Vision for POSCO Carbon Neutrality by 2050

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April 21, 2021

I. Background

UN IPCC[1)] has emphasized actions to reach global carbon neutrality by 2050 by limiting global warming to 1.5 °C above pre-industrial levels and by incorporating the climate-resilient development framework in its **Special Report on Global Warming of 1.5°C**.

As part of the efforts of UN IPCC, **Korea, the European Union, the United States and Japan** have announced their 2050 carbon neutral goals.
TCFD[2)] (e.g., global investor firms) and industries including automotive, ICT and renewable energy have also pledged to move towards the goal of becoming carbon neutral by 2050.
Investment companies and suppliers have also been called on to join the carbon neutrality initiatives.

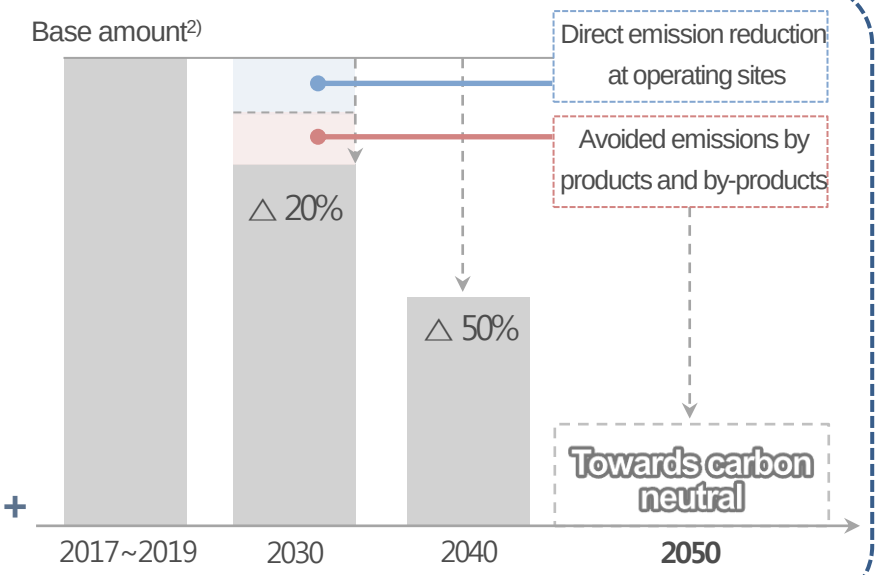
POSCO, recognizing the climate change crisis as an emergency and the urgency to tackle the problem, has implemented company-wide strategies on an annual basis since 2002.
The company announced its voluntary 2020 GHG reduction target in 2010, and disclosed information on its carbon management (e.g., GHG mitigation actions) to stakeholders.

On Dec. 11, 2020, **POSCO** joined global efforts towards carbon neutrality by pledging to attain this goal by 2050. While fulfilling its responsibilities as a corporate citizen, **the company** is determined to enhance its competitiveness by shifting to a low-carbon production system and rebuilding its business portfolio.

1) IPCC, 2018: Global Warming of 1.5°C. 2) Taskforce on Climate-related Financial Disclosures

POSCO aims to achieve carbon neutrality **by 2050**
with the adoption of the hydrogen reduction process in iron and steel making.
Interim reduction targets are set at 20% by 2030 and 50% by 2040.

- **2030**
  Improvement of energy efficiency, usage of low carbon raw material alternatives (e.g., scrap, pellets, etc.)
- **2040**
  Injection of natural gas and H_2-containing gas into BF, new EAF, CCR[1] and etc.
- **2050**
  Commercialization of **HyREX** (Fluidized-bed reduction with green H_2) + **EAF using renewable energy source**



The company will continuously work towards cutting GHG emissions
through the supply of energy efficient steel products[3] and recycling of steel by-products[4].

1) Carbon capture and reuse
2) Baseline: average of CO2 emissions from 2017 to 2019
3) Expanding the supply of high energy-efficiency steel such as high-strength steel, low core loss electrical steel, etc.
4) Eco-friendly use of steel slag such as slag cement, slag fertilizer, marine forest with Triton, etc.

