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White Paper

Internal Carbon Pricing

How to Operationalize, Measure and Control Carbon Emissions

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Content

Executive Summary

Goals

This paper develops a holistic understanding of Internal Carbon Pricing (ICP), answering the following questions:

1. How is Internal Carbon Pricing utilized to steer corporate decision-making processes?

2. How should companies design their Internal Carbon Pricing approach?

Approach

We apply a qualitative research approach conducting ten semi-structured interviews with practitioners and decisions makers in leading companies in terms of their established ICP approach. To guide and structure the analysis, the respective ICP approaches are examined along four dimensions: *Height, Width, Depth and Time*.

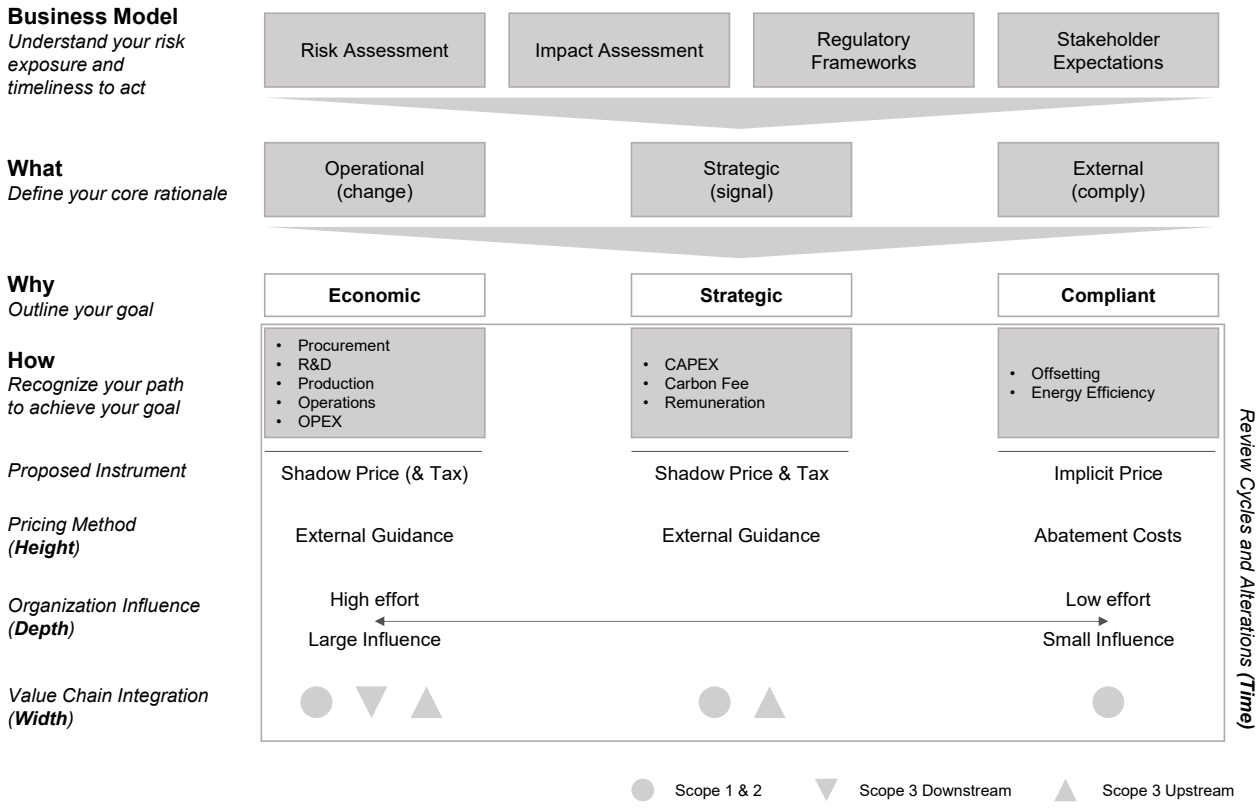
Framework for the Design of Internal Carbon Pricing

This paper provides a comprehensive framework for designing ICP by analyzing, understanding, and applying ICP contingent to their specific environment. Hence, it provides core rationales that ultimately drive the use of ICP.

Case Study

The application of the framework is shown in an anonymized case study.

Framework for the Management Control of Internal Carbon Pricing (ICP)



1 Introduction

Companies face an acute need to measure and internalize environmental externalities into their financial decision-making. Accordingly, the corporate practice of Internal Carbon Pricing (ICP) currently enjoys a rapid adoption globally. Its goal is to monetize the environmental externality of Greenhouse Gas (GHG) emissions, which can be considered in financial decision-making. It ultimately provides a clear financial advantage to activities that lower the carbon footprint of a company. The lack of transparency in divulging methodologies and existence of clear guidelines leaves much room to gauge the impact of ICP on corporate (climate) strategies. Contributing factors must be eyed in an integrative and comprehensive manner since they have a combined effect on the design structure of ICP and thus its successful adoption. To address these challenges, we focus on two questions:

(1) How is ICP utilized to steer corporate decision-making processes?
(2) How should companies design their ICP approach?

To answer this, we combined a state-of-the-art analysis with ten expert interviews in leading companies. This allowed us to take a holistic view on ICP and develop a comprehensive framework for possible design avenues of ICP. The proposed framework lays the foundation for companies in analyzing, understanding, and applying ICP contingent to their specific environment. In doing so it will provide relevant information about core rationales that ultimately drive the constitution of a company's ICP design.

2 Foundations of Internal Carbon Pricing

This chapter first summarizes drivers that influence the use of ICP and outlines existing instruments adopted to integrate ICP. After a discussion on factors that influence the choice of instruments, different methods to determine carbon prices are exemplified.

2.1 Drivers for the adoption of Internal Carbon Pricing

The drivers for companies to adopt ICP are manifold. They vary from sector specific characteristics and jurisdictionally differences to company specific priorities and business-oriented goals. In the following, we summarize dominant motives according to current literature:

Investment Allocation: ICP sets a clear case for reallocating capital toward low-carbon investments, nurturing low-carbon innovation and Research and Development (R&D) investments, venturing into new business segments, cutting emissions from existing processes, and generally catalyzing green financial flows. This is further underlined by the Carbon Disclosure Projects (CDP) corporate survey which lists: 1. Drive low-carbon investments and 2. Drive energy efficiency as the top two drivers for adopting ICP.

Social Impact: ICP allows companies to position themselves as socially responsible organizations that go beyond their climate targets by investing in social initiatives with the revenue generated by ICP. This point emphasizes the reconcilability with the Sustainable Development Goals (SDGs) which companies use as a mean of communication to its share- and stakeholders. This is further underlined by current research noting the increased interest of environmentally aware investors and stakeholders in the disclosure of ICP-related information. Inversely, ICP serves as a driver to attract new investors and is seen as such by companies who consider implementing ICP.

Climate Leadership: Furthermore, ICP enables companies to position themselves in the leadership position on climate action. In that sense, it is possible that an early transition to ICP as part of daily business routines can yield to a competitive advantage in a low-carbon economy.

GHG Regulations: The increased adoption rate of Carbon Pricing Instruments (CPIs) induces companies to implement ICP and thereby hedge themselves against (possible) future energy and emission cost increases. Half of the companies disclosing their data through CDP report that ICP is utilized to navigate GHG regulations. Additionally, a recent study conducted by the CDP suggests that companies perceiving a higher risk (than companies who do not disclose this risk) from external carbon regulations are over five times more likely to implement ICP.

Stakeholder Engagement: Companies are confronted with rising pressure from investors and further stakeholders to not only measure and report their carbon emissions but also to exhibit how climate-related risks and opportunities are identified, assessed, and adequately managed. Exemplarily, BlackRock, the worlds' largest asset manager, recommended that asset owners make decisions on future investments by quantifying the carbon risks embedded in their prospective portfolios. Hence, companies regard ICP as a tool allowing them to communicate and quantify the transition to low-carbon activities and adhere to the increasing interest in non-financial information.

Governance Standards: ICP is further being triggered by corporate climate governance initiatives, particularly by the Taskforce on Climate-related Financial Disclosure (TCFD). The TCFD emphasizes the value of using ICP as a key metric when measuring the impact of climate-related risks. The TCFD recommendations enjoy continuous endorsement with clear implications for affected companies. In Switzerland, large banks and insurances are asked to follow the revised FINMA disclosure obligations which are based on the TCFD recommendations as of mid-2021. Furthermore, New Zealand became the first nation to mandate TCFD reporting in 2020 and the U.K. Government launched a consultation on requiring mandatory TCFD-aligned disclosure by publicly quoted companies, large private companies, and Limited Liability Partnerships. Moreover, to meet its 2030 targets, the EU developed the *EU taxonomy for sustainable activities* which entered into force in 2020 and serves as a classification system for sustainable economic activities. As a potential assessment metric, ICP is explicitly proposed to quantify emissions and calculate monetary savings. Therefore, EU companies are further pushed to consider ICP to comply with the EU taxonomy.

Awareness: More than 50% of companies who reported to the CDP in 2020 highlighted the change of internal behavior as one of their core rationales to adopt an internal price on carbon. According to Microsoft, their carbon tax helps increasing awareness among employees and "has embedded a culture of sustainability leadership and accountability" (DiCaprio, 2013, p. 13). Disney underlines that ICP "has engendered a sense of ownership for employees to develop innovative ways to reduce their carbon footprint […] (Ahluwalia, 2017, p. 8).

Based on the interviews conducted and the subsequent analysis, we argue that it is expedient to subordinate the before talked about motives and cluster them into internal and external drivers (see Figure 1). Applying the suggested classification, it is acknowledged that many here listed drivers are interdependent and in causal relationship. However, by doing so, it paves the way for defining three core rationales which fundamentally determine the constitution of ICP. These core rationales will be discussed in detail in chapter 4.

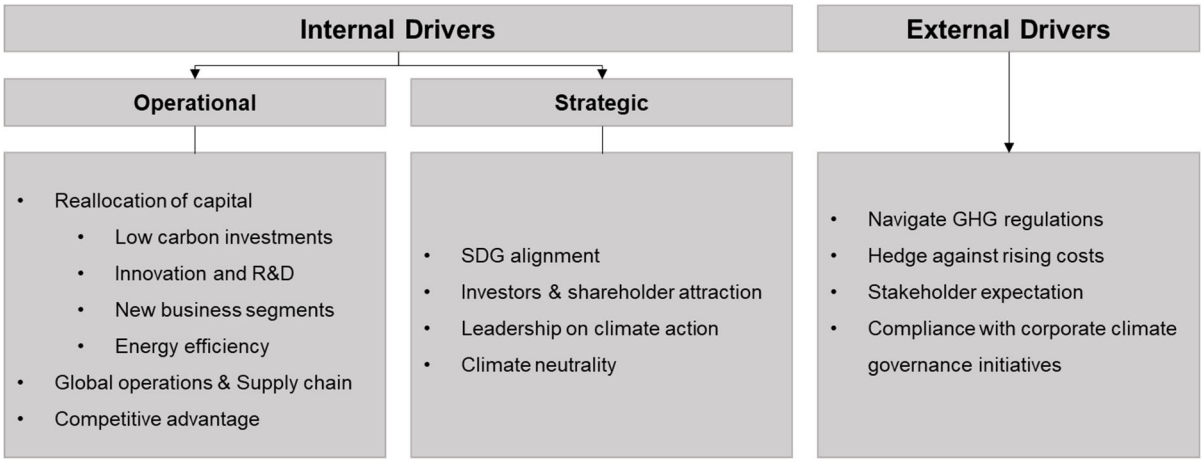


Figure 1: Drivers for Internal Carbon Pricing (own figure)

2.2 Instruments to price carbon emissions

Generally, policy makers' approaches toward curbing carbon emissions are institutionalized in two distinctive manners. First, so called *command-and-control instruments* (implicit carbon pricing instruments) which rely on the introduction of specific standards (e.g., regulations, reporting requirements, emission licensing). Second, *market-based instruments* (MBI; explicit carbon pricing instruments) which in turn "provide incentives for economic agents to reduce or eliminate environmental externalities" (e.g., corporate internal taxes, subsidies, and ETS) (UN, 2020, p. 7). The corporate practices of ICP closely mirror those utilized by today's political practitioners. Figure 2 depicts an overview of the henceforth considered instruments. On a first layer, it can be differed between an explicit and implicit price. It is further distinguished between real- and imaginary fees, where a real fee allows for a direct monetization of emissions while the imaginary fee is expressed through a shadow price, which serves as fictional instrument to account for emissions. In the following, the four instruments are being looked at separately, highlighting key objectives, benefits, and challenges. Further notice will be given to the factors that result in a company prioritizing one instrument over the other.

