



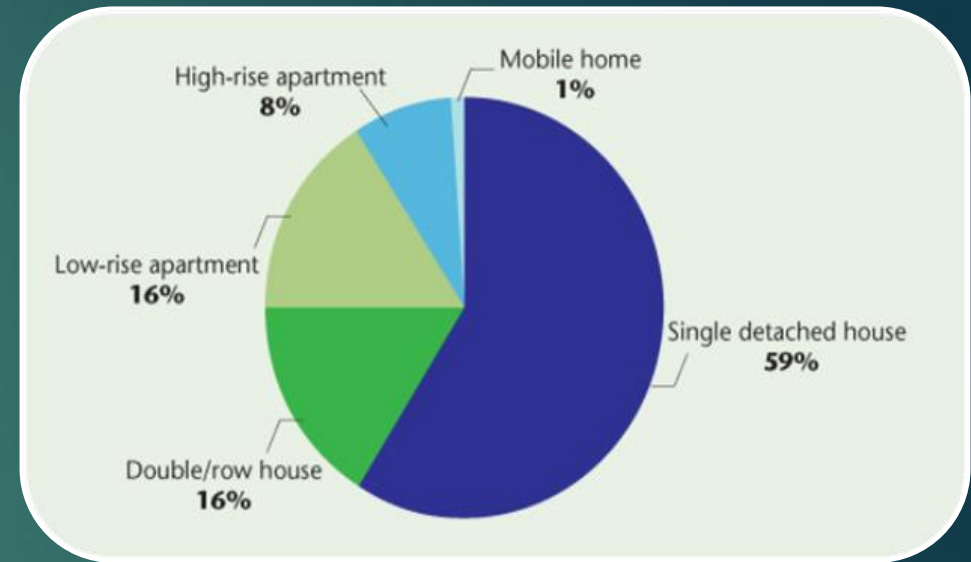
# The Impacts of Code Compliant Ventilation Systems Coupled with a Variety of Mechanical Systems on Annual Heating Energy Performance in a Vancouver Residential House through EnergyPlus Model

ANDREW YANG, M. ENG.

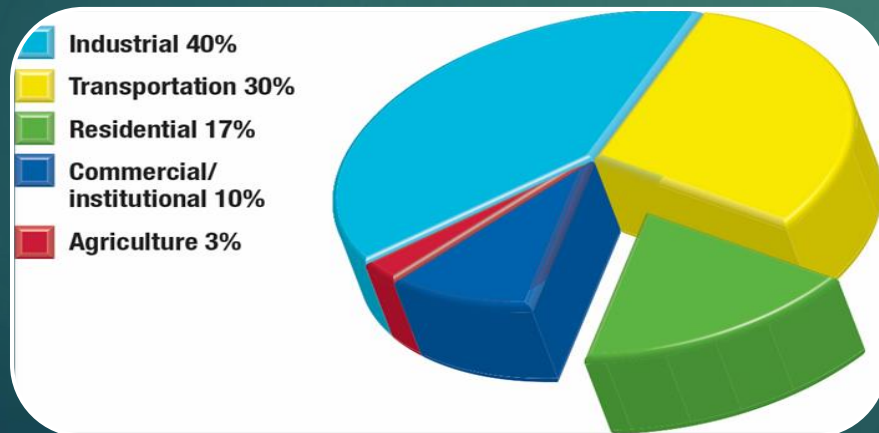
BRITISH COLUMBIA INSTITUTE OF TECHNOLOGY

# Introduction

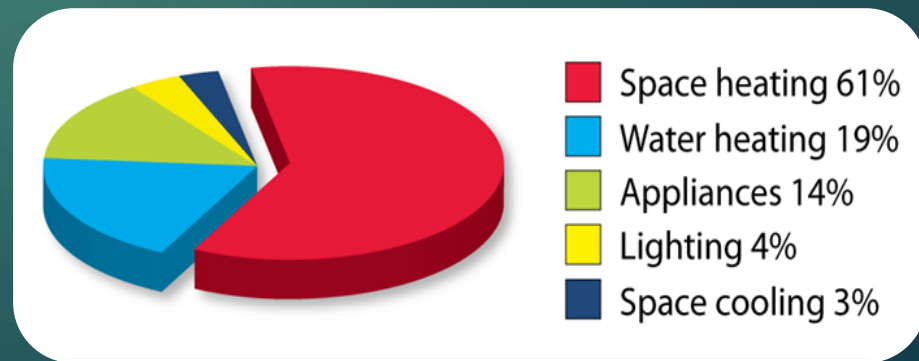
- ▶ Change in BC Building Code
- ▶ Stringent building envelope requirement
- ▶ Importance of quality ventilation



