

## THERMAL SYSTEMS

### Contributing to a more pleasant world by spreading *Monozukuri* that is based on energy management technologies and clean energy

To halt global warming, the curbing of greenhouse gas emissions is an urgent task. With a view to addressing this social issue, the Thermal Systems Business Group will build and disseminate new paradigms for cars and society by going beyond existing frameworks to advance creation with internal and external partners. In these initiatives, we will primarily use environmental technologies that we have developed for the thermal management of cars. Further, we will endeavor to realize a carbon-neutral society as soon as possible by popularizing environmentally friendly products through utilization of the advantages of our well-established global supply chain, which is deeply rooted in many different regions.



Katsuhiko Takeuchi  
Head of Business Group



#### Business Strengths

**Numerous World-Leading Environmental Technologies**

By further evolving its environmental technologies, which are underpinned by some 2,400 environmental technology patents—the largest patent group of its kind in the world—and by numerous world-first products and products that boast leading market shares, the business group will extend the scope of DENSO’s technological contributions from thermal management systems to energy management systems and from cars to society as a whole.

**Co-creation beyond Organizational Boundaries**

In a co-creation initiative with Toyota Motor, DENSO FUKUSHIMA CORPORATION has created a carbon-neutral plant by establishing local production and local consumption of hydrogen. Through such initiatives, the Thermal Systems Business Group will continue creating and raising the profile of new business models by going beyond business group boundaries to mobilize and concentrate DENSO’s technology capabilities and collaborate with customers and new partners around the world.

**Global Supply Chain**

At the approximately 50 bases we operate worldwide, we will help address environmental issues in each country by accurately understanding the diversifying customer demand in countries and regions and providing timely supplies of competitive products through our locally rooted supply chain.

#### Business Strategy

For both combustion engine and electric vehicles, we will refine our accumulated refrigerant and water-based heat exchange technologies, improve our core products, and market new products, thereby maintaining and augmenting our business foundations. In addition, with our sights set on further accelerating initiatives for the realization of a circular economy and carbon neutrality, we will advance business portfolio reweighting that includes resource reallocation. We will also move forward with ambitious initiatives aimed at addressing global warming by pursuing innovation in heat “manipulation” technologies and extending the scope of our business from people to vehicles and from there onward to society at large.

Realization of Sustainability Management	Many years of focusing on our strengths—mass production stability, global supply capabilities, and a commitment to product quality—have advanced our personnel, technologies, and products. Utilizing these fundamental strengths, in the electric vehicle age we will strengthen and stabilize our business foundations by maintaining an emphasis on high quality and stable supply as we continue to create compact, highly efficient thermal management modules and other new products and technologies.
Business Portfolio Transformation	In response to customer demand, which reflects the energy policies of respective countries, we will offer optimal solutions and contribute to the realization of carbon neutrality by rolling out our current products and innovating in new fields. To accelerate development in new fields, we will engage in dialogue with our customers and suppliers with a view to stepping up the pace of business portfolio transformation on a global, industry-wide basis. DENSO will reallocate and optimize the resources freed up by these changes so that it can boost the development and sales of environmental technology products.
Creation of New Value	At DENSO, our goal is not only to achieve progress for cars but also to create a world that reflects society’s needs and is full of happiness. To realize such a future, we will further advance our proprietary environmental technologies to reduce the energy wastage of cars to as close to zero as possible. By extending the scope of these technologies and applying them to society, we will promote ambitious initiatives focused on circulating energy through the connection of cars and society and thereby addressing the energy issues facing society as a whole. Based on these initiatives, we aim to achieve the ultimate in vehicle energy conservation and global warming mitigation.

