Internal Carbon Pricing and Decentralized Budgeting in Higher Education: Building Climate Action through Responsibility Centered Management

INTERNAL CARBON PRICING AND DECENTRALIZED BUDGETING IN HIGHER EDUCATION: BUILDING CLIMATE ACTION THROUGH RESPONSIBILITY CENTERED MANAGEMENT

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ABSTRACT

In the face of climate change, higher education institutions are in an ideal position to develop and test policy solutions that will contribute to de-carbonizing society. One such emergent policy is internal carbon pricing (ICP). First trialed in higher education in 2008, ICP internalizes the social cost of carbon pollution, holding institutions accountable for their emissions. To date, 19 known US academic institutions have trialed ICP policies, though their impacts are largely unknown. Additionally, it is unclear whether these policies have impacted climate-action cultures in colleges and universities, enabling higher education to meet decarbonization goals, educate future climate leaders, and inspire broader societal change.

One critical component of ICP is alignment with university budget models. In particular, a number of universities have transitioned from centralized to decentralized budget models, often referred to as Responsibility Center Management (RCM). Key to RCM is the establishment of incentives to guide campus decision-makers in making budgetary decisions. Also crucial is the allocation of costs to campus subunits, including facilities, staffing, and utility costs. Yet, one cost which has yet to be embedded within RCM models is the cost of carbon. Through applying carbon charges to indirect expense model drivers such as electric and gas utilities, institutions can leverage carbon accounting to build transparency, accountability, and healthy governance practices.

This thesis will investigate two potential impacts of ICP, including how they have impacted carbon emissions through affecting behavior and governance, and how they may function to support campus climate action. The first study assesses emissions reductions from 170 institutions with and without ICP policies using both a statistical modeling approach and interviews with key decision-makers from 15 ICP institutions. The second study proposes a conceptual model for how to embed a carbon charge within an RCM budget model at the University of Vermont, including analysis of focus group deliberations of key institutional challenges to campus climate action. Overall, this thesis aims to benefit the environmental performance of higher education institutions, while facilitating broader cultural change and awareness of decarbonization strategies.

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CHAPTER 1

INTRODUCTION

1.1 Climate Action in Higher Education

As climate change worsens, higher education institutions can serve as a model for our communities, facilitating sustainable development (Bailey & LaPoint, 2016). Yet, colleges and universities have yet to capitalize on all opportunities to decarbonize. A 2015 case study found that higher education institutions emit 3.84 metric tons of carbon equivalents (MTCO2E) per student annually (X. Li et al., 2015). A similar 2020 study found that institutions emit 4.4 MTCO2E per capita student annually (Clabeaux et al., 2020). A study of the signatories of the American College and University Presidents' Climate Commitment found that US institutions emit 7.67 MTCO2E per capita annually. This same study estimated that US higher education institutions account for approximately 1.6% of total US greenhouse gas emissions (Klein-Banai & Theis, 2013).

Within colleges and universities, a number of studies find that electricity and energy generation are the largest sources of emissions. A 2020 case study found that 92.3% of all campus emissions are from electricity usage, followed by transportation at 6.66% (Ridhosari, 2020). Helmers et al. (2021) echoed these claims, finding through a study of 20 universities that over half of university emissions come from energy consumption, specifically electricity and heat production. While emissions that campuses are directly or indirectly (through electricity purchases) responsible for largely come from energy and gas usage, many studies may fail to measure additional "induced" emissions created through commuting, work travel, and purchasing, so-called scope 3 emissions (Klein-Banai &

Theis, 2013). Given that higher education institutions are accountable for a significant amount of emissions and are responsible for facilitating societal change through educating our future leaders, it is critical that colleges and universities engage in sustainable development and decarbonization work (Tomasella et al., 2022).

Fortunately, higher education is not unfamiliar with climate action. In 2006, a group of 12 universities launched the American College and University Presidents' Climate Commitment, now referred to as the College and University Presidents' Climate Leadership Commitment. Since its inception, over 700 institutions globally have signed on, many of which have committed to short-term neutrality goals (Dyer & Dyer, 2017). Of its current signatories, 525 have climate action plans, detailing specific pathways to decarbonization (Second Nature, 2025). Examples of these in practice include investments in more efficient lighting, temperature regulation systems, better ventilation, insulation, and clean energy (da Silva et al., 2023). These greenhouse gas management plans have served as an important collective frame, a catalyst for institutional change, and an action-forcing deadline for higher education institutions. Yet, it is not clear whether these goals alone help colleges and universities work towards truly reducing climate impact.

Though signatory institutions and several others are leading the rest in decarbonizing, the commitment to climate action is highly variable. O'hara (2022) finds that while many of the signatories of the American College and University Presidents Climate Commitment are on the frontier of emissions reductions, there is much variability in their efficiency and success. To date, only 11 institutions have achieved net neutrality, mainly through purchasing greenhouse gas offsets (Barron et al., 2020). With this in mind, it is unclear whether existing commitments and practices have resulted in reliable emissions reductions. Moving forward, it is vital that colleges and universities pursue pathways to reduce on-site emissions that are a result of campus operations. Today's colleges and universities, being a model for our communities and the educators of tomorrows leaders, should engage in developing and testing innovative climate policy to lead the way in decarbonization. One such policy pathway is through internal carbon pricing (ICP).

1.2 Internal Carbon Pricing in Higher Education

According to the National Caucus of Environmental Legislators (n.d.), carbon pricing is a market-based approach of assigning a price on carbon emissions to shift the cost of pollution onto industry emitters. Rather than explicitly enforcing emissions reductions in specific areas, carbon pricing incentivizes behavioral change, enabling individuals and institutions to decide to what extent and how to reduce emissions. The funds from these mechanisms can then be funneled back into environmental projects, thus stimulating clean technology and market innovation (The World Bank, n.d.).

At the international, national, and subnational levels, carbon pricing strategies are widespread, yet inconsistent. According to The World Bank Carbon Pricing Dashboard, there have been 73 regional, national, and subnational carbon pricing initiatives implemented in the world to date. These include 39 national and 33 subnational jurisdictions, representing 23% of global carbon emissions (The World Bank, n.d.). Within these 73 recognized initiatives, there are multiple models for enacting carbon pricing, including revenue positive pricing schemes, revenue neutral pricing schemes, cap-and-trade systems, and cap-and-invest systems (National Caucus of Environmental Legislators, n.d.).

At institutional scales, over 600 corporations internationally had implemented internal carbon prices by 2017 (Bento et al., 2021). In a study of 500 US firms, carbon management policies more broadly were found to reduce emissions by 13.5% per employee (Zhu et al., 2022). Adaptation of these policies is often a product of risk mitigation tactics, a desire to stay ahead of government regulation, and an outcome of exposure to more climate hazards (Ben-Amar et al., 2022).

In the context of higher education, little research has been done on the scale and scope of ICP policies. Barron et al. (2020) found that as of 2020, 11 US institutions had adopted carbon pricing policies. Among these 11 institutions, Barron identified three differing policy types, including carbon charges, proxy prices, and funds, detailed in Table 1.1.

While seemingly effective based on limited research, colleges and universities face many challenges in implementing ICP policies. According to Gorbach et al. (2022), there are two primary barriers to policy implementation, including 1) frequent difficulty allocating emissions to the responsible cost center within an organization, and 2) the challenge cost centers face reacting to the ICP by changing processes, technologies, or products. Should an institution succeed in overcoming these barriers, then it is possible that the policy could reduce campus emissions, while bolstering climate actions amongst affected communities through educational impacts (Macdonald & Patrinos, 2021).

Table 1.1 Carbon pricing policy typologies in higher education (Barron et al., 2020)

Carbon Pricing Policy	Definition
Carbon Charges	*Carbon charges* levy a fee on the carbon emissions from departments or administrative units. The accrued funds can be used to finance sustainability projects, or the charge can be made revenue neutral by providing each administrative unit a rebate to reduce the impact of the charge .
Proxy Carbon Prices	*Proxy carbon prices* (sometimes called shadow carbon prices) are virtual prices used to inform decision-making processes. The social cost of the carbon emissions is included in an analysis as though it were a private cost to the institution (as it would be under a government-run carbon tax).
Carbon Funds	*Carbon funds* reserve funds from the budget (in an amount equal to institutional emissions multiplied by the set carbon price) to fund projects.

The success of ICP may also depend on alignment with institutional budget models. For example, Barron (2024) notes that differing carbon pricing policies are more effective at different levels of organizational centralization. Notably, decentralized budget models such as Responsibility Center Management could effectively deliver carbon charges by incentivizing organizational priorities to campus decision-makers (Lang, 1999). Should a campus aim to incentivize decarbonization through the institutional budget model, then RCM models should be explored as a pathway to reduce emissions.

1.3 Responsibility Center Management Budgeting

Popularized by Whalen (1991), Responsibility Center Management (RCM) is an approach to decentralized campus budget management which divides a university into a number of academic, support, and central executive units, with each responsible for generating its own income and managing its own expenditures. Built in accordance with a broad shift towards corporate management in higher education (Manning, 2018), RCM aims to instill a sense of competition, innovation, and self-reliance within academic units (Fethke & Policano, 2019). This has been deemed necessary due to economic pressures on higher education institutions, such as the impact of shrinking state appropriations (Cekic, 2008). To date, as many as 68 US public institutions are utilizing full RCM models, though the true number of institutions with partial or full RCM deployment is unknown (Kelchen, 2024).

Proponents of RCM systems have argued that decentralized budgeting incentivizes innovation and growth within academic units and eventually the entire institution. For example, in a 2015 interview with an impacted dean, it was found that a new RCM system incentivized a dean of music to engage more students around campus through the creation of courses that engaged the broader student body. This led to more funding and thus more capacity to innovate (Carlson, 2015). A 2017 study by Deering & Lang (2017) echoes these findings, concluding that while RCM rarely reduces institutional costs, it frequently increases revenue, leading to departmental growth. Similarly, Hearn et al. (2006) found that while the implementation of RCM systems at the University of Minnesota had little overall impact on the percent of credit hours taken within a student's home college, it increased the institutional credit hours generated overall.

Another notable benefit of RCM budget models is that it creates more campus decision makers who are supposedly more knowledgeable about the budget decisions to be made at unit levels (Lang, 1999). This is found to be most effective at institutions that have fully deployed RCM, though many universities opt for partial deployment (Deering & Lang, 2017). With partial deployment, campus administration can retain some amount of authority over the campus budget, while being able to establish incentives within the RCM model. Other RCM benefits include motivating entrepreneurial behavior amongst decision makers, reducing the scale and complexity of campus planning, and exposing costs that may have otherwise gone unrecognized (Lang, 1999).

In contrast, adversaries of RCM argue that it destroys collaboration and unity within campuses (Lang, 1999). This is because RCM creates individual pools of money which often pit academic units against each other. Additionally, critics of RCM argue that it has not yet been utilized to improve the cultural and human services of institutions (Adams, 1997). Despite this, RCM implementation is often found to be a product of organizational structure and culture (Vonasek, 2011). This suggests that future research should observe whether RCM models are connected to culture, and how they can be leveraged to advance cultural goals, such as those associated with climate action and sustainability.

Key to the establishment of RCM is the deployment of incentives. Prior research finds that through incentivizing decision-makers in RCM models, institutions have succeeded in bolstering metrics such as tuition revenue, fall enrollment, student retention, financial aid distribution, and graduation rates (Decker, 2023; Jaquette et al., 2018). Yet, as argued, incentives which have societal benefits have yet to be integrated within RCM models. Therefore, as universities shift towards decentralized budgeting structures in the face of a competitive landscape, it is necessary to begin leveraging these budgetary models to accomplish our societal goals, such as decarbonization.

1.4 Study Objectives

Higher education, faced with tightening budgets, competitive student recruitment, and increased pressure to catalyze societal change, can leverage its capacity to innovate and lead on decarbonization and climate action. One such pathway is through internal carbon pricing. Should an institution align its cultural goals, budget model, and leadership with existing climate action plans, then the implementation of ICP policies is believed to come with fewer challenges. Along these lines, this thesis involves two studies assessing the feasibility and impact of internal carbon pricing policies in a changing budgetary and cultural environment.

The first study investigates the environmental and cultural impacts of ICP policies in higher education. To date, there are 19 known US institutions with varying carbon pricing policies. Through analyzing a sample of 170 institutions, the research evaluates the effectiveness of existing ICP policies in reducing campus emissions. Additionally, this study utilizes interviews with representatives from 15 ICP institutions to investigate the relationships between internal carbon prices, campus budget models, and climate action cultures.

The second entails the creation of a conceptual model for the establishment of a carbon charge within a Responsibility Center Management budget model. Using the University of Vermont (UVM) as a case institution, a hypothetical case study investigates the design and management implications of implementing a carbon charge within the existing Incentive Based Budgeting model at UVM. Additionally, focus group research suggests the feasibility and barriers to ICP usage within an RCM model.

Overall, this thesis aims to shed light on the usefulness of internal carbon pricing policies in higher education, while reducing barriers to campus implementation. As more institutions approach carbon neutrality goals, it will be critical that innovative pathways to neutrality be considered, which could entail ICP policies. Through policy implementation, communication, and education, it is possible that such policies could catalyze broader societal change towards a carbon free future.

CHAPTER 2

ASSESSING THE IMPACT OF INTERNAL CARBON PRICING ON HIGHER EDUCATION EMISSIONS AND CLIMATE ACTION CULTURE

Abstract

To address climate change, higher education institutions are challenged with simultaneously teaching, researching, and demonstrating policies that will lead to decarbonization. One such policy solution often taught and studied, but rarely demonstrated, is carbon pricing. First trialed at a US university in 2008, assigning economic value to the cost of internal carbon pollution has the potential to incentivize campus climate action, demonstrate pathways to efficient carbon reductions, and raise needed capital for decarbonization projects. To investigate this potential, this mixed methods study has two main components. First, it utilizes emissions data to measure the impact of internal carbon pricing policies in US higher education. Second, it utilizes interviews with campus sustainability professionals to explore the interplay between campus carbon pricing tools and climate action culture. Results indicate that while these policies have not led to widespread emissions reductions, they have the potential to play a significant role in building a culture and governance supportive of climate action.

2.1 Introduction

In the face of climate change, higher education institutions are emerging as a leader through setting and actualizing decarbonization goals and solutions. For example, since its inception in 2007, more than 700 institutions globally have signed onto the Second Nature Presidents' Climate Leadership Commitment (Dyer & Dyer, 2017). Of its active 375 climate and carbon commitment signatories, 373 have committed to short to medium term carbon neutrality goals; 21% by 2030, and another 56% by 2050 (Sustainability Indicator Management & Analysis Platform, 2024). As of 2022, 9 of these institutions have achieved net carbon neutrality, largely claimed through purchasing carbon offsets (Second Nature, 2022).

