Internal Carbon Pricing

POLICY FRAMEWORK AND CASE STUDIES

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Executive Summary

This report seeks to address the question of how an organization should design and implement an internal carbon charge. Internal carbon pricing is a powerful tool the private sector can employ to reduce carbon emissions.

While policy tools and guidance exist for carbon pricing at the national level, it is not clear how implementation might differ in a business environment or another setting. Our project seeks to supplement the growing carbon-pricing literature, given the promise of internal carbon-charge programs in addressing climate change.

Carbon pricing works to shift the cost of carbon from increased healthcare costs and exacerbated environmental damage to payment at the source of pollution. By doing so, it incentivizes carbon-emissions reductions and carbon-efficient development.

Corporations' internal carbon pricing attempts to correct the incentive structure that underpins consumption choices related to greenhouse gas emissions.

Internal carbon pricing allows companies to assess the financial implications of their carbon emissions and encourage increased energy efficiency. To date, around 1,400 companies have reported implementing or planning carbon prices to regulate their carbon emissions.

Corporations can act collectively with governments to reach the goal of decarbonization.

To provide guidance on designing internal carbon-charge programs, we provide two core contributions:

1. a policy framework of key decisions
2. lessons learned from an examination of case studies on Yale University, Microsoft, Société Générale, Delta, and QANTAS Airlines in the context of our policy framework

These contributions support the use of this policy framework for companies, organizations, and policymakers. We also provide a supplementary theoretical framework and model for evaluating a carbon-charge program in the appendix.

Additionally, we state that the secondary effects of paired taxes and investment subsidies, when considered as a single instrument, could prove cost-effective for internalizing the two market failures associated with climate change: accounting for both the carbon emissions and the cleantech revenues.

Further work and thought, however, is necessary to properly frame this insight in the context of contemporary economic literature on this subject.

Introduction

Internal carbon pricing allows companies to assess the financial implications of their carbon emissions and encourage increased energy efficiency.

CDP, formerly the Carbon Disclosure Project, runs a global self-reported disclosure system for companies, cities, states, and regions to measure their environmental impacts. Part of this disclosure includes questions regarding carbon pricing.[1]

A recent CDP report outlines three major benefits of internal corporate carbon pricing: navigating regulation, sourcing requirements, and carbon efficiency.[2]

1. Companies that track their greenhouse gas emissions and implement an internal price on carbon are better prepared for a regulatory future in which carbon is priced.
2. Companies that sell, source, or operate internationally are inevitably exposed to carbon-pricing standards, given the global patchwork of existing carbon-emissions regulations. For any company that intends to operate globally, it is advantageous to start calculating, tracking, and pricing emissions to ease operation across international pricing policies.
3. Carbon pricing motivates innovation and efficiency improvements, provides a new lens for capital-investment decisions, and spurs carbon-efficient technologies. Carbon pricing makes emissions-intensive business practices more costly, nudging companies to avoid them. In addition to the direct benefits from carbon pricing, investors are starting to prioritize companies that are leaders in corporate sustainability, including carbon pricing, and are increasingly investing in them.[3]

Most of the current activity around internal carbon pricing occurs in Europe, Japan, Korea, Australia, and the United States. This figure indicates that research into the design of internal carbon-pricing programs is currently very globally relevant. It will continue to become more relevant in the near future.

Not all carbon-pricing schemes are alike. The implementation of a carbon-pricing policy requires decisions about revenue neutrality, information provision, incentive and pricing structures, and carbon emissions.

As one of the first universities to implement a carbon charge, Yale piloted four carbon-pricing schemes, each with their own advantages and disadvantages. Yale's experimentation with carbon pricing motivated this research into the policy tradeoffs associated with the design of an internal carbon charge.

1 CDP (2018.) *CDP: Disclosure, Insight, Action*. Retrieved October 31, 2018 from https://www.cdp.net/en

2 CDP (n.d.) *The Business Case for Carbon Pricing*. Retrieved October 31, 2018 from https://b8f65cb373b1b7b15feb-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/comfy/cms/files/files/000/000/284/original/business-case-for-carbon-pricing.pdf

3 "Socially-responsible investing: Earn better returns from good companies." (2017). *Forbes*. Retrieved from https://www.forbes.com/sites/moneyshow/2017/08/16/socially-responsible-investing-earn-better-returns-from-good-companies/#7f7f92df623d

Research Questions and Methodology

Our research question for the project is:
"How should organizations design and implement an internal carbon charge?"

While existing tools from Organisation for Economic Co-operation and Development, World Bank Group, and others give policy guidance for carbon pricing at the national level, few resources address how implementation might differ for an organization.[4] Our project seeks to supplement the growing carbon-pricing literature.

Our policy framework captures key decisions and tradeoffs that organizations must make in the design and implementation of an internal carbon-pricing program. We developed decision points and an accompanying tradeoff framework for them with the Yale Carbon Charge. Our framework highlights the levers available to companies to design internal carbon-charge programs relevant to their specific needs.

We examine four case studies – Yale University, Microsoft, Société Générale, and Delta and QANTAS Airlines – in the context of our policy framework. We provide some lessons learned that can be useful as this policy framework is operationalized for companies, organizations, and policymakers.

We also aim to touch on ancillary questions that may arise in the design of an institutional carbon charge – including what the goals of the program should be, what scope of emissions should be included, and what price should be charged.

Policy Framework

Our work provides a reliable planning framework for actors seeking to institute an internal carbon charge. For internal carbon-pricing programs, a policy framework presents the available questions and options a policymaker has to consider before making critical decisions about the design and implementation of the program.

