Annex 62 "Ventilative Cooling"
- activities towards future buildings -

Future Buildings Forum
October 24-25, 2017

Toshihiro Nonaka
LIXIL Corporation

LIXIL Link to Good Living

EBC
Energy in Buildings and Communities Programme

iea Energy Technology Network

Contents

- The objectives of Annex62
- What is "Ventilative Cooling"?
- Deliverables of Annex62
- Dissemination of Annex62
- Perspectives for the future

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 rare – 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

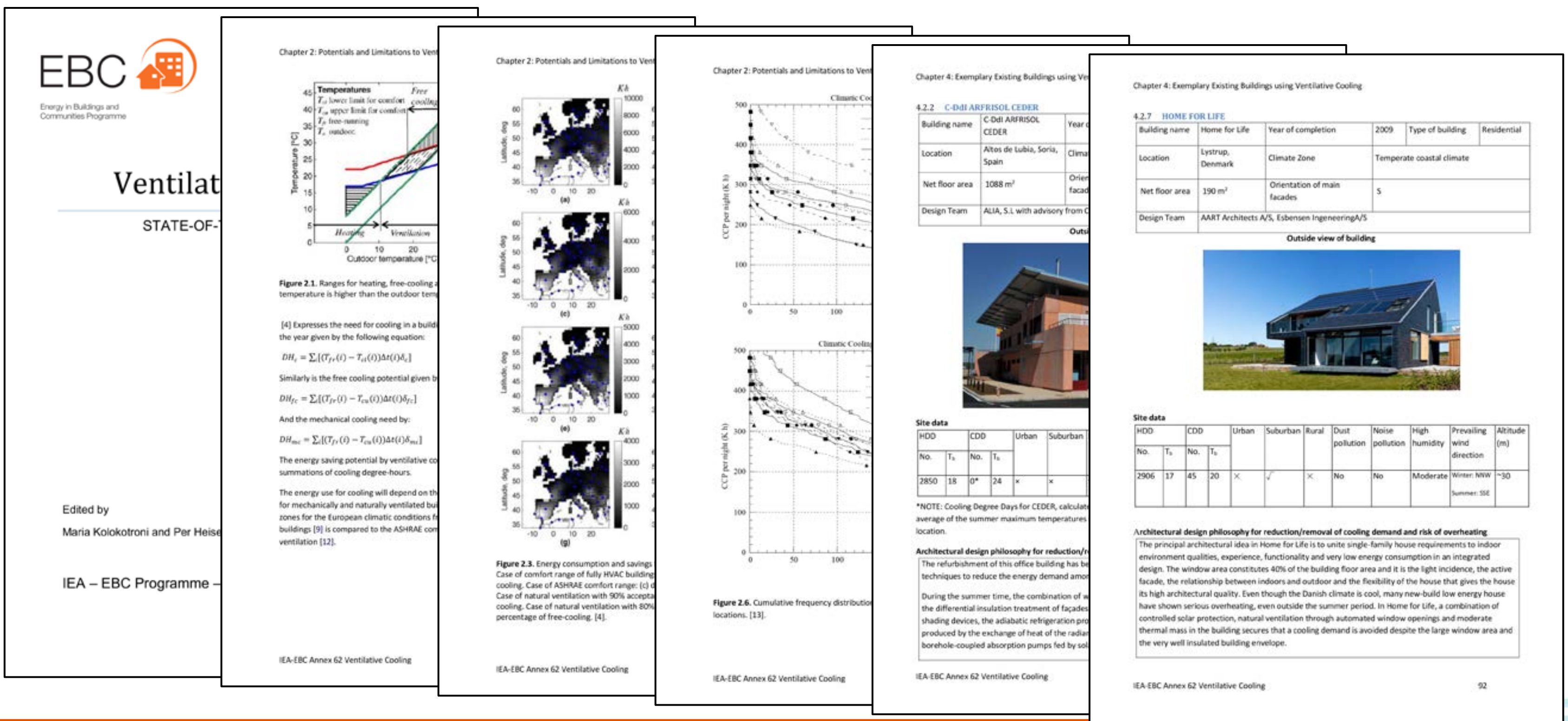
Deliverables of Annex62

	Official deliverables	*Target group*
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 concultants
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

Deliverables of Annex62

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/



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 scientifical)
  - 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

