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Second Party Opinion

Topsoe A/S' Green Finance Framework

May 13, 2024

Location: Denmark

Sector: chemicals

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Alignment With Principles

Aligned = ✓ Conceptually aligned = ○ Not aligned = ✗

- ✓ Green Bond Principles, ICMA, 2021 (with June 2022 Appendix 1)
- ✓ Green Loan Principles, LMA/LSTA/APLMA, 2023

See [Alignment Assessment](#) for more detail.

Dark green

Activities that correspond to the long-term vision of a low-carbon climate resilient future.

Our [Shades of Green Analytical Approach](#) >

Strengths

Solid oxide electrolyzer cells (SOECs) can help decarbonize hard-to-abate sectors by enabling green hydrogen production. When powered by renewable energy, SOECs can be used by emissions-intensive sectors either as an input for chemicals and fuels, or as an energy source to replace fossil fuels. There is a risk that the technology could be powered by fossil fuels, thereby eliminating the climate benefits, but we view this as unlikely.

The technical characteristics of SOECs allow for a more energy-efficient performance than other electrolyzer technologies. This is because, compared to alkaline and proton exchange membrane (PEM) electrolyzers, SOECs require less electricity to operate and are able to reuse waste heat from integrated industrial processes.

Weaknesses

No weaknesses were identified.

Areas to watch

Topsoe's SOECs could be used for activities that the Paris Agreement intends to phase out. These applications, which include refineries for low-sulfur diesel, carry a risk that the SOEC could reduce the production emissions of high emitting outputs, which is not in line with the Paris Agreement's 2050 vision.

Topsoe's initiative to reduce greenhouse gas emissions through supplier engagement is in its early stages. The company has set a target to ensure that two-thirds of its suppliers adopt science-based emission reduction targets by 2027. However, achieving this aim will hinge on Topsoe actively engaging with, and following up on, suppliers.

Eligible Green Projects Assessment Summary

Eligible projects under issuer's green finance framework are assessed based on their environmental benefits and risks, using Shades of Green methodology.

Renewable energy

Dark green

Manufacturing of energy efficient SOECs to produce green hydrogen, including the construction and modification of the manufacturing plant.

Research and development (R&D) related to non-fossil-based technologies and solutions enabling net zero.

Solar energy, waste heat recovery, heat pumps, and energy storage installations.

See [Analysis Of Eligible Projects](#) for more detail.

Issuer Sustainability Context

This section provides an analysis of the issuer's sustainability management and the embeddedness of the financing framework within its overall strategy.

Company Description

Topsoe A/S, headquartered in Denmark, offers decarbonization technologies, catalysts, and services globally for fuel and chemical production, crucial for the energy transition. Their portfolio includes solutions for chemical processing, hydro processing, and air emission control, along with various engineering and technical services. Serving a wide range of industries from ammonia to waste disposal, the company, founded in 1940, evolved from Haldor Topsoe A/S to Topsoe A/S in April 2022 and is a subsidiary of Topsøe Holding A/S.

Material Sustainability Factors

Climate Transition Risk:

Chemical production emits significant greenhouse gases, accounting for about 5%-6% of global emissions. The sector heavily depends on fossil fuels both for energy supply and for product feedstocks. Regulatory pressure to decarbonize chemicals production is likely to grow and require investment in cleaner processes or more innovative feedstocks. Longer term, failure to curb emissions may lead to stranded assets. That said, some industry segments contribute to the economy's decarbonization, for instance the production of specialized materials in key transition technologies. Catalysts play a pivotal role in enhancing the efficiency of chemical reactions, vital for Power-to-X technologies, which convert electricity into fuels, chemicals, or materials. Topsoe has an important role in the transition to net zero because its products enable the storage of renewable energy and the reduction of carbon emissions across various industries.

Physical Climate Risk:

The chemicals sector, integral to numerous industries, faces significant physical climate risks, including extreme weather events and changing climate patterns. These risks pose operational challenges, potentially disrupting supply chains, damaging infrastructure, and impacting resource availability. For instance, increased severity of storms and floods can threaten manufacturing plants and logistics, while temperature variations affect raw material quality and availability. In Denmark, where the chemicals sector is a crucial part of the economy, understanding and mitigating these physical climate risks is vital. The country's geographical location exposes it to specific climate-related challenges, such as rising sea levels and increased precipitation, highlighting the importance of robust risk management practices to ensure resilience and sustainability in the face of changing global climate conditions.

