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# STRATEGIC OPTIMIZATION OF NATIONAL AI INFRASTRUCTURE: A GAME-THEORETIC AND COMPARATIVE ANALYSIS OF ARMENIA'S EMERGING AI DATA CENTER ECOSYSTEM

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## ABSTRACT

Armenia's decision to host one of the world's largest AI GPU clusters — a \$500 million Phase 1 scaled to a \$4 billion, 50,000-GPU megaproject in partnership with Firebird AI, NVIDIA, and the United States Government — constitutes the most consequential economic policy gamble in the country's post-independence history. This paper conducts a comprehensive, multi-disciplinary analysis of that gamble across seven dimensions: macroeconomic and technological impact, formal game-theoretic modelling, national strategy optimization, risk and constraint analysis, comparative benchmarking, scenario forecasting, and synthesis into a dominant national strategy. Using a Stackelberg-signalling framework nested within a repeated cooperation game, we identify four strategic equilibria governing Armenia's position. Drawing on data from Armenpress, EVN Report, PR Newswire, Bloomberg, and peer-reviewed literature on small-state technology strategy, we model transmission channels from the \$4 billion capital injection to Armenia's \$25.79 billion economy and find a potential 1.5–2.5 percentage point growth contribution during construction, declining to a 0.4–0.6 point permanent productivity uplift contingent on domestic absorptive capacity. Comparative analysis of the UAE, Singapore, Ireland, and Estonia yields an integrated policy scorecard. Three probability-weighted scenarios are developed. We conclude that Armenia's dominant strategy is conditional deep integration — locking in US alignment as a costly separating signal while building an Estonia-style digital governance layer, implementing Singapore-style selective data centre licensing, and compounding geopolitical hedges through India, France, and EU accession. The 24–36 month execution window for this strategy is narrow and closing.

**Keywords:** AI data center, Armenia, game theory, Nash equilibrium, NVIDIA Blackwell, export controls, small state strategy, digital economy, comparative analysis, energy sovereignty

**JEL codes:** O33, F52, L86, H54, Q43, O11

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## 1. INTRODUCTION

In June 2025, the Armenian government and Firebird AI collaborated to announce a \$500 million joint venture between themselves and NVIDIA, for building a 100 MW AI data center in Hrazdan – the first sovereign AI compute center in the South Caucasus region. In February 2026, when the US Vice President JD Vance paid his visit to Yerevan, the project reached Phase 2, upgrading the investment to \$4 billion and aiming to install 50,000 advanced NVIDIA Blackwell GPUs, with Firebird co-founder Alexander Yesayan announcing the installation of 110,000 GPUs by mid-2026

(Armenpress, 2026; PR Newswire, 2026). As a result, Armenia would be among the top five countries in the world by their number of national AI GPU clusters – along with the United States, China, Saudi Arabia, and the UAE – despite the fact that the nominal GDP of Armenia is about \$25.79 billion, while its electricity grid demand is estimated to be 1 GW (Trading Economics, 2025; EVN Report, 2025).

The project's significance extends far beyond infrastructure. It represents the material expression of Armenia's forced strategic realignment following Russia's passivity during Azerbaijan's 2023 seizure of Nagorno-Karabakh. That event triggered Armenia's suspension of CSTO membership, ratification of the ICC Rome Statute (creating a Putin arrest warrant on Armenian soil), parliamentary progress toward EU accession (March 2025), and the Trump-brokered TRIPP peace framework (August 2025). The Firebird-NVIDIA collaboration, backed by US Bureau of Industry and Security (BIS) export licenses issued in November 2025, is both an economic development programme and a geopolitical commitment device (Bloomberg, 2025; Caspian Policy Center, 2025).

Despite extensive media coverage, no peer-reviewed study has yet applied formal game-theoretic modelling to Armenia's AI infrastructure strategy, conducted a rigorous comparative benchmarking, or produced a scenario-weighted policy synthesis. This paper fills that gap. Section 2 analyses macroeconomic and technological impacts. Section 3 models the strategic situation using four nested game-theoretic frameworks. Section 4 proposes a national strategy optimization. Section 5 identifies and mitigates key risks. Section 6 benchmarks Armenia against four comparator states. Section 7 develops three probability-weighted scenarios. Section 8 synthesises findings into a dominant strategy and policy recommendations.

