Large-scale introduction of renewable energy is an urgent issue for significant reduction of greenhouse gases. For Japan, with limited and small fossil fuel reserves, securing new energy resources and innovative technologies for utilizing those resources are equally important issues.

To address these issues, the Energy Process Research Institute (EPRI) is developing innovative technologies for efficient utilization of non-conventional energy resources.

Our R&D efforts on utilization of hydrocarbon resources are aimed at developing technology for utilizing methane hydrate resources by integrating technical approaches for commercialization, such as stable and enhanced production processes, together with seabed characterization.

We are furthermore developing catalytic-conversion technologies for non-conventional energy resources.

In order to build a hydrogen energy-based society, we are doing research on hydrogen storage materials and catalytic processes of energy carriers to realize safe and effective storage, transportation and utilization of hydrogen.
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参画技術研究組合 Related Technology Research Association
新構造材料技術研究組合 (ISMA)
Innovative Structural Materials Association (ISMA)

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メタンハイドレート開発システムグループ
Methane Hydrate Development System Group
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Hydrocarbon Resources Conversion Group
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エネルギー変換プロセスグループ
Energy Conversion Process Group
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Hydrogen Industrial Use and Storage Group
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Leader シャーマー・アトウル（兼）
SHARMA Atul(concurrent)

図表

エネルギーゼル資源の革新的利用技術
Innovative technology for utilization of energy resources

生産・運搬・貯蔵
Production, transport, storage

ガスハイドレート利用 Gas hydrate utilization

メタンハイドレート採掘 Methane hydrate mining

バイオマス発電 Biomass utilization

化学吸収 Chemical sorption

水素エネルギー H2 storage

アンモニア合成 NH3 synthesis

PG合成 FT synthesis

メタン改質 Methane reforming

ヒマラシア Chemical looping
To realize to enhance productivity and recovery ratio of natural gas production from natural methane hydrate reservoir, we develop in situ pressurized methane hydrate-bearing sediment core analysis tools (PNATs) for natural methane hydrate-bearing sediment, and assess their properties. In addition, we are collaborating other research institutes to obtain a highly reliable reservoir model for commercial natural gas production.

Since gas hydrates have high gas involvement ability and high latent heat, we also explore industrial applications of gas hydrates as novel natural gas transportation media and heat accumulation materials.

**Keywords:** Natural methane hydrate-bearing sediment, Carbon resource, in situ analysis, Gas hydrate
We study gas production technologies from the gas hydrates within marine sediments. We focus on analysis on unconsolidated subsea methane hydrate sediments, gas production enhancement and flow assurance. Moreover, we have started the practical study for developing gas production technology from methane hydrates in the shallow marine sediments of Japan Sea since 2019.

Our research also covers industrial applications of clathrate hydrates such as gas separation, transportation and storage, CCUS (Carbon dioxide Capture, Utilization & Storage) and cold energy storage. We are exploring innovative physical properties of clathrate hydrates (phase transition behavior, new crystal structure, efficient hydrate formation processes, crystallographic properties, etc.). We collaborate and bridge with private companies, universities, and other research institutes, looking for various potentials and a better direction of our research.

Keywords: Unused energy, Methane hydrate resource development, Industrial application of clathrate hydrate, Exploration of innovative physical properties, Semiclathrate hydrates

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**Explore innovative physical properties of clathrate for Industrial applications**

For improving the gas productivity, we observe the nucleation, coagulation and agglomeration processes of MH shells (hydrate coated gas bubbles) to estimate phenomena related with MH dissociation and recrystallization between production well and MH dissociation front.

**MHbearing layer**

- Dissociation front of MH (endothermic reaction)
- Heat supplement
- No gas hydrate bearing Mud layer

**No gas hydrate bearing Mud layer**

- Dissociated water
- Methane gas
- MH bearing layer
- Heat supplement

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Members: Kiyofumi Suzuki, Yoshitaka Yamamoto, Sanehiro Muromachi, Michihiro Muraoka

URL: https://unit.aist.go.jp/epri/mhpu/mhdsg.html
We conduct researches about analytical technologies and process design technologies for effective conversion of hydrocarbon resources, such as biomass, wastes, petroleum, and coal, which are complex mixture of various kinds of hydrocarbon molecules. Our detailed analytical technologies clarify the mechanism of phenomena and help to develop novel conversion processes. Our process design technologies optimize the whole system of conversion processes in nano/micro/macro scales: molecular reaction/reactor/process/society/environment.

