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Escalating Need for Auto Supply Chain Action to Align with Paris and Limit Warming to 1.5°C

About the Authors

The Center for Automotive Research (CAR) is an independent nonprofit that produces industry-driven research and fosters dialogue on critical issues facing the automotive industry and its impact on the US economy and society. CAR researchers closely track current and future global automotive industry and technology trends and assess their impacts. CAR researchers

also study international collaborations and stay abreast of changes in international trade and regulatory environments, technological standards development, and new vehicle technologies.

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Executive Summary

While sustainability in the automotive industry is not new, it is becoming an increasingly vital part of doing business for many. In recent years, the industry has been coping with supply chain disruptions resulting from the pandemic and ongoing parts and semiconductor shortages. However, amid these enduring challenges, sustainability has become top of mind for many automakers and suppliers. Internal and external pressures are propelling the industry toward incorporating more sustainable practices throughout the supply chain.

As a result, environmental, social, and governance (ESG) initiatives, such as the demand to reduce greenhouse gas (GHG) emissions to meet the Paris Agreement target of limiting global warming to 1.5°C, have become increasingly commonplace across all aspects of automotive operations. Agencies such as the International Energy Agency (IEA)

and the Intergovernmental Panel on Climate Change (IPCC) seek to further guide industry reduction of CO₂ emissions, reaching net-zero emissions globally by 2050. As a result, many vehicle manufacturers have carbon neutrality targets in place, commonly announced through public annual sustainability reports, showcasing their sustainability efforts and goals. Topics included in these reports range from renewable energy to human rights efforts. These announcements are critical in signaling to investors and stakeholders public-facing organizational sustainability initiatives. Still, some companies are limited in providing actionable and measurable data and often lack consistency in reporting from one manufacturer to the next. Despite the challenges from this significant shift in the automotive industry, there are also opportunities to further align across stakeholders, make additional commitments to broader climate initiatives, and advocate



for more comprehensive regulations. A coordinated effort is an important step in achieving sustainability goals now that the industry has recognized accelerated action is required to limit global automotive operations' environmental and social impact.

CAR researchers conducted supplier roundtable sessions, interviews with vehicle manufacturers, and assessed publicly available industry information to help gain a better understanding of industry action in this area. The vehicle manufacturer interviews were a cornerstone of the research, which were conducted to explore sustainability efforts in the automotive industry across six topic areas including

(a) Corporate Goals and Commitments, (b) Carbon, (c) Social, (d) Sourcing and Suppliers, (e) Products and Materials, and (f) Moving Forward. These interviews intended to gain a more comprehensive understanding of existing sustainability goals, strategies for meeting these goals, the existing obstacles to progress, and possible pathways to resolve these obstacles.

Based on these findings, this study has identified recommendations and targeted industry action can help the automotive industry increase collaboration and accelerate efforts to achieve 1.5°C, limiting climate change throughout the supply chain.

Deeper Supply Chain Communication

Communication and collaboration are central to sustainable supply chain success in the automotive industry. Collaboration between vehicle manufacturers and suppliers can make sustainable practices more achievable. Automaker coordination with suppliers on sustainability initiatives can lead to reduced recalls and more achievable climate targets. However, while the positive sustainability implications when coordinating practices

are encouraging, lower-tier suppliers are less likely to be factored into the sustainability chain management, contributing to risks in a corporation's goal of a more sustainable supply chain. CAR has identified recommendations to further develop communication across the industry based on vehicle manufacturer interviews and supplier roundtable sessions.

Proactively Engage Stakeholders to Communicate Clear Implementation Plans

The vehicle manufacturer interviews found that each company emphasized supplier communication, identifying it as a critical part of operations in meeting emission reduction and circularity targets. However, the degree of engagement varies between participating manufacturers. One vehicle manufacturer noted that they work to engage suppliers in periodic meetings to achieve interim and

long-term sustainability targets. Forums used include webinars, stakeholder dialogue, and leadership committees in environmental product design, production environment, and resource recycling to steer progress on sustainability goals. Additionally, this manufacturer requires suppliers to report on annual CO₂ reduction targets and engages with them yearly to help collaborate on

sustainability initiatives. Conversely, another vehicle manufacturer noted that it relies on CDP to evaluate and ensure alignment with their suppliers' goals and progress. However, it highlighted the difficulty of communicating requirements and goals due to the variation in CO₂ reduction and calculation techniques.

Despite communication being a priority for vehicle manufacturers, many auto suppliers noted that communication between vehicle manufacturers and suppliers could be inconsistent from one vehicle manufacturer to the next. Suppliers elaborated that

communication is often confusing and lacks clear, concise directives. For example, climate directives can vary by department, e.g., sustainability, purchasing, and engineering.

Developing and communicating deeper information through short, mid, and long-term implementation plans will help create a clear pathway for suppliers to meet targets. These plans should go beyond high-level goals to help suppliers understand how to modify operations, strategically re-calibrate business practices, and develop new offerings to meet a changing environment.

Consistently Support and Conduct Regular Supplier Industry Forums

Automotive suppliers have emphasized the need for more consistent engagement with vehicle manufacturers on climate initiatives and targets. While vehicle manufacturers also stressed the importance of open and consistent communication with their suppliers as a critical part of their strategy, the tools utilized, and frequency of engagement varied depending on the manufacturer. One vehicle manufacturer stated that they hold supplier conferences that allow for open dialogue and deep dives into sustainability topics with regular reporting to ensure continued progress on the issues discussed.

Another vehicle manufacturer noted that they work to communicate the various sustainability requirements and strategies with suppliers through its procurement team, outlining supplier performance standards and contractually obligated supplier requirements. Online portals and compliance modules are the tools utilized to communicate with suppliers.

Implementing an industry specific-system, or regular industry forums around vehicle manufacturer and supplier climate commitments will help advance sustainability efforts and reduce misunderstanding.



Move Beyond Direct or Tier 1 Suppliers to Engage Supply Chain on a Deeper Level

Most of the emphasis from vehicle manufacturers is placed on Tier 1 activities. One vehicle manufacturer's procurement initiatives follow prescribed guidelines for Tier 1 and Tier 2 suppliers on sustainable practices, indicating that there is some consideration for sub-supplier compliance and concerns.

Currently, most vehicle manufacturers only communicate climate commitments and contractual requirements with their direct suppliers. However, effective climate commitments require actions that extend deeper into the supply chain. Engaging Tier 2, 3, 4, and beyond suppliers on the details of climate commitments, supplier expectations, reporting requirements, and implementation plans is critical to help advance broader understanding of, and implementation of, climate commitments.



Placing Value on Supplier Climate Activity

As the industry continues to set short-, mid-, and long-term climate targets, suppliers have expressed concern about meeting ambitious and less-defined targets without more vehicle

manufacturer partnerships. CAR has identified the following recommendations to help vehicle manufacturers work with suppliers to establish long-term investment strategies.

Redefine the Vehicle Manufacturer-Supplier Model to Focus on Realistic Long-term Investment and Partnership for Transformation

Suppliers noted that more transparency and consistency in valuing climate goals against other targets such as quality, safety, and cost is needed. For suppliers, finding a balance between the value of climate directives and the financial bottom line is often difficult. Current minimum mandates for recycled content and other requirements can make it difficult to manage supplier costs. Less than half of the automotive suppliers examined gave projections on plans to reduce Scope 3; those that did, did not provide comparable targets. Scope 3 emissions reduction goals ranged from simply addressing it as a priority, to incremental reductions, to net zero projections in the future. Suppliers noted that more input from vehicle manufacturers is needed to focus on long-term investment in major climate initiatives.

Vehicle manufacturers agreed on the importance of long-term investment but varied on the deployment and level of implementation of initiatives. Differences between vehicle manufacturers make comparing targets such as Scope 3 reduction plans challenging, so researchers utilized more regional comparisons when evaluating emission reduction plans in the industry. One

vehicle manufacturer interview demonstrated 2050 targets highlighting carbon emission reduction as a strategy in its goal towards a sustainable value chain. The goal is to make use of mid-term goals to incrementally reach long-term targets such as a 90% reduction in new vehicle CO₂ emissions and a CO₂-neutral production and supply chain by 2050. Despite these targets, the vehicle manufacturer expressed concern over the practicality of some sustainability targets, including prioritization and the need for unity in implementing them across its supply base.

Developing vehicle manufacturer/supplier models that place value on long-term horizons instead of short-term transactions will help provide clarity across the industry. Making the necessary investments in climate solutions is possible for suppliers. Still, it will need a fundamental shift in the OEM-supplier relationship and will require investments and contracts that value a longer runway. Notably, the lack of consistent Scope 3 plans or targets demonstrates the need for vehicle manufacturers and suppliers to partner to address the most significant supply chain emissions, particularly as they relate to steel, aluminum, and EV batteries.

Advance Pre-Competitive Activities for More Meaningful Stakeholder Engagement

Many vehicle manufacturers stated they engage suppliers in some form of education, training, and knowledge sharing on an individual supplier basis. Still, none of the vehicle manufacturers interviewed indicated that they worked across the industry to engage stakeholders in a pre-competitive way.

Pre-competitive forums could help advance climate activities on behalf of the entire industry. This would reduce the burden on individual vehicle manufacturers and suppliers when defining specific sustainability and circularity solutions.



Standardization of Targets and Measurement

Numerous standards and frameworks have emerged over the past decade to offer industry tools to help vehicle manufacturers and suppliers track, measure, and disclose the impact of their operations. There is a need for standards to guide the industry, but in the absence of more binding regulatory frameworks, different organizations have created standardization systems. These

agencies provide critical information on how the automotive sector can align to help limit its impact through emission reduction targets, tracking of climate-related data, and disclosing numerous ESG-related metrics. CAR has identified recommendations for further alignment, more stringent oversight, and streamlining across reporting.

Promote Streamlined Reporting and Measurement

Suppliers reporting on activities are increasingly becoming a requirement from vehicle manufacturers for various metrics. Suppliers recognize the need for standards across the industry, but the roundtables identified additional opportunities for creating efficiencies throughout the standards and reporting frameworks. Suppliers note they are required to complete ESG questionnaires for multiple customers, often on different platforms. Additionally, several industry frameworks allow suppliers to report information to various vehicle manufacturers. The suppliers participating in the roundtable discussions strongly supported the need to streamline the process and requirements around reporting ESG metrics.

The vehicle manufacturers acknowledged adherence to protocols like CDP, SASB, and SBTi but one expressed the need for more uniformity in these reporting

requirements, arguing that regulation is the driver of standardization, stating that regulation is particularly necessary when progress is stagnating. That vehicle manufacturer sees the need for concrete targets to reduce the high costs associated with sustainable material sourcing and the push for regulatory movement.

The industry has an opportunity to work across stakeholders to a) consistently implement well-established standards with oversight that are supported by government, industry groups, vehicle manufacturers, suppliers, and other supply chain stakeholders e.g., local communities, unions, civil society organizations etc., and b) promote reporting platforms that allow suppliers to report to multiple customers via a single reporting activity. To achieve well-established standards, having wider stakeholder participation will create a much better outcome across the industry.

Commit to Training the Supplier Base on Standardized Metrics and Guidance

A common challenge for vehicle manufacturers and suppliers is the lack of mutual understanding around industry terminology and metrics. Suppliers noted that metrics for Scope 3 emissions are not well understood across the industry. This lack of clarity creates confusion around reporting. One vehicle manufacturer highlighted the importance of education and communication with suppliers. The company has created initiatives to communicate terminology

definitions and target setting, but the lack of standard industry definitions has led them to develop more internal protocols.

It is crucial that everyone speaks the same reporting language and has a common, deep understanding of the metrics. To ensure a common understanding is realized more quickly and completely, training should occur beyond the Tier 1 suppliers.

