

› Annex 62 “Ventilative Cooling” - activities towards future buildings -

Future Buildings Forum
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LIXIL Link to
Good Living



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- › What is “Ventilative Cooling”?
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The objectives of Annex62

- › To analyse, develop and evaluate methods and tools for prediction of cooling need, ventilative cooling performance and risk of overheating in buildings that are suitable for design purposes
- › To give guidelines for integration of ventilative cooling in energy performance calculation methods and regulations including specification and verification of key performance indicators
- › To extend the boundaries of existing ventilation solutions and their control strategies and to develop recommendations for flexible and reliable ventilative cooling solutions that can create comfortable conditions under a wide range of climatic conditions.
- › To demonstrate the performance of ventilative cooling solutions through analysis and evaluation of well-documented case studies.

What is “Ventilative Cooling” ?

- › Ventilative Cooling is application (distribution in time and space) of ventilation flow rates to reduce cooling loads in buildings
- › Ventilative Cooling utilizes the cooling and thermal perception potential of outdoor air
- › In Ventilative Cooling the air driving force can be natural, mechanical or a combination

Table. Overview of typical ventilative cooling strategies applied depending on outdoor climatic conditions and type of ventilation system.

		Ventilation System		
		Natural	Hybrid	Mechanical
Daytime mean outdoor temperature	Cold (<10°C from comfort zone)	Minimize air flow rate – draught free air supply	Mechanical – heat recovery to ensure draught free supply, increasing air flow rate	Mechanical – heat recovery to ensure draught free supply, increasing air flow rate
	Temperate (2-10°C)	Increasing air flow rate from minimum to maximum	Natural – increasing air flow rate from minimum to maximum	Mechanical – reducing heat recovery, increasing air flow rate
	Hot and dry (<2°C)	Minimum air flow rate during daytime Maximum during night time	Mechanical – minimum air flow rate during daytime Natural – maximum during night time	Mechanical – minimum air flow rate during daytime, maximum during night time
	Hot and humid	-	Mechanical cooling / dehumidification	Mechanical cooling / dehumidification

Deliverables of Annex62

<i>Official deliverables</i>		<i>Target group</i>
1	Overview and state-of-the-art of Ventilative Cooling	Research community and associates. Policy makers
2	Ventilative Cooling Source Book	Building component and HVAC-system developers and manufacturers. Architects, engineering offices and consultants
3	Ventilative Cooling case studies	Architects and consultants
4	Ventilative Cooling Design Guide	Architects, engineering offices and consultants
5	Recommendations for legislation and standards	Policy makers and experts in building energy performance standards and regulation
6	Project Summary Report	Research community and associates + EBC Program

1. Ventilative Cooling State-of-the-art Review

- › Edited by Prof. Per Heiselberg and Prof. Maria Kolokotroni
- › This document have been published in 2015
- › This document can be downloaded from Annex62 website <http://www.iea-ebc.org/projects/ongoing-projects/ebc-annex-62/>

EBC Energy in Buildings and Communities Programme

Ventilative Cooling

STATE-OF-THE-ART REVIEW

Edited by Maria Kolokotroni and Per Heiselberg

IEA – EBC Programme

Chapter 2: Potentials and Limitations to Ventilative Cooling

Figure 2.1. Ranges for heating, free-cooling temperature is higher than the outdoor temperature.

[4] Expresses the need for cooling in a building the year given by the following equation:

$$DH_{T_c} = \sum [(T_{r,i}(t) - T_{c,i}(t)) \Delta t(t)]_0^{T_{c,i}(t) > T_{r,i}(t)}$$

Similarly is the free cooling potential given by:

$$DF_{T_c} = \sum [(T_{r,i}(t) - T_{c,i}(t)) \Delta t(t)]_0^{T_{c,i}(t) < T_{r,i}(t)}$$

And the mechanical cooling need by:

$$DH_{me} = \sum [(T_{r,i}(t) - T_{c,i}(t)) \Delta t(t)]_0^{T_{c,i}(t) > T_{r,i}(t)}$$

The energy saving potential by ventilative cooling is the summation of cooling degree-hours.

The energy use for cooling will depend on the mechanical and naturally ventilated buildings for the European climatic conditions for buildings [9] is compared to the ASHRAE ventilation [12].

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Chapter 2: Potentials and Limitations to Ventilative Cooling

Figure 2.3. Energy consumption and savings Case of comfort range of fully HVAC building cooling. Case of ASHRAE comfort range: (c) Case of natural ventilation with 90% acceptable cooling. Case of natural ventilation with 80% percentage of free-cooling: (4).

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Chapter 2: Potentials and Limitations to Ventilative Cooling

Figure 2.6. Cumulative frequency distribution of cooling degree-hours for various locations: [13].

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Chapter 4: Exemplary Existing Buildings using Ventilative Cooling

4.2.2 C-DtI ARFRISOL CEDER

Building name	C-DtI ARFRISOL CEDER	Year of completion	2009
Location	Altes de Lubia, Sorla, Spain	Climate Zone	Temperate coastal climate
Net floor area	1088 m ²	Orientation of main facades	S
Design Team	ALIA, S.L. with advisory from C		

Site data

HDD		CDD		Urban		Suburban	
No.	T _s	No.	T _s				
2850	18	0 ^a	24	x	x		

*NOTE: Cooling Degree Days for CEDER, calculate average of the summer maximum temperatures location.

Architectural design philosophy for reduction/removal of cooling demand and risk of overheating

The refurbishment of this office building has been techniques to reduce the energy demand and risk of overheating.

