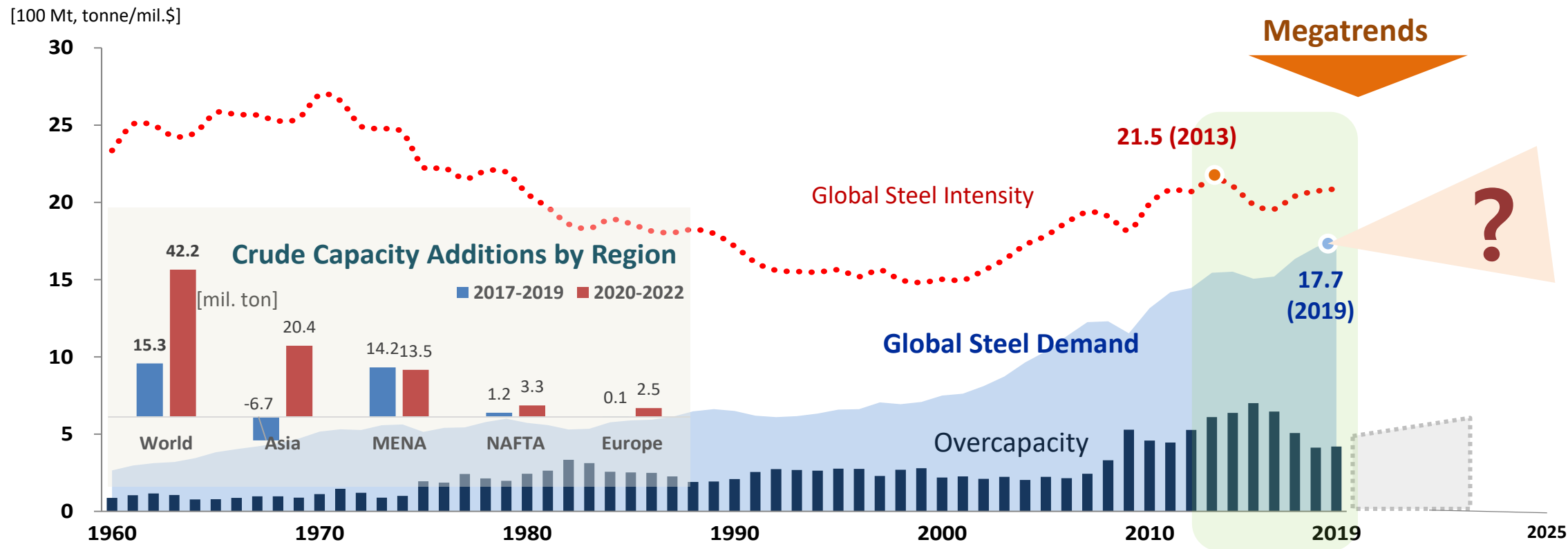


# How will Future Megatrends affect Steel Demand and Products?

OECD GFSEC-Steel Industry Special Event, March 17<sup>th</sup>, 2020

Dr. Jun H. Goh, Research Fellow, Steel and Economic Research Center

# Facing stagnant global economy and faltering steel intensity under excess capacity, will steel demand continue to increase with new and innovative products?



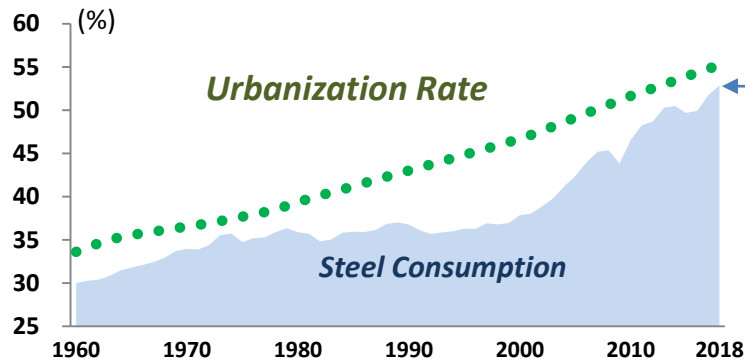
\* Global Steel Intensity = Global Steel Demand/World GDP, Overcapacity = Crude Steel Capacity – Crude Steel Production

Source: worldsteel, OECD Steel Committee, World Bank, POSRI

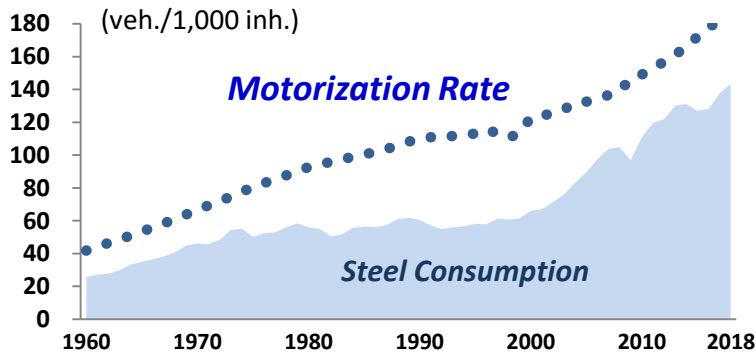
⇒ How will megatrends affect steel demand and products in the future?

Steel demand growth and development of the global steel industry has been led by four main drivers (trends) of steel-consuming industries

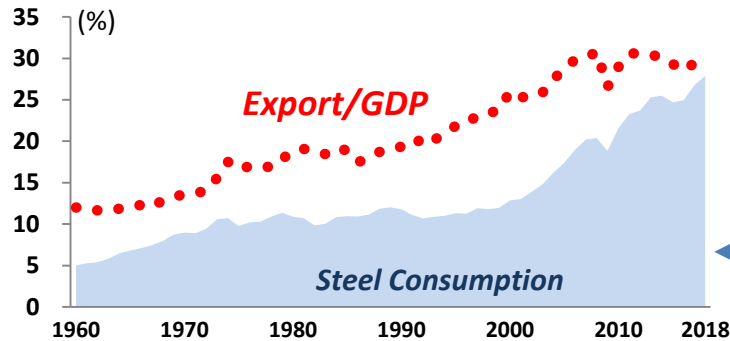
Urbanization



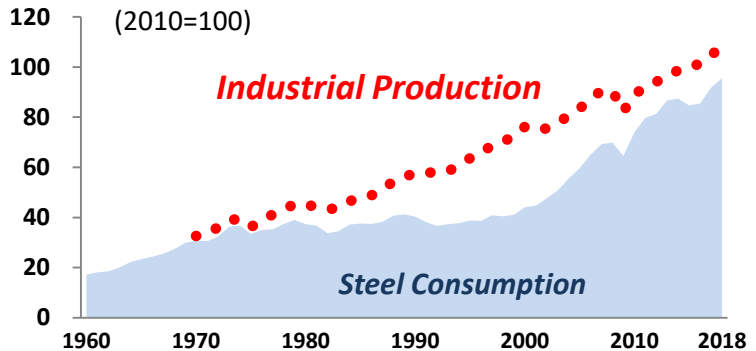
Motorization



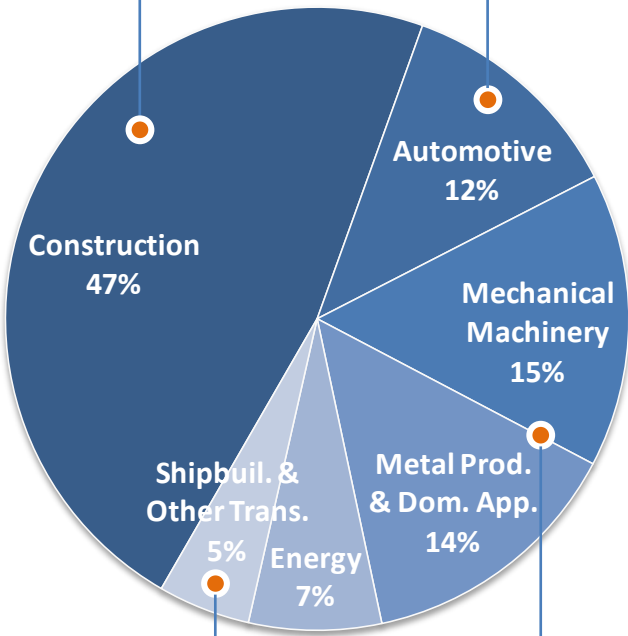
Globalization



Industrialization



[ Global Steel Demand by End-Use ] ('07-'18 average)