Advocate for Standardization of Regulations to Support Progress of Sustainability Targets Across the Supply Base

Many suppliers continue to monitor possible legislation or regulation. Still, the lack of consistent progress has many in the supply base speculating on the direction the industry will move on regulatory actions. Some suppliers felt that there will likely be more regionalized regulation, citing the Inflation Reduction Act (IRA) and the Creating Helpful Incentives to Produce Semiconductors (CHIPS) Act as areas where future trends will develop. End-of-life vehicle recycling and producer responsibility are other areas to monitor as is the SEC ruling on Scope 1, 2, and 3 emissions.

Vehicle manufacturers also cited regulation as a significant consideration for implementing successful sustainability strategies. One vehicle manufacturer noted that they are focusing on an array of potential changes ranging from legislation on manufacturing and procurement requirements to

environmental and social policies. Another automaker agreed and underscored that there are several legislative changes to be considered, including the EU legislation target of a 55% reduction in road traffic emissions in 2030, and the further reduction of CO₂ emissions to 0 g CO₂/km by 2035.

Industry and government partnerships will be key in meeting ambitious climate targets. With government support, vehicle manufacturers advocating for necessary regulation will signal to the industry and the public that the automotive is committed to action on sustainability. As vehicle manufacturers get behind policies that support initiatives like green steel and sustainable sourcing of raw material, they not only demonstrate to their supply base the importance of these initiatives but also help their suppliers meet targets.

Expand Workforce Knowledge Base

Another significant challenge for vehicle manufacturers and suppliers is the availability of skilled workers with knowledge across the climate and sustainability industries. Many stakeholders note that they must upskill or reskill their workforce to meet demand. While some industry efforts are underway such as the Bipartisan

Infrastructure Law (BIL) that provides some funding for workforce development, interviews with vehicle manufacturers found that greater knowledge of circularity and GHG emissions is needed. CAR has identified the following recommendations to help guide industry to develop the workforce targeted at sustainability.

Identify Gaps and Foster Desired Skills

To promote increased sustainability across the organization some vehicle manufacturers have tied upper-level compensation to the achievement of targets. One specifically noted that to help drive an organizational culture of sustainability - a 'grass-roots strategy' - within the company has been implemented, tapping into the passion of their employees.

Another vehicle manufacturer stated they offer training in human rights awareness for policy and processes in its purchasing, sales, and business planning divisions and sustainability training for procurement staff. Despite these types of initiatives there are still gaps in talent and knowledge in the industry. Suppliers and vehicle manufacturers have stated that further workforce development is needed to meet the demand.

Clearly, there is a need for well-trained, knowledgeable professionals across the climate and sustainability industries. The industry should quickly assess these gaps internally with vehicle manufacturers and suppliers and externally with industry stakeholders to develop recommendations for specific skills that are needed. While developing new skills is challenging, the interactions with the industry offered hope. The study participants were committed to making the 'world a better place.' Their passion to create a sustainable industry and that of many within the industry can be leveraged to make these difficult changes.

Develop Climate Workforce Expansion Programs

Developing and utilizing workforce programs can help foster the needed skills to meet demand. One vehicle manufacturer utilizes Sustainability Development Guidelines as a basis in educational programs that address diversity within the workforce and broad supply chain stream (Tier 1 and Tier 2 suppliers).

Once gaps and needed skills are identified, the automotive industry can work with academic institutions and professional training organizations to train resources in the identified areas.

Conclusion

The historic shift across the entire automotive industry to move towards more environmentally sustainable and ethical operations has led to many opportunities and challenges throughout the supply chain. This shift comes as the industry works to improve supply chain resilience and reduce production bottlenecks due to the pandemic and ongoing parts and semiconductor shortages of recent years.

Vehicle manufacturers and suppliers have been increasingly implementing internal and external social and environmental targets through initiatives around GHG reduction, water conservation, responsible sourcing, waste reduction, pay equity, and other

measures. The roundtables and vehicle manufacturer interviews demonstrate how the scope and execution of these initiatives can vary widely across the industry. Through standardization, communication, and engagement, stakeholders can find common ground as the automotive industry adapts to this changing environment.

Additional research on how sustainability initiatives, policies, and regulations are deployed and implemented in the industry and the state of stakeholder collaboration could help further shape the understanding of the long-term benefits of sustainability, help reduce emissions, and limit global warming to 1.5°C.



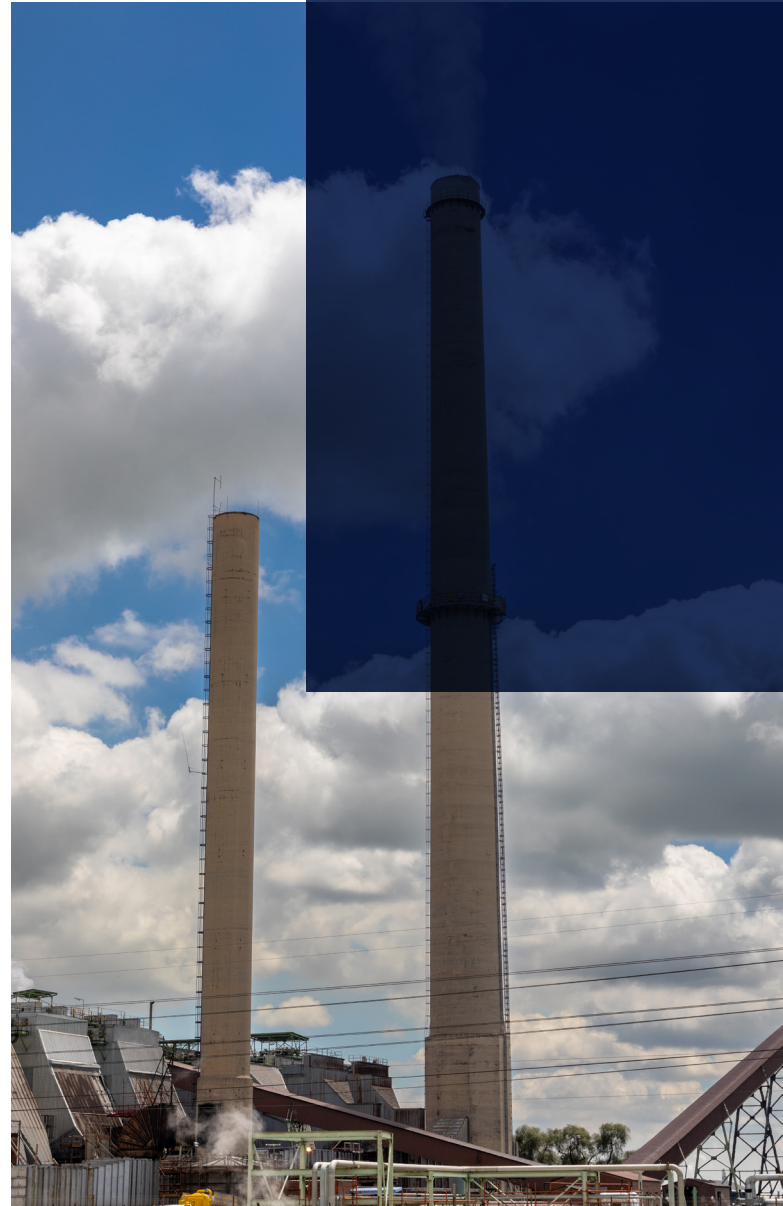
Contents

2	→	About the Authors
2	→	Acknowledgments
3	→	Executive Summary
14	→	Introduction
17	→	GHG Emissions Reporting
19	→	Industry Frameworks
22	→	Overview of Regulatory and Legislative Drivers
27	→	Examining Industry Practices on Sustainability through Annual ESG Reports
28	→	North America
29	→	Europe
30	→	Asia
30	→	Suppliers
32	→	Vehicle Manufacturer Interview Findings
34	→	Company A
38	→	Company B
42	→	Company C
45	→	Recommendations
47	→	Conclusion
48	→	References
50	→	Appendix A
51	→	Appendix B

Introduction

In recent years, the automotive industry has witnessed growing challenges and opportunities around sustainability throughout the entire value chain. Sustainability is complex and challenging. At its core, it contains three pillars: Environmental, social, and governance, commonly referred to as ESG. Company ESG initiatives have become increasingly publicized and scrutinized. As the automotive industry shifts its focus to include more nonfinancial performance indicators surrounding ethical, sustainable, and corporate issues, systems must be in place to guarantee accountability and manage the organization's carbon footprint. In response to this shift, vehicle manufacturers and their suppliers are increasingly reporting on their operations' social and environmental impact while pledging to eliminate unfair or illegal labor practices in their supply chains, curb environmentally harmful operations, and further reduce GHG emissions.

Agencies such as the International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change (IPCC) seek to guide industry reduction of CO₂ emissions, limiting global warming to 1.5°C, and reaching net-zero emissions globally by 2050, in line with the Paris Agreement. Most of the focus to date has been on Scope 3 tailpipe emissions but as the industry increasingly transitions to electric vehicles (EVs), away from internal combustion engine (ICE) vehicles, Scope 3 supply chain emissions become even more important. Most of the focus so far in the industry has been on Scope 3 tailpipe emissions but as the



industry increasingly transitions to electric vehicles (EVs) and away from Internal Combustion Engines (ICEs), Scope 3 supply chain emissions become even more important. There is an opportunity for the automotive supply chain to make further commitments towards these goals, recognizing that accelerated action is required to limit global warming. Many

vehicle manufacturers have carbon neutrality targets in place. While commendable, pathways to achieving these publicly announced targets are often vague and not well defined, demonstrating the complexity and challenges around sustainability. Most vehicle manufacturers release annual sustainability reports to promote their sustainability efforts and goals. Topics included in these reports range from renewable energy to human rights. These reports are critical in signaling to investors public-facing organizational sustainability initiatives, but some companies fall short of providing actionable and measurable data, and have been found to lack consistency from one manufacturer to the next.

Relationships and coordination are central to a more sustainable automotive supply chain. The relationship between vehicle manufacturers and suppliers is vital to the sustainability conversation. Sustainability

goals cannot be achieved without supplier and vehicle manufacturer participation and collaboration, but some suppliers are challenged to understand or comply with industry sustainability practices. In response to this growing concern by suppliers, the Center for Automotive Research (CAR) conducted three Sustainability Roundtables. These roundtables highlighted some challenges and provided valuable feedback to help foster more collaboration, support the automotive industry in reaching its environmental targets, and develop efficiency throughout the supply chain.

This study explores some of the challenges and opportunities by highlighting information obtained from roundtables, regulatory and nonregulatory frameworks, publicly available information on supplier and automaker climate targets, and interviews conducted with vehicle manufacturers.

Sustainability Roundtables

From 2021 to 2022, CAR convened three sustainability roundtables with various suppliers to explore their organization's environmental sustainability challenges. Participants were a diverse group with many different perspectives, including representatives from material suppliers, part and component manufacturers, consulting firms, and service firms. The roundtables were designed to help understand industry stakeholders' most critical concerns in developing and meeting customer environmental sustainability targets. The third roundtable, conducted in November of 2022, focused on a more targeted group

of suppliers, including materials (e.g., steel, chemicals, paint, and specialty materials) and parts (e.g., automotive components).

Participants shared information on topics ranging from regulation driving increased sustainability, ESG, and climate activity, to challenges such as supplier/vehicle manufacturer communication, the need to report to multiple customer platforms, and a lack of consistent subject matter knowledge within the industry to advance ESG efforts. Below is a summary of key observations from the stakeholder sessions.

