



People Aren't the Only Beneficiaries of Power Plant Carbon Standards

by Britt Faulstick

When the Environmental Protection Agency finalized the Clean Power Plan in 2015, it exercised its authority to regulate carbon dioxide emissions to protect public welfare. The Plan, now the focus of escalating debate, also put the nation on course to meet its goals under the Paris Climate Agreement. Given that other pollutants are emitted from power plants, along with carbon dioxide, research has shown that carbon emissions standards for the power sector benefit human health. New research released today shows that they would *also* benefit crops and trees.

The study, "Estimating Potential Productivity Co-Benefits for Crops and Trees from Reduced Ozone With U.S. Coal Power Plan Carbon Standards," was recently published in the *Journal of Geophysical Research Atmospheres* and authored by researchers from Drexel University, Syracuse University, Boston University, and Harvard University, convened by the Science Policy Exchange. It is the first study to model the ecosystem impact of contrasting policies, one of which was similar to the Clean Power Plan. "In assessing the regulatory impact of the Clean Power Plan, the EPA estimated monetary benefits of reduced carbon dioxide emissions, as well as quantifying and monetizing certain public health benefits, such as reduction in premature mortality and morbidity due to particulate matter to ozone exposure," the researchers write. "The EPA did not quantify the co-benefits to crops and trees but treated these co-benefits quantitatively."

According to the study, which included an option similar to the Clean Power Plan, the corresponding reduction in carbon, nitrogen and sulfur emissions from coal power plants would also mean a decrease in ground-level ozone, a known inhibitor of plant growth. By modeling these reductions in the year 2020, the researchers found that they would provide a significant boost to the productivity of key indicator crops, such as corn, cotton, soybean and potato; as well as several tree species. "Our findings suggest that crops like corn, soybeans and cotton could benefit from substantial productivity gains under moderate carbon standards for power plants," said **Shannon Capps, PhD** (pictured right), Assistant Professor in the CAEE Department and author of the study. "With policies similar to those in the Clean Power Plan, we're projecting more than a 15 percent reduction in corn productivity losses due to ozone exposure, compared to business as usual, and about half of that for cotton and soybeans. Depending on market value fluctuations of these crops over the next few years, that could mean gains of tens of millions of dollars for farmers, especially in areas like the Ohio River Valley where power plants currently contribute to ground-level ozone."



Dr. Shannon Capps

The team used three policy scenarios that encompass a range of emissions targets and reductions measures, and they compared each policy scenario with a "business-as-usual" reference case that represents current clean air policies, as well as energy demand and market projections. Then, using a computer model widely employed to help guide state-level decision making for compliance with the National Ambient Air Quality Standards, the group generated a detailed projection of what the surface-layer ozone would look like across the country under each policy scenario through 2020.

The team looked at the consequences of lower ozone for five crops whose primary growing season is June through August, which is the period when ground-level ozone is known to be at its peak. They also evaluated the consequences for 11 tree species, including eastern cottonwood, black cherry, quaking aspen and several species of pine. These crops and trees have been used as standard indicators in environmental research. Based on previous research by crop and tree scientists, the team could relate their models' ozone-exposure findings to the productivity of crop and tree species. "The option most similar to the Clean Power Plan has the greatest estimated productivity gains for the crops and trees that we studied," said Capps. "The improvement in crop yield and tree growth was strongly tied to the level of carbon dioxide emissions reductions and adoption of cleaner energy achieved by the policy."

Under the business-as-usual scenario, the productivity of soybean, potatoes, and cotton is reduced about 1.5 percent, with only slight impacts on corn. These levels of production only slightly improve under a policy scenario that includes only "inside the fence line measures" such as improving the efficiency of coal-fired power plants.

A second scenario, that most closely resembles the Clean Power Plan and includes demand-side energy efficiency, substituting lower-emitting natural gas plants and zero-emitting solar and wind power into the energy mix, produces larger results. The potential corn production lost to ozone exposure in the reference scenario is reduced by 15.7 percent, soybean losses are reduced by 8.4 percent and cotton losses are diminished by 6.7 percent.

Under the third scenario, which reflects putting a price on carbon, and achieves similar emissions reductions as the second scenario, the researchers project slightly lower reductions in ozone-induced losses for corn (12.1 percent), soybean (6.6 percent) and cotton (3.8 percent).

