

Policy Brief

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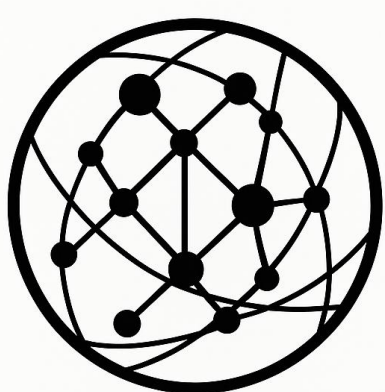
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Energy Endurance Under Systemic Shock:

Divergent Survival Pathways in East Asia During the U.S.–Israel–Iran Conflict

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Key Judgments

- Energy disruption no longer produces immediate collapse, but manifests as sustained cost escalation and systemic friction.
- Japan is converting large reserves into short-term stabilization, reducing long-term endurance capacity.
- South Korea transmits energy pressure directly into industrial output, constraining adjustment flexibility.
- Taiwan's limited LNG buffer (~11 days) creates immediate systemic exposure.
- East Asian energy systems follow three distinct LoCT pathways: slow compression (Japan), accelerated compression (South Korea), and rapid trigger (Taiwan).

Executive Summary

The U.S.–Israel–Iran conflict is transforming energy security from a problem of supply disruption into one of systemic endurance. Energy flows have not collapsed; instead, rising costs, buffer depletion, and structural dependency are progressively compressing resilience across import-dependent economies.

This brief introduces an Energy Endurance & Survival Index (EESI) and situates it within a broader framework linking High-Pressure Systemic Equilibrium (HPSE) and the Loss-of-Control Threshold (LoCT). Together, these concepts explain how systems persist, degrade, and ultimately lose stability under sustained stress.

Although Japan, South Korea, and Taiwan all exhibit high levels of import dependence, their endurance trajectories diverge sharply.

Energy vulnerability is not determined by dependence alone, but by how dependence interacts with buffering capacity and system rigidity.

These interactions generate distinct pathways toward systemic instability.

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Why This Matters

Traditional energy security metrics, such as supply availability or import dependence, fail to capture the dynamics of modern conflict environments. Under sustained geopolitical pressure, systems continue to operate, but resilience erodes and decision space narrows.

Energy security must therefore be redefined as the capacity of systems to sustain function under prolonged stress.

1. From Disruption to High-Pressure Equilibrium (HPSE)

Energy flows in the current conflict exhibit persistence under sustained pressure. Maritime routes remain open but increasingly constrained, while LNG and oil prices remain elevated and financial and insurance costs continue to rise.

These conditions are consistent with a state of HPSE, in which systems remain operational under sustained stress but experience gradual efficiency loss and rising fragility.

Systems do not fail at the onset of disruption, but when prolonged operation under high-pressure conditions exhausts their buffering capacity.

2. Analytical Framework: Energy Endurance & Survival Index (EESI)

The **Energy Endurance & Survival Index (EESI)** conceptualizes resilience as the capacity of an energy system to sustain operations under prolonged stress. It links structural exposure, buffering capacity, and system rigidity into a single operational metric:

$$EESI = \frac{Storage \times Accessibility \times (1 - Dependency)}{Consumption \times Rigidity \times (1 + Cost Pressure)} \tag{1}$$

Variable Definitions

- **Storage:** physical reserves, including strategic and commercial inventories;
- **Accessibility:** the extent to which reserves are preserved or actively deployed;
- **Dependency:** reliance on external energy supply;
- **Consumption:** scale of energy demand;
- **Rigidity:** ability to reduce or shift demand under stress;
- **Cost Pressure:** price volatility and associated financial burden.

Table 1. EESI Scale Interpretation

EESI Score	Interpretation	System Condition
≥ 3.0	High endurance	Strong buffering capacity; pressure absorbed over longer duration
2.0–2.9	Moderate endurance	Increasingly compressed under sustained stress
1.0–1.9	Low endurance	Limited buffering capacity; rapid pressure transmission
< 1.0	Critical exposure	Minimal absorptive capacity; approaching LoCT

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Core Contribution:

The framework captures two dynamics central to system behavior under HPSE:

- **Buffer depletion**, as reserves are converted into short-term stabilization capacity;
- **Demand rigidity**, which governs how efficiently systems absorb or transmit pressure.

EESI operationalizes this shift by translating structural exposure and buffering dynamics into a measurable endurance framework.

3. Structural Exposure

As shown in **Table 2** and **Figure 1**, all three economies exhibit structurally high external dependence, with limited domestic energy production and sustained reliance on imported oil and LNG.