# Hyper-connected and hyper-intelligent Society will require steel-consuming industries to be smart with new biz. models and capabilities, as well as the steel industry

### Communication

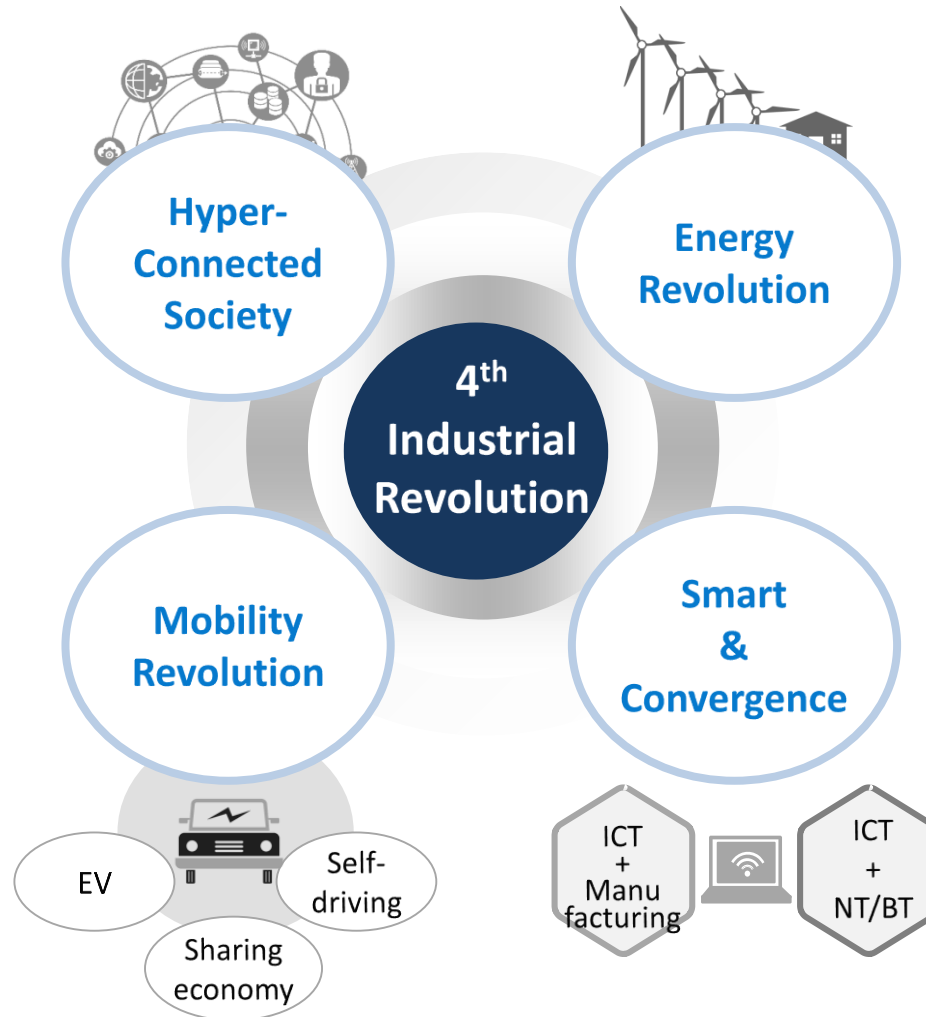
- Connection of people, things, & data
- Emergence of platform biz
- Stronger consumer power

- .....
- From 'own' to 'use'
  - Product life cycle↓, customer need↑

### Mobility

- EV value chain
- Self-driving system

- .....
- Combustion engine-based VC collapsed
  - Sharing economy (Car sharing)



### Energy

- New & renewable energy
- Battery & ESS
- Energy prosumer

- .....
- Global climate action

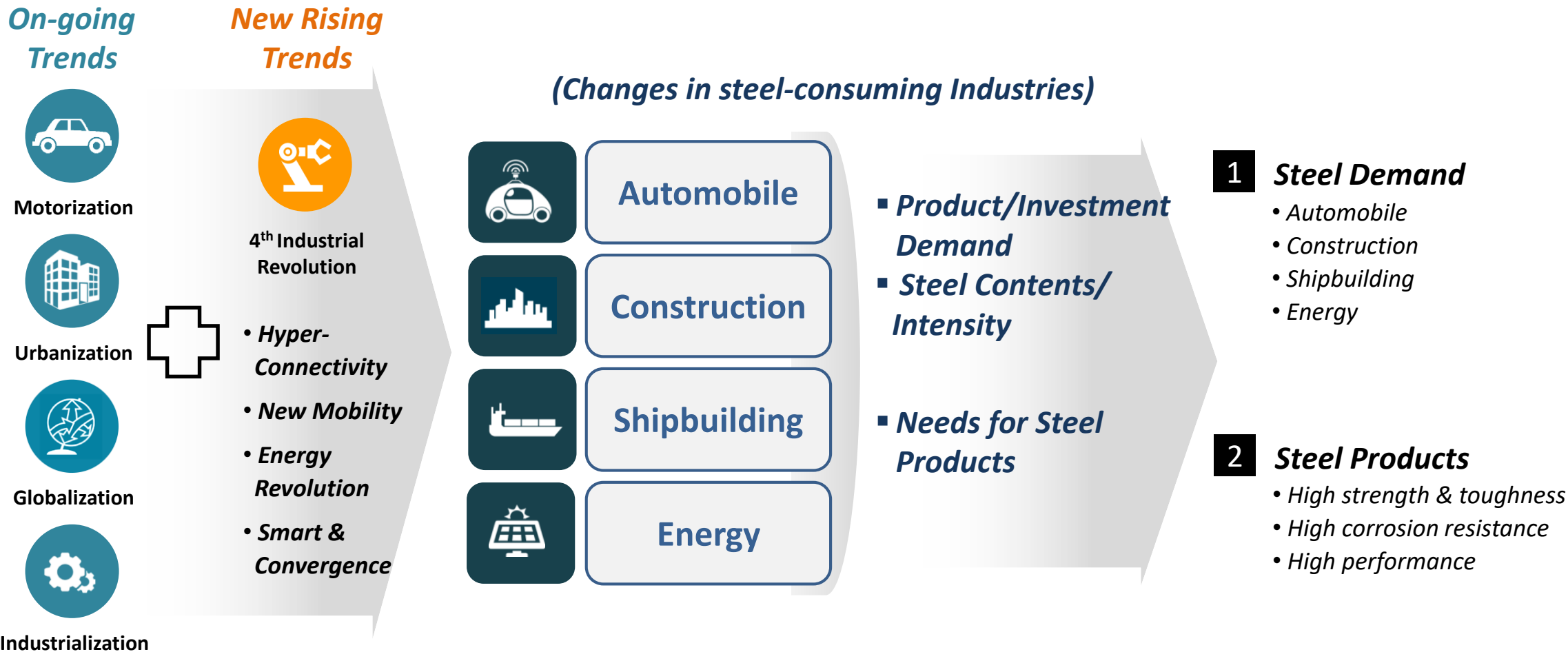
### Industry

- Smart manufacturing, Smart bldg. & city
- New convergence biz.