We designed the internal carbon-pricing policy framework as a set of questions ordered chronologically (as shown in Figure 1). The questions highlight various decisions organizations have to make. They emphasize tradeoffs associated with each decision.

4 Organisation for Economic Co-operation and Development (OECD) and World Bank Group (WBG). (2015.) *The FASTER Principles for Successful Carbon Pricing: An Approach Based on Initial Experience*. September 2015. Retrieved Oct. 31, 2018 from http://documents.worldbank.org/curated/en/2015/09/25060584/faster-principles-successful-carbon-pricing-approach-based-initial-experience

SHOULD ORGANIZATIONS PRICE CARBON INTERNALLY?

Climate change poses great challenges to businesses' activities and value.[5] As the world becomes increasingly concerned about impacts from climate change, companies face physical and regulatory risks which, in turn, pose financial risks.

HOW WILL CARBON BE PRICED?	Only used to evaluate investment opportunities (shadow price)	Applied to emissions (carbon charge)	Used to evaluate investment opportunities (shadow prices) and applied to emissions (carbon charge)	
HOW MUCH WILL BE CHARGED?	Adopt country-specific Social Cost of Carbon		Develop firm-specific carbon price reflecting: abatement target, revenue target, & benchmarking target	
HOW OFTEN IS THE CHARGE ASSESED?	Monthly	Annually	Other	
IS THE MONEY RETURNED?	All Returned ⟷ Not Returned			
WHAT IS THE RETURN MECHANISM?	Fund	Check	Competition	Other
IS THE MONEY EARMARKED OR UNRESTRICTED?	Earmarked for: energy efficiency investment, offset programs, stewardship initiatives, carbon-neutral spending		Unrestricted	

Figure 1: Internal Carbon-Pricing Policy Framework

Physical risks are the most evident as we experience increases in floods and droughts, changes in ecosystems, and changes in temperature. Organizations can be directly affected by damages to business assets, supply chains, and resource and material scarcity, all of which have a direct impact on their economic and financial value.

5 "Internal carbon pricing: A growing corporate practice." (2016). I4CE & EPE. Retrieved Oct. 31, 2018 from https://www.i4ce.org/download/internal-carbon-pricing-an-increasingly-widespread-corporate-practice/

For example, many financial institutions such as HSBC, Morgan Stanley, Deutsche Bank, and Bank of America have received pressure to release information related to their climate-related risks and exposures for fear of having stranded assets due to climate change.[6]

Regulatory risks, however, are highly uncertain. Although some countries have taken measures to reduce or limit greenhouse gas emissions, other countries are still debating the issue. Laws and regulations are also susceptible to change with new election cycles, as we have witnessed recently in the United States.

Risks and opportunities, in a broad sense, are key inputs for organizational decision-making.

The decision to impose an internal carbon price itself presents companies and organizations with a set of explicit costs, including those related to the administration of an internal carbon charge. It also presents a set of opportunities, including competitive advantages in a low-carbon future economy.

An internal price on carbon will drive an organization's plans and strategies towards low-carbon practices. In order to be effective, the objectives of the policy must be clearly defined and the price must be properly set. Ideally, the objective would include greenhouse gas-emission mitigation and green-development promotion. It would also include revenue generation and/or increased efficiency.

Mitigating potential impacts from climate change by instituting internal carbon-pricing programs reduces or limits those risks. In addition, it can present new opportunities for organizations to potentially increase their economic value.

Major benefits of instituting an internal carbon charge can include:

- Preparing organizations for future regulatory carbon taxes and new environmental laws
- Providing competitive advantages in a future low-carbon economy
- Reducing greenhouse gas emissions when the price of carbon is set properly
- Directing investment towards efficient practices and technologies
- Incentivizing long-term research and development opportunities for new cost-effective and green innovations
- Attracting environmentally aware investors and stakeholders[7]
- Positioning organizations as socially responsible
- Contributing to long-term profits and returns by leading in environmental and social issues[8]

6 "Big investors take aim at banks over climate change risk." (2017). *Financial Times*. Retrieved Oct. 31, 2018 from https://www.ft.com/content/a2616a52-988b-11e7-a652-cde3f882dd7b

7 Eccles, R.G., Serafeim, G., & M.P. Krzus. (2011). "Market interest in nonfinancial information." *Journal of Applied Corporate Finance*. 23.4, 113-127.

8 Khan, M., Serafeim, G., & A. Yoon. (2016). "Corporate sustainability: First evidence on materiality." *The Accounting Review*, 91.6, 1697-1724

HOW WILL CARBON BE PRICED?

The two conventional methods of internal carbon pricing are carbon charges and shadow prices. Both options set an explicit price per ton of carbon emissions. However, they differ in the implementation of this price.

An internal carbon charge is a tax applied internally and voluntarily per ton of carbon emitted. The charge reduces emissions in the short term while also encouraging innovation for low-carbon and low-energy technologies in the long term by redesigning incentive structures. The charge, in this case, is collected by the responsible entity from all participants within an organization.

On the other hand, a shadow price internalizes the cost of carbon when making choices about capital investment and estimating costs throughout the investment's lifecycle.

Investments include but are not limited to research and development, infrastructure, equipment, and assets.

A shadow price is a theoretical value that is assigned to a targeted investment but is not actually charged. It usually corresponds to the lifecycle environmental and financial costs of the project or equipment.

The goal of a shadow price is to incorporate the impact of the cost of carbon on the organization's strategy and ROI. The shadow price addresses long-term strategies for future emissions and influences decision-makers to invest in energy-efficient infrastructure and practices. However, it does not change or address current emissions.

