n.11
Winter
2021

EAERE
European Association of Environmental and Resource Economists

EAERE Magazine

Towards a Deep Climate Collaboration

Module 1: United States of America

n.11
Winter
2021

EAERE
European Association
of Environmental and
Resource Economists

EAERE Magazine serves as an outlet for new research, projects, and other professional news, featuring articles that can contribute to recent policy discussions and developments in the field of environmental and natural resource economics. It is published quarterly in the Winter, Spring, Summer, and Fall. Contributions from the wider EAERE community, especially senior level researchers and practitioners, and EAERE Country Representatives, are included in the magazine.

Contributing Authors: **Sylvain Cail, Frank J. Convery, Patrick Criqui, Nathaniel O. Keohane, Bethany A. Davis Noll, Jack Lienke, Maurizio Malpede, Jasper Meya, Paul Neetzow, Lutz Sager, Max Sarinsky, Jason A. Schwartz, Thomas Sterner**

Graphic Project: **Renato Dalla Venezia**

For questions and comments please contact:
Frank J. Convery – frank.convery@envecon.eu
or **Katie Johnson** – katie.johnson@eaere.org

Table of contents

Frank J. Convery (frank.convery@envecon.eu) *completed forestry degrees at University College Dublin and PhD (forestry economics) at the State University of New York, followed by careers at Duke University, Heritage Trust Professor at University College Dublin, and Chief Economist, Environmental Defense Fund. His professional passions: bringing academic research down to where things are done; finding ways that work to protect our shared climate and environmental commons with a focus on mobilizing markets and (latterly) innovation to these ends; help make Ireland and Europe exemplars thereof.*

Dear EAERE friends and colleagues,

I have succeeded Astrid Dannenberg as editor. I would like to thank her for steering the magazine from its inauguration through 10 issues to such excellent effect. I take over the *EAERE Magazine* in rude good health, a bouquet that arrives free every quarter which simultaneously celebrates the many achievements of our profession and provides new insights in short articles that enlighten and excite. I will do my best to maintain this tradition. It is also clear that in Katie Johnson we have an excellent Assistant Editor, and a support team that is dedicated, talented and professional.

Our magazine has three major advantages over most traditional peer reviewed journals, namely, its frequency, the fact that we can address contemporary issues in close to 'real time', and we can expand or contract each issue as needs and supply allow.

To increase the benefits which these characteristics enable, in addition to continuing to celebrate the achievements of our colleagues and encouraging submission of papers, I have decided to pick a big issue, and use our magazine as a place to help develop a shared understanding of its topography over a number of issues that would help inform the development of policy.

Specifically, I have decided to use a section of each of our four issues in 2021 to address a single big topic: "Towards a Deep Climate Collaboration (China, European Union, India, U.S.) – DCC4". This will be in two parts. The first will set the stage by discussing the rationales for such an approach, and the second will address the specifics of past performance and scenarios for the future for all four. This volume of EAERE will conclude with essays from three recent EAERE prize winners.

My choice is informed by the following context: climate policy at global level is struggling to come anywhere close to achieving the reductions in greenhouse gas emissions that are required if we are to manage climate risk responsibly; four jurisdictions – China, the EU, India and the U.S. – account for about 60% of total emissions, and about the same share of global GDP; there has been some thought leadership by our profession on the proposition that a relatively small group of countries or jurisdictions could help break the cycle of failure[1]; the European Union can be regarded as such a club[2].

The Particularities of the European Union[3]

Four characteristics of the European model stand out. It comprises 27 sovereign states who have agreed to cede some of their individual autonomy to help deliver a range of bigger and better collective outcomes, and this includes more effectively addressing the climate change challenge. To this end, it mobilises a number of policy instruments in parallel: at EU level these include *information* (e.g. energy rating of build-

1 In his Nobel Lecture delivered in Stockholm on December 8, 2018, William Nordhaus proposed a 'climate club' as a solution to the free riding problem.

2 The member states (sadly now 27 instead of 28, with the departure of the UK) agree on the overall ambition as regards reductions to be achieved; this obligation is then divided between reductions in the cap of the EU-wide emissions trading scheme (EU ETS, covering power and heavy industry) which covers about 45% of total emissions, and reductions from the non-traded sectors, which are allocated in the form of individual national caps to member states each have considerable freedom as to how they chose to meet them. A third pillar – Agriculture, Forestry and Other Land Uses (AFOLU) is emerging.

3 An important source on the workings of the EU's climate policy system is Delbeke, Jos and Peter Vis, 2019. *Towards a Climate-Neutral Europe – curbing the trend*, Routledge.

ings[4] and appliances), *regulation* (e.g. requiring shrinkage in the average carbon efficiency of car fleets selling into the EU market), carbon pricing [e.g. European Union Emissions Trading Scheme (EUETS], *subsidies* including exemptions from State aid rules (e.g. subsidies thereby enabled for renewable energy in the EU amounted to €34 billion in 2012[5]) *innovation* (about €10 billion over 2020-2030 funded from auction revenues from EU ETS, and the Horizon Europe Research and Innovation prog (~€33 billion for climate over the 2021-2027 period). It addresses **equity issues** by favouring poorer countries with more allowances under EU ETS and more generous caps for non-traded emissions, using GDP per capita as a key determinant of such allocations, and (at macro level) by making very large transfers to poorer regions[6]. Finally, there is a lot of **learning by doing**; the first phase of policies can be relatively ineffectual (e.g., the regulation of average carbon efficiency of car fleets started out as a voluntary agreement which failed) but their performance improves incrementally over time.

There is no presumption that this model is feasible at the global level, but there are elements thereof that could be relevant as the biggest players on the global stage try to find a way forward that works.

Our Ambition

Our ambition is modest: to establish a consistent baseline for each of the four jurisdictions, so that there is a shared understanding as to how the climate policy system in each jurisdiction works, where each has been and what it aspires to, both nationally and on the global stage. In this issue, we frame the challenge, and then address the specifics as regards the U.S. In successive issues we will do likewise for China, the European Union and India, with the intention of having a complete set published in time for the 26th UN Climate Change Conference of the Parties (COP26) in **Glasgow** on 1 – 12 November **2021**.

Our Approach

For this issue, we commissioned papers as follows:

Section I Framing the Challenge

1. Towards a Deep Climate Collaboration (China, European Union, India, U.S.) – DCC4. Frank J. Convery (University College Dublin) and Thomas Sterner (University of Gothenburg)

2. Carbon Dioxide Emissions by the Four Largest World Emitters: Past Performance and Future Scenarios for China, U.S.A., Europe and India. Sylvain Cail (Enerdata) and Patrick Criqui (Université Grenoble Alpes-CNRS and Enerdata)

Section II The U.S. Module

The Institute for Policy Integrity New York University School of Law uses economics and law to support smart policies for the environment, public health, and consumers and has made many important evidence-based contributions to climate policy in the U.S.[7] It is directed by Richard Revesz. He generously agreed to have some of his staff provide three of the four papers in this module addressed to better understanding features of domestic U.S. climate policy (architecture, past, future). The final paper (U.S. global climate policy, past and prospective) was contributed by Nathaniel Keohane, Senior Vice -President, Climate, Environmental Defense Fund. Specifically:

3. Climate Policy Architecture in the U.S. Jack Lienke (New York University) and Jason A. Schwartz (New York University)

4. U.S. Domestic Climate Policy - Looking Back. Max Sarinsky (New York University)

4 We have very recently invested in a relatively deep retrofit of our primary dwelling in Dublin which has increased its energy rating from E to C1 – our decision to invest was influenced by the fact that our outlays are likely to be fully recovered at time of sale by the increment in its capital value, and this is enabled by this rating, which is independently verified.

5 Ecofys, 2014. *Subsidies and costs of EU energy: Final report*

6 Over 2021-27, €352 billion was transferred via the following funds: Regional Development, Cohesion, Social, and Solidarity

7 Institute for Policy Integrity

5. U.S. Domestic Climate Policy – Looking Forward. Bethany A. Davis Noll (New York University)

6. American Climate Diplomacy: Past Performance and New Opportunities. Nathaniel O. Keohane (Environmental Defense Fund)

Thank you

These authors were asked at ridiculously short notice to contribute. They already had commitments that demanded 150% of their available time. They each not only took on the assignment, but did so with grace and to excellent effect, delivering on time, and with no recompense except (I hope) the satisfaction of knowing that they have done their bit to help push the climate policy boulder a little further towards where it needs to be. Thank you.

Section III Celebrating EAERE Doctoral Awardees

One of the signs of an organization's vitality is its willingness to embrace rising talents that challenge some of its mainstream beliefs and assumptions. If you would like to know more about three important, related fields that are rapidly growing in importance, and how they are being carefully cultivated by rising scholars, do take the time to read the three papers which are the products of our 2020 doctoral Award winners

7. The Growing Role of Inequality in Environmental Policy, by **Lutz Sager**

Lutz is Assistant Professor at Georgetown University's McCourt School of Public Policy. He holds a PhD from the London School of Economics and was awarded the *2020 EAERE*

Award for Best Doctoral Dissertation in Environmental and Resource Economics

For some of us, in the past it was routine to assume that: the continuation of rising incomes and education would ensure that future generations would be much richer, with more technology and better information than ours and would therefore have much more capacities than ours to deal with current environmental challenges; our expertise and comparative advantage lay in efficiency an maximizing the size of the pie, not in how it was distributed. But facts have begun to unravel some of our comfortable assumptions: In the U.S., annual income of the bottom 90 per cent of families were been essentially flat over the 1973-2010 period – having risen by only 10 per cent over these 37 years. Over the same period, the incomes of the top 1 per cent tripled. In the expansion which started in January 2002 and ended in December 2007, the median U.S. household income dropped by €2000[8]. In addition, those of us whose focus is on converting economic insights into outcomes have had to deal with the reality that unless distribution and inequality are addressed in time and with skill and sensitivity, the conversion of ambition into action is impossible. This paper opens windows to this challenge and how to address it.

8. You Can't Always Get What You Want: Research Beyond Carbon Pricing, by **Paul Neetzow** and Jasper Meya

Paul is an economist at the German Federal Ministry of Economic Affairs. He obtained his doctorate from Humboldt-Universität zu Berlin and was awarded the *Best Doctoral Dissertation Award by EAERE* in 2020.

A carbon price applied universally at the right level would come very close to successfully addressing the climate change challenge, and so it quite logically has been a primary focus of our profession. But we note that enthusiasm for carbon pricing in practise is inversely related to the extent to which it is needed. It tends to be embraced least by those jurisdictions that produce and use fossil fuels the most, while some of the relatively 'carbon light' economies take it on. The paper by Lutz gives insights as to how to traverse this terrain through the lens of equity. This paper does so by exploring the widening of the policy instrument mix as a parallel stratagem.

8 'The Dream that Died' Edward Luce, *Financial Times Magazine* July 31 August 1, 2010

9. Exploring the Global Economic Consequences of Desertification, by **Maurizio Malpede**

Maurizio is a Post-Doctoral Fellow at the GREEN Center of Bocconi University. He holds a PhD in Economics jointly awarded by Cattolica University and Bicocca University, Milan. His PhD Thesis "Three Essays on Technological Progress and Economic Growth" has been awarded the *2020 EAERE Best European Doctoral Dissertation in Environmental and Resource Economics*.

Einstein observed that: "Everything should be as simple as possible. But not simpler". Understanding the economic impacts of climate change is not for the faint hearted; the early research perforce had to work with aggregate data (GDP etc) with huge uncertainties as to the validity of the estimates and their range. Recent developments in technology and science are enabling a much more credible and granular understanding, which is referenced spatially, and this evolution is epitomized by this work which in the author's words provides "a first step at understanding how human-induced climate aridification greatly impacts the economic development of areas which predominantly rely on agriculture" and makes a convincing case for the "use of the Aridity Index rather than Precipitation only, to have a better understanding of the economic impacts of climate change".

Enjoy!

Frank J Convery

Section I

Framing the Challenge

Towards a Deep Climate Collaboration (China, European Union, India, U.S.) – DCC4

Frank J. Convery[a] and **Thomas Sterner**[b]
[a]*University College Dublin,* [b]*University of Gothenburg*

Frank J. Convery (frank.convery@envecon.eu) *completed forestry degrees at University College Dublin and PhD (forestry economics) at the State University of New York, followed by careers at Duke University, Heritage Trust Professor at University College Dublin, and Chief Economist, Environmental Defense Fund. His professional passions: bringing academic research down to where things are done; finding ways that work to protect our shared climate and environmental commons with a focus on mobilizing markets and (latterly) innovation to these ends; help make Ireland and Europe exemplars thereof.*

Thomas Sterner (thomas.sterner@economics.gu.se) *is a leading environmental economist. His main work is on discounting, environmental policy instruments, and environmental policies in developing countries. Recent published research includes an update to the DICE model, Covid-19 and climate policy, and carbon taxation. He serves on several prominent boards, and is also frequently interviewed in media. He has been elected Visiting Professor at Collège de France, worked as Chief Economist at the Environmental Defense Fund and also been President of EAERE during 2008-2009.*

Introduction

When change is necessary, it is necessary to change. It is a core responsibility of governments everywhere to manage those risks that cannot be managed successfully on their own by their citizens, communities, and enterprises. Amongst the most challenging of these risks is climate change, but they all face very daunting head winds as they seek to manage it.

The key arguments of the series of papers that follow in this issue of EAERE Magazine are that: we need to change how we manage climate change; one change worth serious consideration is for the four largest greenhouse gas emitters (China, the European Union, India and the U.S.) to find ways that work to collaborate; a first step in this process is to establish a shared understanding of the baseline (climate policy architecture, past performance and prospects at domestic level, global performance and prospects) for each of these four jurisdictions.

A key first step is understanding for all four their past performance as regards emissions and economic performance, and to explore possible future trajectories; this is provided by Sylvain Cail and Patrick Criqui. This first issue is devoted to the U.S. In the chapters that follow (author names in brackets) the following baseline information for the U.S. is provided: Climate Policy Architecture (Jack Lienke & Jason A. Schwartz); Domestic Climate Policy – Looking Back (Max Sarinsky); U.S. Domestic Climate Policy – Looking Forward (Bethany A. Davis Noll); American Climate Diplomacy: Past Performance & New Opportunities (Nat Keohane). The same template will be followed in successive issues as the baseline is established for China, the European Union and India. The series will be completed before the COP 26 in Glasgow (Nov. 1-11, 2021) and a compilation will be available there.

We are not the first to use the word 'deep' in the climate policy context. The Deep Decarbonization Pathways initiative (DPPI) was a collaboration of leading research teams currently covering 36 countries. Their aim was to help governments and non-state actors make choices that put economies and societies on track to reach a carbon neutral world by the second half of the century. Their work showing the feasibility of doing what needs to be done was helpful in increasing the prospects for the Paris Agreement in 2015.[1] A recent paper from the U.S. partner in DPPI (Williams et al, 2020) argues as follows: "Modeling the entire U.S. energy and industrial system with new analysis tools that capture

1 Many of the country reports produced in early 2015 are available at: Deep Decarbonization Pathways Project | IDDRI and there are also many activities continuing today at IDDRI which are managed by Henri Waisman.

synergies not represented in sector-specific or integrated assessment models, we created multiple pathways to net zero and net negative CO_2 emissions by 2050... Cost is about $1 per person per day, not counting climate benefits; this is significantly less than estimates from a few years ago because of recent technology progress."

Our proposition is that the prospects of these huge climate dividends being delivered will be greatly enhanced if the Big Four collaborate.

In this framing paper, we set the stage for what follows by addressing: why these four?; the progress that has been made in recent years; the logic of deep collaboration by the four largest emitters.

Why these Four?

They contribute ~60% of total global emissions (Figure 1), account for about the same percentage of global GDP, and are home to close to half of the world's population. Together, they have enormous resources, influence, and talents. If they succeed, we all succeed. But why not just two? China and the U.S. together account for >40% of emissions; they on their own could also be potentially hugely influential as a 'climate club'. There are many reasons for maintaining the number of key actors to four, but a key strategic consideration is the gain in resilience that a larger group could deliver over time. With four, if one or two jurisdictions opt out, that would still leave 3 or 2 still willing to collaborate and sustain the effort. Another important consideration is that India represents in some sense inclusion of the interests of many people of really low income (Camuzeaux et al., 2020). The collaboration must be extended over time to others who are committed and can see mutual advantage in engaging and contributing. The emissions from the rest of the world are rising rapidly, and they too must also be a part of the solution; our case for a deep collaboration by the Big Four is a complement, not a substitute for action at UN and other levels.

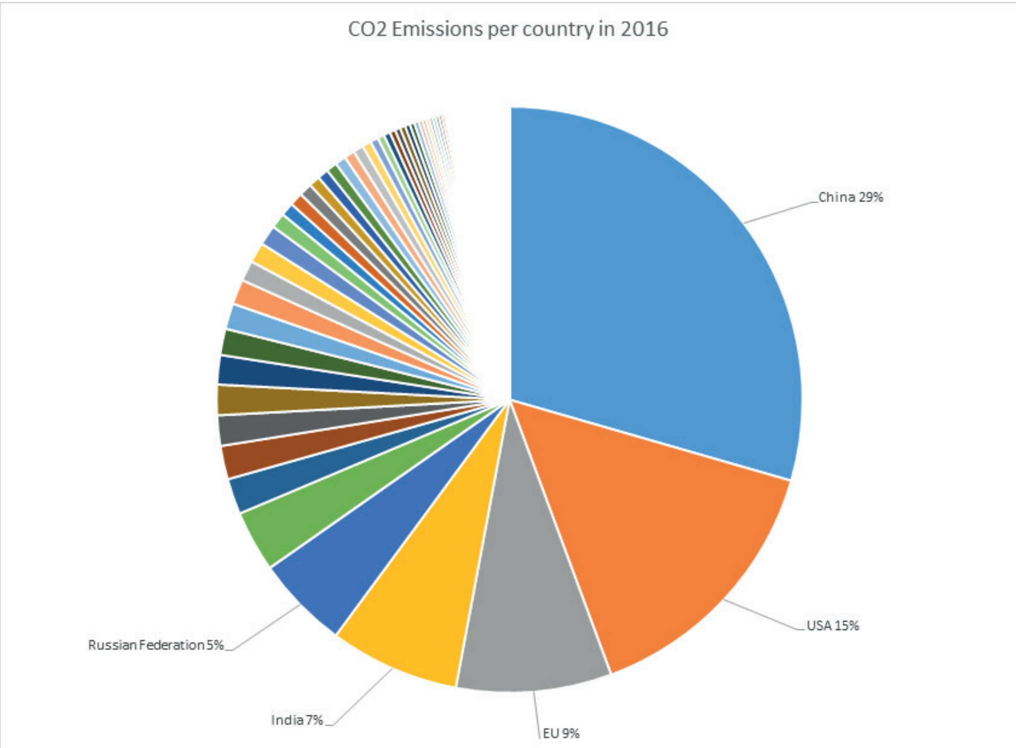

Figure 1. CO_2 by Jurisdiction, 2016
Source: World Bank (CO2 emissions (kt) | Data (worldbank.org)), which in turn have as their source Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States.

Recent Progress in Practise and Perception

At the political level, in "American Climate Diplomacy: Past Performance & New Opportunities" Keohane recounts how, beginning at Copenhagen (COP15) in 2009, the U.S. and China agreed on climate ambition, which was further re-enforced at the Obama-Xi summit in 2013, and culminated in the joint announcement of intended nationally determined contributions in November 2014. This so called "G2" agreement helped pave the way for success at the Paris COP in 2015 which brought developed, emerging and developing countries into the same tent. It also set an important precedent: bilateral cooperation by the two largest emitters of greenhouse gasses.

At the technical level, there has been progress in terms of lowering the costs of reducing emissions, exemplified by the rapid decline in the costs of solar power, to the point that, under certain circumstances, it is cheaper than fossil sources (Nemet, 2019). This is symptomatic of a wider wave of innovation that is also lowering the costs of wind power and of battery storage, which in turn is enabling the electrification of road transport under certain conditions. In all countries, this may deliver jobs and economic activity and act as a sort of counter point to current or prospective economic decline in the fossil fuel dependent regions.

There has been a parallel increased awareness of the costs of inaction and the fact that these costs may occur sooner than expected; this is exemplified by more intense weather events, more flooding, longer droughts and more extensive and longer lasting forest and brush fires. And our understanding grows concerning the links between climate change and economic and political dysfunction and how this is becoming manifest in migration patterns, especially from South to North. At the energy and climate policy level, the Big Four have their own experiences to draw from, especially as regards what works to reduce emissions. A few examples: the member states of the EU have for many decades used very high indirect carbon taxes (in the form of excise duties) on transport fuels, which has had the effect of reducing emissions dramatically from the road transport sector compared to emissions from those jurisdictions which did not apply such taxes (Sterner, 2007); at EU level, car companies selling into the EU have to meet a fleet average emissions target which shrinks every year. Automatic fines are payable for non-compliance,[2] and similar policies are already in place or in prospect in the U.S. and China. The U.S. has had considerable success at reducing emissions from the power sector as a result of innovation (fracking) which dramatically increased the competitive advantage of natural gas over fuel, and in parallel promoting renewables, whose share of the fuel mix has grown rapidly (Mohlin et al, 2018). Both China and India have similarly dramatically increased the supply of renewables.

The Case for Deep Collaboration

The following are arguments for them to consider.

1. Self-interest.

   Climate change is happening, and if not managed successfully, is likely to be a huge disrupter within their respective borders, a destroyer of their physical and social infrastructure, life support systems and of the economic and social wellbeing of their peoples, a destroyer of prosperity in those countries with which they trade, a blighter of future prospects, and the trigger for a 'blame game': who refused to act while there was still time?

