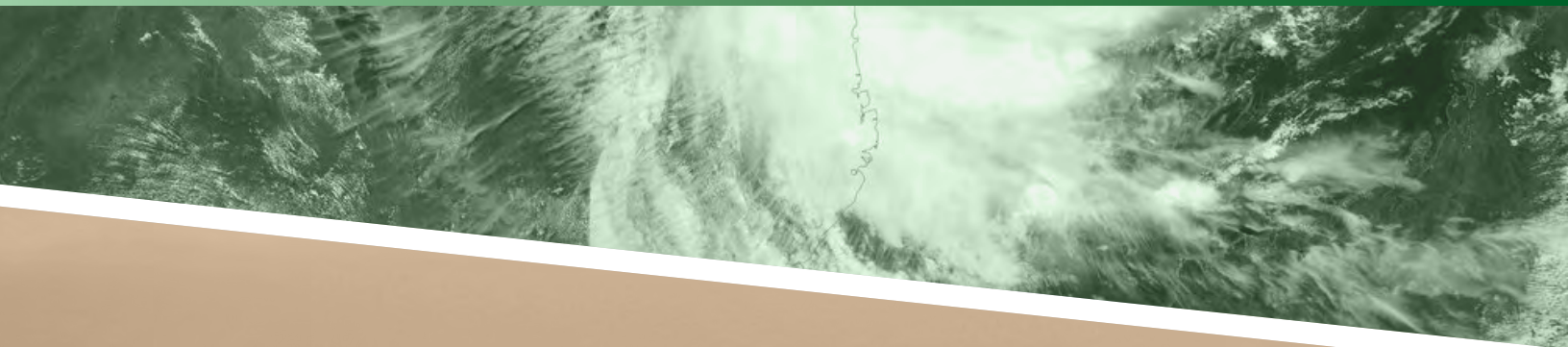




GLOBAL CHANGES

MIT JOINT PROGRAM ON THE SCIENCE & POLICY OF GLOBAL CHANGE
FALL 2019 NEWSLETTER





OUR RESEARCH MISSION

At the Joint Program, our integrated team of natural and social scientists studies the interactions among human and Earth systems to provide a sound foundation of scientific knowledge. Such a foundation will aid decision-makers in confronting the interwoven challenges of future food, energy, water, climate and air pollution issues, among others.

Our mission is accomplished through:

- Quantitative analyses of global changes and their social and environmental implications, achieved by employing and constantly improving an Integrated Global System Modeling (IGSM) framework;
- Independent assessments of potential responses to global risks through mitigation and adaptation measures;
- Outreach efforts to analysis groups, policymaking communities, and the public; and
- Cultivating a new generation of researchers with the skills to tackle complex global challenges in the future.

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SAVE THE DATE:

XLIII (43rd) GLOBAL CHANGE FORUM

March 26–27, 2020 • MIT Campus • Cambridge, MA

Theme: Global Change – Physical and Transition Risks

JOINT PROGRAM SPONSORS' MEETING

March 25, 2020 • 2:00–5:00 pm EST

Forum attendance is by invitation only.

For additional information, please

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Why we all need to pay more attention to worst-case climate scenarios

When an Australian think tank released a [report](#) last May describing climate change as potentially ending civilization as we know it by the year 2050, it drew considerable media coverage. Having devoted nearly 40 years to the study of climate change, the report's title—"Existential climate-related security risk: A scenario approach"—initially struck me as extreme hyperbole, but as I read through the document, I became more convinced that its main argument, while controversial, was something to heed.

First, it proposes that we take seriously the full range of outcomes projected by climate models, including worst-case scenarios. Such "war gaming" is a common approach in the defense establishment to simulate aspects of warfare at the tactical, operational or strategic level. The goal of conceiving of bad scenarios is to be better prepared should they transpire, and to think through how timely and early interventions could prevent the worst from happening. These are not purely scientific undertakings: quantification of certain aspects of these scenarios is done largely to help imagine how not-easily quantifiable events could unfold. With that goal in mind, scenario designers tend to push the edge of what the mainstream scientific community agrees upon. Not surprisingly, a former (Australian) defense minister, familiar with such planning, contributed to the report.

