DAIKIN

Perfecting the Air

Carbon Neutrality Solution:

Healthy and Energy Efficient Air Conditioning(AC) system for ASEAN market

Feb 13, 2025

Daikin is Comprehensive Air Conditioning(AC) Manufacturer

Company name	Daikin Industries, Ltd.
Founded Established	October 25, 1924 (Founder : Akira Yamada) February 11, 1934
Chairman President	Masanori Togawa (Chairman and CEO) Naofumi Takenaka (President and COO)
Capital	85 billion Yen (FY2023)
Employees	98,162
Annual Sales	4.4 trillion Yen (FY2023)
Group Companies	349 Consolidated Subsidiaries (31 in Japan, 318 overseas)
Head Office	Osaka, Japan

Founded in **1924**
100 Years of History

People-Centered Management

100+
Production Bases
In the World

¥4.4 trillion
Overall Sales

Business Development
in **170+**
Countries

84%
of Daikin Sales are
from outside Japan

Comprehensive AC Manufacturer
handling both
AC and refrigerants

98,000+
Employees

PICHONKUN

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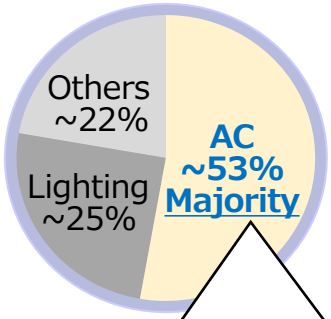
Agenda

1. Quick review of Daikin activity at CEFIA
2. Vietnam verification
3. Building air tightness updates
4. Summary

1. Quick review (1) Market

1.Change after covid-19 pandemic

1)Energy consumption of AC is increasing due to the increased ventilation by covid-19



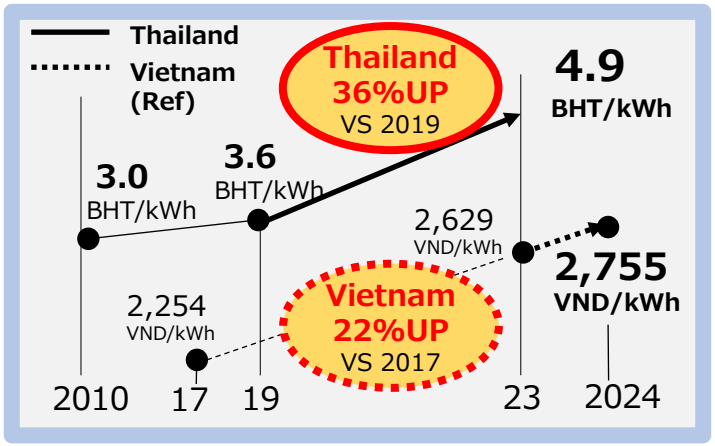
Condition
- Thailand
- 10 person office
-- Sunny daytime during summer
- Covid-19 ventilation
amount 30 m³/h per capita

Cooling load breakdown

Ventilation ~45% | People, lights, outdoor air ~55%

Increased ventilation rates by Covid-19

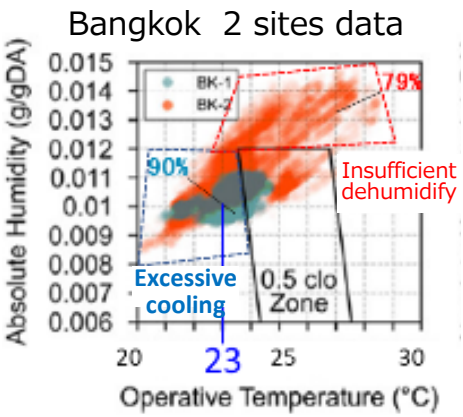
2) Energy bills are also rising due to unstable international situation.



