Delivering On Science's Social Contract

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As an environmental scientist, I think about the questions that you have been discussing today in light of my own experiences in the world of science, engagement, management, policy and public understanding. My remarks therefore will focus on science, but I believe that they are equally applicable for academic scholarship more generally. So if I say 'science', you should feel free to hear 'academic scholarship' in my remarks. I plan to draw liberally on my experiences in academia and in government, and I'll take the liberty of sharing a few stories with you along the way. I will focus initially on the 'Why?' (Why academics should be more engaged with society); then touch on the 'When?' (When should they do so?), the 'Who?' (Everyone? Just some academics?) , and the 'How?' (How to engage effectively); and finally end with some reflections on some of the choices that exist for academics, the enabling conditions for success and how to avoid the pitfalls.

I'll begin with a framing question for you: 'What is the role of science in society?' Put differently, if you were meeting with a member of Congress and you were trying to convince him or her about the importance of funding science, what would you highlight? Or if you were a member of Congress, what would you tell your colleagues about the reasons to fund science? You probably each have your own ideas.

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Most people, in my experience, will focus on one of five different benefits that science provides.

1. Science as an engine of economic growth. That has played well in Congress over the years.
2. Science to conquer disease and improve human health. This benefit also clearly resonates with Members of Congress, witness NIH's budget over the last few decades.
3. Science to enable national security. There was a big bump in investment in science post 9/11.
4. Science to improve our lives through technology. Smartphones are a great example.
5. Science to enhance national competitiveness and set us apart from other nations. Elected representatives around the world often tout this rationale. Being able to brag about the number of Nobel Prizes a country has or to win the race to the moon are examples.

I believe there are two other less frequently articulated but important roles for science:

6. Science simply to satisfy our own innate curiosity about how the world works. And,
7. Science to inform our own understanding of a variety of issues.

This notion of 'science to inform' is one many academics readily identify, but is not often mentioned by others. It is worth a deeper look. I would single out five different ways in which knowledge can benefit understanding. Scientific knowledge can inform an understanding of (1) how something works -- how your body works, how an ecosystem functions, or how the economy works -- i.e., a focus on mechanisms, on processes. (2) How that thing -- let's say the world -- is changing, e.g., as a result of climate change. This element requires a temporal component, e.g., the result of monitoring through time. (3) Using the knowledge about how it works and is changing, what are the likely future states under a business-as-usual situation? This is simply a projection of the current trajectory, informed by an understanding of dynamics. (4) Are there different possible futures and which interventions would most likely result in which outcomes? For example, would a particular antibiotic likely cure the infection you have? Or, how what would be the likely impact on cli-

mate change of different emission reduction scenarios? And then finally, (5) What solutions exist or could be invented to address important problems? New medicines, new solar technology, new policy or management approaches are all examples. The first two elements of 'science to inform' focus on the past and present. The last three look ahead to the future, a future with and without interventions. Scientific knowledge can assist decision-making in all five.

The assumption I am making is that decisions that are informed by a scientific understanding are going to be better decisions. The information that I just described, for example, would assist individuals and societies in understanding the trade-offs in making decisions about different possible options, for example, with respect to climate change. Obviously, the knowledge in any of these arenas is not perfect and care must be taken to communicate degrees of certainty and uncertainty.

I want to be very clear here. I'm not suggesting a simplistic 'deficit model' in which an audience is simply an empty vessel that needs filling up with scientific knowledge, and then that audience will do whatever the filler-upper would want them to do. Nor am I talking about science dictating any particular outcome. The concept of 'science to inform, not dictate', explicitly acknowledges that there are multiple factors that will likely affect decisions made by an individual or an institution, factors such as politics, economics, values, expediency, or peer pressure, for example. My point is that science should also be at the table, not just those other factors.

Unfortunately, all too often, scientific knowledge is not at the table, and it's important to ask, "Why?" In my experience, scientific information is often not taken into account because the information is not readily available, or it's not understandable, or it's not seen as being relevant or useful, or it's not seen as being credible to the person making the decision. Oftentimes it's a combination of many or all of those.

Scientists bear responsibility for all of these failures, to varying degrees. And we can be proactive in addressing the reasons why scientific information is often not available, understandable, useable or credible. For example, in my experience, many, many people, including many politicians, simply assume they won't understand what a scientist is saying. 'It's too technical!' 'I don't understand all those big words!' 'Scientists caveat everything so much, I guess they don't aren't confident about anything.' These are statements I've heard multiple times. I think this is highly unfortunate. I'm reminded of an experience I had during my tenure at NOAA.

