kama 한국자동차산업협회
Korea Automobile Manufacturers Association

Challenges of Future Cars

Government-Industry Collaboration

Tae-Nyen Kim
Vice President
Korea Automobile Manufacturers Association

* Presented at the 14th Jeju Forum for Peace and Prosperity, Jeju, South Korea, May 29-31, 2019, http://www.jejuforum.or.kr/m21_program.php?year=2019

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Introduction

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Global Megatrends & Paradigm Shift

Climate Change & GHG Reduction

A number of countries introducing stricter CAFE regulation
Decarbonization – Phasing out the ICEs

Air Pollution & Public Health

VW Dieselgate
Air Quality Issues – PM, PN, NOx, SOx

Industry 4.0 and ICT Convergence

Hyper-Intelligent/Hyper-Connectivity
Self-driving Technology
New business Model: Mars, ACES

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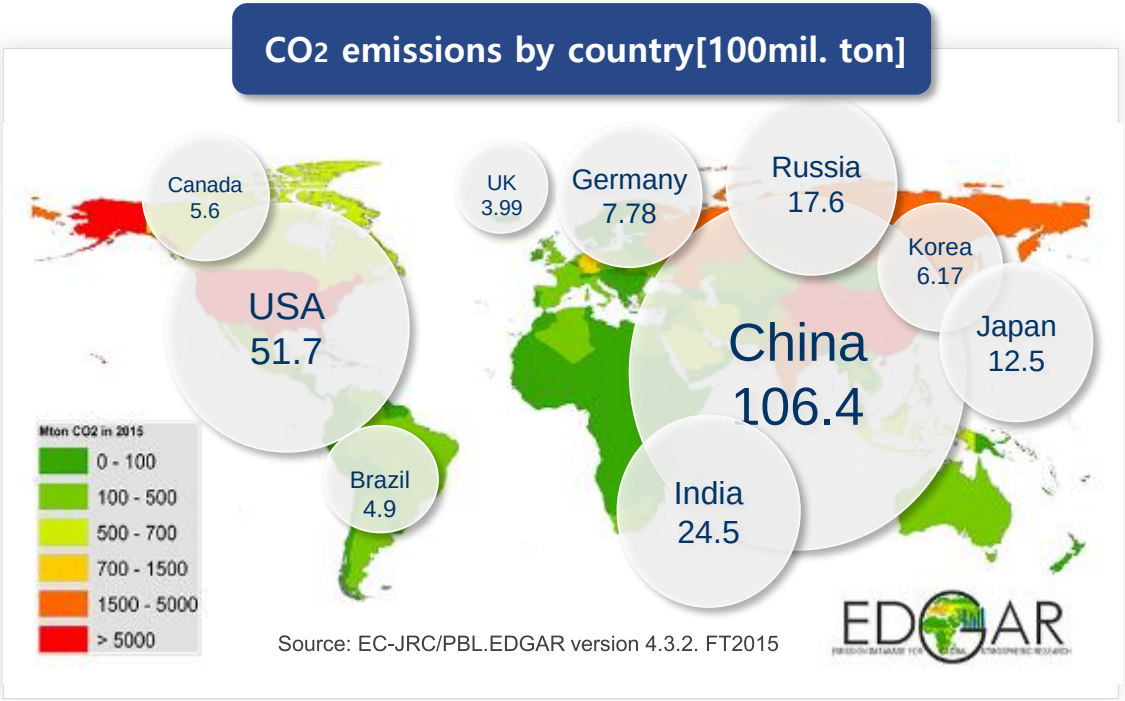
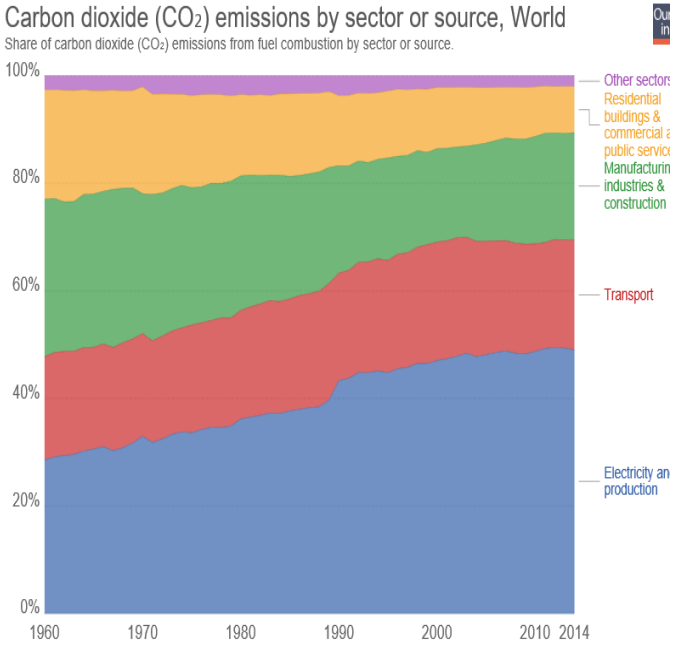
GHG Emission Reduction

