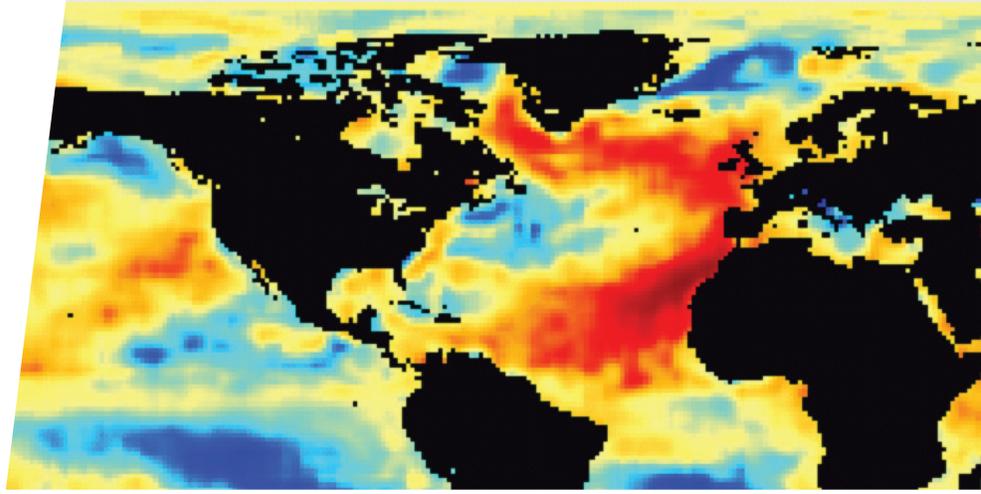




CLARK
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THE CLARK UNIVERSITY

climate action plan

APPROVED BY THE CLARK
UNIVERSITY BOARD OF TRUSTEES

OCTOBER 24, 2009



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Executive Summary

In June 2007 President John Bassett signed the American College and University Presidents Climate Commitment. Through this action Clark University became a charter signatory to a national initiative aimed at mobilizing the resources of colleges and universities in efforts to reduce greenhouse gas emissions. Clark University's Climate Action Plan sets two goals with respect to climate neutrality. First, we adopt an interim goal of reducing emissions by 20% below 2005 levels by 2015. Second, we set a target date of 2030 for achieving climate neutrality (net zero greenhouse gas emissions).

Our Climate Action Plan is based on an inventory of Clark University's greenhouse gas emissions in 2005. The greenhouse gases we track and inventory are the six gases covered under the Kyoto Protocol: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). The inventory covers the main campus and satellite buildings located in Worcester, Massachusetts. The inventory encompasses emissions classified as scope 1, scope 2 and, scope 3 by the American College and University Presidents Climate Commitment. Scope 1 includes direct emissions from the boilers, the cogeneration plant, campus vehicles, and fugitive emissions from refrigerants in air conditioning equipment. Scope 2 includes indirect emissions from purchased electricity. Scope 3 includes indirect emissions from commuting, air travel, and solid waste.

Emissions are expressed in terms of Metric Tons of Carbon Dioxide Equivalent (MTCO₂e), a unit that normalizes the various global warming potentials of the six greenhouse gases tracked. In 2005 our inventory indicates greenhouse gas emissions for Clark University totaling 20,442 MTCO₂e. The largest sources of emissions are those associated with the operation of our main boilers and our co-generation plant, along with purchased electricity, and emissions from air travel and commuting.

Our Climate Action Plan is organized in two phases. The first phase (2010-2015) is directed toward achieving our interim 2015 emissions target and the second comprises longer term strategies to achieve climate neutrality by the target date of 2030. The mitigation strategies outlined in the Climate



EXECUTIVE SUMMARY (CONTINUED)

Action Plan for the period 2010-2015 include a primary focus on renovations to the central heating and cooling plants as they are the largest contributors to our emissions profile. The plan also focuses on the heating and cooling distribution systems, lighting retrofits, fully utilizing the existing chiller plant, and various policy and conservation initiatives. Clark has partnered with a consulting firm to perform an investment grade audit focusing on the central heating plant, distribution of hot water, decentralization of heating loads from the central heating plant, and fuel switching from #6 oil to natural gas for heating purposes. The combined effect of these three projects – the central plant renovation, distribution system replacement, and fuel switching to natural gas – will result in a reduction in greenhouse gas emissions of just over 3,439 MTCO_{2e}.

The second phase of our Climate Action Plan over the period 2016-2030 continues to include a heavy focus on energy systems and energy efficiency as the largest components of our emissions profile. While we specify specific carbon reduction strategies in this section of the plan, we are committed to a continuing and on-going review of energy options that reflects the anticipated further development of renewable technologies. To further reduce our emissions we propose to switch our fuel source for boilers from natural gas to B100 bio-diesel. If implemented in 2016, the switch to bio-diesel would result in an estimated reduction of 3,177 MTCO_{2e}. On or around 2016, we would also commit to source all remaining electricity (that not generated from our cogeneration plant) from renewable sources. In addition, our Climate Action Plan anticipates replacing the co-generation plant with a renewable fuel source on or around 2025. This replacement would result in a reduction in emissions of 7,403 MTCO_{2e} if implement in 2025. Our plan is to remain flexible as to the precise fuel system technology we would adopt at that time. The possibilities range from advanced, combined cycle co-generation, solar, fuel cells, and other renewable energy technologies.

With the implementation of these and many other mitigation strategies, we project that by 2030 Clark University's greenhouse gas emissions will have been reduced to 5,899 MTCO_{2e}. The remaining emissions are primarily those from air travel and commuting. Our plan is to address the remaining emissions through the purchase of carbon offsets. Clark University would have two options for securing offsets. One approach would be for the university to invest directly in projects that generate offset credits. The second option would be to purchase offsets from providers and third party markets. Currently carbon offsets can be purchased for prices that range from around \$10 a metric ton CO₂ equivalent to \$20 per metric ton (prices are also quoted that are much lower and much higher than this range – but with uncertainty as to the 'quality' of the offsets). For the purposes of this plan we adopt a price range for purchased offsets of \$10-\$30 per metric ton. Using these values on total remaining emissions of 5,899 MTCO_{2e}, the cost of purchasing offsets to bring Clark University to climate neutrality in 2030 would be between \$58,990 and \$176,970 annually.



EXECUTIVE SUMMARY (CONTINUED)

The majority of mitigation initiatives discussed here result in annual operating savings (with the critical budget question being the capital investment required to achieve these operating savings). Some mitigation strategies, such as turning off lights and equipment when not in use, are almost pure savings for the institution. Other initiatives, such as many energy efficiency projects, have relatively short payback periods (the savings offset the costs quite quickly). Our climate action plan also includes projects where the payback period is very long. Depending on the price of fuel and other variables, there are a limited number of mitigation initiatives that may result in higher annual operating costs. The initiatives that potentially fall in this category are (i) fuel switching (where the net cost inherently depends on the relative price of oil, gas, bio-fuels and other fuel sources), (ii) purchase of electricity from renewable sources (for example if the cost of purchased electricity from renewable sources is higher than the cost of electricity produced through on-campus co-generation), and (iii) purchase of carbon offsets. Going forward the University may wish to establish a policy to guide decision making on this category of projects.

The major capital costs incurred in this plan relate to investments in energy systems. We estimate the capital costs of the major energy projects proposed for the period 2010-2015 to be \$6.7 million. Given the difficult economic circumstances in which the University is currently operating, we propose holding back implementation of the 2010-2015 capital projects until 2013-2015 when we anticipate circumstances will have improved. We believe that over the medium term (2-5 years) equity financing is likely to be a more viable option than debt financing for these projects. This will necessitate accrual of equity capital over the next several years as part of the overall approved annual budgets for the university. Our financing plan includes continued participation in utility and other provider incentive programs (such as National Grid) and pursuit of Federal and State opportunities for grants and other financing (as occurred, for example, when the co-generation plant was installed at Clark University).