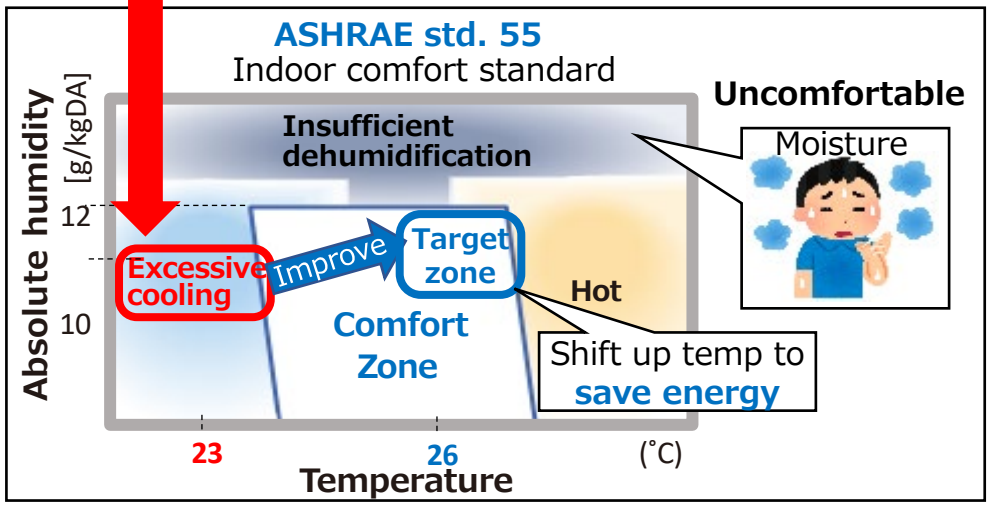
2.Excessive cooling culture in ASEAN

1)AC temp. setting is low at office. ex:23 degree, wearing jacket.

If we can change this culture, big energy saving is achieved.



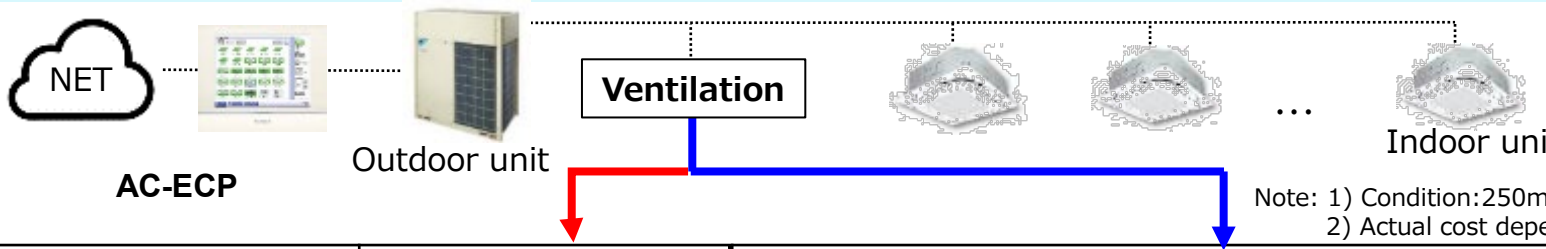
Source
Yuta Fukawa, Ryota Murakami, Masayuki Ichinose, Field study on occupants' subjective symptoms attributed to excessive cooling environments in air-conditioned offices in hot and humid climates of Asia, Build. and Environ. 195 (2021) 2,5.



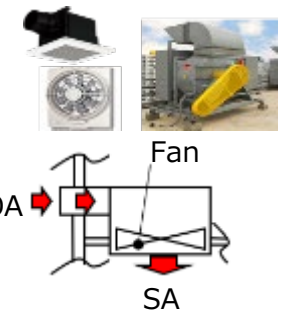
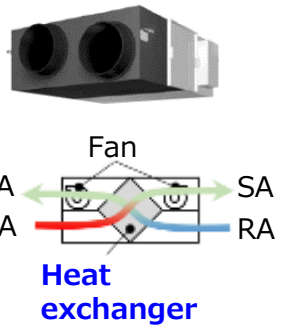
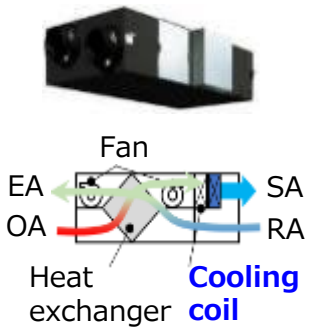
1. Quick review (2) Daikin Proposed "AC-ECP" as CN Solution

AC-ECP:Air conditioning system with excessive cooling protect

1.Promote ventilation and AC that can simultaneously achieve energy saving and comfort.
2.Replace normal ventilation with energy recovery ventilation, ERV, reducing the load of heat and moisture from the outside air, making it comfortable even at 26℃ degree.



Note: 1) Condition:250m2 office area.
2) Actual cost depends on project site.

Ventilation type	Normal ventilation	AC-ECP		
	No energy recovery	Energy Recovery Ventilation (ERV)		
	System A	System C	System D	System E
	 Unprocessed outside air is supplied.			 -CO2 demand control -Positive pressure control
AC set temperature	23 ℃	26 ℃		
Comfort	Excessive cooling	Within ASHRAE std55 comfort zone		
	No	Between NO & YES	Yes	
AC capacity	18 HP	12 HP		

Cost index

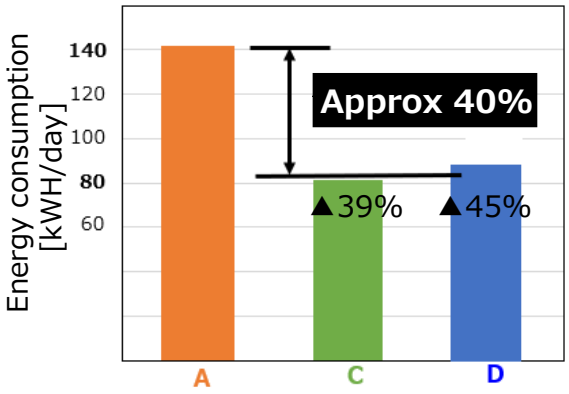
Energy	100%	66%	66%	53%
Equipment(AC, Venti)	100%	75%	99%	101%

