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Steering towards a sustainable tomorrow with efficient green production

Principles for energy efficiency, carbon footprint reduction, and sustainable practices in the automotive industry

www.siemens.com/automotive-smart-manufacturing

Contents

Introduction

The automotive industry, once characterized by the dominance of internal combustion engines and the intensive use of fossil fuels, has undergone a profound transformation in recent years. The driving force behind this change is sustainability, a topic that is increasingly gaining significance within the automotive sector. The industry has been under intense pressure to reduce its environmental impact, given that transportation accounts for a substantial portion of global greenhouse gas emissions.

Regulatory frameworks are compelling car manufacturers to accelerate their shift towards sustainability, mandating not only cleaner vehicle emissions, but also more eco-conscious production processes and operations. However, the urgency to apply and to adopt sustainable principles in production is practices is not only driven by stringent regulatory requirements but also by a growing demand for eco-friendly vehicles and sustainable production processes, fueled by higher environmental awareness. Consumers are increasingly favoring brands that demonstrate a commitment to sustainability, making it a key factor in their purchasing decisions. Additionally, investors are more inclined to support companies with strong sustainability credentials, viewing them as better long-term risks. The way in which the sector manages these changes will not only determine its own future, but also have a significant impact on global efforts to reduce environmental impacts.

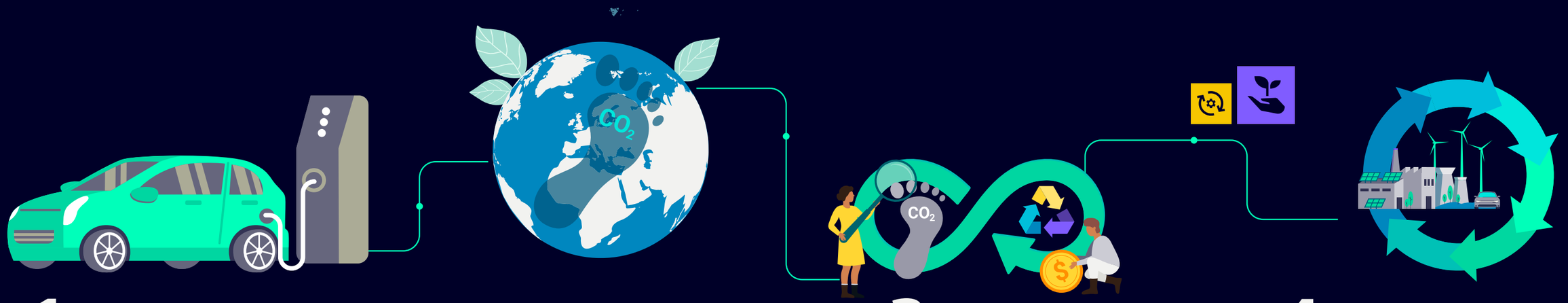
Thus, the automotive industry is confronted by global challenges that necessitate transformative change, making sustainability the number one strategic priority. In line with this transition, the supplier industry is also adapting and undergoing fundamental changes[1].

The automotive industry faces global challenges that require a transformative change, making sustainability the #1 strategic topic.

1. Siemens Talking Digital Industries - Decarbonizing the automotive industry with data transparency

Trends

Driving sustainability in the automotive industry involves key strategies centered on sustainable products, production, and supply chains. This e-book focuses on sustainable production methods, aiming to significantly reduce CO_2 footprints, minimize waste, and extend asset lifespans, ensuring a greener future for the automotive industry.



1

Electrify Mobility

Electrification is a key driver for decarbonizing transportation. Increasing the use of electric passenger vehicles by approxi-mately 25% annually until 2030 is essential for achieving this transformation. [2]

2

Regulatory Requirements

Reducing emissions by 50% this decade and reaching net zero by 2050 are critical regulatory goals. [3]

3

Changing Expectations

Customers and investors are increasingly demanding sustainable products and operations.

4

Circularity & Recycling

Implementing circular economy practices across the value chain can enhance cost efficiency and resource utilization.

