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Energy Use in Buildings

Dr. Miguel Martin

Agenda

1. Importance of buildings in the urban environmental sustainability
2. Energy use in buildings
3. Passive building design strategies to reduce the energy consumed by buildings

References

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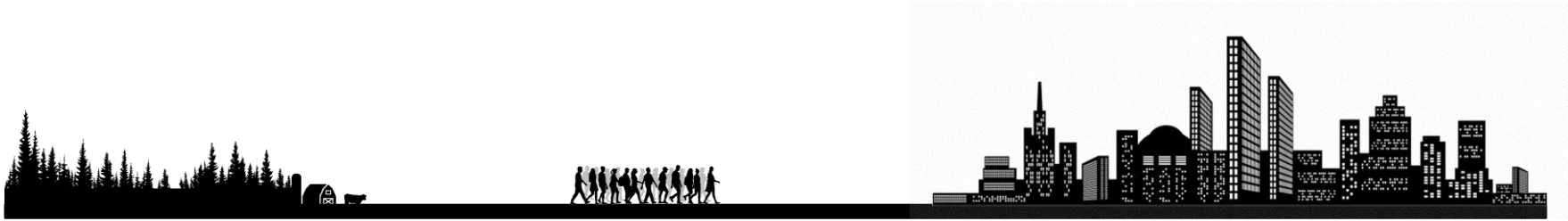
Why are buildings important in cities?

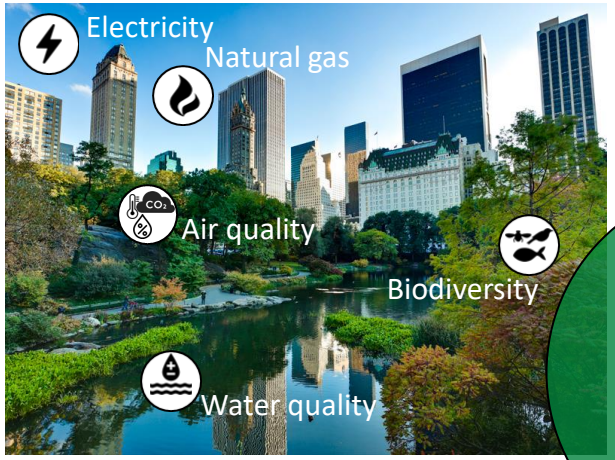
Rural-to-urban migration

> 50% of the world population
> 80% of the U.S. population



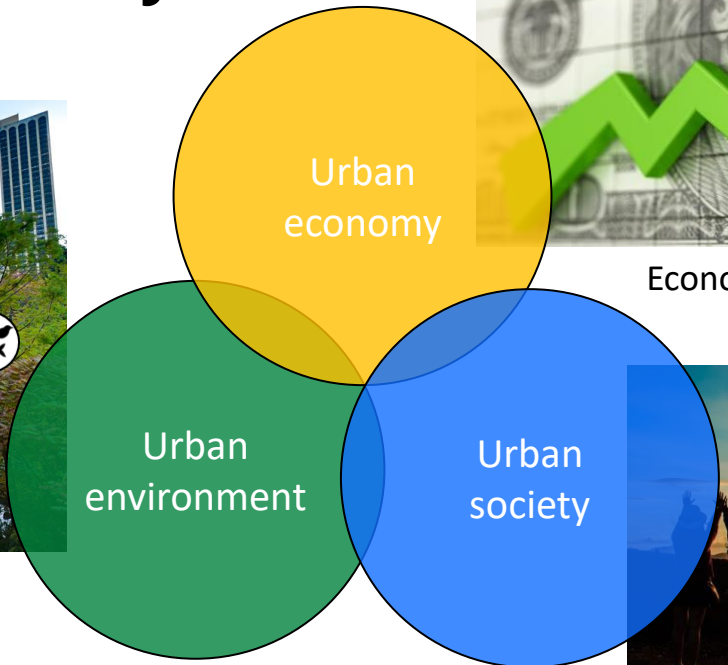
Rural → Urban

Urban sustainability



Resource consumption and environmental impacts

Economic growth and equity



Well-being and health

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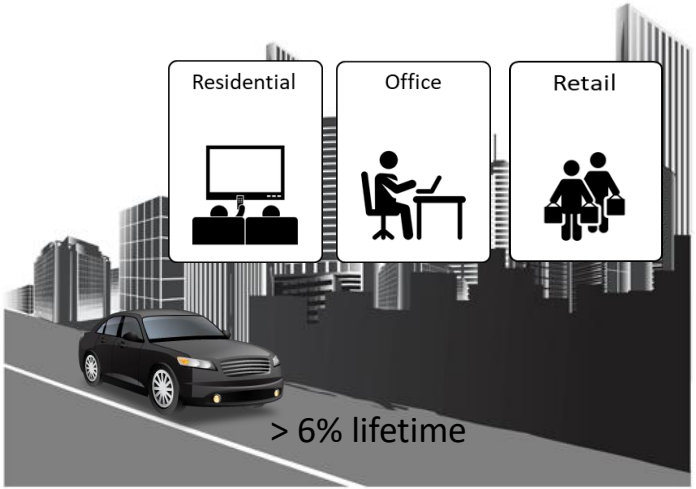
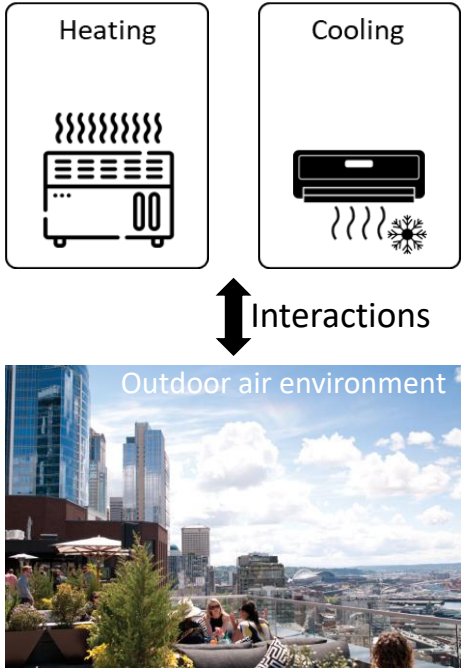
Buildings in the context of urban environmental sustainability

Time spent in buildings
(> 85% lifetime)

> 75% of the U.S. total energy

> 40% of the U.S. total energy





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How is energy used in buildings?