We were in the middle of dealing with the Deepwater Horizon oil spill disaster. About a month into the spill, the president asked the vice president to travel to the Gulf and meet with fisherman to listen to their concerns and talk about what we knew about oil and seafood and what the federal government was doing to amelio-

rate the threat. The VP indicated he was happy to go to the Gulf, but said he needed somebody with him who knew about fisheries and what was happening to the oil in the Gulf.” I had not worked with the VP before, but I was asked to accompany him to the Gulf. So I flew on Air Force Two to the Gulf with him, and began to brief him on the plane. I described what we knew about oil, fisheries and the Gulf. I told him that oil is pretty nasty stuff because it contains toxins, some of which cause cancer. That most fish can metabolize those toxins so that after a while, their muscles are no longer contaminated. I described how other kinds of seafood, such as crabs or shrimp, can also metabolize the toxins, but they do so more slowly; and how oysters and clams can’t metabolize the toxins at all, so once they’re contaminated, they’re always contaminated. I explained that NOAA was closing federal waters to fishing in areas where there was oil present or would be present in the next 24, 48, or 72 hours based on our knowledge of where the oil was and our models showing where it would go, etc. Partway through this explanation, the vice president said, “Hey, wait a minute. I thought you were a scientist.” And I said (more than a little apprehensively), “I am.” Then he said, “But . . . I just understood everything you told me.” (!) Much relieved, I continued to brief him and answer his questions, while also thinking, “Oh, my goodness. What a condemnation his statement was of the hundreds of scientists who have briefed this distinguished politician over many, many years. He thinks he can’t understand us.” Unfortunately, he’s not alone. Most people aren’t quite as forthcoming as the VP in articulating impressions of scientists, but I have heard far too many similar assessments.

One of my pleas to other scientists is to learn to become what I call ‘bilingual’. I think scientists need to be able to speak the language of science with all of its jargon, all of its nuances, all of its caveats, but that we also need to be able to speak the language of laypeople -- to be able to translate very complicated things into something that’s understandable and do so in a way that’s credible.

In fact, despite the open antipathy towards science that does exist in some quarters, I’ve found a pervasive and real hunger for credible information among decision-makers ranging from policy makers to business and civic leaders to ordinary citizens. I am also well aware of the wealth of information that’s not being incorporated into understanding and decisions. We thus have a golden opportunity, should we choose to engage.

Far too often, academics have assumed that it is sufficient to share the results of their discoveries in the peer-reviewed literature, in technical journals and at scientific conferences. They think it’s the job of an academic to discover new knowledge and to publish it. Period. I think there’s often a vague sense that it’s somebody else’s job

to translate this knowledge for the general public, for business leaders, policy and management decision-makers. Perhaps there are knowledge-translation elves that magically appear at night and translate knowledge from academic lingo in scholarly journals to plain language in readily accessible places. Sounds pretty nice actually! In fact, there are some translators that do just that: science journalists, for example -- but they are becoming fewer and fewer. And even in the heyday of science journalism, they were insufficient to do all of the translation that's needed. Moreover, engagement in the way that I think about it is more than just translation, but park that thought for now, and let's come back to it. My point here is simply that the need for translation is far greater than the current ability of translators to deliver it.

Moreover, in my view, the scholars who created the knowledge understand it far better than do most translators. They understand the nuances. They understand the caveats. The problem is that few academic scholars have much experience or training in public communication, and the academic culture has generally not supported academics being public. Fortunately, that is beginning to change, but oh, so slowly.

I believe that academic scholars have a responsibility to be proactive in engaging directly with society. I believe that part of our obligation, our social contract if you will, involves a two-way communication with society. Specifically, in exchange for public funding, our jobs are both to create new knowledge and to share it widely with transparency and humility. When I first proposed this idea of a social contract for science 18 years ago in my presidential address, the academic culture was so chilling toward public engagement, I was pretty darn sure that I would have rotten tomatoes thrown at me when I gave my speech. However, much to my surprise and pleasure, I was given a standing ovation instead. I was told it was the first standing ovation that a AAAS presidential address had garnered. I took it as the beginning of a new awakening within the academic community. The culture was starting to shift and people were more receptive than I thought they might be.

