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Sustainable Energy Connectivity in Central Asia

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International Conference

Sustainable Energy for Environmental Protection. Reviewing International Best Practice

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Features of Implementing Energy Efficiency Technologies in New Construction Projects

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Stantec | intec | ACTED | European University Institute | FSR Energy Florence School of Regulation

Why buildings?

- 30% of global final energy consumption
- 26% of global greenhouse gas emissions
- 45% of materials utilized in construction
- 36% of overall waste generation
- Humans spend 80% of time indoors (residential, health, work environments

For EU it is vision of a decarbonized building stock by 2050

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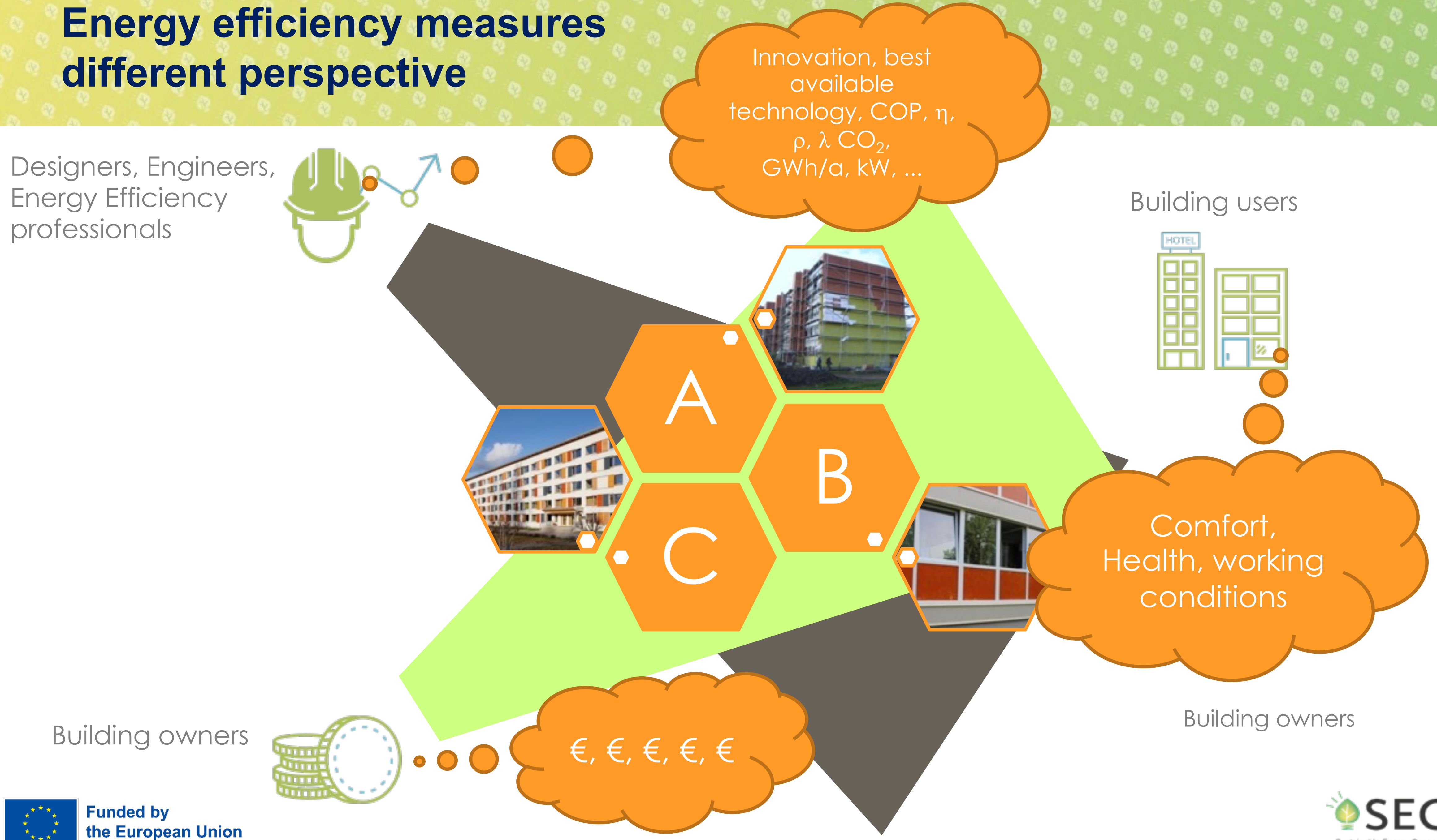
Energy efficiency measures different perspective



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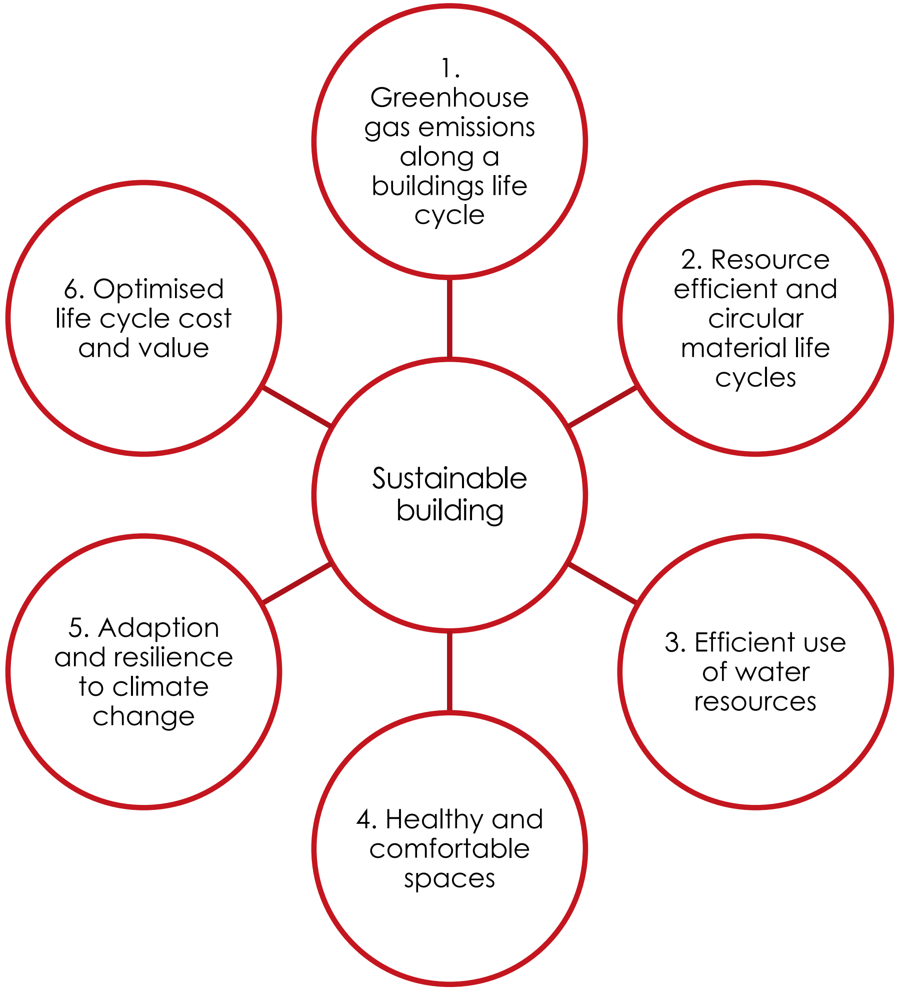
Sustainable Design Strategies