- .....
- High SW competitiveness
  - Invaders from other biz. areas

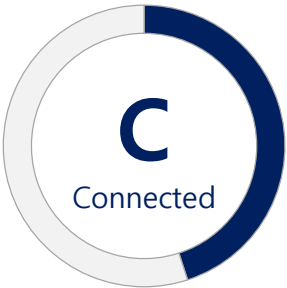


On-going trends and new rising trends will bring changes to the landscape of steel-consuming industries and steel demand & products

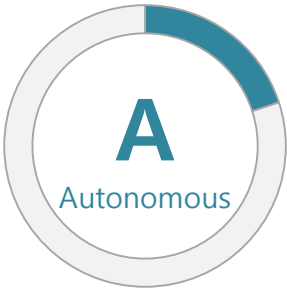


New mobility paradigm (EVs, autonomous cars, car sharing) brings changes to automobile demand, design and materials

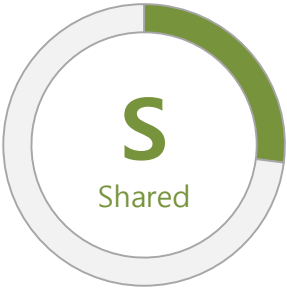
New Mobility Paradigm (In 2035)



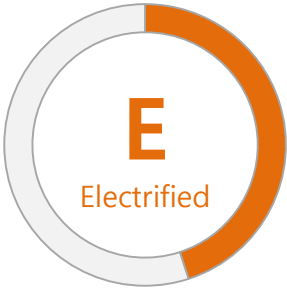
45%  
Preference-based  
personalization  
Enabled (>L3)



18%  
of new cars  
will be  
Level4-5  
autonomous



27%  
of mobility  
demand  
will be absorbed  
by mobility service



45%  
of new cars  
sold in 2035  
will be  
electrified

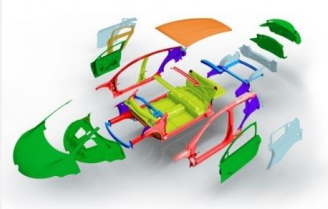
Impact



Car Sales



Design

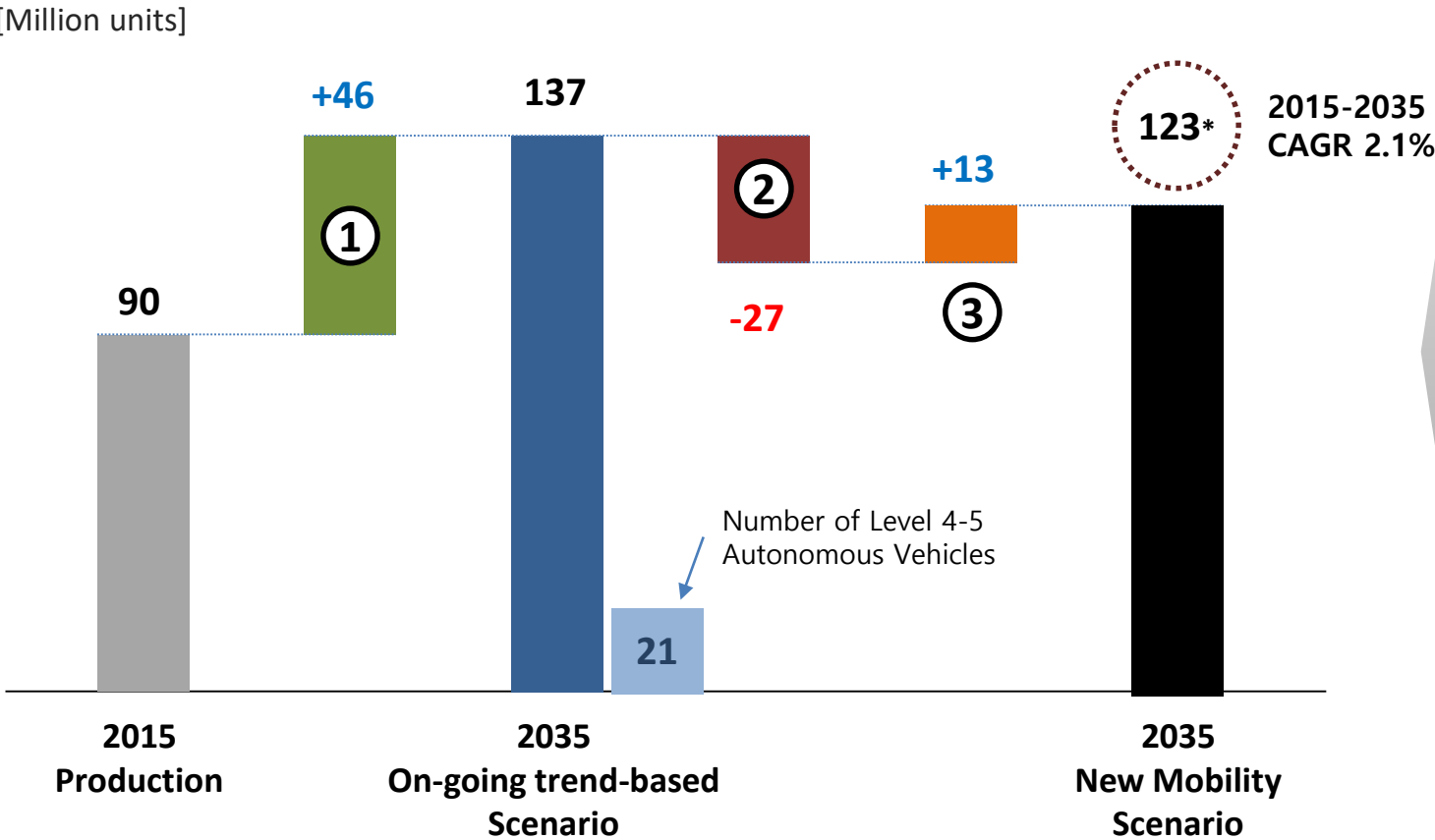


Materials

Source: McKinsey, IHS Markit, BNEF, Roland Berger

Demand for new cars will rise less than expected  
as the market gradually adopts autonomous driving technology and car sharing

Impact of New Mobility on Automobile Demand



- Motorization of emerging countries** ①
- Car sharing impact** ②  
Family-, ride-, car sharing combined with autonomous vehicle effect
- Increasing mobility** ③  
Low cost travel, teenagers, elderly (New mobility scenario)

New mobility platform design will emerge as electrification and mobility service develop – Newer passenger shell design, battery protection strategy

