Chapter 3

Bridgestone's View on Circular Economy

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1. Introduction

1.1. About Bridgestone

Bridgestone is the world's largest tyre manufacturer. Producing approximately one in six tyres, the Bridgestone Group, with headquarters in Tokyo, Japan, has more than 200 production and development centres in 25 countries, conducts business in more than 150 countries, and has more than 145,000 employees worldwide. While majority of its business focus is on tyre sales, 20 percent of its sales is derived from diversified products such as belt conveyors, air springs, roofing materials, bicycles, and golf balls.

1.2. Building a Sustainable Society

The world population is expected to be more than 9 billion by 2050 while the number of automobiles will increase to 2.4 billion. With the increase in population, improved living standards, and increased demand for automobiles, the world is expected to face significant problems concerning climate change, resource shortages, and biodiversity loss. As a global company, the Bridgestone Group is aware of its responsibilities of meeting various needs in the world and assuring the stable supply of high-quality products. Thus, efforts to contribute to building a sustainable society by balancing the company's operations with the earth's capacity and being in harmony with nature are in progress. Based on this philosophy, the Bridgestone Group has prepared a long-term environmental vision to carry out activities.

2. Bridgestone's Environmental Mission Statement

Bridgestone's shared Environmental Mission Statement engages its employees from a wide range of backgrounds to work together towards established environmental goals. Its unchanging vision is 'to help ensure a healthy environment for current and future generations.' This ensures that, together with its stakeholders, the group is committed to continually work towards a sustainable society with integrity. Realising the large impact the

group's operations may have on the global environment, initiatives to create stronger balance and harmony between its business and the environment are underway. Specifically, the focus is on reducing CO_2 emissions, valuing natural resources, and achieving harmony with nature. In each area, an environmental vision for 2050 and beyond has been created while midterm targets are currently being considered. With regard to the long-term vision, back casting was used to formulate the midterm targets set to be accomplished by 2020.

In pursuing its biodiversity goals, Bridgestone is taking steps to minimise the impact of its operations on ecosystems while simultaneously working to preserve and restore ecosystems. In 2014, a goal was set to reduce the company's average water intake rate by 35 percent by 2020, with the 2005 level as baseline. This midterm target will help ensure that the impacts to ecosystems of the company's water usage will be reduced.

Also, a long-term target is to reduce CO_2 emissions by 50 percent or more by 2050, a goal that aims to contribute to the realisation of a low-carbon society. To give further direction to this effort, midterm targets for 2020 give specific numeric goals for reducing CO_2 emissions from the company's operations, including tyre usage, by lowering tyre rolling resistance, a significant contributor to a vehicle's fuel consumption. In 2013, the Bridgestone Group's global carbon management initiatives reduced 27 percent of CO_2 emissions in operations and about 10 percent in tyre rolling resistance.

Figure 3.1. Bridgestone's Environmental Mission Statement

Source: Bridgestone (2014).

With regard to valuing natural resources, a long-term environmental target is to work towards 100 percent sustainable materials by advancing technological developments while defining and passing midterm milestones.

To achieve the environmental vision for 2050 and beyond, efforts beyond current activities will be necessary and issues from new perspectives must be tackled. The company's

operations extend from the upstream region of the supply chain, which includes in-house raw material production bases, to the downstream, which includes retail sales networks and service-based operations.

A vertical and horizontal approach to the business, one of the company's strengths, will continue to be developed while advancing technical and business model innovation. Endeavours to create innovative new technologies, products, and services will be continuously made to help further realise a balance between the business and the environment.

A prime example of activities in this area is the second generation Air Free Concept Tire™, announced at the 43rd Tokyo Motor Show in 2013. A revolutionary departure from the standard approach of supporting a vehicle's weight with the internal air pressure of tyres, the Air Free Concept Tire uses a unique structure of spokes stretching along the inner sides of the tyres to support the weight of the vehicle. This eliminates the fear of punctures. Moreover, the resin used in this technical innovation is recyclable.

Another technical innovation is Bridgestone's ologic™ technology, developed in 2013, featuring an unprecedented tyre design that substantially reduces rolling resistance. Bridgestone's business model innovation is evident in the solution-based business that was launched to help customers reduce their CO_2 emissions while simultaneously realising more efficient resource usage by combining new tyres, retread tyres, and maintenance services.