However, dependency alone does not determine vulnerability; it becomes consequential only through its interaction with buffering capacity and system structure.

Japan’s dependence is mitigated by large reserves, South Korea’s shaped by industrial rigidity, and Taiwan’s amplified by limited LNG buffering capacity. As a result, similar exposure levels translate into divergent resilience outcomes under sustained pressure.

Table 2. Baseline Energy Dependency

Economy	LNG Import Dependence	Oil Import Dependence	Structural Character
Japan	~95%	~72%	Fully externalized system
South Korea	~98%	~108%	Industrial import-dependent system
Taiwan	~98%	~84%	High dependence with weak buffer

Note: LNG and oil import dependence are approximations based on publicly available data.

Source: Worldometer; Analysis: Global AI Governance and Policy Research Center, EPINOVA LLC.

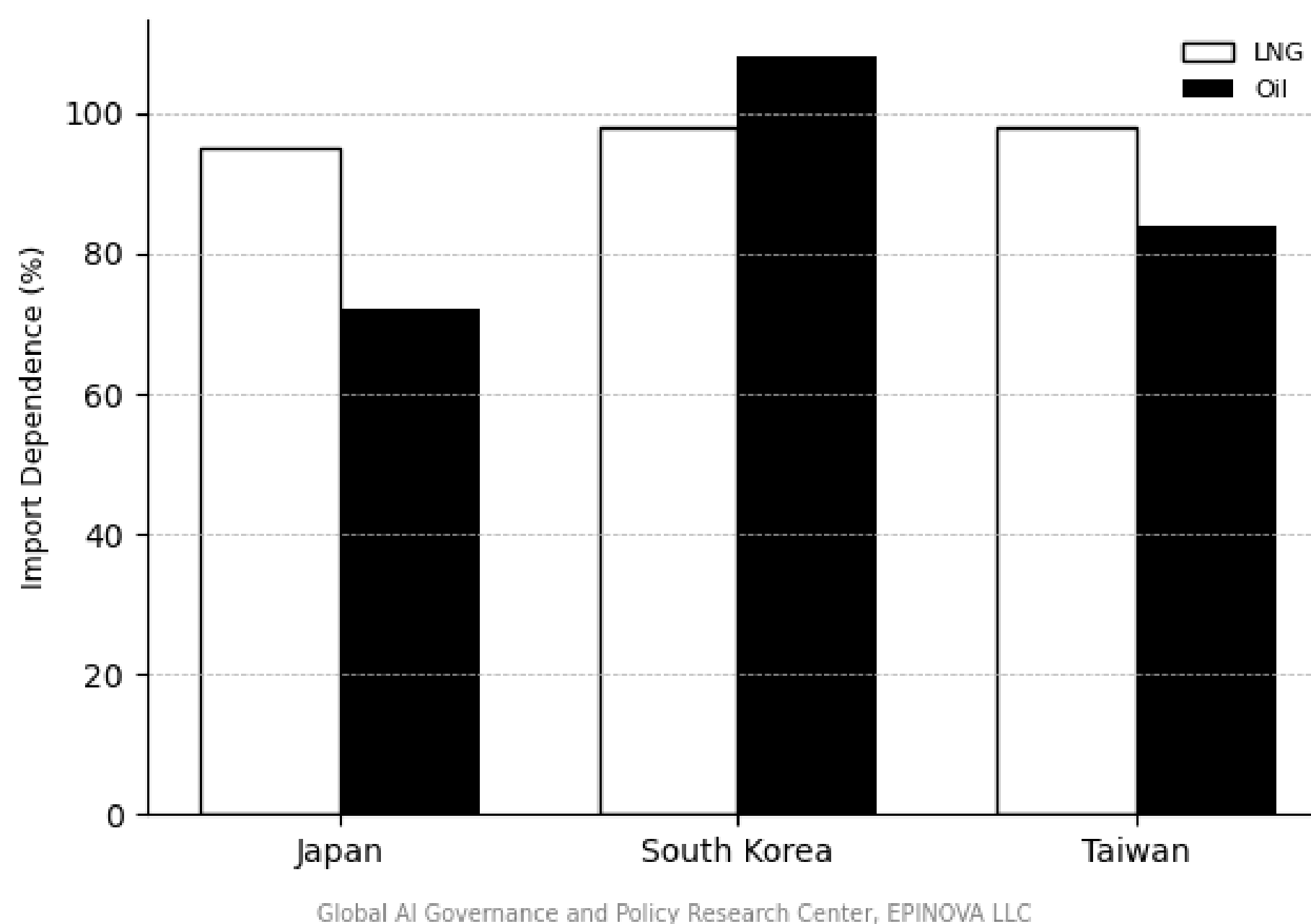


Figure 1. Energy Import Dependency Structure in East Asia

Caption: All three economies exhibit high import dependence, yet structural differences translate similar exposure into divergent resilience under sustained pressure.

