Mid Term Business plan(2024-2026)

Ⅲ. R&D and Manufacturing / Technology Innovation

Bridgestone Corporation
Senior Vice President and Executive Officer
Global Chief Technology Officer Responsible
for Monozukuri

Masato Banno

1st March 2024

BRIDGESTONE
Solutions for your journey

Bridgestone's Technology Innovation toward 2050

VISION

2050

Bridgestone contributes to provide social value and customer value, as a sustainable solutions company.

Contributing to the evolution of a sustainable solutions company through technology innovation

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Review of 21MBP／New challenge towards 24MBP

Review of 21MBP：Pursued technology creation for premium focus, contribution for core・growth business in order to return to strong Bridgestone
For 24MBP, continue to create new premium, strengthen manufacturing and actively sow new seeds

	Core Business	Growth Business	Exploratory Business／Diversified product Business
Review of 21MBP	**Rebuilding earning power, Lay foundation for premium** ✓ Building new premium foundation • Launch ENLITEN・MasterCore product • Establish ENLITEN BCMA **Generation1 Technology** • Define specific BCMA value ✓ **Clarify role & responsibility of 45 tire plant based on BCMA, visualize current Green/Smart level・operational excellence.** Draw strategic investment plan for next stage	**Lay foundation for solution business linkage** ✓ Expand solution business with strategic partner of Mining, Aircraft business • Aviation solution • Mining solution ⇒**Verify Bridgestone's unique tire prediction technology by solution value**	**Sharply utilize Bridgestone's core competence** ✓ Accelerate co-creation activity • Verification for realization of carbon neutral, circular economy, **sowing new seeds** • Establish fundamental tire technology for next generation mobility • New business creation by utilizing tire core technology (Soft robotics business)
Challenge for 24MBP	✓ Expansion of ENLITEN BCMA Generation1, **establish technology for Generation2** ✓ **Manufacturing evolution BCMA× steady productivity improvement×building foundation for Green & Smart. Start contribution and value creation** ✓ **Approach the essential issues in manufacturing**	✓ Amplify value of Dan-Totsu product by strengthening solution ✓ **Further evolve unique tire prediction technology**、convert to new value by combining wear・durability prediction • **Deploy to TB retread solution**	✓ **Accelerate technology verification for social implementation**, grow new seeds ✓ Expand the interaction loop with empathy・Co-Ideation・Co-R&D・Co-creation, further sowing new seeds for new value creation

Initiative for 24 MBP based on 2030 long term strategic aspiration

2030 long term strategic aspiration

- ✓ Focus on premium business・solution business for creation of the new premium
- ✓ Establish business model with high certainty（Premium tire business and accelerate the growth of solution business by utilizing the strength of premium tire business）
- ✓ Balance conflicting values, such as sustainability vs. business growth, ultimate customization vs. improved productivity of the entire value chain /cost optimization

Initiative for 24MBP

Reallocate R&D resources to selected key issue

Core business

Reinforce earning power

Amplify value through the fusion of ENLITEN and BCMA, Mastering tire

- ✓ Ensure to develop Gen.1 product, expand technology for Gen.2 product
- ✓ Accelerate value creation in global through BCMA deployment
- ✓ Manufacturing evolution　BCMA × steady productivity improvement × building foundation for Green & Smart.
- ✓ Steady execution of sustainable material installation road map

Establish sustainable premium brand

New way of product planning to create customer delight, realization of tire

Growth business

Strengthen the linkage of Premium tire／Retread and mobility solution

- ✓ Amplify value creation through linkage of Dan-Totsu product and solution（TB ENLITEN, OR MasterCore, AC）
- ✓ Refine solution technology towards establishment of mobility tech. business

Exploratory Business／Diversified product Business

Creation of sustainability value

- ✓ Small scale verification of technology towards commercialization⇒ “Grow sowed seeds”
- ✓ Strengthen vision driven type value co-creation⇒ “Sowing new seeds”

Sharply utilize Bridgestone’s core competence

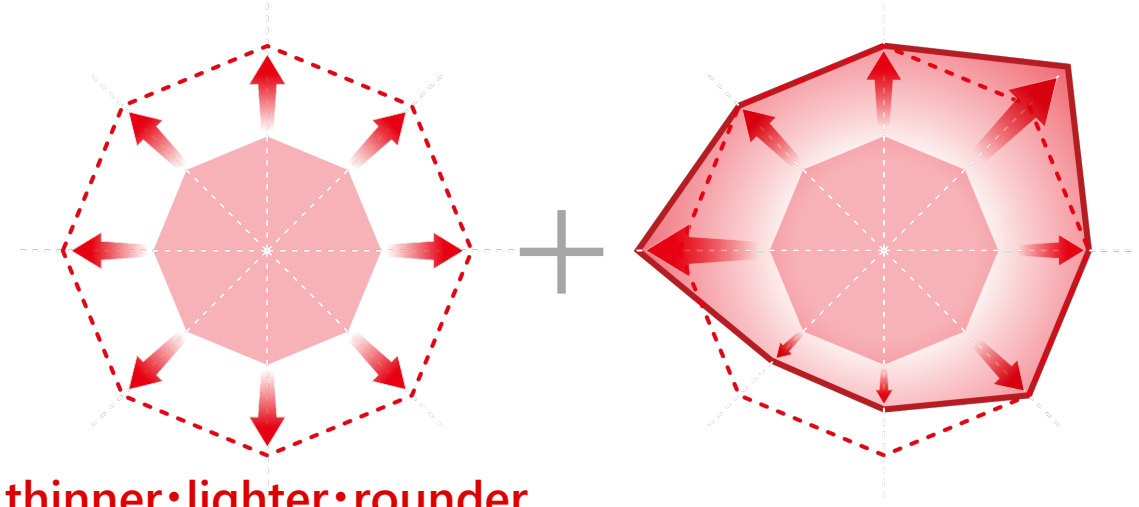
- ✓ Technology・product development for premium hydraulic hose

Create good tires ~base technology for product design ENLITEN~

ENLITEN®
TECHNOLOGY

Ultimate Customization ※1

Empower each and all to achieve their best
Be essential to the future of mobility



thinner・lighter・rounder

Reinforce basic performance requirements and improve all aspects of the performance grid

Sharpen edge for
“ ultimate customization ”

thinner **lighter**
resource productivity／Environmental performance

rounder
Dynamic performance
(Handling stability・ride comfort)

Become weak and fragile	Becomes Easily distorted	
Breakable	Deformation becomes distorted	Shape becomes distorted
Stronger and More flexible material	Necessary to design to distort properly	Technology to make it more round

Mastering Rubber
High strength network rubber
Double network

Mastering Road contact
Optimization of ply tension
Design simulation
Technology to “see”
Real x Digital