In this period of turning pledges into measurable achievement, it is unclear just how deeply these commitments have penetrated organizational policy, incentives, cultures, and management structures. To date, climate action has largely been implemented through low-cost campus updates such as new lighting fixtures, building insulation, and electrifying fleet vehicles, otherwise known as the proverbial "low hanging fruit" (da Silva et al., 2023). Yet, decarbonizing higher education and meeting climate action goals necessitates deeper investment towards climate solutions. It has been reported that US higher education institutions emit approximately 7.67 metric tons of carbon dioxide equivalents per student annually (Sinha et al., 2010). This is nearly double the annual emissions of US metals production, and nearly triple that of US cement production (Minx et al., 2021). With vast differences in institutional size and scope, tackling decarbonization will require immense innovation and collaboration to create impactful higher education climate policy (Shawe et al., 2019).

One such emergent policy in higher education is carbon pricing. First trialed by Princeton University in 2008, internal carbon pricing (ICP) assigns a dollar value to carbon pollution of the institution as a whole or to sub-units such as colleges, schools, or departments (Barron et al., 2020). From a management lens, ICP policies have the potential to raise the capital necessary for decarbonization projects (Boyce, 2018). More importantly, they create an incentive that can stimulate desirable behavioral change and through cultivating a sense of transparency, accountability, and shared decision-making across college and university campuses (Martin et al., 2019; N et al., 2024).

To date, various forms of internal carbon pricing policies have been tested in higher education, including proxy prices, carbon charges, and carbon funds (Barron et al., 2020). In selecting the appropriate pricing policy, success can hinge on existing institutional decision-making structures as well as the administrative culture towards climate action. Should an ICP policy not be conducive to the institutional decision-making structures, nor organizational goals and priorities, the policy could be less effective at aiding a university in its decarbonization efforts.

To explore these connections between campus policy, climate action culture, and higher education governance, this study aims to evaluate the impact of ICP policies on emissions and climate action culture within the early campus adopters. First, the study updated the list of US ICP institutions. Second, the effect of ICP policies on campus emissions was investigated with regression analysis. Finally, analysis of interviews with key campus decision-makers at ICP schools explore the interactions between policy design and implementation with campus climate action cultures. Findings will aid colleges and universities in determining whether an ICP policy is appropriate for their campus. More importantly, they will help in identifying the challenges and barriers that commonly prevent the adaptation of climate policy in higher education.

2.2 Background

Higher education institutions are well situated to develop, test, and teach climate solutions. As evidence, over 700 institutions have signed onto formal Second Nature climate commitments (Dyer & Dyer, 2017), and as many as 83% of US institutions have funded formal sustainability offices or institutes (AASHE, 2023). As a source of future leaders and social changemakers, academia is critical in engaging students in sustainability work and education (Tomasella et al., 2022). In 2021, there were approximately 15.4 million students enrolled at US colleges and universities alone (National Center for Education Statistics, 2021). Through acting as a model for their host communities, higher education is ideally suited as a testing-ground for sustainable planning (Bailey & LaPoint, 2016).

Beyond the inherent responsibility to lead by example, it is also clear that higher education is accountable for a significant amount of emissions. A 2010 study of the signatories of the American College and University Presidents' Climate Commitment found that US higher education institutions emit 7.67 metric tons of carbon dioxide equivalent (MTCO2E) per student annually (Sinha et al., 2010). With 15.4 million students enrolled in US higher education institutions in 2021 (National Center for Education Statistics, 2021), this means that US higher education institutions are accountable for approximately 118,118,000 MTCO2E annually.

Additionally, several studies have assessed the prevalence of scope-one, -two, and -three emissions in higher education (Table 2.1). Notably, it has been consistently reported that over 50% of higher education emissions are from scope-one and scope-two sources (da Silva et al., 2023; Helmers et al., 2021; Ridhosari & Rahman, 2020). While scope-three emissions are not as prevalent in these studies, these emissions are often underreported due to inconsistent collection methodologies (Valls-Val & Bovea, 2021). Overall, campus emissions have been found to be positively associated with an institution's full-time-equivalent students, gross square footage, and presence of a medical school (Klein-Banai & Theis, 2013).

Table 2.1 Greenhouse gas emissions typologies (da Silva et al., 2023)

Type of Emission	Definition
Scope-one Emissions (Direct Emissions)	Emissions from sources owned or controlled by Higher Education Institutions (HEI's) for example, emissions from fossil fuel combustion related to campus buildings and vehicles.
Scope-two Emissions (Indirect Emissions)	Emissions from purchased electricity, defined as electricity acquired or otherwise brought into the HEI organizational boundary.
Scope-three Emissions (Other Emissions)	Emissions generated as a consequence of HEI activities that stem from sources that are not owned or controlled by them, for example, from the extraction and production of purchased materials, transportation of purchased fuels, and waste processing.

While campus sustainability initiatives have grown significantly in the past decades, much work remains towards actualizing campus climate action and decarbonization goals. One feasible pathway to achieving this could be through internal carbon pricing. Carbon pricing is a market-based approach of putting a price on carbon emissions (National Caucus of Environmental Legislators, n.d.). Carbon pricing internalizes the economic cost of emissions, raising funding internally for strategic investments towards energy efficiency, climate action and sustainability work (Ben-Amar et al., 2022).

While research has investigated carbon pricing at the national and sub-national levels, very little research has explored carbon pricing in higher education. Notably, Barron et al. (2020) first summarized the collective status of carbon pricing in higher education, identifying 11 US institutions with internal carbon pricing policies. Barron characterized the three types of ICP policies in use as carbon charges, proxy carbon prices, and carbon funds, defined as:

- Carbon charges. A fee on the carbon emissions from campus sub-units. The accrued funds can be used to finance sustainability projects, or the charge can be made revenue neutral to reduce the impact of the charge (Gillingham et al., 2017).
- Proxy carbon prices. Sometimes called shadow carbon prices, these are virtual prices used to inform decision-making processes (Barron & Parker, 2018; CDP, n.d.). The social cost of the carbon emissions is included in an analysis as though it were a private cost to the institution (Barron et al., 2020).
- Carbon funds. Centrally generated budgets equal to institutional emissions multiplied by the set carbon price. These can be used to fund carbon mitigation projects (Second Nature, 2020).

To date, some ICP policies have yielded positive results. For example, the Yale carbon pricing scheme was found to significantly reduce emissions through incentivizing behavioral changes and efficiency decisions (Wolak, 2014). The Swarthmore College carbon charge has also been found to incentivize campus decarbonization, collecting funds for initiatives such as metering, education, engagement, research, and a green revolving fund (Swarthmore College, n.d.). Further research by Lee and Lee (2022) found that carbon pricing in higher education could even be used as a means to incentivize material waste reductions, though waste is not often included in carbon accounting mechanisms and is thus excluded from carbon prices.

Preliminary research by Barron et al. (2020) and campus case studies suggest that campus carbon prices may also have the potential to positively influence climate action culture. As defined by Fritsche and Masson (2021), collective climate action describes a group member's action that is performed as a representative of the group, which aims at reducing climate change as a group goal. In a university context, this may include developing policy and strategy in climate change research and university operations, strengthening communication and engagement across relevant stakeholders, and building capacity for campus constituents to engage in climate work (Leal Filho et al., 2018). Should an institution have a strong culture of climate action and a decarbonization goal, then it is feasible that an ICP policy could fit smoothly within the pre-existing climate action culture of an institution.

Given that an institution's budget model and policies have deep connections with organizational missions, identity and behavior (Kenno & Sainty, 2017), it is also likely that an ICP policy will have impacts on organizational governance. Beyond having a climate action culture, organizational transparency and accountability are critical in the development of campus incentives. Research finds that strong carbon accounting, or documentation of emissions at the unit level, can be a pathway to building transparency and accountability within institutions (N et al., 2024). Carbon accounting is the first step to building a carbon pricing tool, because it enables administrators to assign a price to real emissions. Thus, this research also aims to highlight how ICP tools have succeeded or failed in building a sense of transparency and accountability, and eventually receptiveness to budgetary decarbonization incentives.

Historically, research indicates that Pigouvian taxes like carbon pricing have succeeded in modifying behavior in response to higher price signals. For example, plastic bag taxes have led to reductions in plastic bag use and changes in consumer behavior (Convery et al., 2007). Similarly, taxes on gas-guzzling vehicles have been found to shift preferences towards hybrid vehicles after nudging consumers into changing transportation habits (Lucas, 2024). Such taxes can shift social norms so that pro-environmental behaviors become morally and socially valued (Lucas, 2024). With this in mind, it is still unclear whether Pigouvian taxes have a net benefit, as they are also believed to provide consumers with a moral license to engage in undesirable behavior (Hartmann et al., 2023). In the context of a university, it is feasible that internal carbon pricing could shift preferences, attitudes and behaviors towards those supportive of climate action through incentivizing repeated pro-environmental behaviors and decisions. Overall, this research will contribute to the larger conversation about Pigouvian taxes, looking not only at emissions data but also at the climate action impacts of ICP policies.

2.3 Methods

To assess the impact of internal carbon pricing policies in higher education, data was collected from a sample of institutions. Initial data was collected on all US institutions reporting scope-one, two and three emissions between 2018 and 2022 to the Sustainability Indicator Management & Analysis Platform, totaling 177 institutions (University of New Hampshire, 2024). Five others were added from the Association for the Advancement of Sustainability in Higher Education database, so that all emissions-reporting institutions with ICP policies could be represented in the dataset (AASHE, 2024).

Additional data was collected for all institutions on 14 other variables that aid in describing institutional size and scope (Tables 2.2 and 2.3). Climate Zone was included because of the impact of varying climactic and weather patterns on campus heating and cooling operations (Li et al., 2012). Census Region was included due to the impact of political geographies and politics on climate behaviors and policies (Kousser & Tranter, 2018). Carnegie Size, Institution Setting, and Degree of Urbanization were included because it is found that the size and scale of a campus will influence the energy consumption, with larger campuses consuming more energy (Klein-Banai & Theis, 2013). Land-grant status, Public or Private status, and Endowment size were all included because of correlations between university resources and capacity to invest in initiatives such as decarbonization, with land-grant institutions and private institutions historically receiving more funding (Kane, 2003). The presence or absence of a medical school was included due to the significant uptick in energy usage on campuses with medical schools (Klein-Banai & Theis, 2013). Budget Model was included because it is believed that more decentralized governance structures are more conducive to incentivizing individual change, such as through a carbon price (Barron et al., 2020). Finally, Gross Square Footage and Full-Time Equivalent students and staff were included because of prior research indicating that larger campuses, and those with larger populations, trend towards producing more carbon emissions (Sinha et al., 2010).

The original panel included data on 182 institutions. Institutions with no physical campuses, those which reported as a campus sub-unit, or those with significant missing data or errors were removed. Additionally, institutions that did not report scope-three emissions were removed. The final panel included data on 170 institutions, including 16 of the 19 known US institutions with internal carbon pricing tools. Table 2.2 summarizes descriptive statistics for each categorical variable. Table 2.3 includes the descriptive statistics for each numerical variable. Endowment was excluded from these tables, because US institutions report endowment values through two differing methods. These were combined through data standardization in later steps.

Table 2.2 Descriptive statistics for categorical variables

Variable	Options	Sample Count (n)	Sample Percent	Population Count (n)	Population Percent
Census Region	Midwest	36	21.2%	1341	22.4%
	Northeast	47	27.6%	1196	20.1%
	South	44	25.9%	2108	35.2%
	West	43	25.3%	1287	21.7%
Carnegie Size	Graduate (No undergraduate enrollment)	2	1.2%	282	4.7%
	Large (>10,000 students, four-year)	72	42.4%	393	6.6%
	Medium (3,000 to 9,999 students, four-year)	49	28.8%	768	12.8%
	Small (1,000 to 2,999 students, four-year)	39	22.9%	1182	19.7%
	Very small (<1,000 students, four-year)	8	4.7%	1098	18.3%
Institution Setting	Associates Colleges	9	5.3%	930	15.5%
	Baccalaureate Colleges	50	29.4%	691	11.5%
	Doctorate-granting Universities	67	39.4%	461	7.7%
	Master's Colleges and Universities	41	24.1%	641	10.7%
	Special Focus Institutions	2	1.2%	1011	16.9%
	Tribal Colleges	1	0.6%	35	0.6%
Public or Private Status	Private	75	44.1%	3955	67.7%
	Public	95	55.9%	1884	32.3%
Land Grant Status	Land-Grant Institution	26	15.3%	115	1.9%
	Not Land-Grant Institution	144	84.7%	5878	98.1%

Table 2.2 continued

Variable	Options	Sample Count (n)	Sample Percent	Population Count (n)	Population Percent
Degree of Urbanization	City: Large	44	25.9%	1397	23.3%
	City: Midsize	19	11.2%	688	11.5%
	City: Small	37	21.8%	753	12.6%
	Suburb: Large	25	14.7%	1453	24.2%
	Suburb: Midsize	9	5.3%	178	3.0%
	Suburb: Small	5	2.9%	120	2.0%
	Town: Distant	14	8.2%	412	6.9%
	Town: Fringe	4	2.4%	121	2.0%
	Town: Remote	6	3.5%	302	5.0%
	Rural: Distant	3	1.8%	107	1.8%
	Rural: Fringe	3	1.8%	344	5.7%
	Rural: Remote	1	0.6%	57	1.0%
Medical School	Yes	35	20.6%	203	3.4%
	No	135	79.4%	5791	96.6%
ICP Policy School	ICP Policy	19	11.2%	-	-
	No ICP Policy	151	88.8%	-	-
Climate Zone	1 (Warmest)	1	0.6%	-	-
	2	6	3.5%	-	-
	3	35	20.6%	-	-
	4	40	23.5%	-	-
	5	47	27.6%	-	-
	6	37	21.8%	-	-
	7 (Coldest)	4	2.4%	-	-
RCM Budget (Decentralized)	Yes	18	10.6%	-	-
	No	152	89.4%	-	-

Table 2.3 Descriptive statistics for numerical variables

Variable	Min	Max	Mean	Median	Standard Deviation
Scope-one Emissions (MTCO2E)	119	253,044	28,357	7,218	50,219
Scope-two Emissions (MTCO2E)	0	243,709	19,001	5,131	36,230
Scope-three Emissions (MTCO2E)	34	1,258,072	27,194	6,797	101,639
Full-Time Eq. Students	103	113,662	14,089	7,249	16,024
Full-Time Eq. Staff	87	33,047	3,528	1,294	4,961
Gross Square Footage	129,397	3,0414,130	5,579,178	2,705,304	6,170,081

A principal component analysis was conducted to observe which campus attributes may be associated with increased campus emissions. This was done through Program R (R Core Team, 2024) replicating the methods used by Klein-Banai & Theis (2013). The outputs of the PCA were then used as controls within two linear regression models, to determine whether ICP policies are associated with changes in campus emissions. The first model measured the impact of ICP policies on campus gross emissions, controlling for the output of principal component one. The second measured the policy impact while controlling for the outputs of principal components one and two. Finally, a correlation matrix was then used to further assess the degree of association between ICP policies, principal components one and two, and three key institutional size and scope variables (Endowment, FTE Students, and Gross Square Footage).