Source: Worldometer; Analysis: Global AI Governance and Policy Research Center, EPINOVA LLC

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4. Endurance Capacity

As shown in **Table 3** and **Figure 2**, endurance capacity, rather than dependence alone, determines how systems absorb sustained pressure.

Japan maintains the largest buffer but is actively converting reserves into short-term stabilization, eroding long-term endurance. South Korea combines substantial oil reserves with a more constrained LNG margin, resulting in partial but uneven resilience. Taiwan, by contrast, faces structurally limited LNG buffering capacity, creating immediate exposure to supply-side stress.

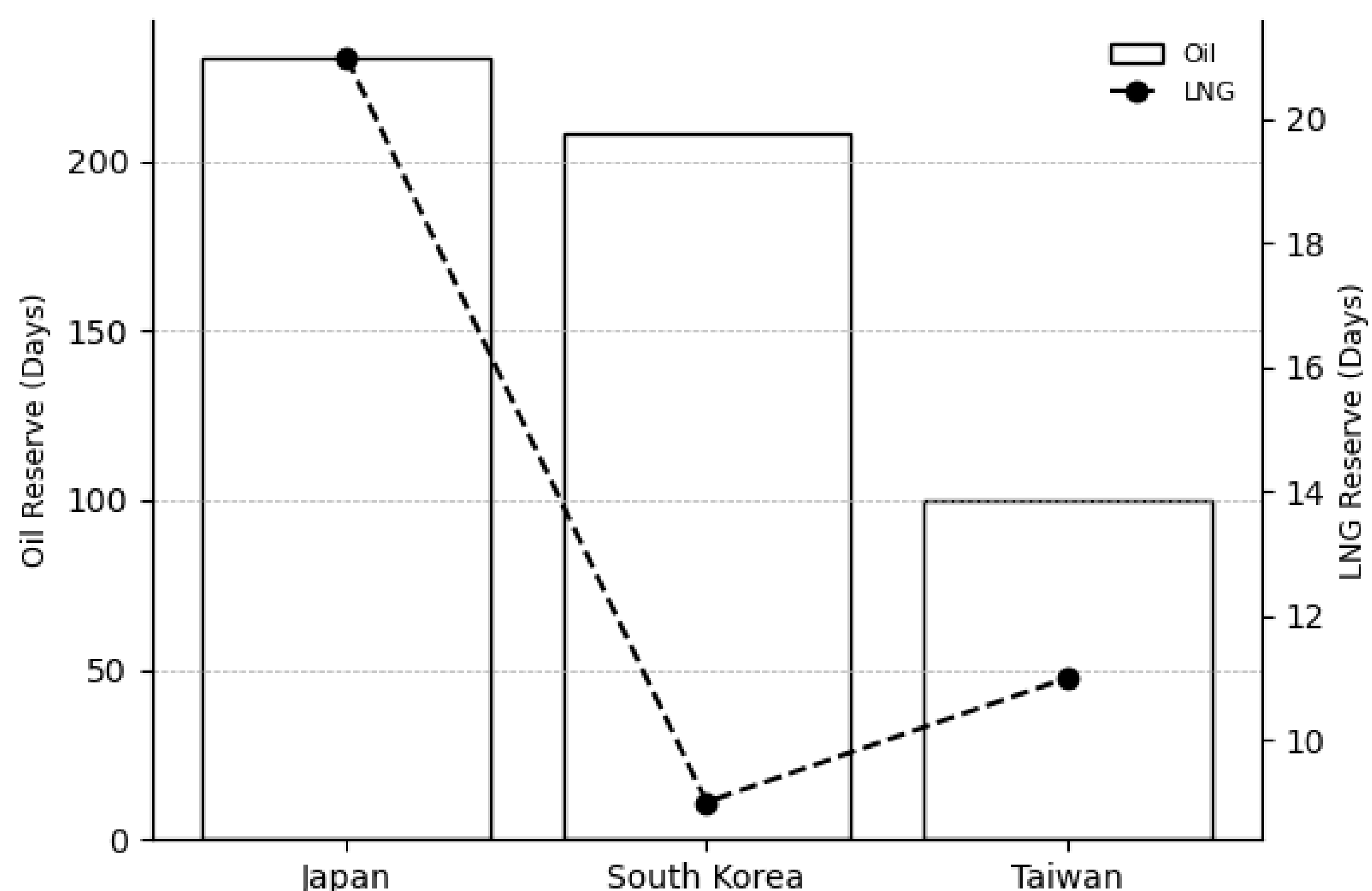
Endurance is defined not only by the size of available buffers, but by how they are deployed and sustained under continuous pressure.