Productivity among tree species, as measured in biomass yield compared to the reference scenario, also suggests that the plants will benefit from ozone-reducing policies. The tree species with the greatest potential for productivity losses, black cherry and eastern cottonwood, show 7.6 and 8.4 percent reductions in the projected ozone-induced biomass reductions, respectively, under the scenario most like the Clean Power Plan.

"Our work shows the importance of considering the co-benefits of our nation's energy policies going forward," said Charles Driscoll, PhD, professor at Syracuse University and co-author of the study. "These benefits to people and plants are nearly immediate and occur in urban and rural communities across the U.S. We know from this and other studies that the economic value of the added benefits from power plant carbon standards are large and exceed the estimated cost of implementation."

Members of the team are analyzing the co-benefits of power plant carbon standards for reducing regional haze and acid rain and conducting new research on the co-benefits of the final clean power plan as compared to different energy policy futures.

Results of the study are accessible at the following link: <http://modelingair.com/croptreecobenefits>.

Emin Aktan Receives Prestigious 2017 Charles Pankow Award

Dr. Emin Aktan (pictured right), John Roebling Professor of Infrastructure Studies, along with Dr. Franklin Moon, a Professor in the Department of Civil and Environmental Engineering at Rutgers University, former PhD students, John DeVitis and David Masceri, together with engineers from Pennoni Associates, Jeffrey Purdy and Anthony Bartolomeo, and Hamid Ghasemi from FHWA, were awarded the American Society of Civil Engineer's Charles Pankow Award for 2017.



Emin Aktan

This award is for a device Moon and Aktan designed and developed by a NIST award to Drexel University for over three years. The device (pictured below) called THMPER, short for "Targeted Hits Measure Performance Responses," is pulled by a van that is equipped with a GPS, computers, internet, and long-term diesel power, and provides controlled impacts at selected positions on a bridge. Using the device, there is no need to close a bridge; just slowing down the speed of traffic is necessary. The impact and corresponding responses are measured by accelerometers deployed by the trailer automatically, and the results are immediately transformed to the dynamic mechanical characteristics of the bridge. This device offers objective quantitative data about bridge conditions from which load capacity is inferred.



THMPER

is based on three things: 1.) Innovative Technologies; 2.) Collaborative Research and Implementation; and 3.) Impact on Construction Industry Performance.

Dr. Aktan won the same award at the University of Cincinnati, together with Strain Monitoring Systems and FHWA, for developing a sensor offering "Simplified Monitoring Systems for Civil Structures."

The Charles Pankow Award for Innovations was established by the Civil Engineering Research Foundation (CERF) in 1996. Named for industry visionary Charles J. Pankow, the award recognizes the contributions of organizations working collaboratively to advance the design and construction industry by introducing innovation into practice. It was instituted as a Society award on December 17, 2008. The Pankow award

Resolving to Act After the 2016 U.S. Election and the United Nations Climate Conference

by **Dr. Franco Montalto and Hugh Johnson**

We attended the 22nd session of the United Nations Climate Conference (also called COP22) as "Observers" in the immediate aftermath of the U.S. 2016 presidential election. Since 1995, the COP has served as the annual UN climate conference, providing an opportunity to assess progress, negotiate agreements, and disseminate information regarding global climate change action. This year's COP was simultaneously exhilarating and uplifting, a message that we are determined to bring home to a country still reeling from an election that has elevated someone who called climate change a hoax to our nation's highest office.



Dr. Franco Montalto (far left) and Hugh Johnson (far right) with representatives from Drexel University at COP22

Thanks to its official Observer status, our employer, Drexel University, was one of hundreds of civil society institutions from around the world permitted to send a delegation to the two-week meeting in Marrakech, Morocco (7-18 November 2016). Our Office of International Programs and our Institute for Energy and the Environment sent an envoy of 10 faculty and students to this meeting, five each week. Our role as "observers" was none other than to attend the various summits, official meetings, and side events and to report on the actions that nation-states, indigenous peoples, businesses, mayors, and individuals are taking to address the challenges posed by climate change. We networked with other civil-service institutions, conducted an informal survey, listened to talks, and were interviewed by National Public Radio (11/21/16, State Impact NPR, "Pennsylvania Academics Find Inspiration at Climate Conference").