HOW MUCH WILL BE CHARGED?

Another key consideration for any internal carbon-pricing program is the price at which the cost of carbon is set. An extremely high charge creates economic burdens for internal business units within an organization and makes it difficult for the program to be approved.

On the other hand, a very low charge will not have as great an impact since it would be cheaper for business units to pay such a charge than to change their operations or reduce their consumption.

Thus, the charge needs to be low enough to be adopted by the decision maker while being high enough to motivate employees and business units to change their practices. If the charge is not set high enough to motivate material changes, its implementation is nevertheless important: policy design and implementation are larger hurdles than increasing the price in the future.

One answer to the question of "How much will be charged?" relies on using a country-specific estimate of the social cost of carbon (SCC). The SCC is calculated using various discount rates that depend on government economic policies. It is considered to be the social cost at which organizations are paying for the environmental impacts they cause.

If an organization instead elects to calculate its own price, the company should first determine current and/or historical emissions and build a greenhouse gas inventory. Next, it should define emissions-reduction targets. It should specify an implementation for the timeline for the carbon charge and associated emissions reductions. The carbon price in a given year should reflect the greenhouse gas inventory and incentivize behavioral change to achieve the program targets and policy goals.

The SCC is usually revisited and adjusted as the integrated assessment models (IAMs) used are updated. This more accurately estimates future damages based on increased CO_2 concentrations and resulting trend changes.

This is why charges privately set by organizations should be revisited over time to account for revised targets. This can prevent the real value of carbon emissions from declining. This will encourage the organization to reduce emissions in the short term and incentivize energy efficiency investments and innovations for the long term.

Shadow prices and carbon charges can be employed simultaneously. And, in some cases, the price used for each method may differ. An example of employing both a carbon charge and shadow price for carbon emissions might involve a graduated carbon charge for future investments. This charge would represent a different discounting scheme or risk analysis than the shadow price used for current investment decisions.

The assumption is that these investments will be completed within a time frame in the future where the carbon prices are expected to be higher.

HOW OFTEN IS THE CHARGE ASSESSED?

Once the price of the internal carbon charge is set, the frequency with which the charge will be assessed and collected must be determined. The frequency of assessment and collection will depend on each organization's structure, activity, and industry.

The ultimate goal is to maintain a frequency at which the incentives for behavioral change still apply. Ideally, organizations should begin with a pilot program to test and assess the responses and results of different schemes.

For example, an institution could compare monthly and annual assessments of the charge via a pilot program.

Pilot programs allow tools and guidelines for future strategies to be evaluated on a small scale. The initial results from such a pilot would indicate the best practices in terms of emissions reduction and behavioral change.

IS THE MONEY RETURNED?

Each organization will have to decide what to do with the fee once it is collected. The two basic options in the framework are to return the revenue or keep it.

Organizations may also choose to return only a portion of the revenue and keep the remaining portion. Ultimately, the decision should always incentivize continued abatement.

From the organization's perspective, the easiest option in the short term is to keep the revenue. This will cut the administrative cost of designing a mechanism for returns. It may not, however, achieve the goal of continued abatement if the revenue is used in carbon-intensive ways.

On the other hand, stock dividends are fractions of profits paid back to shareholders. They exist as part of an incentive structure for investments. Similarly, return dividends from carbon taxes should be set up as an incentive for carbon emission abatement.

Therefore, the decision regarding how revenue will be returned should be evaluated in terms of its power to incentivize emissions abatement. Dividend schemes afford institutions an additional lever by which they can reduce emissions. Mechanisms for dividend return can be optimized within each institution to realize the highest levels of abatement.

WHAT IS THE RETURN MECHANISM?

Any level of return, whether in full or in part, should be designed in a way that best influences behavioral change and encourages emissions reduction. There are number of context-specific mechanisms that an organization can implement to achieve this.

For example, returns could be awarded to the most efficient business units within the organization as an incentive, introducing competition between business units or departments.

Due to fundamental differences between business units, baselines are often used as components of return mechanisms. Different baselines may provide different marginal incentives across business units.

The degree of memory loss built into the baseline – how many prior emissions years are considered in its determination – can determine this margin.

But a hypothetical baseline with perfect memory, while it may be more forgiving of past emissions spikes, makes the fee/dividend structure more varied. It increases the risk of a high fee being levied after a particularly low-emission year.

In deciding how to construct a baseline, organizations can consider how many years of previous emissions should be used in generating the baseline. The baseline can be an important mechanism to level the playing field for carbon-intensive business units so that incentives correspond to the marginal costs of abatement.

IS THE MONEY EARMARKED OR UNRESTRICTED?

The collected charge has two main effects on emissions: the behavioral effect and the investment effect. The behavioral effect is the short-term impact of the charge that would encourage employees, units, and the firm to reduce energy consumption and abate emissions.

In contrast, the investment effect is the long-term impact. It is partially dependent on the returns. Whether the revenues are returned or not, the options for the firm and its units in each case are to have either an unrestricted account or an earmarked account.

An **unrestricted account** essentially grants the decision maker the freedom to handle revenue from the carbon-pricing program.

The Greenhouse Gas Protocol defines Scope 1 emissions as direct emissions from owned or controlled sources, Scope 2 emissions as indirect emissions from the generation of purchased energy, and Scope 3 emissions as all other indirect emissions not included in Scope 2. Since often only Scope 1 and Scope 2 emissions are included in a carbon-charge program, returning revenue as unrestricted cash may be an avenue for leakage, which causes issues. When there is a cash leakage, the revenue collected from carbon-emissions reductions is used to purchase travel or materials that are more carbon-intensive and are outside of the carbon charge.

