Clear Definition of Environmentally Sound Products

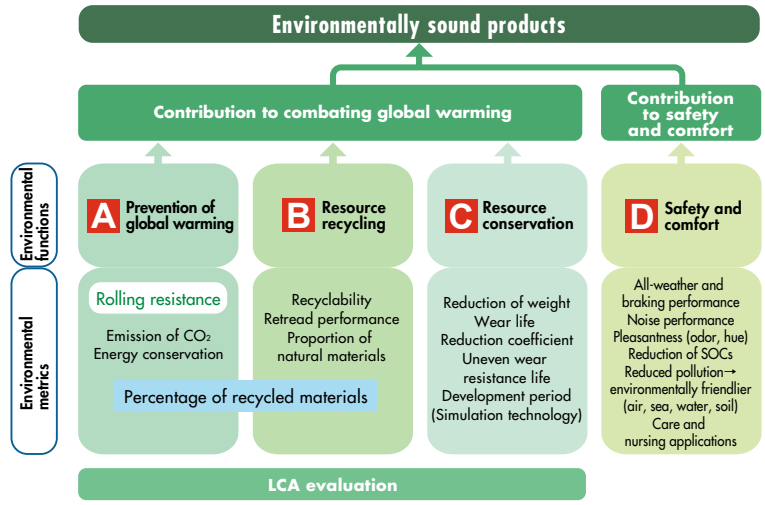
Progress in FY2006 Toward Combating Global Warming

One of a manufacturer's important duties is to help fight global warming through its products. Thanks to continued action led by the Environmentally Sound Product Committee established in June 2006, Yokohama Rubber has made two major steps toward fulfilling this duty: (1) clarification and application of the definition of environmentally sound products, and (2) calculation of the proportion of environmentally sound products in our lineup and the adoption of management by objective using the resulting figures.

Definition of Environmentally Sound Products According to Four Environmental Functions

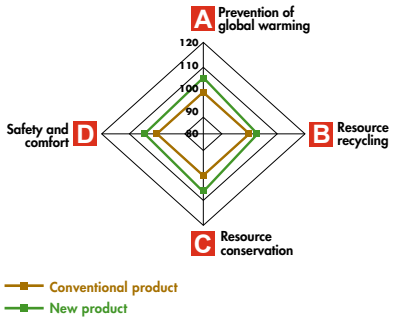
Yokohama Rubber defines environmentally sound products based on their scoring along four dimensions of environmental performance. These are: prevention of global warming, resource recycling, resource conservation, and safety and comfort. A product's environmental performance along these dimensions is assessed based on detailed metrics calculated for each dimension. Only new products that outperform conventional products along all four dimensions and that exceed our own internal general environmental assessment standards are recognized as being environmentally sound.

Four environmental functions and environmental metrics



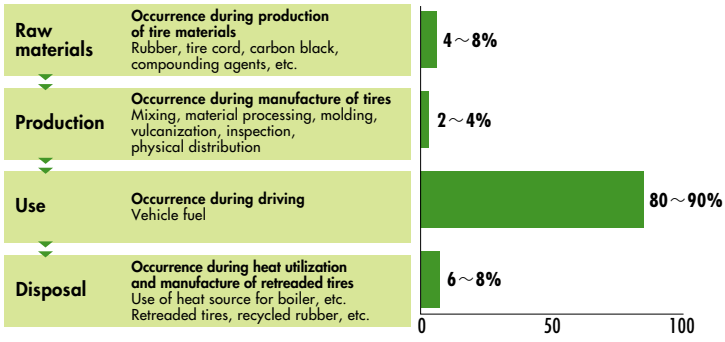
Example of quantification of assessment of environmental functions

If a new product
(1)is not inferior in any category and
(2)its environmental metrics meet or exceed internal standards, it is recognized as an environmentally sound product.



Use of Environmentally Conscious Design Applying LCA

Yokohama Rubber presently examines how environmentally friendly the designs of new products are employing a check sheet called the "Product Environmental Assessment Check Sheet," one of the key items of which is lifecycle assessment (LCA). LCA is a method of analysis using numerical data of the load on the environment at each stage of a product's life, from production to disposal. Although we have conventionally used LCA in tire design, we established the LCA measure and began using LCA for some MB products as well in 2006.