New Mobility Platform

EV Platform

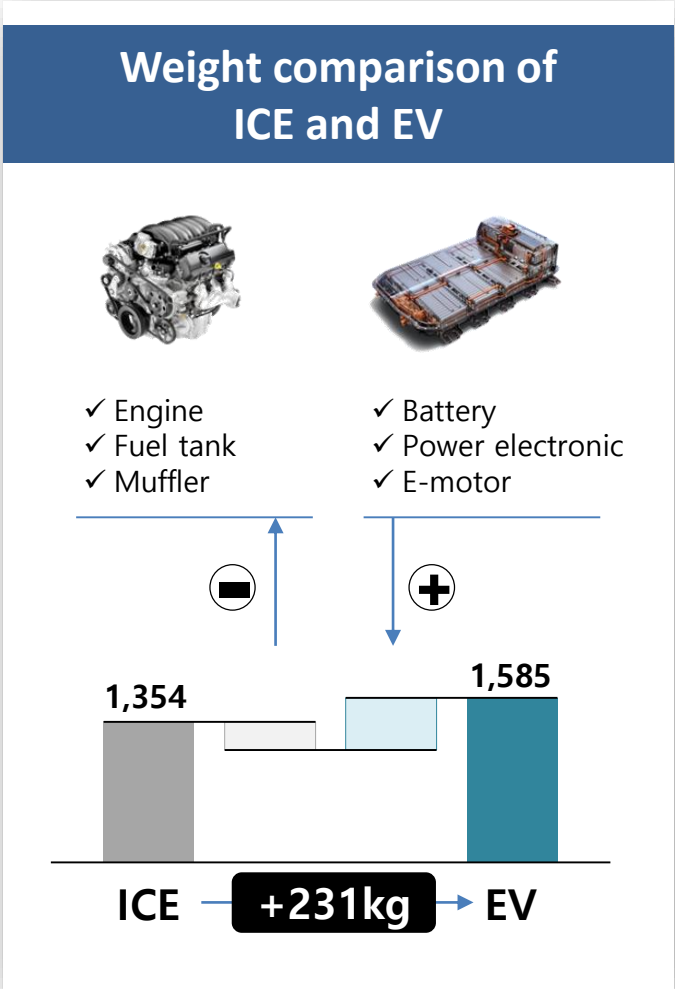


VW MEB platform

Smart Mobility Platform

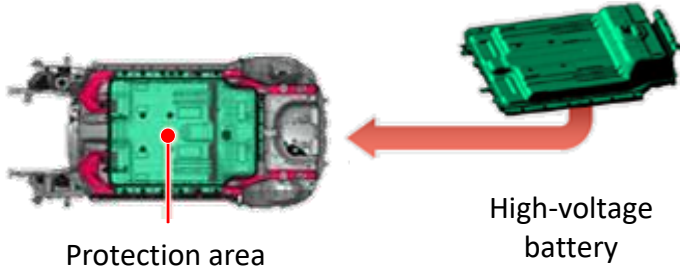


Toyota e-palette

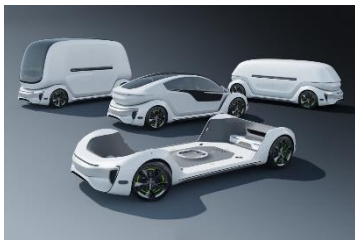


Source: RolandBerger, VW Golf example

Battery protection using high-strength materials



Changes in passenger/cargo shell design

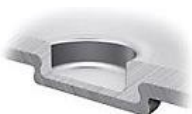


- New protection strategy
- Light modular cabin design



Advanced joining and forming technology allows automakers to use the right material at the right place which will bring the rise of the multi-material era

Development of various joining technology



Mechanical Joining

Clinching, punch Riveting, hemming, ...



Metallurgical Joining

Laser welding, friction welding, resistance welding,...

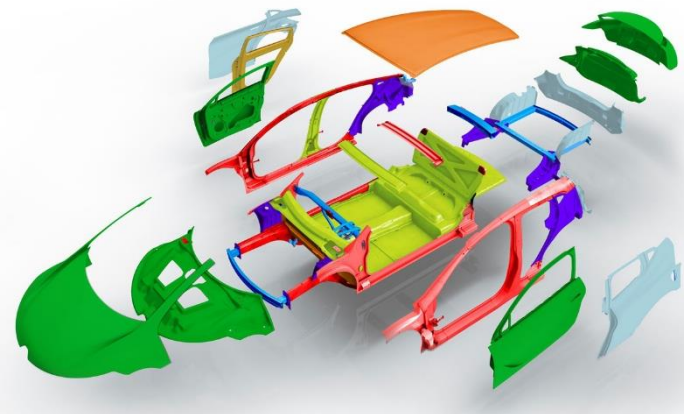


Chemical Bonding

Liquid, gel, tape, patch,...

Source: Audi

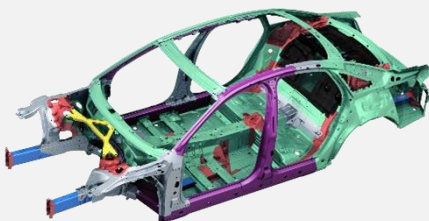
Rise of Multi-material Era



	Material	Cost (\$/kg)	Relative Strength	Relative Weight
	Mild Steel	0.8-1	1	1
	HSS	0.8-4	2.1	1
	Aluminum	1.7-6	0.9	0.34
	Magnesium	2-2.5	1	0.24
	Carbon fiber	15-30	1.7	0.2

Source: Renault EOLAB, BNEF

Audi A8 Body Structure



4th Gen. (2009)

ASF

Aluminum Space Frame

5th Gen (2017)

MSF

Multimaterial Space Frame

8%

Steel

40.5%

92%

Alu

58%

Mg

1.5%

Source: Audi

Steel intensity declines as automobile materials become lighter and stronger owing to stricter standards for fuel efficiency, electrification and safety issue

Lower Emission

CO<sub>2</sub> Emission Regulation [g/km]

- 141('15) → 100('25) → 60('35)
- 5~7% Weight reduction every 10 years

Lighter

Increasing Lightweight materials

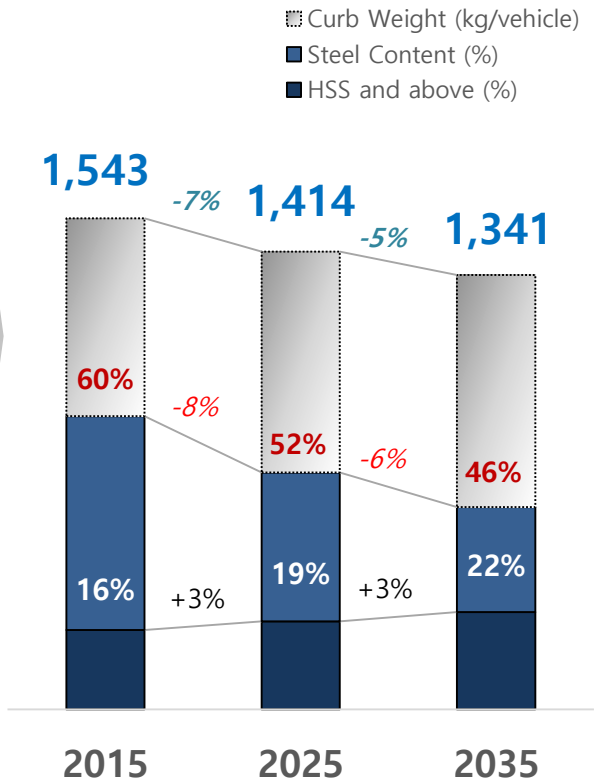
- AHSS, Aluminum, Composites
- Steel Content Reduction
- 60%('15) → 52%('25) → 46%('35)

