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Exhaust Heat Recovery System Market – Global Industry Size, Share, Trends Opportunity, and Forecast, Segmented By Component (Turbine, TEG Module, Compressor, Evaporator, EGR Valve & Cooler, Condenser And Others), By Technology (Exhaust Gas Recirculation (EGR), Thermoelectric Generator (TEG), Organic Rankine Cycle (ORC), By Vehicle Type (Passenger Cars, Commercial Vehicles), By Region & Competition, 2019-2029F

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Abstracts

The Global Exhaust Heat Recovery System Market was valued at USD 30.29 Billion in 2023 and is expected to reach USD 44.70 Billion by 2029 with a CAGR of 6.77% during the forecast period. The Global Exhaust Heat Recovery System Market is experiencing robust growth due to several key drivers. Stringent environmental regulations, which mandate reductions in emissions and improvements in energy efficiency, are a major catalyst for this growth. As industries face increasing pressure to meet these regulations, the adoption of exhaust heat recovery technologies becomes a viable solution. These systems capture and repurpose heat from exhaust gases, leading to significant improvements in overall energy efficiency and reduced operational costs. The push towards cleaner and more sustainable industrial practices further accelerates the demand for these technologies.

In 2024, a new exhaust heat recovery system is being developed to enhance the efficiency of hybrid electric vehicles (HEVs) and plug-in hybrid electric vehicles (PHEVs). By capturing and reusing waste heat from the exhaust, this technology can improve overall energy performance, contributing to reduced fuel consumption and

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increased electric range. The system aims to optimize thermal management, which is crucial for the operation of HEVs and PHEVs, especially in colder climates. This innovation is expected to accelerate the shift toward more sustainable, fuel-efficient transportation solutions.

Key Market Drivers

Rising Emphasis on Energy Efficiency

The growing shift towards electric vehicles (EVs) and hybrid electric vehicles (HEVs) has become another critical driver for the Exhaust Heat Recovery System market. Although EVs are primarily powered by electric energy, HEVs, which combine internal combustion engines (ICE) with electric powertrains, still rely on fossil fuels to operate. These vehicles are designed to be more energy-efficient than traditional vehicles by recovering and reusing energy that would otherwise be wasted. In HEVs, EHRS plays an important role in enhancing engine performance and energy efficiency. It captures exhaust heat and recycles it, assisting in recharging the vehicle's battery, improving power generation efficiency, and optimizing overall fuel consumption. This allows for better fuel economy and lower emissions, both of which are key selling points for hybrid and electric vehicles, as well as meeting stringent environmental regulations. The increased adoption of HEVs, due to rising fuel prices, growing environmental awareness, and government incentives, has driven the demand for technologies like EHRS that improve efficiency and help reduce environmental impact. As more countries focus on reducing their reliance on fossil fuels, automakers are investing in developing hybrid and electric models, further boosting the demand for technologies like EHRS. Additionally, the integration of EHRS in electric and hybrid vehicles helps improve the overall energy efficiency of the vehicle, making it a more attractive option for eco-conscious consumers. With the future of transportation moving toward electrification and hybrid solutions, the need for energy recovery systems such as EHRS is expected to continue rising.

Stringent Environmental Regulations

One of the primary drivers of the Exhaust Heat Recovery System (EHRS) market is the increasing implementation of stringent emission regulations and fuel efficiency standards worldwide. Governments and regulatory bodies are enforcing tougher emissions norms to reduce environmental pollution, primarily focusing on reducing CO2 emissions from the automotive sector. As part of these regulations, automakers are under pressure to improve vehicle efficiency and reduce greenhouse gas emissions.

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Exhaust heat recovery systems play a vital role in meeting these standards. EHRS captures excess heat from the exhaust gases and converts it into usable energy, which helps in improving fuel efficiency by reducing the reliance on fuel combustion. The recovered heat is used to power other vehicle components, thus optimizing engine performance and reducing fuel consumption. By utilizing the wasted heat, the EHRS not only lowers CO2 emissions but also reduces the amount of fuel required for operation, making vehicles more eco-friendly and economically efficient. As nations move toward stricter environmental policies, particularly in regions like Europe, North America, and China, the demand for systems that can effectively reduce emissions and improve fuel economy has surged. These systems also help automakers comply with corporate average fuel economy (CAFE) standards and carbon footprint reduction targets. Consequently, governments' ongoing push for stricter emission control laws has greatly accelerated the adoption of EHRS in automotive manufacturing, contributing significantly to the market's growth. In April 2023, the Environmental Protection Agency (EPA) introduced updated standards aimed at reducing air pollutant emissions from light-duty and medium-duty vehicles, starting in model year 2027. This proposal builds on previous federal greenhouse gas standards for 2023–2026. It leverages advancements in clean car technology to provide benefits such as reduced climate pollution, improved public health, and lower costs for drivers through savings on fuel and maintenance.

