



Kyushu University Hydrogen Project: Challenges to realize a hydrogen society

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KYUSHU UNIVERSITY



Contents

Hydrogen related activities of Kyushu University

- **Fukuoka Prefecture and Kyushu University**
- **Education and Training**
- **Research and Development**
- **US-Japan collaboration**



Why Fukuoka is significantly active in Hydrogen Energy?

Fukuoka Prefecture

Population: 5 million

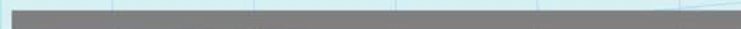
8th among 47 prefectures

Area: 5000m² 29th

- Kyushu University is world-leading intellectual resources
- Hydrogen of 500 million m³ are generated annually
- A 10km long hydrogen pipeline through the city
- Demonstration facilities and fields at Kyushu University
- A Highly concentrated, wide ranging manufacturing sector

Kyushu

1000km

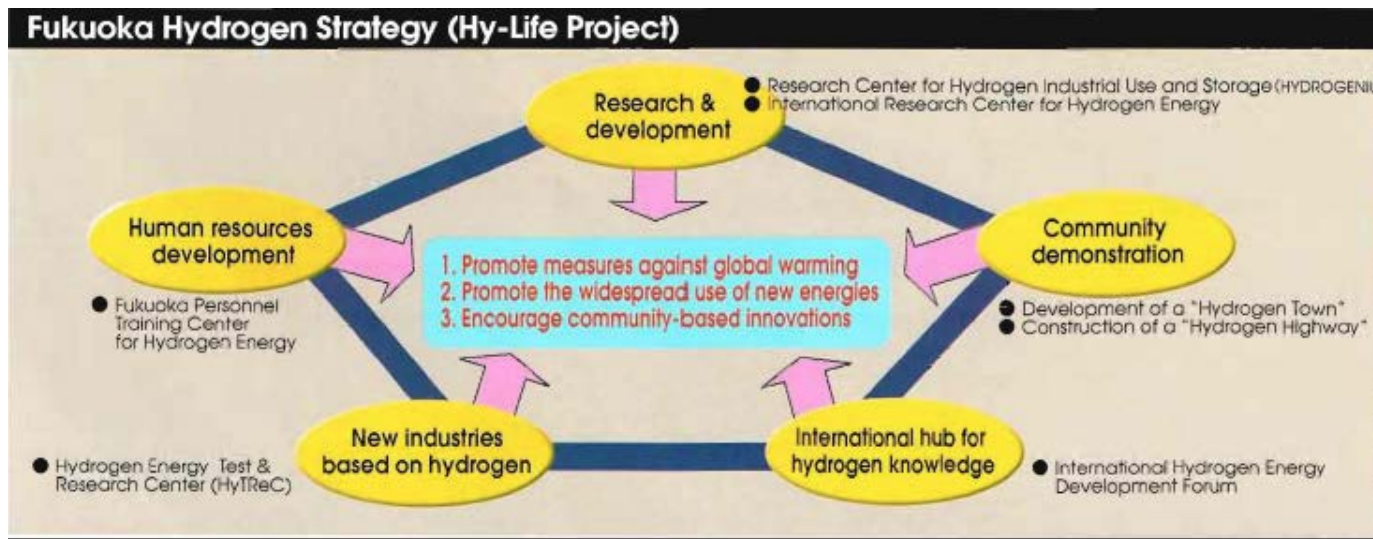


Fukuoka Strategy Conference for Hydrogen Energy

Fukuoka Prefecture established the collaborative government-industry-academia organization in August 2004

The number of members is over 770

The conference promotes R & D, human resource development, technology transfer and demonstration of hydrogen energy technologies



2010 IPHE Award



Kyushu University Hydrogen & Fuel Cell Project

Expansion

International Hydrogen Development Energy Forum
(International conference)



Hydrogen Town
(150 fuel cell units installed)



Hydrogen Highway
(Hydrogen station network)

