



ALIGNING SOUTH KOREA'S AI AMBITIONS WITH NORDIC 'GREEN' TECHNOLOGY

by

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Introduction

Since taking office in 2025, South Korean President Lee Jae Myung has positioned artificial intelligence (AI) as the cornerstone of the nation's growth strategy, aiming to elevate the country into a top-three global AI powerhouse. This ambition is anchored by an unprecedented [\\$880 billion investment](#) package combining public funding with contributions from domestic tech giants such as Samsung Electronics and SK Hynix. The capital injection targets critical physical infrastructure, funding two major semiconductor manufacturing hubs and establishing 8.4 gigawatts of domestic data center capacity by 2029. To shield these next-generation semiconductors and facilities from supply chain disruptions, President Lee secured [treaty-grade mineral agreements](#) with, among others, Latin American nations such as Brazil and Chile. This proactive, streamlined diplomatic approach aims to secure reliable supplies of critical minerals, such as lithium and copper, while systematically mitigating South Korea's dependence on China for these resources.

However, despite targeted investments by the Lee administration, strategic bottlenecks threaten the viability and long-term economic gains of South Korea's AI infrastructure strategy: As global demands for sustainable supply chains intensify, South Korea must resolve systemic sustainability challenges across its AI value chain. Chief among these is the lack of highly effective, low-carbon technologies for mining and refining the minerals required by the semiconductor industry. Furthermore, South Korea faces significant hurdles in securing the clean energy required to power its AI expansion, underscoring the urgent need to address the deficit of circular models in its energy resource management.

To embed sustainability in its rapidly expanding AI sector, South Korea should leverage and expand its

strategic partnerships with the Nordic countries. As global pioneers of "green digitalization," these nations offer proven models for harmonizing rapid technological expansion with ecological sustainability. Drawing on successful initiatives in Denmark, Sweden, and Finland, this blogpost outlines actionable approaches that South Korea can adopt to decarbonize and future-proof its own AI ecosystem.

The Sustainability Gap in South Korea's AI Strategy

While Seoul excludes [offshored emissions](#) from its national accounting under its legally binding "Net-Zero by 2050" policy, global regulatory pressure is mounting. The global standard accounting framework is shifting to mandate [Scope 3 supply chain disclosure](#), with the European Union (EU) actively considering expanding its [Carbon Border Adjustment Mechanism \(CBAM\)](#) to encompass semiconductors and broader technology supply chains by [2030](#). For European buyers, this could result in an estimated US\$588 million in CBAM certificate costs, if they continue buying from higher-emission manufactures, including South Korean producers. Confronted with this looming regulatory overhead, EU importers will likely opt to de-risk their supply chains by shifting to low-carbon alternatives.

Against this backdrop, South Korea's AI ambition faces a fundamental requirement: it must establish a comprehensive sustainable AI supply chain to ensure long-term market viability. If this challenge is left unaddressed, the resulting policy misalignment could restrict the nation's future trade opportunities just as global demand for green semiconductors peaks. Ultimately, South Korea cannot simply rely on overseas extraction agreements; it must also invest in and construct low-carbon mining and refining infrastructure to satisfy increasingly stringent EU compliance protocols.

A second challenge lies in South Korea's national energy architecture, which is currently undergoing a profound structural transition. Specifically, the state is preparing to accommodate an anticipated 30 percent growth in power demand by 2038, driven in part by the expansion of data-heavy AI infrastructure. While South Korean policymakers race to secure the large-scale [carbon-](#)



[neutral grids](#) needed for future AI hubs, they have largely overlooked the potential of embedding circular energy lifecycles into this expanding infrastructure. In particular, incorporating energy reuse mechanisms—such as waste heat recovery and closed-loop urban infrastructure—into the national framework could drastically reduce peak power demand and lower prices for consumers. This would, furthermore, promote the objectives of the “[Act on the Promotion of Smart City Development and Industry](#),” which provides a regulatory framework for smart city development and supports integrated resource planning and green energy adoption. Consequently, achieving higher levels of sustainability and cost-effective mitigation of future capacity constraints requires Seoul to transition from a reactive energy-acquisition strategy to a forward-looking approach grounded in circular resource and energy planning. This framework is best deployed in tandem with South Korea’s ongoing national AI infrastructure rollouts.

Sweden and Finland – ‘Green’ Mining and Refining

South Korea faces challenges in securing a sustainable mineral supply chain due to limited domestic expertise in low-carbon, water-efficient extraction and refining technologies. While domestic conglomerates such as POSCO and LX International maintain established chemical refining and mineral processing capabilities, South Korea’s existing processing infrastructure does not yet consistently deliver the environmental performance required to meet next-generation compliance standards, creating a critical strategic bottleneck for Seoul. Sweden and Finland, by contrast, have established themselves as European leaders in [low-carbon mining and refining](#), leveraging fossil-free energy grids to rewrite the global standard for raw material processing. With ambitious net-zero targets—Finland by 2035 and Sweden by 2045—both nations possess complementary technological expertise that could help South Korea develop more highly sustainable AI supply chains.

Sweden is transforming raw material extraction by converting traditional operations into “smart mines.” By integrating automation, [fleet electrification](#), and digital twin technology, Swedish operators are working to extract critical minerals—such as copper,

lithium, cobalt, and rare earth elements (REEs)—while reducing or eliminating underground diesel emissions. Demonstrating this technological advancement, industry leaders [Boliden, Epiroc, and ABB](#) recently deployed the first battery-electric trolley truck system on an 800-meter underground test track at the Kristineberg mine. The system’s specialized vehicles achieve near-zero local emissions while significantly lowering operational and energy costs.

