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Investing in Circularity in the Auto Industry: Proposed Benefits & Monetization Methods

November 2025



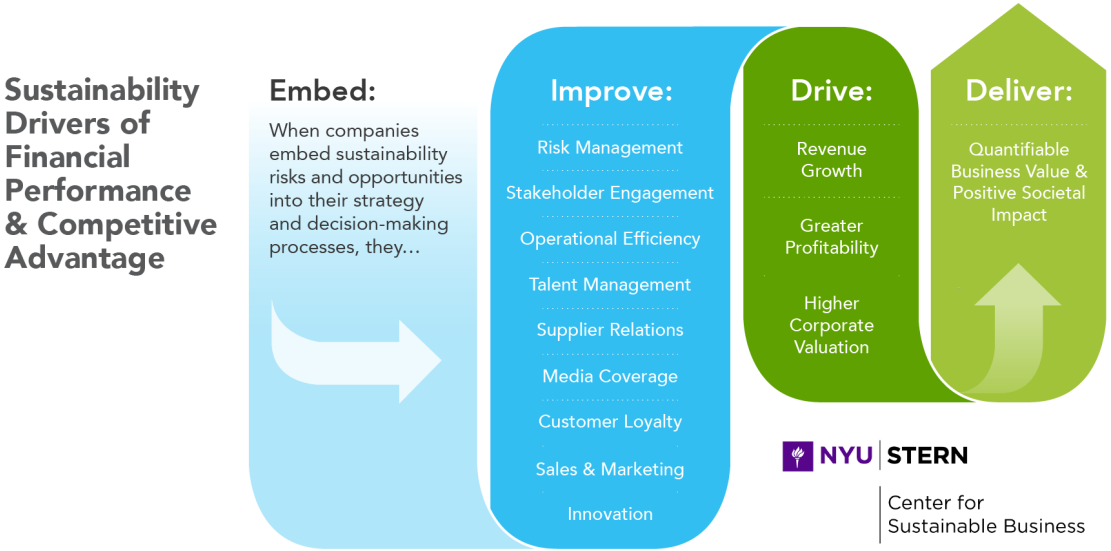
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ROSI™ Framework

Return on Sustainability Investment (ROSI™) Framework



By embedding ESG risk and opportunities within core business strategy, the return on sustainable investment can be quantified, delivering the possibility of both financial value and positive societal impact.

Overview of Auto Industry Framework

NYU Stern CSB is developing a ROSI™ framework for the auto industry with publicly available monetization tools to help the industry understand where and how sustainability can unlock financial value.

Based on research, experience, and engagement with industry leaders, we have identified the following sustainability strategies* used by the industry to include in the framework:

- Mitigate & Adapt to Climate Change
- Waste Management
- Water Management
- Chemical Management
- Support Electrification Ecosystem
- Circularity
- Cyber Security
- Sustainable Sourcing
- Driver Safety
- Supplier and Employee Well-Being

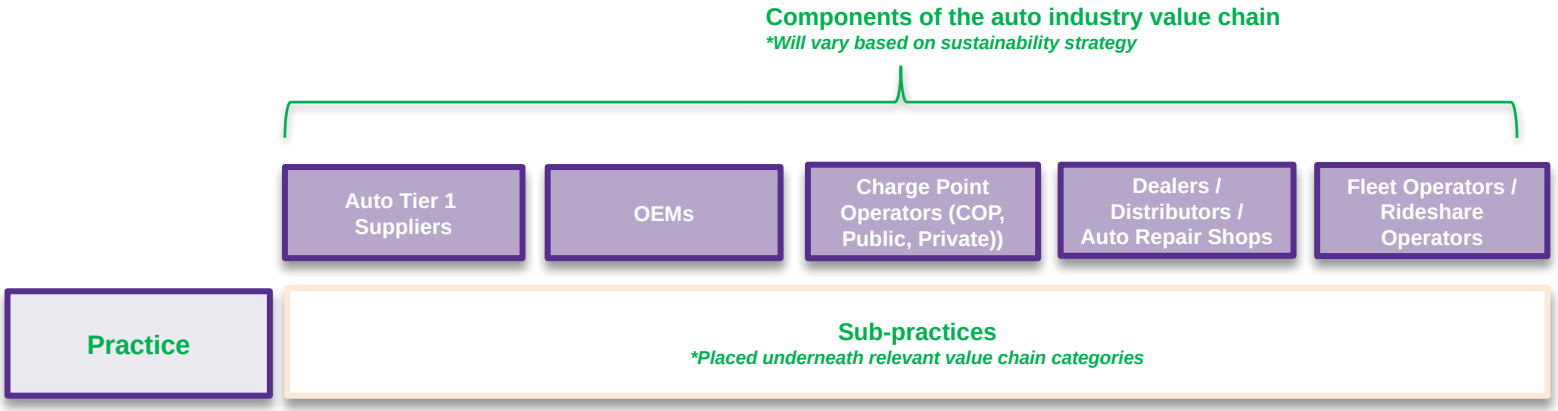
Identified Sustainability Practices and Sub-Practices