Second, the report emphasizes that from a risk perspective, we should concern ourselves not with the most likely outcomes, but rather with those scenarios that would incur the greatest expected loss (calculated as the chance of occurring times the total damage). In that framing, the tail end of the probability distribution of outcomes may have a relatively small chance of occurring, but if the outcome is catastrophic, the expected loss could be enormous.

Third, the authors suggest that scientists have been reluctant to describe catastrophic outcomes. That jibes with my experience over the past 40 years: We scientists have focused on our best estimates—the median outcomes, not the tails—and we have been very hesitant to "speculate" even based on fairly deep understanding of the Earth system unless there's hard data to "prove" the possibility of disaster with a 95% confidence limit. No one wants to go out on that limb and have colleagues ask: What data or evidence do you have to prove that concern? So those deeper speculations, if voiced at all, remain discussed only among close colleagues.

For example, the [IPCC Fourth Assessment Report](#) discussed but did not quantify possible sea-level rise from major



John Reilly. Photo by Dimonika Bray.

ice sheets melting because there were no peer-reviewed estimates, so the range presented was almost certainly biased low. The [Fifth Assessment Report](#) revised the range substantially upward, but meanwhile, coastal communities making long-term decisions had to guess at how much more sea-level rise they should expect. Scientific standards have their place, and scientific papers should adhere to them, but strategic planning needs to include broader thinking.

Finally, we now find ourselves surprised almost every month by the rapidity and severity of climate change, suggesting that more calamitous events could be on the horizon. Sea-ice already melting more than what had been forecast for the end of the century. Large ice sheets melting faster and displaying properties unaccounted for in our models. Dramatically greater flooding from more intense storms than we guessed would occur.

That said, *are* we nearing the end of civilization?

Hardly, unless extreme events multiply, come harder and faster, and hit more of the world on a regular basis, so that most of humanity's energies are consumed by recovery efforts that fail to keep up with the pace and intensity of these events. Even that scenario doesn't seem likely to end civilization as we know it—at least for relatively rich economies like the U.S. that have considerable capacity and resources to throw at these problems. But what happens if these countries fail to take corrective action?

Suppose instead of responding rationally to extreme events—thinking through why they are occurring and how

they might get worse, intensifying national and international efforts to ease the plight of those affected by them, and to rapidly reduce greenhouse gas emissions—we pretend things aren't changing, fail to reach out a helping hand, and ignore the root of the problem? This is where defense planning lingo comes into play, rebranding climate change as a “threat multiplier.”

Under this scenario, food crises, floods or extreme heat create political unrest and environmental refugees. Rather than work to ease these tensions, countries wall themselves off, each believing they can isolate themselves from the effects of events outside their borders while managing effects within them. This then leads to wars, the collapse of domestic and transnational political institutions, and the “end of civilization as we know it.”

Perhaps the biggest error the global change research community has made over the past four decades was to assume that the world would deal with the problem of global climate change rationally, overcome the challenges of getting to a cooperative solution, and do two things at once—reduce greenhouse gas emissions while adapting to the kind of significant climate change that is already underway.

Knowing what I know now, I might have spent my last 40 years working a little more feverishly, and spent more time looking at how domestic and international systems could quickly unravel in a bad way. If scientists and policymakers alike pay more attention to such scenarios, we will be more prepared to intervene and respond with long-term solutions.

—John Reilly, Co-Director

MIT DEPARTMENT ACRONYMS

Due to space considerations, MIT departments, labs and centers referenced here are referred to by their acronyms.

AGAGE Advanced Global Atmospheric Gases Experiment

CEEPR Center for Energy and Environmental Policy Research

EAPS Earth, Atmospheric and Planetary Sciences

IDSS Institute for Data, Systems, and Society

MIT Joint Program News Releases:

Latest research developments and their implications

MIT Joint Program in the Media:

