Technology Development for the system of Area-wide use of Renewable heat

area-wide use / high efficiency / common fundamental

Overview and Results

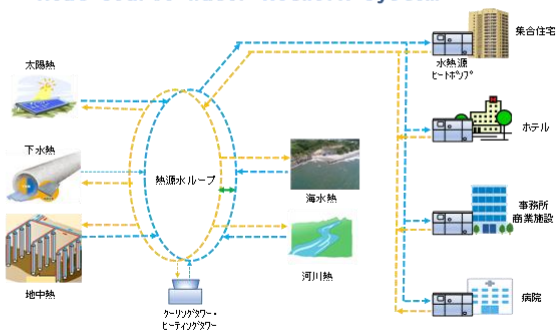
We will implement technological development for thermal utilization that leverages economies of scale, such as renewable energy thermal utilization systems for multiple buildings, apartment complexes, small-to-medium-sized offices, public facilities, etc. (including ZEB and ZEH), and area-wide heat supply systems for multiple consumers. This aims to expand the adoption of renewable energy thermal utilization.

Area-Wide Thermal Energy Supply Concept

Centralized Heat Supply System

Source：Japan Heat Industry Association Pamphlet

Heat Source Water Network System

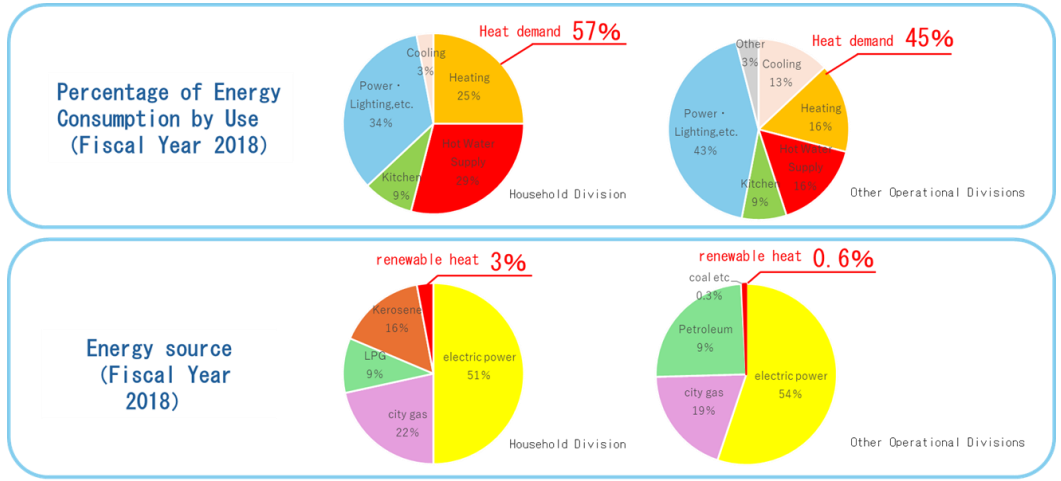


Source：NEDO Results Report (2022)

Current Situation and Background

Thermal utilization accounts for the majority of energy use at the final consumption stage.

- Heat demand is high, but the share of renewable energy heat utilization is low
- Expanding renewable energy use requires not only electricity but also Thermal utilization



Prepared based on the "Energy White Paper 2020" by the Agency for Natural Resources and Energy
Commercial and other sectors: offices and buildings, schools, hospitals, hotels and inns, theaters and entertainment facilities, etc.