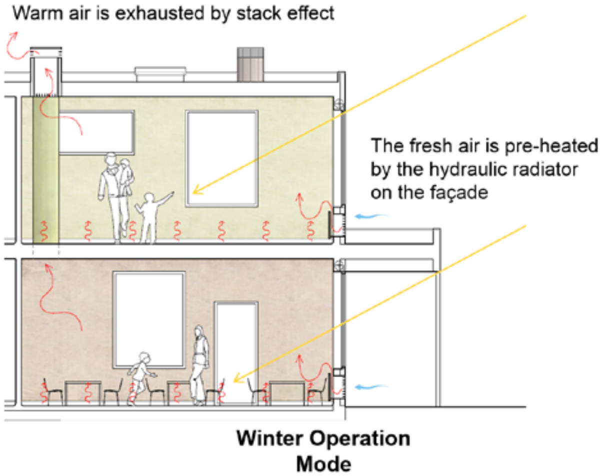
4. Ventilative Cooling Design Guide

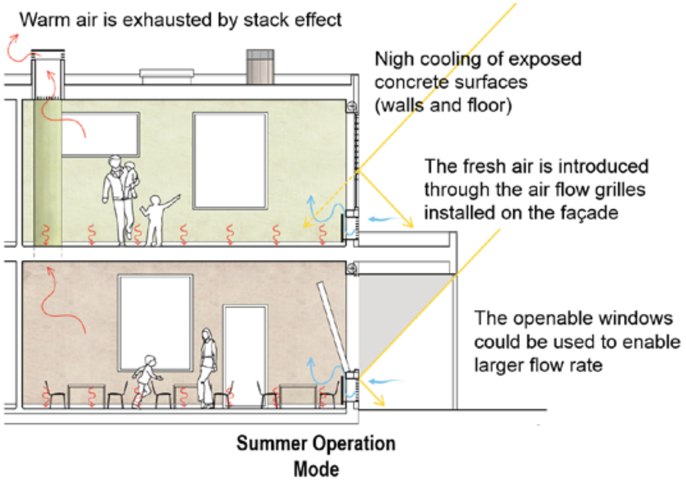
- This design guide is a code of practice
- Content
  - Ventilative cooling concepts and strategies
  - Examples of suitable technology applications
  - Primary KPI's (comfort, energy, climate)
  - A well commented collection of design rules, procedure and tools
  - A collection of good advice how to 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