Since that time, I've seen the culture of academia continue to change. None too soon, in my view. Consider just the environment for a moment: the pace of change, the scale of change, and the kinds of environmental changes are unprecedented in human history. Those changes and the consequences that they have for human health, prosperity, equity and well-being mean that we no longer have the luxury of waiting years to decades for new information to work its way into public understanding and political decision-making. New knowledge and understanding is needed much sooner. Although there are indeed those who are resistant to hearing about certain topics, I have found great interest, curiosity, and receptivity among the public, business leaders, and many elected officials about scientific knowledge

that's relevant to their interests and their problems. Many people want information, and in fact, they're often hungry for it, but they want something they can understand, they can trust, and they can use. In my experience, they put a lot of trust in academic scholars. However, in general, the academic community is not able to deliver those things that the public wants.

Here is our opportunity. Yes, it is fraught with danger, but that doesn't mean we should stick our heads in the sand. So let's consider why academics are so ambivalent about public engagement. I have compiled seven reasons, many of which were undoubtedly in your discussions earlier today.

1. We fear failure. We have witnessed colleagues who have not succeeded in sharing their knowledge accurately, and we don't want to be similarly misquoted, taken out of context or made to look silly.
2. We lack the skills to translate complex information into simpler but still accurate information.
3. We're uncomfortable with modes of communication that are effective in public communication -- storytelling, using analogies and metaphors, talking about ourselves.
4. We fear our colleagues will criticize us for seeking glory by having our names in the media or label us as (the dreaded) Advocate (That's spelled with a scarlet letter A!).
5. We don't want to take time away from the things that count in the academic world -- writing proposals, doing research, publishing results, or teaching.
6. We believe that public engagement will not be recognized as important in promotion and tenure decisions.
7. We fear criticism from activists who conduct aggressive campaigns against scholars with whom they disagree.

In my view, these are all valid concerns, but they stack up on the side of why not, without equal consideration to why yes, or equally importantly, how can some of the hurdles be overcome.

Moreover, the urgency of many of the challenges facing society is driving more and more academics to feel an obligation to be more engaged, witness your conference. Even when those academics -- and there are more and more of them -- are successful at public engagement, they will often advise their own undergraduates and graduate students to focus first on their studies and their research and defer any

public engagement until after tenure. Their advice goes, “Establish your credentials first. Solidify your academic position before doing things that are risky.”

But by and large, the younger generation is not listening to that advice. They feel keenly invested in being part of the solution, not perpetuating the problem, and they want to use their knowledge, not just be hidden away in the ivory tower. Their values differ from those of many of their elders, and they are seeking ways to have meaningful careers that entail engagement.

Let me be very clear about one key issue here. I'm not suggesting that each and every academic scholar needs to be publicly engaged, only that more academics be engaged and that they be actively supported by all of us. Not every one of us is well-suited to public communication, for example, but we should all support our colleagues who are, and – this is crucial -- our institutions should support them as well.

One clear need is for more and better training programs to assist those interested in mastering bilingual and other engagement skills. Faculty and students alike are seeking such programs, but not enough good options exist. Many ‘media training’ workshops (including those offered by universities) are typically conducted by communications experts, not by science communication experts. Those workshops can help scientists learn some of the requisite skills, but are usually insensitive to scientists’ values and culture and unable to help scientists figure out how to translate complex findings into something understandable, or identify accurate metaphors or analogies. In my view, the whole package is needed.

My co-founders and I created the Leopold Leadership Program to provide training specifically for academic scientists. The COMPASS program which I also co-founded provided the all-important scientific communications training component. The Leopold Program also provides leadership and engagement training and was designed to grow a network of colleagues who could support one another and begin to change the academic culture. The Leopold Leadership Program targets mid-career academic environmental scientists.

Again, I was pleasantly surprised by the readiness of academic scientists for such a program. When we first created the program in the mid ‘90s, we were not sure that anybody would even apply simply because being public was not widely valued by university faculty. Much to our delight, the very first group of applicants was both large and included superb scientists from top-notch institutions. They said they were motivated to be more engaged with society despite the culture in their universities. Since 1999, there have been 10 cohorts of ~20 scientists trained in the Leopold Leadership Program for a total of around 200 now adept academic scientist communicators and role models. Many have created courses at their institutions to

replicate their training for their students. And because quite a few of those Leopold Leadership Fellows are now deans or directors or active leaders in their own institutions, they are actively working to change the culture.

