

Bridging East Asia: Assessing the System Costs and Emissions of the Korea - Japan Energy Island

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Summary

The analysis demonstrates that the system-level effectiveness of renewable energy depends more on power system structure and institutional configuration than on installed capacity alone. Rather than pursuing detailed unit-level or spatially resolved modeling, this study adopts a transparent, comparative system-level framework to isolate how different cross-border configurations shape costs, emissions, and surplus dynamics under a common structural baseline.

Across both Korea and Japan, a uniform tripling of domestic renewables primarily displaces LNG generation and leads to pronounced surplus conditions, particularly under solar-heavy expansion. By contrast, a wind-dominant expansion achieves more effective coal displacement due to wind's more temporally distributed generation profile. In Korea, however, the impact of domestic renewable expansion remains limited by structural rigidities associated with a nuclear-dominated and inflexible system.

Interconnection between Korea and Japan improves overall system efficiency by pooling demand and smoothing renewable variability, reducing surplus generation and marginal costs at the margin. However, interconnection alone does not induce a qualitative restructuring of the generation mix or cost structure, and its contribution remains incremental rather than transformational.

The energy island configuration produces a qualitatively different outcome by enabling the introduction of system-scale offshore wind as a new regional supply source. Under this configuration, large-scale coal displacement and deep emissions reductions become structurally feasible, alongside a shift toward persistent surplus conditions reflected in abundance-driven marginal cost signals. Within the current modeling setting, energy storage enhances integration efficiency and reduces curtailment, but plays a supporting role relative to the scale and temporal profile of offshore wind.

Rather than providing a detailed operational or market simulation, this study is designed to clarify structural mechanisms and boundary conditions for regional decarbonization in East Asia. Key limitations—including restricted access to unit-level operational data, coarse spatial abstraction, and the absence of explicit market representations—are treated explicitly and used to motivate future research priorities. The findings underscore the need for improved generator-level data, higher-resolution regional demand information, and a shared, open power system data platform to support credible, scalable, and policy-relevant Asia-Pacific power system analysis.

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Table of contents

[Summary](#)

[Acknowledgement](#)

[Table of contents](#)

[From regional interconnection to the energy island concept](#)

[Analytical Framework](#)

[Model Structure](#)

[Scenario design and configuration](#)

[Optimization and Evaluation](#)

[Data](#)

[Reproducibility and Transparency](#)

[Structural characteristics of the Korea and Japan power systems in the reference scenario](#)

[Renewable composition determines fossil fuel displacement under high renewables](#)

[Interconnection enables solar utilization and coal reduction under high renewable shares](#)

[Interconnection optimizes the system, energy island restructures it](#)

[Energy island enables deep emissions reduction through structural coal displacement](#)

[Energy island with a wind-dominant triple renewable expansion reshapes the fuel cost structure](#)

[Energy island induces a structural shift in marginal price formation](#)

[Data, Market, and Spatial Limitations, and Lessons for Future Regional Power System Modeling](#)

[Challenge 1: Data and operational limitations](#)

[Challenge 2: Spatial abstraction and its implications](#)

[Challenge 3: Market representation and interpretation](#)

[Challenge 4: Distinguishing the structural value of the energy island](#)

[Lessons for regional power system modeling](#)

From regional interconnection to the energy island concept

The concept of international power grids in Asia is not new ¹. Over the past two decades, several regional initiatives have explored the idea of connecting national power systems to enable renewable energy trade and enhance energy security ^{2,3}. These studies demonstrated strong technical potential and highlighted the economic benefits of cross-border cooperation, yet most faced institutional and political challenges. Many of their findings remained inaccessible or proprietary, limiting broader discussion on practical implementation and public engagement.

In recent years, the idea of energy islands, shared offshore platforms linked by high-voltage direct current (HVDC) transmission, has gained global attention as a practical alternative. Such systems allow countries to exchange renewable electricity through neutral offshore hubs without requiring direct bilateral grid interconnection. For energy-importing nations like South Korea and Japan, this approach offers a realistic and politically feasible path to regional energy cooperation ⁴.

While several studies have examined regional interconnection concepts, there remains limited analysis focusing specifically on the energy island approach between Korea and Japan. This project aims to contribute additional insight by using PyPSA to model and evaluate how an energy island could function as a shared offshore infrastructure supporting both countries' energy transitions.

The key objectives of this project are:

¹ REI. History of ASG | Power System. <https://www.renewable-ei.org/> (2019).

² Otsuki, T., Mohd Isa, A. B. & Samuelson, R. D. Electric power grid interconnections in Northeast Asia: A quantitative analysis of opportunities and challenges. *Energy Policy* 89, 311–329 (2016).

³ Chang, H.-I., Chun, Y. & Her, Y. A fair and stable benefit-sharing for the Northeast Asia Supergrid under flexible networks. *Energy Econ.* 103, 105521 (2021).

⁴ Kim, H. & Jung, T. Y. Embarking on the Asia Supergrid: Trade impact of carbon pricing on regional sustainability in northeast Asia. *Renew. Sustain. Energy Rev.* 183, 113426 (2023).

