

# FUKUSHIMA RENEWABLE ENERGY INSTITUTE

*Technology For Renewable Energy  
For Reconstruction  
For the World*



*Photovoltaic power  
generation*



*Wind power  
generation*



*Hydrogen energy  
storage*



*Geothermal  
energy*

# Remarks on the Establishment of Fukushima Renewable Energy Institute



**Ryoji Chubachi**

President of the National Institute of Advanced Industrial Science and Technology (AIST)

Following the government's policy, "Basic Policy of Reconstruction After the Great East Japan Earthquake" (issued in July, 2011), the National Institute of Advanced Industrial Science and Technology (AIST) established the "Fukushima Renewable Energy Institute" in Fukushima, the prefecture that is pioneering an intensive introduction of renewable energy.

AIST plays an important role as an open innovation hub to contribute to the enhancement of industrial competitiveness of Japan. The reconstruction of the disaster struck area by the Great East Japan Earthquake is still in progress. Establishing the institute will contribute to the reconstruction. The Fukushima Renewable Energy Institute, AIST (FREIA) has two essential missions: "Promotion of R&D of renewable energy which is open to the world," and "Contribution to industrial clusters and reconstruction." The new institute will be established as a novel research base to develop innovative technologies in collaboration with domestic as well as international partners who will gather there.



## Our Objectives

Renewable energy such as solar, wind, geothermal energy, hydropower, biomass, etc. is our valuable domestic energy source in Japan. Its introduction at high rate is expected for energy security, energy diversification, and for prevention of global warming.

It is necessary (1) to match intermittent power sources (solar photovoltaic and wind power generation) to power demand, (2) to reduce cost of power generation and environment assessment, and (3) to harmonize adequate location for utilizing natural resources and optimum technology with the environment. Our objectives are as follows:

1. To integrate energy systems including power generation, energy storage using hydrogen and battery, and power electronics, and to demonstrate an integrated renewable energy system by utilizing a high rate of renewable energy that fluctuates temporally,
2. To develop light-weight and cost-effective photovoltaic modules to realize economical mass production technology,
3. To develop database of geothermal sources to help people understand the social value of making use of natural resources.

We would like to attain our objectives by collaborating with industry, academia, and overseas organizations. Moreover, we would like to support your business with our technologies and through human resource development.



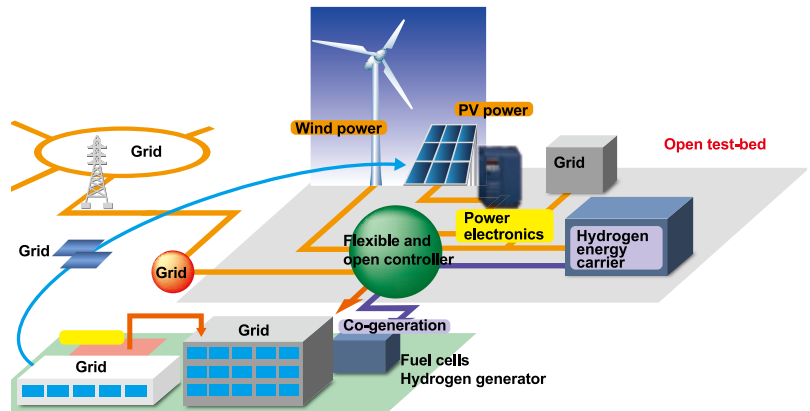
# Main Research Themes

## Research and Verification of Advanced Integration of Renewable Energy Sources

Half of the electricity usage at Fukushima Renewable Energy Institute will be provided from high penetration solar PV and wind power systems at the initial stage. The future goal of our penetration ratio of renewables is 100%.

### Research Themes

- Development of a total energy management system with energy storage using hydrogen energy carriers or batteries and thermal storages, for self-sustained renewable energy networks
- Open test-bed for testing of grid-connected inverters and energy storage systems to be used for Smart Grid and Micro Grid



