United States Steel Policy and Green Transformation 2024-2025

Industrial Policy Analysis

November 2025

1 Executive Summary

The United States steel industry stands at a transformative juncture, driven by unprecedented federal investments through the Inflation Reduction Act (IRA), Infrastructure Investment and Jobs Act (IIJA), and CHIPS and Science Act. With approximately 18 billion dollars in investments announced between 2022 and 2025 for modernization, decarbonization, and electrification, the American steel sector is positioned to emerge as a global leader in green steel production.

The U.S. possesses significant competitive advantages: 70% of domestic steel production already utilizes electric arc furnaces (EAF), the highest share among major producers, resulting in emissions that are 50% lower per tonne than emissions-intensive blast furnace production. However, the industry faces critical challenges including the need to meet projected demand increases of 39.7 million tonnes by 2030 driven by clean energy infrastructure, renewable energy deployment, and domestic manufacturing reshoring.

This document analyzes the comprehensive policy framework supporting the steel industry transformation, major investment programs, technology development initiatives, market dynamics, and the path toward establishing the United States as the competitive leader in low-carbon steel production.

2 Current Industry Profile

2.1 Production Capacity and Technology Mix

- **Annual Production:** Approximately 80-85 million tonnes crude steel (2024)
- **Electric Arc Furnace (EAF) Share:** 70% of production (highest among major producers)
- **Blast Furnace-Basic Oxygen Furnace (BF-BOF):** 30% of production
- **Environmental Performance:** Releases 50% less CO2 per tonne than most major competitors
- **Energy Efficiency:** Among highest globally, though significant improvement potential remains
- **Import Dependency:** Approximately 25% of domestic steel consumption is imported

2.2 Regional Distribution

Steel production concentrated in key regions:

- **Great Lakes Region:** Michigan, Ohio, Indiana, Pennsylvania (legacy integrated mills and EAF facilities)

- **Southern States:** Arkansas, Alabama, Texas (growing EAF mini-mill presence)
- **Mid-Atlantic:** Pennsylvania, Maryland (historical production centers undergoing modernization)

The concentration of iron ore reserves in Michigan and Minnesota positions the Great Lakes as prime location for greenfield hydrogen-based direct reduced iron (DRI) facilities.

3 Federal Policy Framework

3.1 Inflation Reduction Act (IRA)

Enacted in August 2022, the IRA allocates 370 billion dollars in tax incentives and funding for clean energy transition:

Steel Industry Impacts:

- **Demand Generation:** Expected to create 39.7 million tonnes of new steel demand through 2030
- **Domestic Content Bonus:** Enhanced tax credits for projects using American-made steel and iron
- **Manufacturing Tax Credits:** Production tax credits for clean energy equipment manufacturing
- **Clean Hydrogen Production Tax Credit (45V):** Up to 3 dollars per kg for hydrogen produced with renewable energy
- **Carbon Capture Tax Credit (45Q):** Enhanced credits for industrial carbon capture projects

Domestic Content Requirements:

- All manufacturing processes for steel and iron components must occur in the United States
- Predominantly iron or steel products must be 95% U.S.-made
- Other manufactured products must meet escalating thresholds: 60% (2022), 65% (2024), 75% (2029)
- Strong incentive for domestic sourcing to maximize federal funding eligibility

Steel Demand Projections by Sector (2022-2030):

- Wind Energy: Substantial increase for turbine towers and foundations
- Solar Energy: Mounting structures and tracking systems
- Electric Vehicles: Automotive steel for battery electric vehicles
- Grid Infrastructure: Transmission towers, substations, transformers
- Hydrogen Infrastructure: Pipelines, storage, production facilities
- Manufacturing Reshoring: Industrial facilities and equipment

3.2 Infrastructure Investment and Jobs Act (IIJA)

Passed in November 2021, IIJA provides 1 trillion dollars for infrastructure renewal:

Steel-Intensive Infrastructure:

- Roads, highways, and bridges rehabilitation
- Public transit and rail systems expansion
- Port and airport modernization
- Water infrastructure and wastewater systems
- Broadband deployment infrastructure

Industry Impact:

- American Iron and Steel Institute (AISI) estimates 50,000 net tons of steel required per 1 billion dollars infrastructure spending
- Estimated multi-year sustained demand for structural steel, reinforcing bars, and specialty products
- Buy America provisions ensure domestic steel utilization in federally funded projects

