

**Sustainability for the Future 2050:
RIKEN's action plan to create a future together with the environment**

RIKEN aims to be carbon neutral by 2050. To achieve this, we will harmonize environmental considerations with the power of science and promote operational activities that contribute to the global environment to realize a thriving and sustainable future society.

1. A message from the president of RIKEN: Stepping up to the challenge to protect the environment and create a sustainable future

Humanity is facing an intensification of constraints on energy and resources due to international conflicts. In the meantime, challenges on a global scale, such as global warming and climate change are advancing hourly.

At COP30 (the 30th session of the United Nations Climate Change Conference), held in Belém, Brazil in 2025, the conference stopped short of adopting an emissions reduction roadmap for the event's focal point of phasing out fossil fuels. As a result, it has become clear that the shift toward “resilience” based on an assumption of damage is underway, moving from international dialogue centered on “mitigation.” A strong sense of concern and disappointment has been voiced in response to this change. However, since the strengthening of resilience is an extremely pressing and imperative matter, we must search for a balance between “mitigation” and “adaptation.” To do this, a strong scientific foundation is essential to understanding the complex interaction between nature and society, and to quantify risks and project long-term impact. Scientific knowledge underpins the validity of rational and sound policy decisions.

To ensure the sustainability of ecosystems, resource circulation, and disaster resilience that make up the Global Commons, RIKEN has made it our clear aim to pursue scientific knowledge and advance fundamental science through computational science. As part of this aim, RIKEN is collaborating with the Potsdam Institute for Climate Impact Research (PIK, Germany) to establish a scientific research platform that will contribute to the maintenance of the global commons. We are building a structure to carry out reciprocal feedback between basic research and systems science, which have had few common points until now, and we are vigorously promoting science to hold back the collapse of the Earth system.

Results achieved due to the collective of fundamental science and systems science, and societal behavioral modification based on those results. Bringing these two into synergy is precisely the major contribution that RIKEN should make toward environmental conservation. As outlined in this Action Plan, let's aspire to build a sustainable research environment to achieve carbon neutrality by 2050.

2. Targets and roadmap for greenhouse gas (GHG) emissions reduction

2.1 The rationale for setting goals

RIKEN strives to reduce GHG emissions in our research activities. We aim to reduce our GHG emissions by 50% by FY 2030 and to be carbon neutral by 2050 through adoption of renewable energy, energy efficient activities, procurement of renewable energy, and more. More concretely, by FY30 more than 60% of RIKEN's purchased electricity will be renewable energy, and in FY40 we will have more than 80% from decarbonized power sources. Moreover, we will incrementally decrease our GHG emissions from fossil fuels. In five years, we will maintain energy efficient activities, cutting our energy consumption per unit by an average of 1% or more. Additionally, we will endeavor to procure renewable energy, prioritize items eligible under the *Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities* (Green Purchasing Law), promote greening on our campuses, and reduce toxic chemicals, such as freon (see attachment 2), that contribute to global warming. We will also strive to thoroughly follow the 3Rs (reduce, reuse, recycle) and create sustainable environmental management.

2.2 Targets and a roadmap

2.2.1 GHG emissions reduction targets by 2050

To achieve carbon neutrality by 2050, RIKEN will advance the following eight measures: (1) Phased implementation of renewable energy; (2) Phased reduction of GHG derived from fossil fuels (continuous reduction of CO₂ emissions due to combustion); (3) Implementation of activities to save energy of at least 1%; (4) Prioritization of *Green Purchasing Law*-eligible products; (5) Facilitation of greening on campuses; (6) Reduction of toxic chemicals, such as freon, that contribute to global warming; (7) Promotion of 3R+renewable for waste; (8) Facilitation of shared facility equipment (common use)

2.2.2 Energy portfolio concept(*)

RIKEN aims to reduce dependency on fossil fuels and incrementally raise our proportion of renewable energy. Based on our energy usage as of 2024, we will move forward with activities to save energy such as a phased adoption of renewable energy and a phased reduction of fossil fuel use.

However, in working toward our goal of carbon neutrality by 2050, we expect to achieve this through a transition to electricity and conversion to carbon neutral fuels. We are advancing discussions and implementation of concrete measures.