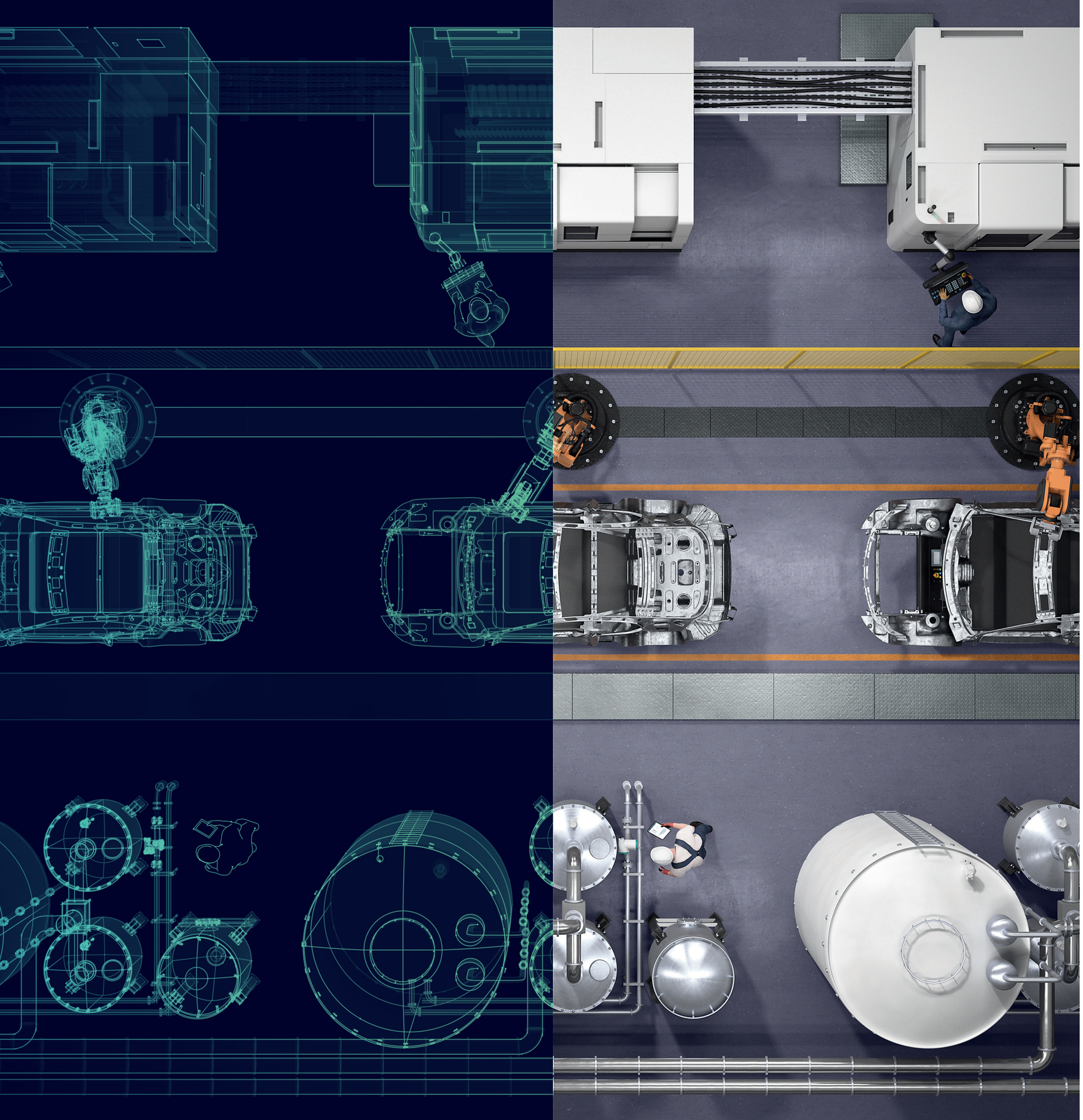
2. Climate math: What a 1.5-degree pathway would take
3. Net-Zero Challenges: The supply chain opportunities

The automotive industry stands at a pivotal crossroads: the urgent need to adopt sustainable practices is reshaping the sector, driving the shift towards e-mobility, and revolutionizing manufacturing methodologies. This evolution is not just about meeting environmental goals but also about staying relevant and competitive in a rapidly changing market landscape.

