The 41st Tokyo Motor Show
Mazda Press Information
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Greetings

Thank you for visiting the Mazda Booth at the 41st Tokyo Motor Show.

Mazda first introduced the “Zoom-Zoom” brand message at the 35th Tokyo Motor Show in 2001. Since then we have launched a new-generation line-up brimming with the Zoom-Zoom spirit, including cars such as the Mazda Atenza, Mazda Axela and Mazda Demio. These cars have received worldwide acclaim for their dynamic and stylish designs, exciting ride and well-thought-out functionality. They are also targeted as eco-cars, receiving a highly favorable reputation. Currently, over 90 percent of Mazda vehicles sold in Japan qualify for the government’s eco-car tax reductions.

Last year, the world entered an unparalleled economic crisis and the knock-on effects of this global recession have severely impacted the automobile industry. In the face of this drastic change in the business climate, Mazda has also had to implement a range of emergency measures. But at the same time, we are looking beyond the current crisis to the motorized society of the future, and investing even greater effort into enhancing the value and appeal that only Mazda can offer.

The foundation for this initiative is our “Sustainable Zoom-Zoom” long-term vision, a plan we announced in March 2007 for technology development. According to this plan, we aim to offer all Mazda customers high levels of driving pleasure as well as excellent environmental and safety performance.

Our theme for the 2009 Tokyo Motor Show is “The Mazda SKY concept—Providing driving pleasure and environmental and safety performance for all our customers!” The concept reflects the “sky‘s the limit” aspirations of our engineers as they pursue optimal efficiency through unconventional thinking free from orthodox restrictions and limitations. We also chose the name SKY for our next-generation powertrain development concept to express our desire to ensure an “everlasting blue sky” under which everyone will be able to enjoy the fun-to-drive pleasure provided by Mazda.

At this year’s Tokyo Motor Show, under the headings of “Today,” “Tomorrow” and “The Future," we invite you to view our technologies aimed at achieving a 30 percent improvement in average fuel economy for all Mazda vehicles sold globally by 2015 compared to 2008 levels.

In “Today's Technologies” we are presenting our unique “i-stop” idling stop system that is already available in the new Axela and Biante.

‘‘Tomorrow's Technologies” features the next-generation gasoline engine “Mazda SKY-G,” clean diesel engine “Mazda SKY-D” and automatic transmission “Mazda SKY-Drive.” Gradual

introduction of these technologies will begin in the Japanese market starting in 2011. Mazda also plans to progressively introduce electrical devices including hybrid technology.

The compact concept car Mazda Kiyora demonstrates our “Tomorrow's Technologies,” incorporating a “Mazda SKY-G” engine and “Mazda SKY-Drive” automatic transmission. A regenerative braking system and lightweight design also contribute to Mazda Kiyora’s remarkable 32km per liter fuel economy that is achieved without assistance from an electric motor.

“Future Technologies” showcases the Mazda Premacy Hydrogen RE Hybrid. Mazda hydrogen rotary engine vehicles were initially leased in Japan and now we have also begun leasing them in Norway as part of our steady drive to promote their use.

In addition, to highlight developments in the safety performance part of “Sustainable Zoom-Zoom,” we are exhibiting technologies developed to prevent traffic accidents.

The challenge we set for ourselves is to offer all our customers driving pleasure and excellent environmental and safety performance. Look to Mazda for exciting developments as we work toward a sustainable future for people and the automobile.

Takashi Yamanouchi

Representative Director, President and Chief Executive Officer

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“Sustainable Zoom-Zoom” — Long-term Vision for Technology Development

Promoting concrete initiatives for a sustainable future

In March 2007, Mazda drafted the “Sustainable Zoom-Zoom” plan, detailing the company’s long-term vision for technology development. This vision commits us to make “cars that always excite, look inviting to drive, are fun to drive, and make you want to drive them again,” and to help achieve “an exciting, sustainable future for cars, people and the Earth.” Based on the plan, we have announced that by 2015 we intend to make a 30% improvement on the 2008 average fuel economy of Mazda vehicles sold worldwide.

Intensive improvement of base technologies, progressive introduction of electric devices

Our basic policy is to “Provide all customers who purchase Mazda cars with the joy of driving, as

well as excellent environmental and safety performance." To realize an advanced Zoom-Zoom world, it is crucial to thoroughly improve base technologies for powertrains — the engines and transmissions at the heart of automobile performance — as well as reduce weight and enhance aerodynamics. It is predicted that base engines (internal combustion engines) will still have a high percentage of the global market in 2020.