During the summer time, the combination of the differential insulation treatment of facades shading devices, the adiabatic refrigeration produced by the exchange of heat of the radiative borehole-coupled absorption pumps fed by solar energy.

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Chapter 4: Exemplary Existing Buildings using Ventilative Cooling

4.2.7 HOME FOR LIFE

Building name	Home for Life	Year of completion	2009	Type of building	Residential
Location	Lystrup, Denmark	Climate Zone	Temperate coastal climate		
Net floor area	190 m ²	Orientation of main facades	S		
Design Team	AART Architects A/S, Ebsensen Engineering A/S				

Outside view of building

Site data

HDD		CDD		Urban		Suburban		Rural		Dust pollution		Noise pollution		High humidity		Prevailing wind direction		Altitude (m)		
No.	T _s	No.	T _s																	
2906	17	45	20	x	✓	x				No	No	Moderate	Winter: NNW						~50	
																				Summer: SSE

Architectural design philosophy for reduction/removal of cooling demand and risk of overheating

The principal architectural idea in Home for Life is to unite single-family house requirements to indoor environment qualities, experience, functionality and very low energy consumption in an integrated design. The window area constitutes 40% of the building floor area and it is the light incidence, the active facade, the relationship between indoors and outdoors and the flexibility of the house that gives the house its high architectural quality. Even though the Danish climate is cool, many new-build low energy houses have shown serious overheating, even outside the summer period. In Home for Life, a combination of controlled solar protection, natural ventilation through automated window openings, and moderate thermal mass in the building secures that a cooling demand is avoided despite the large window area and the very well insulated building envelope.

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LIXIL

Energy Technology Network

Deliverables of Annex62

2. Ventilative Cooling Source Book

- › This source book will be a knowledge base of Ventilative Cooling
- › Content
 - List of software including recommendations on their area of application, limitations, ...
 - Contains information about design elements, technical components and control strategies
 - Always offering short explanation, KPI's, sources (both professional and scientific)
 - Technologies structured according to SOTAR

Deliverables of Annex62

4. Ventilative Cooling Design Guide

- › This design guide is a code of practice
- › Content
 - Ventilative cooling concepts and strategies
 - Examples of suitable technology applications
 - Primary KPI's (comfort, energy, climate)
 - A well commented collection of design rules, procedure and tools
 - A collection of good advice how to make use of Ventilative Cooling
 - Lessons learned from case studies
 - Design approach, use of tools
 - Key Design Indicators, KDI
 - Solutions, control strategies
 - Recommendations for operation

Deliverables of Annex62

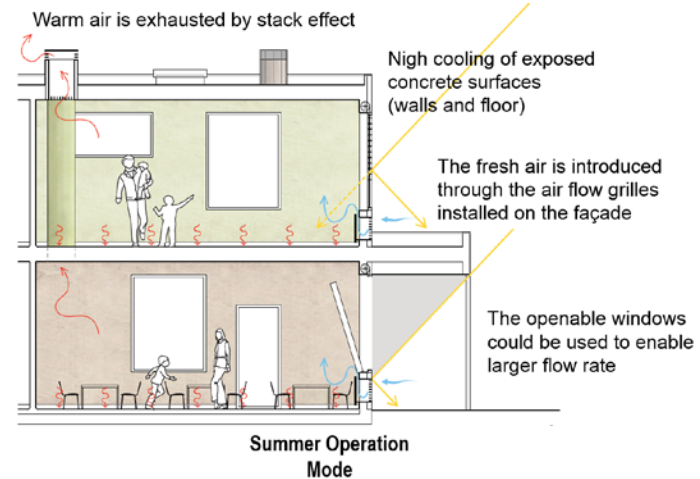
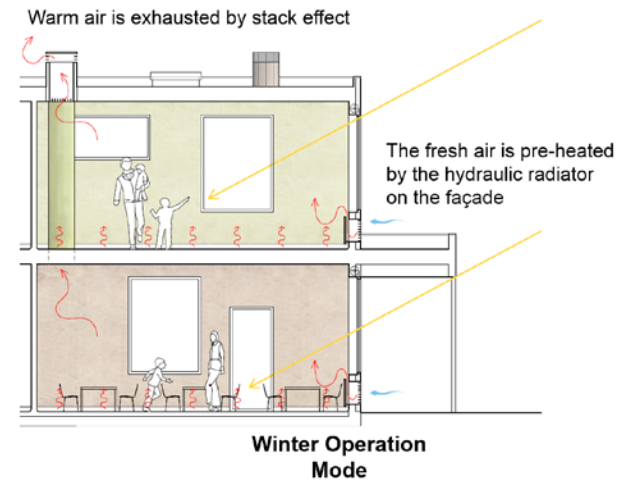
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Deliverables of Annex62

