Financing a Low-Carbon Economy: Towards a Standardized Method for 'Two-Degree' Portfolio Alignment for Banks.

Financing a Low-carbon Economy: Towards a Standardized Method for 'Two-degree' Portfolio Alignment for Banks.

Kaitlin J. Crouch

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Abstract

Climate change poses an unprecedented threat that will require a systemic transition away from high-carbon activities to avoid the worst effects (IPCC, 2015). Bank lending makes up a significant source of external capital for businesses, yet clear market and policy incentives to accelerate the needed shift of investment to low-carbon assets is lacking (Campiglio, 2016). Further, due to the difficulty of calculating the greenhouse gas (GHG) emissions related to the clients and economic activities they finance, banks cannot currently set appropriate emissions reduction targets (Science Based Targets Initiative, 2017). This is a result of low data availability and no market standard for measuring portfolio climate impact. The most common metric, 'financed emissions', the emissions attributed to a bank or investor financing an emitting company, has not yet proven itself accurate enough to be widely adopted among banks for target-setting. Meanwhile a new metric, 'financed technology', the analysis of the type and quantity of a GHG-emitting or -reducing technology or asset directly or indirectly financed in a given portfolio, has recently emerged as a possible alternative metric but has yet to be widely tested. Management begins with measurement, and without reliable, proven metrics, banks will be ill-equipped to set appropriate targets.

Previous studies have qualitatively reviewed existing methodologies. To date, however, there is no guidance on which metrics and methods outperform others in terms of accuracy and utility for effective target-setting. Furthermore, no research has quantitatively compared the two above-mentioned metrics. This thesis, therefore, quantitatively analyzes and compares the 'financed emissions' and 'financed technology' metrics and underlying methodologies to determine whether or not these are accurate and

useful for target-setting. In order to do so, this thesis presents a new framework to compare data inputs – the Data Input Accuracy Scoring (DIAS) framework. For further determining the usefulness of each metric for target-setting, a qualitative review, including a case study, was applied.

My first hypothesis was that due to the unavailability of data for the majority of a bank's clients representing the largest concentration of emissions, methodologies utilizing GHG emissions as a metric will not be an accurate means for a bank to measure and steer its portfolio. I also hypothesized that sector-based metrics focused on financed-technology yield more accurate results that can be utilized for target-setting.

While several financed emissions methods exist, one in particular has emerged among some European banks: the so-called 'PCAF' (Platform Carbon Accounting Financials) approach. With regards to 'financed technology' methods, one has recently been developed and is rapidly garnering attention, the so-called 'PACTA' (Paris Alignment Capital Transition Assessment) approach. In order to quantitatively compare these two methodologies, the present research utilizes a contrived lending portfolio as a control variable by which the metrics were tested and compared on the basis of accuracy and utility for target-setting.

Next to contributing a framework by which climate metrics can be objectively assessed, this research identifies key elements for setting targets in line with the below-2˚C target, providing a clear, quantitative distinction between methodologies. In line with my hypotheses, the two most material findings are 1) that the data inputs of the financed emissions approach suffer considerable inaccuracies, yielding a much lower accuracy score than the financed technology inputs and 2) that target-setting requires a sector-based approach. The results of the present research can help inform banks regarding which

metrics show the most promise for target-setting. Furthermore, the findings could contribute to the establishment of a market standard to which policy makers and stakeholders can hold banks accountable. This in-turn should help incentivize the accelerated shift of finance from high- to low-carbon assets.

Dedication

For my parents who helped shape my love for learning and instilled a sense of personal responsibility for good stewardship of the things we've been given. For my first manager, Hans Triep, whose coaching, encouragement, friendship and support set me on this academic journey. For my friends, especially Vicky, who kept me going and showed me great patience. And lastly, for Tim, whose love and belief in me got me over the finish line and kept me sane.

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Definition of Terms

Assets (financial and tangible): A financial asset is a liquid asset of derived value backed by a contractual claim. A tangible asset has physical value, usually held as collateral, such as land, property, commodities, etc.

Asset manager: a firm that manages investment assets and portfolios on behalf of an investment fund (typically equity and bonds).

Climate-related risks: financial risks resulting from climate change-induced impacts on the value of assets, companies and their financial performance. Two main risk types are captured: physical (related to extreme weather) and transition (related to market or policy changes).

Commercial Banks: a type of financial institution that provides business loans and mortgages using depositor cash and offers basic financial products and services. For the purposes of this proposal, this term will be largely used in the context of wholesale banking which mostly deals with servicing larger corporates.

Institutional Investor: an entity that trades securities in bulk quantities.

Finance: funds provided either as an equity investment (by an investor) or as credit/debt issued by a lender – usually a bank.

Financed Emissions: the greenhouse gas emissions resulting from the underlying assets (e.g. collateral, projects, companies, products, etc.) financed by a bank or investor and proportionately attributed to that financial firm as a part of their GHG emissions footprint.

Financed Technology: the analysis of the type and quantity of a 'climate-relevant' technology/economic activity directly or indirectly financed in a given sector portfolio

Investment: for the purposes of this proposal, this will refer largely to equity investment, the purchase of shares of ownership of a company or asset.

Lending Portfolios: portfolios comprised of debt issued to be repaid in full with interest over a period of time or in the form of a credit limit to be drawn, repaid and redrawn upon.

Science-based targets: targets that will cause a company to align its climate performance with a below- 2˚C trajectory.

The 2˚C Target: the agreement to limit global average temperature rise to ‘well-below’ 2˚C compared to pre-industrial levels. This target was agreed by 196 countries during the United Nations Convention on Climate Change 21st Conference of the Parties.

Chapter I

Introduction

In order for global temperatures to remain well-below a 2˚C rise and ideally no higher than 1.5 ˚C compared to pre-industrial levels, as was agreed in the Paris Climate Agreement, an estimated annual average of $2.4 trillion USD of finance and investment will need to be channeled towards low-carbon technologies and clean energy and away from high-carbon activities until 2035 (UNFCCC, 2016; de Coninck et al.,2018). The last decade and a half have seen a steady increase in the amount of investment in renewable energy production, with a six-fold increase between 2004 and 2011 and with intermittent growth since then (McCrone, 2018). However, the current rate of increase in finance of low-carbon energy and efficiency measures is not enough. In 2014, it was estimated that the global economy is running an annual deficit of $800 billion USD in energy finance in light of what is needed to meet the below 2˚C target, and this gap could grow as signs of slowing begin to show (see Figure 1) (McCollum et al., 2014; McCrone, 2018).

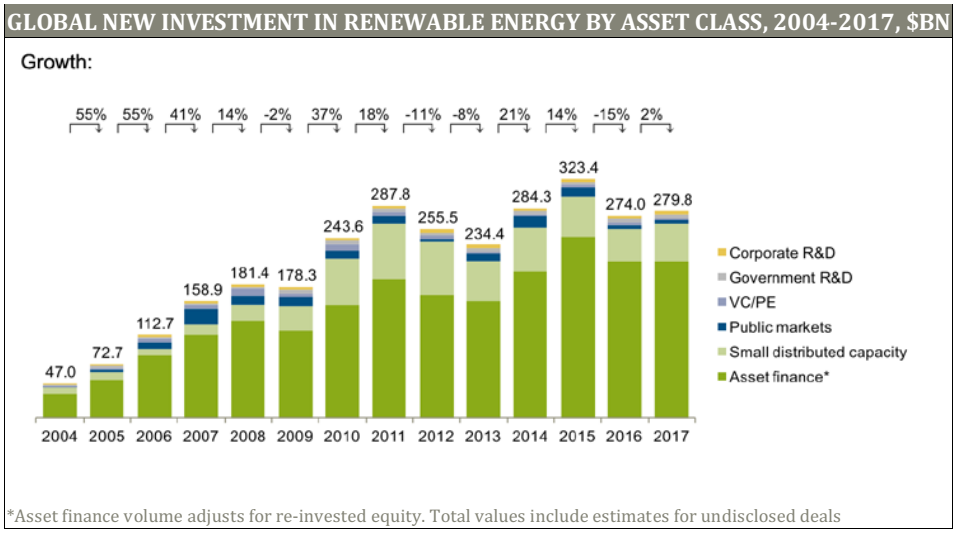


Figure 1. Global New Investment in Renewable Energy by Asset Class. Annual total growth percentages and breakdown of finance source from 2004-2017. Note that this does not have a direct correlation with capacity additions. Source: McCrone, 2018.

Bank lending (debt financing) makes up about 59% of total global capital stock in the market, making it a significant source of finance for companies (Whitley et al., 2018). Banks also have a broad reach as they are active across all sectors of the economy, including the entire energy supply chain and sectors that consume most of the supplied energy. These factors make banks an important player in providing the necessary funding for an orderly transition from a high- to low-carbon economy.

Despite this clear role for banks to play, there is no strong market incentive for banks to act since the financial consequences of climate change are not effectively being priced into existing risk metrics (Financial Stability Board, 2017; CISL & UNEPFI, 2014). Besides market signals, policy incentives are also lacking as environmental indicators are left out of major regulatory frameworks for banks and corporates to-date (HLEG on Sustainable Finance, 2018). Further, sustainability rating indices, considered important indicators of a stock listed company's environmental, social and governance

(ESG) risk/performance, may not appropriately address the climate impact of a bank's lending activities due to their focus on direct rather than indirect impacts (Dorfleitner, Halbritter & Nguyen, 2015; Robeco SAM, 2017). Finally, banks themselves lack the metrics, methods and tools needed to understand the impact of their business on the climate and set targets to reduce this impact (Science Based Targets Initiative, 2017).

In an attempt to solve this problem, banks and financials have worked alongside NGOs and consultancy firms to develop methods for measuring 'financed emissions', the GHG emissions that can be attributed to a bank or investor providing the necessary capital for an emitting company to operate or grow (2° Investing Initiative, 2013). While many methods have helped investors and some banks to estimate the emissions associated with their core investing or lending activities, the results have seemingly only provided broad-strokes assessments that are time-consuming and costly to make, particularly for banks (2° Investing Initiative, 2015). Further, the majority of the available emissions data are limited to listed companies, which make up only a limited percentage of a bank's lending exposure. This has resulted in a very low rate of adoption of the financed emissions approach among banks.

In an effort to rely less on client-reported data, a new metric has emerged: 'financed technology', the analysis of the type and quantity of a GHG-emitting or -reducing asset directly or indirectly financed in a given portfolio and measured against external 2° or below scenarios. This could offer banks an alternative metric to financed emissions but has yet to be widely tested or applied among banks.

The inability to quantify and understand whether or how a bank is contributing to or mitigating climate change will impede appropriate action. As such, without clear metrics for creating portfolio transparency with regards to climate alignment, policy

makers, investors and senior management alike will be ill-equipped to make strategic decisions that lead to an accelerated, necessary shift in finance towards low-carbon assets (Ritchie & Dowlatabadi, 2014; McCollum et al., 2014). Similarly, this can also lead to an unintentional over-exposure to high-carbon assets from a risk perspective (2° Investing Initiative, 2017). Measurement and relevant benchmarks are, therefore, a critical starting point for facilitating the needed transition in climate-resilient, low-carbon finance.

Research Significance and Objectives

This research aims to contribute to the identification of a market standard for portfolio climate-impact measurement that will enable banks to set targets aligned with the below-2˚C target. This study has the potential to provide a novel contribution to this field as existing methodologies and metrics have not been quantitatively tested and compared for accuracy or applicability to a lending (debt-issuing) portfolio prior to this research. Existing methodologies have also not previously been quantitatively assessed on their ability to enable target-setting practices. The conclusions, therefore, can help inform banks and other stakeholders of which metric and method shows the most promise for being further developed into a viable tool for measurement and steering. Alternatively, it can help guide banks, regulators and other stakeholders away from applying or demanding methods that would not yield useful results. Finally, assessing these methodologies' ability to allow for target-setting provides a review of the robustness of greenhouse gas accounting as an approach for climate-impact assessment for banks. This research therefore provides a quantitative analysis of the two main existing methodologies and their underlying metrics based on the above-mentioned parameters, namely accuracy and utility for target-setting.

My research objectives are:

- To provide an objective review of the two main existing metrics and underlying methods for measuring climate impact of lending portfolios – namely the PCAF 'financed emissions' and the PACTA 'financed technology' methodologies – to identify the strengths and weaknesses of each and guide banks towards the most effective metric.
- To identify the key methodological elements that allow for target-setting; meaning that measurement is executed in order to steer towards an intended goal.
- To contribute an objective scoring framework by which climate impact measurement methodologies can be compared for accuracy.

In order to address my research objectives, I first place the problem definition in the broader context of environmental reporting, climate impact measurement and previous studies. The background section is followed by a presentation of my research questions, hypotheses and specific aims, followed by four subsequent chapters providing a description of the applied methodology, results, key conclusions and discussion.

Background

In order to set the stage for my research, I first outline the current state of environmental reporting and target-setting among financials in general and banks in particular and how this has influenced the development of climate impact measurement methodologies. I then evaluate the existing literature that reviews and analyzes these

methodologies and the most relevant claims or contributions made by these studies. Finally, I introduce and describe the two methods under review in this research.

A Brief History of Environmental Disclosures and Target Setting for Financials

Companies, including financials, have been voluntarily reporting on their environmental performance, including GHG emissions, in annually published sustainability reports or in integrated annual reports for more than 20 years – driven partly by investor demand, partly by external stakeholder demand and partly by internal drivers to increase brand value (Siew, 2015). Carbon accounting standards, such as the Greenhouse Gas Protocol (GHGP) developed by the World Resources Institute (WRI), the World Business Council for Sustainable Development (WBCSD) and their corporate partners, were introduced as early as 2001. Today, the GHGP is considered to be the leading standard for carbon accounting among corporates (Greenhouse Gas Protocol, 2018). For nearly fifteen years, a growing number of large corporates have been reporting their greenhouse gas emissions and associated targets to CDP (see figure 2) and have been reporting environmental performance to raters such as Robeco SAM's Dow Jones Sustainability Index (DJSI) since 1999 (Blanco et al., 2016; CDP, 2017; Robeco SAM, 2018). Investors utilize environmental, social and governance (ESG) data from CDP, DJSI and other rating indices to determine how well a company is managing non-financial risk that could otherwise damage shareholder value. For this reason, companies also use external ratings to benchmark their own performance and make improvements (Dorfleitner, Halbritter & Nguyen, 2015).

Both the GHGP and external indices allow corporates to set their own organizational boundaries for carbon accounting and explain exclusions (Greenhouse Gas Protocol, 2018). This 'comply or explain' approach has led to the common exclusion of many so-called 'scope 3' categories which concern the emissions related to a company's core goods or services. For a bank, this concerns the emissions related to its core lending activities such as a project it finances or a client loan. This means that the majority of large corporates disclosing greenhouse gas emissions, including banks, are only held accountable for a very small part of their total indirect emissions, which can be more than a thousand times that of the reported scope (2° Investing Initiative, 2015). As figure 2 demonstrates there is an increasing trend in scope 3 reporting among corporates, both as a result of increased external pressure and as a result of it becoming common market practice. This trend has also reached the financial sector as pressure for scope 3 disclosure has increased, in particular in the European Union, with the latest updates to the EU Non-financial Reporting Directive's non-binding guidelines (European Commission, 2019).

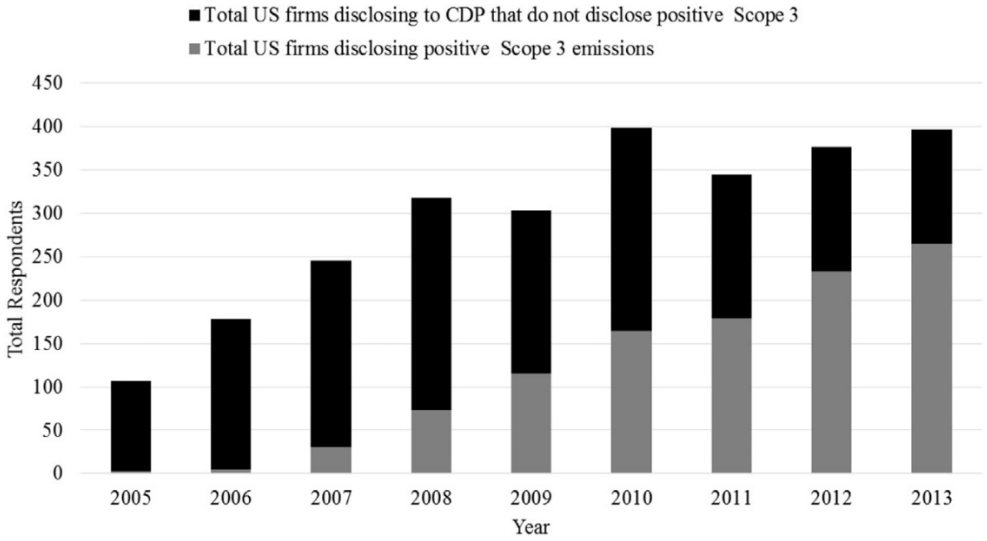


Figure 2. US firms (including non-S&P500) disclosing emissions data to CDP. Number of disclosing firms with and without positive scope 3. Source: Blanco et al., 2016.