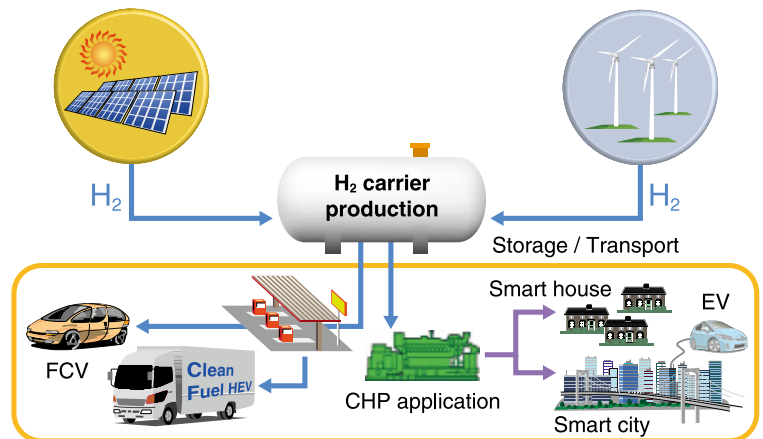
Advanced integration of renewable energy sources with hydrogen energy storage

## Production and Utilization Technology of Hydrogen Carrier

Goal of this research is to store and use renewable energy efficiently as electricity generated by solar and wind.

### Research Themes

- R&D will be conducted on efficient production technology of hydrogen carriers (chemical hydride, ammonia, etc.) which are able to store a lot of hydrogen
- As a utilization technology of hydrogen carrier, R&D will be performed on co-generation engine fueled by hydrogen and bio-diesel
- Water electrolyzation, hydrogen carrier production and co-generation engine will be integrated to build an independent system



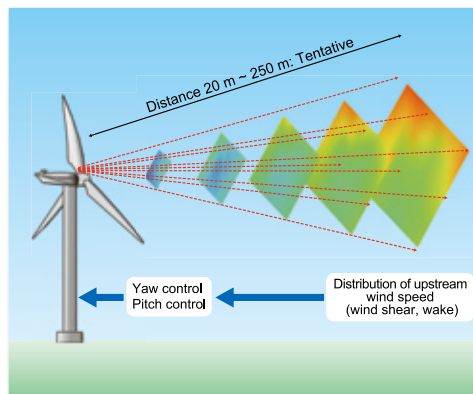
Energy network including hydrogen carrier

## Advanced Technology for Wind Power Generation

For further introduction of the wind power generation, it aims 5% improvement of the energy output and 10% improvement of lifetime of wind turbine generation system by developing advanced wind and noise measurement technology and wind turbine prediction technology.

### Research Themes

- The algorithm of predictive control of wind turbine using nacelle-mounted LIDAR will be developed as an epoch-making technology to increase energy output.
- The site assessment technology that predicts the annual energy output and environmental impact by wind turbine noise will be improved.



Nacelle-mounted LIDAR



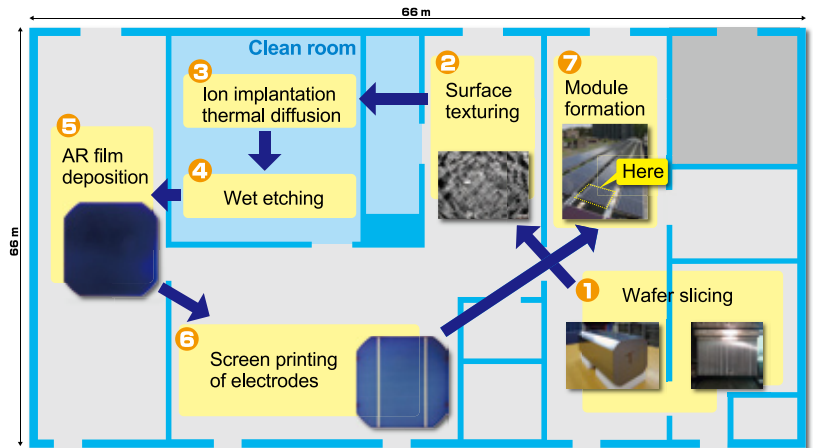
Noise measurement system

## High-Performance Modules with Thin-Crystalline Silicon Solar Cells

The final goal of our R&D is to achieve the power generation cost below 10 yen/KWh.

