

# 2035 NDC and Carbon Neutrality in Korea

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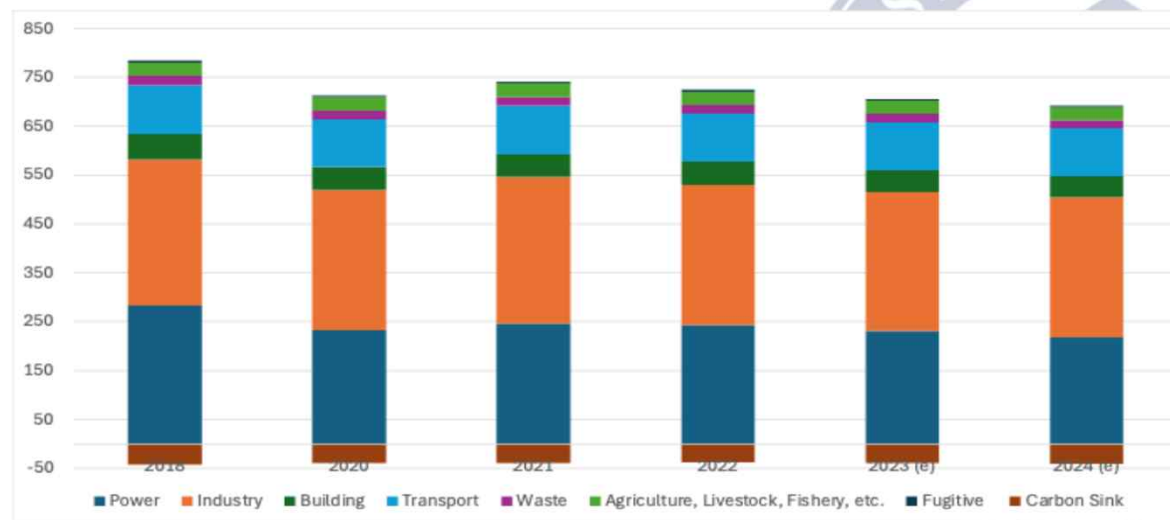
# Korea's GHG emission Trends

## ❑ Slowly decreasing trends of total GHG emissions but different sectoral trends

- Gradually decreasing trends of greenhouse gas emissions, and the total greenhouse gas emissions in 2024 is expected as 691.58 MtCO<sub>2</sub>eq.
- Shifts in power generation (increased share of nuclear and renewable) supported the emission decrease in power sector

⇔ Recovery of petrochemical and steel production leads to a slight increase in industrial emissions

**Total Greenhouse Gas Emissions by Sector (MtCO<sub>2</sub>eq)**

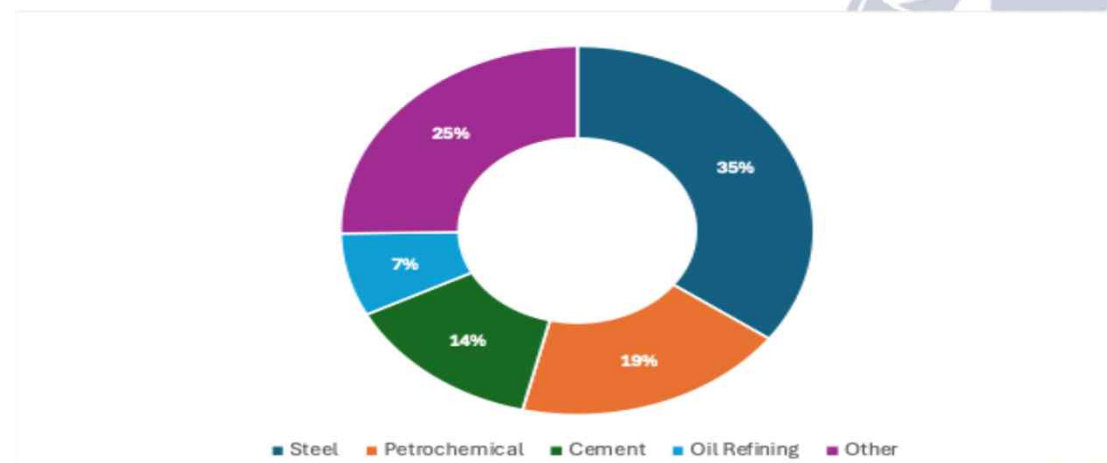


# Korea's GHG emission Trends

## ❑ Industry: Largest share of emissions but mixed signals

- Steel, Petrochemical and oil refining, and cement industries, which are energy-intensive industries, account for the vast majority of industrial emissions in Korea
- Dominance of heavy industries requires the transition of both fuel combustion and process emissions ⇒ New and Innovative technologies, such as hydrogen-based steelmaking (HyREX) and Carbon Capture and Storage, etc., are necessary

GHG emissions by industry (MtCO<sub>2</sub>eq)