We also intend to promote the Climate Action Plan as a key element of the University's next Capital Campaign. We believe these sustainability initiatives will be of considerable interest to Clark University alumni and friends. The Climate Action Plan provides opportunities for capital gifts, along with the possibility of establishing designated annual giving in support of the Plan. Over the longer term, it is important to recognize that the Climate Action Plan, through footprint management, anticipates some slowing in the rate of growth of campus square footage. Sources of capital that would have been required for these building projects may be re-directed toward financing of climate action initiatives in the period 2016-2030 (such as replacement of the co-generation plant).

Successful implementation of this plan will bring Clark University to the goal of net zero emissions by the year 2030.



1

Introduction

“We believe colleges and universities must exercise leadership in their communities and throughout society by modeling ways to minimize global warming emissions, and by providing the knowledge and the educated graduates to achieve climate neutrality. Campuses that address the climate challenge by reducing global warming emissions and by integrating sustainability into their curriculum will better serve their students and meet their social mandate to help create a thriving, ethical and civil society.” <http://www.presidentsclimatecommitment.org/>

In June 2007 President John Bassett signed the American College and University Presidents Climate Commitment. Through this action Clark University became a charter signatory to a national initiative aimed at mobilizing the resources of colleges and universities in efforts to reduce greenhouse gas emissions. The core goal of the commitment is to find ways for colleges and universities to achieve climate neutrality or net zero greenhouse gas emissions. This document constitutes Clark University’s Climate Action Plan for achieving net zero greenhouse gas emissions by a target date of 2030.



Our intent is to pursue climate neutrality in ways that build on and enhance Clark's strengths and differentiating features as a research university. That is, we will internalize the Presidents Climate Commitment within our overall academic and financial planning, and pursue the commitment in ways that promote distinctive areas of excellence within the university. Specifically, our efforts to achieve climate neutrality will be guided by the following principles:

- We will where possible connect this initiative to efforts to strengthen Clark University's use-inspired research and graduate profile in areas of energy and the environment;
- We will seek to maximize the multiple opportunities for student engagement, research, and leadership development created by the Presidents Climate Commitment within the proposed Clark University curriculum framework of Liberal Education and Effective Practice as well as within our graduate programs;
- We will integrate our climate neutrality strategy with visibility and fundraising plans for the University. Clark University's efforts to achieve climate neutrality can be a source of pride for all connected with the university, and provide further proof of concept for our institutional identity as a research university committed to making a difference in the communities locally and globally of which we are a part;
- Clark University has a conscious intention to actively take environmental issues into consideration in its investment strategy.
- Our climate neutrality strategy will be fiscally sound in that we will (i) move first on implementation strategies that both reduce greenhouse emissions and operating costs of the university (over some reasonable period of return); (ii) seek to leverage grants, supplier incentives and other economic opportunities to lower mitigation costs; (iii) maintain flexibility in our planning in response to new technological and market opportunities and cost structures; and (iv) seek innovative and enduring changes in university operations that are a source of greenhouse gas emissions.

A first step in developing Clark's Climate Action Plan occurred within two months of signing the President's Climate Commitment in 2007 when Clark University committed to a series of near term 'tangible actions' that we would undertake while preparing our overall climate action plan. The following tangible actions were adopted in 2007:

- A green building plan that sets sustainability guidelines for new construction and major renovations on campus;
- An Energy Star policy for campus purchases;
- A shareholder responsibility policy for investments;
- A commitment to waste minimization.

<http://www.clarku.edu/offices/campusSustainability/policy/index.cfm>



1.0

INTRODUCTION (CONTINUED)

We have also undertaken a variety of other recent mitigation initiatives that have already reduced significantly our emissions below our 2005 baseline. An illustrative set of mitigation initiatives undertaken between 2005 and 2009 is shown in Table 1.

TABLE 1: SAMPLE MITIGATION INITIATIVES 2005-2009

Green Building Design	Lasry Bioscience Center and Blackstone Hall LEED certified.
Energy Conservation	Goddard Library HVAC replacement and upgrade. Window replacement and airlock doorways in multiple locations, including Jeppson Labs and the Geography building.
Lighting	New energy efficiency lighting installed in Higgins University Center, Kneller Athletic Center, and multiple classroom and office locations. Occupancy sensors installed (various locations).
Energy supply	New energy efficient boilers installed in multiple locations, steam supply upgrades, and new waste heat boiler for co-generation plant.
Food service	Energy efficient dishwashing combined with composting, tray-less dining, and local purchasing.
Residence Halls	Energy and water saving laundry facilities installed.
Transportation	Student bike share program launched.
Information Technology	Energy star purchasing of computers, server consolidation, energy management settings.

The remainder of this document details Clark University’s Climate Action Plan for achieving net zero greenhouse gas emissions by a target date of 2030. Section 2 describes the methods used to develop a greenhouse gas emissions inventory for our 2005 baseline and subsequent years. Section 3 describes specific mitigation strategies available to the university, and Section 4 explains how Clark plans to apply these strategies during two time periods: 2010-2015 and 2016-3030. Subsequent sections of this Climate Action Plan review potential barriers, risks and benefits of our mitigation strategy, financing models, education, research and outreach efforts, and the organizational structure we will use to implement this plan and track and report progress toward our goals.



2 Clark's Carbon Footprint: The Campus Emissions Inventory

This section describes the methods used to calculate the greenhouse gas inventory on which our Climate Action Plan is based.

The greenhouse gases we track and inventory are the six gases covered under the Kyoto Protocol: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆).

The greenhouse gas inventory covers emissions from the main campus located in Worcester, Massachusetts, but does not include minimal emissions associated with the Graduate School of Management satellite facility located in Framingham, Massachusetts. The inventory encompasses emissions classified as scope 1, scope 2 and, scope 3 in the manner prescribed by the American College and University Presidents Climate Commitment. Scope 1 includes direct emissions from the boilers, cogeneration engine, university vehicles, and fugitive emissions from refrigerants in air conditioning equipment. Scope 2 includes indirect emissions from purchased electricity. Scope 3 includes indirect emissions from commuting, air travel, and solid waste. Relevant usage data (e.g. kilowatt hours of electricity consumed, or vehicle miles traveled) were entered into Clean Air – Cool Planet's Campus Carbon Calculator. The calculator converts usage data into Metric Tons of Carbon Dioxide Equivalent (MTCO_{2e}), a unit that normalizes the various global warming potentials of the six greenhouse gases tracked. Emissions are calculated on a calendar-year basis.

The baseline year for our emissions inventory is 2005. Clark's emissions for that year are estimated at 20,442 MTCO_{2e}. The largest source of emissions is the operation of the main campus boilers which provide heat and hot water to much of the campus. Operation of the boilers in 2005 resulted in emissions estimated at 8,621 MTCO_{2e}, or 42% of total emissions. Other large emission sources in 2005 include electricity purchased off the grid (4,415 MTCO_{2e}), and emissions from our co-generation plant (3,042 MTCO_{2e}), air travel (2,011 MTCO_{2e}) and commuting (1,872 MTCO_{2e}).