Table 3. Buffer Capacity and Policy Response

Economy	Oil Reserve	LNG Reserve	2026 Policy Action	System Effect
Japan	~214–254 days	~2–4 weeks	Repeated reserve releases	Buffer erosion
South Korea	~208 days	9–52 days	Release + nuclear ramp-up	Partial stabilization
Taiwan	100+ days	~11 days	LNG expansion plans	Limited mitigation

Note: Values are approximate and reflect structural buffering capacity rather than real-time inventories.

Source: National energy data; Analysis: Global AI Governance and Policy Research Center, EPINOVA LLC



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Figure 2. Oil and LNG Reserve Coverage (Days of Supply)

Caption: Oil provides long-duration buffering, while LNG storage remains significantly constrained, especially in Taiwan, defining short-term system vulnerability.

Source: National energy data; Analysis: Global AI Governance and Policy Research Center, EPINOVA LLC

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5. System Failure Mechanisms

As shown in **Table 4** and **Figure 3**, energy systems do not fail uniformly; they degrade according to their internal structure and constraint profile.

Japan’s system absorbs pressure through gradual buffer depletion, producing a slow compression of stability. South Korea transmits pressure through industrial demand rigidity, accelerating the conversion of energy shocks into economic stress. Taiwan, by contrast, operates with limited LNG buffering capacity, resulting in immediate exposure and rapid threshold proximity.

System failure is not defined by the depletion of resources, but by the loss of control over how pressure is absorbed and transmitted.

Consistent with the EESI framework, these structural differences translate similar exposure levels into divergent pathways toward the Loss-of-Control Threshold.

Table 4. System Typology and LoCT Pathways

Economy	System Type	Core Constraint	Failure Mechanism	LoCT Path
Japan	Buffer-depletion system	External dependence	Reserve exhaustion	Slow compression
South Korea	Industrial rigidity system	Demand inflexibility	Cost transmission	Accelerated compression
Taiwan	Immediate exposure system	LNG shortage	No buffer	Rapid trigger

Note: Typologies reflect dominant system characteristics under sustained stress conditions.

Source: Worldometer; national data; Analysis: Global AI Governance and Policy Research Center, EPINOVA LLC