2. Psychology

   It will be a huge reassurance for farmers in Burundi and shopkeepers in Brisbane to know that the Big Four are deadly serious about meeting the climate change challenge, and willing to collaborate to this end, thereby giving them a future.

3. Delivery of practical dividends with a sectoral focus:

   In the case of climate policies upon which they have already embarked, they can learn from each other at the sectoral level and take

2 Recent developments are addressed by Joe Miller in: 'VW posts €10 billion profit in pandemic ravaged year after late recovery,' Financial Times, January 22, 2021.

advantage of experience effects.[3] In "Carbon Dioxide Emissions by the Four Largest World Emitters: Past Performance and Future Scenarios for China, U.S.A., Europe and India" by Cail and Criqui, inter alia, they show the time series of CO_2 emissions from 5 sectors - power (mainly electricity), transport (mainly road), industry, buildings, and process (mainly steel and cement). In all cases, the power sector is the largest emitter; transport ranks second in the U.S. and the EU, third in India and fourth in China.

For each sector (which should include agriculture and forestry – because our data focusses mainly on CO_2 emissions, we have not included this sector in our benchmarking, which is a weakness) the following sequence could be considered[4], in each jurisdiction:

- A granular assessment of the policies already tried and those under consideration, and their performance, their key strengths and weaknesses, technically and politically
- The current policy ambitions and the challenges that implementation could pose
- The lessons from each jurisdiction that might be of relevance for one or more of the other three
- Potential for policy collaboration and an assessment of the value they could add in terms of increasing and/or accelerating climate ambition

If more than 2 decide that collaboration could yield substantial gains, they find a way that works for them to do so.

An example: China, the EU and the U.S. have set or will set mandatory standards for the carbon efficiency of car fleets sold into their jurisdictions; this policy is already accelerating the share of electric cars in new car sales, and it also provides an opportunity for hydrogen fuelled cars; India is also addressing the air pollution and climate challenges posed by its rapidly growing road transport sector and how best to manage the transition to a cleaner future. Applying the sequence above to this issue could, at a minimum, help some or all four of them individually to improve the design and delivery of this policy and, at a maximum, at least two of them could decide to act in concert. The result could be more total ambition, delivered sooner. The climate impact of electric vehicles depends fundamentally on the carbon efficiency of the power sector; finding ways to collaborate to accelerate carbon-reductions therein would be a logical next step.

4. Delivery of practical dividends with a **policy instrument** focus[5]

The instrument menu is familiar, and some are already being applied, or in prospect, across sectors: it includes voluntary agreements, market-based instruments (carbon taxes and emissions trading), regulation, research and innovation, removing barriers, subsidies etc. The process template suggested above for application to sectoral policy could be similarly employed to the policy instrument mix. For many good reasons, most economists favour market based instruments. In *On American Taxation*, Edmund Burke observed that: "To tax and to please, no more than to love and be wise, is not given to men". This simple sentence goes far to explain why it has proved so difficult to convert this proposition into action.

Thought Leadership

A lot of the thought leadership on policy instruments has been led by economists and political scientists. Because economists have a logical enthusiasm for carbon prices as the key, if not sin-

3 Arrow (1962, p. 156) was the first to formally test the hypothesis that "technical change in general can be ascribed to experience, that it is the very activity of production which gives rise to problems from which favorable responses are selected over time".

4 And this could be broken down to sub-sectoral level – e.g., address common understanding of effective sectoral policies and the argument on learning curves for strategic technological components: wind turbines, PV panels, batteries, fuel cells, electrolysers for H2 etc.

5 Sterner and Coria (2011) provide a comprehensive menu of policy instruments and an assessment of their performance in both developed and developing countries.

gular, instrument[6], much of the recent discussion from the profession has focused on carbon taxes as the instrument of choice. The policy must however be global but who is to start. Research shows that climate treaties are hard to sustain and therefore we may need to start with action by groups, under the general heading of 'climate clubs' or a 'climate compact'. If the group is large and powerful it can overcome the tendencies to free-riding that make treaties crumble. Nordhaus (winner of the Nobel Prize in 2018) has been a leading exponent of this analysis; his prescription is a club whose members "pay dues" through costly abatement with non-members penalized through tariffs. Such a club has the incentives to overcome free-riding. More detail on his thinking and supporting references are in Annex I.

This advocacy provides both a clear logic for action at this level (which we share) and a powerful single instrument to advance it. As regards the latter, our approach is more modest and more incremental, on the grounds that the first steps are often the hardest but most essential, requiring their own forms of quiet courage and skill and acorns can grow into trees. In Annex I more detail is provided on the evolution of thinking across time on collective action at the interface between theory, evidence and finding ways that work in the world of now; this includes some of the references that inform that exciting and essential frontier. We apologise for the fact that this is at present exclusively 'western' (Europe and North America) in focus, an omission we plan to correct in time.

Conclusion

In human as well as business relationships, before they become 'serious', prospective partners often press the 'pause' button, and ask themselves the following sorts of questions: do I really know enough about the backstory and history of this person/company, what their real qualities and achievements are, how well they deal with adversity, the constraints they face, their willingness to make sacrifices in the short term to advance a longer term shared ambition, their ability to convert ideas into ambitious shared achievement, their willingness to share workload, evidence, and credit etc.? Our hope is that this series will begin to bring some clarity on some of these issues. We recognize that this is the easy bit. Finding ways that work to deliver outcomes is always hard, and there are huge competing agendas, some potentially very contentious and rancorous, that will make it challenging for all to sufficiently untangle the climate agenda from the others, and find the time and space to devote to it, and to take advantage of the considerable advantages that collaboration can provide. The Big Four are now committed to climate action (Carlsson et al., 2020) and 2021 in some ways looks like a new dawn. Leonard Cohen wrote that "There is a crack, a crack in everything. That's how the light gets in". We hope that this small step will help them make the most of it.

References

Arrow, Kenneth J. (1962). The Economic Implications of Learning by Doing Author(s). *The Review of Economic Studies*, *29*(3): 155-173.

Carlsson, F., Kataria, M., Krupnick, A., Lampi, E., Löfgren, Å., Qin, P., Sterner, T. & Yang, X. (2020). The Climate Decade: Changing Attitudes on Three Continents. *Journal of Environmental Economics and Modelling.*

Camuzeaux, J., Sterner, T., & Wagner, G. (2020). India in the coming climate G2? *National Institute Economic Review*, *251:* R3-R12. DOI: https://doi.org/10.1017/nie.2020.2

Convery, F.J. (2021). Carbon-reducing innovation as the essential policy frontier – towards finding the ways that work. *Environment and Development Economics*, 1–20. https://doi.org/10.1017/S1355770X20000467

Mohlin, K., Camuzeaux, J.R., Muller, A., Schneider M., & Wagner, G. (2018). Factoring in the forgotten role of renewables in CO_2 emission trends using decomposition analysis. *Energy Policy, 116*: 290–296.

Nemet, G.F. (2019). *How Solar Energy Became Cheap: A Model for Low-Carbon Innovation.* New York: Routledge.

Nordhaus, William D. (2018). Climate Change: the ultimate Challenge for Economics, Nobel Lecture, Stockholm, December.

Sterner T. (2007). Fuel taxes: an important instrument for climate policy. *Energy Policy, 35*: 3194–3202.

Sterner, T., & Coria, J. (2011). *Policy Instruments for Environmental and Natural Resource Management*, RFF Press.

Williams, J., Ryan, H., Jones, A., Haley, B., Kwok, G., Hargreaves, J., Farbes, J., & Torn, M.S. (2020). Carbon-Neutral Pathways for the United States. *AGU Advances*. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020AV000284

Suggested citation

Convery, F.J., & Sterner, T. (2021). Framing the Challenge: Towards a Deep Climate Collaboration (China, European Union, India, U.S.) – DCC4. *EAERE Magazine*, 11.

6 However, innovation is being added to the mix, and this is reflected by the fact that Nordhaus, the winner of the Nobel Prize for economics in 2018, included "Rapid technological change in the energy sector is essential" as one of the four steps in the concluding slide of his Nobel lecture (Nordhaus, 2018). The wider case for innovation as an instrument of climate policy is made by Convery (2021).

Carbon Dioxide Emissions by the Four Largest World Emitters: Past Performance and Future Scenarios for China, U.S.A., Europe and India

Sylvain Cail [a] *and* **Patrick Criqui** [a,b]
[a] *Enerdata,* [b] *Université Grenoble Alpes-CNRS*

Sylvain Cail (sylvain.cail@enerdata.net) *is a senior expert in the modelling and analysis of energy markets worldwide and at country level. His fields of expertise comprise the modelling of interactions between energy and climate policies, and their potential effects on energy demand, supply and the development of energy prices. In particular, he has an extensive knowledge of the use and development of energy models like POLES-Enerdata to build and assess long-term energy and climate scenarios. At Enerdata, Sylvain manages the Global Energy Forecasting department, helping public and private clients from the energy and industry sectors.*

Patrick Criqui (patrick.criqui@univ-grenoble-alpes.fr) *is a senior researcher emeritus at CNRS, working on the economics of energy transition and climate policies in the Grenoble Applied Economics Laboratory. His main research area has been the development of a world long term energy model, POLES, used by the European Commission and different institutions in Europe to analyze the economics of climate policies. He has been a lead author in IPCC's Working Group 3. Member of the Economic Council for Sustainable Development by the French Ministry of Ecology since 2008, he currently works on deep decarbonization scenarios. He is a research associate at IDDRI and Enerdata.*

Introduction

The purpose of this paper is to clarify the magnitude of the climate challenge we face globally and the role that the four largest greenhouse gas emitters – China, the U.S.A., the European Union[1] and India – could potentially play, if they decided on a "deep collaboration". As stated in IPCC's 1.5°C report[2], the challenge is indeed to bring global emissions down to a level where they could be compensated for by anthropogenic carbon capture from the atmosphere.

In this paper, we focus on the abatement of CO_2 emissions as they represent two thirds of total GHG emissions[3]. By doing so, we recognise that confining our data to CO_2 ignores other important gases (methane, nitrous oxides, fluorinated gases) and their emission dynamics. But introducing the other greenhouse gases would make our analysis more fragile, by lack of consistent and reliable time-series. In Annex II we discuss this incompleteness.

The role that a deep climate collaboration could play in aiming at net zero emissions by mid-century (or shortly after) is twofold: first, as they today represent nearly 60 % of total CO_2 emissions, the implementation of carbon neutrality policies in their own jurisdiction would have a major global impact; second the implementation of these policies in the compact will have a significant leverage effect on the other countries, both by the demonstration effect and by the learning effect for low or zero carbon technologies that would benefit every country.

The paper proceeds along three stages. In section 2. "Where we stand, a global view", we recall the dynamics of atmospheric concentrations for two major GHGs, CO_2 and methane. In section 3. "Looking back", we analyse in more detail the trends and bifurcations in the emissions for each of the four constituencies we are considering. Finally, in section 4. "Where we need to go", we analyse for the same constituencies representative scenarios that will allow us to contrast current developments with more constrained trajectories meeting the Paris commitments and, further on, net zero ambitions.

1 In this paper, we define and consider Europe as the European Union plus the United Kingdom (EU27+1 in the Figures). This is by convenience, for reasons of time-series continuity and while taking into account the fact that UK's net zero emissions policy of 2020 keeps in line with the European Union's perspective.

2 www.ipcc.ch/sr15/chapter/spm/

3 www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

In presenting these data and scenarios, there is no implication of judgment or blame, on who is responsible and who should do what. The purpose is to establish a clear vision of the problem and perhaps engender fruitful discussions about how to make progress at scale.

Where we stand, a global view

Climate change is to a large extent the result of the increase in the concentration of greenhouse gasses in the atmosphere, due to human activity. The continuous stock building of CO_2 and methane in the atmosphere are shown below: between 1984 and 2019, CO_2 and methane concentrations have increased by respectively 19% and 13% (Figure 1).

The concentration of anthropogenic CO_2 in the atmosphere is the result of a process that goes back to the industrial revolution, from the beginning of the 19th century. At this moment of history, fossil fuels – initially coal – start to be used as a source of energy. Their rapidly growing importance and supremacy will be confirmed all along the 20th century and early 21st century (Smil, 2019 and Grubler, 2012). However, the take-off in world emissions from fossil energy really takes place after WWII. As shown in Figure 2, the increase is initially moderate and total CO_2 emissions amount to only 5 Gt CO_2 in 1945. They multiplied by a factor of more than 3.5 by 1979, year of the second oil shock, and then again by a factor of 1.9 by 2019.

This perspective reveals the fact that the causes of the build-up of the climate problem pertain to relatively recent economic history. The problem is that the accumulated GHG stock (especially CO_2) is here to stay… for long.

Looking back at the "big four"

Over the past sixty years, world total CO_2 emissions have grown in an almost linear way, which means that the growth rate progressively

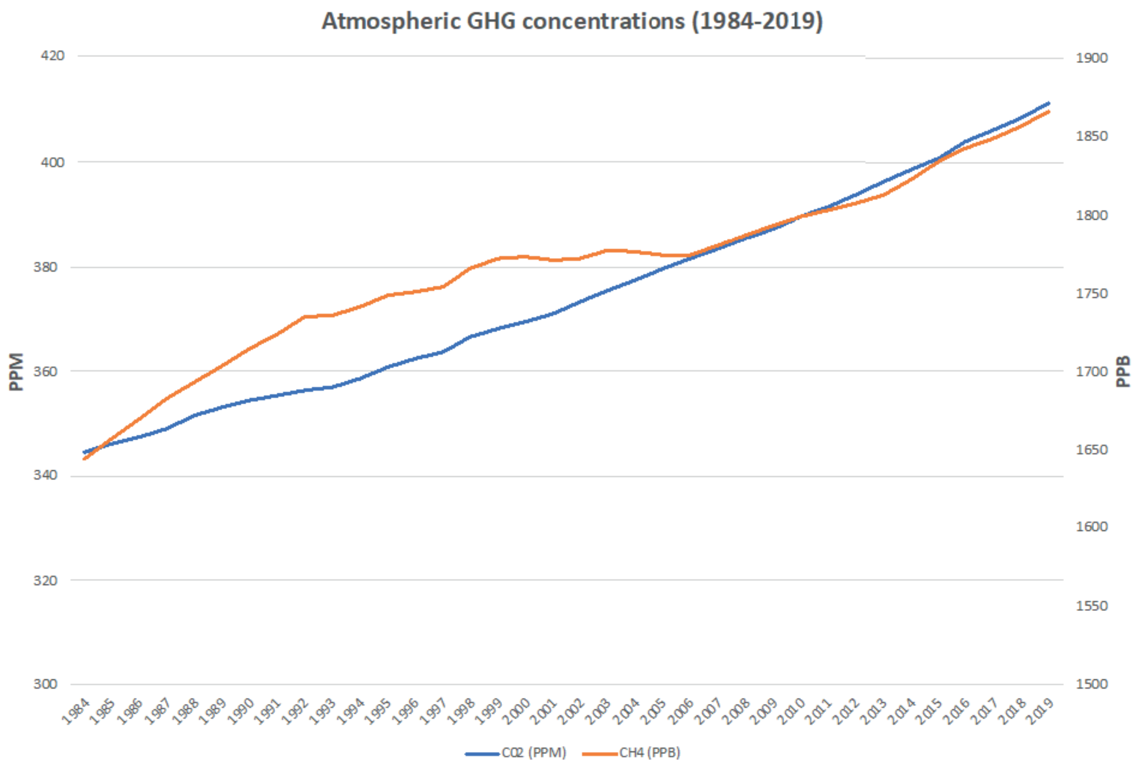

Figure 1. Trends in Atmospheric Concentrations of Carbon Dioxide (CO_2) and Methane (CH4)
Source: NOAA atmospheric GHG statistics (www.esrl.noaa.gov/gmd/ccgg/trends_ch4)

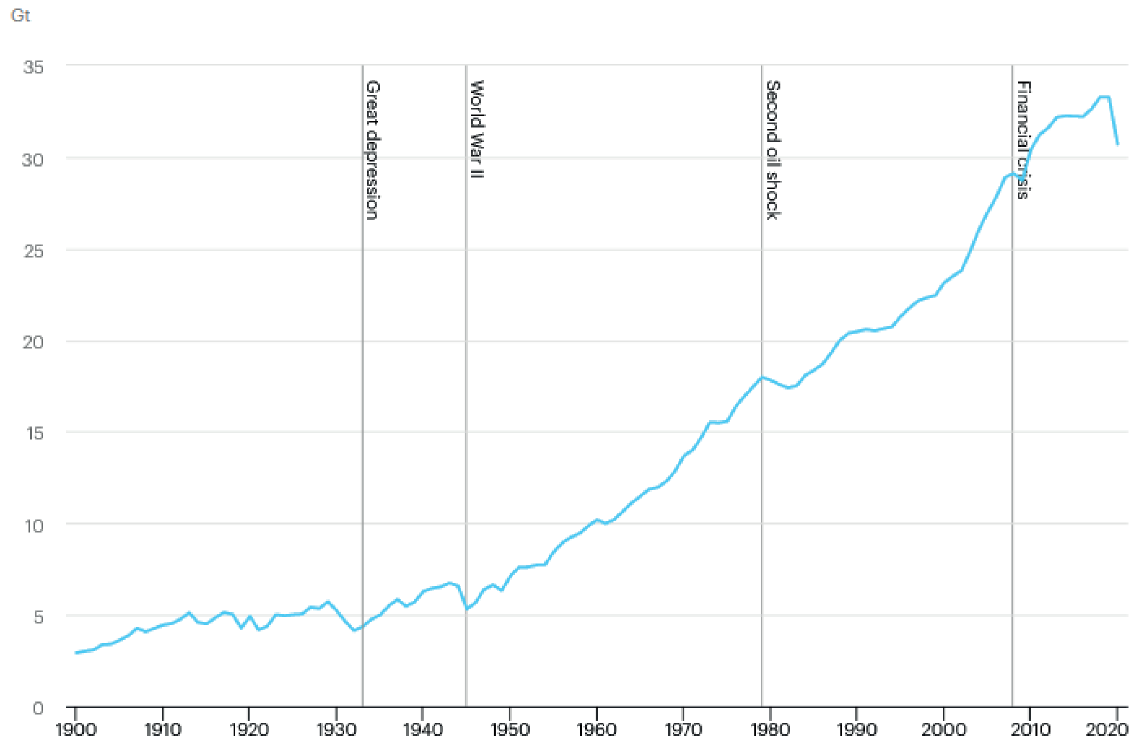

Figure 2. CO_2 emissions, 1900-2020
Source: IEA (www.iea.org/data-and-statistics/charts/global-energy-related-co2-emissions-1900-2020)

decelerates. But what is more striking, is the very uneven growth patterns of the four jurisdictions we are considering (Figure 3).

From 1960 to 1986, the emission trajectories in the U.S. and in Europe are almost identical, both in their level and dynamics. These paths diverge however after the second oil shock, when Europe's emissions start a decline, which accelerates after the financial crisis of 2008. By 2019, Europe's emissions are back to their 1965 level. U.S. emissions plateau only between 2000 and 2008 and begin their downside trajectory only after that date.

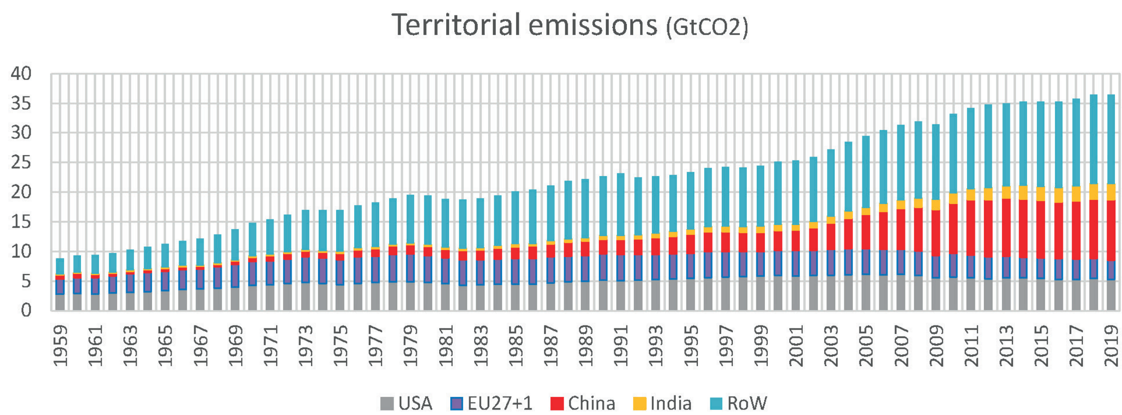

Figure 3. Total fossil CO_2 emissions, a sixty years' perspective (in billion tons of CO_2)
Source: Global Carbon Project, 2020 (www.globalcarbonproject.org)

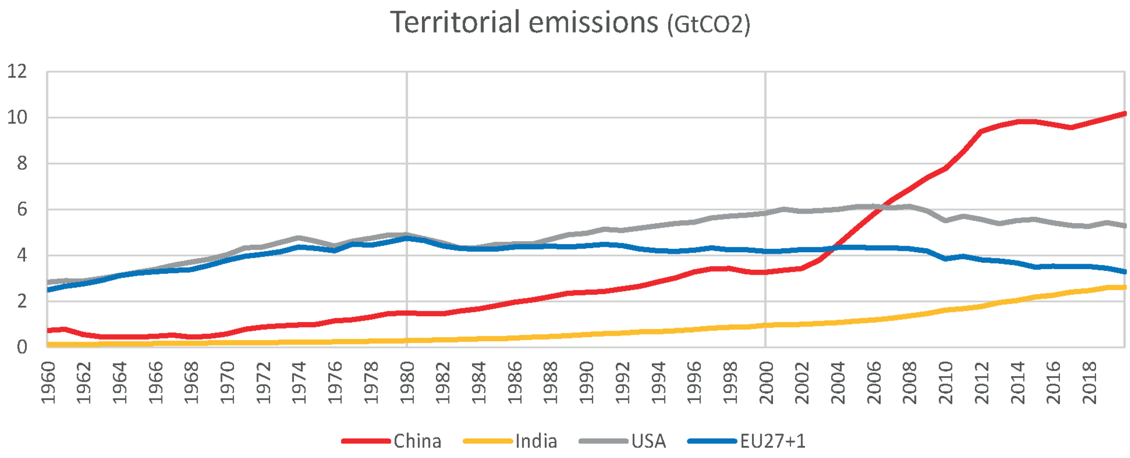

Figure 4. Total CO_2 emissions in the four regions (in billion tons of CO_2)
Source: Global Carbon Project, 2020

The story is different in China, where emissions increase at an annual average rate of 3-4% until 2001, the year of the accession of China to the World Trade Organization (WTO). After this date, economic growth accelerates as do total emissions: from 2001 to 2014, they increase from 3.5 to 9.8 Gt CO_2, i.e., an annual average growth rate of 8.4%. By 2004, China's total emissions overtake those of Europe's and in 2007 those of the U.S. India's emission trajectory shows a more regular profile, with an annual average growth rate of 5-6%. By the end of the period under review, India's total emissions approach those of Europe, while it only represented 4% of it in 1960. A new balance is in place.