The ongoing actions being discussed in Morocco would not have been possible if not for the historic agreement reached last year in Paris at COP21. The so-called "Paris Agreement" represented the first time that world leaders achieved global consensus regarding the need to work collaboratively to hold future global temperature increases to under two degrees Celsius. Over the last year, national governments had to formally ratify the agreement. Only 55 countries, accounting for 55 percent of global greenhouse gas (or GHG) emissions, needed to formally ratify the historic agreement for it to go into force; however, according to U.S. Secretary of State John Kerry, speaking at the meeting in Marrakech, more than 109 countries - collectively responsible for 75 percent of global GHGs - had already signed prior to COP22, a much faster pace of ratification than anyone expected. Clearly, the need for global climate action has become a widely-held international value, shared not just by scientists and environmentalists, but also by governmental leaders, their rank and file governing

bodies and agencies, and the private sector, whose interests underlie many political decisions.

With the signed agreement in force, conversations in the restricted Blue Zone of this year's COP, focused on implementation strategies, identifying knowledge gaps, networking, and financing. The various meetings highlighted the efforts that individual countries have undertaken to identify the sources of their existing emissions, and gave them a platform to articulate their specific strategies for achieving their nationally determined contributions (or NDCs) to global GHG emission reductions. Discussions also addressed how specific countries, cities, and other sub-national actors are planning to nurture, manage, or shape forecasted economic and population growth, peacekeeping, and advances in human rights while keeping their emissions under control. Again, according to Secretary Kerry, each nation is now in the process of developing its own plan, tailored to its own circumstances, and according to its own abilities. It is an example of common but "differentiated responsibilities," with the most vulnerable nations being helped along by those most equipped to address this challenge.

In the publicly-accessible Green Zone of the meeting, attendees were largely focused on the role that the private sector and civil society can and must play. In small and large booths, vivid displays highlighted everything from the voluntary emission reduction goals of large multi-national corporations to small scale entrepreneurial efforts to innovate new ways of deriving fuel from waste, or to create new market opportunities for existing technologies such as the "Nigerian Refrigerator," which can cool a pot of fruit from 40 degrees Celsius to four degrees Celsius relying solely on evaporative processes. The Green Zone included interactive meetings where individuals could spontaneously join group discussions focusing on climate justice, racism, and other struggles intimately related to climate change. It also featured an international, socially-engaged art exhibit.

Marrakech, a beautiful city situated at the foot of the Atlas Mountains and at the edge of the Sahara Desert, was the perfect backdrop for this kind of

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by Dr. Franco Montalto and Hugh Johnson

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multi-faceted exchange of ideas. Each day, as our group walked through its central square, the *Jemaa el-Fna*, a dynamic urban space packed with storytellers and snake charmers, musicians and dancers, traders and merchants, street food vendors, and children, we thought, what better setting to host the growing cost-cultural, global dialogue regarding the planet's future? The square's air is full of smoke, smells, sounds, and slang; its perimeter is lined with shops, rooftop restaurants, and street-level cafes. A vibrant, multi-actor, pulsating center of contrasts between old and new, of negotiation and of barter, it represents, in miniature, what is now happening on the world stage between global leaders, policymakers, entrepreneurs, and other vested individuals.



A scene from COP22, held in Marrakech, Morocco

But what was most exhilarating to witness was how integrated the global response to climate change has become inside other contemporary efforts to improve the human condition. COP22 is just the most recent of a historic string of new pacts and agreements that will collectively guide the next phase of global human development. It began in 2015, when the United Nations officially replaced its *Millennium Development Goals* (or MDG's) with *17 Sustainable Development Goals* (or SGD's), and 169 carefully articulated and intimately-related targets. The SGD's point the way to the next wave of progress on poverty alleviation, environmental protection, and the spreading of economic prosperity. A few months later, in March 2015, and at the request of the UN General Assembly, the *Sendai Agreement of Disaster Risk Reduction* - another global pact focusing on resilience and reducing the impacts of disasters on lives, livelihoods, health, and economic, physical, social, cultural and environmental assets - was adopted. The *Paris Agreement* was signed on December 12, 2015, and went into effect less than one year later on October 5, 2016. On October 15, 2016, after the conclusion of all-night negotiations in Kigali, Rwanda, an agreement was reached to limit the use of

hydrofluorocarbons (or HFC's), resulting in the largest potential temperature reduction ever achieved by a single agreement, as much as 0.5 Celsius. Later, in October of 2016, in Quito, Ecuador, the United Nations Conference on Housing and Sustainable Urban Development (called Habitat III) concluded with the adoption of *the New Urban Agenda*, a document that establishes new global standards for sustainable urban development, focusing on collaborations necessary to more sustainably build, manage, and live in cities.