4. Ventilative Cooling Design Guide

- Example 1: Natural air supply, CML Kindergarten, Portugal

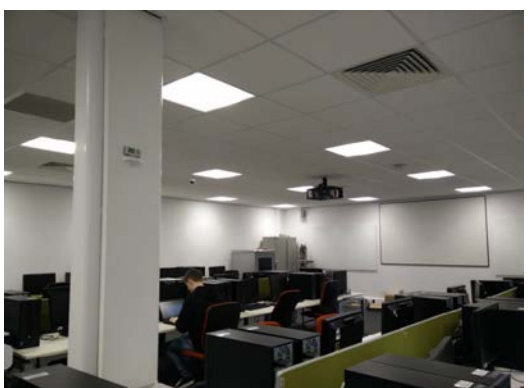


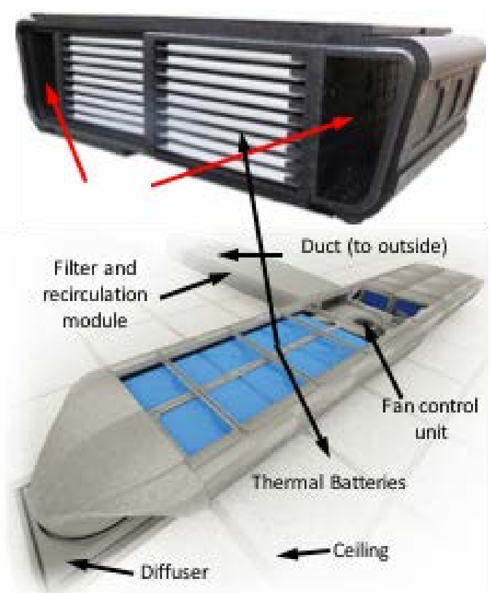


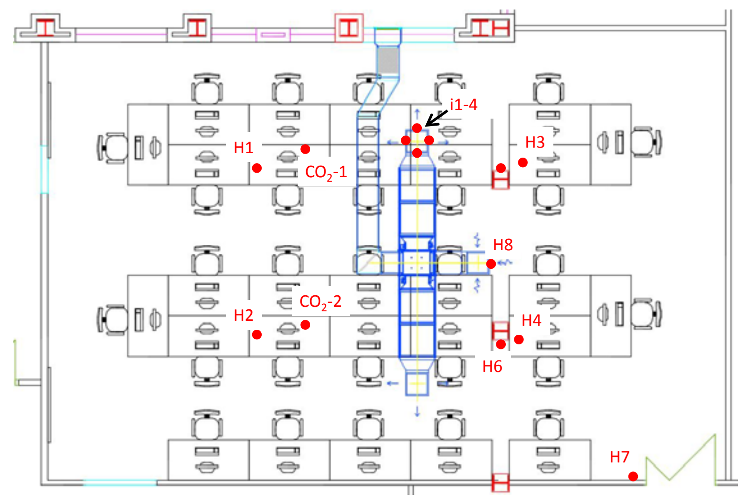
Deliverables of Annex62

4. Ventilative Cooling Design Guide

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



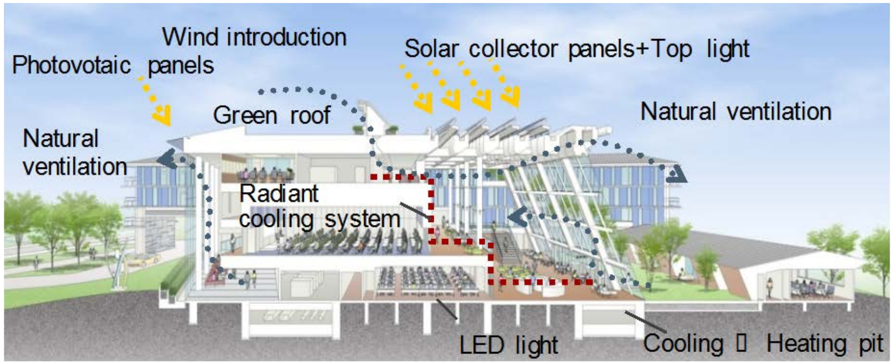




Deliverables of Annex62

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)

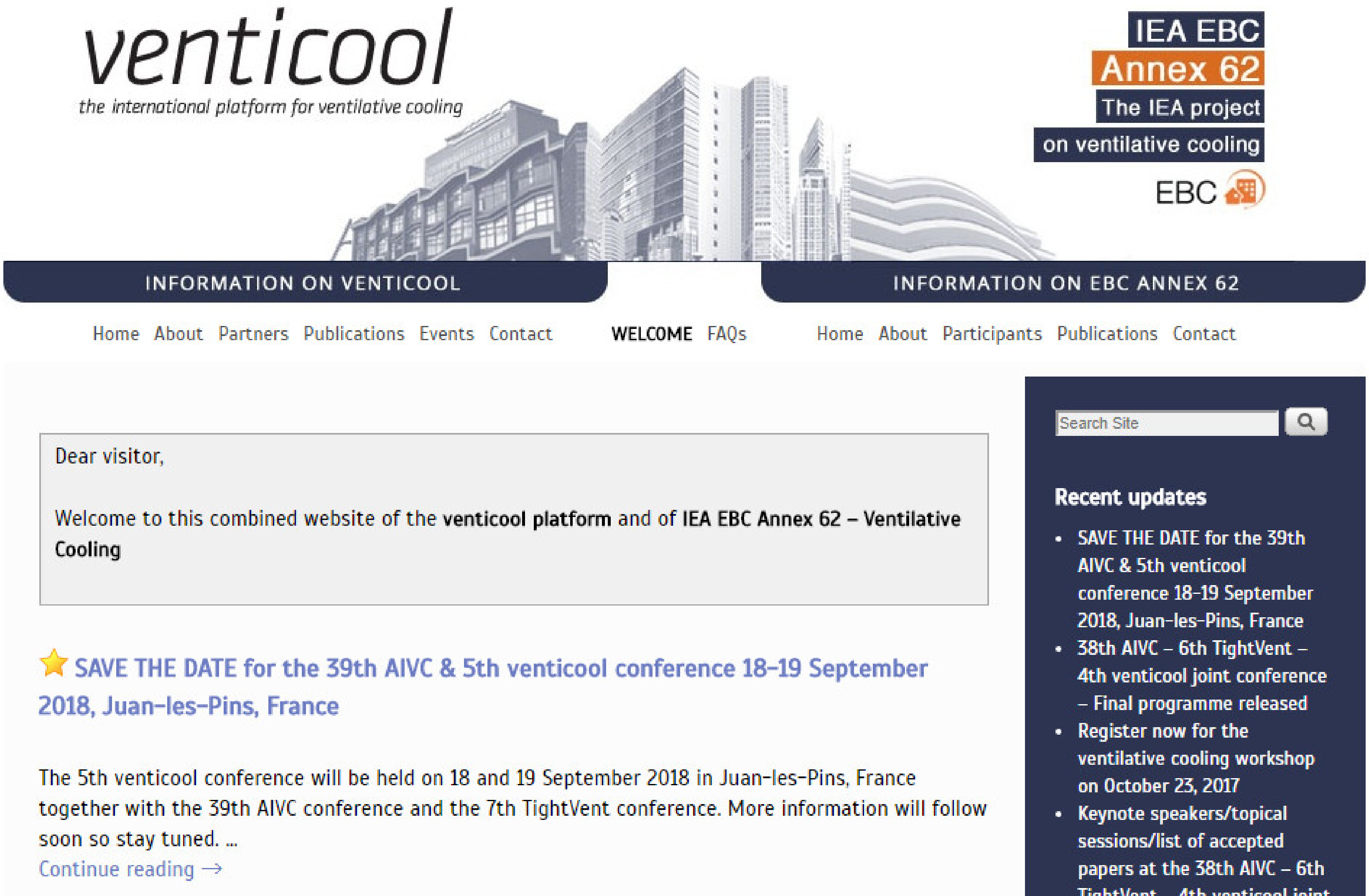
  Main focus: Energy saving

  Type: ISO Standard

  Work proposed to: WG/2 in ISO/TC 205

Dissemination of Annex62

- "venticool" website



EBC Energy in Buildings and Communities Programme

LIXIL

Energy Technology Network

Perspectives for the future

› 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

- U^2(U-square)-Home II : the experimental future house
- Constructed in 1998, renovated in 2016
- Fit to current Japanese energy saving standard

