Global Sustainability

AI Supply Chains Meet Energy Reality: Taiwan and Korea

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ESG
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Energy resilience emerges as a binding constraint in global AI hardware

Taiwan and Korea sit at the core of advanced semiconductor manufacturing—Taiwan in leading-edge logic and advanced packaging, Korea in DRAM and HBM—but that means local power-system stress can now transmit directly to global AI deployment. The next bottleneck is increasingly not chip design, foundry know-how or end demand, but power systems' ability to reliably support rapidly rising, power-intensive semiconductor loads; an issue highlighted by the Middle East crisis. Other ME-related supply chain constraints we are keeping an eye on but are outside the scope of this note include air freight (price & availability) and key material disruptions (eg, helium, sulfuric acid).

The critical risk is availability, not price

Both Taiwan and Korea have absorbed sizable electricity tariff increases of ~60–70% since 2021—without impairing semiconductor profitability, indicating that power price is not the binding constraint. The more material risk lies in availability, with both systems highly dependent on imported LNG and oil. Heightened geopolitical uncertainty in the Middle East increases the risk of fuel supply disruptions during periods of peak demand. While semi fabs rely on UPS systems, backup generation and grid redundancy to manage short-duration events, these measures cannot fully offset prolonged or systemic shortfalls in dispatchable capacity. As such, energy system risk is real and elevated for both regions and remains a structural issue warranting active monitoring and mitigation.

Taiwan's power system is structurally tighter than Korea's

Taiwan's reserve margin is significantly tighter—around ~6% at peak demand in 2025 vs ~10% in Korea, both below international targets of 15–20%. Taiwan's vulnerability is amplified by LNG's role as the marginal balancing fuel: ex-LNG baseload capacity can support only ~50% of peak demand, compared with a materially higher share in Korea, where nuclear accounts for roughly ~30% of generation. Korea benefits from a stronger nuclear backstop and more conservative reserve planning, providing greater operating headroom, though it remains exposed to imported fuels and LNG-driven flexibility at the margin. The difference is one of degree rather than immunity.

Energy policy is increasingly becoming industrial policy

In both markets, semiconductor manufacturing is treated as strategically critical, and formal load shedding frameworks imply administrative prioritisation under stress rather than indiscriminate outages. This makes outright curtailment of fabs unlikely in most scenarios, although it does not eliminate risk. Protecting semiconductor loads can shift stress onto the rest of the power system and increase reliance on policy support and operational coordination. For investors, the right framing is not imminent blackout risk, but allocation and resilience risk within increasingly power-constrained AI supply chains.

Our continuous work on AIDC and energy system constraints

- AI, Data Centres and the Energy Transition: What to know
- What does it actually take to turn a data centre on?
- Global Sustainability "Signs of change for data center operations amid..."
- Global Sustainability "Data centre cooling series: your questions on a..."
- Global Sustainability "Liquid cooling heating up: data centre cooling tech..."
- ESG Investing Op Ed "Can Data Center Demand Restart the Nuclear..."

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ENERGY SYSTEMS UNDER STRESS: STRUCTURAL TIGHTNESS IN TAIWAN AND KOREA

Taiwan's power system is now operating under a more difficult combination of policy and physical constraints. The government's long-running nuclear phase-out has reduced low-carbon baseload capacity and increased reliance on LNG and coal. Taipower's own disclosures show thermal generation still accounted for the overwhelming majority of power supply in 2024, while nuclear had fallen to a very small share. Meanwhile, system peak demand remains high and reserve margin mostly under 10% in 2025, below the government's 15% benchmark. That is not blackout territory by default, but it is tight enough that a supply shock or operational error could become systemically important.

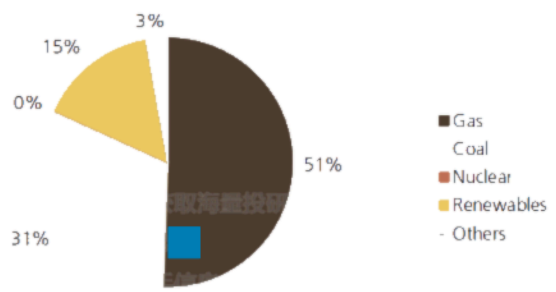
Taiwan's vulnerability is intensified by the character of its fuel dependence. The issue is not only that imported energy accounts for the vast majority of total energy demand; it is that LNG has become the critical balancing fuel in a power system losing nuclear baseload while also trying to integrate more renewables. That makes Taiwan exposed to both fuel-price volatility and physical supply disruption. Recent reporting around Middle East tensions and Taiwan's efforts to secure LNG assurances indicate that policymakers increasingly see this as an energy-security issue, not just a tariff issue.