Primary energy

= energy directly extracted from a natural resource (i.e. fuel) or resulting from its motion (i.e. flow)

Sources of primary energy in the U.S.

Limited

Natural gas

Petroleum

Coal

Nuclear

Renewable

Biomass

Geothermal

Solar

Wind

Hydro

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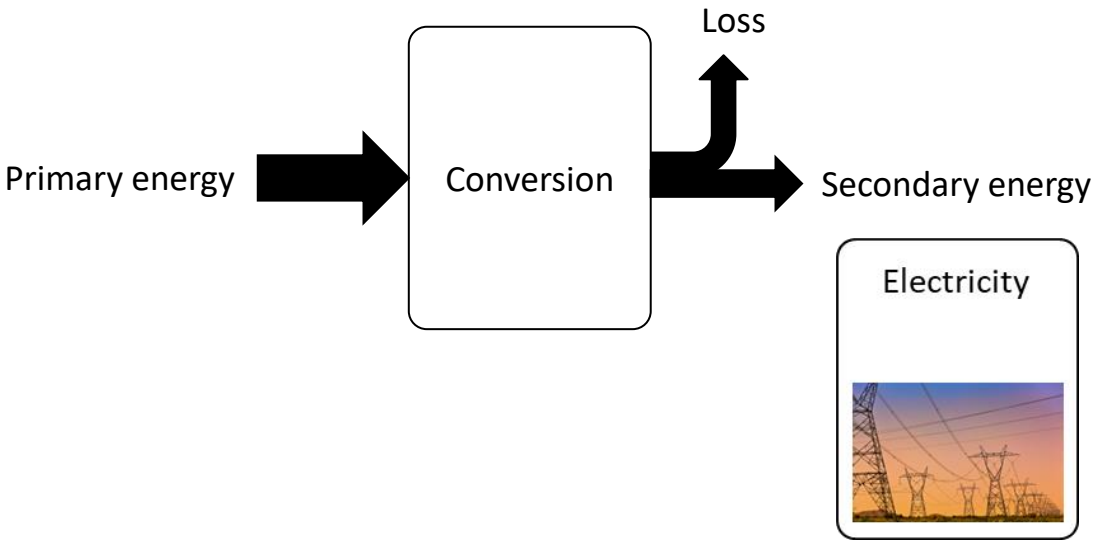
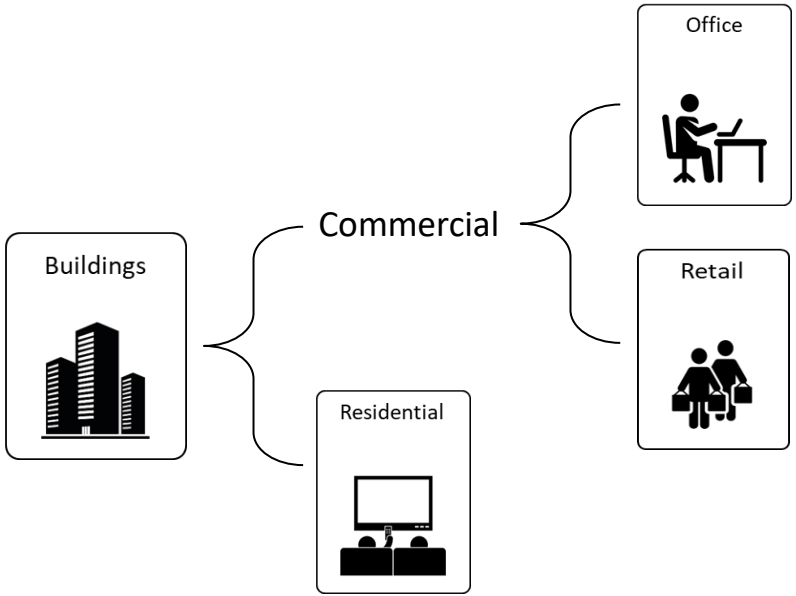
Secondary energy

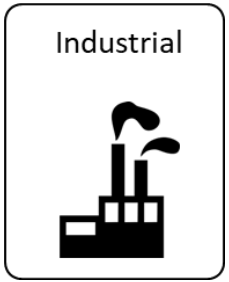
= energy resulting from the conversion of primary energy