However, because unrestricted funds are more valuable to business units than restricted funds, restriction can lower the dollar-for-dollar incentive power of the return.

Earmarked accounts are dedicated towards funds or efficiency projects that would guarantee additional abatement and help business units or firms adapt. These projects should be pre-evaluated to show expected performance. This will demonstrate demonstrate how significantly they would help achieve the defined target.

Case Studies

Four case studies demonstrate the real-world application possibilities of our project. They also allow us to draw some lessons learned from existing internal carbon-charge programs. These insights may offer useful guidance to other companies looking at designing their own plans.

CASE STUDY: YALE UNIVERSITY

HOW WILL CARBON BE PRICED?	Only used to evaluate investment opportunities (shadow price)	Applied to emissions (carbon charge)	Used to evaluate investment opportunities (shadow prices) and applied to emissions (carbon charge)	
HOW MUCH WILL BE CHARGED?	Adopt country-specific Social Cost of Carbon		Develop firm-specific carbon price reflecting: abatement target, revenue target, & benchmarking target	
HOW OFTEN IS THE CHARGE ASSESED?	Monthly	Annually	Other	
IS THE MONEY RETURNED?	All Returned ← ▼ → Not Returned			
WHAT IS THE RETURN MECHANISM?	Fund	Check	Competition	Other
IS THE MONEY EARMARKED OR UNRESTRICTED?	Earmarked for: energy efficiency investment, offset programs, stewardship initiatives, carbon-neutral spending		Unrestricted	

CASE STUDY 1: YALE UNIVERSITY

In 2014, Yale University President Peter Salovey created a task force chaired by Professor William Nordhaus to examine how internal carbon pricing could be applied within the Yale context. The task force recommended a pilot study.[9] It was conducted in the 2015-2016 academic year, making Yale University the first university to experiment with internal carbon pricing. With the pilot study complete

9 Yale University. (2015). Executive Summary: *Report to the President and Provost of Yale University: Findings and Recommendations on a Carbon-Charge Program at Yale.* Retrieved Oct. 31, 2018, from http://carbon.yale.edu/sites/default/files/files/Carbon-charge-report-041015.pdf

and a report of preliminary results released, Provost Ben Polak is expanding the initiative across campus so Yale can serve as a living laboratory for carbon pricing.[10]

The pilot aimed to determine the administrative feasibility, effectiveness, and promise of a carbon charge applied to energy consumption in Yale buildings.

Carbon Charge managers assigned each of twenty buildings representing the diversity of Yale's building stock to one of four treatment groups, with 280 remaining campus buildings serving as a control group.

All four treatment groups received a new custom report summarizing building energy consumption and comparing it to past performance. One treatment group received only the energy report. Three treatment groups were given additional incentive-based carbon-pricing schemes.

The four treatment-pricing schemes are characterized as follows. Each of them was used for five business units, respectively.

- **Information only**: Buildings received a monthly report with information on energy use and indicative carbon charges, but without any financial consequences.
- **Target**: Buildings were given a reduction target 1 percent below their baseline. They paid for emissions above this value and received funds for emissions levels below it.
- **Redistributive**: Companies used a revenue-neutral scheme in which buildings were compared to the group's overall percent change in emissions from a baseline. The buildings incurred charges or received rebates based on performance above or below the baseline.
- **Investment**: Buildings were given funds earmarked only for energy-conservation investments.

Yale uses a SCC of $40/MTCDE for its carbon charge. This is based on United States federal government estimates completed under the Obama administration.[11]

When completing the pilot, the Yale Carbon Charge discovered five key takeaways for designing an internal carbon-pricing program in a university setting. These lessons learned are:

1. Internal carbon pricing has potential for university campuses.
2. Carbon pricing scheme design is important, but many variations can work within similar contexts.
3. An effective carbon-pricing-scheme conveys clear information and incentives.
4. Resulting emissions reductions can be cost-effective.
5. Carbon pricing can benefit greatly from experimentation and collaboration.

10 Yale University. (2016). Yale University's *Carbon Charge: Preliminary Results from Learning by Doing*. Retrieved Oct. 31, 2018, from: http://carbon.yale.edu/sites/default/files/files/Carbon_Charge_Pilot_Report_20161010.pdf

11 United States Environmental Protection Agency. (n.d.). Retrieved from https://www3.epa.gov/climatechange/Downloads/EPAactivities/social-cost-carbon.pdf

Using the lessons learned from the pilot, Yale is incorporating the carbon charge into organizational budgets for 264 out of the over 400 campus buildings starting in fiscal year 2018. These buildings, combined, account for over 70 percent of Yale's carbon emissions.

Administrators and operations staff will receive a monthly building-energy report and will be responsible for net carbon-charge payments and returns at the end of the fiscal year. In addition to implementation, the Yale Carbon Charge will continue to prioritize research. It also will use campus assets for experiential learning.