Note: Energy portfolio refers to the prospects of future use and reduction for energy types, such as electricity, gas, and steam.

3. Steady efforts in line with the national government's action plan

3.1 Alignment with the national government's action plan

Following the *National government action plan* by Cabinet decision on February 18, 2025 and the Plan's executive summary, RIKEN has established and is implementing an energy conservation plan for administrative and research projects as a whole from FY25 until FY50. During the planning period, we will make an appropriate review based on the situation and technological advances. Our plan targets reductions in total GHG emissions

of 50% by FY30, of 65% by FY35, and of 79% by FY40, compared to FY13 levels. This requires reducing emissions from the FY 2013 level (271,327 tons) to 135,663 tons or less by FY30. A revision of these targets is possible depending on our progress and the state of the emissions. As a measure, we are taking action toward expanding installation of solar power generation facilities, making new buildings ZEB (Zero Emission Building) Ready (buildings that reduce energy use standards set for each purpose by 50%), full electrification of RIKEN official vehicles, fully introducing LED lighting, increasing the proportion of renewable energy, and promoting "3R (Reduce, Reuse, Recycle) + Renewable" for waste.

3.2 Targets for individual measures

By FY30, RIKEN will install solar power generating equipment in 50% or more of buildings where they can be installed and we aim to have solar power generating equipment in all buildings by FY40. From FY26, newly constructed buildings will in principle be at least "ZEB Oriented" (Buildings that reduce energy consumption by 30 - 40% compared to the energy standards set for each specific use. One of four levels set by the national government.). We have set a target to achieve having the average newly constructed building have energy-saving functionality equivalent to "ZEB Ready" (Buildings that reduce energy consumption of 50% or more as established by the national government).

Appropriate targets for research facilities and others will be established depending on other details, however, the power stations, the Sewage Treatment Area, the General Storage Room, and the garage will be exempt. From FY26, we will gradually switch over to electric, fuel cell, plug-in hybrid, or hybrid vehicles and have all RIKEN vehicles replaced with electrified vehicles by FY30. We plan to achieve a 100% adoption of LED lighting in RIKEN buildings by FY30. However, individualized energy-saving measures will be put into practice when labs are unable to adopt LED lighting. By FY30, we aim to have renewable energy account for over 60% of purchased power.

4. New challenges for RIKEN

RIKEN will not only implement measures in line with the national government's action plan but also aim to become carbon neutral (CN) by FY50 and take on new challenges.

4.1 Heighten awareness and change behavior of executives and employees

We will facilitate a radical change in RIKEN employee awareness based on the increasing impacts of climate change that was illustrated in the 6th evaluation report by the Intergovernmental Panel on Climate Change (IPCC). Information will be shared about sustainable energy use and waste reduction on RIKEN internal and external websites or through various meetings.

4.2 Contribution to global warming prevention through research activities

RIKEN promotes research on renewable energy, such as the generation of biofuels that use solar energy, and aims to achieve a sustainable energy supply that is not reliant upon fossil fuels, thus reducing GHGs. We also advance research and development of energy saving processes, contributing to the actualization of the capture and reuse of CO₂ and of the development of sustainable synthesis of materials. Additionally, we aim to reduce the energy necessary for the operation of planned upgrades to large-scale research facilities currently under development, the supercomputer Faintest, and the large synchrotron radiation facility SPring-8-II, while also attaining improved functionality. By doing this, we will be contributing to building a sustainable future through our research and development activities to achieve a carbon neutral society.

4.3 Cooperation with local communities

By effectively using unutilized energy, solar power, and others for solving local challenges, RIKEN will improve regional energy self-sufficiency rates and contribute to decreasing fossil fuel reliance. Moreover, we will coordinate with local municipalities to host training or seminar events and raise awareness of decarbonization and promote adoption of technology through student and technician training and education on the environment.