2.0 **FIGURE 1: CAMPUS EMISSIONS 2005 - 2008**

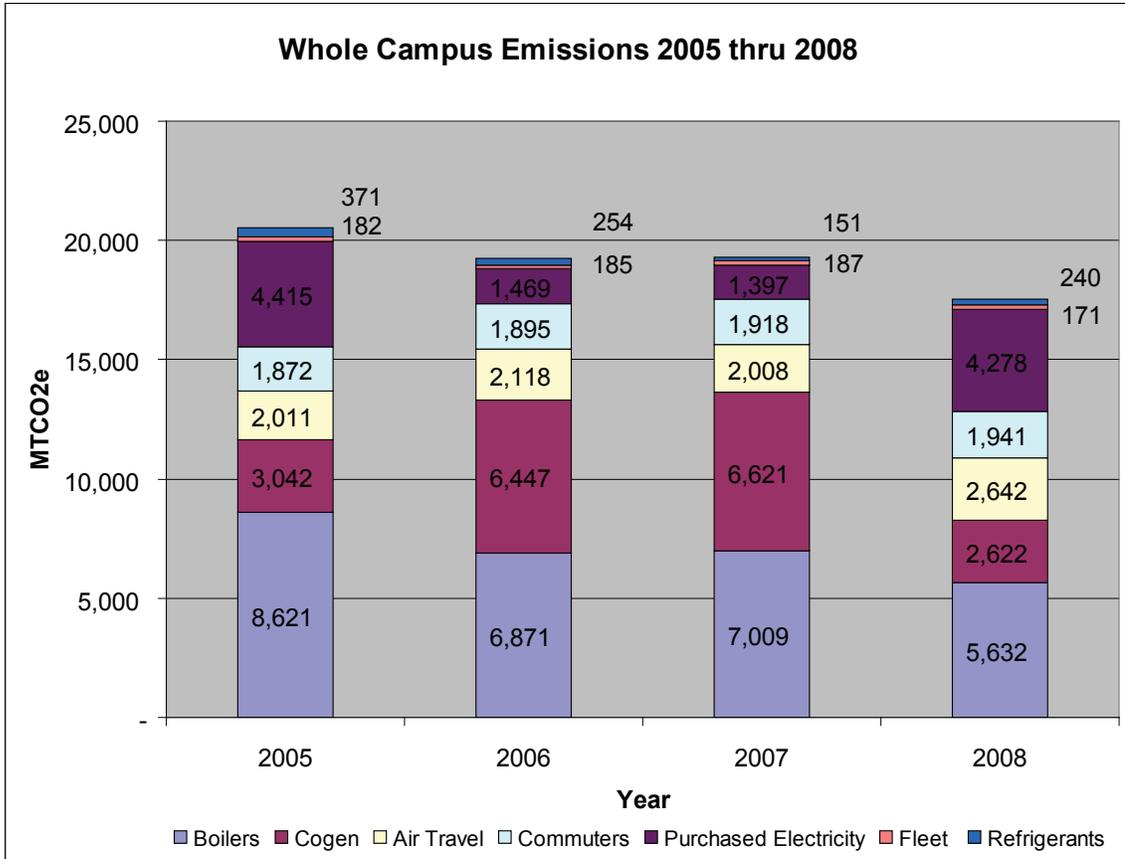


TABLE 2: CAMPUS EMISSIONS INVENTORY 2005-2008

	2005	2006	2007	2008
	MTCO2e	MTCO2e	MTCO2e	MTCO2e
Boilers	8,621	6,871	7,009	5,632
Cogen	3,042	6,447	6,621	2,622
Air Travel	2,011	2,118	2,008	2,642
Commuters	1,872	1,895	1,918	1,941
Purchased Electricity	4,415	1,469	1,397	4,278
Fleet	182	185	187	171
Refrigerants	371	254	151	240
Solid waste	(60)	(55)	(57)	(49)
Total	20,455	19,184	19,233	17,477
Compost	(13)	(13)	(13)	(13)
Net emissions	20,442	19,170	19,219	17,464



As presented in Figure 1 and Table 2 above, net emissions have decreased by nearly 3,000 MTCO₂e between 2005 and 2008 – a 15% reduction. During the same period, the square footage of building space increased by 2%. The emissions profile of the campus is best understood in the context of growth by considering emissions intensity, expressed through the unit of MTCO₂e per 1,000 square feet. Between 2005 and 2008, Clark's emissions intensity was reduced by 16%, from 12.4 MTCO₂e per 1,000 sq ft to 10.4 MTCO₂e per 1,000 sq ft. The primary drivers behind the downward trend in both net emissions and emissions intensity include an increase in the use of natural gas in the boilers (replacing fuel oil), and the combined effect of energy conservation and efficiency projects.

These data also indicate significant year-to-year fluctuations in the contribution of the co-generation plant and purchased electricity to our emissions totals. The contribution of each of these sources of emissions varied depending on the extent to which the co-generation plant was used to generate electricity for campus operations. In 2005 and 2008 the cost of purchasing electricity off the grid was on average lower than the cost of operating the co-generation plant (and thus more of our emissions in those years come from purchased electricity).



3 Mitigation Strategies Ways to Reduce Emissions

This section describes the primary mitigation strategies available to the university. The significance of individual mitigation strategies derives from our current emission profile. As described in section 2, the largest sources of emissions for Clark University are those associated with energy supply, electricity consumption, air travel, and commuting.

3.1 BUILDING & ENERGY SYSTEMS

Clark University has partnered with a consulting firm to perform an investment grade audit of our lighting, heating and cooling systems. The audit will identify which energy related projects will be most effective in reducing energy use and associated greenhouse gas emissions. It is expected that the investment grade audit will reveal:

- The high pressure steam boilers in the central heating plant will be eliminated in favor of high efficiency – hot water producing boilers.
- The central plant will no longer burn #6 oil, and will migrate to natural gas and #2 oil with the ability to be retrofitted to a bio-fuel when it becomes practical.
- Central heating distribution will be changed from steam to hot water.
- Decentralization of distant buildings from the central heating plant will eliminate underground line loss and lead to greater efficiency using natural gas fueled condensing boilers located in the buildings.
- The central chiller plant is capable of adding additional loads and replacing inefficient rooftop cooling units.

Climate neutrality likely will require that Clark University shift to renewable sources of fuel for heating and cooling systems and for the generation of electricity used on campus. Currently our main boilers use fuel oil and natural gas and our co-generation plant is primarily run on natural gas. Electricity used on campus is sourced from a combination of the co-generation plant and purchased electricity, depending on which is the most economical way to deliver a kilowatt. Over time we expect a wider range of renewable sources of energy supply to become available as technology options mature and costs become more competitive with current oil and gas options. One mid-term possibility is the use of bio-diesel in our main boilers. Another is the purchase of electricity generated from renewable sources. Other options include



fuel cells, photo-voltaics, solar power, small scale wind power, and co-generation based on bio-fuels. Our plan anticipates that feasible technology options will shift over the next two decades and for this reason we need to retain flexibility in our technology choices to accommodate developments in technology and cost structures.

3.2 FOOTPRINT MANAGEMENT – SLOWING EMISSIONS GROWTH

Footprint management seeks to reduce greenhouse gas emissions by slowing the growth in emissions below the historic ‘business as usual’ growth rate. At Clark and most other colleges and universities rising enrollment, the addition of new buildings and the expansion of campus services leads to growth in emissions. If we are able to become more efficient in how we deliver on our education and research mission, we can slow the growth in emissions without directly constraining growth in numbers of students, research revenues, or other scale parameters of the institution. We can do this by becoming more efficient in our use of space and other resources and by designing new and renovated buildings in ways that improve resource efficiency.