4. Ventilative Cooling Design Guide

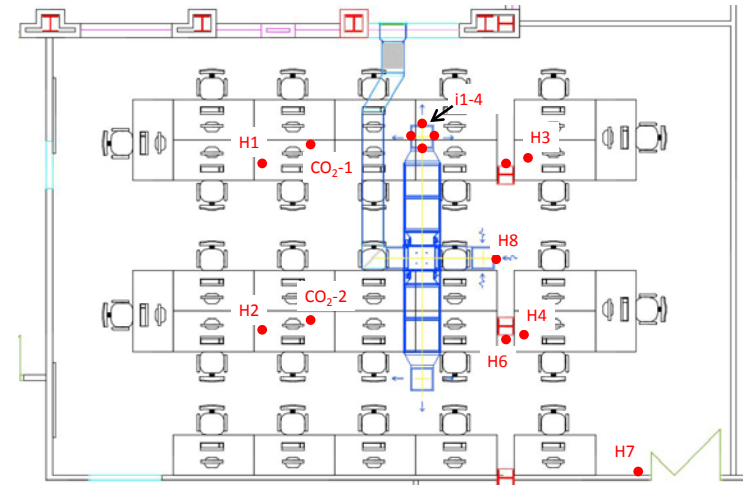
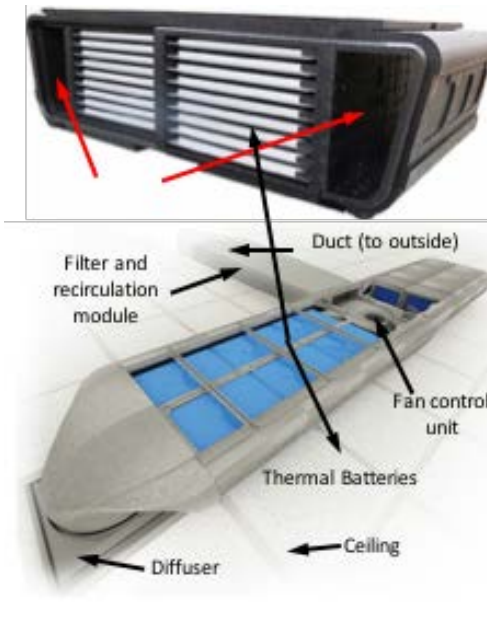
Example 1: Natural air supply, CML Kindergarten, Portugal



Deliverables of Annex62

4. Ventilative Cooling Design Guide

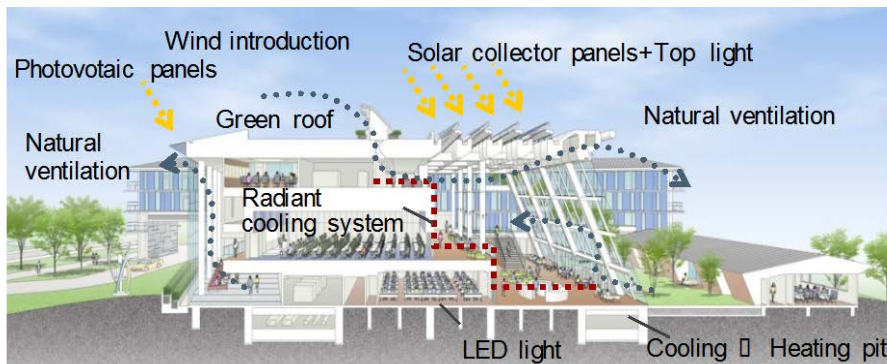
- Example 2: Mechanical Ventilation with increased air supply and energy storage, Bristol University, United Kingdom



Deliverables of Annex62

4. Ventilative Cooling Design Guide

› Example 3: Night time ventilation, Nexus Hayama, Japan



	2011	2012	2013	2014	2015
NV operating time [h/a]	102	146	816	680	1282
AHU operating time [h/a]	1641	467	177	98	128

Deliverables of Annex62

5. Recommendations for legislation and standards

> CEN Standards

› Natural and Hybrid ventilation systems:

- Natural and hybrid ventilation systems in non-residential buildings (N 1586)
Main focus: Indoor air quality
Type: Technical specification
Work proposed to: WG/20 in CEN/TC 156
- Expansion of Natural and Hybrid ventilation in residential buildings in upcoming
"Revision of EN 15665:2009 and CEN/TR 14788:2006" (No NWI # yet)
Main focus: Indoor air quality
Type: E.g. European standard (could be part of revision of EN 15665:2009 + CEN/TR 14788:2006)
Work proposed to: WG/2 in CEN/TC 156

› Ventilative cooling systems

- Ventilative cooling systems (N 1587)
Main focus: Thermal comfort
Type: Technical specification
Work proposed to: WG/21 in CEN/TC 156

Deliverables of Annex62

5. Recommendations for legislation and standards > ISO Standards


› Building environment design:

- Design process of natural ventilation for reducing cooling demand in energy-efficient non-residential buildings (ISO/NP22511)
Main focus: Energy saving
Type: ISO Standard
Work proposed to: WG/2 in ISO/TC 205

Dissemination of Annex62

› “venticool” website

venticool
the international platform for ventilative cooling

IEA EBC
Annex 62
The IEA project
on ventilative cooling
EBC 

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Dear visitor,

Welcome to this combined website of the **venticool platform** and of **IEA EBC Annex 62 – Ventilative Cooling**

★ **SAVE THE DATE for the 39th AIVC & 5th venticool conference 18–19 September 2018, Juan-les-Pins, France**

The 5th venticool conference will be held on 18 and 19 September 2018 in Juan-les-Pins, France together with the 39th AIVC conference and the 7th TightVent conference. More information will follow soon so stay tuned. ...