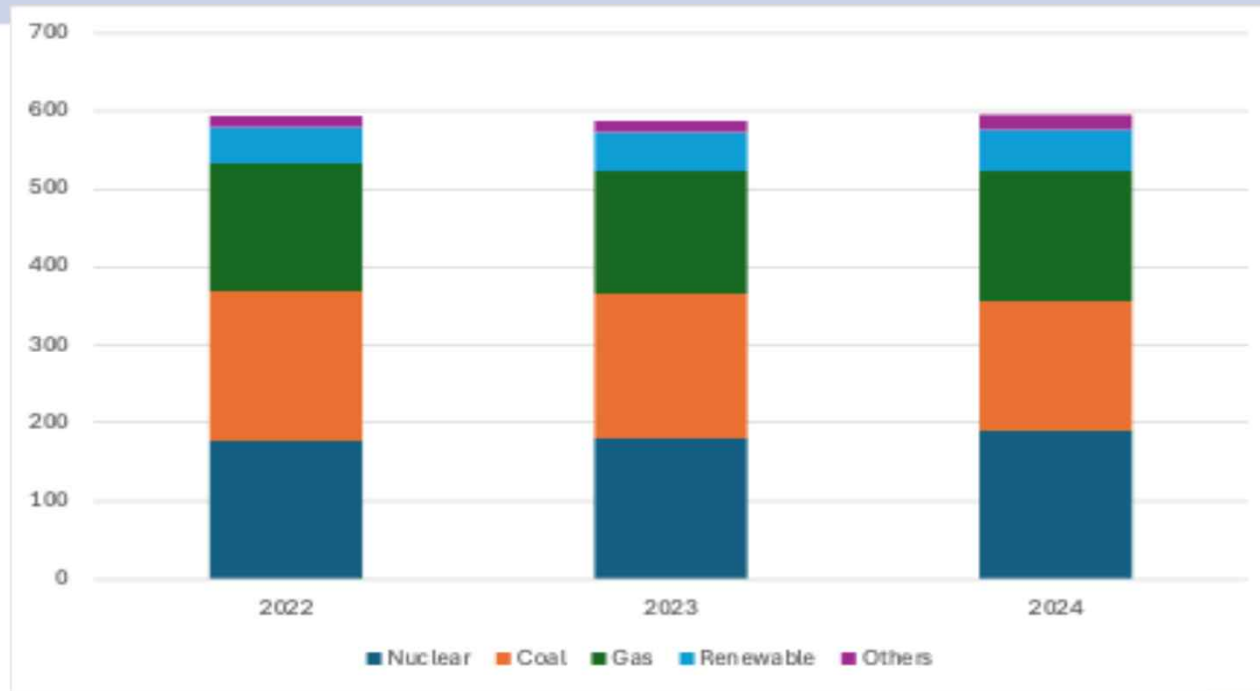


# Korea's GHG emission Trends

## ❑ Power: Gradual shifts toward nuclear and renewables

- The share of coal-fired power generation reduced while nuclear and renewable energy generation increase ⇒ Main driver of a slight decrease in power sector's emission reduction

Electricity Generation (2022-2024) (TWh)



# 2035 NDC target

## ❑ Ambitious mitigation targets:

**53% ~ 61% compared to the 2018-level**

- 53% target: Linear pathway between 2018 base year and the 2050 carbon neutrality target year
- 61% target: Enhanced government efforts, technological innovation and structural transformation of industry

### NET EMISSION REDUCTION

## 2035 Target Range

Compared to 2018 Baseline (742.3 Mt CO<sub>2</sub> eq)

**53-61%**

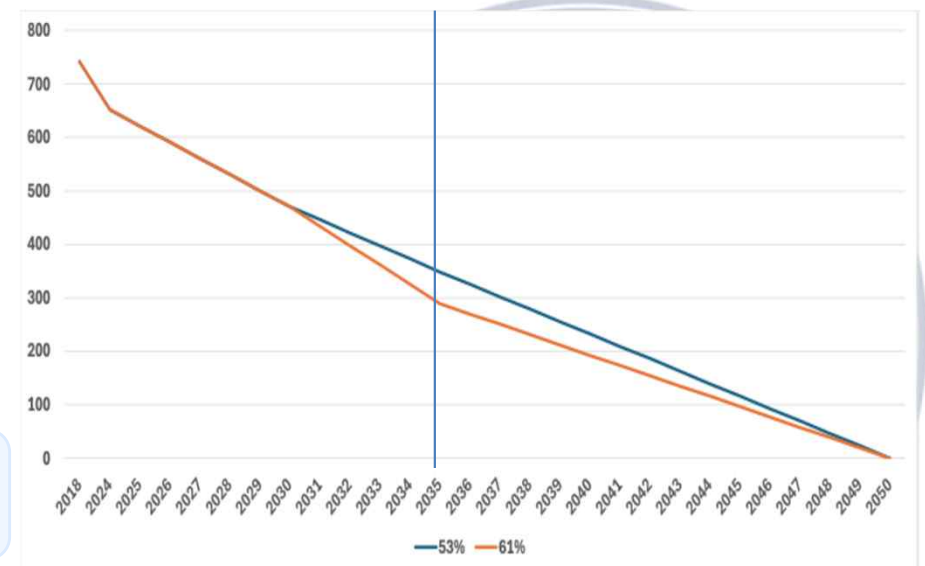
**BASELINE (2018)**

**742.3 Mt**



**TARGET (2035)**






**~289.5-348.9 Mt**



Source: Government of Korea. The Republic of Korea's 2035 Nationally Determined Contribution (NDC)

# 2035 NDC target





## □ Sectoral Targets: Strong decarbonization in Power and Transport

SECTOR	MITIGATION TARGET RANGE	KEY STRATEGY & NOTES
 <b>Power</b> Energy Conversion	<b>68.8 ~ 75.3%</b>	Coal phase-out, massive renewable expansion (Solar / Wind), etc.
 <b>Transport</b> Mobility	<b>60.2 ~ 62.8%</b>	EV scale-up (EV/Hydrogen), fuel efficiency improvement, public transportation; green shipping & aviation.
 <b>Buildings</b> Commercial & Residential	<b>53.6 ~ 56.2%</b>	Zero-energy building mandates, green remodeling subsidies, heat pump deployment.
 <b>Industry</b> Manufacturing	<b>24.3 ~ 31.0%</b>	HyREX steel technology, fuel switching, feedstock replacement (bio-naphtha), etc.
 <b>Agriculture / Waste / Other / International</b> Including Sinks		Recycling and Waste reduction; CCUS technology development and deployment, forest management; international Mitigation, etc.



# 2050 Carbon Neutrality Scenario

## ❑ Two different scenarios

Key Feature / Dimension	A <b>Scenario A</b> Maximize Domestic Abatement	B <b>Scenario B</b> Pragmatic Mix & Offsets
 <b>Power Mix</b>	<b>Renewables dominant</b> Complete coal phase-out, zero LNG power generation. Relies heavily on renewable and zero-carbon gas turbine	<b>Diversified Low-Carbon Mix</b> Coal phase-out, but retains some LNG with CCUS integration as bridge/peaking power.
 <b>Industry Strategy</b>	<b>Innovative Technologies, CCS, and diverse options</b> (Steel) HyREX using green hydrogen, more EAFs with scrap; (cement) 100% fuel transition and some feedstock changes; (petrochemical and oil refining) fuel (electric steam cracker, biomass boiler, etc.) and feedstock change	
 <b>Building</b>	<b>Energy Efficiency, smart energy management, clean energy</b> Zero Energy Building for new buildings, green remodeling, energy efficiency improvement, Energy efficiency standards for appliances, renewables for cooling and heating, etc.	
 <b>Transport</b>	<b>Electrification and hydrogen</b> Demand management, clean shipping/aviation (Road) full transition to electric and hydrogen-based vehicles (over 97%)	<b>Some Use of E-Fuels</b> Demand management, clean shipping/aviation For the remaining internal combustion engine vehicles, use alternative fuels (e-fuels, etc.)



