# Contributing to innovation in xEV\* Projection of HEV and EV production (As of March 31, 2016) Annual growth rate Approx. 30% Europe The Americas China Japan 2020 2023

Source: Company estimates, based on various materials

## Deploying advanced technologies and innovative production lines to address demand and expedite growth globally

### Environmental regulations in various countries boosting demand for xEVs

\* Greneral term for electric vehicles (EVs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs).

The markets for xEVs are rapidly expanding in various nations amid tightening regulations governing CO<sub>2</sub> emissions and fuel efficiency. Due to significantly increasing demand in the Americas, Europe, and China, we expect the global market to grow around 30% per year until 2023.

The U.S. state of California has enacted regulations whereby a certain percentage of automobiles sold must be zero emission vehicles (ZEVs). Moreover, the state is expected to tighten those regulations in 2017. In conjunction with this, every automaker in the Americas is expected to expedite development of various models, including plug-in hybrid electric vehicles (PHEVs) and electric vehicles (EVs). In Europe, meanwhile, the UK and France have declared they will prohibit domestic sales of gasoline and diesel vehicles by 2040.

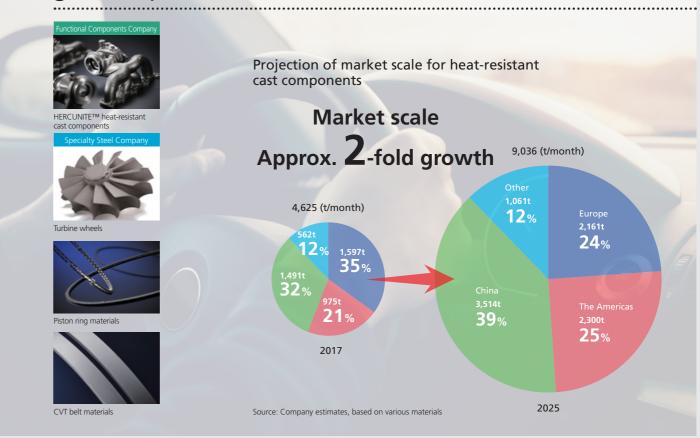
Even in China, the world's largest automobile market since 2009, the market is growing sharply because of subsidies for EV purchases. Moreover, that nation announced its "Energy-efficient and new-energy vehicles industry development plan," which targets xEV production of 5 million units by 2020.

### Addressing vibrant demand through innovative production lines and products from our internal companies

NEOMAX®, a core product of the Magnetic Materials Company, has been highly acclaimed in the market as the world's leading brand of neodymium magnets used in hybrid electric vehicles (HEVs) and EV drive motors. To address worldwide growth of the new-energy vehicle market, we are building innovative production lines and reinforcing our global production system with the start of mass production in a joint venture in China, in a plan to meet increasing customer needs. In building our innovative production lines, we are using IoT technologies to introduce real data management while strongly promoting quality consistency and high-efficiency production. We will also enhance competitiveness from the material flow perspective, by increasing technology to limit the use of heavy rare earth elements to significantly reduce use of those elements, as well as by using proprietary technologies to solidly establish recycling processes.

Further, the Specialty Steel Company offers soft magnetic materials, which are widely used in cladding materials for batteries—including use in current-collecting clad foils of lithium ion batteries to meet increasing capacity requirements—as well as use in electromagnetic compatibility (EMC) and noise-reduction parts. Meanwhile, the Functional Components Company offers battery cases, and the Cable Materials Company's products include magnetic wire incorporating proprietary technologies that contribute to advances in compactness and the longevity of motors. With abundant product lineups offered by our internal companies, we will meet the vibrant demand for xEV.

# High value-added functions to enhance energy efficiency of gasoline-powered vehicles



# Diverse lineup and integrated design and processing system to satisfy increasingly sophisticated needs

### Accelerating fuel saving of gasoline-powered vehicles through multifaceted approaches

To help realize a sustainable society, automakers are expediting efforts to save energy with multifaceted approaches. Even gasoline-powered vehicles, which have driven the motorization era to date, are showing good progress in improving environmental performance. These technologies are continuing to evolve and are mainly aimed at downsizing, materials-based weight reduction, enhanced thermal efficiency through engine combustion improvements, and reduction of friction loss in the drive train

Cars with high environmental performance that achieve downsizing with turbochargers (turbo-engine cars) tend to have lower prices than xEVs. This can be one reason why the production volume of these cars is increasing rapidly worldwide, including in the Americas, Europe, and China.

#### HERCUNITE™ and other products making a contribution

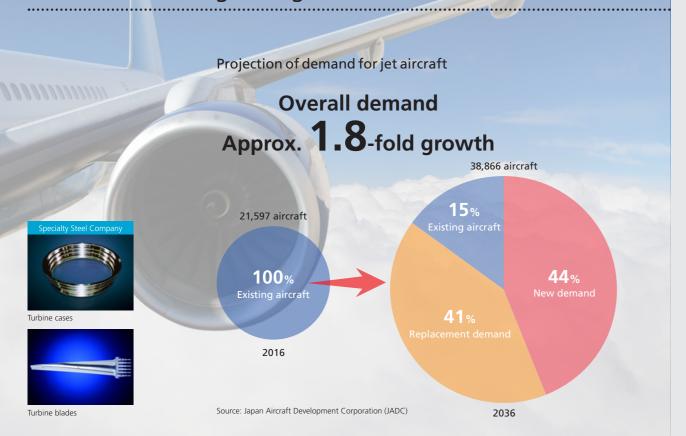
HERCUNITE™ heat-resistant cast components, the mainstay products of the Functional Components Company, are used in turbochargers. These products are frequently adopted in turbo-engine cars not only because of their high heat resistance, but also because they offer solutions backed by our

advanced processing technologies. Our outstanding capabilities in materials development reduce costs with designs that match the temperature ranges required by customers and through optimization of materials in line with the application. We also offer solutions through CAE\*-based design support. Moreover, the Specialty Steel Company makes turbine wheels, which are key turbocharger components.