This evolution is highlighted by the changes in the share of world emissions in the four jurisdictions from 1990 (the benchmark year for the Kyoto Protocol) to 2019 (Figure 5). Between these two dates the four regions have increased their joint share of the total, from 56% to 59%. This is due to the increase in China's share of world emissions, from 11 to 28%, and to a lesser extent to the increase of India's share, from 2 to 7%. Conversely, the U.S. and EU shares decrease over the same period, respectively from 23% to 15% and from 20% to 9%.

This new balance in world emissions reflects the major structural changes in the world economy during the past thirty years of globalization.

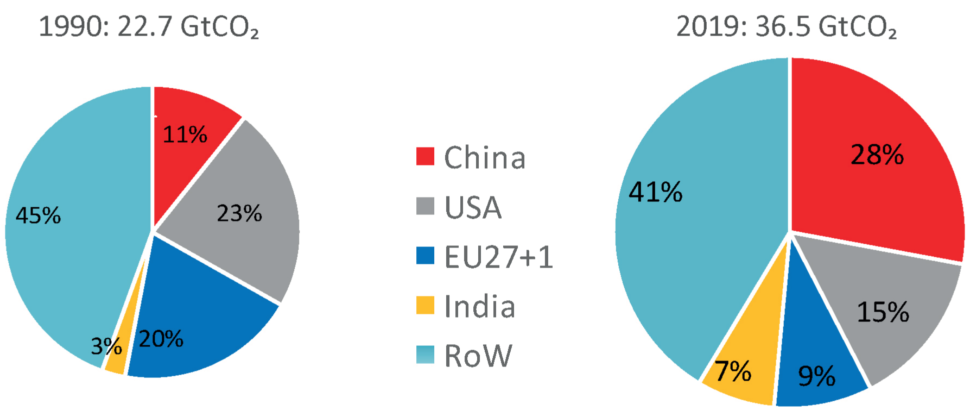

Figure 5. Share of total emissions for the different regions (in billions t CO_2)
Source: Global Carbon Project, 2020

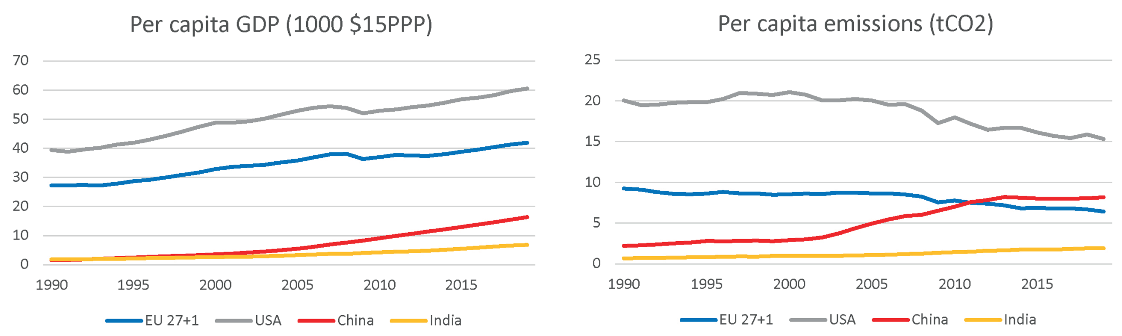

Figure 6a and 6b. Per capita GDP and per capita CO_2 emissions
Source: Enerdata, Global Energy and CO_2 Database, 2020

A per capita analysis

Per capita GDP (Figure 6a) increased in every region but at very different rates, according to the country's category, "mature" or "emerging": the U.S. and Europe both see their per capita GDP increase at an annual average growth rate of 1.4% during the 1990 to 2019 period. The equivalent rate is respectively of 8.4% and 4.5% for China and India. China's per capita GDP, which was 4% of the U.S. level in 1990 had risen to 27% thereof in 2019; for India the equivalent shares were 5% and 11%. Per capita emissions (Figure 6b) follow consistent – although not similar – patterns. While they decrease by 25 and 30 % respectively in the U.S. and the EU between 1990 and 2019, they significantly increase in China and India where they are respectively multiplied by a factor of 3.8% and 2.9%. By the end of the period, per capita emissions of China are higher than those of Europe.

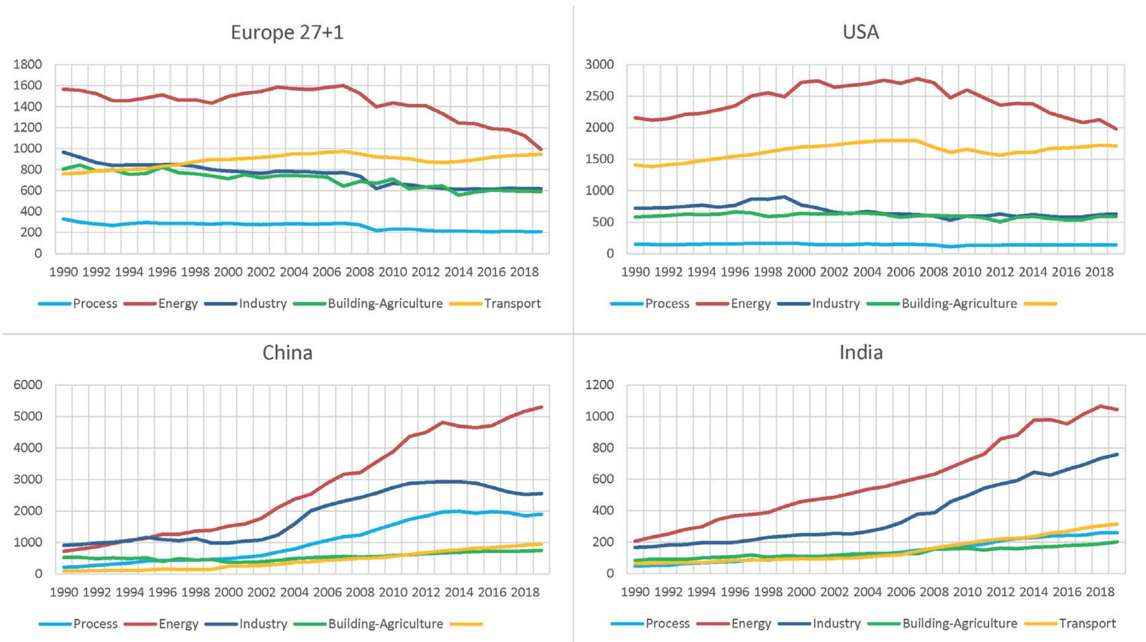

Figure 7. CO_2 emissions, by sector
Source: Enerdata, Global Energy and CO_2 Database, 2020
Note: "Process" stands for CO_2 emissions in the production process of materials (mostly steel and cement); "Energy" stands for emissions in the energy sector, mostly for electricity generation.

A sectoral analysis

The analysis of emissions by sector shows interesting similarities across the two pairs of jurisdictions: "mature" and "emerging". In Europe and in the U.S. the energy and transport sectors dominate the others, with similar profiles: the energy sector (mostly electricity generation) ranks first but has decreased strongly since the mid-2000s, while transport ranks second but is stable and even slightly increasing in recent years. The building and industry sectors are comparable, in level and trend, in both jurisdictions. However, the gap between transport and building is much larger in the U.S. than in Europe, which reflects the relative importance and carbon intensity of the transport activity in the U.S.

In the emerging countries, energy is also the leading emitting sector and has increased rapidly. But contrary to the economically mature jurisdictions, industry, and not transport, is the second highest source of emissions. In China as in India, transport and building are of similar relative importance, rising steadily, but well below industry.

Where we need to go

Together, China, the U.S.A., Europe, and India have been responsible for the emission of 22.6 $GtCO_2$ in 2019. The following section provides an overview of the possible evolution of CO_2 emissions (including industrial processes) in these jurisdictions. Scenarios are based on Enerdata's EnerFuture[4] prospective scenarios, which are performed with the POLES-Enerdata[5] model.

The scenarios presented here are EnerBlue and EnerGreen. EnerBlue is a scenario in which the Nationally Determined Contributions (NDCs) of the four jurisdictions are achieved in the next 10 years, and they continue on this reduction trajectory up to 2050. This scenario is compared to EnerGreen, a more ambitious 2°C-compatible scenario, which would require that a collective additional reduction in the order of 14.5Gt be achieved by 2050. In this scenario, the global carbon budget, in line with the IPCC scenarios (Rogelj et al., 2019), is apportioned to countries according to a "soft-landing" profile, based on capacity and responsibility criteria as developed by (Criqui et. al, 2014). These trajectories are only illustrative, as many other combinations of effort across the four jurisdictions could deliver the same aggregate outcome.

Taken together, CO_2 emissions of the four jurisdictions follow a slightly decreasing trend over the next 30 years in the NDC scenario (EnerBlue), reaching 22.3 $GtCO_2$ in 2030 and 20.7 $GtCO_2$ in 2050 (9% compared to 2019). At the global level, the EnerBlue scenario is likely to result in a temperature increase between 3 and 4°C by the end of the century, compared to pre-industrial levels. In the EnerGreen scenario, which is compatible with a 2°C temperature rise, CO_2 emissions of the four jurisdictions in aggregate are reduced by 72% over the period 2019-2050, which leaves approximately 6.2 $GtCO_2$ in 2050. The 14.5 $GtCO_2$ emissions gap observed in 2050 between the two scenarios reflects the significant effort required globally, and hence at the country level, to achieve the 2°C objective of the Paris Agreement.

This level of effort is illustrated for of each jurisdiction in the following four charts. While the EnerBlue scenario assumes a decreasing emission profile in developed economies (Europe, U.S.A.), the next 30 years look different in China (stable, then slightly decreasing) and India (steady increase of emissions). The additional emission reductions that would need to be delivered to achieve a 2°C future are significant in all jurisdictions, ranging between 61% (India) and 74% (U.S.A.) in terms of 2050 emissions gap. The total 14.5 $GtCO_2$ emission gap discussed above is in the hands of all four countries, whereby China, given its very high current level of CO_2 emissions, has a potential to reduce for half of it.

4 www.enerdata.net/research/forecast-enerfuture.html

5 POLES-Enerdata is the version of the POLES model run, developed and maintained by Enerdata. The POLES model has been initially developed by IEPE (Institute for Economics and Energy Policy), now GAEL lab (Grenoble Applied Economics Lab). www.enerdata.net/solutions/poles-model.html

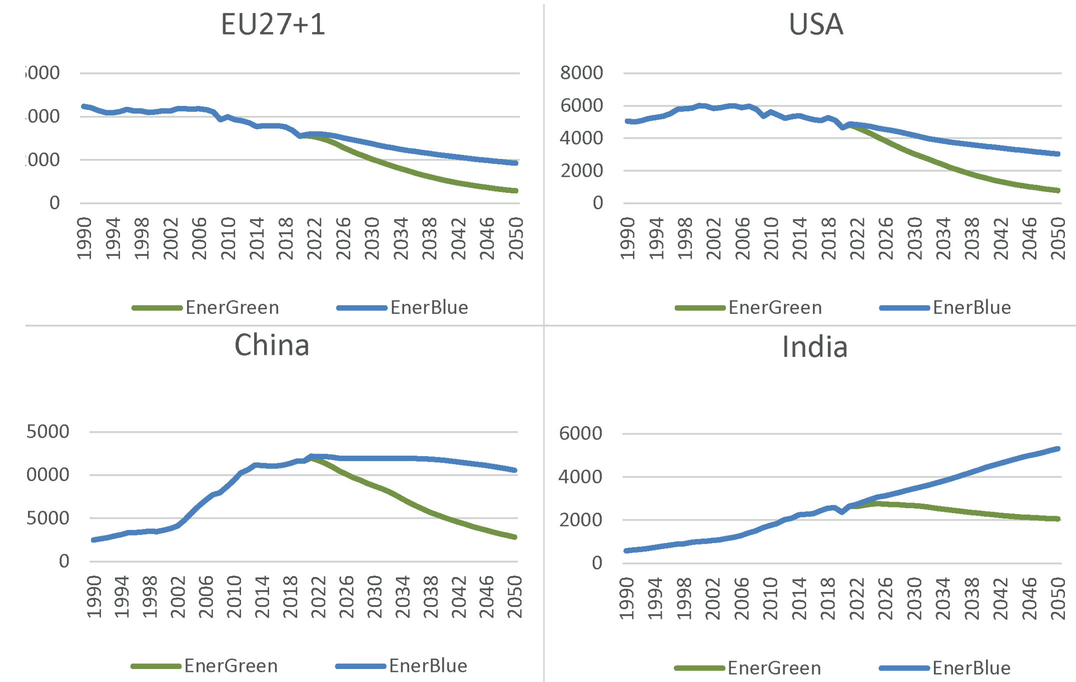

Figure 8. Projected CO_2 emissions in EU27+1, U.S.A., China and India (in Mt CO2)
Source: Enerdata, EnerFuture long-term scenarios, 2020

Limiting the temperature rise to 1.5°C: the case of Europe

The Paris Agreement sets out the global framework to pursue efforts to further limit the temperature increase to 1.5°C. The recent wave of net-zero emission targets' announcements may bring a significant contribution to this objective, if implemented. The following assessment provides a specific focus on Europe carbon neutrality objective by the middle of the century, how it compares to an NDC and a 2°C-scenario, and what sectoral implications are expected.

A 1.5°C-aligned policy commitment in Europe, more precisely a net-zero emission pathway unto 2050, is illustrated in Figure 9. Two main differences appear in comparison with the EnerBlue and EnerGreen scenarios discussed above: on the one hand the very early start of the emissions decrease, as of 2021, and the overall more significant effort over the time horizon. In 2050, the Enerdata-1.5°C scenario reaches 135 $MtCO_2$ of residual gross emissions (including emissions captured by CCS). Where the emission reduction between the NDC and the 2°C pathway is 69%

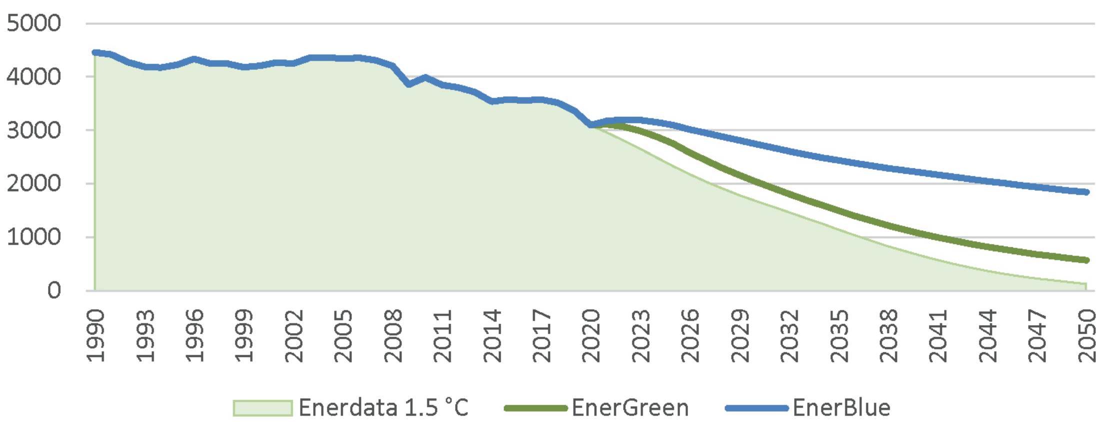

Figure 9. Projected CO_2 emissions in EU27+1(in $MtCO_2$)
Source: Enerdata, EnerFuture long-term scenarios, 2020

in Europe in 2050, the 1.5°C pathway involves a further 24% reduction, necessary to achieve the target. In this scenario, reductions of non-CO_2 gases are also included, amounting to roughly 240 $MtCO_2eq$, mostly CH_4 and N_2O from agriculture. The total residual greenhouse gas emissions in 2050 are expected to be offset by the expected carbon sink provided by the LULUCF (land-use, land-use change and forestry) sector, which is expected to increase slightly in the next 30 years.

From a sectoral perspective, structural inertia and the speed of innovation and technology deployment may lead to significant discrepancies in the contribution to a net-zero emissions objective (Figure 10). At European level, while currently the industry and energy supply sectors today account together for half of CO_2 emissions, these two sectors are expected to be fully decarbonised by 2050, and even to provide net negative emissions. These negative emissions correspond to the contribution of carbon capture and storage by this time horizon, both in the industry and in the electricity generation sector. In such a 1.5°C scenario, the European building sector, both residential households and commercial offices, is also subject to a deep decarbonisation through a range of drivers, including behavioural changes (towards so-called energy 'sufficiency'), stringent policies and incentives in the existing buildings stock and in the regulation for new constructions.

In this net-zero emissions landscape, two sectors appear more difficult to decarbonise, though with a key-role to play. The transport sector would reduce its CO_2 emissions by around 85%, with roughly 140 $MtCO_2$ remaining in 2050, despite the removal of private internal combustion engines from the new vehicle sales shortly after 2040. The agriculture sector would account for a residual 18 $MtCO_2$, (i.e. a 67% reduction compared to 2020), half of it due to energy combustion and the other half from soil amendments and fertilisers. In 2050 however, the bulk of remaining GHG emissions from the agriculture sector are likely to be attributable to CH_4 from cattle and N_2O from soils emissions.

Conclusion: A long way… in a very limited time frame

This quick overview of observed past emissions and required future decarbonisation pathways clearly demonstrates the necessity of adopting a new course in emissions for each of the four major world emitters. In the mature regions, the U.S. and Europe, decarbonisation is already on-going but at a pace that is much too slow.

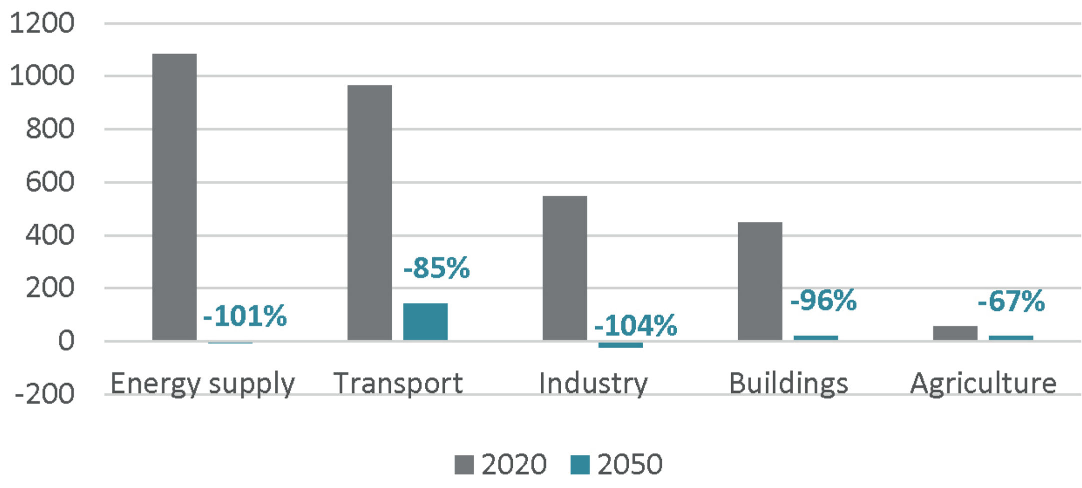

Figure 10. Sectoral CO_2 emission reductions 2020-2050 for a 1.5 °C-compatible EU27+1 (Mt CO_2)
Source: Enerdata, EnerFuture long-term scenarios, 2020

For the largest world emitter, China, the time is decisive: while emissions have been levelling off in the very recent years, it is now time to engage in a rapid decline trajectory and this is clearly required by the new policy of carbon neutrality for China in 2060. As for India, the emissions plateau is still to come but it should take place between now and 2035. Thereafter emissions should also engage in a decreasing trajectory.

Historical experience show that past energy transitions have taken many decades for their full deployment. But on the other hand, IPCC scenarios demonstrate that the game will be over shortly after the mid of this century, that is in thirty years from now. "Accelerated transitions" is thus now a key concept in strategic terms (Sovacool, 2015). And addressing the societal challenge of climate change and energy transitions should become the main research perspective of many scientific and technological endeavours, in a transdisciplinary perspective (OECD, 2020).

References

Grubler, A. (2012). Energy transitions research: Insights and cautionary tales. *Energy policy*, *50*: 8-16.

