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DBS Impact Measurement Project: Technical review

Hao LIANG
Singapore Management University, hliang@smu.edu.sg

Phuong Tran Bao NGUYEN
Singapore Management University

David FERNANDEZ
Singapore Management University, dfernandez@smu.edu.sg

Jun Ho PARK
Singapore Management University

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Authors: Hao LIANG and Phuong T.B. NGUYEN
Contributors: David FERNANDEZ and Junho PARK

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For further information contact: skbi_enquiries@smu.edu.sg

DBS Impact Measurement Project

TECHNICAL REPORT
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SMU
SINGAPORE MANAGEMENT UNIVERSITY

SIM KEE BOON INSTITUTE FOR FINANCIAL ECONOMICS

LEE KONG CHIAN SCHOOL OF BUSINESS

About this report

This report work was commissioned by DBS and SMU's Sim Kee Boon Institute and serves as an evaluation of the Pilot Study on DBS Impact Measurement conducted by Impact Institute. This report was written by Professor Hao LIANG and Dr. Phuong T.B. NGUYEN of Singapore Management University (SMU). Professor David Fernandez and Dr. Junho PARK from SMU also made significant inputs into the report.

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Contents

Executive Summary

- The measurement of ESG and its impact is becoming one of the more important and debated issues in sustainable business practice, with the significant challenges being the subjectivity of scope, criteria, as well as lack of consistency across different rating agencies and data providers
    - Impact measurement goes beyond ESG measurement. Apart from qualitative and input-based approach, it encapsulates a more outcome/impact-based approach, supported with quantitative methods
- Impact measurement and valuation are still at the infant stage, with limited research and guidelines, thus II's approach has significant novelty and is among the first to measure and value impact
    - II works with partners to continuously improve its approach, and helps the development of the field by providing a proof of principle that some of the challenges can be tackled
- The data compiled through Impact Institute's (II) Global Impact Database (GID) are generally in line with what has been used in the mainstream academic literature; however, some data sources used by II focus more on Europe (e.g., Exiobase, European Social Survey), which may not be suitably adapted for the Asian context, and the inclusion of non-English sources can be improved
- The methodologies employed by II (Integrated Profit and Loss Assessment) are based on straightforward and acceptable assumptions; however, there is room for improvement with regard to (i) the attributions along the global value chains; (ii) the rigid weights between direct and indirect impact distribution; (iii) consideration of higher order indirect impact along value chains; (iv) use of interest rate in impact attribution to the loans made by financial institutions
- The two case studies on Palm Oil sector and Automotive (electric vehicles (EV) versus combustion engine vehicles (CEV)) sector both utilise the methodologies and the data developed by II, but embody different approaches reflecting different characteristics of these two sectors
    - The analyses of the palm oil industry involve the combination of the top-down assessment on global demand and supply and bottom-up country- and industry-specific data
    - The Automotive sector is analysed through the bottom-up approach since the production of EVs is composed of several stages assembling a multitude of parts from various sectors
    - Caveats in II's case studies of the two sectors include insufficient higher order impact assessment (i.e. the indirect impact from the education of farmers' children), and leaving the indirect impact of electronic disposals at the end-of-life phase of EVs out of scope
- Overall, the methodologies and the data utilised by II are broadly consistent in comparison with the recent academic literature on the assessment of ESG impact, but may not be fully generalized to other countries and sectors

1 Introduction

1.1 DBS past efforts in sustainable & responsible finance

DBS builds its sustainability framework on three pillars: responsible banking, responsible business practices, and creating social impact. The bank strongly promotes responsible and sustainable finance by offering multiple products and services that target sustainable development of businesses. Green loans and sustainable bonds finance/re-finance social and green projects, with an aim of advancing environmental sustainability. ESG funds factor in environmental, social, and governance (ESG) considerations into the investment process. DBS continuously explores opportunities to incentivise sustainable practices of its customers. Sustainability-linked loans integrate ESG performance metrics in their interest rate assessment, motivating companies to achieve sustainability targets for a better interest rate. In addition, the ESG risk assessment process incorporating Group Core Credit Risk Policy, Group Responsible Financing Standard, and Sector Guides enables DBS to obtain an overall understanding of the customers' approach to managing projects in terms of environment, society, and governance. It demonstrates the institution's commitment to sustainability in making lending decisions as well as its expectations of customers to uphold responsible business practices.

With this project collaboration with Impact Institute and Singapore Management University, DBS is taking a step further in ensuring their loans are creating significant positive impact on the environment and communities in which they operate. The Bank has explored many models for "Impact Measurement", including Integrated P/L, Impact Weighted Accounts, IMP and UNEP FI's Positive Impact Initiative. The project is expected to provide a consolidated approach with a comprehensive and insightful presentation for the loans' impact assessment purpose of DBS.

Other sustainability initiatives taken by DBS include managing its environmental footprints, adopting environmentally friendly technologies, and encouraging its employees to adopt sustainable behaviours through raising awareness and engagement on sustainable lifestyles. In addition, DBS has been producing integrated reports in accordance with the Integrated Reporting <IR> Framework and Global Reporting Initiative (GRI) Standards since 2015. These actions ensure all stakeholders are well-aware and up-to-date with DBS's ongoing efforts in adopting sustainable and responsible financing practices.

1.2 SMU's past efforts in sustainable finance

SMU is a pioneer in Singapore and in the whole Asia-Pacific region in promoting research and education around sustainable finance. Over the past few years, SMU has put significant efforts in building up its capacity in this area. Faculty members at SMU have published numerous research articles on the topics of ESG/sustainable finance in top-tier journals including *Journal of Finance*, *Journal of Financial*

Economics, *Academy of Management Journal*, *Management Science*, *Organization Science*, *Management Science*, *Oxford Review of Economic Policy*, *Journal of Corporate Finance*, *Journal of Econometrics*, among others. The team leader of this project, Prof. LIANG Hao, holds the DBS Sustainability Fellowship and has won several international awards, including twice the prestigious Moskowtiz Prize on Socially Responsible Investing, Alliance for Research on Corporate Sustainability Emerging Scholar Award, FIR-PRI Finance and Sustainability Award, Sustainable Finance Geneva Prize, Zephyr Prize for Best Corporate Finance Paper, Mirae Asset Daewoo Co., Ltd. Outstanding Paper Award, among others.

In terms of education, SMU has launched the Sustainability major (as the second major) at both the undergraduate and postgraduate levels. As part of the initiative, a course on Sustainable Finance has been taught at both levels starting from 2019. A short-term course on Sustainable Finance and Impact Investing is also offered to the public via SMU Academy. Faculty members have developed original teaching cases on sustainability issues in China and Asia via SMU's Center of Management Practice.

With regard to knowledge dissemination, SMU has been actively holding conferences, workshops and roundtables to facilitate deep dialogues between academics and the industry. These efforts include the SKBI Conference on Green and Ethical Finance (September 16-17, 2020; co-organised with Asian Development Bank Institute and Journal of Banking and Finance) at SMU, 9th Annual SKBI Conference on Sustainable Finance (November 7-8, 2019; co-organised with TBLI Group) at SMU, Sustainable Finance Forum (July 13-14, 2019; co-organised with CUHK Shenzhen and Shanghai Advanced Institute, SJTU) in Shenzhen, the Influential Impact Lunch – Sustainability (May 21, 2019) at SMU, among others.

1.3 DBS-SMU collaborations

DBS has established strong collaborations with SMU on various projects. The recent DBS-SMU Sustainability Initiative in February 2019 supports academics, businesses, and students passionate about tackling real world sustainability challenges. The program introduces Singapore's first sustainability major, and funds sustainability research, fellowships as well as community engagement projects. There are many other collaborations made through SMU's Sim Kee Boon Institute (SKBI), which include a research project on DBS' online banking data ("Physical Frictions and Digital Banking Adoption" by Hyun-soo Choi and Roger Loh), a project on "Sustainable Digital Finance in Asia: Creating environmental impact through bank transformation" (joint with Sustainable Digital Finance Alliance and UN Environment). An ongoing project is investigating credit decisions that involve tradeoffs between sustainability goals and developing dashboard/rubric for making loans.

1.4 Impact Institute's (II) previous works

Impact Institute (II) is a social enterprise, with a mission to "empower organisations and individuals to realise the impact economy by creating a common language for impact and providing the tools to use it." (Impact Institute) Impact Institute has been developing open-source standards for measuring and valuing impact, as well as providing training and services to organisations. The organisation recently circulated the beta version of "Framework for Impact Statements", which serves as a guide for impact statements. This is a progressive effort as more organisations and companies adopt ESG data reporting and produce integrated reports, in which impacts are measured and integrated in accounting statements to illustrate their value implications. II has been working with multiple clients (ABN-AMRO, DSM, Akzo Nobel, etc.) on quantitatively measuring impact of their businesses and/or their investments, as well as on delivering the valuation on annual reports to stakeholders. They have successfully developed integrated profit and loss reports for the bank ABN AMRO. II also works with organisations such as The Economics of Ecosystems and Biodiversity (TEEB) by United Nations Environment Programme (UNEP), Fairtrade International, and Ministry of Economic Affairs of the Netherlands on a variety of sectoral case studies, analysing environmental, societal and human impact of production systems and products.

Impact Institute has been working with European, Latin American, and African organisations. This project with DBS is one of the first of their efforts in extending their expertise to Asian context. Asian and European economies bear many discrepancies in terms of economic and social standards. Therefore, this project offers an opportunity to observe how the Integrated Profit and Loss Assessment methodology as well as the integrated reporting framework that Impact Institute has developed adapt in a more diverse condition.

2 Literature Review

2.1 ESG: definition and implication for firm value and investor return

ESG is the broad umbrella term that refers to the incorporation of environmental, social, and governance considerations into corporate management and investor's portfolio decisions. Managers and investors typically assess these ESG factors using non-financial data on environmental impact (e.g., carbon emissions), social impact (e.g., employee satisfaction) and governance attributes (e.g., board structure). As the definition of the term evolves, researchers and practitioners are beginning to include more indirect factors into consideration, and have singled out the E&S components from the G component, as the latter refers to the traditional governance issues which have been discussed and studied for decades.

Table 1 below highlights some of the major ESG issues that companies are typically exposed. There is no consensus on the exact list of issues and their related materiality, but the concern is that some of these may affect the value creation by a firm. These issues are increasingly topical as a growing portion of firm value lies in intangible assets. While such intangibles as the value of a brand and intellectual property are increasingly reported on firm financials (even if reasonable estimates of their value vary widely), many ESG issues relating to intangibles, are most often, not reflected in traditional financial accounting statements.

Table 1. Main ESG Issues

Environmental (E)	Social (S)	Governance (G)
○ Climate change and carbon emission ○ Natural resources use and energy and water management ○ Pollution and waste ○ Eco-design and innovation	○ Workforce health and safety, diversity and training ○ Customer and product responsibility ○ Community relations and charitable activities	○ Shareholder rights ○ Composition of board of directors (independence and diversity) ○ Management compensation policy ○ Fraud and bribery

The environmental (E) dimension measures a company's impact on the natural ecosystem. This comprises emissions (e.g., greenhouse gases), the efficient use of natural resources in the production process (e.g., in terms of energy, water or materials), pollution and waste (e.g., oil spills), as well as innovation efforts to eco-design its products. The social (S) dimension covers a company's relation with its workforce, customers and society. It includes its efforts to maintain loyal workers (e.g., employment quality, health and safety, training and development), satisfied customers (e.g., producing quality goods and services that keep costumers safe) and being a good citizen within the communities it operates. The governance (G) dimension captures the systems in place for management to act in the best interest of its long-term shareholders. This includes safeguarding shareholder rights (e.g., limiting anti-takeover devices), a well-functioning board (e.g., with an experienced, diverse and independent composition), well-designed executive compensation policies and avoiding illegal practices such as fraud and bribery. There is a vast literature on ESG and CSR in finance, accounting, and management. In this section we only review the most representative ones in each field that are pertinent to this project.

The common explanation for why companies engage in ESG is that doing so enhances profitability and firm value, a relationship often referred to as "doing well by doing good" (e.g., Orlitzky, Schmidt, and Rynes, 2003; Flammer, 2015). Conceptually, ESG engagement can enhance firm value through signalling the company's product quality (Cao, Liang, and Zhan, 2019), building up social capital (Lins,

Servaes, Tamayo, 2017) and stakeholder support (Deng, Kang, and Low, 2013), playing a role of insurance and risk management (Koh, Qian, and Wang, 2014), motivating employees (Edmans, 2011), etc. Other studies consider the inverse, that is, "doing good by doing well," by examining whether it is only well-performing firms that can afford to invest in CSR (e.g., Hong, Kubik, and Scheinkman, 2012). The rationale behind this is that total firm value should include the welfare of various stakeholders besides shareholders, thus those with higher profitability for shareholders should also take care of other stakeholders. However, some scholars argue that ESG engagement may be motivated by managers' personal tastes which do not always align with shareholder value maximisation, thus signifies an agency problem (Cheng, Hong, Shue, 2013; Masulis & Reza, 2015; Krueger, 2015).

Empirical evidence of a positive link between corporate ESG (or E&S) engagement and long-term firm value also abounds. Earlier studies mostly examine only one perspective, such as employee welfare (Edmans, 2011), environmental protection (e.g., Dowell, Hart, and Yeung, 2000; Konar and Cohen, 2001), corporate philanthropy (e.g., Seifert, Morris, and Bartkus, 2004), or consumer satisfaction (e.g., Luo and Bhattacharya, 2006; Servaes and Tamayo, 2013). More recent studies looking at ESG as a whole find similar patterns. A meta-analysis of 60 review studies that combine more than 2200 unique primary studies conducted by Friede, Busch and Bassen (2015) documents that 90% of academic studies find a non-negative relationship between ESG and financial performance, of which 48% in vote-counting studies and 63% in meta-analysis show a positive correlation. This positive effect of high ESG on firm value is likely through the channels of lower cost of capital (e.g., El Ghoul, Guedhami, Kwok, and Mishra, 2011; Albuquerque, Durnev, and Koskinen, 2013), lower idiosyncratic risk and a lower probability of financial distress (Lee and Faff, 2009), more positive sell-side analysts' recommendations (Bushee and Noe, 2001), and more resilience to volatile market conditions such as during the global financial crisis (Lins, Servaes, Tamayo, 2017). It is worth noting that in the context of bank lending which is more relevant to DBS, studies find that firms with high environmental and social concerns face higher interest rates of their bank loans (e.g., Chava, 2014; Hoepner, Oikonomou, Scholtens and Schroder, 2016).

Another large and growing literature takes the investor perspective by studying sustainable, responsible and impact investing (SRI), especially those made through institutional investors. The Global Sustainable Investment Review (2019) reports that over US$ 30 trillion were managed according to responsible investment criteria across the world in 2018. There is an active debate around this topic in the academic literature. On one hand, if SRI creates a binding constrain on portfolio optimisation, we should expect a cost to performance. One the other hand, ESG advocates claim that SRI can enhance returns due to markets under-pricing of ESG information. Studies find that many investors accept lower expected returns on socially responsible investments and are willing to pay higher management fees.

The overall evidence suggests that investors value sustainability criteria and are willing to forgo financial performance in order to invest in accordance with their social preferences.

Several studies investigate the role of institutional investors' ESG preferences and their impact on portfolio companies ESG practice. The impact of institutional investors' ESG preference on portfolio firms' ESG is achieved mostly through engagement and proxy voting. In addition, collaboration among activists ("coordinated engagement") played an instrumental role in increasing the success rate of the engagements (Dimson, Karakas, Li, 2015 & 2019).

2.2 ESG measurement: current practices and challenges

One major challenge is that it is very difficult to measure ESG performance. This challenge may be why people usually focus on short-term financial metrics when evaluating a company. For that reason, ESG rating agencies can play a major positive role. They painstakingly collect and aggregate a range of information on a company's ESG performance – its own disclosures, third-party reports (e.g. from NGOs), news items, and proprietary research through company interviews and questionnaires. They derive an overall ESG score, as well as scores for the individual components (E, S, and G) separately. These ESG ratings are mostly given to publicly listed equities that are included in major global equity indices, are industry-adjusted (e.g., only comparing the ESG performance of companies within the same business sector) and utilise different methodologies. Some widely used ratings include KLD (now MSCI ESG STAT, with 3,000+ US companies), MSCI Intangible Value Assessment (now MSCI ESG, with 7,500+ global companies), Thomson Reuters ASSET4 ESG (now Refinitiv ESG, with 7,000+ global companies), Sustainalytics Company Ratings (with 11,000+ global companies), Dow Jones Sustainability Index (RobecoSAM), FTSE4Good, ISS ESG (Ethix), Oekom Corporate Ratings, GES International, Vigeo Eiris, S&P ESG Index and Trucost (including data from Carbon Disclosure Project), Bloomberg, Morningstar, FTSE Russell, Vigeo Eiris, etc. However, many have pointed to potential biases in ESG ratings, such as larger companies may receive better ESG reviews because they can dedicate greater resources to prepare and publish ESG disclosures, and control reputational risk, higher ESG assessments for companies domiciled in regions with higher reporting requirements, and normalizing ESG ratings by industry can be oversimplified.

An emerging literature deals with ESG disclosure and sustainability reporting (including integrated reporting). The common belief underlying this literature is that increased quantity and quality of ESG information can generate benefits to capital markets through greater liquidity, lower cost of capital and better capital allocation. Christensen, Hail and Leuz (2019) offer a comprehensive literature review of accounting and finance research showing that there currently exists substantial variation in ESG

disclosures across firms. This makes an objective comparison of two companies' ESG practices quite difficult, and posts challenges to a regulator in creating and enforcing reporting standards. However, prior literature also shows that corporate disclosures involve proprietary and litigation costs. For example, With regard to policy prescriptions, mandatory ESG reporting would have implementation issues in terms of ESG standard setting process, the materiality of ESG disclosures, the use of boilerplate language and difficulties in enforcement.

2.3 Impact measurement in impact investing

Another emerging trend of ESG is impact investing, in which investors intentionally seek to create both financial return and positive social impact that is actively measured. According to Global Impact Investing Network (GIIN), the global impact investing market has sized to over $500 billion by April 2019, more than doubled from the estimated 228 billion in 2018 and quadrupled the estimated $114 billion in 2017. In an article published on Harvard Business Review, Cole, Ghandhi and Brumme (2018) provide a background note on impact investing. Barber, Morse and Yasuda (2019) find that venture capital funds that aim not only for financial return but also for social impact earn lower returns than traditional funds, suggesting investors derive nonpecuniary utility from investing in dual-objective funds. However, the topic area still remains under-researched.

An important part of impact investing is the measurement of social and environmental impact. To the best our knowledge, there's no formal academic study on how to scientifically measure impact. Nevertheless, some approaches are adopted in practice by impact investors. For example, an HBS report identifies four methods of impact measurement in impact investing:

- **Expected return** takes into account the anticipated social benefits of an investment against its costs, discounted to the value of today's value, and can take various forms, including Social Return on Investment (SROI), Benefit Cost Ratio (BCR), and Economic Rate of Return (ERR).

- **Theory of change and logic model** explain the process of intended social impact. Specifically, logic model is a common tool used to map a theory of change of an organisation, intervention, or program by outlining the linkage from input, to activities, to output, to outcomes, and ultimately to impact.

- **Mission alignment methods** measure the execution of strategy against mission and end goals over time; examples include social value criteria and scorecards used to monitor and manage key performance metrics.

- **Experimental & quasi-experimental methods** are after-the-fact evaluations that use a randomised control trial or other counterfactual to determine the impact of the intervention compared to the status quo.

Similarly, in a Harvard Business Review article, Addy, Chorengel, Collins, Etzel (2019) propose a framework for calculating the value of impact investing and also a new metric of the *impact multiple of money* (IMM): (1) Assess the Relevance and Scale; (2) Identify Target Social or Environmental Outcomes; (3) Estimate the Economic Value of Those Outcomes to Society; (4) Adjust for Risks; (5) Estimate Terminal Value; (6) Calculate Social Return on Every Dollar Spent.

Other frameworks for impact measurement have been developed. For example, the Equator Principles (EPs) were developed by the World Bank's International Financial Corporation (IFC) as a risk management framework for determining, assessing and managing environmental and social risk when funding new projects by financial institutions. EPs apply globally, to all industry sectors and to four financial products: (1) project finance advisory services, (2) project finance, (3) project-related corporate loans, and (4) bridge loans. It is primarily intended to provide a minimum standard for due diligence and monitoring to support responsible decision-making in risk management.[1] The IFC has also reviewed several different impact measurement frameworks in its recent report titled "The Promise of Impact Investing". Notably, a monetisation framework is developed by TPG's RISE Fund, which is based on the calculation of an impact money multiple (IMM) in the spirit of Addy et al. (2019) that quantifies and monetises an investment's net social and environmental impact (p. 53), as shown in the figure below.

