A 13-University Consortium Graduate Program for Power Energy Professionals

Waseda University

Challenge

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Towards the uncharted realms of another dimension

Fostering doctoral human resources that can break new grounds in the era of revolutionary changes in power and energy

“Fostering world-class human resources who can pioneer the future of our society”

Graduate Program for Power Energy Professionals (PEP) was selected by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in 2018 as one of its WISE Programs (Doctoral Programs for World-leading Innovative & Smart Education), an initiative aiming to cultivate talented doctorate human resources. After the subsidy term ended in AY2024, the program received the highest “S” rating from the MEXT. In AY2025, the program entered a new phase in which it runs on its own funds as well as those from partner universities.

As global interest in achieving the SDGs and a carbon-neutral society heightens, the fostering of human resources capable of leading the world in the power/energy sector, which is one of the mainstays of the coming Super-Smart Society, has become an urgent issue. This program offers an unprecedented educational environment, created through the establishment of an inter-university graduate excellence platform that resulted from the collaboration of 13 national, public, and private universities. We also work closely with domestic and international companies, research institutes, and overseas universities to create an environment in which industry and academia can work together in full-scale effort in education and research.

In November of 2021, Waseda University declared the “WASEDA Carbon Net Zero Challenge 2030s”With this program as the backbone of our carbon-neutral research and doctoral human resource development, we hope to foster world-class human resources in the field of carbon neutrality. We hope to fulfill our mission of fostering world-class human resources and will continue to contribute to society by being an exceptional model of graduate school reform not only for the power/energy field but also for other disciplines.

Aiji TANAKA President, Waseda University

“An all-Japan effort for the creation of new industries”

A new era in the power/energy sector has already begun. With the development of digital technology and the acceleration of the GX and DX movements, energy is changing from the traditional one-way flow of supply-side to demand-side, to a complex system of distributed supplies that includes energy generated from the demand-side. As more things become connected to energy via information networks, the related technical areas will span many fields, from materials to systems. In such an era, scientists and engineers must not only focus on their respective fields of expertise but also comprehensively tackle issues beyond technology, such as institutional reform, international standardization strategies, and business model creation, in order to create new value chains and spawn innovation through the integration of new technology into our society.

This program was established as an education and research platform of unparalleled quality and scope under the collaborative cooperation of industry, government, and academia. We are proud that this program will contribute greatly to the creation of new industries while providing the best educational environment and exchange opportunities for talented minds.

Since the first graduating class of 2020, we have sent off many graduates into the real world. Hearing of their success from all corners of society is perhaps the most gratifying moment as the program's coordinator. We hope that our graduates will become “PEP”-minded people who will positively transform the world by collaborating across industry boundaries and playing an active role in energy and innovation, which is essential for achieving carbon neutrality.

Program coordinator Yasuhiro HAYASHI Professor, Faculty of Science and Engineering

Create

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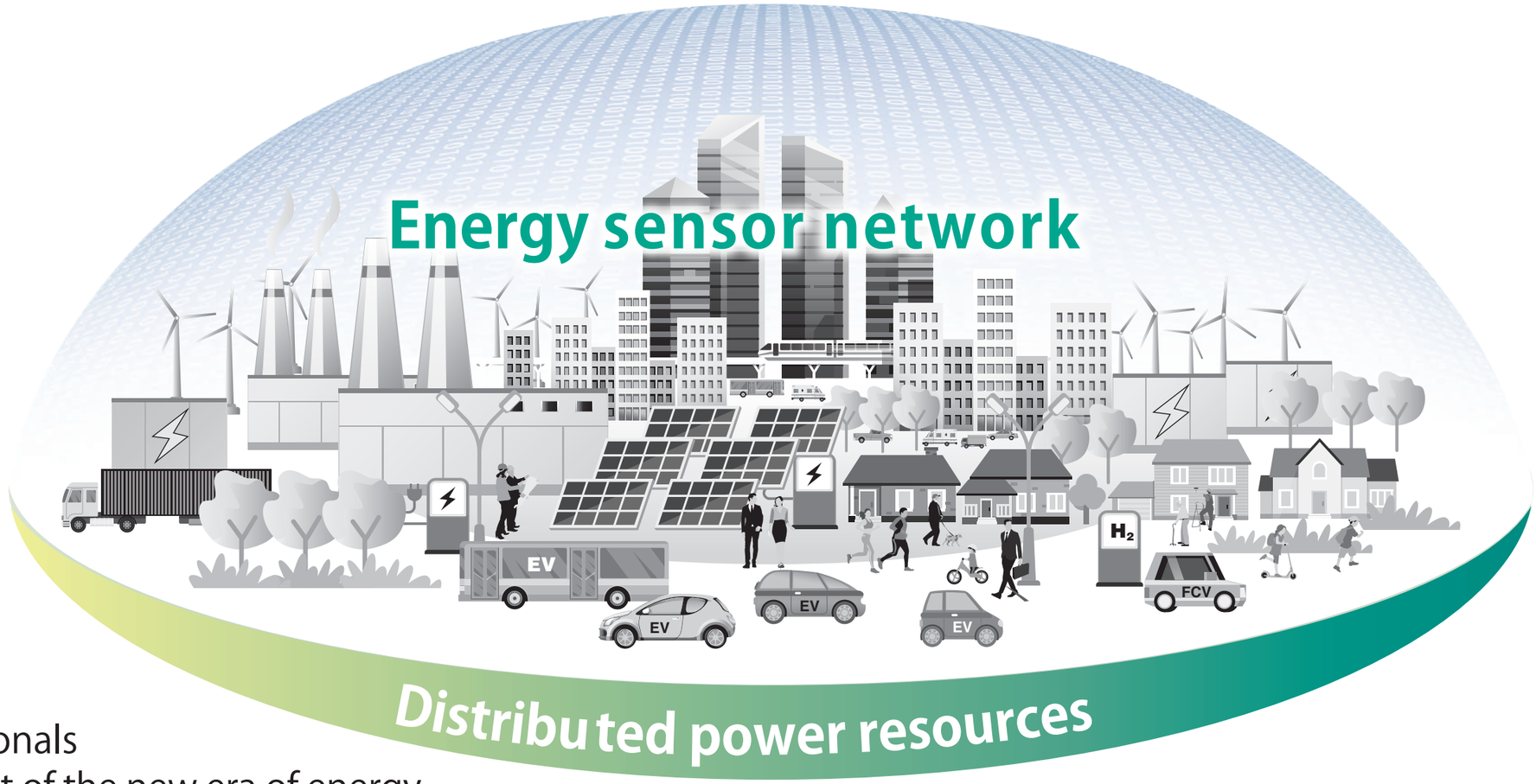


