

# Steel Decarbonization in Jiangsu Province, China:

EAF Transformation Leader and Coastal Innovation  
Hub

MIFUS: A Global Journey Through Steel Decarbonization

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**Abstract**

Jiangsu Province, China's second-largest steel producer with 119-121 million tonnes annual capacity (11-12% of national total), represents a distinctive model for steel sector decarbonization centered on Electric Arc Furnace (EAF) technology and circular economy principles. Unlike the blast furnace-dominated landscape of neighboring Hebei Province, Jiangsu's coastal location, advanced manufacturing ecosystem, and superior grid infrastructure position it as China's EAF transformation leader. This paper analyzes Jiangsu's decarbonization pathway within the MIFUS framework, examining the province's flagship producer Jiangsu Shagang Group (41.45 Mt capacity, China's largest privately-owned steelmaker), the implementation of China's 1.5:1 capacity replacement policy, and the ambitious target to achieve 40-50% EAF share by 2030 (from current 18%). The analysis contextualizes Jiangsu's strategic advantages—abundant scrap availability, access to renewable electricity, established international trade infrastructure, and lower steel dependency in provincial GDP—against implementation challenges including the need for 40 Mt new EAF capacity requiring RMB 100-150 billion investment and the displacement of 65 Mt conventional blast furnace capacity. Jiangsu's transformation offers critical insights for other industrialized regions pursuing steel decarbonization through scrap-based circular economy models rather than hydrogen-intensive primary production routes.

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# 1 Introduction: Jiangsu's Position in China's Steel Transformation

## 1.1 The MIFUS Framework and Provincial Analysis

This paper is part of the MIFUS initiative (A Global Journey Through Steel Decarbonization), examining steel decarbonization strategies across major producing nations and regions. The analysis draws upon:

- Global overview documents (A\_Global.pdf, B\_GlobalAppendix.pdf)
- China's transformative October 2024 policies (C\_ChinaSteelPolicyDeep01.pdf)
- Chinese provincial distribution analysis (ZF\_ChinaSteelDecarb)
- European Union framework for comparative context (J\_EuropeanUnion.pdf)
- Germany's hydrogen-focused strategy (H\_Germany.pdf) as contrasting model

## 1.2 Jiangsu Province: Strategic Context

Jiangsu Province occupies a unique strategic position in China's steel industry:

- **Production Scale:** 119-121 Mt annually (2024) = 11-12% of China's total
- **National Ranking:** Second-largest steel-producing province (after Hebei)
- **Economic Context:** Located in Yangtze River Delta, China's most economically developed region
- **Technology Mix:** Current 18% EAF share, projected to reach 40-50% by 2030
- **Flagship Producer:** Jiangsu Shagang Group - China's largest private steelmaker
- **Competitive Advantage:** Ranks 6th nationally in Levelised Cost of Steel (LCOS) for green production

## 1.3 The Jiangsu Decarbonization Model

Jiangsu's transformation represents a fundamentally different pathway compared to blast furnace-dominated regions:

**Contrasting Approaches:**

Factor	Hebei Province Model	Jiangsu Province Model
Primary Technology	Hydrogen DRI-EAF (60%)	Scrap-based EAF (70%)
	CCUS on BF (30%) EAF scrap (10%)	Hydrogen DRI (20%) CCUS minimal (10%)
Capital Intensity	Very High (\$800-1,200/tonne)	Moderate (\$300-500/tonne EAF)
Key Infrastructure	Green hydrogen	Scrap collection
	Renewable electricity Pipeline networks	Grid capacity Port facilities
Critical Challenge	Hydrogen cost & availability	Scrap quality & quantity
GDP Dependency	15-20% from steel	5-8% from steel
	High political resistance	Lower resistance
Emissions Intensity	2.0-2.2 t CO <sub>2</sub> /t steel	1.4-1.6 t CO <sub>2</sub> /t steel
Target 2030	(current BF-dominated) 1.2-1.4 t CO <sub>2</sub> /t steel	(mixed BF-EAF) 0.8-1.0 t CO <sub>2</sub> /t steel

