DRIVING THE FUTURE WITH SUSTAINABLE MOBILITY

An overview on the road ahead

EXECUTIVE SUMMARY

Sustainability is already a top priority for leading automakers, who are demonstrating success on a range of initiatives, mostly around electrification. However, the industry needs a more holistic and systematic approach that addresses the whole automotive product lifecycle and much more. Capgemini is passionate about sustainability generally, and specifically about helping the automotive industry to achieve it. This document outlines our recommended approach, which is based on the three steps shown in Figure 1: commit, act, and monitor & report.

Figure 1: A three-step framework for achieving end-to-end sustainability in automotive

COMMIT

Corporate strategy

SUSTAINABLE STRATEGY & NEW BUSINESS MODELS

- Net zero strategy
- New sustainable business models
- Carbon footprint value driver landscape

ACT

Domain implementation & operational solutions – sustainable criteria in business decision-making

SUSTAINABLE PRODUCTS, SERVICES, & EXPERIENCE

- EV / PHEV / FCEV powertrain engineering
- Battery development
- Other sustainable engineering such as design to mass & lifetime optimization
- Sustainable activation experience
- Sustainable experience & next economy brand
- New sales models
- Digital services for sustainability

SUSTAINABLE OPERATIONS

- Sustainable operations & supply chain
- Sustainable procurement
- Sustainable factory
- Sustainable data ecosystem management

SUSTAINABLE IT

- Sustainable IT
- IT technology for sustainability

MONITOR & REPORT

Data & enabling IT systems

- Circular economy approach for automotive
- Integrative lifecycle assessment (iLCA)
- Eco design & next gen LCA / Design-PLM / Lifecycle analysis tools coupling

DATA FOR SUSTAINABILITY

- Net zero strategy
- CO_2 control tower
- Data for net zero for auto
- Sustainability data hub
- Sustainable control tower
- Sustainability analytics

Committing to sustainability involves adopting new strategies, business models, and value drivers, along with a new sustainability-oriented corporate culture.

With this commitment in place, an automaker should **act**, i.e. work toward sustainability across the end-to-end lifecycle. This requires the creation of a whole portfolio of sustainable products and services, with an emphasis on the circular economy, and it also requires sustainable operations, reaching right along the supply chain. Sustainable IT is an important element of the "act" step. IT is a powerful tool for reducing environmental impact, but can also contribute significantly to emissions. New technologies such as artificial intelligence (AI) and blockchain can be especially power-hungry when running on legacy infrastructure or even on cloud under non-green contracts. A green transformation of IT infrastructure is therefore needed to ensure that IT can realize its full potential without being a source of environmental damage itself.

Monitoring and reporting sustainability, while essential, is not an end in itself – rather, it is a way to steer the business toward sustainability, while also delivering on conventional KPIs such as profitability. To steer, automotive companies must have the right data – at the level of individual business units but also across the enterprise and beyond. The data needs to provide visibility of the supply chain and the entire product lifecycle, and to support data-driven decision-making, often in real time. A number of tools are emerging to meet these needs, including sophisticated analytics and advanced machine learning (ML).

To create the end-to-end visibility that is needed for sustainability decisions, not only must silos within an automotive company be broken down, the automaker must also find effective and secure ways to share data across its partner ecosystem. A number of regional and auto industry initiatives are pioneering data exchanges to address this issue.

A major enabler of sustainability is **innovation**: Automakers should be open to any technology that can help humanity to innovate for a more positive future, and should use sustainability as a lens for evaluating innovative technologies.

Industrialization and arbitration are also key to enabling sustainability. As has already happened with digital transformation, sustainability will come to pervade the automotive organization and its governance. Meanwhile, we need to develop frameworks for balancing (or "arbitrating" between) sustainability targets and other goals in each area of the business, and also across the enterprise.

Talent is a further enabler and there are various ways to fill the skills gaps that are currently hampering automakers. The quest for talent is just one reason for putting in place our final enabler: the **ecosystem**. A single company cannot achieve sustainability alone; it needs to form strong partnerships that enable extensive sharing of data, insights, and technologies.

So automakers need a coherent approach to sustainability and environmental, social, and governance (ESG) goals across the whole business and across the end-to-end vehicle lifecycle. This is a completely new way of steering a business and it needs to be backed by a comprehensive data approach, together with an extensive ecosystem and innovative technologies. In line with our firm commitment to our own ESG goals, Capgemini is passionate about helping clients achieve these things.

Markus Winkler

Executive Vice President,
Global Automotive, Capgemini

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INTRODUCTION

The drive for sustainability

The pressure on the automotive industry to reduce CO_2 emissions is intensifying. It comes from a wide range of stakeholders, including regulators, customers, shareholders, and the general public. In addition, automotive boardrooms increasingly recognize that sustainability is not a burden but an opportunity to transform organizations, processes, products, and services. For example, the more astute automakers will have foreseen the EU's recent announcement of a ban on internal combustion engine (ICE) vehicles by 2035, and started thinking about how they can best work toward it with their partners and with the industry as a whole.

Many automotive organizations have already made sustainability a strategic priority, often setting net zero deadlines. In practical terms, after some successes particularly with respect to electrification, companies know that they now need to move to a more comprehensive approach that addresses the end-to-end product lifecycle, as well as the whole business and all of its supply chain.

A broader vision

Part of this change is about broadening the industry's view of what constitutes sustainability. To date, most sustainability investments have focused on electric vehicles (EVs). However, EVs are not viable in all regions, and so conventional vehicles must continue to become more eco-friendly. Another reason to broaden the perspective is that any competitive advantage from electrification is likely to disappear quickly because of the levels of activity across the industry.

More importantly, a wider perspective will drive better decisions. In the case of EVs, a stronger ecosystem of renewable charging infrastructure and circular economy is needed before the vehicles can be truly sustainable. And, once we take into account aspects like battery manufacturing and recycling, EVs may not always look like the most sustainable option. (That said, when powered by renewable energy they undeniably represent a fast route to decarbonization and sustainable mobility.)

