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Competition Law in the Nuclear Energy Sector: A Balancing Act for a Low-Carbon Future

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Abstract: The nuclear energy sector, a critical component in the pursuit of global decarbonization and energy security, operates within a unique economic and regulatory environment that often strains traditional applications of competition law. This paper explores the complex interplay between competition law principles—such as the prevention of anti-competitive agreements, abuse of dominance, merger control, and state aid regulation—and the distinct characteristics of the nuclear industry. These characteristics include high upfront capital costs, long project lifecycles, significant state involvement, and overriding policy imperatives related to safety, security, and climate change. Drawing on analyses from international energy bodies and academic research, this paper examines how these factors necessitate a nuanced approach to competition policy, where the goals of fostering market rivalry are frequently balanced against, and sometimes subordinated to, broader strategic objectives. The discussion highlights the challenges in financing new nuclear projects, designing electricity markets conducive to nuclear investment, and managing supply chain concentrations, particularly in the context of achieving ambitious net-zero emission targets.

Keywords: competition, antitrust, nuclear regulation, markets, globalization, carbon, energy.

1. INTRODUCTION

Nuclear energy currently provides a significant portion of the world's low-carbon electricity and is increasingly recognized as an indispensable tool in the global effort to combat climate change and ensure energy security (IEA, 2025; OECD Nuclear Energy Agency [NEA], 2023). As nations strive to meet ambitious net-zero emission targets, the role of nuclear power, with its capacity for large-scale, dispatchable, and low-carbon electricity generation, is under renewed consideration (Hultman et al., 2021; OECD-NEA, 2023). The International Energy Agency (IEA) suggests that nuclear power is on the cusp of a new era, driven by government policies, technological innovation, and private sector interest (IEA, 2025).

Competition law, broadly, aims to ensure that markets operate efficiently by preventing anti-competitive practices such as cartels and abuse of dominant market positions, controlling mergers that could stifle competition, and regulating state subsidies that distort the market (Di Porto & Colangelo, 2024; European Parliament, n.d.). Its objectives are to foster innovation, consumer welfare, and economic efficiency (Fox and Healey, 2014). However, the nuclear energy sector presents a unique landscape where the direct application of standard competition principles encounters significant complexities due to the sector's inherent structural characteristics and overriding public policy goals (Yellin, 1981). This paper will explore these

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interactions, focusing on the tensions and balances struck in applying competition law to this strategically vital industry.

2. THE UNIQUE ECONOMIC AND STRUCTURAL LANDSCAPE OF NUCLEAR ENERGY

The nuclear energy sector is distinguished by several economic and structural features (Matheson, 1997) that profoundly influence market dynamics and the application of competition law.

- High Capital Costs and Long Investment Horizons: Nuclear power projects are characterized by exceptionally high upfront capital costs and long construction lead times, often spanning a decade or more, followed by operational lifetimes of several decades (IEA, 2025; OECD-NEA, 2024). These substantial investments and extended payback periods make nuclear projects highly sensitive to financing costs and market risks. The IEA (2025) notes that nuclear projects have traditionally been hard to finance due to their scale, capital intensity, and technical complexity.
- Market Failures and State Involvement: The significant financial risks and long-term uncertainties associated with nuclear power often lead to market failures, where private investment alone is insufficient to deliver new projects (OECD-NEA, 2024). Consequently, state involvement, through direct ownership by State-Owned Enterprises (SOEs), subsidies, loan guarantees, or long-term revenue support mechanisms (e.g., Contracts for Difference), is a pervasive feature globally (IEA, 2025). This state intervention, while often necessary to achieve energy security or climate goals, can inherently shape market structures in ways that differ from purely competitive ideals (Garon, 2018).
- Economies of Scale and System Costs: Large-scale nuclear reactors have historically benefited from economies of scale. Furthermore, nuclear power offers benefits at the electricity system level due to its reliability and low system integration costs compared to variable renewable sources, especially at high penetration levels (OECD-NEA, 2024). However, valuing these system benefits appropriately in liberalized electricity markets remains a challenge (Freeland and Pecujlic, 2018).
- Stringent Safety, Security, and Non-Proliferation Regimes: The nuclear industry operates under exceptionally rigorous safety, security, and non-proliferation regulations. While indispensable, these regulatory requirements add to costs and project complexity, potentially acting as barriers to entry and influencing technology choices.

3. CORE PRINCIPLES OF COMPETITION LAW

Competition law frameworks globally share core tenets aimed at ensuring fair and efficient markets (Werden and Limarzi, 2010). Key principles, particularly relevant in the European Union context, include:

- Prohibition of Anti-competitive Agreements (e.g., Article 101 TFEU): This targets agreements between undertakings that restrict competition, such as price-fixing or market-sharing cartels.
- Prohibition of Abuse of a Dominant Position (e.g., Article 102 TFEU): While holding a dominant market position is not illegal, abusing that position through practices like predatory

pricing or exclusionary conduct is prohibited.

