

JCR Green Bond Framework Evaluation
By Japan Credit Rating Agency, Ltd.

Japan Credit Rating Agency, Ltd. (JCR) announces the following Green Bond Framework Evaluation Results.

JCR Assigns Green 1 (F) to the Green Bond Framework of NGK INSULATORS, LTD.

Issuer : NGK INSULATORS, LTD. (Securities code: 5333)
Subject : Green Bond Framework of NGK INSULATORS, LTD.

<Green Bond Framework Evaluation Results>

Overall Evaluation	Green 1(F)
Greenness Evaluation (Use of proceeds)	g1(F)
Management, Operation, and Transparency Evaluation	m1(F)

Chapter 1: Evaluation Overview

1. Overview of NGK INSULATORS, LTD.

NGK INSULATORS, LTD. (NGK) was established in 1919 as spin-off the insulators department from Nippon Toki (now Noritake Company Limited) to produce special high-voltage insulators, which were indispensable for the popularization of electricity, in Japan. Since its inception, NGK has been developing a series of ultra-high-voltage and strong insulators to respond to expanded demand for electricity along with economic growth and enriched life while focusing on social mission to contribute to the nation. Having capability to develop ceramic technologies, NGK has rolled out various products, which meet new social needs, including the world's first large capacity storage battery (NAS®), products to eliminate air pollutant from vehicle exhaust gas, precision equipment to support development of communication and electronics in addition to insulators.

2. NGK's sustainability strategy

NGK Group, to which NGK belongs, has passed down the company's founding spirit through the generations, guided by the corporate philosophy of creating new value through products that contribute to a better society. In 2019, the NGK Group celebrated its 100th year. NGK has taken a new look at the philosophical framework that has guided it up to now, and established the NGK Group Philosophy; “Enriching Human Life by Adding New Value to Society” as its mission under the NGK Group's philosophy. As its goals, NGK set out “Quality of people Embrace challenges and teamwork.”

“Quality of Product Exceed expectations,” and “Quality of management Social trust is our foundation.” NGK Group Vision: Road to 2050 was formulated based on this philosophy, and it envisioned “what we want to be” in 30 years from now is “contributing to carbon neutrality (CN) and digital society (DS) with our unique ceramic technologies.” To achieve this aspiration, NGK has set a target of raising CN and DS-related sales to 80% of the total by 2050. At the same time, the NGK Group has also formulated the NGK Group Environmental Vision for 2050, a long-term vision of the environment. The vision aims to contribute to the realization of society's demands of “carbon neutrality,” “a recycling-oriented society,” and “harmony with nature” through NGK's business activities. The goal for 2050 is net zero CO₂ emissions from the entire group. As a milestone target to achieve this goal, NGK set emissions at 550,000 tons (a reduction of 25% compared with the base year of fiscal 2013) in fiscal 2025 and 370,000 tons (a reduction of 50% compared with the base year of fiscal 2013) in fiscal 2030. JCR evaluates that the goals set for these long-term visions as ambitious.

In order to promote sustainability-related initiatives, NGK established the ESG Committee, chaired by the president, in fiscal 2019 to discuss management issues from an ESG viewpoint based on the Group Philosophy. In addition, through the collaboration among the R&D relating divisions, the department in charge of the environment, etc. manages specific measures to achieve the long-term vision and the goals set as milestones.

The scope of this evaluation is the Green Bond Framework (the Framework) to allocate the proceeds to environmentally effective products and services, R&D expenses, capital expenditure and production costs relating to initiatives for carbon neutrality in NGK's business and production activities among the measures for achieving goals set under the NGK's Group Vision and Environmental Vision by NGK. JCR recognizes that any of the eligibility criteria established by NGK in this framework will contribute significantly to curbing global warming faced by Japan and the world as a whole. JCR also evaluates that the project selection process, the fund management system, the post-issuance reporting system, etc. have been properly established and are highly transparent.¹²

As a result, based on JCR Green Finance Evaluation Methodology, JCR assigns “g1 (F)” for “Greenness Evaluation (Use of Proceeds)” and “m1 (F)” for “Management, Operation and Transparency Evaluation.” Consequently, JCR assigns “Green1 (F)” for overall “JCR Green Bond Framework Evaluation” to the Framework.

The Framework meets the standards for the items required in the Green Bond Principles, the Ministry of the Environment's Green Bond Guidelines.

¹ ICMA (International Capital Market Association) Green Bond Principles 2021
<https://www.icmagroup.org/assets/documents/Sustainable-finance/2021-updates/Green-Bond-Principles-June-2021-140621.pdf>

² Ministry of the Environment's Green Bond Guidelines 2020 https://www.env.go.jp/policy/guidelines_set_version_with%20cover.pdf

Chapter 2: Current Status of the Project on Each Evaluation Factor and JCR's Evaluation

Evaluation Phase 1: Greenness Evaluation

Based on the current status described below and JCR's evaluation of the subject, JCR evaluated 100% of the use of proceeds was green project, and assigned “g1 (F)”, the highest rank for Phase 1: Greenness Evaluation.

(1) JCR's Key Consideration in This Factor

In this section, JCR first confirms whether the use of proceeds set out in this framework is used for green projects that have a clear environmental improvement effect. Next, in cases where the use of proceeds is expected to have a negative impact on the environment, JCR confirms that the impact is examined sufficiently by an internal specialist department or an external third party and whether necessary measures for avoidance and mitigation have been taken. Finally, JCR confirms the alignment with the Sustainable Development Goals (SDGs).

(2) Current Status of Evaluation Targets and JCR's Evaluation

a. Environmental Improvement Effects of the Project

<The Framework for Use of Proceeds>

NGK has defined the use of proceeds as follows in this framework. The same amount of the total issuance of Green Bonds by NGK is expected to be allocated to funds for new eligible projects or refinancing funds for existing eligible projects. Where proceeds are allocated to existing projects, NGK has determined that the projects were executed within two years from the issuance of green bonds.

