



Institute of Technology in Architecture
Faculty of Architecture / ETH Zurich

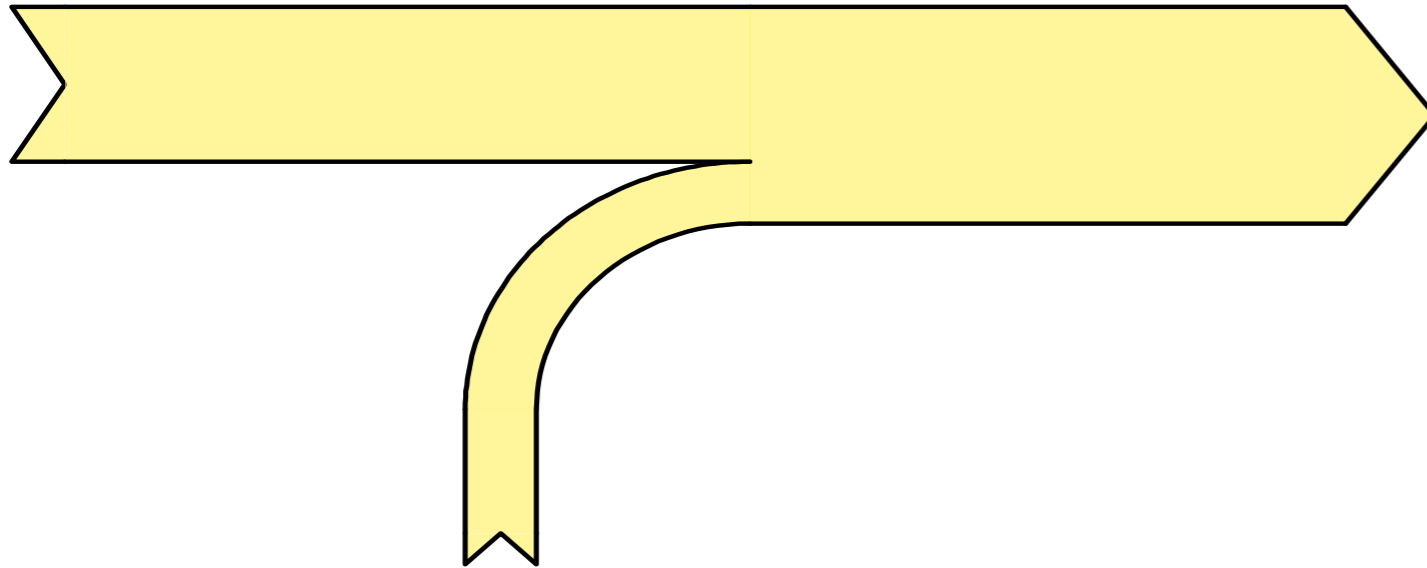
Heat Pumps

The heart of low exergy systems

Forrest Meggers

Professur für Gebäudetechnik (GT) - Building Systems Group

26.Nov 2010



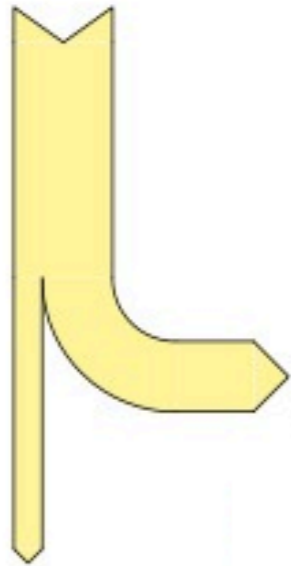
ETH

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Exergy and Buildings and Heat Pumps