Framework Layout

Through our research, we identified key sustainability practices and sub-practices that auto industry value chains are using to achieve their sustainability goals.

- **Each practice is broken into sub-practices, which are mapped to the relevant components of the value chain (and excluded where not applicable).**
- **Benefits are mapped to sub practices, with some benefits appearing across multiple practices.**
- **Specific compliance or enforcement policies are not listed in this framework, except for the new Cross Border Adjustment Mechanism regulations.**

The diagram below illustrates the framework applied for each strategy in the following slides



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Investing in Circularity

Investing in Circularity

	Auto Tier 1 Suppliers	OEMs	Charge Point Operators	Dealers / Distributors / Auto Repair Operations	Fleet Operators / Rideshare Operators
Embed Circularity* in Design, Manufacturing and Services	Design cars for easy disassembly				
	Design cars to incorporate refurbished and recycled parts and materials				
	Implement processes for refurbishing, remanufacturing, recycling, and repurposing			Implement processes for refurbishing, remanufacturing, recycling, and repurposing	
Invest in End-of-Life Initiatives	Implement vehicle recovery programs (including disassembly and recycling)			Implement vehicle recovery programs (including disassembly and recycling)	
	Invest in battery recycling technologies			Invest in battery recycling technologies	
	Form upstream and downstream partnerships for vehicle disassembly and recycling and part repair / refurbishment / recycling programs			Form upstream and downstream partnerships for vehicle disassembly and recycling and part repair / refurbishment / recycling programs	

*Circularity of materials are also detailed in Waste, Water, Chemicals and Sustainable Sourcing strategies.

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Monetization Approach

Investing in Circularity

Overview of Sustainability Strategy and Relevant Value Drivers

Sustainability Strategy Definition

Circularity	Auto industry companies are investing in circularity strategies to design cars for disassembly, refurbish and recycle parts for resale, and incorporate refurbished and recycled materials into new car manufacturing, including efforts focused on recycling EV batteries

The following slides focus on the benefits and relevant value drivers derived from the *Circularity* strategy

Relevant Value Drivers	**Benefits that…**
Operational Efficiency (OE)	Optimize corporate and supply chain efficiencies to lower cost and increase profits
Sales and Marketing (SM)	Increase volume of sales through brand and marketing policies
Customer Loyalty (CL)	Attract an increasing community of conscious buyers & consumers, while reducing retention costs
Risk Management (RM)	Encourage risk mitigation and resilience within the value chain

Investing in Circularity

Overview of Sustainability Strategy and Relevant Value Drivers (continued)

In the following slides, we focus on benefits from the *Circularity* strategy, which are categorized based on the relevant value drivers highlighted below

Relevant Value Drivers	**Benefits that…**
Stakeholder Engagement (SE)	Improve goodwill among the broader stakeholder community (i.e. investors, NGOs)
Talent Management (TM)	Attract and retain high-quality internal talent
Supplier Relations (SR)	Improve upon the relationships between the company and its suppliers
Innovation (IN)	Create new revenue streams using sustainable business models

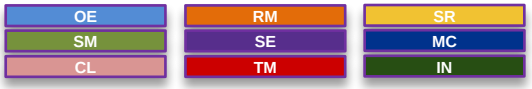
Value Drivers not Captured in this Strategy

