Environmental, Social and Governance (ESG) Frameworks and Advanced Nuclear Energy

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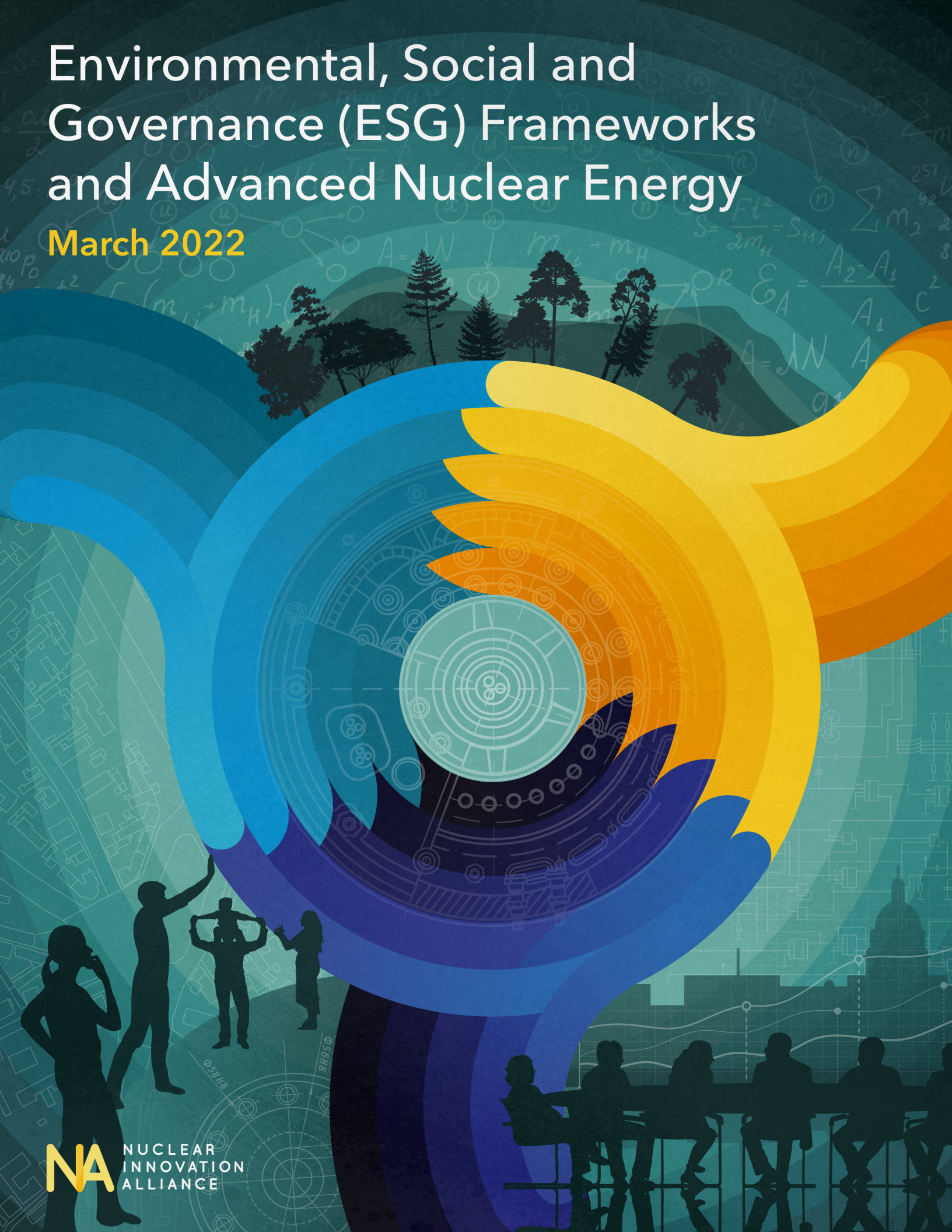

NUCLEAR INNOVATION ALLIANCE

ESG Frameworks and Advanced Nuclear Energy

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Disclaimer:
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Introduction and Executive Summary

Over the past several years investors have developed increased interest in the environmental, social, and governance (ESG) attributes of potential investments. Institutions, both in the non-profit sector and in the for-profit investment reporting and advisory sector, have developed a range of reporting, rating, and accreditation approaches to address this interest. Governments and regulators have begun to consider the consistency and reliability of these approaches and to consider steps to impose standardization on these frameworks.

The underlying objective of ESG frameworks is to create positive interest in potential investments with positive ESG attributes, therefore improving access to and decreasing the cost of capital for those investments. Nuclear energy is particularly affected by the inconsistency of frameworks with regard to environmental attributes. Nuclear energy is clearly a zero-carbon energy source and warrants unbiased, analytical treatment consistent with other such sources (as described in the example reporting at the end of this paper). However, ESG frameworks have diverse origins, and some retain outdated or arbitrary approaches that exclude nuclear energy.

