

Renewable Energy Intelligent Power Module Market – Global Industry Size, Share, Trends, Opportunity, and Forecast Segmented by Operation Voltage (600V, 1200V), by Power Device (IGBT, MOSFET), By Region, Competition 2018-2028

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Abstracts

Global Renewable Energy Intelligent Power Module Market has valued at USD 1.08 Billion in 2022 and is anticipated to project robust growth in the forecast period with a CAGR of 6.8% through 2028. The increasing adoption of renewable energy sources, such as solar and wind power, is driving the demand for intelligent power modules (IPMs). IPMs are used to convert and control the power generated by renewable energy sources, making them an essential component of renewable energy systems. IPMs are becoming increasingly efficient and performant, making them a more attractive option for renewable energy applications. For example, silicon carbide (SiC) IPMs offer significantly higher efficiency than traditional IPMs, which can lead to significant cost savings for renewable energy developers and operators. Governments around the world are providing increasing support for renewable energy development, including through financial incentives and subsidies. This support is helping to drive the demand for IPMs and other components of renewable energy systems.

Key Market Drivers

Rising Demand for Energy-Efficient Solutions

The rising demand for energy-efficient solutions is a compelling force driving the global Renewable Energy Intelligent Power Module (IPM) market towards significant growth and innovation. In today's world, where sustainability and environmental concerns are at the forefront, the need for efficient utilization of electrical power cannot be overstated.

Intelligent Power Modules are emerging as pivotal components in achieving this goal, and here's how their role in energy efficiency is shaping the market landscape. First and foremost, the quest for energy efficiency spans across industries, businesses, and households. The growing awareness of finite energy resources and the environmental impacts of excessive energy consumption has prompted a paradigm shift towards more efficient electrical systems. IPMs, with their ability to optimize power conversion and management, offer an elegant solution to this challenge. These modules are designed to minimize power losses during conversion, which translates into reduced energy consumption. This efficiency not only lowers operational costs but also aligns with global efforts to reduce greenhouse gas emissions.

One of the primary sectors benefiting from the demand for energy-efficient solutions is the renewable energy industry. As the world increasingly turns to solar, wind, and other renewable sources, IPMs are instrumental in ensuring the smooth conversion of energy from these sources into usable electrical power. They enhance the performance of inverters and converters in renewable energy systems, thereby increasing the overall energy yield and making clean energy more accessible and cost-effective. Moreover, the automotive sector is undergoing a revolution with the rise of electric and hybrid vehicles. IPMs play a pivotal role in these vehicles by efficiently managing power distribution, motor control, and battery charging systems. As governments worldwide implement stricter emission regulations, automakers are driven to adopt energy-efficient technologies, further propelling the IPM market forward.

The demand for energy-efficient solutions is not limited to large-scale industries; it extends to the consumer electronics sector as well. From smart appliances to IoT devices, consumers are increasingly looking for products that not only provide advanced functionality but also consume less power. IPMs are integrated into power management and control circuits, contributing to longer battery life and reduced energy bills. In conclusion, the rising demand for energy-efficient solutions is a pivotal driver behind the global Renewable Energy Intelligent Power Module market's growth. IPMs are at the forefront of this revolution, enabling industries and consumers alike to reduce energy consumption, lower costs, and mitigate environmental impacts. As the world continues its journey towards a more sustainable future, the importance of IPMs in achieving energy efficiency cannot be overstated, and their market prominence is poised to expand in response to this pressing demand.

Growing Adoption of Renewable Energy Sources

The growing adoption of renewable energy sources is a powerful catalyst propelling the

global Renewable Energy Intelligent Power Module (IPM) market towards significant expansion and advancement. In an era where sustainable energy solutions are increasingly vital, IPMs are emerging as a linchpin technology, enabling the efficient integration of renewable energy into the global power landscape. Here's how the surging embrace of renewable energy sources is shaping the IPM market. First and foremost, the shift towards renewable energy, including solar and wind power, is driven by the imperative to reduce carbon emissions and combat climate change. Governments and organizations worldwide are setting ambitious renewable energy targets, and as a result, there's a growing need for advanced power electronics solutions to harness the potential of these intermittent energy sources. IPMs are instrumental in this context, playing a pivotal role in the design and performance of inverters and converters used in renewable energy systems.