Media Coverage (MC)	Increase a company's media presence with the development of traditional and social media content

Investing in Circularity in Design, Manufacturing, and Services

Overview of Benefits and Monetization Methods

Practice	Sub-Practice*	Proposed Benefits	Value Drivers	Suggested Monetization Methods
Embed Circularity in Design, Manufacturing and Services	Design cars for easy disassembly	Focusing on circularity can lead to proprietary product or process **innovations**	IN	Assess the impact of proprietary products and services on potential for licensing income, competitive pricing power, and competitive defensive positioning to quantify the benefit
	Design cars to incorporate refurbished and recycled parts and materials	Embedding circularity for disassembly/refurbishing/recycling increases **revenue** from sale of recycled materials and reused parts	SM	Calculate the amount of recycled materials and parts to be sold and multiply by the average price to quantify the benefit
	Implement processes for refurbishing, remanufacturing, recycling, and repurposing	Embedding circularity for disassembly/refurbishing/recycling reduces **GHG emissions**	OE, RM	Calculate the average annual per unit GHG emissions before (baseline year) and after material changes have been made. Multiply the reduction in GHG emissions with an associated cost per unit (e.g. internal price of carbon or carbon offset costs) to quantify the benefits. Alternative approach is to consider the reduction in emissions as a hedge against rising cost of carbon costs. In this case, forecast future carbon prices and multiply the amount of emission reduction by the change in carbon price to quantify the benefit



Value Drivers based on color coding illustrated on previous slides

*Each Sub-Practice has the potential to drive all benefits.

Investing in Circularity in Design, Manufacturing, and Services (continued)

Overview of Benefits and Monetization Methods

Practice	Sub-Practice*	Proposed Benefits	Value Drivers	Suggested Monetization Methods
Embed Circularity in Design, Manufacturing and Services	Design cars for easy disassembly ——— Design cars to incorporate refurbished and recycled parts and materials ——— Implement processes for refurbishing, remanufacturing, recycling, and repurposing	Reduced **input** costs due to decreased use of higher cost virgin materials	OE	Refurbished, remanufactured, recycled or repurposed materials and/or products in tons multiplied by the differential in weighted average price of new materials or new products versus refurbished, remanufactured, recycled or repurposed materials and/or products per ton, less any additional operating costs required to quantify the benefit
		Reduced other **operations** costs (such as energy, water, labor, disposal costs)	OE	Differential in weighted average spend on energy and resources in traditional manufacturing versus the weighted average spend on energy and resources in manufacturing using renewable/recycled/lightweight materials multiplied by the amount of substituted sustainable material, less any additional amount of operating costs incurred on using the substitute materials.
		Incorporating recycled/refurbished materials can enhance **brand image** by attracting eco-minded customer, and provide differentiation in a competitive market	CL	Calculate the additional volumes of business earned from existing and/or new customers or expected improvement in customer loyalty rate driven by improving circularity. Multiply incremental sales by an average sales price to calculate the total $ value and apply an average margin % (that may include the impact of additional costs) to estimate the additional profit driven by improved customer sales
		Avoided costs related to **supply shortages and disruption** of new parts due to improved car design for use of recycled and refurbished parts	RM	Estimate the probability of supply disruptions and associated average costs related to new part acquisition, including related environmental and social sustainability violations. Estimate the reduction in likelihood of an event related to vehicle circularity features. Apply the average costs to the estimate of reduced incidents to quantify the benefit

*Each Sub-Practice has the potential to drive all benefits.

Investing in End-of-Life Vehicle Recovery

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Proposed Benefits	Value Drivers	Suggested Monetization Methods
Invest in End-of-Life Initiatives	Implement vehicle recovery programs (including disassembly and recycling)	`Lower **input** costs due to access to recycled or reusable parts	OE	Calculate the amount of EOL material recycled/refurbished and reused in new car production. Multiply this amount by the differential in weighted average price of new materials versus refurbished, remanufactured, recycled or repurposed materials and subtract any additional operating costs required to quantify the benefit
		Expanded skilled workforce for vehicle recovery/disassembly /recycling programs improves **employee engagement** and offers greater alignment with employee values	TM	Measure impact on employee productivity (revenue per employee, profit per employee, cost per day) and the ability to attract and retain the best talent (turnover, % of high performers) to quantify the benefit. See Employee Wellbeing Monetization Tool for detailed metrics