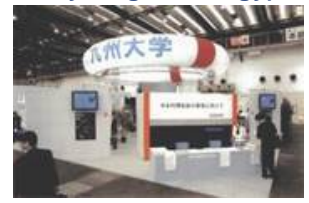


International Inst. For Carbon-Neutral Energy Research (I2CNER)
(Truly-international research institute for low-carbon energies)



Next-generation Fuel Cell Research Center (NEXT-FC)
(Accelerating industry-academia collaborations)

Hydrogen Energy Advanced Technology Exhibition
(EXPO for hydrogen energy)



More than 300 researchers, ca. 13,000m² area, for FC & H2 technologies

Dept. for Hydrogen Energy Systems
(Unique graduate school)



Demonstration Facility for Future Energies
(For demonstration projects)



Center-of-Innovation (COI)
(For technological and social innovations)



International Res. Center for Hydrogen Energy
(Incubation of hydrogen and FC technologies)



HYDROGENIUS (Res. Center for Hydrogen related materials)



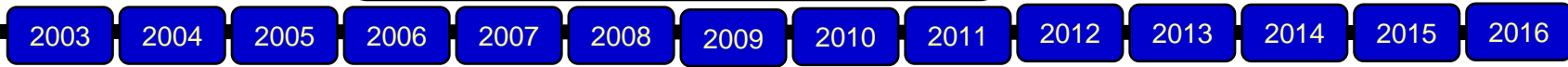
INAMORI Frontier Research Center
(Research center for future science)

