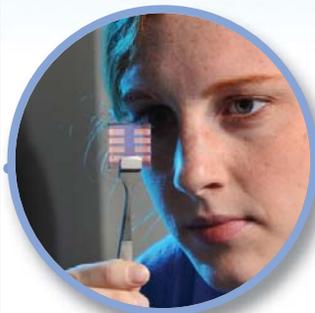


The University of North Carolina at Chapel Hill

2009

Climate Action Plan



THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

A LOT of little Solutions

*"There are no big problems;
there are just a lot of little problems."*
-Henry Ford

Climate change could be a very big problem. Globally big. Trillions of individual decisions made by billions of people compounding into one gargantuan tangle that could take generations to unravel. It's impossible to find all the loose ends — to know exactly where to begin. And yet begin we must.

When the University of North Carolina at Chapel Hill became a signatory of the American College and University's Climate Commitment (ACUPCC), it pledged to untangle its own small part of a global issue. The ACUPCC is a pledge to achieve climate neutrality by reducing the campus carbon footprint and offsetting all greenhouse gas emissions. A year after signing, the University published its first comprehensive greenhouse gas emissions inventory, peeling back the layers of its ambitious goal to reveal the many small opportunities for improvement.

The importance of our task has not faded over the past year, but has become even more urgent as the implications of climate change expand beyond the bounds of scientific or social consideration into the business world. At this writing, the US House of Representatives narrowly passed a carbon cap-and-trade bill that would gradually lower greenhouse gas emissions from large industrial sources by levying fees on emission permits. At the same time, the nation faces the most stifling economic depression in a generation. Attaching a price to carbon presents the University with new opportunities and challenges as we make the business case for emissions reduction.

In this, the University's first Climate Action Plan, we begin by presenting an update to the campus emissions inventory. We've used that historical data,

along with development plans and growth estimates, to create a projection of how the campus carbon footprint will expand if we continue with business as usual. Finally, we present a comprehensive plan for achieving our goal of climate neutrality by mid-century. As our business and educational models work to internalize the cost of greenhouse gas emissions, we will confront and address the many small problems we encounter on the path to climate neutrality.

Learn more about the Climate Action Plan and UNC's progress at

 <http://www.climate.unc.edu>



Figure 1. Historical Emissions. Greenhouse gas emissions grew from about 520,000 Metric Tons of Carbon Dioxide Equivalent (MTCDE) in 2007 to approximately 570,000 MTCDE in 2008. While indirect Scope 2 emissions from purchased electricity decreased slightly, the direct Scope 1 emissions grew by 20%.

Inventory Update 2008

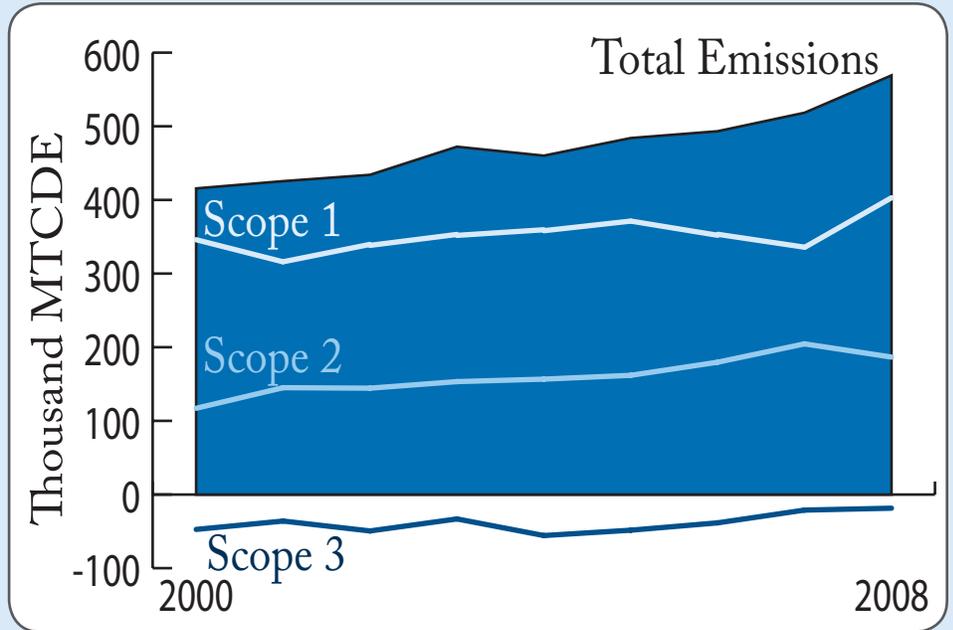


Figure 2. Emissions by Demand A closer look reveals that emissions grew most dramatically in building energy consumption, from fugitive emissions of refrigerants, and from commuter activity. Building energy emissions increased due to additional construction and an increased proportion of coal burned in the Cameron cogeneration facility.

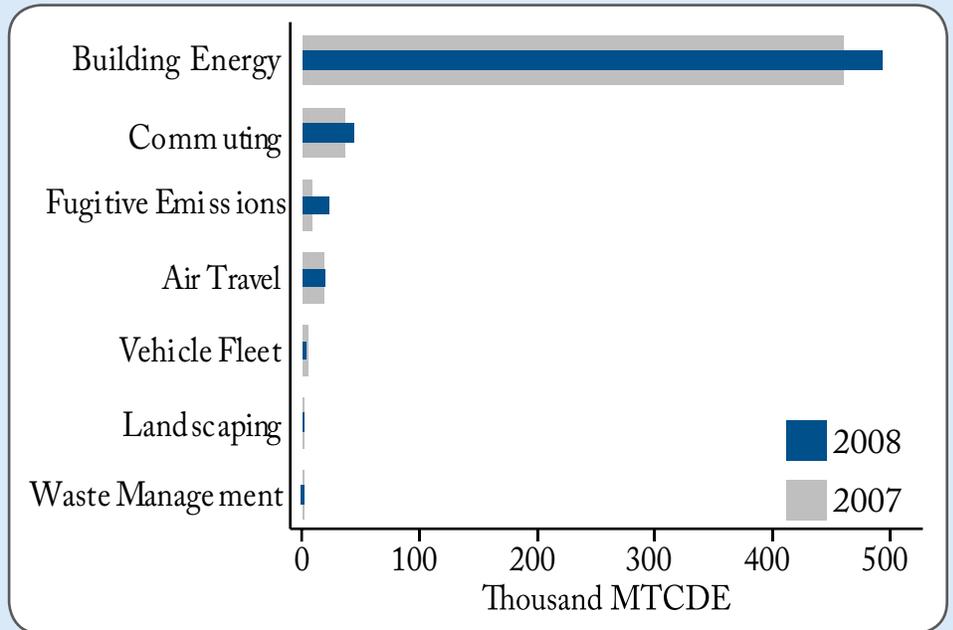


Table 1. Benchmark data reveals increased enrollment and construction of over half a million square feet of building space with the requisite increases in GHG emissions. At the same time, building carbon intensity has fallen by over 12%.