Mastering Manufacturing
Sense each tire
AI ・Big data
Autonomy control

Lead to drive sustainability | sustainable materials

Technology to support ENLITEN

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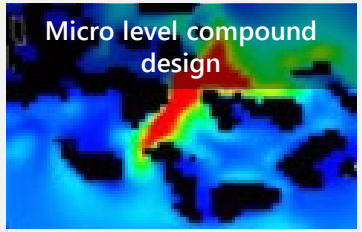
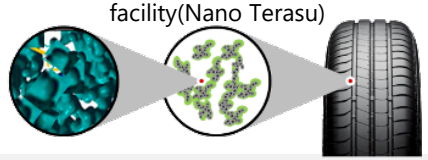
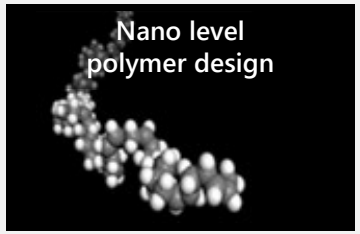
Technology to support ENLITEN：Mastering rubber
～ realize “thinner･lighter” ：Strong and flexible innovative material～

Evolution of technology to “see”
the structure of rubber and molecule can be observed more clearly



Nano level observation using next-generation synchrotron radiation facility(Nano Terasu)





*1 Courtesy of Japan Photonics Innovation Center

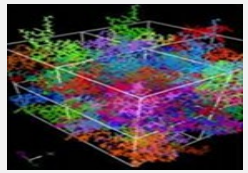
Evolution of technology to “analyze”
Data-driven material development

Extensive knowledge from the past
unique material synthesis evaluation system

- Indoor evaluation data
- Environmental indicators
- Material data
- Market data

Bridgestone’ database

AI data analysis

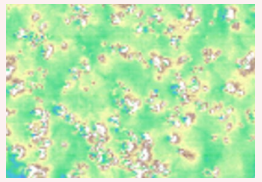


Unique simulation

Real　State-of-the-art material informatics　Digital

Evolution of technology to “Control”
Realization of new material by designing polymer composite

「Mastering rubber」— next stage—

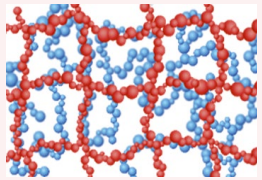


High strength network rubber

Start partial implementation from 21MBP Expand to product in 24MBP

Realized high level strength through Evolution of rubber structure analysis×Evolution of molecular design at nano level

Real（Synthesis technology） × Digital（molecular design）



Double network＊2

Establish technology in 24MBP/Equipping to product in 27MBP

Control network structure of several polymer having different function, at nano level

Tough rubber having「flexible character」and「strong character」

Realize “thinner･lighter”

＊2 Achievement under the Cabinet Office’s Innovative R&D Promotion Program（ImPACT）

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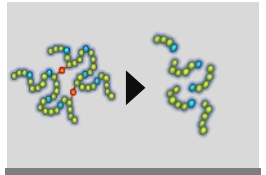
Technology to support ENLITEN ：Lead to drive sustainability

Guayule
(Diversification of natural rubber)

Rice husk silica
(Reinforcement material for tires)

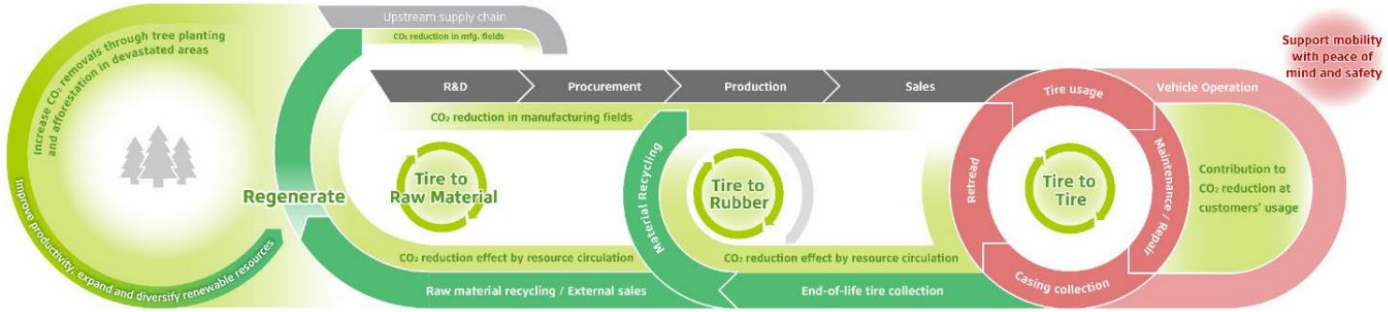
Synthetic rubber derived from biomass

Reinforcement fiber derived from recycling



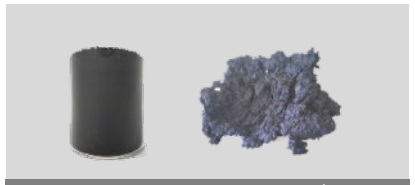
Rubber biodegradable technology (MoonShot)

ISCC PLUS certification is a system that ensures that raw materials derived from renewable and recyclable resources such as biomass are properly managed in the supply chain, including product manufacturing

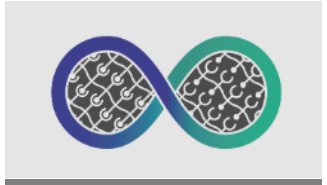


Natural rubber plantation management

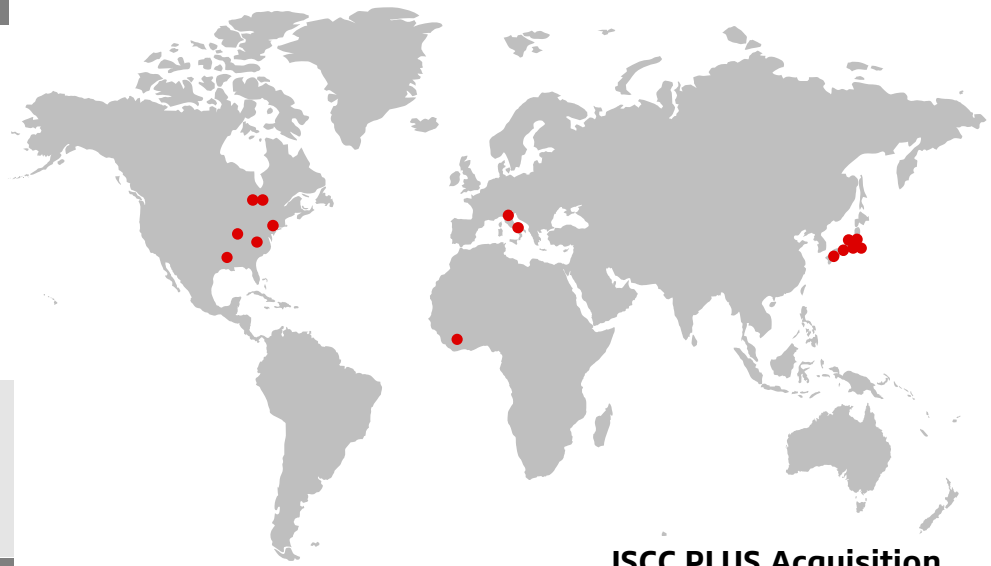
Tire recycle technology
(Green Innovation Fund)



Recycled carbon black／Recycled rubber



Easy-to-reuse rubber



ISCC PLUS Acquisition location

Domestic location	7
Overseas location	9

※Including development sites, logistics, etc. other than mass production plants

＊ This presentation is based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

Aim for 40% Recycled & Renewable material ratio in 2030, 100% sustainable material in 2050, will improve recycled & renewable material ratio in collaboration with Co-creation partners

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Technology to support ENLITEN ：Mastering road contact

