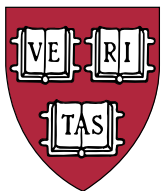

CLIMATE CHANGE DEEP DIVE

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HARVARD

Advanced Leadership Initiative

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About the Advanced Leadership Initiative

The Advanced Leadership Initiative (ALI) is a third stage in higher education designed to prepare experienced leaders to take on new challenges in the social sector where they have the potential to make an even greater societal impact than they did in their careers

ALI Deep Dive sessions highlight one major global or community challenge where ALI Fellows might fill a gap. Deep Dives include readings, outside experts, often faculty from relevant Harvard programs, and a focus on problem solving and practical applications of knowledge.

ALI Fellows contribute ideas based on their experience and knowledge for immediate solution-seeking with major figures in the field under discussion and with affected constituencies.

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Executive Summary



The 2019 Climate Change Deep Dive provided Advanced Leadership Initiative (ALI) Fellows an in-depth view of the complexities and opportunities surrounding global climate issues. Harvard Business School (HBS) Professor and ALI Executive Committee Member Forest Reinhardt chaired the two-day event and convened experts from across Harvard University.

During the Deep Dive, fellows learned from scholars in the natural sciences, the social sciences, the humanities, and the law. They also analyzed case studies of particular organizations whose strategies are affected by climate change and whose behaviors can affect the climate.

Deep Dive presenters included Professors Peter Huybers of Harvard's John

A. Paulson School of Engineering and Applied Sciences, Richard Lazarus of Harvard Law School, Robert N. Stavins of Harvard Kennedy School, Forest Reinhardt, John Macomber, and Amy Edmondson of HBS, James Engell of the Harvard Faculty of Arts and Sciences, former Secretary of the Navy Ray Mabus, and artist Zaria Forman.

At the close of the Deep Dive, Reinhardt led fellows through a discussion of the roles of government, firms, and other actors in addressing climate change. He also encouraged fellows to think of ways they might personally take action on the issue. Ultimately, the group concluded that countries must decarbonize their energy systems, increase the efficiency of energy use, or both to meaningfully reduce global carbon emissions.

The Physical Basis of Climate Change

To launch the 2019 Climate Change Deep Dive, ALI Fellows explored the physics behind climate change. Professor Peter Huybers of the John A. Paulson School of Engineering and Applied Sciences presented a scientific perspective on the fundamentals of climate change. In the session, Huybers explained that while we have long known that man-made greenhouse gases would lead to climate change, questions remain on how great of an impact they will have and how a changing climate will affect important resources around the world.

Huybers began by breaking down the physics behind Earth's climate. He explained that the surface of the Earth receives energy from both the sun and energy that is reflected back from its atmosphere. With more atmospheric carbon dioxide,

less energy can escape the atmosphere, and the temperature of the planet will rise. Even small increases in the amount of global carbon dioxide can have significant impacts on the atmospheric balance of the Earth.

Huybers said that scientists have known about these physical properties for over 100 years. As early as 1907, the scientist Svante Arrhenius predicted that industry would create changes in atmospheric composition leading to global warming. Arrhenius' predictions were startlingly accurate for the time and show just how long scientists have known that the actions of humankind could have serious impacts on the Earth's climate. As Arrhenius predicted, "We are creating an atmosphere that is much more similar to what dinosaurs used to breathe than to what humans

ever have," said Huybers.

He then explained that one of the only questions remaining around climate change is to what extent the dramatic increase in atmospheric carbon will change our environment. In large part, these questions hinge on "feedback loops"—elements that can speed or slow the rate of climate change. For example, water vapor and melting ice can increase the rate of climate change, while the impact of clouds is still as yet unknown.

Huybers explained that the main uncertainty in climate science was how strong these feedbacks could be; as a result, scientists are unsure exactly how much temperature will rise in the coming decades. While massive temperature increases are unlikely, he said there is a huge risk associated with

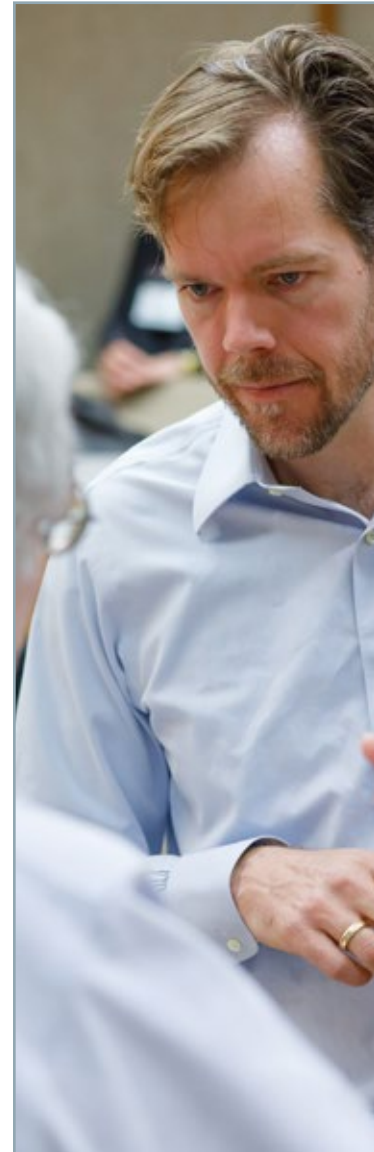
this possibility.

In large part, the ocean has delayed the effects of climate change. “The ocean is like the fly wheel of the climate system,” said Huybers. The ocean is able to absorb massive amounts of heat and mask the impacts of a changing climate. Even so, Huybers explained that the general trend of global temperature has been increasing, especially in the last century. “Overall, we see variability overlaid on a trend that has been increasingly warming.”