1. Vehicle Manufacturer / Supplier Communication

Communication between vehicle manufacturers and suppliers is inconsistent and can vary depending on the organization. For example, climate directives can vary between sustainability, purchasing, and engineering departments. Communication is often confusing and lacking in clear, concise directives. Many stakeholders noted that collaboration between suppliers and vehicle manufacturers is key to meeting sustainability targets.

2. Reporting Efficiency

Suppliers are often required to complete ESG questionnaires for multiple customers on different platforms. Additionally, several industry frameworks are in place for suppliers to report information to multiple vehicle manufacturers. Streamlining the process or requirements around reporting ESG metrics could reduce the burden.

3. Subject Matter Consistency

Suppliers noted that inconsistency and lack of knowledge on a subject matter are among their most significant challenges. More transparency and consistency on valuing sustainability goals against quality, safety, and cost is needed.

4. Value / Cost Balance

It is often difficult to find a balance between the value placed on climate efforts and its cost. Current minimum mandates for recycled content and other requirements can make it tough to manage supplier costs.

5. Regulation

Some suppliers felt that there will likely be more regionalized regulation, citing the Inflation Reduction Act (IRA) and the Creating Helpful Incentives to Produce Semiconductors (CHIPS) Act as areas where future trends will develop. End-of-life vehicle recycling and producer responsibility are other areas to monitor as is the SEC ruling on Scope 1, 2, and 3 emissions. The IRA, CHIPS Act, and Biden's Infrastructure Law contain a lot of "carrots" for the industry. One supplier said there will likely be more regulation around GHG emissions.

6. Human Rights

Social is another area of interest to vehicle manufacturers. There has been a movement toward, and regulation supporting, the elimination of forced labor. Companies are being asked to understand where products come from to eliminate poor labor practices.

Roundtable participants clearly stated they and their companies are ready to embrace a more environmentally sustainable way of doing business. The path forward will be achieved with communication and collaboration designed to create momentum

in the automotive supply chain. Discussions between stakeholders should center around short- and long-term goals, technologies for sustainable solutions, and creating common standards across the industry.

GHG Emissions Reporting

Automakers and suppliers increasingly work to reduce emissions across the value chain and produce more accurate and transparent reports. While the shift to electrification will reduce tailpipe emissions (many vehicle manufacturers already having electrification goals and targets in place that are in line with, or in some cases exceeding those defined by the Biden administration), GHG emissions reporting remains an important tool for vehicle manufacturers in assessing the sustainability impact of their operations.

GHG emissions from transportation account for about 27 percent of total US [1] and 17 percent of global [2] GHG emissions. It is the leading industry for GHG emissions in the US and second in global emissions behind the energy sector.

One of the most critical elements of sustainability for the automotive industry is the reduction of these emissions, specifically

vehicle use-phase emissions, to help limit global warming. The Paris Agreement and the recent IPCC 6th Assessment Report have highlighted the need to limit global warming to a 1.5°C temperature rise.

Policy goals and initiatives, like the Paris Agreement, have encouraged industries to strive for sustainable practices by specific target dates. In the early stages of ESG reporting, a handful of companies pledged to reach carbon neutrality by 2050 in response to the Paris Agreement. Since then, more companies have joined in declaring projected carbon neutrality by 2050 or, in some cases, even sooner.

Corporate average fuel economy (CAFE) is a more direct lever (in the US) that has dictated fuel economy ambitions and resulted in almost all automotive companies documenting their adherence to CAFE in their ESG reporting.



Vehicle manufacturer GHG emissions reporting generally has focused on the ability to broadly mitigate GHG emissions. However, more recently, there has been increased focus on reducing and reporting emissions across all parts of the value chain - referred to as Scope 1, 2, and 3 emissions (see Figure 1).

Scope 1 covers direct emissions from owned or controlled sources i.e., the emissions created by the actual production of the vehicles at that said facility. Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating, and

cooling consumed by the reporting company. Scope 3 includes all other indirect emissions in a company's value chain. For example, Scope 3 includes the CO₂ emissions that arise in the supply chain or because of vehicles being operated by consumers. It also includes the emissions that employees generate on their way to and from the workplace. Scope 3 emissions are particularly important, since they account for a significant part of the GHG inventory of a vehicle manufacturer. Consequently, Scope 3 emissions also provide the greatest opportunities for a company to reduce its GHG footprint.

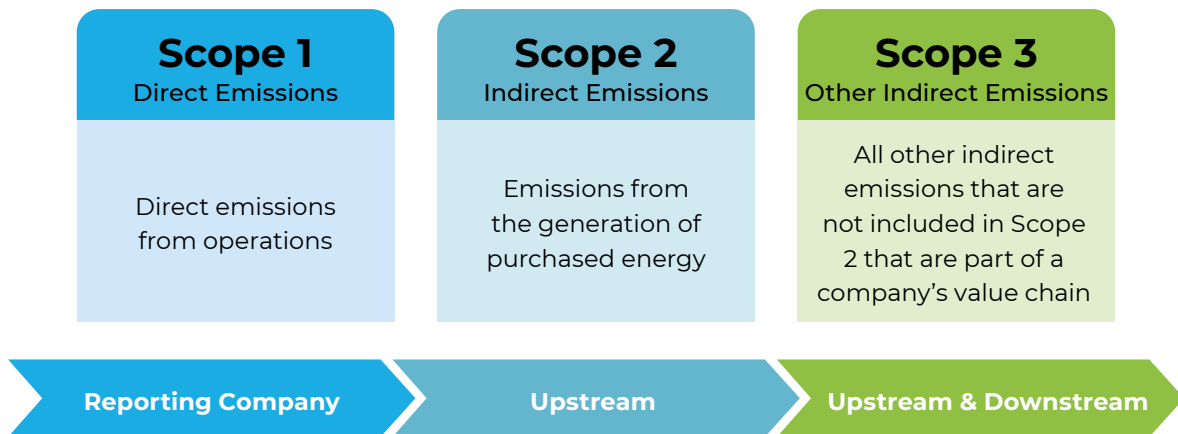


Figure 1. Scope 1, 2, and 3 definitions and impact along the supply chain.

Industry Frameworks

Numerous standards and frameworks have emerged over the past 10+ years to offer industry tools to help vehicle manufacturers and suppliers track, measure, and disclose the impact of their operations. There is a need for standards to guide the industry but in the absence of more binding regulatory frameworks, particularly in the US, different organizations have created systems of standardization. These agencies provide

critical information on how the automotive sector can align to help limit its impact through emission reduction targets, tracking of climate-related data, and disclosing numerous ESG-related metrics. However, there is a need for further alignment, more stringent guidance, and streamlining among the frameworks. Below is an overview of a few leading agencies and initiatives that guide industry-specific ESG issues.

Sustainability Accounting Standards Board (SASB)

The Sustainability Accounting Standards Board (SASB) is an independent nonprofit organization that sets standards for companies across numerous industries when disclosing ESG information to investors. Funded by Bloomberg, The Rockefeller Foundation, Deloitte, Ernst & Young, Price Waterhouse Coopers, and the Ford Foundation, among others, SASB has developed standards for measuring and reporting on ESG metrics [3]. The organization was established with a mandate to develop accounting standards for sustainability information directed at investors in a form comparable to the United States Securities

Exchange Commission's (SEC) requirements for financial reporting. The SASB standard for the automotive sector identified industry-specific issues, including product safety, fuel economy, use-phase emissions, materials efficiency and recycling, labor practices, and materials sourcing [4]. Under these issues, SASB has further identified accounting metrics and a coordinating form of measurement (Appendix A). The SASB recommends the automotive sector disclose these specific metrics that provide insight into performance on the measure, the strategies the company is employing, and related trends.



Global Reporting Initiative (GRI)

The GRI is an international independent standards organization that assists businesses, governments, and other organizations in analyzing and communicating their impacts on climate change, human rights, and corruption. Under the GRI, the Global Sustainability Standards Board (GSSB) was established to set globally accepted standards for sustainability reporting, known as the GRI Standards. The GRI Standards cover various sectors but have identified topics of special interest that should be included in any automotive corporate sustainability program.

Areas of focus include LCA, design-for-the-environment practices, selection of materials to avoid hazardous and toxic materials, end-of-life systems (including design-for disassembly and design-for-recycling), involvement of suppliers in product development, and policies toward suppliers and supplier performance monitoring. A review of GRI's climate-related standards begins in 2023 where additional recommendations on reporting on climate-related impacts and issues will be considered as part of this broader process.

The Science Based Targets initiative (SBTi)

The SBTi is a partnership between CDP, the United Nations Global Compact Fund, World Resources Institute, and the Worldwide Fund for Nature that aims to drive progressive climate action by enabling companies and financial institutions to set science-based targets (SBTs). They do so by providing GHG emissions reduction targets that are aligned with the most recent climate science: i.e., halving emissions by 2030 and achieving net-zero emissions by 2050. These targets were determined using the IPCC recent warning

that global warming must not exceed 1.5 degrees Celsius above pre-industrial levels to avoid the impacts of climate change. For specific industries requiring additional guidance and considerations such as chemicals, financial institutions, Forest, Land and Agriculture (FLAG), SBTi has developed sector-specific guidance to setting SBT's. Many vehicle manufacturers cite the SBTi in their sustainability reports and align their climate goals with SBTi's guidance, which is more closely examined later in this report.

GHG Protocol

The GHG Protocol is the most widely accepted framework by both public and private sector operations that want to measure, report, and manage their GHG inventory. It is jointly published by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI). The Protocol's key objective is to provide

standardized information on emitted GHGs for internal management processes and external reporting purposes based on a principle-oriented set of rules [5]. The GHG Protocol has multiple standards, including their Corporate Standard (Scope 1 & 2 emissions), GHG Protocol for Cities, Mitigation Goal Standard, Corporate Value Chain Standard (Scope

3 emissions), Policy and Action Standard, Product Standard, and the Project Protocol. Their standards are designed to provide a framework for businesses, governments, and

other entities to measure and report their GHG emissions in ways that support their missions and goals [6].

CDP

CDP, previously known as Carbon Disclosure Project, is a nonprofit that runs a global disclosure system for GHG emissions. CDP's climate change questionnaire collects climate-related data from companies globally to measure the impact of operations, set climate-related targets, and demonstrate progress to key stakeholders. CDP questionnaires have three sections: climate change, water security, and forests. CDP's climate change questionnaire [7] is aligned with, and/or encourages use of, the GHG Protocol, Task Force on Climate-related Financial Disclosures (TCFD), and SBTs.

The questionnaire prompts companies to disclose data on how climate-related issues are addressed in their governance, strategy, risk management, and metrics and targets. CDP then grades companies based on their performance. The organization aims to enable a sustainable economy by providing the mechanism for organizations to measure and act on their environmental impact. Many vehicle manufacturers have cited the importance of aligning with CDP and utilizing the CDP Supply Chain program's Climate Change questionnaire.

Task Force on Climate-related Financial Disclosure (TCFD)

To help identify the information investors, lenders, and insurance underwriters need to assess and price climate-related risks and opportunities appropriately, the Financial Stability Board established an industry-led task force called the TCFD. The TCFD was asked to develop voluntary, consistent climate-related financial disclosures useful to investors, lenders, and insurance underwriters

in understanding material risks. As a result, the TCFD developed recommendations on climate-related financial disclosures that apply to organizations across sectors and jurisdictions. The recommendations centered around four areas representing the core elements of an organization's operations: governance, strategy, risk management, and metrics and targets (Appendix B).

Overview of Regulatory and Legislative Drivers

A variety of regulatory and legislative drivers either already exists, or are looming on the horizon (Figure 2). These span a wide range of topics that impact everything from forced labor and traceability of shipments to climate disclosures and product material transparency. They also include regulatory requirements and a series of incentives to encourage companies to advance their climate and sustainability practices. Given

the global nature of the automotive industry, with vehicle manufacturers and suppliers spanning multiple countries and continents, these regulatory actions have the potential to impact everyone in the value chain regardless of where the vehicle manufacturer is headquartered. This section examines the automotive industry’s different legislative and regulatory drivers around sustainability.