Intellectual professionals for the establishment of the new era of energy

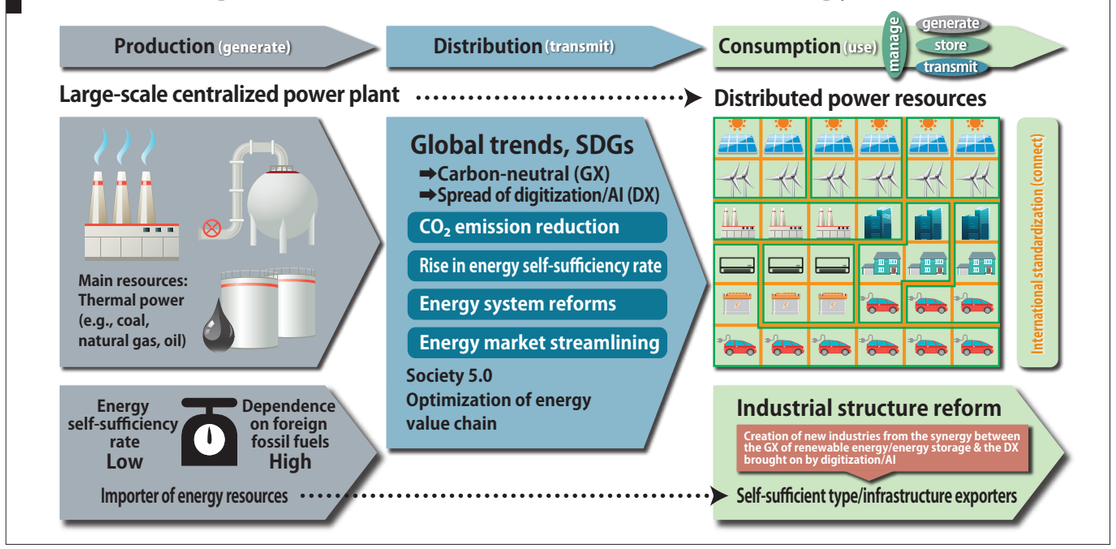
In addition to the worldwide trend towards global environment protection, digitization, and the adoption of Artificial Intelligence for the realization of a sustainable society, Japan is introducing new policies on scientific and technological innovations for the realization of Society 5.0 and is reforming its energy systems for the first time in 6 decades. Consequently, frameworks of industries related to power/energy infrastructure are facing a turning point. Therefore, an alternative kind of professional doctoral human resources with new skills will become highly sought-after going forward.

The total extension of the electrical grid infrastructure is said to be 30 times the Earth's circumference. The size of the industry related to energy infrastructure including oil and gas has become huge; it is expected to expand to other fields such as information and communication, automobile, architecture/construction, and services.

With the spread of renewable energy and systems for managing its use, advances in technological developments such as electric vehicles (EVs) and storage batteries, and the progress in information and communication technology such as IoT, the Green Transformation (GX) and Digital Transformation (DX) movements are picking up pace. To cope with this change, the conventional energy supply has begun to shift from a large-scale centralized to a small-scale distributed system; thus, requiring breakthrough changes and restructuring in the energy network system.

When all sorts of things become connected to the energy network system, the ultimate challenge will be to what extent the entire digitally managed system can be optimized. To find a solution, we will need human resources that have an end-to-end view from the development of materials for the highly efficient generation of energy through to the development of systems including distribution and consumption, and ultimately have the knowledge and coordination ability to socially implement new technologies.