Latest coverage of our research

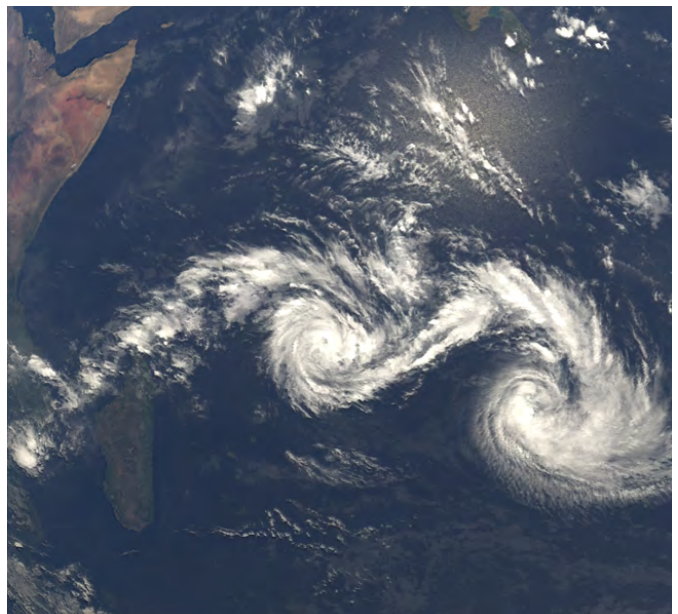
The following summaries are listed by primary research focus area, but may span multiple research focus areas. For full articles, please visit our website at globalchange.mit.edu.

Food, Water & Forestry

Global changes: Risks and opportunities

Key takeaways from the XLII (42nd) MIT Global Change Forum

At the Joint Program's XLII (42nd) MIT [Global Change Forum](http://globalchange.mit.edu) on March 28-29, more than 100 attendees from industry, academia, government and NGOs gathered at MIT to explore how global change is creating challenges and opportunities in agriculture, finance, energy, weather extremes, Earth-system thresholds (tipping points), and security. Here we summarize key points that emerged in presentations and discussions at this year's Forum.



Infrastructure Resilience

Designing water infrastructure amid climate uncertainty [↗](#)

New method identifies opportunities to learn and adapt to changing temperature and precipitation trends

Joint Program researchers have developed a new, systematic approach to designing long-term water infrastructure amid climate change uncertainty. Their planning framework assesses the potential to learn about regional climate change over time as new observations become available, and thus evaluate the suitability of flexible approaches that add water storage capacity incrementally if the climate becomes warmer and drier.

The imperfect storm (*Scientific Computing World*) [↗](#)

Joint Program extreme-weather-event modeling method featured in article on weather prediction

Joint Program Deputy Director Adam Schlosser describes a method that predicts changes in frequency of extreme weather events resulting from global climate change.



Kenya Water Resources Management Authority establishing water quality monitoring station on Mwache River

Air Quality & Health

Health effects of China's climate policy extend across Pacific [↗](#)

Improved air quality could prevent nearly 2,000 premature deaths in the U.S.

A study co-authored by Joint Program researchers estimates China's climate policy air quality and health co-benefits resulting from reduced atmospheric concentrations of ozone, as well as co-benefits from reduced ozone and particulate air pollution in South Korea, Japan and the U.S. The study shows that if China fulfills its climate pledge to peak carbon dioxide emissions in 2030, improved air quality in the U.S. would result in nearly 2,000 fewer premature deaths.

Shift to renewable electricity a win-win at statewide level [↗](#)

Health savings exceed policy costs

A Joint Program-led research team has developed a new modeling framework that combines economic and air pollution models to assess the projected subnational impacts of renewable portfolio standards and carbon pricing on air quality and human health, and on the economy and climate change. In a study focused on the U.S. Rust Belt, the team showed that financial benefits associated with air quality improvements from these policies would more than pay for the cost of implementing them.

Motor vehicle traffic in Beijing contributes to particulate and ozone pollution that could be reduced by China's climate policy, resulting in fewer premature deaths and significant cost savings



AIR QUALITY & HEALTH - CONT'D

Fact-checking presidential candidate Jay Inslee on climate change and 'the worst air in the world' (PolitiFact) [↗](#)

Climate change one of multiple factors making wildfires, and hence air quality, worse

Joint Program Co-Director John Reilly makes this point, and adds that other factors, such as fire suppression, have also made the wildfires worse.

