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CLIMATE CHANGE AND ENERGY

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Climate Change and Energy

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Climate Change and Health Impacts

Interview with Sir Andy Haines
London School of Hygiene and Tropical Medicine, United Kingdom

Would you briefly discuss major direct and indirect health related effects of climate change?

Climate change impacts health through many different pathways. There's obviously the direct effects of heat, which causes increased death rates, particularly amongst elderly people. Extreme heat also makes it progressively more difficult to work, particularly in tropical and subtropical regions. That's also likely a contributing factor to increasing poverty. Another climate change effect is that of wildfires on air pollution. Wildfires, such as we've seen recently in California and Australia, can be responsible for very high levels of fine particles in the air, which are damaging pollutants.

There are also effects of climate change on water availability, water related diseases transmitted by mosquitoes such as malaria and dengue in some regions of the world, and other insect vectors as well. Another major effect is decreased yields of staple crops and decreased nutritional quality of crops, particularly because when there is more CO2 in the atmosphere, the micronutrient level of some types of crops (notably zinc and iron)is reduced.

The most difficult areas to quantify are broader socioeconomic effects such as increasing poverty or migration of populations, either internally or internationally, e.g. as a result of either extreme events or declines in harvests.

That's a wide range of impacts, ranging from the very direct to the rather indirect. Of course, climate change isn't acting alone. It interacts with other environmental changes as well such as land use change, freshwater depletion and biodiversity loss, which may increase impacts. Unfortunately, climate change impacts are going to get progressively worse unless we take very rapid action over the next few years. Populations can adapt to a point but there'll be limits to adaptation, and once those limits are exceeded, things could get quite a lot worse quickly.

How can the international community best work to address health inequalities posed by climate change in developing countries?

The international community did commit in Paris to providing $100 billion a year to support climate action in low-income countries. While it sounds like a lot of money, in international terms, it's not a large amount. But even that target is not being reached and it's not clear when it will be reached. High-income countries have not lived up to their responsibilities, and that's really regrettable. We do need more funding to improve adaptation and increase the resilience of developing countries to effects of climate change on health. But we also need to fund 'low carbon' development so that low-income countries, as they develop, don't do so along a fossil fuel powered pathway, but by clean renewable energy using a range of technologies that are becoming cheaper over time.

The question is whether there's the political will or the political appetite to make the necessary financial commitments, particularly as we hopefully emerge from COVID-19. The private sector is important as well. There are opportunities for the private sector to invest in low- and middle-income countries to support low greenhouse gas emissions, more sustainable development. Regional development banks, bilateral donors, and others all have a role to play as well.

We need to put in place a range of different policies that can help us to adapt to and to mitigate climate change right now. We can't just wait until the situation becomes very extreme, because many of these changes are irreversible.

COVID-19 has severely strained the health sector in a variety of ways. Is there anything that can be learned from the pandemic that could be beneficial in addressing climate change related health issues?

We have learned that science can move very quickly but that the benefits of science are not experienced equitably across the world. We've also learned that unless we react quickly to these kinds of threats when they emerge, they can get out of hand. Even though science moved quickly with COVID-19, many policies weren't quick enough to forestall the very large numbers of deaths that we've already seen. While vaccinology has proved itself invaluable, there have been many deaths that probably could have been prevented by earlier and more decisive interventions. So, it's been a very mixed picture.

With climate change, of course, there's no vaccine, no single answer, and there isn't a magic bullet. We need to put in place a range of different policies that can help us adapt to and mitigate climate change right now. We can't just wait until the situation becomes very extreme, because many of these changes are irreversible. COVID may have reinforced that need and has taught us we need international collaboration and cooperation, although it's been very patchy in the face of COVID. For climate change, there is an imperative that we forge much closer collaborative policies around the world to tackle these intertwined problems.

As we've also seen with COVID, there is the need to counteract misinformation and disinformation as applied to climate change. Mobilizing the best available evidence, and very importantly, communicating that to the public, using trusted sources and trusted messengers who are not seen as biased, but are providing kind of the best available evidence, is crucial. Health professionals are still amongst the most trusted sources of information by the public and potentially have an important role to play. There's a lot more that we need to do to make that happen.

Would you elaborate on what health co-benefits are, as applied to a net zero economy?

While the impacts of climate change on heath are very worrying, if we move to a net zero emission economy, there will be major benefits to human health. Over and above the benefits from reducing the risks of dangerous climate change, there are also near-term benefits, what are often called co-benefits. They are called co-benefits because they are ancillary to the main purpose of the policy, which, in this case is climate change mitigation.

As we move away from burning fossil fuels, one example of a co-benefit is the reduction of air pollution. The WHO estimates seven million deaths a year from air pollution, both ambient (outdoor) and household air pollution. A sizable portion of air pollution, particularly ambient air pollution, comes from the burning of fossil fuels. So, as we move towards clean renewable sources of energy, we can benefit from those near-term reductions in air pollution. Air pollution is a major risk factor for common diseases that afflict all countries, like heart disease, lung diseases (including lung cancer) and stroke. By moving to a net zero economy quickly, we can benefit from those near-term benefits to our health from reduced air pollution.

Another example of a co-benefit is from sustainable food systems. The food system is responsible for about 30% of greenhouse gas emissions, depending exactly where you put the boundaries. A substantial proportion of that comes from methane from livestock. Rebalancing our diets to eat more healthy fruits and vegetables, nuts and seeds, less red meat, particularly in high consuming countries, can benefit health very substantially. There was a report a few years from the EAT-Lancet Commission which suggested that by mid-century, if we could follow their dietary recommendations, what they call the planetary health diet, 10 to 11 million premature deaths could be prevented annually.

A third example would be transport. An overdependence on the private car contributes to sedentary lifestyles, and that sedentarism or lack of physical activity is an important risk factor for many of these common diseases that afflict our populations like diabetes, heart disease, and stroke. Shifting towards more sustainable transport systems in cities, walking and cycling, using more public transport, to reduce the dependence on the private car is beneficial for health as well as beneficial for the climate. Those are just three examples of co-benefits, but there are others as well.

In your opinion, how well is the health sector prepared for anticipated problems related to climate change?

It's variable. Some countries have climate adaptation plans in place including the health sector; for example, early warning systems for heat waves, disease outbreaks, and for disasters like floods and droughts. The effectiveness of such plans needs rigorous evaluation to ensure that they have the intended effect.

We've also learned that with COVID, we can't necessarily rely on what's written down in the plans because, on paper, countries like the UK and the US had very robust public health systems that should have been able to withstand this kind of pandemic. But of course, it didn't quite work out that way. We also need to be wary that, in climate change terms, countries may not perform as well as we think they might, sometimes because political factors override technical capacity.

Another issue concerning climate change adaptation is the need for health facilities to be better equipped and designed to withstand floods or heat waves. If a health facility is dependent on air conditioning, it is vulnerable to electrical grid failures. More health facilities should be designed with the aim of keeping patients cool through passive cooling technologies (e.g, natural ventilation, cool roofs and window shutters).

There's another side to this, which is that the health sector itself is an important source of greenhouse gas emissions. In the US, roughly 8% of greenhouse gas emissions come from the healthcare sector and globally, it's between 4 and 5%, which is pretty substantial. If you look at the sources of emissions from the health sector, it's not necessarily where they might be expected. In order to reduce the carbon footprint of the healthcare system, we don't just need to decarbonize the energy supply of hospitals and healthcare facilities. There is a large proportion of emissions embedded in related supply chains such as for medical equipment and pharmaceuticals. We also need to look at patient and staff transport where a range of different strategies need to be put in place. A number of healthcare systems are already ramping up activities to address decarbonization efforts. For example, 14 countries have committed themselves at COP 26 to net zero emissions with a target date of 2050 or earlier. So there is an increasing kind of appetite to reduce emissions of the healthcare system. Health professionals need to get their own house in order, as well as advocating for climate action more broadly.

Sir Andy Haines is Professor of Environmental Change and Public Health at the London School of Hygiene and Tropical Medicine, with a joint appointment in the Dept of Public Health, Environments and Society and in the Dept of Population Health. He was previously Director (originally Dean) of LSHTM for nearly 10 years up to October 2010, having previously been Professor of Primary Health Care at UCL between 1987-2000. He worked part-time as a general practitioner in North London for many years.

Between 1993-6 he was on secondment as Director of Research & Development at the NHS Executive, North Thames and was consultant epidemiologist at the MRC Epidemiology and Medical Care Unit between 1980-7. He has also worked internationally in Nepal, Jamaica, Canada and the USA.

Sir Haines has been a member of a number of major international and national committees including the MRC Global Health Group (chair) and the MRC Strategy Group. He was formerly chair of the Universities UK Health and Social Care Policy Committee and a member of the WHO Advisory Committee on Health Research. In recent years his research focus has been on the effects of environmental change on health and the impact of policies to adapt to or mitigate these changes. He was a member of Working Group 2 of the UN Intergovernmental Panel on Climate Change for the second and third assessment reports and review editor of the health chapter in the fifth assessment report. He chaired the Scientific Advisory Panel for the 2013 WHO World Health Report on Research for Universal Health Coverage. In 2014/2015, he chaired the Rockefeller Foundation/Lancet Commission on Planetary Health and co-chaired the development group for the Health Knowledge Action Network of Future Earth. Sir Haines was co-chair of the European Academies Science Advisory Committee working group on climate change and health in Europe which published its report in June 2019. He currently co-chairs the InterAcademy Partnership(~140 science academies worldwide) working group on climate change and health and the Royal Society/ Academy of Medical Sciences group on health and climate change mitigation. He also co-chairs the Lancet Pathfinder Commission on health in the zero-carbon economy and participate in the Lancet Commission on Pollution and the Lancet Commission on the COVID-19 response.

The Future of Travel and Tourism in Our Changing Climate

Professor Donald J. Wuebbles
University of Illinois and Earth Knowledge Inc., United States

Introduction

The recently released Sixth Assessment Report (AR6) of the UN's Intergovernmental Panel on Climate Change (IPCC 2021) brought together the science community, including many of the world's leading earth scientists, to update how and why the climate on our planet is changing and what the future may hold. The latest IPCC assessment further strengthens what previous assessments of the science have stated for several decades: Climate change is happening now and it is happening extremely rapidly throughout the world. This has been the warmest decade on record (McGrath, 2020), but surface temperature is just one of many indicators of our changing climate. Certain types of extreme weather events – such as heat waves and heavy precipitation – are increasing in severity and frequency; and there are increasing concerns about droughts in some locations and floods in others (Janssen et al., 2014; USGCRP, 2017, 2018; Wuebbles et al., 2014; Zobel et al., 2018). Sea levels are rising as the oceans warm and land ice melts. We can see these changes play out in the news – whether it is wildfires in the American west and Australia (Di Virgilio et al., 2020; Wang et al., 2021), flooding in Germany (Kreienkamp et al., 2021), heatwaves in Italy (Mayrhuber et al., 2018; Zschenderlein et al., 2019), or an increasing tendency for tornado outbreaks, such as the outbreak that occurred during December 2021 in the U.S. Midwest (NOAA, 2021).

The scientific evidence is clear that climate changes over the last half-century are primarily due to the burning of fossil fuels in tandem with the clearing of forests and other land-use changes. Natural mechanisms cannot explain the observed climate changes. The science further indicates that additional climate change is essentially certain because humanity is not reducing the emissions of carbon dioxide and other heat-trapping gases and particles quickly enough to prevent or lessen further change. However, the extent of future changes does depend on the choices humanity makes to reduce those emissions.

Travel and tourism both affect climate change and are being affected by climate change (Arabadzhyan et al., 2021; Scott, 2021). The aim here is to examine those relationships. Travel is defined here in terms of longer-range trips for either business or pleasure, and not in terms of local activities or commuting to the workplace or schools. As a result, a special focus is given to commercial aviation as part of this study. As will be seen, the future of travel and tourism could be greatly impacted by the changing climate.

Travel and the Changing Climate

With the current heavy dependence on fossil fuels, travel for either business or pleasure results in emissions that affect atmospheric composition, resulting in potentially significant effects (Arabadzhyan et al., 2021; Scott, 2021) on climate. Tourism activities further add to those travel emissions. Together, the travel and tourism industries are significant contributors to climate, especially through global carbon emissions, with a carbon footprint estimated to be about 8% (and possibly larger) of total global emissions of greenhouse gases (Lenzen et al. 2018; World Travel and Tourism Council 2021; Huang and Tang 2021). Before the pandemic, global tourism had been growing 3-5% per year, outpacing the growth of international trade (Lenzen et al. 2018). The pandemic greatly reduced travel and tourism but that effect is expected to be temporary.

As shown in Figure 1, many different activities contribute to the effects of tourism on climate. The carbon footprint includes the carbon emitted directly during tourism activities (e.g., fuel burned) and the carbon embodied in associated commodities and services, including accommodations, food, transportation, and shopping. Lenzen et al. (2018) demonstrate the importance of evaluating the life cycle and / or supply-chain emissions of tourism-related goods and services. Their analyses found that transportation is the largest contributor to the carbon footprint, and that aviation is the largest contributor (about 40% of the total transportation) to the climate-related emissions from transportation. Along with aviation, personal vehicles (about 32% of the total transportation), trains, and ships are all important modes of travel; and there is a need to determine the best pathways for them to transition from their dependence on fossil fuels. Electricity for personal vehicles and hydrogen for trains and ships seem to receive the most attention as alternative fuels at this time.

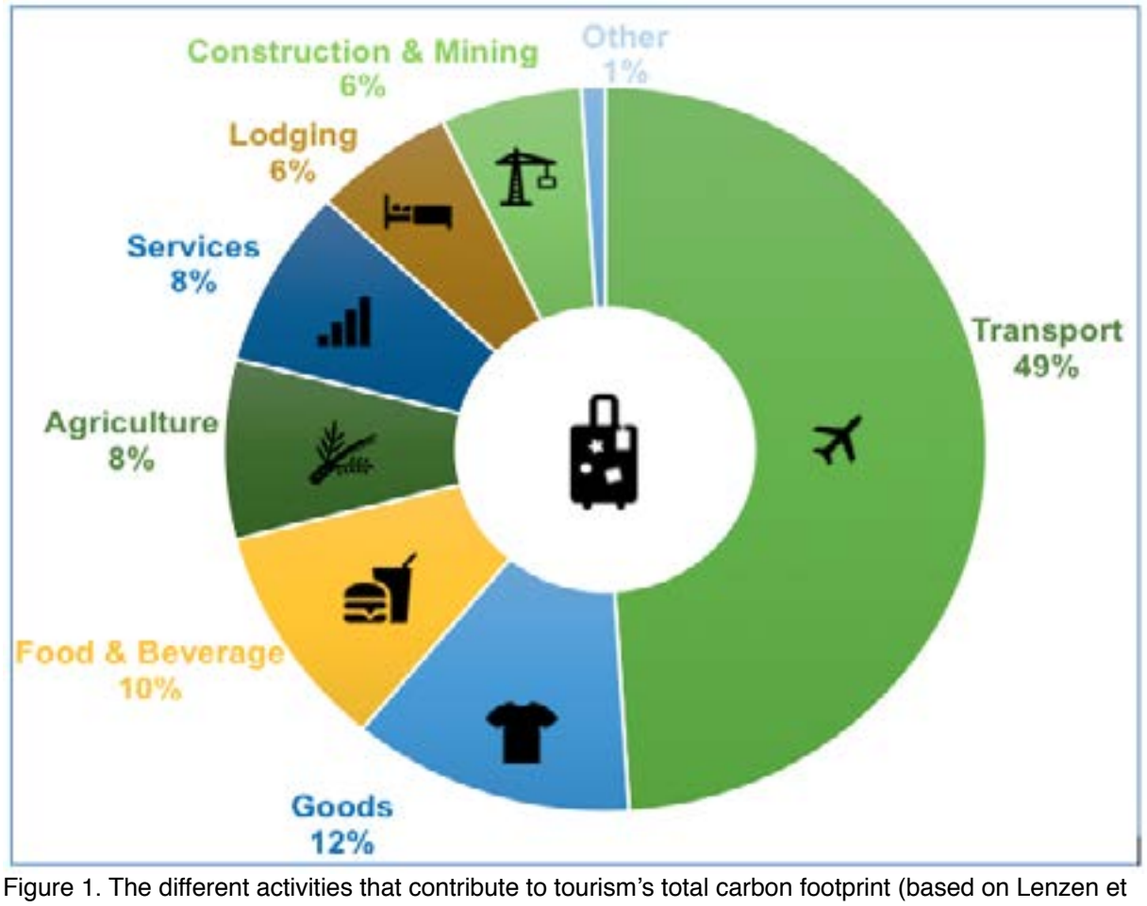

Figure 1. The different activities that contribute to tourism's total carbon footprint (based on Lenzen et al. 2018; also see https://sustainabletravel.org/issues/carbon-footprint-tourism/).

Having shown that travel and tourism affect climate change, let's turn to the effects of climate change on travel and tourism. From the beaches and environs of lush tropical islands to the hiking and skiing in mountainous regions, favorite vacation spots are increasingly at risk from the impacts of the changing climate. As the planet continues to warm, the increasing intensity of extreme weather and rising sea levels are affecting ecosystems and communities around the world. Beaches are shrinking, coral reefs are bleaching, and alpine ski resorts are finding themselves with longer periods without snow. As a result, the impacts of climate change are likely to increasingly affect travel and tourism directly, including effects on demand, interfering with the choice of destination and the period of the trip. Indirect effects can be apparent in the quality of the experience, adverse perceptions after some extreme event, and insecurity in the destination conditions.

The warming temperatures throughout the world are increasing the tendency for very hot days and heat waves; these are changing the seasons for tourism. Warmer weather and more precipitation coming as rain instead of snow is tending to shorten the ski season both for downhill and cross-country skiing. It is affecting lakes and rivers, and ecosystems and biodiversity. These affect nature-based ecotourism as well as hunting and fishing activities. Also, if it is too hot, people will avoid previously attractive destinations.

The increasing intensity of weather extremes is leading to more droughts in some tourism destinations, and more extreme precipitation and flooding in others. Impacts range from water scarcity to infrastructure damage and effects on hiking trails. Extreme wildfires, resulting from the warming climate leading to drier soils and forests, can destroy key tourism landscapes. The increasing intensity of tropical storms, e.g., hurricanes, can seriously affect major tourism areas, like those in the Caribbean or the west Pacific, and key cities for business and tourism like New Orleans.

The warming ocean and sea level rise are already affecting coral reefs, including the Great Barrier Reef, increasing erosion and collapse of coastal cliffs, and eroding beaches. In addition to many heavily populated areas, many popular tourist sites around the world are likely to be affected. Sea level rise may result in the disappearance of many low-lying

islands around the world, including the Maldives and many islands in the western Pacific.

Indirect impacts from climate change on travel and tourism include effects on spending, increasing insurance rates, and helping to drive political unrest and instability. Climate mitigation could affect the travel demand and destination choices. Diseases and pests, including concerns about viruses (e.g., West Nile) and bacteria (e.g., dengue fever) may also affect travel and tourism.

Climate Impacts from Aviation

In 2017, airlines worldwide carried around 4.1 billion passengers. They transported 56 million tons of freight on 37 million commercial flights. Every day, airplanes transport over 10 million passengers and around USD 18 billion worth of goods. Demand for air transport is expected to increase by an average of 4.3% per annum over the next 20 years. By the mid-2030s no fewer than 200,000 commercial flights per day are expected to take off and land all over the world.

Emissions by the aviation sector from the burning of fossil-based fuels currently account for about 2.4% of the total human-related emissions globally of carbon, especially as carbon dioxide (CO2), the most important heat-trapping gas driving the changes in climate (Lee et al. 2021). While the overall efficiency (fuel burn per mile) in the aviation industry is generally increasing, that percentage is growing – aviation emissions grew by 5% per year between 2013 and 2018, and more growth is expected once the current pandemic has ended. Aviation emissions of water vapor that can form contrails (and also affect cirrus cloud formation in the upper troposphere) and emissions of nitrogen oxides that affect the natural levels of atmospheric ozone also affect climate (Brasseur et al. 2016; Lee et al. 2021). Particles resulting from emissions of soot and sulfur (the latter a fuel additive) can also affect climate as well as air quality. According to the European Union), if the global aviation sector were a country, it would rank in the top ten emitters (https://ec.europa.eu/clima/eu-action/transport-emissions/reducing-emissions-aviation_en).

While the current subsonic aviation sector is expected to continue to grow, the increasing demand for air travel, the aspiration for more intercontinental travel, and the desire for shorter flight times, have all contributed to a renewed interest in the potential development of civil aircraft that fly at supersonic speeds. As a result, various governments and companies around the world have been reconsidering development of supersonic aircraft for the business jet and commercial airline markets. Major efforts are ongoing by the governments and industry in the United States, Europe, Russia, and Japan. Potential platform sizes, range from business jets to mid-size aircraft (50-80 passengers) to large aircraft (several hundred passengers). Fleets of hundreds to thousands of these supersonic business jets (SSBJs) and/or supersonic transport (SST) aircraft are likely necessary to make their development economically feasible.

Such supersonic aircraft would fly at higher cruise altitudes than the current fleet of subsonic aircraft, with their emissions primarily being in the upper atmosphere, at altitudes in the stratosphere close to where naturally high levels of ozone protects us all from harmful levels of ultraviolet radiation. The designs of these SSTs all use jet fuel, either conventional and/or sustainable alternative versions (as discussed below), and the concerns about the environmental impacts of supersonic flights remain focused largely on the emissions of carbon dioxide, nitrogen oxides (NOx), and water vapor (H2O), as well as the aircraft takeoff and flight noise (including sonic boom). The direct emissions of NOx and H2O into the stratosphere can then affect the concentrations of ozone. Although these aircraft can use twice as much fuel as comparable service subsonic aircraft, the overall effects of currently projected fleets of SSTs on climate are likely to be small, generally less than a 0.03°C change in globally-averaged surface temperature. Further study of these ozone and climate impacts is needed for fleets of specific supersonic aircraft as their designs are further developed over the next few years.

There is also concern about the public acceptance of sonic boom noise from supersonic aircraft, especially for the flying time over land. Ongoing research to assess the impact on the public indicate that future low-boom supersonic aircraft designs could create significantly quieter sonic booms (thumps) that are much less annoying than those from conventional supersonic aircraft designs.

In addition, towards reducing their effects on climate, the aviation sector, in coordination with the UN's International Civil Aviation Organization (ICAO) and the U.S. Federal Aviation Administration (FAA), among others, is also committed to reducing aviation sector effects on climate. Alternative energy sources are being considered for short haul (electrical batteries) and medium haul (hydrogen) aircraft, but the principal approach for most commercial aircraft is by the development and deployment of sustainable aviation fuels (SAFs) to augment and diversify fuel supplies, reduce CO2 emissions, mitigate environmental impacts, and make aviation more sustainable. In 2009, the aviation industry committed to reducing emissions through both increased efficiency through technology, operations, and infrastructure improvements, and the use of SAF, with the target of a 50% reduction in carbon emissions by 2050 compared to baseline 2005 levels. With the increasing focus on net zero emissions, this goal was recently changed to 100% reduction in carbon emissions by 2050 by several countries, including the United States (FAA, 2021; see Figure 2). The aviation industry itself is making similar commitments (e.g., the International Air Transport Association (IATA) and the International Coordinating Council of Aerospace Industries associations (ICCAI) have both put out strong commitment statements).