Our business as usual scenario indicates an annual growth rate of emissions of 1.2%. This scenario employs the gross square footage of campus buildings as the metric on which the business as usual rate of growth is calculated. 1.2% is the actual historic annual rate of growth of campus square footage. Our gross square footage increased from 1,376,697 in 1992-93 to 1,685,580 in 2009-10 (an increase of 308,883 gross square feet). Recent additions to University buildings include the Lasry Bioscience building (49,686 gross square foot), the Traina Center (32,703), the Dolan Field House (31,500), and Blackstone Hall (73,342).

Building square footage is an effective, albeit imperfect, metric through which to project business as usual growth in emissions. This is especially the case if we schematically assign to buildings associated use-emissions, such as emissions to light, heat and cool the building, as well as the use of technology in the building. As our student enrollment grows, or the breadth and depth of academic and co-curricular program increases, this historically has been associated with increases in our building square footage.

3.3 INFORMATION TECHNOLOGY AND EQUIPMENT PURCHASING

Clark currently has a policy in place for purchasing energy efficient Energy Star appliances. Appliances in use include the full range of office equipment (copiers, printers, computers, projectors, etc.), as well as vending machines, and equipment used in our food services and in our residence halls (e.g. refrigerators, washers and dryers). This policy was established in 2007 and will have continued incremental impact on our emissions as new equipment is purchased on replacement cycles, as the energy efficiency performance of equipment improves, and as Energy Star ratings are extended to other types of appliances and equipment.

The use of computers and other office equipment is a major consumer of electricity on the Clark



University campus and for this reason is an important focus of mitigation initiatives. 'Plug loads' are estimated to be responsible for 15-20% of electricity consumption in a typical office environment. Mitigation efforts connected to the purchase and use of information technology include the following:

Power Management

- Migrate Windows systems to Windows Vista so that we can make use of advanced power management capabilities such as "Wake-on-LAN" for software updates, antivirus scans, and remote desktop access - particularly those in the public sites and departmental labs. This would allow a shift in our current practice of leaving computers on over night. As we move towards network management of Macintosh systems, ensure that the Wake-on-LAN settings are enabled on those machines as well.
- Investigate computer monitoring and/or client-based power management systems like HP OpenView, Microsoft SMS, LANDesk, or Verdiem which could let us accomplish the same things that Windows Vista promises, but might allow us to get there faster (i.e., Windows Vista migration will occur over time as newer machines are deployed and is limited to Windows machines).
- Better educate the Clark Community to enable power management features on their PCs and Macs and to turn off their monitors when they are not in use.

Equipment Purchasing

- Continue to use cycles/watt and other energy criterion in the selection of IT hardware and related equipment.
- Train ITS staff in "green computing" best practices, ENERGY STAR and EPEAT (Electronic Product Environmental Assessment) ratings, so that they will be better positioned to answer questions about and make use of environmental friendly computers and peripherals.
- Investigate participation in the Google/Intel Climate Savers Initiative.

Server / Data Center

- Expand the virtual server environment for consolidation of departmental servers.

Other Initiatives

- Expand our use of conferencing tools for routine meetings, prospective employee searches, etc.



3.4 AIR TRAVEL & COMMUTING

Our inventory includes emissions associated with air travel by university employees, as well as commuting to Clark by faculty, staff, and students. Staff travel in admissions and fundraising, as well as faculty travel to conferences and field sites, comprise the bulk of air travel for Clark University. Increased use of video-conferencing, teleconferencing and other technologies may allow some reduction in air travel. For many university activities, such as faculty attendance at large professional conferences, there is no practical substitute for faculty and staff air travel. For other activities, such as small group meetings, there may be technology solutions that allow us to reduce travel and associated emissions.

Most faculty and staff at Clark University commute to work by car. Given the current availability of public transportation in the greater Worcester area and projections for the next five years, we do not anticipate a major increase in the use of public transportation for commuting in the near and medium term. As commuter rail services improve between Worcester and Boston, we may see some greater use of these services on the part of faculty and staff living near Boston. There may also be opportunities to promote more ridesharing. For those who commute by car, improvements in vehicle fuel efficiency will result in some reductions in emissions. To promote use of fuel efficient vehicles, Clark will explore the feasibility of offering free parking for commuters who drive hybrid vehicles.

3.5 OTHER POLICY AND BEHAVIORAL INITIATIVES

In addition to technological change, Clark University is committed to promoting social change toward sustainability by fostering a community that is aware of the impact of behavior on campus energy consumption. Clark will continue to promote community energy awareness initiatives in various forms, and will enhance and more thoroughly integrate energy awareness and energy conservation in campus initiatives both within and outside the classroom. The recently developed 'Eco-Rep' program in the residence halls carried out in conjunction with the Office of Residential Life and Housing is one example of a new initiative in this area. With this program, the university pays a stipend to a set of undergraduate students to promote energy conservation in the residence halls through energy awareness programs and competitions. Other initiatives can focus on energy and resource conservation by staff and faculty.

The University will investigate the possibility of developing one or more technology demonstration projects that will make our commitment to greenhouse gas reduction very visible on our campus. Such demonstration projects may be a powerful catalyst for promoting cultural and behavioral change.

The university may also investigate the impact of a range of other policy and behavioral initiatives. One example is the possibility of telecommuting for some job functions, as well as longer term, alternative work schedules such as four (longer) day work weeks for staff. A variety of other policies are likely to be of importance, ranging from how classrooms and other facilities are scheduled and used during semester breaks, to policies on printing and other activities.

We will also look to coordinate our climate action plan with initiatives underway within the City of Worcester and the Commonwealth of Massachusetts. The City of Worcester has a Climate Action Plan and there numerous initiatives underway in our community that provide opportunities for synergy and collaboration.



4 Emissions Reduction Plan: How will Clark Reduce Emissions?

In this section of the plan we address the timing and projected impact on emissions of the mitigation initiatives we will undertake.

Our plan is structured over two time periods, namely, 2010-2015 and 2016-2030. The interim goal is to reduce greenhouse gas emissions by 20% below 2005 levels by 2015. Our long term goal is to achieve net zero emissions by 2030.