CASE STUDY: MICROSOFT

HOW WILL CARBON BE PRICED?	Only used to evaluate investment opportunities (shadow price)	Applied to emissions (carbon charge)	Used to evaluate investment opportunities (shadow prices) and applied to emissions (carbon charge)	
HOW MUCH WILL BE CHARGED?	Adopt country-specific Social Cost of Carbon	Develop firm-specific carbon price reflecting: abatement target, revenue target, & benchmarking target		
HOW OFTEN IS THE CHARGE ASSESED?	Monthly	Annually	Other	
IS THE MONEY RETURNED?	All Returned ← ▼ → Not Returned			
WHAT IS THE RETURN MECHANISM?	Fund	Check	Competition	Other
IS THE MONEY EARMARKED OR UNRESTRICTED?	Earmarked for: energy efficiency investment, offset programs, stewardship initiatives, carbon-neutral spending	Unrestricted		

CASE STUDY 2: MICROSOFT

Implemented in 2013, the internal carbon-pricing scheme used by Microsoft is an innovative quantity-based approach. Instead of pricing carbon at the SCC, Microsoft determines its current level of emissions and then calculates the required internal carbon price to make its operations carbon-neutral. However, structural problems are holding back the program.

Microsoft relies on two core formulae in its approach:

> *Cost of environmental initiatives portfolio ($) = Cost of internal initiatives ($) + Cost of green power purchases ($) + Cost of carbon offsets ($)*
>
> *Internal carbon price (per mtCO2e) = Cost of environmental initiatives portfolio ($; from above)/Total emissions (mtCO2e)*

The emphasis of Microsoft's program is on how tax revenues are spent rather than how much the carbon price is or how revenue is collected internally.

In terms of our theoretical framework, this means Microsoft focuses on the secondary benefits of a carbon tax. It takes this approach rather than evaluating the emissions reductions of individual business subunits.

This program is innovative. It would still reap the double effect of emissions reductions if the carbon price is sufficiently high. Because the price of carbon is determined by the total cost of the carbon-fee fund investment strategy, it can change from year to year, although Microsoft has thus far kept its internal carbon price relatively constant.

Unfortunately, Microsoft's current internal carbon price, while not released in official reports, has been mentioned to be between $4-5 USD.[12]

Hence, we expect minimal reductions in energy consumption and carbon emissions internally. Microsoft's approach to carbon neutrality is to simply buy up carbon credits and reduce carbon emissions elsewhere where it is cheaper to do so.

Thus, while Microsoft has often been lauded as a leading example of internal carbon pricing, the company may not be the best example to follow.

12 Pickett, C. Personal communication.

CASE STUDY: SOCIÉTÉ GÉNÉRALE

HOW WILL CARBON BE PRICED?	Only used to evaluate investment opportunities (shadow price)	**Applied to emissions (carbon charge)**	Used to evaluate investment opportunities (shadow prices) and applied to emissions (carbon charge)
HOW MUCH WILL BE CHARGED?	Adopt country-specific Social Cost of Carbon	**Develop firm-specific carbon price reflecting: abatement target, revenue target, & benchmarking target**	
HOW OFTEN IS THE CHARGE ASSESED?	Monthly	**Annually**	Other
IS THE MONEY RETURNED?	▼ All Returned ← → Not Returned		
WHAT IS THE RETURN MECHANISM?	Fund	Check	**Competition**	Other
IS THE MONEY EARMARKED OR UNRESTRICTED?	**Earmarked for: energy efficiency investment, offset programs, stewardship initiatives, carbon-neutral spending**	Unrestricted	

CASE STUDY 3: SOCIÉTÉ GÉNÉRALE

Société Générale Bank Group has been proactive and committed to reducing its carbon emissions for many years. Since 2005, Société Générale has performed a greenhouse gas inventory following the GHG Protocol.[13] The data collected for this inventory is used as the basis for calculating the bank's internal carbon tax, which is priced at €10/tCO2 ($10.8/tCO2). Société Générale was one of the first banks in the world to introduce an internal carbon tax in 2011.

13 GHG Protocol is an international standard that covers how to measure, manage, and report greenhouse gas emissions. It was developed by the World Bank.

The bank developed a Carbon Reduction Program (CRP) based on this tax to achieve its emissions reduction targets. The mechanism involves each entity, defined as either a core business or corporate division, paying an internal carbon tax according to its respective carbon footprint. The business entities of Société Générale Bank are responsible for setting their own action plan guided by the bank's emissions target and incentivized by the internal carbon tax.

The revenue from the tax is then allocated to internal environmental efficiency initiatives via CRP Environmental Efficiency Awards. The competition for awards provides additional motivation and incentive internally. Each award can cover up to 100% of implementation costs with a maximum limit of 200,000 ($182,000) per initiative.

The program is designed to incentivize each business entity to reduce CO_2 emissions to lessen the amount of tax levied and to implement energy efficiency initiatives with an efficiency award.

This ideally can create a virtuous cycle of efficiency upgrades and emissions reductions. Gradually, the group can transition from energy-intensive products and services and become energy efficient through this program. One of the additional goals of this program is to promote awareness in showcasing environmental efficiency initiatives as opportunities for innovation.

The result of the 2012-2015 CRP, which used a price of $10.8/$tCO_2$, was an 11.4% reduction in GHG emissions per occupant compared to 2012. This performance exceeded the initial target of 11%. The program also reduced energy consumption by 11.3% compared to 2012.[14]

In 2015 alone, 56 initiatives won awards worth a total of €3.4M ($3M). Over the three-year period, 119 winning initiatives yielded annual savings of an average of €13M ($11.8M) on overhead. This was an average of 4,700 tCO_2/year in emissions reduction. It also resulted in an average of 30 GWh of energy savings.[15]

These initiatives involved projects targeting built infrastructure, information technology, paper use, and transport innovation.