Korea starts from a stronger position. The system is also highly import-dependent, but it is more diversified. The IEA's Korea 2025 review and related official materials show nuclear contributed about 31% of generation in 2024, with coal and gas together still large but less dominant than in Taiwan. Korea also operates with more formal reserve planning, including a target reserve margin around 20% in the current planning window. That gives the country more operating headroom.

Still, Korea should not be described as insulated. LNG is fully imported, there are no cross-border power or gas interconnections, and gas remains a key flexible source at the margin. In other words, Korea has a stronger base-load foundation than Taiwan, but it is still exposed to imported-fuel risk and to rising industrial demand from semiconductors, batteries, and AI-related infrastructure.

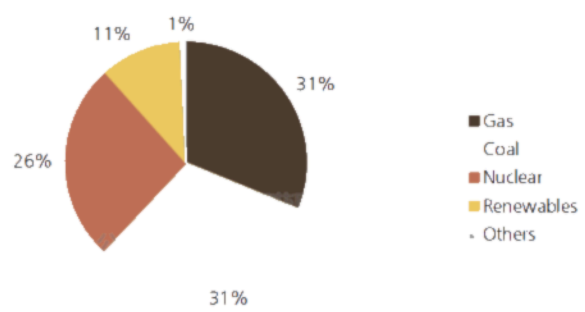
In comparison to other regions, both Taiwan and Korea have relatively lower reserve margins versus the PJM market (US AI alley proxy) and Mainland China at 15% as well as Germany at 13% (Figure 5).

Figure 1: Taiwan power generation mix 2M26



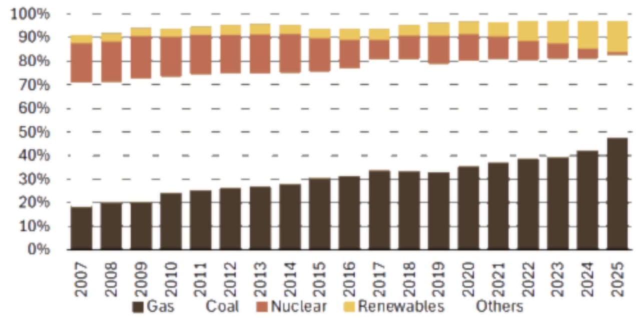
Source: MOEA

Figure 2: Korea power generation mix 2M26



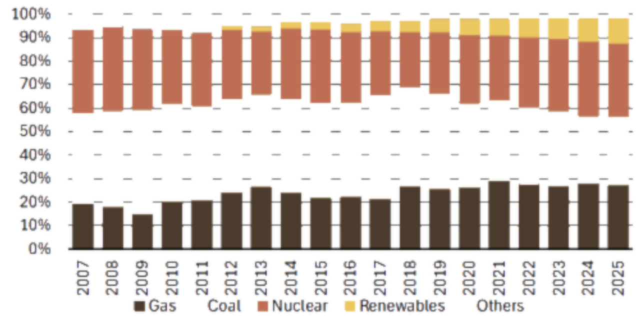
Source: Company data (The Monthly Report on Major Electric Power Statistics