4.1 **BASELINE INFORMATION**

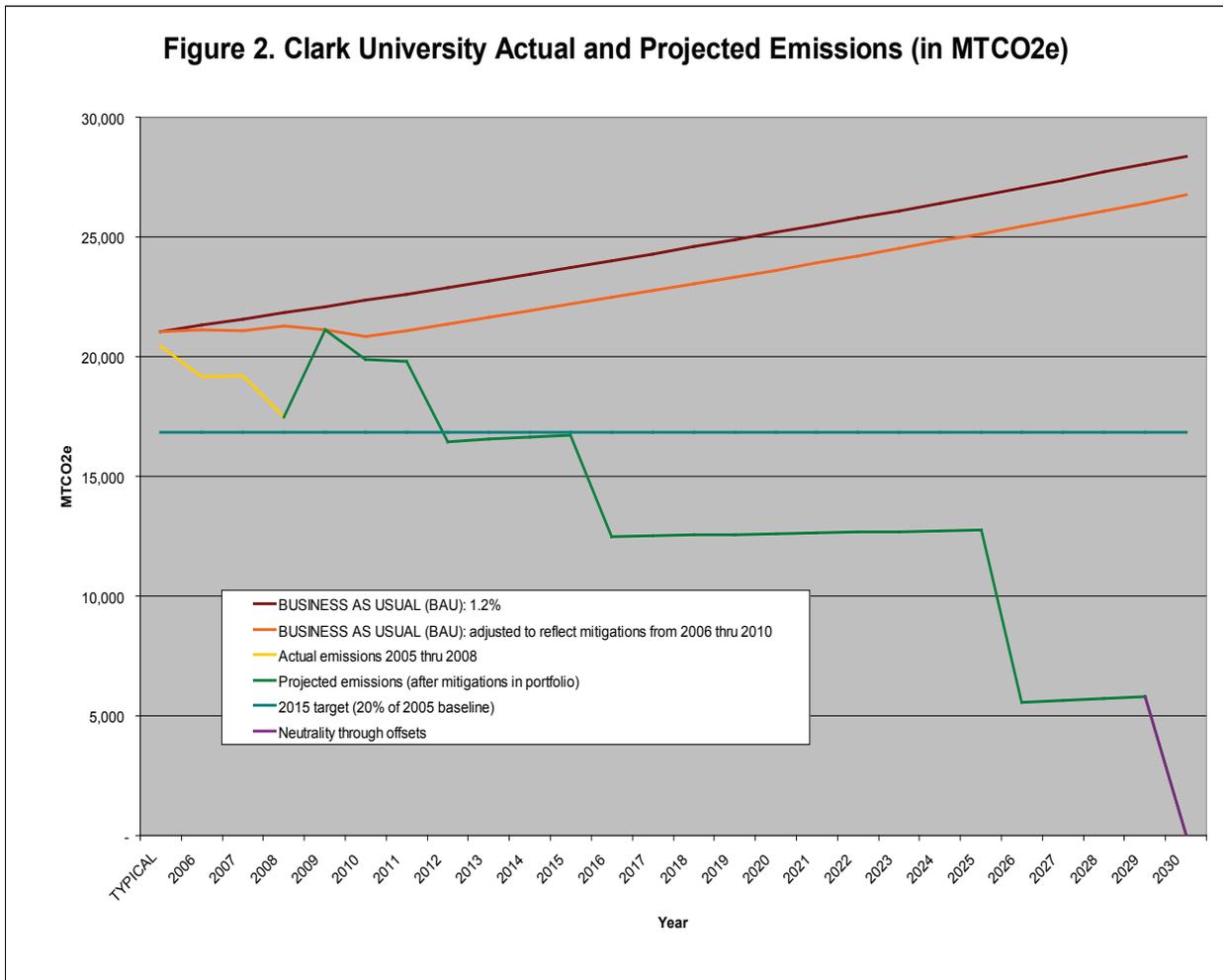
The baseline for the climate action plan is the level of emissions occurring in calendar year 2005. Net emissions that year were 20,442 MTCO_{2e}. To reflect a more typical emissions profile, the emissions from the cogeneration plant and from purchased electricity are adjusted with estimates more aligned with a typical mode of operating wherein cogeneration provides close to 90% of the campus electricity load. With this adjustment, the baseline for net emissions in 2005 is 21,055 MTCO_{2e}.

As previously indicated, our efforts to reduce greenhouse gas emissions occur in the context of a business as usual scenario of emissions growing at a rate of 1.2% per year. At the same time, we are able to include in our projections the impact of mitigation initiatives already put in place over the period 2005-2009. Based on a 2009 BAU projection of 22,084 MTCO_{2e}, the adjusted BAU projection for 2009 taking account of existing mitigation initiatives is 21,101 MTCO_{2e}. The adjusted BAU projection for 2015 is 22,181 MTCO_{2e}.



4.2 NEAR-TERM ACTIONS: 2010-2015

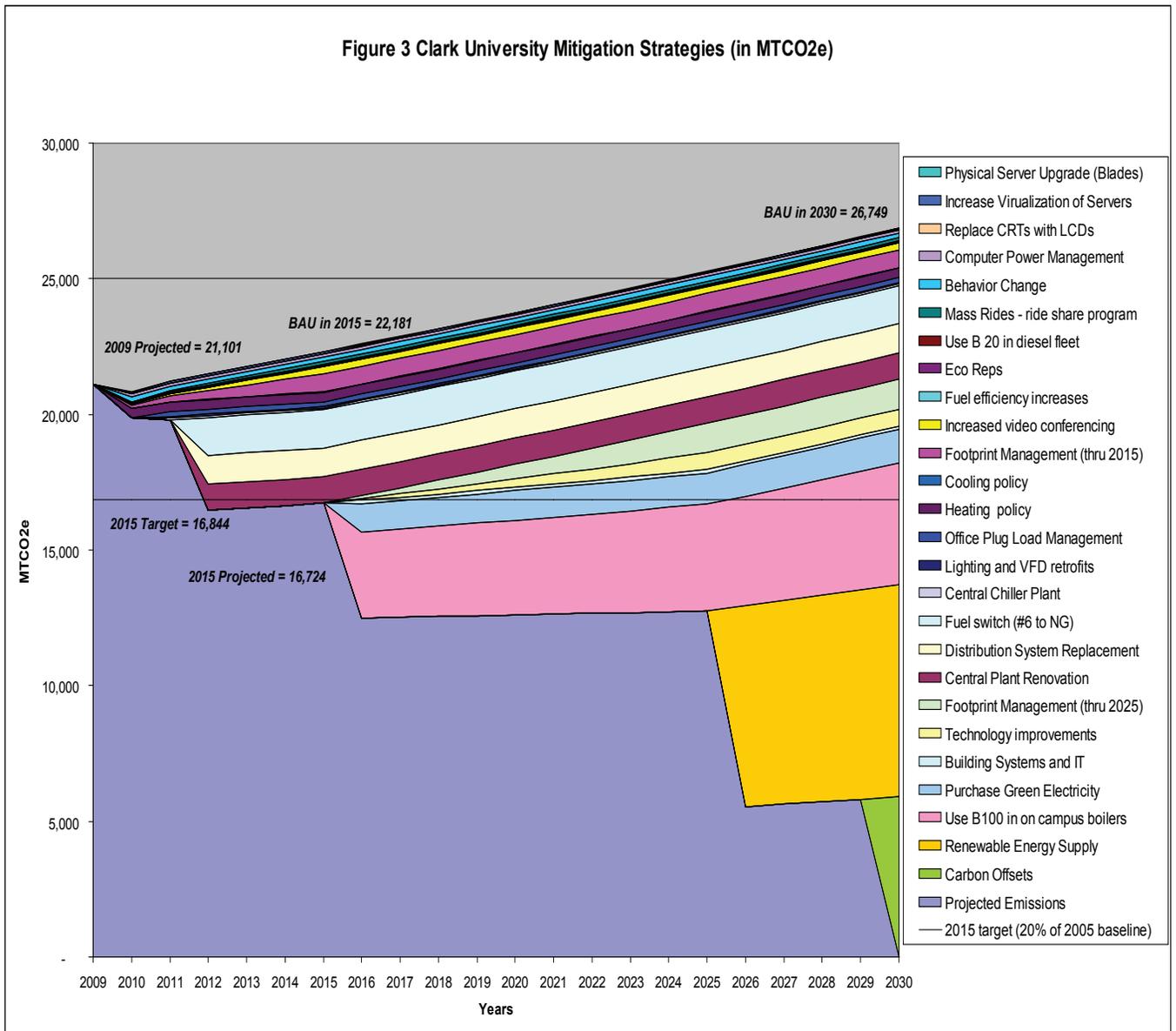
The figure (figure 2) shown below identifies the timeline for achieving climate neutrality.





4.2 NEAR-TERM ACTIONS: 2010-2015 (CONTINUED)

Figure 3 (below) identifies the major mitigation initiatives we propose to undertake.





The goal of the emission reduction plan over the next five years is to achieve a reduction in net emissions of 20% below 2005 levels by 2015. This sets the bar for net emissions in 2015 at 16,844 MTCO_{2e}. The key elements of the 2010-2015 plan are as follows:

Energy

Our plan for the period 2010-15 includes a primary focus on renovations to the central heating and cooling plants as they are the largest contributors to our emissions profile. The plan also focuses on the heating and cooling distribution systems, lighting retrofits, fully utilizing the existing chiller plant, and changes in heating and cooling policy.