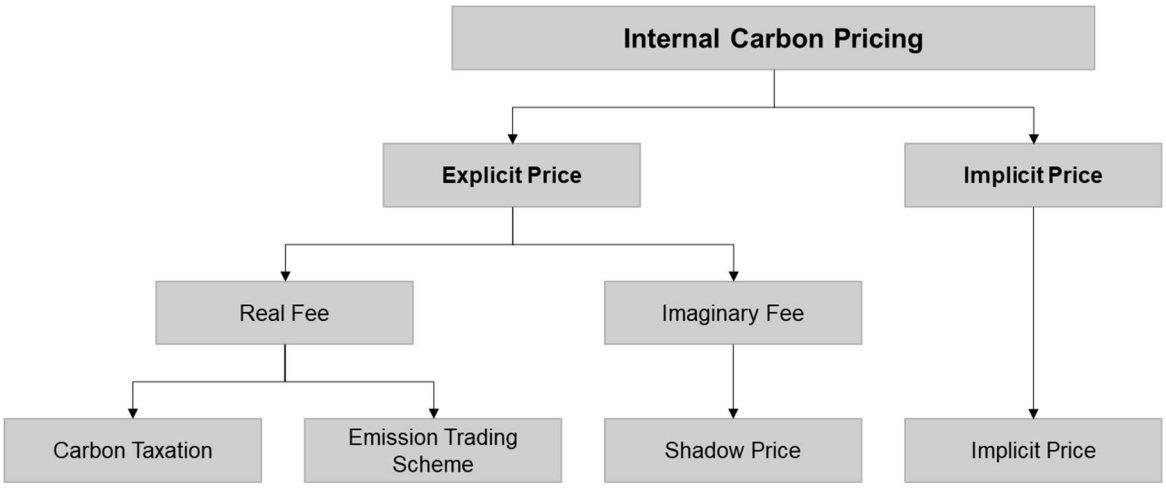


Figure 2: Overview on Instruments for Carbon Pricing (own figure based on Hannen, 2021, p. 58)

2.2.1 Explicit Price

Carbon Taxation

An internal carbon taxation can be defined as a monetary value attached to each metric ton of emissions that result from normal business activity and are charged to the emitting business units, manufacturing unity, or business activity (e.g., business travel). In other words, an internal carbon taxation leads to added costs on operating expenses (OPEX). Therefore, companies may introduce this taxation to steer decision-making processes, but also to achieve emissions reduction targets in current operations. As such, this sensibilizes and incentivizes employees and even more so decision-makers, to be vary of the emission-related costs in their daily activities, operations, and investment decisions as it directly impacts the profit and loss statement (P&L) of a given business unit (BU). Unlike regulatory tax schemes, proceeds stay within the company and can be utilized to finance internal and low carbon committed projects that otherwise lack the required funds, to purchase offset credits externally, and to reward environmentally friendly operations and ideas.

The key benefits of an internal carbon taxation can be summarized as follows: First, it has a practical application as it charges the BUs according to their respective emissions and incentivizes change through impacting the P&L. Second, it generates an internal revenue stream that can be utilized to back environmentally friendly projects, emission reduction initiatives, and carbon offsetting. Third, it fosters behavioral changes as novel ideas on reducing energy and lowering emissions are credited and indirectly remunerated. Fourth, it is an instrument which is result-oriented as it encourages cost effective reduction of emissions and consequently increases competitiveness. Lastly, it works as a hedge against future, jurisdictional carbon price increases. The internally levied tax does not have to be uniform i.e., a single price that is applied firmwide independent of geography, BU, or type of decision – it can very well be differentiated. Moreover, it can be beneficial to distinguish between product-related emissions and non-product-related emissions such as business travel.

At the core of an internal carbon taxation lies a thorough understanding of the company's direct and indirect GHG emissions. A tax is generally levied on scope 1 (i.e., emissions generated by company facilities and company vehicles), scope 2 (emissions from purchased electricity, heat, cooling, or steam), and in some cases scope 3 (emissions from business-related activities, both up-and downstream)[1]. In practice, especially the latter is difficult to account for as companies find it difficult to accurately measure all types of scope 3 emissions. Hence, companies often neglect some or all of scope 3 emissions in their carbon taxation program (except for business travel) albeit that scope 3 emissions generally make up the largest bulk of a company's emissions. According to current data from the CDP, companies (if anything) mainly resort to including business travel for their scope 3 emissions as it is easier to measure, process, and can be simply based on miles.

Adopting an internal carbon taxation, companies must further adhere to a series of operative decisions, summarized in figure 3.

1.) A company must first decide on a cycle-method of payment for the levied taxes. Settlement can occur on a quarterly, semiannual, annual basis or one-year arrears. If taxes are levied one year in arrears, charges are based on the actual costs occurred – final emissions and associated costs are generally not available until at least three months into the new fiscal years. If taxes are levied in the current fiscal year, charges are contingent on projections and may need true

[1] Please refer to the Greenhouse Gas protocol for a detailed visualization on the accounting of each scope. https://ghgprotocol.org/standards/scope-3-standard

ups later. However, DiCaprio highlight that this comes with the advantage of gaining real time cost driver which can be integrated into the existing performance management.

2.) A company must then consider its financing structure which can either follow a central or decentralized approach. A central fund has the benefit of (a) collecting the taxation more efficiently, (b) reverting to a larger investment fund and thus realizing more capital-intensive projects; and (c) relying on stringent investment decisions.

3.) If a company opts for a decentralized financing approach, different return mechanisms can be employed. Funding's can be given based on improvements with regards to energy efficiency and thus initiating competition among BUs or departments. Alternatively, BUs can pitch their investment ideas to receive the necessary funding. Hence, a decentralized financing structure enables and incentivizes BUs to set clear targets which can directly be met with internal projects. Research suggests that acceptancy for a decentral financing approach tends to be higher amongst BUs as they can better steer investments.

4.) Lastly, once funds are allocated, these should be invested in accordance with a predefined investment strategy.

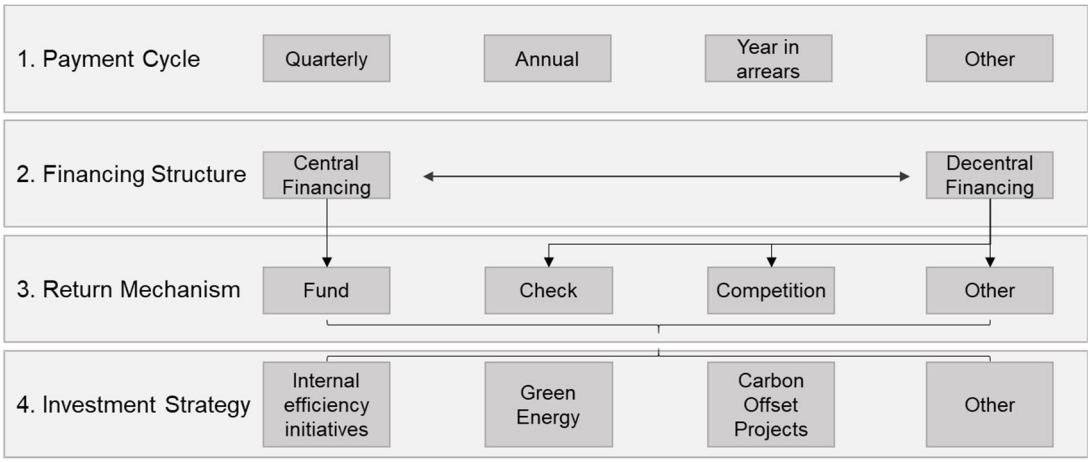


Figure 3: Settlement and Return Mechanisms for Internal Carbon Taxation (own figure)

Emission Trading Schemes

ETS follow the 'cap & trade' principles of established trading schemes like the European Union Emissions Trading System (EU ETS). A cap is set by the group management on the total amount of carbon that can be emitted by each BU and their respective business activities. Subsequently, the cap is reduced over time so that total emissions fall, while the cap on allowances available ensures that they have an intrinsic value. Consequently, the mechanism of price finding is developed through internal supply and demand. Thus, managers have the freedom to trade these allowances with other BUs granted that their final stock covers their total emissions. Hence, an internal ETS provides emission certainty for a company while further incentivizing low-carbon operational and investment decisions – if the cap is stringent enough to enforce shifts in business practices. In practice, mainly companies with high level of emissions adopt and utilize internal ETS. They do so for two primary reasons: First, as a simulation in anticipation of a national ETS and therewith gaining first-hand experience. Second, when they are already subject to external trading schemes as a mean for cost-efficient emissions reduction. However, institutionalizing an internal ETS requires the setup of complex trading schemes which come with a great amount of administrative effort. Insofar, internal ETS may only be a feasible instrument to price carbon for large corporates.

Shadow Price

Shadow pricing works on the premise that costs associated with GHG emissions should be internalized in strategic investment decisions (R&D, infrastructure, financial assets etc.) over the long term. In essence, a shadow price aims at understanding the potential impact of future regulatory carbon pricing on a company's operations while simultaneously steering their investment decisions in a way that fosters low-carbon business routines. Ahluwalia (2017) defines a shadow price as a "theoretical internal cost of carbon applied in project planning processes to test the feasibility of capital expenditure (CAPEX) and R&D investment decisions" (p.18). Thus, a shadow price directly impacts the internal rate of return (IRR) or net present value (NPV) when gauging upon an investment decision. This is comparable to a company considering the volatility of exchange rates or commodity prices in their investment decisions.

Companies currently utilize a shadow price to make three kinds of decisions: First, to assess capital investment projects involving an increase (or decrease) in GHG emissions or change in energy source. The shadow price is budgeted as part of the NPV (or IRR) calculations. In doing so, a company may resort to using a range of prices, depending on the project type or the respective geographical region. Especially the latter is of importance to companies operating in multiple countries, with each having its own GHG regulation. Second, a shadow price may be employed as a risk management tool to incorporate regulatory and share- and stakeholder demands. Third, a shadow price is being implemented as a means of corporate strategic planning to evaluate information on trends in business units. As opposed to an internal carbon taxation, a shadow price does not imply an actual cash flow and is generally not viewed as an additional cost imposed across BU's. Current literature points out, that this allows for an easier buy-in from the board as an initiative to dampen GHG emissions. Paradoxically, this point also highlights a key challenge of an internal shadow price. On the one hand, a notional price does not directly impact the P&L or the budget of a given BU. Thus, a shadow price may not provide a strong enough incentive to reduce GHG emissions with new investment opportunities and change employee behavior as it is regarded as a risk- and strategy tool. On the other hand, unless a binding set of rules and clear guidelines to incorporate a shadow price into investment decisions are communicated, companies will struggle to trigger a shift in investment.