Pollution

Chemical manufacturing processes emit harmful air pollutants, while leakages and spills particularly during production, transportation, use, and end-of-life can have additional and rampant consequences for human health, natural capital, and biodiversity. The UN Environment Program's report on Denmark's Air Quality Policies indicates that the nation complies with limit values for almost all monitored substances. However, the report says Denmark needs to intensify its efforts to address nitrogen dioxide levels. The report also highlights its ongoing air pollution challenges, including ultrafine particles in major urban areas and nitrogen depositions in certain rural regions.

Waste And Recycling:

The sector's management of waste and recycling often draws public attention. For instance, plastic pollution has been increasingly under public scrutiny given the very visual impact on landscapes and immediate toll on biodiversity as wild animals inadvertently ingest waste materials. Chemical companies are thus under pressure to develop technologies and infrastructures

for chemicals collection, recycling, and biodegradation. Accordingly, product lifecycle management is becoming increasingly relevant, especially for commodity chemicals, including through regulation of single-use or short-life plastics. The Danish Environmental Protection Agency oversees regulations for chemicals, biocides, and pesticides, emphasizing the reduction of environmental and climate impacts from waste, including chemical waste. Its policies focus on minimizing the use and disposal of hazardous substances, ensuring safe treatment and disposal to mitigate potential risks to the environment and public health.

Biodiversity And Resource Use:

The industry can have adverse impacts on biodiversity through the promotion of large-scale monoculture for feedstock or the location of industrial complexes in sensitive ecological areas. Policymakers' thinking on the assessment and preservation of natural capital is accelerating stringent regulatory action, which may require changes to materials sourcing. Chemical products can also impact biodiversity through pollution to air, soil, and water.

Issuer And Context Analysis

The project category covered by this framework focuses on renewable energy, encompassing the production of energy-efficient SOECs for green hydrogen, along with R&D for non-fossil-fuel-based technologies and energy-efficiency and renewable-energy measures to achieve lower production emissions. The category also includes projects related to solar energy, waste heat pumps, and energy storage systems. The framework aligns with the increasing demand for power-to-X products that support the transition to a net-zero future. Although the projects within the framework facilitate this transition, challenges persist. These include reducing emissions across the value chain, minimizing pollution and waste, and tackling biodiversity risks.

Topsoe has undertaken a physical climate assessment and is committed to achieving net-zero emissions in its value chain by 2040, though it remains exposed to some energy supply issues.

The company has set 2030 targets to cut its absolute scope 1 emissions by more than 95% and its scope 2 emissions entirely. Its strategy includes reducing emissions in its global operations, and improving energy efficiency. Although scope 1 and 2 emissions (approximately 25% of total emissions in 2023) increased by 40% in 2023, we note that this was due to increased production and the purchase of renewable energy certificates in 2022. Without the certificates, the increase is 11%. It aims to align with the Corporate Sustainability Reporting Directive (CSRD) by defining its material value chain sustainability topics and plans to report on these starting this year. With about 67% of its emissions stemming from scope 3 supply chain activities, Topsoe is engaging with 80% of its suppliers (in spending terms) to encourage them to join the Carbon Disclosure Project (CDP) and to report on their progress toward net zero. Additionally, the company expects two-thirds of its suppliers to have science-based targets by 2027. However, Topsoe's supplier engagement regarding carbon dioxide emissions targets is still in the early stages and limited to compliance with its own Supplier Code of Conduct. Topsoe aims to enhance its data collection on suppliers and will start evaluating their emissions-reduction progress in 2025. In 2022, Topsoe conducted a climate risk assessment, adhering to Taskforce on Climate Related Financial Disclosures (TCFD) standards, in which it analyzed its asset vulnerability to physical climate risks. The evaluation showed that the Herning SOEC plant has a low physical climate risk exposure.

Topsoe complies with Danish Environmental Protection Agency regulations, focusing on reducing environmental impacts by managing pollution, waste, biodiversity loss, and hazardous materials.

In 2023, it transitioned to a chromium-free high-temperature-shift catalyst, in an effort to reduce its use of harmful chemicals. This year, Topsoe is introducing a TertiNOx™ plant to significantly reduce nitric oxide and nitrous dioxide emissions. It also switched to electric trucks at the Frederikssund site to lower noise and emissions. Additionally, to mitigate biodiversity risks along its supply chain, Topsoe has improved its recycled metal usage, and is developing technologies to help produce Sustainable Aviation Fuels (SAF) from sustainably sourced biomass and non-fossil feedstocks. This aligns with its Responsible Minerals Sourcing Policy and Supplier Code of Conduct.