Huybers said that the greatest danger of climate change was the yet-unknown impact on global water resources. He explained that scientific models are not yet able to predict how water availability will change with temperature. “We don’t have a good sense of what will happen, and this has huge

impacts on agriculture.” He also noted that even minor changes in water availability could have significant impacts on communities around the globe.

Throughout the session, Huybers said that the actual emissions from countries around the world have far exceeded even the worst-case scenario models of the Intergovernmental Panel on Climate Change. He also said that understanding the physics behind climate change was critical to establishing well formulated policies for emissions mitigation and reduction. “This is all really simple physics, but it’s at the heart of this issue.”



Legal Aspects of Climate Change

Professor Richard Lazarus of the Harvard Law School gave ALI Fellows a glimpse into the legal aspects of climate change. Lazarus walked the fellows through the last three decades of laws and regulation in the U.S. related to climate change to demonstrate the successes and failures of government efforts to respond to the climate issue. He noted that establishing effective climate change law was especially difficult because climate change's vast spatial and temporal dimensions spread out over time and space the costs and benefits of laws that seek to mitigate climate change, thereby making it hard to forge the political coalitions required to pass tough laws. The "here and now" existing generations regulated by climate change laws are very different from the "there and then" future generations who are the pri-

mary beneficiaries of those laws.

Starting with Bill Clinton's presidency, Lazarus explained how a series of presidential administrations have grappled with the challenge of making climate change law. Clinton picked a vice president who was committed to addressing climate change but then, over eight years, deliberately shied away from enacting mandatory restrictions on greenhouse gas emissions because of concerns about their political unpopularity.

President George W. Bush did the same even though he promised during his original campaign in 2000 to support laws restricting carbon dioxide emissions from power plants. Overriding the strong recommendations of several leading members of his own cabinet,

President Bush ultimately bowed to pressure from his vice president and industry and reneged on his campaign promise.

The U.S. Supreme Court's rejection of Bush's contention that the U.S. Environmental Protection Agency (EPA) lacked authority to regulate greenhouse gas emissions, however, set the stage for the administration of President Barack Obama to take the action that no president before had agreed to do.

President Obama emphasized the climate issue soon after his inauguration and backed it up with a series of cabinet appointments that favored strong climate regulation. "Everything was for climate," Lazarus explained, describing how the Obama administration early on crafted an aggressive climate

lawmaking strategy. However, with a limited number of legislative days in his first two years in office, President Obama made the decision to defer legislation on climate change in favor of ensuring passage of national healthcare legislation.

After losing the Democratic majority in the U.S. House of Representatives in the November 2010 election, the Obama administration's only option was to pursue climate regulation based on existing statutory authority rather than new congressional climate legislation. During the next six years, until the administration's final days, President Obama did just that.

The EPA and the U.S. Department of the Interior promulgated a series of far-reaching regulations designed to curb greenhouse

gas emissions from motor vehicles, powerplants, landfills, and natural gas production. As designed, these ambitious regulations laid the groundwork for the United States to play a critical leadership role in the Paris Climate Agreement in December 2015, which in turn led to the signing then by 195 nations of a historic agreement to curb global greenhouse gas emissions.

The election of Donald Trump to the presidency, however, has since led to an abrupt reversal of U.S. climate policies. In an explicit effort to buoy an otherwise failing coal industry, President Trump has announced his intent to withdraw from the Paris Agreement and to roll back the many Obama administration climate regulations. The legality of the Trump rollbacks has, not surprisingly, led to substan-

tial litigation, which is now pending in federal courts.

In his closing remarks, Lazarus explained that while courts have an important role to play in issues surrounding climate change, they cannot establish laws. He emphasized the importance of the U.S. Congress, presidential leadership, and state and local governments in enacting and administering laws that meaningfully address climate change. Elections matter, Lazarus stressed. "If you care about climate change, vote." There are no judicial shortcuts.

The Economics of Climate Change



Professor Robert N. Stavins of the Harvard Kennedy School detailed the importance of understanding the economics of climate change. While he noted that for some people “environmental economics” may seem like an oxymoron, an economist’s perspective is critical to understanding the problem and addressing issues around climate change. He highlighted the practical realities of climate change that environmental economics is well-positioned to solve.

Stavins explained that environmental economics is critical to understanding and addressing climate change. To begin, the causes of environmental problems are economic—market externalities lead to carbon dioxide emissions. Next, the consequences of climate change have economic di-

mensions—climate change will shape markets around the globe. Finally, an economic perspective is necessary to develop solutions that are effective, economically sensible, and politically pragmatic. All told, we need environmental economics to formulate the right policies to address climate change.

Stavins went on to explain the major challenges of climate change from an economic perspective. Because greenhouse gases mix in the atmosphere, any individual that takes action to reduce emissions will incur the costs of action but the benefits will be spread globally. “This leads to a global commons problem,” Stavins said. As a result, climate change solutions require international, if not global, cooperation.

Further complicating the challenge of climate change

is the element of time. Greenhouse gases accumulate in the atmosphere and are slow to dissipate. “We have a bathtub with an extremely slow drain,” he said. As a result, any benefits from climate change mitigation are felt in the long-term, while costs are felt in the short term. “We’re asking politicians to place costs on the people who elect them when the benefits are going to future generations and other parts of the world.”

With all of these complications in mind, economists recommend carbon pricing as the most practical policy to address climate change. In particular, they highlight a carbon tax or cap-and-trade policies as the most effective policy solutions. Stavins said that these solutions are the only way to provide meaningful emissions reductions and that they are the least

costly approach in both the short- and long-term. He also highlighted several countries and regions around the world that have made significant emissions reductions as a result of their carbon-pricing policies.

To really drive change, though, Stavins said that countries around the world needed to look to the Paris Climate Agreement as a foundation for future action. The agreement, which was ratified by more than 184 countries and the EU—representing more than 88% of global greenhouse gas emissions—is the standard for the sort of international cooperation needed to make a dent in global carbon emissions. While much of the impacts of the agreement are yet to be seen—and depend in large part on the actions of individual countries—he praised the talks

as an important step in the right direction.