SAFs can essentially eliminate CO2 emissions; the life cycle in the production of future SAFs should not depend on fossil fuels. SAFs can either be biofuel-based or e-fuels (e-fuels are synthetic fuels developed by combining hydrogen generated from renewable electricity and carbon from biomass or captured from the air). These SAFs also have low to negligible quantities of aromatic and sulfur compounds, thus leading to a significant reduction in particulate pollution that affects climate and air quality. However, these fuels would still lead to significant production of nitrogen oxides unless special effort is put into designing engines that reduce those emissions. Net zero carbon emissions reductions by 2050 from commercial aviation would be achieved through improvements in aircraft technology, improved flight operations, and the use of SAF. ICAO has expressed its support for this goal (https://www.icao.int/Newsroom/Pages/ICAO-welcomes-new-netzero-2050-air-industry-commitment.aspx). A transition of essentially all Jet A fuel to SAF will be essential to achieving this goal.

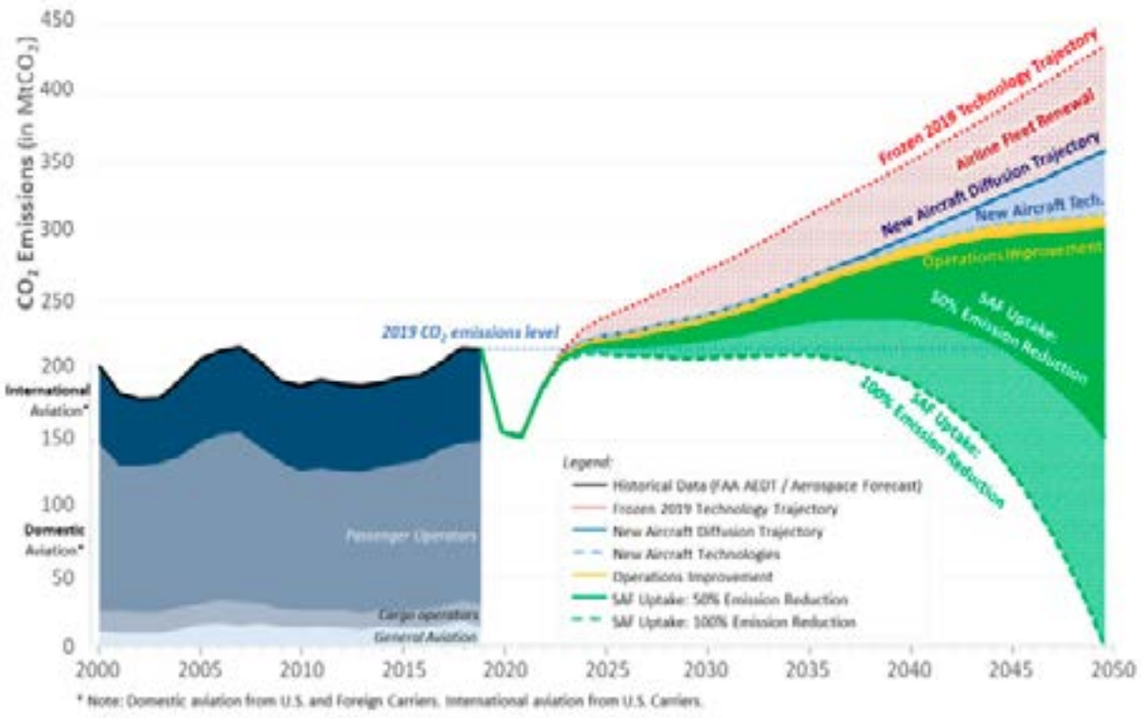

Figure 2. Scenario for a possible pathway to achieve net zero carbon emissions reductions from commercial aviation by 2050 through improvements in aircraft technology, improved flight operations, and the use of SAF. From FAA (2021).

At this point, worldwide, there have been more than 360,000 commercial flights powered by various blends of SAF with conventional Jet A/Jet A-1, and 44 airports are regularly distributing blended SAF (ICAO, 2021). Any new fuel to be used in the aviation sector must be compatible with existing aircraft engines and, it should be considered to be a "drop-in" fuel that doesn't require major new infrastructure or fuel handling capabilities. New fuel candidates must undergo a rigorous qualification and approval process prior to being certified.

Climate Impacts on Aviation

The changes in climate can also affect aviation. Extreme weather events are already known to have major effects on aircraft operations. Higher temperatures (and more heat waves) could especially slow down flight operations by affecting liftoff and airport pavements. Sea Level Rise and

Travel will be affected. Tourism will not die, but it certainly will be changed, with new choices for vacations replacing others that are no longer viable or of interest.

storm surge can affect airport facilities and operations. Climate variability, e.g., the location of the jet stream, storm development, convection, fog, visibility, and ceiling, can affect aviation route decisions. Many major airports – Boston, La Guardia, Newark, San Francisco International, Oakland - are located in coastal locations and are at risk to sea level rise.

The Future of Travel

The discussion above demonstrates the vulnerability of travel and tourism to the changing climate. Both mitigation and adaptation (resiliency) will be essential to the future of travel and tourism. Reducing emissions of carbon dioxide and other heat-trapping gases and particles associated with travel and tourism will be essential, not only to meeting the international goals to reduce future changes in climate, but also because 83% of global travelers think sustainable travel is vital (World Travel and Tourism Council 2021).

One of the side events at COP26 resulted in the Glasgow Declaration on Climate Action in Tourism, with the objective to raise the climate ambition of tourism stakeholders and secure strong actions to support the global commitment to halve emissions by 2030 and reach net zero as soon as possible before 2050 (https://www.unwto.org/event/cop-26-launch-of-the-glasgow-declaration-a-commitment-to-a-decade-of-climate-action-in-tourism). The wording of the Glasgow Declaration was developed by 426 tourism organizations, companies and professionals (https://www.tourismdeclares.com) in consultation with a diverse range of travel and tourism stakeholders, including private sector actors, international organizations, NGOs and academia. More than 300 travel companies, tourism boards and countries have now signed the Declaration since COP26 (https://www.nytimes.com/2021/11/17/travel/travel-climate-change.html).

Travel and tourism will also have to adapt to and prepare for the unavoidable, negative effects of climate change. Extreme weather events, sea level rise, coastal erosion, biodiversity loss, destruction of infrastructure and property, disruption to cultural and natural heritage activities and sites, along with increasing stress on basic natural resources, are all affecting travel and tourism (World Travel and Tourism Council 2021). In addition, the demand for tourism is sensitive to negative economic, environmental, and social impacts, resulting in tourism-dependent businesses, communities, livelihoods being increasingly vulnerable to the threat of climate change.

Nonetheless, there will be challenges and opportunities as climate continues to change. Travel will be affected. Tourism will not die, but it certainly will be changed, with new choices for vacations replacing others that are no longer viable or of interest.

Solutions are available that can reduce or stem the damage but planning needs to start soon. Adaptation is not a choice – our choice is whether to adapt proactively or respond to the consequences. Communities can be better prepared for the increasing likelihood of extreme heat or for the increasing likelihood of extreme precipitation events that can lead to flooding. Better forest management can reduce the spread of wildfires. Coastal communities can consider the protections that may be possible from the rising seas.

Conclusions

In general, to minimize future impacts and associated suffering to those in the travel and tourism industries, as well as those in many other sectors of society, we must achieve a lot of mitigation (reducing the emissions driving the changes in climate) and a lot of adaptation (becoming more resilient). We can slow climate change and reduce its magnitude, but it will take a concerted worldwide effort to greatly reduce the human-related emissions that are driving these changes. All nations need to significantly transition away from emissions associated with fossil fuels and they also need to be more proactive in protecting their forests and other natural resources because of their importance in storing carbon. A variety of analyses show this can be done without harming the economy. The clock is ticking. We need to face the challenges of addressing our changing climate. Meaningful solutions rest on technological, educational, social,

and cultural actions. We need to come together to address what is clearly the biggest challenge of our time.

The travel industry can lead the way by aiming at net zero emissions by or before 2050. The industry can show their leadership by integrating climate considerations into their business strategy and developing a timeline with interim aims and targets, along with reducing their own emissions and reducing value chain emissions. The industry can also influence climate action in society and contribute where it can to community-wide action.

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Donald J. Wuebbles is the Harry E. Preble Professor of Atmospheric Science at the University of Illinois. He also led the development of the Center for Urban Resilience and Environmental Sustainability (CURES) across the three UI campuses and serves as its Director. From 2015 to early 2017, Dr. Wuebbles was Assistant Director with the Office of Science and Technology Policy at the Executive Office of the President in Washington DC, where he was the White House expert on climate science. He was Head of the Department of Atmospheric Sciences at the University of Illinois from 1994 to 2006. Dr. Wuebbles also led the development of the School of Earth, Society, and Environment, and was its first director. He has been a leader in a number of international and national scientific assessments, including being a Coordinating Lead Author on several international climate assessments led by the Intergovernmental Panel on Climate Change (IPCC) that resulted in IPCC being awarded the Nobel Peace Prize in 2007. He co-led the first volume of the 4th U.S. National Climate Assessment published in November 2017 that assesses the science of climate change and its effects on the United States. He led an assessment on the impacts of climate change on the Great Lakes that was published in March 2019 and co-led a special assessment of the impacts of climate change on the state of Illinois published in May 2021. Dr. Wuebbles has received major awards, including the Cleveland Abbe Award from the American Meteorological Society, the Stratospheric Ozone Protection Award from the U.S. Environmental Protection Agency, and the Bert Bolin Global Environmental Change Award from the American Geophysical Union. He is a Fellow of three major professional science societies, the American Association for the Advancement of Science, the American Geophysical Union, and the American Meteorological Society.

Why We Must Connect Research to Action to Solve Critical Food Systems and Climate Challenges

Dr. Gregory Sixt and Professor Peter Smith
Food and Climate Systems Transformation (FACT) Alliance, Massachusetts Institute of Technology Abdul Latif Jamel Water & Food Systems Lab, United States and University of Aberdeen, United Kingdom (Prof. Smith)

Time is running out to address two of the most urgent crises humanity has ever faced: feeding a population of 9-10 billion people by 2050 and climate change. Food underpins the most basic elements of human society, and its relationship to climate is arguably one of the most complex and multi-faceted areas of human activity.

Food systems – including everything from food production to consumption and food waste – are uniquely vulnerable to climate change. The climate crisis is increasingly putting at risk access to safe, sufficient, and nutritious food – a privilege currently enjoyed by only 74% of people on earth. The International Food Policy Research Institute projects that climate change will decrease yields for most staple crops by 2050, and a growing body of research suggests climate change is increasingly harming the nutritional quality of crops. The UN Intergovernmental Panel on Climate Change warns that global warming of 2 degrees Celsius over pre-industrial levels could trigger a worldwide food crisis.

This is where the relationship between food and the climate crisis comes into sharper focus. The food system is responsible for a third of anthropogenic greenhouse gas emissions, and food system emissions alone could push us past the 2 degree limit set in the Paris Agreement of 2015. Food production has degraded 25% of the world's cultivated land, making it less resilient to the impacts of climate change and releasing billions of tons of greenhouse gasses in the process. Put simply, most of the current practices we use to produce our food are destroying the resources that feed us.

Finding solutions to the joint food and climate crises is addressed in the UN Sustainable Development Goals (SDGs), namely SDG 2 (Zero Hunger) and SDG 13 (Climate Action). The target date for achieving the SDGs is 2030, highlighting the urgency of the problem. This has been described as the decade of action for addressing both the climate crisis and the UN SDGs, an ambitious but critical timeline.

We hope 2021 marked a turning point for global action on food security and climate change goals. The year's widespread droughts, wildfires, and floods, and the hottest global July average temperature on record, have laid bare the simple fact that no country is immune from the effects of the climate crisis. The ongoing pandemic has further demonstrated fragility in many components of the global food system.

At the same time, the confluence of three major events this fall offers the opportunity to tackle the joint challenges of food insecurity and climate change together. The UNFCCC 26th Conference of Parties (COP26) took place in Glasgow, during which the dynamic interactions among climate change, food systems, and human activity was high on the agenda. The UN Food Systems Summit, held in New York, generated nearly 300 commitments to accelerate action on transforming food systems. The Nutrition for Growth Summit, held in December 2021 in Tokyo, garnered further commitments from governments, donors, and other stakeholders towards improving nutrition through improved food systems.

Our current lack of an integrated, transdisciplinary understanding of food systems and their interactions with climate is a major obstacle

Siloed agendas and short-term planning are counter to the long-term action needed to transform food systems while ensuring human, planetary, and economic health.

to achieving these vital commitments. Siloed agendas and short-term planning are counter to the long-term action needed to transform food systems while ensuring human, planetary, and economic health. Rapid scaling up of cooperation between the research community, policy makers, and other stakeholders, that integrates expertise across disciplinary and sector boundaries, is needed to collaboratively resolve critical food and climate systems challenges.

Sometimes referred to as "convergence research," this approach focuses on complex problems related to societal need. Multi-institution, cross-sector alliances will facilitate convergence research on food and climate systems through better problem formulation and greater participation by stakeholders. Researchers who engage with practitioners can better assess knowledge gaps and understand how research can contribute to solutions, while producing results that are relevant and usable by policy makers and other stakeholders. Formal researcher-stakeholder alliances help develop connections across networks to make such research more targeted and actionable, and research outcomes more visible and understandable. The *Food and Climate Systems Transformation (FACT) Alliance*, a global consortium of 16 leading research institutions spanning six continents is one such effort. Led by MIT's Abdul Latif Jameel Water and Food Systems Lab and encompassing a growing network of collaborating stakeholder organizations, its mission is to catalyze new research partnerships that will drive food system sustainability transformations. The FACT Alliance represents a new approach to driving change – integrating research across diverse disciplines, making stakeholders partners in the research process, and assessing impacts in complex and interconnected food and climate systems.

Time is not on our side. To date, the research community hasn't delivered the actionable solutions needed if time-critical changes are to be made to our food systems. Research, funding, and publication processes are too slow and too narrowly focused. If we are to see true change and material impact, we must think and act differently.

The policy priorities identified in global agendas for transforming food systems for greater sustainability and climate change resilience require new insight into the interactions, trade-offs, and potential of systemic change. Narrow disciplinary research published solely for academic audiences can be no more than an echo chamber among researchers. The research community has a role to play here, but it can only be effective in that role if it learns to play better with others

The Food and Climate Systems Transformation Alliance (FACT Alliance) is a global food systems convergence research network, connecting researchers, the private sector, NGOs, farming communities, and governments to drive innovation and inform better decision making for resilient, equitable, and sustainable food systems. Led by the Massachusetts Institute of Technology's Abdul Latif Jameel Water and Food Systems Lab (MIT J-WAFS), the FACT Alliance brings together 16 leading research institutions and a growing group of stakeholder organizations working at the vanguard of research and action in the food-climate systems nexus. The FACT Alliance represents a new approach to driving food systems change – integrating research across diverse disciplines, making stakeholders partners in the research process, and assessing impacts in complex and interconnected food and climate systems.

Dr. Greg Sixt directs the Alliance for Food and Climate Systems Transformation, an MIT J-WAFS-led global network of 16 leading research institutions and collaborating stakeholder organizations working to shorten the link between research and action. He is also the Research Manager for Food and Climate Systems on various J-WAFS projects.

Dr. Sixt also worked at the US Department of Agriculture's National Institute of Food and Agriculture (USDA-NIFA) in the Institute of Bioenergy, Climate, and Environment and the Center for International Programs. He has consulted for Stockholm Environment Institute (SEI), World Resources Institute (WRI), International Center for Agricultural Research in the Dry Areas (ICARDA), Wageningen University and Research, Global Development and Environment Institute (GDAE), United Nations Economic Commission for Europe (UNECE), and the United Nations Development Programme (UNDP). He has extensive experience on issues that include agricultural innovation systems, climate change adaptation in agriculture and water management, water-energy and food-water-energy nexus governance, and foreign aid investment.

Dr. Sixt received a PhD in Agriculture, Food, and Environment and Water Diplomacy from The Freidman School of Nutrition Science and Policy at Tufts University. He has an M.A. in Environmental Science and Policy from Clark University and a B.A. in Political Science from the University of Vermont.

Peter Smith FRS FRSB FRSE is Professor of Soils and Global change at the University of Aberdeen where he directs the Scottish Climate Change Centre of Expertise, ClimateXChange.

After obtaining a PhD in 1991, he worked as a Higher- then Senior-Scientific Officer at the MAFF Central Science Laboratory until 1994. He then worked as a Band 6 and Band 5 Senior Research Scientist at Rothamsted Research before joining the University of Aberdeen as a Senior Lecturer in 2001.

He became a Reader in 2003, and Professor of Soils & Global Change in 2005. His main areas of expertise are in modelling greenhouse gas / carbon mitigation, bioenergy, biological carbon sequestration, global food systems modeling, and greenhouse gas removal technologies.

He is co-leader with Prof Jo Smith of the Environmental Modelling Group (2 Academic staff, 2 Senior Research Fellows, 15 Post-docs, 12 PhDs). He is also Science Director of Scotland's Climate Change Centre of Expertise (www.climatexchange.org.uk), and was Director of Food Systems of the Scottish Food Security Alliance-Crops (www.sfsa-crops.org), and Theme Leader of the University-wide theme, Environment and Food Security (www.abdn.ac.uk/environment-food-security/), until 2015. He is editor for Global Change Biology and Global Change Biology Bioenergy.

He was a Royal Society-Wolfson Research Merit Award holder (2008-2013), Royal Society Research Fellow (2008-2013), and is a Fellow of the Society of Biology (FSB; elected 2008), a Fellow of the Royal Society of Edinburgh (FRSE; elected 2009), a Foreign Fellow of the Indian National Science Acedemy (FNA; elected 2017); a Fellow of the European Academy of Sciences (EurASc; elected 2018) and a Fellow of the Royal Society (London; elected 2017).

"Politics as Usual" Will Never Be a Solution to the Current Climate Threat

Interview with Professor Emeritus Richard Falk
Princeton University, United States

Interview by C.J. Polychronou

There is an ever-growing consensus that the climate crisis represents humanity's greatest problem. Indeed, global warming is more than an environmental crisis — there are social, political, ethical and economic dimensions to it. Even the role of science should be exposed to critical inquiry when discussing the dimensions of the climate crisis, considering that technology bears such responsibility for bringing us to the brink of global disaster. This is the theme of my interview with renowned scholar Richard Falk.

The climate crisis is the greatest challenge of our time, but, so far, we seem to be losing the battle to avoid driving the planet to dangerous "tipping points." Indeed, a climate apocalypse appears to be a rather distinct possibility given the current levels of climate inaction. Having said that, it is quite obvious that the climate crisis has more than one dimension. It is surely about the environment, but it is also about science, ethics, politics and economics. Let's start with the relationship between science and the environment. Does science bear responsibility for global warming and the ensuing environmental breakdown, given the role that technologies have played in the modern age?

I think science bears some responsibility for adopting the outlook that freedom of scientific inquiry takes precedence over considering the real-world consequences of scientific knowledge — the exemplary case being the process by which science and scientists contributed to the making of the nuclear bomb. In this instance, some of the most ethically inclined scientists and knowledge workers, above all, Albert Einstein, were contributors who later regretted their role. And, of course, the continuous post-Hiroshima developments of weaponry of mass destruction have enlisted leading biologists, chemists and physicists in their professional roles to produce ever more deadly weaponry, and there has been little scientific pushback.

With respect to the environmental breakdown that is highlighted by your question, the situation is more obscure. There were scientific warnings about a variety of potential catastrophic threats to ecological balance that go back to the early 1970s. These warnings were contested by reputable scientists until the end of the 20th century, but if the precautionary principle included in the Stockholm Declaration on the Human Environment (1972) would have been implemented, then certainly scientists bore some responsibility for continuing to work toward more capital-efficient means of finding technological applications for oil, gas and coal. As with adverse health effects, post-Enlightenment beliefs that human progress depended on scientific knowledge inhibited regulation for the benefit of the public good. Only when civil society began to sound the alarm were certain adjustments made, although often insufficient in substance, deferring to private interests in profitability, and public interests in the enhancement of military capabilities and governmental control.

Overall, despite the climate change crisis, there remains a reluctance to hamper scientific "progress" by an insistence on respecting the carrying capacity of the Earth. Also, science and scientists have yet to relate the search for knowledge to the avoidance of ecologically dangerous technological applications, and even more so in relation to political and cultural activities. There is also the representational issue involving the selection of environmental guardians and their discretionary authority, if a more prudential approach were to be adopted.

The climate crisis also raises important ethical questions, although it is not clear from current efforts to tame global warming that many of the world's governments take them seriously. Be that as it may, how should ethics inform the debate about global warming and environmental breakdown?

The most obvious ethical issues arise when deciding how to spread the economic burdens of regulating greenhouse gas emissions in ways that ensure an equitable distribution of costs within and among countries. The relevance of "climate justice" to relations among social classes and between rich and poor countries is contested and controversial. As the world continues to be organized along state-centric axes of authority and responsibility, ethical metrics are so delimited. Given the global nature of the challenges associated with global warming, this way of calculating climate justice and ethical accountability in political space is significantly dysfunctional.

Similar observations are relevant with respect to time. Although the idea of "responsibility to future generations" received some recognition at the UN, nothing tangible by way of implementation was done. Political elites, without exception, were fixed on short-term performance criteria, whether satisfying corporate shareholders or the voting public. The tyranny of the present in policy domains worked against implementing the laudatory ethical recognition of the claims of [future generations] to a healthy and materially sufficient future.

Taking account of the relevance of the past seems an ethical imperative that is neglected because it is seen as unfairly burdening the present for past injustices. For instance, reparations claims on behalf of victimized people, whether descendants of slavery or otherwise exploited peoples, rarely are satisfied, however ethically meritorious. There is one revealing exception: reparations imposed by the victorious powers in a war.

In the environmental domain, the past is very important to the allocation of responsibility for the atmospheric buildup of greenhouse gas emissions. Most Western countries are more responsible for global warming than the vast majority of the Global South, and many parts of Africa and the Middle East face the dual facts of minimal responsibility for global warming yet maximal vulnerability to its harmful effects.

These various ethical concerns are being forced onto the agendas of global conferences. This was evident at the 2021 COP-26 Glasgow Climate Summit under UN auspices. The intergovernmental response was disappointing, and reflected capitalist and geopolitical disregard of the ethical dimensions of the climate change challenge.

