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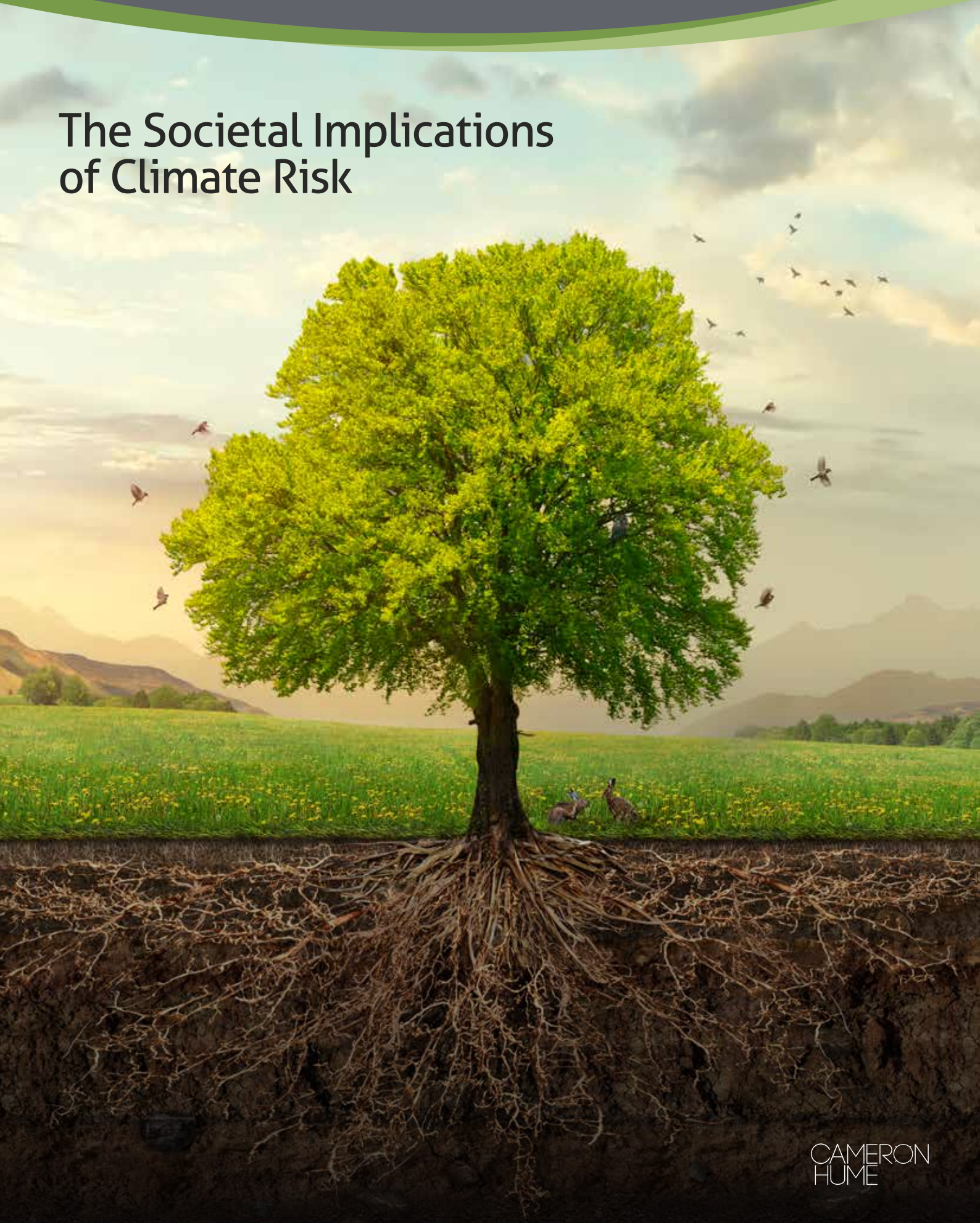
The Societal Implications of Climate Risk



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In this paper, the second of our three-part series on Climate Risk, we look at why it has so far been impossible to reach a consensus on tackling the issue, and the implications the various options could have on our economies and society.

As a global issue, the response to climate change requires global cooperation and coordinated action. To date, this has proved unachievable.