- Merger Control: This involves the ex-ante review of mergers and acquisitions to prevent concentrations that would significantly impede effective competition.
- State Aid Control (e.g., Article 107 TFEU in the EU): This regulates financial support granted by states to undertakings to prevent undue distortions of competition, though aid can be permitted if it serves objectives of common interest and addresses market failures. (Di Porto & Colangelo, 2024; European Parliament, n.d.)

The application of these principles to the nuclear sector requires careful consideration of its unique context.

4. APPLICATION AND TENSIONS IN THE NUCLEAR SECTOR

The distinct characteristics of the nuclear industry create inherent tensions when applying standard competition law.

- State Aid and Subsidies: Given the market failures in financing new nuclear projects, state aid is often crucial. Competition authorities, like the European Commission, assess such aid based on its contribution to an objective of common interest (e.g., climate change mitigation, security of supply), the necessity and proportionality of the aid, and its potential distortive effects on competition (OECD-NEA, 2024). The IEA (2025) emphasizes that governments have a unique capacity to provide strategic vision, policies, incentives, de-risking mechanisms, and public finance for the nuclear sector.
- Market Design and Investment: Traditional liberalized electricity markets, often based on short-term marginal cost pricing, typically fail to provide adequate investment signals for capital-intensive, long-lead-time projects like nuclear power plants (OECD-NEA, 2024). This necessitates innovative market designs or support mechanisms (e.g., Contracts for Difference, Regulated Asset Base models) to ensure revenue predictability and attract investment. The OECD-NEA (2024) argues for "hybrid markets" that combine competitive short-term dispatch with long-term incentives for low-carbon technologies.
- Concentration in Supply Chains: The global nuclear supply chain exhibits high concentration in certain segments (Mishra, 2020). The IEA (2025) points to concentrated markets for nuclear technologies, as well as for uranium production and enrichment, as a risk factor for the future. This concentration can pose challenges for merger control and ensuring a competitive supply base.
- Balancing Competition with Overriding Policy Imperatives: A central challenge is balancing the promotion of competition with other critical policy goals.
  - Energy Security: Nuclear power's role in enhancing energy security often justifies state support and strategic planning that may not align with pure market competition.
  - Climate Change Mitigation: The imperative to decarbonize energy systems provides a strong rationale for supporting nuclear energy as a low-carbon source (Hultman et al., 2021; OECD-NEA, 2023). The OECD-NEA (2023) analysis concludes that tripling global installed nuclear capacity is a realistic path to meet net-zero goals by 2050. This objective may necessitate policy

interventions that competition law must accommodate.

- Safety and Security: The non-negotiable requirements for nuclear safety and security (Kramm, 2012) inherently shape market structures and can limit the scope for unfettered competition.

The OECD-NEA (2024) highlights that improving market designs is necessary but not sufficient for nuclear energy to realize its potential; robust project management and government oversight are also critical, especially when the public sector assumes a greater role in financing.

5. NEW NUCLEAR TECHNOLOGIES (E.G., SMALL MODULAR REACTORS - SMRS)

The development of Small Modular Reactors (SMRs) and other advanced reactor designs holds the potential to alter competitive dynamics (IEA, 2025). SMRs may offer benefits such as smaller upfront capital costs, shorter construction times, and suitability for different applications, potentially lowering barriers to entry and fostering innovation. However, the IEA (2025) notes that SMRs will still require sufficient government support for initial deployment and that highly concentrated markets for nuclear technologies remain a risk. Ensuring a diverse and competitive SMR vendor market will be a key challenge for policymakers and competition authorities.

6. CONCLUSION AND FUTURE OUTLOOK

Competition law in the nuclear energy sector operates in a complex environment where its traditional objectives must be carefully weighed against the sector's unique economic realities and pressing public policy imperatives, notably energy security, nuclear safety, and climate change mitigation (Van Loo, 2019; Drahos, 2017). The high costs, long project timelines, and significant risks inherent in nuclear power often necessitate substantial state involvement and tailored market mechanisms, which can appear at odds with conventional competition principles.

The analyses from the IEA (2025) and OECD-NEA (2023; 2024) underscore that achieving a sustainable, low-carbon energy future will likely require an expanded role for nuclear energy. This, in turn, demands innovative approaches to financing, market design, and regulation. Competition law must adapt to this evolving landscape, ensuring that state support is proportionate and effectively addresses market failures without unduly stifling innovation or efficiency. Future efforts should focus on creating frameworks that facilitate necessary investment in nuclear capacity, including for SMRs, while promoting transparency and managing risks associated with market concentration in critical supply chains (IEA, 2025). The challenge lies in fostering a regulatory environment (Sieg, 2008) where competition policy supports, rather than hinders, the deployment of nuclear energy as a vital tool for achieving global climate and energy goals (Hultman et al., 2021). This requires a sophisticated balancing act, acknowledging that a one-size-fits-all application of competition law is unlikely to be effective in this uniquely strategic sector.

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