| Benchmarks | 2000 | 2008 | Change |
|---|------------|------------|--------|
| GHG Emissions (MTCDE) | 415,705 | 569,195 | 36.9% |
| Full-Time Equivalent Students | 22,980 | 26,369 | 14.7% |
| Emissions Per FTE Student | 18.1 | 21.6 | 19.3% |
| Gross Square Footage | 12,362,885 | 18,477,000 | 49.5% |
| Total Emissions/1,000 Sq. Ft. | 33.6 | 30.8 | -8.4% |
| Building Energy Emissions/1,000 Sq. Ft. | 30.3 | 26.5 | -12.5% |

For a comprehensive picture of campus greenhouse gas emissions and calculation methods, please see *The Step That Leads to Change: 2007 Greenhouse Gas Inventory and Retrospective* at <http://www.climate.unc.edu/GHGInventory>

Climate Action Plan

Stabilization Wedges

•**Energy Supply** - Strategies involving alternative fuels, renewable energy, and the carbon intensity of grid electricity.

•**Energy Conservation – Technical** - Engineering changes to improve energy efficiency. For example, building controls, light retrofits, variable air volume fume hoods, night or weekend setbacks.

•**Energy Conservation – Behavior and Policy** - Energy conservation measures that rely on a change in habit, or new policies that incentivize efficiency.

•**Green Development** - Strategies to build energy efficiency into new campus buildings and through retro-commissioning and space planning.

•**Transportation** - Programs to improve mass transit, modify commuter habits, and reduce emissions due to air travel.

•**Purchasing and Recycling** - Strategies to decrease the impact of the campus supply chain through source reduction, environmentally preferable purchasing, waste reduction, or recycling.

•**Offsets** - As a last resort, carbon offsets or RECs may be banked or purchased to meet emissions targets.

Strategic Approach

The barriers to climate neutrality are substantial, owing to the sheer ubiquity of greenhouse gas emissions as a part of daily campus operations. Because energy and carbon affect everyone, development of a comprehensive, long-range plan required the input and support of a diverse group of campus stakeholders. A steering committee composed of high-level administrators ensured that the project had the support and direction it needed for success.

In order to make the planning process more manageable, greenhouse gas emission sources were divided into a series of “Stabilization Wedges,” akin to those described by Pacala and Socolow (*Science*, 1994). Each wedge was assigned to an expert team leader who worked with other staff, students, and consultants to identify viable carbon abatement opportunities.

To begin, “Wedge Groups” were asked to generate a comprehensive list of mitigation strategies and ideas. Each group took a unique approach to idea generation, looking to existing departmental goals, published strategies, campus focus groups, brainstorming techniques, and cross-pollination between “wedges”. (See sidebar for a *Lean* approach).

Next, groups began to assess the viability of their project lists, developing metrics to demonstrate the feasibility, carbon mitigation potential, and cost of each project. They further refined their recommendations into a smaller set of “Endorsed Alternatives,” identifying the strategies with a strong probability of success.

Technologies that were appealing but not yet commercially available were placed in the “bicycle rack” for future consideration, while others had to be scrapped in the “compost pile” because they failed some critical test.

Wedge Leaders and project managers held periodic meetings with the CAP Steering Committee to ensure that their progress and ideas aligned with University policy and mission.

Projections and Targets

Modeling

As the individual wedge groups met to identify mitigation strategies, the project team developed a spreadsheet model of campus greenhouse gas emissions.

The model considers myriad factors, including campus population growth; construction, demolition, and renovation with energy intensity projections for each type; commodity pricing – with and without federal carbon regulation; and changes in on-site energy generation and from the local utility.

Using this model, the project team assessed the relative contribution of each endorsed alternative toward the goal of campus climate neutrality. By comparing each alternative on the basis of carbon abatement, cost, rate of return, and other metrics, the team selected a portfolio of projects that would serve to decrease carbon emissions in a fiscally responsible way.

Continued on page 5...

Leaning the Campus Supply Chain

Carbon reduction often seems to come with a trade-off: Should we expand our class offerings, or use less energy in the buildings? Should we encourage faculty travel for conferences and meetings, or reduce air travel emissions? Is it better to turn computers off at night, or allow the IT staff to run updates and patches? Without a framework and a common sense of purpose, the answers to these questions remain elusive and can sometimes result in disagreement or conflict.

What if we could find common ground among diverse stakeholder needs, preserving the benefits of a program while eliminating its negative attributes? This is one of the goals of *Lean*, a business and improvement philosophy developed by Toyota over the last 50 years. At its core, *Lean* strives to increase the value of the work we do, while eliminating any waste that doesn't contribute to customer satisfaction.

A university has many customers, both internal and external, and each one has a different set of values. Students may value education at an affordable price. Faculty may value top-notch research space or state of the art classroom equipment. Each person will be a customer to many others, and will serve many others in return – the trick is in knowing what the customer really wants, so we can deliver more value with less waste.

The University's supply chain, from procurement through recycling, is an important part of the campus carbon footprint, but it is difficult to assess the

impact of carbon reduction programs as they filter through a population of 40,000 faculty, students and staff. Instead of simply mandating policies from the top, a team utilized a *Lean* rapid improvement workshop known as *Kaizen* to understand the supply chain from the bottom up. This workshop focuses a diverse stakeholder group on a single product or process, using their many eyes and minds to look for waste and opportunities for improvement.

But where to focus in a complex supply chain? The EPA estimates that over two metric tons of CO₂ are emitted in the harvesting, processing, and disposal of one ton of paper. UNC consumes an estimated 100,000,000 sheets per year, or roughly 500 tons – a meaningful target for emission reductions. The carbon emissions for a computer's life cycle top 15 metric tons per ton of equipment, and with over 80,000 computers on campus, these also became a focus for reduction. As the team explored these two seemingly disparate parts of the supply chain, exciting synergies began to emerge.

Stakeholders representing the purchasing department, computer labs, students, the recycling office, and others were invited for a two-day *Kaizen* workshop. The goal was to understand the true value of paper and computer use to the campus community, and to identify wasted time, resources, or energy that could be eliminated without reducing that value.

The group recognized that faculty, staff, students, vendors, and alumni are customers of the IT department. These customers value reliability, information security, storage space, uptime, speed, support, low cost, etc. Any carbon reduction

or sustainability goals must take these values into account, so that the program doesn't accidentally decrease quality or satisfaction. For instance, we could eliminate our backup file storage sys-

tem to save material, money, and energy, but this would violate the customer's desire for reliability.

With a firm sense of customer value, the groups moved to an interactive Value Stream Mapping exercise. The value stream map describes the people, materials and activities involved at each phase of a process, from start to finish.

Once the entire process was visualized on the wall, it became easier to see the waste, errors, and problems. For example, the team members noticed that when placing an order from a local vendor, it automatically came with a copy of the vendor's catalog – an unnecessary use of paper. At another step, the group realized that students choose to print more documents because their laptops are cumbersome, or because some professors forbid laptops in class.