Technological Advancements and Innovations

Technological advancements in exhaust heat recovery systems are another significant driver of the market. Over the years, there has been continuous innovation in EHRS technology, which has made these systems more efficient, cost-effective, and easier to integrate into modern vehicle designs. Improvements in materials, such as heat-resistant alloys and advanced thermoelectric generators, have significantly enhanced the performance of EHRS. Modern EHRS technologies are now capable of recovering a larger percentage of waste heat, which directly contributes to improved engine performance and overall fuel efficiency. Additionally, advancements in thermoelectric generators (TEGs) and turbo-compounding technology, which enable more effective conversion of waste heat into usable energy, have spurred the adoption of EHRS. These innovations allow automakers to incorporate EHRS in a variety of vehicle models, from small cars to heavy-duty trucks, making it a versatile solution for the automotive industry. Furthermore, manufacturers are increasingly focusing on improving the integration of EHRS with other vehicle systems, such as energy storage and power electronics. This seamless integration allows for optimized energy recovery, making the overall system more efficient and improving the driving experience for consumers. As EHRS technology continues to evolve and more automakers invest in it, the market for

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exhaust heat recovery systems will continue to expand, driven by both performance improvements and cost reductions. These technological advancements ensure that EHRS remains a viable solution for automakers looking to improve fuel efficiency, reduce emissions, and meet the demands of modern consumers.

Key Market Challenges

High Initial Investment Costs

One of the major challenges faced by the Exhaust Heat Recovery System (EHRS) market is the high initial cost of implementing these systems in vehicles. Although EHRS offers long-term benefits in terms of fuel efficiency and reduced emissions, the upfront cost of integrating such systems into vehicles can be significant. The technology involved in heat recovery systems, including specialized materials, components, and the advanced engineering required for their integration, adds to the overall production cost. For manufacturers, incorporating EHRS into their vehicles requires investments in research, development, and testing, which can be expensive. This cost is particularly challenging for automakers in the mass-market segment, where price sensitivity is high. Consumers may also be reluctant to pay a premium for vehicles equipped with EHRS, especially when the immediate benefits are not as tangible as other technologies like electric or hybrid powertrains. As a result, the cost factor can delay the widespread adoption of EHRS, particularly in regions with lower consumer purchasing power. Additionally, the complexity of integrating EHRS into existing vehicle designs presents another hurdle. Modifications to the exhaust system, engine design, and overall vehicle architecture may be necessary, which further increases the cost of manufacturing. While the benefits of EHRS, such as improved fuel efficiency and lower emissions, can offset the initial investment over time, the high upfront cost remains a barrier for both manufacturers and consumers. Therefore, addressing the cost challenge through further technological advancements and economies of scale will be crucial for driving the growth of the EHRS market in the future.

Complex Integration with Existing Systems

The integration of Exhaust Heat Recovery Systems (EHRS) into existing vehicle platforms presents another significant challenge. Modern vehicles are often designed with complex and highly optimized systems for powertrain performance, emissions control, and overall efficiency. Retrofitting EHRS into these existing platforms requires redesigning key components, which can be both technically challenging and expensive. The integration process typically involves modifications to the exhaust system, engine

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components, and power management systems to allow for the efficient capture and use of exhaust heat. For example, placing thermoelectric generators (TEGs) or turbo-compounding systems in the exhaust flow requires careful engineering to ensure compatibility with existing exhaust layouts and vehicle architecture. This is particularly difficult for automakers who are working with older vehicle models that were not designed to accommodate such technology. Moreover, the diverse range of vehicle types—ranging from compact cars to heavy-duty trucks—further complicates the integration process. The systems and components required for EHRS may need to be customized based on the specific needs and requirements of each vehicle class, adding to the complexity and cost. For manufacturers, the challenge of ensuring that the EHRS operates efficiently across various platforms and models can slow down the adoption of this technology.