- 1) **Establish Technical Foundation:** Develop and publish open-source, single-node PyPSA models for the connected Korea-Japan energy island system to ensure transparency and reproducibility for future research.
- 2) **Assess Environmental Impact:** Analyze the change in CO₂ emissions and renewable utilization rates in both South Korea and Japan resulting from the energy island's operation.
- 3) **Quantify Economic Viability:** Model and evaluate the cost and trade balance under both the Interconnected grid model and the independent access model for the Korea-Japan energy island.
- 4) **Investigate Technical Challenges and Requirements:** Document and analyze the technical limitations, data requirements, and necessary assumptions for the PyPSA modelling process to ensure robustness and clarity.

Analytical Framework

This study applies a comparative system modeling approach to evaluate alternative electricity system configurations for South Korea and Japan under a common 2024 structural baseline. The analysis does not aim to forecast future capacity expansion, demand growth, or policy evolution. Instead, it examines how different institutional and technical arrangements for cross-border electricity exchange, specifically the introduction of an offshore energy island, would alter system costs, emissions, and operational outcomes if implemented under current conditions.

All scenarios are therefore interpreted as alternative realizations of the 2024 power system, holding demand levels, technology costs, and policy constraints constant except where explicitly modified.

Model Structure

The model consists of three nodes in total: one node representing South Korea, one node representing Japan, and a third node representing the energy island. Each national node aggregates domestic generation, storage, and demand, while the energy island node serves as an offshore interconnection hub linked to both countries through HVDC transmission.

This abstraction intentionally omits internal transmission constraints within each country and focuses on system-level interactions, trade flows, and aggregate impacts. The modeling choice prioritizes transparency, computational efficiency, and reproducibility over spatial granularity.

Scenario design and configuration

Three distinct configurations were simulated and compared:

- 1) **Independent grid model (reference):** South Korea and Japan have no electrical interconnection.
- 2) **Interconnected grid model (interconnected):** Both South Korea and Japan can freely exchange power with each other via the energy island.
- 3) **Independent access model (energy island):** Each country can receive power from the island, but cannot directly trade power with the other country.

Additional variations were included:

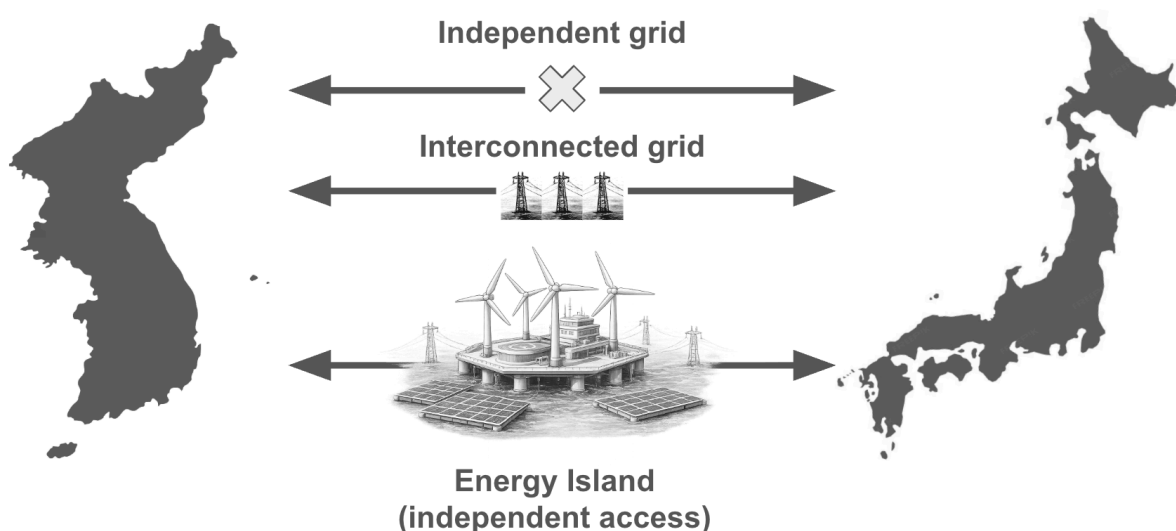
- 1) **High renewable capacity expansion:** A sensitivity scenario in which existing solar and wind capacities in both countries are uniformly scaled from current levels to threefold, to assess system behavior under aggressive renewable deployment. (e.g., 5GW of solar and 1 GW of wind become 15 GW of solar and 3 GW of wind)
- 2) **Wind-dominant expansion:** A variant of the high renewable scenario in which all additional renewable capacity in triple renewable scenarios is

allocated exclusively to wind power, reflecting a wind-focused development pathway. (e.g., 5GW of solar and 1 GW of wind become 5 GW solar and 13 GW wind)

- 3) **Energy storage integration:** A scenario incorporating energy storage systems (ESS) sized at 5% of total installed renewable capacity, with a fixed discharge duration of six hours, to evaluate the role of storage in mitigating variability and curtailment.

A triple renewable expansion was chosen not as an arbitrary scaling factor, but because “tripling renewables” is already established in the IPCC literature as a benchmark representing the minimum level of effort required to align energy systems with climate targets. While the IPCC framing applies at the global level rather than to individual countries, adopting a triple renewable scenario provides a meaningful and policy-relevant reference point for assessing how national power systems respond when subjected to a comparable level of minimum transition pressure.