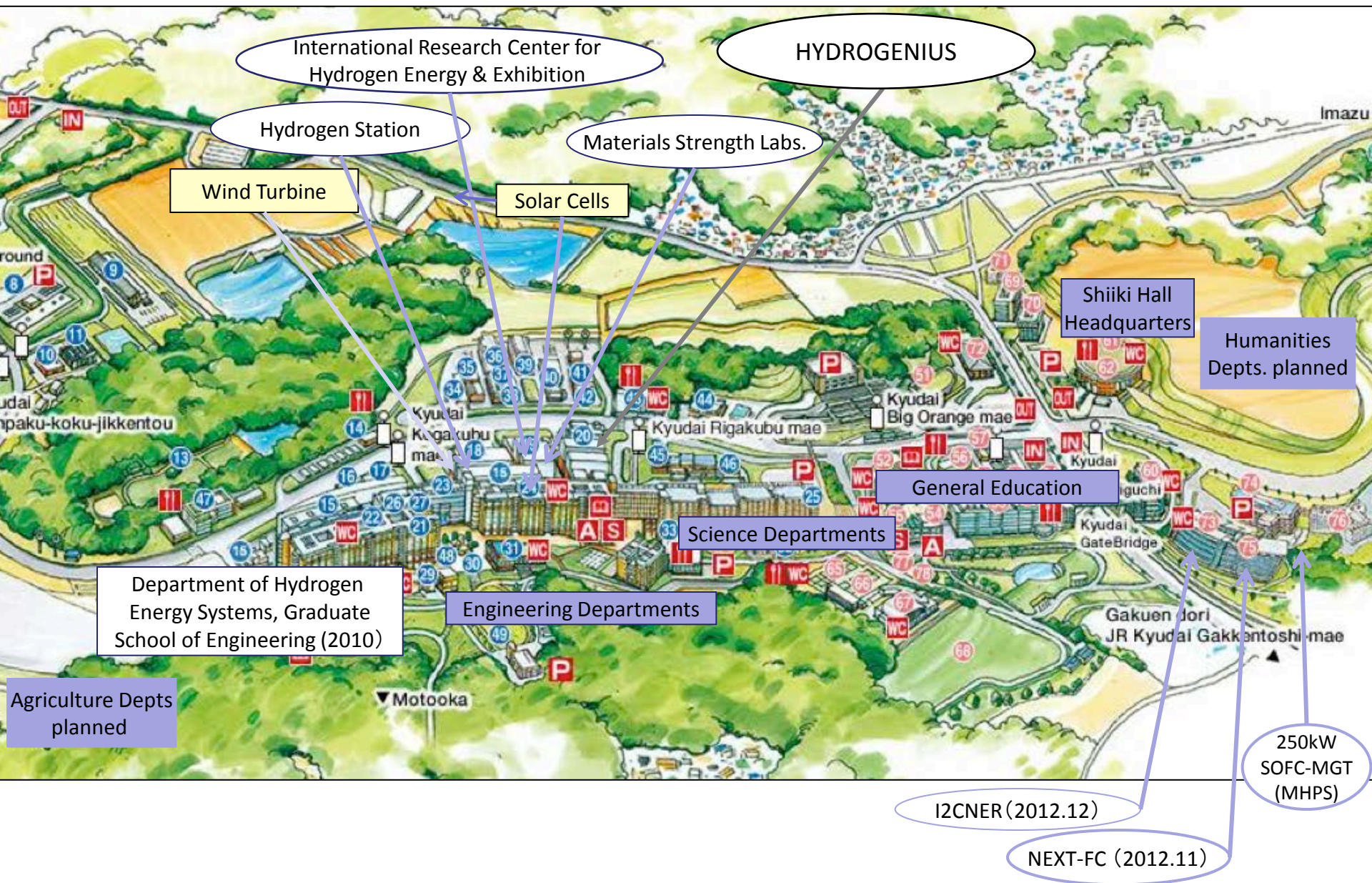


21st Century COE Program:
(“Integration Technology of Mechanical Systems for Hydrogen Utilization”)

Fukuoka Strategy Conference for Hydrogen Energy
(Collaborations with more than 500 corporate members)

Hydrogen Energy Test & Research Center
(Support center for “hydrogen industry”)







