

I²CNER

INTERNATIONAL INSTITUTE FOR CARBON-NEUTRAL ENERGY RESEARCH



Message from the I²CNER Director

Climate change issues such as global warming are becoming more serious recently, and the shift to a carbon-neutral society based on renewable energy has become important and urgent global issue. International Institute for Carbon-Neutral Energy Research (I²CNER) was established in 2010 as the WPI Institute, the only institute at that time bearing the name of Carbon-Neutral Energy, and joined the WPI Academy member in 2020. In the last 13 years, I²CNER has been working comprehensively to develop the innovative science and technology necessary to realize a carbon-neutral society.

There are still many difficult challenges exist for shifting from the current energy system that mainly uses fossil fuels to a society based on renewable energy and materials. However, for this, novel energy conversion technology as well as overall design of a social system which uses materials and energy linked each other is required. In this regard, under one roof, I²CNER is developing to create innovative energy conversion technologies that are interconnected.

Renewable energies such as solar and wind power are widely and evenly distributed energy without regional segregation, and are equally distributed to all people on earth. However, renewable energy has large fluctuations and low energy density, so it is required to develop an effective method for leveling and increase in power density. At I²CNER, we are developing innovative materials and processes such as solar cells that efficiently convert solar energy to electricity, and steam electrolysis that can convert to hydrogen as an energy carrier. Considering CO₂ as a carbon resource and also a hydrogen carrier, the efficient conversion process of CO₂ to useful compounds are also developing. In particular, we are working on the development of materials that can separate CO₂ which is diluted, such as in the atmosphere.

On the other hand, we are also investigating the development of new interdisciplinary science for innovative photocatalysts such as dye modification and enzyme, which can directly convert solar energy into hydrogen. Finally, underground storage of CO₂ will also be necessary for net decrease of CO₂ emission, and therefore, storage technology and the stability of stored CO₂ underground are further studied. We will contribute to a carbon-neutral society in a holistic approach, by creation of innovative science and engineering with interdisciplinary sciences at different time and distance scales.

In the last 13 years, I²CNER has been focused on the creation of high efficiency in conversion technology for realization of carbon-neutral energy society. As a next step, we newly added rapid conversion as a keyword and also focus on the energy that is not being used effectively, cultivating a new academic field by integrating disciplines. We aim to contribute to realizing a carbon-neutral energy society by novel concepts including a scenario and design for renewable society.



Professor Tatsumi Ishihara

Director, International Institute for Carbon-Neutral Energy Research (I²CNER)



カーボンニュートラル・エネルギー国際研究所(I²CNER)とは

About I²CNER



Contribute to the creation of a sustainable and environmentally-friendly society

Shifting to carbon-neutral energy society is globally required important subjects. I²CNER will contribute to realize carbon-neutral society by required novel sciences and also open new research field by interdisciplinary research. On the other hand, securing energy to support a prosperous life is an important global issue and I²CNER will propose social system which uses renewable energy by converting to hydrogen or hydrocarbon synthesized from CO₂ captured and lead to establish a carbon-neutral society.

世界トップレベル研究拠点プログラム(WPI)

World Premier International Research Center Initiative (WPI)

The World Premier International Research Center Initiative (WPI) was launched in 2007 by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in a drive to build within Japan “globally visible” research centers that boast a very high research standard and outstanding research environment, sufficiently attractive to prompt frontline researchers from around the world to want to work in them. I²CNER was selected in 2010. In FY 2017, MEXT established the new WPI Academy to take the vanguard in internationalizing and further renovating Japan’s research environment, making it place that expands and accelerates the international circulation of the world’s best brains. The WPI centers that have achieved “world-premier status” will be the initial members of the WPI Academy. They may possibly be joined later by other Japanese research institutes that have amassed research results and created research environments of the very highest world standard.

