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Driving Ambitions: The Business Case for Circular Economy in the Car Industry

INSIGHT REPORT
MAY 2022



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Foreword

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The automotive industry is at the beginning of its deepest transformation since its rise. Electrification, digitalization and decarbonization require massive investments and attention. Supply chain volatilities demand immediate answers and additional shifts in the value chain. Environmental, Social and Governance (ESG) investors and regulators require far-reaching accountability for the supply chain and use phase. The potential for vehicle sales growth, particularly in developed markets, is finite, as are options to reduce costs and improve margins in the current sales-based business model.

Circularity can help to align and address these challenges and provide a path to greater resilience for the industry. It helps automotive companies deliver on carbon reduction and secondary materials targets. At the same time, it can provide tremendous business benefits across the value chain.

The Circular Cars Initiative (CCI) hopes that this report will help companies across the automotive industry to identify and unlock the massive environmental and business benefits of a circular economy. Over the last two years, the CCI has convened a group of over 60 companies and organizations in an array of workshops, one-to-one interviews and discussions to explore how automotive circularity can be achieved. The first business paper, [Raising Ambitions: A new roadmap for the automotive circular economy](#), provided a guiding roadmap and circularity taxonomy. Simultaneously, the interest and activities at companies has significantly increased. The majority of companies and functions are now deeply invested in creating a circular economy and the CCI has provided guidance and inspiration for many of its members.

We appreciate the invaluable insights and contributions of participating community members from across the value chain and organizational functions. Accenture provided this work with the analytical backbone, based on an extensive modelling of the automotive value chain business model and impacts from circularity initiatives, to arrive at this report.

The approach to create value in circularity is fundamentally different from the current model. It requires a life cycle optimization approach considering the cost and revenue benefits of circularity, which are distributed potentially across many stakeholders. This enables circularity to significantly improve the bottom line, particularly in high usage models in car sharing and mobility-as-a-service (MaaS). Due to the high use, with shorter lifespans, capital costs are impacting the case less, further incentivizing the shift towards full circularity.

Given that there is so much value, how can this be properly distributed? What changes are required in the organization and value chain? Who will take the lead? Are new business models a silver bullet for all players? There are still many open questions, and this paper is one further step in unfolding this complex issue. Some of the next steps for CCI and the automotive industry will include providing opportunities for concrete pilots, further investigating methods of life cycle value measurement and sharing, providing more detailed guidance for individual value chain steps and players, and identifying and supporting those willing to take up the lead of “orchestrating” circularity.

Executive summary

Circularity enables automotive companies to overcome growth limitations and create more value across the vehicle life cycle.

With circularity, companies can tap new value pools beyond the limits of their current business model. It holds the potential to improve profitability by 1.5 times along the value chain and tap revenues per vehicle 15–20 times its sales price. These value pools are mostly in as-a-service models and life cycle services as the focus shifts to maximizing lifetime performance. They are driven by cross-value chain cost and revenue benefits, positive technology cost curve developments and a range of breakthrough business models, particularly as-a-service. All of which become viable in a fully circular value chain. For example, modular vehicle design is a cost in production, but enables profits 1.5–4 times its costs in repair, as well as 2–5 times in end-of-life recycling. With cost improvements in advanced recycling technologies, vehicle end-of-life treatment and material processing could create drastically higher revenues than today and reduce sourcing costs for low-carbon materials. Furthermore, once a value chain is circular, many business cases, particularly as-a-service, but also repair or remanufacturing, benefit from improved vehicle mileage and alignment of initiatives. These improvements in revenue potential are stronger than the dents in vehicle sales caused by higher use.

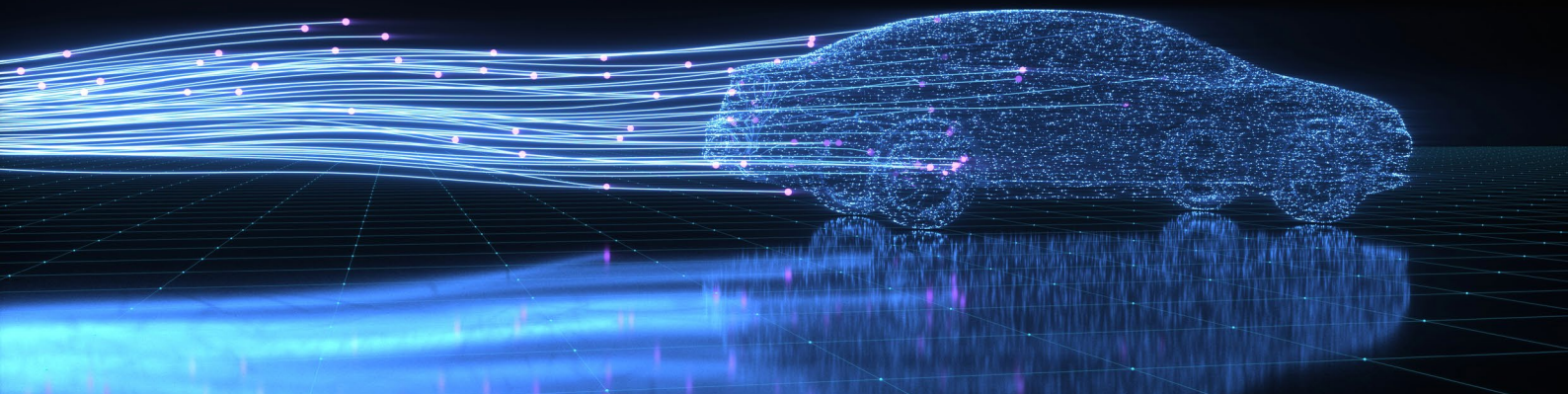
Companies can tap the value potential of circularity by adopting a new perspective on their business case, towards optimizing the full vehicle life cycle across the value chain. Costs and revenues of circularity initiatives are often spread between value chain players and are interdependent with other initiatives. For example, the sourcing of recycled materials depends on vehicle recycling, which in turn is impacted by design choices. Companies can dramatically improve their circularity business case

by accounting for these interdependencies and finding new revenue mechanisms, for example, with as-a-service models.

The creation of a circular value chain requires companies to collaborate and build common platforms for data sharing and transparency. An “orchestrator” organization fosters alignment and the creation of circularity benefits. Research and development and finance take on broader roles, working across the value chain.

Companies must make strategic choices regarding the transformation of their core business. For example, through co-innovation and partnership, and expanding into collaborative activities or the full circular value chain (recycling, repair or as-a-service models). They could start by first transforming selected vehicle models or components and later the full business. The future set-up will be made of diverse circular value chains and segments of as-a-service offerings, sales and private ownership models, thus offering companies a choice of where to play.

Automotive companies already pursue green materials, battery recycling and car subscriptions. Further building out and linking of these initiatives offers companies the opportunity to address their challenges and to align the transformations. A circular automotive value chain is necessary to reduce carbon emissions by up to 75% as well as resources consumption by up to 80% per passenger kilometre (km) until 2030.¹ It boosts resilience, by securing material availability in predictable, localized and higher-quality cycles. It also offers significant business potential.



Introduction

The automotive industry can build on its strong capabilities of optimizing complex systems to move further on circularity.

The automotive industry is already pursuing a range of circularity initiatives. Many companies have announced targets and initiatives to increase recycled content, invested in battery recycling facilities or built out leasing and subscription services. A range of electric, circular and efficient car concepts demonstrate future ambitions, as by Mercedes EQXX, Fisker Ocean, Arrival, BMW to name a few. Around 100 companies from the automotive industry are laying the foundations for an end-to-end vehicle data infrastructure, potentially improving a range of circularity activities, as part of the Catena-X initiative.

