3 Extracting the Essence

When we try to help others think the way we do about our science, we need to be clear. Science is complicated—our descriptions of it don't need to be. But since we are scientists, not salesmen, we want people to believe what we say *because they understand.* This is the challenge for a scientist talking to a decision maker. How can you describe your science so that someone without detailed training can both understand and act on it?

Extracting the essence—learning how to find your most important material without ever dumbing it down—is a major theme of this book. Scientists are rarely taught to do this in school, where providing more and more detail is usually the path to success. Outside the classroom, you all too often get only a few minutes to introduce your ideas to a decision maker.

To extract the essence, ask yourself: What background information does my listener need to understand? Is there a way to simplify my explanation? How can I paint a high-level picture of my work that showcases its merits and helps my listener draw the conclusion I want them to after they hear from me?

An important part of this process is identifying your key messages—the main and most important ideas that you want to convey and have people remember. Distill your key messages into well-constructed, carefully chosen phrases that extract the essence of your arguments and bring your science to life with clear and compelling language. If you don't develop your key messages, you are likely to shower people with detail and information that doesn't have a clearly stated, "So what, why should I care?" orientation.

Garr Reynolds is a well-respected author and advisor on how to construct impactful presentations. Garr counsels us to start preparing our content with a blank whiteboard, or a blank sheet of paper—never by sorting through existing slides. He advises us to take the time to outline the major messages we want to get across first, before compiling or creating slides:

> One reason many presentations are so ineffective is that people today just do not take—or do not have—enough time to step back and really assess what is important and what is not. They often fail to bring anything unique, creative, or new to the presentation. This is not because they are not smart or creative beings, but because they did not have the time alone to slow down and contemplate the problem.[1]

Nowhere is the concept of extracting the essence—and focusing on your key messages—more important than in the first few minutes of a discussion or presentation. Short conversations with your colleagues, friends, bosses, program leaders, or sponsors are essential to advancing your prospect of making an impact or getting a new idea adopted. A five-minute discussion, the first page of a proposal, or a brief slide presentation should generate interest in spending another half an hour on the details.

The brief slide presentation is perhaps the most difficult to create because we are naturally inclined to include more details of our analysis than time or audience attention will permit. It is a daunting prospect to condense the thirty or forty slides you have already prepared. But editing your material to extract the essence is the foundation of championing science.

We call our recommended structure for these short discussions the five slide approach. It can stand alone or function as the setup to a longer conversation. It is a succinct framework for organizing content, and we return to it throughout the book. Whether it is five slides or five sentences, these are the elements that set the context for, and incorporate, your key messages.

Extracting the Essence Is Not Dumbing It Down

A common phrase heard around the scientists' water cooler is, "I have to dumb it down for this audience." That speaker, and every other speaker who takes this attitude, fails as a champion and will almost certainly fail with that audience, no matter what the goal.

Why? This oft-heard reference to dumbing it down implies that your listener isn't smart enough to understand. It suggests a gross oversimplification of concepts that leaves out details and nuances. The act of dumbing it down, therefore, comes with an air of intellectual superiority and disrespect—two mindsets that won't win favor with decision makers.

When decision makers are not deeply steeped in your branch of science, you need to focus on extracting the essence, not dumbing it down. The onus is on you to make the information understandable. Effective persuasion requires that your key messages be tailored to your audience. Focus on the most important ideas that you want to convey and have people remember.

The five slide concept originated with Jay Davis, the first director of the Department of Defense's Defense Threat Reduction Agency (DTRA).[2] Jay is a gregarious Texan transplanted first to California and then Washington, DC, with his love of homespun wisdom and simple solutions intact. A physically imposing man who looks like he would be much more comfortable tossing telephone poles while wearing a Scottish kilt than fine-tuning an accelerator, Jay is always thinking about how to make friends and get along with people. In 1991, his experience with custom accelerator design and the physics of nuclear weapons landed him a spot on the inspection teams that were tasked with looking for the Iraqi nuclear material production facilities after the First Iraq War.

