Innovation for Electric Vehicles in Japan

Utilizing Chances in Electric Vehicle Industry



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CBI Partners Cross Border Implementation

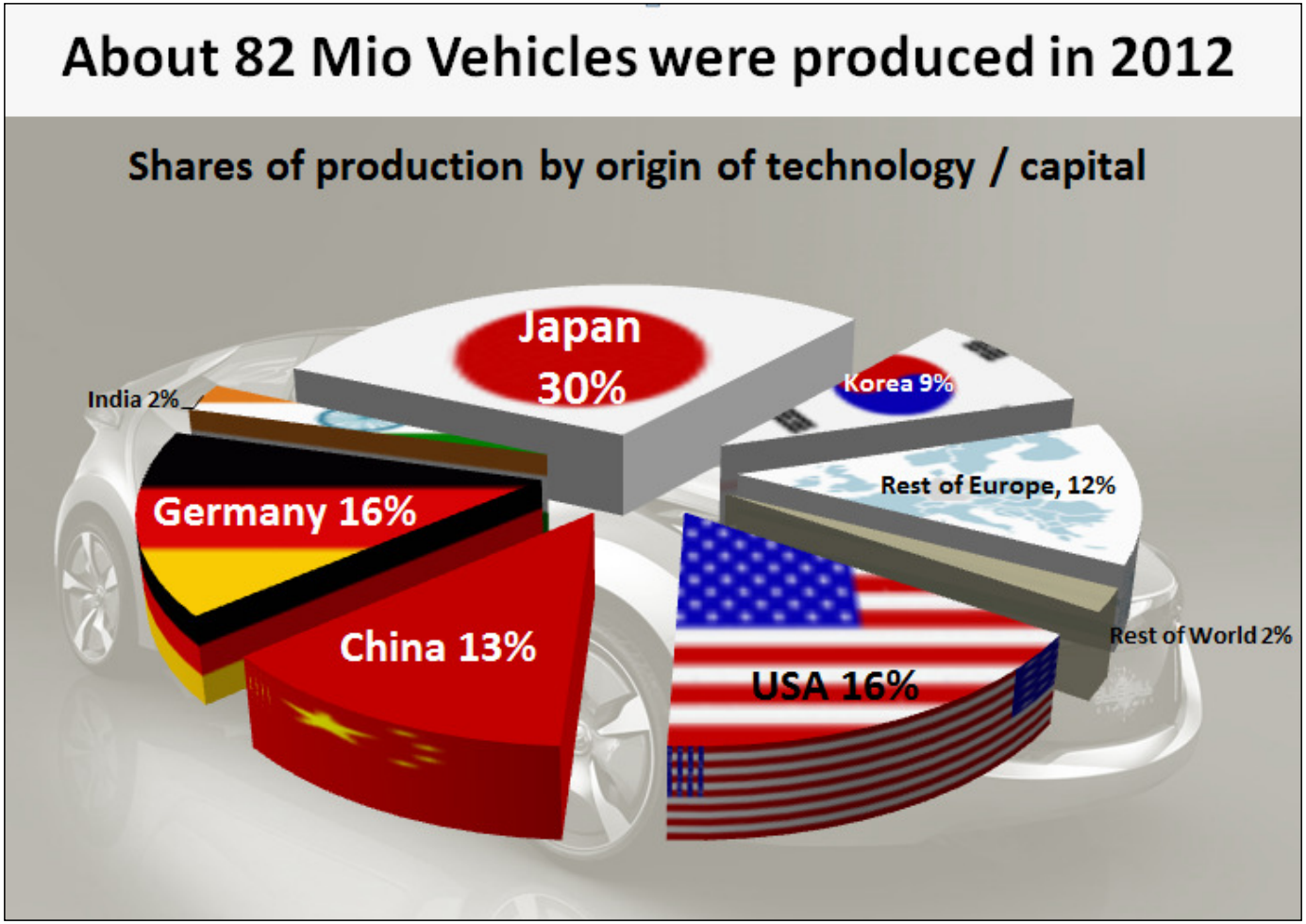
Introduction

Japan is the most successful country in the fields of Electric vehicles and HEVs

- Why Japan was successful?
- Which direction will be the future trend of Japanese EVs?
- What is the supporting innovation concept?