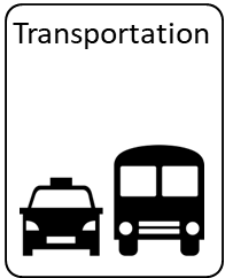
End use sectors

= sectors in which primary or secondary energy is consumed

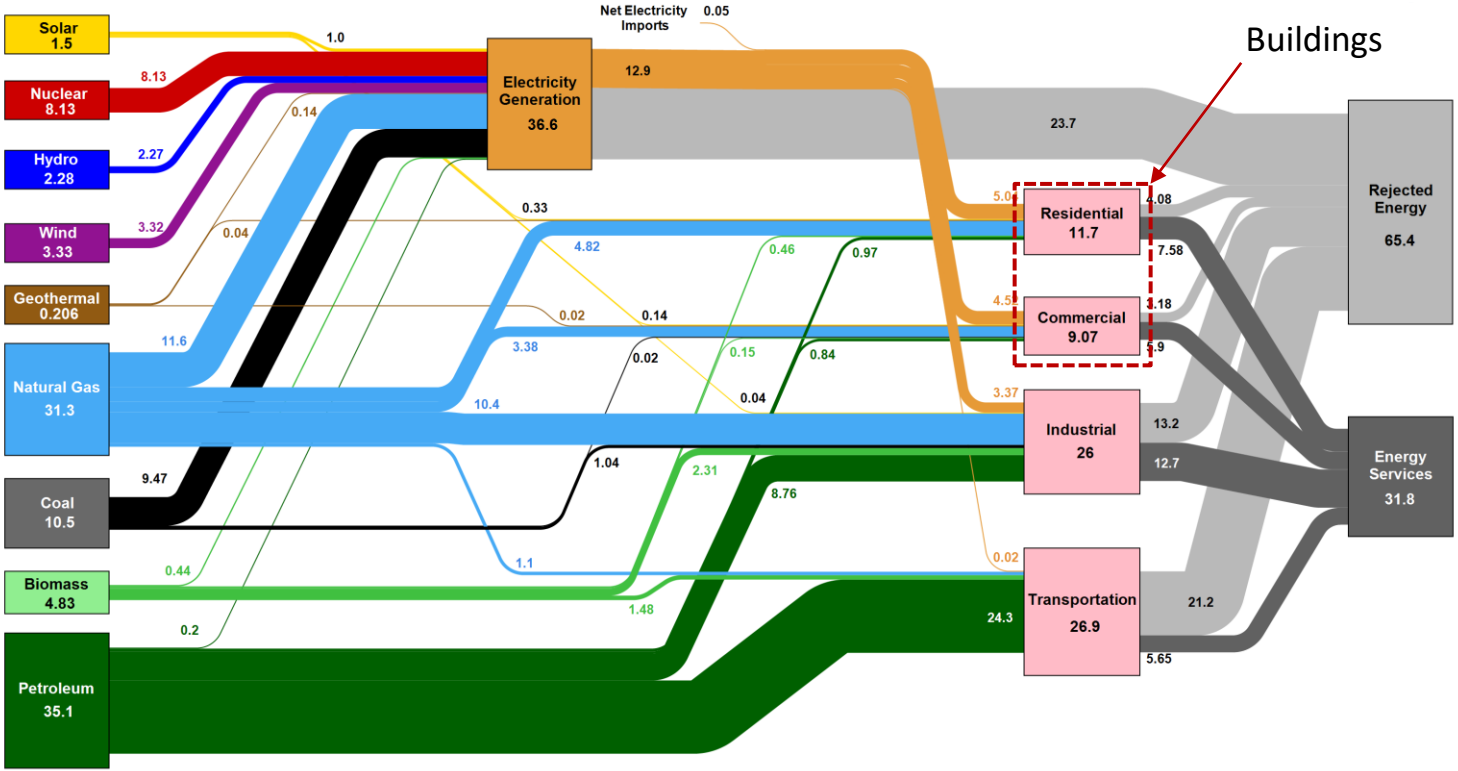




= production of goods



Energy flow chart U.S. (2021)



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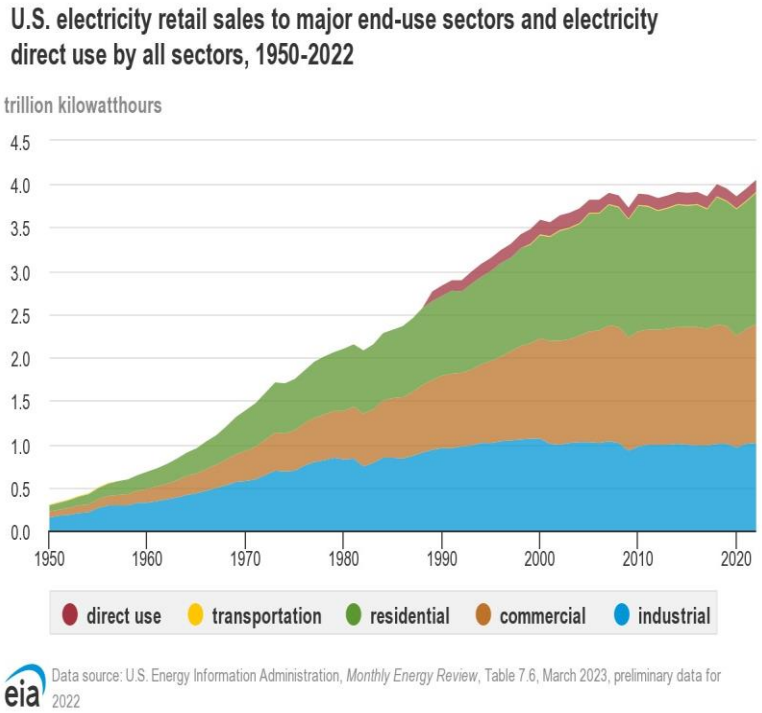
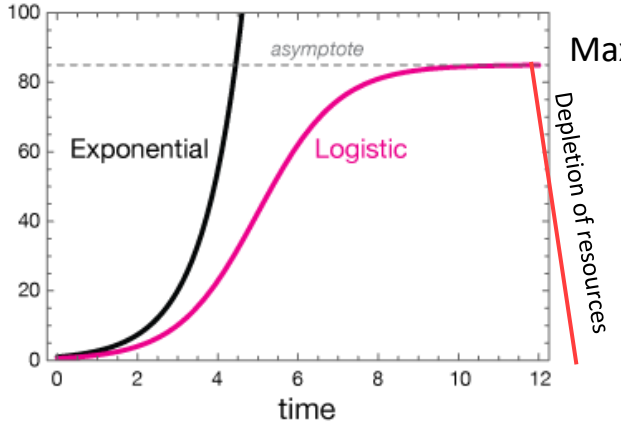
Past and present electricity consumption