After months of futile inspections stymied by deliberate misdirection of the Iraqi military and weapons scientists, Jay's team finally spotted an Iraqi convoy of one hundred trucks transporting the end plates of a large electromagnetic separator across the desert. They gave chase, and despite being fired on in the course of photographing the convoy, they were ultimately able to unveil the full scope of Iraq's attempt to build nuclear weapons using an electromagnetic separation technique that had been abandoned by the West decades before. The Iraqis didn't need an elegant and highly efficient nuclear industry like ones the superpowers had to create thousands of weapons—they just wanted a few, and they didn't have to be anything but deadly, stripped to the essence of mass destruction. Jay's ability to see the heart of the matter made it easy for him to identify the significance of the end plates. He was not looking for the complicated centrifuges of U.S. weapon factories but rather for simple systems that would provide enough distinction among uranium isotopes to make a uranium fission weapon. Jay and fellow inspector David Kay's account of this story in *Physics Today*[3] is an outstanding example of how to tell a riveting and politically appropriate science-based story.

Jay has a passion for particle accelerators, those engines of physics that use electromagnetics to make ions go irrationally fast. He is particularly fond of using them to perform mass spectrometry, a method of measuring the exact mass and number of atoms in a sample at ultralow levels, which he does with his beloved huge, ten-million-volt Tandem Van de Graaff accelerator[4] (Remember the one in the science museum that made your hair stand on end? Think bigger, as in the size of a Midwestern corn silo lying on its side). This type of accelerator now makes it easy for archeologists to measure the age of ancient bones and for doctors to estimate the effects of specific drug interactions in the body by measuring as little as a few thousand atoms at a time.

Early in his career, Roger worked for Jay. Jay was asked to create a new organization at Lawrence Livermore National Laboratory that would combine all the environmental and energy scientists into one large team. This would be the first real experience of science in teams bigger than university research groups for many of these scientists. With almost two hundred scientists on the team, it was important to communicate well. Carrying out the mission to support national needs in the fields of environment and energy required Roger and his colleagues to interact with a diverse set of interested parties and sponsors ranging from environmental activists to former Navy fighter pilots now commanding bases that required dramatic groundwater cleanup.

Jay was adamant that the team be able to prepare five slides at the drop of a hat. The goal was to condense their entire argument, including the ask, into slides that could stand alone if needed. Start with those five. That way, even if you don't get through the entire presentation, you will have covered the important material. And as your listeners become involved in the topic, they will help direct any more detailed discussion in ways that are most useful to them. This is much better than waiting forty-five minutes to get to the key point of your presentation and leaving the audience with no time to evaluate it. This avoids perhaps the most grievous outcome of all: a willing sponsor or an influential policy maker being cut off from helping you by a lack of time. Not on Jay Davis's watch.

Jay emphasized that these are the five things you need to cover:

1. The problem
2. The technical gap
3. How to fill the gap
4. Why you or your team are right for the job
5. The ask

You need the same five elements for a short conversation, the beginning of a presentation, or the first few paragraphs of a white paper. In fact, it is a great idea to discipline yourself so that the first two paragraphs of a white paper match both your five-minute pitch and your first five slides in tone, content, and message (see chapter 13, "Translations, Templates, and White Papers"). This way, you have to create your narrative only once, and you are doing it in the best possible way.

Let's look at what the five slides might contain for a research proposal. This information is as essential when you are trying to attract an outside sponsor as it is when you are asking your boss for internal budget approval.

The Problem

What is missing from the world that both you and your listeners care deeply about? It's good to think about this in two stages: first, the overall context, and second, the gap that keeps us from getting from where we are to where we want to be. That gap is something you will be able to fill with a well-defined research project.

> Context: "Climate change is well known to be an issue."
>
> Focused problem: "Predicting the effect of climate change on Navy force utilization in the Pacific has recently been highlighted by PACCOM (Pacific Command)."