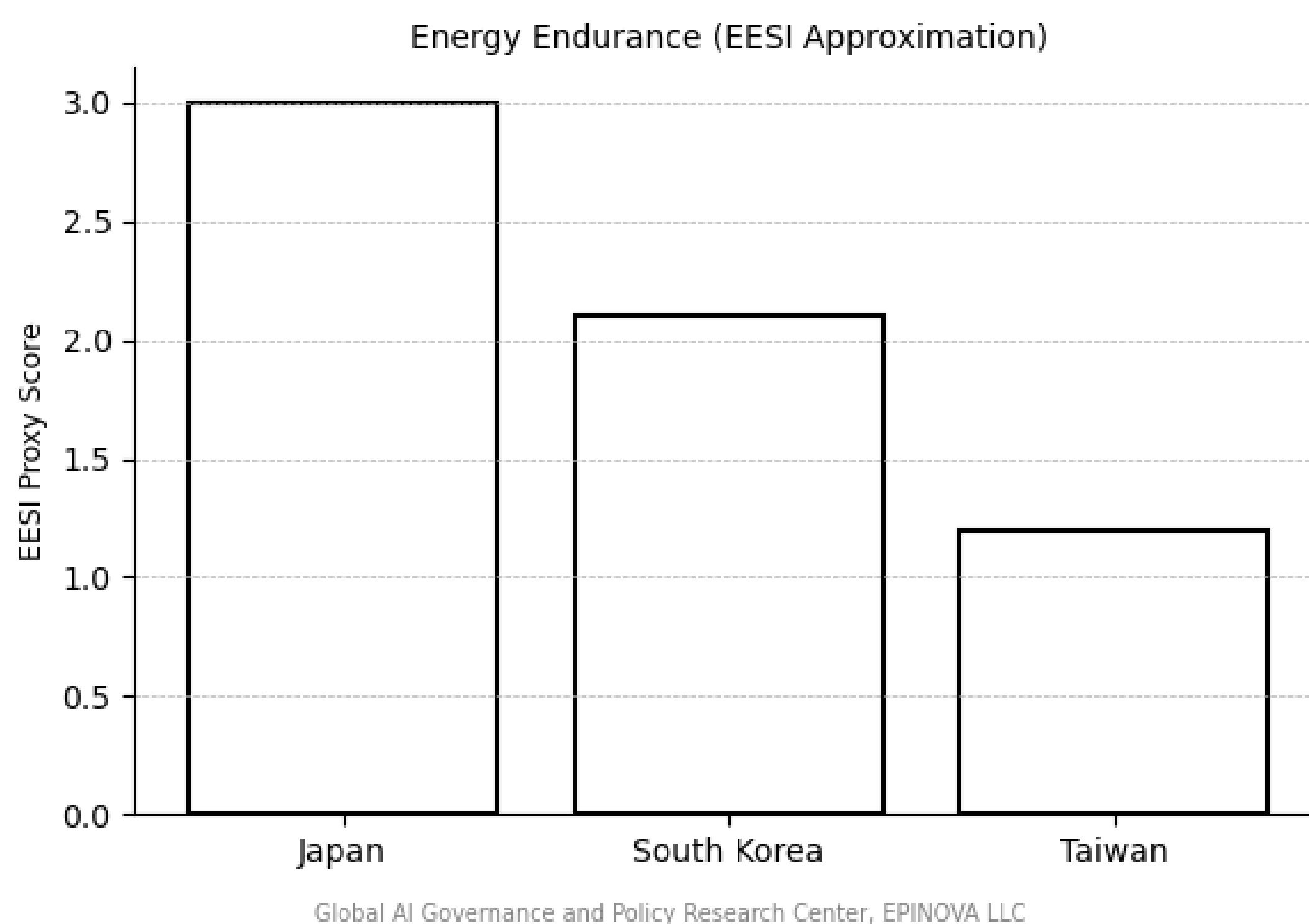


Figure 3. Divergent Pathways Toward the Loss-of-Control Threshold (LoCT)

Caption: EESI-based comparison shows Japan in a high-endurance range, South Korea in a compressed moderate range, and Taiwan in a low-endurance range approaching LoCT, reflecting distinct system-level pathways under sustained pressure.

Source: Worldometer; national data; Analysis: Global AI Governance and Policy Research Center, EPINOVA LLC

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6. Cross-System Dynamics

Under sustained stress, energy shocks propagate across interconnected domains, cascading from supply constraints to cost, finance, and ultimately system stability.

This cross-domain transmission produces a progressive compression of system stability, as pressure accumulates faster than systems can adapt or reconfigure.

System instability emerges not from a single point of failure, but from the cumulative transmission of pressure across interconnected domains.

As illustrated in **Figure 4**, these dynamics link system persistence (HPSE), endurance capacity (EESI), and threshold failure (LoCT) into a continuous process.

