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<https://www.tte-net.com>

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TEL: 03-3455-3600

NIPPON PMAC Co., Ltd.  
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Nihon Setsubi Kogyo Co., Ltd.  
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**– Contact information regarding this pamphlet**

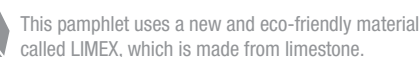
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**TEL 029-755-1337**



## FY2020 Technology Introduction

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Greeting



President and Representative Director, COO

Kazuhito Kojima

小島 和人

This technology pamphlet “Green Air Tech 2020” is an introduction to Takasago Thermal Engineering Group’s continuous efforts in these areas presented in the most approachable manner possible. The pamphlet introduces item by item green air services that we strive to provide as well as our original technologies in HVAC systems and heat sources, advanced technologies by use, construction technologies, etc. We hope this will provide an interesting and understandable look at our efforts and we would appreciate any feedback or requests you may have.

April 2020

Company Outline

Name	: Takasago Thermal Engineering Co., Ltd.
Representative	: President and Representative Director, COO Kazuhito Kojima
Establishment	: November 16, 1923
Head office	: Shinjuku Eastside Square 12F 6-27-30 Shinjuku, Shinjuku-ku, Tokyo 160-0022
Business	: Air conditioning equipment / Clean room and related devices and machines / District heating and cooling facilities / Water supply and drainage sanitation facilities / Co-generation equipment / Electricity, instrumentation, communication facilities / Facilities diagnosis / Failure diagnosis system / Dehumidification and drying equipment / Nuclear power facility air conditioning equipment / High precision air conditioning equipment / Vacuum conveyance equipment for waste / Construction / Exhaust heat recovery facilities / Heating and cooling equipment / Freezing and refrigerating equipment / Design, construction, engineering, installation, and maintenance of other various environmental control, thermal engineering systems / Design, manufacturing, import, export, sales and intermediacy of machines, equipment, and materials, Consulting services in relation to energy conservation and environmental protection initiatives / Business regarding greenhouse gas emissions trading / Sales, purchase, intermediacy, lease, and management of real estate / On-site on-demand personnel dispatch / Security business / Cleaning business / Energy supply business / Power generation business, Water treatment
Number of employees	: 5,886 (Consolidated, as of end December 2019)
Stock listing	: Tokyo Stock Exchange First Section
Branches and offices	: Sapporo Branch / Tohoku Branch / Kanto-Koshinetsu Branch / Tokyo Main Office / Yokohama Branch / Nagoya Branch / Osaka Branch / Chushikoku Branch / Kyushu Branch / Engineering Department / International Business Headquarters
Group companies	: TMES Co., Ltd. NIPPON PMAC Co., Ltd. Nihon Kaihatsu Kosan Co., Ltd. Kiyota Kougyo Co., Ltd. Kazusa Environmental Research Center Nihon Setsubi Kogyo Co., Ltd. Tomakomai District Heating Co., Ltd. Takasago Contractors and Engineers (China) Co., Ltd. Takasago Singapore Pte. Ltd. Takasago Thermal Engineering (Hong Kong) Co., Ltd. Takasago Vietnam Co., Ltd. Thai Takasago Co., Ltd. T.T.E. Engineering (Malaysia) Sdn. Bhd. PT. Takasago Thermal Engineering (Indonesia) Takasago Engineering Mexico, S.A. de C.V. (Mexico) Integrated Cleanroom Technologies Pvt. Ltd. (India)

\*Takasago Thermal Engineering Myanmar branch has been established in Myanmar.

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■ Among the following SDG marks, related ones are noted on each technological article.

Sustainable Development Goals (SDGs)

These are the Sustainable Development Goals (SDGs), which the world has agreed to strive to meet by 2030.



We aim to contribute to SDGs through our business activities.

Green Air®:

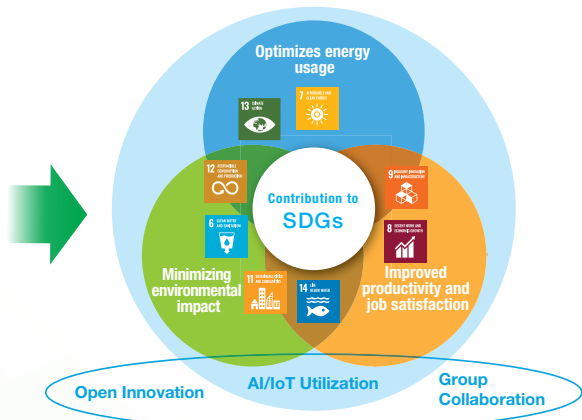
It is the name of our effort to contribute to global efforts toward environmental friendliness by supplying air that is friendly to people as well as the environment in the climate of buildings such as offices, hotels, hospitals, and factories.

■ Efforts to further the development of a sustainable society

As “environmental solution professionals that can affect the global environment,” we create and promote technology and products that contribute to the development of the decarbonized and sustainable society. With the global community’s help, we aim to achieve our goal for the year 2030 while ensuring that our activities contribute to Sustainable Development Goals (SDGs) whenever possible.

Sustainable Development Goals (SDGs)

We aim to contribute to SDGs through our business activities.





## ■ TTE Innovation Center commenced operation

Takasago Thermal Engineering Innovation Center (hereinafter referred to as the Innovation Center) built in Tsukubamirai-shi, Ibaraki (site area: 22,746m<sup>2</sup>) commenced operation. Part of the head office functions (Planning and Development Divisions) and a research facility are combined in the Innovation Center.

### 〈 Feature 1: Office design that inspires innovation 〉

The Innovation Center consists of the office wing (two floors above ground) that houses an office area as well as multi-purpose areas including an exhibition area and hall; the lab wing (two floors above ground) that houses verification rooms and laboratories; and an exhibition space as well as presentation rooms designed to connect the two wings. The office area in the office wing is designed to allow for people to “discuss, serve, cloister, gather, or relax” in the layout, based on the ideas of workplace transformation we have been working on. We have created an environment that inspires innovation and implemented office design that improves productivity.

■ Appearance of TTE Innovation Center



### 〈 Feature 2: Exhibition space and cafeteria open to the community 〉

On the first floor of the office wing, we have built exhibition space wherein people can familiarize themselves with our technologies, as well as a cafeteria. With the intended concept of an “Innovation Center rooted in and open to the local community,” we created a facility including meeting spaces that local people can drop in anytime.

#### ① Exhibition space

The space consists of six areas, showcasing and introducing our company history as well as various HVAC systems and air environments, creatively presented so that visitors can get to know our technologies.

■ Image of the exhibition space



■ Image of the cafeteria

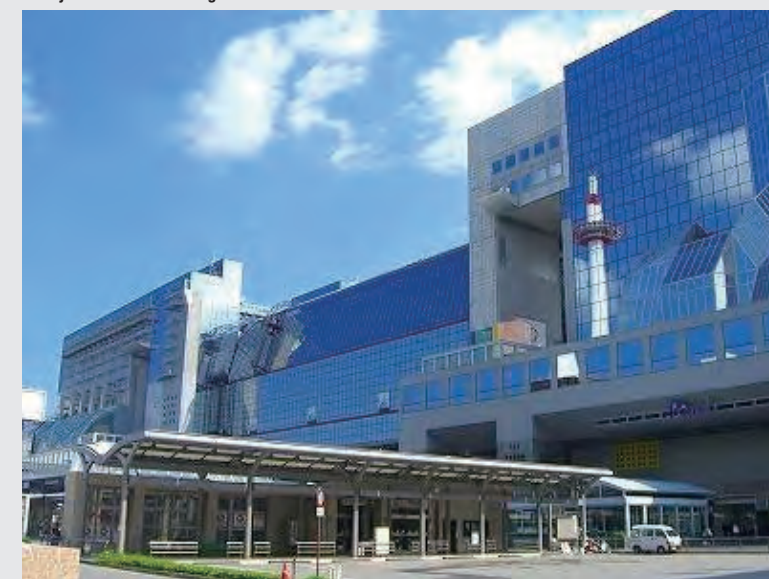


## ■ Winner of the 7th Special Award “Renovation Award” by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan, the 7th “Carbon Neutral Award” by the Japanese Association of Building Mechanical and Electrical Engineers, and the 2018 Energy Conservation Grand Prize “Minister of Economic, Trade and Industry Prize”

Kyoto Station Complex is a multi-purpose building housing the station, a department store, theater, specialty stores, and a hotel from the third basement level to the sixteenth floor, for a total floor space of approximately 238,000m<sup>2</sup>. Before the renovation, the Kyoto Station Complex was emitting the largest amount of CO<sub>2</sub> out of any single building within the environmentally-friendly model city of Kyoto. In order to solve this challenge, our client and commissioning management team along with designers, builders, and operation managers achieved a drastic energy-saving renovation by radically reviewing and modernizing the systems. We handled the construction and participated in the commissioning meetings as a primary contractor.

The introduction of various high-efficiency heat source equipment and its optimum control system to replace conventional systems that mainly used steam was highly praised. We also conducted performance analysis and optimization using GODA<sup>®</sup> CLOUD, reformed the system while maintaining the functions of building in operation 24 hours-per-day, and achieved a 60% reduction of primary energy consumption in the facility. These were highly evaluated as well.

■ Kyoto Station Building



## ■ Winner of the 33rd “Technology Promotion Award” by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan and the 7th “Carbon Neutral Award” by the Japanese Association of Building Mechanical and Electrical Engineers

At Kawagoe Office of Japan Radio Co., Ltd., we combined the advantages of two air conditioner types, “simple management, reasonable price, and good usability” of a package air conditioner and “comfort and energy-saving performance” of a central air conditioner into a general package air conditioner.

[Comfort] The blowing temperature load of the package air conditioner gets reset, moves closer to the setting, and is stabilized. Also, by adopting a type of HVAC system that blows from the floors and evens out the air supply temperature, it enhances the comfort of the rooms.

[Energy-saving performance] Unless the load becomes extremely light, continued operation of the package air conditioner is maintained, reducing energy losses from starting and stopping the compressor.

During the interim periods, natural ventilation and cooling with outside air are actively used to further save energy. The annual consumption of primary energy for the HVAC system was reduced by 61% compared to the standard (1,036MJ/m<sup>2</sup> per year) defined by the Energy Conservation Center of Japan, achieving drastic energy conservation.

■ Kawagoe Office of Japan Radio Co., Ltd.



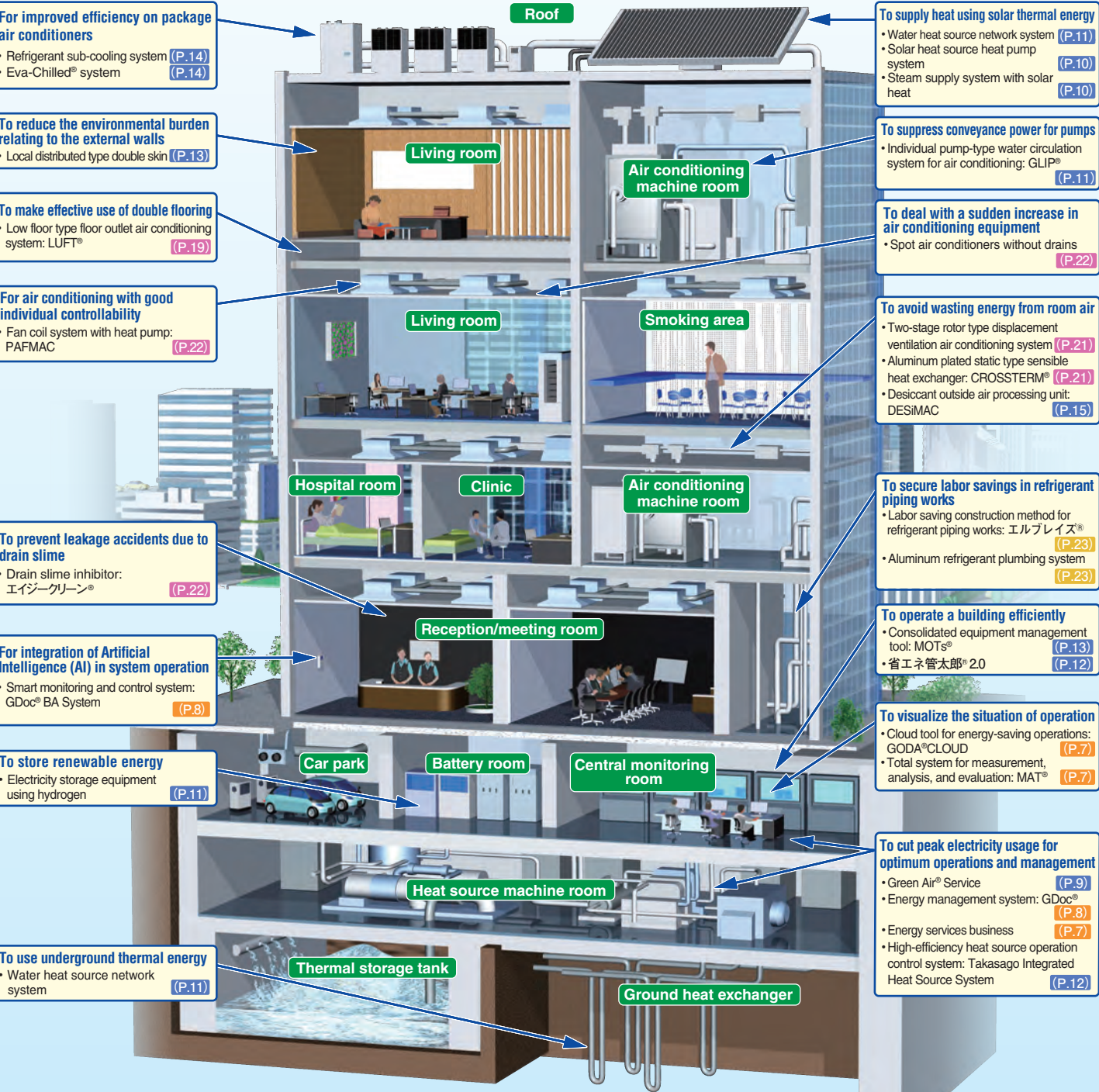
(Photo by Harunori Noda)



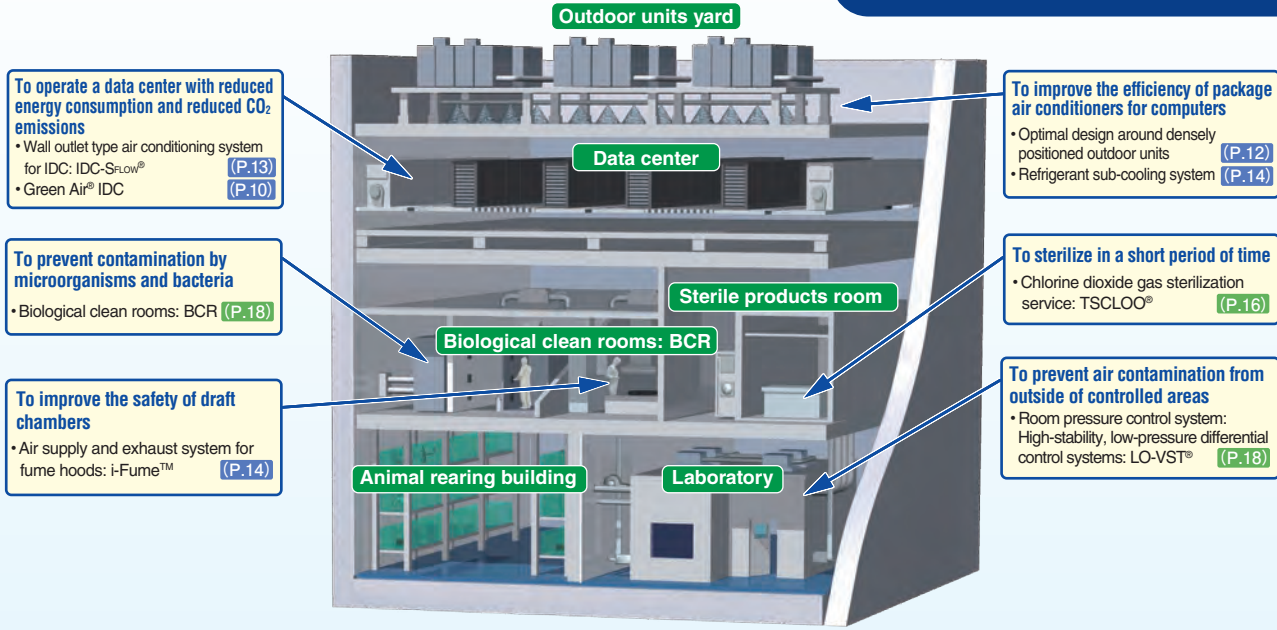
List of environmental burden reducing technologies using Green Air® technology

A reduction in the burden on the environment is achieved by using characteristic Green Air® technology from the planning, design and construction of air conditioning equipment through to its operation, management and renewal work. We make efforts to create environments in a way that will satisfy customers by simultaneously pursuing both an increase in comfort and a reduction in the environmental burden.

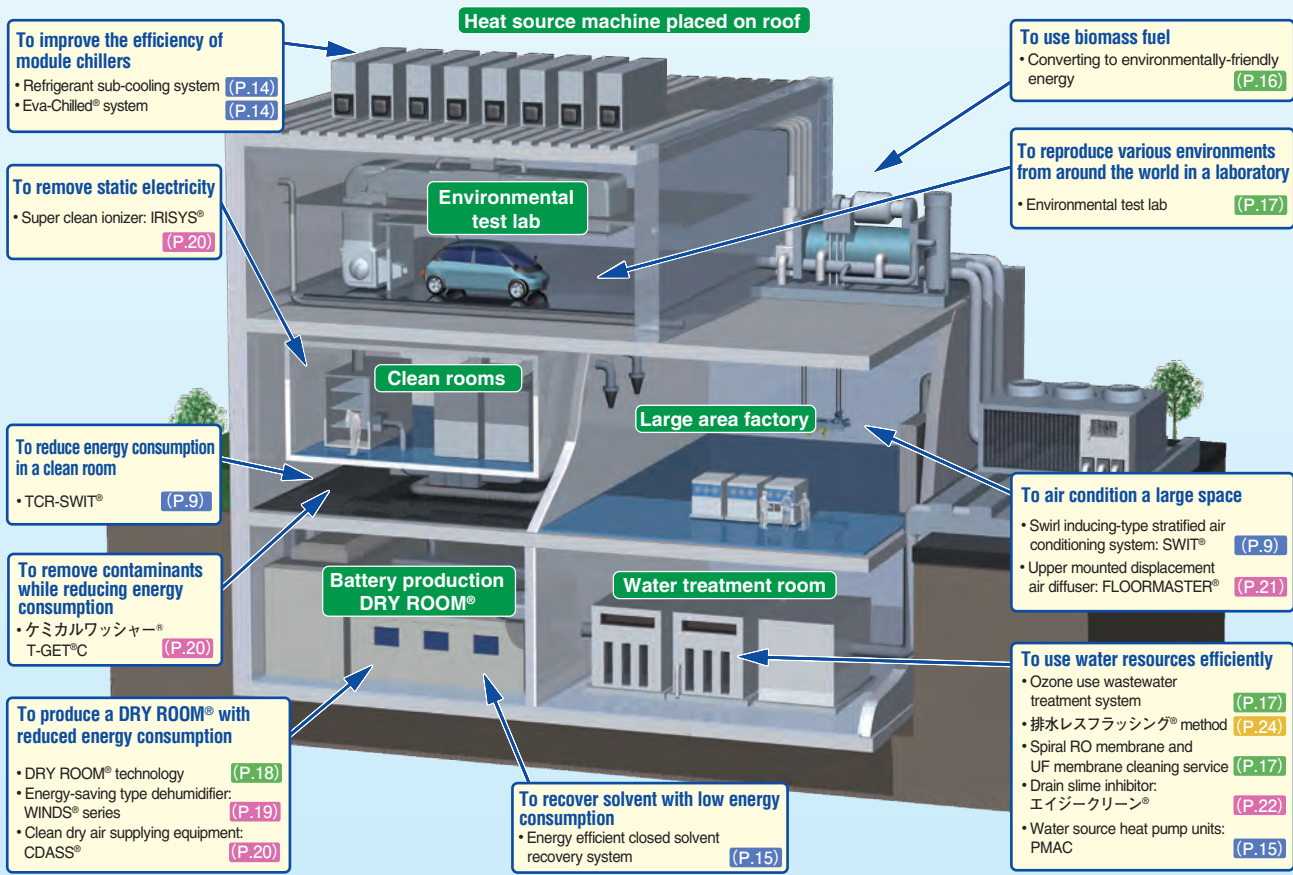
Building air conditioning



Data centers and pharmaceutical



Factory air conditioning



Others

- Development of air conditioners for trains**
  - Development of air conditioners for train operators (new model of the Azusa/TRAIN SUITE Shikishima) (P.24)
- Subway station air conditioning load analysis**
  - Subway station air conditioning load analysis (P.24)
- To distribute marine products in a highly fresh state**
  - High-performance sherbet-like ice-making system: SIS-HF® (P.19)
- Use of IT in construction management work**
  - Measures for BIM and the introduction of IT in construction (P.23)



Energy services business

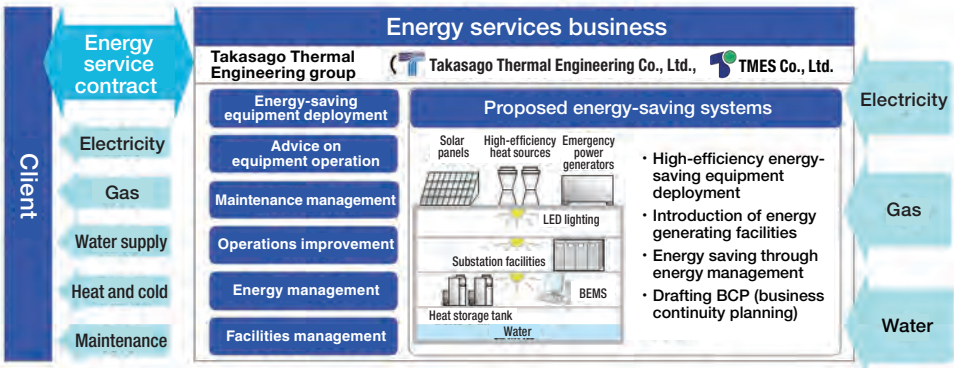


All-round energy service for heat sources, electricity, and water: No initial investment required, cost savings achieved, operations and management tasks outsourcing provided

The energy services business of Takasago Thermal Engineering Co., Ltd involves the provision of a “one-stop” total solution for energy services, covering planning, design, construction, maintenance and operations management including energy

management and energy procurement. By helping to reduce the overall life cycle cost of facilities and outsourcing facilities operations to us, clients can focus on their core business.

Overview of energy services business



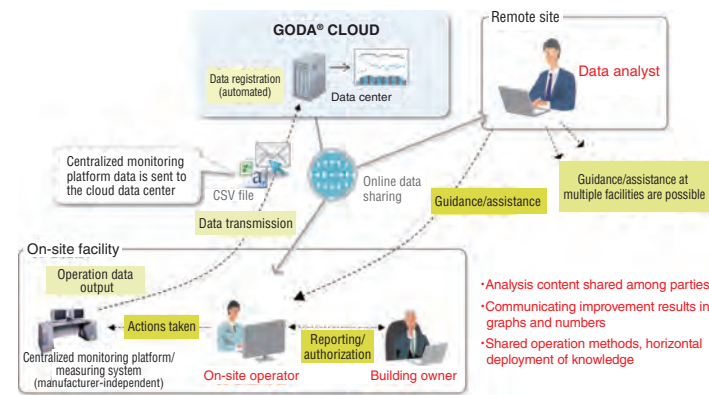
Cloud tool for energy-saving operations: GODA® CLOUD



Infrastructure tool which resolves social concerns of energy conservation, lack of on-site data analysts, and IoT utilization

GODA® CLOUD is a cloud-based energy analysis tool that analyzes on-site energy usage and operating data of HVAC systems, etc., in order to promote more efficient energy conservation management. Operation data is collected from on-site central monitoring equipment and inputted into a dedicated database in the cloud. Data analysts are able to direct and assist on-site operators without having to be on-site themselves by remotely checking and analyzing the data. Operations improvement is performed by sharing information with on-site operators, facilitating energy conservation and life cycle cost reductions.

Usage model for remote assistance in energy conservation tuning



- Winner of the 2017 “Good Design Award for Best Platform”
- Winner of the 2017 “Energy Conservation Award for Best Product or Business Model”
- Winner of the “Energy Conservation Center Chairman’s Award”



GODA®: Gathering Operation Data And Analysis  
Patent No. 4540737

Total system for measurement, analysis, and evaluation: MAT®



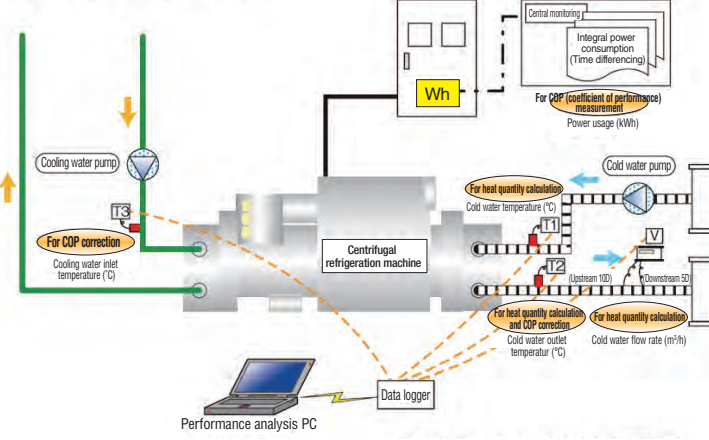
Provision of the information necessary for decisions on the update of equipment and devices

MAT® is a technology that enables the monitoring of a facility’s operational status and the assessment of its performance using virtual design values while maintaining the facility’s normal functionality. Using specifically developed precision-verified surface measurement technology (measuring temperature, flow, and electric current), MAT® is able to utilize accurate data with measurement error factors removed, facilitating analysis and assessment of facility performance. By enabling a system’s users to grasp the actual state of facility performance and energy consumption, MAT® helps them achieve more efficient operations and determine when equipment needs updating.

- Obtaining operational data through surface measurement
- Using the measured values to analyze equipment, system performance, and energy usage
- Supporting comparison of analysis results with standard values

MAT®: Measurement Analysis Evaluation Totalized System  
Patent No. 4694185, Patent No. 4796283, Patent No. 4948079, Patent No. 4949081, Patent No. 4949892, Patent No. 5185429, Patent No. 5749422, and more

Example of measurements around a centrifugal refrigeration machine



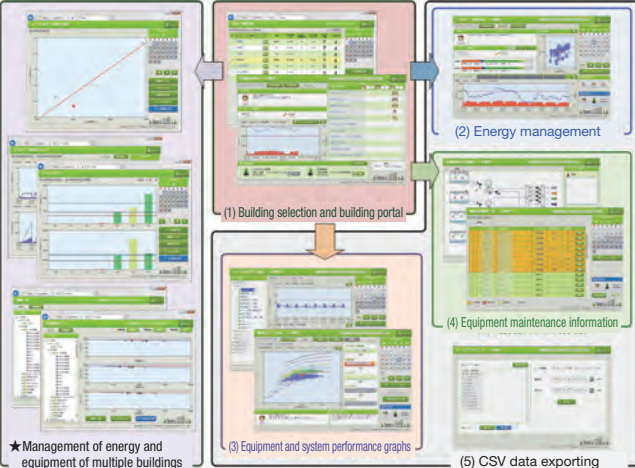
Energy management system: GDoc® advance



Cloud BEMS service which visualizes and advises on facility operations

GDoc® advance is an interactive BEMS (building energy management system) that provides visualization of the energy consumption, system performance of the HVAC system, and maintenance information of equipment, and advises on them over the entire building life cycle. With a user-friendly display design and intuitive operation, GDoc® advance makes it easy to access the charts and data you need. Facility operations data is stored in a secure cloud-based environment, which facilitates centralized management of information from multiple business sites. In addition, the system enables our representatives to submit periodic reports on the operational status of facilities, which we use as a basis for providing energy-saving and cost reduction suggestions.

GDoc® advance display examples



GDoc®: Green Energy Management Doctor

Patent pending, application No. 2018-031518

Energy management system: GDoc® premium



Using a rule engine to achieve facility operation optimization

GDoc® is equipped with an AI (artificial intelligence) rule engine that is capable of learning and that can extrapolate\* optimal control setting values based on measured values and operations knowledge. GDoc® premium is able to generate control setting values for the heat source equipment and conveyance equipment to help save energy and reduce costs while maintaining the appropriate indoor thermal environment and also taking external air conditions into account.

With GDoc® premium, once setting values have been received from the higher-level computer, control logic can be established using a standardized optimization module and easy-to-understand program code, supporting operational improvement based on existing facilities, device and system enhancement, and rapid, flexible post-upgrade tuning. Combining GDoc® advance and GDoc® premium provides optimization of facility operation over the entire building life cycle.

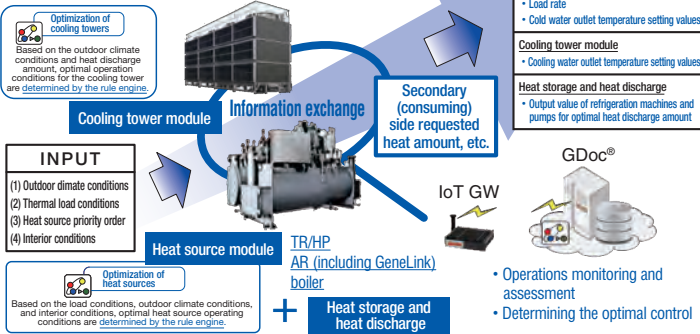
\*Extrapolation technology uses known facts and rules to generate new facts and rules.

Patent pending, application No. 2018-031534, application No. 2018-031535, application No. 2018-031536, application No. 2018-031537, application No. 2018-031538

Approach to optimization of heat source equipment operation embodied by GDoc® premium

The rule engine offers:

- Comprehensive optimization (determines the operation parameters for optimal energy conservation)
- Operational knowledge, machine learning of equipment performance and utilization

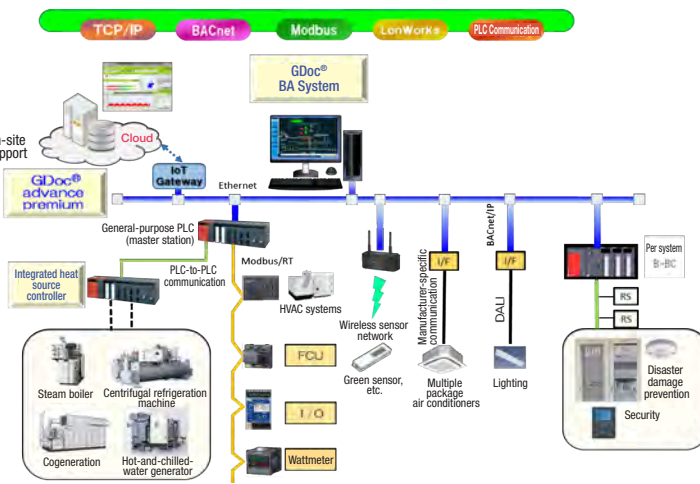


Smart monitoring and control system: GDoc® BA System



An open-standards centralized monitoring system which achieves visualization and optimal control of facility operations

In our capacity as environmental solutions specialists, we offer optimal systems which leverage AI (artificial intelligence) in multi-vendor environments which are aligned with our clients’ needs in order to build a decarbonized society. Combining the open-standards system that we have provided, as seen in Roppongi Hills with GDoc® series such as GDoc® premium and GDoc® advance allow visualization and optimal control of facility operations, contributing to energy conservation and cost savings over whole life cycles of buildings.





SDGs

Affordable and clean energy

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Renewable energy

Industry, innovation, infrastructure

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Industry, innovation, infrastructure

Sustainable cities and communities

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Sustainable cities and communities

Climate action

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Climate action

Green Air® Service

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Sustainable cities and communities

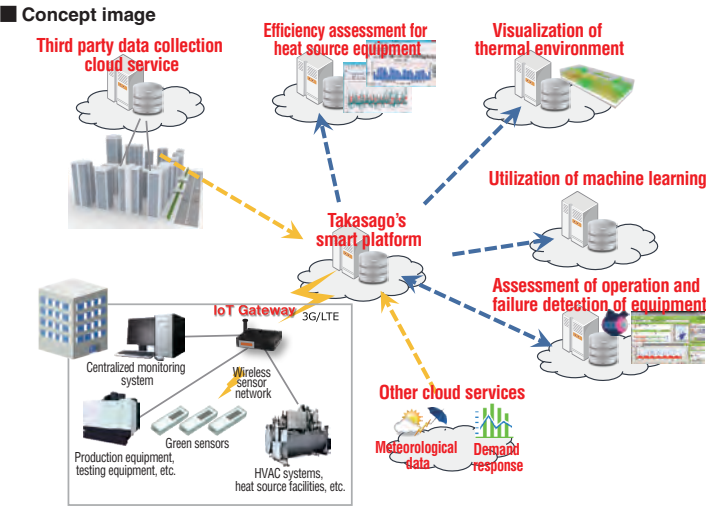
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Climate action

Creating new services that synergize with our technologies through data analysis

While rapid IoT introduction is ongoing in various areas, the IoT wave is gaining momentum in the area of building equipment as well. We utilize IoT devices such as sensors to collect operations data for building equipment and environmental data for indoor spaces on our smart platform, and offer the optimal facilities operations based on analysis of the results. Furthermore, from the diverse data that has been accumulated, we are working on creating new services that utilize next-gen environmental control systems and facilities operations systems as well as artificial intelligence to accelerate the development of these services for practical use.

- [Use cases]
- Visualization of thermal environment
  - Online efficiency assessment for heat source equipment
  - Facilities operations data analysis through machine learning
  - Assessment of operation and failure detection of equipment systems



Swirl inducing-type stratified air conditioning system: SWIT®

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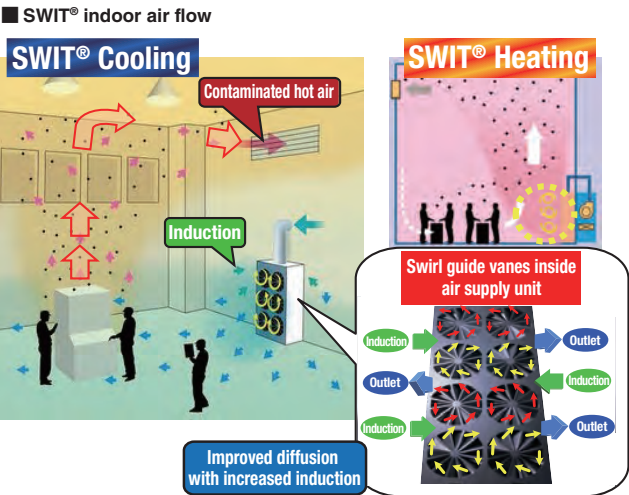
Climate action

Achieving both comfort and energy conservation with a 40% reduction in HVAC energy use

SWIT® is a thermal stratification-type HVAC system which uses the natural principle that warm air rises and cold air falls. The contaminated hot air is moved up to the ceiling and the environment in the working area is kept clean and comfortable. SWIT® can condition the air with less air flow than a mixed air conditioning system as well as with the air flow temperature close to the room temperature. This makes it possible to build an HVAC system that conserves energy with low cost. SWIT® is suitable for large spaces and places with high heat generation loads, high outside air loads, and high dust emission.

Winner of the 7th "Environmental and Equipment Design Award"  
"Winner of the 24th "Technology Promotion Award" by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan and the 2012 Energy Conservation Grand Prize "Agency for Natural Resources and Energy Director-General"

SWIT®: Swirling Induction type TAKASAGO HVAC System  
Patent No. 4006196, Patent No. 4421347, Patent No. 4574317, Patent No. 4790480, Patent No. 5053686, Patent No. 5780892



TCR-SWIT®

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Climate action

Constructs a high-precision environment in an ultra-short execution period while also providing energy and cost savings

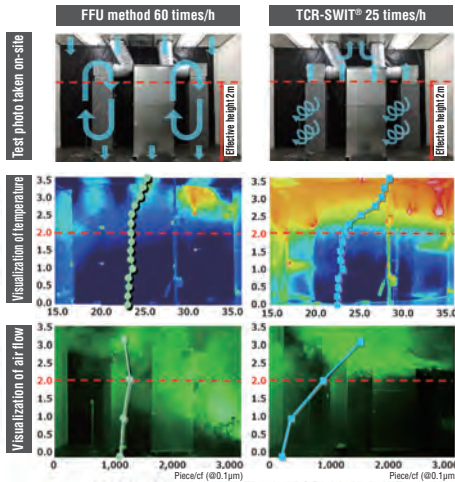
TCR-SWIT® is a next-gen clean room technology which makes it possible to achieve both effective indoor environment maintenance and energy savings in large-scale clean rooms, which had previously been a major challenge. The special features of SWIT® have been technically tested and verified in an ultra-precision air conditioned clean room of JIS Class 5; we demonstrated that thermal environments and cleanliness can be maintained with less air flow by means of excellent ventilation efficiency. We have an established track record of commercial installation in a semiconductor manufacturing process (pre-processing) clean room (Class 5 ultra-precision air conditioning).

TCR-SWIT® installation example



TCR-SWIT®: Takasago Clean Room Swirling Induction Type  
Patent No. 536140, Patent No. 6636859

TCR-SWIT® verification testing (applied to JIS Class 5)



Green Air® Service for IDCs: Green Air® IDC

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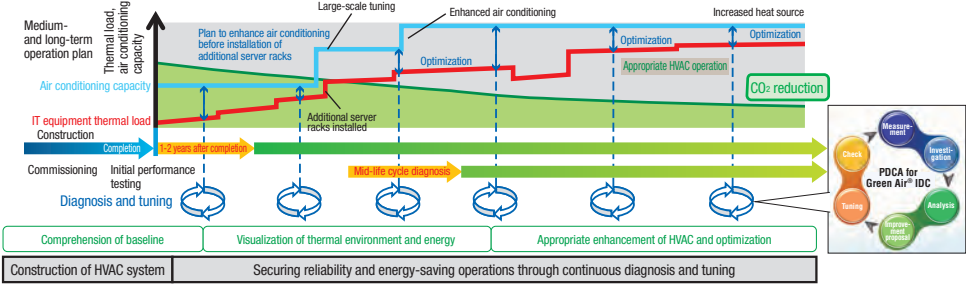
Climate action

Comprehensive assessment technology for IDCs and operation task service for the entire life cycle of IDCs

Green Air® IDC uses our comprehensive assessment technology for service of operations tasks for overall optimization throughout the life cycle of an IDC. The air conditioning load at IDCs changes frequently due to the introduction of new IT equipment and the replacement of old equipment. We have proven results in more than 100 tested installations

located both in Japan and overseas. For an IDC that is already in operation, we diagnose the thermal environment and energy so that we can offer a one-stop service, i.e. support for everything from energy-saving tuning, overall renovation planning and design to the construction work and after-sales support.

Operations task service for the entire life cycle of an IDC



Patent No. 5306969, Patent No. 5306970, Patent No. 5324363, Patent No. 5421570, Patent No. 5729993, and more

Solar heat source heat pump system

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Climate action

Consistently supplying heat taken in from solar radiation and outside air

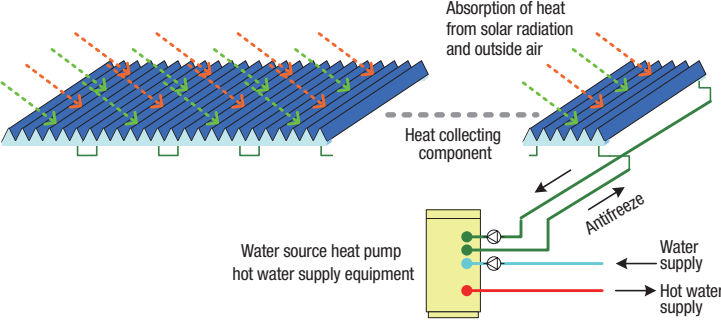
A solar heat source heat pump system substitutes the heat exchanger of a conventional heat pump for heat collecting panels installed on a rooftop. By gathering heat with a single heat collecting component from both solar heat and the outside air, the system supplies heat reliably and at high efficiency regardless of weather, and will also achieve energy conservation and reduced CO<sub>2</sub> emissions.

- Operating efficiency is improved by as much as 40% during daylight hours over conventional heat pumps
- Using low-temperature heat collection results in highly-efficient heat collection (5-15 times of that for solar cells)
- Heat can be supplied even during cloudy or rainy weather without resorting to supplementary heat sources

Winner of the 2007 Idea Competition of the Consortium for Building Research & Development "Judges' Encouragement Award"

Patent No. 5329289, Patent No. 6184052, Design registration No. 1438373, Design registration No. 1438374

System summary image



Low-pressure steam supply system with solar heat

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Climate action

Supplying low-pressure steam with solar heat to reduce the steam load of the building

The system consistently supplies low-pressure steam directly produced by solar heat in a highly-efficient manner. Installing this system in buildings where low-pressure steam is needed, such as factories or hospitals, has the benefits of reduced fuel costs for boilers, which are necessary to produce steam, as well as reduced CO<sub>2</sub> emissions.

- Simple configuration which directly heats water with CPC heat collecting panels\*
- No heat conveyance power is required, resulting in highly reduced power consumption
- Steam generation efficiency: 35-45% depending on the degree of solar radiation (up to 138°C steam)

\*CPC heat collecting panel:  
A heat collecting device (radiative-surface reflective mirror) which collects solar radiation in a heat collecting component housed within a tubular vacuum chamber

Installation image



Patent No. 5794772



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Electricity storage equipment using hydrogen

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Supplying electricity, heat, and hydrogen (fuel) after recharging with renewable energy

This electricity storage equipment supplies a variety of energy types by using hydrogen energy, which is attracting attention as one of the technologies available to solve environmental problems. It is suitable to convert output, absorb excess electricity, supply energy in emergencies including blackouts, and supply carbon neutral fuel, all from renewable resources which are expected to be used more and more on a global scale in the future.

- The production and storage of hydrogen using power from renewable energy. Hydrogen is used on an as-needed basis.
- There is no loss due to involuntary discharge, so long-term power storage ranging from months to years is possible.
- The role fossil fuels have been playing can be replaced by hydrogen.

National Institute of Advanced Industrial Science and Technology Equipment delivered to Fukushima Renewable Energy Institute, AIST (FREIA) and a mobile hydrogen station utilizing the hydrogen produced by these facilities

Hydrogen production and power generation equipment



Mobile hydrogen station



Patent No. 4919314, Patent No. 5152948, Patent No. 5492460, Patent No. 5622544

Water heat source network system

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Renewable energy

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Sustainable cities and communities

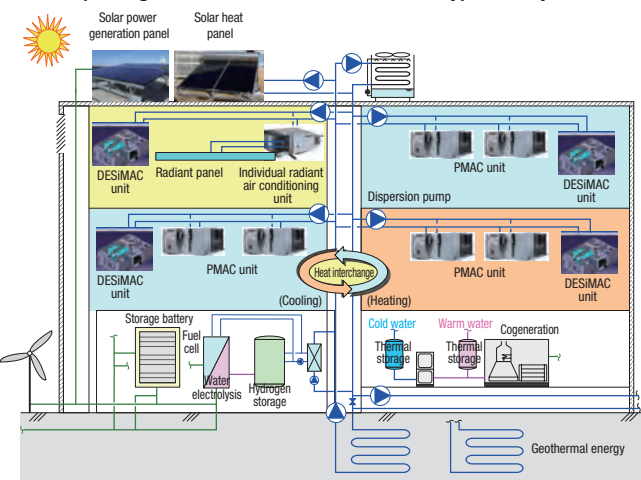
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Water heat source network-type, latent heat/sensible heat separated, multi-split HVAC system for multi-split ZEB

This system is a highly-efficient HVAC system with desiccant outside air processing units (DESiMAC) and water heat source individual dispersed heat pump units (PMAC) as the core devices. We are aiming to achieve Takasago-style ZEB in multi-split HVAC systems from a combination of an HVAC system separating latent heat and sensible heat, control of the entire water heat source, renewable thermal energy, and use of waste heat, etc.

- The combination of the desiccant outside air processing unit (DESiMAC) and water heat source individual dispersed heat pump unit (PMAC) realizes a highly-efficient HVAC system using latent heat and sensible heat separation
- Effective use of waste heat from sources such as CGS, factories, waste treatment sites, and neighboring buildings
- Effective use of renewable thermal energy such as geothermal energy and solar heat
- Control to raise the overall operating efficiency of the system according to the load

Concept image of a water heat source network type ZEB system



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Renewable energy

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Sustainable cities and communities

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Individual pump-type water circulation system for air conditioning: GLIP®

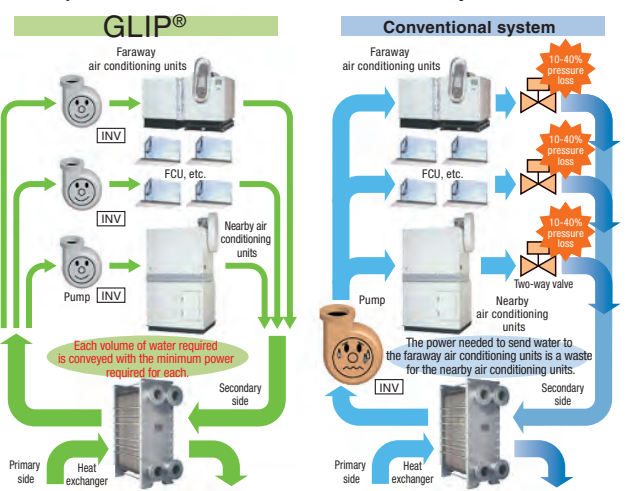
Supplying the necessary volume of warm and cold water with the minimum necessary energy at any given time, 50-90% reduction in conveyance power

GLIP® (Green Loops & Individual Pumps) is an energy-saving system which thoroughly removes any consumption of power transmission resulting from wasteful pressure loss in the water circulation system. The pumps and control valves in the heat source machinery room are abolished, and a pump with an inverter is installed for each air conditioner or for each group. By integrating the transportation function and flow control function, the resistance of the piping is kept low, and the required volume of cold and warm water is conveyed with the minimum possible pump power.

Winner of the 2007 Japan Machinery Federation "Chairman's Award"

Patent No. 4832960, Patent No. 5014922

Comparison between GLIP® and a conventional system



Optimal design around densely positioned outdoor units

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Renewable energy

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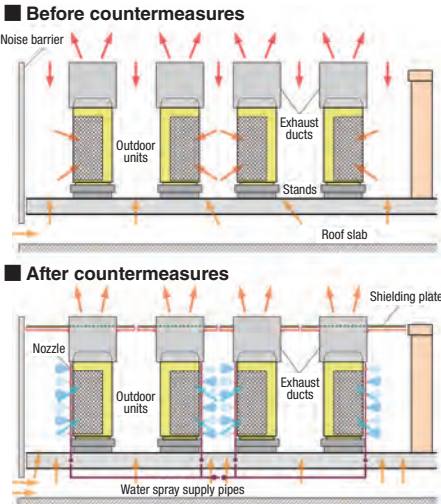
Improving efficiency on air-cooled package air conditioners by using shielding plates for the outdoor units and cooling with water sprays

The operating efficiency of air-cooled package air conditioners is affected by the temperature of the outside air. A large number of outdoor units are positioned densely on high-rise buildings and urban data centers. The exhaust air from one outdoor unit is conducted to another outdoor unit. This means the inlet air temperature for the outdoor unit becomes higher, resulting in a reduction of their operating efficiency. The countermeasure of spraying water onto outdoor units causes problems such as rust and scaling on the fins as well as a steep rise in water costs. We solve these problems through a variety of design methods.

- Separating the exhaust and inlet of the outdoor units using methods such as shielding plates and shielding films (capping)<sup>\*1</sup>
- Spraying a fine-particle mist results in using very little water to wet the fins<sup>\*1</sup>
- Halting the spray when cooling with mist is less effective due to humidity (spray control)
- Water used for cooling spray is purified water<sup>\*2</sup> or soft water in order to reduce or inhibit scaling on the fins of the outdoor units

<sup>\*1</sup> 1 June to September PAC power consumption at a given data center was reduced by 7.4%  
<sup>\*2</sup> Water is purified by RO systems (in-house systems)

Patent No. 4037147, Patent No. 5977559



Energy management system that complies with the Energy Saving Act: 省エネ管太郎®2.0

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Renewable energy

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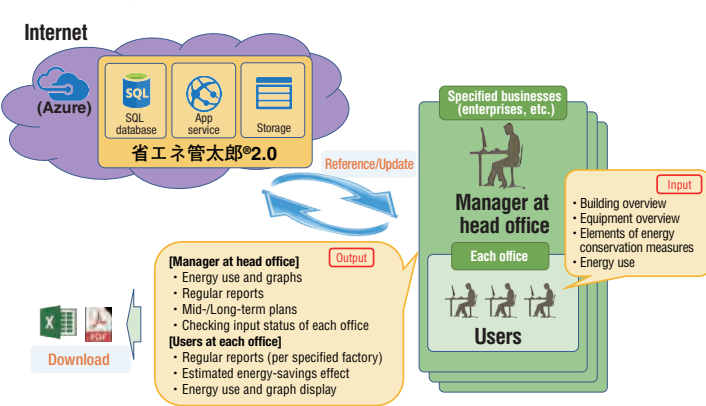
Sustainable cities and communities

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Centralized management of energy use

This is a tool for specified businesses that use 1,500kL or more of energy per year when converted into oil to centrally manage the energy use of all offices within Japan. By entering the monthly energy use such as electricity and gas for each office, energy management can be done per office. Furthermore, control managers can accumulate data from all offices and easily create a regular report or mid- and long-term plans which may be submitted to the government. As there is also a function to estimate how much energy conservation has been done by selecting energy conservation options on a per-office basis, it helps to prepare a plan for energy saving in the future.

System image



E&E Planning Co., Ltd.

High-efficiency heat source operation control system: Takasago Integrated Heat Source System

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Renewable energy

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Extremely high-efficiency and energy-saving heat source system that reduces energy consumption by up to 70%

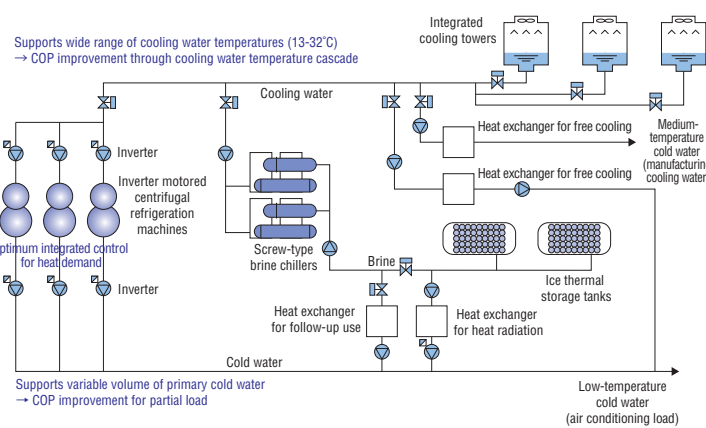
The Takasago Integrated Heat Source System is a heat source system with one of the highest levels of energy conservation performance in the world, which it achieves by removing the wasteful consumption of energy and maintaining the ideal operating conditions. Using the commercially supplied general-purpose equipment, we design the optimal system for each client's needs.

- Optimal prediction system design using highly-accurate simulations
- Use of free cooling throughout the year by recovering the cold thermal energy of outside air in cooling towers
- Energy-saving technologies such as the maximum possible reduction of power for water conveyance
- Operation control technologies to draw out the maximum possible efficiency of refrigeration machines

Winner of the 2009 "Technology Promotion Award" by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan

Patent No. 4022383, Patent No. 4435533

Takasago Integrated Heat Source System





SDGs

Good health and well-being

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HEALTHY LIVES AND WELL-BEING

Affordable and clean energy

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AFFORDABLE AND CLEAN ENERGY

Decent work and economic growth

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DECENT WORK AND ECONOMIC GROWTH

Industry, innovation, infrastructure

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INDUSTRY, INNOVATION, INFRASTRUCTURE

Sustainable cities and communities

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SUSTAINABLE CITIES AND COMMUNITIES

Climate action

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CLIMATE ACTION

Local distributed type double skin

7

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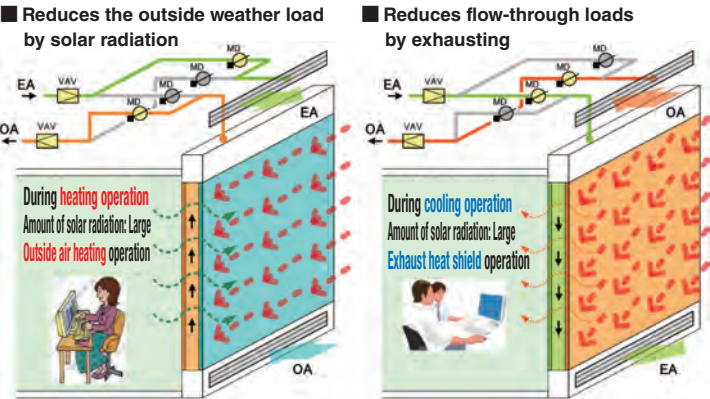
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Ideal for small- and medium-sized buildings, with energy-saving casings that also reduce outside air load

The introduction of the double skin structure is proceeding for advanced, large-scale buildings. This structure helps to reduce the flow-through load by sealing the space between double-glazed building glass surfaces during the winter and naturally ventilating it during the summer. The double skin is installed per window unit, further heightening the energy-saving effects in concert with the ventilation system, and making the installation very easy for ordinary small- and medium-scale buildings as well.

- The space between the glass panes is connected to the outside of the building, with the double skin used as a ventilation path
- Outside air is heated by solar radiation for heating use, reducing the outside air load
- Exhaust is passed when cooling, preventing infiltration of outdoor heat



Patent No. 6286375, Patent pending, application No. 2017-198371

Wall outlet-type air conditioning system for IDCs: IDC-S<sub>FLOW</sub>®

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Personal HVAC system for office use that enables comfort and energy conservation

The IDC-S<sub>FLOW</sub>®\*1 supplies air directly from the side walls of the server room to the interior, so there is little pressure lost along the airflow route and the power needed for the air conditioning's air blower can be reduced to about 1/3 of that required for floor supply systems. Furthermore, technology to control the flow of air supplied to the cold aisles creates an even wind speed at the intake surface on the racks and suppresses any localized increases in temperature. This means that the variation in temperature on the intake surface is small, which enables the use of a relatively high temperature air supply for efficient operation of the heat sources, and extended use of free cooling and cooling using outside air, which together result in a great reduction in the annual energy consumption.

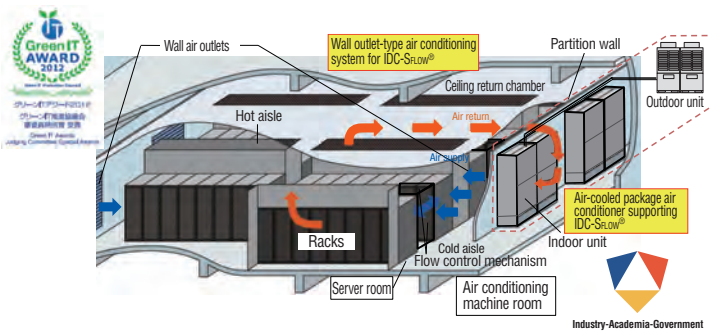
\*1 Joint development with Kanden Energy Solution Co., Inc.

Winner of Green IT Award 2012 "Judging Committee Special Award"  
Winner of the 13th Industry-Academia-Government Collaboration Contribution Award "Ministry of the Environment Award"

IDC-S<sub>FLOW</sub>®: Internet Data Center Side Flow System

Patent No. 5743536, Patent No. 5748469, Patent No. 5926030, Patent No. 6049981, Patent No. 6117500, China Patent No. 102538161, and more

■ IDC-S<sub>FLOW</sub>® system diagram



Consolidated equipment management tool: MOTs®

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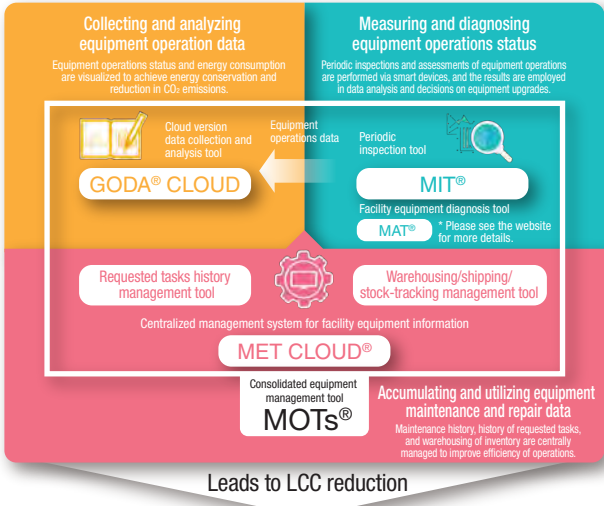
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Discovering challenges in equipment operation and suggesting improvement measures

- Periodic inspection tool: MIT®  
Facility equipment managed with bar codes is inspected with smart devices. Inspection results are managed on an MIT server and put to use for rapid identification of malfunctions and preventive measures thereof.
- Equipment information management system: MET CLOUD®  
MET CLOUD® accumulates maintenance data including fault descriptions, breakdown trends and causes, component breakdown frequencies, and repair costs, then can propose optimal equipment maintenance plans.
- Collecting and analyzing equipment operation data  
Eco-Tuning refers to carrying out improvements to equipment operations in order to reduce CO<sub>2</sub> emissions from buildings while ensuring comfort and productivity.

\*Eco-Tuning is a registered trademark of the Japanese Ministry of the Environment.

MOTs®: Maintenance Operation Tools  
MIT®: Maintenance and Inspection Tool  
MET CLOUD®: Maintenance management system for Expert of TMES



TMES Co., Ltd.

Integrated control system for air supply and exhaust for fume hoods: i-Fume™

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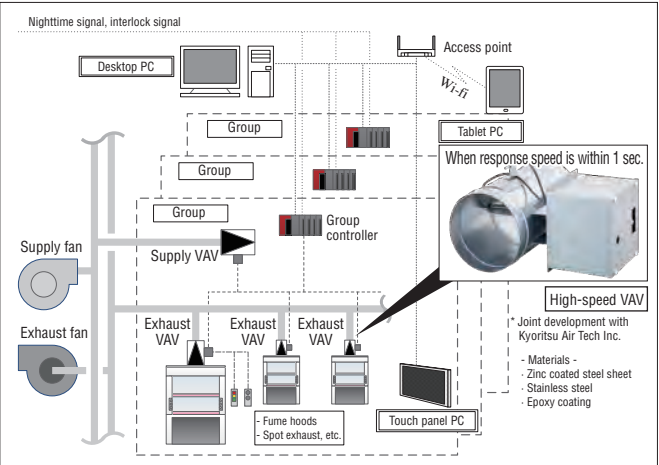
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Providing air supply and exhaust management for fume hoods (draft chambers) that achieves both safety and energy conservation

In research facilities for the medical and synthetic chemistry fields, fume hoods (draft chambers) are used to safely handle toxic substances. The intake surface air velocity at the opening of fume hoods is stipulated by laws and regulations depending on the substances being handled. Compared to general facilities, research facilities have higher amounts of ventilation, and since the exhaust of fume hoods is not circulated as it contains toxic substances and odor, these facilities require massive energy for air conditioning. This means that an air conditioning method to maintain the intake surface air velocity according to the operation status of fume hoods (degree of sash opening) and to control the exhaust air flow would be very effective for energy conservation. On the other hand, in this air conditioning method, in order to ensure high levels of safety, controlling the air flow at high speed and with highly stability is imperative.

■ System summary image



Patent No. 6229873, Patent No. 6342665, Patent No. 6430315, Patent No. 6430316

A water-cooling function added to an air-cooled PAC: Refrigerant sub-cooling system

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Energy conservation and reduced peak consumption on multiple package air conditioners and chillers, reducing electricity consumption by 15% or more

Cooling water cools the liquid refrigerant partway along the refrigerant pipes of air-cooled equipment such as multiple package air conditioners or module chillers to improve the cooling capacity. This leads to a reduction in peak consumption of electricity as well as energy consumption, and at the same time, it alleviates the heat island effect by using the heat from vaporization of the water.

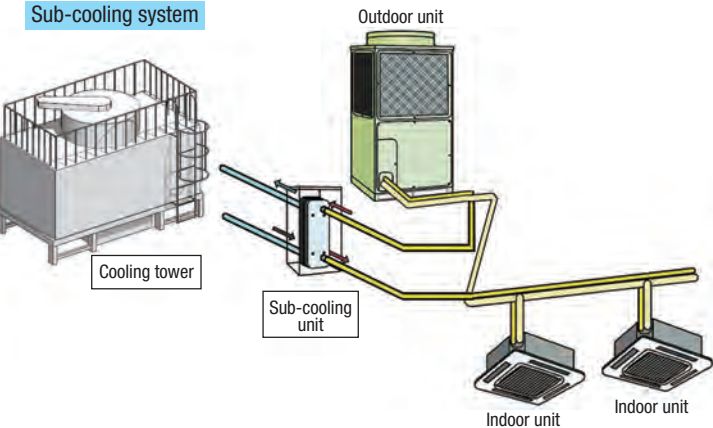
Winner of the 3rd JABMEE Award "Excellence in Environmental Engineering" ("Refrigerant sub-cooling system using PAC for computer rooms" 2011)

Adopted as NEDO "2013 Dissemination and Promotion of Global Warming Countermeasure Technology" (Project exploration and planning on refrigerant supercooling system project for air conditioners in Thailand)

Patent No. 4472383, Patent No. 4798884, Patent No. 4813151, Patent No. 5295481, Patent No. 5693932

■ System summary image

[For large-scale systems]  
Sub-cooling system



Eva-Chilled® system

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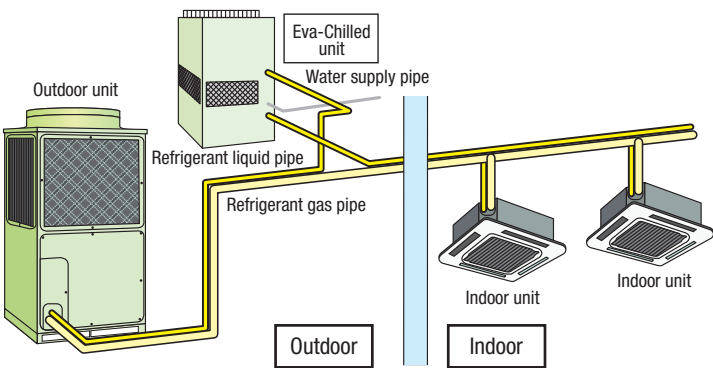
Energy conservation and reduced peak consumption on multiple package air conditioners and chillers, reducing electricity consumption by 15% or more

TMES Co., Ltd.

As an advanced version of the refrigerant sub-cooling system, which improves efficiency of cooling operation of multiple air-cooled package air conditioners, we have developed the Eva-Chilled unit, where a heat exchanger that cools the refrigerant with water and a cooling tower are integrated. Eva-Chilled® systems using this unit require no additional cooling water pipes, drastically simplifying the construction.

■ Eva-Chilled® system summary image

[For small-scale systems]  
Eva-Chilled® system



Patent No. 4472383, Patent No. 4798884, Patent No. 4813151, Patent No. 5295481, Patent No. 5693932



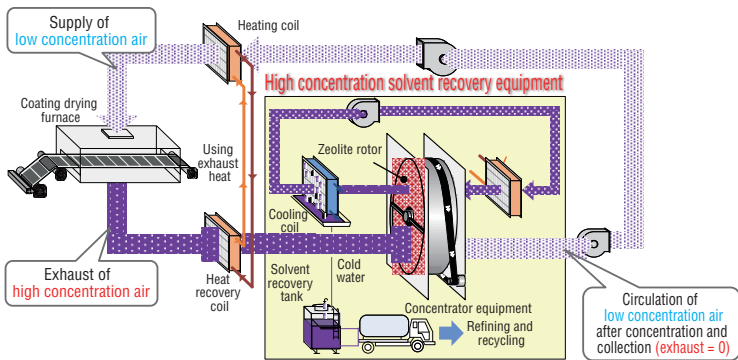
Energy efficient closed solvent recovery system



Environmentally-friendly solvent recovery system that provides excellent energy-saving performance

This is a new solvent recovery system that meets the needs of clients who want to reduce vaporized emissions of solvents from drying systems for printing machines and coaters. By installing the solvent recovery system in a one-to-one arrangement with drying systems and adopting a closed system that supplies treated exhaust to the drying system, it is possible to substantially reduce the emission of VOCs (volatile organic compounds). This Takasago-developed heat recovery system integrates a dry-type solvent recovery system in order to achieve industry-leading energy conservation. Furthermore, we can propose the best possible recovery system depending on the type of solvent in use such as toluene, which has a low boiling point, and ethyl acetate, which are used in adhesive tape factories and printing factories.

System summary image



Patent No. 5600048, Patent No. 5628051, Patent No. 5829498, Patent No. 6078237, Patent No. 6463062, Patent No. 6420115, Patent No. 6463071

Water source heat pump unit supporting renewable energy: PMAC



Individual distributed-type water source heat pump unit with wider water temperature range specification (addition of 0.5HP) NIPPON PMAC Co., Ltd.

We expanded the range of heat source water temperatures at which the water source heat pump unit can be operated. It can now be operated further into the low-temperature region.

Operating water temperature for cooling 7°C to 45°C

Operating water temperature for heating 5°C to 45°C

Renewable energy (underground water, geothermal energy, industrial wastewater, etc.) can be used as heat source water.



Desiccant outside air processing unit: DESiMAC

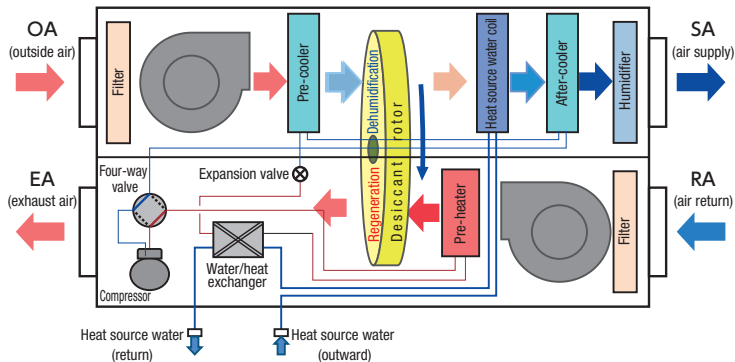


An outside air processing unit that combines a desiccant rotor and water source heat pump

NIPPON PMAC Co., Ltd.

We developed a desiccant outside air processing unit “DESiMAC” that demonstrates high humidity adjustment performance and energy-saving by using dehumidification (latent heat processing) by a low-temperature regeneration-type desiccant rotor in combination with water source heat pump technology (PMAC with wide water temperature range specification of 7-45°C). This unit is suitable for latent heat/sensible heat separated HVAC systems and for HVAC systems for low-humidity rooms as the first technology for conversion to ZEB.

Concept image of cooling operation circuit



Patent No. 5890873

Converting to environmentally-friendly energy



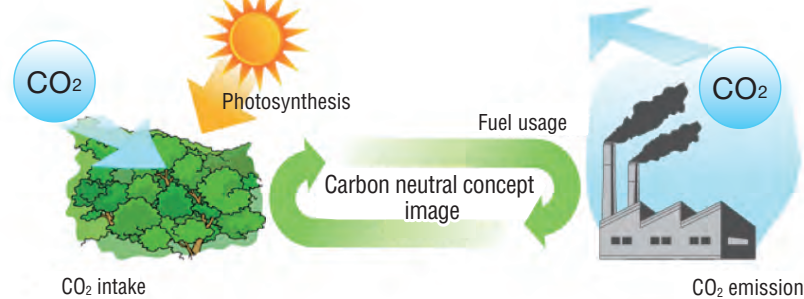
Converting to environmentally-friendly energy (biomass)

We propose energy optimization achieved from our heat utilization technologies (thermal engineering) on a per-business basis. Nowadays, factories are facing various complex challenges such as improving efficiency in production, being environment-responsive, and BCP. Together with our clients, we help them figure out these challenges

through understanding the current status of their operation as well as running feasibility studies and simulations. These optimization challenges are difficult to solve on a per-building basis, so we tailor our approach on a per-business basis.

We promote our environmental solutions for achieving not just clients' pursuit of economic performance for their CSR management, but also risk assessment and contribution to the local community.

Outline of carbon neutral system using a biomass boiler



Municipal development with energy produced locally for local consumption

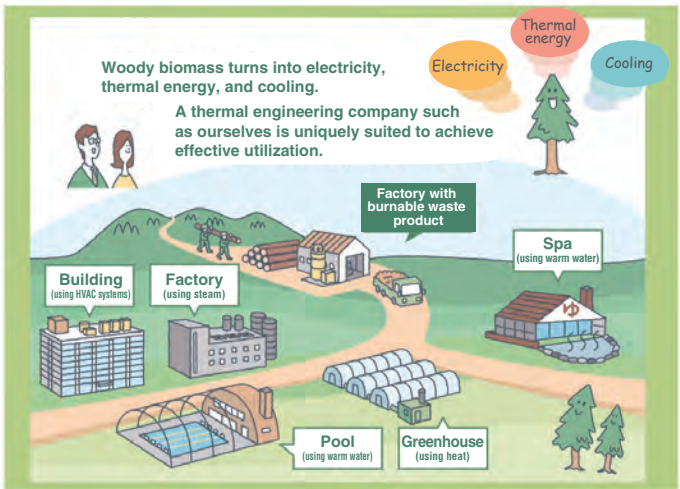


Municipal development with energy produced locally for local consumption: regional revitalization and local energy from biomass

For Japan, a country which has low self-sufficiency for energy, use of community-sourced energy resources is an important topic. Shifting from fossil fuels to utilization of autonomously distributed electricity and heat sources using biomass will not only contribute to progress towards a decarbonized society, but also promote community resilience and revitalization of local economies.

We hope our thermal engineering technologies will create new coordination among businesses and local municipalities and trigger promotion of municipal development through energy produced locally for local consumption.

- 2 projects have received FY2018 promotion project for feasibility studies for local energy production cost grants for commercialization of energy produced locally for local consumption by employing regional resources by the Ministry of Economy, Trade and Industry
- 1 project has received a FY2018 local independent systems using biomass energy verification project grant by the Ministry of Economy, Trade and Industry
- 1 project has received a FY2019 distributed energy infrastructure project grant for master plan drafting by the Ministry of Economy, Trade and Industry



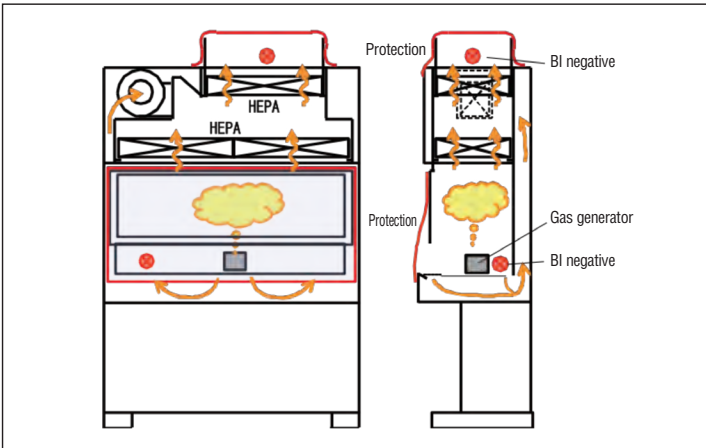
Chlorine dioxide gas sterilization service



Providing quick-acting sterilization services for biosafety cabinets and rooms: TSCLOO®

TSCLOO® service is a sterilization service using chlorine dioxide gas. The service enables sterilization of biosafety cabinets and indoor environments more safely and in a shorter amount of time than conventional methods using formaldehyde. It is suitable for use in regenerative medicine facilities, pharmaceutical facilities, experimental animal facilities, bio-research facilities, food manufacturing/processing facilities, as well as medical facilities where infection prevention is necessary.

Overview of prior sterilization at inspection time of a biosafety cabinet



TSCLOO®: Takasago Sterilization System-CIO<sub>2</sub>  
Patent No. 5449691, Patent No. 5944760, Patent No. 6073694, Patent No. 6162455, Patent No. 6283551, Patent No. 6298620



SDGs

Clean water and sanitation

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SDG icon

Affordable and clean energy

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SDG icon

Industry, innovation, infrastructure

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SDG icon

Responsible consumption, production

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SDG icon

Climate action

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SDG icon

Ozone use wastewater treatment system

Technology that achieves high wastewater treatment performance using an activated sludge treatment tank

This system can be expected to help prevent the occurrence of bulking, to improve and stabilize treatment capacity, and to reduce excess sludge, by supplying a tiny amount of ozone to an activated sludge treatment tank in the course of activated sludge treatment of organic wastewater.

- The bulking occurrence prevention rate is 100% in actual operation
- A 15-30% increase in the amount of wastewater treated is possible
- BOD (biochemical oxygen demand), oil content, chromaticity, and odor of the treated water are improved
- A 15-30% reduction in excess sludge (dehydration) is possible
- Can be installed in existing facilities without interrupting wastewater treatment

■ System summary image of the ozone use wastewater treatment system

Scope achieved with this technology: Improvement in microorganism activity by adding a tiny amount of ozone.

Patent No. 4907103, Patent No. 5095466, Patent No. 5137724, Patent No. 5292240, Patent No. 5607973, Patent No. 5687463, Patent No. 5947067

Spiral RO membrane and UF membrane cleaning service

Reduced operating costs for membrane filtration processes by utilizing spiral RO membrane and UF membrane cleaning technologies

We offer a spiral RO (reverse osmosis) membrane and UF (ultrafiltration) membrane cleaning service to greatly reduce the operating costs for membrane filtration processes. Spiral RO membranes and UF membranes which cannot be expected to be recovered with on-site cleaning and must be replaced can be cleaned at our dedicated factory and reused. In some instances, clients have been able to take advantage of this service four or more times.

As the replacement cost of the membranes will be reduced, installation plans with the premise of multiple replacements per year is possible. Therefore, RO membrane processing can be applied in fields where membrane wear was drastic such as recovery and treatment of wastewater, which was not able to cost-effectively employ membrane filtration until now.

■ Example of membrane cleaning

Left: After cleaning    Right: Before cleaning

Environmental test lab

Reproducing environments from around the world at the test lab level

We reproduce aspects of environments around the world, such as the temperature, humidity, and atmospheric pressure at the test lab level to support development and testing by automobile, construction equipment, and materials manufacturers.

Systems are provided in a way that meets the requirements of each client. For example, an environmental test lab for an automobile manufacturer would include wind tunnel equipment where the wind speed is controlled to follow the car speed, to reproduce actual driving conditions.

■ Example implementation (wind tunnel-type environmental testing)

Environmental test lab, Dynamo pit, Dehumidifier, Exhaust fan, Car speed fan, Electric heater, Direct expansion coil.

An environmental wind tunnel test lab was introduced in China in July 2018.

Patent pending, application No. 2019-184518, application No. 2019-184519, Published international patent application 2019/134601

DRY ROOM® technology

Achieving low-cost and energy-efficient DRY ROOM® facilities with appropriate equipment configuration and optimal operational control

Moisture in the air is an impediment to yield improvements in the manufacturing processes for the increasing production of rechargeable lithium ion batteries and OLED (organic light-emitting diode) products. This manufacturing is therefore performed in a DRY ROOM®, which has the moisture in the air removed in a controlled low dew point atmosphere.

The manufacturing cost for the dehumidified air used in the DRY ROOM® is higher than that for the conditioned air used in ordinary air conditioning. There are therefore increased demands for energy conservation in large-scale mass production factories. In order to respond to these demands, we optimize the configuration of the dehumidification equipment to achieve reduced energy consumption and lowered costs. In addition, we achieve further reductions in energy consumption by implementing optimal operation controls to deal with the periods when the dehumidification load is low, for example, during the winter months.

■ Basic configuration of the DRY ROOM®

Energy-saving type dehumidifier: WINDS®, Lighting equipment, Air outlet, Air supply, Air return, DRY ROOM®, Anteroom, Inlet, Entrance door, Highly-airtight sandwich panels, Pass box, Emergency exit, Inspection door, Outside air, Exhaust.

Patent No. 4754358, Patent No. 4990443, Patent No. 5587571, Patent No. 5681360, Patent No. 5681379, Patent No. 5684478

Biological clean rooms: BCR

Offering a clean environment to prevent contamination from microorganisms and bacteria

Biological clean rooms are where microorganisms and bacteria are removed in addition to particles. These rooms are necessary for the prevention of bacterial contamination in places such as pharmaceutical factories, operating theaters and laboratories, and also for uses such as preventing putrefying bacteria in food factories and for the prevention of cross-contamination in facilities rearing germ-free animals. We use clean room technologies to provide an environment which meets the required quality.

- Air purification and temperature and humidity stabilization technology
- Prevention of contamination from surrounding air through high-precision control of the pressure in the room using LO-VST®
- Multiple technologies such as sterilization technologies for the surfaces in the room are utilized

Val cleaning and sterilization room, Class 10,000, Filling room, Class 100, Packaging room, general air conditioning.

Patent No. 5433361

Room pressure control system: High-stability, low-pressure differential control systems: LO-VST®

Offering reduced power consumption for operation management and securing stable room pressure for various operation mode changes

The LO-VST® system performs high-precision control of the room pressure in highly-airtight rooms, where stable control is considered to be difficult. Even when the door is opened and closed or when the flow rate is reduced to reduce energy consumption, control is possible to ensure that there are no great variations in pressure inside the room.

- Sudden changes in room pressure when a door is opened or closed are suppressed with linked control of doors and dampers.
- Variations in room pressure when the air flow rate changes are suppressed with the variable operation speed of the dampers.
- Start-ups in a short period of time are made possible with the use of a general-purpose controller.

■ System summary image of LO-VST®

Low-pressure differential controller, General-purpose PLC or general-purpose PC, Supply fan, Constant flow equipment with VSTD\* mechanism, Door switch, Linked control-type room pressure control, Damper, Exhaust fan.

\*VSTD: Variable Stroke Time Damper (a damper which makes a motor with variable operation times possible)

LO-VST®: Low pressure difference control using Variable Stroke Time damper

Patent No. 4242684, Patent No. 4684921, Patent No. 4712853, Patent No. 5614949

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SDGs

Affordable and clean energy

7

Renewable energy

Industry, innovation, infrastructure

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Advanced research and development

Sustainable cities and communities

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Smart infrastructure and communities

Climate action

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Climate action

Life below water

14

Marine resources

High-performance sherbet-like ice-making system: SIS-HF®

9

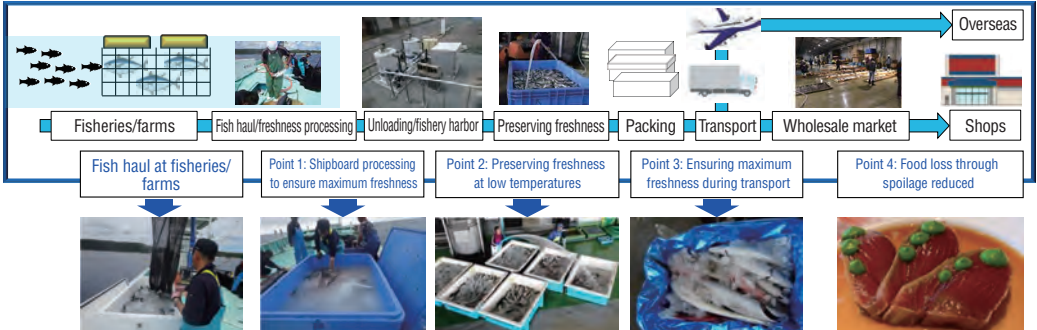
Industry, innovation, infrastructure

14

Life below water

Ice-making system that uses the supercooling phenomenon to produce sherbet-like ice that is as fine as snow

SIS-HF® uses the ice-making technology used for heat storage we acquired through HVAC systems development. The system aims to achieve effective use of declining aquatic resources and increase profits for fishers by transporting very fresh aquatic products as is. SIS-HF® has been implemented by Hirado-Uoichiba Co., Ltd., JF MISAWA, JF IWAKI CITY, JF-Kuji, Tsuji suisan Co., Ltd., and Zengyoren Hachinohe Shokuhin Co., Ltd.



SIS-HF®: Super Ice System for HIGH FRESHNESS  
Patent No. 6339441, Patent No. 6383037, Patent No. 6463399, Patent No. 6480103, Patent No. 6542814, Patent No. 6542815, Patent No. 6612904

Energy-saving type dehumidifier: WINDS® series

7

Affordable and clean energy

9

Industry, innovation, infrastructure

13

Climate action

Greatly reduces energy consumption and costs in the supply of dry air for rechargeable battery manufacturing processes

The WINDS® series products are low dew point dehumidifiers that supply dry air with a dew point temperature of between -50°C and -70°C to a DRY ROOM®. The original dehumidification flow and optimal design technologies contribute to reduced energy consumption in a DRY ROOM®.

- Energy-saving type dehumidifier: WINDS®
- High-performance energy-saving type dehumidifier: WINDS®-II
  - A high-performance dehumidifier that has just a single-stage rotor, but achieves dehumidification performance comparable to that of a two-stage rotor dehumidifier
- Low-temperature regeneration type dehumidifier: WINDS®-III
  - This can supply dry air with a regeneration temperature of 80°C or less, which is a far lower temperature than that of conventional dehumidifiers (regeneration temperature: 140°C)
  - Up to 60% reduction in energy consumption versus conventional dehumidifiers is made possible by utilizing unused low temperature exhaust heat at less than 90°C

WINDS®: W-rotor Innovational New-Dehumidify-System  
Patent No. 5390242, Patent No. 5570717, Patent No. 5576619, Patent No. 5587571, Patent No. 5681379, and more

Energy-saving effect of WINDS®-III

	Conventional dehumidifiers	WINDS®-III
Thermal source	Electric heater	Unused exhaust heat
System configuration		
Regeneration temperature	140°C	80°C
Energy cost reduction percentage per year	Standard	60% reduction

[Main calculation conditions] Dew point: Air supply < -50°C, air return -30°C  
Air flow ratio: Air return/air supply = 90%

Outside air conditions: Standard weather data of Tokyo  
Refrigeration machine COP: 4.0

Low floor type floor outlet air conditioning system: LUFT®

7

Affordable and clean energy

11

Sustainable cities and communities

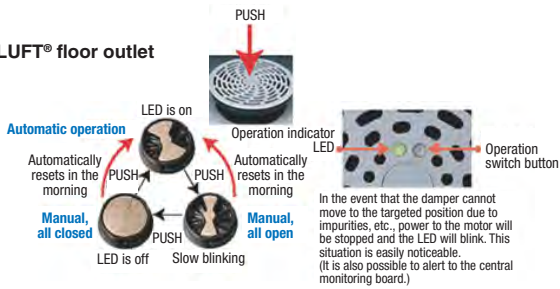
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Climate action

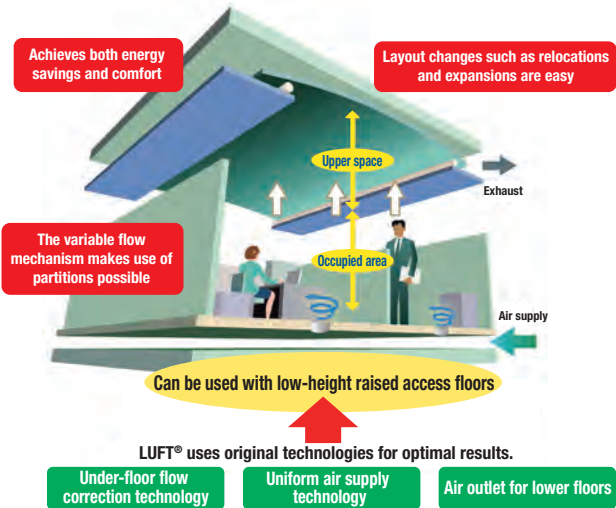
Energy-savings for office buildings using low-height raised access flooring, reducing energy use for air conditioning by 36%

LUFT® is an original floor outlet type air conditioning system designed by Takasago Thermal Engineering. This HVAC system accommodates raised access floor heights of 100mm or less (under floor height limit of 50mm). It addresses the challenges of reduced floor-to-ceiling height which could impose limitations on renovation construction and achieves a comfortable space while minimizing feelings of confinement from low ceilings.

LUFT® floor outlet



LUFT®: Lower Under Floor Air Conditioning System of TAKASAGO  
Patent No. 4430436, Patent No. 4528009, Patent No. 4929198



ケミカルワッシャー® T-GET®C

7

Affordable and clean energy

9

Industry, innovation, infrastructure

11

Sustainable cities and communities

13

Climate action

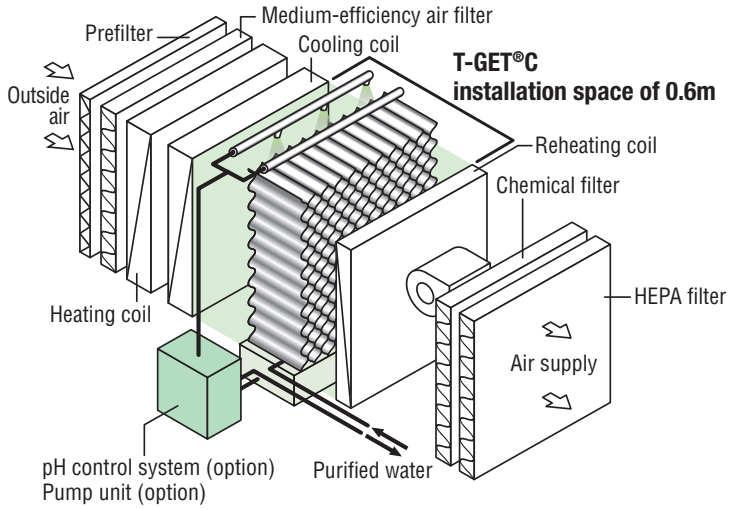
The industry-leading original device to remove soluble gas: ケミカルワッシャー®

ケミカルワッシャー® is an air washer installed on outdoor air processing units in order to prevent gaseous pollutants contained in the outside air from infiltrating the clean room. Compared to the conventional units, T-GET®C can minimize the pressure loss by 60% and unit length by 50%, which in turn makes it possible to reduce blower force and space required for installation.

Removal performance

Removal performance (annual average value)	
Ammonium ions NH <sub>4</sub> <sup>+</sup>	90%
Sulfate ions SO <sub>4</sub> <sup>2-</sup>	85%

T-GET®C: Takasago Gas Eliminator  
Patent No. 4616976, Patent No. 4642559, Patent No. 4757765



Super clean ionizer: IRISYS®

9

Industry, innovation, infrastructure

World-leading adoption of light irradiation method including soft X-rays and vacuum ultraviolet

IRISYS® is an ideal system for the removal of electrostatic in liquid crystal panel manufacturing, where the size of the glass substrates used is increasing, and in manufacturing processes for hard disk media, which are increasing in areal density.

There are two methods for removing electrostatic, to allow the electrostatic to escape via a ground connection and to neutralize it with ions. The grounding method cannot be used in manufacturing processes for electronic components, which are transported in cassettes made of insulators such as ceramics and plastic. The only effective method is ion neutralization using an ionizer.

IRISYS®: Irradiation Ionizing System  
Patent No. 4633524, Patent No. 5032827, Patent No. 5723099, Patent No. 5760290, Patent No. 5927665, Patent No. 6255183

IRISYS®-SX (model: ISX-224)  
Soft X-ray irradiation electrostatic removal device

A powerful tool in any manufacturing environment for the general atmosphere



IRISYS®-UV (model: IUUV-303)  
Vacuum ultraviolet irradiation electrostatic removal device

For use in special environments such as inert gases and reduced pressures



Clean dry air supplying equipment: CDASS®

7

Affordable and clean energy

9

Industry, innovation, infrastructure

13

Climate action

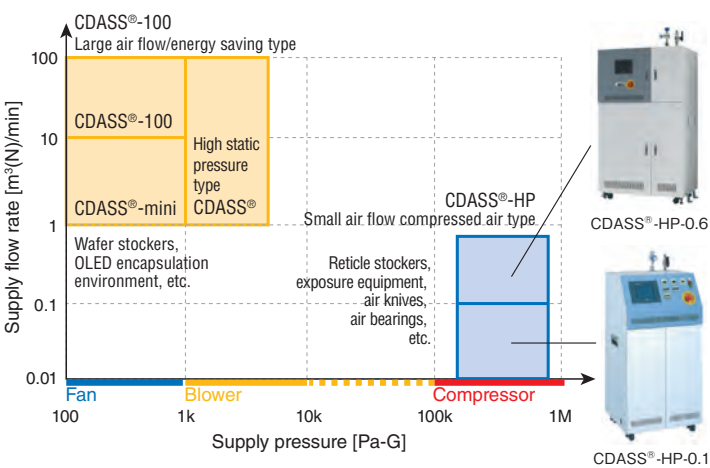
Reduced energy consumption and costs through appropriate pressure and flow rates

The CDASS® supplies clean dry air (CDA) to the manufacturing equipment and wafer handling systems in advanced manufacturing processes such as those for semiconductors, in order to protect the products from the moisture and molecular contaminants in the air, which can adversely affect the manufacturing.

The use of CDA as an alternative to nitrogen gas is expanding as manufacturing costs are lower for CDA than that of nitrogen gas, and there is also no danger of suffocation.

- CDASS®-100
- CDASS®-mini
- CDASS®-HP

Application scope of CDASS® series



CDASS®: Clean Dry Air Supply System  
Patent No. 4754358, Patent No. 4990443, Patent No. 5409279, and more



Upper mounted displacement air diffuser: FLOORMASTER®

FLOORMASTER® enables maximum use of your floor space

TMES Co., Ltd.

In addition to reducing energy consumption when using the displacement ventilation and thermal stratification method for cooling, FLOORMASTER® is a new kind of air outlet which is unique because it removes the need to install air outlets on the floor.

There is no need for a damper switch for either cooling or heating.

Image of air current

Temperature distribution when cooling is on (air current simulation)

Temperature distribution when heating is on (actual measure values)

Installation example of FLOORMASTER®

Two-stage rotor type displacement ventilation air conditioning system

Reducing energy consumption by approximately 40% with a combination of a sensible heat exchanger and total heat exchanger

TMES Co., Ltd.

The system is ideal for displacement ventilation systems with a small sensible heat ratio, such as for theaters, concert halls, and lecture halls. During the post-cooling reheating of the air supply, an air-to-air rotary-type sensible heat exchanger is used to utilize the exhaust heat of the return air. Energy use reduction is also achieved in the efficiency of the total heat exchanger as well, because cooling capacity obtained from the sensible heat exchanger is applied to the exhaust of the total heat exchanger.

- No energy is necessary for reheating
- The enthalpy before the cooling coil goes down, which reduces the burden on the coil

System configuration

Aluminum plated static type sensible heat exchanger: CROSSTERM®

A crossflow static type sensible heat exchanger with aluminum plate that has extremely low leakage rates

TMES Co., Ltd.

CROSSTERM® is a static crossflow type sensible heat exchanger with aluminum plates which recovers sensible heat from the exhaust to the air supply through two adjacent plates.

- A high-temperature exchange efficiency is achieved
- Almost no air leakage between the exhaust and air supply
- Can be used at temperatures from -40°C to 90°C (with the condition that the condensation water does not freeze), with special spec for use to a maximum of 200°C
- There are no moving parts, making maintenance easy

External appearance of the component

System image

Spot air conditioners without drains

Featuring no need for drainage of water outside the system

NIPPON PMAC Co., Ltd.

RES Q (AQP14BA) is an automatic cooling and heating unit that is effective for strengthening the air conditioning in sections where the ducts and piping cannot be extended and for increasing air conditioning in places which have not previously been air conditioned.

The spot cooling floor air conditioner without drainage (ASC40BA) has four wheels, making installation and movement easy. It features the evaporation of drainage water so cumbersome emptying of a drainage tank is not required. It also has an auxiliary heating function that does not exist in conventional spot air conditioners, allowing it to be used during multiple seasons or when it is slightly cold.

Air flow image

During cooling operation

Spot cooling floor air conditioner (ASC40 type)

Fan coil system with heat pump: PAFMAC

Simultaneous cooling and heating operation with a dual-pipe hot/cold water system

NIPPON PMAC Co., Ltd.

This is a hybrid, individual distributed type air conditioner that combines a fan coil unit (FCU) and a water source heat pump. Due to its central heat source method, the unit can perform heating in the summer and cooling in the winter in the same way as with a four-pipe hot/cold water system, even on buildings with air conditioning equipment that is changed with the seasons. Furthermore, it reduces the work time required for renovation.

PAFMAC unit configuration

Winner of the Second Prix of "HVAC & R JAPAN Award 2018" in the Safety and comfort innovation category

PAFMAC: PMAC and Fancoil Module Air-conditioner Cassette

Drain slime inhibitor: エイジークリーン®

Using the antibacterial effect of silver ions to prevent leakage accidents caused by slime

NIPPON PMAC Co., Ltd.

エイジークリーン® (Ag clean) is an effective antibacterial which prevents the occurrence of slime\*, which can cause drain leakage accidents on air conditioning equipment.

By adopting our original elution method, the stable elution of silver ions at the concentration necessary and sufficient for an antibacterial effect has become possible. Furthermore, the product is compact and flexible, so it can easily be installed and retrieved from gaps such as the draw-off piping, which is installed as standard on air conditioners. Dismantling is not necessary on many machine models.

\*Slime: Viscous masses formed of the secretions, etc., of bacteria and mold

- Proven and stable antibacterial effect
- Easy installation and retrieval
- The guideline target for replacement is once every cooling season (24 hours x 6 months)

エイジークリーン® (left: for 5.0kW cooling capacity, right: for 2.5kW cooling capacity)



Measures for BIM and the introduction of IT in construction

Quality and production improvements through effective utilization of BIM/IT in construction management work

We promote BIM (building information modeling) and accelerate our efforts in taking advantage of IoT technologies in order to promote innovation in construction technologies and construction management.

- Establishment of a BIM promotion  
With a dedicated organization which drives BIM/IT utilization, we are further accelerating the promotion of the IT-enabling of work management, which we have been addressing since the 1980s, and striving for further quality and productivity improvements in construction systems.
- Using BIM to make optimum plans for equipment and construction  
We use CAD 3D model planning and execution information. This information then is used for consensus-building with easy-to-understand presentations, as well as calculation, simulation, and execution management.
- Operations innovation aiming for work-style reform
- More sophisticated consensus-building and employee education performed with VR/AR systems

Patent No. 5074328, Patent No. 5073610, Patent No. 5301921, Patent No. 5210744, Patent No. 5064309

BIM use cases

Adoption of aluminum refrigerant plumbing system

Changing the material for refrigerant plumbing systems from copper to aluminum, achieving 28% reduction in CO<sub>2</sub> emissions and contributing to the development of a decarbonized society

- Overview of aluminum refrigerant plumbing systems
  - Aluminum refrigerant plumbing
  - Mechanical joints for aluminum refrigerant plumbing (Alumi Ozon-kun)
  - Branched pipe units for aluminum refrigerant plumbing
  - Brazing method for aluminum refrigerant plumbing

The above components combine to form a system called an aluminum refrigerant plumbing system.

- Purpose of adoption
  - Contribution to the development of a decarbonized society  
We intend to achieve an 85% recycling rate for aluminum piping, and a 28% reduction in CO<sub>2</sub> emissions compared to using copper piping.

Winner of the 36th Excellent Energy-Saving Equipment Award  
"Chairperson's Special Award of Japan Refrigeration Air Conditioning Equipment Industry Association"

Patent pending, application No. 2019-141905, application No. 2019-143742

Aluminum refrigerant plumbing

Branched pipe units for aluminum refrigerant plumbing

Construction of mechanical joints for aluminum refrigerant plumbing

Brazing method for aluminum refrigerant plumbing

Labor saving construction method for refrigerant piping works: エルブレイズ® (method of construction) (localized nitrogen substitution construction method)

New construction method for anti-oxidation measures for use with brazed connections of refrigerant plumbing

As an anti-oxidation measure for brazed connections of refrigerant plumbing, a batch nitrogen substitution construction method has conventionally been adopted. This new construction method reduces labor in refrigerant piping works by approximately 80% by adopting partial nitrogen substitution.

- Simulation of change in nitrogen gas retention (pipe size: 28.58mm)  
Start of encapsulation  
After 20 seconds  
Oxygen  
Nitrogen

Patent エルブレイズ® (method of construction) (pipe joining method):  
Patent pending, application No. 2017-110789, application No. 2019-002567  
Patent エルブレイズ® (method of construction) (specified tools for putting holes in copper pipes):  
Patent pending, application No. 2018-192482

System summary image

The method can be supported with a small nitrogen gas tank

エルブレイズ® (method of construction) (specified tools for putting holes in copper pipes) \*patented

Subway station air conditioning load analysis

Air conditioning load software which aids in improvement of HVAC systems in subway stations

Platforms and concourses in subway stations undergo dramatic temperature and humidity changes as large volumes of air enter therein via tunnels and from aboveground in the course of train operations. This situation raises the technical problem of the difficulty of forecasting air conditioning load. Entrusted from the East Japan Railway Company, we Takasago Thermal Engineering have developed a new software package which forecasts this air conditioning load in subway stations simply and with high precision. Using environmental measurement and computational fluid dynamics (CFD) analyses, the software reproduces temperature, humidity, and air quantity of inflow/outflow through subway stations via tunnels with high precision. Furthermore, it calculates thermal load, heat income and outgoing balances of air conditioning spaces which have been divided into blocks, thus allowing detailed analyses and forecasts of changes in indoor cooling load for each air conditioning zone.

Winner of the 2013 Nikkei Global Environmental Technology, Awards for Excellence (East Japan Railway Company) and Special 2017 R&D Award

Patent No. 6222649

CFD analysis example of train-induced wind draft (when a train enters the station)

Development of air conditioners for train operators (new model of the Azusa/TRAIN SUITE Shikishima)

Development of air conditioners for train operators (crew compartments)

Crew compartments on trains have had to make do with air conditioners from major electronics manufacturers which were developed over 20 years ago. The reasons are believed to be that in a very small market in which there are only two crew compartments per train, it has not been possible for large electronics manufacturers to engage in new development of such units in a manner that takes evolution over time into account.

At Takasago Thermal Engineering, we have been working for the past several years to find new markets for heat pump based air conditioning technologies. In the course of sustained day-to-day sales inquiries as to whether businesses were inconvenienced in the matter of air conditioning, and offering to develop air conditioners to suit their situations, our efforts in this regard came to the attention of the East Japan Railway Company, which gave us the commission to develop air conditioners for their trains.

Installation image of air conditioners for train operators

排水レスフラッシング® method

A system that flushes without any water drainage, contributing to reductions of the burden on the environment

This construction method makes it possible to perform flushing without draining water from the system, with the flushing water treatment system removing suspended matter such as welding debris and by purifying the water in the pipeline. This is an environmentally-friendly construction method as pollutants such as zinc contained in the flushing water are not released into the environment.

- Environmentally-friendly construction technology because the contaminant matter is not discharged
- Great reductions in the work needed for supplying and draining water, etc., for system flushing
- Achieving reductions in the flushing process control work and in the costs

Winner of the 31st "Technology Promotion Award" by the Society of Heating, Air-Conditioning and Sanitary Engineers of Japan  
Winner of the 16th "Environmental and Equipment Design Award" by the Association of Building Engineering and Equipment

Patent No. 6105220, Patent No. 6113997, Patent No. 6285504, Patent No. 6524032

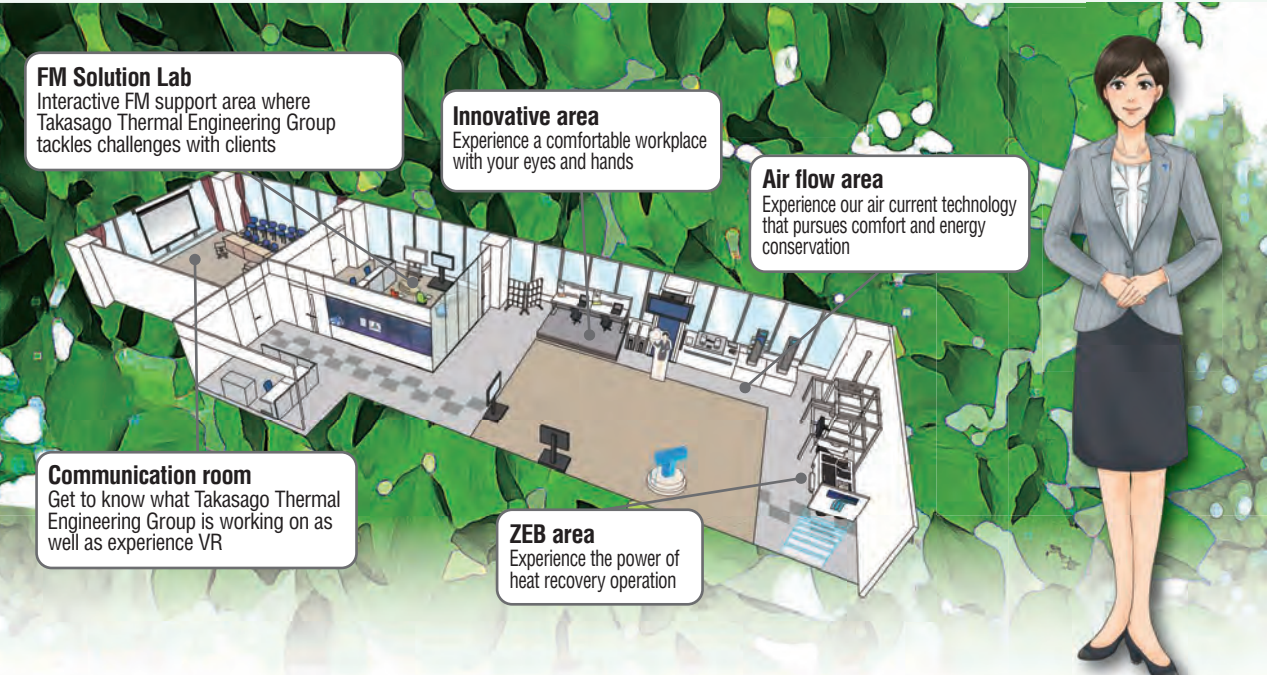
Flushing water treatment system (coagulation sedimentation format)



A place for communication between the Takasago Thermal Engineering Group and our customers

# GreenAir® Plaza

3-1-1 Kyobashi, Chuo-ku, Tokyo Inside Kyobashi Environmental Station, Tokyo Square Garden 6F  
Hours of opening: 10:00 to 17:00 (Closed Saturdays, Sundays, national holidays, and New Year period) TEL 03-5204-2030 FAX 03-3241-7140



In this section, we present the technologies and services of the Takasago Thermal Engineering Group



## Exhibition space

This space holds experiential exhibitions of such environmental technologies as the Takasago Net Zero Energy Building (ZEB) system, the SWIT® circulatory flow inducement-type layered air conditioning system, and drainless heating/air conditioning floor-mounted spot air conditioning.



## Communication room

In this communication place, we listen to the concerns our customers have regarding facilities and systems, and devise solutions. You can experience VR here as well.



## GreenAirPlaza.com

At GreenAirPlaza.com, we provide exhibit descriptions, seminar information, and FM solution information. We invite you to visit the site at <https://www.greenair-plaza.com>

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