UNIVERSITY OF PIRAEUS
DEPARTMENT OF INTERNATIONAL AND EUROPEAN STUDIES

M.Sc. Energy: Strategy, Law and Economics

Special issues in energy financing and risk management

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Part A

Geopolitical Risk in the Era of Energy Transformation:

Navigating the Transition from "Stocks" to "Flows".

Geopolitics and Risk

- **Geopolitics:** how geography affects politics and relations among states.
- **Geopolitical Risk** is the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations.
- Key aspects of geopolitical risk include:
  - **Conflict and Tension:** War (e.g., Ukraine), terrorist acts, and tensions between states.
  - **Economic Impact:** Trade wars, sanctions, resource competition, and abrupt energy supply shifts.
  - **Regulatory Changes:** Government imposition of restrictions, expropriation (confiscation) of assets, or sudden policy shifts.
  - **Market Volatility:** Sudden shocks frequently create short-term fluctuations in stocks, bonds, and currencies.

Navigating the new geopolitics reality

- **Key Concept:** Gradual transition from the G7 and G20 to a "G-Zero" era—a global power vacuum where no single nation or alliance possesses the political or economic leverage to drive a global agenda.
- **The Shift:** US Global Hegemony tends to be replaced by fragmentation, where national interests supersede collective stability.
- **A shift from "rules-based order" to the "Law of the Jungle":**
  - Greater volatility in international markets.
  - Increased regional hegemony.
  - Strategic "transactionalism" over long-term alliances.

The "Old" Geopolitics: The Era of Hydrocarbons

- **The Geography of Control:** Energy security historically dictated by resource concentration. Power is concentrated in "Petrostates" and projectable through pipeline diplomacy and maritime dominance.
- **The "Stock" Constraint:**
  - Dependency on finite, exhaustible assets.
  - Requires continuous extraction, global trade, and combustion.
  - Subject to immediate price shocks and physical supply disruptions.
- **Strategic Vulnerability:** National security is tied to the stability of maritime chokepoints and the "transit risk" of fixed infrastructure.

The Green Upheaval: Mapping a Non-Linear Transition (1/2)

- Transition is a period of unprecedented volatility where "old" and "new" energy architectures must coexist in a dual-track system.
- **The "Feast Before Famine" Paradox:**
  - **Upstream Concentration:** As IOCs divest from high-cost basins, global production concentrates in low-cost Petrostates.
  - **Leverage Spike:** OPEC+ gains significant short-term pricing power as fossil fuel supply potentially tightens faster than demand can pivot.

The Green Upheaval: Mapping a Non-Linear Transition (2/2)

- **Structural Risks & Bottlenecks:**
  - **Industrial Policy Warfare:** The shift from "Price Volatility" (Oil) to "Clean Tech Protectionism" and trade barriers (e.g., CBAM).
  - **Systemic Inefficiency:** The geopolitical friction of managing legacy infrastructure while scaling green technologies simultaneously.
- **Key Insight:** Energy security risks peak during the transition rather than vanish, driven by policy lags and resource nationalism.

The Resource-Technology Shift

- **The Paradigm Shift:** While the "fuel" (sun/wind) is ubiquitous and free, the hardware required to harvest it is highly concentrated. Energy security is no longer about access to reserves, but mastery of complex supply chains.
- **Key Strategic Transitions:**
  - **From Extraction to Refining:** Geopolitical leverage moves from the wellhead to the high-end processing of critical minerals (Lithium, Cobalt, Rare Earths).
  - **Manufacturing as Power:** Security is defined by the ability to manufacture at scale—moving from a Commodity Model to an Industrial Patent Model.
  - **The "Hardware" Lock-in:** Unlike oil, which is a recurring expense, renewables represent a massive upfront CAPEX dependency. If the technology flow is cut, the transition halts.
- **Result:** Trading the "Chokepoints of Geography" (Suez/Hormuz) for the "Chokepoints of Technology" (Refining and Semiconductor capacity).

Critical Minerals—The New Geopolitical Bottleneck (1/4)

- **The Shift: From Wells to Mines**
  - **Geopolitical Leverage:** Power is moving from those who own the hydrocarbons to those who master the refining and processing.
  - **The "Lead-Time" Trap:** Tier-1 mines average 16.5 years to develop, creating a structural supply-demand mismatch that defies short-term policy fixes.
  - **Metallurgical Sovereignty:** In the 21st century, "owning the chemistry" (patents/refining) is becoming more strategically valuable than "owning the dirt.