# Legal and Institutional Framework

## ❑ Foundational pillars supporting Korea's 2035 NDC targets and strategies

- Carbon Neutrality Act: Legalize 2050 Carbon Neutrality and NDC targets; Mandate national strategies and implementation plans; framework for green growth governance
- K-ETS (Phase 4): Operation between 2026-2030; Tighter caps aligned with 2035 NDC emission pathways; Higher share of auction shares
  - Auction share increased, particularly for power sector (Gradual increase to 50% by 2030)
  - Targeting free allocation maintained for trade-exposed industries, which are exposed to carbon leakage risks; The auction share for some industries increases to 15% (from the current 10%)
  - Revenues will be used to support low-carbon transition of industries

# Legal and Institutional Framework

## ❑ K-ETS (Phase 3 & 4)

Category	Phase 3 ('21-'25)	Phase 4 ('26-'30)
Number of Participants	684	772
Emission Cap	Cap based on the Roadmap Total 3,030 MtCO <sub>2</sub> (610 MtCO <sub>2</sub> per year)	Linear Total 2,540 MtCO <sub>2</sub> (510 MtCO <sub>2</sub> per year)
Auction	Entities subject to auctions (10%); Sectors for free allocation (0%)	Power Sector (15~50%) Other sectors subject to auctions (15%) Sectors for free allocation (0%)
Benchmark	Weighted Average of the top 37% of performances	Moving from the weighted average of the top 37% of performances to the top 20%

Source: Government of Korea. The Republic of Korea's 2035 Nationally Determined Contribution (NDC)

# Legal and Institutional Framework

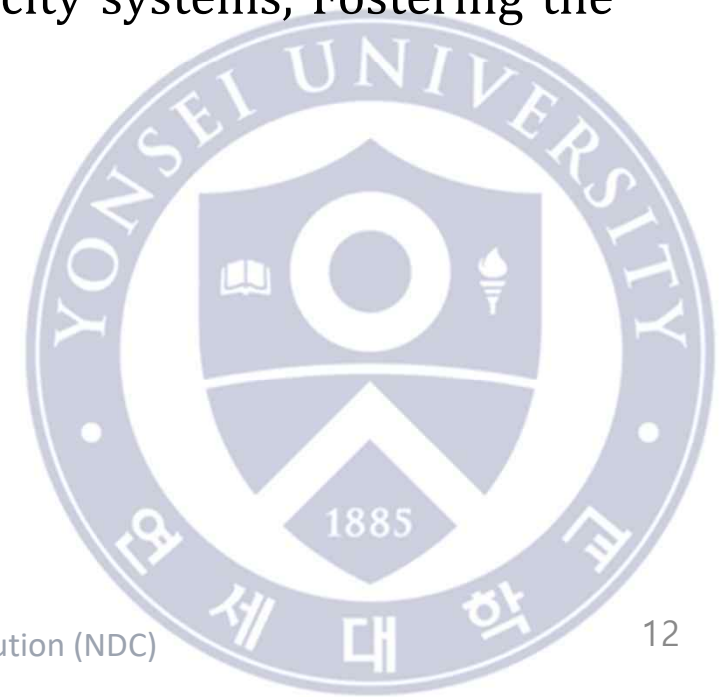
## ❑ K-GX Strategy

- Vision: Transforming from a carbon-based civilization into a leading country in decarbonized green civilization
- Target: Securing Competitiveness in K-GX Green Industries
- Policy Direction
  - Selecting key tasks by sector – power, industry, transport, and building – and **securing the competitiveness of green industries** through integrated support encompassing **finance, taxation, and institutional frameworks**
  - Full support to secure competitiveness in green industries over the next decade through decarbonization, leveraging manufacturing strengths
  - Foster climate-tech innovation and build industrial ecosystem to find new market opportunities

# Legal and Institutional Framework

## ❑ K-GX Strategy: Power Sector

- Scaling up renewable energy (100 GW by 2030), public sector's RE100
- Commercialize next-generation solar modules (perovskite-silicon tandem solar cell); Agricultural Photovoltaic
- Early acquisition of large-scale wind power technologies; onshore and offshore wind infrastructure
- Power Grid: Promotion of decentralized electricity systems, Fostering the ESS and HVDC industries



# Legal and Institutional Framework

## ❑ K-GX Strategy: Industry Sector

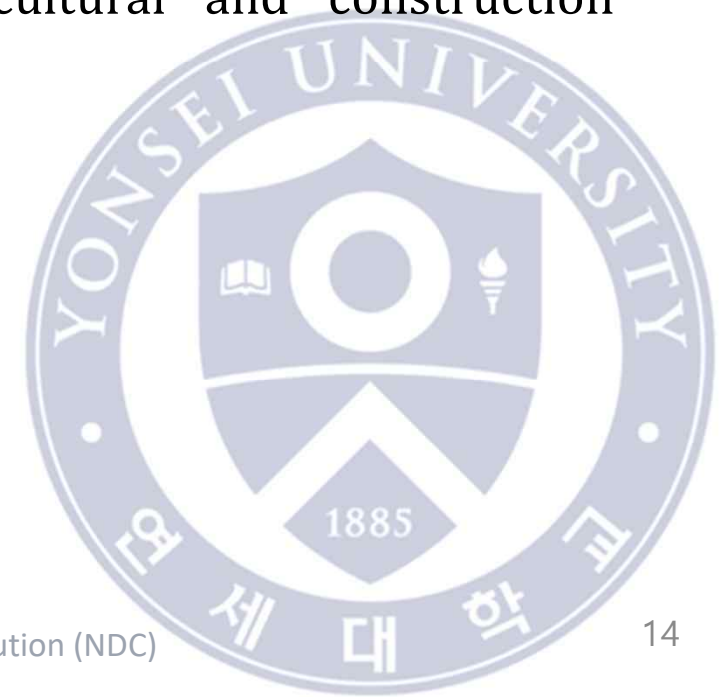
- Innovative Technology: Hydrogen-based steelmaking, Electric NCC, blended cement, etc.
- Feedstock switch: Low-carbon transition linked to CCUS
- Clean Electricity: RE 100 Industrial Complex Expansion
- Demand Creation: Refactoring and expansion of public procurement
- Incentives for Low-carbon products;



# Legal and Institutional Framework

## ❑ K-GX Strategy: Transport Sector

- Electric/Hydrogen vehicle: Accelerating the deployment of electric and hydrogen vehicles and the transition of the internal combustion engine vehicle (including subsidies, financial supports, etc.)
- Related Industries: Fostering secondary battery and battery industries
- Heavy-duty trucks: Hydrogen-based heavy-duty trucks
- Non-Road Transport: Electrification of agricultural and construction machinery, etc.