Increasing Global CO_2 emissions - 36.2 billion tons in 2015

For sustainable growth, global collective efforts are required.





Source : EDGAR, WHO

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Electricity Production by Fossil Fuels (2016)

(Unit : TWh)

Country	Coal	Ratio(%)	Petro.	Ratio(%)	Gas	Ratio(%)	Total	Ratio(%)
China	4,241.8	68.2	10.4	0.2	170.5	2.7	4,422.6	71.1
USA	1,354.0	31.4	34.8	0.8	1,418.1	32.9	2,806.9	65.0
India	1,104.8	74.8	23.4	1.6	71.2	4.8	1,199.5	81.2
Russia	171.4	15.7	11.0	1.0	521.8	47.8	704.2	64.5
Japan	349.4	33.7	84.5	8.2	406.5	39.2	840.4	81.1
Canada	62.1	9.3	8.2	1.2	62.0	9.3	132.4	19.8
Germany	273.2	42.2	5.8	0.9	82.3	12.7	361.3	55.8
Brazil	25.7	4.5	15.3	2.6	56.5	9.8	97.5	16.9
Korea	234.7	41.8	17.8	3.2	126.6	22.5	379.0	67.5
France	10.5	1.9	2.5	0.5	34.9	6.3	47.9	8.6

IEA 「Electricity Information」

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Stricter Environmental Regulations

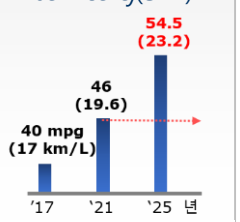
Strengthening CO2 regulations for wider supply of eco cars - 4 to 5% reduction annually

ZEV sales quota system, and purchase incentives for the expansion of ZEV demands

CO2 Emission Targets by Country

USA

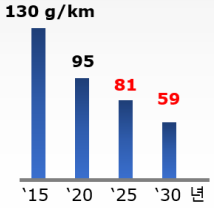
Fuel Efficiency(CAFE)



Trump administration rolled back the CO2 standard(Dec. 2018)

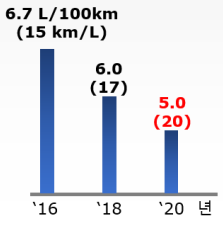
EU

CO_2 Emission



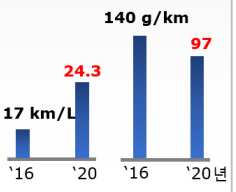
China

Fuel Efficiency



Korea

CO_2 / Fuel Efficiency



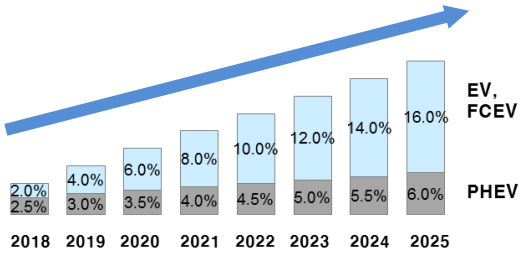
California, ZEV*

◎ **Objective**

1 mil. ZEVs by 2020, 1.5 mil. by 2025

- ZEV 4% quota in 19MY (2% increase every year)
- Penalty: $5,000 per credit
- 10 states are participating including California, Oregon and New York, etc.