～ realize “thinner･lighter” ：Optimized contact condition through more uniform deformation～

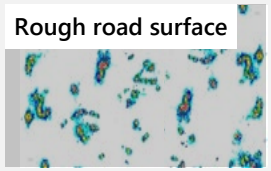
Uneven road contact seen by uneven deformation with thinner tires

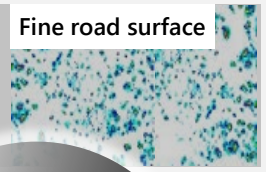
ULTIMAT EYE®
Evolution of technology to “see” road contact

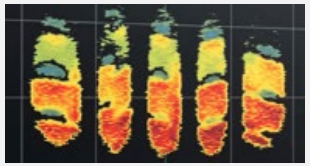
“Visualize” ideal contact condition

ULTIMAT EYE

“Visualize” road contact on various type of road surface

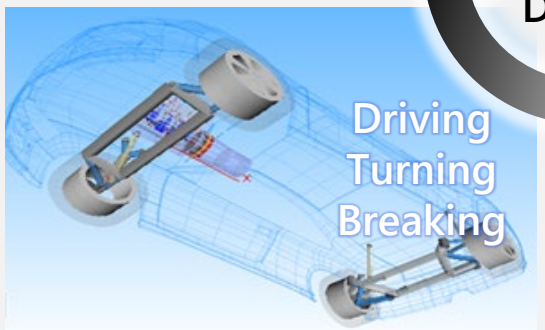






Real

Digital



Observe Human･Vehicle･Tire

Tire simulation

“thinner･lighter･rounder ”

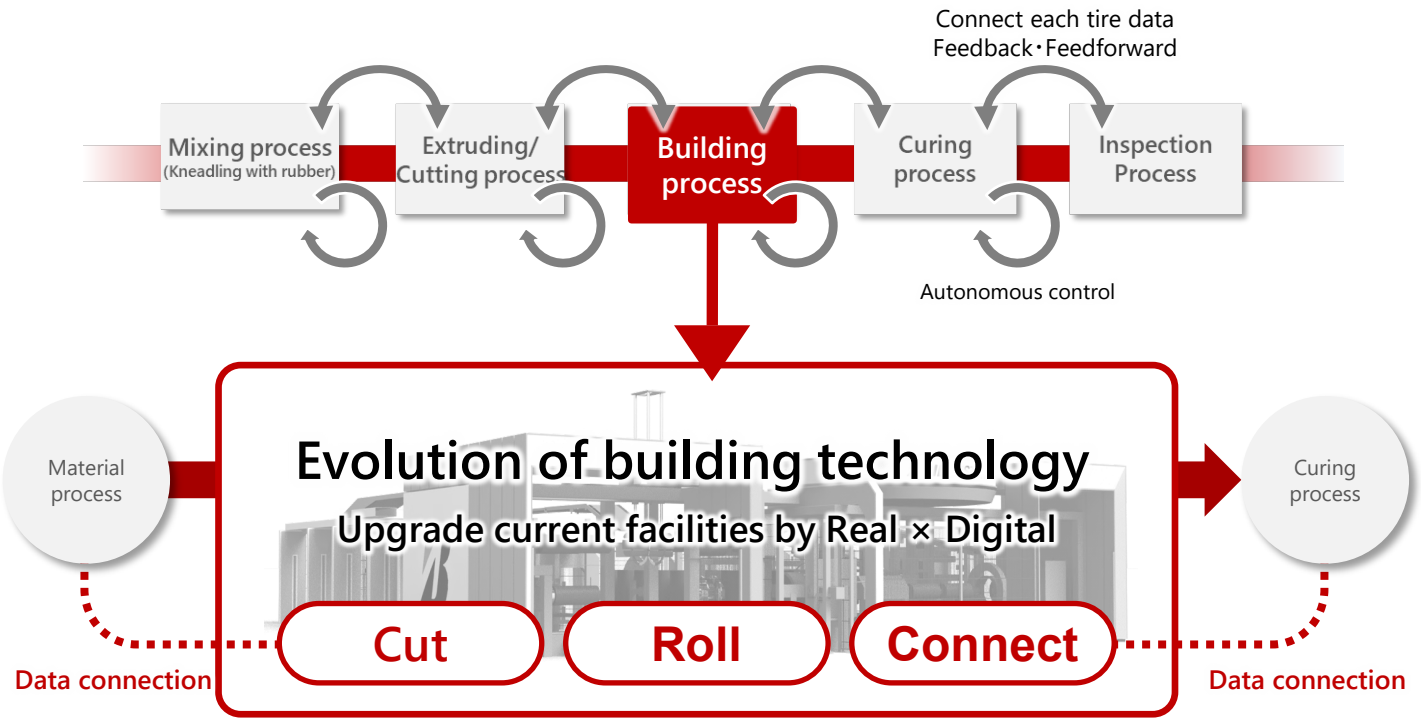
「Mastering road contact」

— Next stage —

Enable “uniform deformation” by optimization of ply tension distribution

Optimized contact condition

Technology to support ENLITEN ：Mastering Manufacturing
～Autonomous control technology to realize ultimate roundness～



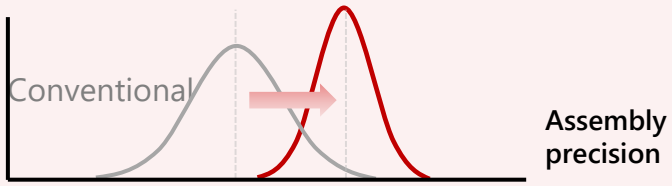
See	Analyze	Manage
Sense work, material, machine	Big Data＋AI	Optimize process per tire

「Mastering Manufacturing」
― Next stage―

Elemental technology for manufacturing developed through EXAMATION

- Sense 480 quality data per tire
- Real time autonomous control to assemble every material at optimized condition
- Improvement in material precision by data feedback to former process
- Less skill by automation

21MBP Already established technology to improve 30% circularity



24MBP Will deploy technology to 20 global factories

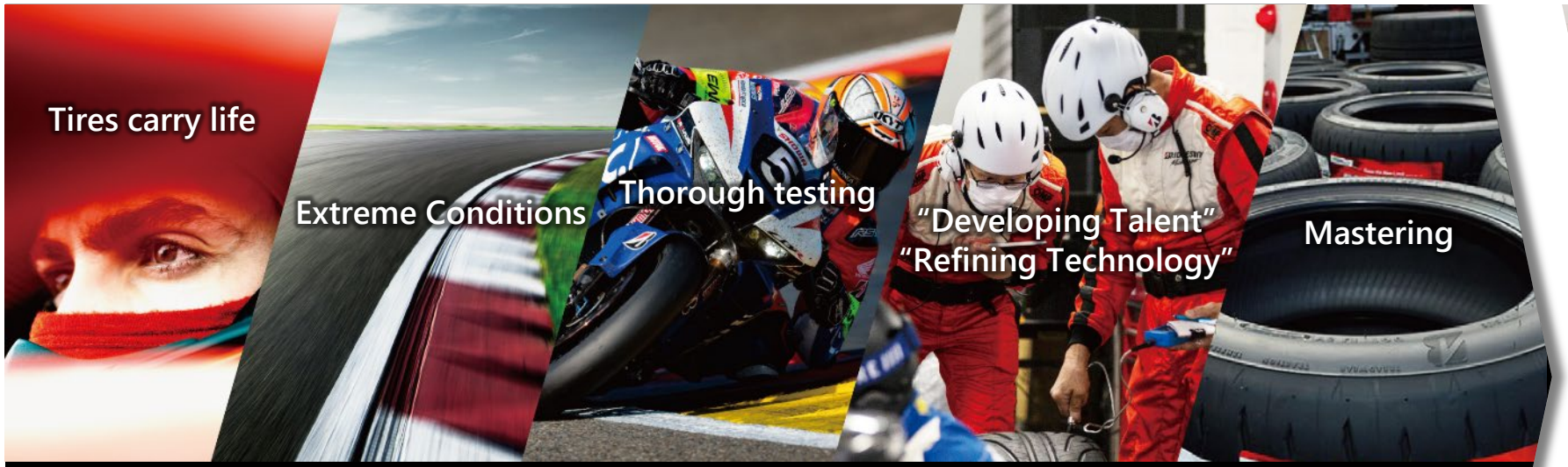
Improve dynamic performance(Handling stability・ride comfort) by evolution of circularity
Contribute to further expansion of performance spider chart (Increase product competitiveness)