# Legal and Institutional Framework

## ❑ K-GX Strategy: Building Sector

- Electrifying heat energy: Accelerating the deployment of heat pump
- Insulation: Expanding green remodeling
- Building exteriors: Building-integrated photovoltaic
- Zero Energy Building: Expanding Zero Energy Buildings

## ❑ K-GX Strategy: Other

- Agri/Forestry/Fishery: Treatment of livestock manure through energy recovery facilities
- Sink: Strengthening forests
- CCUS: Advancing the development and commercialization of CCUS technologies
- International: International mitigation projects under Article 6 of the Paris Agreement



# Legal and Institutional Framework

## ❑ K-GX Strategy: Just Transition

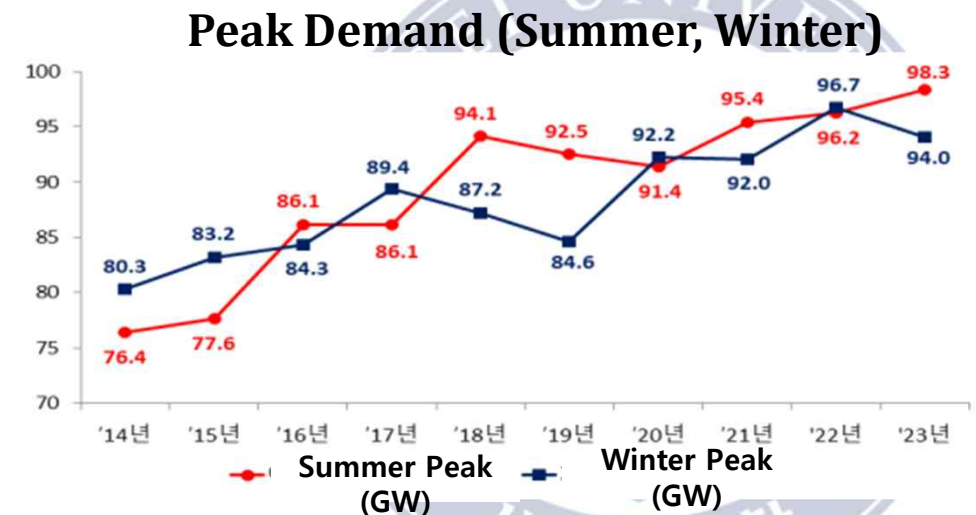
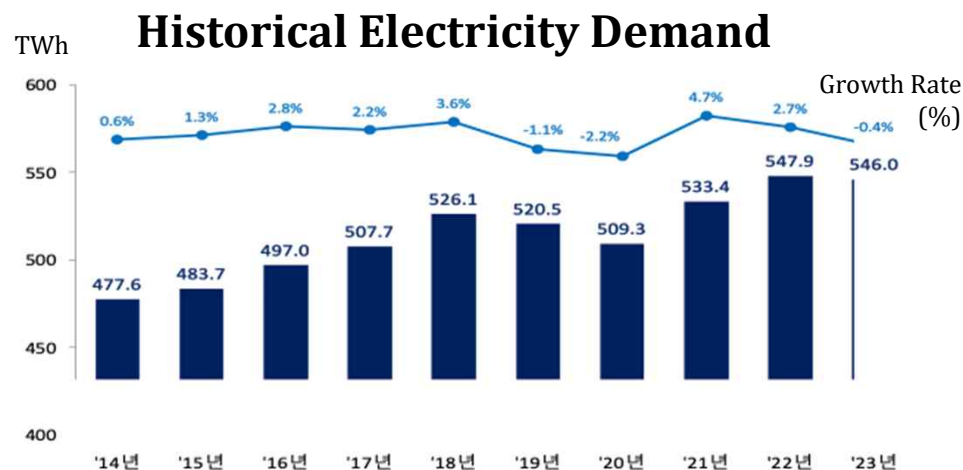
- Support for the job transition and retraining
- Support for SMEs transitioning to green technologies and production processes
- Responding to changes in Automobile parts supply chains and jobs due to the reduction of internal combustion engine vehicles
- Establishing customized transition plans at the regional industrial complex level



# 11<sup>th</sup> Basic Plan for Long-term Electricity Supply and Demand

## □ Strategic Blueprint for Korea's Electricity Supply and Demand (2024-2038)

- Average annual growth rate of electricity consumption (2014-2023): 1.5%
- The peak electricity demand in summer and winter shows the increasing trends