Figure 1. Three scenarios including 1) independent grid, 2) interconnected grid, and 3) the energy island with independent access



Optimization and Evaluation

Each scenario is solved using PyPSA's linear optimization framework to minimize total system cost (fuel cost), subject to electricity balance, capacity, and operational constraints. The optimization determines hourly dispatch, storage operation, and cross-node power flows where applicable.

Key indicators evaluated include:

- Generation share by carrier (e.g., fossil fuels, renewables, nuclear)
- Fuel cost
- CO₂ emissions
- Renewable energy utilization rates (or curtailment)
- Cross-border trade balances

Comparisons across scenarios focus on relative differences, highlighting how institutional design choices, rather than future assumptions, affect economic and environmental performance.

Data

All data used in this study are derived from publicly available sources or official statistics released by relevant national institutions in South Korea and Japan. No proprietary datasets or confidential information were used.

Table 1. Data source for the power sector in South Korea

Data	Source
Generator Capacity	EPSIS - Power plants capacity by year and fuel
Demand pattern	KPX - Hourly electricity demand
Wind and solar generation pattern	KPX - Hourly wind and solar generation pattern by region
Cost data	EPSIS - Unit cost by fuel and month

For South Korea, generator capacity data were obtained from the Electric Power Statistics Information System (EPSIS), which provides power plant capacity by fuel type and commissioning year. Hourly electricity demand data, as well as historical wind and solar generation profiles by region, were sourced from the Korea Power Exchange (KPX). Fuel cost data were based on monthly unit fuel cost statistics published through EPSIS and applied consistently across all scenarios.

Table 2. Data source for the power sector in Japan

Data	Source
Generator Capacity	Aggregation of electricity supply plans for fiscal year 2025 HJKS - Generation capacity by unit
Demand pattern	Renewable Energy Institute - Hourly generation and demand pattern
Wind and solar generation pattern	Renewable Energy Institute - Hourly generation and demand pattern
Cost data	Fuel cost adjustments, etc. included in electricity rates

For Japan, generator capacity data were compiled through an aggregation of publicly available electricity supply plans for fiscal year 2025, supplemented by unit-level capacity information from the HJKS database. Hourly electricity demand and renewable generation profiles were obtained from datasets published by the Renewable Energy Institute, which provide a harmonised time series of demand, wind, and solar output. Fuel cost assumptions and related adjustments were incorporated based on publicly reported electricity pricing structures and fuel cost disclosures.

Emission factors used in this study are derived from publicly available data provided by Ember’s Electricity Data Explorer. Country-specific average emission factors for coal- and gas-fired electricity generation were calculated by combining Ember’s reported annual electricity generation by fuel type⁵ with corresponding power-sector CO₂ emissions⁶ for South Korea and Japan. These emission factors are applied uniformly across all scenarios and technologies within each country, ensuring that

⁵ [Ember’s electricity data explorer - Electricity generation by fuel and country](#)

⁶ [Ember’s electricity data explorer - CO2 emissions by fuel and country](#)

differences in emissions outcomes are driven solely by changes in generation levels rather than by assumptions about technological efficiency or fuel quality. By anchoring emission intensities to a single, transparent, and externally validated data source, the analysis maintains internal consistency and enables reproducible comparison of emissions impacts across scenarios.

All time series data were processed to a common hourly resolution and aligned to a consistent temporal scope to ensure comparability across scenarios. Where necessary, data cleaning, aggregation, and normalization procedures were applied, and these steps are fully documented in the accompanying data processing scripts.

Reproducibility and Transparency

All model code, configuration files, and data processing scripts are developed in accordance with PLANiT's internal reproducibility standards and are designed to be fully executable by third parties. The complete modeling framework is openly shared through GitHub (GPL-3.0 license), and the simplified model structure, together with exclusive reliance on publicly available data, ensures that all results can be independently verified, extended, or adapted for future comparative studies.⁷