To further investigate the impact of ICP policies on climate action culture and governance, interviews were conducted with sustainability professionals from various carbon pricing institutions. Originally, the vice-presidents of finance (or their offices) were contacted via email at all 19 ICP institutions. In every case, researchers were redirected to a sustainability-oriented staff member, with less budget knowledge, but more insight on climate action culture. In total, interviews were conducted with 19 representatives from 15 of the 19 ICP institutions (78.9%) in the study. Four institutions did not respond to any form of outreach, while another four contained multiple interviewees.

Interview questions were developed through researching prior interviews on university budget models and sustainability policies. The first three respondent demographic questions were replicated from Cekic (2008), while the rest were original. Additionally, a vice president for finance at a university was consulted prior to finalizing questions, to ensure that questions regarding university budget models would be interpreted as intended. Given that the interviews were semi-structured, and restricted by time, not all questions were addressed in any one interview, and some questions from each major section were prioritized (see Appendix Item A). At least one question was asked from each major section on university budget models and carbon pricing tools.

Interviews were conducted virtually, over Microsoft Teams. These were conducted in a semi-structured 30-minute format as described by Patton (2002). After conducting the 19 interviews, transcripts were created and edited for accuracy in Otter AI (Otter AI, 2024). Transcripts were then uploaded into NVivo (Lumivero, 2024) and coded manually using a thematic analysis technique. Thematic analysis was conducted in accordance with the guidelines described by Vaismoradi & Snelgrove (2019).

2.4 Results

2.4.1 *Internal Carbon Pricing Policies and Emissions*

Building on the work of Barron (2024), to date there are 19 known institutions that have enacted ICP tools. Two of these institutions (10.5%) have a carbon fund, ten institutions (57.9%) have a carbon charge, ten institutions (52.6%) have a proxy price, and three institutions (15.8%) have multiple tools in use. Of the 23 policies documented below, ten (43.5%) are restricted to air or vehicle travel, thus only impacting scope-three emissions, whereas the other 13 (56.5%) are designed to impact scope-one and scope-two emissions (Table 2.4). Only two institutions (10.5%) have policies which function within the institutional budget model, meaning that they levy a budgetary carbon charge that is not an air travel fee.

Regarding carbon prices, there is much variation in the price signals assigned to carbon emissions. Air travel policies range from $0.01 per mile, to $40 per trip. Non-air travel carbon charges range from $40 to $50 per MTCO2E. Proxy Prices range from $10 to $268 per MTCO2E. Revenue from these tools are typically directed towards other campus projects which either directly or indirectly support decarbonization such as capital projects, green revolving funds, or low-hanging efficiency projects. The only exception to this is proxy pricing tools, which impact capital planning processes through altering decision-making structures with a shadow price. These do not generate immediate revenue, though they generate future value through preventing the damages from emissions that were mitigated when developing capital projects.

When initially observing the annual gross emissions of ICP versus non-ICP schools, ICP schools demonstrated higher total gross emissions per capita (Figure 2.1) and per square foot (Figure 2.2). Notably, scope-three emissions of ICP institutions were found to be much higher, whereas scope-two emissions of ICP institutions were found to be slightly lower than the non-ICP institutions. Overall, US higher education institutions are found to emit 5.4 MTCO2E per capita, and 10.1 MTCO2E per square foot times 1000. These values were calculated using only the most recent reporting year from each of the 170 institutions in the sample.

Table 2.4 US institutions with internal carbon pricing policies

Institution	Type of Policy	Current Price per Ton	Current Price per Trip/Flight	Initial Adoption Year
Princeton University	Proxy Price	$35 to $228	-	2008
Weber State University	Carbon Fund	-	$0.01/mile	2012
Yale University	Carbon Charge	$40 to $50	-	2015
	Proxy Price	$125	-	2021
Swarthmore College	Carbon Fund	$26.24	-	2016
	Proxy Price	$100	-	2016
	Carbon Charge	-	$11	2022
Cornell University	Proxy Price	$100	-	2016
Whitman College	Carbon Charge	-	$5 to $40	2016
University of Maryland	Carbon Charge	-	$5	2017
Arizona State University	Proxy Price	$10	-	2017
	Carbon Charge		$20	2018
Smith College	Proxy Price	$95	-	2018
University of California Los Angeles	Carbon Charge	-	$9 or $25	2018
Utah State University	Carbon Charge	-	$10	2020
California State University East Bay	Carbon Charge	-	$9	2020
Williams College	Proxy Price	$52 to $150	-	2021
Middlebury College	Carbon Charge	$40	-	2022
Colorado State University	Carbon Charge	-	$10 or $20	2022
University of California Berkley	Carbon Charge		$10 or $25	2022
State University of New York Albany^	Proxy Price	$125	-	2023
University of California Davis^	Proxy Price	$261	-	2023
University of California Santa Cruz^	Proxy Price	$265	-	2023

^Price implemented as a product of external policy or guidelines
Table updated based on (Barron et al., 2020)

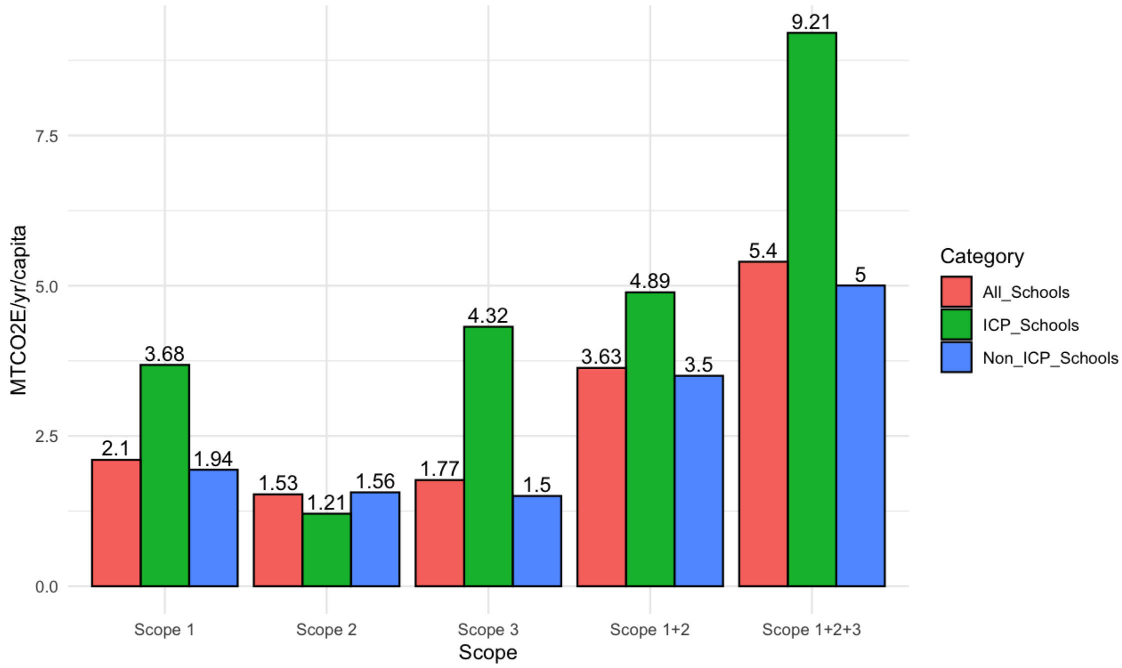

Figure 2.1 *Gross emissions per capita*

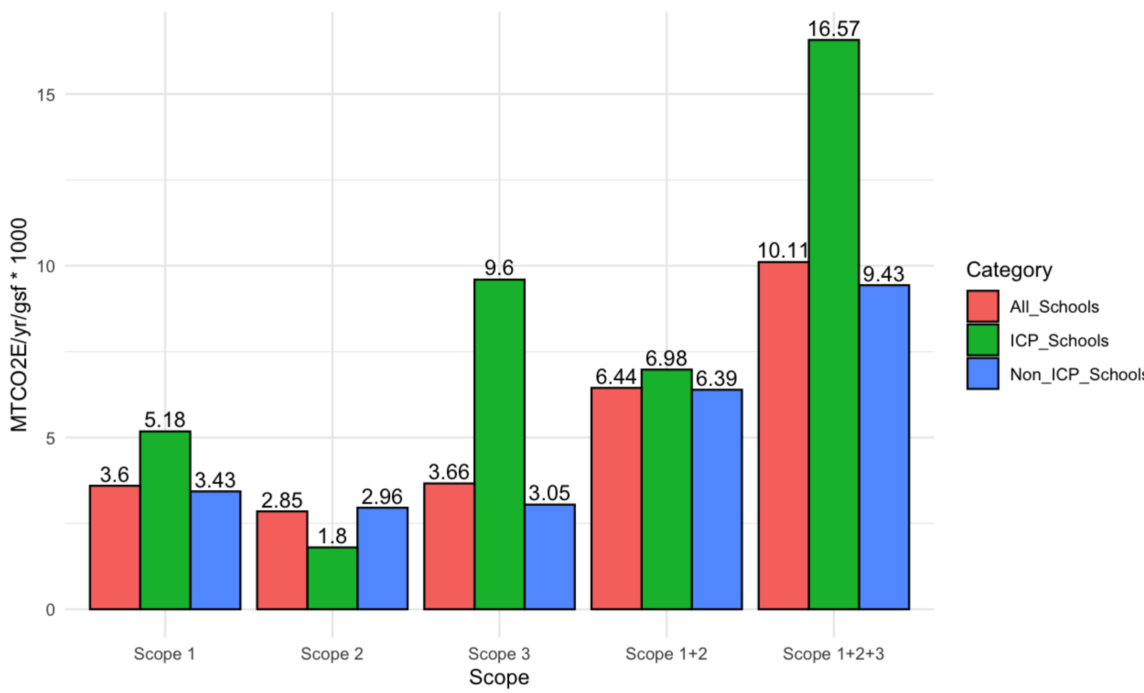

Figure 2.2 *Gross emissions per square foot*

2.4.2 *Principal Component Analysis*

To observe the influence of other variables on campus emissions, a principal component analysis (PCA) was then conducted and graphed. For the PCA, all data was standardized, and endowment values reported through two differing methods were combined. The “year” variable was excluded from the PCA due to fluctuating campus emissions during and after the covid-19 pandemic (Sun et al., 2022). Data from the most recently reported year from each of the 170 institutions was used for the PCA.

Using Program R, the PCA combined all 14 study variables into 14 principal components (PC’s), grouped based on their common characteristics. PC one (SD = 2.22) explained 35.33% of variance in the dataset, and PC two (SD = 1.36) explained 13.13% of the variance in the dataset. Combined, these components explain 48.46% of data variance, and were subsequently investigated. The PCA produced loadings (weights) for the variables of each component, which are indicative of the strength, or leverage which a given variable has on influencing the entire dataset within each component.

Within PC one and PC two, the loadings were compared to determine the variables with the most influence on the dataset as a whole. When observing the variables with the highest loadings in PC one and two, it was found that the effects of PC one were best explained by institutional size and scale characteristics such as gross square footage, FTE staff, FTE students, Medical School presence, and Carnegie Size (loadings = 0.415, 0.408, 0.370, 0.318, -0.318, respectively). In contrast, it was found that the effects of PC two were best explained by climactic variables such as census region and climate zone (-0.562 and 0.499, respectively). All other variables still had an influence on the principal components, though not as significant (Table 2.5). For instance, Degree of Urbanization had a high loading of -0.617 in PC four, though this principal component only accounted for 7.98% of variation within the dataset. Therefore, it was not considered further.

To then identify the variables with the largest impact on university emissions, PCs one and two were graphed. The effects of PC one were plotted on the x-axis, and the effects of PC two on the y-axis (Figure 2.3). University gross emissions values were transformed and plotted using a box-cox transformation to maximize variation, then color coded based on gross emissions values. Through observing the output, it was clear that PC one had a greater influence on university emissions, with lesser-emission schools being skewed to the left, and greater-emission schools being skewed to the right. This indicates that the most heavily loaded variables within PC one have the strongest relationship with university emissions.

Table 2.5 Principal components one and two for study variables (n=170)

Variable	**Principal Component 1: Size and Scale Characteristics**	**Principal Component 2: Climactic Characteristics**
Responsibility Center Management (y/n)	0.250	0.229
Land Grant Institution (y/n)	0.288	0.066
Medical School (y/n)	0.318	0.167
Internal Carbon Price (y/n)	0.120	0.030
Public or Private (y/n)	0.234	-0.271
Census Region (Categorical)	0.102	-0.562
Climate Zone (Categorical)	-0.148	0.499
Institution Type (Categorical)	0.084	-0.158
Carnegie Size (Categorical)	-0.318	0.238
Urbanization Level (Categorical)	-0.193	0.087
IPEDS FTE Students (Numerical)	0.370	-0.057
IPEDS FTE Staff (Numerical)	0.408	0.155
Gross Square Footage (Numerical)	0.415	0.142
Endowment (Numerical)	0.178	0.373
Percent PCA Variance Explained	35.33%	13.13%

Figure 2.3 *Principal Components one and two with gross emissions*

2.4.3 *Linear Regression and Correlation Matrix*

Based on the results of the PCA, two general linear models were developed. The first model was used to measure the impact of ICP policies on emissions, controlling for size and scale characteristics through including PC1 outputs. The second model included both size and scale characteristics (PC1) and climactic characteristics (PC2) as controls. These two equations can be written as follows:

$$ln(Emissions_i) = \beta_0 + \beta_1 \cdot ICP_i + \beta_2 \cdot PC1_i + \varepsilon_i$$

$$ln(Emissions_i) = \beta_0 + \beta_1 \cdot ICP_i + \beta_2 \cdot PC1_i + \beta_3 \cdot PC2_i + \varepsilon_i$$

Linear regression models were used to determine if internal carbon pricing policies are associated with differences in gross campus emissions. Results of the first linear regression (Table 2.6) indicate that an internal carbon price ($\beta = 0.220$, $p = 0.224$) is not statistically associated with changes in gross campus emissions, but that university size and scale characteristics ($\beta = 0.543$, $p = <0.001$) have significant associations with higher gross emissions. Results of the second linear regression (Table 2.7) demonstrated similar results, indicating that an internal carbon price ($\beta = 0.182$, $p = 0.316$) is not associated with changes in gross campus emissions, though both size and scale characteristics ($\beta = 0.551$, $p = <0.001$) and climactic characteristics ($\beta = 0.081$, $p = 0.034$) are associated with higher gross emissions. For both regression models, the internal carbon price was not found to have a significant influence on campus emissions, when size and scale, and climactic characteristics were included and controlled for.

Building on these results, a correlation matrix was made to better assess the degree of association between PCs one and two, and the institutional characteristics which scored the highest loadings in their respective PC outputs. Results confirm that both PCs could be included in the linear regression, representing separate campus elements. PC one is most closely correlated with Medical School Presence ($r = 0.586$), Endowment Size ($r = 0.358$), and Carnegie Size ($r = -0.342$). In contrast, PC two is most closely correlated with Census Region ($r = -0.558$), and Climate Zone ($r = 0.489$). Therefore, linear regression PC variables are not believed to be confounding, with a weak correlation (0.116). PC one closely represents size and scale characteristics, whereas PC two closely represents climactic characteristics.

