Tectonic Episode 02 - Making Science Work for Policy and the Public

Noelle Selin 00:00
Atmospheric chemists have been really involved in helping the community understand that aerosols do travel long distances. So if they can transport across the Pacific Ocean, of course, they can go more than six feet across the room. The idea that this was happening was very hard for the medical community to accept.

Brendan Karch 00:21
This is Tectonic, a podcast uncovering the shifting foundations between science and society. I'm your host, Brendan Karch. In this episode, we explore the interface of science and policy, and see how regulating one specific pollutant can provide a model for future policymakers. Our guest is an atmospheric chemist, who is devoting her career to improving how science benefits the public good.

Noelle Selin 00:53
I'm Noelle Selin. I'm a faculty member at MIT and the Institute for Data, Systems and Society and also in the Department of Earth, Atmospheric and Planetary Sciences. And I direct the Technology and Policy Program at MIT.

Brendan Karch 01:05
Noel earned her PhD in Earth and Planetary Sciences from Harvard. She then moved to MIT, where she's taken on multiple roles at the interface of science and public policy. But it's her own scientific research that has given her the most direct policy experience. Noelle is an expert on mercury, the element that is, not the planet.

Noelle Selin 01:29
When you think about mercury, for example, in a thermometer, and that's the elemental version, that's just mercury in its elemental form. And in fact, most mercury in the atmosphere is also in the elemental form. It's just as a gas as opposed to that silvery liquid that you might be familiar with if you're thinking about an old thermometer.

Brendan Karch 01:48
This is where Noelle's expertise lies, in how mercury interacts with our global environment and with our societies.

Noelle Selin 01:57
Mercury is a really interesting pollutant because people and societies have used mercury for millennia for a variety of different applications. It's been important in industry, it's ubiquitous in society, and it's also a global pollutant.

Brendan Karch 02:13

Mercury has been an integral part of human history dating back to early civilizations, but it's also a history in which mercury's usefulness to humans is inextricable from its toxic effects on our bodies.

News voiceover 02:27
The case of a small child whose development was stunted by mercury poisoning is renewing fears of tainted deep sea fish....

Noelle Selin 02:34
It's dangerous to human health because people are exposed to mercury, largely in the form of methylmercury, a particularly toxic form, which builds up in fish and marine mammals. And people are exposed when they eat fish with high levels of methylmercury, and it causes neurological damages and other health impacts.

Brendan Karch 02:52
Humans didn't always know about mercury's toxicity. In fact, we used to intentionally put it into human bodies as medicine.

Noelle Selin 03:01
Mercury was used as a treatment for many diseases, including diseases like syphilis, and this use persisted over decades and even centuries with no evidence that it actually worked, and potentially causing harm in the process.

Brendan Karch 03:18
Even when not intentionally consuming mercury, one of the challenges is how easily it spreads globally. You might think of mercury as a silvery metal in older thermometers, or in fluorescent bulbs. But as Noelle mentioned, it also exists in a gaseous form where it can travel long distances.

Noelle Selin 03:37
What happens when that mercury gets into the atmosphere is it reacts, it turns into a more reactive gaseous form. And that form is more soluble in the atmosphere, it can rain out and enter waterways.

Brendan Karch 03:49
It's as a gas that mercury is most dangerous, because it can react to create the even more toxic form of methylmercury. And where did these mercury gasses come from?

Noelle Selin 04:00
One of the biggest sources today is burning coal. So the mercury that ends up in fish could come from a coal-fired power plant across the world, travel through the atmosphere, deposit to the oceans, and then build up in fish.

Brendan Karch 04:13

Just as it spreads across the planet, so too does mercury endure across time, even centuries.

Noelle Selin 04:21
One of the really interesting factoids we have in the book is that the mercury that might be in your piece of tuna sushi today could come from today's sources, such as coal-fired power plants, or this artisanal mining, but it could also come from mining centuries ago, and historical sources which continue to circulate in the environment.

Brendan Karch 04:43
It is this long-term human entanglement with mercury that makes it so fascinating. The mercury in our planetary systems -- in our water, in our organisms -- wouldn't exist anywhere on the scale and in the places it does, were it not for humans.