How renewable energy can boost Rust Belt health outcomes (Axios, The Verge) [↗](#) [↗](#)

Study shows that health savings exceed costs of maintaining or strengthening renewables policies

Joint Program research finds substantial health benefits in Rust Belt states when utilities are required to supply escalating amounts of renewable power.

COMMENTARY Weakening the state's renewable energy standards is bad for Ohioans' health (Akron Beacon Journal) [↗](#)

Joint Program research shows economic benefits exceed policy costs

Study shows Ohio's Renewable Portfolio Standards would have a net benefit of \$170 million in 2030 or \$10 for each megawatt-hour of renewable energy supported by the policy.

Reducing China's CO₂ Emissions Would Curb Deadly Air Pollution in the U.S. (Scientific American) [↗](#)

China's move away from fossil fuels would mean 2,000 fewer premature deaths in the U.S. by 2030

Joint Program-led study: China's pledge to cut its carbon dioxide emissions beginning in 2030 includes a generous gift for its downwind neighbors: less deadly air pollution.

Natural Ecosystems

The color of climate change [↗](#)

EAPS oceanographers model how climate change will affect phytoplankton, a crucial component of the global ecosystem

VIDEO: Three MIT EAPS oceanographers, including Joint Program Principal Research Scientist Stephanie Dutkiewicz, model how phytoplankton populations may be affected under different climate change and CO₂ conditions into the future. The group works to understand the dynamics of the ecosystems and the climate system because changes to the numbers and distribution of these organisms can have ripple effects for years to come.

Farewell to the pale blue dot (Int'l Shipping News) [↗](#)

Climate change is altering the color of our planet

Joint Program Principal Research Scientist Stephanie Dutkiewicz: A rise in global sea-surface temperatures by 3°C by 2100 will affect phytoplankton in the oceans, altering ocean color.

As lake levels rise, so do mercury levels in Wisconsin fish (AP) [↗](#)

Climate change is already mobilizing mercury in the environment

Joint Program faculty affiliate Noelle Selin: "Understanding how climate change impacts mercury in the environment will be key to gauging what level of regulations are needed to see improvement."



Principal Research Scientist Stephanie Dutkiewicz

Energy

Projecting Energy and Climate for the 21st Century [↗](#)

At CERAWeek, MIT Joint Program Deputy Director Sergey Paltsev describes the energy transition needed to limit global warming to well below 2°C

VIDEO: Paltsev presents energy and climate projections over the 21st century showing that the Paris Agreement's long-term goal to limit warming to well below 2°C implies a transition to an energy system over the next 50 years with radically lower CO₂ emissions and a radically different fuel mix than currently in use.

Pathways to a low-carbon China [↗](#)

Study projects a key role for carbon capture and storage

A Joint Program-led study of China's long-term power generation mix under its emissions trading scheme projects that until 2065, renewable energy sources will likely expand to meet emissions intensity targets; after that, carbon capture and storage (CCS) could be deployed to meet more stringent targets. The study provides insight into the level of carbon prices and mix of generation technologies needed for China to meet different CO₂ intensity targets for the electric power sector.

Coal-fired electric plant, Henan Province, China



Earth System Science

Challenges for the ozone layer [↗](#)

Unexpected ozone-depleting emissions could delay recovery years to decades

Unexpected observed and potential emissions of ozone-depleting substances (ODSs) could delay the return of stratospheric ozone levels to 1980 levels by years to decades. Recognizing the threat that unconstrained ODSs pose to the continued restoration of the ozone layer, a study co-authored by MIT Joint Program Co-Director Ronald Prinn provides an overview of these substances and the steps needed to control them in alignment with the Montreal Protocol.

The climate optimist (Technology Review) [↗](#)

A profile of Susan Solomon, whose research pinpointed how CFCs caused the Antarctic ozone hole—and later showed that the Montreal Protocol is helping to mend it.

Joint Program faculty affiliate Susan Solomon is convinced we can make progress on addressing climate change, too.

How scientists unraveled the mystery behind the return of a banned greenhouse gas (Technology Review) [↗](#)

The apparent spike in CFC-11 production in China underscores the importance of ongoing emissions monitoring—and the limits of our current system

Joint Program Co-Director Ronald Prinn: More than 10 times the current number of AGAGE stations are needed to comprehensively track greenhouse gas emissions at the nation-by-nation level.