The Future of Environmental Disclosures and Target Setting for Financials

It is a growing concern among investors and regulators that financial institutions are not properly measuring and managing climate-related risks which could have significant financial consequences. However, banks are not yet explicitly required, by regulators or policy makers, to address such risks (Financial Stability Board, 2017; Boston Common Asset Management, 2017). Banks are therefore neither being held accountable for missing material (hidden) risks nor are they incentivized to proactively demonstrate leadership through target-setting and execution (Schwarcz &Anabtawi, 2011; Bowen, Campiglio & Tavoni, 2014). This demonstrates a painful gap between investment need for a below two-degrees world and the ability for lenders to effectively manage portfolios in this direction based on forward-looking risk models and opportunity analysis (Campiglio, 2016).

The Financial Stability Board's (2017) Taskforce for Climate-related Financial Disclosures (TCFD) has made the first major attempt to set a new standard for reporting climate-related risks pertaining to a bank's portfolio or indirect impact through its core lending activities. In particular, the TCFD has outlined the need for forward-looking analyses and target-setting. The TCFD launched its final recommendations in the summer of 2017 offering a reporting framework meant to bring climate-related risk exposures to annual financial filings of major corporates, including banks. Such disclosure is meant to help the financial sector make better-informed investment decisions. However, the TCFD recommendations are far from being widely implemented and are wrought with various shortcomings.

First of all, the TCFD recommendations present a voluntary disclosure mechanism which will mean scattered adoption. Further, the TCFD recommendations do not offer

comprehensive guidance on how a company or banks should define metrics and conduct financial risk assessment. Without such definitions, companies will define their own standards and the data will be virtually incomparable. Finally, and perhaps most significantly, the TCFD recommendations do not define clear time horizons for assessment while lenders tend to have relatively short-term loans compared to investors. This means a bank can easily remain below material risk thresholds while remaining highly exposed to e.g. fossil fuels (Dutch National Bank, 2016).

Therefore, the recommendations will not necessarily lead to a clear understanding of whether or not a bank is contributing enough to help our economy transition to a so-called 'well-below 2 degrees world'. To summarize this, the recommendations ask the question, 'how will climate change (transition and physical risks) impact my business?', rather than 'how can my business contribute to climate change mitigation?' While they are an important first step, the TCFD recommendations will not lead to the necessary shift in capital from high- to low-carbon sectors in and of themselves (Financial Stability Board, 2017). Banks and businesses alike need to be proactively contributing to climate change mitigation if the most devastating effects are to be avoided. Proactive contribution could be demonstrated through robust and transparent reporting of the impact of a bank's activities on the climate and management of these impacts through mitigation efforts.

For this reason, the technical expert group, a 35-member multi-disciplinary working group advising the European Commission on the technical aspects of the Sustainable Finance Action Plan, has advised the European Commission to integrate two new policy themes in the EU Non-financial Reporting Directive (NFRD): 1) integration of TCFD reporting *and* 2) indicators that demonstrate contribution to global climate goals, thereby ensuring that companies go beyond risk reporting to transparently

demonstrate climate mitigation efforts (European Commission, 2019). The Commission accepted this advice and the non-binding guidelines of the NFRD were updated on June 18, 2019 with a set of bank-specific recommendations for climate disclosure, focusing on both the climate risk and climate impact aspects of a bank's portfolio. This is a positive signal, but it remains a non-binding, voluntary exercise that provides guidance for *what* should be disclosed but not *how* this should be executed. What's more, the guidelines do not go beyond disclosure. Management and target-setting are not explicitly covered.

Financed Emissions Disclosures for Investors

Initiatives such as the United Nations (UN) Principles for Responsible Investing (PRI) and the Portfolio Carbon Initiative, a partnership between the 2° Investing Initiative (2°ii) and the UNEP Finance Initiative, have all called for increased transparency of investing portfolios and their impacts. Today, more than 1,800 investors are signatories to the UN PRI and more than 120 have committed to carbon disclosure via the Montreal Carbon Pledge (UN PRI, 2019). Driven largely by social pressure from non-governmental organizations (NGOs), these initiatives have not only provided momentum for transparency but have also given shape to methods, metrics and tools for institutional investors and asset managers to measure, disclose and manage the so-called 'financed emissions' related to their equity and bond portfolios (2° Investing Initiative, 2013).

Financed Emissions Disclosures for Commercial Banks

Many banks have joined the ranks of investors in committing to the UN PRI and Montreal Pledge, however their commitments only concern their asset management or

investment business, not their lending activities. This has kept lending portfolios under the radar for some time. Efforts to develop methods for lenders to measure and align have been undertaken for years in collaboration with banks and NGOs with varied and largely unsuccessful results (World Resources Institute, 2019). In stark contrast to the more straightforward approach to measuring and attributing the emissions related to equity portfolios, the complexity of a bank's capital allocation and various lending products in combination with the low-quality or unavailability of emissions data for non-listed entities reduce greenhouse gas accounting, in many cases, to mere estimations for bank lending portfolios (2° Investing Initiative, 2015). Since 2011, roughly eight different methodologies for measuring the financed emissions of a lending portfolio have emerged (see Table 1), most of which have been developed by or with banks. No single method has, since, been widely adopted beyond the co-developing bank, meaning there is no accepted market standard for measuring financed emissions for banks.

Table 1. Existing methodologies for calculating financed emissions of banks

Model Name	**Year Published**
Platform Carbon Accounting Financials (PCAF)	2017
P9XCA – Credit Agricole	2014
Impact Model – FMO Bank	2014
ASN Bank Carbon Profit and Loss	2013
Carbon Screener Model (BoA/ML, Camradata)	2013
Cross-asset footprint (MFS/AFD)	2012
Profundo	2011

Existing Literature on Evaluating Climate Impact Methodologies

There are few studies that seek to analyze existing methodologies for measuring the climate impact of banks. The first assessment of GHG accounting methods for the financial sector was conducted by the international think tank, the 2° Investing Initiative (2°ii) (2013) which provided a qualitative review of existing methodologies. The study outlined the qualitative differences in the methodologies, pointing to the vast assumptions each applies in order to arrive at their conclusions and doing so at a high cost. This study did not, however, identify which method could be considered more accurate or dependable, or which features would lend themselves to a better estimate.

The next study that outlined the existing methodologies for investors to measure portfolio emissions (Table 2) set out to determine whether or not such approaches would lead an investor to make divestment decisions that result in actual environmental benefits (Ritchie & Dowlatabadi, 2014). However, rather than comparing and qualifying these methodologies, the authors create their own methodology and draw parallels between it and existing ones.

Table 2. Available methodologies for calculating financed emissions (Ritchie & Dowlatabadi, 2014; adapted from 2° Investing Initiative, 2013).

Model name	Methodology	Scope	First availability
Trucost	Extensive database of carbon data reported by companies + proprietary EE-IO model for non-reporting companies	More than 4500 listed companies	2006
INRATE	EE-IO model supplemented with LCA data of products	More than 2800 listed companies	2006
Profundo	Tracking fossil-fuel company transactions using Bloomberg and public data	Bank ratings based on financing provided to fossil-fuel extraction	2011
Cross-asset footprint	Based on Inrate data extrapolated to include financial instruments beyond equities	Listed non-financial companies and financial institutions, sovereign bond, loans, mortgages and green projects	2012
South Pole carbon screener	Extrapolation for each sector based on reported carbon data	Every listed company	2012
Camrdata Carbon Screener® Model	Carbon disclosure project data	Roughly 8000 listed companies	2013
ASN Bank	Based on Trucost for equities along with reported data and national statistics for other products	Methodology applied to its own balance sheet to reach carbon neutral by 2030 goal	2013

Finally, Thomä, Dupré & Hayne (2018) provide a review of existing climate accounting principles for financial (equity and bond) portfolios. This core of this study employed a quantitative approach to compare existing accounting approaches using a contrived dataset applied across a spectrum of approaches. However, where this study differs from the scope of the current research is twofold. First, the authors are analyzing methods for measuring the financed emissions of equity portfolios of investors, not lending portfolios of banks as is the case with the present research. Second, the authors are applying various accounting principles to the same methodologies to test the variability of the outcomes on the basis of which normalization principles (e.g. revenue intensity or enterprise value intensity), attribution rules or accounting principles are applied. The quantitative scope of the authors' research remains limited to the variation in results due to variable accounting rules, rather than the underlying data quality.

Additionally, the authors discuss three different accounting units, or indicators, applied by financials: financed emissions, so-called green/brown metrics and climate scores (e.g. within ESG ratings). The authors review the various use-cases that would justify application of the different indicators, concluding that the "most appropriate choice of indicator is a function of the purpose of the analysis, which can obviously differ widely" (Thomä, Dupré & Hayne, 2018). The authors do not explore the utility of each indicator for target-setting but do outline the sensitivities of the outcomes, in particular for financed emissions approaches, to the underlying attribution choices. While the Thomä, Dupré & Hayne (2018) study does not address the same scope of the present research, it does provide relevant findings that will be applied and considered in light of the current research objectives (see chapter three).

Perhaps the most recent and relevant comparative study of the various climate impact metrics available for banks is one published by Weber & Thomä (2018) which qualitatively discusses the benefits and draw-backs of each. The authors conclude that multiple metrics can be considered useful depending on the type of bank, portfolio composition and asset class. This review is referenced in the discussion section (chapter five). This study, however, does not include the financed technology (PACTA) approach for banks as this methodology had not yet been developed at the time.

In sum, while existing studies review metrics and underlying methodologies, none of them provide a quantitative comparative analysis of the two metrics put forward in this research. Therefore, the present study attempts to fill a gap in existing literature and provide a new approach to climate impact methodology comparison for banks. This comparison is meant to inform banks and stakeholders regarding metrics for target-setting to reduce climate impact, rather than risk metrics. Risk metrics are therefore beyond the scope of the present research.

Description of the two methodologies under review

The two methodologies tested in this research are the 'financed emissions' approach described by the Platform Carbon Accounting Financials (PCAF) and the 'financed technology' method developed by the 2˚ii, hereafter referred to as the PACTA-CL approach. The PCAF approach was selected on the basis that it is the most recently developed 'financed emissions' methodology and is open-source, making it more accessible for research and comparison purposes. PACTA-CL was chosen because it is the first 'financed technology' approach developed and applied to a lending portfolio and is also open-source.

Description of PCAF. The Platform Carbon Accounting Financials (PCAF) is an initiative that was launched in 2015 by a group of eleven Dutch financial institutions. The objective of PCAF is to develop a standard methodology for banks and investors to measure the carbon footprint of their equity, bond and/or lending portfolios. PCAF, in their latest report (2018) describes the carbon footprint of a financial as including scopes 1, 2 and 3 as defined by the Greenhouse Gas (GHG) Protocol. Translating the GHG Protocol guidance for Scope 3, category 15 (investments) and providing guidance for application per asset class, is the focus of the PCAF report. PCAF prescribes Scope 3 emissions to be presented as the sum of financed emissions across all asset classes, ideally over multiple years. While accounting choices pertaining to attribution, coverage, boundaries (scope) and data providers may vary greatly among financials applying PCAF, companies are recommended to openly describe these choices and exclusions and provide their rationale for such choices. As described in their latest report, the ultimate aim of PCAF members is for the carbon footprint to be "a means to an end" which is setting targets in line with the goals of the Paris Climate Agreement (PCAF, 2018).

The latest methodology report was published in November 2018 and covers eight asset classes, including government bonds, listed equity, project finance, mortgages, commercial real estate, corporate debt, corporate/SME loans and indirect investments. For the purposes of this research, the focus will be on the corporate/SME loans 'asset class' methodology (hereafter referred to as PCAF-CL), more specifically, non-ring-fenced lending as the ring-fenced lending applies the PCAF project finance calculation approach which is not in scope of this research (see Figure 3 below). The same scope will be applied to 2°ii's PACTA-CL methodology for comparison.

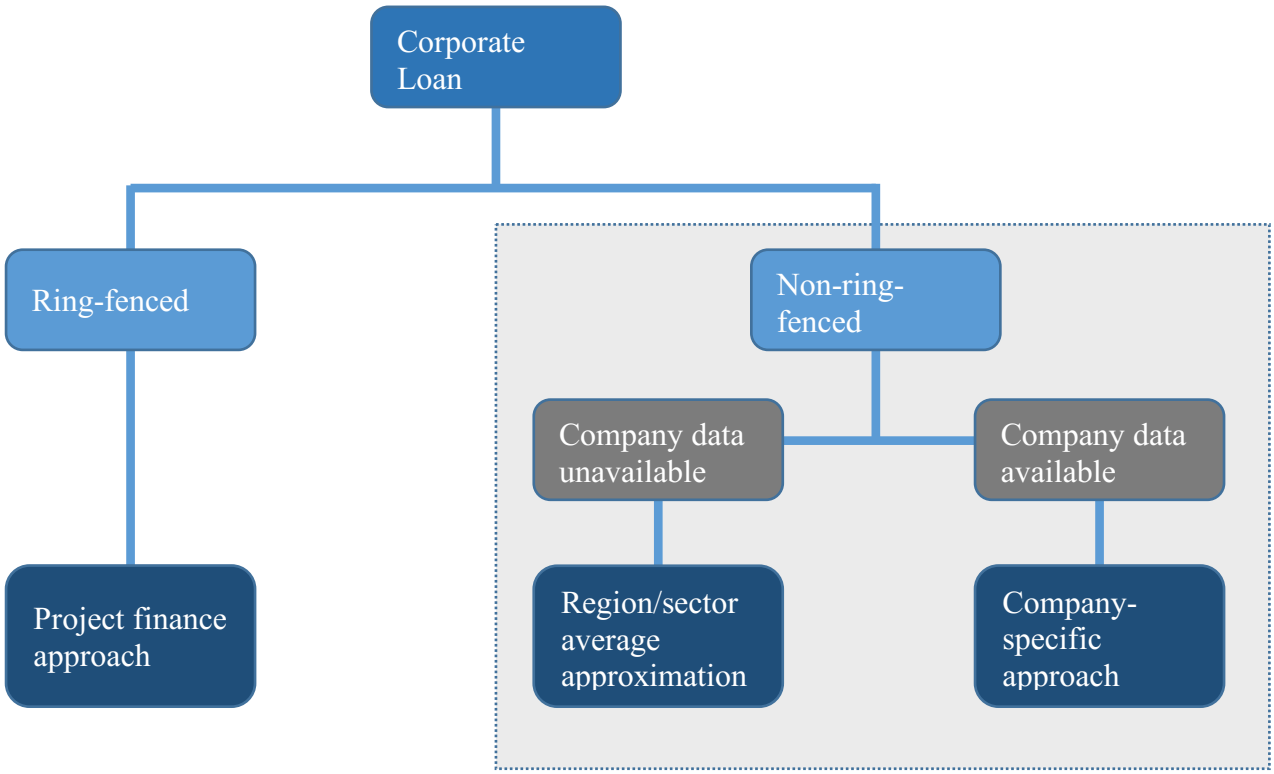


Figure 3. PCAF-CL research scope. Indication of scope of present research by loan type. Source: PCAF, 2018.

The PCAF-CL accounting approach relies on three variables to calculate the financed emissions of a loan: 1) total loan outstandings (exposure) to the borrower, 2) the total balance sheet of the borrower, 3) the total emissions of the borrower. In order to allocate the bank's proportionate share of the borrower's emissions, the 'attribution factor' is determined by dividing total lending outstandings by the total balance sheet of the borrower – a so-called 'balance sheet' allocation principle as coined by Thomä Thomä, Dupré and Hayne (2018). This attribution rule is considered a 'follow-the-money' principle, meaning as the loan matures, the financed emissions of said loan

reduces to zero. Similarly, as the balance sheet fluctuates, so does the share of attribution (see the results chapter for further elaboration) (PCAF, 2018).

The financed emissions of a given loan with the PCAF-CL approach is a function of the attribution factor multiplied by the total emissions of the company. PCAF-CL applies two different approaches to determining the total emissions of a borrower based on company data availability: 1) region/sector average approximation and 2) the so-called 'company-specific approach'.

The region/sector average approximation applies GHG emission intensity averages (e.g. tCO_2e/million revenue) based on a given sector (classified under NACE, ISIC or other international sector classification systems) within a specific region. These emission intensity averages are provided by third-party data sources such as the International Energy Agency or EuroStat (PCAF, 2018). Multiplying these intensity factors by the total client revenue provides the emissions estimate for that client.

The company-specific approach relies primarily on (ideally) audited GHG emissions data reported by the company, calculated according to GHG Protocol guidance. In the absence of this data, PCAF advises to utilize company-specific source data from which the emissions can be calculated (e.g. total product yield) using lifecycle emissions factors for that sector or product.

The above process is followed for each corporate loan in a portfolio in order to arrive at the financed emissions for that loan. The financed emissions of that asset class or portfolio is then the sum of financed emissions for each loan within scope of that asset class. One key distinction between PCAF and PACTA is the categorization approach. In PCAF, each asset class receives guidance on calculating the financed emissions. Whereas in PACTA, the guidance is sector-specific, not instrument-specific.