A. Distribution of environmentally friendly products and services

Eligible project categories / ICMA GBP Category	Eligibility criteria and examples of projects
<p>Batteries</p> <p>Circular economy adapted products, production technologies and processes and/or certified eco-efficient products</p>	<p>R&D and manufacturing of batteries that meet the increasingly complex needs for storage batteries and power generation to promote renewable energy and develop smart grids</p> <p><Examples of projects></p> <ul style="list-style-type: none"> › NAS® batteries: A storage battery required for adjusting supply and demand of electric power of unstable output volume of renewable energy. It has features of large capacity, high energy density, and long life, and it enables high power output in supplying electricity over a long period of time. It is useful for peak shaving and stabilizing renewable energy by leveling electric power load, and contributing to power saving, energy cost reduction, and environmental load reduction. In R&D, NGK aims to improve cost competitiveness while working to build a business model including offering electricity storage services. › Zinc rechargeable batteries: A storage battery (rechargeable battery) that achieves high safety and high

	<p>capacity suitable for indoor installation. It can be installed compactly with high energy density, and can be operated at room temperature. In addition, it is highly safe because it uses incombustible electrolysis water solutions, thereby there are no risks of internal ignition or heat run-off. NGK aims prompt introduction in the market and establishing sales channels and supply system. (R&D)</p> <ul style="list-style-type: none"> › All-ceramic batteries (all-solid-state batteries): A next-generation battery (rechargeable battery) that is being developed worldwide for use in vehicles and stationary applications. The type of products, which use sulfides as electrolyte, is expected to be in practical use soon. However, sulfides generate highly poisoned hydrogen sulfide when they respond to water in the air. Therefore, NGK is developing “all-ceramics battery” that uses safer oxide-based ceramics. Since oxide-based ceramics electrolyte has low ion conductivity, there are not so many examples of development in the world. However, NGK aims of developing its unique high-performance and safe batteries of NGK Group by further developing the technologies cultivated through developing EnerCera® semi-solid batteries. (R&D)
<p>Next-generation power semiconductors</p> <p>Circular economy adapted products, production technologies and processes and/or certified eco-efficient products</p>	<p>Conventional silicon semiconductors used for motor control and power control/conversion (power semiconductors) will be replaced by ultra-low-power consumption semiconductors (SiC/GaN semiconductors, etc.), with R&D conducted to develop materials and parts required for a carbon-neutral society.</p> <p><Examples of projects></p> <ul style="list-style-type: none"> › Gallium nitride (GaN) wafers: R&D for wafers (substrates) using gallium nitride (GaN) semiconductors. They can significantly reduce loss during power control and conversion compared to conventional silicon semiconductors. Therefore, they can significantly reduce power consumption. By using NGK’s high-quality wafers (substrates), power semiconductor manufacturers can produce higher-performance gallium nitride (GaN) power semiconductors. › DCB and AMB substrates: R&D for ceramic circuit boards for power modules (a packaged components combining multiple power semiconductors) for automotive and industrial equipment with superior reliability and thermal conductivity. Demand is expected to expand over the medium to long term due to electrification of automobiles.
<p>CCU/CCS and hydrogen / ammonia</p> <p>Circular economy adapted products,</p>	<p>R&D focusing on technologies and products essential for capturing, storing and utilizing CO₂ and for promoting utilization of hydrogen and ammonia.</p> <p><Examples of projects></p>

<p>production technologies and processes and/or certified eco-efficient products</p>	<ul style="list-style-type: none"> › CO₂ separation membrane: Large ceramic membranes capable of separating CO₂ at the molecular level. They will contribute to reducing CO₂ emitted into the atmosphere by separating and capturing CO₂ from associated gas of natural gas and crude oil. NGK has already started to initiatives to separate CO₂ from industrial emissions from plants, etc. (R&D) › SOEC (solid oxide electrolysis cells): Develop an essential device for a system to use ion-conducting ceramics to create fuels and raw materials from CO₂ and water with high efficiency. › Honeycomb structural reactor for synthetic fuel production: Develop devices (or systems) to utilize large-scale extrusion and separation membrane technologies to make fuel and raw-materials synthesis more efficiency.
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B. The NGK Group's business and manufacturing activities for carbon neutral initiatives

Eligible project categories / ICMA GBP Category	Eligibility criteria and examples of projects
<p>Clean energy utilization</p> <p>Renewable energy</p>	<p>Development and introduction of carbon neutral technologies and facilities for possible applications to the NGK Group's manufacturing activities (including demonstrations and test operations).</p> <p><Examples of projects></p> <ul style="list-style-type: none"> › Development of firing processes for ceramics, using hydrogen and ammonia as fuel › Demonstration testing of a firing kiln for ceramics, using hydrogen and ammonia as fuel <p>Installation of facilities to switch to green electricity for use in the NGK Group's business activities.</p> <p><Examples of projects></p> <ul style="list-style-type: none"> › Installation of solar power generation facilities using NAS[®] batteries and zinc rechargeable batteries › Installation of solar power generation facilities › Procurement of green electricity › Procurement of carbon-neutral fuel
<p>Energy-efficient manufacturing</p> <p>Energy efficiency</p>	<p>Installation of high-efficiency facilities to improve energy efficiency of the NGK Group's manufacturing activities.</p> <p><Examples of projects></p> <ul style="list-style-type: none"> › Investment in high-efficiency facilities with excellent energy-saving performance to achieve carbon-neutral targets › R&D of new energy-efficient manufacturing processes

Classification A-1: Batteries

Use of proceeds of classification A-1 is expenditures related to R&D and manufacturing for provision of batteries to meet various storage and power generation needs that are becoming increasingly sophisticated for promoting use of renewable energy and building smart grids. This use of proceeds falls under the category of “Circular economy adapted products, production technologies and processes and/or certified eco-efficient products” in the Green Bond Principles, and “Projects concerning eco-efficient products, production technologies, and processes” in the Ministry of the Environment's Green Bond Guidelines. As for NAS® batteries and zinc rechargeable batteries, which are cited as examples of projects, they will contribute to “renewable energy (projects to install, manage, and maintain power lines that transmit electricity generated by renewable energy, and batteries that store the electricity, adjust to demand and supply, and store energy)” exemplified in the Green Bond Guidelines and all solid-state batteries will also contribute to the “clean transportation” field.

Features of NAS® battery

NAS® battery is a battery (rechargeable battery) in which sodium (Na) is used in the negative electrode, sulfur (S) is used in the positive electrode, and fine ceramics is used as the electrolyte separating both electrodes. It repeats charging and discharging by the chemical reaction between sulfur and sodium ions. NAS® is a registered trademark of NGK. NAS® batteries are megawatt-class storage batteries that NGK has commercialized for the first time in the world in collaboration with TOKYO ELECTRIC POWER as a means of solving the gap in power demand, such as during daytime and nighttime.

NGK has long history of developing NAS®. Started in 1984, NGK has been continuing various research and development activities until now. NGK expanded production capacity after its commercialization in 2002. NAS® has features of large capacity, high energy density, long life, and is small in size, about one-third of that of lead-acid batteries. It enables stable power supply over a long period of time. In addition, NAS® batteries can contribute to the stabilization of electric power supply by combining them with power generation facilities of renewable energy. As an example of actual use, by installing a 34,000kW NAS® battery for a wind power generation facility with a power generation capacity of 51,000kW, fluctuating power output is absorbed by charging and discharging using NAS® batteries to stabilize. It is expected that NAS® batteries will play an important role in the popularization of renewable energy.