In addition, Mazda is progressively combining its proprietary i-stop idling stop system, regenerative braking system, hybrid technology and other electrical devices, with the aim of offering more customers higher levels of fun-to-drive and excellent environmental performance.

Step-1 Idling stop system

Mazda's idling stop system, i-stop, automatically shuts down the engine when the vehicle stops momentarily. The system yields an improvement of 8% to 10% in fuel economy (with Japan models). Mazda is installing i-stop as our first SKYTECH electrical device in the new Axela and Biante models from 2009.

Step-2 Regenerative braking system

This energy recovery technology converts kinetic energy into electricity as the vehicle decelerates and stores it for use later as needed. The effectiveness of the system varies depending on how the regenerated electricity is used, but the improvement in fuel economy is expected to range from a few percent to 5% or more.

Step-3 Hybrid systems

In general, the gasoline engine uses an electric motor to assist at times when energy efficiency is poor, such as during low-rpm or low-load operation. A hybrid system is combined with an idling stop mechanism, regenerative braking technology and other features to substantially boost overall efficiency.

Mazda SKY concept — Driving pleasure and an everlasting blue sky

Our aim is to offer driving pleasure and excellent environmental and safety performance to all our customers. We chose the name SKY to represent the following three ideas which formed the basis for the development of our next-generation powertrains: the "sky's the limit" aspirations of our engineers as they pursue optimal efficiency through unconventional thinking; ensuring an everlasting blue sky; and offering all our customers pure driving pleasure to enjoy under that sky. This thinking played the key role in the development of our new base technologies.

Mazda SKYTECH — Powertrain technology supporting environmental performance for Mazda vehicles

We created the name Mazda SKYTECH for our innovative technology to embody the development concept of the next generation powertrains. This year's Tokyo Motor Show marks the world premiere of three items based on Mazda SKYTECH.

· Next-generation gasoline engine: Mazda "SKY-G"*

· Next-generation diesel engine: Mazda "SKY-D"*

· Next-generation automatic transmission: Mazda "SKY-Drive"*

* These are concept names given to engines and transmission scheduled for introduction from 2011 onward, and not the names of actual products.

By 2015, Mazda aims to achieve a 30% improvement in average fuel economy over the 2008 level for all Mazda cars sold globally. With the next-generation gasoline engine models, our aims are to reduce weight by over 100kg and improve aerodynamics, and through the combination of Mazda SKY-G and Mazda SKY-Drive, attain fuel economy equivalent to that of current models that are one class smaller. Also, with the next-generation diesel engine models, while reducing weight and improving aerodynamics, we set the lofty goal for Atenza (Mazda6) to attain fuel economy equivalent to that of the Demio (Mazda2) class which is two classes smaller.

There are two important basic technologies underlying our achievement of outstanding fuel efficiency and driving pleasure: the next-generation MAZDA SKY-G and MAZDA SKY-D engines developed with the focus on ideal combustion; and the next-generation MAZDA SKY-Drive automatic transmission with its focus on reducing loses from mechanical resistance. To bring driving pleasure with excellent environmental and safety performance to all our customers, Mazda engineers face the challenge of developing innovative technologies with total determination and unlimited freedom to come up with inventive ideas. Below, we introduce you to some of the results of their efforts.

Premacy Hydrogen RE Hybrid – pursuing a carbon-free society

Mazda is taking the lead with upcoming new energies. Supporting this initiative in part is the Premacy Hydrogen RE Hybrid, which we started leasing in Japan in March 2009. This Premacy variant uses a series hybrid system comprised of a hydrogen rotary engine combined with a generator that produces electricity which powers an electric motor. With power from hydrogen energy and electricity, and extensive use of bioplastic and biofabric, the Premacy Hydrogen RE

Hybrid represents a significant step toward a carbon-free future. With the Premacy Hydrogen RE Hybrid, we aim to advance development of a range of technologies including motors, batteries and control systems.

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Next Generation Powertrains

Mazda SKY concept — Driving pleasure and eco-friendly performance for everyone

In order to bring Mazda's unique Zoom-Zoom driving pleasure and excellent environmental performance to all our customers, we emphasize base technologies to benefit the basic performance of all our vehicles. We believe the right approach is then to gradually combine this technology with electric devices such as the i-stop idling stop system. Mazda SKYTECH introduced at this year's Tokyo Motor Show is innovative technology for powertrains to realize dramatic improvements in internal combustion engines and transmissions.