OECD. (2020). Addressing societal challenges using transdisciplinary research. *OECD Science, Technology and Industry Policy Papers*, N. 88, OECD Publishing, Paris. https://doi.org/10.1787/0ca0ca45-en

Rogelj, J., Huppmann, D., Krey, V., Riahi, K., Clarke, L., Gidden, M., Nicholls, Z., & Meinshausen, M. (2019). A new scenario logic for the Paris Agreement long-term temperature goal. *Nature*, *573*(7774): 357-363.

Smil, V. (2019). *Energy in world history*. Routledge.

Sovacool, B. K. (2016). How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research & Social Science*, *13*: 202-215.

Suggested citation

Cail, S., & Criqui, P. (2021). Carbon Dioxide Emissions by the Four Largest World Emitters: Past Performance and Future Scenarios for China, U.S.A., Europe and India. *EAERE Magazine*, 11.

Section II

The U.S. Module

Climate Policy Architecture in the U.S.

Jack Lienke and **Jason A. Schwartz**
New York University

Jack Lienke (jack.lienke@nyu.edu) *is the Regulatory Policy Director of the Institute for Policy Integrity at New York University School of Law, where he also serves as an adjunct professor.*

Jason A. Schwartz (jason.schwartz@nyu.edu) *is the Legal Director of the Institute for Policy Integrity at New York University School of Law, where he also serves as an adjunct professor.*

Introduction

The central, "federal" government's power is divided among three separate-but-equal branches, each with a distinct role: the legislature (the bicameral Congress) makes law; the executive (the president and the large network of administrative agencies that the president staffs and supervises) implements it; and the judiciary (the district, circuit, and supreme courts) interprets it. In addition to the federal centers of power, state and local governments play major roles in shaping U.S. climate policy, as do business interests and other stakeholders, including community and non-governmental organizations.

To date, Congress has passed little climate-specific law. Consequently, most federal policies that directly or indirectly limit greenhouse gas emissions have originated from executive-branch agencies, operating under broad grants of authority included in bedrock environment- and energy-focused statutes from the 1970s. The judiciary, meanwhile, has played a significant but inconsistent role in shaping these policies—initially interpreting old laws to allow or even require agencies to regulate greenhouse gases, but later issuing decisions that somewhat constrained agencies' ambitions. This paper provides more detail on the workings of the three federal centers of power with respect to climate policy, followed by short discussions of influence wielded by states and other stakeholders.

The Legislature

The U.S. Congress has two chambers: the Senate, which comprises 100 Senators (two for each of the fifty states, elected on staggered six-year cycles), and the House of Representatives, which has 435 members (apportioned among the states based on population, elected every two years). Most of those elected affiliate with either the Democratic or Republican party. Whichever party wins a majority leads the relevant chamber, chairs the key committees, and decides what legislation will be considered by the chamber as a whole. Legislation must be approved by both chambers and signed by the President to be enacted, and as will be discussed further below, the Senate typically has required the support of 60 Senators to advance legislation. Overriding a presidential veto of legislation requires a two-thirds majority in both chambers. These features together erect a high bar for enacting any significant legislation

Congress Is Unlikely to Play a Significant Direct Role in Near-Term Policymaking

Even though the Democratic Party—the only major U.S. political party that is at present committed to mitigating climate change—won

control of the presidency and both chambers of Congress in the 2020 election, major legislation aimed directly at reducing greenhouse gas emissions faces significant hurdles at least through 2022 (after which another election could give Democrats increased legislative majorities). One major hurdle is the filibuster, a longstanding procedural practice through which a single Senator can block legislation from advancing unless a 60-Senator supermajority votes to end debate. It is unlikely that Democrats, who currently hold only 50 of 100 Senate seats,[1] could persuade 10 Republican colleagues to vote for any significant climate legislation. And while Democrats could use their bare majority to eliminate the filibuster altogether, some in their own caucus oppose that move.

The Senate is similarly unlikely to muster the two-thirds majority needed to formally ratify any new international treaties on climate change, though the executive branch has tools to implement certain international agreements without formal Senate ratification.

A few procedural stratagems may allow a simple majority in the House and Senate to advance certain climate policies. For example, once each fiscal year, Congress can pass special budget resolutions with policies aimed at taxation and spending,[2] which are not subject to filibuster and which could include climate-oriented infrastructure spending or perhaps even a carbon tax. Similarly, some smaller-scale climate policies, especially spending on infrastructure and research, may be achievable if attached to "must-pass" legislation like end-of-the-year spending bills, which are less likely to be filibustered.

Notwithstanding these limited opportunities for Congressional action, federal climate policy over at least the next two years is likely to derive primarily from authorities granted to executive-branch agencies by previous legislation.

The Executive

This branch has many policy levers available. Existing legislation grants multiple federal agencies a wide variety of powers that, while not expressly aimed at greenhouse gas emissions, can nevertheless be used to reduce them. A comprehensive survey of all authorities is not possible here, but some of the most significant are flagged below.

Emission-Control Authorities

Under the Clean Air Act,[3] the Environmental Protection Agency (EPA) can directly limit greenhouse gas emissions from new mobile sources and new-and-existing stationary sources. EPA has already established some limits for new cars and trucks, new and existing power plants, and new oil-and-gas wells (and related infrastructure). The design of these regulations, however, remains subject to heated debates both in and out of court, and any efforts to increase their stringency or expand coverage to additional sectors, like petroleum refineries, will spark similar controversy (Lienke, 2020).

Energy-Efficiency Authorities

The Energy Policy and Conservation Act (EPCA) grants the Department of Transportation (DOT) authority to set fuel-economy standards for certain motor vehicles. Because increased fuel economy is also auto manufacturers' primary tool to comply with EPA's greenhouse gas limits, DOT and EPA have traditionally coordinated their standards' design and stringency, though the agencies are not legally obligated to do so.

EPCA also authorizes the Department of Energy (DOE) to set energy-efficiency standards for certain residential, commercial, and industrial appliances (like furnaces and walk-in freezers).

1 With a 50-50 split in the U.S. Senate, the Vice President casts tie-breaking vote. Starting on January 20, 2021, Democratic Vice President Kamala Harris will cast tie-breaking votes, giving slim majority control to the Democrats.

2 This procedural technique is called budget reconciliation. It has been used in the past to open oil drilling in the Arctic National Wildlife Refuge and to pass part of the legislation connected to the health program known as Obamacare.

3 Ironically, much of the legislation on which today's federal climate action is based was originally passed decades ago on a bipartisan basis, often with Republican leadership.

Electricity-Market Authorities

The Federal Energy Regulatory Commission (FERC) has broad authority under the Federal Power Act to ensure that wholesale electricity rates are "just and reasonable." FERC recently signaled openness to the integration of carbon-pricing into regional wholesale markets under its supervision. Together with DOE, FERC also enjoys some authority related to the siting and financing of interstate transmission lines. Because many of the areas most conducive to renewable-electricity generation in the U.S. are far from the country's population centers, developing substantial new transmission infrastructure is a necessary component of power-sector-decarbonization efforts (Zevin et al., 2020).

Resource-Management Authorities

The U.S. federal government owns hundreds of millions of acres of surface and subsurface deposits of coal, oil, and natural gas, as well as offshore deposits in the outer continental shelf. Offices within the Interior Department are tasked, by various statutes, with leasing access to those deposits, and such leases currently account for almost 30 percent of annual U.S. energy production. By curtailing future leases and better managing existing leases, agencies could reduce fossil-fuel production from federal lands (Hein, 2020).[4]

Federal agencies can also affect the supply of coal, oil, and gas through control of transportation and distribution infrastructure. Notably, FERC has authority to review and approve (or not approve) interstate gas pipelines (Unel, 2020). Other federal agencies have responsibilities over international pipelines, export facilities for liquified natural gas, coal railroad routes, and other fossil-fuel supply channels. The National Environmental Policy Act (NEPA) requires agencies to assess the environmental impacts (including climate impacts) of such projects, and agencies may be able to cite their findings to justify denying necessary approvals (Hein & Jacewicz, 2020).[5]

Coordinating Authorities

Several White House offices exercise cross-cutting review and coordination roles across the executive branch. The Biden Administration has appointed a National Climate Advisor (sometimes referred to as the "domestic climate czar") to ensure that key agencies' actions and priorities reinforce each other, and that even agencies not traditionally focused on climate, like the Treasury and the Department of Health and Human Services, consider their programs' climate impacts.

The Office of Information and Regulatory Affairs (OIRA) is responsible for reviewing major regulations, to check that regulatory benefits justify the costs and to ensure that regulations consistently advance presidential priorities. OIRA also helps harmonize agencies' monetary estimates of costs and benefits, including estimates of the Social Cost of Greenhouse Gases—a metric that captures the marginal economic costs stemming from the physical climate damages caused by each additional ton of greenhouse gases. The stringency of climate regulations may depend partly on the estimated magnitude of the Social Cost of Greenhouse Gases (Schwartz, 2020).

The Council on Environmental Quality (CEQ) provides guidance on the preparation of environmental impact statements for major federal actions under NEPA—explaining what kinds of effects should be considered and in what manner—and also helps lead the federal government's internal sustainability efforts.[6]

4 Following reduced production of coal, oil, and gas from federal lands, private and state-controlled lands in the United States, as well as international sources, could increase their production in response. But it is unlikely such alternate sources could perfectly substitute for federal sources by producing the same quantities at the same prices; consequently, the price for coal, oil, and gas will rise, overall supply and demand will fall, and ultimately fewer greenhouse gas emissions will be released.

5 Any such actions must be consistent with agencies' statutory mandates, but various statutes may provide additional authorities not to approve new supply channels. For example, under the Natural Gas Act, FERC could determine that—given the climate impacts—a new gas pipeline would not advance "public convenience and necessity."

6 The federal government is the country's largest single consumer of energy and other goods, and so can help create markets and norms favoring alternative-energy vehicles and other climate-friendly products.

The Judiciary

Lawsuits can be brought—and, in today's political climate, typically will be brought—against most major federal regulations and other agency actions bearing on climate change. Federal courts can temporarily or permanently block actions that fail to comply with relevant procedural requirements, are not supported by sufficient and rational analysis, or exceed the authority Congress delegated to the agency.

Judicial review slowed or stopped many of the Trump administration's efforts to eliminate the Obama administration's climate policies. But courts may do the same to some of the Biden Administration's efforts to go *beyond* Obama-era policies. The Supreme Court—where conservative-minded justices now hold a two-thirds supermajority—in particular may be hostile to agency policies that rely on novel interpretations of older statutory provisions. Anticipation of this skeptical review will likely preemptively constrain the ambition of the Biden administration's executive-branch policies.

That same skeptical review, together with a host of procedural and substantive complexities, may also dim the prospects of various nuisance suits and other common law-based attempts to seek direct remedies from the courts on climate change.

States

In most sectors, federal regulation serves as the floor, not the ceiling, for climate policy. Thus, state and local governments are typically free to exceed the scope or stringency of federal requirements, and many have already done so in the electricity and home-heating sectors. One notable exception to states and localities' policy-making freedom is vehicle regulation. The Clean Air Act generally precludes states from setting their own auto emission standards, though California can request a waiver to do so (and the statute makes it difficult for EPA to deny that request). States can also be very influential by 'showing the way' for other states, the federal government, and even for countries abroad. For example, Colorado established the nation's first methane standards for oil and gas operations in 2014, which informed EPA's issuance of nation-wide standards two years later.

Non-Governmental Stakeholders

The policy arenas described above—federal and state, legislative, administrative, and judicial—provide formal and informal opportunities for participation by non-governmental stakeholders, including business. Fossil-fuel enterprises (especially coal) have historically opposed climate action on the grounds that it will result in large-scale economic and associated losses (Lienke & Revesz, 2016) and have sought to cast doubt doubt on the validity of climate science (Oreskes and Conway, 2010). Recently, however, two of the nation's most prominent trade associations, the Business Roundtable and the U.S. Chamber of Commerce (both of which have fossil-fuel companies among their members), announced support for a nation-wide, market-based climate policy. Whether this endorsement of a hypothetical policy will translate to support for any specific legislative or regulatory proposals remains to be seen.

Non-governmental organizations, from environmental advocates to conservative think tanks, also play a significant role in both public and courtroom debates over climate policy. The shape and success of U.S. climate actions thus depends partly on how well politicians and bureaucrats navigate competing stakeholder interests.

Note

This Chapter does not represent the position, if any, of NYU School of Law.

References

Hein, J. (2020). *A New Way Forward on Climate Change and Energy Development for Public Lands and Waters*. Institute for Policy Integrity, New York.

Hein, J, & Jacewicz, N. (2021). Implementing NEPA in the Age of Climate Change. *Michigan J. Envtl. & Admin. L.* (forthcoming).

Lienke, J. (2020). Rules, Rulings & Repeals: The Shifting State of Climate Policy at U.S. EPA. In: Rom, W, Pinkerton, K. (eds). *Climate Change and Global Public Health* (2nd edn.). Humana, Cham.

Lienke, J., & Revesz, R. (2016). *Struggling for Air: Power Plants and the "War on Coal."* Oxford University Press, New York.

Oreskes, N., & Conway, E.M. (2010). *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. Bloomsbury Press, New York.

Schwartz, J. (2020). *Enhancing the Social Benefits of Regulatory Review*. Institute for Policy Integrity, New York.

Unel, B. (2020). *A Path Forward for the Federal Energy Regulatory Commission*. Institute for Policy Integrity, New York.

Zevin, A., Walsh, S., Gundlach, J., & Carey I. (2020). *Building a New Grid Without New Legislation: A Path to Revitalizing Federal Transmission Authorities*. Institute for Policy Integrity / Columbia Center on Global Energy Policy, New York.

Suggested citation

Lienke, J., and Schwartz, J.A. (2021). Climate Policy Architecture in the U.S. *EAERE Magazine*, 11.

U.S. Domestic Climate Policy – Looking Back

Max Sarinsky
New York University

Max Sarinsky (max.sarinsky@nyu.edu) *is an attorney at the Institute for Policy Integrity at New York University School of Law, where he advocates for rational environmental and economic regulations in U.S. policy.*

Introduction

The U.S. climate policy story has four important, interrelated dimensions: action at the federal level, action at the state level, policy innovation, and technical innovation. The federal story is one of legislative failure but some executive and innovation success, while the state story is one of variegated progress. The country's policy innovations include the use of cap-and-trade programs, while its technical innovation is a product in part of an innovation ecosystem that can deliver disruptive outcomes at scale complemented by certain policies that encourage and enable this.

Federal Level (Policy)

In 2009, with support from newly elected President Barack Obama, the House of Representatives (the lower half of the bicameral legislature) passed a sweeping cap-and-trade bill that would require economy-wide greenhouse gas emissions to decline 17 percent below 2005 levels by 2020 and 83 percent by 2050 (Broder, 2009). To become law, the bill would need to pass the upper legislative house, the Senate, where for the first time in thirty years, the left-leaning Democratic Party held the supermajority power needed to pass legislation against opposition from across the aisle (Hulse, 2009).

But the bill died in the Senate without so much as an up-or-down vote. Post-mortems written about the failure have identified a few key factors in its demise: Opposition from powerful fossil fuel and agriculture lobbies. Skepticism from energy-rich regions and their elected representatives. Near-uniform obstruction from the right-of-center Republican Party and the influential conservative media. A general lack of passionate public or political support following a severe economic recession (Lizza, 2010).

The result has been a decade of legislative inaction. In the fall of 2010—just months after the climate bill's failure—the Republican Party, which is widely hostile to the science behind climate change (Brenan & Saad, 2018), won control of the House of Representatives on a platform of reducing taxes, spending, and government control over free enterprise, effectively dashing the prospects of ambitious climate legislation (Zeleny, 2010). The Democratic Party would not again hold full legislative control for another ten years.

Executive Action

With ambitious climate legislation off the table, the Obama administration turned to its executive-branch agencies to promulgate climate policy, issuing a broad suite of regulations over the ensuing years aimed at curbing greenhouse gas emissions from key sectors. These regulations typically expanded existing regulatory programs or envisioned statutory authority in new ways to tackle climate change, focusing on major-emitting sectors that were already closely regulated by administrative agencies. For instance:

1. The Department of Transportation, which administers a vehicle fuel-economy program that had laid dormant since the energy crises of the 1970s, and the Environmental Protection Agency, which regulates pollution from motor vehicles, jointly issued ambitious new standards requiring declines in vehicle carbon dioxide of approximately five percent annually. (Union of Concerned Scientists, 2017).

2. The Department of the Interior, which manages 500 million acres of federal land, paused its coal-leasing program and issued rules to limit methane leaking and flaring from oil-and-gas lessees' drilling operations (U.S. DOI, 2016).

3. The Environmental Protection Agency issued the Clean Power Plan, its program to reduce carbon pollution from the power sector to 32 percent below 2005 levels by 2030 (U.S. EPA, 2016).

But while these Obama-era regulations made some progress toward reducing the nation's carbon footprint, most did not last. A federal judiciary that is becoming increasingly hostile to regulatory delegation sometimes took issue with these new exercises of agency authority, crippling some key programs following fierce litigation campaigns by opponents. For instance, while the Clean Power Plan was hailed by supporters as a momentous achievement, it was derided by opponents—including Republican Party politicians and powerful business interests—for threatening the coal industry and the communities that rely on it (Davenport & Davis, 2015). Those opponents challenged the Clean Power Plan in court, ultimately persuading the nation's highest court to halt the program before it took effect (Liptak & Davenport, 2016).

Reversal

While judicial review limited the impact of climate regulations during President Obama's tenure, the election of Republican Donald Trump as president in 2016 has been their death knell. Because regulations are promulgated by executive agencies whose leaders are selected by the president, they are subject to rollback when a new presidential administration takes office. And once President Trump took office in early 2017, with the assistance of a Republican-controlled Senate, he placed opponents of climate regulation in key government positions. For instance, a state official who had led many of the legal challenges to Obama-era climate regulations was tapped to serve as the nation's top environmental regulator (Davenport, 2017). The chief executive of ExxonMobil became secretary of state (Harris, 2017).

With a cabinet in place that opposed binding emissions limits—and an explicit directive from the new president to expand domestic energy production (Executive Office, 2017)—the Trump administration launched an anti-regulatory assault on the Obama administration's climate programs. Virtually all of the major Obama-era climate regulations were rolled back during President Trump's four-year term as part of his administration's broader attack on environmental protections (Popovich et al., 2020).

For instance, the Trump administration substantially rolled back the vehicle emission standards that the Obama administration put in place in 2012, requiring just 1.5 percent rather than 5 percent in annual tailpipe emission reductions. It ended the Obama administration's coal moratorium (Frazin, 2020) and opened new swaths of public land for oil-and-gas drilling (Lipton & Tabuchi, 2018). It reversed Obama-era regulations to prevent methane leakage from new and existing wells (Davenport, 2020). And it formally withdrew the Clean Power Plan and replaced it with a toothless alternative that barely limits carbon pollution from power plants (Friedman, 2019).

All in all, the Trump administration's rollbacks have forgone at least two gigatons of greenhouse gas emission reductions that were called for under those Obama-era rules, dealing a dramatic blow to years-long regulatory efforts to reduce carbon pollution (Pitt et al., 2020). While some of these rollbacks are likely to be undone eventually by either the federal courts or the Biden administration (on the final day of the Trump administration, in fact, a federal court vacated the withdrawal of the Clean Power Plan, creating even more uncertainty for the future of that program), the excess emissions occurring while they remain in effect cannot be reversed.

More than a decade after the federal government was on the verge of passing sweeping climate legislation, few ambitious emission standards are now on the books at this level.

State Level

The story at the state level is somewhat more positive. A number of states enacted climate mandates that are far more ambitious and aggressive than federal policies. Twenty-three states (nearly half the 50 total) have adopted greenhouse gas emission targets, which vary in terms of timing, stringency, and enforceability (CCESa). California, home to nearly one-eighth of the U.S. population, has been amongst the most progressive states on climate policy, enacting an economy-wide cap-and-trade program in 2013 (linked to Quebec's program) that is on track to reduce the state's carbon emissions to 80 percent below 1990 levels by 2050 (CCESb). Another eleven states (including populous states such as New York, New Jersey, and Virginia) jointly administer a cap-and-trade program for the power sector known as the Regional Greenhouse Gas Initiative[1], which has reduced carbon emissions from regulated power plants by 47 percent since the program's 2009 launch (RGGI). And 29 states have implemented renewable portfolio standards, which require a set percentage of the states' electricity to derive from renewable sources (CCESa).

While these state-level policies have made an important impact—and will have a greater effect over time as emission targets become more ambitious—there are legal limits to what states can accomplish without federal regulation (Coglianese & Starobin, 2018). While states can reduce emissions within their jurisdictions, their control over national and global energy supply is limited, since the federal government controls foreign policy, interstate and international transmission pipelines, and vast energy reserves. The federal government has also closed off some critical areas of climate regulation to local control. And states controlled by more conservative governments—including many in energy-rich regions—have mostly declined to impose stringent emission controls.

Policy Innovation

In addition to state and federal controls, the U.S. climate story is also one of policy innovations. Policy instruments that have originated or developed in the United States include market instruments (carbon taxes, emissions trading); regulation (dictating carbon reducing technologies and processes); subsidies (grants, tax expenditures that reward reduction), technology and R&D (finding better and cheaper solutions); and voluntary agreements (companies commit to meeting emission reduction targets).

An important early U.S. policy innovation that has been particularly important worldwide in reducing greenhouse gas emissions was the design and implementation of cap-and-trade programs. Specifically, in the early 1990s, federal law created a market-based instrument (emission trading) to reduce sulfur-dioxide emissions from the power sector.[2] Although this initial cap-and-trade program was not for greenhouse gases, it has become the template for trading schemes that were designed to deliver, or guarantee, greenhouse gas emissions' reduction at state level in the U.S. (see above) and abroad, beginning with the European Union Emissions Trading System in 2005.