Alignment Assessment

This section provides an analysis of the framework's alignment to Green Bond and Loan principles.

Alignment With Principles

Aligned = ✓ Conceptually aligned = ○ Not aligned = ✗

✓ Green Bond Principles, ICMA, 2021 (with June 2022 Appendix 1)

✓ Green Loan Principles, LMA/LSTA/APLMA, 2023

✓ Use of proceeds

All the framework's green project categories are shaded in green, and the issuer commits to allocate the net proceeds issued under the framework exclusively to eligible green projects. Please refer to Analysis of Eligible Projects section for more information on our analysis of the environmental benefits of the expected use of proceeds. Topsoe is committed to allocating an amount equivalent to the net proceeds from the green financing instruments to finance or refinance eligible green projects related to renewable energy. We understand from the issuer that the majority of net proceeds will be allocated to the SOEC manufacturing plant, followed by investment in R&D related to non-fossil-fuel-based technologies. The rest will be dedicated to renewable energy and energy storage solutions. The maximum lookback period for operating expenditure is three years before issuance, which is in line with standard market practice.

✓ Process for project evaluation and selection

The framework sets out project evaluation and selection processes. Topsoe has established a Green Finance Committee (GFC) comprising the Chief Financial Officer and representatives from the treasury and sustainability functions. The GFC assesses the potential projects against the framework's eligibility criteria as well as ensuring compliance with the applicable laws and regulations and its internal sustainability strategy and policies. The GFC prioritizes and selects eligible projects for allocation and replaces them if they no longer meet the eligibility criteria. Topsoe has processes to address the environmental and social risks associated with the eligible projects by ensuring compliance with its impact, risk, and opportunity assessment framework. This includes its supplier code of conduct, human rights due diligence, and adherence to its responsible procurement policy especially for imported chemicals and finished products. The issuer has also undertaken a double materiality assessment and is building its due diligence framework to meet CSRD requirements from 2025. We understand the issuer provides power-to-X technology and decarbonization solutions especially for hard-to-abate sectors and that it will prohibit R&D investments in fossil-based technologies under this framework. The absence of an exclusion list does not, therefore, limit our analysis.

✓ Management of proceeds

Topsoe has established a green register to monitor fund allocations to eligible projects. If the projects and assets are divested or are no longer in line with the framework's eligibility criteria, the issuer, through its GFC, will replace them with other eligible projects. Unallocated proceeds will be managed in accordance with issuer's liquidity management policy. Additionally, the issuer endeavors to obtain third-party verification of its internal tracking method, which we view as strong practice because it goes beyond the requirements of the Green Bond Principles.

✓ Reporting

Topsoe commits to reporting on the allocation of net proceeds, which will include a brief description of financed projects and the remaining balance of unallocated proceeds. The report will be published on its website either annually or in the event of material changes until the maturity of the underlying debt instruments. Furthermore, we understand from the issuer that it will disclose the actual environmental impacts of financed eligible projects on a best effort basis. We view as strong practice Topsoe's commitment to an annual third-party verification of its allocation reporting post-issuance until full allocation.

Analysis Of Eligible Projects

This section provides details of our analysis of eligible projects, based on their environmental benefits and risks, using the Shades of Green methodology.

Topsoe expects to allocate 100% of proceeds to the renewable energy category.

The issuer expects 50% of proceeds to be allocated to the construction and modification of its SOEC plant, with the majority of the remaining proceeds dedicated to R&D. Residual proceeds will be used for energy efficiency and renewable energy activities for its facilities.

Overall Shades of Green assessment

Based on the project category shades of green detailed below, and consideration of environmental ambitions reflected in issuer's green finance framework, we assess the framework Dark green.

Green project categories

Renewable energy

Assessment

 Dark green

Description

- Manufacturing of energy-efficient SOECs to produce green hydrogen, including construction and modification of the plant manufacturing the SOECs .
- R&D activities related to non-fossil-based technologies and solutions enabling net-zero.
- Solar energy, waste heat recovery, heat pumps, and energy storage installations.