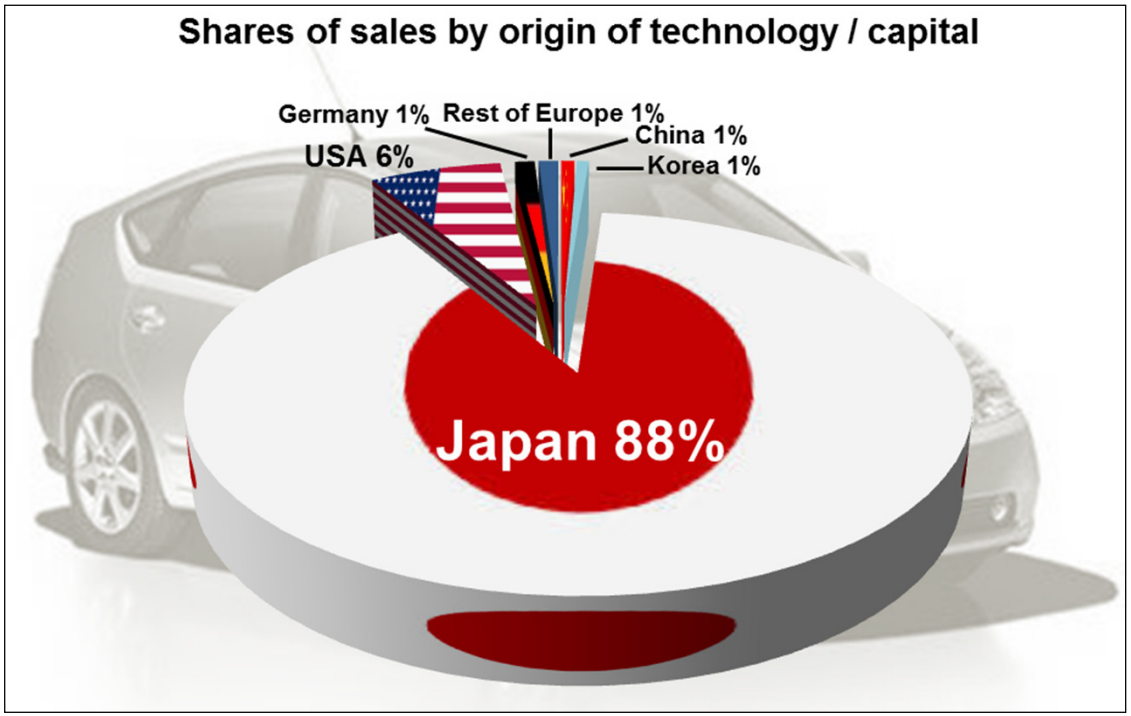
Opportunity of cooperation between European countries and Japan should be discussed

Shares of global production 2012



(Source: Marklines)

Global Shares of EV&HEV Sales 2012



- ~1.6 Mio. units HEVs and EVs sold in 2012 worldwide!
- ~1.4 Mio. units were Japanese brands!
- ~900 000 units sold in Japan!

(Source: Marklines)

Japan is the biggest producer and consumer market for EVs & HEVs

Why Japan was successful in the field of EVs and HEVs ?

Government, OEMs and Suppliers all played a vital role with their efforts in the early stage

- Japanese people have suffered from big air pollution in 1960's and damaged economically by oil shock in 1973
- Fundamental research and development activities (science and industry) have been done continuously from 1970's supported by the government
- Decision of car OEMs to go for EVs and HEVs

These early decisions and efforts led to todays Japanese advantage in EV & HEV technology

Brief history of Japanese EV development (pre-commercialization)

- **Japanese Government**
  - The Ministry of International Trade and Industry (MITI) aligned the approach combined all activities and spent
    - 40 mil. Euro for development of EVs in the 80's
    - 70 mil. Euro for development of Li-ion battery in the 90's
- **Developments 1980 – 1990**
  - Invention of Ne-Fe magnet (1982) and Li-ion battery (1986)
  - In 1990, IGBT was commercialized in Japan
- **California Mandate for ZEV at 1992**
  - Pushed Japanese car industries because the biggest share in California was Japanese automobiles

Government, OEMs and Suppliers all played a vital role with their efforts in the early stage

Comparative Example

As Japan regarding E-mobility, the German government started in the end of the 1980's to resolve and establish several laws and regulations to liberalize the energy sector