Recently, the bank set up a new and more ambitious CRP which aims to reduce emissions per occupant by 20% compared to 2014 levels by 2020.[16]

14 SOCIÉTÉ GÉNÉRALE. (2016). *Corporate and Social Responsibility Report*.

15 Ibid.

16 "Internal carbon pricing: A growing corporate practice." (2016). *I4CE & EPE*. Retrieved Oct. 31, 2018 from https://www.i4ce.org/download/internal-carbon-pricing-an-increasingly-widespread-corporate-practice/

CASE STUDY: DELTA AND QANTAS AIRLINES

HOW WILL CARBON BE PRICED?	Only used to evaluate investment opportunities (shadow price)	Applied to emissions (carbon charge)	Used to evaluate investment opportunities (shadow prices) and applied to emissions (carbon charge)	
HOW MUCH WILL BE CHARGED?	Adopt country-specific Social Cost of Carbon	Develop firm-specific carbon price reflecting: abatement target, revenue target, & benchmarking target		
HOW OFTEN IS THE CHARGE ASSESED?*	Monthly	Annually	Other	
IS THE MONEY RETURNED?*	All Returned ← → Not Returned			
WHAT IS THE RETURN MECHANISM?*	Fund	Check	Competition	Other
IS THE MONEY EARMARKED OR UNRESTRICTED?*	Earmarked for: energy efficiency investment, offset programs, stewardship initiatives, carbon-neutral spending	Unrestricted		

**Not disclosed or publicly available*

STUDY 4: DELTA AND QANTAS AIRLINES

The airline industry is responsible for 2% of global annual emissions, emitting a larger share of global carbon dioxide than many countries.[17]

17 Lampert, A. (2016). "U.N. sets limits on global airline emissions amid dissent." *Reuters*. Retrieved Oct. 31, 2018 from https://www.reuters.com/article/us-climatechange-aviation/u-n-aviation-committee-approves-airline-climate-deal-idUSKCN1261QR

If the airline industry was a country, it would be the 21st most economically productive nation and the 6th largest emitting nation in the world.[18, 19]

However, the airline industry was left out of the 2015 United Nations climate change conference in Paris, despite its carbon intensity. Curbing airline emissions was instead left to the International Civil Aviation Organization (ICAO) and individual countries.

In 2012, the European Union Emissions Trading System (EU ETS) required all airlines operating in Europe to report carbon dioxide emissions and purchase compliance offsets if they exceed their tradeable allowances. A similar program was established under the Australian Emissions Trading System (AU ETS).

The International Civil Aviation Organization (ICAO), seeking to harmonize regional policies for emissions reduction and mitigate the global climate damages attributable to the aviation industry, established a global market-based measure (MBM) to control future carbon dioxide emissions from aviation.

Delta and QANTAS airlines have reported the use of an internal carbon-pricing scheme. While both airlines are committed to using internal carbon pricing, neither is transparent about its application or level.

Instead, an internal carbon-pricing mechanism seems to be voluntarily applied either as a direct pass-through of carbon-pricing regimes established iwn various jurisdictions to the airlines' applicable business units or in anticipation of future carbon pricing or emissions regulations. For many companies in the industry, the aim of carbon pricing now is to prepare themselves for future environmental legislation.

Forthcoming regulations are anticipated to be introduced to help the industry meet the ambitious target set out in the 2016 ICAO General Assembly: to make all aviation growth after 2020 carbon-neutral.

Implementation of policies to meet this goal will include a voluntary pilot phase from 2021 to 2026 and then a mandatory second phase from 2027 to 2035 for countries with a 2018 revenue tonne-kilometre of over 0.5%.[20] Policies employed in the pilot program will either involve global emissions trading, global mandatory offsetting, or global mandatory offsetting with revenue.

Delta and QANTAS, the third and thirteenth largest voluntary carbon offset buyers globally, along with

18 Air Transport Action Group. (2018). *Facts and Figures*. Retrieved from http://www.atag.org/facts-and-figures.html

19 Union of Concerned Scientists. (2018). Each Country's Share of CO_2 Emissions. Retrieved Oct. 31, 2018 from http://www.ucsusa.org/global_warming/science_and_impacts/science/each-countrys-share-of-co2.html#.WQ4AoOUrKUk

20 Bisset, M. (2017). "Aviation emissions – The scheme agreed at the 2016 ICAO General Assembly." *Clyde & Co.* Retrieved Oct. 31, 2018 from http://www.mondaq.com/x/577730/Aviation/Aviation+Emissions+The+Scheme+Agreed+At+The+2016+ICAO+General+Assembly

nine other airlines, currently offset carbon emissions in anticipation of industry-wide regulation from the International Civil Aviation Organization (ICAO) and in compliance with the EU ETS and AU ETS requirements.

Delta also uses a shadow price of carbon to evaluate future routes, project schedules, and investment opportunities. This is also being done in anticipation of compliance requirements for regional or global airline operation.

QANTAS imposed an Australian carbon tax-linked surcharge on fares – but it removed this ahead of the repeal of the carbon tax. A news article from Australia reported that a staffer said, "Our all-inclusive fares have not risen, though we have kept a small carbon surcharge on domestic fares so that we can keep track internally of the cost of the tax... This has now been removed, but there won't be any change to the prices that customers pay."[21]

In that way, the carbon charge applied to air-travel by QANTAS was a direct pass-through of a carbon tax to consumers. The removal of the surcharge did not see a reduction in fares due to increasing market competition on the Australian domestic aviation market.

Lessons Learned from These Case Studies

These different case studies shed several broad lessons learned that may be useful as companies design and implement their own internal carbon-pricing schemes.