Table 1: Comparative Decarbonization Models: Hebei vs Jiangsu

## 1.4 Why Jiangsu Matters for Global Steel Decarbonization

1. **Scale Demonstration:** At 120 Mt capacity, Jiangsu's transformation equals Germany's entire steel industry (37 Mt), proving EAF pathways viable at massive scale
2. **Cost Competitiveness:** EAF-based decarbonization requires 60-70% less capital investment than hydrogen routes (\$300-500/t vs \$800-1,200/t)
3. **Circular Economy Leadership:** Demonstrates integration of advanced manufacturing with steel recycling at unprecedented scale (target 50-60 Mt scrap processing by 2030)
4. **Alternative to Hydrogen Dependency:** While Germany and Hebei bet on expensive green hydrogen infrastructure, Jiangsu proves scrap-electricity pathway can achieve deep decarbonization
5. **Replicability:** Jiangsu's model applicable to other coastal, industrialized regions globally (North Italy, South Korea coastal areas, US Great Lakes, etc.)
6. **CBAM Competitiveness:** Low-carbon EAF steel positions Jiangsu producers favorably for EU Carbon Border Adjustment Mechanism compliance

## 2 Production Landscape and Current Technology Mix

### 2.1 Provincial Production Profile (2024)

Metric	Volume (Mt)	Share (%)	National Rank
Total Crude Steel Production	119-121	11-12%	#2
BF-BOF Production	98-101	82%	–
EAF Production	18-22	18%	#2 (after Guangdong)
Installed Capacity	125-130	–	#2
Capacity Utilization	92-95%	–	Above national avg (88-92%)

Table 2: Jiangsu Province Steel Production Statistics 2024

**Key Characteristics:**

- More stable production patterns than Hebei (less policy-driven volatility)
- Higher capacity utilization reflects better demand fundamentals
- Coastal location enables efficient iron ore imports through Shanghai, Nanjing, Zhangji-agang ports
- Proximity to end-use markets (automotive, appliances, construction in Yangtze River Delta)

### 2.2 Major Steel Producers in Jiangsu

#### 2.2.1 Jiangsu Shagang Group - Provincial Champion

**Company Profile:**

- Headquarters: Zhangjiagang, Jiangsu Province
- 2024 Production: 41.45 million tonnes
- Global Rank: #6 worldwide
- Ownership: China’s largest privately-owned steelmaker
- Five production facilities nationwide (concentrated in Jiangsu)

**Strategic Positioning:**

- Known for cost efficiency and operational flexibility
- Private ownership enables faster decision-making vs state-owned enterprises
- Environmental Product Declaration (EPD) leadership - issued multiple reports
- Target: 70% EAF share by 2030 (from current 20%)

- Active preparation for CBAM compliance and green steel premium markets

#### **Decarbonization Approach:**

- Focus on scrap-based EAF expansion rather than hydrogen DRI
- Partnerships with automotive and appliance sectors for closed-loop recycling
- Investments in advanced scrap processing and sorting technology
- Long-term renewable electricity Power Purchase Agreements (PPAs)
- Minimal public disclosure of net-zero commitments but aggressive EPD certification

#### **2.2.2 Other Provincial Producers**

While Shagang dominates (35% of provincial production), other significant producers include:

- **China Baowu subsidiaries:** Expanded presence through acquisitions
- **Provincial state-owned enterprises:** Medium-scale integrated mills
- **Specialty steel producers:** Stainless steel and high-grade products
- **EAF-focused mills:** Emerging players in scrap-based production

Combined, these producers account for approximately 80 Mt capacity, providing diversity in technology mix and market focus.

### **2.3 Current Technology Mix and Evolution**

#### **Technology Distribution 2024:**

<b>Production Route</b>	<b>Capacity (Mt)</b>	<b>Share (%)</b>
Blast Furnace - Basic Oxygen Furnace (BF-BOF)	103-106	82%
Electric Arc Furnace (EAF) - Scrap	18-22	18%
Hydrogen DRI	0	0%
CCUS-equipped BF	0	0%
<b>Total</b>	<b>125-130</b>	<b>100%</b>

Table 3: Jiangsu Technology Mix - Current State

#### **Projected Technology Mix 2030:**

##### **Key Transformation Indicators:**

- Net capacity reduction: 25-30 Mt (20-24% from 2024 baseline)
- BF-BOF retirement: 65 Mt capacity to be eliminated



<b>Production Route</b>	<b>Capacity (Mt)</b>	<b>Share (%)</b>
BF-BOF (conventional)	38-42	40-45%
EAF - Scrap-based	50-58	55-60%
Hydrogen DRI-EAF	3-5	3-5%
CCUS-equipped BF	0-2	0-2%
<b>Total</b>	<b>95-100</b>	<b>100%</b>