2.2.2 Implicit Price

An implicit carbon price can be defined as "[…] the marginal abatement cost of the measure and initiatives implemented by a company to reduce its greenhouse gas emissions, including the cost of complying with regulations" (Ahluwalia, 2017, p. 4). These initiatives may include renewables purchases, energy efficiency projects, carbon offsets, or compliance with relevant standards. Unlike the explicit pricing instruments covered above, an implicit price is determined retroactively in dependence of the initiatives taken to mitigate emissions. Every company with a GHG emissions reduction goal thus has an implicit carbon price once it allocates capital towards an initiative. Hence, implicit carbon prices can help companies to understand their carbon footprint, bolster internal communication, as well as evaluating the costs associated with regulations. In practice, companies thus utilize implicit carbon prices as an internal benchmark, especially with regards to formally launching explicit ICP instruments. However, as companies aim at reducing GHG emissions preemptively, implicit pricing may not play an equal pedagogical and incentivizing role as explicit pricing instruments suggest.

2.2.3 Choosing the right Instrument

The choice of the respective instrument is highly correlated to the company's sector of activity. Companies from emission intensive sectors, such as energy, chemical, manufacturing, tend to adopt a shadow price. As scope 1 & 2 emissions are prone to be comparably high in these sectors, an internal carbon

tax would lead to unsustainable transfer of funds across BU's. A shadow price, however, allows to steer investments towards greater efficiency which seems to be the consensus within these industries.

Conversely, the banking, insurance, and service sectors exhibit rather low scope 1 & 2 emissions. Therefore, companies from these sectors are inclined to adopt a carbon tax as it allows for short- to medium term results.

Acting in a specific industry is an observable fact – but must not stay the same forever. Thus, the choice of an instrument is also a strategic decision that can drive or hinder the development of an organization, also across industry borders. Hence the choice should be based on specific strategic goals (see Figure 4).

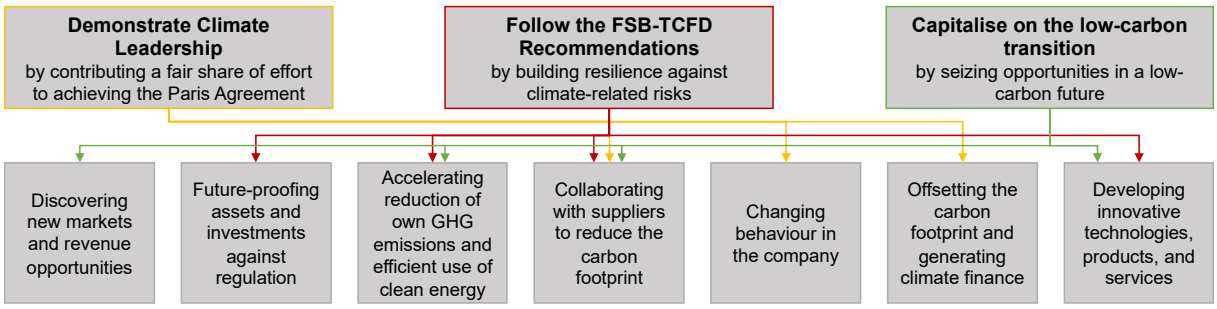


Figure 4: Overarching Goals and Operational Objectives (own figure based on Lam et al., 2017, p.16)

Recognizing the interdependence between operative objective and the company's desire to decide upon a fitting instrument, it helps, to recapitulate the qualities of an internal carbon tax and a shadow price. In simple terms, a carbon tax allows a company to influence the present, while a shadow price consequently affects the future through decisions made today. One changes the incentive structure through its influence on the P&L while the other steers investment decisions towards a low-carbon future. Figure 5 summarizes their qualities and puts them into perspective to each other.

Impact	Internal Carbon Taxation	Shadow Price
Time Horizon	**Short- and medium term:** Tackles current emissions and aims at achieving quick results by targeting running operations	**Medium- and long term:** Thrives for a continous internalization of GHG emissions into decision-making processes. Thus, projecting potential costs into long-term investment considerations.
Focus in the Organization	**Operations:** Clear focus on running operations. Mainly scope 1 and 2 including business travel	**Strategy:** Employed as a mean to assess capital investment projects, evaluate risks and support with strategic planning assumptions
Investment	**Existing Portfolio:** Oriented towards driving energy-efficiency improvements to existing facilities or business activities	**Amplified Portfolio:** Aimed at future challenges by incentivizing emissions through major capital projects
Emissions Focus	**Current:** Given the short time horizon, the primary goal is to price and curb current emissions	**Future:** Focus on understanding current and future emissions and avoiding these
Financial Focus	**Opex:** Leads to an actual internal cash flow and as such to added costs on operating expenses.	**Capex:** Theoretical internal cost to test the feasibility of capital expenditure and R&D investment decisions
Internal Awareness	Taxes are usually levied per business unit/subsidiary and additionally includes business travel. Thus, it primarily affects: **- Middle Management** **- Management of subsdiaries** **- Employees** (Business Travel)	Shadow prices are tangent to specific applications and decision processes. As such, examples for internal units most affected are: **- Project Managers** **- Strategy Division** **- R&D**

Figure 5: Impact Factors of Internal Carbon Pricing Instruments (own figure)

The implications of Figure 5 indicate that an internal carbon taxation and a shadow price can be complementary and are not, by default, mutually exclusive. Companies are free to adopt more than one instrument and there is room for innovation surrounding these i.e., tools can be adjusted in a way that a company sees fit. In a simultaneous manner, short-term operative objective can be managed through a carbon tax, while long-term strategic goals are supported with a shadow price. However, in terms of feasibility, an internal carbon taxation is typically more complex to implement as it not only involves having a thorough understanding of ones GHG emissions, but further implies changing the financial accounting of BUs and headquarters respectively.

The beforementioned suggests that the choice of an ICP instrument is contingent to a company's development in dependence of its sector, as well as the overarching goals and the concomitant operative objectives. The discussion above has underlined that there is no "right" instrument for ICP. Rather, the adoption varies in accordance with the company specific context. Thus, this is in line with contingency theory arguing that an organizational outcome is the consequence of two or more factors.

2.3 Methodological Aspects for Carbon Pricing

Observed prices adopted for ICP not only vary in accordance with the instrument chosen, but further differ between company, sector, and jurisdiction. In the following, four methodological approaches for the determination of carbon prices will be discussed (see Figure 6).

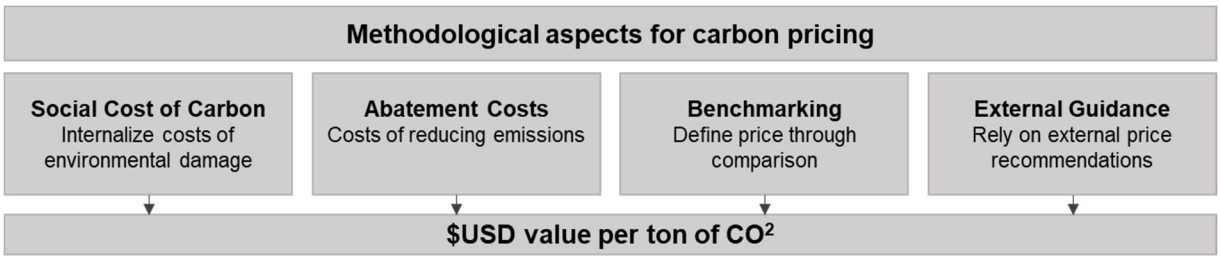


Figure 6: Methodological aspects for carbon pricing (own figure)

2.3.1 Social Cost of Carbon

The social cost of carbon (SCC) is defined as "the net present value of climate damages (with harmful damages expressed as a positive number) from one more ton of carbon […], conditional on a global emissions trajectory over time" (IPCC, 2014, p. 127). The principle behind this method is to internalize costs which occur through the subsequent damage of climate change such as: human and animal mortality impacts, crop failure due to extreme weather, infrastructural damage because of flooding etc. From a corporate perspective, the SCC thus includes both the costs of not avoiding damage to the environment through its emissions and costs associated with efforts aimed at minimizing climate-related damage. In practice, the SCC is used by companies to estimate regulatory price ranges under the assumption that these in turn are calculated based on a costs-by-cause principle. The SCC is usually determined through scientific integrated assessment models (IAMs). However, as the assumptions differ with each IAM approach, so do the respective prices calculated. According to the German *Umweltbundesamt*, the SCC was 180 Euro/tCO^2e in 2016 and is supposed to rise to 205 Euro/tCO^2e by 2030. In the US, the Biden administration announced a SCC of USD 51 as of 2021. Bressler (2021) introduced a new metric, accounting for the mortality cost of carbon (MCC), "that estimates the number of deaths caused by the emissions of one additional metric ton of CO^2" (p.1). Incorporating this metric would raise the SCC to USD 258 per metric ton.

2.3.2 Abatement Costs

Abatement costs are defined as the costs associated with a reduction in emissions juxtaposed to an existing reference technology. This is in line with the definition of implicit pricing discussed in chapter 2.2.4. Hence, the abatement costs refer to the investment-, operational-, and usage-costs of each measure in relation to a reference technology with emissions as a denominator. They are generally specified as USD/tCO^2e. Abatement costs of a given measure are thus calculated as:

$$c_{A,static} = \frac{c_M - c_{Ref}}{e_{Ref} - e_M} = \frac{\Delta c}{\Delta e_M}$$

$c_{A,\ static}$		static abatement costs of a measure in USD/t
REF$_i$	c_{Ref}	spec. costs of the reference technology
	e_{Ref}	spec. emissions of the reference technology
M:	c_M	spec. costs of the new measure
	e_M	spec. emissions of the new measure
	Δe_M	spec. reduction in emissions through new measure

By definition, this approach is only valid if the new technology does indeed yield to a reduction in emissions i.e., there is a positive denominator. However, the eventuality of negative abatement costs does exist in case that the initiative leads to a reduction in expenditure i.e., a negative Δc.

Consequently, abatement costs allow, on the one hand, for comparison among different initiatives in terms of their potential savings and on the other hand for categorizing and prioritizing these internally. Abatement costs thus serve as an internal tool to (a) foster transparency for the costs associated with one ton of CO2, and (b) calculate to investment costs needed to achieve a certain emissions reduction goal. In practice, companies utilize so-called abatement cost curves (ACC) which highlight different projects with regards to their respective abatement costs and emission reduction (see Figure 7). This is especially viable when managers must gauge upon multiple projects faced with budget constraints. Additionally, aggregated ACCs are also calculated on a sector specific level. Companies resort to these to gain an initial overview, understanding and approximation of their abatement costs[2].