The automotive industry is also highly capable of building an interconnected system like a circular economy. It resembles the complexity of vehicles themselves – with every component impacting the overall performance. Automotive companies are therefore well positioned to expand their prowess in performance optimization to the full (circular) value chain and vehicle life cycle.

However, there is more to circularity. It presents an opportunity for the industry to address many of its challenges, as well as align and improve the return on its tremendous investments in the simultaneous transformations towards electrification, digitalization and decarbonization.

Circularity could help to address challenges in the current business models, by overcoming the limited revenue growth potential from vehicle sales through increased revenues made per vehicle. Further, it could address the growing margin pressure, by introducing new avenues to improve costs, as this report will highlight.

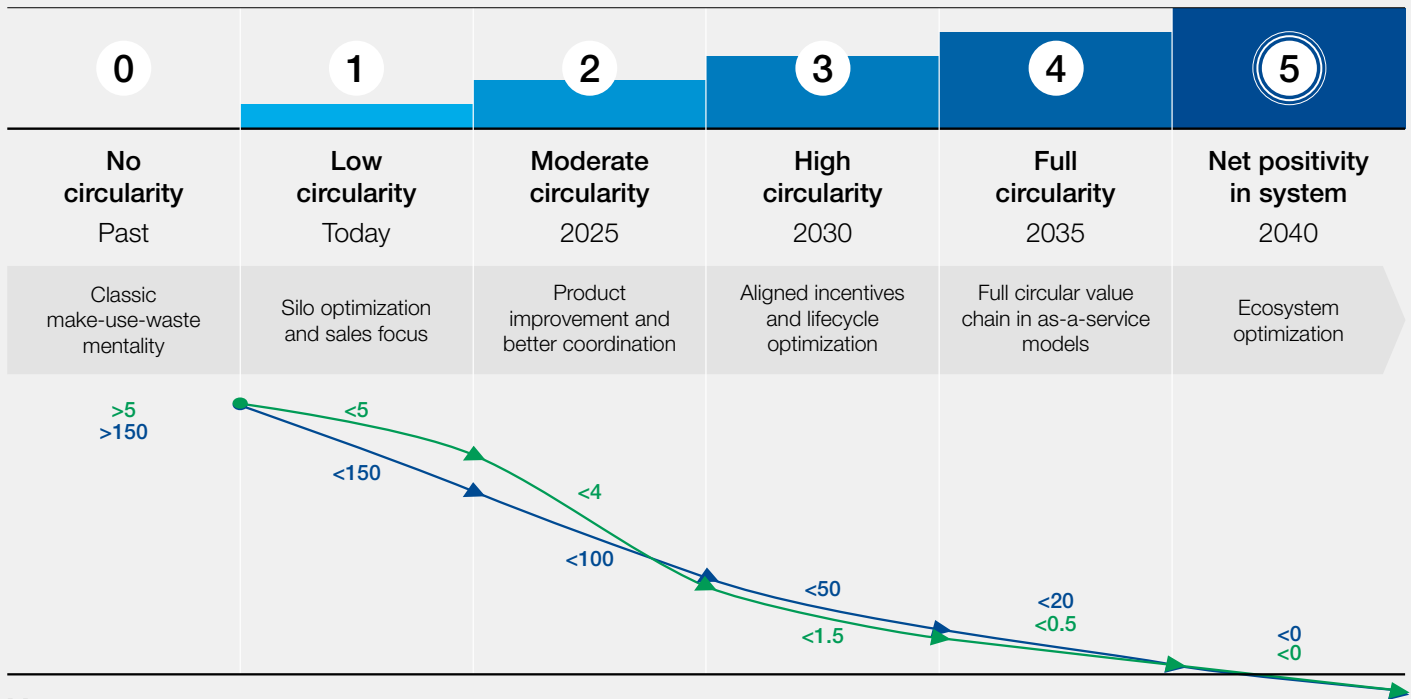
Regarding the challenges in the supply chain, particularly volatilities, circularity helps to improve resilience and predictability by, for example, circulating critical materials in more localized, high-quality recycling loops, or through recurring revenues over the vehicle lifetime. It could help to absorb shocks, such as the ongoing chip shortage, which caused a 7.7 million shortfall in 2021 vehicle production and \$210 billion in revenues alone;² or from volatile metal prices, which increased between 15% (Copper) and 102% (Nickel) over the last year;³⁴ or from the forecasted shortfall in Lithium, Cobalt (50% of demand) and Copper (80% of demand) by 2030.⁵

Circularity also addresses many of the sustainability demands from regulators, such as the new EU supply chain act, by increasing transparency and reducing mining exposure. It also addresses demands from financial markets, including those related to Environmental, Social, and Governance (ESG) and emissions aligned to the Paris Agreements' 1.5°C target, through the reduction of carbon emissions by up to 75% and resources consumption by up to 80% per passenger kilometre (km) until 2030.⁶ To achieve such improvements, the Circular Cars Initiative set out a guiding roadmap for the industry, introduced the five-level taxonomy of circularity and outlined four pathways of circularity transformation in 2021 (see Figure 1). This report expands on this work, laying out where automotive circularity creates new value pools and how these value pools can be achieved.

“Circularity could help to absorb shocks, such as the ongoing chip shortage, which caused a 7.7 million shortfall in 2021 vehicle production and \$210 billion in revenues alone.”

FIGURE 1 | Overview of the five-level circular cars taxonomy, as well as transformation pathways and corresponding circularity initiatives