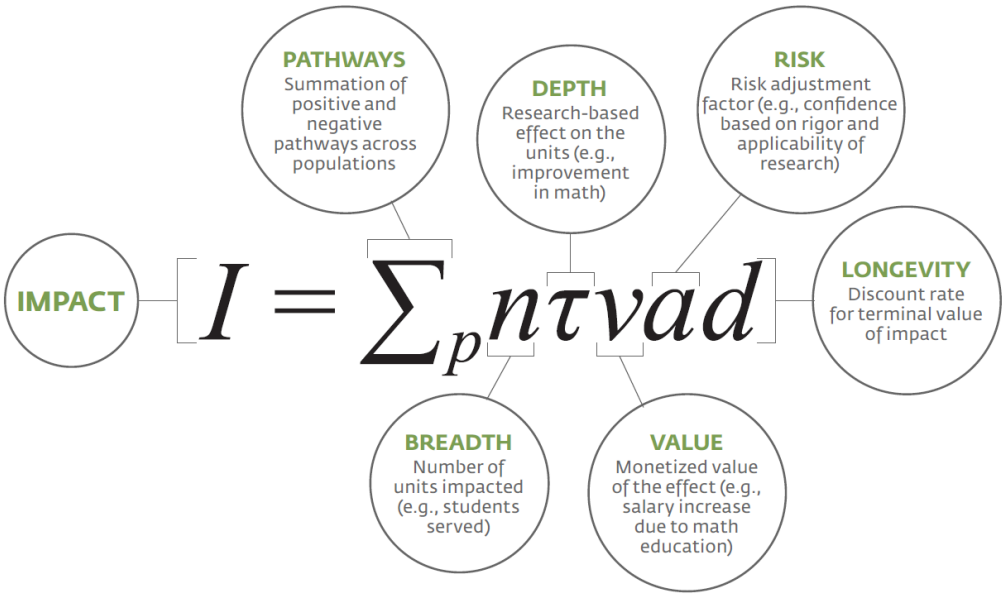

Figure 1. Impact Monetisation Formula used by TPG (RISE Fund). Source: IFC Report "The Promise of Impact Investing"

[1] EPs include ten principles: 1. Review and Categorisation; 2. Environmental and Social Assessment; 3. Applicable Environmental and Social Standards; 4. Environmental and Social Management System and Equator Principles Action Plan; 5. Stakeholder Engagement; 6. Grievance Mechanism; 7. Independent Review; 8. Covenants; 9. Independent Monitoring and Reporting; 10. Reporting and Transparency

Harvard Business School has also being developing the Impact Weighted Accounts Report. Impact-weighted accounts are line items on a financial statement, such as an income statement or a balance sheet, which are added to supplement the statement of financial health and performance by reflecting a company's positive and negative impacts on various stakeholders. Central to impact-weighted accounts is the monetary valuation of the social and environmental impacts. The aim of such monetisation is to (1) translate all types of social and environmental impacts into comparable units that business managers and investors intuitively understand; (2) make these units meaningfully aggregated and compared without obscuring important details needed for decision-making; (3) display financial and impact performance in the same accounts that are compatible to existing financial and business analysis tools. The project is still ongoing, and currently more than 56 companies have experimented with monetary impact valuation, producing environmental or total profit and loss accounts. 86% of them are measuring environmental impacts, 50% are estimating employment/social impacts, and 20% are estimating product impacts.

Other major impact measurement frameworks include the "Six Capitals" defined by International Integrated Reporting Council (IIRC): financial capital, manufacturing capital, intellectual capital, human capital, natural capital, social and relationship capital (which is also the framework that II adopts in this impact measurement project), the Global Reporting Initiative (GRI), Task Force on Climate-related Financial Disclosures (TCFD), and Sustainability Accounting Standards Board (SASB).

2.4 Global value chain with a focus on environmental extensions

Another stream of relevant literature is that on global value chain, which is used in II's methodology for impact attribution. As economies become more integrated and the production of one good spreads out across multiple countries, value chain analysis has been recognised as an important tool in development and environmental research. Value chain concepts revolve around the fact that companies can create value by breaking down their activities (Porter, 1985), and the governance structure embedded in the fragmented but interlinked production systems (Gerrefi et al., 2005). These early concepts, however, refer to pure economic structure of value chains. In the last decade, integration of natural resource consumption, chain-related emissions, and societal impacts has received growing attention. Therefore, terms like "greening the value chain" or "environmental value chain" have been coined to indicate the importance of integrating other impact factors, especially environmental factor, in the value chain framework.

Value chains are typically characterised by input-output tables (IOTs). These tables describe how industries (and even countries) interact with one another in the production process. IOTs are typically in monetary terms, so Input-Output Analysis (IOA) carried out on IOTs allows tracing monetary flows of goods and services across all sectors within an economy or across different economies. IOA has become an important tool in value chain analysis to assess impacts using a wide variety of indicators, ranging from economic and financial to environmental and societal. There are other methods used in value chains analysis such as Life Cycle Assessment (LCA), Material Flow Analysis (MFA), Computable General Equilibrium (CGE) models, and Social Life Cycle Assessment. Each approach has its own limitations in terms of assumptions and applications. For instance, IOA assumes one single production technology for each product, so it is rigid when considering a chains of various production processes. MFA is not an impact assessment tool as it is applied to build indicators assessing natural resource extraction. CGE, due to its complex functional forms, is more suitable for ad-hoc analysis. Thus, depending on the nature of the study, researchers should adopt a suitable approach to value impacts along the production value chains.

A large body of literature utilises value chains analysis to study the effects that a certain sector and/or policy has on natural resources and the environment, especially in tracing and pricing carbon dioxide emissions (e.g., Hertwich & Peter, 2009; Perese, 2010; Zhang et al., 2015). Besides carbon footprints, many studies use IOA to assess impacts on environment. Lenzen et al. (2003) calculate the indirect effects of a development proposal in terms of land disturbance, water use, emissions of NO_x and SO_2. Notably, Lammerant et al (2014) assess the negative impacts of EU demand for certain commodities on biodiversity condition in third countries. Ewing et al. (2012) introduce an improved method to link multi-regional input-output (MRIO) framework and the footprint datasets to calculate carbon, ecological, and water footprints. Kucukva et al. (2014) identify and outline economic, social and environmental impacts, termed as Triple Bottom Line, of US residential and commercial buildings through integrating several social and economic indicators into Life Cycle Assessment approach of IOA. Compared to environmental issues, assessments on human and social impact are still limited. A number of studies focusing on pressing issues such as poverty alleviation (Nadvi, 2004; Mitchell, 2012), employment (Chen et al., 2013), and social hotspots identification (Zamani et al., 2018) also adopt input-output analysis to identify value-chain impacts.

3 Evaluation of II's Data and Methodology

Impact Institute uses both a bottom-up approach and a top-down approach in assembling and analysing data and measuring impact. The Global Impact Database (GID) described below mainly applies to top-down analysis. This approach provides a broad analysis of multiple countries and sectors altogether.

Output from this model can be then supplemented with bottom-up data from DBS and other sources in the overall impact analysis for more granular results. This is the hybrid approach that II proposed in one of their pilot assessments.

3.1 Data

II's approach on impact data. II has developed its proprietary Global Impact Database (GID) Model to quantitatively describe the global economy and estimate economic, social and environmental impacts of investments. The GID Model generally uses a top-down approach, though II also supplements it with bottom-up data in its analysis. The model uses multiple secondary data to estimate and attribute global value chain impacts on a country-sector level. For input-output analysis, GID model uses the Eora Multi-Region Input-Output Table (MRIO) to identify the interdependency across different countries and sectors.[2] To extend the supplement input-output tables, the model utilises other global datasets to back out indicators for country-sector activities in social and environmental issues, including air pollution, land usage, labour productivity, wage information, child labour, health & safety incidents, among others. Lastly, the GID makes use of impact factors – such as ReCiPe Impact Assessment method – to convert extensions into the standard set of impacts under the six capitals (financial, natural, social, human, manufacturing, and intellectual) of the International Integrated Reporting Council (IIRC). Because impacts typically are measured in various natural units, monetisation factors compiled from CE Delft Environmental Prices Handbook are utilised to express impacts in monetary values.

The strength of II's approach. The data sources utilised in producing GID database for impact assessment are highly reliable and commonly used in academic research as well as industrial reports. Firstly, Eora-26 is a multi-region input-output table covering 4,916 sectors across 189 countries for the time period from 1990 to 2015. It is a sub-database among Eora's global supply chain database that has uniform sector classifications across all countries. As production processes become increasingly fragmented in stages and integrated across countries, Inter-Country Input-Output (ICIO) tables have been developed with a purpose of documenting inter-sectoral transfers across countries. These tables link harmonised national input-output tables with bilateral trade data in goods and services by end-use category. Currently, there are six major sources of data on global input-output linkages[3], and Eora is

[2] The Eora global supply chain database consists of a MRIO table model that provides a time series of high-resolution IO tables with matching environmental and social satellite accounts for 190 countries. See more description of the database in Appendix.

[3] Six major ICIO tables include Global Trade Analysis Project (GTAP) [www.gtap.agecon.purdue.edu], World Input-Output Database (WIOD) [www.wiod.org], OECD-WTO TiVA Database [oe.cd/tiva], Eora Multi-Region Input-Output Table (MRIO) [www.worldmrio.com], IDE-JETRO Asian Input-Output Table. [www.ide.go.jp/English/Data/Io], EXIOBASE Multi-Regional Environmentally Extended Supply and Use/Input Output Database (MR EE SUT/IOT) [www.exiobase.eu].

one of them. Compared to other ICIO tables such as IDE-JETRO Asian IOTs and World Input-Output Database (WIOD), Eora provides a wider country and sector coverage with a larger number of Asian economies, as well as a longer time series (e.g. IDE-JETRO Asian IOTs provides tables only for benchmark years 1985, 1990, 1995, 2000, 2005.) In addition, Eora database has been used by multiple organisations such as Deloitte, KPMG, McKinsey Global Institute, the European Commission, the World Bank, the United Nations (UN) as well as by academic institutes and universities. For impact assessment, especially with regard to environmental aspects, Eora is highly recommended resource when it comes to value chain analysis (see Lammerant et al., 2014, and UK's Carbon Footprint 1997-2016). That being said, OECD-WTO TiVA Database would be able to serve as a reference for the results generated from the Eora tables. In addition, II deploys a wide variety of resources - Exiobase, Social Hotspot Database, Wageindicator, OECDstat, etc. – for social, environmental, and economic extensions. These databases are also conventional in academic research and provide extensive information that can serve as impact indicators.

The caveats to II's approach. There are two caveats with regards to the extensions and the impact factors. Firstly, as the model compiles data from a wide variety of resources, discrepancies in terms of granularity, currency and base year are unavoidable. Dealing with this issue, Impact Institute conducted data cleaning via normalisation through inflation and purchasing power parity (PPP) correction, currency conversion, as well as data (dis)aggregation. Such data cleaning process is common in research. However, caution should be taken when dealing with conversion around PPP as it may significantly alter the final impact estimates, despite limited changes in impact per se. Second, according to the document on GID model provided by II, impact factors are taken from the ReCiPe Impact Assessment method, and the monetary factors are from the CE Delft Environmental Prices Handbook, European Social Service, and TEEB. Some of these data sources focus on European economies (such as Exiobase and European Social Survey) and may not be suitably adapted for the Asian context. Although many of the databases do provide global coverage (e.g., Eora is from Australia, Edgar is from the U.S., and ILO, World Bank, OECD, TEEB are international institutions), the perspective is still heavily European- or OECD-based, especially when dealing with social and human aspects.[4] Therefore, we advocate for further references and customisation. For instance, the model can refer to World Bank's World Development Indicators, and utilise national reports on social welfare and labour conditions

[4] It is worth noting that ReCiPe and Wageindicator are European databases but they include granular data from all countries and have a global coverage. CE Delft monetisation factors are developed for the Netherlands but from sources from various countries and adjusted on a country basis.

whenever possible. Please see Appendix for a detailed assessment of the database. In addition, the focus of the data source is on English language literature, and the inclusion of non-English sources can be improved.

Suggestion. An additional data source for global value chain is Factset Revere, which offers a unique dataset of supply chain relationships (firm-level networks of customers and suppliers) that identifies companies' interrelationships and their comprehensive geographic revenue exposures, starting from April 2003. It covers about 30,000 global companies, whose information is culled from company regulatory filings, websites, and daily updates based on new filings, press releases, and corporate actions releases. One advantage of Revere data is that they contain information of both major and minor private and publicly listed customers. This helps to identify who are the corporate customers of the clients (borrowers) of DBS so as to more accurately trace the impact pathway. However, it should be noted that given its coverage is mostly limited to listed companies as suppliers, whereas there are much more companies in the world, Factset Revere is only an additional rather than alternative dataset to MRIO tables.

3.2 Methodology

This section reviews II's methodology in combining top-down and bottom-up approaches to measure impact. It is worth noting that impact measurement and valuation are still a "young science", with limited research and guidelines. Therefore, despite the caveats identified below, in many cases, II's approach has significant novelty and is among the first to measure and value impact. II has been working with partners to continuously refine its methodology and helps the development of the field by providing a proof of principle that some of the challenges can be tackled.

3.2.1 GID's Attribution Methodology

II's approach on value-added attribution. As production becomes more interdependent across countries and sectors, investments in one specific sector create effects throughout the economy and even the world. It is thus essential to take into consideration the impact of investment beyond the first order. The GID model uses value-added analysis to attribute the impact of investment along the value chains productions of goods and services. This methodology analyses both upstream and downstream linkages of a sector in a country, identifying the value added within trade volumes and trade relations across countries and across sectors. Extensions beyond economic factors are also included in the value chain analysis. This process allocates direct impact, which is the impact of the activity in the country/sector itself, to value chain impact of sectors both upstream and downstream.

After measuring value chain impact, the model then conducts attribution of impact to investments, using the value added of the investment as the main driver. As DBS is interested in assessing how much impact their loans create throughout the economy, the model specifically attributes the total impact to the investment of one dollar in specific country and sector. Interest rate is proposed as a potential proxy for value-added provided by the lenders. There are two options under consideration: the net interest income (representing the bank effective interest) and a representative industrial rate. The impact attributed to an investment is calculated as the ratio of the interest of the investment to the impact per unit of value added. The current results in this pilot are derived using 2% interest rate per dollar investment.

The strength of II's approach. Attribution along the global value chains is necessary in the context of current globalisation trend, and the input-output analysis approach is suitably applied in this model. There is a rising number of academic research extending the input-output analysis to account for impacts on environmental issues (e.g. Hertwich & Peter, 2009; Lenzen et al., 2003; Ewing et al., 2012; Zhang et al., 2015) and social issues (e.g. Nadvi, 2004; Mitchell, 2012; Chen et al., 2013). Hence, the GID model does incorporate the key ideas in the current literature. In addition to tracking the trade relations, the attribution method also assigns the magnitude of impact proportionately to the added value following the input-output tables. Sectors that add more value in the chain would get a larger share of overall impact. This assumption is reasonable for distributing the impacts of investment over interdependent sectors along the same value chain.

The caveat to II's approach. Firstly, the current model does not consider the "multiplier effect" of a loan. The current value chain analysis focuses mainly on the external effects related to production process of all the sectors within the chains, yet it does not give much insight on implicit effects such as job creation, education advocacy for employee, or political voice. This issue is reflected also through the limited number of extensions related to social and human impacts, but is not systematically incorporate in the analysis, probably due to data limitation and the difficulty in capturing all indirect impact. This may potentially underestimate the true impact on society. As more comprehensive data sources become available for social, human and natural capitals, the model can be updated to reflect these updates, so that it can provide a more comprehensive impact analysis of investments. Furthermore, spill-over effects (i.e. education of employees' children) are not covered.

Second, attribution to investment using interest rate can have two shortcomings. First, interest rate does not embody all the indirect effects the investment creates along the value chains. It only captures the direct lending effects based on financial values. Second, it can create bias as the counterfactual

scenarios[5] in which another bank provides the loan instead of DBS are not observable, and can have many possibilities. That is, the "marginal impact" of a DBS loan is hard to attribute.[6] Further robustness check using other proxies (i.e. industry average) as attribution factor to investment are encouraged to provide a more comprehensive understanding to the investors. Despite the caveat, it is again worth noting that this approach is one of the first attempt to quantify and value impact.

3.2.2 Integrated Profit and Loss Assessment Methodology (IAM)

II's approach on identifying impact pathway. The integrated profit and loss assessment methodology (IAM) is developed by Impact Institute in order to quantify and assess the values that an organisation contributes to the welfare of its stakeholders and the society within a given timeframe. It mostly uses a bottom-up analysis. The assessment first identifies various stakeholder groups of an organisation, and categorises the organisation's assets into financial, natural, social, human, manufacturing, and intellectual capitals following the IR-framework (IIRC, 2013). The next step is to draw all potential impact pathways as a quantifiable chain of effects and counterfactual effects that an activity of the organisation has on its stakeholders. Along each impact pathway, IAM assesses how much impact the organisation can contribute, whether directly or indirectly through another entity. The assessment also identifies reference scenarios in which the organisation did not realise its activity, and consequently the impacts this might cause.

The strength of II's approach. Identifying impact pathways gives insights into all the stages involved in the value chains of products and services. All the entities that contribute to the production and delivery of a good or service can be captured through such impact pathways. This process helps organisations track all impact contributions. On top of impact pathways, the use of reference scenarios shed light on the impacts of adopting or not adopting a certain activity of the organisation, both immediate effects as well as potential long run effects on other entities along the chain. II's approach provides a comprehensive measurement of total contribution an organisation creates.

The caveat to II's approach. Identifying counterfactual scenario is an intricate process, and it is even tougher when they are placed within a value chain. Also, it is important to acknowledge which reference scenarios are quantifiable and worth assessing, since analysing every single scenario is not practical.

[5] Statistically, a counterfactual is a result one would expect if the intervention had not been implemented. A counterfactual can be developed using a control group, i.e., a group created through random assignment which do not receive an intervention or receive the usual intervention when a new version is being evaluated. In the context of this project, a counterfactual can be the impact without any loan granted ("absolute impact"), or the impact of loans provided by other banks or financing by other means.

[6] A "marginal impact" refers to the impact of DBS loans relative to loans by other banks or financing by other means. It is relative to an "absolute impact" that refers to the impact of loans given by DBS compared to that without any loan.

Another potential caveat in the methodology is that value chain network in practice is much more complex than a simple horizontal sequential link of different actors. There are possible overlapping procedures, interconnection between different value chains, and double counting values as input-output travel across numerous country borders. The methodology should provide instructions on how it deals with such complications.

II's approach on measuring impact contribution. Integrated Assessment Methodology (IAM) distinguishes between direct and indirect impacts, as well as between absolute and marginal impacts. Altogether, they form four types of impact: direct absolute impact, direct marginal, indirect absolute, and indirect marginal. After identifying four types of impact, total impact contribution of the organisation is then a (linear) combination of these impacts. A generic formula for total impact contribution that II has developed is as follows:

$$\begin{aligned}&\boldsymbol{Impact\ contribution}\\&\quad=\boldsymbol{\alpha}[\boldsymbol{\gamma}\times\boldsymbol{Direct\ Absolute\ Impact}+(\mathbf{1}-\boldsymbol{\gamma})\times\boldsymbol{\delta}\\&\quad\times\boldsymbol{Indirect\ Absolute\ Impact}]+\boldsymbol{\beta}[\boldsymbol{\gamma}\\&\quad\times\boldsymbol{Direct\ Marginal\ Impact}+(\mathbf{1}-\boldsymbol{\gamma})\times\boldsymbol{\delta}\\&\quad\times\boldsymbol{Indirect\ Marginal\ Impact}]\end{aligned}$$

For the formula above, II acknowledges that not all parameters can be fixed from first principles. In order to be able to proceed, II provides a parameter choice that enables calculations.

The strength of II's approach. This is a well-articulated general formula for organisations to apply when valuing impacts, and is in line with other methods of impact measurement utilised in the impact investing field (see Section 2.3 of this report). It takes into account different effects an activity may bring. Each impact is followed by a distinct weight parameter so that users can implement different distributions depending on the context and analysis. Furthermore, guidance on certain principles to be implemented while combining multiple types of impacts is provided. Five principles are applied when attributing impact to an organisation: (1) conservation of impact, (2) additivity, (3) sensitivity, (4) sufficient resolution, and (5) co-responsibility. These principles ensure impact contribution is correctly stated and comparable across organisations. For the calculation of total impact contribution, IAM recommends adopting "impact equivalence." This recommendation suggests that when two types of impacts are to be included and there is no strong argument that one is significantly more important than the other, both impacts should be included with equal weight in the total impact contribution.

The caveat to II's approach.

One caveat is the approach towards distinguishing between direct and indirect impacts, and between absolute and marginal impacts. The distinction provided in IAM are to some extent unclear. First, the scope of direct impact crucially depends on the definition of stakeholders that are directly affected. For example, for a loan given to a palm oil planation, who should be included in the analysis of impact on the community? Should family members of an employee of the plantation (i.e., a farmer) be considered as direct stakeholders? Second, the absolute impact refers to the impact of loans given by DBS compared to that without any loan, whereas the marginal impact refers to the impact of DBS loans relative to loans by other banks or financing by other means. Understandably, it is infeasible to measure marginal impact accurately due to the lack of counterfactual. That is, estimating the baseline situation of not having DBS loans but having financing from other financial institutions is extremely difficult, as there are many alternative scenarios.

Another caveat is related to the choice of parameters for pilot measurement calculation. Not all the parameters can be derived from the first principle ("conservation of impact"), so in order to proceed with the calculation, II assumed absolute impact and marginal impact are equally weighted. This means $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are both $\mathbf{50}\%$. This is a strong but understandable assumption as it is not easy to assign exact weights on reference scenarios. II does allow users to modify the parameters as a sensitivity check. With regard to direct and indirect impacts, the methodology provides specific implementation to attribute impacts based on level of the organisation's responsibility along the value chain. If an activity has predominantly internal effects within the organisation only (i.e. salary paid to employees, dividends paid out to shareholders, etc.), then total impact contribution are equally weighted between direct absolute impact and direct marginal impact. This makes sense as the activity's impact does not spread out along the impact pathway. Otherwise, total impact contribution is composed of direct impacts and value chain impacts.