With global environmental concerns intensifying and regulatory bodies enforcing stricter emissions standards, the industry must adopt green production practices. The automotive sector must achieve an immense reduction in CO_2 emissions by 2030 to stabilize atmospheric CO_2 levels and meet global climate targets. This transformation is driven by stringent regulatory measures and evolving consumer preferences towards sustainability. The European Union's mandate for automotive OEMs to phase out the sales of Internal Combustion Engine (ICE) vehicles by 2035 is a critical step towards reducing carbon emissions and aligning with global climate goals. These regulations are accelerating the transition to electric vehicles (EVs), acting as a catalyst for innovation and investment in green technologies. Meeting these ambitious sustainability targets is both a regulatory requirement and a crucial driver of the industry's future relevance. Manufacturers are aligning their operational strategies with the broader goal of environmental stewardship by prioritizing reduced carbon footprints, waste minimization, and resource conservation. This paradigm shift is essential for complying with current regulations and securing a sustainable future for the automotive industry.

The combination of regulatory pressures and the necessity to align with consumer preferences is driving the automotive industry towards a greener future. However, achieving these sustainability goals will require substantial investment in new technologies, infrastructure, and processes, as well as a coordinated effort across the entire automotive value chain.

	Sustainable Product	Sustainable Production	Sustainable Supply Chain
			
 **Decarbonization & energy efficiency**	Electrify mobility & design for fuel efficiency	Decrease CO_2 footprint in production	Track & manage carbon footprints
 **Resource efficiency & circularity**	Optimize recyclability, material use & lifespan	Reduce production waste & increase asset-lifetimes	Establish circular ecosystems
 **People centricity & societal impact**	Design for passenger & traffic safety	Run safe & secure productions	Manage supplier sustainability



Efficient
green production

With tightening regulations and more ambitious sustainability targets, the industry faces complex challenges requiring innovative solutions in manufacturing. Integrating sustainability into all aspects of operations and supply chains is essential to ensure that vehicle manufacturing contributes positively to environmental goals.

- **Integrate Advanced Energy Management**
  Implementing advanced energy management helps identify potential energy savings and optimize resource use. Automotive manufacturers can significantly reduce waste and costs by monitoring and controlling energy consumption efficiently.
- **Adopt Smart Technologies**
  Utilizing smart technologies can drastically cut unnecessary energy consumption and minimize CO_2 emissions. These technologies enhance operational efficiency while contributing to environmental sustainability.
- **Leverage Supply Chain Data**
  Utilize data across the entire supply chain to gain transparency on carbon footprint and mitigate potential risks. This comprehensive approach enables businesses to implement sustainable practices and ensure long-term resilience.