Max. capacity

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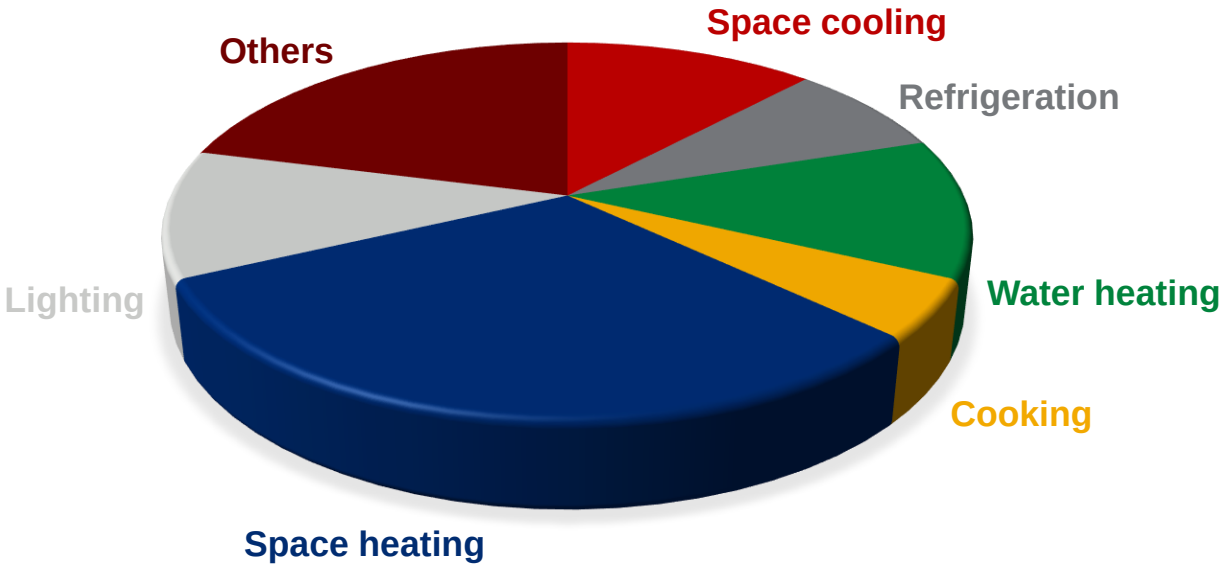
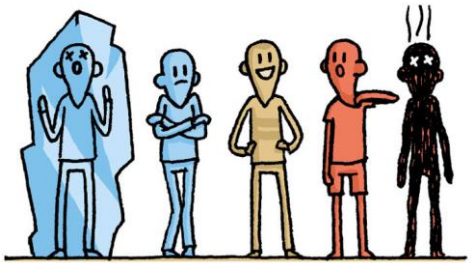
Electricity consumption in buildings (2007, U.S.)



Thermal sensation



> 40% of the total energy use

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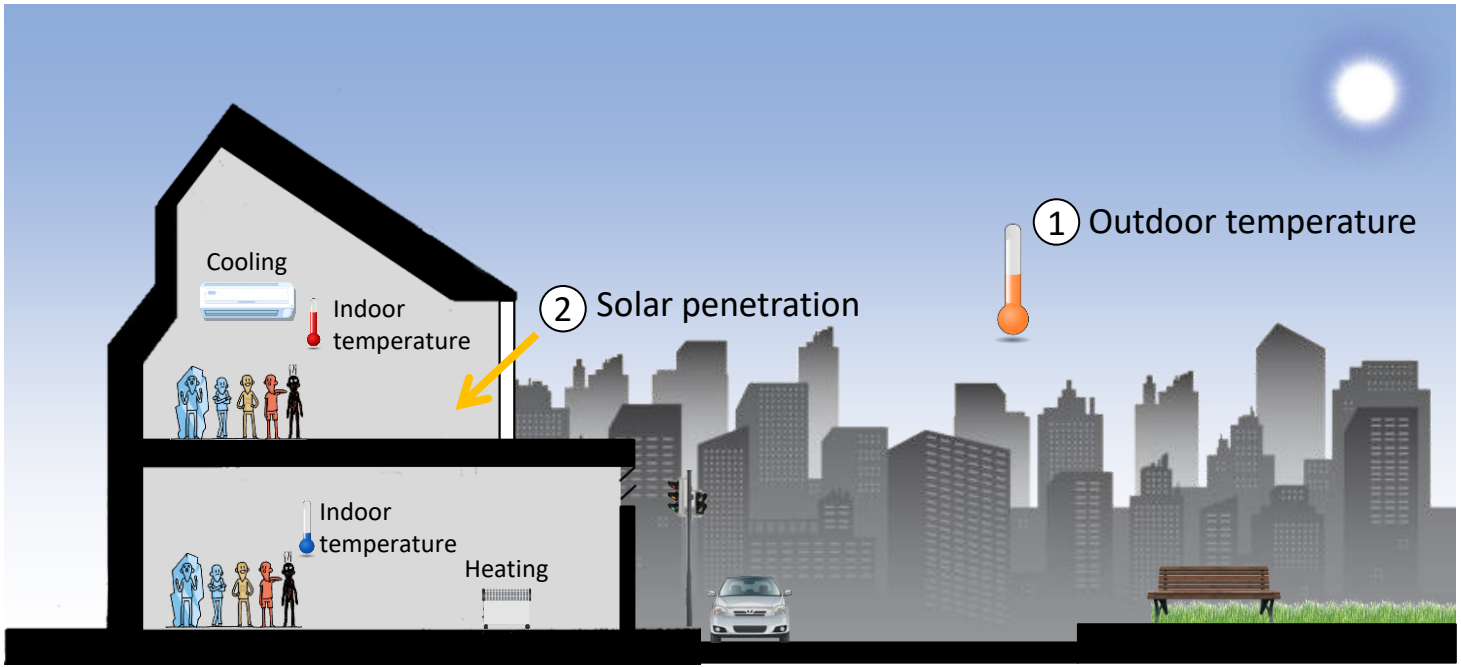
How can energy in buildings be minimized?