Main Challenges in a Continental Climate:

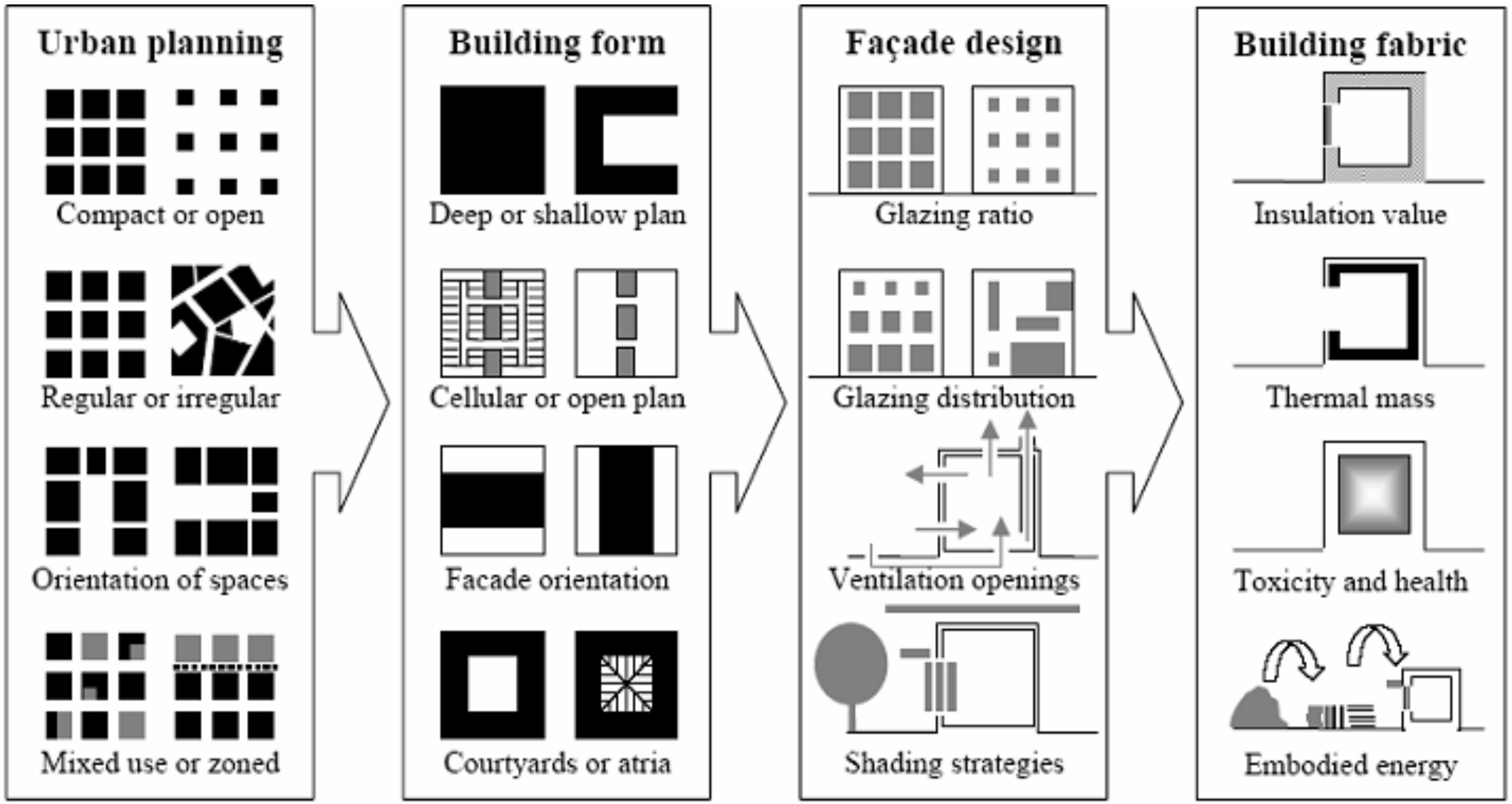
- Increased cooling demands leading to higher electricity peak loads
- Water scarcity

Proposed Sustainable Design Strategies:

- Enhance energy efficiency and integrate renewable energy sources (RES)
- Utilize passive cooling techniques, such as shading, to reduce solar heat gain
- Limit extensive glass areas to improve thermal performance
- Implement night cooling systems to lower indoor temperatures naturally
- Harvest and utilize rainwater for sanitation and irrigation



