

A Comparative Analysis of Nuclear Activity Assessment Processes in the EU and Korean Green Taxonomies

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***Keywords : Nuclear economic activities, Transitional activities, EU Taxonomy, Korean Green Taxonomy, Assessment process**

1. Introduction

As carbon neutrality and sustainable finance have expanded, determining which economic activities should be recognized as environmentally sustainable has emerged as a major policy issue. A green taxonomy provides a set of criteria for assessing whether an economic activity contributes to environmental objectives and for using the assessment results in investment, finance, and policy decisions. The European Union (EU) adopted the EU Taxonomy Regulation in 2020 [1], while Korea introduced the Korean Green Taxonomy in 2021 and has continued to revise the economic activities and assessment criteria covered by the taxonomy [2].

Nuclear energy contributes to climate change mitigation through its low greenhouse gas emissions, but it also involves environmental and safety concerns, including radioactive waste management and accident risks. Accordingly, whether nuclear activities should be recognized as green and what conditions should apply have remained subjects of policy debate. Previous studies have primarily compared whether nuclear energy is classified as a green or transitional activity under each taxonomy and the applicable technical requirements, such as greenhouse gas emission thresholds, radioactive waste management, the latest safety standards, and accident-tolerant fuel [3-5].

Both the EU and Korea include new nuclear construction, the continued operation of existing nuclear power plants, and nuclear research, development, and demonstration (RD&D) under specified conditions, and their principal technical requirements are broadly similar [2,6]. However, the assessment processes through which these outcomes are reached differ. The EU applies common principles and activity-specific technical screening criteria before specifying how an activity contributes to environmental objectives, whereas Korea first assigns economic activities to the Green or Transition Sector and then applies activity-specific assessment criteria [1,2,6]. These differences may become more consequential than current classification outcomes when criteria are revised, new technologies are incorporated, and the taxonomy is used for financial and policy purposes, thereby affecting the stability and predictability of assessments.

This study compares the processes through which nuclear activities are assessed rather than focusing only on the resulting classification. The EU and Korean systems are analyzed in four stages: selection of activities for assessment, application of common principles, placement and application of technical requirements, and assignment of activity types. The study also examines how these procedural differences may affect the visibility of assessment criteria, comparability across activities, and the policy signals conveyed by activity types.

2. Overview of Green Activity Assessment Processes in the EU and Korean Taxonomies

2.1 Assessment Process under the EU Taxonomy

Under the EU Taxonomy, an economic activity must satisfy the common requirements set out in Article 3 of the EU Taxonomy Regulation to qualify as environmentally sustainable. The activity must make a substantial contribution (SC) to at least one of the six environmental objectives, do no significant harm (DNSH) to the remaining objectives, and comply with minimum safeguards (MS) [1].

Activity-specific technical screening criteria (TSC) also apply. These criteria provide quantitative and technical specifications for determining whether an activity makes a substantial contribution to an environmental objective and avoids significant harm to other objectives, and are established through delegated acts adopted by the European Commission [6,7].

Activities for which no TSC have been established cannot readily be assessed under the current taxonomy. However, criteria for new technologies and economic activities may be added through amendments to the delegated acts. Thus, the availability of TSC effectively determines whether an activity can enter the assessment process under the EU framework.

An economic activity satisfying the common principles and TSC may have the character of an activity making a substantial contribution, a transitional activity, or an enabling activity, depending on how it contributes to environmental objectives. Although these concepts are reflected in the applicable requirements and TSC, they do not operate by assigning all economic activities to overarching types before their

environmental sustainability is assessed [1]. The EU Taxonomy can therefore be characterized as a criteria-centered, ex post typology structure in which the character and contribution pathway of an activity are specified primarily in connection with its eligibility assessment under the common principles and TSC.



Fig. 1. Comparison of Green Activity Assessment Processes in the EU and Korean Taxonomies

2.2 Assessment Process under the Korean Green Taxonomy

Under the Korean Green Taxonomy, the first step is to determine whether the activity under review is included in the list of economic activities set out in the guidelines. Economic activities are divided into the Green Sector and the Transition Sector, and this sectoral classification precedes the application of activity-specific assessment criteria [2].

The Green Sector comprises economic activities that contribute to carbon neutrality and environmental improvement, while the Transition Sector comprises activities that are temporarily needed during the transition toward carbon neutrality [2]. Thus, the activity type is determined before the activity-specific criteria are applied.

An activity included in the taxonomy must satisfy the Activity, Recognition, Exclusion, and Safeguard Criteria. The Recognition Criteria assess whether the activity contributes to an environmental objective; the Exclusion Criteria determine whether it causes significant harm to other environmental objectives; and the Safeguard Criteria verify compliance with applicable laws and social safeguards relating to human rights, labor, and safety [2].