High-performance piston rings also contribute greatly to reducing friction loss in the entire engine. The Specialty Steel Company offers stainless steel piston ring materials that are highly effective in reducing friction loss. We also have a broad range of products that accurately reflects fuel-saving needs. These include CVT belt materials, which help reduce friction loss in power trains.

\* CAE (computer-aided engineering): Using computer-based simulations to verify whether a designed structure would meet performance requirements, even before it is built.

# Boldly using technological expertise in the aircraft industry, where demand is growing



# Proprietary No. 1 technologies and synergies among the three companies address needs for fuel efficiency and cost reduction in aircraft

### Demand to grow 1.8-fold in 20 years, driven mainly by small passenger aircraft

In the world aircraft market, annual demand for jet aircraft is projected to reach around 38,866 units by 2036. This represents 1.8-fold growth compared with the current demand, buoyed by flourishing passenger demand, which will rise around 5% per year until 2035, as well as by the introduction of new, highly economical models with good fuel

#### Active investments and synergies among the three companies to address flourishing demand

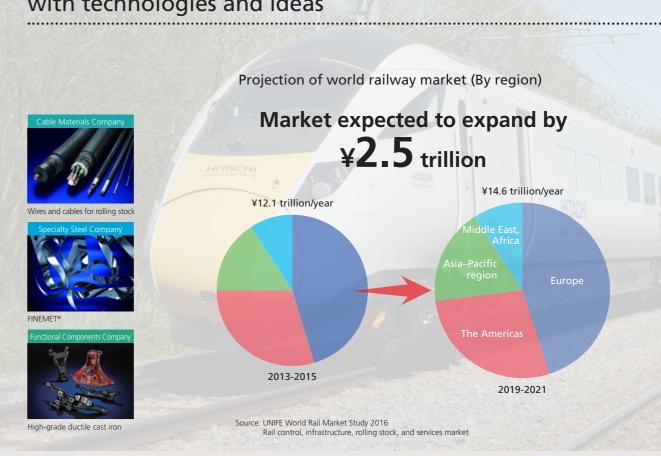
Against this background, we have positioned the aircraft business as a new growth driver.

At our Yasugi Works, in addition to a 24-ton vacuum induction melting and casting (VIM) furnace that commenced operation in March 2015, we have made other major investments, including in a 10,000-ton free forging press and a high-speed radial forging machine. At Hitachi Metals MMC Superalloy, Ltd., we have started operating a large 840-ton ring mill capable of pressure 2.5 times greater than before. In addition to these successful investments, we have formed an alliance with Japan Aeroforge, Ltd., which has a 50,000-ton forging press, the world's largest. Under the alliance, we are setting up a supply system that can handle large components. In 2015, we acquired certification from customers for our engine shaft materials and made good progress in acquiring certifications that are essential in the aircraft and energy businesses. We will expedite these efforts in the future.

Going forward, we will create synergies among the three companies while making continuous capital expenditure and introducing CAE and other analysis technologies to accelerate the development of R&D and manufacturing technology.

We are striving to become one of the world's top four aircraft materials manufacturers. Our revenue targets for the aircraft and energy businesses are ¥37 billion in fiscal 2018 and over ¥60 billion in fiscal 2025, almost double the fiscal

# Contributing to worldwide high-speed railway plans with technologies and ideas



# Powerful backup for realization of high-speed railway through 3D harness design and manufacturing and reinforcement of Chinese operations

### High-speed rail plans progressing in China, Europe, the Americas, and elsewhere

Plans are currently under way to build numerous high-speed railway systems around the world. In addition to global environmental problems and high oil prices, this reflects the economic growth of emerging countries, which has brought about population concentration and traffic congestion in urban areas. There is also pent-up demand in Europe, where high-speed railways are already well developed, and highspeed railways around the world are expected to grow at an average annual rate of 3% over the next 20 years.

Under the Chinese government's 13th five-year economic plan, investments totaling around 3.8 trillion yuan will be made to extend the nation's railway network to 30,000 kilometers from the current 20,000 kilometers. In the UK, the birthplace of railways, the High-Speed Two (HS2) railway plan is showing good progress, while large-scale high-speed railway plans are advancing in India, the U.S., Indonesia, Malaysia-Singapore, Vietnam, and elsewhere.

#### Original technology used in European and Chinese markets

High-speed railway networks will continue serving as important infrastructure because they are environmentally friendly and enable mass transportation. Positioning its railway-related business as a growth area, the Cable Materials Company will

forge ahead with active business expansion in Europe and

The Hitachi Group received orders from railway operator Abellio for Class 385 commuter trains for the global market. In response, our Cable Materials Company designed and built rolling stock harnesses using 3D design techniques, in addition to selling stand-alone rolling stock electric cable. In 2016, we also established a harness supply base for rolling stock in the Czech Republic. Starting by supplying rolling stock production bases in the UK, a business developed by the Hitachi Group, we will strongly target business entry and development with rolling stock manufacturers across Europe.

As for rolling stock manufacturers in China, we have strengthened our solution-based sales capabilities and increased production capacity at our supply base in Suzhou. We will continue contributing to railway development in China by introducing new products that are thinner, lighter, and longer-lasting.

Meanwhile, our Specialty Steel Company offers its FINEMET® series of material for noise control, and our Functional Components Company supplies high-grade ductile cast iron and other products. In these and other ways, Hitachi Metals as a whole continues making proposals to rolling stock manufacturers to address their needs with respect to factors such as weight reduction.