Investing in End-of-Life Vehicle Recovery

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Proposed Benefits	Value Drivers	Suggested Monetization Methods
Invest in End-of-Life Initiatives	Implement Vehicle Recovery Programs (including Disassembly and Recycling)	Increased use of recycled/ sustainable materials reduces exposure to carbon tax and tariffs in select jurisdictions	RM	Evaluate the company exposure to Emission Trading System and Cross Border Adjustment Mechanism tax liabilities and tariffs. This includes assessing company and supply chain implications to capture taxes that likely will be passed on as higher material costs. Tax calculations are calculated based on materials purchased and emissions factors associated with processing (ETS) as as well as materials (CBAM). Compare these costs in a “Business as usual” case to the costs in the forecast reflecting increased sustainable materials to quantify the benefit
		Reduced energy and water use associated with the use of recycled and refurbished EOL material	OE	Differential in weighted average spend on energy and resources in traditional manufacturing versus the weighted average spend on energy and resources in manufacturing using renewable/recycled/lightweight materials multiplied by the amount of EOL materials used less any additional amount of operating costs incurred in using the recovered materials to quantify the benefit
		Reduced waste as compared to new car manufacturing	OE	Calculate the average cost of of waste per unit produced before and after the implementation of the circularity practices and programs. Multiply the differential in cost by the number of units produced and deduct any implementation costs to quantify the benefit

Investing in Battery Recycling Technologies

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Proposed Benefits	Value Drivers	Suggested Monetization Methods
Invest in End-of-Life Initiatives	Invest in Battery Recycling Technologies	Lower input costs related to recycled versus new batteries	OE	Calculate the average per unit differential in input costs for refurbished and recycled batteries and related parts and materials vs new batteries, parts and materials. Forecast increased use of recycled batteries and multiply by cost differential to quantify the benefit
		Avoided costs due to reduced regulatory risk associated with EV battery waste	RM	Assess the probability of experiencing a regulatory sanction and the associated average costs (fines, administrative costs, cost of production delays, legal/PR expenses) associated with EV battery sourcing based on historical data or relevant proxies. Estimate the reduction in probability of being sanctioned due to the increased use of recycled batteries and multiply by the average costs to quantify the benefit
		Elimination of mining, less transportation and more efficient processing of recycled vs virgin batteries and battery materials reduce GHG emissions	OE RM	Calculate the average annual per unit GHG emissions related to recycled vs new EV batteries and forecast increased use of recycled batteries. Multiply the differential in GHG emissions with an associated cost per unit (e.g. internal price of carbon or carbon offset costs) to quantify the benefits. Alternative approach is to consider the reduction in emissions as a hedge against rising cost of carbon costs. In this case, forecast future carbon prices and multiply the amount of emission reduction by the change in carbon price to quantify the benefit.

Investing in Battery Recycling Technologies (continued)

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Proposed Benefits	Value Drivers	Suggested Monetization Methods
Invest in End-of-Life Initiatives	Invest in Battery Recycling Technologies	Improve supplier relations across battery value chain	SR	Measure the impact of supplier collaboration on vendor management and contract administration costs (legal costs, accounts payables staffing), working capital, and inventory management (improved delivery times, lower buffer stock). And measure the impact of community engagement on costs associated with permitting, legal/PR, safety, etc. to quantify the benefit
		Reduced supply disruptions due to increased use of recycled battery technologies	RM	Estimate the probability of supply disruptions and associated average costs related to new battery or related part acquisitions, including environmental and social sustainability violations. Estimate the reduction in likelihood of an event related to increased use of recycled batteries/battery parts and multiply by the average costs to quantify the benefit
		Reduced waste disposal costs	OE	Calculate per unit disposal cost associated with EV batteries at EOL. Measure increase in amount of batteries able to be recycled and multiply by the per unit cost to calculate the savings. Deduct any costs to implement to quantify the benefits