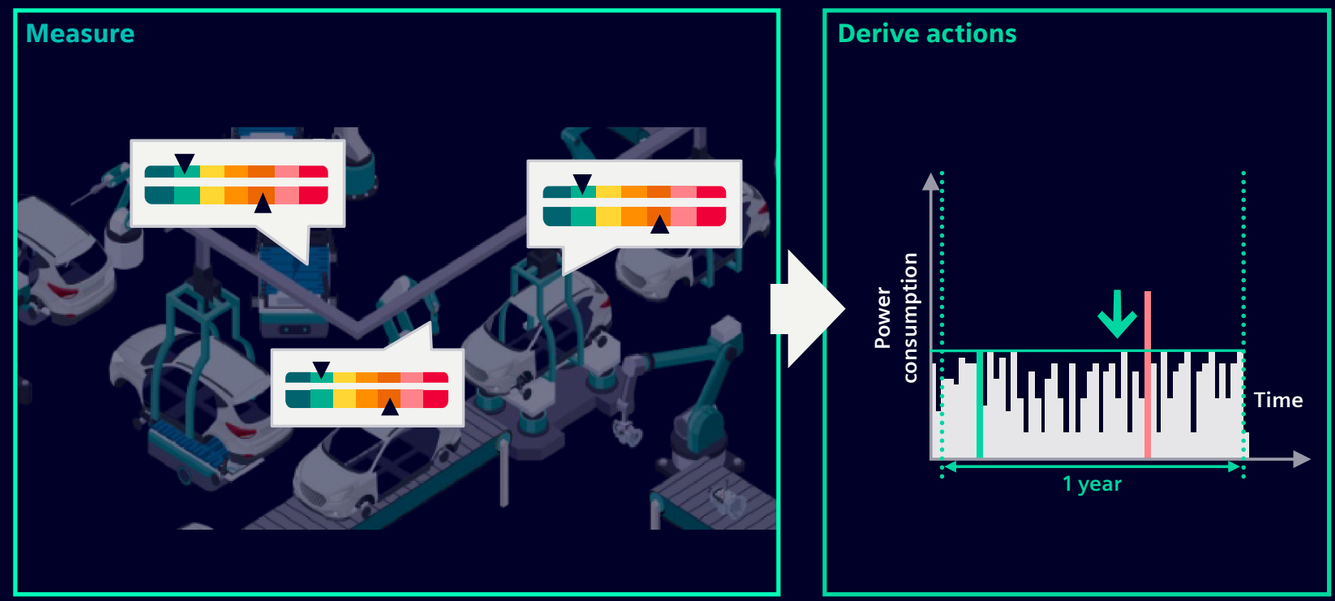
Use Case 1

Transparency on energy consumption and energy management

A critical issue in automotive manufacturing is the lack of transparency and detailed data on energy consumption. Many manufacturing facilities struggle with insufficient data on the energy usage of individual machines and processes. This lack of transparency hampers efforts to benchmark performance and identify areas for improvement. Accurate and consistent data collection is essential for understanding where energy is being used inefficiently and where savings can be made. Effective energy management in the automotive manufacturing industry, particularly in paint and body shops, is crucial for enhancing efficiency and sustainability. The paint shop, which accounts for a significant portion of a plant's energy consumption (45% to 70%), and the body shop, which also has high energy demands due to extensive welding processes, present unique challenges and opportunities for energy management.[4]

Adopting a clear and effective strategy is essential to address the complex energy management challenges in the automotive manufacturing industry. Implementing energy measurement devices across shop floors, suitable for both Brownfield and Greenfield facilities, is a critical step for accurately monitoring energy consumption. This allows for precise control and a better understanding of energy usage.

Evaluating energy efficiency through a standardized approach enables comprehensive analysis at both the individual plant and company-wide levels. This strategy is enhanced by deploying dashboards for detailed analysis and visualization of energy data, which helps identify opportunities for energy conservation and efficiency improvements. Such a structured approach not only supports informed decision-making, including effective load management, but also significantly boosts energy savings. This aligns with the industry's goals of sustainability and reducing environmental impact.



Enabling technologies

- IT/OTconnectivity
- Data analytics
- Energy management
- Cloud

Value:

Decrease energy usage by up to 50%
Enhance energy efficiency to significantly lower energy costs by utilizing a dedicated energy management

Achieve consistency and scalability
Implement an integrated automation solution for improved consistency, scalability, and benchmarking capabilities

4. AMS - Smart savings in paintshop energy

Case study:

Smart energy management for maximum sustainability

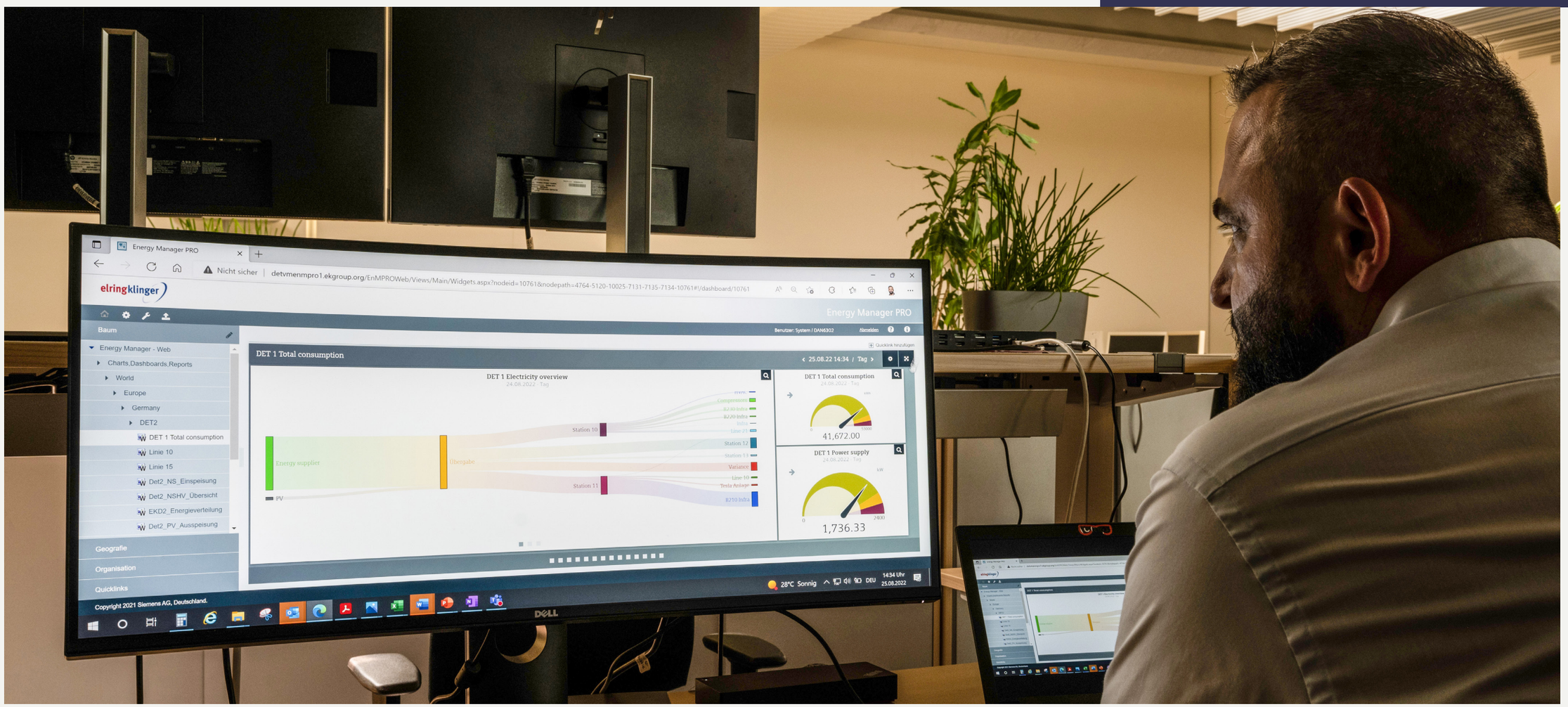
ElringKlinger aims to achieve CO_2-neutral production in Europe by 2025 and in the USA and Asia by 2030. They partnered with Siemens who together, designed the company's digital transformation, which consists of three aspects: digitalization, automation, and standardization. This solution is scalable to all plants worldwide.