Critical Minerals—The New Geopolitical Bottleneck (2/4)

- **Transition Intensity: Hardware vs. Fuel**
  - **The 6x Multiplier:** An EV requires 6x the mineral inputs of a conventional car, shifting security focus from recurring fuel flows to upfront material stocks.
  - **Infrastructure Weight:** Offshore wind requires 9x more minerals (Copper/REEs)/ MW than gas plants, "locking in" geopolitical risk at construction.
  - **The ESG Paradox:** Clean-tech supply chains often rely on carbon-intensive extraction, creating regulatory bottlenecks for Western developers.

Critical Minerals—The New Geopolitical Bottleneck (3/4)

- **The Concentration Gap: Oil vs. Critical Minerals**
  - **The New Oligopoly:** Top 3 HC producers (USA, RU, SA) control ~40% of global output—a relatively distributed and liquid market. China controls 85-90% of the market for Lithium, Cobalt, and Rare Earths.
  - **The Refining Chokepoint:** While extraction is global, mid-stream processing is hyper-centralized, creating a new form of "OPEC-like" dependency.
  - **Hardware Lock-in:** Unlike oil (a recurring expense), renewables are a massive upfront CAPEX dependency. A mineral disruption halts the entire transition.

Critical Minerals—The New Geopolitical Bottleneck (4/4)

- **Strategic Implications: Industrial Statecraft**
  - **Mineral Nationalism:** Rising export bans on raw ore (e.g., Indonesia, Chile) to force domestic value-chain development and capture GDP.
  - **Friend-shoring:** National security is now synonymous with "Supply Chain Resilience," driving regional hubs to break the 86% monopoly.
  - **The Vulnerability Shift:** We are trading "Vulnerable Flows" (maritime chokepoints) for "Vulnerable Value Chains" (refining and semiconductor capacity).

Case Study 1: EU-Russia-China (1/3)

- **The Dependency Architecture**
  - **The 40% Threshold:** Pre-2022, Russia supplied 40–47% of EU natural gas, creating a massive structural vulnerability in the European energy mix.
  - **The Bypass Strategy:** Nord Stream 1 and 2 were engineered to bypass transit countries (Ukraine/Poland), centralizing German dependency and fragmenting EU energy solidarity.
  - **Infrastructure Lock-in:** The "Geopolitics of Pipelines" created a rigid, decades-long commitment that proved nearly impossible to pivot from overnight.

Case Study 1: EU-Russia-China (2/3)

- **Strategic Lessons Learned**
  - **Energy as a Kinetic Weapon:** The 2022 crisis proved that "interdependence" does not always prevent conflict; it can be used as a tool of strategic coercion.
  - **The Vulnerability of "Flows":** Unlike the "Hardware" era, the "Gas Era" was defined by the constant threat of a valve being turned off.

Case Study 1: EU-Russia-China (3/3)

- **The "Green" Concentration**
  - **The 90%+ Threshold:** The EU currently relies on China for 96% of solar wafers and 93% of rare earth magnets—a level of concentration far exceeding the 40% Russian gas dependency.
  - **China** now dominates the entire integrated supply chain for EVs, Lithium-ion Batteries, and Solar Photovoltaics, controlling the intellectual property, refining, and manufacturing.
- **The Strategic Bottom Line:**
  - **From Molecules to Hardware:** We are moving from a world where we fear the "Valve" (Russia) to a world where we fear the "Factory" (China).
  - **Industrial Sovereignty:** Without domesticizing the mid-stream (refining and assembly), the EU’s "Net Zero" ambitions remain subject to the Industrial Policy of a single external power.

The Qualitative Risk of Tech Dependency (1/2)

- **The Vulnerability Paradox:** While the "Flow" (sun/wind) is immune to embargo, the "Hardware" introduces profound new vectors of Sovereign Risk.
- **Digital Vulnerabilities:**
  - **The Cyber-Energy Nexus:** Connected devices (smart inverters, battery management systems) can be remotely manipulated or shut down, turning distributed generation into a decentralized cyber-battlefield (E.g. Spain).
  - **Metadata Exploitation:** The flow of operational data from green infrastructure back to the manufacturing nation offers a persistent intelligence windfall and a strategic tool of coercion.

The Qualitative Risk of Tech Dependency (2/2)

- **Structural Vulnerabilities:**
  - **Inflexible Architecture:** Unlike switching a gas supplier (operational), a green transition creates 20- to 25-year infrastructure lock-ins, meaning dependency on the original manufacturer for all maintenance, software updates, and proprietary spare parts.
  - **Transition Halt:** A breakdown in the technology supply chain wouldn’t just raise prices—it could halt the entire nation's decarbonization pathway for decades.

Case Study 2: USA Strategic Response (1/2)

- **The Pivot:** Faced with China's green tech lead, USA is doubling down on hydrocarbon dominance where it holds an asymmetric advantage.
- **"Drill, Baby, Drill" as Geopolitics:**
  - Expanding domestic oil and gas extraction to flood international markets, specifically Europe.
  - Using fossil abundance to reduce China’s leverage over the technological supply chain.

