What's on the Power Electrification Horizon?

What Engineers Envision for the Future

onsemi

FUTURE ELECTRONICS
A WT Microelectronics Company

Table of Contents

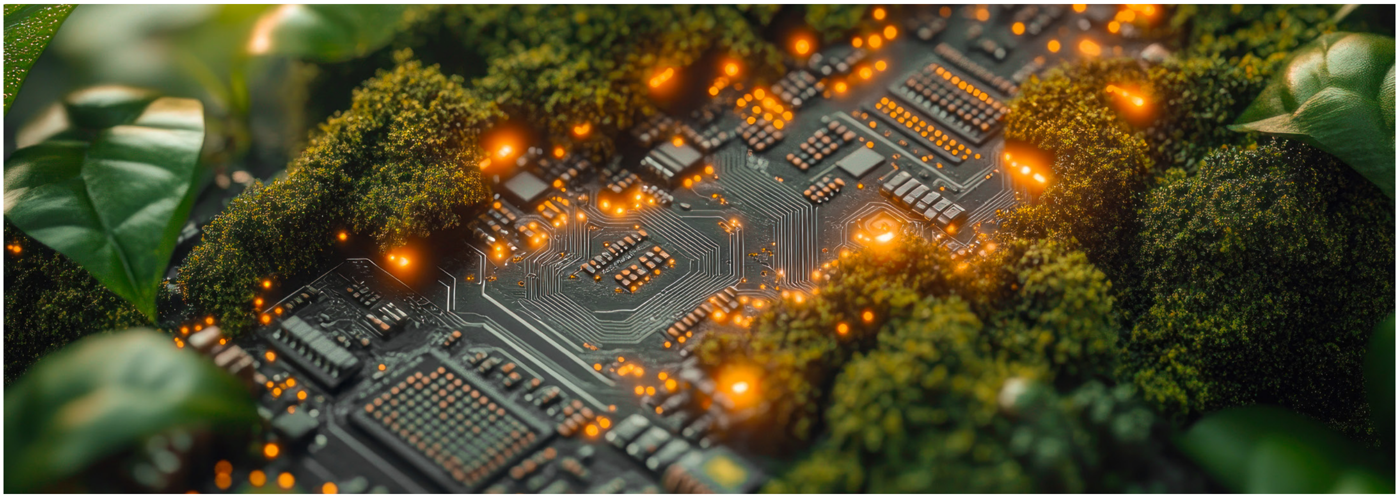
Introduction

The global transition to electrification is accelerating, but the destination is still coming into focus. Broadly, electrification is reshaping transportation, redefining grid behavior, transforming industrial automation, and demanding new models for energy generation and storage.

For engineers, the path to a sustainable future is defined by cleaner energy along with advanced systems that make energy usable, efficient, and scalable. Beyond replacing combustion with electricity, this shift requires re-engineering how power is generated, conditioned, and applied across every level of the system. From materials and circuit topologies to systems integration and infrastructure design, the future of electrification will depend increasingly on the systems that control and move energy.

This eBook explores four areas where electrification is poised to make its most profound impact: e-mobility, electric vehicle (EV) charging systems, energy storage and renewable integration, and robotics. In each case, we'll explore high-level trends, the technical building blocks driving these fields, and how onsemi and Future Electronics are supporting the engineers who are building this future.

Learn more about the future of energy systems. onsemi and Future Electronics' latest power innovations are shaping energy storage, generation, and transfer.



Participating Experts

Alexis Ayala
Control Engineer,
KUKA

Muhammed Basaran
Hardware Design Engineer,
Alstom

Christophe Basso
Business Development
Manager,
Future Electronics

Rahul Bhatia
Power Electronics
Controls Engineer,
Fluence

Pedro Chavez Jr.
Director of Engineering,
FutureMotiv Inc.

Riccardo Collura
Worldwide Power
Segment Manager,
Future Electronics

Morten Feldstedt
Senior Director Marketing
EMEA, Power Solution Group,
onsemi

Alessandro Maggioni
Sr. Manager, Regional
Marketing EMEA, Advance
Solution Group, onsemi