To achieve the long-term environmental targets, the initiatives should span the entire supply chain. Bridgestone encourages and challenges its business partners and customers to join in these important environmental activities. In the upstream areas of the supply chain, technologies for improving the productivity of natural rubber will be developed and support to small-scale rubber farmers will be provided. Also, new raw materials for use in the products to move towards 100 percent sustainable material are being explored. In the downstream areas, reduction in CO_2 emissions is pursued by encouraging as many customers as possible to use fuel-efficient tyres.

3. Initiatives to Exist in Harmony with Nature

Since 2013, the Bridgestone Group has conducted a materiality analysis on the footprint on and contributions to biodiversity made by its operations. Towards minimising the footprint on biodiversity, the Bridgestone Group is committed to reduce the impact of its water intake. Since water resources are used in the production processes as cooling water and steam, the company has been working to enhance their efficient use through the cyclic use of cooling water, improvement of production processes, and water recycling. The target of reducing water intake is set at 35 percent per unit of production by 2020 throughout the group, based on the 2005 levels.

Bridgestone has implemented water management and promoted the efficient use and recycling of water in its locations worldwide. As a result, water intake was reduced by 10.7 percent per unit in 2013 compared to the 2005 level.

3.1. Example: Introducing Closed Drainage at Plant

The Kitakyushu Plant recycles water discharged from the manufacturing process by building a closed drainage system. Also, the plant uses a real-time water monitoring system to manage water intake and recycle volume.

Figure 3.2. Water Recycling System

Source: Bridgestone (2014).

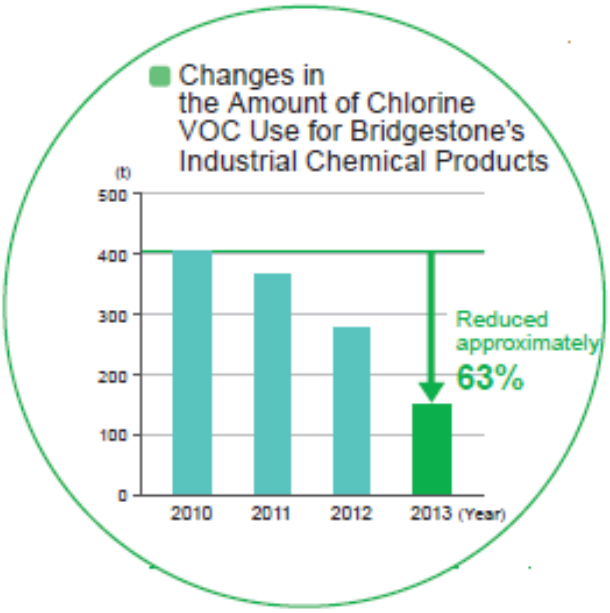
3.2. Example: Utilising Rainwater

Rainwater is utilised in some of the Bridgestone Group's plants. At these plants, rainwater is collected and used for operations or watering plants within the site.

3.3. Example: Improved Reduction of VOC in Manufacturing Processes

The Bridgestone Group is working to replace volatile organic compounds (VOCs) with alternative materials and continuing to reduce the amount of VOC use. For example, between 2010 and 2013, Bridgestone's chemical and industrial manufacturing operations achieved a 63 percent reduction in VOC use. The group is also conducting VOC-reduction activities in Europe to meet or exceed the laws and regulations of each of its countries. Bridgestone Europe NV/SA has reduced VOC emissions per tyre weight by nearly 25 percent over the last 10 years. The amount used in 2013 was less than 2 kg/1 tonne of tyres. Reduction of the amount of VOC use will be continued on a global basis.

Figure 3.3. Reduction of Volatile Organic Compounds



Source: Bridgestone (2014).