Table 2.6 Linear regression controlling for size and scope characteristics (PC1)

Predictor	Estimate	P-value
(Intercept)	10.444	<0.001
Internal Carbon Price in Use	0.220	0.224
Principal Component One	0.543	<0.001

Table 2.7 Linear regression controlling for size and scope characteristics (PC1) and climactic characteristics (PC2)

Predictor	Estimate	P-value
(Intercept)	10.442	<0.001
Internal Carbon Price in Use	0.182	0.316
Principal Component One	0.551	<0.001
Principal Component Two	0.081	0.034

Table 2.8 Correlation Matrix for key variables

Variable	ICP in use	PC1	PC2	FTE Students	Gross Square Ft.	Carnegie Size	Medical School	Census Region	Climate Zone	Endow-ment
ICP in use	1	0.209	0.052	-0.066	-0.007	-0.11	0.085	0.189	-0.046	0.211
PC1	0.209	1	0.116	-0.18	0.033	-0.342	0.586	0.071	-0.128	0.358
PC2	0.052	0.116	1	0.041	-0.05	0.243	0.092	-0.558	0.489	0.238
FTE Students	-0.066	-0.18	0.041	1	-0.006	0.067	0.055	-0.063	0.048	-0.112
Gross Square Ft.	-0.007	0.033	-0.05	-0.006	1	-0.155	-0.082	0.038	-0.027	-0.085
Carnegie Size	-0.11	-0.342	0.243	0.067	-0.155	1	-0.392	-0.22	0.269	-0.038
Med School (Y)	0.085	0.586	0.092	0.055	-0.082	-0.392	1	0.009	-0.166	0.359
Census Region	0.189	0.071	-0.558	-0.063	0.038	-0.22	0.009	1	-0.664	-0.053
Climate Zone	-0.046	-0.128	0.489	0.048	-0.027	0.269	-0.166	-0.664	1	-0.027
Endowment	0.211	0.358	0.238	-0.112	-0.085	-0.038	0.359	-0.053	-0.027	1

2.4.4 *Internal Carbon Pricing, Budgeting, and Climate Action Culture: Thematic Analysis*

After initially reaching out to the finance professionals from the 19 ICP institutions, researchers were redirected to sustainability professionals at all 15 institutions which responded to interview requests. Therefore, interviewees held titles such as Vice President for Sustainability, Sustainability Director, or Climate Action Manager. Four institutions did not respond to any form of outreach, whereas two sustainability professionals were interviewed at four institutions, for a total of 19 interviews.

After conducting and coding the 19 interviews with these sustainability professionals, it was found that a majority of interviewees viewed the carbon price as a product of organizational climate action culture and climate-centered decision-making. Additionally, numerous interviewees voiced the positive impacts of their ICP policies on campus climate action culture, and challenges in enacting such policies. When distilled into themes, it was determined there are four ways in which the campus climate action culture influences the development of a carbon pricing policy. Likewise, three themes emerged which describe how a carbon pricing policy influences climate action culture. The resulting themes can be thought of as an interconnected system and feedback loop, illustrated in Figure 2.4. In the following sections, these will be described with data on the frequency of each.

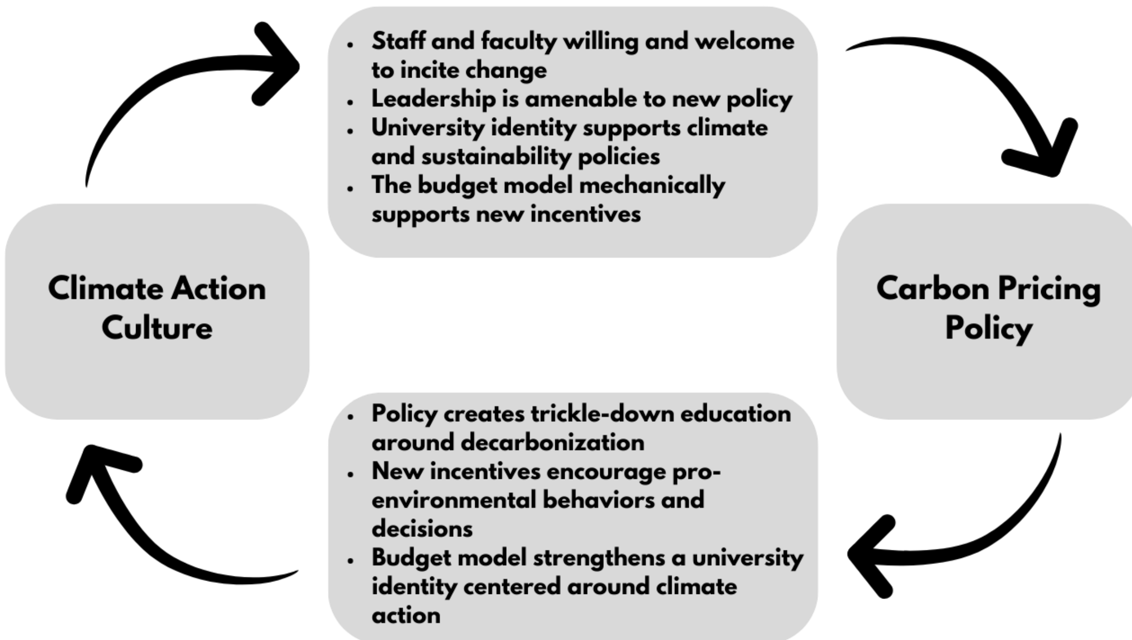

Figure 2.4 *Relationship between ICP policies and climate action culture*

Staff and faculty willing and welcome to incite change

Representatives from 11 of the 15 institutions (73.3%) referenced a campus workgroup that developed or suggested the carbon pricing scheme. Some of these workgroups were created by leadership, whereas others were self-directed. All were critical in the development of the carbon pricing policy, suggesting that bottom-up involvement and advocacy is a force for change when implementing ICP. In speaking to these efforts, interviewees often described the process of developing an ICP policy as bottom-up, rooted in advocacy by faculty and staff. At one institution, an interview stated that the process was "More so bottom-up advocacy. The program came out of a summer working group… to consider how the college could apply carbon pricing within an institutional context." Students were not often involved in this process, though some workgroups included student leaders in policy development. At other institutions, the carbon pricing policy emerged as a means to pay for external (city and state) carbon and environmental taxes, and thus was implemented from a top-down management lens.

Leadership is amenable to new policy

Representatives from three institutions (20.0%) described the university president, or upper-level leadership as a direct hindrance to the development of climate and sustainability policy. Representatives from another six institutions (40.0%) described the university president, or upper-level leadership as critical in advancing a culture of climate action on campus, or in directly supporting the development of the carbon pricing policy. Both ends of this spectrum demonstrate that the values and priorities of university leadership can uplift or suppress the voices and work of the university community. In one instance, an institution was attempting to strengthen its ICP policy, but then a new leader took charge. This leader had such a strong affinity for global citizenship and international travel, that they vetoed the ICP policy because it was viewed as conflicting with the leaders' priorities. In this case, the interviewed staff member emphasized "If you're at that VP Senior or Executive Director level, then you're in those rooms. But… I am not the only staff member who is screaming to get into these rooms." In many cases, despite wanting to facilitate change, sustainability staff are lacking access to the spaces and people who make the final decisions around university climate policy.

University identity supports climate and sustainability policies

Representatives from 11 institutions (73.3%) mentioned public university emissions targets, sustainability plans, and climate action goals as part of a campus culture supportive of decarbonization, climate action, and sustainability. Additionally, representatives from seven institutions (46.7%) described institutional acceptance with economic losses in exchange for community and climate benefits. These institutions actively choose to use a carbon pricing tool even if it meant introducing new financial costs. In several cases, interviewees mentioned philosophical priorities and university values that are more important than the budget. When describing a capital project with a proxy price, one interviewee stated, “we may lose a little money every year on it, but we didn't care… It was the right thing to do.”

The budget model mechanically supports new incentives

Representatives from eight institutions (53.3%) described use of the existing budget model or structures to levy a carbon charge. These were primarily institutions which have enacted a carbon fund or carbon charge. These ICP models are believed to carry more weight as an incentive, because they communicate a carbon price which is a part of the regular budgeting process and requires a financial obligation. For example, one institution which already charges subunits for energy usage simply added a carbon tax on top of this energy bill, through the same allocation mechanisms. This does not require a redesign of the entire campus budget model, but rather utilizes the budgeting tools in place.

Policy creates trickle-down education around decarbonization

Representatives from 11 institutions (73.3%) described the ICP policy as a conversation starter or educational tool. In several cases, the carbon pricing tool was mentioned to have ended up in the classroom. In other cases, the carbon pricing tool was described as a focal point for an institution's sustainability efforts, which was generally known about throughout the campus community. As mentioned by an interviewee, students used the carbon pricing tool in class to learn about externalities, commenting: "How do you think about externalities? How do you really approach these kinds of thorny problems, right? So I think in terms of in the classroom, I think this had a pretty significant impact." In the context of an undergraduate economics course, students are able to see first-hand how an institution is internalizing an externality through paying for the social cost of carbon.

New incentives encourage pro-environmental behaviors and decisions

Representatives from six institutions (40.0%) described witnessing more pro-environmental behaviors, believed to be a product of the ICP tool. When observing students, this was seen in the form of less water and lighting usage, though it is unknown whether this is a product of coinciding educational efforts rather than the policy itself. When observing staff and faculty, behavioral changes were seen in the form of more conscientious decisions which would result in economic benefit, should the incentive carry a high cost. This was most often described in the context of capital planning and witnessing the impact of the ICP tool modifying regular decision-making processes that affect university budgets and resources. As stated by an interviewee, one positive impact of the pricing tool is when, "People kind of become aware and recognize how their choices and behavior impact our carbon footprint … and then seeing that financial thing too kind of cements that a little bit in their minds." Overall, it is likely that when a university staff or faculty leader is aware of budget constraints in a competitive higher education environment, they will take action to preserve their departments resources.

Budget model strengthens an identity centered around climate action

Representatives from nine institutions (60.0%) described the ICP policy as influential in shifting the institutions' culture towards one more receptive and/or supportive of climate action. This was primarily voiced by institutions with higher carbon prices, mainly enacting carbon charges and proxy pricing policies. In contrast, institutions with a lower carbon price, often in the form of an air travel fee, voiced that the carbon price did not sway climate action culture. This suggests that a higher carbon price likely has a greater positive impact when stimulating a culture accepting and supportive of climate action. When describing campus climate action, one interviewee stated, "Just like sustainability, you have to have all the constituents in your campus community rowing in the same direction."

2.5 Discussion

Higher education institutions, being a model for our communities and a source of future changemakers, are uniquely situated to test climate policy solutions. One such policy, carbon pricing, is beginning to permeate the higher education landscape. Through assigning a dollar value to university emissions, an internal carbon price can incentivize climate action while raising funding for critical decarbonization measures (Barron et al., 2020). This mixed methods study analyzed the impact of internal carbon pricing policies on campus emissions. It then used emergent coding to explore the relationships between

ICP policies and campus climate action cultures. Overall, results demonstrate that ICP policies are most commonly implemented as a technical tool to raise funding for decarbonization, though they can also be successful as a governance tool to build transparency, accountability, and shared priorities within college and university campuses. Results also indicate that current carbon pricing policies, while supplementing campus decarbonization efforts, have not yet directly impacted campus emissions as compared to institutions with climate action plans that do not include ICP.

In aiming to understand the cultural impacts of ICP policies in higher education, Vice Presidents for Finance were initially contacted at all 19 ICP institutions. This is because the Vice President (VP) for Finance is often situated in a position of leadership over both the institutional budget model, and the institutional sustainability and climate initiatives. Therefore, it was believed that these individuals could provide unique insight into the relationships between ICP policies, campus budget models, and campus climate action culture. Yet, at all 15 institutions which responded to interview requests, researchers were directed to a university sustainability professional.

This outcome speaks to two critical deficiencies within colleges and universities. Firstly, it indicates that university VPs for Finance have delegated responsibility for campus sustainability efforts, including climate action planning. Secondly, it indicates that VPs for Finance may be less connected with university sustainability initiatives, despite often serving as the individual that oversees institutional sustainability offices. When establishing an institutional carbon pricing policy, the VP for Finance, being in charge of the internal budget, will likely be the final person to sign off on such an initiative. Therefore, prospects for trialing an ICP policy are severely diminished if the

VP of Finance lacks knowledge of or cognitive engagement with campus sustainability goals, challenges, and initiatives.

This finding was demonstrated through research interviews. For instance, one interviewee expressed that they were infrequently invited to key budgetary meetings by their supervisor in a finance management position. This hindered their ability to communicate institutional sustainability priorities and challenges to university leaders. It also alludes to a lack of "teamwork" in addressing sustainability challenges among key campus staff. This is not an uncommon occurrence within and outside of higher education, as sustainability professionals are often isolated from the rest of their coworkers and challenged in integrating sustainability into all facets of their organizations (Singer-Brodowski et al., 2022).

As a result of interviewing only sustainability professionals, interview responses could be biased in favor of carbon pricing. As demonstrated in other research, not all university staff and faculty are as receptive to an internal carbon price. For instance, research reported in the next chapter of this thesis finds that staff in other university positions, such as finance roles, are less receptive towards carbon pricing in higher education. Despite this pro-sustainability bias, conversations with sustainability professionals still provided vital insight into the organizational and climate action impacts of ICP in higher education. Additionally, these individuals are less connected to the institutional budget model, and therefore have less insight into institutional budgetary challenges, but more insight into climate action behaviors.

Perhaps the most important insight from these interviews is that the internal carbon price has not yet been leveraged to build pro-climate action governance within higher education institutions. Currently, sustainability professionals are often excluded from the budgeting process and lack the resources or capacity to enact change. Yet, research demonstrates that effective carbon accounting can be a vehicle to enhancing intra-campus transparency and accountability through reducing information asymmetry (N et al., 2024). Through carbon accounting, university professionals can quickly reveal which campus units or buildings need the most investment when tackling decarbonization, thus contributing to the development of shared spendings priorities. Without clean and accurate carbon accounting, the carbon price will simply exist as a means to raise funding rather than a means to create good organizational governance and a sense of cohesion in tackling campus emissions. Key to this process is using the carbon price and carbon accounting to expose campus constituents to the emissions produced in their workspaces, and instilling a sense of accountability amongst these individuals to advocate for change.

Despite the potential to improve governance, ICP impacts to date have been limited by the policies' use as a market tool in an increasingly corporatized university environment. Currently, carbon prices leverage a market approach which creates competition and can limit policy effectiveness through isolating campus subunits. In a competitive higher education environment that is shifting towards corporate management structures (Manning, 2018), higher education administrators have increasingly adopted policies and organizational structures which encourage competition and isolation. Carbon pricing is no exception to this trend. Through charging individual campus subunits for their emissions, who also have limited control over campus infrastructure decisions, subunits are forced to lobby for only their spaces and units to mitigate costs.