End-to-end transformation

So automakers want to build a broader, and bolder, vision of their future sustainability. Realizing this vision will demand end-to-end transformation supported by new competencies, capabilities, and partnerships. Data, and data sharing, will be vital. And all aspects of the business will be affected: production, sourcing, procurement, IT, aftersales, and more.

Before and during this transformation, complicated decisions will have to be made. For example, if a company can use 100% renewable energy, should it still worry about reducing the energy consumption from, say, IT? We think the answer is "yes" but opinions differ across companies and regions. With the right strategic framework and information flows, decisions like this can be continuously revisited to take account of changing circumstances and macroeconomic trends.

Capgemini's passion for sustainability: ours and yours

Capgemini is passionate about helping automotive companies in their transformation toward end-to-end sustainable mobility. This passion is a natural consequence of our own commitment to ESG goals, including becoming carbon-neutral by 2025, transitioning to 100% renewable electricity by the same year, and helping clients save 10 million tons of CO_2 by 2030.

Empowering automotive clients to achieve similar goals is at the core of our strategy. We have created an end-to-end sustainability offering for the automotive industry drawing on expertise from all over Capgemini.

This report outlines our latest thinking on how automotive organizations can define what sustainability really means for them, and then systematically realize their vision. Please get in touch if you would like to know more.

COMMITTING TO SUSTAINABILITY

New strategy

How can the modern enterprise achieve a 45% cut in CO_2 emissions by 2030 and become net zero by 2050? That is what it will take to achieve the Paris Agreement's carbon reduction targets.

Automotive companies need a practical approach to implementing their net zero commitments: one that will take them from pledge to actionable decarbonization strategy, fast. After assessing transition risks and opportunities, companies need to create a roadmap, assess the available decarbonization levers, and create the right governance mechanisms and strategies for renewable energy sourcing and carbon offsetting (Figure 2).

New business models

Rather than just updating existing business models, automotive organizations are looking to create and transition to new models with sustainability built in. These models will enlist a wide range of stakeholders including consumers, the supply chain, and ecosystem partners in working toward ESG goals. Circular economy measures such as reuse of products and components will be central. The scope will be the end-to-end lifecycle and the whole value chain, not just the product.

The new models will also reflect the move to mobility services, so products will increasingly be seen in the context of getting the customer from A to B in the best and most sustainable way and at the best price. There may be supplementary EV-related business models: Automakers could get involved with the provision of charging infrastructure or Charging-as-a-Service.

New value drivers

While rethinking their strategy and business models, automakers also need to review their value drivers: the factors that determine the worth of their activities. ESG issues must join conventional value drivers such as product excellence and brand strength.

It is not just that this is the right thing to do. With investors increasingly factoring ESG performance into their decision-making, and ratings agencies reflecting ESG in their credit ratings, credible demonstration of progress against ESG targets is becoming a condition of access to capital markets.

For the automotive industry ESG has special resonance, because, rightly or wrongly, the industry is widely viewed as a major contributor to humanity's energy consumption and carbon footprint. That image means that the industry is now viewed as having a special responsibility to help the world deal with problems such as climate change.

Figure 2: Four kinds of work required to create a net zero strategy

New culture

That old image of a polluting and energy-hogging business is linked to a culture of manufacturing, heavy industry, and strong product focus. Automotive companies are now striving to move to a new kind of culture – one that puts the vehicle firmly in the context of providing mobility services, in the most sustainable way possible.

Making ESG part of an automaker's culture requires skill building, stronger governance, and leadership accountability. Employees should be trained and encouraged to adopt more sustainable behavior, not just at work but also beyond the boundaries of the enterprise (for example, teams could be helped to volunteer for eco-friendly community projects).

One area that will require an especially dramatic cultural shift is the supply chain. Most automotive companies have a specific way of procuring parts that has been ingrained in their culture for years. This paradigm needs to be broken up so that decisions are made not just

STRENGTHENING THE CIRCULAR ECONOMY

The circular economy is a concept, regenerative by design, aiming at gradually decoupling growth from the consumption of finite resources, hence moving away from the "take-make-waste" linear model. Circular models help make "*optimal use of resources by avoiding waste over a product's lifetime, maintaining products at their highest value, and regenerating raw materials to their initial state, back to nature.*"[1]

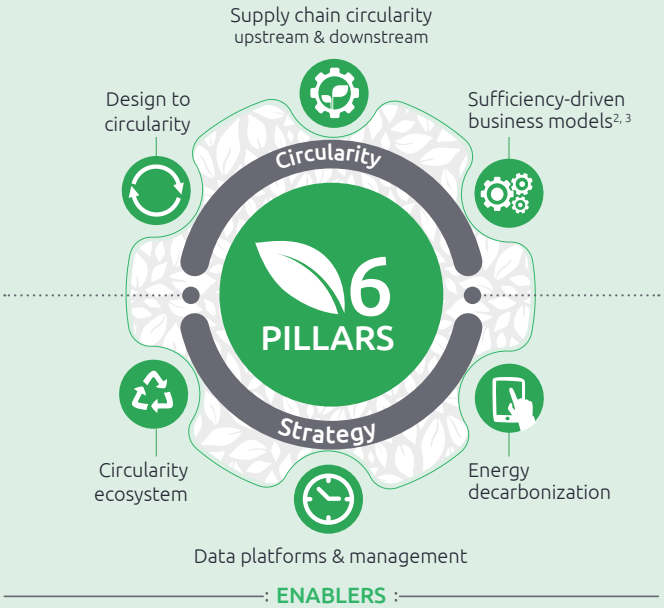
Thus, if well applied, the circular economy can cut global greenhouse gas emissions by 39%, making it an exceptional accelerator for achieving the net zero targets of the Paris Agreement (2021 Circularity Gap Report).