The U.S. is also a leader in the use of private action to reduce greenhouse gas emissions. In January 2021, for instance, General Motors announced its intention to phase out the internal combustion engine by 2035. Many prominent U.S. institutional investors—such as government pension funds and institutions of higher education—have also divested from the fossil-fuel industry. While many question the sufficiency of these voluntary actions, they do provide a signal that may help facilitate government action over time.

Technical Innovation

The innovation ecosystem in the United States is unusual in that private investors are willing to invest billions of dollars, over a long period, in

1 Regional Greenhouse Gas Initiative. Elements of RGGI. https://www.rggi.org/program-overview-and-design/elements

2 This fixed a shrinking absolute cap on emissions, permits were allocated to installations, and these could be traded, with the requirement that emitters hold sufficient permits at the end of the reporting period to cover their emissions. The result was reduction in emissions that far exceeded what the cap required, delivered at much lower costs than anticipated (Ellerman et al, 2000)

companies that have inspirational leadership and are likely to be major disruptors of incumbent businesses. Tesla, which has the ambition of disrupting the auto industry with electric cars, is valued in excess of $600 billion. The federal government also provides tax breaks and funds research and development at scale.

Technical innovation was also key to important reductions in emission by the nation's power sector. For instance, Mohlin et al. (2018) show how important such innovation (and supporting policies) were in explaining how renewables and fracking achieved reductions (4.8-6.9 percent) in greenhouse gas emissions from the power sector (Table 1).

Activity	Decline achieved (% of total)
Renewables (revolution in cost reduction)	2.3-3.3
Switch from coal to natural gas (key to the decline of coal in the US power sector)	2.5-3.6
Total	4.8-6.9

Table 1. Explaining Emissions Reduction in the US Power Sector, 2007-2013
Source: Mohlin et al. (2018).

This innovation has largely been spurred by federal policy. While Congress has not been able to agree on much regarding federal climate policy, it has allocated tens of billions of dollars in renewable energy research and development tax credits as part of bipartisan spending bills to stimulate the economy in both 2009 and 2020, and extended tax credits for solar and wind in 2015 (White House, 2016; Kaplan & Grandoni, 2010; Lacy, 2015). Largely as a result of these incentives, renewable energy funding has soared: Led by wind and solar, nationwide investment in renewable energy reached a record $55 billion in 2019, approximately doubling annual totals from a decade earlier (Rathi & Hodges, 2020). Renewable energy production and consumption also increased nearly 50 percent during the same ten-year period (EIAa).

But the biggest shift in the U.S. energy market has been the rise of natural gas in place of coal (EIAb), as natural gas has gotten cheaper as a result of a boom in shale development through hydraulic fracturing (Gruenspecht, 2019). Because natural gas-fired power plants emit about half as much carbon per kilowatt hour as coal plants, the boom in gas production has produced a substantial decline in power-sector emissions (EIAc), though the extent to which that decline has been offset by corresponding increases in methane emissions from gas wells is hotly debated (Borunda, 2020).

All told, total U.S. emissions declined nearly 10 percent between 2005 and 2018, achieving more than half of the decline called for under the sweeping 2010 cap-and-trade legislation that did not pass (EPA, 2020). Imagine how much better we could have done with a coherent federal policy.

Note

This Chapter does not represent the position, if any, of NYU School of Law.

References

Borunda, A. (2020, Feb. 19). Natura Gas Is a Much 'Dirtier' Energy Source Than We Thought. *National Geographic*. www.nationalgeographic.com/science/2020/02/super-potent-methane-in-atmosphere-oil-gas-drilling-ice-cores/

Brenan, M., & Saad, L. (2018, Mar. 28). Global Warming Concern Steady Despite Some Partisan Shifts. *Gallup*. https://news.gallup.com/poll/231530/global-warming-concern-steady-despite-partisan-shifts.aspx

Broder, J.M. (2009, June 26). House Passes Bill to Address Threat of Climate Change. *N.Y. Times*. www.nytimes.com/2009/06/27/us/politics/27climate.html

Center for Climate and Energy Solutions. State Climate Policy Maps. www.c2es.org/content/state-climate-policy/. ["CCESa"].

Center for Climate and Energy Solutions. California Cap and Trade. www.c2es.org/content/california-cap-and-trade/. ["CCESb"].

Chemnick, J. (2021, Jan. 7). How Climate Opponents Helped Pass a Historic Emissions Law. *E&E News*. www.eenews.net/climatewire/2021/01/07/stories/1063721975?utm_campaign=edition&utm_medium=email&utm_source=eenews%3Aclimatewire

Coglianese, C., & Starobin, S. (2018, Apr. 17). *The Legal Limits to State Climate Action*. Kleinman Center for Energy Policy. https://kleinmanenergy.upenn.edu/podcast/the-legal-limits-to-state-climate-action/

Davenport, C. (Feb. 17, 2017). Senate Confirms Scott Pruitt as E.P.A. Head. *N.Y. Times*. www.nytimes.com/2017/02/17/us/politics/scott-pruitt-environmental-protection-agency.html

Davenport, C. (2020, Aug. 13). Trump Eliminates Major Methane Rule, Even as Leaks Are Worsening. *N.Y. Times*. www.nytimes.com/2020/08/13/climate/trump-methane.html

Davenport, C., & Davis, J.H. (2015, Aug. 3). Move to Fight Obama's Climate Plan Started Early. *N.Y. Times*. www.nytimes.com/2015/08/04/us/obama-unveils-plan-to-sharply-limit-greenhouse-gas-emissions.html

Ellerman, A.D.,Joskow, P.L., Schmalensee, R., Montero, J.-P., & Bailey, E.M. (eds.). (2000). *Markets for Clean Air: The U.S. Acid Rain Program*. Cambridge University Press.

Energy Information Administration. Renewable Energy Production and Consumption by Source. www.eia.gov/totalenergy/data/monthly/pdf/sec10_3.pdf ["EIAa"].

Energy Information Administration. (2020, May 11). U.S. Coal-Fired Electricity Generation in 2019 Falls to 42-Year Low. www.eia.gov/todayinenergy/detail.php?id=43675 ["EIAb"].

Energy Information Administration. (2020, Sept. 30). U.S. Energy-Related Carbon Dioxide Emissions, 2019. www.eia.gov/environment/emissions/carbon/#:~:text=The%20decline%20in%20CO2%20emissions,with%202018%20(Figure%204). ["EIAc"].

Executive Office of the President. (2017). Promoting Energy Independence and Economic Growth. 82. Fed. Reg. 16,093.

Frazin, R. (2020, Feb. 26). Trump Administration Resuming Coal Leasing on Public Lands. *The Hill*. https://thehill.com/policy/energy-environment/484854-trump-administration-resuming-coal-leasing-on-public-lands

Friedman, L. (2019, June 19). E.P.A. Finalizes Its Plan to Replace Obama-Era Climate Rules. *N.Y. Times*. www.nytimes.com/2019/06/19/climate/epa-coal-emissions.html

Gruenspecht, H. (2019). The U.S. Coal Sector: Recent and Continuing Challenges. *Brookings*. www.brookings.edu/wp-content/uploads/2019/01/H.Gruenspecht_U.S.-Coal-Sector_Final_Jan_20191.pdf

Harris, G. (2017, Feb. 1). Rex Tillerson Is Confirmed as Secretary of State Amid Record Opposition. *N.Y. Times*. www.nytimes.com/2017/02/01/us/politics/rex-tillerson-secretary-of-state-confirmed.html

Hulse, C. (2009, July 1). What's So Super About a Supermajority? *N.Y. Times*. www.nytimes.com/2009/07/02/us/politics/02cong.html.

Kaplan, S. & Grandoni, D. (2020, Dec. 21). Stimulus Deal Includes Raft of Provisions to Fight Climate Change. *Washington Post*. www.washingtonpost.com/climate-solutions/2020/12/21/congress-climate-spending/

Lacy, S. (2015, Dec. 18). Congress Passes Tax Credits for Solar and Wind: 'Sausage-Making at Its Most Intense.' *Greentech Media*. www.greentechmedia.com/articles/read/breaking-house-passes-1-1-trillion-spending-bill-with-renewable-energy-tax

Liptak, A., & Davenport, C. (2016, Feb. 9). Supreme Court Deals Blow to Obama's Efforts to Regulate Coal Emissions. *N.Y. Times*. www.nytimes.com/2016/02/10/us/politics/supreme-court-blocks-obama-epa-coal-emissions-regulations.html

Lipton, E., & Tabuchi, H. (2018, Nov. 27). Energy Speculators Jump on Chance to Lease Public Land at Bargain Rates. *N.Y. Times*.www.nytimes.com/2018/11/27/business/energy-speculators-public-land-leases.html

Lizza, R. (2010, Oct. 3). As the World Burns: How the Senate and the White House Missed Their Best Chance to Deal With Climate Change. *The New Yorker*. www.newyorker.com/magazine/2010/10/11/as-the-world-burns

Mohlin, Kristina, Jonathan R. Camuzeaux, Adrian Muller, Marius Schneider, and Gernot Wagner. 2018. Factoring in the forgotten role of renewables in CO2 emission trends using decomposition analysis. *Energy Policy* 116: 290-296.

Pitt, H., Larsen, K., & Young, M. (2020, Sept. 17). *The Undoing of US Climate Policy: The Emissions Impact of Trump-Era Rollbacks*. Rhodium Group. https://rhg.com/research/the-rollback-of-us-climate-policy/?utm_campaign=Hot%20News&utm_medium=email&_hsmi=95544102&_hsenc=p2ANqtz-80e2Dxdsl8Fh-dJ1lrfCyR3n3r0LhR1eI9P9eGmotYR31-yX7Uj00NfbOYWBF4-PU_rZD1JeZHiX_ImyRgQYYoPPvw-g&utm_content=95544102&utm_source=hs_email

Popovich, N., Albeck-Ripka, L., & Pierre-Louis, K. (updated 2020, Nov. 10). The Trump Administration Is Reversing More than 100 Environmental Rules. Here's the Full List. *N.Y. Times*.www.nytimes.com/interactive/2020/climate/trump-environment-rollbacks-list.html

Rathi, A., & Hodges, J. (2020, Jan. 16). Even Under Trump, U.S. Renewable Investment Hit a Record in 2019. *Bloomberg*. www.bloomberg.com/news/articles/2020-01-16/even-under-trump-u-s-renewable-investment-hits-a-record

Union of Concerned Scientists. (updated 2017, Dec. 6). A Brief History of US Fuel Efficiency Standards. www.ucsusa.org/resources/brief-history-us-fuel-efficiency

U.S. Department of the Interior (2016, Jan. 15). Secretary Jewell Launches Comprehensive Review of Federal Coal Program. www.doi.gov/pressreleases/secretary-jewell-launches-comprehensive-review-federal-coal-program

U.S. Environmental Protection Agency (updated 2016, June 27). Fact Sheet: Overview of the Clean Power Plan. https://19january2017snapshot.epa.gov/cleanpowerplan/fact-sheet-overview-clean-power-plan_.html

U.S. Environmental Protection Agency (2020). Inventory of U.S. Greenhouse Gas Emissions and Sinks. www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-main-text.pdf

White House Office of the Press Secretary. (2016, Feb. 25). Fact Sheet: The Recovery Act Made the Largest Single Investment in Clean Energy in History, Driving the Deployment of Clean Energy, Promoting Energy Efficiency, and Supporting Manufacturing. https://obamawhitehouse.archives.gov/the-press-office/2016/02/25/fact-sheet-recovery-act-made-largest-single-investment-clean-energy

Zeleny, J. (2010, Nov. 2). G.O.P. Captures House, But Not Senate. *N.Y. Times*. www.nytimes.com/2010/11/03/us/politics/03elect.html

Suggested citation

Sarinsky, M. (2021). U.S. Domestic Climate Policy – Looking Back. *EAERE Magazine*, 11.

U.S. Domestic Climate Policy – Looking Forward

Bethany A. Davis Noll
New York University

Bethany A. Davis Noll (bethany.davisnoll@nyu.edu) *is Executive Director of the State Energy & Environmental Impact Center and Adjunct Professor at NYU School of Law and co-chair of the Environmental Law Committee of the New York City Bar Association. Prior to joining the Center, she was Litigation Director at the Institute for Policy Integrity, where she wrote articles, led amicus briefing in cases challenging the Trump administration's rollbacks of environmental and other rules, and ran Policy Integrity's "Roundup: Trump-Era Agency Policy in the Courts." She previously served as Assistant Solicitor General in the New York State Attorney General's Office.*

Introduction

On January 6, 2021, Joseph R Biden was inaugurated as President of the United States, to serve until January 2025. In addition to securing the presidency, his party (Democrats) won control of both chambers of Congress after a runoff election in the state of Georgia, and action on climate is one of the Biden administration's four priorities. However, as Lienke and Schwarz already pointed out in "Climate Policy Architecture in the U.S.", this does not mean that the new administration has a legislative path to climate action at scale. There is a major hurdle facing the new administration, namely the filibuster, a procedural device that can be used to block legislation and can only be overcome if 60 Senators vote to advance the legislation. They also go on to conclude that the razor-thin margin between Democrats and Republicans in the Senate makes it unlikely that legislation will come out of Congress or that Congress would even vote to eliminate the filibuster.

There is certainly the possibility of significant legislative progress directed at climate change, perhaps through a broader package addressed at infrastructure or energy for example, as highlighted by the Biden team in its plans. But, as has been the case for many prior presidents (Kagan, 2001), the Biden administration will also need to focus on making policy at the agency level by taking actions within existing statutes.

Within that environment, the Biden administration is taking steps to flex its muscles through its agencies, laying out many of its priorities in two key documents:

- The Biden Plan for a Clean Energy Revolution and Environmental Justice[1]
- Build Back Better: Joe Biden's Jobs and Economic Recovery Plan for Working Families[2].

To accomplish those priorities, there are two broad categories of actions that his administration can and seems likely will take to address climate change aggressively, namely, using its authority to make changes that cut across many different administrative agencies and also using its authority to address specific sources of emissions through specific agency actions.

Cross-Cutting Actions

In the first category of actions, the Biden administration can take steps that will have cross-cutting impact across different regulatory regimes, starting with elevating the importance of science within the cabinet (Zimmer, 2021). The cabinet is staffed primarily with Senate-confirmed heads of all of the major agencies and serves as the president's closest advisory committee. Elevating accountability for science-based policy and actions that address climate change, in particular, to the cabinet level thus sends a strong signal of the issue's importance.

The non-governmental Climate 21 Project recommended numerous "cross-agency initiatives" including requiring agencies to "account for climate in their procurement decisions, strategic planning and performance management" and focusing on building back the budgets for agen-

1 https://perma.cc/6A34-K5TN

2 https://perma.cc/JV88-L7KK

cies that have endured cuts as well as significant staff retirements for years (Biden for President, 2020). In addition, President Biden's focus on equity and environmental racism will ensure that all agency actions pay attention to pollution that "disproportionately harm[s] communities of color and low-income communities" and that they use an "inclusive, community-driven process" (Biden for President, 2021b).

Another cross-cutting action is the administration decision to rejoin the Paris agreement[3], committing the federal government to across-the-board cuts in greenhouse gas emissions (Acceptance, 2021). One key issue in this area will be that the electricity market has moved away from coal and towards natural gas, helping bring about significant reductions in carbon emissions (U.S. Energy Information Administration, 2020). But with the Biden's administration's net-zero goal, the agencies will all need to look for ways to move away from gas as well—and should be particularly cognizant of the need to avoid entrenching gas (Carter & McEnaney, 2019). Working with states and State Attorneys General will be crucial to this effort.

And yet another important cross-cutting priority will be to roll back Trump-era regulations that sought to restrict how agencies use science, such as EPA's Trump-era rule governing cost-benefit analysis (Hijazi, 2020) and another new rule governing use of scientific studies (Lee & Hijazi, 2021).

One way to support regulatory regimes addressed at cutting greenhouse-gas emissions across agencies is to provide a tool to value the benefits of reducing the emissions. With that tool, agencies can provide strong economic justifications for their climate-related rules, which scholars have found aids them in court (Cecot, 2019). In 2009, the Obama administration assembled experts from a dozen federal agencies and White House offices to "estimate the monetized damages associated with an incremental increase in [greenhouse gas] emissions in a given year" based on "a defensible set of input assumptions that are grounded in the existing scientific and economic literature." (Interagency Working Group, 2010). The interagency group produced estimates that agencies could use to value the damages from an additional ton of carbon emissions (Interagency Working Group, 2016). The Obama administration's estimates were repeatedly endorsed by reviewers as based on the best available evidence (Revesz, 2017; Nat'l Acad. Sci., 2017; Nat'l Acad. Sci., 2016; Gov't Accountability Office, 2014) and their use was upheld as in 2016 court case (*Zero Zone,* 2016).

The Trump administration disbanded the interagency group and adopted an "interim" number that purported to estimate domestic-only climate damages (Exec. Order, 2017). But a court has since held that reliance on that "interim" number was unreasonable (*California*, 2020). Now the Biden administration can endorse the best available science and update the numbers to reflect the latest and best data.

In sum, the Biden administration's climate focus will be felt across agencies. And while the Biden climate plan is not a full endorsement of the economy-wide plans in the Green New Deal (a congressional package announced by Representative Alexandria Ocasio-Cortez of New York and Senator Edward J. Markey of Massachusetts in 2019) (Friedman, 2019), it nonetheless embraces the Green New Deal as a "crucial framework." In addition, it contains many similar elements, including embracing the jobs benefits and pushing for net-zero emissions, though on a longer timeline than the Green New Deal (Berardelli, 2020).

Addressing Specific Emission Sources Through Agency-Specific Actions

A second focus of the new administration will be to address specific emissions sources through actions at specific agencies. Despite congressional gridlock, much is possible under existing statutes.

Starting with the Environmental Protection Agency, a priority will be improving the greenhouse-gas emission standards that apply to ve-

3 This is addressed more fully by Keohane in "American Climate Diplomacy: Past Performance and New Opportunities".

hicles. In the United States, the transportation sector is the largest source of carbon emissions (U.S. Energy Information Administration, 2020) and the agency has well-recognized authority to impose emissions standards restricting carbon pollution (*Massachusetts*, 2007).

The agency also has authority under section 111(d) of the Clean Air Act to address greenhouse-gas emissions at existing power plants and other sources (42 U.S.C. § 7411.) Though Obama-era restrictions on greenhouse gas emissions were paused by the Supreme Court, there are many routes available to EPA for designing regulations that fall comfortably within the agency's authority to regulate sources of a pollutant that the agency has already found endangers human health and welfare (EPA, 2009). And as a result of the recent vacatur of the Trump administration's rollback of the Obama regulations, the new administration has an opportunity to begin anew.

The Department of Interior can also make changes in policies regarding mineral extraction and drilling (Hein, 2020). For example, it can rely on discretion to reinstate a pause on new coal and oil and gas leasing while it conducts a long-delayed programmatic review of both the royalty and environmental impacts of new coal leases (Department of Interior, 2016). And it can pause permit decisions, keeping any drilling from occurring (Dlouhy, 2021).

Other agencies have a role to play as well. For example, the agriculture industry contributes significantly to total greenhouse gas emissions (EPA, 2018). The Department of Agriculture, the primary regulator for significant aspects of food and agriculture, has significant steps it could take to address climate change, including helping rural communities become more resilient (Clarke, 2021). The White House Council on Environmental Quality will likely update its guidance on the building sector (Clarke, 2020) and on environmental reviews (Brugger, 2020) to address climate change. The Department of Transportation has infrastructure work it is likely to prioritize (Joselow, 2021). The Security and Exchange Commission is likely to push private companies to disclose climate-related risks (Ho, 2020). And the Federal Energy Regulatory Commission has options for more affirmatively addressing climate (Unel, 2020), through pipeline permitting (Bell, 2020), carbon pricing (FERC, 2020), and pulling back on federal policies that harmed states seeking to promote clean energy (Frosh, Jennings, & Grewal, 2020), among other policies.

Across agencies, the Biden administration will need to move fast and will need to ensure that it complies with procedural rules governing administrative changes (Davis Noll & Jacewicz, 2020). But by following these rules, the administration is well-placed to make significant progress on climate in the coming months and years.

Note

This Chapter does not represent the position, if any, of NYU School of Law.

References

42 U.S.C. § 7411

Acceptance on Behalf of the United States of America. (2021, Jan. 20). https://perma.cc/A8WY-ZLH3

Bell J. (2020, Sept. 16). Big changes may be ahead for natural gas pipelines, if FERC does its job. *Utility Dive*. https://perma.cc/T3GK-MJ4C/

Berardelli, J. (2020, Oct. 5). How Joe Biden's climate plan compares to the Green New Deal, *CBS News* .

Biden for President. (2021a, Jan.). Build Back Better: Joe Biden's Jobs and Economic Recovery Plan for Working Families. https://perma.cc/JV88-L7KK

Biden for President. (2021b, Jan.). The Biden Plan for a Clean Energy Revolution and Environmental Justice. https://perma.cc/6A34-K5TN

Biden for President. (2020, Nov.). Transition Recommendations for Climate Governance and Action. https://perma.cc/6QLD-WEKY

Brugger K. (2020, Dec. 21). Biden CEQ pick signals NEPA changes. *E&E News*.

California v. Bernhardt, 472 F.Supp.3d 573 (N.D.Cal. 2020)

Carter, S., & McEnaney, B. (2019, Jun.). The Climate Crisis Requires That We Move Away from Gas, *NRDC*. https://perma.cc/86L7-M4LE

Cecot, C. (2019). Deregulatory Cost-Benefit Analysis and Regulatory Stability. *Duke Law Journal*, 68(1593).

Clarke, D. (2021, Jan. 4,). USDA Likely to Play Major Role In Biden's Climate Plan But Battles Loom, *InsideEPA*.