Politics also figures prominently in the climate crisis, with questions being raised as to whether our current system of government, both at the national and international level, is adequate to meet the greatest challenge of our time. What are your thoughts on this matter?

As suggested, addressing the global challenge of climate change with the tools developed for problem-solving in a state-centric world possessing weak institutional mechanisms for the effective promotion of the global public good is the organizational root of the problem. The UN was established with the ahistorical hope that the great powers of international relations would cooperate for peace as successfully as they cooperated for war between 1939 to 1945. Despite lofty rhetoric, the UN was designed to be a weak global mechanism. Why else disempower the UN by giving the victors of World War II a right of veto, which in effect was a recognition of the primacy of geopolitics?

Besides geopolitics, there were other obstacles to global-oriented problem-solving as a result of the persistence and expansion of statism after the collapse of European colonialism. This dominance of statism was reinforced by rigid ideological adherence to nationalism on the part of political leaders, shaping relations with other countries even if disguised somewhat by alliance diplomacy, "special relationships" ([such as the U.S.'s relationship with] Israel) and neoliberal patterns of globalization.

The core political issue is upholding the indispensable need for unprecedented degrees of globally oriented cooperation to address effectively climate change challenges that were being stymied by the continuing dominance of statist and geopolitical tendencies in international relations. These tendencies favor the part over the whole in

multilateral forms of problem-solving. This structural reality has recently been accentuated by the rise of autocratic hyper-nationalist leaders in many important states, and by recent preoccupations with overcoming the COVID pandemic and containing its negative economic spillovers.

Until a robust mechanism for the promotion of global public goods is established, the political potential of present structures of world order do not seem capable of fashioning prudent and effective policies to cope with climate change. For such a mechanism to be established will require [either] the shock effect of future climate catastrophes, or a powerful, widely supported, militant transnational civil society movement dedicated to the protection of the Earth.

The climate crisis also reflects the failure of economics, with the argument being made that capitalism is actually the cause of the problem and climate change merely a symptom. Given where we are, and with the window of opportunity rapidly closing, should the fight against global warming be also a fight against capitalism?

David Whyte ends his book on ecocide with these stark words: "[We have to kill the corporation before it kills us." The guiding idea of contemporary capitalism is to maximize short-term profitability, a posture that contradicts the kind of approach that would protect the natural habitat against the ravages wrought by contemporary capitalism.

However, the issue may be broader than capitalism. Actually existing socialist governments, exercising greater state control over the economy, have exhibited no better record when it comes to environmental protection or taking responsible account of longer-term threats to the natural habitat. State-dominated economies may be less concerned about profitability, but their preoccupation with maximizing economic growth and susceptibility to corruption is as dangerous and destructive.

Until economic and political policies grounded upon a new kind of citizenship [prioritizing] humanity gain political traction, it seems highly improbable that ecological threats will be addressed responsibly.

From your own perspective, how do we move forward in the fight against global warming? Indeed, what might be possible approaches to overcome climate inaction?

You saved the most difficult question for last! I do think education in the broad sense is key, including rethinking citizenship and activist civic participation. It is also essential that efforts be made to enable the UN to act more independently of geopolitical and nationalist manipulations, which have prevented the UN from playing an influential role throughout the COVID pandemic. This regressive interaction with states was highlighted by the hostility of Trump's presidency to any kind of meta-nationalist approach to the control of the virus, including his disgraceful decision to defund and disengage from the World Health Organization.

A more credible UN requires independent and increased funding by way of an international tax, as well as curtailing of the right of veto by the five permanent members of the Security Council. Such global reforms will not happen without substantial pressure from civil society mobilizations coupled with the emergence of more enlightened leadership in important countries.

As suggested above, a reconstituted world order responsive to the magnitude and character of climate change challenge would seem to require the radical transformation of economic activity. This seems as though it could happen only through a revolutionary process, either as something that took the unprecedented shape of a transnational movement or spread from state to state as did the Arab Spring of 2010-2011, but without sparking a counterrevolutionary backlash.

Because there is no currently visible transition strategy to move from where we are to where we need to be, indulging the utopian imagination is a political act, envisioning futures attuned to the climate change agenda.

I believe that our escape from present entrapment depends on "a politics of impossibility." Our leaders say, and the general consensus is, that politics should be conceived as "the art of the possible," which assesses the play of forces to discover what is feasible. My argument has been that what is understood by the political class as feasible is insufficient

There are many signs that a green vision of the future is gaining support throughout the planet, especially among youth who have most to lose, and hence to gain.

to produce satisfactory policies and practices with regard to climate menaces. That is, the politics we know lacks the capacity to generate a solution.

It is evident that the impossible happens. This was manifested in recent international experience by the victories of national resistance movements in several major 20th-century anti-colonial wars, the collapse of the Soviet Union, the dismantling of apartheid in South Africa. In each instance, before the impossible happened, experts deemed the outcome utopian or impossible, not worthy of the attention of serious persons. What seems clear is that the impossible happens only when the mobilization of people is great enough to produce outcomes that defy the perceptions of those forces committed to the permanence of the status quo.

This leads me to view the future as uncertain and unknowable. For this reason, whatever future we believe necessary and desirable can unfold, defying current expectations. This makes it rational and justifiable for patriots of humanity to engage on behalf of this better future. There are many signs that a green vision of the future is gaining support throughout the planet, especially among youth who have most to lose, and hence to gain. Youth may be the vanguard among those demanding ecologically responsible patterns of humane governance for the planet.

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For decades, **Richard Falk** has made immense contributions in the areas of international affairs and international law from what may be loosely defined as the humanist perspective, which makes a break with political realism and its emphasis on the nation-state and military power. He is professor emeritus of international law and practice at Princeton University, where he taught for nearly half a century, and currently chair of Global Law at Queen Mary University London, which has launched a new center for climate crime and justice; Falk is also the Olaf Palme Visiting Professor in Stockholm and Visiting Distinguished Professor at the Mediterranean Academy of Diplomatic Studies, University of Malta. In 2008, Falk was appointed as a United Nations Special Rapporteur on the situation of human rights in the Palestinian territories occupied since 1967. He is the author of some 50 books, the most recent of which is a moving memoir, titled Public Intellectual: The Life of a Citizen Pilgrim (2021).

C.J. Polychroniou is a political economist/political scientist who has taught and worked in numerous universities and research centers in Europe and the United States. His latest books are T*he Precipice: Neoliberalism, the Pandemic and the Urgent Need for Social Change* (A collection of interviews with Noam Chomsky; Haymarket Books, 2021), and *Economics and the Left: Interviews with Progressive Economists* (Verso, 2021).

Climate Communication in the Era of "Blah Blah Blah"

Dr. Genevieve Guenther
End Climate Silence, United States

In *Don't Look Up*, the star-studded Hollywood climate-change allegory recently nominated for a Best Picture Academy Award, a scientist and his graduate student, Dr. Mindy and Kate Dibiasky, desperately try to warn the world that a planet-killing comet is heading directly towards Earth, only to be met by the indifference of the government, the news media, and the vast majority of the population. Eventually, Dibiasky gives up trying to communicate the danger and gets a job as a supermarket cashier. Dr. Mindy allows himself to be appropriated by the system, becoming an advisor to the American President, a monstrous reality-TV hybrid of Donald Trump and a Real Housewife, who turns comet-denial into a badge of right-wing identity while she simultaneously collaborates with a sociopathic tech billionaire to try to monetize the rare minerals they discover the comet contains. In the end, this moneymaking scheme comes to naught, and (spoiler alert for those who have yet to see the film) the comet crashes into Earth, destroying our planet and everyone on it.

This narrative about climate communication, and the role of climate communication in climate politics, suggests that the task of conveying the danger of climate change falls to scientists, and successful scientific communication entails getting voters to "look up," as it were, and pay attention to the planetary crisis which they would prefer to ignore. But scientists fail in their task not just because the news media is committed to climate silence—reporting celebrity gossip rather than warning people about preventable planetary catastrophe—but also because the climate crisis gets polarized by right-wing elites, who turn not looking up into a culture-war weapon so that they can continue to profit from the causes of global heating.

This story dovetails with currently fashionable accounts of the intersection of partisan identity and opinion-formation. Arising out of the "cultural cognition" model advanced by Dan Kahan, who argues that our reasoning is "motivated" because we always filter information through our political identities, the idea is that climate communication will never appeal to partisans for whom climate denial is a sign of their belonging in their communities and their own sense of themselves. Implicit in this account of climate communication is the idea that our climate politics will be stuck until, somehow, we get the right-wing on board. Although some climate communicators, such as Katharine Heyhoe, a scientist who is herself an evangelical Christian, try to circumvent this dynamic by grounding their communications in an appeal to common "human values", getting the rightwing on board with ending the general use of fossil fuels seems as impossible as deflecting the comet once it's entered the Earth's orbit.

Luckily, this focus on overcoming partisanship sees only half the story. Times have changed and the discourse has shifted. According to the Yale Program on Climate Change Communication, 59% of Americans, about six in ten, are either concerned or even alarmed about the climate crisis, while only 19% are doubtful or dismissive of the danger. Indeed, the alarmed are the largest group in America; they outnumber the outright deniers more than three to one. They are by no means mobilized yet, but they are there. We should not doubt that the majority of voters is aware and worried about the crisis.

Stakeholders are also responding to this increased level of charged awareness. Major news outlets are adding or expanding their climate desks. Corporations are advertising their clean-energy procurement

strategies. Banks are warning investors against climate risks. Even oil and gas companies are announcing net zero operations targets. And of course, nearly every government in the world professes to aim to halt warming at 1.5° C.

But all of this talk belies the fact that these stakeholders are continuing to support the practices that are making global heating worse. Nearly all global news outlets advertise fossil fuels, and flagship publications such as The New York Times and The Washington Post actually create advertisements for oil and gas companies that greenwash their upstream investments—which even the IEA acknowledges must cease to halt global heating before the entire planet is destroyed.

Corporations buy dodgy offsets which get double-counted and thereby contribute to further greenhouse-gas emissions. Oil executives announcing their operations will become "net zero" is like announcing that tobacco executives will outlaw smoking at their company while they continue to sell cigarettes to kids. And not one Nationally Determined Contribution is strong enough to help halt warming at 1.5°C by 2100—and those weak NDCs themselves are, of course, just pledges. The Biden Administration, for one, returned from COP 26 and just days later sold more leases of public land to fossil-fuel executives than even his orange-hued, red-hatted predecessor, the supposed-climate denier.

All of this suggests that climate politics is stuck not because it's polarized—but because it's unified. The most powerful stakeholders on both sides of the political spectrum are neither ending the fossil-fuel system nor rebuilding our systems on zero-emissions principles, even as they claim to want to halt global heating at 1.5°C. Indeed, we have left the decades of doubt and denial behind, and we have entered the era of "blah blah blah," as Greta Thunberg so succinctly puts it.

Climate communication must evolve to adapt to this new era. It can do so by taking on a three-fold task. First, it should seek to inspire the majority who are concerned and alarmed about the climate crisis to adopt the kind of committed, even revolutionary fervor that can lead people collectively to replace our current stakeholders with leaders who will transform our systems.

Second, it should attempt to give those people the communications tools that can help undermine the ideologies that sustain and justify those stakeholders' power. And finally, climate communication should attempt to introduce new codes and assumptions into political discourse. Without helping to dismantle and rebuild our current ideological systems, climate communication will simply point at the climate-change comet and ask people to care about it but fail to show how the world can divert its course.

Right now, the codes and assumptions that dominate the way most people think and talk about the climate crisis, across the partisan divide, produce and justify our economic-cultural complex—which is to say the fossil-fuel system.

To undermine the ideologies that justify the power of the stakeholders upholding the fossil-fuel system, climate communicators should see the language of climate politics itself as a system with interwoven, interacting components: there is the language of science, the language of economics, of international relations, of activism, of narrative forms like tragedy or eschatology, of psychology, of journalism, of academic research conventions, of right-wing and Russian disinformation, and so on and so on. What is important to remember is that every part of this system is connected with the other. They are all connected to the dominant as well as subordinate discourses of our historical moment, and they all act together to produce a cohesive set of codes and assumptions with which we understand the physical crisis of global heating as well as its cultural valence and its politics. Right now, the codes and assumptions that dominate the way most people think and talk about the climate crisis, across the partisan divide, produce and justify our economic-cultural complex—which is to say the fossil-fuel system.

These codes and assumptions emerge into the language of climate politics via a narrative that goes largely uncontested by stakeholders on both the right and the left. This narrative constellates around a core of seven key terms: *alarmist, cost, freedom, growth, "India and China," innovation,* and *resilience*. It goes something like this: "Yes climate change is real, but to say it threatens human survival is *alarmist*—and anyway the monetary and cultural costs of ending the general use of fossil fuels is greater than the cost of climate change itself. The health of American families, and human welfare around the world, relies on the economic *growth* enabled by fossil fuels, so we need to keep using them at least while the global south develops, decarbonizing them with *innovation* while facing climate impacts by increasing communities' *resilience*. We should be wary of creating international institutions to plan the transition to a post-fossil-fuel economy lest they cancel our freedom. At the same time, America cannot act unilaterally on the climate crisis because *India and China* something something."

What gives this narrative its stranglehold on our politics is that it repeatedly get invoked not only by oil and gas interests, but also by centrist politicians, corporate executives, and bankers, as well as by journalists, scientists, economists, researchers in politics and energy,—and sometimes even climate activists themselves—all of whom to some degree sincerely intend to advance climate solutions. This unified discourse of climate politics amplifies fossil-fuel disinformation and itself reproduces the ideologies that justify the power of the system's biggest stakeholders. Climate communicators must work to expose and neuter the false assumptions of those ideologies and introduce new ways of talking about climate, energy, and the economy that can bring new practices, and new justifications for those practices into view. Once we stop assuming, for example, that technology emerges separate from planetary ecology, we can see that perpetual growth will not protect us from a ravaged planet, and we can begin to imagine how an economic system that takes ecological considerations into account can actually increase human flourishing.

Of course, talking alone will not resolve the climate crisis. But insofar as words shape beliefs and beliefs influence and justify actions, to resolve the climate crisis we will need to remake our discursive systems just as we need to transform our energy systems. We will need to stop reiterating the ideological assumptions of the fossil-fuel, "blah blah blah" era so as to invoke a new world—a world that has swerved to avoid the comet—and then, talking about that world, do whatever is necessary to bring it into being.

Dr. Genevieve Guenther is an author, climate activist, and native New Yorker. An expert in climate communication and fossil-fuel disinformation, she is the founding director of End Climate Silence and affiliate faculty at The New School, where she sits on the board of the Tishman Environment and Design Center. Dr. Guenther advises activist groups, corporations, and policymakers, and she serves as an Expert Reviewer for the UN's Intergovernmental Panel on Climate Change. Her next book, *The Language of Climate Politics,* is forthcoming from Oxford University Press.

Indigenous Practices of Environmental Conservation

Interview with Professor Beth Rose Middleton Manning
University of California Davis, United States

The United States is facing catastrophic fires, drought, soil erosion, and other climate change-related issues. How can we change our approach to land stewardship to tackle these environmental issues? How can Native Americans assist with this type of approach?

The climate threats we face now have a history that is intertwined with colonialism. One of the first laws to pass in the State of California was the 1850 Act for the Government and Protection of Indians, which includes a clause prohibiting burning. This Act, the campaign of genocide against California Indian people, and later public lands' policies such as the Weeks Act (1911) that prohibited prescribed fire, all denied Indigenous peoples the ability to tend landscapes that co-evolved with low-intensity, human-set fires.

Fire suppression led to overstocked, drier forests. The water table dropped due to the volume of vegetation. Ladder fuels proliferated due to the lack of thinning and burning. Meadows disappeared with conifer encroachment. Additionally, pests tend to thrive in leaf litter, contributing to a decline in the health of the overstory. All these factors have been exacerbated by warming temperatures and increasing aridity associated with climate change.

The climate threats we face now have a history that is intertwined with colonialism.

Reintroducing Indigenous stewardship, including but not limited to cultural burning, can help to make forests and other landscapes more resilient to climate change. Indigenous stewardship embodies principles of reciprocity, respect, and relationality, and involves diverse techniques and practices such as coppicing, selective replanting, and low intensity burning. Reintroducing Indigenous stewardship results in improved quality and quantity of plants and animals essential for the continuance of culture, and in related positive outcomes for human health and well-being. Peoples from all backgrounds can be engaged in supporting Indigenous-led land care projects by recognizing and promoting their importance, serving as donors and volunteers (if invited), and advocating for land back or co-management to expand the opportunities for Indigenous stewardship.

The issues we face now are so immense — there are so many acres of unmanaged forests under dry, hot conditions that exacerbate the potential for catastrophic fire. It is imperative that we increase the broader understanding of and commitment to landscape care. Local groups like fire safe councils and prescribed burn associations are important partners in fostering collaboration to expand local burning for landscape health. Primary, secondary, and adult education should involve not only studying local ecology but learning about the important role of human beings in caring for landscapes, understanding colonial history in-place, and developing de-colonial visions for the future that involve implementing collaborative restoration practices and returning land to Indigenous stewardship.

What can be done to protect the land and restore it from the ravages of climate change?

I believe one of the most important things we can do to protect land is to steward it. For millennia, landscapes were cared for intensively by human beings. Tribal members still work to care for homelands, even in the face of imposed private-public jurisdiction. As a broader society, colonization and industrialization have distanced us from the ecosystems that provide our physical, mental, and spiritual sustenance. I would like to see school systems include land stewardship in the curriculum, educating children from young ages about how to contribute directly to ecosystem health. I would also like to see local, state, and federal environmental policy recognize and support Indigenous-led land stewardship initiatives.

It is undeniably important to restore degraded landscapes to increase their resilience to climate change. Current conservation initiatives, such as 30x30 in California and the America the Beautiful at the federal level, aim to conserve 30 percent of natural and working lands by 2030. I participated on an Equity Panel to develop recommendations for centering equity in California's 30x30 effort and advocated for understanding conservation as including active stewardship. Furthermore, conservation must be understood in context of colonialism, so that it does not become another expression of removal and, instead, becomes an opportunity for deep consideration of history and collaboratively developing a more inclusive path to land stewardship that contributes to healing both communities and ecosystems.

What are easements, and why are they important toward positively impacting environmental conservation practices and climate change?

Easements are a legal tool that can be used to facilitate conservation and stewardship. If we use the common metaphor of property rights as a bundle of sticks, an easement is a right to one of those sticks. Common easements involve allowing roads or power lines to cross a property. A conservation easement is different because it is restrictive. A landowner who agrees to have a conservation easement on his or her property voluntarily gives up or sells one of the sticks in the bundle — the right to develop the property.

While most conservation easements are in perpetuity and stay with the property after it is sold, some conservation easements can be short-term, disallowing development for 20 or 30 years, for example. Some conservation easements also allow or even require certain activities, such as public access or particular types of restoration. A landowner may sell or donate a conservation easement. The payment received for the easement helps to offset the reduction in property value (from relinquishing the development value) and may help the landowner to retain ownership of the property. The Conservation Easement Tax Incentive also provides a tax break for qualified landowners who donate or sell conservation easements.

Cultural conservation easements (CCEs) are similar to conservation easements, but typically allow access and stewardship to the owner of the CCE for cultural purposes. In doing the research for Trust in the Land, I had a transformative conversation with then-Chairman of the Little Traverse Bay Band of Odawa, Mr. Frank Ettawageshik. Mr. Ettawageshik had innovated the concept of a cultural conservation easement, which he described as "a property right to hold a ceremony." I thought that description was meaningful, because ceremony transcends concepts of property yet, to have the privacy, resources, and space for ceremony, sometimes the concept of property must be involved. Since that time, I have seen many applications of CCEs by Native entities that want to formalize access to, stewardship of, and protection of sites that are not under tribal or individual Native jurisdiction.

Conservation easements are important for a host of reasons. Another interesting use is restoring waterways or wildlife corridors. Conservation easements may be negotiated on a string of properties to ensure protection and restoration of connected habitats across private and public jurisdictions. This application of a conservation easement is intertwined with cultural values, as protecting waterways and wildlife corridors

supports and safeguards species and landscapes of cultural importance.
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What is the largest challenge we face in attempting to protect the land in the United States?

Trust. We need to build trust and communication across, within, and between communities so that we can link land care initiatives across jurisdictions. Even if you have a private landowner that is a good land steward, and invests in thinning the forest, reducing erosion around streams, planting Native species, and enhancing habitat, if the neighboring public or private landowner allows his or her land to overgrow, be overgrazed, or become polluted, then the impact of the good land care practices is limited.

Furthermore, landowners and managers must be engaged in understanding the history-in-place that led to the current jurisdictional arrangements, to develop points of intervention to address past injustices. Indeed, all of us must work on multiple levels to address the intertwined ramifications of colonialism and climate change. To persist as a species, we must recognize the connections across our watersheds and build systems of land care and mutual support across property and cultural boundaries. That requires trust, listening, and care for the land and one another.

Interview by Alexandra Gilliard

Dr. Beth Rose Middleton Manning is a Professor of Native American Studies at UC Davis. Dr. Middleton's research centers on Native environmental policy and Native activism for site protection using conservation tools. Her broader research interests include intergenerational trauma and healing, rural environmental justice, indigenous analysis of climate change, Afro-indigeneity, and qualitative GIS.

Dr. Middleton received her BA in Nature and Culture from UC Davis, and her Ph.D. in Environmental Science, Policy, and Management from UC Berkeley. Her first book, Trust in the Land: New Directions in Tribal Conservation (University of Arizona Press 2011), focuses on Native applications of conservation easements, with an emphasis on conservation partnerships led by California Native Nations.

Dr. Middleton is currently working with graduate students in NAS, Ecology, and Cultural Studies on articles on regarding opportunities for University of California to work with Native Nations to address its identity as a land grant institution; opportunities for estimating carbon credits from the benefits of traditional burning; and creating curriculum on African and Indigenous intersections in the Americas.

International Organizations, Activists, and Climate Change

Interview with Professor Nina Hall
Johns Hopkins School of Advanced International Studies United States

What can inter-governmental organizations do to respond to climate change? How successful have they been so far in their mandates?

Inter-governmental organizations are an important part of the global response to climate change. They work on many critical global problems — health, refugees, migration, and development — and these issues are all being affected by climate change. In my research I have explored how the United Nations High Commissioner for Refugees (UNHCR), the International Organization for Migration (IOM), and other humanitarian organizations responded to climate change. These organizations — in tandem with the work of climate scientists and climate activists — drew global attention to the fact that climate change would hit the poorest the most, and yet the poorest have contributed the least to the problem.

In the last two decades, these pressures have led many inter-governmental organizations to reinterpret their work and their mandates. The UNHCR, for example, under the leadership of High Commissioner António Guterres, encouraged states to expand assistance and legal protection to those who are forcibly displaced by climate change. They were eager for states to address gaps in international legal frameworks, which result from the fact that the Refugee Convention is narrowly defined and does not include many forms of displacement. However, the UNHCR's attempts were rejected by states who did not want to create any new binding, legal obligations to protect any new categories of people, whether climate induced or otherwise. Interestingly, states made the decision not to expand UNHCR's mandate in 2011, well before the wave of populism and skepticism in multilateralism, heralded by Brexit in the United Kingdom and the election of Donald Trump in the United States.

