

# SUBARU Technology Briefing

Jan. 20, 2020

NOTE) This document is an English translation of an original Japanese document. If there are any discrepancies between this document and the original Japanese document, the original Japanese document prevails.

# Opening Remarks from President and CEO Tomomi Nakamura









# From a company making things, to a company making people smile





#### <Vision> From a company making things, to a company making people smile







#### Different

Become a brand that is "different" from others by enhancing distinctiveness

### **Customer-First**

Engage in business activities that resonate with customers by putting them center-stage Corporate Social Responsibility

Fulfill corporate social responsibilities by contributing to diversifying social needs



#### <Vision> From a company making things, to a company making people smile







#### Different

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# Is SUBARU "Different" from Others?



## **Conversations SUBARU employees often have**



# Is SUBARU "Different" from Others?



# **Owners smiling with their SUBARUs**



# What Makes SUBARU "Different"



# Customer expectations Functional values Long-term use Enjoy driving Safe travel New exciting experiences Image: Comparison of the processing of the processing

Through the life with SUBARU vehicles, customers come to feel and express its life-enriching benefits, not just functional values

Safety	Longevity	Adventure/Versatility	
Caring for loving family and friends	Making a series of precious memories	Enriching lives and leisure time	

What Makes SUBARU "Different"



Strong emotional connection with customers = "Different"

# What makes us "Different" is coming from

passions and dedications of our employees

pursuing the utmost SUBARU





#### <Vision> From a company making things, to a company making people smile







#### Different

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# **Customer-First**

Engage in business activities that resonate with customers by putting them center-stage Corporate Social Responsibility

Fulfill corporate social responsibilities by contributing to diversifying social needs

# **Corporate Social Responsibility**



## **Roots of SUBARU**



Our DNA as an aircraft manufacturer Safety as first priority

# Philosophy of "Safety-First"



Because cars carry the most precious cargo

SUBARU seriously aims to eliminate fatal traffic accidents.

# Toward "zero fatal accidents\*" in 2030

\*Fatal traffic accidents of Subaru drivers/passengers and pedestrians/cyclists Subaru cars collide with

# **Corporate Social Responsibility**



# **Global Environment Preservation**

# 2050

On the well-to-wheel basis, we will pursue our goal of reducing the average  $CO_2$  emissions from new passenger cars by at least 90% by 2050, compared with 2010.

# 2030

By 2030, we will pursue our goal of increasing the ratio of electric vehicles (EV) and hybrid cars to at least up to 40% of the gross number of vehicles sold globally.

In the early 2030's, all commercial SUBARU cars will be equipped with electric powertrain technology.

SUBARU will accelerate the development of fundamental technologies for EVs and hybrid cars with support from alliance partners and continue offering products accentuating SUBARU's distinctions even in the emerging electric age.

SUBARU will contribute to building a carbon-free society through our distinctive and technological innovations.

# **Direction of SUBARU's Car-making**







# SUBARU Technology BriefingJan 20, 2020Technologies that Make a Subaru a Subaru, and their Evolution

Tetsuo Onuki Director of the Board, Executive Vice President & Chief Technology Officer

# Maintaining the Spirit of SUBARU in the Coming Age





# Maintaining the Spirit of SUBARU in the Coming Age





# **Human-Oriented Car-Making**





# SUBARU's human-oriented car-making will never change.

# **Bringing New Values to Cars**



#### "Enjoyment and Peace of Mind" are SUBARU's distinctive spirit, which is to be constantly forged through the ages

#### **Pioneering new categories**



LEGACY Touring Wagon Vans with sporty performance → The basis of touring wagons



+ Rough-road capability The basis of OUTBACK

#### Forester

Crossover vehicles with superior on-road driving performance and rough-road capability → The basis of modern SUVs





Symmetrical AWD



Creation of technical values

SGP (Subaru Global Platform) developed with a focus on human senses → Dynamic Quality

Passive safety performance made possible by the symmetrical power unit

All-around safety based on compatibility

→ Leading passive safety performance

Camera technologies originally developed for combustion visualization → The world's first stereo camera only driver-assistance system,"EyeSight"







## SUBARU GLOBAL PLATFORM

# SUBARU GLOBAL PLATFORM has enhanced the values of "Enjoyment" and "Peace of Mind."





The SUBARU Global Platform underpins "Enjoyment and Peace of Mind."