Figure 3: Taiwan power generation mix 2016-2026



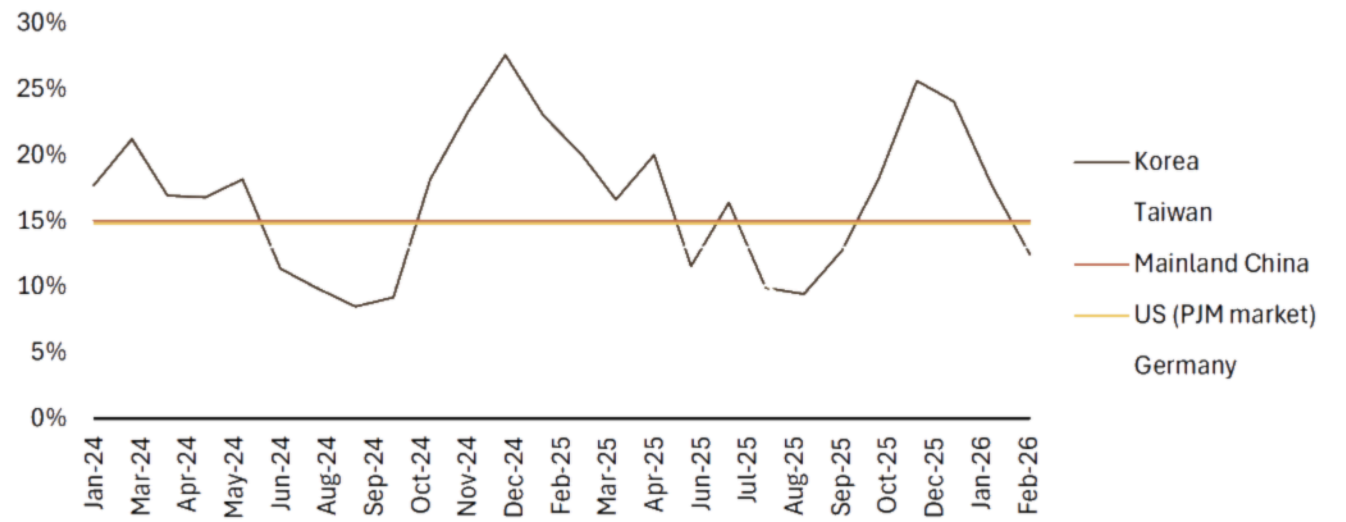
Source: MOEA

Figure 4: Korea power generation mix 2016-2026



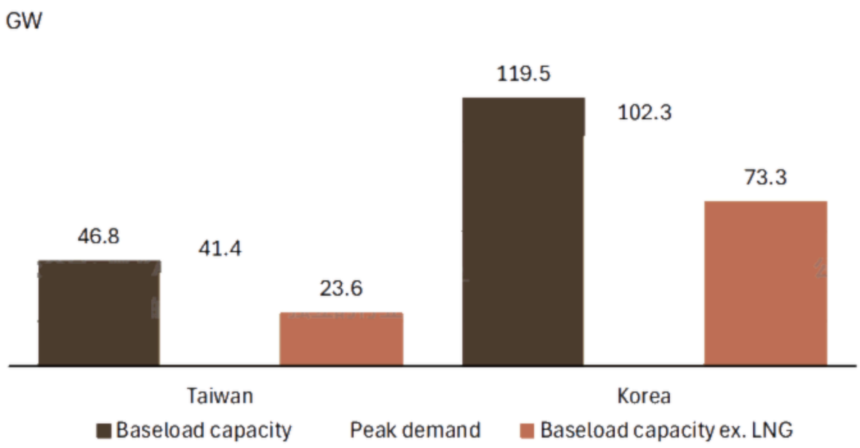
Source: Company data (The Monthly Report on Major Electric Power Statistics

Figure 5: Taiwan reserve margin is below international levels; while Korea is in line with Mainland China, US and Germany



Source: MOEA, Company data, PJM disclosure, BNetzA. Note: Korea and Taiwan reserve margin defines as the difference between net dispatchable peak generation capacity (including renewables available at that moment) and instantaneous peak demand, divided by peak demand. Mainland China number excluded solar and applied 70% discount on wind capacity.