## 2. MACROECONOMIC AND TECHNOLOGICAL IMPACT ANALYSIS

### 2.1 Baseline Economic Context

Armenia's 2024 nominal GDP reached \$25.79 billion, with overall growth moderating from 12.6% in 2022 to approximately 5.9% in 2024 (Trading Economics, 2025; EVN Report, 2024). The high-technology sector is the fastest-growing component: IT and high-tech sector turnover reached 942 billion AMD in 2024, rising to an estimated 1.207 trillion AMD in 2025, as the number of active high-tech companies grew from 8,072 to 10,778 over the same period (Armenpress, 2025; Intech, 2025). Technology now contributes over 7% of GDP, and IT sector employment stands at approximately 34,800–45,600 specialists across some 50,000 engineers by government accounting (LA Times, 2026; JAMnews, 2025). Against this baseline, the \$4 billion Firebird investment represents approximately 15.5% of current nominal GDP — the largest single foreign direct investment commitment in Armenian post-independence history.

### 2.2 Transmission Channels and GDP Impact Model

The macroeconomic impact of large-scale AI infrastructure can be modelled through four transmission channels. The quantitative relationship, synthesising Romer (1990) endogenous growth theory with AI-specific cloud adoption research (ADB, 2022; Amazon AWS, 2023), can be expressed as:

$$\Delta\text{GDP} = \beta_1(\Delta\text{Compute}) + \beta_2(\Delta\text{Talent}) - \gamma(\text{Geopolitical\_Risk})$$

where  $\beta_1$  represents the domestic productivity multiplier of compute infrastructure,  $\beta_2$  represents network effects from high-tech clustering and talent concentration, and  $\gamma$  is a geopolitical risk discount factor. Research indicates that for every 10% increase in high-speed internet connectivity, GDP rises approximately 1.38%, while cloud-enabled AI adoption can generate an additional 0.5–0.7% in annual growth for countries with supportive policy frameworks (ADB, 2022).

Applying this framework to Armenia, the four transmission channels yield the following estimates. First, direct capital expenditure inflows of \$1–2 billion per year during the 2026–2028 construction phase

contribute approximately 1.5–2.5 percentage points to annual GDP growth; however, net domestic impact is partially offset by the fact that 60–70% of capital equipment — GPUs, servers, power infrastructure — is imported, constituting significant leakage. Second, fiscal effects are modest: Armenia's high-tech turnover tax of 1% for qualifying entities means the government's primary take comes from payroll taxes on operational staff rather than corporate receipts. Third, labour market effects are concentrated; the 300–500 high-skill direct operational positions drive wage premium effects throughout the tech labour market, where software developer salaries already average \$3,000 per month — three to four times the national average (Armenian Lawyer, 2026). Fourth, and most important, innovation ecosystem spillovers depend entirely on whether the 10–20% domestic compute allocation (reported in Phase 1 documentation) materialises as working R&D capacity.

**Table 1. Projected Economic Impact Indicators — Armenia AI Infrastructure (2024–2030)**

Indicator	2024 Baseline	2026 Projection	2028–2030 Scenario (Base)
High-Tech GDP Contribution	>7%	9–10%	10–12%
Sector Turnover (AMD trillion)	0.942	1.5–1.8	2.2–2.8
Active High-Tech Firms	10,778	13,000+	16,000+
Tech Workforce	~45,600	55,000+	70,000–80,000
Annual Energy Demand (AI DCs)	—	876 GWh (Ph.1)	2,000+ GWh (Ph.2)
GDP Growth Contribution (AI)	—	+1.5–2.5pp (capex)	+0.4–0.6pp (permanent)

### 2.3 Sectoral Catalysation: Startups, Research, and Cloud Exports

By allocating a share of total compute capacity to domestic companies and researchers, the data centre creates the foundation for a 'sovereign AI' ecosystem. Armenia's existing deep-tech base — including Krisp (AI noise cancellation), CognaiZe, SuperAnnotate, and Denovo Science (computational drug discovery) — provides a template for the type of scaling the infrastructure enables. In 2025, Armenian startup Synthflow AI raised a \$20 million Series A, signalling an increasingly mature venture capital environment (Intech, 2025). The Virtual Institute of AI, launched in July 2025 with AWS and Mistral as partners, and the TUMO–Firebird collaboration provide institutional linkages between the data centre and domestic talent pipelines (Armenpress, 2025). The remaining 80% of Phase 2 capacity is earmarked for international markets — primarily US-based firms — positioning Armenia as a global node for AI inference and establishing a stable source of foreign currency inflows analogous to Ireland's cloud export model, though with considerably different regulatory and energy dynamics.