Because of these early deregulations Germany became one of the leading countries in renewable energy



Early decisions and initiatives by government and/or industry are essential for success

Brief history of Japanese EV development (after commercialization)

Toyota Hybrid (1997)

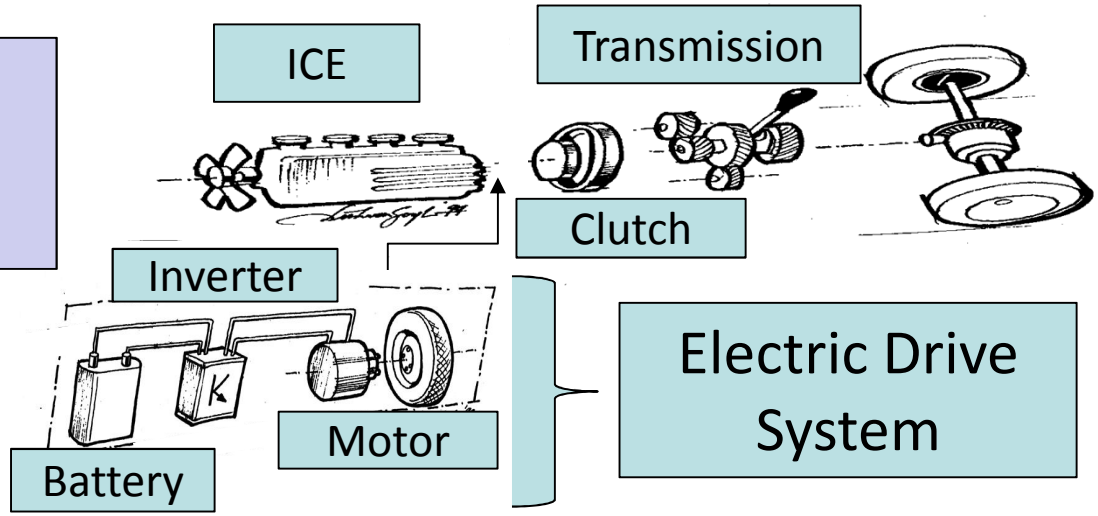
Mitsubishi i-Miev (2008)

Nissan Leaf (2009)

Decisions of executives in each company played a big role in commercializing EVs and HEVs

Structures of HEV & EV

HEV
Electric Motor assisted

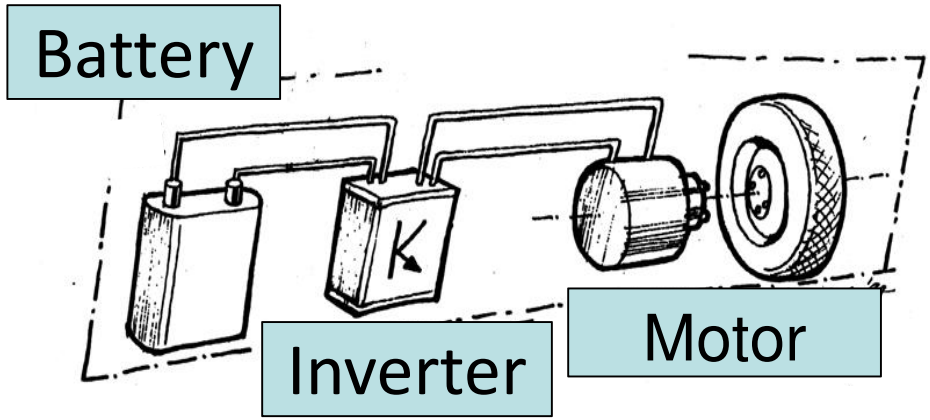


EV

Beside a battery, the electricity source can also be

- Fuel Cell
- ICE Generator (Range Extender)

The systematic is basically the same



Which technology will survive ?

Not necessarily the "best" technical solution survives!