While Stavins noted that the U.S. had expressed its intent to withdraw from the Paris Climate Agreement under President Trump, he expressed some hope for the future. He said that in large part the speed of ratification of the Paris Agreements was in direct reaction to Trump’s threats as a candidate. “It’s also important to think of U.S. action in terms of sub-national policies,” he said. “States and regions of the country are becoming leaders on the issue of climate change.”

“The fundamental problem is that we think about these issues one a time; we don’t consider the challenges of climate and energy **holistically.**”

The Economics of Energy Supply

Harvard Business School Professor Forest Reinhardt exposed ALI Fellows to the economics of energy supply. Using the case study of Chilean energy company Colbún, Reinhardt helped synthesize previous discussions of physics and economics using a practical example. He noted that the choices of the protagonist in the case mirrored many of the choices that companies and governments make about the supply of energy to their communities—choices that have profound effects on economic prosperity and on climate.

Through the case, fellows explored some of the tradeoffs that societies confront in delivering the energy their citizens demand. Some technologies (e.g. wind and nuclear) have high capital costs but relatively low operating costs, while others

(e.g. coal and gas) have low capital costs but relatively high variable costs. Further, capacity utilization is higher for some technologies (e.g. coal and gas) than for others (e.g. wind). Fellows discussed the volatility of fuel costs, the impacts of new gas production technologies—“fracking”—and the implications of social choices about the fuel mix for climate change. They noted that CO₂ emissions from coal-fired electric plants are about twice as high, per unit of output, as those from gas-fired plants, and that wind, hydroelectric, and nuclear plants produce virtually no emissions, as their processes do not involve combustion. Even so, there are serious impediments to using these low-carbon forms of energy.

Reinhardt helped fellows consider the consequences, both in the short-term

and the long-term, around the fuel supply decision. In the case of Colbún, the large hydroelectric plants that the firm wanted to build faced serious political hurdles; on the other hand, building more traditional coal-fired plants would only increase the country’s CO₂ emissions. Reinhardt challenged fellows to consider the tradeoffs—for the environment, for the economy, and for future generations—when determining how to supply energy to a country.

To conclude the discussion, he underscored a fundamental problem of energy and climate: leaders often make decisions without considering the full context of the issues at hand. “The fundamental problem is that we think about these issues one a time; we don’t consider the challenges of climate and energy holistically.”

Sea Level Rise Toolkit: Probabilities, Investment, and Insurance

With the help of Harvard Business School Professor John Macomber, ALI Fellows examined how probabilities, investment, and insurance can help build resilience in the face of climate change. Macomber shared the opportunities cities have to invest in climate change resilience and showed the impact that the investor community and insurance markets can have to drive change. Through his presentation, Macomber explained that investing in sustainable cities can be good not just for the environment but for investor returns.

To open his remarks, Macomber highlighted four major trends that cities are facing around the globe. Urbanization, resource scarcity, increasing weather events, and limited government spending are all increasing the environmental risks for



cities. At the same time, investors are looking for ways to find returns, and cities can be the ideal opportunity for investment—they generate more GDP than rural areas, more pollution than rural areas, and they have a political framework more open to change.

Macomber underscored that resilience planning meant making decisions in the face of uncertainty. “Everything in resilience finance is a matter of probabilities,” he said. “There are many scenarios and they all vary by location; as a result, we need to be able to think like an insurance company.” If resilience finance helps to defray costs, most likely over a longer time horizon, then it might be worth investing. Macomber encouraged fellows to think of ways that resilient design could reduce either the amount or the

probability of catastrophic loss due to climate damage.

To provide practical examples of when and how to invest in resilience planning, Macomber presented two cases: that of a Miami-based waste water treatment plant and of a small-business owner bracing for a flood. Through these examples, Macomber demonstrated two key points: investing in resilience infrastructure tends to make more sense when looking at longer time horizons, and financing resilience infrastructure will become an increasingly more popular option for lenders.

He added that insurance companies and rating agencies would drive much of the action around investing in resilience planning. “There is an active market for insurance linked securi-

ties, weather derivatives, and catastrophe bonds,” he said. Investors are already using advanced data and modeling to generate their own probabilities for climate risks. This sort of information asymmetry was a surefire way for investors to make a profit, he added.

Macomber’s talk highlighted the increasing threats of ocean flooding, wildfire damage, and other environmental risk, but it also stressed the opportunity for governments and individuals to make smart investments for the future. He encouraged fellows to consider the ways they could get involved and help cities develop more long-lasting, sustainable infrastructure in the face of a changing climate. He also left them with a warning: “A destroyed city is not a sustainable city.”

Adapting to Climate Change in the U.S. Armed Forces

Former Secretary of the U.S. Navy Ray Mabus shared his experiences adapting to climate change in the armed forces. By establishing clear goals and building support from within, he was able to convert the majority of the Navy and Marine Corps' fuel supplies to biofuels and renewables. His efforts provided fellows with a clear example of motivating change on a complex issue like climate change, and the importance of strong leadership in adapting to a changing environment

Mabus began his remarks with a bold pronouncement: "Climate change is a national security issue." Severe weather events lead to instability, instability turns to chaos, "and the Navy and Marine Corps are the foremost experts on responding to chaos." Mabus explained that the threats of climate



change are not theoretical; they are immediate. He detailed how sea-level rise was already leading to conflict around the globe, and how even within the U.S. climate change was displacing citizens.

In an effort to combat the impact of global warming, Mabus established a task force on climate change in the Navy and Marine Corps. Through the efforts of this task force, he came to see that energy and fuel was a weapon. "It was a weapon that could be used against us, as a vulnerability, and it was a weapon that we could use." Together with the task force, he set goals that by 2020, at least half of the Navy's energy would come from non-fossil fuel sources.