ElringKlinger has transformed its energy monitoring and scalability with a comprehensive energy management system using standardized energy efficiency packages.

"*Thanks to standardization, we have an integrated software and energy management architecture that can be applied to every new component, every machine, every production line, at every one of ElringKlinger's sites worldwide.*" Daniel Scheurle, former Energy and Sustainability Manager says, "*Now, I can view vast amounts of data in real-time*".

Benefits:

- Transparency of energy usage and energy efficiency
- Comprehensive overview on a large scale
- Proof of improved energy efficiency
- Scalable approach through standardization and digitalization
- Graphical visualization of energy data and flexibility in creating dashboards
- Consistent energy management architecture that can be standardly applied



Use Case 2

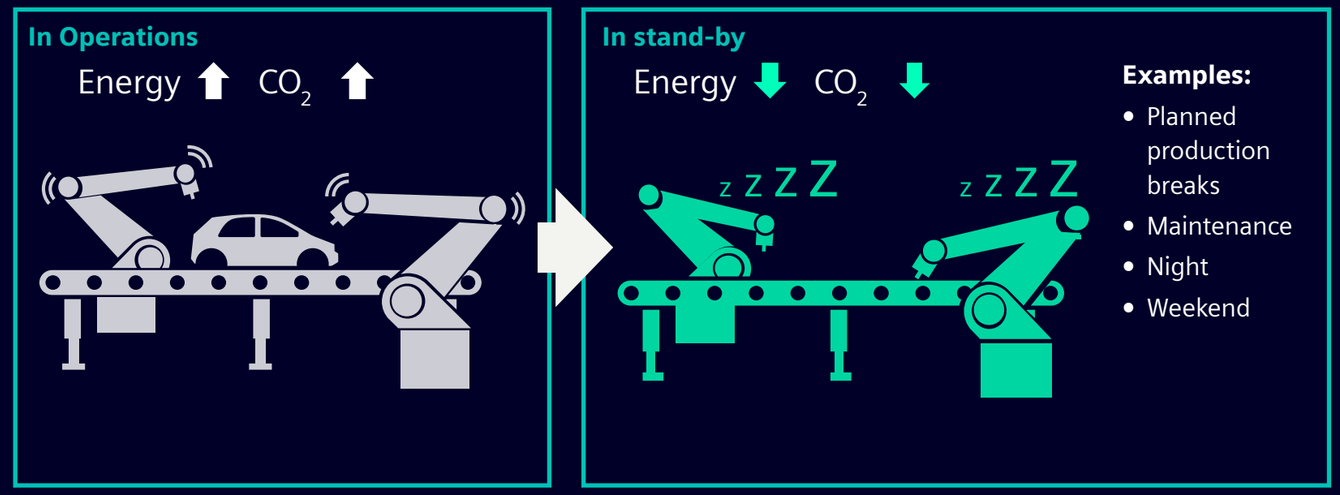
Standby of robotics in robot cells in the body shop