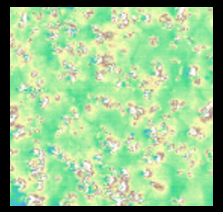
Realize ultimate roundness

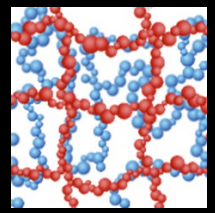
Technology verification

～ Mobile Laboratory Refine technology in extreme conditions, verify values～

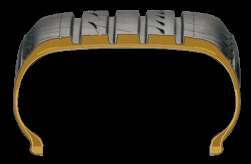
Through Motorsports, extreme condition for tires,
will refine technology in agile, by real × digital – From Circuit to Street -



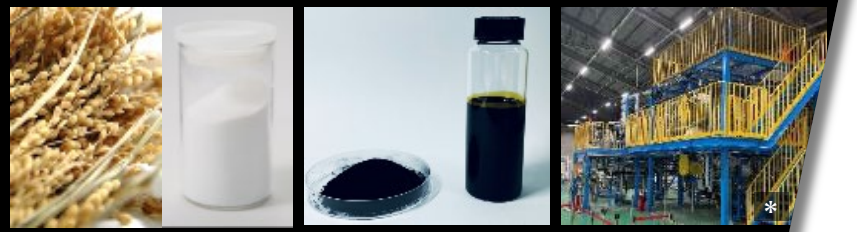




High strength network rubber
／Double network



Optimization of
ply tension distribution



Bio material／Recycle material

＊ This presentation is based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

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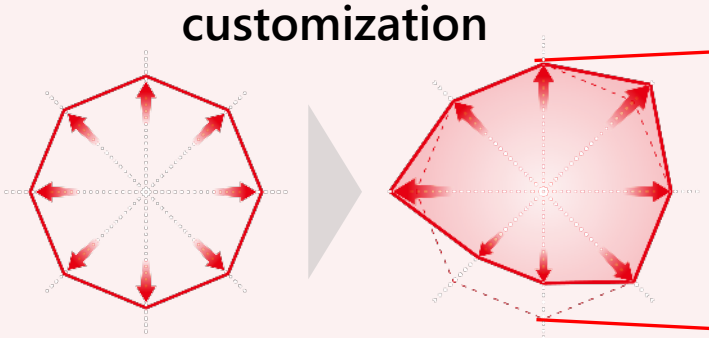
Create good tires ～ENLITEN towards the next stage　Generation 2～

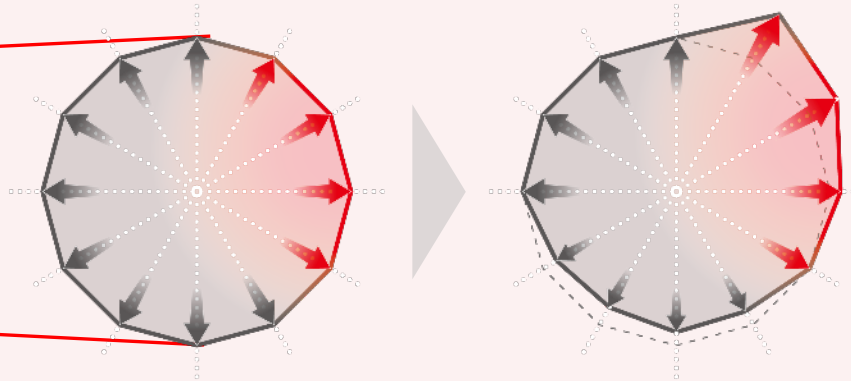
24MBP

Expand Generation 1 Realize ultimate customization



Customize for more various performance
65% ENLITEN ratio in 2026

Focus on 27MBP Technology development of Generation 2



Further pursuit “thinner・rounder・lighter”
Further expand performance spider chart
, suggest new value

27MBP

ENLITEN
To the next stage
Generation 2

Mastering rubber			Mastering road contact			Mastering manufacturing		
High strength Network rubber	Double network	Sustainable material	Strong material・Case line	Design simulation	Technology to “See” Real x Digital	Sense Each tire	AI ・Big data	Autonomous Control

Manufacturing evolution

～Challenge towards business contribution・new value creation based on BCMA～

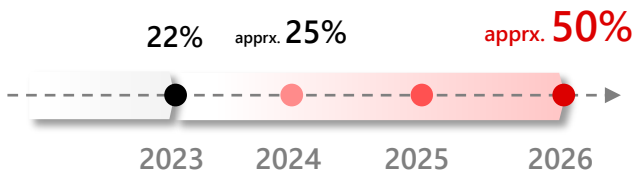
Manufacturing evolution through BCMA

Provide Dan-Totsu product in agile with simple operation through BCMA
＝Support「Ultimate customization」

Primary benefit	• Efficient development, simplification of production • Evolution of production process and precision, reduction in production time・cost
Secondary benefit	• Improvement of manufacturing constitution Improvement in SURURAKU・productivity
Further amplification of value	• Expand effect to procurement, logistics, sales • Influence to whole VC, business contribution, challenge for new value

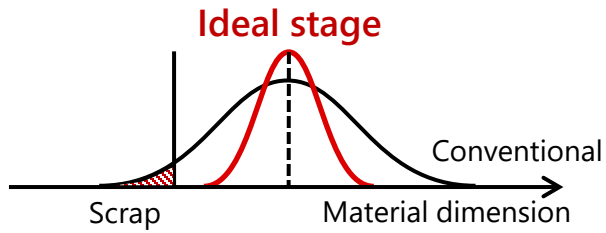
All foundations are manufacturing at Genba,
approach the essence of manufacturing at Genbutsu-Genba