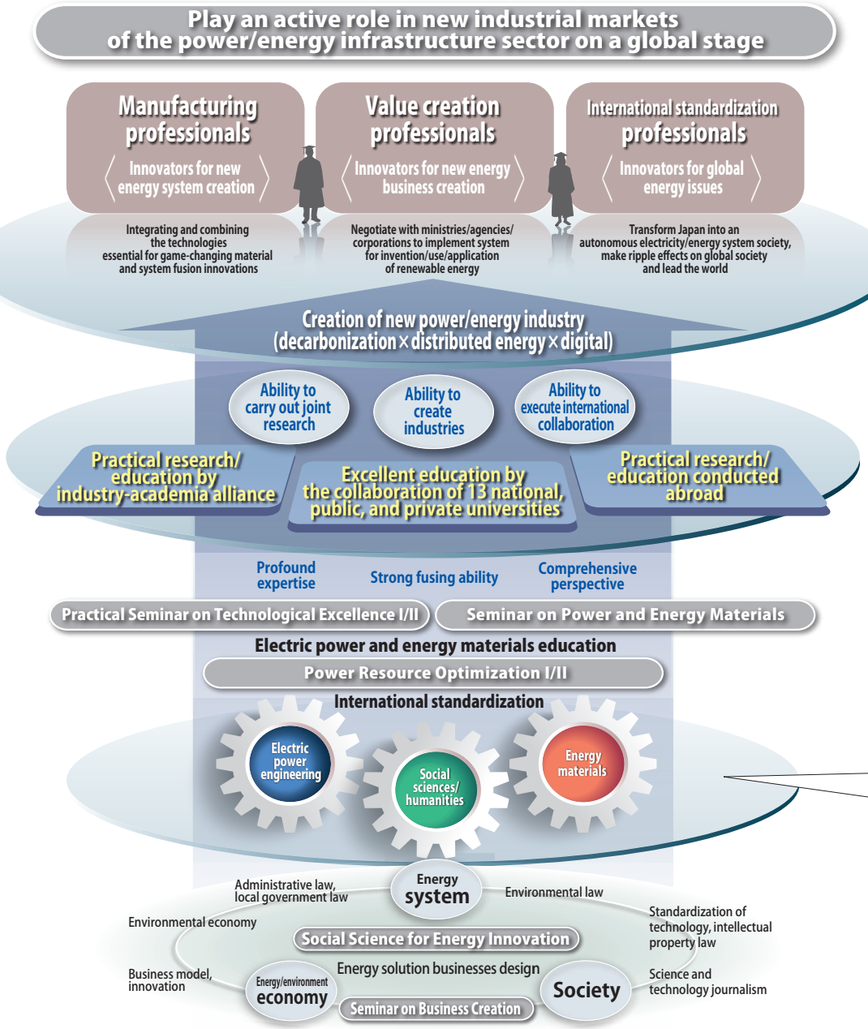
The coming of innovative era in power and energy infrastructure



理 The scheme for fostering human resources that contribute to technological innovation, business creation, and international standardization

Our program offers a systematic education/research program based on a new scientific principle named "Power Resource Optimization". With technological and social innovations as the 2 main objectives, we aim to foster human resources with excellent comprehensive problem-solving skills who can lead the creation of new power/energy industries.

PEP's talent training scheme



A cross-disciplinary graduate education based on Power Resource Optimization

Our program aims to produce 3 types of "intellectual professionals" : 1) manufacturing professionals - innovators for new energy system creation; 2) value creation professionals - innovators for new energy business creation; and 3) international standardization professionals – innovators for global energy issues.

In order to foster such human resources, we established "Power Resource Optimization" as the new scientific principle for the creation of new industries. We view the future energy value chain as a chain of new values from electrical charge, the smallest unit of the phenomenon, through to massive electrical grid systems, to correspond with the new era. By doing so, an end-to-end connection will be made between the energy material field that generates a highly functional distributed power resource with renewable energy and storage batteries that allow charge control on a nano-scale level, and the electric power engineering field that optimally consolidates, controls and operates the energy of such resources through projection and analysis.

Furthermore, we aim to create an optimal energy value chain by including social science fields that bring unconventional added value to fruition as a business from the perspective of "Energy as a Service" , such as the designing of systems in which many players have an active role, including small-scale inter-customer power trading, thereby ultimately contributing to the United Nations' SDGs.

Through a fusional education of electric power engineering, energy materials, and social sciences/humanities, our program will nurture deep expertise, a strong fusing ability, and a comprehensive perspective. With those abilities, our students will further enhance their ability to engage in joint research, the creation of industries, and international cooperation, and set out into the world as professionals of new industry creation.

