AUTOMOTIVE SUMMIT 2014

Green Mobility Changing the World

19 - 20 June 2014

Bitec Bangna, Bangkok

AUTOMOTIVE SUMMIT 2014

Green Mobility for Sustainable Road Transportation
- Efforts and Challenges in JARI -

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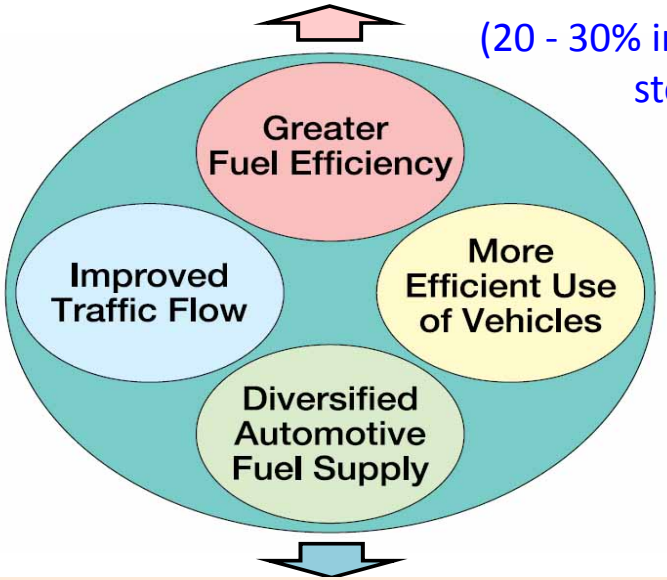
❑ Contents

- Countermeasures for CO2 Reduction toward Green Mobility
- Next-Generation Vehicles in Japan and Key Issues
- Platooning Technologies and its Concept
- Automated Driving

❑ Countermeasures for CO2 Reduction toward Green Mobility

1. Adopting fuel efficiency standards, Reducing vehicle weight, Next-generation vehicles, Promoting replacement

(20 - 30% improvement per 10 years, steady effect)



4. Intelligent transportation systems (ITS)

(5 - 10% improvement, depending on infrastructure)

2. Eco-driving

(5 - 10% improvement, depending on fuel efficiency awareness of users)

3 Alternative fuels (bio-fuels, natural gas, etc)

Source: JAMA

❑ Next-generation Vehicles in Japan and Key Issues

Next Generation Vehicles			Registration number (March. 2014)	Key Issues
xEVs	BEV	Battery Electric Vehicle	42,000	Battery related issues (safety, performance, cost, charging station)
	PHEV	Plug-in Hybrid Electric Vehicle	55,000	
	FCEV	Fuel Cell Electric Vehicle	will be on sale at 2015	Hydrogen related issues (safety, quality, cost, hard/soft infrastructure)
	HEV	Hybrid Electric Vehicle	3,700,000	-
CD		Clean Diesel	75,000	Engine technology
NGV		Natural Gas Vehicle	41,000	-

: promotion required

❑ JARI's Role related to xEVs Key Issues

Battery related issues
(safety, performance, cost, charging stations)

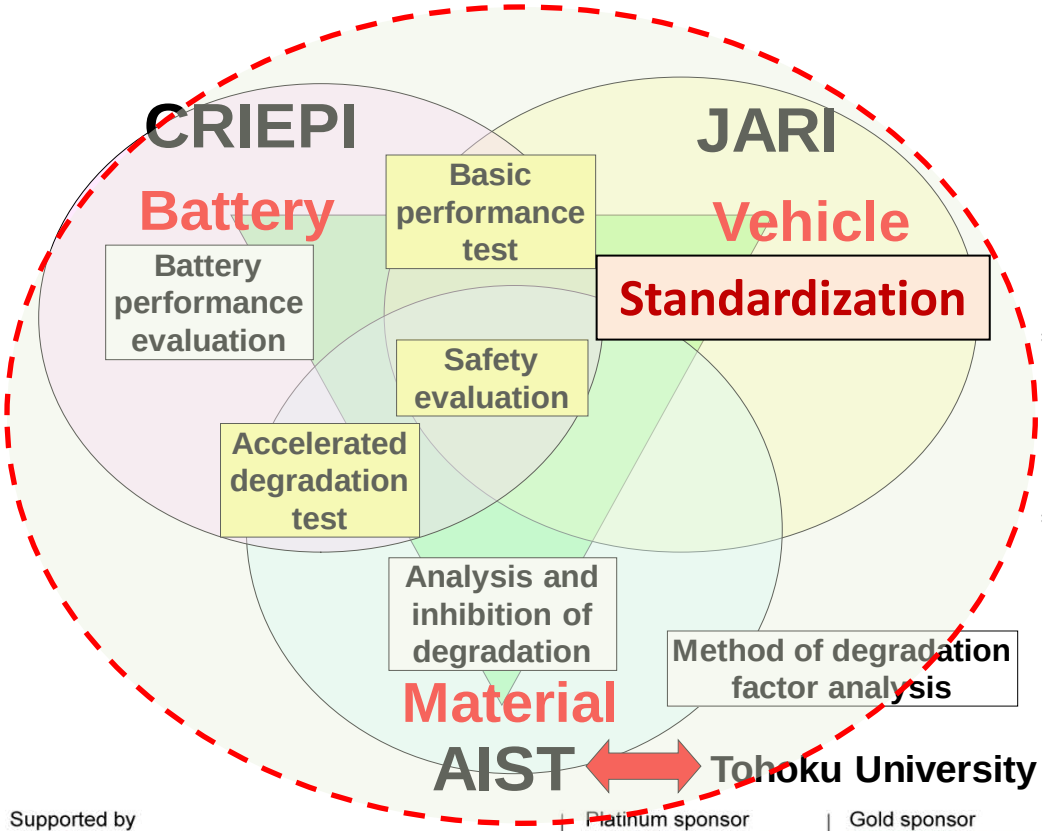
Hydrogen related issues
(safety, quality, cost, infrastructure)

