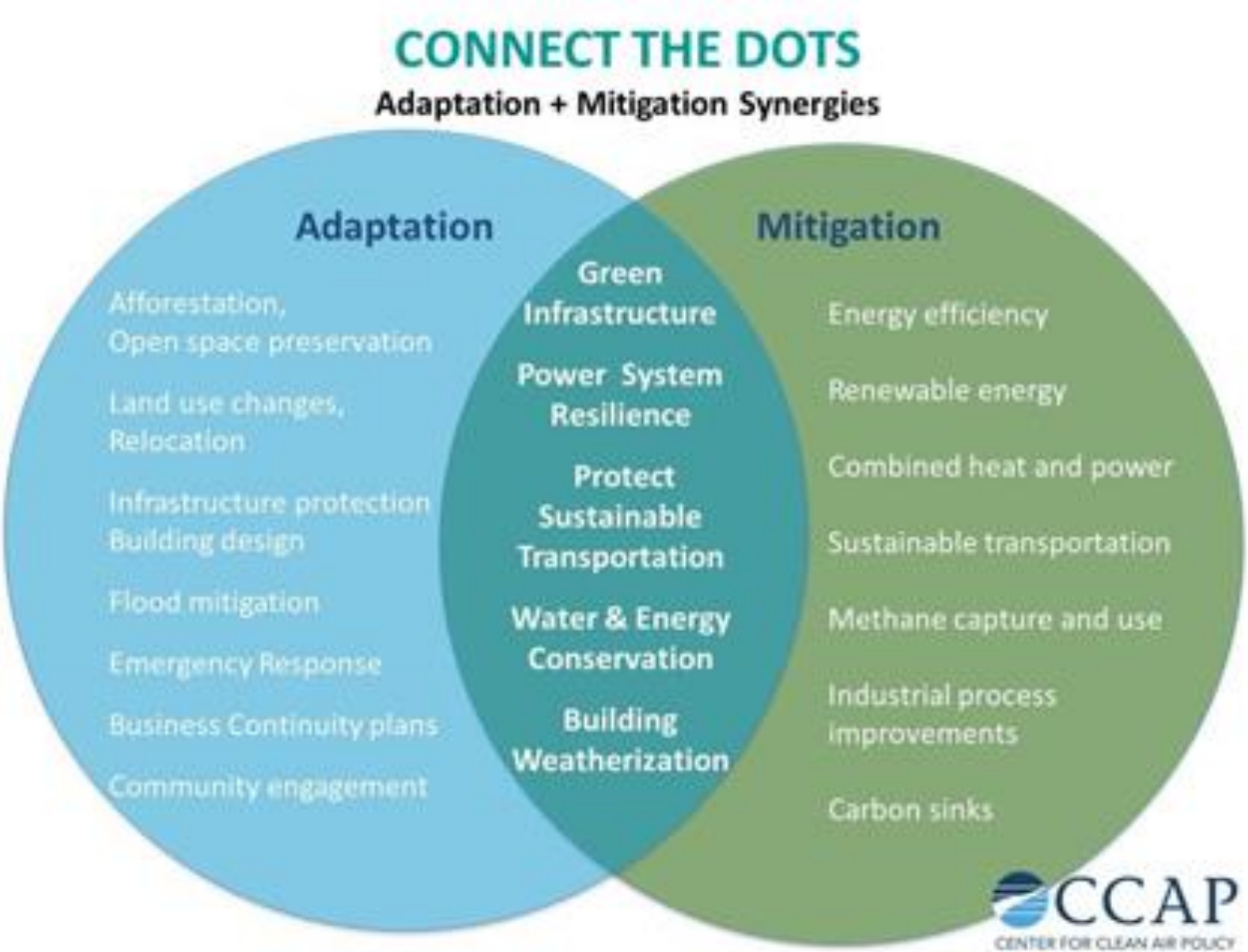
Committee on Climate Change

Climate change will cause more heavy rainstorms and flooding, as well as heatwaves, droughts, forest fires, air pollution incidents

Living in a 1°C warmer world

https://www.instagram.com/p/By3SerGnDXi/?igshid=dopwsu601et2

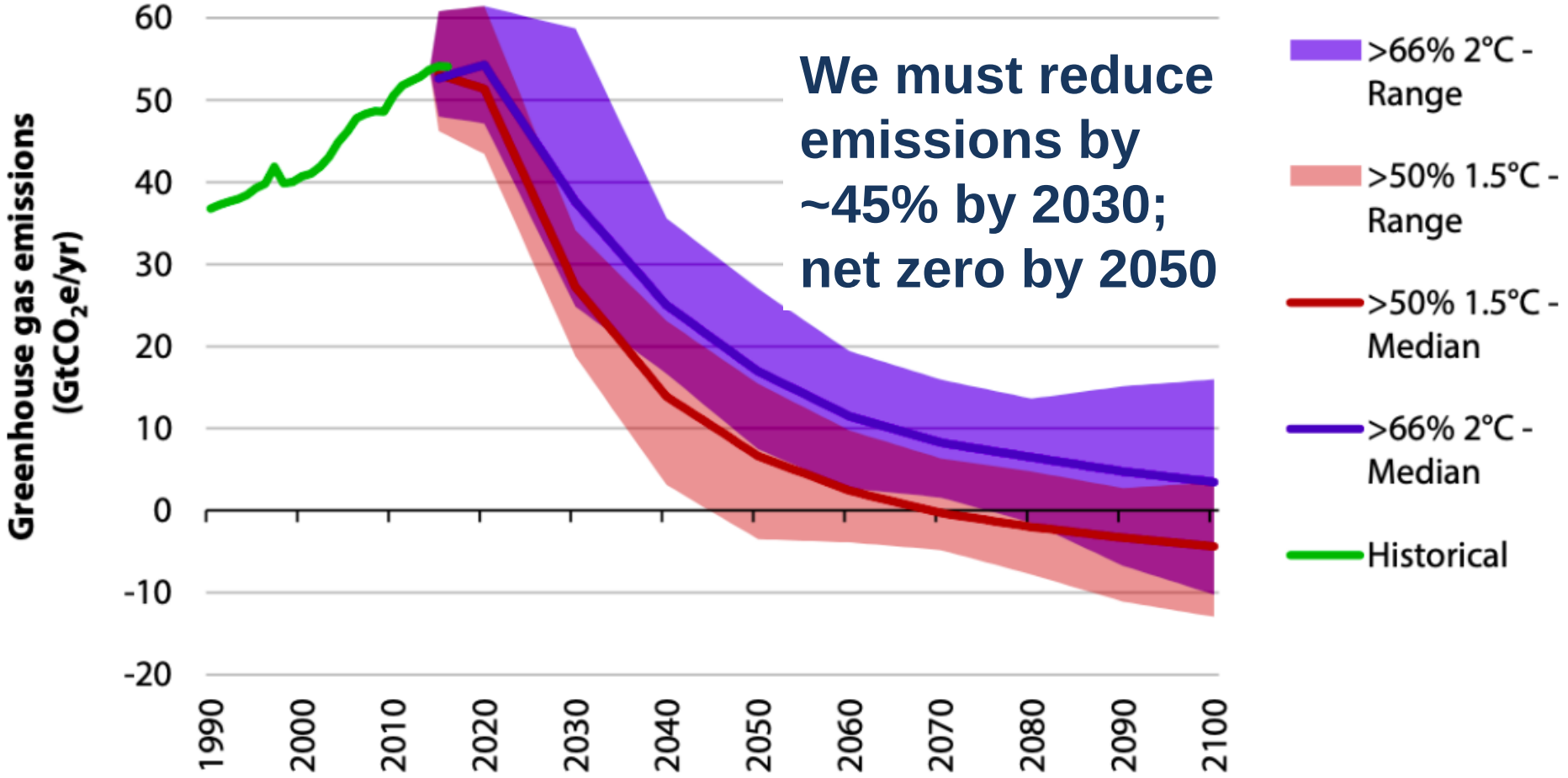
What can we do?