Dwelling Types in Canada



Energy Use by Sector



End-Use Energy Consumption

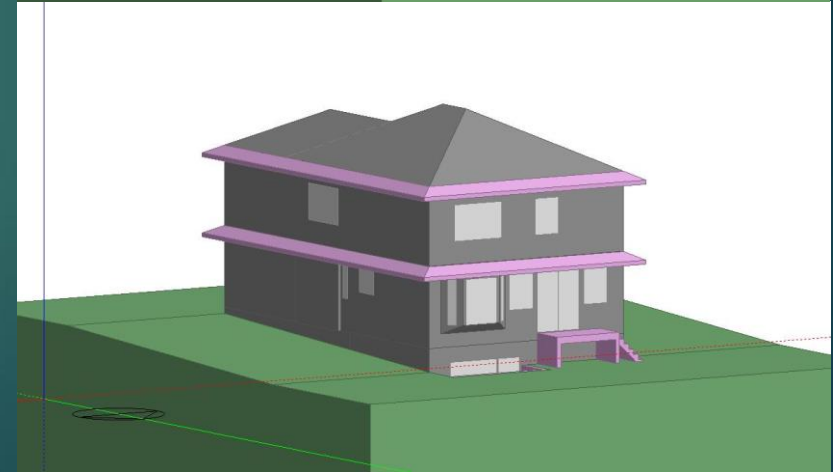
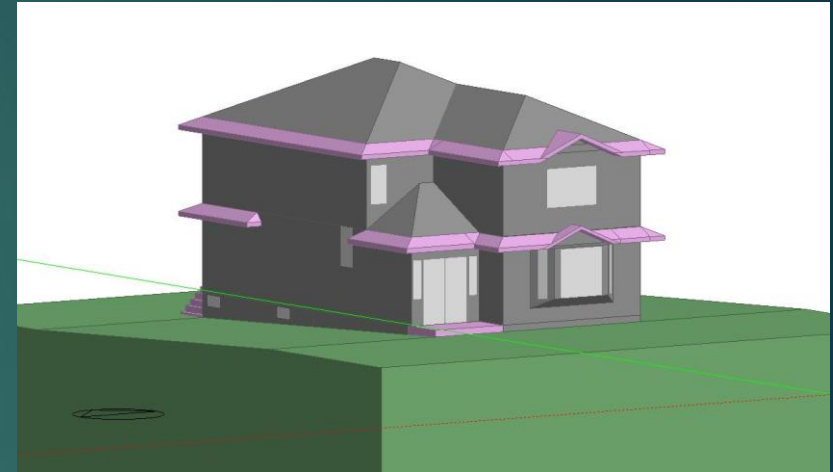
# Objectives

- ▶ To study acceptable ventilation system's heating energy use
- ▶ To analyze heating energy use for different systems through energy model
- ▶ To identify energy saving potential and potential improvements



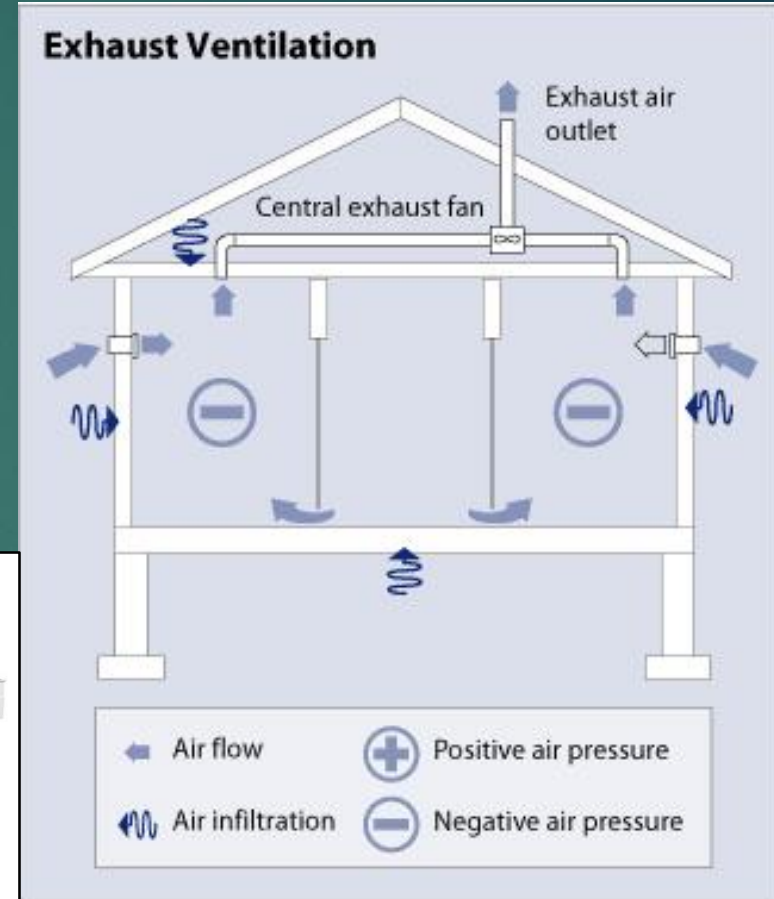
# House Specifications

- ▶ 2-Storey and a basement
- ▶ Area / volume: 2,388 ft<sup>2</sup> / 20,872 ft<sup>3</sup>
- ▶ Window-to-wall ratio: 9%
- ▶ Windows: 0.35 U-Value & 0.32 SHGC
- ▶ Air leakage rate: 2.5 ACH<sub>50</sub>
- ▶ Ventilation rate: 60 cfm