Passive building design strategies

= strategies aiming at minimising the heating and/or cooling consumption by retrofitting the building



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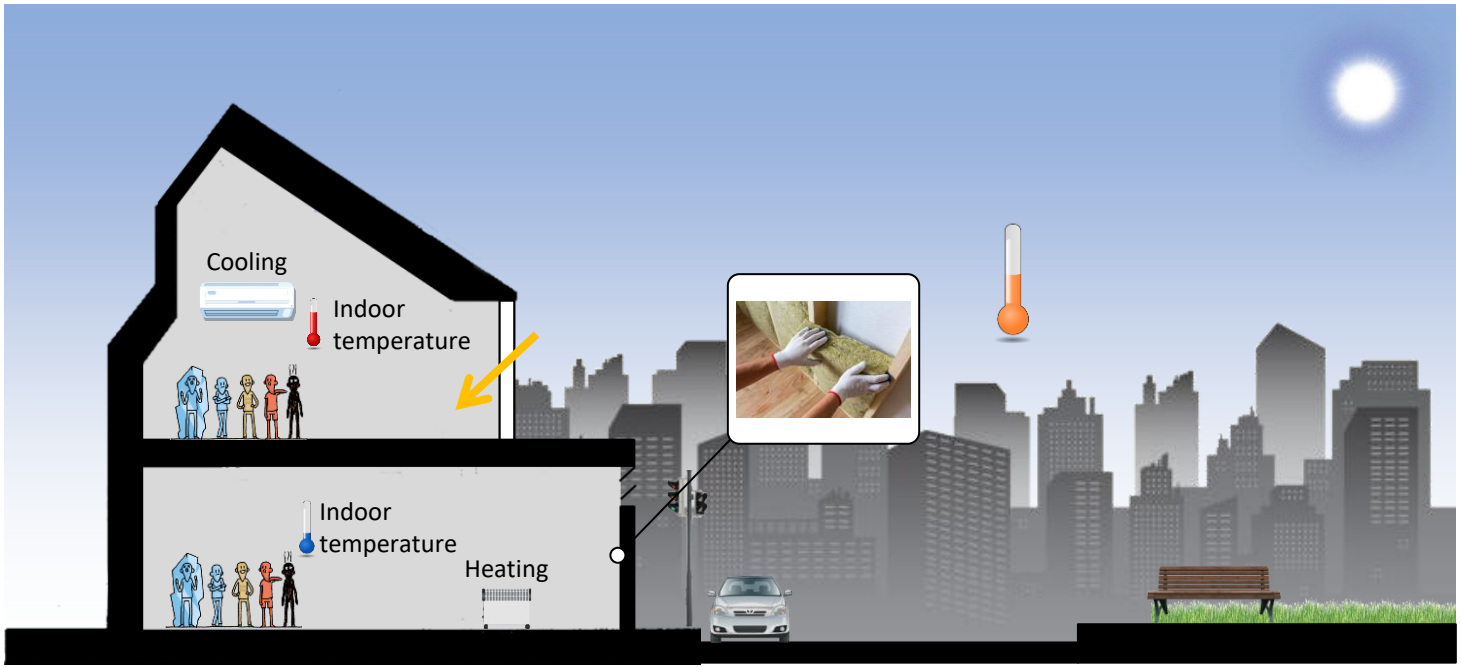
Wall insulation



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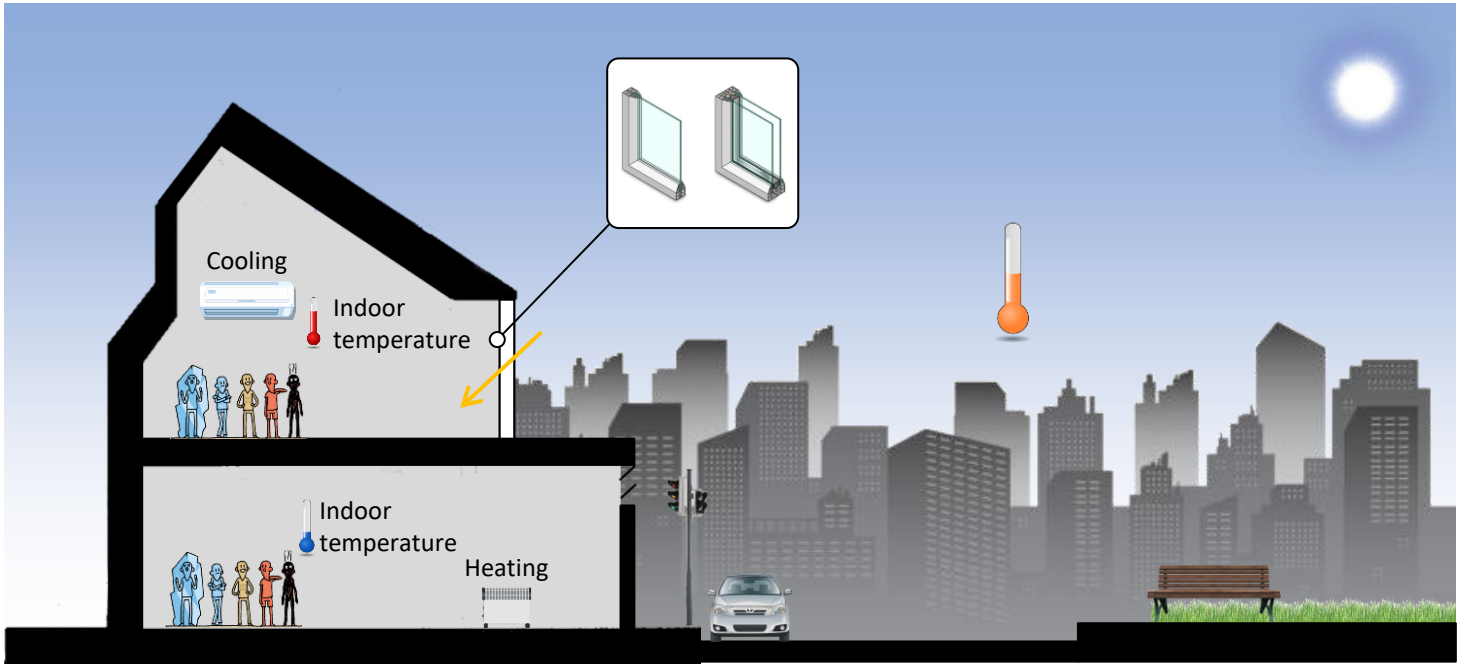
Glass insulation