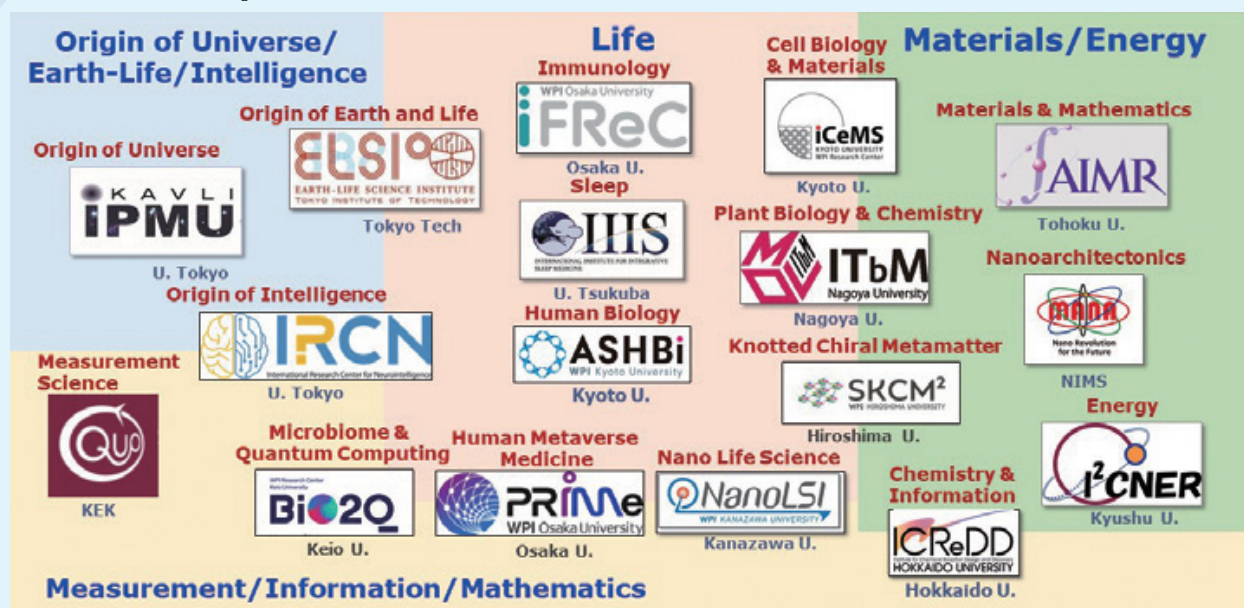
I²CNER was certified as having achieved “World Premier” status by the Program Committee and was inducted into the WPI Academy in April 2020.