Mazda's quest to improve the internal combustion engine

To improve the thermal efficiency of an engine and boost fuel economy and performance, Mazda believes it is necessary to reduce four important loss factors: cooling loss, exhaust gas loss, pumping loss and mechanical frictional loss. Key to reducing these losses is how close we can approach the ideal in technologically controllable factors (control factors). For Mazda, these control factors are expansion ratio (compression ratio), combustion duration, combustion timing, specific heat ratio, effective intake volume, load and coefficient of friction.

We have always conducted technological research and development by envisaging the ideal control factors and setting fundamental targets. For both gasoline and diesel engines, Mazda's policy is to unremittingly pursue the goal of ideal combustion.

Fuel economy and torque up by 15%

Next-generation 4-cylinder direct injection gasoline engine "Mazda SKY-G"

To achieve a breakthrough in gasoline engine performance, we started by intensively researching the process of combustion. We studied air-fuel mixture formation in the cylinder due to air flow and fuel injection, as well as flame propagation, expansion and other parts of the process to ascertain the underlying mechanisms operating in the cylinder. As a result, we clarified which variables must be optimized in order to achieve ideal combustion.

• Four key factors that boost thermal efficiency

Based on this continual research effort, we placed particular emphasis on improving the following four factors in the development of the next-generation direct injection gasoline engine “Mazda SKY-G”: expansion ratio, combustion duration, intake volume control (pumping loss), load and coefficient of friction (mechanical resistance loss).

For example, as shown below, if we raise the expansion ratio, fuel economy improves. But if we increase the compression ratio to get a higher expansion ratio, we reach a limit where knocking and other abnormal combustion effects rapidly increase. This was accepted in the past and we missed the chance to realize fuel economy with great improvements in efficiency. With the “Mazda SKY-G” engine we broke through this limit, and attempted to raise the expansion ratio close to the ideal level. We were able to do this by fully employing the freedom of spray formation given by the direct injection system, and matching air flow and combustion chamber shape with CAE (Computer Aided Engineering) to enable control over flame propagation.

• Low fuel consumption on a par with current diesel engines, as well as stronger torque

The Mazda SKY-G 2.0L gasoline engine, though currently under development, is confirmed to improve fuel economy approximately 15% over the conventional 2.0L gasoline engine. This figure is on a par with Mazda's current 2.2L diesel engine. In terms of performance, it is confirmed that torque is also increased roughly 15% over the current 2.0L gasoline engine.

Main technology examples and aims of the “Mazda SKY-G” engine

Newly designed engine body structure

- Reduced mechanical resistance
- Optimum air-fuel mixture formation

Next generation direct injection system

- Fuel atomization
- Optimum air-fuel mixture formation

Highly functional variable intake valve timing system

- Optimal control of air intake volume

Mazda-developed single-nanocatalyst dramatically reduces precious metal use

The next-generation Mazda SKY-G engine series employs single nanotechnology for the catalyst in its exhaust gas purification system, greatly reducing the amount of precious metal used while achieving excellent purification efficiency and durability. Mazda is the world’s first automaker* to

commercialize this technology. The single nano-catalyst is also employed in the new Axela (Mazda3), where the amount of platinum, palladium and other precious metals used is reduced from 0.55g/L to 0.15g/L. That's an approximate 70% reduction in the use of precious metals compared with the previous model. *As of January 2009

Next-generation "Mazda SKY-D" diesel engine achieves 20% improvement in fuel economy, and smooth power delivery up to high engine speed

The gasoline engine and diesel engine are the same as regards the "control factors" for approaching perfect combustion. Of additional importance in the case of the diesel engine is the need to reduce NOx (oxides of nitrogen) and soot (dry carbon particles) emissions while improving fuel economy. To address this issue, with the next-generation diesel engine development we focused on breaking through combustion timing and load as well lowering frictional resistance.

• Ideal combustion is completed faster with a homogenous air-fuel mixture

There are three key factors that assist in suppressing NOx and soot emissions while raising thermal efficiency, namely:

1 in-cylinder pressure and temperature from fuel spray to combustion start.

2 a combustion chamber shape that facilitates a uniform air/fuel mixture.

3 a fuel injection rate that governs the burn rate.

In a conventional diesel engine, it is difficult to start combustion with the best timing for thermal efficiency while simultaneously suppressing NOx and soot emissions. In contrast, through management of the three key factors mentioned above, the "Mazda SKY-D" diesel engine attains innovative combustion for low fuel consumption and high power while reducing NOx and soot.