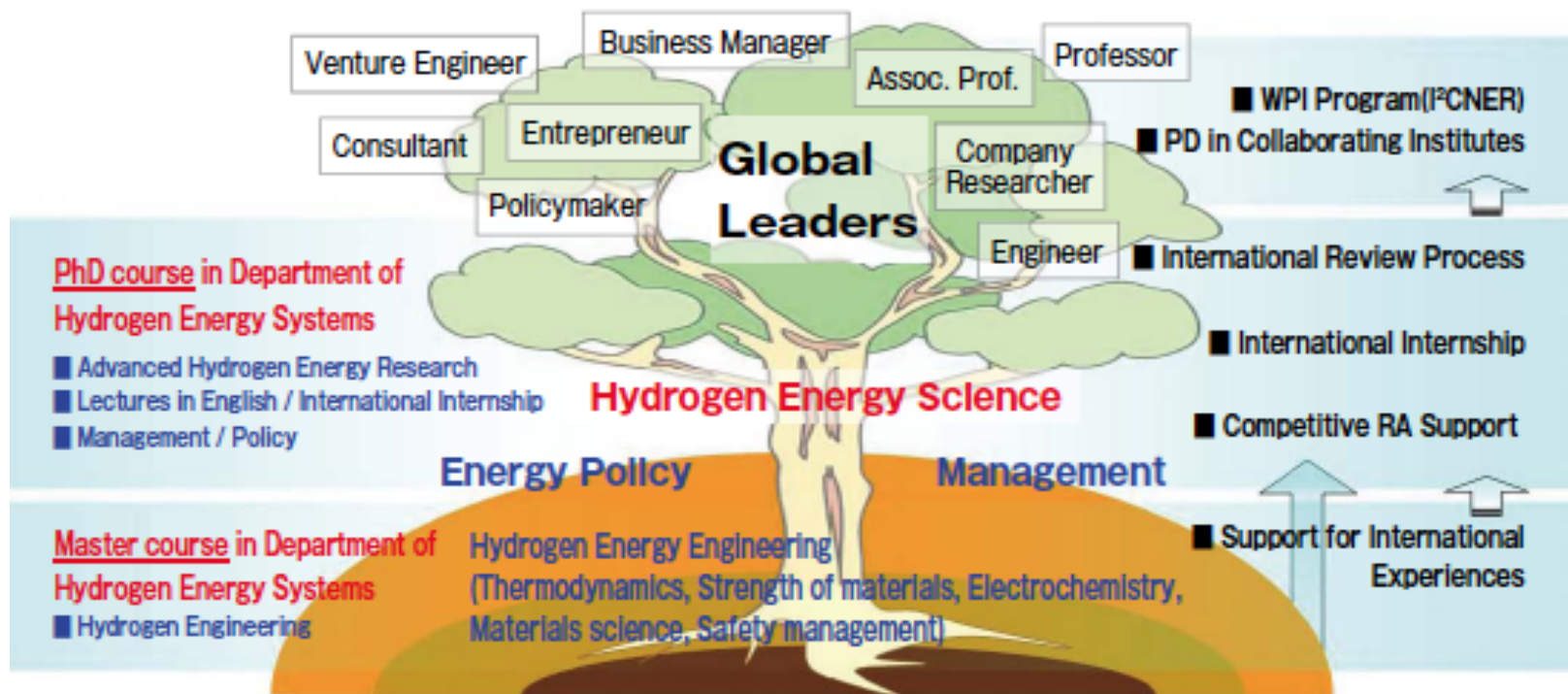
Education and Training

Education of Hydrogen Energy

Only one “Hydrogen” related Department at University

“The Hydrogen Energy System Course” established in April 2010 is the first of its kind in the world

The course gives lectures both in Japanese and English





Training of Human resources

Fukuoka Personnel Training Center for Hydrogen Energy

Established: October, 2005

(Principal: Dr. Hiroyuki Watanabe, Executive Advisory Engineer, TOYOTA)

To train managers, engineers and experts, Fukuoka Strategy Conference and KU jointly offer the courses due to demand from Industry

Over 1,000 company employees and students attended as of 2015

Courses offered as of fiscal (as of June, 2014)

Course type	Number of completed course	Total number of participants
Business managers' course	13	453
Business managers' fuel cell vehicle course	3	98
Engineers' course	16	243
Expert technologists' course	6	169



Research and Development

HYDROGENIUS, AIST (FY2006-FY2012)



NEDO

“Fundamental Research Project on Advanced Hydrogen Science”

- to study **fundamentals of hydrogen and materials** to be used in hydrogen including mechanism of *hydrogen embrittlement*, and to provide data
- to provide **principles for design, testing and utilization** of materials for prolonged use in hydrogen
- to contribute to revision of **regulations and standardization** of materials for hydrogen systems



Kyushu University

HYDROGENIUS, Kyushu University (FY2013-FY2017)

NEDO

“Hydrogen Utilization Technology Development”

- to contribute to revision of **regulations and standardization of metallic materials** for high pressure hydrogen systems
- to contribute to **development and standardization of high pressure hose and seal using polymer material** for high pressure hydrogen systems
- to provide **thermophysical data for hydrogen refueling protocol and proper measuring of hydrogen**