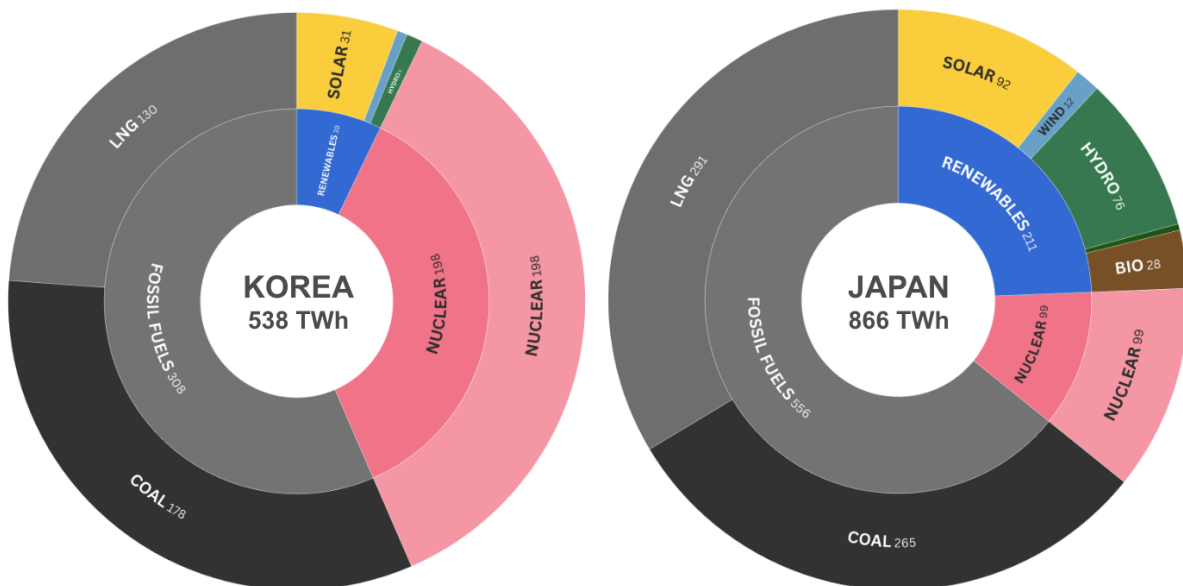
Structural characteristics of the Korea and Japan power systems in the reference scenario

Strict empirical validation against observed 2024 generation data is beyond the scope of this analysis; instead, the reference case is used to confirm that the model reproduces the key structural characteristics of the current power systems in South Korea and Japan. The comparison focuses on the relative roles of major generation technologies and the overall system structure rather than on exact replication of historical dispatch.

⁷ <https://github.com/PLANiT-Institute/KRJP-EnergyIsland>

South Korea’s generation mix is characterized by a strong reliance on nuclear and thermal generation, with renewables playing a limited role, while Japan’s system exhibits a more diversified renewable portfolio alongside continued dependence on fossil fuels and partial nuclear operation. The absence of meaningful oil-fired generation in both systems is also consistent with current operational practice. Overall, the reference results reproduce key structural features of both power systems, providing a credible baseline for comparative analysis of Korea-Japan energy island scenarios.

Figure 2. Generation share of the reference scenario of Korea and Japan*



*Please note that the generation shares in the reference scenario are based on 2024 data and are used as an alternative structural reference rather than a calibrated historical reproduction.

Renewable composition determines fossil fuel displacement under high renewables

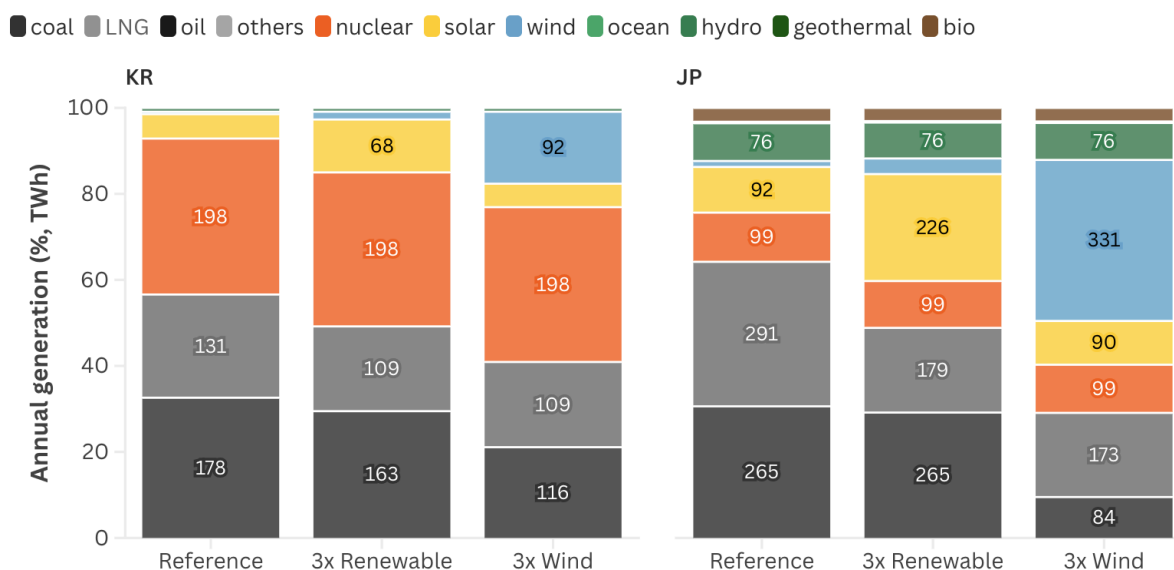
Across both Korea and Japan, expanding renewable capacity primarily affects fossil fuel generation rather than nuclear output, which remains fixed in all scenarios. In both systems, renewables first displace fossil fuels. The difference is that the triple renewables expansion of both solar and wind mainly displaces LNG, leaving coal

largely unchanged, because added solar is concentrated in limited hours. In contrast, a wind-dominant expansion spreads generation more evenly over time, allowing renewables to directly replace coal and achieve deeper fossil fuel reduction.