The evolution of ESG frameworks could have a significant impact on access to capital for nuclear energy companies and projects, and for the perception of nuclear energy as a critical tool to achieve decarbonization and improve energy access. Flawed ESG frameworks that embed arbitrary or biased treatments could preclude access to development financing or other government financing for nuclear projects, and could discourage financial institutions from financing nuclear projects and companies. It is critical that advocates of nuclear energy encourage a consistent, unbiased, and analytical treatment of nuclear power—indeed of all energy sources—within ESG frameworks to ensure nuclear energy can contribute to the improvement of the world's climate and energy future.

This paper describes the ESG landscape and concludes with steps the nuclear industry and the financial community could consider to promote consistent analytical treatment of nuclear energy within ESG frameworks and efficient access to capital for nuclear investments.

The ESG ecosystem includes frameworks and standards, reporting entities, auditors, data aggregators and providers, analysts (and raters) along with end users, regulators, and other participants. The organizations are generally international in nature.

Frameworks and Standards Organizations (examples)

- Sustainability Accounting Standards Board (SASB)
- Task Force for Climate-related Financial Disclosures (TCFD)
- Global Reporting Initiative (GRI)
- Climate Disclosure Standards Board (CDSB)

There are several efforts to consolidate and standardize ESG reporting. The International Financial Reporting Standards Foundation (IFRS)[1] is conducting an international effort to consolidate standards through its formation of the International Sustainability Standards Board (ISSB). The Foundation will consolidate the CDSB and SASB organizations and establish a sustainability reporting standard by

[1] The IFRS Foundation sets accounting standards widely used outside the U.S. Its work on sustainability standards is intended to have worldwide application. https://www.ifrs.org/news-and-events/news/2021/11/ifrs-foundation-announces-issb-consolidation-with-cdsb-vrf-publication-of-prototypes/

integrating their work. The European Commission adopted a legislative proposal for a Corporate Sustainability Reporting Directive (CSRD), which if finalized by the European Parliament would require companies to report in compliance with European sustainability reporting standards to be developed by the European Financial Reporting Advisory Group (EFRAG)[2] and adopted by the European Commission.[3] GRI will be working with EFRAG to construct the standards. In March 2022, the U.S. Securities and Exchange Commission (SEC) proposed a rule requiring that public companies disclose direct greenhouse gas emissions and certain information about climate-related risks and, if companies have them, climate-related transition plans.

Reporting, Analysis, and Ratings Organizations (examples)

- FTSE Russell
- Institutional Shareholder Services (ISS)
- Moody's ESG Solutions
- MSCI
- RepRisk
- S&P Global
- Sustainalytics

In many cases, ESG ratings reflect a view of the potential for ESG issues to affect a company's operations and profits, rather than the potential of a company to affect social ESG goals (for example, ratings of nuclear generators may reflect potential financial risk from challenges associated with nuclear waste, although the potential for nuclear energy to grow as part of a portfolio of clean generation technologies may also be reflected). Furthermore, ESG analysis and ratings incorporate a highly summarized treatment of ESG issues and in some cases can reflect outdated or arbitrary treatments that may place nuclear energy at a disadvantage. One potential action for consideration could be to analyze treatment of nuclear energy by the key ratings organizations and conduct outreach to those organizations to promote consistent analytical treatment of nuclear energy.

Green Bonds

Green Bonds can be any type of bond instrument where the proceeds are used for "green" objectives. The ability to issue Green Bonds may in the future be more tightly controlled by government taxonomies. Some Green Bond standards do not incorporate specific treatment of nuclear power, while some may specifically exclude it. Bruce Power, an Ontario, Canada power producer, recently issued Green Bonds to support the life-extension program at its nuclear power station.

Taxonomies

In the context of ESG, a taxonomy is a classification system establishing a list of qualifying economic activities. The highest-profile example is the EU Taxonomy, though there are also taxonomies or similar frameworks in place or in development in several countries. The influence of taxonomies can extend beyond their original purpose, for example, to financial disclosure, labeling of retail financial products, and eligibility for Green Bonds.

[2] https://efrag.org/

[3] https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

Analytical Treatment of Nuclear Energy in an ESG Framework

If evaluated on their merits, nuclear energy projects could report well against ESG metrics. The following document provides a summary example of ESG reporting for advanced nuclear energy.

Potential Actions

The following actions could help support the development of ESG reporting and ratings for advanced nuclear energy developers and projects.

1. Analyze the treatment of nuclear energy by key ratings organizations and conduct outreach to those organizations to promote consistent analytical treatment.
2. Engage in SEC actions on climate change disclosures to promote a consistent analytical approach.
3. Participate in the development of common frameworks such as the one announced by the International Sustainability Standards Board (ISSB), to promote consistent analytical treatment and a neutral approach to nuclear energy.
4. To provide data to support ESG reporting and ratings, companies developing advanced nuclear technologies would need to commit resources to producing and reporting ESG-relevant data typical of more mature organizations. To support that work, actions could include:
    a. Create an advisory guide for advanced nuclear companies to support ESG data reporting. The guide could include opportunities to integrate good business approaches (supportive of ESG criteria) as companies evolve. If feasible, work with one or more ESG rating entities to develop reporting best suited for use in ratings.
    b. Create an example of ESG data reporting for an advanced nuclear company or project.

