

South Korea Steel Policy and Green Transformation 2024-2025

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1 Executive Summary

South Korea's steel industry, anchored by POSCO, the world's leading steelmaker by competitiveness, stands at a critical transformation point as the nation pursues carbon neutrality by 2050. As the world's sixth-largest steel producer with approximately 68-70 million tonnes of annual crude steel production, South Korea has built a reputation for technological excellence, quality manufacturing, and efficient operations despite complete dependence on imported raw materials.

The Korean steel sector faces unique challenges: 100% reliance on imported iron ore and coking coal, high population density constraining facility expansion, intense global competition from China and other Asian producers, and the imperative to decarbonize while maintaining export competitiveness. However, the industry possesses significant strengths including world-class technology, strong government support, advanced manufacturing capabilities, and strategic positioning in high-value automotive and shipbuilding supply chains.

This document analyzes South Korea's comprehensive policy framework for steel industry decarbonization, POSCO's pioneering HyREX hydrogen reduction technology, government investment programs, export market dynamics, raw material security strategies, and the pathway toward establishing Korea as a global leader in green steel production.

2 Industry Structure and Production Capacity

2.1 Production Statistics

- **Global Ranking:** Sixth-largest steel producer worldwide
- **Annual Production:** 68-70 million tonnes crude steel (2024)
- **Technology Mix:** Approximately 68% blast furnace-basic oxygen furnace (BF-BOF); 32% electric arc furnace (EAF)
- **Export Orientation:** Approximately 30-35% of production exported
- **Quality Focus:** Specialization in high-grade automotive, shipbuilding, and construction steels
- **Per Capita Production:** Among world's highest at approximately 1,350 kg per person

2.2 Key Production Centers

- **Pohang:** POSCO's original integrated steel complex (North Gyeongsang Province)
- **Gwangyang:** POSCO's second major integrated facility (South Jeolla Province)
- **Other Locations:** Hyundai Steel facilities and various EAF mini-mills nationwide

2.3 Product Specialization

- **Automotive Steel:** High-strength, lightweight steels for vehicle manufacturing
- **Shipbuilding Plates:** Thick plates for commercial and military vessels
- **Construction Steel:** High-rise building structural materials
- **Electrical Steel:** Transformer and motor cores
- **Stainless Steel:** Corrosion-resistant products for diverse applications
- **Premium Products:** Advanced high-strength steels, electrical steels, specialty alloys

3 POSCO: Global Steel Leader

3.1 Company Profile

Market Position:

- World's most competitive steelmaker (World Steel Dynamics ranking, multiple years)
- Annual production capacity: Approximately 43 million tonnes
- Integrated operations including iron ore mining investments
- Global presence with facilities in Asia, Americas, and other regions
- Market capitalization among largest steel companies globally

Competitive Advantages:

- Technological leadership in steelmaking processes
- Exceptional quality control and consistency
- High-value product mix generating premium pricing
- Strategic customer relationships with major automotive and shipbuilding companies
- Continuous innovation and R&D investment

3.2 Carbon Neutrality Commitment

2050 Carbon Neutrality Vision:

- Announced comprehensive decarbonization roadmap
- **2030 Interim Target:** 10% reduction in CO₂ emissions
- **2040 Target:** 50% reduction
- **2050 Target:** Net-zero emissions across operations
- Multi-pathway approach combining hydrogen reduction, EAF expansion, and CCUS

Investment Commitment:

- Pledged over 9 trillion won (approximately 7 billion USD) through 2030 for decarbonization
- Focus on breakthrough technology development
- Infrastructure investments for hydrogen and renewable energy
- Facility modernization and process optimization

3.3 HyREX Technology Development

Hydrogen Reduction Technology:

- **HyREX (Hydrogen Reduction):** POSCO's proprietary hydrogen-based ironmaking technology
- **Innovation:** Uses low-grade iron ore with hydrogen reduction, unlike competitors requiring high-grade DR-grade ore
- **Cost Advantage:** Potential for lower capital and operational costs
- **Resource Flexibility:** Expands usable iron ore reserves globally

Development Timeline:

- **2023:** Successful pilot plant demonstration
- **2024-2025:** Scale-up engineering and commercial plant design
- **2027-2028:** First commercial-scale HyREX plant target
- **2030s:** Full deployment replacing blast furnace capacity
- **2040:** Majority of primary steelmaking via HyREX

Technical Specifications:

- Uses fluidized bed reactor technology
- Capable of processing iron ore fines without agglomeration
- Integration with electric arc furnaces for steel production
- Potential for 90%+ CO₂ emission reductions when using green hydrogen
- Modular design allowing phased implementation

Global Licensing Potential:

- Technology licensing to international steel producers
- Revenue generation from intellectual property
- Positioning POSCO as green steel technology leader
- Potential partnerships for global deployment

4 Government Policy Framework

4.1 Korean New Deal and Green New Deal

Overview:

- Comprehensive national strategy for economic transformation
- Steel industry identified as priority sector for decarbonization
- Government investment in low-carbon manufacturing technologies
- Integration with broader climate and industrial policies

Steel Sector Components:

- R&D funding for breakthrough technologies
- Infrastructure support for hydrogen economy
- Incentives for facility modernization
- Export promotion for green steel products

4.2 2050 Carbon Neutrality Strategy

National Commitment:

- Presidential declaration of 2050 net-zero target
- Steel industry contributing approximately 15% of industrial emissions
- Sector-specific pathways and targets
- Alignment with international climate commitments

Implementation Framework:

- Carbon pricing mechanisms development
- Green finance and low-interest loans for decarbonization projects
- Tax incentives for clean technology adoption
- Public procurement preferences for low-carbon steel

4.3 Hydrogen Economy Roadmap

National Hydrogen Strategy:

- Target: World's top hydrogen economy by 2050
- Massive investment in hydrogen production, storage, and distribution
- Steel industry identified as major hydrogen consumer
- International cooperation for hydrogen imports

Hydrogen Supply Development:

- **Domestic Production:** Renewable electricity-based electrolysis
- **Imports:** Strategic partnerships for green and blue hydrogen
- **Infrastructure:** Pipelines, storage facilities, port terminals
- **Cost Targets:** Reducing hydrogen costs to competitive levels for steel industry (below 2 USD per kg)

Steel Industry Integration:

- Co-location of hydrogen production with steel facilities
- Dedicated hydrogen supply for POSCO and Hyundai Steel
- Government support for hydrogen infrastructure investment
- Pilot projects demonstrating hydrogen-based steelmaking

4.4 Industrial Technology Innovation Programs

Government R&D Support:

- **Ministry of Trade, Industry and Energy (MOTIE):** Leading industrial decarbonization programs
- **Korea Institute of Industrial Technology:** Research collaboration with steel companies
- **Funding Mechanisms:** Grants, matching funds, tax credits for innovation
- **Technology Commercialization:** Support for scaling pilot technologies

Focus Areas:

- Hydrogen reduction technologies
- Advanced electric arc furnace systems
- Carbon capture, utilization, and storage
- Energy efficiency improvements
- Process optimization and automation
- Artificial intelligence for steelmaking optimization

5 Hyundai Steel

5.1 Company Profile

Market Position:

- Second-largest Korean steelmaker
- Annual production capacity: Approximately 22 million tonnes
- Part of Hyundai Motor Group
- Specialization in automotive and construction steels
- Both integrated (BF-BOF) and EAF operations

Strategic Focus:

- Vertical integration with automotive manufacturing
- High-strength steels for lightweight vehicles
- Technology collaboration with Hyundai Motor Company
- Export orientation to Asian and other markets

5.2 Decarbonization Strategy

Carbon Neutrality Goals:

- 2050 net-zero commitment aligned with national targets
- Phased approach to emissions reduction
- Investment in EAF expansion
- Evaluation of hydrogen-based technologies

Technology Pathways:

- Increasing EAF share of production
- Renewable electricity procurement for EAF operations
- Collaboration on hydrogen supply infrastructure
- Energy efficiency optimization across facilities
- Potential CCUS implementation for BF operations during transition

6 Raw Material Security Challenges

6.1 Iron Ore Dependency

Import Reliance:

- 100% dependence on imported iron ore
- Annual imports: Approximately 75-80 million tonnes
- Major suppliers: Australia, Brazil, India
- Strategic vulnerability to supply disruptions and price volatility

Mitigation Strategies:

- **Diversification:** Multiple supplier relationships
- **Equity Investments:** POSCO and others investing in overseas mining projects
- **Long-Term Contracts:** Securing stable supply through multi-year agreements
- **Stockpiling:** Strategic reserves to buffer short-term disruptions
- **HyREX Advantage:** Technology enabling use of lower-grade, more abundant ores

Strategic Investments:

- Australian iron ore mine equity stakes
- Brazilian mining partnerships
- Exploration and development projects in Africa
- Technology for improved ore utilization efficiency

6.2 Coking Coal Dependency

Import Reliance:

- 100% dependence on imported coking coal
- Annual imports: Approximately 30-35 million tonnes
- Major suppliers: Australia, Canada, United States
- Supply chain vulnerabilities and price exposures

Strategic Response:

- Supplier diversification efforts
- Efficiency improvements reducing per-tonne consumption
- Transition to hydrogen-based technologies eliminating coking coal need
- Alternative reductant research (biomass, waste plastics)

6.3 Scrap Steel Resources

Domestic Generation:

- Growing scrap availability from end-of-life products
- Automotive scrap from vehicle fleet turnover
- Construction and demolition scrap
- Industrial processing scrap

Infrastructure Development:

- Modern scrap collection and sorting facilities
- Quality grading systems for different applications
- Scrap export restrictions to ensure domestic supply
- Investment in scrap processing technologies

EAF Expansion Support:

- Adequate scrap supply for current 32% EAF share
- Potential constraints if EAF share increases significantly
- Import considerations for high-quality scrap
- DRI/HBI as supplement to scrap for EAF feedstock

7 Export Markets and Competitiveness

7.1 Major Export Destinations

Regional Distribution:

- **Southeast Asia:** Major market for diverse steel products
- **China:** Selected high-value specialty steels
- **Middle East:** Construction and infrastructure steel
- **Americas:** Automotive and specialty products
- **Europe:** Limited but high-value shipments

Product Specialization:

- High-strength automotive steels commanding premium pricing
- Shipbuilding plates for global shipyard industry
- Electrical steels for transformer manufacturers
- Stainless and specialty steels for diverse applications

7.2 Competitive Challenges

Chinese Competition:

- Massive Chinese production capacity (over 1 billion tonnes)
- Price competition in commodity steel grades
- Chinese quality improvements threatening Korean market share
- Government subsidies creating uneven competition

Japanese Competition:

- Historical competitor with similar quality focus
- Technology leadership in certain specialty products
- Both countries pursuing green steel transformation
- Potential for collaboration on decarbonization technologies

Rising Producers:

- Vietnam, Indonesia, other Southeast Asian countries expanding capacity
- Lower labor costs creating price pressures
- Korean technology and equipment exports supporting competitors
- Need for continuous quality and technology advantages

7.3 Green Steel Opportunity

Market Positioning:

- Early mover in hydrogen-based steelmaking with HyREX
- Potential premium pricing for certified low-carbon steel
- European market access through green credentials
- Automotive customers demanding sustainable supply chains

Certification and Standards:

- Participation in global green steel initiatives
- Product carbon footprint certification
- Alignment with Responsible Steel and similar frameworks
- Environmental product declarations for key products

First-Mover Advantages:

- Technology licensing revenue potential from HyREX
- Brand differentiation in premium markets
- Long-term customer relationships based on sustainability
- Avoiding carbon border adjustment mechanism penalties

8 Technology Development and Innovation

8.1 Research and Development Investment

Corporate R&D:

- POSCO maintaining R&D spending at 2-3% of revenues
- Dedicated research facilities and laboratories
- Collaboration with universities and research institutes
- International partnerships for technology development

Government Support:

- MOTIE funding for strategic technology projects
- Tax incentives for R&D expenditure
- Co-funding for high-risk, high-reward innovations
- Technology commercialization support programs

8.2 Advanced Manufacturing Technologies

Industry 4.0 Integration:

- Artificial intelligence for process optimization
- Big data analytics for quality control
- Internet of Things sensors throughout production
- Digital twins for facility simulation and optimization
- Predictive maintenance reducing downtime

Automation and Robotics:

- Advanced robotics for hazardous operations
- Automated material handling and logistics
- Remote monitoring and control systems
- Workforce augmentation rather than replacement focus

8.3 Product Innovation

Advanced High-Strength Steels:

- Ultra-high-strength steels for automotive lightweighting
- Third-generation advanced high-strength steels (3G AHSS)
- Improved formability and crash performance
- Enabling electric vehicle design optimization

Electrical Steels:

- High-efficiency grain-oriented electrical steels
- Non-oriented electrical steels for motors
- Critical for electric vehicle and renewable energy applications
- Continuous improvement in magnetic properties

Specialty Products:

- High-performance alloys for extreme environments
- Corrosion-resistant products for marine applications
- Precision steels for machinery and equipment
- Customized solutions for specific customer needs

9 Domestic Market Dynamics

9.1 Construction Sector

Demand Drivers:

- High-rise building construction in major cities
- Infrastructure renewal and expansion projects
- Industrial facility construction
- Housing development programs

Market Characteristics:

- High quality standards for seismic performance
- Preference for domestic steel for national projects
- Competitive pricing environment
- Cyclical demand patterns following economic conditions

9.2 Automotive Industry

Strategic Importance:

- Hyundai-Kia automotive group among world's largest
- Vertical integration providing stable demand
- Technology collaboration on material development
- Export-oriented production requiring competitive steel pricing

EV Transition Impact:

- Electric vehicles requiring different steel grades
- Lightweight, high-strength steels critical for battery vehicle range
- Potential overall steel content reduction per vehicle
- New opportunities in electrical steel for motors
- Battery pack structural components

9.3 Shipbuilding Industry

Global Leadership:

- Korean shipyards among world's largest
- Specialization in LNG carriers, container ships, tankers
- High-quality thick plates for ship hulls
- Close collaboration between steel producers and shipbuilders

Steel Requirements:

- Thick plates with specific mechanical properties
- Corrosion-resistant steels for marine environments
- Cryogenic steels for LNG containment systems
- Consistent quality essential for vessel safety and certification

10 Environmental Policies and Regulations

10.1 Emissions Trading System

Korean ETS:

- Comprehensive carbon pricing mechanism
- Steel industry included as covered sector
- Emissions allowances allocated and traded
- Price signals encouraging emissions reductions

Industry Implications:

- Carbon costs factored into production economics
- Incentive for efficiency improvements and technology investments
- Potential competitiveness impacts requiring careful policy balance
- Gradual tightening of caps driving long-term transformation

10.2 Air Quality Regulations

Stringent Standards:

- Particulate matter emission limits
- SOx and NOx controls for steelmaking facilities
- Continuous monitoring and reporting requirements
- Penalties for non-compliance

Compliance Investments:

- Advanced emission control technologies
- Electrostatic precipitators and bag filters
- Desulfurization and denitrification systems
- Process modifications for cleaner operations

10.3 Circular Economy Initiatives

Steel Recycling:

- High recycling rates for steel products
- Extended producer responsibility programs
- Scrap collection and processing infrastructure
- Quality management for recycled materials

By-Product Utilization:

- Slag utilization in cement and construction
- Waste heat recovery for electricity generation
- Water recycling and closed-loop systems
- Zero-waste facility goals

11 International Collaboration

11.1 Japan-Korea Steel Dialogue

Bilateral Cooperation:

- Regular ministerial-level consultations
- Technology development collaboration
- Best practices sharing on decarbonization
- Joint research projects on hydrogen steelmaking
- Trade facilitation and standards harmonization

Despite Political Tensions:

- Historical issues sometimes affecting bilateral relations
- Steel industry maintaining technical cooperation
- Mutual interest in green technology leadership
- Competition and collaboration coexisting

11.2 Global Steel Initiatives

Responsible Steel:

- POSCO certified under Responsible Steel standard
- Commitment to ESG principles
- Transparency in sustainability reporting
- Third-party verification of environmental and social performance