UK Climate Change Act 2008 sets target for mitigation but not adaptation

- In 2017 emissions were 42% below 1990 levels, in 2018 emissions were 43% below…
- …but if include aviation and shipping emissions, imports and exports (consumption) – then only 10% fall since 1990!
- Average 0.4% p.a. reduction

Keeping below 1.5ºC requires massive and rapid change



On the basis of equity developed countries like the UK must reduce our emissions much more quickly

CarbonBrief
CLEAR ON CLIMATE

Negative Emission Technologies

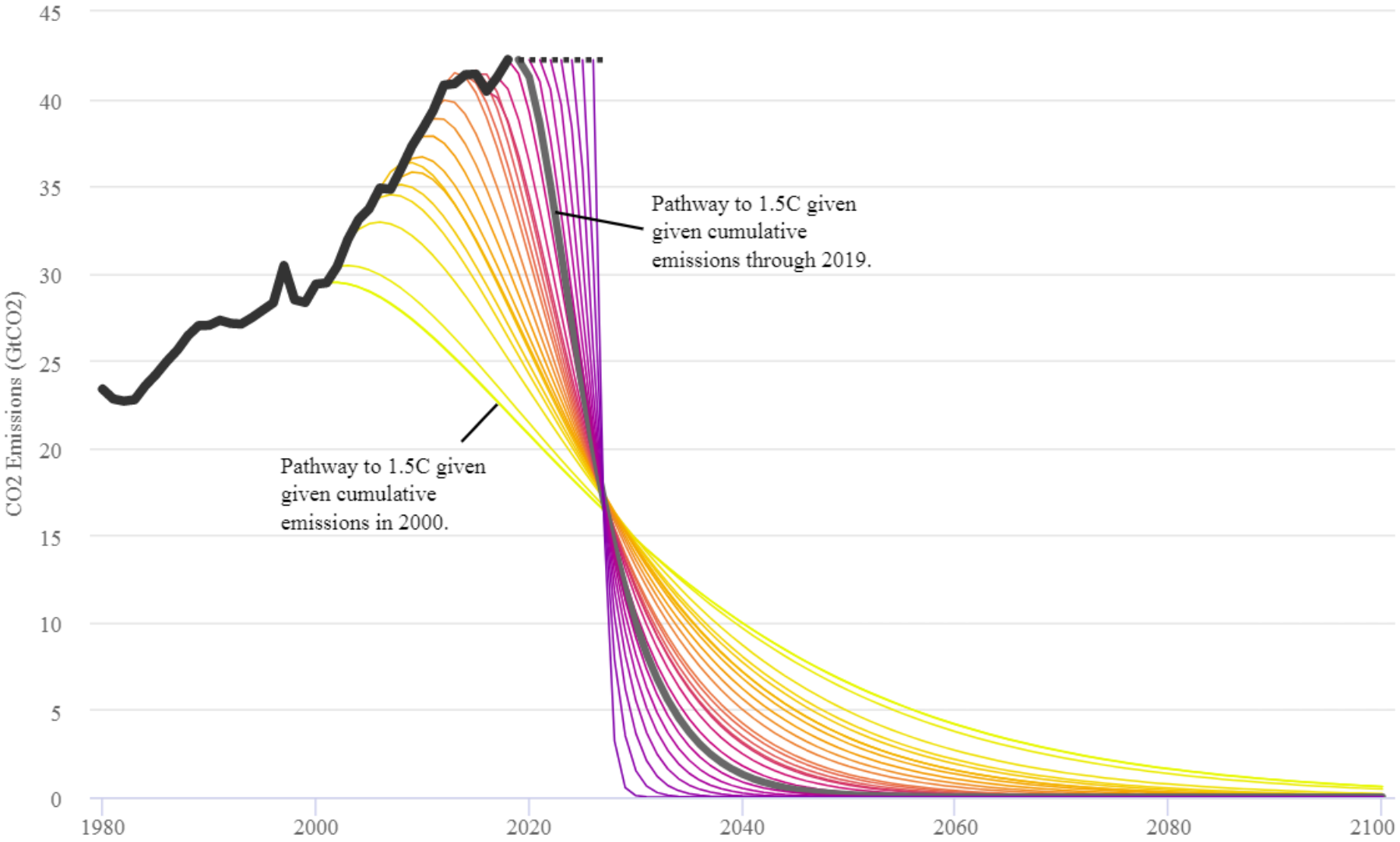
Oceans and plants absorb ~20Gt CO_2/yr (~1/2 of what we emit)

BECCS assumed to absorb ~10-20Gt CO_2/yr
i.e. another planet's worth of biosphere