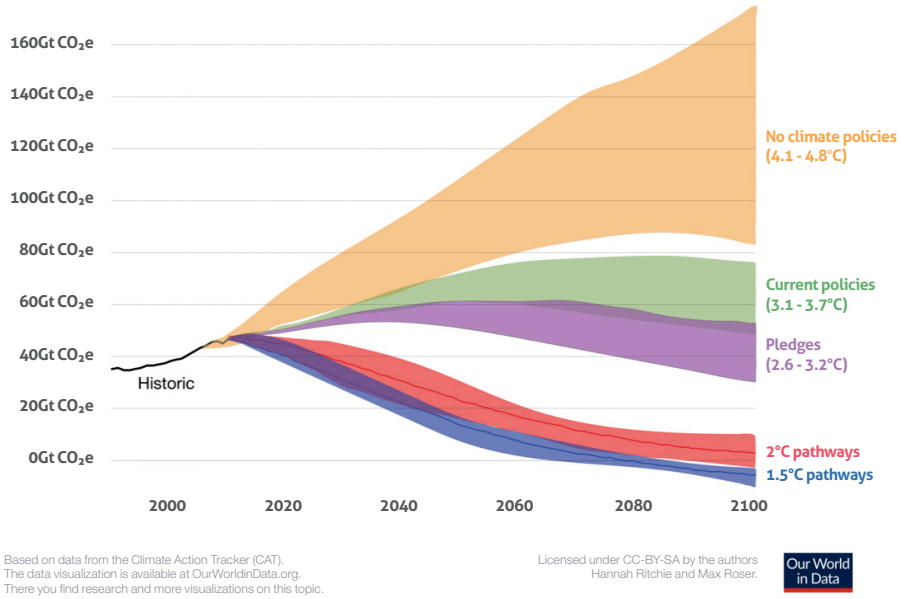
There is a vast array of factors involved, such as population, Gross Domestic Product (GDP) and energy usage among many others, all of which vary considerably from country to country. Bearing this in mind, it becomes easy to see why reaching agreement is difficult.

A Framework for Cooperation – or Individualism

Climate economists have developed scenarios, which they call 'Shared Socioeconomic Pathways' (SSPs) (Riahi et al., 2017)[1], which describe different routes to deal with climate risk. If combined with climate scenarios illustrated in Figure 1 (Nordhaus, 2017)[2], it is possible to explore the implications for both societies and climate change.

Global greenhouse gas emissions scenarios

Potential future emissions pathways of global greenhouse gas emissions (measured in gigatonnes of carbon dioxide equivalents) in the case of no climate policies, current implemented policies, national pledges within the Paris agreement, and 2°C and 1.5°C consistent pathways. High, median and low pathways represent ranges for a given scenario. Temperature figures represent the estimated average global temperature increase from pre-industrial, by 2100.



Based on data from the Climate Action Tracker (CAT).
The data visualization is available at OurWorldinData.org.
There you find research and more visualizations on this topic.

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Our World in Data

Figure 1, from Nordhaus (2017)

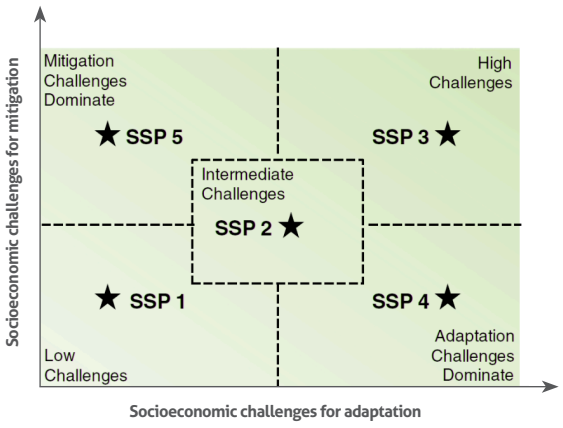

Figure 2, from Riahi et al. (2017)

The SSPs illustrate the challenges societies face in adapting to and mitigating the consequences of climate change.

For each of these scenarios, there is an accompanying narrative, which we have reproduced in the Appendix. Under SSP1, in the bottom left corner of Figure 2, the barriers to achieving global cooperation are low and the world *"shifts gradually, but pervasively, toward a more sustainable path"*.

Under SSP3 there are significant barriers to international coordination and countries "focus on achieving energy and food security goals within their own regions at the expense of broader-based development." SSP1 represents a world in which there is international agreement, whereas SSP3 represents a world in which there is little consensus and nations operate independently.

