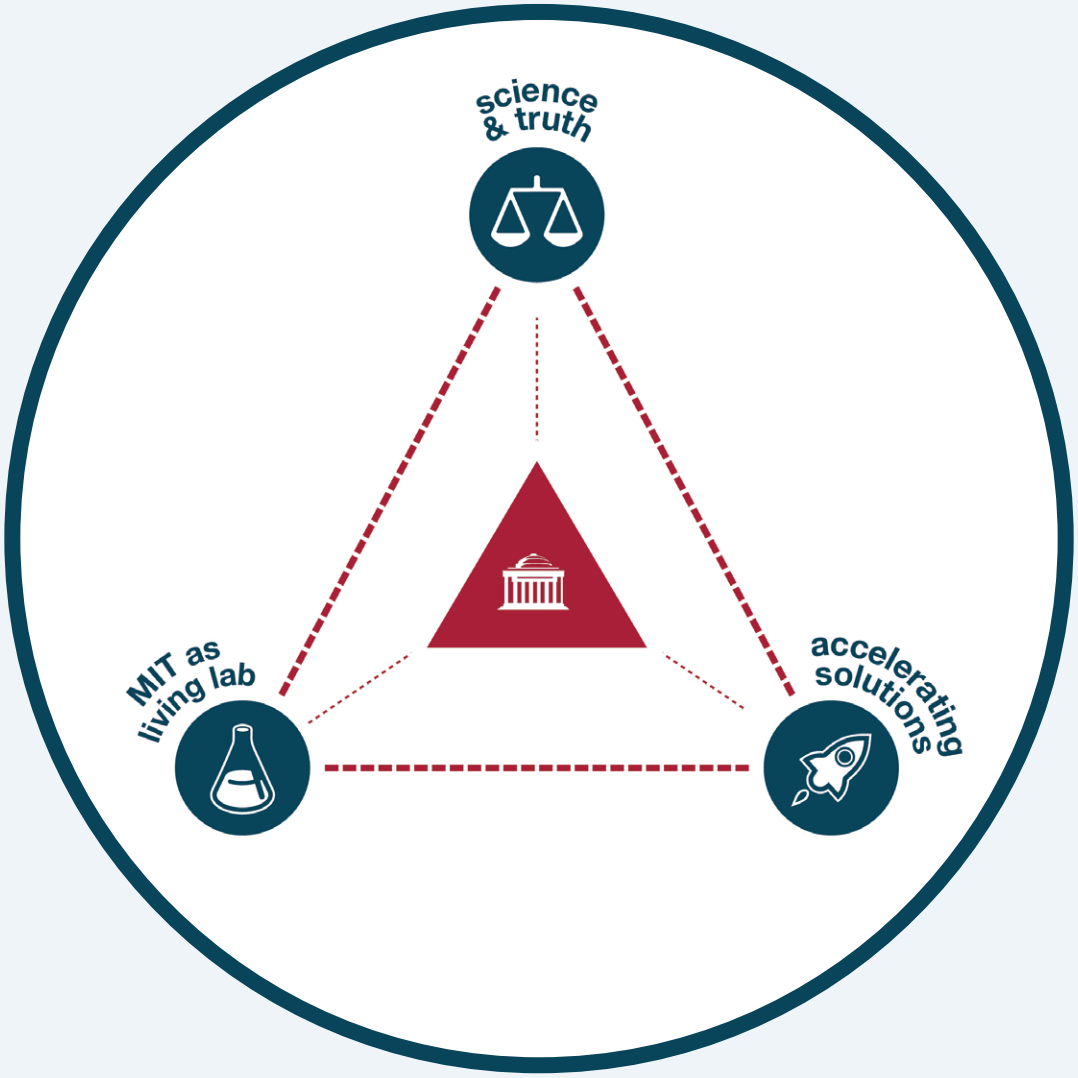
REPORT OF THE MIT CLIMATE CHANGE CONVERSATION COMMITTEE

MIT AND THE CLIMATE CHALLENGE

JUNE 2015



COMMITTEE CHARGE AND MEMBERSHIP

On September 19, 2014, Vice President of Research Maria Zuber announced the formation of the **MIT Climate Change Conversation Committee**, which was tasked to launch an open, campus-wide conversation on how MIT can lead in confronting climate change.

The committee's charge reads:

"The Committee should seek broad input from the Institute community on how the US and the world can most effectively address global climate change. The Conversation should explore pathways to effective climate change mitigation, including how the MIT community – through education, research and campus engagement – can constructively move the global and national agendas forward. Possible activities for the Campus Conversation could include a lecture series, panels and a survey in which all points of view of the MIT community are sought, presented and discussed.

The Committee will produce a final report with key suggestions with associated pros and cons that encompass the range of views of the community. The Committee should accomplish its work during the FY14-15 academic year and submit its report by Commencement 2015.

The Conversation Leadership will solicit reactions to the report from the MIT community and, from the collective input, recommend to the President a path forward."

The composition of the committee was as follows:

Roman Stocker (Committee Chair)
Associate Professor
Department of Civil and Environmental Engineering

Adam Berinsky
Professor of Political Science
Department of Political Science

Sarah Brylinsky
Sustainability Project Manager
Office of Sustainability

Kerry Emanuel
Cecil and Ida Green Professor of Atmospheric Science
Department of Earth, Atmospheric and Planetary Sciences

Henry "Jake" Jacoby
William F. Pounds Professor of Management Emeritus
Sloan School of Management

Bernadette Johnson
Chief Technology Officer
Lincoln Laboratory

Jacqueline Kuo
Undergraduate Student
Department of Mechanical Engineering

Christoph Reinhart
Associate Professor in Building Technology
Department of Architecture

Elly Rostoum
Communications Associate
Climate Change Conversation

Anne Slinn
Executive Director for Research
Center for Global Change Science

Geoffrey Supran
Graduate Student
Department of Materials Science and Engineering

Tavneet Suri
Maurice J. Strong Career Development Associate Professor
Sloan School of Management

Stian Ueland
Postdoctoral Associate
Department of Materials Science and Engineering

Acknowledgement. The committee acknowledges all the members of the community who have contributed to the Climate Change Conversation, giving their time and energy to provide input in person or electronically, attend events, organize or advertise activities, and contribute to this report.

CONTENTS

1. EXECUTIVE SUMMARY—2

2. PREAMBLE—6

2A. Climate Change: the Nature of the Problem 6

2B. Urgency & Opportunity for a Bold Response by MIT to the Climate Challenge 7

3. SUGGESTIONS FOR CLIMATE CHANGE ACTION—11

3A. Standing Up for Science and Truth 11

1. Establish an Ethics Advisory Council 11
2. Take active measures to counter disinformation 13
3. Create a web resource for climate change issues 16
4. Offer Congressional and executive seminars and short courses 17
5. Divestment considerations 18

3B. Transforming MIT Into a Climate Change Living Laboratory 22

1. Implement an internal MIT system of carbon pricing 23
2. Implement carbon efficiency on the MIT campus 26
3. Establish an open data platform to accelerate solutions 28
4. Advance climate change mitigation and adaptation practices 29
5. Require climate change education in the undergraduate curriculum 30

3C. Accelerating Solutions 33

1. Declare climate change the focus of a major capital campaign 34
2. Create a Climate Institute to connect and augment existing activities 35
3. Enhance support for climate change research, development and transition 35
4. Develop new investment strategies 36
5. Accelerate solutions by leading higher education partnerships on climate change 36

4. APPENDICES—40

4A. Engagement of the MIT Community 40

1. Listening Tour 40
2. Idea Bank 41
3. Fall Survey and public events 41

4B. Additional Information on Fossil Fuel Divestment 44

4C. Emission Reduction Goals of the Ivy Plus Sustainability Consortium Institutions 46

4D. Personal Statement by Geoffrey Supran 47

1. EXECUTIVE SUMMARY

Humanity has a limited window of opportunity to avert the most catastrophic risks of climate change. The global and holistic nature of the climate change threat, which affects all nations and requires combined progress on technology, policy, behavioral shifts and beyond, makes it society's grandest challenge of the present day, possibly of all time. Finding solutions to society's biggest problems is in MIT's DNA and is central to its values. The time has come for MIT to play a prominent, visible part in the action and solutions needed to confront the climate challenge. Perils ahead dwarf risks to the Institute in navigating this politically charged issue, such that even exceptional measures should not be eschewed. We call upon the Institute to rise to confront what may prove to be the greatest threat to current and future generations. This report lays out suggestions for a set of actions to move the Institute in this direction.

The report distills a nine-month long 'conversation on climate change' at MIT steered by the Climate Change Conversation Committee. During this time, the committee sought broad input from the approximately 26,000 members of the MIT community on how the Institute could most effectively aid the U.S. and the world to address climate change. The Conversation took place through a combination of different channels for input to and from the community. These consisted of an Idea Bank, a community-wide survey and a series of public events guided by the survey responses, a Listening Tour, and a myriad of personal interactions. The actions suggested in this report represent the input of the community, distilled and organized through the lens and analyses of the committee.

The most important outcome of the Conversation is the widespread agreement in the community around a central point: the Institute should take bold action to contribute to the solution of the climate challenge – including publicly and visibly stating its principles for combating climate change – at the highest levels and ideally as part of a strong climate action plan.

A proactive leadership approach to climate change should be accompanied by a suite of actions to address the problem at all levels. In the report, suggested actions are organized around three themes (see graphic, page 5): (A) Standing up for science and truth; (B) Transforming the campus into a Living Laboratory for climate change; and (C) Accelerating solutions to the climate threat. Importantly, these actions gain power when executed through strong leadership as part of a coherent, visible framework, committed to a holistic quest for solutions.

In Theme A, the committee outlines suggestions for how MIT might take an active role in both countering disinformation and disseminating accurate information on climate change as part of its mission in service to the nation and the world. Disinformation and misinformation are rampant in the climate arena and have strongly contributed to the gap between public perception and professional assessment of the looming threats. Universities are looked upon as islands of intellectual integrity in a rising sea of flawed information, yet they do little by way of a concerted effort to counter disinformation. MIT should speak out in the defense of science, and explicitly combat disinformation and avoid inadvertently supporting disinformation through investments and other actions. Because of the potential ethical risks associated with investments, MIT should

create an Ethics Advisory Council, which would examine ethical issues that include activities such as disinformation campaigns that are antithetical to the Institute's central mission of education. Engagement with and ultimately divestment from entities that persist in spreading disinformation could be recommendations from this Council.

Beyond countering disinformation, MIT should construct a multifaceted approach to proactively disseminate accurate information on climate change, endeavoring to find new and more visible ways to communicate and to ensure that the scientific body of knowledge is properly and prominently represented in the education, media and policymaking circles. This approach could include the creation of a clearinghouse of credible information on climate issues, which would harness MIT's reputation as a neutral arbiter of scientific and technical information in order to provide a resource for policymakers, the media and society globally. Congressional and executive seminars and short courses on climate change, following a successful MIT tradition in other areas, would serve the nation by providing high-level discussions as well as technical and scientific input on the science, policy and technology of climate change.

Seeking solutions to the climate challenge requires experimentation and education on both technology and policy. In Theme B, the committee suggests ideas that harness this opportunity to transform the campus into a Living Laboratory for climate change solutions. As a Living Laboratory, the MIT campus can serve as a testbed for experimentation, research and demonstration of carbon mitigation and adaptation policies, such as carbon pricing, and a showcase for modeling low-carbon, sustainable operations. By establishing itself as a model and a testing ground to develop, evaluate and teach strategies and technologies for the new low-carbon economy, MIT would not only 'get its house in order' in moving toward a more sustainable campus, but harness a unique, *mens et manus* education opportunity focused on the grandest challenge of our time. Furthermore, a Living Laboratory would demonstrate MIT's recognition of the seriousness of the problem and its commitment to a rational approach to solutions, and provide critical learning opportunities for students. Three core areas are suggested to establish the climate change Living Laboratory: implementation of an internal carbon pricing program, implementation of carbon efficiency on the campus, and a pedagogy shift in the undergraduate curriculum.

There is widespread agreement that the most efficient way to reduce carbon emissions is to price them appropriately. As a microcosm of other societal entities, endowed with unique experimentation and analysis skills, MIT could be one of the first university campuses to experiment with and implement such a pricing system, evaluate its effects, and help the U.S. and the world in understanding and undertaking the steps required to enact an efficient and effective carbon pricing system. At the Institute, this entails defining a carbon price associated with MIT's emissions, imposing that price in capital and operational decisions to the degree possible within MIT's management structure, and communicating the approach and its outcomes to other universities, industries and public organizations.

Intrinsic to the Living Laboratory is the integration of experimentation, demonstration and education. By harnessing the inspiring passion of students for addressing climate change, the Living Laboratory would provide multifarious opportunities for student engagement across all departments, from the high-resolution metering of emissions to the analyses of big data, from the development of policies to the analyses of the economics, from new ideas to shift behaviors to creative approaches to influence society through communication. These activities would lend themselves naturally to UROP projects, capstone projects, seed funds for student initiatives, and opportunities for entrepreneurship. Naturally complementing this dimension of the Living Laboratory should be a more pervasive exposure to climate change science, implications, policy and solutions in the undergraduate curriculum, so that every student will be endowed with a strong and interdisciplinary education on what is likely to be their generation's most pressing problem.

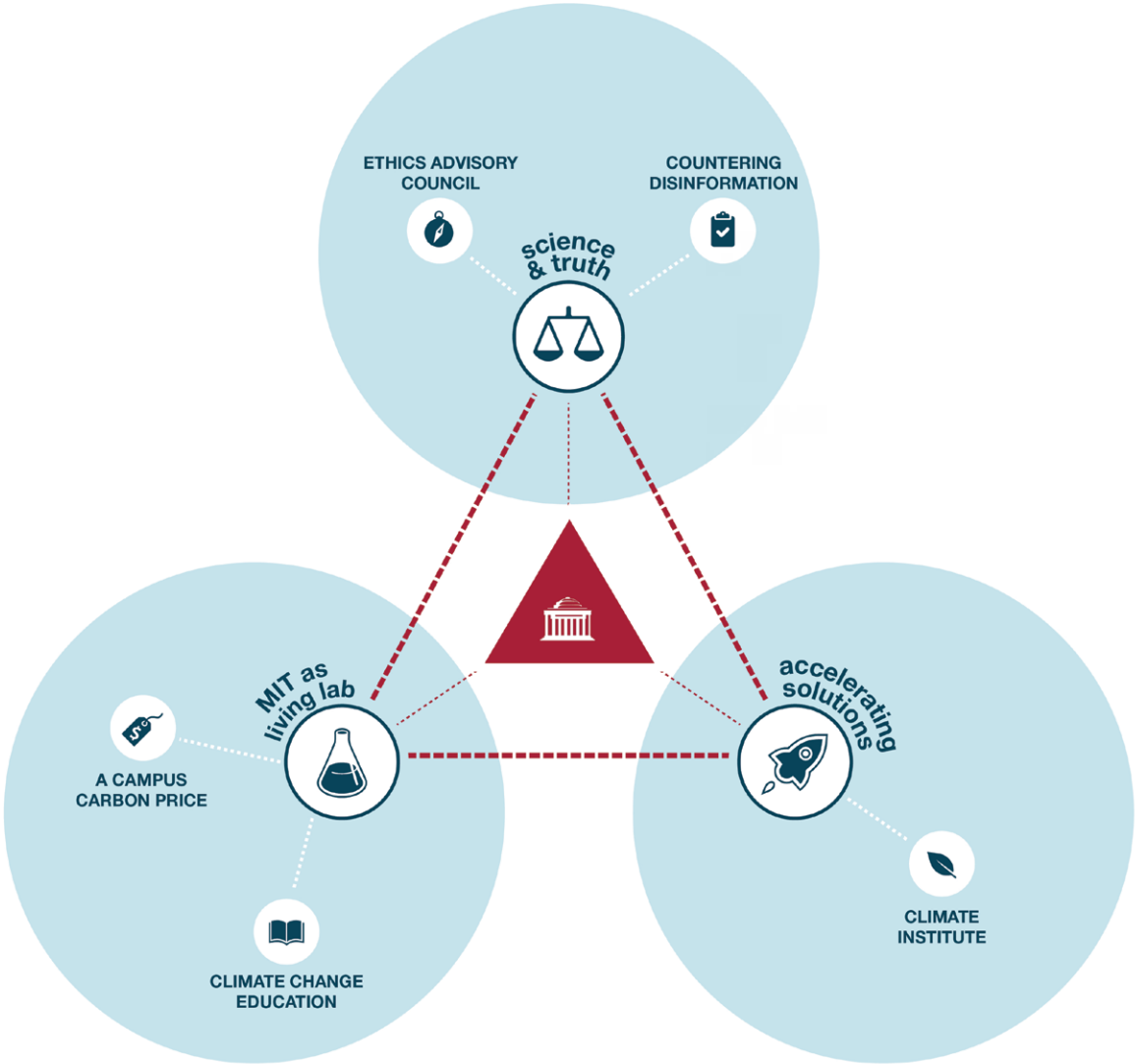
There is an urgent need to accelerate solutions to the climate threat, to invent technologies and develop policies that guide civilization away from the dependence on carbon-producing fuels and processes, and that help society adapt to the changes already underway. In Theme C, the committee suggests that MIT has the opportunity to significantly amplify its already important efforts in this domain by including in the current capital campaign the target of raising funds to support efforts on climate change. These could include redoubling MIT's efforts on the science, policy and technology of climate change, in particular in the area of renewable energy, significantly enhancing the nascent Environmental Solutions Initiative in the area of climate solutions, instituting funds for seed research for students and faculty, and sponsoring a prominent fellowship program for graduate students working on climate change.