Noelle Selin 05:00
We're not looking at a purely natural system, we're looking at a human influenced earth system. So if I look at earth science problems today, I find I can't really understand them without really looking at the human factors and what people are doing.

Brendan Karch 05:13
This idea that humans have so demonstrably changed our earth systems, our flows of elements, our rivers, our global climate -- this idea has a name. Many scientists say that we are living in the era of the Anthropocene.

Noelle Selin 05:31
It's a term that's often used as a proxy for the geological era that is really defined by human influence. So human society has developed in what geologists called the Holocene. And that's a geological era associated with a relatively stable climate. And it's been noted that human influence on the climate and other systems is so overwhelming across the whole earth that it's questionable whether we're really in the Holocene anymore, whether it's another entire geological era that has replaced the Holocene.

Brendan Karch 06:07
If we are indeed living in the era of the Anthropocene, then humankind must also hold itself responsible for the planetary changes it has wrought. But how does one go about changing our practices around an element like mercury? Well, it ends up that our relationship has been evolving for centuries, and can continue to change rapidly.

Noelle Selin 06:34
For example, in history, there were a lot of uses of mercury that were for very useful purposes in society. For example, we tell the story in the book about the use of mercury in chlorine production.

Brendan Karch 06:48

Historically, chlorine was produced by getting mercury cathodes to react with salts. This process emitted mercury into the atmosphere. In the last 50 years, however, newer, cleaner technologies have come online. But chlorine plants have been slow to adapt. Only at the end of 2017 did the EU force 21 chlorine plants still using the mercury method to either convert or close down.

Noelle Selin 07:18
Now there are alternatives to mercury in those production processes in compact fluorescent light bulbs, for example, which reduce energy relative to old incandescent bulbs. And now we have LED bulbs which don't contain mercury. So thinking about what kinds of processes can then phase that out.

Brendan Karch 07:38
While markets and costs can sometimes tilt us away from mercury, it really requires regulation, and international regulation at that, to tackle the global challenge that is mercury pollution.

Noelle Selin 07:51
The awareness that mercury is a global pollutant really prompted the idea that in order to address mercury and mercury pollution globally, it really requires global cooperation. So you're talking about a pollutant that travels across borders, which accumulates in fish in the global oceans, and the sources of mercury were worldwide.

Brendan Karch 08:14
Noelle was deeply involved in helping international organizations to address this planetary problem.

Noelle Selin 08:21
So there's an increasing awareness starting in the early 2000s about the need to cooperatively address mercury and efforts under the United Nations Environment Program started with voluntary efforts. But in the mid 2000s, the agreement was that there should be a global treaty to address mercury.

Brendan Karch 08:42
Noelle attended several sessions that produced the agreement known as the Minamata Convention, named after the town in Japan where methylmercury's danger was first identified.

Noelle Selin 08:53
So the treaty not only addresses some of these issues of products and processes where mercury has historically been used, which I was talking about, but also emissions from coal, for example, from point sources, also artisanal and small scale gold mining, and it really looks at mercury in a comprehensive way. For the final negotiating session, which was actually in Geneva, I was able to take 10 MIT students to that session and really see that treaty actually come to fruition.

Brendan Karch 09:22

Signed by 128 countries, the Minamata Mercury convention sets new limits, or phase out dates, for nearly every part of the mercury cycle, from mining to manufacture, from storage and transport to disposal. And in the process, it's helping control emissions too.

Noelle Selin 09:42
All of the work that I do in air quality and toxic substances and climate change really shows that fossil fuels are a source of all of these things. So there are multiple benefits from getting rid of fossil fuels in the longer term.

Brendan Karch 09:58
The story of mercury leaves a big. Why was global regulation successful? Yet, cooperation on greenhouse gasses always seems to fall short? Some of it is certainly the larger, deeper scale of the problem. Our economies would simply grind to a halt without the constant burning of fossil fuels. But Noelle also believes there are better ways for scientists to engage the public to tackle our big global challenges. The key, she says, is that we must deepen the connections between science and the public at earlier stages, making the process of science more transparent to the larger world.

Noelle Selin 10:40
A longer-term sort of more fundamental solution to this is to really open up the process of science to begin with. To really think about what kinds of questions science is asking, what kinds of communication has been going on during the process of creating that science, and then really embedding that communication as part of a broader scientific process.