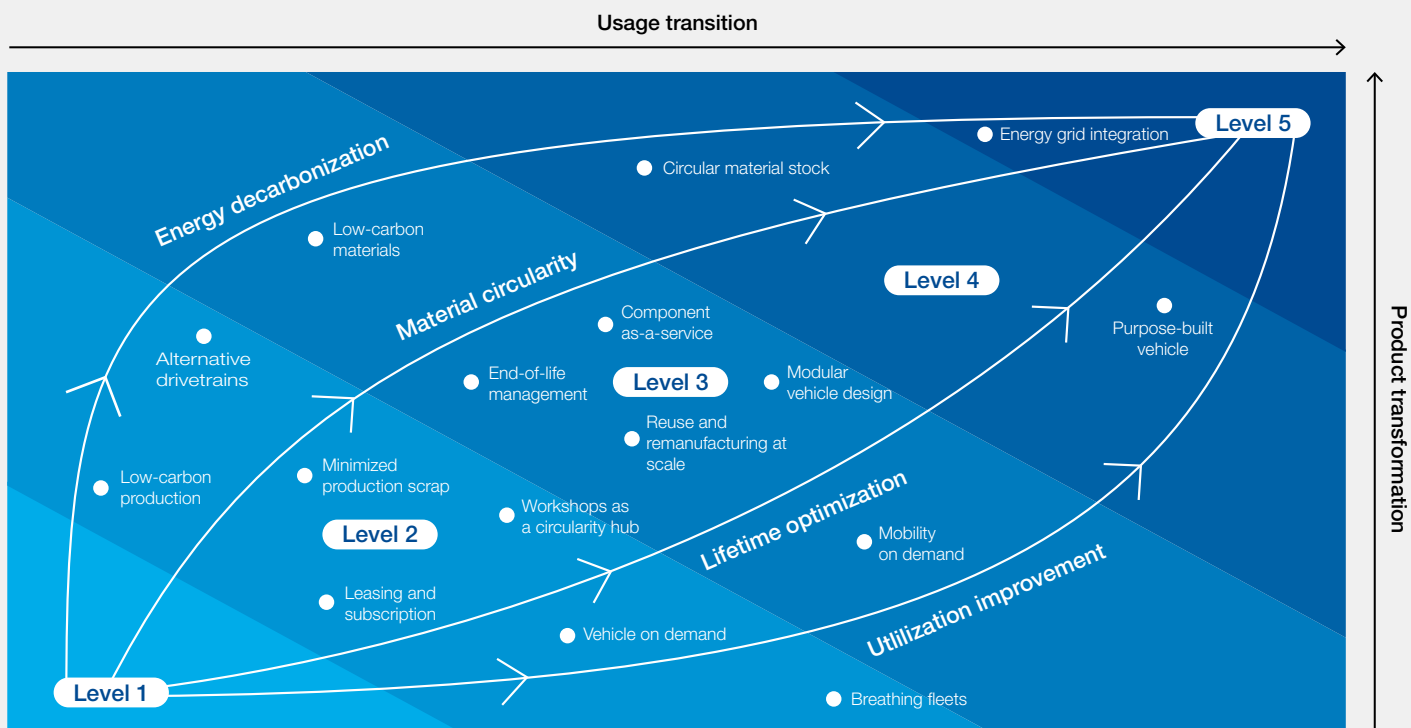
Levels of circularity



Measures



Transformation pathways and corresponding circularity initiatives



○ Example solutions Positioning of circles represents high application level of solution

Source: World Economic Forum and Accenture Strategy, *Raising Ambitions: A new roadmap for the automotive circular economy*, 2021.

1

A new perspective for creating value with circularity

Companies can reap the full value of circularity by shifting their business case perspective towards value chain and life cycle optimization.

Companies can reap the value potential of circularity initiatives by shifting the perspective of the business case beyond the existing organizational scope towards the full vehicle life cycle. This approach helps to uncover the revenue and cost synergies from circularity initiatives across production, services, life cycle optimization and end-of-life processing.

This represents a paradigm shift and fundamentally changes the approach of each player along a circular automotive value chain, broadening their capability to create and capture value. A circular value chain could not be constructed by adding up a range of isolated, linear business cases across the value chain.

To make the circularity business case work for an individual company, the key lever is its ability to account and monetize the cost and revenue benefits it creates across the value chain and life cycle. Setting up suitable revenue mechanisms requires a broad life cycle data infrastructure and alignment between players regarding value measurement and distribution. This makes as-a-service models more likely, as they can better internalize the distributed value into their business case. The following chapter offers a first glimpse into where these value pools are and what potential initiatives could be. The conclusion chapter offers an overview of the concrete steps and choices that companies can take to create business value from circularity.



The business case of a circular value chain is fundamentally different from that of a linear value chain case:

- Costs and revenues of circularity initiatives are often distributed across different value chain players and stages of the life cycle.
- Optimization is focused on the efficiency and effectiveness of the full value chain and vehicle life cycle rather than internal operations and margins alone.
- Business growth is oriented at increasing lifetime revenues and profitability per vehicle (i.e. materials used) instead of only producing and selling a larger number of vehicles.

Thus, the business case for circular cars optimizes full lifetime unit economics of a vehicle, while accounting for the distribution of costs and revenues over the lifetime and corresponding costs of capital. This is next to more usual factors, such as economies of scale and technology costs.

② Value pools – improved profitability and revenues per car

Circularity offers an opportunity to improve profitability about 1.5 times across the value chain and to tap revenues per vehicle 15–20 times its sales value.



2.1 | Circularity significantly expands the value pools per vehicle

Circularity significantly increases value pools over the life cycle of a vehicle, offering companies the opportunity to move beyond the limitations of their current linear business. These limitations are due to revenue sources coming primarily from vehicle sales, financing of young cars and aftersales, as well as cost reduction potential being explored only on the process level rather than cross-value chain level. The prevailing business models incentivize and require mostly insular business case optimization.

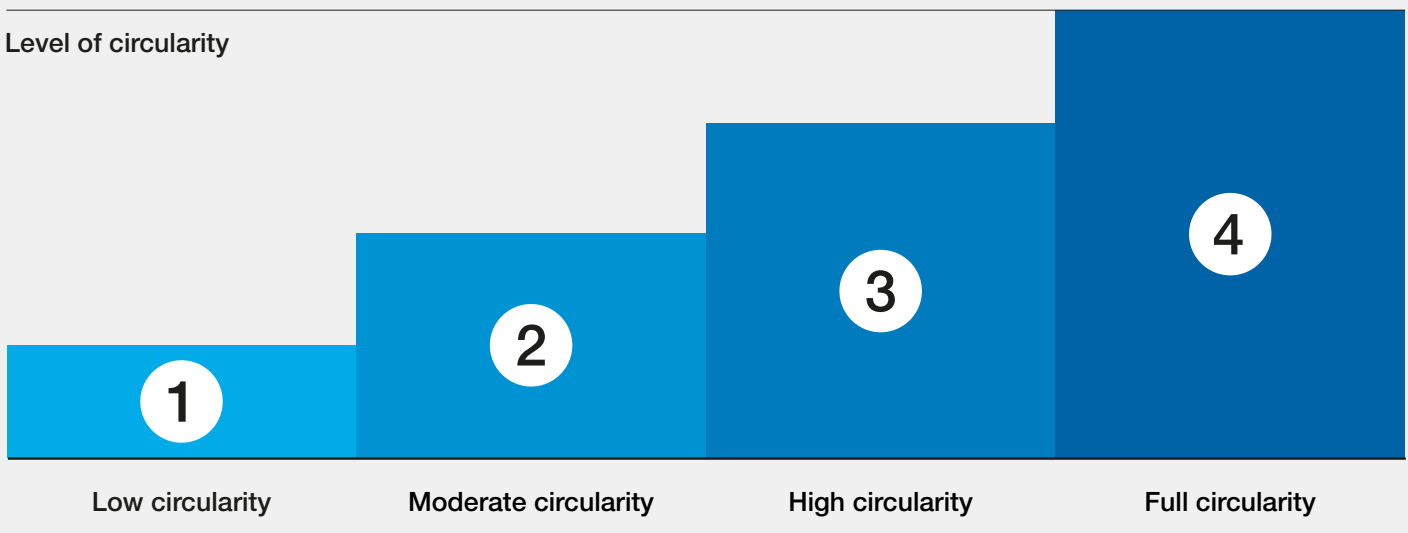
A shift from the current linear value chain (Level 1, ~2022) to a fully circular value chain

(Level 4, ~2035) vastly increases the business potential relating to each produced vehicle over its full life cycle (also see Figure 2; this does not consider resale, insurance or fuelling in the linear value chain):

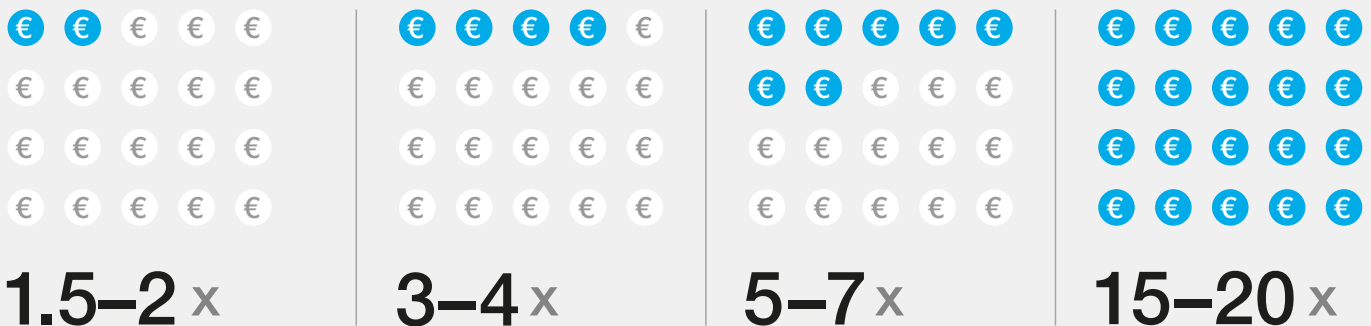
- Revenues per vehicle increase by around ten times over the life cycle, to 15–20 times the vehicle sales price.
- Profitability of the overall value chain increases by around 1.5 times.
- Profit per vehicle over its life cycle increases up to around 15-fold overall.