BECCS = Bioenergy with carbon capture and storage

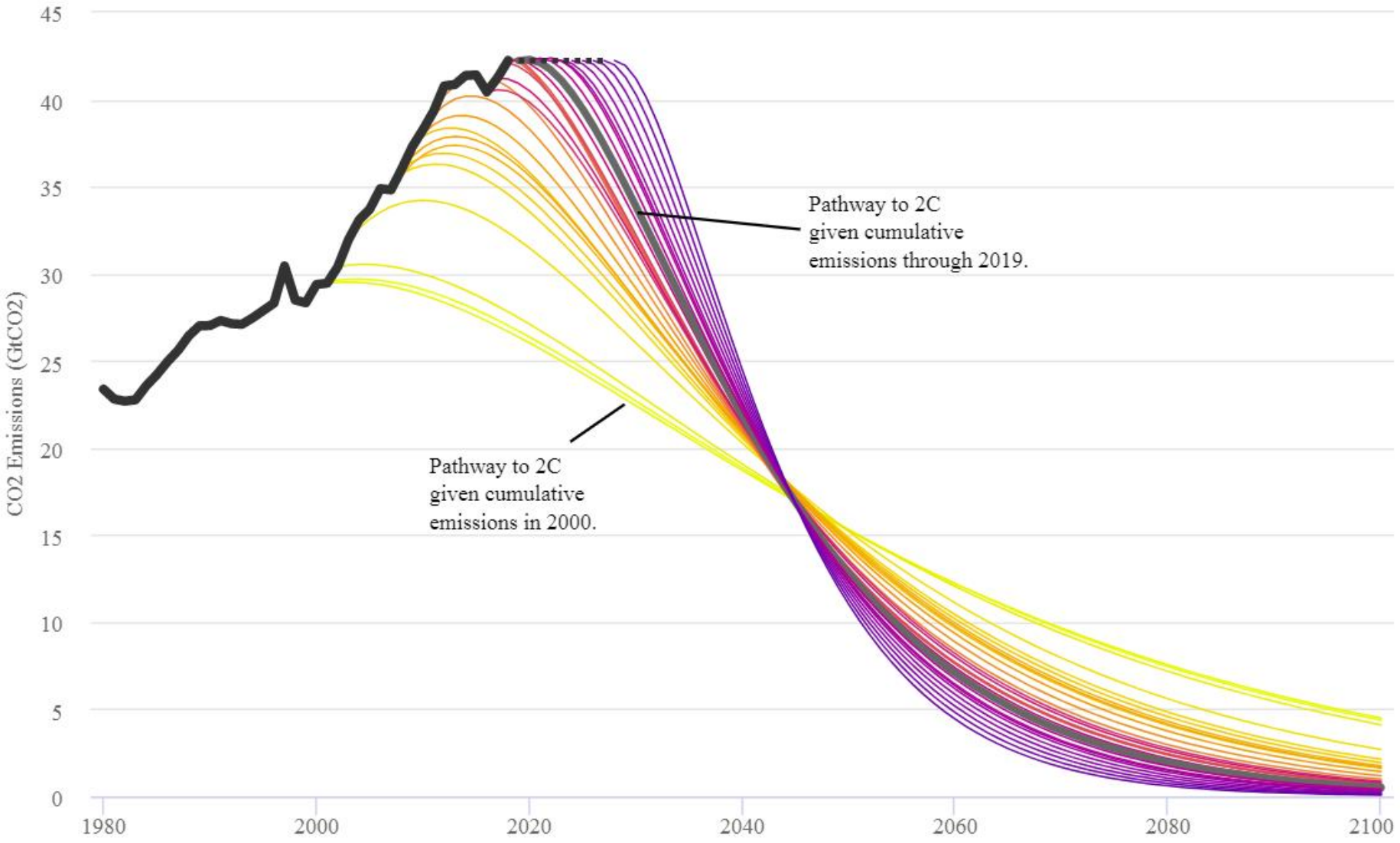
Pathway to 1.5ºC

CarbonBrief
CLEAR ON CLIMATE

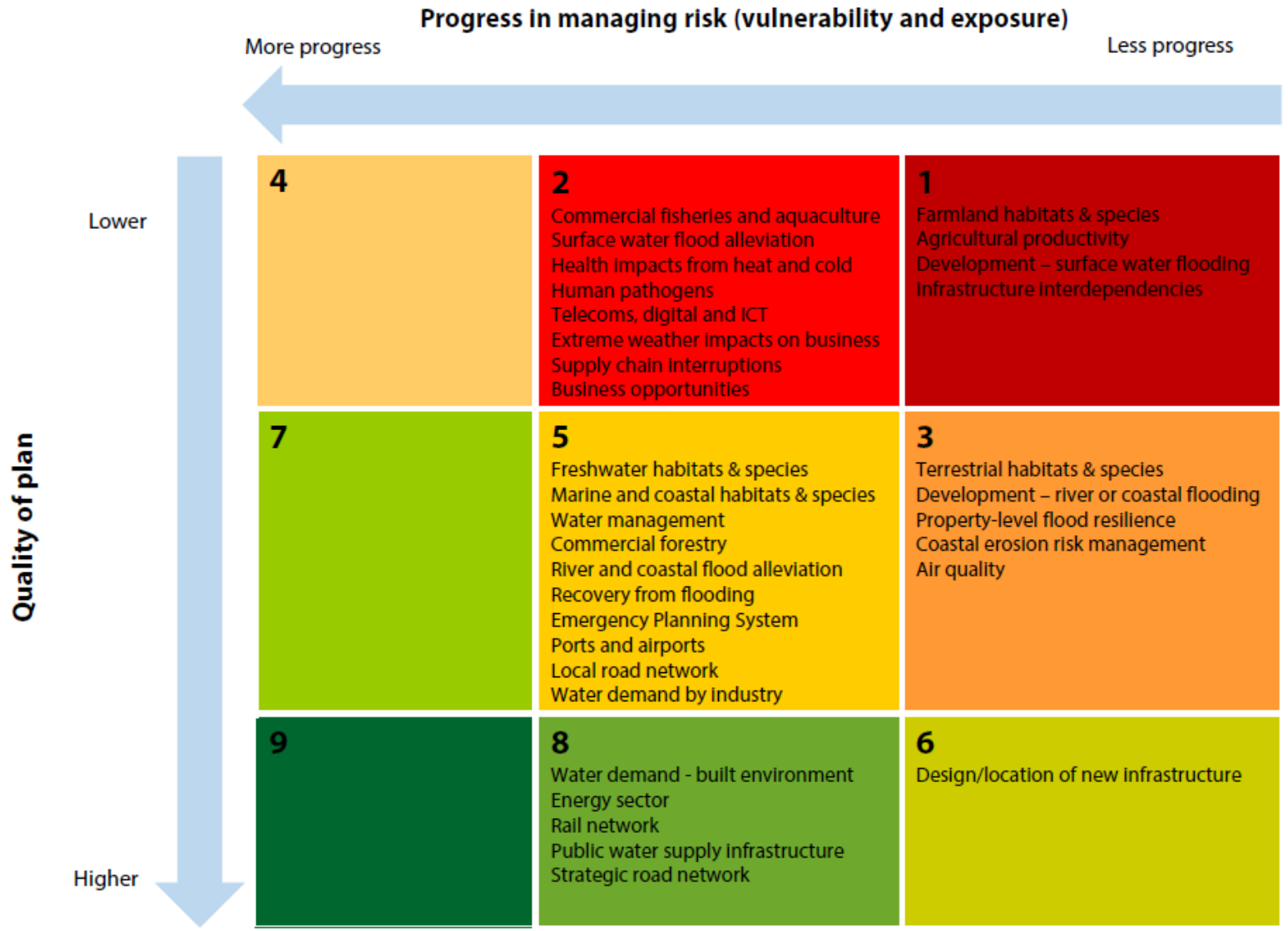


Pathway to 2ºC

CarbonBrief
CLEAR ON CLIMATE

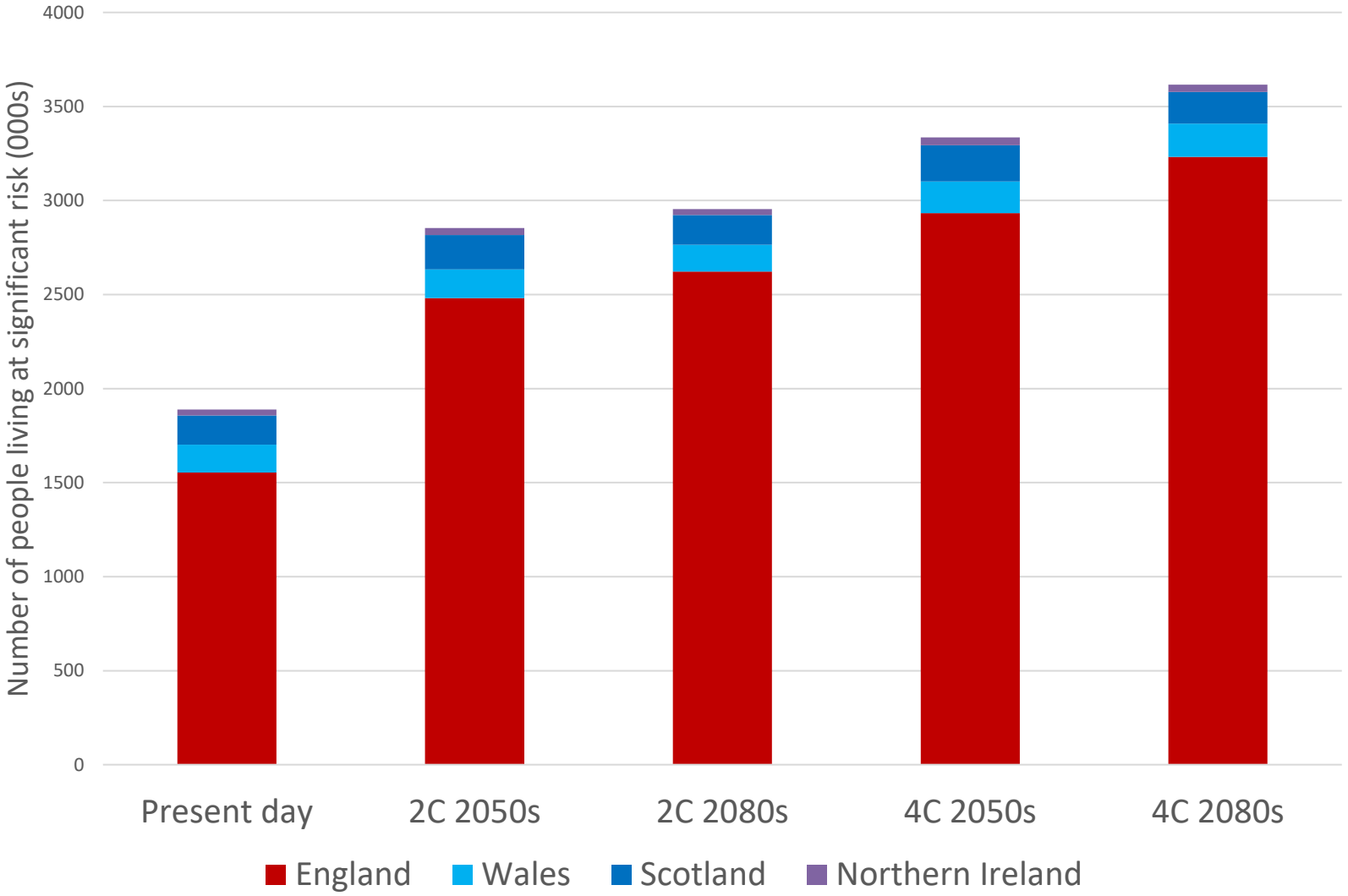


How likely is it we can adapt to a 3°C+ world?



Source: CCC (2019) Progress in preparing for climate change