• Fuel economy up 20%, low and high end torque boosted

With the engine under development, we have confirmed an approximate 20% improvement in fuel economy compared with Mazda's current diesel offering, the MZR-CD 2.2L diesel turbo engine. This was achieved through innovative combustion and by attaining low mechanical resistance on a par with that of a gasoline engine. In performance terms, both low- and high-end torque are much improved compared with the current diesel engine. These benefits are attributable to improved forced induction delivered by a two-stage turbocharger, and the effect of the new combustion chamber shape which optimizes the air-fuel mixture over the entire operating range of the engine.

Main technology examples and aims of the Mazda SKY-D engine

Newly designed engine body structure (aluminum block, lightweight pistons and connecting rods)

- Reduced mechanical resistance
- Higher engine speed

Direct piezo injectors

- Optimization of combustion timing

Wide-range, high volume EGR

- Low emissions

Two-stage turbocharger

- Optimal forced induction over wide range

Highly efficient diesel particulate filter (DPF)

The “Mazda SKY-D” engine incorporates technology for efficient post-treatment of the particulate matter (PM) content of diesel engine exhaust gases. The engine’s diesel particulate filter is highly heat-resistant and features a Mazda-developed world-first catalyst activation mechanism that assists in catalytic combustion of PM. In combination with more accurate engine management, this approximately doubles the diesel particular filter regeneration interval for burning off soot, and shortens the regeneration process time to approximately one third compared with the previous system.

The Mazda-developed PM combustion catalyst facilitates movement of oxygen within the ceramic support material, dramatically boosting the combustion speed of soot by supplying more oxygen. Owing to this, less additional fuel is required for the combustion of soot. This improves the overall fuel economy and results in lower CO_2 emissions and cleaner exhaust gases.

• Towards a low-cost, clean diesel engine

Owing to the innovations outlined above, NOx is also significantly reduced. Along with the diesel particular filter, this enables substantial simplification of the exhaust gas post-treatment system. With new models from October 2009 (subsequent models from June 2010) our plan is to build low-cost clean diesel engines that can clear long-term emissions regulations.

Mazda SKY-Drive

Newly developed six-speed automatic transmission delivers a significant (approximately 5%) fuel economy improvement along with a more direct shift feel

With the next generation automatic transmission, our goals were to contribute significantly to fuel economy and improve the direct feel. As with the next generation engine, we approached development based on the Mazda Sky concept by pinpointing the control factors for achieving our targets, and concentrating on how we could improve them.

Because the next-generation automatic transmission was to be a completely new design we aimed to make improvements in the control factors, and among these we focused particularly on factors that extend the range of the lock-up mechanism and improve the direct shift feel.

• Extending lock-up range and enhancing precision and response of hydraulic control

Of particular importance for extending the lock-up range is managing vibration of the clutch that couples the input and output shafts. We analyzed the mechanisms of high-frequency clutch vibration and ascertained the desired properties for the clutch surface and its heat resistance, the rigidity of the supporting structure, and control factors such as hydraulic fluid volume and hydraulic pressure that influence vibration.

Armed with this information, we conducted CAE and applied quality engineering for efficiency in development, optimized the design including the reciprocal influences of the control factors, and were able to substantially extend the lock-up range as a result. Also, by ascertaining the least required volume of hydraulic fluid for each part of the transmission, we achieved a more direct shift feel due to faster clutch movement.

• Approximately 5% better fuel economy and a sporty, direct feel

The lock-up mechanism of the current five-speed automatic transmission vehicle is active about 50% of normal running time. In an in-house test of a vehicle fitted with the newly developed six-speed “Mazda SKY-Drive” transmission, it was confirmed that lock-up was active for approximately 80% of the running time under Japan’s JC08 fuel consumption mode test cycle.

In terms of actual fuel economy in JC08 mode, the extension in lock-up range and substantially lower resistance resulted in an approximately 5% improvement in fuel economy compared with the current five-speed AT vehicle. At the same time, the new AT achieves a sporty and refined, direct feel comparable to that a of dual clutch transmission.

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Concept Car

Mazda Kiyora — Compact concept car equipped with next-generation “Mazda SKY-G” gasoline engine that realizes 10-15 mode fuel economy of 32km/L

The Mazda Kiyora concept suggests one direction Mazda is pursuing in car development, and demonstrates a 30% improvement in fuel economy in line with our “Sustainable Zoom-Zoom” plan. A feasible compact city commuter car of the near future, Kiyora achieves next generation environmental performance coupled with Mazda’s inimitable driving fun.