The recent surge of public interest in the topic of climate change makes for fertile ground for MIT to seek donors for a major gift to enable the creation of a new, well-endowed Climate Institute. A Climate Institute would be the flagship and the framework for MIT's efforts to address the climate challenge: in addition to boosting MIT's commitment in the eyes of the nation and the world, it would provide a means of connecting, integrating and enhancing the visibility of current activities on campus on climate change. A Climate Institute could also provide the overarching intellectual and governance framework for many of the activities and entities suggested in this report.

The climate challenge is so large that MIT should not go it alone. Significant acceleration in all domains, including education, communication, policy and technology, can be achieved if institutions of higher education team up to speak with a coherent voice. To date, this has occurred only in limited domains, and there are unique opportunities for MIT to take leadership in forming a partnership of universities, both as cradles of innovative solutions and as bastions of truth for humankind at a time of uncertainty and transition. Collective action of focused groups of universities could provide a means of amplifying the impact and accelerating the pace of adoption of many of the suggestions contained in this report.

The Climate Change Conversation has revealed strong support from the MIT community for a systems response to the climate challenge that is commensurate to the magnitude of the

problem and the potential role of the Institute in contributing to its solution. By including the climate challenge among the Institute's highest priorities, with unwavering commitment to a strong response, MIT will positively harness the passion of young generations, remain true to its mission, contribute to solving humanity's greatest current challenge, and ultimately ensure it is on the right side of history.



2. PREAMBLE

2A. Climate Change: the Nature of the Problem

In 1897, the Swedish chemist Svante Arrhenius published his findings showing that fossil fuel combustion would lead to an increase in atmospheric carbon dioxide (CO_2) content and thereby increase the mean surface temperature of the Earth by about 4°C per doubling of CO_2 concentration. His estimates were based on simple but effective laboratory measurements of the infrared absorption of various trace gases in the atmosphere, and on estimates of atmospheric absorption of infrared emissions from the moon. The subsequent development of quantum mechanics would allow precise theoretical quantification of the absorption of radiation at all wavelengths and by all the relevant trace gases in the atmosphere. The advent of ever more sophisticated climate models, which take into account the variability of water and ozone and the transfer of heat by convection and large-scale circulation of the atmosphere and oceans, would confirm the general validity of Arrhenius's estimates. The measured warming of the planet, beginning at about the time Arrhenius first wrote on the subject, is consistent with his and subsequent estimates.

Human civilization developed during a period of unusual climate stability that followed the recovery from the last glacial period. The sea level has been remarkably stable for about the past 7,000 years, following its rise of about 130 meters from its minimum about 22,000 years ago. Arguably, the great stability of climate since the sea level stabilized was a precondition for the development of civilization, though even comparatively minor climate anomalies, such as the Little Ice Age, caused significant disruptions. Our current civilization is finely adapted to the late Holocene climate. For example, a sea level rise of even a small fraction of that attending natural glacial cycles would flood many coastal cities. There can be no question that a substantial increase in the concentration of the most important long-lived greenhouse gas in our atmosphere poses serious risks, with measured, inexorable increase in sea level, retreat of arctic sea ice and mountain glaciers, and increasing hydrological extremes such as droughts and floods portending a risky future.

The increasing risk to coastal cities is already becoming evident. The incidence of flooding in Miami Beach is on the rise, for example, and the disaster caused by Hurricane Sandy in New York would probably not have occurred without the 1-foot increase in sea level that took place over the last century. An additional worry is the potential for political destabilization overseas, as a result of increasing stress on food and water supplies. This is why the U.S. Department of Defense has identified climate change as among the top national security threats of the coming century.

The lifetime of CO_2 in our atmosphere is measured in millennia. Unless we find economically feasible means of extracting carbon from the atmosphere and sequestering it, then whatever concentration we have at the time we finally eliminate emissions will remain at that level, for a very long time. We have a limited window of opportunity to take actions to mitigate the risks associated with climate change.

We have a limited window of opportunity to take actions to mitigate the risks associated with climate change.

With any scientific endeavor, it is easier to explain the past than to predict the future. Our best comprehensive climate models show a wide range of possible outcomes, even if we were certain of the future trajectory of greenhouse gas concentrations in our atmosphere. For a doubling of CO_2, these outcomes range from fairly benign to catastrophic. For a tripling of the carbon dioxide concentration, which we are currently on track to achieve by the end of this century, even the median outcome entails severe risks.

On many past occasions MIT has played a key role in dealing with national challenges such as World War II. We call upon the Institute once again to rise to confront what may prove to be the greatest threat to current and future generations.

Uncertainty is a feature of all risk. Professionals who deal with risk as a matter of course hedge their strategies to account for dangerous outcomes, even if these outcomes are in the tails of the probability distribution. But in the climate arena, those who stand most to gain from the *status quo* have used uncertainty to argue against measures to deal with the problem. Large sums of money have been spent on highly successful disinformation campaigns, capitalizing on the public's reluctance to act on a slowly materializing threat and fully exploiting outliers among climate scientists who downplay the risks. Polls consistently show that more than 90% of climate scientists hold that CO_2-induced climate change is underway and presents serious risks, while more than half the public believes that there is no consensus among scientists on this issue. Disinformation and misinformation contribute to this gap between public perception and professional assessment of the looming threats. To a risk expert, uncertainty warrants added caution; to a sizable portion of the U.S. public, uncertainty excuses inaction.

The rest of this document presents a roadmap of how MIT might exercise increasing leadership in confronting the multiple threats of climate change. On many past occasions MIT has played a key role in dealing with national challenges, such as World War II. We call upon the Institute once again to rise to confront what may prove to be the greatest threat to current and future generations.

2B. Urgency & Opportunity for a Bold Response by MIT to the Climate Challenge

Solving big problems is in MIT's DNA. And there is no greater problem confronting humanity today than climate change.

While MIT researchers have worked to understand and explain the science of global warming, develop low-carbon energy technologies and engage industry, in particular through the MIT Energy Initiative (MITEI), climate change has not risen to the top of the Institute's agenda in a way that reflects either the gravity of the problem or the magnitude of MIT's potential contributions. What can a contemporary university do to help

Solving big problems is in MIT's DNA. And there is no greater problem confronting humanity today than climate change.

the nation and the world deal with climate risk? We contend that, as the world looks to us to both understand and deal with the risks that climate change poses, MIT's education and research missions make it uniquely suited to:

Regardless of where MIT eventually stands on divestment, we should play a bolder, more explicit, and more visible practical role in combating climate change.

- Harness the inspiring passion of students for addressing climate change;
- Rebuild the campus as a "Living Laboratory" for exciting experiments on carbon mitigation and carbon policies (such as carbon pricing);
- Educate future climate change leaders by ensuring a more pervasive exposure to climate change science and solutions in the curriculum;
- Invent technologies that guide civilization away from a dependence on carbon-producing fuels and processes and that help us adapt to the changes already underway;
- Combine individual climate-related efforts at MIT into a coherent, visible initiative;
- Objectively analyze sustainable energy paths and inject the results into the public discourse;
- Be explicit in the defense of science, combat disinformation and avoid inadvertently supporting disinformation through our investments.

According to its mission statement, "The Institute is committed to generating, disseminating, and preserving knowledge, and to working with others to bring this knowledge to bear on the world's great challenges." MIT's moral imperative to act on climate change is in fundamental alignment with this mission. By taking action, the Institute can influence the broader dialogue about solutions and help mitigate the threat of climate change.

This 'year of climate change conversation' at MIT was initially borne out of requests that the Institute divest its endowment from fossil fuel companies. Members of the MIT community hold a wide spectrum of views about divestment, a values-based strategy that relies on the power of symbolic action to precipitate change. The divestment debate has been prominent within MIT and polarizing. Yet, divestment is only one action in a sea of possible solutions, many of which are neither polarizing nor even controversial. The committee found remarkable agreement with the proposition that regardless of where MIT eventually stands on divestment, we should play a bolder, more explicit, and more visible practical role in combating climate change.

Among the most passionate voices calling on MIT to act to address climate change are those of students. The sheer amount of time and energy they devote to the issue[1] poignantly captures

1 Diana Chapman Walsch (member of the MIT Corporation), "[…] Urgently, and with respect, they are asking that we "grown-ups" move to address the threat climate change poses to their future. As they watch the world's leaders stand paralyzed before a window that is closing rapidly on the chance to move fast and far enough to avert a horrific disaster, they find themselves caught between "the impossible" (mobilizing action) and "the unthinkable" (a planetary meltdown). What an agonizing place from which to step out into adulthood. […]." (from the Op-Ed "When students become the teachers", published in the Huffington Post on 4/9/2015; http://www.huffingtonpost.com/diana-chapman-walsh/when-students-become-the-_1_b_7032442.html)

the urgency of the climate-change threat, as well as the very personal realization that this will be their problem tomorrow, if we do not do something today. In a way that scientific findings, natural disasters, market opportunities, funding opportunities, and government initiatives have not, students have laid at the Institute's doorstep the basic question: Will MIT live up to its responsibility in addressing the threat of climate change? Their passion cannot be dismissed as 'just activism', and the committee sees much in their arguments that merits careful discussion and analysis. This analysis has shaped the suggestions contained in this report. From the high level of the discourse to date, we feel that a positive, proactive, unifying outcome is within reach – if MIT will genuinely give the highest priority to the threat of climate change and to the development of a high-impact climate action plan.

The best problem solvers are those who put the problem at the center and adapt their own skills to solve it, not those who tackle the part of the problem that is more attuned to their immediate skills.

Science and technology developments, in the form of redoubled efforts to understand the climate system and develop alternative energy technologies, will be an important part of a climate action plan. Ultimately, however, the perception that MIT should "stick to the science and technology" is limited and at odds with MIT's historical role in addressing global challenges. The Institute has a long tradition of taking decisive positions on important societal problems, supported and complemented by, but not limited to, objective analysis – from establishing a crash program to develop microwave radar technologies within the Radiation Laboratory in World War II, to examining the role of classified military research on university campuses in the 1960s, to underscoring the importance of manufacturing to the U.S. economy, to addressing and promoting women's contribution to science, to promoting the role of universities in knowledge-sharing in the digital economy.

The best problem solvers are those who put the problem at the center and adapt their own skills to solve it, not those who tackle the part of the problem that is more attuned to their immediate skills. Policy change, communication, public engagement and a visible call to action are essential dimensions of the climate change challenge, which underscores the need for MIT to approach the problem in a holistic way.

The current lack of a strong, visible position on climate change is itself a position. The committee discovered widespread agreement that the Institute should – at the highest levels and as part of a strong climate action plan – publicly and visibly state its principles for combating climate change, even if such action requires sacrifice. Humanity must not be deterred from acting to prevent and prepare for what it knows to be dangerous climate change because of fear of the unknown magnitude of specific impacts. So too, MIT must choose to boldly address this issue, without being deterred by unknown risks to its standing, for to take no action or action of little consequence not only denies its historical leadership role in society's most pressing problems, but also jeopardizes the integrity and viability of the Institute.

Indeed, the magnitude of the problem is such that the Institute should not eschew exceptional measures. The precedence for bold action is present in MIT's history in select few, but notably important historical junctures – for example, in 1940, when it redirected major resources, space, and intellectual capital to the formation of the Radiation Laboratory, a decision that significantly contributed to the Allied victory in the Second World War. The threat climate change poses to humanity and the planet, more so perhaps than any other issue in its history, represents an opportunity for MIT to play a necessary and integral part in badly needed action and solutions.

The magnitude of the problem is such that the Institute should not eschew exceptional measures. The precedence for bold action is present in MIT's history.

On the climate problem in particular, MIT should influence rather than merely be influenced. A proactive leadership approach to climate change should be accompanied by a suite of actions to address the problem at all levels. This report provides a set of suggestions for many of those actions. Importantly, these suggested actions can gain power when executed as part of a coherent, visible framework, such as a new Climate Institute with dedicated funding or investment from the MIT endowment. The report does not attempt to coordinate all suggestions into a coherent organizational plan, because the latter will largely depend on which suggestions may be adopted. For example, a Climate Institute will not only connect and elevate the visibility of the multiple existing climate change activities on campus, but will also unequivocally communicate to the world that MIT is serious about climate change.

The MIT administration charged the committee with tackling a formidable problem – how to address climate change? – and, implicitly, with a formidable goal: develop suggestions for an action plan around which the MIT community could rally. The committee did not achieve consensus on every suggestion, especially those pertaining to divestment, but we believe this lack of consensus is reflective of the conversation being held among the MIT community at large on this topic. Despite this, however, the committee has reached unity around a set of suggestions for a climate action plan in this report and we distill what we have learned into a single overarching suggestion: that MIT recognize the urgency of, and embrace the opportunity for, a bold practical response to the climate change threat. By placing the full, unwavering power of the Institute behind such a response, MIT will positively harness the passion of young generations, remain true to its mission, contribute to solving humanity's greatest current challenge, and ultimately ensure it is on the right side of history.

We distill what we have learned into a single overarching suggestion: that MIT recognize the urgency of, and embrace the opportunity for, a bold practical response to the climate change threat.

3. SUGGESTIONS FOR CLIMATE CHANGE ACTION

3A. Standing Up for Science and Truth

Universities are looked upon as islands of intellectual integrity in a rising sea of flawed information. With its history of devotion to science and technology, MIT stands out for its commitment to the pursuit of truth and to solutions to today's outstanding technical and scientific challenges. In response to the growing threats associated with climate change, MIT is developing alternative energy sources and policies for reducing greenhouse gas emissions. It is also a leader in climate-related research and its researchers have sought to communicate their findings through activities ranging from public outreach lectures to congressional testimonies to advanced EdX courses. But there is more we can do. Disinformation is rampant in the climate arena and is antithetical to the central mission of education of universities, including MIT, yet universities do little by way of a concerted effort to counter it. At the same time, there are new ways of communicating the best information to those who need it. But our best efforts to communicate what we know and fight disinformation are potentially undermined by the ethics of our investments, upon which the operation of the Institute increasingly relies.