In Korea, the limited impact of tripling renewables on fossil fuels reduction reflects both the low absolute level of existing renewables and the low utilization rate (i.e., capacity factor) of solar generation. As a result, even with tripled renewables, reductions in coal and LNG generation are modest, and the overall fossil structure remains largely intact. The system’s rigidity driven by inflexible nuclear generation and limited operational flexibility prevents renewables from significantly displacing coal, resulting in only partial substitution of LNG.

In Japan, fossil fuel responses are stronger and highly dependent on the renewable mix. The triple renewable expansion mainly reduces LNG use, leaving coal largely unaffected, but a wind-dominant expansion leads to a substantial decline in coal generation alongside LNG. This indicates that Japan’s system can translate renewable growth into meaningful fossil displacement, particularly when wind plays a dominant role.

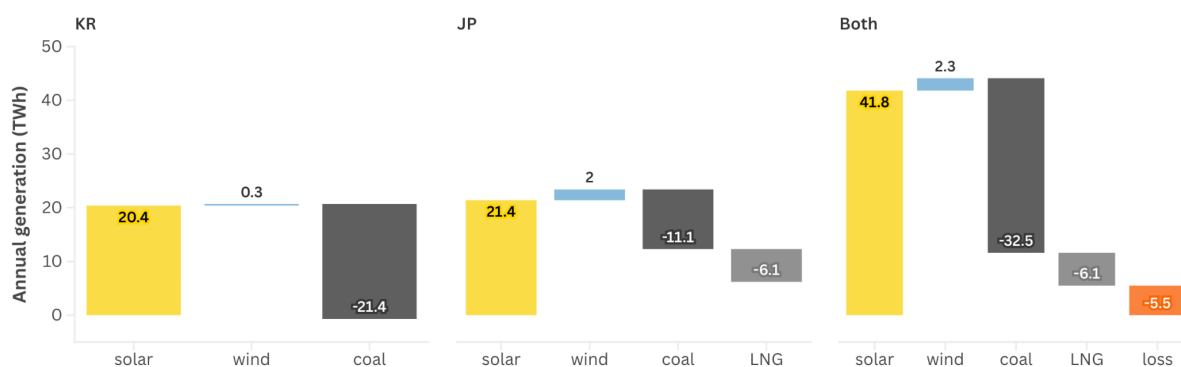
Figure 3. Annual generation of triple renewable and triple wind-dominant renewable scenarios of South Korea (left) and Japan (right)



Interconnection enables solar utilization and coal reduction under high renewable shares

In the reference scenario, interconnection between Korea and Japan results in only marginal changes in generation composition, indicating limited cross-border electricity flows under current system conditions. In the triple renewable energy scenario, interconnection enables an additional 42 TWh of solar generation to be utilized (21 TWh in each country), while wind generation increases only marginally by 2 TWh. This increase in renewable utilization leads to a reduction in fossil fuel generation, with coal decreasing by 32 TWh (11 TWh in Japan and 21 TWh in South Korea) and LNG decreasing by 6 TWh, primarily in Japan; the remaining imbalance is attributable to transmission losses. By contrast, in the wind-dominant triple renewable scenario, total wind generation remains largely unchanged with interconnection, indicating that cross-border transmission provides limited additional value once wind output is already maximized and constrained by system flexibility.

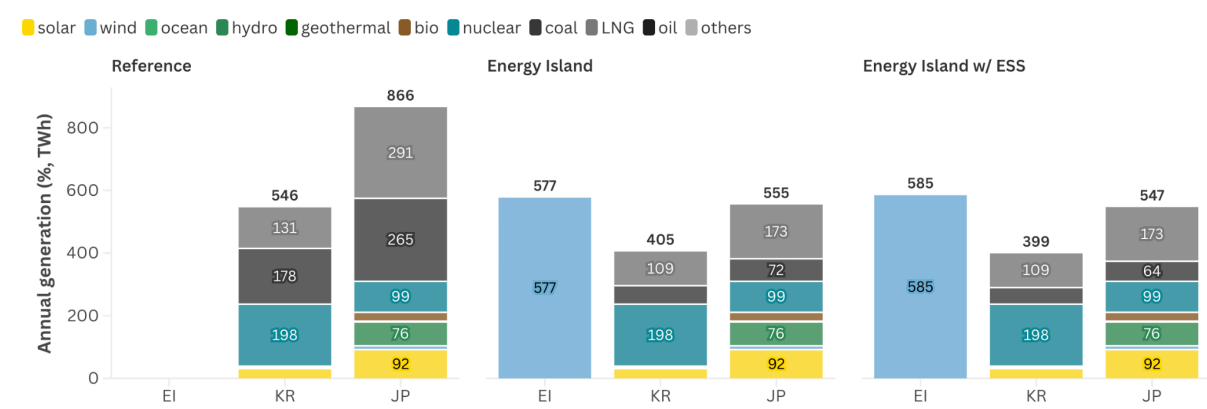
Figure 4. Changes in annual generation by technology due to the Korea - Japan interconnection under the triple renewable scenario



Interconnection optimizes the system, energy island restructures it

The introduction of the energy island leads to a substantial increase in total electricity generation across the combined Korea–Japan system relative to the interconnection scenario, driven almost entirely by large-scale offshore wind. While the interconnection scenario delivers only incremental renewable gains, the energy island with the wind-dominant triple renewable adds roughly 580 TWh of wind generation, operating as a new regional supply source rather than a redistribution mechanism. This additional wind generation directly displaces fossil fuel output in both countries: coal generation declines sharply in Japan and South Korea, accounting for the majority of the adjustment, while LNG generation decreases more modestly and continues to provide balancing services. Nuclear and other non-fossil generation remain unchanged, confirming that the energy island primarily reshapes the fossil generation mix. Compared with interconnection, which reallocates limited domestic renewables, the energy island fundamentally increases total renewable supply and drives large-scale coal displacement across both systems.