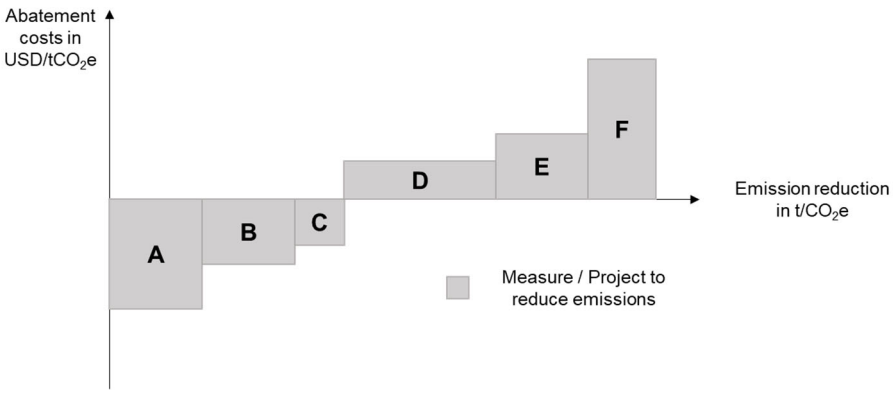


Figure 7: Abatement Cost Curve (own figure based on Braun & Lehrhaft, 2020, p. 26)

[2] Please refer to: *Pathways to a low-carbon economy, version 2 of the global greenhouse gas abatement cost curve* for a detailed overview on sector specific ACCs. McKinsey Report

2.3.3 Benchmarking

A common method to gain an overview on adopted internal carbon prices is benchmarking. In determining and discussing an internal price, a company can hence orient itself at similar companies from the same sector or jurisdiction. As the backbone of annual ICP disclosure, CDP currently provides the most comprehensive set of data for a thorough approach to benchmarking. Their fast-growing data pool allows for sectoral and locational segregation, and thus a solid price analysis. However, current prices suggest significant variances between within-group, as well as between-group. According to CDP's global data, shadow prices exhibit a median of USD/t 28 with internal carbon taxes indicating a median price of USD/t 18 respectively. Meanwhile, the total range of prices disclosed to the CDP expands from USD/t 6 to USD/t 918. The apparel sector exhibits the highest median with USD 86, with the hospitality sector showing the lowest – both sectors, however, have a rather small sample size. In their analysis of CDPs datasets, Fawson et al. (2019) calculate an average price of USD 40.09 per ton for the US private sector. European companies exhibit the highest overall median price.

2.3.4 External Climate-Related Regulations and Price Recommendations

In contrast to benchmarking, which focuses on similar companies, it is further viable to consider externally proposed price levels from regulators and scientific studies. In navigating their pricing decisions, companies especially tend to eye current climate-related regulations which directly and indirectly (i.e., scope 3) affect their operative business practices. Bento & Gianfrate (2020) show that the institutional context (headquarter in a country with high GDP/capita) and the country's climate policy influence both the adoption and height of an internal carbon price. This is further underlined by Harpankar (2019, p. 222) who emphasizes that prices converge towards externally set carbon prices. Carbon-related regulations are comparably well advanced and established in European countries which may partly explain the recognized price differences noted above[3]. Although, local regulations are used as an anchor point, companies struggle to build their ICP in accordance with these. The lack of clarity and long-term certainty in countries' climate policies is seen as major challenge with ICP.

Additionally, companies can consider price recommendations from supranational institutions to align their internal prices accordingly. Two research initiatives are regarded as major players in identifying "indicative corridors of carbon prices that can be used to guide the design of carbon-pricing instruments […]" (High-Level Commission on Carbon Prices, 2017, p. 1). First, the Carbon Pricing Leadership Coalition, which published the *Report of the High-Level Commission on Carbon Prices*, concluding that explicit carbon prices must be at least USD 50 – USD 100/tCO^2e by 2030 to be consistent with the PA. Second, *the Carbon Pricing Corridor Initiative*, a collaborative effort by CDP and the We Mean Business Coalition. Their objective is to enable relevant entities to define the carbon prices needed for a respective industry to deliver on the targets set by the PA. However, these guiding trajectories are only in so far impactful as every market player follows them.

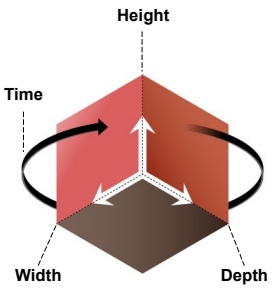
[3] For a global overview on climate-related practices, regulations, and established prices, please refer to the *State and Trends of Carbon Pricing 2021* report provided by the World Bank.

3 Measurement: Dimensions of Internal Carbon Pricing

The following section summarizes the core concept utilized to conduct the interviews and subsequently provides the necessary information with regards to the compiled data, before presenting the main findings in accordance with the introduced four dimensions of ICP.

3.1 Concept and Data

Existing literature on ICP has predominantly focused on two design dimensions. First, the *height* of the carbon price. Second, the *width* ICP is employed across a company's value chain. They are, however, in so far incomplete as they do not consider the influence of ICP on business decisions (*depth*) and how each of the dimension develop over *time*. Currently, Lam et al. (2017) have developed the most comprehensive guide to ICP with the four-dimensional framework. Their work builds on the knowledge gained from the continuous exchange between the CDP and disclosing companies. In order to integrate ICP successfully, all four dimensions should be considered. Figure 8 summarizes the parameter of each dimension and highlights the best-practice approaches proposed by Lam et al. (2017):



Dimension	ICP Parameter	Best Practice ICP Approach
Height *Carbon price level*	Price level per unit of GHG emitted (e.g., USD/tCO2e)	A carbon price should be set at a level capable of influencing business decisions in accordance with the overall ICP goals
Width *GHG emissions coverage*	The extend to which GHG emissions are covered throughout the value chain. This dimension asks which scopes (1,2,3) and how are they considered by the ICP approach.	Eventually, an ICP approach should cover all emissions hotspots across the whole value chain that can be influenced realistically
Depth *Business Influence*	Influence the ICP approach has on business decisions and the value chain partners of a company	Ensure material impact on business decisions
Time *Development Journey*	Considers the development of the first three dimensions over time. Additionally, this dimension also includes the intervals in which e.g., internal fee are levied	Regularly evaluate the other dimensions to steer the respective business strategy towards a low-carbon economy

Figure 8: Dimensions and Parameters for Internal Carbon Pricing (own figure based on Lam et al., 2017)

During the evaluation of the investigated companies, these dimensions served as underlying guidance. We chose interview partners based on the Climate Change reports published by the CDP. The CDP runs a global disclosure system for companies to manage their environmental impacts. Each year, questionnaires are sent out to reporting companies and are later disclosed and rated by the CDP. For companies to be considered, they 1) must have reported to the CDP for at least two years; 2) had a rating on their Climate Change report of A or B, and 3) had to disclose that their organization currently uses an internal price on carbon and is planning on doing so henceforth. Furthermore, to complement this initial pre-selection, the companies' respective sustainability reports and additional ICP relevant material (e.g., independent reports that referred to a company explicitly) were analyzed. This has helped to estimate the degree to which ICP has been adopted and its sophistication. Following that, viable interview partners were specifically selected. A pre-defined criteria for them to be considered was access to privileged information about essential topics in companies' such as decision-making processes. Therefore, viable experts were selected with the premise that they hold a leading position with regards to sustainability in general, and ICP specifically.

In total, ten interviews were conducted with representatives of multinational companies from various industries. Except for one, experts hailed from Europe. Interviews lasted between one and two hours, were conducted between June and November 2021 and recorded. Consequently, their verbatim transcription served as basis for all subsequent analysis. Figure 9 provides relevant basic information.

Interviewee ID	Industry	Revenue FY 2021
1	Insurance	47 bn USD
2	Retail	35 bn USD
3	Pharamceuticals	52 bn USD
4	Building Materials	22 bn USD
5	Information Technology	14 bn USD
6	Chemicals	11 bn USD
7	Chemicals	18 bn USD
8	Utility	19 bn USD
9	Automotives	31 bn USD
10	Household Appliances	0.7 bn USD

Figure 9: Basic Information on Interviews (own figure)

3.2 Height – Price per Ton of Carbon Emissions

The price level per ton of GHG emitted is a central cornerstone to any ICP design. Currently, there exist large variances. Based on the CDPs global survey, prices are heavily influenced by the chosen instrument, regionality, and industries. Figures 10 & 11 depict median prices per scope, instruments, pricing type and region according to companies which are currently reporting to the CDP.

GHG Scope	Implicit Price	Internal Tax	Internal Trading	Shadow Price
Scope 1	$ 28.00	$ 23.00	Insufficient Data	$ 25.00
Scope 2	$ 7.00	$ 64.00	Insufficient Data	$ 29.00
Scope 3	Insufficient Data	$ 19.00	Insufficient Data	$ 49.00
Scope 1; Scope 2	$ 28.00	$ 22.00	$ 31.00	$ 28.00
Scope 1; Scope 3	Insufficient Data	Insufficient Data	Insufficient Data	$ 25.00
Scope 1; Scope 2; Scope 3	$ 23.00	$ 11.00	Insufficient Data	$ 34.00

Figure 10: Median Prices per Scope and Instrument (Lam et al. 2017)

Price Type	Median Price (USD/t)	Price per Region	Median Price (in USD)
Implicit Price	$ 27.00	Africa	$ 8.00
Internal Tax	$ 18.00	Asia	$ 28.00
Internal Trading	$ 27.00	Europe	$ 28.00
Shadow Price	$ 28.00	Latin America	$ 8.00
		North America	$ 23.00
		Oceania	$ 17.00

Figure 11: Price Ranges per Type and Region (Lam et al. 2017)

In comparison to the global median of USD 25/tCO^2e, interviewed companies have set their prices with a median of CHF84/tCO^2e distinctively higher. Figure 12 presents the carbon prices used for each firm's ICP design.

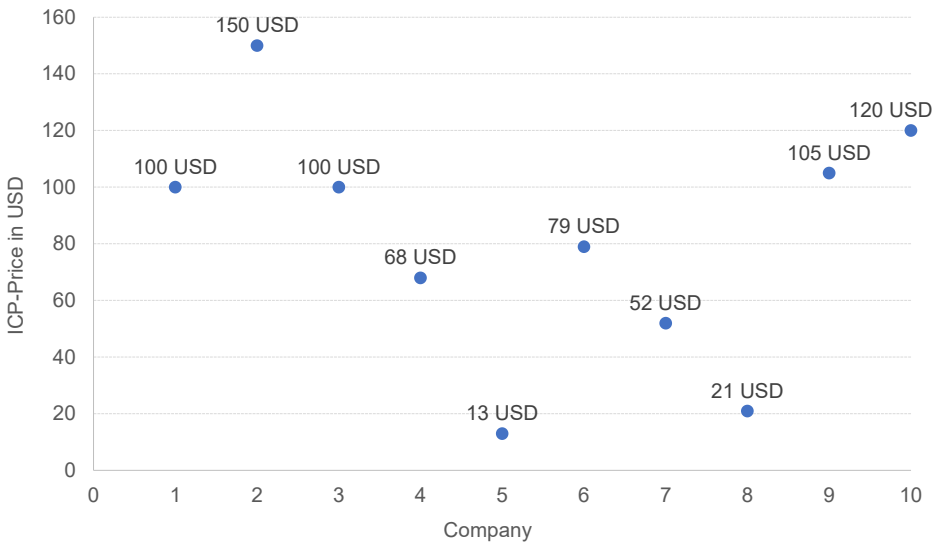


Figure 12: Overview on Internal Carbon Prices per Company (own figure)

Interestingly, companies do not dwell too long on the notion of finding the *right* price. Setting a price, the companies conduct literature reviews, consult scientific reports, and consider regulatory guidelines. As a matter of fact, the exact methods, and processes to determine a price are rather arbitrary and pragmatic. C10 (2021) explains: "*Our process was very rudimentary. The Swiss CO^2-law was at CHF 96 at the time, but we knew that it would be increased to CHF 120. So, we took CHF 120. That was basically our ascertainment of price*". The reliance on external guidance as a method to determine the height of the price is captured in Figure 13.