FIGURE 2 | Embracing full circularity could unlock lifetime revenues per vehicle that are 15–20 times greater than its sales price

Total automotive value chain revenues accrued over the life cycle of a vehicle relative to the sales price



Ratio of vehicle life cycle revenues to sales price



Note: Analysis is based on absolute values, i.e. does not account for net present value. 'Life cycle' figures include all revenues and costs across the automotive value chain over the whole life cycle of the vehicle, i.e. production and sales, as-a-service models, repair and maintenance, remanufacturing and end-of-life. High (Level 3) and full (Level 4) circularity scenarios include charging, insurance and parking costs due to their incorporation in the business models. These costs are excluded in low (Level 1) and moderate (Level 2) circularity scenarios as the costs fall outside of the core automotive revenue streams.

Source: Accenture analysis



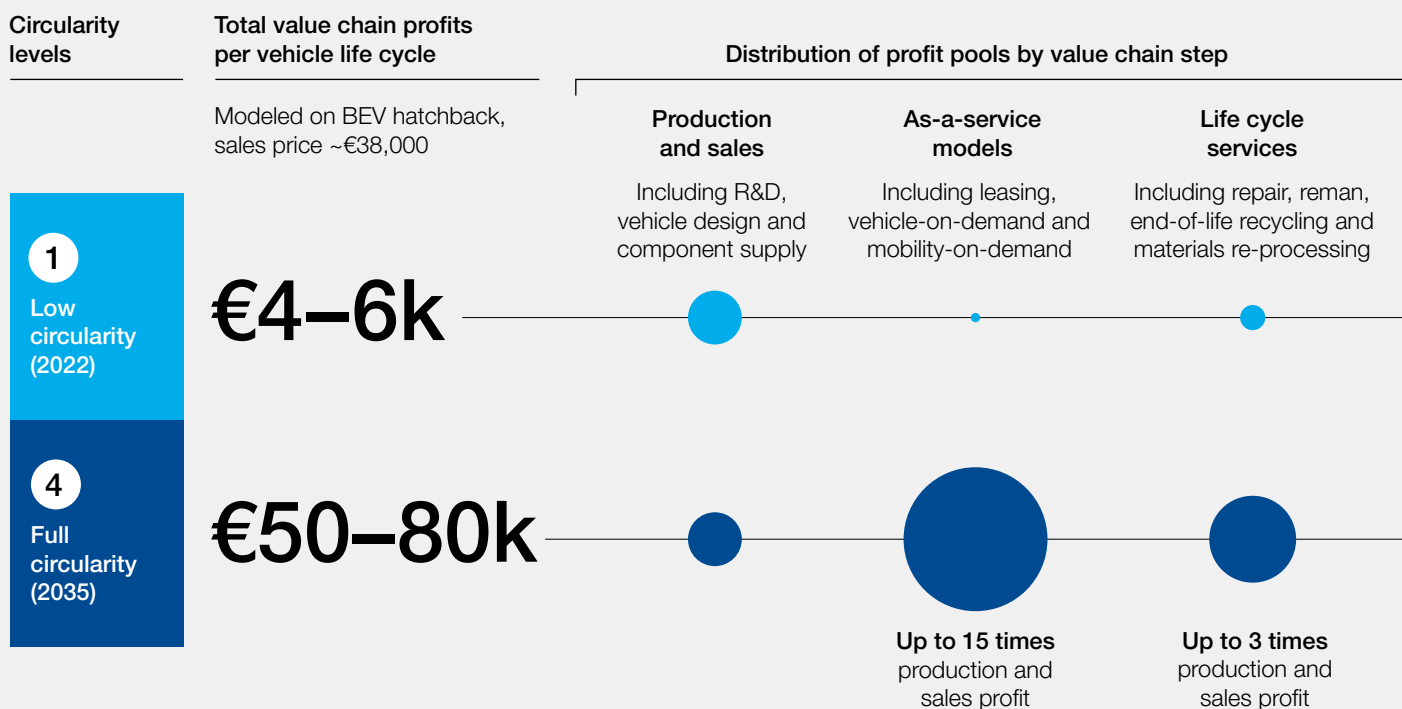
New circularity value pools mainly materialize in as-a-service models (leasing/subscription, car sharing, mobility-as-a-service (MaaS)) and life cycle services (reman, repair and recycling). This is due to the focus of circularity on maximizing the lifetime value of the car. Key factors are extended vehicle usage lifetimes in these models – up to five times their regular two to three-year cycles – along with increased use, made possible by regular predictive maintenance and more advanced life cycle services. Production and sales profit pools could increase by up to 20%

per vehicle, due to the improved cost structures of recycled raw materials and more standardized production in modularity and purpose-built vehicles. At the same time, they would likely also be impacted by the decreasing costs and sales price of electric vehicles, which are not related to circularity.

Overall, the shift in value pools lead to life cycle services offering up to three times the profits of production and sales and as-a-service providing up to 15 times the profits of production and sales.

FIGURE 3 Battery Electric Vehicle (BEV) hatchback case study: the additional life cycle value that can be created by embracing full circularity

Total automotive value chain profits per vehicle life cycle and distribution of profit pools per vehicle across the value chain
(Total value chain profits per vehicle life cycle)



Note: Baseline vehicle represents mid-sized battery-powered electric vehicle hatchback with MSRP of €35,000–39,000. Analysis is based on absolute values, i.e. does not account for net present value. When modelling as-a-service model profit pools, the low (Level 1) circularity scenario is modelled as a vehicle ownership-only scenario, thus excludes as-a-service revenues while full (Level 4) circularity is modelled as a mobility-on-demand only scenario.

Source: Accenture analysis

“ Formulating the right narrative to shift consumer preferences towards mass adoption of access-based models will be a key strategic enabler to higher circularity returns.

To better understand the data, it must be pointed out that the analysis of value pool shifts is not exhaustive. It especially does not consider vehicle resale, as well as insurance or fuelling in the linear value chain. Even though the used car resale market is huge and potentially a significant opportunity to expand revenues, the value pool analysis only considers activities of refurbishment and remanufacturing. These improve circularity by expanding vehicle or component life cycles and could also be part of vehicle resale. Insurance and fuelling are only considered in the value pools analysis once they are part of the as-a-service offerings in a full circular value chain.