#### Business Analysis Q&A

**Q: How will the trend toward vehicle electrification change the thermal management of vehicles?**

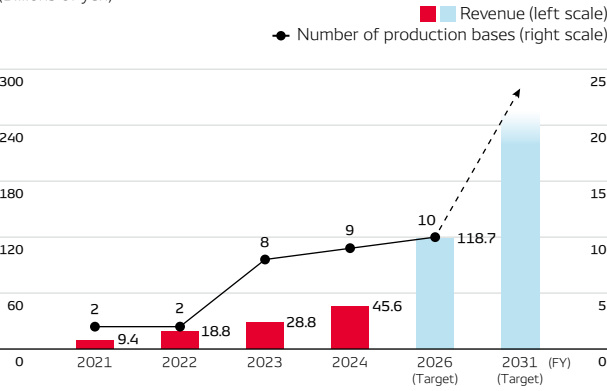
**A:** To achieve carbon neutrality, which is a major objective of vehicle electrification, we must effectively utilize the waste energy from air-conditioning and electric equipment. The basis for solutions to this energy utilization issue is provided by DENSO’s thermal management systems. Indispensable to electric vehicles, these systems use proprietary heat pump technology for the generation of heat with small amounts of power and control air conditioners, batteries, inverters, motors, and other electric equipment to ensure their temperatures are appropriate, thereby contributing to cabin comfort, driving safety, and the extension of driving distance.

DENSO will take on the challenge of enhancing the comprehensive management of vehicle energy with the aim of achieving a 75% reduction in the energy used for vehicle temperature control by 2030. To effectively use energy without wastage, we will realize technologies that collect and reuse heat from electric equipment. We will achieve a whole-vehicle energy management system and broaden the extent of our contributions from the sphere of cars to society at large by forming internal and external collaborations and partnerships and using our all-important insight as a manufacturer with a thorough knowledge of cars.

#### Objectives and Results of Strategies for Green and Peace of Mind

<b>Objective:</b> Develop a new framework to continuously benefit customers <b>Results:</b> Built a framework for the continuous support of customers through the formation of partnerships and realized the transfer of the exhaust gas recirculation cooler and stainless steel oil cooler business to MARUYASU INDUSTRIES CO., LTD., which endorsed the view that the industry as a whole can continue to support customers and became our strategic partner, despite previously being our competitor in this business field
<b>Objective:</b> Complete conceptualization of next-generation thermal management modules incorporating differentiated technologies <b>Results:</b> Worked with customers from preliminary development stages to rigorously seek ideal forms of integration, which culminated in agreements with multiple global customers on product development concepts for modules and system control

Environmental Technology Products:  
Revenue and Number of Production Bases  
(Billions of yen)



**Comprehensive Strengths That Accommodate Customers Worldwide**

In line with efforts to pursue a carbon-neutral society as soon as possible, there is a growing trend toward the provision of a wider range of vehicle options to enable optimal choices to be made in light of regional circumstances, such as differences in infrastructure and regulations. DENSO’s strengths include a wide array of technologies and products accumulated over many years; local knowledge and a regionally rooted supply chain, which have resulted from the Company’s global expansion; and a development system and service network capable of catering to a variety of customer needs. Taking maximum advantage of these comprehensive strengths, we will work together with our customers and advance toward the realization of a carbon-neutral society.

**Resolving Social Issues through Our Businesses**

**Development of Technologies That Make Use of Waste Energy and the Realization of Energy-Neutral Temperature Control in Partnership with Society**

To achieve energy-neutral temperature control—whereby the energy required for automotive air-conditioning and equipment temperature control is effectively reduced to zero—by 2035, we must establish a world where the integration of cars with infrastructure allows society to make maximum use of all available energy resources.

Currently, society is said to lose about 60% of primary energy as waste heat. The resolution of this problem calls for technology that enables waste heat to be efficiently used when and where it is needed. Tackling this issue through efforts related to the manufacture of cars, DENSO will boldly develop energy

storage and thermal energy conversion technologies. Through the recovery of waste heat from vehicles and greater society, the reuse of stored heat energy for other purposes, and the conversion of heat into other forms of usable energy, these technologies will support our creation of ultimate energy-saving vehicles that make full use of energy resources without any waste.

Connecting with Society to Make Full Use of Unutilized Energy