This use of both large-scale (context) and project-scale (problem) thinking tells the decision maker that you are aware of the big picture but have the self-discipline to define a project that is clearly in their interest area, with a budget that the funder can supply.

When using slides, start with this, *not* with your title slide or a list of collaborators. For the first twenty seconds, you have the listener's complete attention. Put it to the best possible use. Put the problem in front of them. But don't perseverate on this topic; the next slide is the most important.

The Technical Gap

Now make the connection between the problem and the area of science or technology that could be improved to jump forward to a better position regarding the problem. The *gap* keeps the sponsor from moving to where they want to be.

> Name the specific thing we can't do today because of a gap in knowledge or ability: "We can't predict the number or intensity of Pacific typhoons."
>
> Link it back to the broad problem statement, but focus on the technical need.

The simple phrase "This gap keeps you from achieving your goal" will get any sponsor's attention. This is the slide where you can talk about the conventional way of thinking about the problem and why the gap exists.

This is also the optimal place to make another statement that will always capture a listener's attention: "What if we could?" For instance, "What if we could skip this hard step?" or, "What if we could apply knowledge from another discipline to solve this tough problem?" An audience, particularly a science and technology audience, will always honor this challenge with another minute of rapt attention. This statement is at the heart of what makes us love science.

Now that you have focused your listeners' attention on a key problem and a potential opening to pursue, you can make the first mention of your contribution.

How Can You Fill the Gap?

What sort of science is needed?

> Imagine the future: "If we could reliably do X, we could fill the technical gap and address the large problem in a new way."
>
> How will this improve the general state of science and technology? (Even a highly focused sponsor wants to know that their efforts fit into the general progress of knowledge).

Obviously, in a detailed slide deck this is more than a one-slide topic, but in the five slide version, it really is *only one slide.* Be concise. Trust that the viewers do not need a detailed description of your previous accomplishments and your experimental plan—just enough highlights to make them confident and to let them ask you questions, which they always love to do.

Let your listeners absorb the material slowly; make them want to get the details. Give them the opportunity to love your idea in the time they have available.

Why Are You Right for the Job?

Among the topics you can choose from to answer this question are:

- Why you or your team are poised to be efficient and effective.
- Why this problem is well suited to your skills, reputation, and facilities.
- What you or your collaborators have done previously in this area.

Emphasizing your collaborators and your past history with the problem is important. Your track record counts. The sponsor wants to know that their money will not be risked on an inexperienced team. If the topic is new to you, talk about your experience in a related field.

The Ask

Now we come to the critical part. You have identified a need, and you have an audience that is connected and interested in solving that need. What is the ultimate goal of your work? Your vision of success sets up the ask. Help your audience understand what you are working to achieve and how you plan to go about doing it. This part of your communication is the ideal opportunity to call on your listeners to become collaborators, funders, or other resources to help you advance your science. Help your audience draw the conclusions you want them to and understand why it matters. Be explicit. What is it you want people to do as a result of listening to you? Close with a concrete call to action.

Jay hammered it into us that the worst possible thing you can do is waste a decision maker's time by not making an ask. How can they participate? How can they advance their agenda by following your lead? How can they convene other resources also interested in the problem? Even if the ask is nothing more than, "Please let me know what you think of this idea," *make the ask.* Every time.

For research proposals, the ask is usually for money, but you should keep this principle in mind for interactions with any decision maker. Be specific so that they are able to invest in you. Give them the information they need to make a case to their oversight committee or slot you into a research theme in their current portfolio. Give them the ability to act.

How much are you asking for? Put the amount at the top of the slide to provide context for the scope of your work. Under the title is good. E.g., "$350K/year for three years."

What general types of work will be done (experiments, models, etc.)?

What will you provide that actually fills the gap you defined in slides one and two?

Don't be vague in your verbal description of what you will provide. "A report" or "a model" is inadequate. Instead, call it, "An analysis that compares the results of this method to previous techniques and evaluates the time and resource requirements for implementing this approach," or, "A working prototype computer model that embodies the physics described here."