- **Energy systems.** Clark has partnered with a consulting firm to perform an investment grade audit focusing on the central heating plant, distribution of hot water, decentralization of heating loads from the central heating plant, and fuel switching from #6 oil to natural gas for heating purposes. The combined effect of these three projects – the central plant renovation, distribution system replacement, and fuel switching to natural gas – will result in a reduction in greenhouse gas emissions of just over 3,439 MTCO_{2e}.
- **Lighting.** The Physical Plant Department has been involved with lighting retrofits for decades in conjunction with National Grid and is actually in the third generation of incentives. As new technologies emerge (possibly LED or inductive lighting) Clark will continue to take advantage of offered incentives from the utility company to decrease the overall consumption of electricity and emissions.
- **Cooling.** The central chiller plant provides air conditioning 37% more efficiently than an electric rooftop unit. The current capacity of the central plant will allow the replacement of three rooftop units currently in service and will reduce 68 MTCO_{2e} per year.
- **Energy policy.** We estimate that a 2-degree reduction (68 to 66 degrees) in building heating, and raising our central chiller plant water temperature from 45 to 47 degrees will save an additional 352 MTCO_{2e}.

Footprint management

If we apply the 'business as usual' rate of growth to emissions over the six year period through 2010-2015 this implies a growth in emissions of approximately 7.4%. If our building square footage grew by that amount, this would mean approximately 125,000 in additional gross square footage added to the campus footprint over this time period. Our current strategic plan discussions include the possibility of several additions to the campus footprint through 2015 as follows: Visitors Center, Fitness Center Expansion, and a new academic building (to accommodate expansion of the Graduate School of Management plus other Master's level enrollments). Renovations to Wright and Bullock residence halls will add a small amount of square footage. Provisionally and in the aggregate, these building projects if carried out might add to the campus footprint approximately 75,000 net square footage – i.e. a somewhat slower growth rate than projected based on historic experience.



For our footprint management strategy through 2015, we incorporate the following guiding principles:

- That we are not constraining enrollment or revenue growth for the direct purpose of reducing greenhouse gas emissions;
- That enrollment growth over this period will occur largely in Master's level enrollment and such growth can be accommodated within the existing footprint along with the 75,000 in square footage identified above.
- That we will actively manage growth in program and co-curricular options for students in ways that allow the University to operate within this existing + 75,000 square foot footprint.
- Active management would include, for example, making more efficient use of existing classroom space across the week and around the year.
- That new buildings and major building renovations will be developed based on our green building policy.

If we assume that business as usual emissions that are not directly associated with buildings correlate with this proxy (e.g. commuting or air travel), then following this footprint management strategy (limiting growth to 75,000 gross square foot versus the 125,000 gross square foot in our business as usual scenario) would allow us to reduce the growth in emissions through 2015 from the business as usual case of 7.4% to approximately 4.4% (i.e. reducing the annual growth rate from 1.20% a year to 0.72% per year). The adoption of the footprint management strategy would mean that in 2015 our emissions would be 657 MTCO_{2e} lower than would occur under the BAU scenario.

Air travel and commuting

Air travel and commuting are significant activity-based sources of emissions. We will seek to reduce emissions from these sources:

- By increased use of video and conference technology, the plan is to reduce air travel by 2% per year from 2010 to 2015 resulting in a reduction of GHG emissions of 253 MTCO_{2e}. This will be measured by tracking air travel expenses.
- According to the Annual Energy Outlook 2009 published by the Energy Information Administration fuel efficiency for new passenger cars and light trucks will increase from an average miles per gallon (mpg) in 2010 of 26.4 to 31.6 in 2015. This is an increase of approximately 1% per year. Assuming the turnover to new passenger cars and light trucks is 20% per year; the average mpg increase for all Clark commuter vehicles could increase by .2% per year or a total of 1% reduction of GHG emissions by 2015 or 24 MTCO_{2e}.

¹ Annual Energy Outlook 2009 published by the Energy Information Administration.
<http://www.eia.doe.gov/oiaf/aeo/pdf/0383%282009%29.pdf>

NEAR-TERM ACTIONS: 2010-2015 (CONTINUED)

Other initiatives

- We estimate that implementation of mitigation strategies in information technology power management and purchasing over the period 2010-2015 will result in reductions of 199 MTCO_{2e}.
- We estimate that the residence hall eco-rep program will reduce emissions by 38 MTCO_{2e} annually.

In the aggregate these energy and mitigation initiatives, along with other mitigation strategies such as participation in the Mass Rides rideshare program, will result in projected emissions of 16,724 MTCO_{2e} in 2015 – relative to our target in 2015 of 16,844 MTCO_{2e}. That is, we project that these mitigation strategies will allow us to reduce emissions in 2015 to 20% below 2005 actual levels.

4.3

LONGER-TERM ACTIONS 2016 – 2030

In this section we describe the plan for reducing and offsetting emissions to achieve our goal of net zero greenhouse gas emissions by 2030. Our plan for 2016-2030 has two key elements: (i) continuation and expansion of mitigation strategies, and (ii) offset of any remaining emissions based on the offset protocol approved by the AUCPCC. We emphasize that it our intent to remain flexible around technology options and the specific plan presented here represents one scenario by which we would achieve climate neutrality. We will continue to review alternative renewable technology options, including solar.

Energy

- Through 2015 we expect to run our main boiler plant on natural gas. To further reduce our emissions we propose to switch our fuel source for boilers to B100 bio-diesel. The new boilers proposed for installation in the period 2010-15 would be designed to accommodate this fuel switch. If implemented in 2016, the switch to bio-diesel would result in an estimated reduction of 3,177 MTCO_{2e} in 2016 and 4,486 MTCO_{2e} in 2030. Further and continuing analysis of the energy balance of B100 bio-diesel will be carried out, along with economic and sustainability analysis of price and feedstock supply options.
- The existing co-generation plant may not accommodate conversion from natural gas and may by 2025 be reaching a point where replacement with a new energy system is warranted from a system maintenance standpoint. Our climate action plan anticipates replacing the co-generation plant with a renewable fuel source on or around 2025. This replacement would result in a reduction in emissions of 7,403 MTCO_{2e} if implement in 2025. Our plan is to remain flexible as to the precise fuel system technology we would adopt at that time. The possibilities range from advanced, combined cycle co-generation, fuel cells, and other energy technologies.
- On or around 2016, we would commit to source all remaining electricity (that not provided from our cogeneration plant) from renewable sources. If implemented in 2016, this would result in a reduction of 1,037 MTCO_{2e} in 2016 and 1,254 MTCO_{2e} in 2030.

Building systems and information technology

- We anticipate that over the time period 2016-2030 there will be continued improvements in the availability, cost and energy performance of building systems, including lighting, computing technology, and other building systems. In the area of lighting, for example, LED or inductive lighting may emerge as practical alternatives. In the absence of robust projections on future technologies, we propose to incorporate into our plan an expectation that technology-based improvements in energy efficiency of building systems and information technology would result in a 1% annual and cumulative reduction in electricity consumption over the period 2016-2030. Since we propose to source all electricity from renewable sources over this period – the net effect on emissions is zero. However, we are able to capture this improvement as a financial benefit (less electricity consumed).
- We also project a 1% annual improvement in thermal efficiency through continued enhancements in building envelope and energy distribution performance. Because thermal energy is produced from a combination of boilers (biofuels) and the co-generation plant, greenhouse gas reductions will be limited to any reduction in GHG emissions from the co-generation plant over the period 2016-2025.