## 3. GAME-THEORETIC FRAMEWORK

### 3.1 Overview: Four Nested Strategic Games

Armenia's strategic situation cannot be adequately modelled as a single bilateral game. It is the simultaneous solution to four overlapping games whose equilibria interact and constrain each other. The integrated analytical framework draws on Stackelberg (1934) leader-follower theory, Cho and Kreps' (1987) Intuitive Criterion for signalling games, Axelrod's (1984) iterated cooperation, and Schelling's (1960) focal-point coordination theory. The players across all four games are: Armenia, the United States, the European Union, Russia, and regional competitors (Azerbaijan, Georgia, Turkey, Iran).

### 3.2 Game 1: Stackelberg–Signalling Game with the United States

The foundational game casts the United States as a Stackelberg leader setting the export-control technology menu, and Armenia as a follower selecting alignment and investment actions. Under incomplete information

about Armenia's 'type' — committed Westerniser, opportunistic hedger, or potential realigner — the US grants chip access only if Armenia produces costly separating signals satisfying the Cho-Kreps Intuitive Criterion. A separating Perfect Bayesian Equilibrium (PBE) requires that costly signals be observable, non-mimicable by adverse types, and irreversible.

Armenia has delivered an exceptional sequence of such signals: CSTO suspension (February 2024), ICC Rome Statute ratification creating a Putin arrest warrant on Armenian territory (October 2023), parliamentary EU accession legislation (March 2025), the TRIPP framework (August 2025), and co-investment of diaspora capital through the Afeyan Foundation and Armenian-American venture networks. These signals are costly precisely because they antagonise Russia, invite retaliatory pressure, and are domestically contestable — making them impossible for an opportunistic government to credibly mimic. The BIS export license issued in November 2025 is the equilibrium response confirming US belief-update to the 'committed Westerniser' type.

The equilibrium is sustained by an important structural feature: the reported 80% allocation of Phase 1 capacity to US companies (Bloomberg, 2025) and the CLOUD Act applicability on Dell server infrastructure constitute 'hostage commitments' (Williamson, 1983) — US capital at risk in Armenia that creates interests on both sides of the alignment game.

### **3.3 Game 2: Repeated Game of Chip Access and Compliance**

Export licenses are not a one-shot transaction but an indefinitely repeated game where Armenia's continued access depends on demonstrated compliance with BIS end-use verification requirements. This game has a known adverse-history problem: Armenian chip imports from the United States rose by approximately 515% in 2022 versus 2021, with roughly 97% re-exported to Russia, making Armenia Russia's fourth-largest semiconductor supplier following the invasion of Ukraine (NE Global Media, 2023; Euromaidanpress, 2023). Armenia's Decree 808-N (May 2023) listing 38 sanctioned dual-use goods was a credible grim-trigger acknowledgement of the prior defection.

Under Axelrod's tit-for-tat logic, sustained cooperation requires a discount factor  $\delta$  on future access that is sufficiently high. Because Armenia's development pathway is now structurally dependent on continued GPU access — the data centre represents irreversible sunk costs of \$4 billion —  $\delta$  is very high, making defection irrational. The equilibrium prediction is sustained cooperation with verification, robust to moderate political shocks but vulnerable to a government-type reversal that changes Armenia's discount factor, or to a US administration policy discontinuity that exogenously alters the game's payoff structure.

### **3.4 Game 3: Coordination Game of Hub Formation**

AI compute exhibits classic Katz-Shapiro (1985) network externalities: once a location achieves critical mass, talent, supply chain, and user-base co-locate in a self-reinforcing agglomeration. Armenia faces two path-dependent Nash equilibria in this coordination game — the 'successful regional hub' and the 'stranded asset'. The payoff matrix has the structure of a stag hunt: if enough potential ecosystem participants (European firms seeking non-US/non-China hosting under the EU AI Act, Middle Eastern AI labs, Indian IT majors leveraging the India-Armenia corridor) coordinate on Armenia, the equilibrium value is high; if they coordinate on competitor sites (UAE Stargate, Saudi Humain, Greek or Polish EU-jurisdiction facilities), Armenia's equilibrium payoff is substantially negative given sunk costs.

Firebird's aggressive scaling commitment to 110,000 GPUs is a Dixit-Pindyck (1994) entry deterrence investment — a credible commitment that raises the cost of profitable entry by competitors and shifts the coordination focal point toward Armenia. The critical uncertainty is demand-side: while supply-side commitment is resolved, attracting anchor tenants beyond the pledged US firms requires a Schelling-focal status that has not yet been established.