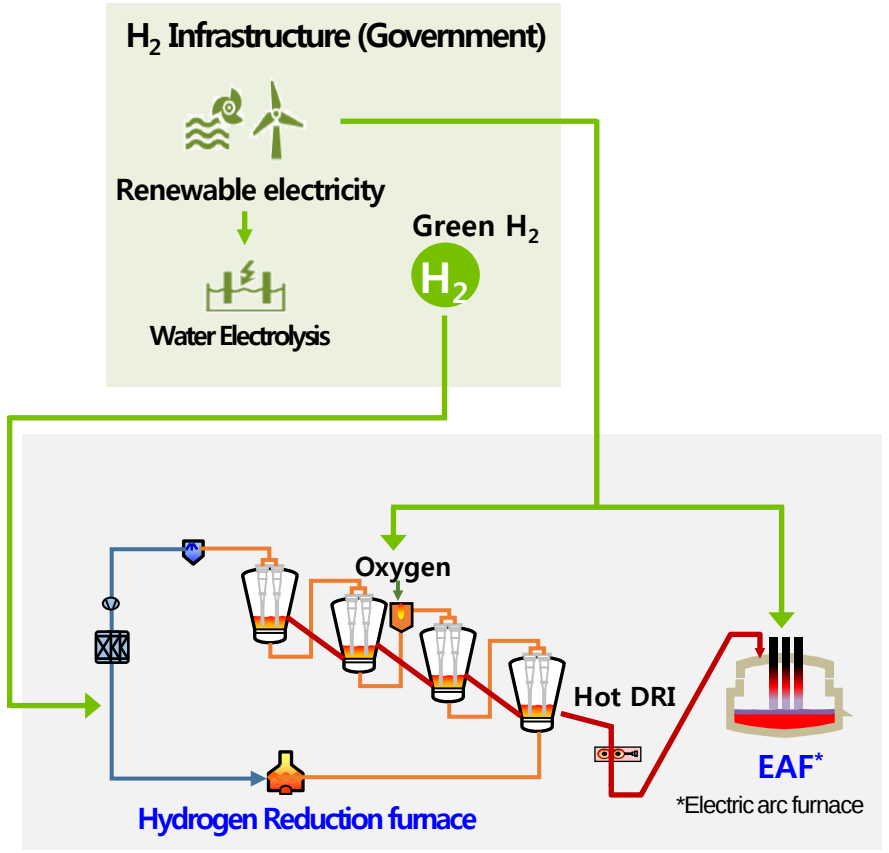
Ref. POSCO Hydrogen Reduction Process - HyREX

- **FINEX**, a coal & oxygen-based iron ore reduction process using fluidized bed reactors, is a key capability of POSCO that enables the development of the hydrogen-based iron-making process.

- Based on such capabilities, **the HyREX** process has been designed to use green hydrogen and renewable electricity.

- **Since 2016**, **POSCO** has participated in government-led R&D projects to develop hydrogen-based iron-making technologies.

- **The HyREX process** is to be developed by 2030 after running pilot plant tests, and **demo plants** are to be operated by 2040 and commercialization is slated for 2050.