3.4. Example: Reduced SOx and NOx Emissions into the Air through Fuel Conversion

To reduce emissions of sulfur oxides (SOx) and nitrogen oxides (NOx) at the plants, Bridgestone is working to convert heavy fuel oil into natural gas. In 2013, the total SOx emission was reduced by 59 percent and the total NOx emission by 81 percent compared to 2005. Heavy fuel oil was replaced by natural gas in 2013 in the Chitose Plant of Bridgestone BRM Corporation, which manufactures retread tyres, and in the Cuernavaca plant in Mexico where passenger tyres are produced.

3.5. Example: Social Forestry Support Activities around Natural Rubber Farm

Forest fires and other factors have devastated national forests around the rubber farms of the P.T. Bridgestone Kalimantan Plantation (BSKP) in South Kalimantan, Indonesia. Support activities by W-BRIDGE, Waseda University, and Japan International Forestry Promotion and Cooperation Center have included a joint project using the residents' forestry system since 2012 in cooperation with BSKP, Lambung Mangkurat University, and the Forestry Department of Tanah Laut Regency. In this project, local residents develop land for Para rubber trees and plant durian and species of local trees in the surrounding forests with biodiversity preservation in mind. It is anticipated that developing forests with significant economic value for local communities will encourage members of the communities to continue caring for them over long term. BSKP aims to conduct activities advantageous to the Indonesian government and area communities by supporting this project through technical assistance, training, and contributing healthy young trees.

4. Initiatives to Value Natural Resources – (1) Reduce–Recycle–Reuse

The Bridgestone Group is committed to value natural resources through the efficient use of the planet's resources throughout the whole life cycle of its products – from raw material procurement to disposal and recycling. Important activities include reducing waste production, promotion of zero waste to landfill status, and the reduce–reuse–recycle (3R) concept.

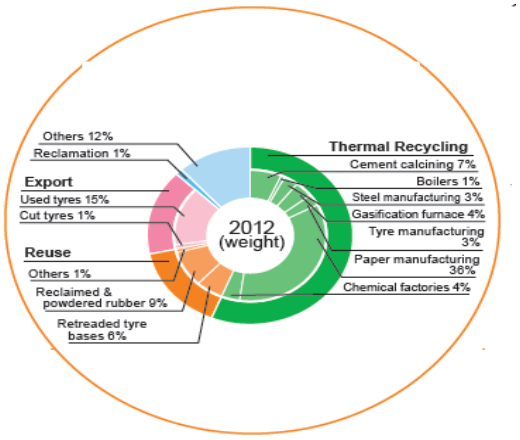
4.1. Example: Reducing Waste

In all its tyre plants, the Bridgestone Group is working to reduce the volume of waste produced during manufacturing processes. It is also committed to recycling waste, either within the company or through other organisations. For example, the Bridgestone Americas Inc. tyre manufacturing plant achieved the Underwriters Laboratories' Zero Waste to Landfill claim validation in December 2013. Since increasing focus on recycling in 2006, recycling by the Bridgestone Americas tyre plants has progressed from nearly half of all waste going to landfills to less than 15 percent overall today. The Bridgestone Americas Aiken passenger tyre plant also achieved zero waste to landfill in December 2012. All of the Bridgestone Group's plants in Japan and four tyre plants in China have also achieved zero waste to landfill status.

4.2. Example: Recycling of Used Tyres in Japan

The Japan Automobile Tyre Manufacturers Association (JATMA) and many others in the tyre industry are working towards reducing (controlling the emergence of used tyres) and recycling used tyres. More specifically, they monitor reduction factors, focusing on making tyres lighter and lasting longer, tyre recycling status, and measures against illegal accumulation and dumping of waste tyres. According to a JATMA survey, the 2012 recycling rate of used tyres in Japan was 87 percent.

Figure 3.4. Recycling of Used Tyres in Japan (2012)



Source: Japan Automobile Tyre Manufacturers Association (2013).