Heat Engine

Hot
heat source, T_{hot}

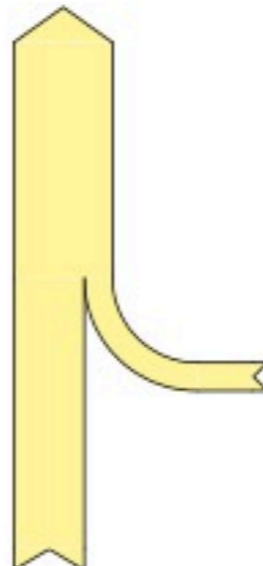


Work
exergy out

Cold
energy sink, T_{cold}

Heat Pump

Hot
heat sink, T_{hot}



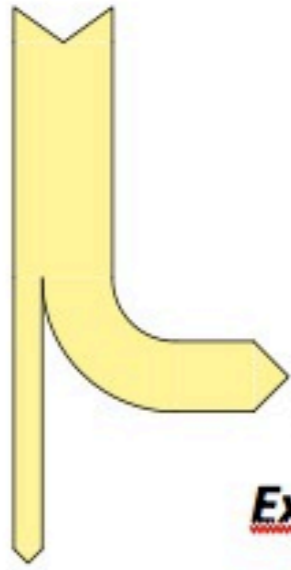
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Work
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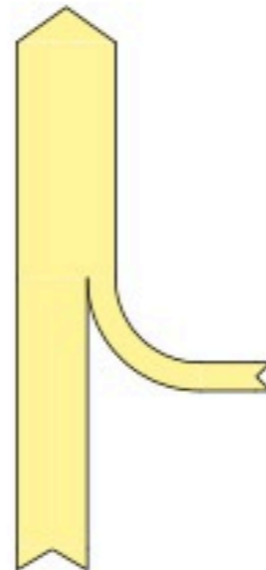
$$\underline{Ex}_{out} = Q_{in} - \underline{An}_{out}$$