Each approach has its merits and drawbacks and PCAF, according to their data quality hierarchy, prioritizes company-reported (CR), audited GHG data. If no such data are available, PCAF prescribes the use of source-data relevant for calculating GHG data, preferably calculated by an independent third party. Non-audited self-reported GHG data would be admissible in the absence of either above-mentioned option. In the case of corporate loans, the region/sector average (SA) approximation is prescribed if no source data are available. Though this may be the only option in the absence of CR data, the use of SA data is not advised, especially for carbon-intensive sectors (PCAF, 2018).

Description of PACTA. The Paris Agreement Capital Transition Assessment is an open-source model that "assesses the exposure of both equity and bond portfolios to physical assets across key sectors (e.g. energy, power, automotive, cement and steel) and the alignment of that exposure with decarbonization scenarios over time" (2˚ Investing Initiative, 2018). This model was developed in 2016 by the 2˚ii. In 2017, 2˚ii began working with ING Group to translate this model, originally intended only for equity and bond portfolios, into a methodology for banks to measure their exposure to climate-relevant technologies and to benchmark these exposures to external climate alignment scenarios (2˚ Investing Initiative, 2018). This translated approach will be hereafter referred to as 'PACTA for corporate lending' or PACTA-CL for short.

Since then, roughly twenty additional globally operating commercial banks began working with 2˚ii to test and apply this methodology to their loan books. Piloting banks have made clear their intended use for this model as five such banks collectively signed the 'Katowice Commitment' at COP 24 in Katowice, Poland on December 4, 2018 (ING Group, 2018b). Signatory banks thereby publicly pledged to progressively align their portfolios, comprising of more than EUR 2.4 trillion, with the well-below 2 ˚C goal of the

Paris Climate agreement, working in collaboration with each other and with organizations like 2˚ii to apply a sector-specific, forward-looking, technology-based approach to measure and steer lending portfolios (ING Group, 2018b). This commitment was made following signatory banks efforts to apply the PACTA-CL methodology.

This methodology distinguishes itself from traditional climate accounting methodologies as it places the underlying 'economic activity' as the focal point. This key point sets itself in contrast to the financed emissions approach as it looks at disaggregated sector-specific economic activities and the underlying production output (e.g. MWh produced by coal vs. gas vs. renewables) being directly or indirectly financed by a bank rather than emissions estimated to result from said activities or a proportion of corporately reported emissions added up over an entire balance sheet. Rather, the metrics vary per sector as each sector will need to follow a different technology roadmap in order to achieve the needed transition to reach the goals of the Paris Agreement. These technology roadmaps are described by external, independent bodies such as the International Energy Agency and include various ambition levels, including 2°C or well-below 2°C alignment pathways. As such, PACTA-CL tracks two different directions of travel described in a scenario for a given sector/economic activity: 1) technology shift or production process (e.g. shift from fossil fuel-based power generation to renewable power generation) and 2) change in production volume over time (e.g. reduction in demand for [petrol] vehicles).

This approach focuses on the sectors key to meeting the Paris Agreement target, namely fossil fuels, power generation, automotive, cement, steel, shipping and aviation, whose direct emissions make up roughly 70-80% of global CO_2 emissions (IPCC, 2015). Further, PACTA-CL relies on actual, detailed asset-level data provided by external

business intelligence databases which compile the entire universe of owned assets across the above-mentioned sectors (2˚ Investing Initiative, 2018). Clients in a bank portfolio are matched with owned assets in the relevant databases. These data include not only information regarding clients' owned assets, but also the production capacity and forward-looking capital expenditure (CAPEX) plans spanning a five-year time horizon.

Methodological Choices of the two methodologies. PACTA-CL also deviates from the PCAF model in some of its methodological choices pertaining to allocation rules, scope of coverage and level of analysis. Beginning with the latter, the model analyzes portfolios on two levels: 1) client relationship level and 2) capital exposure level. The client relationship level allows lenders to identify individual clients who are aligned with climate targets or not. The client-level analysis can also be aggregated to a portfolio level view of the overall alignment of the clients within a given portfolio, irrespective of portfolio exposure. The capital exposure level looks more specifically at the bank's direct exposure to specific activities based on the size of exposure in order to measure the alignment of the capital provided.

Regarding the scope of economic activity within a sector, the PACTA-CL model concentrates on the part of the sector value chain responsible for the bulk of the climate impact. For example, within the power sector, generation assets are considered while distribution grids are not. Figure 4 below identifies the scope of economic activity within PACTA-CL covered sectors (indicated in blue).

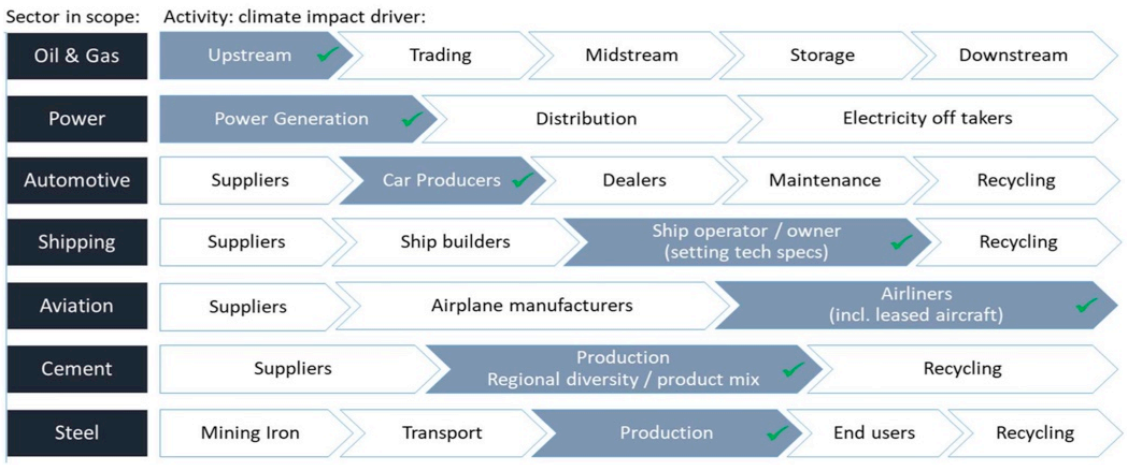


Figure 4. Economic activity scope in PACTA-CL. Breakdown of sector activities in scope of PACTA-CL. Source: Hagedorn, 2019.

Lastly, regarding the allocation rules, the PCAF model applies a "balance sheet approach" for attributing or allocating emissions of a borrower to a lender. The PACTA-CL model deviates from this approach and applies the "portfolio weight approach." The balance sheet approach attributes a portion of the client's emissions based on a loan to balance-sheet ratio. The portfolio weight approach allocates an economic activity to a lender based on the loan to total book value ratio in that portfolio/sector (2˚ Investing Initiative, 2018). In other words, the allocation ratio is the percentage of that loan within the total loan book and thus represents the choice of capital allocation of a portfolio manager.

Research Questions, Hypotheses and Specific Aims

In order to contribute to the development of a standardized method for well-below 2˚C portfolio alignment, my research addresses the following questions: (1) Which existing method for measuring climate impact of corporate lending portfolios provides the most accurate results? (2) Which metric is most useful for target-setting?

My first hypothesis is that due to the unavailability of emissions data of the majority of a bank's clients, and due to the unreliability of available emissions data, financed emissions accounting is not the most accurate or realistic metric for a bank to use to measure and steer its portfolio. I also hypothesize that portfolio (sector)-specific metrics and methods focused on technology mix/output will yield more accurate and complete measurements that can be more easily mapped to external benchmarks for 2°C target-setting.

My specific research aims are to:

1. Test the two approaches for accuracy, coverage and utility for target-setting using a control dataset.
2. Identify which metrics are best suited for the banking sector to measure climate impact and opportunity based on data quality and availability.
3. Define which metric characteristics are critical for banks to set targets and effectively steer portfolios.
4. Provide objective guidance as to which metric has the highest utility rate for banks wishing to measure and steer credit lending portfolios in the spirit of target-setting.

Chapter II

Methodology

This chapter describes the methods applied for addressing each research question and testing my hypotheses. First, a description of the applied method for quantitative assessment of the two methodologies is described. Second, a description of the methods for qualitative review of the two methodologies' utility for target-setting is presented.

Research Question 1: Testing the accuracy of the two methodologies

In order to test both hypotheses and address my first research question, the two existing methods for measuring a bank's climate impact were quantitatively analyzed using a contrived lending portfolio consisting of actual companies (listed and non-listed). In order to simulate a life-like exercise, the contrived dataset was modeled after the internal systems of ING Group (hereafter referred to as ING), a large multinational commercial bank. This contrived portfolio served as a control variable for testing the accuracy of the results of the two methodologies.

The portfolio consists of 64 US-based corporates, falling within the Fossil Fuel, Power Generation and Automotive sectors (see Appendix 1). This scope of sectors was chosen as it covers both energy supply and demand sectors collectively responsible for roughly 60% of global CO_2 emissions (IPCC, 2015). Additionally, these sectors have received the most pressure from stakeholders, including regulators, to take climate impact mitigation measures. Likewise, banks financing these sectors have also fallen under civil society scrutiny, especially for their involvement in fossil fuel financing (BankTrack,

2019; Greenpeace International, 2018). The loan facilities were scoped to non-ringfenced general corporate loans to ensure simplicity and consistency of methodology application. This means that individual projects will not be included in the scope of the data and methodology application – but rather attribution of a portion of a company's climate impact will be allocated to a loan facility based on each methodology's prescribed attribution rules.

The PCAF-CL and PACTA-CL methodologies were applied to the control dataset in order to measure the climate impact of the contrived portfolio. As the literature does not offer methods for comparing two methodologies with two distinct sets of metrics on the basis of accuracy, it was necessary within the current scope of research to develop a method that could serve to objectively and quantitatively compare climate impact measurement methodologies. As the accuracy of any measurement methodology is a function of the accuracy of the data inputs, a scoring framework was developed – the Data Input Accuracy Scoring (DIAS) Framework – based upon quantitative findings of the literature in order to quantitatively assess the accuracy of the data inputs prescribed by the relevant methodology.

The DIAS Framework

The DIAS framework measures accuracy as a function of three indicators: completeness, coverage and quality of the inputs. Completeness is scored on the basis of data availability, either of company-reported (CR) emissions data (accessible via CDP databases or company reports) for PCAF-CL or of the prescribed 'asset-level data' (ALD) through a successful match of a company with external data sources for PACTA-CL. The

coverage of the data was measured on the basis of findings of Sawbridge & Griffin (2017), which were utilized to define a boundary of error for CR data and to define the share of the relevant emissions scope 'covered' by the asset-level data inputs. Finally, data quality refers to the trustworthiness of the data, following the 'garbage in, garbage out' rule of thumb. The use of data proxies, assumptions and estimations, such as sector averages (SA) or deriving emissions from production data (production derivative – PD) was therefore considered as this can negatively affect the accuracy of the data.

The scoring was conducted line-by-line, company by company for each indicator for both methodologies. The below table (Table 3) visualizes the scoring framework. The portfolio-weighted scores for all companies in the loan book were aggregated to result in one accuracy score for each methodology as summarized in the equation (below) where the total accuracy score (a) is equal to the sum of the portfolio weighted ($\frac{l_i}{p}$) accuracy score for each company (i) in the loan book, where l is the total loan outstandings in the portfolio (p). The accuracy score of company i is a function of the completeness score (s) times the coverage (c) times the quality (q). The completeness, coverage and quality scores are further described and explained below.

Table 3. Overview of the Data Input Accuracy Scoring (DIAS) Framework

Accuracy indicator	PCAF-CL	PACTA-CL
Completeness (*s*)* (0-100)	($S1_x + S2_x + S3_x$)	If matched, $s = 100$ If no match $s = 0$
	If no reported emissions data, $s = 1$	
Coverage (*c*)** (0-1)	($S1_x \times C1_x + S2_x \times C2_x + S3_x \times C3_x$)/100	*If i_A, $c = (S3_A/100)$ *If i_A, $c = (S1_P+S3_P/100)$ *If i_A, $c = (S3_F/100)$
	If no reported emissions data, $c = 1$	
Data Quality (*q*) (0-100)	If reported emissions used, $q = 1$	$q = 1$
	If Production Data (PD) inputs used, $q = 75$	
	If Sector Average (SA) inputs used, $q = 70$	
Total Accuracy Score (*a*) (0-100)	$a = \sum_{i}^{n} (s_i \times c_i \times q_i) \frac{l_i}{p}$	

* Completeness (*s*), below 'points' are based on % share of each scope, totaling 100 (Source: Sawbridge & Griffin, 2017)
Scope 1: **Automotive** ($S1_A$) = 2; **Power** ($S1_P$) = 66; **Fossil** ($S1_F$) = 10
Scope 2: **Automotive** ($S2_A$) = 3; **Power** ($S2_P$) = 1; **Fossil** ($S2_F$) = 1
Scope 3: **Automotive** ($S3_A$) = 95; **Power**($S3_P$) = 33; **Fossil** ($S3_F$) = 89
Missing scope = 0, all sectors

** Coverage (*c*) (Source: Sawbridge & Griffin, 2017)
Scope 1: **Automotive** ($C1_A$) = 100%; **Power** ($C1_P$) = 45%; **Fossil** ($C1_F$) = 45%
Scope 2: **Automotive** ($C2_A$) = 50%; **Power** ($C2_P$) = 48%; **Fossil** ($C2_F$) = 48%
Scope 3: **Automotive** ($C3_A$) = 78%; **Power** ($C3_P$) = 40%; **Fossil** ($C3_F$) = 40%

Completeness Scoring Methodology

For PCAF-CL, 100% 'completeness' means company-reported data availability for all three scopes. If data are missing for any one of the scopes, then the share of total emissions that each missing scope represents per sector will be counted as zero. In case no emissions data are available, then $s = 1$, as sector averages or production derivative data will be applied.

The distribution (and thus deduction in completeness score) of the share of each scope across a sector is based on the stepwise scope 3 modeling work conducted by Sawbridge & Griffin of CDP (formerly Carbon Disclosure Project) in 2017. This work (hereafter referred to as SG17) was conducted in order to provide the 'CDP Full GHG

Emissions Dataset' for investor use. Using the company-reported data disclosed to CDP, the authors cleaned the data and filled gaps using bottom up modelling and regression analysis in order to arrive at a more accurate estimate of the actual scope 1, scope 2 and scope 3 (by category) emissions of 3,500 companies. As a part of this work, the authors provided the emissions breakdown (share) by scope for each sector (see Figure 5 below).

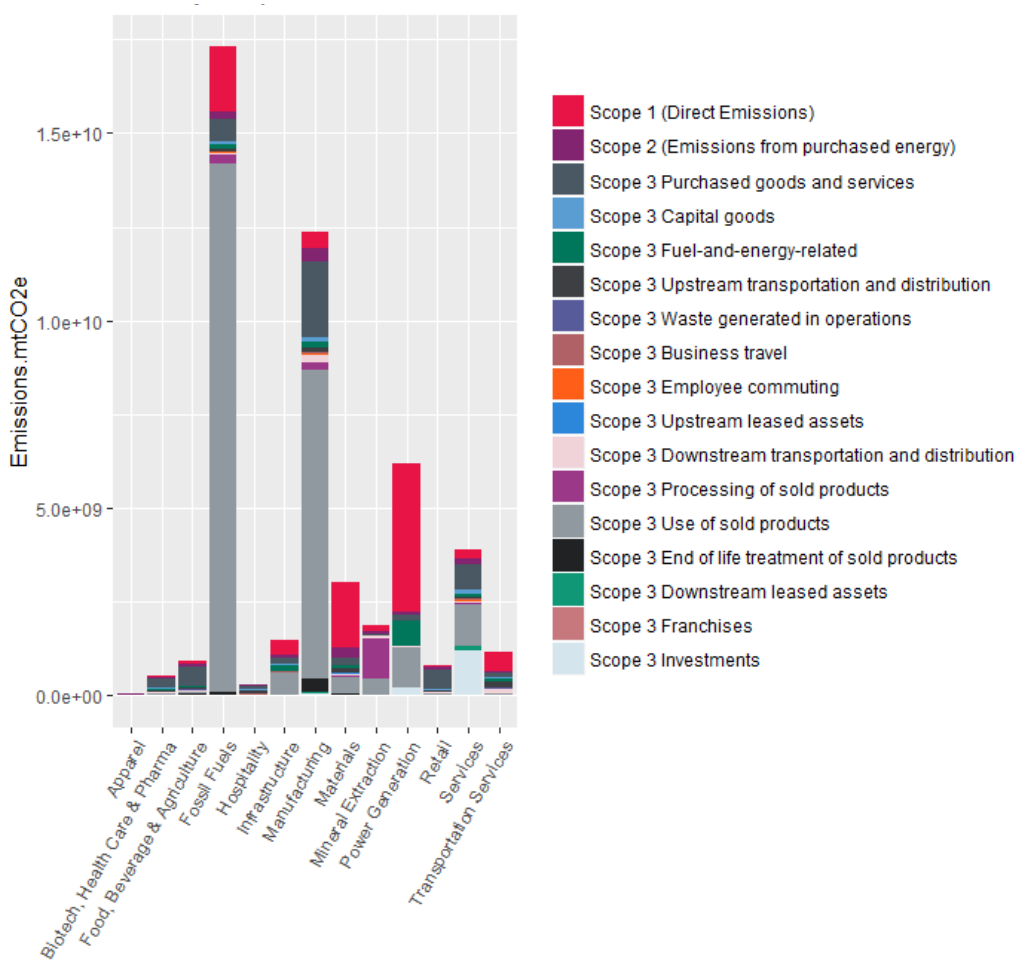


Figure 5. CDP Modelled Emissions by Scope & Industry. Source: Sawbridge & Griffin, 2017.