Each source of waste was addressed with ideas to solve the problem, and all told, the group came up with almost 100 improvement opportunities in just one afternoon. For example, paper-saving ideas ranged from the common (double-sided printing) to the unusual and unique (use the monitor settings employed by journalists to ease eye strain when reading from a screen). These ideas were ranked by their impact on the campus carbon footprint, and on the difficulty of implementation, resulting in a helpful list of high-impact, low-difficulty options for the Climate Action Plan.

By engaging a diverse group of stakeholders in the planning phase, each idea was reviewed with scrutiny and creativity, allowing only the viable options to surface. With such broad understanding and buy-in, these carbon abatement opportunities have a strong potential for adoption and success.

Only the highest impact solutions are described in this Climate Action Plan, but scores of others will allow for continuous improvement in a variety of UNC's business processes. In the future, UNC can apply a *Lean* approach to other aspects of its operation to reduce waste and shrink the campus carbon footprint.

For more information, visit:

 <http://climate.unc.edu/lean>



The Kaizen team collaborates on a Value Stream Map for computers.

Projection

Campus greenhouse gas emissions will grow dramatically over the next 40 years if the University continues with business-as-usual (Figure 3).

Emissions are expected to remain under 600,000 MTCDE until 2012, when the University begins construction of Carolina North, a new satellite campus located just over a mile north of the main campus. This construction pushes the carbon footprint past 700,000 MTCDE, where it continues to increase over the duration of the time frame.

Target and Milestones

The Intergovernmental Panel on Climate Change (IPCC) established a series of stabilization scenarios, describing the long-term equilibrium of global temperature that result from carbon mitigation programs. Category I, their most aggressive scenario, calls for CO₂ emissions that peak by 2015 and decrease by 50-80 percent of 2000 levels by mid century.

The black dotted line on the projection shows the University's target for GHG reductions – a straight line to carbon neutrality in 2050, representing a reduction of almost 15,000

MTCDE per year. This exceeds the IPCC's Category I scenario and ensures that the University is playing its part in the global effort to mitigate the effects of climate change. Climate action planning and portfolio optimization focused on meeting these reduction goals and ensuring that the suite of projects held emissions below the emission target line.

If the University achieves its target reductions, emissions should decrease to year 2000 levels by 2020, a meaningful milestone goal, and a savings of over 300,000 metric tons compared to the business as usual case. Coupled with further construction, building emissions intensity will drop to 18 MTCDE/1,000 Square Feet, a reduction of over 45 percent.

Project Selection

One way to prioritize alternative carbon abatement projects is to rank them based on the cost per ton of carbon reduction, giving priority to projects that offer the best value. This approach requires a method for assuring comparability among projects over long and varying time frames.

A widely used approach for comparison is to calculate each project's "level-

ized" cost per ton of carbon abatement. Levelized cost is the present value of any additional capital or operating costs required by a project over its economic life, divided into equal payments for each ton of carbon that the project saves.

An abatement curve (Figure 4) can be used to visualize and compare both the levelized costs and carbon abatement of each option. Each project is represented by a rectangle: the height shows the levelized cost (expressed as dollars per ton of carbon savings) while the width shows the average annual carbon savings over a project's life (expressed as thousands of tons of carbon equivalent). Items extending below zero on the levelized cost axis represent an opportunity for both carbon mitigation and cost savings. Note that the calculation of levelized costs in Figure 4 do not take into account the effect that greenhouse gas regulation or a cap and trade market may have on the University's operating costs. These additional costs or savings are shown in Figure 6.

Near-Term Portfolio

Wedge groups identified seventeen carbon abatement measures that could be implemented in the near-term. Fifteen of these measures result in savings or cost-avoidance without attributing any cost to greenhouse gases resulting from carbon regulation. These include projects like PC power management, chiller efficiency improvements, and improved teleconferencing facilities to reduce the need for air travel (Table 2).

Two additional strategies were selected to fill out the near-term portfolio based on the University's expectation that federal climate change legislation will place an economy-wide price on greenhouse gas emissions.

The first is a landfill gas (LFG) capture and destruction project. The University

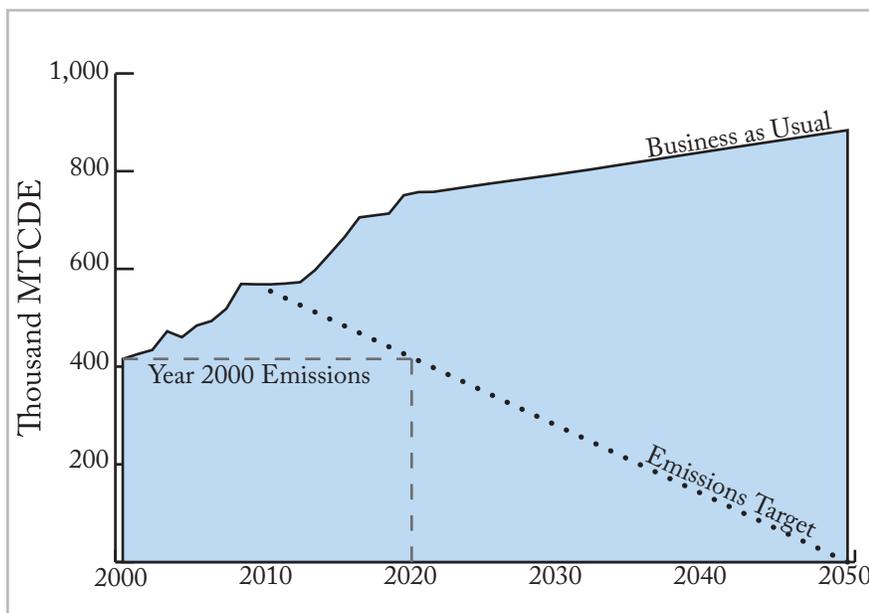


Figure 3. GHG Emissions Projection and Target

Emissions will rise if the University continues with business as usual, but achieving climate neutrality by 2050 sets a path to reach year 2000 emissions by 2020.