[1] Riahi et al., 2017: 'The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview'. https://www.sciencedirect.com/science/article/pii/S0959378016300681

[2] Nordhaus produced climate scenarios known as Integrated Assessment Models (IAMs). Rooted in his 1990 Dynamic Integrated model of Climate and the Economy (DICE), this 'integrated in an end-to-end fashion the economics, carbon cycle, climate science, and impacts in a highly aggregated model that allowed a weighing of the costs and benefits of taking steps to slow greenhouse warming' (1999) http://www.econ.yale.edu/~nordhaus/homepage/homepage/rice98%20pap%20121898.PDF

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Carbon Emissions as a function of socioeconomic choices

The SSPs are based on a simple equation called the Kaya Identity[3]. The equation highlights the need to make socioeconomic choices in order to reduce Greenhouse Gas (GHG) emissions. It also illustrates that while eliminating fossil fuels from our overall energy mix may be the goal, the policies a country adopts to meet that goal can differ.

The Kaya Identity suggests that GHG emissions could be curbed by any combination of: reducing the use of fossil fuels; reducing the energy intensity of GDP (curtailing construction and transportation activity or possibly global trade); preventing a rise in GDP per capita (choosing to limit economic growth); or by reducing the global population.

A comparison of Ukraine and the United Kingdom – considered in isolation – offers an interesting illustration of how these scenarios could play out in practice. The UK has five times the GDP per capita of Ukraine, and Ukraine is far less efficient in its GDP-production. To produce a dollar-equivalent of GDP, the Ukraine uses five times the energy the UK does.

Rewriting the Kaya Identity as:

$$\frac{Carbon}{Pop} = \left[\frac{GDP}{Pop} \times \frac{Energy}{GDP}\right] \times \frac{Carbon}{Energy}$$

we see that the term in brackets amounts to the same output for the United Kingdom and Ukraine. Namely, the UK produces more GDP per capita which leads to higher emissions, but the lower GDP per capita in Ukraine is offset by the higher emissions from energy production. If Ukraine was to reform its economy so that it had the same energy efficiency as the UK, this would help to reduce global CO_2 emissions. The UK could achieve the same reduction in global emissions by reducing its GDP per capita to equal that of Ukraine. Both options involve significant costs to the country concerned.

In an extreme version of SSP3 in our stylised two-nation world, we would see the UK arguing for the first option where Ukraine bears the full burden, and Ukraine would argue for the opposite. The likely outcome would be that neither would be delivered in full.

Conversely, an extreme version of SSP1 would have the UK agreeing to meet the costs of Ukraine's transition. This would be a better outcome for the climate and for global GDP (the reduction in UK GDP would be smaller), but would the UK electorate agree to it? As in the prisoner's dilemma, cooperation would be mutually advantageous, but there are many mitigating factors which dissuade even two nations from cooperation.

The Kaya Identity:

$$Carbon = Population \times \frac{GDP}{Pop} \times \frac{Energy}{GDP} \times \frac{Carbon}{Energy}$$

This formulation shows that carbon emissions are influenced by a range of socioeconomic choices, namely:

- the carbon intensity of energy production: $\frac{Carbon}{Energy}$
- the energy intensity of GDP: $\frac{Energy}{GDP}$
- GDP per capita: $\frac{GDP}{Pop}$
- Global population: $Population$

Carbon intensity of energy production

Determined by the proportion of fossil fuels used in the energy mix. A country's energy mix is influenced by the nature of its economy and the natural resources at its disposal. For example, countries that industrialised more recently or whose population has grown through colonisation and migration, may have greater residual fossil fuel resources.

Energy intensity of GDP

Measures how many units of energy are required to produce a unit of GDP. This is again heavily influenced by the nature of a country's economy and its geography. For example, service industries are less energy intensive than manufacturing or construction; countries with hot or cold climates use more energy than those in temperate zones; rich consumers use more energy than poor.

GDP per capita

A measure of productivity, but it is also an indicator of relative wealth. More productive economies may be less energy intensive, but richer economies consume more energy and that is why GDP is important in climate change terms.

Population

People consume energy for shelter, activity and food production and therefore population is a significant factor for climate change.