Key Market Trends

Increasing Adoption of Hybrid and Electric Vehicles

One of the major trends in the Exhaust Heat Recovery System (EHRS) market is the growing adoption of hybrid and electric vehicles (HEVs and EVs). While electric vehicles operate primarily on electricity, many hybrid vehicles still use an internal combustion engine (ICE) in conjunction with electric powertrains. This presents an opportunity for EHRS technology to significantly improve fuel efficiency and lower emissions. Hybrid vehicles, which rely on both the electric motor and the ICE, benefit from EHRS by capturing waste heat from the engine’s exhaust system and converting it into usable energy. In HEVs, the recovered heat can be used to generate electricity for battery charging or to power other vehicle systems, enhancing fuel efficiency and overall performance. Although fully electric vehicles do not produce exhaust heat due to their lack of an ICE, the integration of EHRS in plug-in hybrids (PHEVs) and range-extended electric vehicles (REEVs) remains crucial for energy optimization. The shift toward hybrid and electric vehicles is being driven by the need for lower emissions and fuel-efficient solutions, as well as government regulations encouraging the adoption of green technologies. Automakers are focusing on improving the efficiency of HEVs and EVs, and EHRS plays an important role in this by contributing to energy recovery and improved vehicle performance. As the global automotive industry moves toward electrification, the integration of EHRS in hybrid models is becoming increasingly common. This trend is expected to continue growing, especially with the rise of government incentives for hybrid and electric vehicle purchases, environmental concerns, and advancements in battery technology.

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Focus on Sustainability and Emissions Reduction

The growing global emphasis on sustainability and emissions reduction is a key trend driving the growth of the Exhaust Heat Recovery System market. Governments worldwide are introducing stricter regulations to reduce carbon emissions and improve fuel efficiency in the automotive sector. The global push to combat climate change, including agreements like the Paris Climate Accord, is forcing automakers to seek innovative solutions to meet emissions reduction targets. EHRS technology aligns perfectly with these sustainability goals by capturing waste heat from the engine exhaust and converting it into usable energy. This process helps reduce fuel consumption and, consequently, lowers CO2 emissions, making it an effective tool in reducing the overall carbon footprint of vehicles. In addition to improving fuel efficiency, EHRS contributes to enhanced engine performance, which can help automakers meet the increasingly stringent emission standards set by regulatory bodies. As a result, automakers are investing heavily in exhaust heat recovery technologies to comply with global environmental standards. The trend toward electrification, hybridization, and more energy-efficient vehicle designs further fuels the demand for EHRS, as manufacturers seek to meet regulatory requirements while enhancing vehicle performance. In regions like Europe, North America, and China, where environmental regulations are particularly stringent, the adoption of EHRS is growing rapidly.

Technological Advancements in Thermoelectric Generators and Heat Recovery Systems

Another significant trend in the EHRS market is the ongoing technological advancements in thermoelectric generators (TEGs) and other heat recovery systems. Thermoelectric technology is at the core of EHRS, as it converts waste heat from the exhaust gases into electricity. Recent innovations in thermoelectric materials, such as high-performance semiconductors, have led to more efficient and compact TEGs that can be easily integrated into vehicles. These advancements in TEGs enable more effective heat conversion, allowing for greater recovery of energy from exhaust gases. Additionally, improvements in the efficiency of turbo-compounding systems and heat exchangers have further enhanced the overall performance of EHRS. With the development of new materials and manufacturing processes, the cost of TEGs has decreased, making it more accessible for vehicle manufacturers to integrate these systems into their designs. As the automotive industry continues to seek ways to improve fuel efficiency and reduce environmental impact, the demand for more advanced and efficient heat recovery solutions has grown. Manufacturers are working towards making EHRS systems smaller, lighter, and more durable to suit a wider range

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of vehicles. Furthermore, integration with electric powertrains and battery systems is also improving, enhancing the overall functionality of the vehicle. This trend of technological innovation is driving the expansion of the EHRS market, as more efficient and cost-effective solutions become available to automakers.