The "conversation" in Marrakech focused on how policymakers, planners, designers, business leaders, and individuals from all corners of the globe can integrate all of these different goals and aspirations into actionable initiatives at local, regional, national, and international scales. How can we design safe, accessible cities, with low-carbon transport systems, stable governing bodies, and equitable access to resources? How can we re-imagine our coastlines as multi-functional living landscapes, equipped to adapt to rising sea-levels, but also supportive of critical fisheries, emergent habitats, and other forms of biodiversity? Where and how, in geographical and economic terms, will we feed ourselves, live, earn a living, and play, as both the global and urban populations of the world reach historical populations? What successful models have been piloted, and what can we learn from them? These and other related, intellectually stimulating, and fundamentally important questions were on the lips of just about everyone we bumped shoulders with on the sprawling conference grounds.

Personally, we were reassured to witness this important conversation elaborated in so many different ways, by so many different people, in so many different languages, at COP22, even as the U.S. prepares for a new president. President-elect Donald Trump's dismissive rhetoric during the campaign, and the expressed views of many individuals he appears poised to appoint as part of his Cabinet, suggest that this administration may not instinctively understand the urgency of global collaboration on any of these issues. Where the Obama administration has led, the incoming administration seems, at least initially, to want to close the door. Like many other Americans attending the meeting, we used phrases like "angrily charged" and disillusioned, but determined" to describe our post-election feelings at a workshop organized at the conference by *Mediators Without Borders* (or MWB) as an outlet for attendees to express our emotional reactions to the election results, and to convert these into a constructive reorientation of our professional activities.

To elicit global perspectives on the election, our Week Two delegation designed an informal survey to conduct after the MWB workshop, as we circulated among the tens of thousands of conference attendees. It featured two core questions: "What was your reaction when you heard the results of the U.S. election?" and "Do you have a message for the incoming U.S. Administration regarding climate change?" Though we would be remiss not to mention that among the conference attendees were certainly a small group of individuals who were not surprised, or even satisfied, by Mr. Trump's victory, responses to the first question overwhelmingly reflected many of the same feelings of shock, horror, and devastation articulated in the MWB workshop. But regardless of their feelings about Mr. Trump, and without exception, respondents to the second survey question urged the President-elect to follow his predecessor's example by collaborating with the international community on efforts to battle climate change and to also lead in related struggles for sustainable development.

Leaders from all levels of government have expressed the same sentiment, tinged with optimism that significant backpeddling may no longer be tenable. UN Secretary General Ban Ki-Moon said he counts "on the U.S.'s continued engagement and leadership to make this world better for all..." Brian Deese, Senior Climate Advisor to President Obama, reported in Marrakech that for the first time in human history, carbon emissions are now completely decoupled from economic growth. Jonathan Pershing, the U.S. Special Envoy on Climate Change, stated confidently that, "The transition to clean energy is now inevitable." While we still have many profound challenges, "the momentum is insurmountable: there is no stopping," he said.

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Charles Haas Receives Distinguished Achievement Award from Society of Risk Analysis



Dr. Charles Haas

Dr. Charles Haas, LD Betz Professor of Environmental Engineering and Department Head, Civil, Architectural, and Environmental Engineering, was presented with the Distinguished Achievement Award of the Society for Risk Analysis for extraordinary achievements in science or public policy relating to risk analysis. The award was presented at the annual meeting of the SRA on December 13, 2016 in San Diego, CA.

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Indeed, the recent open letters from more than 300 companies and from 37 red band, blue state mayors, asking President-Elect Trump not to abandon the Paris Agreement, is further evidence of the deep roots that this movement now has.

For all these reasons, we returned Stateside full of renewed excitement, resolve, and hope. We are not naive to the struggles we may have to face domestically, but we feel more energized, focused, and determined than ever before about the importance of the work we are all doing. The time to perfect our analyses, demonstrate our ideas, publish our work, talk to our neighbors, and to let our values drive our personal and professional activities is now. We must be the change and action that we want to see in the world.

This month, Drexel became the North American Hub of the Urban Climate Change Research Network. We have listed two preliminary goals to guide our activities: we will continue to generate and to disseminate scientific knowledge where it can inform sound decisions and policy, and to support our practitioner colleagues in their efforts to implement change. But in other contexts, ones where change must be catalyzed through other means, we are prepared to apply other forms of pressure, drawing from the enormous fountain of energy, creativity, and connections available to us through the growing international demand for climate action, social justice, and sustainability. We invite you to join us as we transition from debates to determined action at all levels of our global community.