SteelZero and Other Platforms:

- Participation in global decarbonization initiatives
- Buyer-supplier collaboration on green steel
- Technology and policy knowledge sharing
- Market development for low-carbon steel products

11.3 Technology Partnerships

International Collaborations:

- Partnerships with European steel companies on hydrogen technologies
- Joint ventures for iron ore and raw material security
- Equipment suppliers from Germany, Italy, and other countries
- Research collaborations with global universities and institutes

12 Workforce and Social Dimensions

12.1 Employment and Skills

Workforce Characteristics:

- Highly skilled and educated workforce
- Strong engineering and technical capabilities
- Aging workforce in some facilities requiring renewal
- Competitive wages by regional standards

Skills Transition:

- Training programs for new green steel technologies
- University partnerships for talent development
- Emphasis on digital skills and automation
- Continuous learning culture in major companies

12.2 Labor Relations

Union Presence:

- Strong union representation in major steel companies
- Collective bargaining on wages and conditions
- Generally constructive labor-management relations
- Occasional strikes during contract negotiations

Transition Management:

- Consultation on facility modernization impacts
- Job security considerations in transformation planning
- Retraining and redeployment programs
- Balancing automation with employment preservation

12.3 Community Impacts

Steel Town Economics:

- Pohang and Gwangyang economies heavily dependent on steel
- Multiplier effects throughout local service sectors
- Corporate social responsibility programs supporting communities
- Infrastructure and cultural investments by steel companies

13 Challenges and Opportunities

13.1 Key Challenges

1. **Raw Material Dependency:** 100% import reliance for iron ore and coking coal creating vulnerability to supply disruptions and price volatility
2. **Hydrogen Economics:** Need for low-cost green hydrogen (below 2 USD per kg) for HyREX viability; current production costs significantly higher
3. **Chinese Competition:** Massive overcapacity and state support in China pressuring prices and market share
4. **Space Constraints:** High population density limiting facility expansion options; need for brownfield transformations
5. **Energy Costs:** Dependence on imported energy creating cost pressures; need for competitive renewable electricity
6. **Technology Scale-Up:** HyREX and other technologies proven at pilot scale; commercial deployment risks remain
7. **Capital Requirements:** Multi-trillion won investments needed for comprehensive decarbonization
8. **Policy Uncertainty:** Carbon pricing and regulatory frameworks evolving; long-term clarity needed for investment decisions
9. **Global Coordination:** Lack of international green steel standards; carbon border mechanisms creating complexity
10. **Market Transition:** Uncertain customer willingness to pay premiums for green steel; market development challenges

13.2 Strategic Opportunities

1. **Technology Leadership:** HyREX positioning Korea as green steel innovation leader; licensing revenue potential
2. **Premium Market Access:** Early decarbonization enabling European and other premium market penetration
3. **Automotive Integration:** Strong domestic automotive industry providing stable demand for advanced steels
4. **Quality Reputation:** Established brand for high-performance steel supporting price premiums

5. **Government Support:** Strong policy framework and financial incentives for transformation
6. **Hydrogen Economy:** National commitment to hydrogen infrastructure benefiting steel sector
7. **Regional Hub:** Potential to serve as Asian green steel technology center
8. **First-Mover Advantage:** Early market positioning in premium green steel segments
9. **Diversified End-Uses:** Strong shipbuilding, construction, and manufacturing sectors providing balanced demand
10. **Innovation Culture:** Continuous R&D investment and technology adoption capability