The CDP modelled data was cross-examined in the present research using the Economic Input-Output Lifecycle Assessment (EIO-LCA) conducted by Huang et al. (2009). This earlier study identified the share of scopes 1, 2 and upstream scope 3 emissions for each sector, including the sectors modeled by Sawbridge & Griffin (2017) as well as those in scope of the present study (see Figure 6 below 'Power', 'Petro' and 'Veh' for Power Generation, Energy and Automotive respectively). While the results were roughly in line with the SG17 results, the share of scope 3 in the Huang et al. study was significantly lower (in-turn placing a higher weight on scopes 1 and 2) as the assessment only included upstream scope 3 emissions. For sectors such as Automotive and Fossil Fuels, this means the exclusion of one of the largest sources of emissions for those sectors (product use). For this reason, the SG17 findings were favored and applied for the present research. The weighting of each scope per sector for the completeness indicator using the SG17 data is given in the footnote of Table 3 above.

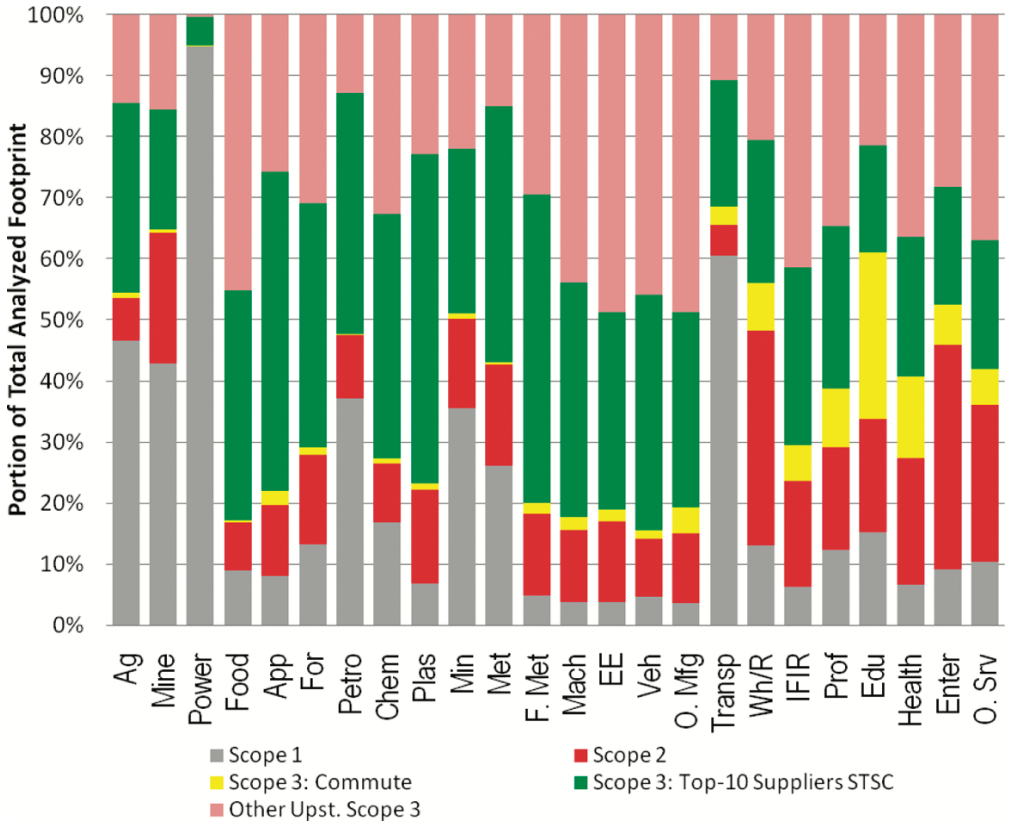


Figure 6. Portion of Total Analyzed Footprint by Sector. Source: Huang et al., 2009.

While the question of completeness should also pertain to the scope of GHG emission type within the context of CR emissions (e.g. is only carbon dioxide reported, or carbon dioxide equivalent, incorporating other greenhouse gases such as methane and nitrous oxide?), this level of data review falls outside the scope of the present research. We therefore take the position that most companies reporting emissions are doing so in accordance with international standards, such as the Greenhouse Gas Protocol, and therefore report in terms of carbon dioxide equivalent. Further research into the reliability of this assumption should be undertaken in later research, but implications of the inconsistency of reporting boundaries are discussed in chapter seven below.

For PACTA-CL, completeness, or full data-availability, means that the asset-level data provided by the external Business Intelligence databases used within the PACTA-CL tooling can be matched with the companies in scope. No match means that there is no climate-relevant data available for that company. Therefore, the completeness score for a company within the PACTA-CL approach is binary, resulting either in a score of one-hundred or a score of zero.

Coverage Scoring Methodology

The coverage indicator for companies assessed in PCAF-CL reflects to what extent the data reported for scope 1, 2 and/or 3 covers the full range of existing emissions in the form of a percentage (value between zero and one). The coverage rate is therefore a function of data availability (completeness) defined by the boundary of error derived from the literature, namely SG17 modelling study. In case CR data inputs are not available, then $c = 1$ as this will mean that SA or PD data inputs are required for the emissions estimation. In the CDP boundary of error study, the authors benchmarked the CR data against the estimated totals by sector, including by each scope 3 category. This was conducted for the entire Morgan Stanley Capital International All Country World Index (MSCI/ACWI) with a specific breakdown provided for the manufacturing sectors, including automotive manufacturing (see Figure 7 below).

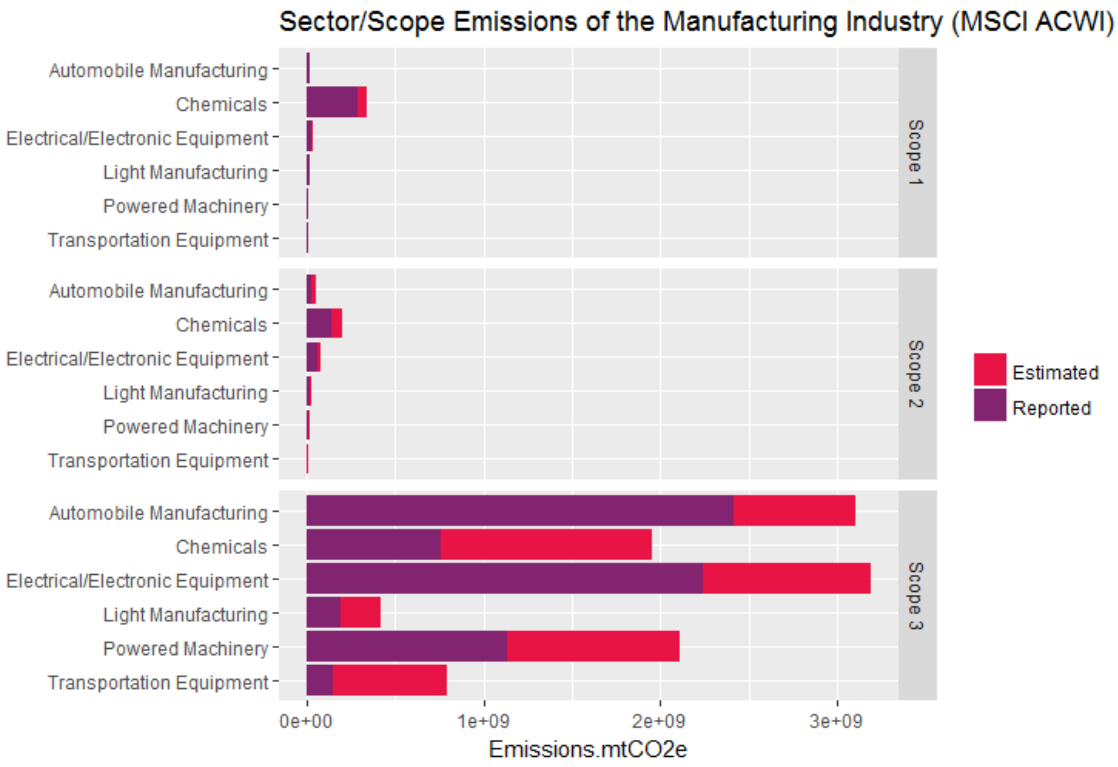


Figure 7. Estimated vs. Reported emissions by Scope for Manufacturing. Source: Sawbridge & Griffin, 2017.

A specific boundary of error for each scope within the automotive sector was provided by the CDP modelling study. This was therefore applied in the coverage scoring methodology for automotive. However, a specific breakdown was not provided for Fossil Fuels and Power Generation. For this reason, the MSCI/ACWI average was applied for each scope within these two sectors (see Figure 8 below). For the sake of simplicity, it will be assumed that this data are normally distributed for these two sectors. With the introduction of sector-specific data on the gap between reported and estimated emissions, the outcomes will be improved, however, as this scoring framework is in its inception phase, a global average will suffice. The coverage formula is expressed in Table 3 above

and is factored into the overall accuracy score via the aggregation method described below.

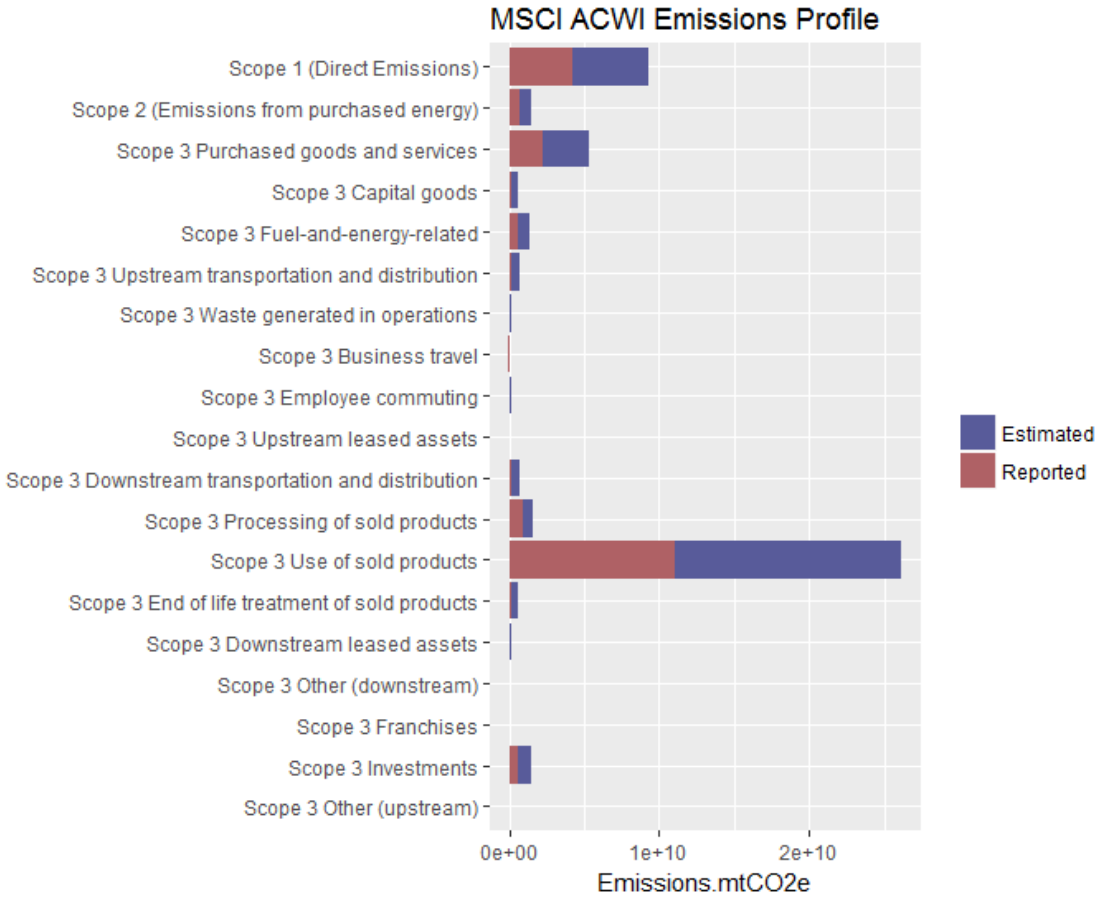


Figure 8. Estimated vs. Reported emissions by Scope for MSCI/ACWI. Source: Sawbridge & Griffin, 2017.

A similar benchmarking analysis was conducted for scope 3 emissions by Blanco et al. (2016) using the EIO-LCA findings of Huang et al. (2009) and comparing this to US firms' company-reported emissions data disclosed to CDP. This research found that on average, reported scope 3 emissions covered only 22% of what was estimated to be the total scope 3 emissions. This result is quite dissimilar to the SG17 research which found that on average 40% was reported. This difference is likely the result of the fact that

company-reported scope 3 emissions are mostly downstream emissions while the Huang et al. study (the 'benchmark' in Blanco's study) only captures upstream scope 3 emissions. For this reason, the findings in the Blanco et al. (2016) study are not relevant.

For PACTA-CL, the coverage indicator is a fixed rate applied to each company within a given sector based on the percentage of the total climate impact (emissions scope) covered by the methodology in that sector. For example, the PACTA-CL methodology covers scope 3 emissions for the Automotive asset-level data and scenarios while scopes 1 and 2 are not considered. Therefore, applying the SG17 findings regarding the share of each scope, the coverage rate for Automotive is 95%. Likewise, as PACTA-CL considers scope 3 in the Fossil Fuel sector, the coverage will be 89% and for Power, scopes 1 and 3 are considered, resulting in a 99% coverage rate. In the framework, the coverage is represented as a percentage, therefore with a value between zero and one.

Data-source Quality Scoring Methodology

There are three recommendations for sourcing emissions data within the PCAF-CL model, namely 1) 3rd party validated CR emissions data, 2) emissions figures derived from company production data (PD) (e.g. total yield or production volumes), and 3) the use of sector averages (SA). Validated CR data are considered to be of the highest quality according to PCAF. Therefore, no quality discount is applied in the scoring framework when CR data are available, meaning $q = 1$. In the absence of the primary data – CR emissions data – PCAF-CL recommends the use of PD or SA data in order to estimate the emissions of a company. As this is considered secondary, low-quality data derived from assumptions and global averages, the use of PD or SA data does receive a discounted quality score.

According to environmental consultant, Ecofys (now Navigant), whom also co-developed the PCAF methodology, the use of SA data carries a margin of error of +/-30% (Linthorst, 2016). In justifying this error margin, Ecofys cites numerous factors that affect the accuracy of the data, namely multiple data sources diverging in sector scope, data quality, age of data and currency movements (Linthorst, 2016). Ecofys does not, however, provide a description of their calculation method for arriving at this error margin. Therefore, in order to sanity-check this conclusion, a bottom-up analysis on a sample of 50 companies in the utilities sector was conducted on the basis of Trucost emissions (2018) data. In this test, an estimate of the company's emissions was calculated based on SA data. In 28% of the cases, the 'wrong' company (the company with a higher actual emissions profile) would have been picked on the basis of SA estimations alone. This result, can be said to be consistent with the 30% margin of error cited by Ecofys and therefore forms the basis of the discounted quality score for SA data, resulting in a score of 70 for SA data. For PD data, given that the external databases use sector/region averages, but supplement this with company-specific data, PD inputs are 'awarded' a quality score of 75, though admittedly this is somewhat arbitrary.

For PACTA-CL, because the data are asset-level and third-party validated and undergoes an internal validation process, the data quality is assumed to be extremely high and therefore, like CR data in the PCAF approach, does not receive any deduction in the quality score. As part of the process for matching asset-level data to a company portfolio, banks using the PACTA approach will identify any gaps, notify the data provider who then makes the appropriate corrections. While this may require some manual checking, the accuracy is improved over time. Further, as the asset-level data includes future capex plans of companies, it may be the case that these plans are not realized, making it seem as

if the data were inaccurate in retrospect. However, there is a difference between data being inaccurate and plans not materializing. Therefore, this aspect of forward-looking data is not deemed incorrect but subject to future circumstances. For this reason, the accuracy score is not affected.

