

Internal Carbon Accounting at a Small Liberal Arts College

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Abstract

As colleges and universities pursue greenhouse gas reductions, it has become clear that some approach is necessary for putting a price on carbon emissions and communicating that cost to energy users on campus. A carbon charge or carbon tax is one approach to establishing a price signal to which the community could respond in making energy use decisions. This approach has been widely used in the context of corporate and state governance. We investigated the theoretical factors that should influence implementation of a carbon charge at a small liberal arts college and discussed the multiple approaches to collecting and distributing funds. Questions of data collection and accounting remain but we conclude that setting an institutional price on carbon supports the call for increased action on climate change and utilizes the position of privilege colleges have to inspire positive social change on their campus and communities.

Note

As a result of this paper, President Catherine 'Cappy' Hill has called for the Sustainability Office and College Committee on Sustainability (CCS) to develop a new Carbon Neutrality Plan for the College. This group will meet in Fall 2015 to set Vassar on a path to major carbon reductions, with an ultimate goal of achieving carbon neutrality by 2035.

Please contact the Sustainability Office at sustainability@vassar.edu to provide comments or to request additional information on Vassar's approach to carbon neutrality.

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Introduction

Many institutions have grappled with how to tangibly and adequately respond to the climate crisis. The science is clear, and action is needed if we are to curb the worst impacts of global climate change. It is often challenging, however, to create incentives that spur action on greenhouse gas reductions. Even when administrators and members of a college community agree that climate action is needed in principle, justifying investments such as efficiency upgrades is rarely easy. One approach to encouraging action is to establish an internal carbon charge, or carbon tax. This strategy has been widely applied by corporations and state governments, and it has recently been taken up experimentally in an academic context at Yale. The dynamics and impacts of a carbon charge at a small institution, of which there are hundreds in the United States, has not been explored, as far as we know. Using the context of Vassar College, a private liberal arts college in New York, we examined how a carbon charge may further climate action.

Our aim in this paper is to review the theoretical frameworks of a carbon charge and strategies for implementation, and to evaluate the constraints associated with applying the charge at a small liberal arts institution. We focus on this mechanism, among the various strategies for pricing carbon, because it has been explored infrequently among colleges and universities, and because in theory it is an administratively efficient strategy, in that it encourages energy users to make their own decisions about reduction strategies. An internal carbon charge program would quantify the carbon emitted and charge a cost per ton that reflects currently unquantified, externalized social and environmental costs of those emissions. In theory, a carbon charge allows an institution to internalize the cost of carbon and begin to more fully conceptualize, manage, account for, and mitigate its carbon footprint. A carbon charge makes tangible the environmental impact of high-emissions activities and thus should incentivize sustainability in administration and operations. Internal carbon charges have been implemented at scores of corporations and national and provincial governments. Nevertheless, how this approach would be implemented at an institution of higher education remains unclear.¹ Yale University is piloting the first program of its kind in the 2015-2016 academic year. This experiment presents a challenge for other universities and colleges to follow suit and explore carbon charge models that could facilitate pathways to carbon neutrality and serve as educational tools.

Colleges and universities have the opportunity to provide broader impacts by approaching carbon reduction through an interdisciplinary, academic lens. Educational institutions can be learning labs, providing space to pilot programs that could be applied to larger governmental entities or corporations. Institutions of higher education also lack some of the administrative and legal barriers to innovation faced by larger organizations. As Stanford economist Frank Wolak writes, “the primary role of research universities is knowledge creation and dissemination. Universities are especially well-placed to address the challenges of pricing greenhouse gas emissions in light of the technical and implementation challenges involved.”² Acknowledging that climate change poses a severe and imminent threat to global environmental and economic stability, it is imperative that institutions with

¹ Carbon Disclosure Project. “Use of internal carbon price by companies as incentive and strategic planning tool.” December 2013. <https://www.cdp.net/CDPResults/companies-carbon-pricing-2013.pdf>

² Wolak, Frank. “Universities Can Do Better Than Symbolism: A Revenue-Neutral Carbon Tax.” SIEPR Policy Brief. October 2014. <http://siepr.stanford.edu/publicationsprofile/2821>

significant resources, public presence, and academic authority take the initiative to create innovative solutions and abatement strategies.

Climate action is a matter of social justice as well as environmental stability. The Intergovernmental Panel on Climate Change (IPCC) has reported that low-income regions and populations will suffer the most devastating effects of climate change, and these populations have the least resilience to recover from environmental change.³ These vulnerabilities exacerbate social instability on local and global scales.⁴ Institutions of higher education, corporations, and governments have a responsibility to address climate change because poorer communities have borne a disproportionate share of the environmental externalities caused by these institutions, who have traditionally not seen the harm caused by their business-as-usual operations. An internal carbon charge system is one way to induce colleges and universities to stop acting as free riders, vis-a-vis disadvantaged communities, and to strive for both social and environmental justice.

Greenhouse Gas Emissions (GHG) & the Vassar Context⁵

As at many colleges and universities, the bulk of carbon emissions at Vassar are associated with building heating and cooling, followed by electricity production and transportation (figure 1). Vassar is a residential campus with more than 2.2 million gross square feet of built space. Most of Vassar's buildings date to the late 19th or early 20th centuries, resulting in a diversity of building systems, conditions, and timing of upgrades. About half of Vassar's emissions are due to the onsite combustion of fossil fuels for space heating (via steam) and domestic hot water. As oil prices rose and natural gas prices fell in 2008, the college transitioned to natural gas as the primary fuel for the central cogeneration plant and other large boilers. Using CarbonMAP emissions factors the lower per-unit energy emissions of natural gas has resulted in lower calculated emissions in recent years (figure 1). Improvements in regional electricity grid, through increased reliance on gas and Canadian hydropower, instead of oil, have also led to reductions in Vassar's emissions.