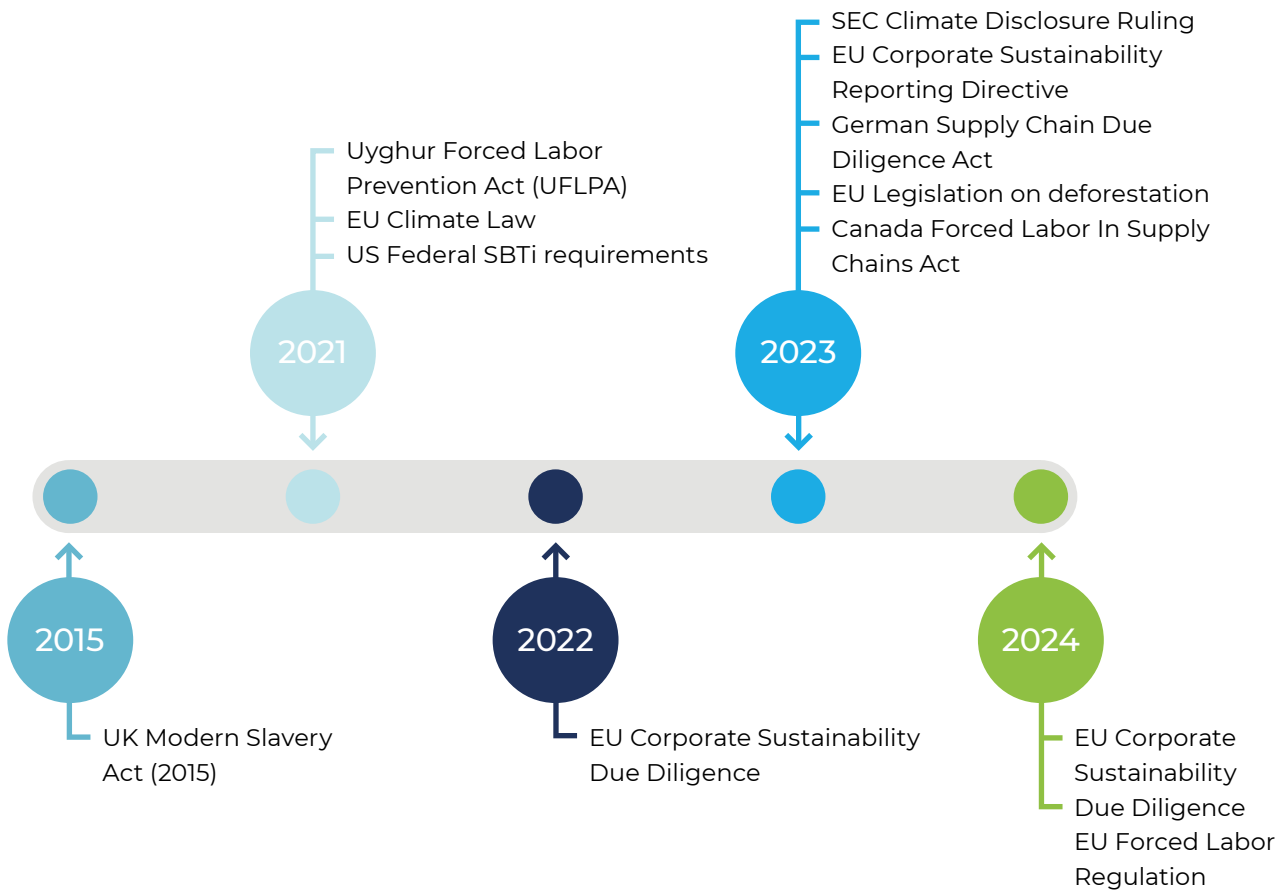


Figure 2. Timeline of legislation and regulation impacting the automotive industry.

Uyghur Forced Labor Prevention Act (UFLPA)

The Uyghur Forced Labor Prevention Act (UFLPA) was signed into law by President Biden on December 23, 2021, and prohibits the import of any goods, wares, articles, and merchandise mined, produced, or manufactured wholly or in part in the Xinjiang Uyghur Autonomous Region of the People's Republic of China. U.S. Customs and Border Protection (CBP) can stop a shipment if it is presumed to come from this region, requiring companies to have proper supply chain traceability documentation. The impact of this law is that automotive OEMs and suppliers must now have an even deeper understanding of supply chain transactions.

UK Modern Slavery Act

Established in 2015, the Modern Slavery Act was designed to eliminate modern slavery originating from the UK and requires businesses to publish an annual statement if they have revenue totaling more than £36 million annually. The statement must confirm that slavery and human trafficking are not taking place in either the business or its supply chain.



EU Climate Law

Adopted in July of 2021, the European Climate Law was officially entered into force and sets a legally binding target of achieving net-zero greenhouse gas emissions by 2050. All EU Member States and Institutions are required to meet the targets. The law also includes an intermediate target of reducing greenhouse gas emissions by at least 55% by 2030 (based on 1990 levels) [8].

Federal Government SBTi Requirements

The US currently relies on guidance principles in its sustainability goals for the industry, which has led to voluntary adherence from the industry. However, in an effort to reach net-zero emissions by 2050, the Biden administration requires that all federal government suppliers disclose their emissions and other climate-related data. If a contract exceeds \$7.5 million, the contractor is required to report Scope 1 and 2 emissions. In addition, these federal contractors must now have science-based emissions reduction targets and Scope 3 emissions if the contracts exceed \$50 million. The federal government will utilize CDP reporting, the TCFD Recommendations, and SBTi criteria in evaluating proposals from suppliers.

German Supply Chain Act

Effective in January of 2023, The German Act on Corporate Due Diligence Obligations in Supply Chains, or the German Supply Chain Act, requires companies to identify, prevent and address human rights and environmental violations. This includes activity in their own operations and their supplier's operations. Initially, the act applies to companies with at least 3,000 employees but will lower to companies with 1,000 employees in 2024.

EU Corporate Sustainability Due Diligence

In 2022, the European Commission passed a corporate sustainability due diligence proposal to promote responsible corporate environmental and human rights behavior. The directive includes a company's value chain inside and outside Europe. These new EU rules are grouped by company size and revenue. Currently, the proposal is with the European Parliament and Council for approval [9].

EU Regulation on Deforestation

In 2022, the European Commission and parliament reached a provisional agreement for deforestation-free supply chains. The new law will guard against deforestation and forest degradation in the EU and elsewhere (purchased goods), helping to reduce GHG emissions and biodiversity loss. In the automotive industry, the primary impact will occur in the rubber industry [10].



EU Corporate Sustainability Reporting Directive

The EU offers a more aggressive approach to environmental sustainability mandates with its newly passed Corporate Sustainability Reporting Directive (CSRD) [11]. The CSRD sets standards for nonfinancial reporting, mandating companies that meet their thresholds to report on various sustainability standards. For example, the CSRD requires EU and non-EU companies to include climate change targets at a certain threshold. These targets include scope emissions, GHG reduction, and carbon neutrality. In addition, they must also report on the circular economy, pollution, water, and biodiversity [12].

SEC Climate Disclosures

While the EU arguably has more robust sustainability and climate regulatory drivers, the US SEC is in the midst of passing a rule requiring annual climate disclosures. The proposed SEC climate rule would require both domestic and foreign registrants to convey climate related risks that impact a business's strategy or outlook. The rule would require businesses to disclose Scope 1 and 2 emissions starting in 2024 for large filers

and other filers phasing in over 2025 and 2026. Additionally, Scope 3 emissions may be required and will also be phased in. The ruling will also require the disclosure of climate risks in financial statements and describing how climate-related risks have, or are likely to have, a material impact on a business. The SEC is expected to finalize and adopt the rule at some point during 2023, after which, legal challenges can be expected to follow.

Bipartisan Infrastructure Law

The Bipartisan Infrastructure Law provides over \$4.9 billion in funding to reduce carbon emissions via energy modernization, transportation investments, workforce development, and building decarbonization [13] [14]. It tackles emissions in an investment-based way, much of which is left to the discretion of the entities charged with allocating funds, clouding the likelihood that this program will support Initiatives that genuinely reduce emissions [15]. The Bipartisan Infrastructure Law contains programs targeting a reduction of carbon emissions - including the Carbon Reduction Program (CRP) [16]. The CRP enables the Federal Highway Administration (FHWA) to fund projects that minimize transportation emissions from applications on road and highway sources. The program includes over \$6 billion to help states and other entities expand transportation options that may reduce emissions [17]. Still, due to the lack of enforceability and targets for these funds, states are not beholden to specific standards in emissions reduction when receiving them. There are also widespread investments toward building charging infrastructures to promote electric vehicle (EV) adoption.

The Bipartisan Infrastructure Law also has programs that directly target changes in the auto industry - namely battery recycling and recovery programs. Over the next four years, over \$3 billion in investments will go towards grants, programs, and government expenditures. Sections 40205 – 40210 of the law provide investments in rare earth element recovery, grants for battery processing and manufacturing, a grant program for advanced energy manufacturing and recycling, and grants for critical mineral research [18]. These programs provide a financial incentive for the automotive industry to source minerals and produce batteries domestically. The battery processing and manufacturing grants offer vehicle manufacturers significant financial motivation to develop batteries domestically. While they may not force the automotive industry to transition to electrification, the \$3 billion grant program attempts to be significant enough to motivate domestic investment in battery development. Additionally, the mineral recovery grants also serve the purpose of helping the supply chain shift to domestic operations, easing the burden on auto manufacturers attempting to bring their supply chain to the US.

Inflation Reduction Act

The Inflation Reduction Act, signed into law in August of 2022, allocates nearly \$370 billion to climate and energy-focused investments and incentives. The Clean Vehicle Credit provision provides incentives for the purchase of new and used clean vehicles, which would help reduce tailpipe emissions, but has also raised concerns about the qualifications for the tax credit, as the supply chain requirements will become increasingly restrictive over the years [19]. On the other hand, the Advanced Manufacturing Production Credit (AMPC) incentivizes manufacturers to produce the eligible components in solar energy, wind energy, inverter, qualifying battery, and applicable critical minerals in the US. Under the AMPC, manufacturers can receive incentives for producing battery cells and modules based on per kilowatt-hour of production. Additionally, under AMPC, producers of electrode-active materials can receive tax credits as a percentage of the production costs, with a phase-out period beginning in 2030. The producers of applicable critical materials can also receive a tax credit as a percentage of production costs, but unlike battery components, the incentives for producing applicable critical minerals do not phase out.