Features of Zinc rechargeable battery

Zinc rechargeable batteries are rechargeable batteries, under development by NGK, that realize high safety and high capacity suitable for indoor installation by using zinc in the negative pole, water solutions as electrolytic solutions, and the company's proprietary ceramic separators to separate positive and negative electrodes. Batteries using zinc in a negative electrode have been widely used for primary batteries such as alkaline dry batteries and air batteries for hearing aids because of their high energy density; however, where they are used for rechargeable batteries, there was a problem that zinc precipitates dendrites from the negative electrode during charging and short-circuits occur through the separator; therefore, they were not put into practical use for a long time. NGK solved the issue by using precise hydroxide anion (OH^-) conductive ceramics, newly developed by NGK by using its own proprietary technology, as a separator, and has successfully developed zinc rechargeable batteries. The ceramic separators developed by NGK can selectively pass only the OH^- required for battery operation, and prevent short-circuits between positive and negative electrodes by physically blocking dendrites.

Therefore, the batteries are to be charged and discharged repeatedly. It is the first time in the world that ceramic separators are used in zinc rechargeable batteries.

Zinc rechargeable battery is with high energy density and can be installed in small area, and it can be operated at a room temperature. In addition to the above, it is highly safe and suitable for indoor installation, since it uses incombustible water solutions as electrolytic solutions, which eliminates the risk of internal ignition and hot runs. In facilities where BCP (business continuity plan) measures are important, such as schools, hospitals, commercial facilities including convenience stores, telecommunications base stations and telecommunications buildings, storage batteries with high safety and high capacity are strongly demanded. NGK assumes that zinc rechargeable batteries can be used for these facilities.

In Japan, it is expected that the local power generation and the local consumption by using each household's private solar panel and its storage are likely to be accelerated in order to prepare for BCP and to shift to a carbon neutral society. Consequently, JCR evaluates that need for safe and compact storage batteries will likely to increase in the future.

It was found that zinc rechargeable batteries will not generate hot runs or fires as a result of experiments of cell-level surface heaters, overcharges, overcharges, and nail cards based on UL9540A test method. NGK has been working on the development of zinc rechargeable batteries since 2015, and is aiming for commercialization in the second half of 2021.³⁴

Features of All-ceramic batteries (All-solid-state batteries)

All solid batteries are batteries with no electrolyzed solutions and only electrolyzed separator layers exist between positive and negative electrodes. Compared with a lithium-ion battery that uses a liquid electrolyte, it has advantages such as higher safeness, longer cruising range and charging time because of its wide temperature adaptability, no risk of explosion, etc. Recently, with the popularization of electric vehicles (EVs), its safety has attracted attention. At present, only a part of mass production technology has been established, and it has not yet been used widely. However, in particular, for the popularization of electric vehicles, current batteries have issues for cruising range and charging time, so the degree of expectation for all solid-state batteries is high, and development is being promoted for practical use.

NGK has succeeded in mass-production of a chip-type ceramic secondary cell EnerCera®, a semi-solid cell for small chips. EnerCera® is a battery with a new concept of “semi-solid-state battery” using a crystal-oriented ceramic electrode plate, developed by NGK, for the positive electrode, while adopting the operation principles of lithium-ion secondary batteries. Applying a small amount of electrolyzed solution to a ceramics material burned by aligning the directions of crystals of positive active material, and lithium ion and electronics are easier to move in the element. This achieves both the advantages of a lithium-ion secondary battery, which is compact / large-capacity, and capable of output at constant voltage, and advantages of a capacitor capable of constant-voltage charging, which eliminates the need for a large-current output and power supply IC. In addition, this product has the property of being able to withstand a high temperature of 105°C. By applying this technology, NGK is aiming the practical use of all-solid-state battery.

³ UL9540A is a standard that UL has established a test method to confirm the event of thermal runaway in the storage system based on the request of the U.S. fire fighting and disaster prevention organizations, and it is highly reliable not only in the U.S.A. requiring strict safety standards, but at present, worldwide. UL9540A tests are intended to confirm the hazards associated with the generation of ignition, flammable combustion, debris scattering, smoke, and combustible gases.

⁴ Regarding the performance explanation of zinc rechargeable batteries, it is quoted from NGK's website.

Fuji Keizai compiled a survey result that the world market of all solid batteries, which are expected to be adopted in electric vehicles, will be 2.1014 trillion yen in 2035, a 1,106-fold increase compared with 2019. The global market for all solid batteries for electric vehicles is expected to expand from 44 megawatt hours expected in 2020 to 102,600 megawatt hours on a capacity basis.⁵

Classification A-2: Next-generation power semiconductors

Use of proceeds of classification A-2 is the costs related to R&D that contributes to improving the energy efficiency of power semiconductors as demand for electricity is expected to expand digital society advances. This use of proceeds falls under “Circular economy adapted products, production technologies and processes and/or certified eco-efficient products” in the Green Bond Principles, and “Projects concerning eco-efficient products, production technologies, and processes” in the Ministry of the Environment’s Green Bond Guidelines.

Power semiconductor is a generic term of semiconductors that control and convert power. Power semiconductors are used to drive semiconductors such as motor drive and battery charge, CPU, LSI, etc., and are widely used in home white goods, smart phones, tablet personal computers, and also industrial equipment including electric vehicles, railways, photovoltaic power generation. The use of power semiconductors makes it possible to reduce waste of electricity as little as possible, and thus plays an important role in saving energy and power in various electrical equipment.

The next generation power semiconductors, which use wafers developed by NGK, are attracting attention as products that contribute to further improvement of energy efficiency in various industries. As an example, gallium nitride (GaN) wafers are used in high-performance gallium nitride (GaN) power semiconductors that can significantly reduce loss during power control and conversion compared to mainstream silicon semiconductors at present. Although GaN power semiconductors are mainly used for information and communication equipment, their application to electric vehicles is also expected in the future.

DCB and AMB substrates are a circuit boards for which a copper circuit plate is directly bonded to the alumina-based oxide ceramic substrate. Since there is no bonding layer serving as a thermal resistance, it is possible to bond the thick copper plate of more than 0.2mmt. It has, high thermal conductivity and high conductivity of copper alloy, and a high insulating property by the ceramic substrate. It is the most appropriate as an insulating substances for high dielectric strength voltage through which a large current flows. Taking advantage of the features, it is used in electric vehicles and other industrial equipment, and this is the area where expansion of demand is expected over medium-to long-term particularly along with increasing demand of electric vehicles.