Energy efficiency different scale



Avots: Steemers, Cambridge university

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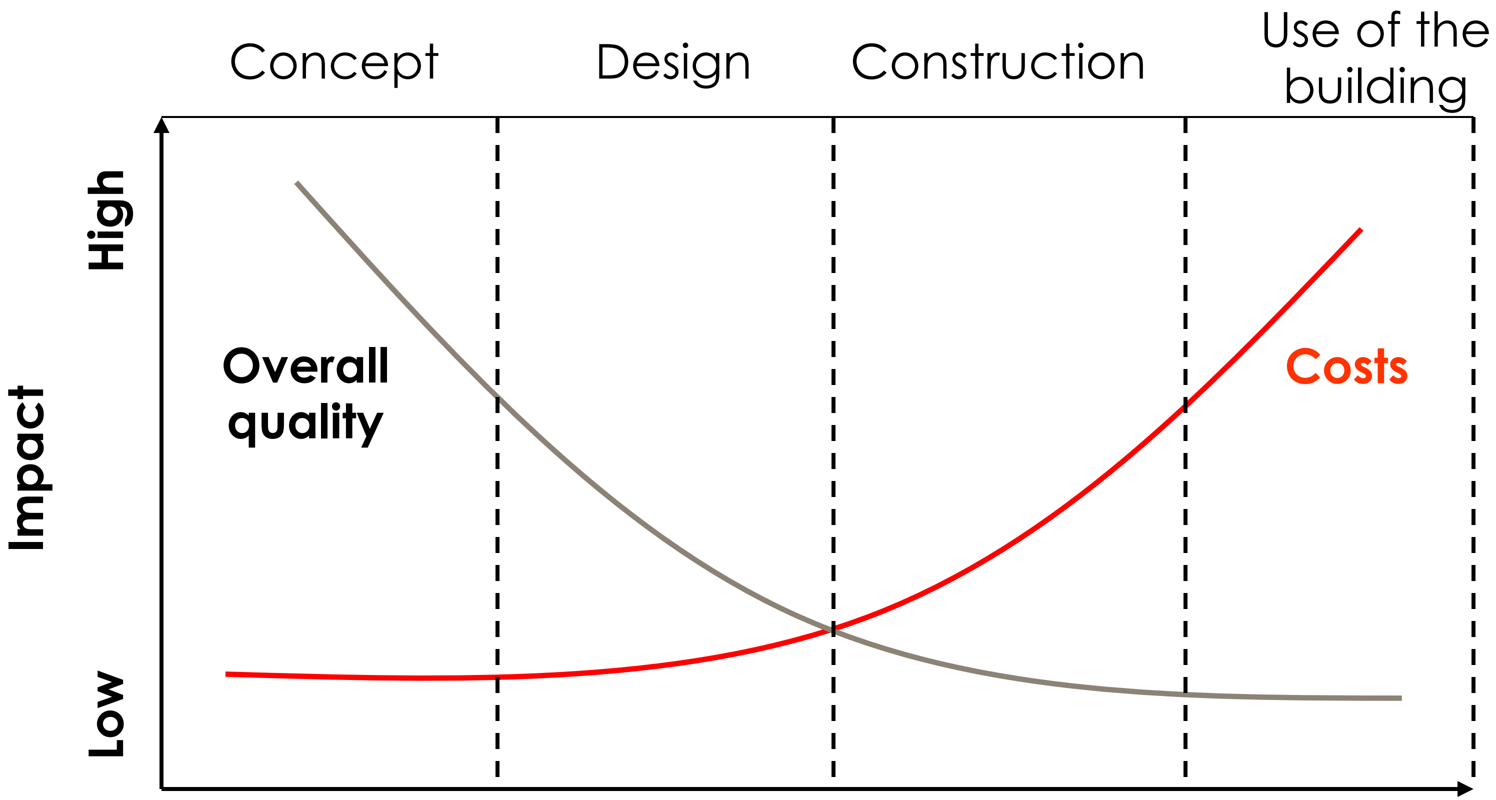
Timely decision-making has a significant impact on costs!



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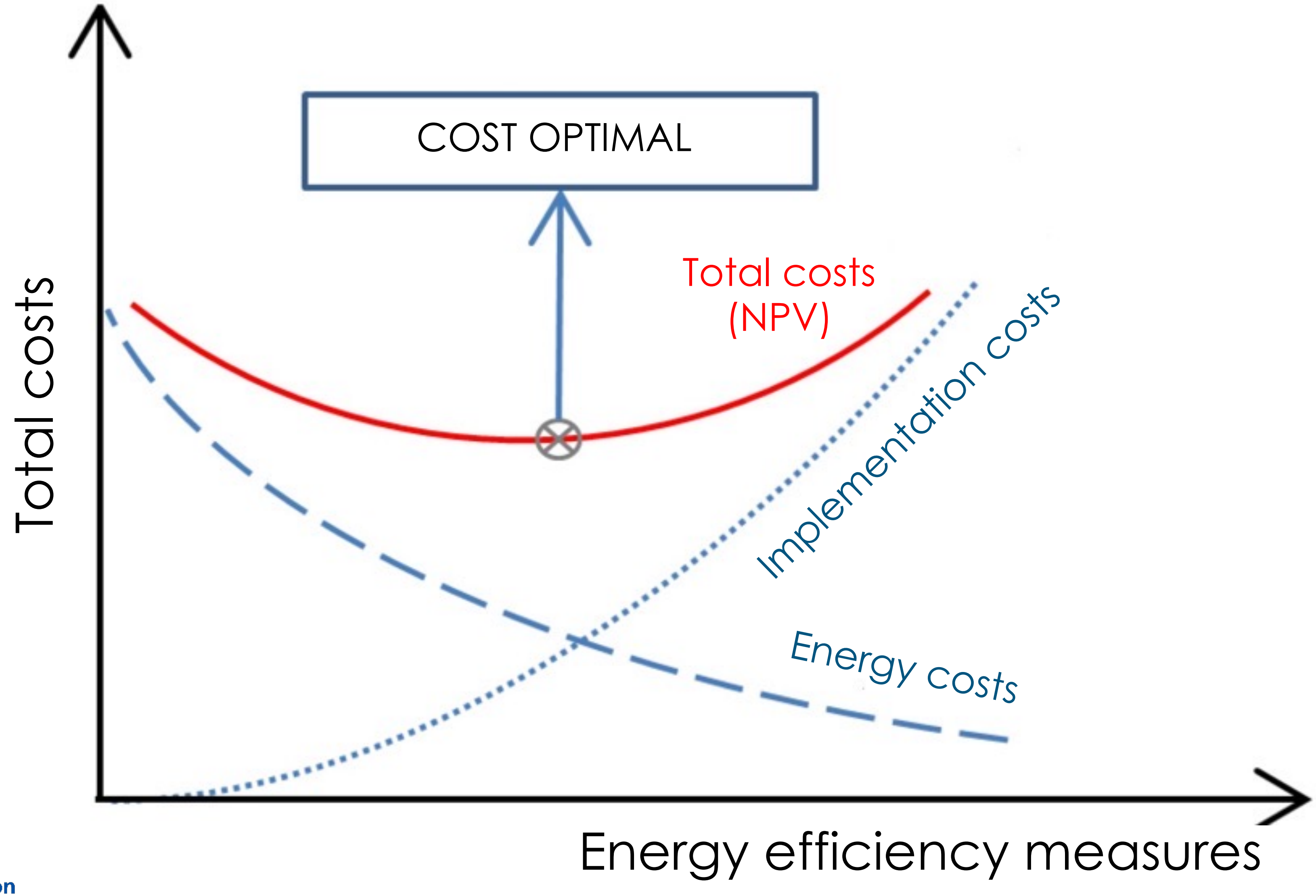
Implementation of new solutions/technologies