In a recent survey, 52% of automotive companies said that supporting and promoting a circular economy is the sector's most commonly deployed type of sustainability initiative. Indeed, circular business models offer benefits that go far beyond environmental concerns for automakers, such as:

- Lower carbon footprint from greater reuse of materials, components, and vehicles
- Reduced dependency on material sourcing, which will be increasingly important in the EV era (for lithium, cobalt, and manganese)
- Cost savings from reusing minerals instead of buying them new
- New revenue streams (reselling parts and recyclable waste, new mobility services, etc.)
- Brand reputation enhancement for employees and customers
- Innovation and progress to support the creation of new circular products, processes, and materials

1. https://ec.europa.eu/eurostat/web/circular-economy

Figure 3: Six pillars of circularity as the strategic cornerstone of sustainable automotive



2. N.M.P. Bocken, S.W. Short, Transforming Business Models: Towards a Sufficiency-Based Circular Economy, 2020
3. M.I. Kornfeld, A. Reichel, The Business Model of Enough: Value Creation for Sufficiency-Oriented Businesses, 2021

In order to fully embrace this paradigm shift, OEMs need to see vehicles as assets they own, and provide access to them for users as part of a mobility service. Leveraging the circular economy, their objective should be to maximize vehicles' utilization through

in the light of cost and quality but also with an eye on ESG implications.

With the right culture, ESG can be engineered into every product or service from the first day of planning, and built into the whole value chain, and the whole product lifecycle. The circular economy (see panel) is a central concept here.

In short, everything a company does should be evaluated with an ESG lens, and every possible way of increasing sustainability should be considered.

The circular economy should be a constant focus from day one of planning any new product or service, along with more specific ideas such as reuse/recycling and durability.

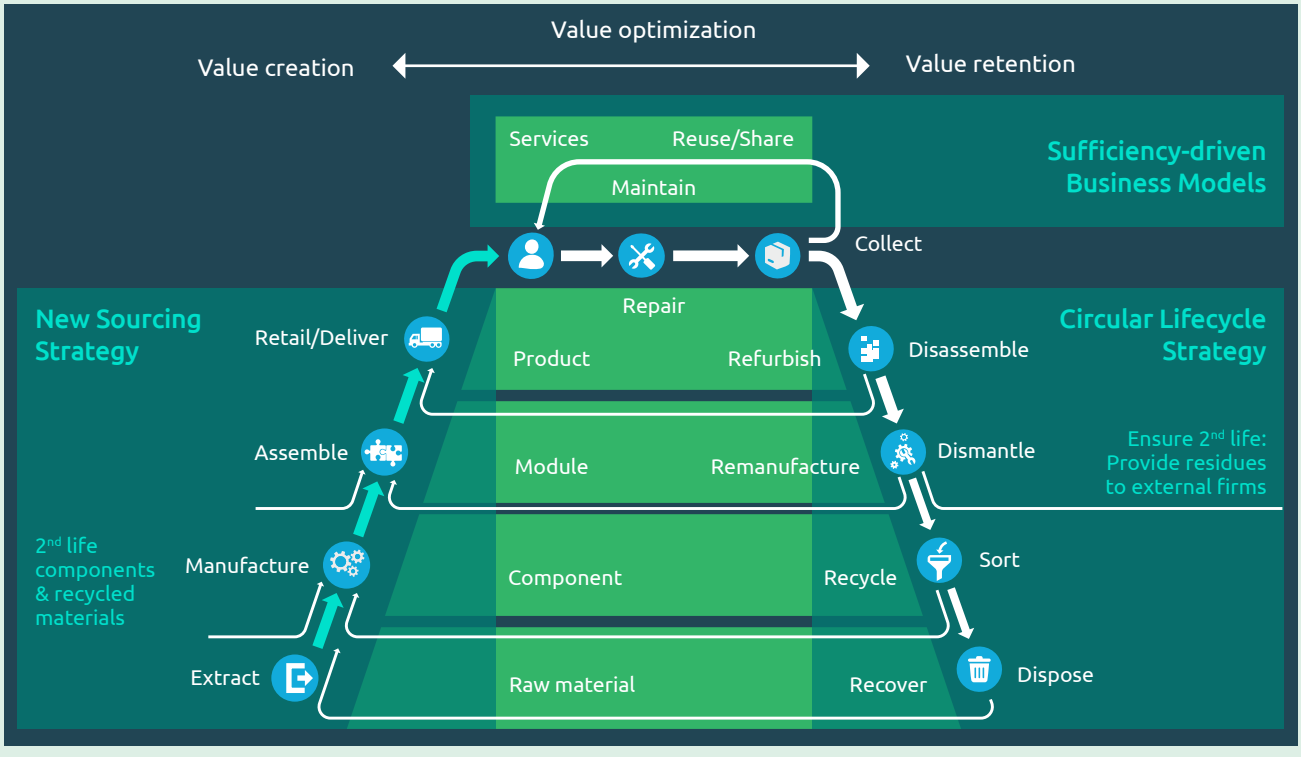
Another cultural change that automakers need to make is to become more outward facing. As we know, many current aspirations require collaboration, and sustainability is no exception. Sustainable mobility cannot be solved by the automotive sector alone: For one thing, energy needs to come from sustainable sources.

services that promote reuse (e.g. car sharing, secondhand sales) and extend the lifetime of vehicles and their components (e.g. repair, remanufacture, retrofit).

The automotive industry is undergoing one of its most dramatic transformations to date. OEMs should apply circular economy principles to major megashifts such as electrification (EV/H_2), secondhand and retrofitting, mobility services, mass customization (via platformization and standardization), connected cars, and autonomous driving. OEMs should position the circular economy as one of their core strategic pillars to embrace the major megashifts ahead of them. Therefore, we can assert that whether automakers are pushed by market disruptions or pulled by the benefits of circularity, or a mix of both, their journey toward a circular economy is inevitable.