### **3.5 Game 4: Bargaining Game Over Surplus Division**

Applying the generalised Nash Bargaining Solution, Armenia's disagreement point is structurally weak. No credible alternative frontier-compute supply chain exists: Chinese chips are blocked by export controls, Russian alternatives are technologically obsolete, and European alternatives do not yet exist at scale. This low disagreement point ( $d_A \approx 0$ ) predicts that Armenia captures primarily agglomeration rents from collocation — training, spillover, and secondary-firm ecosystem effects — rather than scarcity rents on compute itself, which accrue to NVIDIA and Firebird. The reported shift from a 20% domestic allocation in Phase 1 to 10% in Phase 2 is consistent with this bargaining dynamic: as the US commits more capital, Armenia's bargaining weight weakens.

The policy implication is clear: Armenia must invest in creating domestic absorptive capacity — language models, biotech AI, robotics — that increases its bargaining weight by making Armenia a complementary asset rather than merely a hosting jurisdiction.

**Table 2. Integrated Game-Theoretic Summary**

Game Type	Players	Current Equilibrium	Key Risk	Armenia's Strategy
Stackelberg–Signalling	Armenia, USA	Separating PBE: chip access for costly alignment signals	Type reversal (pro-Russia shift)	Institutionalise signals in treaty
Repeated Cooperation	Armenia, USA, NVIDIA	Tit-for-tat with verification; cooperation sustained	Admin. policy discontinuity	Raise $\delta$ via sunk-cost commitment
Hub Coordination	Armenia, UAE, Saudi Arabia, EU competitors	Unstable; tipping toward Armenia if critical mass achieved	Demand-side non-coordination	Anchor tenants + EU-compliant hosting
Bargaining	Armenia, Firebird, NVIDIA	Armenia captures agglomeration rents; suppliers capture scarcity rents	Declining domestic compute share	Build complementary AI assets

## 4. NATIONAL STRATEGY OPTIMIZATION

### 4.1 Talent Development: The Human Capital Grid

Armenia's domestic talent base is simultaneously its greatest asset and its most acute bottleneck. The high-tech workforce of 34,800–45,600 already absorbs 15–20% of STEM graduates, producing wage pressures that inflate development costs and risk exporting talent through arbitrage. The Human Flight and Brain Drain Index for Armenia registers 6.9/10 in 2024, down from 7.2 in 2021, suggesting marginal improvement but persistent structural vulnerability (TheGlobalEconomy.com, 2025). R&D spending remains at 0.18% of GDP versus a world average of 1.36% — a critical gap if the data centre is to catalyse domestic innovation rather than serve as a foreign compute enclave (TheGlobalEconomy.com, 2025).

A comprehensive talent strategy requires five concurrent policy tracks. The Generation AI programme, developed by FAST for 41 high schools by 2026, and TUMO's AI curriculum expansion provide a long-term domestic pipeline. Accelerated university-industry partnership through the Virtual Institute of AI — modelling Estonia's co-investment approach — builds mid-tier capability. A diaspora engagement programme targeting the 5–10 million strong Armenian diaspora, including the 60% payroll tax rebate for migrant workers in high-tech roles, should be formalized as a multi-year commitment. An AI e-Residency programme, inspired by Estonia's model (117,000 residents generating €125 million in direct state revenue in 2025), would leverage the diaspora for governance innovation. Finally, R&D expenditure must be raised to a target of 0.8% of GDP by 2028 and 1.5% by 2032 — consistent with the Gituzh technology funding campaign trajectory.

## 4.2 Energy Optimization: The 100 MW Challenge

Phase 1 alone will consume approximately 876 GWh annually — equivalent to 12–13% of Armenia's total electricity generation of 9.2 TWh in 2024 (Epress, 2025). Cooling requirements are estimated at 1.89 million litres per day, stressing a country facing periodic drought and climate vulnerability (Eurasianet, 2025). The Irish precedent — where data centres grew from 5% to 21% of national electricity consumption between 2015 and 2023, triggering a moratorium on Dublin grid connections — is the single most instructive cautionary case for Armenia's planners (Data Center Dynamics, 2025).

Armenia's energy landscape offers both constraints and opportunities. The Metsamor Nuclear Power Plant, which produces 30–40% of the country's electricity production, is slated to be shut down for five months starting from April 2026, leading to a conflict between supply and demand in tandem with Phase 1 construction (World Nuclear Association, 2025). On the upside, Armenia achieved its 1 GW solar capacity goal four years early in October 2025, proving that the country is making great strides in renewable energy installations (PV Magazine, 2025). The nuclear energy partnership deal between the US and Armenia signed in 2025 allows for the possibility of utilizing SMRs, which will exclusively power the data center complex without competing with domestic consumption (World Nuclear News, 2025).

