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Measuring the Costs of Carbon

The summer of 2017 was an unusually tumultuous weather season for the Chicago area, as thunderstorms and heavy rainfall plagued the region. From July 19 to 23, nature unleashed its full fury on northern Illinois, drenching the region with three to seven inches of rainfall in a 24-hour period. The consequence? Catastrophic flooding in the Des Plaines River and Fox River basins. It took weeks for the floodwaters to recede, especially in Gurnee and other communities in Lake County.

Warming temperatures associated with climate change undoubtedly magnified the intensity of those storms. According to the Lake County Stormwater Management Commission, the atmosphere holds 7 percent more moisture because of increased temperatures since the beginning of the Industrial Revolution in the mid-1700s. What's more, since 1895, the amount of rainfall in Illinois has increased by 4.14 inches per year. In 2018 alone, Lake County experienced six thunderstorms in which the amount of water exceeded flood stages.

BY CHRISTOPHER JOHNSON

These weather events exact a major economic toll. The 2017 floods, for example, damaged or destroyed 550 homes. The overall cost estimates for the damage in the county was \$12.7 million. In addition, the Fox Waterway Agency spent approximately \$3.5 million to clear debris such as trees and broken-up piers from the Fox River.

The Chicago area is far from alone in seeing exploding costs from weather events related to climate change. For example, the United States has seen a 223 percent increase in wildfires since 1983. Last year, the country suffered through 58,950 wildfires, which burned 10,122,336 acres, causing \$16.5 billion in damages. The costliest

year for wildfires was 2017, when \$24 billion in damages was caused. Another \$22 billion in damages was incurred in 2018. A single fire, the Camp Fire in 2017 in California, caused \$10 billion in damages.

As is evident from the 2017 Chicago-area flooding and the western wildfires, climate change is costing enormous amounts of money. What exactly is the toll of climate change? Is the economic growth of the United States and other countries slowing because of costs associated with warming temperatures? To answer these and other questions, economists have developed ways to measure the social costs of carbon (SCC)—the costs to society of extreme weather events and other impacts of rising global temperatures.

According to Jarmo Kikstra, a Research Scholar at the International Institute for Applied Systems Analysis in Austria, “Under certain assumptions about the future, we can calculate how much an extra bit of climate change caused by one tonne of carbon dioxide emission would cost society. The balance of the costs and benefits from emitting extra carbon dioxide will have possible costs and benefits for society. They can be expressed in U.S. dollars, and that’s what we call the social cost of carbon.”

Kikstra continues, “It’s a bit like if someone plays baseball, and the ball accidentally breaks a window. It’s only reasonable and fair to estimate the costs of that accident from playing baseball because we are damaging something that belongs to someone else. You want to see how much you would repay the neighbor for the window.”

Legislators and other policymakers can use the SCC to determine whether the costs and benefits of a particular climate policy are justified economically. If the SCC is higher, then the policy generally is justified. If the SCC is lower, then the policy is not justified. The U.S. Environmental Protection Agency, for example, uses the SCC to weigh the costs and benefits of approximately 100 federal actions,

In recent years, wildfires caused by the hot, dry weather associated with climate change have caused enormous damage in the western United States. Photo courtesy of DeadMityay.

(Top) In July 2017, storms released as much as seven inches of rain in 24 hours in the Chicago area, causing widespread flooding and millions of dollars in damages. Photo courtesy of innimico.

(Bottom) On September 24, 2021, Hurricane Ida swept through New Orleans, yet sea barriers helped prevent the damage from equalling that of Hurricane Katrina in 2005. Photo courtesy of WAMorgan.



such as setting carbon emissions standards for cars and trucks and regulating the amount of pollution from power plants.

According to Kikstra, “We know that when Hurricane Katrina hit New Orleans in 2005, it cost lives and the economy was strongly affected. The economy in New Orleans has never fully recovered. We know that in general, as the climate warms, hurricanes become stronger, so the damage will get even bigger.”

