2010

Temple University
Climate Action Plan

May 24, 2010

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Executive Summary

Temple University (Temple) is a comprehensive public research university with eight campuses and 320 academic degree programs, including five campuses within the greater Philadelphia area. Currently, Temple is ranked as the 25th largest university in the United States, with approximately 39,000 students and about 8,000 faculty and staff.

In support of the American College and University Presidents' Climate Commitment, Temple has made a long-range institutional commitment to carbon neutrality. The American College and University Presidents' Climate Commitment calls for institutions within two years of signing to develop an institutional action plan for becoming climate neutral over time, integrating sustainability into the curriculum, and expanding research and community outreach to achieve carbon neutrality.

> "In this time of acute awareness of the earth's fragility and limited resources, Temple has an obligation to demonstrate how a large urban university can responsibly participate in the global community. The University can act as a model institution and a resource to address growing concerns among citizens and government at all levels and design permanent, affordable, practical, and forward-looking programs for sustainability." — President Ann Weaver Hart

In the fiscal year 2006 baseline year, Temple's greenhouse gas emissions were 226,219 metric tons carbon dioxide equivalent. After accounting for institutional growth, Temple's gross emissions are expected to increase to 287,752 metric tons carbon dioxide equivalent by 2020 and remain there through 2030 under business-as-usual scenarios.

As an interim goal to carbon neutrality, Temple has set a target of reducing campus-wide greenhouse gas emissions to 30% below baseline (fiscal year 2006) levels by 2030. This corresponds to an emissions target of 158,353 metric tons carbon dioxide equivalent by 2030, which is approximately 68,000 metric tons carbon dioxide equivalent below FY 2006 levels, and 130,000 metric tons carbon dioxide equivalent below business-as-usual emissions (45% reduction below business-as-usual).

Prior to the 2030 goal, Temple will target the following:

- 5% below baseline (fiscal year 2006) levels by 2015
    - Corresponds to an emissions target of 214,907 metric tons carbon dioxide equivalent by 2015
- 15% below baseline (fiscal year 2006) levels by 2020
    - Corresponds to an emissions target of 192,285 metric tons carbon dioxide equivalent by 2020
- 22% below baseline (fiscal year 2006) levels by 2025
    - Corresponds to an emissions target of 176,450 metric tons carbon dioxide equivalent by 2025

Temple intends to achieve zero net greenhouse gas emissions as soon as technology and financial considerations will allow. As represented in the table below, Temple will utilize a portfolio of expected strategies to mitigate these emissions.

TABLE ES-1. PORTFOLIO OF STRATEGIES

Demand-Side Management (Infrastructure)	Demand-Side Management (Behavior)	Supply-Side Management	Offsets
Phase I Building Automation Systems: Utilize digital control systems to optimize energy performance of the mechanical systems within high energy using buildings (Section 3.2.2). Phase II Plant Development Fund projects: Complete planned building improvements which include identified energy savings (Section 3.2.3). Phase III Energy Conservation Measures for High Energy Using Buildings: Implement energy conservation measures for targeted high energy using buildings (Section 3.2.4). Design standards for new construction: Target energy consumption in new construction of 30% below American Society of Heating, Refrigerating, and Air Conditioning Engineers 90.1 energy code. (Section 3.2.6).	Behavior Change: Personal actions taken by students, faculty and staff to conserve energy, water and materials, and support sustainable measures (Section 3.5). Transportation Alternatives: Parking changes, carpooling and car sharing, transit pass program, and air travel offsets (Section 3.4). Recycling and Waste Minimization: Implement activities and/or programs to increase campus recycling rates, decrease use of materials, and reuse materials (Section 3.6).	Biofuels and Wind Turbines: Use of waste oil in central plants (Section 3.3.1). Installation of Pearson / McGonigle Halls wind turbines (Section 3.3.3). Central Plant Combined Heat and Power: Installation of a back pressure steam turbine & generator or a gas turbine with heat recovery system at one of the Main Campus Central Steam Plant boilers (Section 3.3.5).	Recycled Computer and Construction Waste: Reuse and recycling of computer equipment by Temple's Computer Recycling Center (Section 3.6.1) Promote and implement the safe and economically feasible recycling of recoverable construction and demolition materials generated on campus. (Section 3.6.1) Purchased Renewable Energy Certificates and Carbon Credits: Purchase offsets, which may include Renewable Energy Certificates, to mitigate a portion of Temple's GHG emissions (Section 4).

Temple has begun incorporating sustainability into the curriculum through a range of course offerings and the following initiatives which include research as well as community outreach opportunities:

-	Develop a sustainability certificate program that consists of four courses, with at least one course included in the General Education curriculum.
-	Align graduate sustainability education with workforce development needs in the Green sector by creating tuition generating programs that include terminal degrees, certificates, and short courses.
-	Complement formal educational experiences through providing a strong array of co-curricular activities that extend beyond the realm of course and curricular activities to make Temple a living laboratory for sustainability.
-	Foster collaboration with the surrounding community to achieve mutually agreed upon goals in alignment with Philadelphia's Green initiatives, such as development of partnerships and programs for pre-school through 12th grade students in both formal and informal educational settings
-	Proposal to establish an interdisciplinary *Center for Urban Ecology*, which will connect faculty research activities in an integrative manner through interdisciplinary efforts drawing from departments and colleges to create a university-wide sustainability research enterprise

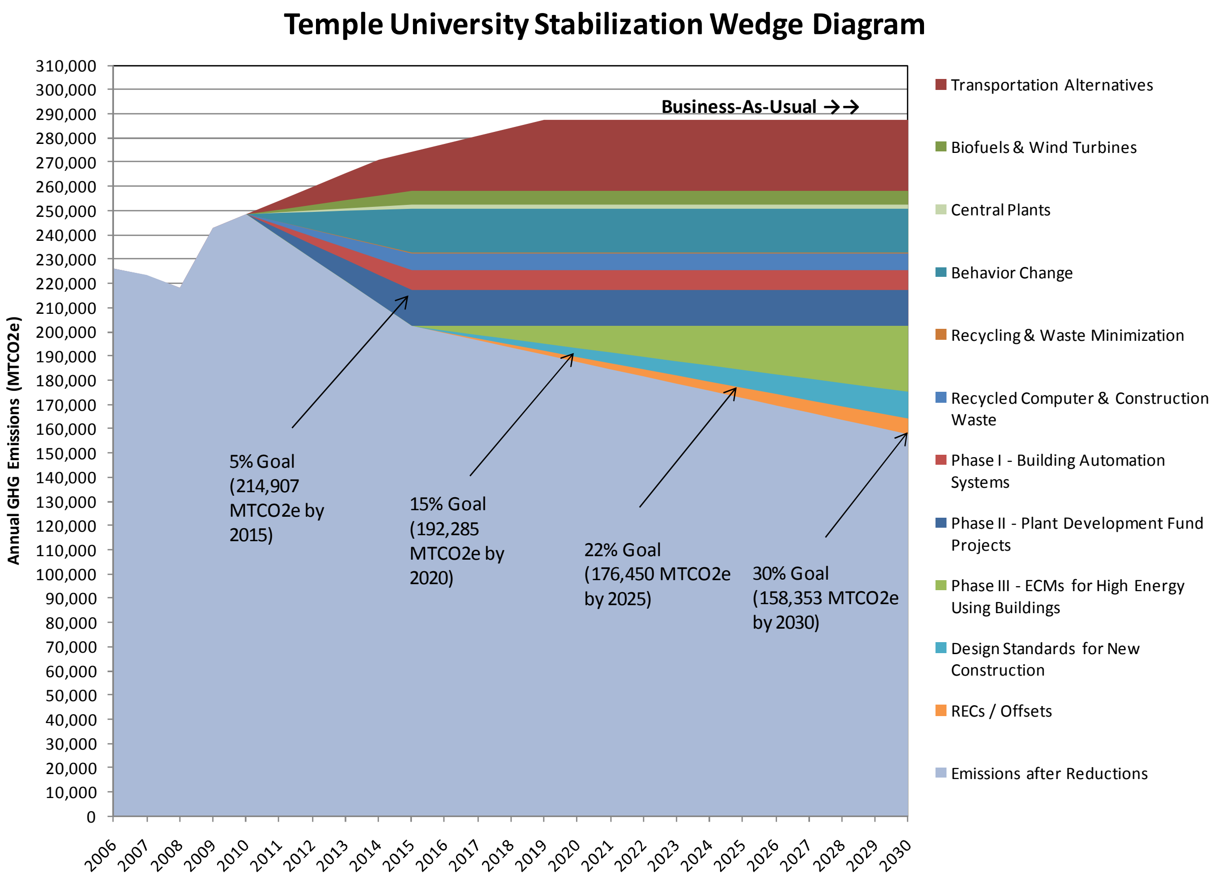
Temple has developed an institutional structure for campus sustainability that is supported by the Office of Sustainability and the following committees:

- Sustainability Advisory Group
- Energy and Built Environment Committee
- Academic Initiatives Committee
- Transportation Committee

Following the launch of this Plan, the Office of Sustainability and the Sustainability Advisory Group will provide on-going support of the emissions reduction projects proposed in this Plan, by providing oversight on funding, implementation, and measurement/verification of the projects.

Temple will utilize a variety of funding sources for implementing emissions reduction projects, which must be approved in accordance with University policy by the Facilities Committee of the Board of Trustees. Some examples of funding sources are:

- Plant Development Fund
- Energy Budget
- Grant Funding
- Donations



Temple's action plan is dynamic and these recommendations will be evaluated at least every two years, as additional analyses and projects are completed and opportunities for new technologies are identified. Temple will also track progress toward goals through biennial public updates to its greenhouse gas emissions inventory and deployment of an electronic utility tracking system.

Acknowledgements

Temple University (Temple) acknowledges those individuals and organizations that have contributed to the development of this Action Plan, including Temple President Dr. Ann Weaver Hart who has provided the leadership to make visionary commitments on behalf of the University. Temple also acknowledges O'Brien & Gere for assisting with the engineering and scientific analysis in the development of this Plan.

Sustainability Advisory Group

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Kathryn D'Angelo	Director of Administrative Projects, Office of the Provost
Sally Harrison	Associate Professor, Architecture, Tyler School of Art
Kenneth Kaiser	Sr. Associate VP Finance & Human Resources-VP-CFO
Michelle Lai	Asst. VP Campus Development & Capital Planning-VP CFO
Thomas McCreesh	Director of Planning & Design- Facilities Management
Sandra McDade	Director, Office of Sustainability
Michael Olszewski	Assistant Professor, Landscape Architecture & Horticulture, School of Environmental Design
Teresa Scott Soufas	Dean, College of Liberal Arts and School of Environmental Design
Katherine Switala-Elmhurst	Graduate Student, Engineering and Academic Extern Office of Sustainability
Korin Tangtrakul	Undergraduate Student, College of Liberal Arts and President of Students for Environmental Action

Energy and Built Environment Committee

Kurt Bresser	Energy Manager
Francis Connelly	Assistant Director of Maintenance & Operations (HSC)
Robert Levis	Professor and Chair, Department of Chemistry, College of Science & Technology
Eugene Maggioncaldo	Assistant Superintendant HVAC
Thomas McCreesh	Director of Planning & Design
Sandra McDade	Director, Office of Sustainability
Steven Ridenour	Professor, Department of Mechanical Engineering, College of Engineering
Andrew Riccardi	Associate Vice President Facilities Management

Academic Initiatives Committee

Committee Chair:

Michel Boufadel, Ph.D., P.E., P.Hydro.
Director, The Center for Natural Resources Development and Protection
Professor and Chair, Department of Civil & Environmental Engineering, College of Engineering
Chaired the Research Subcommittee

Committee Members:

Lynne Andersson, Ph.D.	Associate Professor, Department of Human Resources Management, Fox School of Business and Management
Sierra Gladfelter	Undergraduate Student, College of Liberal Arts
Eli C. Goldblatt, Ph.D.	Professor, Department of English, College of Liberal Arts
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Terry Halbert, Ph.D.	Director, General Education; Professor, Department of Legal Studies, Fox School of Business and Management *Chaired The Undergraduate Subcommittee*
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Zebulon Kendrick, Ph.D.	Associate Dean, Graduate School; Professor, Department of Kinesiology, College of Health Professions
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Kate Wingert-Playdon, M.S. Arch.	Associate Professor and Chair, Department of Architecture, Tyler School of Art

Transportation Committee

Committee Chair:

Bradley Flamm Assistant Professor, Department of Community and Regional Planning, School of Environmental Design

Members:

Leigh-Golding DeSantis	Environmental Engineering Graduate Student
Bradley Flamm	Assistant Professor, Dept. of Community and Regional Planning, School of Environmental Design
Robert Gage	Director of Sponsored Research Programs
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Joseph Katz	Director of Finance and Administration, College of Dentistry
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Sandra McDade	Director of Office of Sustainability
Valarie McDuffie	Director of Finance and Administration, Baptist Temple
Karen Sherlock	Director of Parking Services

Biking Subcommittee (subset of Transportation Committee)

Leigh-Golding DeSantis	Graduate Student, Engineering, Office of Sustainability,
Glenn Eck	Senior Facilities Specialist
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1. Introduction

1.1 Institutional Background: Temple University

Founded in 1884 by Dr. Russell Conwell, Temple College became Temple University in 1907. Temple University (Temple) is a comprehensive public research university comprised of multiple campuses, national and international, including five campuses within the greater Philadelphia area. Temple's flagship campus, Main Campus, is located in north Philadelphia and serves as an important resource for the city and the Commonwealth of Pennsylvania.

Currently, Temple is ranked as the 25th largest university in the United States. In the fall of 2009, Temple's total enrollment was 31,453 full-time and 7,503 part-time students at all campuses. As a comprehensive public research university, Temple's students can choose from 8 campuses and 320 academic degree programs.

Temple's <u>mission</u>

…is to provide access to excellence for talented and highly motivated students regardless of status or station in life and to strengthen Temple's communities by creating a culture of engagement at all levels.

Temple's campuses include Main Campus at Broad and Montgomery St., Ambler Campus in Ambler, PA, School of Podiatric Medicine (TUSPM) at 9th and Race St., Health Sciences Center (HSC) at 3400 N. Broad St., and Temple University Center City (TUCC) at 1515 Market Street. Additional campuses and properties include the Harrisburg campus, Japan campus, Rome Campus, and the Temple University Health System facilities located outside of the HSC campus, and a small presence in Beijing and London.

This Climate Action Plan includes only those campuses where the university has operational control and can enforce a change in policy. Therefore Center City, Fort Washington, Harrisburg, Japan, and the Health System facilities, including Temple University Hospital buildings located on the Health Sciences Campus, are not included and will not be mentioned henceforth in graphs, tables, or discussion. All references to 'University buildings' refer to those within the organizational boundary of the inventory only.

In total, these properties comprise approximately 9 million square feet of building space. Main Campus represents 75% of the space and HSC campus is the second largest area, 17% of the space. The square footage of Temple building space has increased by 33% since 1990, showing steady growth over that time. There are multiple new buildings that have been recently constructed, such as the new Tyler School of Art and Alter Hall on Main Campus and the new Medical Education and Research Building at the Health Science Campus.

1.2 Science Background: Climate Change Impact

In its Fourth Assessment Report released in 2007, the United Nations Intergovernmental Panel on Climate Change (IPCC) stated that:

- Warming of the climate system is "unequivocal" based on observations of temperatures, sea levels, and snow melts;
- Global concentrations of greenhouse gases (GHG) in 2005 far exceeded the natural range observed over the last 650,000 years; and

- Most of the observed increase in global average temperatures since the mid-20th century is "very likely" (i.e., >90% confidence) due to the observed increase in anthropogenic or human-caused greenhouse gas concentrations.

Climate change will cause impacts on water resources, food production, ecosystems, weather patterns and human health in all parts of the world, including:

- Decreased water availability and increasing drought in mid-latitudes and semi-arid low latitudes;
- Decreased cereal productivity at low latitudes;
- Risk of extinction of global plant and animal species (up to 30% or even more depending on scenario);
- Increased warm spells, heat waves and heavy precipitation events; and
- Increased morbidity and mortality from changing weather patterns, changed disease vector distributions, and malnutrition.

Further, these effects will be felt over several decades due to the long atmospheric life spans of greenhouse gases.

1.3 Policy Background: Evolving Climate Change Policy and Legislation

The United Nations Framework Convention on Climate Change (UNFCCC) coordinates international efforts to combat climate change. The Kyoto Protocol to the UNFCCC (1997) called on developed countries to reduce their total greenhouse gas emissions in the 2008 to 2012 commitment period by an average of 5% versus a 1990 baseline. Over the past decade, the European Union has undertaken high-profile steps to meet their Kyoto targets, including the establishment of the European Union Emissions Trading Scheme (EU ETS, 2007).

While the United States has not participated in the Kyoto Protocol commitments, U.S. federal policy on climate change has developed rapidly in recent months as evidenced by the following:

There is a growing federal policy for aggressive climate change action.

- *February 12, 2009:* The American Recovery and Reinvestment Act 2009 allocates over $36 billion for energy efficiency, conservation and renewable programs.
- *March 10, 2009:* The EPA releases a proposed rule for mandatory GHG reporting that would account for 85 - 90% of U.S. GHG emissions.
- *March 31, 2009:* A proposed bill establishing a cap-and-trade system with mandatory GHG reduction targets is circulated among lawmakers (American Clean Energy and Security Act of 2009).
- *April 17, 2009:* The EPA releases an endangerment finding stating that GHGs endanger human health and welfare; this was a follow-up to a 2007 U.S. Supreme Court ruling stating that CO_2 was a pollutant and as such was subject to regulation by the EPA.
- *May 19, 2009:* President Obama announces new vehicle fuel economy standards that harmonize states and the federal legislation / standards.
- *June 26, 2009:* The American Clean Energy and Security Act of 2009 passes the House of Representatives.
- *June 30, 2009:* EPA grants waiver to the state of California to set its own, state-specific greenhouse gas emissions limits from cars.

- *September 22, 2009:* EPA finalizes GHG mandatory reporting rule.

While numerous high profile federal environmental policies are emerging from the Obama Administration, voluntary and mandatory programs have been on-going for some time at the local, state, and regional levels. Prominent among these are:

- EPA Climate Leaders
- The Climate Registry
- Regional Greenhouse Gas Initiative (RGGI)
- California's Global Warming Solutions Act (Assembly Bill 32)
- U.S. Mayors' Climate Protection Agreement
- American College and University Presidents' Climate Commitment (ACUPCC)

1.4 Background: The ACUPCC and Temple University

The American College and University Presidents Climate Commitment (ACUPCC) is an effort to make the U.S. Higher Education sector more sustainable, obtaining institutional commitments to "reduce and ultimately neutralize greenhouse gas emissions on campus" and "accelerate the research and educational efforts of higher education to equip society to re-stabilize the earth's climate" (ACUPCC, 2007).

Climate change poses a fundamental challenge to the way individuals and organizations use energy and resources. ***The ACUPCC presents an opportunity to lead by example, educating the next generation of national, business and media leaders on how to address this challenge.***

ACUPCC Commitment

"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."