Furthermore, applying fixed parameters to those impacts often does not take into account the true intention of an action, such as when a borrowing company intends to avoid their responsibilities for negative impact by letting their suppliers bear more of such responsibilities. There is some empirical evidence for the case of GHG emissions due to regulatory arbitrage and financial constraints (e.g., Bartram, Hou, Kim, 2019). In the case of electricity emission from driving electric vehicles, Holland, Mansur, Muller and Yates (2016) find that electric vehicles generate negative environmental benefits of 0.73 cents per mile on average relative to comparable gasoline vehicles, after accounting for both global and local pollutions, which is largely due to emissions from charging EVs. About 90% of local environmental externalities from driving EVs in one state in the U.S. are exported to other states, implying that although they may be subsidized locally, the environmental benefits are negative overall.

The weight of value chain impact is calculated as the ratio of value added of the organisation relative to that of the whole value chain. This is standard for value chain analysis as an organisation's impact contribution is proportional to how much added value it contributes to the whole value chain. However, as we look closely at the value chain, the link that organisations should take the most responsibility would be the direct upstream and downstream linkages, and less so as we move further along the value chain. The organisation has little say on what its partners choose as suppliers, meaning it should not take responsibility for other actors' actions. This is a caveat of IAM that Impact Institute also acknowledges. So far, there is no standard method to quantify this weight for responsibility along the value chain, so utilising the value-added ratio is still the most acceptable proxy.

In short, the Integrated Profit and Loss Assessment Methodology provides a comprehensive impact assessment of an organisation's activity. It includes the value chain effects and connections, the various scenarios as well as types of impacts. However, there is room for further research with regard to complex value chain networks as well as impact attribution assumptions along the chains.

3.2.3 Monetisation Methodology

II's approach on monetisation. Integrated reporting has long advocated for the importance of distilling impact into monetary units rather than using the natural units. Reasons include the intrinsic value of currency, the wide usage of currency in financial reports, and the ease of handling for firms and managers, particularly when they need to carry out comparative studies and make strategic investment decisions. Since social, human and natural data often come in natural units (e.g. kg of CO2 emissions, hectare of land usage, number of workplace safety incidents, etc.), the GID model uses monetisation factors to convert impact data into monetary units. The conversion methodology is based on remediation of external costs and on valuating well-being effects. Data sources utilised include OECD, the European Social Survey, and the World Bank.

The caveat of II's approach. Monetisation of impact is a complex procedure, but is favoured in research. In the literature of labour economics, several studies have been conducted to assess the earning outcomes in association with years of schoolings (Mincer, 1974), job locations (Moretti, 2004), firm age (Brown & Medoff, 2003), experience and gender (Munasinghe et al., 2008), etc. These studies, in a sense, "monetise" the impact that different variables have on labour outcomes. However, not every impact can be represented through changes in income. In the development economics literature, field experiments are usually conducted to assess the impact a specific incentive has on social welfare such as education, gender equality, health, labour conditions etc. In these studies, impact indices are likely

to be expressed in their natural values, which are not necessarily dollar values.[7] Therefore, not all impacts can be monetised: for some it is by nature not possible to assign a dollar value, and for others the data are often not available.

For investors and industrial practitioners, monetary expression is encouraged as they provide straightforward values and make comparative analysis easier. However, as there has not been a standardised procedure for the monetisation process (besides the ISO14008 "Monetary valuation of environmental impact and related environmental aspects"), analysts should take great caution when conducting impact monetisation. This lacking of standardised metrics may also explain why not many social and human impact are covered, as they may not be able to express in monetary terms.

Another caveat with II's approach is the geographical context of their monetarisation factors. As the True Price methodology is mainly based on European's data sources, it may not be ideal to apply the same standards to non-European's economies. The concept of social welfare (i.e. minimum wage, labour rights, political awareness, etc.) in many developing countries vary significantly from that in the European counterparts. Thus, it is essential to look into specific country's laws and conditions, obtain national dataset if possible, to ensure the conversion factors are sensible. Furthermore, there are potential risks attaching to the monetisation process, such as discounting issues, or putting a cap on the perceived value of a social or environmental outcome (Serafeim et al., 2019). The model should identify these risks and include them in the report as a robustness check for a more comprehensive analysis.

4 Evaluation on Case Studies: Palm Oil and Electric Vehicles

4.1 Overview of II's studies

Impact Institute conducted two pilot measurement case studies on the Palm Oil industry and the Automotive industry utilising the IAM methodology and the data compiled through their GID model.

[7] For instance, Banerjee et al. (2015) reported the long-run impact of an anti-poverty program in India. The evaluation covered a variety of social aspects ranging from income level, consumption, financial stability to labour supply, human well-being, political involvement and women's empowerment. Indicators such as consumption, income level and financial stability were apparently presented through dollar amounts, while other social outcomes were denominated in their natural values: labour supply was represented by minutes spent on paid labour, political engagement reflected through election participation as well as women's contribution in household's decisions. Linking these natural values to monetary values is challenging, as it will likely overlook the indirect impact of empowered women and political engagement on overall household income and local GDP growth. So far, there is no consensus in the literature on quantifying these values. Another study by Mbiti et al. (2019), examining the impact of providing grants and teacher incentives to schools, uses students' test performance as impact index. It is extremely difficult to link students' test performance to their future career and family choices, thus their household incomes and tax contributions. Again, there is no commonly agreeable method in the literature to quantify such higher-order indirect impact.

These two cases embody different approaches due to the nature of the sector as well as data availability. Specifically, the study on Automotive industry uses bottom-up approach, which requires specific sectoral information and analysis for every stage along the value chains, whereas the Palm Oil study uses a hybrid approach which combines bottom-up data (field-level information) with top-down data of countries and sectors across the world. The choice of approaches for these two industries is appropriate considering the nature of their production and use. Production of electric vehicles are composed of several stages, each of which may belong to different sectors and take place in different countries. Therefore, granular analysis along each step of the production chain following the bottom-up approach will provide a comprehensive impact assessment of the whole industry. Palm oil, on the other hand, is an input material with high demand from various industries and countries across the globe. Thus, a top-down approach can provide a broad analysis of palm oil industry across a range of countries and sectors. Then, by combining top-down results with bottom-up industry-specific data, the final detailed assessment will cover impact generated from crude palm oil production in a specific country to all potential use of palm oil along different value chains.

The impact scope of these case studies was chosen according to the Impact Institute Standard Impact List 2019, covering 5 out of 6 IIRC's capitals (IIRC, 2008): natural, financial, social, human and manufactured. Within each capital, multiple impact categories were identified based on materiality and feasibility assessment of the dataset. The studies cover a wide variety of impact, and provides a comprehensive understanding of how the production process of palm oil and automotive vehicles can influence multiple factors beyond the normal economic context. Finally, results of impact valuation were expressed in monetary terms – impact of lending 1 SGD to a specific sector (SGD-eq/SGD-lent). Since data for different impacts are represented by different units, expressing these impacts in the same language (i.e., monetary value) will allow for consolidating all possible factors in the report and making easier comparison. This will be useful for investors and businesses to make strategic decisions regarding their lending portfolio to a specific industry.

4.2 Evaluation

Not only do the reports identify which capitals among the five get the highest impact from the industry, but they also provide a breakdown of impact on each capital category as well as the source of impact contribution. Consequently, readers are able to understand whether the impact originate from the direct production of the goods, or from the use of the goods along the value chains. In the case that the value chain impact is higher, the analysis also identifies which phases/stages are likely to contribute more impact. This is highly informative, especially for investors when making their decisions on whether to invest in a production plant of a specific sector in a country.

There might be a potential issue of over-attribution due to multiple stakeholders involved in the assessment process. However, Impact Institute has addressed this and confirmed that by identifying specific capital involved with the specific stakeholders, impact are duly attributed to the stakeholders. Total impact by capitals are the same as the total impact via the stakeholders. Nevertheless, there are a few issues worth mentioning.

First, one assumption made in the analysis is to consider only top 10 export countries and domestic sales. This is acceptable since the top 10 exporters tend to make up for the majority of total exports of the sector. However, it is important to run a check on this assumption for the sector under study to ensure no value is overlooked. In addition, data limitation is unavoidable, especially since the study covers a wide range of data sources and countries/sectors. In addition, not all countries and sectors provide data on production and export/import, so missing values and estimations are inevitable. When such issues occur, it is advisable that the report informs readers of such shortcomings so that they could analyse the results with sufficient understanding.

Second, the two case studies do not consider second order indirect effects in terms of human and social aspects particularly. For instance, when DBS provides a loan to a palm oil plantation, they are interested in not only the impact the loan creates on the working conditions and education of the workers in this specific plantation, but also the ripple effects the loan may have on the workers' family. For instance, does the loan makes any impact on improving education of the workers' children? Does it help with job creation within the sector/region? This chain of impact assessment also applies to other actors along the value chains of palm oil sector. Quantifying such higher order impact requires a more complex framework with appropriate weights and attribution factors in place. Further research along this line in the future will enhance the scope of impact measurement.

Third, the current electric vehicles case study does not consider the end-of-life phase. When electric vehicles are disposed, the process of handling body parts of the car (metals, tires, plastic dashboard, etc.) and especially the ion-lithium batteries can create long-lasting impact on the environment and the working condition of employees at the disposal centres. Considering it is only one phase along the production chains, the final value may not change significantly. Besides, more efforts have been made to recycle and reuse car parts. For example, Singapore is building a new lithium-ion battery recycle facility to ensure metals from the batteries to be reused to make new batteries (article here). Similarly and as II has properly acknowledged, research from IEA (2019a), Hawkins et al. (2013), and Kukreja (2018) shows that end-of-life only contributes to a small share of the total impact of the whole life cycle of electric vehicles. However, other countries may adopt different methods of handling disposal. If the

location for the majority of Singapore EVs' disposal is known, it will be more informative if the report could consider this phase's impact. Otherwise, the report can provide reasons for excluding it in the first place for a more complete picture.

Lastly, different approaches are employed in the two pilot studies based on the characteristics of the industries. This was possible because these pilot studies focus on two distinctive sectors. Thus, it could significantly improve the applicability and comprehensiveness if specific rules, guidelines, or matrices are provided on how to choose methodologies for each case, or if a universally applicable method is available to analyse the impact on loan applicants across different sectors.

5 Future Extensions and Conclusions

The data sources and methodology for measuring social and environmental impact are in line with the IIRC's framework and other frameworks such as HBS Impact-Weighted Accounts and IFC guidelines that aim to monetise impact. The methodology proposed by the GID model is tractable and has been used widely in global value chains literature. It considers all possible linkages on the supply chains, attributes reasonable effects of investments on interdependent sectors and players. Nevertheless, a study at sector and country level may provide outdated and noisy results. As more detailed and granular data become available, it is advisable to consider modifying the model to utilise these firm-level supply chain data. Being able to track trading partners of a company will enhance the accuracy of identifying the impact a loan creates.

With regard to the generalisability of the approach, the data and methodology used by II can also be useful for monetising (in the form of valuation) social and environmental impact and integrating them into financial statements, especially for multinational corporations. This is consistent with IIRC's integrated reporting framework and Harvard Business School's Impact Weighted Accounts initiative. Therefore, II's approach can be potentially integrated with other existing and developing frameworks and be applied to a much broader context of impact measurement.

However, there are also several caveats on the generalisability of the results. First, the study is conducted in the banking sector with the geographical focus in Asia. When applying the methodology and results to other economies and sectors, an important consideration is the difference in social norms and regulations, which can be extremely large across different jurisdictions and legal systems (Liang and Renneboog, 2017). In addition, the generalisability will also be affected by the difference in ESG standards and practices across industries and sectors. The accounting principles differ significantly between the financial sector and the other sectors, so as the "distance" and sensitivity to environmental

and social impact. For example, the environmental impact of the oil and gas sector can be much bigger and more direct than that of the banking sector, which implies much greater impact attribution to the former. Such cross-country and cross-sector differences will also affect the aggregation of bottom-up and top-down data when assigning the weightage of each country and industry when aggregating the impact.

This project also sheds some light on the regulatory framework in the region and across the world. Different regions are proceeding at different speeds on ESG regulation. Notably, the European Union (EU) currently has a more ambitious regulatory agenda backed by strong political support for a transition to a low-carbon economy. In 2018, the European Commission released an Action Plan for Financing Sustainable Growth with several policy initiatives aimed to re-orient private capital towards sustainable projects so as to meet the 2030 targets that the EU committed to as part of the Paris Agreement. Following the recommendations from the EU High-Level Expert Group on Sustainable Finance, the package included a taxonomy to classify sustainability activities, standards and labels for green financial products and developing sustainability benchmarks. Other non-mandatory international and national frameworks and initiatives are being developed, including the Sustainable Stock Exchange Initiative, UNEP Finance Initiative and other UN SDG-related initiatives, Carbon Disclosure Project; EU Energy and Climate Package; US Clear Air Act; China's Renewable Energy Law (2006); India's National Actin Plan on Climate Change (2008), etc. A key issue of these regulatory frameworks is to quantify and monetise environmental and social impact that can be actioned on. Therefore, the methodology and results of this project, given their consistency with the international practices and academic studies, can have important implications for policymakers in Singapore and in the region to join the global efforts in standardising ESG and impact measurement and regulations.

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Appendix

Usage	Main sources	Period coverage	Country/ Industry coverage	Website	Description	Comments/Notes
Input-Output Analysis	EORA	1990 - 2015	190 / 26	https://worldmrio.com/	Time series of high-resolution IO tables with matching environmental and social satellite accounts; Environmental indicators covering GHG emissions, labour inputs, air pollution, energy use, water requirements, land occupation, N and P emissions, primary inputs to agriculture	Reliable economic representation of global economy; Widely used for IOA in international trade studies
	IDE-JETRO Asian IOTs	1985, 1990, 1995, 2000, 2005	10 / 76	https://www.ide.go.jp/English/Data/Io	Other international Input-Output Tables that are frequently used in literature Can be used as references for global value chains analysis in GID model	Limited countries and time period covered
	WIOD 2016	2000 - 2014	44 / 56	http://www.wiod.org/home		Limited coverage for Asian countries
	OECD ICIOs	1995 - 2015	64 / 36	https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm		Not regularly used for research with environmental extensions
Environmental, social and human extensions	Exiobase Version 1 Version 2 Version 3 Monetary form Hybrid form	 2000 2007 1995 - 2011 2011	 44 / 163 44 / 163 45 / 163 44/ 164	https://www.exiobase.eu	Provide data on air pollution, labour, land use impact indicators	Widely used for IOA in international trade studies
	Social hotspot database (SHDB)		113 / 57	https://www.socialhotspot.org/	An extended input-output Life Cycle Inventory database; IO model is based on GTAP7. Provides data on labour productivity, child labour impact and health & safe incidents	Reasonable data source for human rights, social life cycle assessment, supply chain transparency, social footprint, etc.
	ILOSTAT	Varied	234 / -	https://ilostat.ilo.org/	Average wage data	
	Eora				Rest of extensions	

	Wageindicator		167 / 350	https://wageindicator.org https://glabor.org/platform/wageindicator/	Provides data on real wages, salary check, minimum wage, living wage, wage in context, labour law, etc Use in the methodology as living wage benchmark.	Reliable data source
	OECDstat		OECD countries and selected non-members	https://stats.oecd.org/	Mainly used to calculate mean to median ratio (wages)	Good source for GDP, FDI, Health, unemployment, income distribution, population, labour, education, trade, finance, prices, Economic Outlook, Government Debt, Social expenditure, etc. But unclear whether the coverage is good enough for Asia (where most countries are not OECD members).
Impact factors	ReCiPe Impact Assessment method			https://www.springerprofessional.de/en/recipe2016-a-harmonised-life-cycle-impact-assessment-method-at-m/11919942	A life cycle impact assessment (LCIA) methodology. The primary objective of the ReCiPe method is to transform the long list of life cycle inventory results into a limited number of indicator scores. ReCiPe was developed in 2008 by RIVM National Institute for Public Health and the Environment (https://www.rivm.nl/en), CML, PRé Consultants and the Radboud University Nijmegen on behalf of the Dutch Ministry of Infrastructure and the Environment.	This methodology mainly covers environmental impact factor. It is unclear whether social/human impact factors are taken into account.
	World Development Indicators	Varied by data	217 / -	http://datatopics.worldbank.org/world-development-indicators/	Time series statistics on global development and the fight against poverty	These databases can serve as reference for impact factors, especially with regard to social welfare and humanity aspects
	World Governance Indicators	1996 – 2018	200+ / -	https://info.worldbank.org/governance/wgi/	Reports aggregate and individual governance indicators according six dimensions of governance	
Monetisation factors	CE Delft Environmental Prices Handbook			https://www.cedelft.eu/en/environmental-prices https://www.cedelft.eu/en/publications/download/2622	The prices are per kilo emission in 2015 Euros and differ per country and region; used as a source for environmental monetisation factors	One caveat is whether it can be suitably adapted for Asian economies, and how social and human factors are taken into account. If True Price framework is used, more discussion in terms of geographical context is recommended
	European Social Service				Source for social capital monetisation	May not be suitable for Asia? Maybe it's more appropriate to access individual national database for more accurate information.

	TEEB (The Economics of Ecosystems and Biodiversity)			http://www.teebweb.org/	Based in Geneva, Switzerland; hosted by the United Nations Environment Programme (UNEP) A source for monetisation of natural capitals in True Price Methodology	It is not entirely clear how macro-level numbers are extracted from their reports, or whether there is any other database owned by TEEB
Financial data	World Bank			https://data.worldbank.org/	Provides data for inflation factor, exchange rate, PPP rate in the GID model	Good source for country-level data
	IMF			https://www.imf.org/en/Data	Time series data on IMF lending, exchange rates and other economic and financial indicators	Another good source for country-level data, can be used as reference for financial data

Impact assessment of lending to the automotive industry

Insights into the transition from combustion engine vehicles to electric vehicles

March 2020

External report

IMPACT™ INSTITUTE

DBS

About this report

This pilot impact measurement report is one of the first steps DBS is taking towards more comprehensively understanding and measuring its impacts. It is the result of a collaboration between DBS and Impact Institute to provide insight into the impacts of a bank's lending activities in the automotive sector.

Where applicable, impact measurement definitions, principles and criteria presented in this report follow the Integrated Profit & Loss Assessment Methodology.

Outline of this report

About DBS

DBS is a leading financial services group in Asia with a presence in 18 markets. Headquartered and listed in Singapore, DBS has a growing presence in the three key Asian axes of growth: Greater China, Southeast Asia and South Asia. The bank's "AA-" and "Aa1" credit ratings are among the highest in the world.

https://www.dbs.com/default.page

About Impact Institute

Impact Institute is a social enterprise with a mission to contribute to an economy that creates value for all. We do that by helping organisations to quantify, value and improve their impact on society. Impact Institute assists multinationals, SMEs, NGOs and governmental organizations in risk management and strategic decisions, by providing insight into their impacts and related risks and opportunities.

https://www.impactinstitute.com/

1 Introduction

DBS has started measuring its impact to better steer portfolios towards sustainability

DBS is committed to creating long term value for its stakeholders

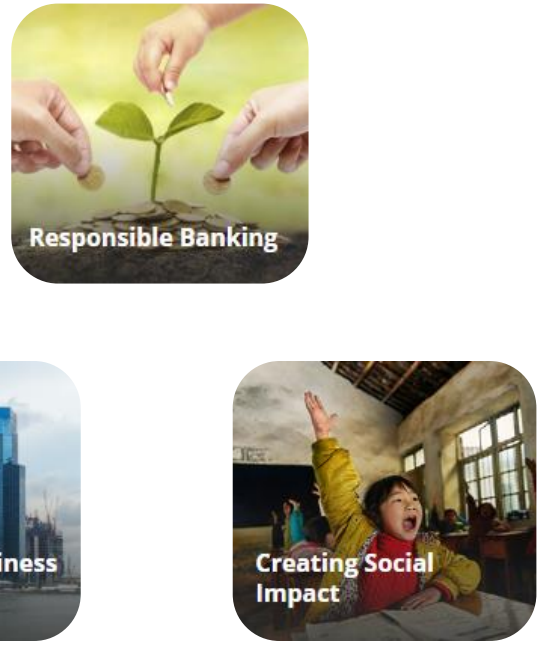
As a purpose-driven bank, DBS is committed to creating long term value by managing its business in a balanced and responsible way. It recognises its obligations to multiple stakeholders and strives to consistently deliver value to all of them, now and in the future. This is reflected in the three pillars of DBS' sustainability approach: responsible banking, responsible business practices, and creating social impact (see Figure 1).

Creating more value requires DBS to better understand the impact of its clients' activities

The impact of DBS' lending depends on the activities of its clients. Understanding the types and magnitudes of the impacts that DBS creates is an important step towards better-informed lending decisions. This can help to steer the bank's corporate lending portfolio to create more long-term value for the economy, society and the environment. Impact measurement is a developing field that can provide this information both in absolute and relative measures.