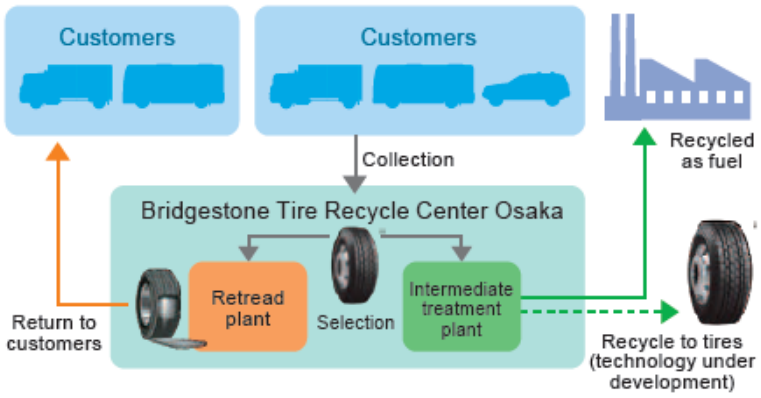
4.3. Example: Activities to Reduce Environmental Impact of Used Tyres through WBCSD

Approximately 1 billion used tyres emerge worldwide each year. Reducing the environmental impact of used tyres is a common issue in the tyre industry. Bridgestone has been involved in the Tire Industry Project of the World Business Council for Sustainable Development (WBCSD), established in 2006. Through the publication of 'End-of-Life Tires: A Framework for Effective ELT Management Systems' and disclosure of survey results, this project aims to develop an effective management system for used tyres by encouraging governments and related industries in various countries to appropriately manage used tyres and reduce their impact to the environment (WBCSD, 2012). Issued by the top 10 tyre companies at the supervision of WBCSD, this report is an excellent and comprehensive guide for ASEAN countries wishing to promote tyre recycling. According to the report, the positive environmental impacts of end-of-life tyres (ELTs) as a resource are significant, particularly as tyre-derived fuel for cement kilns or paper mills. Also, according to the report, most industry organisations in developed countries have ELT programmes. Transferring expertise and know-how from these bodies to developing countries is key to encouraging better ELT management since various efforts are underway in many countries to increase tyre recycle ratio and to find environment-friendly use for ELTs.

4.4. Example: Reusing and Recycling All Used Tyres

In July 2013, the Bridgestone Tire Japan Co., Ltd established the Bridgestone Tire Recycle Center Osaka, integrating a retread-tyre (tyres reused by replacing tread rubber) manufacturing plant and an intermediate used-tyre treatment plant (crushing of waste tyres that cannot be re-treaded). The centre combines functions of a retread-tyre manufacturing plant and an intermediate used-tyre treatment plant, and enables collection (collection areas are whole of Osaka prefecture and parts of Kyoto, Hyogo, and Wakayama prefectures) of customers' used tyres, and reusing and recycling of collected tyres.

Figure 3.5. Tyre Recycle Centre



Source: Bridgestone (2014).

4.5. Example: Initiative to Recycle 100 Percent of Used Products

Bridgestone Americas, Inc. has launched the Tires4ward programme, an initiative to create a waste-free tyre industry. Tires4ward aims to ensure that for every tyre Bridgestone America sells in the US, a spent tyre goes to another valuable purpose. At the end of 2012, Bridgestone Americas set a new standard by repurposing 100 percent of all spent tyres collected at its company-owned retail stores and keeping 10 million tyres out of landfills. Valuable next uses for spent tyres include use as materials in rubberised asphalt, rubberised playground equipment, construction materials, landscaping mulch, or as tyre-derived fuel for valuable energy.

Bridgestone Americas also supports volunteer organisations to help ensure that tyres collected in organised community clean-up events of public spaces, rivers, and waterways are sent to valuable next use.

Figure 3.6. Initiatives to Collect Discarded Tyres

Source: Bridgestone (2014).

5. Initiatives to Value Natural Resources – (2) Sustainable Materials

The Bridgestone Group believes that sustainable materials are not simply renewable resources. To continue its operations in a sustainable manner, raw materials derived from resources with continual supply that can be used as part of the group's business over long term and have low environmental and social impact across the whole life cycle from procurement to disposal are defined as sustainable materials.

