EnergyTag

KOSIF Korea Sustainability Investing Forum

KOREA POWER SECTOR AND POLICY LANDSCAPE FOR ROUND-THE-CLOCK CLEAN POWER

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EXECUTIVE SUMMARY

Round-the-Clock (RtC) renewables provide major energy security and price stability benefits.

RtC demand pressure is accelerating. KEPCO has received 49 GW of data center grid connection applications, with gas co-firing being a major source of energy.[1] Reliance on fossil fuels risks infrastructure lock-in and exposes Korea's electricity prices to volatile global LNG markets.[2] Fossil fuel dependence burdened Korea with US$17 billion in electricity costs in 2022 alone, according to an estimate from the Institute of Energy Economics and Financial Analysis (IEEFA).[3] RtC renewables hedge against price volatility of imported LNG by reducing exposure to global commodity markets and locking in long-term, predictable energy costs.

Hourly matching provides market signals for Korea's energy storage systems (ESS).

As of the end of 2024, over 78% of cumulative renewable capacity is solar.[4] As midday oversupply floods the grid, this creates a steep duck curve. Annual matching masks the mismatch, allowing green claims despite the fossil fuel ramp-up during peak hours. ESS would be crucial to provide the flexibility and demand response that the grid needs. Korea's ESS already participates in grid services through ESS Central Contract Market [5], but the economics are challenging. The cost-based pool structure and regulated retail tariffs compress the wholesale price spread that storage depends on for arbitrage revenue.[6] Hourly matching creates a new value stream: corporate premiums for the "time-shifted" solar for round-the-clock delivery. The Ministry of Trade Industry and Energy (MOTIE, now Ministry of Trade Industry and Resources, MOTIR) Notice 2025-46 is moving in the right direction by allowing ESS facilities to participate in Power Purchase Agreements (PPAs). Together, hourly accounting and ESS-enabled PPAs could begin to close the gap between Korea's solar-heavy generation profile and its evening demand peak.

Hourly matching is becoming the new norm for global electricity accounting and green hydrogen standards.

The direction of travel for GHGP Scope 2 protocols and ISO 14064 is moving towards hourly accounting requirements. Hourly-matched and physically delivered PPAs are required to reduce CBAM compliance costs. While the current scope only covers fertilizer and cement, the cost of CBAM is estimated to go up to USD 588 million between 2026 and 2034 under a high EU ETS price scenario for Korea.[7] Rigorous hourly matching requirements are being incorporated into green hydrogen production regulations, through the 45V hydrogen tax credit in the US and Renewable Fuels of Non-Biological Origin (RFNBO) in the EU. Korea should move faster to enable catch-up with global standards on hourly matching.

The shift to hourly matching levels the playing field for Korea.

Korea and Europe have taken structurally different approaches to renewable procurement. Europe's Guarantee of Origin system allows companies to claim renewable energy from any source across a fragmented continental grid, decoupling consumption claims from when or where generation actually occurred. Korea's single bidding zone, by contrast, has kept procurement more tightly bound to physical delivery, meaning corporate renewable claims have always more accurately reflected real consumption patterns. As global standards converge on hourly accounting, Korea's closer alignment with physical delivery positions it more competitively than its current RE100 reputation suggests.

1. Choi Jeong-hyeon, "데이터센터 전력수요 폭증… 한전 계통접속 신청 49GW 돌파" [Surging Data Center Power Demand: KEPCO Grid Connection Applications Exceed 49 GW], E2 News, https://www.e2news.com/news/articleView.html?idxno=251599.
2. Center for Strategic and International Studies, "The Impact of the Iran Conflict on South Korea, by the Numbers," CSIS, accessed May 28, 2026, https://www.csis.org/analysis/impact-iran-conflict-south-korea-numbers.
3. Institute for Energy Economics and Financial Analysis (IEEFA), "South Korea's Power Trilemma," IEEFA, accessed May 28, 2026, https://ieefa.org/resources/south-koreas-power-trilemma.
4. 27.1 GW of 34.7 GW total, Korea Energy Agency, "에너지이슈브리핑 제267호" [Energy Issue Briefing No. 267], June 2, 2025, Ministry of Trade, Industry and Energy, "신재생 발전비중 첫 10% 돌파" [Renewable Generation Share Surpasses 10% for the First Time], May 12, 2025, https://www.korea.kr/news/policyNewsView.do?newsId=148943045; Ministry of Climate, Energy and Environment, "에너지 대전환 추진계획" [Energy Transition Implementation Plan], April 6, 2026, https://www.newsis.com/view/NISX20260406_0003579494.https://www.newsis.com/view/NISX20260406_0003579494
5. Greenberg Traurig, "Powering the Grid: South Korea's 2025 ESS Auction," July 2025, https://www.gtlaw.com/en/insights/2025/7/powering-the-grid-south-koreas-2025-ess-auction.
6. Hyun-Cheol Lee, Hyungna Kim, and Yong Tae Yoon, "Optimal ESS Investment Strategies for Energy Arbitrage by Market Structures and Participants," Journal of Electrical Engineering & Technology 13, no. 1 (2018): 51–59, https://doi.org/10.5370/JEET.2018.13.1.051.
7. Institute for Energy Economics and Financial Analysis, "Europe's CBAM Raises Supply-Chain Carbon Risks for South Korean Technology Industries," IEEFA, https://ieefa.org/resources/europes-cbam-raises-supply-chain-carbon-risks-south-korean-technology-industries.

Hourly matched green premium and lowering barriers to PPAs will make hourly procurement accessible to corporations.

Most companies procure through Green Premium, a procurement pathway that lacks any hourly data trail. However, pathways with the strongest hourly data infrastructure, such as PPAs, serve less than 2% of corporate procurement. While PPAs are moving to grid parity, non-transparent fee structures are preventing the wide adoption of PPAs. An hourly green tariff rollout would create accessible routes for hourly matching. KEPCO could supply dedicated clean energy, absorbing the PPA complexities that currently deter corporate buyers. This would give corporations a streamlined procurement route with hourly traceability at a predictable cost, without requiring them to negotiate bilateral contracts or navigate opaque ancillary charges from KEPCO.

TOP 3 OPPORTUNITIES FOR SOUTH KOREA'S HOURLY MATCHING JOURNEY

1. **South Korea's transition from the Renewable Portfolio Standard (RPS) to auction-based procurement creates an opportunity to embed stronger time-based signals into the power market.** By incorporating temporal delivery requirements and time-resolved data into auction design, Korea can better align renewable generation with system demand patterns. This would support more efficient integration of variable renewables while improving the credibility of clean energy supply for corporate buyers.
2. **South Korea already has the technical capability to support high-resolution electricity tracking.** The hourly wholesale settlement by Korea Power Exchange (KPX) and full deployment of Advanced Metering Infrastructure (AMI) smart meters create an opportunity to move toward more time-based coordination of generation and consumption.
3. **Allowing energy storage to participate in PPAs creates a pathway to manage renewable variability** by addressing intraday imbalances such as midday oversupply and evening peaks. Emerging approaches, including time-based accounting frameworks for storage such as EnergyTag's Granular Certificate (GC) Scheme Standard, can further support this transition.

TOP 3 CHALLENGES FOR KOREA'S HOURLY MATCHING JOURNEY

1. **The PPA usage charges with monthly settlement options induce system cost and reduce incentives for batteries.** Under the Direct PPA framework, the option to elect monthly flat-rate settlement erases the time-of-use price signal for PPA buyers, discouraging ESS investment for time-shifting. This mismatch is then absorbed by KPX's supplementary settlement charges rather than the grid usage fees,[9] which apply regardless of choice. Korean policy may benefit from explicit guidance on data-retention practices supporting international recognition under CBAM and the revised GHG Protocol Scope 2.
2. **Institutional silos block the connection between metering systems and certificate issuance.** KEPCO holds 15-minute AMI consumption data but does not share it with third-party registries or consumers in machine-readable form. KPX holds hourly generation and dispatch data, but it remains in operational settlement databases rather than feeding the certificate layer. There are no hourly grid emission factors, no residual mix methodology, and no facility-level renewable generation profiles published. Without a data-sharing mandate across KEPCO, KPX, and KEA, Korea's hourly infrastructure cannot translate into verifiable claims.
3. **No verification or accreditation framework exists.** Korea has no national granular energy attribute certificate (GC) system, no voluntary accredited GC issuers, and no verification protocols for temporal correlation claims. These institutional foundations should be established to enable granular tracking.

8. Ministry of Trade, Industry and Energy, Notice No. 2025-125, "재생에너지전기의 직접전력거래 등에 관한 고시" [Notice on Direct Electricity Transactions of Renewable-Generated Power], arts. 5(3), 22, 23, 25, effective July 29, 2025; jurisdiction transferred to Ministry of Climate, Energy and Environment Notice No. 2025-61, December 24, 2025, https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2100000274906.
9. Korea Electric Power Corporation, "송・배전용 전기설비 이용규정" [Transmission and Distribution Equipment Usage Regulation], effective July 31, 2024, https://recloud.energy.or.kr/file/송・배전용전기설비 이용규정 240730.pdf.

CRITICAL FIRST STEPS FOR CORPORATE PROCUREMENT

- **Prioritize PPAs with hourly settlement.**

If entering the Korean PPA market, prioritize PPAs with hourly settlement, which is the statutory default. If a monthly-equalized settlement option is elected, retain the underlying 15-minute / hourly raw metering data separately.

- **Request your 15-minute or hourly interval data.**

If hourly interval data is not yet accessible for your sites, apply a sector-appropriate load profile to distribute your annual or monthly renewable procurement across hours, then calculate your hourly CFE score against that approximated load shape.

01.

ELECTRICITY MARKET OVERVIEW

1.1. MARKET STRUCTURE AND KEPCO'S ROLE

Korea's centralized electricity market structure presents both advantages and constraints for granular electricity matching. The presence of a single bidding zone and a single-buyer model simplifies geographic correlation, which is a key requirement under emerging international frameworks. The introduction of corporate Power Purchase Agreements (PPAs) in 2021 created a limited space for competition by allowing generators to contract directly with corporate buyers.

Korea's electricity market operates through a partial monopoly of KEPCO through transmission, distribution, and retail electricity sales.

KEPCO purchases approximately 95% of the country's electricity through the KPX for resale to end users. Six electricity generation subsidiaries operate under KEPCO, but competition is constrained by KEPCO's control over pricing. This monopoly was partially broken in 2021 when amendments to the Electric Utility Act enabled direct PPAs, allowing renewable energy generators to supply electricity directly to corporate consumers. Both direct PPAs and third-party PPAs are now operational.

Hourly wholesale settlement already exists.

The wholesale market operates under KPX as a day-ahead mandatory cost-based pool. The KPX settles wholesale market transactions on an hourly basis, providing the temporal data foundation necessary for time-stamped certificate systems. For PPA transactions, settlement architecture differs by contract model. Direct PPAs are settled through KPX's market system based on hourly metered volumes, whereas third-party PPAs are settled by KEPCO as the intermediary, with the contract permitting either hourly settlement or monthly/annual generation-equalized averaging. A real-time market pilot was launched in Jeju in June 2024, with plans for nationwide expansion.

Consumption data is recorded through AMI on a sub-hourly basis.

As of 2024, KEPCO completed full deployment of AMI units to all 20.05 million consumers. This infrastructure supports real-time power usage monitoring and has been used since 2019 to enable voluntary demand response programs. The AMI rollout means that hourly (and sub-hourly) consumption data exists for essentially all Korean electricity users, and the demand-side data needed for granular matching is available.

Korea operates as a single bidding zone with uniform wholesale pricing.[13]

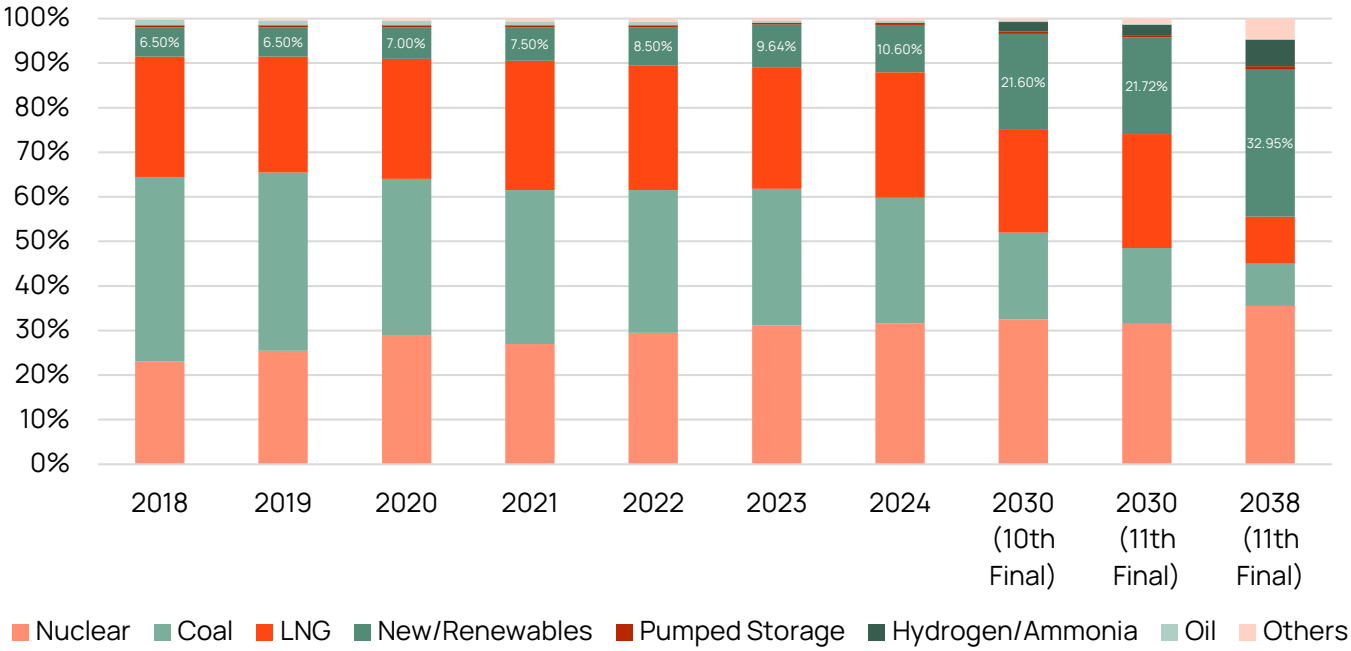
This simplifies geographic correlation, as generation and consumption occur within the same market boundary, making it easier to demonstrate deliverability under emerging international standards and trade-related requirements.

The gap is institutional, not technical.

Hourly generation data flows through KPX settlement systems, and is sufficient to support time-stamped certificate issuance. But this data doesn't flow into the certificate system. RECs are issued with monthly granularity, and PPA settlement records remain in KPX's operational database, but are not leveraged to support time-resolved certificate issuance or verification. Korea possesses the technical capability for granular tracking but lacks the institutional framework to produce verifiable, time-stamped certificates.

10. Ministry of Trade, Industry and Energy (MOTIE), Notice on Direct Power Trading of Renewable Energy Electricity(MOTIE Notice No. 2025-125, amended July 22, 2025), Articles 22, 23, and 25.
11. KEPCO Plaza (광장), 'Advanced Metering Infrastructure deployment completed November 2024,' 14-year programme summary, KEPCO, November 2024.
12. Korea Electric Power Corporation, A New Energy World to Be Created with Smart Metering (AMI)! https://home.kepco.co.kr/kepco/front/html/WZ/2025_01/light.html.
13. International Energy Agency, Korea 2025: Energy Policy Review (Paris: IEA, 2025), https://www.iea.org/reports/korea-2025.