Solar and wind energy systems require highly efficient power conversion and management to maximize energy yield and grid compatibility. IPMs enhance the performance of these systems by efficiently controlling the flow of electricity, ensuring minimal power losses, and providing precise voltage and frequency control. This contributes to higher overall energy efficiency, making renewable energy more cost-effective and accessible. Furthermore, as the renewable energy sector continues to expand, IPMs are deployed in various applications, from residential solar inverters to large-scale wind farms and energy storage systems. This diversification of applications creates a robust and growing market for IPMs, as they become essential components of renewable energy infrastructure.

In addition to their role in power conversion, IPMs are crucial for grid integration and stability. They offer advanced control features that enable renewable energy systems to seamlessly connect with the existing electrical grid, ensuring smooth power flow and grid stability. As more renewable energy capacity is added to the grid, IPMs will play an increasingly vital role in maintaining the reliability of power distribution.

Moreover, advancements in semiconductor technology are making IPMs more efficient, compact, and cost-effective. This aligns with the renewable energy sector's goal of reducing the overall cost of energy production and storage, making IPMs an attractive choice for manufacturers and system integrators. In conclusion, the growing adoption of renewable energy sources is a powerful driver behind the global Renewable Energy Intelligent Power Module market's growth. IPMs are at the forefront of enabling the efficient conversion and integration of renewable energy, making them indispensable components in the transition to a cleaner and more sustainable energy future. As renewable energy continues to gain prominence, the demand for IPMs is set to soar,

solidifying their position as key enablers of the renewable energy revolution.

Automotive Electrification

Automotive electrification is playing a pivotal role in driving the global Renewable Energy Intelligent Power Module (IPM) market towards robust growth and innovation. As the automotive industry undergoes a profound transformation toward electric and hybrid vehicles, IPMs have emerged as crucial components, underpinning the electrification revolution. Here's how the surge in automotive electrification is shaping the IPM market. First and foremost, the shift towards electric vehicles (EVs) and hybrid vehicles is driven by the imperative to reduce greenhouse gas emissions and combat climate change. As governments worldwide implement stringent emission regulations and consumers become increasingly environmentally conscious, automakers are accelerating their efforts to electrify their vehicle fleets. IPMs play an indispensable role in these electric and hybrid vehicles, especially in the motor control and power management systems.

IPMs are at the heart of electric vehicle powertrains, efficiently controlling the flow of electricity from batteries to electric motors, ensuring optimal performance and energy conservation. Their ability to manage high voltages and currents with precision and reliability is essential for the safe and efficient operation of EVs. As the global EV market continues to expand rapidly, driven by both consumer demand and government incentives, the demand for IPMs in this sector is poised for substantial growth. Furthermore, automotive electrification extends beyond passenger cars. Commercial vehicles, such as buses and trucks, are also transitioning to electric and hybrid propulsion systems to reduce operating costs and environmental impact. IPMs are instrumental in these larger vehicles, contributing to their electrification efforts and creating new opportunities in the market.

The automotive industry's pursuit of electrification is not just about environmental benefits; it also encompasses improved performance and energy efficiency. IPMs enhance the control of electric motors in EVs, enabling faster acceleration, smoother driving, and regenerative braking, which recovers energy and extends the vehicle's range. These benefits contribute to the market appeal of electric and hybrid vehicles, further bolstering the demand for IPMs.

Moreover, as advancements in semiconductor technology continue, IPMs are becoming more compact, efficient, and cost-effective. This makes them an attractive choice for automakers looking to design more efficient and competitive electric and hybrid

vehicles. As a result, IPMs are likely to become increasingly integrated into automotive power electronics, solidifying their position as a critical component in the future of automotive electrification. In conclusion, automotive electrification is a driving force behind the global Renewable Energy Intelligent Power Module market's growth. As the automotive industry embraces electric and hybrid vehicles to meet environmental, performance, and efficiency goals, IPMs are at the forefront of enabling this transformation. Their role in ensuring the reliability and efficiency of electric powertrains positions them as a fundamental component in the ongoing evolution of the automotive sector.

Key Market Challenges

Cost Pressure

Cost pressure is a significant challenge that has the potential to hamper the growth and adoption of the Global Renewable Energy Intelligent Power Module (IPM) market. While IPMs offer numerous advantages such as enhanced efficiency and integration, their relatively high initial costs can present obstacles that hinder market expansion. Here's a closer look at how cost pressure can impact the IPM market, Price Sensitivity: Many industries and consumers are highly price-sensitive, especially in markets like consumer electronics and smaller-scale applications. The upfront cost of IPMs can be a barrier to entry, as buyers may opt for lower-cost alternatives or delay investments in IPM technology due to budget constraints.