Prepare standards for social receptivity requirements, production and inspection requirements

Propose government research projects in cooperation with stake holders in industries, public universities, institutes and academia

JARI has been contributing to xEVs's dissemination through standardization activities based on research on the key issues

❑ JARI's Role in the Battery R&D Project



* CRIEP: Central Research Institute of Electric Power Industry

*AIST: Advanced Industrial Science and Technology

❑ Battery R&D for xEVs and its Targets

	2006	Improved (2010)	Advanced (2015)	Innovative (2030 and later)
Performance	1	1	1.5	7
Cost	1	1/2	1/7	1/40
Framework	Industry	Industry	Industry Government Academia	Academia

Source: METI Battery R&D Roadmap, 2006 (METI: Ministry of Economy, Trade and Industry)

❑ JARI's Research - related to BEVs and Batteries for Standardization

- Performance tests
  - ✓Electricity consumption test method
  - ✓Extraction of battery durability test cycle, etc.
  - ✓Real world durability test

- Safety test
  - ✓Overcharge, over-discharge, short circuit, nail penetration, crush, environmental, bonfire test, etc.

Four wheel chassis dynamometer

Field test of EVs and PHEVs

Charge and discharge

Nail penetration and crush

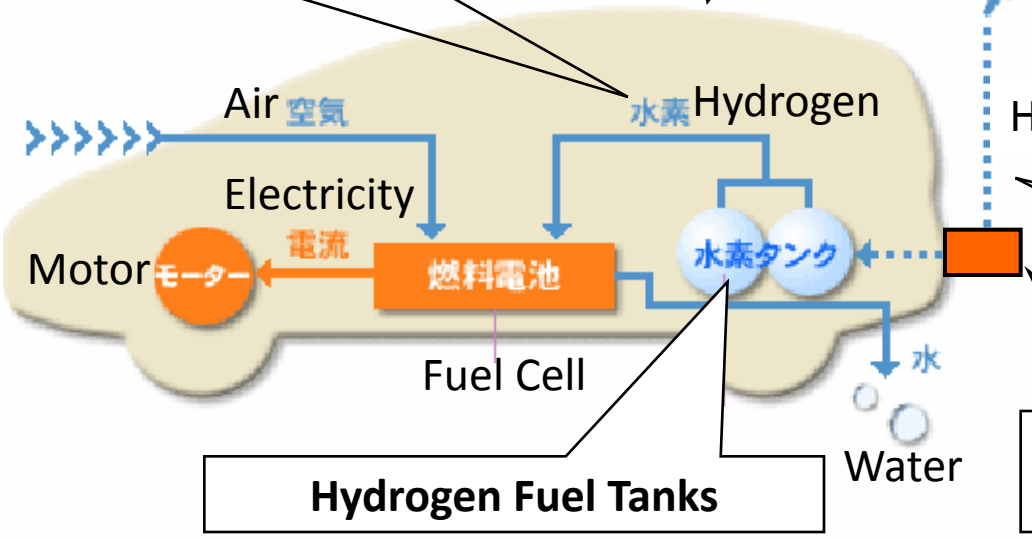
Environmen-tal chamber

❑ JARI's Research - Contribution to Standardization Areas of FCEVs

FCEV Safety
High voltage, Hydrogen, Functional and Crash/ post crash safety

FCEV Fuel Consumption

Hydrogen Quality



Hydrogen Fueling Protocol

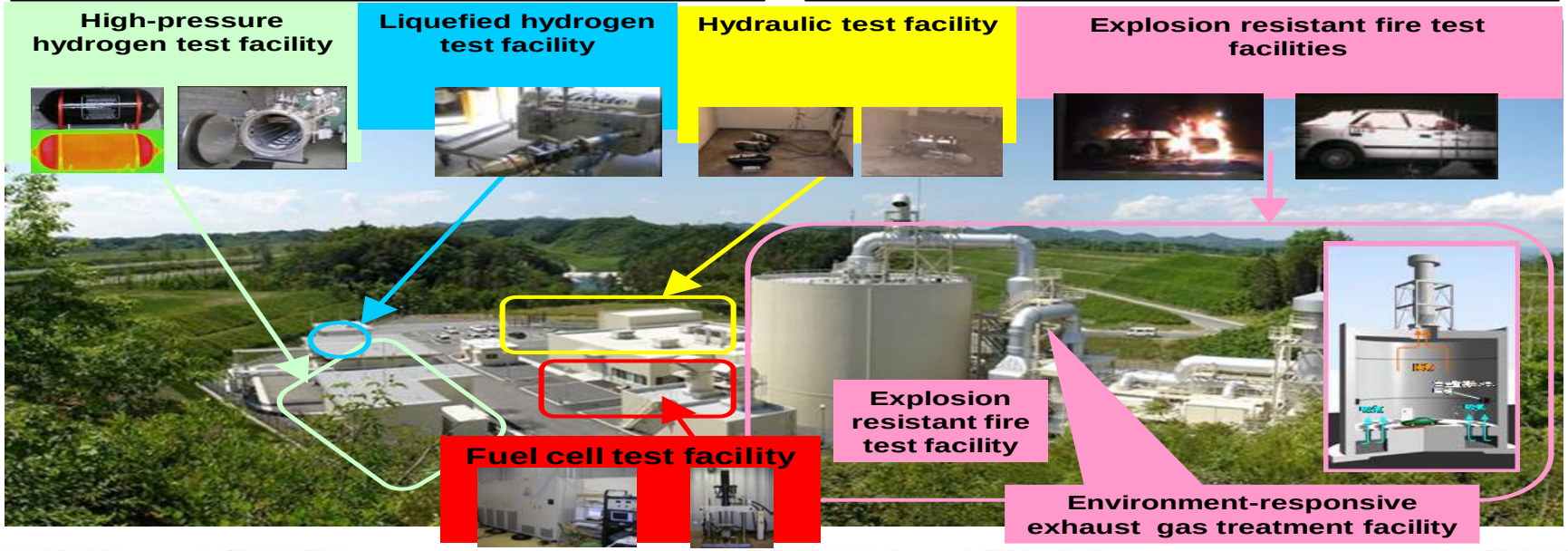
Hydrogen Fuel Tanks

Hydrogen Connection Devices

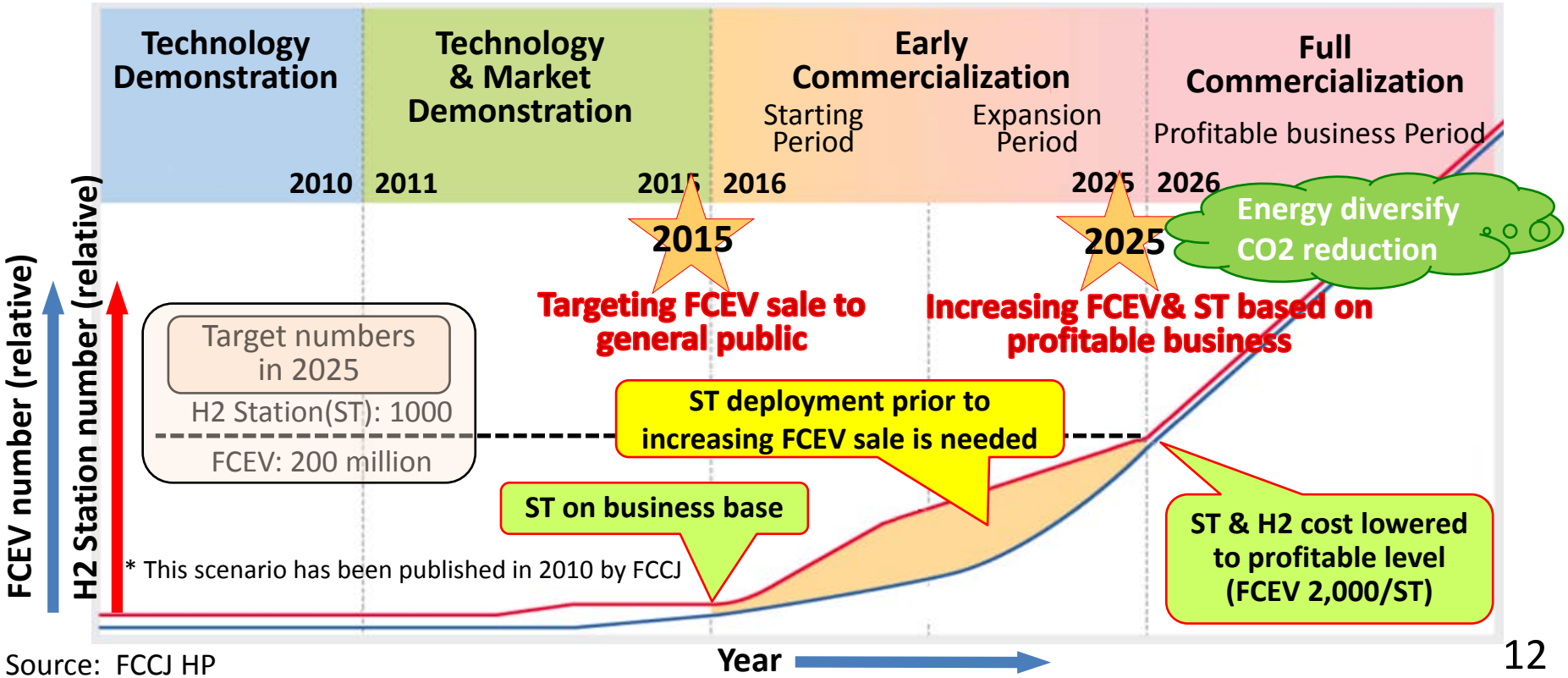
❑ JARI's Research related to Standardization Areas of FCEVs