4.4 RIKEN's GHG emissions and targets for reduction (Refer to attachment 1)

The Greenhouse Gas Protocol is a global standard for GHG reduction measures. In the GHG Protocol, Scope 1, 2, and 3 are defined as categories of GHG emissions. Scope 1 are direct emissions that occur from the company itself; Scope 2 are GHG indirect emissions due to electricity or heat supplied from other companies; and Scope 3 are other indirect GHG emissions. The aggregate of these three are a way to think of a company's emissions as a whole. Until now, RIKEN has implemented major measures with Scope 1 and 2 in mind, but in recent years it has become increasingly important to create GHG emission reduction targets that include Scope 3. RIKEN will incrementally broaden the scope of calculations in relation to Scope 3, and we are implementing realistic plans to focus on categories with high emissions. At the current stage, it is difficult for RIKEN to conduct detailed analysis ourselves. Therefore, we believe that proactively utilizing public databases and guidelines from related ministries and agencies will be an effective technique for analysis. This plan specifies the categories RIKEN should deal with as demonstrated in the overview of Scope 3's estimates. Improvements to the methodology will be considered as necessary.

4.4.1 Measures for the GHG Protocol Scope 3 categories

The following items fall under the GHG Protocol Scope 3 categories. GHG emissions must be calculated for each category. Of the Scope 3 categories, RIKEN will take necessary measures, focusing on the corresponding ones (see the list below).

GHG Protocol Scope 3 Categories and Measures at RIKEN

<u>Scope 3 category</u>	<u>Example of activities at RIKEN (bolded items only)</u>
1. Purchased goods and services	Research equipment, reagents, office equipment, contracted services, etc. (A portion of which has already been supported by the <i>Green Purchasing Law</i>)
2. Capital goods	New and increased facilities and equipment
3 Fuel- and energy-related activities (not included in scope 1 or scope 2)	Upstream process of supplied fuel (mining, refining, etc.) Upstream process of supplied electricity (Mining, refining, etc. of fuel used in power generation)
4 Upstream transportation and distribution	Transportation of research samples or materials (RIKEN is shipper)
5 Waste generated in operations	Disposal of waste from operations (excluding valuables) by a group other than RIKEN
6 Business travel	Business trips for executives and staff (using public transportation)
7 Employee commuting	Commuting by executives and staff (means of commute)
8 Upstream leased assets	Operation of leased assets rented by a company (In systems for appraisal, reporting, and publication, more than half are not applicable due to being included in calculations for Scope 1 and Scope 2.)
9 Downstream transportation and distribution	Transportation of research specimens (transportation following shipment by RIKEN), storage in the Storage Room, sales
10 Processing of sold products	Processing of intermediate products by a company
11 Use of sold products	Use of products by a user
12 End-of-life treatment of sold products	Transportation and treatment when disposing of products by a user
13 Downstream leased assets	Operation of assets owned by the company (as lessor) and leased to other entities
14 Franchises	Account for emissions by franchisors that occur from the operation of franchises (scope 1 and scope 2 emissions of franchisees)
15 Investments	Investing in stocks, bonds, project finance, and others
Others (optional)	Daily lives of employees or consumers

https://www.env.go.jp/earth/ondanka/supply_chain/gvc/estimate_03.html

A portion taken from the Green Value Chain Platform: What are Scope 3 emissions? (Ministry of the Environment, METI, MAFF)

4.4.2 Determining calculation of boundaries for each category and analysis of activity level data

We will clarify the calculation of applicable boundaries in each category and analyze the activity data needed for calculating emissions.

- Example of activity data: Purchase amount, business travel distance, commute distance, amount of waste, etc.
- Emission factors: Utilize the “Database of emissions per unit” and others from the Ministry of the Environment and if possible, companies involved in GHG emissions, etc. (also compare with primary data provided by supply chains)

4.4.3 Calculation of emissions

We will use a basic calculation of **Amount of activity (times) Emission factors**, and calculate the CO₂ conversion of each category's GHG emissions.

4.5 Common usage of equipment (shared use)

There are many duplicate purchases of equipment used for research at RIKEN. In light of the need for items with a high utilization rate, we have determined that purchase and maintenance are necessary. However, maintenance of items with a low utilization rate unnecessarily uses power and energy for waste heat, leading to the allocation of unnecessary space. When persons who use similar equipment confer with each other and raise its utilization rate, we can become more energy efficient and save resources.