In this section of our report, we suggest several routes by which MIT can play a more effective role in disseminating information, combating disinformation, and becoming a leader in these arenas. We also discuss the potential symbolic value of ceasing to invest in those fossil fuel-oriented activities that are most at odds with the goal of mitigating climate change.

Universities are looked upon as islands of intellectual integrity in a rising sea of flawed information.

1. Establish an Ethics Advisory Council

For non-profit organizations, every funding source comes with a set of potential ethical issues. In the sphere of research funding, MIT and many other universities screen proposals for potential pitfalls, for example, restrictions on the publication rights of those receiving funding. Faculty and staff are required to report annually on potential conflicts of interest. As private universities become increasingly dependent on gifts from alumni donors and others, another set of moral challenges presents itself. For example, in 1995 Yale returned a $20 million gift from one of its alumni, Texas financier Lee M. Bass, after Bass insisted on the right to screen faculty appointed to a program in western civilization.

Investment also presents potential ethical challenges. In particular, investments in firms engaged in an activity that is antithetical to the mission of universities can be viewed as a conflict of interest, as has been increasingly recognized by universities in the U.S. and abroad. For example, some British universities now have well defined policies on investment ethics. The large and growing movement by students, faculty and staff to request that their institutions divest from fossil fuel companies is tacit evidence that the ethics of investment are increasingly important to

communities on many university campuses. And yet many institutions, including MIT, do not have well defined mechanisms for dealing with ethics in accepting gifts or in investing endowments or even for dealing with broader ethical issues.

One dominant theme that emerged from the Conversation is that universities should not invest in firms that engage in or actively support activities that are antithetical to their mission.

In our conversations with diverse segments of the MIT community, sponsored events, Listening Tour, the Idea Bank and internal deliberations, the committee encountered a wide spectrum of attitudes about the ethics of investment, ranging from the idea that the only valid ethical consideration in investment is to make as much money as possible, to the view that MIT should divest from all firms involved in fossil fuel extraction. One dominant theme that emerged from the Conversation is that universities should not invest in firms that engage in or actively support activities that are antithetical to their mission. For example, the University College of London (UCL) will not invest in a particular business "where such investment might conflict, or be inconsistent, with the aims, objects or activities of UCL. Thus, for example, investment in the tobacco industry would be inconsistent with and would conflict with UCL's research into cancer."[2]

One, but by no means the only, activity that is clearly antithetical to MIT's central mission of education is disinformation, which is the opposite of education. In the arena of climate, well-funded disinformation campaigns are well documented and lie at the heart of this nation's current paralysis in addressing the issue. It is important to distinguish between mere disagreements within professional communities, misinformation (which is simply being mistaken), and disinformation, which consists of organized activities with the objective of misleading. As there is seldom a clear distinction between disinformation and misinformation, some level of judgment must be exercised, but this should not prevent genuine disinformation from being identified and countered. Some would argue that institutions of higher education have a societal obligation to expose disinformation as part of their educational mission. At the very least, they should not invest in it.

Some would also argue that MIT cannot take a leadership role in climate change while it continues to invest in firms devoted to the exploration, extraction, processing, and/or distribution of fossil fuels. Others argue that the decision to use fossil fuels rests with society at large, not with such firms. MIT has been faced in the past, and will continue to be faced with complex ethical decisions regarding its investments, but it lacks a transparent, community-supported means of making such decisions.

With these considerations in mind, the committee suggests that MIT create an Ethics Advisory Council, reporting to the President, Executive Committee, and/or the Corporation. It would be a regular standing committee with membership determined by MIT's Committee on Nominations.

2 See http://www.ucl.ac.uk/finance/finance_docs/investment_policy.htm

Such a Council would meet regularly and would review concerns raised by anyone in the MIT community. If the Council concludes that such concerns are warranted, it would include such concerns in its periodic reporting. Ideally, the Ethics Advisory Council would be comprised of a broad representation of the MIT community, including faculty, management, staff, students, and alumni, and should include representation from affiliated laboratories. To be effective, the Council's reports would be "potentially actionable", in the sense that MIT would consider, e.g., bringing such concerns to the attention of the appropriate portfolio manager, bringing pressure to bear through shareholder proxies, or in some cases divesting from the firm in question. The Council would consider only those ethical issues confined to activities, such as disinformation campaigns, that are clearly antithetical to MIT's central educational mission. While we would expect MIT to weigh such issues against possible damage to its investment portfolio, we reject the notion that ethics should play no role in investment. As an added benefit, MIT could also use the Council as a resource to help adjudicate broader ethical issues that may arise on campus, such as ethical issues in research, gifts, etc.

The idea of an Ethics Advisory Council at MIT is not new. There appears to be an ad-hoc committee, called the Advisory Committee on Shareholder Responsibility, which reports to the Corporation's Executive Committee and can be called into play as the need arises. This committee has been criticized for its lack of transparency and slow response to events, leading to calls from within the MIT community to elevate it to the status of a standing committee (see, e.g., commentary in the *MIT Faculty Newsletter*, January/February 2008, and a leading article in *The Tech*, September 12, 2008).

We believe that in establishing such an Ethics Advisory Council (EAC), MIT would send a strong message to the MIT community and to the outside world that it takes seriously the idea that investments by institutions regarded as bastions of knowledge and truth in contemporary society should reflect the central educational mission of such institutions and should avoid contradicting or undermining that mission. We also believe that this message could serve to attract donors who are properly concerned with how their gifts are invested, and would serve as an added attraction in recruiting the best faculty, staff and students to the Institute. Since the issue of climate change is so important we recommend that it be the first issue addressed by the EAC.

2. Take active measures to counter disinformation

Tapping the culture of integrity at the Institute could be constructive not only for the inward focus described above, which would enable the MIT community to aid in putting the Institute's house in order, but also for an outward facing effort that directly engages MIT in the fray around climate disinformation. MIT should take an active role in countering disinformation as part of its mission in service to the nation and the world. Pursuant to MIT's commitment to

MIT should take an active role in countering disinformation as part of its mission in service to the nation and the world.

generating and disseminating knowledge, and bringing this knowledge to bear on the world's great challenges, MIT should speak out against attacks on science and strive to narrow the wide gap between public opinion and professional opinion in pivotal scientific areas that are of great import to society.

For example, in the U.S., the misrepresentation and distortion of scientific research is a major obstacle to increasing the recognition of the climate change threat. This attack on science is promulgated through disinformation campaigns that are designed to undermine the validity of climate science, misconstrue the broad agreement among experts, and sabotage the personal and intellectual integrity of scientists.[3] MIT should leverage its reputation as a neutral arbiter of scientific and technical information to clarify the professional consensus that the global warming in recent decades is due to human activities (with 95% probability). And further, MIT should muster a message to convey the scientific basis underlying the knowledge that the current rate of warming has been unprecedented in the last 1000 years, the amount of carbon dioxide now present in the atmosphere has been unequaled in at least the last 800,000 years, and warming is expected to continue for decades even if anthropogenic CO_2 emissions are ceased today.

Climate change disinformation serves to confuse the issue as it is portrayed in the public and political arenas, creating doubt about global warming and diverting attention from the urgency of advancing possible solutions. Deliberate disinformation that aims to delay action on climate reduces our collective ability to avoid exerting a dangerous influence on the climate system, it increases the cost of dealing with the consequences of climate change, and it increases the risk of significant to catastrophic impacts on the Earth's support system, upon which we all depend.

With an explicit and transparent goal of countering climate disinformation, MIT should construct a multifaceted approach that not only aims to address the sources of disinformation, but also considers how it is conveyed, how it can effectively reach its audience, and ultimately how it may be possible to reverse its effect. In this context, MIT should undertake a set of actions to proactively disseminate accurate information that can impact a spectrum of exchanges, from individual conversations, to boardroom deliberations, political discourse, media coverage and popular entertainment.

Through its established relationships with major energy companies and select individual donors, MIT should use its unparalleled access to the most influential forces funding disinformation campaigns. With opportunities for intentional interactions and direct engagement with key organizations and individuals, MIT should pursue the means for identifying shared values and potential options for accord. Such exchanges would presumably be tailored as private conversations or roundtable discussions. However, public engagement of MIT climate experts with skeptical audiences and conservative think tanks has proved productive and could be further promoted.

---

3 For example, see Layzer, J.: Deep freeze: How business has shaped the global warming debate in Congress. Chap. 4 in Business and Environmental Policy, M. E. Kraft and S. Kamienieckim Eds., MIT Press, Cambridge, MA (2007)

To devise effective methods to actively refute attacks on science, MIT should marshal its abundance of relevant expertise and concerned citizenry on campus to organize a framework for countering disinformation and misinformation in the public sphere. Such a system would be general and adaptable, but a pilot phase should focus on climate change in recognition of the urgency of reversing the detrimental influence of climate disinformation. A timely goal would have an operational system in place in early Fall 2015 to accentuate the imperative of interjecting sound science into the realms of the U.S. Congress and the American conscience in advance of the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change[4] (COP-21) in Paris from November 30 to December 11, 2015.

Clearly defined objectives for a pilot project that endeavors to combat attacks on science would need to be articulated, and a faculty advisory group should oversee the scope and execution of the effort, but the bulk of the initial, coordinating, and sustaining tasks could be distributed among participants drawn from many academic and research units. Laying the groundwork for this effort would need to include consideration of such aspects as, for example, formulating guidelines on what constitutes disinformation, identifying how incidents of disinformation would be culled, prioritizing which occurrences should be countered, vetting the content and timing of responses, and measuring the relevance and efficacy of the effort. However, with due acknowledgement of work in political science and psychology that has shown that correcting misinformation is a difficult task, and attempts to correct it can sometimes further compound the prevalence of that misinformation, any strategies adopted by MIT should recognize and account for these difficulties.

To support the collection, synthesis and dispatch of targeted information, a network of contributors should be coalesced. Participants should include students, perhaps engaged under the aegis of a class project, the Undergraduate Research Opportunities Program (UROP) or dedicated funds, as well as interested postdocs, staff, and faculty volunteering to contribute effort and applicable expertise. For example, constructing suitable digital platforms and schemes for content delivery might engage participants from the Media Lab, Comparative Media Studies, Center for Collective Intelligence, or Laboratory for Information and Decision Systems. A 'rapid response' team of content contributors and reviewers might include, for example: climate scientists from Earth, Atmospheric and Planetary Sciences; scholars of public policy from Political Science, the Technology and Policy Program, and the Science Policy Initiative; marketing and sustainability experts from the Sloan School of Management; energy and climate policy analysts from Economics and Sloan; technology experts from MITEI; and communication specialists from the Program in Science, Technology and Society. Preparation of content for specific audiences, for example, fact sheets for congressional staffers or media contacts, might be produced with assistance from the News Office, the new International Policy Lab, the Knight Science Journalism Program, or the MIT Washington Office. The ideal framework to organize this effort would be the new Climate Institute proposed in section 3C.2.

4 http://www.cop21.gouv.fr/en/

In summary, MIT should defend science and communicate to the public its fundamental role. To specifically serve the needs of the nation, MIT should harness its reputation as a neutral arbiter of scientific/technical information and engage the MIT community in efforts to counter disinformation that derails attempts to confront the potential perils of climate change.

3. Create a web resource for climate change issues

An informed public is crucial to making wise national and international decisions to address the climate risk. MIT should endeavor to find new and more visible ways to disseminate information about climate change and ensure that the scientific body of knowledge is properly and prominently represented in the media and policymaking circles. Providing a comprehensive web resource on climate change issues would be a constructive contribution to that end.

An effective public service that MIT could contribute in this domain is to collate a clearinghouse of credible information on climate issues, importantly including external resources. For those who seek to understand the issues, to unpack the popular controversies, or ascertain appropriate retorts for discussion, there is a resounding call for clear, concise and reliable information. Drawing on MIT experts for guidance, an account of authoritative and accessible websites should be compiled. Formulated as a user-friendly portal to accurate information, this component should highlight such syntheses as, for example, the Third National Climate Assessment[5], the U.S. Department of Defense Climate Change Adaptation Roadmap[6], and the Fifth Assessment Report of the Intergovernmental Panel on Climate Change[7]. An expanded service might further involve students, perhaps as the practical component of class assignments or special projects, as well as other members of the MIT community who are passionate about climate change and technology and eager to contribute to an innovative platform that might include blogs, online chats, webcasts or other formats that can help to demystify the complexities of the climate change issue.

MIT should endeavor to find new and more visible ways to disseminate information about climate change and ensure that the scientific body of knowledge is properly and prominently represented in the media and policymaking circles.

Serving also as a repository, the resource should facilitate exploration of key concepts across the spectrum of scientific, technical and socioeconomic topics relevant to climate change. It should cull essential ideas in thematic areas and provide pathways to reliable information that is broadly accessible. It should encompass clarification of common misconceptions and address contentious topics, while establishing the basis for the scientific consensus and the current state of knowledge.

5 http://nca2014.globalchange.gov, doi:10.7930/J0Z31WJ2

6 http://www.acq.osd.mil/ie/download/CCARprint_wForeword_c.pdf

7 https://www.ipcc.ch/report/ar5/

A coordinated institutional resource, ideally one that is facilitated by the framework provided by the Climate Institute (proposed in section 3C.2), that organizes entryways into MIT's archive of diverse climate-relevant research would help convey the broad significance of the climate threat. It would promote a wider appreciation of current MIT activities addressing climate change and help foster new connections and increased collaboration among research entities and individuals. It would also provide distinct opportunities for improved communication, with simplified channels for assimilating and sharing timely information throughout campus, such as notices of climate-relevant funding opportunities, lectures and events, news releases, interviews with researchers, or op-eds.

Our web resource should assemble interesting tools and interactive elements, such as the innovative online tools providing climate-relevant information that have emerged from MIT efforts.

Finally, the web resource should assemble interesting tools and interactive elements, such as the innovative online tools providing climate-relevant information that have emerged from MIT efforts. These include the simulation tools of Climate Interactive[8], which cover climate change negotiation, greenhouse gas emissions, and the long-term impacts of policy scenarios. For example, their interactive climate simulator, C-ROADS, has been used by the U.S. State Department as well as intergovernmental decision-makers, business leaders, NGOs, and educators. Another example is a real-time global carbon counter[9,10] that expresses the combined atmospheric levels of the long-lived greenhouse gases contributing to climate change, which helps convey how fast these levels are increasing, how close we are to the stabilization levels relevant to policy discussions, and the progress, or lack thereof, in slowing the rate of increase. MIT's Climate CoLab[11] should also be a prominently featured component, with its crowdsourcing platform where citizens work with experts and each other to create, analyze, and select proposals for climate action. Highlighting such tools could further stimulate the development at MIT of learning devices, perhaps as a part of course projects, seed funds, or ignition grants, with the web resource then serving as the vehicle for their dissemination.

4. Offer Congressional and executive seminars and short courses

MIT has a distinguished history serving as a scientific and technical knowledge resource for decision makers in Washington, D.C. Beginning

MIT has a distinguished history serving as a scientific and technical knowledge resource for decision makers in Washington, D.C.

8 https://www.climateinteractive.org

9 http://www.sicm.com/carbon-counter.php

10 http://globalchange.mit.edu/research/projects/CarbonCounter

11 http://climatecolab.org

in 1992, it has offered three-day seminars for approximately 25 senior congressional staff, initially every year and now every two. Starting in 2003, this program has also included staff from the executive branch. These seminars are held at MIT and the attendees have been selected on an invitation-only basis to include balanced representation of majority and minority parties. The seminars address specific topics in science and technology that are of special importance to Congress, and for which MIT has special expertise. This expertise is reinforced by drawing on resources from other universities and from industry. These highly successful seminars have served the nation by providing a hospitable but intense forum for high-level discussions of technical and scientific topics of great concern.