### Research Themes

- To construct a PV development line which enables us to obtain high-efficient and very-thin (80 μm) crystalline Si solar cells in a mass production scale
- To develop low-cost/light-weight modules with private companies in the “Next-generation Crystalline Si PV Consortium” (20 companies participating at present)
- To promote R&D with various types of companies covering materials, production equipment and evaluation equipment
- To collaborate with a regional innovation strategy support program (development of thin solar cells by Fukushima Univ.) and a JST program (development of Si nanowire solar cells)



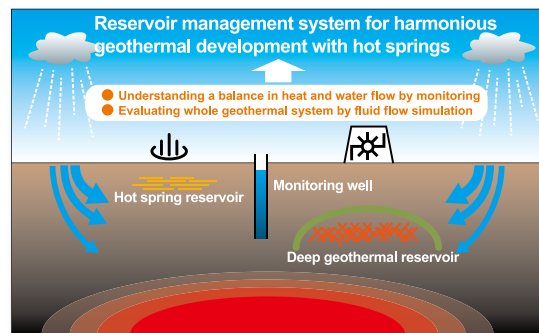
Crystalline silicon solar cell/module R&D foundry

## Technologies for the Effective and Sustainable Use of Geothermal Resources

We will achieve effective development and sustainable management of geothermal reservoirs and harmony with the hot spring resources, using our advanced measurement and exploration techniques for geothermal resources development.

- We will reduce the development cost of geothermal power generation by leveraging advanced monitoring technologies.
- We will provide data and knowledge to the public, such as to local and prefectural councils, for helping consensus formation about geothermal development.

We will develop the technologies for capacity improvement of geothermal reservoirs and artificial geothermal reservoir development to expand the geothermal power generation capability area in harmony with the environment both in Japan and abroad.



Concept of harmonious coexistence of geothermal power generation and hot springs



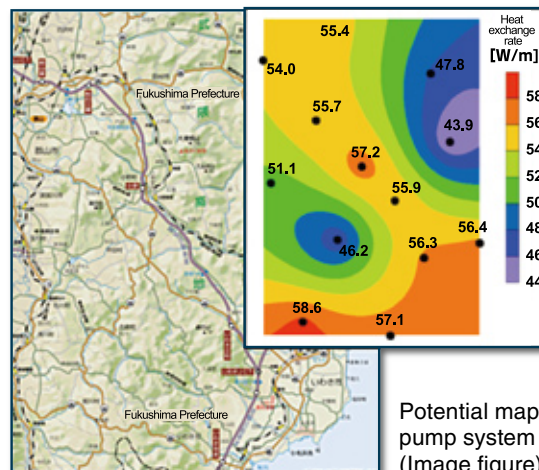
Drilling exploration of a hot spring system in the Minami-Izu area

## Potential Assessment of Ground-Source Heat Pump System and its System Optimization Technology

The ground-source heat pump (GSHP) system is highly efficient and energy-saving as compared to normal air conditioners (air-source heat pump system). The system will be promoted by enhancing its performance and lowering its cost on the basis of geological information.

### Research Themes

- Local geological surveys and groundwater surveys will be conducted to prepare a potential map of the GSHP system based on the groundwater flow and heat exchange simulation.
- By using this potential map, design accuracy of the GSHP system can be increased as well as high performance and cost reduction can be achieved.
- Design technology of the GSHP system appropriate for various characteristics of geology will be developed by collaborating with Nihon University, Fukushima Technology Center (High-tech Plaza) and local business enterprises.



Potential map of ground-source heat pump system prepared by AIST (Image figure)



# Highlights of the Institute

## Demonstration Field / Test-bed As User Facility

The test-bed in the demonstration field is open to industry and academia for developing/evaluating power conditioner, battery, energy management, etc.