Down sizing of AC to almost offset ERV

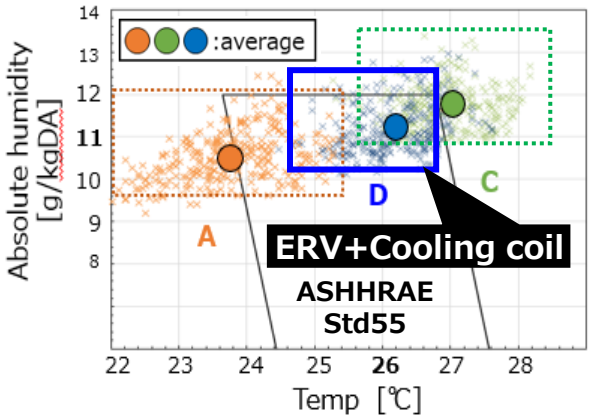
1. Quick review (3) past Result

5th–6th CEFIA, DK reported verification results in Thailand.

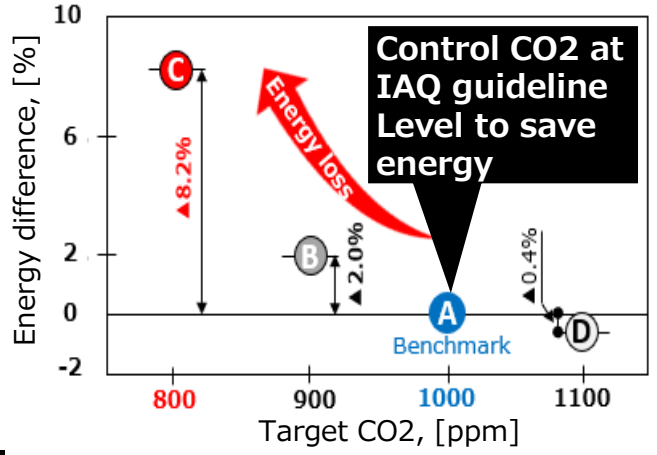
1)Energy/CO2 reduction~40%



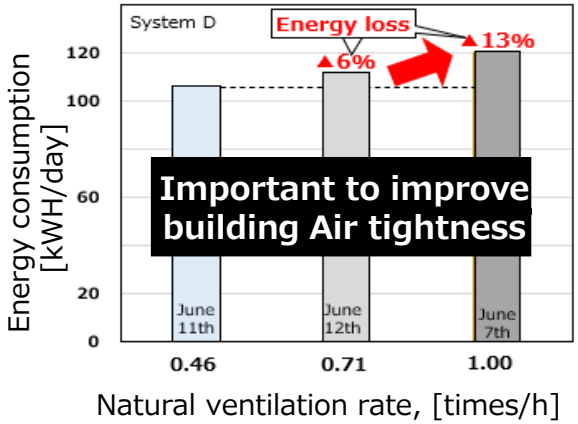
2) Pattern D is the most comfort



3)Impact of target CO2 on energy



4)Impact of natural ventilation (air tightness) on energy



5)Expected CO2 reduction impact

	Total VRF stock (2008-2023)		Annual energy consumption	Number of Thermal power generator (natural gas)		kt-CO2/year reduction
	K unit	K HP	G WH/year	Without AC-ECP	With AC-ECP 40% reduction	
				unit	unit	
Thailand						663
Vietnam						628
Indonesia						464
Singapore	157	1,040	2,200			419
Philippines	98	1,180	1,580	7.5	3.0	300
Malaysia	82	980	1,320	6.3	2.5	251
ASEAN total	**892**	**10,700**	**14,300**	**68.1**	**27.2**	**2,724**

ASEAN total 2700kt-CO2/year saving

For more detail, visit CEFIA website.

https://www.cefia-dp.go.jp/fp/healthy-and-energy-efficient-ac-system

Today in this 7th, CEFIA, DK update result not only Thailand but also Vietnam case.