Aggregation of Scores Across Indicators

For both methodologies, each company in the portfolio was assessed using the DIAS framework. Therefore, an individual accuracy score was calculated for the emissions input data per company in the contrived loanbook, once for PCAF-CL and once for PACTA-CL. Each company's accuracy score was then weighted by portfolio share, which was aggregated into a final accuracy score for the entire loan book. This is summarized in the equation below were the accuracy score (a) equals completeness score of company i (s_i), times the coverage rate (c_i) times the quality score (q_i) times the portfolio weight where l_i is the loan exposure to company i divided by the total portfolio (loan book) outstandings. This portfolio-weighted score is then summed for all companies in the portfolio to reach the total accuracy score for each methodology applied to the contrived portfolio.

$$a = \sum_{i}^{n} (s_i \times c_i \times q_i) \frac{l_i}{p}$$

Isolating Primary Data for Equal Comparison

The above scoring framework was designed to measure the accuracy of the inputs prescribed by each of the two methodologies in question. However, it should be noted that the two methodologies differ in how they deal with the absence of primary data, namely CR data in PCAF-CL and asset-level data (ALD) in PACTA-CL. In the case of PACTA-CL, a no-match result (the absence of ALD), receives a score of zero because the methodology does not allow for estimations to make up for the missing data. This is not so in PCAF-CL. In the case of missing CR data, the recommendation is to use PD or SA data to *estimate* emissions data for that company. In essence, this divergence between the two approaches in dealing with missing data adds an artificial layer of data input diluting the comparability.

For this reason, a second application of the DIAS framework was developed in order to solve for this inconsistency by isolating the primary data inputs of PCAF-CL and comparing this to the primary data inputs for PACTA-CL. This was done in order to create a more uniform and comparable baseline, putting the two methodologies on 'equal footing'. In order to do so, missing CR emissions data resulted in a completeness score, and therefore coverage rate, of zero: $s = 0$; $c = 0$, just as a no-match in PACTA-CL receives a completeness and coverage score of zero. Both the original DIAS framework application ('A') and this 'isolated' application ('B') were run for PCAF-CL and are both compared to the PACTA-CL results in chapter 4 below.

Research Question 2: Utility for Target-setting

Setting a quantitative science-based target, a target that will cause a company to align its climate performance with a below- 2˚C trajectory in line with climate science,

has three key components: 1) a zero-base measurement, 2) a normative below 2-degree climate benchmark (e.g. carbon budget, scenario, etc.) to base the target on and 3) the means to make progress and track performance. In order to answer my second research question regarding the utility of the two methodologies for target-setting, a qualitative review was conducted.

Firstly, however, accuracy and completeness are important preconditions for determining the zero-base measurement. In the Science-based Targets Initiative's (SBTI) (2019) latest manual for setting science-based targets, it is stated, "because the methods [for setting SBTs] are sensitive to the inputs used, and because errors can propagate throughout the methods, company data should be as accurate as possible". Therefore, the quantitative accuracy assessment results of the company inputs were considered. However, the accuracy of the inputs is not the only variable affecting the overall accuracy of the results. The treatment of the individual company-level results in relation to one another (e.g. aggregation, disaggregation, etc.) can also impact the accuracy of the results. This was considered in relation to the zero-base measurement component of target-setting.

Secondly, the metrics utilized by the methodologies were reviewed in light of the available benchmarks in order to better understand the actions prescribed by the benchmark and the translation of these actions to the portfolio. Next to this interaction between metrics and benchmarks, the level of granularity provided by the methodology is an important factor as it determines the extent to which meaningful decisions can be made to steer towards an intended outcome. Therefore, the existence or absence of granular and forward-looking data, is considered on the basis of its added value for steering.

Third, the robustness of methodological choices was reviewed, also in light of findings in literature. This review focused mainly on the attribution/accounting rules and the influence these can have on the outcome. The ethical consideration (reduction in attributable footprint vs. reduction in the real economy) will be deliberated upon in the discussion section.

Finally, the quantitative and qualitative analyses are complemented by a case study of a bank that has applied both methodologies, ING Group. This lived experience was used to validate the results of the control exercise and to enrich the qualitative review. The case study is addressed in the results section below.

Chapter III

Results

The results section is divided into two parts in order to separately address each research question. First, the results of the quantitative analysis of the data inputs is presented in order to compare the accuracy of the two methodologies. Second, the results of the qualitative review of each methodology's utility for target-setting are presented in four main sub-sections: 1) the quality of the zero-base measurement provided by each of the two methodologies, 2) the quality of interaction between the output of each methodology and available benchmarks and how this does or does not aid decision-making, 3) the robustness of methodological choices and how this can influence outcomes, 4) a case study reviewing the experience of a bank – ING Group – in applying both methodologies.

Quantitative analysis: accuracy scores of each methodology

The DIAS framework was applied to the contrived portfolio and the inputs prescribed by each methodology resulting in a final accuracy score for each. The accuracy scores for the contrived portfolio for PCAF-CL and PACTA-CL are displayed in Tables 4 and 5 respectively. Table 4 provides a summary of the data input types per sector in terms of the percentage that each represents, the weighted sum of each sectors' results which were aggregated to reach the total accuracy score for the contrived portfolio applying the PCAF-CL methodology. For the 64 unique companies in scope across the three sectors,

48% of them reported at least one of the three emissions scopes. For the remaining 52%, 8% reported production data while the remaining 44% required the use of sector averages to arrive at an emissions estimate.

As prescribed in the DIAS framework, each company received an accuracy score based on the data inputs and their completeness, coverage and quality scores. Each company's accuracy score was portfolio-weighted and summed for each sector (as shown in Table 4) and then aggregated over the entire loan book for the final accuracy score. Applying DIAS framework (A), where the data inputs prescribed by the PCAF-CL methodology were assessed for the contrived portfolio, resulted in an accuracy score of 56.65 for PCAF-CL. Isolating the primary data in the DIAS framework (B), resulted in a significantly lower total accuracy score of 22.32. In both cases, the scores suffered largely from partial reporting of emissions. Of the thirty-one companies in the Fossil Fuel sector, only fourteen reported emissions, of which, only five reported all three scopes. These five were the only companies including scope 3 emissions (which makes up roughly 89% of the total according to the SG17 findings). For the Power Generation sector, only six out of twenty-two report scope 1, 2 and 3 emissions. Automotive is the exception, where only one of the companies failed to report all three scopes. The second reason for the low scores is that the boundary of error according to literature for company reported data is quite broad for the fossil fuel and power sectors in particular. The summary of the results is provided in Table 4 below.

Table 4. PCAF-CL: DIAS Summary and Results (A&B) for Contrived Portfolio

Sector	CR Data	PD Data	SA Data	Weighted Accuracy Score (A)	Weighted Accuracy Score (B)
Fossil Fuels	45%	13%	42%	23.24	4.19
Power	32%	5%	64%	19.34	4.96
Automotive	91%	0%	9%	14.06	13.17
All Sectors	*48%*	*8%*	*44%*		
Total Accuracy Score (A), (B)				***56.65***	***22.32***

The results of the DIAS framework applied to the contrived portfolio using the PACTA-CL methodology are provided in Table 5 below. The sector accuracy score for each portfolio is a function of the completeness score times the coverage score for each company. This accuracy score is then portfolio-weighted and aggregated to arrive at the total accuracy score for the sector and the loan book. The total accuracy score according to the DIAS framework for the contrived portfolio using the PACTA-CL methodology is 86.01. This relatively high score can be largely attributed to a high match-rate of the companies in the loan book, meaning high availability of data on the assets responsible for the majority of a company's climate impact.

Table 5. PACTA-CL: DIAS Results for Contrived Portfolio

Sector	Completeness Score (*s*)	Coverage Rate (*c*)	Accuracy Score	Portfolio Weight	Weighted score
Fossil Fuels	97.40	0.89	86.69	0.50	43.24
Power Generation	96.00	0.99	95.04	0.32	30.33
Automotive	71.40	0.95	67.83	0.18	12.45
Total Accuracy Score (a)					***86.01***

Qualitative review: utility for target-setting

The results of the qualitative review of each methodology's utility for target-setting are presented in four main sub-sections. First, the quality of the zero-base measurement provided by each of the two methodologies is presented based on the accuracy score. Second, the quality of interaction between the output of each methodology and available benchmarks and how this does or does not aid decision-making is reviewed. Third, the robustness of the methodological choices is reviewed on the basis of how this can influence calculated results. Fourth, a case study reviewing the experience of a bank – ING Group – in applying both methodologies is presented.

Zero-base measurement: quantitative and qualitative review

As we saw in the previous section, the completeness, coverage and quality of the input data has a significant effect on the accuracy of the results. While neither methodology provided a 100% accurate zero-base measurement for the contrived portfolio, the scores differed greatly, with a significantly lower score for the financed emissions inputs due to incomplete reporting by companies or a complete lack of reporting, requiring the use of sector averages for 44% of the portfolio. With an accuracy score of 22.32 for the CR data or 56.65 when including SA and PD data, the PCAF-CL methodology already presents a number of issues with regards to target-setting. First, because the outcome is broadly inaccurate at the onset, this approach would lead to presenting an inaccurate representation of the portfolio. Second, you cannot manage what you do not capture in your measurement, meaning a below-acceptable accuracy rate will result in a large scope of emissions that should be managed are not. It was for this reason

that CDP cleaned and modelled the company reported data of 2,898 of the most carbon-intensive companies, specifically so that investors would be better equipped to comply with disclosure requirements and target-setting commitments. Sawbridge et al. (2016) states:

> "There is a growing appetite from investors for high quality and complete corporate greenhouse gas (GHG) emissions data, born in part as a response to initiatives such as the Portfolio Decarbonization Coalition, the Montreal Pledge and Article 173 of the French Energy Transition Law" (Sawbridge et al., 2016).

There is an inherent need for 'high quality and complete corporate GHG emissions data' in order for financials to arrive at a zero-base measurement from which they can set strategies for reduction. Solely based on the accuracy of the data inputs derived by the application of the DIAS framework, with an accuracy score of 86.01 (>29 points higher than PCAF-CL when including PD and SA data, or almost 64 points higher when comparing CR data inputs to the PACTA-CL data inputs) we see that the PACTA-CL approach provides a more accurate baseline from which reduction targets can be set.

The quality of the inputs is not the only variable affecting the overall accuracy of the results, however. The treatment of the individual company-level results in relation to one another can also impact the accuracy of the outcome. One of the key distinctions between the two methodologies in question is that one aims to arrive at a single aggregate figure that represents the 'financed emissions' (scope 3 – category 15) of the portfolio and the other treats each sector separately, arriving at separate conclusions for each (PCAF, 2018; 2° Investing Initiative, 2018). PCAF-CL prescribes that the scope 1, 2 and 3 ('where relevant') emissions be included in the data inputs. This scope should be collected or estimated for each loan and attributed to the financial according to the

methodological accounting rules. Once the attributable 'financed emissions' has been calculated or estimated for each corporate loan, these are then summed to arrive at the total financed emissions for that portfolio. What's more is that this is done for each asset class (e.g. corporate bonds, mortgages, etc.) to arrive at the total scope 3, category 15 emissions for the financial (PCAF, 2018). This inevitably will result in a vast amount of double counting within the corporate loan asset class as there are multiple sectors in scope.

To illustrate this, in the case of the contrived portfolio, where possible, the scope 1 emissions of the power generation sector are calculated, in this case, for large U.S. utilities. In the same asset class, we are also incorporating automotive manufacturers' scope 2 emissions related to the use of electricity. By aggregating the scope 1 emissions of the utilities companies and the scope 2 emissions of automotive manufacturers, double counting is highly likely to occur. The same can be said when adding the mortgage or real estate lending emissions to the power sector corporate lending emissions. Adding across sectors will always mean the risk of double counting and therefore an incorrect baseline measurement. In contrast, this will never occur in the PACTA-CL model as an owned asset and its production capacity is counted only once and attributed only to its owner. Therefore, the quality of the inputs is not diluted in any way by aggregating across sectors, allowing for strategies to be set based on an accurate zero-base measurement.

Decision-making: steering towards a Paris-aligned benchmark

The degree of utility for science-based target-setting among the two methodologies is affected, in part, by the availability of a normative benchmark

applicable to the outputs of the methodology. Simply setting a reduction target does not mean the target is ambitious enough to support alignment towards and reflect the organization's fair contribution to the global climate target. Therefore, a so-called 'Paris-aligned' benchmark is needed. The PACTA-CL methodology incorporates this type of benchmark as an integral part of the methodology's outputs. As is visible in Figure 9 which presents the output of the tool and results of the PACTA-CL methodology using the contrived portfolio for the automotive sector, the portfolio technology mix is immediately compared to the Beyond 2 Degrees Scenario (B2DS) of the International Energy Agency which identifies the technology 'roadmap' necessary for the automotive sector to align with the Paris Climate Agreement (IEA, 2017). Therefore, the metric used in the PACTA-CL approach links directly to the metrics utilized in the benchmark, allowing for a direct translation (e.g. % increase in electric vehicle [EV] production capacity). This could then be translated to portfolio-level targets to engage with clients to increase EV production capacity over time. In the case of the results in Figure 9, the future technology mix of clients in the contrived portfolio (Portfolio 2023) falls significantly behind the B2DS benchmark (Portfolio Scenario 2023), meaning clients should be engaged to expand the share of capacity for hybrid and electric vehicles by 10.5 and 4.2 percent respectively.

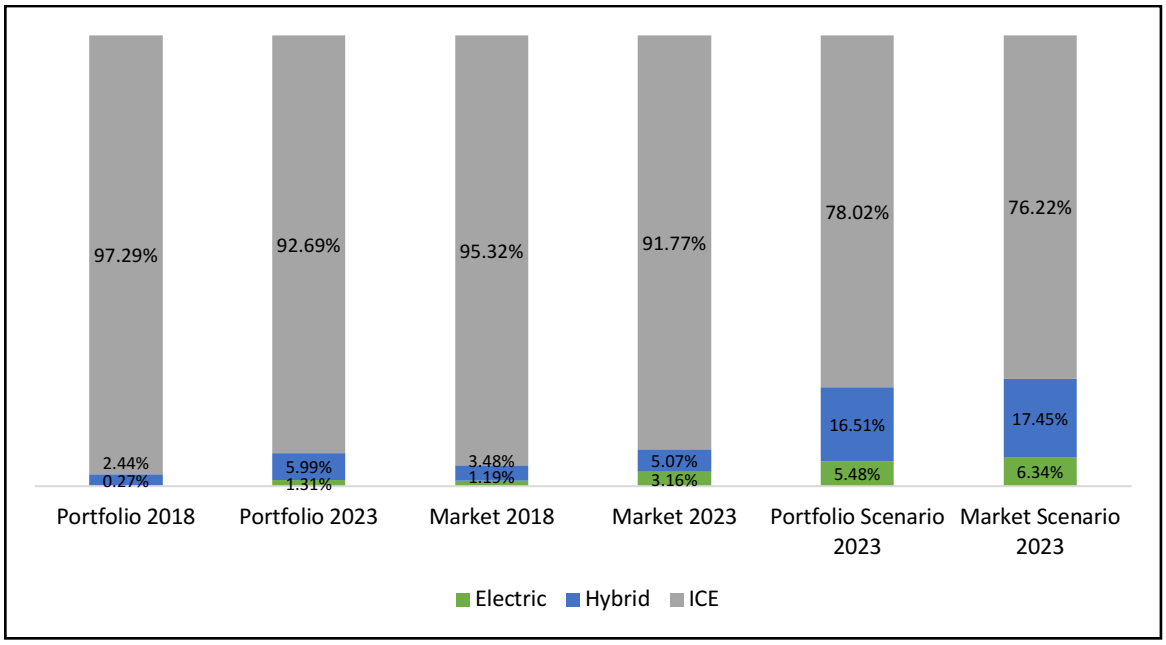


Figure 9. PACTA-CL Results Automotive: Current and Future Technology Mix of contrived portfolio compared to market and B2DS Scenario. Data Source: 2°ii.

The PCAF methodology report states that "a financial institution's footprint reporting is a means to an end" and that the ultimate goal is to steer the footprint towards the goals of the Paris Climate Agreement (PCAF, 2018). While no scenario or benchmark is prescribed, the PCAF report does point to the Science Based Target Initiative's (SBTI) (2019b) work that is currently underway to develop methods to this end. However, to-date, the SBTI framework prescribes the application of a 'sectoral decarbonization approach' specific to each sector's share of carbon intensity reduction modelled by the International Energy Agency. This is the case for corporates across various sectors and, though subject to change pending finalization, it is also currently the case for the draft methodologies being supported within the SBTI Financial Institutions (SBTI-FI) working group (Science Based Targets Initiative, 2019b). The reason for this is that there is not one normative benchmark relevant for a financial institution but rather there are sector-

specific benchmarks that can be translated to financed sectors within the various asset classes of a financial, like corporate lending, real estate or mortgages. The SBTI-FI draft currently prescribes that each asset class, such as mortgages, real estate or corporate instruments, have a separate emissions intensity target (Science Based Targets Initiative, 2019b). The intensity target prescribed is based on CO_2 per unit of production (e.g. ton cement produced or m^2).