³ Intergovernmental Panel on Climate Change. "Climate Change 2014: Impacts, Adaptation, and Vulnerability." *Livelihoods and Poverty*, 2014. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap13_FINAL.pdf

⁴ Colin P. Kelley, Shahrzad Mohtadi, Mark A. Cane, Richard Seager, and Yochanan Kushnir. "Climate change in the Fertile Crescent and implications of the recent Syrian drought." 2015. *Proceedings of the National Academy of Science*. Vol. 112 no. 11.

⁵ We use the term "carbon-dioxide equivalent" (CO₂e) interchangeably with "greenhouse gas." Vassar assesses impacts from the following greenhouse gasses: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Vassar calculates emissions by multiplying energy, waste, purchasing, travel, and other data by known emission factors. Additionally, the impacts of CH₄ and N₂O are weighted by global warming potential and accounted for along with CO₂ emissions. The term "metric tons of carbon dioxide equivalent" (MTCDE) reflects the sum of the weighted impacts of CO₂, CH₄ and N₂O emissions associated college operations and activities.

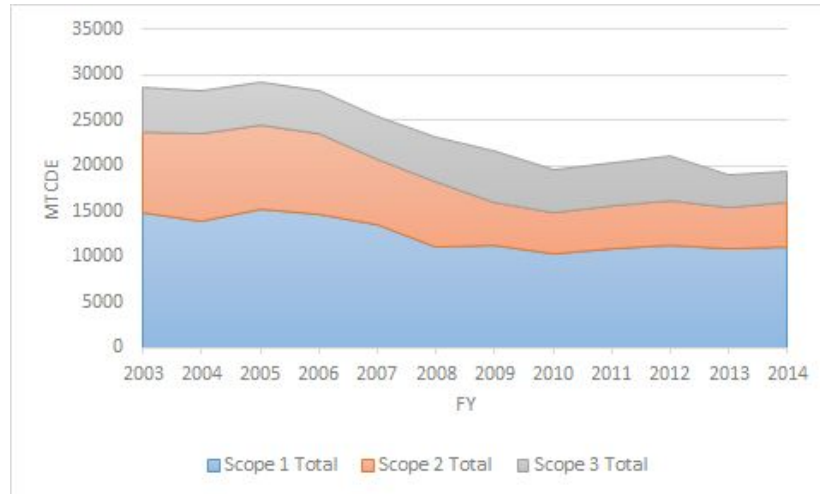


Figure 1: Vassar’s Emissions based on Campus Carbon Calculator in CarbonMap. Scope 1 emissions refer to stationary combustion (mainly heating); scope 2 represents electricity; scope 3 represents travel and other activities.⁶

Challenges to carbon reductions: Economic and cultural barriers to investment in energy efficiency

Though there is wide recognition that direct action and investment in carbon abatement strategies is needed to curb climate change, sustainability efforts always face both cultural and economic barriers. Identifying these barriers can help provide a structure for evaluating obstacles to implementing different carbon charge models. Here we focus on aspects of capital, campus culture and the principal-agent problem, and imperfect information that have been important at Vassar. These will vary among institutions, but many colleges operate in similar contexts and constraints. Identifying the socio-economic context in which change happens or otherwise is an important step in evaluating carbon charge strategies.

Capital Many sustainability improvements require up-front capital investments, although they have long-term payoffs. Moreover, there is a widely held assumption that sustainability is a zero-sum game, in which resources invested in sustainability inevitably lead to resource losses elsewhere. The 2008 recession, increased operational costs - including significant investment in financial aid and a need-blind admissions policy have all limited available funds for capital improvements. There are various competing priorities for funding, including functionality, safety, historic preservation, aesthetic integrity, and accessibility, all of which are core principles of the College. There is thus the dual challenge of encouraging investment in sustainability from limited sources of capital, while also working to allay concerns that sustainability presents an obstacle to other priorities of the college.

Campus culture Administrators, staff, faculty, and students at Vassar are, in principle, strongly supportive of sustainability initiatives. Reducing GHG emissions, however, has not yet risen to the top of the long list of priorities and responsibilities for many members of the community. While many people are aware of the climate crisis and understand in a general sense that action is needed,

⁶ CarbonMap. The Sustainability Institute. The University of New Hampshire. 2015. <http://campuscarbon.com/CampusCalculator.aspx>

climate goals are rarely central to daily work or education. Better information is needed about how individual behavior contributes to both the problem and the solution, and cultural shift could occur if people feel empowered and knowledgeable about how to contribute.

For example, the Microsoft Corporation has established a comprehensive internal marketing and education campaign to communicate building-level energy usage and successes of their carbon charge program to employees.⁷ This practice promotes personal responsibility and leadership in the workplace. Three to ten percent of Microsoft's reductions in carbon emissions have been the product of fostering leadership and accountability in the workplace.⁸

The principal-agent problem Among many economic principles explaining inefficiency in decisions and policies, the principal-agent problem is a useful framework for college operations. In general, this idea describes the fact that those asking for action are not necessarily those that carry out an action. Occupants of a building, for example, may ask for more efficient lighting and heating, but the agents who install lighting and heating are Buildings and Grounds staff; they may not be incentivized to install more efficient appliances. Alternatively, Buildings and Grounds staff may install efficient systems, but building users may not use them appropriately or efficiently, nullifying the efforts of installers.