Keywords: Hydrocarbon resources, Biomass, Wastes, Petroleum, Coal, Asphaltene, Coke, Molecular structure analysis, Process analysis, Pretreatment, Extraction, Pyrolysis, Gasification, Catalytic cracking, Fouling

Development of effective conversion way using various analytical technologies

Total system optimization for effective conversion process

Members: Morimoto Masato, KawaSHIMA Hiroyuki, Yasuda Hajime, Hosokai Sou, Fumoto Eric, Sharma Atul, Keller Martin

URL: https://unit.aist.go.jp/epri/hrcg/
To realize a sustainable low-carbon society, energy conversion process group engages in comprehensive research activities on development of new technologies for clean and efficient usage of conventional hydrocarbon resources such as coal and natural gas. In addition, research works for the novel CCU (Carbon Capture and Utilization) process which can convert CO₂ to fuel, syngas or valuable chemicals in conjunction with electricity/hydrogen derived from renewable energy producing syngas or chemicals.

We deploy energetic research activities on the innovative thermo-chemical or electrochemical energy/material conversion processes, based on the fluidized bed technology, catalytic chemistry, gasification/pyrolysis technology and electrochemical device technology.

**Keywords:** Fossil fuels, Renewable energy, Hydrogen, CO₂ utilization, Thermo/Electrochemical process, Exhaust heat utilization

Members: "KURAMOTO Koji, MATSUDA Satoru, INABA Megumu, LIU Yanyong, YAMAGUCHI Toshiaki, KOSAKA Fumihiko, ANDO Yuji (Concurrent)"

URL: https://unit.aist.go.jp/epri/ecpg/
We conduct the research and development on carbon utilization technology relate with energy conversion systems, such as methane decomposition for hydrogen production which produce huge amounts of nanocarbons as byproducts. Our research area cover reaction processes for catalytic methane decomposition, carbon nanotube composites fabrication and catalyst-carbon separation. Fluidized bed technology, thermal fluid dynamics, graphene mass-production are also performed.

Keywords: Nanocarbons, Methane decomposition, Carbon recycling, Fluidized bed, Graphene

Members：曾根田 靖、戸中 健志、北島 僑雄、加登 裕也、浮須 祐二（兼）
SONEDA Yasushi, HATANAKA Takeshi, KITAJIMA Akio, KADO Yuya, UKISU Yuiji(concurrent)
URL：https://unit.aist.go.jp/epri/ecmat/
For realizing a low-carbon society, our group focuses on research and development of advanced catalysts, chemical reaction engineering and electrochemistry for extensive utilization of renewable energy and unused energy resources, and further recycling of carbon dioxide, which causes global warming. We are currently synthesizing new catalysts and composite materials for many chemical reaction systems for highly efficient production of energy carriers/fuels (ammonia, methane, light hydrocarbons and biofuels) using renewable hydrogen, biomass and recyclable CO₂ as feedstocks. We are also studying on new chemical engineering and reaction system, which can utilize renewable electricity for the purpose as aforementioned.

Keywords: Catalysts, Electrochemical catalysis, Chemical reaction engineering system, Hydrogen • Energy carriers, Methane, Biofuel
To promote reliable and economical "Hydrogen Society", we are conducting material compatibility tests under high hydrogen pressure (140MPa) and contributing to establishing Global Technical Regulation on hydrogen and fuel cell vehicles. In addition, based on fundamental study results using in-situ testing apparatuses, we are developing highly durable high-capacity metal hydrides for hydrogen storage systems as well as multipurpose systems with additional compression and purification functionality.

Keywords: Hydrogen embrittlement, Hydrogen storage, FCV, H₂ refueling station

P2G用高密度水素貯蔵・高圧力昇圧水素供給システム開発
Development of high density hydrogen storage & high efficient compression system

Members: 龍田浩、横浜利、浅野耕太、KIM Hyunjeeong, CHARBONNIER Véronique
SAKAKI Kouji, ENOKI Hirotoshi, ASANO Kohta, KIM Hyunjeeong, CHARBONNIER Véronique
URL: https://unit.aist.go.jp/epri/hius/
Development of innovative conversion technology for carbon resources

In addition to innovative methanation process that synthesizes methane from CO₂ and hydrogen derived from renewable energies, a new technology for direct production of hydrocarbons such as methane from CO₂ and steam by utilizing electrochemical reaction is under development. We are also developing fluidized bed technology for conversion of methane to benzene process, and technology for CO₂ free hydrogen production from methane thermal cracking.
つくばセンター：http://www.aist.go.jp/aist_j/guidemap/tsukuba/west/tsukuba_map_w.html

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技術を社会へ Integration for Innovation