Given the importance of climate and energy to our future, we suggest that MIT build on this highly successful model either by focusing the existing series on topics related to climate and energy, or by creating a parallel series devoted to such issues. In the past, these seminars have been supported through foundations, which would undoubtedly show strong interest in and support of seminars devoted to climate and energy. We believe that a refocusing of the current series, or the creation of a new series devoted to climate and energy, would be an important way that MIT can contribute to greater understanding of the climate threat and to solutions that address the risks it poses.

MIT could also offer short courses to congressional and executive branch staffers in Washington. These would be held in evenings, perhaps once per week for several weeks, and would be taught by MIT faculty. These could be organized by individual MIT departments and, as with the three-day seminar series described above, would address topical scientific and technical issues, particularly in the realm of climate and energy. They could be organized and accredited as a certificate program. The DC-based mini-courses would be especially appealing to White House and congressional staffers as they would not require travel to Cambridge, making the courses more inclusive and affordable. As with the three-day seminars, short courses should prove attractive to foundations and would be another way that MIT could contribute to climate education and solutions. These activities could be coordinated through the Climate Institute proposed in section 3C.2.

5. Divestment considerations

Since November 2012, the student group Fossil Free MIT has been calling on the Institute to divest its endowment from fossil fuels, where divestment refers to the selling of investments in companies whose primary business is the extraction of fossil fuels. Over 3,400 students, staff, faculty, and alumni have signed a petition in support of divestment (for reference, the MIT community comprises approximately 26,000 members). The committee feels that the request for divestment conveys the urgency of MIT taking bold action on the climate threat; as such, it demands respect and consideration (see Appendix 4B for additional information).

In regards to the opinion of the MIT community on divestment, the committee points out that there is currently no basis to ascertain campus-wide support for or against divestment. The

demonstrated support for divestment to date (petition signatures, input to the Idea Bank and Listening Tour) cannot be extrapolated to imply preponderant support for divestment by the entire community. The Listening Tour and Idea Bank were designed to enable the committee to collect as wide a variety of ideas as possible from the community. They were designed for the sole purpose of generating ideas from the MIT community that could then stimulate discussion both around MIT as well as within the committee itself. These methods were not intended to measure community sentiment in any way. Such events would be completely inappropriate for that purpose since small, self-selected samples cannot be considered representative of the views of the broader MIT community. It is also not simply a matter of the size of the sample that contributed or participated in these events – small samples can be representative of larger populations if they are drawn randomly, which is not the case for the Idea Bank and the Listening Tour. It is thus important to stress that, while these sources of input have been invaluable in generating a palette of ideas, they should not be used in any way as metrics of community preferences.

The committee highlights several observations about divestment:

- Divestment is not intended to hurt fossil fuel companies by reducing the value of their shares; this effect is negligible;
- The impact of divestment on endowment returns is not likely to be large;
- (Partial) divestment does not preclude shareholder engagement;
- The implementation of partial divestment appears feasible from the point of view of the mechanics of investing (not so for 100% divestment);
- Divestment will likely lead to the loss of engagement with divested companies, including potentially the loss of research funding.

The public and political discourse on climate change and on a number of other issues has been and continues to be influenced by activities such as the deliberate spread of disinformation, which are antithetical to MIT's educational mission. Investment in entities that engage in such activities thus warrants close analysis, which we propose should be carried out by an Ethics Advisory Council (section 3A.1). This analysis by the Ethics Advisory Council may result in the decision to divest from the company in question, particularly if formal (through shareholder resolution) and informal (through interaction with the company leadership) engagement fails to produce the desired shift in business practices.

In addition to ethical considerations, the committee carefully considered the broad strategic and financial aspects of divestment. The committee rejected the idea of a blanket divestment from all fossil fuel companies, primarily because of (i) a view that any positive effect could be diluted by lumping together firms that differ dramatically in their roles in the climate issue, and (ii) a concern that such action could cause significant loss of engagement opportunities with companies (including research funding and opportunities to influence corporate behavior).

There is, however, support by a (three-quarter) majority of the committee for targeted divestment from companies whose operations are heavily focused on the exploration for and/or extraction of

the fossil fuels that are least compatible with mitigating climate change, for example, coal and tar sands. The reasons put forward by those supporting this action include:

- Divestment calls attention to the need of reducing greenhouse gas emissions dramatically to avoid dangerous interference with the climate system;
- Coal and tar sands are among the most carbon-intensive and environmentally hazardous fossil fuels, and their continued large-scale use is incompatible with economically mitigating climate change;
- In comparison to blanket divestment, targeted divestment would likely carry less risk of lost engagement opportunities with companies (both funding and influence on behavior);
- Divestment, if part of a strong climate action plan, helps signify that MIT is serious about tackling climate change;
- Divestment has garnered widespread attention, inspiring hope that may spur the political will needed for bold leadership and legislation, as it helps channel passion into action to usher the transformation to a low-carbon future.

Reasons advanced by those opposing this particular target for divestment include:

- Such symbolic action by MIT will not have a substantial effect on the national policy response and will divert attention from actions that may;
- Unlike the case of disinformation-based divestment – which was endorsed by the full committee – the case for this targeted divestment was not based on an explicit appeal to the central education and research mission of MIT;
- While a targeted divestment on the proposed grounds may reflect worthy goals, it could also lead to a slippery slope where other groups could argue that MIT should divest from companies to support other goals that are not necessarily related to MIT's core research and education mission.

In general, the committee agreed that MIT should exercise more ethical oversight of its investments and do so in a transparent and community-backed manner, and that divestment of particular businesses may be one outcome of such oversight (see the suggestion of an Ethics Advisory Council, section 3A.1).

Even if divestment is not pursued, addressing the issues at the heart of the divestment request – that MIT should play a bolder role in combating disinformation and the climate threat – presents a positive and exciting way forward, which has the chance to garner broad support from the MIT community if executed with visibility, timeliness, strength and unwavering ambition.

MIT should exercise more ethical oversight of its investments and do so in a transparent and community-backed manner.

COMMUNITY QUOTES: STANDING UP FOR SCIENCE AND TRUTH

"MIT SHOULD RAISE ITS PROFILE AND weigh in more visibly in the national public debate and policy discussions related to climate change."

"THE FOSSIL FUEL INDUSTRY AND MANY well funded political organizations have been sowing seeds of doubt about the science of climate change for years. MIT should take a stance and set the record straight. We should make a campaign to educate the country and the world about what the science of climate change really says and confront and educate through the misinformation."

"ONE OF THE PRIMARY OBSTACLES FOR addressing climate change is the often poor reporting and sometimes outright misinformation. As a result, it's hard to form accurate opinions, and thus to support political action addressing the problem. I think MIT's missions include a duty to help citizens get scientifically accurate information. The idea is to bring a community of scientists to provide feedback about news articles around climate change."

"MY IDEA IS FOR MIT TO CREATE AN easy-to-use open sourced website (and companion mobile app) regular people can use to learn the facts about climate change and make their own personal case for action. These facts could be about major sources of atmospheric pollutants that are driving up CO_2 concentration, about the products and services that contribute the most to this, and about the impact climate change is having on life as we know it."

"THERE ARE CLEAR SIGNS OUR environment is changing, but there is a lack of credible and easy-to-digest information that allows people to build a personal case for change. Giving people user-friendly access to data and analyses about climate change may drive them to make their personal case for change which could translate into concrete demands to their elected officials and to companies they do business with."

"IT'S TERRIFICALLY SAD THAT WE INVEST IN companies that undermine fundamentally MIT's mission statement."

"AS A TRUSTED INTERNATIONAL SOURCE on science and technology, MIT is in a great position to educate people on what is true and what is hype. An MIT report on what is known about climate change, models, data, etc. will go a long way to bring about consensus and trust."

"THE SCIENTIFIC CONSENSUS THAT CLIMATE change is real and anthropogenic is as conclusive as the link between smoking and lung cancer. And yet, largely due to disinformation campaigns funded by prominent fossil fuel companies, much of the American public still believes there to be controversy about this fact. MIT, as a national and international bastion of science, needs to put its money where its mouth is and divest from these companies. This would send a powerful message and help to cut through the fog of disinformation that the companies are trying to spread, perhaps finally enabling political progress on this all-important issue."

"I STRONGLY RECOMMEND THAT MIT BE more circumspect in regards to who it associates with in regards to donors."

"STUDY AFTER STUDY HAS MADE ONE simple fact clear: the business plan of the fossil fuel industry is incompatible with a safe, stable climate. For a 66% chance of limiting global warming to less than 2°C, we can burn no more than 35% of proven fossil fuel reserves prior to 2100. Yet this industry spends close to $700 billion per year searching for more carbon to burn, supported in part by MIT's investment of hundreds of millions of dollars – through its endowment – in fossil fuel companies."

"MY BIGGEST ISSUE WITH DIVESTMENT IS that I am not sure if it is in MIT's mission statement to use its financial holdings to make a political statement. Divestment will not necessarily make the same political statement that people think it will."

"ATTENDING MIT IS A FORMATIVE experience for many people who will go on to do great things in the world, so it is particularly important to set a good example. Divestment from fossil fuels would send a strong message."

3B. Transforming MIT Into a Climate Change Living Laboratory

The educational mandate and mission of the Institute are inextricably linked to its operations. On a global scale, MIT must play a leading role in the study, improvement, and production of climate change solutions through teaching and education, and implement those solutions accordingly on its campus. It is important then to consider two crucial questions: "What would it take for MIT to become a role model that inspires action to confront climate change?" and, "How can we use the physical MIT campus to aid in that objective?"

What better place to test and implement the solutions to a low-carbon future than within our own grounds, residences, and classrooms? And where better to study the impact and efficacy of these efforts?

The answer is found in linking climate change theory and solutions created in the classrooms and labs to the campus itself. Two major efforts at MIT aimed at exploring the future of higher education, the Institute-wide Task Force on the Future of MIT Education[12] and The MIT Innovation Initiative[13], both clearly emphasized the need to preserve a thriving, place-based community and physical laboratories for researchers and scholars. The committee also noted correlating interest from the MIT community in contributing to climate change solutions and improving the MIT campus. What better place to test and implement the solutions to a low-carbon future than within our own grounds, residences, and classrooms? And where better to study the impact and efficacy of these efforts?

In this spirit, the committee suggests that MIT establishes itself as a model and a testing ground to develop, evaluate and teach strategies and technologies for a low-carbon, climate-ready future using the campus as a climate change Living Laboratory. The committee sees this not only as an approach to 'get our house in order', but most importantly, as a unique, *mens et manus* educational opportunity. The committee suggests three actions to establish the climate change Living Laboratory: the implementation of an internal carbon-pricing program, a model implementation scheme for low-carbon campus operations, and a pedagogy shift in the undergraduate curriculum.

The committee suggests that MIT establishes itself as a model and a testing ground to develop, evaluate and teach strategies and technologies for a low-carbon, climate-ready future using the campus as a climate change Living Laboratory.

These actions are inherently linked. For example, a cost/benefit analysis of potential energy-efficiency measures on campus would not only include capital equipment and installation charges, but would also benefit from an internal

12 http://future.mit.edu/

13 http://innovation.mit.edu/

carbon pricing mechanism. A campus carbon pricing scheme would hence serve as a microcosm experiment and demonstration of policy that may ultimately be adopted globally. As such, the Living Laboratory would be most powerful if it was associated with a series of education and research activities that involve a broad cross-section of the campus and aligned with new education initiatives focused on climate change. Once documented and widely disseminated, lessons learned from these activities could have an important multiplication effect outside of MIT.

The three main actions proposed above would be further supported by enabling activities such as establishing an open data policy for campus-internal resource flows, developing and testing next-generation sustainable technologies, and promoting larger community engagement. Taken together, these suggestions necessitate a foundational, Institute-wide commitment to sustainable development in operations, to climate education as a component of both formal and cultural campus experiences, and to leadership in linking the two in order to accelerate learning and solutions.

1. Implement an internal MIT system of carbon pricing[14]

Today, for most members of the MIT community and for their administrative and academic units, even for activities that appear to be climate friendly, there are costs that are not fully appreciated. There is widespread agreement that the most efficient way to reduce carbon emissions is to price them appropriately at their (private and social) global costs. The committee suggests that MIT define a campus carbon price associated with its operational greenhouse gas emissions, impose that price in its capital and operational decisions to the degree possible within the management structure, and lead in the dissemination of this institution-level approach to other universities as well as to public organizations and industry.

MIT can play an important role in addressing the technical and implementation challenges that pricing carbon will no doubt face and, in doing so, minimize the uncertainty associated with its adoption.

Although there is broad agreement that carbon should be appropriately priced, there is less agreement on how to implement the details of a carbon pricing system and what the behavioral responses will be to such prices (and hence how much of a reduction in emissions can realistically be achieved). MIT can play an important role in addressing the technical and implementation challenges that pricing carbon will no doubt face and, in doing so, minimize the uncertainty associated with its adoption. MIT is not only a leading research institute, with an analytical approach to, and wide expertise in, the areas of energy and climate change, but it is also representative of many universities and other organizations that will face the challenge of achieving the benefits of internal behavioral incentives given an existing energy management

14 Although the term *carbon pricing* is used here, it should include pricing all operational greenhouse gas emissions for MIT, in particular the methane from fuel used in the MIT co-generation plant.

system that is highly centralized. By being one of the first few university campuses to experiment with and implement a carbon pricing system, MIT can significantly contribute not just nationally but internationally, to elucidating the steps required to enact and implement an efficient and effective carbon pricing system to tackle emissions.

Although such a price on carbon has been discussed at Yale University as well, there is a vast amount yet to be learned about how to design and implement such a price. MIT is extremely well equipped to play the role of experimenting and learning from such a pricing system as well as demonstrating to the world how such a system can be implemented. An added advantage of a carbon price on the MIT campus is the unprecedented teaching opportunity it affords students at the Institute. Students will be a crucial part of the carbon price system as they would help design the various technical and logistical components of the system, learn from the challenges and bring their experience with such pricing to bear on their respective personal and professional lives once they leave MIT.

The committee therefore suggests that MIT establish a campus carbon price, which would include the following components:

- Define a carbon price to be imposed. Determining the appropriate price is a complex task involving both analytical and value issues, and accounting for the carbon-equivalent contribution of fugitive methane from fuel used in the MIT co-generation plant.
- Impose that price on an "as if" or proxy basis in planning capital and operational decisions. The collection, analysis and publication of the effects of this procedure would be an important contributor to the demonstration value of the effort.
- To the degree possible, while maintaining the advantages of centralization, seek ways to implement internal price incentives. This may include the simulation, without actual financial flows, of the financial implications should an all-campus carbon price be implemented, the exploration of those MIT units where some decentralization of energy control is possible (potentially living units), and the proposal of partial systems as experiments.
- In cooperation with others working on this option[15], lead in the dissemination of this institution-level approach to other universities as well as to public organizations and industry.

Implementation of these components could be facilitated through a Carbon Pricing Working Group that would provide the analyses, test the carbon price on campus, advise the MIT administration, and provide oversight. The Working Group would also decide how the net revenues generated from a carbon price, if any, would be spent on MIT climate related initiatives. The Working Group's membership and planned lifetime will need to support a complex, many-year effort. The Carbon Pricing Working Group would also create a plan for the demonstration component of the carbon price.

15 For example, as of Spring 2015, Yale had completed a study of carbon pricing and is entering an implementation phase. See http://news.yale.edu/2015/04/20/task-force-recommends-yale-adopt-carbon-charge. A number of firms also use some form of emissions pricing as a component of their environmental policy.