ESG Reporting Frameworks

The Sustainability Accounting Standards Board (SASB) describes the sustainability reporting ecosystem as including frameworks and standards, reporting entities, auditors, data aggregators and providers, analysts (and raters) along with end users, regulators, and other participants.[4] Some of the commonly referenced framework and standards organizations include:

Sustainability Accounting Standards Board (SASB): began as a non-profit in 2011. It merged with the International Integrated Reporting Council (IIRC) into the Value Reporting Foundation (VRF), which was officially established in mid-2021. SASB has developed 77 industry-based standards as well as a Standards Application Guidance. Industry standards are available for Electric Utilities and Power Generators as well as fuel cell and battery manufacturers, solar manufacturers and project developers, and wind technology and project developers. https://www.sasb.org/

Task Force for Climate-related Financial Disclosures (TCFD): an industry-led task force established under the auspices of the Financial Stability Board (FSB)[5] in 2015. It issued recommendations in 2017 structured around four "pillars":[6]

- **Governance:** The organization's governance around climate-related risks and opportunities.
- **Strategy:** The actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.
- **Risk Management:** The processes used by the organization to identify, assess, and manage climate-related risks.
- **Metrics and Targets:** The metrics and targets used to assess and manage relevant climate-related risks and opportunities.

Global Reporting Initiative (GRI): Published the first version of the GRI Guidelines in 2000. Maintains "Universal Standards" and has recently begun to issue sector standards. https://globalreporting.org/

Climate Disclosure Standards Board (CDSB): an international consortium of "business and environmental NGOs." Provides a framework for reporting environmental information "with the same rigor as financial information." https://www.cdsb.net/

[4] https://www.sasb.org/about/sasb-and-other-esg-frameworks/. SASB also defines "Frameworks" as sets of principles for how a report is structured, and "Standards" as specific, replicable requirements for what should be reported.

[5] The FSB is a not-for-profit association with a charter endorsed by the Heads of State and Government of the G20. Its mandate is to promote international financial stability by coordinating national financial authorities and international standard-setting bodies. https://www.fsb.org/about/

[6] https://www.fsb.org/2017/06/recommendations-of-the-task-force-on-climate-related-financial-disclosures-2/

Consolidation of Frameworks and Government Initiatives

Efforts to consolidate and standardize ESG reporting have evolved rapidly in the last two years. In September 2020, several organizations including SASB, CDSB, and GRI announced a shared vision for comprehensive corporate reporting to include both financial accounting and ESG disclosure.[7] Also in September 2020, the World Economic Forum (WEF), in collaboration with Deloitte, E&Y, KPMG, and PwC issued a white paper "Measuring Stakeholder Capitalism: Towards Common Metrics and Consistent Reporting of Sustainable Value Creation" describing four core categories of metrics: Principles of Governance, Planet, People, Prosperity.[8]

In April 2021, the European Commission adopted a legislative proposal for a Corporate Sustainability Reporting Directive (CSRD) which if finalized by the European Parliament would require companies to report in compliance with European sustainability reporting standards developed by the European Financial Reporting Advisory Group (EFRAG)[9] and adopted by the European Commission.[10] GRI will be working with EFRAG to construct the standards.[11]

In November 2021, the IFRS Foundation, which sets accounting standards widely used outside the United States (playing a role similar to the Financial Accounting Standards Board or FASB), formed the International Sustainability Standards Board (ISSB). The Foundation announced that it would complete consolidation of the CDSB and VRF (i.e., SASB/IIRC) by June 2022, and that it would build on the work of those organizations, the TCFD and WEF, "to become the global standard-setter for sustainability disclosures for the financial markets."[12] The IFRS Technical Readiness Working Group has published prototypes for climate disclosures and general sustainability disclosures.[13]

The worldwide influence of the IFRS/ISSB organization and the official role of the EFRAG process will give those efforts an outsized influence on the future direction of ESG reporting.

The U.S. Securities and Exchange Commission (SEC) established a subcommittee to review ESG issues, which issued recommendations in July 2021, including:[14]

- Regarding Issuer Disclosure (public company reporting): the SEC should encourage issuers to adopt a framework for disclosing material ESG matters, and the SEC should acquire additional expertise to assess how frameworks could play a more authoritative role in the future
- Regarding Investment Product Disclosure (e.g., ESG-targeted funds): the SEC should suggest best practices, including alignment with the terminology developed by the Investment Company

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[7] https://www.sasb.org/about/sasb-and-other-esg-frameworks/

[8] http://www3.weforum.org/docs/WEF_IBC_Measuring_Stakeholder_Capitalism_Report_2020.pdf

[9] https://efrag.org/

[10] https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

[11] https://www.efrag.org/Assets/Download?assetUrl=%2fsites%2fwebpublishing%2fSiteAssets%2fEFRAG%2520GRI%2520COOPERATION%2520PR.pdf