In the realm of manufacturing, a notable challenge emerges with the energy consumption of robots during production downtime. The practice of manually powering down these robots for breaks, weekends, or idle periods is fraught with impracticalities, primarily because of the extended time required to reboot and the looming risk of complications or failed restarts upon attempting a full shutdown. This situation contributes to unnecessary energy consumption and poses a barrier to achieving greater environmental sustainability within the automotive industry.

The Profienergy protocol presents a compelling solution from Siemens to address this issue. Designed to integrate seamlessly with the Profinet network, Profienergy enables a targeted approach to managing the energy use of robots and machines, especially in the body shop where the demand for energy is particularly high. This protocol allows for the activation of energy-saving modes without the need to purchase additional equipment, representing a cost-effective and efficient method to reduce energy consumption.

The advantages of adopting Profienergy extend beyond mere energy savings. Facilitating targeted standby modes significantly lowers CO_2 emissions, aligning with broader sustainable goals. Moreover, this protocol ensures machines remain in a state of readiness, equipped for quick restarts without undergoing a complete shutdown. This aspect is particularly beneficial, as it avoids the challenges associated with long reboot times and the risk of restart failures.

Thus, Profienergy stands as a testament to the power of innovative technology in addressing the operational challenges of the manufacturing industry. It offers a path to not only enhance energy efficiency but also to foster sustainability without compromising the availability or performance of essential production machinery.



Enabling technologies

- IT/OT connectivity
- PROFIenergy
- Standard interfaces

Value:

100% plant availability
with energy saving on robots in standby mode

Energy-efficient manufacturing
with reduced CO_2 impact due to inactive production assets

95% reduction in energy consumption
by implementing sleep mode operations

Case Study:

German automotive manufacturer

To maximize plant availability, machines and robots were previously kept running continuously, even during breaks and weekends, leading to high energy consumption and CO_2 emissions. Manually shutting down and restarting components was labor-intensive and risky, and using the main switch posed risks of unknown disturbances.

The game changer is Profienergy by Siemens, which automatically puts unnecessary components in sleep/ standby mode that is not necessarily according to shift plans, ensuring a faster, coordinated, and safer restart. This innovation allows for customized shutdowns during breaks, significantly reducing energy use and CO_2 emissions. In one plant alone, it saves over eight hundred metric tons of CO_2 annually while maintaining plant availability and productivity.