Competitive Markets: In industries with intense competition, companies may prioritize cost savings to maintain competitiveness. IPMs that are perceived as too expensive may struggle to gain market share, even if their features and performance are superior.
ROI Concerns: Businesses often evaluate investments based on return on investment (ROI). The longer payback period associated with higher-cost IPMs can discourage adoption, particularly in industries where ROI is a critical factor in decision-making.
Market Penetration: IPMs have tremendous potential for various applications, but their high costs can slow down market penetration. The slower adoption rate may affect the overall growth of the IPM market, as it takes time for businesses and industries to transition to costlier but more efficient technologies.

Limited Consumer Adoption: In consumer markets, where cost-effectiveness is paramount, IPMs may struggle to gain widespread acceptance. Consumers may opt for products that offer similar functionality without the added cost associated with IPMs.
Manufacturing Cost Challenges: For manufacturers of IPMs, there can be significant

challenges in reducing production costs while maintaining quality and performance. The complex semiconductor manufacturing processes and materials used in IPMs can contribute to their higher production costs. To address the challenge of cost pressure in the IPM market, several strategies can be employed, Economies of Scale: As demand for IPMs increases, manufacturers can achieve economies of scale, reducing production costs per unit. This can lead to more competitive pricing for IPMs.

Technological Advancements: Ongoing advancements in semiconductor technology can lead to cost reductions in the manufacturing of IPMs. Smaller, more efficient components can contribute to cost savings. **Customization and Value-added Services:** Manufacturers can offer customization options and value-added services to cater to specific industry needs. Tailored solutions can justify higher price points. **Education and Awareness:** Increasing awareness about the long-term cost benefits of IPMs, such as energy savings and improved system reliability, can help justify their higher upfront costs.

Government Incentives: Governments and regulatory bodies can play a role in incentivizing the adoption of IPMs through subsidies, tax incentives, or mandates related to energy efficiency. In conclusion, while cost pressure is indeed a challenge in the global Renewable Energy Intelligent Power Module market, proactive measures, technological advancements, and a focus on long-term benefits can help mitigate these challenges and promote wider adoption of IPMs in various industries.

Customization Requirements

Customization requirements present a significant challenge that can potentially hinder the growth and expansion of the Global Renewable Energy Intelligent Power Module (IPM) market. While customization offers tailored solutions to meet specific industry needs, it also introduces complexities and potential bottlenecks that can slow down the adoption and mass production of IPMs. Here's an in-depth look at how customization requirements can impact the IPM market, **Increased Development Time:** Customizing IPMs to suit the unique requirements of different industries or applications can extend the product development cycle. The time required for design, testing, and validation of custom solutions can delay product launches and limit the speed at which IPMs can be brought to market.

Higher Costs: Customization often entails additional engineering and design efforts, which can result in higher development costs. This can make customized IPMs more expensive than standard, off-the-shelf alternatives, potentially deterring cost-sensitive

buyers. **Limited Scalability:** Customized IPMs are typically designed for specific applications or industries, making them less versatile and scalable. This can limit the potential for IPM manufacturers to achieve economies of scale and reduce production costs. **Complex Supply Chains:** Customized IPMs may require unique components or manufacturing processes, leading to complex supply chain management. Variability in components and suppliers can increase the risk of production delays and quality issues.

Interoperability Challenges: Customized IPMs may not always be compatible with other off-the-shelf components or systems, leading to interoperability challenges. This can limit the flexibility of system integrators and end-users. **Market Fragmentation:** The proliferation of customized IPMs across various industries can fragment the market. This fragmentation can make it challenging for IPM manufacturers to standardize and streamline production processes.

Niche Markets: Customized IPMs may primarily serve niche markets with limited demand. This narrow focus can restrict the overall growth potential of the IPM market, as customization caters to specific, often smaller, customer bases. To address the challenge of customization requirements in the IPM market, several strategies can be considered, **Modular Designs:** Developing IPM platforms with modular components that allow for easier customization while maintaining standardized interfaces can strike a balance between flexibility and scalability. **Standardized Interfaces:** Encouraging industry-wide adoption of standardized interfaces and communication protocols can enhance interoperability and reduce the need for extensive customization.