Contributing to combating global warming through product development

Yasuhiro Mizumoto
Corporate Officer in charge of Environmental Conservation Dept., General Manager of Tire Technical Div.

What might be described as Yokohama Rubber's first environmentally sound product, a pneumatic fender, appeared on the market around half a century ago in 1958. In 1998, we led the rest of the industry by launching the DNA series of eco-tires for passenger cars, which were the first line of tires designed specifically to save fuel. "Rolling resistance," which is what we used at the time as an indicator of fuel-saving performance, came to be used by the Japanese Ministry of the Environment as an indicator of tires' fuel efficiency. In July 2007, we also launched a new product in the DNA series made from 80% non-petroleum resources. Regarding tires for trucks and buses, we unveiled in March 2007 the ZEN series, featuring drastically improved fuel efficiency performance and tire life. Looking ahead, we intend to contribute to the prevention of global warming by developing products that offer outstanding environmental performance.

Raising employees' environmental awareness through product development

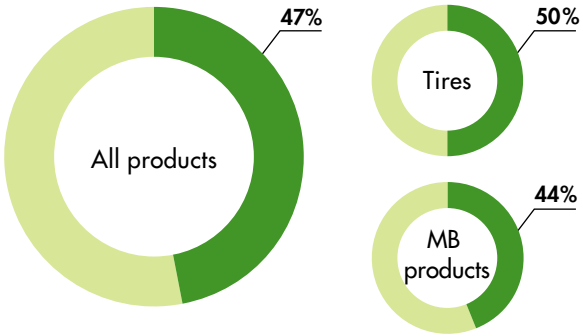
Misao Hiza
Corporate Officer in charge of MB Technical, General Manager of Hamatite Div., General Manager of Hamatite Technical Dept.

Protecting the environment means protecting oneself and one's family, so it is actually a perfectly natural thing to do. By making all of our employees aware of this and committing ourselves to environmental protection activities through our everyday work, it should be possible to achieve the goal of "asserting world-class strengths in technologies for protecting the environment" adopted in GD100. I want to help achieve such a rise in employees' awareness through product development. While MB products cover a diverse range, including industrial products, sealants and adhesives, hoses and pipes, aircraft products, golf products, and care and nursing supplies, we nevertheless managed in fiscal 2006 to complete development of methods of assessing the environmental performance of all MB products, and also introduced LCA (lifecycle assessment) of some products. We hope to extend LCA to all products as soon as possible and further accelerate the development of environmentally sound products in order to contribute to the fight against global warming.

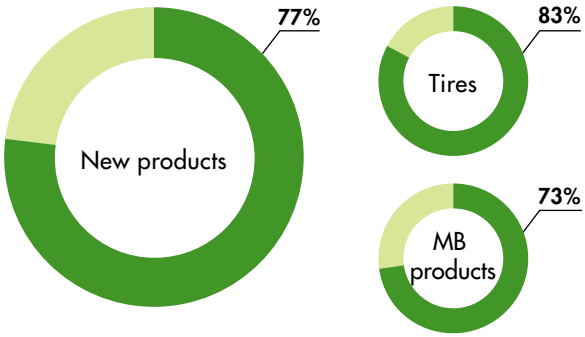
MBO Based on the Percentage of Environmentally Sound Products

Clearly defining environmentally sound products has made it possible to calculate the proportion of environmentally sound products in our lineup. We presently calculate two percentages: one indicates the proportion of environmentally sound products among our entire lineup, and the other indicates the proportion among new products only. By adopting management by objective (MBO) based on the proportion of environmentally sound products, we plan to achieve our goal of "making all products environmentally sound by fiscal 2017" adopted as a goal in GD100.