Analytical considerations

- Topsoe's SOECs can play a key role in enabling the production of green hydrogen, which is needed for energy- and emissions-intensive sectors such chemical and fuel companies, steel producers, refineries, and gas utilities to reduce emissions in line with a low carbon and climate resilient future. We therefore assess the issuer's investments in its SOEC manufacturing capabilities as Dark green to reflect the technology's potential to help Paris Agreement-aligned decarbonization, especially for hard-to-abate sectors. The resulting green hydrogen can be used directly as an energy source or converted into other energy carriers (for example ammonia and methanol) through synthesizing processes.
- SOECs could potentially be used to lower emissions for activities that will need to be phased out to achieve 2050 ambitions, such as refineries for low sulphur diesel. This could create a risk of emissions lock-in by allowing such sectors to generate high-emitting outputs using low-carbon energy. However, we believe the significant overall decarbonization potential of the technology outweighs these risks, and so we consider it a long-term low-carbon climate-resilient solution. Similarly, although unlikely, SOECs could be powered by electricity generated by fossil fuels, which could also undermine the carbon-emissions-reduction potential of the technology.
- Topsoe's SOECs consist of an assembly of cell stacks, each formed of a cathode, anode, and electrolyte, and the electrolysis plant around them. They operate at high temperatures of around 750 degrees Celsius, which allows for improved performance when compared to alkaline and PEM electrolyzers. According to the issuer, this is because SOECs require less electricity than other electrolysis methods to produce the same amount of green hydrogen. SOECs are more energy and electricity efficient and can reuse waste heat from the industrial processes into which they have been integrated. The issuer used its own methodology to conduct a lifecycle assessment of the manufacture of hydrogen and found that, when powered by offshore wind, its SOECs can achieve lifecycle emissions of 0.9 tCO₂e/tH₂. When in operation, this depends on the type of energy used, which is typically determined by the issuer's clients. We acknowledge that it is unlikely that fossil fuels will be used to power SOECs, as the resulting output would not be green hydrogen and the potential for climate benefits would be reduced. The issuer

Dark green

Activities that correspond to the long-term vision of a low-carbon climate resilient future.













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expects the lifecycle emissions for green hydrogen produced using its SOECs will be below the EU Taxonomy threshold of 3 tCO_{2e}/tH₂.

- SOECs do not use fossil fuels as part of the production process. The main materials used are ceramics and nickel. The latter may create exposure to supply-chain environmental and social risks such as ecosystem destruction, air and water pollution, and impact on indigenous communities. To mitigate this exposure, the issuer has implemented due diligence processes that require compliance with its Supplier Code of Conduct and Responsible Minerals Sourcing Policy. It is also working to strengthen this process by regularly assessing supplier performance and has started to assess its value-chain exposures to sustainability issues as to be in line with EU CSRD requirements. Though ceramics are a hazardous substance, through its Global Health and Safety and Global Environmental policies Topsoe is committed to complying with regulations and international standards, eliminating or substituting hazardous substances when possible, and identifying the environmental impacts of its processes, raw materials and additives. In addition, its environmental permit includes specific requirements for the safe handling of environmental substances.
- SOECs require a constant supply of water to operate, but we understand from the issuer that water consumption is 20%-30% lower than for other types of electrolyzers and that water supply would be part of local impact assessments when being considered by production plant project developers. In addition, though the cell stacks have a shorter lifetime than the typical duration of a plant (25 years for the latter), the issuer will undertake long-term service agreements with its clients to ensure adequate maintenance. We view positively that it is working to identify recycling and circularity solutions for the material components.
- The SOEC manufacturing facility in Denmark, which will be financed as part of this framework, will comply with Danish and EU environmental regulations. As part of the environmental permit process required for construction projects in Denmark, the issuer conducted an Environmental Impact Assessment (Vurdering af Virkninger på Miljøet) that included the identification of impacts to human health, biodiversity, land, soil, water, air, climate, and cultural heritage. It also outlined its planned mitigation actions for each, such as recycling construction waste. The issuer has committed to powering the plant with 100% renewable energy sourced through a power purchase agreement but has yet to confirm the specific source. Although the plant will be equipped with energy efficiency and waste heat recovery processes to reduce operational emissions, the issuer is exposed to embodied emissions from the materials used for the manufacturing plant.
- We view positively that the issuer has assessed the facility's physical climate risk exposure in line with the TCFD using Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathways (RCP) 4.5 (a moderate emissions scenario) and 8.5 (a high emissions scenario). The study concluded that the planned manufacturing facility has a low climate risk exposure.
- We understand that under this framework the issuer will also finance R&D for power-to-X projects related to the energy transition. We view the issuer's R&D as Dark green to reflect the potential to help Paris Agreement net-zero-by-2050 ambitions for hard-to-abate sectors. For example, the IPCC Sixth Assessment Report stated that in 2019 transport alone accounted for 23% of global energy-related emissions, with shipping and aviation contributing 11% and 12%, respectively. Potential projects include applications for its SOEC technology, such as e-methanol and green ammonia, and bio-to-X projects seeking to transition conventional chemicals inputs to renewable alternatives, such as bio-glycols (which could replace ethylene glycol used, for example, in anti-freeze liquids for vehicles) and ethanol-to-jet sustainable aviation fuel. With these projects the issuer will aim to advance decarbonization solutions for sectors that have significant climate and environmental impacts but that are necessary for wider economic and societal needs.
- We assess the issuer's investment in energy efficiency and renewable energy measures for its facilities as Dark green, as they will reduce its scope 1 and 2 emissions from the production of solutions needed for the energy transition. In turn, this will contribute to its 2030 and 2040 emission reduction targets. When selecting viable efficiency solutions, the issuer will undertake LCAs to identify key environmental impacts, such as carbon intensity and leakages.