Ky Sealy
Engineering Fellow,
WiTricity

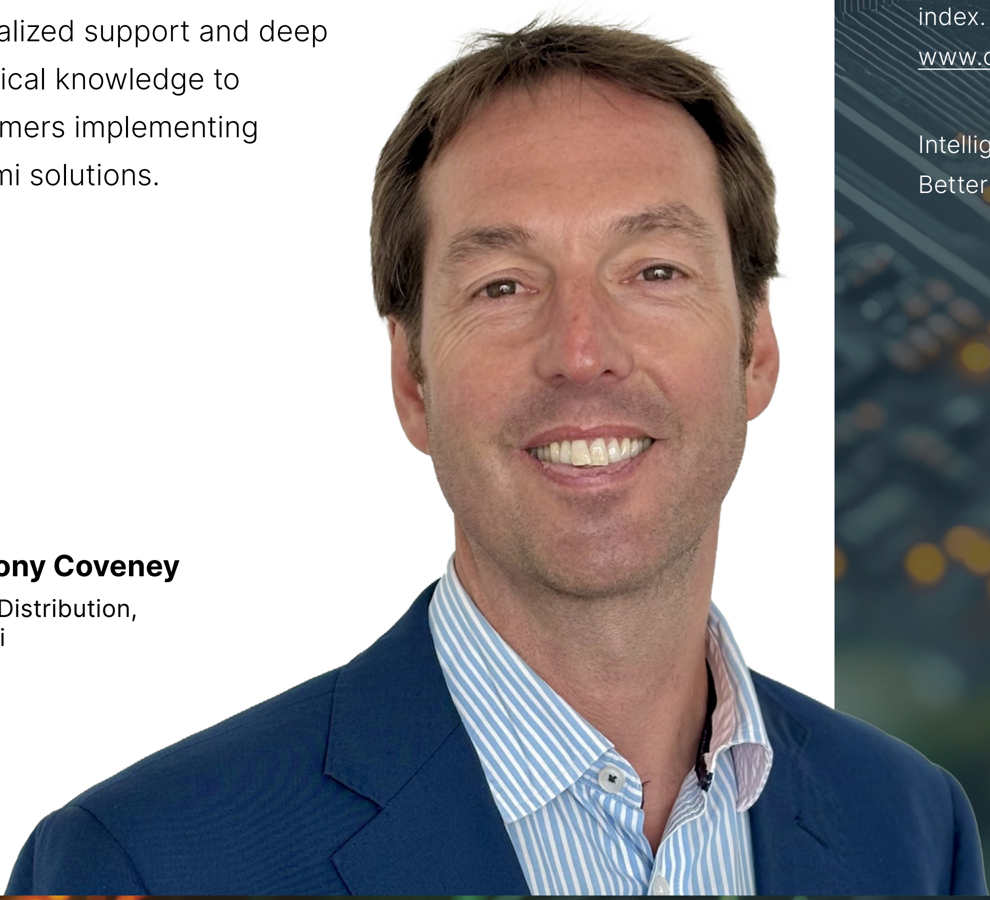
Jeremy Yapp
Policy and Regulation
Director (EU & UK),
ev.energy

Foreword

The global shift towards electrification is reshaping industries and driving innovation. This eBook, a collaboration between onsemi and Future Electronics, explores the transformative impact of advanced power electronics on energy management.

Future Electronics stands as a proudly cornerstone partner for onsemi. onsemi is pioneering silicon carbide (SiC) technology which offers exceptional efficiency and performance in power systems. The solutions are integral to the development of sustainable, high-efficiency applications in electric vehicles, renewable energy, and beyond.

At the heart of Future Electronics' onsemi expertise is their dedicated power team, providing specialized support and deep technical knowledge to customers implementing onsemi solutions.



Anthony Coveney

EMEA Distribution,
onsemi

onsemi is driving disruptive innovations to help build a better future. With a focus on automotive and industrial end-markets, the company is accelerating change in megatrends such as vehicle electrification and safety, sustainable energy grids, industrial automation, and 5G and cloud infrastructure. onsemi offers a highly differentiated and innovative product portfolio, delivering intelligent power and sensing technologies that solve the world's most complex challenges and leads the way to creating a safer, cleaner and smarter world. onsemi is recognized as a Fortune 500® company and included in the Nasdaq-100 Index® and S&P 500® index. Learn more about onsemi at www.onsemi.com.

Intelligent Technology.
Better Future.

Foreword

This team works closely with industry-renowned power expert Christophe Basso, whose technical leadership enhances the value Future Electronics delivers to power design engineers.

The Future Design Centre serves as an innovation hub where customers can explore cutting-edge onsemi technologies with hands-on support from application engineers. This collaborative environment accelerates development cycles and helps bring power electronics innovations to market faster.

This eBook explores key areas such as e-mobility, EV charging, energy storage, and robotics, highlighting the technical advancements and collaborative efforts driving these fields forward. We hope it serves as a valuable resource, inspiring innovation and progress in power electronics and energy.

Etienne Lanoy

VP, Advanced Engineering Group,
Future Electronics

FUTURE ELECTRONICS
A WT Microelectronics Company

Founded in 1968, Future Electronics is a global leader in the electronic components industry. Future Electronics' award-winning customer service, global supply chain programs and industry-leading engineering design services have made the company a strategic partner of choice.

Future Electronics operates in 159 offices across 44 countries with over 5,000 employees. Its worldwide presence powers the company's outstanding service and efficient, comprehensive global supply chain solutions. Future Electronics is globally integrated and supported by one IT infrastructure which provides real-time inventory availability and enables fully integrated operations, sales and marketing services worldwide. In 2024, Future became a WT Microelectronics company, now dual-headquartered in both Montreal, Canada and Taipei City, Taiwan.