Proportion of environmentally sound products among all products (FY2006)



Proportion of environmentally sound products among new products (FY2006)



FY2008 objectives

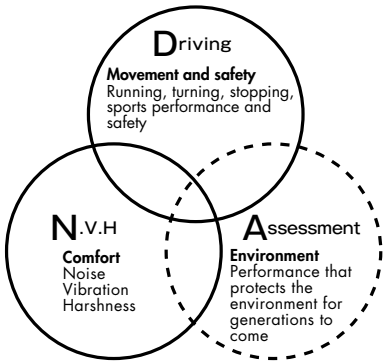
	Proportion among new products
All products	100%
Tires	100%
MB products	100%

Environmental Labeling Based on Voluntary Standards
In order to convey to the customer in an easy-to-understand manner that a product has been designated "environmentally sound products" by Yokohama Rubber, we plan to develope an environmental labeling system for certifying products that clear our own voluntary standards.

Development of Tire Products

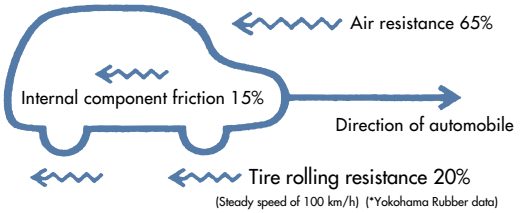
DNA Series of Eco-tires for Passenger Cars

Leading the rest of the industry, Yokohama Rubber launched in 1998 the DNA series of eco-tires, which offer reduced roll resistance and contribute to improved fuel efficiency of vehicles. Since then, we have continued to pursue development of new products and improvements in quality, and now the DNA series has an excellent reputation as an environmentally sound product. Presently, the lineup consists of eight types of tires.



Three tire development concepts

Our tire development is driven by three concepts: Driving (driving performance), N.V.H. (comfortability performance), and Assessment (environmental performance). Following these three concepts, we seek to develop tires that will meet future needs.



Reducing rolling resistance key to reducing CO_2 output

Next to air resistance, the second major factor that hampers vehicle mobility is rolling resistance. The lower the rolling resistance, the less gasoline is used in transit, and the less CO_2 is emitted.

Gattai-gomu™ Underpins the Improved Performance of the DNA Series

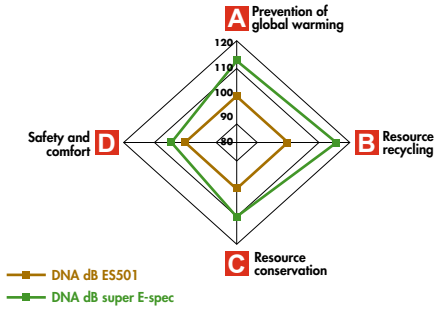
Gattai-gomu™ is a compound that offers outstanding fuel-saving performance and excellent grip, which is achieved by infusing the rubber with a stable mix of the natural mineral silica. It underwent three major evolutions—first-generation Gattai-gomu™ in 1998, second-generation Gattai-gomu II™ in 2002, and third-generation Nano-Power Rubber in 2005—before being reborn in July 2007 as Super Nano-Power Rubber, which further boosts fuel-saving performance and is derived from non-petroleum resources.

1998year — 2001year	2002year — 2004year	2005year — 2007year	
1st generation	**2nd generation**	**3rd generation**	**4th generation**
Gattai-gomu™	**Gattai-gomu II™**	**Nano-Power Rubber**	**Super Nano-Power Rubber**
9-14% reduction in rolling resistance	5-8% reduction in rolling resistance	6% reduction in rolling resistance	20% reduction in rolling resistance
Silica-carbon compound, which is made by mixing a combination of silica and carbon into a polymer (rubber), producing a substance that combines outstanding fuel-saving performance with stronger gripping power.	Fuel-saving performance and grip were further improved by increasing the quantity of silica and increasing the surface area with smaller diameters. Embedding silica in the carbon additionally improved wear resistance.	Using nano-technology, new materials were added to Gattai-gomu II™. This improved road contact, further increasing grip performance while at the same time raising fuel-saving performance and wear resistance.	Compound of natural rubber with plant-derived orange oil. Orange oil makes the rubber more pliable and at the same time releases heat when braking, combining superior energy-saving performance with the sure grip of natural rubber.
DNA ES01·02 *Launched November 1998* DNA GP *Launched November 1999* DNA dB *Launched June 2006* DNA ECOS *Launched January 2001*	map-RV *Launched January 2002* map-i *Launched March 2002* dB EURO *Launched July 2002* DNA dB ES501 *Launched February 2004*	DNA S.drive *Launched January 2005* DNA map ES340 / DNA GRAND map *Launched February 2007* *Launched February 2006*	DNA dB super E-spec *Launched July 2007* NEW NEW