BCMA Deployment ratio
Global PS Total

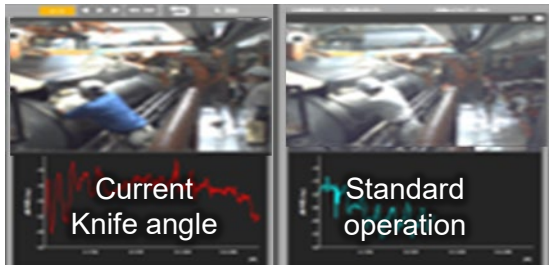


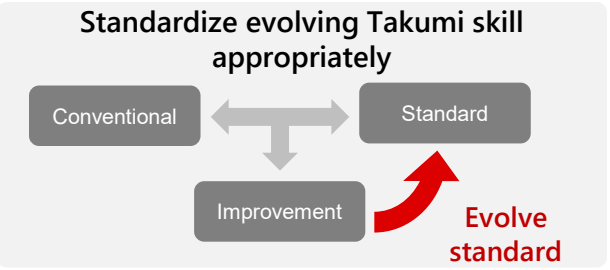
Steady quality・productivity improvement activity at Genbutsu-Genba

Bridgestone DNA、Focus on Genbutsu-Genba・quality

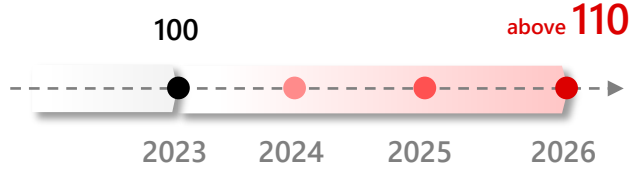


Evolution of standard
Integration of SURURAKU production and digital - Digital skill transfer





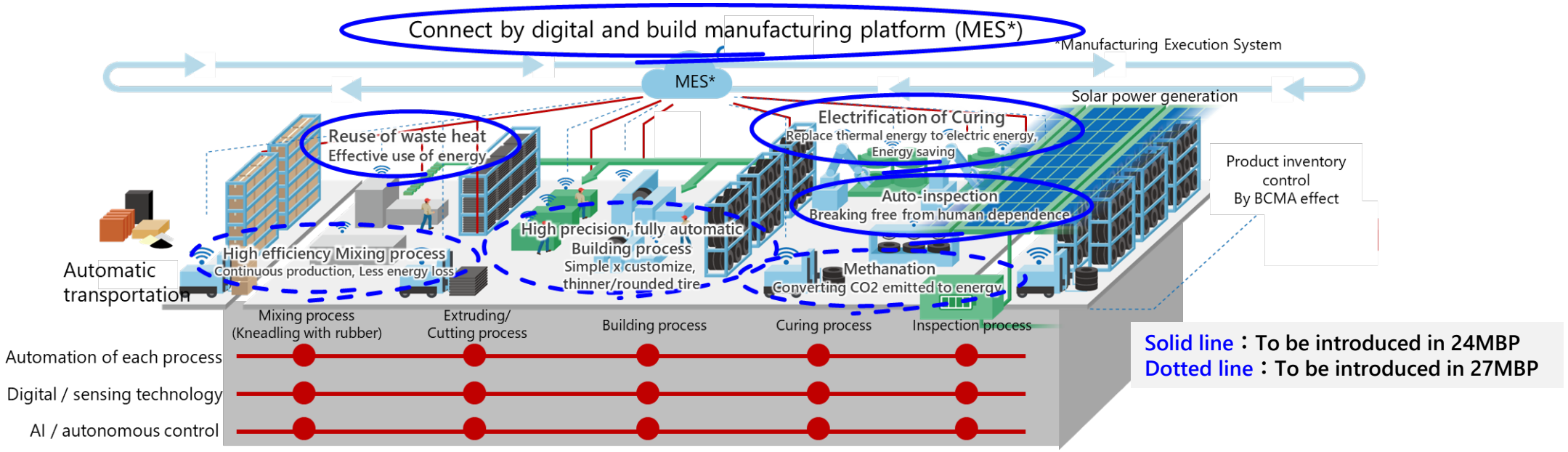
Productivity Improvement rate
Average of global PS/TB
(incl. smartification effect)



Manufacturing evolution
BCMA to support Ultimate customization＋steady productivity improvement＋Greening ＆ Smartening　Manufacturing to the next stage

Evolution of manufacturing ～Creating Greener & Smarter factories～

Digital/Sensing・AI/Autonomous control, Aim for high accuracy・high efficiency manufacturing by connecting data in whole



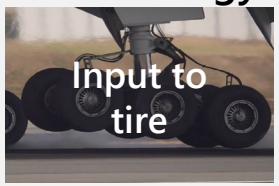
		2026 target	2030 target
Green Maximize value with minimum sustainable resources	CO_2 emission	50% over reduction (vs. 2011) (Scope1,2)	50% reduction (vs. 2011) (Scope1,2)
	Renewable energy(electricity)	70% over	Aim for 100%
Smart "Strong" real (Takumi) x digital mastering manufacturing	Deployment ratio of ultimate "circle" technology *Deployment ratio for technology applicable machine	apprx. 50%	100%
	Less skills/High efficiency Labor productivity	above 110%	130%

Amplification of solution value by evolution of prediction technology

Determined route

Aviation solution

Evolve **tire wear prediction technology**



× AI

⇒**Wear prediction (Wear out timing)**

Mining solution

Evolve **tire durability prediction technology**

× AI

⇒**Durability prediction (optimized operation)**

Evolution of solution technology

Various driving route per customer

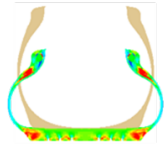
Deployment to TBR

Input to tire

×

Inner pressure, temperature

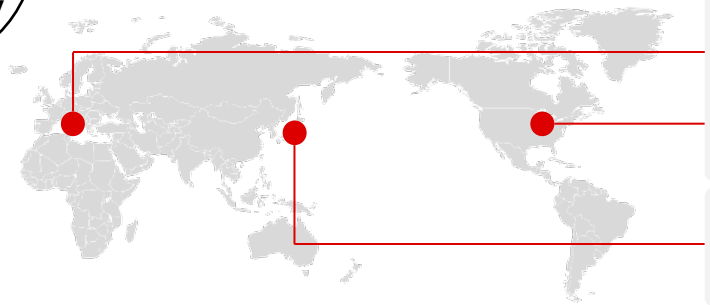
×



Bridgestone's unique physical model

→ Become able to predict each tire endurance margin at wear out

Suggest optimized management per customer



B × webfleet solutions a Bridgestone company

B × azuga a Bridgestone Company

Vehicle data of digital fleet solution provider
⇒**Determine whether to adopt or reject retread for each tires**

B × Transportation company etc.

Traveling data of customer
⇒**Suggest plural retread per fleet**

Amplify value by realizing using up of each tire

Have the customer use tires safely, successfully, efficiently

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Value creation by technology innovation: “from interaction with empathy to co-creation” Promote co-creation leveraging BIP

Promote joint R&D with partners in industry, government and academia to create social value & customer value, with BIP as the starting point

Accelerate joint research with NTT, NIPPON TELEGRAPH AND TELEPHONE CORPORATION

Promote “co-creation” in 3 areas based on strengths of both companies to realize vision of both companies

Sustainability | Digital twin | Creating an environment friendly town through tires

NTT

Cyber related technologies such as computing network fundamental technology and digital twin computing

×

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“Mastering rubber” “Mastering road contact”

Contribute to the evolution of mobility, including research and commercialization of autonomous driving technology : Co-creation with TIER Ⅳ

“Co-creation” in 2 areas

1. “Autonomous driving technology”: Promote activities based in B-Mobility, mini test course in BIP, from 2022
2. “Solution service that supports operations ”: Start demonstration test on public roads leveraging self-driving EV bus and tire management digital tool “Tirematics” from February 2024

Accelerate to create new value from joint research that leverages Bridgestone’s core competencies through collaboration with industry, government and academia

- **Joint research with Tohoku University:** Material development leveraging NanoTerasu, next-generation synchrotron radiation facility, etc.
- **Collaboration with Kyusyu University:** Comprehensive initiatives such as joint research, talent development, etc.