- **Safety**
  - ✓Tank durability
  - ✓Explosion resistance, etc

- **Reliability**
  - ✓Tank pressure cycling
  - ✓Hydrogen leakage, etc



❑ FCEVs Promotion Scenario in Japan



Source: FCCJ HP

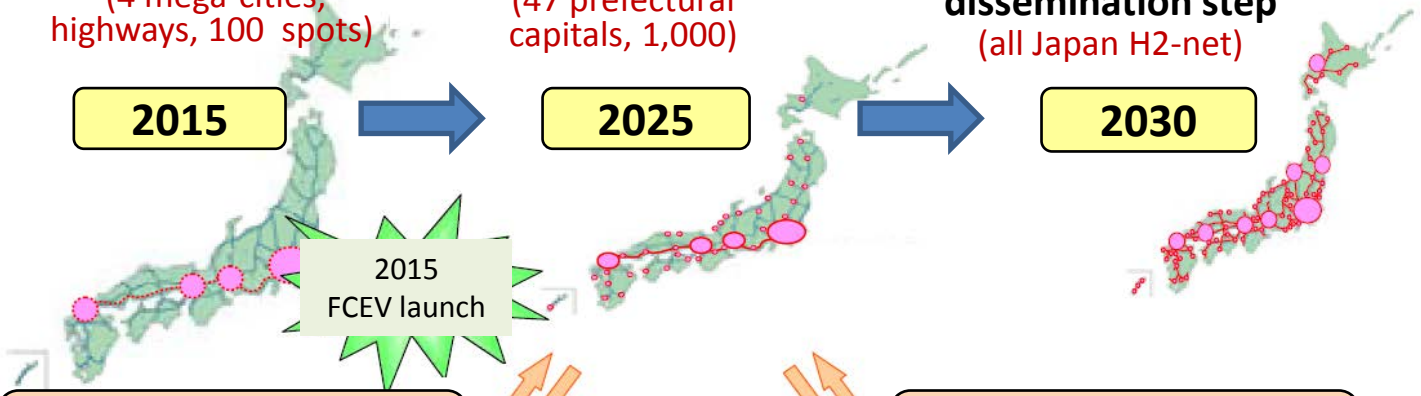
❑ Hydrogen (H2) Station Infrastructure Promotion Strategy