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Recent updates

- **SAVE THE DATE** for the 39th AIVC & 5th venticool conference 18–19 September 2018, Juan-les-Pins, France
- 38th AIVC – 6th TightVent – 4th venticool joint conference – Final programme released
- Register now for the ventilative cooling workshop on October 23, 2017
- Keynote speakers/topical sessions/list of accepted papers at the 38th AIVC – 6th TightVent – 4th venticool joint

› Ventilative Cooling -> Resilient Cooling

- Further development of overheating prevention by passive cooling
- Further development of natural cooling such as night ventilation components together with PCM, comfort ventilation, including direct and indirect adiabatic effects
- New developments in effective sun protection, reflective coatings, shading and evaporative effects from plants.
- Further development of energy efficient and adaptive active cooling devices, ready for use in renovation
- Possibly including heat storage effects for increased robustness against blackouts and for lowering/shifting

Perspectives for the future

- › Future house with strategic control of thermal comfort
 - U²(U-square)-Home II : the experimental future house
 - Constructed in 1998, renovated in 2016
 - Fit to current Japanese energy saving standard



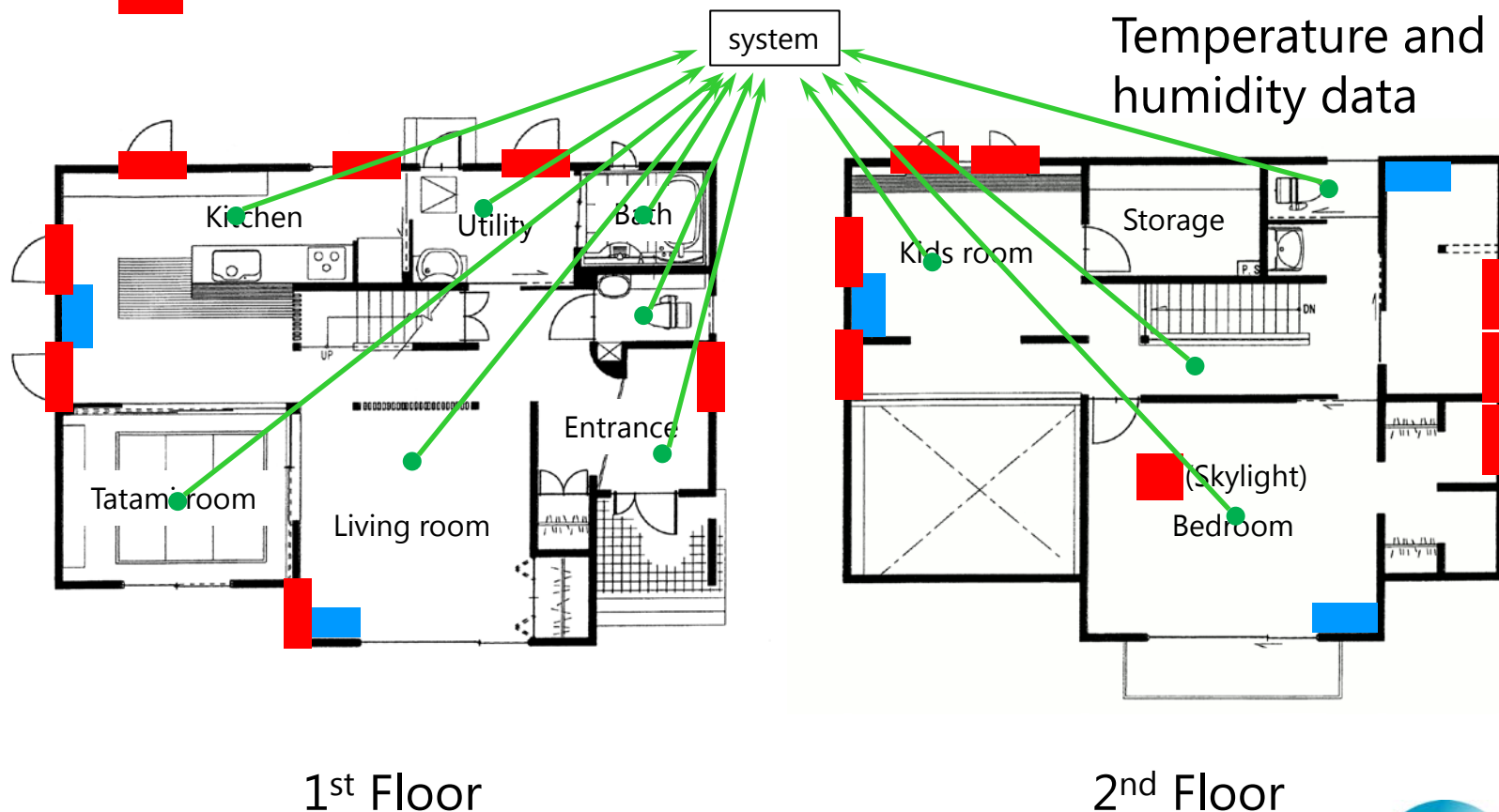
› Background

- The performance of heat insulation of buildings has been improved in these years.
- Temperate condition can be maintained easier and longer than old buildings, with lower energy.
- Once the occupants turned on cooling devices, it is difficult for the occupants to realize the external air condition.
- The occupants tend to keep cooling devices working even if external air temperature is lower than indoor.

