Report of the Harvard University Task Force on Greenhouse Gas Emissions

June 2008

EXECUTIVE SUMMARY

Harvard University President Drew Faust established the Greenhouse Gas Task Force in February 2008 to examine Harvard's greenhouse gas (GHG) emissions and to recommend "an appropriate University-wide greenhouse gas emissions reduction goal and a strategy and timeline to achieve that goal." She also asked the Task Force to deliver its findings at the end of the academic year.

The GHG Task Force[*] was composed of a faculty chair, an administrative vice chair, nine faculty members, six administrators, and four students (1 undergraduate, 3 graduate/professional students). The Task Force met weekly throughout the semester, conducted research on issues related to GHGs, and sought input from a number of external consultants. The Task Force also drew heavily on published conclusions of the international science and economics communities, as well as the results of prior and ongoing work on Harvard's greenhouse gas emissions by the Harvard Green Campus Initiative (HGCI), the Faculty of Arts and Sciences (FAS), the Allston Development Group (ADG), and the Harvard Environmental Action Committee (EAC). Briefings on interim findings to President Faust, members of Corporation, and the Council of Deans provided opportunities for helpful feedback and clarification.

This Executive Summary presents the *Key Findings and Recommendations* of the Task Force.

I. KEY FINDINGS

The following key findings of the Task Force constitute the foundations of its recommendations:

1. The international climate-science community has concluded that climate change resulting from civilization's emissions of greenhouse gases (GHGs) into the atmosphere poses a clear and present danger to society. There is a growing and widespread recognition of the need to address this danger by reducing emissions of GHGs into the atmosphere as immediately and rapidly as possible.
2. Specific targets and timetables for GHG reductions are being debated and adopted by an increasing number of governments, corporations, and universities.
3. Harvard's greenhouse gas emissions are growing rapidly, driven by increases in both the size of the University and the intensity of its energy use. Any strategy to reduce these emissions will need to consider a wide range of interventions encompassing every aspect of campus life and operations and including management of demand for energy services, improvements in energy efficiency and the GHG intensity of fuels, and the use of GHG offsets.
4. Significant reduction in the net GHG emissions of a growing University will require that Harvard create or acquire GHG offsets, i.e. receive credits for reductions achieved by helping others improve their energy efficiency or GHG intensity. The current market for offsets (buyers, sellers, regulators, certifiers) is,

[*] Full names and titles of Task Force members are provided in Appendix A.

however, in a high state of flux. The Task Force heard compelling arguments that letting the market mature before making any substantial investments in offsets could be advantageous. Work could nonetheless begin immediately to develop GHG offset *options and strategies* for Harvard.

5. Dramatic reductions of GHG emissions at Harvard could be achieved. Necessary technologies and systems to substantially improve the energy efficiency of the University's buildings, at least for the next 10 years of reductions, are available. If, as recommended below, Harvard pursues a short term goal of reducing its overall GHG emissions by 30 percent by 2016, the Task Force estimates that these technologies and systems could be put in place for capital outlays in the range of *$10 to 20* million each year. Substantial fractions of such outlays would be recovered promptly through reductions in Harvard's growing energy bill, which is now approaching $100 million annually. In addition to this capital outlay, the Task Force projects that the average annual cost of offsets that would also need to be acquired to meet that goal would be in the range of $2 to $4 million per year. Finally, we estimate that the annual cost to provide the staff support required to implement such reductions would be on the order of $2 million per year.
6. Implementation of strategies for achieving significant GHG reductions benefits from flexible, adaptive approaches and the creation of incentives for innovative thinking at all levels of the organization. Such strategies are facilitated through development of appropriate high-level management structures and committed professional staff.

II. RECOMMENDATIONS

The Task Force unanimously recommends that Harvard take the following actions:

1. **Initiate an aggressive and comprehensive program to reduce its greenhouse gas emissions,** beginning immediately and committing to a future of continuous improvement at the maximum practicable rate. The program should embrace the entire University, including its present operations and future growth.
2. **Establish an adaptive approach to reducing its GHG emissions** that periodically reviews the program's progress, ends and means. In particular, Harvard should assess its progress annually, and conduct a formal review of its progress, problems, goals and commitments for GHG reduction every four years. Both the annual reports and quadrennial reviews should reflect a strong commitment to transparency and accountability.
3. **Set formal goals and timetables for emission reductions.** Harvard's *short term goal* should be to reduce its net GHG emissions resulting from existing operations and future growth by *30 percent relative to its 2006 baseline by 2016.* Future targets should be set on a rolling basis as an outcome of the quadrennial review noted above, such that the review of 2012 would formulate a goal for 2020 and also consider any appropriate adjustment to the 2016 goal. Harvard should commit to a *long term goal* of fostering *continuous improvement* in efforts to

reduce its net GHG emissions, aiming toward GHG neutrality for Harvard's overall operations at the maximum practicable rate consistent with the evolving state of understanding about the climate problem, related sustainability issues and the options for dealing with them.

4. **Achieve reductions using a full range of technical and financial options.** Reductions should be achieved to the maximum extent practicable through improvements in our own operations, i.e., working to improve the efficiency with which we use energy, the GHG intensity of our energy sources, and the management of our demand for energy services. The remainder of the reductions needed to meet our goal should be achieved through the creation or acquisition of high quality GHG offsets, certified by independent verification.

5. **Build capacity to manage and staff Harvard's GHG and sustainability efforts.** Accomplishing these goals will require an investment in staff capacity and expertise across the University, as well as external resources. In addition, Harvard should have a formal structure for continued oversight of its GHG strategy and for other dimensions of sustainability. Direction of these efforts should be through a newly-formed organizational structure designed to achieve progress toward the stated reduction goals and responsible to the University's executive leadership.