[3] Named after the economist who established them 30 years ago, Yoichi Kaya. Drawing from Kaya (1990); Impact of Carbon Dioxide Emission Control on GNP Growth: Interpretation of Proposed Scenarios. Paper presented to the IPCC Energy and Industry Subgroup, Response Strategies Working Group, Paris

The Cooperation Imperative

In real life, of course, decision-making and the quest for compromise involves hundreds of nations and a tremendous number of impacted relationships. Facing this unenviable task is the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat: the body tasked with achieving agreement between nations.

Discussions are held at the Conference of the Parties (COP). The Kyoto Protocol which was agreed at COP3 in 1997 was seen as a significant milestone. It obliges countries to meet their targets primarily through national measures and created what is now known as the carbon market[4]. This allows countries to pursue their own policies to reduce emissions while enforcing their overall reduction commitments through trading emission units – instruments which proxy emission reductions.

COP21 was held in Paris in 2015 and signalled an even greater intent to tackle climate change. The Paris Agreement's aim was:

"to strengthen the global response to the threat of climate change by keeping the global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius".

However, the December 2019 COP25 talks in Madrid suggest that the world may currently be closer to SSP3 (independent action) than SSP1 (mutual cooperation). UN Secretary-General Antonio Guterres expressed his disappointment when he said:

"The international community lost an important opportunity to show increased ambition on mitigation, adaptation and finance to tackle the climate crisis."[5]

The central objective of the COP25 talks was to negotiate terms for a global emissions trading market[6]. The disappointment noted by the Secretary-General stemmed from countries wishing to row back from the terms of the Paris Agreement. Emissions trading is regarded both as the most efficient way to deliver the goals of the Paris Climate Agreement and to enforce commitments. If no agreement is found on emissions trading, then there is a greater risk that the narrative of SSP3 will continue to describe our world.

The approach embedded in the UNFCCC is to combine increasingly binding national commitments with domestic climate policies that respect each country's circumstances. Figure 3 provides an illustration of the challenges by country using another combination of elements from the Kaya Identity: the energy intensity of GDP and the carbon intensity of energy production. The route countries take to reduce their GHG emissions will depend on their individual circumstances: what is appropriate for the EU is unlikely to be appropriate for South Africa, China or India. The intention of the proposed emissions trading market is that countries can respond flexibly while meeting their Paris commitments.

The intensities of energy use in GDP and of CO_2 in energy production

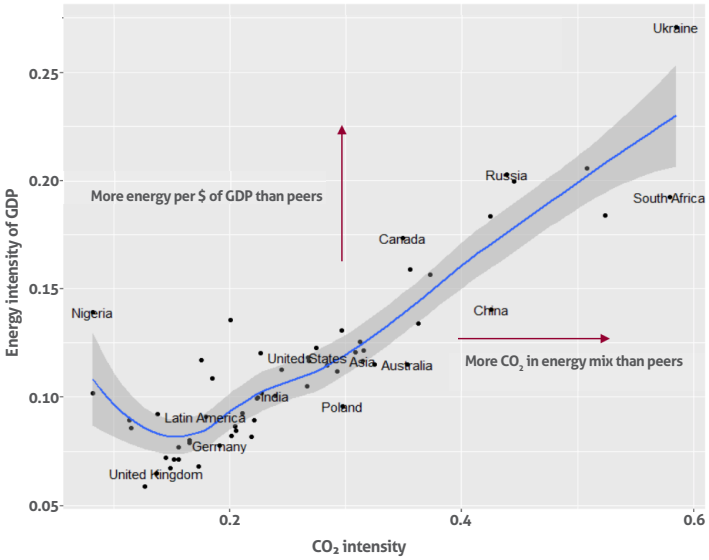

Figure 3

Source: Cameron Hume, EnerData – Energy yearbook

The scale of the UNFCCC Secretariat's task is the clear. The painstaking consensus-building required involves countries ceding aspects of their sovereignty. Kyoto asked countries to make commitments to reduce GHGs; Paris required those commitments to be commensurate with capping global temperature increases; and the objective of COP26 is to make those commitments binding through the mechanism of the carbon market.