< ZEV yearly quota>



* ZEV: Zero Emission Vehicle

China New Energy Vehicle (PHEV/EV/FCEV)

◎ **Objective**

5 mil. NEVs by 2020

- 30% of public procurement for green cars
- FCEV subsidy(200,000 yuan) remains until 2020, while EV/PHEV subsidy is phasing out

◎ NEV Credits

	PHEV	BEV		FCEV	
AER	50	250-350	350	250-350	350-
가중치	2	3.8-6	5-6	4	5

◎ NEV yearly quota

Year	2019	2020
Case #2	10%	12%

* Companies with an annual production/import volume less than 50,000 are exempted

Source : Hyundai Motor Company

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Global Market Trend & Perspective

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Eco-Car Market Trend

Global BEV sales reached 1.3 mil., while FECVs exceeded 5,000 in 2018. The annual growth rate of FCEVs hit 172%, far higher than BEVs' 64%.

(Units, %)

Types	2013	2014	2015	2016	2017	2018	Annual Growth Rate
Total vehicle Sales ('000)	84,481	86,284	89,099	93,030	95,277	94,899	2.4
HEV	1,558,319 (29,110)	1,622,666 (34,641)	1,471,219 (39,064)	1,744,370 (62,305)	2,024,224 (84,673)	2,173,573 (93,144)	6.9 (26.2)
BEV	108,625 (780)	159,798 (1,075)	277,492 (2,907)	444,243 (5,914)	738,299 (13,826)	1,283,229 (31,696)	63.9 (119.3)
FCEV	34	19	498	2,219	3,330 (22)	5,059 (730)	172.0 (3218.2)

Source : KAMA, OICA, Markline
Note: ( ) New registration in Korea

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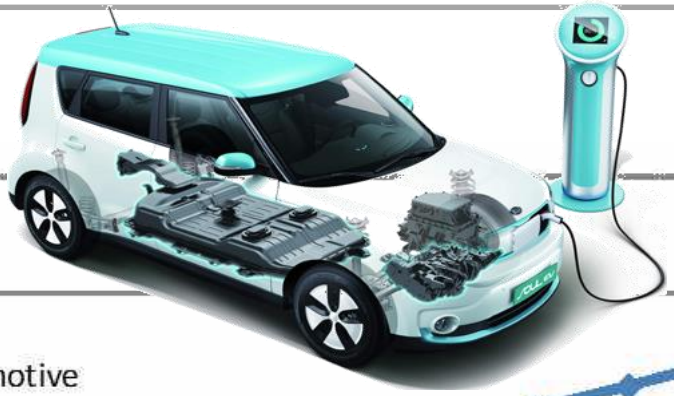
BEV Market Forecast

BEVs accounted for only 1.4% of vehicles registered globally in 2018. It is expected to reach up to 21% M/S in 2030 with an 40% annual growth rate.



Source : IHS Automotive, Bloomberg, Continental Automotive

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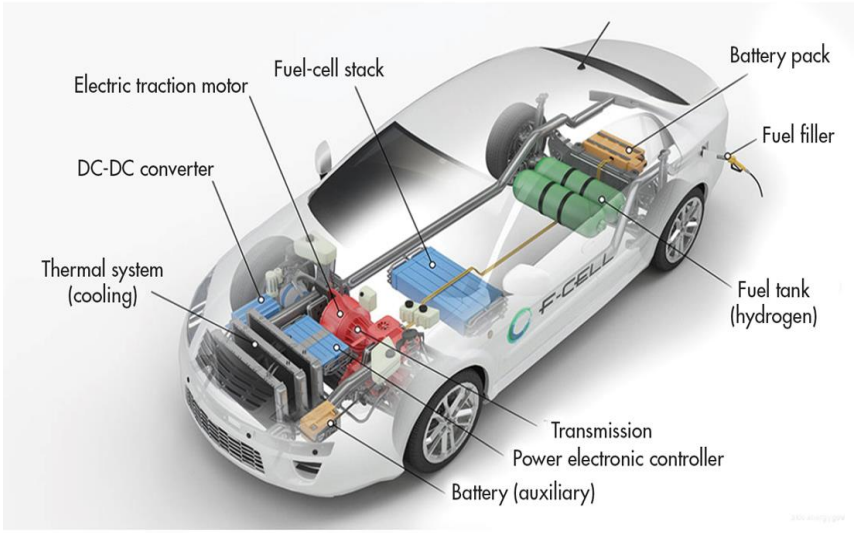
FCEV Market Forecast

FCEVs have had a slow start due to high prices and lack of infrastructure, but in the long term, the on-going support and commitments from policy makers and the automotive industry' efforts will help reach 8 mil. in 2050.