It must also be noted that our model evaluates different vehicle use case scenarios as the automotive value chain moves towards full circularity. At its most basic level, the vehicle use case is split into two categories: ownership (Level 1) and access (Level 2–4). Within access, three different consumer-facing business cases have been modelled: full-life leasing (Level 2), vehicle-on-demand (Level 3) and

mobility-on-demand (Level 4). While it is understood that it is unlikely that there will be a future where mobility-on-demand is the only use case (as modelled in Level 4), but rather a mix of mobility modes scenario, this distinction enables two key insights to be drawn across the four usage models:

1. Carbon- and resource-efficiency are maximized in access-based models.
2. Total life cycle costs are better optimized in access-based models and best optimized in Level 4 (a MaaS scenario).

Thus, we can conclude that, while it is possible to benefit from improved circularity in the current ownership intensive scenario, the returns on circularity (profit and environmental) are strongest in access-based models where vehicle use is intense. This indicates that formulating the right narrative to shift consumer preferences towards mass adoption of access-based models will be a key strategic enabler to higher circularity returns.



2.2 Drivers and tipping points supporting the value pool expansion per vehicle

The expansion of value pools per vehicle in a fully circular value chain is driven by new revenue streams and cost reductions from circularity initiatives across the value chain. The increase in circularity, and resource efficiency, often also leads to improved business value.

New revenue streams

- Significant as-a-service revenues, from subscriptions and leasing to vehicle-on-demand and MaaS, due to the vehicle's usage lifetime being extended in these models.
- Increased revenues in remanufacturing and vehicle repair, due to higher mileage and uptime improvements associated with as-a-service models.
- Significant improvement of end-of-life material value, due to design for recyclability and improved recycling technologies.
- Slightly improved vehicle sales value, due to circular low-carbon materials and production, as well as purpose-built vehicles – this revenue uplift could be offset by modular design.

Cost reductions

- In material sourcing through increased high-quality recycled material flows from end-of-life vehicles
- In production, due to hyper-standardization of modules and purpose-built design

- In vehicle sales to asset managers of as-a-service business models
- In fleet servicing (leasing to MaaS), due to more standardized repairs
- In asset costs, due to extended vehicle mileage (enabled by improved repairs) and improved use (enabled by purpose-built design)
- In critical technologies, like low-carbon materials and recycling technologies, driven by investments in research and development and scale effects.

The shift to a fully circular value chain changes profitability so drastically that, in addition to improving the profitability of existing businesses, some businesses that are not currently profitable can become viable. This holds especially true for full lifetime leasing, vehicle-on-demand and MaaS. These business models profit from maintaining asset ownership over the full life cycle and thus incorporating all circularity cost and revenue improvements into their business case.

The case of MaaS is especially revealing, as it obtains drastic profitability improvements. This is due to the expanded usage time in these models and the application of circularity initiatives. Costs are reduced as a result of improved vehicle use and servicing, as well as in production from circular materials and standardized, modular vehicle design. Revenues increase from usage lifetime extension and purpose-built vehicles, which enable increased asset use and occupancy rates, in addition to stark improvements in end-of-life material value, due to improved logistics and advanced recycling technologies.



Opportunity to reduce material sourcing costs and volatility:

Vehicle recycling rates today are fairly high (e.g. about 65% of end-of-life vehicles in the European Union are recycled in the formal system),⁷ with most of the material being recycled, particularly steel and aluminium. Nevertheless, the recycled materials from cars are usually not processed in a way that allows them to be looped back into automotive manufacturing. Scaling advanced recycling infrastructure and upgrading recycled materials processing could unlock a significant supply of secondary materials in automotive grade quality (e.g. around 50 million tonnes per annum of secondary steel, or around 2 million tonnes per annum of the secondary battery material Lithium, by 2035 globally). The availability of these secondary materials could prevent high price volatility and eventually enable local closed loop systems (e.g. it is expected that available scrap will meet annual steel demand in the European Union by 2050).⁸



During the transformation from a linear to a fully circular value chain, the business case evolves. In the initial three to five years, there is a reduction in value chain profitability. This is due to the higher investments and research and development required to build the infrastructure and advance key technologies such as recycling and modularity. However, within five years, profitability returns to its prior levels, and thereafter increases even further. Increased costs mainly occur in vehicle design and production as well as recycling, in order to improve recyclability and repairability and to make them purpose-built for MaaS. These costs can be recovered through: (a) higher revenues in as-a-service

models, due to improved vehicle lifetime performance and residual value; (b) higher initial vehicle sales prices, due to enhanced circularity performance (this is until standardization leads to a reduction in production costs and prices for vehicles in MaaS); and (c) reduced recycled material prices as a result of increased supply of automotive grade recycled materials from end-of-life vehicles and batteries.

These investments must be regarded as part of the automotive transformation aimed at making supply chains more resilient. Furthermore, the cost of inaction might well be greater than the transition costs stated here.



The case of asset ownership and cost of capital:

The case of asset ownership of the vehicle stock in the different as-a-service models is concerning for automotive companies, particularly regarding the notion that it would dilute returns on assets. Modelling suggests that this common assumption is true for leasing, but less relevant for car-sharing or MaaS.

A business model that leases cars over their full lifetime would be massively impacted by different costs of capital. With every percentage point of capital costs increase, simultaneously reducing profitability by around 1 percentage point. With 3% capital costs, the model could reap profits of around 8%, while at 15% capital costs it would be around -6% at loss. Nevertheless, this effect is mostly due to leasing being a highly competitive financing-oriented model, where most of costs and revenues are due to the financing and only minor effects can be achieved through optimized repair, lifetime value and other typical circularity measures. These models would require a long-term asset investor with low capital costs to be financially feasible.

For more heavily used and shorter lifetime of cars, in car-sharing or MaaS models, the cost of capital plays an increasingly less important role. Due to the high annual revenues and steep depreciation of a car over only five years, every percentage point of cost of capital increase only reduces profitability by around 0.07 percentage points. For this reason, a broader range of asset owners could be feasible, without significantly impacting the case.

2.3 Combining circularity initiatives mutually reinforces value creation

Business value creation from circularity initiatives is primarily driven by:

1. Cross-value chain cost and revenue synergies between initiatives
2. Positive technology cost curve developments, particularly in life cycle services such as recycling
3. A range of breakthrough business models, particularly in as-a-service, becoming viable in a fully circular value chain.

Cross-value chain benefits between circularity initiatives

Circularity initiatives often create cost and revenue benefits across the value chain, outside of the scope of the original initiative or organization.

These benefits must be measured and monetized to make the case for circularity work.