First, the Yale University case study shows that **carbon-pricing-scheme design is important, but many different variations can work within similar contexts**.

In testing four different carbon-pricing schemes, Yale University's pilot found that all business units that participated in any pricing scheme during the pilot significantly reduced their carbon emissions relative to the business units that did not participate in the pilot.

Specifically, the "investment" pricing scheme, in which buildings were given funds earmarked for energy-conservation investments, experienced the greatest reduction in emissions. However, due to the small sample size of the pilot, the explanatory power of these findings is limited.

The airline-industry case study clearly demonstrates the first benefit of an internal carbon-pricing scheme outlined by CDP. Delta and QANTAS employ carbon-pricing strategies as a **form of regulatory preparedness or advanced/anticipated compliance**.

21 News.com.au. (2014). "Quantas scraps carbon tax surcharge." Retrieved Oct. 31, 2018, from http://www.news.com.au/finance/money/costs/qantas-scraps-carbon-tax-surcharge/news-story/aad2d2b4c7a7256a3b5e6143b7c16ad6

In a similar vein, Société Générale's decision to implement a carbon charge was in preparation for the upcoming Emissions Trading System (ETU) in the European Union.

Microsoft, another multinational company, can also be considered to be reaping the **benefits of monitoring and evaluation of carbon emissions as a means of navigating various global standards, commitments, and challenges**.

These two case studies also shed other insights. Société Générale benefited significantly from its early performance of a GHG inventory in 2005 to set an effective internal carbon charge. This suggests that **design elements from its program could be used effectively for other internal carbon-pricing schemes**.

In addition to the charge, **competition between units** encouraged the employees to engage and be creative to propose various internal environmental efficiency initiatives. The initial CRP in the group achieved the defined emission-reduction and energy-consumption targets. It resulted in annual savings of $11.8 million.

The Microsoft case study shows us that while focusing on the uses of revenue for an internal carbon charge is an innovative approach in carbon pricing, **the carbon price must be sufficiently high to reap the double reduction in emissions**, as highlighted by our theoretical model.

While often cited as the leading example for internal carbon-pricing schemes, Microsoft's program may not be the best model for companies seeking significant reduction in carbon emissions.

Conclusion

As we surpass 400 ppm atmospheric carbon dioxide, the responsibilities for carbon-emissions reduction and mitigation fall to governments at all levels as well as the private sector. While there are resources for price instruments to address damages from carbon emissions at the national level, there are limited resources available to companies and other institutions.

Our policy framework captures key decisions and tradeoffs that organizations will face in the design and implementation of an internal carbon-pricing program, highlighting the levers available for companies to design an internal carbon-charge program that meets their needs.

We find that current implementation of internal carbon-pricing schemes by companies generally serve as preparation for certain or anticipated future regulations.

Less common, but still relevant, are positive returns from revenue-neutral internal carbon-charge programs like the Yale Carbon Charge. New incentives for investing in carbon-efficiency technology can potentially address the behavioral failures that lead to underinvestment.

Appendix: Theoretical Framework

We posit that the secondary macroeconomic effects of paired taxes and investment subsidies, when considered as a single instrument, could prove cost-effective for internalizing the two market failures associated with climate change: the climate emergency and the technology transition.[22]

The policy framework provides different decision points and tradeoffs that companies face. Outcome variables, in tandem with the policy framework, would help companies set targets for their internal carbon-pricing schemes and align their targets with the policy decisions they make.

There has been much debate around whether a national carbon tax provides secondary benefits apart from a reduction in carbon emissions.

Goulder first outlined the possibility of a double dividend in which returning carbon tax revenues by lowering other distortionary taxes in the economy would increase non-environmental well-being. This would be independent of any environmental benefits of the tax.[23]

Since then, others, including Goulder, Parry and Oates, demonstrate the tax-interaction effect, where a carbon tax is seen as effectively a tax on a factor of production and hence increases existing tax distortions in the economy.[24, 25]

These debates have sometimes occurred in the context of comparing different policy instruments for climate change, such as the tax versus cap-and-trade debate.[26] Recent work has suggested that whether the double dividend or tax interaction dominates depends on the specific circumstances that underlie the situation in which the carbon tax is implemented.[27]

Little attention has been paid to the effects of using carbon-tax revenues for policies that address other environmental market failures. Examples include subsidies for the cleantech revenues related to energy-efficiency investments and the underinvestment in R&D for green technologies such as

22 Jaffe, A. B., Newell, R. G., & Stavins, R. N. (2005). A tale of two market failures: Technology and environmental policy. *Ecological Economics*, 54(2), 164-174.

23 Goulder, L. H. (1995). Environmental taxation and the double dividend: a reader's guide. *International tax and public finance*, 2(2), 157-183.

24 Goulder, L. H. (1998). Environmental policy making in a second-best setting. *Journal of Applied Economics*, 1(2), 279-328.

25 Parry, I. W., & Oates, W. E. (2000). Policy analysis in the presence of distorting taxes. *Journal of policy Analysis and Management*, 603-613.

26 Goulder, L. H., & Schein, A. R. (2013). Carbon taxes versus cap and trade: a critical review. *Climate Change Economics*, 4(03), 1350010.

27 Goulder, L. H. (2013). Climate change policies interactions with the tax system. *Energy Economics*, 40, S3-S11.

improved PV cells.[28] There is an intertemporal feedback of such policies on the quantity of energy consumed or the amount of emissions per energy consumed respectively.