According to the global market forecast for power semiconductors published by Yano Research Institute in July 2020, despite negative growth in 2020 due to the impact of COVID-19 pandemic, it is expected to pick up from 2021 onwards and will grow to US\$24.351 billion in 2025.⁶

Classification A-3: CCU/CCS and hydrogen/ammonia

Use of proceeds of classification A-3 is the expenditures of R&D for technologies and products indispensable device for capturing, storage and effective use of CO₂ and technologies and products to

⁵ Fuji Keizai Website <https://www.fuji-keizai.co.jp/>

⁶ Yano Research Institute website <https://www.yanoresearch.com/>

facilitate use of hydrogen/ammonia. This use of proceeds falls under the category of “Circular economy adapted products, production technologies and processes and/or certified eco-efficient products” in the Green Bond Principles, and “Projects concerning eco-efficient products, production technologies, and processes” in the Ministry of the Environment's Green Bond Guidelines. CO₂ separation membranes, SOEC, and honeycomb structural reactor for synfuel, which are cited as examples of projects, will contribute to the decarbonization of energy sectors and other industries that emit CO₂ by using fossil fuels.

Features of CO₂ separation membrane

Reducing the environmental burden of fossil resources, such as crude oil and natural gas, is playing a very important role not only in Japan but also in the road map for the world realizing carbon neutrality in 2050.

NGK's subnano-ceramic membrane is one of the world's largest separator membranes made of ceramics with cylindrical shape, which has a diameter of 18 centimeters and a total length of one meter. It can separate CO₂ at the molecular level. The surface area of DDR-type zeolite membranes selectively permeating CO₂ is 12 square meters per bottle. Zeolite is a generic term for porous crystalline aluminosilicate, and DDR is a kind of it. It has a feature of its structure with oval-shaped pores of 0.36 × 0.44 nanometers. Since the short diameter of this pore is larger than CO₂ (0.33 nanometers) and smaller than CH₄ (0.38 nanometers), only CO₂ can be separated instantaneously.

As a technique to separate CO₂, polymer membranes are available at present, but the disadvantage is that separation performance is prone to decrease in high-pressure and high CO₂ concentrations. The DDR-type zeolite membrane developed by NGK has been adopted as a field demonstration test for CO₂ separation and capturing technology of CO₂ from associated gas at the time of crude oil production, which is jointly conducted by JGC Global and JOGMEC since 2019 as a technology to solve the issues for polymer membranes. CO₂ is injected, CO₂ is separated and captured using DDR-type zeolite film from the gases associated with the crude oils taken out from the ground, and then refilled into the ground. The amount of crude oils acquisition increases due to a decrease in the visibility of the crude oils, and also some CO₂ can be kept in the ground. DDR-type zeolite membrane is a technology that contributes to the achievement of CO₂ capture, utilization and storage techniques (CCUS) in various industries, as it assumes CO₂ removal applications when refining natural gas as well as crude oil.

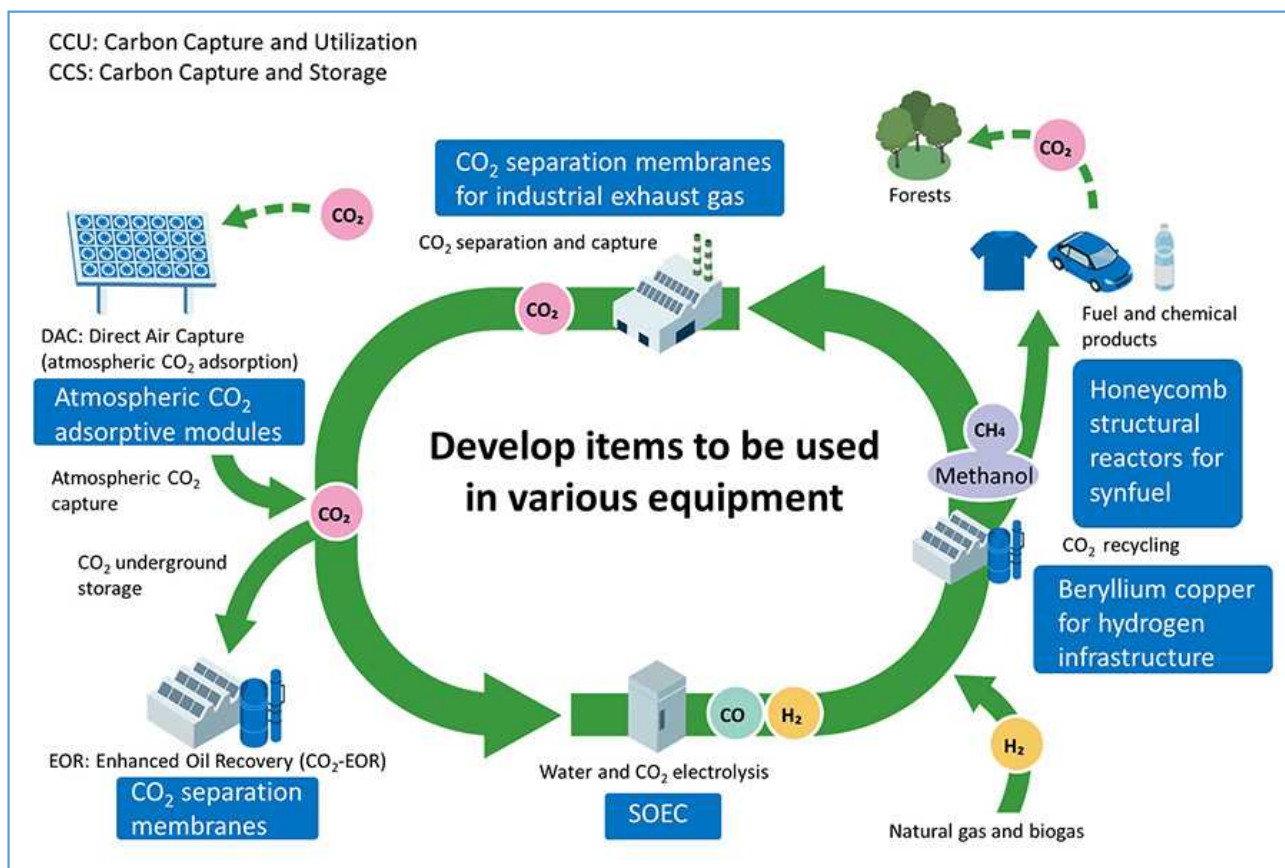
SOEC (Solid oxide electrolysis cells)

SOEC is a type of electrochemical device in which components are all solids. It is a steam electrolysis cell that produces hydrogen by electrolysis of steam. Electrochemical cells that operate at the highest temperatures. These cells enable electrolysis water vapor highly efficiently, and are used to store electric power generated by renewable energy in the form of fuel. It is expected that this technology will play an important role in the process of green hydrogen produced from renewable energy, which is expected to be developed and mass-produced as a future clean energy.