Within the SBTI-FI working group, there is currently no target-setting method proposed for the financed emissions approach. Rather, the draft methodologies all propose setting sector-specific targets – similar to the PACTA approach which is also sector-specific. One of the key reasons for this is that there is currently no normative benchmark for setting climate-targets that could be applied across sectors. Because the PCAF-CL approach measures emissions across sectors within the corporate lending asset class where there is no normative benchmark, the methodology has a very low utility for setting science-based targets. Current emissions-based methodologies propose sector-based emissions intensity targets per unit of production or economic activity as external benchmarks can be converted to this metric. In short, the resulting metric of the PCAF-CL approach (CO_2e) is not able to align or interact with the current benchmark intensity metric (e.g. $kgCO_2e/MWh$).

In addition to the need for a normative benchmark, a few important features remain for effective target-setting. Targets cannot be reasonably set without the means to steer outcomes towards the intended goal. The methodology must provide decision-useful data which prescribes reasonable actions; ideally at a client level, the level at which day-to-day decisions are made within a bank. First, regarding the need for decision-useful client-level data, data availability again becomes an issue. In the case of the contrived

portfolio, CR data was available for only 48% of the companies. For the remainder, the results relied mostly on sector average data which depend on global emissions factors and the lending exposure to calculate the estimated emissions. The only 'change-levers' for decision making in these cases are 1) doing less business with those clients or 2) reallocating capital to lower-carbon sectors. In both cases, there is no actual reduction in GHG emissions, an issue further discussed below. Second, the data must provide insight regarding the future strategies of the company. The average duration of a bank term loan is between five and seven years. This means that for a bank to avoid being locked into a relationship with a client that is not on the right pathway concerning climate change mitigation, the data should be as forward-looking as possible at a client level. At best, the financed emissions approach will provide a snapshot of the client's emissions for the previous year. If available, historical performance data could be collected to provide an indication of the trend the client is currently experiencing. However, the past is no guarantee of the future and therefore cannot be used to evaluate the strategic direction of the client. In contrast, the financed technology approach sets itself apart in that client-specific, forward-looking capital expenditure plans are incorporated into the analysis to determine the direction of travel for existing clients. This helps to identify clients who are lagging behind in their transition and should be targeted for engagement.

Methodological robustness: influencing (unintended) outcomes

This section will focus on the methodological choices of the two approaches under review, namely with regards to the prescribed allocation rules. The allocation rules play a very important role in climate accounting since this determines how much of the client's climate impact should be allocated to the financial. Unless otherwise specified, this

section relies solely on the findings of Thomä, Dupré and Hayne (2018) in their review of existing climate accounting principles with the underlying conclusion being that the accounting principles applied among financials are far from standardized and have a significant effect on the outcome. They also point to some of the pitfalls and benefits of the different accounting choices.

The two methodologies prescribe distinct allocation rules. PACTA-CL utilizes the portfolio weight approach (PWA) while PCAF-CL applies the balance sheet approach (BSA). The PWA puts the bank's capital allocation and exposure choice at the heart of the principle (what this loan means to the financial) while the BSA puts the client's debt choices at the heart of the principle (what this loan means to the client). The PWA, therefore divides the loan outstandings by total portfolio outstandings to arrive at an attribution factor while the BSA divides the loan outstandings by the balance sheet of the client. This leads to two different effects: for PWA, the greater the concentration of exposure to a given client, the greater the share of the client's climate impact; for the BSA, the higher the debt ratio, the higher the share of the client's climate impact. When choosing an allocation rule that reflects the responsibility of the financial, intuitively it makes sense that the allocation rule also puts the responsibility upon the financial, placing the control in their hands. The balance sheet approach will inherently mean that allocation has more to do with the choices of the client than with the choices of the bank. As the client increases its balance sheet, the allocation of the client's impact to the bank shifts.

Perhaps most importantly is the fact that these shifts will be reflected as an increase or decrease in the bank's scope 3 emissions, completely divorced from any real increase or decrease of the client's emissions. For this reason, the balance sheet approach is sensitive to external factors outside the control or responsibility of the bank which can

have unintended, misleading outcomes. Figure 10 from Thomä, Dupré and Hayne (2018) illustrates the volatility of using company financial data as a denominator in the attribution rules. While this example is demonstrating how this can impact normalization outcomes, it also demonstrates the impact of the balance sheet approach over time compared to actual emissions changes.

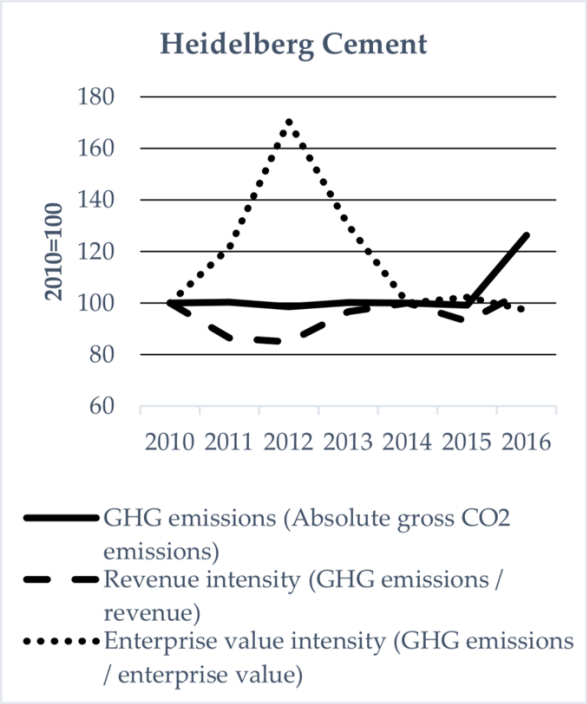


Figure 10. Heidelberg Cement. The impact of normalization choices on outcomes relative to absolute emissions. Source: Thomä, Dupré and Hayne, 2018.

In sum, this approach will take control away from the bank and can lead to misleading outcomes regardless of the actions of the bank – namely reflecting a reduction in financed emissions as a result of an increase in the client's balance sheet and not as a result of reduced emissions.

Case Study: Experience of ING Group with both methodologies

ING Group is one of the few multinational commercial banks that has applied both the financed emissions and the financed technology approaches and has publicly communicated details regarding their experience of both. This section will look at ING's lived experience with both methodologies in order to qualitatively review the applicability of each methodology for target-setting. Using public reports of ING, details on their website and presentation materials, the below case study was formulated.

ING's experience with the financed emissions approach. In 2015, ING Group signed the Science Based Targets Initiative's commitment letter to set science-based targets once a methodology was developed (ING Group, 2017b). Soon after, ING partnered with an environmental consultant to develop an approach to measuring its scope 3 GHG emissions related to its lending (ING Group, 2017a). The approach was developed and tested over the span of two years, focusing on renewable power generation, commercial real estate and general lending. For the renewable power generation portfolio, the methodology focused on 'avoided emissions' or negative emissions. For commercial real estate, the methodology estimated total financed emissions related to the collateral in ING's portfolio. For general lending, the methodology focused on generating a hot spot analysis of the wholesale banking portfolio by estimating emissions across each sector within the general lending portfolio of wholesale banking. This provided an indication of which sector was most carbon intensive and which was most material to ING based on capital allocation (Linthorst, 2016).

The pilot provided a total financed emissions estimation, aggregating the real estate, renewable power generation and wholesale banking estimations. While this

estimation was the first attempt at calculating a part of ING's scope 3 (financed) emissions, providing necessary insights into the complexities surrounding carbon accounting for banks, the figure was deemed "unacceptable for disclosure" due to a high margin of error (ING Group, 2017a). According to ING, this margin of error was likely higher than 40% (van den Berg, 2019). Furthermore, ING cited a lack of data and the subsequent use of data proxies and assumptions as the main challenges to arriving at accurate figures (ING Group, 2018a). ING's stance, therefore, was that publishing a figure with a 40% margin of error would be misleading and would create the expectation that ING could set reduction targets against that figure. However, due to the fact that that much of this figure relied on sector averages, the only 'change lever' provided was to do less business in carbon-intense sectors while doing more business in carbon-negative or low-carbon sectors (van den Berg, 2019).

While this may seem intuitive, ING further explains that there are three critical issues with this approach. First, achieving a low-carbon economy will require transition and transition will require finance and investment (ING Group, 2018c). As bank lending will play a role in financing this transition, ING's stance is that this cannot be achieved by divestment alone, but by supporting existing clients in carbon-intense sectors to adapt, develop and transition to cleaner technologies and production processes (ING Group, 2018a; 2019). The methodology only allows for a shift away from clients in high-carbon sectors towards clients in low-carbon sectors, leaving no room for supporting high-carbon clients in their transition. The second critical issue cited is the lack of a normative benchmark to guide decision making and strategy. While a reduction in calculated financed emissions may be achievable by reshuffling the portfolio, there was no

methodology which pointed the bank towards how much of that shift would be required in order to align with a well-below 2 degrees target (van den Berg, 2019).

In addition to the above-cited methodological issues with this approach, the methodology lacked a clear translation to client insights. Due to the large amount of estimations and proxies, the results could not accurately reflect the climate-relevant attributes of a particular client of ING (ING Group, 2017a; van den Berg, 2019). For this reason, the results were deemed useless for relationship managers and sector heads who would ultimately need to make day-to-day decisions to shift the portfolio. For this reason, the methodology developer strongly encouraged ING to use actual emissions or activity data provided by the client. However, this also faced two critical challenges. First, client-level emissions data are only available for a percentage of stock-listed companies, while the majority of ING's clients are not stock-listed (ING Group, 2017a). Requesting or requiring this data from clients would mean costly changes to systems and processes and could put negative pressure on client relationships. The second key issue was that this data would still say very little about the direction the client is heading in as GHG emissions data provides a snapshot of the past, rather than the strategy and plans of a client in the coming years (van den Berg, 2019). For example, client A in the utilities sector could have a lower emissions profile than client B in the previous year. The financed emissions methodology would therefore recommend that ING choose to finance client A over client B. However, client B could have plans in place to build out three times the renewable power capacity compared to client A who is investing heavily in coal in the coming years. The financed emissions methodology, therefore, proved to be too problematic for ING to measure and steer its lending portfolio towards the well-below 2-degree goal of the Paris Climate Agreement (ING Group, 2017a).

The final observations the bank made in relation to the financed emissions approach it piloted was that it was costly, time-consuming and required a large amount of manual work from the sector teams while yielding unhelpful results (van den Berg, 2019). As banks are increasingly weighed down by regulatory requirements, a successful solution is one that must be automated and integrated as much as possible and does not require burdensome additional requests towards clients.

ING's experience with the financed technology approach. In 2017, ING began piloting the PACTA-CL approach under the umbrella of its public ambition to align its portfolio with the Paris Climate Agreement. ING refers to its alignment strategy which mainly applies the PACTA-CL approach as 'Terra' (ING Group, 2018c). This approach is applied for steering the sectors in its portfolio that are considered the most GHG-intensive, namely energy (which includes oil and gas, renewables and conventional power and thermal coal mining), automotive, shipping, aviation, steel, cement, residential and commercial real estate (ING Group, 2018c). ING reports that PACTA-CL is playing an important role in the bank being able to steer its portfolio because the analysis provides detailed prescriptions of what needs to change by "how much and by when" (ING Group, 2018c; 2019). ING further describes the approach as having a potential impact on how the entire sector measures climate impact as this approach

> "compared to other measurement approaches […] is precise, tailored to each sector's needs, forward-looking, and will ultimately have a bigger impact because it steers key sectors towards technologies that underpin a low-carbon future rather than only measure a carbon-rich past" (ING Group, 2018c).

Chapter IV

Discussion

This chapter presents the summarized conclusion of the present research questions and hypotheses. Furthermore, this chapter identifies the existing limitations of the current research scope and the implications thereof. A discussion regarding a number of further considerations in favor or against the two methodologies in review, namely that of reporting complexity, comparability of metrics and feasibility, is then presented.

Conclusion

The present research utilized a contrived portfolio (control data set) consisting of 64 companies active across three high-carbon sectors, namely fossil fuel, power generation and automotive manufacturing, to conduct a quantitative and qualitative review of two prominent methodologies currently being applied to bank lending portfolios for climate impact measurement. An emissions-based approach, PCAF-CL, and a technology-based approach, PACTA-CL, were quantitatively compared using the DIAS framework to objectively assess the accuracy of the outputs based on three data input indicators: completeness, coverage and quality. The accuracy scores using the DIAS framework for the contrived portfolios applying the PCAF-CL and PACTA-CL methodologies were 56.65 and 86.01 respectively. The low score of the PCAF-CL inputs is due to the lack and incompleteness of corporately reported emissions data and the low coverage rate thereof according to the SG17 modelling.

The higher score of the PACTA-CL inputs is attributed to the high match-rate (completeness of ALD) and to the high coverage rate by focusing on the assets responsible for the majority of the company's climate impact. Therefore, my hypothesis that the technology-based approach would yield more accurate results than the emissions-based approach due to lack of company emissions data is proven correct within the current scope of research.

Regarding my second research question which explores the utility for target-setting, this was addressed by applying a 4-pronged approach to the qualitative review. The following four aspects were therefore considered 1) the ability to arrive at a reasonable zero-base measurement, 2) the availability of applicable benchmarks and whether the methodology allows for appropriate steering actions towards that benchmark, 3) the robustness of methodological choices and how these can impact results and 4) the lived experience of a bank applying both methodologies and that bank's conclusion regarding the methodologies.

Firstly, for the PCAF-CL method, the qualitative review concluded that the low accuracy score and risk of double counting through cross-sector aggregation would not yield a reasonable zero-base measurement. Second, the absence of sector aggregated climate alignment benchmarks renders a cumulative absolute emissions estimation for a multi-sector loan book (scope 3 emissions figure) useless for science-based target-setting. Next to this, the data are backward-looking in nature and would not provide the needed client-level insights to steer towards a benchmark if there were one. Third, the methodological choice to attribute emissions based on the loan to balance sheet function causes a high degree of volatility beyond the control of the lender, which will lead to an erroneous change in reported scope 3 emissions completely divorced from actual

emissions reductions. Finally, the lived experience of ING Group in applying the PCAF-CL approach yielded similar results to the present research. It was for this reason that ING Group abandoned the financed emissions approach as prescribed by PCAF and started testing the PACTA-CL methodology.

For the PACTA-CL approach, the relatively high accuracy score and the sector-specific approach (no aggregating or double counting across sectors) allows for an accurate zero-base measurement whose resulting metric aligns with the metrics used in external climate alignment benchmarks like that of the IEA. The sector-specific roadmaps and granular client-level analysis based on actual asset-level and forward-looking data allow for day-to-day decision making and client engagement to steer towards the intended outcome. The methodological attribution choice to apply a portfolio-weight approach focuses on that which a bank can control and steer, putting them in the driver seat of steering outcomes. This will also mean that the volatility related to the borrower's financials will not affect the climate impact measurement of the bank. Finally, the case study revealed that the PACTA-CL approach has been accepted by ING Group as the main methodology for steering the bank's portfolio in line with their climate commitments.

The current research presents the first study of its kind in quantitatively comparing two methodologies which employ different metrics for measuring the climate impact of a bank lending portfolio. Likewise, the current research contributes a novel framework for objective assessment of climate data inputs. The findings regarding the most conventional and well-known approach, financed emissions, point to considerable flaws and concerns that should not be ignored by institutions looking to implement science-based target-setting, nor by policy makers looking to impose disclosure requirements upon the

financial sector. The aim for measuring climate impact must move beyond tick-the-box disclosure compliance, which will incentivize low-effort estimations, and towards strategy and target-setting, which will guide institutions towards measurements that allow for steering. Without keeping the end in mind, namely financing the transition needed to achieve the goals of the Paris Climate Agreement, empty reporting efforts will be made to appease less informed stakeholders. In short, disclosure-focused policy requirements or guidance, like those in the latest update of the European Commission's NFRD which encourage scope 3 emissions reporting for banks, will incentivize 'greenwashing'-type actions that lead to little or no actual impacts in the real economy (European Commission, 2019).

The findings of the present research also point to a number of critical elements for climate impact measurement methodologies for banks wanting to set targets. First of all, the availability of reliable, granular (client-level), accurate and forward-looking data is necessary to give decision-makers the needed insights for client engagement and strategy execution on a day-to-day basis. Second, approaches must be sector specific as each sector will have a distinct set of actions required to achieve Paris-alignment. These actions cannot be taken or compensated for by another sector. Also, benchmarks are sector-specific, making it necessary to employ sector-specific targets as a bank financing the real economy. Finally, it is not accurate to design accounting methodologies that have inherent volatility which will misrepresent actual impact in the real economy. Therefore, practitioners must not ignore the message their results will send and should ensure that the presentation of results reflects reality. To achieve this, the responsibility of a methodology is not simply to present a figure, but to demonstrate the strategic choices of the financial institution.