# The Value of "Safety"





## Always receives top level evaluations in vehicle safety assessments

## **Facts about Fatal Traffic Accidents**





# SUBARU has realized lower fatal accident rates in USA and Japan for the last decade.

# A TV Spot for the U.S. Market





1. What SUBARU Has Delivered What is "SUBARU-ness?











Human-oriented thinking. Thorough consideration of what is important for users. Bringing new values to cars.



SUBARL

# We think this is **"SUBARU-ness.**"









# Maintaining the Spirit of SUBARU in the Coming Age





2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind Integration of Artificial Intelligence (AI) Technologies



The integration of AI technologies and the Subaru Global Platform is the key to continually offering "Enjoyment and Peace of Mind"

Monitoring condition of driver
Correction of recognition, judgment, and operations
Mitigating damage in the event of an accident



Enjoyment

Dynamic quality
 Connecting with cars
 Excitement of being
 able to go anywhere

SUBARU Global Platform underpins primary safety and active safety.

Pursue "SUBARU-ness" by further enhancing "Enjoyment and Peace of Mind" using AI technologies 2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind

# **Evolution of Dynamic Quality**



#### What we pursue is "controllability and maneuverability in any environment for any driver."



Enjoyable driving with peace of mind to be further advanced by AI technology even in the age of autonomous driving.

# 2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind Quick Vehicle Accurate Vehicle Straight-Line AWD Technology Quick Vehicle Response Accurate Vehicle Straight-Line AWD Technology



# Realize shorter response delay by thoroughly improving stiffness of all parts

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# Realize more predictable and stable vehicle behaviors by shortening the lag in vehicle response

#### 2. Technologies and Evolution Accentuating "SUBARU-ness" - I. Enjoyment and Peace of Mind **Quick Vehicle Accurate Vehicle Response** Accurate Vehicle Straight-Line **AWD Technology** SUBARU Response **Driving Stability** Response Improve the accuracy of vehicle response to realize reliable AD/ADAS\* function. First Half of 2020s It also benefits human drivers by delivering a more enjoyable and secure driving experience. \*Autonomous Drive/Advanced Driver-Assistance Systems 3.5 2-point 3-point top cross-member 3 mounting mounting Transverse position [m] 2.5 Lower arm ball joint 2 1.5 Single point mounting of 1

Time [s] 10 2 6 8 0 As the steering shaft axis is determined by the lower arm ball Improve vehicle behavior accuracy corresponding to joint position, accuracy can be improved by more precise steering inputs mounting of the vehicle body and suspension.

0.5

0

lower arm area

# Improve vehicle response accuracy with a more precise body and suspension.

#### 2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind

**Straight-Line Driving Stability** 

Quick Vehicle<br/>ResponseAccurate Vehicle<br/>Response

#### First Half of 2020s

Further improve AWD's superior straight-line driving stability. With the new wind tunnel, the impact of disturbances such as temperature change and natural winds will be eliminated and more accurate measurement will be enabled.

Straight-Line

**Driving Stability** 

**AWD Technology** 

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# Improve straight-line driving stability by optimizing chassis geometries and vehicle aerodynamics



2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind

 Evolution of AWD Technology
 Quick Vehicle Response
 Accurate Vehicle Response
 Straight-Line Driving Stability
 AWD Technology

# Adequate control over AWD stability and RWD turning performance

Driving force distribution varies between front and rear wheels depending on wheel speed differentials and a multitude of driving forces.