Figure 6: Taiwan's power system is more vulnerable as ex.LNG baseload capacity can only support 50% of peak power demand



Source: Taipower, KEPCO; Note: both peak load demand was from summer 2024, baseload capacity refers to thermal (coal,oil,LNG), nuclear, and hydro capacity as of Feb26

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AI SUPPLY-CHAIN CONCENTRATION: WHY KOREA AND TAIWAN MATTER DISPROPORTIONATELY

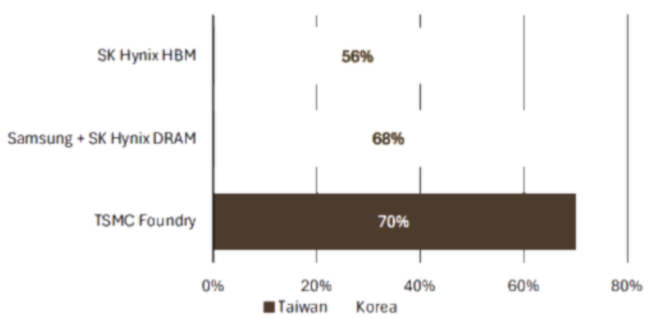
The AI buildout depends on a narrow set of upstream chokepoints, and Korea and Taiwan dominate several of them. Taiwan is the core node for leading-edge foundry and advanced packaging. TSMC's foundry share was close to 70% in 2025, and Taiwan remains overwhelmingly dominant in the most advanced manufacturing nodes. Advanced packaging, especially CoWoS, is also heavily concentrated there, and packaging capacity remains a bottleneck for AI accelerators even after rapid expansion.

Korea plays the same role on the memory side. UBS estimates Samsung and SK Hynix together held about 68% of DRAM revenue in 4Q25 and SK Hynix alone about 56% of HBM revenues. That matters because HBM is no longer a peripheral memory category; it is one of the central enabling technologies for modern AI accelerators.

This is why energy risk in Northeast Asia has become an AI risk rather than just a regional power-market issue. If Taiwan were to face a severe power or fuel shock, the world would not simply lose "some semiconductor output"; it would risk disruption at the leading-edge logic and packaging layers where substitution is extremely limited in the short term. If Korea faces stress, the likely bottleneck is memory bandwidth through DRAM and HBM. Both channels would hit AI server deployment globally.

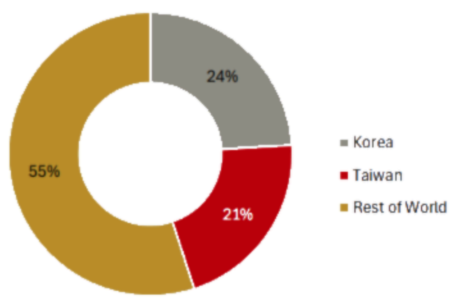
That concentration is also visible at the wafer-capacity level. SEMI projected Taiwan and Korea together would continue to represent a very large share of global 300mm fab capacity, with Korea around 24% and Taiwan around 21% of worldwide share by 2025. That is a useful cross-check that this is not only a market-share story; it is also a physical-capacity story.

Figure 7: Taiwan and Korea dominate critical semi manufacturing nodes



Source: UBSe

Figure 8: 300mm Wafer Fab capacity global distribution (2025)



Source: SEMI

SEMICONDUCTOR ENERGY INTENSITY: DEMAND IS BECOMING SYSTEM-LEVEL, NOT JUST COMPANY-LEVEL

The reason energy now matters more than in prior semiconductor cycles is that electricity demand is rising in both absolute and relative terms. TSMC's 2024 climate and energy disclosures show total energy consumption of 27,456 GWh, with roughly 93% from purchased electricity. That implies power consumption of roughly 25.5 TWh, a level large enough to make the company macro-relevant to Taiwan's power system. Recent commentary has placed TSMC at roughly 9–10% of Taiwan electricity demand, with upside from there as capacity ramps further.

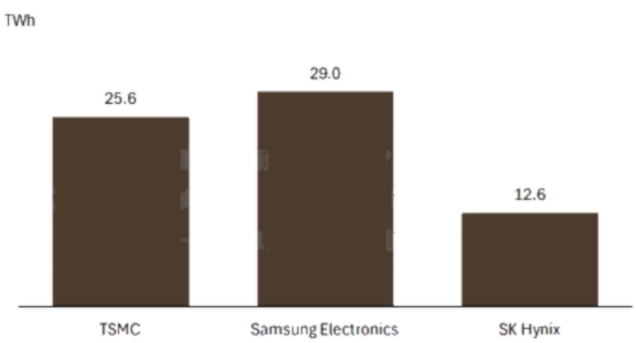
Taiwan's semiconductor load is becoming systemically important because the demand profile is not generic manufacturing demand. It is highly power-quality sensitive, largely continuous, and increasingly concentrated in advanced facilities with rising intensity. That combination is harder for the grid to accommodate than slower-moving commercial or household demand. Taiwan's past large-scale power outages in 2021 and 2022 show that even brief disturbances can matter to semiconductor operations.