6. **Establish itself as a leader in the efforts to address the challenges of climate change and sustainability by linking the University's GHG reduction strategy with broader efforts that stimulate relevant research, innovation and teaching.** In particular, Harvard should commit to at least one major University-wide research initiative on climate change or related sustainability issues; foster an aggressive program of innovations in GHG reductions engaging the entire University and elements of its neighboring communities; enhance the capacity of our teaching programs to prepare our students for the complex, interdisciplinary, and problem (rather than discipline) defined challenges represented by climate change and sustainability; and – as proposed by President Faust in her charge to this Task Force -- "establish further mechanisms that will help us to continue to develop institutional priorities and to determine a broader long-term strategy for sustainability."

7. **Develop a specific GHG implementation plan.** The relatively short period of time available to the GHG Task Force necessarily required it to remain focused at a strategic level. Many details of our findings and recommendations need to be further refined and developed. To ensure that the momentum of the Task Force be continued, and that the urgent needs we identified be addressed as soon as possible, we recommend that Harvard initiate immediately the development of an initial GHG implementation plan. Key elements of this plan should include developing the necessary financial resources, accounting systems, and organization structures. Harvard should also launch a major and continuing campaign to educate the entire Harvard community about the importance of the GHG reduction program and its possible contributions to it. To this end, Harvard should institute an annual University-wide celebration of its accomplishments, challenges and initiatives in promoting sustainability.

Report of the Harvard University Task Force on Greenhouse Gas Emissions

The Harvard University Task Force on Greenhouse Gas Emissions was formed in February of 2008 by President Faust. She charged it to report back in June with recommendations including "an appropriate University-wide greenhouse gas emissions reduction goal, and a strategy and timeline to achieve that goal."

The Task Force was composed of faculty members and students from across Harvard, as well as senior members from the administration. The full Task Force met eleven times to review relevant evidence, develop our findings and formulate our recommendations. We benefited greatly from the results of prior and ongoing work on Harvard's greenhouse gas emissions by the Harvard Environmental Action Committee (EAC)[1], the Faculty of Arts and Sciences (FAS)[2] and the Allston Development Group (ADG). In addition, we drew valuable material from several external studies that are cited where appropriate in the text. Finally, we received valuable input from a number of other experts drawn from the Harvard community, from staff support provided by the President's Office and the Harvard Green Campus Initiative (HGCI), and from opportunities to present and discuss our interim results with President Faust, members of the Corporation, and the Council of Deans.

The body of this report presents the Task Force's *Findings*, *Recommendations*, and possible next steps for *Implementation*.

FINDINGS

1. The international climate-science community has concluded that climate change resulting from civilization's emissions of greenhouse gases (GHGs) into the atmosphere poses a clear and present danger to society.

By 2005, such emissions had already raised the atmospheric concentration of carbon dioxide (CO_2) to 380 parts per million (ppm), compared to 278 ppm in 1750. When the increases since 1750 in the concentrations of other globally mixed GHGs are taken into account, the influence on the global climate from CO_2 and these other GHGs together is equivalent to what would have been caused by a 2005 concentration of 430 ppm of CO_2 alone. The combined influence of globally mixed GHGs is thus expressed as 430 ppm CO_2-equivalent (CO_2-e).

Other human influences on the energy balance of the Earth—mainly an increase in atmospheric particulate matter, a net increase in ozone (up in the troposphere, down in the stratosphere), and increased surface reflectivity from land-use change—add up to a net cooling that in 2005 was offsetting the last 50 ppm CO_2-e of globally mixed GHGs. Thus the net effect of all of the human influences together was equivalent in 2005 to about 430 – 50 = 380 ppm of CO_2 (coincidentally about the size of the actual 2005 effect of CO_2 alone).

These factors had caused an increase of about 0.8°C, as of 2005, in the average surface temperature of the Earth above its estimated value in 1850. The average surface temperature is a sensitive indicator of the overall state of the climate, and its increase as of 2005 has been associated with significant changes in circulation patterns, precipitation,

and the frequencies or intensities of extreme events such as floods, heat waves, wildfires, and powerful tropical storms. Due to inertia in the climate system, moreover, global temperature is predicted to rise to about 1.3°C above the 1850 level even if atmospheric concentrations were stabilized at their current levels.

The probability of truly catastrophic impacts from anthropogenic climate change appears, on current evidence, to rise sharply for increases in the global average surface temperature above 2°C. Stabilizing the sum of human influences at 450 ppm CO_2-e would provide a 50 % chance of not exceeding this value.

Achieving such stabilization would require that *worldwide* GHG emissions be reduced to the range of 15-20 % below their 2005 levels by 2030 and to the range of 50 % or more below their 2005 levels by 2050. Accepting that industrialized countries, with their far higher levels of per capita emissions, should undertake cuts sooner and drop their emissions more steeply than developing countries, it becomes clear that emissions in the United States and the rest of the industrialized world would need to fall to approximately 30 % below their 2005 levels by 2030 and 60-80 % below their 2005 levels by 2050.[3]

Regional reports on climate impacts, many of which are now being synthesized in a new US report, emphasize the urgency of taking action to reduce emissions now.[4] Across multiple systems and sectors, including agriculture, human health, fisheries, coastal development, forestry, recreation, etc., the adverse impacts of climate change become significantly greater a few decades from now if action is not taken today. While in many cases there is potential to adapt to the warmer conditions that will arise from dramatically reduced rates of emissions, the scenarios that resemble the high recent and current emission levels result in impacts that will very likely exceed capacities for adaptation to such change.

2. Specific targets and timetables for GHG reductions are being debated and adopted by an increasing number of governments, corporations, and universities.