Fig 1.1 South Korea's Current and Projected Power Mix



Source: MOTIE

1.2. RENEWABLE ENERGY SUPPLY AND DEMAND PRESSURE

Korea's renewable energy transition is lagging.

Under the 11th Basic Plan for Long-term Electricity Supply and Demand (BPLE), Korea targets 22% renewables in the power mix by 2030. Despite the ambition, in 2024, renewable energy's share of the power mix only surpassed 10% for the first time, but this remains far behind the global average (30.25%), the OECD average (33.49%). [14]

Renewable deployment is constrained and concentrated on solar.

Renewable capacity is 78% solar, resulting in a midday-heavy generation profile. Korea's ability to scale any form of renewable deployment is constrained by limited available land, one of the highest population densities in the OECD, and persistent public opposition to new energy infrastructure.

Korea is in a middle of rapid data center buildout. Installed data-center power capacity grew from 1,149 MW in 2020 to 1,885 MW in 2024 at a CAGR of 13.0%, and is forecast to accelerate to 4,793 MW by 2028.

The 11th Basic Plan for Long-Term Electricity Supply and Demand (BPLE) projects data-center peak demand of 3.3 GW by 2030, while KEPCO has already received 49 GW of grid-connection applications, roughly fifteen times the planning figure. That demand is being locked into fossil fuel infrastructure. With Korea's renewable share at just 10% and a limited grid, operators are turning to dedicated gas-fired cogeneration plants to guarantee baseload supply. Amazon Web Services and SK Group are building South Korea's largest AI hyperscale data center in Ulsan, directly powered by the 1,200 MW Ulsan Gas Power Station. Major companies like SK E&S, Hanwha Energy, POSCO International, GS E&R, and Hanyang plan to build a combined capacity of around 4,700 megawatts (MW) of new liquefied natural gas (LNG) fired power plants. The expansion of LNG capacity reflects Korea's current reliance on fossil generation to meet growing demand, especially during the non-solar hours.

14. Ember, "Global Electricity Review 2024," Ember Energy, accessed May 28, 2026, https://ember-energy.org/latest-insights/global-electricity-review-2024/.
15. Savills, (2025), Korea Data Centers 1H/2025, https://www.savills.co.jp/research_articles/167577/222843-0
16. GIIGNL, (2025), Korea's first AI data center to be powered by LNG, https://www.giignl.org/news/koreas-first-ai-data-center-to-be-powered-by-lng
17. Institute for Energy Economics and Financial Analysis, "South Korea's Economy Risks Missing Out on Global Transition to Renewables," IEEFA, accessed May 28, 2026, https://ieefa.org/resources/south-koreas-economy-risks-missing-out-global-transition-renewables

02.

WHY HOURLY MATCHING MATTERS FOR KOREA

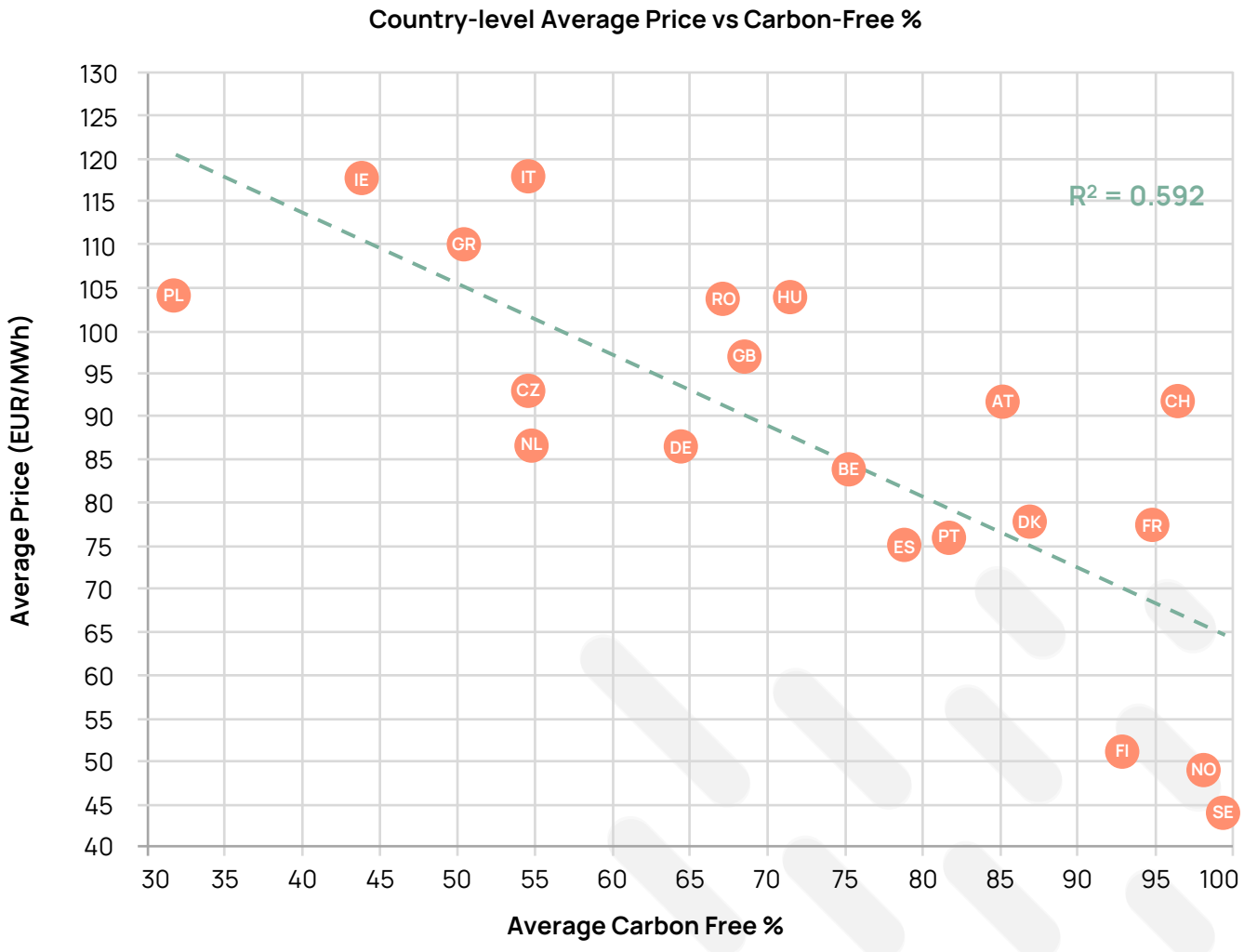
2.1. HOURLY MATCHING AND ENERGY SECURITY

Korea's electricity price tracks the LNG price. In a cost-based market where roughly 60% of generation comes from imported fossil fuels, the System Marginal Price (SMP) is systemically exposed to global commodity shocks. When Russia invaded Ukraine in 2022, wholesale prices rose from around 130 KRW/kWh to more than 200 KRW/kWh, resulting in an additional ₩22 trillion (about US$17 billion) for electricity costs .

The February 2026 closure of the Strait of Hormuz has repeated the same pattern, with Brent rising past US$126, Asian LNG spot prices up by roughly 50% in a week. Reducing this exposure requires not just more renewable capacity but renewable capacity available in the hours where fossil fuels set the price.

Across European markets, the share of carbon-free hours in a country's generation mix tracks closely with its average wholesale price: Sweden, at 99% carbon-free, runs at roughly EUR 44/MWh, while Poland, at 29%, sits at about EUR 105/MWh (Fig 2.1). Every additional carbon-free hour on the Korean grid is a hedge.

Fig 2.1 Average wholesale electricity price against share of carbon-free hours. Sources: ENTSO-E.



Korean renewable policy has moved through three distinct phases to promote renewable uptake:

Phase 1 (2012-2020): Mandate Renewable Consumption

- RE policy was anchored by the Renewable Portfolio Standard that required large utilities to procure a rising share of renewables from independent power producers.

Phase 2 (2021 to 2025): Allowing Voluntary Procurement

- The 2021 amendment to the Electric Utility Act and its Enforcement Decree introduced Direct PPAs between renewable generators and end users, and the parallel launch of the K-RE100 framework operated by the Korea Energy Agency

Phase 3 (2025 to Present): Expanding renewable base

- A series of reforms has been launched since 2025 to place renewable energy expansion at the center of the government's energy policy:
- The July 2025 revision of the Energy Law Enforcement Act removed the 1 MW minimum threshold on Direct PPAs, bringing small-scale generators inside the scheme.
- The October 2025 ministerial restructuring rebranded the Ministry of Trade, Industry and Energy (MOTIE) as the Ministry of Trade, Industry and Resources (MOTIR), and spun off energy functions into the new Ministry of Climate, Energy and Environment (MCEE).
- A 2025 amendment opened bilateral PPAs to renewable ESS operators.
- Presidential Decree 36172, issued in March 2026, added hydrothermal and air-thermal energy to the statutory definition of renewable, unlocking RPS, REC, and subsidy eligibility for heat-pump and seawater/river water-heat deployment;
- The 2026 renewable energy budget nearly doubled to KRW 648 billion, earmarked for RE100 industrial complexes, agrivoltaics, and offshore wind.
- RPS is being retired in favor of a government-led competitive auction with KEPCO as a mandatory off-taker, with a framework due in the first half of 2026.

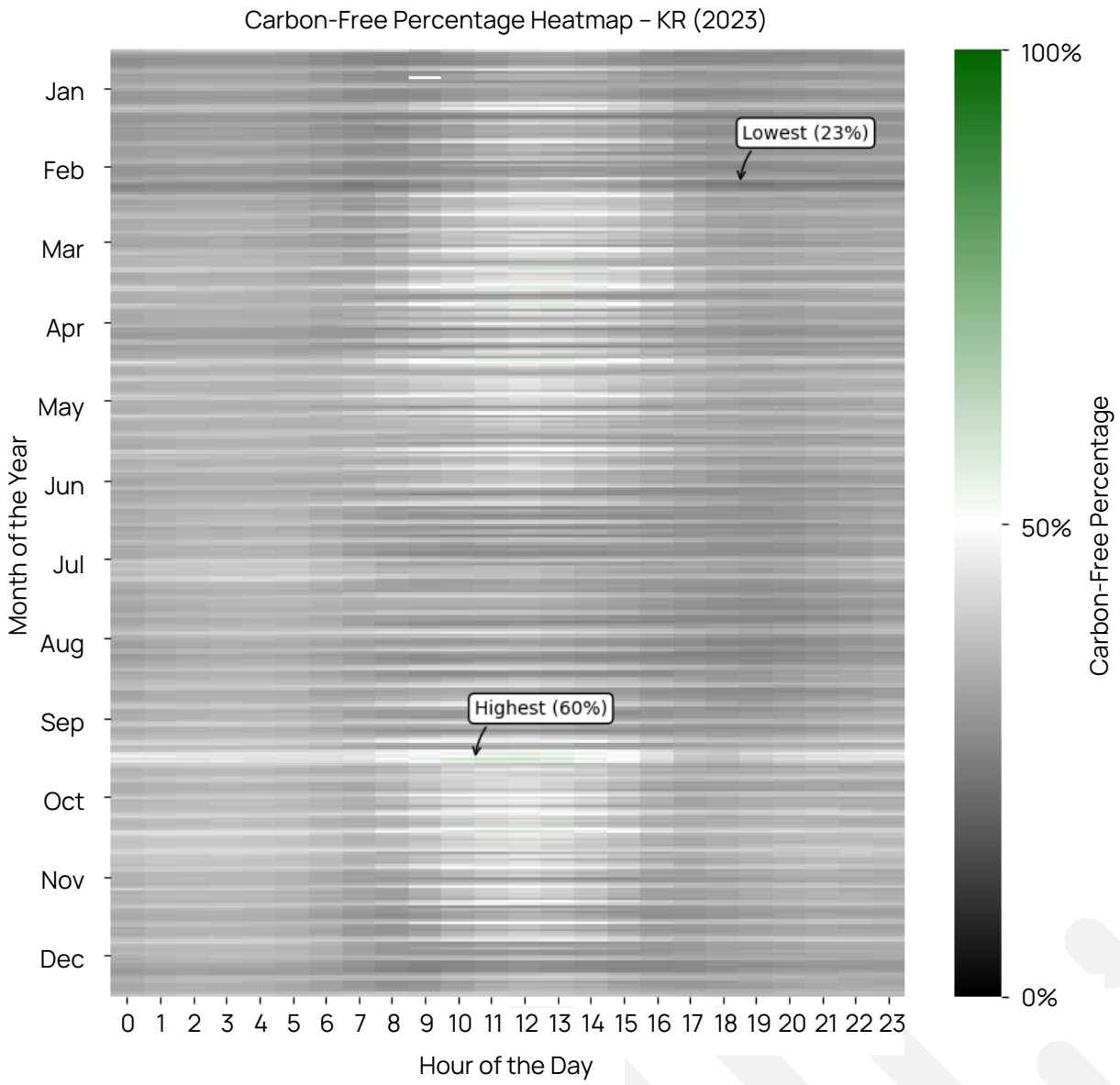
Hourly matching is a continuation of the same policy rationale of expanding renewable capacity by adding time-based market signals. Princeton found that hourly, locally-sourced procurement induces meaningfully more new renewable capacity per MWh than annual matching does.[19] Korea needs a diverse technological profile, including wind, storage, geothermal, and hydrothermal, to deliver around-the-clock clean power. Assigning a distinct price signal to each hour helps guide corporate procurement toward these specific solutions.

18. Institute for Energy Economics and Financial Analysis (IEEFA), "South Korea's Power Trilemma," IEEFA, https://ieefa.org/resources/south-koreas-power-trilemma

19. Ricks, W., Xu, Q. and Jenkins, J.D. (2023) 'Minimizing emissions from grid-based hydrogen production in the United States', Environmental Research Letters, 18(1), 014025. Available at: https://doi.org/10.1088/1748-9326/acacb5

2.2. HOURLY MATCHING PROVIDES SIGNALS FOR ESS

Fig 2.2 Carbon-Free Percentage Heatmap — South Korea (2023)

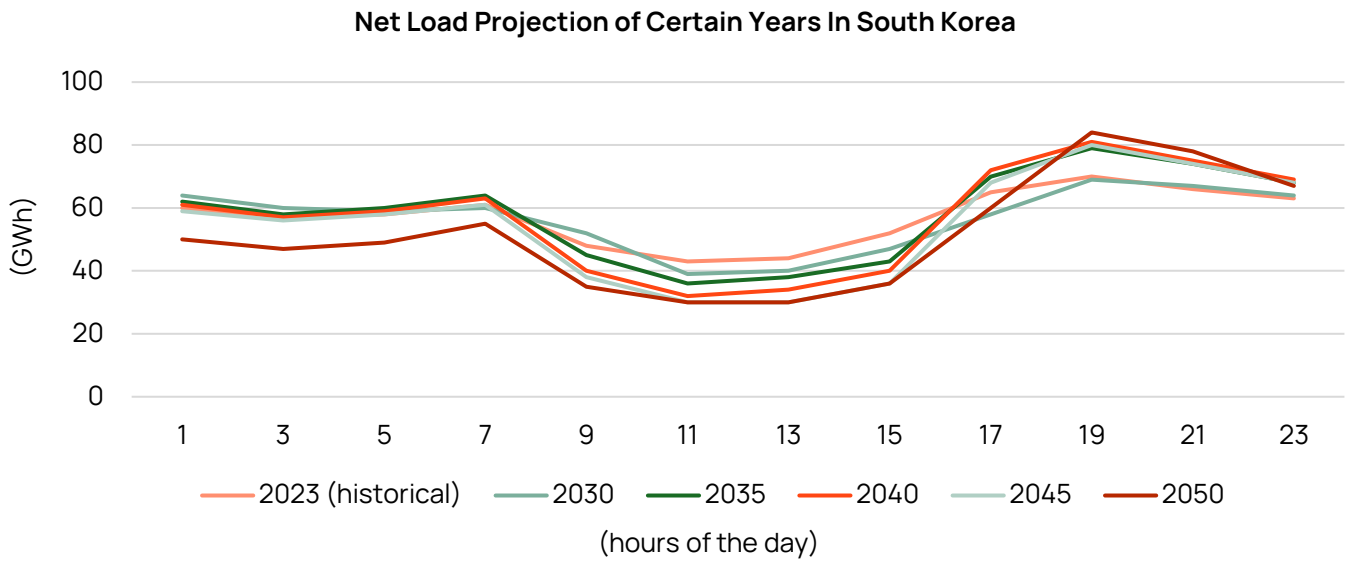


Source: Electricity Map data (2023)

Korea's solar-heavy mix swings sharply by hour and season: the fossil-free share collapses on winter evenings, when solar drops to zero just as demand peaks, and rebounds to its daily maximum on sunny spring and autumn afternoons. An hourly matching framework would give corporates a reason to shift flexible loads into those windows to maximise their matching score.