Safety

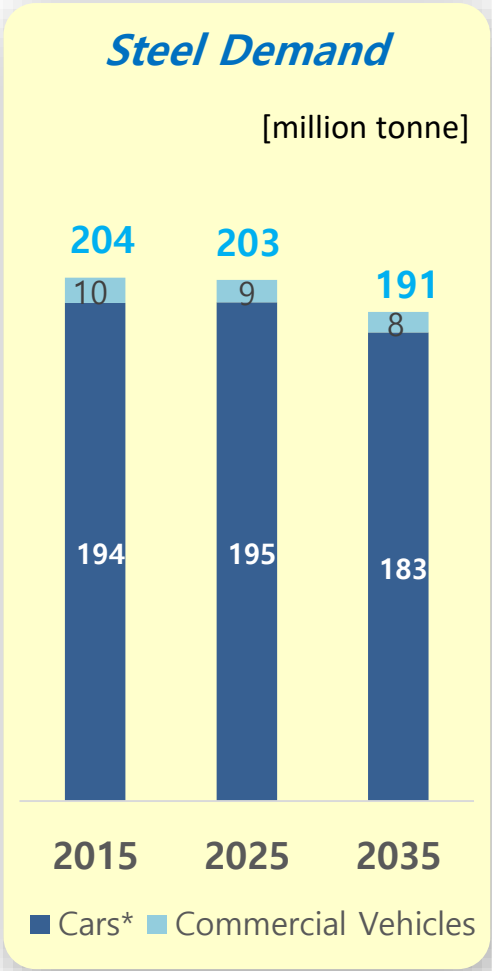
Higher Safety Standards

- High Strength Steel (HSS, AHSS, UHSS):
- 16%('15) → 22%('35) of vehicle total

Steel Content\* Per Vehicle

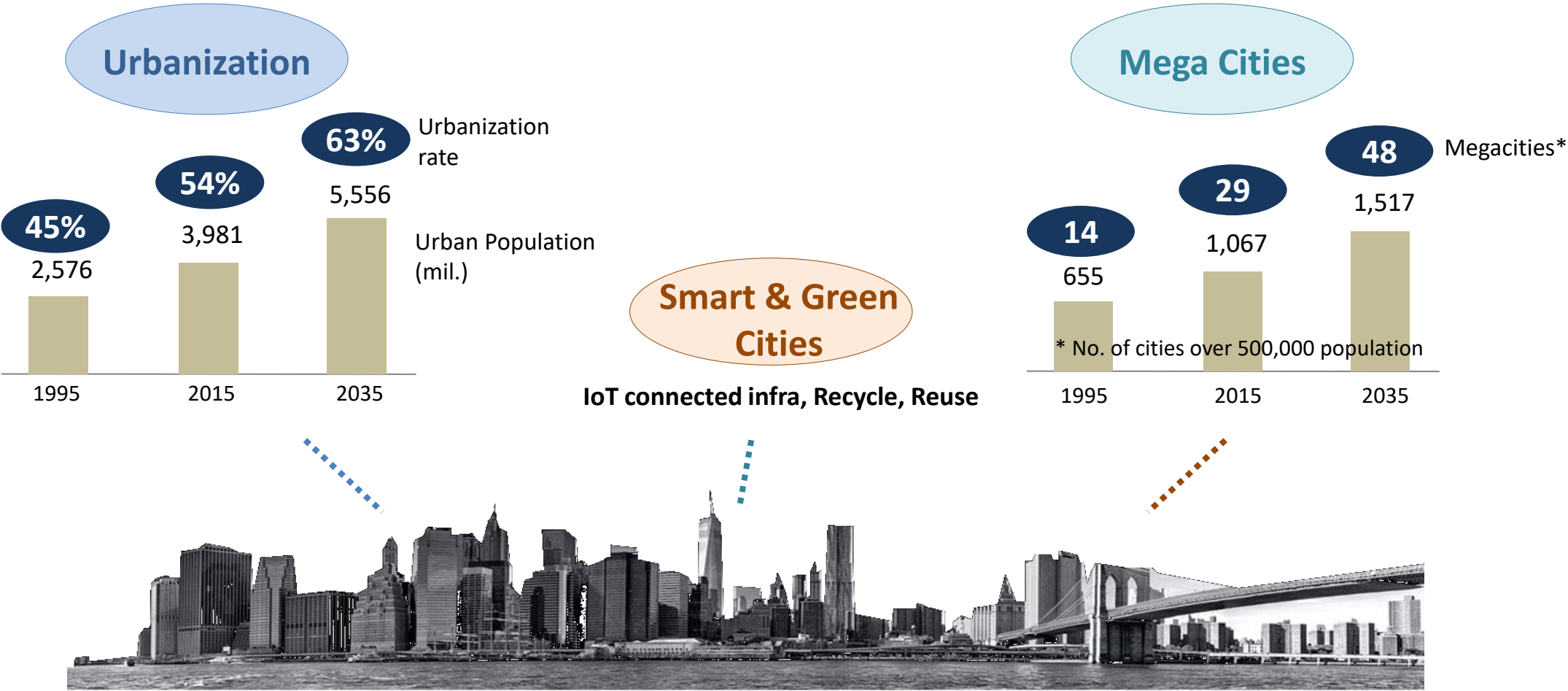


Source: POSRI




\* Steel Content: Finished Steel & Iron Products, Cars(Light Duty Vehicle): Curb weight under 6 ton

Under the trend of urbanization, cities will be transformed into Mega City, Smart and Green City in the future



Global steel demand for construction will rise by 2.3% each year for the next 15 years, due to fast growing construction investment though steel intensity declines

Urbanization



Share of material cost ↓, labor cost ↑

Fast-growing lower-intensity\* sector

\* infra, commercial, residential sector

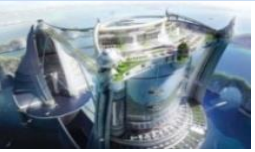
Smart & Green Cities



Super Structure (buildings/bridges)

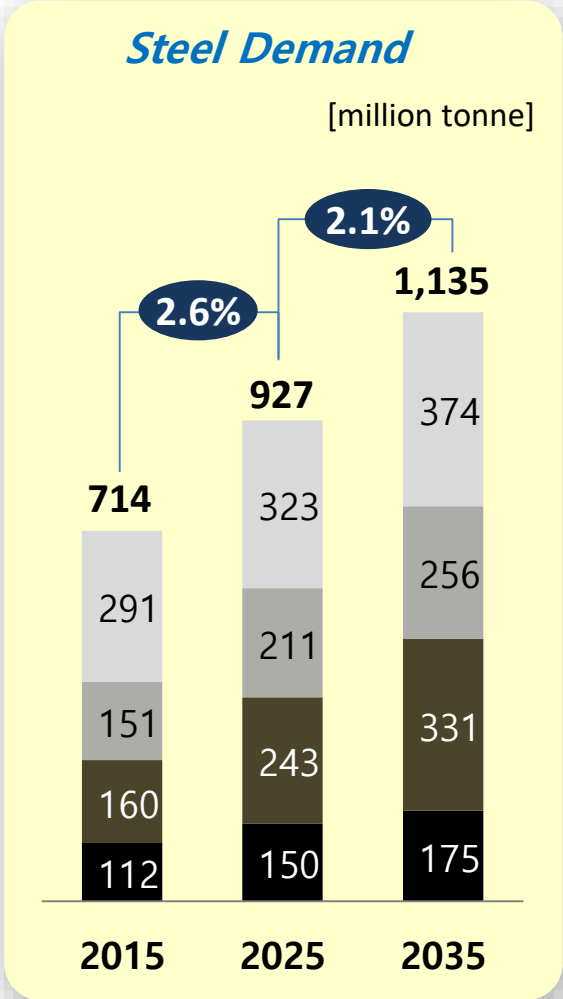
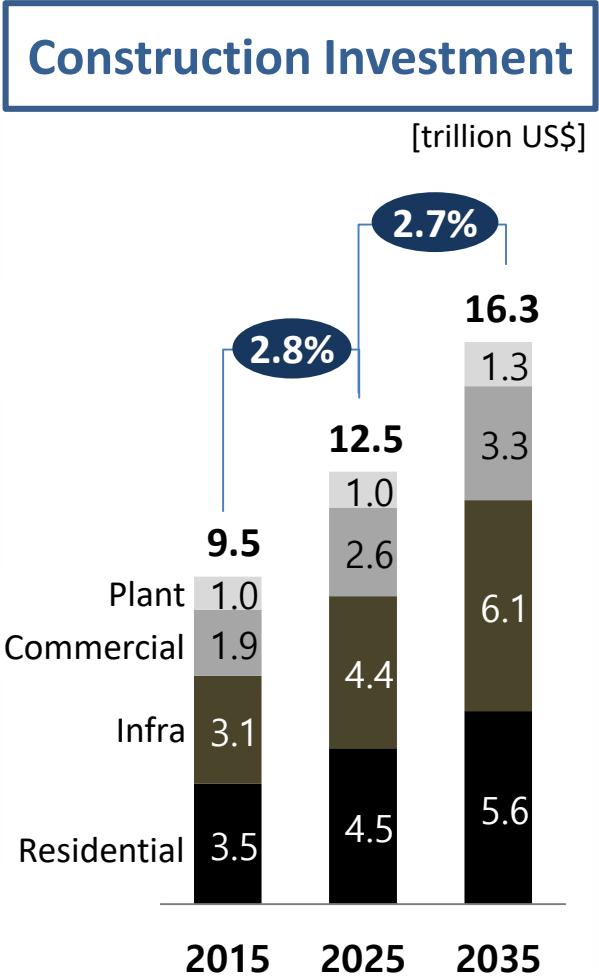
→ High strength steel ↑ Steel demand ↓

Megacities



Rising share of smartization cost

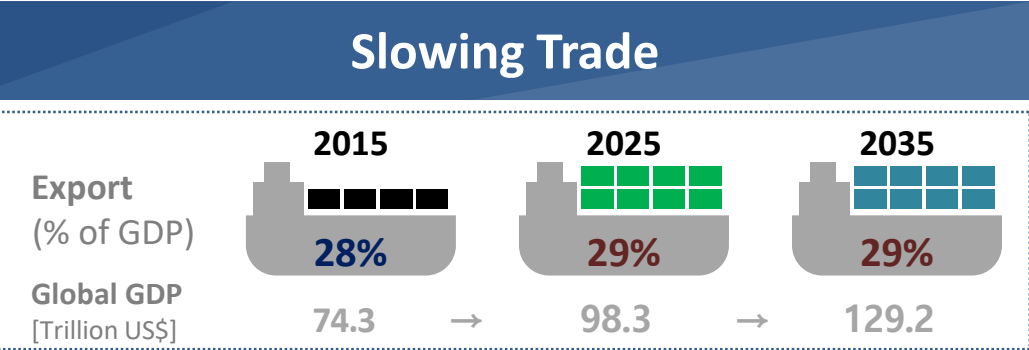
• IoT, sensors in intelligent structure



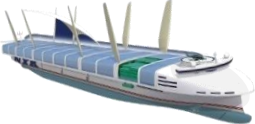
Steel Intensity: 100 ('15) → 95 ('25) → 89 ('35)