Honeycomb structural reactor for synthetic fuel production

Equipment (or system) that uses large-scale ceramics extrusion technology and separation membrane technology to make fuel and raw material synthetic highly efficiently from the captured CO₂.

By developing these technologies and products, NGK assumes to construct the following CCU and CCS system.



(Source: NGK website)

Classification B-1: Clean energy utilization

Use of proceeds of Classification B-1 is the expenditures of carbon neutrality-related technologies such as ammonia and hydrogen fuel, which NGK aims to use its production activities in the own plants, and also introduction of facilities and initiatives to convert electricity using in the business activities to clean energy. The use of proceeds falls under the category of “renewable energy” in the Green Bond Principles and “projects for renewable energy” in the Ministry of the Environment’s Green Bond Guidelines.

NGK will work on the initiatives in the Classification B to achieve Scope 1+2 in the Environment Vision of 2050 Carbon Neutral and the milestone of CO₂ reduction goal.

First, to accelerate the active utilization of renewable energy, NGK intends to develop a burning method, which uses ammonia and hydrogen as fuels, and introduce renewable energy-related facilities such as solar power generation facilities utilizing storage batteries. Among the manufacturing processes of products using NGK’s ceramics, particularly the burning process is the core process of the ceramic engineering, and careful management of temperature, humidity and air components are required. Although technological innovation is required to convert fossil fuels currently in use to hydrogen, etc., the utilization of low-carbon fuels and the development and introduction of technologies for separating and collecting CO₂ are essential measures for NGK’s carbon neutral strategies.

Classification B-2: Energy-efficient Manufacturing

Use of proceeds of the Classification B-2 is for introduction of high-efficiency equipment and initiatives to improve energy efficiency in production activities at its own plants. This use of proceeds falls under the category of “Energy efficiency” in the Green Bond Principles and “Projects for energy efficiency” in the Ministry of the Environment's Green Bond Guidelines.

As a measure for achieving the Environmental Vision, NGK intends to introduce and replace existing facilities with high-efficiency equipment that contributes to improving energy efficiency in the production activities of its own plants, in addition to introducing renewable energy. NGK limits the eligible criteria for the use of proceeds to investment in high-efficiency equipment that meets sufficient energy conservation levels and research and development of new processes for energy conservation to achieve carbon neutrality.

Based on the above, JCR evaluates that the use of proceeds determined by NGK is a measure that contributes to the achievement of the goals set by NGK Group Vision and Environmental Vision, and that all of these measures are expected to have high environmental improvement effects.

b. Negative Impacts on the Environment

JCR has confirmed that NGK takes the following measures to mitigate environmental and social risk factors where it is necessary to do so considering nature of projects.

- Complying with environment-related laws and regulations in Japan and local governments of the project location, and implementation of environmental impact studies as necessary
- Proving sufficient explanations to local residents in carrying out businesses
- Procurement of materials, prevention of environmental pollution, and consideration for the working environment and human rights in accordance with the NGK Group's basic philosophy and policies for global environmental conservation activities, basic purchasing policy, etc.

Regarding the safety of products, NAS® batteries have built-in hazardous materials (natrium, sulfur). Therefore, disposal and recycling of the batteries should also be considered after using them. As an accredited business entity of the wide-area accreditation system based on the Waste Management and Public Cleansing Law, NGK has established a collection and recycling system for used NAS® batteries for recycling and proper treatment.

Regarding ensuring the safety for factory workers, JCR confirmed that NGK has prepared safety management guidelines and safety and health handbooks, and is ensuring its employees to thoroughly follow them.

c. Consistency with SDGs

JCR evaluated the use of proceeds set out in this Framework contributes to the following SDGs goals and targets referring to SDGs mapping of ICMA.



Goal 7: Affordable and clean energy

Target 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix.

Target 7.3 By 2030, double the global rate of improvement in energy efficiency.



Goal 9: Industry, innovation and infrastructure

Target 9.4 By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.



Goal 11: Sustainable cities and communities

Target 11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries.

Target 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.



Goal 13: Climate action

Target 13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning.

Evaluation Phase 2: Management, Operations and Transparency Evaluation

Based on the current situation described below and JCR's evaluation of the subject, JCR evaluated that the management and operational system had been well developed, that transparency was very high, and that it was fully expected that the project would be implemented as planned and that the proceeds would be adequately allocated. In Phase 2, JCR evaluated “m1 (F)” as the highest level in terms of management, operation and transparency.

1. Appropriateness and Transparency Concerning Selection Standard and Processes of Use of Proceeds

(1) JCR's Key Consideration in This Factor

In this section JCR confirms the goals to be achieved through green bonds, the selection criteria for green projects and the appropriateness of the process, and whether the process is properly disclosed to investors and others.

(2) Current Status of Evaluation Targets and JCR's Evaluation

a. Goals

<The Framework for Issuing Green Bond>

NGK Group Vision: Road to 2050

Still valuing the philosophy of sustainability, we formulated a mid- to long-term vision in April 2021 in order to continue contributing to the resolution of social issues in an era of extreme change. Envisioning the future society of 2050, we will seize the enormous trends of rapid advancement toward the realization of carbon neutrality and a digital society as an opportunity for new development and work on promoting Five Transformations: (1) Promotion of ESG management, (2) Profitability improvement, (3) Focus on R&D, (4) Focus on commercialization, and (5) DX (digital transformation). With “Surprising Ceramics.” as the slogan for our unique ceramic technology, we intend to convert our business structure in anticipation of the “Third Foundation.”

We will position fields related to “carbon neutrality,” in which people coexist with the natural environment, and “digital society,” in which they can live securely, conveniently, comfortably, and in good health, as the focus fields and will develop business so that products related to these fields make up 80% of the company's sales in 2050. We plan to allocate a total of 300 billion yen in R&D expenses over the next 10 years and distribute 80% of that amount to both fields. We have established a goal of “New Value 1000” to achieve net sales of 100 billion yen from new businesses in 2030, which will be a checkpoint in the plan. We will invest management resources with a focus on promising development topics for creating new products and businesses.

NGK's Core Policy on the Environment

Recognizing that protecting the environment is a vital issue that all of humanity must face, the NGK Group formulated its Core Policy on the Environment in April 1996 in order to bring its corporate activities into harmony with the environment. Based on the NGK Group Environmental Vision for 2050 formulated in April 2021, we will promote initiatives to contribute to carbon neutrality, a recycling-oriented society, and harmony with nature. On the basis of this policy, the NGK Group works to reduce the environmental impact of business activities, and actively strives to help protect the environment by developing products and technologies to that end.