Be sure to give clear examples of what you will do. Asking for money to evaluate what needs to be done will rarely be well received. However, a midstream decision among two or three options to determine the final path is a great intermediate milestone.

Despite Jay's wise advice, presentations of this sort are often longer than five slides. In chapter 13, we discuss formulaic or templated presentations and how to avoid boring your audience to death with the exact slides they requested. But the five slide approach is always a vital discipline for *starting* a discussion, with or without visuals. Before you go into detail about the technical work or members of your team, give the full five slide context. To move on, you can then say, "Let me talk more about the technical details." With a firm grip on the importance, methods, and overall structure of what you are proposing, the listener will have sufficient context to absorb the particulars of how you will succeed.

Getting the five slide approach right takes practice. We recommend that you pilot your pitch with anyone willing to listen. Make sure it is coming across the way you want, and pay close attention to questions asked that indicate where your listeners were lacking key information. Translate feedback into improvements to your language, flow, and overall content. The five slide presentation is the ultimate place to be self-aware and self-correcting.

Is the right number always five? Of course not. In many instances, these five topics will be the ones you want to focus on, but don't be a slave to the number. The idea is to outline your key messages and your request in a minimalist format that encourages the decision maker to ask for the details. If you force yourself to think, "Five is my target," and you find you need six or seven, you will not go wrong.

Editing to Extract the Essence

Editing your thoughts, your writing, or your slides is absolutely necessary to achieve impact with any audience. The five slide constraint will quickly teach you this, although it may be very frustrating at first. If you want your extraordinary science to be recognized as such, it has to be carefully described. If you are writing for *Science* magazine, you can use the full power of the complex language and principles of your field in your elegant, extended descriptions. However, when you are championing science to a nonspecialist decision maker, keep your description both accurate and simple, or the listener might miss your point.

John Maeda is the president of the Rhode Island School of Design and a computer scientist. He describes the path to simplicity simply: "Simplicity is about subtracting the obvious, and adding the meaningful."[5] This is a remarkably hard distinction for scientists to make because most of their science is obvious (to them) and *all* of it is meaningful. In chapter 5, we take a deep dive into why scientists misread their audiences, but for now we can give this interpretation of Maeda's advice: Make sure you put yourself in the audience's shoes. What do they already know, and what will they consider meaningful?

In a similar vein, Albert Einstein is widely reported to have said, "Everything should be made as simple as possible, but no simpler." This quote was attributed to Einstein by the famous composer Roger Sessions and cited in the *New York Times.*[6] Since it purportedly came from the man who simplified physics to general relativity, it was quickly endorsed as a statement of how to conduct understandable science. And given its popular cachet (it has been cited over one million times on the web, according to Google), it is a statement that many people believe holds true.

Even more interesting is that Einstein didn't actually say it.

Apparently, Sessions applied John Maeda's style of logic to something that he heard Einstein say. The quote that we are *certain* Einstein said, as documented by Alice Calaprice in *The Ultimate Quotable Einstein,*[7] was much more scientific: "It can scarcely be denied that the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience."[8]

That sounds like something scientists would say to their colleagues, but we are sure it would be lost on almost everyone else. And yet we can see the critical elements of the simplified version of the statement clearly exposed in the original. What a marvelous example of the conundrum we face when championing science. Einstein's original, highly accurate, and carefully framed statement fails the impact test. Sessions, however, was able to extract the essence.[9] It was Sessions's summary that caught the attention of the world, not the scientist's detailed original.

Certainly, simplicity in expression makes a message more accessible. But what interests us is why it took a composer to produce one of the most famous quotes about science. Do scientists have to insist on all the accuracy and detail, obscuring the clarity of their message?