Scientists discover source of new CFC emissions [↗](#)

Despite global phase-out, ozone-depleting chemical still in production in eastern China

Since 2013, annual emissions of a banned chlorofluorocarbon (CFC-11) have increased by nearly 8,000 tons from eastern China, according to new research published in *Nature* by an international team of scientists including Joint Program Co-Director Ronald Prinn. Using AGAGE data, the team found that emissions of CFC-11 from eastern China had increased by around 7,700 tons per year after 2013—primarily around the northeastern provinces of Shandong and Hebei.

Future nitrogen availability has major impact on the fate of carbon sequestration in Northern Eurasia [↗](#)

Study underscores critical role of region in global climate and land-use change

Understanding the future availability of nitrogen and its effect on carbon sequestration in Northern Eurasia is key to developing more effective strategies for addressing global change impacts. A study co-authored by Joint Program researchers explores how changes in nitrogen availability associated with permafrost degradation, atmospheric nitrogen deposition, and the abandonment of agricultural land



Since 2013, annual emissions of a banned, ozone-depleting chlorofluorocarbon (CFC) have increased by nearly 8,000 tons from eastern China. That year South Korea's Gosan GAW Regional Station, on the southwestern tip of Jeju Island, started detecting spikes in CFC-11 levels drifting in from eastern Asia.

to forest regrowth influence carbon storage in the region's forest vegetation over the 21st century.

Climate Policy

Friendlier skies [↗](#)

A win-win solution to reduce aviation CO₂ emissions

A study by Joint Program Principal Research Scientist Niven Winchester advances a carbon-pricing system for international aviation that incents airlines to implement all CO₂ abatement options that cost less per ton of emissions abated than the social cost of carbon. This would result in a level of emissions abatement at which net social benefits—gains from avoided climate damages minus total abatement costs—are maximized, delivering a “win-win” for the aviation industry and the planet.

Population Connection announces winners of “World of 7 Billion” international student video contest [↗](#)

Joint Program Co-Director John Reilly judges Sustainable Resource Use category

Eighteen winners earned top spots in the eighth annual “World of 7 Billion” video contest sponsored by [Population Connection](#), a national organization focused on stabilizing world population at a level that can be sustained by Earth's resources. Drawn from over 5,500 students in grades 6 through 12 from 43 countries and 47 U.S. states and territories, the winning videos explored population growth as it relates to preserving biodiversity, sustainable resource use and protecting human rights.

COMMENTARY Don't let the 'Green New Deal' hijack the climate's future (*Hartford Courant*) [↗](#)

A call for a more focused approach

Joint Program Founding Co-Director Henry Jacoby and co-authors argue against bundling climate policy with multiple social objectives.

In blow to climate, coal plants emitted more than ever in 2018 (*Washington Post*) [↗](#)

The limitations of climate policies around the globe

MIT CEEPR Deputy Director Michael Mehling: Today's climate policies cannot offset increased emissions from economic growth, or spur the level of decarbonization needed to meet long-term Paris goals.

Was Joe Biden a climate change pioneer in Congress? (*Politifact*) [↗](#)

History says yes.

Some historians argue that climate change and greenhouse gases were the motivation behind a provision of the Clean Air Act of 1963, says Joint Program Co-Director John Reilly.

Hopes for Cutting Carbon Do Not Yet Match Reality (*Scientific American*) [↗](#)

