

Fiscal Trends in Korea's Nuclear Science and Technology Sector (2007-2025): Policy Driven structure changes and Future outlook

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1. Introduction

Nuclear energy has re-emerged as a central pillar of national energy policy amid carbon-neutrality commitments, global energy security concerns, and surging electricity demand driven by AI and data-center growth. The government has pursued continued operation and new construction of large reactors, development of small modular reactors (SMRs), and expansion of nuclear exports. However, systematic analysis of how these policy directions are reflected in actual fiscal allocation has been limited. This gap is particularly notable given the sector's long investment cycles and diversified spending across R&D, facility construction, safety regulation, radioactive waste management, and decommissioning. This study analyzes 19 years (2007–2025) of national fiscal expenditure data for Korea's nuclear science and technology sector, utilizing on the Ministry of Economy and Finance's Open Fiscal Data system, to examine how policy shifts have shaped the sector's investment structure and to project future investment priorities.

2. Methods

Using expenditure and settlement data filtered by nuclear-related keywords, the study identified 478 line items across 67 unit programs (9 programs) under three ministries—the Ministry of Science and ICT (MSIT), the Ministry of Climate, Energy and Environment (MCEE), and the Nuclear Safety and Security Commission (NSSC)—totaling approximately 10.15 trillion KRW. Python-based time-series analysis (pandas, matplotlib, seaborn) was used to identify major inflection points, which were then cross-referenced with domestic and international policy events.



Fig. 1. Analysis Flowchart

3. Result

The analysis finds that sector expenditure grew from 323.7 billion KRW in 2007 to 829.3 billion KRW in 2025—a 2.6-fold increase—with the sharpest contractions occurring in 2009 (–27%, amid a government reorganization that dissolved the Ministry of Science and Technology) and 2015 (–26%, driven by a reallocation of national R&D funding toward ICT and bio-industries, the permanent shutdown decision for Kori Unit 1, and fallout from safety and cybersecurity incidents), and the sharpest expansion in 2012 (+54%, following the launch of a new reactor construction and operation program).

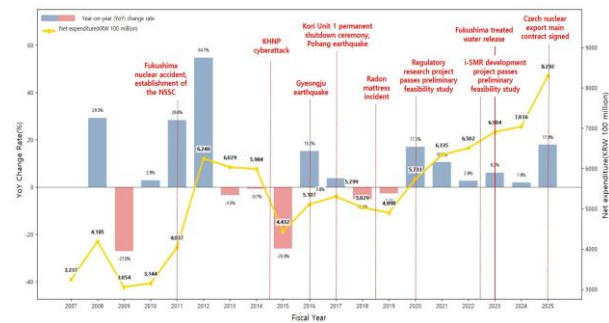


Fig. 2. Annual Expenditure Trends in the Nuclear Science and Technology Sector (2007-2025)

Ministry-level analysis reveals a structural evolution from a single-axis R&D-centered system (2007–2010, dominated by the predecessor of MSIT) to a two-axis promotion–regulation structure, following the NSSC's establishment as an independent body in 2011. More recently to a three-axis structure in which the Ministry of Climate, Energy and Environment's spending on radioactive waste management (204.4 billion KRW in 2025) has become a key growth driver alongside R&D and safety regulation. Program-level analysis identifies two structural break points—2011–2012 (emergence of dedicated nuclear-safety programs) and 2016 (radioactive waste management becoming a stable 20–30% share)—after which a standardized allocation pattern (roughly 50–65% promotion, 20–30% R&D, 10–15% safety infrastructure) has persisted through 2025, indicating a shift from politically volatile budgeting toward institutionalized, multi-year portfolio management.

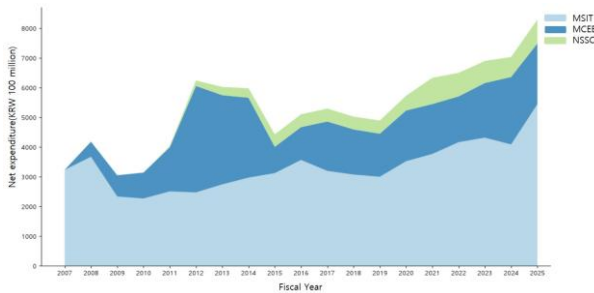


Fig. 3. Expenditure Trends by Governing Ministry in the Nuclear Science and Technology Sector (2007-2025)

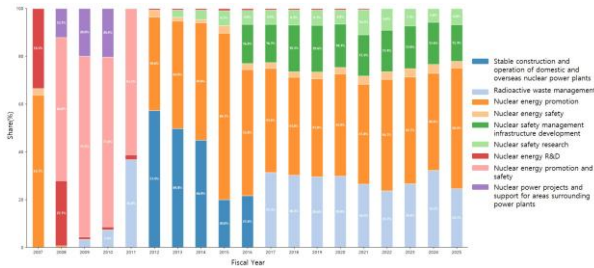


Fig. 4. Changes in Program Expenditure Composition in the Nuclear Promotion and Regulation Sectors of the Science and Technology Field (2007-2025)

Synthesizing the fiscal timeline with the policy timeline, the study identifies four distinct phases: (1) an industrial-development phase (through 2011) centered on reactor construction and technological self-reliance; (2) a safety-regulation-building phase (2011–2016) following Fukushima and the NSSC's launch; (3) a policy-transition phase (2017–2021) marked by the Energy Transition Roadmap and reduced new-build investment; and (4) a nuclear-ecosystem-restoration phase (2022–present), characterized by i-SMR project approval, resumption of the Shin-Hanul Units 3–4 construction, and the Czech Dukovany export contract.

4. Conclusion

Looking ahead, the study identifies four converging driving factors of future fiscal demand: (i) expanded new-build and SMR investment under the 11th Basic Plan for Electricity Supply and Demand and the 2026 SMR Special Act; (ii) growth in nuclear export-related industrial support following the Czech Dukovany contract; (iii) sustained increases in back-end investment—particularly high-level radioactive waste management—following the 2025 establishment of a dedicated management authority; and (iv) new regulatory infrastructure needs arising from emerging technologies such as AI-assisted reactor operation, fusion, and non-light-water reactor designs. The study concludes that nuclear energy is a path-dependent, capital-intensive industry requiring continuous investment across construction, operation, safety regulation, and decommissioning regardless of shifting energy policy. Aggregated fiscal demand is unlikely to

contract substantially, even as the balance between promotion and regulation shifts within policy direction. This underscores the policy implication that balanced, cross-ministerial, medium- to long-term fiscal planning—rather than investment concentrated in either promotion or regulation alone—is essential to sustaining both industrial competitiveness and safety assurance in Korea's nuclear sector.

REFERENCES

[1] Ministry of Planning and Budget, Open Fiscal Data System, <https://www.openfiscaldata.go.kr>