World Premier International
Research Center Initiative

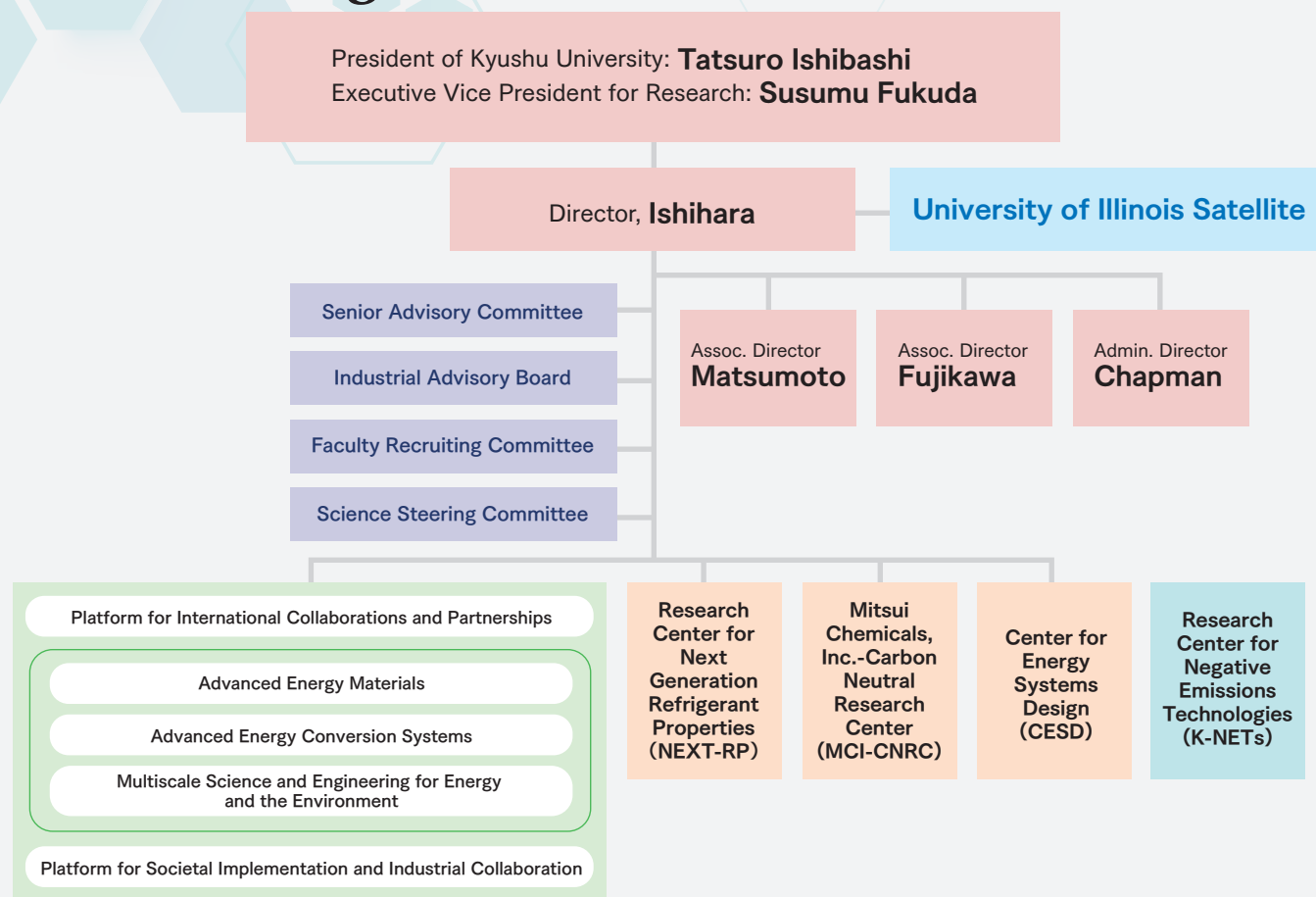
WPI Program Mission

- World-Leading Scientific Excellence and Recognition
- Global Research Environment and System Reform
- Values for the Future

» Science Map of WPI Centers



I²CNER Organizational Structure



Research Units

Advanced Energy Materials

Develop molecular, nano, and bulk materials based on new science of surfaces, interfaces, and microstructures for applications involving H₂, H₂O, and CO₂

Advanced Energy Conversion Systems

Development and evolution of systems which either lower carbon emissions, increase energy efficiency, or both

Multiscale Science and Engineering for Energy and the Environment

Pull together the range of challenges facing Japan and the world's energy transition, namely the transition from largely fossil fueled energy technology to a carbon-neutral or a carbon-free energy supply

Research Platforms

Platform for International Collaborations and Partnerships

This platform is intended to maintain and foster I²CNER's international identity. Because this platform and the three thrusts are interwoven and the members of this platform collaborate with researchers from the thrusts, this is an effective way to promote interdisciplinary collaborations across the Institute and around the world.

Platform for Societal Implementation and Industrial Collaboration

The three research thrusts contribute directly to the transition of future I²CNER scientific advances to applicable technology transfer through a large and growing network of I²CNER industrial interactions. With its strengths in both advanced energy science and energy analysis, I²CNER contributes to the achievement of the 2050 carbon reduction goals.



附属研究センター

Affiliated Research Institutes

Research Center for Next Generation Refrigerant Properties (NEXT-RP)



<launched in Apr. 2016>

NEXT-RP is an international research center that develops and evaluates next-generation refrigerants to solve global environmental issues and future energy crises. Our essential duty is to find the following next generation refrigerants: (i) Lower ODP (Ozone Depletion Potential), (ii) Lower GWP (Global Warming Potential), (iii) Non-flammable or Mildly flammable, (iv) No toxicity or Lower toxicity.