International negotiations pursuant to the "Bali Roadmap" of the UN Framework Convention on Climate Change are considering reduction targets of 50-70 % below 1990 emissions by 2050. The European Commission has committed the European Union to reduce its GHG emissions 20 % below 1990 levels by 2020, and will go to 30 % if other advanced nations make similar commitments. The EU is discussing targets of 60-80 % below 1990 levels by 2050. The US Congress is currently considering a number of bills that would set goals of 20-30 % below 1990 emissions by 2030 and 60-80 % below 1990 emissions by 2050. The Presidential candidates have endorsed goals within this range. Corporations have also been active in setting GHG reduction goals, with many having set goals in the range of 5 % (or better) below their 1990 emissions rates by 2010. Many of these firms have already achieved or exceeded these reduction targets, while continuing to grow.[5]

Universities have been actively engaged in goal setting to reduce GHG emissions. More than 500 signatories to the American College and University Presidents' Climate Commitment have pledged to "initiate the development of a comprehensive plan to achieve climate neutrality as soon as possible."[6] Other Ivy universities have made specific commitments to reduce their annual GHG emissions substantially during the next

ten years.[7] Harvard students have articulated a vision for a campus that does no harm to the climate. Together, Harvard's many environmental groups have collected 4,500 petition signatures, the Undergraduate Council's endorsement, and further endorsements from all 12 House Committees and 15 Student Groups, all calling for Harvard to commit to climate neutrality.

The Task Force reviewed the various goals and timetables noted above, and discussed extensively their implications for Harvard. We found that there is a broad consensus that the US and other wealthy countries must do better than the average world performance on GHG reductions.[8] Many on the Task Force believe that Harvard and other leading institutions (be they states, corporations or universities) must do better than the average US performance. The Task Force also found a broad consensus on the need to start immediately with strong programs of emission reductions as part of a comprehensive strategy that leverages experience to enable long term programs of continued and aggressive reductions into the future. Regarding long term targets and timetables, many on the Task Force noted the strong attraction of the concept of carbon or climate "neutrality" as a goal, reflecting the widely held view that drastic reductions of humanity's pressures on the climate and earth systems more generally are needed.

3. Harvard's greenhouse gas emissions are growing rapidly, driven by both an increase in the size of the University and the intensity of our energy use.

The Harvard Green Campus Initiative has annually calculated the University's GHG emissions since 2000. The Harvard Greenhouse Gas Inventory[9] reports the results of this effort. The inventory presently includes *direct emissions* from sources owned by Harvard (the so-called 'Scope 1 emissions', e.g. those from our steam plant used to heat our buildings) plus *indirect emissions* from purchased energy (the so-called 'Scope 2 emissions', e.g. grid electricity). Work is underway to understand and document more fully *other emissions* related to Harvard but not caused by sources owned by Harvard (the so-called Scope 3 emissions, e.g. commuting and air travel).[10]

In FY2006 Harvard University's total GHG emissions (Scopes 1 and 2) for the Cambridge, Allston, and Longwood campuses was 282,000 Metric Tons of Carbon Dioxide Equivalent (MTCDE). Table 1 shows the breakdown by campus and the changes in calculated emissions (using the best available data) since FY2000. During this period Harvard's GHG emissions have grown by 86,400 MTCDE. This amounts to a 44 % overall increase, at an average rate of almost 4 % per year. The Table also shows that while campus growth accounts for over half of the GHG emissions increase, a large proportion can also be attributed to an increase in energy intensity (energy used per square foot), which is due to new laboratories (major energy users), growth in air conditioning, and increased plug load associated with computers, peripherals and other occupant-chosen electrical devices.

Table 1: Harvard's Greenhouse Gas Emissions

	Square Footage			Emissions (MTCDE)			MTCDE/1000 Sq Ft		
	Cambridge/ Allston	Longwood	Total	Cambridge/ Allston	Longwood	Total	Cambridge/ Allston	Longwood	Total
FY00	12,020,000	1,926,000	13,946,000	143,000	53,000	196,000	12	27	14
FY06	14,342,000	3,104,000	17,446,000	196,000	86,000	282,000	14	28	16

Reviewing these trends, the Task Force concluded that Harvard's GHG reduction strategy will need to consider a wide range of interventions encompassing every aspect of campus life and operations. The Task Force adopted the following widely accepted accounting identity to assure clarity in its deliberations about intervention options: E(missions) = D(emand) * E(fficiency) *I(ntensity) – O(ffsets). The way that the Task Force has thought about the pros and cons of reducing emissions through each of these options is summarized below:

- ***Demand management*** **of need for energy services can be carried out through managing the effective "size" of Harvard (e.g. its gross square feet, or number of students and employees) and our consumption of energy services (e.g. lighting, computing, air conditioning) at whatever size we are.** Demand management can impose limits on the growth of Harvard's size or consumption of services and thus has the potential to conflict with some visions of our mission, but is a powerful means for reducing GHG and other impacts of energy on the environment. In short, managing energy demand requires balancing the scale and energy burden of the University with its mission, sometimes referred to as "right sizing."
- **Improvements in *energy efficiency* (i.e. energy consumed per service delivered).** Energy efficiency improvements allow Harvard to sustain services needed for achieving its mission, to reduce GHG and other impacts on the environment, and to save money on forgone purchase of increasingly expensive energy.
- **Reductions in the (net) *GHG intensity* of energy consumed (i.e. net GHG emissions per unit of energy consumed).** GHG intensity improvements (e.g. shift from oil to gas, use of renewable energy sources, or use of carbon sequestration or GHG destruction) allow Harvard to sustain the energy services needed for achieving its mission and to reduce damages due to GHG emissions. Reducing GHG intensity may not reduce other environmental damages of energy supply and use, and may cost more than conventional fossil fuels.
- **Creating *GHG offsets* (i.e. receiving credits for reductions achieved by helping others improve their energy efficiency or GHG intensity).** Offsets have the advantage of letting us sustain services needed for achieving our mission, and reduce GHG and possibly other damages of (others') energy use.

On the other hand, they often cost more than other means of emission reductions. And they carry the liability of letting Harvard appear to be "buying indulgences." (The special challenges and opportunities presented by offset options are further discussed immediately below).

4. Any significant reduction in the net emissions of a growing University will require that Harvard create or acquire GHG offsets.

GHG offsets are a vehicle for an agent (individual, firm, university, or political entity) to apply its own expertise, resources and/or capital to reduce GHG emissions from sources external to the agent. In Harvard's case, the use of GHG offsets would be a means of receiving credit toward our own GHG reduction targets by enabling others to reduce their own emissions. (This could involve installing GHG reduction technology for, taking other direct actions on behalf of, and/or by paying other actors).