DBS has started measuring impact through two pilot studies focusing on the palm oil and automotive sectors. These pilot studies use the Integrated Profit & Loss methodology developed by Impact Institute and aim to deepen DBS' understanding of its impacts, specifically in its institutional banking business. Ideally impact measurement is based entirely on specific client data. Our current pilot studies are an initial step towards such a goal. *The report on the impact of lending to the palm oil sector can be found here.*

Figure 1: The DBS approach to sustainability



DBS aims to deepen the understanding of a transition from combustion engine vehicles to electric vehicles

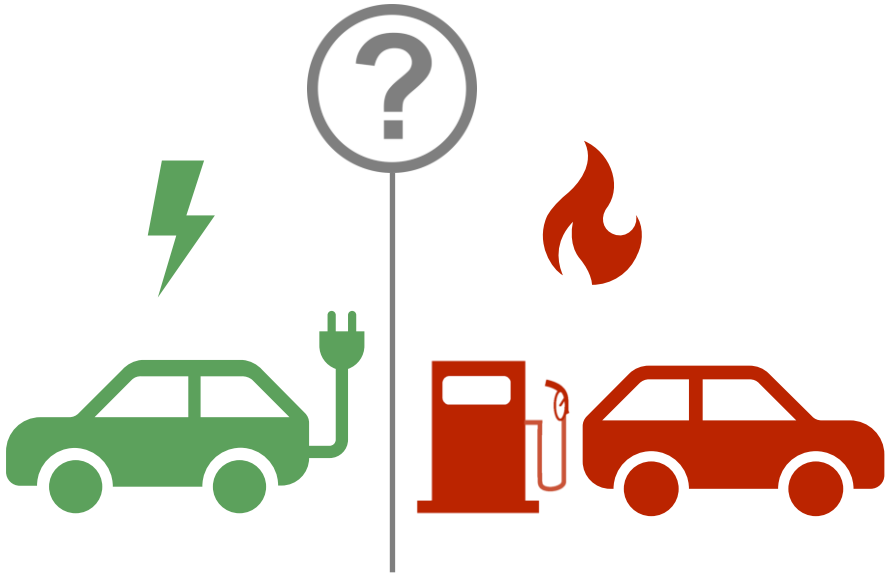
Transitioning from combustion engine vehicles to electric vehicles has trade-offs

As electric vehicles (EVs) are powered by electricity, they are often assumed to be more sustainable than combustion engine vehicles (CEVs).[1] EVs can improve the environmental impact of driving, as they do not use fuel, nor produce tailpipe fumes and emissions. Such improvement in environmental impact is the reason for the transition in the automotive industry, as well as the rapid growth of the EV sector in China.[2] On the other hand, the production of EVs – and especially of the battery – is also associated with negative social and environmental impacts from, for example, raw materials mining.

DBS wants to better understand the impacts of this transition

As a lender to the automotive sector, DBS is working with clients to enable the transition to EVs and wants to understand the environmental and social impacts of such a transition. DBS has already performed research on the transition risks and opportunities of EVs (see EV: China leads the way).

This impact measurement pilot on the automotive sector allows DBS to further increase its understanding of the economic (e.g. profits and taxes), social (e.g. employment) and environmental (e.g. scarce materials and climate change) impacts. By focussing on the differences between electric and combustion engine vehicles, this study provides insight into current and upcoming challenges as the transition unfolds.



[1]US Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). (2019). Reducing pollution with electric vehicles.
[2]IEA. (2019a). Global EV Outlook 2009 – scaling-up the transition to electric mobility. International Energy Agency.

DBS IMPACT INSTITUTE

Impacts are assessed using the Integrated Profit & Loss (IP&L) methodology

Impact is the measurable economic, social and environmental effect of an activity

Impact is about *effects* – not intentions. Impact goes beyond inputs and outputs and focuses on the difference an organisation makes for society and the environment. An impact can be positive or negative. An impact can be, for example, a contribution to the well-being of people (for example, through job creation or medicine production), a contribution to the stock of assets in society (where assets can be, for example factories, data or forests) or a breach of a right (such as child labour).

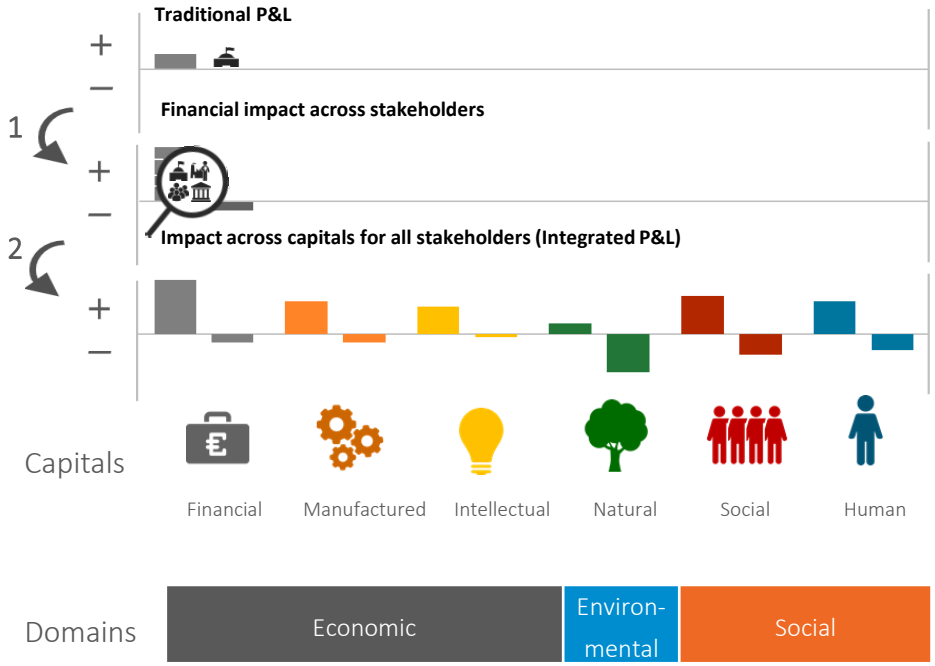
The Integrated Profit & Loss (IP&L) methodology is used to assess impacts

The IP&L methodology provides a novel and rigorous approach to measure and value impact, by extending the traditional profit and loss (P&L) account in two steps (see Figure 2):

1. It takes into account the value created for all stakeholders of an organisation – such as their clients and society – in addition to the value created for investors.
2. It includes both non-financial and financial value creation. In particular, the IP&L methodology includes value in the form of six capitals, following a rigorous categorisation based on The International <IR> Framework. The six capitals can be mapped to three intuitive impact domains: economic, social, and environmental.

As a result, the IP&L methodology provides a complete overview of an organisation's impact on all its stakeholders through all the capitals. The foundation and principles used in the IP&L methodology for impact measurement and valuation are built upon, among other documentation, the Integrated Profit & Loss Assessment Methodology and Framework for Impact Statements.

Figure 2: Two-step extension of the traditional P&L to IP&L



This study focuses on the key differentiating components and materials used in CEV and EV

Focus on differences in engine and batteries for CEV vs EV

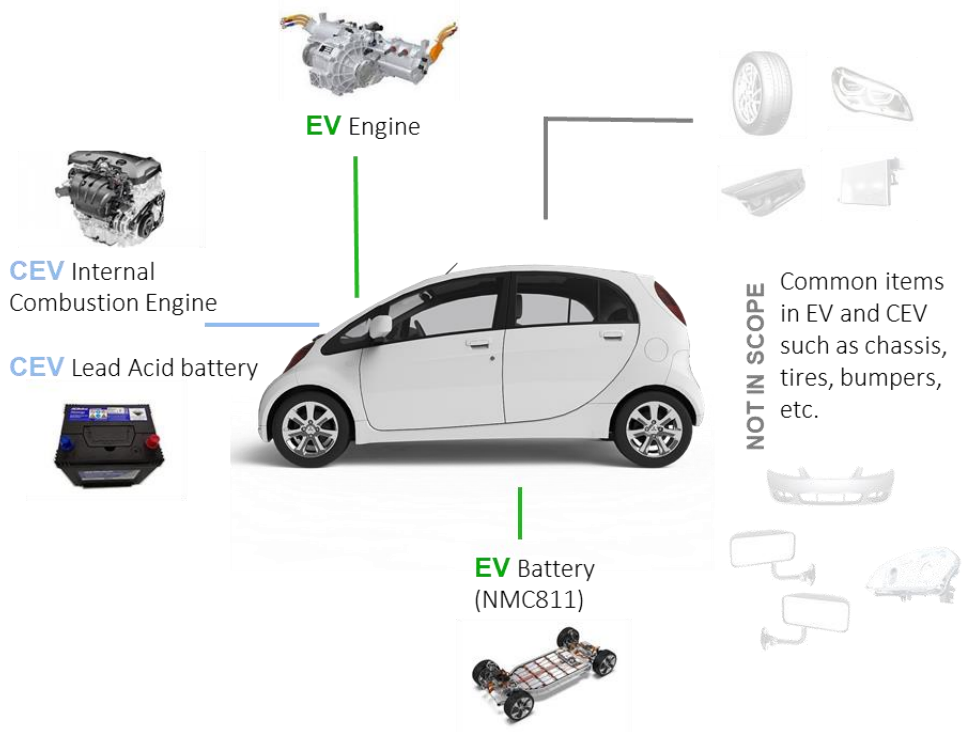
This pilot study aims to assess the impacts of lending to the automotive sector by considering two different type of vehicles: CEVs and EVs. The assessment focuses on their differentiating components - the battery and engine. Components common to both vehicles, such as chassis, tires and trace materials, are out of scope in the assessment (see Figure 3).

The study makes its assessment of the impacts based on industry averages and does not utilise actual data from DBS' clients.

Similar vehicle specifications allow for comparable results

Similar specifications (e.g. average lifespan and efficiency) are selected to provide comparable results. Here, the efficiency of EVs is based on the size and type of battery (Li-ion (NMC), 12.3 kWh/100km)[3] and the efficiency of CEVs is based on an average gasoline consumption of 6.8L/100km.[3] This is comparable to the efficiency of commercial EVs and CEVs. In both cases, an average lifespan of 150,000 km over ten years is used.[3]

Figure 3: Illustration of components in scope



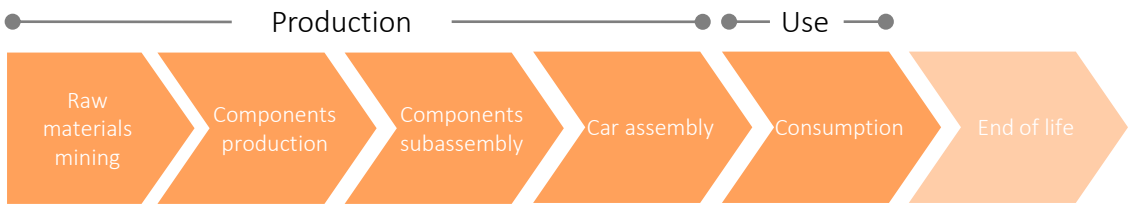
[3] *IEA. (2019a). Global EV Outlook 2019 – scaling-up the transition to electric mobility. International Energy Agency.*

The assessment considers impacts arising from production to use of CEVs and EVs

Value chain scope includes steps and geographies based on their materiality

The assessment covers the value chain of the vehicles from production to use but excludes the decommissioning of vehicles (see Figure 4). This involves considering many materials, steps and countries. In the production stage, the assessment focuses on the most important materials in producing the battery and engine. The sourcing countries are selected based on their global share (e.g. Australia is selected as the source country of lithium because it covers 49% of global lithium production). The impacts arising at end of life of the vehicle are relatively small,[4] and therefore are not included. A detailed overview of the value chain is included in the Appendix.

Figure 4: Value chain scope



[4] *IEA. (2019a). Global EV Outlook 2019 – scaling-up the transition to electric mobility. International Energy Agency.; Hawkins, T. R., Singh, B., Majeau-Bettez, G., & Strømman, A. H. (2013). Comparative environmental life cycle assessment of conventional and electric vehicles. Journal of Industrial Ecology, 17(1), 53-64.; Kukreja, B. (2018). Life cycle analysis of electric vehicles – quantifying the impact. City of Vancouver & The University of British Columbia.*

The assessment considers economic, social and environmental impacts

Impacts scope includes a range of positive and negative impacts

The basis of the assessment is an estimate of the socio-economic benefits and social and environmental costs of CEVs and EVs. Based on this, the impact of lending to either sector can be compared.

The impacts under review were chosen according to the Impact Institute Standard Impact List 2019 (see Appendix for definitions) and were determined based on a materiality and feasibility assessment. Based on this, intellectual capital impacts are beyond the scope of this assessment. Similarly, impacts outside the main value chain, impact multipliers of financial impacts (e.g. the impact of the use of tax payments by governments) and higher order effects (e.g. effects of economic activity on institutions) are also excluded from the study.

For visualisation purposes, the impacts of each capital are classified according to the ESE (economic, social, and environmental) domains (see Table 1 and 2). The economic domain contains (net) positive impacts, the environmental domain contains negative impacts, and the social domain contains both positive and negative impacts. Results are expressed as impacts incurred for every Singapore dollar (SGD) lent to the palm oil sector. These impacts are converted to a monetised form in equivalent Singapore dollars (SGD-eq) so as to allow the comparison of financial and non-financial impacts (see Appendix for further explanation). The results are shown as SGD-eq/SGD lent. The year of measurement is 2018.

Table 1: Impacts in scope (benefits)

Domain	Impact Category
Economic	Salaries, taxes and profits
	Other financial impacts
	Contribution to consumer goods
	Other manufactured impacts
Social	Well-being effects of employment
	Creation of human capital
	Value of employee time

Table 2: Impacts in scope (costs)

Domain	Impact Category
Social	Occupational health and safety breaches
	Gender skill gap
	Underpayment
	Child labour
	Forced labour
	Overtime
	Workplace harassment
	Lack of freedom of association
Environ-mental	Contribution to climate change
	Air pollution
	Water pollution
	Scarce water depletion
	Fossil fuel depletion
	Scarce materials depletion
	Land use

Detailed information on the impacts covered by the assessment is included in the Appendix.

2 *Impacts of lending to the automotive sector*

Key result: the transition from CEV to EV reduces the environmental and social costs of the automotive industry

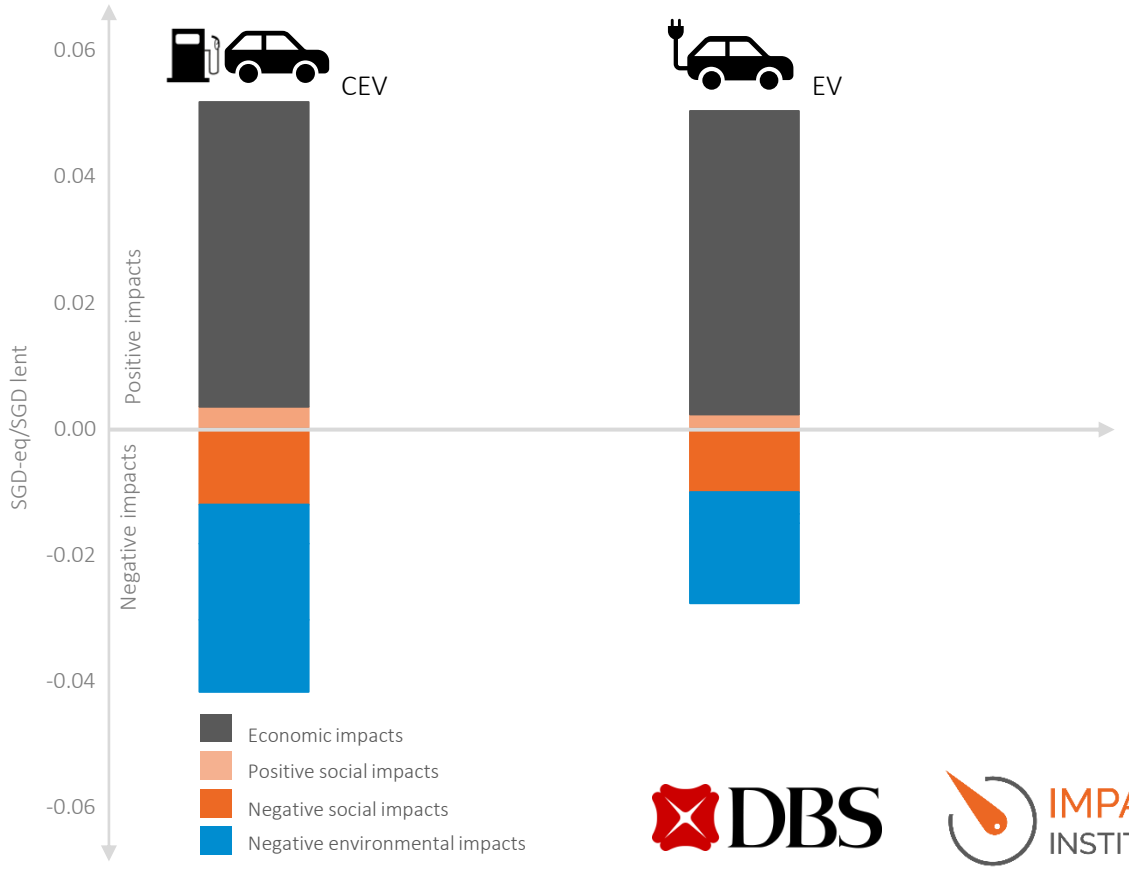
Both the CEV and EV sectors create economic benefits, but transitioning to the EV sector reduces environmental and social costs.

Lending to the automotive industry, be it to the CEV or EV sector, creates economic benefits to society. This impact is mainly driven by salaries, taxes and profits, as well as consumer value of driving a vehicle.[5] Both sectors also produce positive social impact, such as the well-being effects provided by employment across the value chain.

However, both sectors also have environmental and social costs (see Figure 5). Transitioning from CEV to EV reduces these costs. Lending to the EV instead of CEV sector has lower environmental and social costs of approximately 40% and 16% respectively.

Figure 5: Impacts of lending to the automotive industry *(SGD-eq/SGD lent)* categorised per ESE domain

Impacts are monetised to make financial and non-financial impacts comparable.



[5]Differences in the consumer value of CEVs vs EVs, such as costs for fuel or energy and accessibility of petrol or charging stations, are not included.

Moving from CEVs to EVs results in significant reductions in environmental and social costs

The top three environmental costs due to lending to the EV and CEV sectors are air pollution, contribution to climate change, and fossil fuel depletion

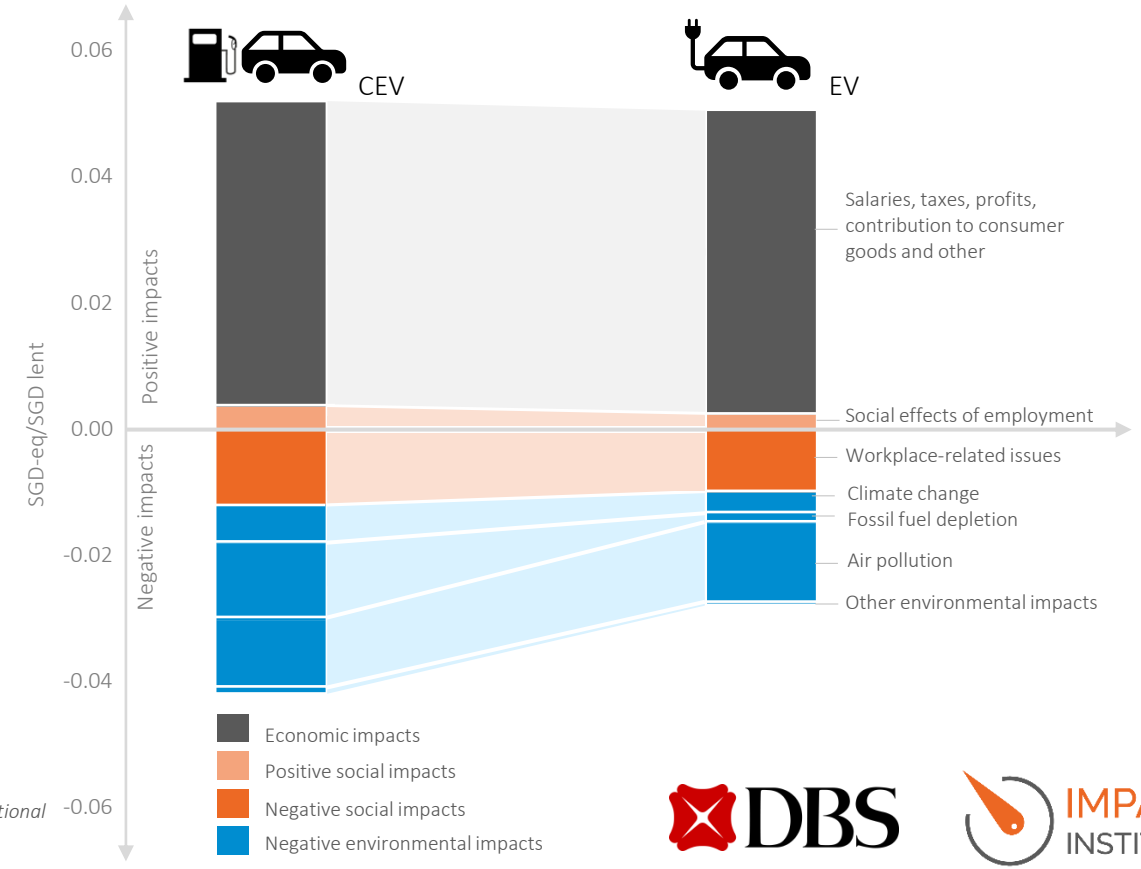
For CEVs, fossil fuel depletion is the highest environmental impact (41%) followed by air pollution (35%) and contribution to climate change (21%). In the EV sector, where environmental costs are substantially lower, air pollution is the highest impact (69%).