Mitsui Chemicals, Inc.-Carbon Neutral Research Center (MCI-CNRC)



<launched in Nov. 2021>

MCI-CNRC, in collaboration with Mitsui Chemicals Inc., will develop and acquire cutting-edge environmental infrastructure technologies that will contribute to carbon neutrality, as well as pursue the practical use and commercialization of these technologies. By carrying out focused and efficient research into the elemental technologies needed to achieve carbon neutrality, the center will speed up the process of getting these technologies adopted in society.

Center for Energy Systems Design (CESD)



<launched in Nov. 2022>

CESD hopes to promote research on carbon-neutral technologies required for social implementation by collaborating with six research organizations (Hokkaido University, Tohoku University, Tokyo Institute of Technology, Kumamoto University, RIKEN, and National Institute for Materials Science). This center consists of six research teams. The teams of "Light Energy Conversion", "Electric Energy Conversion", "Material Conversion", and "Materials, Storage and Transport" conduct research to enable "high-speed conversion". The "Energy Analysis" research team is responsible for the design of energy research by back-casting. The "Data Science" research team supports each research team by promoting data science, leading to discontinuous innovation. Not only achieving innovative outcomes, but the center also aims to foster the scientists of the future by making the center a field where young researchers can actively participate.

学内共同教育研究センター

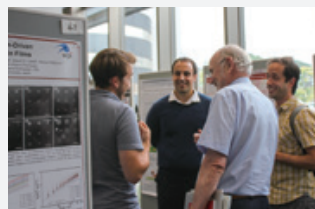
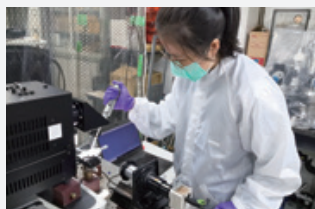
Centers for Common Education and Research

Research Center for Negative Emissions Technologies (K-NETs)



<launched in Apr. 2021>

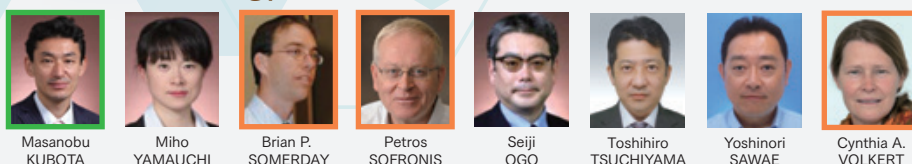
This center aims to develop negative emissions technologies of greenhouse gases, i.e., developing technologies for CO₂ capture directly from the atmosphere, conversion and storage of the captured CO₂, and utilization of renewable energy. CO₂ can be captured anywhere since air exists ubiquitously on the earth. This nature of ubiquitous existence will enable the construction of an energy-robust society through local production for local consumption of carbon resources and contribute to the control of global warming by underground storage of excess emissions. This research project is supported by the Moonshot Research and Development Program launched by the Cabinet Office of Japan.



主任研究員(PI)の体制

Principal Investigators (PIs)

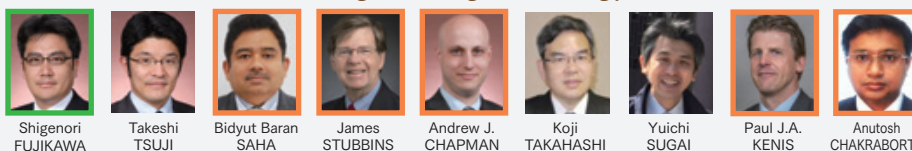
Advanced Energy Materials



Advanced Energy Conversion Systems



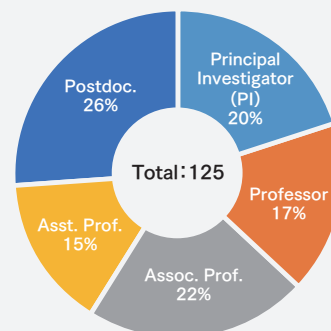
Multiscale Science and Engineering for Energy and the Environment