NEDO Project

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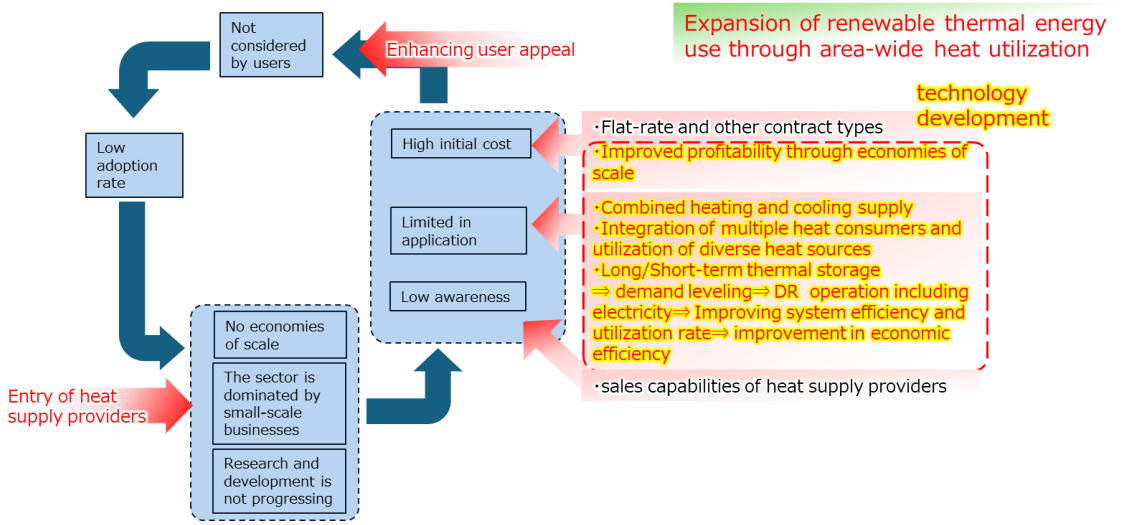
Social Challenges

The adoption of renewable thermal energy is caught in a vicious cycle due to high initial costs, limited applicable uses, and low public awareness. However, if area-wide thermal utilization can improve profitability through economies of scale, it could enhance appeal to users and encourage new thermal energy providers to enter the market.



Technical Challenges

Challenges	Specific technical challenges
Maximization of economies of scale	・Enhancement of renewable thermal energy output ・Cost reduction through consolidation of drilling and related operations ・Modularization and standardization of various equipment
Improvement of system efficiency through integration of multiple heat sources and consumers	・Development of technologies for effective utilization of heat sources with varying temperature ranges ・Development of combined heating and cooling supply technologies
Supply-demand balancing to accommodate the variability of renewable energy	・Development of small-scale thermal storage technologies ・Development of large-scale thermal storage technologies(e.g., aquifer thermal energy storage, borehole thermal energy storage) ・Utilization of AI/IoT (integration with power systems, development of demand response technologies)
Maximized and cost-effective utilization of low-temperature renewable thermal energy	・Development of piping installation technologies for low-temperature heat supply ・Development of technologies for integrating renewable thermal energy into existing heat supply systems,designing and optimizing operations with multiple heat sources
Shared challenges (fundamental technologies)	・Visualization and simulation of deployment potential ・Construction of optimal area-wide thermal systems ・Advancement of renewable thermal energy potential data

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Initiatives by NEDO

1.Development of elemental technologies contributing to renewable heat utilization systems

Elemental technologies related to renewable heat utilization will be targeted for development of new devices, equipment, and systems that contribute to cost reduction or performance improvement through demonstration testing. In doing so, advanced technologies from overseas will also be considered, with the aim of establishing solutions suited to Japan's specific usage environment.

2.Demonstration of technologies for cost reduction and advancement of renewable heat utilization systems

Utilizing renewable thermal energy sources—either singular or in combination—tailored to regional characteristics, this project aims to demonstrate the design and technologies that contribute to cost reduction and improved efficiency of thermal utilization systems. These systems are intended for deployment across multiple heat demand sites, such as residential buildings, apartment complexes, offices, and public facilities. The demonstration also includes thermal storage systems to balance fluctuations in heat demand.

※The goal is to achieve a total cost reduction of 20% or more in renewable thermal energy utilization systems by the final year of the project (compared to FY2024).