Scientific principle of "Power Resource Optimization"

"Technology optimization" by end-to-end science and engineering approach from energy material science to electric power engineering

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"Social optimization" by social-scientific approach from systematic, economic and social perspectives

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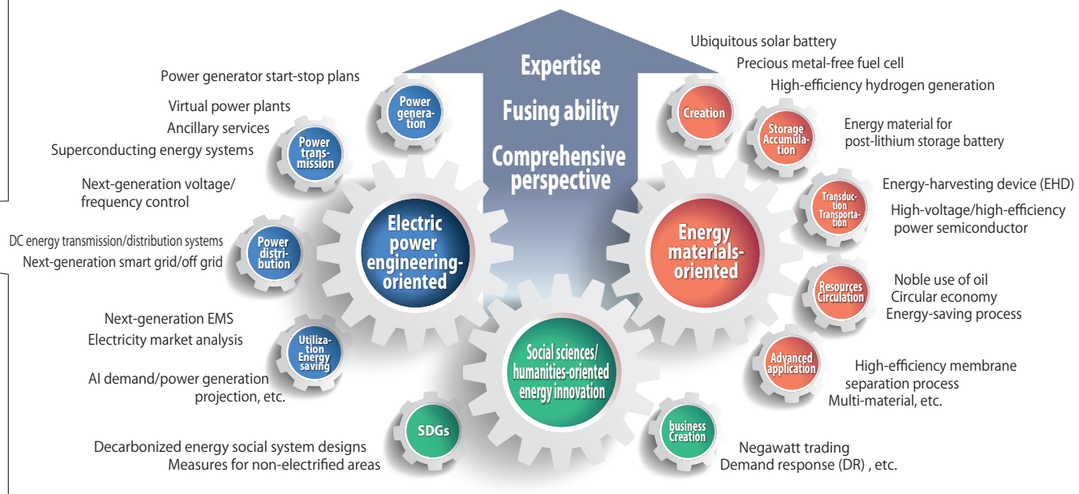
A new academic area of **"optimization of energy social systems"** under a new concept

Optimal energy value chain

(Chain of new values in materials, system, kW/Δ kW, and environment)



新 Excellent educational program structure

The features of our program that cannot be acquired through traditional doctoral programs:

1. Wide-ranging collaborations with 13 domestic universities, overseas universities, corporations, and research institutions

In order to create new industries, a wide range of industry-government-academia alliances is needed; thus, we established an education/research platform of quality and quantity that has never been achieved. 13 national, public, and private universities that have proven track records in the power/energy field joined forces; we also obtained cooperation from top-rated universities and research institutes in the United States, Europe, and Asia that serve as the core in each region to promote researches in the power/energy field. From the industrial world, we are collaborating with organizations of all energy domains, namely electricity, gas, oil, and hydrogen, and will continue to call for wider cooperation in the future.

2. Cross-disciplinary education for the designing of future society

In order to create new industries with the global market in scope, ample knowledge surrounding the specialized fields and the ability for social design are essential. Our program brings together the wisdom of science and engineering faculty from 13 partner universities and humanities and social sciences faculty from Waseda University to focus on "Power Resource Optimization(Lecture)", a science and engineering course of electric power and energy material fields, but have also established "Social Science for Energy Innovation", a humanities and social science course that provides a comprehensive perspective of environmental economics, social systems, laws, business models, as well as "Seminar on Business Creation". Students will use what they learned in these courses and seminars to take on the challenge of implementing their research theme in society. Joint research with companies and research organizations inside and outside Japan on a scale made available only by the PEP program will be a valuable opportunity for students to gain new insight or perspective on their commercialization plan. Students can also receive feedback on business creation from the expert point of view since social sciences and humanities faculty members take part in QE and FE2. Through this process, students will refine their research theme, considering whether it is viable from a business perspective or how it contributes to social change, and put the plan into practice as the final deliverable of the PEP program.

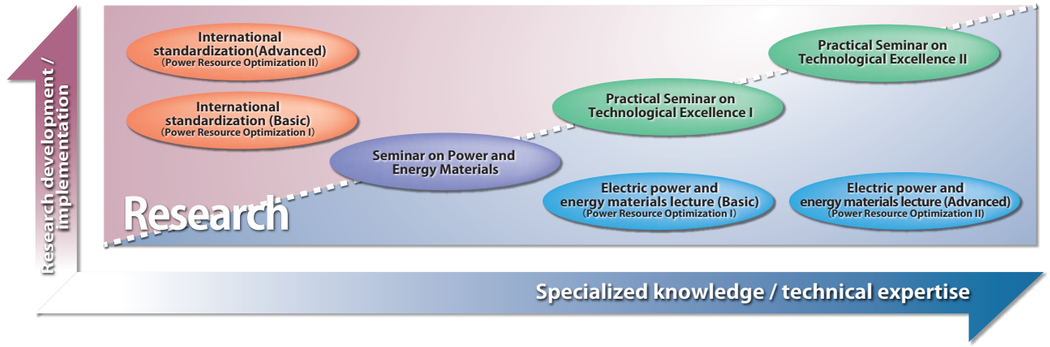
3. Education on international standardization for the global development

In the course of overseas business development, it is essential to bring regulations, benchmarks, and product standards into compliance with international standards; it is extremely important to promote them strategically.Waseda University is well-experienced in the operation of the EMS Shinjuku R&D Center, the sole institute in Japan that has socially implemented demand-response standardization techniques through the industry-government-academia alliance. The Center will be converted into an educational facility for international standardization education based on seminars with real machines.