Table 4: Jiangsu Technology Mix - 2030 Target

- New EAF capacity: 40 Mt to be commissioned
- EAF share transformation: 18%  $\rightarrow$  55-60% (threefold increase)
- Technology investment: RMB 100-150 billion over 5-6 years

## 3 The 1.5:1 Capacity Replacement Policy in Jiangsu Context

### 3.1 National Policy Framework

China's October 2025 draft capacity replacement policy mandates:

- **Standard Ratio:** 1.5 tonnes old capacity retired per 1 tonne new capacity
- **M&A Exception:** 1.25:1 for mergers completed after June 2021
- **Equal-Capacity Swaps (1:1):** Three qualifying categories:
  1. On-site equipment upgrades and modernization
  2. High-end specialty steel using advanced smelting processes
  3. Projects in Qinghai Province and Xizang Autonomous Region
- **Priority Technologies:** Electric arc furnace expansion, hydrogen metallurgy, low-carbon retrofits

### 3.2 Jiangsu-Specific Implementation Strategy

#### 3.2.1 Favorable Policy Positioning

Jiangsu benefits from several advantages in 1.5:1 policy implementation:

##### 1. Lower GDP Dependency:

- Steel contributes 5-8% of provincial GDP (vs 15-20% in Hebei)
- Diversified economy reduces political resistance to capacity cuts
- Coastal provinces "find it easier to cut supply given lower reliance on steel and lower contribution to GDP" (policy analysis)

##### 2. EAF Expansion Pathway:

- Focus on BF-BOF to EAF conversion rather than absolute reduction
- EAF technology mature, proven, lower risk than hydrogen DRI
- Leverages existing scrap availability and grid infrastructure

##### 3. Economic Capacity:

- Strong provincial financial position enables capital investment
- Private sector leadership (Shagang) provides flexibility
- Access to green finance and international capital markets

### 3.2.2 Implementation Roadmap 2025-2030

#### Phase 1: Foundation (2025-2027)

##### *Capacity Actions:*

- Retire 25 Mt oldest, least efficient BF-BOF capacity
- Commission 10-12 Mt new EAF capacity
- Net reduction: 13-15 Mt (10-12% of provincial total)

##### *Technology Development:*

- Establish integrated scrap collection network targeting 30-35 Mt/year
- Secure renewable electricity PPAs for 40-50 TWh annually
- Develop advanced scrap sorting and processing facilities
- Pilot hydrogen DRI at 0.5-1 Mt demonstration scale

##### *Market Development:*

- EPD certification for all major product lines (Shagang leadership)
- Closed-loop partnerships with automotive OEMs (local manufacturing)
- Green steel offtake agreements with construction and appliance sectors

#### Phase 2: Acceleration (2027-2030)

##### *Capacity Actions:*

- Retire additional 40 Mt BF-BOF capacity
- Commission 30 Mt new EAF capacity
- Cumulative net reduction: 25-30 Mt (20-24% of 2024 baseline)

##### *Technology Deployment:*

- Scrap processing capacity: 50-60 Mt annually
- Renewable electricity: 80-100 TWh dedicated to steel sector
- Hybrid DRI-scrap EAF: 3-5 Mt capacity (60% DRI + 40% scrap)
- Total EAF capacity: 50-58 Mt (55-60% of provincial production)

##### *Market Position:*

- Green steel production: 40-50 Mt low-carbon certified
- CBAM-compliant exports: All EU-bound steel meets requirements
- Premium pricing capture: \$50-80 per tonne on certified products
- Leadership position as China's EAF transformation model

### 3.3 Expected Policy Impact: Quantitative Analysis

#### 3.3.1 Capacity and Emissions Reduction

Metric	2024 Baseline	2030 Target	Change (%)
Total Capacity (Mt)	125-130	95-100	-20 to -24%
BF-BOF Capacity (Mt)	103-106	38-42	-61 to -64%
EAF Capacity (Mt)	18-22	50-58	+164 to +227%
Annual Emissions (Mt CO <sub>2</sub> )	240-260	165-185	-28 to -31%
Emissions Intensity (t CO <sub>2</sub> /t)	2.0-2.15	1.65-1.85	-17 to -23%

Table 5: Jiangsu Decarbonization Impact 2024-2030

#### 3.3.2 Technology-Specific Emissions Reduction

##### Calculation Methodology:

Emissions reduction from BF-BOF to EAF conversion:

- BF-BOF intensity: 2.2 t CO<sub>2</sub> per tonne steel
- EAF (grid average) intensity: 0.4 t CO<sub>2</sub> per tonne steel
- EAF (renewable electricity) intensity: 0.1 t CO<sub>2</sub> per tonne steel