Conceptually, the Recognition, Exclusion, and Safeguard Criteria correspond to the EU principles of SC, DNSH, and MS, respectively. In Korea, however, these common principles and activity-specific technical requirements are not presented as separate assessment stages but are provided together through the Activity, Recognition, Exclusion, and Safeguard Criteria for each economic activity [2].

In summary, the Korean Green Taxonomy can be characterized as an ex ante typology structure in which economic activities are first assigned to the Green or Transition Sector and are then assessed against activity-specific criteria.

3. Comparison of Nuclear Activity Assessment Processes

This study compares nuclear activity assessment under the EU and Korean taxonomies in four stages: selection of activities for assessment, application of common principles, placement and application of technical requirements, and assignment of activity types.

First, selection of activities for assessment examines which nuclear economic activities are eligible for assessment under the taxonomy and the procedures through which those activities are selected.

Second, application of common principles compares how the overarching principles used to determine environmental sustainability are applied to nuclear activities.

Third, placement and application of technical requirements analyzes how nuclear-specific requirements, including greenhouse gas emissions, radioactive waste management, and safety standards, are positioned within the assessment framework and related to the common principles.

Fourth, assignment of activity types compares when green, transitional, or other types are assigned in the assessment process and what functions and meanings those types carry.

3.1 Selection of Activities for Assessment

Both the EU and Korea include nuclear RD&D, the continued operation of existing nuclear power plants, and the construction and operation of new nuclear power plants as activities subject to assessment [2,6]. However, the scope of RD&D differs. The EU focuses on advanced, pre-commercial nuclear technologies intended to minimize waste from the nuclear fuel cycle,

whereas Korea covers a broader range of nuclear technologies, including small modular reactors, accident-tolerant fuel, radioactive waste management, nuclear decommissioning, and research reactors [2,6].

Under the EU Taxonomy, only economic activities for which TSC have been established can be assessed as environmentally sustainable under the current framework. Nuclear activities were not included in the initial Climate Delegated Act, but were added through the 2022 Complementary Climate Delegated Act following technical assessment by the Joint Research Centre and expert review [6,8].

The EU process for including nuclear activities did not begin by pre-classifying nuclear energy as green or non-green. Instead, nuclear activities entered the assessment framework through the establishment of applicable TSC. Environmental risks associated with nuclear energy, including radioactive waste management and safety, are assessed and managed through the DNSH principle and the activity-specific TSC.

In Korea, only activities included in the taxonomy list can enter the assessment process. The Korean Green Taxonomy explicitly lists the relevant nuclear activities and assigns nuclear RD&D to the Green Sector and the continued operation and new construction of nuclear power plants to the Transition Sector [2].

Accordingly, the establishment of TSC is central to entry into the EU assessment framework, whereas in Korea the selection of an activity for assessment and the assignment of its type occur simultaneously. This difference concerns whether a policy status as green or transitional is assigned before the technical assessment begins.

3.2 Application of Common Principles

In the EU, nuclear activities must satisfy the same three common principles of SC, DNSH, and MS that apply to other economic activities. Nuclear power must make a substantial contribution to climate change mitigation through low life-cycle greenhouse gas emissions and must not cause significant harm through radioactive waste, impacts on water resources and ecosystems, or other channels [1,6].

Radioactive waste management and accident risks were examined in particular as central issues in the DNSH assessment of nuclear energy. The Joint Research Centre concluded that there was no scientific evidence that nuclear energy causes greater harm to human health or the environment than other electricity-generation technologies. On the basis of this review, detailed waste-management and safety requirements were incorporated into the TSC [8].

In Korea, nuclear activities must also contribute to greenhouse gas mitigation, avoid significant harm to other environmental objectives, and comply with applicable laws and social safeguards. However, these common principles are applied within the activity-

specific Recognition, Exclusion, and Safeguard Criteria rather than being presented as independent assessment stages.

For new nuclear construction, the Recognition Criteria include both greenhouse gas emission requirements and requirements relating to radioactive waste management and safety [2]. This illustrates a structure in which requirements related to substantial contribution and DNSH are presented together within the activity-specific criteria rather than in clearly separated stages.

Thus, in the EU, the common principles apply to nuclear activities as independent overarching requirements, whereas in Korea the corresponding principles are applied within the activity-specific Recognition, Exclusion, and Safeguard Criteria.

3.3 Placement and Application of Technical Requirements

The EU and Korea apply similar technical requirements to nuclear activities, including greenhouse gas emission thresholds, radioactive waste management, the latest safety standards, and accident-tolerant fuel [2,6]. The key difference between the two systems lies less in the content of individual requirements than in how those requirements are positioned and applied within the assessment framework.