Company	Pricing method applied	Dynamic element to ICP
Company 1	External Guidance: UN Global Compact & Gold Standard Voluntary Emissions Reductions	Uniform; Price will be incrementally increased from CHF 100 to CHF 200 by 2030
Company 2	External Consultation (Energy agency & WWF)	Uniform and static price
Company 3	External Guidance: Stern Review	Uniform and static price
Company 4	External Guidance: EU-ETS	**Prior**: regional differences **Today**: Uniform; Prices vary based on simulations in accordance with EU-ETS
Company 5	Abatement Costs	Uniform; Prices are project dependent
Company 6	External Guidance: EU Commission publicati	Uniform; Three carbon prices: **Short-term** (1 year): forward prices of EU-ETS **Mid-term** (10 years): CHF 52 for CAPEX **Long-term** (2050): CHF 79 for valuation of carbon footprint in sustainable portfolio assessment (SPM)
Company 7	Own Approach	Uniform and static price
Company 8	External Guidance: EU-ETS	Uniform; Prices: CHF 21 (base case) - CHF 42 (worst case)
Company 9	External Guidance: Climeworks, Scientific paper	Uniform and static price
Company 10	External Guidance: Swiss CO2 Law	Uniform and static for carbon fee. For Shadow Price: Uniform; Small price variations with regard to product portfolio

Figure 13: Height Dimension: Overview (own figure)

As there is a general understanding for the arbitrary nature of a given price level, it is reasonable for companies to either rely on a scientific approach or regulatory price. Scientific approaches, such as the Carbon Pricing Corridors initiative which determine price trajectories in accordance with the Paris Agreement are developed with the support of national and sub-national governments. Consequently, companies are inherently aligned with their governments view on carbon pricing.

Generally, regulatory frameworks are regarded as crucial or at least influential factors for initiating and outlining an ICP approach. This has been confirmed by every interview partner apart from C5. Geographically, however, C5 is the only one to has its headquarter outside of Europe. This is not surprising as Europe is considered to have a globally leading position for the development of environmental law and stringent policies. To this extent, European companies are generally more accustomed to these policies but are also expecting other countries to follow the example of Europe. Especially companies which operate internationally, closely monitor the evolution of the EU-ETS because they anticipate other countries to follow its lead and act in accordance with set standards.

C5 is the only one to calculate its carbon price retrospectively, utilizing abatement costs as their pricing method. Nonetheless, abatement cost curves are used by companies as a decision-taking and management tool as it allows for a simple comparison to highlight relative advantages of initiatives. Benchmarking, as a mean of price ascertainment has not been chosen explicitly. While companies do consider what their peers are doing, they primarily do so with other intentions. Social costs of carbon were not considered by a single company. As already discussed, they are highly arbitrary in the input factors and the abundance of theoretical and empirical foundation. The resulting price discrepancies ultimately can damage a company's credibility with regards to its ICP approach. Indeed, credibility seems to be the bottom-line for companies in setting the height of their price. However, determined, it must be credible. C9 (2021) captures this fittingly: *"Well, we need to use the credible and scientifically proven version of removing CO^2 out of the atmosphere. […] And the best forecast available right now says that perhaps we will be at the level of $100 a ton and then we use that […]"*. Credibility does not only matter in setting an initial price but also in revising it on a continuous basis, as highlighted by C7 (2021): *"However, it [the price] will change soon. […] Because the market price is somewhere around EUR 65+ today. So yeah, it must be increased at least a little bit to be credible in conversations with other people".*

Concerning the dimension of *height*, literature recommends setting price levels capable of influencing business decisions. However, in the context of this paper, it is argued that it is extremely difficult to assess the impact different price levels have on business decisions a priori. Companies do resort to scenario analysis based on varying prices to estimate the impact on the business and the competitive landscape per se - especially C4 and C8 do so. But they are not trying to gauge upon the effectiveness with regards to decision-making. Given the arbitrary nature in setting a price, knowing that there is no such a thing as *the right price*, companies value the credibility of their price much higher than the actual effect it has on decision-making. The latter is much more of a concern as part of before-mentioned incremental adjustments.

Finally, as companies lay out their ICP approach, they must consider to which degree their price should have a dynamic element to it (see Figure 13, column three). A price can be increased over time, vary by region, by BU or by application. Uniform refers to a price used in the whole organization, independent of the region, BU, or application. If a price will not rise or decrease in the near future, it is regarded as static. Concerning the interviewed companies, the most complex approach has been implemented by C6, as three different prices are used in accordance with predefined time horizons.

3.3 Width – Scope of Coverage

The *width* dimension eyes the extent to which GHG emissions are covered throughout the value chain and by which means these emissions are accounted for. Therefore, chapter 2.2 outlined different instruments companies can resort to for their ICP design. Current CDP data draws a distinct picture of shadow prices and carbon taxations being the preferred instruments. Appositely, this is reflected by the conducted interviews (see Figure 14).

Company	Instrument	GHG emissions coverage across value chain	Application in organization
Company 1	Carbon Fee	Scope 1, 2, 3 (business travel)	Group (all operations)
Company 2	Shadow Price Implicit Price	Scope 1, 2 (Shadow Price) Scope 3 (Implicit Price)	CAPEX (unconditional), Offset initiatives
Company 3	Shadow Price	Scope 1, 2, (3)	R&D, CAPEX (conditional)
Company 4	Shadow Price	Scope 1, 2	Operations, Regional offices, CAPEX (unconditional), M&A
Company 5	Implicit Price Carbon Fee	Scope 1, 2, 3 (Fee: business travel)	Group (all initiatives)
Company 6	Shadow Price	Scope 1, 2	CAPEX (conditional), M&A, Procurement, R&D, product portfolio
Company 7	Shadow Price	Scope 1, 2	CAPEX (conditional), product portfolio
Company 8	Shadow Price Carbon Fee	Scope 1, 3 (Fee: employee car fleet)	CAPEX (unconditional)
Company 9	Shadow Price	Scope 1, 2, 3	Operations (all), CAPEX (uncond)
Company 10	Shadow Price Carbon Fee	Scope 1, 2, 3 (business travel): Carbon Fee Scope 1, 2, 3 (Shadow Price)	Group (Carbon Fee) CAPEX (uncond), Fabrication (Shadow Price)

Figure 14: Width Dimension: Overview (own figure)

Interestingly, not a single company has opted to develop an internal ETS. As highlighted in chapter 2.2.2, companies setting up an internal ETS mostly come from the fossil fuel industry, and they do so to proactively soothe the burden of an external ETS. However, institutionalizing an internal ETS requires the setup of complex trading schemes which come with a great amount of administrative effort. This stands in stark contrast to the instruments deployed by the interview partners. A carbon taxation, as well as a shadow price (depending on its application) are comparably easy to implement. An implicit price, as discussed in chapter 2.2.4 is calculated retrospectively and therefore represents the indirect costs per ton of CO^2e of e.g., energy-efficiency initiatives. While all companies can calculate their marginal abatement costs without too much effort, only C2 and C5 do so with the intent to use it as their ICP instrument. Furthermore, companies 2, 5, 8 and 10 demonstrate the complementary nature of different instruments and the willingness to adjust instruments in a way they see fit.

Based on the companies analyzed, the carbon tax has two primary use cases. First, to account for business travel and commuting, such is the case for C5 and C8. Second, to levy a tax on BUs and their operations including business travel, as can be seen by C1 and C10. Generally, funds are collected and distributed centrally. The investment strategy aims at energy-efficiency projects, reforestation, and different forms of offsetting. It must be emphasized, that a clear communication with regards to the return mechanisms and investment strategy (see Figure 3) is crucial. This can be exemplified with C10. In their case, BUs can apply for funding to finance BU-specific projects which should help to decrease their respective carbon footprint. A problem occurs when it is not clear what sort of projects are financed and different BUs have a different understanding on the matter. Some initiatives e.g., new car fleet can be regarded as self-evident as they are part of a company's everyday business decision and for that matter an investment that would be done with or without the additional support of a carbon fund.

A shadow price provides companies with the opportunity to adjust it to their owns needs and leaves more room for innovation compared to other instruments. This is reflected in the varying degree to which shadow prices are adopted internally. C2 utilizes a shadow price for their investment decisions, thereby underlining on of the core drivers brought upon by current research into ICP (see Chapter 2). C4 uses it as a risk management tool to incorporate regulatory measures and stakeholder demands. C8 utilizes shadow prices to better understand the market dynamics and the effect rising carbon costs have on their customers. C9 (2021) has effectively defined a development and manufacturing process that accounts for carbon costs in each step, i.e., a stage-gate model in which the cars profitability is evaluated based on an additional cost of carbon. Cars are to not pass to the next gate unless they are CO^2 adjusted profitable. Companies 3, 6, 7 and 10 go one step further. Their goal is to gain a comprehensive understanding of their products and the respective externalities. Therefore, they are never considering carbon in isolation. Much rather, so called impact indicators are defined where the shadow price for carbon makes up for just one of them. The underlying logic is summarized by C6 (2021):

> *10 years ago, when we developed this methodology to supplement our decision-making process from a theoretical point of view, we wanted to determine what is the cost for the planet i.e., the externality of manufacturing one kilogram of a given product. This is based on the life lifecycle assessment science. We have 19 impact factors for which we do have what we call a shadow cost, amongst all this CO^2 […] If you appreciate the logic in terms of decision-making, then you need to have a system in place to ensure that you will consider all the impacts and express them in the same unit. There's a reason why we do monetize them so that ultimately you can compare one solution to another one in full consciousness.*

Notably, given the theoretical nature of a shadow price, companies in fact do think it can lead to less resistance internally compared to a carbon tax.

As highlighted before, an ICP approach should eventually cover all emission hotspots along the value chain that can be influenced realistically. However, as discussed in chapter 2.2.1, scope 3 is difficult to accurately measure which results in companies limiting their scope 3 ICP design to business travel, albeit that scope 3 emissions generally make up the largest bulk of a company's emissions. Figure 14 captures this tellingly. Companies which do consider scope 3, only do so for business travel and commuting except for C9. Interestingly, the discussion on the dimension of *width* drastically shifts depending on the chosen instrument. Companies who adopted an internal carbon taxation think and act with regards to scopes: *"Scope 1, 2 and business travel for scope 3. That is the width of our impact."* (C10, 2021). Contrary, companies who utilize a shadow price talk of applications: *"So, we have a 90% plus view on the existing portfolio, 100% of the innovation pipeline, 100% of the investment pipeline and 100% of the M&A pipeline."* (C6, 2021) To generalize the *width* dimension to a discussion on mere scopes would therefore be undertheorized. However, independent of the chosen instrument, the long-term ambition for companies with their ICP design does indeed go hand in hand with the best practice ICP recommendation of Lam et al. (2017). Companies' long-term strategies are aimed at understanding their products in their entirety, allowing for an emission accounting on the product level. The goal is to determine the footprint of materials used across the whole value chain. The underlying motive is that every business-decision thus incorporates environmental externalities.

Regarding CAPEX, there is a notable difference between companies applying a conditionality and those who do not (see Figure 14). Companies relying on conditional requirements define a certain monetary threshold for capital investments. In case this is breached, the project would need to be additionally assessed based on a shadow price. This can be compared to the practice of internal project segregations where certain projects (e.g., +CHF 20mio) require a steering committee and others do not. This is in support of Lam et al., (2017, p. 25) pointing to the possibility of linking ICP to concrete business

decisions with the goal of lowering the administrative burden. However, companies do so only as a temporary measure while rolling out an ICP approach with the clear aim of eventually applying no conditionality. This is aptly captured by C3 (2021): *"The goal is, that every CAPEX decision accounts for GHG emissions – irrelevant of a given threshold. […] Recapitulatory, the more externalities are internalized in your NPV decisions, the more balanced your decisions will be."*

3.4 Depth – Business Influence

Essentially, the *depth* dimension aims to understand the influence the ICP design has on business decisions and the value chain partners. In an attempt to analyze this element with regards to the interview partners and deduce meaningful insights, the focus henceforth lies on the ICP responsibilities and the degree to which value chain partners are integrated (see figure 15**Fehler! Verweisquelle konnte nicht gefunden werden.**). It must be noted that the *value chain integration* column strictly refers to an ICP integration. A company may very well be extremely active in considering sustainability aspects with corporates and institutions along their value chain – just not based on their ICP design.