This presents an inherent conflict, as an individualized market approach would be expected to fail at addressing collective climate action goals. As stated by an interviewee, “So the big levers to be able to change those emissions and see a change in the carbon charge are not controlled by departments or individuals.” Another interviewee supported this, noting that “[We] have to be louder about this. Staff members at universities have much less ability to be spicy than faculty… which is also hard, right?” Thus, how can we build more democratic processes more inclusive of staff voices and faculty efforts? If not done with a commitment to transparency and team building, internal carbon pricing could quickly turn into a means to create competition through propagating individualism.

Quantitative findings reflect these challenges, as ICP policies are not found to yet have a significant influence, positive or negative, on reported gross campus emissions as compared to peers without ICP. One potential reason for this is that ICP institutions likely devote more attention and resources to carbon accounting, and thus report higher emissions values than institutions without robust carbon accounting. That said, there are no standardized criteria for collecting and reporting the emissions of higher education institutions (Valls-Val & Bovea, 2021). Another reason includes policy lag time, in which ICP policies are likely to take years to work, especially when they are targeting capital project and infrastructure decisions that happen on an infrequent basis. In fact, over half of the current documented ICP institutions enacted policies in 2020 or later. Yet, it is still rare for an ICP policy to be enacted with the intent of building transparent and accountable governance at the unit and sub-unit level. This was only demonstrated by one interviewee, who established a public report with the emissions and price which each campus unit was accountable for through a carbon charge.

Thus, if higher education hopes to enact ICP policies in a way which will stimulate meaningful change, policy design will be critical in building good governance and stimulating climate action. Though 19 institutions have adopted a variety of carbon pricing policies, Barron et al. (2020) emphasized that proxy prices have the greatest potential for creating the most change, given that they directly influence the decision-making structures at the university. In the time since that research, four institutions have adopted proxy prices, aiming and often succeeding in influencing the capital planning. In contrast, institutions with air travel carbon charge policies generally acknowledged that the ICP policy has not necessarily moved the climate action needle on their respective campuses, perhaps due to low-value carbon prices (Table 2.4).

Surprisingly, there has been minimal experimentation with the higher education carbon charge. Only two institutions of the 19 in the sample, Yale and Middlebury, have attempted to embed a non-air travel carbon charge within their budget model. Yale has demonstrated success in doing so (Gillingham et al., 2017), though such a pricing scheme requires immense investment in metering, carbon accounting, and administrative time (Barron, 2024). When placed within the budget model, the carbon charge has the potential to reach all campus financial decision makers, particularly among institutions that have shifted towards decentralized budget models (Zierdt, 2009). This may also explain why institutions with internal carbon prices haven't necessarily reduced campus emissions as compared to peers. Yet, in the absence of a fully decentralized budget model, it is unlikely that carbon charges can be integrated in a way which maximizes incentives for change.

With this in mind, higher education institution budget models could be improved to better cater to unique institutional priorities (Rylee, 2011). For example, should an institution value a biology program, they include that program within the budget. In the same regard, an ICP tool can be one methodology through which to express priorities related to climate mitigation and decarbonization. Unfortunately, several interviewees acknowledged that the budget model is not accessible and is rarely used as a tool to accomplish climate action goals. Some even referenced inadequate training to utilize the budget model as intended. Thus, if universities are building budget models without the engagement and input from financial decision-makers, then is it unlikely that higher education sustainability professionals will be capable of leveraging the budget model for deep ICP policies. This speaks to a lack of communication and transparency in the budgeting process, serving as a barrier to implementing innovative climate policy solutions.

In addition to budgetary constraints, it is worth noting that campus sustainability efforts are subject to their own unique challenges. As sustainability offices and institutes emerge and grow through a variety of different pathways (Jurge et al., 2024), campus climate action cultures subsequently grow through a variety of mechanisms. In many instances, interviewees acknowledged that the carbon price did not have substantial financial benefits, and may have even caused financial losses in the short-run. Thus, it is worth understanding how the identity of an institution may drive or hinder the adaptation of an ICP policy.

Within any organization, there are strong ties between identity and culture (Hatch & Schultz, 2002). From thematically coding interviews with representatives from 15 ICP institutions, findings suggest that university leadership and organizational priorities are critical in influencing the values and culture associated with climate action. While leadership was found to be both a hindrance or facilitator of ICP policies at some institutions, others adapted and practiced ICP simply because it aligns with their organizational philosophy. In one case, a proxy pricing tool was solely adapted to support an institution's philosophy around climate change mitigation, rather than as a tool to achieve return-on-investment. Both are suitable approaches to create a carbon pricing policy, though these approaches exist within different organizational cultures. In the case of an institution which values economic return, the sustainability professional must seek to justify an ICP policy through return-on-investment and risk mitigation arguments. In contrast, a sustainability professional at an institution which values a stable climate and healthy community may justify a carbon price through arguments based on accepted institutional priorities, decarbonization goals, and marketing tools. Ultimately, the ICP tool must fit within the context of the institutions' values, culture and priorities.

Should a campus achieve the adaptation of an internal carbon pricing tool, it is possible that the tool has the capacity to shift an organization's culture towards one supportive of climate action, creating a feedback loop. As demonstrated through interviews, the ICP policy was often believed to be a supplementary tool in shifting campus behaviors towards those which were pro-environmental, while also shifting larger capital decisions towards environmentally preferable designs. At the same time, the ICP tool has been used to raise capital for initiatives such as green revolving funds, green lab certifications, sustainability fairs, LED replacements, insulation projects, and larger capital projects.

2.6 Limitations and Future Research

Though this study finds that the ICP policy may have stronger connections to organizational governance than emissions and economics, there are multiple limitations. Most notably, despite collecting emissions data from a reputable database, higher education emissions are rarely verified, and thus must be compared and analyzed with caution. For instance, scope-three emissions widely vary across reporting institutions, and in some cases were not even reported due to challenges associated with collection methodologies.

Additionally, while this study finds that ICP policies are associated with higher campus emissions, it is worth noting that the current sample size of US ICP institutions is relatively small (n=19), even less of which reported emissions data during the timeframe studied (n=16). As a product of observing only years 2018 through 2022, the ICP policies recently enacted have had very little time to produce true emissions reductions, if they truly succeed in doing so. Regarding sample size, it must also be acknowledged that all institutions included in the study (n=170) were those which report emissions to either SIMAP or AASHE. Therefore, reports of emissions per capita and per square foot reflect the institutions which are most likely to devote resources to emissions tracking and reduction. It is possible that actual emissions values for all US higher education institutions are much higher than those represented in this study.

Regarding interviews and qualitative findings, the main barrier is that all interviews were conducted and coded by one researcher. To avoid confirmation bias, semi-structured interview questions were created in consultation with a university vice-president for finance. Interviews all began with questions related to university budget models, to avoid inciting pro-sustainability jargon that is likely to emerge when asking sustainability professionals about their sustainability initiatives (such as carbon pricing). When coding, emergent themes were created and reviewed, rather than seeking specific notions about university culture through a priori. Additionally, as discussed, all interviewees were sustainability professionals, and thus it is anticipated that there is a pro-carbon pricing bias within qualitative findings.

Ideally, once more institutions adapt carbon prices, future research should observe the impact of specific carbon pricing policies and carbon prices on emissions and climate action culture, rather than observing all institutions at once. This study suggests that the proxy price and carbon charge (non-air travel) will have long-term positive impacts towards reducing emissions. That said, as highlighted by an interviewee, the internal carbon price is just one piece of an institutions decarbonization journey, rather than the end-all solution. Additional research could observe the impact of politics, leadership, and institutional priorities on climate action culture, as well as how the higher education carbon price is interconnected with external city and state carbon prices. In some cases, the development of an ICP policy is simply a means to pay for an externally imposed carbon price, although this relationship must be further explored, and may extend beyond the scope of higher education. Finally, because this research conflicts with prior research on moral licensing, it is worth exploring whether the role of a higher education decision-maker influences their identity as a consumer. If a staff or faculty member is not acting in the capacity of a consumer, then perhaps the internal carbon price will not provide the same moral license as a retail carbon tax would.

2.7 Conclusion

As climate change progresses and society changes, higher education institutions are confronted with a crisis of purpose. These institutions must decide what their role is in stimulating the problem-solving, innovation and policy that will be necessary to solve global environmental issues. As many of these institutions work towards decarbonization, one such policy solution being tested is internal carbon pricing. This study finds that while ICP policies have not yet produced meaningful emissions reductions, they can aid in building transparency, accountability, and a deeper culture of climate action throughout campus communities.

Should an institution succeed in aligning its leadership, administrative culture, budget model, and decarbonization goals, then the implementation of an internal carbon pricing policy will come with fewer challenges. That said, sustainability professionals in higher education are not unfamiliar with cultural, political, and administrative barriers. As best stated by an interviewee, building a sustainable campus is “a combination of institutional commitment, political and social culture, and economic reality.” These are some of the many constraints confronting institutions, especially when trying to implement an ICP policy.

Moving forward, campus carbon pricing should be considered a pathway through which to better account for emissions, save money, and build climate action culture and good governance. The internal carbon price has been demonstrated to have benefits beyond its ability to create long-term cost savings, potentially stimulating sustainability education, engagement, and virtuous decision-making throughout campus communities. Additionally, the university, often referred to as a model for a city and community, has the potential to catalyze broader change beyond the physical constraints of campus. Thus, the carbon price should not be disregarded as a tool to supplement campus and community decarbonization efforts. Overall, higher education institutions are in a position to incite change. Through innovative policy, adaptive leadership, and interaction with an engaged community, colleges and universities can produce the solutions to pressing issues such as the climate crises.

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CHAPTER 3

BUILDING A CONCEPTUAL MODEL TO LEVERAGE RESPONSIBILITY CENTERED BUDGETING FOR DECARBONIZATION IN HIGHER EDUCATION

Abstract

Over the past 40 years, higher education budget models have shifted from centralized to decentralized structures. On the decentralized end of this spectrum is Responsibility Center Management (RCM). RCM aids universities in achieving their strategic goals through utilizing incentives that guide financial decision-makers throughout an institution. Key to RCM is the allocation of costs, often dependent on metrics such as space usage and enrollment. Yet, in an era of campus climate action, one cost often ignored within RCM systems is the social cost of carbon. Though 19 known US institutions have implemented internal carbon prices, none have succeeded in developing a carbon price that is fully embedded in a decentralized budget model. Through building a conceptual model within the University of Vermont RCM system, this study demonstrates how effective carbon accounting can be used to leverage a decentralized university budget for building transparency, accountability, and more democratic processes for campus climate action. Internalizing the social cost of carbon through a carbon price also communicates climate action throughout the organizational hierarchy, while incentivizing decarbonization. This study will aid higher education sustainability professionals and administrative leaders in considering the potential for carbon pricing policies embedded within organizational budgetary frameworks.

3.1 Introduction

The people, management structures, and philosophies governing higher education institutions (HEIs) have significantly transformed over the past several decades (Manning, 2018). Notably, the development of corporate management structures has led to major changes in the budgetary frameworks governing college and university decisions (Yielder & Codling, 2004). One such trend is the decentralization of budget authority through Responsibility Center Management (RCM).

Conceptualized by Edward Whalen at Indiana University Bloomington in 1990 (Cekic, 2008), RCM is “an organizational structure that logically groups a university’s academic units according to similarity of purpose and funding source into ‘responsibility center’s’, each under a single manager, typically an academic dean, with decentralized decision-making authority” (Vonasek, 2011). RCM allocates costs, resources, and decisions to those most equipped to make decisions within the university (Lang, 1999). Most importantly, RCM utilizes incentives to communicate university values and priorities to decision-makers.

Despite its potential to facilitate change through incentives, the use of RCM has largely been restricted to maximizing economic utility, rather than contributing to the development of solutions to ongoing social and environmental issues such as climate change (Cekic, 2008). For example, to date, 525 institutions have signed on to Second Nature Climate Commitments (Second Nature, 2025). In fact, many of these institutions have adopted climate action plans and near-term decarbonization goals to achieve net carbon neutrality, with 21% aiming for neutrality by 2030, and another 56% by 2050 (Sustainability Indicator Management & Analysis Platform, 2024). Despite this, campus incentives at the unit or sub-unit level to reach these goals have yet to be incorporated within institutional budget models, such as RCM structures.

One potential decarbonization incentive which can be built into a campus budget model is an internal carbon price. First trialed in 2008 in higher education, carbon pricing assigns a dollar value to an institution's carbon emissions, creating both transparency and accountability to greenhouse gas emissions (Barron et al., 2020). To date, at least 19 US institutions are using internal carbon prices to incentivize behavioral change and campus decisions in order to reduce emissions (A. Barron, 2024), though only two are believed to meaningfully interact with institutional budget models (as discussed in chapter 2). Some of these policies have shown signs of success in reducing emissions, as a means to raise funding for decarbonization initiatives, and to build cohesion amongst the campus community.

To explore the potential to align internal carbon pricing with a decentralized university budget model, this research proposes and tests a conceptual model for the University of Vermont (UVM). UVM serves as a valuable case study given the institution's longstanding commitment to sustainability, climate action, and decarbonization (University of Vermont, 2023). Notably, UVM was one of the first national signatories to the American College and University Presidents' Climate Commitment, joining the coalition in 2007 (University of Vermont, 2024b). Additionally, UVM uses a highly decentralized version of RCM, meaning that it already leverages an incentive-based budgeting structure to drive campus decisions (University of Vermont, 2021).

Overall, this research will aid higher education leaders in meeting their decarbonization goals through considering changes to budget models to account for and price carbon. First, it will utilize spatial and energy data to analyze the energy usage of campus academic and non-academic units. Secondly, it will demonstrate through a conceptual model how a carbon charge can be embedded within the University of Vermont RCM budget model. Finally, it will assess the feasibility of such a model through a focus group conversation with key campus stakeholders. Overall, this study will investigate the mechanisms that could enable an RCM budget model to deliver a carbon charge, while also contributing to the conversation around carbon accountability and information transparency in a changing higher education environment.

3.2 Background

According to the Education Advisory Board (EAB), there are six types of budget models in use in higher education, ranging from Centralized Budgeting to Responsibility Center Management (RCM) (EAB, 2024). Under RCM, institutional revenues and costs are decentralized to various degrees to responsibility centers for each budget period (Whalen, 1991). Thus, campus subunits have an incentive to earn and save revenue, as well as control costs, with proceeds typically carrying over from year to year.

Prevalence of RCM in higher education seems to be growing. In 2015, an estimated 24% of HEIs had adopted some form of RCM, up from 14.2% in 2011 (Delancey & Devries, 2023). Kosten (2016) found that 47 public and private institutions had adapted RCM by 2016, while Jaquette et al. (2018) identifies 23 public institutions with RCM by 2018. More recently, a 2024 budgeting blog notes that 68 public US institutions had adapted full RCM models by 2023 (Kelchen, 2024). Yet, these figures often do not account for hybrid models with elements of RCM. While most campus responsibility centers are academic units such as departments and schools, several campuses have adopted RCM models in which non-academic units serve as responsibility centers. For instance, Kent State University operates numerous auxiliary units as if they were responsibility centers, including housing, parking services, an airport, and a golf course, among other units (Kent State University, n.d.).