When service members saw the benefits of moving away from fossil fuels, they quick-

ly bought in to Mabus' plan; by the end of his tenure, two thirds of all the Navy's energy came from non-fossil fuel sources. Moreover, Mabus had helped save over \$300M annually on fuel costs. The benefits were not just limited to the military: because of its size, the Navy was also able to help kickstart a move to alternative fuel sources across the country.

In addition, Mabus used a crowd-sourcing model to get suggestions from sailors and Marines on how they could save more energy. Through this process, the Navy also made the switch to LED lightbulbs on warships and began constructing hybrid ships. The crowd-sourcing model essentially became a competition to generate the best ideas, and service men and women were eager to get recognition from their peers for their contributions.

Fellows asked Mabus what lessons in change management he had learned through the process of adapting to climate change. Mabus explained that there were five critical steps to effective change management: decide where you want to go; think big; hold people accountable; use metrics; and narrow your focus. "You set the example others will follow," he added.

Fellows also asked him how they might be able to translate his adaptive solutions to democratic institutions. "Even in the Navy," he explained, "I had to convince people that this was a good idea." Mabus said that leaders needed to convince people that climate change would have a personal impact on their lives, and they needed to acknowledge the short-term pains of adapting to climate change.

Mabus concluded his remarks by stressing the need for all sectors to get engaged on issues of climate change. "There are all sorts of military reasons to take action," he said. "There are also equally as many compelling reasons for everyone to do this." He added that the entire government and the entire country needed to get behind the movement to renewable energy sources, and he encouraged the private sector to take the lead.

Climate and Organizational Change

Professor Amy Edmondson of Harvard Business School (HBS) helped ALI Fellows see how change management lessons could help address complex problems like climate change. Using a case study on Siemens' supply chain and sustainability goals, Edmondson illustrated the differences between classic change management and change management as a learning process. She also helped fellows understand how these lessons could be applied to solving pressing problems with ill-defined solutions.

In the case of Siemens, the protagonist faced the challenge of streamlining the supply chain for the company. To tackle this problem, she convened a team who had specific roles in supply chain and procurement, established key targets, and made structural changes to

help achieve them. During the discussion, fellows noted that this was a problem she had faced in the past at other companies and that she had a clear plan for driving success on the supply chain.

To complicate matters, however, the protagonist also faced challenges of creating and meeting sustainability goals for the company. To address this issue, she brought together stakeholders from around the organization, found champions for her cause, and used careful incentives to drive action from within. Edmondson explained that the case really represented two distinct examples of change management.

The protagonist's first challenge around the supply chain represented a classic challenge in change management. The issue of the



supply chain was a well-defined problem with well-defined solutions. Drawing on the work of HBS Professor John Kotter, Edmondson explained that these types of challenges had three distinct phases with eight steps:

Phase 1: Getting started

- Create a sense of urgency
- Form a powerful guiding coalition
- Create a vision

Phase 2: Involving everyone

- Communicate the vision broadly, in a variety of ways
- Empower others to take action that helps achieve the vision
- Define, plan for, and measure short term success

Phase 3: Institutionalizing new ways of working

- Consolidate

improvements and produce still more change

- Institutionalize new approaches in the culture

In contrast, the protagonist's second challenge around sustainability goals represented an adaptive challenge. Addressing these sorts of challenges requires an experimentation and learning process because neither problems nor solutions are clearly specified. These challenges require decentralized, distributed leadership, emergent approaches, and adaptation. Progress is often difficult to measure in these cases, and leaders must build coalitions, make education guesses, and experiment.

Edmondson explained that most of the issues the fellows planned to tackle—including climate change—would

require this sort of adaptive change management. She added that implementing an effective learning process for change was primarily a matter of reducing fear among members of their teams. "Ultimately, it's the difference between a blueprint logic and a learning logic."

New Consciousness? New Decisions?

Professor Jim Engell, an English professor from the Harvard Faculty of Arts and Sciences, made a case for the importance of considering a humanist view on climate change. Engell defined humanism as the study of issues from the point of view of human values across the broadest possible spectrum—in this case, the end result of how science, economics, and diplomacy affect entire communities and how those communities can mobilize themselves for change. He explained that the fundamental challenge with climate change is altering the way people think about the issue, their own values, and their own behavior. He used Pope Francis' Papal Encyclical as focal point for discussion to highlight the importance of reframing our collective consciousness on the issue of climate change.

Engell said the ultimate challenge with climate change was that it requires a fundamental shift in values. People need to change their thinking in a radical way—an astonishing shift, but one that humans have proven capable of throughout history. “We need to yoke humane values to scientific thinking,” he added.

He then shared a clip from the 1958 film, *The Unchained Goddess*, to illustrate how long we have been aware of the issue of climate change. The film, produced by Frank Capra for Bell Labs, spoke of the dangers of a warming planet and rising sea levels. Today, there is near universal consensus among scientists on the human-caused changes to climate; yet, to this day not nearly enough is being done on the issue.

Turning the group's attention to the Papal Encyclical, Engell praised the document for taking a stand on scientific issues. He highlighted Pope Francis' appeal to start a new dialogue on climate change—to begin thinking of the Earth's climate as a common good and seeing that a true ecological approach would also require a social change. Francis encourages a profound shift in values that prioritize the needs of other people, especially the poor, around the world.

Francis cautions against trusting capitalism to resolve the problem on its own. He warns of the dangers of a “deified market” and explains that externalities associated with market forces are exacerbating the problems around climate. “This is a question of human rights and international jus-

tice,” Engell said. “This is a question of public health.”

Engell noted that there must be international action on issues of climate change. He underscored the urgency of Francis’ message, and described the document as a call to action for leaders around the world. “This is a very simple and very difficult message from Pope Francis.” Francis discusses the need for profound inner conversion—not religious but personal—for individuals around the world. In this sense, we are all humanists; we all share a common responsibility.