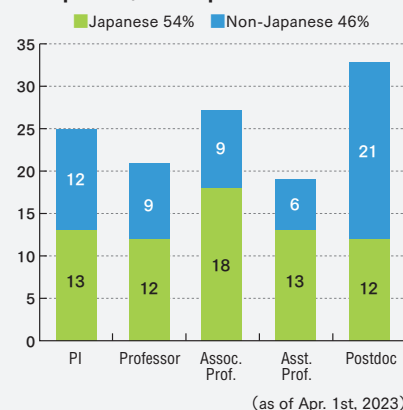
Non-Japanese PIs 12/25=48%

PERSONNEL

Researchers



Japanese/Non-Japanese Researchers

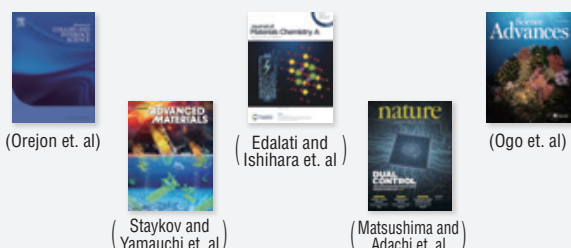


実績

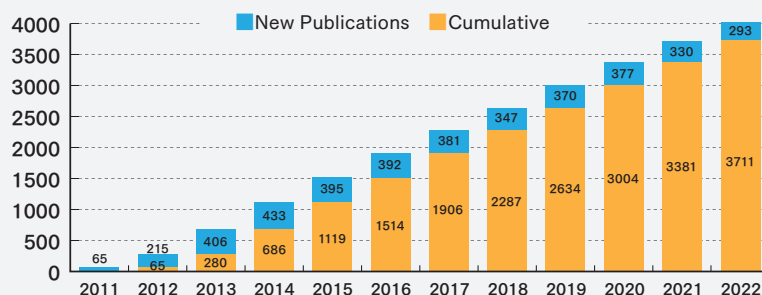
Achievements

Publications Consistently published in internationally-reputed academic journals

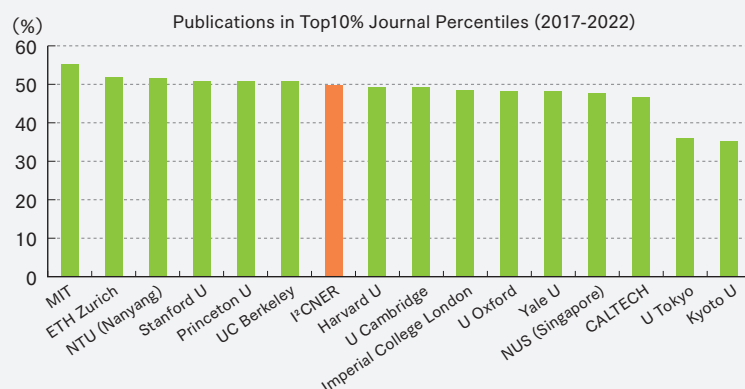
Example of papers published in internationally-reputed academic journals