Though each budget model has unique advantages and disadvantages, RCM is distinct in that it aligns decisions closer to the domain of cause and effect (Lang, 1999). This limits negative impacts associated with administrative leaders making programmatic decisions which they may be disconnected from or unknowledgeable about. Yet, it has also been noted that academic leaders, often charged with decision-making powers in an RCM model, are not equipped to be in the position of a financial manager (Responsibility Center Management at Major Public Universities, 2008). As RCM increases the number of financial decision-makers on a campus, it is key that there are incentives in place to guide these individuals. Furthermore, RCM incentives can guide the culture of an institution from within, through conveying what values are truly prioritized by campus leadership (Cekic, 2008; Kenno & Sainty, 2017).

To date, research on the incentives in place at several RCM institutions has found positive impact on commonly referenced metrics such as tuition revenue (Jaquette et al., 2018). Additionally, RCM models have been found to have positive relationships with fall enrollment, retention, graduation rates, and financial aid (Decker, 2023). That said, budget models designed for the narrow pursuit of economic efficiency have not always aligned with the multi-faceted culture of an institution, such as its moral, civic, intellectual, artistic, and religious values (Adams, 1997). For example, as hundreds of US institutions seek to decarbonize in the face of climate change, the potential to financially incentivize climate action through RCM models is an important topic of research and institutional design.

One climate action incentive particularly aligned with decentralized budgeting is internal carbon pricing. First trialed at Princeton University in 2008, internal carbon pricing creates an incentive for carbon reduction through placing a dollar value on carbon pollution (Boyce, 2018). To date, there are 19 known US institutions with internal carbon pricing policies in the US, though little is known about the overall impacts of these early adopters. Initial research on the Yale University carbon pricing scheme found that a carbon price created strong incentives for behavioral change (Gillingham et al., 2017). The Swarthmore College scheme was found to raise funds for a variety of decarbonization measures, including metering, research, and a green revolving fund (Swarthmore College, n.d.). Wolak (2014) further notes that campus carbon pricing schemes have the potential to make meaningful contributions towards addressing climate change. Despite this, many of the existing campus carbon prices only encompass scope 3 emissions, for instance from university sponsored air travel. Several institutions also use proxy prices, which mainly impact the capital planning process through altering decision-making tools (Barron et al., 2020). Few of these early pricing policies directly interact with and alter institutional budget models (see Table 3.1 for a condensed summary)

Table 3.1 US institutions with internal carbon pricing policies

Institution	Type of Policy	Price per Ton	Price per Trip/Flight	Initial Adoption Year
Princeton University	Proxy Price	$35 to $228	-	2008
Weber State University	Carbon Fund	-	$0.01/mile	2012
Yale University	Carbon Charge	$40 to $50	-	2015
	Proxy Price	$125	-	2021
Swarthmore College	Carbon Fund	$26.24	-	2016
	Proxy Price	$100	-	2016
	Carbon Charge	-	$11	2022
Cornell University	Proxy Price	$100	-	2016
Whitman College	Carbon Charge	-	$5 to $40	2016
University of Maryland	Carbon Charge	-	$5	2017
Arizona State University	Proxy Price	$10	-	2017
	Carbon Charge		$20	2018
Smith College	Proxy Price	$95	-	2018
University of California Los Angeles	Carbon Charge	-	$9 or $25	2018
Utah State University	Carbon Charge	-	$10	2020
California State University East Bay	Carbon Charge	-	$9	2020
Williams College	Proxy Price	$52 to $150	-	2021
Middlebury College	Carbon Charge	$40	-	2022
Colorado State University	Carbon Charge	-	$10 or $20	2022
University of California Berkley	Carbon Charge		$10 or $25	2022
State University of New York Albany^	Proxy Price	$125	-	2023
University of California Davis^	Proxy Price	$261	-	2023
University of California Santa Cruz^	Proxy Price	$265	-	2023

^Price implemented as a product of external policy or guidelines
Table updated based on (Barron et al., 2020)

As first defined by Barron et al. (2020), there are three types of higher education carbon prices, including proxy prices, carbon funds, and carbon charges. These are defined as follows:

- Carbon charges levy a fee on the carbon emissions from departments or administrative units. The accrued funds can be used to finance sustainability projects, or the charge can be made revenue neutral (Gillingham et al., 2017).
- Proxy carbon prices are virtual prices used to inform decision-making processes (Barron & Parker, 2018).
- Carbon funds reserve an amount from the budget equal to institutional emissions multiplied by the set carbon price (Second Nature, 2020).

The first step in any carbon pricing policy is setting the price, whether as an actualized cost or as a proxy to aid decision-making. Estimates of the 2024 US social cost of carbon are as high as $190 per metric ton of carbon equivalent (MTCO2E) (Fisher, 2024), however, current higher education carbon charges do not exceed $50 per MTCO2E. Should a carbon price be embedded within an RCM budget model, a carbon charge would act as an internal tax, alongside energy utility bills. Many RCM models already include formulas and mechanisms for allocating indirect costs such as energy and water usage to responsibility centers (Kosten, 2016). Therefore, it would not require significant modifications to these systems to add a carbon charge, so long as the budget model already has a system to allocate and deliver energy expenses to responsibility centers.

In selecting an institution to conceptually model an RCM carbon charge, the University of Vermont (UVM) was chosen for several reasons. First and foremost, UVM has a highly decentralized RCM budget model, referred to as Incentive Based Budgeting (IBB) (University of Vermont, 2024a). This was adapted in 2015 and utilizes seven cost and revenue algorithms to achieve university goals. Within this model, the campus has eight academic colleges which serve as responsibility centers.

Additionally, UVM is an institution with a strong and long-standing culture of climate action. UVM first began carbon accounting in the 1990s and currently holds a gold rating from the Association for the Advancement of Sustainability in Higher Education Sustainability Tracking, Assessment, and Rating System (*University of Vermont STARS Report*, 2023). The institution was also an early signatory of the American College and University President's Climate Commitment, joining the coalition in 2007 (University of Vermont, 2024b). More recently, UVM launched its first Comprehensive Sustainability Plan in 2023, committing to net carbon neutrality by 2030 (University of Vermont, 2023).

Through creating a model which demonstrates how a carbon charge could be embedded within the IBB system at UVM, this study will provide a guide for higher education leaders as they work to decarbonize. The higher education budget model is rarely thought of as a mechanism to reduce emissions, though it should be considered as a delivery mechanism for incentives, environmental or otherwise. This work will investigate the barriers preventing sustainability professionals from implementing innovative carbon pricing policy within their budget models. If leveraged correctly, the budget model has the potential to further support a campus culture supportive of climate action and decarbonization. Beyond that, the use of carbon accounting through a budgetary carbon price could be a pathway to stimulate transparency, accountability, and shared decision-making within the higher education landscape.

3.3 Methods

In order to develop a model for a carbon charge in an RCM system, UVM's Incentive Based Budgeting (IBB) Manual (University of Vermont, 2021) was used to map the budgetary framework, including its seven revenue and cost algorithms, eight responsibility centers, and various support centers (Figure 3.1). Additionally, the pathway through which utilities bills are paid was added to this graphic to highlight the relationship between energy and emissions. Once mapped, the same budget manual was used to document the incentives driving university budgetary decisions at the decentralized level, enumerated in Table 3.2.

In developing an idealistic model to integrate a carbon price in the UVM budget model, various assumptions were made. Firstly, it is assumed that all campus electricity usage could be estimated with accuracy to the square foot. In cases in which a single meter tracks utilities for several buildings, it was assumed that the energy usage of all covered buildings was identical per square foot. In reality, energy usage varies based on building use, age, and external climactic conditions among other factors. Secondly, total electricity usage was used as a proxy for total utility consumption. This is because the utilities charges are expressed as a single line item in the IBB model, rather than divided into electricity, natural gas, water, and sewer. Finally, this model assumes that responsibility centers, or academic units, are accountable for all campus emissions, encompassing those produced by other units such as libraries, offices, and other non-academic units. For the purposes of this conceptual model, a carbon charge can be applied to the University of Vermont with these assumptions. In reality, building-level carbon accounting barriers would need to be first overcome for maximum accuracy and transparency.

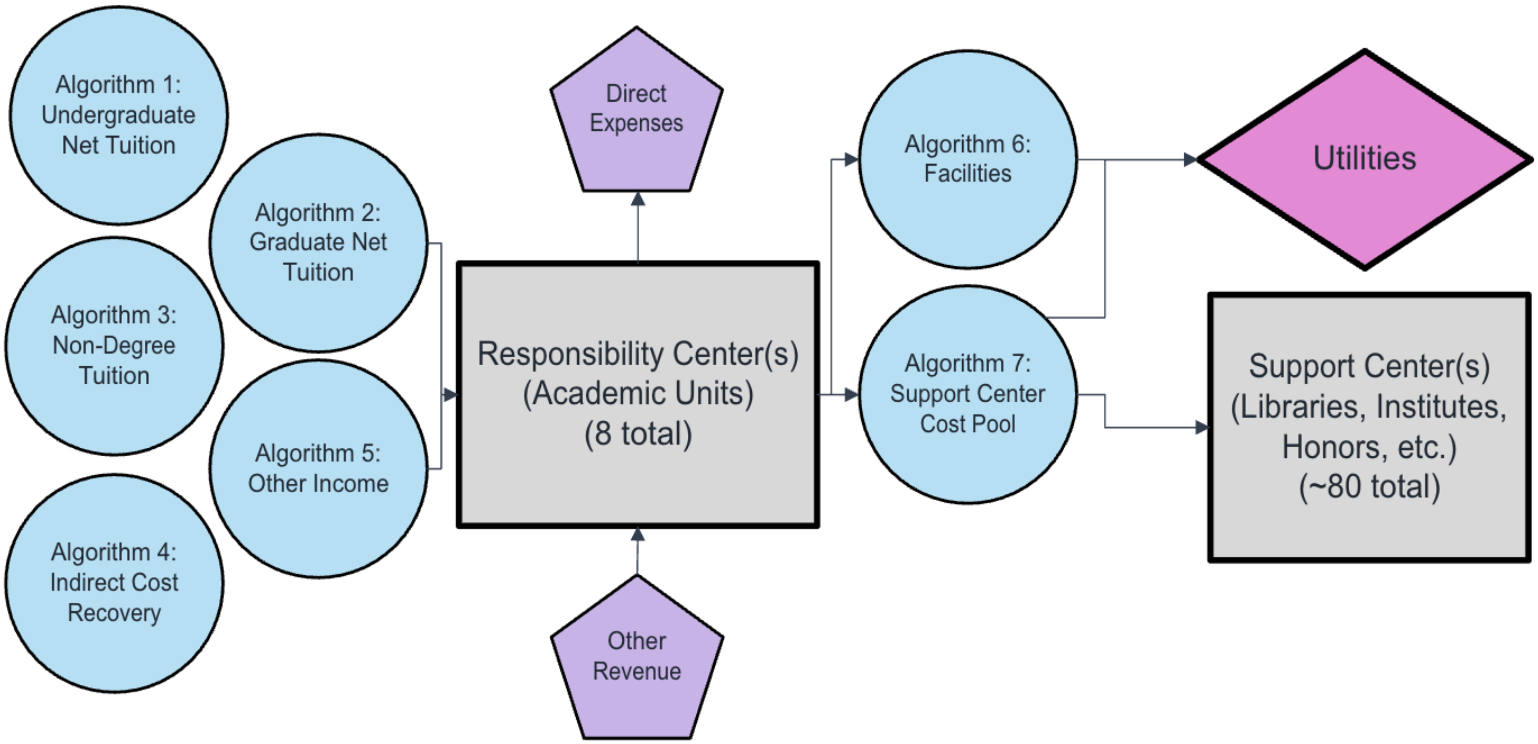

Figure 3.1. *IBB model at the University of Vermont*

Table 3.2 UVM Incentive Based Budgeting incentives

Algorithm	Direction	Relevant Passage from IBB manual	Simplified Incentive
1 Undergraduate Net Tuition	Income	85% based on a Responsibility Center's (RC's) percentage of the two-year trailing average of Student Credit Hours (SCH) taught. 15% based on a RC's percentage of the two-year trailing average of majors.	Increase Undergraduate Enrollment Increase Undergraduate Courses
2 Graduate Net Tuition	Income	The home college or school of a graduate student's program is allocated 100% of the student's gross tuition generated in the Fall, Spring, or Summer minus centrally funded aid. The home college or school of a graduate student is responsible for paying 100% of that student's institutional financial aid, including any institutional financial aid provided for the Comprehensive Fee or Health Insurance.	Increase Graduate Enrollment Increase Graduate Courses
3 Non-Degree Tuition	Income	85% based on a colleges or school's percentage of the non-degree SCH taught (as defined in Algorithm 1). 15% allocated to Professional and Continuing Education (PACE), or academic college if for summer courses	Increase non-degree student enrollment
4 Indirect Cost Recovery	Income	In FY22, 92.5% of Facilities and Administration (F&A) revenue is allocated to the RC of the grant's Principal Investigator(s) and 7.5% is allocated to the Office of the Vice President for Research (OVPR) for research incentive funds. In FY23 and beyond, the percent distribution changes to 90% and 10% respectively. If grants have multiple PIs, the F&A allocated to the RCs is distributed according to their respective planned effort on the grant. 100% of the F&A for grants generated by support centers is allocated to the OVPR also for research incentive funds.	Increase grant and research revenue
5 Other Income	Income	Other Income generated within a Responsibility Center is allocated to that RC (e.g., course fees, or revenue from income/expense activities within the RC). Other Income generated by Support Centers is allocated via the same driver as Algorithm 7 thereby offsetting the total of expenses allocated to RCs.	Increase Other Revenue
6 Facilities	Expense	These costs are allocated to a Responsibility Center based on its percentage of the total campus assignable square feet (ASF). For example, if a college's occupied space accounts for 10% of the total campus ASF, it is attributed 10% of the expense.	Reduce Space Ownership
7 Support Center Cost Pool	Expense	RC Algorithm 1 (Undergraduate SCH's and majors) percentage – weighted at 60%. RC Direct expense percentage – weighted at 40%, which the exception of specialized research incentives related to grants.	Decrease Enrollment Decrease Direct Expenses

With this model and assumptions, several key pieces of information needed to be collected to determine the carbon emissions and assigned cost to each academic unit. First, the energy usage of each campus building was determined through the Brightly data management system (Brightly, 2024). This energy usage was then allocated to the respective responsibility centers by using campus space allocation data. For instance, if a responsibility center was assigned 15% of the space in a given building, it would be allocated 15% of the energy usage from that building.