Offsets are often discussed as providing a potentially cost-effective means of investing in reducing net GHG reductions. They are generally more expensive than many efficiency improvements, but may be less expensive than some measures to reduce the GHG intensity of our own fuel supply and usage.

Many factors in addition to cost effectiveness need to be considered when making the decision as to where offsets should sit in Harvard's GHG reduction strategy. One is that they provide a means through which Harvard can reduce the impact of human activity on the global climate even when the need to accomplish aspects of our core mission limit the amount or rate of GHG reductions we can in fact accomplish in our own operations. (For example, the limiting factor in reducing the GHG emissions from our dormitories and houses may well not be financial, but rather the rate at which we can schedule major renovations without unacceptable impact on operations).

Offsets can work along side on-site reductions to provide external GHG reductions that generate a variety of positive co-benefits (e.g. assistance to the community or poverty alleviation in the developing world). Finally, the Task Force found strong support for the value presumption that Harvard should lead by reducing its own emissions to a substantial degree before investing heavily in offsets, even if those offsets would be attractive options in purely financial terms.

The current market for offsets (buyers, sellers, regulators, certifiers) is in a high state of flux. While work could begin immediately to develop GHG offset options and strategies for Harvard, the Task Force was impressed by the argument that letting the market mature before making any substantial investments might be advantageous.

When Harvard does enter the offset market, it can do so in two different ways. One way is as an offset generator, seeking certification for offsets of our own making that are produced off-campus. The other is as a purchaser of offsets, i.e. buying offsets that are produced by others. (In addition, Harvard may find this an ideal space in which to collaborate with other academic institutions, forming, for example, an "Ivy registry" upholding a set of standards for the acquisition of offsets).

Participation in the market as an offset generator would require a more sophisticated effort at project development, but Harvard could achieve additional control, enhanced

credibility and more adaptability with respect to how offsets might be used to meet future regulatory requirements. With the likely emergence of regulations governing GHG emissions in the United States, it will be essential to engage in a strategy for GHG offsets that has currency in a wide variety of potential regulatory frameworks.

5. Dramatic reductions of GHG emissions at Harvard could be achieved. Necessary technologies and systems to substantially improve the energy efficiency of the University's buildings, at least for the next 10 years of reductions, are available. If, as recommended below, Harvard pursues a short term goal of reducing its overall GHG emissions by 30 percent by 2016, these technologies and systems could be put in place for capital outlays estimated in the range of *$10 to 20* million each year. Substantial fractions of such outlays would be recovered promptly through reductions in Harvard's growing energy bill, which is now approaching $100 million annually. In addition to this capital outlay, we project that the average annual cost of offsets that would also need to be acquired to meet that goal would be in the range of $2 to $4 million per year. Finally, we estimate that the annual cost to provide the staff support required to implement such reductions would be on the order of $2 million per year.

Harvard has already gained considerable experience with the technologies and systems needed to improve the performance of numerous campus buildings and the carbon intensity of its energy supply. A few examples are indicative of these efforts: The Faculty of Arts and Sciences has prepared a detailed GHG reduction plan with many specific energy efficiency projects identified. Last fall the University adopted a formal program of green building guidelines that requires all new construction and renovation projects to meet new energy efficiency standards. And, University Operations Services has reduced the GHG emissions rate of the Blackstone Steam Plant by 12 % and is now purchasing 5 % of the electricity for the Cambridge and Allston campuses from renewable energy sources.

The technology for increasing energy efficiency in buildings is advancing rapidly, and with the rising cost of fuel it is expected that the market for economically-justified investments will continue to expand.

It has been well-established that many energy efficiency measures provide significant economic benefits as well as contribute to the reduction of GHG emissions. Experience at Harvard with the Green Campus Loan Fund, which has supported more than 130 projects during the past seven years, indicates that well-designed programs for energy efficiency improvements can yield returns exceeding 30 % annually.

This finding is broadly supported by the McKinsey study "Reducing US Greenhouse Gas Emissions: How much at what cost?" in which savings from similar categories of energy efficiency projects far exceed their initial costs.[11]

Harvard's overall energy costs are approaching $100 million annually, and are projected to rise significantly in response to market pressures. Although savings from energy efficiency programs can be substantial and often yield a high rate of return, some physical improvements will require an initial capital investment beyond what the schools

and departments might otherwise spend on routine maintenance and replacement of equipment.

These costs depend on reduction targets and timetables. As an example, consider the costs for Harvard to pursue the short term goal recommended below of reducing its overall GHG emissions by 30 percent by 2016:

- We estimate that *capital costs* for achieving such a goal through energy efficiency and carbon intensity projects related to existing buildings would be on the order of $10-20 million per year. However, consistent with actual experience and the rapidly rising cost of energy, we expect that many of these projects will yield savings that will offset much of this cost.
- In addition, the *cost of GHG offsets* must be considered. Market-based offsets are typically purchased by the unit of GHG to be reduced (typically MTCDE). Current prices for certified offsets meeting the highest standards range from $20 to $60 per MTCDE. We estimate that the costs of offsets required as part of a cost-efficient strategy to achieve such reductions would be in the range of $2 to $4 million per year.
- Finally, we estimate that the annual *cost of staff support* required to implement such reductions would be on the order of $2 million per year.

These are University-wide estimates and no particular assumptions are made as to sources of funding. However, with full acknowledgement of Harvard's decentralized financial and management structure, the Task Force recognizes that it will be important to align responsibilities for costs (and the benefits of savings) with the GHG emissions associated with each school and departmental unit. Development of appropriate financial policies will require the engagement and support of all of the schools.

6. Implementation of strategies for achieving significant GHG reductions benefits from flexible, adaptive approaches and the creation of incentives for innovative thinking at all levels of the organization. Such strategies are facilitated through development of appropriate high-level management structures and committed professional staff.