Without additional adaptation, number of people living in significant flood risk areas could nearly double in the next 30 years, even on a 2°C path



Source: Sayers and Partners (2020) for the CCC: CCRA3 Future Flood Risk Projections

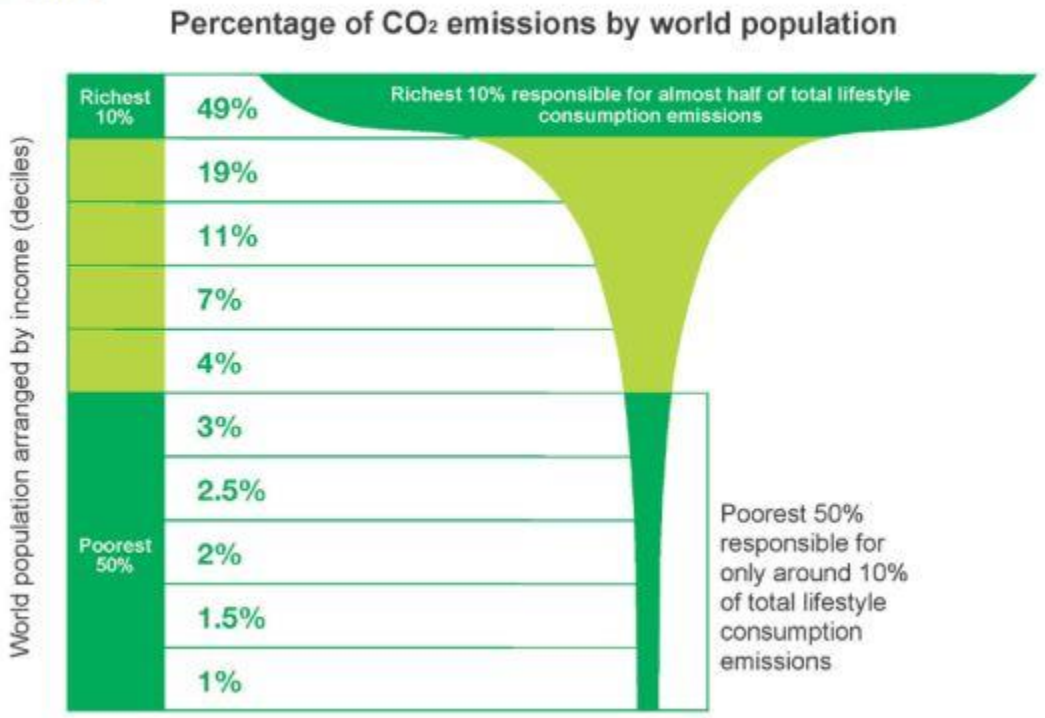
Reasons for optimism

extinction rebellion

#climatebreakdown

10% of the global population produce 50% of emissions

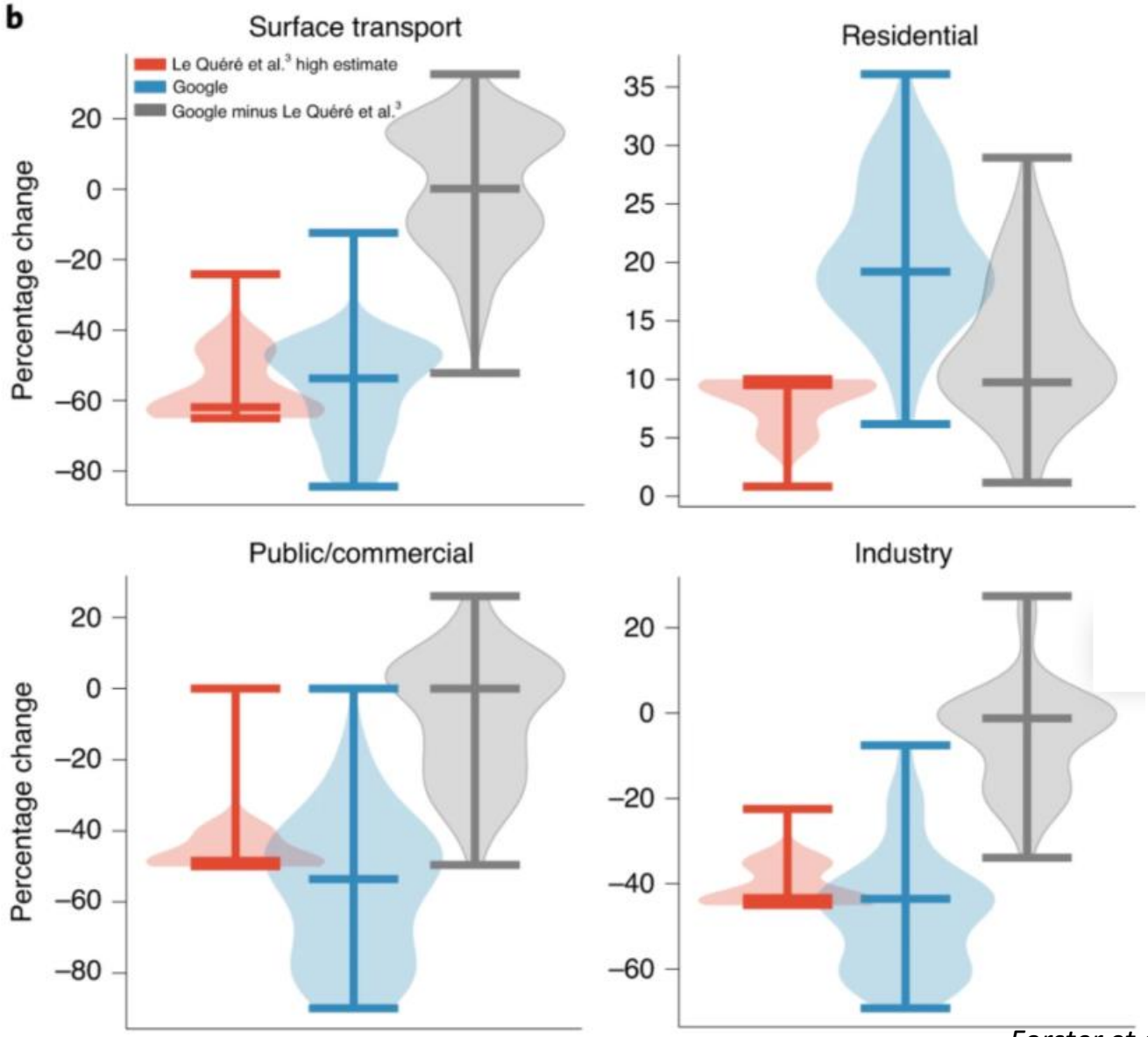
Figure 1: Global income deciles and associated lifestyle consumption emissions