Imperfect information At Microsoft, success was tied to making building occupants aware of the resources that their spaces consume. At Vassar, detailed information has been difficult to produce. Building electric metering, an essential first step, can cost over a hundred thousand dollars, a high price tag even when set against the roughly \$2 million spent on electricity every year. Proposals for building-level electricity metering have been submitted, but to date, a system is not in place. Because utility bills are aggregated and paid centrally in the Buildings & Grounds department, individuals and departments have little information about their operational impact. Thus there is neither the information nor the financial incentive for departments to change their daily practices.

Detailed data on campus energy usage is an important component for making informed decisions about how to invest in energy efficiency and renewable technology. Without such a system, project proposers cannot offer realistic budget, cost, or savings estimates.

Carbon Charges and the Social Cost of Carbon

By assigning a cost to carbon emissions, a carbon charge program would incentivize members of the college community to live and consume resources more deliberately - to make an active, conscious recognition of their individual environmental impacts. This behavior change would result from a market intervention, namely the application of a price on activities that consume energy and generate pollution. Depending on the level of granularity in data collection and accounting, an institution could charge departments for electricity use, for building heating, or even for every piece of paper used in printing, every mile travelled, or every watt of electricity consumed. The carbon charge is thus levied on activities in proportion to their emissions.

⁷ DiCaprio, Tamara. "The Microsoft Carbon Fee: Theory and Practice." *Microsoft*, December 2013.

⁸ Microsoft. "Our Environmental Footprint." Infographic. 2015.
<http://www.microsoft.com/environment/our-commitment/>

Implementing a tax could have a variety of benefits. The funds produced by a tax can be used to invest in capital projects to improve energy efficiency or generate renewable energy, to incentivize additional behaviors that would reduce energy consumption, or to redistribute funds across administrative units based on environmental performance. In the event that a federally mandated tax for carbon dioxide emissions were developed, having an established carbon charge program would also alleviate the financial shock of such regulation.

The magnitude of the charge can be set in a variety of ways, but a widely used approach is to base charges on estimates of the projected long-term costs associated with environmental damage (the externalities), such as changes in agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs and demands.⁹ The US Environmental Protection Agency (EPA) as well as leading environmental economists refer to these externalities as the Social Cost of Carbon (SCC). This dollar figure also represents the value of damages avoided for a small emission reduction (i.e., the benefit of a CO₂ reduction). The EPA's current base case price estimate is \$40, though considerable variation exists in the estimates depending on certain assumptions inherent to any long-term climate projection.¹⁰

Carbon Charge Strategies

A first step in carbon accounting is to assign a dollar price to metric tons of carbon dioxide equivalent (MTCDE) emissions. Pricing the social cost of carbon involves estimating a value of one MTCDE based on current climate trends and projected future carbon mitigation costs and benefits. Due to the dynamic nature of these projections, any carbon accounting system should include the flexibility to change the carbon price each year, as new data and research become available.

We discuss below a number of strategies for translating that price into policy changes. These are shadow pricing, offset purchases, a central carbon fund, additional fees on emissions-generating activities, a redistributive program, or a hybrid approach. Generally speaking, carbon charges can be incurred by individuals, departments, larger administrative units, or the entire institution in an aggregate way. The following sections outline different strategies for applying a carbon charge, including where money originates and how it is distributed [is directed and from where it originates.]

Shadow Pricing

A shadow price is a theoretical value assigned to purchases of infrastructure or equipment. This price is calculated, though not actually charged, at the point of purchase, to correspond to the life-cycle environmental and financial costs of the project or equipment. Thus the shadow price attached to purchasing a Nissan Leaf for the college motor pool is lower than the price attached to buying an inefficient SUV. The SUV might have a lower up-front cost, but the shadow price reflects the

⁹ U.S. Environmental Protection Agency. "The Social Cost of Carbon." 2015.
<http://www.epa.gov/climatechange/EPAactivities/economics/scc.html>.

¹⁰ Environmental Protection Agency. "Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis." Current estimates of the 2015 social cost of carbon range from \$11 to \$105 depending on the discount rate and statistic used. Some of the assumptions and price variations are discussed in detail later in the paper.

long-term cost of operation and helps to equalize the two vehicle options. A shadow price allows the college to quantify those increased emissions in dollar terms and project the social cost of its capital projects.

While it does not create a fund or address individual behavior, shadow pricing can be used to institutionalize environmentally responsible investment. It would, for example, shorten payback times for efficiency improvements, because payback estimates would account for the dollar value of both the energy savings and the projected monetary value of emissions abatement. Shadow pricing should also give Building and Grounds departments the mechanism and incentive to invest responsibly during maintenance, renovations, and new construction processes. At Yale, for example, adding a shadow price was a minor adjustment to standard accounting practices.¹¹ Shadow pricing can be used in conjunction with or independently from a carbon charge, and the additional strategies discussed below.

