

Korea's Experience with Country-Specific Emission Factors in the Energy Sector

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Dr. Dahae Choo | Head / Research Fellow

Department of Climate Change Policy Research, Korea Energy Economics Institute

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EMISSION TRENDS

Energy is Korea's single largest emitting sector

Energy has led every year since 1990; in 2023 it accounted for 77.1% of national emissions.

707.2 MtCO₂e

Total GHG Emissions in 2023

Net GHG Emissions – 667.8 MtCO₂e

545.0 MtCO₂e

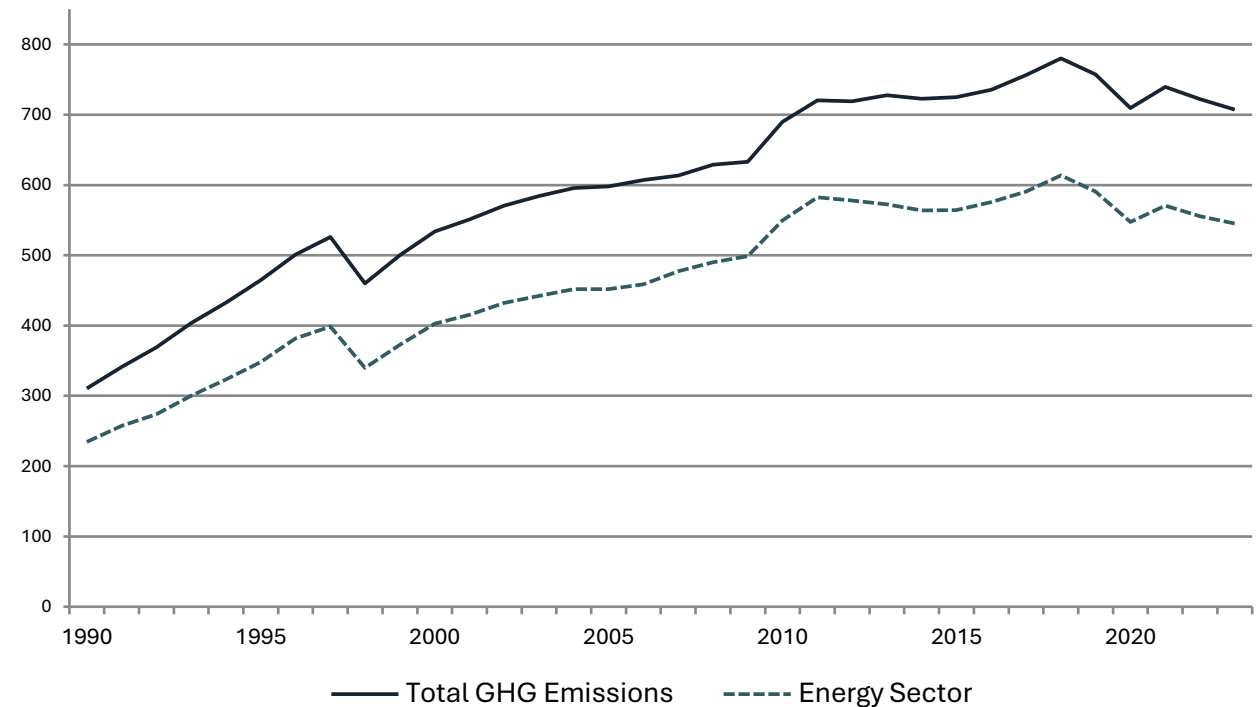
From Energy Sector

77.1% of The National Total

Driven by fuel combustion. Within the energy sector, fuel combustion rose from 98.6% (2000) to 99.4% (2023), reaching 541.7 Mt.

Structural cause. Korea's export-oriented, manufacturing-heavy economy has driven combustion emissions in energy industries and manufacturing upward with economic growth.

Total GHG Emissions and Emissions from the Energy Sector, 1990–2023



LEGAL FOUNDATION

Korea's country-specific factors rest on an explicit legal mandate

The governing statutes mandate the national GHG information system, GIR duties and factor management.

STATUTORY PATH

2010

Framework Act on Low Carbon, Green Growth

Established the national GHG information system and GIR.

2022

Carbon Neutrality and Green Growth Act

Current governing statute for development, verification and management of factors.