Capturing the Essence Visually: Climate Wedge Example

Simplicity is vital when the topic is the enormity of what it will take to address climate change challenges. A case in point is managing the emissions of carbon dioxide. Julio Friedmann is one of the world's leading thinkers on this topic. He helped originate the concept of carbon capture and storage, where carbon dioxide from industry and power plants is captured from the smokestack and then stored underground as a fluid, much like oil. Julio got his bachelor's degree in music and a master's degree in geology from MIT and his PhD in sedimentology, the study of how rocks like sandstone form, from the University of Southern California. He has worked at Exxon, the University of Maryland, and Lawrence Livermore Lab. He also served during the Obama Administration as the Deputy Assistant Secretary of Energy for Clean Coal, and the Principal Deputy Secretary for Fossil Energy.

Julio thinks that podiums are holy places because they give speakers an opportunity to change people's minds and affect the way they think and act in the world. When we asked whom he regarded as a true champion of science, he sang the praises of Rob Socolow, Professor Emeritus of Mechanical and Aerospace Engineering at Princeton. Julio reflected on Rob's strong communication skills:

> I think Rob spends every waking moment thinking, "How can I educate, how can I communicate complex ideas to people?" Rob has briefed many, many people on Capitol Hill. He has briefed captains of industry and he has spent his share of time with the people who have access to leaders of countries. He ultimately does not view his job as one of influence. He believes it is most important for him to clarify and elucidate. He wants these busy decision makers to understand the issues. He would say, "I don't run a country, I don't run a Fortune 500 company, I don't know all the other things around all the complexities of these guys' jobs, but if I can communicate my point very clearly and they believe me, they will weave that information into whatever else they do." And in a room full of experts who are busy trying to convey as much detail as possible, Rob will do the opposite. He will elicit as much information as he can from the decision makers in the room, so that he can repackage the details in a form coherent to them—and only then re-communicate it back to the policy makers.[10]

Julio saw Rob give a talk at the World Bank about greenhouse gas emissions using his famous wedge diagram. The wedge diagram is Rob's way of communicating the complexities of climate science in the easiest, simplest way to the widest set of people. He was championing a new way of thinking about the problem. To do so, Rob used several approaches that we recommend. He extracted the essence, really understood his audience, and used the wedge, a familiar shape from geometry, to build a bridge for understanding his recommendation. Julio explained the challenge Rob was facing and how he came up with using the wedge to address it:

> Rob was deliberately trying to push back on the idea that then Secretary of Energy Spencer Abraham put forward, which was that we needed a

transformational equivalent to the discovery of electricity to solve climate change. Rob's response to that was, "Poppycock, we just need to spend some money and apply the technology we have." As he tried to package that idea, he realized there was always this bucket of stuff, this bag of rocks of technology and a whole bunch of people trying to champion their respective technology. What was lost in all of this was what's useful and what's materially important. And so Rob, with his colleague Steve Pacala, came up with the wedges.

A climate abatement wedge is just a unit that is 50 years long and represents 25 gigatons of carbon (or about 100 gigatons of carbon dioxide) depicted in the shape of a triangle. Rob said, over 50 years, if you want an emissions trajectory that is flat (and we are currently on a trajectory that is up) then everything between up and flat is some amount of emission that you can break up into bite-size wedges and assign one technology to one wedge. Maybe that's a whole bunch of wind power, or maybe that's a whole bunch of energy efficiency for cars, or maybe that's planting a bunch of trees. Whatever it is, it has to be big enough to count. That means, over 50 years, it has to account for that much emissions.

By breaking it down in that very simple way, Rob and Steve were very quickly able to dispense with technologies that were marginal and would never matter. Rob and Steve were also able to say, "We don't care which of these technologies you use as long as you have enough wedges to get the job done." And that allowed people to push forward their own ideas credibly. It also meant that you could very quickly see that you couldn't solve the problem with just one approach, like energy efficiency gains, because you needed seven wedges of that and it just wasn't possible. In a very simple heuristic, the wedges communicated a bunch of very complicated ideas.