\*steel intensity [2015=100] = steel demand/construction investment (tonne/thousand US\$)


As deglobalization progresses, overcapacity will linger until 2025, meanwhile, eco-friendly natural gas trade will grow and eco- & smart ships lead the market



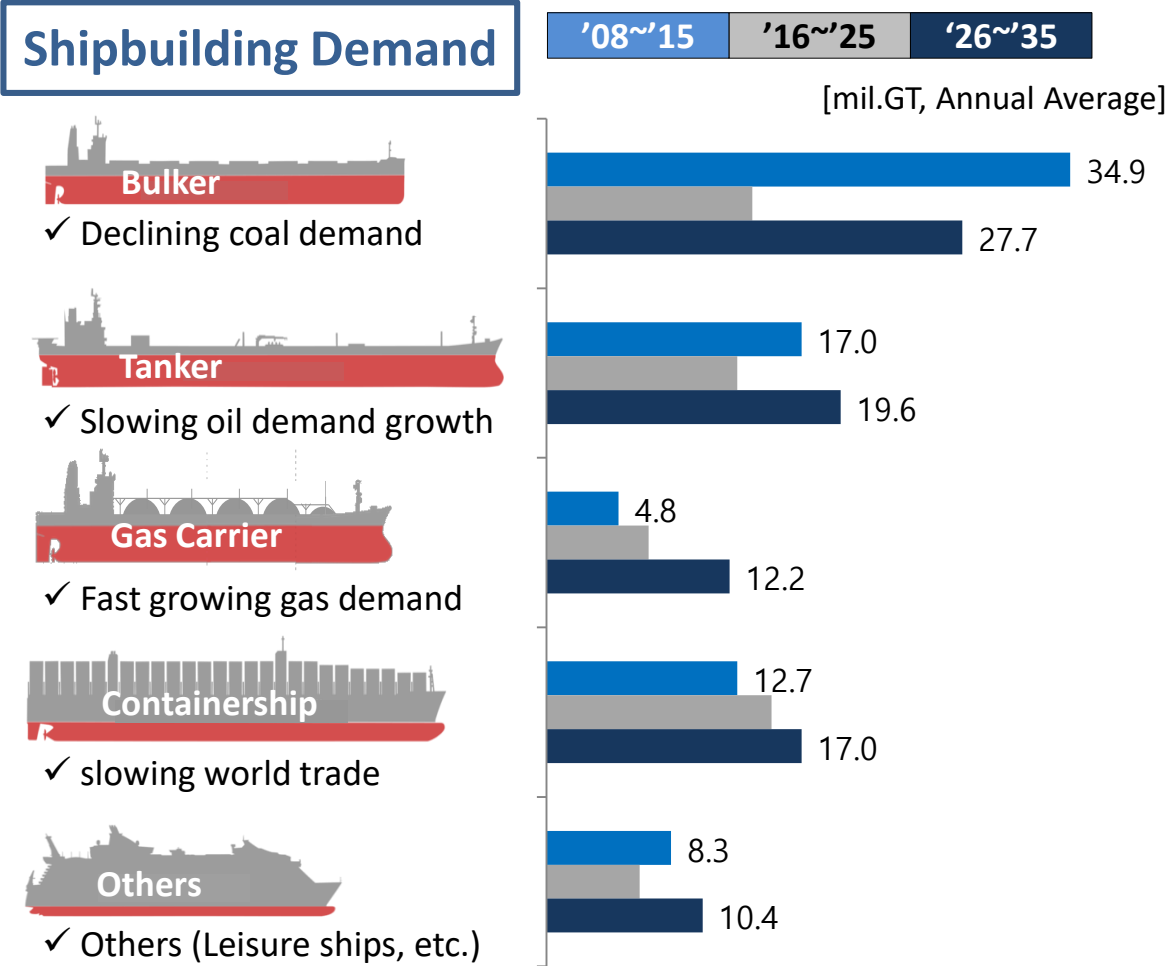
### Sustainable Future Ships

- **Larger & lighter ship**
  - ✓ Ultra large vessel

- **LNG related vessels**
  - ✓ LNG Carrier
  - ✓ LNG-FPSO\*
  - ✓ FSRU\*\*

- **Eco-ship & Smart ship**
  - ✓ Efficient fuel (LNG, fuel cell)
  - ✓ Connected / Unmanned Ship
  - ✓ Autonomous Ship

\*Floating Production Storage and Off-landing    \*\*Floating Storage Re-gasification Unit