In the EU, the TSC operationalize the common principles established in the Regulation. The greenhouse gas emission threshold for nuclear activities is linked to the assessment of substantial contribution to climate change mitigation, while requirements concerning radioactive waste management and safety are linked to the assessment of DNSH to other environmental objectives [6]. It is therefore relatively clear which common principle each technical requirement operationalizes.

Under the Korean Green Taxonomy, the activity-specific assessment framework comprises the Activity, Recognition, Exclusion, and Safeguard Criteria [2]. For new nuclear construction, however, the principal nuclear-specific technical requirements are concentrated in the Recognition Criteria. These include not only greenhouse gas emission requirements but also requirements concerning high-level radioactive waste storage and disposal plans, low- and intermediate-level waste disposal facilities, the latest technical standards, and accident-tolerant fuel. Consequently, the placement of the criteria alone does not always make clear whether each requirement is intended to demonstrate substantial contribution, prevent significant harm, or ensure safety as a separate condition.

This structure may be convenient for practitioners determining the eligibility of an individual activity. However, it may constrain the ability to trace which common principle an individual technical requirement operationalizes and to compare the purpose and stringency of requirements applied to different activities

within a common assessment framework. The key distinction between the two systems therefore lies not in the stringency of the technical requirements themselves, but in whether the framework allows the relationship between principles and technical requirements to be identified.

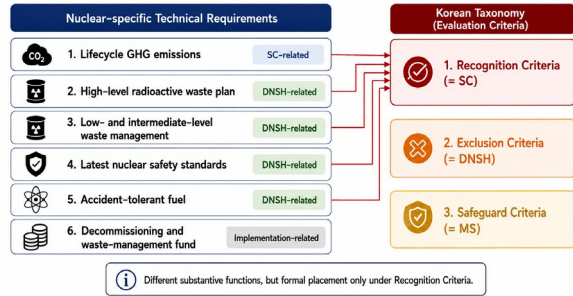


Fig. 2. Nuclear-specific Technical Requirements and Their Placement in the Korean Taxonomy

As illustrated in Fig. 2, nuclear-specific technical requirements in the Korean Taxonomy serve different substantive functions, but are formally grouped under the Recognition Criteria. This structure may limit the visibility of the linkage between each technical requirement and the underlying assessment principle.

3.4 Assignment of Activity Types

In the EU, new nuclear construction and the continued operation of existing nuclear power plants may qualify as environmentally sustainable economic activities under specified conditions. Activity types are used in connection with the assessment under the common principles and TSC to explain how an activity contributes to environmental objectives [1,6].

In Korea, nuclear RD&D is included in the Green Sector, whereas new nuclear construction and continued operation are included in the Transition Sector [2]. Green or transitional status is therefore assigned at the economic-activity classification stage rather than after completion of the technical assessment.

Consequently, even if new nuclear construction satisfies all detailed requirements concerning greenhouse gas emissions, radioactive waste management, and the latest safety standards, it remains classified as a transition activity under the Korean framework. This can be understood as combining the assessment of environmental sustainability with a policy judgment regarding the role of nuclear energy in the transition toward carbon neutrality.

The designation of an activity as transitional may signal to financial markets and policy users that it is needed only on an interim basis rather than as an activity classified in the Green Sector. When the type is assigned before the technical assessment, the policy character of the activity may be perceived before, and separately from, whether the detailed assessment criteria are satisfied.

Table I: Comparison of Nuclear Activity Assessment Processes in the EU and Korean Green Taxonomies

Assessment element	EU	Korea	Expected implication
Entry into assessment	Activities with established TSC	Activities included in the taxonomy list	Method and predictability of expanding assessment coverage
Common principles	SC, DNSH, and MS applied independently	Embedded in Recognition, Exclusion, and Safeguard Criteria	Visibility and verifiability of principle application
Technical requirements	Subordinate criteria operationalizing common principles	Concentrated in the Recognition Criteria	Identifiability of links between principles and technical requirements
Activity type	Contribution pathway specified in connection with eligibility assessment	Green or Transition Sector assigned before assessment	Possibility of policy signals preceding technical assessment

4. Implications of Procedural Differences and Directions for Improvement

4.1 Ex Ante Typology and Policy Signaling

A green taxonomy is intended to assess the environmental sustainability of economic activities according to consistent principles and technical criteria. From this perspective, when an activity type is determined before technical assessment, the classification may reflect not only environmental sustainability but also policy considerations concerning the role of the activity.