Source: Oxfam

If we reduced the top 10% of emitters to the EU mean then we would immediately reduce global CO2 emissions by 1/3

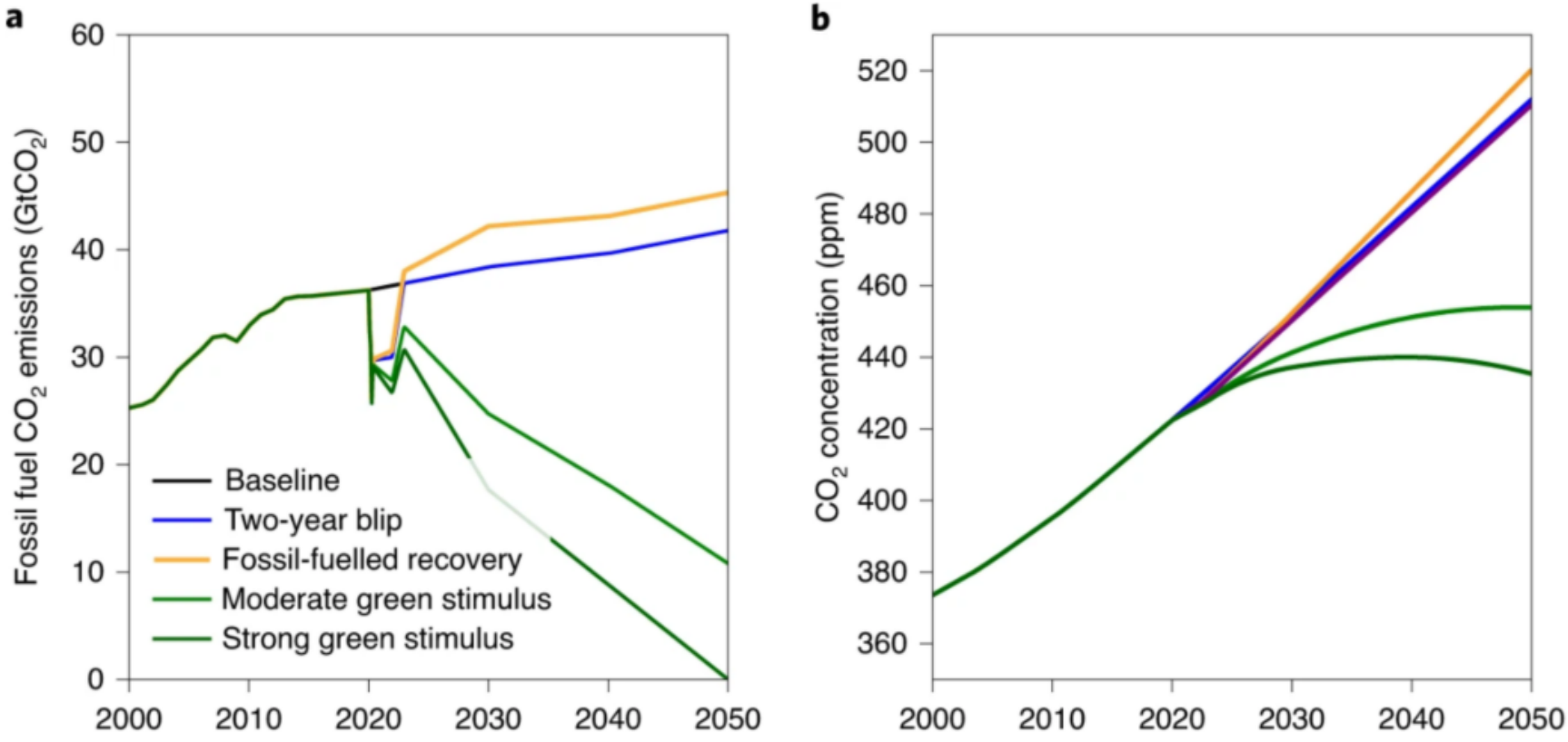
Effect of **COVID-19** on CO_2 emissions



The distribution, minimum, maximum and median levels of national trends weighted by CO_2 emissions for Google and Le Quéré et al.[3] datasets for April 2020

Forster et al. Nature Climate Change (2020)