[12] https://www.ifrs.org/news-and-events/news/2021/11/ifrs-foundation-announces-issb-consolidation-with-cdsb-vrf-publication-of-prototypes/

[13] https://www.ifrs.org/groups/technical-readiness-working-group/#resources

[14] https://www.sec.gov/files/spotlight/amac/recommendations-esg.pdf

Institute ("ICI") ESG Working Group,[15] and clear description of each product's strategy and investment priorities, as well as description of non-financial objectives

In March 2022, the SEC proposed a rule requiring that public companies disclose direct greenhouse gas emissions (Scope 1) as well as those from purchased energy (Scope 2) and establishing standards for how emissions should be measured and disclosed.[16] The proposed rule also requires disclosure of emissions from upstream and downstream activities (Scope 3) under certain circumstances, including if the company has publicly set climate-related targets or goals. Companies would also be required to disclose certain information about climate-related risks and, if companies have them, climate-related transition plans. The requirements would phase in over time depending on the size of the company, with the earliest reporting requirements potentially effective for reporting for fiscal year 2023. The proposed rule will be open for public comment through at least May 20, 2022, before it is finalized, which requires a vote of the SEC commissioners.

[15] "Funds' Use of ESG Integration and Sustainable Investing Strategies: An Introduction," Investment Company Institute, July 2020, https://www.ici.org/pdf/20_ppr_esg_integration.pdf

[16] https://www.sec.gov/files/33-11042-fact-sheet.pdf

Reporting, Analysis, and Ratings

ESG analysis, ratings, and index construction is provided by organizations with a long history of investment analysis, as well as some organizations begun with a specific focus on ESG. Common examples include:

FTSE Russell: Long history of investment research and investment portfolio construction. Produces the FTSE4Good index series. https://www.ftserussell.com

Institutional Shareholder Services (ISS): a long-time provider of data for institutional investors, initially focused on corporate governance https://www.issgovernance.com/esg/

Moody's ESG Solutions: Moody's acquired Vigeo Eiris (VE) and integrated it into Moody's ESG Solutions in 2020; the VE brand is being retired. Data reporting, public indices, reported indices. https://esg.moodys.io/solutions

MSCI: Long history of investment research. 1,500 equity and fixed-income ESG indexes. https://www.msci.com

RepRisk: a broad-based provider of ESG data for analysis and diligence https://www.reprisk.com/

S&P Global: Long history of investment research and ratings. Acquired the SAM ESG Ratings and Benchmarking business from RobecoSAM (SAM) in 2020. https://www.spglobal.com/ratings/en/products-benefits/products/esg-evaluation

Sustainalytics: Began independently but subsequently merged with and is part of Morningstar. https://www.sustainalytics.com/

Many other organizations also provide ESG analysis, ratings, and indices; for example, common financial data platforms such as Bloomberg and Thomson Reuters Eikon report ESG data and ratings.

The interpretation of ESG ratings can be problematic. In many cases, ESG ratings reflect a view of the potential for ESG issues to affect a company's operations and profits, rather than the potential of a company to affect social ESG goals. For example, ratings of nuclear generators may reflect potential financial risk from the uncertainty regarding final disposal of nuclear waste, although the potential for nuclear energy to grow as part of a portfolio of clean generation technologies may also be reflected.

Furthermore, ESG analysis and ratings incorporate a highly summarized treatment of ESG issues, using methodologies that are often not transparent or publicly available, and that in some cases can reflect outdated or arbitrary treatments that may place nuclear energy at a disadvantage. For example, MSCI's materiality map for electric utilities measures "opportunities in renewable energy" rather than opportunities in or commitment to clean energy that could include nuclear.[17] One potential action for consideration could be to analyze treatment of nuclear energy by the key ratings organizations and conduct outreach to those organizations to promote consistent analytical treatment of nuclear energy.

[17] https://www.msci.com/our-solutions/esg-investing/esg-ratings/materiality-map

Green Bonds

Green Bonds can be any type of bond instrument where the proceeds are used for "green" objectives. The International Capital Market Association (ICMA) Green Bond Principles, which are voluntary process guidelines, recognize broad categories of eligibility for Green Bonds, such as climate change mitigation, climate change adaptation, natural resource conservation, biodiversity conservation, and pollution prevention and control. The Principles list indicative categories (which are described as not exclusive) that include renewable energy but not nuclear energy or other forms of clean power.[18] Other green bond frameworks explicitly include nuclear power, such as the Climate Bonds Initiative.[19] The ability to issue Green Bonds may in the future be more tightly controlled by government taxonomies, as noted below.