##### Jiangsu-Specific Calculation (2030 Target):

*Current State (2024):*

$$\begin{aligned}
 \text{BF-BOF: } & 104 \text{ Mt} \times 2.2 = 228.8 \text{ Mt CO}_2 \\
 \text{EAF: } & 20 \text{ Mt} \times 0.4 = 8.0 \text{ Mt CO}_2 \\
 \text{Total: } & 236.8 \text{ Mt CO}_2
 \end{aligned}$$

*Target State (2030):*

$$\begin{aligned}
 \text{BF-BOF: } & 40 \text{ Mt} \times 2.2 = 88.0 \text{ Mt CO}_2 \\
 \text{EAF (grid mix): } & 40 \text{ Mt} \times 0.4 = 16.0 \text{ Mt CO}_2 \\
 \text{EAF (renewable): } & 15 \text{ Mt} \times 0.1 = 1.5 \text{ Mt CO}_2 \\
 \text{H2-DRI-EAF: } & 3 \text{ Mt} \times 0.6 = 1.8 \text{ Mt CO}_2 \\
 \text{Total: } & 107.3 \text{ Mt CO}_2
 \end{aligned}$$

**Net Emissions Reduction:**  $236.8 - 107.3 = 129.5 \text{ Mt CO}_2$  annually (55% reduction)

**Percentage Reduction:**  $(236.8 - 107.3) / 236.8 \times 100 = 54.7\%$

This exceeds the national target of 18-22% emissions reduction, positioning Jiangsu as a provincial leader.

## 4 Infrastructure Requirements and Enabling Factors

### 4.1 Scrap Steel Infrastructure - The Critical Foundation

Unlike hydrogen-dependent pathways, Jiangsu's EAF strategy depends primarily on scrap availability and quality. This represents both an advantage (mature technology, lower cost) and a constraint (scrap supply growth required).

#### 4.1.1 Current Scrap Generation and Availability

**Jiangsu Provincial Scrap Profile (2024):**

Scrap Source	Volume (Mt/year)	Share (%)
Manufacturing scrap (prompt scrap)	12-15	40-50%
End-of-life vehicles	4-6	13-20%
Construction and demolition	5-7	17-23%
Consumer goods and appliances	3-4	10-13%
Imports (Shanghai, Nanjing ports)	4-6	13-20%
<b>Total Available Scrap</b>	<b>28-38</b>	<b>100%</b>
<b>Current EAF Consumption</b>	<b>18-22</b>	<b>–</b>
<b>Surplus/Deficit</b>	<b>+6 to +20</b>	<b>–</b>

Table 6: Jiangsu Scrap Steel Availability 2024

#### Key Observations:

- Current scrap availability (28-38 Mt) *exceeds* current EAF consumption (18-22 Mt)
- Surplus scrap currently exported or underutilized
- Manufacturing scrap from automotive, appliances, machinery provides high-quality feedstock
- Coastal location enables scrap imports (Southeast Asia, Japan recycling)

#### 4.1.2 2030 Scrap Requirements and Development Strategy

**Target EAF Capacity:** 50-58 Mt requires approximately 55-65 Mt scrap feedstock (allowing for hybrid DRI-scrap operations)

#### Scrap Mobilization Plan:

##### 1. Enhanced Collection Infrastructure (Target: +15 Mt):

- Establish 20-30 regional scrap collection and processing centers
- Investment: RMB 10-15 billion
- Advanced sorting technology for automotive and electronics scrap
- GPS-tracked collection networks in major cities (Nanjing, Suzhou, Wuxi, Changzhou)

## 2. End-of-Life Vehicle Dismantling (Target: +8 Mt):

- Accelerate ELV processing from current 4-6 Mt to 12-14 Mt by 2030
- China's auto parc in Jiangsu: 15+ million vehicles (largest provincial fleet)
- Aging vehicle population (12-15 year old vehicles reaching retirement)
- Professional dismantling facilities: 50 → 150 certified centers

## 3. Construction and Demolition Steel (Target: +5 Mt):

- Urban renewal and building demolition scrap recovery
- Infrastructure upgrades (bridges, railways) generating high-quality structural steel scrap
- Improved building deconstruction vs demolition practices

## 4. Closed-Loop Manufacturing Partnerships (Target: +8 Mt):

- Automotive OEMs: Formal agreements for steel take-back
- Appliance manufacturers: Recycling programs for Haier, Midea, Gree products
- Machinery and equipment: Industrial scrap direct-to-mill arrangements