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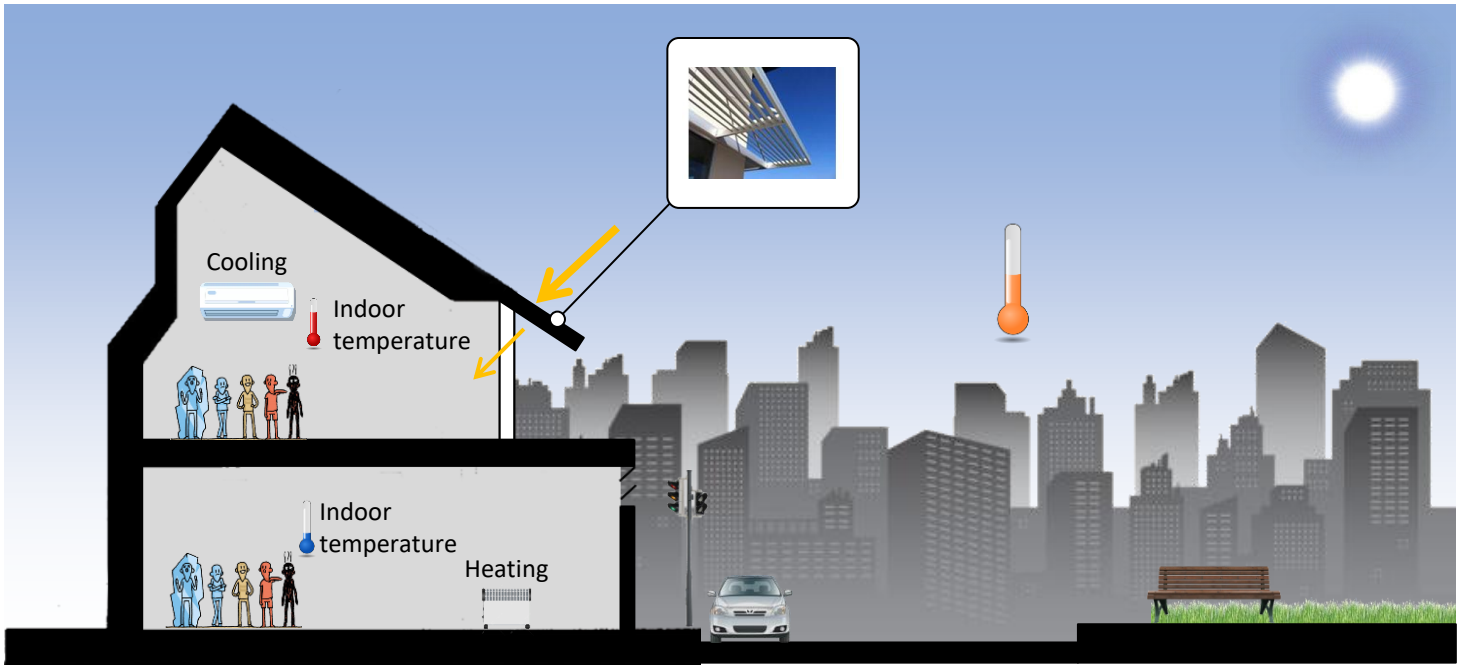
Shading devices