Carbon Charge with a Consolidated Carbon Fund

The consolidated fund model charges individuals or administrative units a fee (or tax) based on their operational carbon emissions and creates a central pool of money that is allocated for carbon-reduction projects. For Vassar, this fund size would be \$800,000 per year based on current emissions of approximately 20,000 MTCDE and a standard price of \$40/MTCDE. Presumably this amount would decrease over time as with emissions decline. The structure is explicitly designed to phase itself out as carbon neutrality is achieved, and it most effectively addresses the barrier of deploying capital for efficiency projects within institutions. It can create behavioral change within institutions by providing monetary incentives for units to reduce their carbon footprints, depending on the recipient and price level of the charge. Alternatively, Microsoft determined the price per ton of carbon by determining the cost of projects needed to achieve the carbon reduction investment goals for that year, dividing that value by total carbon dioxide emissions, and collecting the fund in the form of a charge.

A carbon charge can be phased in over several years to reduce the shock of implementing this carbon charge structure. A gradual phase in of the charge allows departments to adjust their budgets and for the College to take steps to reduce emissions so that fund size decreases before reaching 100% phase-in (for an example of this strategy, see figure 2).

¹¹ Yale University. "Report to the President and Provost of Yale University: Findings and Recommendations on a Carbon-Charge Program at Yale." April 10, 2015.

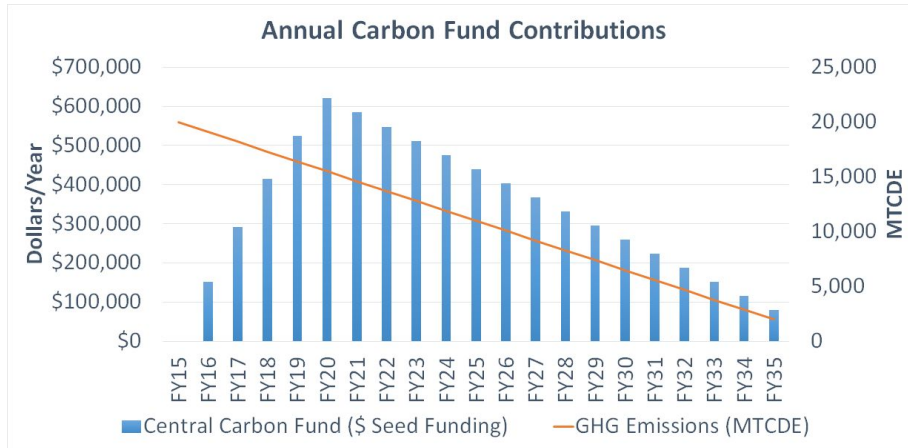


Figure 2: Carbon Fund Allocations and GHG Emissions. In this hypothetical scenario funding is gradually phased in over time. In fiscal year 2016, the fund is only 20% of its maximum theoretical size and reaches 100% in 2020. The amount is based on a \$40 SCC and the yearly allotments are used to finance energy efficiency projects and upgrades that drive down the overall emissions levels over time. As emissions decrease so too does the maximum amount that can be contributed to the fund.

This pool of money can be used for carbon-reduction investments. For example: it could supplement renovations or new construction that are tight on budget to ensure that energy efficiency is accounted for. It could also be used to provide the salary for a full-time energy manager, if one does not already exist, responsible for ensuring the college has an accurate accounting of both the current emissions and financial savings associated with efficiency projects/upgrades. This money can also be used as a green revolving fund.¹²

Carbon Offset Purchases

Purchasing carbon offsets is an alternative means to fund high impact carbon reduction projects that are more cost effective than traditional, on-campus efficiency upgrades. Carbon offsets are sold in a market at a price significantly lower than the Social Cost of Carbon, thus they reduce the overall cost of meeting reduction targets.¹³

The market value for carbon offset projects across the world in 2012 was \$523 million, totalling 101 million MTCDE in emissions reductions. The average price to purchase an offset is thus just over \$5. According to a Forest Trends’ Ecosystem Marketplace and Bloomberg New Energy Finance analysis of carbon markets in 2013, among the largest shares included 34% of projects funding renewables, 32% forestry and land use, 9% household devices, and 8% energy efficiency and fuel switches.¹⁴

¹² Sustainable Endowments Institute. The Billion Dollar Green Challenge. 2015. <http://greenbillion.org/the-challenge/>.

¹³ Natalie Tawil, “The Use of Offsets to Reduce Greenhouse Gases,” *Congressional Budget Office*, August 3, 2009, <http://www.cbo.gov/sites/default/files/08-03-offsets.pdf>.

¹⁴ Molly Peters-Stanely and Daphne Yin, “Maneuvering the Mosaic State of the Voluntary Carbon Markets 2013,” *Forest Trends’ Ecosystem Marketplace & Bloomberg New Energy Finance*, June 20, 2013, <http://about.bnef.com/white-papers/state-of-the-voluntary-carbon-markets-2013/>.

There is considerable debate over the efficacy of offsets as well as the ethical implications of detaching the purchaser from projects in developing countries. Extensive measures are also required to fully verify the carbon reductions. These include the need for the purchase to bring about additional reductions that would not have occurred without an offset purchase, quantifiable results, permanence, and accounting for leakage of higher emissions in other sectors of the economy. There are many competing standards and verification services, further complicating the process.¹⁵

Carbon offset prices vary among offset-selling companies, verification criteria, and geographic locations of projects. According to the report by Forest Trends' Ecosystem Marketplace and Bloomberg New Energy Finance of volume weighted average of 2012 prices, a college like Vassar, with about 20,000 MTCDE per year, could offset its emissions for approximately \$120,000 a year.¹⁶ This purchase would make Vassar among the first institutions of higher education to achieve carbon neutrality, a marketable achievement and internalization of GHG emissions. In addition, the real cost to the College could still incentivize on-campus GHG reductions to reduce the amount of carbon offsets paid on a yearly basis. An institution seeking to achieve neutrality in this way could still choose to implement one of the other carbon charge strategies, especially if it believes that carbon offsets are currently underpriced relative to the SCC.