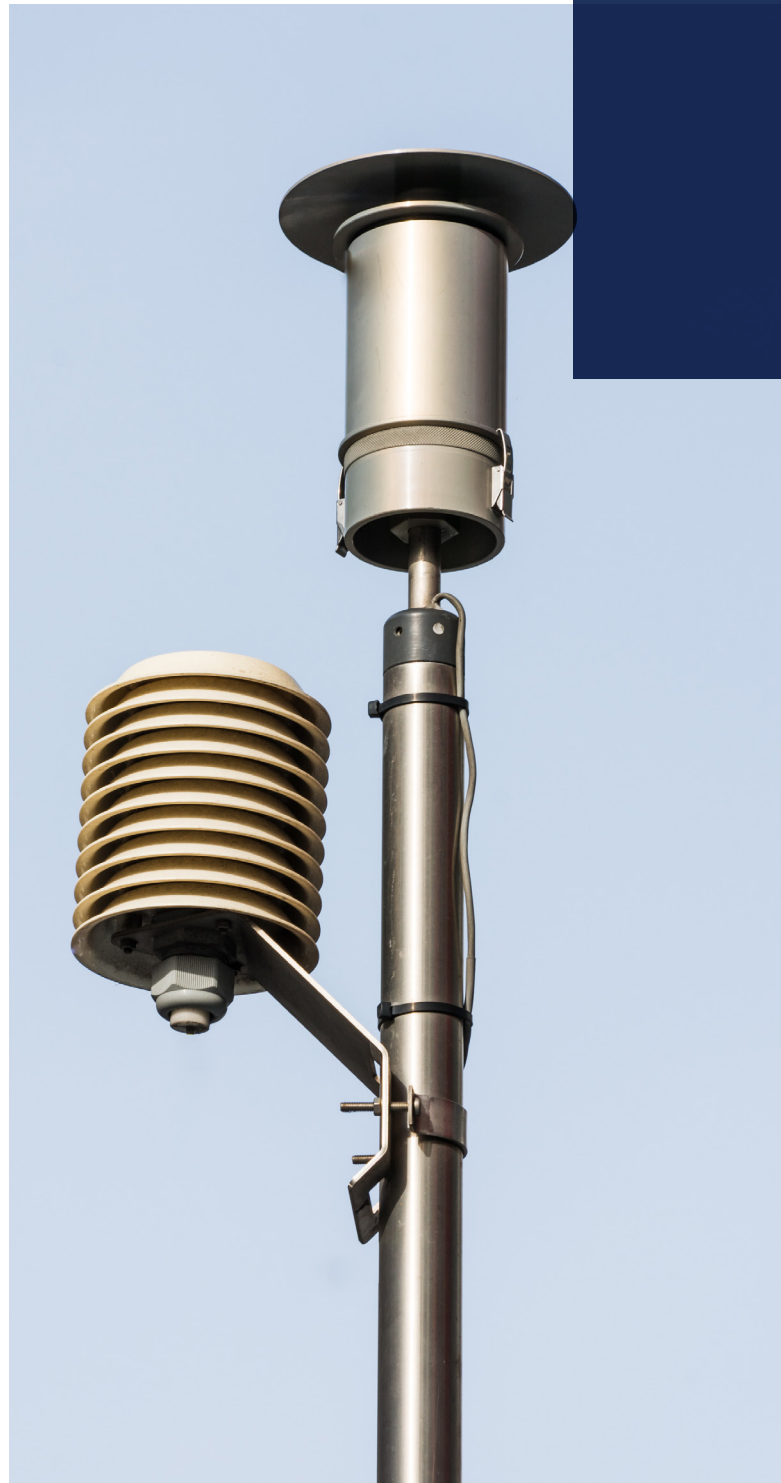
The automotive industry is not facing any new federal stringent emission reduction regulations forcing an EV shift, but there are current incentives for continued emission reduction. Commitments by the Biden administration, which include a financial incentive to transition to clean energy, are an attempt at promoting cleaner vehicles and vehicle production. Even if they are not binding, the automotive industry has opted into some of these commitments from President Biden. Recent US legislation has provided funds to make these transitions more feasible and incentivize a clean transition through grants and tax credits. While these pieces of legislation may not be direct and face implementation hurdles, they are the most direct attempts by US lawmakers to lower emissions in recent years and offer the industry a more practical path to a sustainable future. Conversely, California has some of the most ambitious climate goals in the country. The California Air Resources Board (CARB) released a mandate that all new passenger vehicles and light trucks sold in the state must be electric by 2035.



Examining Industry Practices on Sustainability through Annual ESG Reports

Auto manufacturers in North America, Europe, and Asia all provide their pledges to emission reductions in their ESG reports. Each region features their unique approaches to reducing emissions but shares similar long-term goals of reaching carbon neutrality. The regional standards and regulations likely shape each manufacturer's commitment to emission reductions as the standards are addressed in different ways throughout these regions. These differences make it challenging to compare vehicle manufacturers' targets globally, so regional comparisons are more appropriate when evaluating emission reduction plans in the industry.

However, automotive suppliers share a common approach to projecting their emission reduction targets, making comparison easier across the cases observed. The CAR Sustainability database utilizes public vehicle manufacturer and annual supplier sustainability reports to track ESG metrics across 38 material sustainability topics to demonstrate how each supplier and vehicle manufacturer plans to respond to critical issues. For this study, the following analysis mainly focuses on emission and carbon neutrality targets to identify the automotive industry's path towards reducing emissions and limiting global warming to 1.5°C.



North America

US manufacturers Ford and GM gave specific emissions targets in their sustainability reports, which were generally comparable due to their similarity in reporting. They target emissions reductions of around 75% by 2035 with a similar base year. The decrease in emissions is an effort to align with SBTi metrics to achieve the 1.5°C pathway.

Ford went so far as to directly address their willingness to comply with President Biden's ambitions to reduce US GHG emissions by 52% in the US by 2030. Ford set an interim target of 2023, hoping to reduce Scope 1 and 2 GHG emissions by 18% compared to the base year of 2017. GM and Ford have similar commitments to reducing their Scope 3 emissions, but they provided few details on collaborating with suppliers to achieve these reductions. GM aims to reduce Scope 3 from sold products of light-duty vehicles by 51%

per vehicle kilometer by 2035 with a 2018 base year, while Ford aims to reduce Scope 3 emissions by 50% per vehicle kilometer by 2035 with a 2019 base year.

GM has made it clear that they are also committing to renewable electricity at all US sites by 2025 and will expand that goal to 100% renewable by 2035, which also seems to meet the US goal of 100% carbon-free electricity by 2035. Ford plans to reach 100% carbon-free manufacturing by 2035, and by all indications, they are trending towards meeting these goals.

In terms of operation, GM has set out to reduce the energy intensity by 35% by 2035 with a 2010 baseline. GM's carbon neutrality goals are at three levels: 2025 for professional services, 2035 for manufacturing suppliers, and 2038 for raw materials/logistics.

Europe

European automakers are less uniform than their US counterparts in their emission reduction plans but offer precise projections, especially when reviewed by SBTi. Mercedes-Benz, BMW, and Volkswagen (VW) all have carbon-neutral ambitions by 2050 but range in scope of intermediate goals.

Mercedes-Benz and BMW have Scope 1 and 2 emission reduction targets for 2030 with similar base years. Mercedes-Benz is projecting a 50% reduction, while BMW is projecting an 80% reduction at their production sites and locations per vehicle produced.

Mercedes-Benz AG commits to reduce Scope 3 GHG emissions from the use of sold products by 42% per vehicle kilometer by 2030 from a 2018 base year. The company's goal is to cut by at least half the CO₂ emissions per passenger car along the entire value chain by the end of this decade, compared to 2020. In the reporting year 2022, the Mercedes-Benz Group achieved its target of reducing CO₂ emissions at its own plants (Scope 1 and Scope 2) by 50% by 2030 compared to 2018.

BMW offered several Scope 3 related projections for 2030, including a goal to reduce their Scope 3 upstream emissions (carbon reduction in the supply chain) per vehicle produced by 20% and a reduction of at least 50% per kilometer driven – an increase from their original target

of 40% driven by demand for EV's - for Scope 3 (downstream carbon emissions). These metrics were validated by SBTi for the most part and represent the most substantial emission-related projections from these European automakers.

VW also has emissions reduction goals, but SBTi has only partially evaluated their targets. VW's most critical carbon-related plan entails attempting to reduce the carbon footprint of passenger and light commercial vehicles by 30% per vehicle by 2025 (using a 2015 base year), which will be fueled by their offset action, along with renewable energy investment and carbon reduction. They also set targets for reducing their CO₂ emissions of passenger cars and light vehicles by 30% in the production and use phase by 2030, with a 2018 base year. The essential difference between 2025 and 2030 is that 2030 includes pure CO₂ reduction.

The plan also includes a target for heavy trucks and buses from Scania, a subsidiary of VW that manufactures heavy lorries, trucks, and buses. VW also wants to reduce CO₂e (carbon dioxide equivalent) per vehicle in the EU by 40% by 2030 (with a 2018 base year), surpassing the 2030 baseline. The goals signal VW's willingness to reduce emissions in the future but lack concrete, specific details in how these targets will be achieved, demonstrating the complexity and difficulty behind achieving these goals.

Asia

While Toyota and Hyundai did not attribute SBTi as the primary influencer of their goals or projections, they still provided emission reduction plans across various segments of their production phase. Toyota's long-term goals entail achieving carbon neutrality by 2050, while Hyundai plans to reach carbon neutrality by 2045.

Hyundai is offering an incremental approach by influencing the supply chain of raw materials and parts to reduce emissions by 10% by 2035, 65% by 2040, and finally, reaching carbon neutrality by 2045. While they have expressed plans to reduce emissions throughout the supply chain, the plans are in the early stage, and reports on compliance or feasibility of these plans are currently unavailable. They failed to give any specific or SBTi-approved Scope 1 or 2 emissions goals but acknowledged the importance of implementing renewable energy sources and replacing fossil fuels. Scope 3 is also undefined, but a shift to EVs and fuel cell vehicles (FCEVs) appears to be integral to these plans. Hyundai pointed to electrification as a critical component to achieving emissions reductions. They aim to achieve 100% electrification in the European market in 2035, another major market by 2040, and all other markets by 2045.

Suppliers

Automotive suppliers have also provided sustainability goals similar to those of vehicle manufacturers in their ESG reports, but they are more uniform and, therefore, more easily comparable. The suppliers examined in this case study were Yazaki, Aisin, Hyundai Mobis,

Toyota's intermediate targets include an 18% reduction in CO₂ emissions throughout the entire vehicle lifecycle by 2025, and 25% reduction by 2030 with a 2013 base year. Other goals include a 35% reduction in global average CO₂ emissions from new vehicles by 2030, and a 30% reduction by 2025 with a 2010 base year. They also target a 30% reduction of global CO₂ emissions from global plants by 2030 with a 2013 base year.

While they do not have a specific goal for Scope emissions, their target is to achieve carbon neutrality at their plants by 2035. Scope 1 and 2 are not included in Toyota's projections, nor were verifications from the SBTi. They acknowledged an increase in their Scope 1 and 2 emissions yet noted they are still on track to reach their 2035 targets. Lastly, they have FY2026 targets which include reducing absolute CO₂ emissions from logistics by 15% and minimizing supplier emissions by 14%, both with a base year of FY2018. They doubted their ability to reach the logistics targets but seemed to recognize the supplier targets as on track. Toyota's targets seem less binding and uniform than other major OEMs, but they are working with suppliers to build concrete plans for reducing emissions.