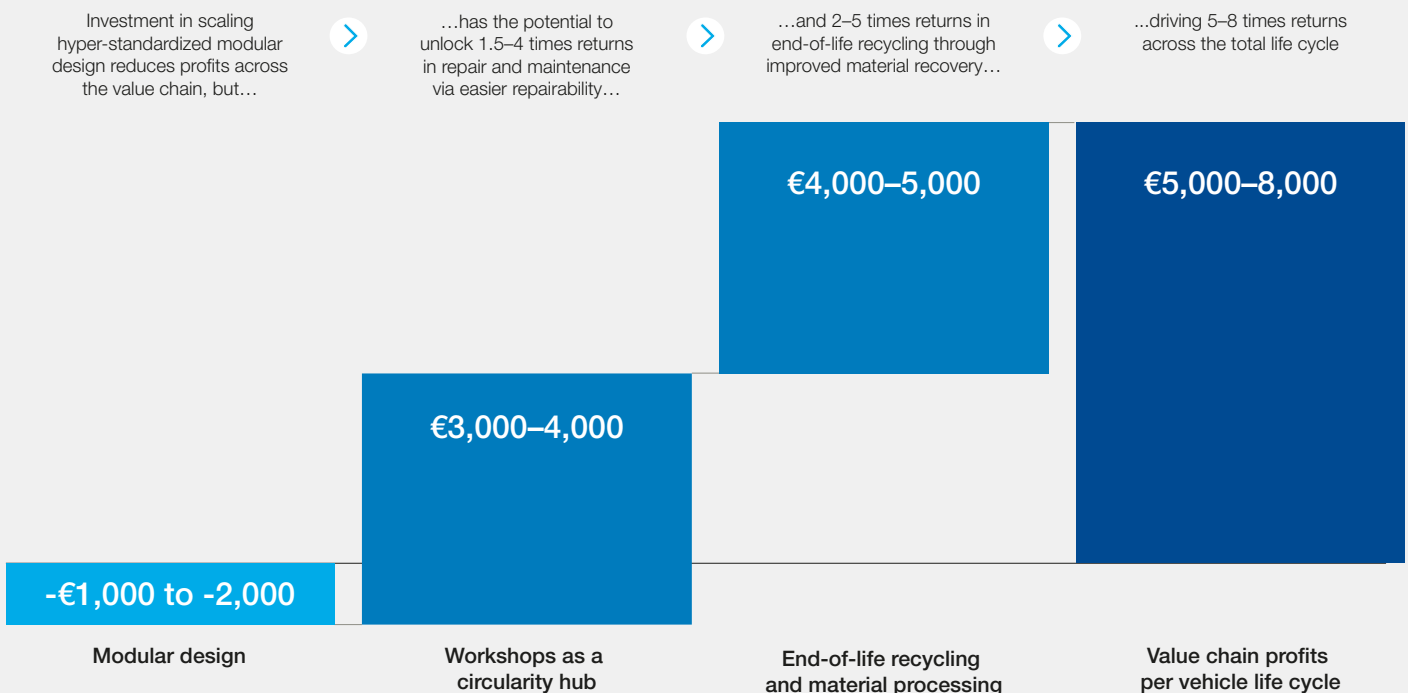
The example of modular vehicle design illustrates the benefits of cross-value chain collaboration. The initial costs of implementing the solution, during design, production and sales phases – in a full value chain perspective – are more than compensated by 1.5–4 times profits in repair workshop, stemming from easier and increased repair, and by 2–5 times profit improvements in end-of-life recycling, through improved material recovery (weight and quality) (see Figure 4). Original equipment manufacturers (OEMs) can tap into this value through improved sales prices, while mobility-providers can reduce lifetime costs per passenger km. This will require investments in modular design capabilities and close interlock and data sharing with repair and end-of-life value chain steps.

FIGURE 4

Case example – Circular business cases should account for benefits between circular initiatives to understand their true profit potential, for example, investment in modular vehicle design unlocks profits in other areas of the value chain

Impact on total automotive value chain profits per vehicle life cycle from implementing modular design, workshops as a circularity hub and end-of-life recycling in a full circularity scenario

(Change in total value chain profits per vehicle life cycle)



Note: Baseline vehicle represents mid-sized battery electric vehicle hatchback with MSRP of €35,000–39,000. Analysis is based on absolute values, i.e. does not account for net present value.

Source: Accenture analysis

Over time, circularity significantly increases revenues from end-of-life vehicle recycling and material processing from about €200–500 to about €8,000–13,000 per vehicle.

Positive technology cost curve developments and improved profitability over time

Circularity is also expected to become more profitable in the coming years due to cost reductions resulting from technological advancements and the new revenue streams that will result from widespread implementation of new technologies, such as in recycling.

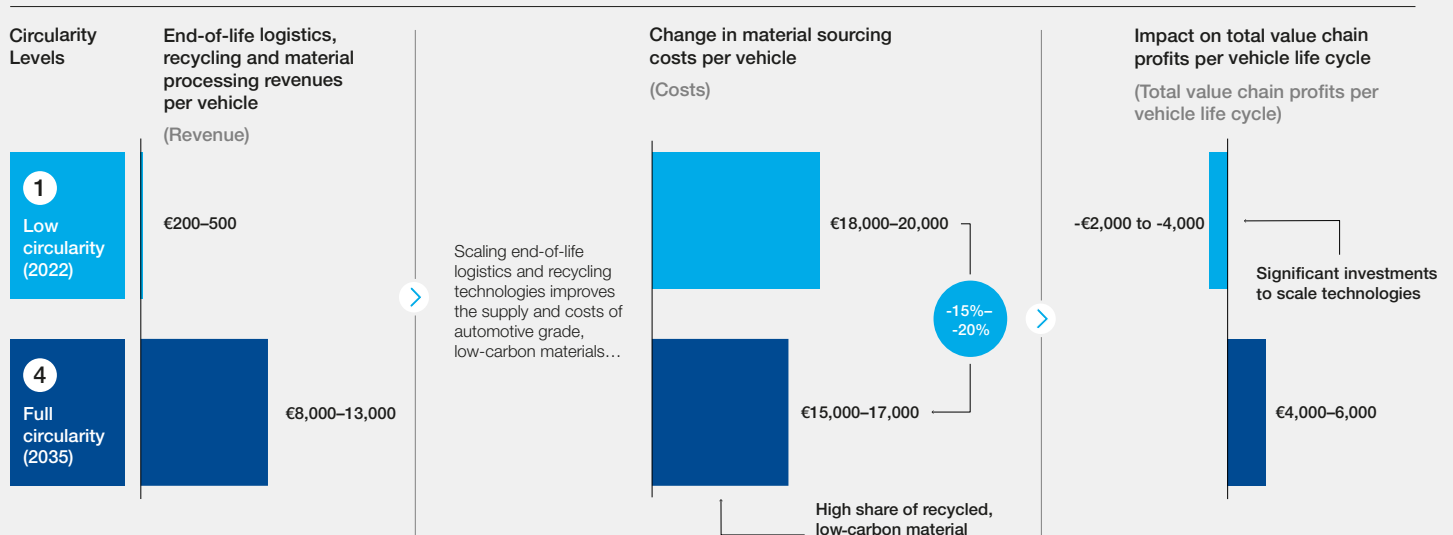
End-of-life vehicle treatment and logistics is a good example of how technological improvements can shift the circularity business case. Over time, circularity significantly increases revenues from end-of-life vehicle recycling and material processing from about €200–500 to about €8,000–13,000 per vehicle. Similarly, a circular

value chain offers benefits by improving material availability, consequently reducing costs for low-carbon materials by about €3,000 per vehicle (see also Figure 5). Overall, the impact of the initiative improves from initially reducing value chain profitability by -€2,000 to -4000 in low circularity (Level 1, 2022), to improving profitability by around €4,000–6,000 in full circularity (Level 4, 2035). Scaling this initiative requires investments in advanced recycling technologies, easier recyclability via modular vehicle design as well as vehicle data transparency (e.g. product passport). These investments are distributed between recyclers and OEMs, both of which are also the main beneficiaries of this initiative. The viability of the case depends on the development of raw material availability and prices, the speed and cost of technology development and the building-up of a vehicle data infrastructure.

FIGURE 5

Case example – Scaling end-of-life logistics and recycling technologies can close the loop for critical materials, driving supply chain resilience and lower material input costs

Impact of improving end-of-life logistics and recycling technologies on low carbon material sourcing costs and total value chain profits per vehicle life cycle



Note: Baseline vehicle represents mid-sized battery electric vehicle hatchback with MSRP of €35,000–39,000. Analysis is based on absolute values, i.e. does not account for net present value.