Efficiency, η

Cold
energy sink, T_{cold}

Heat Pump

Hot
heat sink, T_{hot}



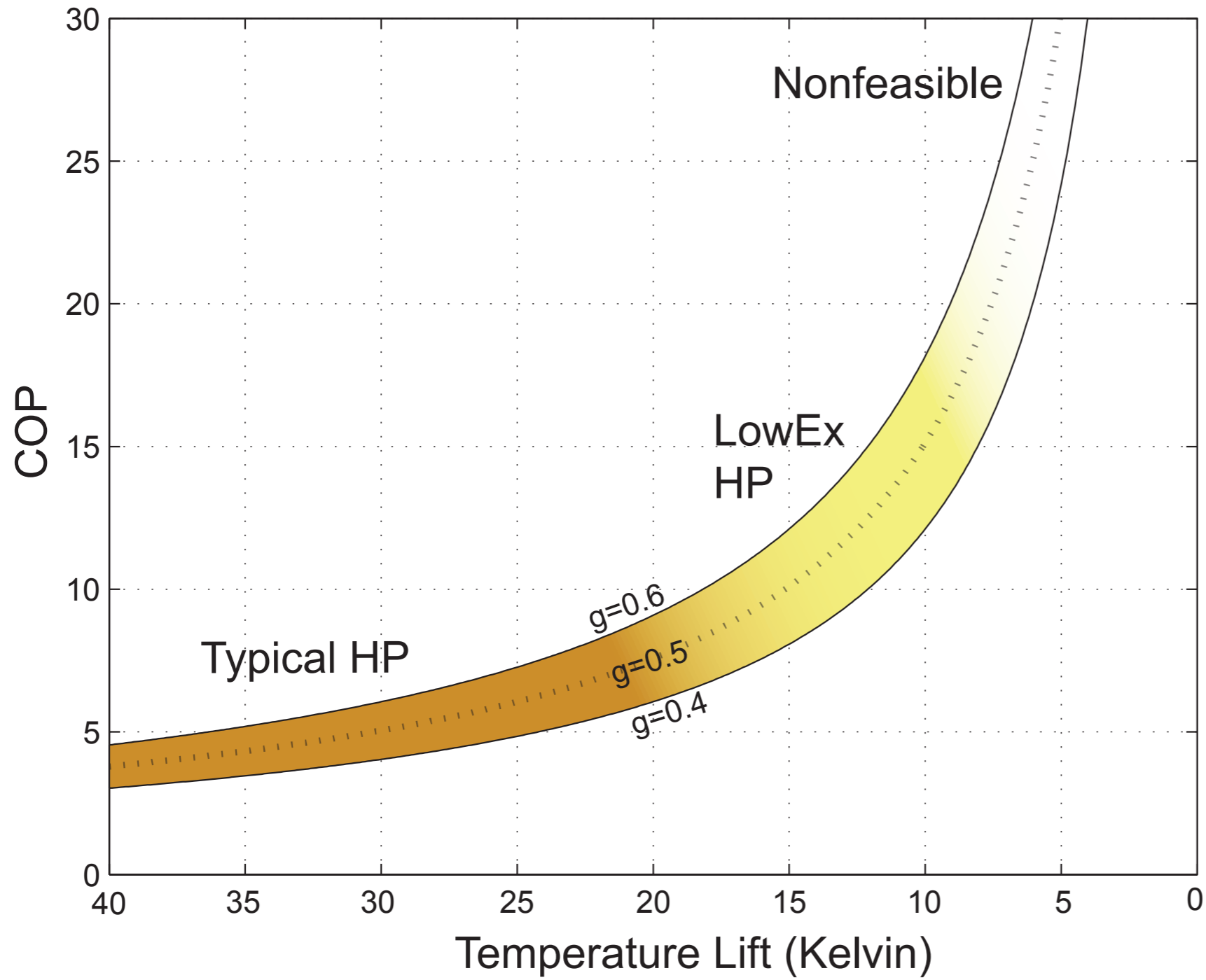
Work
exergy in

$$\underline{Q}_{out} = \underline{Ex}_{in} + \underline{An}_{in}$$

**Coefficient of Performance,
COP**