HYDROGENIUS
the world unique
research center
for hydrogen
materials



**Our Original
Instruments**

**40MPa
Tribology
Testers**



**Friction test under
highly controlled
environment**



**120MPa Fatigue Test Facilities
(6 systems)**



Fatigue Test under Air



**Fatigue Test
under 1 MPa
Hydrogen**



**Compression
depression
apparatus for
elastomers
(95MPa, 100°C)**

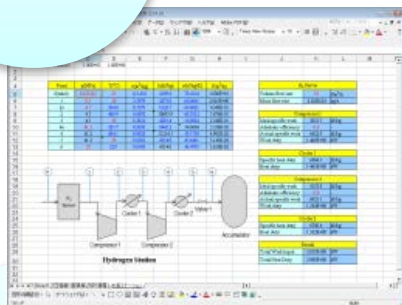


**Unique
Observation
Technique**

**Collaboration
with
organizations**



**Thermophysical
Database of Hydrogen
up to 100MPa-773K**



**PVT measurement
(100MPa, 500°C)**



**Viscosity measurement
(100MPa, 500°C)**

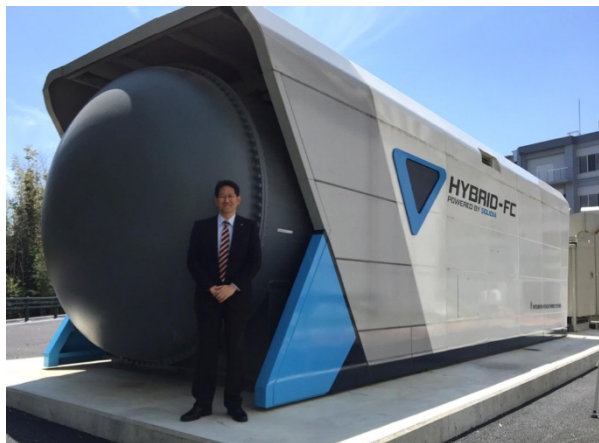


NEXT-FC: R&D with Industry

Advanced fuel cell research facilities for academia-industry collaborations:
"One stop support" from basic science to applied research and demonstration (SOFC etc.).

<The concept>

- ✓ Daily collaboration
- ✓ Top-secret cell/stacks
- ✓ Own space for companies
- ✓ Advanced analytical facilities
- ✓ Joint development



Pressurized 250kW SOFC-MGT power plant (MHPS):
>7000-hour operation
successfully demonstrated!



NEXT-FC building



Hydrogen storage materials on board



The First TOYOTA's Fuel Cell Vehicle
(EVS-13 October, 1996, Osaka, Japan)

Another TOYOTA's FCV
equipped with Hydrogen
storage materials

These TOYOTA FCV equipped with hydrogen storage materials developed by Akiba (AIST) and Iba (TOYOTA)

At present, KU develops hydrogen storage materials and systems for on board application with car industry supported by NEDO

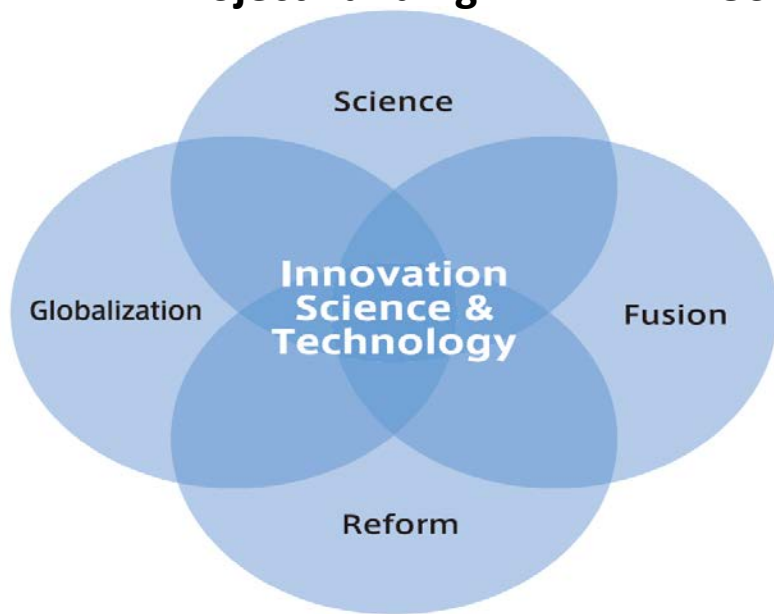
US-Japan collaboration



Outline of WPI Program



- **World Premier International (WPI) Research Center Initiative**
 - Launched in 2007
 - Ministry of Education, Culture, Sports, Science and Technology (MEXT)
 - Project Funding: 7M – 14M US \$ / year for each center, for 10 – 15 Years



Establishment of “Highly Visible Research Centers”

Critical Mass of Outstanding Researchers	Research Environment with Top Level International Standards
Long-term Financial Support	Robust Follow-up System

Origin of Universe/Earth/Life	Life Science	Materials/Energy
 Adopted in FY 2007	 WPI Osaka University Adopted in FY 2007	 Adopted in FY 2007
	 KYOTO UNIVERSITY WPI Research Center Adopted in FY 2007	 Adopted in FY 2007
		 Adopted in FY 2010
 EARTH-LIFE SCIENCE INSTITUTE TOKYO INSTITUTE OF TECHNOLOGY Adopted in FY 2012	 INTERNATIONAL INSTITUTE FOR INTEGRATIVE SLEEP MEDICINE Adopted in FY 2012	 Nagoya University Adopted in FY 2012

Feature of I²CNER, Kyushu University since 2010

Vision

- Creation of a sustainable and environmentally-friendly society

Mission

– To contribute to the advancement of ...