Korea's demand is more distributed across corporate players, but the scale is still large. Samsung Electronics' 2025 sustainability reporting indicates group electricity use of 32,083GWh and DS-related electricity usage of 28,996GWh. That means Samsung alone is operating at power-consumption levels comparable to TSMC. SK Hynix reported electricity consumption of 12,620GWh in 2024, with 30% coming from renewables.

Just as important as scale is trajectory. AI-related semiconductor production is structurally more power-intensive than legacy production. Advanced nodes require more process steps and more EUV exposure. HBM adds energy intensity on the memory side. Advanced packaging adds another layer of electricity demand. TSMC's own efforts to cut peak EUV tool power by 44% in selected tools are telling: the company is no longer optimising energy use simply for ESG reasons, but because power consumption itself is strategically material.

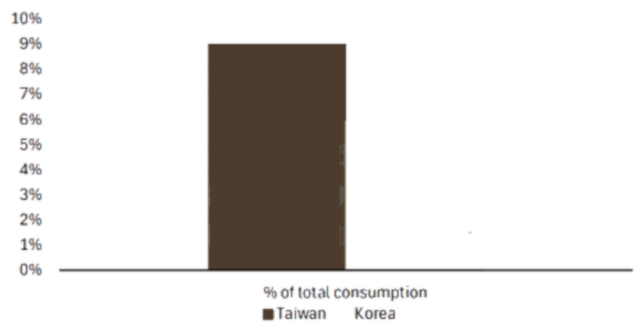
The implication is that the traditional assumption—higher semiconductor output but manageable energy intensity—no longer holds cleanly for AI. The AI mix is pushing the sector toward higher electricity consumption per unit of value-added output, and that means power-system adequacy is becoming a first-order variable in supply-chain resilience.

Figure 9: Semiconductor manufacturers' power consumption in 2024



Source: Company data

Figure 10: TSMC accounted for 9% of total power consumption in Taiwan; while Samsung and SK Hynix accounted for 6% in Korea in 2024



Source: Company data, MOEA, KEPCO

POWER PRICE VERSUS MARGIN: MANAGEABLE COST, UNMANAGEABLE OUTAGE

A key pushback to the energy-risk thesis is that semiconductor companies can simply absorb higher power prices. On that point, we think the evidence broadly supports a narrower claim: they can absorb moderate tariff increases, but not actual supply disruption.

Reuters reported Taiwan raised electricity prices by an average of 11% in March 2024, including a 25% increase for large industrial users. Yet TSMC still reported 56.1% gross margin and 45.7% operating margin in 2024. That is a powerful reminder that electricity cost is not a dominant enough share of advanced-semiconductor economics to break the business model under normal tariff adjustments.

Using TSMC's disclosed electricity consumption of roughly 25.5 TWh, a simple sensitivity is illustrative. Every US$10/MWh increase in effective electricity cost would add roughly US$255 million of annual electricity expense. That is real, but it is still small relative to TSMC's revenue base, US$117bn in 2025, and margin structure. A similar directional exercise for Samsung Electronics, based on 27.0 TWh of electricity use, implies about US $270 million of annual incremental cost per US$10/MWh increase vs a revenue base of US$248bn in 2025. Again, material, but likely manageable in the context of semiconductor gross margins and product pricing power.

Importantly, Taiwan's leading semiconductor fabs are not passive grid loads. TSMC has disclosed that its fabs are equipped with **UPS (Uninterruptible Power Supply)** systems designed to cover essentially all critical loads during short duration outages—similar to protections deployed for seismic events—and with on-site backup generation to mitigate longer disruptions and reduce tool damage or wafer scrap. Fabs are also connected via multiple substations, transformers, and high voltage feeds, providing local redundancy. As seen during the 2021 voltage dip incident, these measures can materially limit operational impact from brief disturbances, even if they do not eliminate risk under prolonged system stress.