Korean nuclear is currently dispatched as baseload, leaving little hourly variation in carbon-free share from this source; the primary beneficiaries of hourly matching are therefore flexibility and time-complementing resources: storage, wind, geothermal and hydrothermal, and demand-side response.

Fig 2.3 Net load projection of selected years in South Korea



Source: S&P Global Commodity Insights

The midday surplus and evening deficit together describe the so-called duck curve, and make the case for serious storage investment. By 2050, renewable generation is expected to supply 65% of hourly load in the highest-output month, significantly reducing net load and pressing down on the SMP (Fig 2.3).[20]

Korea is already curtailing. Jeju has been issuing renewable-generation curtailment orders at a scale of hundreds per year since 2023, with cumulative revenue losses stacking up for solar and wind operators. In 2022, the mainland saw its first curtailment on the Honam grid (South and North Jeolla), and volumes have risen sharply through 2024. S&P Global's power-grid model projects that up to 32% of Korea's solar and wind generation could be curtailed by 2040 if the grid and market structure do not adapt[21], resulting in high balancing costs to ratepayers.

At the retail price level, midday solar surplus and evening fossil dependence have become acute enough to require active price-signaling. Recent time-of-use tariff reform is a policy response to the growing duck curve. On 16 April 2026, Korea's industrial time-of-use tariff underwent its first structural overhaul in 49 years: the midday peak window (11:00–15:00) was reclassified from top-rate to mid-rate, the evening window (18:00–21:00) was moved up from mid-rate to top-rate, with a difference of roughly 22 won/kWh between the two new extremes.

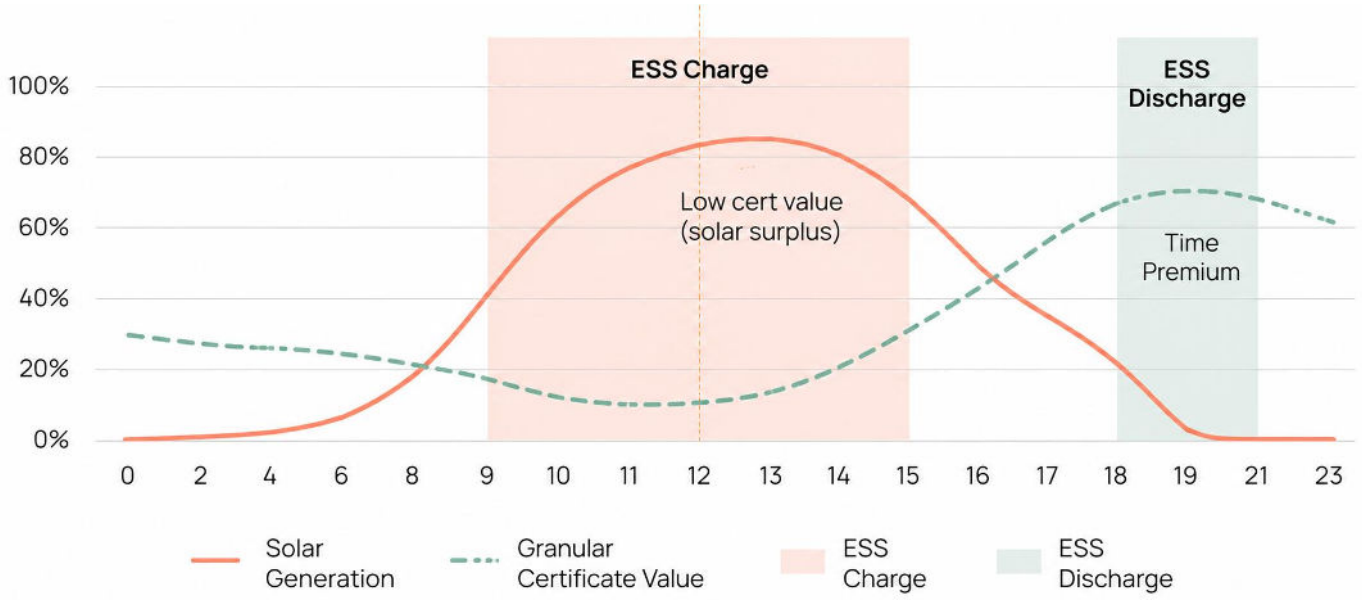
KEPCO's rationale is to make electricity prices reflect "the recent shift toward renewable-centric supply.

2.3. MISSING MONEY IN KOREA'S ESS MARKET

Higher Variable Renewable Energy (VRE) penetration in Korea's power system will increase its flexibility requirements. Korea's ESS is already participating as a grid service provider in the Centralized Contract Market, in which KPX will procure 2.1 GW by 2030 through a 15-year fixed-capacity contract[22]. However, the ESS market has contracted sharply since 2019, driven by the reduction in REC multipliers, diminishing the primary revenue incentive. Korea's broader electricity market structure also limits the commercial viability of energy storage. Price differences between low- and high-demand periods are relatively small, reducing the financial incentive to store and shift electricity. In addition, regulated retail tariffs limit the savings that consumers can capture from using storage behind the meter[23]. The International Energy Agency (IEA) suggested that providing new revenue opportunities could encourage participation in behind-the-meter battery ESS for flexibility and system services.

20. S&P Global Commodity Insights, 'South Korea's future power grid to tackle curtailment and price challenges' (2023). https://www.spglobal.com/energy/en/news-research/blog/energy-transition/030625-south-koreas-future-power-grid-to-tackle-curtailment-and-price-challenges
21. Ibid
22. Greenberg Traurig, "Powering the Grid: South Korea's 2025 ESS Auction," July 2025, https://www.gtlaw.com/en/insights/2025/7/powering-the-grid-south-koreas-2025-ess-auction.
23. Lee, H. C., Kim, H., & Yoon, Y. T. (2018). Optimal ESS investment strategies for energy arbitrage by market structures and participants. Journal of Electrical Engineering & Technology, 13(1), 51–59. https://doi.org/10.5370/JEET.2018.13.1.051

Fig 2.4 GC capturing time-shifting value of ESS



Hourly matching would address this from the demand side. Shifting ESS revenue from subsidy-dependent REC multipliers to demand-driven procurement gives storage operators a durable commercial reason to deploy (Fig 2.4). Under annual matching, a data center consuming fossil-generated electricity around the clock can buy daytime solar RECs and claim 100% renewable status; hourly granularity closes that gap. Operators must match consumption with verified clean generation in each hour, creating genuine demand for the time-shifted clean energy in the evening and nighttime.

With GC deployed to track charge and discharge of ESS, solar oversupply in the midday window depresses certificate value, and scarce generation in the evening commands a 'time premium'. Storage absorbs the midday surplus and discharges into the evening peak, capturing the spread.

- **Key Revision 1 (Hourly EAC Matching):** EACs must be issued and retired for the same hour as energy consumption. Shifts from annual to hourly matching. Korea's RECs system operates without hourly timestamps; certificates would no longer qualify.
- **Key Revision 2 (Hierarchical Emission Factors):** Proposes hierarchy from hourly/node-level to national annual average. Korea publishes only national annual (0.42 $kgCO_2/kWh$) and would default to the lowest resolution tier.
- **Key Revision 3 (Standard Supply Service):** SSS refers to electricity supplied through default or regulated service, not voluntary procurement. Consumers can claim a pro-rata share of SSS generation; unclaimed SSS is ineligible for others. SSS is allocated first, then voluntary instruments are layered on top. Korea's nuclear share could qualify, but no institutional process exists for this allocation.

2.4. TRADE AND STANDARD REQUIREMENTS

2.4.1. GHG PROTOCOL SCOPE 2 REVISION

The GHGP is undergoing its first major revision since the Scope 2 Guidance was published in 2015. The public consultation period closed on January 31, 2026, with final guidance expected in 2027. The revision affects virtually every large corporation that reports emissions. 97% of disclosing S&P 500 companies use the GHG Protocol for Scope 2 reporting.

2.4.2. CARBON BORDER ADJUSTMENT MECHANISM (CBAM)

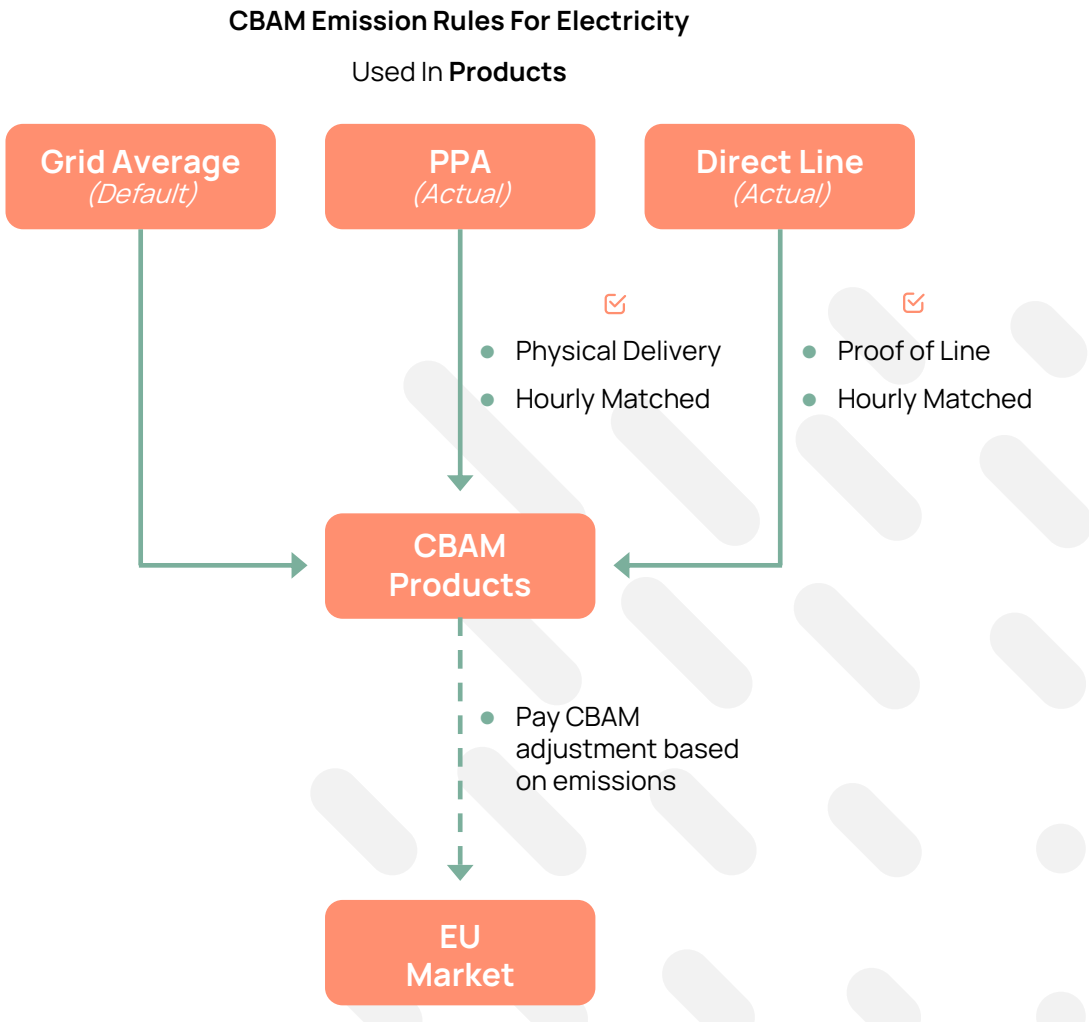
Table 1: List of products covered by CBAM emission reporting requirement

	Iron & Steel	Aluminium	Cement	Fertilisers	Hydrogen	Electricity
Direct Emission	✓	✓	✓	✓	✓	✓
Indirect Emission	X	X	✓	✓	X	✓
50-tonne threshold exemption	✓	✓	✓	✓	X	X

The EU CBAM entered its definitive period on 1 January 2026, with the first certificate surrender deadline set for September 2027. The current scope covers six product categories.

For Korean exporters, cement and fertilizer exports to the EU will be required to report indirect emissions and direct emissions.