Mazda Kiyora is powered by a next-generation “Mazda SKY-G 1.3L” gasoline engine mated to a next-generation “Mazda SKY-Drive” transmission. The vehicle is also equipped with Mazda's proprietary i-stop idling stop system and regenerative braking system. Mazda Kiyora achieves ultra-high fuel economy of 32km/L in Japan’s 10-15 mode test cycle assessment, without drive assistance by an electric motor.

Next-generation standards of driving pleasure and eco-friendliness

Mazda Kiyora is a next-generation compact concept born from research into the future of the global environment and the lifestyles of young city dwellers. Mazda Motor Europe’s Advanced Product Strategy (APS) team conducted an in-depth analysis of the small city car segment in Europe. Results showed that young people wanted cars that are fun to drive, easy to park and use, cost little to run and produce low exhaust emissions.

“Mazda Kiyora” is our response to these demands from global markets, using next generation technologies based on Mazda's “Sustainable Zoom-Zoom” plan.

Mazda Kiyora’s powertrain mates a newly developed “Mazda SKY-G 1.3” direct injection gasoline engine with “Mazda SKY-Drive” — a newly developed, compact and lightweight six-speed AT with manual mode. The results are exceptional environmental performance as well as a powerful and refined drive with excellent response even from low speeds. The car is also equipped with Mazda’s proprietary “i-stop” advanced idling stop system which eliminates wasted fuel consumption when the vehicle is momentarily stationary.

To efficiently harness energy regenerated during deceleration, we installed a regenerative braking system that converts kinetic energy to electricity as the vehicle decelerates and uses it to recharge the battery. The system greatly reduces the load on the engine required to drive the alternator to generate electricity, and this translates into commensurately lower fuel consumption.

The exhaust gas purification system employs a newly developed catalyst — produced using single-nanotechnology, which controls particles even smaller than those of conventional nanotechnology — resulting in the highest ranking emissions purification performance in the class.

In addition, thorough weight reduction gives a weight 100kg below that of Mazda Demio. This,

together with a superbly crafted aerodynamic body, helps to enable Mazda Kiyora's ultra-low fuel consumption of 32km/L (Japan's 10-15 mode test cycle) without drive assistance by an electric motor.

With regard to weight reduction, CAE was employed to design an ideal body structure which includes lightweight materials such as aluminum and a special resin foam, currently under development at Mazda. These are found not only in interior parts such as the instrument panel, but are also used for the hood, tailgate and sections of the chassis. Their effective usage contributes to an improved yaw moment of inertia and reduced unsprung weight, leading to superb handling.

Exterior — Fusing form and function

With an overall length 10cm shorter than the Mazda Demio, Mazda Kiyora represents a further evolution of the company's design DNA, combining a signature five-point grille with 3-dimensional elements over the entire body. Its silhouette features character lines that are sleek and smooth, moving upwards and rearwards to fuse into the rear spoiler. Combined with 18-inch alloy wheels and extremely short overhangs, the result is a truly sporty look in a small package. The transparent roof is equipped with solar panels which provide electricity for the car's interior systems.

The compact body and low overall height keep the area of the front cross-section to a minimum. In addition, detailed aerodynamic studies of the body surface shape, use of devices to control underfloor airflow and a rear roof spoiler combine to create exceptional aerodynamics.

Interior design — All-round weight reduction and integrated development

The interior design is not only an expression of beauty and functionality, it also achieves minimized weight while moulding shapes to produce a rigid structure for the cabin. To achieve this, the designers thoroughly analysed the body structure and conducted comprehensive weight-saving development before considering high-cost replacement materials. As well as drastically reducing weight, this also results in high rigidity and excellent impact resistance. Integrating the rear seats with the body frame structure was born from this approach.

Color and materials

The exterior is blue-green with transparent plastic doors chosen to express the purity of water. Inside are forms that give the impression of flowing sea grass — for example, the wavy side

member of the body shell. The overall color scheme gives the impression of looking into water when viewed through the doors from outside the car.

The interior seen through the skeletal body shell reflects the water theme with wavy, flowing forms. The instrument panel and door trim have a soft coating and use light metal to enhance this impression.

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Weight Reduction

From 2011, models will be 100kg lighter than current levels

Until now, improvements in crash safety performance and equipment upgrades have generally meant automobiles gained in weight with each successive model change. Mazda believes that this continuing weight gain is unsustainable for the future.