Other Key Success Factors have to be met

- **Consumer orientated** - usability, service
- **Production orientated** - low production costs, easy to make
- **High efficiency** - running costs, energy consumption

Technologies succeeded as a combination of these factors:
LCD display (against plasma), ICE & TGV against Linear Magnet

Evaluation of technology

	HEV	EV		
		Pure battery	Range Extender	Fuel cell
Usability	+++	++	+++	+
Efficiency	++	+++	+++	++
Simplicity	++	+++	+++	+

Comparison of Efficiency

Electric Power

from several Energy Sources

Electric Battery (plug-in)

Efficiency 95%

Hydrogen Production

Efficiency 50 - 60%

Fuel Cell

Efficiency 70%

Overall Efficiency 30%

Future trend of EVs and HEVs

- The evaluation of technology shows that currently EVs with range extender seems to be most promising.
  E.g. BMW i3 with range extender goes in a good direction.
- In-wheel motor has a 30 % higher efficiency
- Only considering optimization of total drive system will create the best electric vehicle

Li-Ion Battery, Ne-Fe Magnet, IGBT invented and developed so far are enough to realize the high-performing EV

Structural Elements of Platform

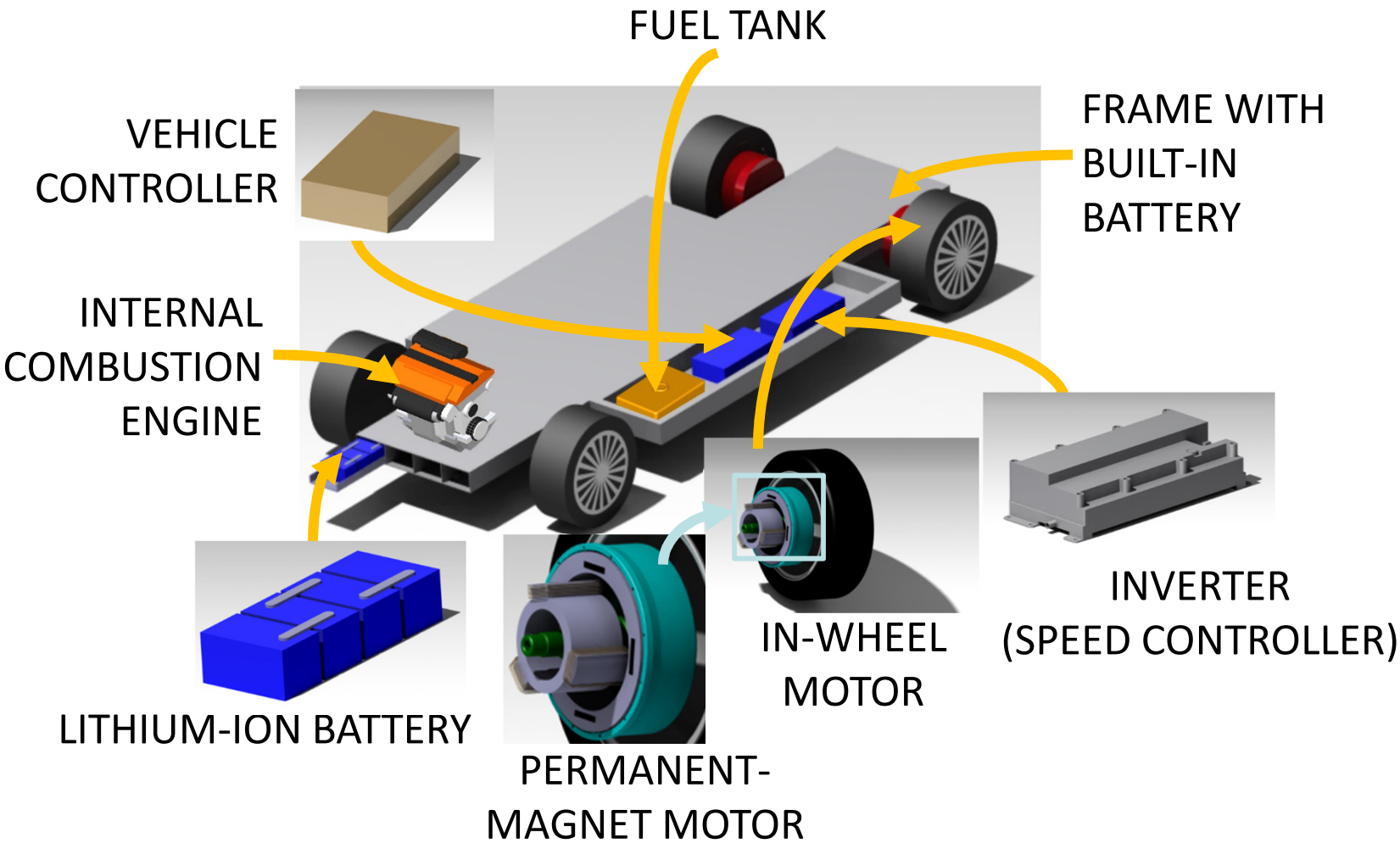
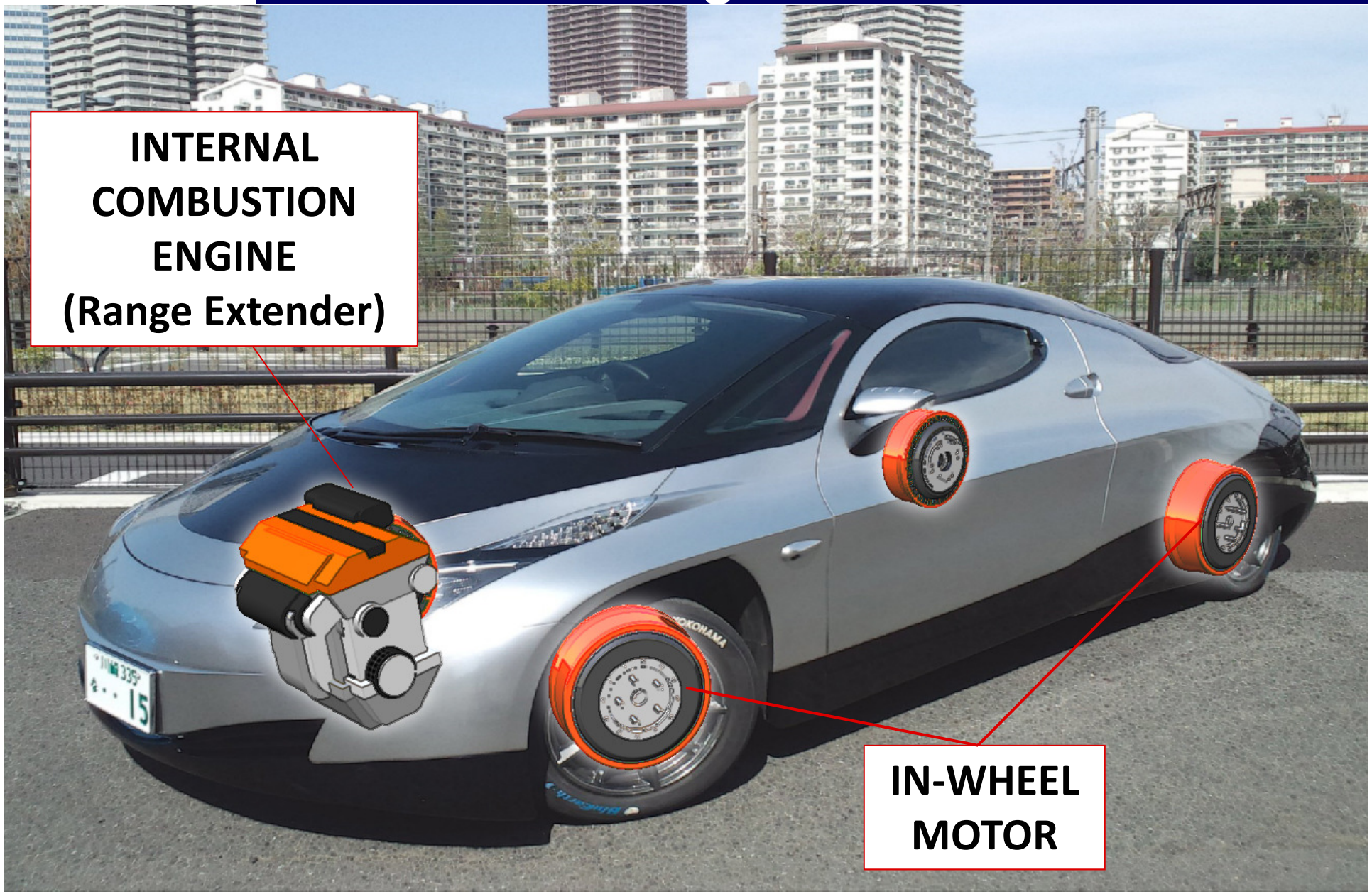