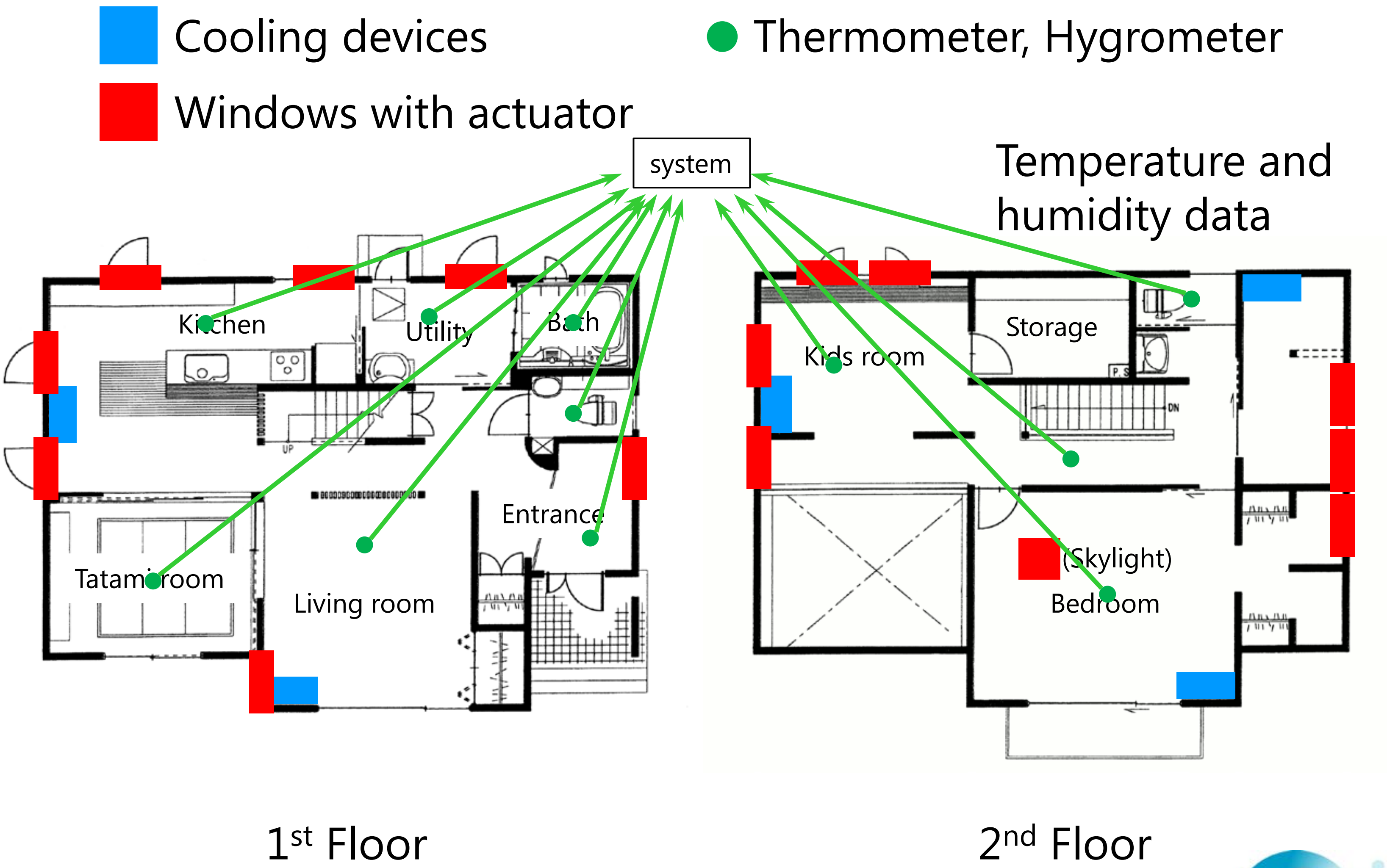
Perspectives for the future

› 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.