Bruce Power, an Ontario, Canada power producer, recently issued Green Bonds to support the life-extension program at its nuclear power station.[20] The bonds received an independent review by CICERO Shades of Green, which gave the project an overall designation of Medium Green. This designation is given to projects that represent "steps towards" the long-term vision of a low-carbon and climate-resilient future.[21] The Bruce Power issuance is the first instance of green bonds having been issued to finance nuclear generation. Although this issuance was to support refurbishment of existing nuclear generation, evaluations of green designations for private-sector financing of new nuclear generation could be similar. More recently, the Government of Canada has issued a Green Bond Framework applicable to bonds financing *government expenditures* that explicitly excludes expenditures supporting nuclear energy.[22]

[18] https://www.icmagroup.org/sustainable-finance/the-principles-guidelines-and-handbooks/green-bond-principles-gbp/

[19] https://www.climatebonds.net/standard/taxonomy

[20] https://www.newswire.ca/news-releases/a-global-first-bmo-supports-bruce-power-with-world-s-first-nuclear-green-financing-framework-848817283.html; also see https://newsroom.bmo.com/2021-11-22-A-Global-First-BMO-Supports-Bruce-Power-with-Worlds-First-Nuclear-Green-Financing-Framework

[21] See the factsheet at https://cicero.green/

[22] https://www.canada.ca/en/department-finance/programs/financial-sector-policy/securities/debt-program/canadas-green-bond-framework.html

Taxonomies

In the context of ESG, a taxonomy is a classification system establishing a list of qualifying economic activities. There are taxonomies or similar frameworks in place or in development in the European Union, United Kingdom, Canada, China, Russia, South Africa, and other countries.[23] They establish bright lines for qualifying activities, such as eligibility for government investment, which is challenging. Regardless of initial intent, they are likely to be referenced in further regulations. For example, the EU Taxonomy has received significant attention because of the potential breadth of its reach; it will also control financial disclosures,[24] eligibility to receive the EU Ecolabel for retail financial products,[25] eligibility to issue an EU Green Bond,[26] and eligibility for development finance.

The EU Taxonomy has also received attention because of the extended process undertaken to consider the status of nuclear energy. The EU Taxonomy established six environmental objectives: (1) climate change mitigation, (2) climate change adaptation, (3) sustainable use and protection of water and marine resources, (4) transition to a circular economy, (5) pollution prevention and control, and (6) protection and restoration of biodiversity and ecosystems. An activity is considered sustainable (qualifying) if it addresses one of the six objectives and does not significantly harm any of the others (the "do no significant harm" or DNSH criterion).[27] Many activities focused on climate change mitigation were included in the EU Taxonomy as sustainable in early 2021, but a determination on the "do no significant harm" aspects of nuclear energy was submitted to an extended review.

The technical assessment has been completed and reviewed, with the Joint Research Centre[28] concluding that its analysis "did not reveal any science-based evidence that nuclear energy does more harm to human health or to the environment than other electricity production technologies already included in the Taxonomy as activities supporting climate change mitigation,"[29] and other reviewing bodies concurring or not challenging that conclusion.[30] In January, 2022, the European Commission began consultations on a draft Delegated Act that would include nuclear power in the EU Taxonomy as a transitional activity[31] under strict conditions, such as that projects begin construction by 2045 and that

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[23] An extended list is available at https://www.world-nuclear.org/information-library/energy-and-the-environment/appendices/nuclear-energy-and-sustainable-finance.aspx

[24] https://www.spglobal.com/esg/insights/a-short-guide-to-the-eu-s-taxonomy-regulation

[25] https://www.spglobal.com/esg/insights/a-short-guide-to-the-eu-s-taxonomy-regulation

[26] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/european-green-bond-standard_en

[27] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

[28] The Joint Research Centre is the European Commission's science and knowledge service, and was asked to perform the technical assessment. https://ec.europa.eu/info/departments/joint-research-centre_en

[29] European Commission Joint Research Centre, JRC Science for Policy Report: Technical assessment of nuclear energy with respect to the 'do no significant harm' criteria of Regulation (EU) 2020/852 ('Taxonomy Regulation') (29 March 2021) https://ec.europa.eu/info/file/210329-jrc-report-nuclear-energy-assessment_en

[30] See https://www.world-nuclear.org/information-library/energy-and-the-environment/appendices/nuclear-energy-and-sustainable-finance.aspx and https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en for a further discussion of the process to consider inclusion of nuclear power in the EU Taxonomy.

[31] A fundamental issue with the treatment of nuclear energy under the EU Taxonomy is that only "renewable" energy generation can be considered "sustainable" by virtue of the underlying EU regulatory basis for the

countries in which they would operate have detailed plans for waste disposal facilities to be operational by 2050, among other criteria.[32] These consultations are the beginning of a several-month process that, if completed, would culminate in a vote by the European Parliament.

Taxonomy itself, so nuclear energy is confined to being considered a transitional activity regardless of the conclusions of the scientific evaluation. See REGULATION (EU) 2020/85 at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020R0852#d1e1327-13-1.