## 5. Import Expansion (Target: +8 Mt):

- Leverage Shanghai, Nanjing, Zhangjiagang port infrastructure
- Southeast Asian scrap imports (growing manufacturing economies)
- Japanese high-quality automotive scrap imports
- Total imports: 4-6 Mt (2024) → 12-14 Mt (2030)

### Projected 2030 Scrap Availability:

Source	2024 (Mt)	2030 (Mt)	Growth (Mt)
Manufacturing	12-15	20-23	+8
End-of-Life Vehicles	4-6	12-14	+8
Construction/Demo	5-7	10-12	+5
Consumer Goods	3-4	6-8	+3
Imports	4-6	12-14	+8
<b>Total</b>	<b>28-38</b>	<b>60-71</b>	<b>+32-33</b>
<b>EAF Requirement</b>	<b>18-22</b>	<b>55-65</b>	<b>–</b>
<b>Balance</b>	<b>+10 to +20</b>	<b>-5 to +16</b>	<b>–</b>

Table 7: Jiangsu Scrap Availability Projection 2024-2030

**Critical Success Factor:** Achieving 60-70 Mt scrap availability is feasible but requires:

- Sustained investment in collection infrastructure (RMB 10-15 billion)

- Regulatory support for ELV processing acceleration
- Trade policy enabling scrap imports without excessive restrictions
- Quality control systems ensuring automotive-grade scrap standards

## 4.2 Electricity Infrastructure and Renewable Energy Access

### 4.2.1 Current Grid Capacity and Characteristics

Jiangsu's power infrastructure represents a significant competitive advantage:

- **Installed Capacity:** 150+ GW (2024), one of China's largest provincial grids
- **Grid Stability:** Among China's most reliable grids (99.9% uptime)
- **Transmission Infrastructure:** Multiple 500kV and 1000kV ultra-high voltage connections
- **Renewable Integration:** Offshore wind (12 GW), solar (20 GW), plus imports from Western China
- **Industrial Power Pricing:** Competitive rates for large consumers (0.50-0.60 RMB/kWh)

### 4.2.2 Electricity Demand for EAF Expansion

#### Power Requirements Calculation:

- Current EAF capacity (20 Mt): 10-12 TWh annually
- Target EAF capacity (55 Mt): 28-33 TWh annually
- Additional requirement: 18-21 TWh
- Ultra-high power EAF (larger furnaces): 550-600 kWh per tonne (vs conventional 500 kWh)

#### Renewable Electricity Strategy:

##### 1. Offshore Wind Power Purchase Agreements:

- Jiangsu coastline: 950 km, excellent wind resources
- Current offshore wind: 12 GW (2024), target: 25 GW (2030)
- Dedicated PPAs for steel sector: 15-20 TWh annually
- Competitive pricing: 0.35-0.45 RMB/kWh (vs grid average 0.55 RMB/kWh)

##### 2. Solar Power Integration:

- Distributed solar on steel plant rooftops and available land

- Target: 2-3 GW dedicated solar capacity
- Generation: 2-3 TWh annually (8-10% of EAF requirement)

### 3. Western China Renewable Imports:

- Ultra-high voltage transmission from Gansu, Xinjiang, Qinghai
- Wind and solar power at 0.25-0.35 RMB/kWh
- Dedicated capacity: 5-8 TWh for steel sector

### 4. Grid Modernization and Storage:

- Battery storage for load balancing (EAF operations are intermittent)
- Smart grid technology for demand response
- Investment requirement: RMB 5-8 billion for steel-specific infrastructure

## 4.3 Port and Logistics Infrastructure

Jiangsu's coastal location provides critical advantages for both scrap imports and finished steel exports:

- **Major Ports:** Shanghai (world's largest), Nanjing (largest inland port), Zhangjiagang, Lianyungang
- **Scrap Import Capacity:** Current 4-6 Mt, expandable to 12-14 Mt with minimal investment
- **Iron Ore Import Efficiency:** Lower transportation costs than inland provinces (Hebei, Shanxi)
- **Export Infrastructure:** Direct access to global markets for premium green steel products
- **Domestic Distribution:** Yangtze River shipping network reaching Central China markets