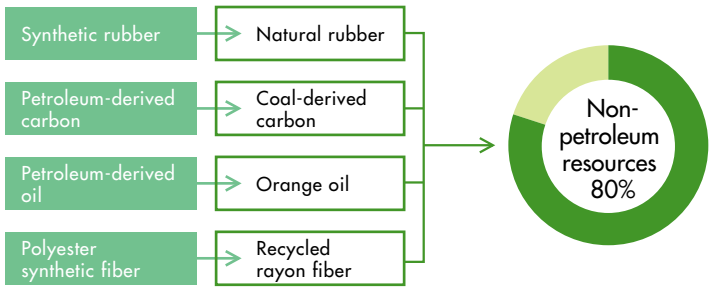
DNA dB super E-spec Made from 80% Non-petroleum Resources

The DNA dB super E-spec tire for passenger cars announced in December 2006 is Yokohama Rubber's flagship environmentally sound product, and was developed with the aim of producing the ultimate eco-tire that contributes to the global environment in every possible way. It is made from a variety of new materials and technologies that raise environmental performance, including a new compound made using orange oil called Super Nano-Power Rubber, and offers the largest reduction in rolling resistance of any tire in the DNA series (20% less than the DNA dB ES501). The proportion of materials used to make the tire that are derived from non-petroleum resources has also been raised to 80%, contributing to conservation of limited petroleum resources. The tire went on sale in three sizes in July 2007.

Assessment of environmental functions of DNA dB super E-spec



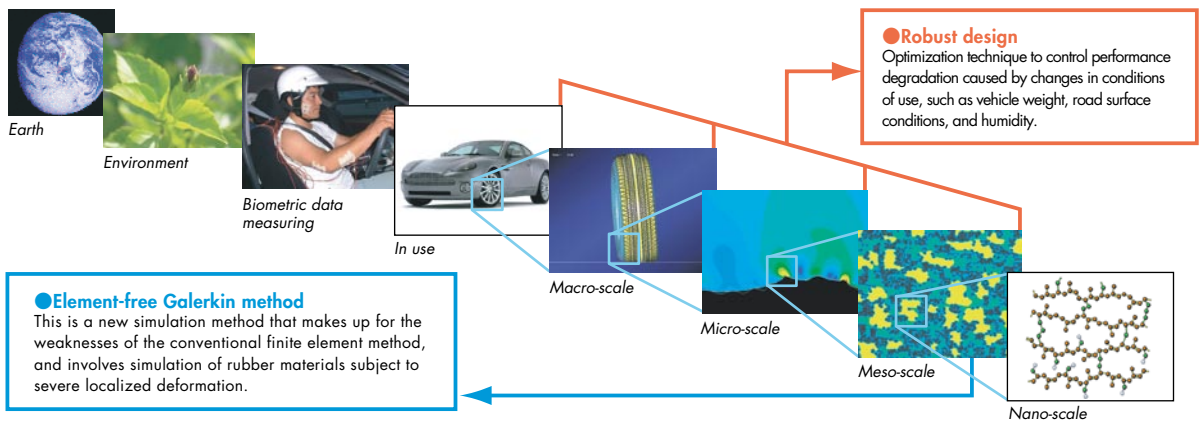
Made mainly from non-petroleum resources, reducing environmental load



Core Design Technologies

Yokohama Rubber employs "multi-scale simulation," a third-generation basic design technology, in tire development. This is a means of simulating tire performance across a wide range of scales—all the way from the nano-scale to the global environmental scale—to develop tires that offer better performance while at the same being more environmentally friendly. In fiscal 2006, two new techniques were added to our design arsenal: the element-free Galerkin method, which leads to more precise material design simulation, and robust design, which increases products' market stability.