AMERICAN COLLEGE & UNIVERSITY PRESIDENTS CLIMATE COMMITMENT

Over 684 colleges and universities have committed to being carbon neutral over time. ***In April 2008, President Hart signed the American College and University Presidents Climate Commitment (ACUPCC).*** Becoming a signatory to the ACUPCC requires implementation of the following:

- Establishing an institutional structure to oversee the school's ACUPCC: *Temple has developed a comprehensive structure designed to engage all areas of the Temple community in collaboration and consensus building, including the Sustainability Advisory Group.*

- Completing a greenhouse gas (GHG) emissions inventory within one year: *Temple has prepared a baseline GHG inventory and publicly posted it on the ACUPCC online reporting tool (AASHE, 2009).*

- Developing a climate neutrality action plan (CAP) – including a target date for climate neutrality and interim progress milestones – within two years: *The Temple Climate Action Plan has been developed in accordance with the timeline.*

- Choosing at least two of seven action steps towards greenhouse gas reduction: *Temple immediately adopted two tangible actions: 1) Adopt an energy-efficient appliance purchasing policy requiring purchase of ENERGY STAR certified products in all areas for which such ratings exist; and; 2) Participate in the Waste Minimization component of the national RecycleMania competition, and adopt 3 or more associated measures to reduce waste.*
- Implementing the work products of the Climate Action Plan (CAP)
- Integrating sustainability into the educational curriculum.
- Making the CAP, GHG inventory, and progress reports publicly available: *Temple's GHG inventory and CAP have been made available on the AASHE website http://www.aashe.org/.*

1.5 Overall Approach: Development of the Climate Action Plan (CAP) within the ACUPCC Framework

The requirements of the ACUPCC signatory letter include development of an institutional action plan for becoming climate neutral (no net greenhouse gas emissions) by minimizing greenhouse gas emissions as much as possible through demand and supply side management and using carbon offsets or other measures to mitigate the remaining emissions.

The institutional action plan has been developed within two years of signing the ACUPCC and includes:

- A target date for achieving climate neutrality as soon as possible;
- Interim targets for goals and actions that will lead to climate neutrality;
- Actions to make climate neutrality and sustainability a part of the curriculum and other educational experience for all students;
- Actions to expand research or other efforts necessary to achieve climate neutrality; and,
- Mechanisms for tracking progress on goals and actions.

1.6 Aligning the Climate Action Plan with Temple's Future: University Planning Initiatives

Opportunities exist to align the goals and actions of the CAP with concurrent key initiatives driven by internal and external programs. The directives of these programs are summarized within the following plans:

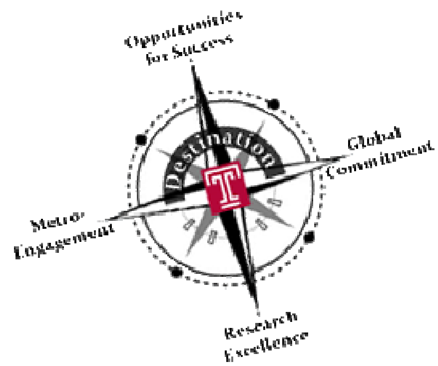
- Academic Strategic Compass
- Sustainability Task Force Report to the President
- Temple 20/20 Framework Plan
- Greenworks Philadelphia

Many components of these existing initiatives lend support to Temple's CAP or, in turn, can be supported and enhanced by the CAP as summarized below.

The *Academic Strategic Compass* identifies points to enable Temple to "continue as a force of growing vitality and impact, enhancing the quality of life for current and future generations." The points are implemented in order to advance Temple as a destination for students, faculty, alumni and the community now and into the future.

The **Academic Strategic Compass** revolves around four points:

- "Opportunities for Success" including maintaining class size, increasing faculty and improving student support services;
- "Research Excellence" including aggressively increasing sponsored research, expanding opportunities for undergraduate research and promoting entrepreneurial culture;
- "Metro-Engagement" to foster collaborative partnerships in research, teaching and outreach, and to promote sustainability on campus and adjacent communities; and,
- "Global Commitment" to develop new world-class intellectual centers on Temple campuses.



In the spring of 2007, President Hart established a Sustainability Task Force (STF) and charged its members with, "... providing insights, counsel, and advice on current issues regarding environmental responsibility in large, urban universities; new and best-practice methods for addressing these issues, and possible actions Temple University might take toward creating and maintaining a sustainable campus environment. In answer, the Sustainability Task Force provided the *Sustainability Task Force Report to the President* in October 2007.

In completing its work, the group was guided by four underlying principles:

• Promote a green campus culture.

• Foster practical, useful, and forward-looking change.

• Promote environmental literacy across the University.

• Make recommendations to the President.

SUSTAINABLE
TEMPLE UNIVERSITY

Three areas of environmental sustainability were addressed by the Sustainability Task Force:

- **Sustainable Campuses – Need for sound energy management, master planning, conservation & recycling, and transportation policies**
- **Academic Initiatives – Increase sustainability awareness and promote curricular and research initiatives**
- **Outreach and Engagement – Develop partnerships and initiatives with students and community, and promote communications regarding**

sustainability efforts.

In 2009, Temple celebrated its 125th year as an educational institution. Over those 125 years, Temple has seen many changes and those changes continue to occur as the school continues to pursue its mission. *Destination Temple: 20/20 Framework Plan for Campus Development* was published in May 2009, and was developed to fully integrate with the Academic Strategic plan and the president's guiding commitments and values. The purpose of the framework plan is to provide a vision for the development of Temple's Main Campus over the next 10 to 12 years and to support Temple's goal of achieving the level of "Top 100 Research Institute."

The plan embraces a "string of pearls" concept for campus development regarding new construction, modifications, parking, and open space with the least amount of intervention to the existing campus structure. Plans include utility infrastructure improvements (e.g., building envelope, HVAC, water, lighting, power, and electrical equipment) and improving the "path" between buildings and to transit. Development is proposed to work within existing "footprint" of campus-owned property and the Institutional Development District and includes increases in gross square footage for academic, indoor recreation, housing and dining uses.

The Destination Temple: 20/20 Framework Plan identifies 15 development criteria, including:

- Maintain student enrollment
- Create design review committee and planning office
- Increase green space, recreational and open space
- Creation of improvements affecting surrounding neighborhoods or "neighborhood interface"
- Development on Broad Street corridor
- Creation of a new campus core
- Building replacement, renovation and modification
- Modification and/or increase in parking
- Residential and athletic facilities modifications and increases

Sustainability recommendations and initiatives for campus development are provided alongside proposed design guidelines and include:

- Reduction of building emissions and energy use;
- Adoption of a campus standard for new construction or major renovation;
- Upholding the ACUPCC; and,
- Initiatives specific to the four Main Campus development districts (e.g., green roofs, use of natural delighting, natural ventilation, and shading devices along south-facing glass).

Built upon the 2007 *Local Action Plan for Climate Change* and the City's open space plan, *GreenPlan*, *Greenworks Philadelphia* contains goals, measurable targets and specific initiatives to be met in the City of Philadelphia by 2015. The goals and targets are listed below.

- Goal: Philadelphia reduces its vulnerability to rising energy prices.
  - Target 1 – Lower City government energy consumption by 30%
  - Target 2 – Reduce City-wide building energy consumption by 10%
  - Target 3 – Retrofit 15% of housing stock with insulation, air sealing and cool roofs
  - Target 4 – Purchase and generate 20% of electricity used in Philadelphia from alternative energy sources

- Goal: Philadelphia reduces its environmental footprint.
  - Target 5 – Reduce greenhouse gas emissions by 20%
  - Target 6 – Improve air quality toward attainment of Federal standards
  - Target 7 – Divert 70% of solid waste from landfill

- Goal: Philadelphia delivers more equitable access to healthy neighborhoods.
  - Target 8 – Manage stormwater to meet Federal standards
  - Target 9 – Provide park and recreation resources within 10 minutes of 75% of residents
  - Target 10 – Bring local food within 10 minutes of 75% of residents
  - Target 11 – Increase tree coverage toward 30% in all neighborhoods by 2025

- Goal: Philadelphia creates competitive advantage from sustainability.
  - Target 12 – Reduce vehicle miles traveled by 10%
  - Target 13 – Increase the state of good repair in resilient infrastructure
  - Target 14 – Double the number of low- and high-skill green jobs

- Goal: Philadelphians unite to build a sustainable future.

As mentioned previously, the development and implementation of this Climate Action Plan (CAP) provides opportunities for shaping existing internal and external initiatives. In turn, these initiatives provide guidance for the priorities outlined in this CAP. In summary, this CAP has been developed in the context of complementary objectives including:

- Temple's academic vision
- Temple's sustainability vision
- Temple's master planning objectives
- The City of Philadelphia's sustainability objectives

These concurrent programs have the aim of making Temple a more vibrant, livable, and resourceful community that makes efficient use of energy and resources.

2. Campus Emissions

2.1 Baseline Year FY 2006

As part of its commitments under ACUPCC, Temple has prepared a baseline greenhouse gas (GHG) inventory and publicly posted it on the ACUPCC online reporting tool (AASHE, 2009). In the fiscal year 2005-2006 (FY2006) baseline year, total gross emissions were 226,219 metric tons carbon dioxide equivalent ($MTCO_2E$).

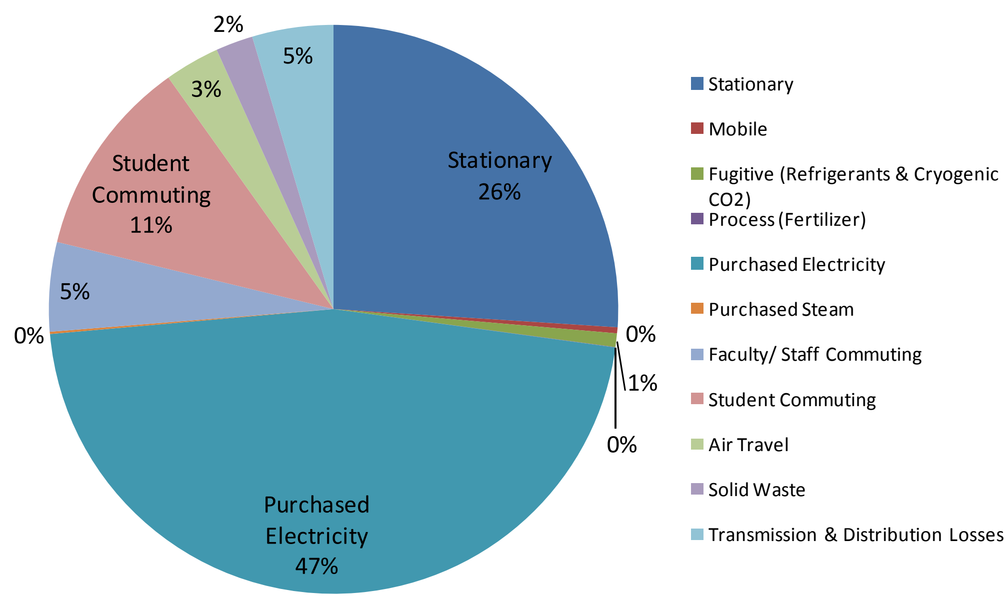


FIGURE 2-1. GREENHOUSE GAS (GHG) EMISSIONS BY SOURCE (FY2006)

The primary emission sources were purchased electricity, stationary combustion, and commuting (student and faculty/staff), collectively accounting for approximately 89% of total annual gross emissions. As Temple progresses toward the long-term goal of achieving carbon neutrality, these three sources will have to be prioritized in order to achieve meaningful overall greenhouse gas emissions reductions.

2.2 Trends from FY 2006 to 2008

In FY 2008, total gross emissions declined 3.5% relative to the FY 2006 baseline, due to stationary combustion fuel switching from fuel oil to natural gas. Over this period, total net emissions declined by 4.5% due to both fuel switching and an increase in purchased renewable energy credits (RECs) to offset purchased electricity.

TABLE 2-1. GREENHOUSE GAS (GHG) EMISSION ESTIMATES (FY2006 – FY2008)

		FY 2006	FY 2007	FY 2008
Scope 1 Emissions (Metric tons CO_2E)	Stationary	58,834	56,871	46,739
	Mobile	782	796	803
	Fugitive (Refrigerants & Cryogenic CO_2)	1,764	1,702	1,682
	Process (Agriculture/Fertilizer)	14	11	13
	Total Gross Emissions	61,394	59,380	49,238
Scope 2 Emissions (Metric tons CO_2E)	Purchased Electricity	105,118	103,726	107,278
	Purchased Steam	281	315	324
	Total Gross Emissions	105,400	104,041	107,602
Scope 3 Emissions (Metric tons CO_2E)	Faculty/ Staff Commuting	11,475	11,453	11,625
	Student Commuting	25,682	25,898	26,762
	Air Travel	7,047	7,868	7,950
	Solid Waste	4,810	4,582	4,267
	Paper Purchasing	N/A	N/A	213
	Transmission & Distribution Losses	10,411	10,275	10,627
	Total Gross Emissions	59,426	60,076	61,444
Scope 1 – 3 Gross Emissions (Metric tons CO_2E)	**Total Gross Emissions**	**226,219**	**223,497**	**218,284**
	Gross Square Footage (GSF)	8,266,175	8,271,765	8,271,765
	Full-time Equivalent Students (FTE)	27,055	27,560	28,535
	Total Gross Emission Intensity per 1000 GSF	**27.37**	**27.02**	**26.39**
	Total Gross Emission Intensity per FTE	**8.36**	**8.11**	**7.65**
Scope 1 – 3 Net Emissions (Metric tons CO_2E)	Purchased Offsets	-157	-2,423	-2,272
	Total Net Emissions	**226,063**	**221,074**	**216,012**
	Total Net Emission Intensity per 1000 GSF	**27.35**	**26.73**	**26.11**
	Total Net Emission Intensity per FTE	**8.36**	**8.02**	**7.57**

In FY 2008, total gross emission intensity per 1000 GSF and per FTE declined 3.6% and 8.5%, respectively, relative to the FY 2006 baseline. Over the FY 2006 to 2008 period, total student enrollment (FTE) grew by 5.5% while total gross emissions declined, resulting in the considerable decline in emission intensity per FTE. As Temple progresses towards its long-term goal of achieving carbon neutrality, emission intensity will have to continue to decline in order to reduce GHG emissions while allowing for institutional growth.

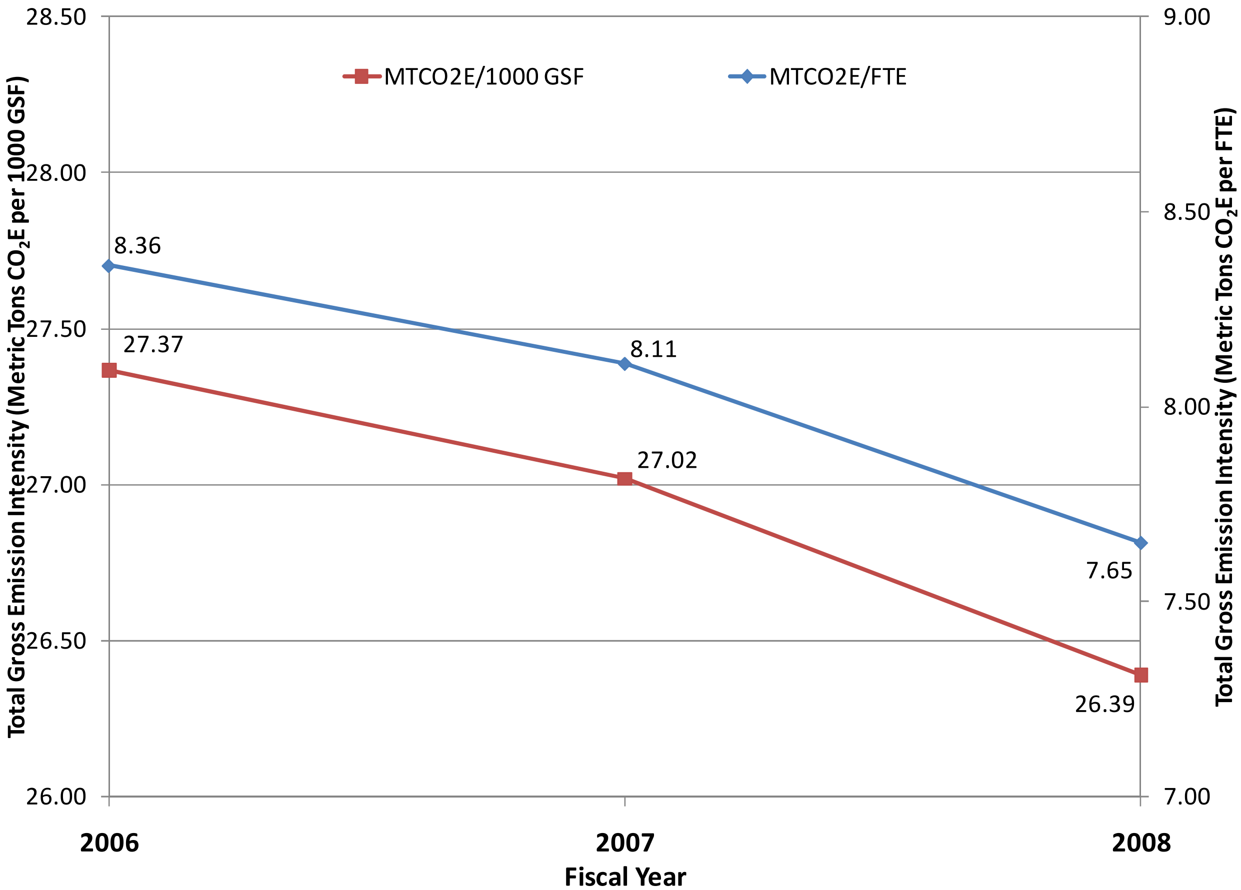


FIGURE 2-2. TOTAL GROSS EMISSION INTENSITY (FY2006 - FY2008)

For reference, average Scope 1-3 gross emission intensities for doctorate-granting universities are 20.59 MTCO2E/1000 GSF and 8.33 MTCO2E/FTE (ACUPCC Reporting System, 2009; http://acupcc.aashe.org/). On a per FTE basis, Temple's emission intensity is 8% lower than average, whereas on a GSF basis, Temple's emission intensity is 31% higher than average. For the purpose of this CAP, peer institutions are doctorate-granting institutions that have posted to the ACUPCC online reporting tool.

2.3 Forecasting Emissions through 2030

Scope 1, 2 and 3 emission sources were placed into two categories according to their correlation with two emission intensity metrics, building space (GSF) and population (FTE).

TABLE 2-2. EMISSIONS INTENSITY BY EMISSIONS SOURCE (FY2006 – FY2008)

	Average Emission Intensity
Sources dependent on GSF ($MTCO_2E$ per 1000 GSF)	
Purchased electricity	12.742
Fugitive sources	0.208
Purchased steam and chilled water	0.037
Stationary combustion	6.548
Process sources	0.002
T&D losses	1.262
Sources dependent on FTE ($MTCO_2E$ per FTE)	
Mobile combustion	0.029
Faculty/Staff commuting	0.416
Student commuting	0.942
Air travel	0.275
Solid waste	0.165
Paper purchasing	0.007

The average GHG emission intensity (GSF and FTE basis) during the FY 2006-2008 period was calculated and combined with projected changes in GSF and FTE to forecast future GHG emissions.

- Gross square footage (GSF) projections are based on the Temple (2009) master plan which considers campus development through 2020, with updates from Temple's Office of Sustainability. GSF is assumed to level off after 2020.
- Student enrollment was conservatively assumed to remain constant despite demographic projections featuring a decrease in the population of ages 18 to 24 years in the Commonwealth of Pennsylvania through 2030 (Source: U.S. Census Bureau, 2005) and in all combined age groups in Philadelphia County through 2030 (Source: Pennsylvania State Data Center, 2008).

TABLE 2-3. PROJECTIONS FOR EMISSIONS INTENSITY METRICS

Fiscal Year (FY)	1000 GSF	FTE
2008	8,272	28,535
2010	9,442	28,535
2020	11,320	28,535
2030	11,320	28,535

Forecasted business-as-usual emissions show an increase in total $MTCO_2E$ emissions from 226,219 $MTCO_2E$ emissions in the baseline year (FY 2006) to 287,752 $MTCO_2E$ in 2020 and through 2030. This represents a 27% increase in emissions by 2020 through 2030 compared to the baseline level.