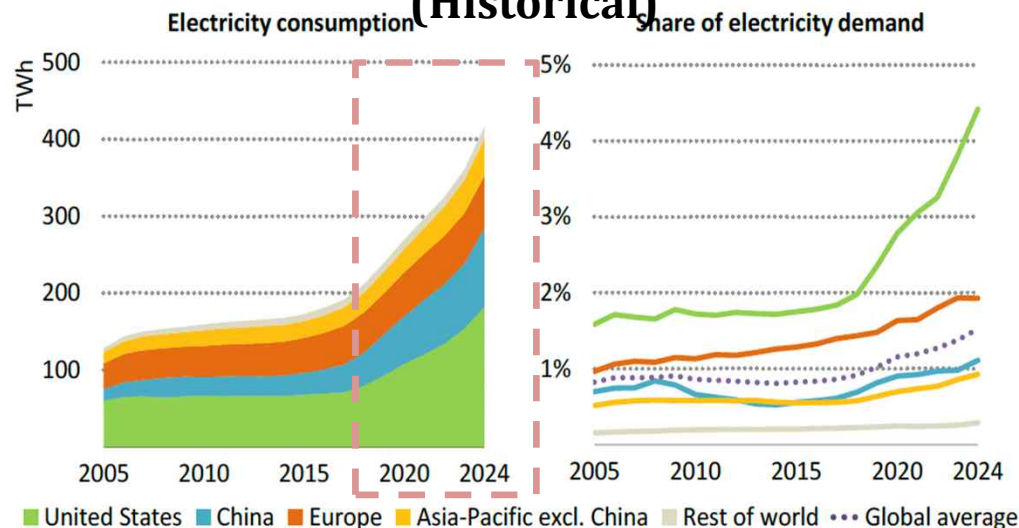


# AI and Electricity Demand

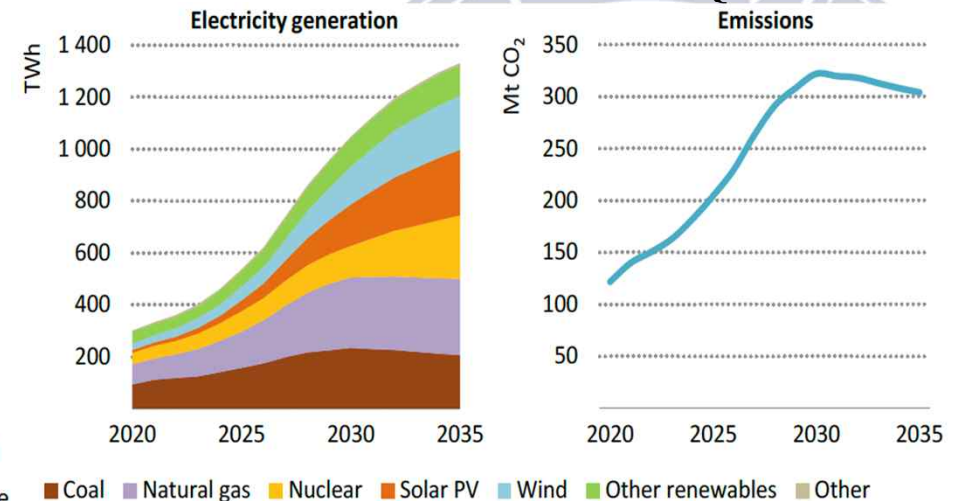
## □ Global Data Center Electricity Consumption

- The electricity consumption of data center has been rapidly rising recently
- In the near future, the electricity generation for data center is expected to increase substantially (IEA, 2025)
  - 460 TWh (2024) ➔ over 1,000 TWh (2030) ➔ 1,300 TWh (2035)

### Electricity Consumption of Data Center (Historical)



### Global Electricity Generation and CO2 emissions for Data Centers (2020-2030)

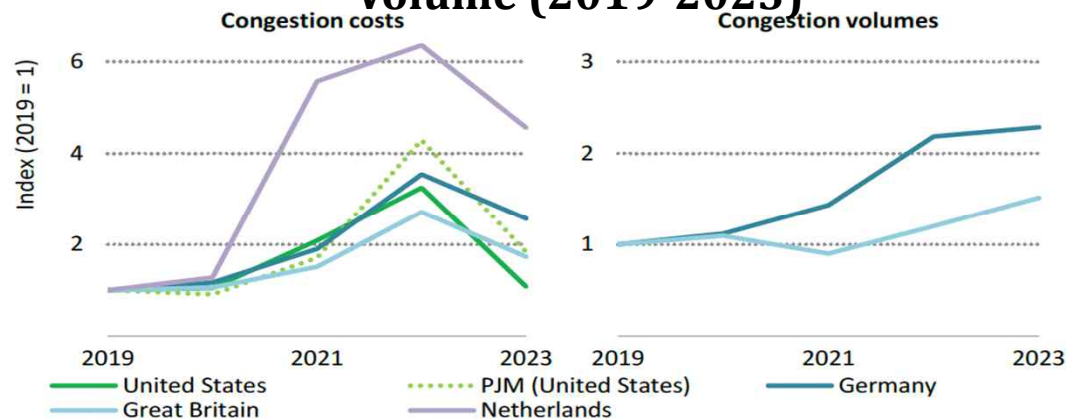


# AI and Electricity Demand

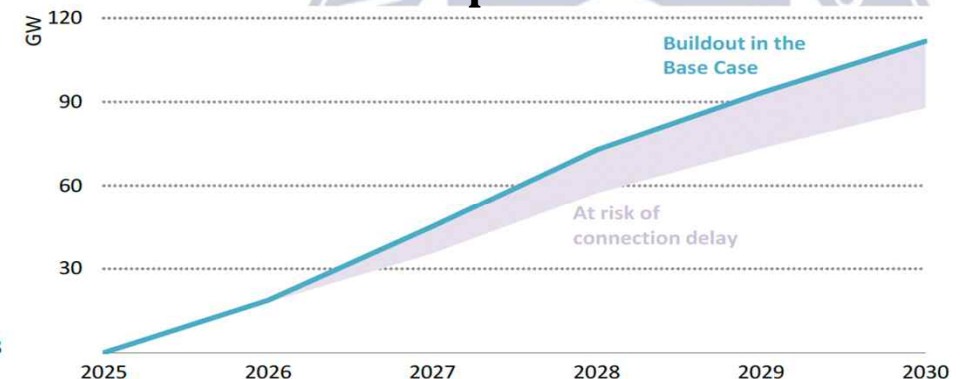
## ❑ Transmission Grid Congestion due to Data Center

- In addition to increasing electricity supply to satisfy the surging electricity demand due to data center and AI, the bottleneck (transmission grid) needs to be addressed → Grid congestion became worse in many countries already
- IEA(2025) indicated the grid constraints could delay around 20% of the global data center capacity by 2030