After Katrina, city, state, and federal governments spent millions to protect New Orleans by building sea barriers. Kikstra explains, “This year, Hurricane Ida hit, but it had a smaller impact, and that’s because there is now a sea barrier that basically reduced mortality by a lot.” By measuring the SCC, policymakers were able to justify the costs of building barriers to better protect the city.

Economists use computer models to determine the dollar amount of the SCC, using four factors:

- Social and economic factors, such as the amount of economic growth and the amount of carbon emissions.
- Projections of climate change, including how much temperatures are expected to rise and how long emissions are projected to stay in the atmosphere.
- Estimates of costs and benefits. For example, how much will it cost to build sea walls to protect coastal cities like New York and Miami? How much will it cost to rebuild forests destroyed by wildfires? What are the costs of building wind turbines? Of installing solar panels?
- The discount rate. Most of the benefits from mitigation policies will come in the future, but we pay for them in the present. As a result, economists apply a discount rate—the rate at which we are willing to trade the benefits today for benefits in the future. If we use a high discount rate, we value the money today more than the value of the climate mitigation policy in the future. A low discount rate implies that we are willing to spend more money today to protect future generations.

How does the U.S. government establish the SCC? Back in the early 1980s, the Reagan Administration started to require federal agencies to analyze the costs and benefits of federal policies. Since then, every administration has conducted cost-benefit analyses for proposed federal policies. In 2008, the U.S. Court of Appeals ruled that the federal government must take into account the economic impact of climate change in cost-benefit analyses.

The following year, the Obama Administration established an Interagency Working Group (IWP) of the federal government, and that Group formulated an estimate of the SCC that all government agencies would use. The Obama Administration established a social cost of carbon of \$51 per tonne of greenhouse gas emissions, with a discount rate of 3 percent.

The Trump Administration—reflecting President Trump’s skepticism about climate change—disbanded the IWP in 2017. In the absence of an IWP, government agencies, including the EPA,

used SCC estimates that were as low as \$1 per tonne of emissions, greatly understating the economic impacts of climate change.

When Joe Biden took the oath as President in January 2021, he immediately re-established the IWG, which set an interim SCC of \$51 per tonne of emissions and a discount rate of 3 percent. The re-invigorated IWG is currently updating the SCC, not only for carbon dioxide but also for methane and nitrous oxide.

In recent years, many economists, including Nobel laureate Joseph Stiglitz, have argued that the government should establish a discount rate of two percent rather than three percent. Doing so would give more weight to future mitigation of climate change as opposed to current costs. Dr. Stiglitz argued that “there is no ethical justification for giving so little weight to future generations’ welfare.”

What does the SCC mean for citizens as we consider climate-change policies and how they might affect our children and grandchildren? Jarmo Kikstra says, “If we want to take the social cost of carbon into account in policies, policymakers might put a carbon tax or at least value carbon emissions when you are deciding policies. If you don’t take the social cost of carbon into account, you’re basically only counting the positives. You can’t develop policy if you don’t take into account the negatives. If you drive a very polluting car, for instance, this creates much more pollution. If you travel by train, the pollution is much lower. So you might design mobility more around trains than cars. You’re more holistic in your policy design.”

Take the example of Lake County flooding. The SCC helps us understand policies that the Lake County Stormwater Management Commission has undertaken. In 2006, the County adopted the Lake County Countywide All-Natural Hazards Mitigation Plan, in which county officials assessed flood risks and developed mitigation strategies for flooding in the future.

The strategies include voluntary buybacks of residences in flood-plains, preservation of wetlands, control of erosion and sedimentation, stream restoration, and construction of flood detention basins. Such measures cost money, but in the long run, these mitigation costs will save money by reducing the effects of flooding in the future.

Federal, state, and local governments are taking such steps partly because the concept of the SCC has made government officials—as well as business executives—aware of the costs and benefits of steps to mitigate the impact of climate change. As Jarmo Kikstra emphasizes, “Calculating these damages makes us aware of the impacts.” □