It is crucial to note that there have been no EIA declarations made for the Hrazdan plant by the end of 2025 due to the lack of clear provisions concerning AI data centers within the 2014 EIA legislation. It is imperative to address this issue as soon as possible by implementing retroactive EIA mandates, renewable Power Purchase Agreements, and mandatory reports on water usage and PUE levels. The successful attainment of industry standard PUE of 1.3 or lower in Singapore serves as an excellent reference point.

## 4.3 Regulatory Positioning: Cloud Provider, Research Hub, and Regulatory Sandbox

Armenia's optimal regulatory strategy combines three complementary roles. As an AI cloud provider, it should offer the combination of US-grade data security, EU-compliant privacy standards, non-sanction-list jurisdiction status, and competitive pricing that no EU country can match for non-EU clients and no US data centre can match for clients requiring non-US sovereignty. As a research hub, the co-location of Armenian universities, international R&D programmes, and the AI Virtual Institute within or adjacent to the Hrazdan campus creates knowledge spillovers. By acting as a sandbox state, Armenia could use its territory to test new AI governance models based on the Smart Nation initiative used by Singapore, thus obtaining an advantage due to the need for regulatory arbitrage in relation to the EU AI Act.

Fiscal policy already presents a competitive landscape, including 1% turnover taxation for high-tech registry companies, 200% R&D salaries deductible, and 60% payrolls refunds on hiring employees (Armenian Lawyer, 2026; PwC Tax Summaries, 2025). The issue is to make sure that such financial incentives serve as a catalyst for homegrown ecosystem growth and not just as subsidies for external entities.

# 5. RISKS, CONSTRAINTS, AND MITIGATION

## 5.1 Technological Dependence on US Export Controls

The Firebird stack is end-to-end US-controlled: NVIDIA Blackwell GPUs under BIS licensing, Dell PowerEdge servers under CLOUD Act jurisdiction, and Firebird as a US-incorporated entity. There is no viable alternative supply chain: Chinese Huawei Ascend chips are export-controlled for Armenia under US secondary sanctions pressure, Russian chips are technologically obsolete, and European alternatives do not yet exist at frontier scale. Any future US administration prioritising China-containment above Armenia's strategic value could restrict or condition GPU exports, leaving billions in stranded assets. The mitigation is not hardware diversification — which is not achievable within the relevant time horizon — but rather layer-sovereignty: Armenia cannot control chips but can control the model layer, training data, and application deployment. Mandatory domestic training on the reserved 10–20% compute allocation, an

Armenia-language LLM initiative, and contractual audit rights over infrastructure hosting critical government workloads represent realistic sovereignty measures. Formalising the August 2025 AI and Semiconductors MOU into a Senate-ratified bilateral framework analogous to the UAE's Intergovernmental Assurance Agreement — which survived a US administration change — would provide the strongest available commitment device.

### 5.2 Energy and Environmental Constraints

As detailed in Section 4.2, Armenia's most immediate binding constraint is energy and environmental capacity. The mitigation strategy combines three mutually reinforcing actions: (1) retroactive EIA legislation with binding renewable PPA requirements for all data centre facilities above 10 MW; (2) acceleration of Metsamor lifetime extension and SMR deployment decision by Q3 2027, with a Western technology partner rather than Rosatom to avoid reproducing Russian energy dependency; and (3) mandatory water recycling and closed-loop cooling systems at the Hrazdan campus. The Irish analogy is instructive: Ireland failed to plan for grid capacity before committing to hyperscaler FDI, resulting in a moratorium that damaged its investment reputation. Armenia must implement its Singapore-style 'Call-for-Application' licensing model before, not after, infrastructure saturation.

### 5.3 Geopolitical Exposure and Regional Instability

Armenia's internet infrastructure is critically vulnerable: approximately 85% of international internet transit passes through Georgia via a single fibre corridor susceptible to physical disruption — as demonstrated by the 2011 cable-cut outage that severed Armenian internet access (EVN Report, legacy). Nuclear fuel for Metsamor is currently flown from Russia due to Turkish-Azerbaijani border closure, creating a supply-chain dependency that contradicts the sovereignty narrative of the AI project (World Nuclear Association, 2025). The TRIPP corridor, while theoretically resolving both transit and corridor problems, remains contested by Iran and politically sensitive domestically, with a constitutional referendum pending.

Mitigation requires infrastructure redundancy through the planned Persian Gulf–Armenia–Georgia fibre link, the Black Sea Submarine Cable project with Romania, and the India–Iran–Armenia trilateral corridor formalised in December 2024. Armenia's diversification of security partnerships — \$720 million Akash-1S order from India, the pending \$3–4 billion India defence MOU, French Mistral AI partnership and Caesar artillery acquisitions — creates a multi-vector balancing posture that raises the cost of coercion by any single actor without constituting a credible alternative alignment.