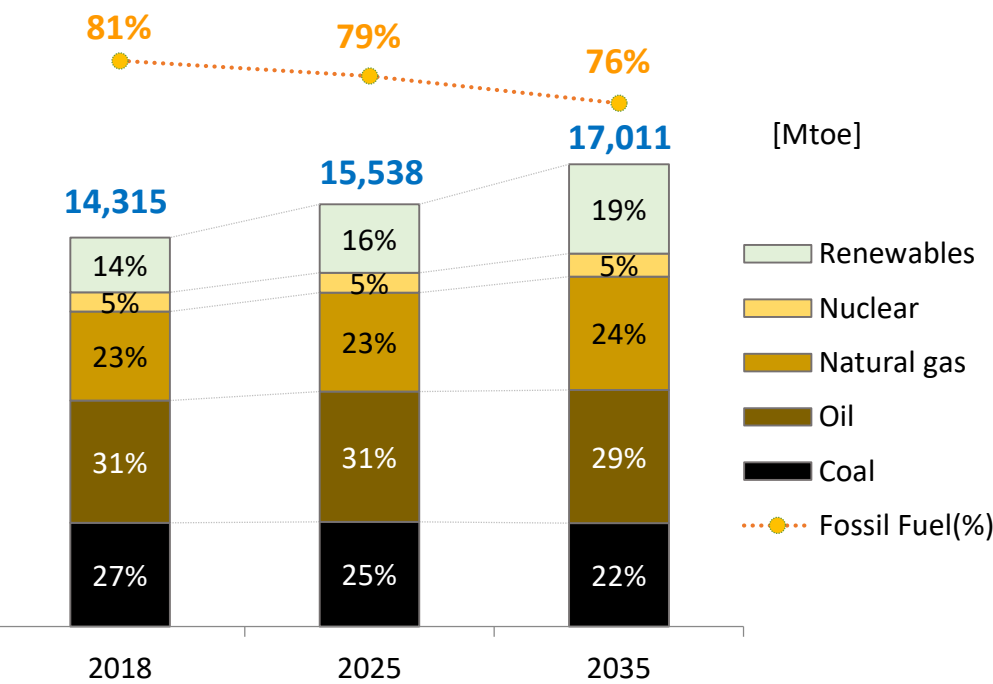


Global energy demand is expected to grow until 2035

There will be a gradual transition toward renewable energy in the share of fuels

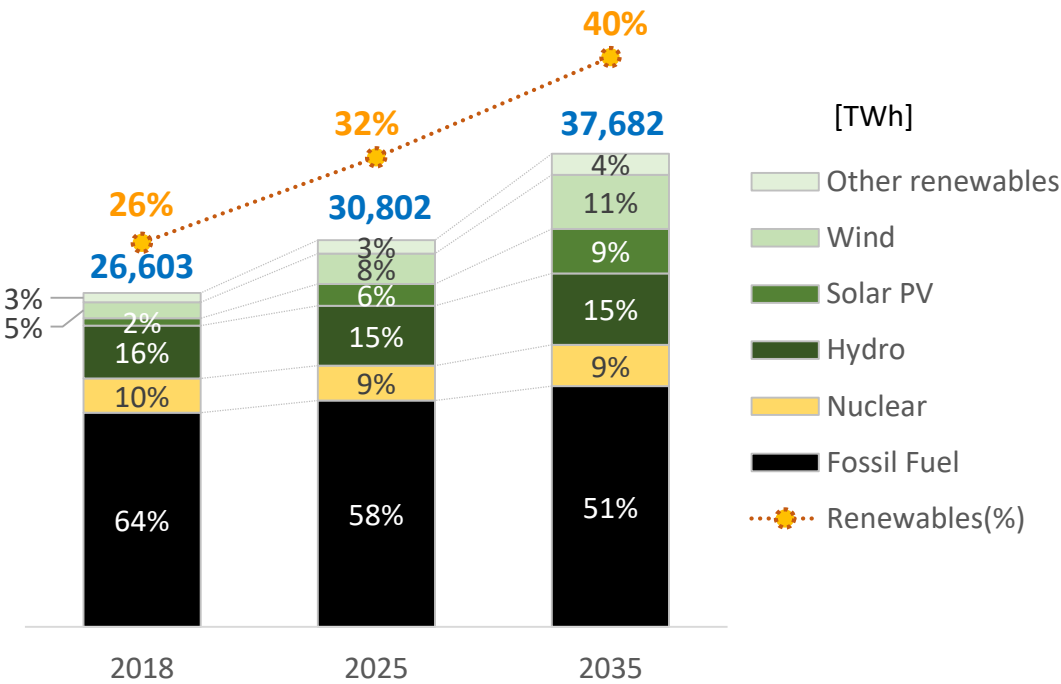
Primary Energy Demand by Fuel Type

Shares of oil and coal decline, whereas those of gas and renewable energy grow fast



Electricity Generation by Fuel Type

Share of renewable energy in total electricity generation will grow to 40% led by wind and solar power



Source: World Energy Outlook 2019, IEA (Stated Policy Scenario)

\*Mtoe: Million tons of oil equivalent, TWh: Terrawatt hour

Steel demand will rise with energy investment growth, although steel intensity of energy sector declines gradually

Energy Infrastructure



Share of Energy Infra. Invest.

• 85% ('15) → 83% ('35)

Steel Intensity\* in infra.

• 0.039 ('15) → 0.036 ('35)  
[tonne/thousand US\$ ]

T&D



\*T&D: Transmission and distribution

Share of T&D Investment

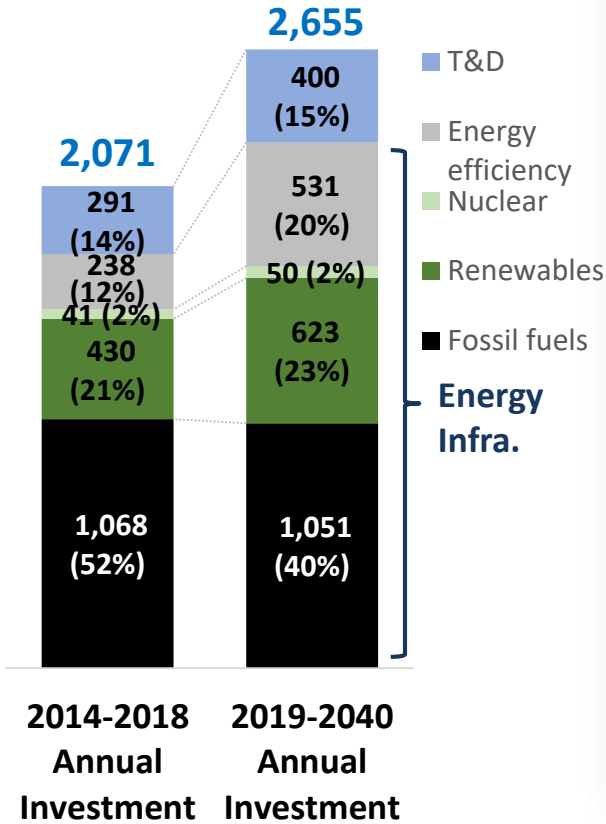
• 15% ('15) → 17% ('35)

Steel Intensity in T&D

• 0.07 ('15) → 0.06 ('35)  
[tonne/thousand US\$ ]

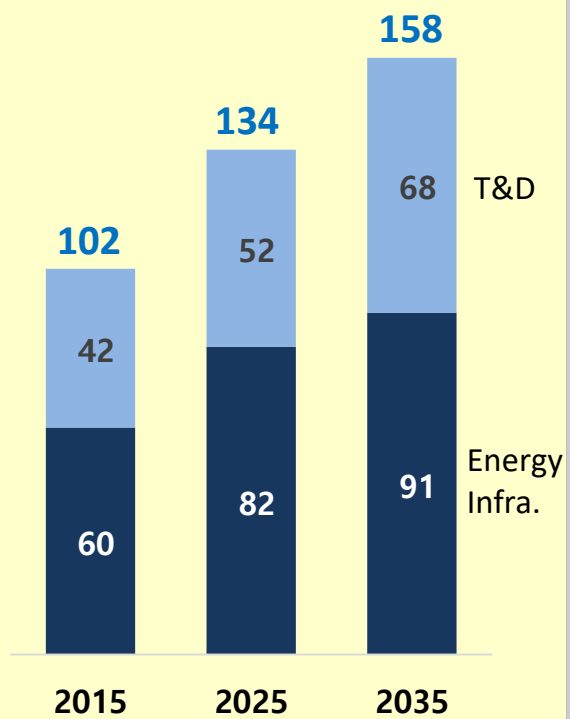
Energy Investment

[Billion US\$ per annum]



Steel Demand

[million tonne]






Source: POSRI

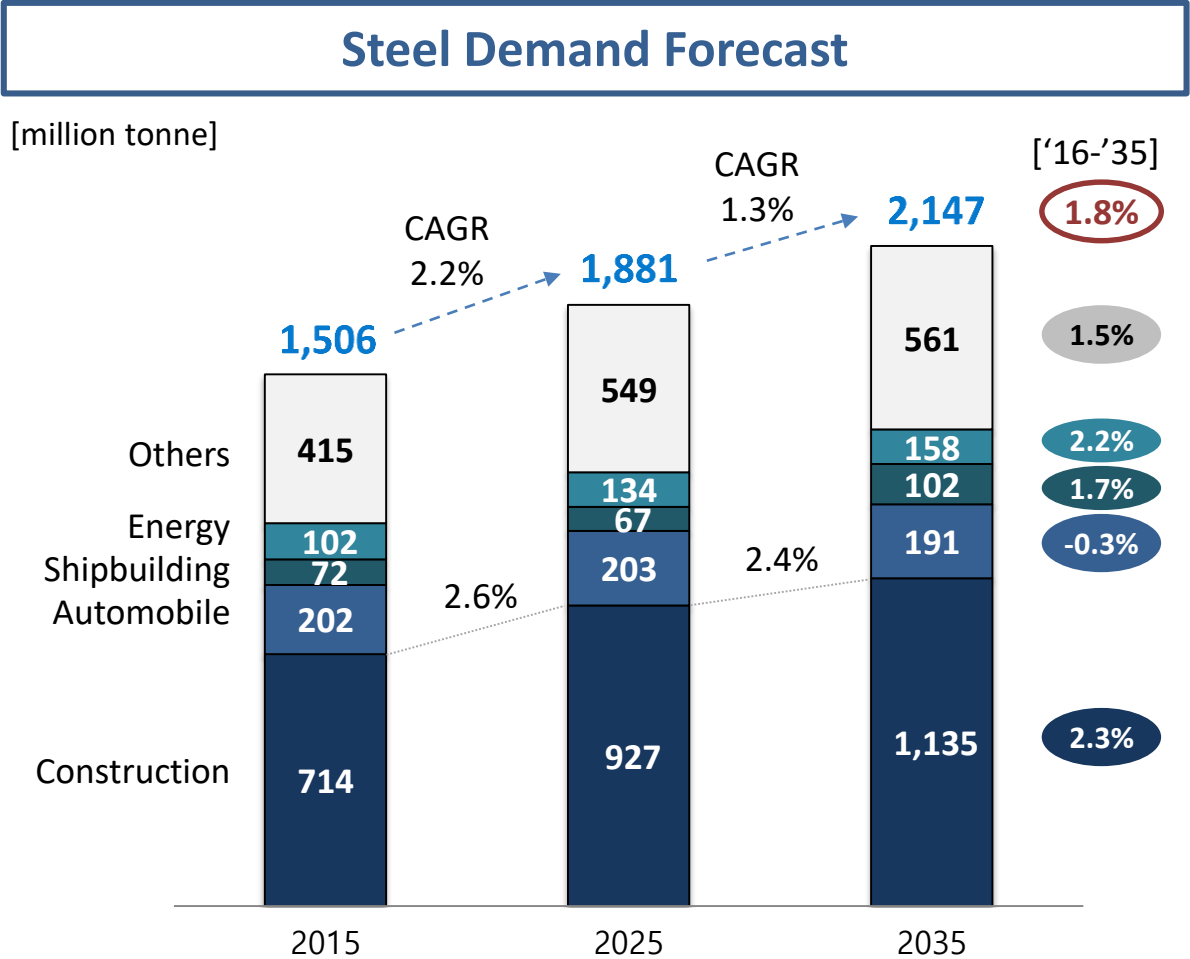
Steel Intensity: 100 ('15) → 99 ('25) → 97 ('35)