Prices on carbon are not strict enough to make significant dents in emissions

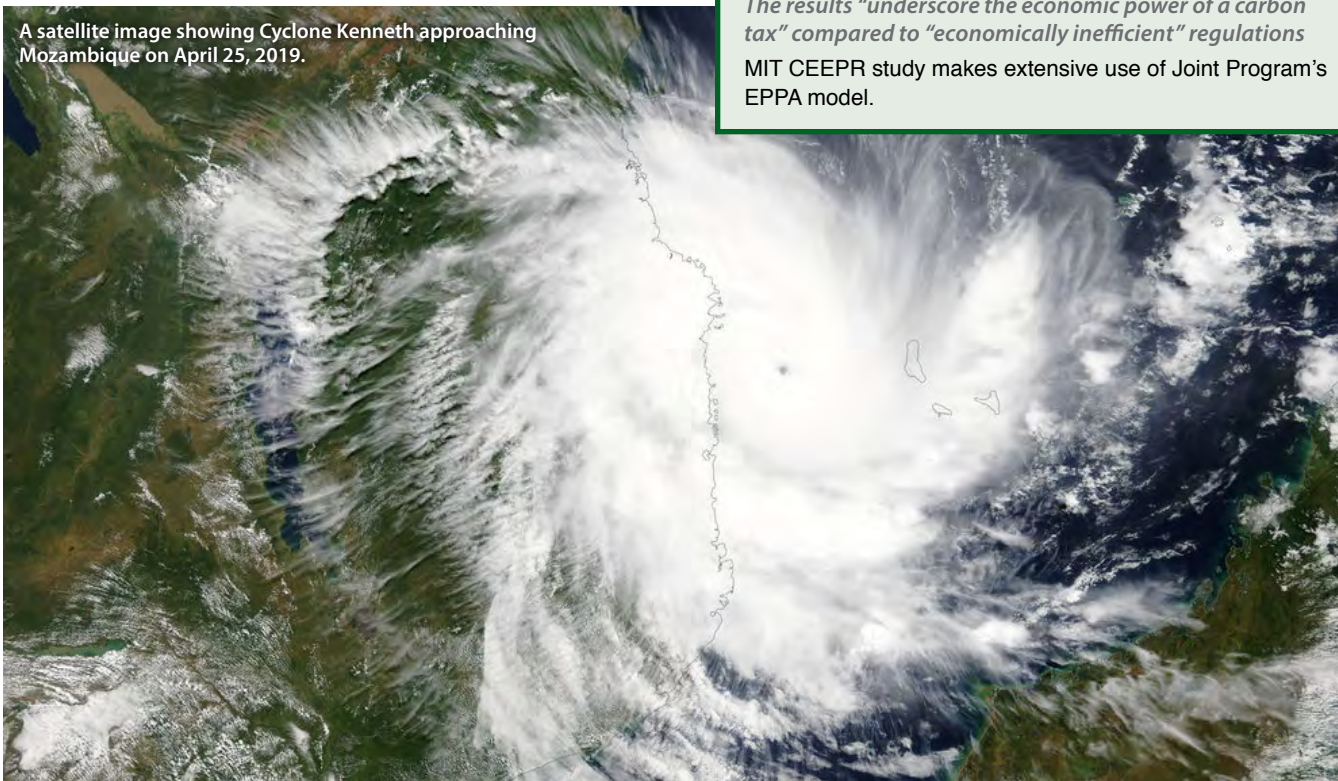
MIT CEEPR Director Christopher Knittel: Even where the majority of the population favors climate action, carbon pricing is a tough sell.

CLIMATE POLICY - CONT'D

Study: For low-income countries, climate action pays off by 2050 [↗](#)*Economic benefits of mitigation arrive much sooner than previously thought*

Successful global efforts to substantially limit greenhouse gas emissions would likely boost GDP growth of poorer countries over the next 30 years, according to a study co-authored by multiple Joint Program researchers. The study shows that beyond the benefits of reduced extreme weather in the long term, global mitigation efforts would also lower oil prices in coming decades, resulting in a significant economic boon for most poorer countries.

A satellite image showing Cyclone Kenneth approaching Mozambique on April 25, 2019.

**Going 'Zero Carbon' Is All The Rage. (WBUR)** [↗](#)*But Will it Slow Climate Change?*

NPR station cites Joint Program study that found that pricing carbon and returning the revenue from it to the public would reduce greenhouse gas emissions.

Advice on climate policy for the 2020 presidential candidates (The Hill) [↗](#)*Be ambitious, but not at the expense of credibility*

Joint Program Founding Co-Director Henry Jacoby and co-authors argue for fair, realistic, streamlined proposals.

New working paper makes case for "modest" carbon taxes (Axios) [↗](#)*The results "underscore the economic power of a carbon tax" compared to "economically inefficient" regulations*

MIT CEEPR study makes extensive use of Joint Program's EPPA model.