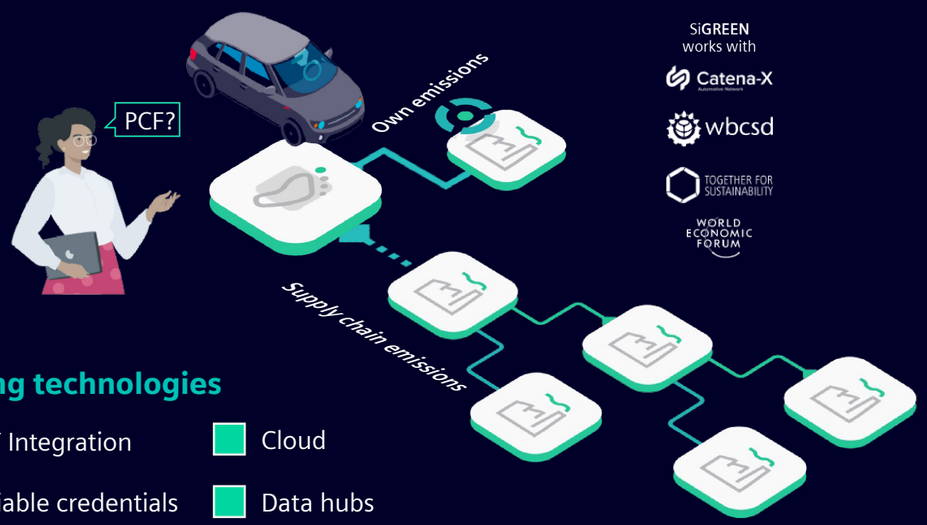
Use Case 3

Track and manage carbon footprint data within your supply chain

With 90% of industrial CO_2 emissions occurring within supply chains, enhancing transparency is crucial for identifying and addressing emission sources. Moreover, exchanging reliable Product Carbon Footprint (PCF) data across the entire value chain presents significant challenges. These challenges include difficulties in comparing data due to varying standards and formats and the need to aggregate carbon footprint information in compliance with diverse regulations. These complexities highlight the challenge of managing PCF data within a fragmented landscape of information and regulatory requirements, emphasizing the need for cohesive and standardized approaches to achieve effective emission reductions.

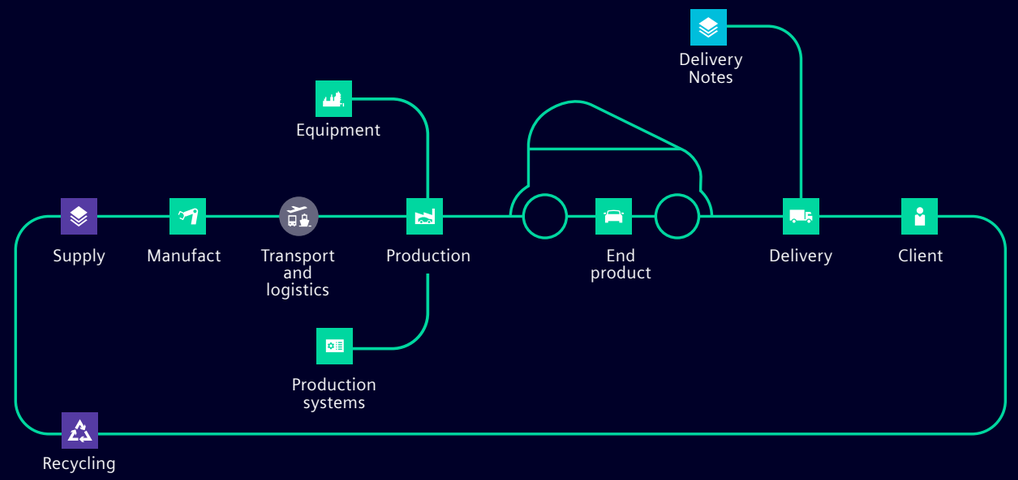
Navigating the complexities of sharing accurate PCF data across the value chain calls for a dynamic PCF management approach. Catena-X represents the first collaborative, open, and decentrally organized data ecosystem for the automotive industry, featuring uniform standards and shared principles. The supply chain contributes significantly to product-related emissions. Cooperation across often complex, cross-industry supply chains is essential to measure and reduce these emissions.

This method relies on efficient communication for regular updates, ensuring the system is both agile and adaptable. Aggregating PCF data at every step of the supply chain provides a complete carbon footprint picture, pinpointing areas for improvement. Collecting data directly where emissions occur guarantees precision. Moreover, facilitating data movement across the supply chain not only validates PCF claims but also encourages ongoing enhancements in environmental performance. Designed to comply with multiple standards (e.g., Catena-X, Estainium), this strategy streamlines PCF management, addressing comparability issues and bolstering sustainability efforts in a concise, effective manner.



Enabling technologies

- IT/OT Integration
- Cloud
- Verifiable credentials
- Data hubs



Value:

Achieve full transparency
Obtain a clear understanding of CO_2 emissions throughout the supply chain

Make data-driven decisions
Utilize a dynamic PCF to drive effective emission reduction strategies

Leverage data for sustainability
Transform data into a powerful tool for sustainable product decarbonization, making a significant impact on environmental goals

Catena-X:

Siemens and some of the market's major players joined forces to form the Catena-X global partner network to connect automotive manufacturers, suppliers, and service providers from the entire supply chain to one another and enable a secure flow of information and exchange of data. This network is where users meet suppliers, SMEs meet large companies, and raw material suppliers meet recyclers. Thanks to the consistent use and processing of data, they can all achieve new value and develop new business models.