Research Limitations and Implications

The conclusions reached in the present research provide useful insights into the key differences, concerns and benefits related to the two methodologies under review. It must be emphasized, however, that these findings were tested within a limited scope. Due to their high carbon intensity, materiality and resulting NGO pressure on banks for financing them, fossil fuels, power generation and automotive manufacturing were the three sectors in scope of the present study. A similar analytical approach applied to three different sectors would likely yield different results. That said, the PACTA-CL methodology is prescribed for seven of the most carbon-intensive sectors (fossil fuels, power generation, automotive, shipping, aviation, cement and steel), making up around 75% of global CO_2 emissions, but is not applicable beyond these (IPCC, 2015). By default, sectors responsible for the other 25% of global emissions are left out.

Therefore, banks should first consider the composition of their portfolios before applying the PACTA-CL methodology. For example, a bank financing only low-carbon assets and residential mortgages would not be helped by this methodology. For banks financing the sectors in scope of PACTA-CL, it may be the case that they will need to consider the application of multiple methodologies in order to eventually address all sectors in their portfolio. For example, ING Group includes residential and commercial real estate in its scope of climate impact measurement (ING Group, 2018c). For these sectors, another approach will need to be applied to reach full coverage of the portfolio.

Additionally, the selected scope was limited to US-based companies and non-ring-fenced loans. Should the quantitative exercise be applied to a different geography or scope of loan facilities, the results might also vary.

Reporting Complexities of a Sector-based Approach

The above consideration, combined with the clear need for banks to apply a sector-specific approach, creates a challenge of its own. Banks will not be able to set 'a' science-based target but will need to employ a set of science-based targets, applying, in some cases, different methodologies and different metrics across sectors. While this is an accurate and effective means to steer portfolios and support clients, it comes with a high level of reporting complexity. In essence, this will lead to banks disclosing climate-alignment dashboards rather than a science-based target.

In contrast, simplicity of reporting is one of the benefits of normalizing climate impact to one metric across all asset classes and sectors, as is prescribed in the PCAF-CL approach. This simplicity is also why the approach is well-known, easily understood, and even recommended by policy makers and investors. However, this is also what makes the approach dangerous as it can be imposed upon banks without careful consideration. Therefore, all findings of this study should be considered before disclosure requirements are imposed (see conclusion section above).

Comparability of Results: PCAF vs. PACTA

Next to simplicity, comparability of performance between banks (e.g. for regulators, investors, policy makers) has been another argument in favor of the financed emissions approach. However, the findings of the present research, namely the volatility of the results and the broad options of data sources and attribution rules that can be applied within the framework of the PCAF methodology, will mean that, depending on the resources and time available, results will differ greatly between banks. Further research applying a different set of choices allowed within the PCAF methodology to the

same two portfolios will also yield a high variance in the results. For example, in their 2018 Sustainability Facts & Figures report, ABN AMRO (2019) published the financed emissions of their corporate lending portfolio using only sector averages. Had they applied the highest level of data hierarchy prescribed by PCAF-CL, they would have used CR data and the results would have been very different. It is worth noting, that according to the results of the DIAS (B) application, the use of CR data in ABN AMRO's case would have likely resulted far less accurate emissions figures than those reported based on sector averages. The findings in the present research, therefore, call into question the assumption of the PCAF methodology that CR data deserves the highest level of preference. Furthermore, the variance in results using different attribution rules will also be vast (see results section above).

Besides the application of different data sources and attribution rules, comparability is also skewed between banks due to the variance in scope of GHG accounting. Variance can occur on a number of levels. A very granular detail, that of reporting on all GHG emissions types, is one that is widely overlooked. Some companies apply the GHG Protocol and include all types of GHGs normalized to the CO_2 equivalent while some companies include a subset or only carbon dioxide. For example, Chevron discloses only carbon dioxide emissions for its use of sold products (by far the largest portion of emissions) while it discloses CO_2 equivalent for its scope 1 and 2 emissions (Chevron Sustainability Report, 2018). Another more obvious source of variance, especially in scope 3 emissions reporting, is the freedom to choose which of the 15 categories under 'scope 3' to include. If company A reports only scope 3 emissions related to business travel while a similar company in size, location, sector, etc. – company B – reports downstream emissions related to the use of sold products, the emissions of

company B will be exponentially higher, while on paper, they both report scope 3 emissions.

Beyond the variance between companies in scope 3 categories, vast differences have been uncovered by similar companies reporting the same category of scope 3 emissions but using different calculation methodologies. Table 6 below from the SG17 study of CDP demonstrates how vast the difference can be among two companies reporting scope 3 emissions in the same category using two different methodologies, both of which are allowed by the GHG Protocol. The SG17 study therefore points to the complexities this raises with regards to accuracy but also how this complicates comparability between companies. The study states, "This patchy data means that it is difficult to compare the GHG inventories of two similar companies and any sort of analysis using reported data is likely to be flawed" (Sawbridge & Griffin, 2017).

Table 6. Illustration of the differences in methodologies used by two companies (Sawbridge & Griffin, 2017)

Company Name	Methodology	Purchased Goods and Services Emissions (tCO2e)	Total Revenue (millions USD)	Revenue Intensity (tCO2e / million USD)
Johnson Controls	Tier 1 Suppliers	13,200,000	37,179	355
United Technologies Corporation	EIO-LCA Model	143,789,320	56,098	2563

This misperception of comparability this can have negative implications for banks or other financials using this data for steering purposes or financing choices. If considering both companies in the illustration above for financing, one might be prone to

choose Johnson Controls over United Technologies Corporation as it has a lower emissions profile on paper. However, this 'lower profile' has more to do with its calculation methodology than with its supplier engagement program to drive down emissions. In sum, in order to determine the sensitivity of results to data sources, attribution rules and varying scopes and accounting methodologies applied for corporately reported emissions data, further research is recommended.

In contrast to the comparability issues masked by 'one metric within one scope', PACTA-CL is a promising approach that presents a big leap forward for setting standards in the banking industry for science-based target-setting. As data sources, attribution rules and scenarios are firmly set within the methodology, results between banks will be reasonably comparable and not subject to arbitrary choices and company volatility.

Feasibility and Ease of Implementation

The ABN AMRO example points to another issue not fully explored in the present research, namely the ease of data collection and methodology implementation. As discussed in the introduction, closing the financing gap will mean that the financial sector is incentivized, held accountable and has accurate insight into the direction of its capital flows compared to climate targets. For this, a scale up of adoption of accurate climate impact metrics is necessary, metrics that will allow for science-based target-setting. The speed of scale-up will be a function of the time and resources needed to implement such metrics.

The data collection process for PCAF-CL in the present research was completely manual. Where CDP data was not available – which was manually collected from online data sets – CR data had to be mined from company annual reports and sustainability

reports. This can be managed in the context of a research paper with only 64 companies in scope, but not when thousands of companies are in scope. It is for this reason that banks like ABN AMRO resort to sector averages and estimations that can be calculated in a matter of minutes. The issue of practicality was also qualitatively discussed by Weber and Thomä (2018), in their review of climate metrics for banks, who found that the financed emissions approach currently faces a number of pragmatic hurdles to make it a viable option for most banks to apply.

Again, in contrast, the PACTA-CL approach is mostly automated and requires no extra data collection from the client or manual data collection from external sources, combining the need for ease of implementation with the need for granular, forward-looking client-level data. It should be added, however, that the PACTA-CL methodology is still in its infancy and will benefit from further adoption by banks and the accompanying iterations of continuous improvement. The transition of businesses that have enjoyed high returns from high-carbon products will not be easy – not for clients, not for banks and not for society. No one methodology will make these challenges disappear, but they can create the needed transparency and insight that will support dialogue, solution-seeking and, eventually, change.

In conclusion, identifying and applying useful, feasible and meaningful metrics for science-based target setting is no simple task for a bank. There are unavoidable tradeoffs that will need to be made between accuracy and simplicity, utility for target setting and ease of communication. Banks will need to have an openness to building a 'toolbox' of methodologies and metrics for the array of sectors in their portfolios, but banks like ING Group have demonstrated that this can be done. Policy makers and regulators should also consider the negative and unintended consequences of imposing

carbon accounting requirements upon banks as this will likely lead to compliance-driven estimations rather than impact-driven strategies that will effect real change; the kind of change needed for the banking sector to help close the financing gap and align financing flows with the goals of the Paris Climate Agreement.

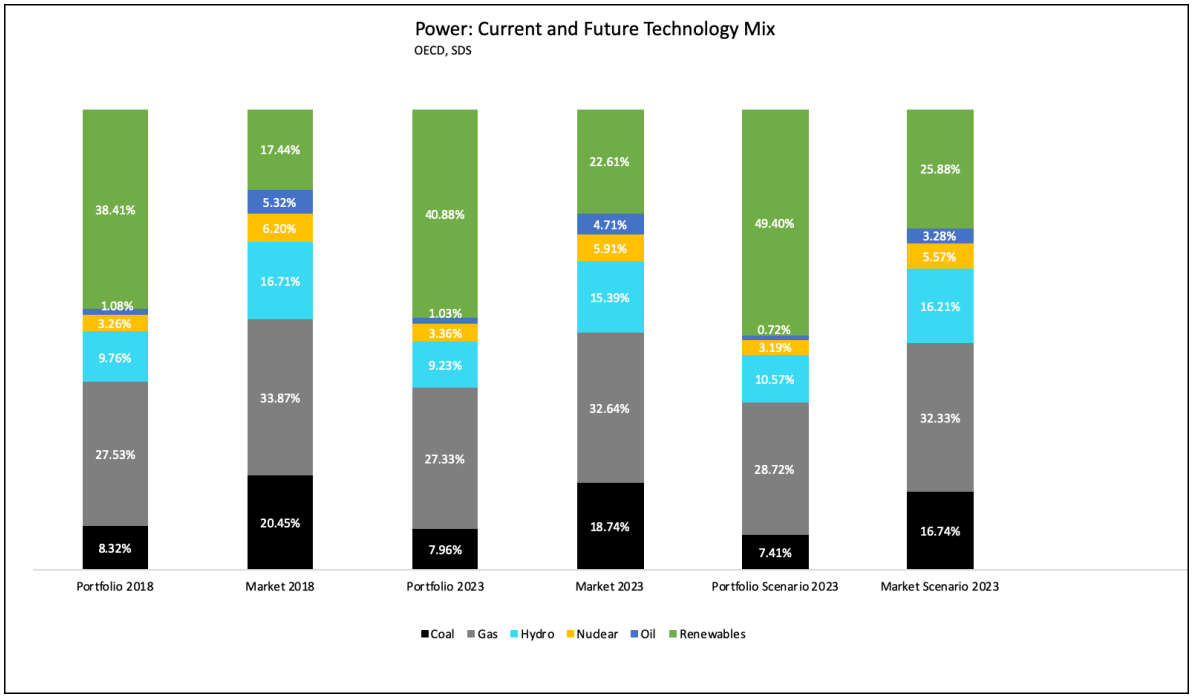
Appendix 1 Contrived Portfolio

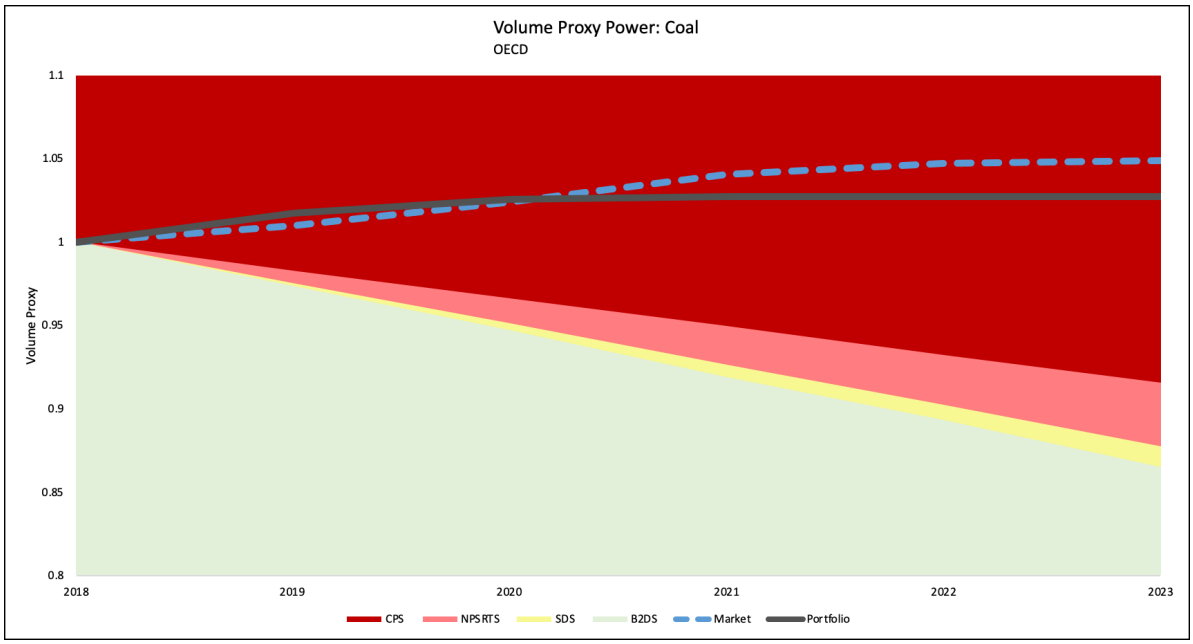
Borrower	Sector	Loan Outstanding
Conoco Phillips	FF	€ 3.915.000
Alta Mesa Holdings Lp	FF	€ 1.973.000
Chevron USA Inc	FF	€ 975.000
Exxon Mobil	FF	€ 1.035.000
Extraction Oil & Gas Inc	FF	€ 956.000
Hess Corp	FF	€ 1.027.000
Chief Oil & Gas Llc	FF	€ 953.000
Suncor Energy Inc	FF	€ 996.000
Koch Industries Inc	FF	€ 963.000
Pioneer Natural Resources Co	FF	€ 1.004.000
Newfield Exploration Co	FF	€ 1.000.000
Marathon Oil Corp	FF	€ 935.000
Total Sa	FF	€ 984.000
Chesapeake Energy Corp	FF	€ 1.017.000
W&T Offshore Inc	FF	€ 1.005.000
Devon Energy Corp	FF	€ 1.000.000
Eog Resources Inc	FF	€ 2.029.000
Bp Plc	FF	€ 1.001.000
Murphy Oil Corp	FF	€ 1.003.000
Matador Resources Co	FF	€ 998.000
Arch Coal Inc	FF	€ 1.864.000
Heritage Coal & Natural Resources Llc	FF	€ 977.000
Drummond Co Inc	FF	€ 1.045.000
Cloud Peak Energy Inc	FF	€ 1.024.000
Kiewit Peter Sons' Inc	FF	€ 1.017.000
Westmoreland Coal Co	FF	€ 1.991.000
Peabody Energy Corp	FF	€ 976.000

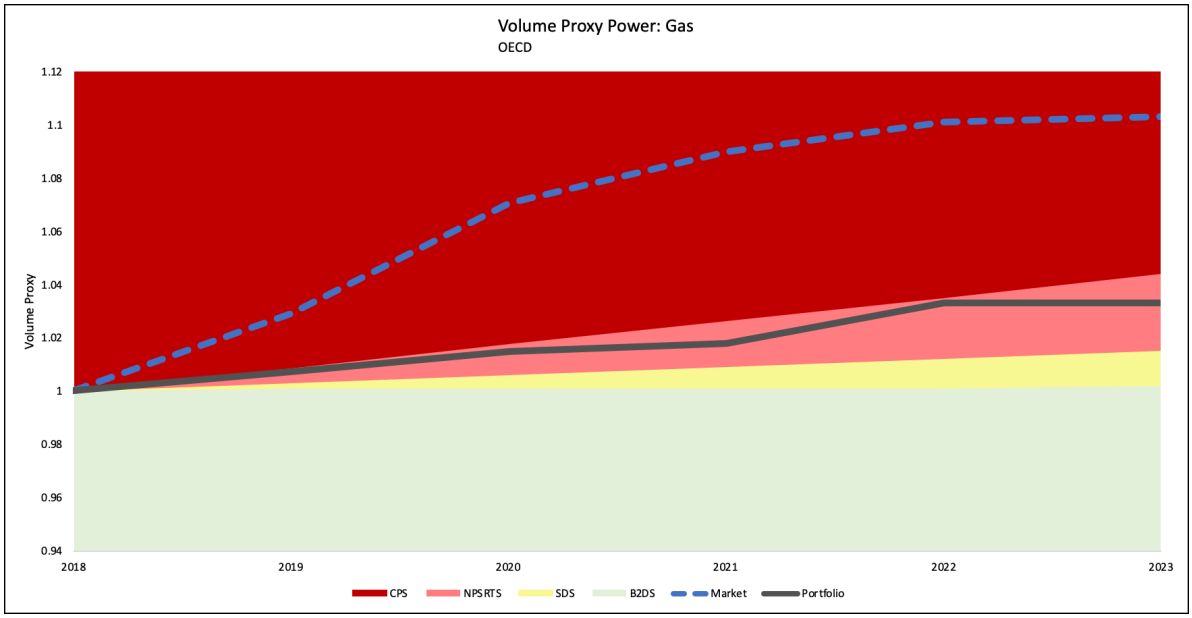
Alliance Resource Partners, LP	FF	€ 968.000
Alpha Natural Resources Inc	FF	€ 1.044.000
Metinvest B.V.	FF	€ 1.998.000
Contura Energy Inc	FF	€ 1.029.000
Florida Power & Light Co	Power	€ 956.000
Duke Energy Carolinas, LLC	Power	€ 992.000
General Electric Co	Power	€ 965.000
Hp Inc	Power	€ 1.032.000
Indiana Michigan Power Co	Power	€ 1.016.000
Nicor Gas	Power	€ 983.000
Entergy Corp	Power	€ 1.947.000
Talen Energy Corp	Power	€ 1.940.000
Duquesne Light Holdings Inc	Power	€ 972.000
Dominion Energy Inc	Power	€ 2.023.000
Tennessee Valley Authority	Power	€ 1.037.000
Central Maine Power Co	Power	€ 1.002.000
Duke Energy Florida Llc	Power	€ 947.000
American Electric Power Co Inc	Power	€ 969.000
Pacific Gas & Electric Co	Power	€ 967.000
Alabama Power Co	Power	€ 1.020.000
Duke Energy Corp	Power	€ 1.009.000
Nv Energy Inc	Power	€ 1.043.000
Wolverine Corp	Power	€ 994.000
New York State Electric & Gas Corp	Power	€ 1.009.000
Public Service Electric & Gas Co	Power	€ 952.000
Northern States Power Company.	Power	€ 1.010.000
General Motors Co	Auto	€ 2.043.000
Nissan Motor Co Ltd	Auto	€ 988.000
Fiat Chrysler	Auto	€ 994.000
Honda Motor Co Ltd	Auto	€ 2.039.000
Tesla Motors Inc	Auto	€ 997.000
Honda Corp	Auto	€ 1.000.000
Volkswagen Ag	Auto	€ 1.003.000