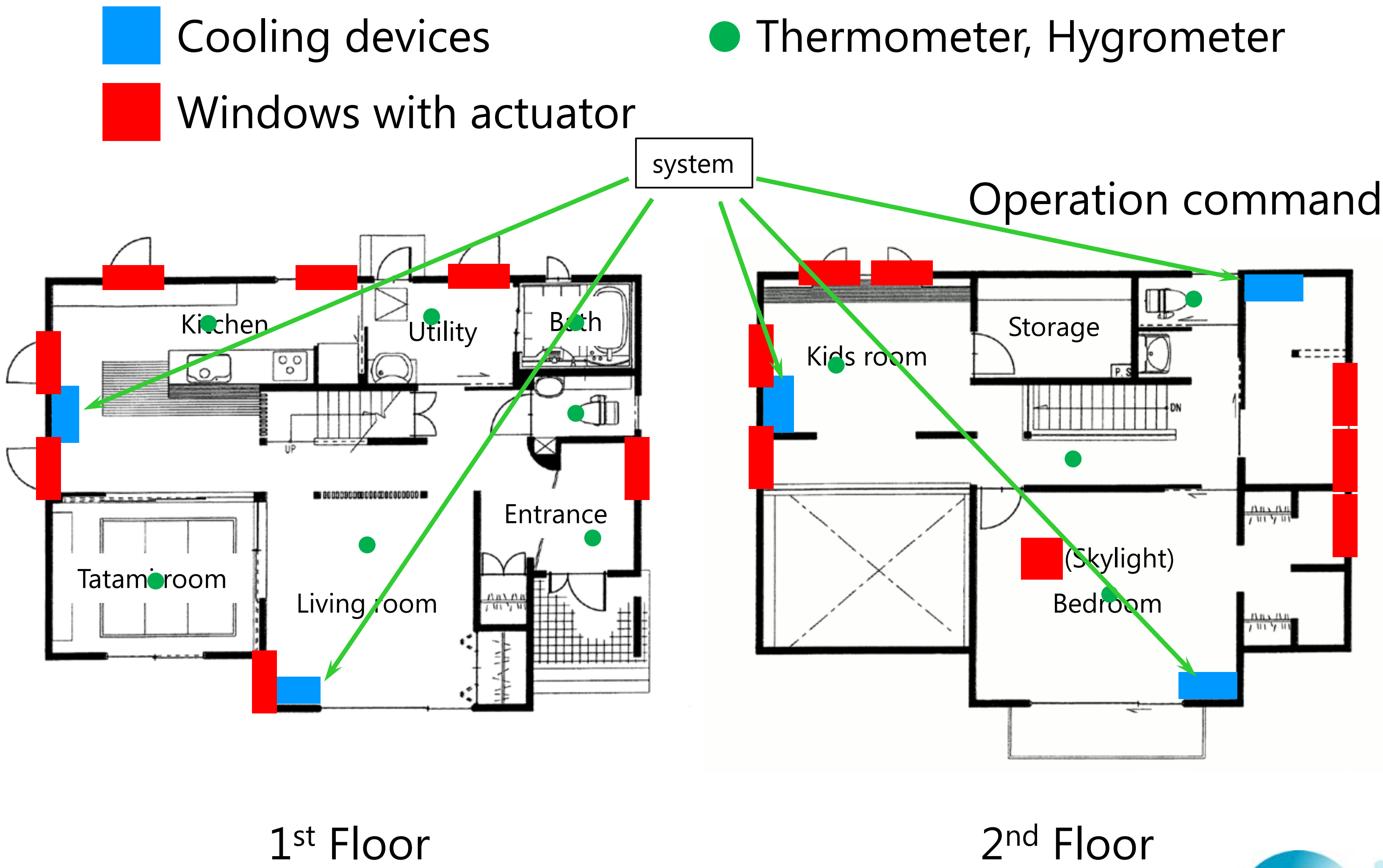
Perspectives for the future

› Future house with strategic control of thermal comfort



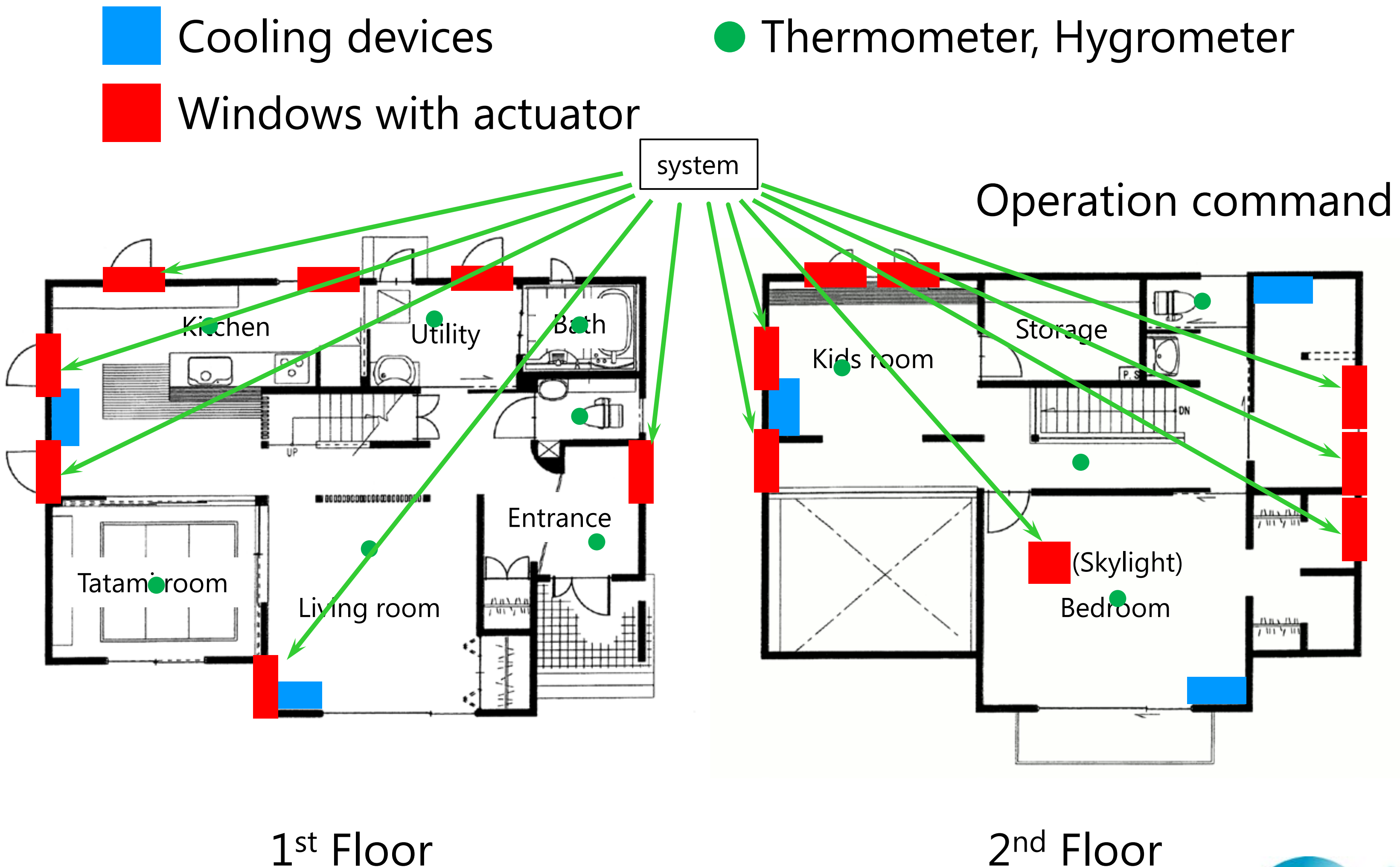
Perspectives for the future