Meanwhile, the IOM expanded its operations into climate adaptation projects. They have also developed research on the impacts of climate change on migration, which has informed public debates. The IOM, alongside others, has illustrated that there is not a simple causal link between climate change and migration. When a disaster hits, such as Hurricane Katrina, not everyone will migrate as a result. Moreover, those who do move may not be the worst off. Certainly, for Katrina, the most vulnerable were those who remained in New Orleans. So, if we are trying to conceptualize categories of who will be worst affected by climate change, we need to look not only at those who migrate, but also at those who cannot move. In fact, migration can even be an effective adaptation strategy to climate change, as the IOM and other organizations have pointed out.

Which new issue areas that inter-governmental organizations do not currently focus on do you think are key to addressing climate change in the next few decades?

Inter-governmental organizations will have to adapt to many new issues in the coming years. The COVID-19 pandemic, of course, has been a real shock, and most of our institutions — whether national or international — have struggled. One of the issues that limits inter-governmental organizations' ability to adapt to new issues is the current funding model. Most UN agencies rely on member-states for their funding, but we have

seen a stagnation, if not an overall decline, in this financing. In addition, there has been an increase in the proportion of earmarked funding. Earmarking occurs when a country gives funds to an international organization such as the World Health Organization (WHO), but stipulates what these funds can be used for. Today, over 80 percent of the of the financing WHO receives is earmarked. Forty years ago, it used to have 80 percent core funding (which was not earmarked). The IOM has even higher rates of earmarked funding — over 90 percent. The result, as I have explored with other researchers, is that UN agencies have less flexibility to adapt their funding to new crises that emerge, and/or where it's needed most.

How does climate change impact global peace and security? What changes to this can we expect to see in the coming decades if climate change is not addressed successfully?

Climate change will, and already is, having a massive impact on us all. Just last year we saw massive floods in China and Germany and huge heat waves and wildfires in Northern America. However, the links between climate change and conflict are complex. Some have claimed we will see more conflicts because of climate change — for instance, the conflicts in Syria or Darfur have been linked to climate change. However, these claims are often oversimplified and miss out on the political dimensions of warfare.

A common underlying argument is that resource scarcity will lead to conflict. Yet, scholars have pointed out that intra-state conflict is more likely to occur over an abundance of resources. Paul Collier, for example, suggests civil wars occur when both parties can generate revenue and the war is financially viable. Meanwhile, resource scarcity may lead to cooperation and collaboration. We should be careful about framing policy in overly simplistic terms and hence misreading the policy problem that needs to be solved. Climate change is a massive global challenge, and we need to tackle it by cutting global emissions radically and enabling developing countries to adapt.

What is exciting about the student-led climate movement is how fast they can mobilize millions of people globally.

How have climate activists impacted governmental efforts to curb climate change? Have climate protests been effective in achieving what they set out to do?

Climate activists have, over decades, pushed for stronger state action on climate change. In the last few years we have seen the rise of new and successful movements, like Fridays for Future and Extinction Rebellion. These groups are building off decades of climate activism by climate scientists, indigenous activists, and environmental NGOs. It's thanks to all the efforts of scientists and activists in the latter part of the 20th century that we have the United Nations Framework Convention on Climate Change in the first place.

What is exciting about the student-led climate movement is how fast they can mobilize millions of people globally. Also, they are mobilizing people around the world — not just in capital cities, but also in small towns from India to Sweden, New Zealand to South Africa. Fridays for Future have done so without the financial resources of the big professional NGOs, like WWF or Greenpeace. In addition, they have put pressure on decision-makers. Angela Merkel, for instance, has credited the Fridays for Future movement for accelerating Germany's climate policies — although Fridays for Future would point out that the German government has not yet gone nearly far enough to cut emissions.

Interview by Alexandra Gilliard

Nina Hall is an Assistant Professor of International Relations at Johns Hopkins School of Advanced International Studies. She has recently finished a book: *Transnational Advocacy in the Digital Era* (Oxford University Press, 2022). Her core areas of expertise are international organizations, transnational advocacy, climate adaptation, and global refugee governance. She holds a PhD in International Relations from the University of Oxford and a Master's Degree from the University of Auckland, New Zealand. She previously worked as a Lecturer at the Hertie School of Governance and as a policy officer at the New Zealand Ministry of Foreign Affairs and Trade. She is a co-founder of an independent think tank, *New Zealand Alternative*, writes frequently on New Zealand foreign policy, and has edited a book on New Zealand's role in the world.

Fighting Global Warming: Challenges Ahead

Interview with Bill McKibben
Middlebury College, United States

Your book, *The End of Nature* (published in 1989) is widely considered to be the first book addressing climate change. What have been the major impediments for addressing global warming since its publication?

The major impediment – by far – is that the fossil fuel industry decided to run an all out campaign of denial and then delay - their big lie tactics delayed by decades the time when we would finally start to reckon with this overwhelming challenge

You've written that lowered costs of renewable energy has been a positive force in combating climate change. Would you briefly discuss progress made for making these technologies cost-viable?

The consensus now is that costs drop ten percent a year for renewable energy – each doubling in capacity seems to drive prices down about 30%. This learning curve does not seem to be running out of steam, and does seem to apply to batteries as well.

What emerging technologies and/or practices do you find most exciting/promising?

Cheap solar power, wind power, and batteries are the key – they solve 80% of the transition, and we have them in hand.

It's a fight between scientists and activists on the one hand, and the fossil fuel industry on the other.

Another positive you've noted is the rise of citizen involvement. How can average citizens best assist in fighting global warming?

The key thing has been citizens weakening the power of the fossil fuel industry. That's why divestment, and the fight against pipelines and other infrastructure, have been so crucial. Fossil fuel divestment alone now includes more than $40 trillion in endowments and portfolios.

Looking back on COP26, what were your impressions, disappointments, and points for encouragement, if any?

I thought it was pretty limp. Biden had nothing to put on the table thanks to Sen. Joe Manchin, and so little real progress got made.

Any final thoughts on the outlook for achieving a successful fight against global warming?

It's a fight between scientists and activists on the one hand, and the fossil fuel industry on the other. We'll win eventually, but this is a timed test, and I'm not sure we'll win in time.

Bill McKibben is founder and senior adviser emeritus of 350.org. His 1989 book *The End of Nature* is regarded as the first book for a general audience about climate change, and has appeared in 24 languages. He's gone on to write many more books, and his work appears regularly in periodicals from the *New Yorker* to *Rolling Stone*. He serves as the Schumann Distinguished Scholar in Environmental Studies at Middlebury College, as a fellow of the American Academy of Arts and Sciences, and he has won the Gandhi Peace Prize as well as honorary degrees from 19 colleges and universities. He was awarded the Right Livelihood Award, sometimes called the alternative Nobel, in the Swedish Parliament. Foreign Policy named him to its inaugural list of the world's 100 most important global thinkers.

Energy Demand Reduction: Its Importance in Meeting Climate Change Targets

Dr. Tina Fawcett
Environmental Change Institute, University of Oxford, United Kingdom

It is just a few short months since the conclusion of COP26, held in Glasgow, UK. There, citizens from all over the world took to the streets in their tens of thousands demanding action on climate change, calling for climate justice. Governments seem to be listening to citizen concerns and to the science; many countries have targets to achieve net zero greenhouse gas emissions by 2050 or sooner. Internationally, COP26 is judged to have made enough progress that the goal of limiting global temperature rise to 2°C, and perhaps even 1.5°C, remains within reach. However, these targets can only be achieved with massive and rapid change to global energy systems, whose use of fossil fuel is the largest source of greenhouse gas emissions. The question is whether governments are looking in the right places for the levers for change.

This article argues that they are not - there is too little focus on the role of energy demand reduction in delivering net zero emissions. The transition to net zero will not be solely, or even primarily, about changes to the energy supply side (Eyre and Killip, 2019). Energy experts agree that a transition to net zero, particularly a just transition, must go beyond electricity grid decarbonization, through replacement of fossil fuels by renewables, towards a greater focus on energy demand reduction and on engagement of users in the transition (Nolden et al, 2021).

The key arguments for a greater focus on energy demand reduction are:

1. There is far more scope for energy demand reduction than is commonly understood;
2. Energy demand reduction has many social and economic benefits beyond meeting net zero goals;
3. Without significant energy demand reduction and increased flexibility[1], renewable and low carbon energy cannot meet net zero goals.

Energy systems consist of a range of energy sources, fossil fuel, renewable and low carbon, which via a transformation and transmission infrastructure, and after losses, meet energy demand. Globally, energy demand continues to rise, as do associated carbon dioxide emissions. Although the use of renewable forms of energy is growing rapidly, fossil fuel use also continues to rise, resulting in ever higher carbon emissions. However, this is not inevitable; in some countries and regions different patterns are emerging. In Europe, for example, energy use has been gradually falling since the mid-2000s, as have carbon emissions. This results from a combination of energy demand reduction across all sectors of the economy, primarily via energy efficiency measures, and increased use of renewable and low carbon sources of energy, particularly for electricity generation. Accelerating these changes will be key to meeting net zero targets. They will also help deliver affordable access to modern forms of energy to the billions of people who are currently missing out.

The common vision for a net zero energy system is one based primarily on renewable sources of energy with a switch towards using decarbonized electricity for heating, industrial process and transport where possible, and indirect use of electricity through an energy carrier such as hydrogen, where not. Making this change will require the transformation of the whole energy system. The challenges range from the technical – how to ensure reliability in an electricity system powered by renewables? – to the economic – who is going to pay for this transition? – to the social – what role will individuals play in the

...far too little research, policy and public attention is paid to energy demand reduction.

new energy system? – to the political – how will governments design policy to steer this transition? Many issues are hotly debated, for example the future role of nuclear power or the need for, or feasibility of, carbon dioxide removal (CDR) technologies. Scenarios are used by governments, international organizations, and research groups to explore different futures and ways of reaching net zero by 2050.

In all scenarios, the importance of replacing fossil fuels with other energy sources in the transition to net zero is recognized. However, this article argues that far too little research, policy and public attention is paid to energy demand reduction. In scenarios, or futures thinking, energy demand is frequently assumed to be fixed or to rise in line with GDP and population growth. This thinking fails to understand that the demand for the goods and services which energy facilitates (also known as energy service demand) differs from energy demand. People can use far less energy to get the same service. For example, to travel to a cultural event which is beyond walking distance, transport energy use could be reduced by using a smaller car, a more efficient car, car sharing, traveling by public transport, traveling by moped or bicycle. Travel demand could further be reduced by accessing culture closer to home, attending online or attending fewer events. Carbon emissions could be reduced by using electric vehicles. As illustrated by this example, there are many options to reduce the carbon and energy impacts of consumption of goods and services.

There are two fundamental ways to reduce energy demand. Firstly, through energy efficiency, i.e. providing the same service using less energy and secondly, by reducing the demand for energy services. There is still a huge untapped potential for improving energy efficiency (Rosenow and Eyre, 2018). Energy efficiency, or energy productivity, is more widely recognized as an important focus for governments. The European Union has declared an ‘energy efficiency first’ principle. This means policymakers should take utmost account of cost-efficient energy efficiency measures in shaping energy policy and making relevant investment decisions. However, many experts would argue that more needs to be done to operationalize this principle. Reducing demand for energy services is a broader idea, which can touch upon ideas of sufficiency and limits to growth and consumption, as well as more modest ideas such as land use planning to reduce the need to travel, or passive architecture which drastically reduces the energy needed for thermal comfort. There is an emerging range of thinking on what ‘energy sufficiency’ is and how policy could encourage this (Association Négawatt, 2018), but much more research, experimentation and consultation on this and related concepts is needed.

Actions to reduce energy demand have significant net positive co-benefits for nearly all areas of human development and natural ecosystems. This was demonstrated in a landmark report on the impacts of global warming 1.5°C above pre-industrial levels, published in 2018 by the Intergovernmental Panel on Climate Change (IPCC 2018). It showed that limiting global warming to 1.5°C could go hand in hand with ensuring a more sustainable and equitable society. The impacts of three mitigation strategies – energy demand, energy supply and land management – on all other sustainable development goals (SDGs) were calculated in terms of synergies and trade-offs. For energy demand strategies, this modeling showed the positive effects on SDGs are much greater than the negative effects. Energy demand also out-performed energy supply in terms of its net positive benefits for nearly all SDGs.

Meeting net zero carbon emissions is not the only goal of an energy system. This is particularly obvious given the current crisis in energy markets, with huge price rises for natural gas. In many countries, there is considerable public and political concern about the impact of prices on individual energy users, particularly lower-income households, as well as on businesses - with debate about what governments can or should do to ameliorate the impact of high prices. Recent UK analysis has shown that if the government had not scrapped previous energy efficiency policies, householders would be significantly less exposed to these higher prices, as average energy use would be lower.

A sustainable energy system must deliver three key objectives:

- Energy Security
- Energy Equity (accessibility and affordability)
- Environmental Sustainability of Energy Systems

These goals are characterized as a 'trilemma', but one where the focus is on meeting all three goals, despite potential trade-offs between them. The World Energy Council produces an annual Energy Trilemma Index, which compares national progress in meeting these goals (WEC, 2021). Their evidence demonstrates that achieving high scores in all three objectives is possible given a sustainable mix of policies. Importantly, reducing the demand for energy can meet all three objectives simultaneously. A smaller energy system is more secure and has less impact on the natural environment.

The importance of demand reduction in meeting net zero goals is demonstrated by new scenarios from the UK Centre for Research into Energy Demand Solutions (CREDS), a research center looking at how reductions in energy demand can support the transition to a net zero society. CREDS has developed a set of national 'positive low energy futures' (Barrett et al, 2021). This is new modeling and analysis, which has never before been carried out so comprehensively at a national level. The approach was first to develop coherent narratives of plausible futures based on social and technological changes and then turn these into quantified scenarios. Five activities were modeled: food and agriculture, transport, residential buildings, non-domestic buildings and industry/ products. The scenarios incorporate social changes that would reduce demand for energy services (e.g., fewer miles traveled), as well as energy efficiency strategies (e.g., better insulated homes).

Four scenarios have been developed showing very different options for UK energy demand to 2050 (Figure 1). These are briefly described:

Ignore demand – baseline scenario, showing energy demand and supply to 2050 based on current known and planned UK policies.

Steer demand – same energy service demand as in 'Ignore' scenario, but incorporating other measures that aim to reduce emissions to net-zero by 2050.

Shift demand – a low energy demand scenario with changes that reduce demand for energy across the whole economy using proven technologies and under current social/political norms. Net zero is achieved with high investment in zero carbon supply and a range of carbon dioxide removal (CDR) technologies.

Transform demand – a low energy demand scenario that includes transformative change in technologies, social practices and behavior, infrastructure and institutions. It is intended to generate significant co-benefits in health, local environment, affordable warmth and work-life balance. Energy demand falls by 52%. Net zero is achieved with lower supply side investment and without engineered CDR.

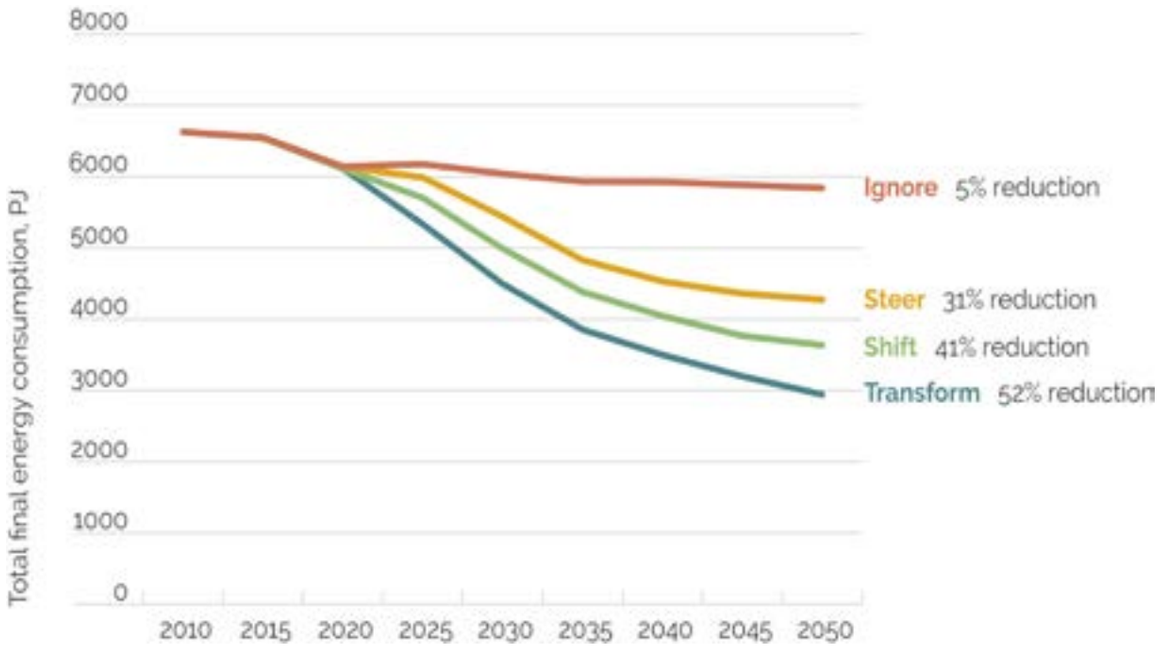

Figure 1: Total final energy consumption in the UK to 2050 under various scenarios

Only the Shift and Transform scenarios meet the UK's net zero by 2050 goal. Importantly, the Transform scenario can be delivered at lower cost and reduces the risks and costs associated with relying on untested, undeveloped technical solutions in energy supply and engineered carbon dioxide removal. The CREDS work concluded that a low energy demand strategy could be at the heart of a fair, affordable and healthy route to net zero.

There is no doubt that government choices about energy policy, and other policy areas which influence energy demand, are critical. In their 2021 scenarios exercise, the International Energy Agency stated: “decisions made by governments are the main differentiating factor explaining the variations in outcomes across our scenarios” (IEA, 2021). Government policies made the difference between scenarios that met the net zero goals globally, and those which did not.

In conclusion, the transition to net zero will require huge change at all scales in the socio-technical systems which supply our energy. This challenge cannot be met simply by changes to energy supply; significant reductions in energy demand and increased flexibility are also needed. Reductions in energy demand can be met in part by increased energy efficiency and switching to less energy intensive means of getting the service desired. However, there are also more difficult decisions to be made about limiting access to some types of energy service to ensure we meet carbon reduction targets. Governments and other policy actors need to pay more attention to these options, to investigate them in more detail, and to start conversations with the public about synergies and trade-offs on the path to net zero.

Tina Fawcett is a Senior Researcher and Deputy Leader of the Energy Group at the Environmental Change Institute, University of Oxford. Her research concerns energy use by households and organisations, and uses a multi-disciplinary approach to understand current patterns of use and to identify opportunities and policies for reducing energy use and carbon emissions. Dr Fawcett leads the 'policy and governance' theme in the Centre for Research on Energy Demand Solutions. Her research work within CREDS focuses on policy for further, faster and more flexible delivery of energy demand reduction, particularly in relation to buildings energy use. She also works on: Energy Superhub Oxford, a large demonstration project trialling smart local energy systems; M-BENEFITS an EU H2020 project on the multiple benefits of energy efficiency for businesses; and, the EPSRC Network for the Decarbonisation of Heating and Cooling. Other interests include climate change education research and outreach, including work with Oxford's Department of Education on 'climate change education futures in India' and in developing Maths for Planet Earth.

International Climate Change and Energy Policy

Professor Margot Hurlbert
University of Regina, Canada

The Climate Change Crisis

Climate change is about risk. And risk poorly managed can engender a crisis. In 2019 climate change became the 'climate crisis,' in 2021 the International Panel on Climate Change "IPCC" dropped the 'red flag' warning of climate change, and we can only surmise what 2022 might bring. After describing the crisis of climate change, this policy brief will expound on the three crises of interdisciplinary science: negative emission technologies, nuclear energy deployment, and continued incrementalism.

These past years, the evidence of the impacts of climate change (CC) has been undeniable: Fires, droughts, and floods are happening at increasingly frequent rates with increasing intensity. In drylands, such as Saskatchewan we experience climate change as being 'less cold.' Our average winter minimum temperature has increased to minus 16 degrees Celsius today from minus 22 degrees Celsius 55 years ago (a 6 degree Celsius warming). Our average frost-free growing period has similarly increased to 140 days, up from 106 days in the mid-1960s. This warming has manifest in such things as the advent of West Nile virus and the unprecedented extent and severity of the pine beetle infestation.

Globally interconnected CC risks are only beginning to be understood and experienced. Multi food supply failures exacerbate urbanization, migration, and conflict as El Nino and La Nina events potentially create cascading risk through northern and southern hemispheres. In a synthesis of the latest peer-reviewed, state-of-the planet research more than one third of scientists identified the underlined threat posed by the synergistic interplay and feedback loops between the top five global risks that 'might cascade to create global systemic crisis." These include extreme heatwaves accelerating global warming by releasing large amounts of stored carbon, at the same time intensifying water crisis and/or food scarcity; at the same time loss of biodiversity weakens the capacity of natural and agriculture systems to cope with climate extremes increasing vulnerability to food crisis (Future Earth 2020).

CC risk is increasingly the outcome of limited, ineffectual, and maladaptive responses (that might make sense in the short term, but not in the long term, and not in the context of reducing emissions). Our socio-ecological systems are not developing fast enough for the world to achieve net zero as the horizons within which we have discussed climate change have been well beyond most government and business horizons. Through the delivery of six assessments of the IPCC we have still failed to adapt to our changing climate and to mitigate or reduce our emissions to the extent required to achieve a series of stated global climate change goals. Our short term incentives have been ineffectual in solving the endemic, complex, and long term problems of climate change. Although energy, and specifically the power production system, has been earmarked as one of the first sector's to reduce GHG emissions, only a handful of countries have been successful.

Time is fast running out and CC impacts will be longer lasting and more

massive than that of COVID-19. As the IPCC warned in 2019 “the window of opportunity, the period when significant change can be made, for limiting CC within tolerable boundaries is rapidly narrowing”. While many have endorsed a mantra of ‘build back better,’ this has been mostly hollow, un-measureable words, with vague goals.

Today there is a gap between current policy and the behavioral and policy changes needed to address climate change. People, their livelihoods, their employers, their businesses, and economy are all critical factors in addressing this gap. But decision makers tend to discount the future, particularly when it involves longer-term horizons as is the case with CC. As a result, extinction of species and ecosystems, melting of polar ice caps, are given a diminishing value. Today is a time for the kind of moral leadership that recognizes failure to act now threatens the welfare of future generations. Without it, we face making decisions that create stranded assets in the future, such as coal or natural gas power plants that are not equipped with carbon capture technology, and become impediments to reaching our goal of a net zero carbon emission future by 2050.