3.3 CHIPS and Science Act

Enacted August 2022, CHIPS Act allocates 52 billion dollars for semiconductor manufacturing:

Steel Demand Generation:

- Construction of semiconductor fabrication facilities (fabs) across multiple states
- Steel-intensive cleanroom construction and support infrastructure
- Specialized electrical steel for precision power systems
- High-purity gases and chemicals distribution infrastructure

3.4 Buy Clean Initiative

Launched in 2021, Buy Clean leverages federal procurement to drive low-carbon materials adoption:

Program Structure:

- **EPA Role:** Developing first-ever climate performance standards for construction materials
- **Funding:** 4.5 billion dollars for General Services Administration, Department of Transportation, and EPA
- **Covered Materials:** Steel, concrete, asphalt, flat glass
- **Federal Demand:** Approximately 9 million tonnes annual steel demand by 2030

Implementation Challenges:

- Defining appropriate emissions thresholds without causing supply disruptions
- Balancing near-term emission reductions with long-term deep decarbonization pathways
- Avoiding carbon leakage by driving domestic production offshore

- Creating pathway for green steel commercialization while maintaining industry competitiveness

State-Level Programs:

- California developing comprehensive Buy Clean program
- Minnesota implementing Buy Clean study and pilot program for steel rebar and structural steel
- Other states considering similar procurement policies

4 Steel Decarbonization Funding

4.1 DOE Office of Clean Energy Demonstrations (OCED)

March 2024 Awards: 1.5 billion dollars for six iron and steel decarbonization projects funded by IRA and IIJA

Expected Impact:

- Avoid 2.5 million metric tonnes of CO2 emissions annually
- Equivalent to 747 wind turbines or 4% of domestic iron and steel emissions
- Demonstration of commercial-scale green steel technologies
- Technology proving ground for hydrogen-based DRI and advanced EAF systems

Technology Categories Supported:

- Hydrogen-based direct reduced iron production
- Advanced electric arc furnace technologies
- Carbon capture, utilization, and storage (CCUS)
- Electrification of heating processes
- Energy efficiency improvements
- Alternative fuel integration

4.2 DOE Advanced Manufacturing Offices

Advanced Materials and Manufacturing Technologies Office:

- FY2025 Budget Request: Approximately 500 million dollars
- Focus on breakthrough material processing technologies
- Steel-specific research on hydrogen reduction, electrolysis-based production

Industrial Efficiency and Decarbonization Office:

- Process optimization and energy efficiency research
- Cross-cutting technologies applicable to steel manufacturing
- Waste heat recovery and industrial electrification

Office of Manufacturing and Energy Supply Chains:

- FY2025 Request: 113 million dollars
- Supply chain resilience for critical materials
- Coordination with steel industry on raw material security

4.3 Recommended Budget Increases

Industry advocates and policy analysts recommend substantial budget increases:

- Advanced Materials and Manufacturing: Expansion beyond 500 million dollars request
- Office of Clean Energy Demonstrations: Increase from 180 million dollars FY2025 request
- Rationale: Ensure deployment pace matches innovation research output
- Focus: Multiple 100% clean steel and iron plants in legacy communities with union labor

5 Major Industry Players and Investments

5.1 Nucor Corporation

Profile:

- Largest steel producer in the United States
- Primarily EAF-based mini-mill operator
- Market leader in scrap-based steelmaking

Decarbonization Commitments:

- **November 2023:** Announced net-zero science-based GHG targets for 2050
- **2030 Interim Target:** Significant reduction in Scopes 1, 2, and 3 emissions
- Targets defined by Global Steel Climate Council (GSCC) methodology
- Focus on renewable electricity procurement and energy efficiency

Strategic Positioning:

- Representing over 70% of American steel capacity using recycled steel
- Positioned to benefit from IRA recognition of low-emissions EAF steelmaking
- Investment in circular economy and scrap processing infrastructure

5.2 United States Steel Corporation (U.S. Steel)

Modernization Strategy:

- **2050 Net-Zero Roadmap:** Comprehensive decarbonization plan
- **Technology Transition:** Expanding EAF-based mini-mill capacity while modernizing integrated operations
- **DRI/HBI Development:** Plans to adopt direct reduced iron/hot briquetted iron technology with natural gas, transitioning to hydrogen