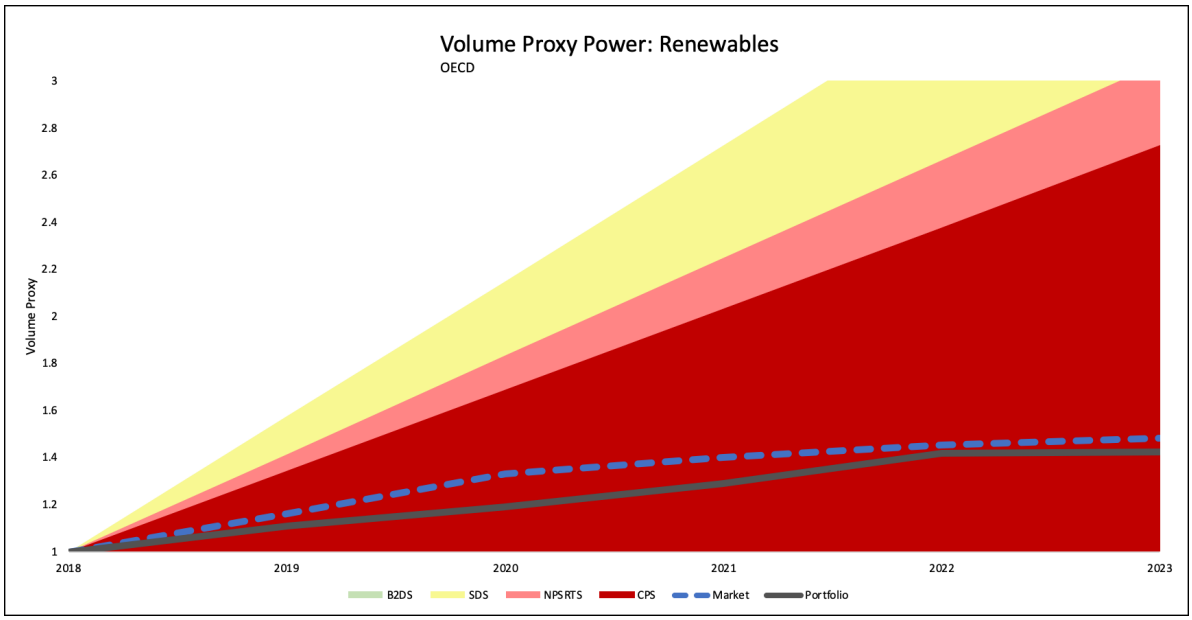
Ferrari Nv	Auto	€ 2.099.000
Fiat Chrysler Automobiles Nv	Auto	€ 994.000
Toyota corp	Auto	€ 1.024.000
Ford Motor Co	Auto	€ 992.000
Total Loan Book		**€77.660.000**

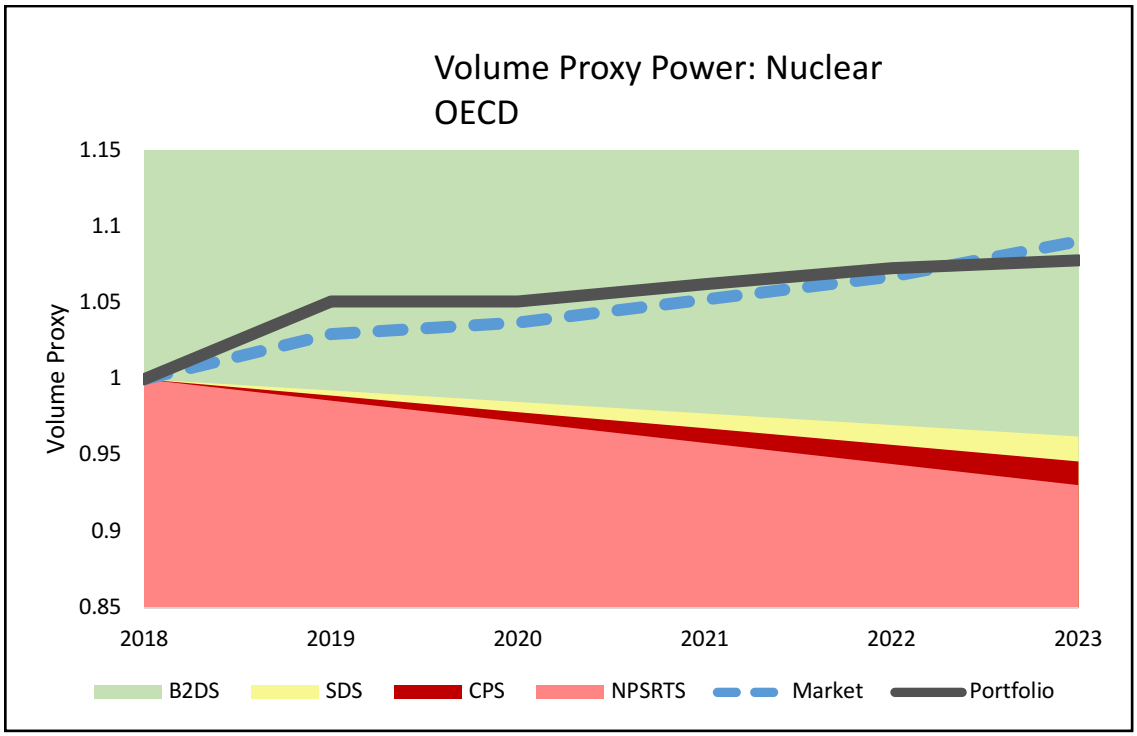
Appendix 2 Results PACTA-CL using Contrived Portfolio

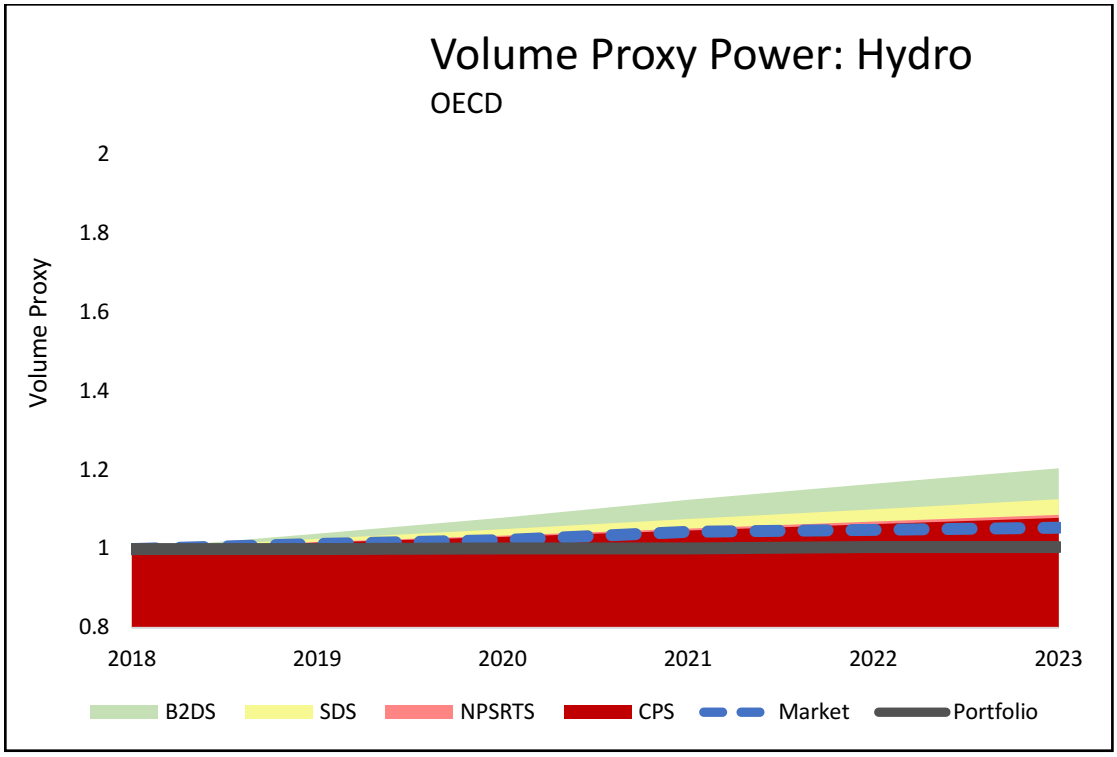


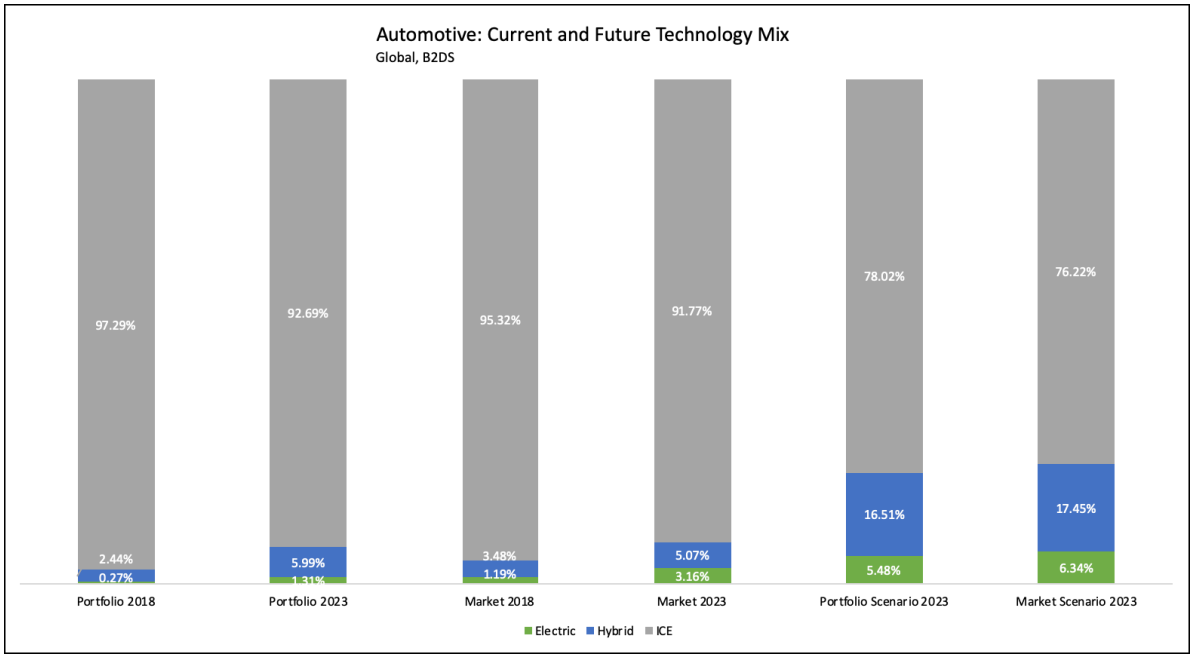


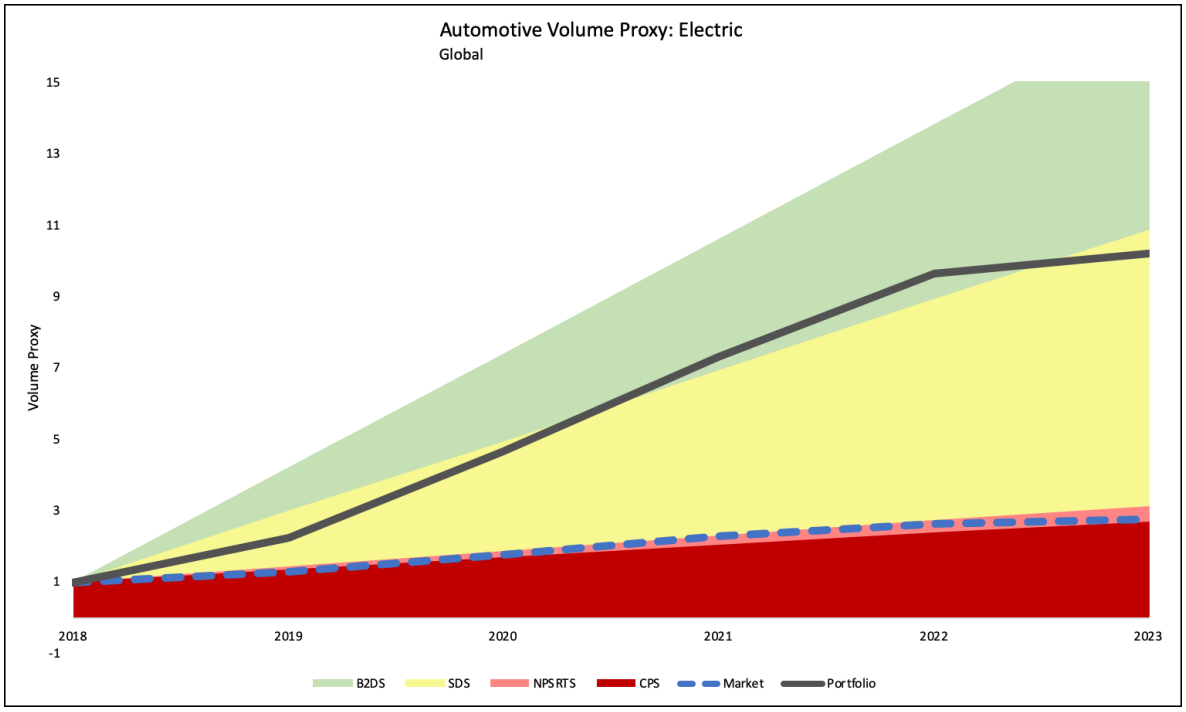

Volume Proxy Power: Gas
OECD
Volume Proxy
1.12
1.1
1.08
1.06
1.04
1.02
1
0.98
0.96
0.94
2018
2019
2020
2021
2022
2023
CPS
NPSRTS
SDS
B2DS
Market
Portfolio


Volume Proxy Power: Renewables
OECD
Volume Proxy
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
2018
2019
2020
2021
2022
2023
B2DS
SDS
NPSRTS
CPS
Market
Portfolio


Volume Proxy Power: Nuclear
OECD
Volume Proxy
1.15
1.1
1.05
1
0.95
0.9
0.85
2018
2019
2020
2021
2022
2023
B2DS
SDS
CPS
NPSRTS
Market
Portfolio


Volume Proxy Power: Hydro
OECD
Volume Proxy
2
1.8
1.6
1.4
1.2
1
0.8
2018
2019
2020
2021
2022
2023
B2DS
SDS
NPSRTS
CPS
Market
Portfolio


Automotive: Current and Future Technology Mix
Global, B2DS
97.29%
2.44%
0.27%
92.69%
5.99%
1.31%
95.32%
3.48%
1.19%
91.77%
5.07%
3.16%
78.02%
16.51%
5.48%
76.22%
17.45%
6.34%
Portfolio 2018
Portfolio 2023
Market 2018
Market 2023
Portfolio Scenario 2023
Market Scenario 2023
Electric
Hybrid
ICE


Automotive Volume Proxy: Electric
Global
Volume Proxy
15
13
11
9
7
5
3
1
-1
2018
2019
2020
2021
2022
2023
B2DS
SDS
NPS RTS
CPS
Market
Portfolio

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