Application-Specific Solutions: Focusing on developing pre-designed, application-specific IPMs that require minimal customization can streamline production and meet the needs of specific industries. **Collaboration:** Collaborating with system integrators and end-users to identify common customization requirements and develop standardized solutions can reduce the complexity of customization. **Education and Awareness:** Raising awareness about the benefits of standardized, off-the-shelf IPMs, particularly in terms of cost-effectiveness and faster time-to-market, can encourage broader adoption. In conclusion, while customization can cater to specific industry needs, it also presents challenges that need to be carefully managed in the IPM market. Striking a balance between customization and standardization is essential to promote broader adoption and ensure the long-term success of IPMs in various applications and industries.

Key Market Trends

Rapid Growth in Electric Vehicles (EVs)

The rapid growth of electric vehicles (EVs) is a transformative trend that is exerting a profound influence on the Global Renewable Energy Intelligent Power Module (IPM) market. As the world shifts toward cleaner and more sustainable transportation solutions, the demand for IPMs has surged, positioning them as pivotal components in the burgeoning EV industry. Here's a closer look at how the expansion of EVs is driving the IPM market, Motor Control and Power Management: EVs rely on sophisticated power electronics to control electric motors and manage power distribution effectively. IPMs are at the heart of these systems, ensuring precise control of the electric drivetrain and efficient power conversion. This fundamental role positions IPMs as indispensable in the EV ecosystem.

Efficiency and Range Optimization: IPMs contribute significantly to improving the efficiency of EVs. By minimizing power losses during conversion and optimizing power management, IPMs help extend the range of electric vehicles. This directly addresses one of the primary concerns of EV adoption, making them more attractive to consumers. **Regenerative Braking:** EVs leverage regenerative braking to recover energy during deceleration and braking. IPMs play a crucial role in this process by efficiently converting kinetic energy back into electrical energy, further enhancing the overall efficiency of EVs. **Advanced Thermal Management:** EVs demand effective thermal management to dissipate heat generated during operation. IPMs with integrated thermal protection and monitoring contribute to the reliability and longevity of EV power electronics, ensuring safe and sustained performance.

Diverse EV Ecosystem: The EV market is diverse, encompassing everything from compact electric cars to electric buses and commercial vehicles. IPMs are adaptable to various power levels and applications, allowing them to serve different segments of the EV market, further driving demand. **Government Incentives and Regulations:** Many governments worldwide are incentivizing EV adoption through subsidies and regulatory measures. These incentives encourage automakers to integrate advanced technologies like IPMs to meet energy efficiency and emission standards. **Global EV Charging Infrastructure:** The expansion of EV charging infrastructure is another driver of the IPM market. IPMs are integral to power management in EV charging stations, ensuring fast and efficient charging processes, which, in turn, fosters consumer confidence in EV adoption.

Automotive Manufacturers' Commitment: Major automotive manufacturers are increasingly committed to electric vehicle development. As the EV market expands,

automakers are investing in IPM technology to enhance vehicle performance, efficiency, and reliability. Technological Advancements: Ongoing advancements in semiconductor technology are leading to the development of more compact, efficient, and cost-effective IPMs. These innovations contribute to the overall competitiveness of electric vehicles. In conclusion, the rapid growth of electric vehicles is a driving force behind the Global Renewable Energy Intelligent Power Module market's expansion. As EVs become a mainstream mode of transportation, the demand for IPMs will continue to rise, further solidifying their role as essential components in the electrified automotive industry. The convergence of sustainability, efficiency, and technological innovation in the EV market is closely intertwined with the growth of IPMs.

Industrial Automation and Industry 4.0

The integration of industrial automation and Industry 4.0 principles is a compelling force propelling the Global Renewable Energy Intelligent Power Module (IPM) market towards significant growth and innovation. Industry 4.0, characterized by the digitalization and automation of industrial processes, is driving the demand for advanced power electronics solutions, and IPMs are playing a pivotal role in this transformation. Here's a closer look at how industrial automation and Industry 4.0 are driving the IPM market, Motor Control and Drives: In industrial automation, precise motor control is critical for optimizing manufacturing processes. IPMs are employed in motor drives and control systems, enhancing the efficiency and precision of machinery. This is essential for achieving the high-level automation goals of Industry 4.0.

Energy Efficiency: Industry 4.0 emphasizes energy efficiency as a means of reducing operational costs and environmental impact. IPMs offer advanced power management capabilities, helping industries minimize energy consumption while maintaining productivity. Integration and Connectivity: Industry 4.0 relies on seamless integration and connectivity between various devices and systems. IPMs equipped with communication interfaces enable real-time data exchange and monitoring, facilitating the seamless integration of power electronics into automated systems.