Future Electronics' mission is always to Delight the Customer®. For more information visit www.FutureElectronics.com.

Chapter 1

E-Mobility Technologies and Applications

The most eminent impact of electrification right now is in transportation. As urban transportation systems increasingly embrace e-mobility, electrified two-wheelers, light EVs, and autonomous mobile robots (AMRs) are becoming go-to options for future mobility ecosystems. Ultimately, achieving scalable, efficient, and cost-effective e-mobility requires advances across the stack from semiconductors to system-level integration.

New Materials Paving the Way

In many ways, the shift toward e-mobility is only becoming possible thanks to innovations in material technology.

From a power electronics perspective, wide-bandgap semiconductors are integral to the e-mobility equation. Silicon carbide (SiC), in particular, is unlocking features like high-efficiency traction inverters, onboard chargers (OBCs), and auxiliary power converters. Compared to traditional silicon-based devices, SiC has the notable benefits of maintaining exceptional performance at elevated temperatures and higher voltages and offering significantly reduced switching losses. For high-power use cases, such as EVs, SiC offers an unmatched efficiency profile, particularly in fast-charging or high-load conditions. Cumulatively, these characteristics allow designers to minimize heat generation, shrink passive components, and create more efficient systems that translate into improved driving range.

Meanwhile, battery chemistry innovation further strengthens the ecosystem. For example, emerging lithium iron phosphate cells offer improved thermal characteristics and longer life under repeated fast-charging cycles. Solid-state batteries promise even higher energy densities and safety margins but remain in early-stage development. Continued progress on this front will ultimately support electrification at scale as the field develops.

> **The traction inverter is where most of the power is consumed. By reducing losses there with SiC, we can significantly boost system efficiency, and with it, the vehicle's range."**

Morten Feldstedt
Senior Director Marketing EMEA,
Power Solution Group,
onsemi

A New Direction for Charging

To improve the convenience of e-mobility solutions, the industry is pushing heavily for faster charging solutions. However, this pursuit introduces new challenges, as high charging currents generate heat and accelerate battery wear.

Fortunately, SiC's thermal robustness and efficiency also make it well suited to fast DC charging. As charging voltages rise to support larger platforms, reaching up to 1,500 V in commercial fleets, power modules built with SiC allow for compact, high-density charging infrastructure without sacrificing performance or safety.

At the same time, designers are deploying sophisticated battery management systems (BMS) that monitor voltage, current, and temperature in real time. For the same reason, complementary cooling strategies, like heat sinks and liquid cooling, are becoming standard in high-performance platforms.

Charging algorithms also continue to evolve. Variable current profiles, adaptive ramp rates, and tapered charging during the final stages of the charge cycle help reduce thermal stress and extend battery longevity. As these strategies mature, they will become enablers for both user convenience and battery health.

Beyond EVs

Importantly, the e-mobility landscape extends well beyond EVs. For instance, electrified two-wheelers are proliferating in cities as more affordable and flexible forms of mobility. Meanwhile, in industrial settings, AMRs are expanding the boundaries of e-mobility. Used for logistics and material handling, these self-powered systems demand the same energy optimization found in urban EVs.

Despite scale differences, electrified two-wheelers and AMRs largely mirror EVs in their energy management approach. All rely on constant current–constant voltage (CC-CV) charging, thermal protection, and efficient power conversion. While such alternative e-mobility platforms operate at lower power levels than EVs, typically between 250 W and 1kW, they still require compact, high-efficiency power conversion. To this end, topologies such as totem-pole power factor correction (TP-PFC) and resonant LLC dc-dc converters are commonly used to maximize power conversion efficiency, minimize losses, and reduce the size and weight of power supplies. Meanwhile, designers can integrate controllers with direct voltage-controlled oscillator–based feedback to improve regulation stability and achieve greater design robustness.

The commonality between EVs and other e-mobility solutions is good news for the designer, as shared architectures can be reused across platforms to leverage well-tested and proven designs regardless of e-mobility type.

Future Electronics and onsemi help designers develop e-mobility systems by:

> **“Advancements in semiconductor materials like SiC and GaN are dramatically improving system efficiency and thermal performance, making electrification solutions more scalable and feasible than ever before.”**

Muhammed Basaran
Hardware Design Engineer, Alstom

- Supplying industry-leading SiC components optimized for e-mobility solutions like traction inverters and chargers
- Providing power modules and gate drivers optimized for high-density, high-voltage charging infrastructure
- Offering application-specific components such as TP-PFC controllers and resonant LLC converters
- Supporting thermal and system-level challenges with dedicated SiC gate drivers and advanced BMS integration strategies
- Providing advanced design tools such as the Elite Power Simulator that enables power electronic engineers to accelerate time to market

From powertrain efficiency to battery management, discover how onsemi is driving the future of electric mobility with scalable, high-performance technologies.