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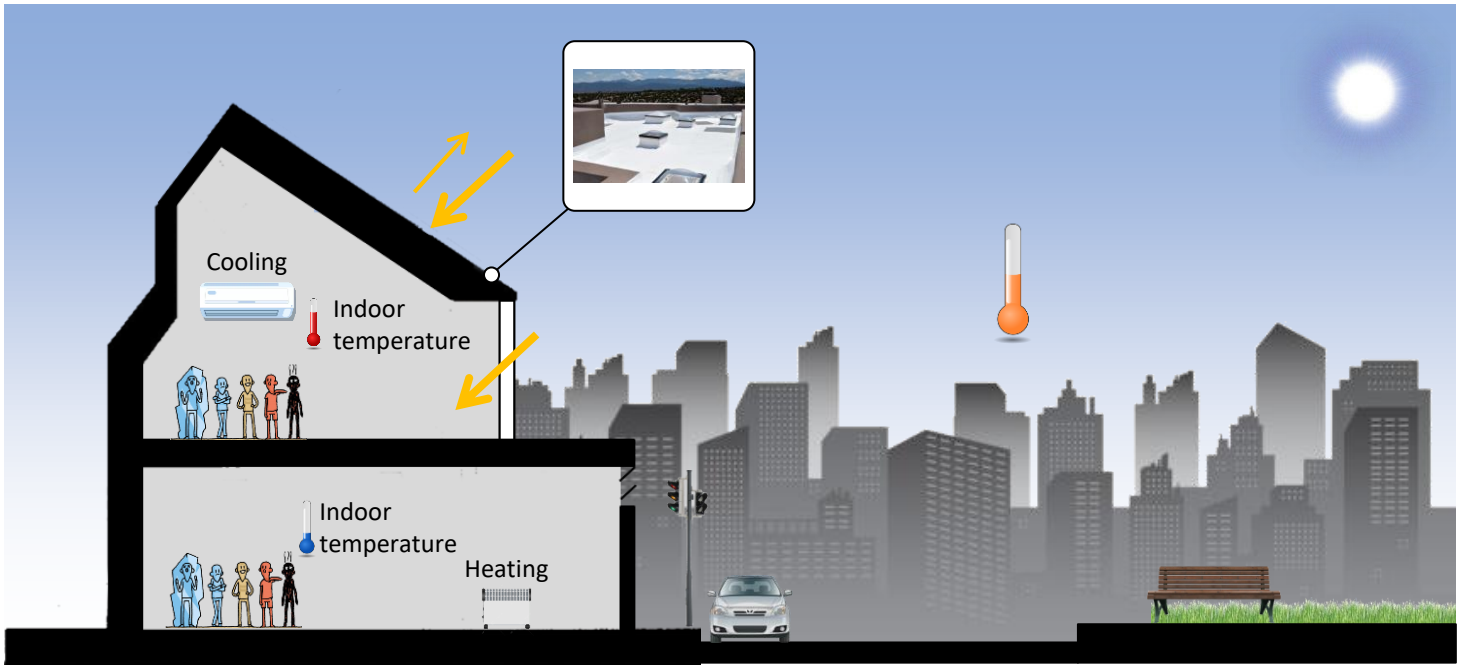
Cool roofs



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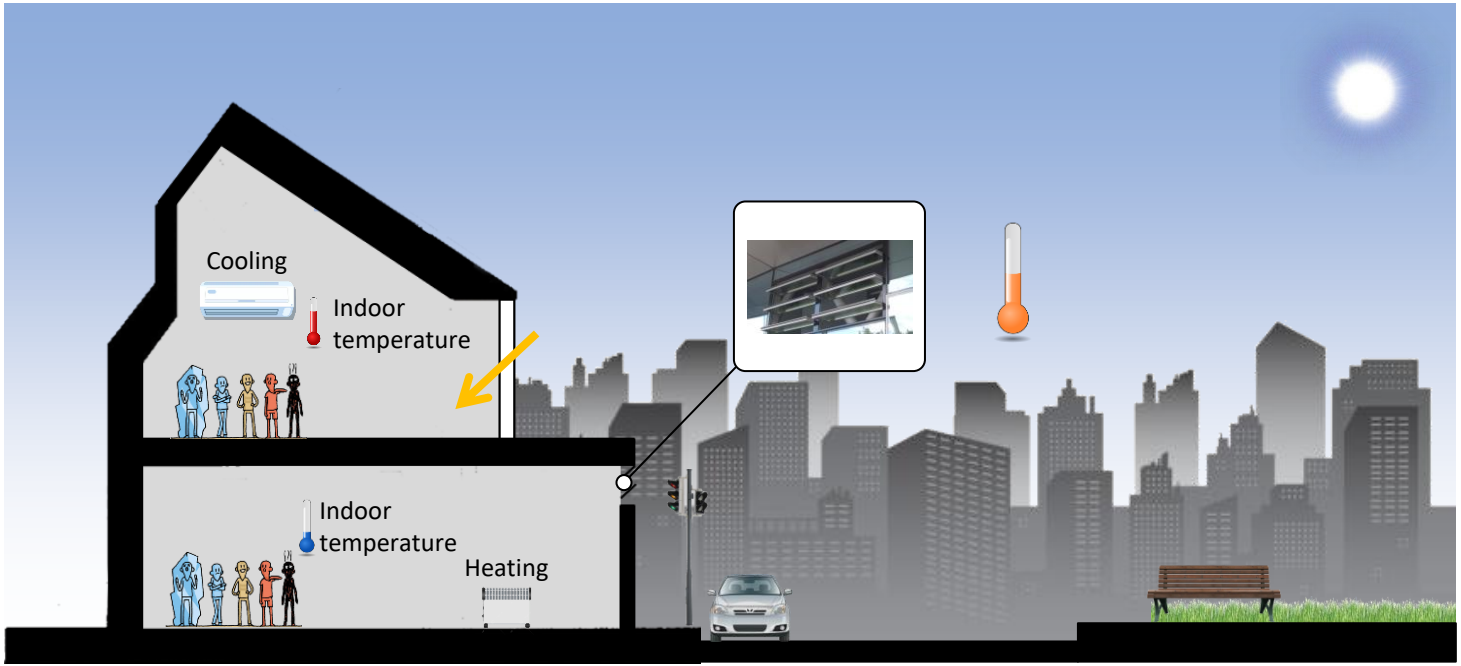
Natural ventilation system