Figures 1 and 2 show some of the visuals Rob and Steve created to tell the wedge story. As you will see after you read chapter 9, "Designing Effective Visuals," they are masterful in their ability to convey a singular message by following the best design principles. They adeptly introduce the wedge concept, explain it, and show the elements that could, in combination, be considered technology solutions.

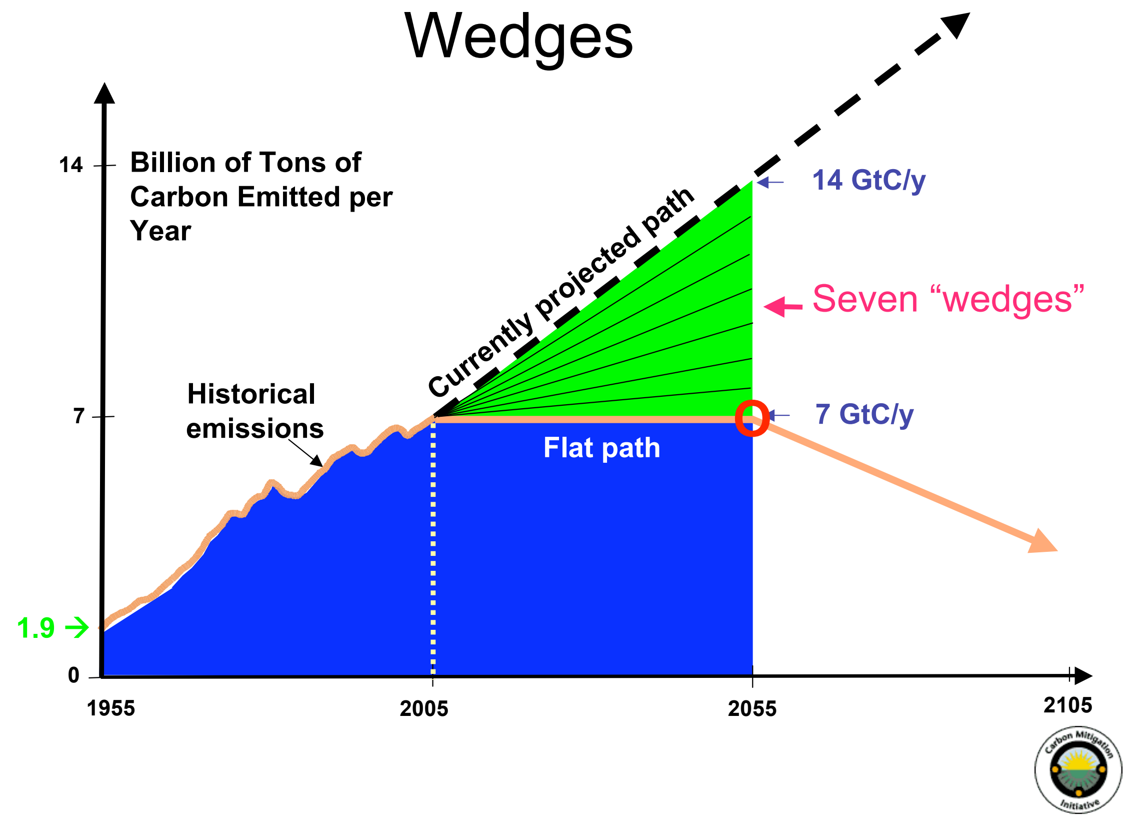

Figure 1. A slide depicting Socolow and Pacala’s wedge diagram. Each wedge of climate abatement, described in Figure 2, can be addressed by one of the technologies in Figure 3. (Figure by Rob Socolow).