2020 GIR GUIDELINES

국가 온실가스 배출 · 흡수계수
개발 · 검증 지침

2020. 12

온실가스종합정보센터

CURRENT OPERATIVE PROVISIONS

Act. Article 36

Establishment of the National Greenhouse Management System

Enforcement Decree. Article 39

The GIR operates NGMS and develops, analyzes, verifies, compiles and manages GHG statistics — including emission/removal factors.

Regulation on Master Management of National GHG Statistics

Delegates detailed guideline to the GIR.

Guidelines for the Development and Validation of
National GHG Emission and Removal Factors

GUIDING PRINCIPLES

Five principles govern every factor

The 2020 GIR Guidelines establish principles, institutions, procedures and verification rules before any factor is built.

Development and Validation Principles

01 Accuracy

Reflect domestic emission/removal conditions so the inventory is neither over- nor under-estimated.

02 Suitability

Reflect the specific emission and removal characteristics of each sector.

03 Objectivity

Rest on clear criteria that a third party can accept — not subjective judgment.

04 Comparability

Apply the same standard across sources so results can be compared on equal terms.

05 Transparency

Document assumptions and methods clearly enough for third-party assessment and reproduction.

Validation Items and Elements

I	Development Methodology	1 Consistency with calculation guidelines 2 Suitability of methodology 3 Characteristics reflected
II	Factor Representativeness	4 Suitability of sample population 5 Adequacy of sample size
III	Measurement & Analysis Accuracy	6 Measurement/analysis method 7 Laboratory credibility 8 Instrument credibility
IV	Data Management	9 Adequacy of data management 10 Time-range consistency
V	QA / QC	11 Adequacy of QA/QC activities 12 Equivalence evaluation
VI	Uncertainty	13 Suitability of uncertainty method 14 Uncertainty evaluation

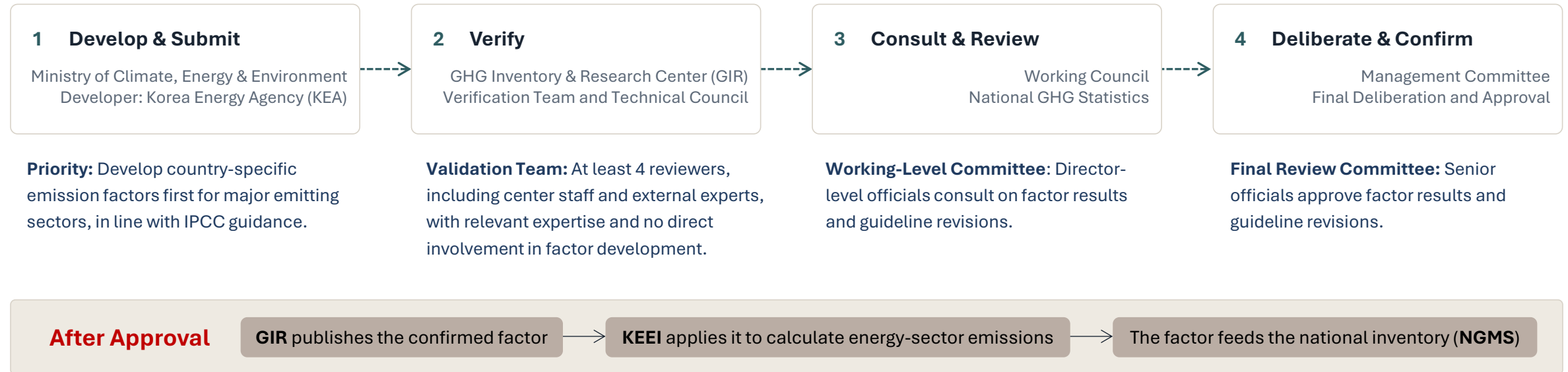
Each factor is reviewed against 6 items and 14 elements
by four or more reviewers who did not develop it

INSTITUTIONAL ARCHITECTURE

Development follows a four-stage pipeline

Energy-sector factors move from development and submission to verification, consultation, final deliberation and publication.

DEVELOPMENT PROCEDURE IN THE ENERGY SECTOR



Timing. The approval pipeline typically runs about 4–6 months, excluding the factor development period itself.

Objectivity. Separate institutions oversee factor development, validation, and application to ensure objectivity.

Transparency. Document and cross-check the emission factor development process, including QA/QC.

DEVELOPMENT RECORD

Country-specific factors were built first for the highest-emitting fuels

Coverage remains strongest for CO₂ and thinner for non-CO₂ gases, especially CH₄.