Image of an EV with In-wheel motors and a range extender



Strategies of Japanese OEMs

- Toyota
  Development of all types of technology by themselves
- Honda
  HEV and fuel cell are main target
- Nissan
  Keep selling Leaf more and construct charging stations
- Mitsubishi
  Outlander with a new hybrid concept

All OEMs have their own EV/HEV approach with different directions

Strategies of Japanese Suppliers

Also the Japanese automotive suppliers are leading in most of EV-related technologies and knowhow

546 Suppliers for EV components worldwide - 177 from Japan (32%)

Source: Marklines

The suppliers have the intention to grow and globalize their business:

- Tier 1 suppliers
- Major material and component suppliers (such as battery, Ne-Fe magnet and new electric devices)
- Raw material producers

Japanese suppliers want to expand their market shares in Europe

Status of power electronics devices

New Transistor devices will increase the performance of EVs from the view points of energy efficiency and the size of an inverter .
SiC and GaN will be the best candidates.

- Japan steel have been developing the crystal of SiC.
- Rohm and Toyota is going to commercialize SiC device.
- Panasonic, Fujitsu and other venture companies have been developing GaN devices.

Collaboration to develop and commercialize new Transistor devices between European and Japanese companies will make a real opportunity.

Comparison European/Japanese Automobiles

	Europe	Japan
Fun to Drive/Drivability	Best	Fast Follower
Mechanical Technology	Best	Fast Follower
Electronics and Material Technology	Fast Follower	Best
Quality	High	Best

Europe and Japan can complement each other

Glass-wall between European and Japanese Industry

- Currently only limited exchange of technology
- The mega-players in the (automotive) industry, suppliers and makers, have developed their own approach in Europe and Japan.
- There are glass walls between Europe and Japan in EV industry because many of the normal supply channels are not established yet

Benefits & Targets of European/ Japanese Cooperation

Customers Markets

- Combining the 2 leading markets to one potential
- Access to European or Japanese Makers in China, Asia and USA
- Achieving critical scale of business faster