Magna, Lear, BorgWarner, Bosch, ZF, and Forvia. All these suppliers gave an interim goal of reducing Scope 1 and 2 emissions by 2030 with similar base years around the late 2010s. Their reduction plans for Scope 1 and 2 emissions range from 30% to 85% by 2030

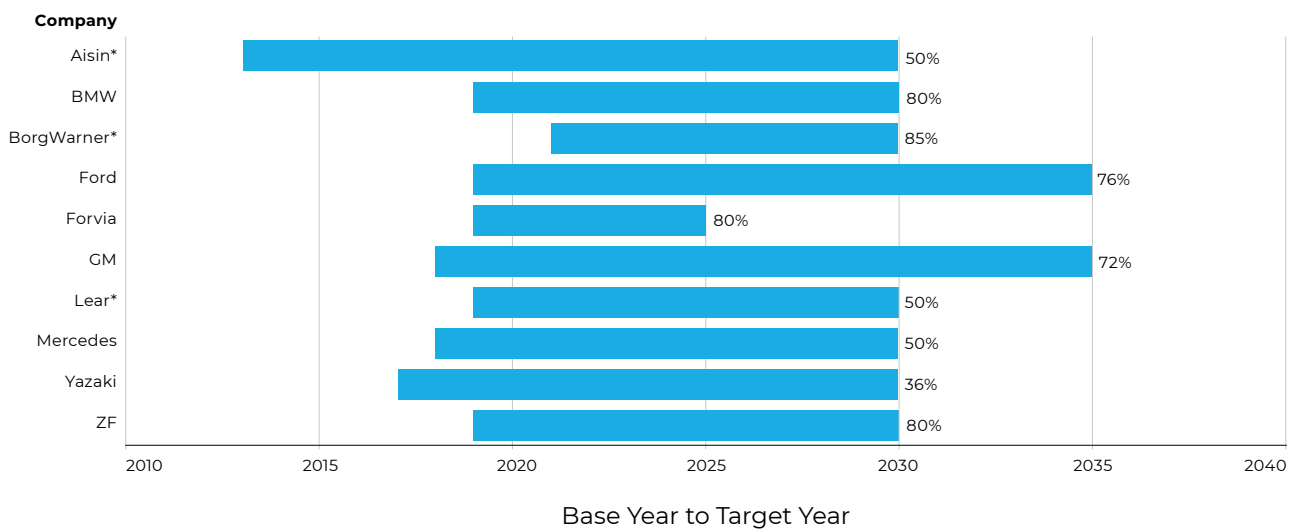
(Figure 3). While these projections are more comparable across the board than vehicle manufacturers, their size, capacity, and current commitments to renewables make their pledges hard to compare directly.

Additionally, these automotive suppliers have well-defined plans to achieve these targets with explicit projections on how they plan to scale renewables by 2030. Most feature an aggressive approach to scaling up their renewable energy production, with some going as far as projecting 100% renewable energy in manufacturing. Lastly, less than half of the auto suppliers gave projections on plans to reduce Scope 3, those that did, did not provide comparable targets. Scope 3 emissions reduction goals ranged from simply addressing it as a priority, to incremental reductions, to net-zero projections in the

future. All suppliers explained their strategies to engage with their respective supply chains by providing strategies through assessments and disclosure programs, which may still be in the early stages. As their supply chain assessment programs become more uniform, Scope 3 comparisons across all supplier reports should be easier to obtain.

Similarly, the reports mentioned vehicle manufacturers' relationships and the practices needed to achieve common goals. However, standardization has yet to reach a point where these practices are well-defined. The steps to attaining these sustainability goals, especially when assessing Scope 3 emissions, are contingent upon coordination, which should be achievable if standardization of emissions targets continues to improve.

Scope 1 & 2 Emission Reduction Targets by Company



* Company did not specify emission reduction target as scope 1 & 2

Figure 3. Vehicle manufacturer and supplier Scope 1 and 2 emissions reduction targets.

Vehicle Manufacturer Interview Findings

CAR researchers conducted a series of interviews on sustainability with three separate vehicle manufacturers (Companies A, B, and C). The interview questions covered six topic areas, including (a) Corporate Goals and Commitments, (b) Carbon, (c) Social, (d) Sourcing and Suppliers, (e) Products and Materials, and (f) Moving Forward. The intent of these questions was to gain a more comprehensive understanding of their existing sustainability goals, their strategies

for meeting these goals (including how suppliers are integrated into this process), their perspective on existing obstacles to progress, and how to resolve these obstacles.

Figure 4 provides a high-level overview of the key goals, strategies, and best practices derived from the interviews. A more detailed summary of their responses is provided in the following section.

Goals, Strategies, and Best Practices

Corporate Goals & Commitments

- Science-based GHG Emissions Reduction Targets
- Water conservation targets
- Waste reduction targets
- Carbon neutral supply chain goals
- Carbon neutral vehicle goal (LCA)
- Transparent progress reports
- Executive Compensation Plan (achievement of targets)
- Vehicle electrification targets
- Circular economy goals (end-of-life recyclability and single-use product elimination)
- Internal & external stakeholder engagement
- Top-down goal setting & grass root buy-in
- Dedicated, interdisciplinary sustainability team
- Biodiversity programs
- Sustainability training for purchasing group
- Alignment with industry/sustainability standards (SBTi, GHG Protocol, SASB, CDP, etc.)

Carbon

- Scope 1-3 GHG emission reduction goals in alignment with most recent climate science Energy efficiency & clean/renewable energy targets (manufacturing)
- Vehicle electrification targets
- Renewable energy based charging systems
- Climate change risk assessment of internal operations and external investments
- Working ahead of regulatory mechanisms (e.g. setting renewable energy goals in consideration of anticipated carbon taxes)
- Carbon neutral supply chain
- Carbon neutral vehicle goal (LCA)
- Collaboration with suppliers to achieve scope 3 and carbon neutral vehicle production target
- Market research investment
- External consultation on Scope 3 emission reduction

Figure 4. Summary of goals, strategies, and best practices cited in the vehicle manufacturer interviews.

 **Social** 

- Gender equity and reduced inequality targets
- Inclusion Index targets and transparent reporting on progress
- Supplier sustainability goal requirements
- Ethical supply chain
- Contractual supplier requirements for adherence to ethical, environmental, and safety standards
- Adherence to regulatory requirements on ethical, environmental, and safety standards
- Internal Human Rights Policy
- Workforce guidelines for suppliers
- Alignment with UN Guiding Principles on Business and Human Rights
- External due diligence checks (with enhanced focus on identified high-risk points in supply chain)

 **Sourcing and Suppliers** 

- Carbon neutral value chain targets
- Annual supplier CO₂ emission reduction targets
- Life cycle vehicle goals
- Supplier engagement processes
- Compliance frameworks for suppliers
- Supplier Sustainability goal requirements
- Value-based supplier selection processes
- High impact material identification and focus on low carbon suppliers (steel, aluminum, batteries, etc.)
- Communication of trainings, goals, and industry trends through webinars (to suppliers)
- Responsible sourcing standards and green purchasing policies
- Procurement conditions requiring UN Guiding Principles on Business and Human Rights & OECD fulfillment
- Utilization of supplier monitoring tools for global supply chain (CDP)
- Supplier self assessments & internal review
- Focus on supply chain transparency

 **Products and Materials** 

- Product circularity projects programs and targets
- Secondary materials targets
- Battery recycling programs
- Focus on end-of-life processes (rebuild/reuse/recycling) for key components and materials (batteries, plastics, etc.)
- Plastic recycling targets
- Carbon neutral supply chain (and therefore raw materials)
- Inclusion of recycled raw materials (plastic & aluminum)
- Strict audit requirements of raw material mines
- Standardization of terminology and metrics for suppliers

 **Moving Forward** 

- Modernizing labor laws
- Continued to commitment to GHG emissions reduction targets, water use reduction, carbon neutral supply chain, carbon neutral vehicles, vehicle electrification, focus on the circular economy, and other stated goals
- Expansion of carbon pricing
- Collaboration with suppliers
- Setting specific targets on use of recycled material
- Compliance with regulatory drivers (e.g. SEC proposed rules, EU regulations, etc.)
- Focus on environmental and human rights risks
- Focus on materials with high embodied carbon emissions
- Supplier contract requirements for carbon emissions in the value chain
- Rational data driven approach to sustainability

Figure 4. Summary of goals, strategies, and best practices cited in the vehicle manufacturer interviews.

Company A

Corporate Goals & Commitments

Within Company A's management structure, the ultimate responsibility of achieving sustainability goals and commitments falls on a designated management board which is comprised of select members of senior management. Companywide alignment of ESG strategies is done using a top-down approach, with goal setting at the corporate management level and implementation happening at the departmental level. As a result, responsibility is split both vertically and horizontally along the management chain. For example, there are separate boards responsible for monitoring progress on various vehicle divisions CO₂ emissions reduction commitments, with specific vehicle divisions bearing responsibility for vehicle level goals.

Company A has set numerous corporate sustainability goals and commitments driven by business strategies, regulatory requirements, and consumer preferences. Some of their goal setting and reporting has been done in alignment with sustainability frameworks including CDP and SBTi, along with SASB and TCFD. The GHG emissions reduction goals set by Company A are in line with SBTi recognized targets and include interim targets. They also have

goals focused on reductions in water consumption, improved inclusion of secondary material percentages (per vehicle basis), commitments to engaging suppliers in emission reduction plans, and incrementally electrifying the vehicle fleet. To accomplish the sustainability goals, they have developed an interdisciplinary team of environmental experts, buyers, production specialists, and many other functions to ensure success. Company A provides interim progress reports that increase transparency regarding mid- to long-term goals.

Communication of sustainability strategies and targets between Company A's procurement team and suppliers is outlined in the internal supplier performance standards and communicated via supplier requirements which are contractually obligated. Regular monitoring and reporting by suppliers using internal emissions guidelines and supplier self-assessments using the CDP Supply Chain Program assists with transparency and comparability of supplier data. An example of this participation is tier 1 suppliers, who comprise about 80% of the procurement volume of Company A and have an approximate 90% participation rate in the CDP reporting program.

Carbon

Company A has validated near-term SBTs for Scope 1, 2, and 3 emissions and reports their emissions annually in their response to the CDP questionnaire. Their Scope 1 and 2 emission reduction targets include a drastic, medium-term reduction, which they are close to accomplishing by utilizing effective short/medium-term milestone goals. Company A has reported measurable reductions in their Scope 1 and 2 emissions on an intensity basis (per car) from 2020 to 2021. They have a 2022 goal for all their electricity to be generated by renewable sources. In addition to their Scope

3 SBT, Company A specified their willingness to reduce Scope 3 emissions across their value chain significantly. Their medium-term plans to reduce Scope 3 emissions comprise Company A's most concrete strategy to reduce lifecycle emissions up to this point. Company A used the addition of Scope 3 reduction goals as evidence that they are constantly working on their climate plans and will continue to adapt to meet targets like IEA and IPCC. For example, Company A set mid-term targets to drastically reduce per-passenger vehicle life cycle emissions by 2030.

Social

Company A provided detailed information on their gender and cultural equity policies, achieved goals, and strong detailed responses on their human rights policies and monitoring. Company A emphasized the advancement of women and cultural equality and aligned themselves with Sustainable Development Goals, specifically highlighting Gender Equality (SDG 5) and Reduced Inequalities (SDG 10), which they have worked towards since the mid 2000's. Company A has made policy commitments towards achieving gender equality and has set continuous targets to meet these goals. They have achieved their interim goal for the Inclusion Index rating (measured every 2 years) ahead of the proposed 2025 target date. Yet, future progress on equal opportunity based on questionnaire responses is not clear. Company A's worker welfare considerations were clearly outlined and utilize the Supplier Sustainability

Standards to define minimum standards that direct suppliers, and their subsidiaries, must comply with as a contractual obligation. Company A provides examples of contractual obligations for suppliers that emphasize human rights protection and anti-child labor laws that comply with the International Labor Organization (ILO) conventions, specifically 29 (Forced Labor Convention), 138 (Minimum Age Convention), and 182 (Worst Forms of Child Labor Convention). They also provide an example of supplier quality assurance, covering working and social standards and remark that these audits are more detailed in high-risk regions. Company A provided further targets to review raw material sourcing and commodity supply chains with high risk to human rights infringements on a yearly basis, having attained some success based on 2021 data.



Sourcing & Suppliers

Company A's interview provided detailed insights into their supplier coordination, requirements, and measurement goals. In their responses to the questionnaire, they underscored broad supply chain emission reduction as a tenet of their sustainability plans. Company A has long-term targets to reach carbon neutrality throughout its value chain before 2040, which requires coordination across the supply chain. They began these efforts in 2020 and relayed this information to their suppliers. After 2040, only CO₂ - neutral production material will be allowed within Company A's production chain. Company A utilizes a wide set of strategies with suppliers to communicate the various sustainability requirements, including supplier dialogue, online portals, and compliance modules.