Footprint management

- Over the period 2016-2030 we propose to continue to implement footprint management policies. As discussed previously, our plan uses gross square footage of buildings as the metric on which business as usual growth is calculated. Based on our BAU scenario, absent footprint management the gross square footage of buildings on campus (as the proxy for emissions growth) is projected to grow at a rate of 1.2% per year (or a total of 19.6%). Based on our current gross square footage of 1,685,580 sq feet, this equates to approximately 330,000 gross square feet of additional buildings. Using the same principles articulated in our footprint management strategy for 2010-2015, we propose to limit our footprint growth over the time period 2016-2030 to 150,000 gross square feet of additional space. This equates to a cumulative increase in emissions of 8.9% versus 19.6% in the business as usual scenario. This would result in an emissions reduction of 1,098 MTCO_{2e} relative to the BAU scenario.

Commuting and air travel

- This is another emissions source where it is hard to predict the impact of longer term technological improvements in fuel efficiency. Should we anticipate in our plan, for example, that by 2030 the mean fuel efficiency of automobiles is 50 miles per gallon, or that the carbon efficiency of air travel improves significantly through the development of ever more fuel efficient aircraft? In addition, will there be any developments in public transportation over this time period that results in fewer commuter miles traveled (e.g. through enhanced commuter rail service to and from Boston)? It seems reasonable to assume for the purpose of our climate action plan that



technology-based improvements in vehicle and aircraft efficiencies result in a 15% reduction in emissions from both commuting and air travel by 2030. A 15% reduction equates to 305 MTCO_{2e} lower emissions in 2030 from commuting, and 313 MTCO_{2e} lower emissions in 2030 from air travel.

Combining the mitigation strategies identified above, we project net emissions in 2030 of 5,899 MTCO_{2e} (before offsets).

Offsets

Within our climate action plan we propose to use carbon offsets as a means to negate any greenhouse gas emissions that have not been eliminated through mitigation strategies. We propose to adopt the ACUPCC protocol on carbon offsets that requires that offsets are based on projects that provide emissions reductions that are:

- Real
- Additional
- Transparent
- Measurable
- Permanent
- Verified
- Synchronous
- Account for leakage
- Registered
- Not double-counted
- Retired

Clark University in effect would have two options for securing offsets. One approach would be for the university to invest directly in projects that generate offset credits. The second option would be to purchase offsets from providers and third party markets. There is a high level of uncertainty as to how offset markets might develop in coming years. Currently carbon offsets can be purchased for prices that range from around \$10 a metric ton CO₂ equivalent to \$20 per metric ton (prices are also quoted that are much lower and much higher than this range – but with uncertainty as to the ‘quality’ of the offsets. Many analysts believe that should a large market for carbon offsets emerge in the United States, the price of offsets that meet the standards set by the ACUPCC is likely to increase significantly, perhaps to \$30 per ton or higher.

For the purposes of this plan we adopt a price range for purchased offsets of \$10-\$30 per metric ton. Using these values on total remaining emissions of 5,899 MTCO_{2e}, the cost of purchasing offsets to bring Clark University to climate neutrality in 2030 would be between \$58,990 and \$176,970 annually.



5

Barriers and Risks

Achievement of the goals outlined in this plan is dependent upon the successful execution of the strategies described and the mitigation of the inherent risks outlined below:

- The university grows more rapidly than anticipated. Our climate action plan indicates that the university will become more efficient in its use of space and other resources to accommodate growth in enrollments and other program activity with lower emissions intensity. Should enrollment and program growth occur more rapidly than anticipated, or the University fails to become more efficient in its use of space and resources, it will be more difficult and more expensive to achieve climate neutrality.
- Price of carbon offsets increase substantially. Even with very substantial mitigation initiatives, the University will need to offset remaining emissions from off-campus boilers, commuting and air travel. In this plan we estimate the costs of purchased offsets based on the price ranges at which offsets can currently be purchased. It is possible that as the demand for offsets increases, and the capacity to bring on-line projects that meet ACUPCC guidelines is constrained, the price of offsets may increase substantially. Should this occur, the cost of achieving climate neutrality will increase.
- Fuel costs increase putting pressure on carbon reduction strategies. Historically Clark University's energy practices have been heavily influenced by the cost of fuel, especially the fluctuation in price of oil and natural gas. In the future, the cost of natural gas and bio-fuels as well as the price of electricity generated from renewable sources, will be a constraint on our climate action plan strategy. In addition, constrained availability of bio-fuels may limit our ability to switch out of natural gas and as a result make it more difficult and more costly to achieve climate neutrality.
- Growth and use of technology in university operations becomes more energy intensive. Over the past decade technology has become an ever more pervasive dimension of the academic enterprise. We have seen growth in the number of computers connected to the Clark network, as well as increased use of other electronic equipment. Should these trends continue unabated, it will become more difficult and more costly to achieve climate neutrality.



- Cost of capital increases significantly and access to capital is more constrained. As detailed in the next section, this climate action plan anticipates significant capital investments, especially in energy plant systems. Should the cost of capital increase significantly, or the ability of the University to access capital becomes more constrained (as is currently occurring in credit markets), it will become more difficult for the University to provide financing for this climate action plan.

It is also important to recognize that there are risks and costs of not moving forward on this climate action plan. These risks and costs include:

- Reputational risk. Were Clark University not to demonstrate a strong commitment to reducing greenhouse gas emissions, we face a significant risk with regard to how the University would be viewed by current and prospective students, parents, alumni and other constituencies. While ranking of colleges based on sustainability initiatives are already emerging, the broader risk is of Clark not living up to statements we make about ourselves as an institution.
- Future energy costs. There is considerable uncertainty with regard to future energy costs, including oil and gas, and the impact that future energy prices might have on the University absent significant progress in enhancing energy efficiency on campus. We have already experienced years in which energy prices have risen significantly and placed pressure on the operating budget.
- Regulatory and climate policies. It is unclear how the University might be impacted by future climate legislation in the United States if we remain heavily dependent on carbon-intensive fuels.



6

Financing

Financial analysis of the Climate Action Plan includes an assessment of capital needs as well as annual operating costs. The standard approach to developing a budget model entails identification of capital needs, operating costs, the net present value of investments, and the payback period for investments. In addition, to aid in our decision planning we seek to calculate the cost per ton of carbon reductions for different mitigation initiatives.

The majority of mitigation initiatives discussed here result in annual operating savings (with the critical budget question being the capital investment required to achieve these operating savings). Some mitigation strategies, such as turning off lights and equipment when not in use, are almost pure savings for the institution. Other initiatives, such as many energy efficiency projects, have relatively short payback periods (the savings offset the costs quite quickly). Our Climate Action Plan also includes projects where the payback period is very long. As is the case throughout this plan, the level of precision of the analysis is much higher for the period 2010-2015 than is the case for the longer term mitigation initiatives over the period 2016-2030. In addition, it is sometimes not possible to separate out costs associated with implementation of the climate action plan from other budget goals. For example, replacement of older, energy intensive computer equipment may occur as part of regular computer replacement cycles, rather than as a climate action plan initiative per se.

Depending on the price of fuel and other variables, there are a limited number of mitigation initiatives that may result in higher annual operating costs. The initiatives that potentially fall in this category are (i) fuel switching (where the net cost inherently depends on the relative price of oil, gas, bio-fuels and other fuel sources), (ii) purchase of electricity from renewable sources (for example if the cost of purchased electricity from renewable sources is higher than the cost of electricity produced through on campus co-generation), and (iii) purchase of carbon offsets. Going forward the University may wish to establish a policy to guide decision making on this category of projects.



Table 3 below provides financial analysis for mitigation initiatives proposed for the period 2010-2015 that incur significant capital cost, as well as an analysis of initiatives that have the potential to increase operating costs.