Rapidly changing context for GHG reductions: Whatever decision Harvard makes regarding reductions in its GHG emissions will take place in a turbulent environment of rapidly changing costs, technologies, regulations and science of the climate problem and GHG reductions. Price increases in energy, and the expectations of a regulated cap on carbon emissions are driving innovations in energy efficiency and in low to zero carbon energy sources. The regulatory arena is developing rapidly if chaotically, with many bills before the US Congress and many options on the table internationally. Scientific research continues to produce new and surprising findings, almost all of which point to an even more serious problem than suspected even a few years ago. GHG reduction strategies that aim to remain relevant, effective and efficient must therefore be flexible and adaptive.

Engagement of innovators throughout the organization: The Task Force was impressed by a variety of evidence and arguments stressing the rewards that can be obtained by

effectively engaging innovative thinking at all levels of the organization in a GHG reduction effort. Providing incentives and rewards for suggestions emerging from the "grassroots" of students, lab managers, operations staff and contractors can be as important as leadership from the top in securing effective and efficient GHG reductions.[12]

Embedded Responsibility: Experience in other organizations, and in relevant operations at Harvard, argues for the importance of embedding GHG reduction strategies (and broader sustainability initiatives) in the core planning and budgeting operations of the University. Given Harvard's decentralized structure, such embedding seems likely to require a strategic management approach that strongly engages individual schools, faculty and operational units. But both the "public good" character of GHG reductions and the necessarily centralized character of some key decisions affecting GHG emissions (e.g. purchase of power from the regional grid) argue for the importance of significant centralized management capability and responsibility as well.

Professional staffing: The Task Force's review of experience in other businesses and universities found that successful implementation of energy efficiency improvements and reduction of environmental impacts is highly correlated with the availability and competency of professional staff. In those areas where such staff support has been available, GHG reduction efforts have typically been much more successful than where the burden is simply added to staff with other duties and insufficient expertise.

RECOMMENDATIONS FOR REDUCING HARVARD'S GHG EMISSIONS

In view of the seriousness of the climate problem, the need for urgent action to address the climate problem, and the other findings noted above, the Task Force recommends that Harvard University:

1. Initiate an aggressive and comprehensive program to reduce its greenhouse gas emissions.

Harvard should adopt an aggressive program for accelerating its existing GHG emission reduction efforts, beginning immediately and committing to a future of continuous improvement at the maximum rate practicable.

Harvard's GHG reduction program should embrace the entire University, including its present operations and future growth.

- It should begin by building on the strong base of understanding already developed regarding our campus buildings and operations (i.e. Scopes 1 & 2).
- Further consideration should be given to how the University might address GHG emissions associated with other activities, including University business travel and employee commuting, our supply chains, and our investments (Scope 3).

Harvard's program for reducing GHG emissions of its present and future operations should utilize opportunities for demand management, efficiency improvements, switching to energy sources with lower (or zero) GHG emissions (i.e. GHG intensity improvements), and the use of high quality GHG offsets as defined below.

The University's implementation strategy should initially emphasize measures that reduce our own emissions, turning to earning offset credits by facilitating the reduction of others' emissions only after the best opportunities for reducing our own emissions have been exploited and the offset market has sorted out some of its present disarray.

2. Establish an adaptive approach to reducing its GHG emissions.

The Task Force has noted the many uncertainties associated with energy costs, emerging technologies, new regulations, and scientific understanding of the climate problem and GHG reductions. It therefore recommends that Harvard adopt an adaptive strategy for its GHG reduction program, periodically reviewing, revising and extending both program ends and program means.

In particular, we recommend that Harvard assess the progress of its GHG reduction program annually. We further recommend that Harvard conduct a more thorough review and revision of the program every four years. (The next such major review would thus be in 2012 and at 4 year intervals thereafter).

- Annual reporting: Annual reporting on Harvard's GHG reduction program will be critical for assessing progress, for continuing to motivate members of the Harvard community to reduce their greenhouse gas emissions, and for rewarding sectors of Harvard that made significant reductions.

  The annual report should include at least the following, both for the University as a whole and for sub-units as appropriate: GHG emissions levels for the current year and previous years as available; major initiatives implemented during the past year (conservation, fuel-switching, renovations/retrofitting, etc.); analysis of successes and challenges; the contributions of students, staff and faculty to the GHG reduction program; and major actions planned for the coming year.

- Quadrennial reviews: Every 4 years, the University should conduct a formal review of its progress in reducing its GHG emissions, revise existing targets and timetables as appropriate, and recommend new targets for 8 years into the future. This review should encompass the contemporary state of climate-relevant science, technology, economics and policy. Additionally, it should evaluate the achievements, shortcomings and lessons of Harvard's efforts to reduce its greenhouse gas emissions. A primary purpose of the quadrennial review should be to recommend a specific GHG reduction goal for 8 years in the future that reflects lessons learned in the previous 4 years as well as new developments at the University and in the science, economics, technology and policies relevant to the problem. In circumstances warranted by unanticipated developments of sufficient magnitude in the climate and GHG arena or in Harvard's own experience with its GHG reduction efforts, each quadrennial review should also be authorized to recommend adjustments upward or downward in the University's most immediate future goal, i.e. the next four years after the date of the review. Our hope and expectation is that successive reviews will seek to carry forward the sense of urgency and excitement developed by the present Task Force.

- Public accountability: The design and execution of both the annual reports and quadrennial reviews should entail a strong commitment to transparency and accountability. The results should be presented at a public event, and made accessible to students, staff, faculty, and the world beyond Harvard.

3. Set formal goals and timetables for emission reductions.

The University should commit itself to both long and immediate goals for emissions reductions. These should be adapted to changing circumstances using the review procedures outlined earlier.