Evaluation of these commitments includes CO₂ targets, adherence to Company A's value chain ambitions, the internal development of sustainable sourcing standards, use of the industry-wide Sustainability-Assessment Questions, the Responsible Supply Chain Initiative and supplier cooperation in the CDP assessment program. Measuring supplier sustainability performance is contingent upon suppliers sharing data. Supplier CDP

questionnaire responses and contracts allow for transparency when evaluating value chain emission reductions.

This transparency with suppliers enables Company A to provide intermediate goals for select materials along the supply chain that produce high CO₂ emissions such as steel, aluminum, some types of plastics, and batteries. These intermediate goals are in turn integrated into the criteria for awarding contracts. An example of this is the use of CO₂ and recycling requirements when awarding EV contracts. In their answers to the questionnaire, Company A has provided examples of various areas of the supply chain that they intend to focus on, and suppliers they have already partnered with to meet target goals. Examples include procurement of CO₂ - neutral batteries from internationally certified suppliers and sustainably sourced manufacturing materials for new vehicle models by 2025. The requirements in supplier contracts are not limited to climate neutrality - they also include human rights, following the UN Guiding Principles on Business and Human Rights and the Organization for Economic Cooperation and Development (OECD) guidelines.

Products & Materials

Company A cited their Sustainability Report, in response to their working goal of increasing circularity within their supply chain. The focus of Company A's strategy seems to be aligned with the EU legislation on maintaining the longevity of products, materials, and components. Although Company A provided many examples of partnerships and projects in answering the questionnaire, it was noted that they lacked many concrete goals on circularity outside of their CO₂ - neutral

supply chain goal. The most defined goal focused on utilizing secondary materials in their production chain. However, the path to achieving this goal and the interim milestones are unclear. Company A did go into some detail on their battery module reuse and recycling strategy, including goals of reducing the use of critical materials and requiring strict permitting when sourcing rare earth materials in the procurement chain. However, this commitment also lacked definitive goals.

Moving Forward

Company A has identified several industry-specific and legislative changes that will require consideration in the future if they wish to progress on their ESG goals. Incorporating CO₂ neutrality into supplier contracts and the strict adherence to a CO₂ - neutral product chain are core principles held by Company A. Applying this strategy to all levels of the supply chain is considered key to CO₂ neutrality in the automotive industry. As of 2022, Company A's purchased electricity has shifted to renewable sources. However, Company A has suggested that for there to be corresponding improvements in sustainable mobility there needs to be an adequate expansion of availability of green electricity, improved CO₂ pricing systems for fossil fuels, improvements in charging infrastructure, and hydrogen fuel cell technology.

Company A also highlights the need for flexibility with the coming modernization and digitization of labor and highlights the Universal Declaration of Human Rights and the Core Labor Standards of the ILO as key in the modernization of labor laws. Company A underscores several legislative changes to be considered, including the EU legislation target of a 55% reduction in road traffic emissions in 2030, and the further reduction of CO₂ emissions to 0 g CO₂/km by 2035. These changes are expected to greatly impact investment requirements and are therefore driving an expansion of Company A's Green Bonds program.

Company B

Corporate Goals & Commitments

The second auto manufacturer interviewed, Company B, responded to CAR's questionnaire with details that expanded upon its sustainability reports. Company B has a designated group that is broadly responsible for ESG and Sustainability. They also have a senior management position that is dedicated to the promotion of sustainability activities, along with a department that engages with relevant divisions on this task. Company B's senior sustainability management position also oversees responsibility for human rights practices within the organization.

During the interview, Company B provided insight into its long-term commitment to sustainability in its global production chain by 2050. They have a series of commitments under their proposed plan which includes a focus on supply chain and product lifecycle emission reduction targets, as well as commitments to environmental and circular economy goals. Company B highlighted its commitment to interim targets to provide a path to incrementally reaching ambitious goals for 2050. Further commitments to environmental protection were highlighted in Company B's associated environmental plan.

Company B provided detailed information on progress toward meeting these targets and made it clear that further work is required. How these environmental targets align with Company B's ambitious pathway to its 2050 goals is unclear. Company B's success in achieving these goals depends on company-wide education, participation, communication,

and supply chain coordination. While Company B has mechanisms to accomplish these interim goals, they acknowledge the remaining difficulties such as a lack of standardization in targets and measurements, the business case for sustainability initiatives, global regulatory inconsistencies, and disparate sustainability commitments across the supply chain.

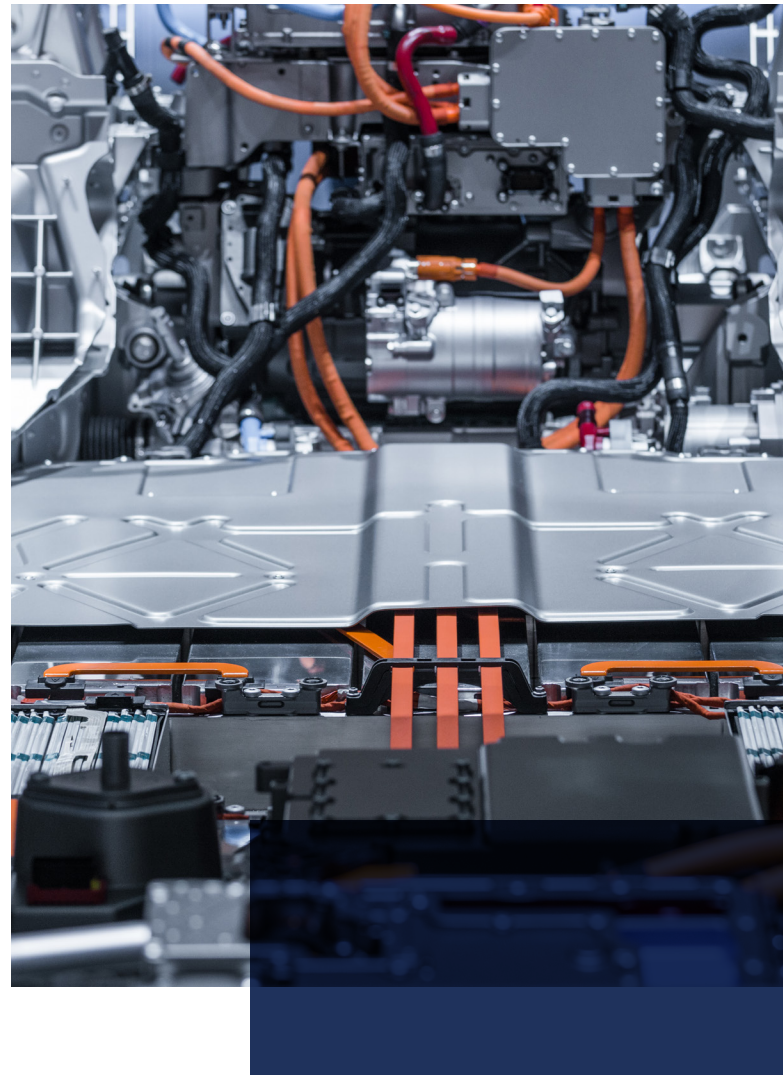
Company B explained that most plans were publicly available in its Sustainability Reports, but communication within its departments to strategically release realistic goals is crucial. They engage in periodic meetings to achieve interim and long-term sustainability targets. They also utilize webinars, stakeholder dialogue, and leadership committees in environmental product design, production environment, and resource recycling to steer progress on sustainability goals. Along with regular meetings, they stress the importance of education throughout the organization regarding internal sustainability goals, policies, and past successes as key to achieving their internal targets. Company B provided examples of training in human rights awareness for policy and processes in its purchasing, sales, and business planning divisions, as well as sustainability training for procurement staff and suppliers alike. SBTi validates Company B's emissions reduction targets, and they utilize SASB, CDP and TCFD frameworks.

Carbon

Company B has validated SBT's Scope 1, 2, and 3 GHG emissions. Scope 1 and 2 targets are 1.5°C aligned, and their Scope 3 target is 2°C aligned. Company B's 2050 targets highlight carbon emission reduction as a strategy in its goal towards a sustainable value chain, making use of effective mid-term goals to incrementally reach long-term targets such as a 90% reduction in new vehicle CO₂ emissions and a CO₂ neutral production and supply chain by 2050. Although they mention the role of EVs in particular scenarios (using high level discussion of scenario analysis), they do not explicitly state EV production goals. Although Company B is positively addressing its sustainability requirements in various target stages by utilizing near term SBTs, it does not provide concrete target planning and execution methodology for later-stage goals. Company B considers an internal carbon price when evaluating capital investments and other activities to acknowledge the risk of increased production and purchasing costs.

Social

A similar core principle of education was shown in Company B's answers on social and cultural equality within the company's structure, emphasizing its responsibility and highlighting equality and modernization goals and initiatives. Company B uses the Sustainability Development Guidelines as a basis in educational programs that address diversity within the work force and broad supply chain stream (Tier 1 and Tier 2 suppliers). They have made strides towards improving gender equality in management, as shown in mid-term targets of increasing women in management by 2030 but did not indicate the projected proportion of women



in management positions in their answers to the questionnaire. Company B underscores its responsibility to respect the human rights of employees and persons affected by business and highlights their alignment with the UN Guiding Principles on Business and Human Rights, and the Sustainability Suppliers Guide. Company B also emphasizes its enhanced human rights due diligence practices in high-risk countries, focusing on child labor, forced labor and migrant worker rights. They have also created internal guidelines to eliminate exploitation and participated in the formation of internationally recognized guidelines to improve migrant work rights.

Sourcing & Suppliers

Company B stresses education and communication with suppliers, creating initiatives and promoting communication between vehicle manufacturers and suppliers on terminology definitions and target setting. They have also suggested the M2030 Data and Reporting commonality for defining the interpretation of targets. Other procurement initiatives, which follow prescribed guidelines for Tier 1 and Tier 2 suppliers on sustainable practices, indicate that Company B considers sub-supplier compliance and concerns.

They cited previous materials regarding emission reductions, including plans to drastically reduce and eliminate CO₂ emissions from suppliers and operations by 2050. They also include interim emissions reduction goals, carbon neutrality in manufacturing, electrification of their fleets, and enhancing battery recycling capabilities as part of their joint efforts with suppliers to meet these ambitious 2050 targets. To achieve supply chain reduction in CO₂ emissions, Company B requires suppliers

Products & Materials

Although Company B generally advocates for greener, low-carbon materials and processes, it remarked that its strategy is not heavily focused on sustainable material sourcing, with no specific material sourcing targets outlined in its answers. Company B links this lack of concrete targets to the high costs of sustainable material sourcing and little push for regulatory movement. Company B has focused on “top-level” sustainability issues and has attempted to address material sourcing by advocating for

to report on annual CO₂ reduction targets and engages with them yearly to help collaborate on sustainability initiatives.

This collaboration helps them effectively achieve their goals throughout the value chain and eliminates misunderstandings. They also acknowledged adherence to protocols like CDP, SASB, and SBTi but expressed the need for more uniformity in reporting requirements. Company B suggested minimal use of CDP Supply Chain Programs supplier self-assessment in their interview responses regarding assessments of supplier due diligence. However, they use a self-developed self-assessment form with their suppliers, including scoring and feedback on the progression of supplier sustainability targets. Company B viewed all measurements as having strengths but said standard definitions would help them with reporting, leading them to develop internal protocols. Company B posited as the best model for achieving interim targets is the one that makes supplier coordination most straightforward.

circularity in its production chain, such as the reuse and recycling of battery modules and car recycling initiatives outlined in its environmental plan. These initiatives include improved vehicle design and end-of-life processing based on resource circularity and developing technologies to improve the rebuild, reuse, and recycling of battery modules on a global front.

