Utilization and Evaluation of PECS in a Research Facility Office in Japan

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Waseda University

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T Innovation Center

Takasago Thermal Engineering WASEDA University

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T Innovation Center

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Location	Tsukubamirai-city, Ibaraki, Japan
Hight	2-story building (15.5m)
Target office	2nd floor with Activity Based Working (ABW)
Floor Area	Office building: 4,750m^2 Laboratory building: 6,050m^2
Energy System	Groundwater heat exchange Wood biomass heat and power supply system (CHP) PV panels 200 kW Battery power storage 4,600kWh

Certification in 2020 (5 stars, Nearly ZEB)

Certification in 2020 (Gold)

Certification in 2020 (Superior (S) rank)

ASHRAE Technology Award 2024 (Commercial Building, New), Second Place

Planning of the Research Facility

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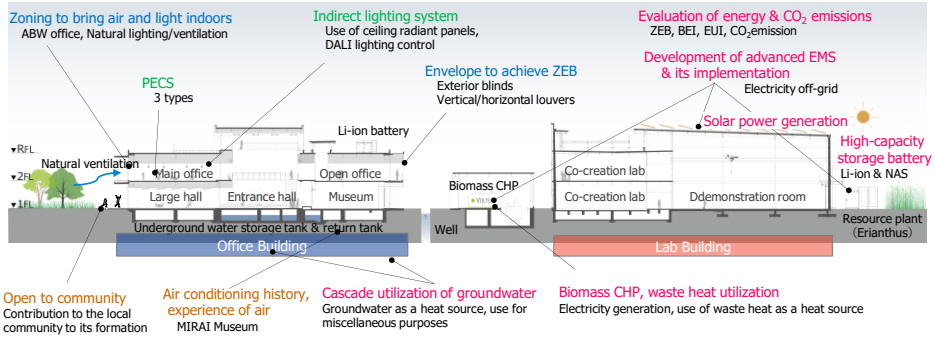

ABW: Activity-Based Working
DALI: Digital Addressable Lighting Interface
BEI: Building Energy Index
CHP: Combined heat and power
EMS: Energy Management System

1. Architectural plan
2. Heat source & energy plan
3. Indoor environmental planning
4. Contribution to the community & transfer of technology

Net Zero Energy

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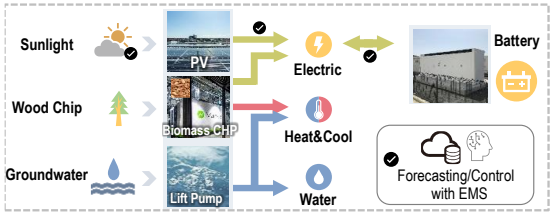
Wood biomass gasification CHP（Biomass CHP）
Wood chip-fueled combined heat and power system

Major issues to achieve net zero in the future ➡ the introduction of large-scale renewable energy and off-grid energy



Additional batteries installed for the effective use of renewable energy after the construction completion

Net Zero Energy

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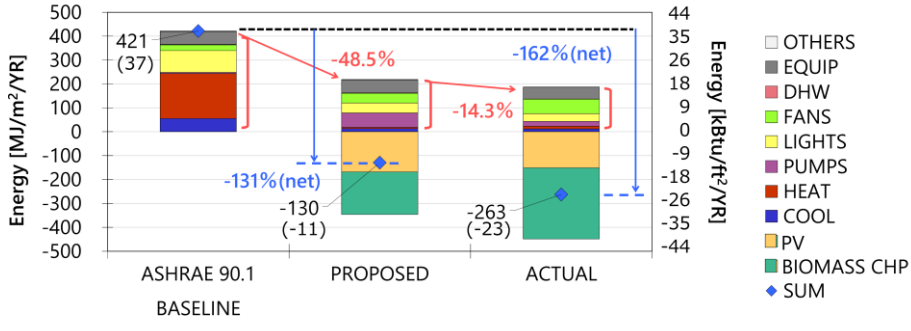
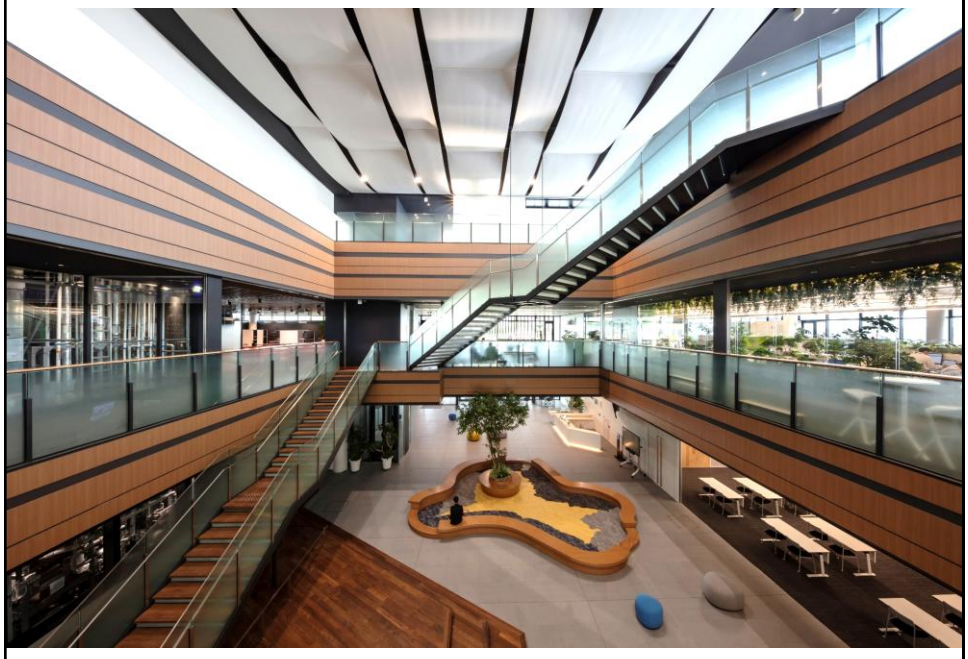


✓ **The actual 2021 records showed a 162% reduction from the baseline value. (Simulations based on ASHRAE90.1_2010)**



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Three Types of PECS

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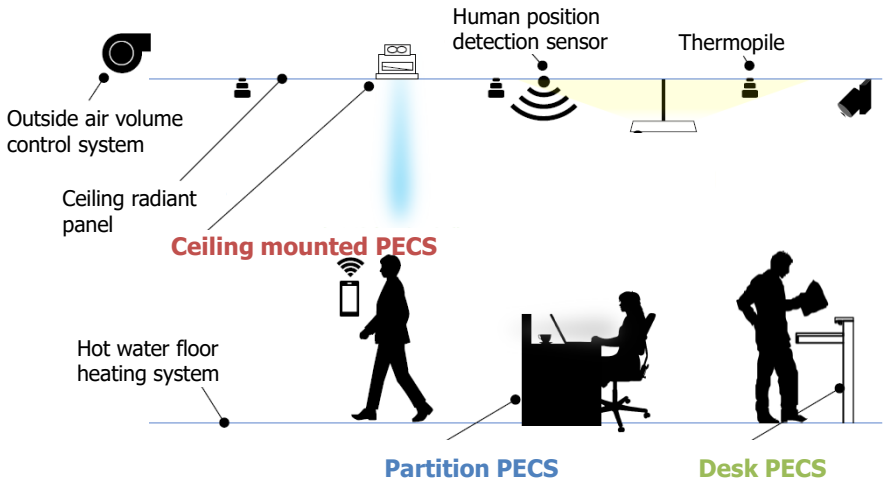

Energy Efficiency: using groundwater as a cold heat source in summer and exhaust heat from biomass CHP as a heat source in winter

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Ceiling installed PECS

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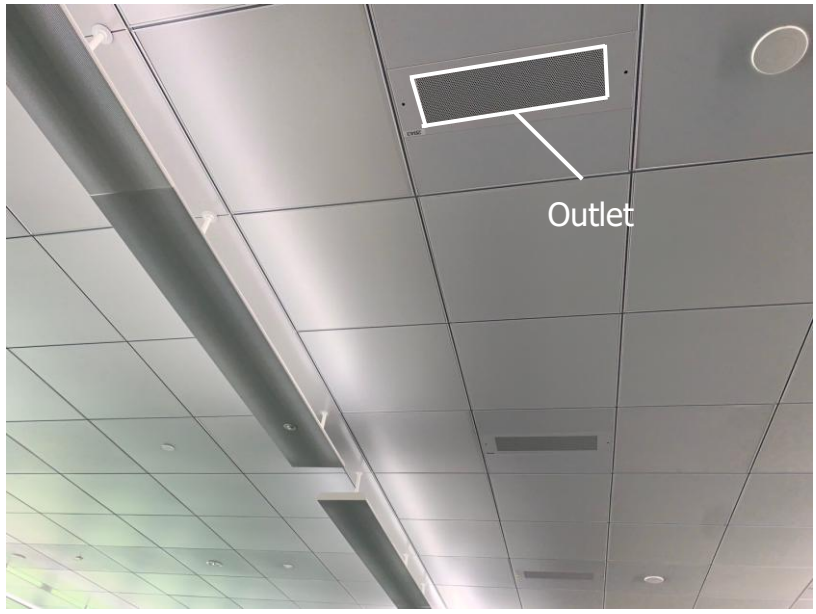

Ceiling installed PECS

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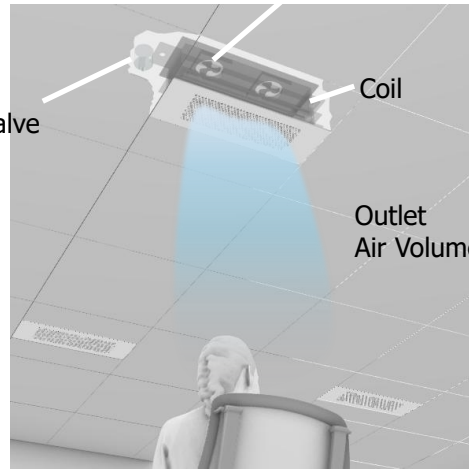

Cooling capacity 470W

Partition PECS

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Partition PECS

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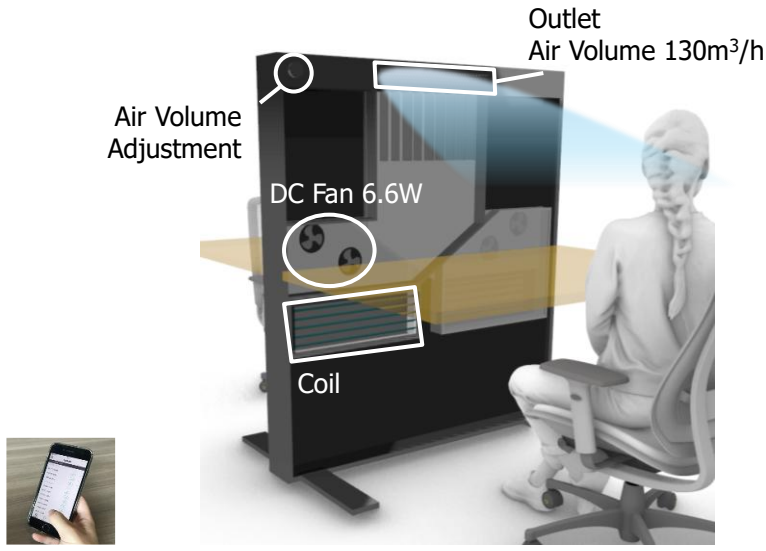

Cooling capacity 150W

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Desk PECS

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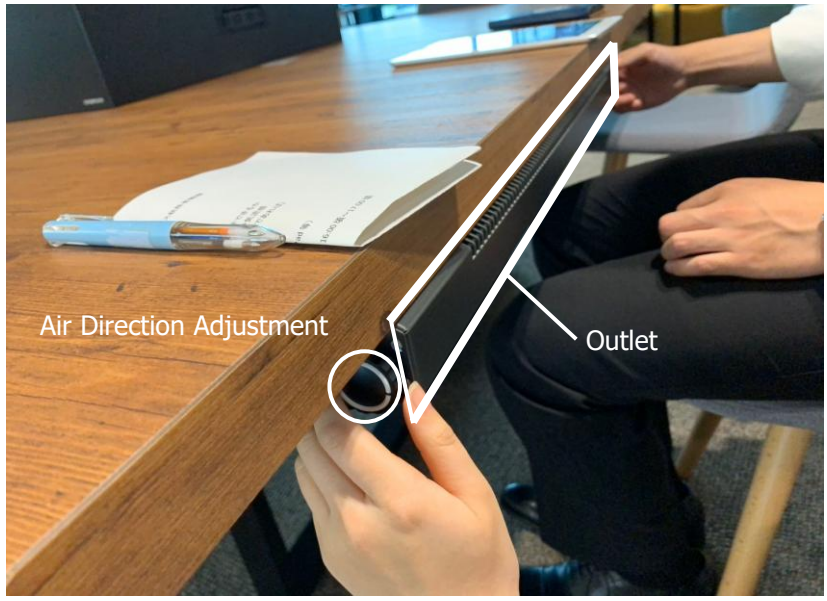

Desk PECS

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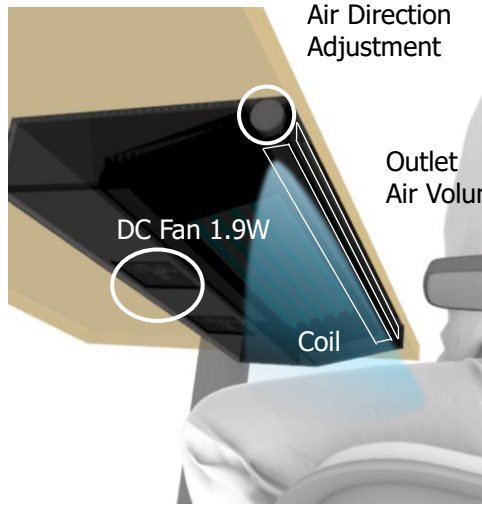

Cooling capacity 70W

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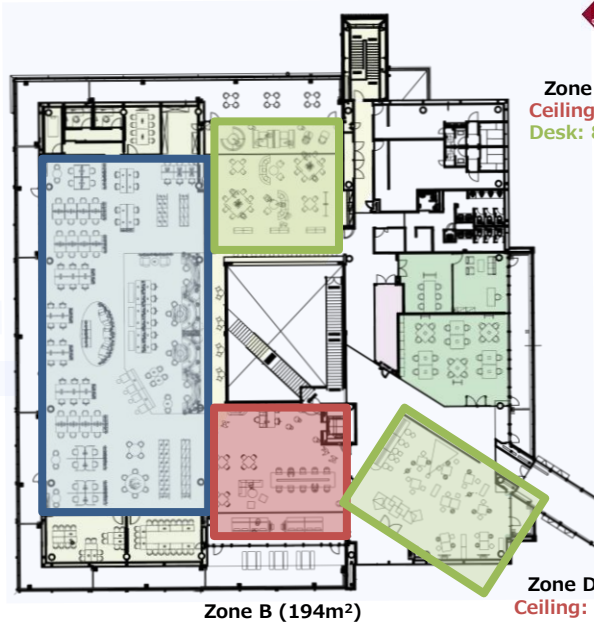

Zone A (634m²)
Ceiling: 57 units
Partition: 30 units
Desk: 28 units

VIEW

Zone C (204m²)
Ceiling: 36 units
Desk: 8 units

Zone B (194m²)
Ceiling: 34 units
Partition: 10 units
Desk: 18 units

Zone D (274m²)
Ceiling: 38 units

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Season Usage Rates of PECS

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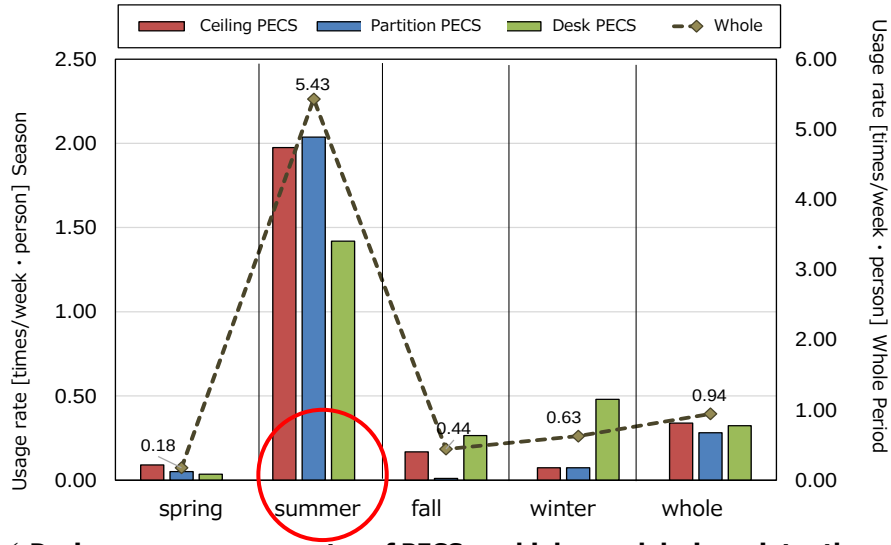

✓ **During summer usage rates of PECS are higher and during winter they use desk type PECS for warming.**

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Daily Usage Rate of PECS

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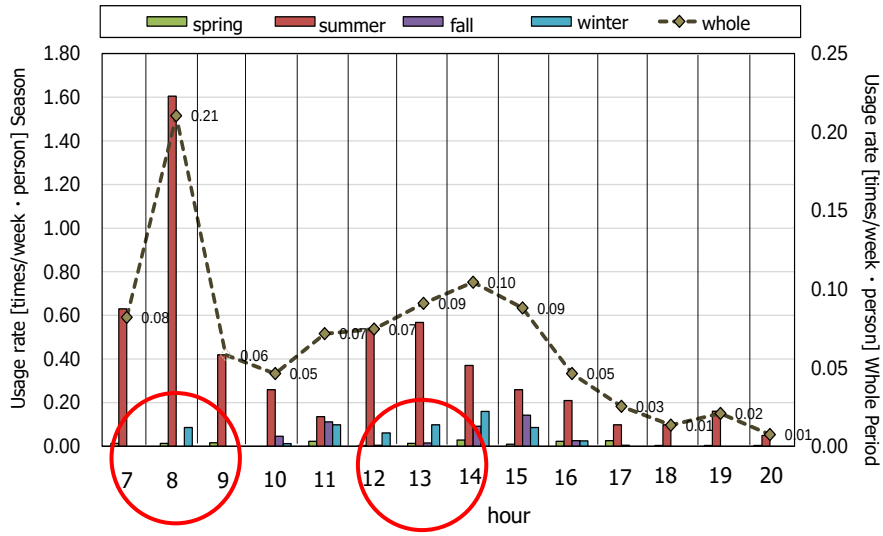

✓ **More use in the morning and after lunch due to high metabolic rate.**

Ambient Thermal Conditions

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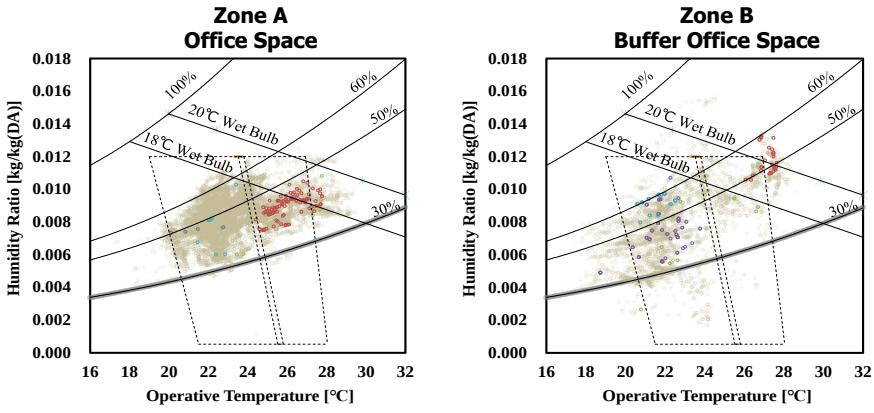

: w/o PECS
: Spring with PECS
: Summer with PECS
: Fall with PECS
: Winter with PECS

✓ **In office space (Zone A), they use PECS in the morning and after lunch due to high metabolic rate.**

✓ **Buffer office space (Zone B), they use PECS to compensate thermal sensation.**

Percentage of Satisfied

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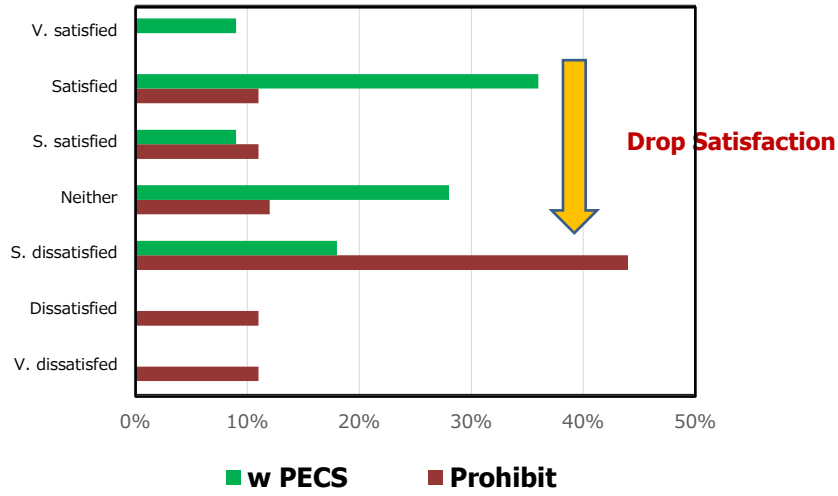

We prohibit to use PECS system during certain period.

Conclusions

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T Innovation Center opened in January 2020

- ✓ In office building unit net Zero Energy and Emission were achieved during 2021.
- ✓ Three types of PECS are installed in the different area.
- ✓ System specifications are described.

Usages of PECS are investigated

- ✓ During summer usage rates of PECS were higher and during winter they use desk type PECS for warming.
- ✓ They used PECS more in the morning and after lunch due to high metabolic rate.
- ✓ In office space (Zone A), they used PECS in the morning and after lunch.
- ✓ Buffer office space (Zone B), they used PECS to compensate thermal sensation.

We prohibited to use PECS system during a certain period.

- ✓ Percentage of dissatisfied significantly increased w/o PECS.

Acknowledgments

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