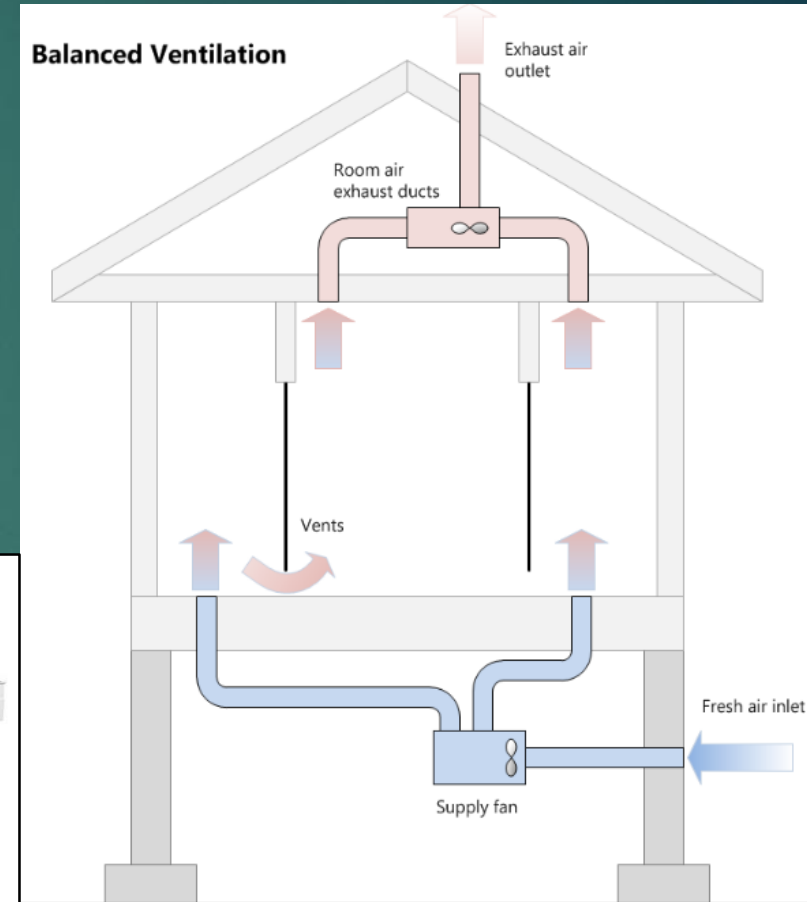
# Type of Systems Investigated

- ▶ Electric Baseboard (Exhaust-only ventilation)
- ▶ Electric Baseboard (Balanced ventilation)
- ▶ Electric Baseboard (with HRV)
- ▶ Furnace
- ▶ Furnace (with HRV)