Clarke D. (2020, Dec. 31). CEQ Sustainable Federal Building Guide Urges Resilience But Omits GHGs. *InsideEPA*.

Davis Noll, B., & Jacewicz, N. (2020, Aug. 17). A Roadmap to Regulatory Strategy in an Era of Hyper-Partisanship, Institute for Policy Integrity. https://policyintegrity.org/publications/detail/a-roadmap-to-regulatory-strategy-in-an-era-of-hyper-partisanship

Dlouhy, J. (2021, Jan. 6). Big Oil Skips Trump's Last-Minute Arctic Drilling-Rights Auction. *Bloomberg*

Department of Interior. (2016, Jan. 15). *Secretary Jewell Launches Comprehensive Review of Federal Coal Program*. Dep't of Interior Press Releases. https://perma.cc/8SMY-U3V4

EPA. (2018). Sources of Greenhouse Gas Emissions. https://perma.cc/7KJ8-8PFT

EPA. (2009, Dec. 15). Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496.

Exec. Order No. 13,783 § 5(b), 82 Fed. Reg. 16,093 (2017, Mar. 28)

FERC. (2020, Oct. 15). FERC Proposes Policy Statement on State-Determined Carbon Pricing in Wholesale Markets. *FERC*, Docket No. AD20-14-000.

Friedman, L. (2019, Feb. 21). What Is the Green New Deal? A Climate Proposal, Explained. *New York Times*.

Frosh, B., Jennings, K., & Grewal, G. (2020, Feb. 21). FERC's effort to undermine state clean energy policies cannot stand. *The Hill*.

Gov't Accountability Office. (2014). Regulatory Impact Analysis: Development of Social Cost of Carbon Estimates. http://www.gao.gov/assets/670/665016.pdf

Hein, J. (2020, Oct. 22). *A New Way Forward on Climate Change and Energy Development for Public Lands and Waters*. Institute for Policy Integrity. https://policyintegrity.org/publications/detail/a-new-way-forward-on-climate-change-and-energy-development-for-public-lands-and-waters

Hijazi J, (2020, Dec. 15) EPA cost-benefit rule could undermine Biden climate action, E&E News, https://perma.cc/45QP-MRXJ

Ho, S. (2020, Dec. 14). SEC During Biden Administration Likely to Focus on Climate Change Risk Disclosures. *Reuters*.

Interagency Working Group on Social Cost of Carbon. (2010). Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866.

Interagency Working Group on Social Cost of Greenhouse Gases. (2016). Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 at 16.

Joselow, M. (2021, Jan. 5). How will Pete Buttigieg sell Congress on infrastructure? *E&E News*.

Kagan, E. (2001). Presidential Administration, *Harv. L. Rev.*, 114: 2245, 2264.

Lee, S. & Hijazi, J. (2021, Jan. 6). Biden Team in a Bind Over Reversing EPA's 'Secret Science' Rule. *Bloomberg Law*.

Massachusetts v. EPA, 549 U.S. 497 (2007).

Nat'l Acad. Sci., Engineering & Med. (2017). Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide 3. https://www.nap.edu/read/24651/chapter/1

Nat'l Acad. Sci., Engineering & Med. (2016). Assessment of Approaches to Updating the Social Cost of Carbon: Phase 1 Report on a Near-Term Update 1. https://www.nap.edu/read/21898/chapter/1

Revesz, R., Greenstone, M., Hanemann, M., Livermore, M., Sterner, T., Grab, D., Howard, P., & Schwartz, J. (2017). Best Cost Estimate of Greenhouse Gases, *Science, 357*(6352): 655.

Unel, B. (2020, Sept.). *A Path Forward for the Federal Energy Regulatory Commission*. Institute for Policy Integrity. https://policyintegrity.org/files/publications/A_Path_Forward_For_FERC.pdf

U.S. Energy Information Administration. (2020, Aug.) Energy and the environment explained. https://perma.cc/JA2M-9DUG

Zero Zone, Inc. v. U.S. Dep't of Energy, 832 F.3d 654, 677 (7th Cir. 2016).

Zimmer C. (2021, Jan. 15). Biden to Elevate Science Advisor to His Cabinet. *N.Y. Times*.

Suggested citation

Davis Noll, B.A. (2021). U.S. Domestic Climate Policy – Looking Forward. *EAERE Magazine*, 11.

American Climate Diplomacy: Past Performance and New Opportunities

Nathaniel O. Keohane
Environmental Defense Fund

Nathaniel O. Keohane (nkeohane@edf.org) *is Senior Vice President for Climate at Environmental Defense Fund, where he heads EDF's climate advocacy in the United States and around the world. In 2011-2012, he served as Special Assistant to the President for Energy and Environment in the White House National Economic Council. Before joining EDF in 2007, Dr. Keohane was Associate Professor of Economics at the Yale School of Management. He has published research in leading journals and is the co-author of Markets and the Environment. He received his Ph.D. from Harvard and his B.A. from Yale.*

Introduction

Joseph R. Biden is the first U.S. President to have campaigned on a climate agenda – making climate one of his top four priorities, releasing an ambitious and comprehensive plan, and highlighting climate in his campaign ads. At the same time, the new administration must overcome a deep credibility deficit abroad. The actions of the Trump Administration – withdrawing the United States from the Paris Agreement on climate change and seeking to roll back emissions standards put in place by the Obama Administration – have not only stalled progress in reducing emissions, but have also undermined America's standing abroad, and fueled heightened skepticism about the staying power of America's commitment to multilateralism. Meanwhile, other major emitters have asserted greater leadership, including the European Union (long at the forefront of climate action) as well as China.

While recent years have shown that the United States is not indispensable to global climate action, it remains well-positioned to play a leadership role. The U.S. is the second-largest greenhouse gas emitter (accounting for 13% of global greenhouse gas emissions in 2017) and still the largest historical emitter (responsible for roughly one-quarter of cumulative greenhouse gas emissions).[1] As the world's largest economy, the U.S. wields significant "soft power" through trade, finance, and development policies. And the U.S. has a history of international leadership as well as strong foreign policy institutions accustomed to playing this role.

Past performance: America's contributions to international climate action

Although United States climate policy has been inconsistent, its leadership has often proven critical, particularly in three areas: (1) innovation on incentive-based environmental policies; (2) the Paris Agreement on climate change; and (3) the development of a range of pluri- and multilateral approaches to climate action during the Obama Administration.

Incentive-based environmental policies

In the 1990s, the United States played a key role in pioneering environmental policies that harness economic incentives to cut pollution at lower cost while spurring technological innovation. The 1990 Clean Air Act Amendments created the world's first large-scale emissions market, the Acid Rain Program. The program (and its market-based successor the Cross-State Air Pollution Rule, promulgated in 2011) cut U.S. sulfur pollution from electric power plants by 86%, dramatically reducing acid deposition and contributing to a dramatic fall in fine particulate pollution (known as PM2.5) across the eastern United States, saving hundreds of thousands of lives over two decades.[2] The success of this program provided a model for greenhouse gas emissions trading systems elsewhere, including in the European Union, California, and most recently China.

The United States government also advocated for market-based measures in the international arena. The George H.W. Bush administration

1 See emissions data at www.c2es.org/content/international-emissions

2 Data on emissions and acid deposition are available at epa.gov/acidrain/acid-rain-program-results. The 86% figure compares SO2 emissions from electric power plants in 1990 to levels in 2015, the year that the Environmental Protection Agency's Mercury and Air Toxics Standards took effect and required essentially all remaining coal-fired generating units to install pollution abatement equipment that also cut SO2 emissions. Lives saved based on the estimate of 17,000 premature deaths avoided annually in 2010, in Chestnut and Mills (2005).

pressed successfully to include such approaches in the first assessment report of the International Panel on Climate Change (IPCC) in 1990 and in Article 4.2(a) of the United Nations Framework Convention on Climate Change, which the Senate ratified in 1992.[3] Under President Bill Clinton and Vice President Al Gore, the U.S. secured the inclusion of emission trading in Article 17 of the 1997 Kyoto Protocol. The Protocol's exclusion of rapidly-growing developing countries from emissions reduction obligations, pursuant to the 1995 Berlin Mandate, led to the U.S. refusal to ratify Kyoto.[4] Nevertheless, the emission trading provisions played a key role in the European Union's development of its Emissions Trading System (EU-ETS) and laid the foundation for subsequent multilateral market-based mechanisms, including the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) of the International Civil Aviation Organization, and Article 6 of the Paris Agreement, which creates a framework for voluntary international cooperation through carbon markets.

From Copenhagen to Paris

Barack Obama came into the White House in 2009 having campaigned on an ambitious climate target of cutting emissions 80% below 1990 levels by 2050. Although Congress failed to enact cap-and-trade legislation, the Obama Administration played a key role in the development, design, and negotiation of the landmark Paris Agreement.

The first crucial step was at COP15 in Copenhagen. Although the conference itself ended in failure, President Obama's personal intervention helped to salvage the Copenhagen Accord, which – despite initially lacking formal legal status – set the stage for subsequent progress (Harvey et al., 2009). By securing emission reduction pledges from China and other emerging economies, Copenhagen in effect revoked the Berlin Mandate. Two years later, at COP17, the Durban Platform established a mandate to negotiate a new "protocol, another legal instrument, or an agreed outcome with legal force" that would be "applicable to all Parties" – a key phrase that owed a crucial debt to Copenhagen and represented a triumph of U.S. climate diplomacy.[5] By moving past the developed-vs-developing country divide that had crippled Kyoto, Durban set the stage for a much more ambitious, effective, and comprehensive accord in Paris.

The Obama administration then played a key role in the negotiations leading up to COP21 in Paris. The relationship with China was particularly important, starting with the Obama-Xi summit in 2013 and culminating in the joint announcement of intended nationally determined contributions in November 2014.[6] The alignment of the so-called "G2" (which also included agreement on key language referring to "common but differentiated responsibilities and respective capabilities, *in the light of different national circumstances*"; emphasis added) played a crucial role in paving the way for agreement in Paris.

The U.S. leaned in on climate diplomacy in myriad other ways as well, establishing the Major Economies Forum and helping to form the High Ambition Coalition. President Obama himself engaged in direct and targeted diplomacy to world leaders (Goldberg, 2015). Of course, many others made critical contributions to the Paris outcome – foremost among them the French COP Presidency, whose combination of gracious hospitality and skillful diplomacy was instrumental in securing the agreement. Nonetheless, American leadership was a critical ingredient of the success in Paris.

Finally, the U.S. shaped the fundamental design of the Paris Agreement's mitigation provisions. The use of "nationally determined contributions" – targets that are determined by countries themselves from the bottom up, rather than

3 See Chapter 7.3, "Economic mechanisms", in Intergovernmental Panel on Climate Change, Climate Change: The IPCC 1990 and 1992 Assessments (World Meterological Organization & United Nations Environment Programme, 1992), p. 139ff; and United Nations Framework Convention on Climate Change, May 9, 1992, S. Treaty Doc No. 102-38, 1771 U.N.T.S. 107.

4 Berlin Mandate, UNFCCC Decision 1/CP.1, Berlin, April 7, 1995. The Byrd-Hagel Resolution (S. Res. 98, 105th Congress, 1st Session), passed by a vote of 95-0 on July 25, 1997, declared the sense of the Senate that the U.S. not sign the Kyoto Protocol unless it also mandated emission reduction commitments for developing countries.

5 Durban Platform, UNFCCC Decision 17/CP.1, Durban, December 11, 2011.

6 "U.S. China Joint Announcement on Climate Change," Beijing, 12 November 2014, https://obamawhitehouse.archives.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change

through top-down negotiations – can be traced to U.S. thinking. An equally significant U.S. contribution to the accord is its emphasis on rigorous and transparent monitoring, reporting, and verification (MRV) – known as the "transparency framework."

Mobilizing action in other forums

The Obama Administration helped secure the Kigali Amendment to the Montreal Protocol in 2016, which leveraged the structure of one of the world's most successful multilateral environmental agreements to secure a global phaseout of hydrofluorocarbons (HFCs), powerful greenhouse gases used in cooling, refrigeration, and a range of industrial applications. The U.S. also played key roles in the adoption of the CORSIA program international aviation; the Climate and Clean Air Coalition, which mobilizes public and private sector action on short-lived climate pollutants; and regional initiatives on climate, including the North American Leaders Summit in June 2016, where the leaders of Canada, Mexico and the US committed to reduce methane emissions from oil and gas production by 40-45%.[7]

Prospects for the future: International climate policy in the Biden Administration

The Biden Administration enters office having run on a strong climate platform, anchored by a pledge to achieve net zero emissions across the U.S. economy by 2050 and buoyed by significant and growing popular support for climate action. Although most of the public focus of the campaign was on domestic climate action, the contours of possible international action are beginning to come into focus.

The first contour line is defined by appointments. A Washington adage popularized in the Reagan Administration is that "Personnel is policy." That phrase aptly describes the Biden Administration's whole-of-government approach to climate change: In addition to creating a dedicated White House team, headed by National Climate Advisor Gina McCarthy, to lead domestic climate policy, the Biden-Harris team has filled "traditional" roles with climate champions – including Michael Regan as Environmental Protection Agency Administrator, Janet Yellen as Treasury Secretary, Pete Buttigieg as Secretary of Transportation, Brian Deese as the Director of the National Economic Council, and John Finer as Deputy National Security Adviser.

Perhaps most importantly for international climate action, Biden has also named John Kerry as Special Presidential Envoy for Climate Change. As a former Secretary of State, Kerry has the stature to represent the United States at the leader level around the world – giving the U.S. a full-time voice on climate at the highest level.

The second contour line is given by Biden's Executive Order on his first day in office to rejoin the Paris Agreement. Because the United States can meet the legal obligations of the Paris Agreement under existing authorities already granted to the executive branch, it can accede to the Agreement as an executive agreement rather than a formal treaty requiring the advice and consent of the Senate.

While formally rejoining the agreement is straightforward, the U.S. must prepare and communicate a revised NDC. The Obama Administration's commitment to cut total U.S. net greenhouse gas emissions 26-28% below 2005 levels by 2025 became moot when the U.S. withdrew, and is likely out of reach now given the recalcitrance of the Trump administration. (Emissions in 2019 were only 12% below 2005 levels.) Determining the new target will be the task for an interagency policy process involving the White House, State Department, EPA, the Departments of Energy, Transportation, Agriculture, and Interior, and other departments and agencies across the federal government.

As with the Obama Administration, the watchwords are likely to be "ambitious and credible." Ambition must be evaluated in light of President Biden's net-zero-by-2050 pledge as well as the recent commitments by the EU to cut emissions 55% below 1990 levels by 2030, by Japan and Korea to reach net-zero by 2050, and by China to achieve carbon neutrality by 2060. A

7 Full statement at: https://obamawhitehouse.archives.gov/the-press-office/2016/06/29/leaders-statement-north-american-climate-clean-energy-and-environment.

straight-line trajectory from 2019 emissions to net zero in 2050 would imply, at a minimum, a 43% reduction below 2005 levels in 2030. Environmental advocates are likely to press for even greater ambition given the need to demonstrate leadership, the immediate emissions reduction opportunities available in the power sector, and recent advances in electric vehicles and other low-carbon technologies. The administration has said it intends to announce its NDC by April 22, when President Biden will host a (virtual) Climate Summit from the White House.

The third and final contour line of likely U.S. international climate policy is mobilizing action in other forums beyond the Paris agreement. Likely areas of focus include protecting tropical forests; phasing out coal around the world; coordinating efforts to achieve deep reductions in emissions of methane; and raising the ambition of international aviation and maritime sectors. In all these areas, the Biden Administration is certain to anchor its approach in the core priorities of economic recovery and social and racial justice that were central to its campaign.

Conclusion

As America reengages in the world and recommits to multilateralism, including on climate policy, the Biden Administration will inherit a mixed record that combines significant past successes with a history of inconstancy. The new administration will need to act on multiple fronts to build confidence among America's allies and other countries around the world that the nation's newfound recommitment to climate action will last beyond the next four years.

Administrative actions under existing authorities such as the Clean Air Act will provide the start. Such actions are more durable than typically imagined: most of the regulatory achievements of Obama's first term, such as the 2012 Mercury and Air Toxics Standards, had taken full effect before Trump took office, and the efforts of the Trump Administration to overturn Obama-era actions were largely unsuccessful, as demonstrated most spectacularly by the decision of the D.C. Court of Appeals to strike down the Trump EPA's power plant standards on Trump's final full day in office. Legislation that establishes enforceable limits on carbon pollution, supported by investments in low-carbon infrastructure, can drive deployment of wind and solar power, electric vehicle charging stations, and other technologies – changing the "facts on the ground" and locking in the transition to a clean economy. Investment in electric vehicle manufacturing, low-carbon industry, and climate-resilient agriculture can reposition key sectors of the economy toward a net-zero future. And continued leadership from states and cities – which maintained momentum on climate action during the Trump Administration – can demonstrate that U.S. climate progress does not depend solely on Washington.

With strong and concerted action, the Biden Administration can put the country firmly on a trajectory to net zero by midcentury – building on and extending America's legacy of accomplishment, while ensuring durable and lasting change.

Note

The author thanks Frank Convery, Jill Duggan, Robert Keohane, Suzi Kerr, Kelley Kizzier, and Annie Petsonk for helpful comments, without implicating them in remaining errors.

References

Goldberg, S. (2015, Dec. 13). How US negotiators ensured landmark Paris climate deal was Republican-proof. *The Guardian*. https://www.theguardian.com/us-news/2015/dec/13/climate-change-paris-deal-cop21-obama-administration-congress-republicans-environment

Harvey, F., Crooks, E., & Ward, A. (2009, Dec. 20). Copenhagen: A discordant accord. *Financial Times*. https://www.ft.com/content/8fb70c48-ed9b-11de-ba12-00144feab49a.

Chestnut, L.G., & Mills, D.M. (2005). A fresh look at the benefits and costs of the U.S. acid rain program. *Journal of Environmental Management, 77*: 252-66.

Suggested citation

Keohane, N.O. (2021). American Climate Diplomacy: Past Performance and New Opportunities. *EAERE Magazine*, 11.

Section III

Celebrating EAERE Doctoral Awardees

The Growing Role of Inequality in Environmental Policy

Lutz Sager
Georgetown University

Lutz Sager (Lutz.Sager@georgetown.edu) *is Assistant Professor at Georgetown University's McCourt School of Public Policy. Much of his research is on the linkages between economic inequality and environmental policy. He holds a PhD from the London School of Economics and was awarded the 2020 EAERE Award for Best Doctoral Dissertation in Environmental and Resource Economics for his thesis titled "Inequality, Consumer Choice, and the Environment".*

Inequality is back on the public agenda

Since the financial crisis of 2007-2008, there has been a renewed interest in the high, and often rising levels of income and wealth inequality around the world, and the harm such inequality may do to welfare and social cohesion (Stiglitz, 2012).

Distributional concerns are crucial for successful environmental policy

If a policy, say for a carbon tax, has regressive effects—imposing a larger burden on those with less economic resources—that may not only be undesirable. It can also pose a major obstacle to public acceptance of said policy. In France, the yellow vest protests of 2018-2019 were motivated in part by concerns about the unfair burden of fuel taxes. During Germany's most recent carbon tax deliberations, concern for lower income households, but also for groups such as car commuters, was again a central element (Edenhofer et al., 2019). The perceived fairness of an environmental intervention has a measurable impact on how it is evaluated (Dietz & Atkinson, 2010; Douenne & Fabre, forthcoming).

And so it is welcome that economists are paying more attention to inequality

Economists, including many EAERE members, have been studying inequality for decades. But the topic has drawn particular interest of recent,

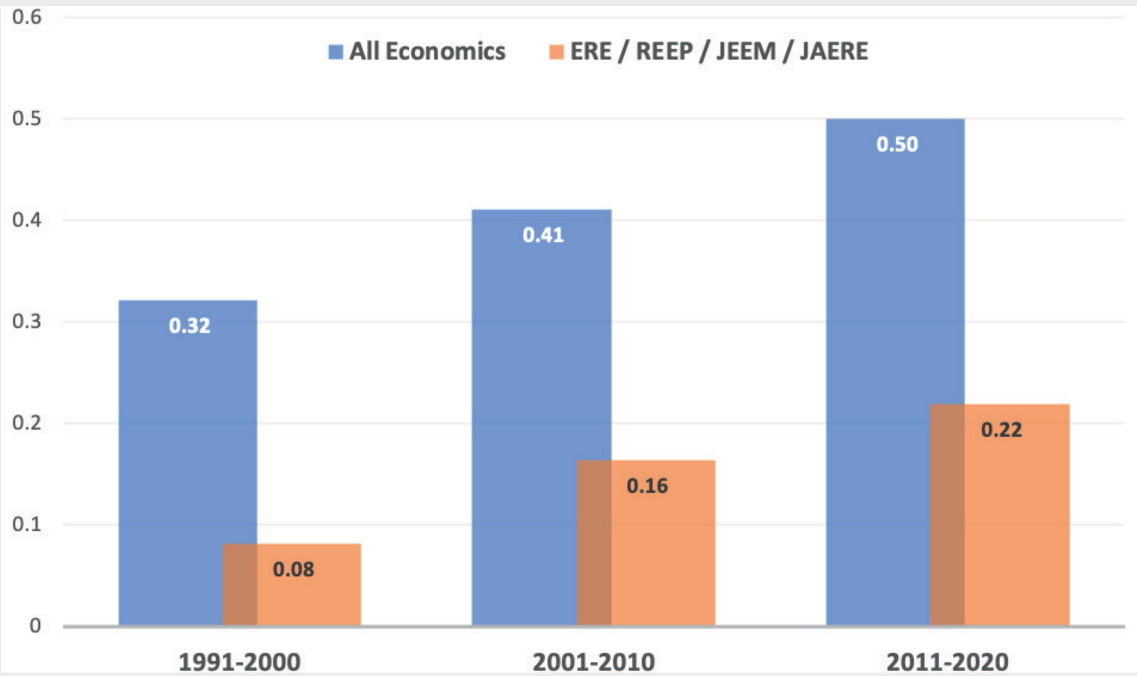

Figure 1. Number of articles on inequality divided by number of articles on efficiency.
Source: Web of Science topic search for "inequality"/ "distributional" and "efficiency"/ "efficient". ERE: Environmental and Resource Economics, REEP: Review of Environmental Economics and Policy, JEEM: Journal of Environmental Economics and Management, JAERE: Journal of the Association of Environmental and Resource Economists

which we see in our academic journals. Figure 1 shows the average number of economics papers mentioning inequality divided by the number of papers mentioning efficiency. We witness a strong increase in the relative weight of inequality. Between 1991-2000, the ratio was around 0.3—there were on average three papers on inequality for every ten papers on efficiency. This has risen to five in the past decade. We see a similar trend in four journals specialised in environmental and resource economics. Whereas in the 1990s, there was less than one paper on inequality for every ten papers on efficiency, there are now more than two.