5. Progress management and information disclosure

Based on revisions to global and governmental standards, we will regularly calculate and manage emissions, and we will revise our targets and measures based on our progress. The results of these efforts will be disclosed in our environmental reports and websites to heighten transparency and fulfill our social responsibilities.

Scope categories in the GHG Protocol delineating environmental initiatives

Scope 1 (direct emissions)

- Burning of fossil fuels
- Freon gas leak

Scope 2 (indirect emissions)

- Indirect emissions from energy sources

Scope 3 (other indirect emissions)

1. Purchased goods and services

2. Capital goods

3. Fuel- and energy-related activities (not included in scope 1 or scope 2)

4. Upstream transportation and distribution

5. Waste generated in operations

6. Business travel

7. Employee commuting

8. Upstream leased assets

9. Downstream transportation and distribution

- Processing of sold products
 - Use of sold products
 - End-of-life treatment of sold products
 - Downstream leased assets
 - Franchises
 - Investments
- Others

RIKEN will **consider new initiatives for reducing GHG emissions** in these categories

(However, this consideration is not required for items subject to the Green Purchasing Law.)
Specifically, we will **analyze GHG emissions throughout the entire supply chain** and consider selecting goods and services with low emissions.

- Fuel use for combustion facilities (boiler rooms, generators, etc.)
- Fuel use for vehicles (RIKEN vehicles, etc.)
- Use of utility gas
- Freon and other gas leaks (AC equipment, temperature control for research equipment, etc.)



Purchase and use by RIKEN

- Electricity
- Heat
- Steam ...others



Category 1

- Research equipment
- Reagents
- Supplies
- Outsourced services, etc.



Category 2

- New or increase in facilities, equipment



Category 4,9

- Research samples
- Transportation and delivery of materials, etc.



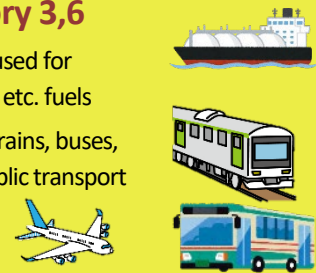
Category 5

- Research activities
- Waste management for admin activities (excluding valuable materials)



Category 3,6

- Energy used for shipping, etc. fuels
- Planes, trains, buses, other public transport uses



Category 7

- Employee methods of transportation
- Private car
 - Public transportation
 - Vehicle
 - Walking, etc.



* Examples of categories applicable to RIKEN

(Reference) Types of Greenhouse Gases (GHG) Attachment 2

GHG	Global warming potential*	Properties	Uses, emission sources
Carbone dioxide (CO ₂)	1	The most representative greenhouse gas.	Combustion of fossil fuels, etc.
Methane (CH ₄)	25	The main component of natural gas, gaseous at room temperature. Highly flammable.	Rice cultivation, intestinal fermentation in livestock, landfill waste, etc.
Nitrous oxide (N ₂ O)	298	The most stable among nitrogen oxides. It is not as harmful as other nitrogen oxides (e.g., nitrogen dioxide).	Fuel combustion, industrial processes, etc.
HFCs (hydrofluorocarbons)	1,430 etc.	Fluorocarbons that do not contain chlorine and do not deplete the ozone layer. Potent greenhouse gases.	Sprays, refrigerants in air conditioners and refrigerators, chemical manufacturing processes, etc.
PFCs (perfluorocarbons)	7,390 etc.	Fluorocarbons composed solely of carbon and fluorine. Potent greenhouse gases.	Semiconductor manufacturing processes, etc.
SF ₆ (Sulfur hexafluoride)	22,800	Hexafluoride of sulfur. A potent greenhouse gas.	As an electrical insulator, etc.
NF ₃ (Nitrogen trifluoride)	17,200	An inorganic compound composed on nitrogen and fluorine. A potent greenhouse gas.	Semiconductor manufacturing processes, etc.

* Global warming potential (GWP) is a value indicating the degree of greenhouse effect for each GHG. Since the longevity of each gas differs, the GWP will vary depending on that period when estimating the greenhouse effect. The values here correspond to those for the Kyoto Protocol's second commitment period.