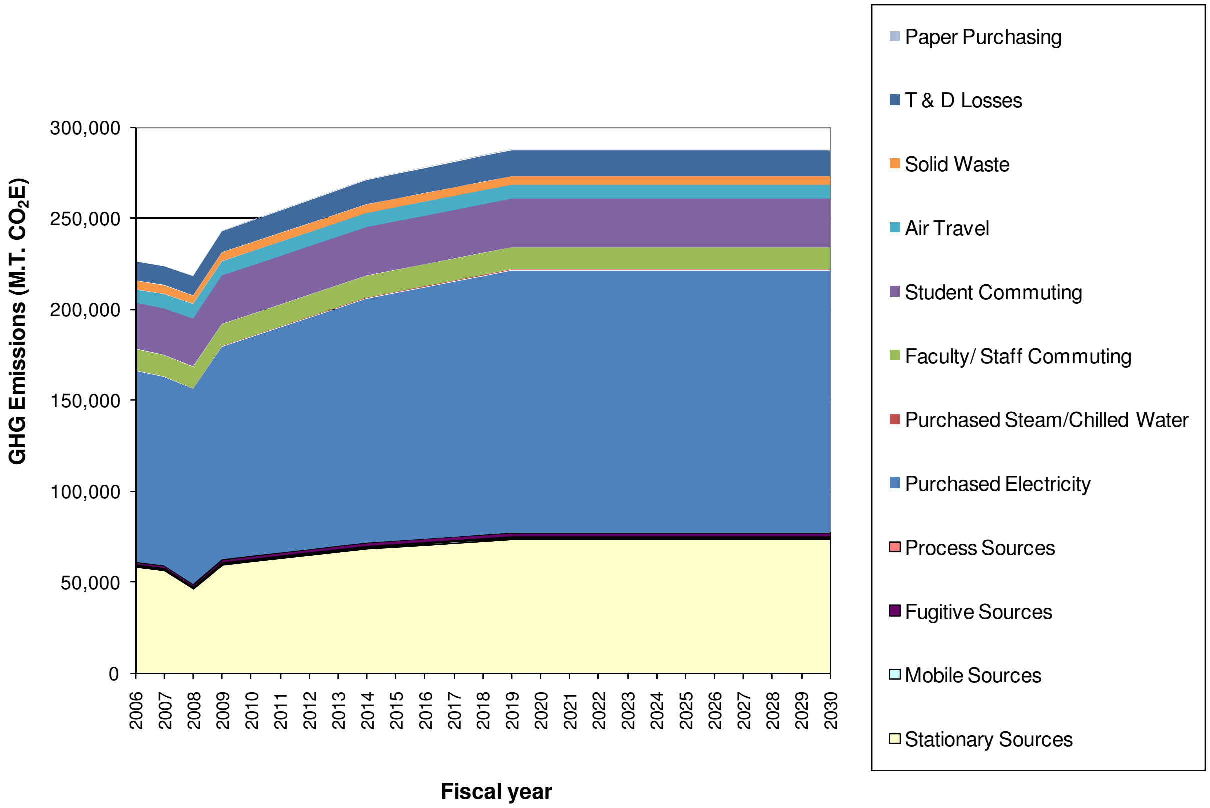


FIGURE 2-3. BUSINESS-AS-USUAL GHG EMISSION FORECAST

The business-as-usual greenhouse gas emission (GHG) forecast is based on the assumption that emission intensity remains constant. However, emission intensity is variable, and the above forecasts are based on the average values for this parameter from the baseline data.

In order to evaluate uncertainty in the greenhouse gas emissions forecast, a sensitivity analysis utilizing the range of emission intensities from FY 2006 to 2008 can be utilized to estimate lower and upper bound future emissions.

This sensitivity analysis indicates that future GHG emissions are forecasted to be between 21 to 32% higher than baseline levels (FY 2006) by 2020 through 2030. This wide range of forecasts reflects the variability in the input parameters used to develop the business-as-usual emissions forecast.

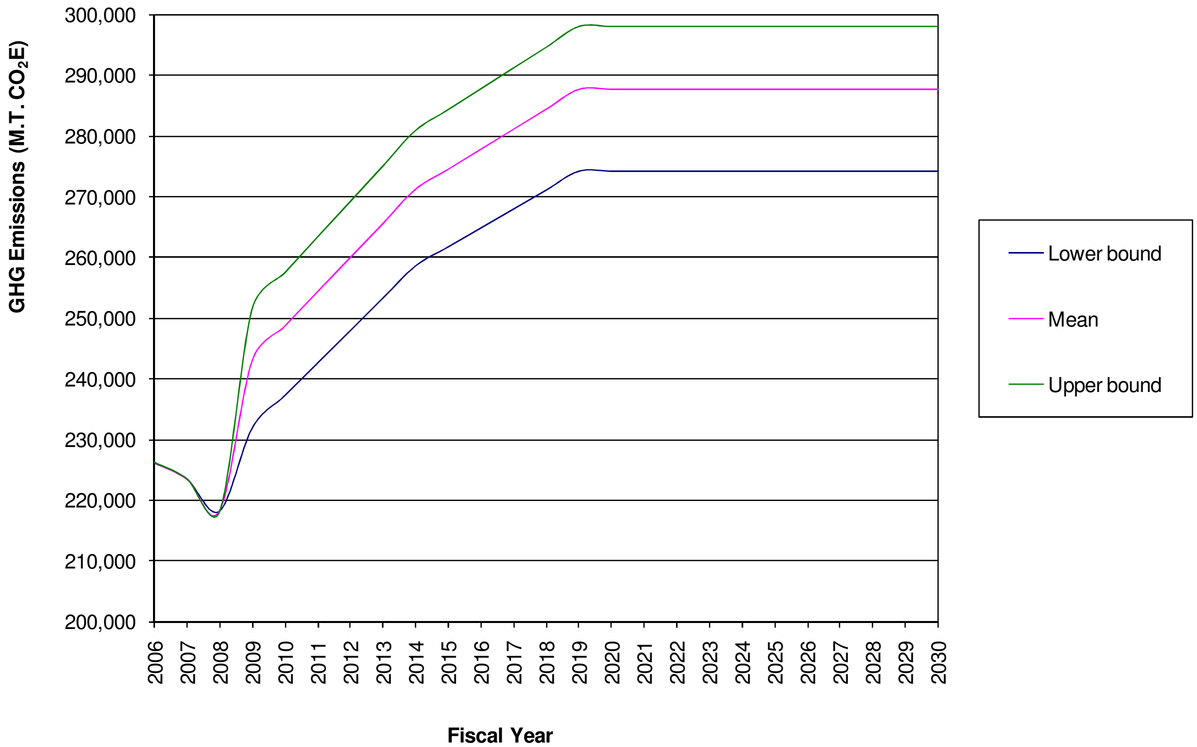


FIGURE 2-4. FUTURE GREENHOUSE GAS EMISSIONS SENSITIVITY ANALYSIS

2.4 External Goals

The ACUPCC does not prescribe a timetable for when each signatory must achieve its long-term commitment to carbon neutrality. It is common practice for institutions involved in climate action to establish interim and long-term emissions reduction goals to facilitate planning for ambitious climate neutrality goals. Both science-based and policy-based targets can provide guidance for potential reduction goals. *The table below summarizes various proposed goals at the local, national, and international level for greenhouse gas emissions reductions:*

TABLE 2-4. INTERIM AND LONG-TERM CLIMATE ACTION GOALS

Scope	Organization	GHG Emission Reduction Goal[b]
International[a]	Intergovernmental Panel on Climate Change (IPCC, 2007)	• 25% below 1990 levels by 2020
		• 80% below 1990 levels by 2050[c]
National	American Clean Energy and Security Act of 2009[d]	• 3% below 2005 level in 2012
		• 20% below 2005 level in 2020
		• 42% below 2005 level in 2030
		• 83% below 2005 level in 2050[c]
Local	U.S. Mayor's Climate	• 7% below 1990 levels by 2012

	Protection Agreement	
Local	Philadelphia Greenworks	• 20% below 1990 levels by 2015

Notes:
(a) Also recommended in the ACUPCC Implementation Guide.
(b) For the purposes of this table, FY2006 is used as the baseline for reductions.
(c) Although this goal is set for 2050, only goals up to 2030 are considered within the scope of this Climate Action Plan.
(d) Passed the U.S. House of Representatives on June 26, 2009.

Under these external goals, Temple would need to decrease GHG emissions by approximately 130,000 metric tons CO_2E by 2030, relative to the University's business-as-usual trajectory. If Temple begins taking action in 2010, this would involve reductions of approximately 6,000 metric tons CO_2E annually.

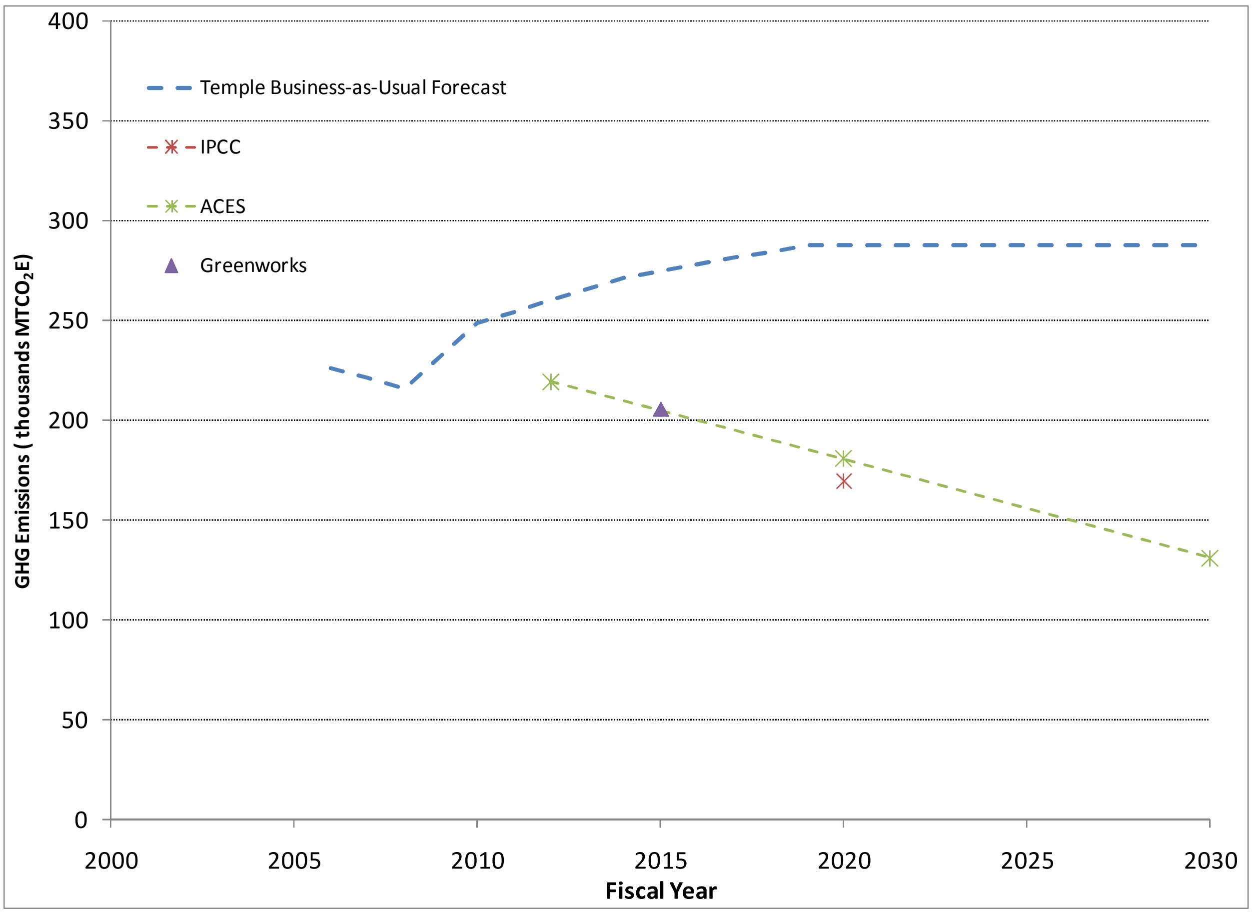


FIGURE 2-5. FORECASTED CLIMATE ACTION GOALS

The following table shows how an annual GHG emissions reduction of 6,000 metric tons CO_2E would translate into actual energy and resource usage reductions for various emission sources.

TABLE 2-5. ANNUAL GREENHOUSE GAS (GHG) EMISSIONS AND USAGE REDUCTIONS

Scope	Source[a]	Annual GHG Emissions Reduction ($MTCO_2E$)[b]	Corresponding Annual Usage Reduction[c]	Usage Units (substance used)
1	Stationary sources	1,649	31,263	MMBTU (natural gas)
	Mobile sources	22	2,518	gallons (gasoline)
2	Purchased electricity	2,947	5,620,722	kWh
	Purchased steam	8	107	MMBTU (steam)
3	Commuting	1,042	2,643,999	vehicle miles
	Air Travel	197	255,378	passenger-miles
	Solid Waste	135	125	US tons
1-3	Total	6,000		

(a) T&D losses, while listed as a contributor to the GHG inventory, are excluded from this table because the end-user does not have direct control over reducing these emissions, except through reduction in Scope 2 usage (which is already accounted for in this table). Process and fugitive emissions are also excluded from this table due to their small (< 1%) contribution to total emissions.

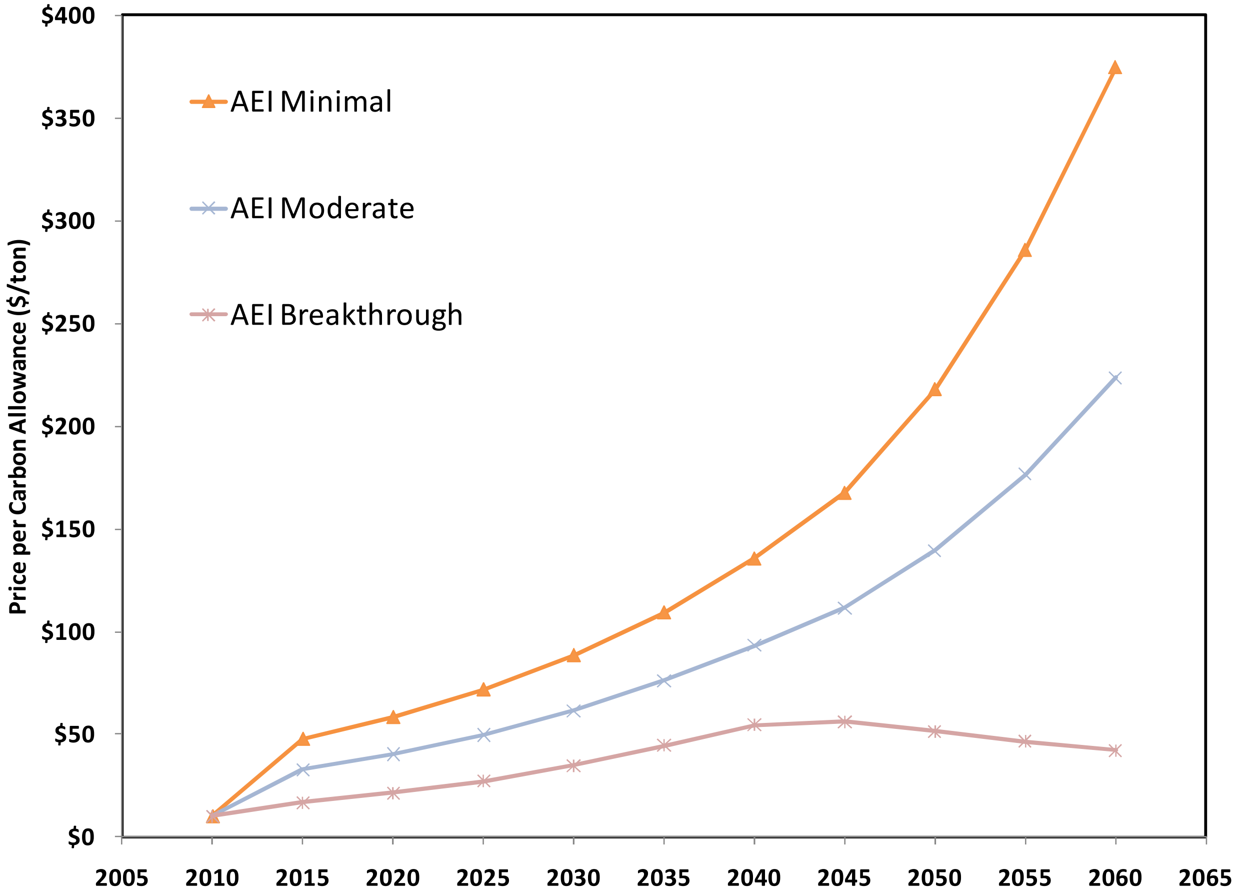
(b) The target overall reduction of 6,000 $MTCO_2E$ is distributed among sources according to the percentage contribution of each source.

(c) Emission factors are obtained from Clean-Air Cool-Planet Campus Carbon Calculator. The emission factor for natural gas is used for stationary sources, gasoline for mobile sources, and auto travel for commuting. The emission factor for solid waste is based on emissions of MTCO2E for solid waste disposal per amount of solid waste generated in FY 2006.

2.5 Regulatory Risk

This section summarizes the assessment of Temple's exposure to potential federal climate change regulation. Direct stationary combustion in Temple's Central Steam Plants is Temple's primary regulatory risk driver. As a result of these sources, Temple's Main Campus and Health Sciences Center Campus exceed reporting thresholds under the U.S. EPA mandatory reporting rule, as well as thresholds under the proposed Waxman-Markey federal cap-and-trade program. Under the latter program, financial exposure can be estimated by considering projected prices of carbon allowances over the coming decades. Based on a compilation of economic projections, carbon allowances are expected to increase in price by over an order of magnitude by 2030 to 2050 (Synapse, 2008; Trexler and Nexant, 2006, CRA, 2008, Brattle, 2009).

FIGURE 2-6. FORECAST OF UNIT PRICE OF CARBON ALLOWANCES THROUGH MID-CENTURY



Financial exposure was calculated by AEI (consultant in 2009) using a GHG emissions scenario based on the CA-CP file prepared by Temple. The GHG projections for the exposure estimations were calculated for Scope 1 stationary combustion forecasted through 2060 (see Figure 2-3).