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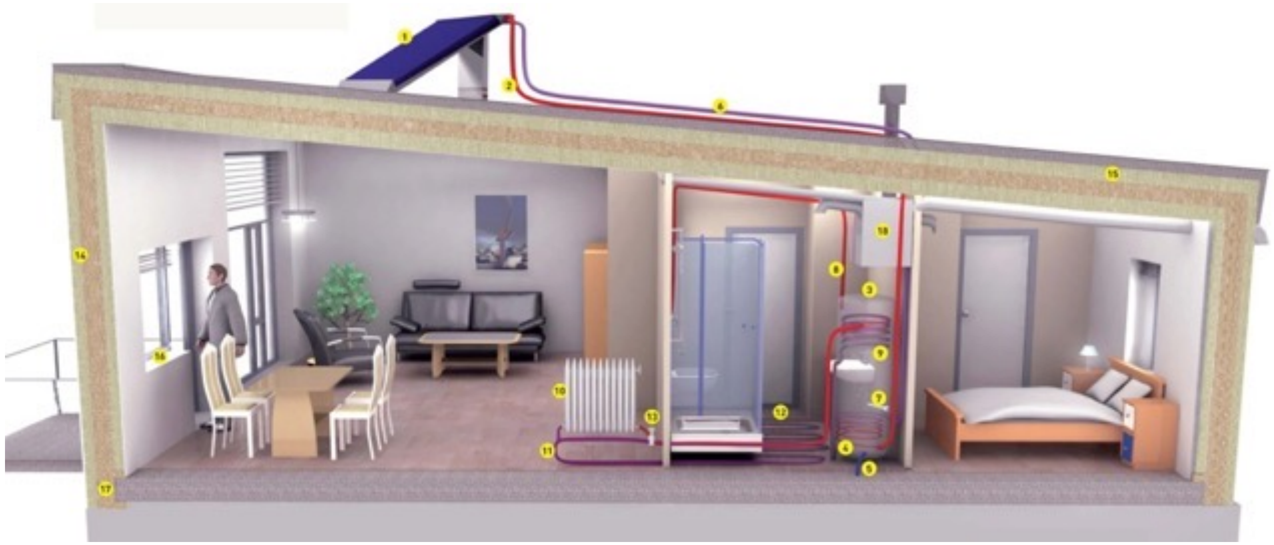
Future requirements in EU for new buildings

Transforms a building or building:

- before 1 January 2030, into a **nearly zero-energy building** (starting from 2021)
- as of 1 January 2030, into a **zero-emission buildings (**as of 1 January ***2028***, new buildings owned by public ***bodies***)



Bosco Verticale, Milan

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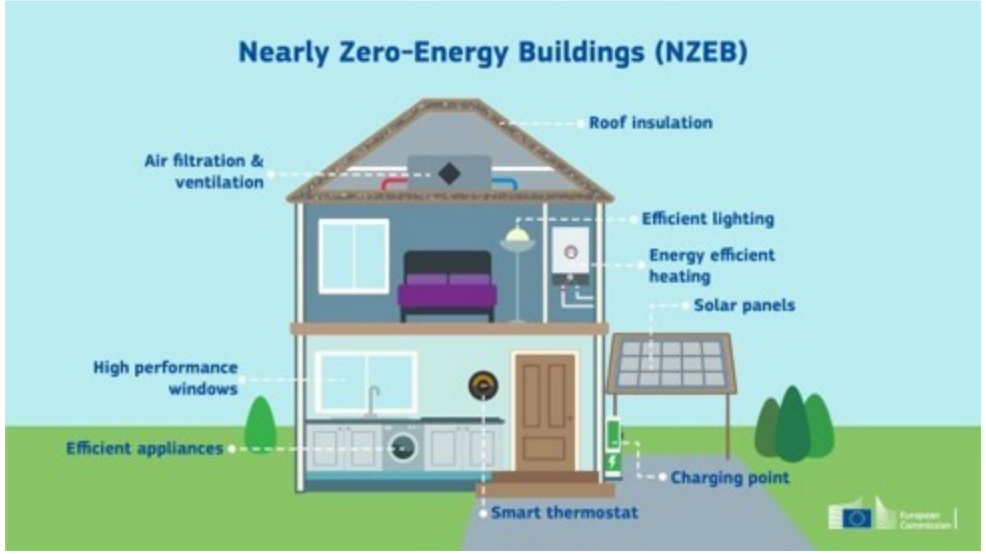
Future requirements in EU for new buildings: Zero-emission buildings

- Nearly zero-emission building (NZEB) means a building that has a very **high energy performance**, while the nearly zero or very low amount of energy required should be covered to a very **significant extent by energy from renewable source**
- Focus of the proposal is the reduction of **operational greenhouse** gas emissions, ZEB definition further include the calculation life-cycle Global Warming Potential (GWP) and its disclosure through the energy performance certificate of the building