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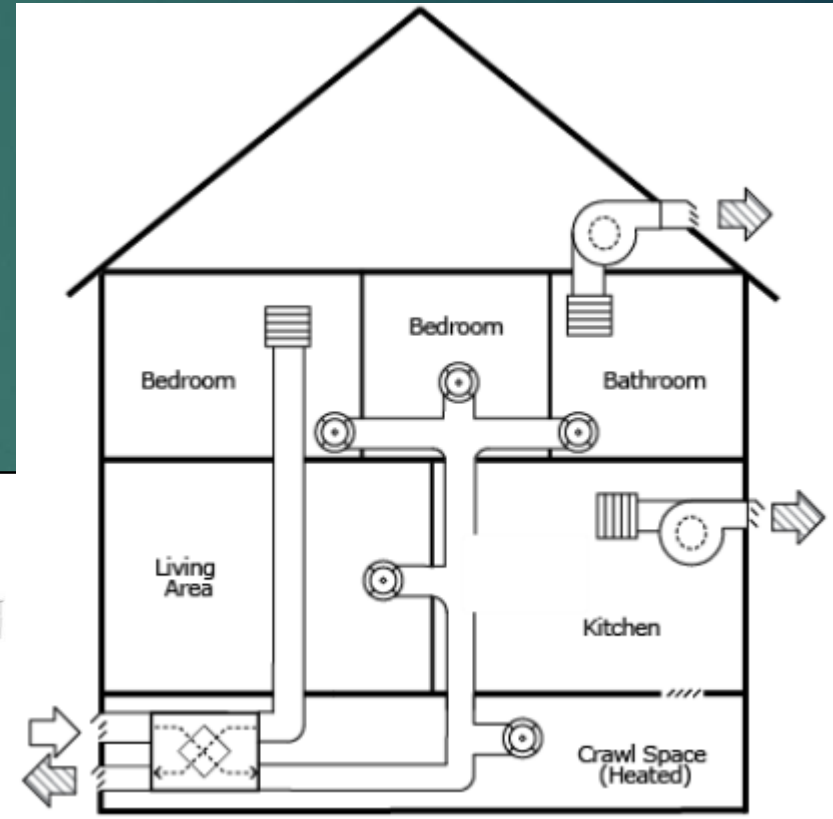
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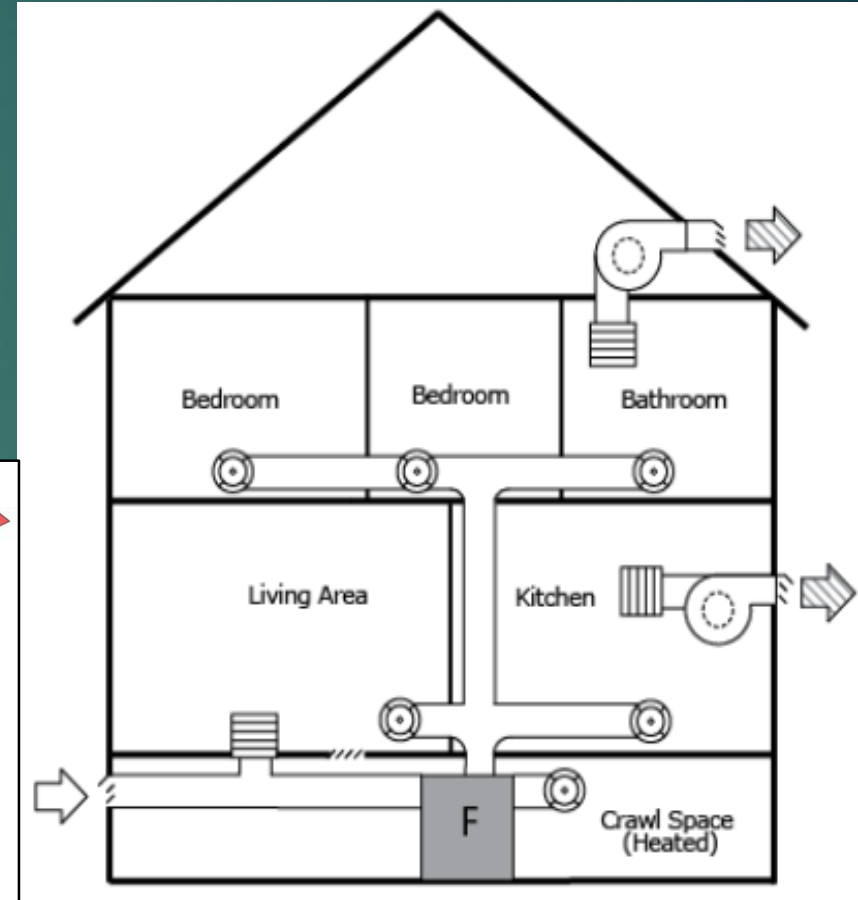
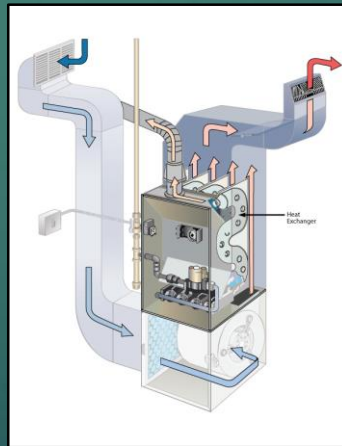