The CEV sector's heavy reliance on fossil fuels (coal, oil, natural gas) required for driving the vehicles explains the biggest differences between CEVs and EVs. A transition from CEVs to EVs can reduce the contribution to climate change by 45%, as there are less greenhouse gas emissions associated with driving.[6] All environmental impacts are lower for EVs, except air pollution, which is on average, slightly higher for EVs than for CEVs (see Figure 6).[7] The key driver for this is battery production and (grey) electricity generation needed to drive an EV over its lifespan.

The social costs of lending to the EV and CEV sectors are mainly workplace-related

There are indications of social costs in both sectors. Workplace harassment, overtime and underpayment are the biggest social impacts in both. There are slightly lower social costs for the EV sector. The assembly of an EV requires more highly skilled labour and fewer hours than the assembly of a CEV.[8] As a result, there appear to be fewer labour rights issues in EV production, although reliable data in the relevant steps and countries is scarce.

Figure 6: Breakdown of material impacts of lending to the automotive industry *(SGD-eq/SGD lent)*



[6] *Otten, M.B.J., & Afman, M.R. (2015). Emissiekentallen elektriciteit. CE Delft.*
[7] *Hawkins, T. R., Singh, B., Majeau-Bettez, G., & Strømman, A. H. (2013). Comparative environmental life cycle assessment of conventional and electric vehicles. Journal of Industrial Ecology, 17(1), 53-64.*
[8] *European Commission. (2014). Analytical highlight – focus on automotive sector and clean vehicles. EU Skills Panorama*

Current EV production still has substantial negative environmental impact

There are multiple steps in the value chain process, that can be split between production and use phase. The production phase includes steps from mining to car assembly, while the use phase includes driving the car and fuel production (for CEVs) or electricity generation (for EVs). Maintenance is excluded in this assessment

Environmental costs primarily occur in the use phase for CEVs, as opposed to EVs

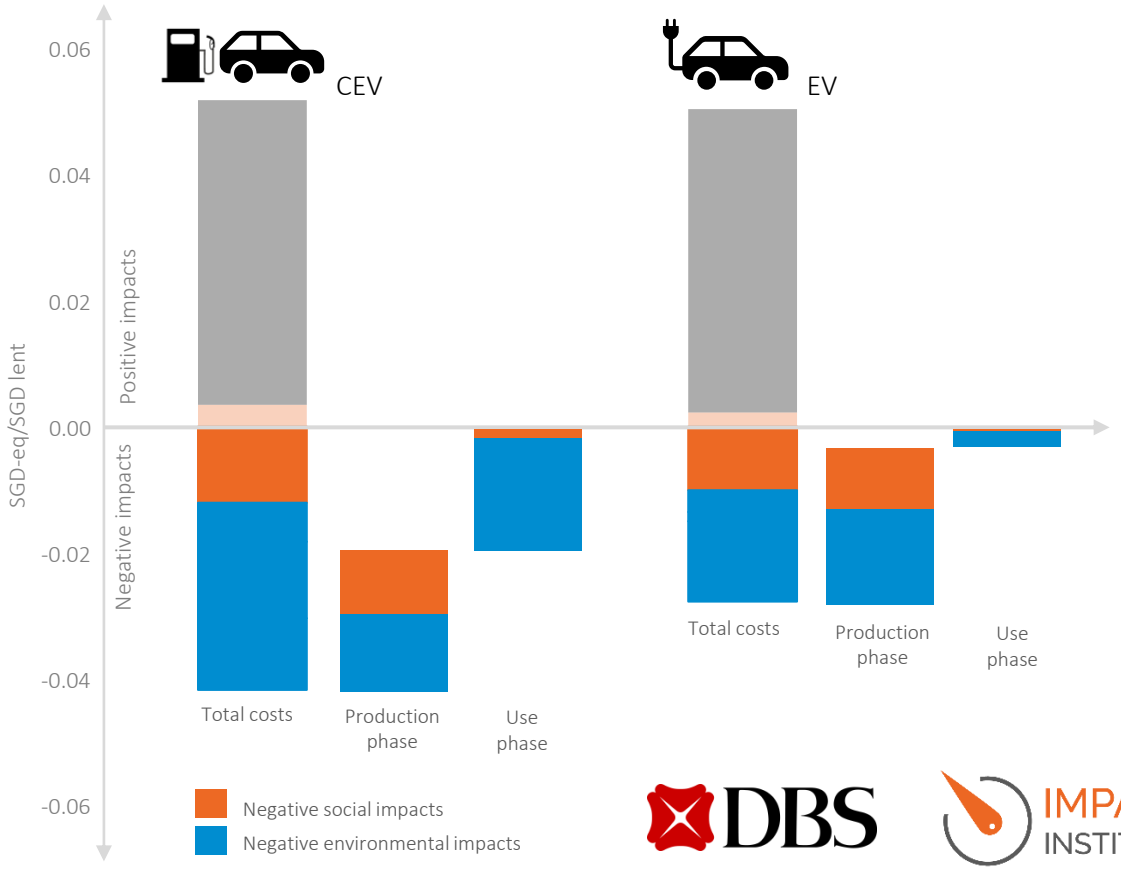
In the use phase, CEVs have significantly more environmental costs than EVs. A substantial portion of the environmental costs for CEVs is due to greenhouse gas emissions and fossil fuel depletion, which is substantially higher than the environmental costs of the electricity used by EVs (see Figure 7).

In the production phase, CEVs have slightly less environmental costs than EVs. The environmental costs for both CEVs and EVs are mainly from the mining of materials and electricity use. The battery component of EVs requires more minerals such as lithium and graphite, and its assembly is more polluting, which results in increased environmental costs for EVs.

Social costs mostly occur in the production phase for both vehicles

The production phase is the largest contributor to most social costs in both sectors. In particular, manufacturing of batteries and engines, as well as assembly, have the largest social impacts. These parts in the value chain are the most labour intensive.

Figure 7: Impacts of lending to the automotive industry *(SGD-eq/SGD lent)* classified per phase



Environmental costs of EV can be further reduced with a shift to renewable energy sources for electricity

The energy mix drives the environmental costs of the use phase of EV

The type of fuel used to produce electricity is an important factor in determining the environmental costs associated with the use of EVs. Thus, a selection of the energy mixes of markets were assessed and compared, based on EV use in 2018.[9] The energy mix of these markets is quite different (see Figure 8), with coal dominating in China, natural gas in Singapore, coal and gas in the USA, and hydro and nuclear in Europe (approximated by the largest EV markets: Norway, France and Germany).

Reducing the use of coal and natural gas can strongly reduce the environmental impact of electricity generation

Greenhouse gas (GHG) emissions lead to some of the largest negative impacts of electricity generation, followed by particulate matter formation and fossil fuel depletion (see Figure 9). In China, where electricity is predominantly generated from the burning of coal, there is a significant increase in environmental costs resulting from GHG emissions and particulate matter formation compared to other markets with different energy sources.

While China is the biggest market of EVs,[10] the environmental costs associated with the use of EVs is still considerable. However, China is projected to cut 20% of its coal in electricity generation and substitute it with more environmentally friendly sources by 2030. It is expected to increase solar and wind power generation by approximately 15% and 10%, respectively.[11] Such changes can potentially reduce the environmental costs associated with the use of EVs by approximately 33%.

Figure 8: Energy mix of selected markets

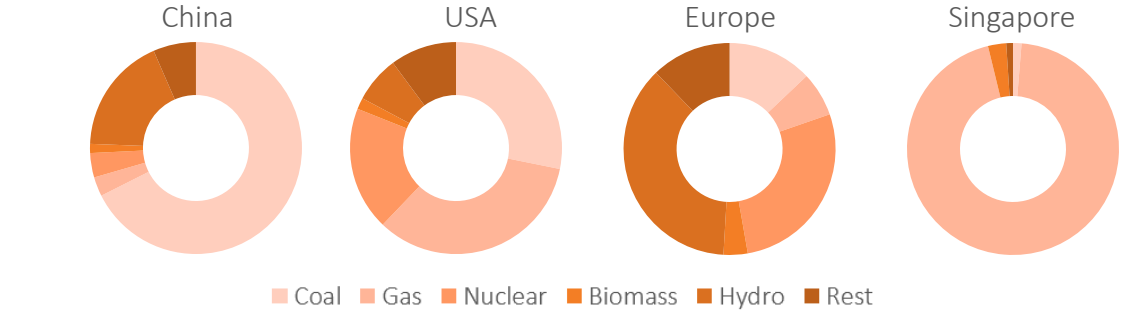
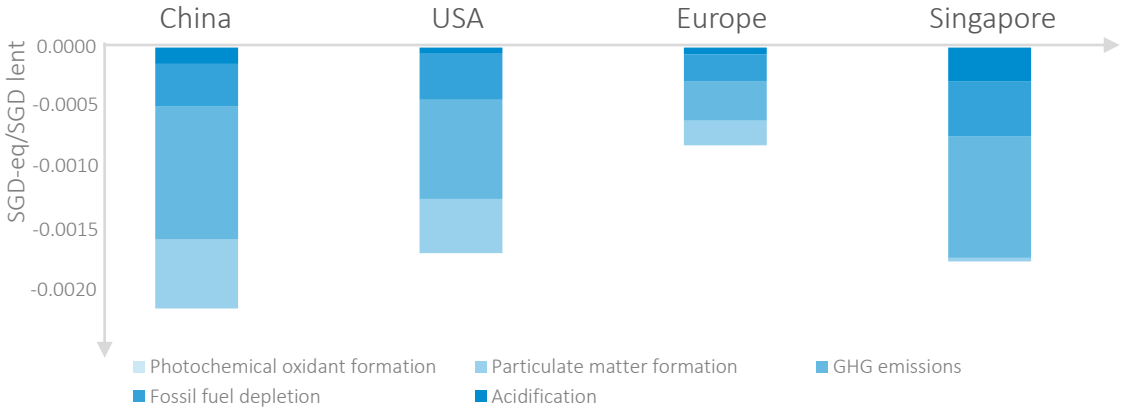


Figure 9: Breakdown of environmental costs of electricity generation in the use phase (illustrative only)



[9] *IEA. (2020). Countries and regions. International Energy Agency.*
[10] *IEA. (2019a). Global EV Outlook 2019 – scaling-up the transition to electric mobility. International Energy Agency.*
[11] *IEA. (2019b). Installed capacity by technology in China in the new policies scenario, 2000 – 2040. International Energy Agency.*

3 *Concluding insights*

Key insight of this study: the transition to EVs makes the automotive industry more sustainable

Focusing on the transition from CEVs towards EVs, this study provides insights into the impact of producing and driving both type of vehicles, as well as the trade-offs involved.

Insights into the benefits of the transition to electric vehicles

Electric vehicles promise to make the automotive industry more sustainable. Existing research shows a potential trade-off between somewhat higher environmental costs of production and lower environmental costs of driving an EV. This study shows that when considering the various effects, the transition from CEVs to EVs can result in a strong improvement of the environmental impact.

The largest reduction in environmental costs can occur in the use phase, due to the switch in power source from fossil fuels to electricity. The expected future increase in renewable energy sources to generate electricity can further reduce the environmental costs of driving electric vehicles. Therefore the gap between EVs and CEVs is likely to grow. In markets with higher adoption of EVs, the potential to reduce negative impacts by shifting to a greener energy mix is even greater. In contrast, the production phase is where most social issues occur. The EV sector has slightly lower social costs although less data is available on social issues.

Insights for future actions

Shifting to electric vehicles improves the impact of the automotive sector. DBS can have a positive impact by accelerating this shift through helping its clients finance the transition and manage the environmental and social risks of car manufacturing.

4 Appendices

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IP&L is a methodology to assess impact in a structured way using impact pathways

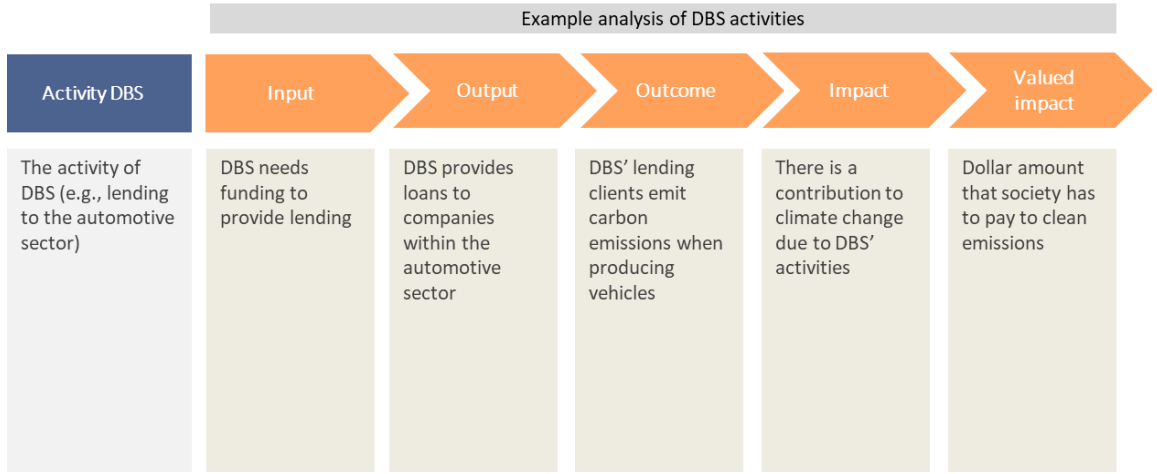
The IP&L framework measures and values impacts following an impact pathway approach: a structured step-by-step approach providing a link between an activity and the resulting impacts. Figure 10 provides an visual representation. The pathway approach incorporates three key concepts for measuring and valuing impacts:

Impact measurement. Impacts were measured using extended input-output models with trade data, environmental and social footprints and combined with desktop research. Here, Impact Institute's Global Impact Database (GID) was used for baseline estimates.[12]

Impact contribution. An impact is typically not the sole responsibility of the organisation where it occurs; most impacts in the automotive value chain are shared amongst organisations active in the value chain, such as DBS. The IP&L shows the specific contribution of the organisation under review to the value creation for society.

Impact valuation. The results of an impact assessment are expressed in monetary terms (e.g. Singaporean Dollar equivalents) to allow comparison amongst impacts for communication (reporting) and decision-making (steering) purposes. In this way, for example, the non-financial benefits of employment (such as autonomy and social status) are translated into monetary terms and can be compared to the financial benefits of employment (such as salaries). Similarly, by expressing carbon emissions as the costs required to take these emissions out of the air, the societal cost-efficiency of measures to reduce the carbon footprint can be assessed.

Figure 10: Illustration of impact pathway approach, from activity to impact



[12] *The GID contains specific impact data across the whole economy, covering 189 countries with 26 sectors. It is built by Impact Institute, based on the interconnectedness of industries in various countries and their economic, environmental and social impact from a range of global databases.*

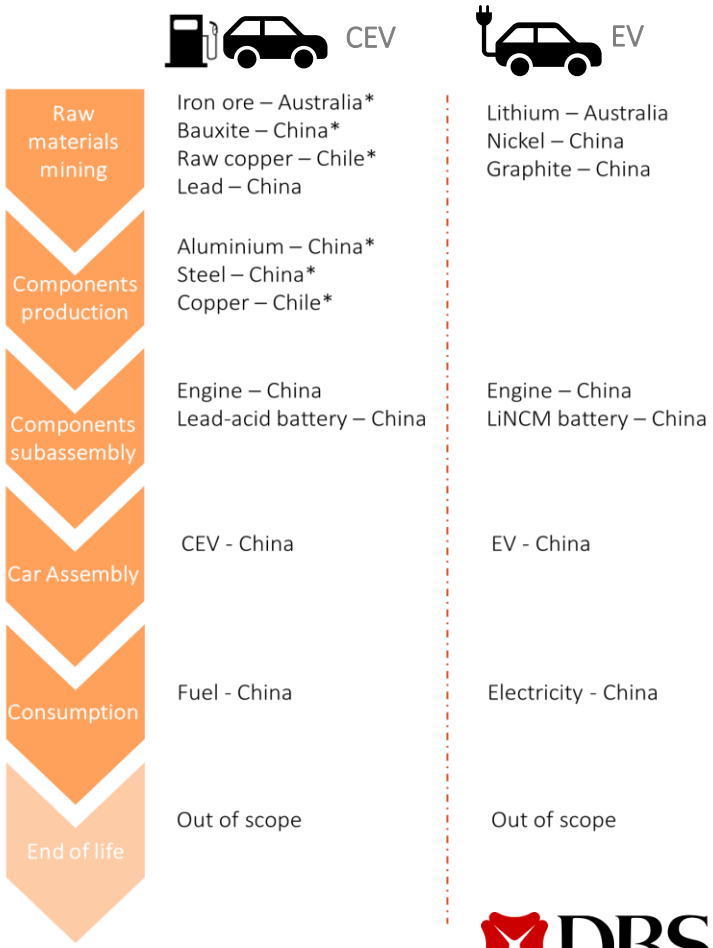
Value chain scope includes both production and use of the vehicles

The value chain scope of both vehicles covers the lifecycle from the production of vehicles through to the consumers' use of the vehicles. It involves many materials, parts and countries. In this assessment, the most important materials in producing the battery and engine components are included.

Raw materials are mined in different countries, and the countries selected for this assessment are based on their global share of the production (see Figure 11). Raw materials are then processed into components such as aluminum, steel and copper. These are used as inputs in the manufacturing stage where the car's engine or battery is assembled. The engine and battery are then assembled into the car. The car is then shipped to customers and used throughout its lifespan.

Impacts arising from the end of life are relatively small for both CEVs and EVs and are not included in the scope of this assessment.

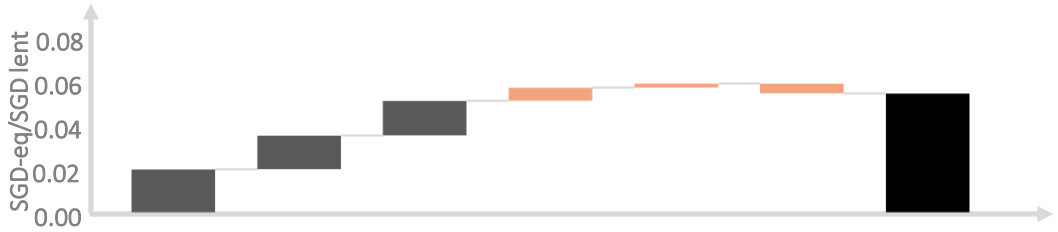
Figure 11: Value chains analysed for CEVs and EVs



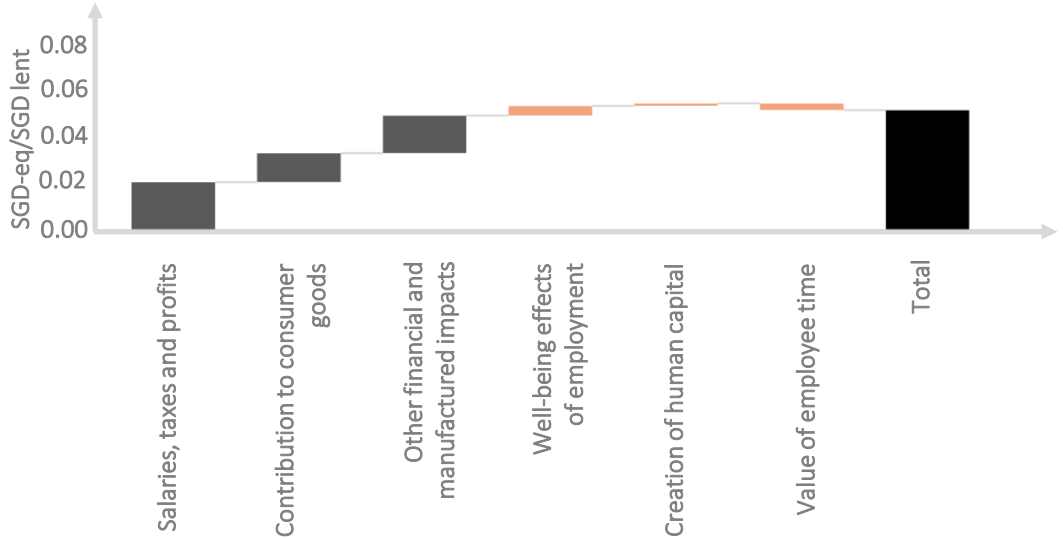
**material is used in both type of vehicles*

Breakdown of social and net economic benefits and social and environmental costs

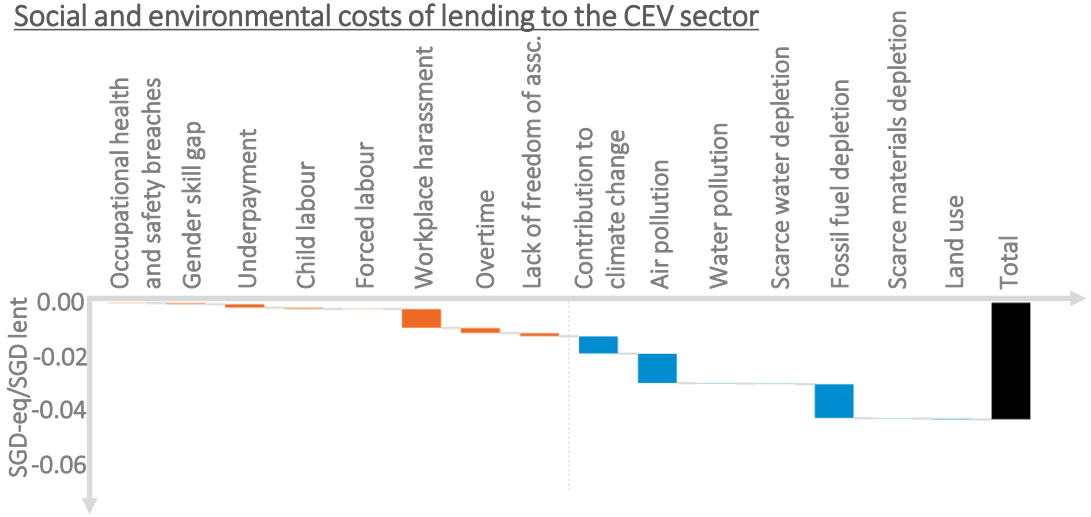
Social and net economic benefits of lending to the CEV sector



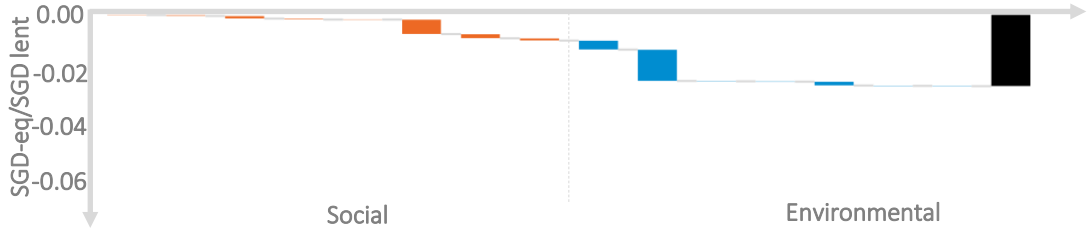
Social and net economic benefits of lending to the EV sector



Social and environmental costs of lending to the CEV sector



Social and environmental costs of lending to the EV sector



Impacts related to a well-being contribution and respecting rights are presented separately, because a breach of human or environmental rights can never be offset (netted) by a positive contribution to well being, following the No Offsetting of External Costs principle stated in FIS (2019).