[32] See https://ec.europa.eu/commission/presscorner/detail/en/ip_22_2 and https://int.nyt.com/data/documenttools/european-commission-draft-proposal/9865f31c3619fee9/full.pdf

Achieving Consistent Analytical Treatment of Nuclear Energy in an ESG Framework

Several analyses show that if evaluated on their merits, nuclear energy projects could report well against ESG metrics. For example, the Generation IV International Forum produced a report that describes how nuclear energy could report against the World Economic Forum's ESG framework of Governance, Planet, People, and Prosperity.[33] A report by the Expert Group on Resource Management of the United Nations Economic Commission for Europe (UNECE) describes how nuclear power satisfies the 17 UN sustainable development goals (See Appendix 2).[34]

Renewable energy technologies such as wind and solar generation are often accepted on their face as sustainable, whereas nuclear power may be viewed as sustainable or not based on preconceived views of its characteristics. A more thoughtful, consistent, analytical approach would consider the details of specific technologies, companies, and projects, such as land use, local environmental impacts, labor and community impacts, governance, supply chains for raw materials and components, waste management, and end-of-life management. The following limited summary describes at a high level how nuclear energy could be evaluated against ESG criteria.

Summary Example of ESG Reporting for Advanced Nuclear Energy

The following discussion is intended only to provide summary examples of nuclear energy attributes that might be considered in an ESG context. It is not intended as a comprehensive treatment, which would require a much more complete and detailed discussion. [Where relevant, the examples identify distinctions between conventional and advanced nuclear technologies.]

Environmental

- Air emissions
    - Lifecycle CO_2 emissions per kWh among the lowest of the power generation options, with no generation emissions at the plant site
    - Largest current source of zero-carbon power in developed countries (IEA),[35] second largest worldwide behind hydro
    - Does not emit particulate matter, nitrogen oxide (NOx), sulfur oxide (SOx), volatile organic compounds, or other air pollutants
- Land use: estimates vary, but all conclude nuclear energy uses far less land per kWh than other zero-carbon generation. For example, the Generation IV Forum estimates that wind power generates 0.77 MWh/km^2, solar PV 1.0 MWh/km^2, and a small modular reactor 14.5 MWh/km^2. Opportunities to site advanced reactors at retired coal plants can also make use of brownfield rather than greenfield sites, and reduce the need for supporting infrastructure like new transmission lines and maintenance roads.
- Waste
    - Production of nuclear waste (particularly used or "spent" fuel) is frequently cited as a significant harm caused by nuclear power. Nuclear waste requires careful management (which is a key point of focus in nuclear operations) and disposal (the fundamental

[33] https://www.gen-4.org/gif/jcms/c_179264/nuclear-energy-an-esg-investable-asset-class

[34] https://unece.org/info/publications/pub/353609

[35] https://www.iea.org/reports/nuclear-power-in-a-clean-energy-system

technical approach to which has been determined to be sound, as described below, although it has proven politically challenging to agree on the construction of facilities). However, it is useful to keep in mind that the quantity of waste produced is small compared to waste from other energy technologies; all the used fuel produced by US commercial nuclear generation since the 1950s would fit on one football field[36]

  - Conclusion of the Joint Research Centre (JRC): "Presently, there is broad scientific and technical consensus that disposal of high-level, long-lived radioactive waste in deep geologic formations is, at the state of today's knowledge, considered as an appropriate and safe means of isolating it from the biosphere for very long time scales."[37]
  - Many advanced reactor technologies will use fuel more efficiently and produce less waste per unit of energy generated than conventional reactors
  - Nuclear waste is carefully managed and tracked; plant operators pay for the cost of future used fuel disposal through government fees[38] and provide financial assurance for eventual decommissioning; other energy technologies do not manage waste and end-of-life with similar levels of attention and financial responsibility, even though some of their wastes may pose a significant risk
  - A disproportionate focus on nuclear waste ignores waste issues from other technologies, such as emerging concerns with managing end-of-life waste from solar and wind as the first major projects begin to reach the end of their useful lives (and battery storage will also generate significant waste when retired)
- Materials use
  - Building nuclear power plants requires far smaller quantities of other materials (e.g., concrete, steel, etc.) per unit of output than solar or wind power;[39] CO_2 emissions from production of these materials may be particularly challenging to reduce compared to achieving reductions from energy production
- Mining impacts
  - Legacy uranium mining, as with many mining operations, did not implement sound environmental management
  - Current uranium mining is conducted primarily in Australia, Canada, and Kazakhstan by multinational mining companies with strong regulatory oversight and environmental management systems
  - Many mines currently feature *in-situ* mining techniques, which limit land-use disruptions
  - Current uranium mining has greater regulatory oversight than other mining operations (such as mining for rare earth elements needed for solar panels and lithium-ion batteries) and the resulting operational performance is generally as good or better than comparable mining activities.[40]

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[36] https://nei.org/fundamentals/nuclear-waste

[37] European Commission Joint Research Centre, JRC Science for Policy Report

[38] Due to the delays in establishing a permanent US Government disposal site, forcing operators to continue to care for their waste, some operators have suspended their fee payments, but have paid substantial fees to date.