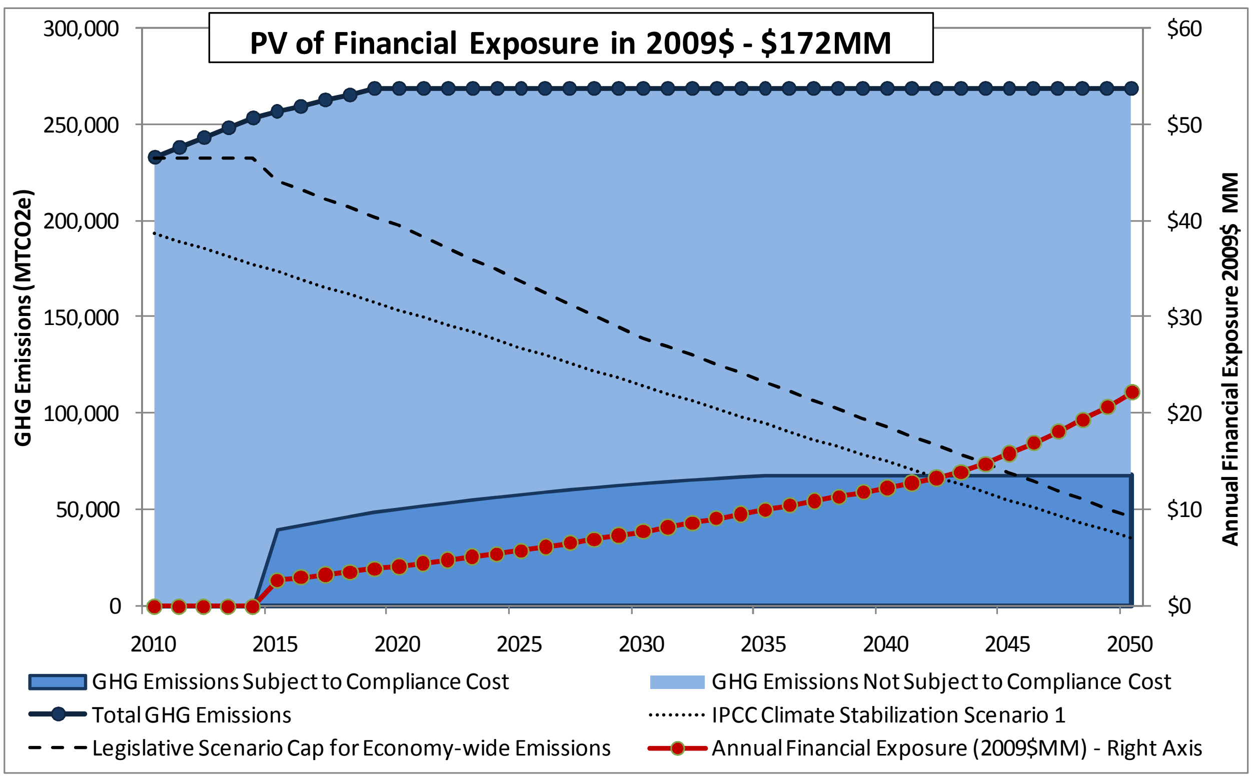
AEI calculated annual financial exposure for Temple based on a range of GHG policy and energy scenarios and potential cases of technological advancement. Legislation and technology are the significant factors shaping future pricing scenarios regarding GHG emission reduction. Legislation affects the quantity of emission allowances that would need to be purchased by Temple. Technological advances affect the cost of an allowance. The calculated cumulative financial exposure is provided in the following table expressed in millions (MM) of 2009 dollars.

TABLE 2-6. CUMULATIVE FINANCIAL EXPOSURE [AEI, 2009]

		Legislative Scenario		
		Weak	Moderate	Stringent
Technology Advances	Breakthrough	$11MM	$35MM	$59MM
	Moderate	$21MM	$66MM	$125MM
	Minimal	$27MM	$98MM	$172MM

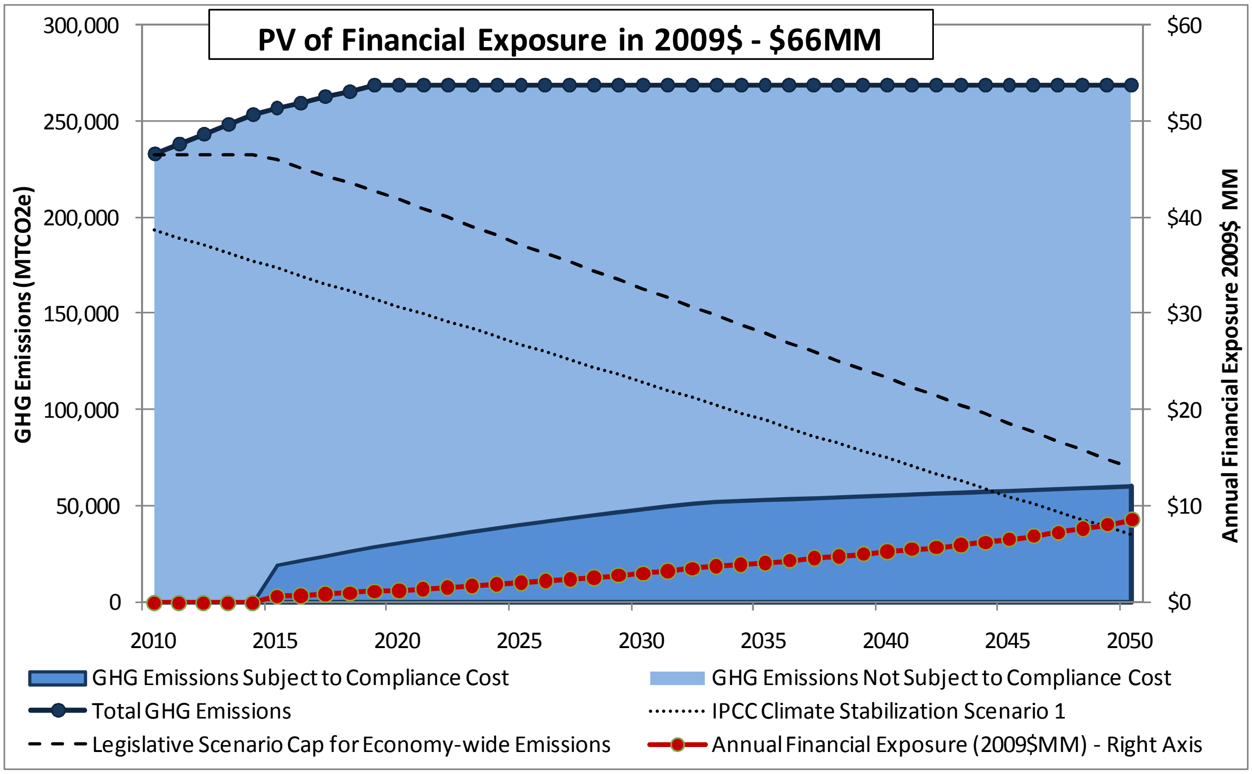
The worst-case scenario of $172 million is based on a stringent legislative cap and limited advances in technology relating to mitigation of greenhouse gas emissions. This scenario is depicted graphically in the following figure.

FIGURE 2-7. WORST-CASE SCENARIO OF FINANCIAL EXPOSURE [AEI, 2009]



The "expected" scenario of $66 million is based on a moderate legislative cap and moderate advances in technology relating to mitigation of greenhouse gas emissions. This scenario is depicted graphically in the following figure.

FIGURE 2-8. EXPECTED VALUE OF FINANCIAL EXPOSURE [AEI, 2009]



This analysis, while speculative, puts a potential price on carbon which can be used in institutional decision-making.

3. Mitigation Strategies

3.1 Background

In the previous section, it was concluded that Temple would have to reduce greenhouse gas (GHG) emissions by 1 to 2% per year below baseline (FY 2006) levels in order to meet potential interim and long-term emission reduction goals. This translates into a reduction of 40,000 $MTCO_2E$ by 2020 and 130,000 $MTCO_2E$ by 2030, relative to Temple's business-as-usual trajectory, which is equivalent to reductions of approximately 6,000 $MTCO_2E$ per year. When this quantity is apportioned to the various Scope 1, 2 and 3 emission sources using their percentage contributions to the baseline footprint, this corresponds to the annual emission source reductions shown in Table 2-5 in the previous section, which have in turn been converted to their corresponding reductions in energy or travel.

In order to identify potential emission reduction projects that could help realize the reduction goals, Temple has conducted surveys and/or reviews focusing on the following areas:

- Buildings and Central Plants
- Renewable Energy
- Transportation
- Behavior Change
- Recycling and Waste Minimization

Recommendations pertaining to these areas are summarized below.

3.2 Buildings and Central Plants

3.2.1 Ranking of Building Energy Consumption

A total of 131 facilities consumed 1,660,334 million British Thermal Units (MMBTU) of energy in the FY 2009 period, related to the usage of electricity and steam. End user facilities were ranked by descending order of total energy usage. Figure 3-1 includes the 30 top-ranking end user facilities which consume approximately 81% of the total energy. Biology Life Sciences, the top-ranking user, consumes approximately 8% of the total energy or 140,398 MMBTU.

Energy intensity data (electricity and steam usage per square foot of building space) was also analyzed and compared against the U.S. Department of Energy (USDOE) Commercial Buildings Energy Consumption Survey (CBECS) benchmarks for U.S. Climate Zone 3 (Figure 3-2).

Based on analysis of energy and energy intensity data, the following were selected as high energy-consuming buildings to be targeted in this Climate Action Plan:

<u>Science and Research</u>

- Biology Life Sciences
- Medical Research Building
- Beury Hall
-

- Pharmacy Building
- Dental School (old and new)
- Kresge Science Hall

Academic/Administration

- Ritter Annex
- Tuttleman Learning Center
- Weiss Hall
- Wachman Building

Student Life

- Mitten Hall
- Faculty Student Union (Health Science Center)

These buildings fall within the top twenty emitters of CO_2E from electricity and steam usage. Together, they account for about 36% of total greenhouse gas emissions from stationary combustion and purchased electricity.

FIGURE 3-1. TEMPLE UNIVERSITY BUILDINGS RANKED BY TOTAL ENERGY USAGE

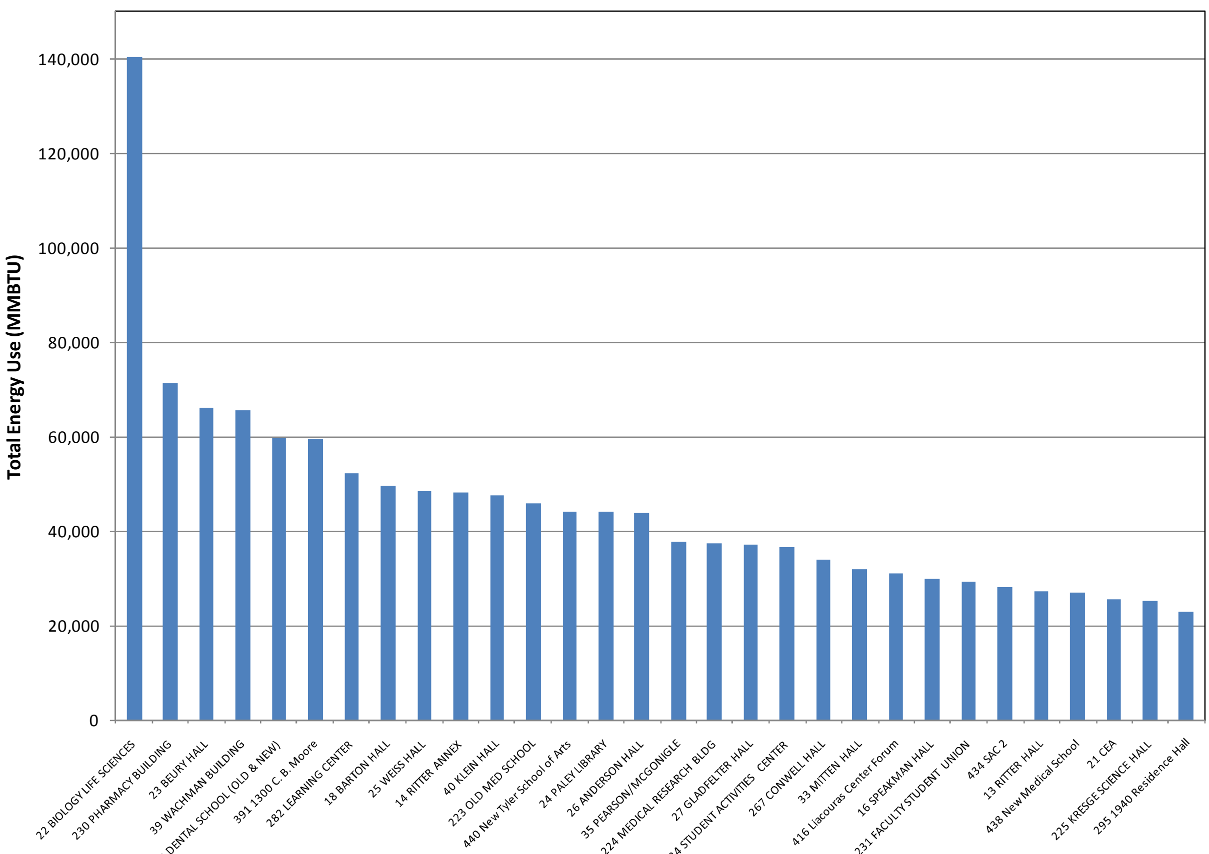
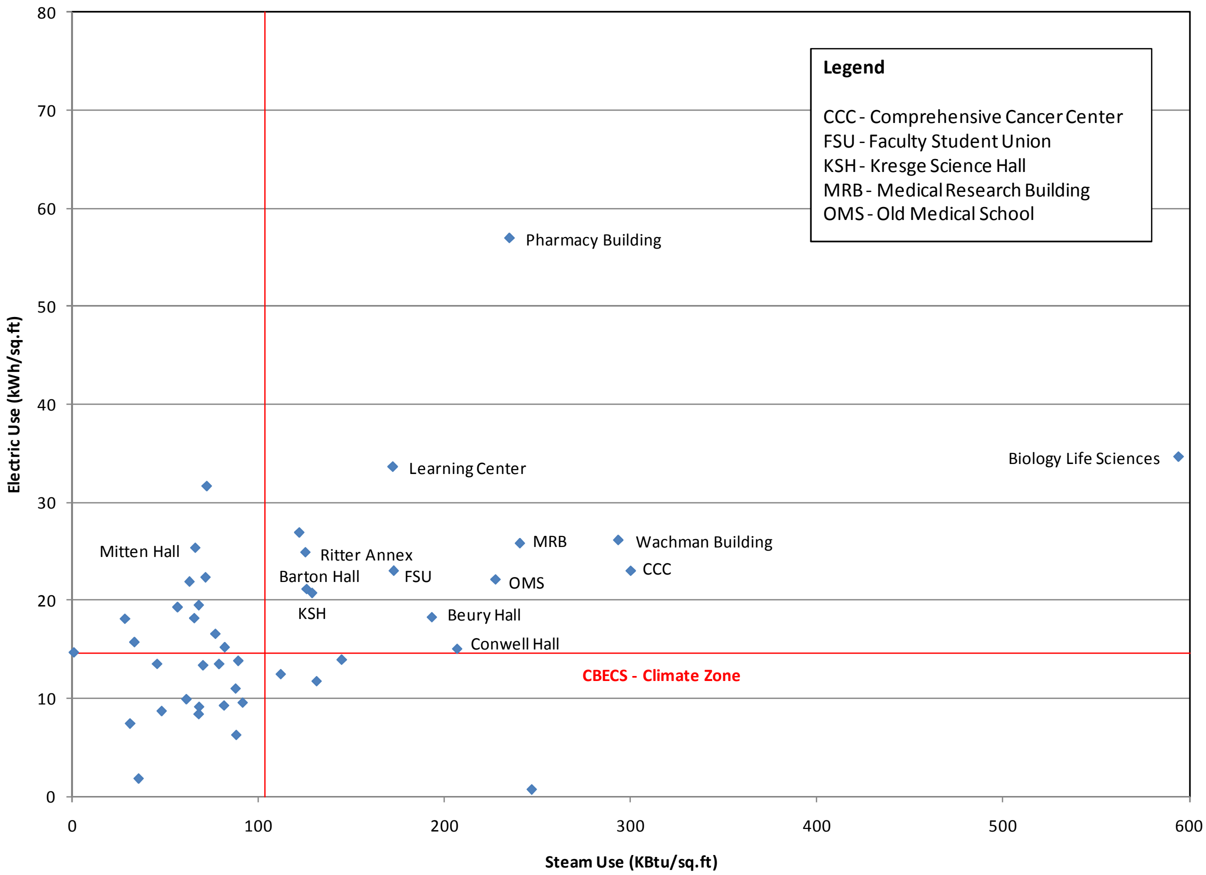


FIGURE 3-2. Temple University building energy intensity (in blue diamonds) compared to U.S. Department of Energy (USDOE) Commercial Buildings Energy Consumption Survey (CBECS) benchmarks for electricity and steam intensity (in solid red lines). Note: buildings in northeast quadrant exceed average energy intensity in Climate Zone 3 for both electricity and steam usage.



3.2.2 Phase I Building Automation

Temple will conduct a phased approach to building energy management. The first phase will institute building automation systems for high energy using buildings. As opposed to relatively simple temperature control systems whose primary function is to just monitor and maintain room temperatures, building automation systems are utilized to optimize energy performance of the mechanical systems within any given building or group of buildings. These systems are easy to confuse as they are often provided by the same manufacturer. The primary difference is the level of control and the number of monitored points and sophistication of the control sequences. The following are all typical strategies employed by building automation systems:

- All variable volume pumping and air handling systems should be optimized, such that there is always at least one zone calling for 90% flow – as opposed to controlling pressure to an arbitrary set point that is often guessed at, and incorrect.
- Provide feedback that confirms commanded points, such as end switches on actuators – rather than assuming that if a damper is commanded closed that it actually is closed.
- Provide complete access to all monitoring data, so that it may be trended in a timeline that is useful for comparing data to applicable equipment – such as a trend that records chilled water BTU usage by building with an output from the chiller controls that trends chilled water temperature and chiller efficiency.
- Provide real-time energy usage data and estimated energy costs so that facility operators can monitor building performance, predict maintenance issues and make necessary adjustments to how facilities run.
- All mixed-technology equipment of the same output (such as mixed technology boilers or chillers) can be automatically staged and brought on line in such a manner that energy costs are minimized based on gas and electric rates and demand charges.
- Provide calculations and predict optimal start and stop times for equipment, in order to maximize setback times and minimize discomfort by pulling down or warming up spaces to anticipate occupancy.
- Interface with the campus maintenance automation program to provide automated service requests and closure – based on alarms and manufacturer's suggested operation and maintenance procedures.

Further details are provided in Appendix A.

Project Type	**Demand Side Management**	
Project Title	Phase I Building Automation Systems	
Timeline	Starting in calendar year 2010	
Project Description	Building automation systems will be implemented in the following facilities beginning 2010 and to be completed as soon as possible (see Appendix A): Biology & Life Sciences Building; Barrack Hall; Bell Building; PNAH; Dental School (Old and New); Wachman Building; Old Medical Building; Beury Hall; New Tyler; 1300 C. B. Moore; HSC CCWP West; Anderson Hall; Medical Research Building; Ritter Hall and Annex; Weiss Hall; Gladfelter; Pearson / McGonigle; Faculty Student Union; Klein; Paley Library; New Medical School; Temple Towers; Mitten Hall; Student Activities Center; Kresge Hall; Podiatric Building (Main and Dorm); CEA; Conwell Hall; Johnson; Speakman; Annenberg / Tomlinson; SAC 2; Standby Generator; Ambler Learning Center; Comprehensive Cancer Center; 1940 Residence Hall; Student Pavilion; White Hall	
Project Metrics	Simple Payback (years)	6
	Annual Energy Cost Savings	$1,550,700
	Annual GHG reduction ($MTCO_2E$)	8,165
	Annual Energy Savings	7,753,500 kWh 77,500 MMBTU

3.2.3 Phase II Plant Development Fund Projects

As a second phase to building energy management, Temple will implement a series of planned building improvements during the period of 2011 to 2013. Improvement projects that have identified energy savings are summarized below. Further details are provided in Appendix B.