Overview of multi-scale simulation



Development of Tire Products

The New ZEN Eco-brand of Tire for Trucks and Buses

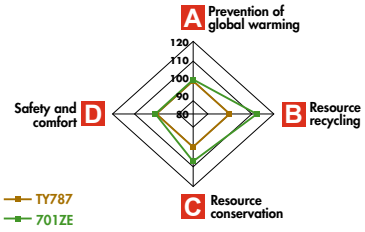
March 2007 saw the unveiling of three products under the new ZEN* eco-brand of tires for trucks and buses. This brand was developed with three goals in mind: to allow tires to be retreaded for reuse by extending the life of the casing, to reduce tire consumption by extending tread life, and to improve fuel efficiency by reducing rolling resistance. To achieve these three goals for environmental performance, a variety of new technologies were deployed, including “skew control profiling” and "C’ roll compounding,” to greatly improve durability, wear resistance, and fuel-saving performance. Progressive roll-out of eco-brand tires commenced in April 2007.

*“ZEN” is short for “Z-environment.”

Wear resistance

ZEN 701ZE all-season tire

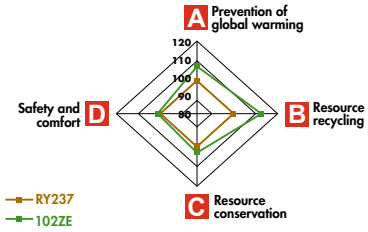
An all-season tire whose extended tread life increases tire life and saves resources due to tire consumption. 12% better wear resistance than conventional products (PRO FORCE tough TY787).



Reduced fuel consumption and maintenance

ZEN 102ZE ribbed tire

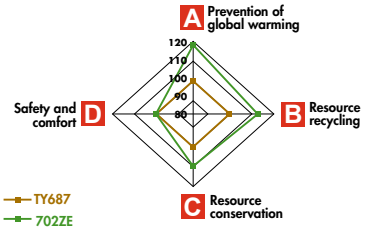
A ribbed tire whose dramatically reduced rolling resistance improves vehicle fuel efficiency, thus helping to save resources and lower exhaust emissions while at the same time reducing maintenance needs. 22% lower rolling resistance than conventional products (PRO FORCE eco RY237).



Improved fuel-saving performance

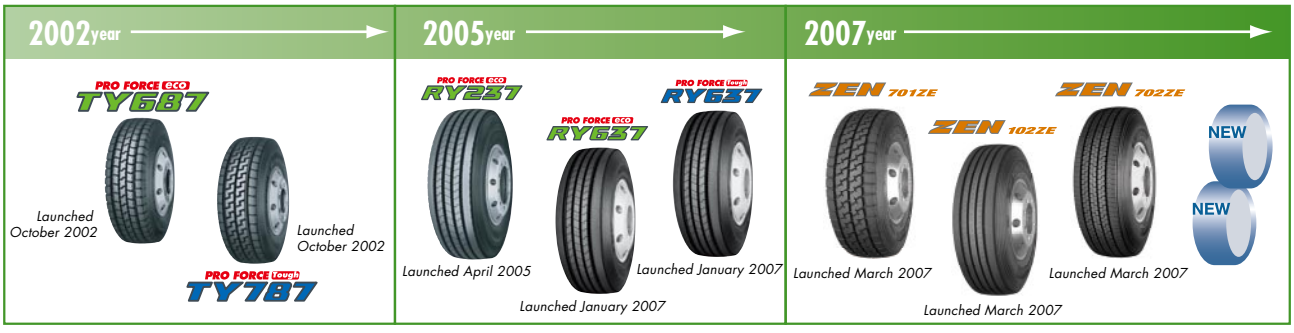
ZEN 702ZE all-season tire

An all-season tire offering improved fuel-saving performance thanks to reduced rolling resistance, and also lower maintenance due to uniform wearing. 18% lower rolling resistance than conventional products (PRO FORCE eco TY687).