- Long term goal: Harvard should commit to a long term goal of fostering *continuous improvement* in efforts to reduce its net GHG emissions, aiming toward GHG neutrality for Harvard's overall operations at the maximum practicable rate consistent with continued pursuit of the University's core mission and the evolving state of understanding about the climate problem and related sustainability issues.
- Immediate goal: As an initial step in pursuit of its long term goal, Harvard should commit to an immediate goal of reducing its net GHG emissions resulting from existing operations and future growth by *30% relative to its 2006 baseline by 2016*.[13]

This immediate commitment would apply to the University's Scopes 1 and 2 emissions. Further study will be required to understand the extent of other emissions and to produce recommendations on whether and how they should be incorporated into Harvard's evolving program of GHG reductions. Scope 3 emissions, including emissions resulting from business travel and commuting employees, should be more fully characterized and their place within Harvard's overall emission reduction strategy should be evaluated within the coming year. Other emissions over which Harvard does or could exert influence, including those involving our supply chains and investment strategies, should be characterized and their possible place within Harvard's overall emissions reduction strategy should be evaluated within two years.

4. Achieve reductions using a full range of technical and financial options, starting with energy efficiency and reductions in the GHG intensity of fuels.

Harvard should pursue the full range of existing and emerging technical and financial options in order to achieve its goals in the most effective and efficient manner possible.

- Start with our own emissions: Reductions should be achieved to the maximum extent practicable through improvements in our own operations. This means working to improve the efficiency with which we use energy, the GHG intensity of our energy sources, and the management of our demand for energy services.
- Then move on to develop offsets: The remainder of the reductions needed to meet our goal should be achieved through the acquisition or creation of high quality GHG offsets. The quality of those offsets Harvard selects should be certified by independent verification. Harvard should enter the offset market judiciously, in order to establish momentum in its own program of internal GHG

reductions and to allow the current turbulent offset market to stabilize. Harvard should nonetheless begin immediately to develop—on its own or with other partners—internal design, certification, and implementation protocols for high quality offsets. A report on this work should be completed within the coming year. At that point Harvard should initiate exploratory development of several alternatives for offset evaluation, creation, acquisition and management. These explorations should involve, but not necessarily be restricted to, engagement with Harvard's neighboring communities with the goal of creating offsets with substantial local co-benefits.

5. Build capacity to manage and staff Harvard's GHG and sustainability efforts.

The Task Force recognizes that achieving aggressive GHG reduction targets will require an investment in staff capacity and expertise. Given the compressed time for its deliberations, the Task Force is not recommending a specific staffing plan and will leave that to the follow-up work on development of an implementation plan that we recommend later in this report. However, the Task Force does recognize that the University must have a structure for continuing oversight of the University's GHG strategy and that it must be coordinated with other dimensions of sustainability. We recommend, as a starting point for further discussion, a structure illustrated in Figure 1 and described below. Our principal concern is that there be an organizational structure well designed to achieve progress toward the stated reduction goals; we anticipate that there may be modifications to the illustrative structure outlined here.

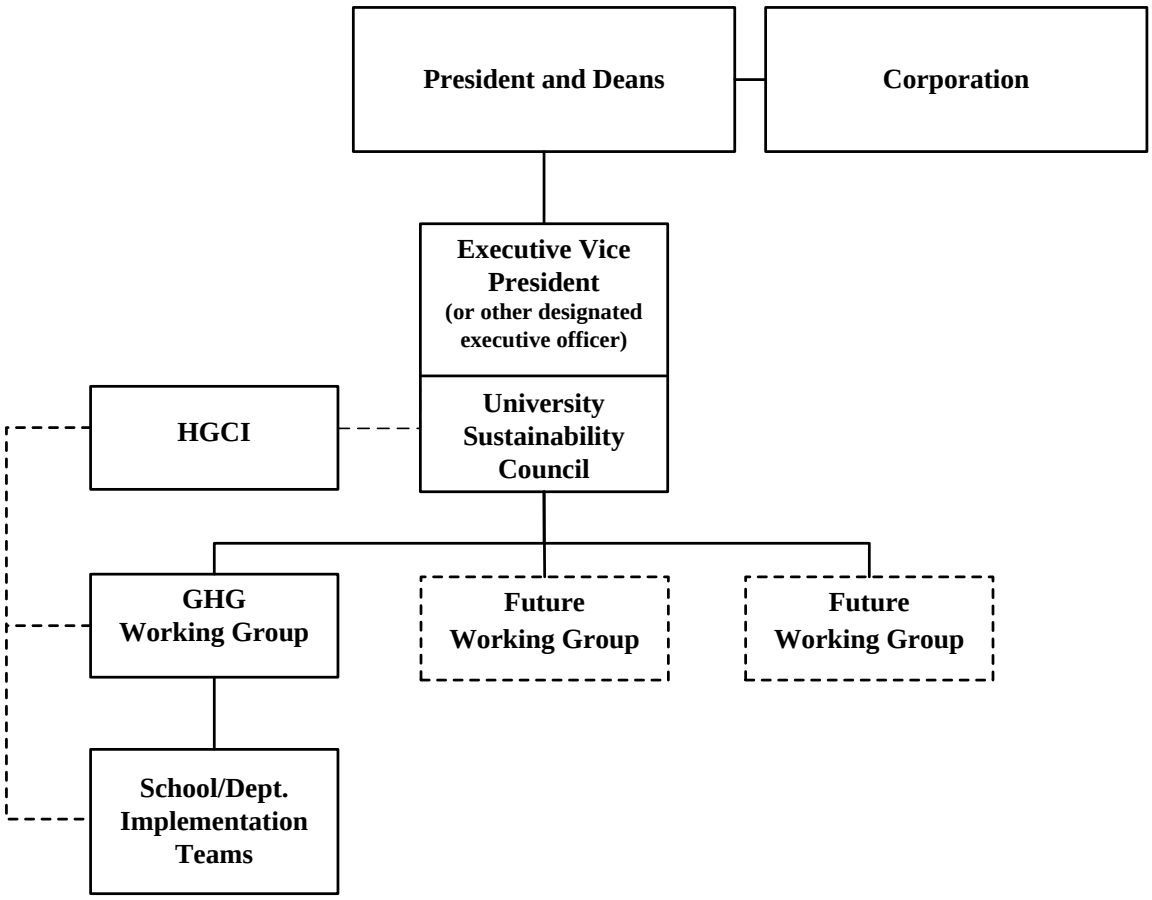
- University Sustainability Council: We recommend the creation of a University Sustainability Council (USC), or similar oversight organization. The USC should be chaired by the Executive Vice President (or other designated executive officer), and be accountable to the President and the Deans. Its primary function should be to promote Harvard's non-academic sustainability efforts, including recommending priorities and proposing and developing campus-wide initiatives and standards. Its membership should be broadly based with representatives from faculty, staff, and students, and potentially with external friends (e.g. alumni) of the University.
- GHG Working Group: For oversight and continuity of the University's GHG reduction effort, we recommend that the USC establish a standing working group charged with developing the necessary steps to implement the University's GHG reduction program. The GHG Working Group should consist of appropriate members of the USC and responsible managers from each of the major operating entities (schools and departments) across the University. The Working Group should be responsible for developing detailed University-wide GHG implementation plans and for monitoring overall progress with targets. It should also recommend additional policy actions to advance the University's carbon reduction efforts. The GHG Working Group should be a consensus oriented body, and implementation of specific projects should continue to be the responsibility of individual schools and departments.