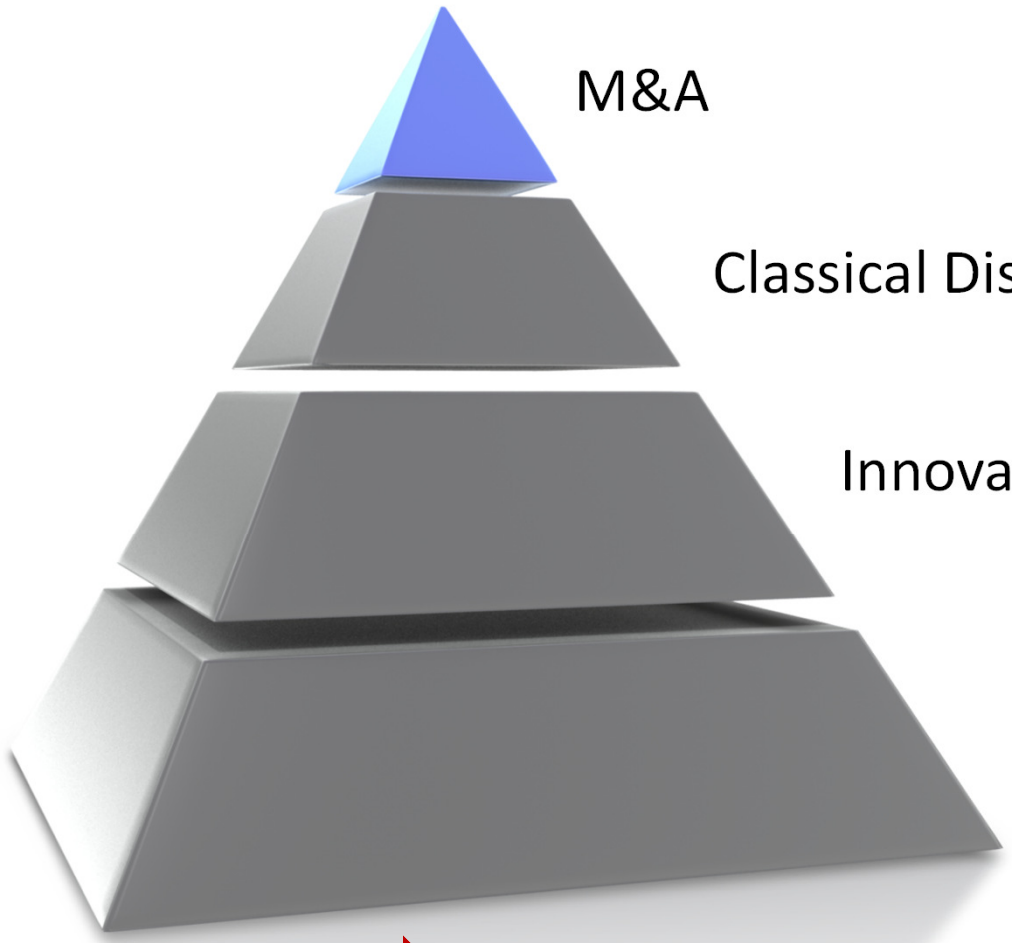
Technology

- Easier to create global leading standards and norms
- Sharing R&D cost
- Utilizing technology leadership of other country

Society

- European and Japanese approach to environmental technologies is complementary = High commitment to Kyoto
- Common work on EV increases maturity of both countries
- Mentality is close and will even become closer

How to participate in the Japanese Market



Success across Borders

How to establish exchange between Europe and Japan?

Europe | **Japan**

To overcome the glass-wall and reach the targets,
a common platform is necessary

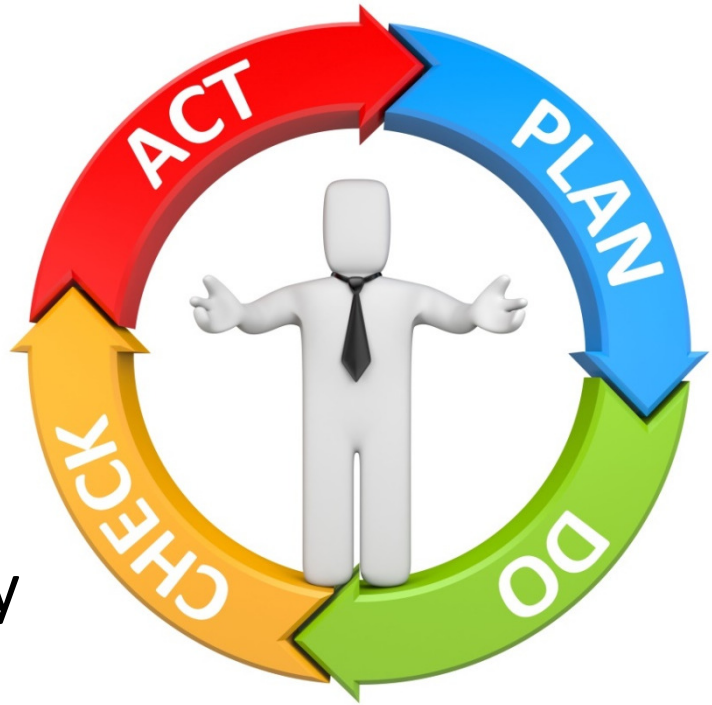
Participating companies & organizations

Participating companies & organizations

Using different information channels and instruments (symposiums, workshops, newsletters, delegations) to align organizations and business between Europe and Japan

Next Steps

- Find a facilitator
- Create a collaboration scheme between Europe and Japan soon
- Implement the scheme
- Create benefits for all participants and with it substantial progress in E-mobility

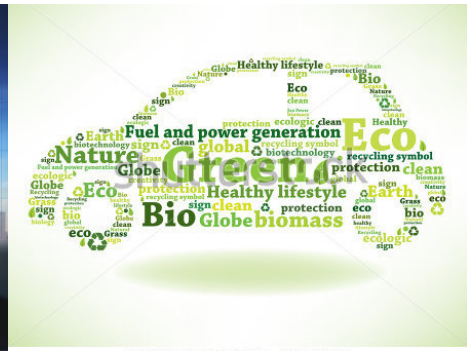


It is essential that a certain number of participants will join

Final Target

- Developing the next generation vehicle
  - High performing and environmental friendly
  - Capability have to enough to be accepted in the society
- Distribute the vehicle to all over the world
- People in the world should have comfortable mobility and sustainable environment



Collaboration between Europe and Japan are the key of developing mobility for the global future

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