\*steel intensity [2015=100] = steel demand/energy investment (tonne/thousand US\$)

Source: World Energy Outlook 2019, IEA (New Policy Scenario)

Under the new trends, global steel demand will still be on a growing path, even though growth rate moderates

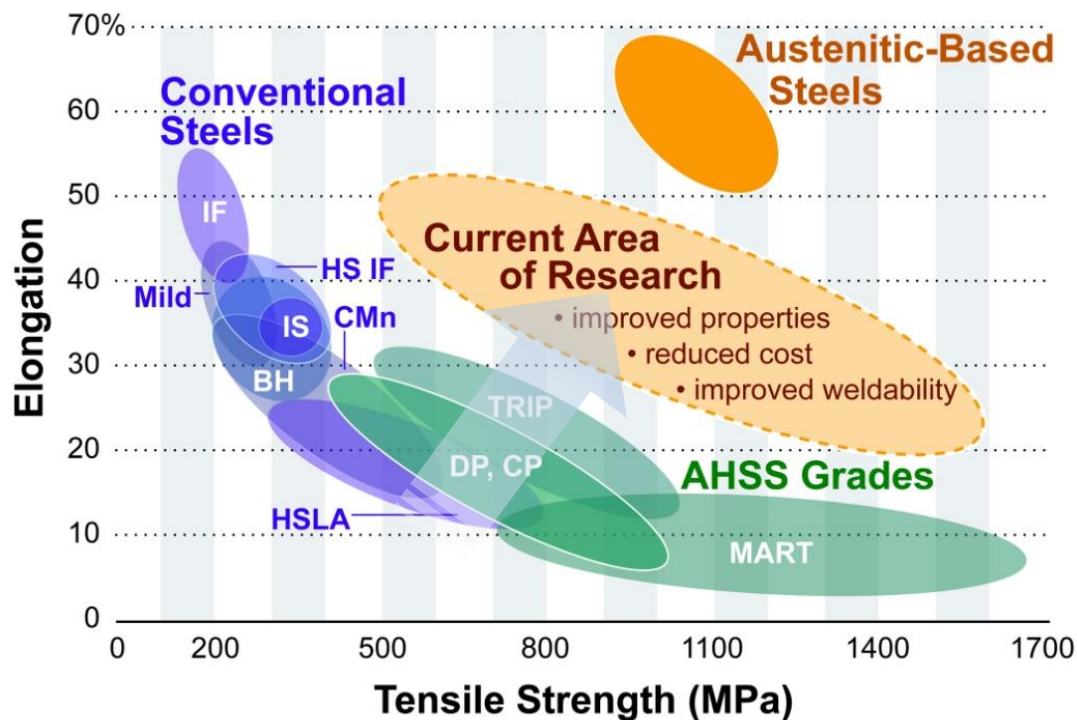
-  • Demand for new cars less than expected due to car sharing
-  • Slowing global trade and demand for containership
-  • Increasing construction investment ('15-'35) CAGR 2.7%
-  • Increasing energy investment ('19-'40) US\$2,673 (Billion US\$ per annum)



Source: POSRI  
Note: Shipbuilding sector includes other transportation  
Demand for other sectors is forecast using industrial production index

**Demand is rising for high strength and highly formable steel with low cost, and the steel industry is delivering multi-material issues for automotive body and products**

### Research on Automotive Steel Sheet



\* DP (Dual Phase), TRIP (TRAnsformation Induced Plasticity), XF (eXtra Formable) steel, TWIP (TWinning Induced Plasticity), CP (Complex Phase), Mart (Martensitic) Steel, FB (Ferrite and Bainite)

#### New Product

- **High strength & elongation with performance and versatility**
  - Expanded application of giga-pascal AHSS for lighter cars
  - Highly efficient hyper NO for EV motors, bio-shield steel for sensors, vibration damping steel, etc.

#### Quality Improvement

- **Resistant to cracking and adaptable to types of welding**
  - LME (Liquid metal induced embrittlement)
  - Hydrogen induced embrittlement
  - High welding performance

#### Multi-material vehicles

- **Machining & parts technology for multi-materials delivering**
  - Assembling multi-material body and parts
  - Teardown & Recycling issue
  - Galvanic corrosion problem

Increasing demand for new steel products in line with urban regeneration and the rise of future architecture ⇒ Pioneering B2B2C\* market with premium construction steel

\*Business to Business + Business to Customer



Urban Concentration & mega structures

- High-performance & multi-purpose CR
- Earthquake- & fire- resistant steel



High speed transport infrastructure

- New technology for infrastructure construction including hyperloop



Floating City and Underground City

- High performance marine steel
- High strength, high-corrosion resistant steel

Brand-Marketing Premium Solutions



\* POSCO's Premium Construction Brand "INNOVILT" example



# Customers' needs become more sophisticated and varying Demand is rising for high-strength, sour-resistant, high-performing cryogenic steel

## Shipbuilding



- Gas carrier → Cryogenic gas carrier
- Container ship → High-strength container ship
- Bunker → Low cost bunker

- High-strength cryogenic steel for deep sea and pola region operations  
: high strength BCA, TMCP

## Plant



- LNG onshore plant (TANK) → Cryogenic, high strength
- Petrochemical plant (Pressure vessel) → Cryogenic, high strength
- Wind power (Tower, substructure) → Fatigue-resistant, marine steel

- Maximization of abraision & fatigue-resistance
- Thick steel plate for offshore wind tower  
Radiation shield steel for nuclear power

## OCTG & Linepipe



- OCTG → Sour-resistant, high-strength
- Linepipe → Sour-resistant, high-strength

- High strength and sour-resistant steel for extreme conditions  
: API Linepipe

## The steel industry will need to adapt to new trends in steel demand, and produce better and innovative products satisfying varying needs of customers

### ✓ **Challenges for the steel industry during the next decade are two-fold,**

First, global excess capacity may continue to increase since crude capacity additions are rising  
Second, the steel industry needs to create new demand and satisfy increasing demand

### ✓ **Global steel demand will grow to reduce the excess capacity that is expected under control**

- Steel demand growth(1.8% annually) will fall short of GDP growth owing to falling steel intensity, however, steel demand will not peak in quantitative terms for the next 15 years
- Steel demand for construction and energy will grow above 2% annually, and for shipbuilding modestly while that of automobiles will be maintained

### ✓ **Customer needs for more advanced steel products are rising and the steel industry will continue to evolve through:**

- Continuous R&D and innovation to develop steel for eco-friendly car, smart city & infra, future ships, eco-friendly energy, etc and maintain its premiumization

# Thank you!



If you have any comment and suggestion on this presentation, please feel free to send an e-mail to 'jgoh@posri.re.kr'.