UPS (Uninterruptible Power Supply) systems provide instantaneous, battery backed power to maintain stable electricity during voltage dips or short outages, protecting critical semiconductor manufacturing equipment until generators or grid power are restored.

Korea tells the same story. Industrial tariffs have risen materially in recent years, including a 9.7% increase in October 2024 before partial easing in March 2026, yet semiconductor profitability remained strong during the AI upcycle. That suggests power-price inflation is a second-order issue relative to cycle conditions, mix, and pricing power.

The more important risk is availability. Semiconductor fabs are highly sensitive to voltage dips, short outages, and poor power quality. Brief events can interrupt production and create scrap risk or restart costs. So while price can be absorbed, reliability cannot be arbitraged away. That is why we think the right framing is not "electricity is cheap so the sector is safe," but rather "electricity cost is manageable while electricity continuity is critical".

Over the past decade, South Korea's grid has shown superior operational stability, avoiding major nationwide blackouts since 2011. In contrast, Taiwan's 2017 island-wide outage exposed systemic vulnerabilities, though its semiconductor sector remained largely unscathed. Crucially, this resilience stemmed not from active grid prioritization during the crisis, but from pre-engineered infrastructure redundancy: key science parks utilized dual-circuit designs and automatic switching, while manufacturers relied on on-site backup generators. Thus, while Korea benefits from inherent grid reliability, Taiwan's chip supply chain security depends on capital-intensive passive hardening that successfully insulated production during past failures.

Figure 11: Major power outage incidents in Taiwan and Korea (2016-2026)

Date	Region	Event	Trigger	Scale	Semiconductor Impact	Key Companies
2017-08-15	**Taiwan**	**Large-scale blackout**	**Gas supply valve error at CPC affecting Datan plant**	**~6.68m households**	**Semiconductor factories protected by emergency power allocation**	**TSMC**
2021-05-13&17	Taiwan	Rolling outages	Plant fault (Hsinta) + low	Millions affected	No confirmed major fab disruption	TSMC
2022-03-03	**Taiwan**	**Large-scale blackout**	**Grid fault at Xingda power**	**~5.5m households**	**No confirmed major fab disruption**	**TSMC**
2020-01-01	Korea	Fab-level power outage (Hwaseong)	Regional power transmission cable failure	Samsung semiconductor facility	Samsung DRAM and NAND production halted; 2-3 days for full recovery	Samsung Electronics

Source: Company data, KEPCO, Taipower

PEAK-LOAD STRESS TEST: IF LNG IS IMPAIRED, IS THERE ENOUGH CAPACITY?

Taiwan

Taiwan's reserve margin monthly low had been consistently below 10% for most of the months in 2025, while the government benchmark is above 15%. Taipower also cited total installed capacity near 58 GW, but installed capacity is not the right metric for system stress because a significant part of that total is renewable, under maintenance, or otherwise unavailable at the exact hour of peak demand. What matters is dispatchable and flexible capacity at the margin.

That is why LNG matters disproportionately in Taiwan. LNG is not merely a large annual share of generation; it is also a critical flexible source used to balance the system during high-demand periods, especially given falling nuclear baseload and the intermittency of renewables. If LNG availability were materially impaired during summer peak conditions, our directional conclusion is that Taiwan would likely face a real capacity shortfall. Emergency dispatch, demand response, and load prioritisation would become necessary, and rolling outages would become plausible under a sufficiently severe disruption.

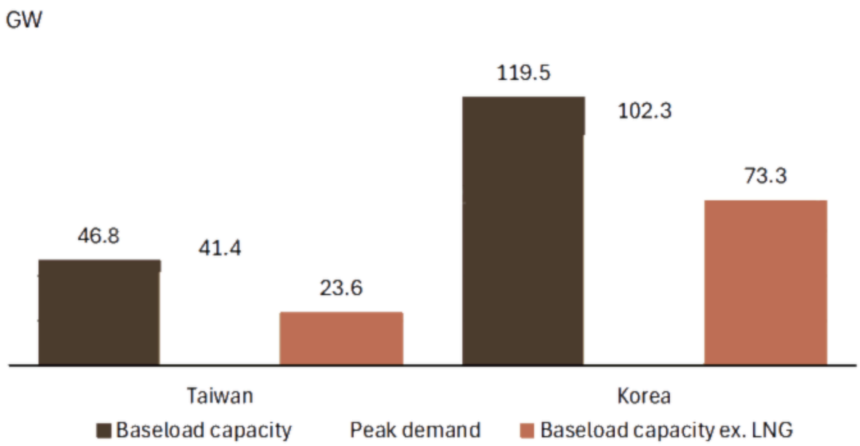
This conclusion is also consistent with Taiwan's operational behavior in recent years. Taipower has leaned on demand-side response and peak-load clipping, and Taiwan has experienced system-wide outage events in 2021 and 2022. That does not reflect chronic inadequacy, but it does seem to indicate the system has limited tolerance for stress and operational error.