- Harvard Green Campus Initiative (HGCI): The HGCI has contributed much to Harvard's sustainability programs during the past eight years and, through its leadership and services, it has helped the University's schools and departments build overall capacity and awareness. We believe strongly that the HGCI should continue to be a vital resource to the schools and departments in the implementation of the University's GHG reduction program.

  As the University's sustainability efforts continue to evolve, the governance and reporting relationship of the HGCI may need to change to ensure its maximum effectiveness for Harvard. We therefore recommend that, once formed, the USC undertake a review of the roles, responsibilities, and organization of the HGCI and determine its appropriate reporting relationship within the University's administrative structure.

  Pending the outcome of this review, the HGCI should continue in its current role of advocacy and program services for the schools and departments. It should also provide the USC and its working groups with staff support to enable successful implementation of the sustainability priorities of the University.

Figure 1: Organizing Harvard's climate and sustainability initiatives



6. Harvard should establish itself as a leader in efforts to address the challenges of climate change and sustainability by linking its GHG reduction strategy with broader efforts to stimulate relevant research, innovation and teaching.

Harvard's existing activities give it enormous potential to emerge as a leader in efforts to address the challenges of climate change and sustainability more broadly. We recommend that Harvard's GHG reduction program be envisioned and portrayed as an integral part of the University's broader contributions to meeting those challenges. In so doing, we support President Faust's intention as set forth in her charge to us that Harvard "establish further mechanisms that will help us to continue to develop institutional priorities and to determine a broader long-term strategy for sustainability that capitalizes on the University's potential as a contributor in this area and links directly to the curricula at both Harvard College and the graduate and professional schools." In particular:

- Sustainability of Harvard's operations: We recommend immediate action to implement President Faust's intention, as stated in her charge to this Task Force, that Harvard should build on the foundations established by our work to "lay the groundwork for a thorough evaluation of Harvard's strategies for building construction and renovation, water and energy conservation, waste management, transportation, and enhancements of our landscapes and ecosystems."

- Research: Harvard should explicitly link its commitment to reducing its own GHG emissions with a parallel commitment to harnessing its unique research and training capabilities for addressing the climate problem and related sustainability issues. In particular, within the next year, Harvard should commit to at least one major University-wide initiative that will significantly strengthen our capacity to conduct problem-driven research and training on climate change and related sustainability issues. Long term funding of such a program should be a high priority of the forthcoming Harvard campaign.

  Many such initiatives would be possible, given Harvard's foundational strengths in relevant areas. One example of the kind of effort we have in mind that has already been widely discussed across various faculties and schools is the draft "A Harvard Initiative on Energy and its Consequences." This has been designed under the leadership of the Harvard University Center for the Environment to allow Harvard to **"**lead the world in solving this challenge through coordinated programs of research and education that span the University."[14]

- Innovation, on campus and beyond: The program on GHG reductions recommended by the Task Force provides numerous opportunities for Harvard to foster innovation in ways to tackle the challenges of climate change and sustainability more broadly. In implementing its GHG reduction strategy, Harvard should take every opportunity to realize those opportunities, both for the contributions such innovations will make to the problem at hand and for the opportunities that they will provide for training and learning across the University.

  Many particular examples that could be considered in the activities following up on our recommendations were discussed by the Task Force, and are documented in back-up materials assembled by the co-chairs. Some of these focused on

incentives and rewards for stimulating "innovation from below" by Harvard's students, faculty, and staff. Others addressed opportunities to experiment with innovative energy efficiency measures and renewable energy technologies for achieving on-campus reductions. Still others explored the prospects for developing "Crimson Green Partnerships" with others outside the University to explore means for facilitating reductions.

Many on the Task Force stressed the multiple advantages that could come from a public and long term commitment with Harvard's neighboring communities in these innovation efforts. Such local involvement might include competition for the most innovative offset proposals and for new ways of supplying high-efficiency, low-GHG solutions to the University's purchasing, renovation and construction needs.

- Teaching and training: Harvard should enhance the capacity of its teaching programs to prepare students, alumnae and the broader community for the complex, interdisciplinary, and problem (rather than discipline) defined challenges represented by climate change and sustainability more broadly.

IMPLEMENTATION

1. Develop a Specific GHG Implementation Plan:

The relatively short period of time available to the GHG Task Force necessarily requires many details to be further refined and developed in the form of a more detailed implementation plan. In order to ensure that the momentum of the Task Force be continued, we recommend that work on such a plan be initiated as quickly as possible, with the expectation that a more definitive implementation framework be available by the fall of 2008. Key elements of this plan should include:

- Establishing the organizational capacity to implement the recommendations, including the proposed University Sustainability Council, reviewing the role of the Harvard Green Campus Initiative and other staff groups, and identifying specific additional staff requirements.
- Developing the necessary financial resources and accounting structures.
- Launching a major and continuing campaign to educate students, employees and alumnae about the importance of the GHG reduction program and their possible contributions to it. Students, faculty and staff should receive regular reminders throughout the year on progress towards achieving Harvard's GHG reduction goals. Other forms of outreach should also be developed.
- Planning a University-wide Celebration of Sustainability: GHG reductions programs and broader sustainability initiatives must be central to student, staff and faculty life at Harvard. The Task Force recommends establishing an annual celebration of sustainability at Harvard, to be held each fall for members of Harvard's community.