[39] https://world-nuclear.org/information-library/energy-and-the-environment/nuclear-energy-and-sustainable-development.aspx

[40] Nuclear Energy Agency, "Managing Environmental and Health Impacts of Uranium Mining," https://www.oecd-nea.org/jcms/pl_14766

- Water
    - Gross water consumption for conventional nuclear power is material, but there are approaches to mitigate fresh-water requirements; nuclear power plants and the nuclear supply chain are not a large source of water pollution or contaminants
    - Many advanced nuclear technologies can use less water for cooling or be air-cooled
    - Nuclear energy has significant potential as the energy source for desalination plants, making fresh water more accessible

Social

- Energy affordability
    - Much attention has been given to the steep decline and current low levelized cost of energy (LCOE) production from solar and wind generation; however, solar and wind generation must be supplemented with energy storage to manage its variable output, and generally requires significant transmission and interconnection costs
    - Additional system costs associated with variable renewable energy could be $30/MWh at 50% VRE and $50/MWh at 75% VRE,[41] offsetting the simple LCOE advantage in many circumstances; these costs are not applicable to dispatchable power technologies such as nuclear
    - Once built, nuclear energy produces electricity at low costs for decades
- Safety
    - Nuclear energy sites incorporate multiple safety programs, are closely regulated for safety, and safety culture is very strongly embedded in nuclear operations
    - Despite two high-profile failures leading to core compromises at early-generation nuclear reactors (Fukushima and Three Mile Island),[42] nuclear energy remains among the safest energy technologies on the basis of fatalities per unit of energy produced[43]
    - Advanced nuclear technology designs incorporate inherent safety features that rely on natural phenomena (gravity, convection, heat transfer, etc.); these designs also pose less risk due to their smaller sizes and smaller radioactive material inventories compared to conventional designs
    - Best estimates indicate that advanced reactors could be at least ten to one hundred times safer than conventional reactors
- Non-Proliferation
    - There is a very strong international framework to protect against diversion of nuclear material for weapons
    - Nuclear proliferation is primarily driven by governments' views of national security, not the spread of nuclear energy
    - It is unrealistic to expect that existing nuclear weapons states would denuclearize even if nuclear technology was no longer used for energy production

[41] https://www.oecd-nea.org/jcms/pl_15000/the-costs-of-decarbonisation-system-costs-with-high-shares-of-nuclear-and-renewables

[42] This sets aside Chernobyl, the failure of which was a function of a severely flawed governance and regulatory system and the design of which does not represent modern commercial nuclear power reactors

[43] For example, see European Commission Joint Research Centre, JRC Science for Policy Report

    - A continued healthy civil nuclear sector in countries with strong non-proliferation commitments, like the U.S. and Europe, is important to the strength of global non-proliferation norms
- Supply chain
    - Supply chains for nuclear power are carefully controlled and documented. Corruption has occurred in nuclear supply chains (e.g., Korea) but the degree of control and documentation makes it likely that it will be discovered and remediated
- Labor standards and worker safety
    - Globally, nuclear regulators require careful attention to workplace safety, and require the tracking and reporting of safety incidents. Organizations such as the International Atomic Energy Agency (IAEA) and World Association of Nuclear Operators (WANO) help provide international transparency on operational safety and promote safe operation of nuclear power plants around the world.
- Jobs/Pay/Living wage
    - Both construction and operation of nuclear power plants require a high level of skill, resulting in jobs that typically command high wages
    - Nuclear power operations require sophisticated training and offer opportunities for advancement
    - Economic multipliers for spending on nuclear energy projects are the highest among green investments[44]
- Nuclear projects employ more people during operations than other zero-carbon generation, which strengthens the host communities
- Advanced nuclear reactors can be sited at retired coal sites (e.g., Wyoming), facilitating continued support of the local economy

Governance

- Governance attributes are primarily a function of individual companies and projects rather than the types of technologies employed. However, the nuclear sector's highly regulated nature, typically including requirements regarding ownership and control of nuclear assets, encourages positive reporting on governance measures.

[44] https://www.imf.org/en/Publications/WP/Issues/2021/03/19/Building-Back-Better-How-Big-Are-Green-Spending-Multipliers-50264

Potential Actions

Potential actions to promote consistent analytical treatment of nuclear energy under ESG frameworks and efficient access to capital for investments in nuclear energy could include efforts to participate in the development of ESG frameworks as they evolve and are consolidated, to conduct outreach to key organizations, and to support the work of companies developing advanced nuclear technologies to report against ESG metrics. Specific actions to consider include:

1. Analyze the treatment of nuclear energy by key ratings organizations and conduct outreach to those organizations to promote consistent analytical treatment.
2. Engage in SEC actions on climate change disclosures to promote a consistent analytical approach.
3. Participate in the development of common frameworks such as the one announced by the International Sustainability Standards Board (ISSB), to promote consistent analytical treatment and a neutral approach to nuclear energy.
4. To provide data to support ESG reporting and ratings, companies developing advanced nuclear technologies would need to commit resources to producing and reporting ESG-relevant data typical of more mature organizations. To support that work, actions could include:
    a. Create an advisory guide for advanced nuclear companies to support ESG data reporting. The guide could include opportunities to integrate good business approaches (supportive of ESG criteria) as companies evolve. If feasible, work with one or more ESG rating entities to develop reporting best suited for use in ratings.
    b. Create an example of ESG data reporting for an advanced nuclear company or project.