Cold
energy source, T_{cold}

The potential of heat pumps



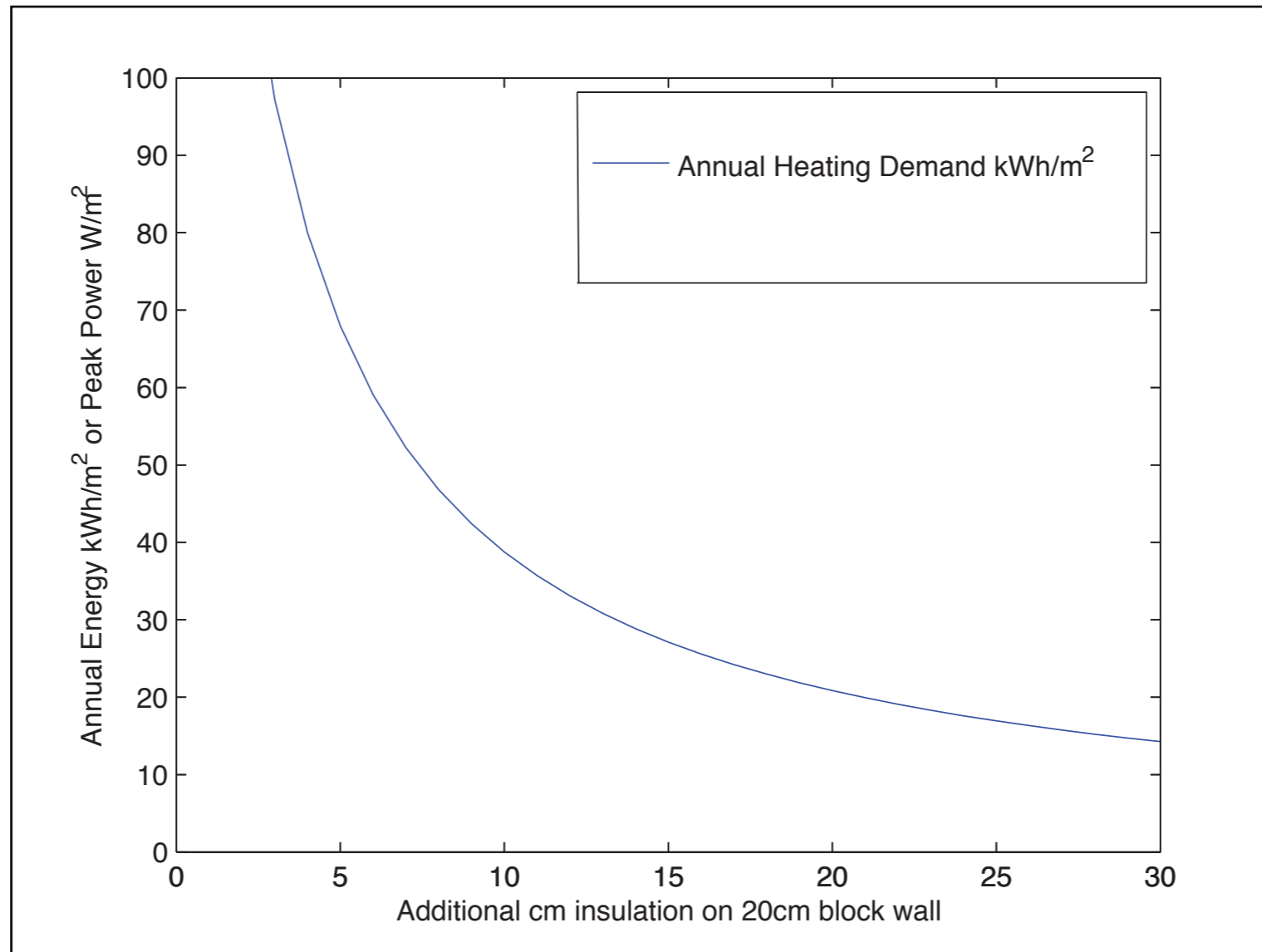
**Units of heat
per
Input!**

Improving heat pumps vs Adding insulation

The Minergie Debate (see Toward Zero Emission press)