The circular business models affect every aspect of the lifecycle, and so an end-to-end implementation approach is needed. To achieve significant results in the circular economy across the value chain, we are convinced that technology must determine tactics.

Figure 4: Value hill diagram of circular economy implementation in automotive



ACTING ON SUSTAINABILITY

An end-to-end perspective

What does it take to move from sustainability commitment to sustainability action? Minimizing tailpipe emissions is not enough. Vehicles need to be sustainable through their lifecycle, right up to (and perhaps beyond) the point where they are scrapped – preferably after several cycles of reuse. The manufacturing process itself needs to be sustainable too, along with the workings of the supply chain. And so does customers' use of products and services. The overarching concept is that of the circular economy, and implementing it requires change at every stage of the lifecycle (see panel in previous section).

Sustainable products, services, and experience

Products

Automakers are already working hard to increase vehicle sustainability, although the current focus on hybrid and fully electric vehicles (and their batteries) often comes at the expense of ICE vehicles which also need to become more sustainable. Promising research areas include software-based battery management and hydrogen fuel cells, which are of special relevance to commercial vehicles, and the use of biowaste.

However, what is not always sufficiently appreciated is that a vehicle is now becoming part of a mobility service, and that the whole service has to be sustainable.

Services

In all sorts of ways, services can empower customers to use vehicles more sustainably – and the evidence is that customers, particularly younger ones, value this type of service highly.

Mobility services can help people share vehicles, driving up utilization, or complement them with other modes of transportation in the mobility ecosystem so that they can complete journeys more sustainably.

There are other ways for connected services to drive up sustainability. For example, AI-enabled services can preheat or cool the vehicle's electric systems ahead of a trip which, as well as extending range, can increase the sustainability of the journey. Other services can optimize charging patterns by adjusting engine use to make better use of power sources.

AI-driven connected services can also provide guidance on sustainable vehicle use, for example on adjusting driving behavior to reduce fuel consumption. In the case of hybrid cars, services can minimize the use of fossil fuels by ensuring that EV mode is used as much as possible. As cars become more autonomous, this type of adjustment could even be automated.

Experience

It is not just what automakers themselves do that influences sustainability. The ways customers use the product or service can reduce or increase environmental impact: for example, how they drive the vehicle, whether they share it with other drivers when it is not needed, and what they do with it at the end of its life. So companies also need to think about how they can influence customer behavior. There are two aspects here: first, to satisfy the customers who are already keen to act sustainably, and second, to educate the rest about the need to do so.

Visibility is an important tool for influencing both types of customer. Just showing people how much energy they are using per kilometer can motivate behavioral change, especially when coupled with information about how to improve matters.

Automakers need to create more of these "sustainability experiences" as we might call them. Sustainability needs to be built into every action with the customer. The configurator should display sustainability characteristics along with color and so on. The dealership should demonstrate charging stations as well as cars and explain how everything fits together. The car should tell drivers about its sustainability features, not just leave it to the driver to find out about and enable them. And the charging station should give them visibility of power consumption, and of the length of charging cycles.

In all these ways and many more, automakers have it in their power to bring customers' experience of

sustainability to life so that they are motivated to act on it. Throughout the lifecycle, there are opportunities to promote sustainable behavior. Continuous updates can encourage customers to use their vehicles for longer, and increase the attractiveness of secondhand products, in line with circular economy principles.

Sustainable operations

Meeting sustainability goals such as net zero requires a radical re-examination of every aspect of the industry: consumption of raw materials, global sourcing of components, assembly, distribution, and so on. Design, engineering, and manufacturing processes must all be adapted to take account of sustainability goals.

Fortunately, many of the leading-edge tools and techniques used to meet other goals such as efficiency and rapid time to market also contribute to sustainability goals. For example, generative design is an exploratory approach using intelligent algorithms to create multiple variations of a product design for validation and optimization purposes. This could lead to redesign of components to reduce mass and weight, helping to create more fuel-efficient cars.

An Intelligent Industry approach to manufacturing can improve sustainability along with performance. For example, digital twins can provide end-to-end visibility of the whole operation, including the supply chain. This makes it possible to answer questions such as "How big a share of the CO_2 emissions relating to parts delivery to our plants comes from transportation by sea and how much from transportation by road?" and make appropriate adjustments.

Companies are also realizing that they need to overhaul their traditional plan-and-control approaches to manufacturing. To ensure compliance with today's rapidly shifting regulatory targets, they need tools and processes that adjust production plans dynamically to simultaneously meet both CO_2 targets and production targets.

Below we review three key elements of sustainable operations: procurement, factory, and supply chain.

Procurement

Procurement – especially supplier selection – can make a huge difference to the environmental footprint. Emissions from purchased goods and services account for up to 90% of a company's carbon impact.

Assessing the current performance of the supplier ecosystem is an important starting point. The automaker can then start building sustainability KPIs into procurement processes, and introducing tools that help the procurement team to assess suppliers against sustainability KPIs. AI-enhanced tools can help sift the large volumes of data.

It is vital to upskill the procurement team, and also their opposite numbers within key Tier 1 suppliers, so that they fully understand the company's vision of sustainability and are empowered to realize that vision. In this way, the KPIs will become an integral part of procurement processes.

Factory

Industrial carbon emissions are another major contributor to the climate crisis. Automakers are moving toward what we call the "green, lean, digital factory," characterized by use of renewable energy, emission-free production, and energy- and resource-efficient processes. These factors leverage lean principles such as 7W, use shared IT data networks, and employ closed-loop value streams.

Although most automakers are already on this journey, they should conduct regular assessments to ensure that they are on track and flag up opportunities for rapid improvement, for example through circular economy techniques such as short loop recycling, which optimizes the use of resources and minimizes environmental impact by keeping raw materials as local as possible.

