

› Workshop for Dissemination and Promotion of ZEB (Zero Energy Building) and ZEB Family Concept

LIXIL HOUSING TECHNOLOGY - ASIA

SEIJI OSUGI

OCT 2019

LIXIL Link to
Good Living

INTRODUCTION

PROFILE

- **Name** : Seiji Osugi
- **Birthday** : 19th July 1967
- **Date of Joining** : 1st Apr 1990
- **Work History** Working on the development of core window and high-performance window as a chief engineer not only in Japan but also global market since joining company.



- Development of the most premium window “ WIDE WIN “ for Japan Market in 2007
- Development of the core high insulation window ” SAMOS “ for Japan Market in 2009
- Development of all series of products for China market since 2010
“ TA Window “ “ TD window” ” TE window”
and “ TF window”

ABOUT **LIXIL**

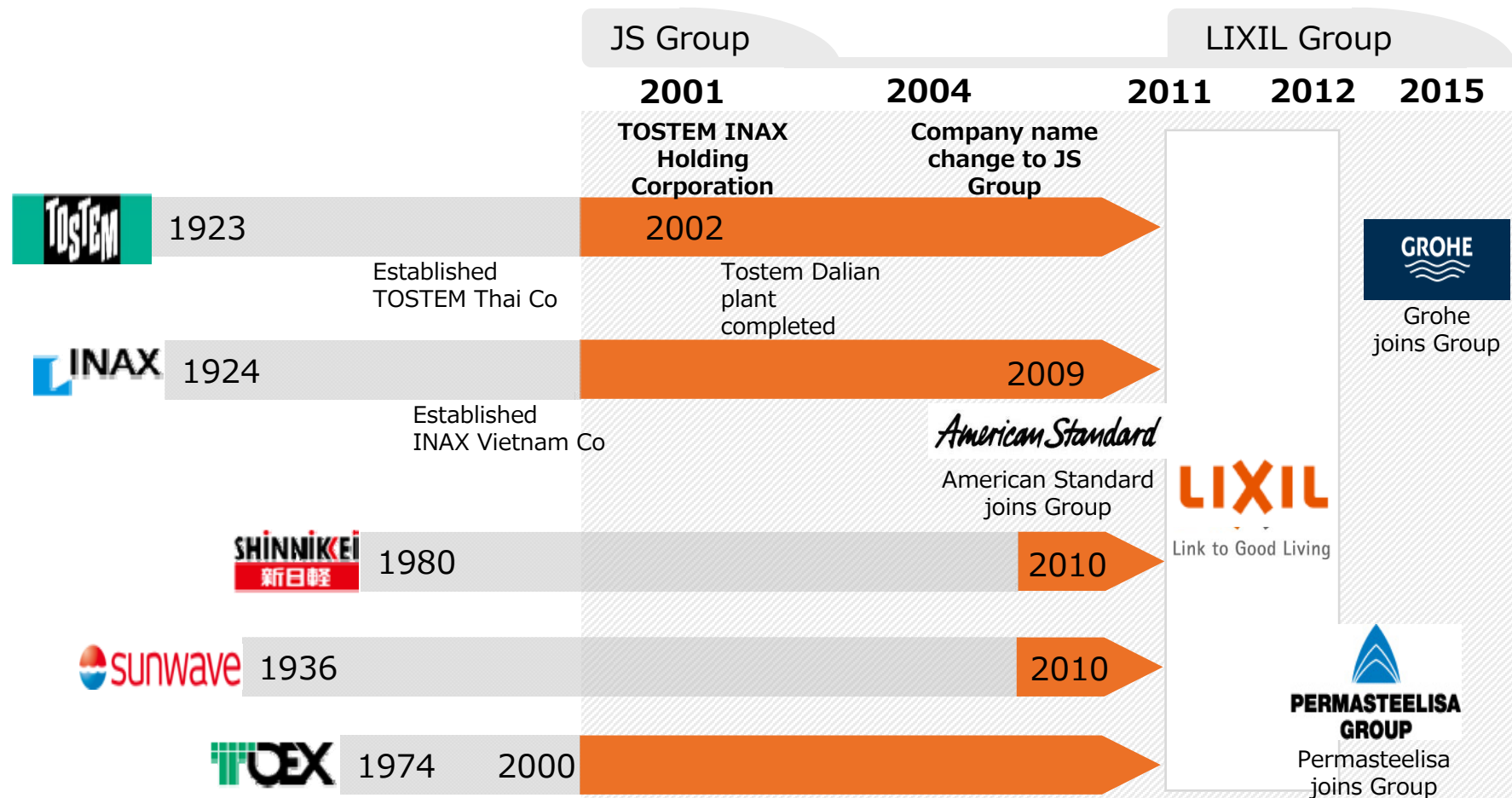
- LIXIL is the most comprehensive and connected global company in the building industry



- Every person on the planet dreams of a better home. LIXIL make that possible with pioneering water and housing products.
- LIXIL is proud that its products touch the lives of more than a billion people every day, but believes it has the potential to still do so much more.

GROUP HISTORY

- Know as LIXIL Group Since 2011, through a merger of 5 companies, LIXIL is positioned as a full service provider of Housing & Building solutions.



LIXIL BUSINESS CATEGORIES

➤ LIXIL is a ¥ 1,668 B business consisting of the following Technology Division



LIXIL Housing Technology

- AL Window / PCV Window
- Entrance Door
- Exterior products
- Wooden products

¥ 535.2 B



LIXIL Water Technology

- Sanitary
- Faucet
- Bathroom
- Exterior / Interior tile

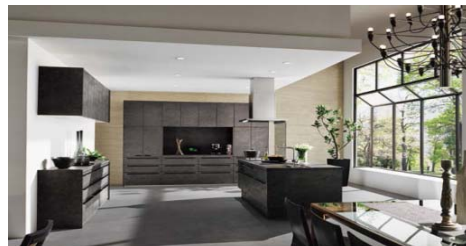
¥ 715.9 B



LIXIL Building Technology

- Curtain wall
- Interior decorating business
- ✂ not include PERMA

¥ 107.0 B

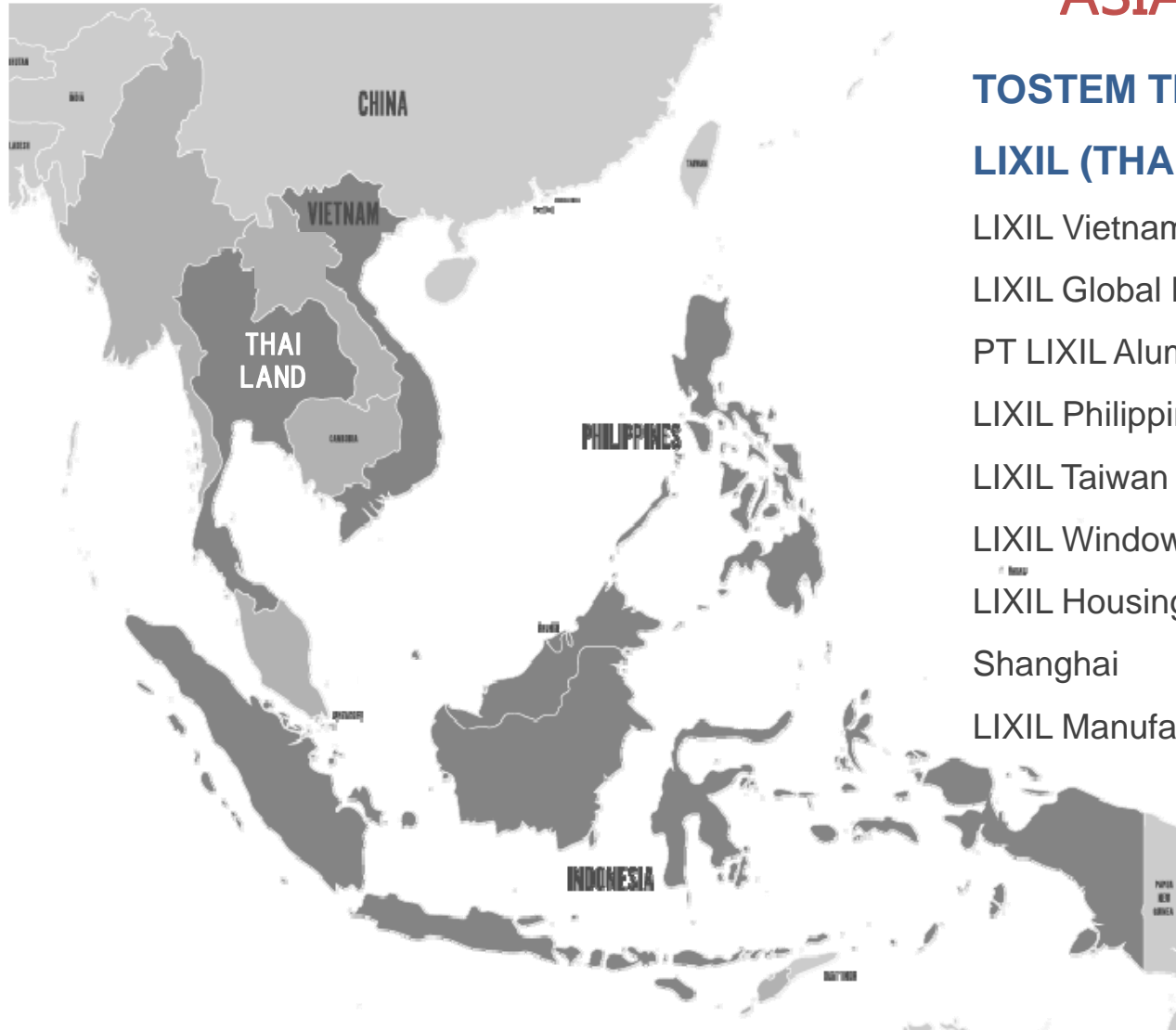


Retail, Housing & Service ,Other

- System Kitchen
- Home Center
- Housing

¥ 345.8 B

OUR LOCATIONS



ASIA -PACIFIC

TOSTEM THAI CO.,LTD.

LIXIL (THAILAND) Public Co.,Ltd.

LIXIL Vietnam Corporation

LIXIL Global Manufacturing Vietnam Co.,Ltd

PT LIXIL Aluminium Indonesia

LIXIL Philippines Ltd. Co.

LIXIL Taiwan

LIXIL Window Systems (INDIA)

LIXIL Housing Products Manufacturing

Shanghai

LIXIL Manufacturing Dalian Cooperation

www.tostem.com

[Facebook.com/tostem](https://www.facebook.com/tostem)



TOSTEM TIMELINE IN THAILAND

1987



Creative Living

Founded TOSTEM THAI Factory

2007



P7

The luxury-design residential line for specialty or high-end residential properties.

2013



WE Series

Launched WE70 and WE40 to anticipate the inner needs of value-minded consumers and mid-range large scale property developers.

2014



Folding Door

Combining smart design profiles and high quality for both luxury residential and commercial projects.

2015



WE-Plus Series

Reshape the needs
of high rise market.

2016



GIESTA

Completing
exceptional low rise
business.

2017



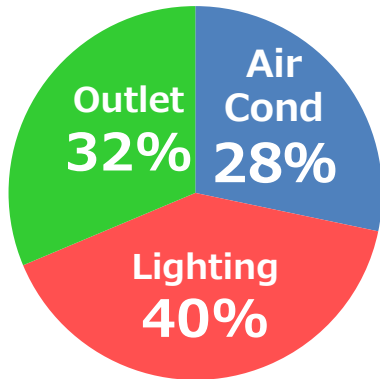
Exterior

Expand exterior business

LIXIL ZEB SOLUTION

Three major energy consumption in buildings

Primary energy consumption of buildings



Energy-saving energy creation methods

2000 MJ/year/m²

natural ventilation
Heat insulation and shielding
 natural lighting

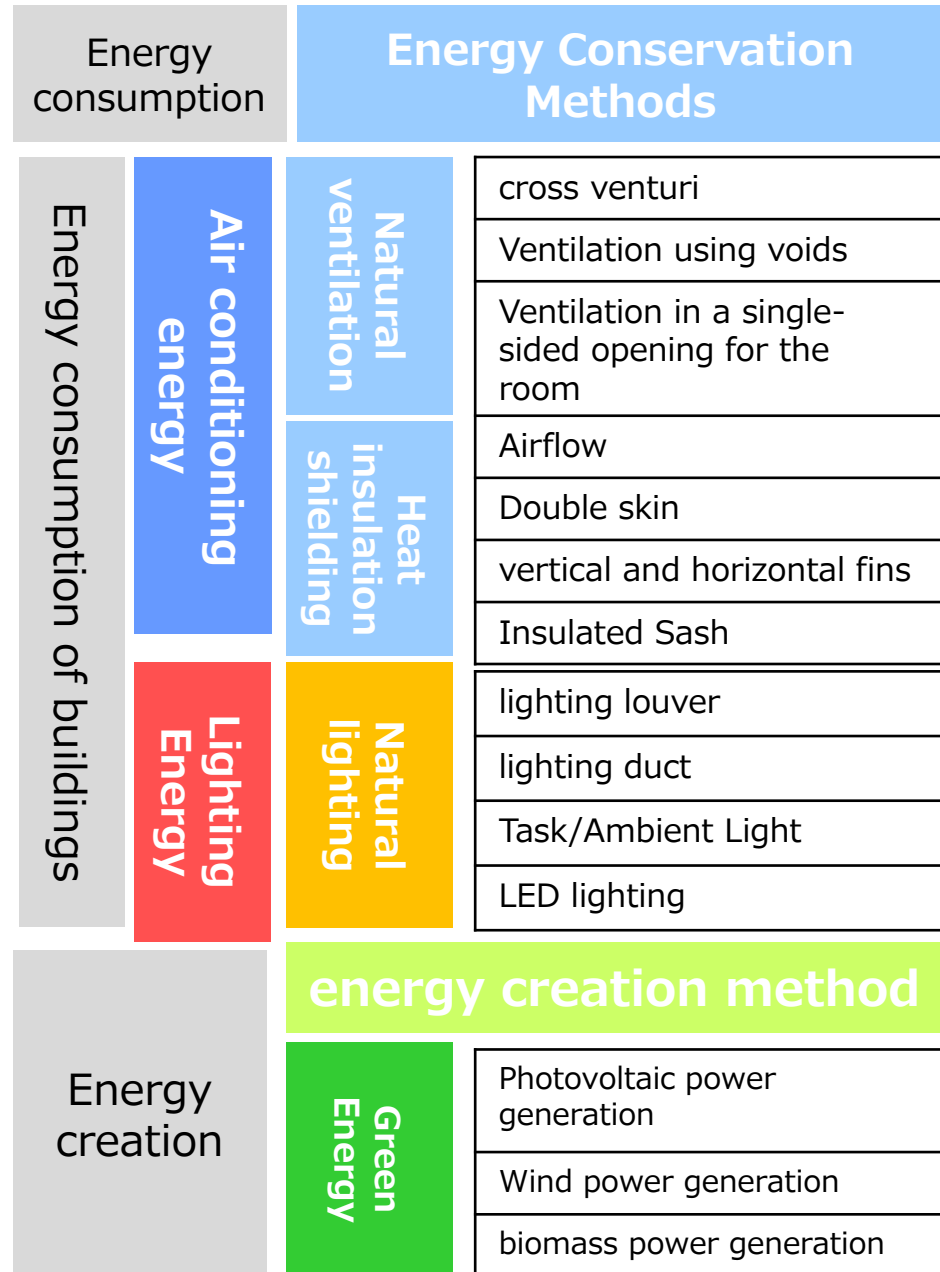
Energy conservation

500 -600 MJ/year/m²

Photovoltaic power generation
 Wind power generation

energy creation

0 MJ/yr/m²

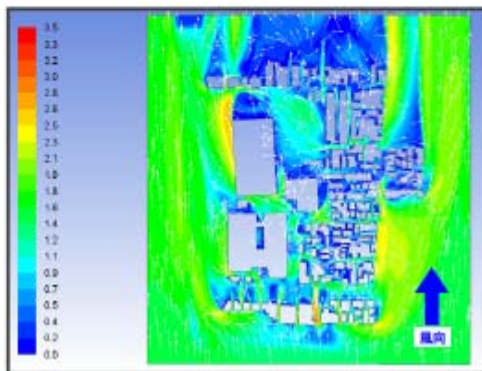
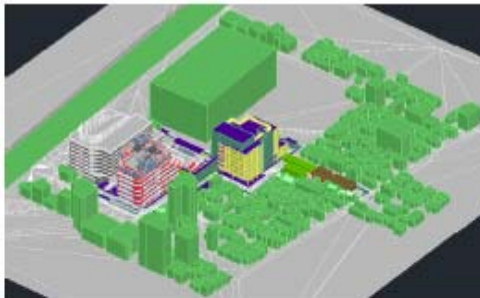


Natural ventilation (CFD analysis considering surrounding environment)

It is important to make a plan for natural ventilation.

- Consideration of the surrounding environment of the construction site
- Consideration of Seasonal Wind Direction based on Weather Data
- Consideration of wind speed by building height

Consideration of the **surrounding environment** of the construction site



Consideration of **wind direction** from meteorological data

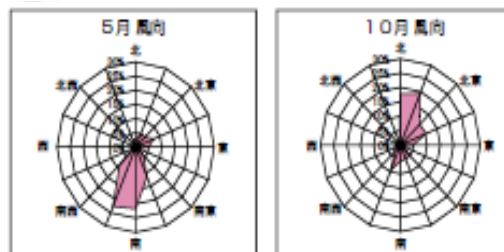
Ambient Temp

| 時間 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 平均 | 最大 | 最小 | |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 1月 | 10.2 | 10.5 | 10.8 | 11.1 | 11.4 | 11.7 | 12.0 | 12.3 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 |
| 2月 | 10.5 | 10.8 | 11.1 | 11.4 | 11.7 | 12.0 | 12.3 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | |
| 3月 | 10.8 | 11.1 | 11.4 | 11.7 | 12.0 | 12.3 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | |
| 4月 | 11.1 | 11.4 | 11.7 | 12.0 | 12.3 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | |
| 5月 | 11.4 | 11.7 | 12.0 | 12.3 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | 21.0 | |
| 6月 | 11.7 | 12.0 | 12.3 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3 | |
| 7月 | 12.0 | 12.3 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3 | 21.6 | |
| 8月 | 12.3 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3 | 21.6 | 21.9 | |
| 9月 | 12.6 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3 | 21.6 | 21.9 | 22.2 | |
| 10月 | 12.9 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3 | 21.6 | 21.9 | 22.2 | 22.5 | |
| 11月 | 13.2 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3 | 21.6 | 21.9 | 22.2 | 22.5 | 22.8 | |
| 12月 | 13.5 | 13.8 | 14.1 | 14.4 | 14.7 | 15.0 | 15.3 | 15.6 | 15.9 | 16.2 | 16.5 | 16.8 | 17.1 | 17.4 | 17.7 | 18.0 | 18.3 | 18.6 | 18.9 | 19.2 | 19.5 | 19.8 | 20.1 | 20.4 | 20.7 | 21.0 | 21.3 | 21.6 | 21.9 | 22.2 | 22.5 | 22.8 | 23.1 | |

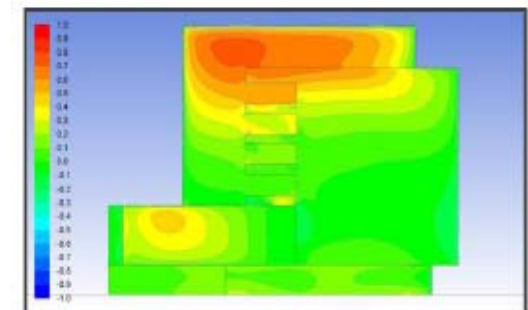
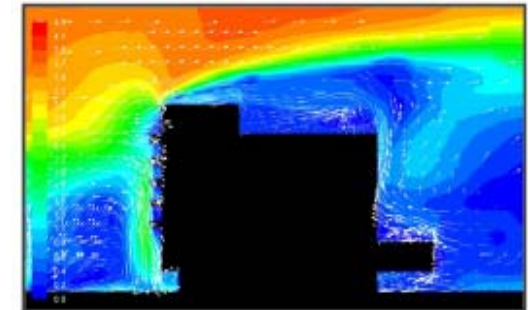
Wind Speed

| 時間 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 平均 | 最大 | 最小 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1月 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 |
| 2月 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 |
| 3月 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 |
| 4月 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 |
| 5月 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 |
| 6月 | 1.7 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 |
| 7月 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 |
| 8月 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 |
| 9月 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 |
| 10月 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 |
| 11月 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 |
| 12月 | 2.3 | 2.4 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 |

Wind Rose



Consideration of **wind speed** by building height

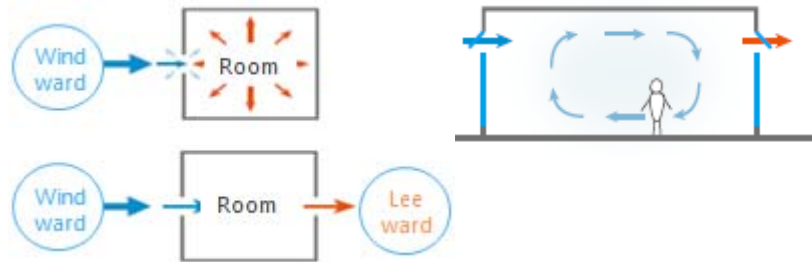


Natural ventilation Method

Choosing the right ventilation method can contribute to energy conservation.

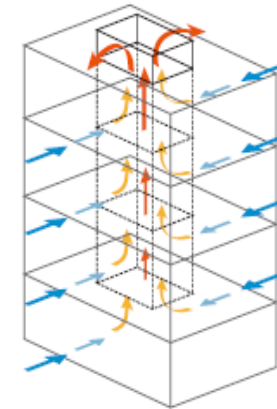
Cross ventilation

Supply air from the windward side and exhaust air from the leeward side.



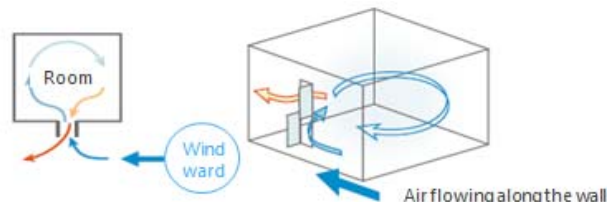
Void type ventilation

Supply air from the exterior wall and exhaust at the top of the void.



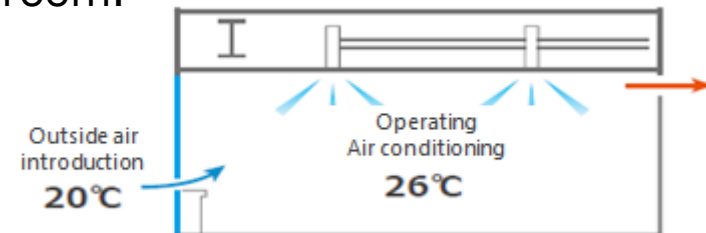
Ventilation for room in a single-sided opening

By attaching casement windows with different opening directions top and bottom, guides wind into the room and exhausts it from the other side to the outside.



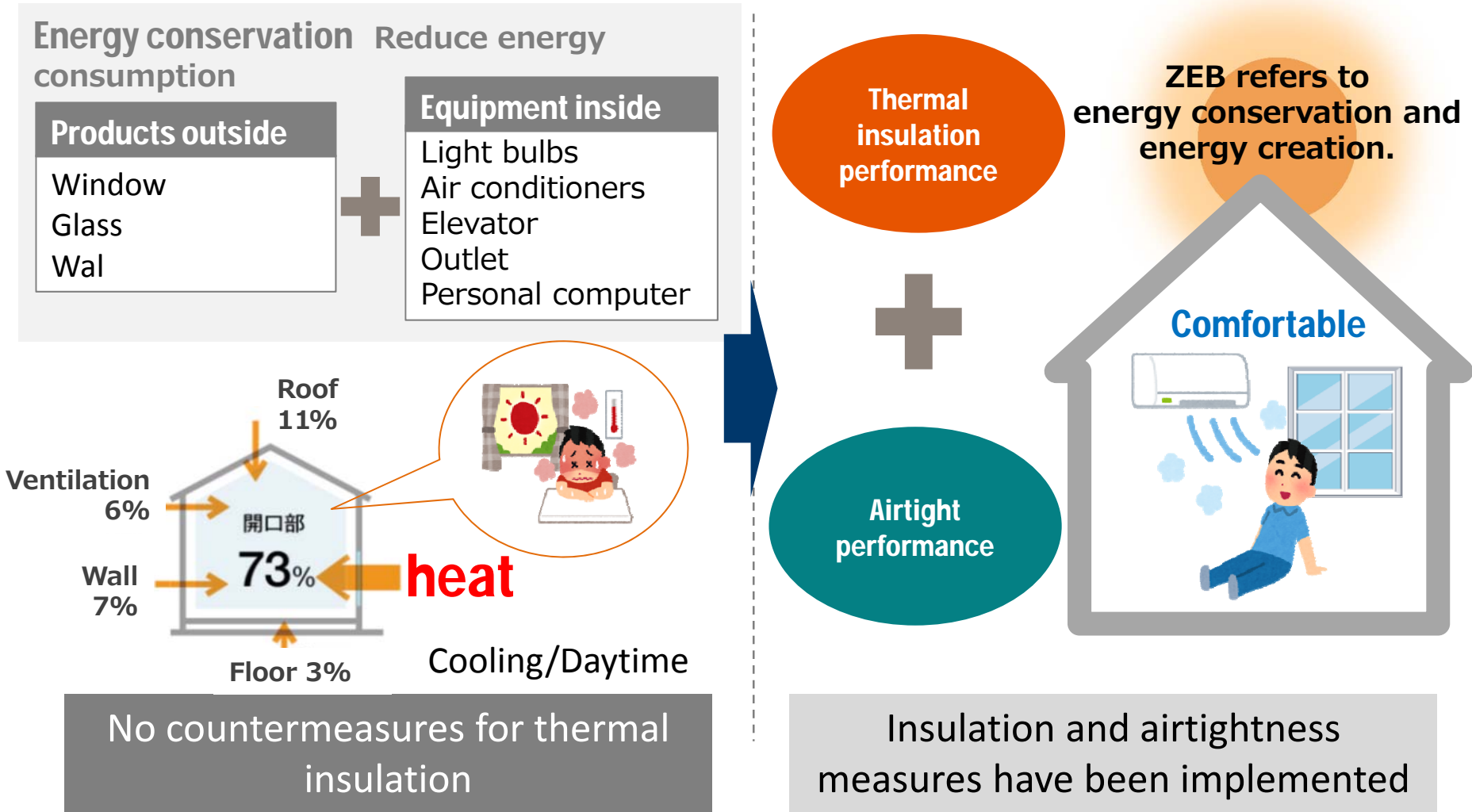
Hybrid ventilation

Reducing Air conditioning load by introducing outside Air while operating air conditioning in the room.



To realize ZEB > "windows" are important for energy conservation

Hot air from outside penetrates 73% through the window.
Improving the performance of windows leads to a healthy and comfortable life.



Window to ZEB > Thermal Insulation Performance

Thermal insulation performance

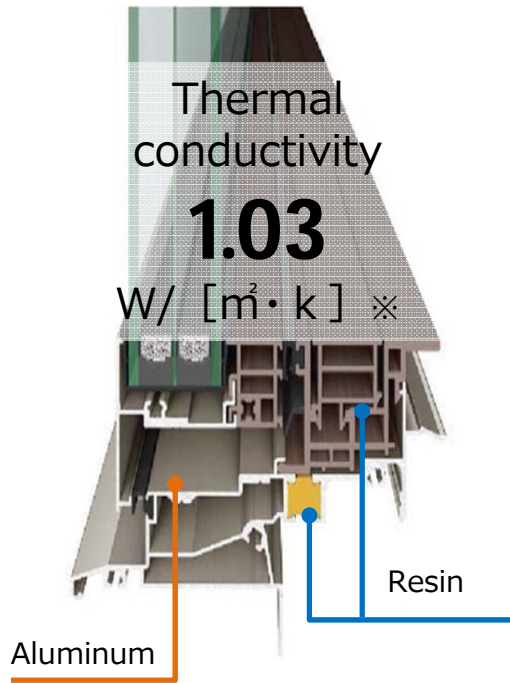
How to improve insulation performance?

Use a high-performance frame : **Materials**

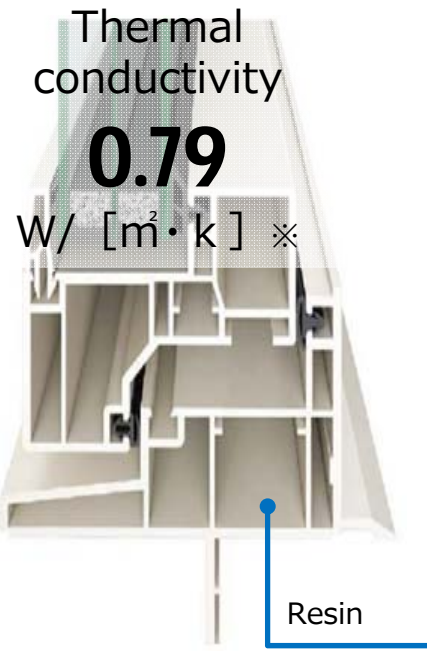
aluminum sash



PVC composite sash



PVC sash



高断熱

※ガラス等条件による

Window to ZEB > Insulation Performance

Thermal insulation performance

How to improve insulation performance?

Use high performance Glass

single glass

Thermal Conductivity **5.9W/m²/K**



* 5FL Glass

double glazing

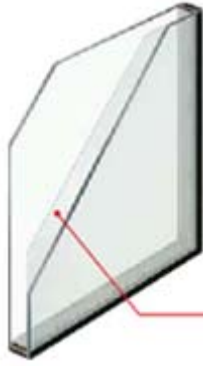
Thermal Conductivity **2.8W/m²/K**



Common Double glass (3-16-3)

Low-E Double

Thermal Conductivity **1.1W/m²/K**



Low - E Double glass (3-16-3) With argon gas

Special Metal coat

Triple glass

Thermal Conductivity **0.59W/m²/K**



Double Low - E glass (3-10-1.3-10-3) With krypton gas

Special Metal coat

high thermal insulation

*For reference: AGC Glass Plaza

Window to ZEB > Insulation Performance

Thermal insulation performance

How to improve insulation performance?

Use High-Performance Frames: **Frame Thinner**

Slim frame for improved insulation and viewing



Thick Frame


Slim Frame

INNOVATIVE PROFILE AND HARDWARE DESIGN

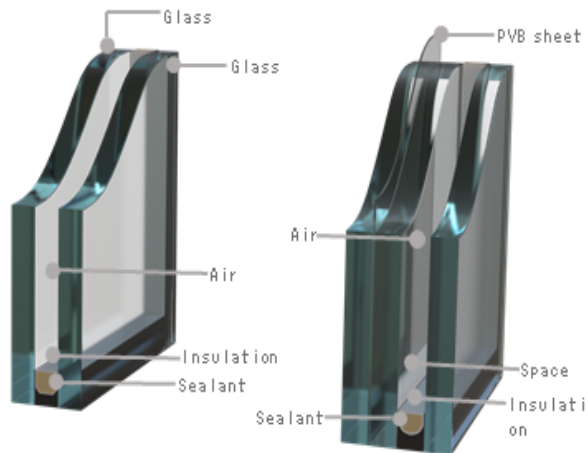


Even if the frame is the same material, Making the frame that is easily affected by heat thinner can improve thermal insulation performance .

For ZEB realization > Thermal insulation performance

 In summary, the combination of high-performance sash and high-performance glass is the key to improving insulation performance.

High performance glass



High performance Window



Maximum Glass area

Thermal Insulation performance improvement



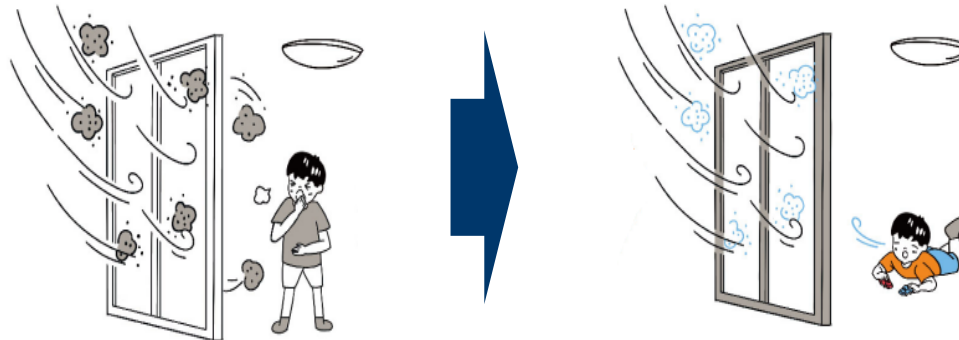
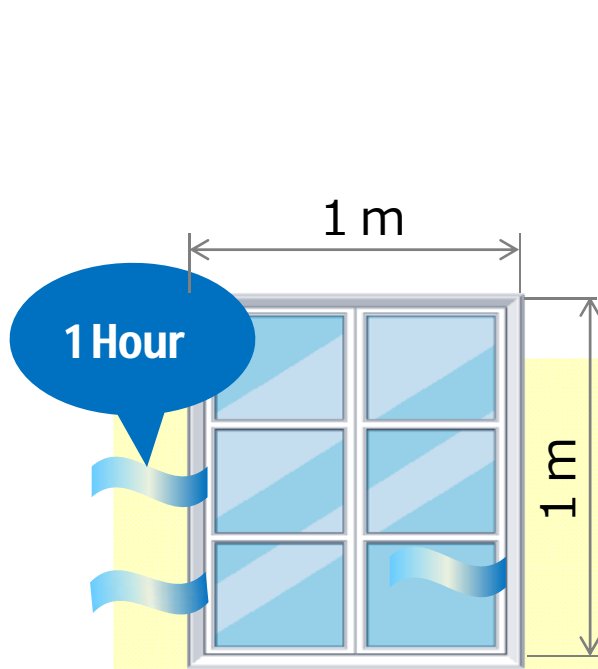
From Window to ZEB > Airtightness

Airtight performance

How to improve the airtightness of a building?

Use a highly airtight sash

Thermal insulation performance is also improved by enhancing airtightness performance of window while suppressing inflow of cold air and warm air



[airtightness of the window]

It indicates how much air leaks from the frame or between panels of sash .

- Airflow per hour in 1m^2 sash (m^3/h)
- The higher the grade, the less draft.

From Window to ZEB > Airtightness

Airtight performance

How to improve the airtightness of a building?

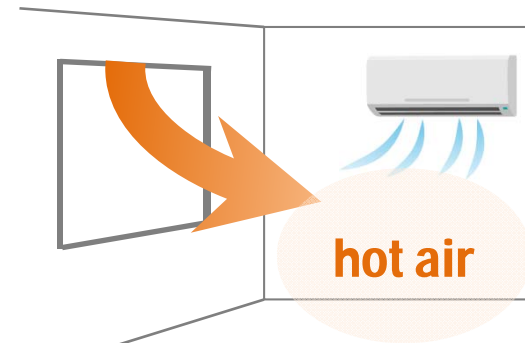
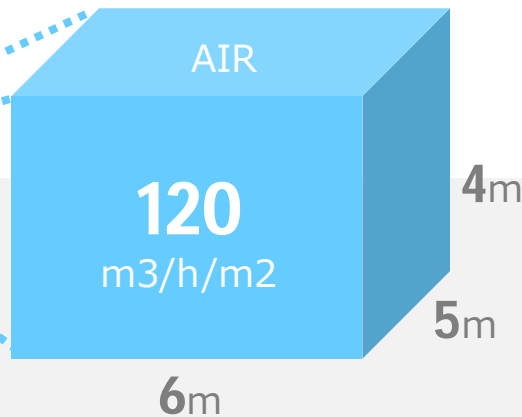
Use a highly airtight sash

A draft of 120 m³/h flows into the room
From Sash with poor airtightness in one hour per square meter.

Draft



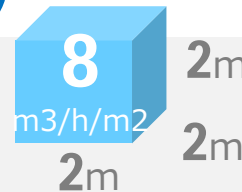
A common sash that uses mohair
JIS A -2 120 m³/h/m²



The more Draft leak
The more cooling load

less Draft


High-performance sash with airtight materials
JIS A -4 8 m³/h, m²

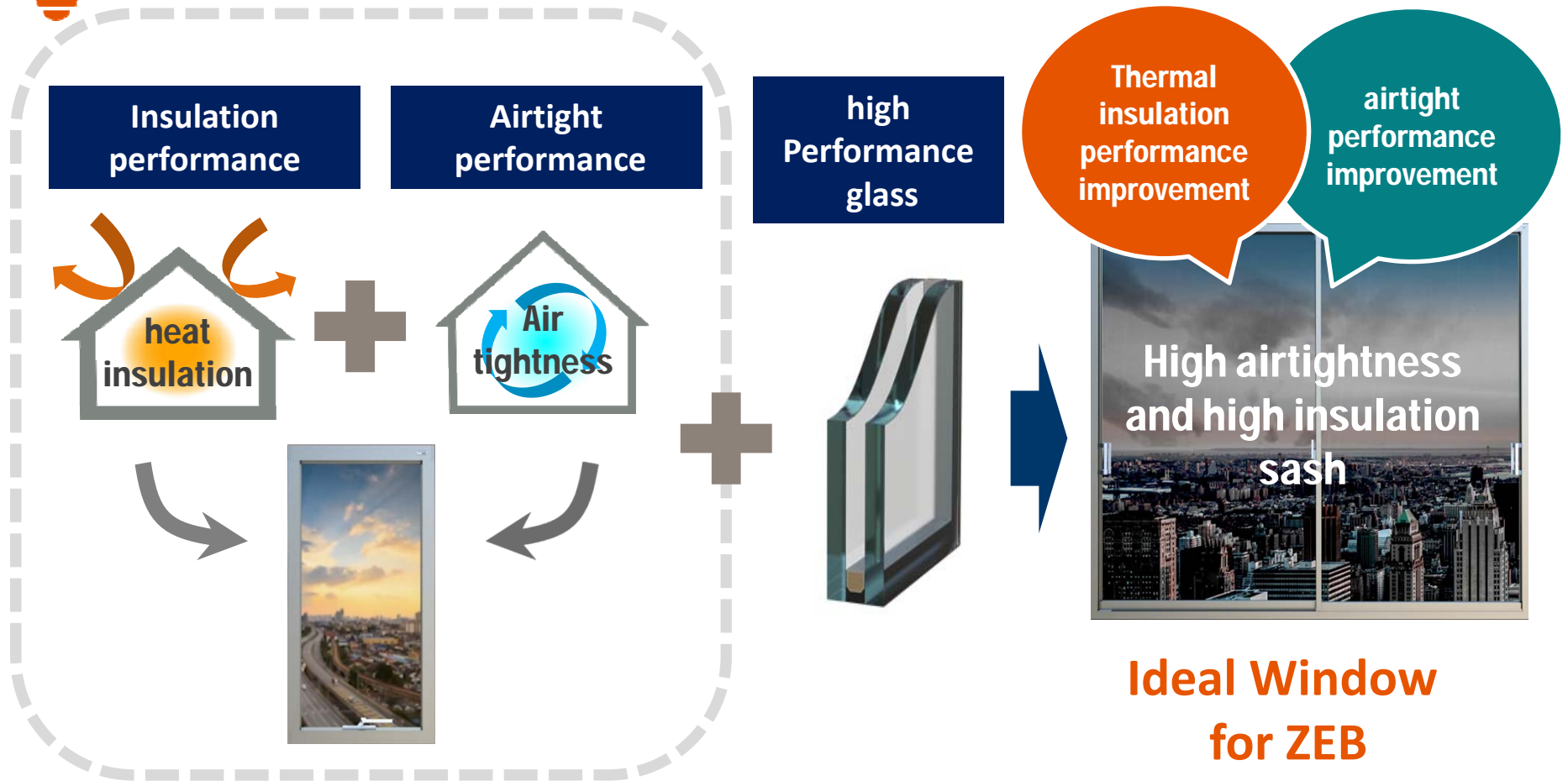


Volume: 1/15

Under certain circumstances cooling load is about **1/15** between class A -4 and class A -2 windows

For the realization of ZEB

 In summary, in order to save energy, it is important to use a window with high heat insulation and airtightness.



[GRANTS]
TOSTEM



**BREAK THE NORM
WITH FINE LINE OF
DESIGN & FUNCTION.**



INNOVATIVE PROFILE AND HARDWARE DESIGN



Conventional



GRANTS

Allow seamless transition between outdoor and indoor
No screw hole or caps appearance.



GRANTS

Innovative Ideas