Project Type	**Demand Side Management**	
Project Title	Phase II Plant Development Fund Projects	
Timeline	1 – 3 years	
Project Description	Planned building improvements will be implemented in the following facilities in the near term (see Appendix B): Health Sciences Campus-Central Steam Plant; Ambler Campus; Pharmacy Building; Anderson Building; Medical Research Building; Gladfelter Building; Faculty Student Union; Kresge Hall; Podiatric Building; School of Engineering & Architecture; Conwell Hall; Ritter Hall; Medical Office Building; Main OFM; Dixon Building; Widener Hall; Bright Hall; Ambler Administration	
Project Metrics	Simple Payback (years)	10-14
	Annual Energy Cost Savings	$2,447,000 - $3,695,800
	Annual GHG reduction ($MTCO_2E$)	11,760 – 17,900
	Annual Energy Savings	15,406,700 – 24,262,800 kWh 70,600 – 99,710 MMBTU

3.2.4 Phase III Energy Conservation Measures (ECM) for High Energy Using Buildings

As a third phase to building energy management, Temple will implement energy conservation measures (ECMs) at high energy using buildings. A comprehensive audit has been conducted for Temple buildings that have identified potential energy conservation measures in the following areas: building envelope, lighting, heating and cooling, plumbing, utility distribution, electrical and special systems, and operations and maintenance. Projects that have identified energy savings are summarized below. Further details are provided in Appendix C.

Project Type	**Demand Side Management**	
Project Title	Phase III Energy Conservation Measures for High Energy Using Buildings	
Timeline	4 – 10 years	
Project Description	Energy conservation measures will be implemented in the following facilities by 2020 (see Appendix C): Biology and Life Sciences Building; Beury Hall; Mitten Hall and Annex; Ritter Annex; Wachman Hall; Weiss Hall; Dental School (old and new); Faculty Student Union; Kresge Hall; Medical Research Building; Pharmacy Building.	
Project Metrics	Simple Payback (years)	6 – 10
	Annual Energy Cost Savings	\$3,746,800 - \$6,634,500
	Annual GHG reduction ($MTCO_2E$)	19,580 – 34,670
	Annual Energy Savings	30,582,763 – 54,880,280 kWh 68,850 – 114,650 MMBTU

Note that as a potential follow-up to Phase III, Temple is considering a Phase IV that implements energy conservation measures for the remaining campus from 2020-2030.

3.2.5 Central Plant Energy Conservation Measures

Various energy conservation measures have been implemented at Temple's central plants, which include steam and chilled water plants and a standby electric generating facility. Potential future opportunities include the following:

- Steam Plant Energy Conservation Measures – Boiler replacement; boiler stack economizers; blow-down heat recovery; combined heat and power; emergency generation and peak shaving; natural gas rate switch
- Chilled Water Plant Energy Conservation Measures – Condenser water reset; chilled water reset;, proper pump sizing; water-side economizers; chiller replacement; variable speed cooling tower fans; variable flow pumping

Further details are provided in Appendix D.

3.2.6 Mitigating Campus Growth

Temple is a member of the U.S. Green Building Council (USGBC), and campus growth that is anticipated in Temple's master plan will be mitigated through a variety of measures established by the Temple's Office of Facilities Management. Design standards for new construction include:

- Occupancy sensors are required for all renovations
- Direct Digital Controls (DDC) are required for all mechanical system installations or upgrades
- All DDC controls must be tied into the campus energy management system
- The standards are distributed electronically to all professional design firms
- Many sustainable and energy-conserving measures for both new construction and renovations
- Electronic ballasts and fixtures
- Non-CFC (no chlorofluorocarbons) building equipment
- Recycled content of building materials
- Leadership in Energy and Environmental Design (LEED) accredited professionals as participants of project teams
- Energy star rated appliances

Overall, Temple is targeting new building design to limit energy usage to 30% below the industry standard baseline (ASHRAE 90.1).

Project Type	Demand Side Management	
Project Title	Design standards for new construction	
Timeline	0 - 5 years (near term)	
Project Description	Target new building design to limit energy usage to 30% below the industry standard baseline (ASHRAE 90.1).	
Project Metrics	Simple Payback (years)	-
	Annual Energy Cost Savings	$2,120,000
	Annual GHG reduction ($MTCO_2E$)	11,130
	Annual Energy Savings	15,840,000 kWh; 53,340 MMBTU

3.2.7 Reflective and Green Roofs

During building design or roof replacement on campus, use of reflective roof coatings or materials can be considered. According to the Energy Star program, solar reflectance is the most important characteristic of a roof product in terms of yielding the highest energy savings during warmer months. Reflective roofing products can lower the temperature by 100 degrees Fahrenheit, which can be reflected as a 10 to 15% drop in a building's cooling bill. Painting a roof white can offset as much as five metric tons of CO_2 a year on a 500 square foot roof.

Vegetated roof covers (green roofs) are comprised of subsurface drainage systems, growth media, and vegetation. The vegetation intercepts direct precipitation and delays runoff by capturing and holding the precipitation in the plant foliage, absorbing water in the root zone, and slowing the velocity of direct runoff through the dense vegetation. Retained precipitation is returned to the atmosphere through evapotranspiration.

Green roofs not only reduce storm water generation, but can have the secondary effect of reducing emissions from the building sector. Landscaping with herbaceous and woody plants has proven to reduce local heat island effects. By lowering rooftop temperatures, higher efficiencies are achieved in rooftop mounted HVAC equipment (*e.g.*, heat exchangers, cooling towers) and electrical equipment (*e.g.*, solar panels), thereby reducing building energy requirements.

The vegetated roof covers range from simple single layer systems with free drainage to more complex multi-layer systems incorporating restricted drainage. Green roofs can reduce peak flows to city sewers as well as reduce the total amount of rain water that reaches city sewers. Another, secondary, advantage is that vegetated roof covers have the ability to provide an effective insulating layer, which reduces heating energy costs. During hot weather, temperatures on green roofs are much less than traditional black roofs which yield potential energy savings from a reduction in interior cooling requirements. In 2005, Temple's Ambler Campus unveiled a working green roof atop the new Intercollegiate Athletics Field House, built with the assistance of a $50,000 grant from PECO.

3.3 Supply-Side Management

3.3.1 Biofuel

Temple currently produces steam at central plants through the consumption of natural gas and fuel oil. Temple is considering biofuel alternatives to fossil fuel combustion, including combustion of waste vegetable oil (WVO). Biofuel combustion is generally considered carbon neutral, because the emissions from biofuel combustion are balanced by the sequestration of carbon during plant growth. For example, biofuel combustion does not fall under the reporting thresholds for the USEPA mandatory greenhouse gas reporting rule, and is documented separately from fossil fuel greenhouse gas emissions.

Project Type	Supply Side Management	
Project Title	Fuel Switching from No. 6 Fuel Oil to Waste Vegetable Oil (WVO)	
Timeline	0-5 years (short term)	
Project Description	Provide approximately 20% of maximum hourly heat input to one central steam plant boiler through combustion of WVO (576,000 gallons per year; 0.130 MMBTU/gal; $10.94/MMBTU) instead of No. 6 fuel oil (0.150 MMBTU/gal; $10/MMBTU). Project cost is incremental cost over purchasing No. 6 oil and is an annual recurring cost. In addition to this, there will be an initial boiler retrofit to preheat WVO prior to combustion, which will cost approximately $50,000. Annual energy cost savings is the avoided compliance cost of projected GHG cap-and-trade regulation with which Temple would have to comply as a large emitter. An allowance price of $20/MTCO$_2$E is assumed under cap-and-trade regulation.	
Project Metrics	Simple Payback (years)	-
	Annual Energy Cost Savings	$112,191
	Annual GHG reduction (MTCO$_2$E)	5,610
	Annual Energy Savings	-

3.3.2 Solar

Solar photovoltaic (PV) systems use solar panels made of silicon to convert sunlight into electricity. In a grid-interconnected solar power system, the photovoltaic panel or array of panels is added onto a regular source of electricity (provided by either off-site or on-site generation). The use of solar energy can reduce Temple's reliance on purchased electricity depending on how big a system is purchased. In an urban setting, unshaded south-facing roof areas of buildings and rooftop space on parking decks are suitable locations for solar PV systems. To help reduce the simple payback on solar PV projects, solar renewable energy certificates (SRECs) can be sold at the current rate of $220/MWh in exchange for generic RECs at the current lower rate of $2/MWh.

Solar thermal systems use flat plate collectors for harnessing solar energy for thermal energy (heat). The use of solar thermal energy can reduce Temple's reliance on natural gas for heating water. In a campus setting, solar thermal systems are most applicable in buildings with strong demand for hot water, such as residence halls.

3.3.3 Wind Power

Small wind turbines are wind turbines which have lower energy output than large commercial wind turbines, such as those found in wind farms. Small units often have direct drive generators, direct current output, aeroelastic blades, lifetime bearings and use a vane to point into the wind. Larger, more costly turbines generally have geared power trains, alternating current output, flaps and are actively pointed into the wind. Temple is considering installation of three 6-kW wind turbines as part of the Pearson-McGonigle capital renovation project.

Project Type	Supply Side Management – Renewable Energy	
Project Title	Pearson-McGonigle Wind Turbines	
Timeline	3 - 5 years (short term)	
Project Description	Installation of three 6-kilowatt wind turbines at Pearson and McGonigle Halls. Annual energy cost savings includes savings from avoided purchased grid electricity.	
Project Metrics	Simple Payback (years)	-
	Annual Energy Cost Savings	$1,800 - $3,600
	Annual GHG reduction (MTCO$_2$E)	9 – 18
	Annual Energy Savings	18,000 – 36,000 kWh

3.3.4 Geothermal Systems

Geothermal heating and cooling systems provide space conditioning, *i.e.*, heating, cooling, and humidity control. The systems may also provide water heating, either to supplement or replace conventional water heaters. Geothermal systems work by moving heat, rather than by converting chemical energy to heat like in a furnace. Every geothermal heating and cooling systems has three major subsystems or parts: a geothermal heat pump to move heat between the building and the fluid in the earth connection, an earth connection for transferring heat between its fluid and the earth, and a distribution subsystem for delivering heating or cooling to the building.

Future capital projects at Temple could be considered as candidates for installation of geothermal heating and cooling systems, taking into consideration building heating and cooling loads, space constraints, and available funding. Construction of these systems at other campuses has replaced use of conventional boilers and similar equipment and has resulted in reduction of GHG emissions, as well as provide energy and cost savings. Due to the space considerations required for installation of geothermal wells, potential future geothermal systems may be most appropriate in Temple's Ambler Campus.

3.3.5 Central Plant Combined Heat and Power (CHP)

Combined heat and power (CHP) can be defined broadly as the generation of mechanical and thermal energy in a simultaneous or sequential manner, in a single, integrated system (USEPA, 2008). CHP systems overcome the inefficiencies associated with the rejection of waste heat downstream of a power generation unit (typically turbine-driven), by using this heat to produce steam, hot water, hot air, or chilled water for process cooling. In conventional power generation, this heat is lost to the atmosphere through cooling towers or direct emission of flue gases.

Project Type	Supply-Side Management	
Project Title	Combined Heat and Power (CHP)	
Timeline	3 - 5 years (short term)	
Project Description	Design, development, and installation of a back pressure steam turbine & generator or a gas turbine with heat recovery system at one of the Main Campus Central Steam Plant boilers. Assumes natural gas heat input of 100,000 MMBTU.	
Project Metrics	Simple Payback (years)	3
	Annual Energy Cost Savings	$350,000
	Annual GHG reduction ($MTCO_2E$)	1,833
	Annual Energy Savings	35,000 MMBTU

3.4 Transportation

A *Transportation Recommendations Report* was developed by Temple's Transportation Committee in August 2009 to provide recommendations to reduce transportation-related GHG emissions (commuting, air travel and campus vehicle fleets), which represent 21% of FY 2008 GHG emissions. These recommendations are intended for consideration and inclusion in Temple's CAP, and to provide opportunities for mitigation, community outreach, and engagement with students and outside organizations.

Principle measures identified in the *Transportation Recommendations Report* include reducing motorized travel, increasing efficiency of motorized travel, and reducing carbon intensity of fuels for motorized travel within the following categories of transportation policies and practices:

- Creation of an Office of Transportation with a full-time director;
- Education and communication activities, such as development of a web portal;
- Parking and driving recommendations;
- Car-sharing and car-pooling;

- Public transit, such as development of a Universal Transit Pass program;
- Bicycling initiatives;
- Walking recommendations, such as promotion of the Employee Home Ownership program;
- Air travel recommendations, such as offsetting of emissions;
- Campus Vehicle Fleet recommendations, including appointment of a Director of Fleet Services;
- Travel alternatives, such as increasing online learning courses and offering flex time to employees; and,
- Master Plan considerations, including incorporation of recommendations of the transportation committee.

Temple's transportation-related emissions represent 21% or approximately 45,000 tons of the university's FY 2008 greenhouse gas emissions. Commuting is a significant emissions source: approximately one million miles are driven by single-occupant Temple commuters on a weekly basis, including Philadelphia and Ambler campuses. According to a university survey conducted in December 2007, an estimated 40% of all students, faculty and staff commuters drive alone. On the other hand, 41% of Temple's commuters do not use a car at any point in their commute, instead taking public transit, bicycling or walking.

The recommendations developed by the Transportation Committee were based on an understanding of the three principal ways in which GHG emissions can be reduced in the transportation sector:

1) **Reduce motorized travel associated with the university's mission**, including student, staff and faculty commuting, operations of the university's vehicle fleet, and travel to off-campus sites for university business and academic meetings and conferences.
2) **Increase the efficiency of motorized travel** by reducing single-occupancy vehicle travel, increasing shared travel and non-motorized travel, and encouraging the purchase of higher fuel-efficiency vehicles.
3) **Reduce the carbon intensity of fuels for motorized travel** by encouraging the purchase by commuters and university vehicle fleet managers of vehicles that operate on compressed natural gas, biodiesel, electric batteries and other lower-carbon content sources of energy.

Per the *Transportation Recommendations Report*, if all forty-five recommendations are implemented, the reduction of greenhouse gas emissions could be 42% of the university's total expected transportation emissions (*i.e.*, a reduction of approximately 19,000 MTCO2E by 2020). The Transportation Committee identified four recommendations that would have the most significant effect on GHG emissions reductions. Emissions reductions from these four recommendations would total approximately 16,000 MTCO2E, or 36% of FY 2008 transportation-related emissions. These recommendations are described below.

Project Title	Priority Parking and Lower Parking Rates
Project Description	Priority parking and lower rates would be given to low-GHG emission vehicles (those with combined city-highway fuel economy ratings of 35 miles per gallon or higher) and motorcycles. Discounts would be based upon revenue-neutral pricing, which raises parking fees for non-fuel-efficient vehicles a small amount in order to fund deep discounts for the comparatively smaller number of high-fuel-efficiency vehicles used by Temple commuters. To implement such a program would require an awareness campaign to inform commuters of

	the incentives, redrawing of the parking garage layout to create more priority parking spots, and additional signage. Similar discounts could be applied to vehicles used for carpooling.
Timeline	Short-term goal (*i.e.*, by June 30, 2011)
Funding	No funding required
Coordination	Internal university coordination
Estimated GHG Reduction	4,661 MTCO2E (10.3% of FY2008 transportation emissions) *Assuming a 50% conversion of commuter vehicles to a fuel economy of 35 miles per gallon.*

Project Title	Higher Commuter Participation in Car-sharing / Car-pooling
Project Description	This recommendation is a combination of six individual recommendations directed at car-sharing and car-pooling, including (1) expansion and increased coordination with car-sharing organizations, (2) more effective publicizing of the existing ride-sharing program, (3) encouraging ride-sharing through use of the *Greenride* online software program, (4) providing a guaranteed ride home program to meet emergency transportation needs of ride-sharing commuters, (5) incentivizing car-pooling through priority parking spots and discounted parking rates for car-poolers, and (6) utilizing the *Zimride* application for creation of ride-sharing user profiles on a social network.
Timeline	Short-term goals or, as in the case of the existing ride-sharing program or use of *Zimride*, immediately implementable
Funding	Most require little or no funding, or continued ongoing funding; purchase of the *Greenride* program includes an initial license fee and an incrementally reduced annual fee
Coordination	With the exception of the expansion of car-sharing organizations, all would require only internal university coordination
Estimated GHG Reduction	1,245 MTCO2E (2.8% of FY2008 transportation emissions)

Project Title	University Transit Pass Program
Project Description	This program would be negotiated with the metropolitan public transit authority, SEPTA, to provide reduced fee transit passes for all registered students. The program could be funded through student fees, university administration contributions or a combination.
Timeline	Medium-term goal (*i.e.*, by June 30, 2015)
Funding	Little or no university funding required
Coordination	Coordination with public transit agency
Estimated GHG Reduction	2,336 MTCO2E (5.2% of FY2008 transportation emissions)

Project Title	Offsets of Air Travel
Project Description	This recommendation is a combination of university-related air travel recommendations including (1) providing information about the carbon footprint of air travel to travelers, (2) establishing a University Carbon Fund based on voluntary purchase of carbon offsets, (3) establishing a carbon travel credits policy to enforce limits on university departments or offices, (4) establishing minimum miles or travel time limits, and (5) increasing

	teleconference capabilities at the university.
Timeline	Short-term goals with the exception of a medium-term timeline for teleconference capabilities
Funding	No funding or one-time funding (Carbon Fund and expansion of teleconferencing)
Coordination	Internal university coordination
Estimated GHG Reduction	7,950 MTCO2E (17.6% of FY2008 transportation emissions)

3.5 Behavior Change

Temple residence hall students were provided with a sustainability practices survey in the Fall 2009 semester. Many of the questions contained in the survey, which was completed by 1,032 students, are pertinent to identification of greenhouse gas emissions reductions based on behavior change. The student responses are categorized and summarized in Appendix E. The survey response provided insight that will assist Temple in focusing behavior-related sustainability practices or improvements on campus, including:

- A significant percentage of students (30.9%) reported opening windows while the heat and/or air conditioning was operating.
- A majority of the students (67.6%) do not use a master power strip to turn off electronics in their rooms.
- A relatively low percentage of students recycle electronics and batteries (11.4 and 11.2%, respectively).
- Most of the students (71%) indicated an interest in having an end-of-semester campus "yard sale" for recycling and/or reuse of unwanted items.
- Over half of the students indicated a willingness to get involved in a sustainability organization or attending sustainability events, and helping to manage or participate in a campus composting effort.

In an open-ended question, the students were also asked how Temple can promote 'green' living on campus. Of the 675 responses, most students requested an expanded recycling program and increased information and awareness to educate students as to the meaning of 'green living' on campus. Other responses included a composting program, community gardens, light motion sensors, and residential hall competitions related to sustainability.

Temple will conduct a sustainability pledge campaign to motivate conservation-minded behavior change among students and faculty/staff that will target an overall reduction of 8% of baseline campus-wide emissions. In support of behavior change, Temple will initiate a behavior campaign that will include:

1) Identification of a designated representative in each department, campus unit and/or residence hall;
2) Personal energy and waste audits of student, faculty and staff, supported by the use of portable, hand-held meters (*e.g.*, "Kill-A-Watt" meter);
3) Performance tracking using an electronic utility tracking system (see Section 6.1.1); and,
4) Student support from the Green Council.

The "Kill-A-Watt" or similar hand-held feedback device connects to an appliance, such as a computer, air conditioner or refrigerator, and assesses the kilowatt-hour consumption and efficiency of the application, as well as checks the quality of the power by monitoring voltage, line frequency and power factor. The personal audit results can be used to develop personal reduction goals.

In keeping with its underlying principles of promoting a green culture, fostering forward-looking change, and promoting environmental literacy, Temple's Office of Sustainability is well positioned to continue to be a portal for collecting sustainability-related suggestions at the grassroots level. Suggestions could be recorded on a bulletin board managed by the Office, and would complement Temple's policy-driven sustainability efforts.