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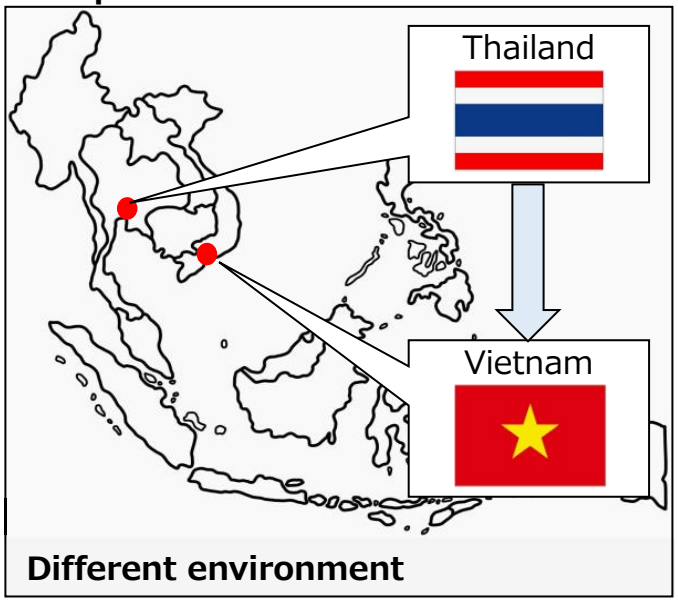
Agenda

1. Quick review of Daikin activity at CEFIA
2. Vietnam verification
   - Definition comfort zone in Vietnam & excessive cooling
   - Summary of verification condition difference against Thailand
   - Verification result for dry season
3. Building air tightness updates
4. Summary

2. Vietnam verification

1.Expand "AC-ECP" to Vietnam to verify under different environment.
2.Work with Ho Chi Minh City University of Technology in regard to academic aspect.
3.We have started verification at Daikin service call center in Ho-Chi-Min in July 2024.

1. Expansion to Vietnam



Different environment

2.Work with local university

Ho Chi Minh City Univ of Technology

Department:
Heat and Refrigeration Engineering

3.Verification site

Ho Chi Minh City

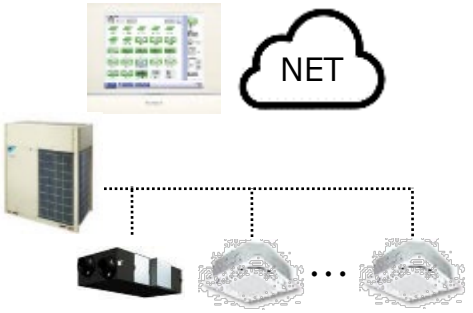
Daikin Service Call Center @38F

[Target office area]
-Office area:350m2
-Ceiling height:3.0m
-50～85 staff

Application difference

Vietnam	**Call center**
Thai	General office

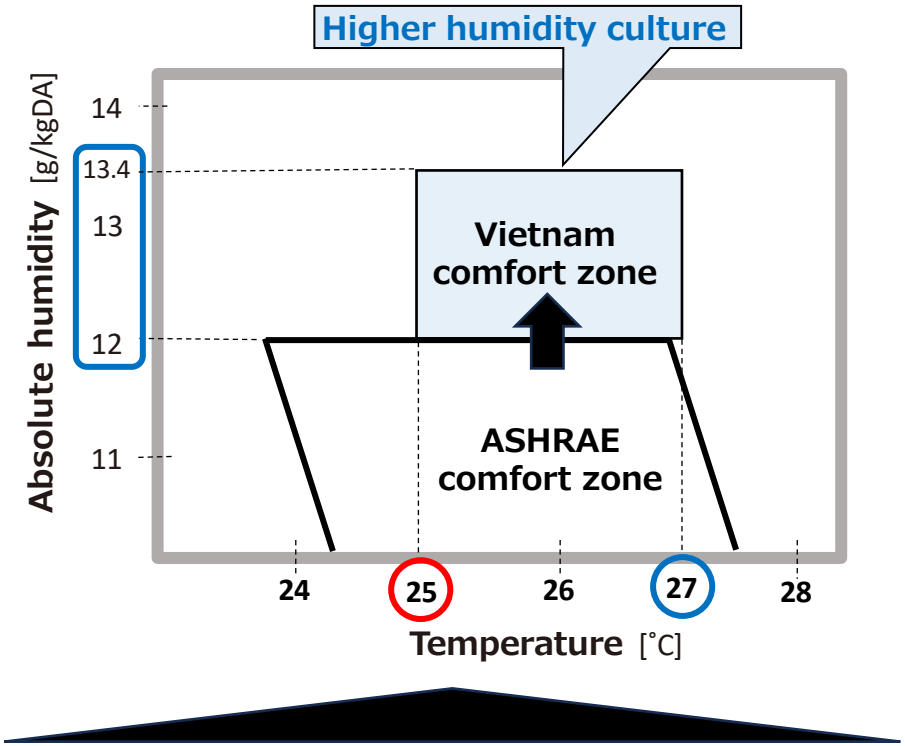
AC-ECP system



Definition comfort zone in Vietnam & excessive cooling

1.Vietnam comfort std (TCVN5687-2040); accept higher humidity than ASHRAE std 55.
2.Daikin marketing data in Ho-Chi-Min, show some excessive cooling(less than 25℃).
3.We will shift up temperature around 27℃ (humidity ～13g/KgDA)