The world’s remaining carbon budget (the amount of GHG emissions that can be released into the atmosphere over time) may be depleted as soon as 2028. At this point, if we emit further carbon into our atmosphere, we will likely be unable to meet our Paris Agreement commitments. In order to limit global warming to 1.5 degrees Celsius, we need to reduce our emissions by 50% by 2030. Currently, our stated NDCs are positioning us on a pathway to overshoot our targets with median global warming in the vicinity of 3 degrees Celsius. It is clear urgent action is required - a combination of new technology (clean and renewable), energy efficiency and societal change (IPCC 2018).

Many countries have declared (Sweden, United Kingdom, France Denmark, New Zealand, Hungary - while Suriname and Bhutan have achieved) or are currently considering (European Union, Spain, Chile, Fiji) ambitious net zero emissions goals (Energy & Climate 2020). Finland, Austria, Iceland, Germany, Switzerland, Norway, Ireland, Portugal, Costa Rica, Slovenia, Marshall Islands have these targets in policy documents; Uruguay, Italy, Canada, South Korea, Mexico, the Netherlands, Colombia, Argentina, Belguim, Pakistan, and many more are considering these measures (ibid.). 77 countries, 10 regions and more than 100 cities announced their commitment to net zero carbon emissions by 2050; the momentum is building (Beguin et al. 2020).
A large number of global organizations have declared carbon neutral targets, especially those with end-consumer-facing business models (including Amazon, Google, Apple, Cenovus Energy, TELUS, and Maple Leaf Foods). Even oil and gas companies have signed up - Calgary’s Canadian Natural Resources Limited has set an aspirational goal of net zero.

Enduring Barriers to Address Climate Change

Significant enduring barriers to achieving GHG reductions remain unaddressed; my focus in this brief will be on what I see as the three communication ‘chasms’ of the CC solution space. The majority of climate change scenarios consistent with the Paris Agreement rely on a combination of negative emission technologies (NET), carbon dioxide removal (CDR), and clean energy technologies such as solar, wind, and nuclear. To achieve Paris commitments the IEA states, “renewables will not be enough on their own” (Chestney 2020) and solar, wind, low-carbon hydrogen, batteries and carbon capture and storage (CCUS) should be a part of governments’ plans for both stimulating clean energy transitions and stimulating economies (Birol 2020; Chestney 2020). Further, we will not achieve Paris commitments without decarbonizing the transport sector (Chestney 2020). Adding transportation into the power production system, at the same time as transforming this system to net zero and negative emission technologies, makes the transition all the more arduous.

In my interdisciplinary and cross-sector work in studying the transition needed to achieve Paris commitments I see three significant barriers. First I will discuss the ‘chasm’ around negative emission technologies, and specifically CCS; next, I will discuss the elusive promise of nuclear

power production which was positioned to deliver clean energy since the 1950s but has consistently failed; and finally, our continued demonstration and perpetuation of 'incrementalism' in policy and societal change.

Negative emission technologies also comprise nature-based solutions such as planting trees and expanding protected areas, converting biomass to biochar (charcoal-like substance made by burning organic material in a controlled process) and using it as a soil amendment, bioenergy CCS (burning of biomass (switchgrass or loblolly pine) to produce energy and capture CO2 using CCS), and direct air capture with carbon capture and storage (CCS). The issue with everything I've listed until direct air capture with CCS, is the very large amount of land required (taking land out of production for food) in order to achieve our climate targets. Another reason CCS has received negative publicity, is due to allegations it is delaying the phasing out of fossil fuels. CCS has traditionally been associated with use on coal fired power plants (the Boundary Dam power station in Saskatchewan, Canada), and CCS has played a key role in enhanced oil recovery (arguably increasing net GHG emissions). With this background, the CCS industry has failed to address concerns through transparent accounting, verification, and reporting (AVR) of GHG emission reductions. Not only is AVR for the carbon removed required (which is very clearly accounted for and verified), but it is also needed across the entire supply chain of coal mining, oil and gas mining, plastic fabrication, CO2 pipelines, and derivative product sales (including fly ash and Nitrogen). Critics of CCS have accurately pointed out that CCS with enhanced oil production actually increases the total amount of GHGs.

... while CCS will be important for decarbonizing difficult sectors including cement and steel, it is currently within a CCS industry self-imposed 'valley of death' in failing to leap frog into the future net zero envisioned world.

The CCS industry's communicative failure in describing how CCS projects will fit into a future decarbonized world has resulted in CCS projects not qualifying for 'clean energy' subsidies in some countries (due to concerted lobbying by environmental groups and academics to this end). So while CCS will be important for decarbonizing difficult sectors including cement and steel, it is currently within a CCS industry self-imposed 'valley of death' in failing to leap frog into the future net zero envisioned world.

The Promise of Nuclear Power

In the decades since its discovery, nuclear power production has failed to address people's concerns surrounding nuclear power plant accidents, nuclear weapons, nuclear waste, and more recently, nuclear power plant building cost overruns. Albeit lack of public acceptance is a complex problem (given the variety of governments, scientists, and industry involved in nuclear science and nuclear power production) this public acceptance failure is an enigma, given the incredible feats the nuclear industry has achieved. To mention a few achievements, the nuclear industry has a stellar record of cooperating in relation to information exchange and nuclear industry insurance, and the industry has a predominantly positive health and safety record (especially in comparison to other forms of power production). While often criticized for being an insular industry only conversing with itself, Sovacool et al. (2020) goes further in their criticisms, documenting the lack of renewables in the power production mix of countries with nuclear power production and the lack of social science and environmental support (due to the concerns expressed above). Albeit some countries and regions (U.K., France, and Ontario, Canada) have very successfully deployed nuclear energy and decarbonized their power production sectors, for many people and in many countries, there still exists confusion about nuclear energy being GHG free (with only peripheral components such as the cement required in nuclear power plants entailing GHG emissions). While CCS appears to be living within a self-inflicted 'valley of death,' nuclear power production has created its very own 'cone of silence.'

The Barrier of Incrementalism

Lastly, the biggest challenge for addressing climate change and the energy system is our failure to grasp the degree of change that our energy systems need to undertake to achieve the reduction in GHG emissions within the very short time frame required. CC is no longer just a problem of our children and future generations; the impacts and risks of CC are here – and so is the urgent requirement for climate action now. What used to be an incremental policy approach to address problems of future generations is no longer a luxury we can afford. Not only does our remaining carbon budget (explained in CC above) require urgent action, but so do our planning horizons.

To illustrate my point I consider what is needed to reduce GHG emissions by 50% by 2030 and by 100% a few short decades thereafter. All infrastructure (building, bridges, roads) – including energy infrastructure (transmission and distribution lines, power plants, metering) are built with an expected lifetime of 25 years. This period of time is utilized in cost and risk projections surrounding infrastructure. As such, building a natural gas power plant today would mean the plant would expect to still be running in 2047. Often these power plant's lives are extended through refurbishment such that they last upwards of 50 years. As natural gas power production produces GHG emissions, this delays any ability to reduce emissions and potentially achieve net zero targets at least until 2047 or 2072, when a much earlier date is required. Further, building power production plants has a lead time from several months (for renewable energy) to several years (for a CCS plant or a nuclear plant). Our infrastructure decisions of 2005 have already impacted our ability to achieve our 2030 targets.

Envisioning all of the world's existing power production infrastructure, and the change that would be required to achieve net zero emissions by 2030, is gargantuan. When adding the electrification of transport, and potentially home heating, to the power production system and the resulting increase in electricity needs, this vision is almost unimaginable. Engaging in the exercise has never been more important in order to 'back cast' the change that is required today in order to achieve the future climate we want. However, many governments, climate change reports, and climate reports continue to endorse 'incrementalism.'

This incrementalist endorsement is not intentional. With mandates against policy prescriptiveness, a suite or mix of policies are presented as 'options' which can be chosen by governments depending on politics and context. This misses the point that addressing carbon leakage to other jurisdictions, and infrastructure issues requires a large range of CC policies working together. Further, socio-economic pathways provide a series of strategies for achieving Paris Commitments. While this range provides the appearance of a diversity of possible pathways, these pathways are not often grounded in the local landscape and personal accompanied individual change. The price of carbon, the reductions in GDP, and reduced individual consumption accompanying pathways to achieve Paris Commitments are not always clearly articulated.

So how might these barriers be addressed? The first step is acknowledging the barriers. The good news is young people are engaged and governments are starting to get serious. 70% of young people consider the speed of energy transition to be either stagnant or too slow and these young people are willing to pay for the necessary change and accept the lifestyle changes required for energy transition (WEF 2020). Governments are increasingly recognizing the need to embrace laws and policies with targets of net zero emissions by 2030 or 2050 with more setting targets. And corporate responsibility is also changing. Youth public trust claims are increasing against governments for inadequate climate efforts, but so are lawsuits against private entities for failure to adapt to CC, failing to incorporate CC risks into investments and planning, failing to report CC risks, or weak, misleading or inadequate disclosure surrounding planning for CC risk including CC scenarios for limiting global warming well below 2 degrees Celsius (Setzer and Byrnes 2019; Peel et al. 2017). Increased obligations surrounding corporate planning for net 2 degrees Celsius and communicating it (akin to net zero by 2050)(IPCC 2018) has been endorsed by the G20 (Carney 2019), the American Bar Association (Brammer et al. 2019), and the European Commission.

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Professor Hurlbert has been a Coordinating Lead Author, Contributing Author and Review Editor for the Intergovernmental Panel for Climate Change. She has also authored numerous journal articles, book chapters and scholarly papers on a broad range of topics but more recently on the subjects of energy, Aboriginal justice, water and climate change adaptation. She has co-authored a book entitled *School Law and the Charter of Rights and Freedoms* with her fathers (second edition 1992), edited a second edition of *Pursuing Justice, an Introduction to the Study of Justice*, co-edited *Vulnerability and Adaptation to Drought: The Canadian Prairies and South America* in 2016, and published, *Adaptive Governance of Disaster: Drought and Flood in Rural Areas* in 2018.

A 'Plan B' for Addressing Climate Change and the Energy Transition

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Climate change is increasingly being referred to as a crisis, emergency, existential threat and most recently as 'code red.' Climate change has become a grand narrative in which man-made global warming is regarded as the dominant cause of societal problems. Everything that goes wrong reinforces the conviction that that there is only one thing we can do prevent societal problems – stop burning fossil fuels. This grand narrative leads us to think that if we stop burning fossil fuels, then these other problems would also be solved. The end result is narrowing of the viewpoints and policy options that we are willing to consider in dealing with complex issues such as public health, water resources, weather disasters and national security.

So, exactly what is wrong with this grand narrative of climate change? In a nutshell, we've vastly oversimplified both the problem of climate change and its solutions. The complexity, uncertainty, and ambiguity of the existing knowledge about climate change is being kept away from the policy and public debates. The dangers of man-made climate change have been confounded with natural weather and climate variability. The solutions that have been proposed for rapidly eliminating fossil fuels are technologically and politically infeasible on a global scale.

Specifically with regards to climate science, there is some good news. Recent analyses from the International Panel on Climate Change (IPCC) and the International Energy Agency (IEA) indicate that the extreme tail risks from global warming, associated with very high emissions and high climate sensitivity, have shrunk and are now regarded as unlikely if not implausible.

Further, the IPCC's climate projections neglect plausible scenarios of natural climate variability, which are acknowledged to dominate regional climate variability on interannual to multidecadal time scales. Apart from the relative importance of natural climate variability, emissions reductions will do little to improve the climate of the 21st century – if you believe the climate models, most of the impacts of emissions reductions will be felt in the 22nd century and beyond.

How did we come to the point where we're alleged to have a future crisis on our hands, but the primary solution of rapid global emissions reductions is deemed to be impossible? The source of this conundrum is that we have mischaracterized climate change as a tame problem, with a simple solution. Climate change is better characterized as a wicked mess. A wicked problem is complex with dimensions that are difficult to define and changing with time. A mess is characterized by resistance to change and contradictory and suboptimal solutions that create additional problems. Treating a wicked mess as if it is a tame problem can result in a situation where the cure is not only ineffective, but worse than the alleged disease.

How Urgent is the Need for an Energy Transition?

Under the auspices of the UN Framework Convention on Climate Change, the world is attempting to reach net zero in carbon emissions by 2050. I refer to this as Plan A. Using the precautionary principle, Plan A is based on the premise that rapidly reducing CO2 emissions is critical for preventing future dangerous warming of the climate.

In spite of the numerous UN treaties and agreements to reduce emissions over the past two decades, the atmospheric CO2

concentration relentlessly continues to increase. By 2050, global emissions will be dominated by whatever China and India have done, or have failed to do. The IEA Roadmap to net zero finds that there is a possible but very narrow pathway to net zero by 2050, provided that there is a huge leap in energy innovation and major efforts to build new infrastructure. Others find that reaching net zero by 2050 is a social and technological impossibility.

For the past two decades, we've been hearing about the climate crisis, climate catastrophe, existential threat, and most recently a code red for humanity. These terms are used by politicians and policy makers to emphasize the urgency of action to stop burning fossil fuels. Note that the IPCC itself does not use the words 'crisis', 'catastrophe', or even 'dangerous'; rather it uses the term 'reasons for concern.' Apart from the scientific uncertainties, the weakest part of the UN's argument about man-made global warming is that it is dangerous. The highest profile link to danger relies on linking warming to worsening extreme weather events, which is a tenuous link at best.

Any evaluation of dangerous climate change must confront the Goldilocks principle. Exactly which climate state is too hot versus too cold? Some answer this question by stating that the climate we are adapted to is 'just right'. However, the IPCC uses a preindustrial baseline, in the late 1700's. Why anyone thinks that this is an ideal climate is not obvious. This was during the Little Ice Age, the coldest period of the millennia. In the U.S., the states with by far the largest population growth are Florida and Texas, which are warm, southern states. Property along the coast – with its vulnerability to sea level rise and hurricanes – is skyrocketing in value. Personal preference and market value do not yet regard global warming as 'dangerous.' While politicians in developed countries argue that we need to address climate change for the sake developing countries, addressing climate change ranks much lower in these countries than developing access to grid electricity.

The planet has been warming for more than a century. So far, the world has done a decent job at adapting to this change. The yields for many crops have doubled or even quadruped since 1960. Over the past century, the number of deaths per million people from weather and climate catastrophes have dropped by 97%. Losses from global weather disasters as a percent of GDP have declined over the past 30 years.

In addressing the challenges of climate change and the energy transition, we need to remind ourselves that addressing climate change isn't an end in itself, and that climate change is not the only problem that the world is facing. The objective should be to improve human well-being in the 21st century, while protecting the environment as much as we can.

All other things being equal, everyone would prefer clean over dirty energy. However, all other things are not equal. We need secure, reliable, and economic energy systems for all countries in the world. This includes Africa, which is currently lacking grid electricity in many countries. We need a 21st century infrastructure for our electricity and transportation systems, to support continued and growing prosperity. The urgency of rushing to implement 20th century renewable technologies risks wasting resources on an inadequate energy infrastructure and increasing our vulnerability to weather and climate extremes.

How the climate of the 21st century will play out is a topic of deep uncertainty. Once natural climate variability is accounted for, it may turn out to be relatively benign. Or we may be faced with unanticipated surprises. We need to increase our resiliency to whatever the future climate presents us with. We are shooting ourselves in the foot if we sacrifice economic prosperity and overall societal resilience on the altar of urgently transitioning to 20th century renewable energy technologies. Alarmism about climate change misleads us and panic makes us less likely to tackle climate change smartly.

Towards a 'Plan B'

Even without the mandate associated with global warming and other environmental issues, we would expect a natural transition away from fossil fuels over the course of the 21st century, as they become more expensive to extract and continue to contribute to geopolitical instability.

The problem is with the urgency of transitioning away from fossil fuels, driven by fears about global warming. By rapidly transitioning to this so-called clean energy economy driven by renewables, we're taking a big step backwards in human development and prosperity. Nations are

A more pragmatic approach to dealing with climate change drops the timelines and emissions targets, in favor of accelerating energy innovation.

coming to grips with their growing over dependence on wind and solar energy. Concerns about not meeting electricity needs this winter are resulting in a near term reliance on coal in Europe and Asia. And we ignore the environmental impacts of mining and toxic waste from solar panels and batteries, and the destruction of raptors by wind turbines.

Opponents of Plan A reject the urgency of reducing emissions. They state that we stand to make the overall situation worse with the simplistic solution of urgently replacing fossil fuels with wind and solar, which will have a barely noticeable impact on the climate of the 21st century. Opponents of Plan A argue that its best to focus on keeping economies strong and making sure that everyone has access to energy. And finally, the argument is made that there are other more pressing problems than climate change that need to be addressed with the available resources.

Does all this mean we should do nothing in the near term about climate change? No. But given the problems with Plan A, we clearly need a Plan B that broadens the climate policy envelope. By considering climate change as a wicked mess, climate change can be reframed as a predicament for actively reimagining human life. Such a narrative can expand our imaginative capacity and animate political action while managing social losses.

We should work to minimize our impact on the planet, which isn't simple for a planet with 8 billion inhabitants. We should work to minimize air and water pollution. From time immemorial, humans have adapted to climate change. Whether or not we manage to drastically curtail our carbon dioxide emissions in the coming decades, we need to reduce our vulnerability to extreme weather and climate events.

Here's a framework for how we can get to a Plan B. A more pragmatic approach to dealing with climate change drops the timelines and emissions targets, in favor of accelerating energy innovation. Whether or not we manage to drastically curtail our carbon dioxide emissions in the coming decades, we need to reduce our vulnerability to extreme weather and climate events.

To thrive in the 21st century, the world will need much more energy. Of course we prefer our energy to be clean, as well as cheap. To get there, we need new technologies. The most promising right now is small modular nuclear reactors. But there are also exciting advances in geothermal, hydrogen and others. And the technology landscape will look different even 10 years from now.

Developing countries don't just want to survive, they want to thrive. We need much more electricity, not less. Going on an energy diet like we did in the 1970's is off the table. We need more electricity to support innovation and thrivability in the 21st century. Consumption and growth will continue to increase throughout the 21st century. We need to accept this premise, and then figure out how we can manage this growth while protecting our environment.

In addressing the climate change problem, we need to remind ourselves that climate isn't an end in itself, and that climate change isn't the only problem that the world is facing. The objective should be to improve human wellbeing in the 21st century, while protecting the environment as much as we can. Climate-informed decision making that focuses on food, energy, water and ecosystems will support human wellbeing in the coming decades.

So what does a Plan B actually look like? Rather than top-down solutions mandated by the UN, Plan B focuses on local solutions that secure the common interest, thus avoiding political gridlock. In addition to reimagining 21st century electricity and transportation systems, progress can be made on a number of fronts related to land use, forest management, agriculture, water resource management, waste management, among many others. Human wellbeing will be improved as a result of these efforts, whether or not climate change turns out to be a huge problem and whether or not we manage to drastically reduce our emissions. Individual countries and states can serve as laboratories for solutions to their local environmental problems and climate-related risks.

Conclusions

It is an enormous challenge to minimize the environmental impact on the planet of 8 billion people. I have no question that human ingenuity is up to the task of better providing for the needs and wants of Earth's human inhabitants, while supporting habitats and species diversity. But this issue is the major challenge for the next millennium. It is a complex challenge that extends well beyond understanding the Earth system and developing new technologies – it also includes governance and social values.

To make progress on this, we need to disabuse ourselves of the hubris that we can control the Earth's climate and prevent extreme weather events. The urgency of transitioning from fossil fuels to wind and solar energy under the auspices of the UN agreements has sucked all the oxygen from the room. There's no space left for imagining what our 21st century infrastructure could look like, with new technologies and greater resilience to extreme weather events, or even to deal with traditional environmental problems.

Humans do have the ability to solve future crises of this kind. However, they also have the capacity to make things much worse by oversimplifying complex environmental issues and politicizing the science, which can lead to maladaptation and poor policy choices. In 50 years time, we may be looking back on the UN climate policies, and this so-called green economy, as using chemotherapy to try to cure a head cold, all the while ignoring more serious diseases. In other words, the climate crisis narrative gets in the way of real solutions to our societal and environmental problems.

Climate change is just one of many potential threats facing our world today, a point made clear by the COVID-19 pandemic. Why should climate change be prioritized over other threats? There's a wide range of threats that we could face in the 21st century: solar electromagnetic storms that would take out all space-based electronics including GPS and electricity transmission lines; future pandemics; global financial collapse; a mega volcanic eruption; a cascade of mistakes that triggers a thermonuclear, biochemical or cyber war; the rise of terrorism.

We can expect to be surprised by threats that we haven't even imagined yet. Vast sums spent on attempting to prevent climate change come from the same funds that effectively hold our insurance against all threats; hence, this focus on climate change could overall increase our vulnerability to other threats. The best insurance against any and all of these threats is to try to understand them, while increasing the overall resilience of our societies. Prosperity is the best the indicator of resilience. Resilient societies that learn from previous threats are best prepared to be anti-fragile and respond to whatever threats the future holds.

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Low-Carbon Energy Transitions: Interconnections between Security and Justice from a European Perspective

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The past few years have seen a rapidly accelerating energy transition. Approximately 290 gigawatts of new renewable energy capacity have been installed globally during 2021 (IEA, 2021a). Following COP26 more than 40 countries are now committed to phasing out coal power (UNFCCC, 2021). The sales of electric vehicles increased by 43 percent between 2019 and 2020 (IEA, 2021b), and new smart electricity grids are being constructed. These shifts have already enabled the reduction of global greenhouse gas emissions, while much remains to be done, and the society also needs to be better equipped to adapt to the effects of climate change that are rapidly materializing. Some key implications of this transition are placed on societal justice and security, which are also intertwined by the achievement or failure of one affecting the other.

Energy Justice and Just Transitions

Besides technological developments, the energy transition is frequently connected to the advancement of energy democracy and justice. Energy democracy has been conceptualized via three elements: Citizens as recipients and stakeholders in energy policy, participatory and inclusive energy governance with energy education and awareness, and civic ownership of power generation and distribution capacity (Szulecki, 2018). Energy democracy based on this definition is rather limited to actors within one jurisdiction or locality. Further it has been argued that it ignores issues like energy extraction and indigenous communities (Droubi et al., 2022).

Instead, the concept of energy justice takes more often a global approach. It has been defined in the context of the global energy system as a fair distribution of benefits and costs of energy services combined with representative and impartial energy decision-making (Sovacool & Dworkin, 2015). As an approach, energy justice can be used to uncover where injustices emerge, which sections of society are ignored, and which processes exist for their remediation (Jenkins et al., 2016). The energy (in)justice framework in particular has been used to analyze and compare justice impacts of different energy transition technologies locally, nationally and globally (Sovacool et al., 2019).