Supply chain

One of the most important determinants of the sustainability of automotive operations is the supply chain. The industry is currently having to rethink this whole area in the face of disruptors such as the pandemic and the current tragic events in eastern Europe. Leading automakers are taking the opportunity to address ESG aspects of the supply.

The same techniques that can increase supply chain resilience often improve sustainability – and there can be cost reductions too. By reviewing a sourcing process involving more than 10,000 Tier 1 locations, one leading automotive company achieved a 10% reduction in CO_2 emissions with 32% lower costs per delivery.

However, creating a sustainable supply chain is, above all, about collaboration. For example, OEMs need to be able to rely on Tier 1 and 2 suppliers to help them ensure ESG compliance at lower tiers. Collaboration can also reduce waste by ensuring that suppliers produce exactly what is needed, no more and no less. And when suppliers with a commitment to sustainability collaborate, innovation can happen much faster, as the Catena-X example (see panel) shows.

CATENA-X: COLLABORATION AS PART OF A FULL ECOSYSTEM

The Catena-X Automotive Network is using the GAIA-X platform to increase digitalization and sustainability, while reducing breakdowns, via an alliance for secure, standardized data exchange. Use cases to date relate to the circular economy and CO_2 footprint, and digital twin, traceability, and quality management. Participants include BMW, Deutsche Telekom, Robert Bosch, SAP, Siemens, ZF Friedrichshafen, Mercedes-Benz, and Capgemini.

Sustainable IT

IT is a double-edged sword from the sustainability perspective. It can be a tremendous asset, but it can have a large environmental impact itself.

On the plus side, advanced technologies such as AI can help with many sustainability decisions, from those required during procurement to those that dictate how the vehicle is driven or how the factory operates. Data from existing ERP systems can also play an important role in supporting sustainability decisions and in monitoring and demonstrating regulatory compliance.

However, IT contributes significantly to an automaker's carbon footprint. In 2019, 53.6 million tons of e-waste were generated across all human activities worldwide – an increase of 21% in five years. Automotive companies may be more conscious than most of the need to make IT sustainable, but adoption and deployment of solutions is often undermined by a lack of tools and expertise.

Recent advances in IT may actually be compounding the problem. For example, valuable as it is, AI can be power-hungry, particularly when run on legacy infrastructure, or even in the cloud if the technology or contractual arrangements are less efficient than they should be.

A green transformation of IT is needed, therefore. It must include a review of infrastructure (covering both legacy platforms and cloud hosting arrangements) to limit the environmental impact of necessary IT solutions, including newer ones such as AI. Importantly, this review needs to consider the power sources used.

Figure 5 shows the four focus areas for such a transformation.

Figure 5: A framework for sustainable IT

MONITORING AND REPORTING SUSTAINABILITY

We can only act on what we can measure

Automotive companies now face the challenge of steering the business toward sustainability goals while also meeting traditional objectives such as profitability. For that, they need data.

As well as data for each part of the business, automakers need an end-to-end view that brings together data from different silos and different parts of the supply chain. This will enable them to optimize overall sustainability, and to evaluate the knock-on effects in one area of the business or supply chain on another. For example, a change of battery type might reduce the vehicle's emissions but increase the emissions from battery production, or make reuse harder.

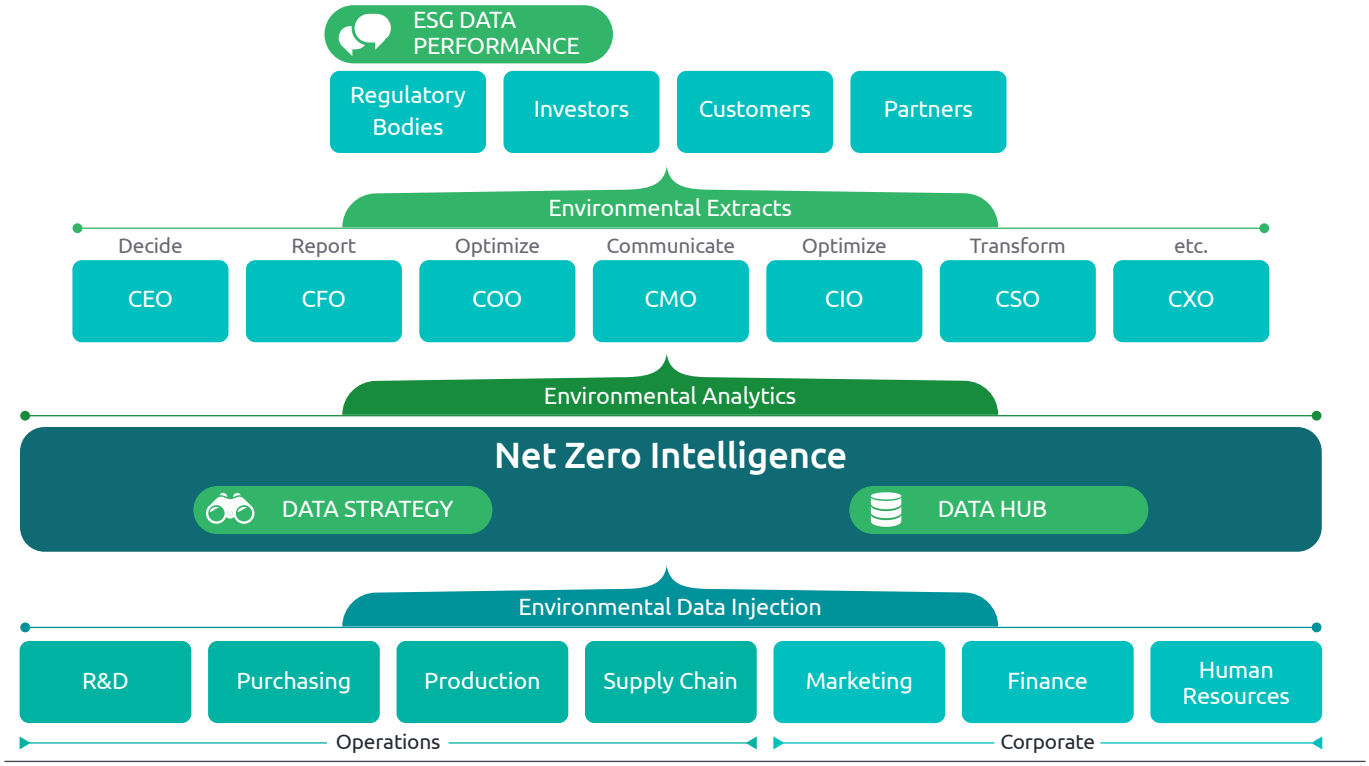
Another reason end-to-end visibility is needed is to enable a company to balance different objectives, such as short-term profit versus emission reduction. Robust data also makes it possible to demonstrate sustainability to stakeholders and refute accusations of greenwashing.