Exploratory business "Sowing new seeds"
—Initiatives for an autonomous driving society(co-creation with TIERⅣ)

New value demands of autonomous vehicles

Challenge : understand the functions and characteristics required of tires

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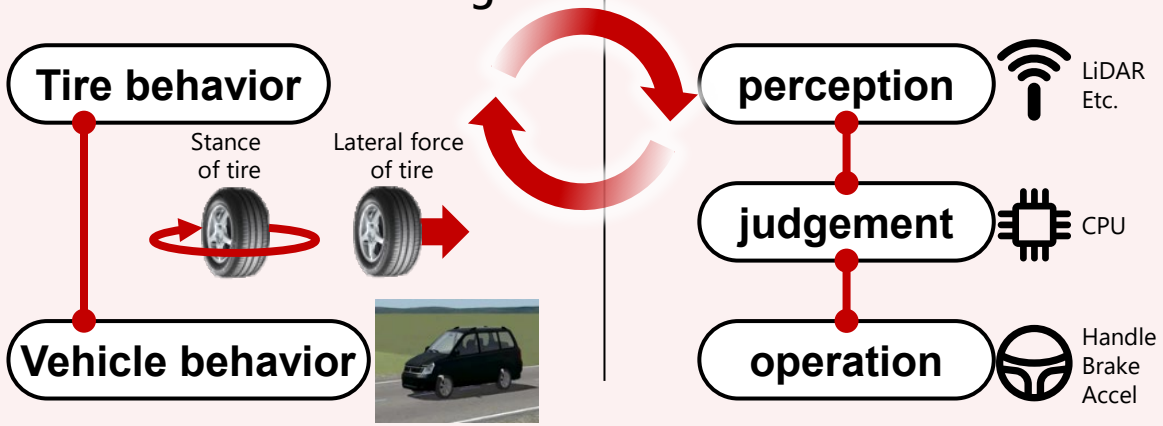
Examination of tire and vehicle behavior in autonomous driving

TIER Ⅳ

Disclosure of autonomous driving algorithms and data



Create the technology needed to develop tire and service which contribute to autonomous driving

The realization of a safe autonomous driving society（Extension）

Knowledge of tire characteristics

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Technical value

Understanding of autonomous driving algorithms and the utilization of data

autonomous driving technology and data

TIER Ⅳ

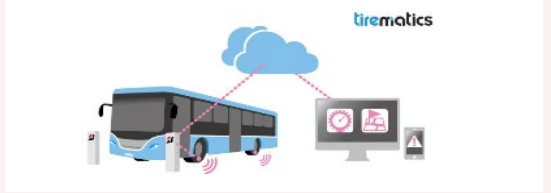
Technical value

Differentiation of algorithms with the addition of tire knowledge

Development of tire and solution suitable for autonomous driving (ease, efficiency)

B-Innovation
create ideas

B-Mobility
form ideas and test



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Exploratory business "Sowing new seeds"
—providing social value & sustainability at the core —

Evolution of "Air Free" to provide social value: Based on "co-creation", "continue to support the mobility of people and objects"

Mission: "Support the mobility of local communities"

In response to the challenges of local communities (aging population, depopulation, labor shortage), commit to nonstop safe mobility with peace of mind, as well as to contributing to a society that ensures accessibility and dignity for all.

Air Free

24MBP：From concept to "Air Free" – Technology evolution for safety & peace of mind and sustainability

	Initial Concept		Evolution of Technology
Character of material:	non-breakable material	→	Tough and flexible material
Character of design:	Do not distort	→	Distort properly
Feature of product:	Support load	→	Support load＋ride comfort
	Recyclable	→	Recyclable＋Retread

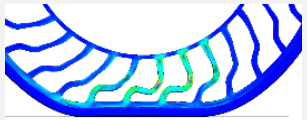
- Safety and peace of mind ：Adopt "Empowering Blue" for increased visibility

"Blue to empower local communities' safe mobility with peace of mind"
A color to maximize visibility at twilight when many traffic accidents occur※

※ Color scheme based on the usage condition in Bridgestone's demonstration experiment

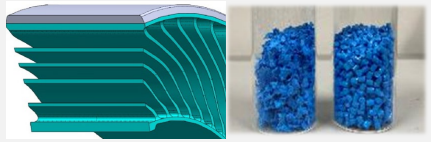
- Non-stop mobility： No punctures / no need for inflation —Improve maintenance efficiency
- Sustainability—Contribute to improving resource productivity & a circular economy: Use of renewable material / simple structure / adapted to retread / recyclable

Unique Algorithm
Utilization of material
Optimize road contact・control strain



Shape optimization by Machine learning

Sustainable design
Retreadable/Recyclable
Material and simplified structure



Linkage with the sustainability business model

Mar. 2024:
- Start demonstration experiments on public roads in Kodaira City, Tokyo where Bridgestone Innovation Park is located
- Develop "Air Free" characteristics & performance in various usage conditions and evolve toward social implementation

24MBP: In parallel with demonstration experiments, explore business model

2026: Create a "co-creation" mobility system for small mobility and autonomous driving, etc.

BRIDGESTONE

Exploratory Business "Sowing New Seed" — providing social value & sustainability at the core —

Support mobility in local communities through safe, peace of mind and sustainable technologies

Safe and peace of mind mobility in local communities by Empowering Blue

Establishing technologies for social implementation and exploring business models- creating a mobility system
Co-creating with partners: small mobility x autonomous driving systems

AirFree

Expanding missions from community to space

Providing safety and peace of mind in extreme environments and "supporting space exploration with the dreams of humanity on our shoulders"

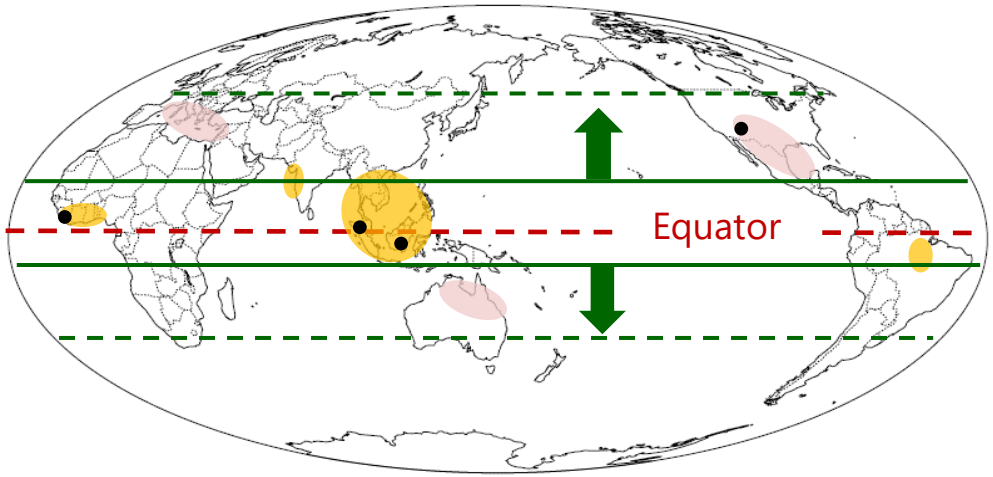
Bridgestone, which has known the way of the world and supported the evolution of all kinds of mobility on Earth contributed to development of human-being by knowing the way of space and supporting the evolution of space mobility