Perspectives for the future

› Future house with strategic control of thermal comfort

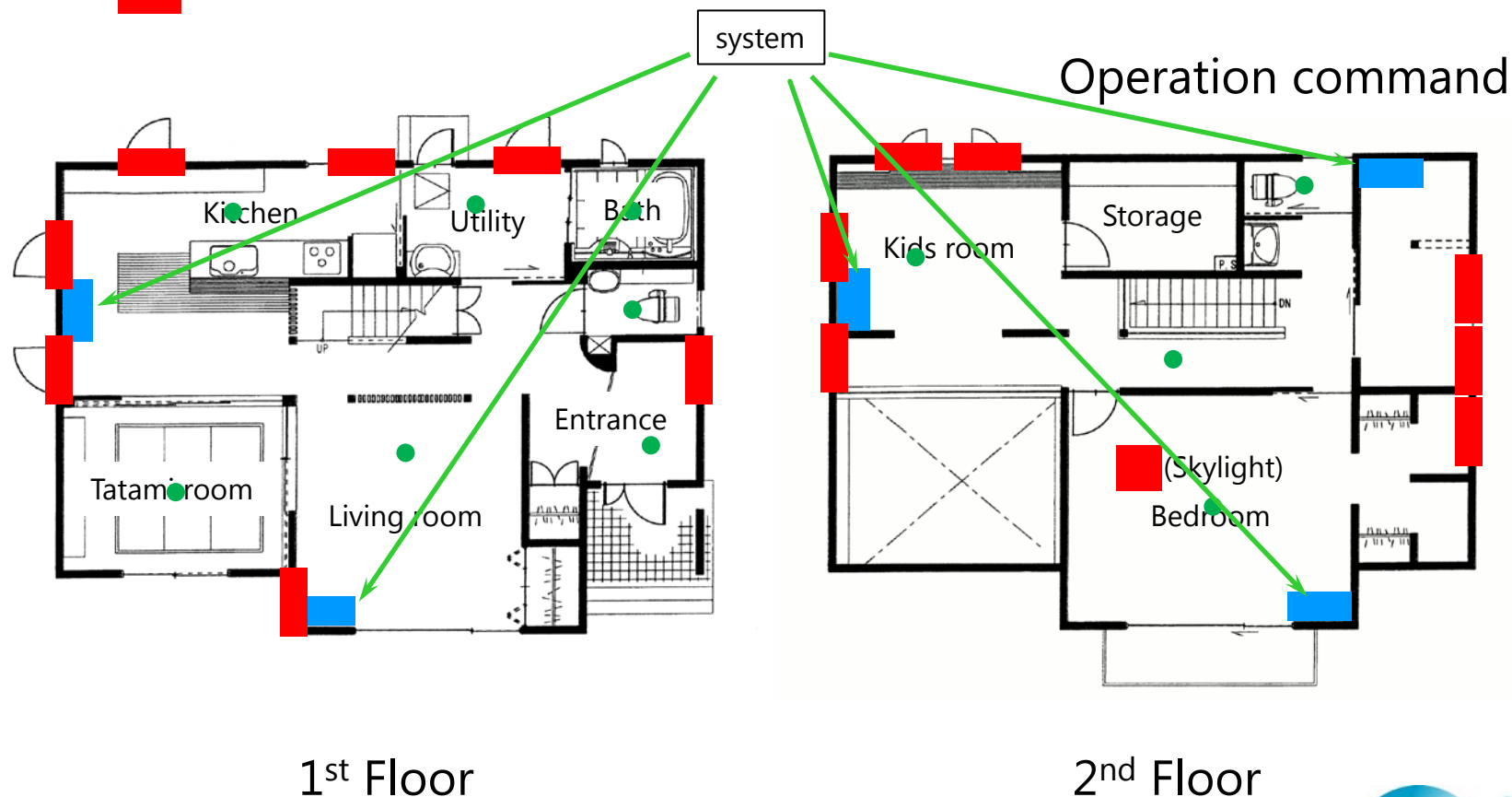
- Cooling devices
- Windows with actuator
- Thermometer, Hygrometer