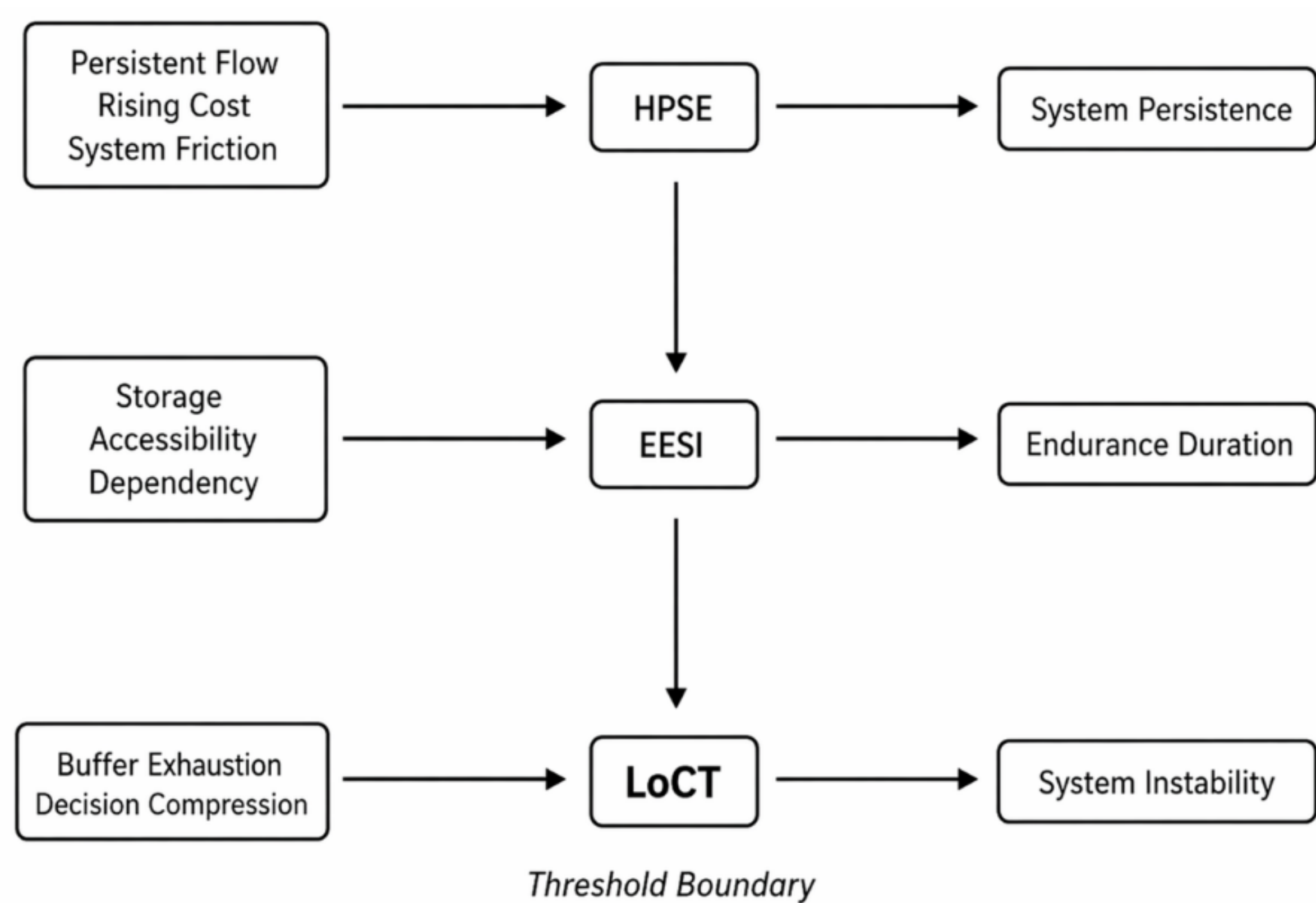


Figure 4. Integrated Framework of HPSE, EESI, and LoCT

Caption: HPSE explains system persistence under sustained stress, EESI measures endurance capacity, and LoCT defines threshold failure. Together, they form a continuous model linking system persistence, degradation, and eventual loss of control.

Source: Analysis: Global AI Governance and Policy Research Center, EPINOVA LLC

7. Policy Implications

Policy responses must be aligned with how each system absorbs and transmits pressure under sustained stress.

Japan’s short-term stabilization through reserve releases must be balanced against long-term endurance, as continued drawdowns convert strategic buffers into finite delay capacity.

South Korea’s resilience depends on reducing industrial rigidity, given the direct transmission of energy shocks into production and economic performance.

Taiwan faces the most immediate constraint, making the expansion of LNG storage and supply diversification an urgent priority.

More broadly, energy security must be reframed not as supply assurance, but as the capacity of systems to endure, absorb, and adapt under sustained pressure.

Policy Brief**8. Limitations**

This analysis relies on publicly available data and simplified proxies. The EESI should therefore be interpreted as a comparative indicator of system endurance, not a precise predictive measure.

The framework captures structural exposure and buffering capacity, but it does not fully model real-time inventory changes, nonlinear feedbacks, cross-system interactions, or policy adjustments. Its findings are contingent on a continued high-pressure, non-collapse environment and may shift under major escalation, rapid de-escalation, or a direct disruption of energy flows.

Conclusion

The U.S.–Israel–Iran Conflict reveals a structural shift in energy risk: supply persists, but pressure accumulates. East Asian economies remain operational, yet their resilience diverges as exposure interacts with buffering capacity and system structure.

Japan converts reserves into time, South Korea transmits pressure through rigid demand, and Taiwan faces immediate exposure, together defining distinct pathways toward the Loss-of-Control Threshold.

The central challenge is no longer preventing disruption, but managing how systems absorb, transmit, and ultimately succumb to cumulative pressure.