Closing out the discussion, Engell emphasized Francis’ message—one that all major world religions share, as well as many scientists—that humans are the stewards of creation. “The actions of human beings affect and dom-



-inate every ecosystem on Earth.” He also encouraged fellows to get involved in their communities to drive change on the issue: “Think locally and regionally—that is the way to effect leadership.”

Synthesis and Discussion

To conclude the 2019 Climate Change Deep Dive, Faculty Chair Forest Reinhardt led ALI Fellows through a discussion of the roles of government, firms, and other actors in addressing the issue. He also encouraged fellows to think of ways that they might be able to personally take action on the challenges of climate change.

In their discussion of the roles of government and other actors, fellows highlighted the need for countries around the world to embrace carbon pricing policies, whether through taxes or through a cap-and-trade system. They stressed the communications challenge around the issue and noted that leaders needed to convince the electorate that this was an issue that mattered to their communities.

While some fellows encouraged innovation around climate change, others said the primary issue was around execution. With the science clearly established, some argued that the main problem was educating and galvanizing citizens on the topic.

Turning their attention toward their own actions, fellows highlighted the need to raise knowledge on the issue, particularly among younger generations. They also said they would take steps to reduce their personal consumption and to engage their families and friends in conversations on the issue. Fellows noted that young people were often already leading on this topic, and the fellows' role could be to empower and mobilize younger generations to take action.

In his final remarks, Reinhardt observed that “Climate change involves dissaving by the present occupants of the planet at the expense of future generations.” To reduce global emissions, we can decarbonize our energy system, increase the efficiency with which energy is used, or both. Making these sorts of changes, however, will not be easy. “Energy is the ability to do work, and to be rich means to have lots of energy at your disposal,” he said. He pointed to consumer demand as an important place to start driving change—on the demand side of energy there is opportunity for conservation, and on the supply side there is an opportunity to use low-carbon or carbon-free technologies.

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Stillness and Momentum

Artist Zaria Forman shared with fellows her efforts to convey the urgency of climate change through art. She communicated her experiences traveling around the world to explore moments of transition in the Earth's climate. "I explore turbulence and tranquility," she said, "I want to expose viewers to places they may never see."

Forman showed fellows photos and drawings from trips to Antarctica and Greenland, trips that gave her the opportunity to witness ice from an entirely new perspective. On these trips, she observed first-hand the increasing rates of ice melt, and was able to learn from scientists why ice loss was happening at unprecedented rates.

With the drawings she created from these trips, For-

man aims to create an emotional connection to remote places of the world and to foster stewardship. "I want my drawings to spark curiosity, to create a visual language of time and pressure," she said. Her drawings attempt to convey "the impossibility of these places" and serve as a call to action for viewers.

Her process begins with the thousands of photos that she takes from her trips around the world. Using the photos as inspiration, she creates pencil sketches before layering pigment on to the canvas with soft pastel. She smudges the pastel with her fingers and palms and breaks it into sharp shards to render finer details. Her work is on a large scale to recreate the wonder of seeing these places up close.

On her journeys, Forman

has come to understand the urgency of taking action, but she also feels that the momentum around climate change has shifted. As an example, she explained that clean energy is now cheaper and more common. "Real solutions exist," she said, "It's important to focus on the positive too." She hopes to give viewers a sense that they still have the chance to take action. "I hope to generate momentum through moments of stillness."

Forman also said the work to stop climate change is intergenerational. Her mother, a fine arts photographer, first exposed her to the beauty of these remote regions around the world. The two had planned a trip to Greenland together before Forman's mother was diagnosed and passed away from brain cancer. Forman carried out their final journey on her



own, scattering her mother's ashes in Greenland's glaciers and ice fields. She said that her mother inspired her to focus on the positive and to uphold a reverence for the natural world. "Action on climate change is now unstoppable."



Speaker Biographies

Amy C. Edmondson



Amy C. Edmondson is the Novartis Professor of Leadership and Management at the Harvard Business School, a chair established to support the study of human interactions that lead to the creation of successful enterprises that contribute to the betterment of society.

Edmondson has been recognized by the biannual *Thinkers50* global ranking of management thinkers in 2011, 2013, 2015 and 2017 and was honored with the Talent Award in 2017. She studies teaming, psychological safety, and leadership, and her articles have been published numerous academic and management outlets, including *Administrative Science Quarterly*, *Academy of Management Journal*, *Harvard Business Review* and *California Management Review*. Her books – *Teaming: How organizations*

learn, innovate and compete in the knowledge economy (Jossey-Bass, 2012), *Teaming to Innovate* (Jossey-Bass, 2013) and *Extreme Teaming* (Emerald, 2017) – explore teamwork in dynamic organizational environments. In *Building the future: Big teaming for audacious innovation* (Berrett-Koehler, 2016), she examines the challenges and opportunities of teaming across industries to build smart cities. Her new book, *The Fearless Organization: Creating Psychological Safety in the Workplace for Learning, Innovation and Growth* (Wiley, 2018), offers a practical guide for organizations serious about success in the modern economy.

Before her academic career, she was Director of Research at Pecos River Learning Centers, where she worked on transformational change in large companies. In the

early 1980s, she worked as Chief Engineer for architect/inventor Buckminster Fuller, and her book *A Fuller Explanation: The Synergetic Geometry of R. Buckminster Fuller* (Birkhauser Boston, 1987) clarifies Fuller's mathematical contributions for a non-technical audience. Edmondson received her PhD in organizational behavior, AM in psychology, and AB in engineering and design from Harvard University.

James Engell



James Engell, Gurney Professor of English and Professor of Comparative Literature, began his studies first in science and was a young NSF fellow at the Jackson Laboratory in Maine. He also researched comparative effects of non- and biodegradable detergents immediately introduced to freshwater fish populations, with results later confirmed by others.