TABLE 3: FINANCIAL ANALYSIS FOR SELECTED MITIGATION INITIATIVES

Emissions Reduction Strategies <small>* NPV assumes 3% escalation, 6% discount rate</small>	INITIAL CAPITAL INVESTMENT	ANNUAL COST or SAVINGS	PROJECT LIFETIME (YEARS)	NPV OVER 20 YEARS *	PAYBACK PERIOD BASED ON NPV (YEARS)	MTCO2E REDUCTION (PROJECT LIFETIME)	TOTAL COST (-) OR BENEFIT (+) PER MTCO2e
2010 thru 2015							
Central Plant Renovation							
Distribution System Replacement							
Fuel switch (#5 to NG)							
PROJECT TOTAL	(\$6,700,000)	\$560,000	20	\$1,699,092	15	68,780	\$25
2016 thru 2025							
Purchase Green Electricity	N/A	(\$81,290)	1	N/A	N/A	1,037	(\$78)
Use B100 in all boilers	N/A	(\$403,136)	1	N/A	N/A	3,177	(\$127)
Carbon Offsets	N/A	(\$117,980)	1	N/A	N/A	5,899	(\$20)

As shown in Table 3, we estimate the capital costs of the major energy projects proposed for the period 2010-2015 to be \$6.7 million (switch from steam to hot water boilers, switch to natural gas in main boilers, hot water distribution system). Implementation of these projects would result in estimated operating cost savings of \$560,000 per year. Using a net present value formulation, the operating cost savings from the projects result in a payback period of fifteen years (the time period over which operating savings pay for the initial capital investment). If parts of the capital costs are covered by gifts or supplier incentives, then the payback period would be shorter.

Table 3 identifies three projects in the period 2016-2030 that have the potential to increase operating costs. Currently we estimate that purchasing electricity from renewable providers carries a price premium of between \$0.014 per kWh and \$0.04 per kWh over our current electricity contracts. Applying the higher value of the price premium to our projected electricity consumption in 2016, results in an estimated increased annual operating cost of \$81,290. In the case of bio-fuels, we model a price premium for bio-diesel of \$1 per gallon relative to the cost of natural gas. Applying this price premium to our projected consumption of bio-diesel in 2016 would result in an increase in annual operating cost of \$403,136. Given this substantial increase in operating costs, a shift to bio-fuels likely depends on a significant reduction in the price premium over natural gas. Lastly, the cost of purchased offsets (\$117,980) is based upon an offset price of \$20 per ton.

**Financing Plan for Capital Projects**

As indicated above, the major capital costs incurred in this plan relate primarily to investments in energy systems. Our provisional financing plan for these investments is as follows:

- Given the difficult economic circumstances in which the University is currently operating, we propose holding back implementation of the 2010-2015 capital projects until 2013-2015 when we anticipate circumstances will have improved.
- We believe that over the medium term (2-5 years) equity financing is likely to be a more viable option than debt financing of these projects. This will necessitate accrual of equity capital over the next several years as part of the overall approved annual budgets for the university.
- Continue to maximize participation in utility and other provider incentive programs (such as National Grid) and monitor Federal and State opportunities for grants and other financing (as occurred, for example, when the co-generation plant was installed at Clark University).
- Promote the Climate Action Plan as a key element of the University's next Capital Campaign. We believe these sustainability initiatives will be of considerable interest to Clark University alumni and friends. The Climate Action Plan provides many opportunities for capital gifts, along with the possibility of establishing designated annual giving in support of the Plan.

Over the longer term, it is important to recognize that the Climate Action Plan, through footprint management, anticipates some slowing in the rate of growth of campus square footage. Sources of capital that would have been required for these building projects may be re-directed toward financing of climate action initiatives in the period 2016-2030 (such as replacement of the co-generation plant).



7 Educational, Research, and Community Outreach Efforts

This section describes the role of educational programs, research and community outreach in Clark University's climate action plan.

7.1 EDUCATIONAL PROGRAMS (ACADEMIC CURRICULUM INITIATIVES)

Our Climate Action Plan benefits from the rich array of existing courses, and undergraduate and graduate programs in which sustainability issues are already addressed at Clark University. Undergraduate majors include environmental science, geography, and global environmental Studies. Relevant undergraduate courses are offered across a range of other undergraduate majors, including biology, economics, government, management, philosophy, physics, and sociology. Graduate programs with a substantial sustainability focus include Master's degrees in environmental science and policy, GIS, and international development and social change and doctoral program in geography. For some years the University has offered an innovative course titled "The Sustainable University" and maintained an undergraduate research program entitled the "Human Environment Regional Observatory."

As part of this Climate Action Plan we intend to further strengthen academic curriculum initiatives as follows:

- Encourage faculty to use the Climate Action Plan as the context for course teaching and student research. Among the multiple opportunities to connect our curriculum to the Climate Action Plan are: economics and sociology courses that assess behavioral responses to incentives to reduce energy use; physics and environmental science courses examining feasibility of bio-fuel use in boilers; management and finance courses considering ways to reduce travel; and so on.
- Promote student involvement in the development and implementation of the Climate Action Plan as opportunities to develop capacities of effective practice (planning, team work, resilience, persuasion, and so on). Several successful recent sustainability initiatives on campus have arisen as a result of effective student leadership, including a bike share program, a community campus garden, and campus composting.
- Explore opportunities to develop and expand graduate program offerings that are tailored toward students pursuing careers in sustainability management.

**Research**

The George Perkins Marsh Institute currently serves as the focal point for sustainability research on campus. In addition, the Mosakowski Institute for Public Enterprise promotes exemplary use-inspired research connected to the environment, education and other important social concerns. In conjunction with our Climate Action Plan, we intend to pursue the following initiatives:

- Support the development of the newly established socio-technical systems group within the Marsh Institute focused on sustainability transitions;
- Launch in collaboration with WPI and other partners a new Institute for Innovation in Energy and Sustainability focused on local and regional energy transitions.

Outreach

The Campus Sustainability Taskforce serves as the primary vehicle for outreach to the campus community. The Taskforce will maintain a website tracking and reporting on the CAP and other sustainability initiatives. The student group Campus Sustainability Initiative coordinates student engagement in campus sustainability. Starting in 2009 we are launching a paid student eco-reps program in conjunction with our Office of Residential Life and Housing. The eco-reps are responsible for outreach within the campus residential halls.



8

Implementation Structure and Reporting

Clark's Campus Sustainability Task Force is responsible for the management, implementation, tracking, and reporting of the Climate Action Plan.

CAMPUS SUSTAINABILITY TASK FORCE MEMBERS:

- David Angel, Provost
- Kara Baylog, Graduate Student
- Justin Brooks, ITS
- Jim Collins, Treasurer
- Michael Killeen, Business Office
- Jody Emel, Professor, Geography
- Kevin Forti, Resident Life and Housing
- John McKenzie, Graduate Student
- Will O'Brien, Visiting Assistant Professor, Management
- Joe Sarkis, Professor, Management
- Dave Schmidt, Campus Sustainability Coordinator
- Jennie Stephens, Assistant Professor, Environmental Science and Policy
- Chris Traft, Undergraduate Student
- Ashley Trull, Undergraduate Student
- Heather Vaillette, Food Services (Sodexo)
- Tom Wall, Physical Plant

Progress toward carbon neutrality will be assessed and reported annually to the Campus Sustainability Task Force and the campus community. The capital cost and operating budget impacts of the Climate Action Plan will be included and presented as part of the annual budget submission of the University, and incorporated into the Academic and Financial Plan of the University. We recommend a formal review of the Climate Action Plan take place every three years, involving faculty governance and the Environment committee of the Board of Trustees.