Learn More >

> **We're seeing a high degree of reuse across applications—from e-bikes to robots to small delivery vans—all leveraging the same CC-CV charging methods and similar control topologies."**

Riccardo Collura
Worldwide Power Segment Manager, Future Electronics

Key Points:

- Wide-bandgap semiconductors like SiC are enabling high-efficiency systems that support greater range, smaller form factors, and reduced thermal overhead.
- Fast charging introduces thermal and chemical stress, but evolving BMS strategies, cooling solutions, and adaptive charging algorithms are mitigating battery degradation.
- Light vehicles and AMRs require compact, efficient power conversion and increasingly mirror EVs in architecture.
- Future Electronics and onsemi support designers with SiC-based power modules, optimized gate drivers, and high-efficiency controllers tailored for scalable e-mobility system design.

Chapter 2

EV Charging Infrastructure and Systems

As EVs continue to scale, the infrastructure responsible for charging them is evolving on a daily basis. The next generation of EV charging is expected to deliver speed, efficiency, and flexibility, all without compromising system reliability, thermal performance, or grid stability. Achieving these requirements requires a blend of new power architectures, wide-bandgap materials, and advanced control strategies.

EV Charging Architecture

EVs can be charged using two main approaches: through an OBC or via a dedicated offboard charging station. OBCs typically convert ac power from residential or commercial sources into the dc voltage needed to charge the battery. These systems range from a few kilowatts to 22 kW and are constrained by space, weight, and thermal limits within the vehicle. Offboard chargers, by contrast, are stationary systems, often installed along highways or in urban hubs, that deliver high-power dc directly to the battery, bypassing the OBC.

Though their physical configurations differ, both onboard and offboard charging systems rely on a common two-stage architecture. The first stage is a front-end PFC circuit, which ensures that current drawn from the ac grid is sinusoidal and in phase with the voltage. This step minimizes harmonic distortion and improves overall system efficiency.

The PFC stage outputs a regulated high-voltage dc bus, which is typically in the range of 400 V to 800 V, depending on system requirements. This bus then feeds into the second stage: a high-voltage dc-dc converter responsible for managing the battery charging process. These converters must accommodate a wide range of input and output voltages while maintaining tight regulation and minimal switching losses. Resonant topologies such as LLC and CL-LLC are frequently used here because they enable soft-switching behavior, which reduces electromagnetic interference (EMI) and improves converter efficiency at high frequencies.

“High-power charging stations draw from a three-phase network to deliver dc current directly to the battery, bypassing the onboard charger and operating under the BMS’s supervision. With power levels ranging from tens to hundreds of kilowatts, these stations require dedicated electrical infrastructure, especially when deployed along highways.”

Christophe Basso

Business Development Manager,
Future Electronics

To support bidirectional operation, where EVs can return power to the grid, many OBCs now implement a six-switch (“six-pack”) topology or a Vienna rectifier, both capable of enabling vehicle-to-grid (V2G) and vehicle-to-home (V2H) energy exchange.

Discover efficient, reliable components and reference designs to accelerate your EV charging infrastructure—from residential to ultra-fast public systems.

Explore EV Charging Solutions >

Wide-Bandgap Semiconductors for EVs

SiC is now the material of choice for high-power charging applications.

For example, fast-charging stations that deliver 50 kW to 350 kW of power benefit significantly from SiC’s ability to minimize switching and conduction losses. These stations often operate at up to 1,500 V to support commercial vehicles, trucks, and fleet applications, and SiC’s thermal stability guarantees that even under these conditions, system efficiency and reliability are maintained.

Notably for the designer, SiC-based systems require specialized gate drivers to handle fast edge rates and high common-mode transients while maintaining tight control over dead-time and switching behavior. These drivers must be capable of driving SiC metal-oxide semiconductor field-effect transistors (MOSFETs) with high dV/dt without introducing noise susceptibility or control instability. To avoid false turn-on and ensure safe operation during fast switching events, these drivers

> **Wide-bandgap semiconductors like SiC and GaN make it possible to achieve higher switching frequencies and greater efficiency, reducing heat and size in power modules. The result: compact, high-power dc fast chargers that are more reliable and charge vehicles faster.”**

Pedro Chavez Jr.
Director of Engineering,
FutureMotiv Inc.

typically apply a negative gate voltage during turn-off to enhance noise immunity and prevent unintended conduction due to Miller capacitance.

Compactness and Power Density

Charging systems are often subject to stringent constraints on both physical size and thermal dissipation. Space is generally at a premium, and forced-air cooling may be impractical or undesirable due to noise and system complexity. In these contexts, every cubic centimeter and watt counts.

SiC’s ability to switch at much higher frequencies than silicon allows designers to reduce the size of passive components such as inductors and capacitors significantly. This, in turn, enables more compact charger designs with lower weight and better thermal profiles.