Appendix 1

List of Acronyms

CDSB – Climate Disclosure Standards Board

CSRD – Corporate Sustainability Reporting Directive (CSRD) (directive of the EU)

EFRAG – European Financial Reporting Advisory Group

ESG – Environmental, Social, and Governance

FSB – Financial Stability Board

GRI – Global Reporting Initiative

ICMA – International Capital Market Association

ISSB – International Sustainability Standards Board (established by the IFRS Foundation)

SASB – Sustainability Accounting Standards Board

SEC – U.S. Securities and Exchange Commission

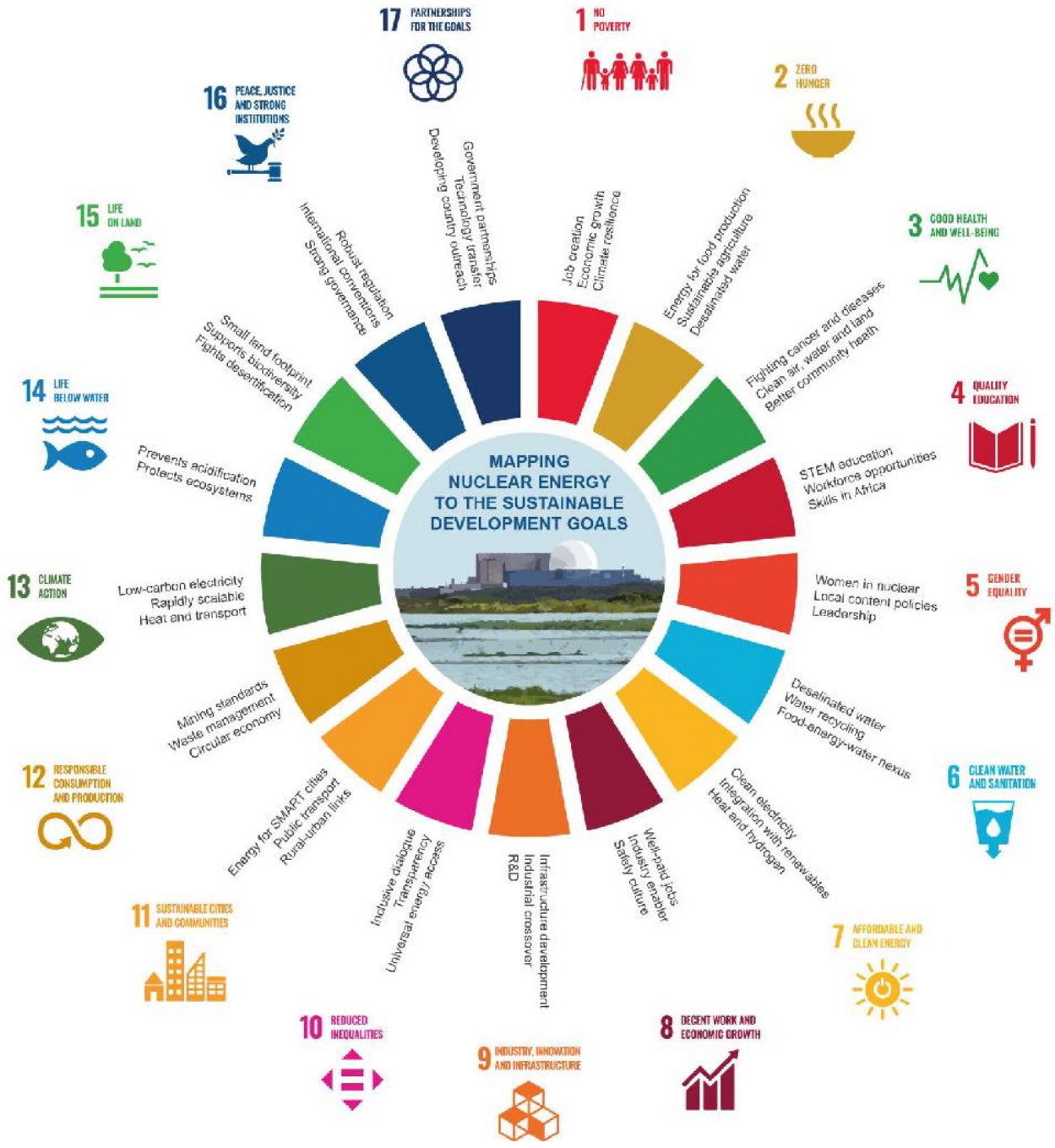
TCFD – Task Force for Climate-related Financial Disclosures

UNECE – United Nations Economic Commission for Europe

WEF – World Economic Forum

Appendix 2

Nuclear Power Satisfies the 17 UN Sustainable Development Goals



Source: Application of the United Nations Framework Classification for Resources and the United Nations Resource Management System: Use of Nuclear Fuel Resources for Sustainable Development – Entry Pathways, A report prepared by the Expert Group on Resource Management Nuclear Fuel Resources Working Group, Geneva, 2021 https://unece.org/info/publications/pub/353609