2. Organize the University Sustainability Council and GHG Working Group:

The Task Force recognizes that this effort to date has created a level of momentum that should be leveraged. We recommend that the University Sustainability Council and GHG Working Group or their functional equivalents be organized under an interim structure to ensure ongoing support and engagement with the schools and departments, and to assist with the implementation of the GHG Implementation Plan.

ENDNOTES

[1] "The Imperative for Action – Climate Neutrality and Harvard's Future", a report of the Harvard Environmental Action Committee.
[2] "Greenhouse Gas Reduction Project – Draft Strategic Plan", Faculty of Arts and Sciences.
[3] Source is Intergovernmental Panel on Climate Change, 2007, "Climate change 2007: Summary for Policymakers," http://www.ipcc.ch/ <accessed 5 March, 2008>, and interpretations of more recent scientific literature by members of the Task Force.
[4] See, for example, Frumhoff, P.C., J.J. McCarthy, J.M. Melillo, S.C. Moser, D.J. Wuebbles, 2007. *Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions.* Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA. Union of Concerned Scientists (UCS). (146 pp). The forthcoming summary is Hassol, S.J., T.R.Karl, J.M. Melillo, T.C. Peterson, in prep. I*mpacts of Global Warming on the United States*. United Synthesis Product, U.S. Climate Change Science Program and Subcommittee on Global Change Research (due for release late in 2008).
[5] Pew Center on Global Climate Change, "A look at emissions targets," http://www.pewclimate.org/what_s_being_done/targets <accessed May 28, 2008>; Andrew Hoffman. 2007. "Carbon strategies: How leading companies are reducing their climate change footprint." Ann Arbor, Univ. of Michigan Press; additional updates provided by Task Force members.
[6] The American College and University Presidents' Climate Commitment is described on its web site, http://www.presidentsclimatecommitment.org/index.php <accessed May 18, 2008>. The idea of carbon or climate "neutrality" is variously defined. EPA describes setting a carbon neutral goal for corporations as follows: "EPA allows goals to be expressed as a commitment to be 'carbon neutral' at the corporate level, which is a commitment to achieve and maintain net zero GHG emissions in a company's operations (rather than, e.g., products or events). Credible carbon neutral goals should include the following components: … a robust GHG inventory and inventory management plan…; internal GHG reductions…; purchase [of] green power, renewable energy certificates (RECs), and/or offsets." http://www.epa.gov/climateleaders/resources/goal-setting.html <accessed May 29, 2008>.
[7] The specific reductions announced by colleges and universities can only be taken as approximate because of inconsistencies in what emissions are counted and uncertainties in the actual emissions on the base (usually 1990) date. The Task Force computed approximate conversions of announced reductions to a common 2006 baseline. We found that most institutions are discussing reductions of 30-40% below their 2006 rates by 2020, or 20-30% below their 2006 rates by 2016.
[8] Intergovernmental Panel on Climate Change, 2007, "Climate change 2007: Summary for Policymakers," http://www.ipcc.ch/ <accessed 5 March, 2008>; Scientific Expert Group on Climate Change (SEG), 2007. "Confronting climate change: Avoiding the unmanageable and managing the unavoidable." United Nations Foundation and Sigma Xi.; Nicholas Stern. 2007. "The economics of climate change: The Stern Review," Cambridge Univ. Press.
[9] The Harvard Greenhouse Gas Inventory is described on, and its results are available through, the web site of the Harvard Green Campus Initiative (HGCI): http://www.greencampus.harvard.edu/ggi/. The Inventory now uses the World Resource Institute's *Greenhouse Gas Protocol* and the Climate Registry's *General Reporting Protocol*. During the past several years there has been an explicit effort to standardize these calculations so that they may be compared with others and rolled up within local, regional and national GHG measurements.

[10] 'Scope 1" or direct emissions include those from Harvard's central steam plant (Blackstone), Building-sized boilers and other combustion sources, fugitive emissions of refrigerants, and the Harvard vehicle fleet. "Scope 2" or "Indirect emissions" include those from the production of purchased electricity, steam and chilled water. "Scope 3" or "Other emissions" emissions of methane from the decomposition of solid waste produced by the University, emissions resulting from student and staff commuting, and emissions resulting from business-related air travel.

[11] McKinsey and Company, 2007.Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost", Exhibit B, http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp <accessed March 3, 2008>

[12] Hoffman. 2007. "Carbon strategies: How leading companies are reducing their climate change footprint." Ann Arbor, Univ. of Michigan Press; US Environmental Protection Administration, "Climate Leaders" http://www.epa.gov/climateleaders/index.html <accessed May 27, 2008>.

[13] Baseline numbers are from HGCI Inventory (op. cit.), summarized in Table 1 of this report.

[14] Fall 2007 memo by HUCE Director Professor Dan Schrag on "The Future of Energy:
A Harvard Initiative on Energy and its Consequences." This proposed initiative has been discussed by HUSEC (Harvard University Science and Engineering Committee) and a number of deans and has a broad existing base of faculty support. It proposes programs that would allow Harvard to: i) Produce cutting edge research contributions that help the University, the nation, and the world respond to future energy needs in a manner that is sensitive to environmental issues; ii) Educate future leaders about the future of energy based on current knowledge from science, engineering, policy, business, law, health, design, and other disciplines; and iii) Provide a center of knowledge that attracts academic, business, and governmental leaders from around the world to exchange ideas about the world's energy future.

APPENDIX A: *Harvard's Task Force on Greenhouse Gas Emissions*

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