High-frequency operation also facilitates the use of advanced circuit topologies that further enhance power density and efficiency. TP-PFC architectures are replacing traditional diode bridges with active switches to reduce conduction losses and improve overall system efficiency. When paired with SiC field-effect transistors, TP-PFC circuits operate efficiently even at elevated switching frequencies for reduced filter size and better input harmonic performance.

Infrastructure and Grid Implications

While user convenience remains a primary motivator, EV charging also introduces systemic challenges for the electrical grid. For example, high-power charging infrastructure can create localized peak demand events and voltage fluctuations. To address this, grid-aware charging systems are being developed, capable of scheduling or throttling charging based on grid conditions and electricity pricing.

Ultimately, the long-term vision for EV charging combines ultrafast, high-efficiency infrastructure with intelligent control and seamless user experience. Whether at home, in public, or integrated into commercial fleets, charging must be adaptable to diverse use cases while delivering reliability and speed.

Technologies like SiC power modules, optimized gate drivers, and high-frequency topologies are making this vision possible. As battery chemistries evolve and grid integration deepens, the charging ecosystem will continue to expand in both scale and sophistication.

Future Electronics and onsemi offer solutions for EV charging such as:

- Dedicated gate drivers designed for SiC devices, featuring negative gate drive, fast switching capability, and integrated protection functions
- TP-PFC and resonant dc-dc controllers optimized for high-frequency operation to support lighter, smaller, and more thermally efficient charging architectures
- Application-specific support for implementing bidirectional charging systems, including topologies like six-pack inverters and Vienna rectifiers for V2G and V2H functionality

Unlock the full potential of high-voltage applications with onsemi's EliteSiC™ portfolio—engineered for superior efficiency, thermal performance, and reliability.

See How EliteSiC™ Performs >

> **"As EV adoption grows, power conversion efficiency in charging becomes increasingly critical. Fortunately, today's power modules are already optimized for easier integration and ultra high-power applications."**

Ky Sealy
Engineering Fellow, WiTricity

Key Points:

- EV charging systems use two-stage architectures, PFC followed by dc-dc conversion, to regulate power delivery efficiently across both onboard and offboard platforms.
- SiC enables higher-voltage operation, superior thermal performance, and high-frequency switching for EV chargers.
- Bidirectional topologies like Vienna rectifiers and six-pack inverters are transforming EVs into distributed energy assets capable of returning power to the grid.
- Future Electronics and onsemi provide SiC power modules, optimized gate drivers, and high-frequency controller solutions that support compact, efficient, and grid-integrated EV charging infrastructure.

Chapter 3

Energy Storage and Renewable Energy Integration

Electrification at scale cannot succeed without clean, reliable, and flexible power. As transportation, heating, and industry transition to electric energy, the demand on global electricity systems will rise sharply. Meeting this demand sustainably requires both a shift to renewable energy sources and the widespread deployment of scalable energy storage systems.

Electrification is Doubling Load Demand

Looking at the automotive industry, replacing internal combustion engines with EVs significantly increases the electrical load of every household. In fact, charging a single EV at home can effectively double a residence's average power draw. Multiplied across millions of homes, this shift places considerable stress on local distribution networks and national grids. In this context, the challenge is about not just power supply but also power timing.

Electricity demand and renewable generation are both variable. Solar and wind sources do not produce power on demand, and peak energy use often occurs when generation is low. This mismatch between supply and demand makes grid balancing increasingly complex. To resolve this issue, a combination of smart demand management and flexible energy storage is required.

> **"Electrifying road transport will demand a massive increase in electricity. Charging an EV at home can nearly double a household's energy load—and when millions do the same, the overall demand becomes enormous."**

Jeremy Yapp
Policy and Regulation Director (EU & UK), ev.energy

Energy storage systems serve as a buffer between variable generation and unpredictable consumption. By absorbing excess energy during low-demand periods and releasing it when demand peaks, battery systems help stabilize voltage, reduce reliance on fossil-fuel peaking demand power plants, and enhance grid reliability.

Still, while managed charging and demand response can address part of the problem, they cannot fully solve it. Human behavior introduces variability that cannot be eliminated with pricing signals alone. Energy storage offers a mechanical solution to an economic and behavioral challenge.

Bidirectional Charging and System-Wide Benefits

Bidirectional charging marks a fundamental change in how EVs interact with the grid. Rather than functioning purely as loads, EVs become

> **The sporadic nature, lack of inertia support, and fault current contribution are the biggest challenges in integrating renewable energy. However, research has provided solutions, namely, Energy Storage and Grid-Forming technologies."**

Rahul Bhatia
Power Electronics Controls Engineer, Fluence

distributed energy resources. With V2G and V2H capability, stored energy in an EV battery can support the grid during peak demand or provide backup power to homes and buildings.

The benefits are multilayered. At the household level, bidirectional energy exchange can lower electricity bills. At the system level, it flattens peak demand, reduces infrastructure costs, and enables more effective use of renewable generation. Over time, widespread deployment of bidirectional charging could reduce the need for standalone grid-scale storage by distributing capacity organically through consumer assets.