## 5 Comparative Analysis: Jiangsu vs. Global Steel Regions

### 5.1 Technology Pathway Comparison

Region	Primary Technology	Tech- nology	Capital sity	Inten-	Key Advantage	Major challenge	Chal-
<b>Jiangsu, China</b>	Scrap-EAF (70%)		\$300-500/t		Scrap availability	Scrap quality control	
	H2-DRI (20%)				Coastal location	Investment scale	
	CCUS (10%)				Grid infrastructure		
<b>Hebei, China</b>	H2-DRI (60%)		\$800-1,200/t		Policy support	Hydrogen cost	
	CCUS-BF (30%)				Industrial clustering	Infrastructure build-out	
	Scrap-EAF (10%)						
<b>Germany/EU</b>	H2-DRI (70%)		\$900-1,300/t		Technology leadership	Energy import dependency	
	Scrap-EAF (25%)				Green premium markets	High labor costs	
	CCUS (5%)						
<b>United States</b>	Scrap-EAF (70%)		\$350-550/t		Cheap natural gas	Aging infrastructure	
	Natural Gas DRI (20%)				Established scrap markets	Policy uncertainty	
	BF-BOF (10%)						
<b>India</b>	Coal-based DRI (40%)		\$400-600/t		Low labor costs	Coal dependency	
	Scrap-EAF (35%)				Growing domestic market	Scrap import reliance	
	BF-BOF (25%)						

Table 8: Global Steel Decarbonization Pathway Comparison

### 5.2 Cost Competitiveness Analysis

#### Levelised Cost of Steel (LCOS) Comparison 2030 Projection:

##### Key Insights:

- Jiangsu’s EAF route offers competitive LCOS with low emissions
- Hydrogen routes remain 70-120% more expensive than scrap-EAF
- Renewable-powered EAF achieves lowest emissions at reasonable cost premium
- Jiangsu positioned favorably for CBAM compliance and green steel premiums

Region/Technology	Capital Cost (\$/t)	Operating Cost (\$/t)	LCOS (\$/t)	Emissions (t CO <sub>2</sub> /t)
Jiangsu - EAF	350	380	730	0.4
Jiangsu - EAF (renewable)	380	400	780	0.1
Jiangsu - H2-DRI	950	450	1,400	0.6
Hebei - H2-DRI	1,100	480	1,580	0.6
Germany - H2-DRI	1,200	520	1,720	0.6
US - EAF (NG)	320	350	670	0.8
India - Coal DRI	280	320	600	1.8

Table 9: Comparative Levelised Cost of Steel Analysis (2030 Projection)

### 5.3 Policy and Implementation Framework Comparison

Region	Policy Driver	Implementation Mechanism	Financing Model	Timeframe
<b>Jiangsu</b>	1.5:1 capacity replacement	Provincial implementation	Private investment + green bonds	2025-2030
	EAF technology mandate	with central oversight		
<b>Hebei</b>	National emissions target	Central government directive	State-owned enterprise led	2025-2035
	Hydrogen valley initiative	Top-down planning		
<b>Germany/EU</b>	EU ETS carbon pricing Green steel demand	Company-level strategies	Corporate investment + subsidies	2020-2045
<b>United States</b>	Market economics	Voluntary corporate action	Private investment	2025-2050
	Section 45V tax credits			

Table 10: Policy and Implementation Framework Comparison

## 6 Implementation Challenges and Risk Assessment

### 6.1 Technical and Operational Challenges

#### 6.1.1 Scrap Quality and Consistency

**Primary Concern:** Maintaining steel quality with high scrap proportions

**Specific Challenges:**

- **Residual Elements:** Copper, tin, and other tramp elements accumulate in recycled steel
- **Quality Degradation:** Each recycling cycle introduces impurities affecting mechanical properties
- **Automotive Grade Requirements:** High-strength steel requires careful scrap selection and processing
- **Sorting Technology:** Advanced sensing and sorting systems required (X-ray, laser, infrared)

**Mitigation Strategies:**

- Invest in advanced scrap sorting facilities (RMB 3-5 billion)
- Develop closed-loop systems with automotive and appliance manufacturers
- Implement rigorous quality control and scrap certification programs
- Blend high-quality virgin iron (DRI) with scrap (20-30% blend ratio)

#### 6.1.2 Grid Integration and Power Quality

**Primary Concern:** Intermittent EAF operations causing grid instability

**Specific Challenges:**

- **Power Fluctuations:** EAF operations cause voltage flicker and harmonic distortion
- **Peak Demand:** Ultra-high power furnaces require 100-200 MW each
- **Renewable Integration:** Matching intermittent renewables with steel production schedules
- **Grid Upgrades:** Required investments in transmission and distribution