### Transmission Grid Congestion Cost and Volume (2019-2023)



### Risk of Connection delay and Data Center expansion



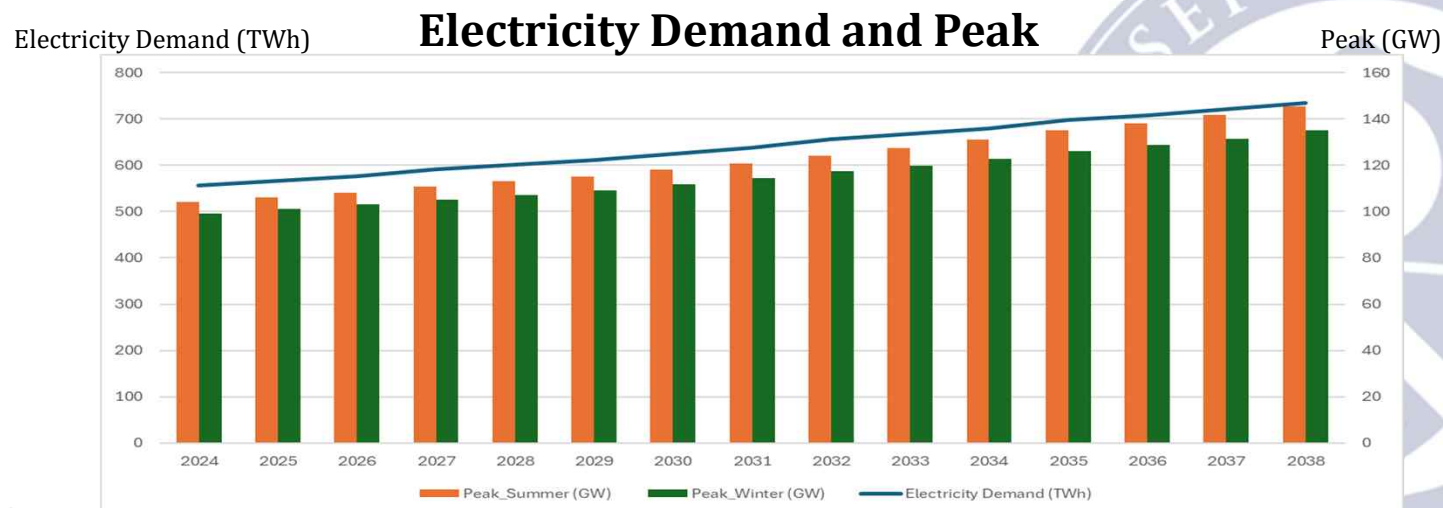
# 11<sup>th</sup> Basic Plan for Long-term Electricity Supply and Demand

## ❑ Strategic Blueprint for Korea's Electricity Supply and Demand (2024-2038)

➤ Planned investment in high-tech industries, including Semiconductor and secondary battery + Increasing data center + Electrification

⇒ Expected to increase the domestic electricity demand significantly

⇒ Electricity Demand: 557.1 TWh (2024) → 735.1 TWh (2038)



Source: Government of Korea. 2025. 11<sup>th</sup> Basic Plan for Long-term Electricity Supply and Demand

Demand

# 11<sup>th</sup> Basic Plan for Long-term Electricity Supply and Demand

## ❑ Strategic Blueprint for Korea's Electricity Supply and Demand (2024-2038)

- Data Center and Electrification\* are expected to lead the increase in the electricity demand

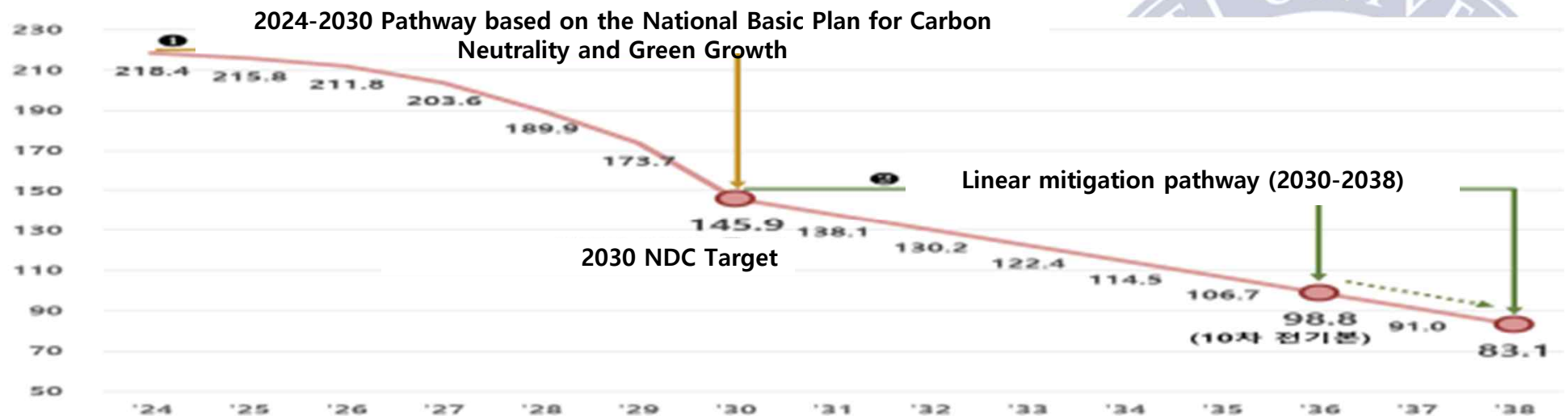
Year	Modeled Demand Projection (TWh)	High-tech Industry (TWh)	Data Center (TWh)	Electrification (TWh)	Total (TWh)
2025	556.4	5.8	2.7	1.2	566.1
2027	572.1	7.7	8.4	2.8	590.9
2030	596.6	10.3	10	8.4	625.2
2036	642.5	7.6	13.9	43.8	707.9
2038	655.5	1.1	15.5	63	735.1



# 11<sup>th</sup> Basic Plan for Long-term Electricity Supply and Demand

## □ Strategic Blueprint for Korea's Electricity Supply and Demand (2024-2038)

- Based on the National Basic Plan for Carbon Neutrality and Green Growth and the 10<sup>th</sup> Basic Plan for Long-term Electricity Supply and Demand, it follows the emission pathways over 2024-2030
- (2031-2038) It sets a linear pathway, and it can be adjusted to follow the alternative pathways based on 2035 NDC