However, the value of bidirectional charging depends on smart coordination. While time-of-use tariffs aim to shape consumer behavior, they are often too blunt, especially for low-income households with limited load flexibility. More effective approaches must focus on targeted flexibility programs that aggregate and control distributed assets to benefit both consumers and the grid.

> **For electrification to truly make sense, the energy must come from clean sources, not coal. However, with renewables, energy storage banks will be crucial to manage peak shaping and ensure net synchronization."**

Morten Feldstedt

Senior Director Marketing EMEA,
Power Solution Group,
onsemi

Power Electronics as the Enabler

The movement of energy from renewable generation to storage to end use must have as little loss as possible. Each stage of conversion, whether it is rectification, inversion, or voltage transformation, must operate at the highest possible efficiency.

Therefore, the performance of energy storage and renewable integration systems hinges heavily on advanced power electronics. At power levels above 50kW, SiC becomes essential. Notably, as storage systems scale, the trend is shifting from discrete power components to integrated SiC power modules. These modules simplify layout, improve power density, and reduce parasitic inductance. In turn, this improves overall system efficiency and makes high-power designs more thermally manageable.

Future Electronics and onsemi offer energy storage solutions such as:

- SiC power modules for systems operating above 50 kW
- Dedicated gate drivers optimized for SiC devices
- Integrated SiC MOSFET modules
- Engineering support for bidirectional converter topologies including simulation tools to estimate power losses

Explore advanced solutions for battery energy storage systems and renewable integration—designed for efficiency, scalability, and grid resilience.

Discover Energy Storage Solutions >

> **"Wide-bandgap semiconductors are catalyzing the renewable energy transition. They reduce equipment footprint while saving valuable energy resources. These devices are enabling megahertz switching cycles—something unheard of just a few years ago."**

Rahul Bhatia
Power Electronics Controls Engineer, Fluence

Key Points:

- Rising EV adoption is doubling household energy loads, requiring a major rethink of grid infrastructure and timing to avoid overload during peak demand periods.
- Energy storage systems are essential for balancing intermittent renewable generation with consumption.
- Bi-directional charging transforms EVs into energy assets by enabling power flow back to the grid and reducing system-level infrastructure costs.
- Future Electronics and onsemi provide SiC power modules, gate drivers, and design support for high-power energy storage and renewable systems.

Chapter 4

Robotics as a Frontier of Electrification

The technologies enabling the transition to e-mobility and renewable energy are equally transformative for robotics. As autonomous machines increasingly assume roles in manufacturing, logistics, agriculture, and urban services, their power demands, energy management strategies, and charging infrastructures are converging with those of EVs and distributed storage systems. Namely, robotics draws from the same semiconductor, converter, and control innovations that are driving electrification as a whole.

Electrification of Motion and Autonomy

Robotics platforms, especially AMRs, operate under tight energy budgets. Whether navigating a warehouse or delivering goods on city streets, these systems are expected to balance real-time compute loads, sensing, and wireless communication from onboard battery systems. Naturally, efficient energy conversion becomes essential at every layer of the architecture.

Meanwhile, electric drive systems (i.e., motor inverters, gate drivers, and high-efficiency control loops) draw directly from the same design principles used in EVs. SiC MOSFETs and optimized gate drivers provide optimized switching performance that drives compact, low-loss motor stages in robotic applications. As in EVs, SiC's thermal performance and high-frequency operation unlock tighter packaging, less aggressive cooling requirements, and longer runtimes.

BMS for robotics also mirror those used in larger e-mobility platforms. These systems must monitor temperature, voltage, and state of charge across cell stacks to guarantee longevity and safety. In AMRs, space constraints

> **The integration of safety devices, localization technology, and robust data processing power enables robotics to tackle complex tasks in bustling environments."**

Alexis Ayala
Control Engineer,
KUKA

> **Smart robots, equipped with AI and advanced sensors, are revolutionizing warehouses and production plants. To fully harness their capabilities, a thorough redesign is essential, focusing on interaction with humans and other machines, optimizing battery technology, and enhancing efficiency.”**

Alessandro Maggioni
Sr. Manager, Regional Marketing EMEA, Advance Solution Group, onsemi

amplify the need for compact, integrated solutions that provide power conditioning and real-time monitoring without incurring significant thermal overhead.

Learn how high-efficiency motor control, sensing, and power solutions are advancing the capabilities of autonomous mobile robots.

Read the Article >

Shared Power Topologies Across Applications

Robotics platforms often adopt the same converter topologies used in consumer and commercial EV systems. For example, TP-PFC circuits are used in robotic charging stations to deliver high-efficiency ac-dc conversion. When paired with SiC switches, these topologies support high-frequency operation with reduced conduction losses for improved energy throughput and EMI performance.