Smart Factories: Industry 4.0 is driving the transition to smart factories equipped with autonomous systems and IoT-enabled devices. IPMs are instrumental in the power control and management of these intelligent systems, enabling efficient and autonomous operation. Predictive Maintenance: Predictive maintenance is a key aspect of Industry 4.0, and IPMs contribute by ensuring the reliability of power electronics systems. IPMs with diagnostic capabilities can provide real-time information on system health, enabling proactive maintenance and reducing downtime.

Compact and Integrated Solutions: The space-saving design of IPMs makes them ideal for use in compact and densely automated manufacturing environments. Their integration capabilities reduce the footprint of control cabinets, a crucial aspect of modern industrial automation. **Modularity and Scalability:** IPMs often offer modular designs, allowing for scalability to meet the evolving needs of automated systems. This adaptability aligns with the dynamic requirements of Industry 4.0.

Global Industry Standards: The adoption of common industry standards and communication protocols promotes interoperability among devices and systems. IPMs are designed to adhere to these standards, ensuring compatibility with a wide range of automation equipment. **Safety and Reliability:** In industrial automation, safety and reliability are paramount. IPMs with advanced protection features and fault detection mechanisms enhance the overall safety and uptime of automated processes.

Market Growth: The increasing adoption of Industry 4.0 practices across manufacturing sectors worldwide is driving the demand for IPMs. As more industries embrace automation and digitalization, the IPM market is poised for substantial growth. In conclusion, the convergence of industrial automation and Industry 4.0 is a transformative trend that is shaping the Global Renewable Energy Intelligent Power Module market. IPMs are at the forefront of this evolution, enabling the efficient, connected, and sustainable automation of industrial processes. As industries continue to embrace the principles of Industry 4.0, the demand for IPMs is expected to grow, making them essential components in the modern era of smart manufacturing.

Segmental Insights

Operational Voltage Insights

In terms of market segmentation by voltage, the market was dominated by the up to 600V segment in 2022, which is also expected to witness the highest growth rate during the forecast period. The 'up to 600V' intelligent power module market share is driven primarily by the demand for consumer electronics.

Regional Insights

North America is expected to dominate the market during the forecast period. The North American region is expected to remain among the most important regions in the global Renewable Energy Intelligent Power Module market owing to the high usage of

renewable energy in end-user industries, and higher penetration of advanced consumer electronic products, along with the rising EV usage. Higher consumer awareness about using energy-efficient products is also among the key driving factor for the studied market's growth in the North American region.

In the North American region, especially in the United States, there are numerous international automotive and automotive part manufacturers such as Ford, General Motors, Fiat Chrysler Automobiles, and Tesla, putting the country among the world's largest automotive marketplaces. According to the Bureau of Economic Analysis (BEA), in 2021, about 14.9 million units of light vehicles (including autos, light trucks, etc.) were sold in the United States. As IPMs are widely used in the automotive industry in applications such as powertrains, oil pumps, AC compressors, etc., such trends are supporting the studied market's growth.

Key Market Players

Mitsubishi Electric Corp.

Infineon Technologies AG

Fuji Electric Co. Ltd

Fairchild Semiconductors (ON Semiconductor)

Semikron Elektronik GmbH & Co. KG

ROHM Co. Ltd

Vincotech GmbH

Future Electronics Inc.

ST Microelectronics NV

Powerex Inc.

Report Scope:

In this report, the Global Renewable Energy Intelligent Power Module Market has been

segmented into the following categories, in addition to the industry trends which have also been detailed below:

Global Renewable Energy Intelligent Power Module Market, By Operational Voltage:

600V

1200V

Global Renewable Energy Intelligent Power Module Market, By Power Device:

IGBT

MOSFET

Global Renewable Energy Intelligent Power Module Market, By Region:

North America

United States

Canada

Mexico

Asia-Pacific

China

India

Japan

South Korea

Indonesia

Europe

Germany

United Kingdom

France

Russia

Spain

South America

Brazil

Argentina

Middle East & Africa

Saudi Arabia

South Africa

Egypt

UAE

Israel

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Renewable Energy Intelligent Power Module Market.

Available Customizations:

Global Renewable Energy Intelligent Power Module Market report with the given market data, Tech Sci Research offers customizations according to a company's specific

needs. The following customization options are available for the report:

Company Information

Detailed analysis and profiling of additional market players (up to five).

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