- low carbon emission
- cost effective energy system
- improvement of energy efficiency

Organization

- Fundamental research to industrialization
- U.S. style organizational operation
- Strong tie with I²CNER Illinois Satellite Institute
- Ripple effects in internationalization of KU



Director Petros Sofronis
University of Illinois at Urbana-Champaign

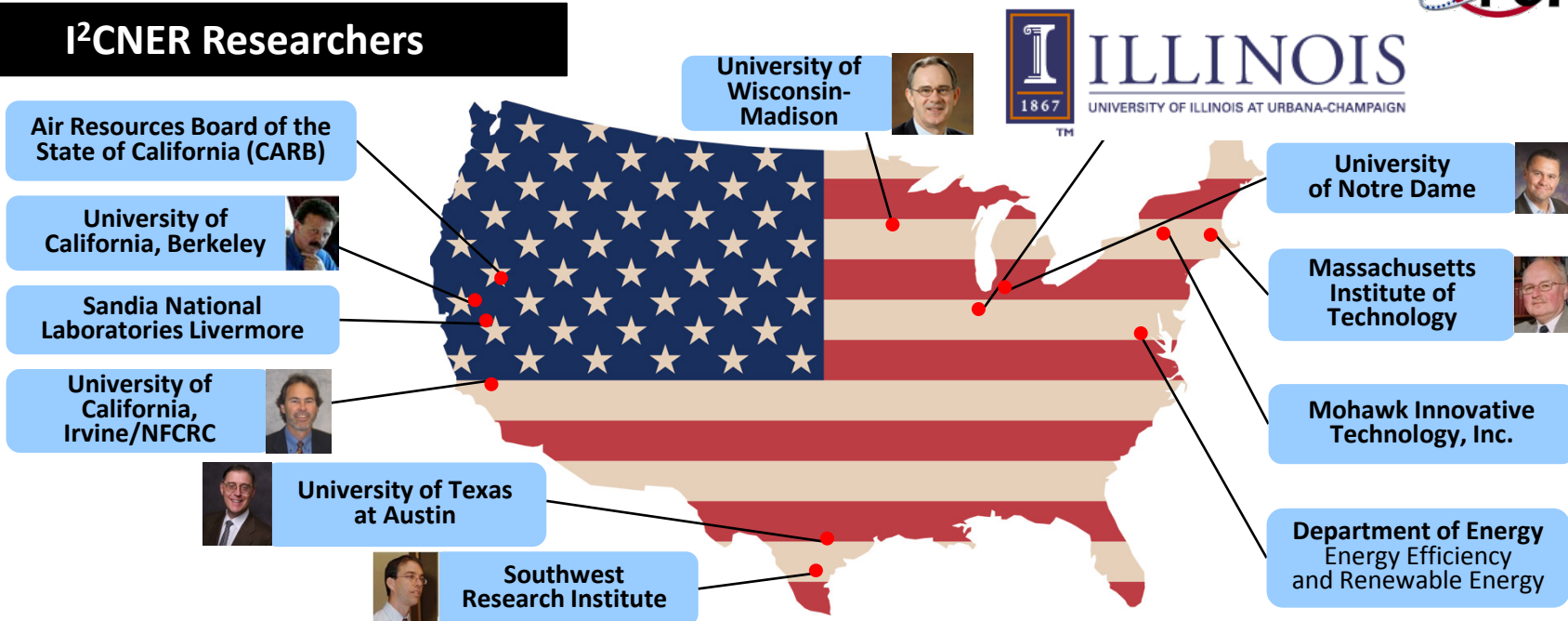




Strengthening Japan-U.S. Ties



I²CNER Researchers



I²CNER Tokyo Symposium ~ Japan-US Collaboration on Energy ~

■ December 7, 2012

■ December 12, 2014



John Roos, Former US Ambassador to Japan



Caroline Kennedy, US Ambassador to Japan



Strengthening the KU-UIUC Ties