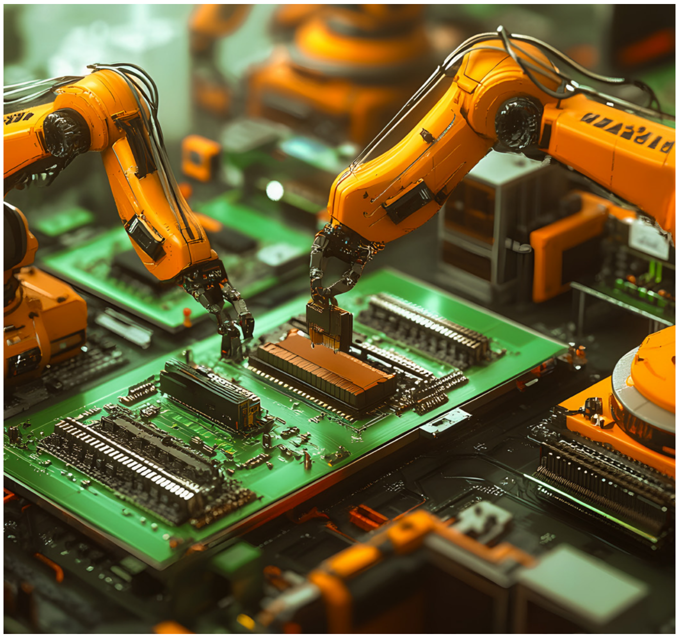
For onboard power conversion, resonant topologies such as LLC and CLLC enable soft-switching behavior, reduce switching losses, and improve EMI performance. These converters allow robotic power systems to maintain high efficiency across the unpredictable power profiles and load conditions experienced by autonomous systems.

In some industrial environments, robots are deployed in fleets, creating new demands on power infrastructure. Charging banks must support multiple units simultaneously without straining facility power budgets. Here, bidirectional dc-dc converters and power-dense ac-dc stages allow robots to charge efficiently and feed energy back into local systems when idle, similar to the V2G concept discussed earlier.

Robotics Meets Energy-Aware Intelligence

Autonomy in robotics is also becoming increasingly energy-aware. Power availability and battery status now influence decision-making. Similar to EV smart charging and load scheduling to reduce peak demand and stabilize the grid, robots may delay tasks or prioritize charging opportunities based on energy optimization strategies.

Power-aware autonomy is especially valuable in dynamic environments like warehouses or smart factories. Robots operating with a shared fleet-wide power budget must make decisions influenced by their immediate objectives as well as the energy impact of their actions on the system as a whole. These behaviors require a confluence of energy forecasting, BMS telemetry, and centralized control algorithms, many of which are directly inspired by techniques used in grid-responsive EV charging systems.



Scalable Robotic Power Architectures

As robotics deployments scale, modularity and system density become primary design considerations. Here, high-efficiency power modules allow for standardized, high-performance motor control across a broad range of robotic platforms. These modules reduce the need for complex thermal management and unlock compact housing designs with simplified system certification.

Meanwhile, gate drivers tailored for high-speed SiC operation are necessary. Fast edge-rate switching, low propagation delay, and built-in protection features such as desaturation detection and short-circuit response guarantee safe, predictable system behavior even under high dynamic load conditions. With these capabilities, robotics developers can focus on application-specific logic without needing to reinvent the power electronics layer for every use case.

In some cases, robots themselves are evolving into infrastructure. Mobile battery packs with onboard intelligence and grid interfaces are being designed to serve as temporary microgrid elements that supply backup power or load balancing capabilities during facility transitions or outages. This closes the loop between energy storage, mobility, and autonomy to reinforce the idea that robotics is a system-level player in the future energy landscape.

Future Electronics and onsemi offer solutions for robotics such as:

- Rugged, high-resolution imaging systems, high-power motor control, and highly efficient and compact battery charging solutions, all designed to ensure your industrial robot is reliable and capable of navigating the harshest environments.

Discover intelligent power and sensing solutions that drive efficiency, precision, and performance in next-generation industrial and factory automation systems.

Explore Smart Automation Solutions >

> **Significant advancements in robotics have led to improved cycle times, greater precision during pickup and drop-off, and, most importantly, enhanced safety alongside production."**

Alexis Ayala
Control Engineer,
KUKA

Key Points:

- Robotics platforms increasingly rely on SiC-based drive systems, compact battery management, and high-efficiency converters originally developed for EVs.
- Shared topologies like TP-PFC and LLC enable robotics systems to achieve high efficiency, EMI compliance, and compact form factors.
- Energy-aware autonomy allows robots to optimize task scheduling and charging behavior based on fleet-wide power budgets, similar to grid-responsive EV infrastructure.
- Future Electronics and onsemi support robotics design with reliable intelligent power and sensing solutions, including rugged, high-resolution imaging systems, high-power motor control, and highly efficient and compact battery charging solutions.