S&P Global Ratings' Shades of Green

Assessments					
 Dark green	 Medium green	 Light green	 Yellow	 Orange	 Red
Description					
Activities that correspond to the long-term vision of an LCCR future.	Activities that represent significant steps toward an LCCR future but will require further improvements to be long-term LCCR solutions.	Activities representing transition steps in the near-term that avoid emissions lock-in but do not represent long-term LCCR solutions.	Activities that do not have a material impact on the transition to an LCCR future, or, Activities that have some potential inconsistency with the transition to an LCCR future, albeit tempered by existing transition measures.	Activities that are not currently consistent with the transition to an LCCR future. These include activities with moderate potential for emissions lock-in and risk of stranded assets.	Activities that are inconsistent with, and likely to impede, the transition required to achieve the long-term LCCR future. These activities have the highest emissions intensity, with the most potential for emissions lock-in and risk of stranded assets.
Example projects					
 Solar power plants	 Energy efficient buildings	 Hybrid road vehicles	 Health care services	 Conventional steel production	 New oil exploration

Note: For us to consider use of proceeds aligned with ICMA Principles for a green project, we require project categories directly funded by the financing to be assigned one of the three green Shades.

LCCR--Low-carbon climate resilient. An LCCR future is a future aligned with the Paris Agreement; where the global average temperature increase is held below 2 degrees Celsius (2 C), with efforts to limit it to 1.5 C, above pre-industrial levels, while building resilience to the adverse impact of climate change and achieving sustainable outcomes across both climate and non-climate environmental objectives. Long term and near term--For the purpose of this analysis, we consider the long term to be beyond the middle of the 21st century and the near term to be within the next decade. Emissions lock-in--Where an activity delays or prevents the transition to low-carbon alternatives by perpetuating assets or processes (often fossil fuel use and its corresponding greenhouse gas emissions) that are not aligned with, or cannot adapt to, an LCCR future. Stranded assets--Assets that have suffered from unanticipated or premature write-downs, devaluations, or conversion to liabilities (as defined by the University of Oxford).

Mapping To The U.N.'s Sustainable Development Goals

Where the financing documentation references the Sustainable Development Goals (SDGs), we consider which SDGs it contributes to. We compare the activities funded by the financing to the International Capital Markets Association (ICMA) SDG mapping and outline the intended linkages within our SPO analysis. Our assessment of SDG mapping does not impact our alignment opinion.

This framework intends to contribute to the following SDGs:

Use of proceeds	SDGs
Renewable energy	  7. Affordable and clean energy* 13. Climate action

*The eligible project categories link to these SDGs in the ICMA mapping.

Related Research

- [ESG Materiality Map: Chemicals](#), May 18, 2022
- [Analytical Approach: Second Party Opinions: Use of Proceeds](#), July 27, 2023
- [FAQ: Applying Our Integrated Analytical Approach for Use-of-Proceeds Second Party Opinions](#), July 27, 2023
- [Analytical Approach: Shades of Green Assessments](#), July 27, 2023

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