Big River 2 Mini Mill:

- **Location:** Osceola, Arkansas
- **Investment:** 3.2 billion dollars (board-approved capital increase)
- **Capacity:** 3 million metric tonnes annually

- **Timeline:** Commercial operation second half 2024
- **Emissions Reduction:** 10-60% decrease against 2018 baseline depending on deployment scale
- **Technology:** State-of-the-art EAF with capability for high-quality flat-rolled products

Nippon Steel Acquisition (Blocked):

- Biden administration blocked proposed acquisition by Nippon Steel in early 2025
- Decision based on national security considerations and economic nationalism concerns
- Reflects broader trend toward protectionism in strategic industries
- U.S. Steel continues as independent American company

5.3 Cleveland-Cliffs

Integrated Steel Operations:

- Operates both integrated mills (BF-BOF) and EAF facilities
- Vertical integration including iron ore mining in Michigan and Minnesota
- Strategic positioning with access to domestic iron ore reserves

Modernization Investments:

- Upgrading existing facilities with efficiency improvements
- Evaluating pathways for decarbonization of blast furnace operations
- Potential hydrogen integration in ironmaking processes

5.4 Steel Dynamics Inc. (SDI)

EAF Specialization:

- Third-largest U.S. steel producer
- Exclusively EAF-based production
- Focus on flat-rolled and long products

Growth Strategy:

- Capacity expansion to meet infrastructure demand
- Investment in advanced EAF technologies
- Renewable energy procurement for power-intensive operations

6 Green Steel Technologies and Pathways

6.1 Electric Arc Furnace (EAF) Dominance

Current Status:

- 70% of U.S. steel production from EAF (highest globally among major producers)
- Majority of steel since 2002 produced via EAF route
- Established infrastructure and operational expertise

Advantages:

- Uses 100% recycled steel scrap, dramatically reducing emissions
- Flexible capacity to respond to demand fluctuations
- Shorter construction timelines compared to integrated mills
- Compatible with renewable electricity integration
- Lower capital investment requirements

Emissions Profile:

- Current: Approximately 0.4-0.6 tonnes CO2 per tonne steel (scrap-based)
- With Renewable Electricity: Near-zero emissions achievable
- Comparison: BF-BOF produces 1.8-2.3 tonnes CO2 per tonne steel

6.2 Hydrogen-Based Direct Reduced Iron (DRI)

Technology Overview:

- Uses hydrogen (or natural gas transitioning to hydrogen) to reduce iron ore
- Produces DRI or hot briquetted iron (HBI) for EAF feedstock
- Enables high-quality primary steel production without blast furnaces
- Essential for products requiring virgin iron rather than scrap

Development Status:

- Pilot and demonstration projects underway with DOE funding
- Natural gas-based DRI commercial technology (transition fuel)
- Green hydrogen-based DRI under development for zero-emission pathway
- Target: Commercial deployment by 2030 with favorable hydrogen economics

Cost Projections (Boston Consulting Group Analysis):

- **Green-Powered EAF (90% scrap, 10% DRI):** 385 dollars per metric tonne by 2030
- **Hydrogen DRI + Green-Powered EAF (80% hot metal, 20% scrap):** 560 dollars per metric tonne (with IRA tax credits)
- **Competitive Advantage:** Lower costs than European competitors due to IRA subsidies
- **Germany Comparison:** 390 and 640 dollars per metric tonne respectively

6.3 Molten Oxide Electrolysis (MOE)

Technology Description:

- Electrochemical reduction of iron ore using electricity
- Direct conversion without carbon-based reductants
- Produces liquid iron for continuous casting or EAF feeding
- Potentially lowest emissions pathway if powered by renewables

Development Status:

- Pre-commercial stage with pilot demonstrations
- Significant technical challenges remain
- Long-term potential for game-changing technology
- Timeline: Post-2030 commercial viability

6.4 Carbon Capture, Utilization, and Storage (CCUS)

Application to Steel:

- Capture CO2 from blast furnace operations
- Applicable to existing integrated mills
- Bridge technology during transition period
- Enhanced 45Q tax credits under IRA

Limitations:

- High energy penalty and operating costs
- Does not eliminate emissions, only captures them
- Requires CO2 transport and storage infrastructure
- Less economically attractive than transitioning to EAF or hydrogen-based routes

7 1.5 Degree Celsius Alignment Scenario

7.1 Emissions Reduction Requirements

Current Trajectory (Business-as-Usual):

- Power demand: 11 TWh per year (2025) increasing to 15 TWh per year (2050)
- Emissions: Rising 33% to reach 83 million metric tonnes CO2 annually by 2050
- Equivalent to 221 fossil gas power plants annual emissions

1.5C-Aligned Pathway:

- **Technology Mix Required:** Molten Oxide Electrolysis-EAF, Electrowinning-EAF, Hydrogen-DRI-EAF, and modernized BF-BOF with CCUS
- **Clean Electricity Requirement:** 174 TWh annually by 2050
- **Renewable Capacity:** Approximately 28 GW wind and solar, 53 GW battery storage
- **Near-Zero Emission Plants:** 8% of U.S. production (9.4 million tonnes) must come from near-zero emission ore-based plants by 2030

7.2 Grid and Infrastructure Requirements

Electricity Infrastructure:

- 174 TWh nearly equals Illinois' total 2023 electricity output
- Requires massive grid expansion and modernization
- Long-distance transmission to connect renewables to steel communities
- Advanced grid technologies for stability and reliability

Interconnection Queue Challenges:

- PJM (Mid-Atlantic): 3,042 active projects, 2-year backup in queue
- MISO (Midwest): 1,734 active projects, similar delays
- Urgent need for streamlined interconnection processes
- Regional coordination essential for transmission planning

8 Raw Material Security and Supply Chains

8.1 Iron Ore

Domestic Production:

- Major reserves in Michigan (Marquette Range) and Minnesota (Mesabi Range)
- Historic production centers with existing infrastructure
- High-grade ore suitable for direct reduction processes
- Cleveland-Cliffs major domestic producer with vertical integration

Strategic Considerations:

- U.S. does not currently designate iron ore as critical mineral (adequate domestic supply)
- Contrast with EU, Japan, Korea, India treating iron ore as critical
- Growing focus on high-purity DR-grade ore for hydrogen-based steelmaking
- Potential need to expand domestic beneficiation capacity

8.2 Steel Scrap

Availability:

- Robust domestic scrap generation and processing infrastructure
- Mature collection, sorting, and trading networks
- High-quality scrap supports premium EAF steel production
- Circular economy advantages with steel's infinite recyclability

Demand-Supply Balance:

- Current supply adequate for 70% EAF share
- IRA-driven demand increase may strain high-grade scrap availability
- Need for continued investment in scrap processing technologies
- Quality sorting critical for advanced steel grades

8.3 Hydrogen Supply

Production Pathways:

- **Green Hydrogen:** Electrolysis using renewable electricity (IRA 45V credit up to 3 dollars per kg)
- **Blue Hydrogen:** Natural gas with carbon capture (lower 45V credit tier)
- **Current Status:** Limited commercial-scale production, rapidly expanding
- **Cost Target:** Below 2 dollars per kg for steel industry viability

Infrastructure Development:

- Regional hydrogen hubs supported by DOE funding
- Pipeline and storage infrastructure investment needed
- Co-location of hydrogen production with steel facilities under consideration
- Gulf Coast, Great Lakes, and Appalachian regions key development areas

9 Market Dynamics and Competitive Position

9.1 Demand Growth Projections

IRA and IIJA Impact:

- 39.7 million tonnes new demand from now to 2030
- Distributed across renewable energy, EV supply chains, grid infrastructure, and reshored manufacturing
- Estimated 9 million tonnes annual federal government purchases by 2030
- Sustained long-term demand from clean energy transition

Capacity Utilization:

- Current industry operating below full capacity
- Sufficient existing capacity to absorb initial demand increase
- Strategic capacity additions targeting high-growth segments
- Focus on electrical steel for transformers and EVs

9.2 Import Competition and Trade Policy

Section 232 Tariffs:

- Trump administration imposed 25% tariff on steel imports (2018)
- Biden administration maintained tariffs with modifications
- EU tensions over tariff structure and carbon border mechanisms
- Ongoing debates about balancing protection with supply chain needs

Global Arrangement on Sustainable Steel and Aluminum (GASSA):