1. Vietnam comfort culture

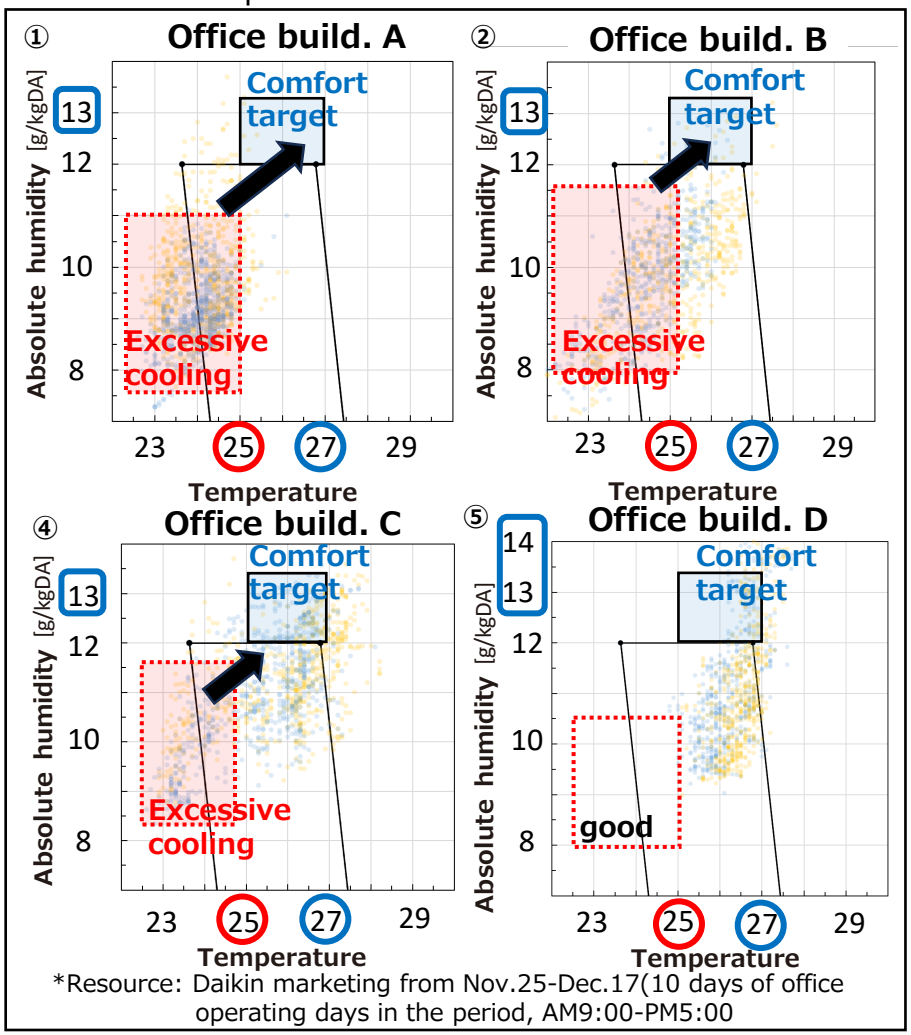


Vietnam standard for comfort TCVN5687-2024

	Temp [℃]	Humidity	
		Relative [%]	Absolute [g/KgDA]
Vietnam TCVN5687-2024	25-27	60-70	**RH60%:11.9(25℃)-13.4(27℃)** RH70%:13.9(25℃)-15.7(27℃)

2.Daikin marketing data for Ho-Chi-Min office (n=4)

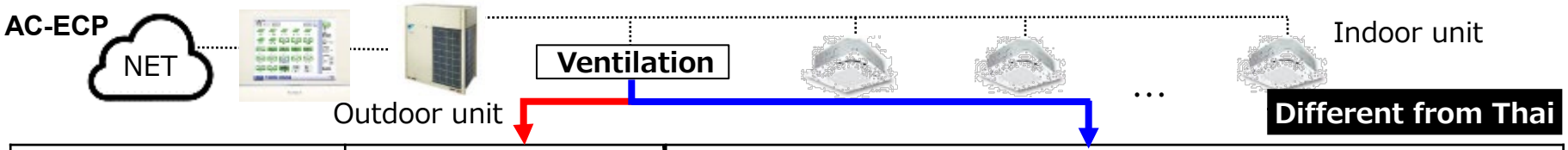
Actual operation data at customer site



*Resource: Daikin marketing from Nov.25-Dec.17(10 days of office operating days in the period, AM9:00-PM5:00

Summary of verification condition difference against Thailand case

Three major points are different from Thailand verification.
① Normal ventilation, system A:AC set temp in Thai was 23℃, but in Vietnam, 25℃
② AC-ECP, system C,D,E:AC set temp in Thai was 26℃, but in Vietnam, 27℃
③ Running cost index: In Vietnam, it is 2% higher than Thailand case.



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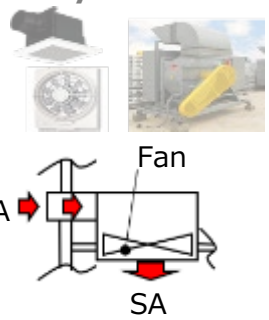
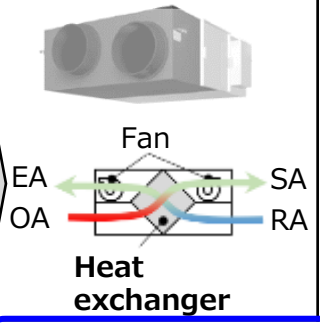
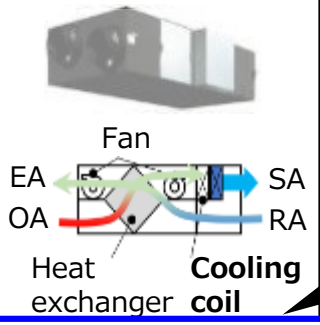
				 Optimized control
AC set temperature	Less than 25 ℃	27 ℃		
Comfort	Excessive cooling	Vietnam comfort std		
	No	Between NO & YES	Yes	
AC capacity	38 HP	26 HP		

①Thailand: 23℃

②Thailand 26℃ ASHRAE std 55

③ 2% energy cost higher than Thailand

Cost index

Energy	100%	68% → 66%	68% → 66%	55% → 53%

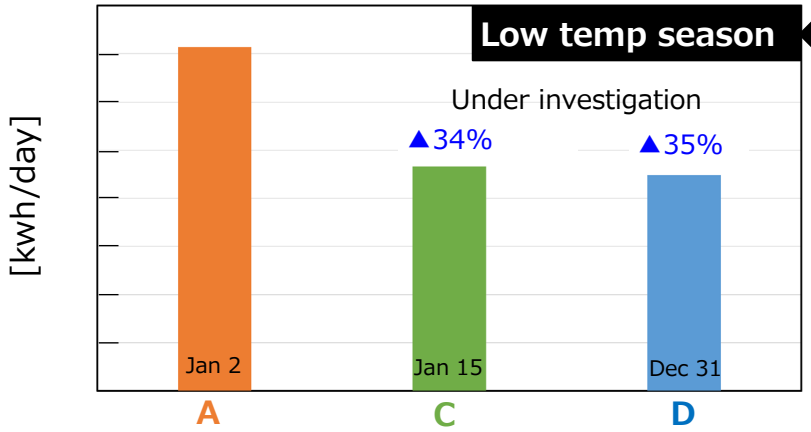
Note: 1) Condition:350m2 office area.
2) Actual cost depends on project site.

Verification result for dry season

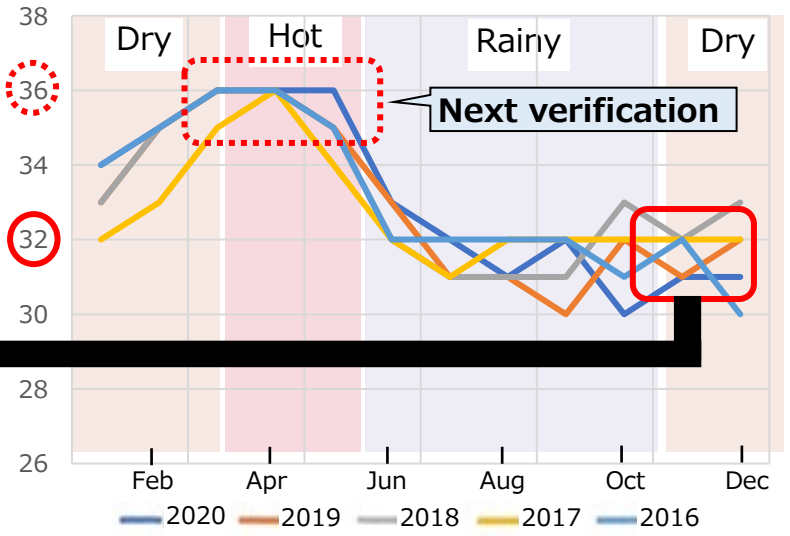
A: Conventional Natural ventilation, C: ERV only, D: ERV with cooling coil

1. Dry season is actually low temperature season in Ho-Chi-Min. So preliminary result.
2. Graph 1: Approx 30% of energy was saved in case of "system C&D" compared to normal ventilation(A).
3. Graph 2: System D is the most comfortable because it is within Vietnam comfort zone.
   System C is partly out of comfort zone:
4. In the hot season, around April, we will verify again and finalize report at next CEFIA.

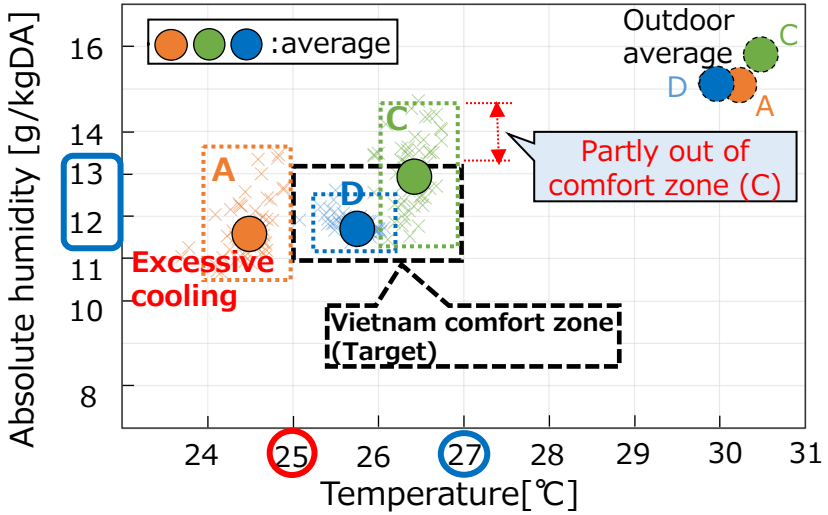
Graph1: Energy consumption per day



- Ho-Chi-Min monthly peak temp ave, ℃

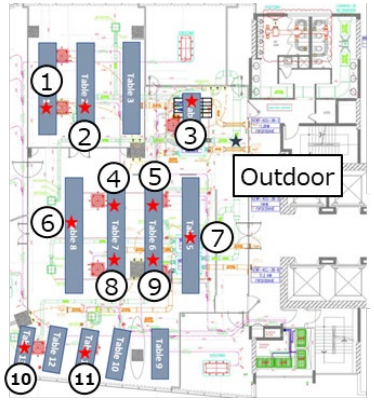


Graph2: Comfort zone by ASHRAE std55



Office layout and sensor location (N=11)

Daikin Call center



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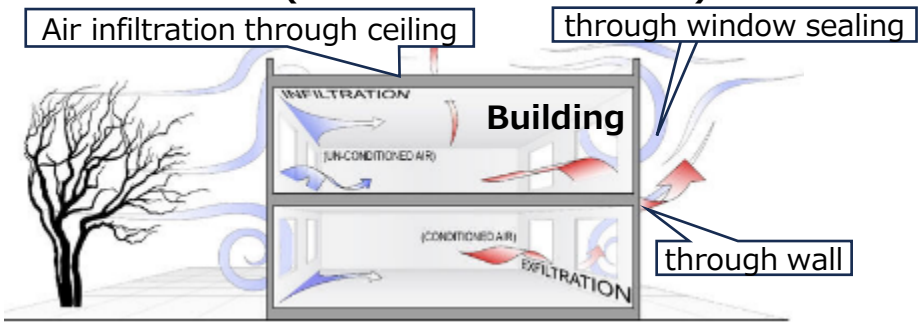
3. Building air tightness update

1. 6th CEFIA: Daikin reported "If air tightness of building is not good, air infiltration (natural ventilation) occur through wall, window sealing,etc, resulting in more energy consumption. Graph 1: shows energy loss increases as natural ventilation rate increases.
2. Daikin made further market research on natural ventilation rate of office building. Graph 2: shows: Old building, no good. Green building(ZEB), good result with 0.1 time/h.
3. Therefore, improving building structure to enhance air tightness is also key for CN.

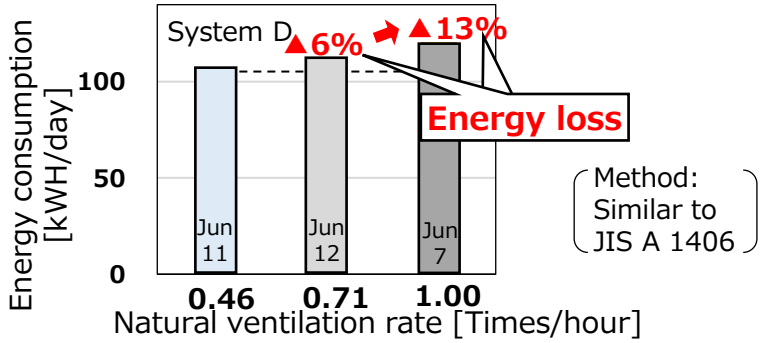
1. 6th CEFIA report

1. Air infiltration (Natural ventilation rate)



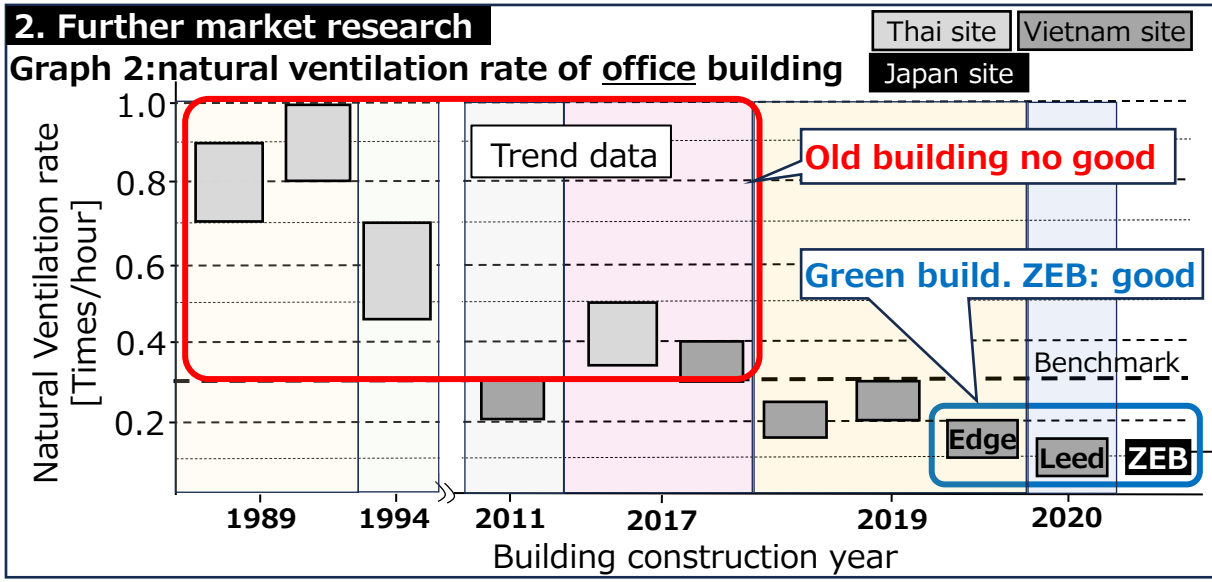
Graph 1:Impact of natural ventilation on energy

As natural ventilation rate increase, energy loss increases.



2. Further market research

Graph 2:natural ventilation rate of office building



<Reference>
Office building photo sample

4. Summary

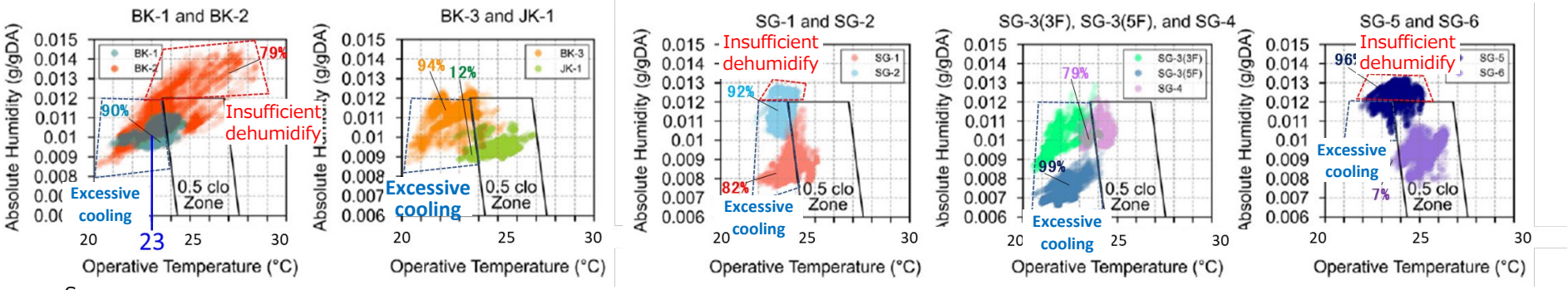
- **Daikin "AC-ECP", contribute to Carbon Neutral(CN) also in Vietnam Ho-Chi-Min in dry season.**

  - **Energy saving is expected approx. 30% , which is smaller than Thailand 40%. It is because Vietnam has different AC culture---Higher humidity is acceptable.**
  - **Further verification will be done in hot season(peak load) around April, 2025 in order to finalize Vietnam result.**

- **Building air tightness trend**

  - **It is no good generally Especially, older building is worse.**
  - **Air tightness should be improved for the Carbon Neutral**

ASEAN cooling culture/market data.



Source
Yuta Fukawa, Ryota Murakami, Masayuki Ichinose, Field study on occupants' subjective symptoms attributed to excessive cooling environments in air-conditioned offices in hot and humid climates of Asia, Build. and Environ. 195 (2021) 2,5.

To be continued at next CEFIA