4. Industry-academia collaboration on education

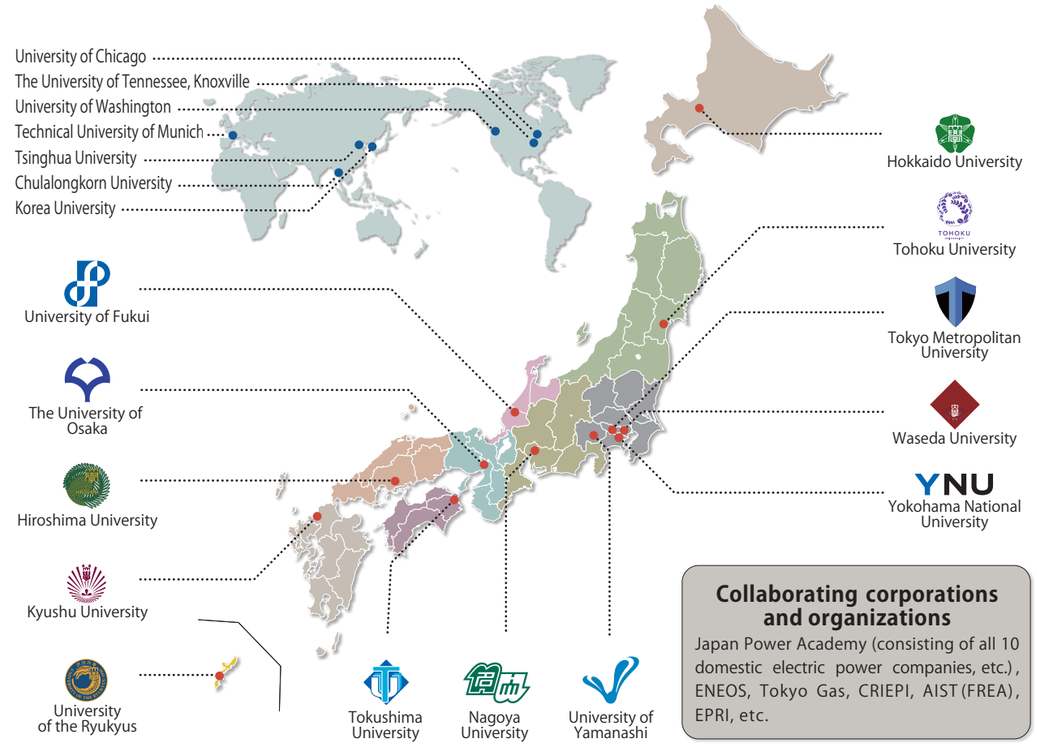
The program offers practical education and conducts joint research in cooperation with core companies and research institutes that represent Japan in the development of infrastructure and cutting-edge technologies related to electric power and energy materials. In the "Practical Seminar on Technological Excellence", jointly developed through industry-academia collaboration, students learn cutting-edge specialized technology from front-line experts and businessmen through lectures with abundant examples and exercises using actual equipment that are not open to the general public. In the "Seminar on Power and Energy Materials", students learn about the local energy supply chain, demonstration projects, and other energy sites from a variety of perspectives.

Cultivation of expertise and pragmatic resolve as a foundation for the creation of new energy industries



A wide range of collaboration with 13 domestic universities, corporations, research institutes, and universities abroad

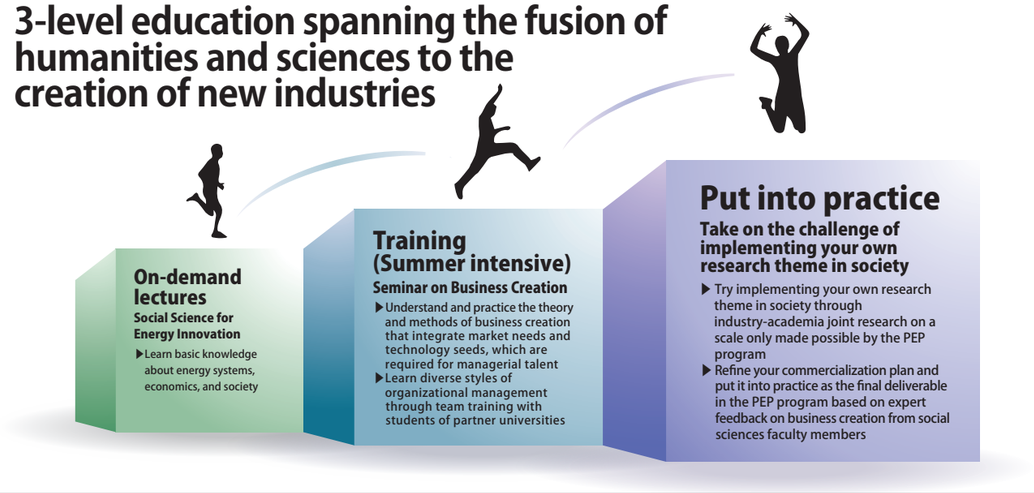
An education/research platform of unparalleled quality and quantity



Collaborating corporations and organizations

Japan Power Academy (consisting of all 10 domestic electric power companies, etc.), ENEOS, Tokyo Gas, CRIEPI, AIST (FREA), EPRI, etc.