Fig 2.5 CBAM Emission Rules for Electricity



Source: EnergyTag based on European Commission – CBAM Implementing Acts

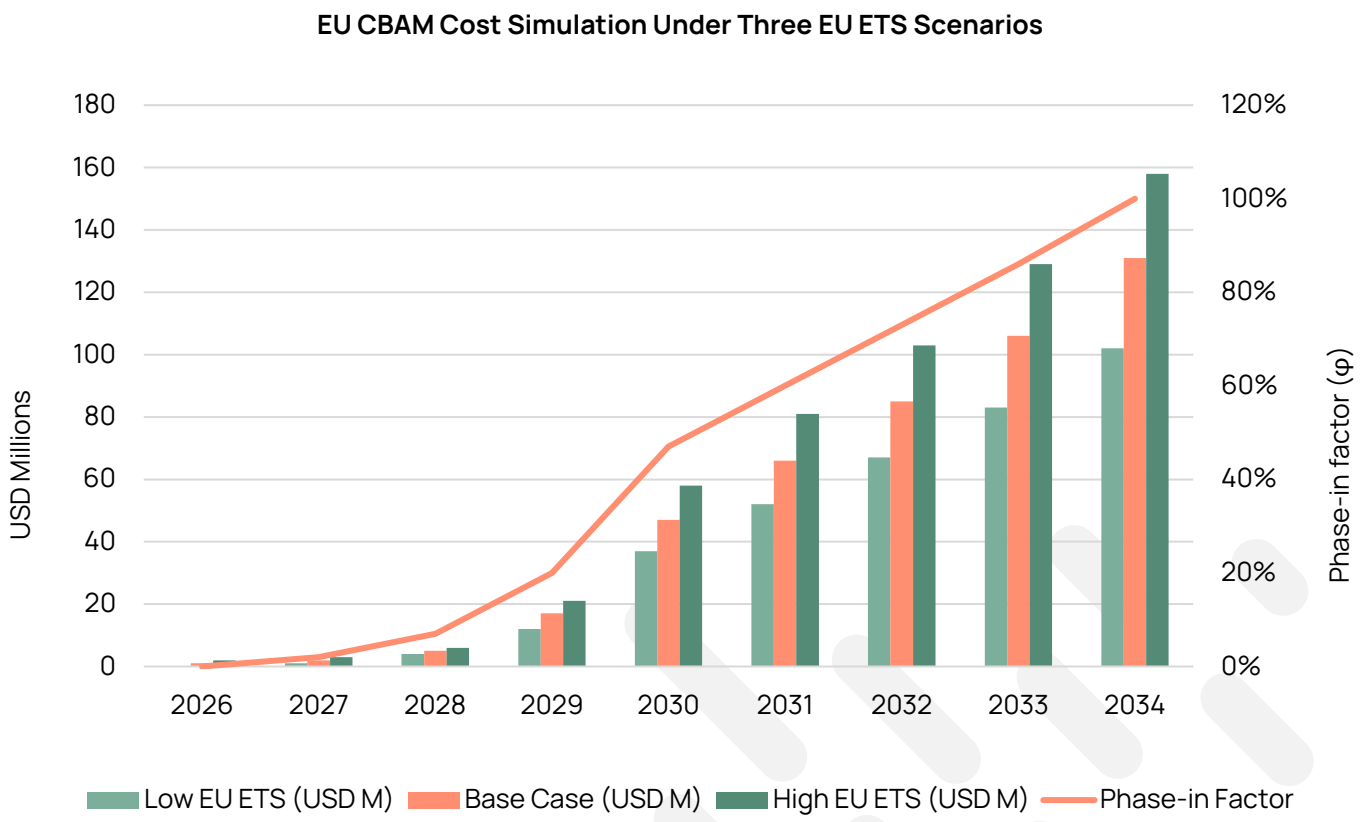
Hourly matching is a requirement for both direct and indirect emissions. On the direct emission side, when Continuous Emissions Monitoring Systems apply, measurements must be recorded and reported as per-hour averages under EU Implementing Regulation B.6.2. Hourly granularity is thus the baseline measurement standard for CBAM product manufacturing.

Indirect emissions are more consequential for Korean electricity procurement. Under the "actual emissions" route, two conditions must be met together (Fig 2.5):

- **Physical delivery:** a verifiable grid connection or proven electricity flow between the production facility and the generation source, not a certificate purchase
- **Hourly matching:** proven via smart-metering data that generation and consumption volumes did not exceed each other within the same one-hour measurement period.

If companies fail to submit or verify hourly-matching data, the national grid average emission factor (or a more unfavorable default) is applied. IEEFA's high-price scenario estimates that Korean chip exporters will pay roughly US$162 million of CBAM certificates by 2034, with cumulative exposure approaching US$588 million over 2026–2034 across all covered categories (Fig 2.6).[24]

Fig 2.6 EU CBAM cost simulation under three EU ETS scenarios



Source: IEEFA.

For Korean exporters, simply purchasing EACs is no longer sufficient. Korean steel exporters using annual RECs cannot claim emissions reductions under CBAM; aluminium and chemical producers face the grid-average default unless they can demonstrate hourly-matched PPAs.

The category coverage is still narrow (five product groups today), but the Commission plans to extend it to up to 180 downstream steel- and aluminium-intensive categories, with longer-term options running into the hundreds.

24. Institute for Energy Economics and Financial Analysis, "Europe's CBAM Raises Supply-Chain Carbon Risks for South Korean Technology Industries," (2022026) https://ieefa.org/resources/europes-cbam-raises-supply-chain-carbon-risks-south-korean-technology-industries

Table 2: Korea's Seven-Agency CBAM Response

Agency	Role
MOTIR	Lead agency for trade policy and industrial/resources regulation (energy functions migrated to MCEE)
MCEE	GHG emissions trading (K-ETS), climate policy, RE100, and certificate policy
Ministry of Foreign Affairs	International negotiations, EU liaison
Ministry of SMEs and Startups	Impact assessment on small/medium exporters
Ministry of Economy and Finance	Fiscal impact, carbon pricing coordination
Korea Customs Service	CBAM compliance verification at borders
National Climate Crisis Response Committee	Cross-ministerial coordination

2.4.3. HOURLY MATCHING IN GREEN HYDROGEN REGULATION

Hydrogen is one of Korea's largest energy priorities. The 11th BPLE targets hydrogen and ammonia to supply 6.23% of power generation by 2038. Five major conglomerates have collectively committed US$38 billion by 2030[25] , and all six state-owned GENCOs have published hydrogen transition plans. Yet current Korean production runs at roughly 2 million tonnes annually, all of it fossil-derived. [26]

The world's largest clean hydrogen policy frameworks have made hourly matching a core requirement.

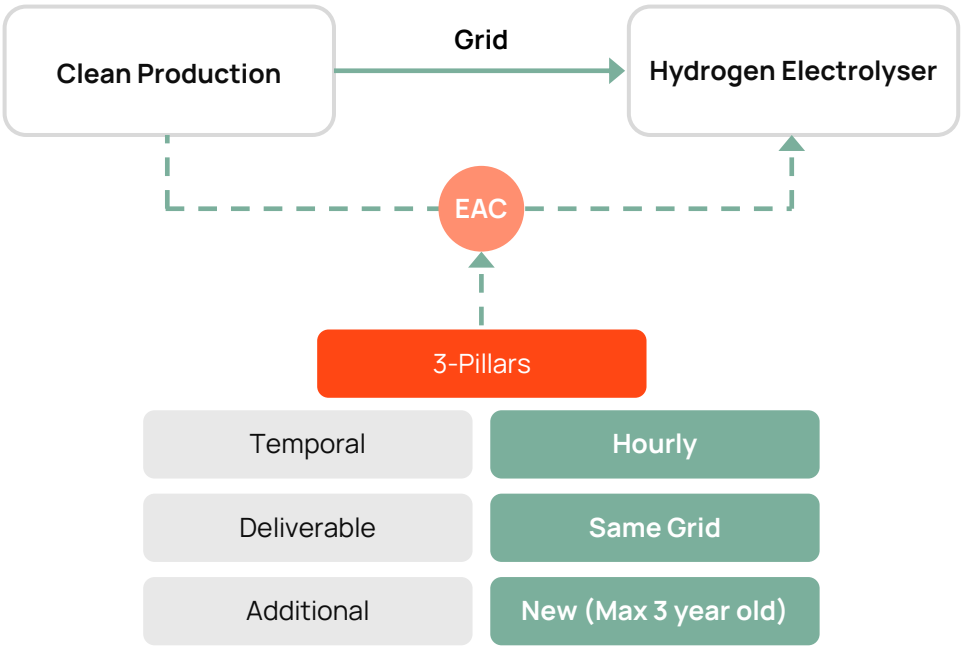
The EU's RFNBO Delegated Act requires that, from January 1, 2030, hydrogen production must correspond hour by hour to the generation of contracted renewable electricity, alongside additionality and geographic correlation requirements.[27] The US Section 45V clean hydrogen tax credit similarly requires hourly matching of clean power generation to hydrogen production from 2030, as part of the "three pillars" framework: incrementality, temporal matching, and deliverability.[28] (Fig 2.7)

THE THREE PILLARS

- **Incrementality (additionality):** The renewable generator must be new: commercial operation date no more than 36 months before the electrolyser enters service.
- **Temporal correlation:** Monthly match permitted through 2029; from 1 January 2030, generation and electrolyser consumption must fall within the same calendar hour.
- **Deliverability (geographical correlation):** Generator and electrolyser must sit inside the same bidding zone, or a zone connected without congestion.

25. Hyundai, SK, POSCO, Hyosung Agree to Launch Korea's Hydrogen Council," KED Global, June 11, 2021. https://www.kedglobal.com/hydrogen-economy/newsView/ked202106100019
26. Kim et al., "Economic Effects of the Hydrogen Fuel Cell Sector in South Korea: An Input-Output Analysis," International Journal of Hydrogen Energy (May 2024). https://www.sciencedirect.com/science/article/abs/pii/S0360319924015738
27. Commission Delegated Regulation (EU) 2023/1184, Art. 6 (temporal correlation) and Art. 7 (geographical correlation), supplementing Directive (EU) 2018/2001; see also European Commission, "Renewable hydrogen production: new rules formally adopted," June 20, 2023, https://energy.ec.europa.eu/news/renewable-hydrogen-production-new-rules-formally-adopted-2023-06-20_en
28. U.S. Department of the Treasury, "Final Rules for Clean Hydrogen Production Tax Credit (Section 45V)," January 3, 2025, https://home.treasury.gov/news/press-releases/jy2768; see also Cherry Bekaert, "IRC Section 45V: Final Rules Released," February 11, 2025, https://www.cbh.com/insights/articles/section-45v-hydrogen-tax-credit-final-rules-released/

Fig 2.7 Three pillars of green hydrogen regulation



Source: European Commission and US Treasury

2.5. ALIGNING KOREA'S HYDROGEN STRATEGY WITH INTERNATIONAL STANDARDS

Korea has no hourly matching requirement for its clean hydrogen production.

Korea's Clean Hydrogen Certification System is effective March 2024, with a threshold of 4kg CO_2eq/kg H_2 that establishes emissions grades.[29] A certification system designed for domestic purposes alone will be re-evaluated at the export gate.

Without rigorous temporal matching, hydrogen extends fossil fuel lifetimes in Korea.

Princeton's research finds that weak annual matching can yield "clean" hydrogen with two-to-three times the lifecycle emissions of conventional grey hydrogen.[30] The second round of Clean Hydrogen Power Standard (CHPS) auction was cancelled on the deadline day of 17 October 2025 after regulators recognized that coal-ammonia co-firing under CHPS could extend coal plant operations to 2043 or 2044, depending on project timing and grace periods, directly conflicting with the 2040 coal phase-out.

2.6. SUPPLY CHAIN PRESSURE ON HOURLY MATCHING

South Korean companies are significantly lagging behind their peers in managing supply chain carbon risks. RE100 members in Korea source only around 12% of their electricity from renewables domestically, compared to 53% globally.[31] Building on RE100, the 24/7 Carbon-Free Energy (CFE) movement requires every megawatt-hour consumed to be matched by clean generation produced in the same hour and on the same grid. Following the launch of CFE, Google and Microsoft have each committed to operating on 100% carbon-free energy on a 24/7 hourly-matched basis by 2030.

RE100 began as a voluntary initiative and is rapidly becoming a procurement baseline. A similar trend will follow for 24/7 carbon-free movement, and the implications cascade through supply chains. If Korea does not build the infrastructure for hourly-matched certificates, its largest exporters will be unable to demonstrate compliance using domestic instruments, forcing them toward production relocation or supply chain exclusion risk.

29. Ministry of Trade, Industry and Energy (MOTIE), Clean Hydrogen Certification System Operation Plan (December 2023, effective 2024)
30. Ricks, W., Xu, Q. and Jenkins, J.D. (2023) 'Minimizing emissions from grid-based hydrogen production in the United States', Environmental Research Letters, 18(1), 014025. Available at: https://doi.org/10.1088/1748-9326/acacb5
31. Climate Group. "A 'New Chapter' for Climate in Korea: Climate Group's Letter to Newly Elected President Lee Jae-myung." June 23, 2025. https://www.theclimategroup.org/our-work/news/climate-group-letter-newly-elected-president-korea

03.

KOREA'S CERTIFICATE AND DATA INFRASTRUCTURE

3.1. HOURLY MATCHING DATA REQUIREMENT: IMPLICATIONS FOR KOREA

Korea's current EAC system cannot support hourly matching requirements.

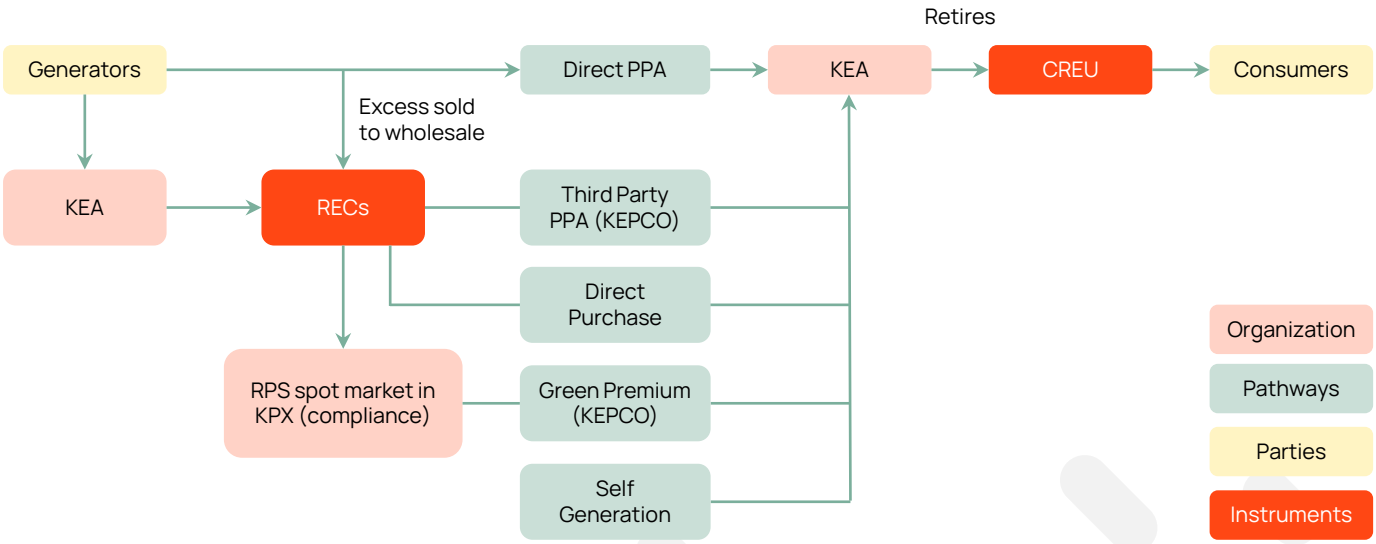
Korea's renewable energy tracking infrastructure operates exclusively on annual or monthly granularity. Hourly matching frameworks share a common set of underlying data requirements:

- **Hourly generation timestamps:** production data recorded at one-hour (or finer) intervals, linked to a specific generating device
- **Hourly consumption data:** demand-side data showing when electricity was actually consumed, at the same temporal resolution
- **Geographic linkage:** a defined boundary (bidding zone, grid region, or market area) connecting the generation and consumption locations
- **Anti-double-counting controls:** a registry or tracking system that ensures the same MWh of renewable generation is not claimed by multiple consumers
- **Third-party verification or audit trail:** some form of independent assurance that the matching claim is valid

Korea has the raw data for hourly matching, but the institutional infrastructure to connect them does not exist.

3.2. EXISTING CERTIFICATION SYSTEMS

Fig 3.1 Structure of the certification system



Korea's existing certification landscape involves two layers of instruments, both administered by the Korea Energy Agency (KEA) through its New and Renewable Energy Center (KNREC).[32] (Fig 3.1)

- **The generation-side layer: Renewable Energy Supply Certificate (REC),[33]**

Records 1 MWh of renewable generation and is the unit of trade in both compliance and voluntary markets, branded as "RECs" in the voluntary K-RE100 context.[34]

While they record the generation month and location, they lack hourly timestamps.