Perspectives for the future

Future house with strategic control of thermal comfort

- Cooling devices
- Windows with actuator
- Thermometer, Hygrometer



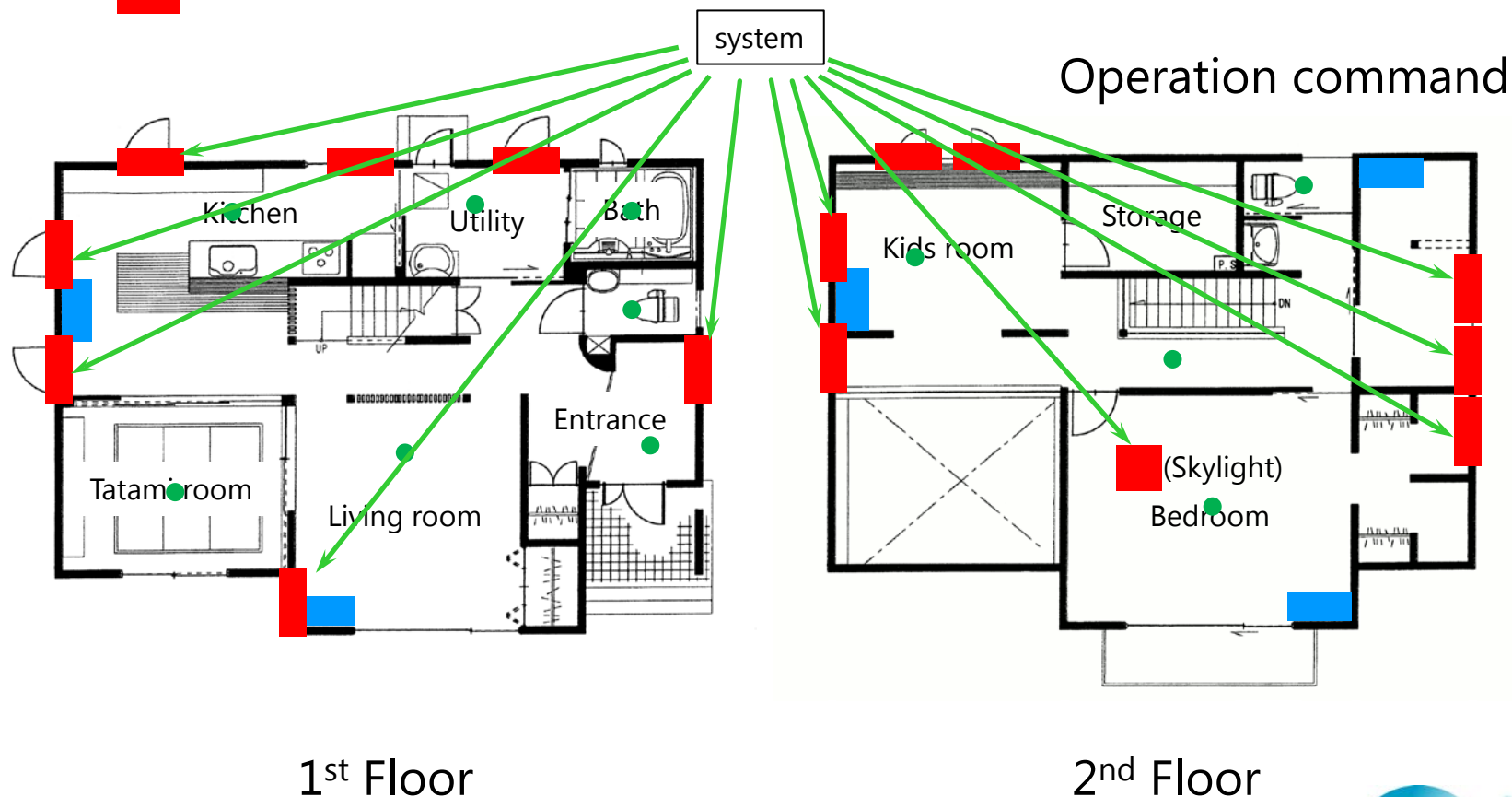
Perspectives for the future

› Future house with strategic control of thermal comfort

■ Cooling devices

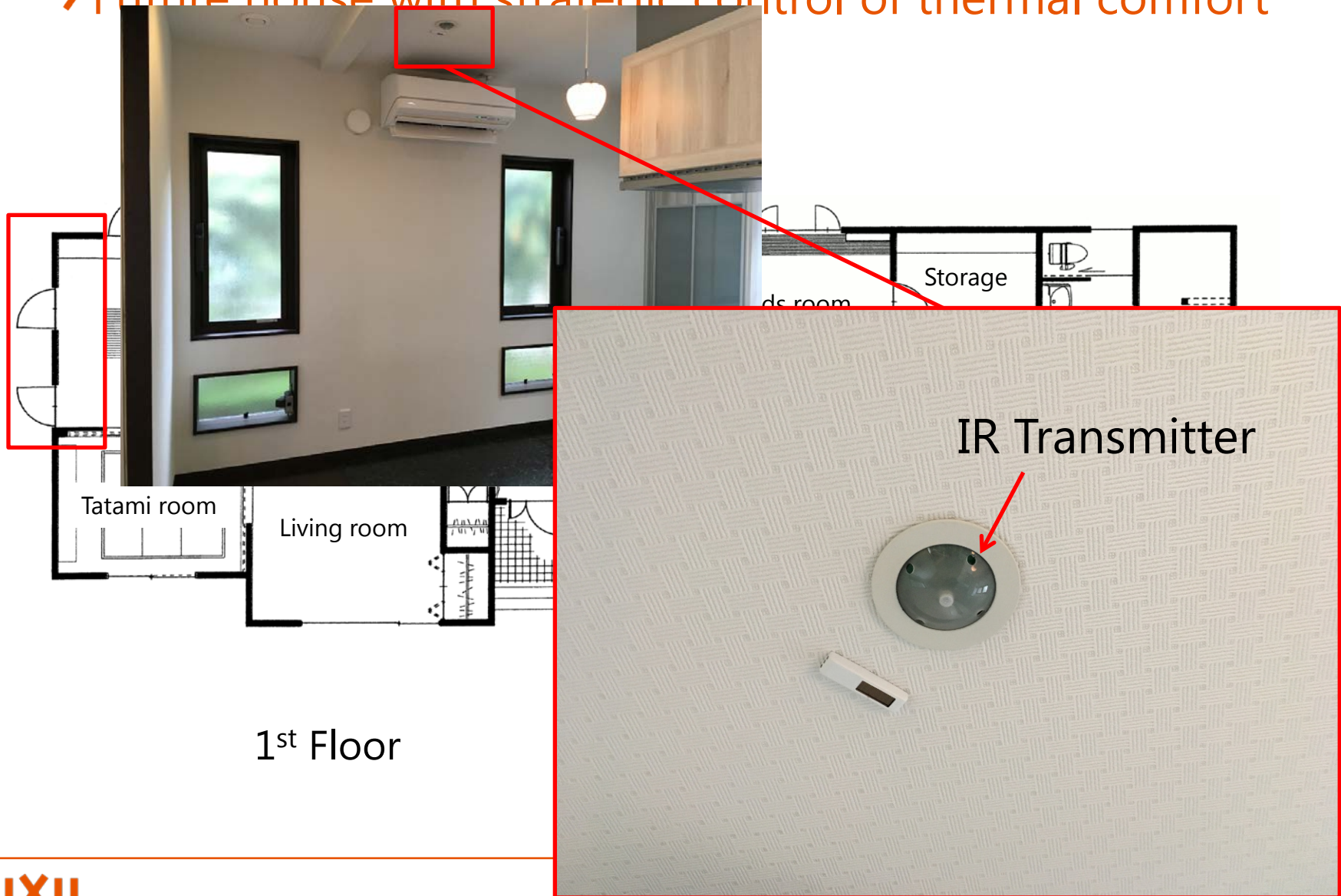
● Thermometer, Hygrometer