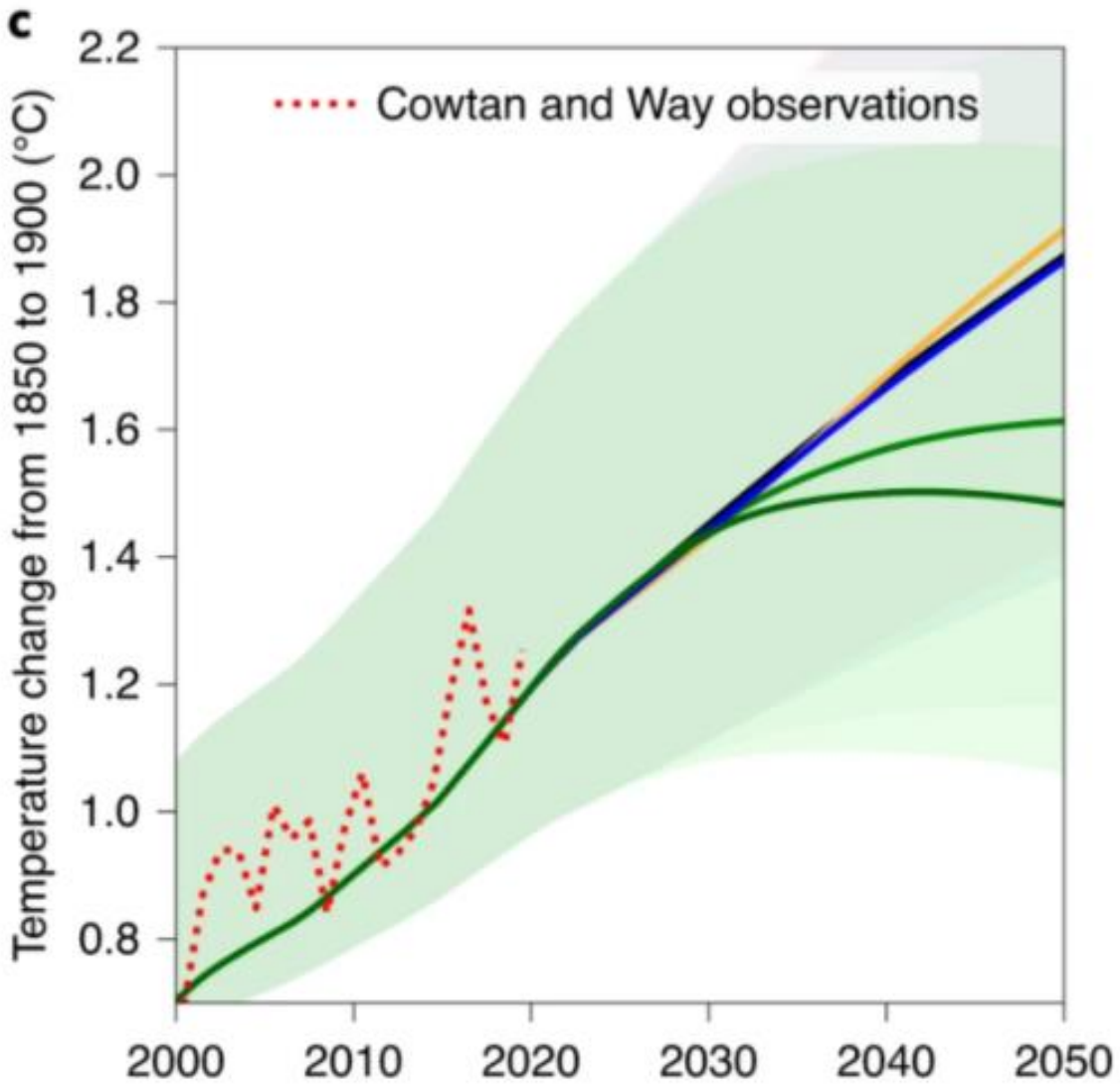
Effect of COVID-19 on GMST response



Longer term climate response. Emissions of CO_2 (**a**), CO_2 concentrations (**b**)

Forster et al. Nature Climate Change (2020)

Effect of COVID-19 on GMST response



Forster et al. Nature Climate Change (2020)

We need a Green economic recovery

- Passive house standards
- CCS on cement
- Retro-fit existing buildings
- Solar on all new builds
- Frequent flyer levy
- Car-free cities
- No airport expansion
- No second homes
- Max car Co2/km
- E-bike subsidies
- Less meat and dairy
- Low-CO2 electricity
- Electrification
- Green stimulus measures

650Gt overall CO2 budget
UK budget 3.5Mt – 9yr@current rate

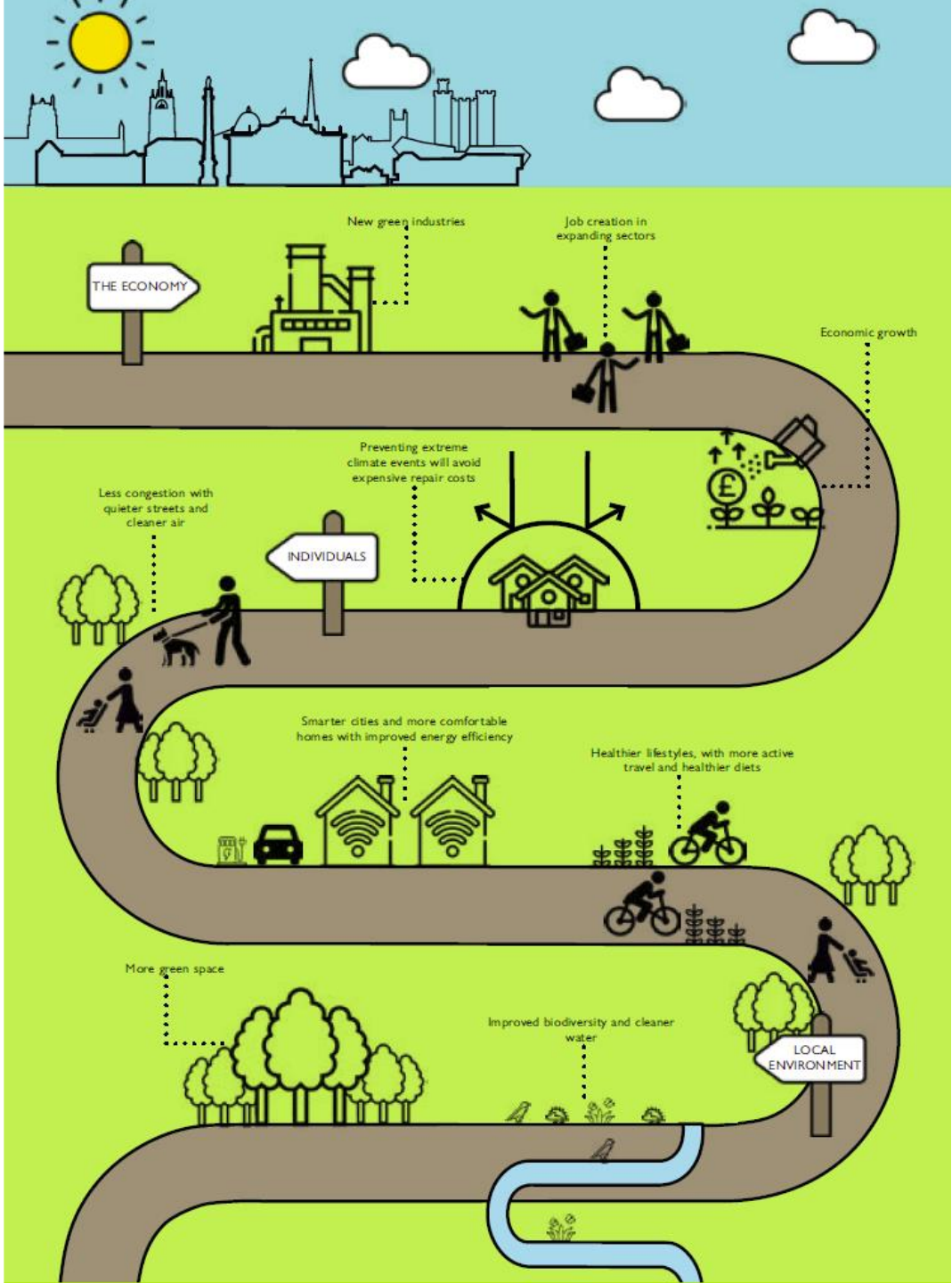
Need 10-13% reduction p.a.
30% by 2022, 70% by 2030
Fully decarbonised by 2035-40

We need a Green economic recovery

"Without underlying long-term system-wide decarbonization of economies, even massive shifts in behaviour only lead to modest reductions in the rate of warming. However, economic investment choices for the recovery will strongly affect the warming trajectory by mid-century."
Forster et al. Nature Climate Change (2020)

Newcastle's Net Zero Action Plan

Local city-scale and regional initiatives are pushing forward action



What does a low-carbon, sustainable home look like?

Current technology, and measures aimed at preparing for the impacts of climate change, can help new and existing homes to become low-carbon and ultra-efficient as well as adapted to flooding, heat and water scarcity.