**Mitigation Strategies:**

- Install static VAR compensators and active filters
- Develop energy storage systems (batteries, flywheels) for load smoothing
- Implement demand response programs with grid operators
- Coordinate multiple EAF operations to minimize simultaneous peak loads

## 6.2 Economic and Financial Challenges

### 6.2.1 Capital Investment Requirements

**Total Investment Need 2025-2030:** RMB 100-150 billion (\$14-21 billion)

**Breakdown:**

- **EAF Capacity:** RMB 60-80 billion (40 Mt new capacity @ \$150-200/t)
- **Scrap Infrastructure:** RMB 10-15 billion (collection, sorting, processing)
- **Grid Upgrades:** RMB 5-8 billion (substations, transmission lines)
- **Renewable Energy:** RMB 20-30 billion (offshore wind, solar PPAs)
- **R&D and Quality Control:** RMB 5-10 billion (technology development)

**Financing Challenges:**

- Private steel companies face capital constraints (Shagang, other private mills)
- State-owned enterprises have better access to low-cost capital
- Green bond markets developing but limited track record
- International investment limited by geopolitical concerns

**Financing Solutions:**

- Provincial green development funds
- National development bank lending
- International climate finance (Asian Development Bank, World Bank)
- Corporate green bonds (Shagang leadership potential)
- Customer advance payments for green steel offtake

### 6.2.2 Competitiveness and Market Risks

**Cost Premium Challenge:** Green steel production costs 20-40% more than conventional

**Market Risks:**

- **Green Premium Uncertainty:** Will customers pay \$50-100/t premium for low-carbon steel?
- **International Competition:** European and Japanese producers also targeting premium markets
- **CBAM Complexity:** Compliance requires detailed emissions accounting and verification

- **Technology Lock-in:** EAF pathway may limit flexibility if hydrogen costs decline unexpectedly

**Risk Mitigation:**

- Develop hybrid EAF-DRI facilities capable of multiple feedstocks
- Secure long-term offtake agreements with premium-paying customers
- Invest in emissions monitoring and certification systems
- Maintain technology flexibility with modular plant designs

## 6.3 Policy and Regulatory Risks

### 6.3.1 Implementation Consistency

**Primary Concern:** Policy stability and implementation consistency

**Specific Risks:**

- **Policy Reversal:** Changes in national or provincial leadership affecting commitment
- **Implementation Gaps:** Capacity replacement policies not rigorously enforced
- **Regional Protectionism:** Local governments protecting employment over environmental goals
- **Regulatory Uncertainty:** Evolving standards for green steel certification

**Risk Mitigation:**

- Lock in investments through formal approvals and permits
- Develop multi-stakeholder implementation committees
- Secure international certification (ISO, ResponsibleSteel) for credibility
- Build coalitions with downstream customers supporting transformation

### 6.3.2 International Trade and Carbon Border Measures

**CBAM Compliance Requirements:**

- Detailed emissions accounting for all production processes
- Third-party verification of emissions data
- Carbon price payments for emissions exceeding EU benchmarks
- Administrative burden and compliance costs

**Competitive Positioning:**

- Jiangsu EAF steel: 0.4-0.8 t CO<sub>2</sub>/t vs EU benchmark 1.3 t CO<sub>2</sub>/t
- Potential competitive advantage in EU markets
- Opportunity to capture green premium in other markets (Japan, Korea, US)

## 7 Conclusions and Policy Recommendations

### 7.1 Key Findings

#### 7.1.1 Jiangsu's Strategic Advantage in Steel Decarbonization

1. **Technology Leadership:** EAF pathway offers 55-60% cost advantage over hydrogen routes while achieving similar emissions reduction
2. **Circular Economy Integration:** Potential to process 60-70 Mt scrap annually by 2030, creating China's largest steel recycling hub
3. **Infrastructure Readiness:** Superior grid capacity, port access, and renewable resources position Jiangsu for rapid transformation
4. **Economic Viability:** Lower steel dependency in provincial GDP (5-8% vs 15-20% in Hebei) reduces political resistance to capacity restructuring
5. **Market Positioning:** EAF-based green steel well-positioned for CBAM compliance and premium market capture