Of course, just having data is not enough. Automakers must create KPIs embodying sustainability goals, and then use data to inform decision-makers as they steer the business toward those goals. Therefore, tools are needed to translate the data into insights that can power communication and drive decisions, both strategic and tactical. In this section, we discuss what is needed to achieve those insights.

Creating the intelligence nerve center

Each automaker should set up a sustainability intelligence nerve center at the crossroads between all enterprise functions (Figure 6).

Figure 6: Sustainability intelligence nerve center



To create this nerve center, several elements are needed.

Data strategy: The automaker should identify the types of data that will be needed to support the company's ESG commitments, steer the business toward its targets, and provide proof-points on ESG performance. This evaluation will provide the basis for a roadmap to acquire the necessary data. Data governance, necessary technologies, and the data partner ecosystem should also be considered at this stage.

Sustainability data hub: Organizing all sustainability-related data, both internal and external, onto a single hub allows data to power decision-making in real time, and stakeholders' requests for data to be satisfied easily and fast. As well as the technological platform, the mechanisms for data ingestion and analytics must be carefully chosen.

Data mastering: Data from a large number of disparate sources, both inside and outside the company, needs to be ingested and made available in a usable form. This requires sharing and standardization – a topic we will return to below.

ESG performance steering infrastructure: Mechanisms should be established to ensure that ESG insights and performance metrics reach the right decision-makers. Reports should be automated and routed in compliance with regulatory requirements and investor expectations.

With these elements in place, the amount of data in the nerve center can grow progressively to support the company's sustainability journey.

Modern tools and techniques for working with data

For specific requirements, automakers can choose from a range of innovative tools and techniques, many of them incorporating advanced technologies such as AI and ML. Just a few examples are listed here.

Carbon accounting: Rigorous quantification of CO_2 emissions is fundamental to transparency and accountability, and can provide a baseline for defining improvement goals. Tools exist to industrialize measurement and to translate raw metrics into meaningful insights.

Control towers: Supply chain control towers are virtual viewing platforms that capture and use data across the automotive supply chain and present it in the form of dashboards and similar. Control towers can help the automaker to monitor and steer any aspect of the supply chain, including CO_2 emissions and other ESG indicators. Management can be alerted to issues requiring urgent action.

ESG reporting: Tools are available to industrialize and automate ESG reporting to comply with evolving regulations and meet increasing expectations from investors. Because of the bewildering volumes of data and the lack of clear standards and reporting metrics, specialist help may also be needed.

Lifecycle assessment: A systematic look at the whole vehicle lifecycle may reveal hidden potential to cut costs and promote sustainable practices at the same time. New integrative lifecycle assessment tools and techniques make it easier to compile and evaluate the potential environmental effects of a product throughout its lifecycle.

Of course, just having data is not enough. Automakers must create KPIs embodying sustainability goals, and then use data to inform decision-makers as they steer the business toward those goals. Therefore, tools are needed to translate the data into insights that can power communication and drive decisions, both strategic and tactical.

The need for data sharing

It is only through collaboration that OEMs can deliver measurable environmental benefits on a global scale – which means sharing a lot of data. For example, real-time mapping of road conditions is needed to eliminate unnecessary mileage and the associated waste of fuel, and these can probably only be achieved through the collaboration of multiple automakers as well as communication companies.

Mechanisms for secure data sharing are being pioneered by initiatives such as Gaia-X (an EU-sponsored federation of data infrastructure and service providers) and Catena-X (a group of automotive companies), both mentioned earlier.

ENABLERS OF SUSTAINABILITY

Innovation

Today's rapid reorientation toward sustainability and ESG goals is disruptive, and one of the most important tools for tackling disruption is innovation. On their quest for sustainability automakers should be open to any technology that can help them innovate for a more positive future. They should use sustainability as an additional lens for evaluating innovative technologies. After all, a technology may pay dividends in terms of ESG goals before it becomes financially attractive. Indeed, it may be worth investing in a technology that is sustainable even if it is always going to cost more than the alternative.

Industrialization and balancing of goals

As has happened with digital transformation, sustainability needs to be an overarching philosophy that is ingrained into the organization and its governance. As well as becoming part of the organizational culture, it needs to become an intrinsic part of the business. This means that every time a decision is made, whether within a single team or department or across the enterprise, lifecycle, or supply chain, sustainability needs to be considered. Often, too, sustainability objectives will conflict with others: For example, the most sustainable choice of component is not likely to be the cheapest.

Therefore, in every area of the business, and also across the enterprise, supply chain, and beyond, we need to balance ESG goals against considerations like cost while satisfying constraints relating to issues such as location and the sociocultural values of the end-customer (will they be willing to accept tradeoffs or sacrifices implicit in the more sustainable solution, such as sharing a vehicle rather than owning their own?). We call this balancing of goals "arbitration."