1. Deployment of H2 stations

Introduction step
(4 mega-cities, highways, 100 spots)
2015

Expansion step
(47 prefectural capitals, 1,000)
2025

Full-fledged dissemination step
(all Japan H2-net)
2030

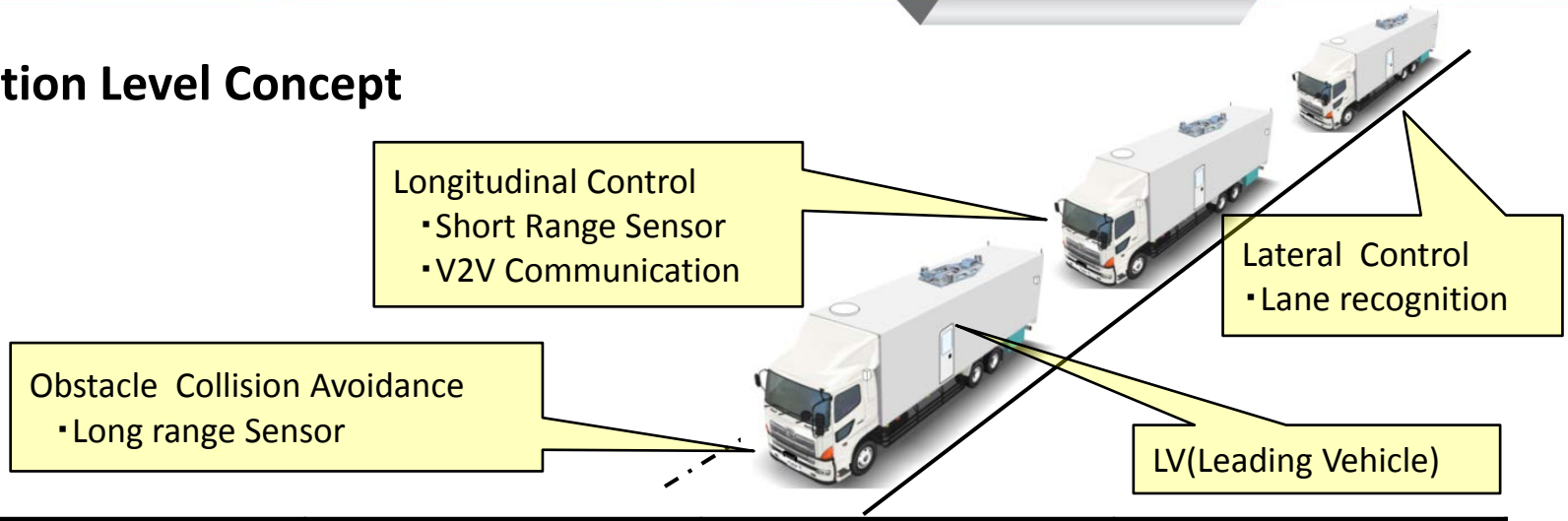


2. H2 Station R&D (low cost issue)

3. Review of regulations

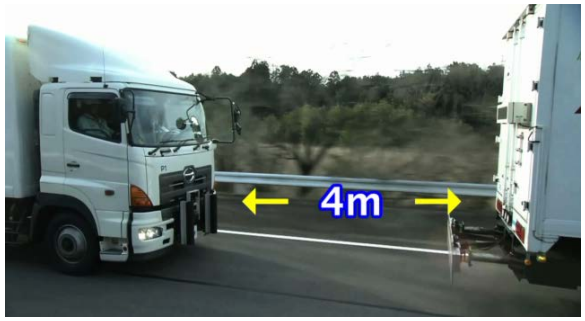
Source: FCV-H2 Station promotion project

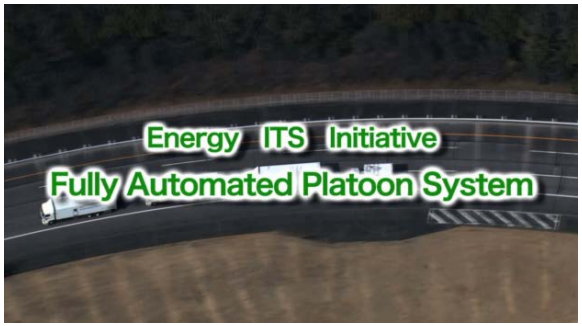
❑ Automation Level Concept

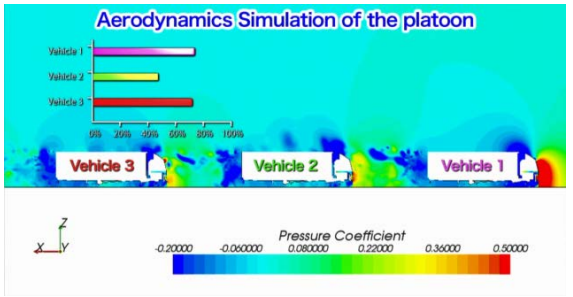


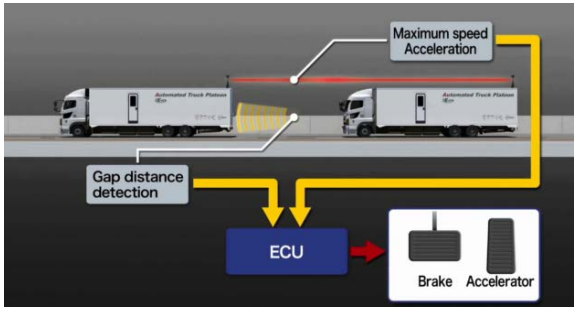
		Concept X	Concept Y	Concept Z
LV	Automation Level	Driver Assistance	Driver Assistance	Highly Automated
	Lateral	without	Lane tracking	Lane tracking
	Longitudinal	CC/ACC / Pre-crash	←	←
FV	Automation Level	Driver Assistance	Highly Automated	Fully Automated
	Lateral	without	Lane tracking	Lane tracking
	Longitudinal	CACC	←	←

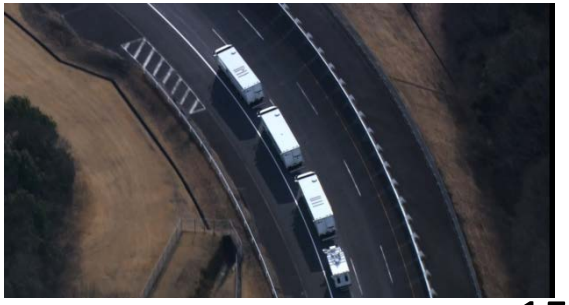
❑ Platooning Technology: 5 min. 30 sec.