14 Policy Recommendations

1. **Accelerate Hydrogen Infrastructure:** Prioritize hydrogen production, storage, and distribution to achieve cost targets below 2 USD per kg for steel industry
2. **Expand Government Co-Investment:** Increase direct funding for HyREX and other breakthrough technology commercialization to de-risk private investments
3. **Raw Material Security:** Strengthen strategic partnerships for iron ore and coking coal; increase equity stakes in overseas mining projects
4. **Green Steel Standards:** Lead regional efforts to establish common definitions and certification for low-carbon steel products
5. **Carbon Price Predictability:** Provide long-term carbon pricing trajectory to enable confident investment planning
6. **Public Procurement:** Implement buy-clean policies favoring low-carbon steel in government infrastructure projects
7. **Technology Export Promotion:** Support HyREX licensing and Korean steel technology exports to generate revenue and global influence
8. **Scrap Infrastructure:** Continue investment in high-quality scrap sorting and processing to support EAF expansion
9. **Regional Cooperation:** Deepen collaboration with Japan, ASEAN, and other partners on decarbonization technologies and standards
10. **Workforce Development:** Expand training programs for green steel technologies; partnership with universities and technical schools
11. **Market Development:** Support industry efforts to create demand for premium green steel through certification and customer education
12. **Energy Security:** Accelerate renewable energy deployment to provide competitive clean electricity for steel production

15 Comparative Advantages and Global Position

15.1 Versus China

Korean Strengths:

- Superior quality control and consistency
- Advanced technology and innovation capability
- Early green steel leadership positioning
- Established reputation for premium products
- Responsive customer service and technical support

Chinese Advantages:

- Massive scale economies
- Lower labor and production costs
- Comprehensive domestic supply chains
- Government support and financing
- Rapidly improving quality capabilities

Strategic Response:

- Focus on high-value specialty products
- Technology differentiation through HyREX
- Green credentials for premium markets
- Avoid commodity steel price competition

15.2 Versus Japan

Similar Characteristics:

- Quality-focused production strategies
- Raw material import dependencies
- Advanced technology capabilities
- Export-oriented industries
- Decarbonization imperatives

Korean Competitive Edge:

- HyREX using low-grade ore (versus Japan's focus on high-grade DRI)
- More aggressive EAF expansion (32% vs Japan's 24%)
- Integrated automotive supply chains
- Younger facilities on average

Japanese Strengths:

- Longer R&D tradition in some specialties
- Superior electrical steel technology
- Established European market presence
- COURSE50 hydrogen reduction technology

15.3 Versus European Producers

Korean Advantages:

- Lower production costs
- Modern facilities and equipment
- Strong government support for transformation
- Growing technology leadership in green steel

European Strengths:

- Established premium market access
- Carbon border adjustment creating protection
- Strong sustainability credentials
- Advanced specialty steel capabilities

16 Future Scenarios and Outlook

16.1 Baseline Scenario: Successful Transformation (2025-2050)

Key Assumptions:

- HyREX commercialization successful by 2027-2028
- Government maintains policy support and funding
- Hydrogen costs decline to competitive levels
- Global green steel markets develop as anticipated

Industry Trajectory:

- **2030:** 10-15% of primary steelmaking via hydrogen reduction; 40% EAF share
- **2040:** 50-60% hydrogen-based production; 50% EAF share; majority of BF capacity retired
- **2050:** Near-complete transition to hydrogen-DRI-EAF route; net-zero operations achieved
- Production capacity maintained at 65-70 million tonnes annually
- Export competitiveness preserved through technology leadership
- Premium pricing for certified green steel products
- POSCO licensing HyREX technology globally generating significant revenue

16.2 Optimistic Scenario: Green Steel Leadership

Favorable Developments:

- HyREX proves superior to competing technologies
- Rapid hydrogen cost reductions (below 1.50 USD per kg by 2030)
- Strong global demand for green steel with substantial premiums
- Korean government increases support beyond current commitments

Outcomes:

- Korea becomes recognized global leader in green steel
- Substantial technology export revenue from HyREX licensing
- Market share gains in premium European and North American segments
- Expansion of production capacity to 75-80 million tonnes
- Attraction of foreign investment in Korean green steel ecosystem
- Regional hub status for Asian green steel development

16.3 Challenging Scenario: Delayed Transition

Risk Factors:

- HyREX scale-up encounters technical difficulties
- Hydrogen costs remain above 2.50 USD per kg through 2035
- Chinese competitors rapidly adopt competing green technologies
- Global green steel premiums fail to materialize
- Policy support weakens due to economic pressures

Consequences:

- Continued reliance on blast furnace operations through 2040s
- Loss of first-mover advantages in green steel
- Market share erosion to lower-cost or greener competitors
- Difficulties accessing European markets due to CBAM
- Production capacity declining to 55-60 million tonnes
- Competitiveness pressures on profitability and investment capacity

17 Integration with National Economic Strategy

17.1 Manufacturing Competitiveness

Steel as Foundation:

- Competitive steel critical for automotive, shipbuilding, construction, and machinery sectors
- Quality and availability of steel affecting downstream industries
- Green steel enabling sustainable positioning for Korean manufactured products
- Technology leadership generating spillover benefits across manufacturing

17.2 Export Strategy

Value-Added Exports:

- Transition from commodity to premium steel exports
- Bundling green steel with Korean automotive and industrial exports
- Technology exports (HyREX licensing, equipment, consulting)
- Sustainability credentials supporting Korean brand globally

17.3 Energy Independence

Hydrogen Economy Integration:

- Steel industry as anchor customer for hydrogen infrastructure
- Scale enabling cost reductions benefiting other sectors
- Technology development applicable beyond steel
- Reduced dependence on imported fossil fuels

18 Conclusion

South Korea's steel industry stands at a defining moment with the potential to transition from a quality-focused follower to a global green steel technology leader. POSCO's HyREX technology represents a breakthrough innovation that could reshape hydrogen-based steelmaking globally by enabling use of abundant low-grade iron ore rather than scarce DR-grade material.

The convergence of strong government support through the Korean New Deal and hydrogen economy roadmap, substantial corporate investment commitments exceeding 9 trillion won through 2030, world-class technical capabilities, and strategic positioning in premium supply chains creates favorable conditions for successful transformation. The nation's 2050 carbon neutrality commitment provides long-term policy certainty, while the emissions trading system creates market-based incentives for decarbonization.

However, formidable challenges must be overcome. The complete dependence on imported raw materials creates vulnerability to supply disruptions and price volatility that competitors with domestic resources do not face. Hydrogen costs must decline dramatically from current levels to enable economic viability of HyREX and other green technologies. Chinese competition intensifies continuously as the massive neighbor upgrades quality while maintaining cost advantages. The technical risks of scaling pilot technologies to commercial deployment remain substantial.

The domestic market provides a foundation through integrated automotive and shipbuilding supply chains, but export competitiveness is essential given Korea's production scale. Success requires not only technology excellence but also market development for green steel products, customer willingness to pay premiums, and favorable evolution of carbon border mechanisms and international standards.

The HyREX technology's commercial deployment between 2027-2028 represents a critical milestone. If successful, it positions Korea to lead the global transition to hydrogen-based steelmaking while generating technology licensing revenue. If delayed or unsuccessful, Korea risks losing first-mover advantages to Japanese, European, or Chinese competitors pursuing alternative pathways.

The government's role is pivotal: maintaining strong policy support, accelerating hydrogen infrastructure development, ensuring competitive energy costs, co-investing in technology commercialization, and leading regional efforts on green steel standards and market creation. Private sector execution, particularly POSCO's ability to deliver on HyREX promises and manage the complex facility transition, will determine ultimate outcomes.

By 2030, Korea's trajectory should become clear. Successful initial HyREX deployment, declining hydrogen costs, growing green steel market premiums, and preserved export competitiveness would confirm the nation's path toward global leadership. Conversely, technology delays, persistent cost disadvantages, or market development failures would necessitate strategy reassessment.

The stakes extend beyond the steel industry. Success would reinforce Korea's reputation for technology innovation, support key manufacturing sectors, demonstrate hydrogen economy viability, and contribute meaningfully to climate goals. Failure would undermine industrial competitiveness, increase import dependency, and call into question the nation's broader green transformation strategy.

With existing strengths in quality manufacturing, strong government commitment, pioneering technology under development, and strategic imperative for decarbonization, South Korea possesses the foundations for success. The coming five years will reveal whether these advantages can be translated into global green steel leadership or whether the formidable challenges will constrain ambitions.

Note: This document is based on publicly available information as of November 2025. Data sources include South Korean government publications, POSCO corporate reports, Ministry of Trade, Industry and Energy, World Steel Association, industry analyses, and international steel policy research organizations.