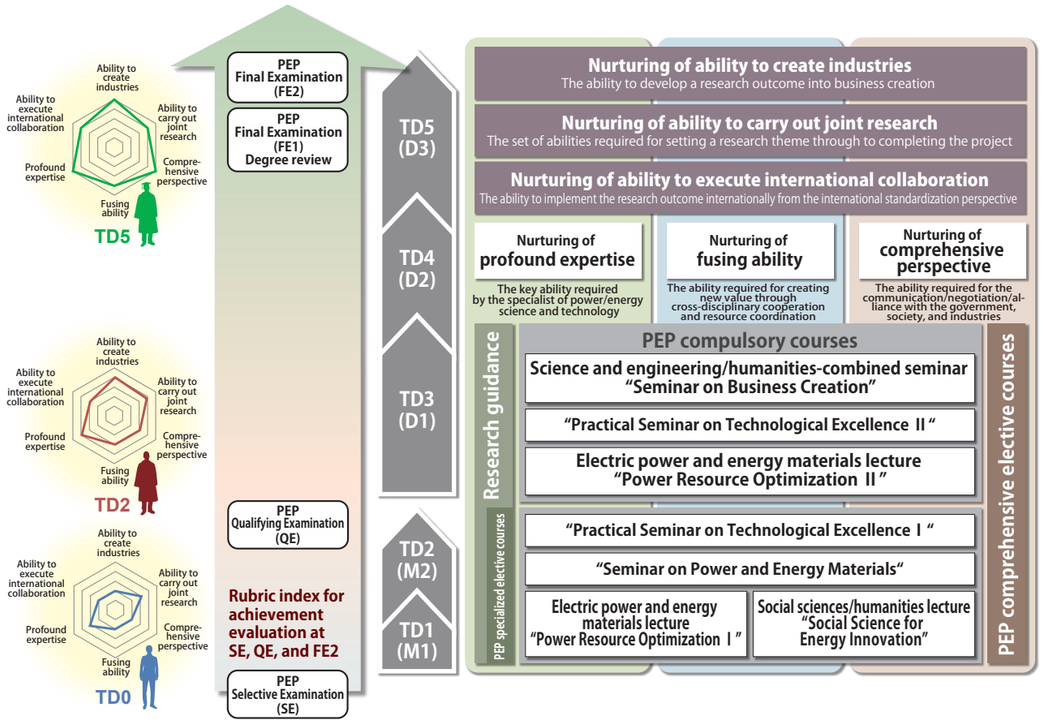
3-level education spanning the fusion of humanities and sciences to the creation of new industries



伸 The program overview and our solid quality guarantee

Our program is a 5-year integrated doctoral degree program in which students can enroll and complete while attending one of the 13 partner universities. We offer excellent student support. Students will continue to receive Research Assistant (RA) fees for working on research and expenses for completing the curriculum even after the end of the government subsidy program. Each member university also offers its own unique support programs. We have also created the "PEP rubric" by subdividing the 6 major capabilities to be fostered (deep expertise, strong fusion, broad overview, industry creation, research collaboration, and international collaboration) into 26 capabilities. This rubric will be used as a standardized educational indicator across all 13 universities to measure the 5-year growth of each student.

Overview of the education program



● Curriculum

PEP is a 5-year integrated program that considers the master's and the doctoral program as TD years 1-5.

[PEP compulsory courses (common across 13 partner universities, 10 credits required)]

Consists of 9 courses: "Power Resource Optimization I & II" by science and engineering faculties from the 13 partner universities; "Social Science for Energy Innovation" and "Seminar on Business Creation" by Waseda University's social sciences and humanities faculties; "Seminar on Power and Energy Materials" for real-life cutting edge knowledge in the power/energy field; "Practical Seminar on Technological Excellence I & II" with guidance from experts cooperating with partner companies and research institutions.

[PEP specialized elective courses (15 or more credits required*1)]