Existing homes

Improving existing homes can help existing house-holders meet the challenges of climate change

1. **Insulation** in lofts and walls (cavity and solid)
2. **Double or triple glazing with shading** (e.g. tinted window film, blinds, curtains and trees outside)
3. **Low-carbon heating** with heat pumps or connections to district heat networks
4. **Draught proofing** of floors, windows and doors
5. **Highly energy-efficient appliances** (e.g. A^{++} and A^{+++} rating)
6. **Highly water-efficient devices** with low-flow showers and taps, insulated tanks and hot water thermostats
7. **Green space (e.g. gardens and trees)** to help reduce the risks and impacts of flooding and overheating
8. **Flood resilience and resistance** with removable air brick covers, relocated appliances (e.g. installing washing machines upstairs), treated wooden floors

24%
REDUCTION
NEEDED IN DIRECT CO_2 FROM HOMES BY 2030, FROM 1990 LEVELS

15%
REDUCTION
REQUIRED IN ENERGY USED FOR HEATING EXISTING BUILDINGS BY 2030 THROUGH EFFICIENCY IMPROVEMENTS[1]

New build homes

New build homes can and should meet even more ambitious standards in some areas

- **A** **High levels of airtightness**
- **B** **More fresh air** with mechanical ventilation and heat recovery, and passive cooling measures such as openable windows
- **C** **Triple glazed windows and external shading** especially on south and west faces
- **D** **Low-carbon heating** and no new homes on the gas grid by 2025 at the latest
- **E** **Water management and cooling** more ambitious water efficiency standards, green roofs and reflective walls
- **F** **Flood resilience and resistance** e.g. raised electricals, concrete floors and greening your garden
- **G** **Construction and site planning** timber frames, sustainable transport options (such as cycling)

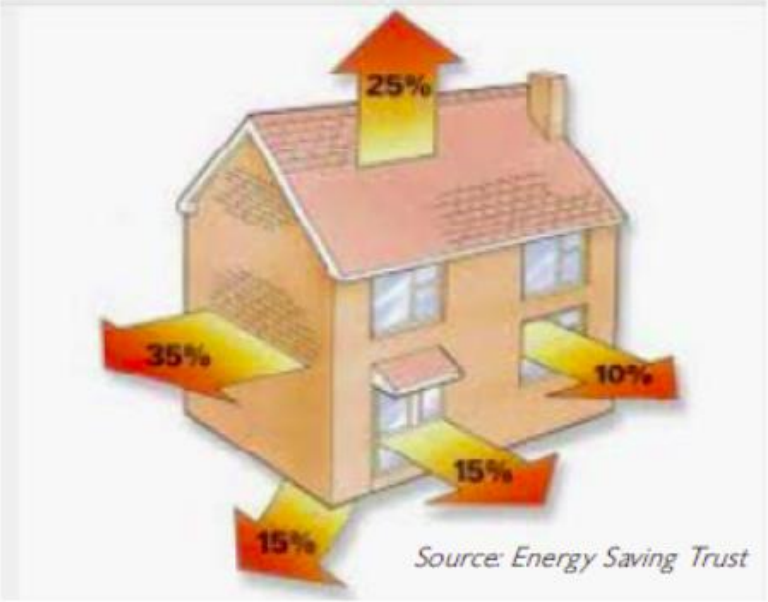
Heat Loss in the Home

External Walls

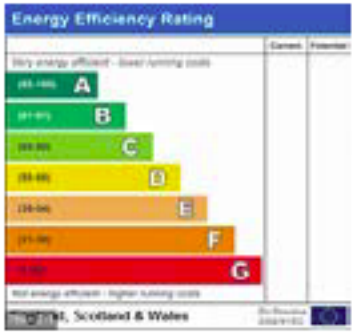
Up to 35% of the heat loss from a property goes through the walls. Walls can be insulated by filling the cavity with insulation material which is the least disruptive and most cost effective method. Where the cavity is not suitable, or the walls are of solid construction then external insulation cladding or internal insulation is the only alternative. External and internal insulation solutions are more complex and costly compared to cavity wall insulation and will change the appreance of the property.

Roof

Up to 25% of the heat that is lost from a property is through the roof and the installation of loft insulation to pitch roof properties is one of the simplest and most economical solutions to improve performance of the property. Insulation of flat roofs and properties with rooms in the roof are more complicated and costly unless undertaken as part of a wider roof replacement programme.



Source: Energy Saving Trust



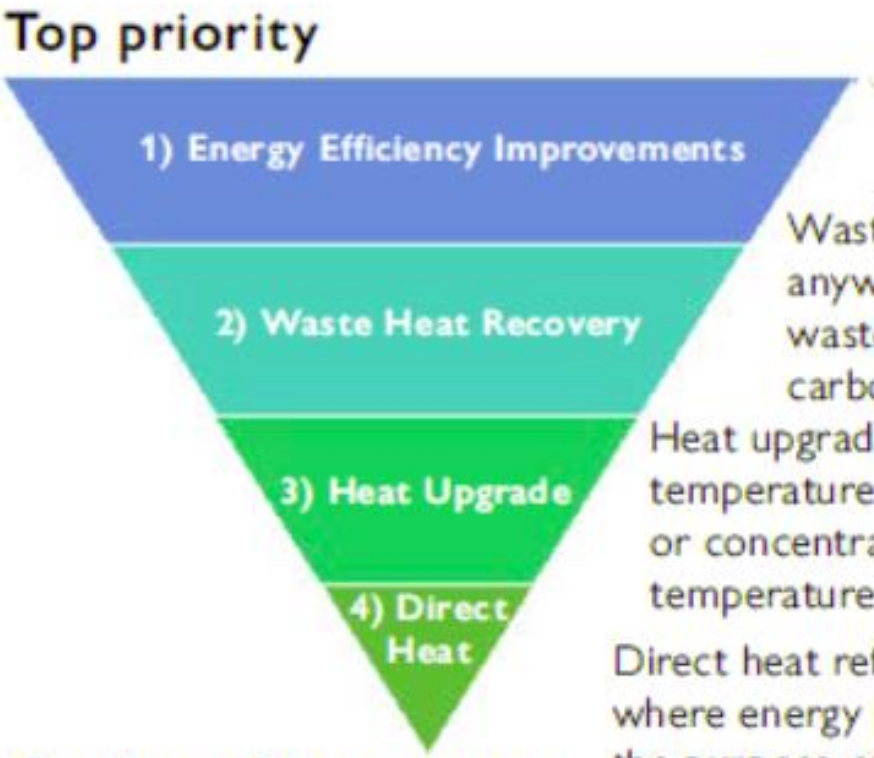
Opening and draughts

Up to 10% of heat loss is through the windows and doors and a further 15% from draughts from ill-fitting windows & doors. Draught stripping can be applied to these openings at relatively low cost and can be fitted on a DIY basis. Identification of services that penetrate the fabric that have not be fitted correctly and gaps in the fabric such as gaps between floorboards on the ground floor, spot lights in the ceiling below the roof can reduce in heat loss and can also be sealed relatively easily.

Floors

Up to 15% of heat lost goes through the ground floor of a property, the majority of properties built before the 1960s will have no insulation as part of the construction. As with solid roofs, floors can normally only be insulated by removing the existing flooring which is very disruptive and costly. Your Homes Newcastle (YHN) have partnered with QBot, a new innovative way of insulating suspended timber floors using robot vehicles to spray insulation on the underside of the floor. Reducing the need to lift carpets and remove flooring decreasing the disturbance to the tenant. Solid floor properties require renewal of the whole floor or adding insulation on top which requires significant adjustments to doors, services and skirting to accommodate the change in height of the floor.

Heating and hot water for buildings make up around 40% of the UK's total energy demand, and 20% of its total GHG emissions



Waste heat is neat that exists anyway, but would otherwise be wasted, meaning that it is very low carbon.

Heat upgrade refers to lower temperature heat that will be upgraded or concentrated to a more useable temperature by using a heat pump.