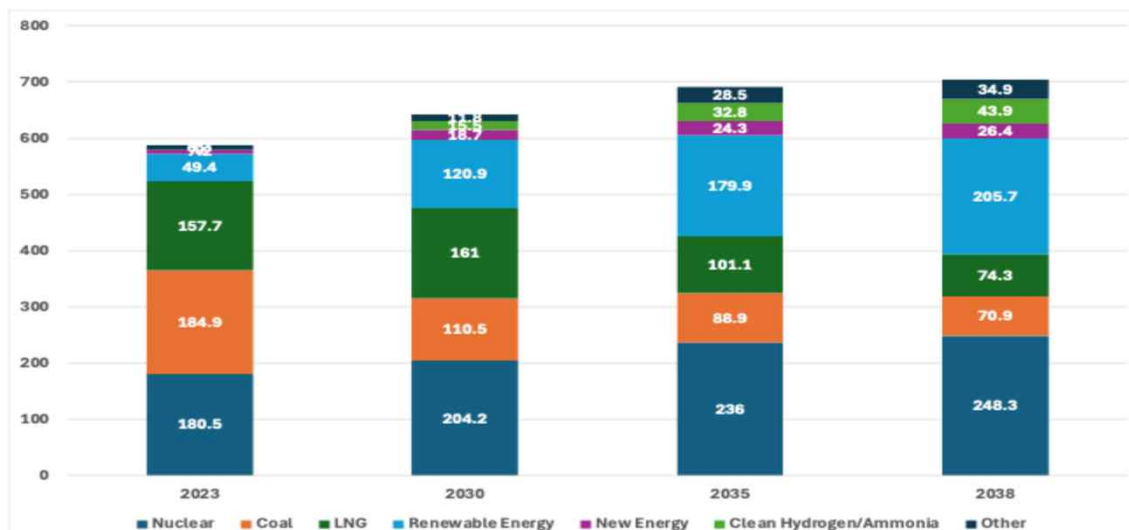


# 11<sup>th</sup> Basic Plan for Long-term Electricity Supply and Demand

## □ Strategic Blueprint for Korea's Electricity Supply and Demand

➤ Beside the expansion of renewable energy, as a carbon-free energy source, the plan emphasized the continued use of nuclear power

- Continued use of existing nuclear power plants; Build and operate Shin-Hanul nuclear power plant (#3-4), Saeul (#3-4);
- Development and commercialize Small Modular Reactor (SMR) in 2030s
- Secure location and facilities for radioactive waste



⇒ The share of nuclear power in the power mix is expected to increase slightly

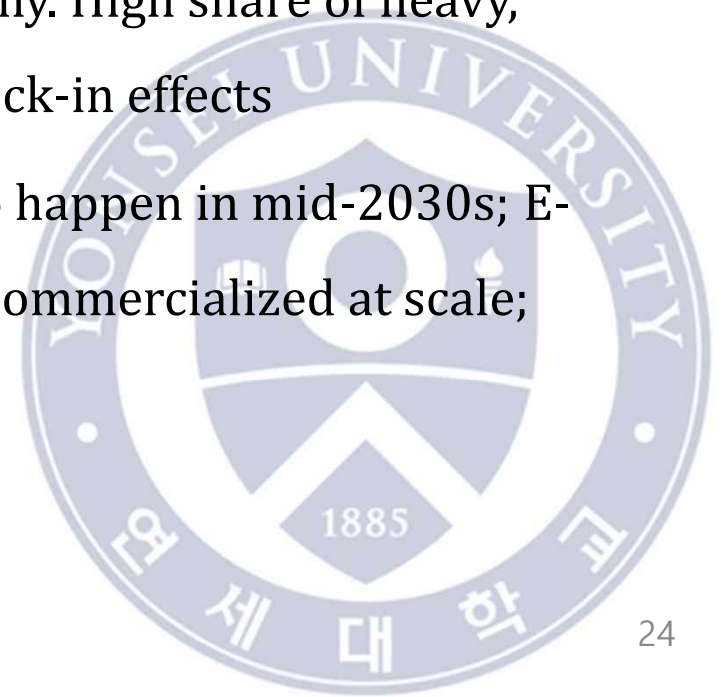
30.7% (2023) → 35.2% (2038)

# Challenges and Opportunities

## ❑ Technological Challenges and Opportunities

➤ For achieving 2035 NDC and 2050 Carbon Neutrality, the development and deployment of innovative technologies, such as hydrogen-based steelmaking, are essential ⇒ High uncertainty and requiring huge investment and time

- Hard-to-abate sectors dominate the economy. High share of heavy, energy-intensive industries creates deep lock-in effects
- Commercialization of HyREX is expected to happen in mid-2030s; E-crackers and CCS technologies are not yet commercialized at scale; lacking domestic Carbon Storage



# Challenges and Opportunities

## ❑ Technological Challenges and Opportunities

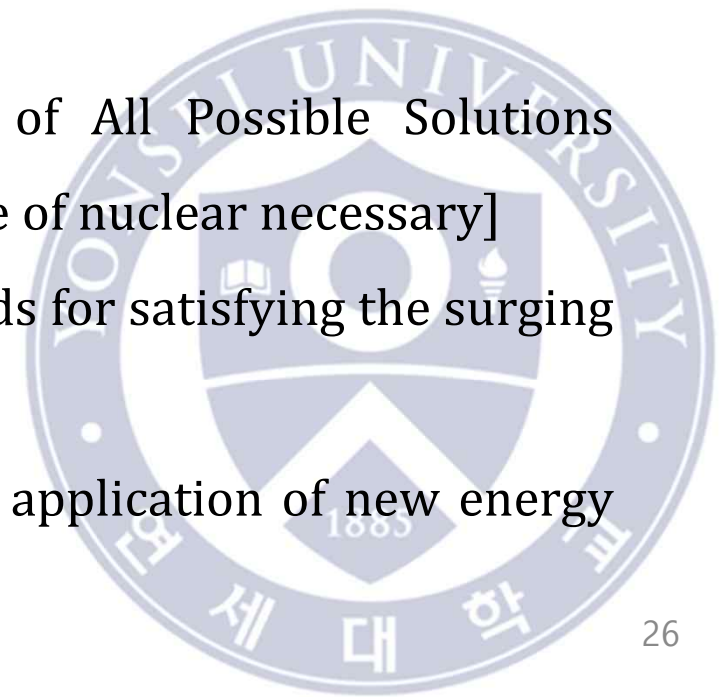
- Challenges in securing electricity system stability with a very high shares of renewables; Expensive clean hydrogen production
- New Market Opportunities and Technology Leadership: climate-tech and green industries, such as electric vehicles, battery, hydrogen and smart grid, are considered as new growth engines