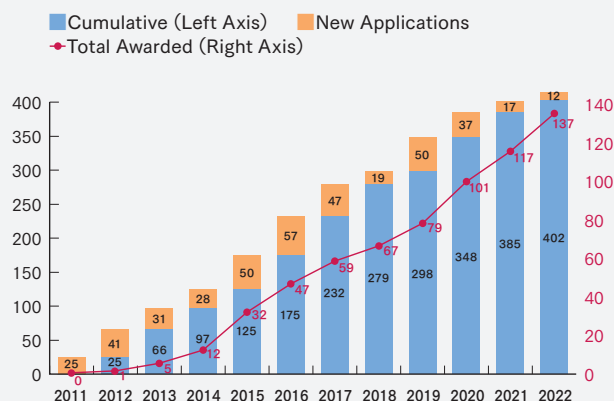
WPI-I²CNER Affiliated Publications



Publications in Top 10% Journal Percentiles



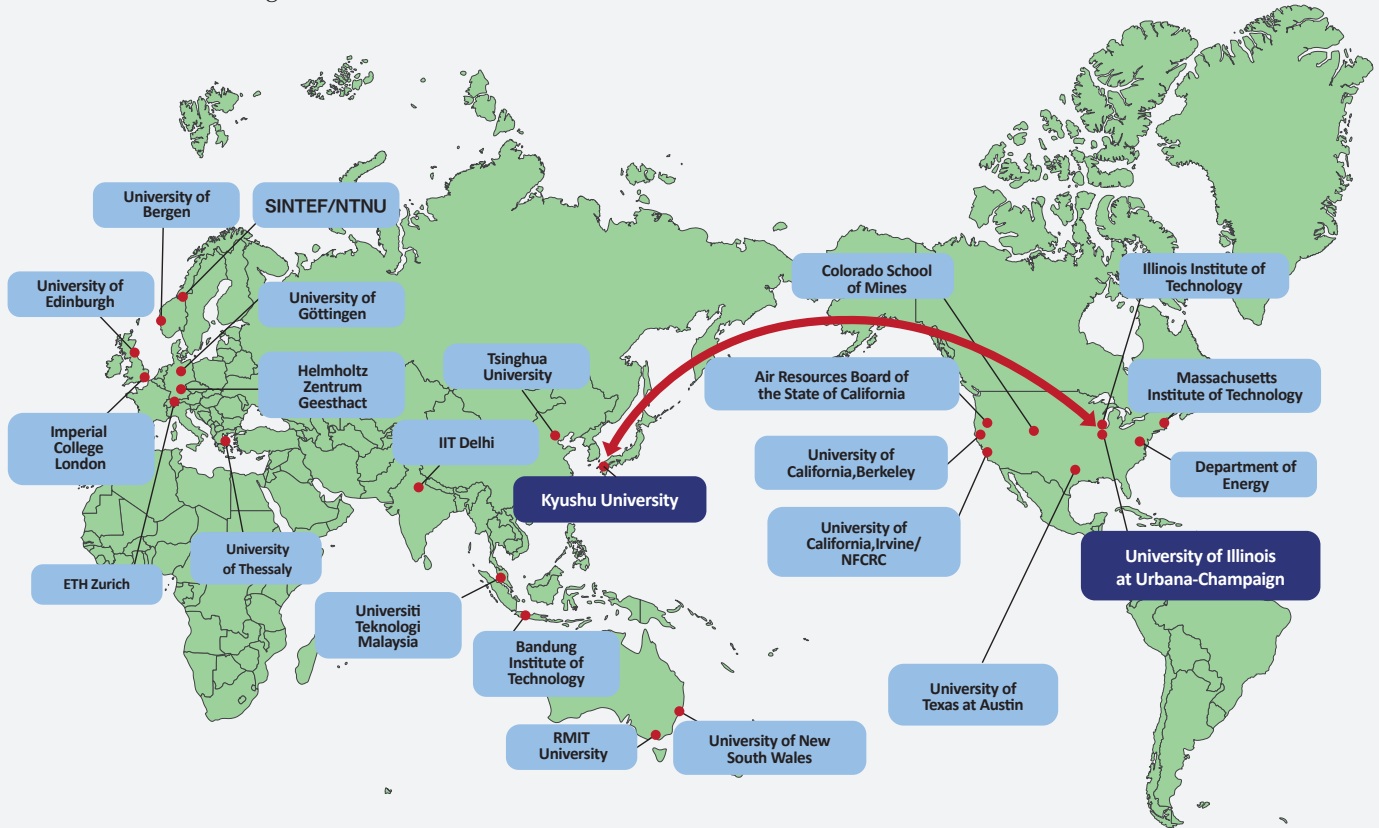
Patents



I²CNERの国際連携ネットワーク

I²CNER's Network of International Collaborations

To carry out its mission, the Institute established collaborations with internationally recognized research centers, universities, and national and international laboratories. These collaborations involve and promote research interactions and researcher exchanges and visits between the institutions.