While carbon offsets offer immediate reductions, it is important to consider that there is also social value in investing in on-campus efficiency measures and renewable energy. Although \$120,000 spent on local projects would be unlikely to achieve 20,000 tons worth of carbon reduction, investments in on-campus projects have multiple benefits. On campus abatement strategies directly support the College financial, turning neutrality into an investment rather than expense. Furthermore, such local projects provide valuable learning opportunities for students, faculty, and staff, contribute to regional energy security, foster a culture of sustainability, and are more easily verifiable.

Offsets can accompany any of the other strategies and although the price of most offsets sits far below the SCC, they can still enable an institution to achieve carbon neutrality more rapidly. Internal research is required to identify verifiable projects, local or international, that align with institutional goals and the social implications of an institution's carbon output.

Individual Charges

An approach that targets individual behavior change and generates funds for energy-efficiency projects would be to impose a real-time charge on individual users as they conduct emissions-generating activities, rather than assessing an aggregate charge at the end of each fiscal year. This individual carbon charge would ensure that every member on campus feels their impact on the environment. Individuals (or departments, where applicable) would pay a carbon premium on services such as paper printing or actions like traveling to participate in a conferences or semester abroad. Ideally, students and faculty living in campus housing would also pay the carbon charge associated with their personal electricity and natural gas/oil consumption. Certain scope 1 activities,

¹⁵ Natalie Tawil, 2009.

¹⁶ Molly Peters-Stanely and Daphne Yin, 2013.

like Buildings and Grounds' usage of campus-owned vehicles, could also entail a small individual charge for each mile driven or gallon of fuel consumed.

Accounting for individual emissions from utility usage presents a large administrative hurdle, as most universities are not set up to send bills at this highly granular level. Thus, such a program may be most helpful for offsetting scope 3 emissions. Scope 3 emissions are typically associated with paper use, transport-related activities in vehicles not owned by the college, air travel, waste disposal, food purchases, and other activities. This program would not intend to restrict faculty or student travel or participation in academic ventures, rather it would aim to encourage accountability for personal emissions and would provide education regarding individual environmental impact.

Despite the challenges associated with charging for scope 1 and 2 emissions, as submetering and other data tracking tools become both more comprehensive and sophisticated, such an approach may prove increasingly possible in the coming years. In the meantime, colleges and universities can begin by charging their members for emissions impacts of paper use (with appropriate scaling for use of recycled paper products) and travel. A variety of open source carbon calculators could serve as a starting point for this program. Yale, for example, has also developed a proprietary system in conjunction with a sustainability and design firm.¹⁷ Periodically, or at the end of each fiscal year, these charges would need to be aggregated by the budget office to inform the number of energy efficiency projects that could be undertaken using the funds in the subsequent year.

Alternatively, the charges could simply be returned to the central budget without contributing to a central fund or green revolving fund, as they would still serve as a disincentive to excessive emissions-generating activities. While perhaps more administratively palatable, assessing individual carbon charges without generation of a fund for efficiency projects would likely have a limited effect on overall emissions levels. Moreover, small fees may not translate into significant reductions in individual staff or student energy use, especially if they are paid by departments.

Redistributive Charges

Where most carbon fees charge all users at the same rate per MTCDE, a redistributive carbon charge would be designed to charge more to poor performers and then redistribute those charges as rebates to users that show improvements in carbon emissions. The balance of charges and rebates makes this system "revenue neutral" in that it does not accumulate a central fund. This system of carbon accounting strives for behavior change. It poses charges or rebates on administrative units according to their relative rates of carbon reduction. This is the approach being piloted by Yale University in the 2015-16 academic year. For Vassar, the carbon charge would likely be applied to Dean-level groupings (the Vice President for Finance and Administration, the Communications Office, Dean of the Faculty, Dean of the College, Department of Strategic Planning, etc.) rather than individual departments such as History or Music, because both budgets and large infrastructure decisions are made at the level of deans and vice presidents. Individual departments make few decisions about building maintenance or management, grounds, energy systems, or staffing, so most of the decisions involving carbon emissions do not involve departments. Therefore the administrative and technological costs of

¹⁷ Yale Office of Sustainability. Yale University Community Fund Carbon Calculator. 2011. <http://yccf.sustainability.yale.edu/>.

determining emissions at finer scales are likely prohibitive. Smaller departments may have the ability to influence individual behaviors like turning off computers and lights, but they have little power to reduce carbon emissions through retrofits and upgrades.

A redistributive carbon charge would calculate changes in carbon emissions for administrative units, then compare those changes to an overall campus-wide emissions change. For example, if there were a college-wide reduction of 5% from FY2015 to FY2016, then each administrative unit achieving *less than* a 5% reduction would have its budget charged in the subsequent year. Each administrative unit achieving *more than* 5% reduction would receive a rebate. School-level reductions are measured at Yale by determining a “baseline” for each by averaging their respective energy usages for the past 3 years. The amount paid (or received) is calculated as the difference in carbon emissions for a given year and their baseline multiplied by the SCC, in Yale’s case, \$40 per MTCDE. The amount of the reduction or rebate (the carbon charge) would be the difference between average university-wide reductions and departmental emissions for that year multiplied by the price of carbon.