His first employment was at Janney, Battles & E. W. Clark (now Janney), where he was offered a partnership in a local brokerage office. He decided in the end primarily to pursue studies in the humanities with an emphasis on literature. In that field he has authored four books and edited and contributed to nine others. His writing on energy policy has appeared in *The Huffington Post* and *The*

Energy Collective. He conceived of and co-edited the widely used text *Environment* (Yale, 2008). His awards and fellowships include those from the Ford Foundation, the Council for Advancement and Support of Education, and The National Humanities Center. *Saving Higher Education in the Age of Money* (2005, co-authored with Anthony Dangerfield) won the Association of American Colleges and Universities award for “Best Book on Liberal Education.” His essay “The CFR Task Force Report on ‘U.S. Education Reform and National Security’: A Reply and Response,” received acclaim.

While devoting most of his career to the humanities, he has pursued a life-long formal and informal interest in science. A member of the American Academy of Arts

and Sciences and recipient of several faculty-wide teaching prizes as well as a national mentoring award, Engell teaches (as well as co-teaches, in the Economics Department at Harvard) courses that engage environmental and other issues involving human values and expression, history, science, economics, and reform.

Zaria Forman



Zaria Forman documents climate change with pastel drawings. She travels to remote regions of the world to collect images and inspiration for her work, which is exhibited worldwide. She has flown with NASA on several Operation IceBridge missions over Antarctica, Greenland, and Arctic Canada. She was featured on CBS Sunday Morning, CNN, and PBS. She delivered a TEDTalk, and spoke at Amazon, Google, and NASA's Goddard Space Flight Center, exhibited in Banksy's Dismaland, and was the artist-in-residence aboard the National Geographic Explorer in Antarctica. Her works have appeared in publications such as The New York Times, National Geographic, The Wall Street Journal, and the Smithsonian Magazine. Forman currently works and resides in Brooklyn, NY, and

is represented by Winston Wächter Fine Art in New York, NY and Seattle, WA.

To learn more about the artist, visit: www.zariaforman.com



Peter Huybers



Peter Huybers is a Professor of Earth and Planetary Sciences at Harvard University whose research interests lie in developing a better understanding of the climate system and its implications for society. On-going research involves interactions between volcanism and glaciation, trends and predictability of extreme temperatures, and implication of climate change for food production.

Huybers received a B.S. from the United States Military Academy at West Point in 1996 and a Ph.D. from the Massachusetts Institute of Technology in 2004.

Richard Lazarus



Photo by Brooks Kraft

Richard Lazarus is the Howard and Katherine Aibel Professor of Law at Harvard University, where he teaches environmental law, natural resources Law, Supreme Court advocacy, and torts. Professor Lazarus has represented the United States, state and local governments, and environmental groups in the United States Supreme Court in 40 cases and has presented oral argument in 14 of those cases. His primary areas of legal scholarship are environmental and natural resources law, with particular emphasis on constitutional law and the Supreme Court. He has published two books, *The Making of Environmental Law* (U. Chicago 2004), and *Environmental Law Stories* (Aspen Press, co-edited with O. Houck 2005). He was also the principal author of *Deep Water - The Gulf Oil Disaster and the Future of Offshore Drilling* (GPO 2011), which is the Report to the President of the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling Commission, for which he served as the Executive Director. The Commission was charged with investigating the root causes of the oil spill in the Gulf of Mexico in the Gulf of Mexico in 2010 and recommending changes in law and policy to reduce the risk of future spills and to mitigate their impacts. Prior to joining the Harvard law faculty, Lazarus was the Justice William J. Brennan, Jr., Professor of Law at Georgetown University, where he also founded the Supreme Court Institute. He graduated from Harvard Law School in 1979 and has a B.S. in chemistry and a B.A. in economics from the University of Illinois.

Ray Mabus



Ray Mabus has been a change leader throughout his career, from attacking entrenched public corruption as Mississippi's State Auditor in the early 1980s to reviving a bankrupt publicly traded sector manufacturing company with no loss in equity and no loss to creditors to revolutionizing the Navy and Marine Corps as Secretary of the Navy under President Obama.

The longest serving Secretary of the Navy since World War I, Mabus has also served as Governor of Mississippi, Ambassador to the Kingdom of Saudi Arabia, and Chairman and CEO of Foamex.

Recognized by Glassdoor as one of the top 50 CEOs in the country, Mabus earned international attention leading Navy for his efforts to rebuild the U.S. fleet; revolu-

tionize energy procurement and consumption, including moving the Navy away from fossil fuels; promoting innovation in personnel and business practices; and strengthening global partnerships by traveling over 1.3 million miles to meet with Sailors and Marines and leaders in over 152 separate countries and territories.

In June 2010, President Obama gave him the additional task of producing a long-term Gulf Coast restoration plan after the Deepwater Horizon spill. Many of the recommendations in his report, "America's Gulf Coast," were adopted into law when Congress passed on a bipartisan vote and the President signed the "Restore Act."

The youngest governor of Mississippi in more than 150 years at the time of his

1987 election, he stressed education and job creation, passing one of the most comprehensive education reform programs in America; while providing teachers the largest pay raise in the nation. In 2000, he was chosen in a poll of Mississippians as the Best Governor of the 20th Century.

As Ambassador, a crisis with Iraq was successfully deterred, a terrorist attack was weathered, and contracts worth more than \$16 billion were signed between Saudi Arabia and American companies.

Currently, Currently, Mabus is CEO of The Mabus Group, a strategic advisory consulting firm focusing on resiliency, helping business, organizations and institutions prepare for, mitigate against and gain competitive advantage from man-made

and natural change. He also serves as an advisor to Google Ventures, a lecturer at the Harvard Law School, an executive fellow at the Harvard Business School and as a visiting fellow with the Institute of Politics and the Belfer Center for Science and International Affairs.