## Crystalline Silicon Solar Cell/Module R&D Foundry

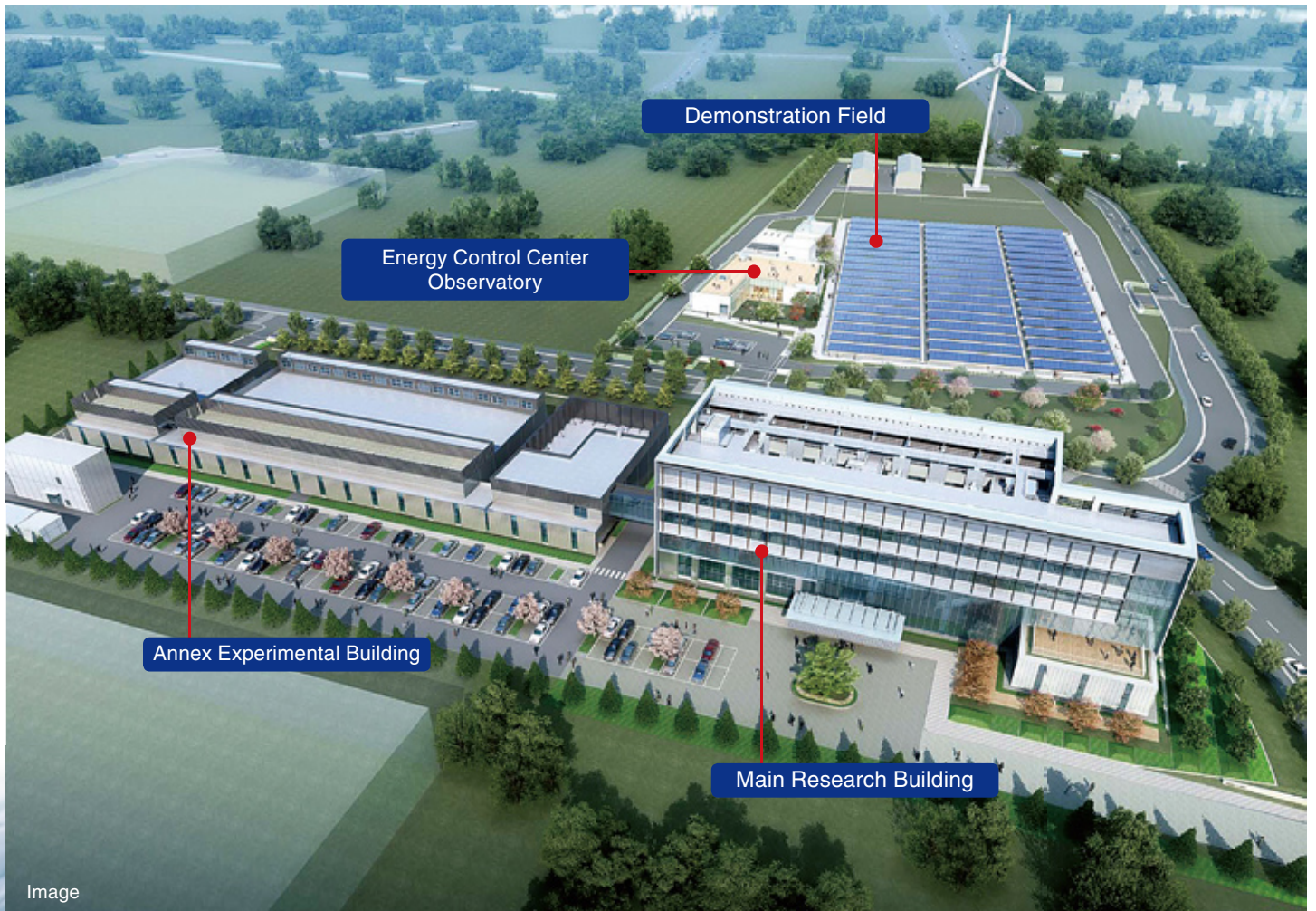
R&D of advanced process technologies is conducted for future mass production of crystalline silicon solar cells and modules. AIST organizes the “Next-generation Crystalline Silicon PV Consortium” with the participation of 20 companies.

## Other Facilities

Photovoltaics, wind power, ground-source heat pump, solar heat, co-generation engine fueled by hydrogen, etc. are installed to demonstrate production, storage, and utilization of renewable energy.