A SOCIOCULTURAL FRAMEWORK FOR SUSTAINABILITY DECISIONS

Arguably, one of the major outstanding obstacles to sustainability is the fact that it is hard to define, and definitions are to some extent subjective, since different stakeholders will place different values on various aspects of sustainability, e.g. some will prioritize climate change concerns over human rights and others will do the opposite.

Another obstacle is that, although customers are increasingly concerned about sustainability, they have other objectives that may override it, such as safety or convenience. Since the end-customer will determine the success of any initiative, it makes sense to use their views to shape sustainability strategy.

That means we need to understand customers' sociocultural values and integrate them into our sustainability offers to satisfy customer expectations. Sociocultural dimensions to take into account include the "wow" effect that intuitive technology can produce, and the positive emotions that can arise in relation to sharing, support, and intimacy.

To take a simple example, we might have to decide whether and when a large price reduction on a part justifies accepting a larger CO_2 footprint – a complex decision, especially if the cost saving would be invested in another aspect of sustainability.

To flesh out this idea further, we can return to the idea of the circular economy. Reuse and recycling can only be achieved if energy and/or matter is added to the system. This means that sustainable operations will always require arbitration between the costs of sustainable activities, including the additional energy and/or matter required, and the value of the results, such as reused or remanufactured products. The assessment of the value of the results will need to consider complexities such as the logistical cost of getting those products to customers who will buy them – if these markets are not local ones, then those costs may be prohibitive.

In addition, making circular economy decisions requires assessment of the cost of rejecting the sustainable option. In some countries, sending material to landfill is prohibitively expensive, or it may even be forbidden, making recycling and reuse much more attractive.

So there will be difficult judgments to make as sustainability becomes industrialized. Companies will need to develop frameworks to help them integrate sustainability criteria into their daily decisions and to weigh up the various conflicting objectives and constraints.

One promising approach is to broaden the total cost of ownership (TCO) concept to reflect sustainability implications, and then integrate the resultant TCO concept into engineering toolsets. This will enable engineers to naturally consider sustainability issues at each stage of the process.

Filling talent gaps

The industry is currently undergoing a transformation that involves blending skills from both traditional engineering and IT. The necessary profiles are scarce and in demand by other industries that have already set a high bar in hiring, training, and retaining the best talent. Add the requirement for sustainability and the situation looks bleak. It is not even clear yet which specific skills will be needed, although work is being done to define that.

However, the new initiatives that are already emerging to tackle skills shortages can probably be modified to cover knowledge of sustainability. These initiatives include setting up software academies, launching reskilling programs, and spinning off subsidiaries, often in partnership with tech companies, to create long-term career prospects for possible candidates.

Specialist skills in sustainability will still be required and will often be obtained through ecosystem partnerships. Better, talent in the ecosystem can be used to train your workforce. Even so, the necessary skills may be hard to find at times.

In sustainability, as in other specialist areas, it will increasingly be possible to use AI to make the most of scarce talent. For example, a tool could be developed to identify potential ESG violations in the supply chain by analyzing a combination of supplier records and news reports.

How can you, as an individual, use your capabilities to help tackle the climate emergency, while also adapting to the growing demand for sustainability skills on a résumé? Already, short academic programs are emerging; however, for up-to-the-minute and automotive-specific knowledge, working with experts from the ecosystem may be the best and fastest way to learn.

Extending the ecosystem

No single OEM acting independently can deliver measurable environmental benefits on a global scale – certainly not with the speed dictated by the climate emergency. A wide range of collaborative initiatives at industry level and above are already emerging, such as the German government's Innovate2030-SDG11, designed to foster climate-smart and sustainable cities and communities.

It makes sense for automakers, too, to work together to share knowledge and establish standards, as is happening in initiatives like Catena-X. That said, automakers are also assembling their own individual ecosystems to help them meet their sustainability goals. Each ecosystem is likely to include a wide range of different types of organization depending on the specific topic of innovation.

For example, when it comes to charging EVs, OEMs have a number of choices, all of which will involve collaboration. They could become energy producers themselves, providing access to green energy tariffs to proactively drive CO_2 reduction, or they could offer customers solutions to enable them to produce and maybe store their own green energy. All of these

imply partnerships, with power companies, specialist equipment manufacturers, and infrastructure providers among the obvious candidates.

> Many of our clients see Capgemini as an actual or potential ecosystem partner in the area of charging, since we offer our own solution to help clients build an agile, evolving EV charging station network. Our value proposition includes EV charging station management and operations, customer experience process management, and business models to cover charging and much more.

For development of connected services, including those to promote more sustainable driving behavior, OEMs will want to collaborate with specialist developers, making the vehicle accessible to them via APIs, app stores, and the like. It will also be necessary to collaborate with providers of 5G and of smart city and road infrastructure so that intelligent vehicles can work with that infrastructure to operate more sustainably, for example by traveling at the correct speed when approaching traffic lights. Power infrastructure providers will also be part of the ecosystem: EVs can be made more economical and sustainable if they can communicate with the grid to agree when to draw energy from the network (and maybe when to upload it).

As a company strengthens its commitment to the circular economy, it is likely to want to engage more with partners such as resellers, independent service centers, and recycling companies, as well as with customers who need to be informed about the advantages of reuse.

Other likely collaborators are companies from other industries, tech, academia, politicians, and anyone able to identify or develop sustainable solutions or help with the definition of sustainability goals and criteria.

Startups are likely to be well represented in the ecosystem. Their innovative capabilities are widely acknowledged, and some companies are launching their own initiatives to identify and foster the most promising.

Customer-friendly sustainability

As noted earlier, automakers' sustainability depends on customers' acceptance of sustainable products and services, and that depends on giving them the right experience: experience that generates enthusiasm. This enthusiasm is determined to a considerable degree by the process of buying a vehicle, as well as the experience of using it. Expertise in customer experience and user experience design can help.