Finland, meanwhile, is spearheading the decarbonization of the midstream supply chain by pioneering water-efficient mineral refining. By shifting away from traditional, water-intensive “wet” processing, Finnish refiners are deploying closed-loop systems, dry processing, and advanced hydrometallurgy. This enables the production of high-purity materials—such as lithium, nickel, and cobalt—while drastically slashing freshwater consumption and mitigating environmental risks associated with massive tailings dams.

The [Sibanye-Stillwater Keliber](#) project stands as a premier example of Finnish leadership in water-efficient mineral refining, setting new sustainability benchmarks for Europe. By utilizing [Metso’s](#) proprietary hydrometallurgical technology, the project is reported to achieve a [40 percent to 60 percent](#) reduction in water consumption compared with traditional acid-leach methods. Furthermore, its closed-loop processing system continuously treats and recirculates water from the main hydrometallurgical circuit, rather than discharging it, significantly optimizing overall resource efficiency.

Recommendation & Feasibility

A strategic partnership with Sweden and Finland would provide South Korea with access to more sustainable mining and refining expertise, helping it to extract and refine high-purity critical minerals to support its AI boom. This collaboration could help South Korean producers meet current and evolving sustainability benchmarks, including potential expansions of the EU CBAM, and safeguard South Korea’s market access in Europe. Given existing bilateral green-transition [cooperation](#) between these nations, institutionalizing deeper government-to-government cooperation is



highly feasible. However, because this initiative depends on technology sharing and collaboration among industry leaders like Boliden and Metso, protecting and incentivizing intellectual property transfer adds a layer of complexity. To secure corporate buy-in and create favorable business conditions, the governments could champion joint ventures and or co-investments in pilot plants in South Korea and abroad.

Denmark and Waste-Heat Recovery Systems

Denmark boasts arguably the world's most advanced ecosystem for data center waste-heat recovery (WHR), having successfully integrated this surplus energy into its municipal district heating grids since 2019. The nation has built an infrastructure framework that effectively repurposes the massive thermal energy—up to [50 kW per server rack](#)—generated by graphics processing units (GPUs). Utilizing advanced liquid-to-liquid heat exchangers engineered by companies such as the Danish manufacturer Danfoss, water absorbs heat directly from the server cooling loops before industrial, megawatt-scale heat pumps distribute it to households. Because approximately 60 percent of Danish households are already connected to a unified municipal district heating network, new data centers can potentially plug directly into urban grids, while utilizing the grid's cooler return water as a heat sink for their cooling systems.

A prime example of this industrial-utility symbiosis is [Meta's Odense Data Center](#), where the waste-heat recovery system supplies up to 165,000 MWh of surplus energy annually to the local community. Danish energy systems modelling suggests that integrating data center waste heat into district heating networks reduces Denmark's national carbon emissions by [1.4 percent overall](#). From a financial perspective, this surplus thermal energy operates as a [highly competitive "greener" alternative](#): it simultaneously drives down municipal heating costs for consumers while allowing data center operators to monetize a byproduct that would otherwise be [wasted](#).

Recommendation & Feasibility

The planned expansion of high-density AI computing facilities outside the Seoul metropolitan area—specifically within the [Honam and Gangwon regions](#)—

presents a significant opportunity to integrate Danish-scale waste-heat recovery systems in South Korea. While South Korea's lack of an integrated district heating grid prevents a literal "plug-and-play" adoption of the Danish blueprint, the real opportunity lies in constructing thermal energy networks (TENs) concurrently with new data center developments. In master-planned smart city projects like Honam's ["Solaseado,"](#) planners can avoid the costly hurdle of tearing up existing urban roads. Instead, they can lay down local thermal pipelines alongside data center construction, mimicking Denmark's integrated industrial layouts in a cost-effective and technically feasible manner. By additionally integrating absorption chillers adapted to South Korea's hot summer climate, data center waste heat can also be used to support district cooling. Furthermore, integrating this framework directly advances the Ministry of Trade, Industry and Energy's (MOTIE) [strategic mandate](#) to expand district heating infrastructure nationwide over the coming years.

Consequently, by embedding data center waste-heat recovery systems into regional development, South Korea can accelerate its transition toward lower-carbon residential heating and cooling solutions, thereby advancing its broader energy policy objectives. As with the proposed partnerships with Sweden and Finland, strong government-to-government cooperation on the green transition could support this Denmark–South Korea initiative, but successful execution would also require private sector participation. Since core waste-heat recovery technologies are developed and supplied by proprietary manufacturers like Danfoss, targeted commercial incentives and appropriate intellectual property protections will be critical to encouraging technology transfer and industry participation.

Conclusion

To fully realize its AI ambitions, Seoul must urgently address critical policy bottlenecks in its AI infrastructure investment strategy. Simply securing mineral agreements abroad without green foresight risks costing South Korean producers millions in future export revenue, particularly if upstream and midstream AI supply chains fail to meet evolving sustainability standards. Furthermore, to mitigate the



looming power supply constraints associated with the AI boom, South Korea must transition from a reactive energy-acquisition model to a forward-looking, circular energy management framework.

By leveraging strong government-to-government ties, South Korea can partner with Nordic leaders like Denmark, Sweden, and Finland to bridge these infrastructure gaps and overcome policy bottlenecks. Specifically, collaborating with Sweden and Finland could enable South Korea to adopt automated smart mining and water-efficient refining methods. This would ensure that minerals used in semiconductor production meet future strict international standards, thereby safeguarding access to key export markets, particularly in Europe. Adopting Denmark's advanced waste-heat recovery systems could enable South Korea to capture data center thermal energy for local heating and cooling networks. This industrial symbiosis would help alleviate the effects of the projected 30 percent power demand surge by 2038 while lowering consumer energy costs.

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