Such a carbon pricing effort would have several constructive outcomes:

- **Demonstrate the seriousness of the climate problem and MIT's commitment to a rational solution.** A serious public effort by the Institute to implement a carbon price would send a clear message to the public, our partners, and policymakers that MIT considers the climate-change threat serious enough to create a program to reduce emissions-producing activities, and model how these activities should bear a cost for their contributions to the climate threat. As important, the existence of an MIT emissions charge that accounted for and influenced daily activities would provide a continuous reminder to us all of the climate issue and our individual and institutional contributions to the problem.
- **Create educational opportunities, demonstration and dissemination, within MIT and outside.** As highlighted, there are many uncertainties about how best to implement a carbon price on campus. There is therefore an opportunity to pilot and study what a carbon price may look like and the impacts it may have – understanding how individuals respond is essential to the design and implementation of a carbon price within larger society. The process of calculation of the appropriate price, the development of tools and procedures for emissions accounting, and the assessment of the impact on campus operations and implementation of emissions-reducing activities would provide a variety of opportunities for student projects and classroom activities.
  In addition to the educational opportunities that experimenting with a carbon pricing system would open up, there would be an important national and international demonstration effect. MIT would actively demonstrate the value of appropriately pricing carbon and how challenges to its implementation can be overcome. Given the Institute's global reputation and reach, it is in a position to magnify the impact of its demonstration, education and efficiency outcomes by a set of external initiatives. For example, within the framework of the Climate Institute (proposed in section 3C.2) and in the courses with policymakers (section 3A.4), the Institute's plan for and experience with carbon pricing could be disseminated widely. Perhaps in collaboration with Yale, other universities, industries and organizations thinking about experimenting with carbon pricing arrangements, MIT could take the lead in convening a group to share experiences and to more effectively publicize effective ways to price carbon.
- **Help meet any Institute emissions target.** Implementation of an emissions price would contribute to any overall emissions goal that the Institute may adopt, and help align its activities with a globally efficient response to the climate change threat.

2. Implement carbon efficiency on the MIT campus

The field of resource-efficient building design and operation has made tremendous advances over the past four decades[16]. From a technological standpoint, we are at a time when we can dramatically reduce the energy consumption of buildings, and therefore one of the largest sources of greenhouse gas emissions, using off-the-shelf technologies. New building management technologies, such as programmable thermostats, and better grid integration through in-house battery storage are likely to further trigger a new generation of smart buildings over the coming years.

Given unlimited financial resources, MIT could implement many efficiency measures today to substantially reduce its operational campus energy use. But, given the reality of limited resources, MIT – as any other building owner – must prioritize what efficiency measures to implement, and when and where to implement them. The Accelerated Capital Renewal Program[17] – MIT's commitment to maintain and upgrade campus facilities – offers MIT a unique opportunity to develop, implement and test prioritization schemes that identify the most cost-effective and efficient carbon reduction strategies for our campus. The groundwork for such a prioritization scheme has been laid over the past 18 months through an internal MIT working group that supported MIT's engagement with the Net Zero Task Force for the City of Cambridge[18]. The Office of Sustainability is currently working with Building Facilities to adopt and further refine a spreadsheet-based retrofitting evaluation method that was developed for MIT by an external consultant that focuses on retrofitting strategies.

There have been previous efforts to develop such prioritization schemes, most notably the McKinsey cost abatement curves[19], which directly compare the payback times of different energy saving technologies. These curves are easy to understand and have had a profound impact on many owners' attitude toward different energy efficiency measures. Their main limitation is that they only provide rough estimates of costs and savings that are often too general to be applied to specific building decisions, and may even be wrong in some circumstances. By developing a set of prioritization schemes, grounded in modeling and analyses and tested on our campus, MIT could make a significant contribution to the state of understanding of this field. If MIT shares not only the prioritization scheme itself but also the data related to the outcome of the carbon-reduction projects they undertake, it offers an additional measure of validation and transparency that is currently in short supply. To date, the building industry as a whole tends to shy away from sharing

16 Initially triggered by the oil crises of the 1970s, interest in reducing the energy used to heat, cool and light buildings has grown ever since. Beginning in the 1990s, buildings have been viewed as "integrated systems," in which heat flows are meant to be holistically controlled and optimized. In the U.S., this trend was popularized during the 2000s through the U.S. Green Building Council's LEED green building rating system. With the increased reliability and falling costs of photovoltaic systems came the notion that certain buildings – such as smaller residential and office buildings – could become "net zero," meaning that over the course of the year buildings supply, on balance, as much energy into the grid as they take during times of insufficient solar supply.

17 http://web.mit.edu/mit2030/themes/renovation-renewal-stewardship/accelerated-capital-renewal.html

18 http://www.netzerocambridge.org

19 http://www.mckinsey.com/client_service/sustainability/latest_thinking/greenhouse_gas_abatement_cost_curves

such detailed project analyses, which perpetuates an uncertainty about which technologies work best in the field.

In order for MIT to inspire action on climate change, our own actions and practice must yield scalable, high-impact results that lower our carbon footprint, reduce cost, and promote innovation.

Apart from the potential high impact and leadership opportunity for MIT, there are other reasons why MIT should concentrate on improving its campus operations. For example, through the Idea Bank and the Listening Tour, the MIT community spoke in favor of building and maintaining a campus that showcases cutting-edge, low-carbon building technology and transportation, sustainable food and product procurement, land and water management, and energy systems. The community also noted that existing campus commitments to low-carbon operation seem disconnected, missing a larger, Institute-wide mandate to pursue the highest possible standard of operational performance. In order for MIT to inspire action on climate change, our own actions and practice must yield scalable, high-impact results that lower our carbon footprint, reduce cost, and promote innovation.

Further, within the landscape of higher education, MIT is somewhat late to the game when it comes to formulating carbon reduction targets. Unlike MIT, all of the other Ivy Plus Sustainability Consortium[20] campuses have established a commitment to operational greenhouse gas reduction (see Appendix 4C). In addition, over 600 U.S. campuses[21], including numerous urban research institutions, have committed to pursuing carbon neutrality or substantial reduction of campus greenhouse gas emissions. Institutions that made commitments to improve campus operations a decade ago have experienced financial savings from these actions.[22]

In summary, MIT can use this opportunity to build on the successes of our peers, but also to leap ahead, seeking new and innovative strategies that represent the 'next generation' of campus climate change actions. The committee suggests implementing a comprehensive strategy to transform the carbon efficiency of our campus into a scalable role model for other educational and industrial campuses worldwide. The following actions should be taken to ensure successful implementation of this goal:

- **Presidential commitment to climate change leadership.** Sign and publicly share a statement outlining MIT's commitment to operating a campus that is exemplary in its commitment to climate mitigation and adaptation. A presidential commitment is necessary to catalyze serious commitment to activities on campus, and show the public that MIT is serious about addressing climate change.

20 http://www.sustainablecampus.cornell.edu/initiatives/ivy-plus-sustainability-working-group See also Appendix 4C.

21 http://www.presidentsclimatecommitment.org/

22 http://www2.presidentsclimatecommitment.org/ACUPCC-Progress/Summary-June2013.pdf

- **Campus climate change task force.** Create a campus climate change task force whose charge is to set carbon reduction and mitigation goals specific to the MIT campus and MIT's physical assets. The task force would also set target dates for achievement, climate adaptation priorities, and seek alignment with educational and other Institute initiatives. The task force could be merged or maintain strong ties with the Carbon Pricing Working Group proposed under section 3B.1. As with climate action plans[23] found at other institutions, the task force would produce annual reports with emissions reduction goals and progress toward those goals. Other topics addressed by the task force would include climate change adaptation planning, climate resilience metrics and infrastructure ideas.
- **Revolving loan fund.** The committee's suggestion to implement carbon pricing for MIT indicates that methods must be established to ensure the financial feasibility of carbon-reducing infrastructure projects. In order to enable these investments, a revolving fund[24] should be allocated as part of the capital renewal campaign. A revolving loan fund enables energy efficiency upgrades to become high-return investment opportunities. The MIT revolving loan fund would annually support projects with the lowest carbon reduction costs across campus. Entities at all levels including individuals, laboratories, departments and student organizations could bid on the use of the assets in the fund, which could be administered by the Carbon Pricing Working Group (section 3B.1). For some projects, the selection could be biased toward measures that affect building occupants, such as building controls for lighting, thermostats, etc. Savings from these (and other) projects should be tracked and a set portion should be returned into the revolving fund for continued implementation of low-carbon campus infrastructure.

3. Establish an open data platform to accelerate solutions

Linking better data to transparent systems will enable the wider body of interested and educated MIT community members to participate in identifying opportunities for improvement.

One cannot manage what one cannot measure, and existing measurements of campus energy consumption are insufficient for detailed analysis and intelligent decision making with respect to carbon-reduction schemes or sustainable operational improvements. Current assessments partly rely on aggregating and averaging supply and consumption across several buildings. However, the energy and resource use of each building is different – determined by construction style, weather, occupancy behavior and usage – and must be metered accordingly. Better data about the ways our resources are used and how our buildings function can in turn lead to smarter decision making. Furthermore, linking better data to transparent systems will enable the wider body of interested and educated MIT community members to participate in identifying opportunities for improvement.

23 http://presidentsclimatecommitment.org/node/3090/

24 http://www.aashe.org/resources/campus-sustainability-revolving-loan-funds/all/

If MIT is to be a model for experimentation and education, the Institute should examine how to effectively monitor all significant resource flows across the campus, from electricity, steam and chilled water, to potable water and waste, and ensure that this platform and data are securely and reliably accessible within the MIT community.

Fortunately, MIT has deep in-house expertise[25] and existing relationships with companies that can manage such campus-wide data sets. The MIT Facilities Department is already a recognized leader in the creation and maintenances of Geographic Information System (GIS) and Building Information Modeling (BIM) datasets of all of MIT's built assets. The MIT spinoff company KSG already provides a closed data platform for sharing energy in select buildings, accessible through MIT Atlas.

Specific further actions that should be pursued to facilitate measuring energy use across campus include investing in sub-metering of campus resource flows (energy, water and waste), centrally collecting measured energy savings and implementation costs from previous retrofitting projects, providing up-to-date analysis of carbon-reduction efforts, and ranking the success of different carbon reduction measures. The resulting information would feed into the retrofitting prioritization scheme. This effort would be an enabler for the implementation of carbon efficiency on campus described in section 3B.2.

4. Advance climate change mitigation and adaptation practices

There are a number of areas of research and practice where MIT can be a facilitator for sustainable choices through better data and knowledge of climate impacts, establishing precedence through internal activities, and creating new tools and ways of doing business. Several avenues are already actively pursued by MIT's Office of Sustainability[26], and this topic is therefore treated here only briefly.

Better strategies, tools and resources are needed to assess the carbon impact of personal choices. The committee suggests that MIT create cutting-edge metric and management systems to aid the MIT community in reducing their carbon footprint contributions from commuting, food, purchases and travel.[27] MIT could help set new standards and develop original technology for low-carbon conferences, business meetings, and events, including the development of significantly improved virtual conferencing technology as well as incentives to reduce high-carbon business travel.

The committee suggests that MIT create cutting-edge metric and management systems to aid the MIT community in reducing their carbon footprint contributions from commuting, food, purchases and travel.

25 http://idss.mit.edu/

26 http://sustainability.mit.edu/

27 In line with the World Resources Institute Greenhouse Gas Protocol, MIT currently measures operational greenhouse gas emissions from Scope 1 and Scope 2 greenhouse gas emissions, i.e. direct emissions from sources owned or controlled by the Institute and indirect emissions from the generation of purchased energy.

Additionally, the committee suggests offering a fossil-free option in MIT's 401K plan to enable a large fraction of the MIT community the flexibility and choice of investing their retirement funds in a way that is consistent with their view of social responsibility.

5. Require climate change education in the undergraduate curriculum

In addition to making MIT's campus more carbon efficient and exposing students to more sustainable ways of living through the creation of a model campus, it is important to provide educational experiences that allow students to recognize that climate change poses some of the greatest technical and scientific challenges they will likely face. Few students at MIT are educated in the complexities of climate science or are aware of how their chosen discipline might affect and be affected by a global environment that is likely to undergo significant changes in their lifetime. As future leaders and citizens, every MIT student should understand the causes of climate change, how their professional endeavors might relate to the problem, and how they can aid in the adaptation to and mitigation of climate change.

Few students at MIT are educated in the complexities of climate science or are aware of how their chosen discipline might affect and be affected by a global environment that is likely to undergo significant changes in their lifetime.

We suggest several mechanisms for integrating climate change into the undergraduate curriculum:

- The introduction of a General Institute Requirement (GIR) on climate change;
- The inclusion, in each major field of study at MIT, of classes and/or exercises that focus specifically on aspects of climate change germane to that major;
- The introduction of a Minor in Environment and Sustainability;
- The introduction of an EdX course on climate science that could be integrated into the undergraduate curriculum.

A GIR on climate change might take the form of a multi-disciplinary course involving various topics such as geoscience, engineering, science and technology policy, economics, international relations, and life sciences. Such a course would be taught by experts in these disciplines from several MIT departments. There could be classroom, laboratory and online elements, for example, offering instruction, interaction and experimentation to enhance knowledge and engage students. This GIR would introduce students to many MIT departments and provide a way to broadly disseminate knowledge on climate change across MIT. It could also serve as a model for other universities interested in integrating climate change into their curricula.

The major-specific classes on climate change would be tailored to relevant fields of study. For example, a class for chemistry majors would not only address the role of biogeochemical processes in climate, but would also focus on how a career in chemistry could contribute to solutions to the problem. As another example, mechanical engineers could learn about energy

efficiency of systems across scales – from large manufacturing factories to microsystems and devices – and understand how to minimize the environmental effects of product design, development, and production, while maximizing quality and revenue. Given the foundational knowledge students are expected to have mastered in their department, these classes would explain how to approach climate-relevant concerns within their fields.

If MIT graduates are to be world leaders, it is essential that they have a thorough grasp of climate change issues and the associated implications for their professional pursuits.

MIT's Environmental Solutions Initiative (ESI) is proposing to develop a Minor in Environment and Sustainability. We strongly support this effort as one route to increasing the environmental literacy of MIT students and promoting climate-related studies on campus. As the ESI is developing a detailed proposal for such a Minor, we only mention it here as part of a suite of curricular innovations MIT might undertake.

MIT students already have many demands on their time, imposed through Institute and departmental requirements. One way to supplement their education without imposing additional classroom time is to offer one or more EdX courses devoted to climate-related topics; these could be integrated into various existing classroom courses. One such course – 12.340x, "Climate Science" – already exists and could be expanded upon and/or supplemented by additional EdX courses.

MIT's mission is to "advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century." As climate change is among the greatest challenges of the 21st century, MIT should make sure that every student is equipped to meet the challenges that climate change poses for their futures. Mitigating and adapting to the effects of climate change will require a concerted effort by experts from many backgrounds – technology, engineering, economics, policy, and international relations, to name a few. Therefore, if MIT graduates are to be world leaders, it is essential that they have a thorough grasp of climate change issues and the associated implications for their professional pursuits.

The impact of the Living Laboratory concept could be further magnified by expanding education activities to the wider community. MIT has the opportunity to establish itself as a leading institution for online climate change education resources for public audiences, including K-12 students, educators, and academic institutions, in particular through online education platforms such as EdX and the web resource suggested in section 3A.2. On campus, MIT could offer a distinguished annual public lecture series on climate change, augmenting the successful tradition of the Carlson Lecture and expanding this to include, for example, policy aspects of climate change. Broadcast online and open to the public, the series would serve as a worldwide stage for the presentation of climate change topics, addressing scientific and political breakthroughs as well as roadblocks encountered. The public lecture series would help establish MIT as a nexus for scientific innovation and political discussion related to climate change.