27

CO₂ country-specific factors

in use for fuel combustion as of 2026
(excl. transport & fisheries)

88.1%

2023 combustion emissions

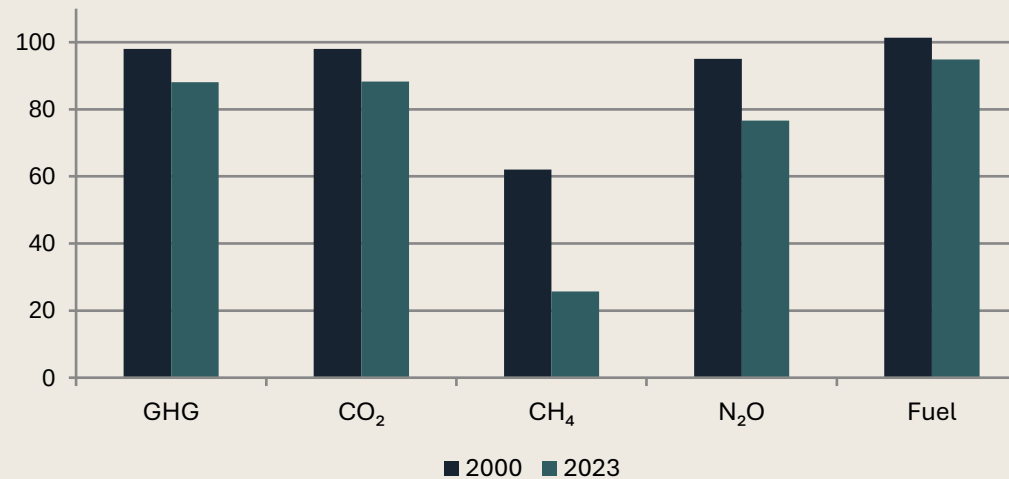
estimated with country-specific factors

98.0%

coverage at the outset

fuels with factors covered early
emissions

Country-specific factor coverage (%): 2000 vs. 2023



Coverage = share of combustion emissions excluding transport and fisheries estimated with country-specific factors developed in 2022.

DEVELOPMENT ROUNDS

2007

21 energy products — CO₂ country-specific factors developed

2012

Added energy products including imported anthracite and bituminous coal;
27 products total

2017

CH₄ and N₂O emission factors developed for power, heat-only and CHP

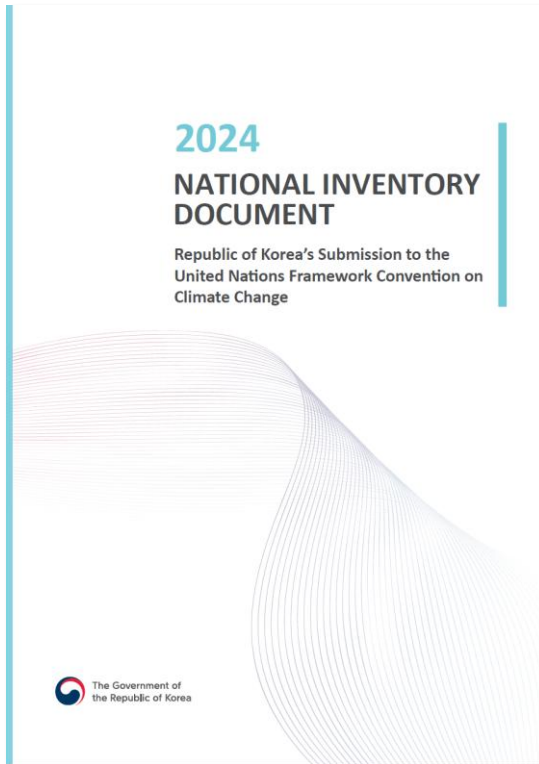
2022

CO₂ Emission factors updated across existing energy products

REPORTING & DOCUMENTATION

Report to the UNFCCC

Every country-specific factor used in the national inventory is documented in the NID and reported to the UNFCCC.