イリノイ大学アーバナ・シャンペーン校との連携

International Strategic Partnership



KYUSHU UNIVERSITY

- World leader in hydrogen research and technology
- Best-equipped and most-funded laboratories in the world for research on hydrogen/materials interactions
- Exemplary collaboration and engagement with local, prefecture, and national energy stakeholders

I ILLINOIS

- Significant contributions to research of hydrogen embrittlement and materials over the last 40 years
- Research network of excellence with national laboratories and industry
- Tradition of leadership and impact

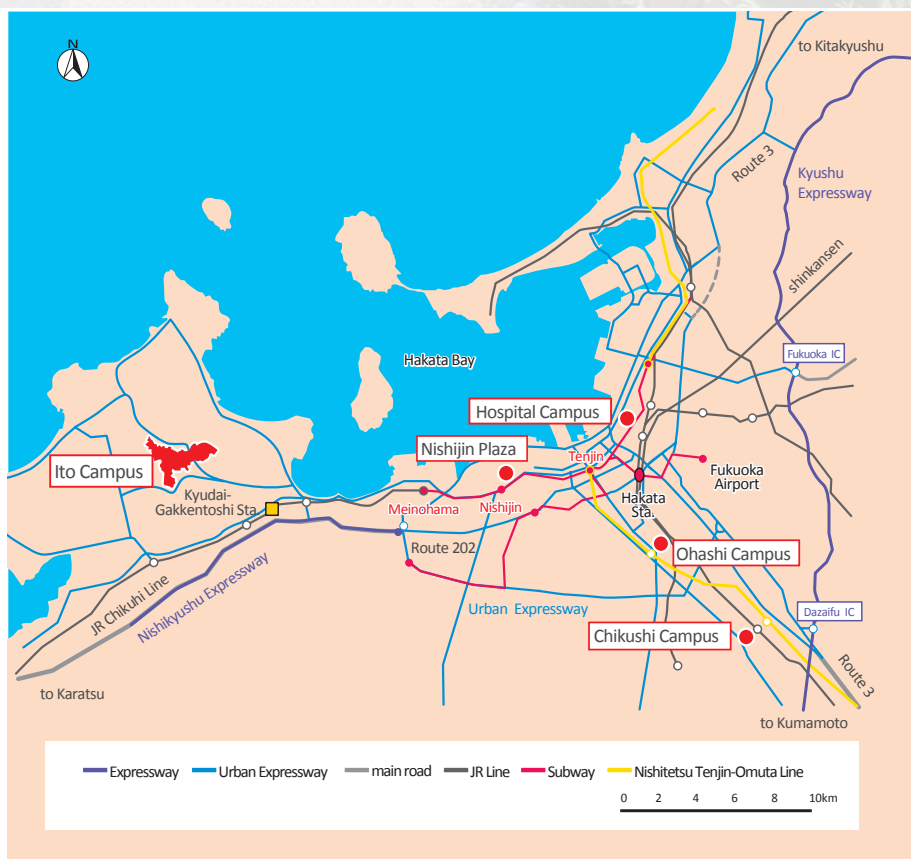


I²CNER's Facilities

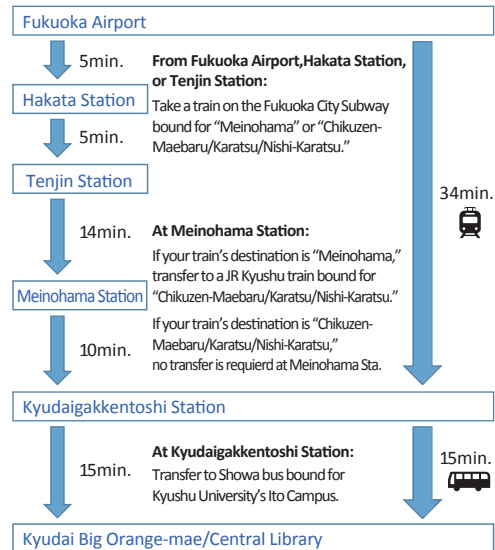
Three years after its inception as the sixth WPI center, in January 2013, I²CNER celebrated the inauguration of its first building, located at the center of the Ito Campus of Kyushu University. Since the number of researchers from all over the world has increased significantly, I²CNER Building 2, which is four stories tall with a total of 5,000m², was completed in February 2015 in order to maintain the high-quality environment indicative of a top-level research center. Holding true to the I²CNER mission and vision for creating a carbon-neutral society, I²CNER Building 2 was designed around the concepts of sustainability, harmonization, and consciousness of environmental impact.



Left: I²CNER building 2, Right: I²CNER building 1



Access Map



Contact us

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