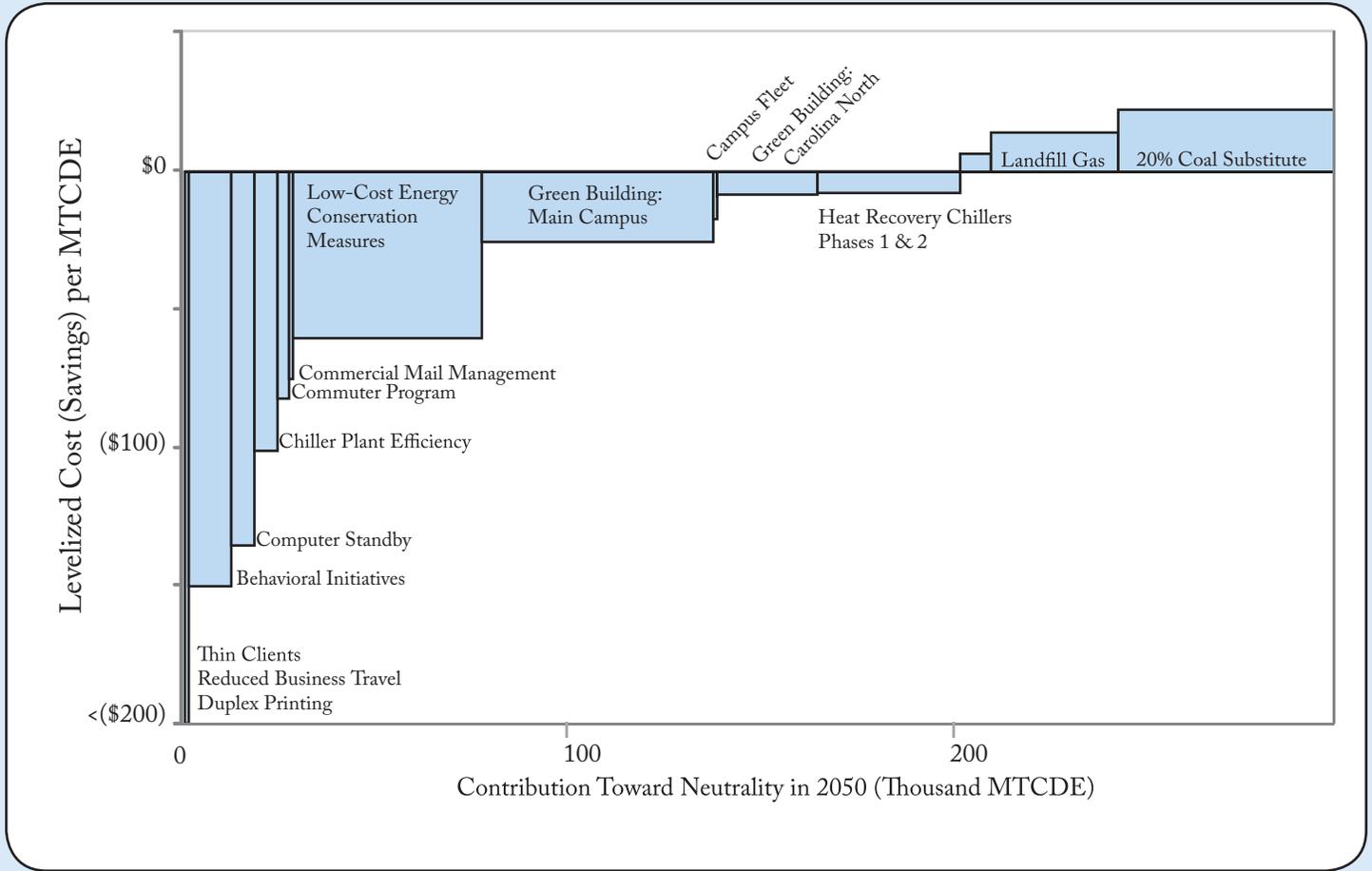


Figure 4. Near-Term Abatement Opportunities

Ranking projects based on levelized cost of each ton of carbon reduction shows that energy and operational efficiency are financially sound opportunities for carbon abatement.

Table 2. Near-Term Portfolio

Seventeen strategies can be implemented in the near-term to help UNC meet its GHG reduction targets.

| | |
|-------------------------------|--|
| Thin Clients | Utilize low-energy, longer lasting web-based computers for libraries and other applications |
| Business Travel | Improve teleconferencing facilities to decrease air travel |
| Duplex Printing | Make double-sided printing the default for campus printers |
| Behavioral Initiatives | Outreach and training to encourage occupants in energy savings |
| Computer Standby | Manage computer sleep and standby modes for campus computers |
| Low-Cost ECMs | Improve energy efficiency in existing buildings using low-cost Energy Conservation Measures |
| Commuter Travel | Avoided parking construction and increased public transportation (light rail) |
| Commercial Mail | Reduce the amount of junk mail or undeliverable mail sent to campus |
| Green Building | Adhere to NC Senate Bill 668 energy efficiency requirements (30% below ASHRAE standards) |
| Vehicle Fleet | Increase fuel efficiency of campus fleet based on CAFÉ standards |
| Composting | Extend composting to additional campus dining facilities |
| Chiller Efficiency | Three projects to replace or upgrade chillers to more efficient models |
| Heat Recovery Chillers | Capture heat from chiller condensing unit for HVAC use, rather than venting to a cooling tower |
| Landfill Gas | Capture and combust landfill methane |
| 20% Coal Substitute | Replace 20% of coal with torrefied wood in cogeneration boilers |