3.Development of common foundational technologies contributing to renewable heat utilization systems

To support the expansion of renewable thermal energy adoption, common foundational technologies will be developed, including enhanced potential data, system performance evaluation methods, energy management technologies, and tools such as simulators for assessing the impact of area-wide utilization and emulators for optimal system operation.

Budget: 2 billion yen Implementation period: 2024 to 2028

Future Outlook

A vision for widespread area-wide thermal utilization maximizing renewable heat

the year 2050

Phase1: early deployment phase	Phase2: transitional phase	Phase3: autonomous diffusion phase
a penetration rate below 2.5% (Adopters: Innovators※)	a penetration rate between 2.5% and 16% (Adopters:early adopters※)	a penetration rate between 16% and 50% (Adopters:early majority※)
By utilizing subsidies and other support mechanisms, area-wide thermal utilization systems that maximize renewable heat are developed and operated in favorable locations as advanced case studies, aiming for substantial technology demonstration and high added value. Implementers: Voluntary companies and local governments Subsidies: Required Stage: Technology demonstration, small-scale pilot projects Target Areas: Public facilities, high-rise condominiums, commercial complexes, etc. For example, pilot projects may be conducted in a few blocks of a redevelopment district or within relatively large facilities to test and showcase the system's effectiveness	As the reputation of early cases spreads, awareness increases and more projects are implemented. The accumulation of case studies leads to greater know-how, improved reliability, and cost reductions through economies of scale. Implementers: Developers, general contractors Subsidies: Partially required Stage: Commercial-scale demonstration Target Areas: High-rise condominiums, large-scale commercial facilities, etc. For example, pilot projects may be conducted in areas with diverse environmental or infrastructural conditions, as well as in facilities of greater scale to test broader applicability	Taking advantage of opportunities such as equipment upgrades, area-wide thermal utilization systems that maximize renewable heat are autonomously developed. Implementers: Various companies and organizations Subsidies: Not required Stage: Full-scale implementation Target Areas: Various facilities and regions "For example, projects may include the redevelopment of standard city districts, upgrades to urban infrastructure, or the construction and renovation of residential and commercial buildings

※ "The definitions of diffusion rates and adopter categories are based on E.M. Rogers' Diffusion of Innovations (1990).

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NEDO's Projects

1.Development of elemental technologies contributing to renewable heat utilization systems

Technological development for suitable site evaluation, monitoring methods, and cost-effective system design to support the stable use of high-temperature ATES systems (University Public Corporation Osaka)

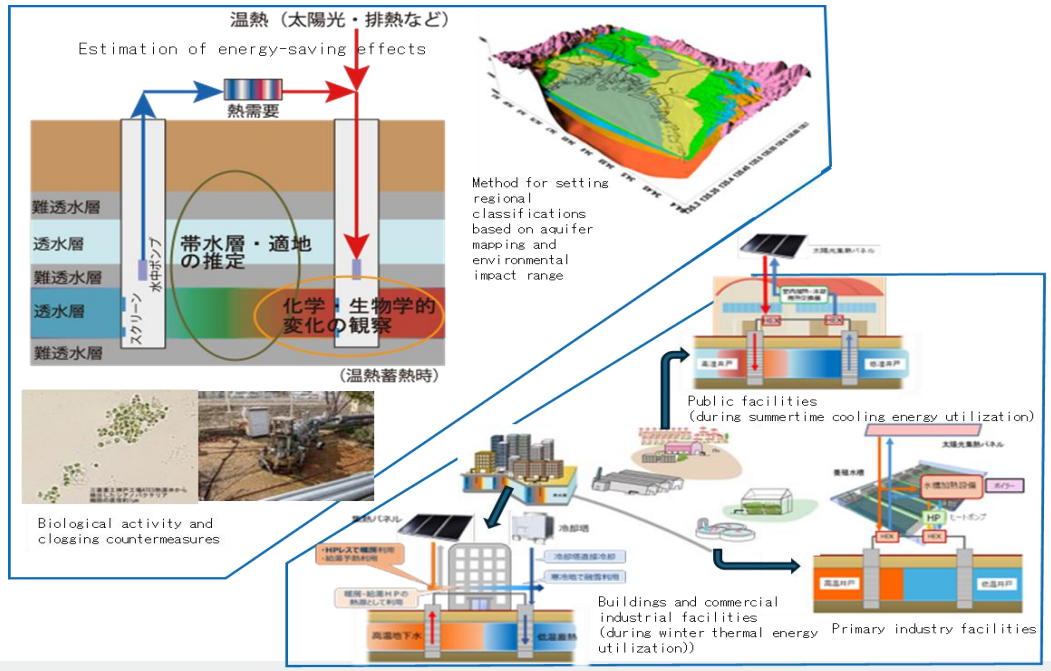
The ultimate goal is to promote the widespread adoption of high-temperature ATES. Research and development is being carried out with a focus on public facilities used as evacuation centers during disasters, envisioning their dual use for daily educational activities and for thermal, electricity, and water needs in situations where utilities are unavailable during emergencies