NGK Group Environmental Vision

“NGK Group Vision: Road to 2050” outlines the kind of entity NGK strives to become by 2050 and stresses ESG management as a key reform towards realization. To this end, we formulated the NGK Group Environmental Vision as the environmental policy in the ESG management. The NGK Group will contribute to the realization of society's direction toward “carbon neutrality,” “a recycling-oriented society,” and “harmony with nature” through its business activities.

■ Toward carbon neutrality

We will develop and provide products and services that contribute to the realization of a carbon-neutral society and apply them to our own business activities in order to achieve our goal of net zero CO₂ emissions by 2050.

■ Toward a recycling-oriented society

We will contribute to the realization of a recycling-oriented society by reducing our natural resource consumption and developing and providing resource-efficient products.

■ Toward harmony with nature

We will minimize our environmental impact on ecosystems and raise stakeholder awareness through educational activities in order to achieve harmony with nature.

<JCR's Evaluation for the Framework>

In the “NGK Group Vision: Road to 2050” formulated in 2021, NGK intends to actively promote new businesses that contributes carbon neutrality and digital societies to generate 80% of net sales from such businesses by 2050. Of the uses of proceeds determined in this framework, JCR evaluated that Classification A: Promotion of R&D in the provision of environmentally effective products and services is an important area NGK focuses on as a measure to vigorously promote the NGK Group Vision.

In addition, NGK's environmental vision up to 2050 published in April 2021 based on the Basic Environmental Policy states that it will contribute to realization of carbon neutrality, a recycling-oriented society, and harmony with nature. In particular, to achieve carbon neutrality by 2050, NGK indicates CO₂ emission of 550,000 tons (a reduction of 25% compared with the fiscal 2013 base year) for fiscal 2025 and 370,000 tons (a reduction of 50% compared with the fiscal 2013 base year) for fiscal 2030 as milestone. Among the uses of proceeds, JCR evaluates that Classification B is that to contribute to the goal of decarbonization among NGK's medium- to long-term environmental target achievement.

Based on the above, JCR has evaluated that the businesses under the scope of this framework are consistent with NGK Group Vision and Environmental Vision.

b. Selection standards

The eligible criteria for the use of proceeds specified by NGK are as described under the eligible projects in Evaluation Phase 1. JCR evaluates that any of selection criteria of NGK are targeting highly meaningful projects for curbing global warming and preventing contamination.

c. Processes

<The Framework for the Selection Process>

Candidate projects, for which use of proceeds of green bonds are allocated, will be specified by NGK's ESG Management Department based on the conformity to the eligible criteria set forth in the use of the proceeds. The executive officer in responsible for the ESG Management Department makes a final decision that specified projects are qualified from the viewpoint of consistency with NGK Group's basic environmental policy and environmental vision. The results are reported to the ESG Committee, which is chaired by President and consisting members of the general managers of each business division.

<JCR's Evaluation for the Framework>

In NGK's Green Bond selection process, the ESG Management Department identifies target candidates based on the status of conformity to the eligible criteria and the executive officer who is responsible for the ESG Management Department makes the final decisions, and the results are reported to the ESG Committee, which is chaired by the President. Thereby an appropriate selection process has been established.

NGK's goals, selection criteria, and processes set out in this framework are properly established. In addition, at the time of issuance of the Green Bonds under this framework, NGK plans to disclose these standards and processes to investors through press releases, this evaluation report provided by JCR, and the Amended Shelf Registration Statement, thereby ensuring transparency.

2. Appropriateness and Transparency of Management of the Proceeds

(1) JCR's Key Consideration in This Factor

It is usually assumed that the management of the funds varies widely depending on the issuer, but JCR confirms whether the funds procured by the framework are properly allocated to green projects and whether a mechanism and an internal system are in place to ensure that the funds are easily tracked and managed by the issuer.

JCR also emphasizes assessing whether the funds procured under the framework are expected to be used for green projects at an early stage, as well as how to manage and operate the funds that have not yet been allocated to them.

(2) Current Status of Evaluation Targets and JCR's Evaluation

<The Framework for Management of the Proceeds>

Funds procured through green bonds are allocated to eligible projects and managed by NGK's Finance & Accounting Department. The Finance & Accounting Department tracks and manages funds every fiscal year using internal accounting system until the bonds are redeemed so that the same amount of bonds issued based on the framework will be allocated to any of eligible project. Unallocated funds until proceeds of green bonds fully allocated to the eligible project are treated as cash or cash equivalents, and it intends to fully allocate the funds within two years or so from the bonds issuance (including the case where there are no sufficient eligible projects available).

<JCR's Evaluation for the Framework>

JCR confirmed funds management method determined under the Green Bonds Framework by NGK though documents of management accounts, management methods, document management rules, etc. of the internal accounting system. In addition, fund management and allocation should be approved by General Manager of the Finance & Accounting Department. The results of the allocation are to be reported to ESG Committee chaired by President with consisting members of general manager of each business divisions together with the evaluation and selection of the business. Proceeds from Green Bonds will be treated as cash or cash equivalents until they are allocated.

Proceeds from green bonds will be allocated to new investments in projects that meet eligibility criteria or to refinance such funds. NGK plans to allocate the funds raised within two years or so.

With regard to whether the system is functioning soundly, the head of the ICT Center checks the accounting system annually through internal controls. In addition, in the process of putting together the financial results by the Finance & Accounting Department to submit them to the executive officer who is responsible for the Finance & Accounting Department, appropriateness of figures are also checked including external audit. For vouchers, documents, etc. for managing proceeds from the green bonds issue, the system to store them until redemption of bonds and sufficient period beyond the redemption has already been established.

Based on the above, JCR evaluates the appropriateness and transparency of NGK's fund management are high.

3. Reporting

(1) JCR's Key Consideration in This Factor

In this section, JCR evaluates whether the disclosure system for investors before and after the issuance of green bond, which is implemented with reference to the framework, is planned in detail and in an effective manner.

(2) Current Status of Evaluation Targets and JCR's Evaluation

<The Framework for Reporting>

Allocation reporting

NGK plans to report the following items relating to allocation status of proceeds from green bonds to the eligible project annually as much as possible considering the practical operation until the proceeds are fully allocated.

- Total amount of proceeds allocated to eligible projects
- Allocated and unallocated amounts by eligible project category
- Where unallocated amounts exist, scheduled allocation
- Percentage of new financing and refinancing

NGK will disclose any major changes in its funding position in a timely manner after the amount of the proceeds has been allocated.