Korea

Korea's peak demand hit roughly 102.3 GW in August 2024. The system is better positioned because nuclear already contributes about one-third of generation and reserve planning is more conservative, with the current framework targeting around 20% reserve margin. That provides a stronger starting point than Taiwan.

Even so, an LNG impairment scenario would still matter. Gas remains important for flexibility, even in a system with stronger baseload. Remove LNG entirely and Korea would still see tighter peak-hour operating conditions, greater dependence on coal and nuclear availability, and reduced system flexibility during weather shocks or outages. The difference versus Taiwan appears to be one of degree, not immunity: Korea is more resilient, but it is not structurally insulated from imported-fuel disruption.

Figure 12: Taiwan's power system is more vulnerable as ex.LNG baseload capacity can only support 50% of peak power demand



Source: Taipower, KEPCO; Note: both peak load demand was from summer 2024, baseload capacity refers to thermal (coal,oil,LNG), nuclear, and hydro capacity as of Feb26

Substitution capacity: how much can coal and nuclear realistically offset?

This is where policy matters. In Taiwan, the main medium-term nuclear restart option appears centered on Maanshan and potentially Kuosheng, while Chinshan looks less feasible. Public reporting around the MOEA and Taipower process suggests restart could restore roughly 2–4 GW if approvals and physical work proceed. On coal, there is some upside through higher utilisation or reactivation of under-used capacity, but that is constrained by environmental policy, maintenance, and political considerations. A directional replacement range of roughly 2–4 GW from coal flexibility appears reasonable for scenario framing. Taken together, Taiwan may be able to mobilise roughly 4–8 GW of partial substitution capacity, but that still would not fully replicate LNG's flexible role in peak balancing.

Korea has more room. Nuclear life extensions and new build progression potentially offer a more sizable medium-term uplift—directionally around 3–5 GW—and the country's large coal fleet provides somewhat greater short-term dispatch flexibility, potentially in the 3–6 GW range if utilisation rises or retirements are delayed. So Korea may be able to offset around 6–10 GW in broad scenario terms, but again, that is not the same as replacing LNG's marginal flexibility hour for hour.

As a result, Taiwan appears to face higher-beta risk because LNG is more critical to adequacy today. Korea has lower risk, but LNG still matters at the peak margin.

REGULATION AND PRIORITISATION: WHO GETS POWER IN A SHORTAGE?

Neither Taiwan nor Korea publishes a simple, formal hierarchy saying which industries receive power first in a shortage. There is no transparent, public "priority list" that explicitly names semiconductors as number one. What does exist are policy tools and operational practices that imply how shortages would likely be managed.

In Taiwan, the official toolkit includes demand-response programs, time-of-use tariffs, and use of standby units. These mechanisms imply that large controllable users bear a disproportionate share of peak balancing under stress. At the same time, Taiwan's semiconductor sector is plainly treated as strategic, both politically and economically. So while there is no published guarantee that fabs are formally prioritised, the most defensible inference is that the government would seek to protect systemically important semiconductor loads to the extent possible, with greater curtailment falling on less strategic industrial demand.

Taiwan does, however, operate under a formally codified load shedding framework. The "Power Consumption Restriction Rules during Power Shortage Periods" set out a graduated curtailment sequence that prioritises demand reduction from large industrial users before resorting to rotational outages for smaller users or households, while allowing exemptions for national defense, transportation, and other designated critical users. The framework does not explicitly name semiconductors, but it confirms that curtailment is managed administratively rather than indiscriminately—and that prioritisation can be exercised under stress.