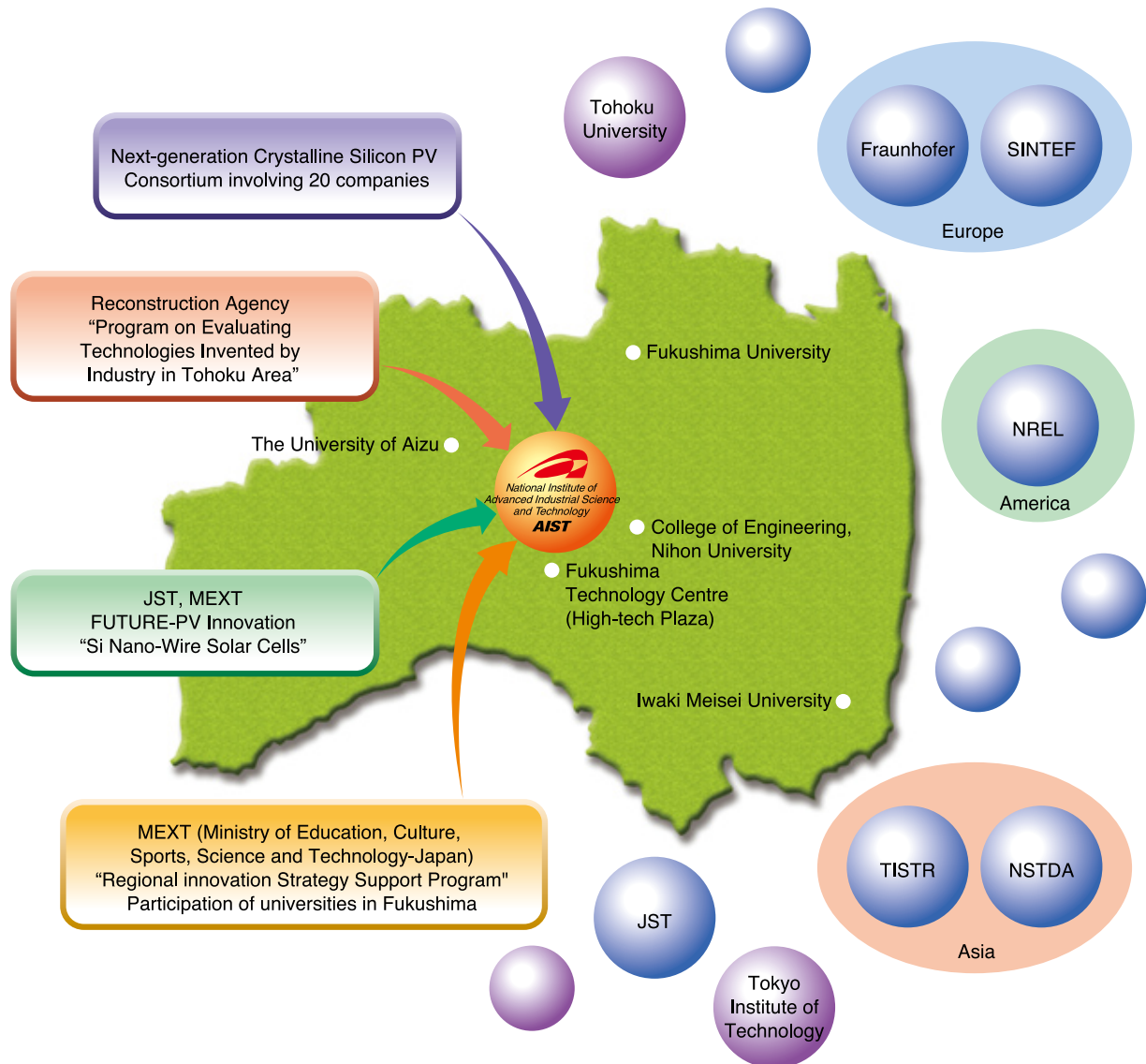
## Research Buildings

The main research building (4-story) is environment-friendly (CASBEE S rank), and the annex experimental building has large and user-friendly experimental rooms. Half of the energy consumption can be supplied by renewable energy.



# Collaboration

AIST is one of the largest public research institutes in Japan, and works to promote collaboration among industry, academia, and government by encouraging people to make the best use of various resources AIST has. The Fukushima Renewable Energy Institute will be promoting collaboration with overseas organizations as well as domestic ones.