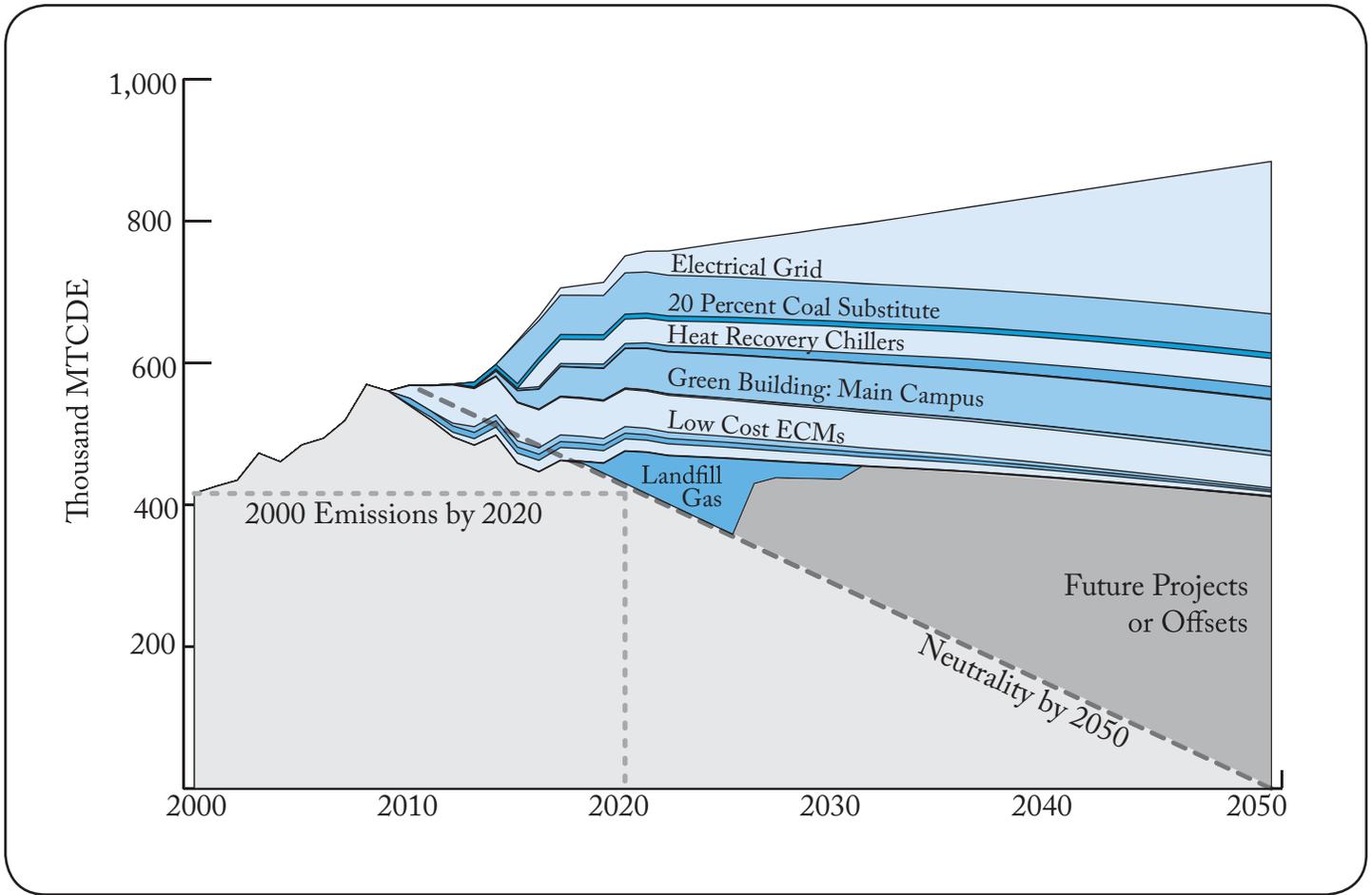


Figure 5.
Near-term Wedge Diagram

A portfolio of 17 projects may be implemented in the near term to reduce UNC's carbon footprint to year 2000 levels by 2020. Further carbon abatement will come from additional projects to be developed in the future. As a last resort, carbon offsets may be used to achieve the goal of climate neutrality. An interactive version of this chart may be found at <http://climate.unc.edu/portfolio>.

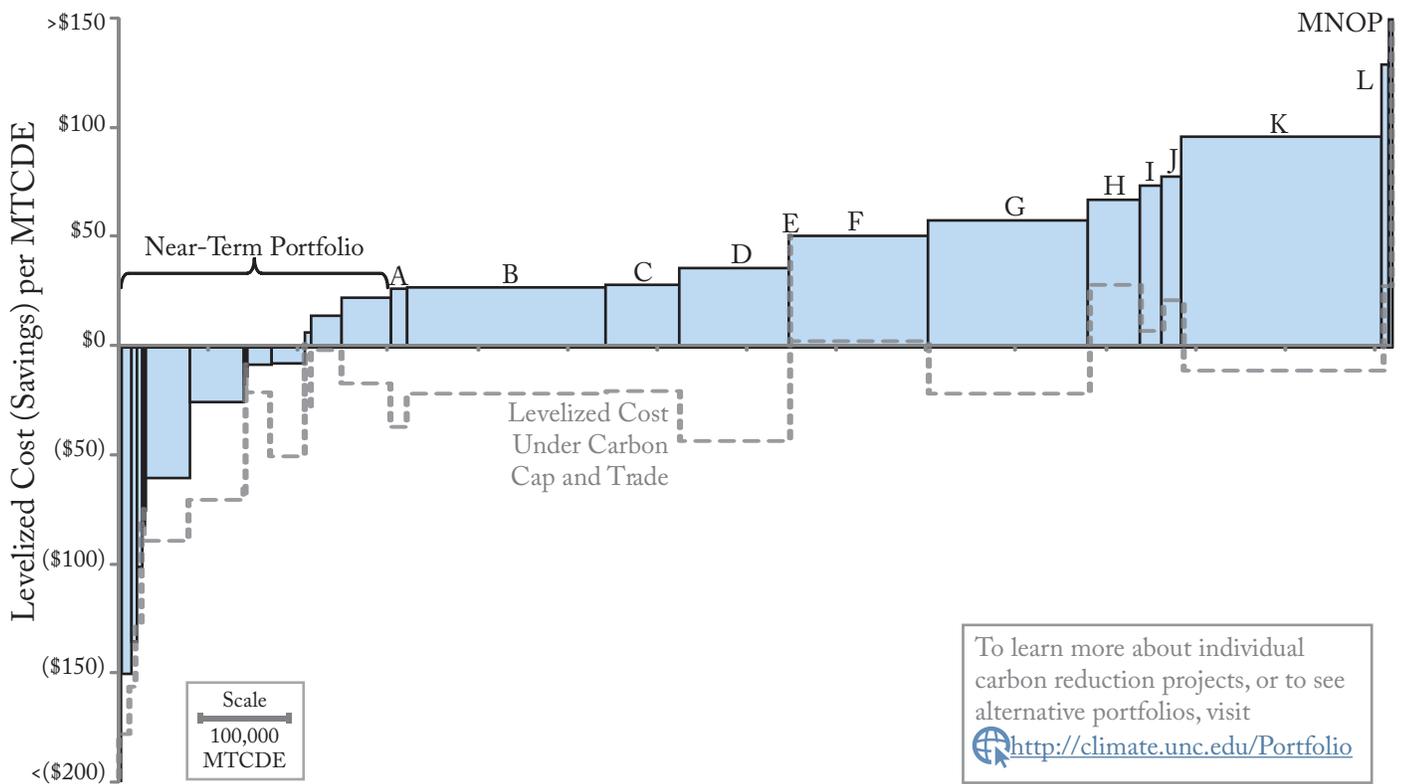
has entered into a contract with Orange County to purchase all the gas from the landfill that serves the region, slated to close in 2011. The LFG project will provide carbon offsets through methane destruction in its early years, to be followed by electricity generation during the development of Carolina North.

The second additional strategy in the base portfolio is a fuel switching opportunity. The cogeneration facility on Cameron Avenue utilizes two circulating fluidized bed boilers, fired primarily with bituminous coal. As part of a comprehensive study of renewable energy opportunities, the Energy Services Department has identified torrefied wood, a charcoal-like biomass, as an alternative to offset the use of coal in these boilers. Commercial sources for torrefied wood are currently under development, and the University is beginning tests to ensure compatibility with existing equipment. The proposed strategy involves co-firing coal with torrefied wood or another coal substitute in an 80:20 percent ratio.

A time-series, or "Wedge Diagram" (Figure 5), shows how each project impacts the university's carbon footprint over its lifetime. Each strategy, when overlaid on carbon emissions growth, carves a stabilization wedge and moves the University toward its goal of climate neutrality. Of particular note is a large wedge labeled "Electrical Grid" which represents Duke Energy's work to reduce the emissions intensity of grid-connected power plants. As the utility expands the proportion of nuclear and renewable energy sources, the campus's Scope 2 emissions are decreased in turn.