# Enjoyable driving like a skilled driver regardless of driving skill

2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind Realize Greater Dynamic Quality with a Human Anatomy-Focused Approach





# An anatomical approach to reveal the mechanisms of comfort

#### 2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind Facts about Fatal Traffic Accidents (Reminder)



# SUBARU has realized lower fatal accident rates in USA and Japan for the last decade.

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2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind Technologies to Safeguard Human Lives



SUBARU's unique philosophy of "overall safety"		What has been done	What	What is to be enhanced	
6. <u></u> 6	Primary safety	Excellent visibility/Package	DMS capability to recognize driver/passengers		
<b>\$</b>	Active safety	Dynamic performance/ Risk-aversion performance	Vehicle motion control technologies		
	Preventive safety	Real world-oriented measures	Image recognition performance and its automation		
	Passive safety	Vehicle occupants protection + Compatibility	Vulnerable road users protection ADAS coordination		
			Connected safety	AACN*/Infrastructure coordination/STARLINK	
			* Advanced Automatic Collision Notification		
			AI technology applications		

# Toward the goal of "zero fatal accidents" in 2030

#### 2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind Breakdown of Fatal Traffic Accidents of SUBARU Cars





Accidents caused by own vehicle account for 60-70% while accidents caused by another vehicle account for over 30% of all accidents
2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind

A Scenario toward Zero Fatal Traffic Accidents



#### Fatal traffic accidents of SUBARU cars (estimated from US FARS data)



Advancing EyeSight and coordinating it with connected safety and passive safety

2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind

### **Evolution of ADAS**

ADAS

SUBARU

Collision

safetv

**AACN** 

All-around sensing with a stereo camera as its core to promote the constant evolution of object recognition and situation judgment capabilities.



### **Thorough and constant enhancement of ADAS technologies**

2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind Evolution of Accident Prevention Features of EyeSight ADAS

#### First Half of 2020s

#### Enhance capacity for avoiding Enhance capacity for monitoring driver intersection/urban area accidents condition and respond to driver errors Hitting pedestrian **Right-turn collision** Swaying Loss of consciousness while turning 000 1000-Unintentional acceleration Head-on crash Avoidance by steering **Driver distraction** & runaway

# Some features to be developed for avoiding severe accidents and risks

Collision

safety

SUBARU

AACN

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### State-of-the-art features for comfortable and safe travel on highways

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2. Technologies and Evolution Accentuating "SUBARU-ness" - I. Enjoyment and Peace of Mind

### **EyeSight: Stereo Camera System**

EyeSight obtains precise stereoscopic views of all objects in camera images. It captures every object's profile, measures distance and velocity, and identifies its location.



e.g. EyeSight Ver.3 on a highway



ADAS

**AACN** 

Collision

safetv

SUBARL

The strong points of the system are object detection, object locating and motion prediction based on high-resolution distance data points

# The stereo camera system enables efficient collection of essential information for recognition and judgment.

2. Technologies and Evolution Accentuating "SUBARU-ness" - I. Enjoyment and Peace of Mind Integration of Stereo Camera and AI

#### Second half of 2020s Stereo camera system's recognition capacity + AI's judgment capacity

Segmentation technology Al-based driving-range detection integrated with proprietary stereoscopic recognition

#### **Holistic Path**

AACN

ADAS

Al-based prediction of traveling path







Collision

safety

2. Technologies and Evolution Accentuating "SUBARU-ness" - I. Enjoyment and Peace of Mind **Communication with the Car** Collision ADAS AACN SUBARU safety - Observing the driver with DMS\* and linking the detected information First Half of 2020s with various controls including EyeSight - Deploying the new infotainment system globally \*Driver Monitoring System **Display device** DMS CAN Audio **Driver Information(\*)** Body integrated Head position unit •Eye opening Seat •Facial features Personal recognition & Air conditioner Mirror EyeSight

#### **Connect EyeSight with DMS**

2. Technologies and Evolution Accentuating "SUBARU-ness" - I. Enjoyment and Peace of Mind

### Value of Connecting with a Car





Provides values suited to the modern era through new experiences

2. Technologies and Evolution Accentuating "SUBARU-ness" - I. Enjoyment and Peace of Mind

# "Enjoyment of Connecting"



#### SUBARU STARLINK



### High subscription rates for both free and paid services



# in the event of an accident.

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2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind

 A Roadmap for AACN Evolution
 ADAS
 AACN
 Collision safety



Commitment to survival rate improvement through greater information accuracy

2. Technologies and Evolution Accentuating "SUBARU-ness" — I. Enjoyment and Peace of Mind Constant Enhancement of Passive Safety ADAS

Second half of 2020s

Airbag system to protect cyclists as well as pedestrians



Protection area needs to be extended to protect cyclists



# Idea of occupant restraint system controls coordinated with EyeSight

**AACN** 

Collision

safety

SUBARL

Controls the use of restraint equipment depending on the characteristics of collision situations, occupants, and pedestrians. It can reduce injuries to vulnerable road users, e.g. children and the elderly



# Enhance passive safety in preparation for severe crashes that cannot be avoided by ADAS and no-fault accidents.

# Maintaining the Spirit of SUBARU in the Coming Age



# Maintaining the Spirit of SUBARU in the Coming Age





**Customer Expectations and Improvement of Fuel Efficiency** 



#### SUBARU has refined its proprietary technologies to respond to environmental needs.



Enhance environmental performance while offering driving enjoyment

**Customer Expectations and Fuel Efficiency Improvement** 



#### SUBARU has refined its proprietary technologies to respond to environmental needs.

Fuel Efficiency of SUBARU: Top-level in the SUV category Proprietary technologies >>>> BOXER engine / Symmetrical AWD / Subaru Global Platform



2020MY HWY label [MPG] U.S. Market D-SUV AWD



Enhance environmental performance while offering driving enjoyment

**Technology Roadmap for Reduction in CO<sub>2</sub> Emissions** 



# Reducing CO<sub>2</sub> emissions with electrification technologies while further accentuating "SUBARU-ness" in the environmental era



By 2050: Reduce average well-to-wheel CO<sub>2</sub> emissions from new vehicles (in operation) sold worldwide by 90% or more compared to 2010 levels By 2030: Make at least 40% of Subaru global sales BEV or HEV



#### **Evolution of proprietary technology (BOXER engine)**



## Next-generation BOXER engines offer both abundant torque and environmental performance





# Enhance "SUBARU-ness" in the environmental era with the evolution of internal combustion engines



# Enhance environmental performance while offering driving enjoyment

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### Accentuating "SUBARU-ness" through integration of proprietary technologies with THS

### SUBARU's Hybrid System

Engine Cars Hybrid Cars

SUBARU

**BEV** 

### Integration of SUBARU technologies with THS



SUBARU's accumulated expertise elaborately applied to hybrid vehicles

Maximize the synergy effect through efficient engine operation in consideration of motor-assist

# Maximize the advantage of BOXER engines with the advantages of electric systems

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## SUBARU's Hybrid System

Engine Cars Hybrid Cars

**BEV** 

Increase both vehicle stability and regeneration energy efficiency with front and rear restraint forces of direct-connecting AWD

AWD



# Enhance safety, AWD performance, and dynamic quality besides reducing CO<sub>2</sub> emissions

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SUBARU Electrification Technologies (BEV) Engine Cars Hybrid Cars

Improve functionality and driving performance to meet customer expectations

#### **Customer expectations**

Items that were selected more for SUBARU cars than for any other brand in our internal survey as reasons for purchasing SUBARU (USA)

- Safety features
- AWD availability
- Holds road well during hazardous driving
- Fun To Drive

#### **Subaru's Direction**

- Superior traction with highlyresponsive motor control
- Stable handling in any condition with flexible driving force distribution

**BEV** 

SUBARL



### Launch BEV with distinctive "SUBARU-ness" in the first half of 2020s



At Subaru, we have always been committed to human-oriented car-making. Even in this once-in-a-century period of profound transformation, our strong commitment and dedication towards car-manufacturing that we have cultivated throughout our history remain unchanged. This is why we continue to pursue the delivery of vehicles that are friendly to the globe where we live and enjoyment that people can have in taking the wheel and going anywhere they wish.

# Delivering the enjoyment of taking the wheel with safety and peace of mind. Protecting people's lives.

Our dedication toward these goals will never change.