Under the Korean Green Taxonomy, new nuclear construction and continued operation are assigned to the Transition Sector before detailed technical requirements are assessed. This reflects a policy judgment that nuclear energy is temporarily needed during the transition toward carbon neutrality.

However, if the pre-assigned transitional status is retained even after nuclear activities satisfy technical criteria demonstrating substantial contribution to greenhouse gas mitigation and avoidance of significant harm to other objectives, the assessment of environmental sustainability and the classification of policy roles may become intertwined.

Green or transitional types should therefore function as supplementary descriptors of an activity's contribution or policy role after the sustainability assessment, rather than as preconditions for that assessment.

4.2 Independence of Common Principles and Comparability across Activities

When common principles are presented as independent overarching criteria, it is easier to compare and verify which principles are operationalized by the technical requirements for each economic activity. When principles and activity-specific requirements are presented together within a single criteria framework, however, the purpose and stringency of criteria applied to different activities may be more difficult to compare on a common basis.

This distinction is particularly important for activities such as nuclear energy, which involve both environmental benefits and risks. Judgments concerning substantial contribution and DNSH should be clearly distinguished. When greenhouse gas mitigation benefits and radioactive waste management requirements are assessed together under the Recognition Criteria, the purpose and function of each requirement may be less transparent.

The common principles should therefore be presented as independent overarching criteria applicable across economic activities, while activity-specific technical requirements should be structured as subordinate criteria that operationalize compliance with each principle.

4.3 Predictability in the Selection of Activities for Assessment

Neither the EU nor Korea automatically assesses every economic activity. In the EU, an activity can be assessed only when TSC have been established, while in Korea only activities included in the taxonomy list are subject to green assessment.

Once TSC are established for a particular activity, the EU can add that activity to the existing assessment framework. In Korea, by contrast, adding an activity also requires a policy judgment as to whether it should be placed in the Green or Transition Sector.

If the criteria for selecting economic activities and assigning activity types are unclear, technologies not currently listed may have limited opportunities to be assessed despite their potential environmental contribution, and market participants may find it difficult to anticipate whether and how new activities will be added.

The criteria and procedures for selecting, adding, and removing economic activities should therefore be stated more clearly. In particular, disclosing how potential environmental contributions and the availability of technical criteria affect entry into the assessment framework would improve the predictability of whether new technologies and activities may be included.

Improving the institutional foundation of the Korean Green Taxonomy would also support the predictability of these selection and revision processes. The current guideline-based approach provides flexibility in responding to technological and policy changes, but may offer less continuity in economic-activity classifications and assessment criteria. The principles of

assessment, procedures for selecting and revising activities, and links to green-finance policy should therefore be more clearly formalized in official institutional documents, with consideration given, where appropriate, to establishing a legal or equivalent institutional basis.

5. Conclusions

This study focused on differences in the processes through which nuclear activities are classified under the EU and Korean green taxonomies rather than only on the resulting classifications. The two systems were compared across four stages: selection of activities for assessment, application of common principles, placement and application of technical requirements, and assignment of activity types.

The analysis shows that although the EU and Korea apply broadly similar technical requirements to nuclear activities, their principal differences lie in the order and relationships among activity types, common principles, and technical requirements within the assessment process. The EU centers on eligibility assessment under common principles and activity-specific TSC, in connection with which the character and contribution pathway of an activity are specified. Korea, by contrast, first assigns economic activities to the Green or Transition Sector and then applies activity-specific criteria in which common principles and technical requirements are presented together.

Korea's ex ante typology structure offers policy flexibility and practical usability, but it may cause activity types to function as policy signals before technical assessment and make it more difficult to verify whether common principles are applied consistently.

These procedural differences may appear limited when viewed only in terms of whether currently listed nuclear activities are recognized. However, green taxonomies are repeatedly used to add new technologies, revise existing criteria, determine the eligibility of financial products, and inform corporate investment and disclosure. If activity types are assigned before technical assessment or the links between common principles and technical requirements are unclear, the classification of activities with comparable technical performance may be more sensitive to policy changes, and the timing and conditions under which new technologies can enter the assessment framework may be harder to predict. Financial institutions and investors may also face greater uncertainty when evaluating the long-term taxonomy eligibility and policy durability of economic activities. The clarity of the assessment process is therefore not merely a matter of procedural coherence; it is linked to the stability and predictability of classification outcomes and to market acceptance.

The Korean Green Taxonomy should therefore reconsider activity types as descriptors of assessment outcomes rather than prerequisites for determining

environmental sustainability, and should more clearly identify the assessment principle associated with each technical requirement. It should also improve the transparency and predictability of activity selection and criteria revision procedures and strengthen the institutional foundation of the taxonomy, including its legal basis where appropriate.

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