Table 1 shows the effects of a redistributive structure in a simplified system with three administrative units. Following the Yale University model, these charges or rebates generally would fall between \$0 and \$10,000 for any given department—ideally this would be enough to incentivize new energy-saving behaviors and policies but not enough actually to impair primary functions, such as research, services, or administrative responsibilities.

Table 1. An example of a redistributive carbon charge. In this hypothetical scenario, the total campus-wide reductions are 750 MTCDE, which is 5% of the FY 2015 emissions level. This 5% is the baseline by which individual administrative units are compared. Unit A, which reduced emissions by 10%, therefore beat the average by 5%. They receive a rebate equal to 5% of their FY 2015 emissions multiplied by the \$40 cost of carbon. In this case, 5% of 5,000 MTCDE equals 250 MTCDE, multiplied by \$40, equals a rebate applied to the 2016 fiscal year of \$10,000.

Revenue-Neutral Scenario	FY15 Emissions	FY16 Emissions	MTCDE Reduction	FY16 Budget	FY17 Budget
Administrative Unit A	5,000 MTCDE	4,500 MTCDE	10%	\$ 1,000,000	\$ 1,010,000
Administrative Unit B	5,000	4,750	5%	\$ 1,000,000	\$ 1,000,000
Administrative Unit C	5,000	5,000	0%	\$ 1,000,000	\$ 990,000
Total	15,000	14,250	5%	\$ 3,000,000	\$ 3,000,000

Implementing this sort of program would require careful measurement of emissions and spending by administrative unit. In the case of Yale’s carbon charge, two additional accounting staff members are being employed to oversee charges, at least for the start of the program. Technological requirements are also important. Building submetering, with several years of data collection to establish baseline energy use, constitutes the first step in this endeavor. For buildings containing multiple administrative units, those units could be charged proportionally, for example according to the square footage of area each uses in the building.

If departments are charged only according to changes in their energy performance, the total amount of money being redistributed will be quite small relative to the overall total cost of emissions (based on the product of SCC and MTCDE). This can be either an advantage or disadvantage of the model, depending on budget constraints and attitudes to environmental action within the organization. Either way, the redistributive approach should theoretically precipitate greater behavior change than a central fund system, as academic units are placed in competition to find innovative ways to reduce energy use.

There are several potential critiques of this approach. If Unit A falls behind one year and loses some money, they could merely appeal for a larger overall budget to cover core programs or pay for some needed acquisition. This possibility reinforces the need for charges that strike the right balance between making departments “feel” the impact while not limiting their major operational prerogatives.

The other main criticism is that different units may believe the system unfairly punishes departments who have already taken energy-reducing measures or who simply cannot reduce their carbon footprint based on their educational mission. It may indeed be easier to achieve reductions for some units than other units such that some units will always “win” while others will always “lose.” Collecting submetering data for 2-3 years could help alleviate this concern, assuming the charges could be modeled based on real-life yearly changes in electricity use rather than a randomization variable. Of course, colleges cannot truly know the effects until the system is in place and the incentives are real. Departments may find creative ways to achieve abatement - indeed, this is the core educational component of a redistributive system.

Another comment made by Yale staff involved in the carbon charge program is that the administrative overhead for this system is high, and it does not guarantee actual carbon reductions. Staff investments can be high because this approach requires extensive and minute accounting. Carbon reductions are uncertain because rebates may or may not be invested in further efficiency upgrades. Achieving optimal efficiency improvements can also be uncertain because individuals with incomplete information, and possibly with split incentives or principal-agent problems, are responsible for local decisions about energy improvements. If those decision makers have the knowledge and leverage to implement maximum carbon reductions, then this approach can be extremely efficient. If not, then the climate impact of this approach is less clear.

Hybrid Strategies

Hybrid models have the potential to capitalize on the strengths of both redistributive and consolidated fund approaches to carbon accounting. One hybrid model would use a portion of a carbon charge proceeds to create a consolidated fund, and the rest would be redistributed among rate payers. The redistributive component would ensure that individual administrative units are incentivized to reduce emissions through independent initiatives.

Another hybrid option is to charge departments for the portion of their emissions that fail to meet an established institutional emissions reduction target. Units not meeting the targets would contribute

to the central fund at a rate equal to the price of carbon multiplied by the emissions shortfall. Departments would therefore not be in direct competition through the redistributive system, but would still be encouraged to efficiently reduce individual emissions to avoid budget cuts. The size of the central fund would thus depend on the level of emission reduction specified by the administration and the ability of individual units to significantly alter their emissions levels.

Discussion: How do these approaches compare at a small college?

The models discussed above all have the potential to move the college towards carbon neutrality, but they vary in how they would be implemented and the degree to which they are likely to accomplish reduction goals. The ability to raise capital for carbon abatement projects or to inspire behavior change, and the administrative (or accounting) complexity involved in implementing the program, have each been determined to be core measures for the models. This section compares likely effectiveness of goals and the ways they may support different institutional goals. Among these goals are ability to direct capital toward efficiency improvements, ability to influence individual behaviors, and whether implementation is simple enough to be feasible (Table 2).

Table 2. Effectiveness of the different models for raising capital, inspiring personal behavior change, and how administratively feasible the model is. Each box is given a rank of Low (L), Medium (M), High (H), or Not Addressed (-).