The development and roll-out of an ICP approach comes with a clear call for ownership and dedicated responsibilities. This is aptly encapsulated by C7 (2021):

> *I have learned that creating transparency and taking decisions are two completely different beasts. Just because you are now able to highlight your emissions next to financial key performance indicators (KPIs) does not help you in taking any decisions. Everyone will just look at it and ask themselves, "okay and what now?" Transparency is one thing, taking decisions another.*

To this extent, companies greatly value the existence of a central instance that functions as a competence center and accelerator for the rollout of an ICP approach. Figure 15 underlines that every company has a central team who ultimately oversees their ICP approach. These teams effectively function as virtual organizations, comprised of people from various fields of the business e.g., manufacturing, retail, logistics, and real estate etc. The overall responsibility lies with the core sustainability team. Together they build a project management office (PMO).

While the emphasis on having a central instance who manages the ICP is strong, the goal is to eventually have it run as part of business as usual. This desire naturally varies with the chosen instrument. C1 and C10, which levy a carbon tax will always have a central team that manages the carbon fund, there is no need for a transition to business as usual. Similarly, C5 which adopted an implicit price builds on the competencies of its sustainability team with no further plans to expand to other units. The process of transitioning to BAU is captured by C7 (2021):

> *This mode we have had from 2019 to 2020. We have changed it now. We have restructured it all and are now saying: "dear organization, you must now carry this topic going forward". The organization is ready. […] We [the PMO] now work on special topics that are relevant to the overall approach and coordinate these, but very selectively. The overall responsibility now lies with the organization, clearly.*

The handover can either occur to business as usual, as the above example highlighted or in the form of regional offices as is the case for C4 and C8. Here, a central team outlines to guidelines for ICP with regional offices in charge of converting these into their operations.

Crucially, companies consistently regard the management integration as indispensable. As is reflected in Figure 15, every company has at least one person from the management board overseeing the development of the ICP roll-out and subsequent development. The strong commitment by the management raises awareness beyond ICP and simultaneously motivates employees to consider ICP in their work.

Company	Organizational Responsibility	Management Integration	Value Chain Integration
Company 1	**Central**: dedicated "Internal Environmental Management" team which is responsible for GHG neutrality program, carbon footprint management and employee awareness programme ”COyou2”	**Yes**; Top-Management has responsibility. Recurring reporting to CEO	**No**; as carbon fee is concerned with absolut emissions on scope 1, 2 and business travel
Company 2	**Central**: responsibility lies with the "Resource Efficiency and Climate Protection" steering committee. Members are representatives of various deperatments such as manufacturing, retail, wholesales, logistics, real estate and sustainability. Additionally, excellence teams are in charge of BaU.	**Yes**; A member of the Executive Committee heads the committee. BoD oversees climate strategy.	**Yes**; but relatively small as the company controls most of the value chain itself. However, there is a strong focus on sustainable products with a lower carbon footprint with respect to its category. Therefore, there is a strong ask for CO2 emissions/product transparency to be provideed by producers and manucfacturers of sold products.
Company 3	**Central**: Split between Impact Measurement Team and Environmental Sustainability Project Team (corporate level)	**Yes**; management board integrated; CFO office	**Yes**; close collaboration with down- and up-stream partners to better understand scope 3 emissions. Biggest polluters were determined and approached - ask for certified GHG reporting to foster comparability among partners -> Desire to provide transparency and realize "Best-Buy" partners from a sustainable and price perspective.
Company 4	**Central**: Sustainability team, working with price scenarios and outline ICP design **Decentral**: regional heads responsible for conversion	**Yes**; sustainability team reports directly to board member who oversees all ESG initiatives	**No**; as emissions mainly stem from scope 1. Focus lies on research collaborations for new technologies.
Company 5	**Central**: Sustainability team, overseeing climate strategy and all corresponding initiatives	**Yes**; management board integrated	**No**; as there are no existing supply chain partners to consider
Company 6	**Central**: Initial pilot and roll-out phase was done by project team. Transitioned from project team to central team responsible for SPM and CE and LCA program	**Yes**; management board integrated	**Yes**; close collaboration with down- and up-stream partners to better understand scope 3 emissions. Special focus lies on strategical key accounts from which additional growth is expected.
Company 7	**Central**: PMO in charge of circular economy program. Slow transition of responsibility to BaU.	**Yes**; overall responsibility lies with CEO and BoD	**Yes**; close collaboration with down- and up-stream partners to better understand scope 3 emissions. Closely monitor all relevant suppliers, sometimes through on-site auditing.
Company 8	**Central**: sustainability team in charge of CO2 management and price scenario planning **Decentral**: Regional heads responsible for conversion	**Yes**; management board integrated	**Yes**; strong focus on customer side and providing carbon price adjusted solutions
Company 9	**Central**: Sustainability team, overseeing climate strategy and all corresponding initiatives. Operational hand over to finance and BaU	**Yes**; management board integrated	**Yes**; close collaboration with down- and up-stream partners to better understand scope 3 emissions. Special focus lies on understanding manufacturing processes of their suppliers.
Company 10	**Central**: sustainability team with integrated line function (operations, sales, finance, R&D, HR). Fund is managed by a separate development team	**Yes**; management board integrated	**No**; as carbon fee is concerned with absolut emissions on scope 1, 2 and business travel **Yes**; with regards to recents efforts in establishing LCAs for their product portfolio.

Figure 15: Depth Dimension: Overview (own figure)

The *depth* dimension further lays special focus on the extent to which value chain partners are integrated with regards to a company’s ICP approach. The corresponding results of this paper are summarized in Figure 15, column three. Notably, companies such as C1 and C10 which adopted an internal carbon tax have no active program that thrives for an integration of its partners along the value chain. Given the fact that the tax is levied on business operations and travel, this is comprehensible as there is no current focus on extending the levy across scope 3. Similarly, C4 is active in the sector of building materials. Consequently, there are only few up-stream partners and more can be gained by focusing on own operations as scope 1 makes up for most of their GHG emissions. Moreover, the business model of C5 (2021) does not offer a convincing case to expand on its ICP approach either: *“Us being in the service industry, we don't really have what you traditionally call a supply chain because we do not rely on someone giving us a component to assemble something. It's all service.”*

Those companies who engage in integrating their value chain employ stringent mechanisms to do so. Companies compute heavy polluters in their value chain and approach these with new vendor-policies. Therein they require them, amongst others, to file their rapports in accordance with the CDP. Truthfully, it must be added that they *[…] are aware of the limits to this approach. Any firm can file a seemingly perfect report, without telling us all there is. Think about outsourcing etc. This is problematic as we really want to get a picture of our whole value chain's footprint." (C3, 2021)* Nonetheless, there is a clear desire to better understand one's own products through increased thoroughness and transparency in information exchange with value chain partners. Consequently, this will influence how companies assess their suppliers: *"Therefore, we are not only considering our vendors from a price-point of view, but we ask for a coverage on their environmental-footprint, possibly on a product-level." (C3, 2021)* Thus, there is an evident case for companies to differentiate themselves with thorough data transparency to gain new customers and position themselves as attractive value chain partner.

For the companies employing these standards, the underlining theme, however, is education and enablement of their value chain partners. As C7 (2021) explains: *"This is not only about our carbon household and our approach to circularity but enablement of circularity for our partners and emission reductions in their respective value chains"*. In essence, it is about learning from and with each other. This is further encompassed by the ambition to be at the forefront of co-defining methodologies on how to assess suppliers and account for carbon emissions. There is a strategical component to it as it allows companies to act as industry leader and send a strong signal to peers and relevant stakeholders. C9 (2021) captures this ambition:

> *And I think they [peers] likely have the same issues as us in terms of accessibility of data in terms of no standardized methods on how to calculate this etc. But at the end of the day, instead of us waiting around and hoping that someone else should set that methodology, we are taking the opposite stance and try to go out and tell how we do it and what we do. […] we all need to have the details agreed upon to be able to run on this moving forward. So, we are hoping to set the standard for how we should calculate CO^2 and thereby evaluate suppliers on it because we usually have the same suppliers. And then it would be easier for us to evaluate them on their carbon footprint as well.*

Notably, in doing so, companies are extremely wary of their credibility to do so. As discussed in chapter 3.2, how a company designs an ICP approach boils down to the reception by their stakeholders:

> *"You need to make yourself credible to them, so that they will be comfortable. That they will trust the capabilities we have and then they will engage with us in a conversation, as they realize we are interesting to speak to and discuss the methodology, CO^2 footprint, scope 3, etc."* (C6, 2021)

3.5 Time – Review Cycle

Discussing the design avenues for ICP, it is necessary to acknowledge the dynamic element to its continuous development and improvement. The practice of ICP is new to most companies and regarded as highly experimental. Accordingly, companies are fully aware of the continual need to review their ICP specific decisions and choices. Figure 16 adequately highlights that every company has certain review mechanisms in place. Furthermore, the second column captures relevant alterations that have occurred since the initiation of the respective ICP program.

Company	Review Cycles	Alterations to ICP design
Company 1	**Yes** - None so far. New strategy in place since January 2021	Increases price from CHF8 to CHF100 in 2021. Strategy in place til 2030. Incremental price increase
Company 2	**Yes** - Annually; Cost/benefit analysis	None, strategy in place til 2023
Company 3	**Yes** - Annually; data refreshing and computation	None so far
Company 4	**Yes** - Every four months (high level); prices are dynamic	Shifted from Europe focused ICP approach to a global roll-out in 2014.
Company 5	**Yes** - Every two years; in case of external impact on sustainable projects	Implicit ICP approach has been adopted retroactively (2016) in acordance with climate neutrality strategy (2011). Price moved from CHF9 to CHF13
Company 6	**Yes -** Annually; review of market signals and impact categories (21 impact indicators)	**Mid-term**: Price increase from CHF26 to CHF52 **Long-term**: SPM has been introduced in 2008, price has been static ever since. Possible increase in the future.
Company 7	**Yes** - Quarterly; review of Circular Economy (CE) relevant aspects. ICP part of that.	ICP as part of wider CE approach and therefore relatively new. No alterations so far.
Company 8	**Yes** - But no fixed review cycles. Closely monitoring EU-ETS prices.	ICP design experienced alterations with strategical shift of the company. Besides CAPEX, ICP is now utilized for pricing simulations.
Company 9	**Yes** - But none so far. New strategy in place since 2021. Revisions will take place however.	Original ICP built upon EU CO2 fleet regulation for car manufacturers. New ICP roll-out has taken place in 2021.
Company 10	**Yes** - Annually; determination of fund allocation	Carbon fee and respective carbon fund were set up in 2018. ICP design will be extended by a shadow price to reconsider product materials.