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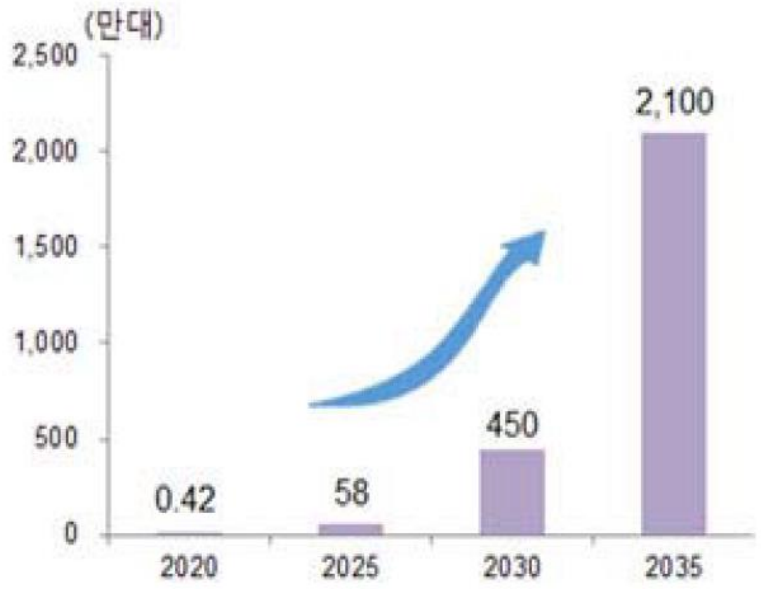
Source : Meckinsey report(2018)

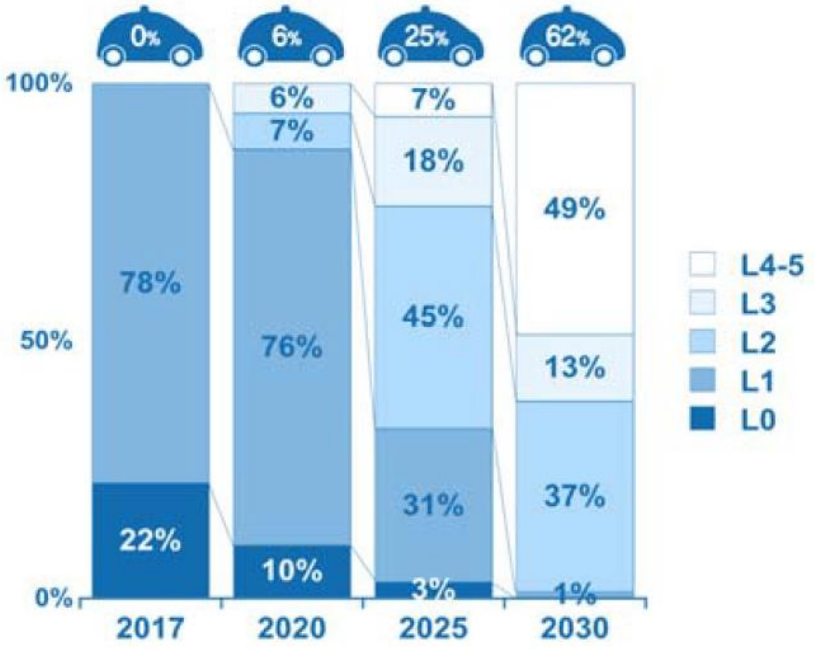
AV Market Forecast

The initial market for autonomous vehicles will be established in less regulated countries (US and Europe).
Global demands of level 4/5(Highly or fully automated) will be 4.5 mil. In 2030, accounting for around half of all levels of autonomous vehicle sales.