Launch of Eco-tires for Trucks and Buses in 2002

The PRO FORCE eco-tire brand, the first such range for trucks and buses, was launched in 2002, and we have so far brought five products to market. Furthermore, we unveiled the new ZEN eco-tire brand in 2007, completing our line-up to meet a wide range of user needs.



Development of MB Products

Development of Multitude of Products with Outstanding Environmental Performance

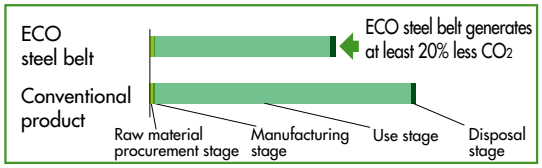
Yokohama Rubber's MB product range covers a diversity of fields, including industrial products, sealant and adhesives, hoses and coupling, aircraft products, and golf products. We have developed and sold a multitude of products whose excellent environmental performance contributes to the fight against environmental pollution, resource conservation, and recycling.

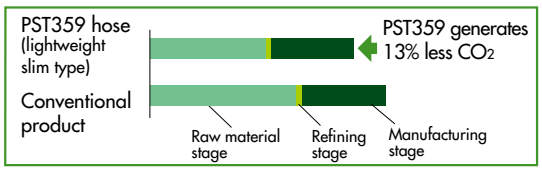
	1958	1970s	1980s	1990s	2000	2001	2002	2003	2004	2005	2006	2007
Hose and coupling products				•Low-permeability air-conditioning hose	•Noise- and vibration-proof power-steering hose	•"LEVEX" lightweight high-pressure hose				•Lead-free hose •"ECOFINELEX"Chlorine-free hose •Hexavalent-chrome-free hose fittings •Hose for dimethyl ether •Ecocute Kakin hose •Air hose for aeration systems	•"ibar HG35" 35 Mpa hose for hydrogen •Super Stream hose	
Sealants and adhesives				•"ADGUARD PC-1" labor-saving 1 component epoxy resin adhesive	•"ECU-193" elastic flooring adhesive to counter sick house syndrome		•"e-can" recyclable container for Construction Sealants	•"URBAN ROOF EU-ONE" environmentally friendly urethane waterproofing agent		•"U-300K" non-solvent quick-dry primer for urethane waterproofing agent	•"T-LEX" non-solvent elastic adhesive for tiles	•"U8000" environmentally friendly waterproofing agent •"UH-01NB" urethane sealant  •"Non-solvent WS" car window sealant
Marine products	•Pneumatic fender 	•Pneumatic fender for docking at piers	•"Seaflex" marine hose	•Honeycomb fender •Double carcass hose with oil leak detector			•Flashing hose with solar-powered light attachment		•"IAMOS" mooring simulation software •"Globuoy" air-filled rubber buoy			
Industrial equipment and aircraft products, etc.					•Prepregs for aircraft			•"Ecotex" energy-saving conveyor belt				•Porous elastic road-surfacing material •"Medi-Air" air cell cushion for preventing wheelchair pressure sores

Completion of Definition of Environmentally Sound Products and Commencement of LCA

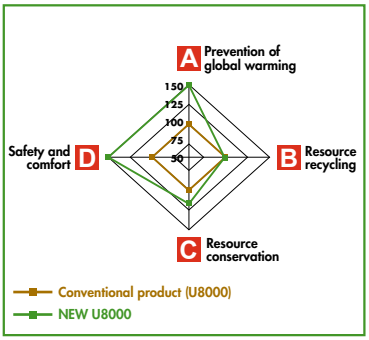
Whether tires or MB products, goods brought to market by Yokohama Rubber as "environmentally sound products" are subject to the same assessment of environmental performance. As MB products span an extremely wide range, development of environmental metrics has taken some time. By fiscal 2006, however, we had finished work on developing methods for assessing environmental functions in each product group. Methods of LCA(lifecycle assessment) of belts and hoses were also introduced in fiscal 2006, and the intention is to develop LCA methods for assessing all our MB products as soon as possible.