Investing in Partnerships

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Proposed Benefits	Value Drivers	Suggested Monetization Methods
Invest in End-of-Life Initiatives	Form Upstream and Downstream Partnerships for Vehicle Disassembly and Recycling and Part Repair / Refurbishment / Recycling Programs	Partnerships to enable greater EOL recovery/recycling/reuse generate new revenue streams associated with refurbished parts, powertrains, retreaded tires, etc. as well as improved extended warranty contract sales due to lower repair costs	SM	Calculate the amount of material to be sold and multiply by the estimated difference in purchase price and sale price to quantify the benefit Calculate the impact of incorporating refurbished/recycled materials on repair costs and related warranty sales. Estimate the increase in extended warranty contract sales expected related to lower repair costs to quantity the benefit
		Partnerships to enable greater EOL recovery/recycling/reuse eliminate the higher energy intensity process of producing part from raw materials (related to extraction, transportation and processing) reduce GHG emissions	OE, RM	Calculate the average annual per unit GHG emissions related to recycled vs new EV batteries and forecast increased use of recycled batteries associated with the partnership. Multiply the differential in GHG emissions with an associated cost per unit (e.g. internal price of carbon or carbon offset costs) to quantify the benefits. Alternative approach is to consider the reduction in emissions as a hedge against rising cost of carbon costs. In this case, forecast future carbon prices and multiply the amount of emission reduction by the change in carbon price to quantify the benefit
		Partnerships to enable greater EOL recovery/recycling/reuse lead to reduced input costs	OE	Calculate the average per unit differential in input costs for refurbished and recycled parts and materials vs new parts and materials. Multiply the differential cost by the increased use of recycled/refurbished materials associated with the partnership to quantify the saving and subtract incremental costs to quantify the benefit
		Fosters innovation	IN	Identify product or process innovations related to EOL programs and processes across the sustainable supply chain and estimate the impact on costs, risk management, and product sales

Investing in Partnerships (continued)

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Proposed Benefits	Value Drivers		Suggested Monetization Methods
Invest in End-of-Life Initiatives	Form Upstream and Downstream Partnerships for Vehicle Disassembly and Recycling and Part Repair / Refurbishment / Recycling Programs	Partnerships to enable greater EOL recovery/recycling/reuse improves **supplier relationships** driving operating efficiencies	SR	OE	Measure the impact of supplier collaboration on vendor management and contract administration costs (legal costs, accounts payables staffing), working capital, and inventory management (improved delivery times, lower buffer stock).
		Reduced **waste disposal** costs due to increased partnerships supporting EOL vehicle disassembly and recycling	SE	OE	Calculate waste cost per unit of production before and after partnerships and resulting changes in materials or processes. Multiply the differential in waste cost per unit cost by the number of units produced to calculate the savings and deduct any costs to implement to quantify the benefits Measure the impact of reducing waste on community engagement and costs associated with permitting, legal/PR, safety, etc. to quantify the benefit
		Partnerships enable shared infrastructure and processing costs, improving economies of scale	OE		Calculate the capex and operating costs (labor, facility and technical requirements) and benefits (revenues and reduced waste) of developing a recovery/recycling program with and without the partnership including a timeline for implementation and compare the differences to quantify the benefit

Investing in Partnerships (continued)

Overview of Benefits and Monetization Methods

Practice	Sub-Practice	Proposed Benefits	Value Drivers	Suggested Monetization Methods
Invest in End-of-Life Initiatives	Form Upstream and Downstream Partnerships for Vehicle Disassembly and Recycling and Part Repair / Refurbishment / Recycling Programs	Partnering on recovery/recycling/reuse of critical materials like lithium, cobalt, and nickel reduces dependence on expensive virgin materials and volatile commodity markets	RM	Estimate the probability and average cost of supply disruptions related to critical material sourcing including environmental and social sustainability violations. Estimate the reduction in likelihood of an event due to the recovery partnership and multiply by the average costs to quantify the benefit
		Partnering with suppliers on EOL recovery/recycle/reuse programs reduces Extended Producer Responsibility liability exposure	RM	Assess the probability of experiencing a regulatory sanction and the associated average costs (fines, administrative costs, cost of production delays, legal/PR expenses) based on historical data or relevant proxies. Estimate the reduction in probability of being sanctioned now or in the future associated with the establishment of the partnership. Multiply the probability reduction by the average costs to quantify the benefit



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