(10 thousand units, %)



Global autonomous car market forecast with level 4 & 5



Global autonomous car's market share forecast by level

*Source : IHS, PwC

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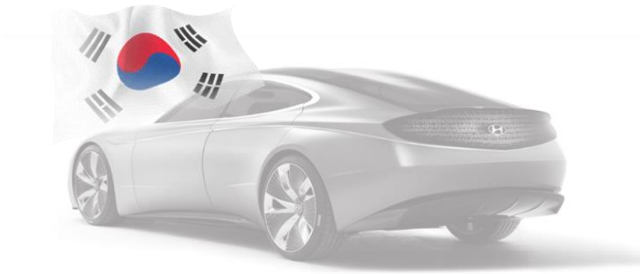
Future Car Development in Korea



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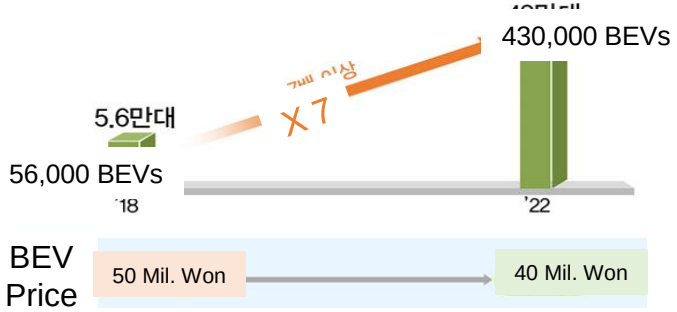
BEVs

- **CBUs** 'Ioniq', all-electric model, was developed in 2016.
  → Most recent model 'Kona EV' with a driving range of 406km
- **Parts** World-leading EV battery manufacturers in Korea
  → Samsung SDI, LG Chem.
- **Supply** Accumulated 56,000 BEVs by Dec. 2018
  → 430,000 BEVs by 2022
- **Charging Stations** 3,800 fast chargers by Dec. 2018
  → 10,000 fast chargers by 2022(1,500 per year)
- **Subsidy** Max 9 mil. Won per vehicle
  → Phasing out by 2022

<BEV supply target in Korea(Accumulated)>



<BEV Registration in Korea>

Types	2011	2012	2013	2014	2015	2016	2017	2018	Total
Units	338	753	780	1,075	2,907	5,914	13,826	31,696	57,289

<Comparison of EV Models sold in Korea>

EV Models	Driving Distance (km)	Battery Capacity (kWh)	Purchase Subsidy (₩10,000)
Hyundai Kona EV	406	64	1,200
Kona EV(Light)	254	39.2	1,200
Hyundai Ioniq EV(HP)	200	28	1,127
Hyundai Ioniq EV(PTC)	200	28	1,119
Kia Soul EV	180	30	1,044
GM Korea Chevrolet Bolt EV	383	60	1,200
Renault Samsung SM3 Z.E.	213	36	1,017
BMW i3 94Ah	208	33	1,091
Tesla Model S P100D	424	101.5	1,200
Tesla Model S 100D	451	101.5	1,200
Tesla Model S 75D	359	87.5	1,200