The role of inequality in environmental and resource economics is complex

Our current understanding of the inequality-environment nexus may be grouped into four channels. First, the distribution of environmental amenities, natural resources and pollution is often correlated with income and wealth. Second, the degree of economic inequality can itself have effects on environmental outcomes. Third, the costs and benefits of environmental policy are often borne unequally. And finally, fourth, both the distribution of environmental quality and economic inequality change the welfare considerations underlying policy appraisal. There is a substantial literature on each of these four channels. We attempt a systematic overview in a recent review article (Drupp et al., 2021). In what follows, I offer some selective considerations.

Better data continues to improve our understanding of location and scale

Take local air pollution as an example. We know that air quality tends to be worse in low-income and otherwise disadvantaged neighbourhoods (Banzhaf et al., 2019). We also know that this association varies with scale (Hsiang et al., 2019). Across neighbourhoods in a given city, the association between income and pollution is often negative. But compare cities to rural areas, which have both less pollution and lower incomes, and the sign flips. The scale of analysis changes the result and quite possibly the policy implications. Location matters, too. The pattern may look different in Italy from what we find in France or the United States. Much work remains to be done, making use of ever more granular data and exploring new locations.

Distributional effects involve multiple mechanisms

Take carbon pricing as an example. We know that, at least within rich countries, the initial incidence from higher prices may affect consumers with lower incomes more. They spend a higher share of their incomes on energy-intensive necessities such as heating and electricity, resulting in this regressive use-side effect (Grainger & Kolstad, 2010). We also know that revenue recycling, for example through a carbon dividend, can overturn that result (West & Williams, 2004; Klenert et al., 2016). More recently we have learned more about so-called source-side effects—changes to factor incomes and especially jobs. They may well be progressive, falling harder on capital- and emissions-intensive industries (Rausch et al., 2011; Goulder et al., 2019).

Feedback effects matter

Consider again air pollution. We might be tempted to see better air quality in richer neighbourhoods as merely a symptom of economic inequality—richer households pay a premium to breathe better air. But what if pollution exposure leads to lower productivity (He et al., 2019), in turn exacerbating economic inequality? Or what if the rich lobby to preserve the air in their neighbourhoods (Hamilton, 1995)? Similar feedbacks exist in pricing carbon. Carbon dividends may well render the policy progressive. But redistributing income in turn affects consumption. If consumers with lower incomes use the additional income to buy more emissions-intensive goods, think again electricity or heating fuel, redistribution may inadvertently raise emissions, as I find in my thesis (Sager, 2019a). With such feedback effects, focussing on just one direction of the inequality-environment relationship will not suffice.

Context matters

Much of the work on the distributional effects of climate policy has focused on the distribution across income groups within a single, rich

country (Grainger & Kolstad, 2010; Rausch et al., 2011). But we know that there are important differences in distributional dynamics between countries. Energy taxes may be regressive in rich countries, but progressive in some developing ones (Sterner, 2012; Dorband et al., 2019). It is important to evaluate each proposed policy in its' context. We still lack evidence on distributional effects of climate policy in many countries.

There is value to taking a global perspective

Many climate policy efforts are regional, such as the EU Emissions Trading Scheme, or even global, such as the Paris accord. Yet we know that multinational coordination can be hindered if some parties perceive the burden as unfair, or claim so for strategic reasons (Lange et al., 2010; Tavoni et al., 2011; Bretschger, 2013). It can be helpful to take a global perspective. In my thesis, I asked how the cost of carbon pricing is distributed globally—both between countries and across income groups within them. Some of the findings at the national level are reversed at the global scale (Sager, 2019b). Where you live tends to be more important than your position in the income distribution, at least for the initial use-side incidence of carbon pricing. Chinese consumers purchase mainly Chinese goods. And these are produced in more emissions-intensive value chains than the goods purchased by a Swedish consumer. But I also confirm the positive role of carbon dividends at a global scale. The costs net of carbon dividends are strongly pro-poor across the world income distribution, even without international transfers.

We cannot escape normative deliberation

Even when we understand all inequality-environment linkages, we usually need to take normative positions when choosing among policy options. We often do so implicitly, such as when deeming it desirable that one policy has progressive effects and undesirable that another is regressive. But explicit welfare economic analysis is important. In many cases, the initial distribution of environmental quality will matter for the evaluation of marginal damages (Hsiang et al., 2019). And economic inequality may in turn affect the aggregate willingness to pay for environmental quality (Baumgärtner et al., 2017). Considering again climate change, income inequality within countries may even alter the social cost of carbon (Kornek et al., 2019).

While we already know a lot, there is still much to learn

It is heartening to see the growing interest in the interplay between economic inequality and environmental policy shown in Figure 1. But there is another reading of Figure 1, namely that there is still a significantly larger share of papers on inequality in the Economics discipline as a whole than there is in our community of environmental and resource economists. There certainly is room for more work in this domain.

References

Banzhaf, S., Ma, L., & Timmins, C. (2019). Environmental justice: The economics of race, place, and pollution. *Journal of Economic Perspectives, 33*(1), 185-208.

Baumgärtner, S., Drupp, M. A., Meya, J. N., Munz, J. M., & Quaas, M. F. (2017). Income inequality and willingness to pay for environmental public goods. *Journal of Environmental Economics and Management, 85*, 35-61.

Bretschger, L. (2013). Climate policy and equity principles: fair burden sharing in a dynamic world. *Environment and Development Economics, 18*(5), 517-536.

Dietz, S., & Atkinson, G. (2010). The equity-efficiency trade-off in environmental policy: Evidence from stated preferences. *Land Economics, 86*(3), 423-443.

Dorband, I. I., Jakob, M., Kalkuhl, M., & Steckel, J. C. (2019). Poverty and distributional effects of carbon pricing in low- and middle-income countries – A global comparative analysis. *World Development, 115*, 246-257.

Douenne, T., & Fabre, A. (forthcoming). Yellow vests, carbon tax aversion, and biased beliefs. Forthcoming in *American Economic Journal: Economic Policy*.

Drupp, M., Kornek, U., Meya, J.N., & Sager, L. (2021). *Inequality and the environment: The economics of a two-headed Hydra*. Mimeo.

Edenhofer, O., Flachsland, C., Kalkuhl, M., Knopf, B., & Pahle, M. (2019). *Optionen für eine CO2-Preisreform*. Arbeitspapier, No. 04/2019, Sachverständigenrat zur Begutachtung der Gesamtwirtschaftlichen Entwicklung, Wiesbaden.

Goulder, L. H., Hafstead, M. A., Kim, G., & Long, X. (2019). Impacts of a carbon tax across US household income groups: What are the equity-efficiency trade-offs? *Journal of Public Economics, 175*, 44-64.

Grainger, C. A., & Kolstad, C. D. (2010). Who pays a price on carbon? *Environmental and Resource Economics, 46*(3), 359–376.

Hamilton, J. T. (1995). Testing for environmental racism: Prejudice, profits, political power? *Journal of Policy Analysis and Management, 14*(1), 107-132.

He, J., Liu, H., & Salvo, A. (2019). Severe air pollution and labor productivity: Evidence from industrial towns in China. *American Economic Journal: Applied Economics, 11*(1), 173-201.

Hsiang, S., Oliva, P., & Walker, R. (2019). The distribution of environmental damages. *Review of Environmental Economics and Policy*, 13(1), 83-103.

Klenert, D., Schwerhoff, G., Edenhofer, O., & Mattauch, L. (2016). Environmental taxation, inequality and Engel's law: The double dividend of redistribution. *Environmental and Resource Economics, 71*(3), 605-624.

Kornek, U., Klenert, D., Edenhofer, O., & Fleurbaey, M. (2019). *The social cost of carbon and inequality: When local redistribution shapes global carbon prices*. CESifo Working Paper No. 7628.

Lange, A., Löschel, A., Vogt, C., & Ziegler, A. (2010). On the self-interested use of equity in international climate negotiations. *European Economic Review, 54*(3), 359-375.

Rausch, S., Metcalf, G., & Reilly, J. (2011). Distributional impacts of carbon pricing: A general equilibrium approach with micro-data for households. *Energy Economics, 33*(1), 20-33.

Sager, L. (2019a). Income inequality and carbon consumption: Evidence from Environmental Engel curves. *Energy Economics*, *84*, 104507.

Sager, L. (2019b). *The global consumer incidence of carbon pricing: Evidence from trade*. Grantham Research Institute on Climate Change and the Environment Working Paper No. 320. London: London School of Economics and Political Science.

Sterner, T. (2012). Distributional effects of taxing transport fuel. *Energy Policy, 41*, 75-83.

Stiglitz, J. E. (2012). *The price of inequality: How today's divided society endangers our future*. New York, NY: WW Norton & Company.

Tavoni, A., Dannenberg, A., Kallis, G., & Löschel, A. (2011). Inequality, communication, and the avoidance of disastrous climate change in a public goods game. *PNAS, 108*(29), 11825-11829.

West, S.E., & Williams III, R.C. (2004). Estimates from a consumer demand system: Implications for the incidence of environmental taxes. *Journal of Environmental Economics and management, 47*(3), 535-558.

Suggested citation

Sager, L. (2021). The Growing Role of Inequality in Environmental Policy. *EAERE Magazine*, 11.

You Can't Always Get What You Want: Research Beyond Carbon Pricing

Paul Neetzow [a] and **Jasper Meya** [b,c]

[a] German Federal Ministry of Economic Affairs and Energy, [b] German Centre for Integrative Biodiversity Research (iDiv), [c] Leipzig University

Paul Neetzow (paul.neetzow@hu-berlin.de) *is an economist at the German Federal Ministry of Economic Affairs and Energy where he contributes to the conceptualization and legislation of new policy instruments to decarbonize the building and heat sector. He obtained his doctorate from Humboldt-Universität zu Berlin and was awarded the Best Doctoral Dissertation Award by EAERE in 2020. He was one of the organizers of the first virtual EAERE conference.*

Jasper Meya (jasper.meya@idiv.de) *is a senior researcher at the German Centre for Integrative Biodiversity Research (iDiv) and the Department of Economics, Leipzig University. He co-organised the EAERE 2020 Workshop on the Economics of Inequality and the Environment and co-edits a related JEEM-special issue. As part of his research on nature's values, he is contributing author to the ongoing IPBES Value Assessment.*

Environmental Economics: A science in the climate crisis

Environmental economics has achieved a lot since Pigou published "The economics of welfare" about 100 years ago. Powerful concepts and tools were created and often implemented. In stylized economic models the solution to environmental problems is straightforward: price the externality, cooperate, pay transfers if you mind distribution. Nevertheless, the human pressure on natural systems has continuously increased such that geologists now proclaim the epoch of the Anthropocene. Today, humanity is causing and facing aggravating environmental destruction of previously unknown extent. The approaching climate catastrophe, accelerating biodiversity loss and aggravating pollution from plastic or other waste directly come to mind but by far do not depict a complete list.

Particularly the imminent climate catastrophe calls for immediate and extensive policy intervention. Surely, the merits of a global price on carbon emissions are undisputed among economists. The 2019 EAERE statement on carbon pricing counts more than 1750 signatories, including the authors. Unfortunately, in reality, a global carbon price is still far out of scope despite being strongly advocated for more than two decades. Today, only about a quarter of global emissions are covered by carbon pricing (World Bank 2020); only a handful of countries have implemented carbon prices exceeding 40 USD, which is the lower bound of the necessary carbon prices in 2020 to likely keep warming below two degrees according to the IPCC (2014). Additionally, not only the implementation but also its continuation has some pitfalls. The 2018 Yellow Vests protests in France and Australia, which repealed its carbon tax after just two years are warning examples.

Beyond the "first-best"

Insisting on a global carbon price might be not very helpful or even counterproductive for policy advice if it is politically infeasible. A global carbon price faces implementation barriers due to the inherent and well-studied collective action problems and is particularly hard to achieve where the trust in the political system is low (Klenert et al. 2018) or where there is a general objection to market-based instruments. Empirically, we observe that the most successful pollution reductions have often been achieved with alternative policies rather than the praised tax or cap and trade instruments. The Montreal Protocol that bans ozone layer depleting substances is the prime example of successful cooperation and effective policy. Furthermore, the public funding of research and development is

often fundamental to technological and societal transitions. Last but not least, a great contribution to decarbonization was achieved by governments' financial support of renewable energy technologies like wind and solar photovoltaics. It is at least questionable whether a carbon price could have achieved a similar renewable energy deployment dynamic. If well-designed, such renewable energy subsidies may be almost as efficient as carbon pricing (e.g. Abrell et al., 2019), offering a way forward if the latter is politically out of reach.

Even if it is implemented, a carbon price does not do the entire job. The efficiency of carbon pricing might be compromised by the well-studied challenges of transaction costs, uncertainty or path-dependence. In particular, economic approaches for (dis)incentives rely on well-informed, rational actors. While the assumption of rationality is surely reasonable for (large) firms, the manifold situations where private individuals do not base their decisions on return on investment calculations cannot be overcome with monetary incentives only. Furthermore, in multi-level governance systems, governments could dilute the effects of a global carbon tax by introducing counteracting policies on a (sub-) national level. Where today lower-level governments have incentives to abstain from joining a multinational pricing scheme, under a global price it could be rational to offset the price by redistributing its revenues as subsidies. As a consequence, a global, unified carbon price would not be sufficient to drive the needed ecological transition but needs to be complemented by additional measures.

We, therefore, argue that our community of (environmental and resource) economists should pursue a twofold strategy:

(i) *Explaining the first-best and building support*. This includes researching how the various design options of pollution pricing can contribute to its public acceptability as well as informing policymakers and the general public on the functionality and merits of price instruments to contribute to its political feasibility.

(ii) *Researching non-first-best instruments*. This means to simultaneously foster research on alternative instruments for an imperfect world, with its currently prevailing institutions, actors and political or societal preferences. Research in this direction could equip and guide those actors who want to move forward on climate change mitigation now.

Example: Renewable energy policies in federal government systems

Let us illustrate the second point by a research example on renewable energy (RE) policies in multi-level government systems (Meya and Neetzow, 2019), although many others could have been chosen. In most world regions, there are several nested levels of governance, whose RE targets and support instruments may differ. In setting targets, lower-level governments might be interested in co-benefits and economic development within their jurisdiction while upper-level governments focus on overall national welfare. In fact, all countries of the European Union use between two and six RE support instruments and are characterized by overlapping national and lower-level RE policies (Del Río & Mir-Artigues, 2014).

In Meya and Neetzow (2019) we ask: (i) How are incentives for lower-level governments to support RE affected by the upper-level policy instrument(s) in place? (ii) In which circumstances can the overlapping provision of RE support by "upper" and "lower" governance levels be efficient? The research contributes to the understanding of overlapping policies in multi-level government systems for pollution control (Williams III 2012, Ambec and Coria 2018, Coria et al. 2018) or renewable support (Meier & Lehmann, 2020) and thus provides insights on instruments beyond a carbon price.

In our analytical model of optimal RE policy design, an upper-level federal government and multiple lower-level state governments simultaneously choose their level of RE support. On the federal level, we analyze the two most prominent RE policies: a nationwide price instrument (feed-in tariff, FIT) and a nationwide quantity instrument (capacity auction). On the state level, we consider a multitude of implicit RE support measures, equivalent to and expressed by a single yet state-specific financial subsidy per unit

of capacity. The costs of the federal RE policy are exogenously distributed among all states. For given federal and state-level policies, competitive suppliers decide on the deployment of RE capacity (Figure 1). RE deployment in one state can cause positive externalities for other states (spillover benefits); as well as negative (cost) externalities, by increasing their burden of financing federal RE policy.

We find that whether the federal government chooses either a price or a quantity instrument changes the incentives for states to implement their own RE support measures, as well as the circumstances under which overlapping RE policies are efficient. While price and quantity instruments are equivalent if the upper-level government implements a single nationwide policy, this does not hold if lower-level governments implement additional RE support. Our key results are: (i) With a federal FIT, a state's subsidy is

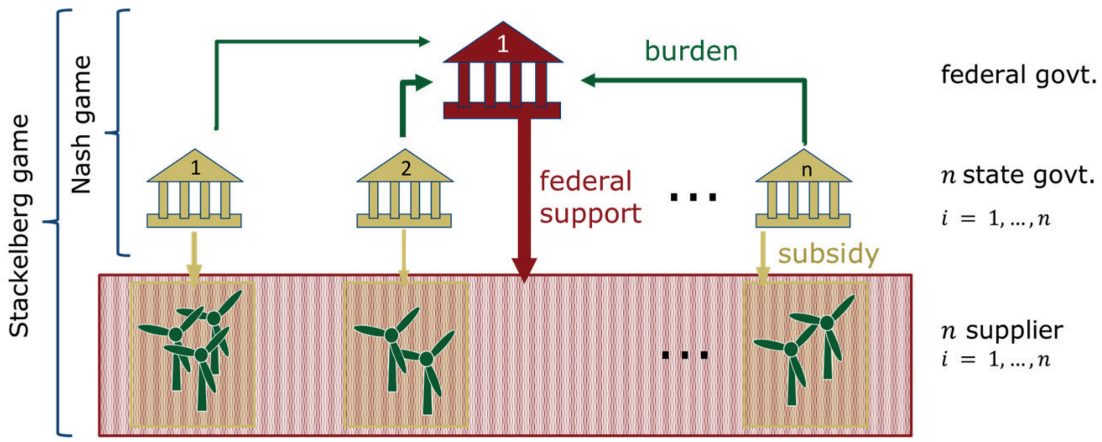

Figure 1. Modelling set-up for two-level government support for RE deployment.

inefficiently high (low) if its share in the marginal benefits from nationwide RE deployment is larger (smaller) than the state's relative burden share. (ii) With a federal auction, a state's subsidy is inefficiently high (low) if its RE capacity share is smaller (larger) than its relative burden share.

These results are directly relevant to the efficient design of RE support schemes in multi-level governance systems. The efficiency of a price or quantity instrument and the incentives for state RE policies will depend on how the burden is distributed among states. States can have incentives to offer subsidies that are too high or too low, leading to surplus or deficit RE capacity, respectively. Under FIT, a state can reduce its burden share by reducing its subsidies, as this will cause a reduction in nationwide RE capacity. This strategy does not work under an auction system as capacity is fixed. Here, however, a state can reduce its burden share by increasing state subsidies, thereby reducing the national quota price. As a consequence, federal FIT or auction-based policies give rise to opposing policy-setting incentives at the state level.

Making climate policy work

Despite some encouraging national carbon pricing initiatives, it is highly unlikely that a global carbon price will turn the tides for climate mitigation efforts in the 2020ies. While its general idea should not be abandoned, we need increasing openness and research focus towards alternative instruments and various design options. As Klenert et al. (2018, p. 670) aptly coin it "[l]essons about equity and efficiency from traditional economic analyses are of little value if carbon pricing cannot be implemented". Since a strong policy response is needed in this decade to get on track for the Paris climate goals, research on implementable second or third-best policies will find more resonance than studies on an optimum that remains hypothetical. *We can't always get what we want. But if we try sometimes* and offer scientific advice on the efficiency and

equity of such second-best policies, *we just might find* that in times of accelerating environmental change these will regularly be less expensive than the cost of inaction. And thus, researching the imperfect can make us hopeful that *we get what we need*.

Note

This article reflects only the personal opinions of the authors. It was written, in part, by Paul Neetzow in leisure time as part of his ongoing hobby to do research.

References

Abrell, J., Rausch, S., & Streitberger, C. (2019). The economics of renewable energy support. *Journal of Public Economics*, *176*, 94-117.

Ambec, S., & Coria, J. (2018). Policy spillovers in the regulation of multiple pollutants. *Journal of Environmental Economics and Management*, *87*, 114-134.

Coria, J., Hennlock, M., & Sterner, T. (2018). Fiscal federalism, interjurisdictional externalities and overlapping policies. *University of Gothenburg Working Paper in Economics*, 742.

Del Río, P., & Mir-Artigues, P. (2014). Combinations of support instruments for renewable electricity in Europe: A review. *Renewable and Sustainable Energy Reviews*, *40*, 287-295.

IPCC (2018). Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

Klenert, D., Mattauch, L., Combet, E., Edenhofer, O., Hepburn, C., Rafaty, R., & Stern, N. (2018). Making carbon pricing work for citizens. *Nature Climate Change*, *8*(8), 669-677.

Meier, J.N., & Lehmann, P. (2020). Optimal federal co-regulation of renewable energy deployment. *UFZ Discussion Paper,* No. 8/2020.

Meya, J.N., Neetzow, P. (2019). Renewable energy policies in federal government systems, *Oldenburg Discussion Papers in Economics, No.* 423-19.