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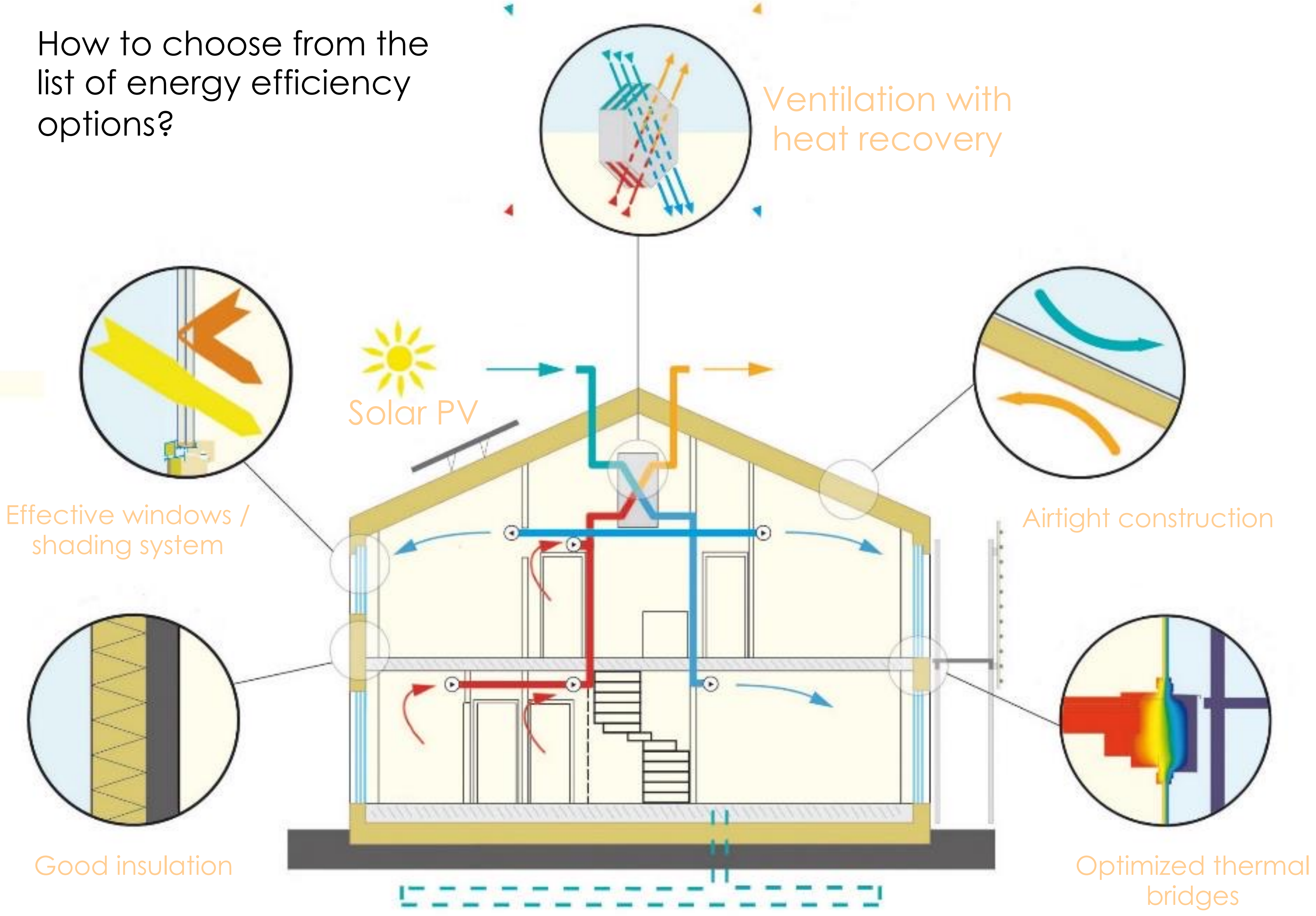
How to choose from the list of energy efficiency options?



source: passive.de

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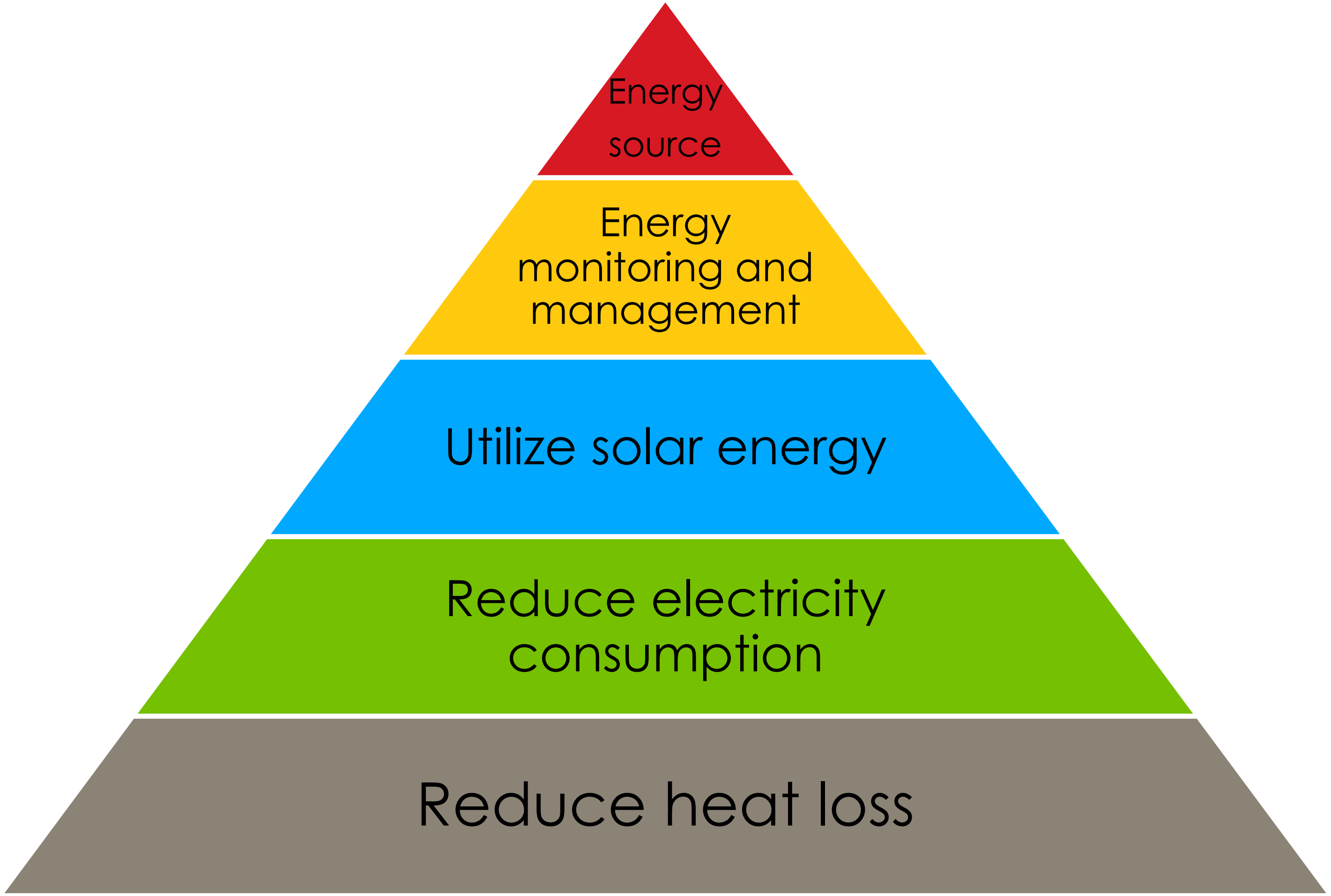
Conceptual approach to tackling the energy efficiency