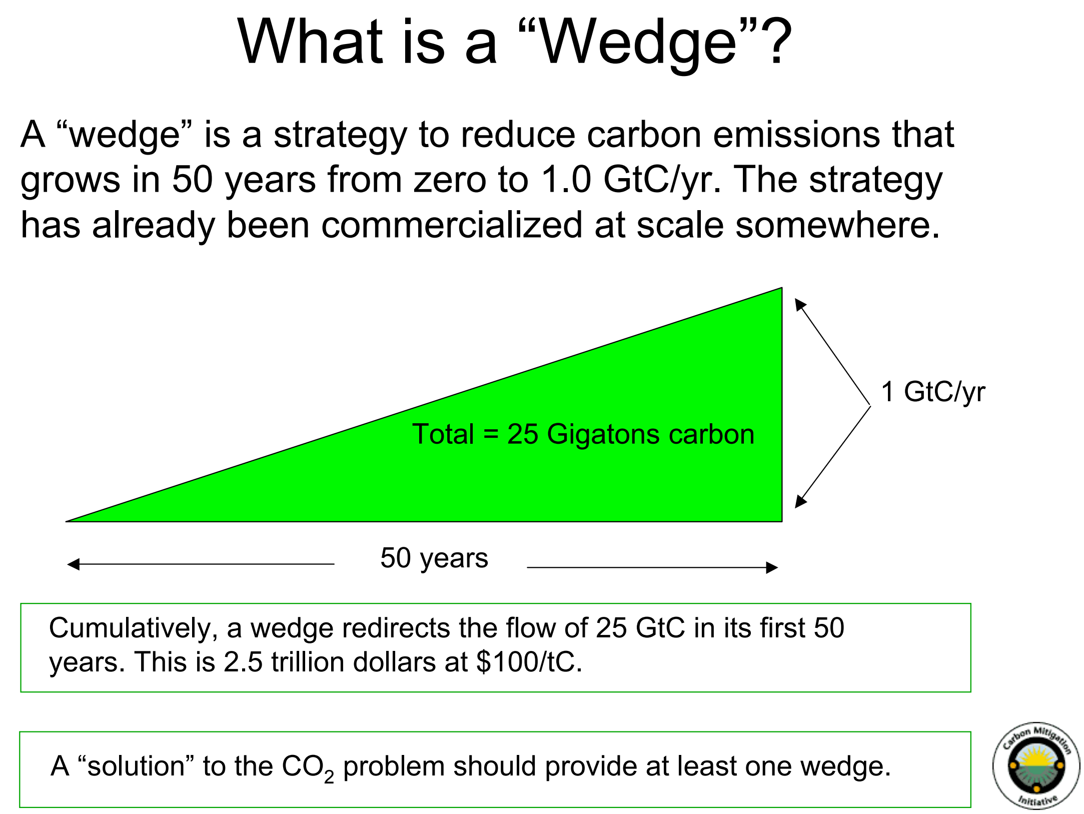

Figure 2. Each wedge in Figure 1 is a simplified technology implementation pathway that ultimately reduces emissions by a total of 25 billion tons of C (or about 100 billion tons of CO2).[11] (Figure by Rob Socolow).

Figure 3 is from a teacher's guide for a game that uses the wedge concept to teach college students options for climate management. It lists a variety of simple options for wedges that extract the essence of the climate technology.[12]