However, our Taiwan tech team noted that in a more critical scenario, the U.S. and other overseas governments could step in to help Taiwan secure LNG supply to ensure fabs remain operational. Given that much of the global AI and high-end semiconductor supply chain depends on Taiwanese output and underpins the market capitalisation of many of the world's largest tech companies, there would be strong strategic incentives for governments to prioritise energy supply to keep these fabs running.

Korea follows a similar pattern, though within a more centralised planning framework. The country has more formal reserve planning and a stronger demand-management structure. Again, there is no explicit public ranking by industry, but the semiconductor sector is clearly treated as strategic in broader industrial policy. The reasonable inference is the same: in a severe stress event, controllable non-critical industrial loads would likely shoulder more of the curtailment burden than semiconductors.

This nuance matters because the real risk is not simply whether semiconductors "get power." They probably would, to the extent the system can manage it. We think the bigger issue is whether the grid can sustain that prioritisation without broader instability. Protecting fabs during a shortage would likely push more stress onto the rest of the system, reducing operating flexibility.

Valuation Method and Risk Statement

The immediate risk in relation to the subject matter covered by UBS's Global Sustainability Team arises from a lack of definition in the field, reflected in the many names and acronyms in use by practitioners: sustainability; responsible investment (RI); socially responsible investment (SRI); ESG (environmental, social and governance) investment; ethical investing, impact investing, etc. The field covers an enormous range of potential issues and, over time, their importance fluctuates. At the time of writing, we believe the issues raised in this research to be relevant to investors, but this may change. Additionally, this research should not be read as a complete or definitive account of all relevant issues for firms. Although we attempt to address all significant or nascent issues, these may not always be apparent, and these may change over time.

TSMC: We base our price target for TSMC on a PE multiple. We think TSMC faces a variety of risks, including rapidly changing technology, intense competition, high capital investment and cyclical demand. TSMC also has a history of paying stock options to its employees, which could dilute earnings.

SK Hynix: Whilst overall cyclical risks have decreased longer term for DRAM (our "Goldilocks scenario"), amidst significant consolidation (3 players, from 15 in 1998) and lower growth, cyclical corrections will still occur as the sector retains commodity-like characteristics. The NAND flash industry structure has not changed as dramatically, but the coming rollout of 3D NAND flash manufacturing is restraining the players' willingness to add large increments of capacity at 2D. That being said, both segments are sensitive in particular to smartphones/ tablets demand, mix within those segments, and to a lesser extent enterprise spend (enterprise solid state drives, servers). The industry also remains capital-intensive, and with contract prices negotiated every 2 weeks to 3 months, cash flows can change quickly – so adequate capitalization is required. Lastly, the industry may have to move to new memory technologies longer term to supplement, if not replace, current silicon-based Flash and RAM memory structures. We value SK Hynix shares using a 12-month forward target P/BV multiple based on long-term average ROE and cost of equity.

Samsung: Some of Samsung's operating profit comes from mobile phones directly (and more indirectly for components) where we see revenue growth for the industry decelerating as the smartphone market starts to mature. The industry is characterized by product cycles, intense competition and requires significant scale and ongoing expenses for marketing/promotional activities. Some of its divisions (Memory and Display Panels) operate in industries which are cyclical and characterized by fluctuations in supply, demand and capital spending. Both industries have commodity-like features – although it is to be noted that the DRAM industry is now operating with significantly fewer players than before. Whilst overall cyclical risks have decreased longer term for DRAM (our "Goldilocks scenario"), cyclical corrections will likely occur. Consumer exposure overall at Samsung is universally high across products, although well balanced in terms of geographies. Strength in the Korean Won vs. major currencies can penalize earnings. Being a large component of the KOSPI, Samsung faces country risks as well indirectly. Corporate governance risks re the Samsung group center around some degree of opacity in decision-making, and limited consideration for shareholder returns (this may change). On the flipside, Samsung Electronics is the "crown jewel" of the group and its interests tend to supersede those of other Samsung companies. We value Samsung Electronics ordinary shares using a target NTM P/BV multiple based on long-term average ROE and cost of equity. Our GDR price target comes from using a conversion ratio of 25 from Samsung ordinary shares (005930.KS) and the latest FX.