› Future house with strategic control of thermal comfort



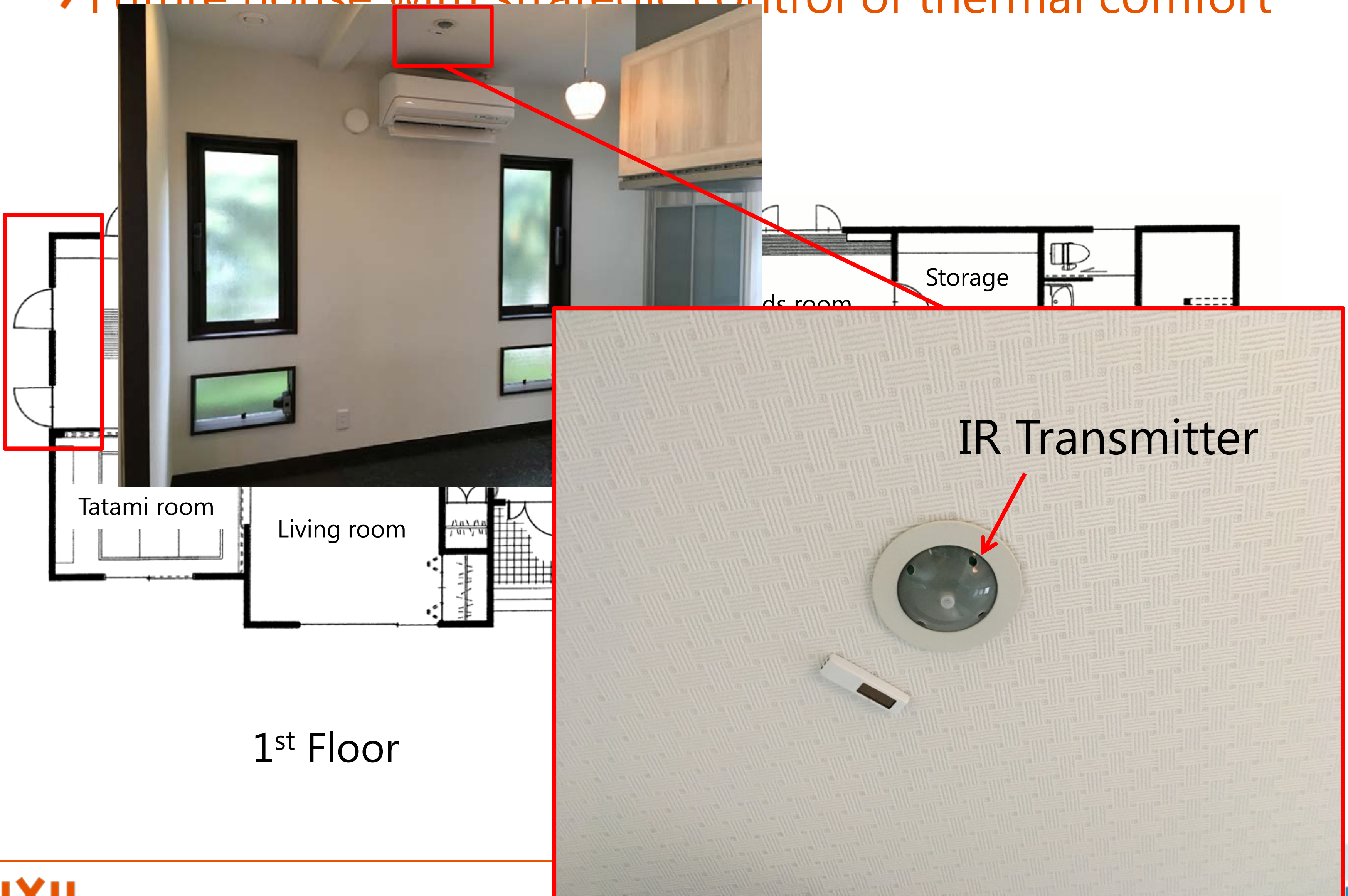
Perspectives for the future

› Future house with strategic control of thermal comfort



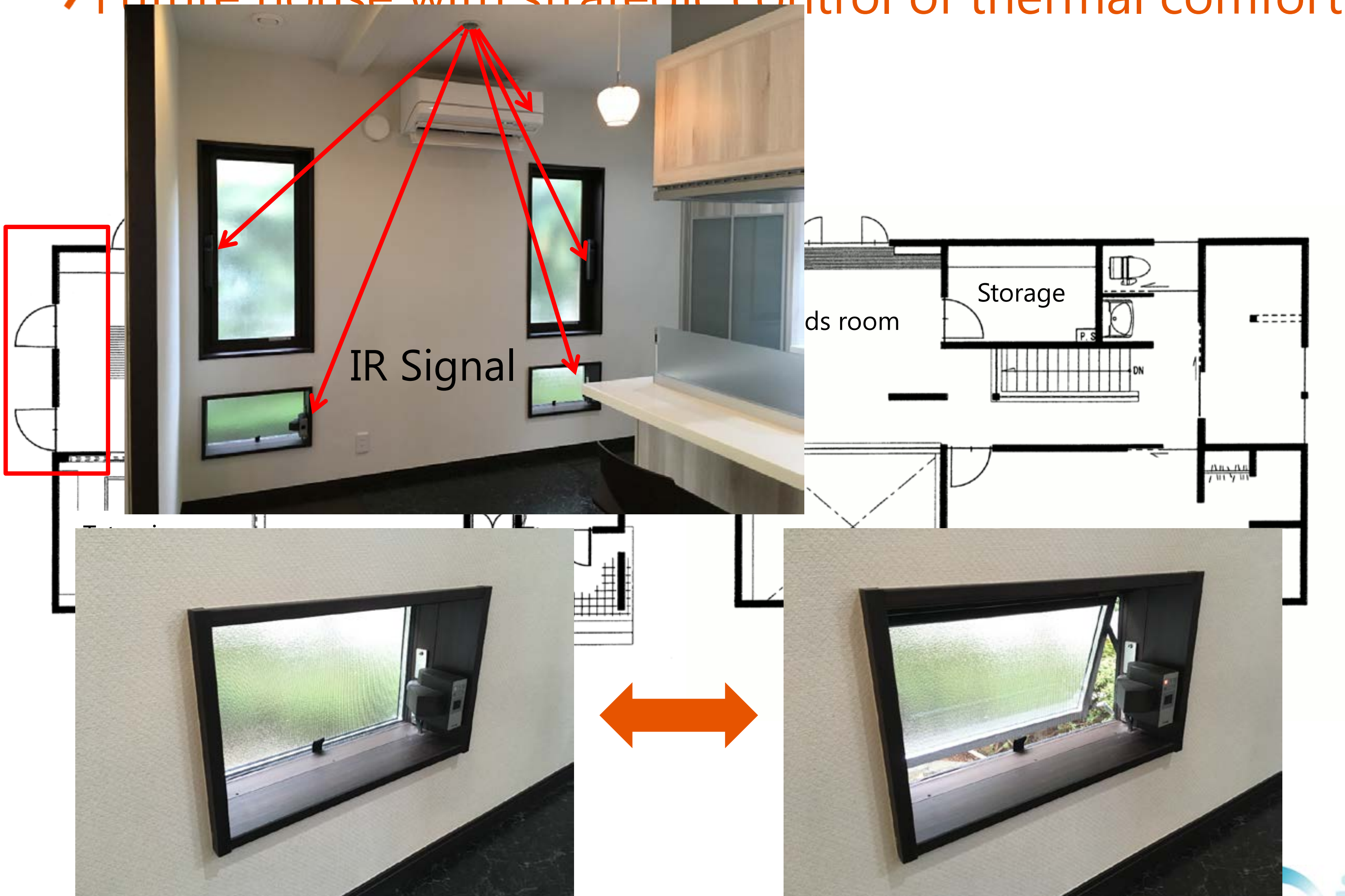