Definitions of capitals used in the IP&L

Capital	Definition
Financial	All assets consisting of a form of money and other financial assets
Manufactured	All tangible assets including goods delivered to consumers and the value created by the services
Human	The increase in well-being of employees caused by employment through effects on, i.a. self-esteem, autonomy, social relations, and social status
Social	All value relating to communities, groups of people, including trust, networks, and norms
Natural	Natural assets such as water, air and scarce resources
Intellectual	All value relating to individual people, including health and competences

The six capitals defined in the IP&L methodology follows a rigorous categorisation based on The International <IR> Framework.

Definition of impact categories: Social and net economic benefits

Domain	Capital	Impact Category	Definition
Economic	Financial Capital	Salaries, taxes and profits	The financial value created due to lending which contributes to the economy (GDP).
		Other financial impacts	The impacts created due to money-flow throughout the value chain. They represent money exchanges between stakeholders (e.g. between a business and a consumer or between two businesses) in the value chain. Note that, the net effect of these exchanges is zero.
	Manufac-tured Capital	Contribution to consumer goods	The value to consumers of the final goods and services produced in the value chain (e.g. products containing palm oil).
		Other manufactured impacts	The net effect of investments in property and equipment and the consumption (depreciation) of this.
Social	Human Capital	Well-being effects of employment	The increase in well-being of employees caused by employment through effects on, i.a. self-esteem, autonomy, social relations, and social status.
		Creation of human capital	The value of an increase in productivity of employees as a result of being employed (e.g. through gaining experience and learning on the job).
		Value of employee time	The value of the time employees spent on work, representing the opportunity cost.

Definition of impact categories: Social and environmental costs (1/2)

Domain	Capital	Impact Category	Definition
Social	Human Capital	Occupational health and safety breaches	The loss of healthy life years due to fatal and non-fatal occupational accidents in the workplace
	Social Capital	Gender skill gap	Presence of discrimination (e.g. unequal access to highly skilled jobs) based on gender
		Underpayment	Insufficient financial compensation for work, expressed as the difference between the actual income workers receive and the living wage (which provides a decent standard of living)
		Child labour	Presence of child labour throughout the value chain
		Forced labour	The presence of forced labour constitutes a negative impact and an external cost. This applies both to forced labour at the organisation in scope (direct impact) or forced labour as an indirect impact
		Workplace harassment	Presence of workplace harassment, both sexual and non-sexual, physical and non-physical, in own operations and in the value chains
		Overtime	This refers to workers experiencing excessive working hours (more than the maximum legal working hours). Overtime at the company in scope (direct impact) or as an indirect impact constitutes a negative impact and an external cost
		Lack of freedom of association	Lack of freedom of association means that workers are denied the freedom to form organisations of their choice, to promote and defend their interests, and to negotiate collectively with other parties. Lack of freedom of association at the company in scope (direct impact) or as an indirect impact constitutes a negative impact and an external cost

Definition of impact categories: Social and environmental costs (2/2)

Domain	Capital	Impact Category	Definition
Environ-mental	Natural Capital	Contribution to climate change	Contribution to climate change via the emissions of greenhouse gases
		Air pollution	Negative effects of pollution to air quality
		Water pollution	Negative effects of pollution to water quality
		Scarce water depletion	The use of scarce water resources, such that these become unavailable to others
		Fossil fuel depletion	The use of scarce energy resources, such that these become unavailable to others
		Scarce materials depletion	The extraction of scarce, non-renewable resources besides fossil fuel (e.g. minerals, metals), such that these become unavailable to others
		Land use	The occupation of land, harming the natural habitats and ecosystems, leading to biodiversity loss and loss of ecosystem services

Key assumptions and limitations

Key assumptions:

- The impact that is attributed to DBS is determined by its net interest income (amongst other factors). In this assessment, a 2% net interest income is assumed as a proxy.
- The impact assessed is the impact of DBS' lending activity as compared to a reference in which no lending is provided.
- The model focuses on impacts and car components that drive the differences in impact between CEV and EV.
- There is limited quantitative data available for social impacts in China. If qualitative data is available, global average data from Global Impact Database (GID) is used. In cases where no indications of social issues were found, the social impacts are assumed to be absent (e.g. child labour in China is assumed to be absent in the mining sectors, except for coal).

Key limitations:

- Impacts with high uncertainty and complexity are beyond the scope: this includes impacts outside of the organisation's value chains (e.g. how lending policies of DBS influences other banks or government policies), multipliers (e.g. to which degree a dollar in tax income generates more or less well-being than a dollar in income to households) and higher order effects (e.g. whether higher salaries can lead to more consumption and CO_2 emissions).
- Impacts from transportation of goods and the end of life phase are not included,
- Data from different life cycle inventories have been included, which may have been built on different LCA definitions and methods.
- For some cases, the best available data is not from the desired year of measurement. Therefore, adjustments are made through, for example, conversion which may lead to uncertainties.
- A proxy is used when specific bottom-up data is not available (for example, for the social impacts of lithium and iron ore mining in Australia, data points were used from the general mining sector in Australia), which makes the results less granular.
- Only absolute impacts were measured. Marginal impacts were beyond the scope of this assessment, as it would entail an analysis of policies of other banks and their effectiveness.
- The use of industry averages for several impacts and part of the value chain leads to approximation of the actual impacts. Therefore, the estimates are approximations and contain uncertainties.
- The difference in perceived value for the consumer is not included, e.g. the difference in price to fuel throughout the lifetime of the vehicle, and accessibility of charging stations is beyond the scope of the assessment.

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DBS IMPACT INSTITUTE

IMPACT INSTITUTE

Address: Haarlemmerplein 2, 1013 HS, Amsterdam
Twitter: impact_inst
Tel.: +31 20 2403 440

Site: https://www.impactinstitute.com/
Mail: info@impactinstitute.com

DBS

Address: 12 Marina Boulevard,
Marina Bay Financial Centre Tower 3,
Singapore 018982

Site: https://www.dbs.com/default.page
Mail: sustainability@dbs.com

Impact assessment of lending to the palm oil industry

March 2020
External report

IMPACT INSTITUTE

DBS

About this report

This pilot impact measurement report is one of the first steps DBS is taking towards more comprehensively understanding and measuring its impacts. It is the result of a collaboration between DBS and Impact Institute to provide insight into the impacts of a bank's lending activities in the palm oil sector.

Where applicable, impact measurement definitions, principles and criteria presented in this report follow the Integrated Profit & Loss Assessment Methodology.

Outline of this report

About DBS

DBS is a leading financial services group in Asia with a presence in 18 markets. Headquartered and listed in Singapore, DBS has a growing presence in the three key Asian axes of growth: Greater China, Southeast Asia and South Asia. The bank's "AA-" and "Aa1" credit ratings are among the highest in the world.

https://www.dbs.com/default.page

About Impact Institute

Impact Institute is a social enterprise with a mission to contribute to an economy that creates value for all. We do that by helping organisations to quantify, value and improve their impact on society. Impact Institute assists multinationals, SMEs, NGOs and governmental organizations in risk management and strategic decisions, by providing insight into their impacts and related risks and opportunities.

https://www.impactinstitute.com/

1 Introduction

DBS has started measuring its impact to better steer portfolios towards sustainability

DBS is committed to creating long term value for its stakeholders

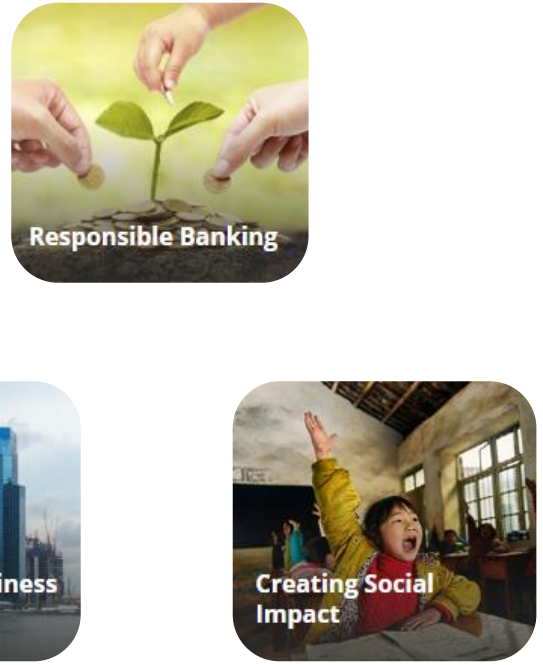
As a purpose-driven bank, DBS is committed to creating long term value by managing its business in a balanced and responsible way. It recognises its obligations to multiple stakeholders and strives to consistently deliver value to all of them, now and in the future. This is reflected in the three pillars of DBS' sustainability approach: responsible banking, responsible business practices and creating social impact (see Figure 1).

Creating more value requires DBS to better understand the impact of its clients' activities

The impact of DBS' lending depends on the activities of its clients. Understanding the types and magnitudes of the impacts that DBS creates is an important step towards better-informed lending decisions. This can help to steer the bank's corporate lending portfolio to create more long-term value for the economy, society and the environment. Impact measurement is a developing field that can provide this information both in absolute and relative measures.

DBS has started measuring impact through two pilot studies focusing on the palm oil and automotive sectors. These pilot studies use the Integrated Profit & Loss methodology developed by Impact Institute and aim to deepen DBS' understanding of its impacts, specifically in its institutional banking business. Ideally impact measurement is based entirely on specific client data. Our current pilot studies are an initial step towards such a goal. *The report on the impact of lending to the automotive sector can be found here.*

Figure 1: The DBS approach to sustainability



Impact measurement enables DBS to better understand value creation in the palm oil sector

The palm oil sector has large positive and negative effects on society and the environment

Palm oil is the world's most popular vegetable oil, and due to the demand in several sectors such as food and energy, the most rapidly increasing crop. The global annual demand is projected to keep increasing, with Asia-Pacific being the largest and fastest growing market.[1] It is a key driver for economic development, as it is a highly productive crop and used in many different end products. As beneficial as it is, its production is also known to have environmental and social external costs.[2]

As a lender to the sector, DBS wants to better understand and improve its impact

As a lender to the palm oil sector, DBS wants to better understand the impact of its lending activities and identify levers for improvement. While DBS' total lending to the palm oil sector is not material compared to its total lending activities, DBS recognises that it can play a role in achieving a more sustainable palm oil sector. DBS is already active in this respect, for example, by requiring new clients to demonstrate alignment with its No Deforestation, No Peat and No Exploitation (NDPE) policies.

This impact measurement pilot on the palm oil sector allows DBS to further increase its understanding of value creation in the palm oil sector in terms of economic (e.g. salaries), social (e.g. employment) and environmental (e.g. climate change) impacts. In addition, this study provides insights into how effective NDPE policies are in reducing negative environmental and social impacts.

[1]Strategyr. (2019).Focus on biofuels made from palm oil production waste as an energy security solution drives healthy market growth.
[2]Raynaud, J., Fobelets, V., Georgieva, A., Joshi, S., Kristanto, L., de Groot Ruiz, A., Bullock, S., Hardwicke, R., (2016). Improving Business Decision Making: Valuing the Hidden Costs of Production in the Palm Oil Sector. A study for The Economics of Ecosystems and Biodiversity for Agriculture and Food (TEEBAgriFood) Program.

DBS IMPACT INSTITUTE

Impacts are assessed using the Integrated Profit & Loss (IP&L) methodology

Impact is the measurable economic, social and environmental effect of an activity

Impact is about *effects* – not intentions. Impact goes beyond inputs and outputs and focuses on the difference an organisation makes for society and the environment. An impact can be positive or negative. An impact can be, for example, a contribution to the well-being of people (for example, through job creation or medicine production), a contribution to the stock of assets in society (where assets can be, for example factories, data or forests) or a breach of a right (such as child labour).

The Integrated Profit & Loss (IP&L) methodology is used to assess impacts

The IP&L methodology provides a novel and rigorous approach to measure and value impact, by extending the traditional profit and loss (P&L) in two steps (see Figure 2):

1. It takes into account the value created for all stakeholders of an organisation – such as their clients and society – in addition to the value created for investors.
2. It includes both financial and non-financial value creation. In particular, the IP&L methodology includes value in the form of six capitals, following a rigorous categorisation based on The International <IR> Framework. The six capitals can be mapped to three intuitive impact domains: economic, social, and environmental.

As a result, the IP&L methodology provides a complete overview of an organisation's impact on all its stakeholders through all the capitals. The foundation and principles used in the IP&L methodology for impact measurement and valuation are built upon, among other documentation, the Integrated Profit & Loss Assessment Methodology and Framework for Impact Statements.

Figure 2: Two-step extension of the traditional P&L to IP&L

The focus of this assessment is crude palm oil produced at plantations in Indonesia

This pilot study aims to assess the impacts of the entire palm oil sector. While it considers the entire value chain of palm oil, the analysis focuses on its cultivation, as this has larger negative impacts than other stages of the value chain.

The value chain under review therefore covers the entire value chain of crude palm oil (CPO) up to and including the use (domestic and export) of CPO but excluding the use of final products containing palm oil (e.g. the burning of biodiesel). In other words, this covers the plantation, its suppliers and clients (see Figure 3). The end product considered is CPO. Palm kernel oil is not a part of the scope of this study.

This study makes its assessment of the impacts of lending activities based on industry average data, which means it does not focus on specific segments (e.g. certified or non-certified plantations), nor does it utilise actual data from clients, including DBS' corporate clients.

Figure 3: Value chain in scope covers the plantation, its suppliers and clients

Impact assessment on industry average data includes a range of economic, social and environmental impacts

The impacts under review were chosen according to the Impact Institute Standard Impact List 2019 (see Appendix for definitions) and were determined based on a materiality and feasibility assessment. Based on this, intellectual capital impacts are beyond the scope of this assessment. Similarly, impacts outside the main value chain, impact multipliers of financial impacts (e.g. the impact of the use of tax payments by governments) and higher order effects (e.g. effects of economic activity on institutions) are also excluded from the study.

For visualisation purposes, the impacts of each capital are classified according to the ESE (economic, social, and environmental) domains (see Table 1 and 2). The economic domain contains (net) positive impacts, the environmental domain contains negative impacts, and the social domain contains both positive and negative impacts. Results are then expressed as impacts incurred for every Singapore dollar (SGD) lent to the palm oil sector. These impacts are converted to a monetised form in equivalent Singapore dollars (SGD-eq) so as to allow the comparison of financial and non-financial impacts (see Appendix for further explanation). The results are shown as SGD-eq/SGD lent. The year of measurement is 2018.

Table 1: Impacts in scope (benefits)

Domain	Impact Category
Economic	Salaries, taxes and profits
	Other financial impacts
	Contribution to consumer goods
	Other manufactured impacts
Social	Well-being effects of employment
	Creation of human capital
	Value of employee time

Table 2: Impacts in scope (costs)

Domain	Impact Category
Social	Occupational health and safety breaches
	Gender skill gap
	Underpayment
	Child labour
Environ-mental	Contribution to climate change
	Air pollution
	Water pollution
	Scarce water depletion
	Fossil fuel depletion
	Scarce materials depletion
	Land use

Detailed information on the impacts covered by the assessment is included in the Appendix.

2 *Impacts of lending to the palm oil sector*

Lending to the palm oil sector has large economic benefits, but also large costs to environment and society

Lending to the palm oil sector has significant economic and social benefits

Benefits are observed primarily in the economic domain (see Figure 4). The positive economic impact is driven by salaries, taxes, profits and the inherent value for consumers of products that include palm oil (e.g. cooking oil, soap). In addition, the palm oil sector has positive social effects, including the well-being effects of employment throughout the value chain and increases in human capital (e.g. experience and work-related skills).

However, there are also substantial environmental and social costs

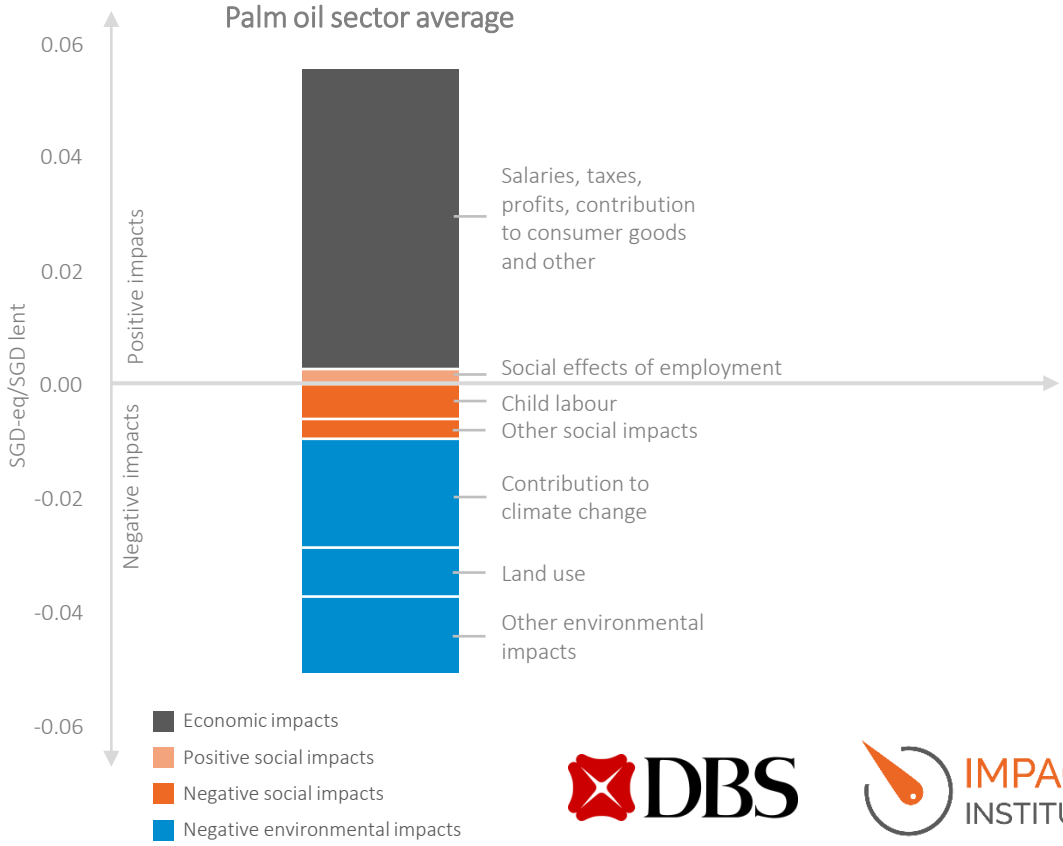
The largest negative impacts are environmental, with the main drivers being the contribution to climate change – predominantly due to deforestation – followed by biodiversity loss related to land use, and air pollution. Negative impacts in the social domain are mainly occurrences of child labour, for which evidence is found both on palm oil plantations and in other steps in the value chain. In addition, significant underpayment may occur in the value chain.

While palm oil has economic benefits, it is important to note that these cannot be set off against environmental and social costs. The goal is therefore to bring the costs as close to zero as possible, while striving to maintain or increase existing benefits.

The results, based on industry average data, suggest that there is a need to strengthen and expand current industry efforts to reduce environmental and social costs, such as through NDPE policies. This would enable society to enjoy the economic benefits of palm oil without harming society and the environment.

Figure 4: Impacts of lending to the palm oil sector *(SGD-eq/SGD lent)* categorised per ESE domain.

Impacts are monetised to make financial and non-financial impacts comparable.