Figure 5. Annual generation by technology under the energy island and energy island with ESS scenarios relative to the reference system



Adding energy storage sized at 5% of renewable capacity with a 6-hour duration to the energy island further improves system performance by slightly increasing usable wind generation and reducing losses and curtailment. Fossil fuel generation,

particularly coal, declines further with storage, but the overall generation structure remains largely unchanged: coal is already largely displaced, LNG retains its balancing role, and nuclear output is unaffected. This shows that storage enhances efficiency at the margin rather than introducing an additional structural shift.

Taken together, the results show that the energy island acts as a system-restructuring asset, fundamentally changing the merit order by displacing coal across both national power systems. Energy storage strengthens this outcome by improving integration efficiency and renewable utilization, but it does not alter the qualitative conclusion based on the current modelling setting: deep decarbonization of the Korea-Japan power system is driven primarily by the scale and temporal profile of shared offshore wind, with storage playing a supporting role.

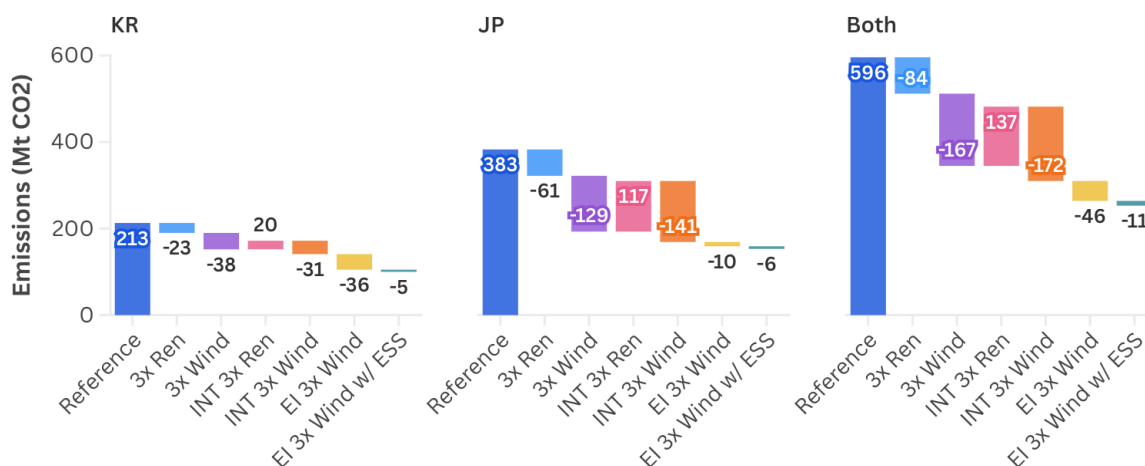
Energy island enables deep emissions reduction through structural coal displacement

Across all scenarios, CO₂ emissions closely track changes in coal and LNG generation, with nuclear and renewable sources contributing no direct emissions. In the independent triple renewable scenario, emission reductions are modest in both countries, falling from 213 to 190 Mt in Korea and from 383 to 322 Mt in Japan. These reductions are driven primarily by LNG displacement, particularly in Japan, while coal emissions remain largely unchanged. By contrast, a wind-dominant triple renewable expansion produces substantially larger emission reductions, lowering emissions to 152 Mt in Korea and 193 Mt in Japan, as wind directly displaces coal generation in both systems.

Interconnection further enhances emission reductions under high renewable penetration, but its impact remains incremental. In the interconnected triple renewable scenario, emissions decline to 172 Mt in Korea and 310 Mt in Japan, reflecting improved utilization of domestic renewables but continued reliance on coal. Under the interconnected wind-dominant triple renewable scenario, emissions fall

further to 141 Mt in Korea and 169 Mt in Japan, driven by additional coal displacement, enabled by cross-border electricity exchange.