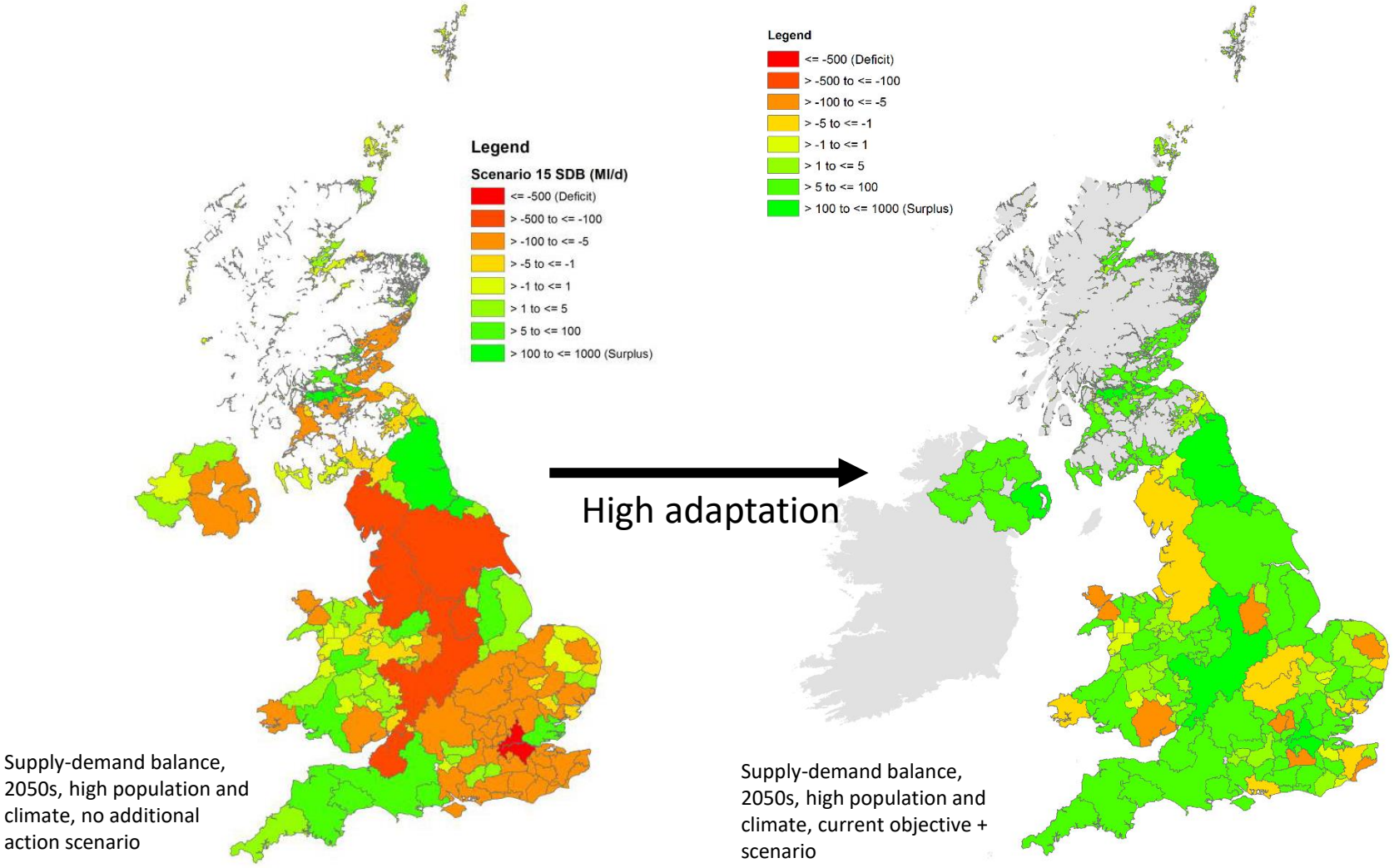
Direct heat refers to circumstances where energy is directly input for the purpose of creating heat – for example electricity into a panel heater, natural gas or hydrogen, or biomass or bioLPG into a boiler.

New technologies, policies and funds

- Low carbon District Energy Networks accessing wastewater, water, and geothermal heat
- Energy efficiency, better insulation and low carbon heat interventions
  - small-scale renewable energy installations with self-consumption, e.g. rooftop solar PV
  - Heat pumps
  - Hydrogen
- **Future Homes Standard**
- **Minimum Energy Efficiency Standard**
- **Public Sector Decarbonisation Fund**

EXTRA SLIDES

Benefits of adaptation: water availability

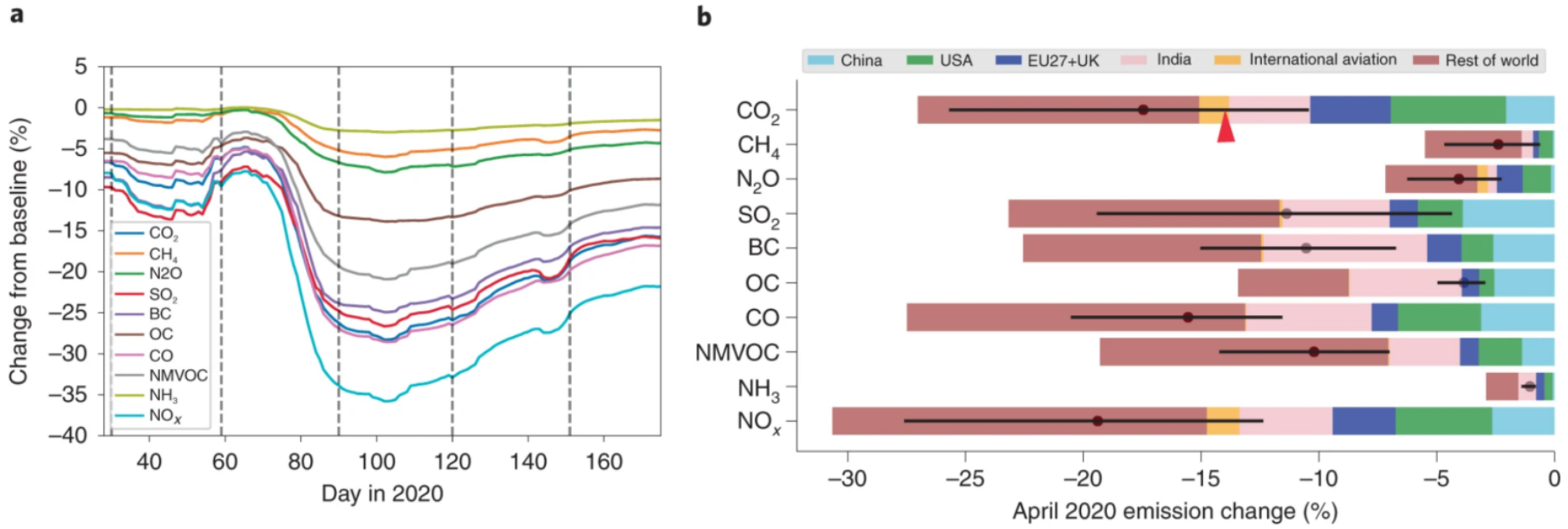


Supply-demand balance, 2050s, high population and climate, no additional action scenario

Supply-demand balance, 2050s, high population and climate, current objective + scenario

HR Wallingford (2015) for the ASC

Effect of COVID-19 on gas species



a, % globally averaged emission changes for the considered species as a function of day in the year of 2020. The changes are for fossil fuel CO_2 emissions and total anthropogenic emissions from the other sectors. The vertical grey
dashed lines mark the first day of the months February to June to aid orientation. **b**, A breakdown of the April 2020 average global emission reductions
compared to a recent year for the different species. The breakdown is for major emission-producing nations, including international aviation

Forster et al. Nature Climate Change (2020)