COMMUNITY QUOTES: TRANSFORMING MIT INTO A CLIMATE CHANGE LIVING LABORATORY

"MIT HAS TO START BY BUILDING A MODEL campus for sustainability. Leading by example is important."

"MY OPTION WOULD BE FOR BETTER management of MIT internal physical plant, and to make sure to manage better the resources we have. We waste a whole lot of energy in winter and in summer, and we need better controls. We should put what we teach and preach to use – and we should do better.

"CARBON PRICING MOVES THE DEBATE IN A positive direction and gives universities more options than just fossil fuel equity divestment. It could be a great mechanism for education and research."

"AS AN INFLUENTIAL AND RESPECTED institution, MIT should lead in pushing for development of a carbon tax to put a price on the environmental impact of CO_2 emissions. MIT can also lead in research to properly price carbon."

"CARBON PRICING PROVIDES VALUABLE real world data, and helps advance the research. Implementing it could be part of policy studies, economic studies, behavior studies and technology research."

"CARBON-INTENSIVE ACTIVITIES AT MIT ARE likely inefficiently priced if social/carbon costs are considered. Examples: printing, clothes dryers, parking, and electricity. To discourage waste and influence behavior, MIT should review and adjust its pricing and study how consumer behavior changes as a result."

"MIT CAN START BY BETTER MANAGING our own climate and temperature control. I believe it is a waste of energy to cool down unused spaces."

"I THINK WE SHOULD USE A SYSTEM THAT turns off automatically the lights of most of the offices and labs after 8:00 pm."

"RETROFIT ALL BUILDING FLUORESCENT lights with LED tube lights which are getting lower in price, have a better color temperature and are much lower in energy consumption. Besides they last far longer (~10 years) thus saving on replacement and maintenance costs. All of which reduces the carbon footprint."

"LET'S PROVIDE INCENTIVE FOR FOLKS TO work from home. Perhaps there are ways to provide managerial oversight through the internet."

"MIT COULD BECOME A GLOBAL LEADER that embraces a decentralized workforce. The first question is: What is the carbon footprint of MIT's daily commuters? If it is significant, and I suspect it is, lets work to reduce the environmental impact."

"MIT SHOULD REQUIRE ALL undergraduates to take an introductory course on the science of climate change like we require for math, physics, biology, chemistry, etc. (aka General Institute Requirements - GIRs). Just as all MIT students should learn how to integrate around a sphere, they should also learn the science behind climate change."

"BEING AN MBA STUDENT, IT'S MY perspective that the core curriculum needs to have an introduction to sustainability, climate etc. That's necessary."

"MIT SHOULD PARTNER WITH THE surrounding communities that are actively working to make a difference on climate change, to enhance the K-12 education. We should be bringing elementary, middle and high school students to exciting events hosted at MIT by MIT faculty and students to get them excited to learn about climate change and how they can make changes to address it."

"MIT NEEDS AN ESTABLISHED POLICY OF being sustainable – that will make news, I think."

3C. Accelerating Solutions

Several aspects of climate change make it an exceptionally difficult challenge to confront. At root, it is a problem of the global commons, in which a shared resource (the atmosphere) that is essential to each individual's well being is collectively affected by actions taken by all others. In this context, cooperation is vital to protect the common good. However, human activities that cause harm to the shared resource are intertwined with fundamental facets of our modern life (such as the consumption of fossil fuels for energy and transportation, common methods of industrial agriculture, increasing trends toward urbanization, etc.).

Transitioning society away from a reliance on greenhouse-gas-emitting processes and practices requires substantial changes to policies, infrastructure, habits and hubris. Climate policy cannot, however, be separated from issues of tax structure, international trade regimes, agricultural policies, energy security and conservation initiatives, and other environmental concerns (such as urban air pollution and the appropriate role of nuclear power). Moreover, any long-term emissions-control agreement inevitably raises questions of international equity, most importantly between the current industrial economies and the developing nations.

The current momentum of international negotiations, regional initiatives and commitments to climate action plans signifies a growing recognition of the climate threat. However, we must also acknowledge that, while mitigation can reduce the risk of significant climate disruption, it cannot forestall changes already underway. Adaptation to climate change is expected to require significant outlays, and inevitable suffering. With this tremendous challenge and looming crisis in sight, MIT should move quickly to rally its strengths to accelerate solutions and help escalate a global response that is commensurate with the climate-change risk.

As a world-class educational and research institution that considers relevance to the practical world as a guiding principle, MIT has much it can contribute. Advancing solutions to climate change entails many dimensions that engage the traditional strengths of MIT: collaboration across disciplinary boundaries, quantitative analysis of complex situations, independent assessment of viable options, development and deployment of novel solutions, partnerships all over the globe, and a wealth of experience in assisting communities as they grapple with decisions that must be made. MIT is also a leader – in education and in influencing public thinking – but the global scope of the climate change problem requires collaborative action as well as leadership. MIT can amplify the role of higher education in confronting climate change through regional and national partnerships.

Advancing solutions to climate change entails many dimensions that engage the traditional strengths of MIT: collaboration across disciplinary boundaries, quantitative analysis of complex situations, independent assessment of viable options, development and deployment of novel solutions, partnerships all over the globe.

To accelerate progress on addressing climate change, MIT should aim to greatly expand its portfolio of climate change research, with a concomitant effort to raise the requisite funds. Importantly, there should be a significant increase in funding available to students and faculty to pursue climate change projects. An overarching suggestion to bolster MIT's response is to establish a Climate Institute or a dedicated entity that can connect and enhance the various climate-relevant efforts across departments, labs, and centers. This entity could coordinate the communication activities suggested in prior sections of this report, and it could consider new investment strategies that can proactively align MIT's resources with its mission. Finally, MIT should ensure coordination with other higher education institutions on critical climate change issues through the establishment of a regional consortium, and investment in existing national partnerships focused on accelerating climate change solutions.

1. Declare climate change the focus of a major capital campaign

Solutions to the climate change problem will not be found in any single department or school's research portfolio. An integrated systems approach to research is required, yet such a multidisciplinary agenda can often be difficult to support financially. To make significant headway in accelerating solutions, MIT should include in its current capital campaign a target of raising funds to support MIT efforts on climate change. This could be broadly framed and open-ended, with the funds to be directed toward either research or education, without a particular entity or department in focus, or for major investments into campus operations, as outlined in section 3B.2. A more deliberate alternative would be to seek donors for a major gift to enable the creation of a new Climate Institute with an endowment at the $100-200 million level, as discussed in the next subsection. Inclusion of climate change as a focus of a funding campaign would convey a strong signal that MIT considers climate change a high-priority problem facing the world. It would also facilitate the multidisciplinary efforts that are needed to address climate change. Anecdotal input from MIT alumni suggests that a number of them would be willing to give to such a capital campaign so that a major campaign target of the $100-200 million range may be reasonably met.

A more deliberate alternative: Seek donors for a major gift to enable the creation of a new Climate Institute with an endowment at the $100–200 million level.

A related suggestion is to explicitly elevate the focus on climate change in SOLVE[28], MIT's new commitment to identify and implement technology-centered solutions to the most difficult challenges of our times. The inaugural SOLVE event, set for October 5–8, 2015, will convene researchers, business leaders, philanthropists, policymakers, and change agents to initiate a process of exploration to identify workable solutions that address problems in four critical themes (learn, cure, make, fuel) and to start projects to test those ideas. While climate change is itemized as one of several problems relegated under the theme of 'fuel', this subordinate status misses a

28 http://solve.mit.edu

unique and important opportunity to engage potential donors, catalyze action around the broader space of climate-change solutions, and explicitly recognize the priority that solving the climate challenge should have in society.

2. Create a Climate Institute to connect and augment existing activities

A Climate Institute at MIT would be both the flagship and organizational framework for MIT's efforts in confronting the climate challenge.

A Climate Institute at MIT would be both the flagship and organizational framework for MIT's efforts in confronting the climate challenge. A Climate Institute would have several functions. First and foremost, it would enhance the visibility of MIT's commitment to addressing climate change. Second, it would provide a means of connecting the various activities happening on and around the MIT campus that can be brought to bear on the challenges of climate change. MIT's collective response to climate change could be greatly escalated with improved interconnections. Finally, an institute with an endowment on the order of $100–200 million could provide fellowship funding for students and postdocs, endowed faculty chairs, and seed grants for research and ignition projects. Thus, the broader agenda of such an institute would be to augment existing MIT efforts to address climate change, foster the integration of the many complementary aspects of climate-relevant research at MIT to achieve greater coherence, enhance communication activities, and accelerate the identification and adoption of viable options for climate mitigation and adaptation.

A Climate Institute could also represent the framework for several of the efforts suggested in this report and contribute to the governance of associated entities. An institute could coalesce the contributor cohort for countering disinformation and manage the associated communication initiatives (section 3A.2), serving as the natural home for a climate web resource (section 3A.3). An institute could coordinate efforts comprising the theme of a climate change Living Laboratory (section 3B), and administer the funds for fellowships, grants and prizes (sections 3C.3 and 3C.4). It could also provide a faculty pool to develop external courses (section 3A.4) and weigh in on the GIR-type curriculum requirements (section 3B.5). Finally, an MIT Climate Institute could serve as the lead body for an intercollegiate council that coordinates efforts across higher education in the region (section 3C.5).

3. Enhance support for climate change research, development and transition

Under the Climate Institute, part of the funds raised should be dedicated to seed grants for students and faculty, and fellowships for graduate students working on climate change issues. This should be a large commitment – on the order of $10 million a year. This could also be accomplished by significantly enhancing the nascent Environmental Solutions Initiative in the area of climate solutions. The fellowships would be spread across all departments at MIT to encourage more research on climate change issues both at departments that already do research in the climate change space as well as at departments in which such research may be

under-represented. One potential tool to encourage broader and higher-risk/higher-return research in the area would be to institute a monetary prize on the order of $2-10 million for climate change. Such prizes have been successfully used across a number of fields and could be used either to target breakthrough technologies or for bold solutions to the climate challenge.

We suggest that the proposed Climate Institute not only promote research and development, but also offer a means for expedited testing, evaluation, and transition of successful concepts to the outside community, with the Living Laboratory (section 3B) available as a testbed. The Climate Institute could host workshops, where industry is exposed to early-stage research progress, as a means of expediting the commercialization of promising technologies. Thus, the Climate Institute would serve not only to promote and coordinate the research activities germane to climate change, but also to ensure their migration to practice and implementation at scale.

4. Develop new investment strategies

MIT should consider an allocation to a green fund that would be used to accelerate efforts on climate change at different scales, both inside and outside of MIT. For example, the green fund could be invested in public shares of companies whose core business is in the development and deployment of environmental technologies, such as those included within the FTSE Environmental Markets Index Series[29]. At a local scale, a portion of the fund could be invested in MIT early-stage start-ups whose core business plan involves green technologies, such as energy generation, storage and efficiency. Furthermore, the fund could be used for investments in energy efficiency and energy infrastructure on the MIT campus (see section 3B.2). As a final example, the fund could be invested in student-led concepts. Throughout the Conversation, the committee received suggestions from students concerned with issues such as the use of revolving doors, recycling of waste at campus events, selling/recycling furniture when students move, and other ways of promoting a culture of sustainability. These funds could be important enablers for student enthusiasm to work toward climate change solutions. Within the concept of the Living Laboratory (section 3B), student-led projects could simultaneously represent experiments with approaches to trigger behavioral shifts. Students also expressed that funding for projects promoting and advancing such measures on campus could dramatically increase student engagement in climate change issues.

One possible source of funding for the green fund is the revenue (if any) from the campus carbon price proposed in section 3B.1. Presumably at least a part of this revenue would be invested in technology that addresses climate change in some way. The green fund may also serve as the vehicle for efficient allocation of this capital among start-up companies, student projects, departments or other entities that contribute to accelerating solutions to climate change.

5. Accelerate solutions by leading higher education partnerships on climate change

Collective action of focused groups of universities could provide a means of amplifying the impact of many of the suggestions contained in this report. The committee suggests MIT take

29 http://www.ftse.com/products/indices/Env-Markets

a more active role in accelerating solutions in higher education and regional partnerships on climate goals by forming and leading a Regional Intercollegiate Council on Climate Change Solutions. Some partnership areas may be best addressed through existing organizations or consortia, while others may require the establishment of new goals, formal partnerships, or initiatives led by MIT. Analysis of the appropriate advancement for these partnership opportunities could be coordinated by the suggested Climate Institute (see section 3C.2) and the existing Sustainability Taskforce[30]. Three priority focus areas for collective effort are:

- **Developing criteria for climate change coursework and open-source resources.** As more institutions of higher education offer courses on climate change issues, it would be beneficial to have a common set of core requirements. MIT should develop a standard "minimum" curriculum, coordinate the establishment of specific degrees, develop course-sharing opportunities among institutions, and serve as a model for other universities. Furthermore, the committee suggests using the online EdX platform to offer climate change education to a global audience.
- **Sharing best practices for campus mitigation and adaptation, focusing on collaborative action.** A divide exists between the Ivy Plus institutions and most other U.S. universities, which participate in a separate yet aligned consortia focused on climate change campus goals. MIT should be a leader in alleviating this divide and coordinating the sharing of best practices for mitigation, defining operational boundaries for greenhouse gas accounting, climate adaptation and resilience, and strengthening the commitment to sharing solutions widely.
- **Coordinate research agendas prioritizing necessary climate change solutions.** In general, current areas of climate change research at a given institution reflect the existing resources at that institution; what is lacking is a more integrated strategic research agenda whose execution may be beyond a scale that is affordable or achievable by any single university. As an example, consider research designed to develop safe, affordable nuclear power. The fundamental elements of such research could be conducted at several universities, but a scaled-up test facility would require a sizeable investment in money, land, and infrastructure. The same logic applies to many potential climate change research areas (wind farms, solar arrays, transportation systems, novel agricultural practices, etc.) – the individual technologies need to be tested at a scale, which is often prohibitive for any single non-government entity (or even a committed commercial entity).

Specific to local solutions generation, we suggest a Regional Intercollegiate Council on Climate Change Solutions[31] (initially potentially focused on the greater Boston area), which could take

30 http://sustainability.mit.edu/campus-sustainability-task-force

31 The Council could be modeled after other thematic consortia that have arisen regionally, such as the Center for Integration of Medicine and Innovative Technology (CIMIT) (founded in 1998 to promote innovative development in patient care), the Boston Consortium for Higher Education (founded in 1995 to create a collaborative environment for developing and implementing cost-saving and quality improvement ideas), or the more relevant Climate Science Centers (Federal-university collaborations addressing issues of relevance to climate change).

advantage of geographically common attributes and constraints to climate change adaptation and mitigation, such as energy pricing, access to public transportation, population density, weather, and local and state government incentives. The proposed Council should aim to have representation from all regional colleges and universities to facilitate the adoption of recommendations at a scale commensurate with the problems associated with climate change. The general argument that one institution cannot make a difference in addressing problems of global magnitude weakens when 100 institutions take on the challenge.

The general argument that one institution cannot make a difference in addressing problems of global magnitude weakens when 100 institutions take on the challenge.

With the coordination of a formal Council, large-scale renewable investments could become a reality, strengthening the energy resilience of New England and collectively reducing the carbon footprint of campuses. Furthermore, the influence of a large multi-institution body could be leveraged for lower-carbon services. The Council might create the demand needed for local vendors to, for example, offer green manufacturing or net-zero waste disposal practices, especially if there were state or local economic incentives to do so.