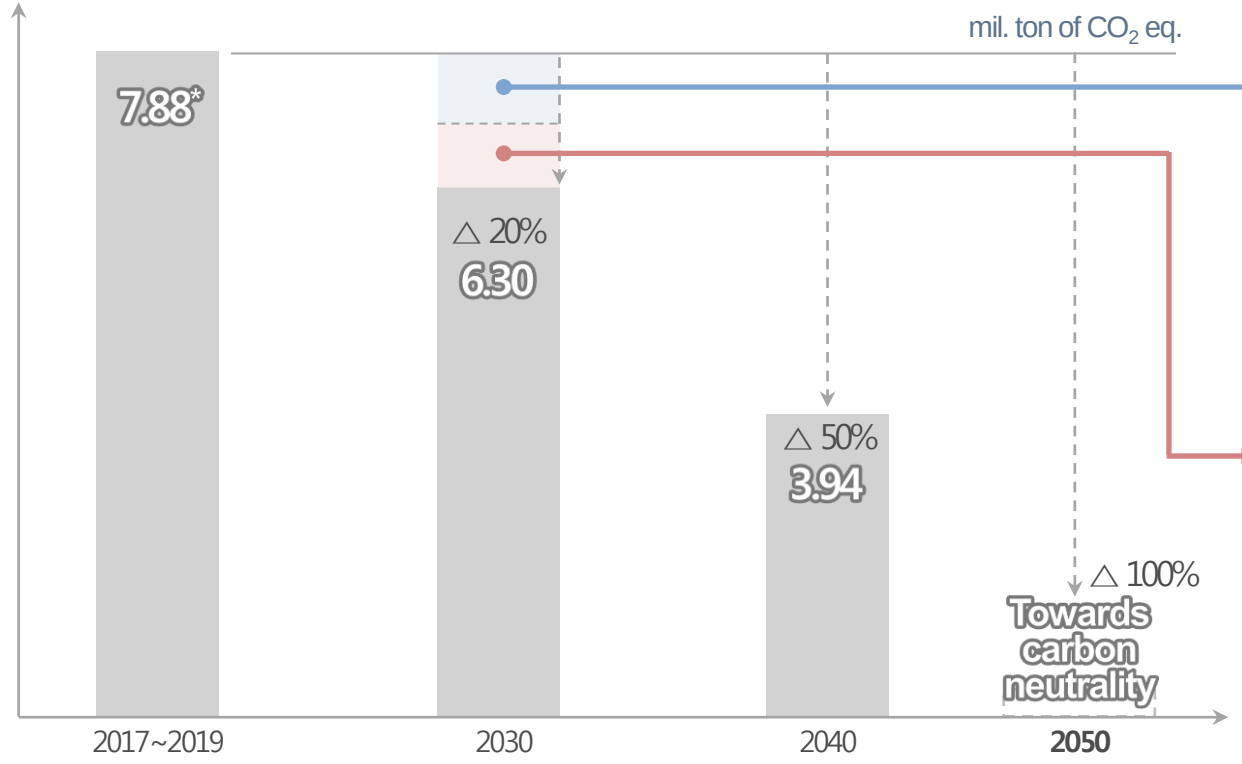
POSCO HyREX Process

III. Reduction Target by 2030

POSCO plans to reduce emissions by 20% by 2030.

The target includes the reduction of direct emissions from production sites and avoided emissions that occur in our value chain, especially from the use of by-products.

Performance in reducing emissions will be reviewed on an annual basis and **the emission reduction plan** will be updated every 10 years.



Direct Reduction
(△10% / 7.88 mil.ton↓**)**

- By improving energy efficiency
- By using low carbon raw materials (e.g., scrap, pellets and etc.)

Avoided Emissions
(△10% / 7.94 mil.ton↓**)**

- By providing energy-efficient steel products
- By recycling by-products

* Baseline: average of CO2 emissions from 2017 to 2019

IV. 1.5℃ Scenario and Business Opportunities

Following the TCFD guideline, **global investors such as BlackRock** have urged companies to align their business portfolio with the 1.5℃ scenario by identifying climate-related risks and seeking opportunities.
POSCO has defined three focus areas - **steel, rechargeable battery materials, hydrogen/LNG** - and has set a goal to achieve carbon neutrality by 2050.

	Steel	EV battery materials	Hydrogen/LNG
Risk	● Competitive markets focused on low carbon products ● Strengthened carbon regulations ● Increased electricity rate ● Increased exposure to natural disasters	● Early reduction of EV subsidies ● Decrease of EV demands with rise of electricity rate ● Delay in improving EV range to limit demand	● Monopoly power of KOGAS puts limits on business ● Price decline of crude oil ● Economics and safety issues
Oppor-tunities	● Improved cost competitiveness with breakthrough tech. ● Enhanced product competitiveness with energy-efficient steel	● Lower CO_2 emission than combustion engine vehicles ● EV market expansion	● Increase of LNG and hydrogen under the government's 9th basic plan for energy ● Biz expansion in linkage to current biz
Reduction Pathways	❖ Intermediate reduction targets : 20% by 2030 and 50% by 2040 ❖ Sales increase of EV steel plate ❖ Build portfolio to focus on low carbon products	❖ Increase sales of high capacity cathodes and anodes ❖ Expansion of lithium business and launch of EV battery recycling biz ❖ Cooperation with global EV players and battery suppliers	❖ Expansion of LNG import terminal biz ❖ Supply of high manganese steel for LNG carriers ❖ Build infra for FCEVs charged with by-product hydrogen ❖ Re-evaluation of coal business at Group level
2050 Carbon Neutrality	❖ Commercializaton of HyREX based on nationwide H_2 supply and renewable energy infrastructure	❖ Next generation battery materials ❖ High-capacity ESS materials for factories and buildings	❖ Power supply from microgrids paired with renewable energy and LNG ❖ Mass production of green H_2 with water electrolysis