Project Type	Demand Side Management	
Project Title	Conservation-Minded Behavior Change	
Timeline	0 - 5 years (near term)	
Project Description	Temple will initiate a sustainability pledge program for students and faculty/staff to encourage conservation-minded behaviors. The program will be informed by the residential life sustainability survey and will also require personal energy audits conducted by faculty and staff using portable electric usage monitors. The program will also use departmental and dorm sustainability challenges to encourage conservation. The program will be conducted by the Office of Sustainability in coordination with University Housing and Residential Life, the Faculty Senate and Human Resources as well as an outside consultant. The program will target an overall reduction of 8% of baseline campus-wide emissions.	
Project Metrics	Simple Payback (years)	< 1
	Annual Energy Cost Savings (Present Value)	$2,500,000
	Annual GHG reduction ($MTCO_2E$)	18,100
	Annual Energy Savings	16,000,000 kWh; 89,000 MMBTU

3.6 Recycling and Waste Minimization

In the 2006 base year, solid waste accounted for 2% of campus emissions (4,810 MTCO2e). While this is a small portion of the campus' total carbon footprint, recycling and waste minimization programs are important means of raising campus awareness and support for sustainability-related initiatives in other areas. Reducing the amount of waste by increasing recycling rates and/or reusing items not only decreases the amount of greenhouse gas emissions but also saves money for the University.

3.6.1 Recycling

In Calendar Year 2006, the University's recycling rate was 26% (1,408 tons) and it generated 3,933 tons of trash. Through educational programs, expanding recycled materials, simplifying collection methods, gradual introduction of outside recycling containers, as well as targeted waste minimization activities, the University's recycling rate in Calendar Year 2009 was 32% (1,615 tons) and it generated 3,390 tons of trash. From Calendar Year 2006 to Calendar Year 2009, this represents an increase of 15% for recycled materials and a decrease of 14% in trash.

Recycled materials in the CY 2009 rate include primary materials (beverage containers made of glass, plastic and aluminum as well as paper and cardboard); secondary materials (post consumer food waste, garden materials, waste cooking oil); and specialty materials (computers, toner & ink cartridges, light bulbs, batteries, pallets) In Calendar Year 2009, the cost of disposing recycled materials was $34 a ton versus $155 a ton for trash removal. Expenses for trash removal include landfill tipping fees, personnel and trucks for internal removal of trash and payment to outside vendors for open container disposal. This significant cost difference should help make the business decision to increase the recycling efforts. Not included in the 32% recycling rate were recycled construction site materials. Approximately 78% of construction site materials were recycled in 2008 and 2009.

Project Type	Offsets	
Project Title	Recycled Construction Waste	
Timeline	0 - 10 years (near term)	
Project Description	Approximately 1,400 tons of construction debris was recycled in 2008 and 2009, including drywall, lumber and pallets, metal, and plastics. This effort to recycle construction debris is planned to continue with the growth of Temple's campuses through 2019.	
Project Metrics	Simple Payback (years)	-
	Annual Energy Cost Savings (Present Value)	-
	Annual GHG reduction ($MTCO_2E$)	2,220
	Annual Waste Reduction (U.S.tons diverted from landfill)	971

Activities to increase recycling rates include participation in the RecycleMania contest, recycling contests among residence halls, promotional activities at sports events to raise awareness about recycling, and providing educational facts about the merits of recycling.

The Computer Recycling Center was initiated in 2003 with the creation of a $50 advance recovery fee (ARF) charge on all new computer purchases to fund the consolidated collection and diversion of electronic equipment away from a landfill destined waste stream for all of Temple University's local Campuses. This small fee allows the CRC to gather electronic related surplus equipment from departments, secure the data related to the equipment, refurbish that equipment when possible, resell the equipment to the Temple community, donate any unwanted usable equipment and lastly arrange for the proper disposal of all unusable equipment and scrap. This program won the prestigious EPA achievement award in 2009.

Project Type	Offsets
Project Title	Computer Recycling
Timeline	0 - 10 years (near term)

Project Description	In 2009, Temple's Computer Recycling Center facilitated the reuse and recycle of over 3,100 and 1,100 pieces of computer equipment (CPUs, CRTs), resulting in a net GHG mitigation of almost 3,200 $MTCO_2E$. Together with reused/recycled printers, scanners, and other miscellaneous items, the Center's efforts led to the diversion of over 181 tons of waste from landfills.	
Project Metrics	Simple Payback (years)	-
	Annual Energy Cost Savings (Present Value)	-
	Annual GHG reduction ($MTCO_2E$)	3,199
	Annual Waste Reduction (U.S.tons diverted from landfill)	181

3.6.2 Waste Minimization

In addition to recycling, Temple University is committed to waste minimization programs to reduce its carbon footprint. Minimizing waste either by reusing materials or by using fewer materials initially can have a substantive effect on reducing materials slated for landfills.

In addition to the Computer Recycling Center discussed above, Temple has developed several innovative programs for re-use of materials.

Environmental Health and Radiation Safety (EHRS) has won the Award of Recognition from the Campus Safety Health and Environmental Management Association's Solutions at Work Program. EHRS won this award in 2009 for its program "Thinking Outside the Box: One University's Approach to In-House Waste Minimization." EHRS presently has a high-volume waste minimization program including: 1) Chemical Redistribution (the taking of unused and unexpired chemicals and allocating them to other labs); 2) Mercury Exchange (changing out mercury-containing equipment for mercury-free alternatives); 3) Chemical Recycling (certain chemicals can be recycled and reused, saving on the cost of purchasing new chemicals or the disposal of old ones).

Other programs to re-use materials are the donation of good conditioned items to charitable groups. Furniture and large appliances were donated to charitable groups such as Habitat for Humanity, Goodwill Industries and Pennsylvania School for the Deaf from a large residence hall renovation project which required new furniture and appliances due to more efficient reconfiguration of space. Other reuse projects include the year end residence hall clean out in June of 2009 which yielded over 1200 pounds of materials (clothing, small appliances, cleaning and office supplies) for donation to local community groups; collecting used books for Better World Books a group dedicated to eradicating global illiteracy; organizing office supply give-aways or swaps to encourage redistributing items across the University.

In addition to reusing items, using fewer materials initially can contribute to reducing waste. Temple has initiated programs to reduce paper usage including reducing the paper quota in the student computer laboratories from 400 to 300 pages per semester, setting the printing default in student computer laboratories and department offices to double-sided, encouraging faculty to use technology rather than paper to post syllabi, and accept and grade assignments.

An initiative with Alpha Office Supplies and Staples has been established in which orders are delivered in reusable cartons instead of cardboard cartons. Alpha Office Supplies, Inc. delivered approximately 16,000 corrugated boxes to Temple University yearly. The new reusable containers will eliminate approximately 12.8 tons of trash each year – and they have a life expectancy of 100 to 200 deliveries.

3.6.3 Recommendations

Initiatives for recycling and waste minimization need coordination and a focused vision and clear goals. Temple will develop a comprehensive *Waste Minimization Plan* which details what its goals are, the timetable for increasing recycling and reducing waste and what means and resources must be employed to achieve these goals. This plan should be formulated by the end of calendar year 2010. Overall, the plan will target decreasing emissions from landfilled solid waste by 10% by 2015 relative to baseline (FY 2006) levels.

Project Type	Demand Side Management	
Project Title	Recycling and Waste Minimization	
Timeline	0 - 5 years (near term)	
Project Description	Temple will develop a comprehensive Waste Minimization Plan to decrease emissions from landfilled solid waste by 10% by 2015 relative to baseline (FY 2006) levels. Among considerations for this plan will be: increasing the recycling rate from the current rate of 32% to 40% by 2015; increasing outdoor recycling opportunities so that every trash can is accompanied by a recycling can; exploring composting of food waste in addition to the current practice of diverting food waste to a pig farmer; reviewing opportunities in the food service area to replace disposable dinnerware and eating utensils in all dining halls; reviewing business practices which contribute to excess waste; engaging students in residence halls to reduce waste.	
Project Metrics	Simple Payback (years)	< 1
	Annual Energy Cost Savings (Present Value)	$45,000
	Annual GHG reduction ($MTCO_2E$)	400
	Annual Waste Reduction (U.S.tons diverted from landfill)	370

3.7 Summary of Mitigation Strategies

Implementation of these projects is expected to allow Temple to reduce campus-wide emissions to 30% below baseline (FY 2006) levels by 2030. This corresponds to an emissions target of 158,353 $MTCO_2E$ by 2030, or approximately 130,000 $MTCO_2E$ below business-as-usual emissions (Figure 3-3). This would serve as an interim goal toward achieving carbon neutrality. Project implementation would also allow Temple to meet additional interim targets of 5% below baseline by 2015, 15% below baseline by 2020, and 22% below baseline by 2025.

A summary of these projects is included as Appendix F. For reference, project types are compared on a cost per ton basis (one-time Project Cost divided by Annual GHG Reduction) in Figure 3-4.

FIGURE 3-3. TEMPLE UNIVERSITY STABILIZATION WEDGE DIAGRAM

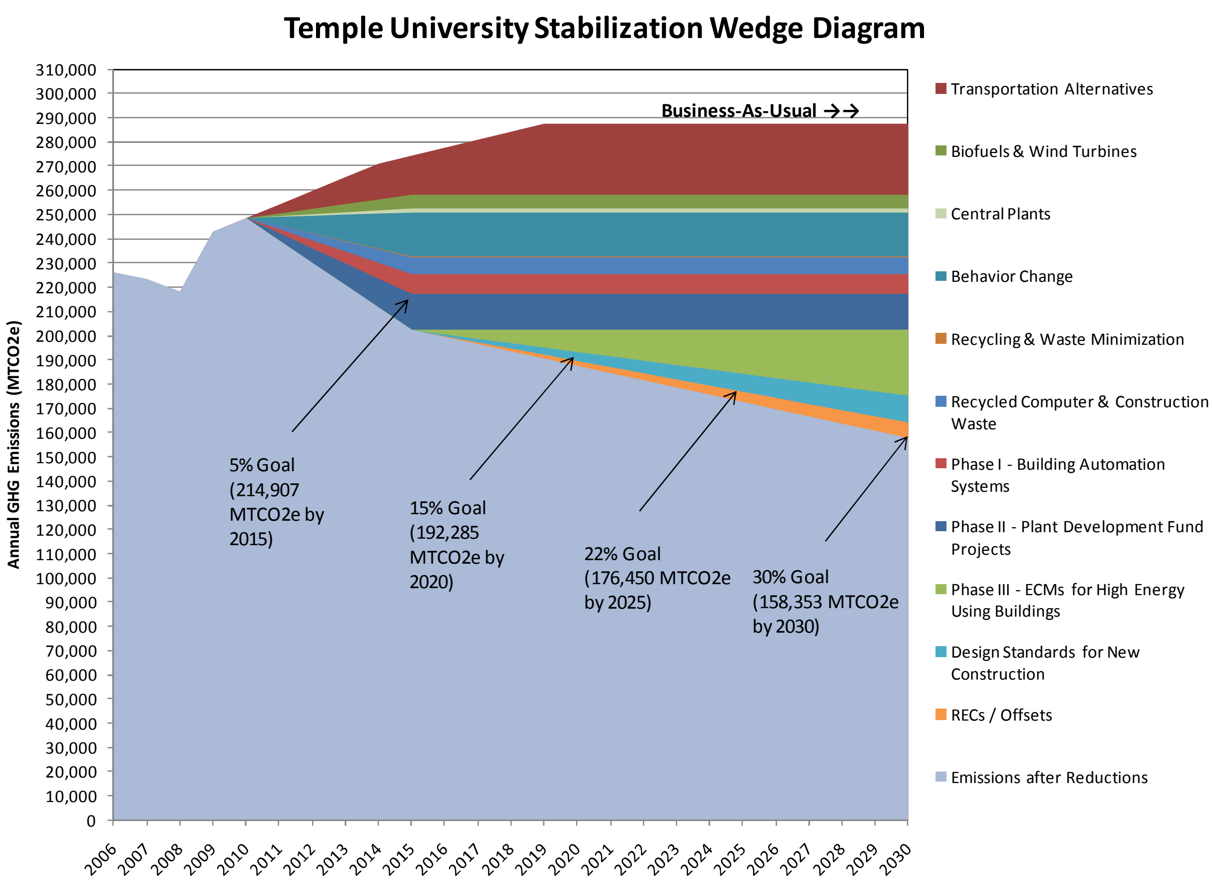
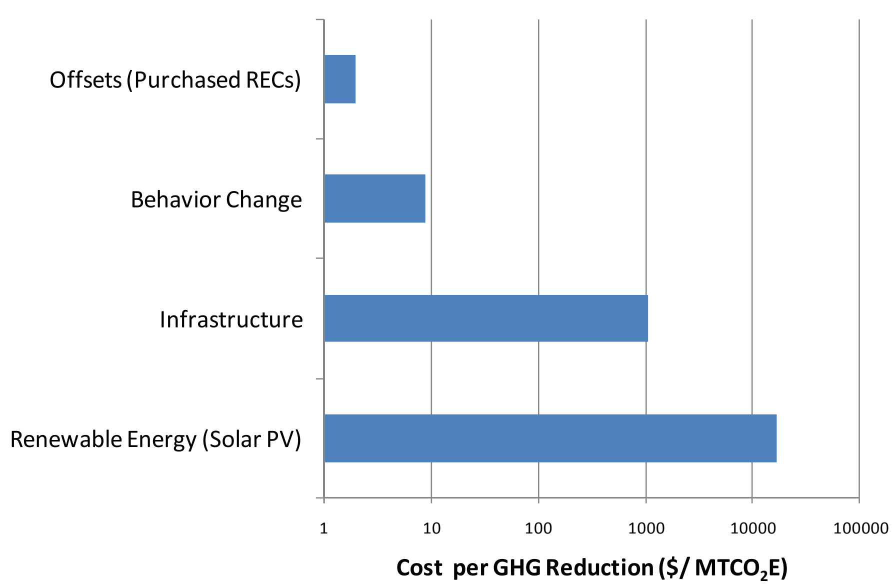


FIGURE 3-4. COST PER TON OF REDUCING GHG: COMPARISON OF PROJECT TYPES



4. Offsets

Beyond implementing internal emission reduction projects, Temple may need to purchase offsets to mitigate a portion of its emissions. Offsets may include Renewable Energy Credits or Certificates (RECs) for green power, carbon credits from voluntary and regulatory markets, and carbon allowances under regulatory markets. Purchasing offsets would allow Temple to mitigate emissions without having to implement infrastructure or behavioral changes. However, purchasing offsets provide no return on investment. In addition, offsets are projected to become more costly under expected future regulatory programs. For these reasons, in most instances, offsets will be a lower priority than implementing emission reduction projects.

Despite this, Temple recognizes that offsets can and do play a vital role in providing a means to achieve immediate emissions reductions in a cost-effective manner. Temple also recognizes that offsets provide an opportunity for additional research and development in addressing climate change. As such, Temple has determined that there are instances when it furthers the dual mission of achieving climate and educational gains to participate in offset projects, especially those which will have a local impact.

Appendix G includes an examination of offsets and describes their features, reputable categories and current and future projected cost, including potential offset projects based in the local Philadelphia community. Where these options are consistent with the recommendations in the ACUPCC Offset Protocol, Temple may selectively engage in this market to meet its ACUPCC commitment.

4.1 Renewable Energy Offerings of Temple's Local Electric Distribution Company

PECO Energy (PECO) is the local electric distribution company servicing Temple. PECO, in association with Community Energy, a leading wind energy marketer, offers PECO WIND™, a 100 percent pollution-free wind-generated electricity product to its customers. PECO WIND is generated by wind turbines located in Pennsylvania. The wind energy is delivered directly to the electricity grid that supplies most of the homes and businesses in the mid-Atlantic region. By participating in the PECO WIND program, Temple would be supporting this new renewable source of electricity and reducing the need to generate electricity from other sources. In addition, building and maintaining wind farms creates jobs and revenue for landowners and local communities.

The cost of producing electricity from wind energy is slightly higher than generating electricity from a conventional power source like coal or nuclear power. The price of wind energy is directly related to the cost of developing and constructing a wind farm and the seasonal production at wind power projects. PECO WIND is available for purchase in blocks of 100 kilowatt-hours for $2.54 per block. As of January 2010, PECO Wind is fully subscribed and is not available for increased or new subscribers.

Temple recognizes that concerns have been raised about the impact of wind farms on bird populations. Studies are now conducted to understand bird migration patterns to ensure the safe positioning and siting of wind farms. Ideally, sites should be free of ground prey and bodies of water that attract birds, not be within the hunting range of raptor nests or located on bird migratory routes. In addition, modern wind turbine designs are much more bird-friendly; solid tubular towers are used to prevent birds from perching and turbine blades rotate much more slowly than earlier designs.

Temple recognizes that any use of natural resources may have attendant environmental aspects. For this reason, Temple will seek to support only those renewable energy projects that have appropriately and adequately assessed and addressed these environmental aspects and any related impacts.

4.2 Direct Procurement of Renewable Energy

Temple could enter into a long-term renewable power purchase agreement as an alternative to buying RECs. Community Energy Inc. (http://www.communityenergyinc.com/) is currently pursuing solar farm developments in the mid-Atlantic region, including Pennsylvania. Community Energy's market experience, local relationships and financial backing can combine to provide a reliable source of high quality solar development projects and REC creation.

Renewable energy development goes much deeper than protecting the environment. The development and operation of the solar project creates temporary construction jobs and long-term management jobs, again providing an economic co-benefit.

Community Energy (CEI) has RECs available for sale. The RECs would be from Green-e certified wind that is sourced from anywhere in the U.S. A 3-year contract for quantities of 10,000MWh or more entered into effective February 2010 would be priced as follows:

$1.43 per MWh in the 1st year
$1.67 per MWh in the 2nd year
$2.11 per MWh in the 3rd year

It should be stated that there is a risk to REC purchases for years 2012 and beyond. It is possible that federal carbon regulation will become effective which would eliminate the carbon benefit associated with REC purchases. This is a risk to purchases in years for which such federal rules might be effective (most likely 2012 or beyond).

As Temple pursues its 2020 plan, Temple may also pursue LEED certification for its new or renovated buildings. To earn the point(s) available under the Green Energy section of Energy and Atmosphere, projects generally have to enter into a contract to purchase at least 35 percent of their electricity for two years that is Green-e eligible from a green power supplier, as defined by Green-e program. If an institution purchases an amount double the threshold, Temple could also get an innovation credit under the LEED program. At a minimum, Temple may decide to procure RECs as part of a LEED certification effort.

Community Energy Inc. (CEI) also develops wind and solar projects under three business models:

- Retail Division - Solar and wind projects can be sited on host properties. The host can then enter into a long-term power purchase agreement (PPA) and REC purchase agreement. CEI would be the owner and operator of the installation.
- Large-Scale Solar – These projects, usually located on 20 or more acre parcels, range in the project size of 5 to 10 MW. The power purchase and REC agreements can be arranged to suit host needs.
- Large Scale Wind – These projects are usually owned and operated by CEI and are the support for their retail REC sales.

Temple might be able to identify existing locations where on-site generation can be located (20 acre parcels of land, building roofs which would require 100 square feet per kW). Temple could then decide to enter into a long-term (perhaps 20 year) PPA for the electricity from the project. If the PPA pricing was more favorable than Temple's current retail procurement costs, the savings could be used to fund additional sustainable investments.

Alternatively, Temple could site a solar generation project on its property, retaining both the electricity and the RECs. Temple could then sell the RECs into the market and use the proceeds to invest in other sustainable investments. It is expected that, in Pennsylvania, solar RECs could sell for $200 per MWh.