With this in mind, we envisaged the kind of vehicle required to improve fuel economy 30% by 2015, and set a goal of reducing weight by 100kg or more in order to achieve this. Employing the new platforms and powertrains now in development, we intend to achieve this with our next-generation products to be introduced from 2011 onward. In addition, from 2016 we think it will be necessary to reduce weight by a further 100kg or more.

Although such a substantial weight reduction would be relatively easy with extensive use of high-cost, lightweight materials, it would present problems from the viewpoint of providing this benefit to all our customers. However the new Demio received world recognition by attaining a 100kg reduction in weight compared with the previous model, as well as improved fuel economy and driving performance. It also proved that extensive use of high-cost, lightweight materials was not essential in achieving such a substantial weight reduction.

Three viewpoints enabling a 100kg weight reduction

Mazda currently takes a comprehensive approach to weight reduction from three points of view: “Pursuing the ideal structure,” “Developing new processing techniques” and “Replacement materials.”

“Pursuing the ideal structure” involves setting a rational basic structure from the aspects of strength and rigidity, etc. and intensive optimization of the structure using CAE and other methods.

“Developing new processing techniques” particularly involves machining technology and

welding technology, and with “Replacement materials” we focused on replacing heavy materials, such as steel, with aluminum, magnesium or plastic.

Comprehensive weight reduction contributes to fuel economy improvement

With regard to the body, we are reducing total weight while working to further reinforce crash safety performance. First, since a reasonably straight frame is of key importance, we create an ideal body structure by solving any layout problems associated with major elements, such as the powertrain and suspension. Then, using CAE, we thoroughly optimize materials and thicknesses. Finally, while pursuing body weight reduction we use laser welding, weld bonds and other new construction techniques to further improve crash safety performance and rigidity. For the chassis, we completely optimize the suspension structure and mounting method. Through this approach we can reduce vehicle weight by as much as 100kg, allowing us to attain great improvements in fuel economy in fully redesigned models to be introduced from 2011.

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“i-stop” Idling Stop System

“i-stop” — New eco-friendly driving technology already on the streets

While pursuing driving pleasure, Mazda is also concerned about conserving natural resources and other environmental problems. One of our new eco-technologies is the proprietary “i-stop” idling stop system. Installed in the new Mazda Axela and Biante, i-stop improves fuel economy by shutting down the engine when the vehicle is stationary, and instantaneously restarting it to resume driving while maintaining a smooth and comfortable ride.

Thanks to its favorable reputation among users, i-stop-equipped vehicles accounted for 50% of total sales of the new Axela, and 70% of sales of the Biante in August 2009.

15% improvement in fuel economy over the previous model, as well as instantaneous engine restart

Idling stop systems reduce fuel consumption by automatically shutting down the engine when the driver momentarily stops the vehicle, such as at a red light or in heavy traffic. The engine automatically restarts when driving resumes, thereby economizing on fuel consumption. Conventional systems restart the engine using only the starter motor.

In contrast, i-stop restarts the engine with combustion occurring in the engine in a “combustion

plus motor assist start" system. The system normally restarts the engine in 0.35 sec, which is about half the time taken by conventional technology. Installed as standard in all 2.0-liter FWD Axelas, this world-first technology from Mazda improves fuel economy approximately 15% (20C model grade comparison) to 16.4km/L (under Japan's 10-15 mode test cycle).

During engine shutdown, on-board equipment continues to function in basically the same way as when the vehicle is running so there is no loss of comfort to vehicle occupants. And since reliability is built into engine restarting, a high level of safety and reliability is assured.

Eco-friendly driving support functions

In parallel with i-stop, the following three new functions are used to support daily eco-driving.

1 Eco-lamp : The eco-lamp in the meter cluster supports eco-driving by lighting up when driving parameters, such as the throttle opening and vehicle speed, are efficient (fitted as standard on the new Axela and Biante).

2 Eco-drive gauge : The percentage of time the eco-lamp is lit over the course of one whole trip is indicated when the drive ends (when the ignition is switched off). If the vehicle is equipped with the multi information display (MID), eco-driving performance is continuously displayed during driving in the form of leaf graphics in four color (green, blue, yellow and red) displaying the result of diagnosis. This contributes to boosting the driver's motivation to practise eco-driving. (Available on new Axela equipped with MID).

3 i-stop monitor (tree graphic) : Based on the amount of time the engine is stopped due to i-stop, a tree graphic on the MID indicates how much the driver's driving pattern contributes to boosting fuel economy. The monitor shows a sprout gradually budding and growing into a tree, indicating the amount of time i-stop has been engaged. When the total idling stop time reaches 8.4 hours, the graphic becomes a mature tree. The system thus gives a visual representation of the contribution to resource conservation alongside the actual reading of idling stop time. (Available with new Axela equipped with color LCD MID).