Figure 16: Time Dimension: Overview (own figure)

Chapter 3.2 highlighted the importance of credibility for companies in determining their prices. As the quotations have shown, this further influences incremental changes to the height of the price. While companies do consider external influences in regular frequencies, there are also solid arguments to not alter the corresponding ICP design too hastily. C6 (2021) reflects: *"What we must avoid is to change the carbon price because you want to reflect the results of the action, you're undertaking to reduce your carbon footprint. You do not want to reflect the changes you bring in the methodology."* This point of view is especially prevalent for company 3, 6, 7, and 10 as their impact measurement approach does not only consider carbon (see chapter 3.3). Thus, the effect of a changing carbon price would lead to a considerable influence on their assessment of externalities. Furthermore, if prices were to be changed too frequently this can have an irritating effect, both internally and with regards to relevant stakeholders.

Interestingly, C1 is the only one to have a pre-defined price trajectory that will be followed in the next 10 years. This resembles the low-to-high price strategy advertised by Lam et al. (2017). According to this strategy, a company could start with a low price to minimize the impact on its competitive position or enable departments to familiarize themselves with ICP which in turn could lead to a higher acceptability within the company. However, the rationale behind these incremental price increases is the alignment with their 2030 net-zero strategy and the expected price increase of carbon removal certificates. Illustratively, except for C1, not a single company has contemplated about setting a fixed price target to be reached in a set number of years. Moreover, setting a comparably low carbon price due to a competitive disadvantage was not raised as an argument by any company. Thus, it can be argued that a low-to-high strategy is of theoretical relevance and has little practicability.

4 Steering: Management Control Framework for Internal Carbon Pricing

Breaking the topic of ICP into different dimensions allows for concrete discussions to understand, compare, and deploy different ICP approaches. The interviewee's have convincingly demonstrated the expedience of doing so. However, discussing ICP solely based on these dimensions would be incomplete to understand the underlying strategical themes that motivate companies to approach ICP in the way they do. As accentuated in the beginning, the lack of transparency in divulging methodologies and existence of clear guidelines leaves much room to gauge the impact of ICP. In order to understand and navigate between different approaches to ICP, a framework driving the strategic allocation of a company's ICP is necessary.

The proposed framework is depicted in figure 17 and lay the foundation for analyzing, understanding, and applying ICP contingent to the specific firm environment. The framework proposes possible design avenues for ICP. Specifically, the Business Model- and Rationale-layer are regarded as crucial before turning to the just discussed four dimensions. It is argued that companies must first consider ICP holistically, understand their risk exposure and define core rationales which ultimately determine how a company reflects and acts upon ICP. If not, companies risk misaligning their ICP design with overall business ambitions.

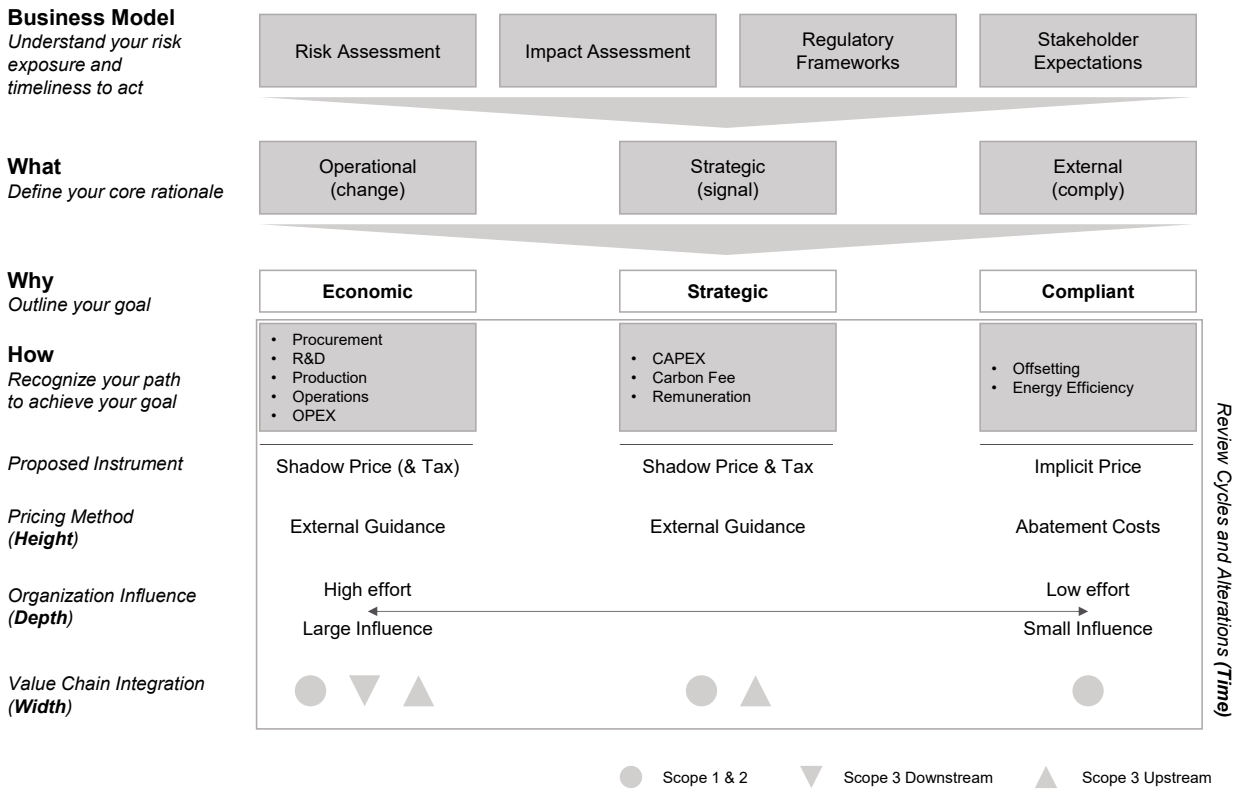


Figure 17: Framework for the Design of Internal Carbon Pricing (own figure)

The Business Model layer aims at understanding contributing factors that influence the degree to which carbon pricing impacts a firm, both from an out- and inside perspective. Assessing the four aspects portrayed in figure 17 allows companies to contemplate on the importance of ICP. To that extent it can be that a firm decides that ICP is currently a low-priority topic. By no means is it suggested, that ICP is recommended to every company by default. The four aspects are accompanied by a set of questions which address central themes that have emerged during the data analysis phase of the interview. They are not exhaustive but reflect major considerations to be contemplated by firms when gauging upon the adoption of ICP.

Business Model: *Understand your risk exposure and timeliness to act*

Risk Assessment *Outside - In*	• Does ICP change the playing field among competitors? • Is there an acute need to seek alternative ways of doing business? • Is the industry closely regulated and how fast can development steps be changed? • Is the company's unavoidability of business nature understood?
Impact Assessment *Inside - out*	• How are emissions distributed across scope 1, 2 and 3 and what are the main drivers? • Are relevant value chain partners and their corresponding actions known? • How to the product development cycles look like?
Regulatory Framework	• Exposure to new standards? E.g., Taskforce for Climate-related Financial Disclosure (TCFD), FINMA in CH (Finance) & EU Taxonomy • Domicile / countries of operations with legal differences? • Is there an opportunity to co-shape upcoming methodologies and work alongside companies and regulatory initiatives?
Stakeholder Expectations	• Listed vs non-listed → Different expectations and reporting requirements for listed companies • Shareholder and Stakeholder expectations? E.g., Blackrock communication: quantify carbon risks in portfolio • Broad public exposure → does my company enjoy lots of media focus? • Political player → system relevant ?

Figure 18: Overview of Business Model Layer (own figure)

The **Risk Assessment** intends to grasp the impact carbon pricing has on an industry and the dynamics between players therein. To that extent, it is also necessary to recognize how fast internal processes can be changed while complying with existing regulations. For example, industries like pharmaceutical and medicine are heavily regulated with regards to a single manufactured product. This can drastically impede the ability to use ICP to its full extent. Lastly, companies must recognize their bottom-line of emissions. Unless drastic changes in business operations were to occur, certain emission hotspots will prevail. These must not only be recognized but also carefully considered in the respective ICP design approach.

The **Impact Assessment** aims at understanding aspects which are company specific and concern the analysis of their respective carbon footprint. With regards to a company's emissions, it is advised to not limit the discussion to mere scopes. There is equal value in understanding emissions with regards to the product portfolio, divisional and functional differences, investment decisions etc. Acquiring the knowledge for emissions on an operational level allows for a thorough exertion of ICP. Furthermore, companies must consider their respective "position" in the value chain. Do we have a lot of influence over our partners? Can our ICP approach shape and form carbon treatment beyond our firms' operations i.e., multiply the effects of our ICP approach? This is the element of Education & Enablement discussed in chapter 3.4 and an eventual necessity for companies to reflect upon as part of the Impact Assessment in an attempt to design a context specific, comprehensive and auspicious ICP approach.

Current within the **Regulatory Framework,** there is a multitude of initiatives (e.g., TCFD, EU Taxonomy, national carbon pricing policies; see chapter 2.1) for companies to consider and not every company is affected equally. Thus, there is an acute need to continuously monitor the development and consider the impact on business operations. Therefore, it is no surprise that companies actively try to co-shape this rapid progression. For example, the value balancing alliance (VBA), a consortium of multinational companies developed their own methodologies to account for the environmental and social impact and

convert these into financial data. Currently, they are in close collaboration with the EU to refine the EU Taxonomy.

Lastly, **Stakeholders** greatly influence the conception of ICP. That is, companies not only react to stakeholder expectations in contemplating to pick up ICP i.e., it serves as a motive, but the actual design of an ICP approach is further outlined in accordance with stakeholder expectations. Thus, it is crucial for companies to realize the manifoldness of expectations through constant exchange with relevant stakeholders for they must ultimately recognize and deliver upon the respective stakeholder needs. The underlying theme, as restated by multiple interviewee's, is credibility. In the context of ICP, credibility does come in many colors as companies differ between Internal communication, Customers, Value chain partners, Market / investor relations.

Naturally, the degree to which a company is affected by stakeholder expectations fluctuates with its sector, size, political exposure and whether it is a listed or non-listed company etc. This paper has not accounted for any such variables explicitly. Hence, the reader is asked to refer to the research of Bento & Gianfrante (2020) who worked out the determinants of ICP in detail.

To recapitulate, the Business Model layer fundamentally helps a company to reflect on the impact carbon pricing has on its business operations and thus, will allow companies to contemplate on the relative importance of ICP. Every company will have different answers and take-aways from analyzing the above outlined elements. As will be discussed hereafter, this greatly influences the underlying rationales for firms to deploy an ICP strategy. In chapter 2.1, we argued that it is expedient to subordinate the drivers for ICP and cluster them into *Operational*, *Strategic* and *External* drivers (see Figure 1). We regard those as three core rationales which fundamentally determine the constitution of ICP. They are summarized below, see figure 19.