5.1. Example: Improvement of Natural Rubber Production

Natural rubber is an indispensable biological resource for Bridgestone's business and is a renewable resource that can be produced from the Para rubber tree that grows in tropical rainforests such as those in Southeast Asia. Unlike synthetic rubber from petroleum, rubber from the Para rubber tree can be a sustainable resource. However, as tyre demand rises, indiscriminate expansion of Para rubber tree farms is undesirable from the perspective of

biodiversity. The Bridgestone Group is conducting activities to improve productivity of rubber farms and increase production volumes of natural rubber. In Southeast Asia, the Para rubber tree is currently suffering from the spread of white root disease, affecting the production volumes of natural rubber. In Indonesia, damage accounts for multi-billion yen per year, and 6 percent of production volumes is estimated to be damaged. If the disease spreads, developing new Para rubber farms will require forest development and, thus, will affect biodiversity.

In a collaborative research project with the New Energy and Industrial Technology Development Organization between 2010 and 2011, Bridgestone developed a technology to diagnose diseases at an early stage. As a result, four diagnosis technologies have been developed: (i) satellite image analysis developed from remote-sensing technology, (ii) measurement of optical spectrum and temperature of leaf surface, (iii) component analysis of latex, and (iv) detection of pathogens at DNA level.

Regarding increase in rubber production, efforts are underway to find good cultivars that yield a higher amount of latex. With a well-defined breeding programme, the production per unit area of land is expected to improve.

In June 2012, a genomic analysis of the Para rubber tree was conducted and complete genome base sequences in the chromosomes of good cultivars were successfully decoded. In the future, if cultivars that are strong against dryness or disease are found, they will be selectively bred so they can be cultivated in lands previously inappropriate for cultivation.

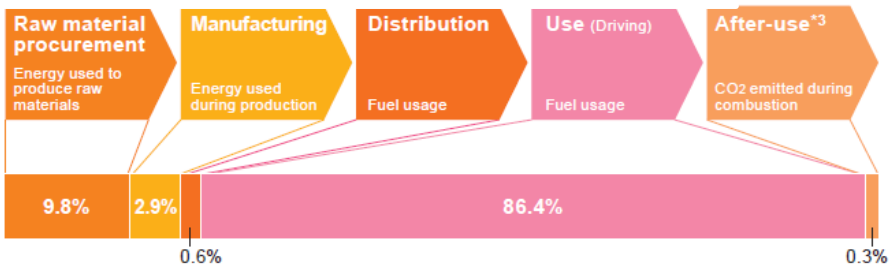
Throughout Indonesia, natural rubber is produced mostly by small-scale farmers, and there are many concerns in terms of productivity. For example, domestic yield per unit area is said to be about half that from all farms of the Bridgestone Group. With increased yields, the area of development necessary for rubber planting can be reduced, thus minimising the associated ecological impacts.

One factor causing stagnant productivity is the tapping process used in incising the trunk of Para rubber trees to collect sap. Because small-scale farmers can't afford to buy adequate tools and have little technical knowledge and know-how of the process, it is difficult to collect latex efficiently. Thus, Bridgestone provides the local community with highly productive young trees cultivated at its farms, tools for tapping, and tapping workshops.

6. Initiatives to Reduce CO_2 Emissions – (1) Reduction of Tyre Rolling Resistance

Within the life cycle of a tyre, the largest CO_2 emissions occur during the usage stage due to automobile exhaust emissions. A key way to reduce CO_2 emissions from automobile exhaust is by increasing fuel efficiency. Tyre rolling resistance is a significant factor in fuel consumption and reducing it can significantly reduce CO_2 emissions from automobile exhaust.

Figure 3.7. Greenhouse Emissions by Tyre Life Cycle Stage



*2 Greenhouse gas emissions throughout the life cycle of one fuel-efficient passenger car tyre (195/65R15): 243.9kgCO2e.
Source: Bridgestone (2014).

6.1. Example: Fuel-Efficient ECOPIA Tyres (Public–Private Partnership)

A 2013 survey shows that Bridgestone's ECOPIA tyres are 'fuel-efficient tires selected by the largest number of people in Japan' and contribute to the improvement of automobile fuel efficiency through reduced tyre rolling resistance. More people have been using the tyres since common voluntary standards in the industry were formulated in 2010. Bridgestone has worked on the development of reduced rolling resistance tyre technology for decades, following the principle of improving fuel efficiency without sacrificing safety and tread life performance. As a result, shipments of fuel-efficient tyres in Japan increased by 3.5 times between 2010 and 2013. In general, savings in fuel by using ECOPIA pay back in 2 to 3 years.