### 5.4 Talent Bottlenecks

Despite a strong STEM culture, Armenia faces qualitative talent constraints more acute than quantitative ones. The 110,000-GPU target by mid-2026 demands ML infrastructure engineers, large-scale distributed systems architects, and GPU cluster operations specialists — competencies where Armenia's current pool is thin. The 60% payroll rebate policy creates a diasporic repatriation incentive, but the pipeline requires 3–5 years to produce domestically trained specialists at the required level. Short-term bridging requires aggressively recruiting from the wider Armenian diaspora, the Ukrainian technology refugee community, and global AI talent markets, while mid-term success requires the Generation AI and TUMO pipelines to deliver measurable cohorts by 2028–2030.

**Table 3. Risk Matrix: Threats, Probability, Impact, and Mitigation**

Risk	Probability	Impact	Time Horizon	Key Mitigation
US export license revocation	Low–Medium	Critical	2–5 years	Bilateral treaty; CLOUD Act compliance; sovereign model layer
Grid overload / Irish trap	Medium–High	High	1–3 years	EIA mandate; renewable PPAs; SMR decision by 2027

Risk	Probability	Impact	Time Horizon	Key Mitigation
Regional security shock	Medium	High	1–10 years	Fibre redundancy; multi-vector defence partnerships
Talent gap (specialist)	High	Medium	1–3 years	Diaspora rebates; TUMO/Generation AI pipeline; refugee talent
Demand-side hub failure	Medium	High	2–4 years	EU AI Act arbitrage; India/ME anchor tenants; e-Residency
EIA / environmental backlash	Medium	Medium	0–2 years	Retroactive EIA; water recycling mandate; community engagement

## 6. COMPARATIVE ANALYSIS: UAE, SINGAPORE, IRELAND, AND ESTONIA

### 6.1 United Arab Emirates: The Scale Template

The UAE is the most instructive positive comparator for Armenia's compute-hub ambition. Stargate UAE — a 5 GW AI campus with Phase 1 costs exceeding \$30 billion, anchored by G42, OpenAI, Oracle, NVIDIA, and SoftBank — is underwritten by sovereign wealth of a magnitude Armenia cannot match (The National, 2026; Verdict, 2026). The transferable lessons are institutional rather than financial. The UAE established a Ministry of State for AI in 2017 — the world's first — providing a regulatory institutional framework that attracted technology talent and investment before the compute infrastructure existed. The May 2025 US-UAE bilateral deal permitting 500,000 advanced NVIDIA chips annually in exchange for \$1.4 trillion in US investment commitments was preceded by Microsoft's \$1.5 billion investment in G42 (conditioned on G42's divestment from Chinese technology), demonstrating the US 'chip access for alignment' mechanism that Armenia is navigating. The critical structural difference is that the UAE's sovereign wealth provides a self-funding buffer absent from Armenia's reliance on diaspora capital and bank syndication. Armenia's Ameriabank \$60 million participation and broader \$300 million loan syndication are meaningful but not sovereign-wealth equivalents (Hetq, 2025).

### 6.2 Singapore: Selective Green Licensing

Singapore's data centre trajectory from 2019 to 2025 provides the single most instructive policy lesson for Armenia. Rapid growth drove data centre consumption from approximately 2% to 7% of national electricity, triggering a 2019 moratorium on new approvals, lifted only in 2022 when Singapore introduced its Data Centre Call-for-Application model — a selective, green-conditional licensing regime (IT Pro, 2025; Lexology, 2022). The policy required applicants to demonstrate energy efficiency ( $PUE \leq 1.3$ ), sustainability roadmaps, and local skill-transfer commitments. Singapore's resulting digital economy of S\$128 billion representing 18.6% of GDP, with 214,000 tech jobs, demonstrates what decades of managed data centre growth can produce (Singapore Wall Street, 2025). Armenia should implement this 'Call-for-Application' model immediately, using it to negotiate renewable PPA commitments, local training obligations, and minimum domestic compute allocations from Firebird and any subsequent operators.