	Shadow Pricing	Fund Model		Redistributive Model		Hybrid Model		Offset Purchases	Individual Charges
Effect	College level	Dept level	Dean level	Dept level	Dean level	Dept level	Dean level	College level	College level
Raise Capital	-	H	H	-	-	L	M	-	L
Change Behavior	M	L	L	L	L	M	L	L	H
Feasibility	H	H	H	L	L	M	M	H	M

In its simplest form a carbon charge is a funding mechanism for carbon abatement projects. The Fund model is the best at generating capital. A fund model may seem counterintuitive because it is simply redirecting money the college is already spending. On the other hand the fund makes sense because it provides a mechanism for redistributing funds that otherwise are not being spent on GHG reductions. The other benefits of a fund model come from the potential for inducing behavior change by taxing the accounts where largest emissions are occurring.

The potential for behavior change is the cornerstone of the redistributive model. The competitive aspect of this approach may produce an excitement factor that motivates more behavior change than a tax, especially because units have the chance to be rewarded for their actions. At Yale, the belief is that because this model has a reward and is ‘revenue neutral’ it may be more palatable than a charge.

We expect that split incentives would be addressed more effectively at the department level than at the dean level, if it were possible to do accounting at the department level. A charge imposed at the department level would encourage energy-conservation actions of staff and faculty to have a direct impact on their departmental monetary outcome. For example, a professor at Vassar explained to us that their paper is locked in the closet for safekeeping because their department pays for its own paper, while computers are often left on at night because electricity is *not* paid for. At the dean level, however, the actions of faculty and staff would not directly affect their monetary circumstances, and deans would be expected to enforce behavior change at the department level. How they would enforce this remains an issue. If faculty and staff do not create a mental link between their energy usage and a monetary outcome, then split incentives have not been addressed.

Behavioral change is also dependent on faculty and staff having the relevant information they need to reduce emissions. Education and outreach efforts regarding building-level emission trends and best practices are paramount for any effective carbon charge program. T.J. DiCaprio, coordinator of Microsoft's carbon charge program, says that educating departments about their energy performance has been very important for the success of their program. Educating departments on the importance of reducing emissions and on successes achieved has been critical for fostering accountability at Microsoft.

Carbon Charges and Pre-Existing Carbon-Reduction Support Networks

A carbon charge should function to support other GHG reduction efforts, such as a green revolving fund (GRF). Robust green revolving funds in particular are considered an important step for carbon reduction. The Billion Dollar Green Challenge (BDGC) is a growing initiative that aims to allocate more than 1 Billion dollars in green revolving funds across colleges and universities.¹⁸ In its 2012 report, the Billion Dollar Green Challenge boasted a 60% increase in participants between 2010 and 2012 – with all GRFs totaling \$111 million, funding 900 efficiency projects with a median payback period of 3.5 years. Depending on scale, a proposed carbon charge program should support establishment or enlargement of a robust revolving fund. The BDGC states the benefits of implementation include reconfiguring investment decisions, creation of an effective institutional mechanism to fund efficiency projects, and performance tracking to better account for energy savings and revolving accounts.¹⁹ The proposed hybrid model would provide funding as well as create the internal competition to spur behavior change and foster a culture of sustainability. The carbon charge provides the opportunity to fund programs and subsidize capital projects to choose more efficient options, while a competitive or redistributive aspect has compounding impacts designed to incentivize behavior change that the BDGC would not.

Data management is also an essential step toward carbon reduction. In order to effectively approach a goal of carbon neutrality, Vassar must reevaluate its data management, reporting, accountability, and long-term sustainability planning standards relative to its peers. A public and well communicated goal for carbon neutrality, with interim deadlines and tracking are needed to instill within the college

¹⁸ Billion Dollar Green Challenge. <http://greenbillion.org/>

¹⁹ Flynn, Emily. "Greening the Bottom Line," *Sustainable Endowments Institute*, October 30, 2012, <http://greenbillion.org/wp-content/uploads/2012/11/Greening-the-Bottom-Line-2012.pdf>.

community a value for conservation and environmental stewardship. The combination of capital projects, investment in renewable energies, and programming to influence behavior modification require funding, and the carbon charge represents an opportunity to address these multiple goals.

The American College and University President's Climate Commitment (ACUPCC) marks the industry standard for sustainability planning with 685 signatories, 539 of which have already written Climate Action Plans, and all of whom are committed to achieving carbon neutrality by 2050 or earlier (figure 3).²⁰

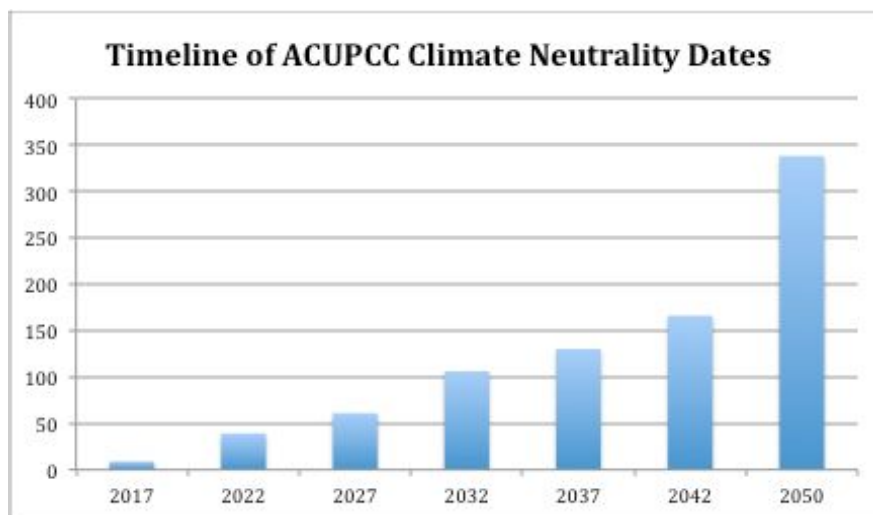


Figure 3. ACUPCC Climate Neutrality Pledges: Blue bars indicate the number of colleges committed to carbon neutrality by five year increments. More than 30% of signatories have committed to achieving carbon neutrality within 20 years, far exceeding the minimum guidelines of the ACUPCC.²¹