Perspectives for the future

› Future house with strategic control of thermal comfort



Perspectives for the future

› Future house with strategic control of thermal comfort



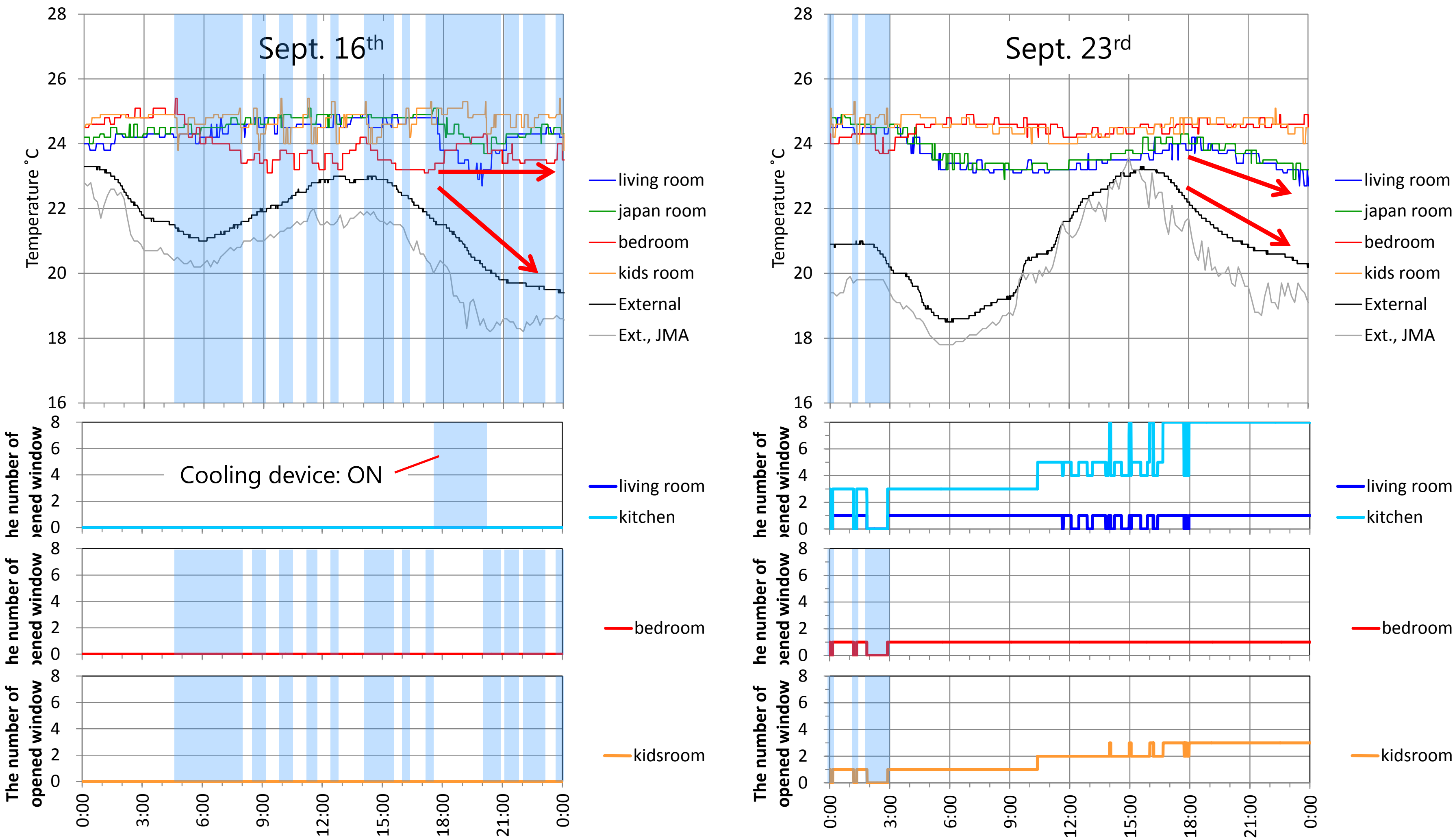
Close

Open

LIXIL

Perspectives for the future

› Future house with strategic control of thermal comfort



LIXIL Cooling devices only

Cooling devices + ventilative cooling

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!