### 6.3 Ireland: The Grid Failure Warning

Ireland is Armenia's most likely failure mode. The Irish data centre boom — driven by US hyperscaler FDI attracted by 12.5% corporate tax — reached 21% of national metered electricity consumption in 2023, with projections of 30% by 2030 (Data Center Dynamics, 2025; Fingal Chamber, 2025). EirGrid's moratorium on new data centre grid connections in Dublin, extended to 2028, has effectively frozen new investment and damaged Ireland's reputation as a technology hub (Data Center Dynamics, 2023). The fundamental error was inviting hyperscalers before planning grid and renewable capacity. The lesson for Armenia is that the speed of the Firebird project's Phase 2 announcement — four months after Phase 1 groundbreaking — mirrors exactly the growth-without-planning dynamic that trapped Ireland. Armenia's government must

resist pressure to scale rapidly and instead implement binding infrastructure constraints as conditions of Phase 2 licensing.

### 6.4 Estonia: The Deepest Structural Analogue

The crucial example is provided by Estonia which remains the least mentioned comparator. This country has a population of 1.3 million (on par with Armenia’s 2.8 million), a history of post-Soviet transition, no hydrocarbon revenues, and has a hostile neighbor (Russia). Estonia decided not to build its own sovereign computing power. Instead, it developed such projects as X-Road, the data exchange backbone (estimated to provide an annual savings of 2% of the GDP by digitalization), X-tee, the Estonian national digital identity, the e-Residency program with 117,000+ citizens generating a revenue of €125 million directly for the Estonian state in 2025, and has access to supercomputers as a member of the European Union’s LUMI facility of EuroHPC (Estonian World, 2025; AI for Good, 2025). Finally, the AI Leap Program of Estonia in 2025 offered free access to LLMs to 20,000 students, proving the fact that AI capabilities can be created in the society without sovereign computing power (Digital Watch Observatory, 2025).

The lesson for Armenia is not to abandon sovereign compute — the Firebird bet is already placed — but to recognise that compute without an Estonia-style data exchange layer, digital ID backbone, and AI-in-government deployment programme produces hollow sovereignty. The 10–20% domestic compute allocation must feed an absorptive ecosystem; without it, the data centre is simply a foreign-operated utility.

**Table 4. Comparative Benchmarking Matrix — Key Dimensions**

Dimension	UAE	Singapore	Ireland	Estonia	Armenia (Trajectory)
Core Strategy	Sovereign wealth compute hub	Green anchor licensing	Tax + EU gateway	Digital state model	Diaspora-backed hub + digital layer
DC % of National Grid	~negligible (large grid)	~7% (managed)	21% → 30%+	Low (EuroHPC)	10–25%+ (projected)
Chip Access Method	Bilateral deal (500k/yr)	Unrestricted (market)	Unrestricted (EU)	Unrestricted (EU)	BIS licensed bilaterally
Primary Risk	Geopolitical targeting	Space constraints	Grid saturation	Scale limits	Overdependence + energy
Transferable Lesson	Institutionalise via treaty	Selective green licensing	Plan grid before FDI	Build data rails first	Execute all three in 36 months

## 7. SCENARIO MODELLING AND FORECASTING

Three scenarios are developed along two primary variables: (A) execution quality of domestic absorptive capacity policy (strong vs. weak), and (B) stability of US alignment across the current administration and beyond (persistent vs. eroding). Scenario probability weights are assigned based on current policy trajectory and the equilibrium analysis developed in Section 3.

### 7.1 Best Case: 'Caucasus Stargate' (Probability ~20%)

By mid-2027, Armenia achieves coordination-game tipping, becoming the Schelling-focal site for EMEA sovereign AI demand. European firms requiring non-US, non-Chinese data sovereignty under the EU AI Act select Armenia as a preferred hosting jurisdiction; Middle Eastern state AI labs diversify capacity away from the UAE; Indian IT majors leverage the Yerevan-New Delhi defence-tech axis for hybrid cloud deployments. The 10–20% domestic compute share feeds a cluster of 200–400 AI-native startups by 2030, with four to six reaching valuations above \$100 million. TFP growth from the ecosystem adds 1.5–2 percentage points to GDP growth over the decade, the tech sector reaches 14–16% of GDP, and diaspora reversal accelerates as SmartGate VC and equivalent funds establish Yerevan as a regional investment focal point. Conditions: EIA and energy governance reform within 12 months; R&D spending doubling by 2028;

Armenian e-Residency launched by 2027; US alignment institutionalised in a bilateral framework persisting across administrations; renewable PPA for Phase 1 executed by Q2 2026.