Brendan Karch 11:03
In other words, scientists need to build relationships over the longer term, be more transparent while doing science, and democratize their engagement. Scientists can't simply swoop in at the final moment when policies are decided, in order to assert their conclusions.

Noelle Selin 11:20
If you're sort of starting with the 'I already have my science, and I need to figure out a way for the public to accept it,' you're starting already too late.

Brendan Karch 11:28
This means instead addressing policymakers at the earlier problem stage, in order to co-create the solutions with partner buy-in. At MIT, new oil helped work on this very challenge with climate change.

Noelle Selin 11:41
One example was some early work we did on thinking about ways to reduce greenhouse gasses in the US context. We looked at what the air quality implications of that were. And when we originally had written the proposal, we were looking at, you know, way out until 2080, for example, and this was a study we did we did about 10 years ago, and we called in, we had some partnerships with air quality regulators from US states. And they said, Well, you know,

actually, what would be more useful and interesting is to think about the near term. What's happening between now and 2030? What kinds of interventions could we actually do that would be the most beneficial for air quality?

Brendan Karch 12:25
Refining the problem together with policymakers meant better solutions could be reached.

Noelle Selin 12:31
We came up with a study that really looked at, well, if you take this carbon out of energy first or out of transportation first or just out of the whole economy, do those have different implications for air quality? That whole question came out of our conversations with the air quality regulatory community. And it made it much more effective to communicate afterwards, because we were asking a question that they were interested in the answer to.

Brendan Karch 12:55
Getting scientists more interested in policy at an earlier stage is one of Noelle's core goals, as head of MIT's Technology and Policy Program. She's leading the charge to help train a new generation of MIT students to be both responsible scientists and citizens.

Noelle Selin 13:15
So the idea really is to create a cohort of people who are hopefully leading this area, and really enhancing the ability of people who are trained in science and engineering to operate in policy spaces, to really contribute to these societal problems, and to have the skills that are needed to sort of bring people together. One of the priorities that I have is really to think about this program as creating leadership, but also to embed policy and societal thinking in a wider range of science and engineering fields. Going back to what we talked about, about the Anthropocene, to really understand what's going on in environmental science in many fields really needs understanding of what's driven by humans, but also societal and social processes that really affect what we're seeing in data, and what we're seeing in the atmosphere and the land. So really understanding these feedbacks and having the tools to engage with society as people are trying to build a more sustainable future: that's really what I see as the the goal of education in this area.

Brendan Karch 14:22
This policy strategy also means reaching out to communities and making sure diverse stakeholders are heard and represented -- in other words, democratizing the reach of science.

Noelle Selin 14:34
We're doing a bunch of things at MIT to try to enhance that. One partnership that has been really fruitful is I'm working as part of the Superfund Research program at MIT. And we have connections to local communities who are affected by pollution, as well as Native American communities, in particular in the state of Maine, who are concerned about pollution in their communities.

Brendan Karch 14:53
For Noel, socially engaged science is as much about asking questions as providing answers. And it's also about being more transparent, making the scientific process, in all its imperfect glory, accessible to the public. This also means admitting mistakes or imperfect knowledge.

Noelle Selin 15:14
That history definitely sort of raises awareness, raises the idea that, you know, medicine isn't always perfect.

Brendan Karch 15:24
This humility in the face of rapidly changing science has been especially important for dealing with the response to the COVID pandemic.

Noelle Selin 15:34
As science changes, decisions change, and it's hard to change decisions. It's hard to change recommendations, and you get the sense that well, you know, we were recommending this yesterday and something else today.

Brendan Karch 15:47
Remember, for example, how at the start of the pandemic, everyone was vigorously cleaning surfaces like all the time?

News voiceover 15:54
The CDC says the risk of infection from contaminated surfaces is now pretty low. Now that's a change from their initial thoughts from last year.

Brendan Karch 16:04
And also remember how many experts said that the virus couldn't possibly travel more than six feet in the air?

News voiceover 16:10
There is growing concern that the Coronavirus may spread farther than previously thought in those tiny airborne particles we keep hearing about. Researchers around the world say the evidence is clear. The coronavirus is likely airborne.