From Factors to the National Inventory

2024 National Inventory Document

Carbon Emission Factors

Table 3-10 | Carbon Emission Factor

		(Unit: t C/TJ)											
Fuel Type		1990 — 2006	2007 — 2011	2012 — 2016	2017 — 2021	2022	Fuel Type		1990 — 2006	2007 — 2011	2012 — 2016	2017 — 2021	2022
Petroleum	Crude Oil	20.0					Coal	Sub-bituminous Coal	26.2	29.3	26.2	26.468	26.868
	Orimulsion	21.0						Lignite/Brown coal	27.6				
	Natural Gas Liquids (NGL)	17.5						Oil Shale	29.1				
	Gasoline ⁽¹⁾	18.9	19.7	20.0	19.548	19.731		BKB & Patent Fuel	26.6				
	Jet Fuel ⁽²⁾	19.5	19.6	19.8	19.931	19.956		Coke	29.2				
	Boiler Kerosene ⁽³⁾	19.6	19.5	19.6	19.969	19.926		Coke Oven Gas	12.1				

1) Annex 6, Item 14: Petroleum Refining Activities in *Guidelines for Reporting and Certification of Emissions under the GHG Emissions Trading System*, Ministry of Environment (MOE)

CH₄ and N₂O Emission Factors

Table 3-17 | CH₄ and N₂O Emission Factors for Public Electricity and Heat Production¹⁾

		(Unit: kg/TJ)	
Fuel Type		CH ₄	N ₂ O
Coal ²⁾		0.25	1.66
Petroleum		0.15	1.75
Gas ³⁾		0.41	1.06

Note: 1) Default emission factors from the 2006 IPCC Guidelines were used from the 1990 to 2016 time period.
2) For solid waste and biomass such as municipal waste and solid biomass, emission factors of coal were applied based on expert judgment.
3) Emission factors of gas were applied for petroleum-based gases including refinery gas, propane and butane, coal-based gases including coke oven gas and blast furnace gas, and gaseous biomass including biogas and landfill gas.

Source: 2017 Country-specific Emission Factors, Greenhouse Gas Inventory and Research Center of Korea (GIR)

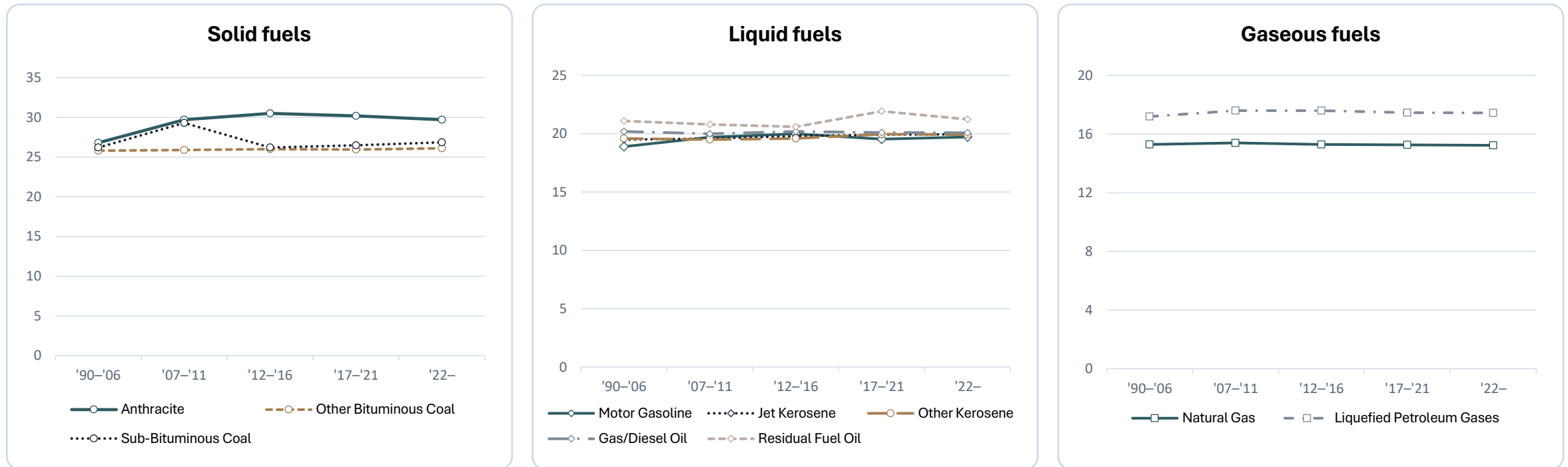
Fuel Type		1990 — 2006	2007 — 2011	2012 — 2016	2017 — 2021	2022	Fuel Type		1990 — 2006	2007 — 2011	2012 — 2016	2017 — 2021	2022		
	Indoor Kerosene ³⁾	19.6	19.5	19.6	19.969	19.926		Blast Furnace Gas	70.8						
	Shale Oil	20.0						Oxygen Steel Furnace Gas ⁹⁾	49.6						
	Diesel	20.2	20.0	20.2	20.111	20.090		Peat	28.9						
	B-A Oil	20.5 ⁴⁾	20.2	20.4	20.657	20.440		Coal Tar	22.0						
	B-B Oil	20.8 ⁴⁾	20.6	20.5	21.384	20.900		Gas	Natural Gas	15.3	15.4	15.3	15.312	15.281	
	B-C Oil	21.1	20.8	20.6	21.929	21.249	City Gas (LNG) ¹⁰⁾		15.3	15.4	15.3	15.272	15.236		
	By-product Fuel No. 1 ⁵⁾	20.0	20.0	19.7	20.067	20.165	City Gas (LPG)		17.2	17.6	17.6	17.454	17.453		
	By-product Fuel No. 2 ⁵⁾	20.0	20.0	21.0	21.729	21.877	Other Fossil Fuels	Municipal Waste (Non-renewable)	25.0						
	Propane	17.2	17.6	17.6	17.641	17.630		Industrial Waste	39.0						
	Butane	17.2	18.1	18.1	18.107	18.094	Other Non-Fossil Fuels	Municipal Waste (Renewable)	27.3						
	Ethanol	16.8				Biomass	Wood/Wood Waste	30.5							
	Naphtha	20.0	18.6	19.2	19.157		19.083	Sulfite Lye	26.0						
	White spirit & SBP	20.0	19.4	19.3	19.172		19.128	Other Primary Solid Biomass	27.3						
	Bitumen	22.0	21.5	21.6	21.544		21.473	Charcoal	30.5						
	Lubricants	20.0	19.7	19.9	19.979		19.897	Biogasoline	19.3						
	Petroleum Coke	26.6	27.2	27.2 ⁶⁾	26.086		26.192	Biodiesel	19.3						
	Refinery Gas	15.7					Other Liquid Biofuels	21.7							
	Other Oil Products ⁷⁾	20.0	20.0	19.7	20.067		20.165	Landfill Gas	14.9						
	Coal	Domestic Anthracite	26.8	29.7	30.5		30.185	29.705		Sludge Gas	14.9				
		Imported Anthracite (Fuel) ⁸⁾	26.8	26.8	28.6		27.404	27.320		Other Biogas	14.9				
Imported Anthracite (Feedstock) ⁹⁾		26.8	26.8	29.2	29.909	28.990	: Country-specific emission factors								
Coking Coal ¹¹⁾		25.8	25.8	26.2	25.963	25.349	: Default emission factors from the 2006 IPCC Guidelines								
Other Bituminous		25.8	25.9	26.0	25.951	26.105									