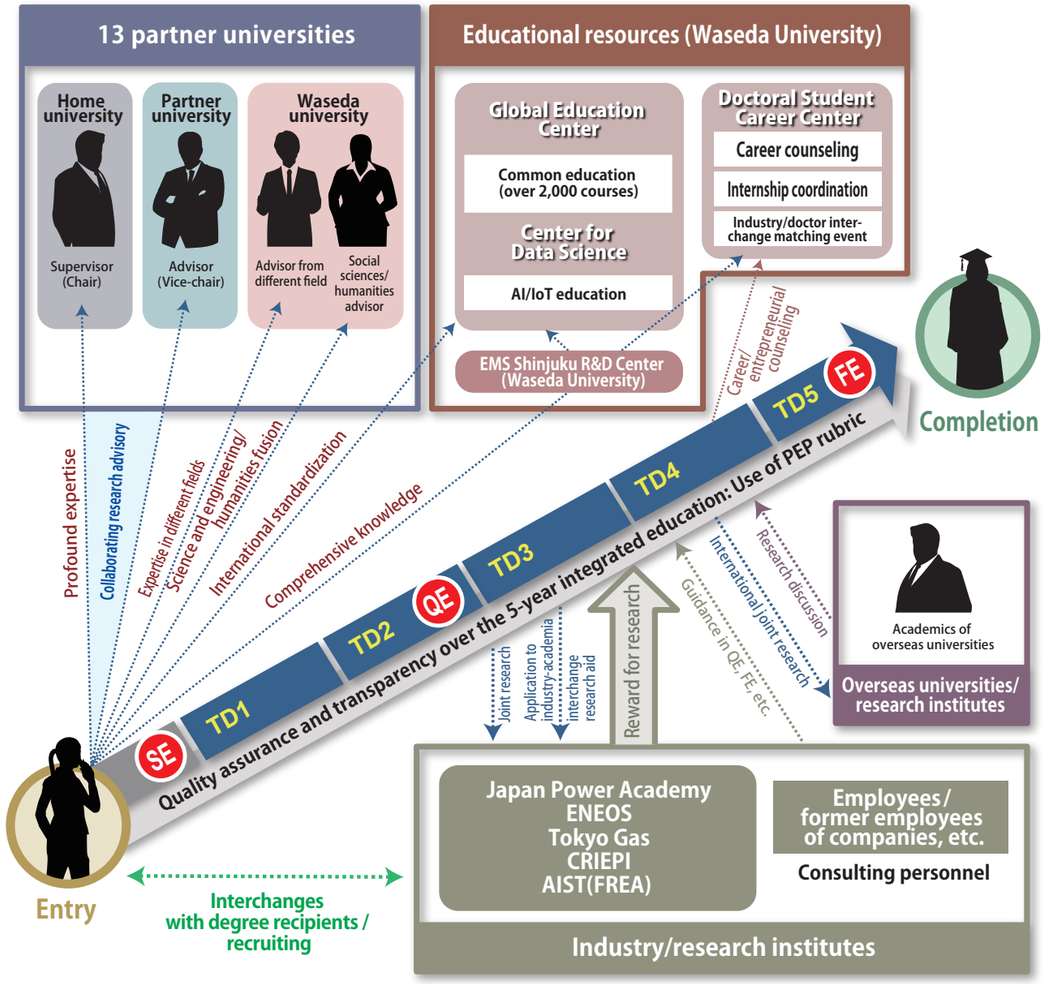
Specialized courses designed by the participating universities under the program's common curriculum policy. Electric power engineering students will take specialized courses on electric power equipment (hardware) and projection/operation/control (software), while energy material students study basic and applied specialized courses on physicality, materials, and processing.

[PEP comprehensive elective courses (5 or more credits required*1)]

At each of the participating universities, we offer a wide selection of courses in accordance with each student's preference, such as lab rotations, fieldwork at training institutions overseas, corporate internship, leadership courses, basic courses on AI and IoT as well as those on social sciences and humanities.

*1: The number of credits is different for TD3 transfer students.

Excellent educational/research guidance and student support



● Review Process

[PEP Selective Examination (SE)]

A qualification review for program entrants. It will assess the entrant's acquisition of fundamental knowledge in specialized fields. Undergraduate students of the 13 partner universities that intend to advance to graduate school, and are expected to graduate in the current academic year, are eligible to take the exam. Furthermore, several openings are available for those transferring from TD years 1-3 (including those who are already in the workforce).

[PEP Qualifying Examination (QE)]

Students who have completed the prescribed courses (30 credits) and submitted at least one academic paper are qualified to take the examination*2. The exam will assess their research achievements, depth of understanding, and post-TD year 3 research project.

*2: The timing and eligibility for taking the QE will differ for some TD2 transfer students and all TD3 transfer students.

[PEP Final Examination (FE1)]

Degree assessment at the student's home university and its department. It will assess the student's advanced specialized research ability in the power/energy field, ranging from materials to systems.

[PEP Final Examination (FE2)]

Students who have taken the prescribed courses (45 credits) and have coauthored one or more academic papers with one of the participating institutions, in principle, for international conferences are eligible to take the exam*3. The feasibility and the social significance of the research outcome are evaluated through an oral examination.

[Rubric evaluation of the PEP Graduate Program]