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Hydrogen Rotary Engine

The Hydrogen rotary engine opens the door to the future of "Sustainable Zoom-Zoom"

The future-oriented hydrogen rotary engine (Hydrogen RE) is one of Mazda's signature Zoom-Zoom powerplants under development. It takes the harmony between driving pleasure

and excellent environmental performance to a higher level. Our aim for a “Sustainable Zoom-Zoom” future includes further improving the hydrogen rotary engine vehicle.

Steady acceleration towards commercialization

Mazda has already commercialized two models powered by the hydrogen rotary engine. In 2006, we began leasing the RX-8 Hydrogen RE to government agencies and energy-related organizations in Japan, and it has enjoyed an excellent reputation with customers. Also, since 2007, we have been collaborating in HyNor (Hydrogen Road of Norway), a national project to expand the hydrogen infrastructure of Norway. First leasing at overseas has begun in Norway in 2009.

We began leasing the Premacy Hydrogen RE Hybrid in Japan in May 2009. Use of the hybrid system in this model results in dramatically improved performance.

In this way we are steadily advancing the future of our hydrogen rotary engine vehicles.

Premacy Hydrogen RE Hybrid with hydrogen rotary engine plus hybrid system

Since Mazda’s hydrogen rotary engine uses hydrogen fuel, it exhibits exceptional environmental performance with zero CO_2 emissions. In addition, when the hydrogen fuel runs out, a convenient dual-fuel system enables the vehicle to run on gasoline.

The Premacy Hydrogen RE Hybrid exhibited at this year’s Tokyo Motor Show has a hydrogen rotary engine combined with a generator that produces electricity. A series hybrid system employing an electric motor developed with Mazda technology drives the wheels. The system yields improved energy efficiency and acceleration performance, and achieves a cruising distance of 200km when running on hydrogen fuel.

Mazda Biotechmaterial*

We developed our own plant-derived bio materials, collectively known as Mazda Biotechmaterial*, as part of our efforts to use non-petroleum based resources and mitigate CO_2 emissions. We use these materials in the Premacy Hydrogen RE Hybrid. The gear shift panel and other interior fittings are made of 80% plant-derived bioplastic that is extremely durable and heat resistant. Seat covers and door trim are made from a 100% plant-derived biofabric that demonstrates wear-, flame- and weather-resistance.

* Collective name given to bioplastic, biofabic and similar plant-derived materials developed by Mazda.

Recycling Technology

Bumper-to-bumper recycling technology

Mazda is positively committed to recycling plastic parts from automobiles. We put special effort into recycling large plastic components such as bumpers, and have established bumper-to-bumper recycling technology to collect damaged bumpers and re-use the material to make bumpers for new vehicles. Mazda introduced recycled bumpers* made possible by this technology from March 2005, and is progressively extending the range of models to which they are fitted.

In March 2009, Mazda developed the world's first scrapped bumper recycling automation technology that automates the series of processes from pulverization of end-of-life vehicle bumpers to recycled material manufacturing. Though considered difficult in the past, this advanced technology treats scrapped bumpers from different makers simultaneously, and automatically sorts and discards metal attachments. The system has enabled a higher than ever recycling efficiency for Mazda.

* Recycled content ratio 30% or less. Content ratio varies with the volume of damaged bumper collection and other conditions.

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Safety Technology

Toward an accident-free and safe motorized society Mazda's advanced safety technologies

To ensure a sustainable future for road transport, Mazda is intensifying safety-related research and development towards the ultimate goal of realizing an accident-free and safe motorized society, based on the idea that Mazda offers all our customers vehicles that are fun to drive and have excellent environmental and safety performance. This involves both passive safety, and also a higher level of active safety technology to support the driver with accurate hazard recognition and assessment, handling that matches the driver's intentions, and vehicle dynamics that facilitate easier collision avoidance. At the same time, we are aggressively developing comprehensive safety technologies that include the use of data generated by a transport infrastructure.

Eliminating the causes of human error

There are various causes of accidents, but most are the result of human error. Driving involves recognition of hazards, judgment and action. Analysis of research results shows recognition errors to be the most frequent, followed by judgment errors and then action errors in descending order. Mazda's research and development efforts aim to produce measures to counter such human errors when they occur and even eliminate the causes of human error altogether, to realize "cars that accurately recognize and assess driving and running conditions and enable the driver to take appropriate safety action."