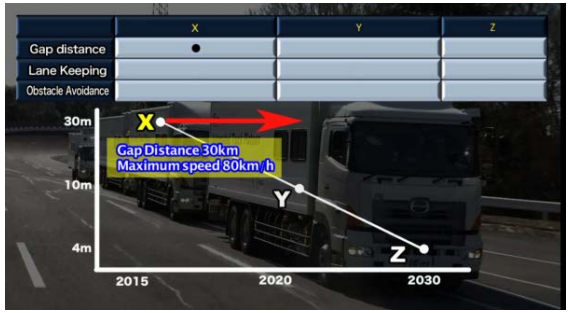


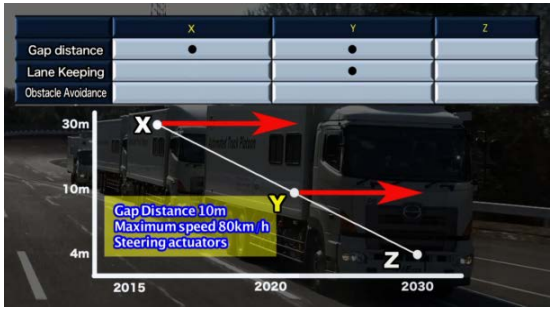


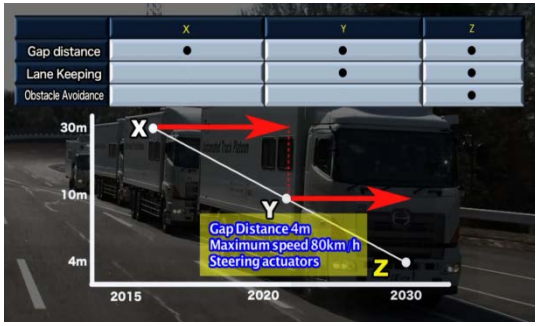




❑ Concept X, Y and Z: 4 min.







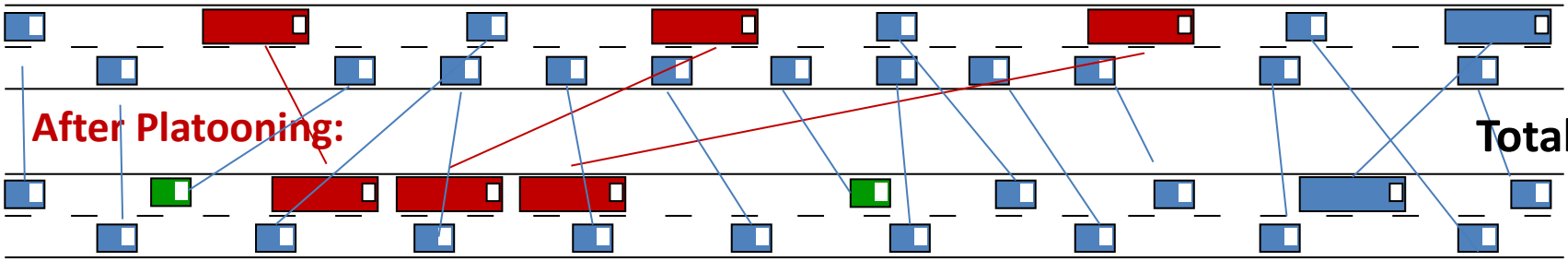
❑ Estimate of CO2 Emission Reduction by Simulation

- Roadway: Tomei Expressway, Tokyo area, about 100 km
- Traffic flow: light vehicles 69%, heavy vehicles 31%
- Platoon rate: 40% of heavy trucks

Speed	Gap	Micro effect (less aero drag)	Macro effect (capacity increase)	Total
80 km/h	10 m	2.0 %	0.1 %	2.1 %
	4 m	3.5 %	1.3 %	4.8 %

❑ Capacity Increase by Space Reallocation

Before Platooning:



: Truck to be in Platooning

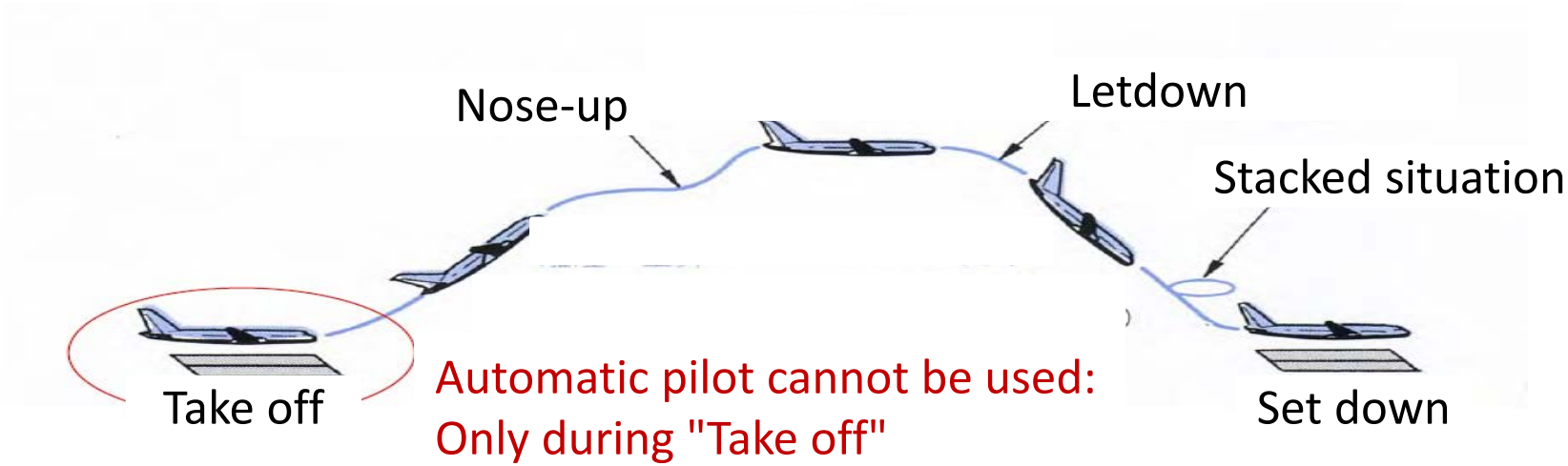
: Car in the same lane

: Truck not to be in Platooning

: Car changing the lane

❑ Automatic Pilot of Airplanes

- Annual flight time of a pilot of international flights: 800 - 900 hours and manual flying by a pilot: around 3 hours (Flight Daily News, 9 Sep. 2009)



- Role of a pilot: Supervisory control (Inagaki 2014)

❑ Authority and Responsibilities

- Airplane

A pilot takes the final responsibility for the safety of aeronautical systems.
Therefore, a pilot has to gain control (have the final say).

(Billings 1997; Inagaki 2012)

- Automobile

Driving is an absolutely driver-centered activity.

(Inagaki 2014)

- Agreements convention on road traffic in Vienna, 1949 and 1968

A driver has to control the vehicle at all times...etc.

❑ 5 Levels of Vehicle Automation, NHTSA, US

- **No-Automation (Level 0):** The driver is in complete and sole control of the primary vehicle controls at all times.
- **Function-specific Automation (Level 1):** Automation at this level involves one or more specific control functions.
- **Combined Function Automation (Level 2):** This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions.
- **Limited Self-Driving Automation (Level 3):** Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions
- **Full Self-Driving Automation (Level 4):** The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions.

NHTSA: National Highway Traffic and Safety Administration

❑ Applicable Scope of Automated Driving

NHTSA level	Safety in careless driving	Safety in drowsy driving	Driving load reduction	Energy saving	Traffic flow improve -ment	Comfort enhance -ment
0: No-Automation						
1: Function-specific Auto.	++	+	+			
2: Combined Function Auto.	++	+	+			
3: Limited Self-Driving Auto.	++	++	++	+	+	+
4: Full Self-Driving Auto.	++	++	++	++	++	++

❑ Issues for Practical Application of Automated Driving Technologies

- **Establish safety and reliability**
  - ✓Develop and demonstrate "Performance of perception and judgment" to be the same, or more than that of a driver
  - ✓Develop and demonstrate "Reliability" to be the same, or more than that of a driver
- **Acquire social receptivity**
  - ✓Make clear the scope of responsibility between a driver and a system
  - ✓Build consensus on safety among people
- **Ensure compliance**
  - ✓Study the relationship with "Agreements in Geneva and/or Vienna", "Road Traffic Act (Japan)" and "Safety Standard (Japan)"