- **The consumer-side layer: Confirmation of Renewable Energy Use (CREU)[35]**

CREU is a corporate-side claim document that KEA issues following RECs retirement or Green Premium payments.

32. Article 12-7 of the New and Renewable Energy Development, Use and Promotion Act.Original Korean: 「신에너지 및 재생에너지 개발·이용·보급 촉진법」 제12조의7 (Article 12-7). Establishes the legal basis for REC issuance; KEA administers and delegates to KNREC.

33. Original Korean: 공급인증서. Issued to generators under Article 12-7; records supply quantity and is valid for three years. KNREC issues certificates based on monthly meter data submitted within 90 days of the supply month-end.

34. REC is the international branding convention used in Climate Group's 24/7 CFE Technical Criteria v1 (2025) and KoSIF/Climate Group corporate-renewable literature to disambiguate Korea's renewable energy certificate from other national systems (e.g., Taiwan's T-REC). The formal Korean statutory term is 신·재생에너지 공급인증서 (often shortened to 공급인증서); MCEE Notice 2025-61 §2(24) defines it as the certificate issued under New and Renewable Energy Act §12-7. The official English abbreviation in the regulation itself is simply "REC".

35. Original Korean: 재생에너지 사용확인서. The final certificate issued via the K-RE100 system. Issued under MCEE Notice 2025-61 Article 69 (procedures), using Annex Form No. 3 (별지 제3호 서식). The five implementation pathways are defined at Article 68-2(1) of the same regulation.

COMPLIANCE RECS:

Korea's Renewable Portfolio Standard (RPS) obligates large generators to meet escalating renewable energy quotas, rising to 15% by 2026. These RECs are issued by KNREC and trade on the KPX-operated REC market or the KEA-operated K-RE100 voluntary market, depending on the buyer's purpose. As the RPS is phased out in favor of government auctions, this compliance market is gradually closing.

Green Premium stream produces CREU backed by pooled compliance RECs with no buyer-specific RECs retirement. This pathway bypasses the RECs layer. Under KEPCO's Green Premium, buyers pay a tariff premium to receive CREU. The green premium is settled against a pooled RPS-obligation REC volume (previous + current year), matched round-by-round to a generator pool (source type, region, production period). There is no buyer-specific 1:1 REC retirement, no facility-level audit trail, and no hourly link.

K-RE100 VOLUNTARY STREAM:

RECs are converted into CREU. Outside the RPS, certificates are sold into the voluntary K-RE100 market as "RECs." Upon a buyer's request, KEA retires the RECs and issues a CREU; existing regulations mandate the immediate disposal of the underlying supply certificate upon issuance.[36] Four K-RE100 pathways utilize this retirement route:

- **Direct REC purchase:** Corporate buyers purchase and retire RECs listed on the K-RE100 platform at their discretion to receive a CREU.
- **Direct PPA:** Corporate buyers enter a long-term contract for the direct sale of electricity, where the use of renewable electricity is proven through the issuance of CREU. RECs are issued only for the generator's excess generation sold to the wholesale market.
- **Third-party PPA:** KEPCO mediates contracts where buyers receive electricity, and the underlying RECs are retired into a CREU.
- **Self-generation:** Corporations with on-site renewable installations consume the electricity behind the meter and submit monthly usage data to KEA, which issues a CREU directly without RECs involvement.

An additional equity-investment route exists, but converting this stake into K-RE100 credit requires a Third-party PPA or RECs purchase; investment alone is not a pathway for CREU issuance.[37]

Across these pathways, RECs are issued based on monthly KEPCO meter data, the finest resolution available. CREU expresses the Period of Use and Production as date ranges, lacking the sub-monthly granularity required for hourly matching.

3.3. DATA ACCESSIBILITY GAP

Korea's Advanced Metering Infrastructure (AMI) deployment has been completed as of 2024, with 20.05 million users across commercial, industrial, and residential use. The AMI records consumption data at a 15-minute interval for industrial and commercial users and at an hourly interval for residential users. Only Combined Heat and Power (CHP) facilities and Community Energy Systems (CES) are not covered by the AMI rollout.

Despite Korea's advanced metering infrastructure, data access is severely constrained:

36. 신·재생에너지 설비의 지원 등에 관한 규정」 별지 제3호 서식 footnote: "재생에너지 사용 확인서를 발급받는 경우 발급 즉시 해당 공급인증서는 폐기함"— the REC is discarded immediately upon Confirmation issuance.
37. Per Ministry of Trade, Industry and Energy notice, equity investment is a recognized participation route, but obtaining a Confirmation requires an additional PPA or RECs purchase.

Table 3: Korea's Data Accessibility

Data Type	Availability	Access Barrier	Entity
Consumer hourly consumption	Exists in KEPCO AMI	Not accessible	KEPCO internal policy
Generation meter data	Exists for KPX	Available only to KPX/owners	KPX settlement
Grid emission factors (hourly)	Does NOT exist	Only annual national avg (0.42 kgCO2/kWh)	MCEE
Residual mix	Does NOT exist	No methodology	KEA/MCEE
Real-time grid carbon intensity	Does NOT exist publicly	Not published; KPX has dispatch data internally	KPX
RE generation profiles (hourly)	Exists in KPX dispatch	Not facility-level	KPX/KNREC

Korea's hourly matching problem is not a lack of data but a lack of connection between the institutions that hold it. Even where data does exist, access is constrained. KEPCO collects consumers' AMI-based usage information, but only through KEPCO's own platform, with no data portability to third-party registries.

3.4. THE RPS-TO-AUCTION TRANSITION: A DESIGN WINDOW FOR GRANULAR CERTIFICATES

The government is moving from the RPS to a government-led competitive auction system.

Under the proposed system, the government will set mandatory renewable energy procurement volumes linked to the Basic Plan for Electricity Supply and Demand, then open competitive bidding. KEPCO or other entities designated by MCEE will serve as mandatory off-takers for auction-awarded capacity.

Hourly information underlies the new competitive bidding framework, but does not provide market signals.

The competitive bidding operates similarly to a Contract for Difference (CfD): generators win capacity through competitive auctions, receive a strike price locked in long term, and settle the difference against the hourly SMP.

However, given that Korea operates on a cost-based pool, the SMP is a cost index, not a price signal. SMP reflects cost rather than scarcity pricing; it provides limited signals during periods of renewable oversupply. A more market-based pricing framework could strengthen such signals.

An opportunity to incorporate hourly information into the new certification framework arises.

Under this reform, the obligatory REC spot market would be abolished under the Act on the Promotion of the Development, Use, and Diffusion of New and Renewable Energy. The MCEE is targeting the first half of 2026 to finalize the auction framework. The proposed reform anticipates a new form of 'power generation information certificate' that will be issued to winning generators and renewable energy operators.[38] This gives rise to the possibility of incorporating the underlying hourly information into the new certification system.

3.5. WHAT NEEDS TO CHANGE

The gap is governance, not technology. Three interventions would unlock hourly matching.

First, a data-sharing mandate.

KEPCO and KPX should be required to share facility-level hourly data to accredited certificate registries and to consumers for their own matching purposes.

38. Kim Jin-hu, "RPS Comes to a Close After a Decade… 'Secondary Legislation Must Be Prepared Urgently for the Contract Market to Take Hold'," Jeon'gi Sinmun [Electric Times], March 12, 2026, https://www.electimes.com/news/articleView.html?idxno=365989.

Second, a registry capable of hourly issuance

by upgrading the KEA K-RE100 platform, or creating a new national registry. Korea could proceed with 3 pathways forward:

- **Configuration 1:** The GC scheme evolves directly from the existing EAC system. The national issuing body issues GCs with hourly timestamps as an upgrade to existing RECs.
- **Configuration 2:** A third-party platform manages GC issuance under the oversight of the existing EAC issuer.
- **Configuration 3:** GCs are issued based on already-cancelled EACs combined with hourly production data. This is the "retrofit" option, and the most immediately relevant for Korea. This means Korean companies could begin demonstrating hourly matching using their existing RECs as a foundation.

Third, hourly emission factors and residual mix.

The government must publish hourly grid emission factors derived from KEPCO dispatch data and establish a methodology for calculating the residual mix. Without these, corporations will default to the lowest resolution tier in GHGP Scope 2 compliance.

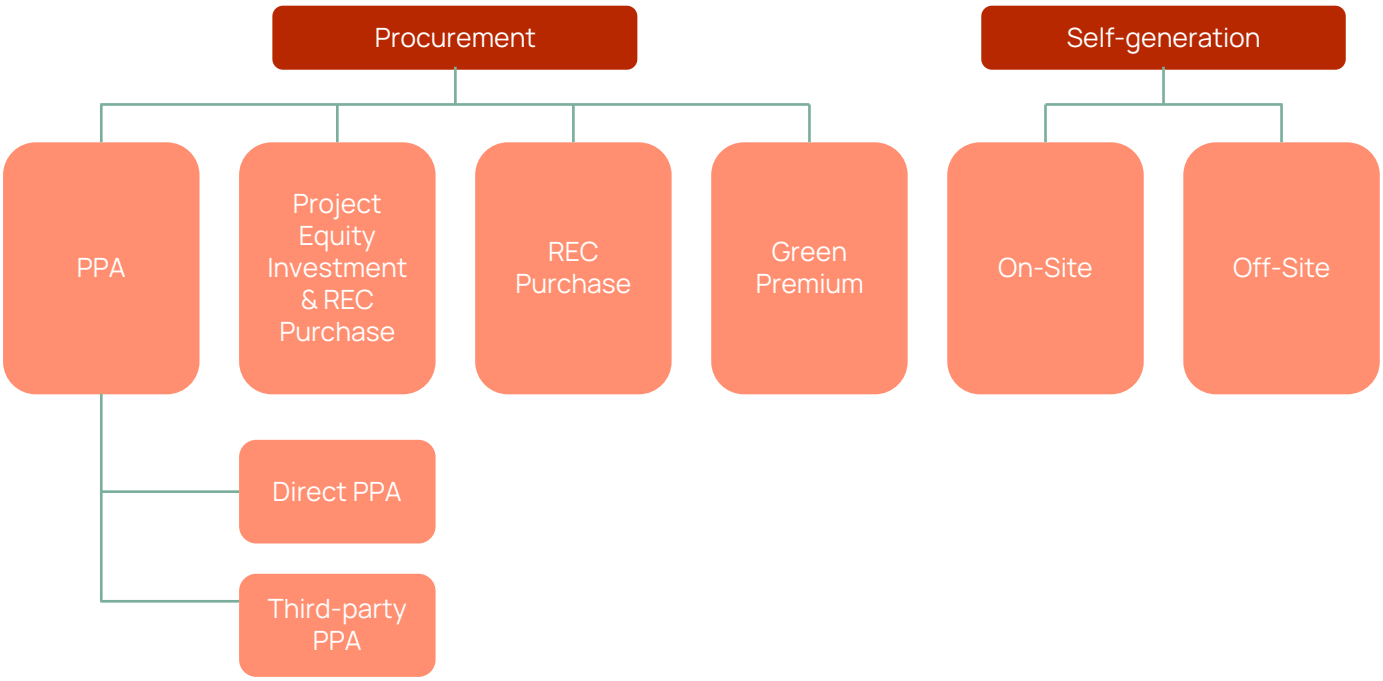
32. Kim Jin-hu, "RPS Comes to a Close After a Decade… 'Secondary Legislation Must Be Prepared Urgently for the Contract Market to Take Hold'," Jeon'gi Sinmun [Electric Times], March 12, 2026, https://www.electimes.com/news/articleView.html?idxno=365989.

04.

GRANULAR PROCUREMENT PATHWAYS FOR KOREA

Fig 4.1 Renewable Energy Procurement Methods in Korea

Renewable Energy Procurement Method In Korea



Under the K-RE100 program, introduced in 2021 by MOTIE, companies can procure renewable energy through five pathways: the Green Premium, direct REC purchase, Direct PPA, Third-party PPA, and self-generation (Fig 4.1). Each pathway results in the issuance of a CREU.[39]

Each of these five pathways carries its own administrative spine: statutory forms, filing windows, and issuance categories that determine where time-stamped data can travel and where it is aggregated away. Table 4 below maps the settlement architecture:

Table 4: Settlement Architecture of Each procurement pathway

Pathway	Settlement architecture
Green Premium	KEPCO collects the premium together with the standard tariff. RPS-obligated generators submit RECs to KEPCO, KEPCO settles their cost (ownership transfers to KEPCO), and the qualifying RECs are then separated and sold via Green Premium, transferring final ownership to the buyer; no buyer-specific 1:1 REC retirement[40]), matched round-by-round to a generator pool (source type, region, production period) per KEA round notice.[41]

39. Article 69 of MCEE Notice 2025-61 (Renewable Energy Equipment Support Regulation), prescribing Annex Form No. 3.

40. Qualifying RECs: among RPS-issued RECs, only those from renewable energy sources (solar, wind, hydropower excluding large hydropower, bioenergy) qualify for Green Premium. RPS-eligible New Energy (NRE) sources (hydrogen, fuel cells, IGCC / coal gasification) and waste-to-energy are issued RECs under RPS but cannot be converted into a Confirmation of Renewable Energy Use and are therefore excluded from Green Premium supply. Commercial operation date within the past 15 years per RE100 technical criteria. Operationally aligned to the annual KEA matching notice (2026 round: 2013 onward). Annual eligible volume set by KEA's Renewable Energy Use Deliberation Committee under MCEE Notice 2025-61 §70 ⑤. Source: KEA Green Premium Explanatory Document. KEA 2026 round-matching notice. MCEE Notice 2025-61 §70 ⑤.

41. KEPCO Basic Supply Terms §107

Pathway	Settlement Architecture
Direct REC purchase	Corporate buyers acquire RECs through the K-RE100 voluntary platform operated by the KEA, either via spot purchase in twice-monthly trading sessions or via long-term fixed-price contracts concluded directly with renewable generators registered on the platform. RECs are issued by the KNREC. Upon issuance of the Renewable Energy Use Confirmation, KEA retires the underlying REC. KPX operates a separate REC market for RPS compliance, with parallel spot and contract venues serving RPS-obligated entities.[42]
Direct PPA	Direct PPA links a renewable generator and a corporate consumer through a long-term bilateral contract. Each hour, KPX meter readings serve three purposes simultaneously: they identify how much renewable electricity actually matches the consumer's load.[43] For any shortfall, the consumer must buy from KEPCO at standard retail rates, and they track any excess generation the supplier sells back to the wholesale market, which is the only portion eligible to receive a REC. The PPA-supplied volume itself does not receive a REC.[44]
Third-party PPA	KEPCO-mediated long-term contract. Bidirectional KEPCO meter supports hourly readings. Settlement = consumer offtake × auxiliary settlement-fee unit price.[45]
Self-generation	Behind-the-meter generation registered through the K-RE100 platform. CREU issued without a tradable REC underlying.