Case Study 2: USA Strategic Response (2/2)

- **Kinetic Force & Regime Change:**
  - **Venezuela:** Targeting Maduro to "tap the world's largest oil reserves" and sideline Beijing.
  - **Iran:** Military strikes on oil infrastructure (e.g., Kharg Island) to disrupt the 15% of China's oil imports sourced from these sanctioned states.
- **The $750B Transatlantic Deal:**
  - A massive energy and trade agreement between the US and EU to anchor allies through offtake of US LNG, oil, and nuclear products.
  - **Strategic Rationale:** Reducing the US trade deficit while ensuring Europe remains a "massive buyer" dependent on US supplier terms rather than Chinese tech.

Permitting as a Geopolitical Barrier (1/2)

- **The Bureaucratic Bottleneck**
  - **Project Attrition:** In the West, most clean energy projects "die in permitting offices, not labs." Innovation is outpaced by administrative friction.
  - **The "Green Paradox":** Environmental regulations designed to protect local ecosystems often delay the very transition needed to solve global climate change.
- **The Competitive Gap: West vs. China**
  - **The 15-Year Timeline:** In the US and EU, bringing a new strategic mine or high-voltage grid online takes 10–15 years due to litigation, land rights, and environmental impact assessments.
  - **The Accelerated Model:** China operates on a fraction of this timeline, deploying infrastructure at a scale and speed that creates a de facto manufacturing monopoly.

Permitting as a Geopolitical Barrier (2/2)

- **Strategic Implications**
  - **Capital Flight:** Global investment flows toward markets with regulatory certainty and faster "time-to-market.“
  - **Industrial Erosion:** By the time a Western mine is permitted, the global market may already be saturated by subsidized competitors, making domestic projects economically unviable.

Widening the Vulnerability Gap (1/2)

- **The Transition Inequity**
  - **The Vulnerability Trap:** Developing nations exhibit the highest "Energy Transition Vulnerability" due to a fundamental lack of domestic financial capital and technological capacity to pivot.
  - **Capital Cost Divergence:** Clean energy projects face significantly higher costs of capital in the Global South due to perceived country risk, making the transition inherently less affordable and often "unbankable" without multilateral support.

Widening the Vulnerability Gap (2/2)

- **The Strategic Response: Mineral Nationalism**
  - **A Sovereign Defense:** Resource-rich nations are responding to potential "green exploitation" by increasing state control over critical minerals (Lithium, Nickel, Cobalt).
  - **The Refined Mandate:** Countries are shifting from exporting raw ore to mandating domestic processing and refining, aiming to capture a greater share of the clean tech value chain.

The Nuclear Renaissance: A Geopolitical Bridge (1/2)

- **The Renaissance Drivers**
  - **Meeting the Energy Gap:** The global "Net Zero" transition and the unprecedented power demands of AI and data centers have catalyzed a return to nuclear energy.
  - **At COP28 and COP30,** 33 nations pledged to triple global nuclear capacity by 2050, solidifying its role as a core transition pillar.
- **The Competitive Landscape**
  - **Rosatom’s Monopoly:** Russia and China are the dominant global leaders in nuclear exports, currently controlling a vast majority of the nuclear fuel cycle and new reactor construction.
  - **The SMR Pivot:** To break this monopoly, the West is accelerating the deployment of SMRs, shifting the focus from large-scale, 15-year projects to faster, factory-fabricated, distributed nuclear energy.

The Nuclear Renaissance: A Geopolitical Bridge (2/2)

- **The Geopolitical Legacy: "Multi-Decadal" Lock-in**
  - **The 80-Year Tie:** Unlike LNG contracts (operational), nuclear commerce creates multi-decadal dependencies on the reactor vendor for fuel, maintenance, and waste management.
  - **The Ultimate Chokepoint:** Trading the "Pipeline Valve" for the "Nuclear Fuel Cycle," where dependence is measured in human generations, not quarterly shipments.

Strategic Conclusions (1/2)

- **Weaponized Interdependence:** The West is pivoting to a "dual-track" strategy, using HC dominance to bridge the gap while scaling SMRs to break the 80-year "Nuclear Tie" held by RU.
- **The "Valve" vs. "The Factory":** Geopolitical risk has shifted from resource access to supply chain mastery (China), trading maritime chokepoints for technological bottlenecks.
- **The 6x Mineral Trap:** Energy security is now a materials science race; clean tech requires 600% more mineral inputs, creating a new "OPEC-like" dependency on hyper-centralized refining.