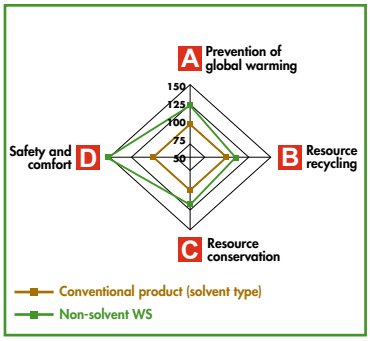
LCA of belt and hose products





Example of assessment of environmental functions (sealant)





Our Activities case number 02

As They Pound Our Roads Everyday, the Environmental Performance of Truck and Bus Tires is Especially Important

Environmental awareness is rising in the transport and bus industries, whose fuel-hungry vehicles are constantly on our roads, so in March 2007 we unveiled our new ZEN brand of eco-tire.

■Achievement of World-class Fuel-saving Performance

In the six years since development of the ZEN brand began in 2001, we have achieved major improvements in durability, along with our goal of improved fuel-saving performance, resulting in improved fuel efficiency and lower exhaust emissions. Three products have been announced, one of which, the ZEN 702ZE, offers world-beating fuel-saving performance in its class.

■Focus on Increasing Retreadability

Considerable resources go into making truck and bus tires, and so I have been feeling for long that increasing the number of times that they can be retreaded makes it possible to reduce tire consumption, contributing to the fight against global warming. Increasing retreadability was therefore made an explicit design goal of the ZEN brand, and in order to achieve such high retreadability, significant improvements were made to durability. To combat global warming, we aim to play our part in contributing to the spread of retreaded tires as well as increasing the useful life of new products.

No.1 Design Group Leader of TB Tire Designing Dept. Toshiro Oyama

Toshiro Oyama and the ZEN 702ZE

Recycling Waste Tires to Make Quieter Roads

We invest a lot of effort in "material recycling," a prime outcome of which is the development of "a porous elastic road-surfacing material" produced from rubber chips made out of scrap tires.

■Reducing Noise by 90%

"The porous elastic road-surfacing material" is made by hardening ground scrap tires with urethane resin. In trials on a section of public road last year, it was found to reduce noise by around 90% compared with ordinary asphalt, and users who actually drove on the surface reported that it sounded completely different. Since then, we have received over 150 inquiries.

■Laying at Ordinary Temperatures and Need for Fewer Road Repairs Contributes to Prevention of Global Warming

Unlike ordinary asphalt, our "porous elastic road-surfacing material" can be laid at ordinary temperatures. It is also expected to be more durable than conventional materials, as no flow rutting occurs under vehicle loads. Emissions of heat when the material is laid should therefore be lower, and repair work should be required less frequently, which means that exhaust emissions due to traffic congestion during surfacing and repair work will be reduced.