4.1. GREEN PREMIUM

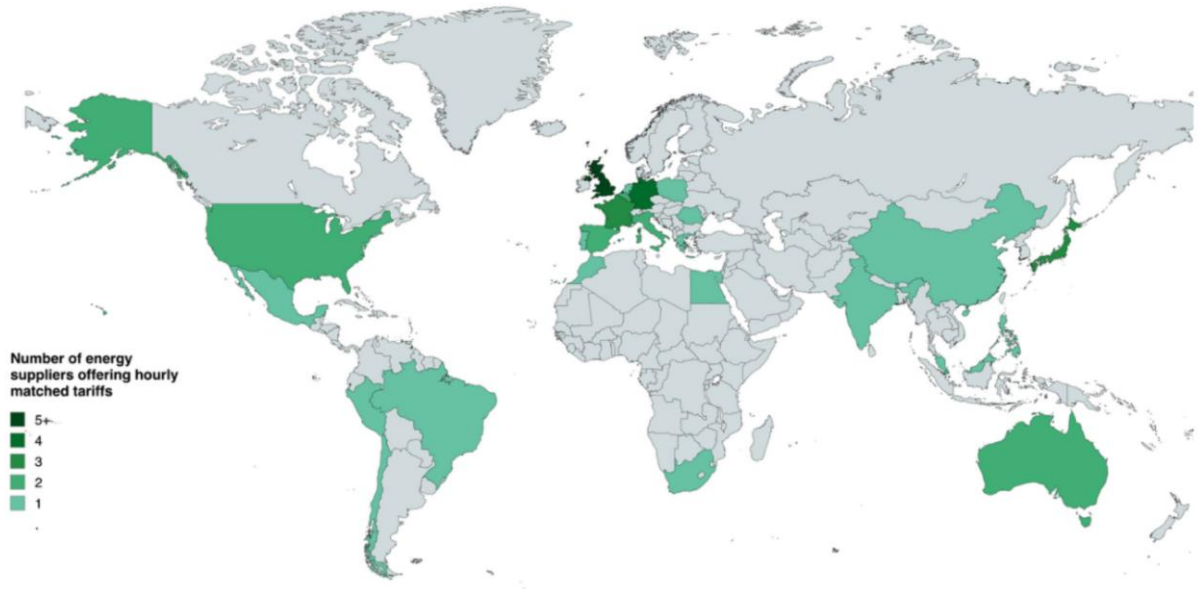
Green Premium is widely used among K-RE100 participants. Under its design, the premium is collected by KEPCO together with the standard electricity tariff, and the proceeds are transferred to the Korea Energy Agency (KEA), which issues a CREU to the buyer for the awarded volume.

This CREU is distinct from a Renewable Energy Certificate (REC): RECs are issued to generators under the Renewable Portfolio Standard, are valid for three years, and transfer a specific generation attribute on retirement, whereas Green Premium retires pooled RPS-obligation RECs at the round level rather than tying one REC to one buyer.

The CREU form anonymizes the source at the facility level[46] and only Plant Location, Commissioning Date, Period of Use, and Period of Production are recorded, with no sub-monthly time resolution and no per-MWh identifier linking a specific kWh of clean generation to the buyer.

42. KNREC Notice 2015-1
43. (the volume the consumer can claim for RE100, with KEA issuing a Confirmation directly from this data)
44. Electric Utility Act §16-5(5) statutorily excludes Direct PPA volumes from §12-7 REC issuance. Only excess generation sold to the wholesale market is REC-eligible under MOTIE Notice 2025-125 §7(2). Jurisdiction transferred to MCEE Notice 2025-61, effective 2025-12-24. Such RECs are tradable separately on the KEA RE100 platform. Settlement variants by configuration: Off-Site contracts apply transmission-loss adjustment. On-Site contracts have 0% loss, no excess generation, and are exempt from KEPCO network fees. Settlement cadence: buyer elects hourly or monthly-equalised per §5(3). Final invoicing collapses to monthly per §25(1). Source: MOTIE Notice 2025-125.
45. MOTIE Notice 2021-108, as amended by MOTIE Notice 2023-175 and republished as MCEE Notice 2025-61
46. Plant Name and Generator ID are omitted from the Confirmation form 별지 제3호

Fig 4.2 Hourly matched green premium availability globally[47]



Given corporate consumers' reliance on green premium, addressing the gap between green premium and hourly matched green premium will be crucial to making hourly matching accessible to more Korean customers.

Many markets have already solved this by redesigning the green premium to support hourly matching claims.

A total of 52 energy suppliers are already offering an hourly matched green premium to corporate consumers or planning to introduce one, according to Baringa(Fig 4.2). The premium is tied to a specific project, and the RECs are retired on the customer's behalf. Most hourly matched green premium provide transparent information on hourly electricity consumption and the associated clean energy supply.

What an hourly matched green premium would require:

- **Link the premium to a specific generator pool.** Today, the premium is collected by KEPCO alongside the standard tariff under KEPCO's standard supply tariff terms and transferred to KEA, which issues the CREU against an annually pooled renewable volume rather than a named facility. A reformed Green Premium would match each subscription to output from identified RE installations within the same grid period instead of drawing from this anonymized pool.[48]
- **Provide hourly consumption data to the purchaser.** KEPCO already has this data via AMI. The reform would require KEPCO to share machine-readable hourly data with Green Premium subscribers.
- **Retire temporal-specific attributes.** The current CREU records only Period of Use without sub-monthly resolution and omits Plant Name and Generator ID.[49] The reform would replace this annual volume artefact with hourly-stamped energy attribute certificates retired at the hour of consumption.[50]

The green premium is the procurement route with the broadest participation eligibility for Korean corporate buyers. For Korean companies without access to PPAs, hourly matched green premium will transform vulnerable procurement options to hourly matching into scalable, hourly compatible solutions.

47. Baringa, (2026), The State of Hourly Matching, https://granular-marketing-website.cdn.prismic.io/granular-marketing-website/aV6DJ3NYClf9o3VZ_Stateofhourlymatchingtariffs-1-.pdf
48. KEPCO Basic Supply Terms (cyber.kepco.co.kr) Article 107; KEA Korea Renewable Energy 100 Confirmation issuance practice.
49. (MCEE Notice 2025-61, Annex Form No. 3)
50. Annex Form 3 (재생에너지 사용 확인서), MCEE Notice 2025-61 (effective 2025-12-24, supersedes MOTIE Notice 2024-34), Period of Use field.

4.2. Renewable Energy Certificates (RECs)

Companies directly purchase unbundled Renewable Energy Certificates (RECs) separately from electricity, then convert them into a CREU. Originally designed for RPS compliance, the certificate market was opened to corporate buyers in 2021 as part of K-RE100.

RECs operates in two markets sharing the same REC issuance[51]: the RPS compliance market for obligated suppliers and the voluntary K-RE100 market for corporate buyers. Only RECs not retired for RPS compliance are eligible for sale into the K-RE100 market[52]. Trading runs through four channels on KEA's platform (nr.energy.or.kr): bilateral over-the-counter transfer, monthly or semi-monthly platform sessions, ad-hoc spot trades, and short- or long-term bilateral contracts[53]. At conversion, KEA retires the REC and issues a CREU. RPS weightings are normalized out, so one MWh of actual generation yields one CREU regardless of the issuance multiplier[54]. The six renewable sources eligible for conversion are solar, wind, hydro, marine, geothermal, and bioenergy[55]; RPS-eligible new-energy (hydrogen, fuel cells, IGCC) and waste-to-energy are excluded[56].

RECs is not ready for hourly matching. The KNREC issuance rule sets a monthly cadence, so the certificate cannot carry an hour-specific claim even though KPX hourly settlement and KEPCO 15-minute AMI already capture the underlying data upstream.

A practical transition pathway exists without waiting for full REC redesign. EnergyTag's Configuration 3 approach allows granular certificates to be issued using existing cancelled certificates combined with underlying hourly production data. In practice, this means Korea could retain the existing REC infrastructure while layering hourly attributes onto cancelled certificates using generation and metering data already collected by KPX. This approach could enable voluntary granular matching without requiring immediate redesign of Korea's certificate architecture.

4.3. Power Purchase Agreement (PPA)

Both third-party and direct PPAs are among the most ready Korean RE100 procurement options for hourly matching: each pathway is metered on an hourly basis and ties procurement to a specific generator. The two pathways differ in metering and certificate flow.

51. Renewable Energy Act, Article 12-7; MCEE Notice 2025-61, Article 2(24), which defines the Renewable Energy Certificate as a single statutory instrument applied to both RPS compliance and K-RE100 voluntary uses. Source: https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2100000274906
52. K-ETS Reporting Guidelines (Ministry of Climate, Energy and Environment), Article 18(6), which restricts K-RE100 market eligibility to RECs not already retired for RPS compliance. Source: https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2100000257748
53. KEA REC Trading Market Notice (12 September 2023), Section 1; KNREC Notice 2015-1 Article 50, which sets platform trading sessions on the first and third Fridays of each month, 10:00-16:00 KST; Korea New and Renewable Energy Center official guidance at knrec.or.kr. Source: https://new.kpx.or.kr/boardDownload.es?bid=0032&list_no=48226&seq=645
54. CoREi Working Paper 2022-11, pp. 11-12, which sets out the weighting-normalization rule (one MWh of actual generation equals one Confirmation); aligned with KNREC Notice 2015-1 Articles 2(9) and 58, and MCEE Notice 2025-61 Article 69. Source: https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2100000274906
55. MCEE Notice 2025-61, Article 2(19), which defines renewable energy as solar, wind, hydropower, marine, geothermal, and bioenergy. Source: https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2100000274906
56. MCEE Notice 2025-61, Article 72(2), which limits certificate-based corporate use to certificates issued for the six renewable sources defined in Article 2(19); RPS-eligible new-energy and waste-to-energy sources are explicitly excluded. Source: https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2100000274906

Direct PPAs are metered through hourly meters installed and managed under the Electricity Market Operation Rules. The operative meter specifications are set by the KPX Market Operation Rules.[57] Direct PPA contracts do not issue RECs for the contracted volume because electricity supplied to the buyer is statutorily excluded from REC issuance, and only excess volume sold to the wholesale market is eligible for REC issuance.[58] The CREU is issued directly from KPX-confirmed hourly metering data.

Third-party PPAs are intermediated by KEPCO.[59] Metering may be installed in three options: installed by the generator at its own cost, installed by KEPCO with a unidirectional device (cost borne fully by the generator), or installed by KEPCO with a bidirectional device (cost split 50:50). The RECs issued for the contracted volume are retired immediately upon CREU issuance and do not enter the K-RE100 trading market operated by KEA[60]. The resulting CREU is issued on a monthly volume basis. Excess volume sold into the wholesale market retains its REC for separate trade.

Settlement methodology is buyer-elected on both pathways. Direct PPA buyers choose between hourly settlement and a monthly flat-rate.

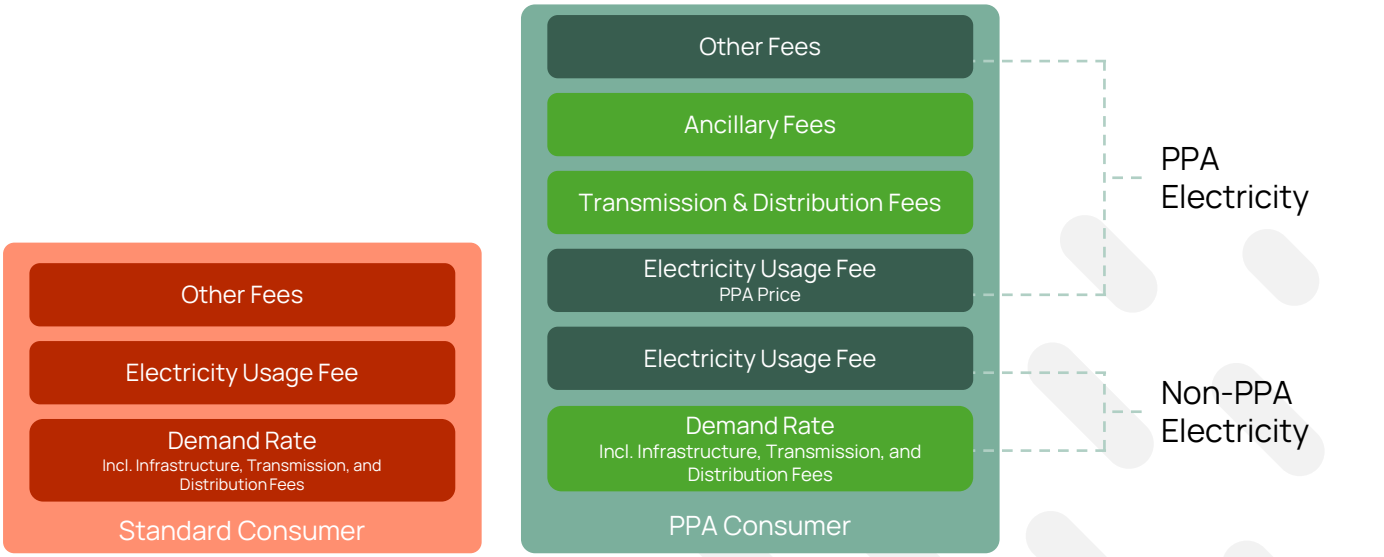
Third-party PPA buyers choose between hourly, monthly flat-rate, and annual flat-rate settlements when purchasing total generation, or hourly settlement only when purchasing on the buyer's hourly consumption profile.

Hourly matching readiness, therefore, depends on (a) whether the buyer elects hourly settlement at the contract level, and (b) whether the hourly meter records are retained alongside the CREU, since the CREU itself aggregates to monthly volume under the current issuance flow.

Corporations wishing to conduct hourly matching should refrain from the monthly flat-rate settlement option.

The option provides administrative simplicity but allows the contractual claim of renewable energy in hours when the generator does not produce[61]. This shifts the verification burden onto raw metering data: buyers electing the monthly option, particularly those targeting hourly matching for international compliance, should retain the underlying 15-minute / hourly metering records for separate verification.

Fig 4.3 Electricity Tariff Structure for regular users and direct PPA users in Korea (Source: SFOC)



57. MOTIE Notice 2025-125 ("Notice on Direct Electricity Transactions of Renewable-Generated Power"), Articles 22 (hourly meter installation under the Electricity Market Operation Rules), 5(3) (settlement choice), and 7(2) (excess REC issuance). Annex 13 of the KPX Market Operation Rules sets the operative meter specification. Issued 22 July 2025, effective 29 July 2025; jurisdiction transferred to MCEE on 24 December 2025. Source: https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2100000274906
58. Electric Utility Act, Article 16-5, Paragraph 5: electricity supplied under the Direct Electricity Transactions framework is excluded from REC issuance under Article 12-7 of the New and Renewable Energy Act. Source: https://www.law.go.kr/법령/전기사업법
59. MCEE Notice 2025-61 ("Guideline on Third-Party Electricity Transactions of New and Renewable Energy-Generated Power"), Articles 5 (KEPCO intermediation), 12(1) (three metering configurations), 6(2) (settlement choice between hourly, monthly flat-rate, and annual flat-rate), and 8(3) (excess REC retention). Effective 24 December 2025, jurisdictional successor to MOTIE Notice 2021-108. Source: https://www.law.go.kr/LSW/admRulInfoP.do?admRulSeq=2100000273986
60. KNREC Notice 2015-1, Article 58, Paragraph 4: "The director of the New and Renewable Energy Center shall destroy the corresponding supply certificate immediately upon issuance of the Confirmation of Renewable Energy Use." Source: https://new.kpx.or.kr/boardDownload.es?bid=0032&list_no=48226&seq=645
61. MCEE Notice 2025-61, Article 5(3): monthly-equalised settlement option. Lineage: MOTIE 2025-203 (administrative pre-notice draft, 2025-02-28) → MOTIE 2025-46 (full amendment enacted, 2025-03-26/27) → MOTIE 2025-125 (further amendment, effective 2025-07-29) → MCEE 2025-61 (jurisdiction transfer, effective 2025-12-24). Source: https://www.law.go.kr/LSW/admRulLsInfoP.do?admRulSeq=2100000257046

While PPA is ready for hourly matching, the complex cost structure deters high uptake. Since the 2020 amendment to the Electricity Utility Act opened the system to direct power purchase, a total of 1.7 GW capacity by June 2025 has been signed. Direct PPAs incur additional charges like network usage, transaction, settlement, and power infrastructure fund fees. Third-party PPAs include all these, plus power loss fees, welfare, and special discount fees. Grid use fees can add high costs to the total price of a PPA, and with the secrecy surrounding how grid fee rates are set, companies cannot predict the long-term costs of their 20-year PPA.