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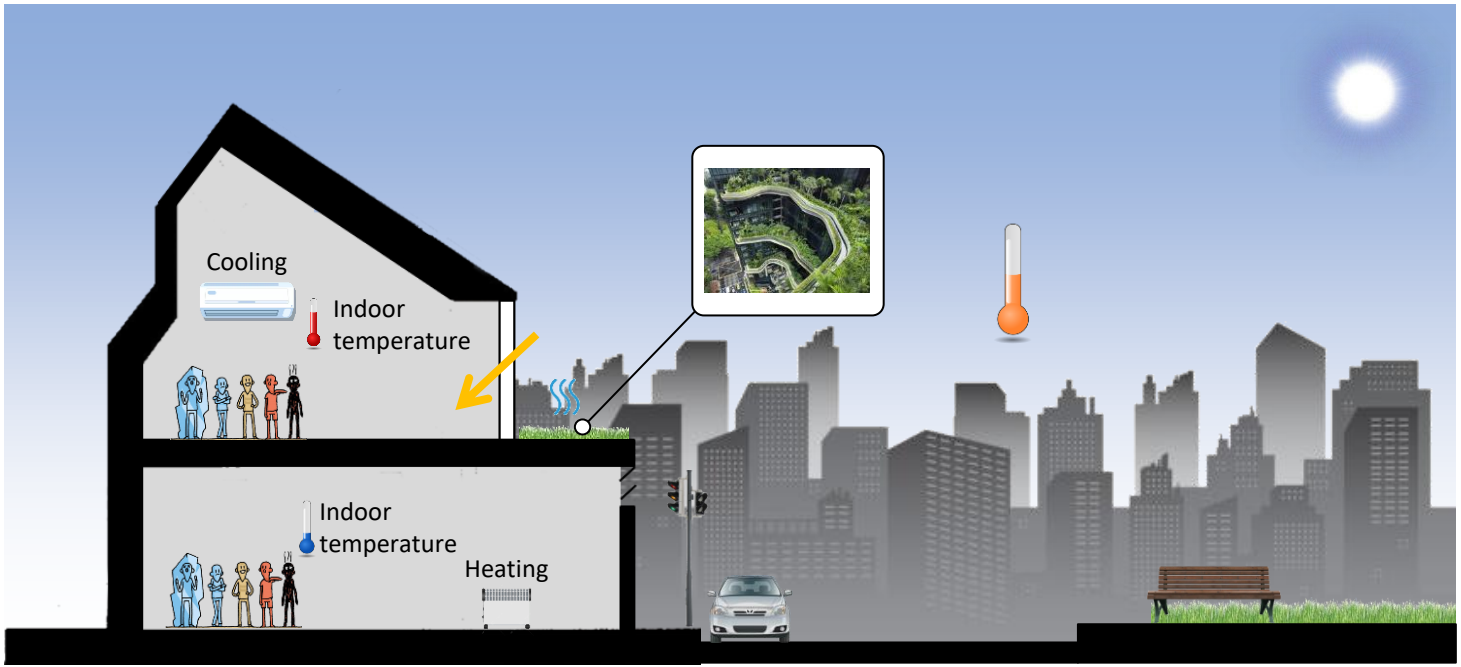
Green roofs



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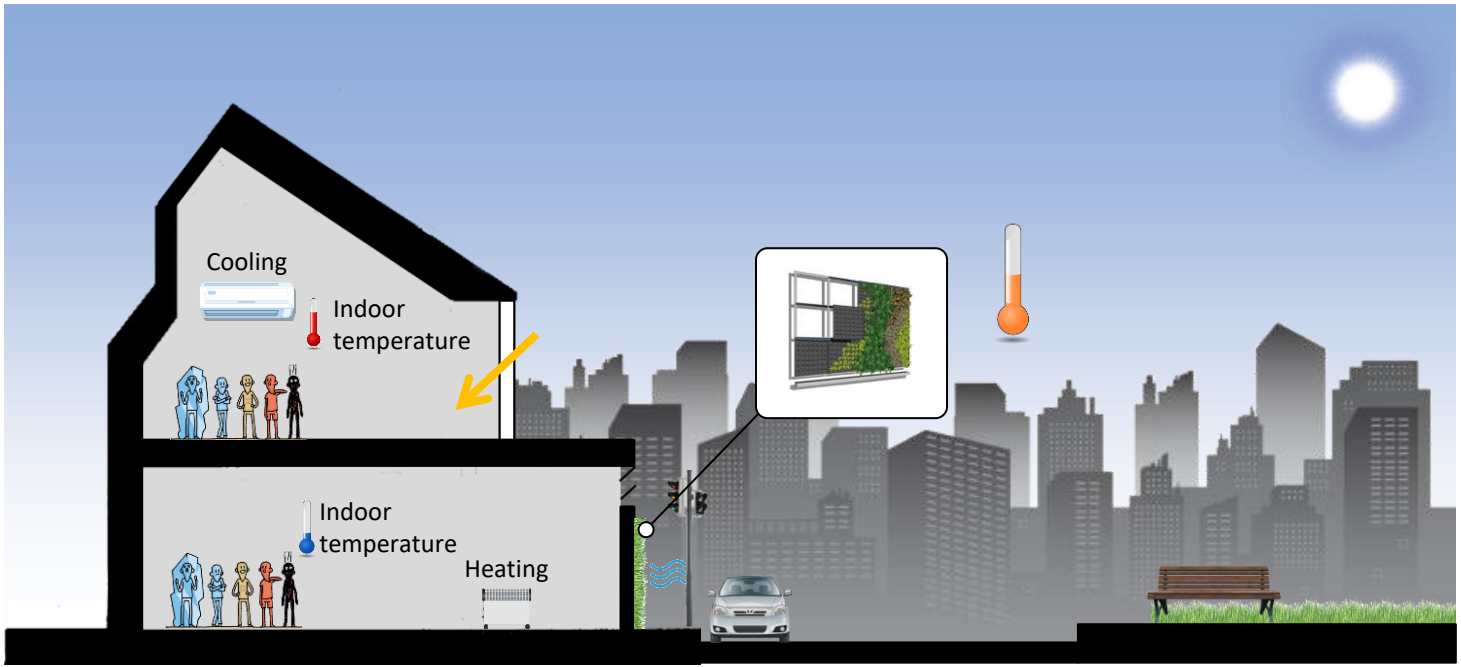
Vertical green systems



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