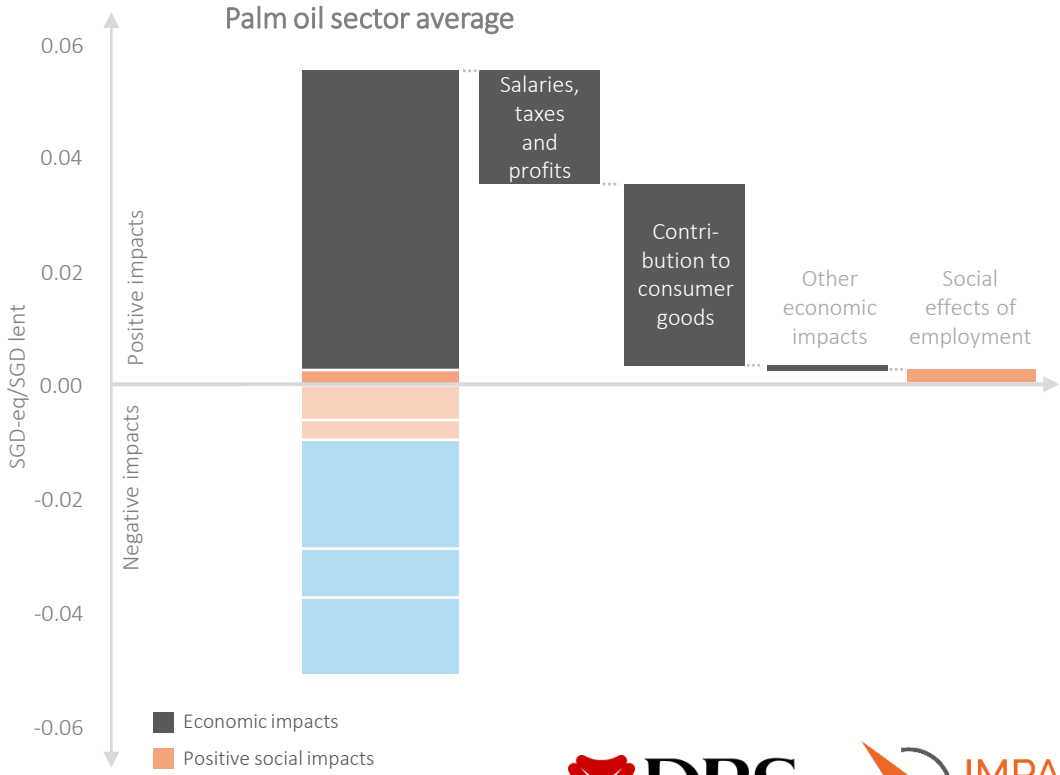


Lending to the palm oil sector stimulates economic and social benefits in the value chain

The results indicate that the key driver for absolute[3] economic benefits relates to consumers buying and using products that contain palm oil, which may include cooking oil, soap and biodiesel, followed by direct financial benefits such as salaries to employees, tax payments and profits (see Figure 5).

Lending to the palm oil sector also has social benefits as palm oil production involves labour. The social effects include the well-being effects of employment and increased human capital, such as work experience that increases productivity in the future. These impacts are primarily present in the domestic palm oil sector and domestic value chain (e.g. the processing of food products containing palm oil, producing agricultural supply products for the plantations, etc.).

Figure 5: Breakdown of net social and economic benefits



[3]*This study does not consider the relative value of palm oil vis-à-vis other substitutes. Palm oil is known to be a highly productive crop, see Saifuddin, N.M. & Salman, Bello & Hussein, Refal & Ong, Mei Yin. (2017). Microwave pyrolysis of lignocellulosic biomass—a contribution to power Africa. Energy, Sustainability and Society. 7. 10.1186/s13705-017-0126-z.*

Environmental and social impacts of the palm oil value chain occur predominantly at the plantations

Palm oil plantations are the biggest driver of most negative impacts in the palm oil sector

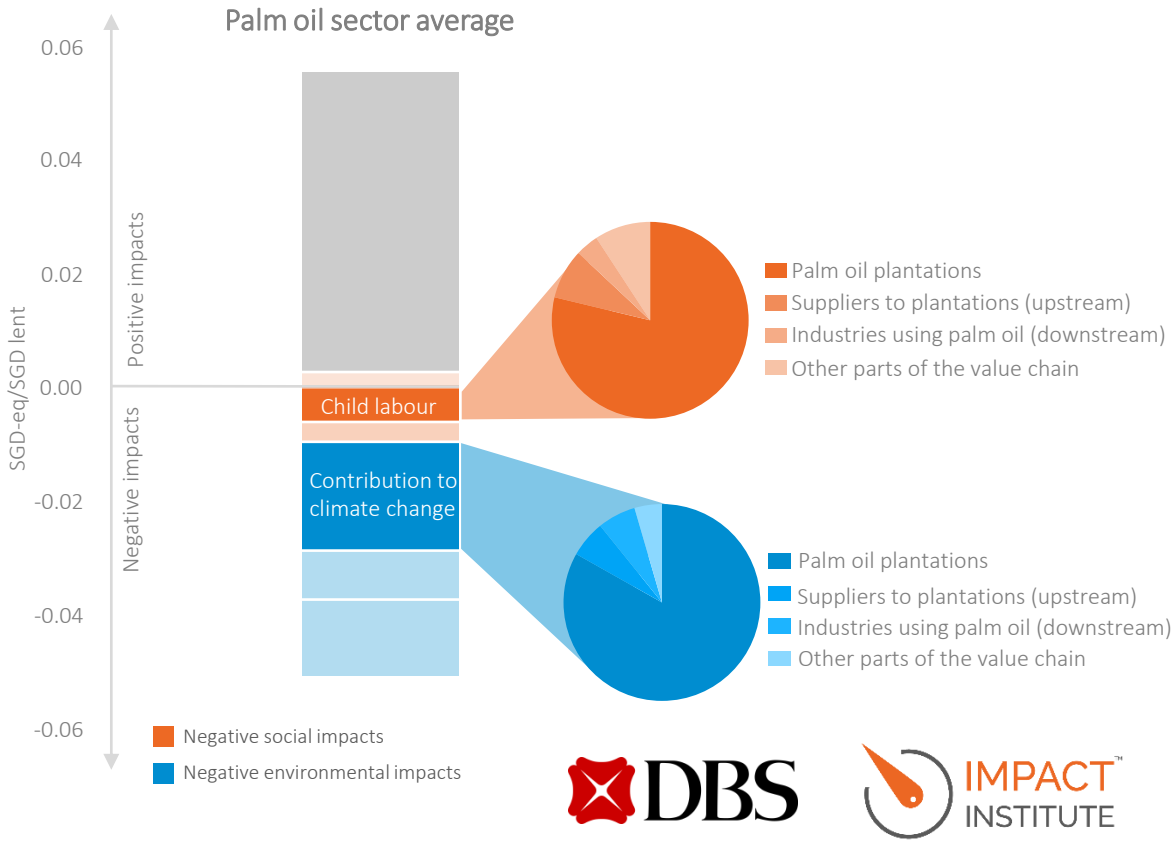
The largest environmental and social costs in the palm oil value chain are (respectively) contribution to climate change and child labour (see Figure 6). Observations include:

- The contribution to climate change is mainly caused by deforestation occurring at plantations. In contrast, less than 20% of the contribution to climate change occurs in the other analysed parts of the value chain, such as the use of palm oil in the food and beverages sector in India, or in the energy sector of Indonesia.
- There is evidence of child labour in the Indonesian palm oil sector.[4] Child labour in Indonesia is a problem not restricted to palm oil plantations: there are incidents in the entire Indonesian agriculture sector. Although less than what occurs on the plantations, incidence of child labour is also observed in other sectors of the palm oil value chain, which also contributes to the impact of palm oil.

Focus for improvement is at plantations, but negative impacts exist at other steps

The analysis shows that the greatest negative impacts occur at plantations. Therefore, an effective approach for lenders to improve the sustainability of palm oil value chains would be a clear (but not exclusive) focus on plantations. However, such an approach should still take into account that other sections of the value chain also contribute to costs (albeit to a smaller degree).

Figure 6: Sources of material impact contributions



[4] *U.S. Department of Labor. (2018). List of goods produced by child labor or forced labor.*

The way forward: effective implementation of NDPE policies can reduce negative impacts by up to 49%

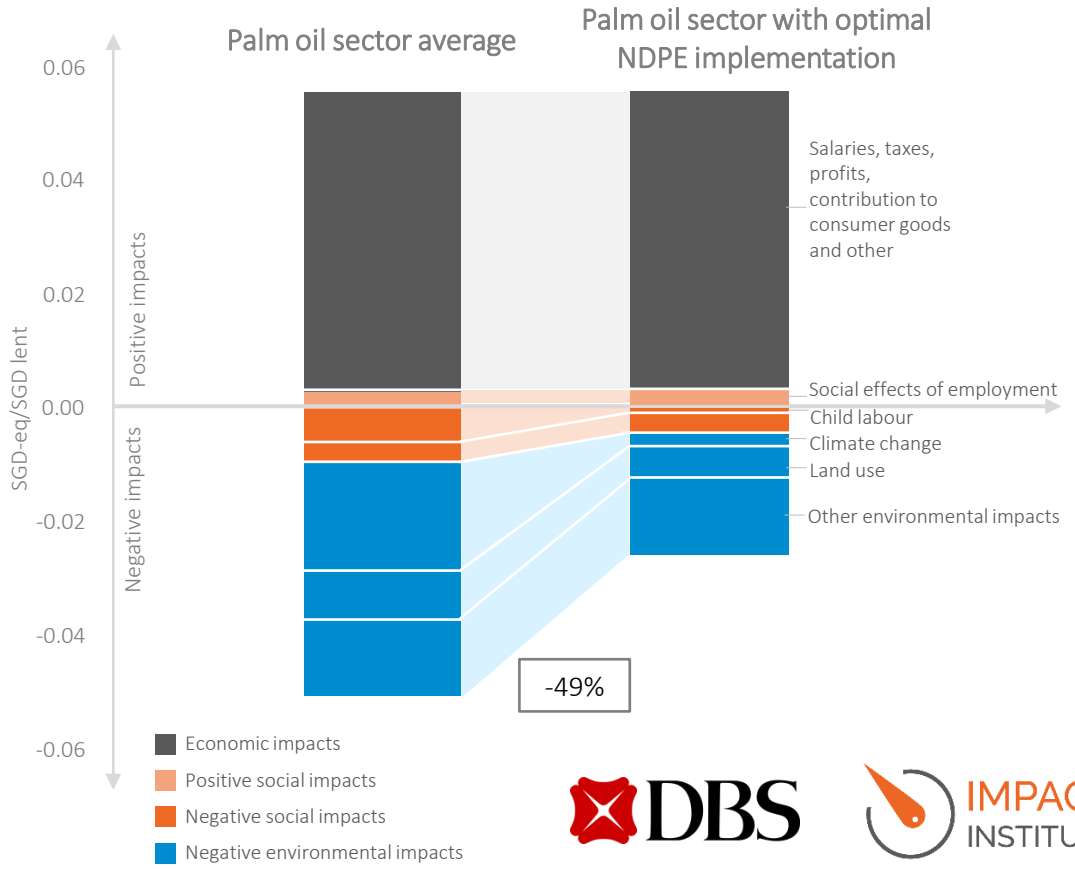
As a lender, DBS requires new lending relationships in the palm oil sector to demonstrate alignment with sustainability-related policies that reduce negative impacts of palm oil. These include the NDPE policies. For more information refer to DBS' approach to the palm oil sector, which also discusses certification standards such as the Indonesian Sustainable Palm Oil (ISPO) and Roundtable on Sustainable Palm Oil (RSPO).

NDPE policies are designed to reduce social and environmental costs and there is evidence that supports this at the plantation-level. However, despite the large-scale adoption of NDPE policies at many plantations, many have not yet achieved optimal NDPE implementation, which refers to an outcome in which there is zero deforestation, zero peatland degradation and zero exploitation of any kind. This implies that with improved enforcement of NDPE policies, there may be potential to further reduce social and environmental costs. More information on the impact of NDPE implementation is given in the Appendix.

The results of this assessment show that optimal NDPE policy implementation can reduce the negative impacts arising from the palm oil sector by up to 49% (see Figure 7). The greatest potential is on the contribution to climate change through avoiding peatland degradation and deforestation. In addition, the existence of child labour can also be reduced significantly through adequate monitoring of the policy.

Note that this analysis is based on average palm oil sector data and results are not reflective of any clients of DBS and its NDPE policies.

Figure 7: Impacts of lending to palm oil sector industry average vs optimal NDPE implementation



3 *Concluding insights*

Lending policies for the palm oil sector can reduce social and environmental costs and preserve economic benefits

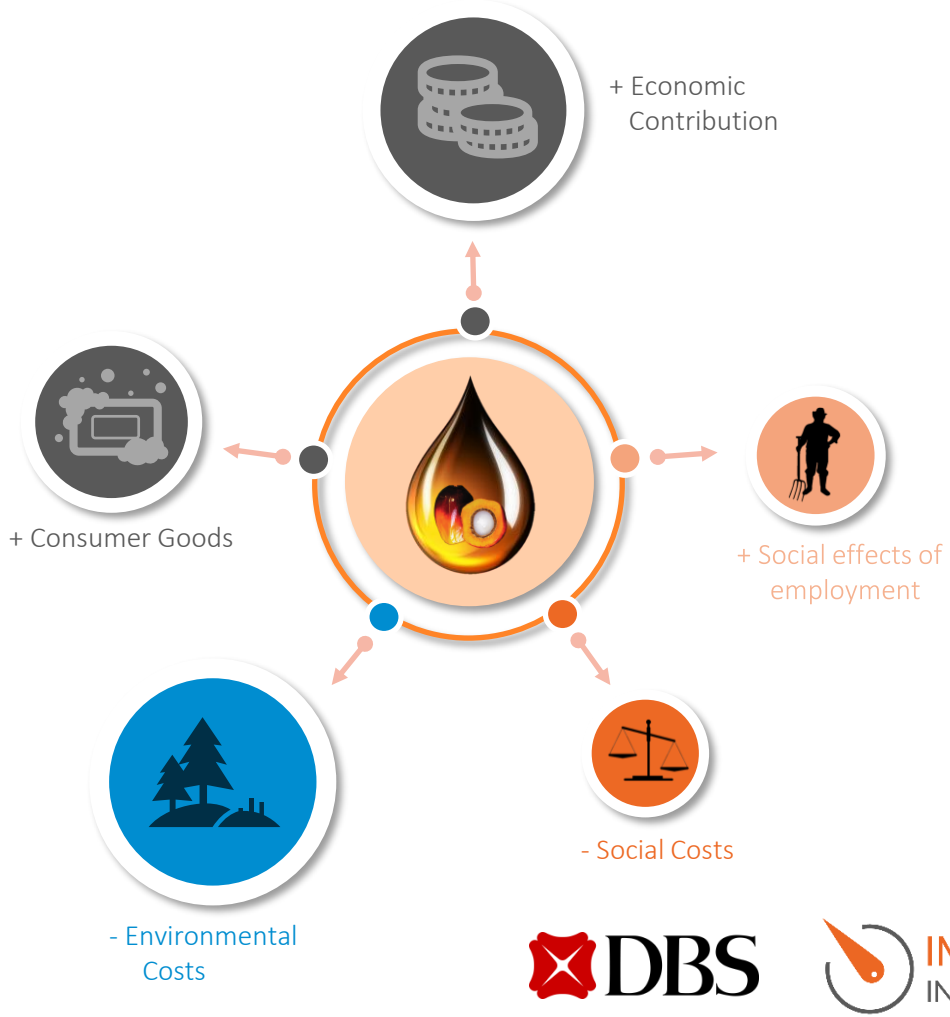
This study has contributed to key insights in the palm oil sector in Indonesia by quantifying the magnitude and types of positive and negative impacts across the value chain. Furthermore, this study has indicated that NDPE policies have the potential to improve the impact of the sector.

Insights on palm oil

Palm oil is a key ingredient in many products that are widely used by consumers. Therefore, the economic value to end-users of such products may be considered high. This is reflected in this study by the large positive economic impact it has. On the other hand, the palm oil sector in Indonesia takes a significant toll on the environment, mainly driven by carbon dioxide (CO_2) emissions from land-use change (deforestation and plantations on peatland). Within the social domain, there is evidence of child workers still active on palm oil plantations. Lastly, workers on plantations are often underpaid, even though there is evidence that the wages in the palm oil sector are already higher than the average in the Indonesian agriculture sector.

Insights for future actions

The negative environmental and social impacts of palm oil production can be further reduced significantly by strengthening and expanding current NDPE policies in the sector. The two biggest costs – contribution of palm oil cultivation to climate change and child labour – can be significantly reduced with optimal implementation of NDPE policies. Presently, DBS already requires new lending relationships to demonstrate alignment with NDPE policies.



4 Appendices

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IP&L is a methodology to assess impact in a structured way using impact pathways

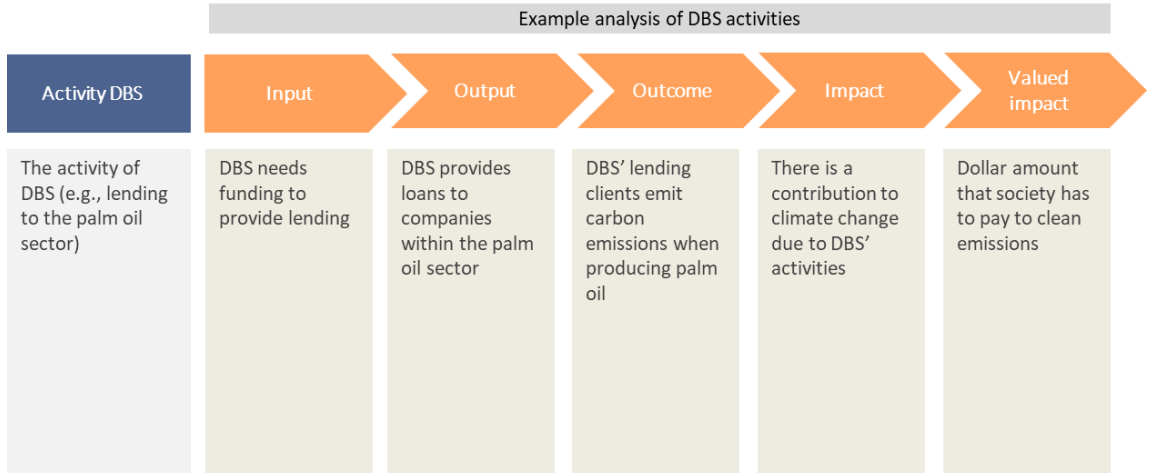
The IP&L framework measures and values impacts following an impact pathway approach: a structured step-by-step approach providing a link between an activity and the resulting impacts. Figure 8 provides a visual representation. The pathway approach incorporates three key concepts for measuring and valuing impacts:

Impact measurement. Impacts were measured using extended input-output models with trade data, environmental and social footprints and combined with additional desktop research. Here, Impact Institute's Global Impact Database (GID)[5] was used as the basis and enriched with specific palm oil data.

Impact contribution. An impact is typically not the sole responsibility of the organisation where it occurs; most impacts in the palm oil value chain are shared amongst organisations active in the value chain, such as DBS. The IP&L shows the specific contribution of the organisation under review to the value creation for society.

Impact valuation. The results of an impact assessment are expressed in monetary terms (e.g. Singaporean Dollar equivalents) to allow comparison amongst impacts for communication (reporting) and decision-making (steering) purposes. In this way, for example, the non-financial benefits of employment (such as autonomy and social status) are translated into monetary terms and can be compared to the financial benefits of employment (such as salaries). Similarly, by expressing carbon emissions as the costs required to take these emissions out of the air, the societal cost-efficiency of measures to reduce the carbon footprint can be assessed.