COMPASS has honed its communication offerings and now offers a range of superb options for multiple academic stages from graduate students through full Professor, for both academic and conservation organizations. COMPASS helps scientists engage and engage effectively by training, coaching, and connecting them. Nancy Baron, the Director of Science Outreach at COMPASS, is with you and can provide more information about who COMPASS is, what they do and why it has been so successful.

Both the Leopold and the COMPASS programs are in high demand as more and more academics seek to hone their skills. More and more university administrators appreciate the value of the training, but struggle to find ways to fund these and other effective training programs.

Many of the elements of the COMPASS training parallel my own experiences about what makes for effective communication. Here are five tips:

1. Know your audience – who they are, what they care about, and what they know about your subject.
2. Answering the ‘So what?’ question. Why should anyone care about what you’re telling them? Why is it important? Whom does it affect?
3. Learn to translate complex scientific concepts and findings into plain language that is understandable but also accurate.
4. Use metaphors and analogies to help folks connect the dots from the known to the related unknown.
5. Tell stories. Social scientists tell us that stories are sticky. People remember them. Hence, they are very effective communication tools. Moreover, making it personal can help make you more accessible, less of a ‘nerdy’ scientist, and even more credible.

With that in mind, let me tell you a couple of stories about communicating scientific information during my NOAA days.

My first story deals with the importance of knowing what your audience knows, and starting from there. Here’s the relevant background information you need for context: The National Weather Service, part of NOAA relies on multiple sources of information to make weather forecasts, including weather balloons, ground radar stations, oceanic buoys and satellites. Among these, satellites loom large: over

90% of the data that go into the numerical weather models come from weather satellites. When I arrived at NOAA, I learned the satellites we had in space were functioning well but the program to build the next generation of weather satellites had been dysfunctional for some time. It was imperative we fix the program, so we did. The next step was to communicate to Members of Congress how we fixed it and to urge they provide funding now that things were in order. I vividly recall meeting with one member of Congress who was on a key committee, describing to him how important these weather satellites were and how important it was to fund them. He listened for a short time, then looked at me and said, "Doctor, I don't need your weather satellites. I've got the Weather Channel." (!!!) At that, I thought 'Oh, brother! I obviously misjudged what he knew and had to take a few steps back and communicate to him that the Weather Channel, AccuWeather, and all of the other private weather providers get their information from NOAA and that NOAA's weather satellites provide the bulk of the observations. Without NOAA's weather satellites, he wouldn't have the Weather Channel. Communication 101 -- know your audience. Know what they know about something, and then move from there, from the known to the related unknown.

My second story is about finding the right analogies in communicating science. Again, first some context. NOAA is one of the lead federal agencies producing, sharing and assessing scientific information about climate change. NOAA keeps the climate records, leads the National Climate Assessment, hosts Climate.gov, produces new climate knowledge and shares information about climate change and climate variability widely. As Administrator, I received a lot of questions about climate change, some friendly, some seeking information, some antagonistic. I recall one congressional hearing where the topic du jour was the 10-year period of time called the 'pause' or the 'hiatus' in which we thought there had been no detectable change in the global average temperature (new information has now shown the hiatus to be an artifact). And at the hearing, a number of members of the committee asked "Doctor, isn't it true that the global average temperature of the planet has not changed in the last 10 years?" I replied, "Yes, Mr. Representative, that's what the data show." "Well, then, Doctor, isn't it true that climate change isn't happening?" And I replied something like "10 years is not a long enough period of time to detect a meaningful trend in a system that's very complex and very noisy." That answer was expected and didn't seem to make any difference to the questioners. Then I would have another individual ask me pretty much the same question. When a Member whom I knew was a surfer posed essentially the same question, I tried a different tack. I said to him, "Congressman (name), have you ever stood on a beach and

watched 10 waves coming ashore? Could you tell me, based on those 10 waves, if the tide was going out or if it was coming in?” And he said, “No, of course not. Ten waves is not enough.” Then he became silent, connecting the dots. He understood the analogy. His later public statements have suggested he has not changed his mind about climate change, most likely because for him it’s not really a scientific or an evidence-based issue, but rather a political one. But I think that analogy was useful to many people who were at the hearing who heard it because they could understand better why 10 years is not long enough to detect a meaningful trend in the climate record. Finding a good analogy can be very, very helpful.