The landfill methane capture and destruction project, slated to come online in 2011, will generate registered carbon offsets that the university may retire or bank depending on their financial value or regulatory requirements under a carbon cap-and-trade program. In Figure 5, the model shows a scenario in which the offsets are banked and saved until they can be applied to achieve the University's carbon reduction goals.

Figure 6. Long-term Abatement Opportunities



- A. Biomass Gasification at Carolina North (CN)
- B. 100% Coal Substitute
- C. 50% Coal Substitute
- D. Plasma Gasification of MSW - Syngas
- E. Shops and Informal Contract Recycling
- F. 50% Natural Gas, 50% Coal Substitute
- G. Plasma Gasification of MSW: Syngas + Natural Gas
- H. 50% Natural Gas

- I. Biomass Gasification w/ Biochar Production (CN)
- J. Energy Conservation (Mid-High Investment)
- K. Large Scale Biomass
- L. Biomass Gasification at CN (Phase II)
- M. Solar Thermal (CN)
- N. Solar Thermal to Electricity (Troughs) (CN)
- O. Solar Thermal to Electricity (Dish Sterling) (CN)
- P. Demo Scale Concentrating Solar PV (CN)

Mid- to Long-term Portfolio

The near-term alternatives will allow the University to meet its interim milestones through about 2025, after which additional projects will be required. Due to the uncertain nature of technology and financing twenty years in the future, the project team developed a number of alternative scenarios for additional carbon abatement.

In the mid- to long-term time frame, solar thermal panels, heat recovery chillers and a biomass gasification plant are options for the Carolina North campus to ensure further campus development does not defeat the University’s carbon

abatement goals. In addition, a group of energy conservation measures with higher capital costs will become financially viable as energy and carbon prices rise. These strategies form a basis (called Long-Term Common in Figure 7) for four alternative energy scenarios.

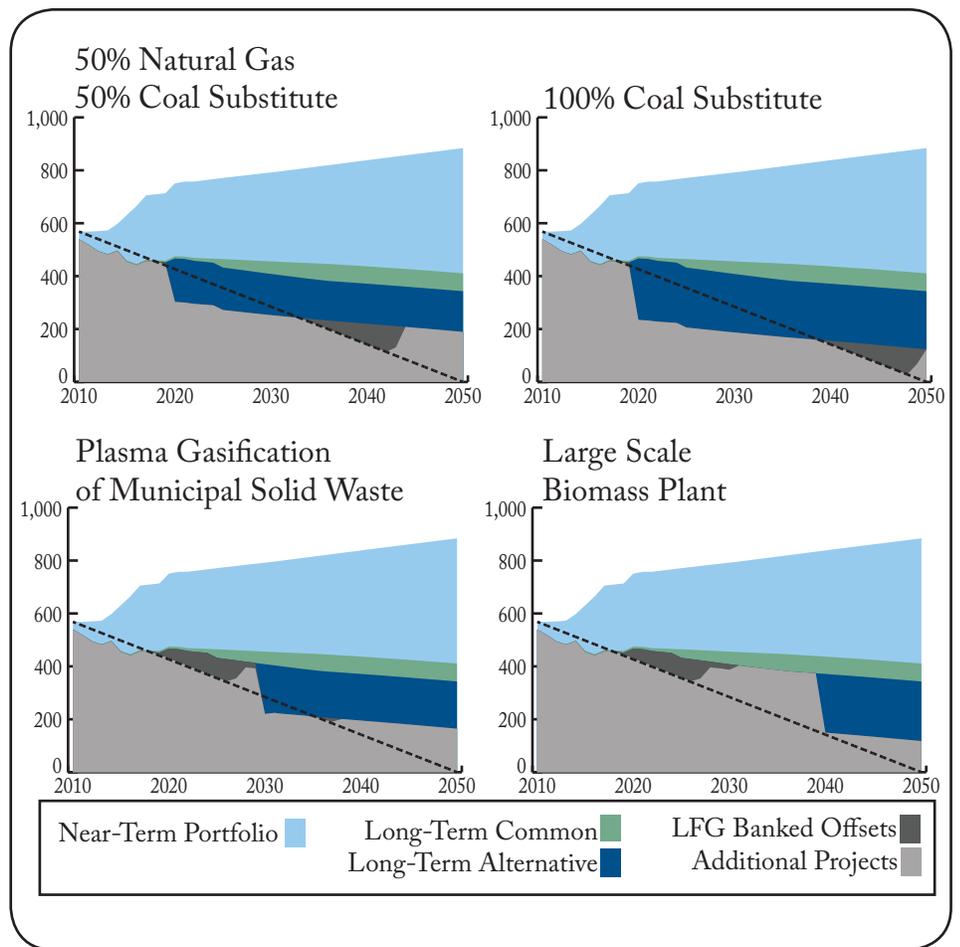
The first scenario replaces coal generation with a mixture of natural gas and a biogenic coal substitute. This strategy is appealing due to its reliance on existing technology, but it maintains the use of a fossil fuel with the associated carbon emissions.

The second scenario replaces coal entirely with torrefied wood or some

Figure 6. Long-term Abatement Opportunities
Near-term project allow the University to meet its climate goals through 2025. After that, additional opportunities for fuel switching and energy efficiency will be options for a long-term portfolio. Though there is a substantial cost for many of these strategies, carbon cap and trade may provide the incentive to meet aggressive reduction targets. Project price under cap and trade is indicated by the grey dashed line.

Figure 7. Long-term Alternative Wedge Diagram

Four alternative scenarios build on the near-term portfolio to further reduce greenhouse gas emissions. The difference between emission reductions and the 2050 goal may be met with carbon offsets.



other substitute. While using a biomass is carbon neutral, there is significant uncertainty surrounding the availability and pricing of these fuels.

The third scenario implements a technology known as plasma gasification that uses an electrical arc to literally vaporize municipal solid waste, releasing a combustible hydrocarbon gas. This biogas would then be blended with natural gas for use in a boiler. The added benefit of plasma gasification is its ability to deal with solid waste management in an age of overflowing landfills.

The fourth, and final, scenario proposes the construction of a large-scale biomass gasification plant to replace the cogeneration facility at the end of its useful life. Boilers at the Cameron plant are expected to last another 30 years, placing construction of the biomass plant in the 2040 time frame. While it would make a significant impact on the campus carbon footprint at inception, it leaves a gap both before and after construction in which the University would exceed its interim abatement goals.

In the scenarios above, carbon offsets generated by the University's landfill gas project are saved until they can be applied toward a target shortfall (dark grey). Any remaining emissions (light grey) must be abated with additional projects, or be covered by carbon offsets. These offsets could either be purchased on the market, or be developed through renewable energy or methane destruction projects in the region.

These strategies demonstrate that it is possible to achieve climate neutrality through the use of existing technologies, but they will require further study. Their feasibility will be evaluated against newly emerged technologies every five years as part of the CAP process to ensure that the best alternatives are chosen at every step.