Advanced technology supporting recognition and judgment

• Establishing a human-machine interface (HMI)

At Mazda, active safety is based on fast and accurate communication of the driver's intentions to the vehicle, and accurate communication of various information and feedback to the driver from the vehicle. In other words, our emphasis is on establishing an efficient human-machine interface (HMI). We focus on basic functions, such as better field of view and visibility, user-friendly operation and optimized cockpit design that will comfortable accommodate drivers of any physique.

In the new Axela (Mazda3) for example, we introduced a zone layout concept, whereby the displays and controls are optimally positioned in consideration of the eye and hand movements of the driver, as well as the importance of each type of information and frequency of use. The new Multi Information Display (MID) is located where it can be seen or read with a natural glance that is within the driver's forward field of view. Likewise, the audio switches, air conditioner controls and gear shift knob, etc., are laid out so that they can be reached with minimal hand movement, creating an environment that enables the driver to focus on the road.

• Emergency Signal System (ESS)

During emergency braking at speeds above 50km/h, the Emergency Signal System (ESS) rapidly flashes the hazard warning lights to alert following drivers. (Fitted as standard equipment on all model grades of the new Axela)

• Rear Vehicle Monitoring (RVM) System

At speeds over 60km/h, the Rear Vehicle Monitoring (RVM) system detects vehicles approaching from behind using radar sensors located at the left and right rear corners of the vehicle. The system alerts the driver by LED lamps and a buzzer, to support judgment about changing lanes. In the driver alert situation, if the driver operates the turn signal on the side where an LED lamp is lit, the buzzer sounds and the LED flashes to warn the driver. Since the RVM uses 24 GHz radar,

it is not susceptible to the effect of rain or other weather conditions, assuring safe detection performance. (Available as a factory-installed option on some model variations of Axela and Atenza)

• Adaptive Front-lighting System (AFS)

The Adaptive Front-lighting System automatically turns the headlamp beams in the driver's intended direction according to steering-wheel input and vehicle speed. This illuminates the road in the direction the driver intends to proceed and greatly improves visibility. The system swivels the headlights up to 15 degrees to the right or left. (Available as a factory-installed option on some model variations of the new Axela and all models of MPV. Some Atenza models are equipped as standard with a fixed AFS.)

Advanced technology for dynamic performance

• Mazda Pre-crash Safety System

The Mazda Pre-crash Safety System recognizes vehicles ahead, oncoming vehicles and other obstacles using radar sensors, and when a collision is predicted, warns the driver with a buzzer and light. Also, it automatically applies light braking to alert a driver who has failed to apply the brakes. Moreover, if the driver is late in taking action to avoid a collision and a crash is determined to be inevitable, the pre-crash brake system automatically applies the brakes to lessen the severity of impact. At the same time, seatbelts are pre-tensioned to minimize slack and more effectively restrain occupants to reduce injury. (Available as standard on some model variations of the CX-7, and as a factory-installed option on some model variations of the Atenza and MPV)

Driver support technology involving coordination with the infrastructure

To solve the problem of human error, it is important to counter the risk of accidents well in advance. To do this, in addition to advancing technology in the vehicle for hazards the driver cannot see, it is essential to develop coordination between the vehicle and the infrastructure. For example, to prevent accidents such as a collision with another vehicle on blind corners or during a turn across the flow of oncoming traffic, facilities that use ITS* technology for road-to-vehicle communication and vehicle-to-vehicle communication are required. * ITS: Intelligent Transport Systems

• Collaborative driving safety support systems

Since 2006, Mazda has been participating in a collaborative DSSS (Driving Safety Support

System) development project that is being promoted by the National Police Agency and Universal Traffic Management Society of Japan (UTMS). As part of the project we have been conducting public road trials in Hiroshima prefecture from January 2008 and in Tokyo from February 2009.

• Information exchange driver support system

Regarding driver support systems that use vehicle-to-vehicle communications, Mazda has been participating in an Advanced Safety Vehicle (ASV) promotion plan, a collaborative project between industry, academia and government bodies that was set up primarily by the Road Transport Bureau of Japan's Ministry of Land, Infrastructure and Transportation (MLIT). As a member of this project we conducted trials on public roads in Tokyo in 2009.

This initiative in road-human-vehicle interfacing and control technology is not aimed at the problems of specific regions alone, but is seen as basic research to be deployed in a variety of regions and situations from now on.

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