My third and final story also focuses on climate change and analogies. Context: Hurricane Sandy triggered a plethora of questions about the relationship between that Superstorm and climate change, “Is this a harbinger of things to come? Was Sandy caused by climate change?” I was asked this over and over. Many scientists at the time were answering that question by talking about attribution, and the challenges of attributing any single event to climate change. In my experience, when people hear a word like attribution that they don’t understand, they tune out, distrust the information, or react negatively. So when I was asked that question, I responded with a baseball analogy. I would say, “When a baseball player starts taking steroids, the chances of his hitting home runs suddenly increases dramatically. Not only does he hit more homers, but more powerful ones. Everyone knows one cannot point to any particular home run and say, ‘Aha, that home run is because he is taking steroids,’ but the pattern that you’re seeing of more and bigger is understood to be attributable to steroids. In similar fashion, what we are seeing on Earth today is weather on steroids, weather on climate steroids. We are seeing more, longer lasting heat waves, more intense storms, more droughts, and more floods. Those patterns are what we expect with climate change.” For many people, that analogy is very helpful.

One of the most difficult aspects of this communication is figuring out how to translate very complicated scientific information into English without losing accuracy. No analogy, no metaphor, is perfect, but working to find the right ones is very worthwhile. Also figuring out how to talk about something that’s complicated in plain language is important. The COMPASS team is highly skilled at coaching scientists to do both.

Again, I would caution you that learning to become bilingual is much more than what is typically offered in “media training.” It takes skilled trainers who understand the science to help scientists find accurate but understandable ways of talking about things in ways that audiences understand. And it’s important that trainers

understand the culture of science. Most media training offered by universities and by others often don't meet either bar.

For anyone interested in science communications, I urge you to read Nancy Baron's book, *Escape from the Ivory Tower*. She treats this issue in some depth and very eloquently.

I mentioned earlier that 'engagement' to me means more than translation, more than sharing what you know with others. 'Engagement' implies a two-way interaction. It means listening, not just talking. Moreover, there may well be benefit in both directions! I've witnessed some fascinating shifts in the problems that scholars are tackling because they are listening to the concerns and questions of lay people and have been motivated to seek answers that they were not previously researching.

For example, my colleagues and I had articulated in the mid to late '90s the need for more fully protected Marine Protected Areas to protect biodiversity and recover depleted fisheries. Marine resource managers and NGOs listened and said, "Okay, we understand MPAs are important. How big do they need to be? How many do we need? How far apart should they be? Where should they be?" We scientists didn't have answers to those questions. A number of us realized that these were really important questions and if we put our minds to it, we should be able to come up with good answers. So we put together a working group at the National Center for Ecological Analysis and Synthesis, NCEAS, an NSF-sponsored synthesis center affiliated with the University of California at Santa Barbara. We convened an interdisciplinary team of scientists, and challenged ourselves to be more useful in providing answers to practical questions. Lo and behold, we came up with what has now become really useful guidance about how many, how big, how far apart for creating fully protected marine reserves.

That guidance was inspired by societal needs, but it required fundamental advances in science. That type of science does not, therefore, fit cleanly into either the 'applied science' or the 'basic science' paradigm. It was not 'applied science' which often means using existing knowledge and applying it in a new situation. Nor was it 'basic science' which is curiosity-driven. Donald Stokes would call what we did 'use-inspired science'. In his book, *Pasteur's Quadrant*, he points out that the classic formulation of basic and applied science does not fully describe the spectrum of research. He proposes this third category of 'use-inspired science' as fundamental, cutting edge science that is responsive to society's needs. I think we're seeing an amazing proliferation of use-inspired science in almost all arenas of science, but especially around the topics of sustainability science, resource use, energy, health and much more.

One very real reason to be more engaged with society, then, is also to be challenged by society - to be exposed to the kinds of questions whose answers might, in fact, be helpful to society.

Hence, 'engagement' is a rich endeavor for scientists. There really is a two-way exchange of information and perspectives. It's not just scientists communicating in one direction, i.e., just sharing knowledge with laypeople. It's also listening and being inspired to solve other problems that might not have been on your radar screen.

One of the toughest issues for many academic scholars who choose to engage with society is where they should engage along the spectrum of very low-risk to very high-risk activities. Becoming involved in K-12 education, citizen science or public lectures is a lot less risky, but still very useful. At the opposite end of the risky spectrum is outright advocacy for a particular solution. This is what I call the 'Scarlet Letter of the Scientific World': Advocacy. Scientists are conflicted on the topic of advocacy. On the one hand, they feel a moral obligation to help society deal with important issues but are simultaneously cautioned that tainting science with bias will undermine the credibility of science.