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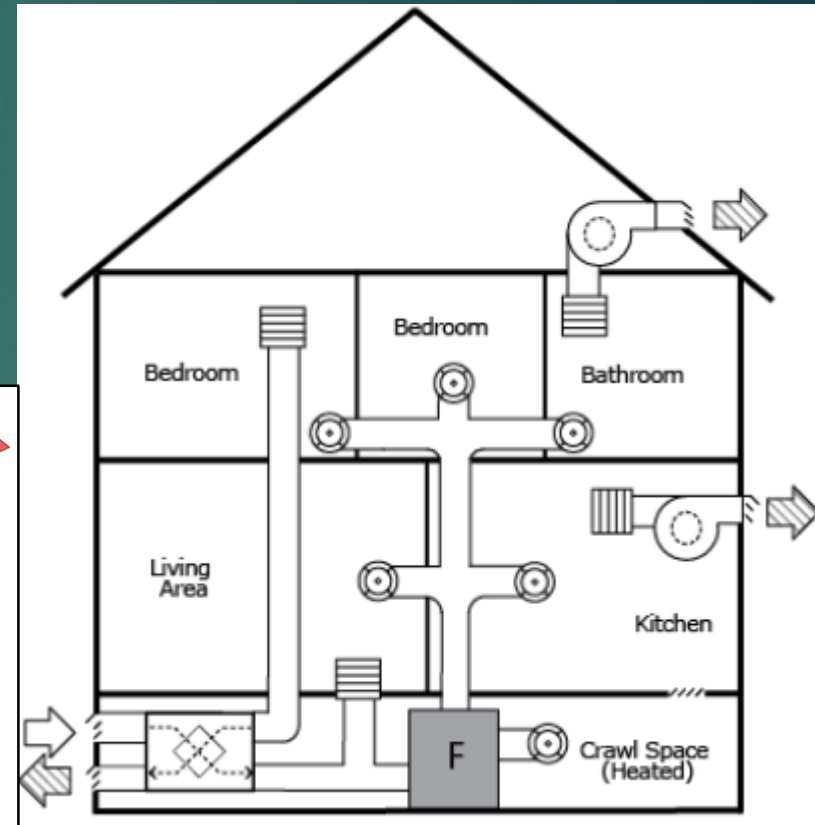
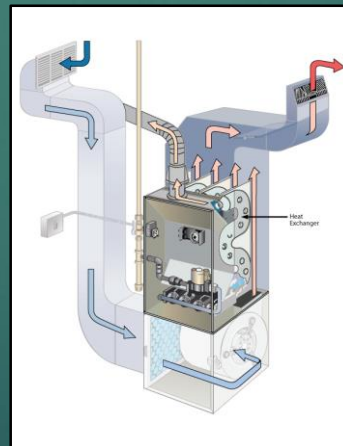
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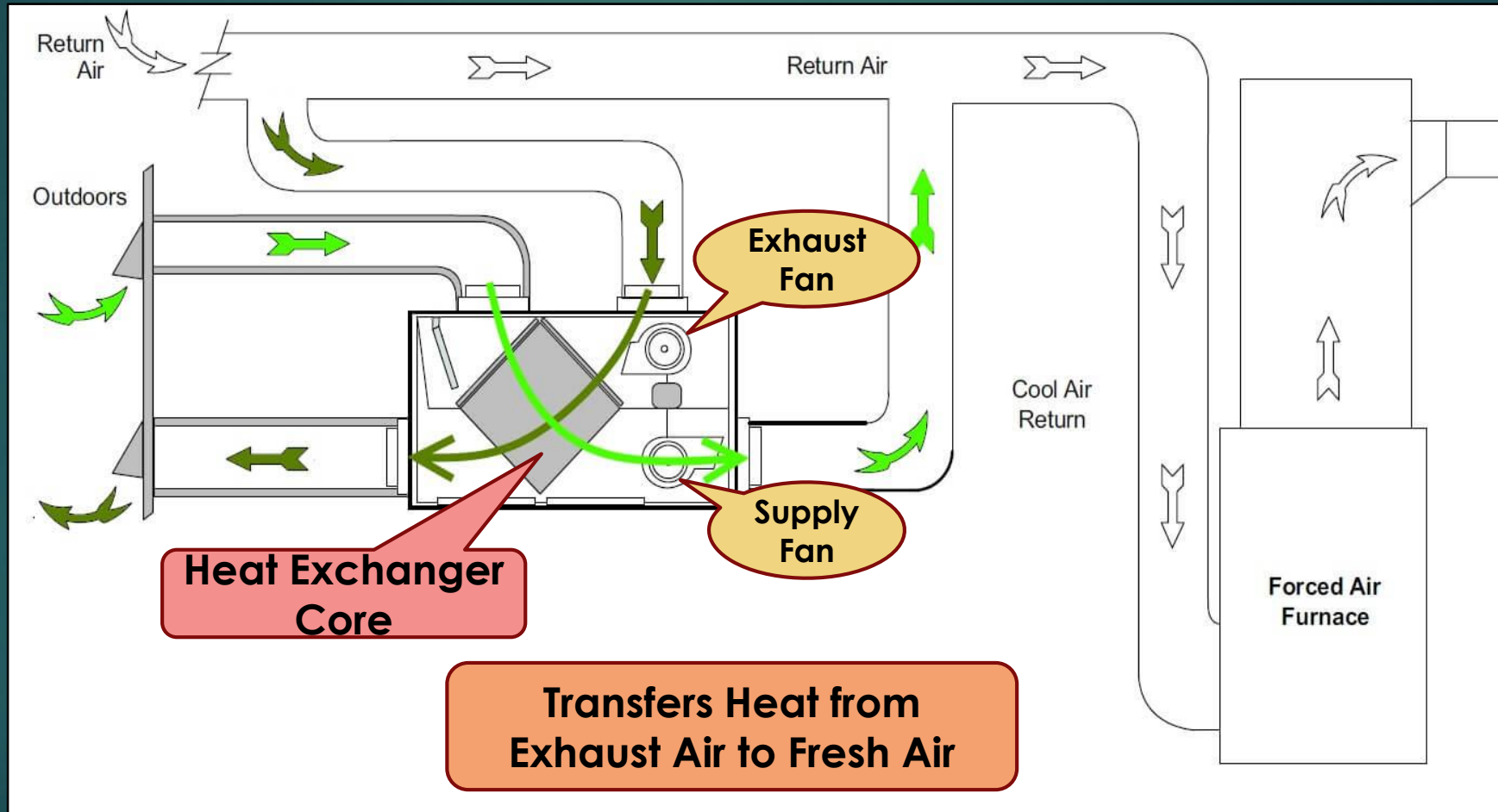