A fourth generation Mississippian, he holds a bachelor's degree from the University of Mississippi, Summa Cum Laude, a master's degree from the John Hopkins University, where he was a Woodrow Wilson Fellow, and a law degree, Magna Cum Laude, from Harvard. He also served in the U.S. Navy aboard the cruiser USS Little Rock.

John D. Macomber



John Macomber is a Senior Lecturer in the Finance unit at Harvard Business School. His professional background includes leadership of real estate, construction, and information technology businesses. At HBS, Macomber's work focuses on the urban impacts of private finance and delivery of public infrastructure projects in both the developed and emerging worlds. These include transportation, energy, water/sanitation, and real estate investments that speed economic development, reduce environmental impacts (notably air and water pollution), and facilitate individual opportunity. His teaching combines infrastructure finance (including public-private partnerships), economic development, and urban planning as well as the impact of new technologies.

Macomber is engaged in

the Business and Environment Initiative and Social Enterprise Initiatives at HBS and is a member of the Executive Committee of the Harvard University Center for African Studies. He teaches Finance, Real Estate, Urbanization, and Entrepreneurship courses in the elective curriculum and in Executive Education.

Macomber is the former Chairman and CEO of the George B H Macomber Company, a large regional general contractor; and remains a principal in several real estate partnerships. He serves or has served on the boards of Young Presidents Organization International (YPO), Boston Private Bank, Mount Auburn Hospital, and the WGBH Educational Foundation.

Forest L. Reinhardt



Forest L. Reinhardt is the John D. Black Professor of Business Administration at Harvard Business School.

Reinhardt is the head of HBS's Business, Government, and the International Economy unit. He also serves as the faculty chair of Harvard Business School's Asia-Pacific Research Center and the chair of the HBS Executive Education in the Asia-Pacific Region.

Recently, Reinhardt taught, with HBS colleagues Martha Crawford and Joe Lasiter, an MBA elective course called "Twenty-First Century Energy." This course analyzes the global energy system from economic and political perspectives, and explores the strategies both of incumbent firms and startups.

Reinhardt also teaches reg-

ularly in the HBS Agribusiness Seminar, and he teaches an MBA elective course called "Food and Agribusiness," which uses case studies from all over the world to examine the ways in which people raise plants and animals and the ways in which food is transported, processed, distributed, marketed, and consumed.

Reinhardt's other recent teaching assignments have included a core course called Global Markets in the HBS Owner/President Management Program. Drawing on microeconomics, macroeconomics, political science, and history, the course helps business leaders understand the economic and political environment in which business is conducted, and the strategic opportunities and risks to which globalization gives rise. In addition, Reinhardt has taught the

required MBA courses on Strategy and on Business, Government, and the International Economy at HBS.

Reinhardt is interested in the relationships between market and nonmarket strategy, the relations between government regulation and corporate strategy, the behavior of private and public organizations that manage natural resources, and the economics of externalities and public goods. He is the author of *Down to Earth: Applying Business Principles to Environmental Management*, published by Harvard Business School Press. Like that book, many of his articles and papers analyze problems of environmental and natural resource management. He has written numerous classroom cases on these and related topics, used at Harvard and elsewhere in MBA curricula

and in executive programs.

Reinhardt serves on the Board of Tutors for the Harvard College concentration in Environmental Science and Public Policy, on the Steering Committee of the Harvard University Center for the Environment, and on the Steering Committee of the HBS-Harvard Kennedy School Joint Degree Programs. He is Co-Chair of the Harvard Advanced Leadership Initiative.

Reinhardt received his Ph.D. in Business Economics from Harvard University in 1990. He also holds an MBA from Harvard Business School, where he was a Baker Scholar, and an A.B., cum laude, from Harvard College.

Born and raised in Montana, he lives in Belmont, Massachusetts.

Robert N. Stavins



Robert N. Stavins is the A.J. Meyer Professor of Energy & Economic Development at the Harvard Kennedy School, Director of the Harvard Environmental Economics Program, Chairman of the Environment and Natural Resources Faculty Group, Director of Graduate Studies for the Doctoral Program in Public Policy and the Doctoral Program in Political Economy and Government, Co Chair of the Harvard Business School Kennedy School Joint Degree Programs, and Director of the Harvard Project on Climate Agreements. He is a University Fellow of Resources for the Future, a Research Associate of the National Bureau of Economic Research, Co-Editor of the *Review of Environmental Economics and Policy*, and a Member of: the Board of Directors of Resources for the Future, the Board of Ac-

ademic Advisors of the AEI Brookings Joint Center for Regulatory Studies, the Editorial Boards of *Resource and Energy Economics*, *Climate Change Economics*, *Environmental Economics Abstracts*, *B.E. Journals of Economic Analysis & Policy*, *Economic Issues*, and *Environmental Economics and Policy Studies*. He is also a Vice-President of the American Association of Wine Economists, an editor of the *Journal of Wine Economics*, and is the Chair of the Expert Advisory Board of the Harvard Alumni Alliance for the Environment.

He was elected a Fellow of the Association of Environmental and Resource Economists in 2009, and was named the 2016 recipient of the Edmund G. Pat Brown Award. He was formerly a member of the Scientific Advisory Board of the Fon-

dazione Eni Enrico Mattei, the Editorial Board of *Land Economics*, *The Journal of Environmental Economics and Management*, the Board of Directors of the Association of Environmental and Resource Economists, a member and Chairman of the Environmental Economics Advisory Committee of the U.S. Environmental Protection Agency's (EPA) Science Advisory Board, a member of the Executive Board of the U.S. Environmental Protection Agency's (EPA) Science Advisory Board, the Editor of the *Review of Environmental Economics and Policy*, Chair of the Scientific Advisory Board of the Massachusetts Executive Office of Environmental Affairs, a member of the Executive Committee of the Harvard University Center for the Environment, a Lead Author of the Second and Third Assessment Re-

ports and a Coordinating Leading Author of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, and a contributing editor of *Environment*. He holds a B.A. in philosophy from Northwestern University, an M.S. in agricultural economics from Cornell, and a Ph.D. in economics from Harvard.