Siemens Battery Passport

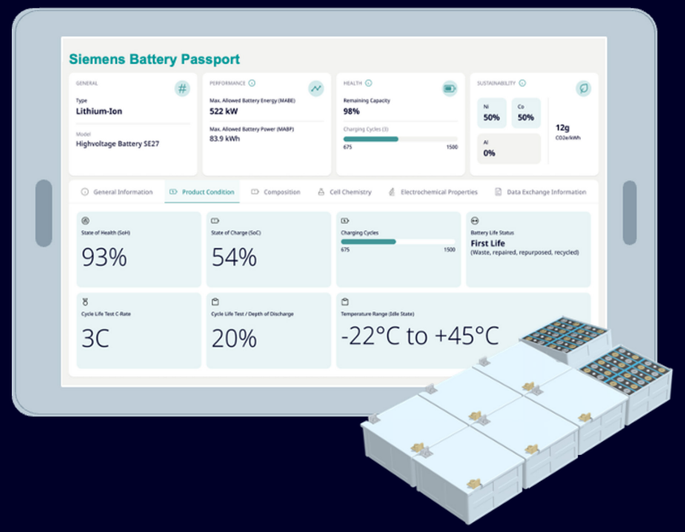
The battery production sector, especially for electric vehicles (EVs), confronts critical issues such as unethical labor practices, environmental damage, poor recycling processes, and safety risks. A major hurdle is the lack of transparency across the supply chain, making it hard to track and report the myriad of attributes each battery possesses, a necessity for meeting strict regulatory standards.

Siemens introduces a game-changing solution: the Siemens Battery Passport. This solution guarantees compliance with regulations and enhances the integration of diverse data models. It is a pivotal step towards a greener EV production line by offering precise monitoring and improving the carbon footprint tied to battery production, aiming for a zero-environmental impact.

Moreover, the Siemens Battery Passport extends its utility by aiding in predicting EV battery lifespans, which is crucial for those in the business of repurposing batteries. It equally benefits recyclers by making the mineral recycling process more efficient, thus supporting the cycle of resource use.

For those upstream in the supply chain, such as miners and materials suppliers, aligning with the Battery Passport's data standards means gaining a significant edge. It displays a commitment to upholding ethical and sustainable practices within the industry. The Siemens Battery Passport stands as a lighthouse for ethical, sustainable, and safer battery production, steering the industry towards better environmental and social governance.

Battery Passport



Enabling technologies

- IT/OT connectivity
- Data Hubs
- Cloud technology

Value:

Adhere to EU Battery Pass and Catena-X requirements
Ensuring compliance with these guidelines guarantees content meets the highest regulatoryand industry standards

Compatibility with Siemens Xcelerator
Leverage open APIs, such as those for Battery Carbon Footprint, to ensure smooth integration and interoperability within the Siemens ecosystem

Seamless supply chain integration
With native support for Catena-X, integration into existing supply chains becomes effortless, enhancing collaboration and data sharing

Open DPP4.0 architecture utilization
This approach opens the door to third-party business opportunities, fostering innovation and expansion by embracing a flexible and accessible architecture

Conclusion

The automotive industry's journey toward sustainability is a transformative process that requires innovative approaches and a steadfast commitment to environmental stewardship. The automotive industry can significantly reduce its carbon footprint and resource consumption by standardizing machine efficiency evaluation processes, implementing sustainable practices in energy consumption and waste management, and conducting company-wide energy analyses and optimization.

Siemens is an invaluable partner in this journey. With cutting-edge solutions and expertise, Siemens provides the solutions and support needed to overcome sustainable manufacturing challenges.

With strategic efforts and collaborative initiatives, the automotive industry and Siemens can lead the way in creating a greener and more sustainable world. The path to a sustainable future is complex, but with Siemens as a partner, the automotive industry is well-equipped to navigate this transformative journey.

About Siemens Digital Industries:

Siemens Digital Industries (DI) is a leading innovator in automation and digitalization, empowering organizations of all sizes to transform their operations and create sustainable products for the future. Through its Digital Enterprise portfolio, DI offers a comprehensive suite of software, hardware, and services that facilitate the seamless integration and digitization of the entire value chain, customized to meet the unique needs of each industry. Siemens Xcelerator business platform provides a unified environment for organizations to leverage the full potential of DI's solutions, including its robust digital twin technology. DI assists organizations of all sizes in their digital transformation journey, utilizing software, hardware, and services from the Siemens Xcelerator business platform. In partnership with its customers, DI accelerates transformation, helping them achieve greater productivity, flexibility, and sustainability.

For more information on Siemens Smart Manufacturing for Automotive, visit siemens.com/automotive-smart-manufacturing or follow us on LinkedIn and X.

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