Co-creating with various partners in the space business network ▶ **Contributing to international missions — Promoting technology exploration —**

Exploratory business "Sowing new seeds"
—Making Natural rubber resource sustainable

Social issue Ensure sustainability of resources

Business issue Increase in Natural rubber demand
Concentration of Hevea production area



Hevea　Guayule　Bridgestone private farm

【Expansion】Productivity improvement of Hevea

Do not reduce

Technology for disease diagnosis

(Collaboration with former Information Services International-Dentsu, Ltd. (ISID)

Increase

Selection Technology of elite tree

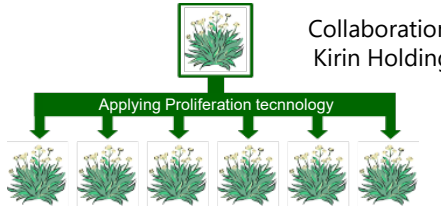
Plantation management Technology

(Collaboration with The Institute of Statistical Mathematics)

21MBP： Started trial at private farm　24MBP：Study expansion to support small scale farmers

【Diversification】Diversification of raw materials using guayule which grow in arid land

Technology for mass propagation of superior varieties of Guayule



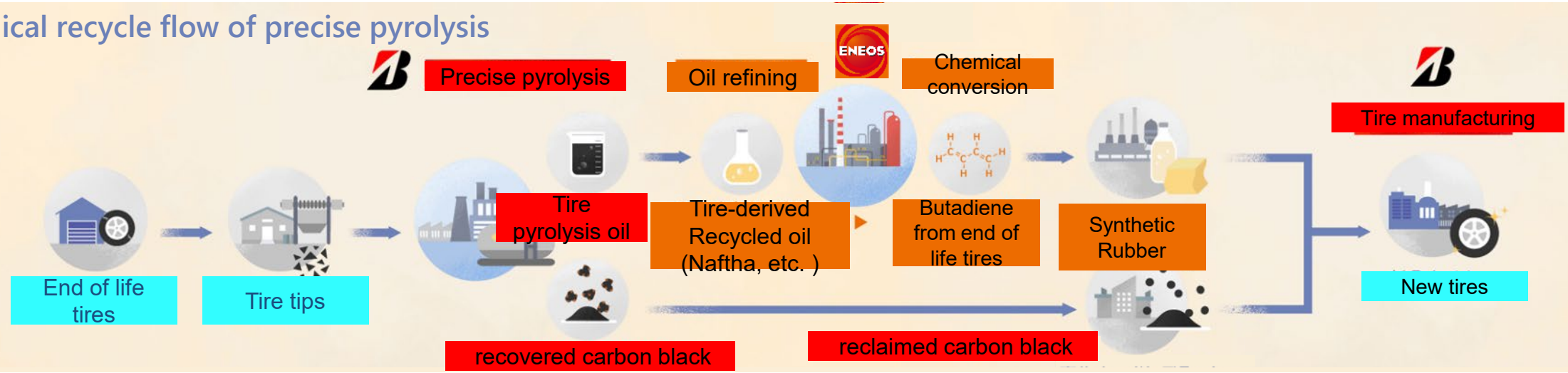
Collaboration with Kirin Holdings Co.

Provide tires using Guayule to NTT INDYCAR® SERIES

21MBP：succeeded in the large-scale propagation of superior varieties through original technology. Guayule applied to motorsports tires.
24MBP：Co-create a breeding technology of superior plant varieties.

Exploratory business "Sowing new seeds"
—Recycle pyrolysis technology of End of life tires（Co-creation with ＥＮＥＯＳ）—

Chemical recycle flow of precise pyrolysis



2021-23	2024-26	2027-30
Development of element technology	**Establish and optimization of precise pyrolysis process**	**Social implementation verification**
Optimization of pyrolysis condition / Study on refining・Catalyst condition	Design process for Tire pyrolysis / Design process for Oil refining	Verification through design・construction・operation

Result of 21MBP

Collected carbon black（left）and oil (right)

Start precise pyrolysis verification through small scale demonstration（Renew end of life tires to raw material）

Approach for 24MBP

- Establish precise pyrolysis process
- Verify and improvement for scale up
- Study on reduction of CO_2 emission

Approach for 27MBP

- Social implementation of tire horizontal recycle
- Establish recycle business model

This presentation is based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

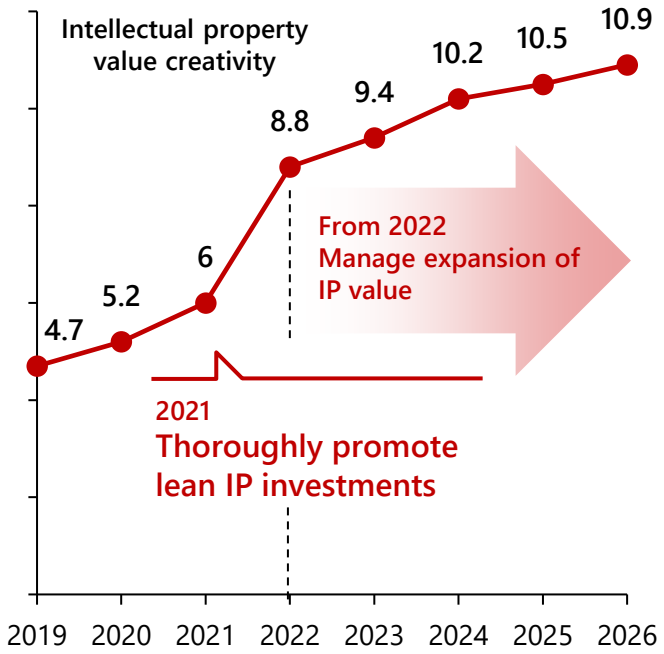
Intellectual property strategy

Intellectual property mix

Understand “based on-site” and combine intellectual property that supports each business strategy for the premium tire business, the solutions business, and the exploratory business

Convert intellectual property into value ⇒ Amplify customer value & social value

$$\text{IP* value creativity} = \frac{\text{IP value}}{\text{IP investments}}$$



Focus on “value creation” aligned with business strategy
- Support value creation across value chain