# Challenges and Opportunities

## ❑ Energy Supply and Demand, particularly Electricity

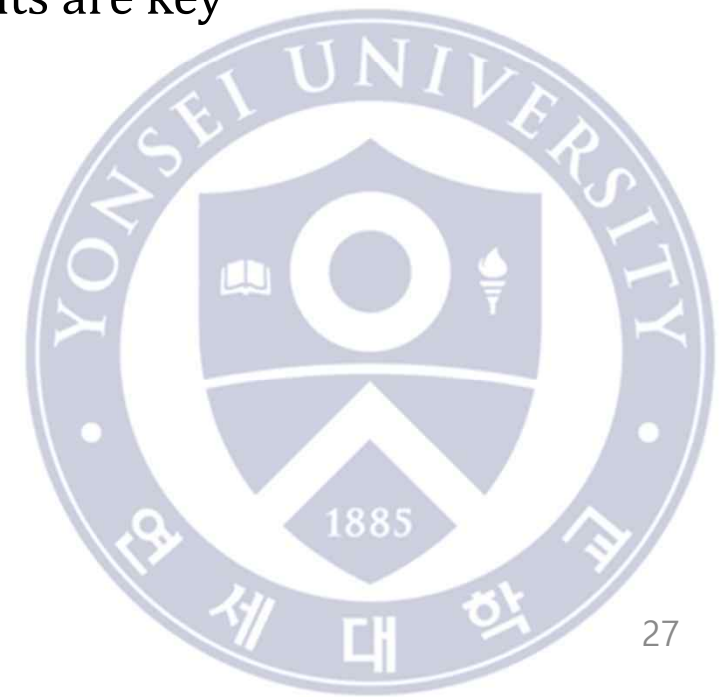
- Import the majority of its energy resources, particularly fossil fuels
  - Adopting strategies centered on developing and commercializing climate technologies, including innovative technologies, efficiency improvement, and reducing fossil dependence
  - Importance of enhancing Energy security by reducing fossil energy imports
- Limited renewable utilization ➔ Utilization of All Possible Solutions  
[Renewable energy expansion and continued use of nuclear necessary]
- Challenges in the expansion of transmission grids for satisfying the surging electricity demand
- Industrial transition and the development and application of new energy technologies are essential



# Challenges and Opportunities

## ❑ Energy Supply and Demand, particularly Electricity

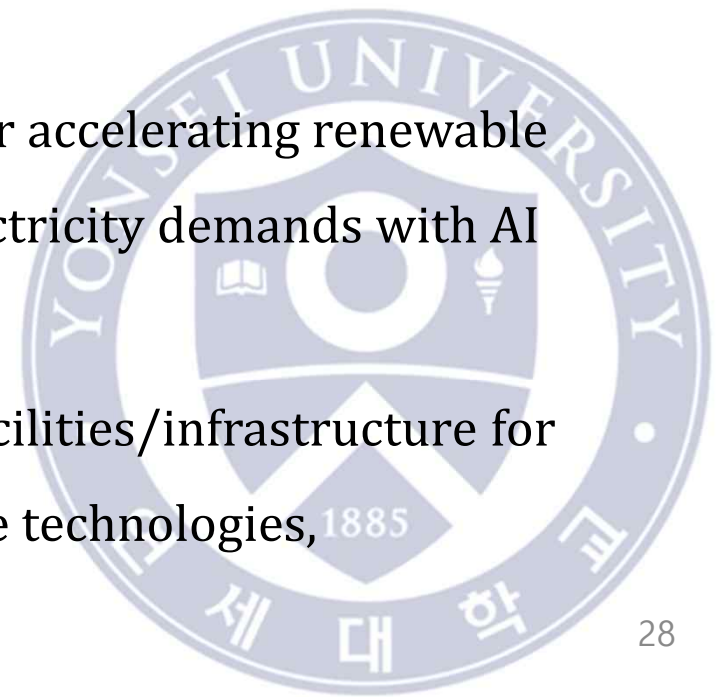
- Necessary to shift the Government and Public-led energy policies toward the comprehensive participation of public/private/civil society in establishing energy policies
- Investing and Developing new market opportunities, such as SMR, ESS, Hydrogen, is essential
- The combination of Digital and Green components are key



# Challenges and Opportunities

## ❑ Economic Challenges and Opportunities

- Substantial transition costs required across all industries
  - Concerns about the financial burden of investing in equipment replacement and innovation, while rising carbon prices may pose economic burdens
  - Limited capabilities of SMEs to cover transition costs
- Huge investment requirement
  - Significant investment in grid expansion for accelerating renewable deployment and responding to surging electricity demands with AI and electrification
  - R&D investment and investment in such facilities/infrastructure for developing and commercializing innovative technologies, 1885



# Challenges and Opportunities

## ❑ Economic Challenges and Opportunities

- Opportunities for international carbon markets based on Article 6 of the Paris Agreement
- Responding to global climate and carbon policies, such as Carbon Border Adjustment Mechanism





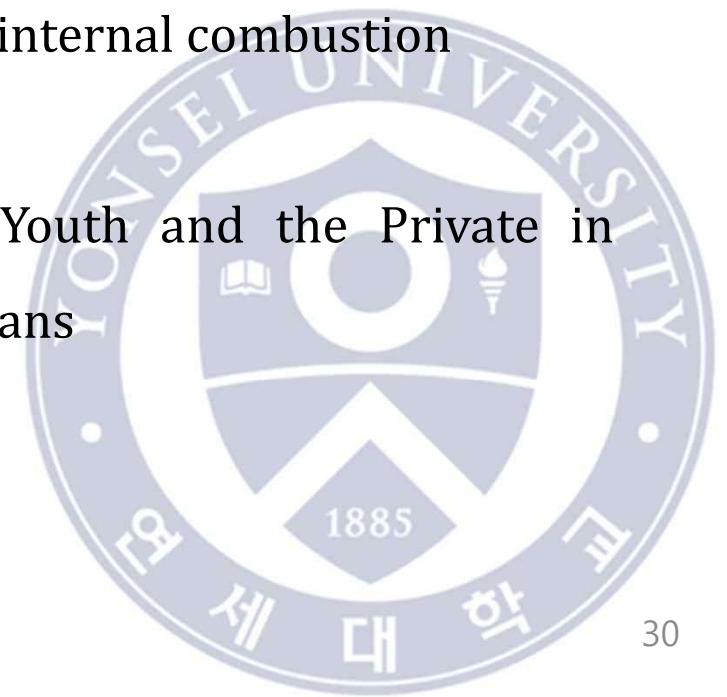
# Challenges and Opportunities

## ❑ Social Challenges and Opportunities

### ➤ Social Acceptance and Just Transition

- Conflicts for Renewables and transmission lines
- Just transition of energy-intensive, fossil-based industries and power (employment, local communities, etc.)
- Social acceptance on rising electricity tariffs due to carbon pricing and renewable transitions, on phasing out internal combustion engine vehicles, etc.

### ➤ More participation of the Civil society, the Youth and the Private in establishing long-term plans, including energy plans



# Thank you