V. Carbon Management and Disclosure

① Providing low carbon products and services to customers

② Implementing TCFD recommendations for investors

③ Building a low carbon supply chain

④ Pursuing dialogue with stakeholders

① Providing low-carbon products and services to customers

- POSCO has constantly been disclosing carbon information (e.g., carbon footprint, certified green products, renewable energy consumption) to its customers.
- The company obtained the EPD[1)] certification from the Ministry of Environment for 13 product groups[2)] that have contributed to reducing product carbon footprint in 2019.
- POSCO became Korea's first steelmaker to receive a "low-carbon product[3)] certification" by the Ministry of Environment for its thick plates and hot-rolled products in 2019.

Scope	Cradle-to-gate assessment of steel products that includes stages from raw material mining, transport, manufacturing to packaging
Inventories	Inventories sourced from the mining and transport of raw materials are provided by the Korea LCI DB and the Ecoinvent DB, while inventories from manufacturing and packaging are listed via the POSCO carbon management system.
Software	Customized S/W for EPD (e.g., TOTAL, ez EPD)

- The company will first provide REC (Renewable Energy Certificated) steel to RE100[4)] members. Mid-to long-term plans on securing renewables are under review.

1) The Environmental Product Declaration (EPD) is one of the Type III Environmental Declaration programs which was introduced in 2001 by the Korean Ministry of Environment to accurately disclose the environmental impact of products to consumers.
2) The product groups include steel plates, wire rods, hot rolled steel, cold rolled steel, hot-dip galvanized steel, electrical galvanized steel, electrical steel, stainless steel, PosMAC, etc.
3) Low-carbon product certificate is given to products with a carbon footprint certificate, under the condition that the product's GHG emission is less than the average emission of products in the same category
4) Renewable energy 100

② Implementing TCFD recommendations for investors

Climate change has been **the top agenda at POSCO's recent board meetings** and will continue to be. In accordance with the TCFD guideline,
the company studied new business opportunities based on the 1.5℃ scenario and developed business strategies on three focus areas.

- **Build comprehensive portfolio of eco-friendly, low-carbon products**
  - Sales increase of ultra high strength steel for EVs including PASS 2025
    POSCO Automotive Steel Strategy
  - Sales increase of high efficiency electrical steel
  - Development of bipolar plate for FCEVs
  - Development of high manganese steel for LNG carriers
  - Development of special steel products for wind turbine and photovoltaics
- **Expand EV battery materials business**
  - Development of high capacity anode and cathode for EV battery
  - Expansion of lithium business and launch of the EV battery recycling business
- **Expand hydrogen and LNG business**
  - Building infra for FCEVs charged with by-product hydrogen
  - Mass production of green hydrogen through water electrolysis
  - Expansion of LNG business and re-evaluation of the coal business

③ Building a low-carbon supply chain

- POSCO is to review investment in low-carbon materials, and build a low-carbon supply chain with global suppliers.

- In order to secure a stable supply of low-carbon materials, POSCO is reviewing opportunities to invest in the scrap business and long-term supply contracts.

- Furthermore, POSCO plans to sign long-term supply contracts with preferred low-carbon raw material suppliers.

④ Dialogue with stakeholders

- Technological breakthroughs are a key element in drastically reducing greenhouse gas emissions in the steelmaking process and for such advancements to be achieved, the respective roles of stakeholders (government included) and POSCO must be clearly defined for the parties to work in cooperation.
- While steelmakers focus on technology development and commercialization, R&D and infrastructure will be supported by the government.
- With greater customer demand for low-carbon products, co-development of low-carbon materials and a preferred supplier arrangement for procurement is a pre-requisite.
  Investors will rebuild investment portfolios with focus on the sustainability of steelmakers.