The Kyoto Pyramide

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Macroeconomic and private benefits of energy efficiency in buildings

Macroeconomic co-benefits (Government)	Private co-benefits (Building owners)
Environmental benefits	**Building quality benefits**
Reduction of air pollution	Building physic and technical improvements
Construction and demolition waste reduction	Ease of use and control by the user (automatic thermostat controls, easier filter changes, faster hot water delivery)
Economic benefits	Aesthetics and architectural integration
Lower energy cost	Useful building areas
New business opportunities	Safety (intrusion and accidents)
Employment and green jobs	**Economic benefits**
Subsidies to cover energy costs avoided	Reduced exposure to energy price fluctuations
Improved productivity	**User wellbeing benefits**
Social benefits	Thermal comfort
Improved social welfare and fuel poverty alleviation	Natural lighting and contact with the outside environment
Increased comfort	Indoor Air quality
Reduced mortality and morbidity rates	Internal and external noise
Reduced physiological effects	Pride, prestige, reputation
Improved energy and water security	Ease of installation and reduced annoyance

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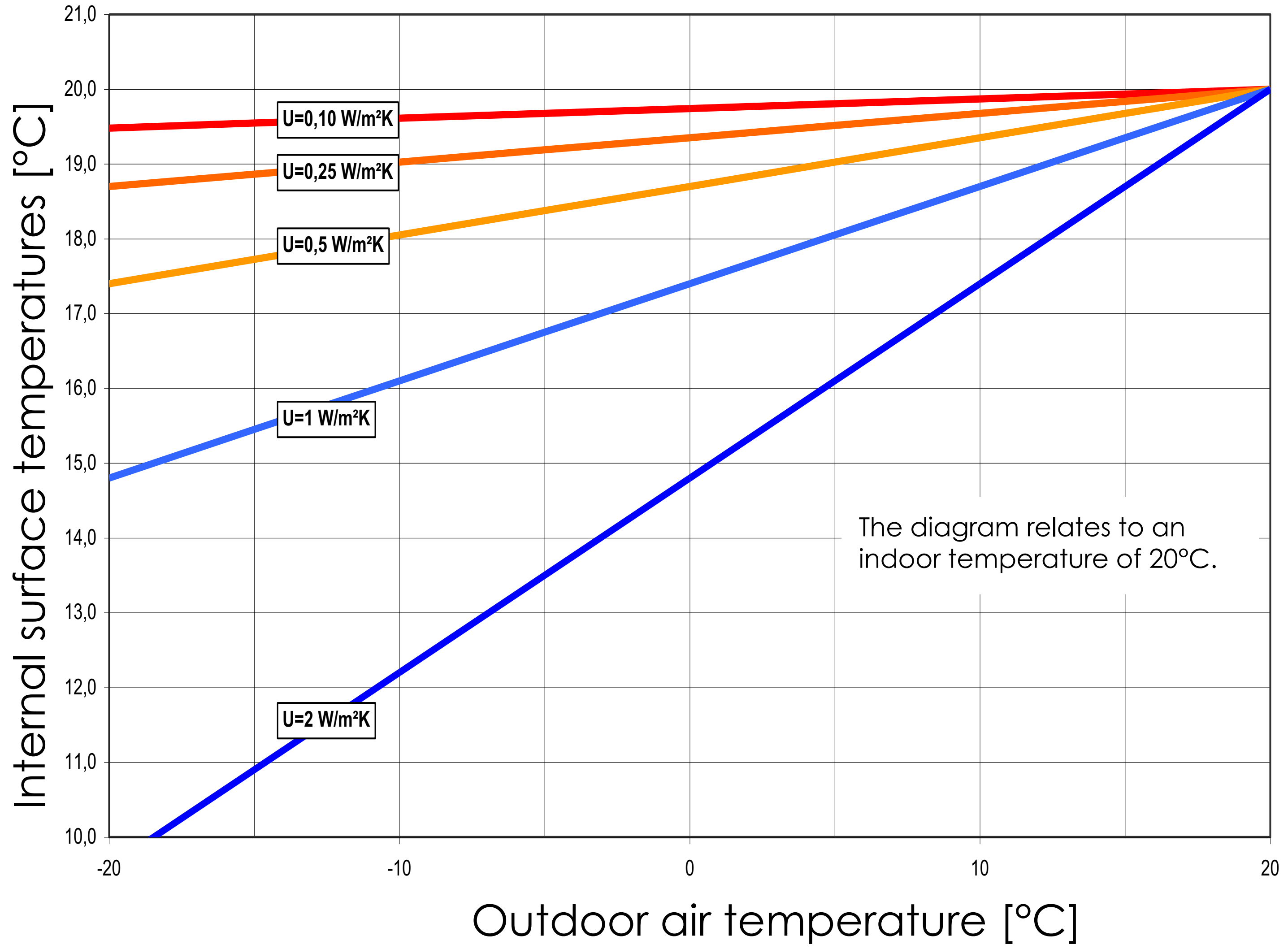
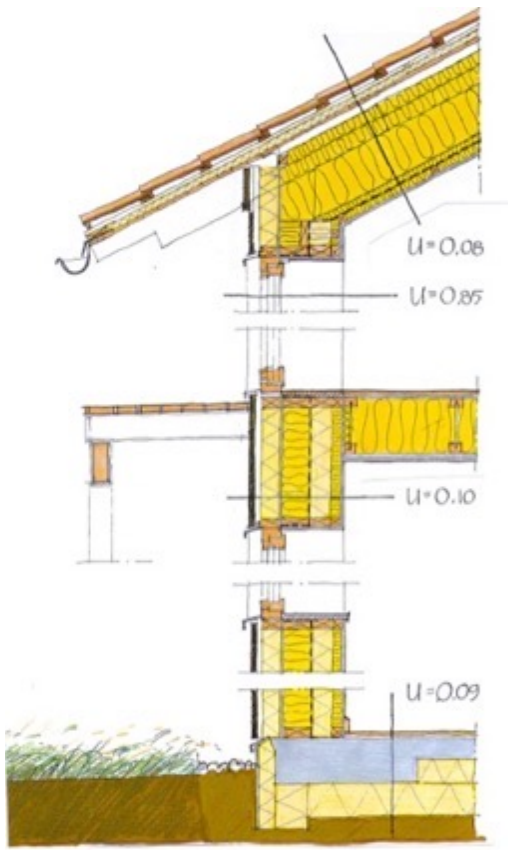
U-value and surface temperature and comfort