Source: Accenture analysis

Breakthrough business models becoming viable in a fully circular value chain

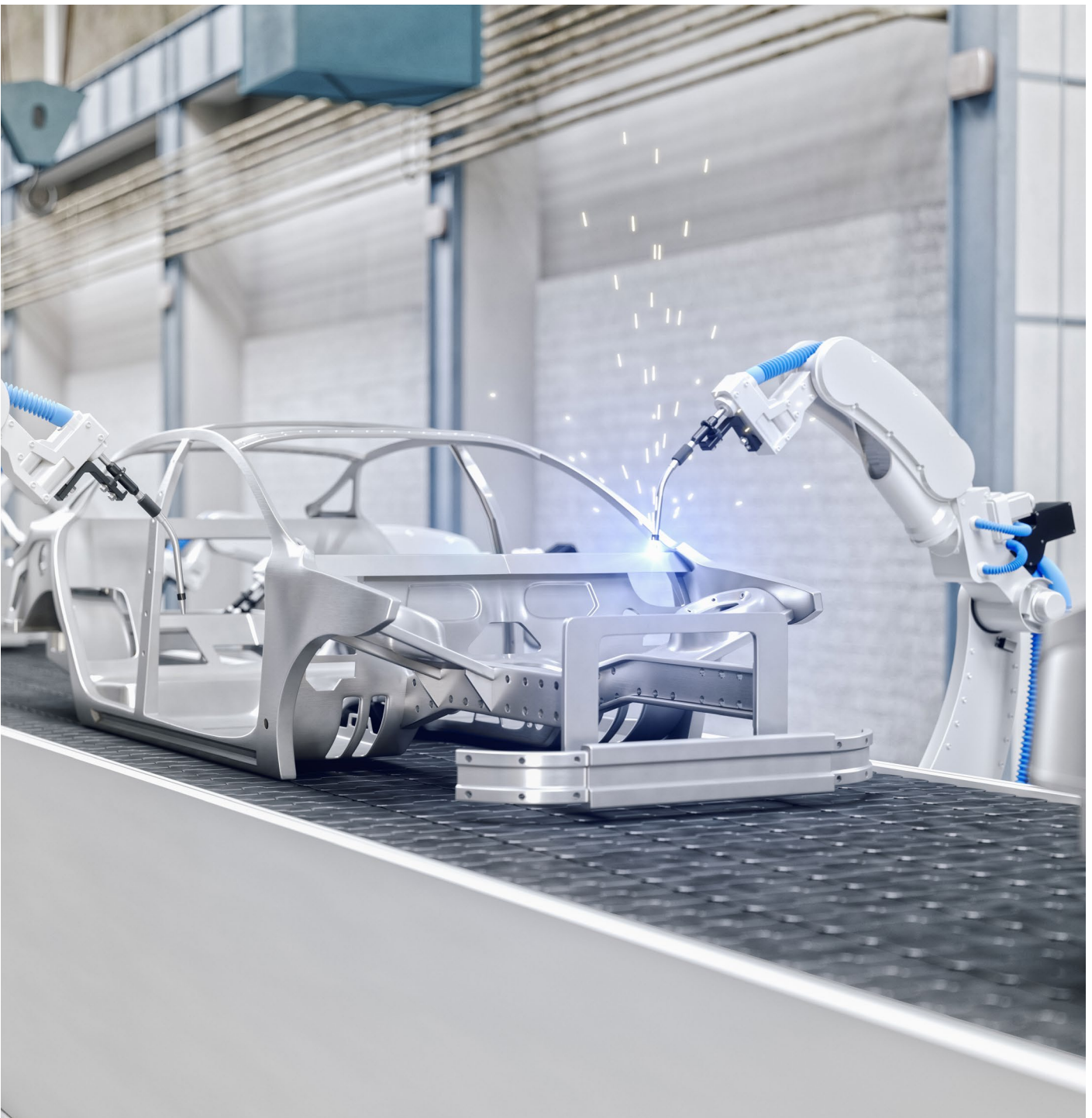
Circularity initiatives have a mutually reinforcing efficiency and value generating effect, particularly at higher maturity. In this set-up, from 2030 onwards, a range of breakthrough business cases can be implemented thanks to improved cost and revenue benefits across the value chain. The most impacted are as-a-service business models, which benefit from circularity cost improvements

in life cycle services, as well as increased revenues from higher vehicle mileage and asset value, particularly at end-of-life. On a smaller scale, existing profitable business models (e.g. in vehicle repair or remanufacturing) can further increase revenues and profits per vehicle due to longer vehicle mileage and increased, standardized demand. Beneficiaries are mostly the asset manager, mobility services operators and life cycle service providers. Key signals for the arrival of these cases are maturing circular value chains and sustained demand for as-a-service offerings, from leasing and subscriptions to vehicle-on-demand and MaaS.

3

Setting up the operating model and value chain for circularity

The shift to circularity drastically changes the roles and operation practices of players along the value chain.



To unlock the outlined potential of a circular economy in the automotive industry, the entire value chain forms a loop, characterized by a high level of collaboration and transparency across all players. The transformation process behind it will be fostered and initiated by a “value chain orchestrator”, and requires changes to the operating model of each player within the value chain.

Full circularity transforms each step and player in the value chain

In a fully circular value chain (see Figure 6), players along the value chain form a loop of highly interconnected activities oriented towards effectively

servicing personal mobility needs. The focus of the value chain shifts from vehicle production and sales, driven by the OEM and its suppliers, to vehicle usage and the customer’s personal mobility needs. This signifies a transition from building vehicles to building services (with circular cars).

To establish a fully circular value chain defined by new characteristics from each value chain step (see Figure 7), a shift towards a holistic approach beyond company boundaries is essential. Close collaboration and partnerships are vital between all actors along the value chain, building on a high level of transparency acquired through the exchange of data and information. Further, systemic thinking with an understanding of the entire circular value chain is necessary to set up effective alignment and collaboration.

FIGURE 6 Vision of a fully circular value chain (Level 4/5)



Source: Accenture Strategy



FIGURE 7 | Characteristics of each step in a circular value chain

Circular value chain step	Characteristics
Value chain orchestration	<ul style="list-style-type: none"> – Enhances collaboration and enables closing the loop for a circular value chain by aligning players and supporting mechanisms to settle costs and benefits across players – Guides the network of actors and creates the required transparency
Research and development	<ul style="list-style-type: none"> – Lays the foundation for the circularity of a car and value opportunities for all value chain steps – Embraces all steps along the value chain and includes all requirements of all stages along the life cycle
Financing	<ul style="list-style-type: none"> – Fosters the transformation through financing assets and lowering capital costs by shifting capital investments in carbon- and resource-efficient circularity models, as demonstrated by ESG investor preferences
Material sourcing	<ul style="list-style-type: none"> – Develops circular material flows, in consideration of CO₂ emissions and resource consumption, together with suppliers
Component manufacturing	<ul style="list-style-type: none"> – Fosters modularity and lifetime optimization of the vehicle – Enables circularity through direct connections to repair and remanufacturing as well as end-of-life value chain steps
Vehicle assembly	<ul style="list-style-type: none"> – Provides the ability for easier reparability, disassembly and recyclability via modularity and purpose-built vehicles
Marketing and sales	<ul style="list-style-type: none"> – Connects to customers throughout the vehicle life cycle – Sells services, improves customer experience and nudges sustainable behaviour
Repair and maintenance	<ul style="list-style-type: none"> – Optimizes the vehicle lifetime and is closely connected to (re)manufacturers and end-of-life players
Reuse and reman	<ul style="list-style-type: none"> – Optimizes vehicle and components lifetime, closely aligned with repair, manufacturing and end-of-life
Collection and disassembly	<ul style="list-style-type: none"> – Captures end-of-life vehicles via direct access due to commercial ownerships and digital asset tracking – Efficiently disassembles vehicles in scaled and automated processes
Recycling	<ul style="list-style-type: none"> – Defines standards and requirements for the research and development and production phases of a vehicle and provides high-quality recycled materials