Outreach

The University's responsibility for understanding and mitigating climate change cannot be confined by campus

boundaries, but extends to the community, the state, and beyond. Therefore, our advances and understanding of climate issues must be shared widely through outreach, curriculum, and research.

Offerings like the Climate Leadership and Energy Awareness Program (Climate LEAP) seek to engage young people in an interactive dialogue about climate change. High school students spend a week exploring the science and solutions of climate change through hands-on activities like energy monitoring and climate portfolio optimization, preparing them for careers in science, mathematics, and policy. (See sidebar for links to further information.)

For many years, the towns of Chapel Hill, Carrboro and the University have partnered on climate-conscious endeavors. The three share the cost of a regional mass-transit system, and offer fare-free rides across the community. They also maintain a system of park-and-ride lots that reduce congestion downtown. Chapel Hill and UNC have

both committed to a path of carbon reduction, and work toward that end through operational improvements, outreach, and community education events. Recently, a joint town and University working group has developed an innovative new development agreement for the Carolina North campus. This agreement includes standards for energy use, water consumption, transportation, and GHG emission targets.

Curriculum

A study of UNC's class offerings recently identified more than 300 sustainability-related courses. Conducted by capstone students in environmental studies, the effort included surveys of academic departments and searches of the course bulletin and departmental websites. Classes offered were primarily in the College of Arts and Sciences, though several graduate and professional schools, including Business, Journalism and Mass Communications, Public Health, and Social Work have also introduced sustainability into their curricula.

A new sustainability minor, introduced in 2008, offers courses in environmental science, business, public policy, and planning.

Local businesses partner with students from the UNC Institute for the Environment through senior capstone projects. Clients begin by posing a question: "Is my product packaging carbon intensive?" or, "How can I communicate energy use to apartment dwellers?" Businesses get the answers they need to understand complex environmental topics, while students get real-world experience in project management, carbon accounting, and working with a client. Recent capstones have explored the carbon intensity of the local transit system, University air travel, and campus dining services.

Research

The University remains a source for scholarship and advanced research. A study recently requested by the NC General Assembly explored the feasibility of installing offshore wind power in North Carolina waters. The study

examined the impacts of power generation on fish and wildlife, cultural sites, and military airspace, pinpointing the areas with strong wind resources and stable geological structure. The General Assembly has appropriated additional funds to continue the study, and requested a contract for three pilot turbines that can be installed off the North Carolina coast.

In 2008, the Solar Energy Research Center was launched by the Chemistry Department and in fall 2009, it became one of 46 Energy Frontier Research Centers funded by the U.S. Department of Energy and American Recovery and Reinvestment Act. \$17.5 million over five years will support 30 postdoctoral fellows and graduate students. Research will focus on solar fuels catalysis, development of hybrid materials, organic photovoltaics, and advanced spectroscopy and theory.

UNC's Institute for the Environment serves as a hub for multidisciplinary environmental research across campus. Faculty and staff in the Institute's five research centers partner with others at UNC to find comprehensive solutions to pressing environmental problems. For example, The Center for Sustainable Energy, Environment and Economic Development explores energy issues facing the state, nation, and world. Researchers examine the rationale and consequences of various energy choices and the feasibility of alternative and nuclear energy sources.

Many more examples of UNC's climate-focused outreach, curriculum, and research offerings can be found in the University's Sustainability Report at:

<http://sustainability.unc.edu>

Tracking

Because carbon emissions are spread throughout the University, abatement opportunities are distributed among the various departments and academic units, each reporting along a separate chain of command. To manage a project of this scale and diversity without direct managerial control requires a tracking mechanism with both clarity and transparency.

A3, a strategic tool named for its

On the Web

ClimateLEAP

<http://climateleap.unc.edu/>

Chapel Hill Transit

<http://tinyurl.com/CHTransit>

Commuter Alternatives Program

<http://tinyurl.com/UNCcommute>

Carolina North

<http://cn.unc.edu/>

UNC's Sustainability Classes

<http://tinyurl.com/UNCClass>

UNC Sustainability Minor

http://cf.unc.edu/ecology/sustainability_minor.cfm

Environmental Capstones

<http://www.ie.unc.edu/content/education/courses/capstone.cfm>

Institute for the Environment

<http://www.ie.unc.edu/>

NC Coastal Wind Study

<http://www.climate.unc.edu/coastal-wind>

Solar Energy Research Center

<http://www.serc.unc.edu/>

use of A3 sized paper, provides a helpful framework for planning, communicating, and implementing a strategy or improvement program. It focuses on telling a project's story in a single page, which helps to promote a fundamental understanding of the project outcomes and methods. Through collaboration on the A3 process, team members work to build consensus, aligning efforts and resources toward a common goal.

A3 begins by exploring the reasons for embarking on the project and by identify-

ing the current state of the organization. For UNC, the climate action plan is a response to our commitment as outlined in the ACUPCC, as well as a recognition that carbon legislation will affect our business in profound ways. We are developing the plan to prepare for those changes.

We recognized that emissions have grown by an average of four percent per year, culminating in the most recent carbon footprint of 570,000 MTCDE in the 2008 calendar year. At the same time, we

are setting the goal of achieving climate neutrality, and will target emissions reductions of almost 15,000 MTCDE per year.

The A3 process includes some analysis about our largest emission sources, serving to focus our efforts on the high-impact targets for GHG reduction. Each of our projects should address these emission sources in some measurable way.

Countermeasures describe the projects and programs we will implement to achieve our goal of carbon reduction. Each countermeasure must address a

Climate Action Plan 2009-2012



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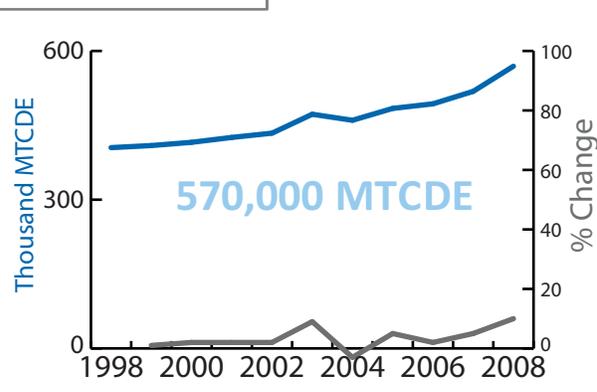
Prepared by: Arneman

Version: August 2009

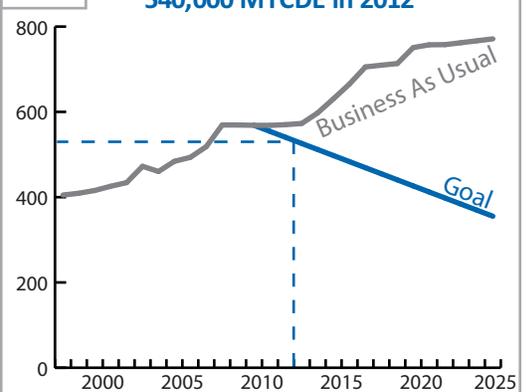
Background

The University has signed the ACUPCC and committed to achieving climate neutrality by 2050
The University must prepare for federal carbon regulation