## Collaborations relating to the Fukushima Renewable Energy Institute, AIST

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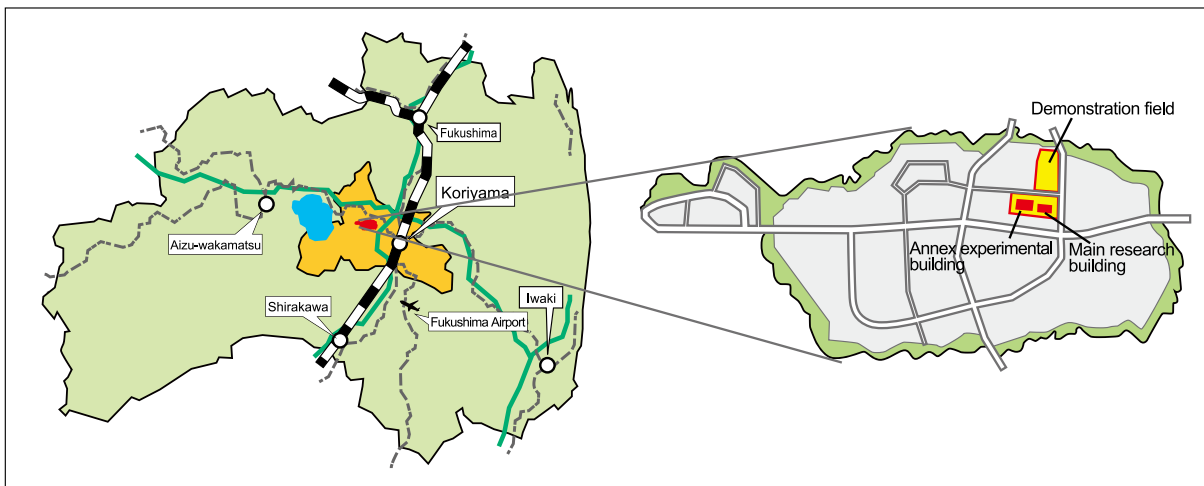
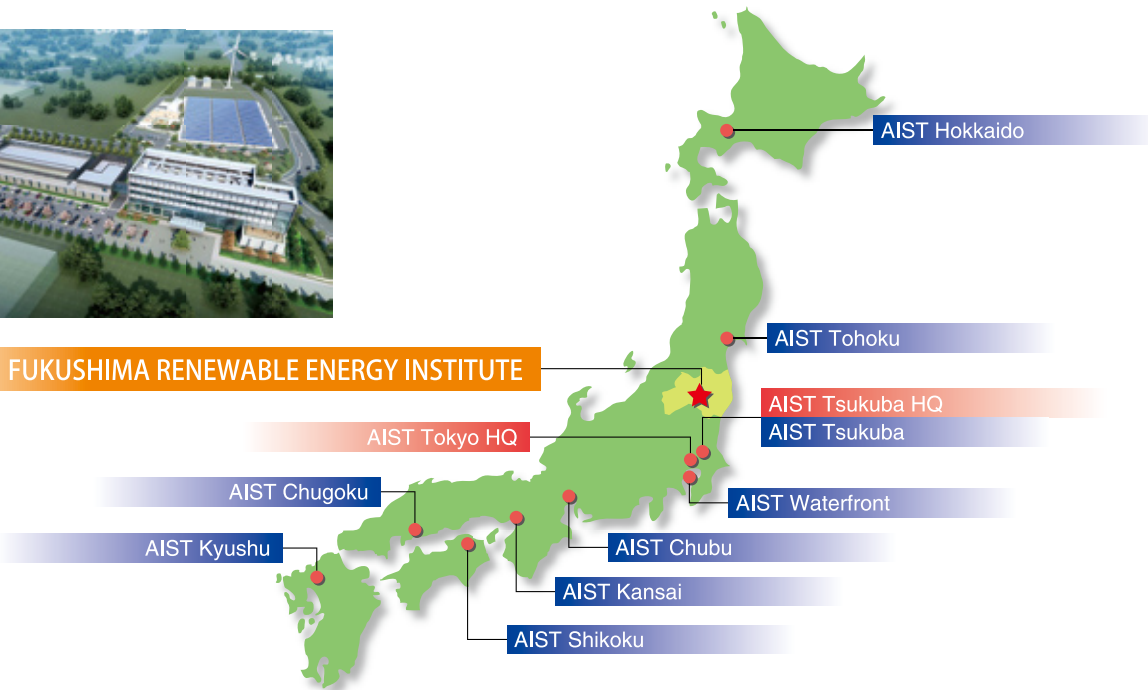
Developed technologies at Fukushima Renewable Energy Institute will be available for everyone!  
We accept technical problems, proposals of collaborative research, etc. from industry on renewable energy business.

- AIST researchers in Japan offer advice about research and development.
- We measure and evaluate performance of products manufactured by industry.
- We provide the latest information on renewable energy.

First contact us!



**FUKUSHIMA RENEWABLE ENERGY INSTITUTE**



**FREIA**  
FUKUSHIMA RENEWABLE ENERGY INSTITUTE, AIST

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