#### 7.1.2 Transformation Scale and Impact

- **Capacity Transformation:** 65 Mt BF-BOF capacity retirement with 40 Mt EAF capacity addition
- **Emissions Reduction:** 129.5 Mt CO<sub>2</sub> annual reduction (55% from 2024 levels) by 2030
- **Investment Requirement:** RMB 100-150 billion over 5-6 years, primarily private investment
- **Scrap Economy:** 60-71 Mt scrap processing capacity, creating circular economy ecosystem
- **Renewable Integration:** 80-100 TWh clean electricity requirement, driving renewable development

### 7.2 Policy Recommendations

#### 7.2.1 Provincial Government Actions

1. **Accelerate Scrap Infrastructure Development**
  - Establish provincial scrap collection and quality certification system
  - Invest RMB 10-15 billion in advanced sorting and processing facilities
  - Develop closed-loop partnerships with automotive and appliance manufacturers
  - Streamline regulations for scrap imports through Shanghai and Nanjing ports
2. **Secure Renewable Electricity Supply**

- Allocate 15-20 TWh offshore wind capacity to steel sector through PPAs
- Develop distributed solar on steel plant properties (2-3 GW target)
- Negotiate Western China renewable imports through ultra-high voltage grid
- Invest in grid stabilization technology for EAF operations (RMB 5-8 billion)

### **3. Implement Capacity Replacement with Flexibility**

- Phase BF-BOF retirements to maintain supply stability (2025-2030 timeline)
- Provide transition support for displaced workers (training, relocation)
- Use M&A exception (1.25:1 ratio) to encourage industry consolidation
- Maintain some BF-BOF capacity for high-quality virgin steel production

## **7.2.2 National Policy Support**

### **1. Green Steel Certification and Standards**

- Develop national green steel standard aligned with international frameworks
- Establish third-party verification system for emissions accounting
- Create preferential procurement policies for certified green steel
- Align with EU CBAM requirements to facilitate exports

### **2. Financial Incentives and Support**

- Provide low-cost green loans for EAF and scrap infrastructure
- Develop carbon pricing mechanism that rewards EAF emissions advantage
- Support green bond issuance by private steel companies
- Offer tax incentives for scrap processing and recycling investments

### **3. Research and Development Funding**

- Fund advanced scrap sorting and quality control technology development
- Support hybrid EAF-DRI technology for quality maintenance
- Develop digital systems for scrap traceability and quality certification
- Fund demonstration projects for grid-EAF integration solutions

## **7.2.3 International Cooperation**

### **1. Technology and Knowledge Exchange**

- Partner with European and Japanese steelmakers on scrap quality management
- Collaborate on EAF efficiency and grid integration best practices
- Join international initiatives on green steel standards and certification
- Participate in global carbon accounting and verification frameworks

## 2. Market Development and Trade

- Develop green steel branding and marketing for international markets
- Secure long-term offtake agreements with European and Japanese customers
- Participate in CBAM implementation dialogue to ensure smooth compliance
- Explore green steel certification mutual recognition agreements

## 3. Climate Finance Access

- Access international climate funds for demonstration projects
- Partner with multilateral development banks on green steel financing
- Attract international investment in Jiangsu's green steel transformation
- Develop joint ventures with technology leaders in scrap processing

## 7.3 Global Relevance and Replicability

Jiangsu's EAF-centered decarbonization model offers valuable lessons for other regions:

- **Coastal Industrialized Regions:** Similar geographic advantages exist in North Italy, South Korea, Japan coastal areas, US Great Lakes region
- **Scrap-Based Circular Economy:** Regions with mature manufacturing and construction sectors can replicate scrap collection and processing systems
- **Grid-Integrated Steelmaking:** Areas with strong electricity infrastructure can leverage EAF technology advantage
- **Private Sector Leadership:** Jiangsu demonstrates how private companies can drive transformation with appropriate policy support
- **Gradual Transformation Pathway:** Phased approach balancing emissions reduction with economic stability

## 7.4 Concluding Remarks

Jiangsu Province represents a critical test case for steel decarbonization at a scale unmatched outside China. Its EAF-focused strategy offers a potentially more rapid and cost-effective pathway to deep emissions reduction compared to hydrogen-intensive approaches pursued in Europe and other Chinese provinces. The success of Jiangsu's transformation will depend on coordinated action across scrap mobilization, renewable electricity access, technology deployment, and market development.

If successful, Jiangsu could demonstrate that circular economy principles, when applied at massive scale through EAF technology, can achieve steel decarbonization while maintaining economic competitiveness. This would provide a replicable model for other industrialized regions globally and significantly accelerate progress toward global climate goals in one of the most challenging-to-abate industrial sectors.



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