Figure 6. Changes in annual emissions by scenario relative to the reference system



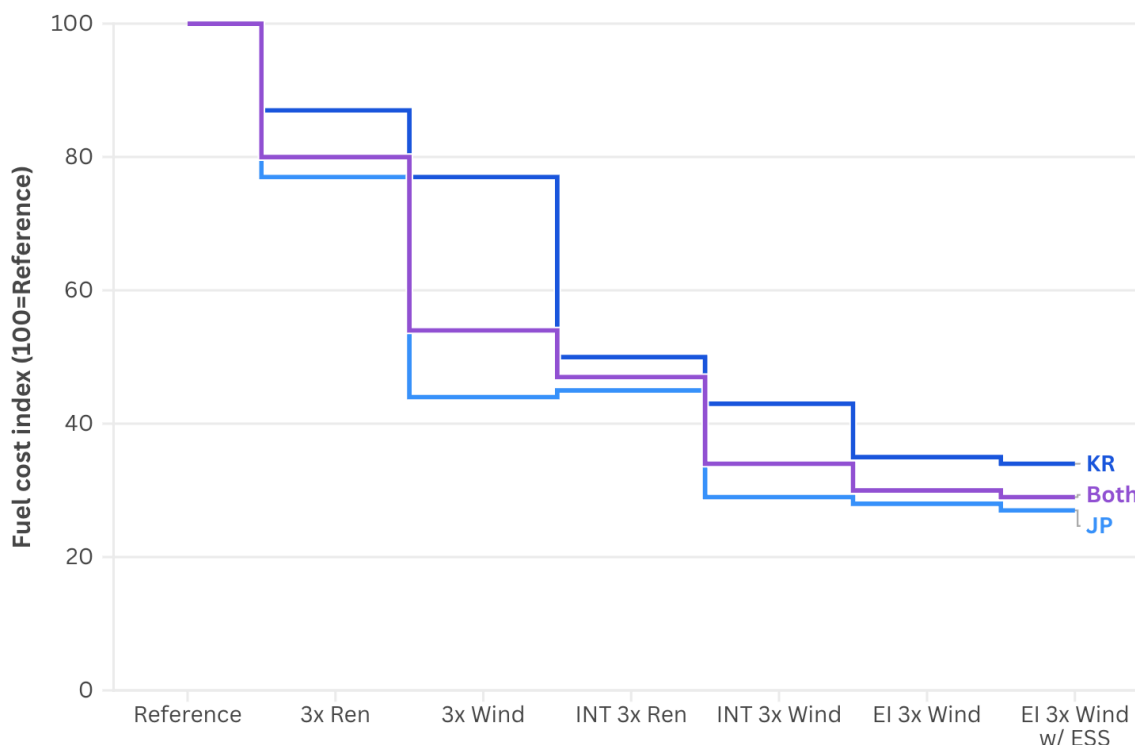
The energy island scenarios deliver the deepest emission reductions. Without energy storage, emissions drop to 105 Mt in Korea and 159 Mt in Japan, reflecting large-scale coal replacement by offshore wind supplied from the energy island. Adding energy storage reduces emissions further to 100 Mt in Korea and 153 Mt in Japan by improving wind utilization and marginally lowering residual coal generation. Taken together, the results show that while renewable expansion and interconnection reduce emissions incrementally, the energy island fundamentally changes the emissions trajectory by enabling system-scale coal displacement, with energy storage providing additional but secondary benefits.

Energy island with a wind-dominant triple renewable expansion reshapes the fuel cost structure

Fuel cost reductions across scenarios are primarily driven by the expansion of solar and wind generation, which directly reduces the need for fossil fuel consumption rather than improving operational efficiency alone. In the independent scenarios,

renewable expansion first lowers fuel costs by displacing LNG, reflecting the role of gas as the marginal balancing fuel. When wind becomes dominant, cost reductions deepen as renewables begin to substitute for coal, which carries a higher and more persistent fuel cost burden.

Figure 7. Fuel cost index across scenarios (reference = 100)



Interconnection further strengthens this effect by improving the utilization of variable renewables, particularly solar, and by enabling additional fossil fuel displacement across borders. However, its impact remains incremental, as it does not introduce new renewable supply but rather reallocates existing generation more efficiently within the system.

The Energy Island fundamentally changes the fuel cost structure by adding large-scale offshore wind as a new regional energy source. This shifts the system away from fossil fuels at scale, leading to a structural reduction in fuel expenditures. Energy storage enhances this outcome by smoothing renewable delivery and reducing balancing needs, but its contribution remains secondary; the dominant

driver of fuel cost reduction is the expansion and effective utilization of wind and solar generation, especially offshore wind enabled by the Energy Island.

Energy island induces a structural shift in marginal price formation

In the reference scenario, Korea experiences only 42 hours with zero marginal shadow prices, indicating limited periods of surplus generation under current system conditions. Under the triple renewable scenario, zero-price occurrences increase sharply to 2,018 hours in Korea and 1,826 hours in Japan. This increase reflects the strong temporal concentration of renewable output, particularly from solar generation, within a system that retains limited flexibility and aggregation at the national level.

When renewable expansion is wind-dominant, the number of zero-price hours declines substantially to 685 in Korea and 408 in Japan, indicating that wind generation, with its more temporally distributed production profile, reduces the frequency of surplus conditions relative to solar-heavy expansion.

Interconnection further moderates surplus conditions by allowing demand pooling and partial smoothing of renewable variability across countries. In the interconnected grid scenario, zero-price hours fall to 1,359 under the triple renewable case and to 44 under wind-dominant expansion. These results indicate improved system-level balancing and reduced surplus frequency under cost-minimizing dispatch, rather than the emergence of a fully integrated electricity market.