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# Heat Recovery Ventilator



# System Specifications

- ▶ Design Heating Load

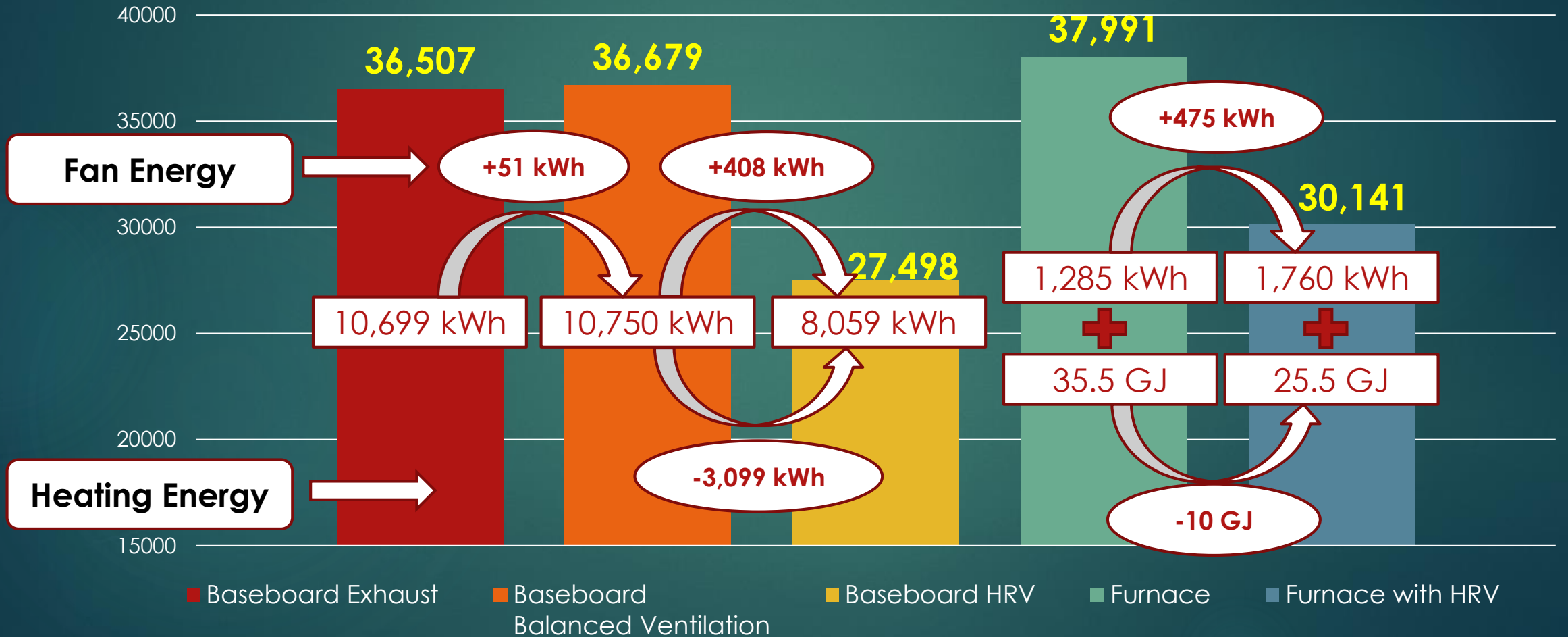
<b>Base Systems</b>	<b>Design Heating Load</b>	<b>Ventilation Load</b>
<b>Without HRV</b>	<b>25,420 Btu/h</b>	<b>2,611 Btu/h</b>
<b>With HRV</b>	<b>23,540 Btu/h</b>	<b>731 Btu/h</b>

- ▶ Equipment sizing based on the design heating load

<b>Equipment</b>	<b>Specifications</b>
<b>Electric Baseboard</b>	<b>Meets zone level loads</b>
<b>Furnace</b>	<b>2.5 Ton (30,000 Btu/h) / 800 cfm</b>
<b>HRV</b>	<b>79 cfm / 72% sensible efficiency</b>