Signing the ACUPCC is not necessary to achieve carbon neutrality, but public accountability is known to improve success in meeting goals. Moreover, the mechanisms outlined are the current best practices of Vassar's peer institutions. These include an official target date for neutrality, interim goals, integration of sustainability into the curriculum, expansion of research, and mechanisms to track progress, reporting standards, and the adoption of official policies.²² A carbon charge program would easily align with these mechanisms, as percentage reduction goals could be set at the administrative level and would develop a method for funding and internal accountability. Further, joining a broader community of institutions pursuing carbon neutrality offers shared resources as well as instill a measure of competition for achieving goals. A commitment with third-party verification would establish and align with Vassar's internal operations to prioritize sustainability and ensure the College is being held to externally accepted standards.

²⁰ "ACUPCC Five Year Report," *American College & University President's Climate Commitment*, June 25, 2012, http://www.presidentsclimatecommitment.org/files/documents/ACUPCC_2012_Update.pdf

²¹ Modified from *American College & University President's Climate Commitment*, 2012.

²² *American College & University President's Climate Commitment*, 2012.

Regional competitions and incentives can also encourage progress. In New York state, the Governor's office is calling for increased investment and leadership in the clean energy economy through an initiative known as REV (Reforming the Energy Vision). For the 2015-2016 academic year, the REV Campus Challenge is asking colleges and universities to strive for progress on three criteria: on-campus clean energy investment and emissions reductions, research and development and curriculum, and community engagement around clean energy. Participating NY State colleges will compete and submit one development in each category. Winners will be judged holistically based on their improvements.²³ A carbon charge would be an innovative way to address community engagement and the projects it could fund would fulfill the other criteria. The additional, external incentive provides a guiding force to jump start projects and allow for a public commitment to sustainability initiatives.

A public commitment to larger programs can help to establish cultural shifts toward sustainability. Without general agreement among administration, faculty, staff, and students, it is likely to remain difficult to overcome behavioral and institutional barriers of achieving significant emissions reductions. National and regional programs such as the Billion Dollar Green Challenge, ACUPCC, REV Challenge, or an internal administrative mandate formalizes the structures and emphasizes the urgency of immediate climate action. A carbon charge can provide a source of funding and incentives for efficiency upgrades, integrate better long-term planning into the capital budgeting process and Campus Master Plan, and address the behavior change required to minimize individual carbon consumption.

Conclusion

Carbon charge programs have gained traction in policy debates as mechanisms for governments to reduce emissions and assign a societal cost to individual energy consumption. Despite the urgent need to instill environmental behavior change, few governments have enacted a broad-based regulatory solution to account for environmental damages. Small liberal arts college can use their status as centers of learning to experiment with carbon neutrality strategies and provide case studies for others, furthering the goal and need for broader societal and governmental action.

There are additional benefits of internalizing environmental costs, and these benefits are an important reason for establishing carbon accounting systems. Internalizing environmental costs can help promote regional energy security by decreasing demands on the grid and altering university operations and decision-making to prevent potential financial shock from volatile fossil fuel prices or the imposition of future government regulation on emissions. Transparency and better rationalization of financial decision making can also be promoted by carbon accounting. Long-term financial planning is also improved by accounting systems that explicitly account for operational costs of infrastructure, rather than simply up-front purchase or construction costs.

²³ "College & University Clean Energy Initiative REV Campus Challenge," *NYSERDA*, June 30, 2015. http://revcampuschallenge.ny.gov/index.php?utm_source=C39815_BU21362_CL11353_052015.

Carbon accounting also encourages an institution to take seriously its responsibilities to society. As an institution of privilege, liberal arts colleges, like Vassar, must work to account for and internalize the damage done by carbon emissions to communities near and far. Any carbon charge system should aim to internalize the costs of carbon emissions, rather than continue to defer negative externalities to systemically disadvantaged populations. The recognition that issues of climate change are implicitly social will bolster the relevance and validity of environmental endeavors within academic departments that do not primarily focus on the environment and to the campus more broadly.

Carbon charges can seem like administratively intensive accounting games. However, some sort of price mechanism is almost certainly necessary if we are to institutionalize awareness of environmental impacts and environmentally responsible behavior that survives beyond a single administration or student population. Internal carbon pricing also provides an opportunity to support a cultural shift towards sustainability in administrative engagement and in expanded curricular focus. An effective carbon charge program will require consistent direct feedback loops between participants and sustainability, fostering ownership of workplace environment and engage the campus in energy-reduction programs that fundamentally change the way colleges operate. More inclusive and transparent data management would create the opportunity to incorporate sustainability into the classroom, thereby fostering responsible citizenship, an understanding of the interconnectedness between our physical and social environments, and the potential inspiration for careers in sustainability. These principles of environmentalism will remain relevant for students after they graduate, in their lives, communities, and employment opportunities.

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