FY2024～2026：Development of guidelines for the introduction of high-temperature ATES

1. Heating experiments using a test well and groundwater heating equipment, including water quality and microbial community analysis
2. Creation of a 3D aquifer distribution map and geological information database of the Osaka Plain for site selection
3. Design of a low-cost and easy-to-operate high-temperature ATES system
4. Estimation of the benefits of area-wide implementation of high-temperature ATES
5. Development of guidelines for the introduction of high-temperature ATES

FY2027–2028: Expansion and Area-Wide Utilization of High-Temperature ATES

1.Demonstration experiment of high-temperature ATES at the university gymnasium (as an evacuation facility)
2.Outreach activities to promote social implementation
3. Feasibility study for introducing ATES to primary industry facilities such as land-based aquaculture and vegetable factories
4. Evaluation of advantages in urban area-wide utilization



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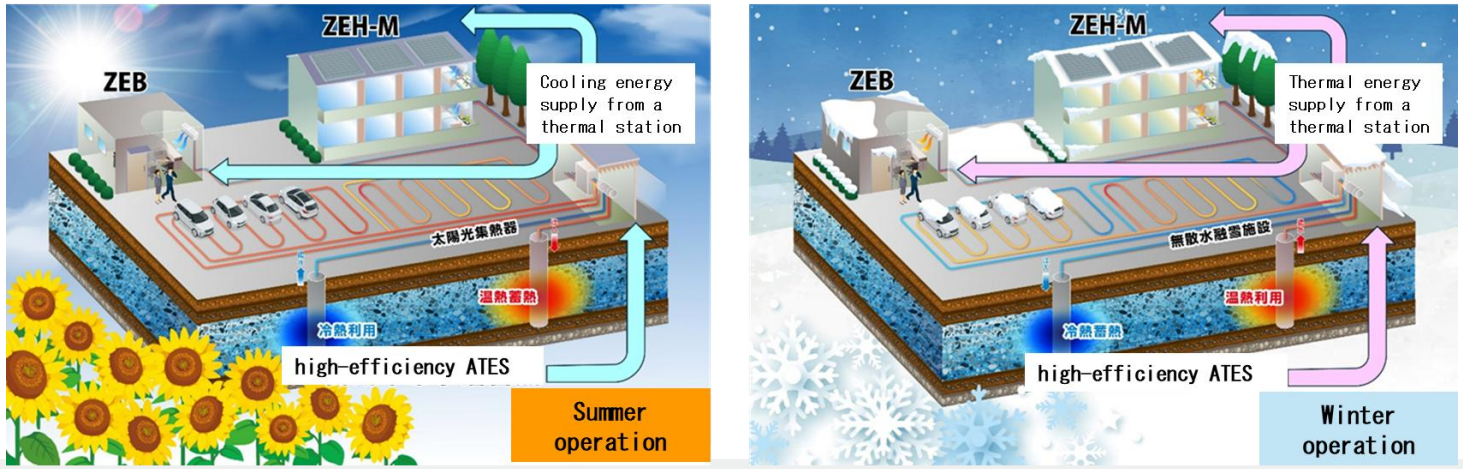
NEDO's Projects

2.Demonstration of technologies for cost reduction and advancement of renewable heat utilization systems

Technological development for the operation of ZEB and ZEH-M through area-wide thermal energy utilization centered on aquifer thermal storage
(Japan Groundwater Development Co., Ltd、Zeneral Heat Pump Industry Co., Ltd)

To achieve local production and consumption of energy, the operation of area-wide thermal energy utilization centered on high-efficiency aquifer thermal energy storage (ATES) systems will be demonstrated in ZEB and ZEH-M facilities. The project aims to level thermal loads, enable thermal energy sharing, and enhance the sophistication of thermal utilization, thereby reducing overall costs.

Area-wide utilization of high-efficiency aquifer thermal energy storage systems



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NEDO's Projects

3.Development of common foundational technologies contributing to renewable heat utilization systems

Development of implementation support technologies to promote area-wide utilization of renewable thermal energy in regional areas (National Institute of Advanced Industrial Science and Technology)

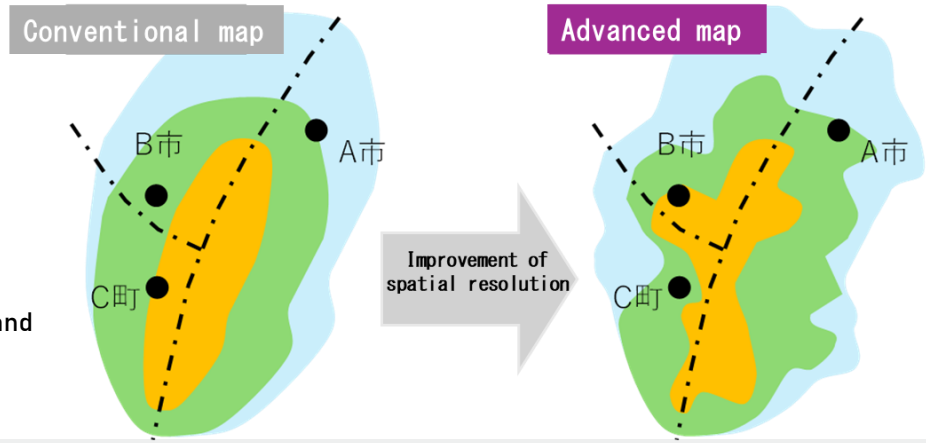
To realize large-scale deployment of renewable thermal energy and regional revitalization, efforts are being made to develop implementation support technologies in local areas. As part of this initiative, technologies to support commercialization are being developed, including the construction of business models and the formulation of guidelines for area-wide utilization of renewable thermal energy

① Closed-Loop (CL) System: Advancement of Potential Evaluation Methods
1)Development of technologies to improve the spatial resolution of potential data
2)Development of preliminary potential evaluation techniques using existing groundwater models and related resources
3)Development of multi-purpose mapping technologies for area-wide application of CL systems

② Open-Loop (OL) System: Development of System Optimization Technologies Considering Water Quality
1)Development of decision-support technologies for OL system implementation, taking groundwater quality into account
2) Implementation of reinjection experiments to support long-term operational cost evaluation of OL systems

③ Development of Regional Models for Area-Wide Renewable Thermal Energy Utilization and Guideline Formulation
1)Construction of regional models for area-wide renewable thermal energy utilization
2) Development of decision-support technologies for geothermal system selection based on local conditions and thermal demand
3) Formulation of guidelines for the promotion and utilization of renewable thermal energy

Conceptual image of improving the spatial resolution of geothermal potential data



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