Learn More About Our Experts

Alexis Ayala

Control Engineer,
KUKA

Alexis Ayala is a seasoned control engineer specializing in industrial automation and autonomous mobile robots (AMRs). With over six years of international experience across Mexico, the U.S., and Canada, he has expertise in PLC programming, HMI design, robot integration, and motion control systems. Alexis has worked extensively with KUKA AMRs for platform transportation and Oceaneering Mobile Robots (OMR) for material handling, leading deployments that enhance efficiency and streamline operations.

Muhammed Basaran

Hardware Design Engineer,
Alstom

Muhammed Basaran is a skilled electrical and electronics engineer with 10 years of experience in hardware design, testing, and commissioning. Currently a hardware design engineer at Alstom in Sweden, he has previously worked with Knightec, Volvo Construction Equipment, and Hitachi Energy. Holding a master's degree from Erciyes University, he specializes in PCB design, communication systems, and power electronics. His visionary and inquisitive approach drives innovation and system improvements in every role.

Christophe Basso

Business Development Manager,
Future Electronics

Christophe Basso is a seasoned power electronics expert with over 25 years of experience in ac-dc and dc-dc switching converters. Currently a business development manager at Future Electronics, he previously spent decades at ON Semiconductor as a technical fellow, leading an application engineering team and developing industry-leading power conversion solutions. A recognized author and speaker, Christophe, has contributed to numerous technical publications, patents, and seminars, shaping the field of power electronics.

Rahul Bhatia

Power Electronics
Controls Engineer,
Fluence

Rahul Bhatia is a power electronics controls engineer at Fluence, specializing in the design and modeling of grid-forming inverters for battery applications. He holds a master's degree in power electronics and power systems from IIT Bombay. Previously, Rahul worked as a system development engineer at SMA Solar Technology. He is passionate about renewable energy, inverter control, and power electronics, with a particular focus on simulation methodologies and digital twin technologies.

Learn More About Our Experts

Pedro Chavez Jr.

Director of Engineering,
FutureMotiv Inc.

Pedro Chavez Jr. is the Director of Engineering at FutureMotiv Inc. and Director of the Executive Board at the Phoenix Foundation with 20 years of experience in systems engineering, EV systems, and EE architecture. He holds a graduate certificate in systems engineering from Purdue University Global and a BS in electrical and electronics engineering technology from ECPI University. Pedro is a respected mentor and public speaker, actively involved in SAE and IEEE and an expert in EV charging standards.

Riccardo Collura

Worldwide Power
Segment Manager,
Future Electronics

Riccardo Collura is the Worldwide Power Segment Manager at Future Electronics, driving innovation in power solutions across key industries. With expertise in switched-mode power supplies, ac-dc converters, and wide-bandgap devices (SiC and GaN), he provides technical and commercial support globally. Passionate about emerging technologies, Riccardo collaborates with leading suppliers to enhance efficiency and performance in power electronics.

Morten Feldstedt

Senior Director Marketing EMEA,
Power Solution Group,
onsemi

Morten Feldstedt is the Senior Director of Marketing EMEA, Power Solutions Group at onsemi, where he leads business strategy and marketing initiatives for power semiconductor solutions across Europe, the Middle East, and Africa. With over two decades of experience in the semiconductor industry, he has held key leadership roles in sales, applications, and marketing, driving business development and strategic execution across distribution channels and global accounts.

Alessandro Maggioni

Sr. Manager, Regional Marketing
EMEA, Advance Solution Group,
onsemi

Alessandro Maggioni is the Senior Regional Marketing Manager for EMEA at onsemi's Advanced Solutions Group. He has over 20 years of experience in the semiconductor industry, with a background spanning automotive and industrial sectors. Alessandro joined onsemi in 2017 and specializes in technical marketing, particularly in analog and power technologies, as well as strategic marketing.

Learn More About Our Experts

Ky Sealy

Engineering Fellow,
WiTricity

Ky Sealy is an engineering fellow at WiTricity and a globally recognized expert in wireless power transfer. He plays a key leadership and advisory role in numerous international standards organizations, including SAE, IEC, ISO, CISPR, ITU-R, and AirFuel Alliance. Representing the United States, Ky serves as a delegate and subject matter expert on wireless power, consulting with regulatory bodies on issues such as electromagnetic emissions, compatibility, and human exposure. His contributions continue to shape the future of wireless power technology and its global standards.

Jeremy Yapp

Policy and Regulation
Director (EU & UK),
ev.energy

Jeremy Yapp is Policy and Regulation Director (EU & UK) at ev.energy, where he advocates for energy flexibility to enable a clean power system. He has held senior roles in the UK Civil Service, including leading the UK EV Energy Taskforce's Technical Working Group. With deep expertise in smart metering, EV infrastructure, and cybersecurity, he now chairs the smartEn e-mobility taskforce and continues to shape energy policy across Europe.


onsemi
FUTURE
ELECTRONICS
A WT Microelectronics Company