I can tell you that many scientists feel that they are not only scientists, but citizens, and that they have a right as citizens to express their opinions about the solutions that they think are the right ones based on their both information, but also their values. They say that they can do so in a way that's not confusing, that they can say, "Okay, I'm wearing my scientist hat and this is what the science says, and now I'm going to wear my citizen's hat and this is my recommendation." The ability to distinguish which hat one is wearing makes scientists more comfortable about engaging in advocacy. However, in my experience, most lay people and policymakers don't even hear the distinction between "this hat" and "that hat". They hear everything a scientist says and interpret it as scientific guidance (which of course contributes to confusion when scientists disagree with one another).

Other scientists say that any scientists who voice their own opinions undermine the credibility of all scientists. They believe that any advocacy will compromise all of science. I would note that physicians are routinely advocates, and are expected to be, but do not lose their credibility in the process. Recommending that people not smoke or that they exercise does not seem to make physicians less credible. But the dialogue in the environmental science arena seems to have different rules.

This is a very rich dialog for which there is no one single answer for all scientists or all academics. Many scientists choose a middle ground in which scientists offer useful, actionable input to policymakers without making overt recommendations. For example, one can say about climate change, "This is what we know, and based

on our understanding of what we know, if we choose this path, this is the likely outcome. If we choose a different path, this is the likely outcome.” So you can frame answers in the fashion of choices with consequences in which you are not making overt recommendation but are focusing mostly on the scientific understanding. This, of course, is the ‘policy-relevant but not policy-proscriptive’ approach taken by the IPCC. But, I would emphasize that which level of engagement you choose is a personal choice, and that you need to think deeply about the issues and make a conscious decision.

It may be useful to consider history here. In past decades, the bulk of academic scientists have erred on the side of isolation to protect the objectivity of the ivory tower. Engagement was perceived as tarnishing the reputation of science. The reputation of science may well still be an issue, but the consequences of not engaging are far different today than in earlier times. The balance is shifting, with society more at risk and more in need of scientific knowledge, which is why you are having this discussion. Science has a meaningful role to play in charting the future of all people. Do we sit idly by and protect the integrity of science, or do we figure out how to minimize the negative consequences and engage whole heartedly because it’s our obligation to be helpful? Today, more and more scientists believe that the consequences of not engaging outweigh the consequences of engaging. If scientists don’t engage, society does not have the benefit of the information scientists have that may be useful in addressing many of the most challenging issues of our time. I firmly believe that we need more scientifically informed citizens and policymakers and that science should be at the table informing the decisions they make. I believe that scientists should engage both in the public discourse and in the policy arena. I believe that scientists have an obligation to be helpful to society.

Thus far, we’ve explored a little bit about the ‘Why’, the ‘Who’ the ‘When’ and the ‘How to engage’. I’m sure that you will pursue many of these topics, either in our Q and A or in your deliberations tomorrow. Engagement presents significant challenges and opportunities to academia; we’ve talked about some of the tradeoffs.

For many academics, engagement is a defining issue of our time. Bob Dylan’s words are appropriate: ‘The times, they are a-changin’’. I’ve personally witnessed a seismic shift in academics’ attitudes toward public and political discourse and, importantly, I’ve seen a generational divide emerge as younger scientists find their voices and as their values differ from those of their elders. This is critically important issue for the academic community to grapple with. The topic goes to the heart of the responsibilities of individuals and the academic community to society and how we can best be of service to society.

As a senior scientist, I don't believe that my students should follow the path that I took: establish your scientific credentials first and then begin to be more public. Those choices were informed and framed by different times. Engaging with society was not even on the radar screen of most academics when I began my career. Only as the environment began to change radically and neither the public nor policy makers were paying much attention did I begin to engage. When I did so, I felt I had to break away from academic conventions. Doing so was difficult, but it was the right thing to do. The world continues to change and to need scientists and scholars to help chart the future. I continue to feel compelled to both engage actively with society – on the public and on the policy fronts – and to create pathways for others to do so. I feel strongly about the need for my generation to also champion the right of younger academics to chart their own path along the continuum of engagement, and to do so with their seniors' full support.

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