In addition, CEI is working with a Pennsylvania company, PaceControls, on delivering an HVAC optimization solution that reduces energy usage. CEI is able to support pricing structures that take advantage of Pennsylvania Act 129 incentives for energy efficiency. PaceControls, an ENERGY STAR Partner, develops and manufactures eco-smart, easy-to-install, energy-saving HVACR solutions. Designed for a wide variety of commercial, industrial and residential heating, cooling and refrigeration equipment, PaceControls technology is a highly flexible retrofit solution. The patented technology establishes optimal run times for compressors and burner units, "pacing" the equipment's consumption of electricity, natural gas, fuel oil or propane saving 10 to 20 percent or more on energy bills. A typical payback for a project ranges from just one to three years. The technology — designed and refined with significant input from the HVACR maintenance industry and equipment manufacturers — complies with all accepted industry standards for control equipment. PaceControls products have proven successful in thousands of installations, including hundreds installed by electric utilities under demand side management programs. Temple may choose to implement this or a similar energy saving technology in existing buildings.

Finally, CEI also offers carbon offsets that Temple could purchase to offset emissions. Temple most likely will consider this for Scope 3 travel and commuting emissions, but could also purchase offsets to address Scope 1 emissions.

Discussions with CEI on these and other options are recommended.

4.3 Other Incentives for Renewable Energy Investment in Pennsylvania

There are numerous investment funds available that may provide financing for Temple to make a direct investment in a renewable energy project whether on Temple property or in another location.

The **Philadelphia Industrial Development Corporation** (PIDC) is a private, not-for-profit Pennsylvania corporation, founded in 1958 by the City of Philadelphia and the Greater Philadelphia Chamber of Commerce to promote economic development throughout the city. PIDC's central strategy is to leverage financing and real estate resources to retain and to grow employment in Philadelphia. PIDC also coordinates tax incentive and work force development programs offered by the City and the Commonwealth. Clients range from the traditional base of commercial and industrial businesses to the developers of large, public purpose facilities to non-profits, in all neighborhoods of Philadelphia. Throughout its over fifty year history, PIDC has closed a total of 5,350 individual transactions with combined project costs of $15 billion, which have contributed to retaining and creating over 442,000 jobs in Philadelphia. To learn more about PIDC, visit www.pidc-pa.org.

The Reinvestment Fund (TRF) is a national innovator in capitalizing distressed communities and stimulating economic growth for low- and moderate-income families. TRF identifies the point of impact where capital can deliver its greatest financial and social influence. TRF's investments in homes, schools and businesses reclaim and transform neighborhoods, driving economic growth and improving lives throughout the Mid-Atlantic region. Since its inception in 1985, TRF has made almost $600 million in community investments. In the area of energy, TRF has managed the Sustainable Development Fund (SDF), a $32 million energy fund created by the Pennsylvania Public Utility Commission in its final order in the PECO Energy electric utility restructuring proceeding. The SDF is one of several energy funds managed by TRF. To learn more about TRF, visit www.trfund.com. To learn about the requirements for energy-related financing, visit http://www.trfund.com/financing/energy/energy-guidelines.html.

Founded in 1999, **Community Energy Inc.** (CEI) is a leading developer and marketer of renewable energy generation. To learn more about CEI, visit http://www.communityenergyinc.com/. Community Energy On-Site Solar is meeting the demand for clean energy with new on-site solar energy projects that deliver emission-free electricity directly to customers. Community Energy On-Site Solar provides a solar power option with no upfront costs to commercial and institutional customers in New Jersey and Pennsylvania through Power Purchase Agreements (PPAs). To learn more about CEI's On-Site Solar program, visit http://www.communityenergyinc.com/wind-farms/highered100/.

4.4 Renewable Energy Requirements in Pennsylvania

In 2004, Pennsylvania enacted the Alternative Energy Portfolio Standards (AEPS) which requires that by 2011, 3.5 percent of the energy sold to PECO customers be comprised of energy generated from alternative and renewable resources such as wind, low-impact hydro, methane, geothermal, biomass, or fuel cells, increasing to 8 percent by 2020. In the fall of 2008, PECO became the first utility in Pennsylvania to buy and bank credits to meet the state's requirements. On May 20, 2009, PECO announced that it had signed five-year agreements for the purchase of renewable energy credits equal to 412,000 MWhs of renewable energy. This agreement, along with a similar agreement made in August 2008, brought PECO's renewable energy credit purchase to 452,000 per year. Under this May 2009 purchase, PECO's aggregate supply of renewable energy credits has a weighted average price of $20.42 per credit.

Thus, starting in 2011, this act means that the amount of emission-free power that supplies the University will increase, and the carbon footprint of the electricity available on the grid will be lower, with little effort on the part of the University. Thus, we may see the emission rates for electricity actually begin to decline with this increase in generation from alternative and renewable sources. The Act 213 regulations are being incorporated into the University's plans.

4.5 Excess Self-Generated Electricity

If Temple were to purchase and install renewable energy fueled electricity generation equipment to offset its usage from PECO, Temple might generate more electricity than it needs. Through Net Metering programs, PECO purchases any excess electricity produced from customers' renewable energy equipment via its Net Metering (RS-2) tariff. Under this tariff, if any excess electricity is produced, PECO will provide a credit to Temple. To utilize net metering, Temple would work with PECO operations personnel to approve and connect the generation to the PECO distribution system.

PECO's Net Metering process is completely independent of PECO's efforts to comply with AEPS regulations in Pennsylvania.

For specific details on this process, reference PECO's Net Metering and Interconnection Information (see http://www.peco.com/pecores/energy_rates/Net+Metering+and+Interconnections.htm) for more details and contact information.

4.6 Temple Initiating and Partnering on Carbon Offset Projects

Temple will look to undertake projects in its community that can generate offsets, such as,

- Community home energy audits and retrofits, with the Energy Coordinating Agency and Habitat for Humanity;
- Urban forestry through the public-private partnership called TreeVitalize; and
- Energy efficiency investments with various organizations.

4.7 Summary

Temple recognizes that offsets not only provide a means to achieve immediate climate benefit, but also they provide an opportunity to achieve sustainable co-benefits, advance educational objectives and augment community economic development. As such, Temple will pursue use of offsets as follows:

- Opportunities to site renewable generation projects on its own property to generate RECs;

- Opportunities to partner with local renewable energy companies to develop power purchase agreements and/or REC purchase agreements that would enable the development of new renewable generation resources;

- Purchasing RECs as a means to offset some or all of its emissions associated with its Scope 2 purchase of electricity; and

- Purchasing carbon credits as a means to offset some or all of its emissions associated with its Scope 3 commuting and travel.

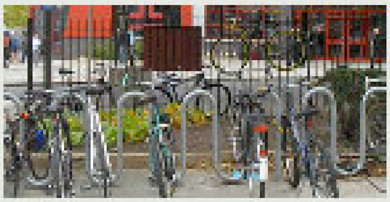
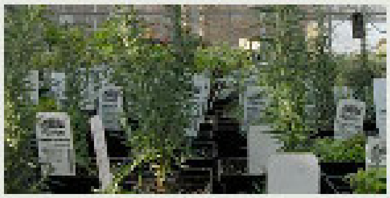
Local opportunities for use of offsets include an expansion of Temple’s current involvement with Habitat for Humanity to build energy efficient homes. For example, the Partners in Sustainable Building Program has issued grants to Habitat for Humanity affiliates for homes built following Energy Star, LEED or other nationally recognized green building guidelines. Additionally, Temple could enter into a long-term renewable power purchase agreement as an alternative to buying RECs with an organization such as Community Energy, Inc., which is pursuing renewable energy developments in the mid-Atlantic region.

Project Type	Offsets
Project Title	Purchase of Offsets / Renewable Energy Credits
Timeline	0 - 5 years (near term)

Project Description	Purchase of 12,500,000 kWh of RECs annually.	
Project Metrics	Simple Payback (years)	-
	Annual Energy Cost Savings (Present Value)	-
	Annual GHG reduction ($MTCO_2E$)	6,554
	Annual Energy Savings	-

5. Education, Training and Communication

In December 2009, Temple's Academic Initiatives Committee for Sustainability submitted a report entitled *Strategic Directions in Sustainability for Academic Achievement and Research for the 21st Century at Temple University* to the University Provost as included in this chapter.

Sustainability: the ability to "meet the needs of the present without compromising the ability of future generations to meet their own needs" - U.N. 1987

5.1 Introduction

Temple joined hundreds of colleges and universities across the United States in a national effort to provide leadership related to the achievement of an environmentally sustainable society when President Ann Weaver Hart signed the ACUPCC in 2008. Provost Lisa Staiano-Coico convened an Academic Initiatives Committee in July of 2009 to support Temple's effort. The committee is comprised of faculty members, administrative staff, and student representatives. It is charged with the core responsibility of creating a plan for achieving these goals in alignment with the strategic direction of the university and the interdisciplinary and collaborative approach promulgated by the Provost. The Committee's report contains recommendations related to undergraduate and graduate education, outreach and research for achieving the goals of the Climate Commitment. The report is an integral part of this Climate Action Plan that must be filed with the ACUPCC in May of 2010.

2008

President Hart signs American College and University Presidents' Climate Commitment

Office of Sustainability at Temple University is established

Temple participates in first annual Campus Sustainability Day nation-wide event

2009

Mayor Nutter Holds Green Initiatives Press Conference at Temple University announcing Philadelphia Green Jobs programs

Academic Initiatives Committee was charged by the Provost with preparing strategic recommendations for integrating sustainability

2010

Climate Action Plan submitted to ACUCPP

The Academic Initiatives Committee met six times since convening in July 2009. The focus of meetings has been to discuss how climate neutrality and sustainability can be integrated with ongoing and new: (a) educational experiences of students; (b) community collaborations; (c) co-curricular efforts; and (d) research, scholarly and creative works. The approach of the committee has been to meet as a whole and in subcommittees related to undergraduate and graduate curriculum, outreach, co-curricular activities, and research. In addition, members of the committee met with Deans across the university to elicit input about college-level commitments to the aims of the Climate Action Plan for Temple. The Deans and colleges represented through this process included:

Amid Ismail, Kornberg School of Dentistry
JoAnne Epps, Beasley School of Law
John Daly, School of Medicine
Keya Sadeghipour, College of Engineering
Hai-Lung Dai, College of Science and Technology
Moshe Porat, Fox School of Business and Management
Ron Brown, College of Health Professions and Social Work
Teresa Soufas, College of Liberal Arts and School of Environmental Design

Finally, the committee reviewed several institutional models, reports related to sustainability initiatives from nationally recognized research centers and agencies, and key policy documents to formulate final recommendations for Temple University's academic achievements and research efforts related to sustainability.

5.2 Undergraduate Education

The overall aim of undergraduate education in sustainability is to provide educational opportunities for all Temple undergraduate students that foster the development of a base of knowledge, framework for action, and integration of principles of sustainability into their every-day lives. Discussions related to the undergraduate educational experiences at Temple were guided by three commonly agreed upon principals: (a) sustainability education should feature hands-on experiences that connect students with local issues, community organizations, and problem settings when applicable; (b) program elements should be as flexible and inclusive as possible; and (c) there is a strong need for new, interdisciplinary courses at Temple.

We suggest that the best way to accomplish our goal in alignment with our guiding principles is to develop a ***sustainability certificate program*** that consists of four courses, with at least one course included in the General Education curriculum. The remaining courses would include electives created across disciplines at the department level. Students who complete the certificate program would be required to take a culminating, capstone like course that features project based and experiential learning activities grounded in local neighborhood sustainability initiatives.

5.3 Graduate Education

The overall aim of graduate education in sustainability is to provide Masters level programs that meet emerging needs in Green Jobs through programs in business, engineering, science, management, policy and education. We recommend that Temple align graduate sustainability education with workforce development needs in the Green sector by creating tuition generating programs that include terminal degrees, certificates, and short courses. Many deans expressed an interest in creating college-based programs that support the graduate education sustainability goals. For example, the Kornberg School of Dentistry is planning to offer a tuition scholarship for a dentistry student to take courses related to life-cycle analysis and carbon foot-printing in the College of Engineering. The purpose of this initiative is to involve that student in developing a plan for "greening" the laboratory procedures across the School of Dentistry. In addition, some deans expressed an interest in collaborating on interdisciplinary models that create new credentials in sustainability. Two interdisciplinary program examples that we recommend developing include: (a) an **M.S. in Environmental Science** involving the Colleges of Science and Technology and Engineering; (b) an **M.S. in Sustainable Business** involving the Fox School of Business and Management, the College of Engineering, and the Beasley School of Law.

Finally, we recommend pursuing a university-wide interdisciplinary graduate program in sustainability through seeking external funding for state-of-the art training models. Two such funding opportunities include the Science Masters Program (SMP) and Integrated Graduate Education and Research Training (IGERT) initiatives of the National Science Foundation. Both provide resources to create new interdisciplinary science programs that can support our graduate sustainability goals.

5.4 Co-curricular Activities

We recommend complementing formal educational experiences through providing a strong array of co-curricular activities that extend beyond the realm of course and curricular activities. We envision co-curricular activities that pertain to all levels of educational attainment, including undergraduate, graduate and professional programs. Our approach will be to build on current co-curricular activities, which currently include:

- New student and family orientation sessions in sustainability
- Participation in national events to raise awareness on sustainability such as: *Campus Sustainability Day, RecycleMania, the National Teach-In on Global Warming, National Park(in) Day* and *Earth Day*
- The creation of Residence Hall Sustainability Representatives
- Holding speaker series on environmental topics in Civil and Environmental Engineering and in the School of Environmental Design
- Student organizations with sustainability initiatives, including: Students for Environmental Action, Students for Responsible Business, Temple Community Gardens, Environmental Law Society
- Student led projects, including the light switch decal program and selling food to support *Share Foods*

Our recommendations are: (a) to create a Living and Learning Community in Sustainability within a residence hall; (b) to foster sustainability competitions among residence halls related to the reduction of energy use, increase in recycling, and integration of slow and local food practices; (c) to create student groups in professional schools that raise awareness about sustainability; (d) to create student internship opportunities in sustainability; and (e) to broaden the base of guest speaker and lecture series related to sustainability.

Finally we seek to transform Temple's Main Campus into a Living Laboratory that encourages students to develop and implement sustainability projects, installations, and technological innovations that improve the overall university compliance with the Climate Action Plan tenets.

5.5 Outreach

The main objective of outreach in sustainability at Temple is to extend the university's research and educational missions through public education, dissemination, and awareness for life-long learners, within different types of institutions, and across geographic settings. Our approach is to foster collaboration with the surrounding community to achieve mutually agreed upon goals in alignment with Philadelphia's Green initiatives. Our specific recommendations are to:

- Foster greening initiatives at local sites where immediate impacts for improving environmental quality and sustainability goals are achievable, building on the presence of strong community organizations
- Develop an advisory board that provides public information and advice related to sustainable community development, local environmental quality issues, and public actions for sustainable living
- Create an interactive web site on sustainable initiatives that individuals and groups can undertake, engage, and promote
- Implement a public speakers bureau including both Temple and Community participants available to provide lectures, talks, workshops, and other events in local schools, neighborhood associations, and community organization settings
- Develop partnerships and programs for pre-school through 12th grade students in both formal and informal educational settings

5.6 Research

The objective of sustainability research at Temple is to advance an understanding of urban ecology, a rapidly emerging focus on the intersection of urban and human dynamics with ecological systems that draws from of a number of different fields of study, including conservation biology, environmental engineering and science, geography, public health, resource management and urban planning and design. We seek to build on foundations in this field already begun at other institutions, including: (a) ***Ecological Cities***, an interdisciplinary research program based at the University of Massachusetts – Amherst (founded in 1999), which seeks to create greener cities, promote health in urban spaces, and foster greater social equity across neighborhoods and urban communities; (b) the ***Urban Ecology Initiative*** of the University of Washington, founded in 2000, is based in the School of Forestry; it examines the impacts of urbanization on ecology through integrating policy, education, and science studies of human-urban-ecology interactions; (c) the National Center for Ecological Analysis and Synthesis (founded at University of California – Santa Barbara in 1995), which established an ***Economics and Ecology*** research track that aims to provide ecology managers with decision making tools for balancing conservation and development goals; and (d) Arizona State University's Global Institute of Sustainability ***Urban Ecology Integrated Graduate Education and Research Training (IGERT) Program*** (established in 2005), which trains social scientists to examine the iterative relationship between the development of cities and ecology impacts.

Temple is uniquely well situated as a large, public, urban comprehensive university to provide an evidence based, translational research initiative in Urban Ecology that advances basic and applied knowledge in the dynamics and interactions of plant, animal, human, land, and climate systems of urban settings and the impacts of urban settings on environmental systems. We recommend that Temple's Urban Ecology research activities aim to: (a) better understand the human impacts on urban ecological systems towards the goal of designing healthier and better managed communities as well as protecting and conserving ecological systems; (b) examine the effects of natural resource use in urban settings as a means of improving knowledge of urban resource management; (c) analyze the dynamics of urban climate systems and natural hazards as a basis for improved knowledge about climate and hazards mitigation in urban regions; (d) contribute to knowledge and practice at the intersection of environmental and water quality, biodiversity, the food chain and public health concerns; (e) providing best practices solutions for aging urban infrastructure; and (f) contribute to short, middle and long-term solutions through innovations in technology, policy, and management for urban environmental systems.

In order to accomplish this research agenda, we recommend that Temple ***establish an interdisciplinary Center for Urban Ecology.*** We envision that this proposed Center will connect faculty research activities in an integrative manner through interdisciplinary efforts drawing from departments and colleges to create a university-wide sustainability research enterprise. The proposed Center will involve faculty and graduate fellows to conduct sustainability research related to the urban ecology theme, sponsor visiting scientists, host seminar and workshop events, and build interdisciplinary research teams related to the emphasis areas outlined above.

We are presenting two options for consideration. The first is to create an *Academic Model* that fosters broad-based collaboration of sustainability scholars and scholarly activities. The second is an *Integrated Academic and Research Model* that addresses the goals of the academic model seeks external support for research programs related to Urban Ecology.