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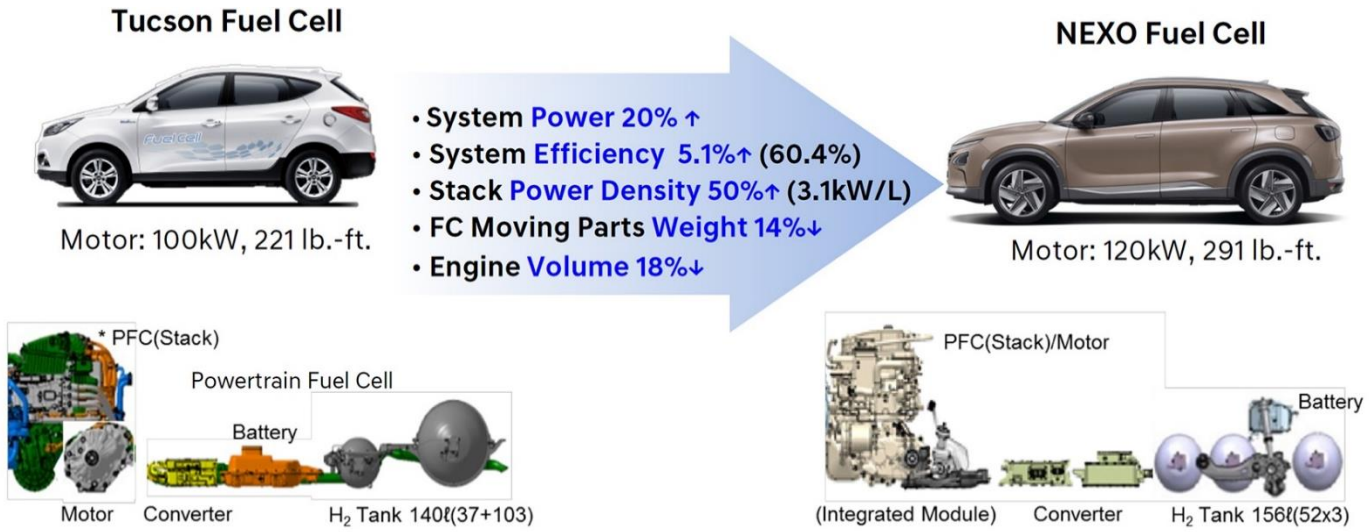
Source : Korean Government Press Release (Dec. 2018), Hyundai Motor Company

FCEVs

- **CBUs** The world's first mass-produced FCEV, ix35, released in 2013. 'NEXO', the world's first all dedicated hydrogen powered SUV delivering a range of 609km(373 miles) released in 2018.
- **Parts** 99% localization of FCEV parts → Localization planned for core parts, including fuel cell stack and storage tank, currently underway
- **Supply** Accumulated 900 FCEVs by Dec. 2018 → long-term target : 2.75 million FCEVs by 2040
- **Charging Stations** 14 stations (2 in Seoul) by Dec. 2018 → target : 1,200 stations by 2040
- **Subsidy** Central Government 22.5 million won, additional local government subsidy (Daejeon 13.0, Seoul 12.5, Gyeongnam 10.6 mil. Won, etc.)



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Source : Government Press Release (Dec. 2018), Hyundai Motor Company, Ministry of Environment

AVs

Automobile Industry

Hyundai Motors developed level 2 automation technology and are targeting commercialization of level 3 autonomous vehicles by 2020.

- established Safety Technology Center exclusively dedicated to the R&D of self driving.
- announced joint development and technical cooperation with US autonomous vehicle company, Aurora, in Jan. 2018.

Hyundai Mobis started trial driving of level 3 autonomous vehicles, and are targeting commercialization of level 4 or 5 autonomous vehicles by 2022.

Mando started trial driving of autonomous vehicles with self-manufactured radar and camera, and established R&D center in Bangalore, India.

ICT Industry

Samsung acquired world-renowned automotive electronics maker, Harman Int., and started trial driving autonomous vehicles.

- formed 300 million dollar Innovation fund for the innovative technology of self-driving automotive electronics
- took over shares of the Austrian self-driving startup, TTTech, started technical cooperation of self-driving operation system company, Renovo Auto.

LG applied for 147 patents for self-driving technology in Nov., developed V2X self-driving technology based on LTE.

- started massive investment by establishing Joint R&D center with Qualcomm for 5G V2X.

Naver developed a platform for the level 4 self-driving technology in 2018

- started 65 million dollar joint investment with Israel LiDAR maker, Innoviz Technologies

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* AV Competitiveness

Major companies from the USA, Europe and China rank higher than Korean companies in AV competitiveness

- Korea is highly dependent on imports of core parts due to lack of LiDAR, RADAR, CAMERA and relevant software technologies.
- Even with world-level ICT and infrastructure technologies, the lack of vehicle-parts-ICT inter-industrial cooperation is the major challenge in developing autonomous vehicles.