Thus, it might be insightful to examine the interdependence of the carbon tax and the subsequent policy implemented, rather than treat them as two separate policy instruments. Kolstad acknowledges the link between these two market failures, but in terms of incentives for induced innovation rather than through potential uses of carbon-tax revenues to subsidize innovation.[28] Figure 2 below illustrates our core theoretical idea.

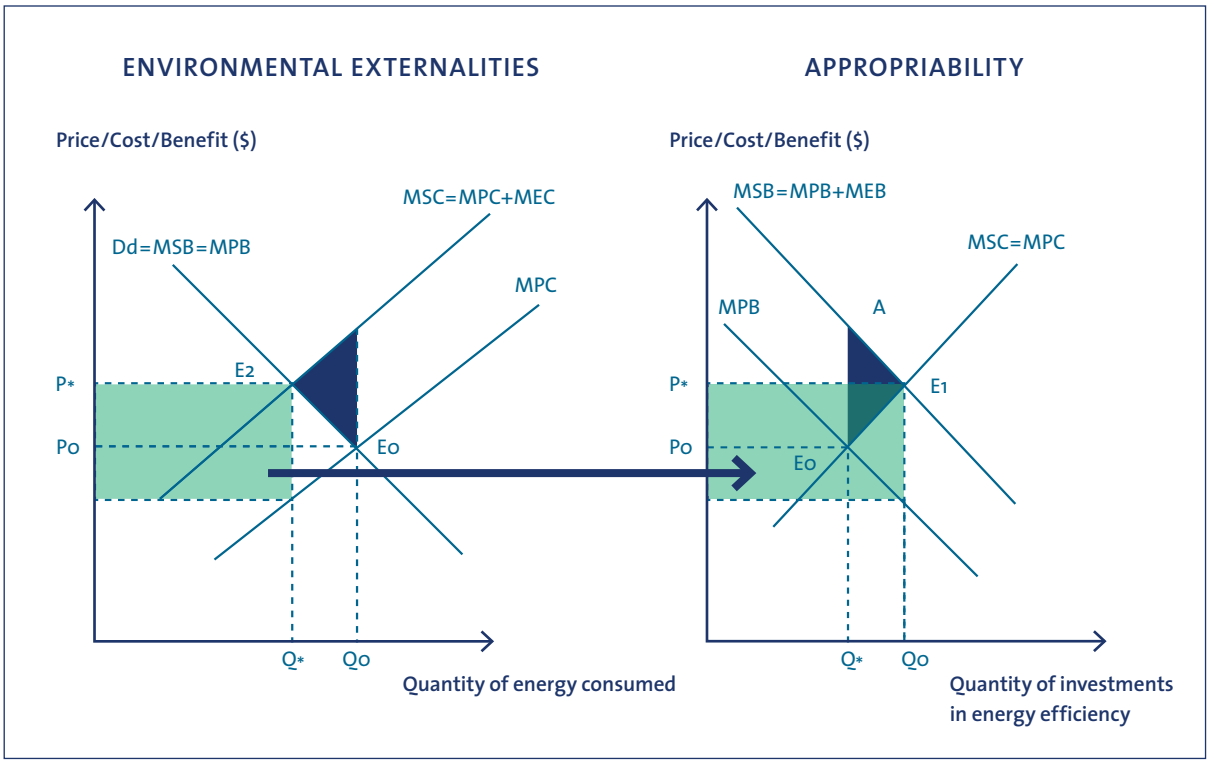

Figure 2: Using carbon tax revenues to address the appropriability market failure for cleantech revenues

The graph on the left is the classic theoretical diagram for negative externalities. Ideally, governments or companies should set a carbon tax equal to the marginal external costs of energy consumption. This would force consumers or business units to internalize all the external costs associated with energy consumption.

Assuming this ideal scenario, the quantity of energy consumed would decrease from Qo to Q* and the tax revenue collected would be equal to the blue box.

28 Kolstad, C. D. (2010). *Regulatory choice with pollution and innovation* (No. w16303). National Bureau of Economic Research.

Given that there is another externality, a positive externality in terms of revenues from energy efficiency or cleantech development, these revenues may be used as subsidies. Should the amount correspond perfectly, the subsidies would allow consumers or business units to internalize the external benefits of energy efficiency investments. This causes an increase in energy efficiency investments from Qo to Q*. These investments lower the quantity of energy consumed in future time periods, resulting in further carbon-emission reductions.

Thus, using carbon-tax revenues to subsidize other externalities such as cleantech-development revenue would provide additional environmental and social benefits that may or may not be greater than the benefits of reducing other distortionary taxes.

However, there has yet to be a comparison of the effectiveness of different uses of carbon tax revenues in the context of optimal tax theory that would go beyond reducing other distortionary taxes or returning the revenues' lump sums.

Goulder examined whether carbon taxes are a more efficient revenue-raising mechanism for governments as compared to other revenue sources and simply concluded that the environmental gain from green taxes is essential for green taxes to be less costly than other forms of general taxes.[29]

We think that a comparison of different uses of carbon tax revenues can provide new perspectives to the debate on double-dividend-versus-tax interaction—as well as, perhaps, a carbon-tax-versus-cap-and-trade evaluation.

When companies set internal carbon-pricing schemes, they do not face the macroeconomic effects of revenue recycling or tax interaction as discussed in the current academic literature, so the use of carbon tax revenues for other policies become a central consideration.

In particular, companies can choose to earmark these revenues for green investments within the company or externally. Or they can return them to individual business units or departments earmarked such that the units themselves engage in these green investments.

29 Goulder, L. H. (2013). Climate change policies interactions with the tax system. *Energy Economics*, 40, S3-S11.