Center for Urban Ecology (proposed):
Academic Model

- Act as a point of information sharing and coordination for academic and research activities at Temple related to Sustainability
- Assist faculty to enhance sustainability related content in their teaching
- Review and make recommendations regarding Graduate fellowships, Undergraduate projects in sustainability, and Sustainability projects submitted for internal funding
- Organize seminars and workshops on sustainability

Center for Urban Ecology (proposed):
Integrated Academic and Research Model

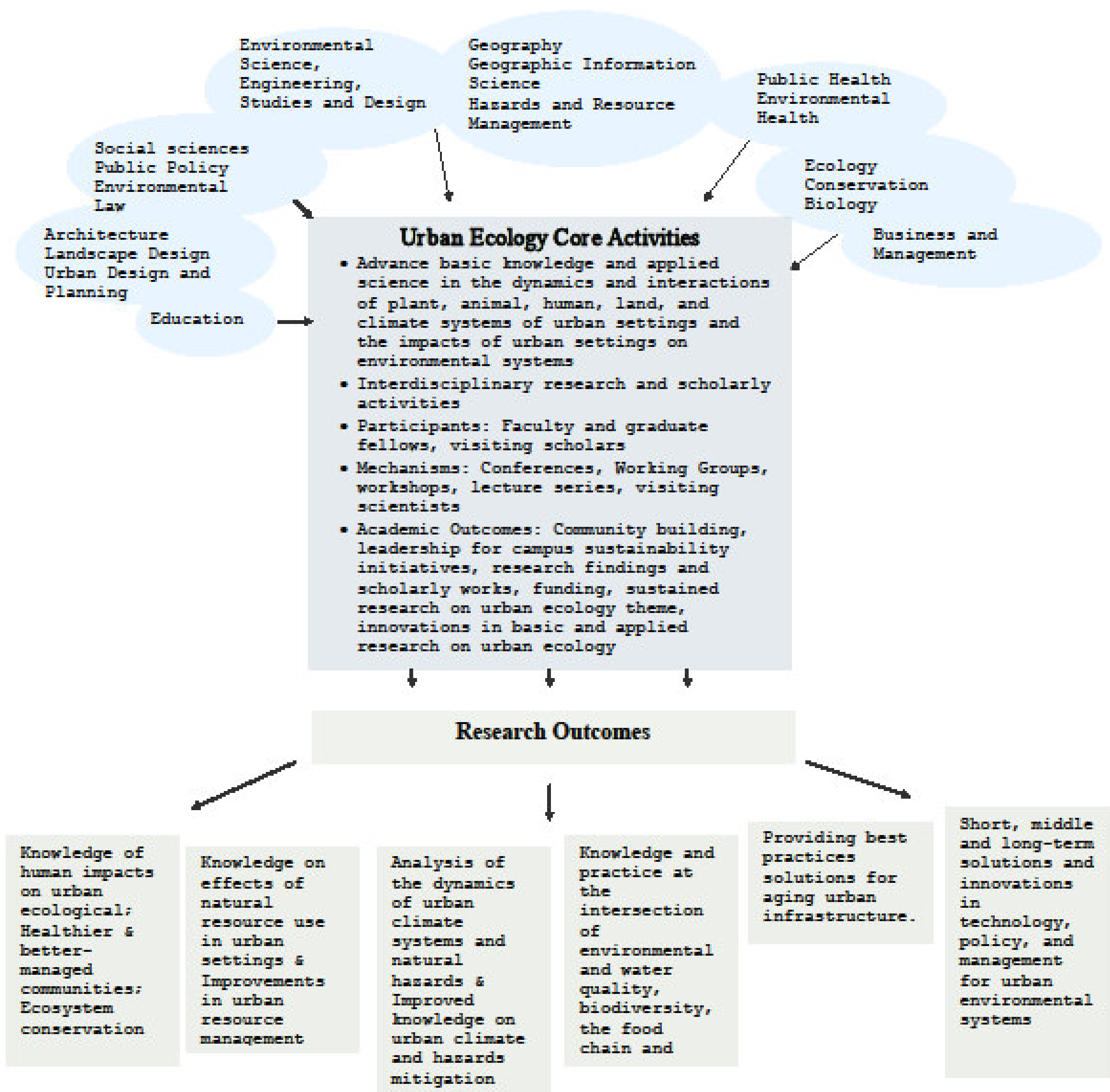
Academic Model components:

- Act as a point of information sharing and coordination for academic and research activities at Temple related to Sustainability
- Assist faculty to enhance sustainability related content in their teaching
- Review and make recommendations regarding Graduate fellowships, Undergraduate projects in sustainability, and Sustainability projects submitted for internal funding
- Organize seminars and workshops on sustainability

Additional Integrated Model components:

- Champion research projects on Urban Ecology
- Build research-community partnerships to deal with health problems in surrounding communities, especially in underserved groups
- Position Temple to be capable of acquiring major funds, such as from the American Recovery and Reinvestment Act (funds are available through 2012)
- Submit quarterly reports and recommendations to the Provost on short term, mid-term, and long term directions in sustainability research, and in particular, environmental and alternative energy

FIGURE 5-1. INTEGRATED ACADEMIC AND RESEARCH MODEL



5.6.1 Funding Sources to Support Urban Ecology: Integrated Academic/Research Model

Long-term funding for an *Integrated Academic and Research Model* will leverage cross-cutting, interdisciplinary and collaborative activities of the proposed Center for Urban Ecology. Presented below are examples of NSF, NIH and EPA funding programs that reflect society's need to address urgent, multifaceted, dynamic, geographically widespread, and systemic problems through innovative research, education, and policy research activities. These examples demonstrate the need for a Temple research center that builds collaborations involving interdisciplinary research groups at Temple, partners with academic and research institutions across the country, and integrates a variety of funded program components to respond to these opportunities.

- NSF Environmental Sustainability Program – This program supports sustainable engineering programs that examine the intersection of human well-being that support sustaining natural systems. The program contributes to such fields of knowledge as industrial ecology, ecological engineering, and earth systems engineering. It draws on collaborations among environmental engineers, social scientists and ethicists.

  http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=501027

- The National Science Data Library Pathways Project Proposals – NSDL is an NSF funded initiative that supports educational, basic and applied scientific, and information technology researchers to collaborate to share data resources emanating from grounded empirical research with the aim to support both informal and formal educational initiatives.

  http://nsdl.org/contribute/?pager=proposers

- The NSF Science Masters Program – This program provides support for interdisciplinary graduate programs that provide students with training in a science, technology, engineering, and math (STEM) field of study that integrates experiential learning, management training, and research experiences and prepares them to enter careers in business, industry, nonprofit and government organizations.

  http://www.nsf.gov/pubs/2009/nsf09607/nsf09607.htm

- NSF Engineering Research Centers (ERCs) – Engineering Research Centers are interdisciplinary, multi-institution research collaborations that address focused research topics connecting discovery science with applications that meet social needs. This program initiative provides between 3 and 4 million dollars of funding for five years to promote new directions in research that can result in new industries to form, provide the knowledge for deep restructuring of existing industries, and develop new approaches for solving long-standing concerns. The thematic focus for the current competition is sustainable energy, a program area that aligns with the proposed Center for Urban Ecology.

  http://www.nsf.gov/pubs/2009/nsf09545/nsf09545.htm

- Ecology of Infectious Diseases Initiative – Jointly sponsored by NIH and NSF – This funding initiative aims to support research that contributes to the understanding of ecological and biological mechanisms related to human impacts on environmental change that relates to the emergence and spread of infectious diseases. This program involves faculty in biology, ecology, geographic information systems, epidemiology, engineering, climate change, and pollution.

http://www.fic.nih.gov/programs/research_grants/ecology/index.htm

- EPA Eco-Logical Grants Program – This program provides support for multiple institutions, including transportation, research, and resource management collaborators to develop planning approaches in cooperative agreement relationships. Programs aim to improve wildlife conservation, eco-system sustainability, and land stewardship through finding pathways for improved infrastructure planning and implementation.

  http://www.environment.fhwa.dot.gov/ecological/eco_index.asp

5.7 Achieving Milestones

The implementation of recommendations in this plan should take place over a three-year period, beginning in the Spring of 2010. A timeline for achieving milestones related to the program is presented below. Initial activities will involve developing courses, certificate programs, and graduate training programs with the aim to begin enrolling students in the Fall of 2011. We recommend that graduate fellowships could be named as soon as Spring 2010 to begin working on sustainability research projects anchored to faculty interests as soon as Fall 2010. Plans for community involvement, Living Laboratory and Community activities, outreach, and co-curricular activities can build on current activities that have been initiated through student organizations, current centers, departments and the Office of Sustainability at Temple. We recommend beginning the planning process for implementing the proposed Center for Urban Ecology in the Spring of 2010, with the aim of beginning efforts in the Fall of 2010. Budget details for both the academic and integrated model are attached to this document. Finally, in the third year of implementation of this plan, we anticipate a first cohort of graduate students will graduate from programs, a strong community of scholars and researchers in sustainability at Temple will have formed, and our community outreach program will have integrated a robust, sustainability public education and awareness scope of work.

2010

Hold public, community forum and select Advisory Board members for Academic Sustainability at Temple in Spring 2010

Initiate academic planning process to create undergraduate and graduate courses and curricular elements for sustainable education in Fall 2010

Implement first cohort of graduate fellowship program for Fall 2010 fellows in sustainability

Launch Center for Urban Ecology in Fall 2010; first faculty fellow cohort

Continue ongoing Outreach and Extra-curricular activities

Implement Living Laboratory and Communities and associated programs in Fall 2010

2011

Create web portal for interactive community engagement and public education in Fall 2011

Enroll first cohort of M.S. students in new graduate programs; begin offering Undergraduate certificate program

Identify second cohort of graduate and faculty fellows of the Urban Ecology and Sustainability Research Center; begin dissemination of short-term outcomes;
Academic Center Model - continues to build Sustainability interests and community at Temple;
Integrated Center Model - Ramp up of funded initiatives, submission of proposals, and dissemination of research outcomes

Continue Living Laboratory, Living and Learning Communities, Outreach and Extra-curricular activities

Participation in national initiatives related to Sustainability

2012

First cohorts of new graduate M.S. programs complete degree; formal assessment of program quality based on exit interviews with students

Third cohort of graduate and faculty Sustainability fellows work with Sustainability Research Center

Preliminary outcomes of first round of funded projects disseminated

Academic Center Model - continuing;
Integrated Center Model - funded through external grants by Fall 2012; continued dissemination of outcomes; rotation of Center Director

Web portal community building continues with ramp up of online tools for sustainable education and outreach

New programs for community education, partnerships implemented

5.8 Budget Recommendations

The two models for the proposed Center for Urban Ecology will require different budget options. An Academic Model, with no research component would require a small annual operating budget. An Integrated Academic and Research Model would require only one time funding, with the expectation that outside funding would eventually enable the Center for Urban Ecology to be self sustaining.

6. Results Tracking and Financing

Successful implementation of a climate action plan involves flexibility and long-term support from Temple's leadership and stakeholders. Above all, it involves measuring and reporting progress toward a specific target, in addition to consideration of the opportunities and constraints for financing climate actions.

6.1. Greenhouse gas emissions Tracking

A biennial update of the campus greenhouse gas emissions (GHG) inventory is required by the ACUPCC. Temple will publicly update the inventory biennially, but internally track GHG emissions annually. This will allow Temple to determine if progress is being made with regards to planned emissions reductions and adjust strategies accordingly.

Section 3 presented potential emissions reduction projects through 2030. The projects comprised both infrastructure change and behavior change. A key strategy for assuring progress with regards to planned emissions reductions will be to assign sponsors for each emissions reduction project proposed.

As presented in the Acknowledgements and discussed in Section 1, Temple has established several committees, including the Sustainability Advisory Group, that have supported the development of this Action Plan. Following the public launch of this Plan, the Sustainability Advisory Group will become the sponsor for the emission reduction projects recommended in the Plan and will oversee project implementation. The sponsor's role will be to guide the funding, implementation, and measurement/verification of the project.

To assist with measurement/verification, Temple plans to implement and use a utility tracking system for management and analysis of campus utility consumption and costs, which may also serve to identify further utility savings opportunities. In addition to demonstrating whether Climate Action Plan projects have achieved expected energy savings, the system will help to reduce utility bills by identifying utility waste, cost and meter problems, and billing errors, which can save a percentage of the annual campus utility budget, as well as reduce GHG emissions.

6.2. Financing

Smart financial planning prioritizes cost-effective emissions mitigation measures, schedules them to maximize synergies and savings allowing some measures to pay for others, identifies obvious and unusual funding sources, and uses creative financing techniques to make serious climate action affordable.

Projects, measures, and programs that reduce greenhouse gas emissions can be paid for by a variety of funding mechanisms including:

- Grants from government, foundations or business partners
- Energy efficiency and renewable energy incentives provided by government or utilities
- Self-financing performance contracts
- Borrowed money from tax-exempt bonds or other types of borrowing
- Financial instruments specifically designed to promote renewable energy development
- Alumni donations, student fees, graduating class gifts and other fundraising solicitations

Affordability is a key factor that weighs heavily on whether a climate action plan actually gets implemented. This means minimizing costs while seeking all available dollars. Temple will finance the plan through traditional mechanisms such as capital project requests, campus and departmental budgets, and external grants as available, as well as through other non-traditional means. *In accordance with University policy, all selected Climate Action Plan projects will be evaluated and approved by the Board of Trustees Facilities Committee prior to implementation.* Specific measures and programs to finance CAP actions are summarized below.

6.2.1 Plant Development Fund (PDF) and Energy Budget

The Plant Development Fund (PDF) is a capital fund for infrastructure projects that can help fund climate action plan projects. There are three phases of projects that may be completed under the PDF:

- Phase I includes the Building Automation System (BAS) starting in 2010 as described in Section 3.2.2.
- Phase II is a series of already planned building improvements from 2011-2013 as described in Section 3.2.3.
- Phase III will be implementation of energy conservation measures for top energy-using buildings from 2014-2020, as described in Section 3.2.4.

In addition to the PDF, Temple's Energy Budget can be used to fund CAP projects that relate to fuel and/or electricity procurement. These include the purchase of renewable energy certificates (RECs) and biofuels.

To complement these funding sources, Temple will also pursue available local, state, and federal grants, including funding for renewable energy and energy conservation projects available through Temple's local utility (PECO).

6.2.2 Additional strategies

Seed Funds

Seed funds can be a very effective financing mechanism for campus sustainability project, and numerous types of seeds have been developed at peer institutions. A seed fund is both a source of financing and a strategy for managing climate neutrality funds that can become a generator of new funding. With a seed fund, an initial pool of capital is used to fund a number of projects with a predictable return. The savings from these projects recapitalize the loan fund, preferably with some fixed premium to allow the fund to grow. Because it is managed internally, seed fund managers can loan money with low interest rates over longer payback periods than a traditional bank loan. This expands the pool of projects eligible for funding.

Some seed types allow savings from projects (once the loan and fixed premium/interest have been repaid) to remain in the budget of the unit that implemented the project. Other models return savings to the general budget. One possibility would be for a seed fund to be administered by Temple Facilities Management and capitalized initially (to an agreed upon level) by money from savings generated by ongoing and future energy conservation projects. A fixed, negotiated interest rate would allow the fund to grow, with additional savings returning to a central Temple budget. This hybrid model, also proposed at the University at Buffalo, State University of New York, would allow Temple Facilities Management to fund new greenhouse gas mitigation actions while contributing some savings to a central Temple budget.

A seed fund is an excellent funding method, but it is not without limitations. Projects must generate a return fairly quickly if the fund is to finance many projects and have a significant impact on campus emissions. Bundling projects to include a mix of short and long or uncertain payback projects will allow managers to tailor the mix of projects to meet the seed fund's required payback timeframe. High-visibility and/or pilot projects may be bundled with reliable performers to achieve a high level of economic performance for the complete package. Bundling should be used to ensure that a broad mix of projects receives support.

Finally, while a seed fund may be created with the goal of achieving climate neutrality, fund managers may choose to fund projects that do not directly contribute to climate change mitigation, yet do result in a reduction in Temple's utility costs. Fund managers must carefully consider whether such projects should be funded from a seed fund or through traditional financing mechanisms.

Energy Savings Performance Contracts

An Energy Savings Performance Contract (ESPC) is a partnership between a university, or other organization, and an energy service company (ESCO). The ESCO may conduct a comprehensive energy audit for the campus and identify improvements to save energy. In consultation with the university, the ESCO designs and constructs a project or projects to meet university needs and arranges the necessary financing. The ESCO guarantees that the improvements will generate energy cost savings sufficient to pay for the project over the term of the contract. After the contract ends, all additional cost savings accrue to the university.

Under this type of agreement, an ESCO will furnish the up-front capital for an energy efficiency improvement to Temple in return for payments over the lifetime of the agreement. These payments are generated from the energy cost savings generated by the project. The ESCO guarantees the energy savings. A utility energy service contract is similar to an energy savings performance contract, but the utility company (instead of an ESCO) delivers the energy services and pays for upgrades in exchange for payments from the institution. Payments are made from the energy cost savings generated by the project.

Temple has previously worked with ESCOs and this financing measure would assist in the implementation of infrastructure change at Temple. The benefits of these ESCO partnerships include access to private sector expertise and expert technical support, and flexible and practical contract and procurement processes, to meet emissions reduction goals.

Alumni Donations/Fundraising/Student Fees and/or Donations

Other examples of funding strategies are to solicit alumni and outside donors for specific projects, such as development of LEED certified buildings. Some universities have implemented a student-driven campus green fund as a mechanism for funding portions of the climate action plan, where students have indicated the willingness to pay a small to moderate fee (e.g., a minimum of $10).

Solicitation of graduating students for funds related to specific green projects is another effective method for expanding funding for projects.

7. References

American College & University Presidents Climate Commitment (ACUPCC), September 2007. *Implementation Guide: Information and Resources for Participating Institutions*.

ACUPCC, November 2008, v1.0, *Investing in Carbon Offsets: Guidelines for ACUPCC Institutions,* http://www2.presidentsclimatecommitment.org/documents/CarbonOffsetsGuidelines_v1.0.pdf.

ACUPCC, November 2008. *ACUPCC Voluntary Carbon Offset Protocol,* http://www2.presidentsclimatecommitment.org/documents/ACUPCCVoluntaryCarbonOffsetProtocol_Nov08.pdf.

ACUPCC, 2009. *Reporting System (http://acupcc.aashe.org/).*

AEI, 2009. '*Temple_-_Potential_GHG_Exposure_r1c_2009_05_06(1).xlsx*'.

Brattle. 2009. *Volatile CO2 Prices Discourage CCS Investment.* The Brattle Group.

Business for Social Responsibility, *Getting Carbon Offsets Right,* July 2007, www.bsr.org/reports/BSR_Getting-Carbon-Offsets-Right.pdf.

Business for Social Responsibility, *Offsetting Emissions: A Business Brief on the Voluntary Carbon Market* (Second Edition, February 2008), http://www.bsr.org/reports/BSR_Voluntary-Carbon-Offsets-2.pdf.

City of Philadelphia Mayor's Office of Sustainability, 2009. *Greenworks Philadelphia*.

CRA. 2008. *Economic Analysis of the Lieberman-Warner Climate Security Act of 2007*. CRA International.

Ecosystem Marketplace and New Carbon Finance, *Fortifying the Foundation: State of the Voluntary Carbon Markets 2009*, October 28, 2009, http://ecosystemmarketplace.com/documents/cms_documents/StateOfTheVoluntaryCarbonMarkets_2009.pdf.

European Commission of the European Union, 2007. *European Union Emissions Trading Scheme (EU ETS).*

Intergovernmental Panel on Climate Change (IPCC), 2007. *Fourth Annual Assessment Report: Climate Change 2007 (AR4).*

O'Brien & Gere, April 2009. *Greenhouse Gas (GHG) Inventory Program, Temple University*.

PECO Press Release, PECO Supports Pennsylvania Green Energy Sources; Company signs agreements for renewable energy credit purchases, May 20, 2009, see http://www.peco.com/newsroom/newsreleases/NR+052009.htm.

Pennsylvania State Data Center (PaSDC), November 2008. *Detailed Population Projections By Age, Gender, Race and Hispanic Origin: Pennsylvania 2000 to 2030.*

Responsible Purchasing Network, 2009. *Responsible Purchasing Guide for Carbon Offsets*, http://www.responsiblepurchasing.org/purchasing_guides/carbon_offsets/purchasing_guide.pdf.

Synapse, 2008. *CO_2 Price Forecasts*. Synapse Energy Economics.

Temple University Academic Initiatives Committee for Sustainability, December 2009. *Strategic Directions in Sustainability for Academic Achievement and Research for the 21st Century at Temple University*

Temple University Sustainability Task Force, October 2007. *Sustainability Task Force Report to the President*.

Temple University, April 2009. *Temple University Academic Strategic Compass: Mapping a New Destiny*.

Temple University, May 2009. *Temple 20/20: A Framework for Campus Development*.

Temple University Transportation Committee, August 2009. *Transportation Recommendations Report*.

Trexler and Nexant, 2006. *Will Maturing GHG Markets Make IGCC the Coal Technology of Choice?* Fifth Annual Conference on Carbon Capture and Sequestration, Alexandria, VA.

United Nations, 1997. *Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC).*

U.S. Environmental Protection Agency (EPA), December 2008. *Catalog of CHP Technologies*.

U.S. Census Bureau, Population Division, April 2005. *Interim State Population Projections*.

U.S. Conference of Mayors, 2005. *U.S. Conference of Mayors Climate Protection Agreement*.

U.S. Congress, 2009. *American Clean Energy and Security Act of 2009 (H.R. 2454).*