Figure 8: Illustration of impact pathway approach, from activity to impact



[5]*The GID contains specific impact data across the whole economy, covering 189 countries with 26 sectors. It is built by Impact Institute, based on the interconnectedness of industries in various countries and their economic, environmental and social impact from a range of global databases.*

NDPE policies can improve social and environmental costs of the palm oil sector

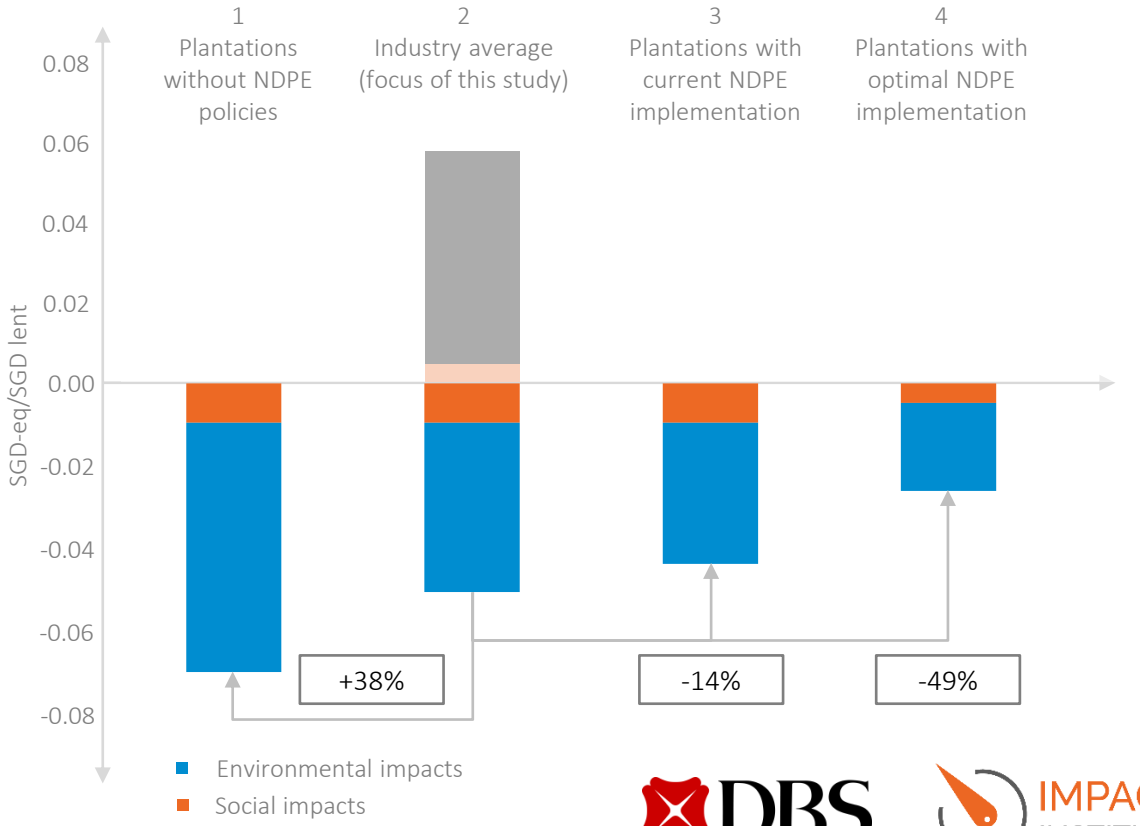
To understand the effect of NDPE lending policies, the study considered four scenarios, with differing levels of NDPE implementation. For each scenario, the social and environmental costs due to lending were considered. *This estimate is based on industry average data and results are not specific to DBS' policies or clients.*

1. Plantations without NDPE policies.
2. The industry average, comprising approximately 74% of plantations with NDPE and the remaining without.[6] This study focuses on this scenario.
3. Plantations that currently have NDPE policies (based on 2018, the year of measurement). However these plantations are not deemed to have achieved full implementation. This could be due to weak enforcement or monitoring.
4. Plantations with optimal, or full, NDPE implementation. This is the ideal, with plantations causing no deforestation, no peatland degradation, and no exploitation of workers.

Given that many plantations *have* already adopted NDPE policies (and that implementation is generally imperfect), it can be concluded that current NDPE lending policies have a limited effect. Nonetheless, it is worth noting that current adoption levels are already a success of lending policies in the past.

The analysis shows that in comparison with the industry average (Scenario 2), the current effect of NDPE lending policies (Scenario 3) is an estimated 14% improvement, while the potential effect of optimal NDPE policy implementation (Scenario 4) could be up to approximately 49% (see Figure 9).

Figure 9: Potential changes on environmental and social costs depending on extent of NDPE implementation



[6] *Steinweg, T., Drennen, Z., & Rijk, G. (2017). Unsustainable palm oil faces increasing market access risks: NDPE sourcing policies cover 74 percent of southeast Asia's refining capacity. Chain Reaction Research.*

Detailed analysis of impacts of the palm oil sector: current vs optimal NDPE implementation

Current NDPE implementation (Scenario 3) still has limited effect in reducing environmental and social costs within the palm oil sector. This result is in line with the report by the Environmental Investigation Agency,[7] which states that because of inadequate enforcement and ineffective monitoring, NDPE policies (as currently implemented) cannot completely stop deforestation or breaches of human rights.

In contrast, plantations that implement NDPE policy optimally (Scenario 4) can potentially reduce the environmental and social costs of the palm oil industry average (Scenario 2) by up to 49%. The largest potential for improvement is on climate change through the avoidance of peatland degradation and deforestation. The latter (i.e. the avoidance of deforestation) is also expected to reduce environmental costs significantly through the reduction in air pollution. (However, because of the limited availability of data, this has not been estimated in this assessment.) Furthermore, optimal NDPE implementation can also significantly reduce child labour impact (see Figure 10).

Figure 10: Potential improvement to environmental and social costs depending on extent of NDPE implementation

	Affected impact categories*	Effect of NDPE policy	Scenario 2 to 3*	Scenario 2 to 4*
Environ-mental	Contribution to climate change	No peat	9%	28%
		No deforestation	2%	6%
	Land use	No deforestation	3%	5%
	Air pollution	No peat	<1%	<1%
	Water pollution	No peat	<1%	<1%
Social	Child labour	No exploitation	<1%**	9%
	Underpayment	No exploitation	<1%**	1%
Total impact reduction (%)			14%	49%

*Numbers are a high-level estimation and only provide an indication of impact improvement possibilities by using best-available data. The estimation of actual impact improvements requires primary data directly from the plantations of clients.

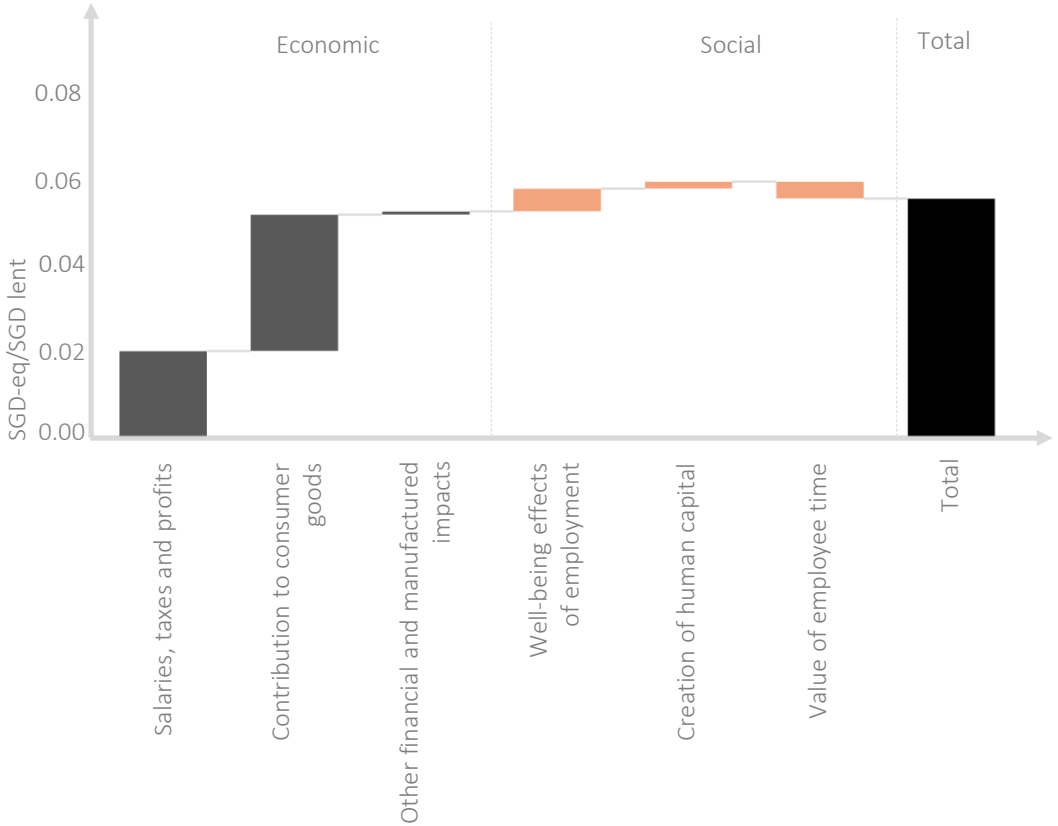
**There is no quantitative data regarding the reduction of negative social impacts. Conservative assumption is taken (<1%) due to the evidence of existence of human rights' abuse in palm oil plantations (EIA, 2019).

[7] *EIA (Environmental Investigation Agency). (2019). Promises in practice – the limited reliability of voluntary "No deforestation" commitments in Papua's palm oil plantations.*

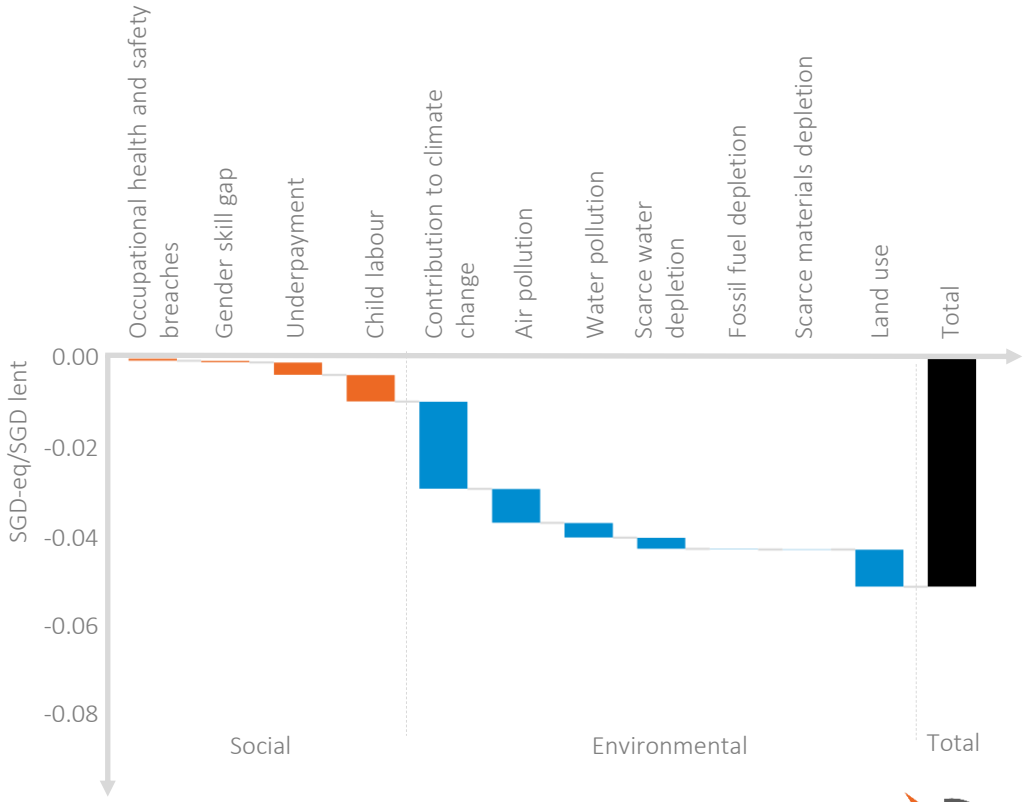
Breakdown of industry average social and net economic benefits vs social and environmental costs

Scenario 2
Industry average
(focus of this study)

Social and net economic benefits of lending to the palm oil sector



Social and environmental costs of lending to the palm oil sector

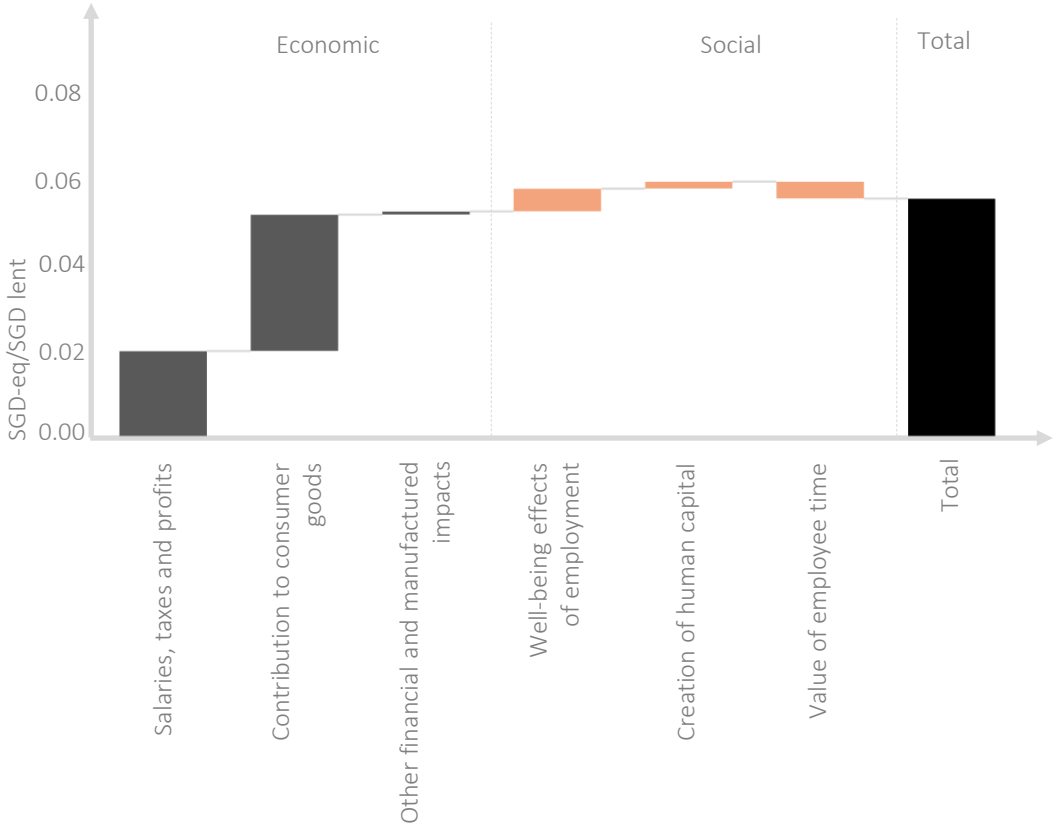


Impacts related to a well-being contribution and respecting rights are presented separately, because a breach of human or environmental rights can never be offset (netted) by a positive contribution to well-being, following the No Offsetting of External Costs principle stated in FIS (2019).

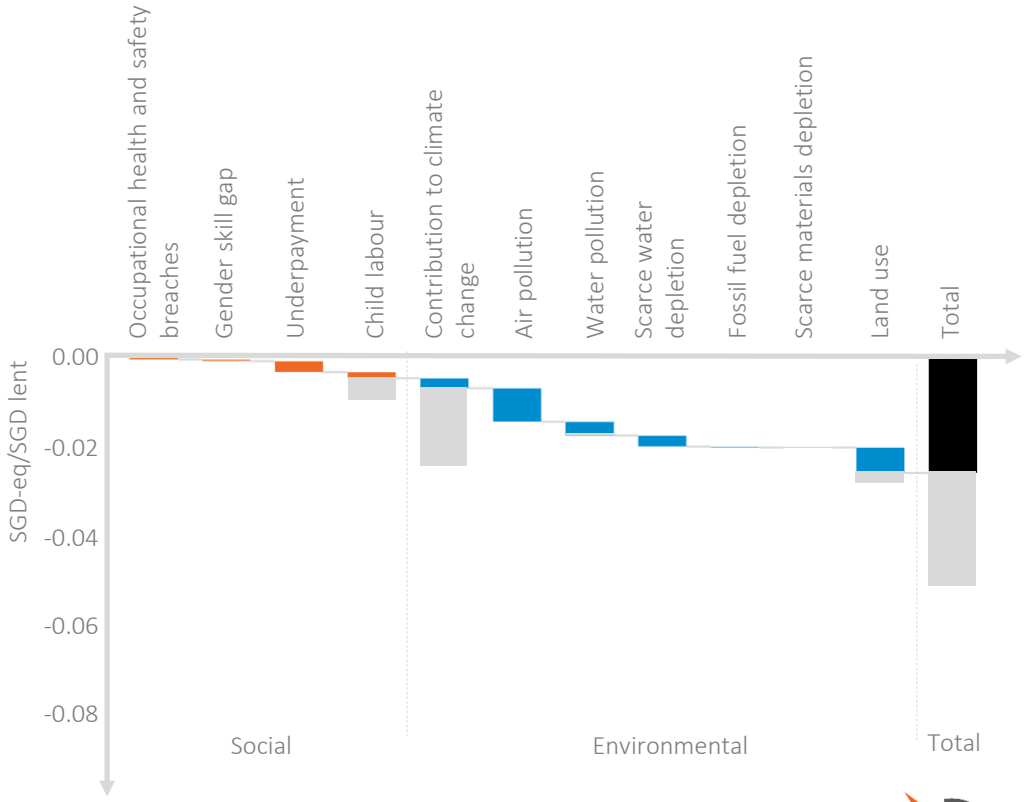
Breakdown of optimal NDPE implementation social and net economic benefits vs social and environmental costs

Scenario 4
Plantations with optimal NDPE implementation

Social and net economic benefits of lending to the palm oil sector



Social and environmental costs of lending to the palm oil sector



Impacts related to a well-being contribution and respecting rights are presented separately, because a breach of human or environmental rights can never be offset (netted) by a positive contribution to well-being, following the No Offsetting of External Costs principle stated in FIS (2019).

Definitions of capitals used in the IP&L

	Capital	Definition
	Financial	All assets consisting of a form of money and other financial assets
	Manufactured	All tangible assets including goods delivered to consumers and the value created by the services
	Human	The increase in well-being of employees caused by employment through effects on, i.a. self-esteem, autonomy, social relations, and social status
	Social	All value relating to communities, groups of people, including trust, networks, and norms
	Natural	Natural assets such as water, air and scarce resources
	Intellectual	All value relating to individual people, including health and competences

The six capitals defined in the IP&L methodology follows a rigorous categorisation based on The International <IR> Framework.

Definition of impact categories: Social and net economic benefits

Domain	Capital	Impact Category	Definition
Economic	Financial Capital	Salaries, taxes and profits	The financial value created due to lending which contributes to the economy (GDP).
		Other financial impacts	The impacts created due to money-flow throughout the value chain. They represent money exchanges between stakeholders (e.g. business and consumer or between two businesses) in the value chain. Note that the net effect of these exchanges is zero.
	Manufac-tured Capital	Contribution to consumer goods	The value to consumers of the final goods and services produced in the value chain (e.g. products containing palm oil).
		Other manufactured impacts	The net effect of investments in property and equipment and the consumption (depreciation) of this.
Social	Human Capital	Well-being effects of employment	The increase in well-being of employees caused by employment through effects on, among others, self-esteem, autonomy, social relations, and social status.
		Creation of human capital	The value of an increase in productivity of employees as a result of being employed (e.g. through gaining experience and learning on the job).
		Value of employee time	The value of the time employees spent on work, representing the opportunity cost.

Definition of impact categories: Social and environmental costs

Domain	Capital	Impact Category	Definition
Social	Human Capital	Occupational health and safety breaches	The loss of healthy life years due to fatal and non-fatal occupational accidents in the workplace
	Social Capital	Gender skill gap	Presence of discrimination (e.g. unequal access to highly skilled jobs) based on gender
		Underpayment	Insufficient financial compensation for work, expressed as the difference between the actual income received by the workers and the living wage (which provides a decent standard of living)
		Child labour	Presence of child labour throughout the value chain
Environ-mental	Natural Capital	Contribution to climate change	Contribution to climate change via the emissions of greenhouse gases
		Air pollution	Negative effects of pollution to air quality
		Water pollution	Negative effects of pollution to water quality
		Scarce water depletion	The use of scarce water resources, such that these become unavailable to others
		Fossil fuel depletion	The use of scarce energy resources, such that these become unavailable to others
		Scarce materials depletion	The extraction of scarce, non-renewable resources besides fossil fuel (e.g. minerals, metals), such that these become unavailable to others
		Land use	The occupation of land, harming the natural habitats and ecosystems, leading to biodiversity loss and loss of ecosystem services

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Key assumptions and limitations

Key assumptions:

- The impact that is attributed to DBS is determined by its net interest income (amongst other factors). In this assessment, a 2% net interest income is assumed as a proxy.
- The impact assessed is the impact of DBS' lending activities as compared to a reference scenario in which no lending is provided.
- The suppliers of the palm oil sector are approximated by the suppliers of the Indonesian agriculture sector, taking into consideration the sectors that supply the palm oil sector and the relative sizes of the sales.
- For some impacts that are not considered material, industry average data for agriculture is used as a proxy.
- RSPO is a comparable certification to NDPE policy to estimate the impact of NDPE policy in practice.

Key limitations:

- Impacts with high uncertainty and complexity are beyond the scope of this study: they include impacts outside of the organisation's value chains (e.g. how lending policies of DBS influences other banks or government policies), multipliers (e.g. to which degree a dollar in tax income generates more or less well-being than a dollar in income to households) and higher order effects (e.g. whether higher salaries can lead to more consumption and CO_2 emissions).
- For some countries, the best available data is not from the desired year of measurement. Therefore, adjustments are made through for example conversion that may lead to uncertainties.
- Only absolute impacts were measured. Marginal impacts were beyond the scope of the study, as they would entail an analysis of policies of other banks and their effectiveness.
- Only the top ten export countries and domestic sales are considered. Doing this, 99% of all exports are covered. Within each country, only the most important sectors are considered. Where data was not available, the average global relative size was used.
- The use of industry averages for several impacts and part of the value chain leads to approximation of the actual impacts. Therefore, the estimates are approximations and contain uncertainties.

Disclaimer

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DBS IMPACT INSTITUTE

Address: Haarlemmerplein 2, 1013 HS, Amsterdam
Twitter: impact_inst
Tel.: +31 20 2403 440

Site: https://www.impactinstitute.com/
Mail: info@impactinstitute.com

Address: 12 Marina Boulevard,
Marina Bay Financial Centre Tower 3,
Singapore 018982

Site: https://www.dbs.com/default.page
Mail: sustainability@dbs.com