<Cooperation with stakeholders to achieve carbon neutrality by 2050>

① Countrywide infrastructure for the supply of green hydrogen and renewable energy

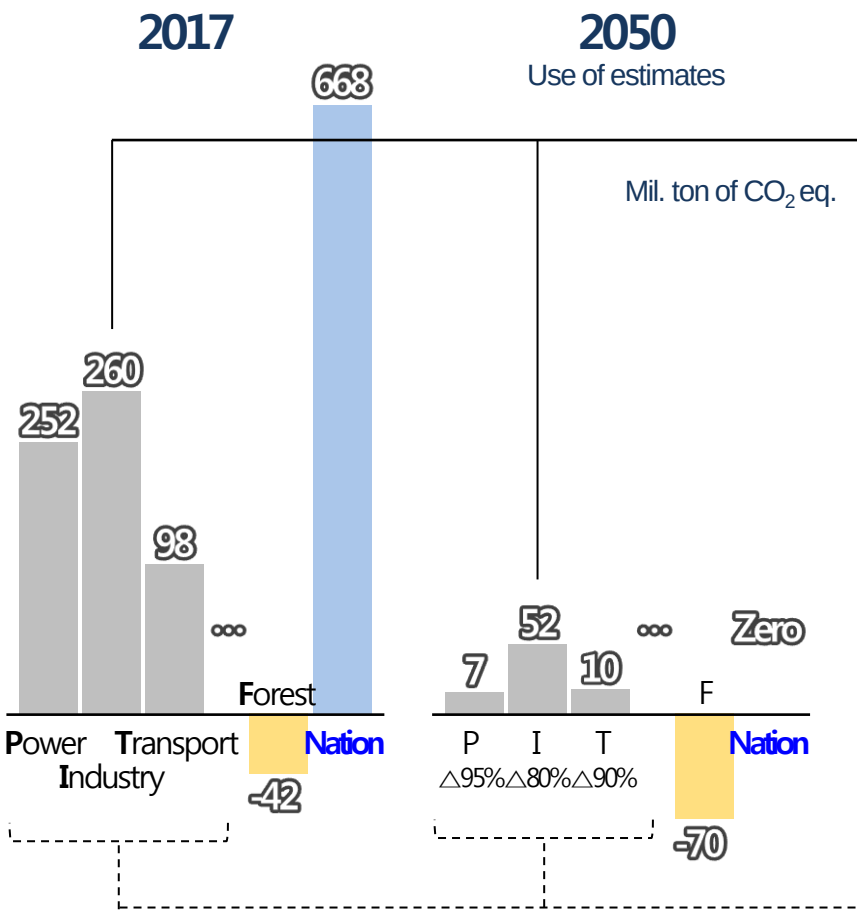
② Financial support for breakthrough technology development (e.g., hydrogen reduction iron and steelmaking process) and the shift towards a low-carbon (e.i., hydrogen-based) steelmaking process

③ Joint development of low-carbon products, procurement sourced from preferred low-carbon material suppliers

④ Including sustainable companies who have reported carbon emissions in the long-term investment portfolio

Appendix 1) Carbon Neutrality Plan of Government and POSCO

Government Target for 2050



POSCO Target for 2050

Direct reductions at operating sites are linked to government regulations (e.g., ETS)

Avoided emissions* are made by voluntary efforts, irrelevant to government regulations.

* The TCFD guideline recommends the disclosure of 1) avoided emissions target, 2) measures, key performance indicators for reduction pathways.

Appendix 2) Avoided CO_2 Emissions

The supply of low-carbon steel products can reduce up to 7.18 Mt of CO_2 eq. per year by 2030. Ultra high strength steel reduces the vehicle weight and consumes less fuel.

By using high efficiency electrical steel in electric motors, the voltage transformer consumes less power compared against the existing product.

Ultra high strength steel

Ultra high strength steel in vehicles can reduce **0.60 tCO_2 eq.** per year by reducing the vehicle weight and improving fuel consumption.

ton | thou.ton of CO_2eq.

연 도	2019	2025	2030
Ultra high strength steel sales	4,217	4,350	4,500
CO_2 reduction	2,530	2,610	**2,700**

High efficiency electrical steel

Non-Oriented (NO) electrical steel can reduce **0.48 tCO_2 eq.** per year by reducing power consumption compared against existing electric motors.