Avots: P. Holzer, Donau Universität Krems   Autors: kra/EIV

Examples: Components of central ventilation equipment

- Air-to-air heat exchanger with heat recovery ≥ 75%
- DC motor
- Control/regulation: operation levels and air balance
- Thermal insulation and airtightness Condensate drain
- Filter: exhaust air + outdoor air Anti-frost protection Summer bypass

Utilization of solar energy and daylight

Positive Impact: Free Energy

- Passive Systems: Utilize solar heat gains
- Active Systems: Implement solar collectors, PV panels

Negative Impact: Potential Room Overheating and Glare

Solar energy utilization is crucial for achieving low-consumption buildings

Solar energy through glazed surfaces: 10-60 kWh/m^2 per year depending on the building, location...

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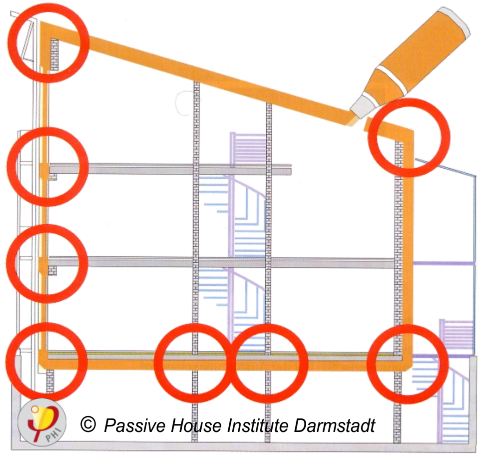
Sustainable technologies used

- **Primary energy efficiency** in buildings includes heat pump and renewable energy technologies (solar PV)
- **Heat pump for energy,** significantly more efficient than standard solutions, supporting ventilation heating and hot water preparation. Water-to-air heat pump linked with the city's sewage, maintaining 12-18°C for higher operational efficiency. This system supports heating, cooling, and summer freecooling mode
- **Building Management System (BMS)** - display in the building to show heat exchange data, symbolizing the gained energy
- **Experimental solar panel** placement in the courtyard allows parking space below, maximizing sun exposure without affecting the building's aesthetics
- **Ensuring air tightness** in passive building constructions concept
- **Rainwater:** An excellent, biologically active resource for automatic green wall irrigation



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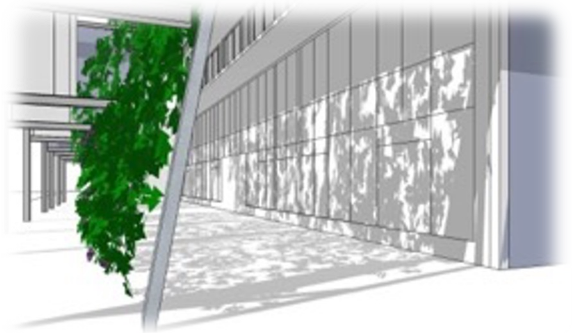
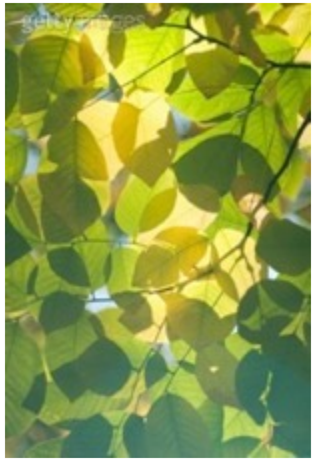
Shading using nature-based solutions





- West side features automatic blinds. East side uses **climbing plants on the facade to reduce solar impact**
- **Plants act as a passive solution:** providing shade in summer and allowing solar warmth in winter
- Emphasizes the importance of sharing experiences among Latvian low-energy building designers, highlighting both successes and areas for improvement

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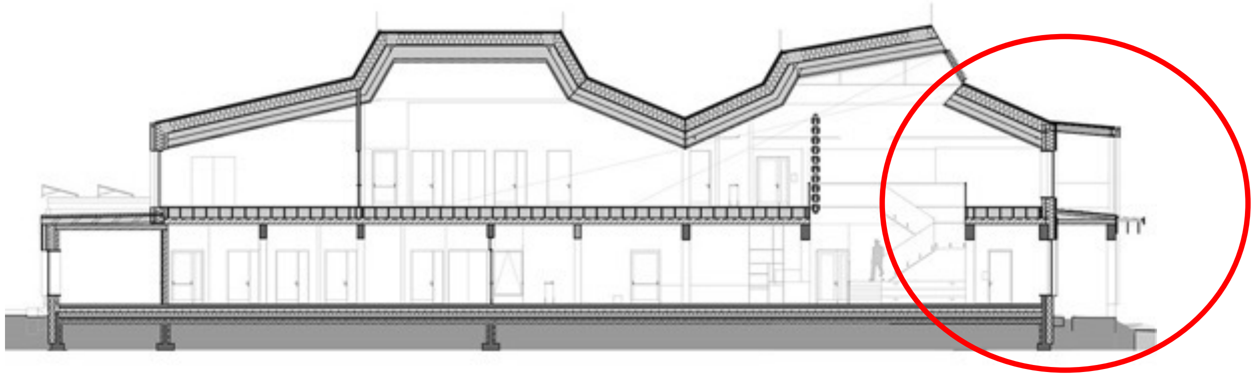
Smart lighting adjusts brightness based on room depth and proximity to windows