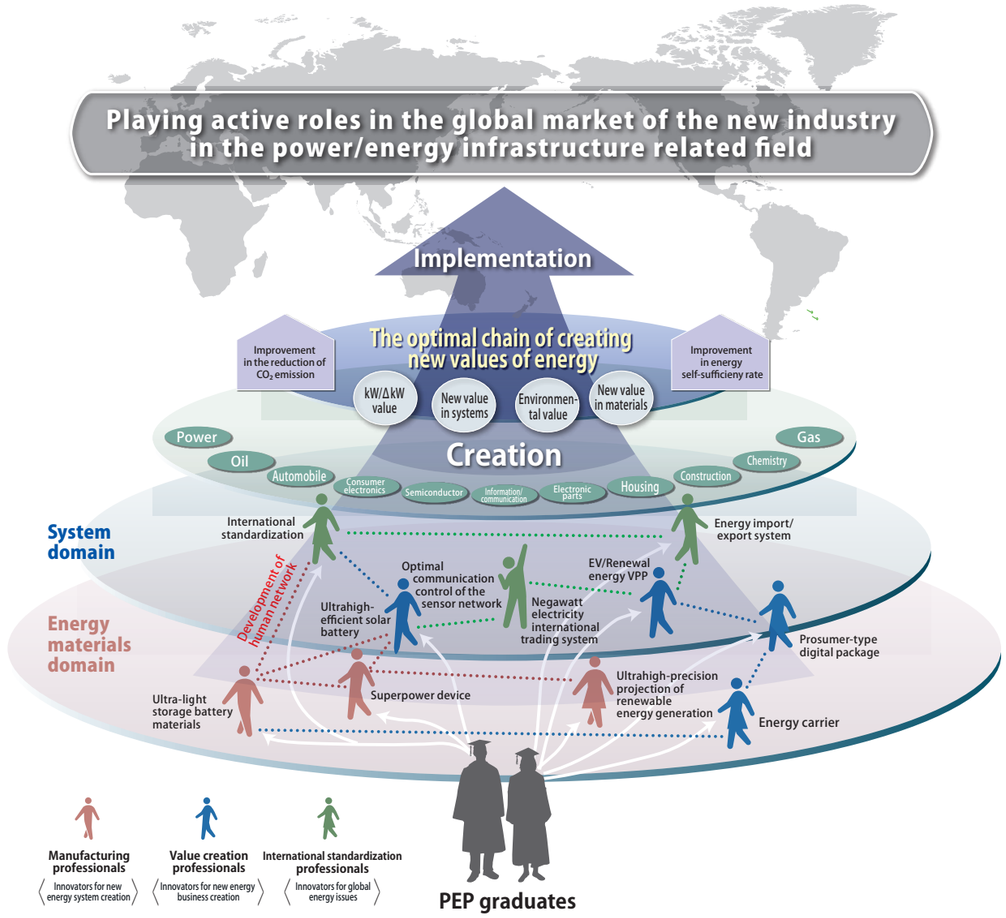
QE and FE2 will be cross-assessed - self-assessed and assessed by the judges - using rubric indicators.

*3: TD3 transfer students have different eligibility requirements for FE2.

翔 PEP graduates pioneering the future of the power/energy sector

This program advocates an energy future society where a stable supply of power and energy, environmental response, and economic growth are coexisting through the creation of new industries, which we believe can be attained when the new value created by innovative materials, devices, and systems overlap in a complex yet timely manner, and the stream of small innovations spills over into larger innovations. Therefore, one of the main goals of this program is to build a strong human network among partner universities, companies, research institutions, and students while they are still attending university. Graduates of this program will be able to use the extensive human network they have built up to successfully carry out projects in their respective career paths by sharing their ideas and gaining new collaborations with those around them, and ultimately go on to pioneer the future of the power/energy sector.

Creation of new values in energy in the global society by PEP graduates



PEP graduates are active not only in academia, such as universities and research institutes but also in the private sector.
We have a proven track record of graduates finding employment with manufacturers and trading companies as well as power/energy infrastructure companies that we collaborate with.

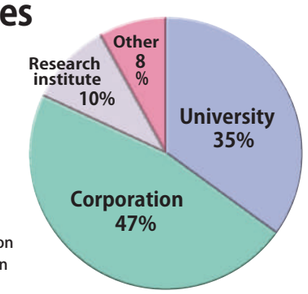
Certificate of program completion

Those who successfully complete the PEP Final Examination will receive a certificate of program completion, stamped with the seals of the presidents and chancellors of the 13 partner universities, on top of the doctoral degree awarded at each university. It is a testament to the advanced knowledge, extensive experience, and skills acquired through the PEP program.

Diverse employment opportunities for graduates

Major employers

AGC Inc.
Central Research Institute of Electric Power Industry
Chubu Electric Power Co., Inc.
Electric Power Research Institute [in the United States]
ENEOS Corporation
Ernst & Young ShinNihon LLC
Hitachi, Ltd.
Honda R&D Co., Ltd.
Indonesian Institute of Science (LIPI)
Konica Minolta, Inc.
Mitsubishi Materials Corporation
MITSUI & CO., LTD.
National Institute for Materials Science
ROHM Co., Ltd.
Sumitomo Electric Industries, Ltd.
Suzuki Motor Corporation
TechnoPro, Inc. TechnoPro R&D Company
Tokyo Electric Power Services CO., Ltd.
Toshiba Electronic Devices & Storage Corporation
Toshiba Energy Systems & Solutions Corporation
Tosoh Corporation, etc.



In today's Japan, doctoral graduates who can play an active role in the industrial sector are highly sought after. Many of our graduates are employed in the private sector.


Practice on International Standardization @Waseda University International Standardization Research and Education Center


Facility tours in PEP compulsory courses


Exchange meeting of students from 13 universities


Departure - together with friends, time to leap into the future

Through the PEP program, students from 13 universities will study together, connect and form friendships.
We hope this friendship will become your lifelong asset.

Professors

師

Faculty members

Education and research advice offered by a group of top-rated researchers from home and abroad

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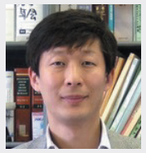

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Shinji OHATA	CEO, O Ltd.	Social innovation

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"PEP" also means "to cheer up" in English.
The logo represents our desire to "Energize Japan through the uniting of 13 universities".

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