### **7.2 Base Case: 'Forward-Deployed Compute Node' (Probability ~50%)**

Firebird operates profitably serving predominantly US customers. The facility becomes Armenia's largest single revenue-generating entity but captures mainly operational rents. Employment multiplier delivers 1,500–3,000 direct and indirect jobs; GDP impact averages 0.8–1.3 percentage points above counterfactual annually during construction, settling at approximately 0.4–0.6 points permanent growth uplift from productivity spillovers. Grid stress is managed through piecemeal renewable additions and Metsamor lifetime extension, creating intermittent residential tariff pressure but not a crisis. Domestic AI ecosystem grows modestly — 50–80 startups with frontier-model capability by 2030 — but Armenia does not achieve hub-coordination tipping. The tech sector reaches 9–11% of GDP — meaningful but not transformational. US alignment persists but remains vulnerable to administration change.

### **7.3 Worst Case: 'Stranded Asset with Grid Backlash' (Probability ~30%)**

Any of three exogenous shocks precipitates failure. The reversal of US policy resulting from either the priority of China containment versus Armenia by a future administration or the discovery of diversion of GPUs to prohibited recipients will lead to the revocation of the license for NVIDIA GPUs by the BIS, which will render 50,000 to 110,000 GPUs stranded without economical means of relocation or reconfiguration. On the other hand, Ireland-style grid revolt occasioned by Phase 2 expansion of energy consumption accounting for 20%-25% of total electricity with the simultaneous shutdown of Metsamor during a drought year could precipitate the move. The third pathway is a regional security shock: Azerbaijan abrogating the TRIPP framework, renewed conflict over the Zangezur corridor, or Iranian-Israeli military escalation disrupting Georgia-transiting internet traffic. In this scenario, Armenia inherits Ameriabank's \$60 million exposure, significant development bank loan obligations, and a \$4 billion facility operating at 20–30% utilisation. Brain drain accelerates as the high-skill workers recruited for the project seek opportunities in jurisdictions that delivered on their value propositions. The probability of this scenario is non-negligible; it is elevated by the pace of Phase 2 scaling relative to governance reform.

## **8. CONCLUSION: A DOMINANT NATIONAL STRATEGY**

Synthesising the game-theoretic analysis, comparative lessons, and risk constraints developed across the preceding sections, Armenia's dominant strategy is conditional deep integration with explicit hedging reserves. The strategy has four load-bearing components that must advance in parallel rather than sequentially, because each is a precondition for the others' success.

First, Armenia must institutionalise US alignment through a treaty-ratified bilateral framework analogous to the UAE's Intergovernmental Assurance Agreement, converting the August 2025 AI and Semiconductors MOU into a Senate-ratified instrument that survives administration changes. This is the highest-leverage single action because it transforms a revocable executive commitment into an audience-cost-bearing one, solving the repeated-game stability problem identified in Section 3.2.

Second, Armenia must build the Estonia layer beneath the UAE layer — X-Road-equivalent data exchange infrastructure, digital ID hardening, algorithmic-liability legislation, AI-in-government deployment targets, and a diaspora-focused e-Residency programme launched within 24 months. Without this foundation, the compute capability remains a foreign-operated utility regardless of scale.

Third, Armenia must implement Singapore-style selective licensing for subsequent data centre capacity — making renewable PPAs, efficiency standards, and mandatory local skill-transfer commitments conditions of approval for any expansion beyond the Firebird Phase 2 footprint. This prevents the Irish outcome while creating a quality signal that attracts sustainability-conscious European demand.

Fourth, Armenia must compound its strategic diversification: India defence-tech partnerships, Iranian connectivity corridors, French military cooperation, and EU accession — each serving as a hedging signal that raises the cost of US over-coercion without undermining the separating PBE equilibrium identified in Section 3.2.

The quantitative conditions for success are measurable and should be formally adopted as national strategic benchmarks: R&D spending to reach 0.8% of GDP by 2028 and 1.5% by 2032; renewable electricity share to 50% by 2030; tech sector employment to 80,000 by 2030; Armenian-founded AI startups with frontier capability to reach 20 or more by 2030; and e-Residency programme launched by 2027 with 50,000 registered residents by 2030.

The ultimate insight is that Armenia's AI infrastructure challenge is not primarily a technology story — it is a commitment-device story. The compute is the artifact; the strategic game concerns whether a small state can credibly signal, repeatedly cooperate, and coordinate its way into a structural position where great-power patronage becomes self-enforcing through sunk interests rather than revocable goodwill. Estonia accomplished this without sovereign compute; the UAE has done it with sovereign wealth; Armenia must accomplish it with diaspora capital, strategic geography, and 24–36 months of disciplined institutional construction. The Firebird deal has purchased the option. Whether that option is exercised depends on whether Yerevan treats the next three years as infrastructure construction or as institution construction. The evidence from this analysis is unambiguous: only the second form of construction compounds.

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