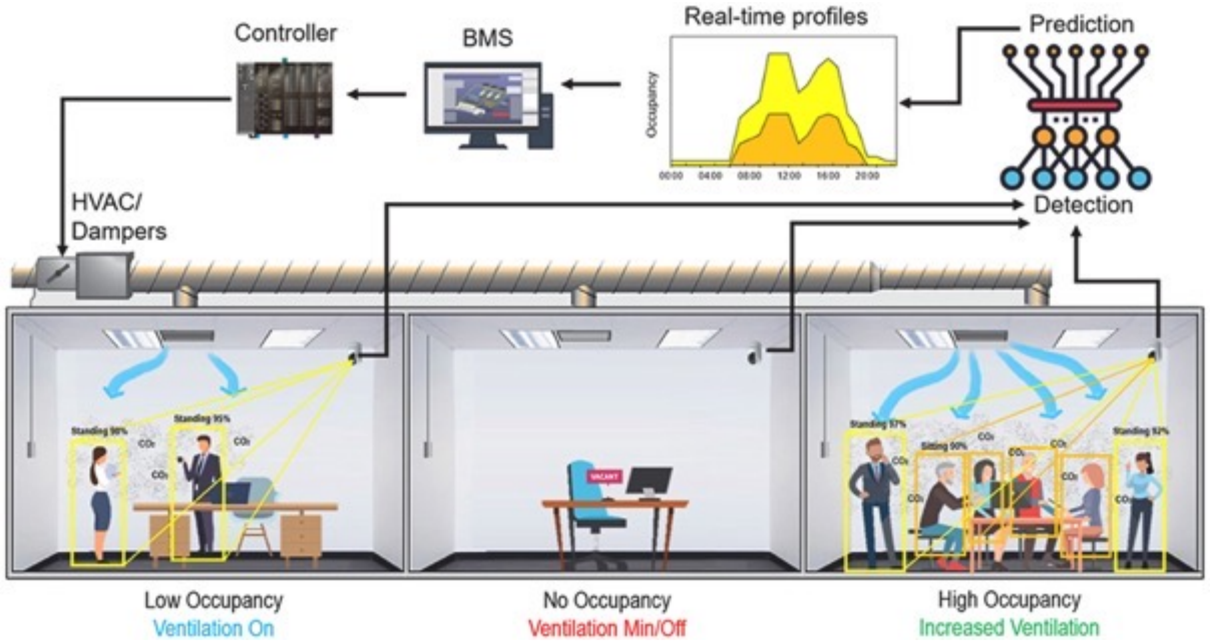
Optimal design

- **South-facing large glass facade** designed for unobstructed outdoor views
- To prevent overheating, initially considered installing blinds, but **extensive overhangs** were chosen as a better solution



Energy monitoring and control

- **CO_2 sensors control ventilation based on occupancy**, ensuring optimal air quality



Conceptual approach with CO_2 sensors control ventilation based on occupancy

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Key functionalities

Energy performance & operation 1

Energy efficiency | *Maintenance & fault protection*

Energy flexibility 3

Energy flexibility & storage

Responds to the needs of occupants 2

Comfort | *Convenience* | *Health, well-being & accessibility* | *Info to occupants*

aims at:

- the ability of a building to manage itself
- to interact with its occupants,
- to take part in demand response and
- to contribute to smooth, safe and optimal operation of connected energy assets

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Impact criteria

Energy efficiency

Maintenance & fault protection

Comfort

Convenience

Health, well-being & accessibility

Info to occupants

Energy flexibility & storage

Overall

Technical domains

Heating | Cooling | Domestic hot water | Ventilation | Lighting | Dynamic building envelope | Electricity | Electric vehicle charging | Monitoring & control

Impact criteria

Energy efficiency | Maintenance & fault protection | Comfort | Convenience | Health, well-being & accessibility | Info to occupants | Energy flexibility & storage

Key functionalities

Energy Performance & Operation | **Responds to the needs of occupants** | **Energy flexibility**

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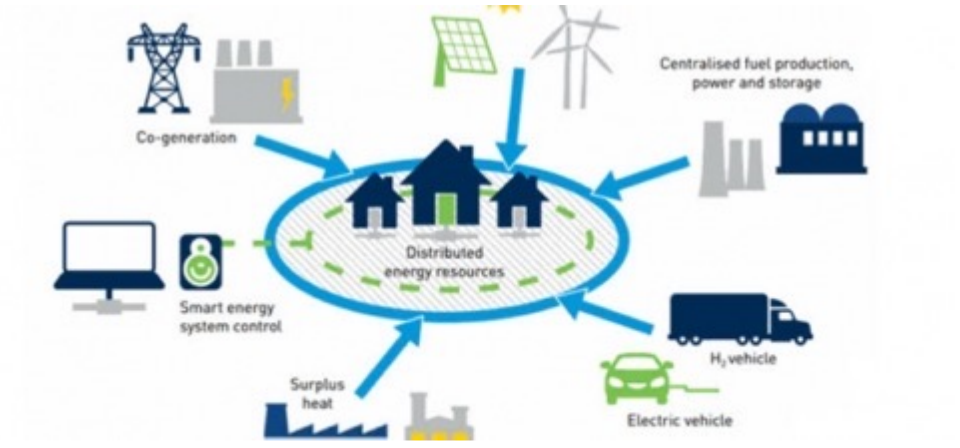
Buildings for Tomorrow: Emerging Practice in the EU

- Moving towards clean construction to **tackle embodied emissions**. Including increasing building and material life spam.
- Use of new innovative materials (vacuum insulation, smart glass, ..)
- **Smart building operations – digitalization and electrification**
- Moving from energy efficiency to **energy flexibility** – react to signals from the energy grid **and energy storage**
- From energy consumer to **energy prosumer** – **integration of renewable** energy (solar PV and heat pumps)
- Focus un **adaptation to climate change** (cooling during heat wave, rainwater utilization)



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