Current Conditions



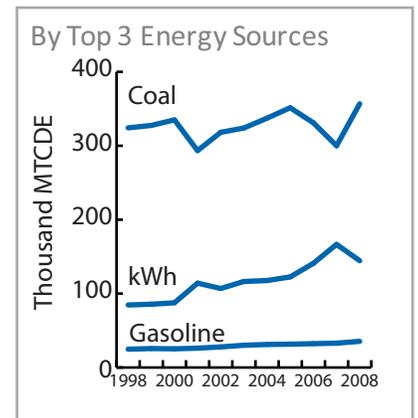
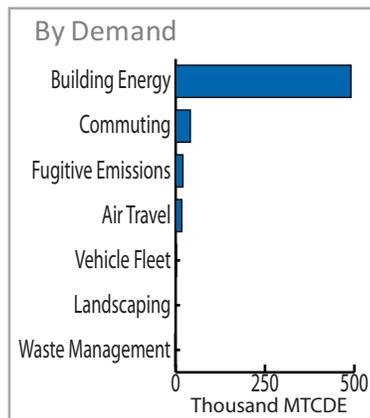
Goal



Emissions Analysis

Building energy accounts for 90% of campus carbon emissions.

In 2008, 63% of emissions were due to coal combustion. Another 25% came from electricity purchases.



Though only a fraction of the total space, laboratory buildings account for a growing proportion of energy use and carbon emissions

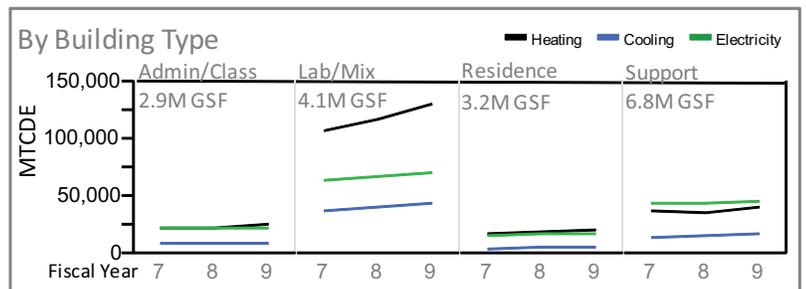


Figure 8.
Climate Action Plan A3 Report
This simple report gives stakeholders a quick understanding of the project background, goals, plans and results - all in a single page.

stated need or emission source, and the A3 report identifies an individual who will be accountable for its progress and sets a deadline for completion. The status of each project will be updated monthly so that stakeholders can mark progress and respond to delays or mitigating circumstances.

Under the countermeasures lies a series of “leading indicators.” These metrics were designed by the group to provide frequent feedback on the university’s progress as each countermeasure is implemented,

rather than waiting for a single, yearly carbon inventory update. By designing indicators with sufficient granularity, we will be able to measure and verify the effects of each countermeasure as it is implemented.

Finally, the A3 process includes a plan for dealing with outstanding issues. If project managers encounter problems or changing circumstances, they will be documented in this area for escalation or further study.

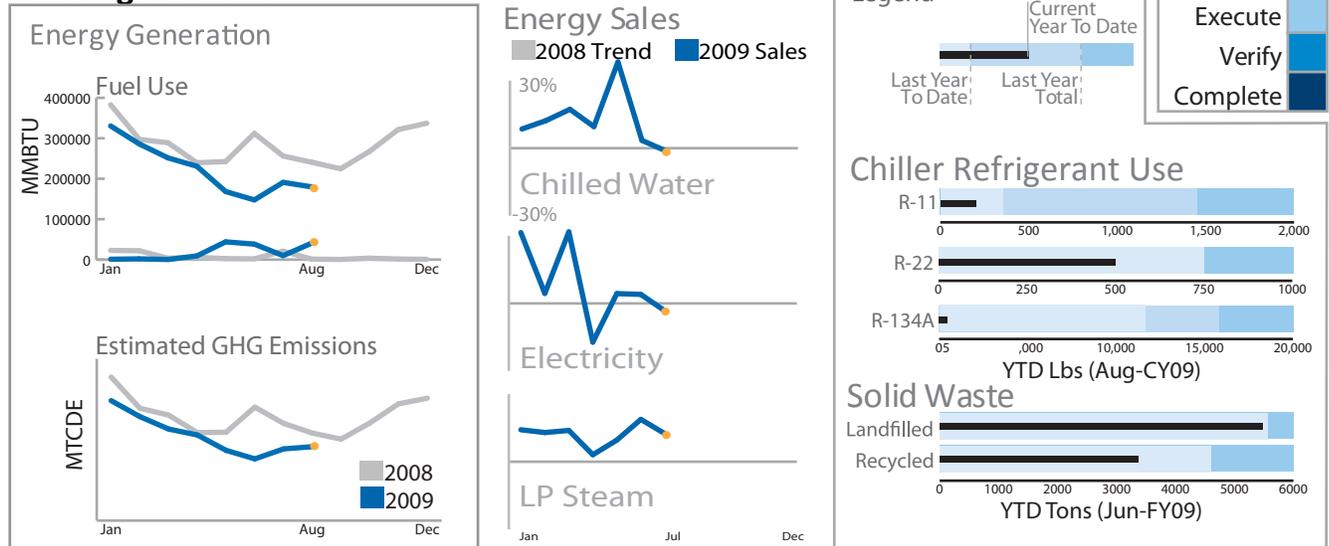
The sample report below describes a three year period, recognizing that many

projects would not fit within a shorter time frame, and that longer time periods add uncertainty to the number and types of projects the University can complete. The A3 process ensures that this will be a living document, as the background, conditions, and goals will be reassessed periodically to identify new countermeasures over time. In this way, the Climate Action Plan can adapt to changing conditions, allowing it to meet the demands of accountability and transparency over the life of a forty-year project.

Countermeasures

| Issue | Countermeasure | Outcome | Owner | Due | ✓ |
|---------------------|---|------------------------|-------|-----|---|
| Building Energy | Energy conservation measures: Phase 1 | Decreased Energy Sales | | | |
| Reporting | Create monthly carbon emission report | Feedback | | | |
| Reporting | Monitor and record CO2 emissions at stack | Feedback | | | |
| Waste Management | Flare landfill gas | Offsets | | | |
| Energy Source: Coal | Test burn torrefied wood biomass | Decreased Emissions | | | |
| Energy Source: kWh | Chiller plant efficiency improvement | Electricity Savings | | | |
| Etc..... | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Leading Indicators



| Unresolved Issues | Owner | Due | ✓ |
|-------------------|-------|-----|---|
| | | | |

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“Student Bicycling Across Campus” by Dan Sears

“Sarah Stoneking Holds a Fabricated Solar Cell” by Dan Sears

“Campus Recycle Bins” by Steve Exum

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