Grain-Oriented (GO) electrical steel can reduce **0.48 tCO_2 eq** per year, improving the power consumption of current voltage transformers.

ton | thou.ton of CO_2eq.

연 도	2019	2025	2030
High efficiency **NO** sales	221	345	350
CO_2 reduction	2,651	4,140	**4,200**
High efficiency **GO** sales	220	242	250
CO_2 reduction	249	270	**280**

Reusing steel slags can reduce up to 8.87 Mt of CO_2 eq. per year by 2030.

Water-cooled granulated slag, used to produce cement, can be a substitute for the cement clinker. Basic Oxygen Furnace (BOF) slag can be used to make the artificial reef TRITON* to cultivate a sea forest in desolate areas.

Slag cement

Slag cement can reduce **0.80 tCO_2 eq.** when using the one ton of granulated slag as a substitute for the cement clinker.

ton | thou.ton of CO_2eq.

연 도	2019	2025	2030
Slag sales for cement	10,587	10,800	10,900
CO_2 reduction	8,470	8,670	**8,720**

Silicate fertilizer

Silicate fertilizer containing granulated slag can reduce **0.48 tCO_2 eq.** per the one ton of fertilizer by limiting methane generation.

ton | thou.ton of CO_2eq.

연 도	2019	2025	2030
Slag sales for fertilizer	229	290	315
CO_2 reduction	110	140	**150**

TRION sea forest cultivation

TRITON made of BOF slag can reduce **0.37 $kgCO_2$ eq.** per square meter per year through blue carbon stored in coastal and marine ecosystems.

ha | thou.ton of CO_2eq.

연 도	2019	2025	2030
Accumulated cultivating area	26.2	40	49
CO_2 reduction	0.10	0.14	**0.18**

* TRITON is an artificial reef brand made with POSCO's steel slag which has proven to be safe for the environment as well as for marine life.

Providing EV battery materials* can reduce up to 5.90 Mt of CO_2 eq. per year by 2030.
EVs have better mileage than gasoline vehicles.

* e.g., lithium, cathode, anode)

Comparison of CO_2 emissions of EVs and gasoline vehicles

There is a **1.23 tCO_2 eq./year gap** between the two vehicles based on government data. Gasoline vehicles are estimated to emit **2.50 tCO_2 eq.** per year while EVs are estimated to emit **1.27 tCO_2 eq.**

thou. ton | thou.

Year	2019	2025	2030
Lithium Sales	0.1	72	216
EV production capacity	2	1,595	**4,800**
CO_2 reduction	2.5	1,970	**5,900**

* Data estimated based on Hyundai CONA EV and gasoline vehicles

EV production capacity by battery material type

thou. ton | thou.

Battery materials	Requirement (kg)	Material Sales			EV production capacity		
		2019	2025	2030	2019	2025	2030
Lithium	45	0.1	72	216	2	1,595	**4,800**
Anode	83.2	0.7	164	394	8	1,971	4,735
Cathode	51.2	1.1	88.5	172	21	1,728	3,359