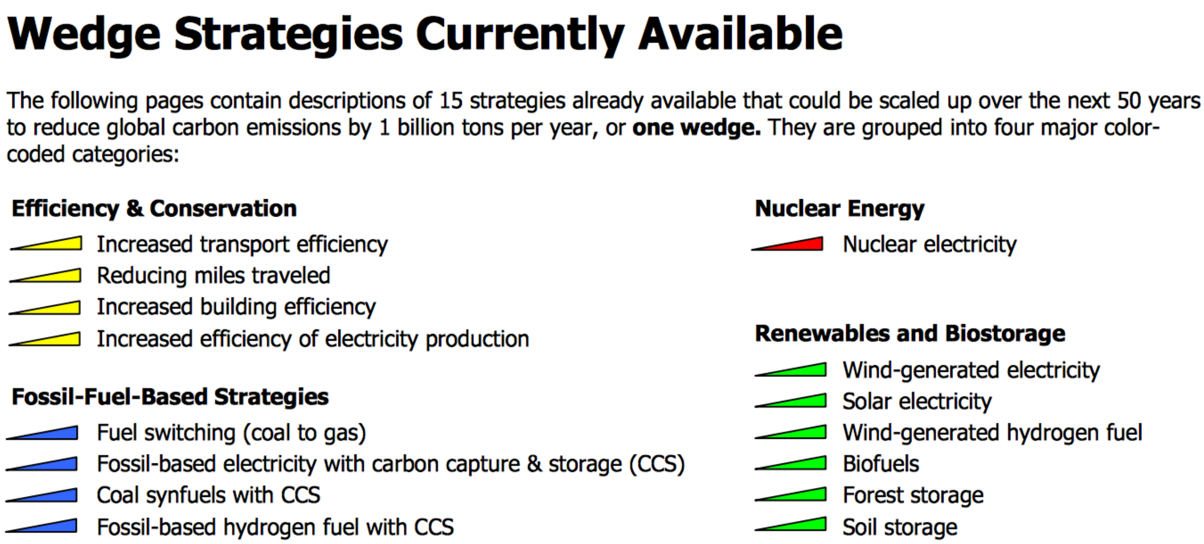

Figure 3. Possible technologies to take up each of the required seven wedges (in total) to bring carbon emissions down to the point that they are no longer growing over time. (Figure by Rob Socolow).

Notes

1. Garr Reynolds, *Presentation Zen: Simple Ideas on Presentation Design and Delivery* (Berkeley, CA: Pearson Education, 2011), 56.

2. The Defense Threat Reduction Agency is the U.S. Department of Defense's official combat support agency for countering weapons of mass destruction. For more information, see the agency's website: www.dtra.mil/About.aspx.

1. Jay C. Davis and David A. Kay, "Iraq's Secret Nuclear Weapons Program," *Physics Today* 45, no. 7 (1992): 21–27; https://doi.org/10.1063/1.881312.

2. Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory (website), accessed June 3, 2018, https://cams.llnl.gov.

3. John Maeda, *The Laws of Simplicity: Design, Technology, Business, Life* (Cambridge, MA: MIT Press, 2006), chapter 10.

4. Roger Sessions, "How a 'Difficult' Composer Gets That Way," *New York Times,* January 8, 1950, www.nytimes.com/1950/01/08/archives/how-a-difficult-composer-gets-that-way-harpsichordist.html.

5. Alice Calaprice, ed., *The Ultimate Quotable Einstein* (Princeton: Princeton University Press, 2011), 384–385.

6. According to Wikiquotes, Einstein used this quote on two occasions: Einstein, "On the Method of Theoretical Physics," The Herbert Spencer Lecture (Oxford University, Oxford, June 10, 1933); Einstein, "On the Method of Theoretical Physics," *Philosophy of Science* 1, no. 2 (April 1934): 165. See "Albert Einstein," Wikiquotes, last updated May 24, 2018, https://en.wikiquote.org/wiki/Albert_Einstein.

7. See the excellent tracing of the quote on the Quote Investigator website: Garson O'Toole, "Everything Should Be Made as Simple as Possible, but Not Simpler," Quote Investigator, May 13, 2011, www.quoteinvestigator.com/2011/05/13/einstein-simple.

8. Roger and Amy Aines, "Influencing Decision Makers: From Julio Friedmann," Championing Science, March 4, 2014, www.championingscience.com/influencing-decision-makers.

11. This was another simplification of Rob's -- most people think about CO2, not carbon, so he wanted to use different units for different audiences. And rather than multiply the mass by 3.66 (the technically accurate number), he multiplied by 4.

9. This teacher's guide, for a game created for students to compare options, is available at the website of the Carbon Mitigation Initiative at Princeton University: http://cmi.princeton.edu/sites/default/files/wedges/pdfs/teachers_guide.pdf.