Cheaper PPAs make this pathway more accessible than previously. PPAs are getting closer to grid parity in Korea due to the increase in industrial rates, falling equipment costs, and more favorable financing conditions. A couple of policy changes are on the way to make the PPA cost lower by expanding the PPA supply:

- The minimum capacity requirement for generators participating in PPAs is abolished.[62] Until July 2025, renewable generators needed at least 1 MW capacity to sign PPAs, which excluded small and medium-sized projects and businesses. This expands the scope of generators allowed to enter PPAs.
- Generators already participating in the competitive bidding market of RPS will have the option to agree to participate in the PPA brokerage market, meaning a portion of the RPS capacity will be allocated to PPA.[63]

Overall, the supply of renewable capacity released to the voluntary market is increasing. But high grid fees and grid constraints that limit renewable generation remain the biggest barrier to renewable procurement. Renewable generation capacity is concentrated in Korea's southern regions, while demand centers are in the capital area, and transmission infrastructure has grown only 26% since 2003, compared with 154% growth in generation capacity over the same period.

ESS-PPA provides price hedging benefits against costly supplementary electricity in hours of deficit. Under Korea's PPA framework, electricity volumes are settled on an hourly basis. Every hour in which renewable generation falls short of the buyer's consumption requires supplementary electricity. While supplementary electricity can be procured through the wholesale market or KEPCO, companies are only purchasing supplementary electricity through KEPCO due to high wholesale market prices. KEPCO provides supplementary supply at a separate and more expensive rate than the industrial electricity rate. (Fig. 4.4) Since the majority of PPAs are solar PPAs, the result is systematic deficits during non-solar hours and surpluses during peak irradiance, driving up effective PPA costs.

Under a 2025 amendment, renewable energy ESS operators can now enter into bilateral PPAs in the same manner as renewable electricity generators.[64] An ESS-facilitated PPA co-located or contracted storage absorbs excess solar generation during peak irradiance hours and discharges it during evening deficit periods, physically reshaping the generation profile to match the corporate buyer's load. This reduces supplementary supply volumes to be bought from KEPCO, lowers the buyer's all-in PPA cost, and improves revenue predictability for the developer. The reform also lowered the minimum capacity threshold for off-grid ESS PPAs to 500 kW, broadening participation to smaller storage assets, which creates a pathway for distributed solar-plus-storage configurations.

4.4. SELF-GENERATION

Self-generation is the most physically direct form of renewable energy procurement. A company installs solar panels, small wind turbines, or other renewable generation assets on or adjacent to its own premises and consumes the electricity behind the meter, offsetting a portion of its grid load. Where the installation has a monitoring system or compatible meters, sub-monthly resolution data can be captured at source for both generation and consumption.

62. Ministry of Trade, Industry, and Energy (Electricity Market Department) 2025. Legislative proposal for Electricity Business Act Enforcement Decree Partial Amendment (Draft), Notice 2025-324. https://moleg.go.kr/lawinfo/makingInfo.mo?mid=a10104010000&lawSeq=82566&lawCd=0&lawType=TYPE5&pageCnt=10&currentPage=2&keyField=lmNm&keyWord=&stYdFmt=&edYdFmt=&lsClsCd=&cptOfiOrgCd=%EC%82%B0%EC%97%85%ED%86%B5%EC%83%81%EC%9E%90%EC%9B%90%EB%B6%80

63. Ibid

64. MOTIE Notice 2025-46, Article 22 (ESS bilateral PPA): https://www.law.go.kr/LSW/admRulLsInfoP.do?admRulSeq=2100000257046

For self-generation, KEA currently issues only the CREU. No RECs is issued for behind-the-meter generation. The CREU records monthly aggregates of generation and usage because the KEA CREU form uses month-unit fields, even when the installation has finer-resolution metering. Companies submit monthly generation and usage data to KEA, with supporting evidence drawn from the company's monitoring system, electricity meter readings, or inverter screen captures comparing start-of-month and end-of-month cumulative output.

Time-stamped equipment photos are required at registration and at each submission. Hourly matching at the source, therefore, depends on the company retaining hourly data separately from the CREU. MCEE's 2030 100 GW deployment strategy announces plans to introduce a separate certificate for self-installations, the Renewable Energy Guarantee of Origin (REGO), intended to provide additional revenue for self-installation owners. Implementation timing and legal basis have not yet been specified.

Table 5: Hourly Readiness of Each Pathway

Pathway	Readiness	Assessment
PPA	High	Most feasible entry point for voluntary granular matching. Hourly settlement, generator-specific metering, and KPX data already exist. Requires retaining hourly generation and load data and transparent disclosure. The monthly-average settlement option (MOTIE 2025-46) requires complementary raw-data retention for hourly-matching compliance; the default hourly settlement avoids this additional step.
Green Premium	Low	Cannot support hourly matching under the current design. Pool-level generator linkage only (source type, region, production period per round); no buyer-facility 1:1 mapping, no hourly granularity, no hourly data sharing. Requires structural redesign: link to specific generator pool, share AMI hourly data, and retire hourly-stamped RECs.
RECs	High	Existing RECs cannot support hourly matching today because issuance remains monthly. However, Korea already collects the underlying hourly generation data. Registry upgrades are one pathway. Alternatively, EnergyTag Configuration 3 could enable granular certificates to be layered onto cancelled RECs, creating a transitional pathway without replacing existing certificate infrastructure.
Self-generation	Physical: high / Certified: low	Natural foundation for granular matching behind-the-meter data provides real-time proof of hourly alignment. As MCEE is expected to introduce REGO independent of CREU, REGO could be designed to reflect the granularity of generation data.

4.5. WHAT CAN A KOREAN CORPORATE BUYER DO TODAY TO CONDUCT HOURLY MATCHING?

TIER 1: IMMEDIATE ACTION

Direct PPA, with the option of ESS to enable round-the-clock clean power: Start by signing a direct PPA for even a partial share of your load and establish the data infrastructure and contractual relationship that retains hourly data and hourly match through the following steps.

- Retain your hourly generation and consumption data internally,
- Publish voluntary hourly matching disclosures alongside existing RE100 reports.
- Launch pilot projects between PPA buyers and generators to test temporal correlation methodologies.
- Issue transparent methodology statements that document the matching approaches used.

On-site generation: Begin retaining hourly and sub-hourly monitoring data for hourly matching

TIER 2: BUILDING READINESS

Adopt Energytag Configuration 3: Buyers who already procure through Direct REC purchase, Direct PPA, or Third-party PPA can layer hourly resolution onto RECs that have already been retired, without waiting for Korea to launch a national granular certificate registry. Engage with an EnergyTag-accredited GC issuer. While none yet operating in Korea, explore other accredited GC issuers for data sharing agreement.

Load approximation: Where data is not available, apply a sector-appropriate load profile to distribute existing annual or monthly renewable procurement across hours, using the GHG Protocol load profile hierarchy.

05.

CONCLUSION

The gap Korea faces between the status quo and hourly matching is institutional, not technical. The underlying data infrastructure and procurement pathways for granular energy tracking exist. What is missing is a certificate system that records hourly data as a tradable instrument, a registry capable of issuing and retiring time-stamped certificates, and a legal framework that gives those certificates standing under Korean energy law.

The following steps are needed to close this gap:

1. IMMEDIATE VOLUNTARY PATHWAYS

Corporate consumers and non-utility suppliers (e.g., RE generators) can begin recording hourly /sub-hourly consumption and generation data where possible. To build an hourly matching track record, corporate buyers can:

- Track and retain your hourly generation and consumption metered data
- Launch pilot projects between corporate consumers and generators (PPA providers) to test temporal correlation methodologies.
- Issue transparent methodology statements that document the matching approaches used.

These measures establish market practice and generate the operational experience needed to inform future regulatory design.

2. REGISTRY MODERNIZATION

Korea's RECs system currently issues monthly certificates with no temporal or locational attributes, regardless of having hourly generation data using AMI. Upgrading this architecture to embed hourly timestamps into each certificate would bring Korea's registry in line with emerging international standards. This represents an enhancement to the existing RECs infrastructure rather than a replacement.

In the meantime, RECs can be paired with underlying hourly generation data to layer it up with time attributes to enable hourly matching by the corporate consumers. EnergyTag GC Scheme Standard has configurations 2 and 3 that articulate the process to issue granular certificates while working with the existing REC system.

3. RESIDUAL MIX DEVELOPMENT

As global carbon accounting standards move towards granular matching, the need for residual mix is increasingly important.

In practice, this would require renewable electricity attributes claimed through hourly matching to be removed from the underlying grid mix on an hour-by-hour basis. Developing such a system would require transparent certificate issuance and retirement data, alignment between electricity settlement and certificate tracking systems, and robust hourly generation and consumption data. South Korea is relatively well-positioned for this evolution because Korea Power Exchange already operates an hourly electricity settlement system and has access to granular operational data.

In the near term, South Korea could start by improving transparency around RECs issuance, transfers, and retirements across mechanisms such as Green Premiums, PPAs, and direct REC purchases. This would help establish a reliable accounting foundation and reduce risks of double-counting for residual mix development.

A credible market-based emissions accounting regime under GHG Protocol Scope 2 requires that renewable attributes claimed by individual buyers be excluded from the grid average applied to all other consumers. Korea currently does not meet this condition: the renewable generation underlying K-RE100 claims through REC purchases, Green Premium, and third-party PPA is included in the KEPCO Monthly Electricity Statistics, which serves as the raw input for the national grid emission factor, producing structural double counting. Closing this gap does not require new dispatch or settlement data, as both KPX wholesale data and KEPCO retail data already exist on an hourly basis. Rather, an institutional process is needed to deduct individually claimed renewable MWh from the grid-factor input before calculation of the residual mix. The MCEE, in coordination with KNREC's K-RE100 CREU registry, is the natural locus for this calculation. Direct PPA settlement, permitted as the statutory default with a monthly-equalized option available at the buyer's election, demonstrates the technical tractability of implementing an hourly residual-mix layer.

4. ACCREDITATION AND VERIFICATION FRAMEWORK

Korea currently has no accredited granular certificate issuers, no verification protocols for temporal correlation claims, and no legal framework for certificate liability. Establishing these institutional foundations is a prerequisite for international recognition of Korean granular certificates. This requires defining issuer accreditation criteria, adopting or developing verification standards for hourly matching claims, and establishing clear rules on certificate ownership, transfer, and retirement. The institutional architecture matters more than the specific body that administers it.

5. INTEGRATION WITH INTERNATIONAL HYDROGEN AND TRADE REGULATION ON HOURLY MATCHING.

Hourly matching is already enshrined in regulations governing green hydrogen production, with cadence stepping up over time. The US 45V production tax credit allows annual matching until 2030 in-service before requiring hourly, and the EU's RFNBO framework permits monthly matching until 2029 before mandating hourly from 2030.[65]

Korea's hydrogen economy ambitions and its exposure to the EU's Carbon Border Adjustment Mechanism mean that the ability to demonstrate temporally matched renewable consumption will increasingly carry direct economic consequences. Aligning Korea's certificate infrastructure with these requirements now avoids the risk of a second, more costly, catch-up effort later.

65. U.S. Treasury Final Regulations on Section 45V Clean Hydrogen Production Tax Credit (T.D. 10023, January 2025); European Commission Delegated Regulation (EU) 2023/1184 of 10 February 2023, Articles 6 and 7.

APPENDIX A

REGULATORY REQUIREMENTS

APPENDIX A: INTERNATIONAL REGULATIONS ON HOURLY MATCHING (PRIMARY SOURCES)

This appendix reproduces the operative text of the three regulatory regimes that establish hourly matching as a compliance requirement: EU RFNBO, US IRA Section 45V, and EU CBAM. All quotations are verbatim from the primary sources. Motivational material (recitals, preambles) is included where it explains the legislative intent.

A.1 EU RFNBO: COMMISSION DELEGATED REGULATION (EU) 2023/1184

Scope: Renewable liquid and gaseous transport fuels of non-biological origin (RFNBOs: renewable hydrogen and e-fuels) under the Renewable Energy Directive III (RED III).

TEMPORAL CORRELATION: ARTICLE 6 (TRANSITIONAL, THROUGH 31 DECEMBER 2029)

"Until 31 December 2029, the temporal correlation condition [...] shall be considered complied with if the renewable liquid and gaseous transport fuel of non-biological origin is produced during the same calendar month as the renewable electricity produced under the renewables power purchase agreement or from renewable electricity from a new storage asset that is located behind the same network connection point as the electrolyser [...]"

Source: Article 6, Delegated Regulation (EU) 2023/1184

TEMPORAL CORRELATION: ARTICLE 6 (FROM 1 JANUARY 2030)

"From 1 January 2030, the temporal correlation condition shall be considered complied with if the renewable liquid and gaseous transport fuel of non-biological origin is produced during the same one-hour period as the renewable electricity produced under the renewables power purchase agreement or from renewable electricity from a new storage asset [...] Following a notification to the Commission, Member States may apply the rules set out in this paragraph from 1 July 2027 for renewable liquid and gaseous transport fuel of non-biological origin produced in their territory."

Source: Article 6, Delegated Regulation (EU) 2023/1184

LOW-PRICE EXCEPTION

"The temporal correlation condition shall always be considered complied with if the renewable liquid and gaseous transport fuel of non-biological origin is produced during a one-hour period where the clearing price of electricity [...] is lower or equal to EUR 20 per MWh or lower than 0.36 times the price of an allowance to emit 1 tonne of carbon dioxide equivalent [...]"

Source: Article 6, Delegated Regulation (EU) 2023/1184

GEOGRAPHICAL CORRELATION: ARTICLE 7

"The geographical correlation condition [...] shall be considered complied with if at least one of the following criteria relating to the location of the electrolyser is fulfilled: (a) the installation generating renewable electricity under the renewables power purchase agreement is located [...] in the same bidding zone as the electrolyser; (b) the installation generating renewable electricity is located in an interconnected bidding zone [...] and electricity prices in the relevant time period on the day-ahead market [...] in the interconnected bidding zone is equal or higher than in the bidding zone where the [RFNBO] is produced; (c) the installation generating renewable electricity [...] is located in an offshore bidding zone that is interconnected with the bidding zone where the electrolyser is located."

Source: Article 7(1), Delegated Regulation (EU) 2023/1184

ADDITIONALITY: ARTICLES 4 AND 5

Renewable electricity source must be a new installation with a commercial operation date (COD) no earlier than 36 months before the electrolyser's start of operation.

LEGISLATIVE INTENT: RECITALS

"In order to demonstrate that renewable hydrogen is produced when renewable electricity is available, hydrogen producers should show that production of renewable hydrogen takes place in the same calendar month as the production of the renewable electricity [...] The criterion for synchronisation should become stricter when markets, infrastructures and technologies allowing for a quick adjustment of hydrogen production and the synchronisation of electricity generation and hydrogen production become available."