Strategic Conclusions (2/2)

- **Permitting as a Kinetic Barrier:** Innovation is currently irrelevant if it cannot be deployed; the West’s 15-year administrative friction is a self-imposed strategic handicap compared to the "Accelerated Model" of competitors.
- **The Hardware Lock-in:** Unlike HCs, which are an operational expense, renewables and nuclear represent a 25- to 80-year sovereign dependency on the original manufacturer for data, software, and parts.
- **G-Zero Autonomy**: In a leaderless global order, security cannot be "bought" via alliances; it must be engineered through circular exergy, mineral nationalism, and domestic technological sovereignty.

Part B

Vasileios Papakostas

Who is who?

Education

- **Integrated Master of Materials Science and Engineering - University of Ioannina | Dept. of Materials Science and Engineering (2015)**
  - **Thesis:** Assessment of CO2 and N2 Absorption of Ionic Liquids and S.I.L.Ps.
- **M.Sc. Petroleum Engineering - Technical University of Crete | Dept. of Mineral Resources Engineering (2017)**
  - **Thesis:** Oil-in-Water Emulsions: Techniques and Processes for Maximizing the Oil Recovery in High Water Cut Oil Wells.
- **M.Sc. Energy: Strategy, Law, and Economics - University of Piraeus | Dept. of International and European Studies (2020)**
  - **Thesis:** Energy Security and Geopolitical Co-opetition in the Eastern Mediterranean.
- **SEP Data Analyst - National and Kapodistrian University of Athens (2021)**
  - **Focus:** Advanced quantitative analysis and data-driven decision-making
- **PhD Candidate University of Piraeus | Dept. of International and European Studies (2023 – Present)**
  - **Dissertation:** Geopolitical implications of disruptive sustainable energy technologies.

Work Experience

- **RESEARCHER | UNIVERSITY OF PIRAEUS RESEARCH CENTER | (2021-2024)**
  - Executed environmental, geopolitical and social impact assessments for the ORCHYD Horizon 2020 program focusing on deep geothermal drilling innovations.
  - Utilized advanced LCA software to quantify the environmental footprint of water-based fluids in energy extraction.
- **PROJECT MANAGER AND SUSTAINABILITY ANALYST | IRES | (2024)**
  - Implemented quantitative assessment techniques (LCA, LCC, Risk Assessment) for four Horizon 2020 programs (EXFAN, METAWAVE, MELODIZER, DOMMINIO).
  - Managed cross-functional research teams to ensure compliance with EU environmental standards and project deliverables.

Work Experience

- **ENERGY TRANSITION AND NEW TECHNOLOGIES SPECIALIST | EAST MEDITERRANEAN GAS FORUM (2024 – PRESENT)**
- Directly coordinating Institutional Stakeholders (Ministries, Regulatory Authorities and NOCs) from **8 Member Countries** and major **International Observers** (EU, US, World Bank).
- Mandating the **EMGF's Long-Term Strategy and Scope Expansion roadmap** in cooperation with BCG; conducting comprehensive governance assessments and implementation monitoring.
- Spearheading **Phases 3 and 4 of the EMGF Carbon Intensity Certification mechanism** with the World Bank and S&P Global; designed the Business Case & Business Plan and Pilot Execution plan for a standardized regional carbon accounting framework.
- Engineered and fully operationalized the **EMGF Project Development Unit** to streamline technical appraisal and facilitate financing for regional energy infrastructure.
- Providing structured support to the **Egyptian Ministry of Petroleum (MOPMR)** in developing **National NG MMRV guidelines** aligned with EMGF's harmonized regulatory framework and international methane standards.

Work Experience

- **ENERGY TRANSITION AND NEW TECHNOLOGIES SPECIALIST | EAST MEDITERRANEAN GAS FORUM (2024 – PRESENT)**
- Directed the technical assessment of the **EMGF Gas Balance Model**; overseeing development to ensure data-driven forecasting of regional supply-demand dynamics.
- Coordinating **EMGF Technical Implementation Groups** (comprised of Ministries, NOCs, IOCs, Regulatory Authorities & IFIs) across four critical pillars: NG Export Regulations (Group 3), Exploration Activities (Group 4), Decarbonization Projects (Group 6), and Carbon Intensity Certification (Group 7).
- Orchestrating the development of the **CCUS Framework for the East Mediterranean**; creating a blueprint for regulations and commercial arrangements with diverse regional stakeholders.
- Representing the EMGF in the **World Bank's H4D (Hydrogen for Development)** initiative and planning the regional hydrogen pathway;
- Technical subject matter expert at **COP29** and **Africa CCUS Forum 2025.**
- Developed comprehensive **Energy Policy Briefs and Strategic Recommendations for EMGF Member Countries**, translating complex technical data into actionable policy for peace and prosperity in the East Med.

Thank You

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