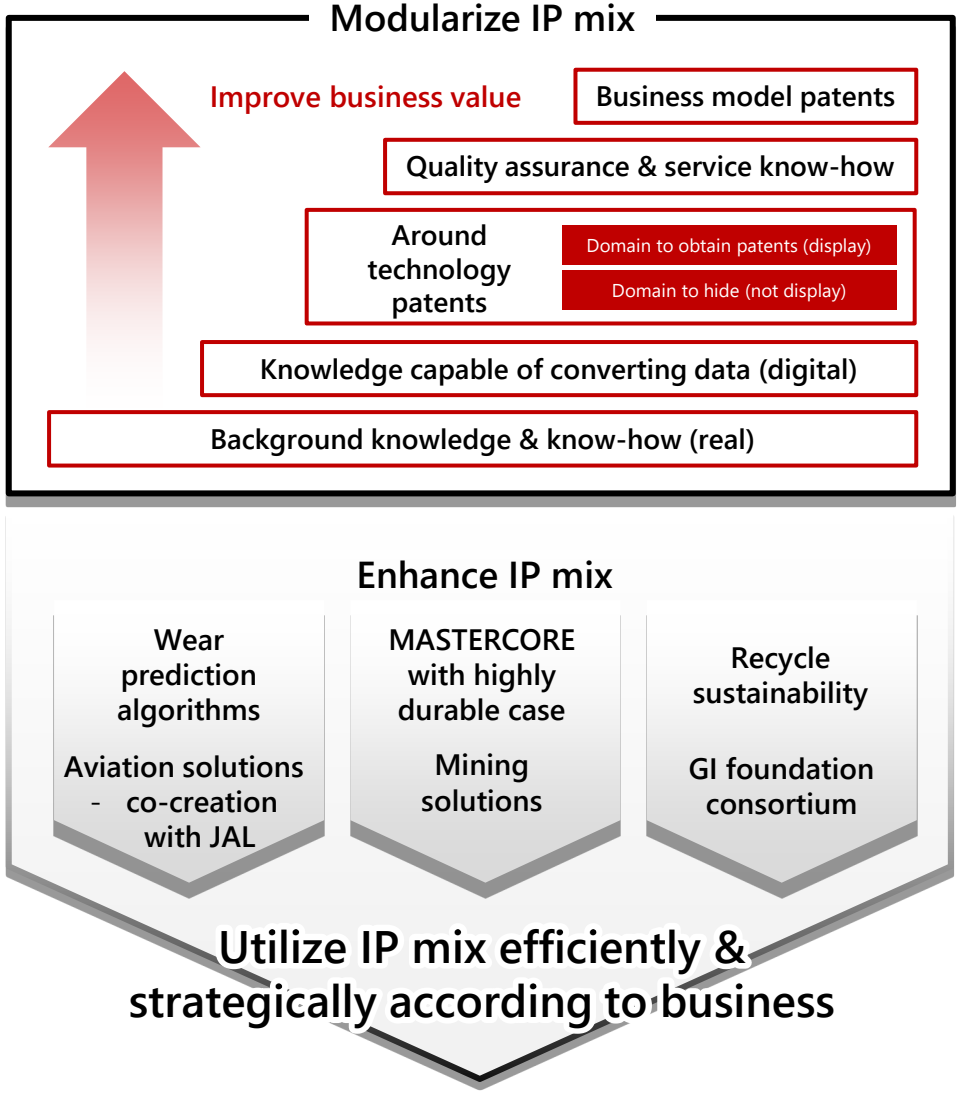
From the conventional premium tire business-focused IP strategy to one that visualizes IP with the entire value chain of “produce and sell,” “use,” and “renew” as a scope, including the solutions business and the exploratory business
⇒**Amplify value through IP management linked with characteristics by business portfolio and business strategy**

“Maximize efficiency and effectiveness”
- Utilize IP mix

Realize efficient & strategic IP activities by combining and utilizing a variety of IP such as knowledge, know-how, and patents spread throughout the value chain from the perspective of value creation

Discover IP that leads to business value, “respecting being on-site”⇒ Expand value that cannot be imitated

Amplify value by strengthening “Genbutsu-Genba (respect for being on-site)” communication in development & manufacturing – logistics -sales service and solutions and extracting on-site craftperson skills (tacit knowledge)

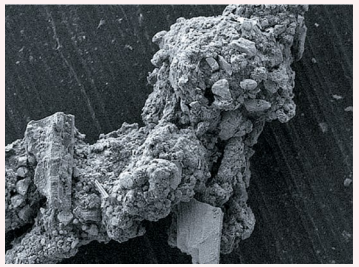


Technical approach toward Global management risk

Target substance

TRWP ：
Tire and Road Wear Particles

Character of TRWP



Component	Agglomeration of tire & pavement material
Shape	long and narrow particle
Size	several μm ～ over 100μm
Rubber : road ratio	Approx. 50 : 50
Specific gravity	About 1.8 g/cm^3

Cited from “Tire Industry Project 10-Year Progress Report / WBCSD”

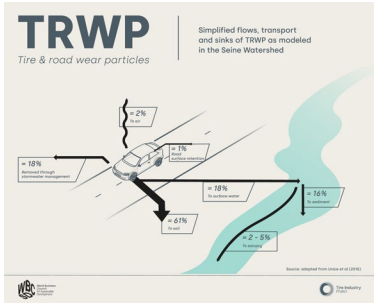
6PPD：Anti-oxidant

Bridgestone’s status

Understand the essence
Correct understanding through co-creation and internal R&D collaboration

- As a leader、research characteristics and affect of TRWP through TIP*1
  - Through co-creation, understand environmental dynamics・affect of TRWP, and continuously work on to solve and visualize the issue

*1 Tire Industry Project under the World Business Council for Sustainable Development (WBCSD)

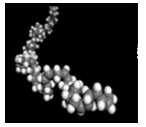


Simplified flows, transport and sinks
as modeled in the Seine watershed
- the reference to Unice *et al.*, 2018
- the credit to “WBCSD Tire Industry Project”

Reduce TRWP：Utilize Bridgestone’s Core competence for reduction of TRWP

- Dan-Totsu tire performance：Reduce TRWP amount by Dan-Totsu wear performance
- Suggested solution：Reduce TRWP amount by fleet management
- 「Mastering rubber」：Apply Innovative material technology for development of bio-degradable polymer*2

*2 Polymer that is naturally degraded by microbes



Mastering Rubber

ENLITEN TECHNOLOGY

Solution Technology

- Anti-oxidant commonly used in tire industry. Will work on through the whole tire industry and promote evaluation of substitutional

Optimization of Global R&D

	Europe(Rome)	Japan(Tokyo, Kodaira)	United States(Ohio, Akron)	
Role	✓ Sustainable management ✓ Model-Based Development(OE) ✓ **Dan-Totsu product development**	✓ Manufacturing ✓ Recycle of end of life tires (pyrolysis) ✓ Data driven material development ✓ Establish IT platform ✓ **Dan-totsu product development**	✓ Guayule (Research conducted in Arizona) ✓ Recycle of end of life tires (Fermentation) ✓ Establish IT platform ✓ **Dan-Totsu product development**	
Geographic characteristics・Strength	**Strong attentions to sustainability** **Actively leading Environmental regulations and policies. Consistent green growth strategy** **Premium・Prestige European OE**	**Core of manufacturing** **Global center of Co-creation in Bridgestone** **Dense network of industry-government-academia collaborations**	**Cutting edge of IT and computing technology** **Leads social implementation of environmental technologies** **Environmental consciousness in the West Coast**	**Role sharing based on geographic Characteristic and strength Global R&D**
Dan-Totsu Products	**TURANZA BLIZZAK etc.**	**REGNO、BLIZZAK MasterCore・Aircraft etc.**	**ALENZA TURANZA (All season) etc.**	**Region based product development**