# Simulation Results

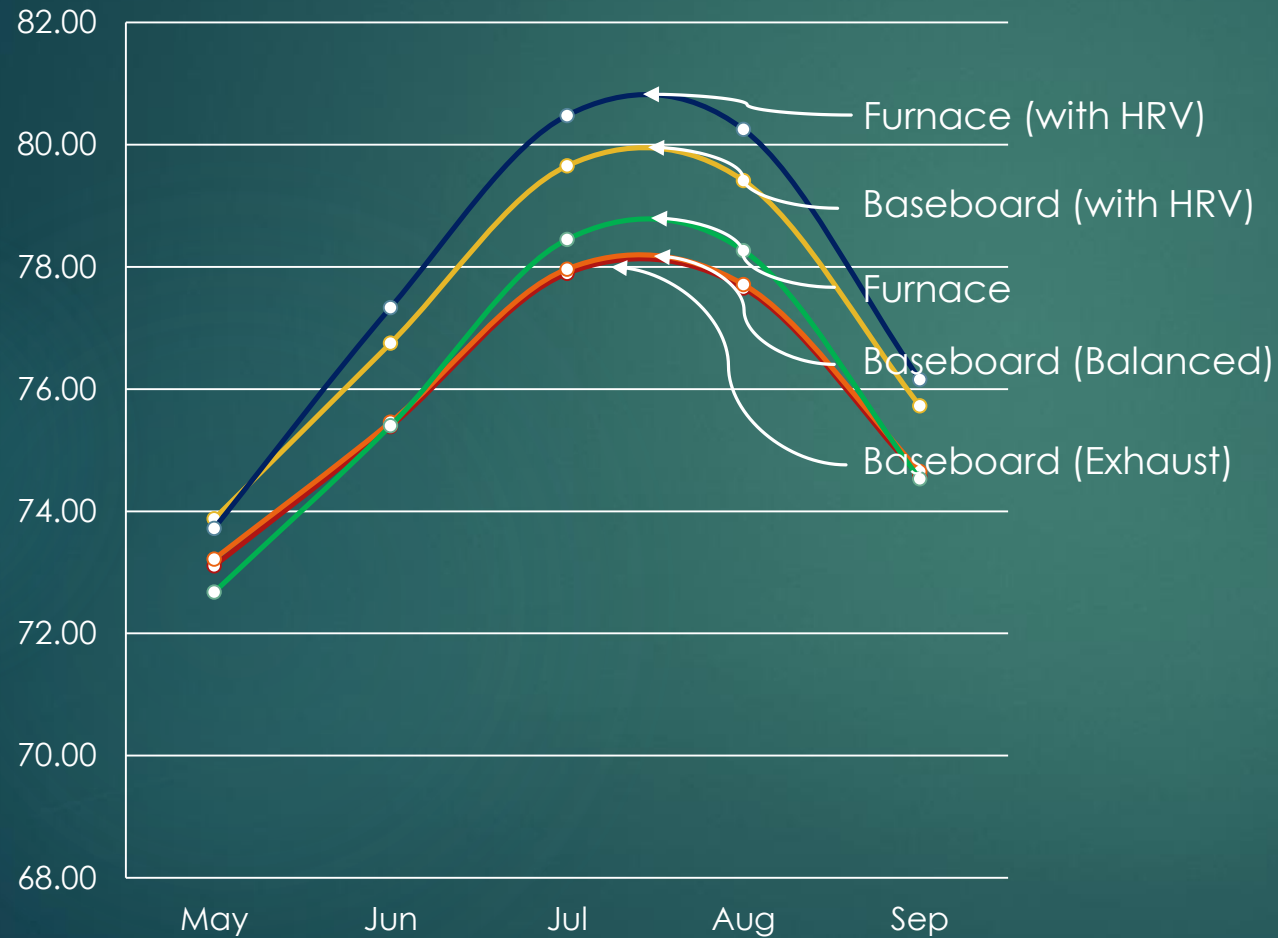
Annual Heating Energy Consumption [in kBtu]