Source: Accenture Strategy



A “value chain orchestrator” shapes the broader value chain transformation

Collaboration and partnerships, a prerequisite for a circular economy, will most likely be encouraged by one or several parties taking a central role within the circular value chain: the “value chain orchestrator”. This “orchestrator” establishes a direction and common framework for stakeholders along the value chain by assisting in the development of standards and regulations. This role further fosters collaboration among all players to align activities and enhance efficiencies, while laying the foundation to establish the required transparency.

The OEM – or a similar player with direct access to customers and responsibility for the research and development and production process of the vehicle – already plays a key role in the value chain and may therefore be held accountable for vehicle circularity, requiring them to take on the orchestration role. Currently, some OEMs are responding to these developments by increasing horizontal integration along the value chain. For example, AB Volvo founded Volvo Energy, which allowed them to align the end-to-end value chain for batteries, thus increasing circularity. Volvo Energy is able to

proactively manage and anticipate repair and reman cycles, allowing for lifetime optimization due to improved data transparency for each battery.

Likely, an organization or network will be responsible for guiding the circularity transformation and setting standards. For example, the Catena-X initiative provides a collaboration platform to jointly set standards and build end-to-end data infrastructure for vehicles – a task that individual players would not be able to accomplish alone. Similarly, the Partnership for Carbon Transparency (PACT) by the World Business Council for Sustainable Development (WBCSD) brings together relevant actors and steers their collaboration towards carbon transparency, while considering the needs of the different actors.

The orchestrator role can be undertaken in a deliberate and focused way, as well as incrementally. Often, companies or overarching networks take up orchestration roles around a concrete issue (e.g. securing recycled material flows for batteries) and gradually morph into broader roles with wider engagement across the value chain. Once established with mutually reinforcing processes, capabilities and value creation, the importance of this role might decrease and shift focus towards the continued development of the value chain and future innovation.

⚙️ Individual players can either gradually adapt their operating model to the circular car strategy, or follow a leaping transformation through horizontal expansion.

Transforming the players' operating model towards circularity

The circularity transformation of the value chain will require each player to transform its own operating model. The necessary changes can be derived from a novel circular car strategy that should be defined by each player individually.

The transformation of the operating model should be accompanied by a cultural and mindset change towards circularity and with an understanding of the full value chain and life cycle by also making it a pillar of performance management.

Further, transformation of the operating model will require players to build new capabilities and develop new technologies. It will include capabilities to govern, steer and manage collaborations as well as specific capabilities to optimize the life cycle of a vehicle and its components, for example, collecting and analysing vehicle life cycle and usage data and implementing corresponding circularity KPIs for each value chain step and function. Technologies should be developed and deployed to enable circularity. This could be in data and data transparency across

the value chain with product passports or digital vehicle twins, or in modular manufacturing or advanced disassembly and recycling technologies.

There are two possible scenarios for the transformation. Individual players can either gradually adapt their operating model to the circular car strategy, or follow a leaping transformation through horizontal expansion, which can be achieved through mergers and acquisitions or strong investments in building new capabilities, as in the example of AB Volvo.

The degree to which companies are affected by the circularity transformation varies. OEMs are highly exposed, as their business and operating model would fundamentally change. However, OEMs are in a central position within the current value chain that allows them to cope with the upcoming changes and adapt their models, as they have the potential to actively shape the transformation. Other players might increase cooperation and value-add while keeping core operations and business largely the same (e.g. in component manufacturing or repair).

However, the transformation of the individual player cannot be successful without following a holistic approach beyond company boundaries.



Conclusion

Companies must decide how far to tap circularity opportunities and get ready for circularity.

More resilience in automotive value chains is needed and circularity is a key contributor to that. The transformation to circularity is costly. However, as described above, the business case can work. The cost of inaction might be significantly higher.

To kick-start the circularity transformation, depending on the amount of investment and potential risks, companies could choose to first circularize a selected vehicle model or components, later circularizing the full business. Potential key steps to reap the benefits of a circular value chain are:

1. **Select an initiative or pilot scope** (e.g. a vehicle model, component, as-a-service or life cycle offering and the related market segment(s)) to build up the circular value chain. This can potentially address areas of high disruption and volatility, such as electric vehicle batteries or purpose-built vehicles for inner-city mobility services.
2. **Identify the value pools** around this initiative or pilot, accounting for costs and revenues across the circular value chain, vehicle life cycle and potential additional circularity initiatives by others. In addition, develop revenue mechanisms and business models to incorporate value pools into the business case and incentivize the creation of supportive circularity initiatives by other players (see also chapters 1 and 2).
3. Align a **shared vision and targets** for the circular value chain, including clearly defined key indicators, with all affected stakeholders, potentially leveraging support of overarching networks acting as “orchestrators” (see also chapter 3).
4. **Build circularity capabilities** in the company and across the value chain, particularly for collaboration and data transparency, to align and improve circularity performance and value pools (see also chapter 3).
5. **Roll out the initiative/pilot**, drive customer demand and develop circularity opportunities along the value chain, review status and potentially expand to further business areas.

When deciding where to first focus circularity initiatives and pilots, a look at the circularity impact potential and current volatilities can act as guidance. This could lead to the following rough order of focus points for circularity initiatives:

1. **Close material loops**, particularly at end-of-life recycling, starting with individual components such as batteries.
2. **Improve vehicle life cycle performance**, particularly its lifetime, through improved repair and reman and disassembly.
3. **Increase use**, via service models, either as as-a-service or sharing platforms for private owners.

Circularity value pools can be tapped by any player who takes advantage of them. It is an opportunity for OEMs to expand into services, as well as for asset managers or mobility providers to integrate vehicle design, life cycle services and end-of-life more closely. It offers the chance to recover investments into the necessary circularity transformation and build new, more sustainable revenue avenues. Thus, OEMs, mobility players and ecosystem providers must make strategic choices on how much they wish to change to reap the opportunities of a circular value chain along three key areas:

1. **Transformation of the core business** is the basis to participate in a circular value chain achieved through co-innovation and partnering.
2. **Collaboration with or expansion into connected value chain steps** offers the opportunity to reap more benefits and increase circularity. For example, by co-innovating and partnering between manufacturing and end-of-life, building new capabilities or conducting acquisitions for selected value chain steps.
3. **Integration or expansion into the full spectrum of circularity, connecting design, production, as-a-service offerings and life cycle services** is likely the “end game” for many players, as this offers the highest potential to tap benefits through co-innovation and partnering, building new capabilities or conducting acquisitions along the fully circular value chain.

The future set-up will likely feature diverse circular value chain types as well as segments of as-a-service offerings, sales and private ownership models. Thus, companies have a choice where and to what level of circularity to build out their value chain.

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Circular Cars Initiative

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Endnotes

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