The Energy Island scenarios exhibit a qualitatively different pattern. In both the triple renewable and wind-dominant configurations, zero marginal shadow prices occur for more than 3,000 hours per year in both Korea and Japan, with only marginal differences between cases with and without energy storage. This outcome should be interpreted as an upper-bound structural signal of persistent surplus conditions under system-scale offshore wind supply within a highly aggregated, cost-minimizing framework. Rather than indicating market inefficiency or literal price outcomes, the

convergence of zero-price frequencies across both countries reflects a shared abundance regime in which marginal generation costs are frequently driven to zero by large-scale offshore wind.

Data, Market, and Spatial Limitations, and Lessons for Future Regional Power System Modeling

This study identifies several limitations that are inherent to power system modeling in East Asia and reflect broader structural and data constraints, rather than shortcomings specific to the modeling approach adopted here. At the same time, these limitations offer clear lessons for interpreting claims of structural change and for guiding future regional system analysis.

Challenge 1: Data and operational limitations

Empirical validation against observed dispatch behavior is constrained by limited access to operational data. Generation cost information is typically available only at monthly, fuel-aggregated levels, while unit-level operational characteristics, such as ramping constraints, minimum stable generation, dispatch priorities, and start-up costs, are not publicly disclosed. These limitations restrict the model's ability to reproduce real-world dispatch dynamics, particularly for large thermal and nuclear units, and may lead to overly smooth substitution patterns between renewables and fossil generation.

As a result, outcomes such as wind-driven coal displacement should be interpreted as structurally feasible trajectories rather than precise operational forecasts. Introducing simplified representations of unit-level constraints would materially improve realism and should be a priority for future work as data availability improves.

Challenge 2: Spatial abstraction and its implications

The absence of spatial granularity limits the representation of congestion, curtailment, and regional imbalance. The single-node national abstraction removes internal transmission bottlenecks and locational constraints that are critical under high renewable penetration. In practice, the scale and frequency of surplus generation, renewable curtailment, and zero marginal prices are highly sensitive to internal grid constraints.

Accordingly, the high prevalence of zero marginal price hours observed in the energy island scenarios should be interpreted as an upper-bound structural signal rather than a literal market outcome. These results indicate the direction of change under abundant renewable supply, but not the exact magnitude that would emerge in a spatially constrained system.

A minimal but high-impact extension would be to disaggregate Korea and Japan into a small number of regional nodes connected by simplified inter-zonal transfer capacities. Even coarse spatial representations would significantly strengthen confidence in conclusions regarding curtailment, fossil fuel displacement, and system-level price formation.

Challenge 3: Market representation and interpretation

The absence of explicit market mechanisms complicates the interpretation of price outcomes. Marginal prices in this study are derived from cost-based optimization and reflect shadow prices under assumptions of perfect competition and full short-run cost minimization. These prices do not capture key institutional features of real electricity markets in Korea and Japan, including capacity markets, bilateral contracts, regulated pricing structures, and strategic bidding behavior.

Consequently, results related to price formation should be interpreted as indicators of structural tendencies, such as shifts toward abundance-driven marginal pricing, rather than as forecasts of wholesale market prices. Future modeling efforts should explicitly frame marginal prices as shadow prices and, where possible, complement fuel-cost minimization with simplified representations of fixed-cost recovery, such as annualized capital costs or stylized capacity remuneration mechanisms.

Challenge 4: Distinguishing the structural value of the energy island

A further interpretive challenge lies in distinguishing the structural value of the energy island concept from the effects of renewable capacity expansion alone. In the present framework, interconnection primarily optimizes the utilization of existing domestic generation, while the energy island functions as a vehicle for introducing large-scale offshore wind as a new regional supply source.

To clarify the unique contribution of the energy island, its technical distinctiveness must be defined more explicitly for future studies. Beyond capacity addition, the energy island represents a neutral offshore hub enabling multi-country access, shared HVDC conversion and collection infrastructure, and potentially lower political and institutional barriers compared with direct bilateral interconnection.

From a modeling perspective, this distinction can be sharpened by including comparison scenarios in which equivalent offshore wind capacity is developed independently by each country without a shared hub. Such scenarios would allow the incremental value of the island-as-hub architecture to be isolated from pure capacity effects, strengthening the analytical basis for policy conclusions.

Lessons for regional power system modeling

Taken together, these findings underscore that structural change in power systems cannot be inferred from capacity scale alone. While large-scale offshore wind with favorable temporal profiles is a necessary condition for deep decarbonization and fossil fuel displacement, it is not sufficient. Spatial constraints, operational limits, cost recovery mechanisms, and institutional design ultimately determine whether structural shifts identified in stylized models can materialize in practice.

Future regional power system analysis in East Asia therefore requires both improved data availability and incremental increases in model realism, guided by transparency and reproducibility. In particular, access to generator-level operational data,

higher-resolution regional demand information, and harmonized representations of diverse market structures are essential.

The analysis highlights the need for a dedicated, open, and continuously updated Asia-Pacific power system database. Such a platform should consolidate generation, demand, cost, and network data across countries; support interactive data selection through a dashboard interface; generate standardized PyPSA-ready input datasets; and connect directly to optimization environments. Developing this data infrastructure in parallel with physical initiatives such as an Asia Power Grid is essential for enabling credible, scalable, and policy-relevant system analysis.

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