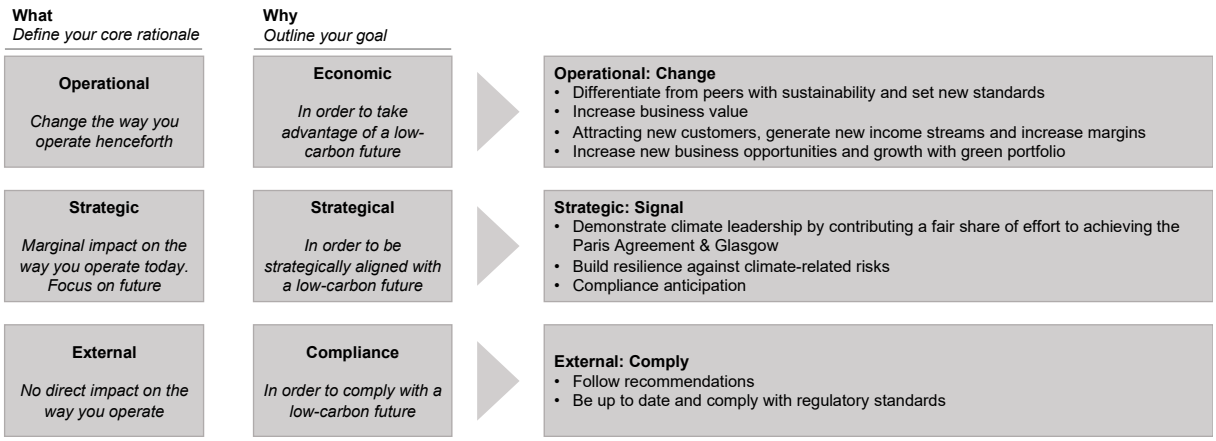


Figure 19: Core rationales and Corresponding Objectives (own figure)

The fundamental goal of the **Operational rationale** is to take advantage of a low-carbon future. At the core lies the assumption that business operations will continuously shift towards less emissions and the concomitant opportunity to capitalize on the potential of additional premiums to be gained by serving the increased demand for low-carbon products i.e., "because somebody is ready to pay a premium for it" (C6, 2021). Based on the interviews conducted, firms who fall under this category tend to apply a shadow price and think in applications e.g., R&D, Procurement, Production. As they strive for a comprehensive understanding of their carbon footprint down to the product level and constitute their ICP approach respectively, their width and depth dimension is extensive. This comes with high organizational efforts but is offset by the immense understanding of and influence over their value chains.

In a similar manner, the **Strategic rationale** also builds on the assumption that industries will shift towards low-carbon economies. However, in contrast to the operational rationale, it primarily aims for a strategic alignment and does not fully commit to changing operations today. To this degree, sending a clear signal of acknowledging and contributing to the PA is at the center of the Strategic rationale. Interviewed companies which fall in this category predominantly adopt an internal carbon tax and focus on scope 1 and 2 emissions with the inclusion of business travel (scope 3). Utilizing a shadow price, the focus lies on CAPEX to pave the way for long-term emission reductions. Interestingly, aligning the remuneration with absolute emission reduction targets is seen as one of the strongest signals to external stakeholders.

The **External rationale** equally recognizes the shift to a low-carbon future but does not pro-actively act upon it. This means that companies which fall under this category only deploy ICP mechanisms if there exists an external demand. Based on the interviews conducted, implicit prices are primarily adopted with a mean to comply and live up to these demands.

Evaluating the above, it is important to capture differing characteristics of each core rationale. ICP approaches constituted based on the *Operational* rationale are to be considered as the most disruptive and progressive for businesses. They differ mainly in their acute effect on current business operations. Furthermore, a decisive feature of *Operational* ICP approaches is the willingness of firms to develop and design a unique method to price carbon internally. This distinctive element allows companies to conceptualize ICP contingent to their firm-specific context and consider own needs. Consequently, these approaches are difficult (and not suitable for that matter) to replicate. As C6 (2021) put it when asked whether they think their approach would be scalable to other firms: “I think it is not, actually”. This is especially prevalent for the interviewed companies which developed impact measurement systems that go beyond the consideration of carbon. To this extent, their ICP approach must and indeed is much closer aligned with the group strategy. While the underlying goal of the *Operational* rationale is to gain a competitive advantage in a low-carbon environment, the *Strategic* rationale aims at demonstrating climate leadership by contributing to achieving the climate targets formulated in the PA. Here, ICP designs do not represent the same degree of distinctiveness but still allow for an organizational influence aimed at pro-actively curbing emissions in anticipation of upcoming regulatory standards. This stands in contrast to the *External* rationale which is expressed by a tempered and reactive behavior. These ICP approaches are comparably easy to replicate and demonstrate a low organizational influence.

The beforementioned characteristics can be visualized based on Stacey’s (2011) matrix (see Figure 20). The terminology is taken from Stacey (2011) while the content represents the three core rationales and corresponding ICP measures. It captures the relationship between the influence on the organization and the varying complexity depending on the core rationale.

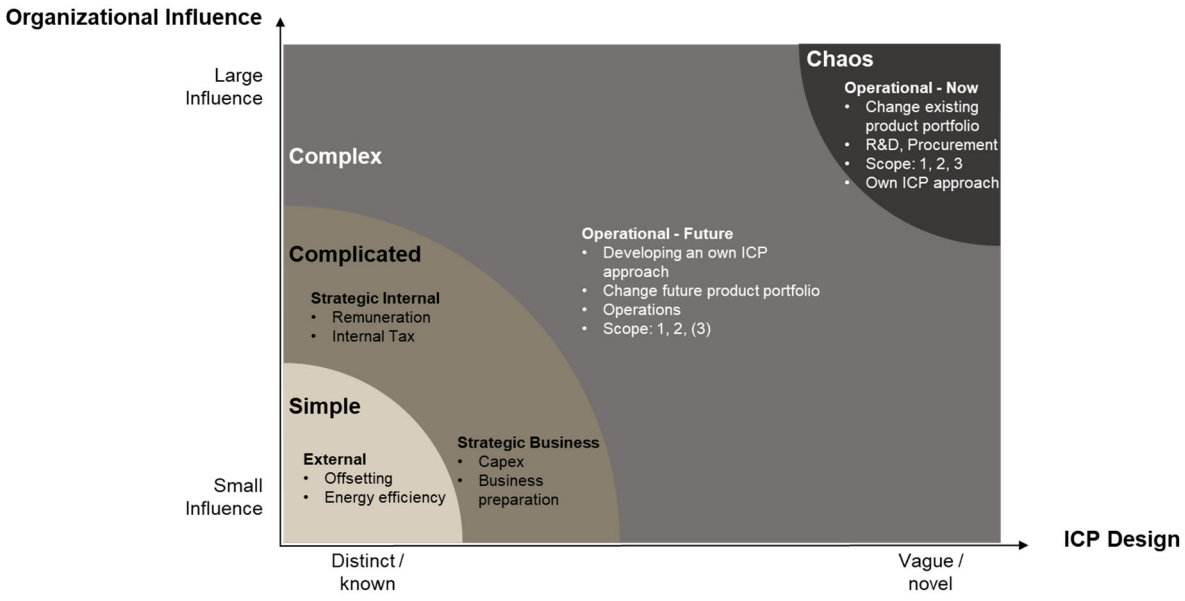


Figure 20: Relationship Between Design and Organizational Influence (own figure)

It must be emphasized, that these core rationales and corresponding ICP features are by no means mutually exclusive. With its specific ICP approach, a firm can and may very well display elements of all rationales – however, its fundamental approach towards ICP should not. That being said, it is important to recognize that companies who follow either the *Operational* or *Strategic* rationale are always compliant with current regulations. They just go one or two steps further. The combination of the proposed framework (see figure 17) and adoption of the Stacey matrix should therefore simply serve as a starting point for firms and analysts to conceptualize and compare different ICP designs. Consequently, this allows to map companies and their ICP designs.

5 Outlook

Finally, this chapter will discuss a possible approach to ICP and thus serve as a practical example. The core considerations are summarized in figure 21. It assumes a successful completion of the steps elaborated under the Business Model layer and follows the four dimensions with a five-year view.

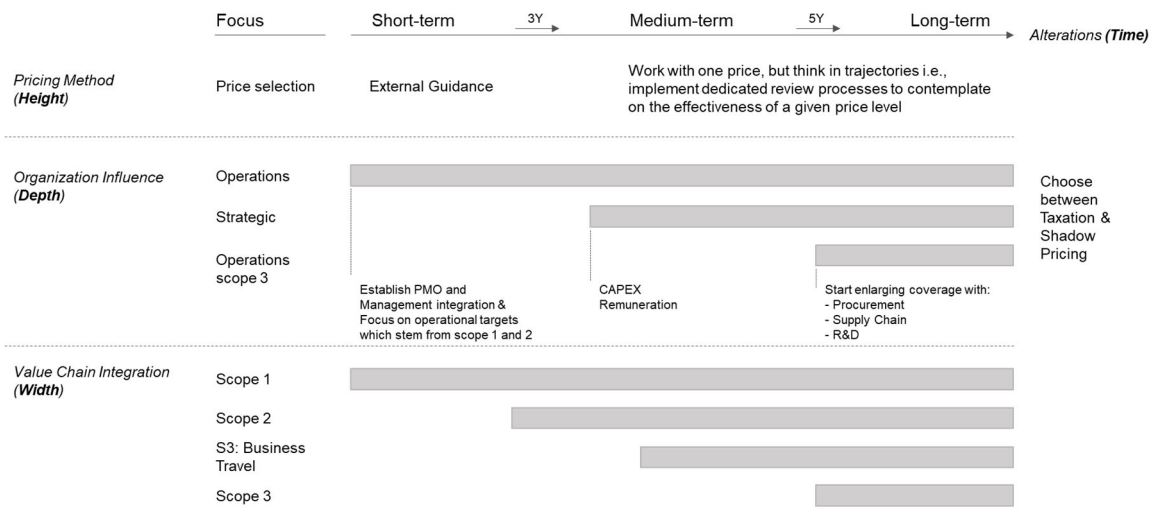


Figure 21: Possible outlook for the adoption of ICP (own figure)

Here, the **Height-Dimension** follows the logic of relying on external guidance as a methodological approach for the price determination. The reasons for doing so are threefold. First, research initiatives such as the *Carbon Pricing Leadership Coalition* and the *Carbon Pricing Corridor Initiative* are widely considered as leading in terms of scientific guidance for carbon price levels. Thus, this choice comes with an inherent credibility that is unlikely to be matched if a company were to determine its carbon price inhouse or through some other approach. Second, the pragmatic decision to consider external guidance allows for quick shift in focus on questions such as “Where and how do we want to apply this price”. Third, potential national and international regulations on carbon pricing are closely mirroring scientific recommendations themselves. Therefore, companies which follow similar recommendations are likely to be aligned by default. Furthermore, it is important to recognize that the initial price level set is not meant to be understood as fixed. It is suggested to start working with one price but thinking in price trajectories and scenarios.

Regarding the **Depth-Dimension**, the company should first focus on operational targets that can be tackled without too much effort – these generally stem from scope 1 and 2. Beyond that, investment decisions (e.g., CAPEX, M&A) as well as remuneration can be considered. Only at the later stages, should the ICP approach be enlarged to an extent that covers all emissions hotspots across the whole value chain that can be influenced realistically. However, there should be consistency with regards to a central instance that functions as a competence center and accelerator for the rollout of an ICP approach as well as a constant management integration to facilitate its development. Moreover, companies are generally advised to either choose between an internal taxation and a shadow price or a mix of both instruments. Their characteristics and respective impacts are summarized in figure 5. Should a company, however, solely opt for shadow pricing it must further consider how it can raise money for sustainable initiatives beyond the core business i.e., how are energy efficiency projects to be financed. Unlike an internal carbon tax, a shadow price will not provide the company with a central fund and consequently with the financial means to allocate these towards specific projects that are not part of day-to-day business.

In this example, the aspects of the **Width-Dimension** are to be understood as logical consequence from the focus laid in the Depth-Dimension. The company is expected to gradually transition from scope 1 to scope 3. Business Travel stands in isolation as it allows for a comparably easy integration of scope 3 emissions into the respective ICP design. Given the capabilities of a company, this aspect can also be considered in an earlier phase.

Lastly, as the time intervals already suggest, the **Time-Dimensions** acknowledges the dynamic element to a ICP designs continuous development and improvement. To that extent, it is important to establish review mechanisms which solidify this progress. As discussed above, this can imply changing the height of the price but also the scale of the a given ICP design, see also figure 16.

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7 Contact

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