Impact reporting

As long as outstanding balance of green bonds exists, NGK plans to report the following items related to the environmental impact of eligible projects on an annual basis as much as possible considering the practical operation. In addition, NGK will disclose any major changes in circumstances in a timely manner.

A. Distribution of environmentally friendly products and services

Eligible project categories	ICMA GBP Category	Examples of Impact Reporting Indicators
Batteries	Circular economy adapted products, production technologies and processes and/or certified eco-efficient products	<ul style="list-style-type: none"> - Technology and product overview - In the case of R&D, <ul style="list-style-type: none"> • Outline and progress of R&D plan • Overview of projects targeted for research and development and explanation of targeted effects (purpose of use, expected additional effects, expected storage capacity, expected energy density, life expectancy, etc.)
Next-generation power semiconductors	Circular economy adapted products, production technologies and processes and/or certified eco-efficient products	<ul style="list-style-type: none"> - Technology and product overview - In the case of R&D, <ul style="list-style-type: none"> • Outline and progress of R&D plan • Overview of projects targeted for research and development and explanation of targeted effects (anticipated use purposes, products, etc.)

CCU/CCS and hydrogen/ammonia	Circular economy adapted products, production technologies and processes and/or certified eco-efficient products	<ul style="list-style-type: none"> - Technology and product overview - In the case of R&D, <ul style="list-style-type: none"> • Outline and progress of R&D plan • Explanation of the outline of the businesses targeted for research and development and the expected effects (purpose of use, anticipated final products, equipment of users, expected additional effects, etc.)
B. The NGK Group's business and manufacturing activities for carbon neutral initiatives		
Eligible project categories	ICMA GBP Category	Examples of Impact Reporting Indicators
Clean energy utilization	Renewable energy	<ul style="list-style-type: none"> - Overview of facilities - A reduction in CO₂ emissions through use of hydrogen in the manufacturing process - Number of facilities introduced and output capacity of photovoltaic power generation using NAS® batteries - Purchased amount of electricity of renewable energy source - Avoided CO₂ emissions amount by use of renewable energy
Energy-efficient manufacturing	Energy efficiency	<ul style="list-style-type: none"> - Overview of the facility installed - Overview of Initiatives for improving energy efficiency - Status of energy saving (reduction in power consumption/percentage)

<JCR's Evaluation for the Framework>

a. Reporting on the allocation status of the proceeds

NGK plans to disclose allocation status of the proceeds from Green Bonds annually on its website. In case that the unallocated portion arise due to any material events or material changes in the allocated projects, NGK plans to disclose the facts on the website and/or any other disclosure materials. JCR evaluates that reporting on the funds allocation is appropriate.

b. Impact reporting on environmental improvement effects

NGK plans to disclose the reporting items listed in this framework annually on its website and/or any other disclosure materials as its impact reporting. The content of the report includes concrete and quantitative data on the environmental improvement effects. JCR evaluates that the reporting items and its frequency of disclosures stipulated in the reporting plan in this framework are appropriate; as the variety of the indicators are well enough to clearly show each project's environmental improvement effects .

4. Organization's Environmental Initiatives

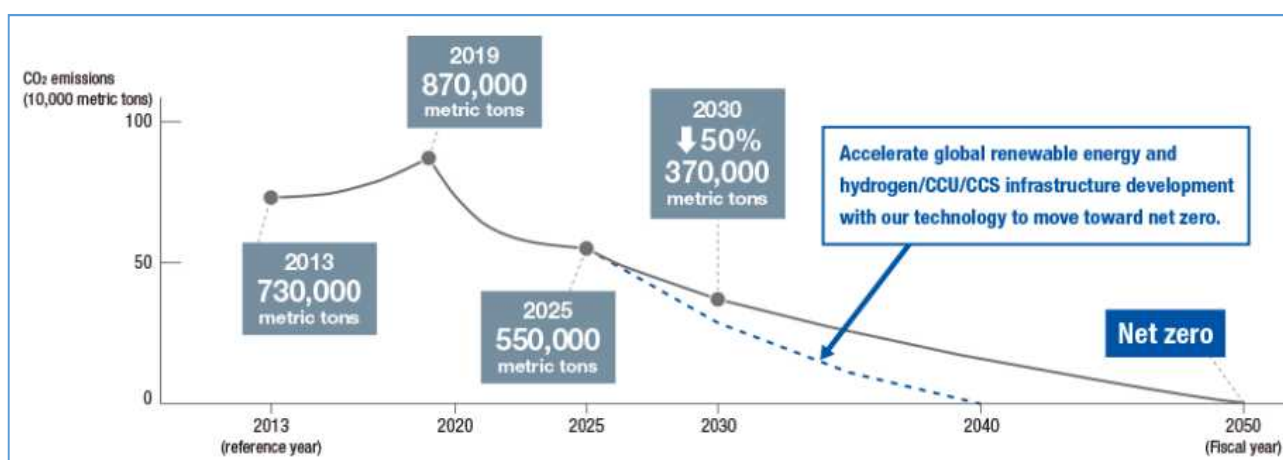
(1) JCR's Key Consideration in This Factor

In this section, JCR evaluates whether the management of the issuer regards environmental issues as a high priority issue for management, and whether the green bond policy, process, and selection criteria for green projects are clearly positioned through the establishment of a department specializing in environmental issues or collaboration with external organizations.

(2) Current Status of Evaluation Targets and JCR's Evaluation

In 2019, the NGK Group celebrated its 100th year. NGK has reviewed its philosophical framework that has guided them up to now, and raised the NGK Group Philosophy; “Enriching Human Life by Adding New Value to Society” as its mission. As its goals, the group set out “Quality of people Embrace challenges and teamwork,” “Quality of Product Exceed expectations.” and “Quality of management Social trust is our foundation.” NGK Group Vision: Road to 2050 was formulated under this philosophy, and the ideal image for 30 years from now is “contributing to carbon neutrality (CN) and digital society (DS) with our unique ceramic technologies.” To achieve this aspiration, the Group has set a target of raising CN and DS-related sales volume to 80% of the total by 2050. To achieve this long-term target, it has announced that it will make capital investment of JPY250 billion and research and development investment of JPY130 billion under the investment plan for fiscal 2021-2025.