Coordination of education efforts, including alignment with the above priorities, could also lead to critically needed climate change solutions. First, by identifying specific research focus areas of potential high impact in addressing climate change, projects could be distributed throughout the member institutions according to the relative strengths and resources of each member. Large-scale testbeds could be established either through donor funds, the establishment of a government center of excellence, or targeted investment by one or more Council members[32]. Second, the Council could serve as the coordinating body for technology transfer of "successful" developments, which would facilitate the adoption of promising research areas and potentially provide revenue for the promotion of new areas of research. Finally, if the model is successful, it can be replicated in other regions with similarly high densities of universities.

While MIT can and should have an impact on higher education and on promoting solutions at the national and global scale, we must ensure that our own "backyard" is prepared, resilient, and coordinated to address climate change. As this is the action we call upon others to do, so too must MIT be a leader and convener in doing the same – both to secure the resilience of our surrounding community in a changing climate, as well as to harness the unique opportunities of the dense, urban, higher-education environment that the Boston area has to offer.

32 An example of a similar entity is the Massachusetts Green High-Performance Computing Center, in Holyoke, MA.

COMMUNITY QUOTES: ACCELERATING SOLUTIONS

"MIT SHOULD DIRECTLY FUND climate-focused research in the form of graduate student fellowships and/or professorships. One option might be to re-direct/re-purpose some of the MITEI fellowships or Martin Fellowships for Sustainability. Areas include climate science, technologies for climate change mitigation and adaptation, climate economics, policy, communication, etc."

"ALL THE SECOND YEAR STUDENTS AT Sloan are asked to donate to the annual fund. The issue that comes up is that we don't know where the money is going. […] One thing that I think will be great to do with the fund is to have some kind of sustainability issue that we can put our money behind to show how many students are actually feeling strongly about this. I think some professors and some of the administration don't actually grasp how much we care about this and this would be a way for students to show that and put our money behind it."

"I WOULD LIKE TO SHOW SUPPORT FOR AN internal research fund. I work a lot with a lot of our industry partners who are [tentative] to spend a lot of money on sustainability research, and by having a start-up fund we are able to show they can support that."

"WHAT WE NEED IS AN ACTIVE DYNAMIC repository of all the work that is being done on climate change, environmental and sustainable research on campus. I have been here for three years and every time I look around I have found something new that I haven't known about, or someone that I could have been collaborating with, but haven't been because we don't have some sort of a running website (or however we want to store that information). [...] We can store that work on a website, create a center or whatever way is the best to communication all the good work."

"WE NEED TO STUDY THE SOCIAL ASPECTS of replacing fossil fuels. We need to do more: not just in terms of green technology, but also social aspects of research."

"HAVE A GRANT FOR STUDENTS TO actually design and implement a large-scale green project on campus."

"I AM INTERESTED IN THE IDEA OF USING some of our endowment and investing in companies that solve huge existential problems for society. A lot of universities do this – they will give grants to students to start up companies on campus. If MIT were to allocate $1M annually we can do a lot for really smart startups on campus [...] that work on the sustainability space."

"I REALLY WOULD LIKE TO ECHO THE ISSUE about developing a platform. There are so many disciplines that can collaborate with this and they could make progress not only from the policy aspects [...] but also for research. This is of particular importance to unify all the forces that are here."

"THERE NEEDS TO BE A DIALOGUE AROUND the political AND financial AND scientific issues related to climate change at MIT. They are all deeply tied to one another."

"AS CRUCIAL NATIONAL AND international decisions are being made that can seriously impact global policies and actions, MIT can contribute to ensuring that the scientific body of knowledge, uncertainties and all, is properly and prominently represented in the media and policy-making circles. I encourage the Institute's Administration to find new and more visible ways to do so, including joining with other universities in this task. Leadership means not only that the scientific research is done right, but also that it is rightly discussed when and where it matters."

"TAKE A VOTE OF THE FACULTY AND MAKE A strong public statement that anthropogenic climate change is real and that our society must tackle the challenge head-on with a high priority. In taking on this lean-forward position, reach out to and coordinate with other top-tier institutions of higher learning to make a group statement. While continuing to function as a symbolic and real institution of broad learning and action, invest the full intellectual and moral power and prestige of the Institute in this correct direction for the continuation of our civilization."

4. APPENDICES

4A. Engagement of the MIT Community

The committee sought broad input from the Institute community on how the U.S. and the world could most effectively address global climate change. The Conversation was framed as a combination of different channels for input from the community and input to the community. In addition to a myriad of personal interactions and email exchanges, the Conversation conducted some specific ways of engaging the community: a Listening Tour, an Idea Bank, and a series of public events guided by a prior survey to ascertain salient topics. Here we describe each major activity.

The Listening Tour and Idea Bank were designed to enable the committee to collect as wide a variety of ideas as possible from the community. They were designed for the sole purpose of generating ideas from the MIT community that could then stimulate discussion both around MIT as well as within the committee itself. These efforts were not intended to measure community sentiment in any way. Such events would be inappropriate for that purpose since small, self-selected samples cannot be considered representative of the views of the broader MIT community. It is also not simply a matter of the size of the sample that contributed or participated in these events – small samples can be representative of larger populations if they are drawn randomly, which is not the case for the Idea Bank and the Listening Tour. It is thus important to stress that, while these sources of input have been invaluable in generating a palette of ideas, they should not be used as metrics of community preferences.

As part of its social media and public engagement campaign, the Climate Change Conversation committee had accounts in Facebook, Twitter, YouTube, MIT TechTV, as well as an email and a blog.

1. Listening Tour

Held in April and May 2015, the Climate Conversation Listening Tour was undertaken by the committee as a method of directly engaging the community and soliciting additional input through live interactions and discussion. The Listening Tour was designed as a series of six targeted gatherings across campus to encourage expression of comments, suggestions, and concerns, under the motto of "We want to hear from everyone!" The events were very widely advertised, and geographically and temporally distributed (different parts of campus, different days of the week, different times of the day), to allow the broadest possible participation. Two of the six listening events specifically targeted students and were held later in the day and led by student members of the committee, in addition to other committee members. Five of the six listening events occurred on the MIT campus and featured a live webcast[33], the sixth was held at Lincoln Laboratory.

33 http://climatechange.mit.edu/blog/mit-climate-change-conversation-committee-embarks-listening-tour

2. Idea Bank

Launched in October of 2014, the Idea Bank[34] solicited reactions to how MIT should address climate change from everyone in the MIT community. Until June 11, 2015, 268 students, 263 faculty and staff, and 52 alumni submitted a total of 192 ideas[35]. The Idea Bank was divided into 6 categories: campus operations, finance, education, policy, research, and other. The collective input from the Idea Bank served as a catalyst for original ideas, debate, and analysis, has directly informed the writing of this report, and selected quotes have been included for each of the three themes comprising the report.

3. Fall Survey and public events

The Conversation hosted four public events tackling different aspects of climate change. The committee carefully considered the content and format of these events, in part drawing upon community input obtained from a survey conducted in the fall of 2014. The committee developed the survey to help direct the next steps in the Conversation by gauging the community's interests for various topics in the arena of climate change. The survey was sent to a total of 24,609 members of the MIT community, covering all constituents of the MIT campus and Lincoln Laboratory. A total of 8,137 individuals completed the survey, representing a response rate of 33%. Of the 8,137 respondents, 3,202 were students (undergraduate and graduate), 1,408 were academic staff, 2,433 were non-academic staff and 1,094 were from Lincoln Labs. The survey contained several questions that sought an indication of the level of interest in different topics and events, for the purpose of guiding further activities of the committee during the year. It was not designed to measure community preference or support for any one action. Of the topics included in the survey that the MIT community may be interested in learning about related to climate change, the effects of climate change on national security and conflict had the lowest level of interest, and learning about mitigation and adaptation had the highest. Similarly, of the potential events that individuals would like to attend, divestment was the lowest ranked options and how MIT could contribute to research on climate change the highest.

All four events were well attended and included a live webcast. Video recordings of two of the events are available on MIT Tech TV[36]. The fossil fuel divestment debate had the largest audience, with approximately 500 members from the MIT community in attendance.

One Man's Journey to Climate Activism: A Talk with Dr. Larry Linden

January 21st 2015, 3:30 – 5:00pm , MIT Kirsch Auditorium 32-123

The first event was an inspirational talk by Dr. Larry Linden, MIT alum and former General Partner and Managing Director of Goldman Sachs. From growing up in smog-filled Los Angeles,

34 http://climatechange.mit.edu/ideabank

35 The complete list of ideas is summarized here: https://climatechange.mit.edu/sites/default/files/images/CCCC_IdeaBank_AllSubmissions%20%281%29_0.pdf

36 http://techtv.mit.edu/collections/ccc

to MIT, the White House, and then a career on Wall Street, Dr. Linden described the experiences and transformation that brought him to launch an effort to move the politics of climate change in the United States. The Linden Trust for Conservation is seeking to advance a national conversation on the use of a revenue-neutral carbon tax to minimize greenhouse gas emissions, a centrist concept with the potential to draw bipartisan support. Describing lessons learned on the role of science in regulation, government technology policy, and financial risk management, his insights are both personal and global as they apply to our individual and collective ability to make a difference in one of the 21st century's most pressing challenges.

Getting the Job Done: Creating a Roadmap to Reducing MIT's Carbon Footprint[37]

March 12th 2015, 4:00 – 6:00 pm, 3-270

The second event convened MIT students, faculty, staff, and senior administration to discuss current and potential strategies for measuring and creating a plan to reduce MIT's contribution to climate change. Some of the questions tackled include: What are the current scientific realities? How do we set and align our goals? How should we prioritize projects and innovation potential? How do we finance, incentivize, and make real progress – quickly and efficiently? By examining our greenhouse gas footprint, this innovative event – a first for MIT – invited all contributors to help envision and shape our roadmap toward a lower-carbon institute.

Julie Newman, the Director of MIT's Office of Sustainability moderated a panel assessing the context for decision making and opportunity at MIT. Israel Ruiz, MIT's Executive Vice President and Treasurer, was one of the panelists presenting on the current realities MIT is facing regarding current greenhouse gas emissions, plans for facilities and capital renewal, and the constraints and possibilities of envisioning climate change as a component of decision making at MIT. Professor Henry (Jake) Jacoby, William F. Pounds Professor of Management Emeritus at the Sloan School of Management and member of the committee, presented and led a discussion on financing carbon reduction (a carbon price).

Getting Through on Global Warming: How to Rewire Climate Change Communication[38]

March 31st 2015, 4:00 – 5:30pm, E51-115

This third event tackled the question of why most of us recognize that climate change is real, yet few take action? Why do some not recognize it as real? The event convened MIT students, faculty and staff to discuss the challenges of climate change communication. By exploring the roadblocks to effective climate change communication, a diverse panel of faculty and media experts unpacked why our brains are wired to ignore a monumental threat to society. Through the moderated conversation, panelists provided insights into the following questions: Can we recast the problem? What is the role of science in the communication challenge? How and why has this particular issue changed the public's perception of scientists?

37 https://climatechange.mit.edu/events#2 - roadmap

38 http://techtv.mit.edu/collections/ccc/videos/31729-getting-through-on-global-warming

Drawing on the MIT community's input to the Climate Conversation Idea Bank and through live Q&A, the panel identified and examined communication strategies that MIT and others can employ to shift the global climate debate and to inspire action.

Participants included:

Moderator: John Durant, MIT Museum Director and Adjunct Professor in the Science, Technology & Society Program

Kerry Emanuel, Cecil and Ida Green Professor of Atmospheric Science at MIT's Department of Earth, Atmospheric and Planetary Sciences

Susan Hassol, Director, Climate Communication

Judy Layzer, MIT Associate Professor of Urban Studies and Planning

Thomas Levenson, Professor of Science Writing at MIT and Director of the Graduate Program in Science Writing

Chris Mooney, Reporter at the Washington Post

Drazen Prelec, Professor of Management Science and Economics at the MIT Sloan School of Management.

Should MIT Divest? A Debate on Fossil Fuel Investment[39]

April 9th 2015, 4.00 – 6.00 pm, Kresge Auditorium

In its fourth event, the MIT Climate Change Conversation invited the MIT community to learn about different facets of divestment from fossil fuel companies and explore whether MIT should divest its endowment as part of its response to climate change. Six prominent voices in the dialogue on climate change and energy were staged as two teams that presented PRO-divestment and AGAINST-divestment arguments in a classic debate format. The discussion provided a nuanced view of the relevant issues being widely contested on university campuses, and in particular at MIT. This was an unprecedented opportunity for the MIT community to hear a diversity of expert perspectives, to have questions answered, and to deepen our understanding of the opportunities, drawbacks, and alternatives to fossil fuel divestment and of how universities can address climate change.

Participants included:

Moderator: Tony Cortese, Intentional Endowments Network

Debating for fossil fuel divestment:

Naomi Oreskes, Professor of History of Science at Harvard University

Don Gould, Trustee Pitzer College & CIO Gould Asset Management

John Sterman, Professor, MIT Sloan School of Management

Debating against fossil fuel divestment:

Brad Hager, Professor, Director of the MIT Earth Resources Laboratory

Frank Wolak, Professor of Economics, Stanford University

Timothy Smith, Director of ESG Engagement, Walden Asset Management

39 http://techtv.mit.edu/collections/ccc/videos/31680-should-mit-divest-from-fossil-fuels

4B. Additional Information on Fossil Fuel Divestment

Over the past five years, a divestment campaign has taken shape and garnered momentum worldwide, with its proponents demanding that major institutions withdraw their investments from fossil fuel companies. Selected examples of fossil fuel divestment at institutions around the world are given in the table below.

Selected Examples of Fossil Fuel Divestment at Institutions around the World

(different organizations use different metrics for defining their total divestment from fossil fuels)*

Institution	Investment Portfolio	Amount to be Sold (i.e. Reinvested)	Divestment Option
Rockefeller Brothers Fund	$860M	No information on initial holdings	initially reduce coal and tar sands to 1% of portfolio, looking into reducing all fossil fuels* + invest 10% in clean energy
Stanford University	$19B	Initial holdings unclear	coal
Oxford University	$3.1B	No assets held, therefore none to be sold	coal + tar sands *(future commitment to not purchasing)*
Church of England	$13.9B	£12M to be sold	coal + tar sands
Australian National University	$1.1B	1% of holdings to be sold	7 resource companies *Only two Australian oil and gas companies, the five others are metal mining companies*
Norway's Government Pension Fund Global (GPFG) *The fund that holds some of Norway's surplus oil and petroleum revenues.*	$900B	Approx $5B to be sold	53 coal companies to date, Divest from companies with 30%+ of profits from coal* starting in Jan 2016
World Council of Churches	$9.3M	No assets held, therefore none to be sold	all fossil fuels* *(future commitment to not purchasing)*
Syracuse University	$1.2B	Initial holdings unclear	all fossil fuels*
University of Dayton	$670M	$34M to be sold	all fossil fuels*
Glasgow University	$198M	£18M to be sold	all fossil fuels*
Pitzer College	$124M	$5.4M to be sold	all fossil fuels*
Axa Insurance Company	$1T	$559M to be sold	coal + triple green energy investments, i.e. invest €3B by 2020
Guardian Media Group	$1.24B	No information on initial holdings	all fossil fuels* + increasing socially responsible investments
University of Washington	$2.8B	Approx $2.3M to be sold	coal

A number of universities have explicitly chosen not to divest. Examples include Harvard, Yale, Brown, Princeton, University of California, Cornell University, New York University and Washington University St Louis, among others. Both this list and the table are not intended to be complete, but only to provide examples.

The demand for divestment has also been made at MIT, specifically by the group Fossil Free MIT, which has collected over 3,400 signatures from members of the MIT community in support of divestment. The committee has taken the view that the request for divestment cannot be ignored, but must be carefully analyzed, because of (i) the sheer number of signatories and (ii) the fact that this demand channels the passion and enthusiasm of students for climate change mitigation, in the face of powerful business forces leading society down unsustainable paths on climate change, and action by the younger generation can send a strong signal to the rest of society. Divestment has garnered substantial attention in this Climate Conversation year, including being featured in the Idea Bank and Listening Tour, in the survey, and in the well-attended debate.