In addition, OEMs need to overcome some barriers to take-up of sustainable products, making sure that consumers can access the information they need about batteries and charging (for example), and that dealers are equipped and motivated to direct them toward the more sustainable option.

THE ROAD TO SUSTAINABLE MOBILITY

An agile, coherent, end-to-end approach

Already, automakers are faced with difficult decisions around sustainability, and there will be far more to make in future. These decisions need to be approached from a holistic sustainability perspective: one that takes account of the whole vehicle lifecycle – pursuing circular economy concepts such as maintenance, reuse, and recycling – as well as the entire value chain.

Automakers' sustainability approach also needs to be agile, not least because targets will evolve fast. Today, fuel supply and tailpipe account for the lion's share of the industry's environmental impact, but electrification will change this picture rapidly. Then other areas, particularly sourcing of raw materials, are likely to become the main targets for sustainability initiatives.

Targeting sustainable mobility

Rather than think in terms of the sustainability of the automotive industry, it makes sense to address the broader notion of sustainable mobility. This concept covers all modes including public transportation, walking, and cycling, viewing them holistically from the perspective of the individual user.

Balancing goals

So automakers need a coherent approach to sustainability and ESG goals across the whole business and across the end-to-end vehicle lifecycle, the whole supply chain, and beyond. And, of course, these goals need to be seen in the context of the company's strategy and target markets, and balanced against traditional objectives such as profitable growth.

New ways of doing business

This is a completely new way of steering a business, and, as we have seen, it needs to be backed by a comprehensive data approach, plus decision-making frameworks that help balance conflicting objectives. Innovative technologies and partnerships will be required. A green revolution in IT must make infrastructure and power supplies as eco-friendly as possible so that power-hungry applications remain viable.

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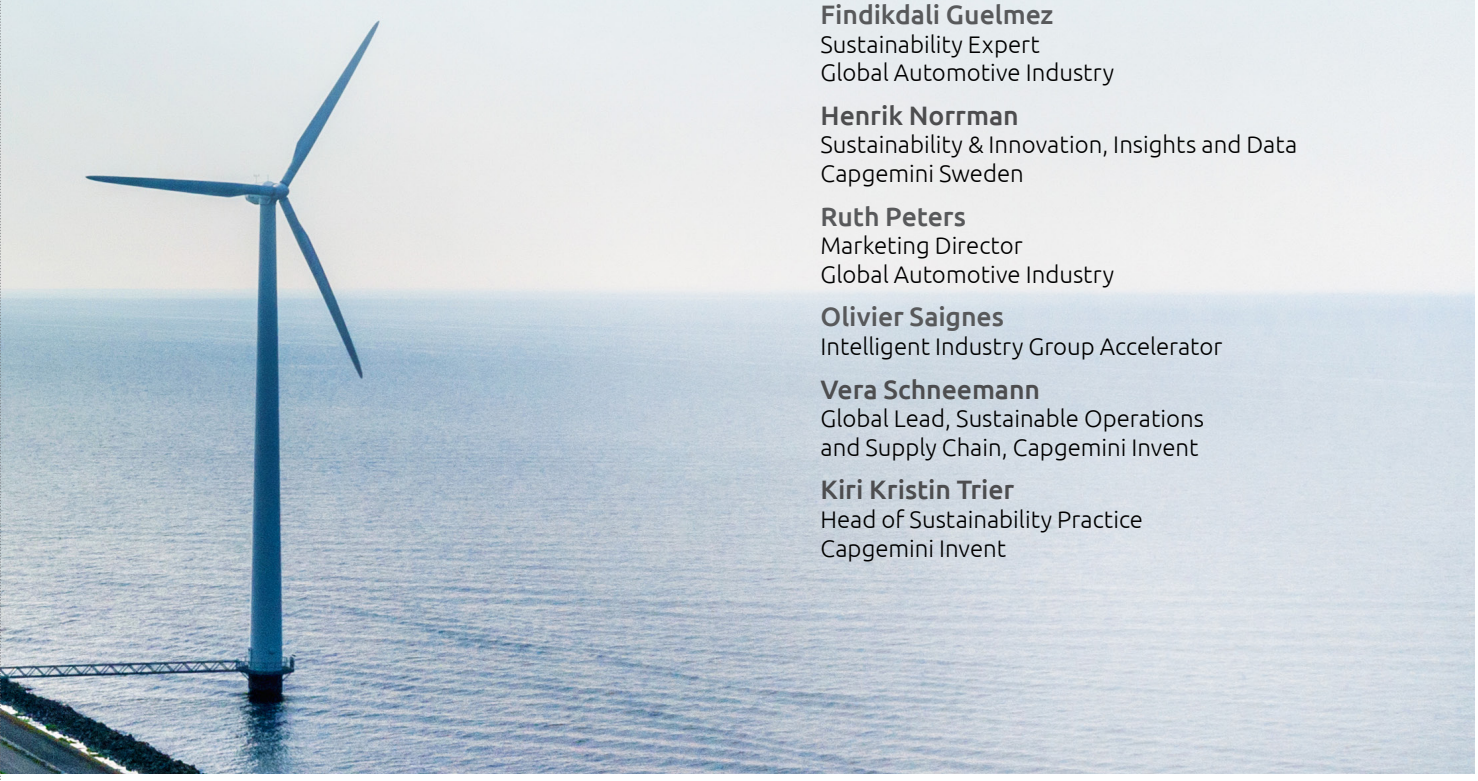

Our passion for sustainability

Capgemini is passionate about sustainability – ours and yours. Please get in touch with Findikdali Guelmez (*findikdali.guelmez@capgemini.com*) in our team of experts to find out more about our sustainability vision and how we can help you achieve yours.

About Capgemini

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