The idea of justice is also connected to new policy frameworks. For example, 'just transitions' has been brought to the political agenda by the European Commission in connection to the Green Deal, a set of proposals to make the EU's climate, energy, transport, and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to the 1990 level. The EU's Just Transition Mechanism aims to allocate 55 billion euros during 2021-2027 to lessen the socio-economic impact of the transition especially in the most affected regions in Europe. The United Nations Sustainable Development Goals also relate to questions of justice.

Justice is a complicated concept as it involves multiple dimensions and scales. The literature on environmental and energy justice has identified four types: *Distributive justice* concerning the equal distribution of monetary and non-monetary costs and benefits of a transition or a policy action; *Restorative justice* that implies compensating those who have suffered; *Recognitive justice* that is focused on how those in more vulnerable or marginal positions in society are faced with the

transition or related policies; and *Procedural justice* paying attention to the participation opportunities, fairness and transparency of policymaking processes (e.g. Jenkins et al., 2016; Rawls, 1971). Justice can also be looked at from different scales, ranging from local equality, vulnerability and compensation to global equality and fairness. Thus, the evaluation of how the transition, or policy measures addressing the transition, affects justice is complicated and requires evaluating different criteria. Moreover, the ways in which injustices are experienced are likely to differ between different people, groups of people and cultures, also affected by the benefits they have received from the old system. Some are also more vocal about this than others, while the most marginally placed or poorest may not have the resources to be verbal at all. Thus, the attention a given (in)justice issue receives in public should not automatically be interpreted as its measure of value.

Effects of Energy Transition on Security Link with Just Transitions

Besides justice, the energy transition also has consequences on security. Security refers to the absence of threats or low risks regarding societal values, or sufficient protection against such threats (Baldwin, 1997). Security is often connected to the protection of certain values, such as territorial integrity, human survival, or environmental sustainability. Security does not only mean the protection of nation states, but also of individuals, societal structures, technical systems, and humanity as a whole (ibid.).

The energy transition extends the idea of energy security from emergency stockpiles of coal and oil, to security of supply of renewable energy technologies and critical materials (Criekemans, 2018) and to increasing dependence on international electricity grid communities (Blondeel et al., 2021). Many see the new emerging energy systems as more secure than before, due to the reduced dependence on hydrocarbons for those countries with little or no domestic fossil fuel production (e.g., Overland, 2019; Scholten, 2018). However, the transition also involves many technological, geopolitical, and societal risks that are connected to the phase-out of hydrocarbons, and its economic and employment consequences.

Technological risks are created by more complicated energy systems via intermittent energy sources, such as wind power, and a development of smart energy systems with demand response. The digitalization of the electricity grids – irrespective of their low-carbon status – also creates new surface areas for cyber risks (Cornell, 2019). The energy sector has already faced an increasing number of hybrid threats, ranging from supply disruptions to disinformation coupled with cyber attacks on the electrifying energy system (Dupuy et al., 2021).

However, the geopolitical risks are perhaps more significant. The power balance of states is changing, and it is still uncertain how those states that will take losses from hydrocarbon phase-out will react. It has been argued that, for example, Russia may become a more dangerous country geopolitically when the impact of energy as its political leaver is reduced, and it may resort even more to military means for impact (Tynkkynen, 2020).

The geopolitical risks also pertain to questions of justice at different levels. Initially local conflicts may cascade into security risks in larger regions or internationally. Such conflicts may be results from climate change impacts (Carter et al., 2021) or energy transitions. However, more generally energy transitions are expected to reduce the number of large conflicts between countries and regions (Vakulchuk et al., 2020), and the efforts towards just transitions aim to reduce conflicts by addressing social inequality (Szulecki & Overland, 2020).

One potential source of conflicts and injustice, nevertheless, is created around the supply of critical minerals and metals that are used in energy transition technologies alongside many other societal uses (Lee & Scheibe, 2020). Same as fossil fuels in certain places being mined in dangerous and unethical conditions, the mining of critical minerals and metals suffers from illegal or otherwise poor mining conditions. For example, the Republic of Congo has often been recognized as a country that has experienced environmental and social conflicts in and around mining areas, child labor, and unhealthy and dangerous conditions for miners (Sovacool, 2019). Some of the impacts can be alleviated with the Global North doing its share of mining some of these materials. Other important solutions are increasing the recycling of materials and innovations in circular economy.

At least two factors, however, make this a tricky issue. First, the energy transition coupled with other mineral needs of the digitalizing society requires such vast amounts of materials, such as lithium and cobalt, that the need is likely to increase rather than decrease even with innovations to improve the efficiency of materials use (e.g., Michaux, 2021). Second, mining is important for the livelihoods of many regions, for example, in South America (Marín & Goya, 2021). Thus, instead of aiming to stop mining, we should aim for international regulation that advances ethical and safe mining operations.

Advancing justice in these questions from a global perspective can minimize local and regional conflicts, and also prevent them from escalating to the international level. This not only concerns critical materials, but also the energy transition and climate security more broadly. This means that we need to consider the potential impacts of the energy transition and climate change in different regions and help alleviate the consequences. For example, countries such as Algeria that are highly dependent on hydrocarbon trade may experience environmental and social conflicts leading to higher levels of out-migration, as Europe moves away from hydrocarbons (Desmidt, 2021). Helping the Global South prepare for and adapt to climate change will improve global security by reducing cascading impacts from climate hazards (e.g., Carter et al., 2021). Thus, aiming, globally, to increase distributive, restorative, procedural and recognitive justices improves the chances of maintaining global stability. Yet, many contradictory developments continue and make this challenging.

The energy transition, and related climate change mitigation pursuits, are also a source of potential contestation and injustice in more local settings. The employment effects of phasing out hydrocarbon power production have been widely discussed (e.g. Abraham, 2017). Another issue is the unequal access of people to low-carbon technologies, such as heat pumps, solar panels, or electric vehicles. The current political climate, increased intensity of the far right, and nationalist ideas have put more focus on national interests instead of global solidarity and have created opposition for climate change mitigation and the energy transition. In parts of Europe, civil unrest around energy transitions has been observed from right-wing populists (Vihma et al., 2021) who have been noted

Energy transition has consequences on security and justice at different levels.

to be more antagonistic towards renewable energy and carbon taxes (Lockwood, 2018). In turn, they face the so-far peaceful demonstrations by activist groups, such as Extinction Rebellion. So far, the tensions between these groups and others have not led to physical conflicts in Europe. Rather, it has remained at the level of verbal aggression (Żuk & Szulecki, 2020). Efforts towards just transitions and a thorough consideration of social justice in the context of climate and energy policies are, thus, important to manage transition in a way that remains peaceful and avoids physical conflicts. Yet, it has been noted that, while there is the objective of preventing right-wing populists increasing their popularity in coal dependent areas in Germany with just transition policies, it may not work as intended (Abraham, 2019). Thus, improving peoples understanding about climate change, intergenerational effects and how different groups experience these changes is paramount for stability and security.

Concluding Remarks

Energy transition has consequences on security and justice at different levels. Some key examples relate to the fossil fuel phase-out and the reactions of and in hydrocarbon-producing countries and regions, the global production and supply of critical minerals and metals needed in the energy transition, as well as employment effects of the energy transition. Yet, issues such as indigenous communities, energy ownership, and know-how and resources needed to be an active energy consumer that can utilize new energy technologies, are also relevant. They place attention on questions of restorative and recognitive justice alongside distributive justice. Thus, both how equal opportunities are created for different people and countries, and how the more marginal and vulnerable groups are recognized, helped, and compensated are important. This is important not only from ethical and moral perspectives, but also because global security and justice are interconnected. Local conflicts initiated in part by the energy transition and natural disasters caused by climate change may have cascading impacts on other countries and regions,

for example, via global supply chains and the migration of people. Thus, justice is intertwined with national and global security; the relationship is complex. Security is also affected by other developments. Efforts to improve justice may fail. Even when such efforts will be successful, the perceptions of injustice may prevail causing a fertile ground for tensions and conflicts. We should aim to maintain global and local stability with the help of just transition policies, but how the latter will affect the former is not certain. Thus, more knowledge and understanding are needed on the dynamics between justice and security in the context of the energy transition and climate change.

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Research Professor, Dr. Paula Kivimaa has been named in the 2021 Highly Cited Researchers List compiled and published by Clarivate Analytics. The researchers included in the list rank among the top 1% by citations for their field in the Web of Science database.

Since 2019, Dr. Kivimaa has worked as Research Professor at SYKE´s Climate Change Programme, while she first came to SYKE already in 2003. Her recognition as Highly Cited Researcher has also been noted in the University of Sussex where Dr Kivimaa worked previously as Senior Research Fellow and is now Associate faculty member.

Dr. Kivimaa has several projects under her wing at SYKE, for instance the projects IDEALE and CASCADES. IDEALE, an Academy of Finland Fellowship project, connects sustainability transitions research to policy coherence and policy integration, to analyze the interconnections between national energy and security policies and the potential impacts of unfolding energy transitions to security. Empirical research in this project is carried out on Finland, Estonia, Norway, and Scotland. The EU Horizon 2020 project CASCADES examines, among other things, coherence between European Union´s climate, foreign, trade and finance policies in the cross-border and climate adaptation context. The international and interdisciplinary researcher is also a Member of The Finnish Climate Change Panel.

Energy Conservation Through Behavioral Change

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The latest Sixth Assessment Report of the Intergovernmental Panel on Climate Change points to a stark disconnect between climate science and climate policy. On the other hand, the global literacy level is going up, but this is certainly not reflected in progressive climate policy among voters. In this editorial, we argue that the volume of literacy may have increased, but not its essence, which could sensitize citizens to take ambitious mitigation.

So we propose that a vigorous social movement should be raised globally to effect behavioral changes in citizens, aimed for energy conservation at scale. The American energy expert Amory Lovins introduced the concept of negawatts (negative watts), against the traditionally used term of megawatt. He argued that one unit of electricity saved should be considered as equal to one unit generated. The idea sounds fully rational—the saved unit can be used for doing additional work. As explained, this saving can be achieved in two ways: through increasing energy efficiency or through behavioral change by avoiding profligate or wasteful practices.

This negawatt concept is also called demand side management (DSM): earning the same or more profits through supply of more efficient technologies and appliances, which reduces the total demand for power. Of course, buying more efficient gadgets initially costs more, which can be termed the "first cost disease," but their maintenance and operating costs are a lot cheaper. So on a life cycle basis, DSM, as opposed to traditional supply side management (SSM), is much cheaper, varying from half to three fourths of savings, depending on the type of demands and appliances.

...we propose that a vigorous social movement should be raised globally to effect behavioral changes in citizens, aimed for energy conservation at scale.

The direct means of achieving energy conservation is through behavioral change, a hitherto underexploited concept particularly in many developing countries. Essentially, saving through a small change in habits and practices can be achieved at zero or negligible cost. Due to increasing concerns of economic and environmental sustainability in recent years, development engineers, with assistance from psychologists, have been focusing on better understanding human behavior, which is viewed as a key variable in ensuring sustainable development. We may recall that the World Bank titled its 2015 annual report as World Development Report: Mind, Society and Behavior. After so many decades of promoting a market economy along the neoclassical economic model of rational choice, the World Bank has come to terms with the limitations of such a framework—that human beings are not guided solely by money and profit motives, but also by other less selfish motives. Actually, Nobel Prize winning economist Amartya Sen had advocated long ago that human beings are not made purely of selfish genes, but also have altruistic ones. This was reflected in his article titled "Rational Fools" published way back in 1977. The whole idea is that human beings are not just calculating automatons. The mind, unlike a computer, is psychological,

not always logical. Human beings think and act in different ways: thinking automatically and emotionally, thinking socially but deliberately. So these processes can and are very much the subject of efforts at behavioral change.

Why behavioral changes do not happen is that there is a knowledge-attitude-practice-gap in this area. The general masses are not aware of individual and social gains from the conservation of electricity. Another reason is that the market price of electricity does not internalize the externalities of negative impacts on human and ecosystem health from burning fossil fuels. Now after so many decades of limitless physical growth and economic expansion, the era of resource and environmental constraints has set in, as reflected in overuse of the atmospheric carbon sink.

Literature in this field shows that since the 1970s psychologists and behavioral economists have been concerned with devising ways of energy conservation. President Carter used to wear warmer clothes and keep the thermostat lower in the winter at the White House. The Prime Minister of Bangladesh Sheikh Hasina switches off the lights when exiting meeting rooms. Though these are symbolic gestures, they have huge demonstration effects on citizens. However, in the 1970s conservation efforts were mostly guided by uncertain energy supply, challenged by the many-fold increases in price of Middle Eastern oil. Later, because of concerns over economic and environmental sustainability, efforts targeted DSM more through changing human habits, like switching off lights when not needed or getting used to using more efficient energy technologies. Some research shows that the health impacts of energy use figure more prominently in human calculations in the longer term, but monetary savings work in the short run.

So, we need to have a new lens that defines energy technology to include human behavior, because if the latter is not attuned to efficient technologies, there will not be much effect from installing them. Many energy technology devices are critically dependent on human behavior to make them effective, such as smart sensors like smart metering, plug load monitors, and programmable controllable thermostats. These devices critically depend on human observations and responses after their installation. But lack of attention and focus on this aspect results in not realizing the potential of huge savings at almost zero cost. For this purpose, energy experts and engineers must consult with behavioral economists and psychologists in devising ways and means of what works best in changing human habits. In this task, universities and their youthfully vigorous students can raise a massive behavioral change movement for conservation of energy to achieve net zero emission targets by the next three decades.

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He is an expert in adaptation to climate change in the most Vulnerable developing countries and has been a lead author of the third , fourth and fifth assessment reports of the Intergovernmental Panel on Climate Change (IPCC) and he also advises the Least Developed Countries (LDC) group in the United Nations Framework Convention on Climate Change (UNFCCC).

He has published hundreds of scientific as well as popular articles and was recognised as one of the top twenty global influencers on climate change policy in 2019 and top scientist from Bangladesh on climate change science.

Prof. Mizan R. Khan is Program Director at the International Centre for Climate Change snd Development (ICCCAD). He has a PhD in Environmental Policy and Management from the University of Maryland School of Public Policy (UMCP), MD, USA. Currently, he is Deputy Director and Programme Director of Least Developed Countries University Consortium on Climate Change (LUCCC). Prior to joining ICCCAD, he has worked in academia as a Professor for more than 18 years along with working closely with the Government and the development sector of Bangladesh and beyond. Prof. Khan has served as the Director of External Affairs at North South University (NSU). He was also an Adjunct Professor at the Natural Resources Institute (NRI), University of Manitoba, Canada and was a Visiting Professor/ Fellow at the School of Public Policy, University of Maryland at College Park, MD, USA; Universite de Poitiers, France & at Brown University, USA.. Prof Khan is a Lead Author of the Intergovernmental Panel on Climate Change (IPCC).

He has also served at the Bangladesh Institute of International & Strategic Studies (BIISS), Dhaka, where he was a Research Director and was Chair of the Department of Environmental Science and Management at NSU in early July 2003, he served for four years as UNDP Environment Policy Specialist, working with the Government of Bangladesh. In the early 1990s, he worked for three years as a Senior Researcher at the Centre for International Development and Conflict Management (CIDCM) of the UMCP, MD.
He was Vice Chair of the Least Developed Countries Expert Group under the United Nations Framework Convention on Climate Change (UNFCCC) during 2002-2004. He has been attending the UNFCCC process as the lead negotiator on climate finance with the Bangladesh delegation since 2001. Prof. Khan has a wide range of publications in peer-reviewed journals along with three books on climate change economics & politics published by Routledge and MIT Press.

Migration Patterns and Climate Change

Interview with Professor Robert McLeman
Wilfrid Laurier University, Canada

An area of your specialization is human dimensions of environmental change, with a special focus on human migration. Would you briefly discuss the major types of climate related migration?

Migration generally falls along a continuum of agency (or voluntarity, on the part of the migrant). At one end are people who are free to move where and when they like, at the other end people who are involuntarily displaced and have no choice except to move. Climate-related migration can be placed along this spectrum: from 'snowbirds' that choose to migrate to warmer climes on a seasonal or permanent basis, to folks whose homes are destroyed in storms or floods and fires and must relocate. In 2020, it's estimated by the Internal Displacement Monitoring Centre that 30 million people worldwide were involuntarily displaced by storms, floods, fires, droughts and other weather/climate-related events.

What are some notable recent patterns and effects of environmental migration?

Most environmental migration takes place within countries; if international, it's most often between countries within the same geographic region, especially countries with contiguous borders. Long-distance international migration for environmental reasons is generally rare at the moment. The two biggest environmental drivers of displacement are extreme storms and floods; together they account most years for about 80% of all climate-related displacements. The countries that experience the most frequent climate-related displacements India, China, the Philippines, USA, Bangladesh, with other countries in South and SE Asia also experiencing large numbers of climate-related displacement. The Horn of Africa and some parts of sub-Saharan Africa also suffer a lot of climate-related displacements, as do parts of the Caribbean during years with a lot of hurricane activity.

Assuming projected levels of climate change increase as expected, what migration patterns do you anticipate to see?

More displacements in South and SE Asia and China, especially densely populated areas along the coast and in river valleys. Also many more storm-related displacements along the US Gulf and Atlantic coasts, with the impacts of sea level rise becoming more noticeable toward the tail end of this century. More fire-related displacement in the SW USA and Mediterranean parts of Europe and parts of Australia as well. Small island states in the Pacific will be at significant risk in the period 2050-2100 from combined effects of sea level rise + storm surges.

Environmental migration has different impacts on higher income countries and developing countries. What general policies would you like to see for these types of countries to ease possible migration issues?

Wealthy countries have more financial means to build protective infrastructure for exposed settlement and can better mobilize resources for recovery after extreme climate events. Even so, that wherewithal is going to be severely tested in coming decades. I would like to see

> *...when people are allowed to migrate through regular, legal, official channels and are able to participate in the labor market at their destination, everyone benefits: receiving community, sending community, and the migrants and their families.*

high-income countries be more willing to allow higher levels of labor migration from low-income countries in general, especially from areas heavily exposed to climate hazards. The reality is that most high-income countries are aging and need to replenish their labor forces; the low-income countries most heavily exposed to climate hazards typically have young populations. Why wait until the impacts of climate change force people from their homes – why not allow greater labor mobility? It benefits the receiving countries, and allows migrants to remit money home, money that can be used to make sending communities more resilient.

While environmental migration carries many negative perceptions, you're offered some positive aspects of it. Would you expand?

We need to worry less about migration and worry more about the conditions under which migration occurs. The research is very clear that when people are allowed to migrate through regular, legal, official channels and are able to participate in the labor market at their destination, everyone benefits: receiving community, sending community, and the migrants and their families. Receiving community gets energetic new workers, sending communities receive remittances, migrants get a chance to better their economic circumstances and help their families. Conversely, when we force people to move clandestinely – as is currently happening at the US-Mexico border and in the Mediterranean – the only people that win are the criminals that smuggle migrants. Everyone else loses, some folks lose their lives. A terrible waste.

You are co-director of an interesting citizen research project, RinkWatch. Would you discuss the project and its goals?

RinkWatch is a citizen science project that invites people that build outdoor skating rinks in their backyards or neighborhood parks to submit info about daily skating conditions through an interactive website. We use the data to identify how changes in temperatures affect the "skateability" of rinks. We started in 2013. Using data volunteered by participants, we've bene able to identify changes in winter weather trends going back to the 1940s and make projections for future decades. Our findings show that winters are becoming shorter and milder, especially in the lower Great Lakes region, and that by the end of this century there is likely to be 30-40% fewer days/winter suitable for outdoor skating here in eastern North America (20% fewer in the west). The project provides a way for people in Canada and the northern US to see, using this specific example that many can readily identify with, how climate change affects our wellbeing and happiness.

Robert McLeman is a Professor at the Department of Geography and Environmental Studies, Wilfrid Laurier University. He specializes in research on the human dimensions of environmental change, with particular attention to the relationship between environment and human migration; community adaptation to climatic variability and change; and, fostering citizen participation in environmental science.

As a former Canadian foreign service officer, he worked at Canadian diplomatic missions in Belgrade, Hong Kong, New Delhi, Seattle and Vienna. In recent years he has advised UN agencies, the World Bank, and governments in Canada, the US, and Europe on issues related to climate change, migration, and security. Professor McLeman currently a Coordinating Lead Author for the Intergovernmental Panel on Climate Change's working group on impacts, vulnerability and adaptation.

Climate Displacement and Small Island Nations

Interview with Ama Francis
Columbia University, and the International Refugee Assistance Project, United States

Who are climate-displaced people and what are the challenges they face? What must the receiving nations of climate refugees do to help them?

Climate-displaced people are people who have been forced to leave their homes because of the negative effects of climate change. They might move within their own countries or across borders, temporarily or permanently. Climate change has increased the frequency and severity of extreme weather events, including drought, flooding, and hurricanes, uprooting lives all around the world. Many climate-displaced people end up internally displaced within their own countries, but others are forced to migrate internationally to find safety and stability.

It is also important to realize that those displaced by climate change are also those least likely to have contributed to global emissions. Too often, climate-displaced people are framed as a potential national security threat. It is crucial to recognize that climate change itself is the real national security threat, and migration is an adaptation strategy. Rather than demonize those affected by climate change, we need bold climate action and a justice-focused adaptation approach that upholds the right of all people to have a safe place to live and a safe way to get there.

In its recent interagency report on climate change's impact on migration, the United States government's own experts recognized the need for the U.S. to take leadership in recognizing climate-displaced people's rights and creating pathways to get them to safety. In addition to reducing emissions, we need to start thinking about and implementing policies to make sure affected people have access to safety.

The International Refugee Assistance Project (IRAP) released a report, "U.S. Opportunities to Address Climate Displacement," that outlines specific ideas that the Biden Administration can adopt right now using existing legal tools. These include leveraging the U.S. refugee definition, Temporary Protected Status (TPS), supporting regional allies through existing multilateral commitments, and passing legislation to open new immigration pathways. The U.S. should also train immigration officials to recognize how climate change contributes to valid refugee claims.

How will climate change impact small island nations and the people who live on them?

As climate impacts worsen, more and more people are being forced to flee home. For many small island nations, a single climate-related storm can overwhelm the entire country. Thus, islanders fleeing climate impacts often must seek shelter across borders, even though most climate-displaced people in other parts of the world are forced to seek shelter in another part of their own country.

Climate change is an environmental challenge, but it's also a social justice issue. For example, the Caribbean is facing some of the most severe impacts from climate change because of a legacy of colonization that continues today. A history of extraction and marginalization in global

Historically, Black, poor, and other marginalized folks have been more likely to experience harm and premature death, and these patterns have been exacerbated by the disproportionate impacts of climate change, including in Dominica.

politics has left the Caribbean with few economic resources to adapt to climate change, even though the Caribbean islands have contributed very little to global carbon pollution. People should not be forced to leave their homes because of climate change. Providing islands with the resources to adapt is very important, so people can stay in place if that's what they choose.

How must international law change to protect climate migrants?