❑ "Automated Driving System" Nominated in SIP

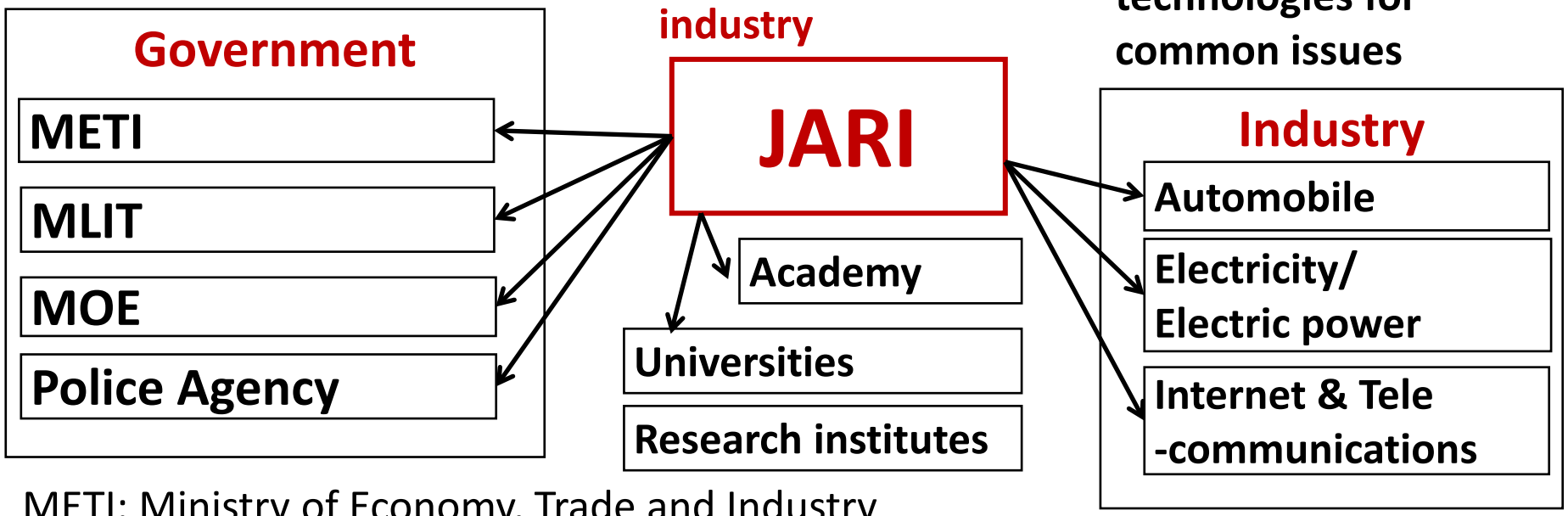
- A new cross-ministry Strategic Innovation Promotion (SIP) program in JFY2014 was launched by the Japanese government.
- 10 candidate technology fields including "Automated driving system for dodging accidents and minimizing traffic congestion" were selected.
- SIP budget in JFY 2014 is 51.7 billion Japanese yen (517 million US dollar).

<Note> This is a summary from translations of a Nikkei Newspaper article - September 12, 2013 and a Japanese government cabinet office website article - September 13, 2013

Contribution to policy making

Role to connect government and industry

Assessment tests/ technologies for common issues



METI: Ministry of Economy, Trade and Industry
MLIT: Ministry of Land, Infrastructure, Transport and Tourism
MOE: Ministry of the Environment

❑ ARV: Augmented Reality Vehicle

JARI's Driving simulator

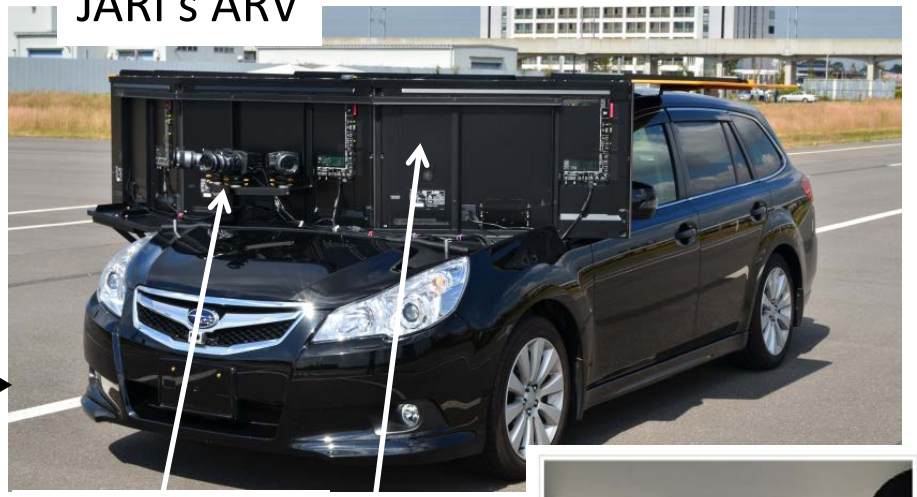
Virtual

JARI's All-purpose test road

Real

Fusion

JARI's ARV



3 Cameras

Display

Forward display view

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THANK YOU

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