Williams III, R. C. (2012). Growing state–federal conflicts in environmental policy: The role of market-based regulation. *Journal of Public Economics*, *96*(11-12), 1092-1099.

World Bank 2020. State and Trends of Carbon Pricing 2020. Washington, DC: World Bank. https://openknowledge.worldbank.org/bitstream/handle/10986/33809/9781464815867.pdf?sequence=4&isAllowed=y

Suggested citation

Neetzow, P., & Meya, J.N. (2021). You Can't Always Get What You Want: Research Beyond Carbon Pricing. *EAERE Magazine*, 11.

Exploring the Global Economic Consequences of Desertification

Maurizio Malpede
Bocconi University

Maurizio Malpede (malpedemaurizio@gmail.com) *is a Post-Doctoral Fellow at the GREEN Center of Bocconi University. He holds a PhD in Economics jointly awarded by Cattolica University and Bicocca University, Milan. His PhD Thesis "Three Essays on Technological Progress and Economic Growth" has been awarded the 2020 EAERE Best European Doctoral Dissertation in Environmental and Resource Economics. His research mainly focuses on the roots of historical development and on the economic effects of climate and resource extraction in Sub Saharan Africa.*

To this day, approximately 52 million square km of earth land surface is drylands. Drylands are defined as zones where the total amount of precipitation is balanced by the evaporation from the surface and by the natural transpiration of the plants. This "right" balance between precipitation and water evaporation is pivotal for the biological productivity of the land.

The economics effects of global warming on different areas of the world have been a central question in the recent economic literature. To the best of my knowledge, there is an extensive number of studies dealing with the economic and social impacts of reduced rainfalls and higher temperature both at a macroeconomic and at a micro perspective. For instance, Maccini and Yang (2009) study the long-term effects of variations in rainfalls in Indonesia and find a positive impact of precipitation on the heath and wealth of individuals who have grown up during years with higher precipitations. A recent study by Peri (2019) find that rising temperatures reduce rural-urban migration in poor countries while the opposite effect is shown for middle-income countries. However, taken alone, total precipitation is a poor measure of the dryness of a given location. This because if a particular zone is characterized by high but variable amount of precipitation throughout the year, as well as, excessive heat and high humidity levels, then this zone might be more arid compared to a zone with lower levels of precipitation but characterized by lower temperature and humidity.

Figure 1 below shows that, while the recent trend in total precipitation (Panel A) has decreased in most areas of the word, in particular in Africa and countries of the Middle East; large parts of Latin America and South-East Asia have experienced an increase in precipitation compared to their historical average. On the other hand, Panel B shows that the increase in precipitation levels experienced in Latin America and South East Asia was accompanied by higher potential evapotranspiration.

If the increase in precipitation in those areas is accompanied by a higher increase in the evapotranspiration of the soil, then based on the

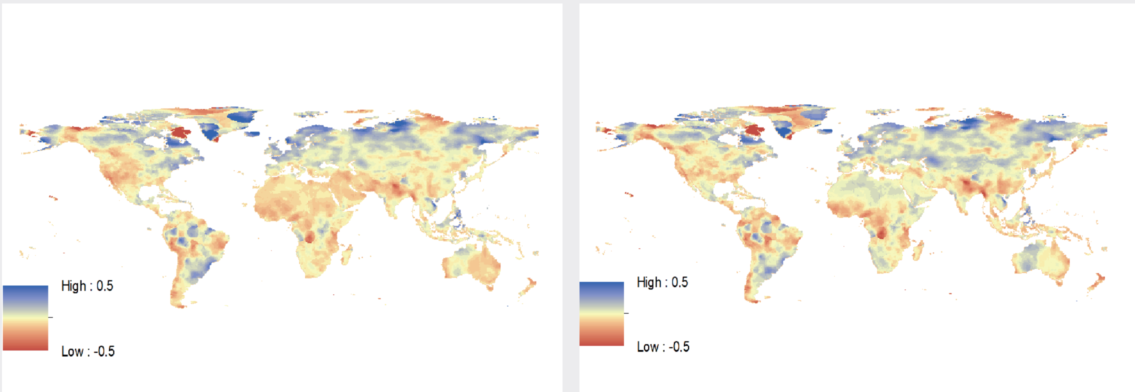

Figure 1. Global distributions of percentage changes (%) in (a) Precipitation, and (b) PET, taken as the difference between the present day (2000–2015) and the historical average (1900–1980).
Notes: Secular data for precipitation and PET are retrieved from Fu et al. (2016)

results achieved by the economic literature we might be tempted to conclude a positive economic impact. Nevertheless, the zone might have become more arid.

Therefore, to have a better measure of the dryness of a particular area, total amount of precipitation needs to be divided by the potential evapotranspiration of the soil. This ratio is defined as the Aridity Index (AI). The AI is a simple but convenient measure of the actual water availability of the soil. Higher levels of evapotranspiration of the soil lead to more arid land (at a given level of precipitation). In particular, Potential Evapotranspiration (PET) is defined in Kirkham (2014) as a measure of the "drying power" of the atmosphere to remove water from land surfaces by evaporation (e.g., from the soil and plant canopy) and via plant transpiration. PET is calculated by method of Penman, and considers different variables such as atmospheric humidity, solar radiation, and wind. All of them are affected by climate change (Salem et al., 1989). More recently, Cowley et al. (2017) highlight the different impacts or rainfall and potential evapotranspiration soil moisture on different regions of the world. Consequently, the major difference between Precipitation and Aridity is that if PET is greater than P, then the climate is arid. Of course, anomaly water deficits may also occur over shorter time periods, e.g., seasonally, or monthly, which are called droughts depending on their intensity and duration.

A decreasing aridity (i.e., the land becomes drier which is largely predicted for future decades) may lead to a loss in agricultural output and productivity. Less developed countries might, as a result, suffer the most (Dell, 2012). While the direct effects of global warming are likely to be only marginal for more advanced economies which mainly rely on the tertiary sector, the effects of higher temperature, higher precipitation and evaporation will substantially affect low and lower-middle income countries which predominantly rely on agricultural output and livestock.

The World Atlas of Desertification (WAD) uses the Aridity Index to classify five subtypes of arid lands or drylands, namely:

- Hyper-arid, or desert (AI < 0.05)
- Arid (0.05 < AI < 0.2)
- Semi-arid (0.2 < AI < 0.5)
- Dry subhumid (0.5 < AI < 0.65)
- Humid (AI > 0.65)

The process in which the biological activity of drylands decreases is called "desertification" or "soil aridification" and corresponds to lower levels of AI. During the last forty years the process of desertification has accelerated by more than 30 times his historical rates (United Nations Convention to Combat Desertification, 2020). The principal factors of soil aridification are farming and human activities which clear away trees and other vegetation.

Huang et al., (2016) show how by the end of the present century dryland areas will increase between 11% and 23%, based on different future carbon emissions scenarios, relative to 1961–1990 baseline. Such an expansion of drylands would lead to reduced carbon sequestration and enhanced regional warming, resulting in warming trends over the present drylands that are double those over humid regions. The increasing aridity, enhanced warming and rapidly growing human population will exacerbate the risk of land degradation and desertification in the near future in the drylands of developing countries. A more recent study by Park (2018) also shows that aridity is projected to decrease (that is, areas will become drier) as a consequence of anthropogenic climate change. However, Park (2018) points out that accomplishing the 1.5°C temperature goal will substantially reduce the likelihood that large regions will face substantial aridification and related impacts. Moreover, Fu et al. (2016) also show the differences between precipitation and potential evapotranspiration using grid cell data for the whole world.

For this reason, recently there has been a growing literature focusing on the differences between rainfall and aridity. To this regard, one of the first studies is Sherwood et al. (2014) in which they distinguish between droughts, which are transient regional extreme phenomena typically defined as departures from a local climatological norm that is presumed known, from the so-

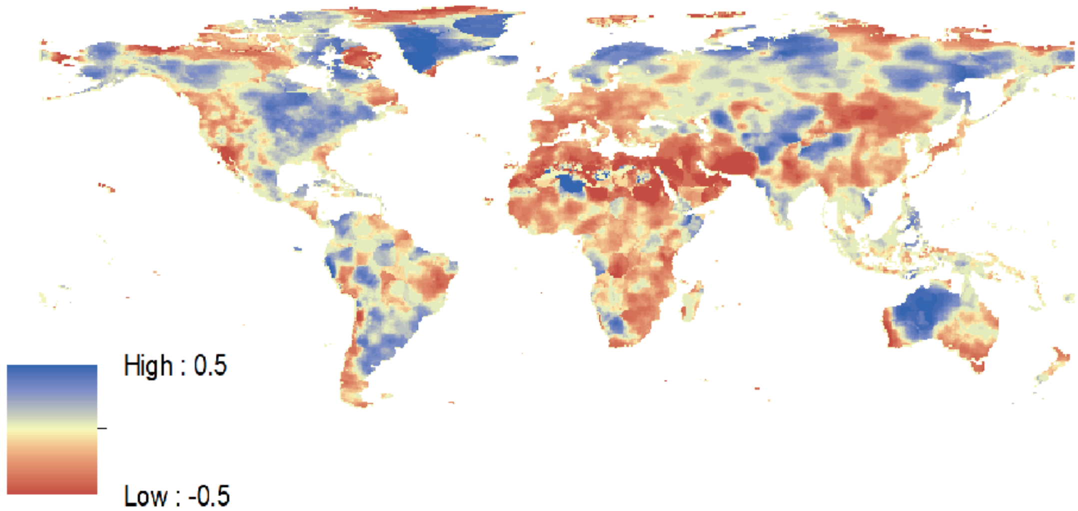

Figure 2. Global distributions of percentage changes (%) in the Aridity Index, taken as the difference between the present day (2000–2015) and the historical average (1900–1980).
Notes: Secular data for precipitation and PET are retrieved from Fu et al. (2016)

called "background" dryness. The latter beside being a function of the amount of precipitation, also depends on *how fast* water would evaporate. The example is that one main consequence as the planet warms is that global average rainfall is predicted to increases. On the other hand, evaporation will increase as well. As a result, the net impact of the two forces on average aridity is uncertain.

The effects of soil aridification caused by human induced climate change on different economies are a novel question for economists and social scientists and, to the best of my knowledge, the economic literature focusing on this topic is still young and growing. One of the first papers is Harari and La Ferrara (2018), in which they assess the incidence of the potential evapotranspiration (called SPEI, which stands for Spatial Potential Evapotranspiration Index) on the onset of conflicts in Africa. However, no studies have exploited the relationship between aridification and development, as well as, on crop production.

To clearly assess the effects of soil aridification on economic growth, I exploit a 56km-by-56km grid cell level dataset covering the whole world at annual frequency during the period 1990-2015.

The mechanisms behind the economic effects of desertification

I analyze the channels through which desertification impacts the economic development by using spatial time series data on total yields available for four major water-intensive crops, namely maize, rice, soybean, and wheat. Specifically, I use worldwide data on harvested area and yield for four the major crops from three time periods between 1995 and 2005. Time series spatial data on crops are from Ramankutty et al. (2002). The reasoning behind is that if a particular area experiences substantially less precipitation in a given year (or changes in humidity or temperature, wind speed or even UV radiations, which determine an increase in PET) then, the yield of certain crops could be negatively affected. This in turn, will translate to economic losses. A number of theoretical and empirical economic contributions provide relevant insights for this interpretation (Parry, 2019; Burke et al., 2015; Dell et al., 2014; Tol, 2009).

I show that areas that have become more arid (i.e., the Ai has decreased) are associated to a reduction in GDP per capita and in net migration flows. The effects of desertification are more pronounced in poor African countries relying predominantly on agriculture. Finally, I show that variations of the Aridity Index are

significant predictors of crops yield at grid level, as well. Overall, I provide a first step at understanding how human-induced climate aridification greatly impacts the economic development of areas which predominantly rely on agriculture. Moreover, this example motivates the use of the Aridity Index rather than Precipitation only, to have a better understanding of the economic impacts of climate change.

References

Burke, M., Hsiang, S. M., & Miguel, E. (2015). Global non-linear effect of temperature on economic production. *Nature, 527*(7577): 235–239.

Cowley, G. S., Niemann, J. D., Green, T. R., Seyfried, M. S., Jones, A. S., & Grazaitis, P. J. (2017). Impacts of precipitation and potential evapotranspiration patterns on down- scaling soil moisture in regions with large topographic relief. *Water Resources Research, 53*(2): 1553-1574.

Dell, M., Jones, B. F., & Olken, B. A. (2012). Temperature shocks and economic growth: Evidence from the last half century. *American Economic Journal: Macroeconomics, 4*(3):66-95.

Dell, M., Jones, B. F., & Olken, B. A. (2014). What do we learn from the weather? The new climate-economy literature. *Journal of Economic Literature, 52*(3): 740-98.

Fu, Q., Lin, L., Huang, J., Feng, S., & Gettelman, A. (2016). Changes in terrestrial aridity for the period 850–2080 from the community earth system model. *Journal of Geophysical Research: Atmospheres, 121*(6):2857-2873.

Kirkham, M.B., 2014. Principles of soil and plant water relations. Academic Press.

Harari, M. & Ferrara, E. L. (2018). Conflict, climate, and cells: a disaggregated analysis. *Review of Economics and Statistics, 100*(4):594–608.

Huang, J., Yu, H., Guan, X., Wang, G., & Guo, R. (2016). Accelerated dryland expansion under climate change. *Nature Climate Change, 6*(2):166–171.

Maccini, Sharon, & Dean Yang. 2009 Under the weather: Health, schooling, and economic consequences of early-life rainfall. *American Economic Review 99*.3: 1006-26.

Park, C.-E., Jeong, S.-J., Joshi, M., Osborn, T. J., Ho, C.-H., Piao, S., Chen, D., Liu, J., Yang, H., Park, H., et al. (2018). Keeping global warming within 1.5 c constrains emergence of aridification. *Nature Climate Change, 8*(1): 70.

Parry, M. L. (2019). *Climate change and world agriculture*. Routledge.

Peri, G. & Sasahara, A. (2019). *The impact of global warming on rural-urban migrations: evidence from global big data (No. w25728).* National Bureau of Economic Research.

Ramankutty, N., Foley, J. A., Norman, J., & McSweeney, K. (2002). The global distribution of cultivable lands: current patterns and sensitivity to possible climate change. Global Ecology and biogeography, 11(5):377–392.

Salem, B. et al. (1989). *Arid zone forestry: a guide for field technicians. Number 20.* Food and Agriculture Organization (FAO).

Sherwood, S. & Fu, Q. (2014). A drier future? *Science, 343*(6172):737–739.

Tol, R.S. (2009). The economic effects of climate change. *Journal of economic perspectives, 23*(2):29–51.

Suggested citation

Malpede, M. (2021). Exploring the Global Economic Consequences of Desertification. *EAERE Magazine*, 11.

EAERE
European Association
of Environmental and
Resource Economists

EAERE Membership

CALL FOR 2021 EAERE Individual Membership

Join EAERE in calendar year 2021. Individual membership is open to persons who by their profession, training and/or function are involved in environment and resource economics as a science. EAERE offers a rich portfolio of benefits for individual members, making the return on a membership more valuable than ever.

Individual benefits

- A free personal subscription for the electronic version of the Association's official journals: Environmental and Resource Economics (ERE), published by Springer and Review of Environmental Economics and Policy (REEP), published by University of Chicago Press;
  Members are offered a discount subscription fee to the paper version of these journals.
- A discounted personal subscription rate for the journals: Annual Reviews; Environment and Development Economics; International Review of Environmental and Resource Economics; Journal of Environmental Economics and Management; Resource and Energy Economics; Resources Policy; Strategic Behavior and the Environment Water Resource and Economics
- A 40.00% discount on books published by Springer;
- Eligibility to participate to the EAERE Annual conference;
- Eligibility to apply for participation in the EAERE Winter and Summer Schools;
- The right to post announcements in the Association's Highlights issued monthly;
- The right to post announcements in the contributed pages of the EAERE website;
- Access to the EAERE membership full directory;
- The right to vote in the EAERE General Assembly and in the EAERE Elections;
- The right to send nominations for the EAERE Awards;
- A discount on personal membership fee for our sister Association AERE (Secondary Membership).

Collective benefits

Supporting EAERE in: Lobbying for environmental and resource economics research funding from the European Commission and elsewhere; Advancing the science of economics; Advancing the application of environmental economics in the development and application of policy; Advancing the application of environmental economics in business and commerce; Advancing communication between scholars, teachers, students and practitioners

Membership options and prices

EAERE provides two mutually exclusive options.

EAERE Annual membership (Until Dec 2021): FULL €50.00 or REDUCED €14.00

EAERE Triennial membership (Until Dec 2023): FULL€135.00 or REDUCED €37.80

New members applying for an annual membership can purchase a one-year subscription at discounted rate to the print version of one or both of the EAERE's official journals ERE (€96,72) and REEP (€18.00). Subscription prices will be added to the membership fee.
If you are a member of AERE in calendar year 2021 you can apply for a EAERE Secondary Membership with a discounted fee.

Payments can be done by credit card, bank transfer or Western Union Money Transfer. Please note that an administrative fee of €20.00 will be charged to payments made by bank transfer and Western Union Money Transfer.

CALL FOR
2021 EAERE Institutional Membership

Join EAERE in calendar year 2021. Institutional membership is open to associations, and public and private institutions which operate in fields connected with the aims of the Association or which pursue the aims and materially support the activities of the Association or individual initiatives promoted by the Association, by providing human, organisational or financial resources.

Incomes from institutional membership fees will be used exclusively and completely to further the aims of the Association. EAERE offers a rich portfolio of benefits for institutional members, making the return on a membership more valuable than ever.

Benefits

- One complimentary 2021 individual EAERE membership for one staff member, including all the related benefits
- One non-transferable registration for institutional staff to the EAERE Annual Conference
- Recognition at the Annual Conference of the European Association of Environmental and Resource Economists
- The right to post announcements and articles in the Association's Highlights issued monthly
- Listing on the EAERE website and every issue of the Newsletter
- Listing in every issue of Environmental and Resource Economists
- The right to send nominations for the EAERE Awards
- 10% discount for the payment of "group membership" for a minimum of 10 individual members

Collective benefits

Supporting EAERE in: Lobbying for environmental and resource economics research funding from the European Commission and elsewhere; Advancing the science of economics; Advancing the application of environmental economics in the development and application of policy; Advancing the application of environmental economics in business and commerce; Advancing communication between scholars, teachers, students and practitioners.

Membership options and prices

EAERE provides two mutually exclusive options.

1. Full institutional membership: € 1,200.00 or € 3,600.00 for a triennial (2021-2023) membership
2. University institutional membership: € 300.00 or € 900.00 for a triennial (2021-2023) membership.

Only Universities, University departments, and University centres can apply for this membership category.

Payments can be done by bank transfer.

Further information

Further information is available at: www.eaere.org/institutional-membership

EAERE Full institutional members – 2021*

- Basque Centre for Climate Change – BC3, Spain
- The Beijer Institute of Ecological Economics, Sweden
- Environmental Defense Fund – EDF, USA
- Fondazione Eni Enrico Mattei – FEEM, Italy
- Institute for Public Goods and Policies, Spanish National Research Council – IPP – CSIC, Spain
- Research Institute of Capital Formation, Development Bank of Japan Inc. – RICF DBJ, Japan
- Toulouse School of Economics – TSE-R, France
- University of Manchester – UoM, UK

EAERE University institutional members – 2021*

- Ca' Foscari University of Venice, Department of Economics, Italy
- Center of Economics Research at ETH Zurich – CER-ETH, Switzerland
- Centre for Research in Geography, Resources, Environment, Energy and Networks – GREEN, University Bocconi, Italy
- Corvinus University of Budapest, Hungary
- Environment for Development Initiative – EfD, Sweden
- Euro-Mediterranean Center on Climate Change Foundation – CMCC, Italy
- The Grantham Research Institute on Climate Change and the Environment – GRI, UK
- Mercator Research Institute on Global Commons and Climate Change – MCC, Germany
- Paris School of Economics – PSE, France
- Ragnar Frisch Centre for Economic Research – CREE, Norway
- Research laboratory on Socio-Economic and Environmental Sustainability – ReSEES, Athens University of Economics and Business, Greece
- Technische Universität Berlin – TU Berlin, Germany
- Tilburg Sustainability Center – TSC, Tilburg University, Netherlands
- Umeå University, Department of Economics, Umeå School of Business, Economics and Statistics, Sweden
- University of Bologna, Department of Economics, Italy
- University of Ferrara, Sustainability Environmental Economics and Dynamics Studies – SEEDS, Italy
- University of Graz, Wegener Center for Climate and Global Change, Austria
- University of Helsinki, Department of Economics and Management, Finland
- University of Santiago de Compostela, Instituto de Estudios y Desarrollo de Galicia – IDEGA, Spain
- University of Southern Denmark, Department of Sociology, Environmental and Business Economics, Denmark

EAERE is grateful to its 2021 Institutional Members for their support!

** As of February 2021*

EAERE
European Association
of Environmental and
Resource Economists

The European Association of Environmental and Resource Economists (EAERE) is an international scientific association whose aims are:
_to contribute to the development and application of environmental, climate and resource economics as a science in Europe;
_to encourage and improve collaboration and communication between scholars, researchers, policymakers, students in environmental, climate and resource economics in different European countries;
_to develop and encourage the cooperation across universities and research institutions in Europe.
Founded in 1990, EAERE has approximately 1200 members in over 60 countries from Europe and beyond, from academic and research institutions, international organisations, the public sector, and the business world. Membership is open to individuals who by their profession, training and/or function are involved in environmental, climate and resource economics as a science, and to institutions operating in fields connected with the aims of the Association.

www.eaere.org