Country-specific emission factors
Default emission factors from the 2006 IPCC Guidelines

COUNTRY-SPECIFIC EMISSION FACTORS

Factor values move differently by fuel group

Unit: t C/TJ. Panels use separate scales so fuel-specific movement is visible.



- The figure shows trends in country-specific emission factors for selected solid, liquid, and gaseous fuels and the 1990–2006 point is the IPCC default.
- Values vary above and below the IPCC defaults, with no consistent direction, yet country-specific emission factors tend to stabilize in recent years.
- Liquid fuels show greater variation over time, reflecting changes in crude oil import sources.

LESSONS LEARNED & TAKEAWAY

Korea’s experience offers three practical lessons

Three lessons for building and sustaining country-specific factors under the enhanced transparency framework.

01 Built where it matters most

National factors may be higher or lower than IPCC defaults. Korea develops country-specific factors for key emission sources to improve transparency and better reflect national conditions.

02 Standardized across the inventory

The Guidelines establish standardized principles and procedures, ensuring the quality of country-specific factors across the entire national inventory—not just the energy sector.

03 Updated on a cycle

Priority sources vary with industrial structure and climate policies, requiring national factors to be periodically updated to maintain inventory accuracy.

NEXT DEVELOPMENT PRIORITIES

Bio-energy Country-specific factors for sources now entering the fuel mix.

Non-CO₂ Refine CH₄ and N₂O factors where coverage is thinnest.

Industry Extend development into industrial sub-sectors beyond current combustion categories.

LOOKING
AHEAD
2027

Ahead of the 2027 update, KEEI is preparing the inventory calculations to ensure newly approved factors are promptly reflected in national statistics.

Thank you

Dr. Dahae Choo
dhchoo@keei.re.kr

Korea Energy Economics Institute