- Negotiations with EU to establish carbon-based steel club
- Deadline extensions due to fundamental disagreements
- U.S. proposal: Common external tariff using Section 232 framework
- EU proposal: Carbon Border Adjustment Mechanism (CBAM) approach
- Key tensions: WTO compatibility, decarbonization approaches, third-country treatment

China Competition:

- Chinese steel production approximately 10 times U.S. capacity
- Concerns about subsidized overcapacity and dumping
- U.S. tariffs and anti-dumping measures in place
- Growing Chinese focus on decarbonization may level playing field

9.3 Premium Green Steel Market

Corporate Procurement:

- Major corporations setting supply chain decarbonization targets
- Willingness to pay premium for certified low-carbon steel
- Automotive, construction, appliance manufacturers leading demand
- Science-based targets (SBTi) driving procurement shifts

Sustainable Steel Purchasing Platform:

- Collaborative procurement initiative aggregating buyer demand
- Goal: Support investment in at least three low-emission facilities (2 million tonnes per year each) by 2030
- Offtake agreements providing revenue certainty for green steel investments
- Technical partners defining product-level parameters and certification

Market Evolution:

- Green premium narrowing due to IRA incentives and technology improvements
- Potential price parity or advantage by 2030 in certain segments
- First-mover advantages for companies establishing green credentials
- Risk of market share loss for slow-transitioning producers

10 Challenges and Barriers

1. **Hydrogen Economics:** Green hydrogen costs must fall below 2 dollars per kg for steel industry viability; current costs significantly higher
2. **Electricity Grid Capacity:** Massive renewable energy and transmission expansion needed; interconnection queues creating bottlenecks
3.
4. **Capital Requirements:** Multi-billion dollar investments needed for new technologies; uncertainty about returns
5. **Policy Uncertainty:** Potential changes to IRA and climate policies under future administrations; Trump administration signals possible funding cuts
6. **Technology Readiness:** Some pathways (MOE, hydrogen-DRI) not yet commercially proven at scale
7. **Workforce Transition:** Need for retraining and new skills in green steel technologies; community impacts in legacy steel regions
8. **Scrap Quality and Availability:** High-grade scrap constraints for premium steel production; investment needed in sorting technologies
9. **International Coordination:** Lack of global standards for green steel definition and carbon accounting
10. **Trade Policy Complexity:** Balancing protectionism with supply chain needs and climate goals
11. **Legacy Asset Stranding:** Risk of premature retirement of existing facilities; community economic impacts

11 State-Level Initiatives

11.1 Great Lakes States

Minnesota:

- Energy and Climate Omnibus Bill includes Buy Clean study and pilot program
- Focus on steel rebar and structural steel
- Data compilation on embodied carbon in building materials
- Prioritizing low-carbon steel in state procurement

Ohio and Pennsylvania:

- Home to electrical steel production facilities (only two in U.S.)
- Critical for transformer and EV manufacturing
- State support for manufacturing modernization
- Workforce development programs for advanced steel production

11.2 California

Buy Clean California:

- Nation's most comprehensive state-level Buy Clean program
- Environmental Product Declarations (EPDs) required for major projects
- Emissions thresholds for eligible materials
- Model for other states developing similar programs

11.3 Southern States

Arkansas, Alabama, Texas:

- Attracting new EAF mini-mill investments
- Business-friendly regulatory environment
- Proximity to raw materials and markets
- Growing clean energy resources (wind, solar)

12 Employment and Community Transition

12.1 Workforce Considerations

Current Employment:

- Direct steel industry employment: Approximately 140,000 workers
- Indirect and induced employment: 500,000+ across supply chains
- High-wage manufacturing jobs critical to regional economies
- Union representation significant in legacy steel regions

Transition Support:

- Federal funding recommendations for deployment in legacy communities with union labor
- Retraining programs for new green steel technologies
- Community college partnerships for workforce development
- Apprenticeship programs combining classroom and on-the-job training

12.2 Legacy Steel Communities

Economic Revitalization:

- Green steel investments opportunity for regional renewal
- Leveraging existing infrastructure and skilled workforce
- Preventing community decline from facility closures
- Creating new industries around clean energy manufacturing

Just Transition Principles:

- Worker protections and reemployment guarantees
- Community input in transition planning
- Investment in local infrastructure and services
- Environmental remediation of legacy industrial sites

13 Policy Recommendations

1. **Accelerate Hydrogen Cost Reduction:** Increase support for green hydrogen production to achieve below 2 dollars per kg; expedite regional hydrogen hub development
2. **Grid Modernization:** Streamline interconnection processes; invest in transmission infrastructure connecting renewable resources to steel production centers
3. **Expand Buy Clean:** Implement robust federal procurement standards for low-carbon steel; extend to all agencies and project types
4. **Increase DOE Funding:** Expand budgets for Office of Clean Energy Demonstrations and Advanced Manufacturing offices to match innovation pipeline
5. **Workforce Development:** Create comprehensive training programs in partnership with community colleges and unions; prioritize deployment in legacy steel communities
6. **International Coordination:** Establish common definitions and standards for green steel; resolve GASSA negotiations with EU on mutually beneficial terms
7. **Technology Deployment:** Target multiple commercial-scale 100% clean steel plants by 2030; provide financial de-risking mechanisms
8. **Scrap Infrastructure:** Invest in advanced scrap sorting and processing technologies to support quality requirements for high-grade steel
9. **Carbon Pricing:** Consider complementary carbon pricing mechanisms to create long-term market signals for decarbonization
10. **Trade Policy Coherence:** Align Section 232 tariffs with climate goals; prevent carbon leakage while supporting domestic production
11. **Regional Planning:** Coordinate federal, state, and local efforts for integrated steel-energy-infrastructure development

14 Conclusion

The United States steel industry stands at a pivotal moment with unprecedented opportunities to establish global leadership in green steel production. The convergence of federal policy support through the IRA, IIJA, and CHIPS Act, combined with the industry's existing 70% EAF share, positions America uniquely among major steel-producing nations.

The IRA's projected generation of 39.7 million tonnes of new steel demand through 2030 provides market certainty for major investments in decarbonization technologies. With appropriate implementation of Buy Clean procurement standards and continued expansion of DOE funding programs, the pathway to multiple commercial-scale near-zero emission steel plants is achievable within this decade.

Critical success factors include: achieving green hydrogen costs below 2 dollars per kg, massive expansion of renewable electricity generation and transmission infrastructure, streamlined

grid interconnection processes, and sustained policy support across administrations. The technical pathways are clear—EAF with renewable power, hydrogen-based DRI, and potentially molten oxide electrolysis—with cost projections showing U.S. competitiveness against global competitors by 2030.

However, significant challenges remain. The 174 TWh annual clean electricity requirement by 2050 necessitates unprecedented grid expansion. Hydrogen infrastructure must scale rapidly. Existing interconnection queues threaten to delay critical renewable energy projects. Policy uncertainty, particularly regarding IRA implementation continuity, creates investment hesitation.

The stakes extend beyond environmental compliance. America's steel industry can either lead the global transition and capture premium green steel markets, or risk losing competitiveness to nations making bolder investments. The integrated steel sector must modernize or face obsolescence as customers demand low-carbon materials and carbon border mechanisms proliferate.

Regional implications are profound. Legacy steel communities in the Great Lakes and Mid-Atlantic face either revitalization through green steel investments or continued decline. The promise of high-wage union manufacturing jobs in clean industries can anchor community prosperity, but only with intentional policy support and workforce transition programs.

International dimensions matter critically. Resolution of GASSA negotiations with the EU will shape global green steel markets. China's massive steel capacity and growing decarbonization focus present both competitive threats and opportunities for technology cooperation. Developing coherent trade policies that protect domestic industry while advancing climate goals requires diplomatic sophistication.

The American steel industry's transformation over the next five to ten years will determine whether the United States becomes the competitive leader in low-carbon steel or cedes this strategic sector to international competitors. With existing EAF dominance, abundant renewable energy resources, technological innovation capacity, and substantial federal funding, success is achievable. The question is whether policymakers, industry leaders, and communities will execute with sufficient speed, scale, and coordination to capture this historic opportunity.

Note: This document is based on publicly available information as of November 2025. Data sources include U.S. Department of Energy, Environmental Protection Agency, American Iron and Steel Institute, company reports, Global Energy Monitor, RMI, Boston Consulting Group analyses, and congressional testimony.