Regional Analysis**Controlling emissions under rapid economic growth** [↗](#)*How South Korea can meet its Paris climate pledge at low cost*

To better understand the emissions and economic impacts of South Korean climate policies, and how they can be optimally deployed to meet the nation's 37% emissions reduction goal, Joint Program researchers developed and applied a customized economy-wide model of the country. They showed that despite requiring a high economy-wide carbon price, South Korea can meet this goal while keeping GDP and welfare costs below one percent, due to the country's rapid economic growth.

Lowering emissions without breaking the bank [↗](#)*How India could meet its climate targets while maintaining economic growth*


Using an economy-wide model of India with energy-sector detail that they developed, Joint Program researchers assessed the economic implications of different policies aimed at meeting India's climate goals. They found that imposing an economy-wide emissions reduction policy alone, simulated by a carbon price, would result in the lowest cost to India's economy. By contrast, they found that a renewable portfolio standard would cost more than 10 times as much.

REGIONAL ANALYSIS - CONT'D

Pathways to decarbonizing a major economy 

Study shows how Brazil could meet Paris climate goals at minimum cost

A study by Joint Program researchers and collaborators shows that Brazil could meet both short- and long-term climate goals without imposing significant costs on its economy. The study projects that the economic impact of Brazil's Paris pledge would be less than one percent of GDP in 2030 under the nation's current plan, and that further efforts to reduce the nation's greenhouse gas emissions beyond 2030 could be implemented at low cost through an economy-wide carbon pricing system.

Making coal pricier is a cheaper way to cut Indian emissions than pushing renewables (Quartz) 

MIT Joint Program study explains why

Study suggests that combining a cap-and-trade system with renewable portfolio standards could enable India to set a carbon price that's politically palatable.

Farmland southwest of Luís Eduardo Magalhães, a town in the western coastal state of Bahia that has become a hub for agribusiness in Brazil.

The study projects that emissions reductions from the agriculture sector will help the country meet its Paris climate pledge for 2030, but other sectors will play a significant role after that.

**New Research Projects****Mercury pollution and human-technical-environmental interactions in artisanal mining**

Project Leader: Noelle Selin

Duration: 4 years

Collaboration: Led by MIT, involving Boston University (Henrik Selin) and University of California, Irvine (Ruth Goldstein)

This project applies a social, technical and environmental systems perspective to analyze mercury use and human well-being with a focus on artisanal and small-scale gold mining (ASGM) in Peru's Amazonian region of Madre de Dios. Mercury is an environmental pollutant that can travel far from its emission source, where it can damage human health and the environment. ASGM is estimated to be the largest source of global mercury emissions, and occurs in the context of power, race and gender dynamics in mining communities. A better understanding of the multiple, interacting factors that influence mercury use in ASGM will help advance knowledge about the atmospheric mercury system

and support governance efforts to address environmental and human health risks from mercury pollution. The project will develop and evaluate a new theoretical framework that can be employed to analyze interactions of people, technologies and the environment that can contribute to sustainability transitions. The project's broader impact will be to inform initiatives to mitigate environmental and social harms of ASGM activities, including those under the global Minamata Convention on Mercury. Project participants will engage with international organizations, NGOs, those affected by mercury contamination in communities and other experts to translate findings to practical action.

Sponsor: NSF Dynamics of Integrated Socio-Environmental Systems (CNH2) program

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1: See p 7

2: See p 3(b)

3: See p 3(a)

Joint Program Reprints

- 2018-20.** Air Quality Co-benefits of Carbon Pricing in China (*Nature Climate Change*)
- 2018-21.** Baseline evaluation of the impact of updates to the MIT Earth System Model on its model parameter estimates (*Geoscientific Model Development*)
- 2018-22.** Estimates of Climate System Properties Incorporating Recent Climate Change (*Advances in Statistical Climatology, Meteorology and Oceanography*)
- 2019-1.** Integrity of Firms' Emissions Reporting in China's Early Carbon Markets (*Nature Climate Change*)
- 2019-2.** Advanced Technologies in Energy-Economy Models for Climate Change Assessment (*Energy Economics*)
- 2019-3.** Learning about climate change uncertainty enables flexible water infrastructure planning (*Nature Communications*)
- 2019-4.** Ocean Colour Signature of Climate Change (*Nature Communications*)
- 2019-5.** Future nitrogen availability and its effect on carbon sequestration in Northern Eurasia (*Nature Communications*)