The NGK Group also established its environmental vision at the same time. The vision aims to contribute to the realization of society's demands of “carbon neutrality,” “a recycling-oriented society,” and “harmony with nature” through NGK's business activities. The goal for 2050 is net zero CO₂ emissions for the entire group. As a milestone target to achieve this goal, NGK set emissions at 550,000 tons (down 25% from the base year of fiscal 2013) in fiscal 2025 and 370,000 tons (down 50% from the previous fiscal year) in fiscal 2030. In addition, four strategies (development and provision of carbon neutrality (CN)-related products/services, top-down enhancement of energy-saving, promotion of technical innovation, and expanded use of renewable energy) have been established to achieve a series of targets, and these strategies have been incorporated into the plan by the time of launching specific measures. On October 14, 2021, NGK announced its intention to switch the total amount of electricity used at overseas bases to renewable energy sources by fiscal 2025. As of fiscal 2025, approximately 60% of the electricity consumption of NGK Group will be sourced from renewable energy and will contribute to reduce 330,000 tons of CO₂ per year. The target of reducing emissions in fiscal 2025 by 25% of fiscal 2013 level will be achieved through this initiative.



(Source: NGK Report 2021)

In the Fifth Five-Year Environmental Action Plan (FY2021-2025), in addition to carbon neutrality, management indicators are set for each of the other important environment-related issues, namely, a recycling-oriented society,

harmony with nature, environmental social contribution, and promotion of environmental communication, with the aim of achieving them.⁷

In order to unify discussion platform of ESG, NGK established the ESG Committee, chaired by the president, in fiscal 2019 to discuss management issues from the viewpoint of ESG based on the Group Philosophy. The Chair of the various committee organizations which are directly under the control of the president, including Compliance Chairman, Development Chairman, HR Chairman, Facilities Chairman, Environment, Industrial Safety and Health Chairman and Quality Chairman, participate in ESG Committees and discuss ESG issues across the entire company. Since April 2021, NGK Group activities related to ESG and SDGs have been handled horizontally, and to strengthen the dissemination of information, the ESG Management Department has been established to assist the ESG Committee.

In promoting ESG initiatives, NGK is also actively participating in external initiatives such as the Global Compact and TCFD. In new technological development, industry-government-academia collaborations and joint R&D with companies in other industries are being carried out actively.

Based on the above, JCR has evaluated that NGK's management positions environmental issues as a high priority issue, and that internal and external experts are involved in sustainability initiatives as an organization.

⁷NGK's website (Fifth Five-Year Environmental Action Plan) <https://www.ngk-insulators.com/en/sustainability/environment-management03.html>

■Evaluation result

Based on the JCR Green Finance Evaluation Methodology, JCR assigns “g1 (F)” for the “Greenness Evaluation (Uses of Proceeds)” and “m1 (F)” for the “Management, Operation, and Transparency Evaluation.” As a result, JCR assigns “Green 1 (F)” for the “JCR Green Bond Framework Evaluation” to the Framework. The framework meets the standards for the items required in the Green Bond Principles, the Green Bond Guidelines, and the Green Loan Principles.

[JCR Green Bond Framework Evaluation Matrix]

		Management, Operation, and Transparency Evaluation				
		m1(F)	m2(F)	m3(F)	m4(F)	m5(F)
Greenness Evaluation	g1(F)	Green 1(F)	Green 2(F)	Green 3(F)	Green 4(F)	Green 5(F)
	g2(F)	Green 2(F)	Green 2(F)	Green 3(F)	Green 4(F)	Green 5(F)
	g3(F)	Green 3(F)	Green 3(F)	Green 4(F)	Green 5(F)	Not qualified
	g4(F)	Green 4(F)	Green 4(F)	Green 5(F)	Not qualified	Not qualified
	g5(F)	Green 5(F)	Green 5(F)	Not qualified	Not qualified	Not qualified

(Responsible analysts for this evaluation) Atsuko Kajiwara and Takahiro Yamauchi

Important explanation regarding the evaluation of the Green Finance Framework

1. Assumptions, Significance, and Limitations of JCR Green Finance Framework Evaluation

JCR Green Finance Framework evaluation, which is granted and provided by Japan Credit Rating Agency, Ltd. (JCR), covers the policies set out in the Green Finance Framework, and expresses the overall opinion of JCR at this time regarding the appropriateness of the Green Project as defined by JCR and the extent of management, operation and transparency initiatives related to the use of funds and other matters. Therefore, it is not intended to evaluate the effects of specific environmental improvements, management and operation systems, and transparency of individual bonds and borrowings, etc. to be implemented based on these policies. In the event that an individual bond or individual borrowing based on this framework is subject to a green finance evaluation, it is necessary to conduct a separate evaluation. In addition, the JCR Green Finance Framework evaluation does not demonstrate the environmental improvement effects of individual bonds or borrows implemented under this framework, and does not assume responsibility for environmental improvement effects. In principle, JCR does not directly measure the environmental improvement effects of funds procured under the Green Finance Framework, although JCR confirms the quantitative and qualitative measures by the issuer or a third party requested by the issuer.

2. Method used to perform this evaluation

The methodologies used in this assessment are described in “JCR Green Finance Evaluation” on the “Sustainable Finance ESG” section of the JCR website (<https://www.jcr.co.jp/en>).

3. Relationship with Acts Concerning Credit Rating Business

The act of granting and providing an evaluation of JCR Green Finance Framework is conducted by JCR as a related business and differs from the act related to the credit rating business.

4. Relationship with Credit Ratings

The Evaluation is different from the Credit Rating and does not commit to provide or make available for inspection a pre-determined credit rating.

5. Third-Party Evaluation of JCR Green Finance Framework Evaluation

There are no capital or personnel relationships that may result in a conflict of interest between the evaluation parties and JCR.

■ Matters of Attention

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■ Glossary

JCR Green Finance Framework Evaluation: The extent to which the funds procured through green finance are appropriated for green projects as defined by JCR, and the degree to which the management, operation, and transparency of the green finance are managed. Evaluations are performed on a 5-point scale, from the top to the top using the Green1 (F), Green2 (F), Green3 (F), Green4 (F), and Green5 (F) symbols.

■ Status of Registration as an External Evaluator of Green Finance

- Registered as an External Reviewer of Green Bonds by the Ministry of the Environment
- ICMA (registration as an observer with the Institute of International Capital Markets)

■ Other status of registration as a credit rating agency, etc.

- Credit Rating Agency Commissioner (Rating) No. 1
- EU Certified Credit Rating Agency
- NRSRO: JCR is registered in the following 4 classes of 5 credit rating classes (as defined by the NRSRO (Nationally Recognized Statistical Rating Organization of the U.S. Securities and Exchange Commission): (1) Financial institutions, broker-dealers, (2) insurance companies, (3) general business corporations, and (4) governments and municipalities. If we are subject to disclosures under Rule 17g-7(a) of the U.S. Securities and Exchange Commission, such disclosures are attached to news releases appearing on the JCR website (<https://www.jcr.co.jp/en>).

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