Climate change is already a leading driver of displacement globally, yet there is a legal protection gap for people fleeing climate-related disasters because there are almost no laws that specifically recognize the rights of climate-displaced people.

The United Nations High Commissioner for Refugees (UNHCR) has already released guidance that climate-displaced persons may have valid refugee claims based on international and regional refugee and human rights law, but more needs to be done internationally and at the level of individual governments. Full protection would mean adapting current laws, as well as creating new pathways to ensure climate-displaced people have access to safety.

The international community must act with urgency because climate-displacement is happening now. This is a make-or-break decade for climate action, and climate-impacted people already on the move need immediate support and long-term solutions.

Can you tell us about your experience and those who you know who have been impacted by climate change in Dominica?

The importance of solving the climate displacement challenge in particular hit home for me when Hurricane Maria devastated my home island, Dominica. The hurricane wiped out 90 percent of homes, including the one I grew up in. The experience was heartbreaking, but motivated me to work towards making sure everyone has a safe place to call home.

Historically, Black, poor, and other marginalized folks have been more likely to experience harm and premature death, and these patterns have been exacerbated by the disproportionate impacts of climate change, including in Dominica. My work on climate displacement envisions a future where survival and safety are possibilities no matter what identities you embody.

Interview by Alexandra Gilliard

Ama R. Francis is a non-resident fellow at the Sabin Center, and the Climate Displacement Project Strategist at the International Refugee Assistance Project, where they are spearheading efforts to expand legal protection and pathways to safety for climate displaced people.
Ama first joined the Sabin Center in September 2018 as the 2018-2021 Climate Law Fellow to develop legal solutions to internal and cross-border climate-induced migration. Ama's work also supports small island state and developing country governments. As a consultant to the Open Society Foundations International Migration Initiative, Ama developed a regional initiative to protect the rights of climate displaced persons in the Caribbean. A native Dominican, Ama received their J.D. from Yale Law School, and B.A. (magna cum laude) from Harvard University, and is a member of Phi Beta Kappa and the New York bar.

Climate Migration

Robert Stojanov
Mendel University, Czech Republic

In human history, environmental degradation, resource depletion, and natural hazards including climate change play a contributing role of important 'push' factors in affecting population movement, often filtered through contexts of economic factors, food deficiency, conflicts, and social inequity. According to Nawrotzki and Bakhtsiyarava (2017), climate extremes such as storms, floods and drought are often traced through the "agricultural pathway", meaning that the impact of climate on migration is moderated by changes in agricultural productivity. Other major impacts of climate change, such as sea level rise on low-lying islands and coastal areas, are having a significant impact on people's lives and their futures.

The term *climate migration* is often used interchangeably with other terms such as climate-induced migration, climate displacement, climate refugees, and climate mobility. There is no consensus about what terminology to use. Terms like climate refugee are popular but problematic since refugee status is strictly defined in international legislation and limited to people crossing an international border and fleeing persecution owing to strictly defined factors such as their race, ethnicity, religion faith, political belief, or membership of a particular social group (Stojanov, et al. 2021).

At first glance, climate migration or movement appears to be a completely different form of migration than, for example, labor migration or political migration, because it is based (at least in part) on different assumptions. Political migration (political persecution, war, conflict) is also forced migration, but the decision to migrate comes very quickly, spontaneously, based on coercion and fear for one's life or the life of family members. In this respect, political migration is similar in the speed of decision-making to the so-called fast-onset displacees who have to leave their homes due to rapid natural hazards such as floods, hurricanes, etc. However, political migration is in most cases different from slow-onset displacement, where people have relatively more time to think.

There is a direct link between people who lost their jobs or their livelihoods were negatively affected by any impact of climate change. In this respect, we can understand labor migration, at minimum partly, like climate migration.

While labor-motivated migration is usually understood as a more voluntary movement, climate migration is generally viewed as a forced movement. However, there is a direct link between people who lost their jobs or their livelihoods were negatively affected by any impact of climate change. In this respect, we can understand labor migration, at minimum partly, like climate migration.

Most of the literature on climate migration focuses on the topic of predicting the processes. The number of people potentially displaced by sea level rise globally will reach 190 million by 2100 under low emission and 630 million under high emission scenarios (Kulp and Strauss, 2019). Groundswell reports (Rigaud, et al. 2018; Clement et al. 2020) predict about 216 million internal climate migrants by 2050. They will move mostly from rural areas to nearby towns and cities where there will be more opportunities to seek new jobs and protection.

Although global attention is often paid to only international migration such as the European migration crises (2015-2016), far more people are moving inside their countries of origin. Migration to cities is the dominant

part of the movements, including climate migration. This is a typical in Bangladesh, for instance, where most climate change migrants move from rural to urban areas, and only a minority of such persons cross an international border (Ahsan, 2019). Lustgarten and Kohut (2020) described the migration strategy in Guatemala where farmers displaced by decreased rainfall from rural drought-affected areas firstly to big cities, supporting a rapid and increasingly overwhelming urbanization. Then they move farther north, increasing the number of labor migrants toward the United States. Internal migration on Pacific low laying islands is fueling urban growth in the capitals of Kiribati and Tuvalu, according to Locke (2009). According to him, migration to the cities of South Tarawa and Funafuti is triggered by economic and environmental issues such as coastal erosion and gradual salinization of drinking water sources and agricultural soil.

Another example of internal migration and displacement can be seen within the US. Houston, Texas became a temporary home to more than 250,000 people displaced by Hurricane Katrina in 2005, and between 40,000 and 100,000 are estimated to have stayed there permanently (BBC, 2017). According to Hauer, et al. (2020), when people in the USA are displaced in response to sea level rise hazards, they more often migrate to nearby cities. Similarly, many climate migrants in Bangladesh gravitate toward wage opportunities in urban economic centers. However, unlike in the USA, many of these migrant destinations include cities under similar risk of future sea level rise. Paradoxically, sea level rise-induced migration may, therefore, contribute to the further expansion of a nation's informal settlements. These climate migrants or displaces live in slums and squatter settlements.

The interlinkages between internal and international migration dynamics remain under-explored in climate migration research. Although it is often argued that most climate migration is likely to be internal (e.g. Mueller, et al. 2014). In this respect, Paul (2011) examines international migration as a stepwise process, whereby migrants gradually accumulate more capital and expand their migration range – from the nearest city to a neighboring country, to ultimately a higher income destination country.

This is consistent with a number of findings that poor people tend not to migrate because the ability to migrate depends on finances, education, knowledge of migration networks, etc. This effect is known as immobility and it may result in a deepening cycle of poverty, vulnerability and exposure to adverse impacts of climate change coupled with the inability to move (Black, et al. 2011). Thus, it is important to distinguish between people who want to move but cannot and those who do not want to move (voluntary immobility) (de Sherbinin, 2020). Some people are strongly attached to their place of origin and simply do not want to leave their homes.

These climate factors contribute to mobility, but their contribution is rarely in isolation from other, generally more important, socioeconomic factors such as wage differentials, family reunification, and various aspects that improve living standards (Foresight, 2011).

Climate research has recently started to take an interest in migration as a potential societal response to the impact of climate changes. Climate migration will become an important element of multidisciplinary research in the future, increasing media and public attention, as well as those of political decision makers on this issue as part of growing climate change discourse.

Robert Stojanov is an environmental and population geographer at the Faculty of Business and Economics, Mendel University in Brno, the Czech Republic. He focuses on drivers and techniques of smart migration; environmental factors of population dynamics; social and economic impacts of climate change and adaptation strategies; migration, remittances, and development; and effectiveness of development interventions such as development aid. Robert was awarded by the Jean Monnet Postdoctoral Fellowship at the European University Institute; by a Certificate for Climate Change & Its Impact from Brown University. In early 2018, his paper was ranked among the top 1% of the most cited papers in Social Sciences at Web of Science (Clarivate Analytics). For details, see www.stojanov.org

The European Union's Response to Climate Change: a Public Policy Perspective

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Introduction

The European Union's (EU) response to climate change can be regarded as part of its broader environmental policy. It can also be examined in tandem with aspects of the EU's energy transition policy, and as a distinct policy field incrementally formulated in the 2000s and separated from the environmental policy portfolio in 2010, with the establishment of an autonomous institutional structure within the European Commission ('DG Clima').

The Evolution of the European Union's Environmental Policy

Back in the late 1950s, the European Economic Community, the predecessor of what is currently known as the European Union, and the other two sectoral European Communities, had no interest whatsoever in considering the environment as a distinct policy field. By the same vain, the three Communities did not plan any environmental program or action nor had embedded any environmental dimension in their founding Treaties. Things started to change since the United Nations (UN) held its first conference on environment in Stockholm in 1972. The conference served as a genuine turning point for the EC's policy change on environmental issues, by offering the opportunity to the European Council, the informal (at that time) top-level decision body of the EC, to reconsider its stance upon the environment, during its summit (Paris, 1972). Thus, the leaders of the six EU member-states (nine the following year) moved towards a more holistic, coherent, and in principle, common European environmental policy rather than adhering to entrenched national regulatory landscapes of, different in content, environment policies, which was setting obstacles to the promotion of the internal (single) market project. Respectively, the European Commission built on the environmental-friendly political discourse, and in 1973 proposed the first multi-annual action program for the environment (1973-1977).

Since 1973 and up to the mid-1980s, two EU environment programs were subsequently launched (1977-1981 & 1982-1986). In 1986 a new phase on the EC's environment policy begun (for an overview of the phases see: Lenschow, 2020), due to the recognition of the importance of the environmental dimension in the Single European Act (SEA, 1986), thus putting pressure on member-states to take up consequent actions to preserve, protect and improve the environment alongside pursuing economic development. In addition, the 'polluter pays' ground-breaking principle was introduced, causing a fundamental reconsideration of the role of the environment in economic development. This phase lasted up to 1992, when the third period in the EU's environment policy started. A critical juncture followed the SEA with the explicit mentioning of the 'environment' within the Treaty of Maastricht (1992). Henceforward, the EU and its member-states would consider the environment across all policy areas and integrate environmental concerns into sectoral EU policies (Treaty of Amsterdam, 1997) as well as addressing sustainable development issues and climate change (Treaty of Lisbon, 2007).

In addition, the introduction of Environmental Action Programmes (EAPs –starting in 1973, the 7th EAP implemented during the 2014-2020 period) based on long-term successive programming periods became the EU's operational mechanism in the environmental field, aiming at promoting policy priorities, such as improving and/or expanding the regulatory

framework, increasing sectoral collaboration, and advancing public participation. In that respect, EAPs allowed for the gradual deepening of the environmental policy field. Furthermore, in 1992 the EU launched a new financial tool, the 'LIFE' [French: L'Instrument Financier pour l'Environnement] program substituting fragmented EU financial initiatives. The LIFE program co-funded environmental and climate projects regarding the air and noise pollution, waste disposal, water management, nature protection, biodiversity, land use and climate change in successive programming periods turning into the EU's 'financial spearhead' for environmental and climate projects, by funding more than 4,500 projects during the 1992-2020 period, with a total budget of approximately €8.7 billion (2010=100). In that respect, the LIFE program served the environmental objectives of the EAPs, and both EAPs and LIFE funded projects facilitated the realization of the EU's environmental ambitions altogether.

The Unfolding of the EU's Climate Policy

The evolution of the environmental policy fueled the EU's aspirations for its role on the respective international arena, and particularly on actions regarding climate change. At first, from an institutional perspective, the separation of climate issues from the environmental portfolio through the establishment of an autonomous Directorate-General in the European Commission (DG Clima) in 2010, fully responsible for the climate policy, underlined the primary interest of the EU on climate issues.

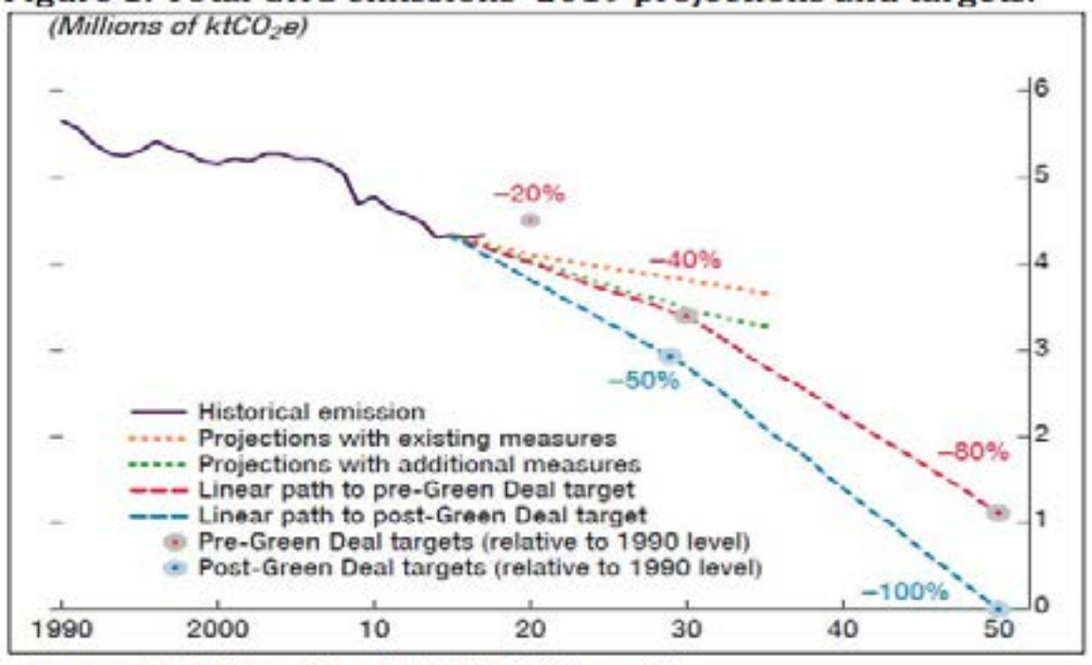
Secondly, since the late 1990s, the EU set in motion new economic tools to facilitate the effective and efficient implementation of the EU's environmental policy objectives. These tools included motives at the national level for decreasing gas emissions (CO_2), renewable energy certificates, emission allowances (CO_2 certificates) which would give birth to the introduction of the EU Emission Trading System (EU ETS) in 2003 (2005 in operation) and emission (carbon) taxes. In particular, the EU ETS has nowadays become the EU's primary tool for tackling the increase on green-house gas (GHG) emissions, and is the cornerstone of the EU's climate policy, constituting its key financial tool for reducing GHG emissions in a cost-effective way (IMF, 2020). Interestingly, the idea of organized environmental markets was first implemented in the United States (at the local level) in the early 1990s. Regarding the EU ETS, it aims at controlling and reducing the carbon emissions through a cap-and-trade system. In practice, the system works by setting an annually reducing 'cap' on GHGs emitted by companies (such as power plants and industry factories, with a view to expanding to other production sectors as well) allowing for the decrease of the overall emissions. Within the cap, companies receive or buy emission allowances, which have been issued and properly allocated by the European Commission. The allowances can be traded as needed by enterprises, following the demand and supply rule. Companies that fail to comply with the EU's 'cap' pay administrative fines. Currently, the EU ETS stands for the biggest global environmental market. It has been suggested, the green bond market has developed to over €700 billion within its first ten years in operation, "with exponential growth during the past five years" (EIB, 2019, p. 57).

The international environmental arena, as already argued, has also impacted on the EU's climate policy considerations. The Paris Agreement (2015) provided a legally binding framework, requiring from the 181 parties that ratified the Agreement to act so as to reduce GHG emissions. The reduction of the emissions aims at holding global temperature increase to well below 2°C and even limiting it to 1.5°C in comparison to the pre-industrial levels. The European Commission has placed particular emphasis on the available scientific evidence according to which global warming pertaining to human activities has already "reached 1°C above pre-industrial levels and is increasing at approximately 0.2°C per decade" and that without proper action "global average temperature increase could reach 2°C soon after 2060 and continue rising afterwards" (European Commission, 2018) with devastating implications not only for the environment but also for the economy, and for the society as well (EEA, 2017).

The new mandate for the European Commission in 2019 (2019-2024; President Ursula von der Leyen) signaled the revived interest of the EU on becoming a world 'pace-setter' in climate action, after a rather short period of a slowing down in pace, mainly due to the economic and financial crisis of 2007-08 (Buchan, 2020, p. 319). The EU's climate ambitions are manifested in the European Green Deal (European Commission, 2019) which is the brand-new umbrella strategy of the

EU, launched in 2019. The European Green Deal is related with the international environmental agenda as well, since it incorporates the Commission's strategy for the implementation of the seventeenth (17) sustainable development goals (SDG) of the 2030 Agenda of the United Nations. Next to other critical environmental issues promoted by the European Green Deal, the climate issue stands at its heart, with the introduction of the EU's first coherent climate law (Regulation (EU) 2021/1119). The European Climate Law has set out explicit climate goals and a framework for achieving the Paris agreement targets, stating that, according to the climate-neutrality objective, the GHG emissions within the EU should be reduced to net zero by 2050, achieving negative emissions thereafter (article 2). In addition, the new Regulation set out binding targets for a net domestic reduction in GHG emissions for 2030, declaring that the member-states shall reduce their (net) GHG emissions by at least 55% compared to 1990 levels (figure 1).

Figure 1: Total GHG emissions' 2019 projections and targets.



Source: EEA found in: IMF (2020b, p. 2).

To effectively address climate challenges altogether, the EU has planned to spend approximately $550 billion, that is the equivalent of almost 30% of the money from the 2021-2027 multi-annual financial framework (MFF) and the 'Next Generation EU' initiative, to support the transition of

> *At the national level, the EU member-states face different challenges when dealing with climate issues, considering the energy mix they need to follow to comply with the European Climate Law provisions.*

Europe to climate neutrality by 2050.[1] There is a rather complex funding mechanism through which money will be allocated, including funding administered solely by the European Commission and other initiatives. Among them is the Just Transition Fund, the Modernization Fund, the Innovation Fund, the InvestEU initiative, subsidies provided by the annual EU budget and loans dispersed by the European Investment Bank (see EIB, 2019).

Contemporary Challenges

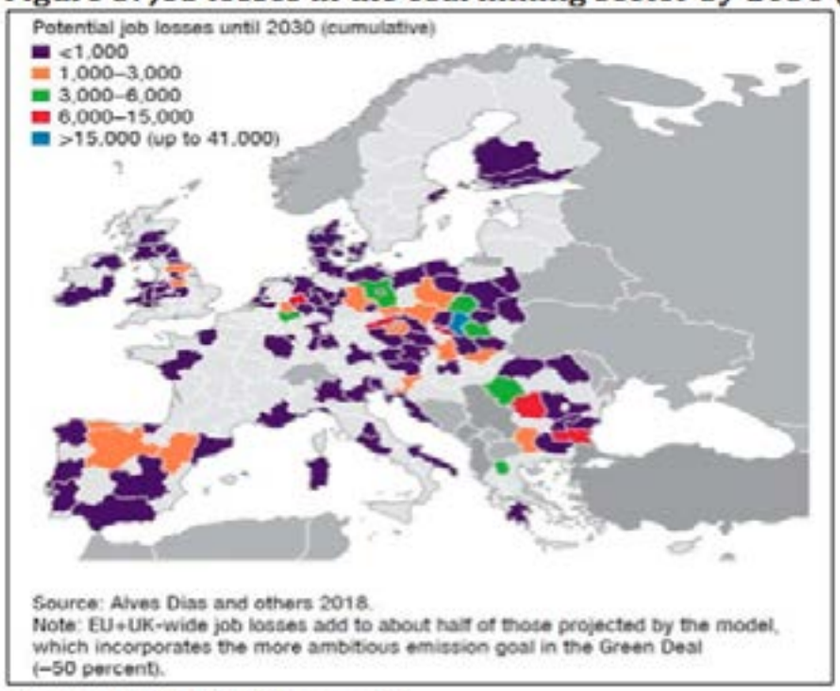
Despite the EU's climate initiatives and earnest ambitions, certain challenges lay ahead. At the national level, the EU member-states face different challenges when dealing with climate issues, considering the energy mix they need to follow to comply with the European Climate Law provisions. For instance, it has been suggested that newer member-states have expressed worries regarding the cost of the energy transition (Buchan, 2020, p. 337). Thus, Estonia, Poland, and the Czech Republic are expected to face increased transition costs to successfully adapt to the EU's Climate Law provisions, substituting traditional sources of energy (i.e. coal and oil – see figure 2) with renewable ones (i.e. solar, wind, and geothermal energy, biomass, as a well as hydropower). By the same vein, the projected job losses and the subsequent costs for households and local societies need to be also sufficiently addressed (figure 3).

Similarly, another challenge relates with the energy policy mix followed by the EU's member-states and their preparation and response on external 'energy shock' incidents during the energy transition period, until reaching the climate-neutrality objective (by 2050). For example, Greece chose to de-carbonize its economy by shutting down traditional coal power plants rather hastily, instead of choosing a longer energy transition period, within the EU's climate framework. Due to the rapid rise of energy prices

worldwide, following the escalation of the Ukrainian crisis (since autumn 2021) no sooner Greece had scheduled to close their coal-based power plants (until 2023) than it was forced to urgently reconsider its program, deciding (in late 2021) to keep some of them operating in order. In fact, the whole of the EU's energy transition strategy from fossil-based to zero-carbon energy resources should take into consideration the possibility of the emergence of (an) exogenously driven 'energy shock' episode(s), focusing on the energy policy mix the EU needs to rely upon (namely the kind of energy resources) during the transition period.

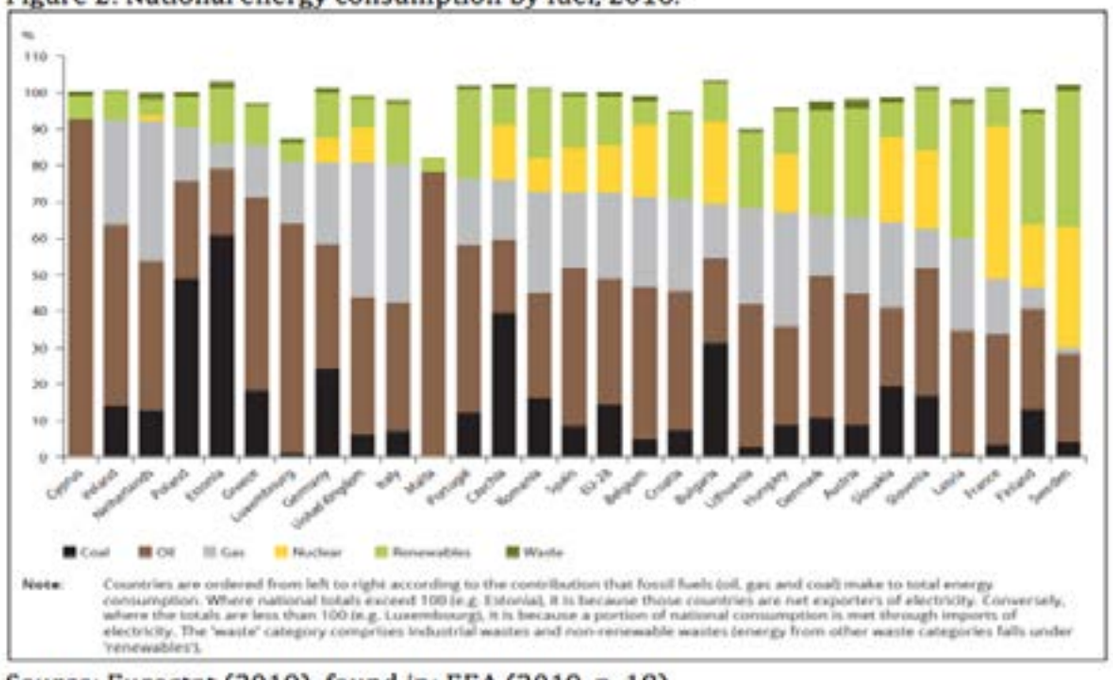
Furthermore, the "carbon leakage" problem which is evident when EU companies choose to move their productive facilities to countries outside the EU, thus escaping from the tight grip of the EU ETS provisions, constitutes another challenge the EU needs to consider. Finally, global cooperation on climate change is a precondition for coping successfully with climate issues. The EU is a pivotal environmental global actor, and its participation is deemed necessary, however is not sufficient per se since approximately only 10% of the global GHG emissions is attributed to the EU whereas 90% to the rest of the world (European Commission, 2018).