2019-6. Representing the Costs of Low-Carbon Power Generation in Multi-region Multi-sector Energy-Economic Models (*International Journal of Greenhouse Gas Control*)

Peer-Reviewed Studies & Pending Reprints

- A global 3-D ocean model for polychlorinated biphenyls (PCBs): Benchmark compounds for understanding the impacts of global change on neutral persistent organic pollutants (*Global Biogeochemical Cycles*)
- A Win-Win Solution to Abate Aviation CO₂ Emissions (*Journal of Air Transport Management*)
- Challenges for the recovery of the ozone layer (*Nature Geoscience*)
- Climate change and developing country growth: The cases of Malawi, Mozambique, and Zambia (*Climatic Change*)
- Co-benefits of China's climate policy for air quality and human health in China and transboundary regions in 2030 (*Environmental Research Letters*)
- Evaluating India's climate targets: the implications of economy-wide and sector specific policies (*Climate Change Economics*)

Health Co-Benefits of Sub-National Renewable Energy Policy in the U.S. (*Environmental Research Letters*)

Impacts of China's emissions trading schemes on deployment of power generation with carbon capture and storage (*Energy Economics*)

Modeling Unit Commitment in Political Context: Case of China's Partially Restructured Electricity Sector (*IEEE Transactions on Power Systems*)

Resilience of the Eastern African electricity sector to climate driven changes in hydropower generation (*Nature Communications*)

The Economic, Energy and Emissions Impacts of Climate Policy in South Korea (*Climate Change Economics*)

The Impacts of the Brazilian NDC and their contribution to the Paris Agreement on Climate Change (*Energy and Development Economics*)

Joint Program Reports

- 336.** Did the shale gas boom reduce US CO₂ emissions?
- 337.** Health Co-Benefits of Sub-National Renewable Energy Policy in the U.S.
- TN-18.** The MIT U.S. Regional Energy Policy (USREP) Model: The Base Model and Revisions

Milestones

In October Joint Program Founding Co-Director and MIT Sloan School of Management Emeritus Professor **Henry ("Jake") Jacoby** will receive an honorary doctorate from the University of Geneva. The University's School of Economics and Management is honoring Jacoby's contributions in the area of climate change and recognizing his strong ties to the School's efforts in this area.

An *Energy Economics* **study** on tight oil market dynamics co-authored by Joint Program Deputy Director **Sergey Paltsev** was cited in both a News & Views feature in the journal *Nature Energy*, and in Chapter 5, "**Unleashing the Power of American Energy**," of the 2019 Economic Report of the President.

Joint Program Research Scientist **Muge Komurcu's** paper "**High Resolution Climate Projections for the Northeastern United States using Dynamical Downscaling at Convection Permitting Scales**" was recognized as a "top 20 most read paper" in the journal *Earth and Space Science*.

MIT **IDSS/EAPS** Associate Professor **Noelle Selin**, supervising author of the paper "**Global and Local Impacts of Delayed Mercury Mitigation Efforts**," was honored as one of 24 outstanding researchers in the *Environmental Science and Technology* Early Career Scientists Virtual Issue.

Selin was a coauthor on two papers in the journal *Environmental Science: Processes & Impacts* that were nominated as part of the journal's Best Papers initiative in 2018: **One** on understanding the factors leading to detection of mercury policies in deposition the Great Lakes; **the other**, also on Great Lakes mercury, on responses of mercury deposition and bioaccumulation to policy.

Kerry Emanuel, EAPS Cecil & Ida Green Professor of Atmospheric Science and co-director of the Lorenz Center at MIT, **was elected** to the American Philosophical Society, the oldest scholarly society in the nation.

Stephanie Dutkiewicz was promoted to Senior Research Scientist.

Xiang Gao was promoted to Principal Research Scientist.



MIT JOINT PROGRAM ON THE SCIENCE AND POLICY of GLOBAL CHANGE

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