Moving Forward

Company B expressed further concerns when assessing the practicality of sustainability targets, including the prioritization of targets, and lack of unity in implementing them. They said the pace of sustainability strategies needs more coordination with the government and suppliers to achieve them in the projected timeline. A challenge they acknowledged is the 1.5°C limitation on global warming. They were unsure how this could be implemented at a company level. One limiting factor in resolving this challenge is minimal regulation which motivates a company to focus on targets with the most practical business implications.

Company B mentioned regulation as a driver of standardization but also stated that regulation is only necessary when progress is stagnating. They have observed increased consumer interest in more sustainable

vehicles, but there is a lack of clarity on when consumers will pay for more sustainable vehicles on a widespread basis. Currently, they work to comply with regulations in all markets they reach and see further regulation as motivation to adopt new sustainability goals that are not economically viable in current business plans. Disparate sustainability initiatives have also forced Company B to bridge the gap through communication and ensure that sustainability, safety, cost, and quality align. This standardization should lead to better sustainability practices and human rights compliance along the supply chain. Company B acknowledges expanding carbon pricing as a potential risk to purchasing costs but suggests promoting renewable energy and hydrogen fuels, as well as collaborating with suppliers to reduce emissions, is an opportunity for growth in these sectors.



Company C

Corporate Goals & Commitments

Company C has a top-down structure for managing and driving sustainability goals, driven by their understanding of the need for buy-in from management. Their board is ultimately responsible for setting and approving sustainability targets. They noted that thoughtful organizational structure has been a key to achieving success. Additionally, they have tied upper-level compensation to achievement of sustainability targets. They also noted, and are tapping into the passion of their employees, to help drive an organizational culture of sustainability - a 'grass-roots strategy' - within the company. Company C emphasized the importance of transparency around their corporate goals and commitments and cited the importance of non-financial targets (compared to financial targets, which generally receive priority).

Carbon

As previously stated, Company C has SBTi validated Science-Based Targets. They have set very detailed and transparent targets for Scope 1, 2, and 3 emissions but noted Scope 1 and 2 emissions are easier to set and achieve targets for because they have more control over those emissions sources. Strategies mentioned to help achieve these Scope 1 and 2 targets include electrification and procurement of renewable / green

Company C is participating in a robust net-zero campaign with involvement from all ESG departments. They have committed and validated SBT's with a detailed breakdown for emissions reduction goals. These goals span their value chain with a dedicated focus on Scope 3 emissions. Their ability to make these commitments, specifically against their Scope 3 emissions, stems from their willingness to engage consultants and their supply chain. They have specific targets on secondary material usage in their vehicles and have communicated this to their suppliers through their purchasing team. They also utilize 3rd party evaluators to ensure their suppliers are meeting their standards. Company C emphasized that sustainability and transparency will be key for any organization moving forward.

electricity. They have engaged consultants and their suppliers (upstream emissions) to help with measuring and managing Scope 3 emissions. Other strategies they are pursuing to reduce Scope 3 emissions include: vehicle electrification, a focus on secondary material usage, supply chain engagement and requirements, and investing in market research.

Social

Concerning Human Rights, Company C's code of conduct includes a policy statement for supply chain on respect for human rights and other social and environmental aspects, which is included in every purchasing contract. This code includes ESG requirements and the mandatory completion of a questionnaire to help identify risks in their supply chain. They

also encourage their direct suppliers to share the questionnaire and report responses from sub-suppliers. Company C has set general Diversity, Equality, and Inclusion (DEI) targets for management-level positions and has established strict targets and approaches to ensuring pay equality.

Sourcing & Suppliers

Company C stressed the importance of open and consistent communication with suppliers as a critical part of their strategy. They hold supplier conferences that allow for open dialogue and deep dives into sustainability topics with regular reporting to ensure continued progress on the issues discussed. They have an academy of sustainability training materials available to their suppliers. Additionally, they emphasized the importance of considering suppliers as a stakeholder in

their success and therefore focus on listening to their suppliers to ensure their success.

Company C utilizes CDP to evaluate and ensure alignment with its suppliers' goals and progress. Company C highlights the difficulty of communicating requirements and goals due to the variation in CO₂ reduction and calculation techniques, emphasizing the need for standardized measures in a global sense.

Products & Materials

Based on the answers to the questionnaire, Company C has put considerable focus on circularity and a closed-loop system within their procurement chain, reiterating the need for supplier communication, buy-in, and effective monitoring of sustainability requirements. Company C stressed the importance of market research on secondary material usage, cost, and safety while pushing for communication of these requirements to suppliers.

Many of Company C's answers highlight the difficulty with implementing end-of-life battery and vehicle strategies, pointing out that without effective planning, the execution of any strategy may fall below sustainability goals. Company C has identified a list of critical raw materials that may offer an opportunity to cut emissions effectively but stressed that standards, education, and risk assessments need to be effectively disseminated down the supply chain for this to ring true.

Moving Forward

The core principles of effective planning, education and strict adherence to international policy are evident in Company C's strategy for the future. They do not specify any one piece of legislative change as critical but focus on an array of potential changes ranging from legislation on manufacturing and procurement requirements to environmental and social policies. In their answers, Company C suggests that country-specific approaches to sustainability must find a 'happy medium', suggesting that some regions require greater focus on their sustainability approach.

Company C stresses the need for buy-in from management, suppliers, and customers, suggesting the need to further tap into supply chain and recycling streams, and improve the communication of sustainability practices to suppliers and consumers alike.

Company C responsibly forecasts the likely short-term increase in Scope 3 upstream emissions due to their electrification strategy but is promoting the rapid movement to the feasible use of green energy and electricity, specifically mentioning green hydrogen as a possible solution. Company C does state that sustainability needs a rational, data-driven approach, where sustainability becomes an equal aspect of vehicle manufacturing. Company C wishes to make sustainability a core belief in their company structure from management to customer but adds that efficient implementation and planning in the early stages can lead to effective scalability, and success in the long term.



Recommendations

After conducting industry roundtable sessions, interviewing vehicle manufacturers, and assessing publicly available industry information, the following recommendations

are proposed to advance collaboration among automotive industry supply chains and their efforts to limit climate change.

Deeper Supply Chain Communication

Proactively Engage Stakeholders to Communicate Clear Implementation Plans – Develop and communicate deeper information through short, mid, and long-term implementation plans. These plans should go beyond high-level goals to help suppliers understand how to modify operations, strategically recalibrate business operations, and develop new offerings to meet a changing environment.

Consistently Support and Conduct Regular Supplier Industry Forums – Implementing an industry-specific system, or regular industry forums around vehicle manufacturer and supplier climate commitments will help advance sustainability efforts and reduce misunderstanding.

Move Beyond Direct or Tier 1 Suppliers to Engage Supply Chain on a Deeper Level – Currently, vehicle manufacturers communicate climate commitments and contractual requirements with their direct suppliers only. However, effective climate commitments require actions that extend deeper into the supply chain. Engaging Tier 2, 3, 4, and beyond suppliers on the details of climate commitments, supplier expectations, reporting requirements, and implementation plans are critical to help advance a broader understanding of and execution against climate commitments.

Placing Value on Supplier Climate Activity

Redefine the Vehicle Manufacturer-Supplier Model to Focus on Realistic Long-term Investment and Partnership for Transformation – Develop vehicle manufacturer/supplier models that place value on long-term horizons instead of short-term transactions. Making the necessary investments in climate solutions is possible for suppliers, but it will require a fundamental shift on approaching the OEM / supplier

relationship and will require investments and contracts that value a longer runway.

Advance Pre-Competitive Activities for More Meaningful Stakeholder Engagement – Engage in pre-competitive forums to help advance climate activities on behalf of the entire industry. This will reduce the burden on individual vehicle manufacturers and suppliers when attempting to define specific circularity solutions.

Standardization of Targets and Measurement

Promote Streamlined Reporting and Measurement – The industry has an opportunity to work across stakeholders to (a) consistently implement well established standards with strong oversight that are supported by government, industry groups, vehicle manufacturers, and suppliers, and (b) promote reporting platforms that allow suppliers to report to multiple customers via a single reporting activity.

Commit to Training the Supplier Base on Standardized Metrics and Guidance – It’s crucial that everyone speaks the same reporting language and has a common, deep understanding of the metrics. Training should occur deep into the supplier base,

so this common understanding is realized immediately and completely.

Advocate for Standardization of Regulations to Support Progress of Sustainability Targets Across the Supply Base - Industry and government partnerships will be key in meeting ambitious climate targets. With government support, vehicle manufacturers advocating for necessary regulation will signal to the industry and the public that the automotive industry is committed to action on sustainability. As vehicle manufacturers get behind policies that can support initiatives like green steel and sustainable sourcing of raw materials, they help their supply base meet targets.

Expand Workforce Knowledge Base

Identify Gaps and Skills Needed – A shortage of well-trained, knowledgeable professionals exists across the climate and sustainability industries. The industry should quickly assess these gaps internally with vehicle manufacturers and suppliers, and externally with industry stakeholders, to develop recommendations for specific skills that are needed. For example, interviews with vehicle manufacturers found that greater knowledge of circularity and GHG emissions is needed.

Develop Climate Workforce Expansion Program – Once gaps and needed skills are identified, the automotive industry can work with academic institutions and professional training organizations to train resources in the identified areas.

Conclusion

The historic shift across the entire automotive industry to move towards more environmentally sustainable and ethical operations has led to many opportunities and challenges throughout the supply chain. This shift comes as the industry works to improve supply chain resilience and reduce production bottlenecks as a result of the pandemic, and ongoing parts and semiconductor shortages of recent years.

Vehicle manufacturers and suppliers have been increasingly implementing internal and external social and environmental targets through initiatives around GHG reduction, water conservation, responsible sourcing, waste reduction, pay equity, etc. The roundtables, assessment of public

information, and vehicle manufacturer interviews, demonstrate that the scope and execution of these initiatives can vary greatly across the industry. Through standardization, communication, and engagement, stakeholders may find common ground as the automotive industry adapts to this changing environment.

Additional research on how sustainability initiatives, policies, and regulations are deployed and implemented in the industry, and the state of stakeholder collaboration, could help shape the understanding of the long-term benefits of sustainability, help reduce emissions, and limit global warming to 1.5°C.



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Appendix A

SASB has further identified accounting metrics and a coordinating form of measurement

Topic	Accounting Metric	Unit of Measure
Product Safety	Percentage of vehicle models rated by NCAP programs with overall 5-star safety rating by region	Percentage (%)
	Number of safety-related defect complaints, percentage investigated	Number, Percentage (%)
	Number of Vehicle recalled	Number
Labor Practices	Percentage of active workforce covered under collective bargaining agreement	Percentage (%)
	(1) Number of work stoppages and (2) total idle days	Number, days idle
Fuel Economy & Materials Sourcing	Sales-weighted average passenger fleet fuel economy, by region	Mpg, L/km, gCO ₂ /KM, km/L
	Number of (1) zero emission vehicles, (2) hybrid vehicles, and (3) plug-in hybrid vehicle sold	Number
	Discussion of strategy for managing fleet fuel economy and emissions risks and opportunities	n/a
	Description of the management of risks associated with the use of critical materials	n/a
Materials	Total amount of waste from manufacturing, percentage recycled	Metric tons (t), Percentage (%)
	Weight of end-of-life material recovered; percentage recycled	Metric tons (t), Percentage (%)
	Average recyclability of vehicles sold	Percentage (%) by sales-weighted metric tons (t)

Appendix B

TCFD Recommended Climate-Related Financial Disclosures