This technology was developed in a public–private partnership where the New Energy and Industrial Technology Development Organization, a semi-governmental entity, jointly conducted a research project with Bridgestone, Japan Synthetic Rubber, and the academia.

6.2. Example: Environmental Activities in Collaboration with Sales of Fuel-Efficient Tyres

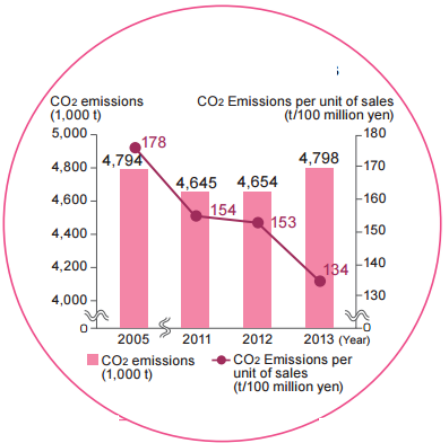
Since 2010, Bridgestone Tire Sales Malaysia has been conducting a One Tire, One Good Deed Campaign as a way to contribute to CO_2-emissions reductions through tyre sales. This project makes one ringgit (Malaysian currency) contribution per unit sales of fuel-efficient tyres to the Global Environment Centre, a non-governmental organisation. The collected fund is used for the development of the North Selangor Peat Swamp Forest. In addition, Bridgestone Tyre Sales Malaysia is planting trees with the help of its employees, local residents, and Bridgestone retail stores. Through these activities, Bridgestone contributes to both dissemination of fuel-efficient tyres and preservation of local natural ecosystem.

7. Initiatives to Reduce CO_2 Emissions – in Tyre Manufacturing

7.1. Example: Reduced CO_2 Emissions at Tyre Plants

The Bridgestone Group is working to reduce CO_2 emissions from its facilities by using energy more efficiently and switching to alternate forms of energy that result in lower emissions. As a result, CO_2 emissions per unit of sales was 25 percent lower in 2013 than in 2005. Going forward, the company is working to introduce more energy-efficient equipment and implement stringent energy management measures to further reduce CO_2 emissions.

Figure 3.8. CO_2 Emissions at Bridgestone Group Plants



Source: Bridgestone (2014).

7.2. Example: Conducting Energy Surveys to Improve Energy Consumption

To reduce CO_2 emissions while manufacturing to the volume that meets expanding demands, it is necessary to reduce energy usage by a greater amount year over year.

Since 2009, Bridgestone's technical centres have been conducting energy surveys to quantify wasted energy at plant facilities, expand awareness, and identify areas for improvement. Energy surveys were conducted in 22 locations in six countries over 5 years. The company continually develops the capacity and competence of their personnel to recognise energy-saving opportunities and undertake activities to continually improve so those who demonstrate proficiency may earn the distinctive role of 'energy diagnosis technician'. Bridgestone has assigned an 'energy diagnosis technician' in every tyre plant in Japan and will continue to increase their numbers throughout Asia, the Americas, and Europe.

8. Implication for Policy and Practice

It is indispensable that governments provide full support to industries to promote sustainability development, in particular, circular economy. Government incentives through public–private partnerships are a good mechanism to encourage industries to work on circular economy. The case of Japan's New Energy and Industrial Technology Development Organization (NEDO) is a useful example to look at as a model, as it promotes networking between the government, the private sector, and the academia. As Japan's largest public research and development management organisation, NEDO undertakes technology development and demonstration activities to address energy and global environmental issues and enhance industrial technology by integrating combined efforts of the industry, the academia, and the government. Another example is the National Science Foundation grant in the US which ASEAN nations can use as a model.

The second recommendation is to encourage policymakers to work together to reach consistency among nations regarding circular thinking in environmental policy. International firms often face challenges in meeting policies of many countries where they conduct business and where policies significantly differ from one to another. It would help if more consistent policies exist. For instance, ASEAN could proactively take the lead in the region to establish a coalition among governments for a consolidated policy or common guiding principles to ensure consistency among its member nations. Alternately, the United Nations Environment Programme or the United Nations Environment Organization could take this role to ensure global consistency.

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