In working towards embedding a carbon charge within the IBB model, a new algorithm was then developed to encompass both existing utilities costs and a new carbon charge. Unlike algorithm six, which relies on space utilization for cost distribution, and algorithm seven, which relies on student enrollment for cost distribution, the proposed algorithm eight relies solely on energy usage to distribute utility and carbon costs. Therefore, if a responsibility center was found to use 20% of campus energy, then it would be assigned 20% of the campus utility and carbon costs.

To embed a carbon charge within this new algorithm, a university carbon cost needed to be determined. This was accomplished through utilizing the Sustainability Indicator Management and Analysis Platform (Sustainability Indicator & Management Analysis Platform, 2024) to collect emissions data. In 2022, the University of Vermont emitted a reported 29,884 scope one metric tons of carbon equivalents (MTCO2E). A carbon cost of $51 per MTCO2E was then applied to arrive at a total university carbon cost of $1,524,084. $51 per MTCO2E was selected because it sits at the upper end of current higher education carbon charges (Table 3.1) and was also the previously federally recognized social cost of carbon (Fisher, 2024). This cost, along with pre-existing utilities costs, was then funneled through the newly conceptualized algorithm eight. Potential financial impacts and marginal costs on responsibility centers were then analyzed.

Lastly, to gauge institutional receptiveness to this conceptual model, a focus group was conducted with the UVM Assistant Deans for Business Operations in each of the eight Responsibility Centers. These are the administrative staff who work under each academic dean to manage financial operations. The focus group was conducted in accordance with the qualitative guidelines established by Berg (2001) over Microsoft Teams. This was done during a one-hour regularly scheduled monthly meeting with the Assistant Deans for Business Operations. At this meeting, representatives from six of the eight university responsibility centers were present. Additional feedback was collected from absent representatives via email. The focus group was recorded, then transcribed and edited for accuracy within OtterAI (*Otter AI*, 2024). The conversation and emails were then coded for emergent themes using NVivo (Lumivero, 2024).

3.4 Results

3.4.1 *Modeling a carbon charge in the IBB model*

After pairing Brightly campus energy data with the corresponding campus buildings from the 2022 Campus Space Survey, the energy usage of each campus subunit was determined (Table 3.3). Within this new dataset is the energy usage of each major campus subunit, including the eight responsibility centers as well as other units such as the Graduate College, Chief Information Officer, and VP of Student Affairs. In total, the eight responsibility centers were responsible for 74,879 MBTUs (12.75%) of campus energy in

2023, whereas the remaining spaces, collectively known as the support centers, were responsible for 512,414 MBTUs (87.25%).

Vital to the construction of a new internal charge in the IBB system is the usage of energy data to create incentives for resource reduction. Therefore, the newly determined Responsibility Center energy usage from Table 3.3 was extrapolated to create distribution percentages, which are used to allocate IBB costs. These were used for the creation of an eighth algorithm for utilities and emissions. Most notably, based on assigned energy usage, some responsibility centers carry a much larger share of the new algorithm eight cost than others. The largest share of this cost would be allocated to the College of Medicine, consuming 37.76% of the energy used by Responsibility Centers (Table 3.4).

Using these new distribution percentages, the estimated $1,524,084 university scope one carbon cost was then allocated to campus Responsibility Centers. Additionally, the university utility costs, which were previously embedded within algorithms six and seven, were extracted and moved to the newly constructed algorithm eight. Therefore, a Responsibility Center's share of algorithm 8 would be determined by their estimated energy usage, while fully funding the university carbon and utility costs. The College of Arts and Sciences and College of Medicine have the greatest algorithm 8 expenses in this model, given that they consume the most campus energy (Table 3.5).

Table 3.3 Campus sub-unit energy usage

Campus Energy Allocation	Total Energy Usage (Mbtu)	Percent Total Energy Usage
Responsibility Centers		
College of Agricultural and Life Sciences	11431.28	1.95%
College of Arts and Sciences	18049.73	3.07%
College of Education and Social Services	5377.82	0.92%
College of Engineering and Mathematical Sciences	4510.28	0.77%
College of Nursing and Health Sciences	3202.21	0.55%
Grossman School of Business Administration	692.88	0.12%
Rubenstein School of Environment and Natural Resources	3341.44	0.57%
Larner College of Medicine	28273.63	4.81%
Support Centers		
Chief Information Officer	4717.49	0.80%
Dean of Libraries and Learning Resources	8099.73	1.38%
General University	74991.31	12.77%
Graduate College	202.59	0.03%
Honors College	141.23	0.02%
President's Office	11157.96	1.90%
Safety and Compliance	1764.99	0.30%
Senior VP and Provost	2510.49	0.43%
UVM Foundation	1367.39	0.23%
VP Academic Affairs & Student Success	519.24	0.09%
VP Enrollment Management	5750.58	0.98%
VP Finance and Facilities	353307.34	60.16%
VP for Operations and Public Safety	8.49	0.00%
VP Human Resources, Diversity, and Multicultural Affairs	773.94	0.13%
VP Legal Affairs and General Council	142.29	0.02%
VP Research	3879.72	0.66%
VP Student Affairs	43079.22	7.34%
Responsibility Center Total	74879.26	12.75%
Support Center Total	512414.00	87.25%
Grand Total	587293.26	100.00%

Table 3.4 Developing algorithm eight distribution shares

Campus Energy Allocation	Total Energy Usage (Mbtu)	Algorithm 8 Distributions
College of Agricultural and Life Sciences (CALS)	11431.28	15.27%
College of Arts and Sciences (CAS)	18049.73	24.11%
College of Education and Social Services (CESS)	5377.82	7.18%
College of Engineering and Mathematical Sciences (CEMS)	4510.28	6.02%
College of Nursing and Health Sciences (CNHS)	3202.21	4.28%
Grossman School of Business Administration (GSB)	692.88	0.93%
Rubenstein School of Environment and Natural Resources (RSENR)	3341.44	4.46%
The Robert Larner M.D. College of Medicine (LCOM)	28273.63	37.76%
Total	74879.26	100.00%

Table 3.5 Embedding a carbon charge and utilities within Algorithm Eight

Responsibility Center	Algorithm 8 Distribution	Utility Costs (moved from Algorithm 6 and 7)	New Carbon Charge	Total Algorithm 8 Cost
CALS	15.27%	$1,768,962.95	$232,670.99	$2,001,633.94
CAS	24.11%	$2,793,038.43	$367,382.20	$3,160,420.63
CESS	7.18%	$831,771.71	$109,459.54	$941,231.25
CEMS	6.02%	$697,390.76	$91,801.72	$789,192.48
CNHS	4.28%	$495,819.35	$65,177.42	$560,996.77
GSB	0.93%	$107,736.45	$14,102.73	$121,839.17
RSENR	4.46%	$516,671.56	$68,011.26	$584,682.82
LCoM	37.76%	$4,374,331.44	$575,478.15	$4,949,809.59
Totals	100.00%	$11,585,722.64	$1,524,084.00	$13,109,806.64

Once allocated to the academic units, the impacts of the revised utility cost and new carbon charge on IBB bills were analyzed. Fiscal year 2025 IBB cost projections were compared before and after the conceptualization of algorithm 8 (Table 3.6). Given that utility costs are currently allocated based on space usage and enrollment, there were significant marginal cost impacts after to algorithm 8. Even with a new carbon charge, five Responsibility Centers would see reductions in their annual IBB expenses under this new system (CAS, CEMS, CNHS, RSENR, GSB). That said, three academic units would see increased IBB expenses, given their high assignment of campus energy use (CALS, CESS, LCoM). The most significantly impacted unit would be the College of Medicine, with an estimated $2 million in additional costs assigned each year, representing a 6.88% increase in their annual IBB expenses.

Overall, in comparison to the current model, this new conceptual model would directly incentivize sub-unit decarbonization through allocating costs based on estimated energy consumption, while raising approximately $1.5 million annually for critical decarbonization work.

Table 3.6 IBB model revisions and marginal impacts

	CALS	CAS	CEMS	CESS	CNHS	RSENR	GSB	LCoM	Sum
FY25 Alg 6 Bill (Original)	$5,005,659	$10,264,216	$3,672,405	$1,364,562	$1,825,331	$1,712,628	$859,731	$12,004,472	$36,709,004
FY25 Alg 7 Bill (Original)	$15,875,364	$45,429,619	$17,469,742	$8,537,816	$8,653,025	$8,631,368	$6,561,024	$19,962,572	$131,120,530
FY25 Total (Original)	$20,881,023	$55,693,835	$21,142,147	$9,902,378	$10,478,356	$10,343,996	$7,420,755	$31,967,044	$167,829,534
FY25 Alg 6 Bill (Revised)	$4,234,719	$8,683,386	$3,106,804	$1,154,401	$1,544,205	$1,448,860	$727,321	$10,155,619	$31,055,315
FY25 Alg 7 Bill (Revised)	$15,157,010	$43,375,482	$16,680,146	$8,151,923	$8,261,195	$8,239,538	$6,264,183	$19,060,177	$125,183,718
FY25 Alg 8 Bill (Revised)	$2,001,634	$3,160,421	$789,192	$941,231	$560,997	$584,683	$121,839	$4,949,810	$13,109,807
FY25 Total (Revised)	$21,393,363	$55,219,289	$20,576,142	$10,247,555	$10,366,397	$10,273,081	$7,113,344	$34,165,605	$169,348,840
Marginal Cost with ICP and Revisions	$512,340	$(474,546)	$(566,005)	$345,177	$(111,959)	$(70,915)	$(307,411)	$2,198,561	$1,519,306
Percent Change with ICP and Revisions	2.45%	-0.85%	-2.68%	3.49%	-1.07%	-0.69%	-4.14%	6.88%	0.91%

3.4.2 *Findings from a campus focus group*

After developing this model, a focus group was conducted with the UVM Assistant Deans for Business Operations to gauge the feasibility of an internal carbon charge within the IBB model. Questions were asked about the UVM IBB model, Responsibility Center Management, and embedding a carbon charge within this model. Overall, it was clear that the Assistant Deans were reluctant to adopt a carbon charge, though they felt that it could be accomplished if done with a commitment to transparency, and if done in accordance with university values. From the conversation which emerged, five themes arose, including algorithm design, carbon impact, cost burden, transparency, and university values.

In discussion about the IBB algorithms, the importance of inputting the carbon price and model drivers (distribution percentages) was clear. There was agreement that through allocating the carbon cost to Responsibility Centers, energy usage could be used as an accurate proxy for emissions for cost allocation, rather than using space or enrollment as dictated by algorithms six or seven.

On impact, the Assistant Deans confirmed that carbon pricing in the IBB model has the potential to facilitate behavioral change that will stimulate decarbonization and climate action. Notably, this was voiced by staff who work for colleges with broad mandates, beyond environmentally focused degrees and programs. One representative indicated that their academic college has a significant environmental impact and thus should be included in a mitigation system.

In regard to impact, the group agreed that the addition of a new charge to the academic units is generally undesirable, though could be worthwhile in the long run. One representative voiced, “How, with all the things we have to budget for, how are we going to add something like this?" This comment was agreed upon by nearly everyone in attendance and spoke to the burden of years of additional line items being added within the IBB model for new initiatives and activities. These individuals share the burden of communicating these new costs to the deans, faculty, and staff of their respective Responsibility Centers.

Transparency was a fourth theme in focus group discusses, with strong agreement that adherence to open and honest communication would determine the success or failure of a carbon pricing initiative and its campus cultural impacts. The Assistant Deans voiced that they must understand the charge and how resulting funds would be used to decarbonize campus. This was the most mentioned theme during focus group deliberations. In fact, the group shared a frustration that many additional line items are continually added to the IBB model with minimal incentive to reduce costs, nor an explanation of how the costs will benefit the Responsibility Centers. A focus group participant stated, "I think the intent of transparency has been lost over the past ... eight years that we've had IBB ... This [carbon pricing] is a really important topic. It addresses our strategic priority of planetary health. But it needs to be transparent. We need to understand if we are going to get charged. We need to understand how those funds are being used to reduce those charges."

Finally, Assistant Deans noted that the alignment of the budget model with university values such as our commitment to sustainability is increasingly important. Carbon pricing could help to facilitate and finance this shift. As UVM has a positive environmental reputation, it was generally accepted that environmental initiatives such as carbon pricing should not come as a surprise. Numerous participants agreed that a new carbon charge in the IBB model could be fitting, given the institution's recent campus wide commitments to planetary health. The group recognized that a carbon price could aid the institution in actualizing their environmental priorities and sustainability goals.

3.5 Discussion

Overall, this study succeeded in developing a conceptual model for embedding a carbon charge within a Responsibility Center Management (RCM) budget model. Using the University of Vermont (UVM) as a case study, decarbonization incentives were explored within an RCM model that is currently in practice. This model was then conceptually challenged to add a new carbon charge while shifting campus sub-unit utility costs to a new cost incentive. Such a change could strengthen transparency and accountability through budgeting for campus climate action, while increasing the number and diversity of incentives available to campus decision-makers in an RCM system. As numerous institutions develop and approach decarbonization goals, it will be critical to consider mechanisms such as internal carbon pricing to decarbonize.

Prior research indicates that RCM models are well suited for the implementation of incentives to meet goals (Whalen, 1991). RCM has been found to be positively correlated with tuition revenue, fall enrollment, graduation rates, financial aid and retention (Decker, 2023; Jaquette et al., 2018), though no known institutions have truly utilized an RCM model to accomplish goals such as climate action beyond the core mission of colleges and universities. The limited literature exploring the connection between RCM and institutional culture is somewhat ambivalent. While Cekic (2008) notes that RCM has connections with institutional culture, Adams (1997) acknowledged that RCM rarely contributes positively to an institution’s culture.

Should institutions aim to embed a carbon price within their budget model, the practice of accurately measuring and documenting carbon emissions down to the unit or building level, will be vital. At most higher education institutions, the infrastructure and capacity for decentralized carbon accounting is lacking, including building-level metering and necessary staff to document carbon pollution. Yet, research has found that reducing information asymmetry through carbon accounting has helped to build transparency within institutions and organizations (N et al., 2024; Schaltegger & Csutora, 2012).

Should transparency be established through carbon accounting, then accountability could potentially follow. In the context of firms, it has been found the high transparency is correlated with higher accountability (Wong et al., 2021). This is because visible emissions data will aid in publicizing who and what is causing the most campus carbon pollutions. Ultimately, through building transparency, carbon accounting tools level the information playing field through exposing campus constituents to the actual emissions of campus subunits, thus holding them accountable.

If transparency and accountability were established through carbon accounting, then a carbon price could aid in raising the necessary funds for decarbonization. Dependent on the selected carbon price, colleges and universities can raise anywhere from hundreds to millions of dollars for decarbonization measures. If an institution succeeds at building the transparency and accountability that is absent through strong and public carbon accounting, then stakeholder governance can lead the way in prioritizing campus upgrades to reduce emissions (Kiker et al., n.d.).