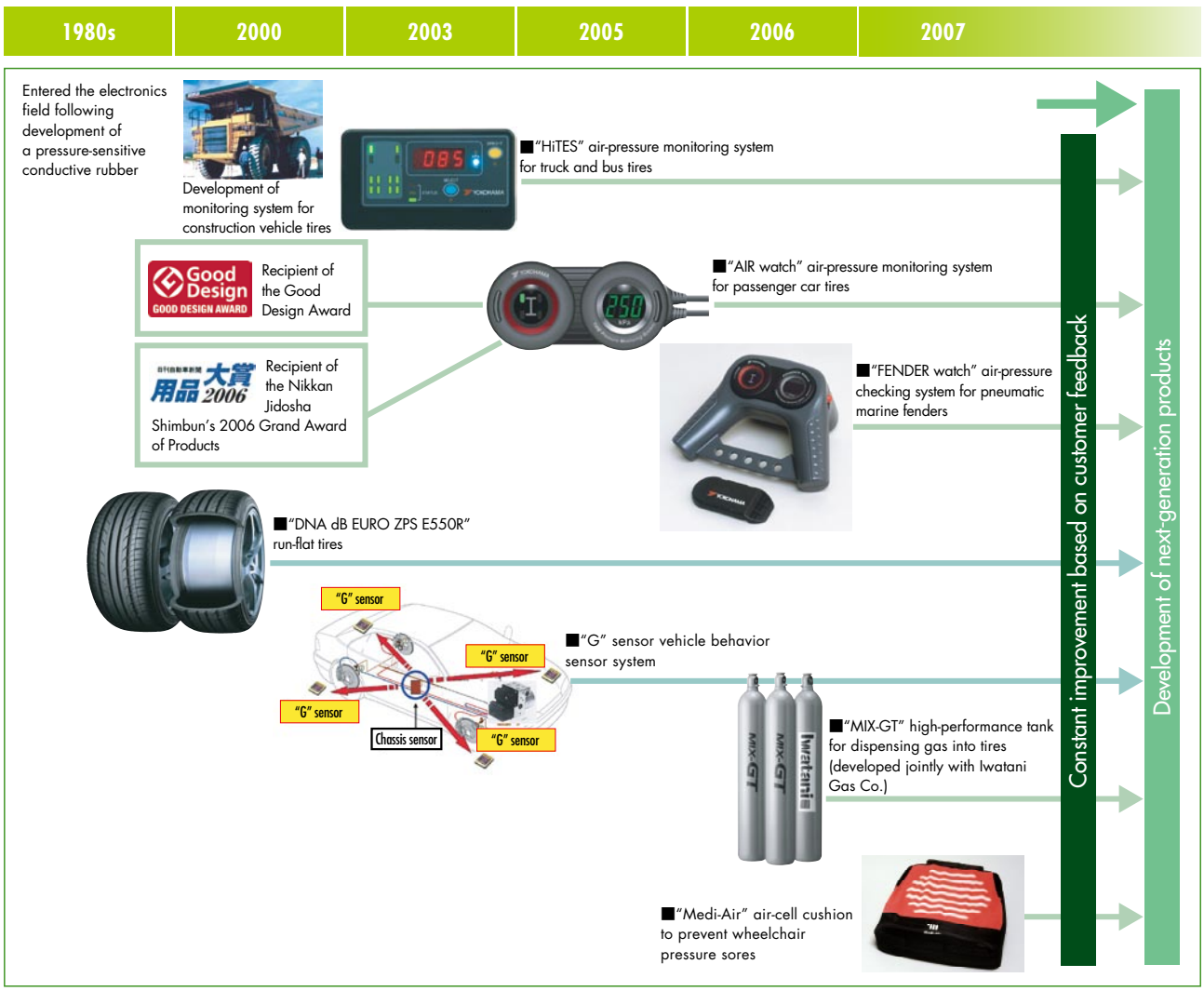
Senior Engineer of MB Business Development Dept. Masato Kokusho

Masato Kokusho and a section of road in front of the Zama City Office in Kanagawa surfaced with the porous elastic road-surfacing material for testing (November 2006)

Developing Safer, More Comfortable Products

Development of Disability and Care-related Products Now Also Underway

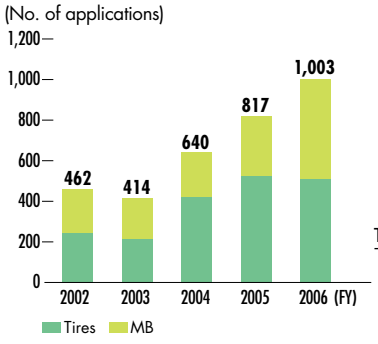
Yokohama Rubber develops a multitude of products designed to make life safer and more comfortable. One such example is the air-cell cushion for wheelchair users unveiled in July 2007, which is designed to prevent pressure sores, and we have also begun development of other disability and care-related products.



Intellectual Property Situation

Led by the Intellectual Property Department, individual divisions work with research and analysis specialist Yokohama Techno Research to protect Yokohama Rubber's intellectual property. In 2006, the number of published applications for patents was 1,003 (513 by the Tire Group and 490 by the MB Group), and the number of patent registrations was 261. The total number of intellectual property rights held is 2,727 in Japan, and 2,617 overseas.

Number of published patent applications



Number of IP rights held

(as of March 31, 2007)