Stavins' research has focused on diverse areas of environmental economics and policy, including examinations of: market based policy instruments; regulatory impact analysis; innovation and diffusion of pollution control technologies; environmental benefit valuation; policy instrument choice under uncertainty; competitiveness effects of regulation; depletion of forested wetlands; political economy of policy instrument choice; and costs of carbon seques-

tration. His research has appeared in the *American Economic Review*, *Journal of Economic Perspectives*, *Quarterly Journal of Economics*, *Journal of Economic Literature*, *Science*, *Nature*, *Journal of Environmental Economics and Management*, *Ecology Law Quarterly*, *Journal of Regulatory Economics*, *Journal of Urban Economics*, *Journal of Risk and Uncertainty*, *Resource and Energy Economics*, *The Energy Journal*, *Energy Policy*, *Annual Review of Energy and the Environment*, *Explorations in Economic History*, *Brookings Papers on Economic Activity*, other scholarly and popular periodicals, and several books. In 2017, he received the Publication of Enduring Quality Award from the Association of Environmental and Resource Economists, together with Richard Newell and Adam Jaffe for their 1999 article, "The Induced

Innovation Hypothesis and Energy-Saving Technological Change,” published in the *Quarterly Journal of Economics*.

He is the co-editor of *Post-Kyoto International Climate Policy* (Cambridge University Press, 2009), *Architectures for Agreement: Addressing Global Climate Change in the Post-Kyoto World* (Cambridge University Press, 2007), editor of the fourth, fifth, and sixth editions of *Economics of the Environment* (W. W. Norton, 2000, 2005, 2012), co editor of *Environmental Protection and the Social Responsibility of Firms* (Resources for the Future, 2005), editor of *The Political Economy of Environmental Regulation* (Edward Elgar, 2004), co editor of the second edition of *Public Policies for Environmental Protection* (Resources for the Future, 2000), and

the author of *Environmental Economics and Public Policy: Selected Papers of Robert N. Stavins, 1988–1999* (Edward Elgar, 2000) and *Economics of Climate Change and Environmental Policy: Selected Papers for Robert N. Stavins, 2000–2011* (Edward Elgar, 2013).

Stavins directed Project 88, a bi partisan effort co chaired by former Senator Timothy Wirth and the late Senator John Heinz, to develop innovative approaches to environmental and resource problems. He continues to work closely with public officials on matters of national and international environmental policy. He has been a consultant to the National Academy of Sciences, several Administrations, Members of Congress, environmental advocacy groups, the World Bank, the United Nations, the U.S. Agency for Inter-

national Development, state and national governments, and private foundations and firms.

Prior to coming to Harvard, Stavins was a staff economist at the Environmental Defense Fund; and before that, he managed irrigation development in the Middle East, and spent four years working in agricultural extension in West Africa as a Peace Corps volunteer.

Michael W. Toffel



Mike Toffel is the Senator John Heinz Professor of Environmental Management, Faculty Chair of the HBS Business and Environment Initiative, and is course head of and teaches the Technology & Operations Management core MBA course. Toffel's research examines companies' management of environmental affairs and occupational safety, identifying which types of management programs and regulations improve environmental and safety performance.

His work ranges from academic articles based on econometric analyses of large datasets to case studies of individual companies. His research on occupational health and safety has been profiled by the head of U.S. OSHA and featured in the national press including US News & World Report,

and Scientific American. His research has been published in many top scholarly journals including Science, Management Science, Strategic Management Journal, Administrative Science Quarterly, and Organization Science, in practitioners journals including Sloan Management Review and California Management Review, and in mainstream outlets including The Atlantic Monthly and Newsweek/DailyBeast.

Toffel serves as an Associate Editor of Management Science and on the Editorial Boards of the Strategic Management Journal and Organization Science. He is also a founding board member of the Alliance for Research on Corporate Sustainability (ARCS), which organizes a leading annual academic conference to foster high-quality research

on corporate sustainability and to build collaboration among scholars engaged in these topics.

His co-authors include Julia Adler-Milstein, Ronnie Chatterji, Magali Delmas, Anil Doshi, Glen Dowell, Kira Fabrizio, Andrea Huggill, Chonnikarn (Fern) Jira, Matthew Johnson, Andrew King, David Levine, Julian Marshall, Chris Marquis, Melissa Ouellet, Lamar Pierce, Erin Reid, Tim Simcoe, Sara Singer, Jodi Short, David Vogel, and Yanhua Zhou.

He recommends the HBS Business & Environment Initiative, Environmental Leader, Grist, Ethical Corporation, and Sustainable-Business.com to keep up on corporate environmental news.

Toffel has organized sev-

eral conferences related to his research, including conferences on corporate sustainability at HBS (2010), the role of information disclosure in corporate transparency and accountability at the National Press Club in Washington DC (2009), business and human rights in operations and supply chains at HBS (2008), and industry self-regulation at HBS (2007).

Toffel received a Ph.D. from the Haas School of Business' Business and Public Policy department at the University of California at Berkeley, an MBA from the Yale School of Management, a Master's in Environmental Management (Industrial Environmental Management) from the Yale School of Forestry & Environmental Studies, and a BA in Government from Lehigh University. He has worked as the Director

of Environment, Health and Safety at the Jebsen & Jessen (South East Asia) Group of Companies, based in Singapore. He has also worked as an environmental management consultant for Arthur Andersen, Arthur D. Little, and Xerox Corporation. He started his career as an operations management analyst at J.P. Morgan.

Toffel has served on the Advisory Panel of the Newsweek Green Rankings and on the School Site Council of the Edward Devotion School, a public school in Brookline, MA.



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