Company	Technologies
NVIDIA	- Introduced an AI Xavier in collaboration with Audi - Commercialized autonomous computer for CVs with ZF - Developed map solution for AVs with HERE
Mobileye	- Developed Autonomous system with Delphi & Intel - Developed HD map for autonomous car with HERE
Google (Waymo)	- Commercialize full autonomous cars by 2020 - Recorded 10 mil. Mile of autonomous driving - Recorded the lowest driver engagement per 5,000 mile
Apple	- More focused on autonomous system than CBUs - Target tier-I supplier for AV systems
Uber	- Co-develop full AVs in collaboration with Volvo - Plan unmanned taxi or trucks on autonomous system
Baidu	- Released commercial AVs in 2018 - Plan mass production of AVs by 2021 - Developed AI-assisted auto driving cars

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Recommendations

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Government & Industry Collaboration

Government

Infrastructure Set-up

- Build up large-scale charging/fueling stations for EVs and FCEVs in collaboration with local governments at an early stage.

Financial incentives

- Maintain financial incentives enough to make up the loss of auto makers due to low profits incurred by small demand in the beginning.

Regulatory Assistance

- Introduce future car-favorable laws and regulations aligned with significant changes in technology, parts, materials, process, design and logistics.

R&D Support

- Implement supportive policies for the start-ups and SMEs as a priority for core parts and technology development.

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* Subsidy for BEV/FCEV

<Central Government>

Max. Million won

BEV			FCEV
Passenger Cars		9	22.5
Mini Cars		4.2	-
Trucks	Below 1 ton	11	
	Light-duty	18	
Buses	Medium	60	
	Large	100	

<Local Government>

Max. Million won

	BEV	FCEV
Seoul	4.5	12.5
Busan	5	12
Daegu	6	n.a.
Incheon	5	10
Gwangju	6	10
Daejeon	7	13
Ulsan	6	10
Sejong	6	10
Gyeonggi	7	10
Gangwon	9.4	10
Chungbuk	8	10
Chungnam	10	10
Jeonbuk	6	13.5
Jeonnam	8	n.a.
Gyeongbuk	10	n.a.
Gyeongnam	8	10.6
Jeju	5	n.a.

Source : Ministry of Environment
* Excluding tax incentives

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** EV Subsidy by Model

Classification		Maker	Model	Vehicle Type	Sales (Units)	Subsidy per U (₩10,000/Unit)	Total Subsidy (₩100Mil.)
Local	Korean	Hyundai	Ioniq	Car	5,606	1,627	912
			Kona EV	Car	11,193	1,700	1,903
		Kia	Soul EV	Car	1,746	1,544	270
			Ray	Car	8	1,206	1
			Niro EV	Car	3,433	1,700	584
		R-Samsung	SM3 ZE	Car	1,235	1,517	187
		DaeChang Motor	Danigo	Mini	214	750	16
		Hyundai	Elec City	Large Bus	56	10,000	56
		Edison Motor	E-FiBird	Large Bus	15	10,000	15
		WooJin	ApoloBus	Large Bus	10	10,000	10
		Power Plaza	Labo Peace	Mini Truck	7	1,100	1
		Sub-total			23,523		3,954
	Import	GM Korea	Bolt	Car	4,722	1,700	803
		R-Samsung	Twizy	Mini	1,498	750	112
		Sub-total			6,220		915
Local Maker Total					29,743		4,869
Import	China	SemiSysco	D2	Mini	196	750	15
		BYD	e-Bus 7	Medium	20	6,000	12
		Hanshin Motor	Magnum	Large Bus	20	10,000	20
			Adeona	Large Bus	10	10,000	10
		Pline	Hypers	Large Bus	13	10,000	13
		Sub-total			259		70
	Germany	BMW	i3 94ah	Car	191	1,591	30
	USA	Tesla	Model S	Car	544	1,700	92
		Sub-total			735		123
Import Total					994		193
Grand Total					30,737		5,062

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Government & Industry Collaboration

Industry

Open Collaboration
- Expand joint R&D projects and exchange work forces with relevant industries including ICT to enhance the competitiveness.

Localization of Core Components
- Core parts with high dependency on imports should be localized for price competitiveness.

Set-up of Eco-system on a Virtuous Cycle
- Auto manufacturers and component suppliers should form a cooperative value chain for future mobility development.

  * Hyundai Motor and its suppliers will jointly invest 200 billion won for the development of FCEV cars for the next 2 years, aiming to achieve 30,000 annual sales by 2022 with a thousand jobs created.

Partnership with Global Leading Players
- Partnering with global advanced companies for the internalization of core technical know-how.

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Thank you

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