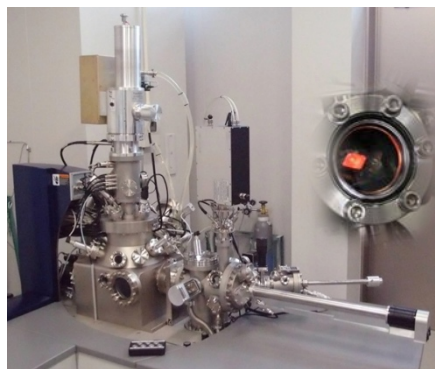


Research Collaboration

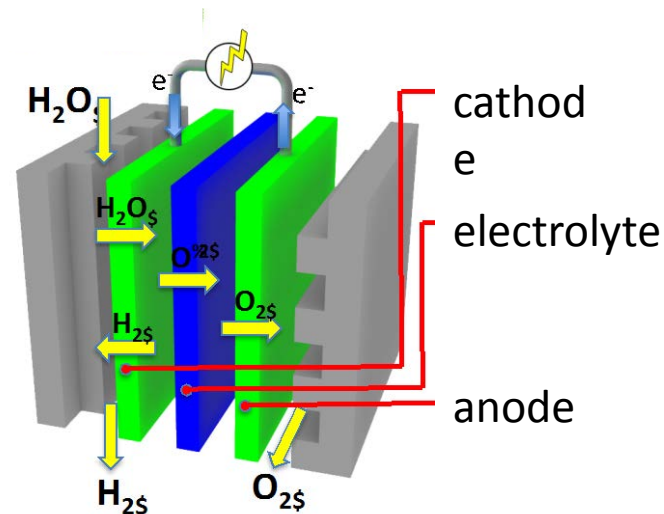
■ US NSF PIRE Award to KU & UIUC



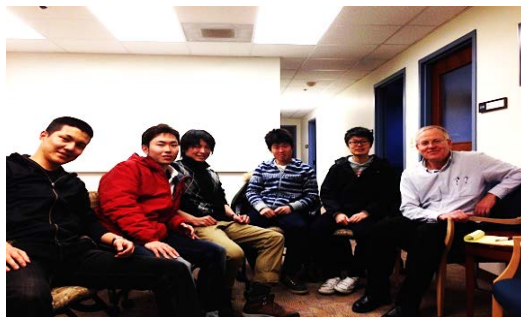
NCSA Blue Waters sustained petascale computing, Illinois



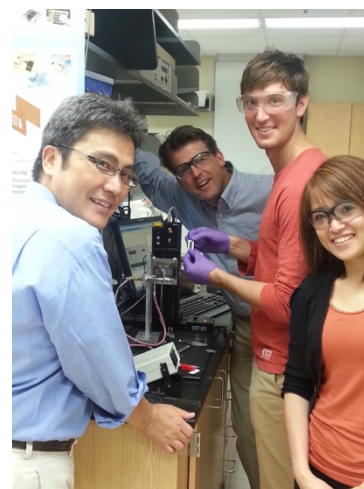
High-brightness LEIS
I²CNER, Kyushu



Exchange



KU undergraduate students with I²CNER Director, Prof. Sofronis

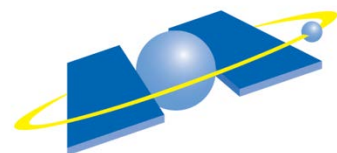


I²CNER researcher collaborating with UIUC researchers



Acknowledgements

Fuel Cell and Hydrogen Energy Research Team in Kyushu University



HYDROGENIUS
Hydrogen saves the Earth



NEXT-FC



共進化社会システム創成拠点





Thank you