The committee applauds Fossil Free MIT for the consistently high standards and professionalism in their discussions and the demeanor of the group throughout this intense period of discussions, as well as the continuous help with activities and events, a help which transcended their original demand for divestment and demonstrates their passion for a better future in the face of climate change. This body of support for divestment should be seen and respected as the voice of a significant fraction of the community expressing a strong desire for MIT to take a meaningful stance on the issue of climate change.

4C. Emission Reduction Goals of the Ivy Plus Sustainability Consortium Institutions

Data collected from public reporting and institution websites, up to date as of June 10, 2015. The baseline year for greenhouse gas (GHG) reduction and operational boundaries vary.

University	Climate Mitigation Goal	Date to Reach Goal
Brown University[40]	42% GHG reduction	2020
Columbia University[41]	30% GHG reduction	2017
Cornell University [42]	Carbon neutrality	2035
Dartmouth College[43]	30% GHG reduction	2033
Duke University[44]	Carbon neutrality	2024
Georgetown University[45]	71% GHG reduction	2020
Harvard University[46]	30% GHG reduction	2016
Johns Hopkins University[47]	51% GHG reduction	2025
Massachusetts Institute of Technology	No commitment to GHG reduction	-
Princeton University[48]	Reduction to 1990 GHG levels	2020
Stanford University[49]	80% GHG reduction	2050
The University of Chicago[50]	20% GHG reduction	2025
University of Pennsylvania[51]	23% GHG reduction	2014
Yale University[52]	43% GHG reduction	2020

40 Brown: http://www.brown.edu/initiatives/brown-is-green/campus

41 Columbia: http://environment.columbia.edu/energy-climate

42 Cornell: http://statements.cornell.edu/2015/012915-climate-commitment.cfm

43 Dartmouth: http://sustainability.dartmouth.edu/power/campus-efforts

44 Duke: http://sustainability.duke.edu/about/reports/index.html

45 Georgetown: http://sustainability.georgetown.edu/initiatives/carbonfootprint

46 Harvard: http://green.harvard.edu/topics/energy-emissions/greenhouse-gas-reduction-goal

47 Johns Hopkins University: http://hub.jhu.edu/2015/04/22/sustainability-progress-report

48 Princeton: http://www.princeton.edu/reports/2011/sustainability/greenhouse/

49 Stanford: http://sustainable.stanford.edu/sites/default/files/documents/Stanford_Energy_%26_Climate_Plan_2nd_Edition.pdf

50 University of Chicago: http://sustainability.uchicago.edu/resources/ssp/climate_change/

51 University of Pennsylvania: http://rs.acupcc.org/progress/314/

52 Yale: http://sustainability.yale.edu/planning-progress/areas-focus/emissions

4D. Personal Statement by Geoffrey Supran

I would like to begin by expressing my complete and unreserved endorsement of every action suggested in the Report ("the Report") of the MIT Climate Change Conversation Committee ("the Committee"). The suggestions in the Report, if enacted in a timely fashion, would firmly establish MIT as a leader in the collective effort to mitigate anthropogenic climate change and, in my view, could have a profound effect on the social and political discourse surrounding climate change. My intention is not to distract from the suggestions in the Report, but rather to suggest a conceptual framework that could unify all of these efforts, and to make the case for an approach to fossil fuel divestment that extends beyond that endorsed by the Committee.

A Framework for Action: The 2°C Target

As stated in the Report, in reference to MIT, "The current lack of a strong, visible position on climate change is itself a position." As such, a course of action on climate change should be viewed not in comparison to a *status quo* of inaction, but in comparison to the opportunity that a fully realized climate action plan could present. We at MIT must ask ourselves not only "what more could MIT be doing to stop climate change?", but "what all could MIT be doing to stop climate change?" We must not simply seek out the easiest individual actions to take, but identify the strongest possible stance that a university in MIT's position could take on climate change. Not every action may be the right fit for MIT, but the process by which we assess each action must ask "Why not?" as well as "Why?"

I believe the strongest stance that MIT could take on climate change would be to publicly and holistically align all of the activities of the Institute – its campus operations, research and educational endeavors, investment portfolio, and public and political engagement efforts – with the target of holding the anthropogenic increase in global temperature below 2 degrees Celsius.

141 nations have signed the Copenhagen Accord, signaling their intention to prevent "dangerous anthropogenic interference with the climate system" by "hold[ing] the increase in global temperature below 2 degrees Celsius". Uniting the ideas generated from the Climate Change Conversation under this common, quantitative, scientifically-based and ethically-motivated theme would provide a powerful framework for action. The 2°C target is especially apt and timely in advance of the 21st Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP-21) in Paris this December. Swift and purposeful action from MIT, in alignment with that target, could help to build international political will for the strong, binding targets that are necessary to avert the worst potential impacts of climate change.

One of the foremost implications of the 2°C target is that, if nations across the world take appropriate action to meet it, the majority of fossil fuels – both the reserves and resources of coal, oil, and natural gas – must remain unburned. For a 66% chance of limiting global warming to less than 2°C above pre-industrial temperatures, no more than approximately 35% of current

proven fossil fuel reserves can be burned prior to 2100[53,54,55,56,57,58]. Recent research indicates that worldwide, to hold warming below 2°C, one third of oil reserves, half of gas reserves, and over 80% of current coal reserves should remain unburned through 2050, even with widespread adoption of carbon capture and sequestration. Arctic drilling for oil and gas, and any increase in heavy oil production – such as tar sands and Venezuelan heavy crude – are incommensurate with this goal.

The 2°C framework would have clear implications for every category of action open to MIT. In campus operations, it would entail putting MIT on the same emissions reduction pathway that developed nations must follow to achieve the 2°C target, committing MIT to a net-zero-carbon campus by 2050 at the latest. In MIT's research portfolio, it would entail addressing the question of whether it is ethical for MIT to pursue research in fossil fuel exploration when the burning of current proven fossil fuel reserves would be sufficient to break the 2°C target three times over; this question should be a priority of the Ethics Advisory Council recommended in section 3A.1 of the Report. In the public and political arena, it would entail using MIT's institutional voice – through the national media and relationships with companies and policymakers – to advocate for science-based policies that would put the nation and the world on the path to the 2°C target. And in our investments, it would entail divestment from the fossil fuel industry, whose business practices are in fundamental opposition to the 2°C target – an industry that spends almost $700 billion per year finding and developing new fossil fuel reserves when only a fraction of current reserves can be utilized. Below, I lay out an approach to fossil fuel divestment that would align MIT's investments with the 2°C target while addressing the concerns stated in the Report regarding complete fossil fuel divestment.

A Balanced Approach to Fossil Fuel Divestment

The goals of fossil fuel divestment are briefly summarized in section 3A.5 of the Report. Beyond the holistic alignment of investments with international climate targets described above, these goals are perhaps best encapsulated in an open letter from 79 MIT faculty members published on June 5, 2015: "By divesting from fossil fuels, MIT can call out the contradictions between the fossil fuel industry's business practices and the requirements for a safe and stable future. The social and political momentum created can help shift the efforts of both policymakers and industry toward development of sustainable resources. And as a component of a larger strategy, divestment inspires hope and galvanizes passion and action in both society and our students."

53 http://www.ipcc.ch/report/ar5/wg3/

54 http://www.nature.com/nature/journal/v517/n7533/full/nature14016.html

55 http://www.nature.com/nature/journal/v458/n7242/abs/nature08017.html

56 http://www.carbontracker.org/report/carbon-bubble/

57 http://unfccc.int/files/press/statements/application/pdf/20140805_carbontracker.pdf

58 http://www.worldenergyoutlook.org/publications/weo-2012/

The Committee considered a number of approaches to divestment, ranging from immediate blanket divestment from all fossil fuel companies, to targeted divestment focused on the worst offenders in terms of environmental risk and climate science disinformation.

The Report states that the Committee rejected "blanket divestment from all fossil fuel companies", citing concerns related to: (i) painting the entire fossil fuel industry with too broad a brush; and (ii) the possibility of loss of engagement opportunities with fossil fuel companies. I wish to dissociate myself from the notion that these concerns are sufficient grounds to reject a broad and nuanced formulation of fossil fuel divestment. The concerns raised by our Committee are understandable, yet they represent constraints on a solvable problem for which an optimized solution exists. There is an approach to divestment that would simultaneously address these concerns and meet the goals of divestment. I propose the following course of action for divestment at MIT:

- MIT should at once establish the Ethics Advisory Council suggested by our Committee in section 3A.1, to specifically address MIT's investments in companies with track records, past or present, of climate science disinformation.
- MIT should at once divest from "companies whose operations are heavily focused on the exploration for and/or extraction of the fossil fuels that are least compatible with mitigating climate change, for example, coal and tar sands," as supported by the majority of our Committee (section 3A.5).
- MIT should immediately announce its intent to divest, at the end of a 3-year "grace period", from companies involved in fossil fuel extraction that have not realigned their business practices and trajectories with the 2°C target within the 3-year window. This alignment on the part of a specific company would entail:
    - Halting exploration for new fossil fuel reserves, and committing to limit extraction to the pro-rata fraction of a company's fossil fuel reserves that is compatible with limiting temperature rise to 2°C. (A recent study provides a quantitative framework for determining the fraction of different fossil fuel reserves that must go unburned; it may be the task of an MIT working group, along the lines of the Carbon Pricing Working Group suggested in section 3B.1 of the Report, to keep this analysis up to date as a guide for the divestment process.)
    - Demonstrably ceasing their funding of lobbying in support of political aims that are at odds with the 2°C target and ceasing donations to politicians who deny the reality of anthropogenic climate change.
- Until the end of those 3 years, MIT should pursue formal and informal engagement strategies with those fossil fuel companies to which it has access, in an effort to convince those companies to align their operations with the 2°C target.
- At the end of the 3-year grace period, MIT should divest its endowment, to a fraction not less than 99%, of direct and commingled holdings in companies that have not aligned their operations with the 2°C target.

- If a company succeeds in aligning its operations with the 2°C target after divestment has taken place, it should be "released" from the list of divested companies.

This approach avoids painting all fossil fuel companies with a single brush and gives fossil fuel companies the opportunity, in good faith, to realign their business practices with international climate targets. It also ensures that MIT has the chance to fully harness any potential opportunities to engage with fossil fuel companies and to influence their behavior before pursuing the action of divestment, while achieving the goals of divestment.

Three Specific Points Regarding Fossil Fuel Divestment

I now wish to address some of the arguments that have been proposed against fossil fuel divestment. I do not believe that these arguments tip the balance in favor of ongoing investment in those fossil fuel companies that continue to set themselves in opposition to the 2°C target.

1. It has been argued that divestment from fossil fuels may lead to a "slippery slope" and could encourage groups of people to argue that MIT divest in support of other causes.

I agree that if MIT were to divest from fossil fuels, some MIT members may be inspired to think more deeply about the ethical implications of other aspects of their lives as members of the MIT community and of the world. Yet, I do not see this outcome as undesirable. I also note that divestment is but one of many tactics that may be used to address any of a number of areas of moral and ethical concern. MIT chose to divest from the Sudanese government during the Darfur crisis, but not from the Apartheid regime in South Africa or from tobacco companies. MIT severed its connection with operational weapons research at Draper laboratories, but did not divest its endowment from weapons manufacturers. A judgment that divestment is warranted in the case of fossil fuel companies does not mean that it is the appropriate course of action for addressing every concern in society. But the inspiration to think more deeply about ethics at the Institute and the ways in which MIT could contribute to solving the world's great problems are, in my mind, a corollary argument in support of divestment, rather than an argument against it.

2. It has been argued that the symbolic action of divestment may not have a substantial effect on discourse and actions regarding climate change.

I agree with the characterization of divestment as a symbolic action. The symbolic nature of divestment is precisely why it would carry such power. Symbols represent ideas and paradigms that structure our way of thinking about the world. Against a problem as deeply seated as climate change, the most meaningful actions are those that challenge the paradigm that begat the problem, not those that tinker at the edges. Divestment is one such way to challenge the paradigm that has led us to the climate crisis: the paradigm stating that immediate personal gains outweigh long-term societal costs; that infinite growth is possible in a finite system; and that it is acceptable to support business models that would lead to humanitarian catastrophe in the name of short-term profit. Past divestment campaigns have been successful in motivating legislative change and shifting public and political opinion on contentious moral issues such as South African apartheid, the business practices of the tobacco industry, and the Darfur crisis. An honest

assessment of the fact that the fossil fuel industry's actions and business plan are inconsistent with international climate targets, followed by the associated action of divestment, is firmly in keeping with the data-driven analysis and solutions-oriented action that is the MIT way.

I note that the symbolic action of divestment is also tangible. As recently as 2.5 years ago, SEC filings show that MIT was directly invested in Rhino Resource Partners, a company active in mountaintop removal coal mining. Current reports[59,60] (accessed June 11, 2015) suggest that MIT continues to hold more than a 5% stake in Rhino, making MIT the company's second largest shareholder. Divestment from fossil fuels – including divestment from the most carbon-intensive fuels, as supported by the majority of the Committee – would not merely be a notional endeavor.

3. It has been argued that divestment could lead to loss of engagement opportunities with fossil fuel companies, including research funding and opportunities to influence corporate behavior.

I am not aware of a convincing argument for why fossil fuel companies would choose to stop funding beneficial research at MIT in retaliation for divestment of endowment funds. Since an intended effect of divestment is to stigmatize certain business practices, it is unclear how a company's cessation of funding for beneficial research at MIT would be an effective method to counteract the stigma incurred by divestment. It is even possible that companies may see visible collaboration with MIT on climate solutions as a way to offset the stigmatization brought about by divestment and bolster their public image.

To cite a concrete example, ExxonMobil has recently used the fact that it contributes research funds to the MIT Energy Initiative to justify its stance in opposition to a shareholder resolution proposing that ExxonMobil "adopt quantitative goals for reducing total greenhouse gas emissions from the Company's products and operations". The ExxonMobil board recommended that shareholders vote against the resolution, partly because "The Company also conducts strategic research with leading universities around the world focused on developing fundamental game-changing scientific breakthroughs that could lead to lower GHG emissions and a less carbon-intensive global energy system. Examples include the MIT Energy Initiative and Global Climate and Energy Project at Stanford University." Divestment would put explicit pressure on ExxonMobil to take the action proposed in this resolution; were ExxonMobil to cease funding research at MIT, it would forfeit one of its own arguments against taking such action.

(I acknowledge MIT's close connections with the fossil fuel industry and the possibilities these may provide for active engagement; the 'balanced approach' to divestment proposed above includes the opportunity for engagement, but within a time limit imposed by the urgency of the climate crisis. It is important to be realistic about the potential efficacy of engagement; I note the well-publicized – and failed – attempts to encourage ExxonMobil to accept the realities of climate change through private pressure and public shareholder engagement.)

59 http://www.streetinsider.com/holdings.php?q=RNO

60 http://www.fool.com/quote/nyse/rhino-resource-partners-lp-com-unit-repstg-ltd-partner/rno/major-holders

While I disagree with the notion that divestment would necessarily risk the loss of research funding, a choice not to divest predicated solely on the perceived risk of loss of research funding would be a woeful abdication of MIT's stance as a leader on climate change. The message that MIT would send to the world were it to subscribe to this reasoning is that MIT, as an institution, is unwilling to take the risk of personal sacrifice in order to address the threat of climate change. We would signal that, even with the unique confluence of talent, passion, and prestige that MIT has earned and is privileged to represent, we choose to weigh potential personal cost over potential benefit to society. I do not believe that that is a statement that the MIT community is willing to endorse.