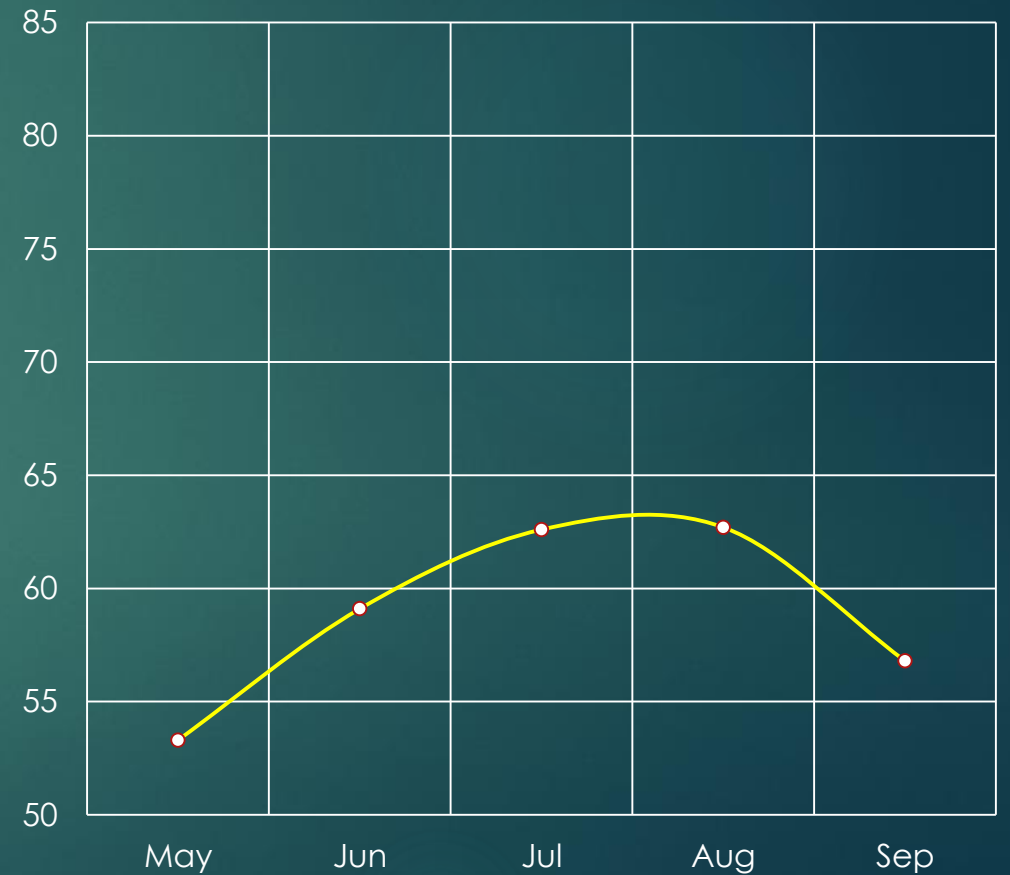
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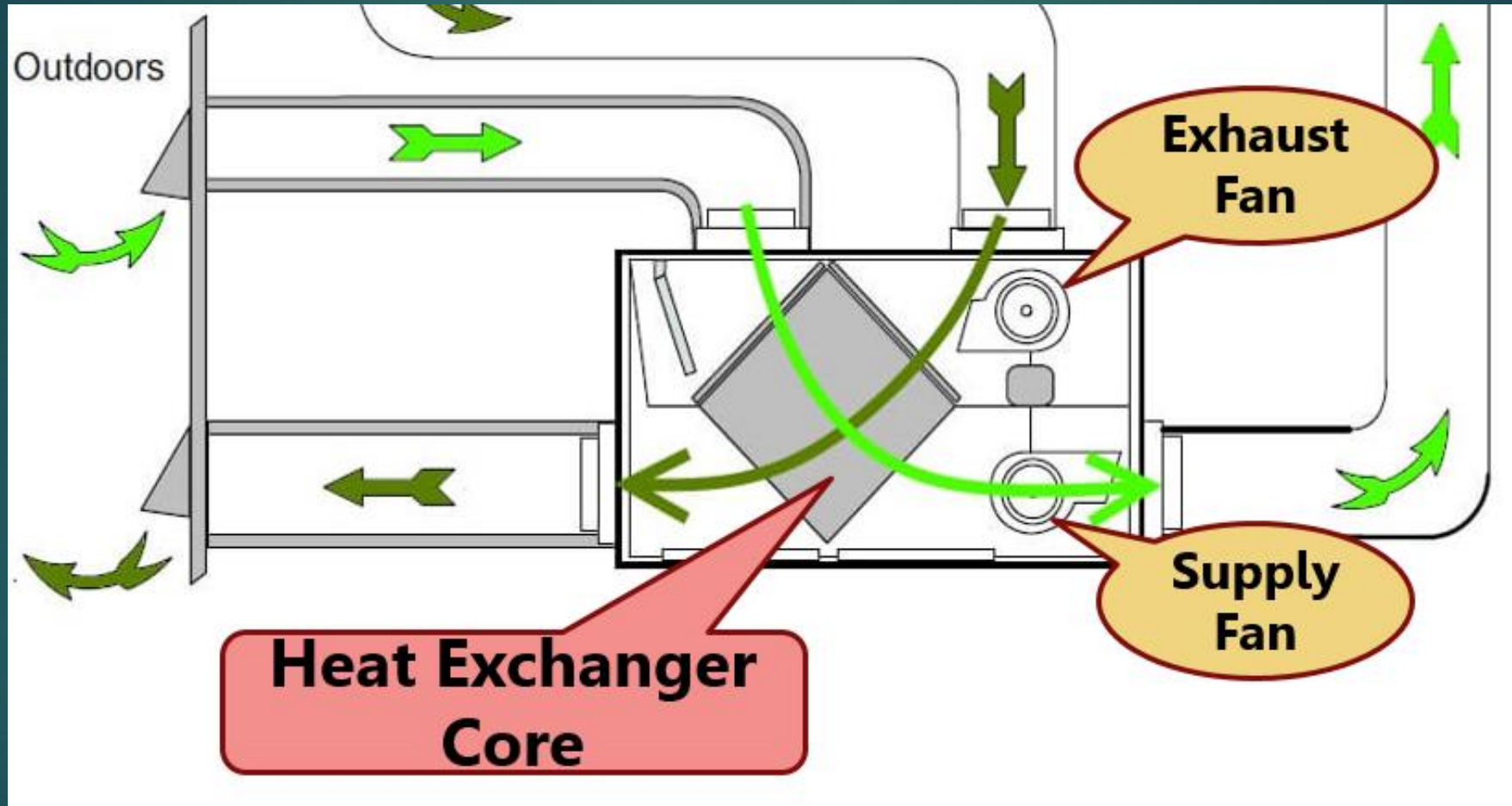
Avg. Indoor Air Temperature [°C]



Ave. Outdoor Air Temperature [°C]



# Simulation Results





# Conclusion

- ▶ HRV saved about 28% for the hypothetical house
- ▶ Saving percentage is closely related to envelope performance
- ▶ Summer overheating phenomena to be addressed
- ▶ Mechanical design to avoid unnecessary blower fan continuously running

Thank you