■ Windows with actuator



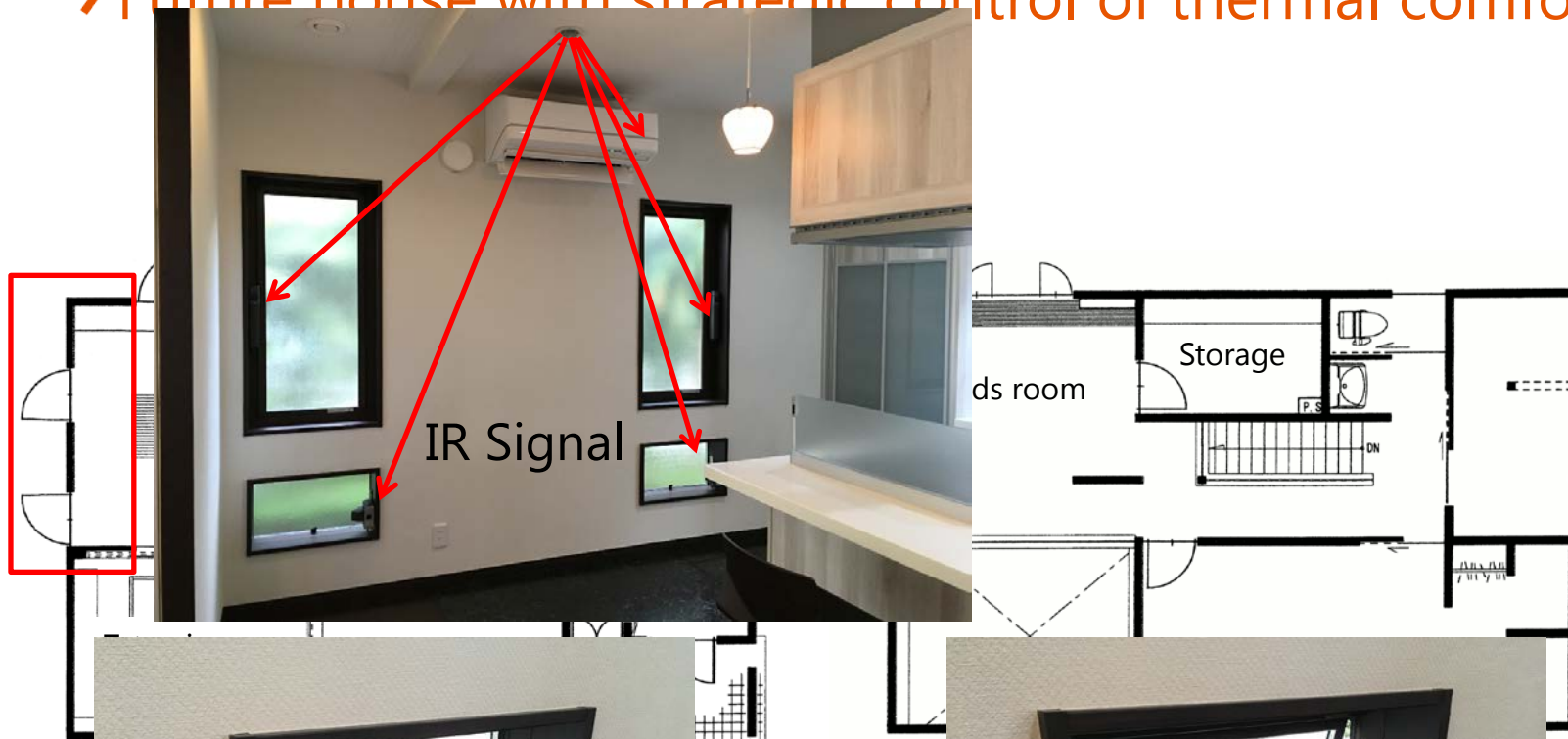
Perspectives for the future

➤ Future house with strategic control of thermal comfort



Perspectives for the future

› Future house with strategic control of thermal comfort



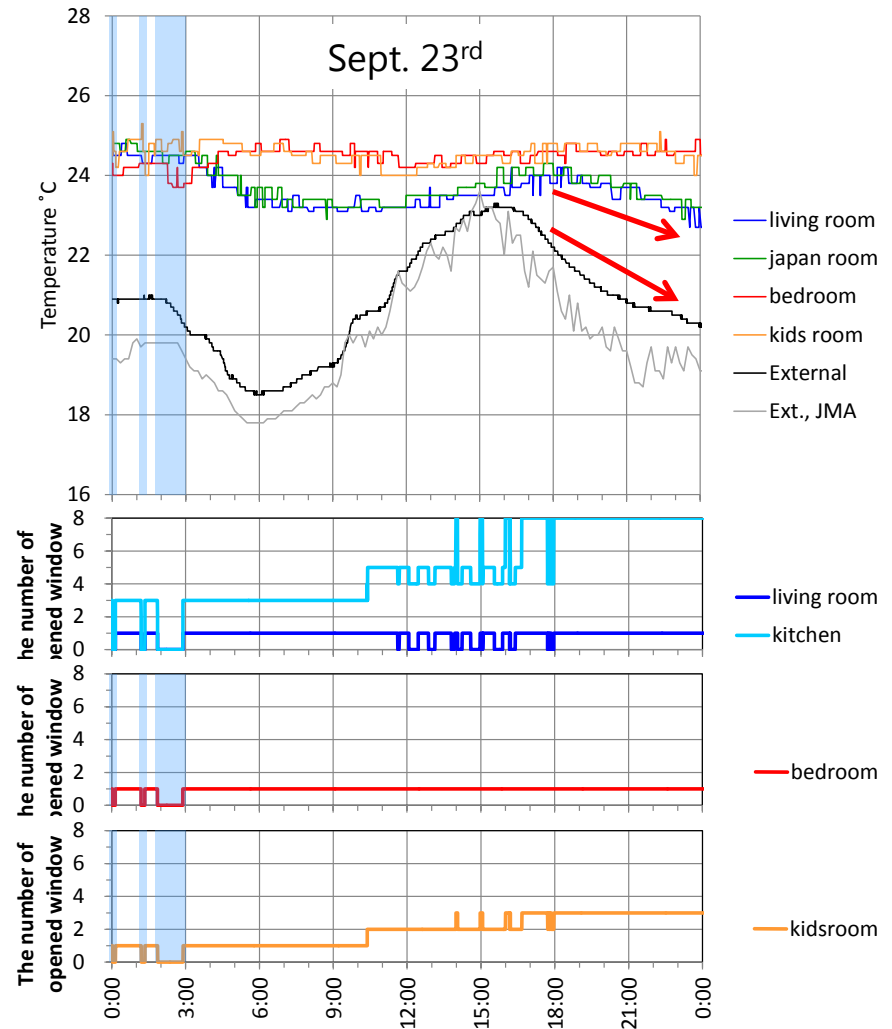
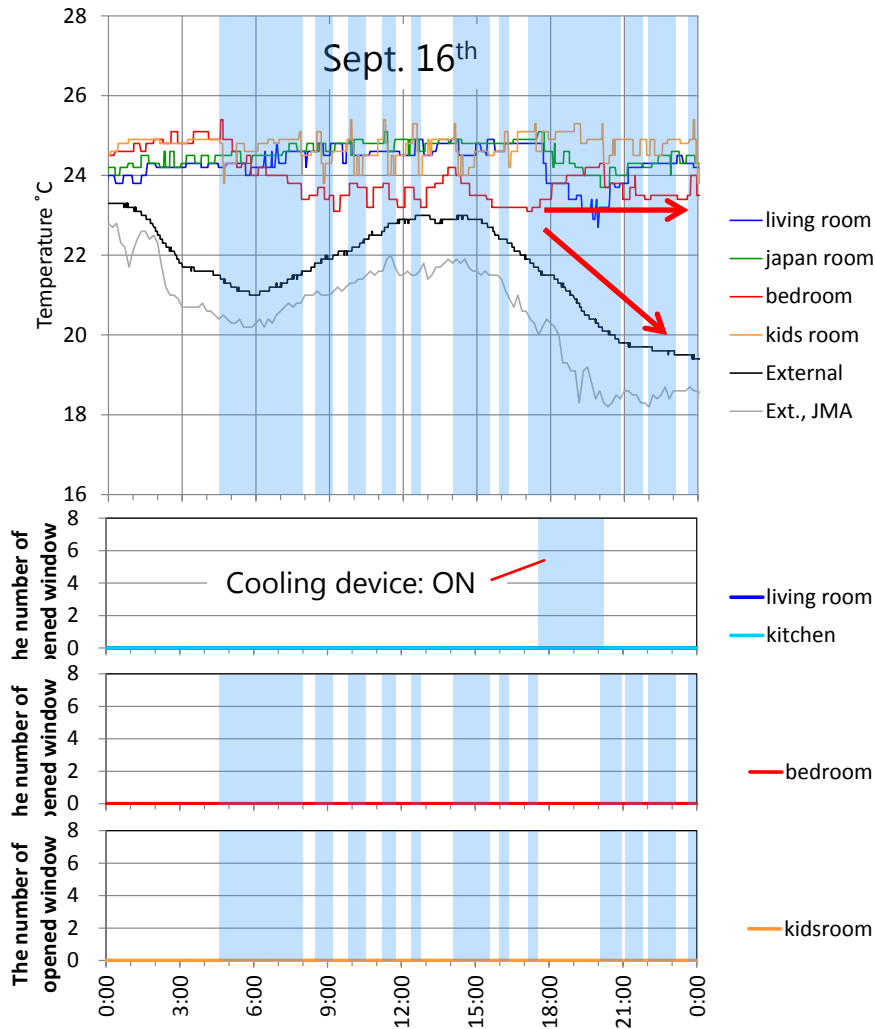
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Open

Perspectives for the future

Future house with strategic control of thermal comfort



Perspectives for the future

› Future house with strategic control of thermal comfort

Operating time (min)	Using only cooling devices	Using both cooling devices and natural ventilation
Living room	158.6	0.0
Kitchen	158.6	0.0
Bedroom	608.4	77.8
Kids room	608.4	77.8

Thank you for your attention!