Figure 3: Job losses in the coal mining sector by 2030 (projection).



Source: IMF (2020a, p. 21).

Figure 2: National energy consumption by fuel, 2016.



Source: Eurostat (2019), found in: EEA (2019, p. 18).

Concluding Remarks

The evolution of the EU's environmental policy has been characterized by incremental expansion and substantial deepening during specific episodes of change. In addition, the environmental policy intertwines with other policy sectors, principally the economy and energy sector. Since its official launching in the 1990s, the environmental policy has gained momentum and acquired multiple regulatory tools, modern and sophisticated financial mechanisms (EU ETS), increased multi-channeled funding, and more recently, ambitious climate targets. The policy expansion led to the separation of the climate issues from the environmental portfolio and the creation of an autonomous institutional structure (DG Clima). At present, the emblematic European Green Deal strategy facilitates the EU's ambitions for a global leadership in climate issues, by establishing a European Climate Law which, in turn, sets out, as a core objective, the transformation of the EU into the first climate-neutral economy by 2050. Significant challenges still remain in place as to whether the EU will successfully manage to secure a smooth energy

transition from traditional (fossil-based) to zero-carbon energy resources, thus addressing not only climate but also economy and societal needs as well.

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Climate Mitigation Isn't Just a Matter of Ethics; It's Life and Death

Interview with Professor Emeritus James K. Boyce
Political Economy Research Institute of the University of Massachusetts, United States

Interview by C.J. Polychronou

The climate crisis worsens with each passing year — and even the current levels of warming are disastrous, affecting ecosystems as well as social and environmental conditions of health. People in the world's poorest countries remain most vulnerable to the crisis. The world's governments are slow to react to the greatest challenge facing humanity today, even though potential solutions are not in short supply, with the transition to a green economy offering the most effective pathway to tackling the problem of global warming at its roots.

There are, in addition, intermediate steps that can be taken toward climate stabilization, such as carbon pricing and even the adoption of a universal basic income scheme as a means to counter the effects of global warming. Meanwhile, policy frameworks for climate adaptation are urgently needed, as renowned economist James K. Boyce points out in this interview.

C.J. Polychroniou: The climate crisis is the biggest problem facing humanity in the 21st century. In the effort to avoid a greenhouse apocalypse, competing approaches to climate action have been advanced, ranging from outright technological solutions to an economic and social revolution as envisioned in the Green New Deal project and everything in between. Two of those "in between" approaches for cutting carbon emissions are cap-and-trade, a system already implemented in the state of California, and carbon pricing and carbon dividends, which is the approach you are advocating. Why do we need to put a price on carbon? How does carbon pricing work, and what are its benefits?

James K. Boyce: First, let me say that I do not think it is useful to invoke the language of a coming "apocalypse." It's a vision with a lot of historical baggage, much of it downright reactionary, as my partner Betsy Hartmann explains in her book, The America Syndrome: War, Apocalypse, and Our Call to Greatness (Seven Stories Press, 2019). It misrepresents the climate crisis as a cliff edge, an all-or-nothing question akin to nuclear war, as opposed to an unfolding process that has ever-worsening consequences for humans and other living things. And it can instill a sense of despair and hopelessness that is deeply counterproductive. I agree with the late Raymond Williams that the task of the true radical is "to make hope possible, not despair convincing."

Something similar can be said about the contrast between technological fixes and revolutionary transformations. Economic and social revolution is a process, too, not a one-off affair. Technological change can help to propel institutional change, and vice versa, and often there is an intimate connection between the two. I do not think we will solve the climate crisis with new technologies alone. The transition to a clean energy economy will require profound changes not only in how we relate to the natural world but also in how we relate to each other. I have argued that it will

require a narrowing of inequalities and a deepening of democracy. But it would be folly to sit aside, waiting for social and economic revolution, before tackling the climate problem.

Cap-and-trade and carbon dividend policies both put a price on carbon. Instead of being able to dump carbon into the atmosphere free of charge (more precisely, free of monetary charge, since nature is charging us big time), pollution would carry a price tag. But there are crucial differences between these two policies. Cap-and-trade gives free pollution permits to corporations, up to the limit set by the cap. Consumers feel the bite in higher prices for transportation fuels, heating and electricity, just as they do when the oil cartel restricts supplies. The extra money they pay goes as windfall profits into the coffers of the corporations that received free permits. This may blunt political opposition to a carbon price from fossil fuel lobbyists, but their first preference remains no cap at all, as was shown in the repeat debacles of efforts to pass cap-and-trade bills in Washington, D.C. in the first decade of the century.

Carbon dividend policies put a price on carbon, too, either via a cap with auctioned (not free) permits or by means of a tax. But instead of fueling windfall profits, the money from higher prices goes directly back to the public in equal per-person payments, consistent with the principle that we all own the gifts of nature — in this case, the limited capacity of the biosphere to absorb carbon emissions — in common and equal measure. As I discuss in my book, The Case for Carbon Dividends (Polity Press, 2019), this is an example of universal property. The right to receive carbon dividends cannot be bought or sold, or accumulated in a few hands, or owned by corporations. Universal property is individual, inalienable and perfectly egalitarian. This new kind of property, which is more akin to traditional common property than to private property or state property, could be a cornerstone for what is sometimes called “libertarian socialism.”

It’s not that we simply need to put a price — any price — on carbon, although anything is better than the prevailing de facto price of zero. What we need to do is to keep the fossil fuels in the ground, to curtail their extraction at a pace and scale ambitious enough to stabilize the Earth’s climate by the middle of the century. This is the goal of the Paris Agreement. In practice, it means that high-consuming countries, like the United States, must cut their use of fossil fuels by about 8 or 9 percent per year, year after year, between now and 2050. The easiest way to arrive at the “right” price on carbon is to cap the amount of fossil fuels we allow to enter our economy to meet this trajectory. For each ton of carbon they sell, fossil fuel firms would have to surrender a permit. They would buy permits (up to the limit set by the cap that tightens over time) at auctions. This is not rocket science. Quarterly auctions have been held since 2009 under the Regional Greenhouse Gas Initiative for power plants in the northeastern states of the U.S. The carbon price comes about as a side effect of keeping fossil fuels in the ground, not as an end in itself.

In addition to climate stabilization, a side benefit of carbon dividends is that they would take a modest step toward reducing economic inequality, which has reached obscene levels in the U.S. and many other countries. Most households would come out ahead financially with carbon dividends, receiving more in dividends than they pay in higher fuel prices, for the simple reason that their carbon footprints are smaller than average. High-income households with their outsized consumption of carbon, and everything else, would pay more than they get back, but they can afford it.

You have also argued for a universal basic income as a solution to inequality and the effects of global warming. How would a universal income be funded, and would it be an addition to existing welfare programs or a replacement for them?

Correction: Universal basic income can be part of the solution. Guaranteed employment can also be part of the solution, and as my colleagues Bob Pollin and his coauthors have shown, the clean energy transition will generate millions of jobs. The extent to which existing welfare programs become redundant would depend on how much money we’re talking about. A big advantage of universal income, compared to means-tested welfare payments, is that it unites society rather than dividing it between the welfare-eligible poor and everyone else. Universality helps to ensure political durability, as we’ve seen with Social Security and Medicare here in the U.S.

Every year that passes without serious policies to keep fossil carbon in the ground, where it belongs, increases the suffering that climate change will inflict.

For universal basic income, a key question is how to pay for it. Most proposals rely on government funding. But redistributive taxation can be a heavy lift, and its durability is never certain since it depends on the vagaries of party politics. This is one reason I favor universal property as a source of universal basic income [universal property refers to the idea of a universal birthright to an equal share of co-inherited wealth]. Carbon dividends are one example. In his new book, Ours: The Case for Universal Property (Polity Press, 2021), Peter Barnes discusses a number of other possibilities.

We now know that dramatic mass climate catastrophe is inevitable, especially for mega-cities and coastal populations. What are the sorts of changes (involving migration, changes in how cities are structured, changes in how nations relate to each other, technologies, etc.) that could help humans as a global community weather these catastrophes without massive human deaths? And what are the sorts of pressures and dynamics (protests, legislation, international cooperation) that would actually make these changes imaginable to implement in time?

Every year that passes without serious policies to keep fossil carbon in the ground, where it belongs, increases the suffering that climate change will inflict. Coastal populations will be among the most seriously affected, but they will not be alone. Drought-prone regions in Africa, for example, are at grave risk, too.

Not long ago, proponents of action to halt climate change ("mitigation" in the official lingo), including many governments in the Global South, were averse to discussing adaptation, fearing that it would let the big polluters off the mitigation hook. Times have changed. Today, the need for adaptation is urgent and undeniable. The key questions are how adaptation resources will be allocated across and within countries, and who will foot the bill.

In principle, the 1992 Framework Convention on Climate Change, an international treaty which today has near-universal membership, addresses the "who will pay" question by saying that countries will contribute "in accordance with their common but differentiated responsibilities and respective capabilities." The advanced industrialized countries bear greater responsibility and have greater capabilities, so they should pay for adjustment costs accordingly. Whether and to what extent this principle will be translated into concrete action remains an open question. So far, the results have not been encouraging.

The issue of how scarce resources for adaptation will be allocated — and whatever happens, they will be scarce relative to needs — is a critical question that has yet to receive much serious attention. If allocation obeys the default setting prescribed by neoclassical economics, the lives and properties of richer people will get priority over those of the poor because that the rich have greater ability (and hence willingness) to pay. Sea walls will be constructed to protect the "most valuable" real estate in Manhattan and Mumbai, for example, diverting flood waters to the locales where poor people live. In my view, this would be a travesty, adding injury to insult. If we believe that a clean and safe environment is a human right, not a commodity that should be allocated on the basis of purchasing power, then adaptation policies ought to prioritize those at greatest risk regardless of their ability to pay. Protests, legislation, international cooperation — all of these will be needed to make this happen. This is not just a matter of economics and ethics; it's a matter of life and death.

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C.J. Polychroniou is a political economist/political scientist who has taught and worked in numerous universities and research centers in Europe and the United States. His latest books are T*he Precipice: Neoliberalism, the Pandemic and the Urgent Need for Social Change* (A collection of interviews with Noam Chomsky; Haymarket Books, 2021), and *Economics and the Left: Interviews with Progressive Economists* (Verso, 2021).

Environmental Protection via Multilevel Governance

Jean Vilbert
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Every society seeks to develop and achieve better standards of living. In the past, this meant exploiting natural resources to exhaustion on the way to progress. In recent years, however, climate change and other environmental concerns set the tone for sustainability (Bailey et al., 2019)[1]. Countries are now searching for ways of living that preserve the planet and can be sustained in the long run (Steeves and Ouriques, 2016).[2]

In this pursuit, scholars such as Geoffrey Chen and Charles Lees believe that the Chinese model of central planning might be an attractive path to be followed (Chen and Lees, 2016).[3] Through a state-directed approach, a country can coordinate the mobilization of resources toward a clearly defined objective and tackle common enemies such as global warming and environmental degradation.

Central planning also presents downsides, though. Directive governments acting in highly profitable fields like energy production are auspicious to rent-seeking, offering the opportunity for great gains for those aligned with the ruling class (North, Wallis, and Weingast, 2009).[4] Besides, the government may transgress the neutrality toward competing technologies by picking winners and losers, for example, solar over wind, over geothermic, and vice versa (Holly, 2020)[5], let alone the vulnerability to selection mistakes. Germany may be the best (worst) example of that: the country took bold steps to discontinue its nuclear project (Parnell, 2021).[6] Yet in a hurry to do so, Germany substituted nuclear with coal — the energy product with the highest environmental damage and today responsible for over 40 percent of the country's electric power (Grossman, 2013).[7]

Given that central planning has not exactly the best of records, scholars like Rebecca Henderson (2020) prefer relying on the private sector. For instance, when Donald Trump announced that the United States would leave the Paris agreement, a group of companies representing 68 percent of the U.S. GDP launched a collective effort called "We Are Still In" to ensure that the country would meet its commitments to the agreement regardless of the withdrawal. If in the past big corporations were the problem, today they may be the solution.[8]

However, a wide skepticism about a private-leaded model of environmental governance stays in place. Even though entrepreneurs may have genuine environmental concerns, economic interests often drive overexploitation of natural resources and negative externalities. Thus, while there has been growing optimism about cooperative initiatives involving businesses and NGOs, the actions of non-state actors alone may still lead to politically contentious outcomes, especially when economically influenced and when the promised benefits are not matched by actual outcomes (Chan et al., 2019).[9]

Therefore, both central planning and the market system seem to present important risks and weaknesses, which raises the question: Is there an intermediate solution? Multilevel governance (MLG) may be the answer, that is, "the sum of the many ways individuals and institutions, public and

private, manage their common affairs" (Burger and Mayer, 2019).[10] This approach assumes that governments do play a significant role but should not monopolize all functions of public interest (Zürn, 2012).[11] Such a mixed architecture can be built via delegation to new autonomous entities, acknowledgment of existing actors, creation of community councils, and other instruments to provide autonomy and leverage to decentralized state entities and nonstate agents (Utting, 2002)[12] with a close-knit network with the civil society (Di Gregorio et al., 2019).[13]

One may wonder why would MLG be a better option? A possible answer is that in market-economy democracies, a model of governance spread across different tiers of policymaking is more effective than policy monopoly at hands of a strong central government.[14] Under MLG, environmental policy gains horizontal brokerage as local policy actors tend to be more responsive to citizens' preferences (Yi et al., 2019).[15] Besides, academics and entrepreneurs have no tenure and can potentially expand the decisions' time prospect, minimizing the effects of political electoral cycles.

MLG is also expected to produce more equilibrate decisions due to a better network that incorporates different visions, sparks interactions, and facilitates cooperation, information, and resource sharing (Di Gregorio et al., 2019).[16] By allowing a process of multidirectional participation across levels of public and private management, it refutes the idea of 'saviors' — instead of relying solely on politicians or entrepreneurs, the multilevel framework aligns a diverse set of actors and instruments to address environmental problems. Instead of undermining markets and the system of preferences inside heterogeneous systems, MLG works with these elements and seeks to offer solutions that are coherent with a democratic structure.

On the way to orchestrating multilevel governance, starting from within the government is a good idea.

On the way to orchestrating multilevel governance, starting from within the government is a good idea. In the United States, whenever states pass environmental restrictions that are stricter than those mandated by federal rules, they need an Environment Protection Agency (EPA) waiver (NBCNews, 2008).[17] MLG means improving the balance between local and national powers, allowing local governments, which are closer to citizens, more autonomy (Hooghe and Mark, 2001).[18] Further, MLG can use the interests of associations and other nonstate organizations to lift the bar for standards of environmental protection. Autoregulation is always a controversial topic, but it can work well under certain conditions — in 2019, when the Trump Administration suggested that it would eliminate regulation that requires oil and natural gas companies to reduce methane emissions from their operations, major companies (BP, ExxonMobil, and Shell), took a public stand in support of the restrictive regulation (Pinko, 2019).[19] Also, a stronger role for civil regulation can help: providing state support for labels of quality control such as the ISO 14001, bestowed to companies that abide by environmental guidelines (Iso, 2021),[20] would immediately incorporate a body of rules that is voluntarily accepted by many entrepreneurs. Last, but not least, MLG can be implemented via popular councils entitled to deliberate about multiple aspects of environmental policy, e.g., zoning, procedures to licensing pollutive activities, and biding goals for the public administration. These bodies may engage academics, specialists, and the population and should not be merely consultive — providing them with effective authority would increase the sharing of power between the state and the civil society.

All this does not mean that MLG is risk-free (Ostrom and Janssen, 2004).[21] Mixed structures can be captured by private interests that do not always align with broader social goals (Fidler, 2007).[22] Encroachments are also a constant threat in forums in which agents hold different interests (Mueller and Pevehouse, forthcoming).[23] Still, the hope is that these soft spots can be circumvented due to the flexibility of the model in comparison to classical governments — it can be more easily adapted, build, and rebuild.

In sum, MLG overcomes the boundaries of traditional governance and changes the political landscape to attend the complex scale of the contemporaneous net of relations between government and non-government actors, opening the decision-making process to more collaborative governance in critical areas like the environment; its power-sharing feature establishes collaborative relationships that can make governance more efficient and responsive (Hassel, 2011).[24] Even if multilevel governance is not a perfect solution (there is no such thing), it is likely to be the best option to drive the transition to clean energies in market economies ruled by democratic principles.

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Nuclear Energy in the EU: Could Germany's Unyielding Stance Drag its Partners into a Strategic Misstep?

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As of December 2019, the European Union (EU) arguably has the most ambitious climate action plan on earth: to become the first climate-neutral economy by the year 2050 by achieving zero net emissions of greenhouse gases. When considering the means to such aim, some disagreements among EU Member States recently arose on whether to classify nuclear energy as a climate-friendly investment. The Commission's proposal sought a compromise between the positions of the two main heavyweights of the Union: Germany and France. While the former has been phasing out nuclear power since the Fukushima disaster of 2011, the latter has invested deeply in this energy source. Should the draft be approved, it would grant the "green" label to existing nuclear power plants and those built before 2045, and the same treatment would be enjoyed by gas-powered plants until 2030, which Germany favors as a transitory energy source. German authorities harshly rejected it though, as they would rather have other countries follow their example on nuclear and promote solely renewable sources such as wind and solar instead. This editorial explores the feasibility and desirability of the German stance on nuclear energy for the EU.

Energy supply was responsible for a quarter of all greenhouse gas (GHG) emissions in the EU in 2019 (European Environment Agency, 2021). Nuclear energy is especially well-suited for the climate-neutrality goal, as it generates no GHGs during operation and similar or lower amounts of carbon dioxide (CO2) from infrastructure and supply chain emissions than renewable sources such as wind and solar (Schlömer et al., 2014). By contrast, natural gas is the third largest CO2 emitting fuel worldwide, only surpassed by coal and oil, and it is responsible for most of the EU's CO2 emissions derived from fuel consumption. Its extraction process also releases methane into the atmosphere. When looking at CO2 emissions per capita, it becomes apparent that while France and Germany rely more or less evenly on oil, their paths diverge significantly on natural gas, but even more worrisome is Germany's reliance on coal, which is seven times larger than France's (Ritchie & Roser, 2020). This suggests that Germany is in dire need of more nuclear reactors, not less, as coal emits almost two times more CO2 than natural gas. The EU could benefit from more nuclear reactors as well, since coal is responsible for more or less the same amount of CO2 emissions as oil.

Despite its impressive record on GHG emissions, nuclear power is not a renewable source of energy and this constitutes the core argument of its detractors. They fear the risk of contamination due to long-lived radioactive waste, and the menace of nuclear disasters such as the ones that occurred in Chernobyl or Fukushima (von der Burchard, 2022). However, these arguments disregard than not all nuclear waste is equal and that significant progress has been made in the creation of industrial methods for the safekeeping of high, intermediate and low-level waste (International Atomic Energy Agency, 2018). Furthermore, nuclear power plants operate since the early 50's with only three severe accidents recorded so far; the fact that both an earthquake and a tsunami had to hit the Fukushima nuclear plant for a disaster to unfold is a testament to the technology's improvements in safety standards since Chernobyl. Additionally, these accusations belittle the efforts put forward by the EU

Including nuclear energy in its diplomatic strategy could make the EU's fight against carbon more alluring to more countries as well.

and its Member States to decommission old reactors and stress-test their facilities post-Fukushima.

There are strategic reasons to favor nuclear power as well. The recent surge in energy prices in all of Europe should be a bitter reminder that the Union's vulnerability to the price of Russian gas comes at a high and undesirable cost, and nuclear energy could solve part of that problem, thus enabling a more autonomous Europe. Moreover, if the EU does not lead in nuclear energy safety standards and research, someone else will. China aims to do so, as evidenced by its commitments to build several nuclear reactors in countries participating in the Belt and Road Initiative, its research on thorium-based reactors and recent state-of-the-art experiments on nuclear fusion. The question Europeans must then ponder is whether it will be them that set the rules or someone else. If safety standards and the potential contamination is the real concern behind the German position, then a more active EU should be in order, not its opposite. Including nuclear energy in its diplomatic strategy could make the EU's fight against carbon more alluring to more countries as well.

Lastly, a least considered argument is that a cohesive EU on nuclear energy could offer much favorable conditions for the research and development of new technology such as nuclear fusion reactors, which could be four times more powerful than traditional fission reactors, with potentially no dangerous waste or meltdown risk (Barbarino & Chatzis, 2021). Private-public partnerships such as SpaceX in the United States of America, along with smaller partnerships in the field of nuclear fusion, demonstrate their potential in rendering pioneering technologies commercially viable (Woodruff, 2021). Said partnerships could benefit noticeably from incentives and a more welcoming regulatory environment, and the EU would arguably benefit from any achievements attained within its frontiers as well.

In conclusion, the German vision for the energy policy of the EU could hamper its goal of becoming the first carbon-free economy by prioritizing sub-optimal energy sources such as natural gas and coal and relying excessively on less reliable sources such as wind and solar. In addition to this, providing incentives for the use of natural gas as a transitory energy source risks leaving the EU even more vulnerable to Russian manipulation of this commodity's price, and neglecting nuclear energy could eventually make Europeans rule-takers instead of rule-makers in a direly sensitive field, forgoing those decisions to external and perhaps more unreliable actors. Contrary to this, an active EU on nuclear energy would make the objective of the European Green Deal much more attainable, reduce dependence on Russian gas and promote top-tier safety standards worldwide, with the added potential of obtaining first-mover's advantages in new and promising technology.

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