Appendix 3) POSCO's Action on Climate Change

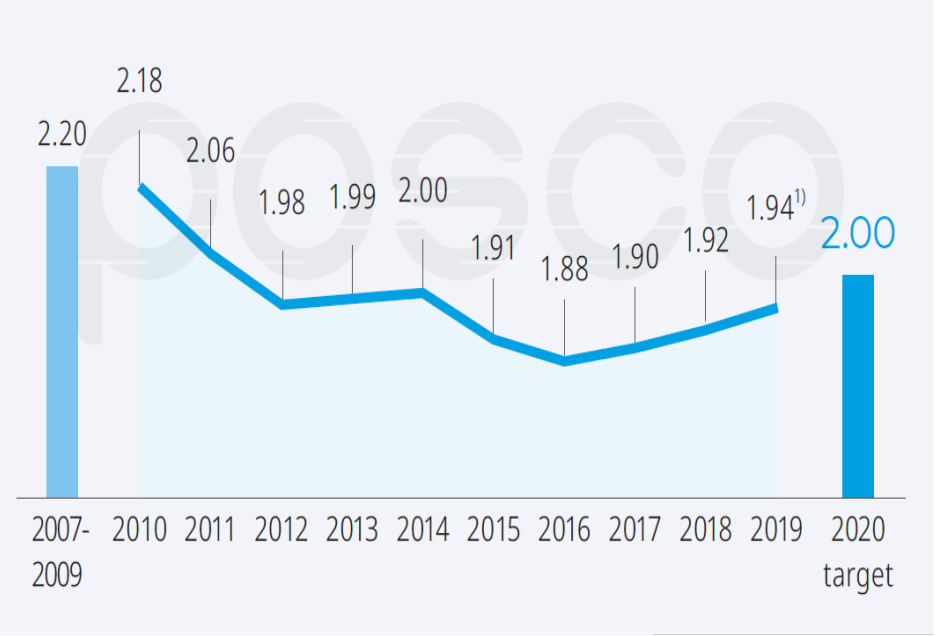
- **Company-wide strategies to cope with climate change** have been set up on an annual basis since 2002.
- POSCO has implemented the **GHG management system** since 2006.
- POSCO announced its voluntary **2020 GHG reduction target** in 2010.
- Korea's first **2009 Carbon Report by POSCO** was published in 2010.
- POSCO successfully achieved the target proposed in the **Korea GHG & Energy Target Management Scheme** from 2011 to 2014.
- **Korean Emissions Trading Scheme** (K-ETS) has been implemented since 2015.
- POSCO announced its **2050 Carbon Neutrality Plan on** December 11, 2020.

Appendix 4) 2020 Carbon Reduction Pathways

- POSCO declared the goal of reducing greenhouse gas emissions at the 7th Green Growth Committee chaired by the President of the Republic of Korea in February 2010.

- The target was to reduce CO_2 emissions intensity of 9% at the steelworks by 2020 against the average level of 2007-2009.

- Through ongoing energy saving efforts, the emission intensity target of 2.00 tCO2/t-S was surpassed.



Emissions were calculated in accordance with the government's Administrative Guideline.
- GHG: CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6
- Direct emissions (Scope 1) from steel production, fuel combustion, mobile combustion, and waste incineration
- Indirect emissions (Scope 2) from the use of purchased electricity

The above data covers our Pohang and Gwangyang Steelworks only, and this may lead to discrepancies against the inventory data submitted to the government. 1)The data does not include the emissions from the acquisition of the off-gas generation business in 2019.

Over the past decade, POSCO invested KRW 938 billion (approx. $827 million) in energy recovery equipment and process improvements.

The improvement of the power generation efficiency at the Gwangyang LNG Power Plant along with the installation of high energy efficiency invertors are some key examples.

Ongoing R&D projects with the goal of reducing CO_2 include:

- Smart blast furnace & sintering to reduce reducing agents
- Optimization of coke ovens and CDQ operations
- Replacing a proportion of coal with hydrogen in the iron making
- Carbon captured from by-product gas, CO_2 reuse technology

Coke Dry Quenching (CDQ) facility in operation at Pohang steelworks. The CDQ recovers the heat from the hot coke which is converted into electricity. Last year, approx. 140,000 tCO_2 was reduced via the CDQ. CDQs have been installed in all coke ovens except for one which is to be revamped by 2023.

Appendix 5) Carbon management system

- In 2002, **POSCO developed its own methodology** to calculate the amount of GHG emissions based on diverse global guidelines including those of **IPCC**[1], **WBCSD**[2], **WRI**[3], **worldsteel**, and **ISO 14404**[4].

- As a result, **the POSCO Carbon Management System** was launched in 2006 and has been implemented since. All activity data across operating sites are collected in real time through the manufacturing execution system (MES). Carbon emission factors are measured by analyzing the material carbon content % in KOLAS[5] certified laboratories.

- GHG inventories are listed from various sources - **cost centers, plants, and steelworks** - and have been used as the basic data for carbon management, ETS implementation, and carbon footprint analysis.

1) IPCC: Intergovernmental Panel on Climate Change
2) WBCSD: World Business Council for Sustainable Development
3) WRI: World Resources Institute
4) ISO 14404 : Calculation method of carbon dioxide emission intensity from iron and steel prod
5) Korea Laboratory Accreditation Scheme