Segmental Insights

Technology Insights

Exhaust Gas Recirculation (EGR) is rapidly emerging as the fastest growing segment within the Exhaust Heat Recovery System (EHRS) market due to its significant role in reducing vehicle emissions and improving fuel efficiency. EGR works by recirculating a portion of an engine's exhaust gases back into the combustion chamber. This process lowers the combustion temperature, thereby reducing the formation of nitrogen oxides (NOx), which are harmful pollutants linked to air quality degradation and respiratory issues. Several factors contribute to the accelerated growth of EGR in the market. Global emission regulations are driving automotive manufacturers to adopt technologies like EGR to comply with stringent standards, especially in the European Union, China, and the United States. Reducing NOx emissions is a primary focus of these regulations, and EGR provides a cost-effective and reliable solution. Increasing consumer demand for fuel-efficient vehicles, particularly in the passenger car and commercial vehicle segments, has spurred the adoption of EGR systems. EGR contributes to better fuel economy by optimizing the combustion process, making vehicles more energy-efficient and environmentally friendly. Growing trend toward downsized engines in modern vehicles. Downsized engines typically produce higher combustion temperatures, leading to increased NOx emissions. EGR helps mitigate this issue by cooling the exhaust gases and enhancing the overall efficiency of smaller engines. The technology's versatility also supports its growth, as it is compatible with various fuel types, including gasoline, diesel, and alternative fuels. This adaptability makes EGR a preferred choice across different vehicle categories, from light-duty passenger cars to heavy-duty trucks. EGR's ability to reduce emissions, improve fuel efficiency, and adapt to evolving regulatory and market demands positions it as the fastest growing segment within the Exhaust Heat Recovery System market.

Regional Insights

Europe & CIS is the dominating region in the Exhaust Heat Recovery System (EHRS) market, driven by a combination of stringent environmental regulations, robust automotive manufacturing sectors, and a strong focus on sustainability. The region has

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established itself as a global leader in implementing advanced technologies aimed at reducing vehicle emissions and improving fuel efficiency, and EHRS plays a key role in achieving these goals. One of the primary reasons for Europe's dominance in this market is the European Union’s strict emission standards, such as the Euro 6 regulations, which set tight limits on nitrogen oxides (NOx) and carbon dioxide (CO2) emissions. These regulations push automakers to integrate EHRS technologies, including Exhaust Gas Recirculation (EGR) and Waste Heat Recovery (WHR) systems, into their vehicles to comply with the legal requirements. This is particularly evident in countries like Germany, France, and the United Kingdom, which are home to some of the largest and most technologically advanced automotive industries in the world.

The region’s commitment to achieving carbon neutrality by 2050, as part of the European Green Deal, further accelerates the adoption of EHRS. The transition toward hybrid and electric vehicles also benefits from EHRS technologies, which enhance the energy efficiency of vehicles by recovering waste heat and converting it into usable energy, reducing reliance on conventional fuels. In the CIS region, countries like Russia are seeing increased investments in automotive infrastructure and a growing demand for fuel-efficient, eco-friendly vehicles. While not as stringent as the EU, CIS countries are gradually adopting emission regulations that encourage the use of EHRS technologies, adding to the market growth. Europe & CIS’s leadership in environmental regulations, technological advancements, and a proactive stance on sustainability have cemented its position as the dominant market in the Exhaust Heat Recovery System sector.

Key Market Players

FORVIA Group

MAHLE GmbH

Continental AG

DENSO Corporation

Honeywell International Inc.

Dana Incorporated

Marelli Holdings Co., Ltd.

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PHINIA Inc

Mitsubishi Heavy Industries, Ltd

Cummins Inc

Report Scope:

In this report, the Global Exhaust Heat Recovery System Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Exhaust Heat Recovery System Market, By Component:

Turbine

TEG Module

Compressor

Evaporator

EGR Valve & Cooler

Condenser

Others

Exhaust Heat Recovery System Market, By Technology:

Exhaust Gas Recirculation (EGR)

Thermoelectric Generator (TEG)

Organic Rankine Cycle (ORC)

Exhaust Heat Recovery System Market, By Vehicle Type:

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Passenger Cars

Commercial Vehicles

Exhaust Heat Recovery System Market, By Region:

North America

United States

Canada

Mexico

Europe & CIS

Germany

Spain

France

Russia

Italy

United Kingdom

Belgium

Asia-Pacific

China

India

Japan

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Indonesia

Thailand

Australia

South Korea

South America

Brazil

Argentina

Colombia

Middle East & Africa

Turkey

Iran

Saudi Arabia

UAE

Competitive Landscape

Company Profiles: Detailed analysis of the major companies presents in the Global Exhaust Heat Recovery System Market.

Available Customizations:

Global Exhaust Heat Recovery System Market report with the given market data, TechSci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

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

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