Source: Recital (11), Delegated Regulation (EU) 2023/1184

"Bidding zones are designed to avoid grid congestion within the zone. To ensure that there is no electricity grid congestion between the electrolyser producing renewable hydrogen and the installation generating renewable electricity it is appropriate to require that both installations should be located in the same bidding zone."

Source: Recital (12), Delegated Regulation (EU) 2023/1184

A.2 US IRA SECTION 45V: 26 CFR 1.45V-4 (TREASURY FINAL RULE, 90 FR 2306, 10 JANUARY 2025)

Scope: The Clean Hydrogen Production Credit, offering up to USD 3/kg for hydrogen meeting lifecycle GHG thresholds. Qualifying requires Energy Attribute Certificates (EACs) meeting the 'three pillars' framework.

GENERAL EAC PRINCIPLE

"The taxpayer may treat such hydrogen production facility's use of electricity as being from a specific electricity generating facility rather than as electricity with the annual average lifecycle GHG emissions of the regional electricity grid [...] only if the taxpayer acquires and retires qualifying EACs [...] The requirements of this paragraph (d) (1) apply regardless of whether the electricity generating facility is grid connected, directly connected, or co-located with the hydrogen production facility."

Source: Section 1.45V-4 (d) (1), 26 CFR

PILLAR 1: INCREMENTALITY

"An EAC meets the requirements of this paragraph [...] if the electricity generating facility that produced the unit of electricity to which the EAC relates has a COD (commercial operation date) that is no more than 36 months before the hydrogen production facility for which the EAC is retired was placed in service [...]"

Source: Section 1.45V-4 (d) (3) (i) (A), 26 CFR

PILLAR 2: TEMPORAL MATCHING (FROM 1 JANUARY 2030)

"An EAC meets the requirements of this paragraph [...] if the electricity represented by the EAC is generated in the same hour that the taxpayer's hydrogen production facility uses electricity to produce hydrogen."

Source: Section 1.45V-4 (d) (3) (ii) (A), 26 CFR

PILLAR 2: TEMPORAL MATCHING (TRANSITIONAL, BEFORE 1 JANUARY 2030)

"For EACs that represent electricity generated before January 1, 2030, the EAC will be considered generated in the same hour [...] if the electricity represented by the EAC is generated in the same calendar year that the taxpayer's hydrogen production facility uses electricity to produce hydrogen."

Source: Section 1.45V-4 (d) (3) (ii) (B), 26 CFR

ENERGY STORAGE PROVISION

"For purposes of meeting the requirements of paragraph (d)(3)(ii)(A) [...] an EAC meets such requirements if the electricity represented by the EAC is discharged from a storage system in the same hour that the taxpayer's hydrogen production facility uses electricity to produce hydrogen. The storage system must be located in the same region as both the hydrogen production facility and the facility generating the stored electricity [...] the volume of electricity use substantiated by each EAC representing stored electricity must account for storage-related efficiency losses."

Source: Section 1.45V-4(d)(3)(ii)(C), 26 CFR

PILLAR 3: DELIVERABILITY

"An EAC meets the requirements of this paragraph [...] if the electricity represented by the EAC is generated by a facility that is in the same region [...] as the hydrogen production facility. Whether the electricity generating source and the hydrogen production facility are located in the same region is determined by the balancing authority to which each is electrically interconnected, not the geographic location."

Source: Section 1.45V-4(d)(3)(iii)(A), 26 CFR

LEGISLATIVE INTENT: TREASURY PREAMBLE

"Incrementality, temporal matching, and deliverability requirements are important guardrails to ensure that hydrogen producers' electricity use can be reasonably deemed to reflect the emissions associated with the specific generators from which the EACs were purchased and retired. If hydrogen producers rely on EACs without attributes that meet these three criteria there is a significant risk that hydrogen production would significantly increase direct and significant indirect GHG emissions, and, in particular, induced grid emissions [...]"

Source: Preamble, Treasury Final Rule, 90 FR 2306 (January 10, 2025)

A.3 EU CBAM: REGULATION (EU) 2023/956 + IMPLEMENTING REGULATION (EU) 2025/2547

Scope: Carbon border adjustment on imported carbon-intensive goods (cement, fertilisers, iron/steel, aluminium, hydrogen, electricity). CBAM certificates required from 1 January 2026; first certificate surrender due September 2027.

DEFAULT VALUE VS ACTUAL VALUE

"Embedded emissions in imported electricity shall be determined by reference to default values [...] unless the authorised CBAM declarant demonstrates that the criteria to determine the embedded emissions based on the actual emissions listed in point 5 of Annex IV are met."

Source: Article 7(3), Regulation (EU) 2023/956

FIVE CUMULATIVE CRITERIA FOR ACTUAL EMISSIONS: DIRECTLY IMPORTED ELECTRICITY

"An authorised CBAM declarant may apply actual embedded emissions instead of default values [...] if the following cumulative criteria are met: (a) the amount of electricity [...] is covered by a power purchase agreement between the authorised CBAM declarant and a producer of electricity located in a third country; (b) the installation producing electricity is either directly connected to the Union transmission system or it can be demonstrated that at the time of export there was no physical network congestion [...]; (c) the installation producing electricity does not emit more than 550 grammes of CO_2 of fossil fuel origin per kilowatt-hour; (d) the amount of electricity [...] has been firmly nominated to the allocated interconnection capacity [...] and the nominated capacity and the production of electricity by the installation refer to the same period of time, which shall not be longer than one hour; (e) the fulfilment of the above criteria is certified by an accredited verifier."

Source: Annex IV, Point 5, Regulation (EU) 2023/956

ACTUAL EMISSIONS: ELECTRICITY USED IN THE PRODUCTION OF GOODS

"An authorised CBAM declarant may apply actual embedded emissions instead of default values [...] if it can demonstrate a direct technical link between the installation in which the imported good is produced and the electricity generation source or if the operator of that installation has concluded a power purchase agreement with a producer of electricity located in a third country [...]"

Source: Annex IV, Point 6, Regulation (EU) 2023/956

IMPLEMENTING REGULATION 2025/2547: PPA HOURLY MEASUREMENT

"Contractual evidence demonstrating the existence of a PPA concluded directly between an installation producing goods listed in Annex I [...] and a producer of electricity located in a third country for the physical delivery of electricity. Where the PPA was concluded through an intermediary, the contractual evidence shall demonstrate that only one single contract was concluded between the three contracting parties [...] Data from a smart metering system demonstrating that an equivalent amount of electricity was delivered, within the same measurement period which shall not exceed one hour, to the installation producing goods [...]"

Source: Annex II, Point D.4.3, Implementing Regulation (EU) 2025/2547

LEGISLATIVE INTENT: RECITALS

"The physical characteristics of electricity as a product justify a slightly different design within the CBAM as compared to other goods. Default values should be used under clearly specified conditions [...] Electricity trade is different from trade in other goods, in particular because it is traded through interconnected electricity grids, using power exchanges and specific forms of trading."

Source: Recital (51), Regulation (EU) 2023/956

"To avoid the risk of circumvention and improve the traceability of actual CO_2 emissions from import of electricity and its use in goods, the calculation of actual emissions should only be permitted under certain strict conditions. In particular, it should be necessary to demonstrate a firm nomination of the allocated interconnection capacity and that there is a direct contractual relation between the purchaser and the producer of the renewable electricity [...]"

Source: Recital (52), Regulation (EU) 2023/956

A.4 PRIMARY-SOURCE LINKS

Source	Citation
EU RFNBO	Commission Delegated Regulation (EU) 2023/1184, 10 February 2023 (EUR-Lex)
EU CBAM base regulation	Regulation (EU) 2023/956, 10 May 2023 (EUR-Lex)
EU CBAM Implementing Regulation (2025)	Commission Implementing Regulation (EU) 2025/2547, 10 December 2025 (EUR-Lex)
US IRA 45V Final Rule	Treasury Final Rule, 26 CFR Part 1, §§ 1.45V-1 through 1.45V-6 (90 FR 2306, 10 January 2025) (Federal Register)
US IRA 45V statute	26 U.S.C. § 45V (Cornell Law)

APPENDIX B

KOREAN GLOSSARY

CORE CONCEPTS (핵심 개념)

English	Korean
Granular Certificate (GC)	세분화 인증서 (GC)
Granular Electricity Accounting	세분화 전력 회계
Hourly Matching	시간 단위 매칭
24/7 Carbon-Free Energy (CFE)	24/7 무탄소 에너지 (CFE)
Annual Matching	연간 매칭
Temporal Correlation	시간적 상관관계
Geographic Correlation / Deliverability	지역적 상관관계 / 전달 가능성
Additionality / Incrementality	추가성
Three Pillars	3대 원칙 (추가성 · 시간적 상관관계 · 지역적 상관관계)

MARKET MECHANISMS (시장 메커니즘)

English	Korean
Competitive Bidding (Auction)	경쟁입찰
System Marginal Price (SMP)	계통한계가격 (SMP)
Contract for Difference (CfD)	차액계약 (CfD)
Time-of-Use Tariff	시간대별 요금제
Single Bidding Zone	단일 입찰구역
ESS Central Contract Market	ESS 중앙계약시장

CERTIFICATES AND TRACKING (인증서 및 추적)

English	Korean
Confirmation of Renewable Energy Use	재생에너지 사용 확인서
Energy Attribute Certificate (EAC)	에너지 속성 인증서 (EAC)
Renewable Energy Guarantee of Origin (REGO)	재생에너지 원산지 보증서 (REGO)
REC Multiplier / Weighted Value	REC 가중치
Certificate Issuance	인증서 발급
Certificate Retirement	인증서 폐기
Double Counting	이중계상

PROCUREMENT MECHANISMS (조달 메커니즘)

English	Korean
Monthly Equalized Settlement	월별 정산
Annual Equalized Settlement	연간 정산

INTERNATIONAL REGULATORY FRAMEWORK (국제 규제 체계)

English	Korean
Carbon Border Adjustment Mechanism (CBAM)	탄소국경조정제도 (CBAM)
Renewable Fuels of Non-Biological Origin (RFNBO)	비생물학적 재생연료 (RFNBO)
IRA Section 45V (Clean Hydrogen Tax Credit)	미국 IRA 제45V조 (청정수소 세액공제)
GHG Protocol Scope 2 Guidance	온실가스 프로토콜 Scope 2 가이드라인

KOREAN REGULATORY FRAMEWORK (한국 규제 체계)

English	Korean
Renewable Portfolio Standard (RPS)	신재생에너지 공급의무화제도 (RPS)
Clean Hydrogen Power Standard (CHPS)	청정수소발전의무화제도 (CHPS)
Korea Emissions Trading Scheme (K-ETS)	배출권거래제 (K-ETS)
Electric Utility Act	전기사업법
Act on Promotion of New and Renewable Energy	신에너지 및 재생에너지 개발·이용·보급 촉진법
MOTIE Notice No. 2025-46	산업통상자원부 고시 제2025-46호
Presidential Decree No. 36172	대통령령 제36172호
11th Basic Plan for Electricity Supply and Demand (BPLE)	제11차 전력수급기본계획

GHG AND CLIMATE ACCOUNTING (온실가스 및 기후 회계)

English	Korean
Emission Factor	배출계수
Market-based Method (MBM)	시장기반 방식 (MBM)
Standard Supply Service (SSS)	표준공급서비스 (SSS)
Residual Mix	잔여전력믹스

TECHNICAL INFRASTRUCTURE (기술 인프라)

English	Korean
Advanced Metering Infrastructure (AMI)	지능형 계량 인프라 (AMI)
Energy Storage System (ESS/BESS)	에너지저장장치 (ESS/BESS)
Duck Curve	덕 커브
Curtailment	출력제한
Power System / Power Grid	전력계통 / 전력망
Transmission Network	송전망
Distribution Network	배전망
Market Boundary	시장 경계
Monitoring System (REMS)	재생에너지 모니터링 시스템 (REMS)

APPENDIX C

GLOBAL HOURLY MATCHED GREEN PREMIUM SUPPLIERS

Source: Granular Energy, Hourly Matching Tariffs Available (accessed 2026-04-27)

Energy Supplier 에너지 공급사	Country 국가	Min Size 최소 규모	24/7 CFE Coalition	EnergyTag Compliance
A2A	Italy	Any	Not communicated	Not communicated
Brook Green Supply	United Kingdom	Any	Not communicated	Planning to become compliant
CLP	China	Any	Not communicated	Not communicated
Constellation	United States of America	Any	Yes	Yes
Drax	United Kingdom	Any	Planning	Planning
EDF Energy	United Kingdom	Any	Yes	Yes
EnBW	Germany	Any	Not communicated	Not communicated
ENGIE	Australia	10 GWh	Yes	Planning to become compliant
ENGIE	Belgium	10 GWh	Yes	Planning to become compliant
ENGIE	Brazil	10 GWh	Yes	Planning to become compliant
ENGIE	Chile	10 GWh	Yes	Planning to become compliant
ENGIE	Egypt	10 GWh	Yes	Planning to become compliant
ENGIE	France	10 GWh	Yes	Planning to become compliant
ENGIE	Germany	10 GWh	Yes	Planning to become compliant
ENGIE	India	10 GWh	Yes	Planning to become compliant
ENGIE	Italy	10 GWh	Yes	Planning to become compliant
ENGIE	Japan	10 GWh	Yes	Planning to become compliant
ENGIE	Malaysia	10 GWh	Yes	Planning to become compliant
ENGIE	Mexico	10 GWh	Yes	Planning to become compliant
ENGIE	Morocco	10 GWh	Yes	Planning to become compliant
ENGIE	Netherlands	10 GWh	Yes	Planning to become compliant
ENGIE	Peru	10 GWh	Yes	Planning to become compliant

Energy Supplier 에너지 공급사	Country 국가	Min Size 최소 규모	24/7 CFE Coalition	EnergyTag Compliance
ENGIE	Philippines	10 GWh	Yes	Planning to become compliant
ENGIE	Poland	10 GWh	Yes	Planning to become compliant
ENGIE	Portugal	10 GWh	Yes	Planning to become compliant
ENGIE	Romania	10 GWh	Yes	Planning to become compliant
ENGIE	Singapore	10 GWh	Yes	Planning to become compliant
ENGIE	South Africa	10 GWh	Yes	Planning to become compliant
ENGIE	Spain	10 GWh	Yes	Planning to become compliant
ENGIE	United Kingdom	10 GWh	Yes	Planning to become compliant
ENGIE	United States of America	10 GWh	Yes	Planning to become compliant
Flow Power	Australia	Any	Not communicated	Not communicated
Good Energy	United Kingdom	Any	In progress	Yes
JERA Cross	Japan	Any	Yes	Yes
Last Energy	United Kingdom	10 GWh	Not communicated	Planning to become compliant
LichtBlick SE	Germany	Any	Not communicated	Yes
Octopus Energy for Business	United Kingdom	1 GWh	Yes	Not communicated
Octopus Energy France	France	Any	Not communicated	Not communicated
PPC SA	Greece	10 GWh	Yes	Yes
Prokon Regenerative Energien eG	Germany	1 GWh	Not communicated	Planning to become compliant
Saxon Renewables	Singapore	Any	Not communicated	Not communicated
SmartestEnergy	United Kingdom	10 GWh	Yes	Yes
Tepco	Japan	10 GWh	Not communicated	Not communicated
TotalEnergies	Belgium	10 GWh	Not communicated	Not communicated
TotalEnergies	France	10 GWh	Not communicated	Not communicated
TotalEnergies	Spain	10 GWh	Not communicated	Not communicated
TotalEnergies Gas & Power	United Kingdom	1 GWh	Not communicated	Not communicated