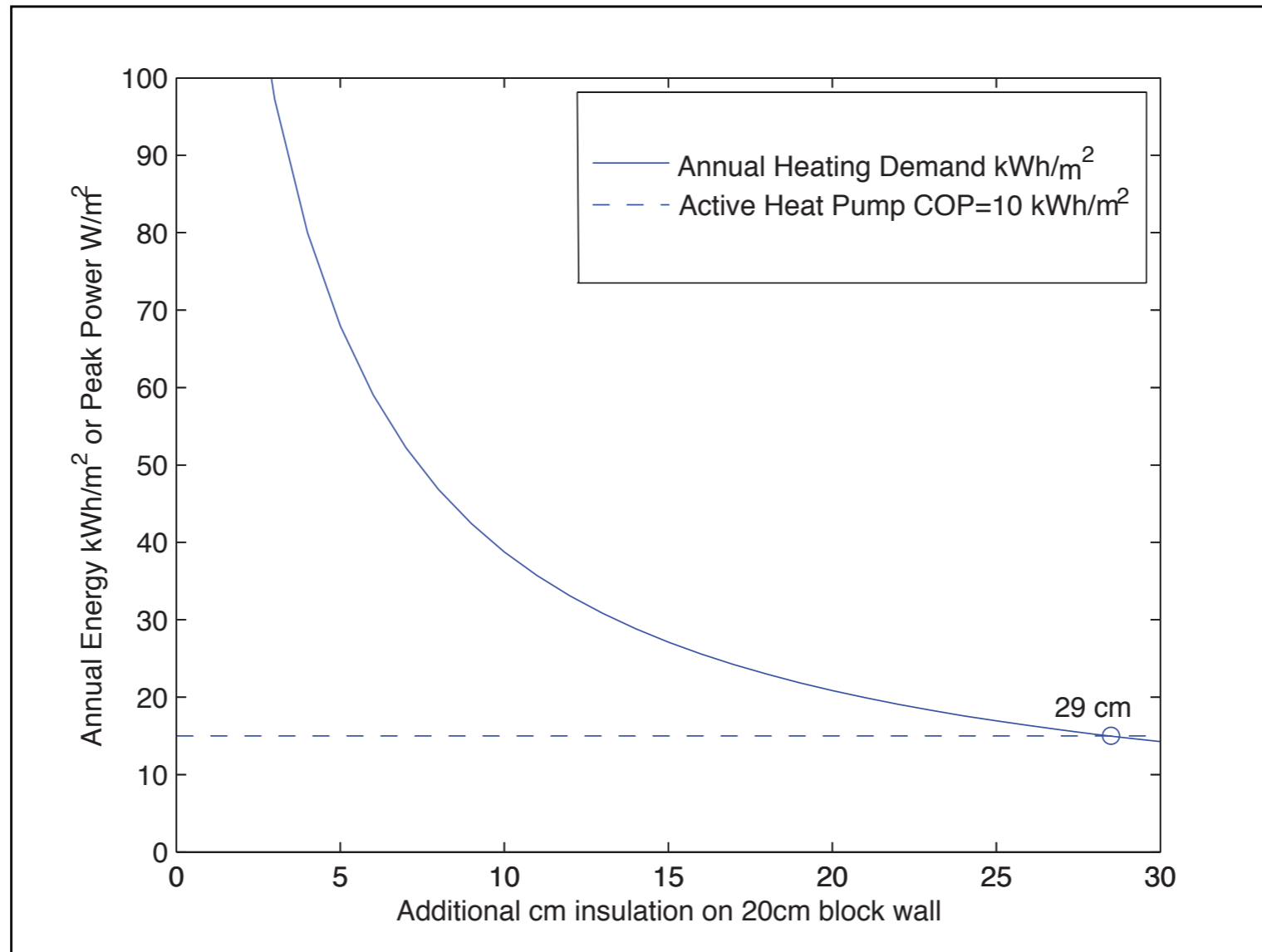
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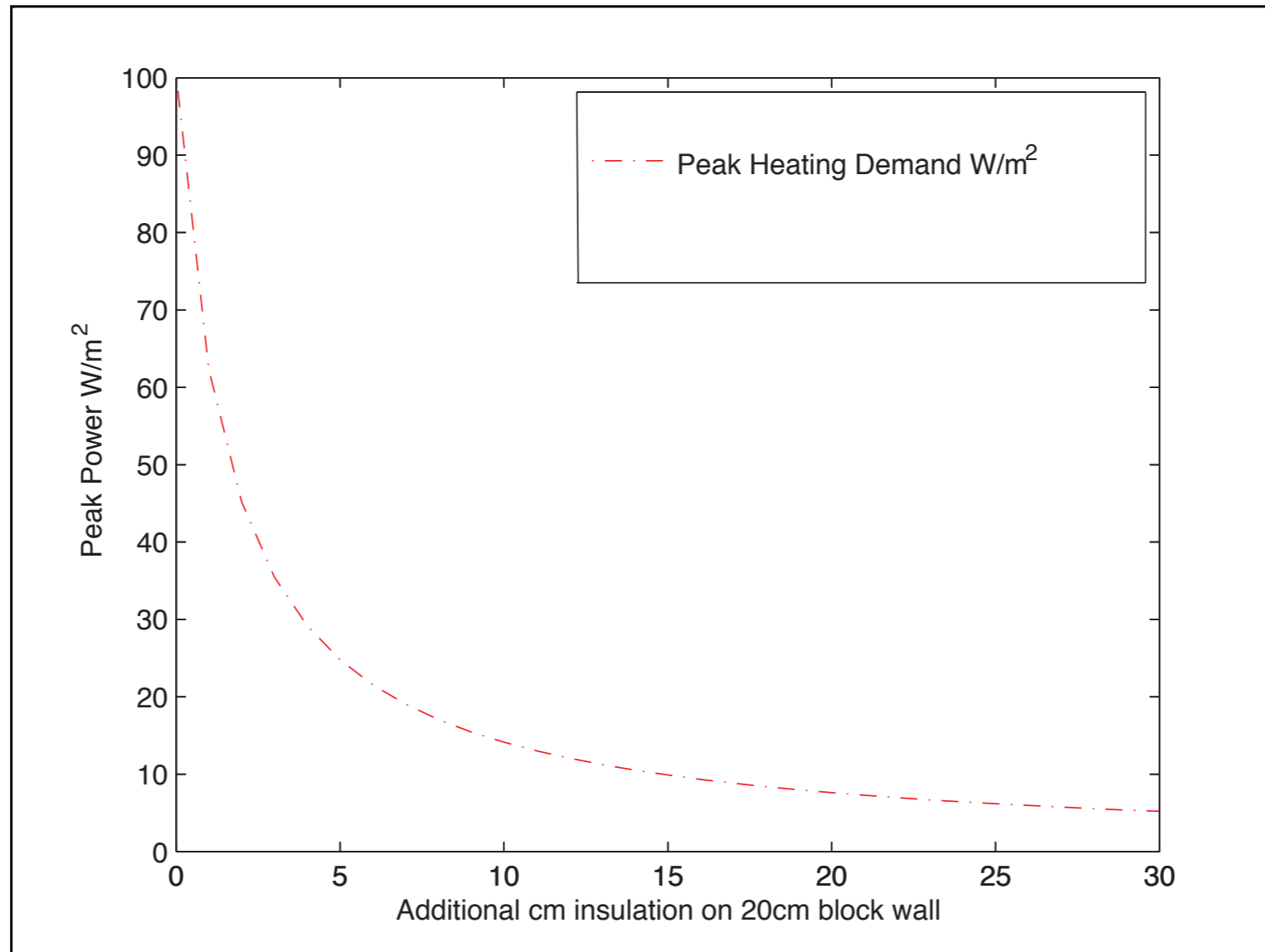