Tackling climate change will require our politicians not only to make tough decisions, but also for those decisions to be seen to be fair. This is difficult, as French President Emmanuel Macron found in his unsuccessful attempt to impose so-called "green taxes" in 2018[7]. As various climate talks propose ever more binding objectives, agreement may become harder to achieve. What choices will politicians make when international commitments clash with domestic priorities? What choices will democracies expect their politicians to make? In less democratic nations, will the leader(s) feel any incentive to participate in the proposed global effort? The policies chosen will affect not only the future path of GHG emissions, but also societies and international relations.

[4] https://unfccc.int/process/the-kyoto-protocol/mechanisms
[5] https://www.un.org/sg/en/content/sg/statement/2019-12-15/secretary-generals-statement-the-results-of-the-un-climate-change-conference-cop25
[6] The nature of the envisaged carbon market is explained in https://www.ieta.org/resources/Resources/101s/Article%206.pdf
[7] https://www.politico.eu/article/macrons-mistake-taxing-the-poor-to-tackle-climate-change/

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An optimistic view would be that under the UNFCCC the world will develop a coordinated, timely response to climate risk. If it does, then we will be making deliberate decisions about the costs and consequences we are prepared to bear. On the other hand, if the world fails to take deliberate decisions, our failure to make choices will almost certainly mean greater costs. Such an outcome would have consequences outside our control, dependent on how the climate responds.

If the world develops a coordinated, timely response to climate risk, then we are likely to reduce emissions by focusing on our use of carbon and the energy intensity of our activities. If we fail to coordinate, then climate change may cause GDP per capita to fall or the world's population to decrease – catastrophic real-world consequences.

2020 has unfurled very differently to the expectations of many, casting international cooperation against a shared problem in a new light. COP26 is now due to be held in Glasgow in 2021. We await with interest to see if a change in emphasis is apparent as a result of the impact the coronavirus pandemic has had on societies, economies and the climate.

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Appendix, reproduced from Riahi et al. (2017)

SSP1 Sustainability – Taking the Green Road (Low challenges to mitigation and adaptation) The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries. Management of the global commons slowly improves, educational and health investments accelerate the demographic transition, and the emphasis on economic growth shifts toward a broader emphasis on human well-being. Driven by an increasing commitment to achieving development goals, inequality is reduced both across and within countries. Consumption is oriented toward low material growth and lower resource and energy intensity.

SSP2 Middle of the Road (Medium challenges to mitigation and adaptation) The world follows a path in which social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making relatively good progress while others fall short of expectations. Global and national institutions work toward but make slow progress in achieving sustainable development goals. Environmental systems experience degradation, although there are some improvements and overall the intensity of resource and energy use declines. Global population growth is moderate and levels off in the second half of the century. Income inequality persists or improves only slowly and challenges to reducing vulnerability to societal and environmental changes remain.

SSP3 Regional Rivalry – A Rocky Road (High challenges to mitigation and adaptation) A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. Policies shift over time to become increasingly oriented toward national and regional security issues. Countries focus on achieving energy and food security goals within their own regions at the expense of broader-based development. Investments in education and technological development decline. Economic development is slow, consumption is material-intensive, and inequalities persist or worsen over time. Population growth is low in industrialized and high in developing countries. A low international priority for addressing environmental concerns leads to strong environmental degradation in some regions.

SSP4 Inequality – A Road Divided (Low challenges to mitigation, high challenges to adaptation) Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing inequalities and stratification both across and within countries. Over time, a gap widens between an internationally-connected society that contributes to knowledge- and capital-intensive sectors of the global economy, and a fragmented collection of lower-income, poorly educated societies that work in a labor intensive, low-tech economy. Social cohesion degrades and conflict and unrest become increasingly common. Technology development is high in the high-tech economy and sectors. The globally connected energy sector diversifies, with investments in both carbon-intensive fuels like coal and unconventional oil, but also low-carbon energy sources. Environmental policies focus on local issues around middle and high income areas.

SSP5 Fossil-fueled Development – Taking the Highway (High challenges to mitigation, low challenges to adaptation) This world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development. Global markets are increasingly integrated. There are also strong investments in health, education, and institutions to enhance human and social capital. At the same time, the push for economic and social development is coupled with the exploitation of abundant fossil fuel resources and the adoption of resource and energy intensive lifestyles around the world. All these factors lead to rapid growth of the global economy, while global population peaks and declines in the 21st century. Local environmental problems like air pollution are successfully managed. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary.