Modernization of Uzbekistan Building Code (UBC) System

Localization of passive house construction

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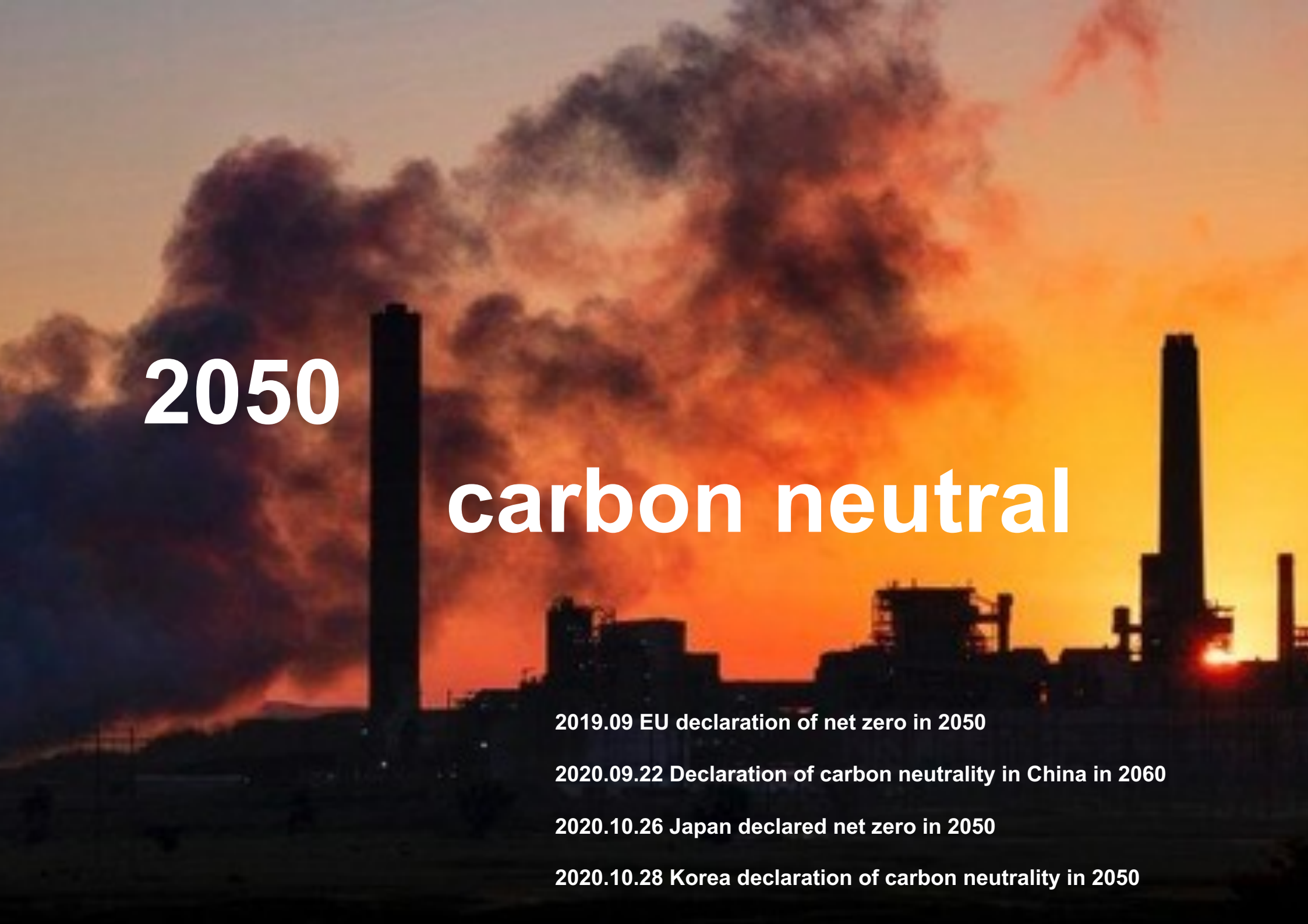
Introduction

- **Carbon neutral & Zero energy building**
  - Korea declaration of net zero in 2050
  - Energy Zero Building

- **Localization**
  - Climate
  - South Window
  - Shading
  - Envelope U-value
  - Thermal Storage
  - Lifestyle

- **Zero Energy Building - EDC**


2050
carbon neutral
2019.09 EU declaration of net zero in 2050
2020.09.22 Declaration of carbon neutrality in China in 2060
2020.10.26 Japan declared net zero in 2050
2020.10.28 Korea declaration of carbon neutrality in 2050

Korea declaration of net zero in 2050

▪ ZEB Responsibility & Want

01 **Global problem**

The damage caused by climate change is estimated to increase to 20% of global GDP annually

02 **Country - Energy Policy**

Push!! Push!!

40% reduction compared to 2018, the peak emission level (4.17%/year reduction)

2050 Net zero

03 **Industry Development**

Develop new market in the field of construction and foster new and renewable energy industry

Developing overseas market by improving international competitiveness

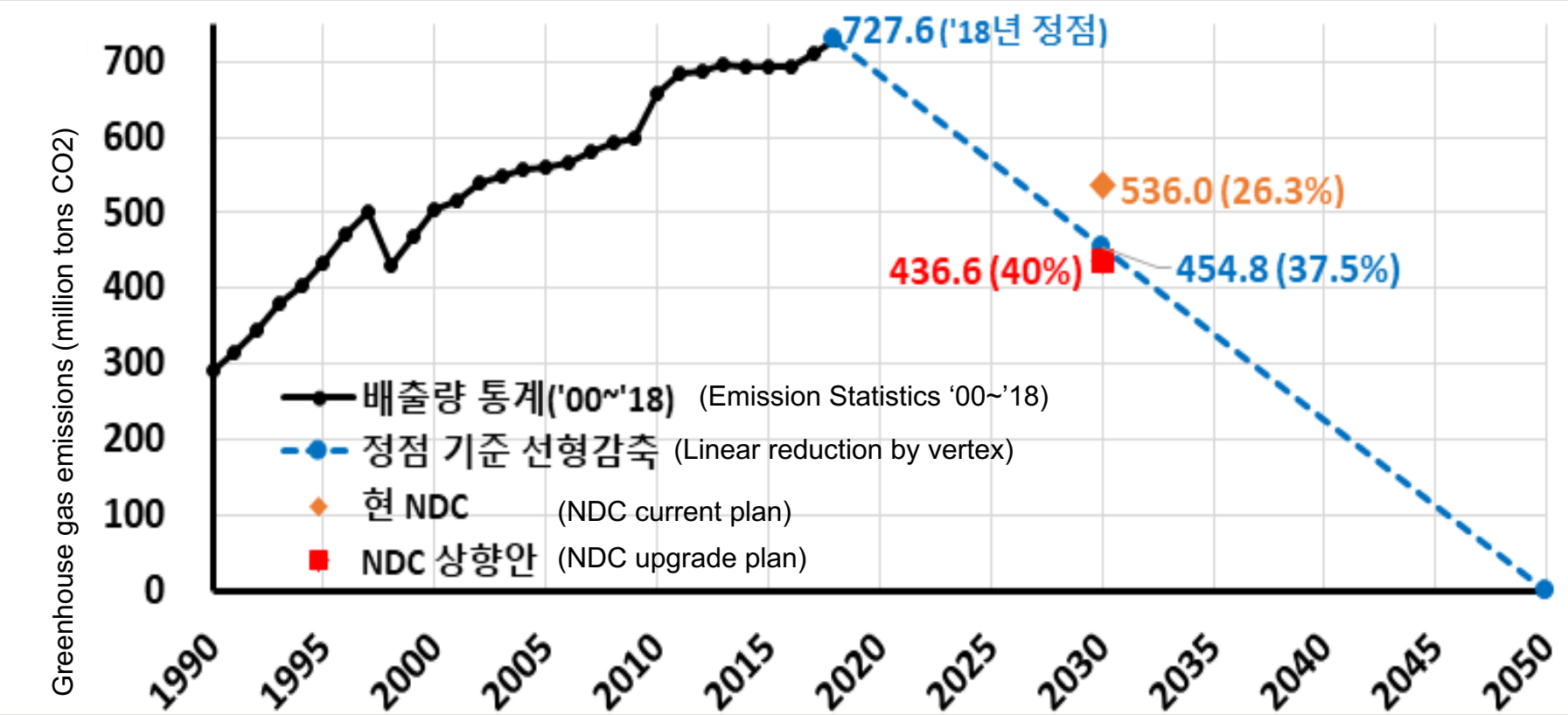
04 **Personal - Reduce energy costs / Ensure a comfortable living environment**

Responding to rising energy costs

It is possible to secure a healthy and pleasant living environment

Korea declaration of net zero in 2050

- **Korea declaration of net zero in 2050**
  - Greenhouse gas reduction roadmap -2021



⇒ (NDC raised level) 40% reduction compared to 2018, the peak emission level (4.17%/year reduction)

Source: 2030 National Greenhouse Gas Reduction Target (NDC) Upgrade Plan – 2021-10-18 / Jointly distributed data with related ministries

Korea declaration of net zero in 2050

▪ Korea declaration of net zero in 2050

- Greenhouse gas reduction roadmap (Architecture part)

- Improve energy efficiency

Expansion of **zero-energy building** that minimizes energy consumption and **green remodeling** that improves energy efficiency of old buildings

- Supply of high-efficiency equipment, demand management

Promoting the distribution of high-efficiency devices such as lighting and home appliances, strengthening energy efficiency standards, and strengthening energy demand management

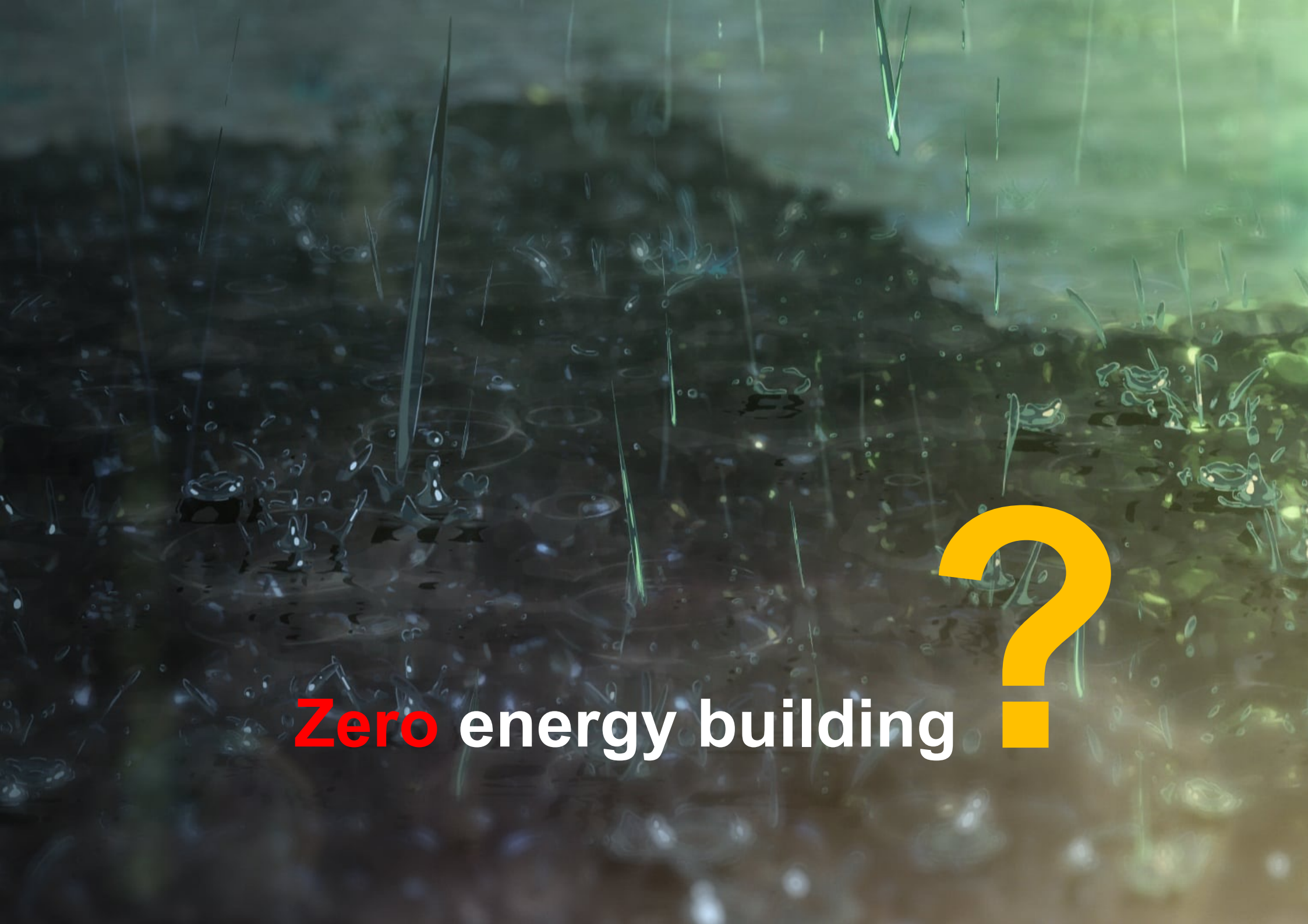
- Smart Energy Management

Installation of sensors and measuring equipment in air conditioning/heating ventilation, lighting, hot water supply, etc., and introduction of real-time automatic energy control system in connection with communication network

- Expanding the supply of clean energy

Expand the supply of new and renewable energy such as solar, geothermal, and water heat, improve the efficiency of district heating heat supply, electrify equipment using fossil fuels, etc.

Source: 2030 National Greenhouse Gas Reduction Target (NDC) Upgrade Plan – 2021-10-18 / Jointly distributed data with related ministries

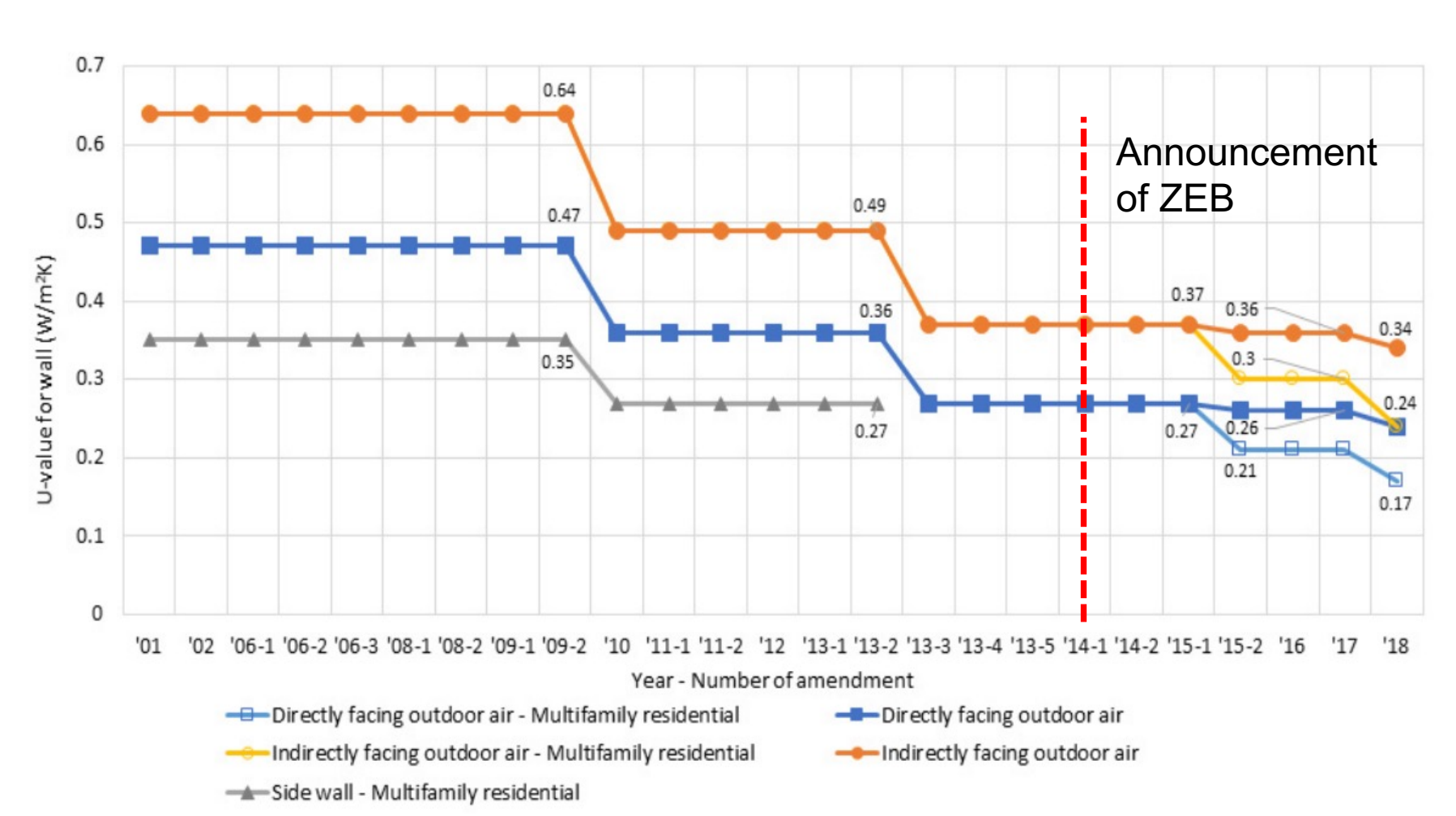

Zero energy building ?

Government's zero energy building certification system

▪ Zero energy building mandatory roadmap

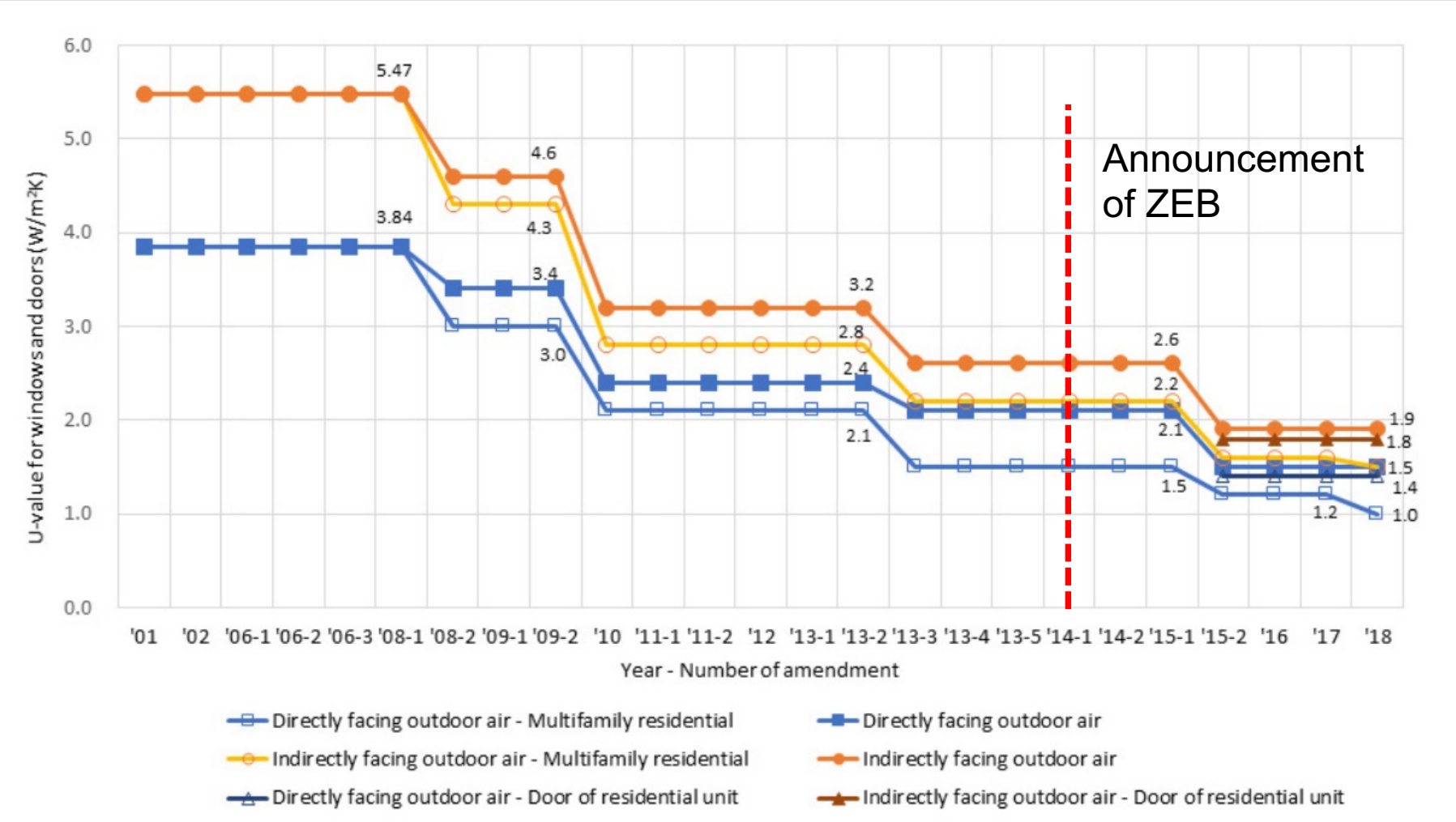
Government's zero energy building certification system

- **Preparation of legal basis**
  - Changes in legal insulation performance according to the roadmap



Government's zero energy building certification system

- **Preparation of legal basis**
  - Changes in legal window and door U-value according to the roadmap



Government's zero energy building certification system

▪ Zero energy building certification

ZERO ENERGY BUILDING
BI DESIGN SYSTEM
2016

Zero Energy Building Certification System

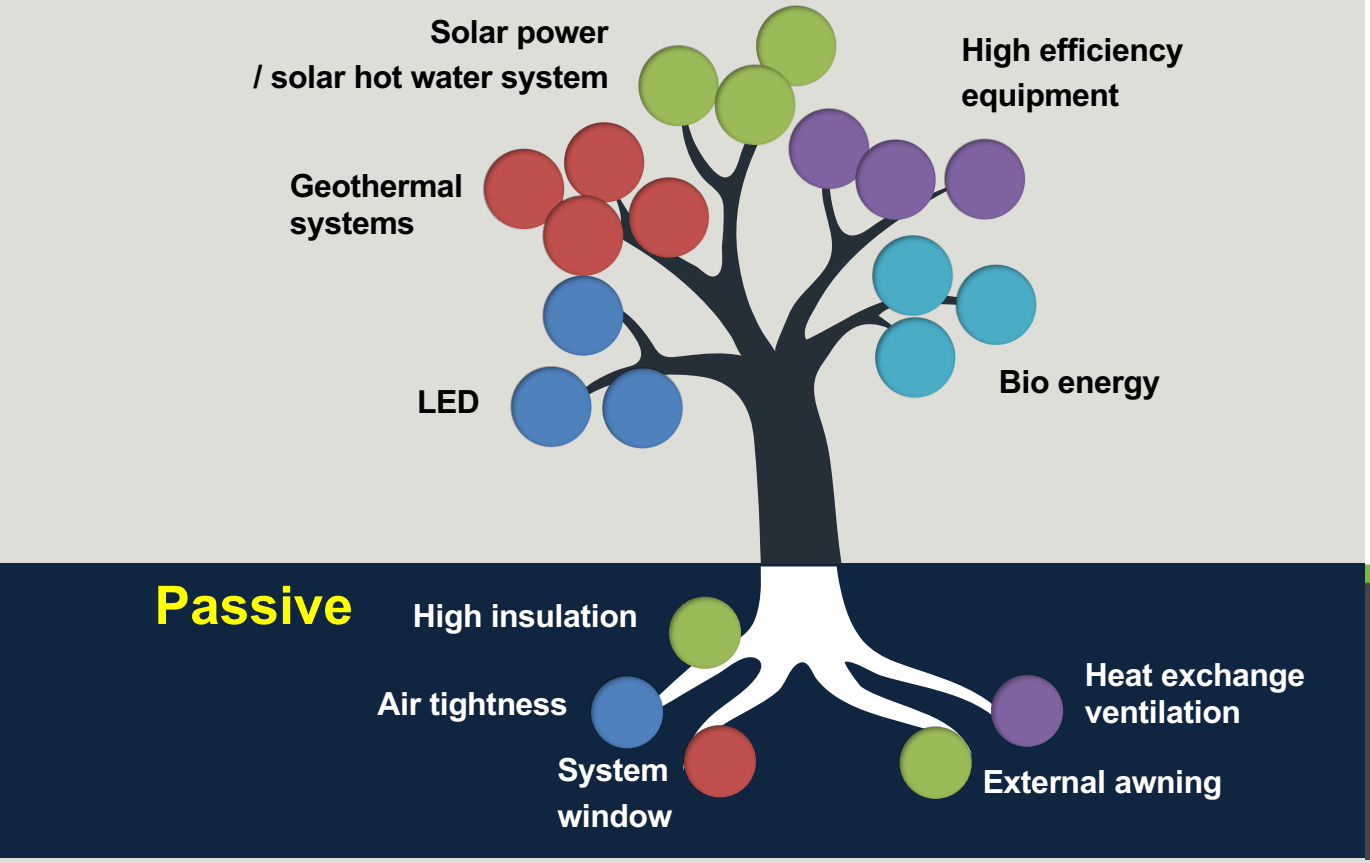
- 2020 in public sector
- 2025 in private sector

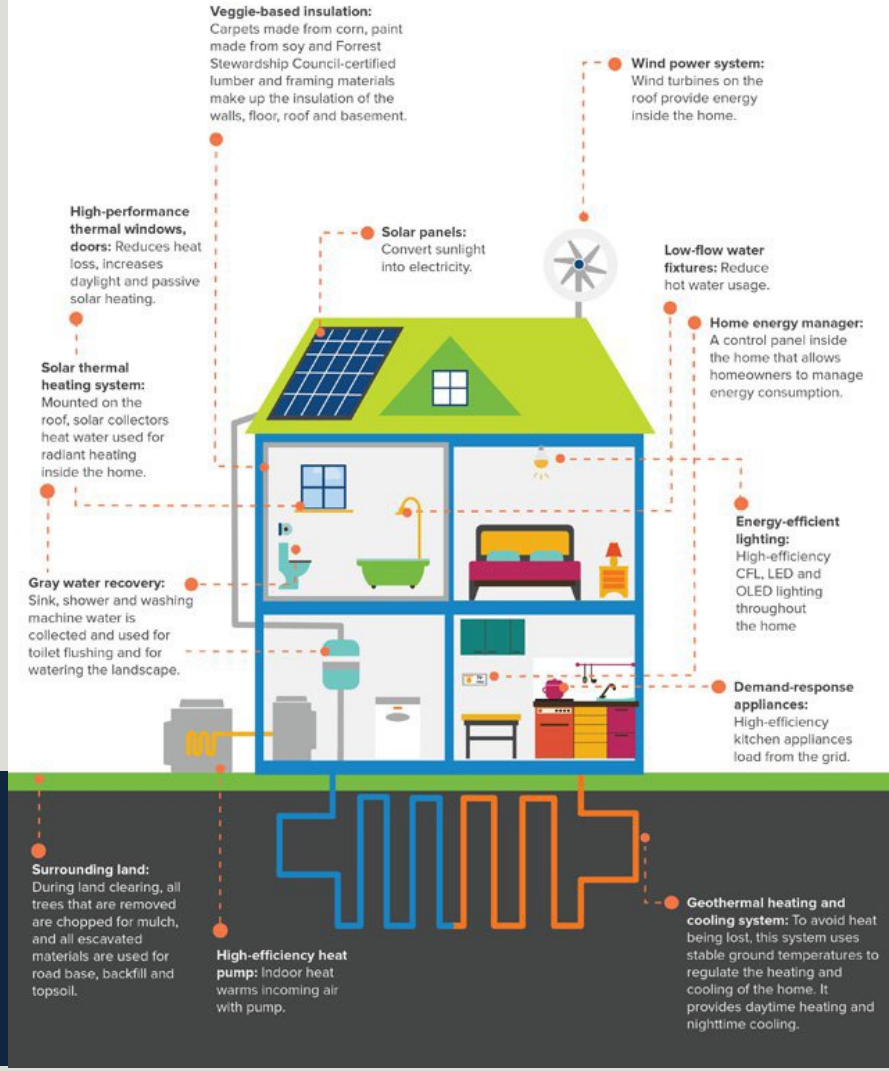
Minimum requirement

- Building energy efficiency 1++
  (Residential > 90 kWh/㎡a
  Non-residential > 140 kWh/ ㎡a)
- Energy independency over 20%
- BEMS

Technical point of a zero-energy building

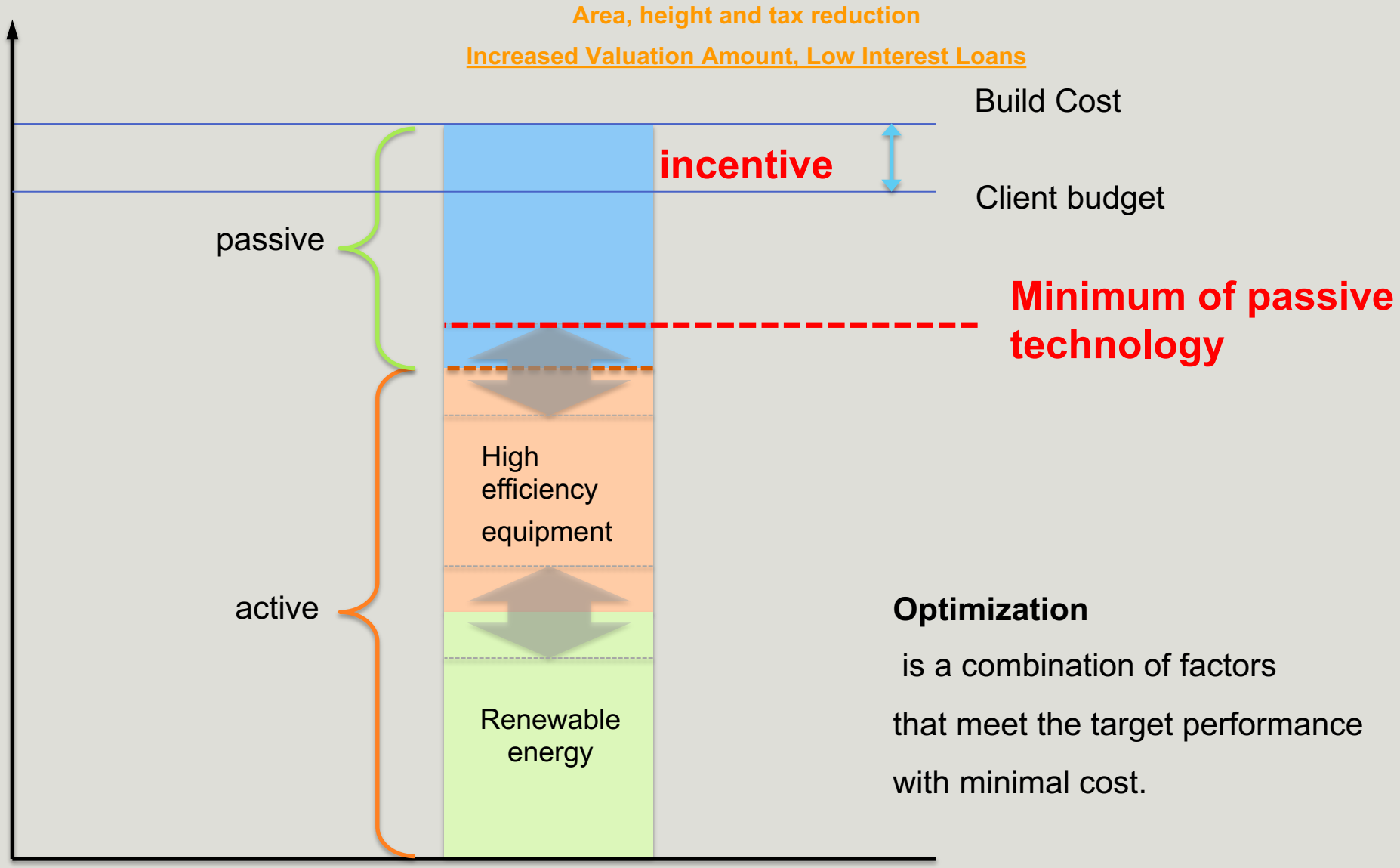
- **Balance between active and passive**





Technical point of a zero-energy building

- **Optimum Mixing?**



Optimization

is a combination of factors that meet the target performance with minimal cost.

Technical point of a zero-energy building

▪ Minimum of passive technology

01

Thermal comfort

it should satisfy KS A ISO 7730's thermal comfort such as PMV, PPD, discomfort air flow.

02

Anti-condensation and mold

KS F 2295, Simulation: ISO 15099, KS L ISO 13788 Temperature and humidity performance of building components Critical surface humidity and internal surface temperature calculation to prevent internal condensation

03

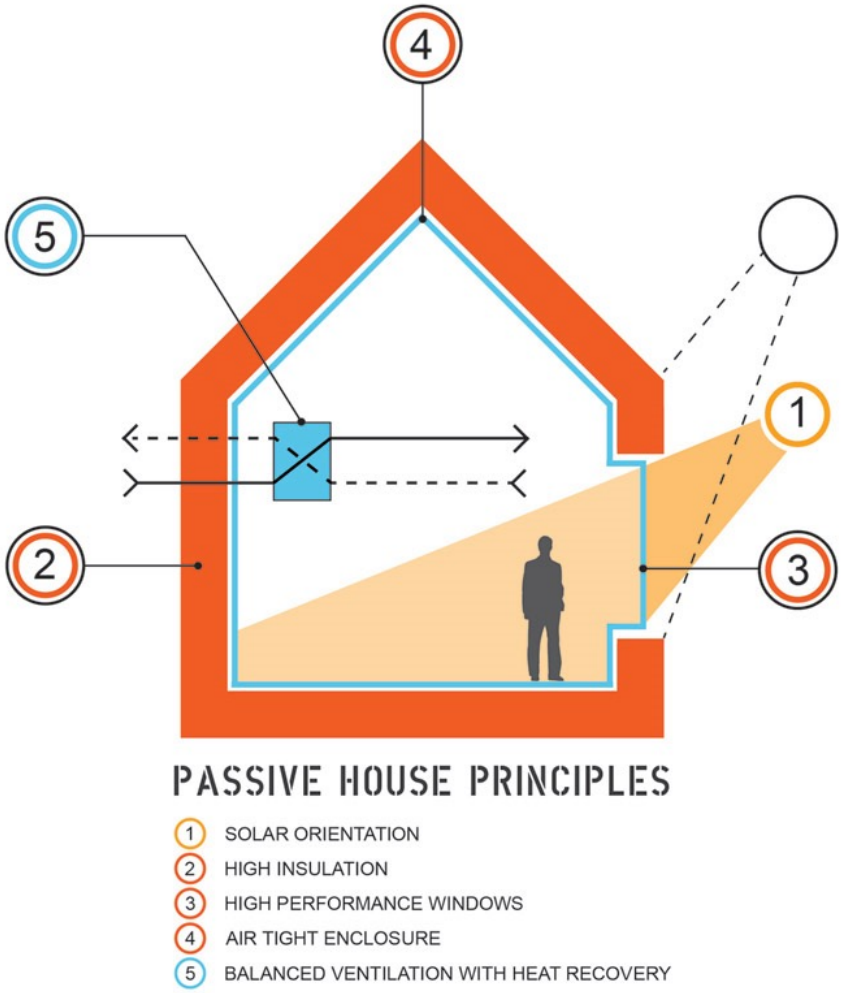
sufficient amount of ventilation

Korea should require the installation of mechanical ventilation for buildings over a certain size and ensure 0.5 ventilation per hour for internal carbon dioxide concentration and pollutant emissions.

Localization

Localization of passive house

▪ PHI Passive House standards (Germany)

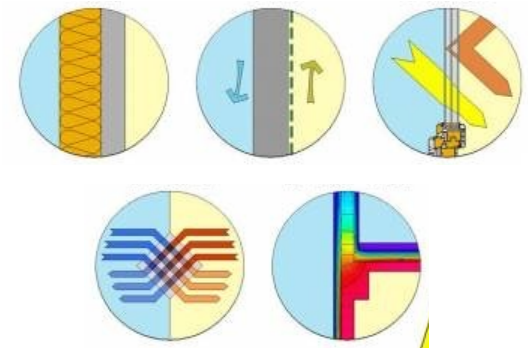


- Heat Demand : ≤ 15 kWh/(m²a)

- or Peak Heating Load : ≤ 10 W/m²

- Primary Energy Consumtion : ≤ 120 kWh/(m²a)

- Air Tightness (50pa) : ≤ 0.6 /h



Source : Richard Pedranti Architect

Localization of passive house - climate

Climate

Localization of passive house - climate

- **Case Study of 1.5L House**
  - Compare the same building with central Germany and Seoul
  - A building with a performance of 1.5 liters in Germany was analyzed with a performance of 1.1 liters in Seoul.

		PHI		Seoul											
Performance	Heating Demand (kWh/m2a)	15	25	11	9	7	15	15	18	19	20	26	30	30	48
	Heating Load (W/m2)	10	14	11	10	10	14.0	14.0	14	16	17	19	22	22	33
	n50(h-1)	0.3	0.3	0.3	0.3	0.6	0.6	0.6	0.3	0.6	0.6	0.6	1.0	1.0	1.5
	Primary E. (kWh/m2a)	83	86	72	71	69	77	76	79	81	82	89	93	94	74
	Over Heating %	1	1	27	28	31	26	29	24	24	28	23	25	24	27
	Cooling Demand (kWh/m2a)	1	1	7	7	9	7	9	7	7	8	7	8	11	11
	Cooling Load (W/m2)	8	8	7	7	8	7	8	7	7	8	7	8	10	11
U-value	Wall (W/m2K)	0.100	0.150	0.100	0.100	0.056	0.140	0.110	0.150	0.150	0.150	0.200	0.200	0.200	0.360
	Roof (W/m2K)	0.100	0.150	0.100	0.069	0.040	0.100	0.110	0.150	0.150	0.150	0.200	0.200	0.200	0.200
	Ground (W/m2K)	0.090	0.150	0.100	0.076	0.046	0.100	0.110	0.150	0.150	0.150	0.200	0.200	0.200	0.300
창호성능	Ug (W/m2K)	0.60	0.60	0.65	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.40	1.40
	g-value	0.52	0.52	0.52	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.60	0.60
	Uf (W/m2K)	0.97	0.97	0.97	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00
	U-win (W/m2K)	0.86	0.86												
	Psi spacer	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	Psi install	0.02	0.02	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Heat Exchage Perp.		80%	80%	80%	80%	80%	80%	80%	80	80	80	80	80	80	80

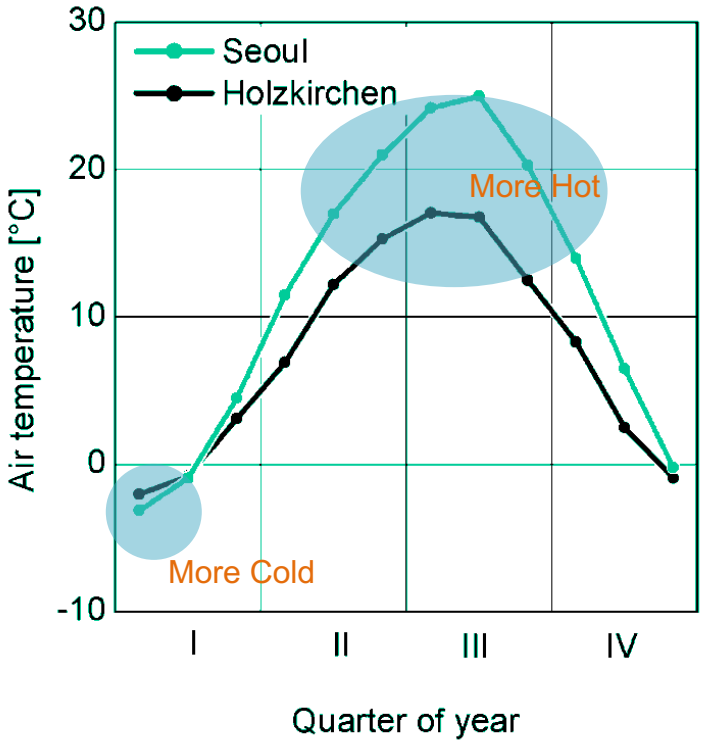
Localization of passive house - climate

- **Climate in Korea and Germany**
  - Korea is colder in winter and hotter in summer
  - High humidity in summer, high discomfort index

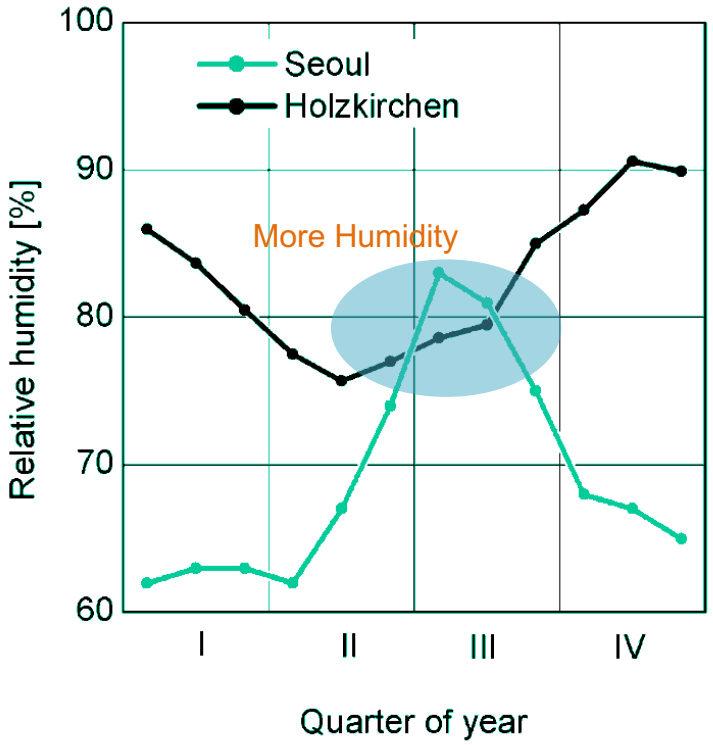
Field test site in Holzkirchen (alt.: 680 m, lat.: 48° N)

Seoul (alt.: 20 m, lat.: 37° N)

Fraunhofer IBP



=> More peak load



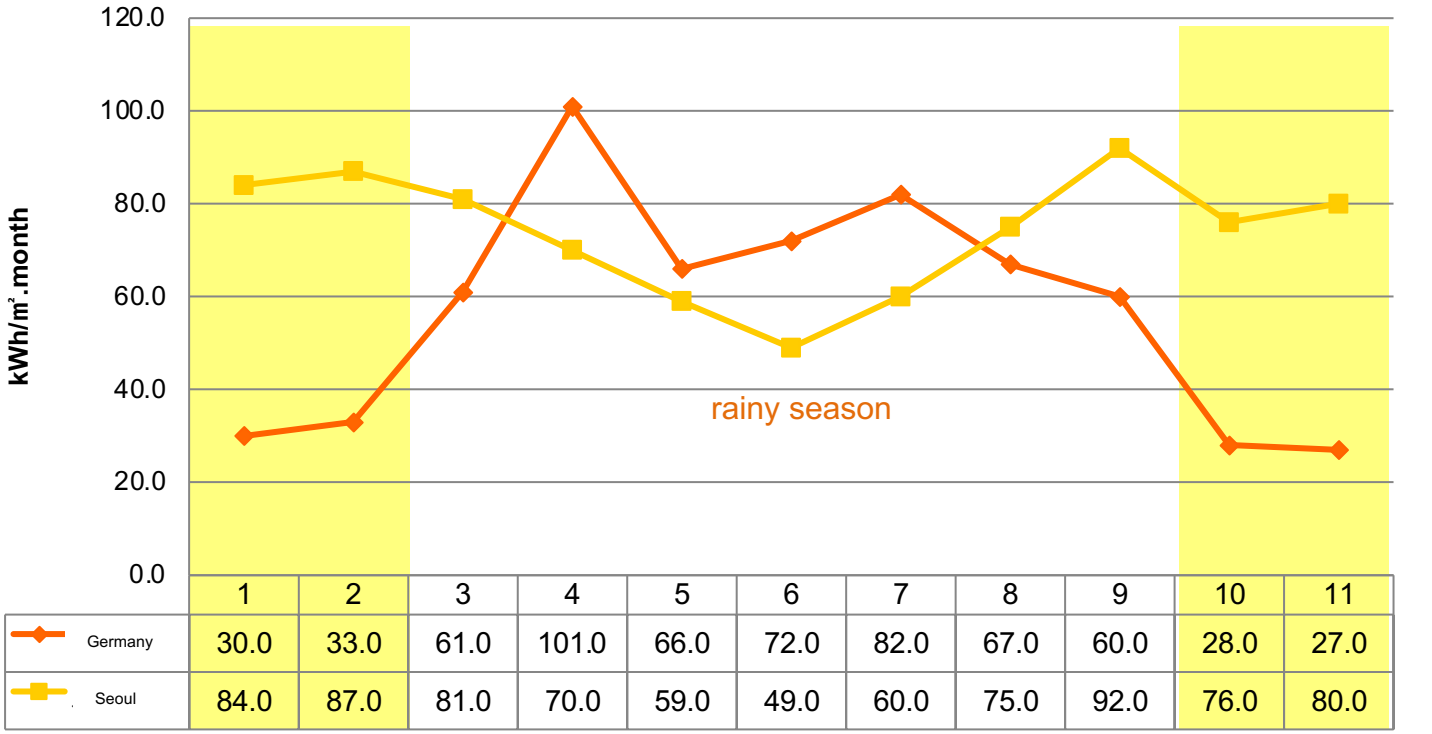
=> More mold risk

Localization of passive house - climate

- **Climate in Korea and Germany**
  - 2.5 times more winter solar energy than Germany

Field test site in Holzkirchen
(alt.: 680 m, lat.: 48° N)

Seoul (alt.: 20 m, lat.: 37° N)



	1	2	3	4	5	6	7	8	9	10	11
Germany	30.0	33.0	61.0	101.0	66.0	72.0	82.0	67.0	60.0	28.0	27.0
Seoul	84.0	87.0	81.0	70.0	59.0	49.0	60.0	75.0	92.0	76.0	80.0

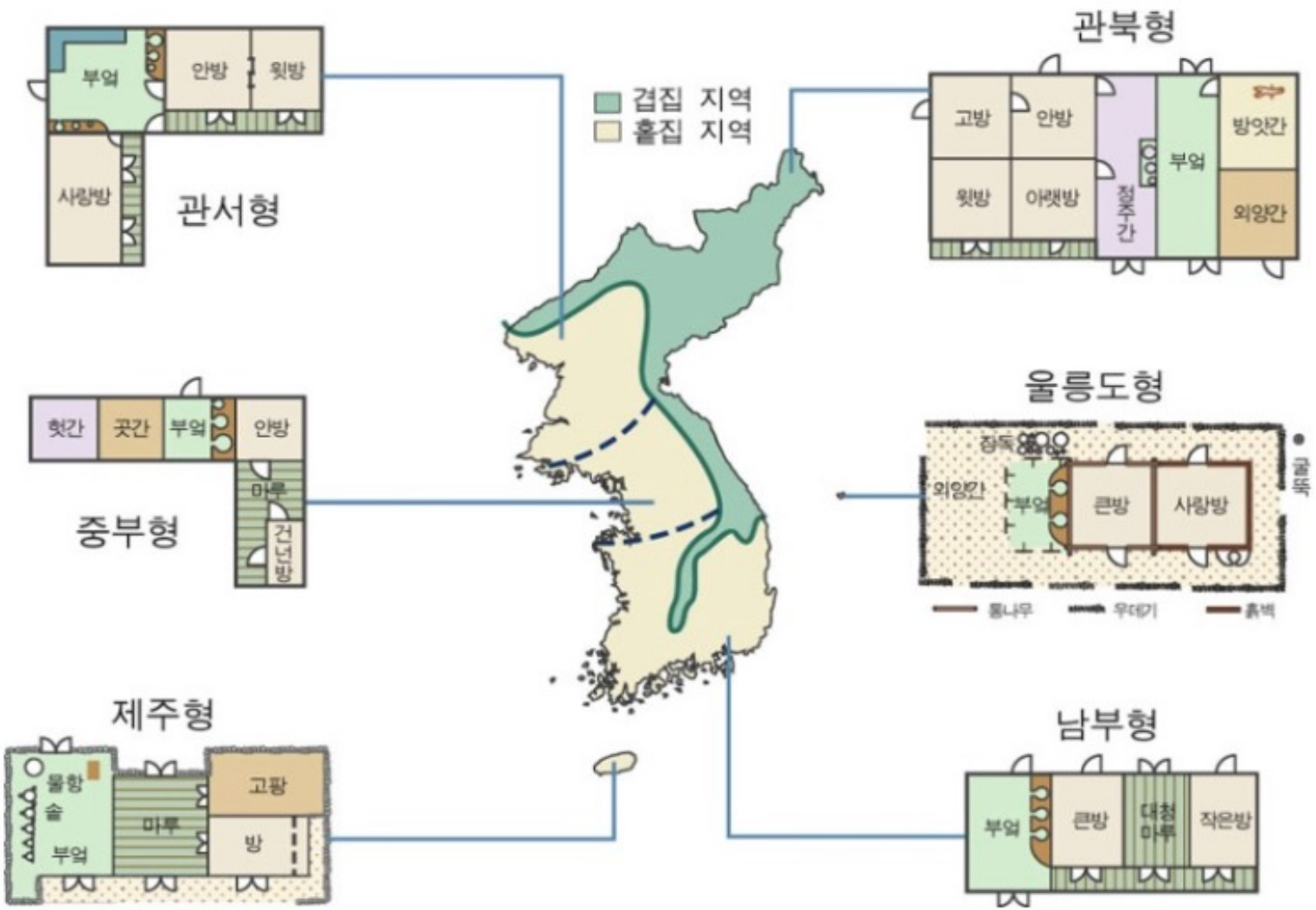
solar gain in winter

solar gain in winter

Fraunhofer IBP

Localization of passive house - climate

- **Traditional Korean Architecture adapted to Regional Climatic Variations**



Source: http://toytvstory.tistory.com/644

Localization of passive house - climate

- **Region of PHI and Köppen Climate Classification**

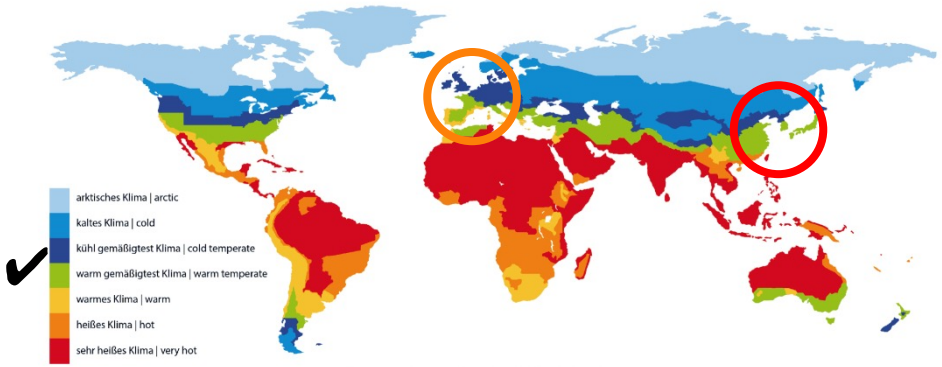
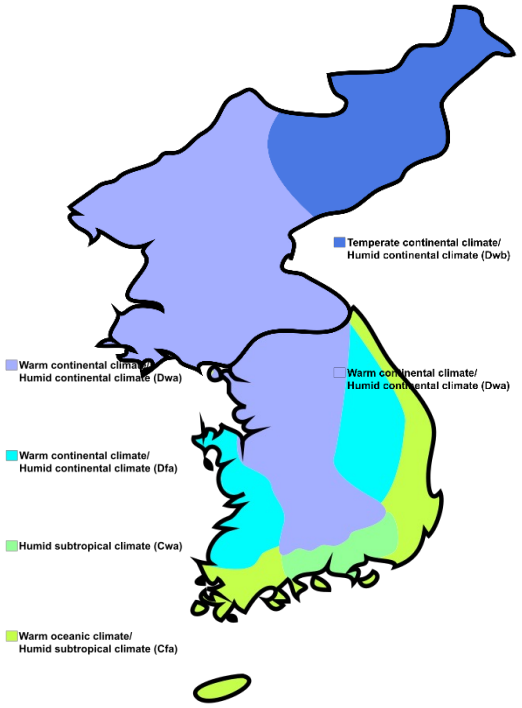


Figure 1: Assignment of regions with identical requirements

GERMANY = KOREA
WARM TEMPERATE CLIMATE

Source: PHI



5 Types: Climate Classification

Source: Köppen-Geiger vector by Ali Zifan

Localization of passive house - South Window

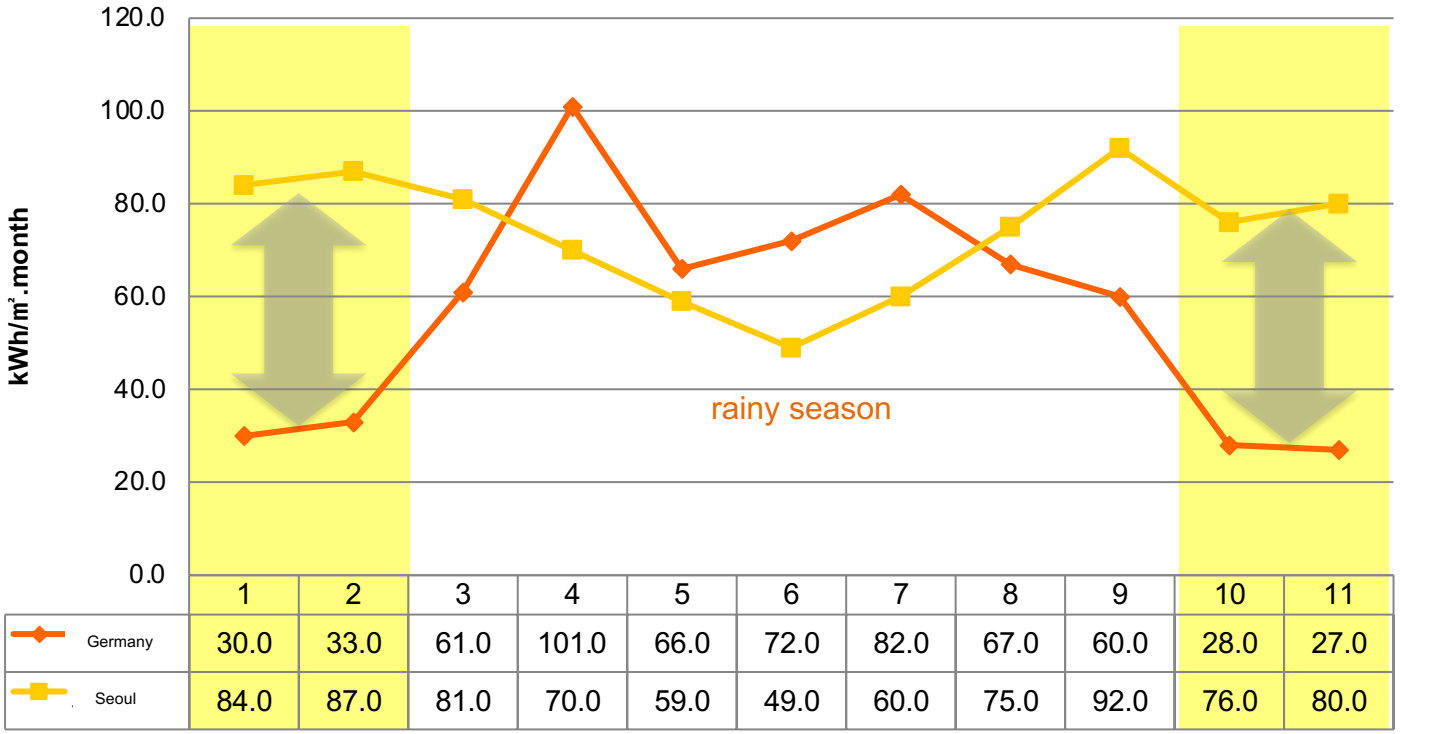
South Window

Localization of passive house - South Window

- **South solar radiation**
  - Establishment of strategy to utilize abundant solar energy

Field test site in Holzkirchen
(alt.: 680 m, lat.: 48° N)

Seoul (alt.: 20 m, lat.: 37° N)



	1	2	3	4	5	6	7	8	9	10	11
Germany	30.0	33.0	61.0	101.0	66.0	72.0	82.0	67.0	60.0	28.0	27.0
Seoul	84.0	87.0	81.0	70.0	59.0	49.0	60.0	75.0	92.0	76.0	80.0

solar gain in winter

solar gain in winter

Fraunhofer IBP

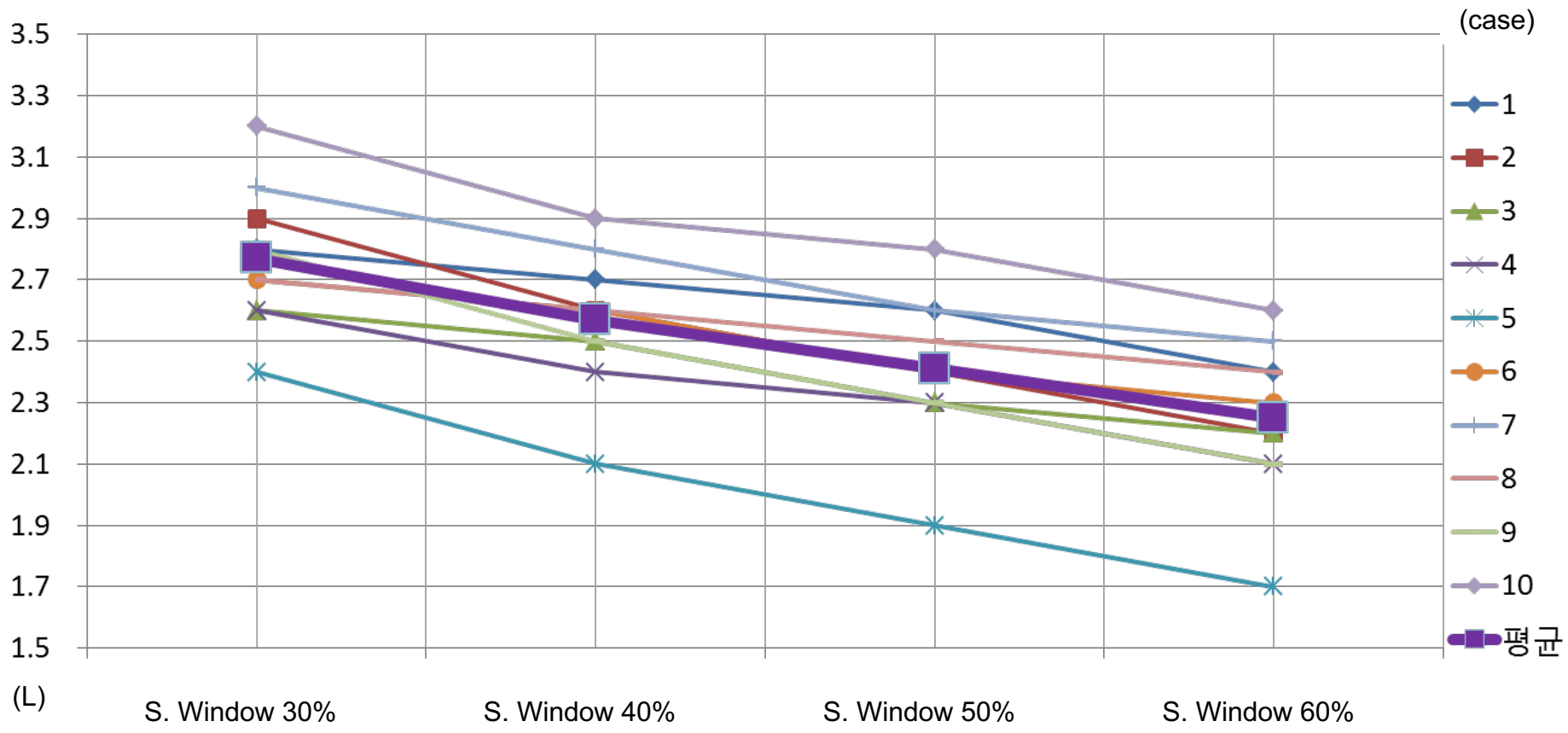
Localization of passive house - South Window

- **Case study of south window percent**
  - Comparison of performance by adjusting the area of the south window for 10 certified buildings

case	1	2	3	4	5	6	7	8	9	10	mean
Heat Demand (L)	2.9	3.1	3.0	2.8	2.6	2.9	3.0	2.9	2.9	3.2	2.93
S. Window area	20.22	10.81	19.88	23.46	15.51	14.92	19.50	21.42	9.26	12.42	16.74
S. wall area	94.28	50.85	152.72	103.88	60.65	68.11	70.61	83.87	40.69	42.96	76.86
S. Window %	**21.4%**	**21.3%**	**13.0%**	**22.6%**	**25.6%**	**21.9%**	**27.6%**	**25.5.%**	**22.8%**	**28.9%**	**23.1%**

Localization of passive house - South Window

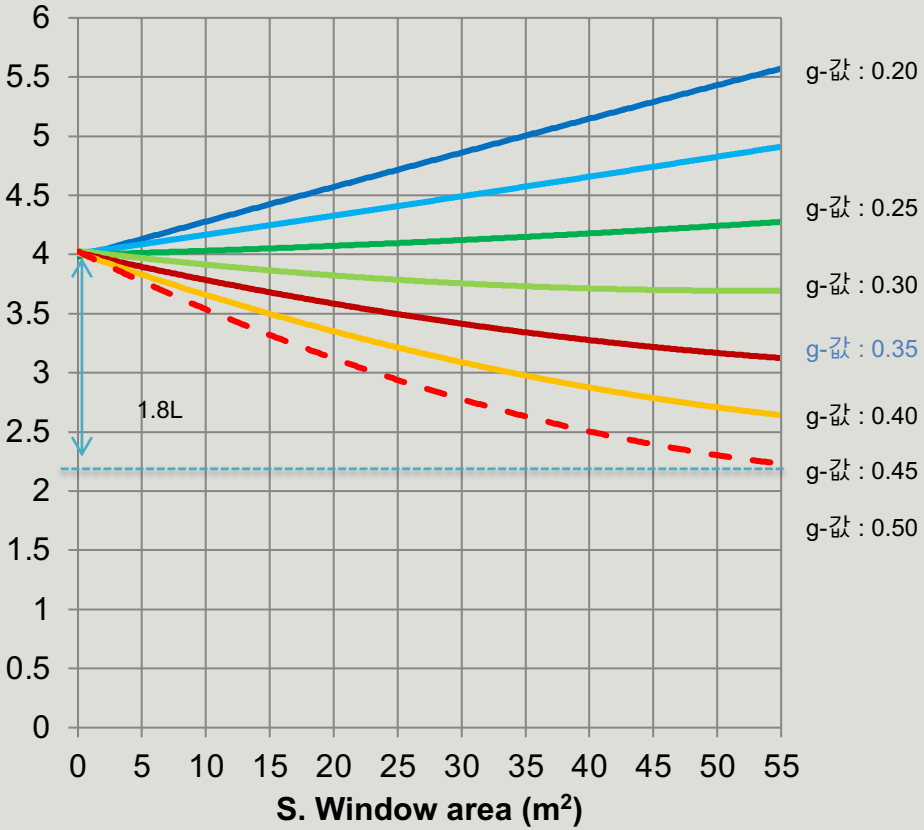
- **heating demand according to south window percent**
  - It can be seen that the heating energy performance improves as the area of the south window increases.



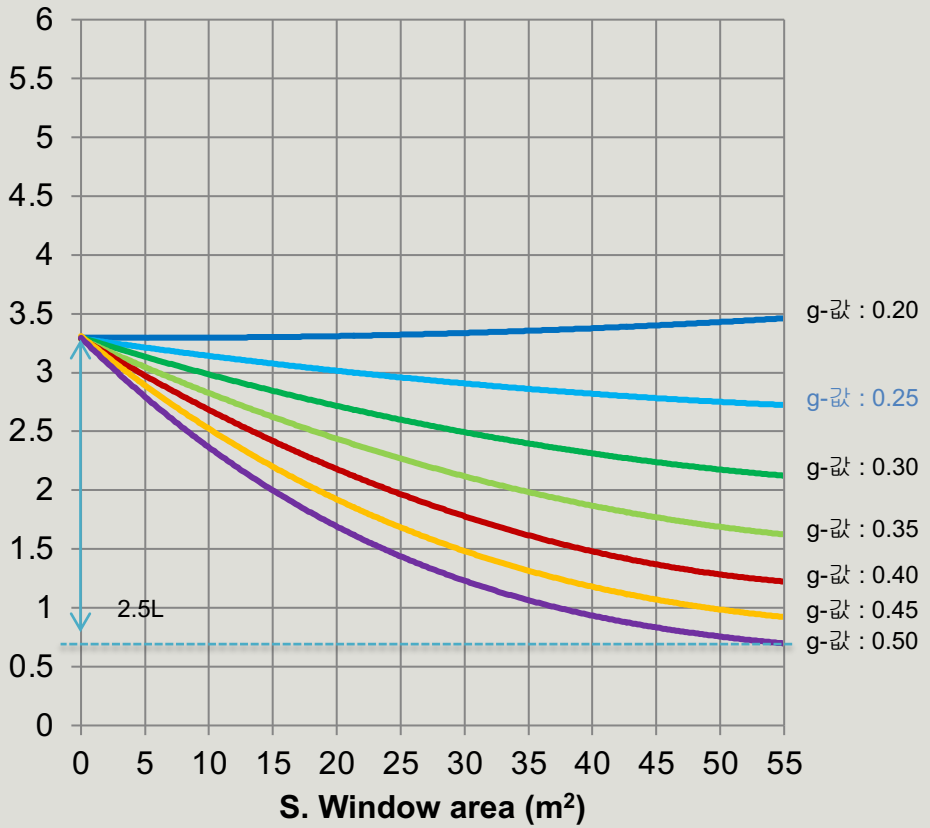
Localization of passive house - SHGC (g-value)

- **heating demand according to g-value**
  - It has the same effect of reducing heat demand with a lower g-value compared to Germany.

- Middle of EU



- Seoul

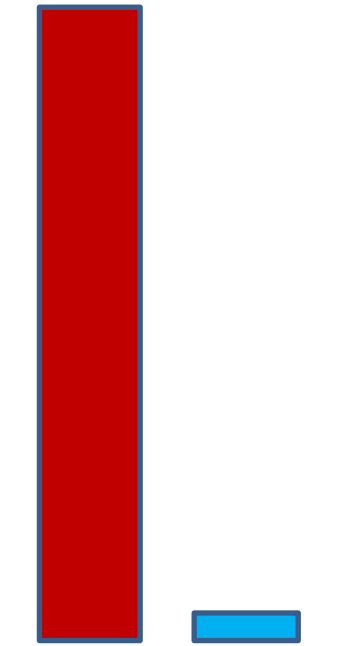


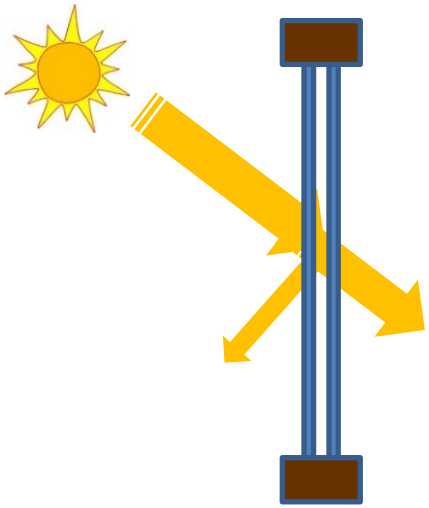
Localization of passive house - SHGC (g-value)

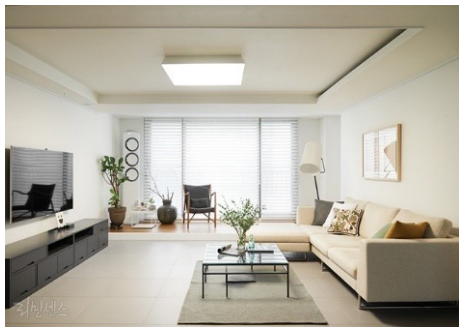
- **Adjust g-value according to energy consumption pattern**
  - Residential facilities receive a lot of solar energy to reduce heating energy, and non-residential facilities block solar energy to reduce cooling load.

Residential buildings

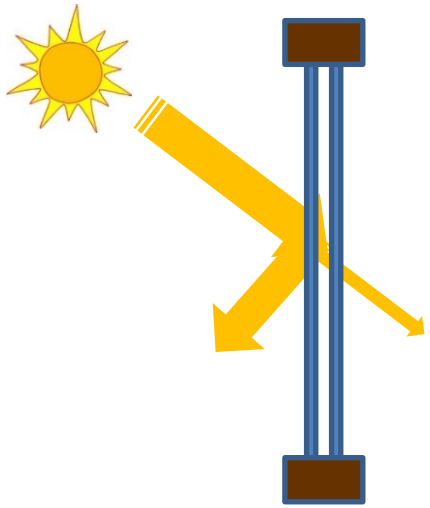
Energy Consumption

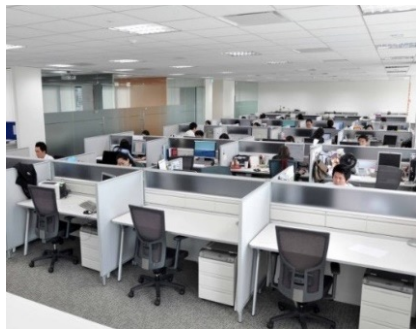






Low Internal Heat Gain

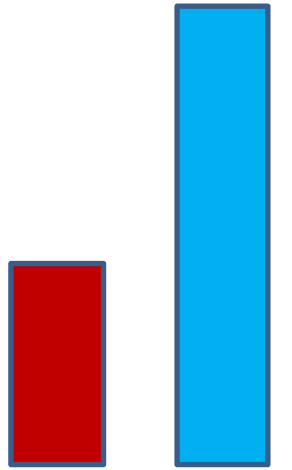




Large Internal Heat Gain

Non-Residential buildings

Energy Consumption



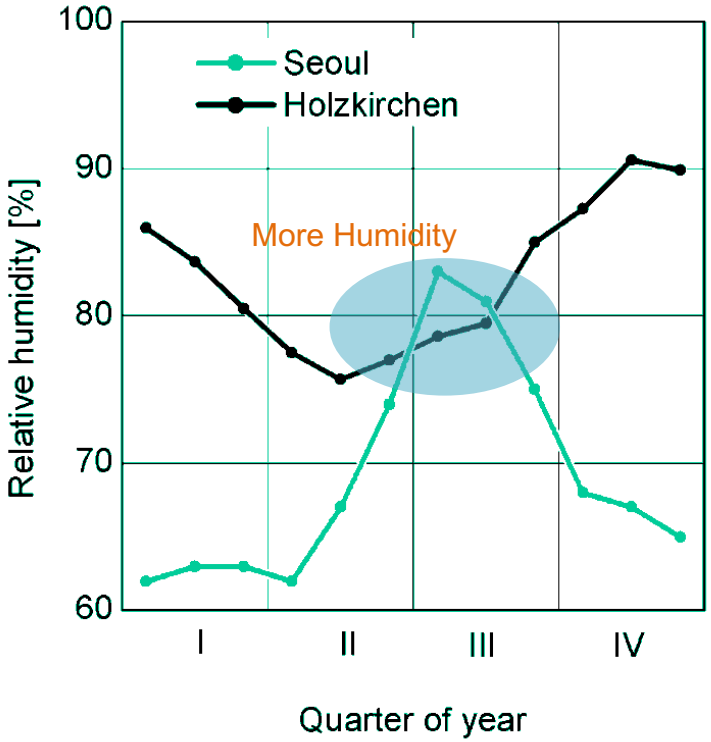
Localization of passive house - Shading

Localization of passive house - Shading

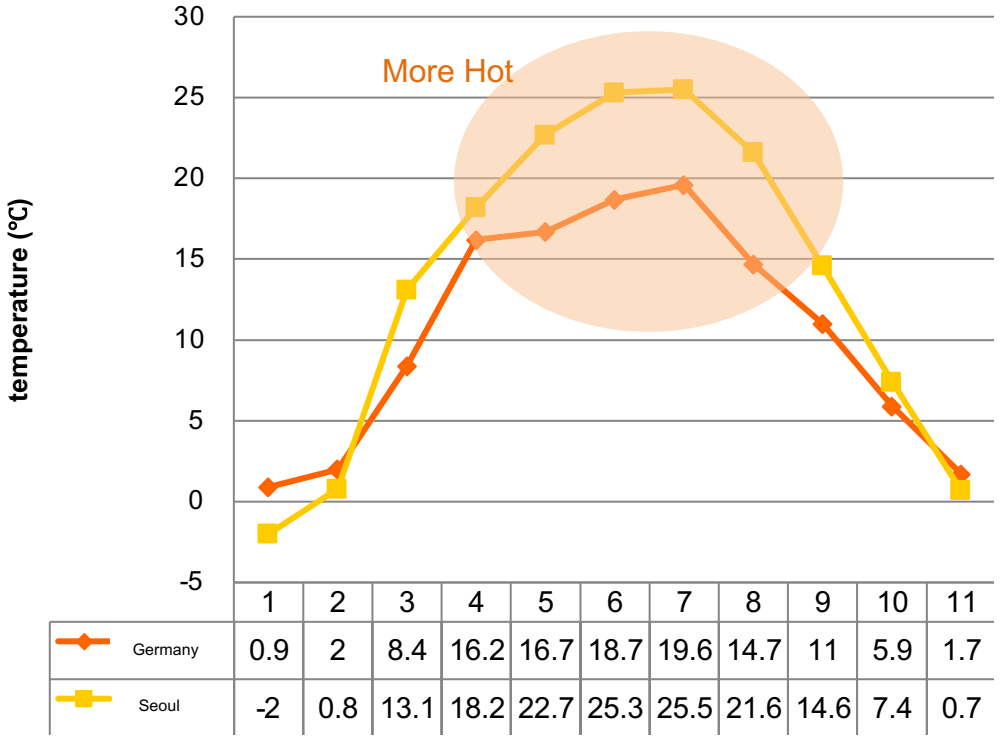
▪ Necessity of Shade

- Since the temperature and humidity are higher than in Germany, it is necessary to reduce the cooling load by actively blocking solar radiation.

- South solar radiation



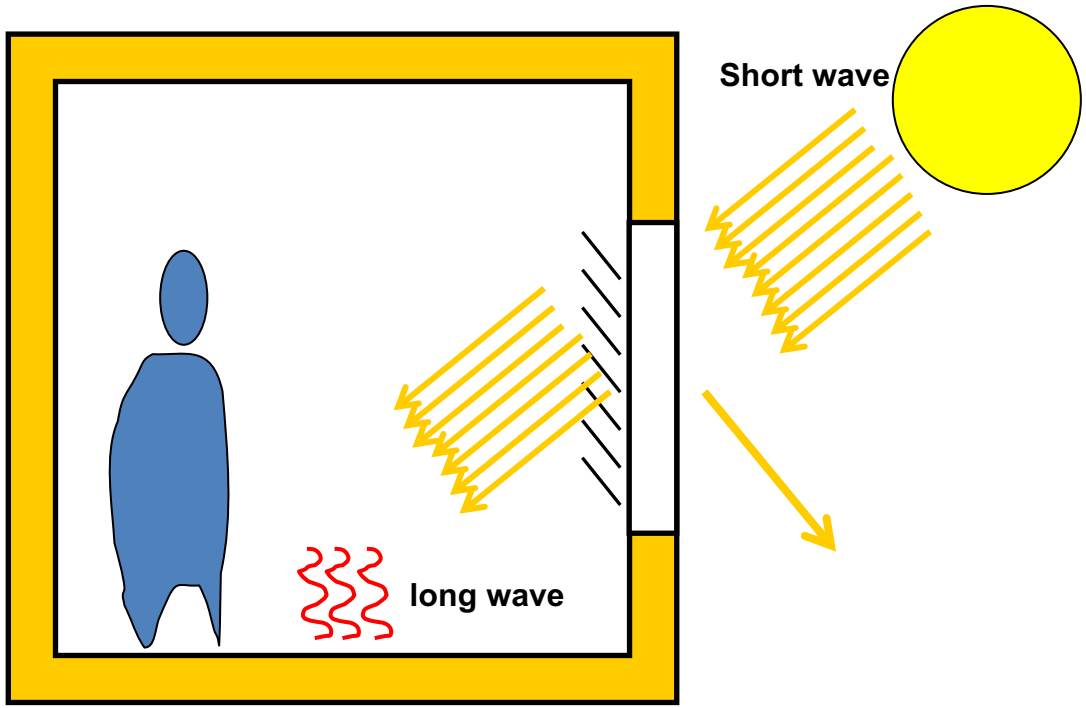
- Outdoor temperature



	1	2	3	4	5	6	7	8	9	10	11
Germany	0.9	2	8.4	16.2	16.7	18.7	19.6	14.7	11	5.9	1.7
Seoul	-2	0.8	13.1	18.2	22.7	25.3	25.5	21.6	14.6	7.4	0.7

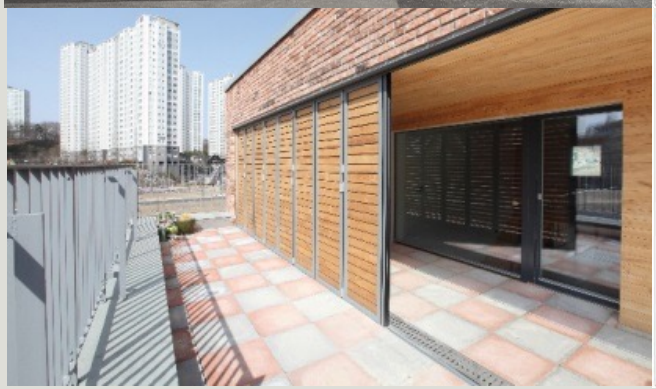
Localization of passive house - Shading

- **The need for an external awning**
  - Short-wave solar energy that enters through the transparent building material turns into a long-wave and heats the inside.



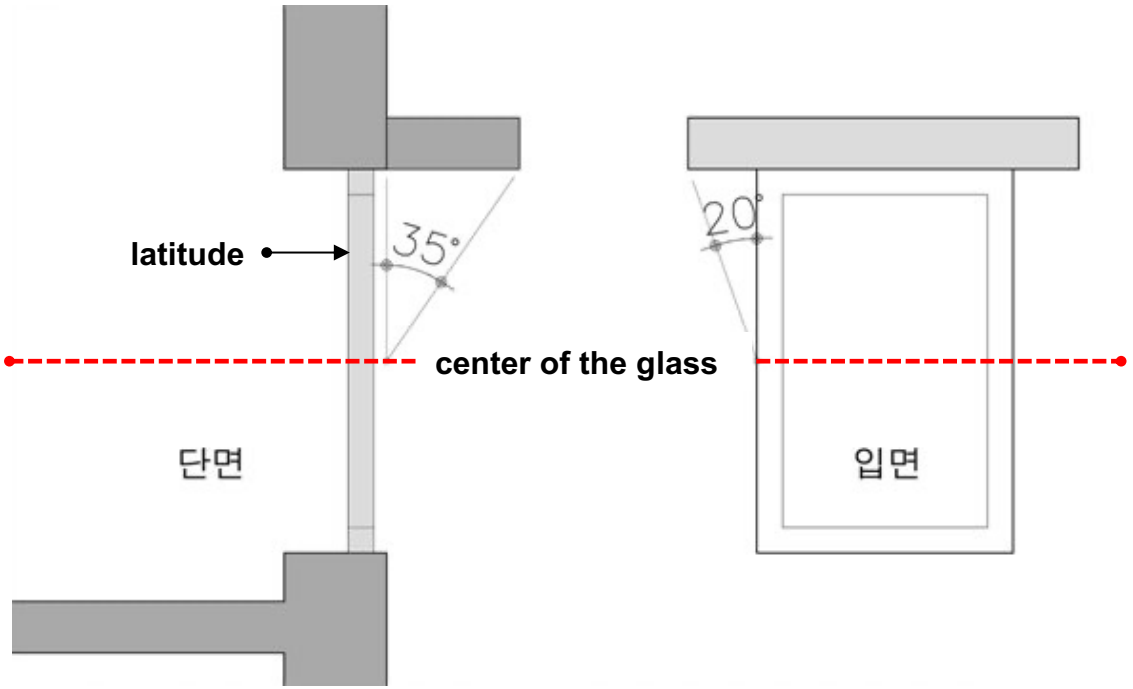
Localization of passive house - Shading

- **Various type of shading**
  - There are sun protection devices of various materials.
  - A shading device considering the design of the building should be planned from the beginning of the design.

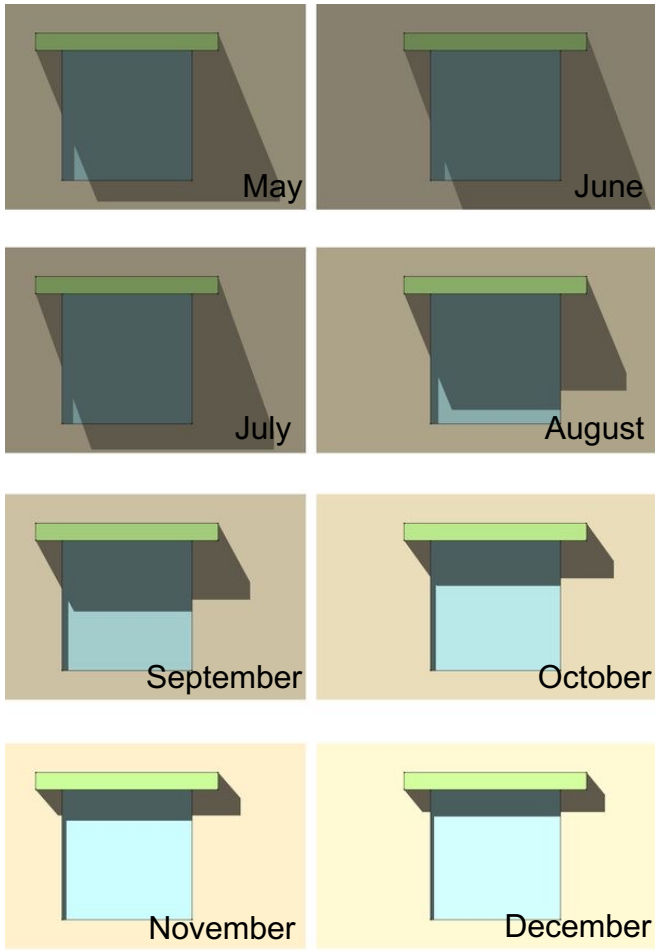


Localization of passive house - Shading

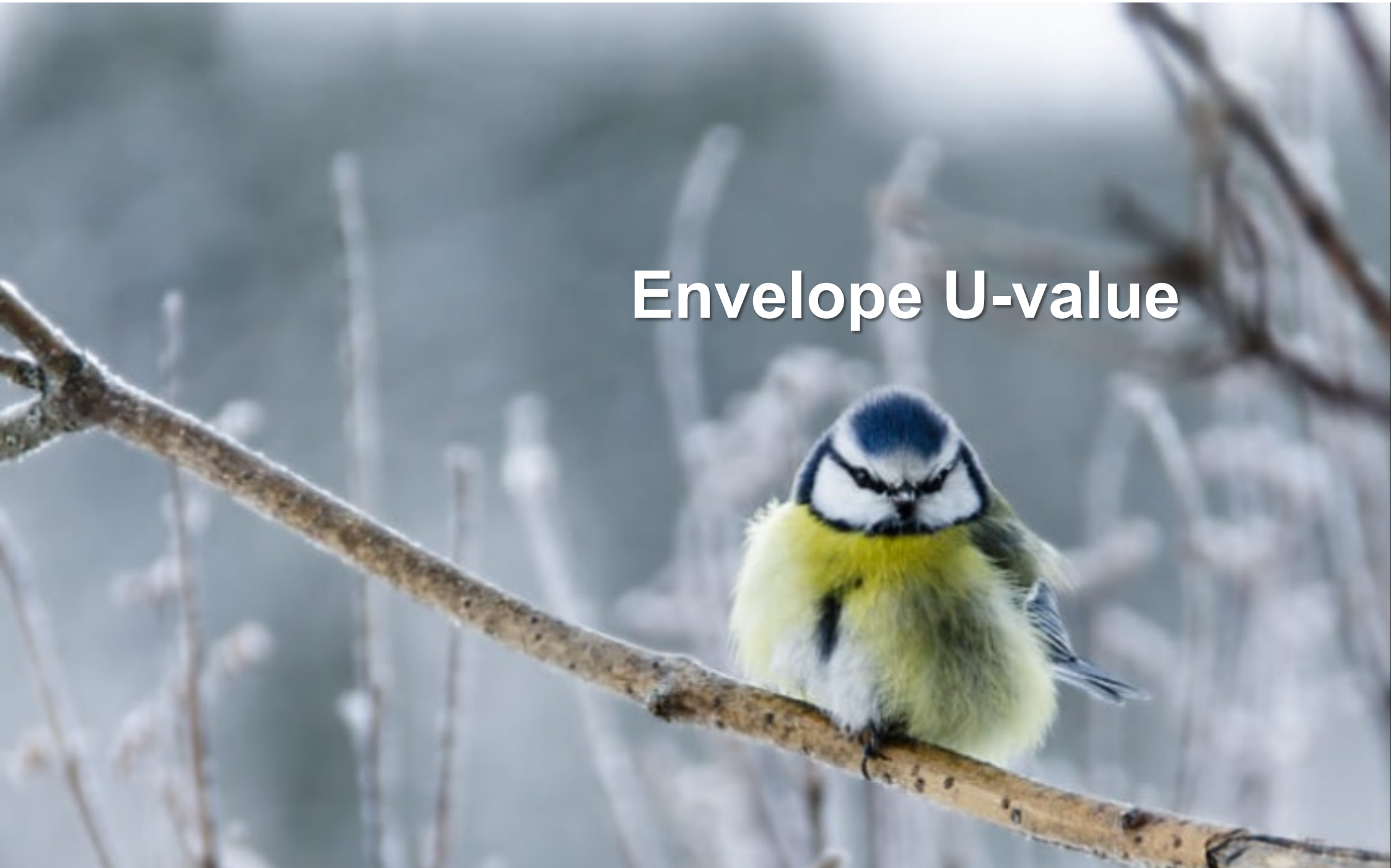
- **Fixed awning plan**
  - Draw a line with the latitude of the area based on the center of the glass.
  - Extrude the structure close to the line.



Shadow at 2pm on the 15th of each month



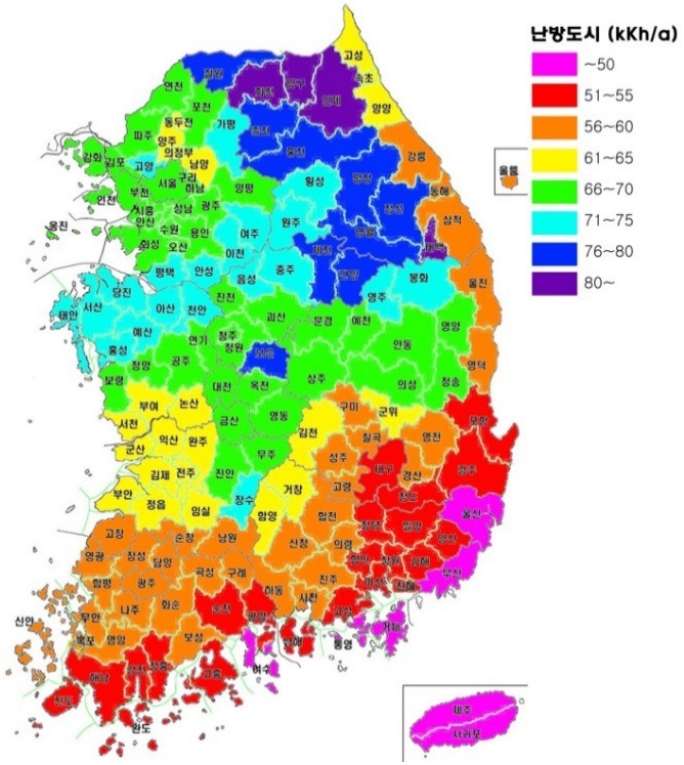
Localization of passive house – Envelope U-value



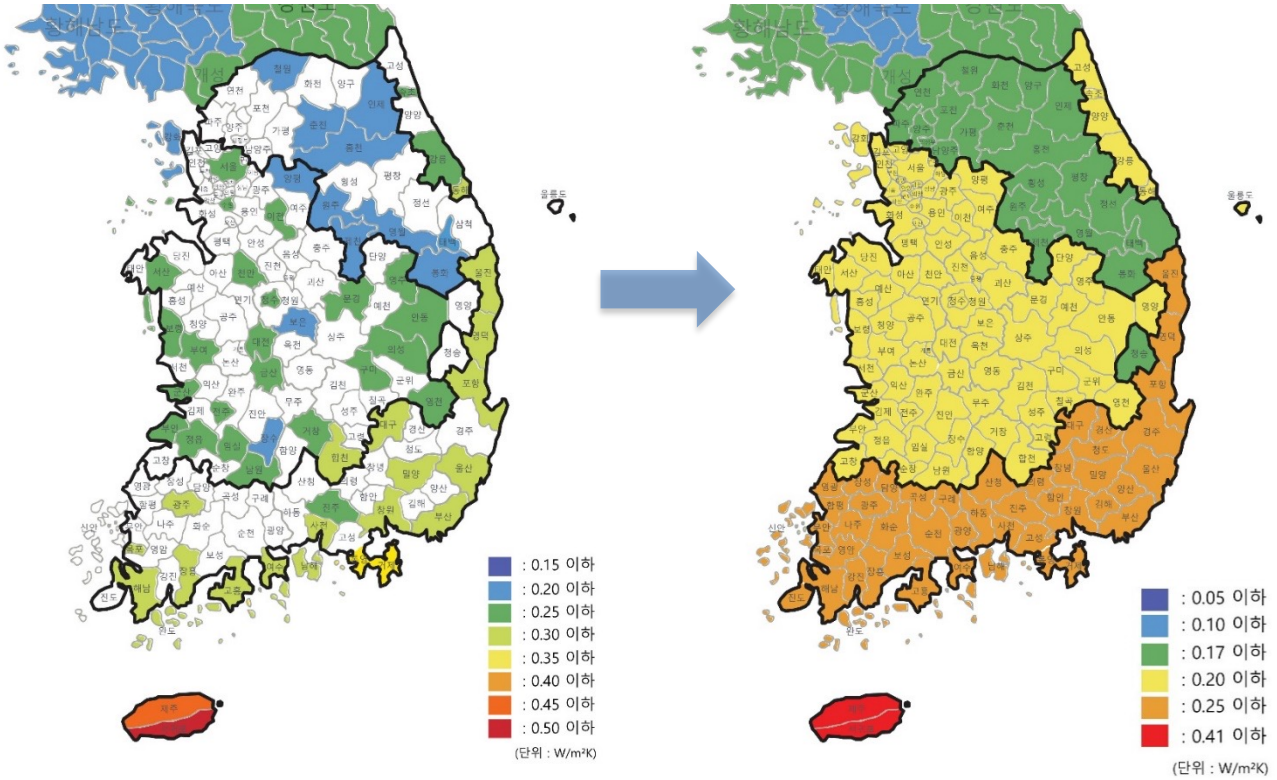
Localization of passive house – Envelope U-value

- **Exterior wall insulation standards based on climate data**
  - Insulation performance analysis to prevent condensation mold in the corner of the exterior wall

- Heat Degree Hours in South Korea

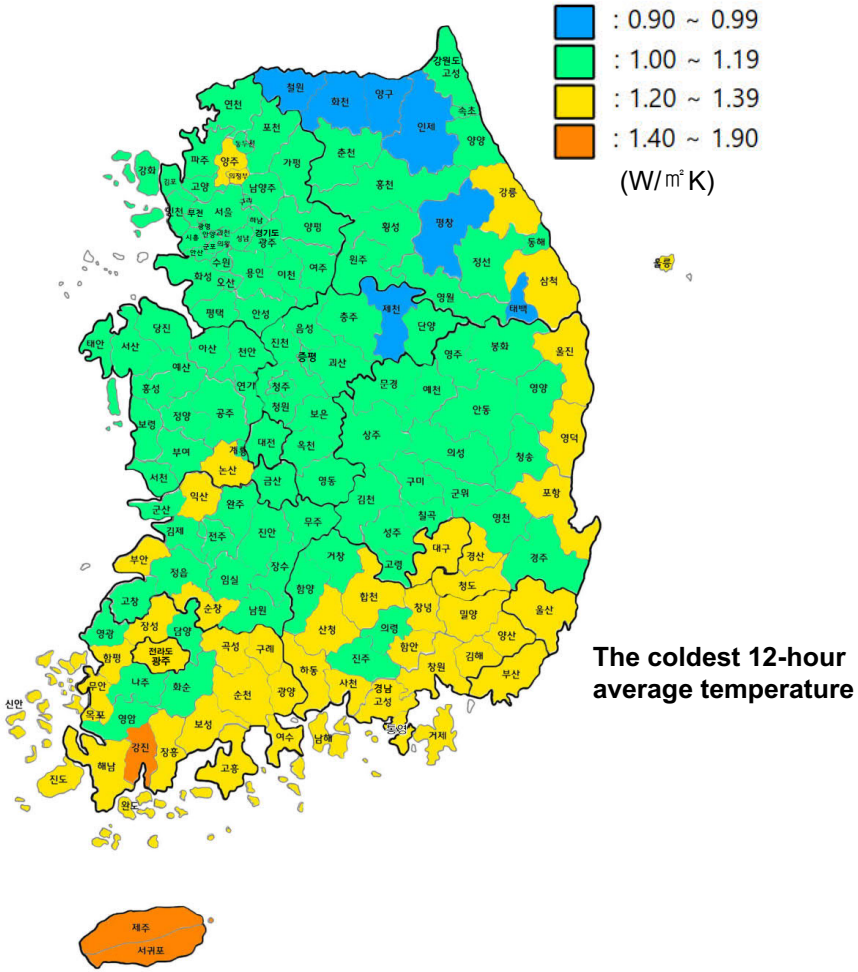


- current law and Organized by region



Localization of passive house – Envelope U-value

- **Window Performance by Climate**
  - The temperature difference between the inner wall and the window surface is 3K or less
  - Conditions under which cold drafts do not occur around windows

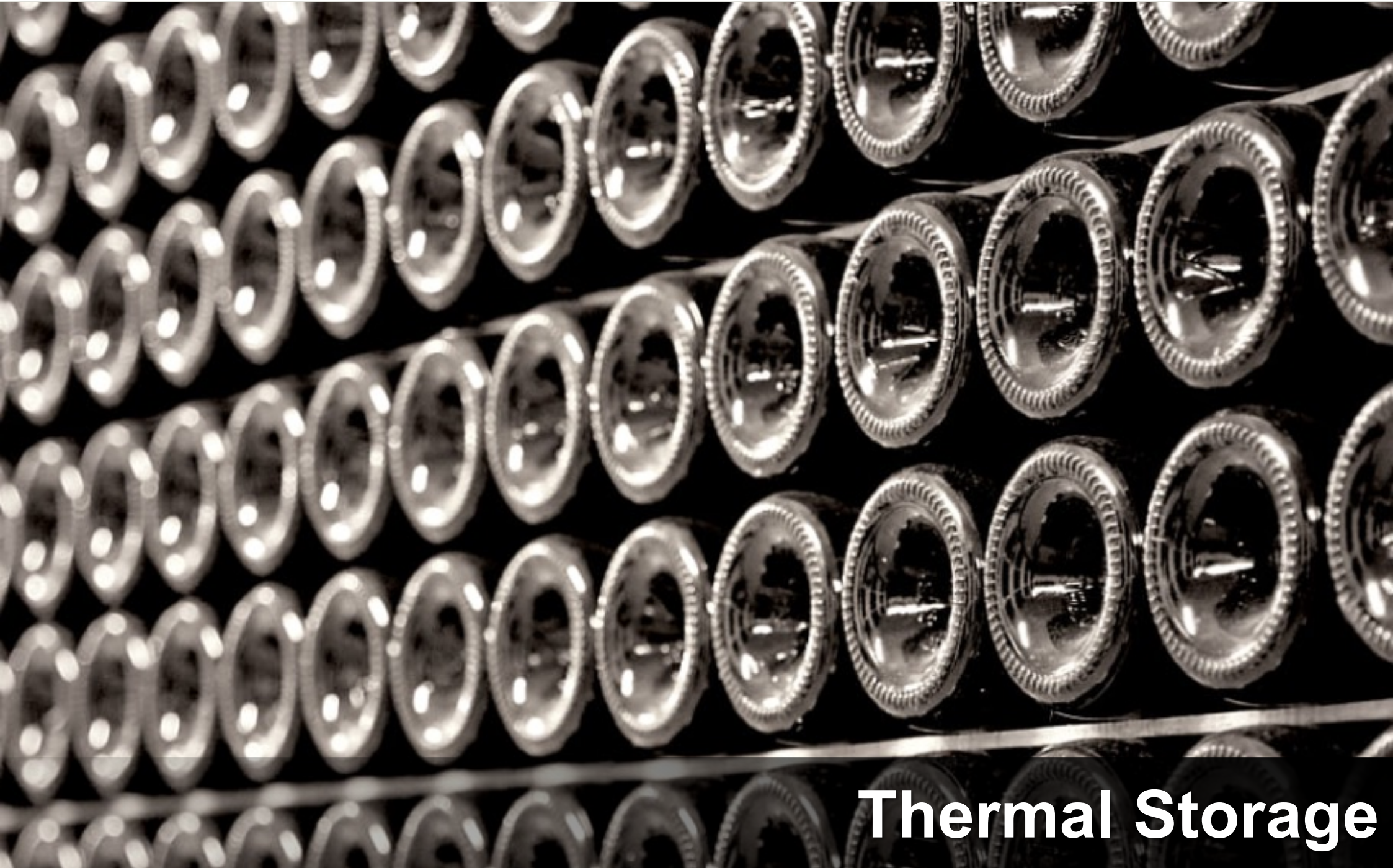


The coldest 12-hour average temperature

- Conditions that do not generate cold drafts based on the coldest 12-hour winter temperature interval

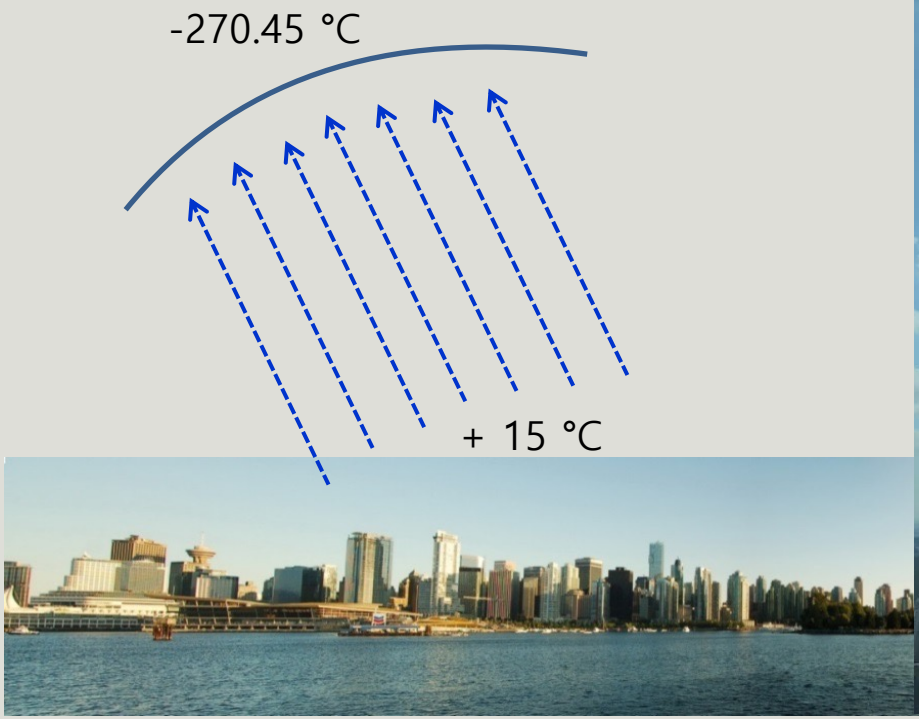
  Uw = 4.2K / [1.1(m^2K/W) X (22℃ - Ext. Temp.)]

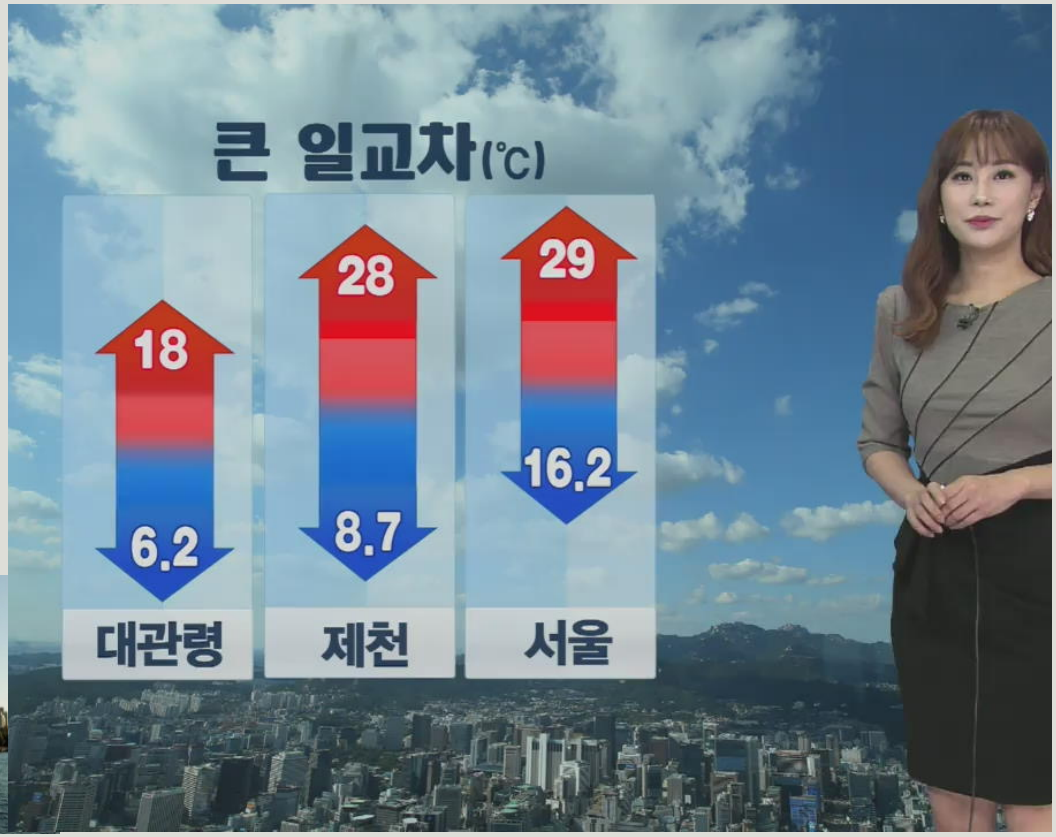
Localization of passive house – Thermal Storage



Localization of passive house – Thermal Storage

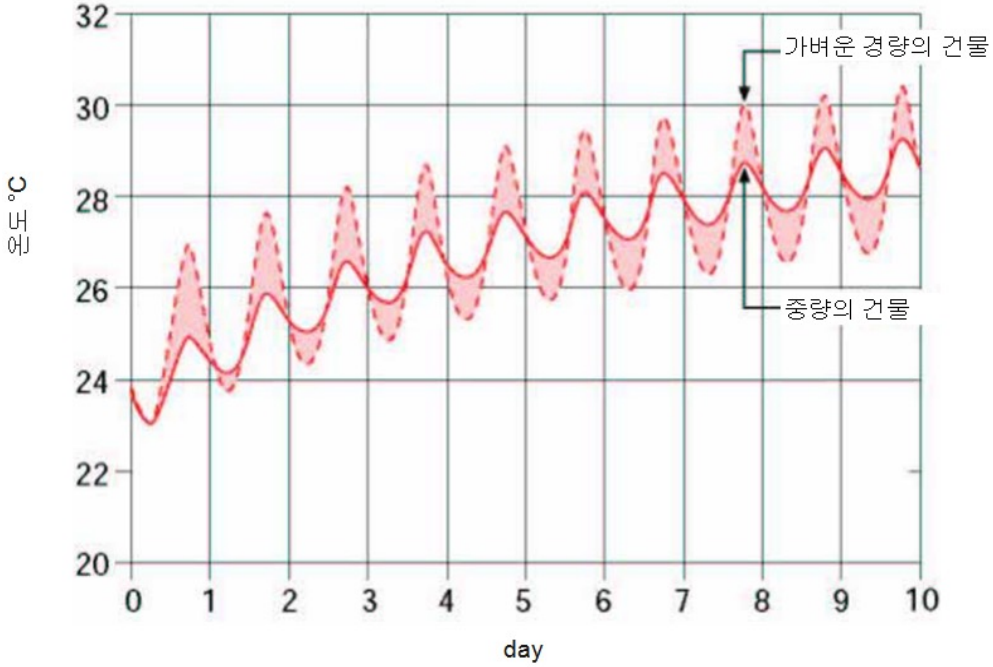
- **Large temperature differences between day and night**
  - Due to the large temperature difference between day and night, it is necessary to plan for facility response capability and comfort level management.



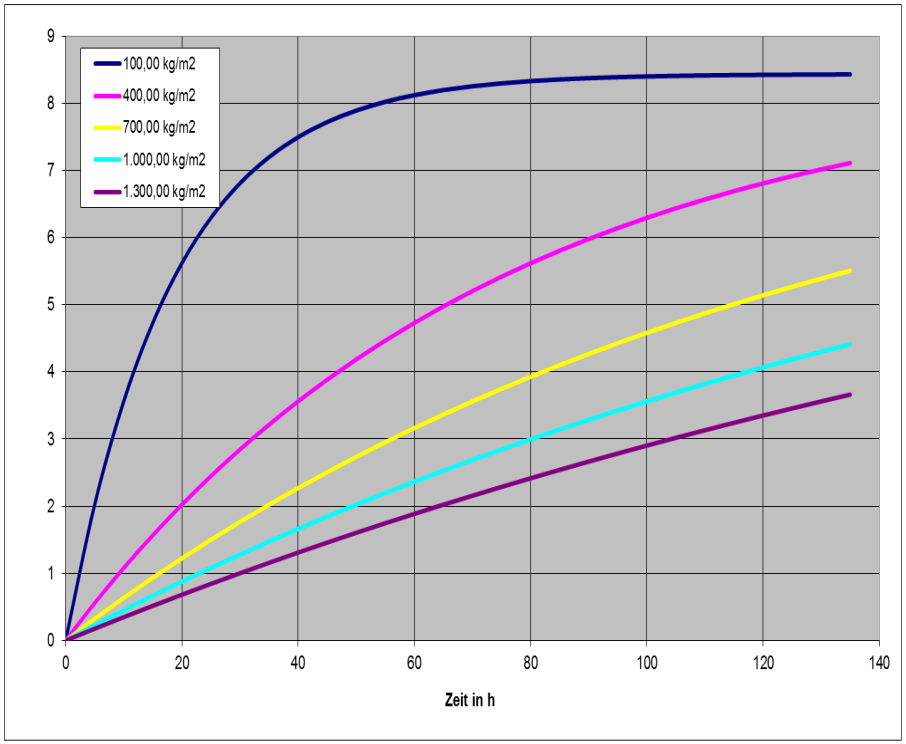


Localization of passive house – Thermal Storage

- **Effect of heat storage performance**
  - By using the thermal storage performance, it is possible to prevent the indoor temperature from changing rapidly when the outside temperature changes greatly.



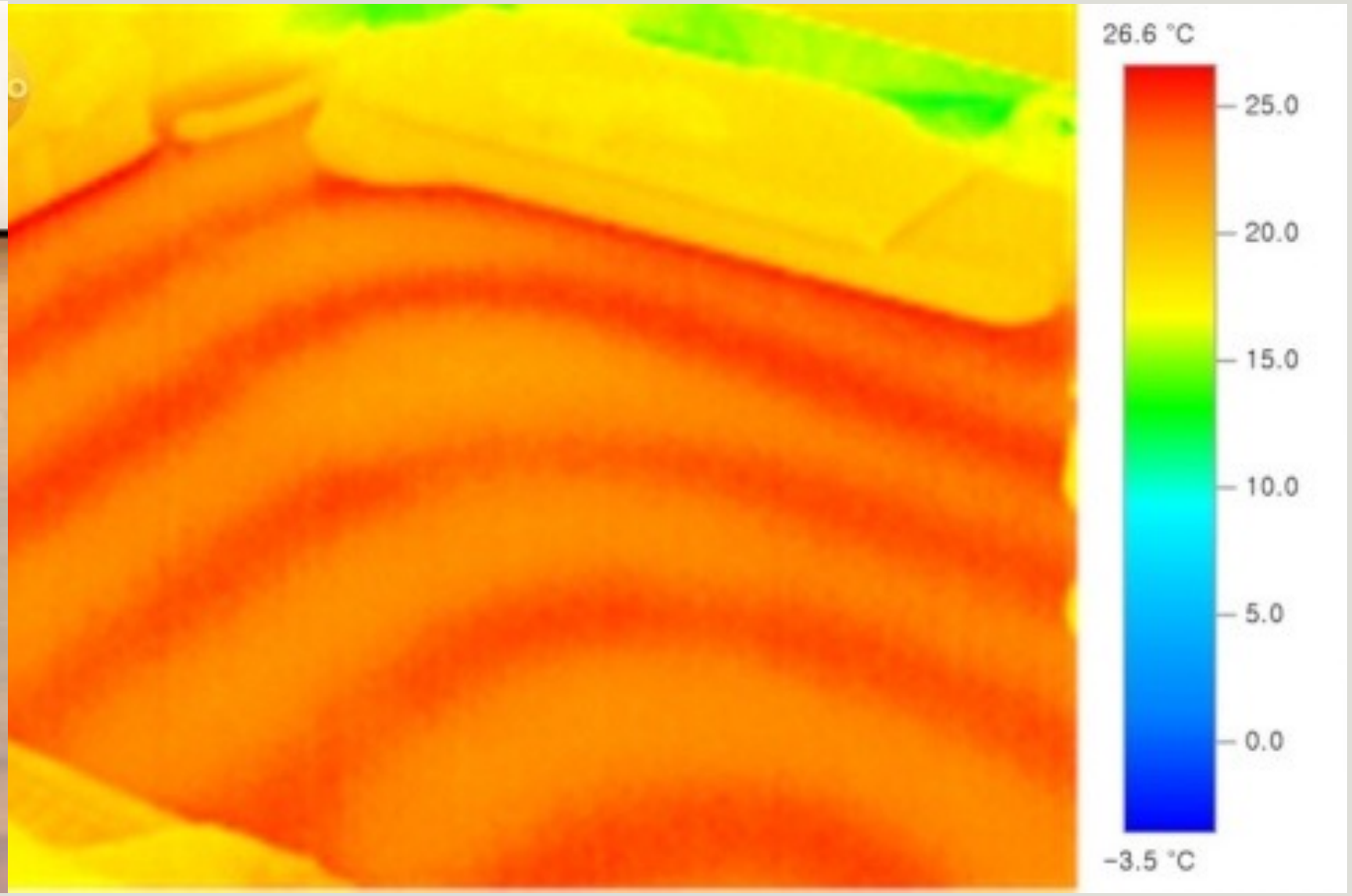
출처: Eine Initiative des Bundesministeriums Für Verkehr, Innovation und Technologie, Haus der Zukunft, Passivhausschulungsunterlage



Localization of passive house – lifestyle

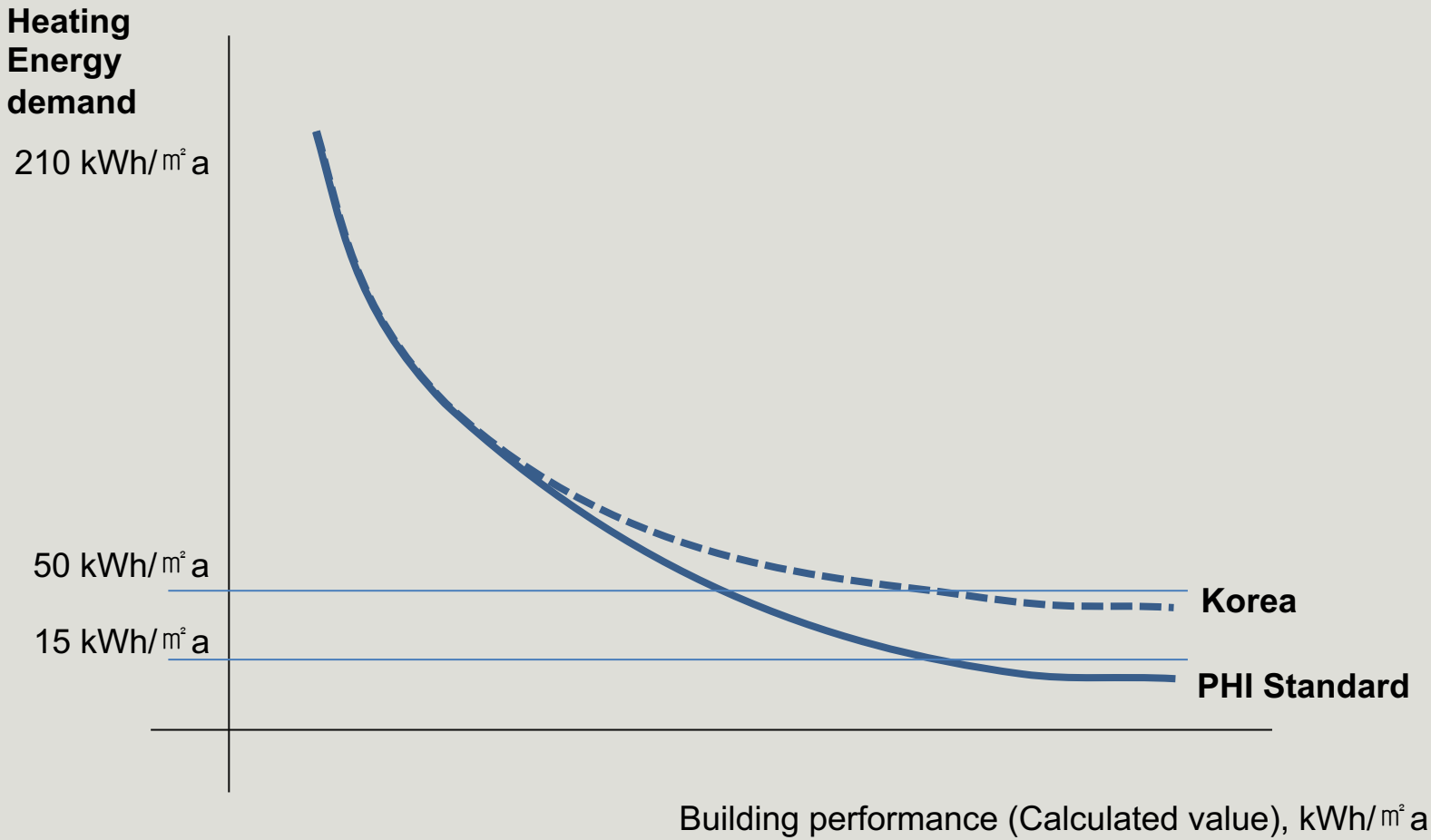
Localization of passive house – lifestyle

- **Different lifestyle**
  - The floor heating method used in Korea for more than 1000 years is being applied to residential facilities in a modified form in modern architecture.



Localization of passive house – lifestyle

- **Criteria suitable for local residential culture**
  - In early days of Korean passivehouse, heat is stored in mortal with high-temperature boiler. And it got worse when it release its heat during morning, the time when it starts to obtain solar radiation. It cause an overheating and people tend to open the window because of it.

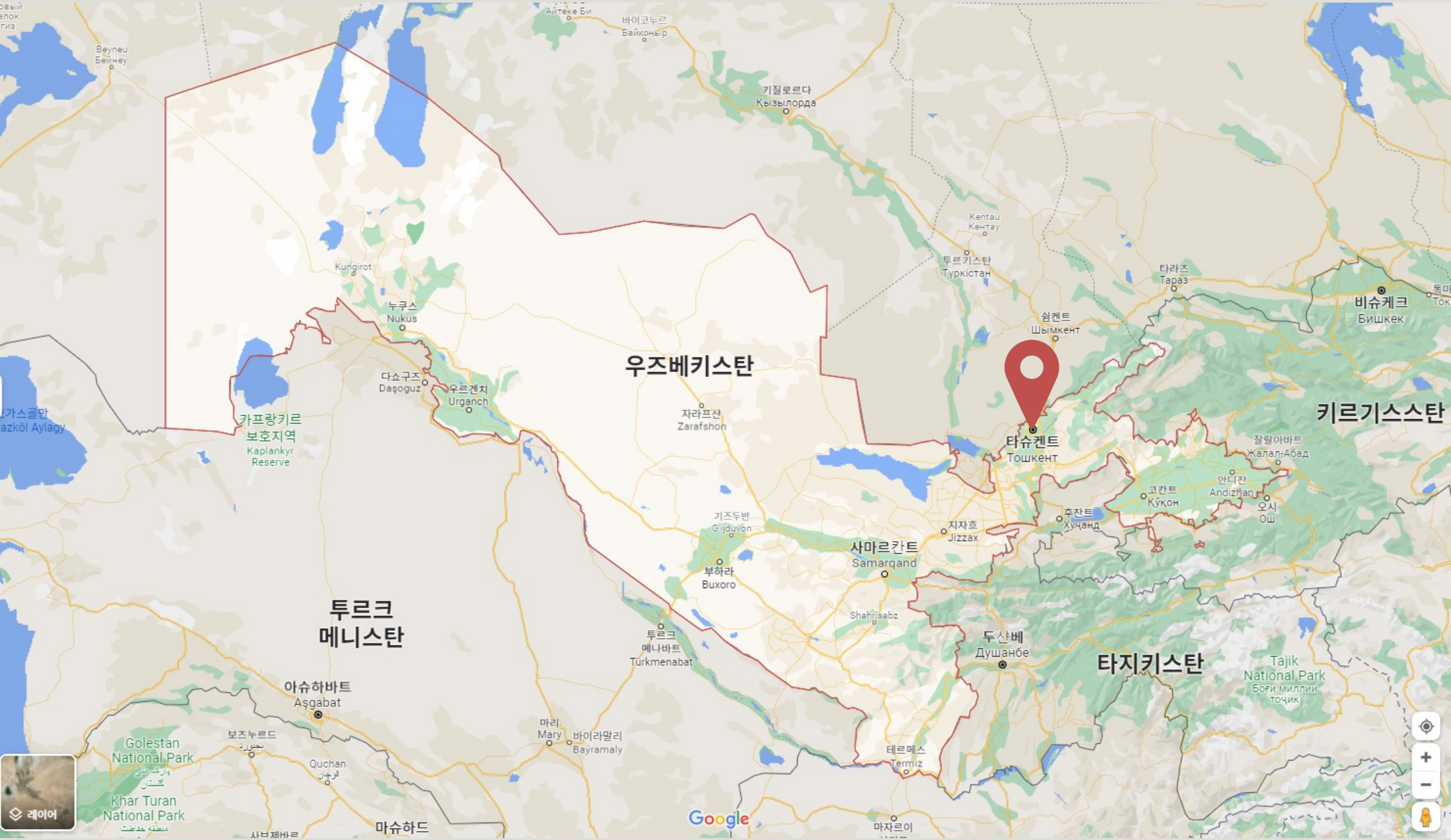


Localization of passive house – lifestyle

▪ Passive House standard in PHIKO

		German	Korea
U-value	Ex. Wall	0.15 W/m²·K	**0.15 ~ 0.18 W/m²·K**
	roof	0.15 W/m²·K	**0.12 ~ 0.15 W/m²·K**
	U-glass	0.8 W/m²·K	**0.9 ~ 1.4 W/m²·K**
	U-frame	0.8 W/m²·K	**0.8 ~ 1.4 W/m²·K**
	U-window	0.85 W/m²·K	**0.9 ~ 1.5 W/m²·K**
	door	0.8 W/m²·K	**1.2 W/m²·K**
g-value	glass g-value (SHGC)	0.5	**0.4**
Heat Exchanger	Efficiency	75%	**75%**
	Power Consumption	0.45 W/m³h	**0.50 W/m³h**
Performance	Air tightness	0.6 /h @ 50Pa	**1.0 /h @ 50Pa**
	Heating Demand	15 kWh/m²a	**50 kWh/m²a**
	primary energy consumtion	120 kWh/m²a	**150 kWh/m²a**

Localization of passive house

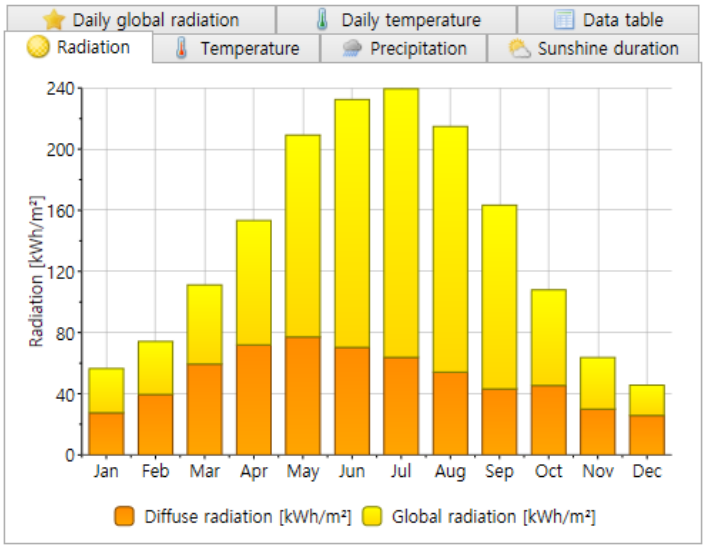


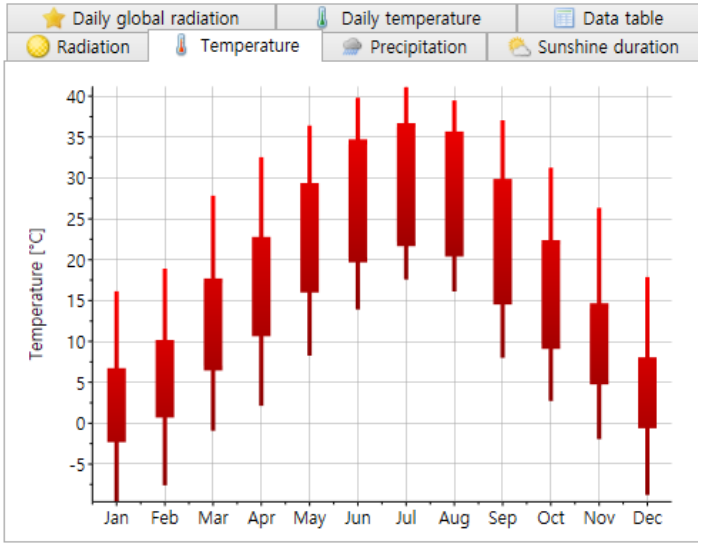
Localization of passive house

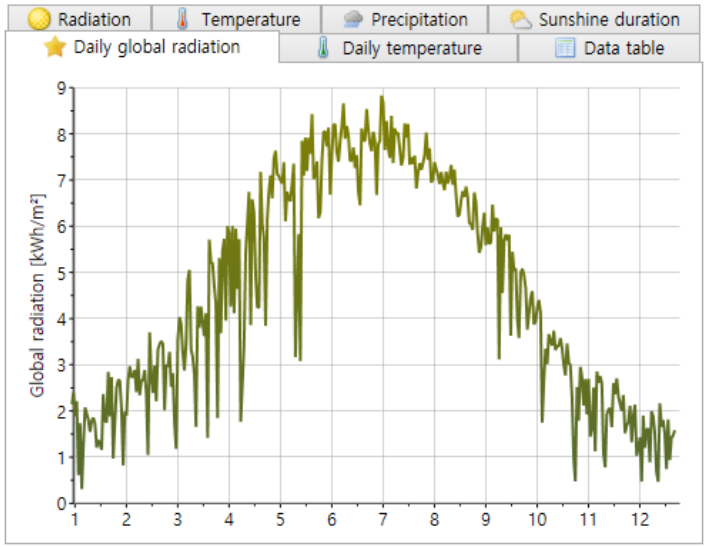
- **Tashkent City Park**

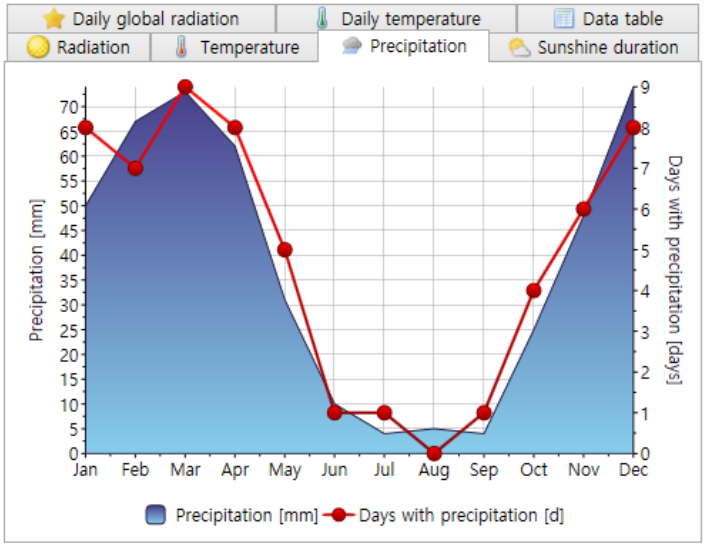
Localization of passive house

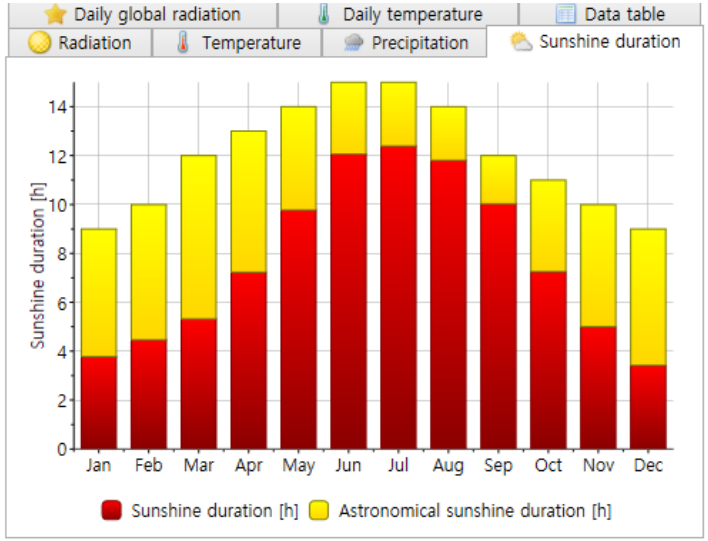
- **Tashkent City Park – climate data**

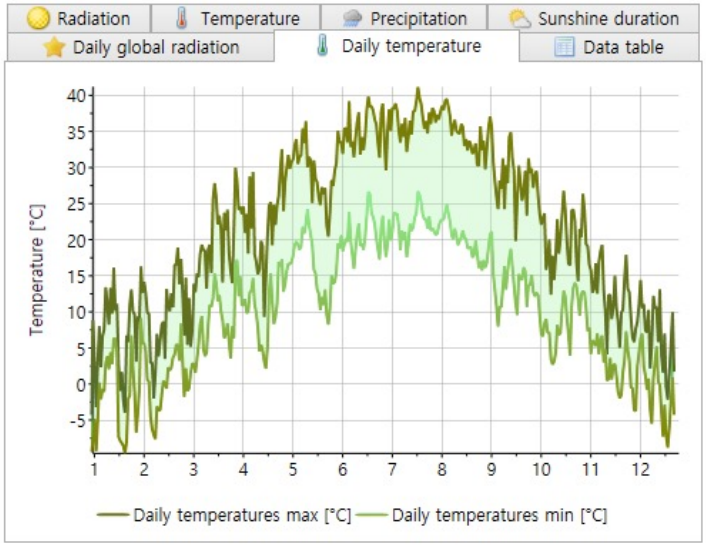






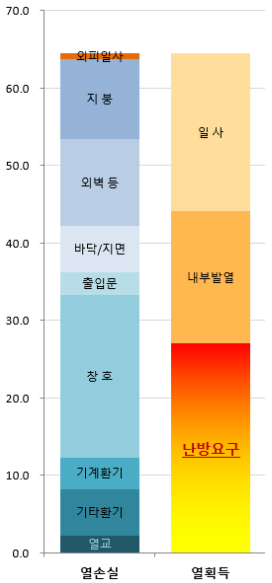






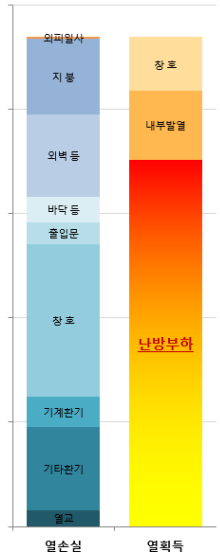
Localization of passive house

- **Heating demand Seoul & Tashkent City Park**
  - The same building was compared by applying the climates of Seoul and Tashkent.



Seoul

27.06 kWh/㎡a



Tashkent City Park

21.59 kWh/㎡a

Zero Energy Building - EDC

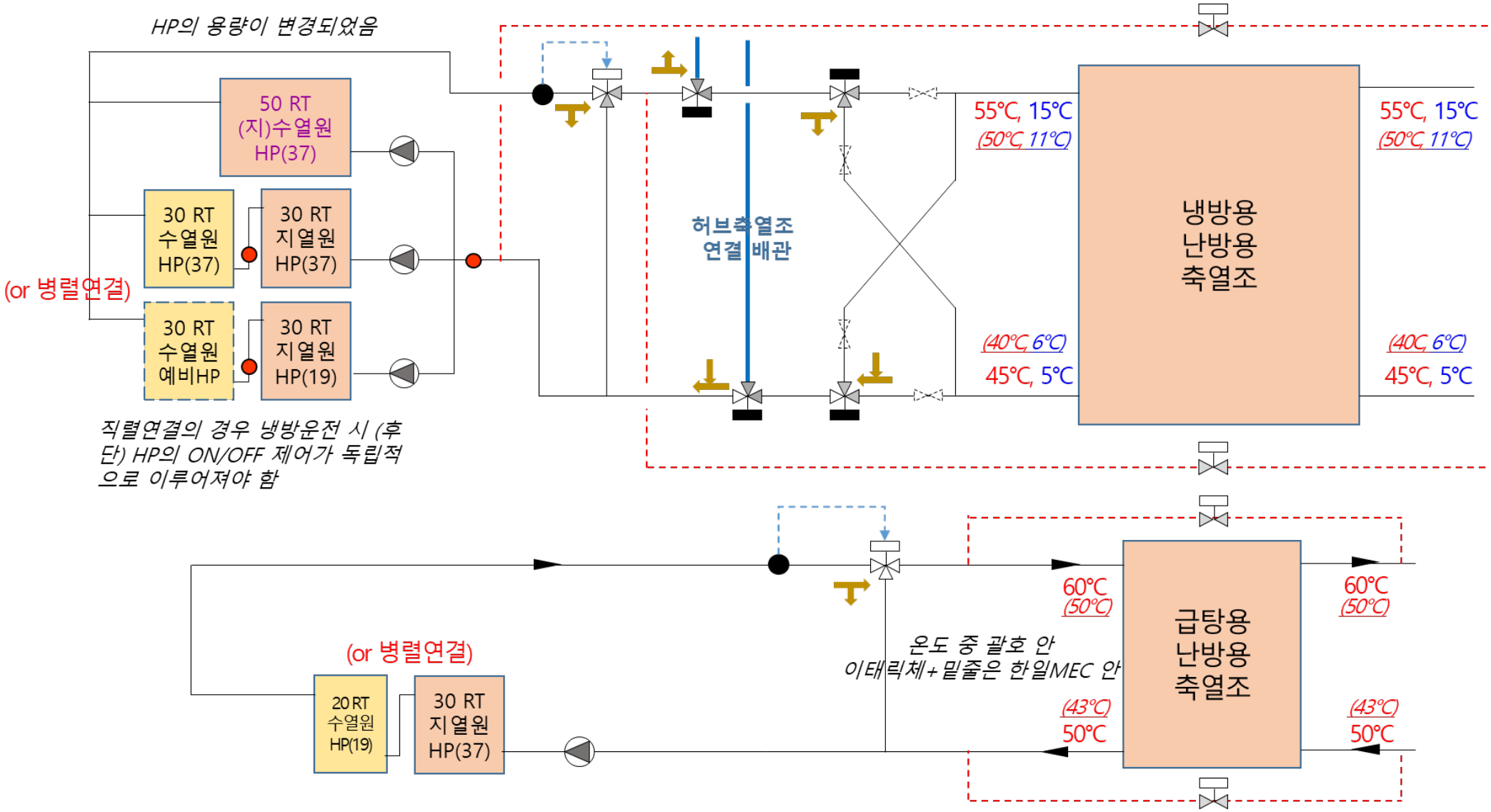
Zero Energy Building - EDC

- **solar power panel**

- Detached house energy self-sufficiency rate 109%
- Public Relations Hall Housing Energy Self-Reliance Rate171%

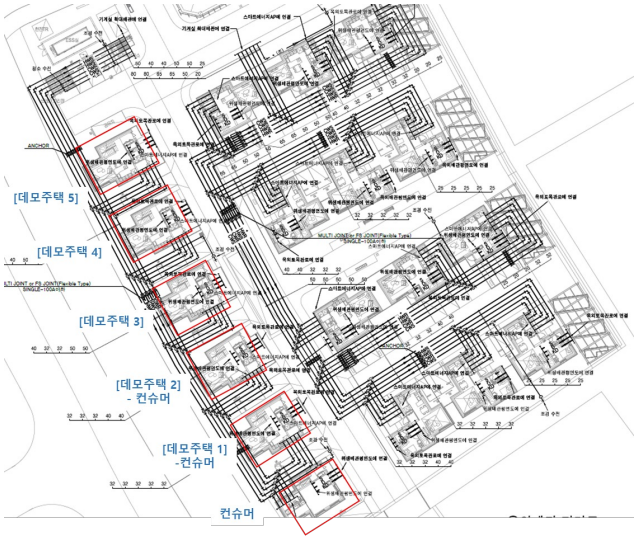
Zero Energy Building - EDC

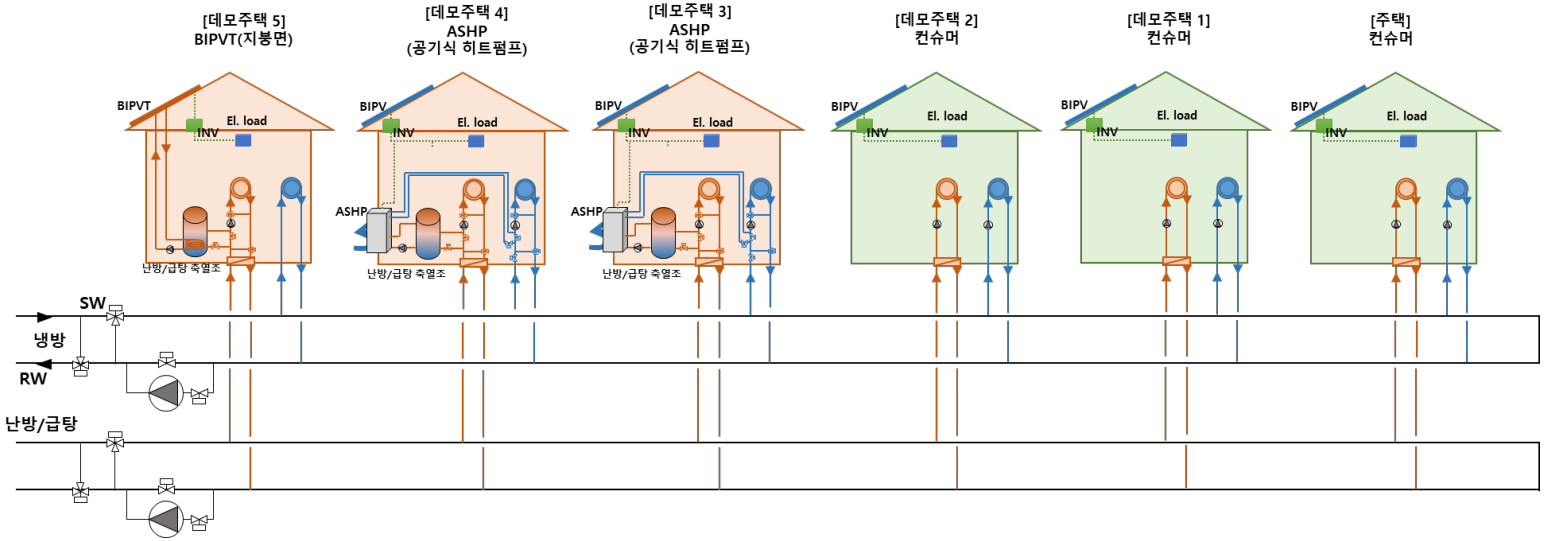
- **Geothermal source heat pump system & Water source heat pump system**

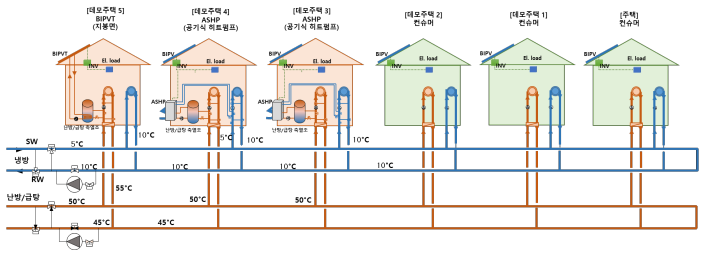


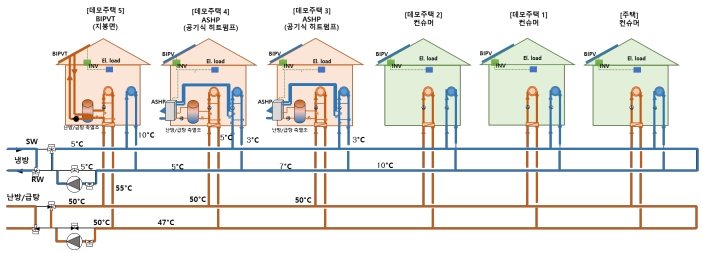
Zero Energy Building - EDC

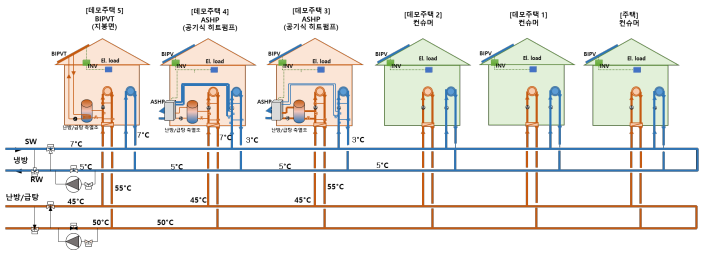
- **Geothermal source heat pump system & Water source heat pump system**





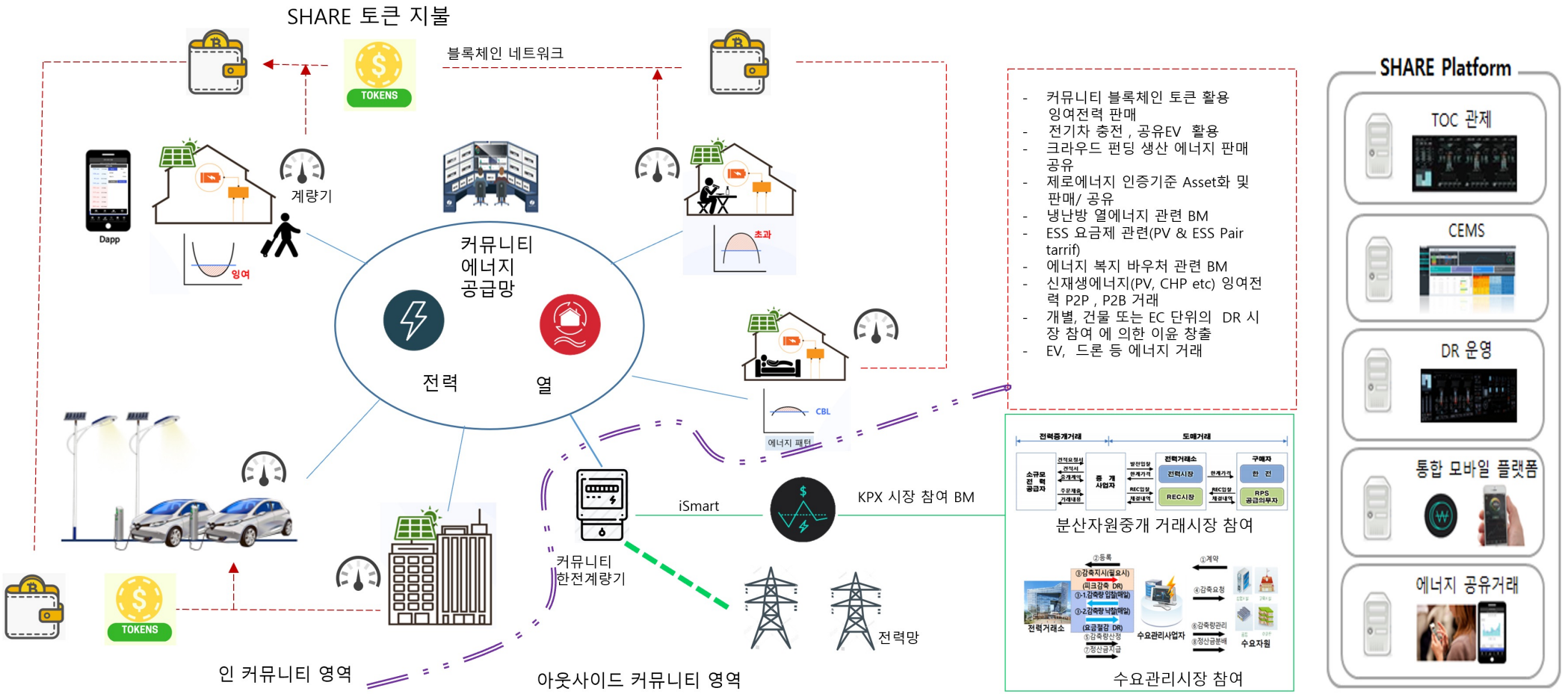






Zero Energy Building - EDC

▪ Energy sharing platform development and business model development



Modernization of Uzbekistan Building Code (UBC) System

Thank you

국토교통부
Ministry of Land, Infrastructure and Transport

해외건설협회
International Contractors Association of Korea

KICT
한국건설기술연구원

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KOREA RESEARCH INSTITUTE FOR CONSTRUCTION POLICY