Focus group deliberations confirm these findings. In the case of embedding a carbon price within the IBB model at UVM, Assistant Deans for Business Operations believe that such a model would only be successful through a commitment to transparency. Responsibility Centers must know why they are being charged for carbon, how that cost was developed, where their emissions are coming from, and what is being done with the resulting revenues. Additionally, they must understand why shifted utility costs, while having negative budgetary implications for three of the eight academic units in the model, are necessary to better reflect internal campus resource usage within the budgeting process. These conversations echo prior research, finding that campus constituents expect transparency when it comes to campus resource allocation (Sinuany-Stern, 2021). Not only is building this transparency vital in accurately distributing carbon costs, but it is also viewed as a pillar of good governance (Carlitz, 2013).

Therefore, should colleges and universities enact such a model, attention must be paid to crafting mechanisms to hold Support Centers accountable. In this conceptual model, Responsibility Centers were only accountable for ~13% of campus energy use, yet were assigned 100% of the utility costs, among all other facilities and operational expenses in the IBB model. Therefore, even though this model proposes a mechanism through which Responsibility Centers can minimize their own bills through reducing emissions assigned to their energy use and space utilization, savings in energy and carbon costs would largely be transferred to other Responsibility Centers unless the Responsibility Centers are able to facilitate or inspire emissions reductions and efficiency projects amongst the 80+ campus Support Centers. This is where shared governance could be the most impactful, alongside access to emissions data. Should the Deans know where the emissions they are paying for are being produced, then they may be more likely to pressure administration to facilitate decarbonization measures for energy-intensive units, which are often associated with non-academic spaces.

Notably, the UVM utility costs, which are closely related to university emissions, are currently allocated based on space usage rather than actual energy consumption. Through extracting these utilities costs from algorithm six and seven, then reallocating them based on estimated energy consumption in algorithm eight, the restructured utility charges and corresponding new carbon charges are a more accurate reflection of internal activities that drive emissions upward. This change could then better incentivize sub-unit activities that contribute to university decarbonization. With utility and carbon costs more visible to sub-unit decision-makers, the likelihood of catalyzing action and engaged governance increases.

With this in mind, it should be noted that the usage of financial incentive-based tools such as carbon charges are just one potential route to achieve carbon neutrality. A carbon charge at the unit level, absent of any ability of units to decarbonize due to central planning of energy infrastructure, functions more as a "stick" than a "carrot," punishing campus users for emission rather than rewarding them for pro-sustainability behavior. Absent of financially independent responsibility centers, each responsible for their own support that currently comes from central administration (including energy infrastructure projects), it is not clear whether the internal carbon price will actually stimulate desirable behavioral change towards reducing emissions at the unit level. Additionally, through adding a price on carbon, it is possible that motivational crowding out will occur, undermining intrinsic motivations to pursue desirable behaviors (Ezzine-de-Blas et al., 2019). Thus, other options should also be considered to decarbonize, such as additional education, external fundraising, or pooled incentives that are likely to reinforce cooperative behavior between units in an RCM model.

3.6 Limitations and Future Research

In building a model for a carbon charge within the University of Vermont Incentive Based Budgeting system, several assumptions had to be made. First and foremost, it is worth noting that not all university buildings are metered, and that many buildings are grouped together through single meters. Thus, in determining the energy usage of each building, it was assumed that all buildings covered by a single energy meter consume the same amount of energy per square foot. Additionally, through extrapolating Responsibility Center energy usage to the rest of campus to determine algorithm eight distribution percentages, it was assumed that the eight responsibility centers utilize campus services (e.g., cafeterias, libraries, athletics, etc.) in similar proportions to their own energy usage. Finally, it was assumed that electricity usage is an adequate proxy for all utility charges, as UVM utilities (including water and sewer) are grouped into a single line item during the budgeting process.

Regarding these limitations and assumptions, it is important to recognize that other carbon pricing models may be more applicable in the UVM system, such as embedding a carbon charge within algorithms six or seven. These alternative solutions would pose a greater barrier in incentivizing unit level emissions reductions, though they would enable such an institution to move forward with carbon pricing despite having limited metering and carbon accounting infrastructure.

Most importantly, the UVM IBB model does not have any mechanisms in place to hold support centers (non-Responsibility Center spaces) accountable to their activities, energy consumption, and emissions. In the UVM IBB model, the Responsibility Centers pay for all campus utilities just as they do every other line item, and thus there is no way to build incentives for support center staff to reduce their energy consumption and emissions. This places significant pressure on Responsibility Centers to facilitate the campus change that is incentivized within the IBB model. It also serves as a barrier to enacting cultural change on a campus when only a subset of the campus community is subject to budgetary incentives. As found in the data analysis, campus Responsibility Centers only consume approximately 13% of campus energy, yet are accountable for campus wide utilities through the IBB model (Table 3.3). Thus, future university budget model research must emphasize varying accountability mechanisms, that would hold all campus units accountable, rather than just academic Responsibility Centers.

Regarding the qualitative portion of this study, the main barrier is that the focus group was conducted and coded by a single researcher. To mitigate bias during the coding process, emergent themes were confirmed with a focus group participant within a week after the focus group occurred. The participant confirmed that the themes were reflective of the conversation that occurred, and that no information voiced was misconstrued. Given that representatives from six of the eight Responsibility Centers were present during the focus group, not all Assistant Deans for Business Operations were able to verbalize feedback. Rather, the two missing representatives voiced feedback over email.

Building on this work, further research could aim to deeply investigate the incentive structures in non-RCM budget models. There are five other dominant budget models in higher education (EAB, 2024), and thus it is likely that several of these also utilize some form of incentives and decentralized decision-makers. Should they use incentives, then there will be further opportunities to embed carbon pricing within these models, along with other culturally rooted incentives. For instance, if a budget model could be leveraged to incentivize decarbonization goals, then a budget model could also be leveraged to achieve diversity, equity, inclusion, and environmental justice goals. There is untapped opportunity in researching how to leverage university budget models to achieve goals beyond those related to enrollment and economic efficiency.

3.7 Conclusion

Higher education, often regarded as a source for societal innovation and a model for our cities (Bailey & LaPoint, 2016), will likely be a leader in the development of climate solutions. As hundreds of institutions work to decarbonize, it will be critical to incentivize the internal campus action and behavior that will stimulate innovation around energy efficiency and sustainability. One mechanism through which this can be accomplished is within campus budgetary frameworks. More specifically, through embedding carbon charges within decentralized budget models such as Responsibility Center Management, decarbonization can be placed in the hands and minds of higher education decision-makers and leaders.

Though not every institution has an identical budget model, this study provides an example for institutions of higher education as they seek to pursue societal goals within the budget. Should an institution aim to decarbonize, then it makes sense to leverage the budget model to achieve this goal, as the budget model is the essential decision-making framework at an institution (Szatmary, 2011). Given that at least 19 institutions in the U.S. have implemented varying types of carbon pricing tools to date, perhaps the receptiveness to addressing the social cost of carbon is growing in higher education. This is especially pertinent given that over 700 institutions have signed onto various decarbonization commitments such as the Second Nature Presidents' Climate Leadership Commitment (Dyer & Dyer, 2017). With a growing number of institutions leveraging RCM budget models to accomplish their goals (Jaquette et al., 2018; Kosten, 2016), there is untapped potential to embed carbon charges and other societal goals within existing and emergent decentralized higher education budget models.

From a governance lens, carbon pricing could be a pathway to establishing transparency, accountability, and more democratic decision-making processes within higher education. If carbon pricing policies were to expand in higher education, robust carbon accounting would be necessary to accurately price emissions. This accounting can be leveraged to reveal the source and accountability of campus emissions. Ideally, it will then aid in prioritizing decarbonization costs.

Ultimately, through a commitment to transparency and campus climate action, university budget models can be leveraged to achieve decarbonization. Through shifting incentives to match social characteristics and goals, universities can better emphasize cultural priorities within their budget model. Should leadership, the budget, and organizational climate action culture align in pursuit of decarbonization, sustainability staff and university leadership will face lesser barriers in developing innovative carbon pricing policies. If embedded deep within organizational budgetary frameworks, the internal carbon price could significantly strengthen cultural commitments to climate action, while inspiring the innovation necessary to keep our planetary health in check.

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CHAPTER 4

CONCLUSION

In a changing cultural and economic environment, it is critical that higher education institutions engage in work to forward climate action and sustainability. This thesis demonstrates that one potential pathway to do so is through internal carbon pricing. Though still emergent, ICP policies in higher education could be leveraged as a means to decarbonize, support a campus climate action culture, and stimulate broader impact towards building sustainable communities.

In observing the 19 US institutions with ICP policies, the study summarized in chapter 2 finds that ICP policies have yet to collectively produce emissions reductions in higher education. This could be because many of these policies have had very little time to produce meaningful impact. Additionally, very few policy types have actually been experimented with. Consequently, the impact of ICP policies has largely been constrained to climate action behaviors and decision-making structures. It was also found that the presence of an ICP policy can have positive impact on organizational governance, leveraging carbon accounting to build transparency and accountability throughout an institution. Overall, this work highlights that the value of an internal carbon price extends beyond its hypothesized ability to reduce emissions and create cost savings. The ICP policy in higher education can contribute to even broader societal change through educating and inspiring our current and future leaders.

The second study summarized in chapter 3, though conceptual, demonstrates that the impact of an ICP policy can be magnified when it is truly embedded within an institutional budget model. Currently, of the 19 institutions who have utilized ICP policies, only two have attempted to leverage their core budget models to enact such policies. Institutions that shift toward decentralized budget structures such as Responsibility Center Management can leverage ICP to convey climate action incentives such as decarbonization. Should these incentives be effectively communicated through transparent leadership, broader cultural change could be enacted within colleges and universities. Through an RCM model, the ICP policy becomes a tool to aid academic deans in decarbonizing, while inspiring the innovative policy and solutions necessary to meet campus sustainability goals. Yet, this study also highlights the challenges associated with implementing an individualistic incentive-based policy as a tool to meet a centralized decarbonization goal. Attention must be paid to building transparency, accountability, and shared decision-making structures if ICP is to succeed as a budgetary incentive.

Through conversations with sustainability and budgetary professionals in both studies, it is clear that college and university staff members deeply care about achieving environmental goals through a commitment to transparency and innovation. Unfortunately, interviews with sustainability professionals revealed that higher education staff are largely excluded from the budgeting process. Similarly, higher education budget professionals feel that transparency is often lost in the budgeting process, limiting the cultural impact of budget modifications. As a consequence, budgetary initiatives are often viewed as an additional burden placed upon academic units, redirecting spending from other academic functions. In the context of this work, it is crucial that higher education leadership begins to view transparency as a pillar of good governance (Carlitz, 2013), and a means to forward campus climate action goals. An internal carbon price could be a good place to start, meeting both societal needs while communicating a strong message of environmental responsibility to campus constituents.

Logistically, both studies highlight that the university budget model has yet to be leveraged for the delivery of environmental goals. As many universities have shifted towards corporate management structures (Manning, 2018), budget models can be better designed to incentivize innovation and creative problem-solving. There has been some success in improving traditional metrics such as enrollment and graduation rates (Decker, 2023), however the pursuit of cultural goals within these models has been elusive. Should sustainability professionals be provided with the training to understand institutional budget models, perhaps they could then leverage such models to meet their impending decarbonization goals. This is especially critical given that over 525 U.S. institutions have climate action plans detailing carbon neutrality pathways (Second Nature, 2025).

In a broader sense, higher education institutions are situated in a position to make an impact. Colleges and universities educate our future leaders and societal changemakers (Tomasella et al., 2022). Additionally, these institutions often become a model for our communities, demonstrating policy that can be successful in meeting societal goals (Bailey & LaPoint, 2016). If we hope to see climate action touch all facets of society, then it must start with higher education. With over 15 million students impacted annually in the U.S. alone (National Center for Education Statistics, 2021), there may be no greater place than our colleges and universities to trial tools such as internal carbon pricing for decarbonization. As noted by several interviewees, the internal carbon price served as an educational tool inside and outside of the classroom, while sometimes also supporting institutional philosophies centered around sustainability and justice.

As climate change worsens, higher education institutions will be challenged with creating and testing the solutions to environmental challenges. As institutions approach their decarbonization goals, it will be critical that all pathways be explored to achieve net carbon neutrality. This thesis demonstrates that internal carbon pricing could be a viable option to meet emissions targets, build a climate action culture, and strengthen clear and transparent governance in higher education. Through a commitment to climate action, colleges and universities can lead the way in building a healthy future for all. With transparent leadership, innovative policy, smart decision making, and an engaged community, climate action can become a reality on college and university campuses.

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APPENDICES

Appendix Item A
Interview Protocol

1. Demographic Information
    a. How long have you been at your institution?
    b. How long have you been in your current position?
    c. Please describe your university position. Approximately how many students, staff, and faculty are under your personal organizational umbrella?
    d. How does sustainability fall under your umbrella?

2. University Budget
    a. Can you describe your institution's overarching budgeting model? Is this a new approach? Recently adapted?
    b. Under this budgeting model, where do you feel that the most budget authority lies within your institution? Centrally or decentralized?
    c. Who are the most decentralized "decision-makers" in your budget model
    d. How does your budget model utilize incentives? Are campus decision makers receptive to these incentives?
    e. How do campus decision-makers manage competing incentives in the budget?
    f. Can you provide an example of how a budget incentive has changed behavior?
    g. How does your budget model drive decision-making around sustainability?

3. Carbon Pricing
    a. What motivated your institution to implement carbon pricing?
    b. How were the students, staff and faculty involved at your institution in the creation/development of the carbon pricing tool?
    c. Can you describe key characteristics of your institution's carbon pricing tool? What university stakeholders are directly affected?
    d. How has the carbon pricing tool affected your institutions' culture of climate action?
    e. How has the organization culture changed since the implementation of your carbon pricing tool, as a result of said tool?
    f. Do you believe there are any barriers preventing your institution from adding additional incentives, environmental or not, to your budget model?

Appendix Item B
Focus Group Protocol

1. Demographic Information (each person responds)
    a. How long have you been at the University of Vermont?
    b. What Responsibility Center do you represent?

2. Four Primary Questions
    a. Can you tell me about the IBB system? Why is the IBB budget model the best solution for UVM?
    b. Why would embedding a carbon charge into the IBB system work? What are the benefits?
    c. Why would embedding a carbon charge into the IBB system not work? What are the drawbacks/barriers?
    d. Do you believe the IBB systems currently meshes with UVM's values?
    e. How can a university budget be used to communicate values?

3. IBB General Questions
    a. What is it like working at an institution using a responsibility center management budget model? How would your job differ if in a CAM budget institution?
    b. The IBB model clearly has competing incentives, with at least seven represented by the seven algorithms. Which of these incentives do you see dominate the decision-making process' the most in academic colleges?
    c. Do you feel that the IBB system is responsible for shifts in organization culture over time?
        i. Do you have any examples of this?

4. Carbon Pricing Questions
    a. Administratively, which incentives in the IBB system do you feel that a carbon charge would function the best within? Why?
    b. How would a carbon price in the IBB system benefit, or harm the responsibility centers as a whole?
    c. Does the IBB system do anything to propagate equity on campus? With a dividend system, do you think a carbon charge within IBB would help build equity on campus.