Noelle Selin 16:23
Many atmospheric chemists have been really involved in helping the community understand that aerosols do travel long distances. And this is something that was obvious to atmospheric chemists. I mean, we study the global transport of these small particles. So if they can transport across the Pacific Ocean, of course, they can go more than six feet across the room. Just the idea that this was happening was very hard for the medical community to accept. And think about what the implications of that are for protecting people from COVID.

Brendan Karch 16:57

Our scientific understanding of COVID has rapidly evolved, and we got some things wrong early on. We no doubt still get things wrong. But that doesn't mean science is useless. If we can peel back the curtain and let the public see the science developing along the way, then they will be more likely to trust shifting findings.

Noelle Selin 17:18
Being clear about the tentative nature of decisions and that there might be changes in the future, and acknowledging that this is sort of the best we know now.

Brendan Karch 17:32
This can be hard to do in today's media landscape, where some outlets are keen to discredit science and weaponize uncertainty. But Noelle says the bright side of today's diverse media is that there's more ways for scientists to directly reach the public.

Noelle Selin 17:49
This is certainly a challenge. And I think I would boil it down to making sure that scientists are working with audiences that they can build trust over the longer term. And this is one advantage at the same time of the media landscape where you certainly talk about the flattening and the idea that things are taken out of context. But we have many, many more opportunities to really tell that rich story than we did even a decade ago, and really sort of engage on a deeper level and provide that context in ways that are new and different. What you should be seeing is scientists who are not just relying on those sound bites, but actually working directly with people.

Brendan Karch 18:37
Science remains the best global language we have for ascertaining the truth and dispelling old truths. It's a matter of making that language accessible and inclusive.

Noelle Selin 18:49
It's not saying I was telling you one thing, and then suddenly, I'm telling you another, because hopefully you as the user of that knowledge have sort of followed the process between those two things and really understood, you know, why a decision was tentative, what kind of new information was being gathered, and what the potential for being wrong was, and under what conditions. So if you're transparent in the beginning, then maybe that makes that easier down the line.

Brendan Karch 19:15
We still have more work to do, especially in getting the science disciplines themselves to value outreach and public communication.

Noelle Selin 19:25
One of the things that we can do is also elevate the scientists that are working on the ground, and that are working to build these partnerships that historically -- and this is something that I've been talking about with colleagues and in the context of other work. Oftentimes the work that

they're doing to really build those partnerships isn't rewarded and whether it's the media ecosystem, or even in their own institutions.

Brendan Karch 19:50
Asking how we can accomplish this is among the questions that keeps Noelle motivated.

Noelle Selin 19:56
Broadening that idea of, what is the science that's meaningful, what's the science that is contributing to people making decisions on the ground, and what science does the media and other institutions and broader scientific communities choose to highlight? A lot of these partnerships are going on, but they're not highlighted as much as they could, because we see in the media more sort of star-studded to science then the actual sort of on-the-ground work that's required to do these long-term partnerships.

Brendan Karch 20:35
Thanks for listening to this episode of Tectonic. If you're interested in learning more about Noelle's work, check out her co-authored book, Mercury Stories. On the next episode, we hear from Anne-Marie Slaughter, CEO of New America, and former Director of Policy Planning in the US State Department under Hillary Clinton. Her recent book, Renewal, calls for owning up to America's past, in order to strengthen its future.

Anne-Marie Slaughter 21:00
Our version of capitalism is unsustainable, but it's also based on just a relentless ethic of growth, and more -- as opposed to, I write about, you know, the ethic of enough. We want everyone to have enough.

Brendan Karch 21:17
We'll talk about her hopes for solving pressing social and global issues, both in the US and abroad. Tectonic is hosted by me, Brendan Karch, with production and sound design by Anour Esa. You can subscribe to our podcasts on Apple podcasts, Spotify, Google, or wherever you get your podcasts. And if you have a second, leave us a review on Apple podcasts. We'd love to hear from you. We are a production of Swissnex in Boston, the world's first science consulate located in the heart of Cambridge, Massachusetts. You can find us on LinkedIn or on Twitter at @swissnexboston, or on the web at www.swissnex.org/boston.