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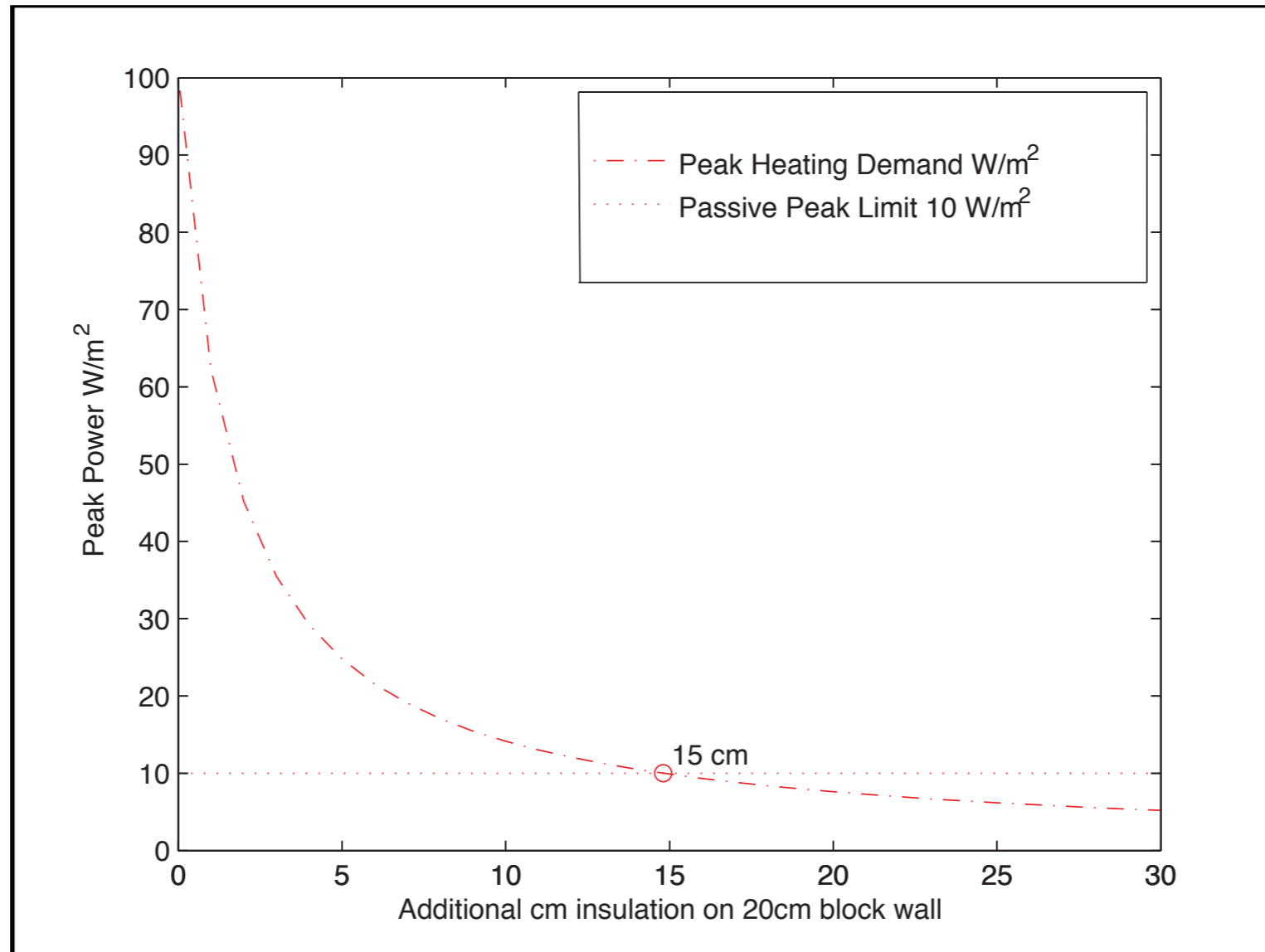
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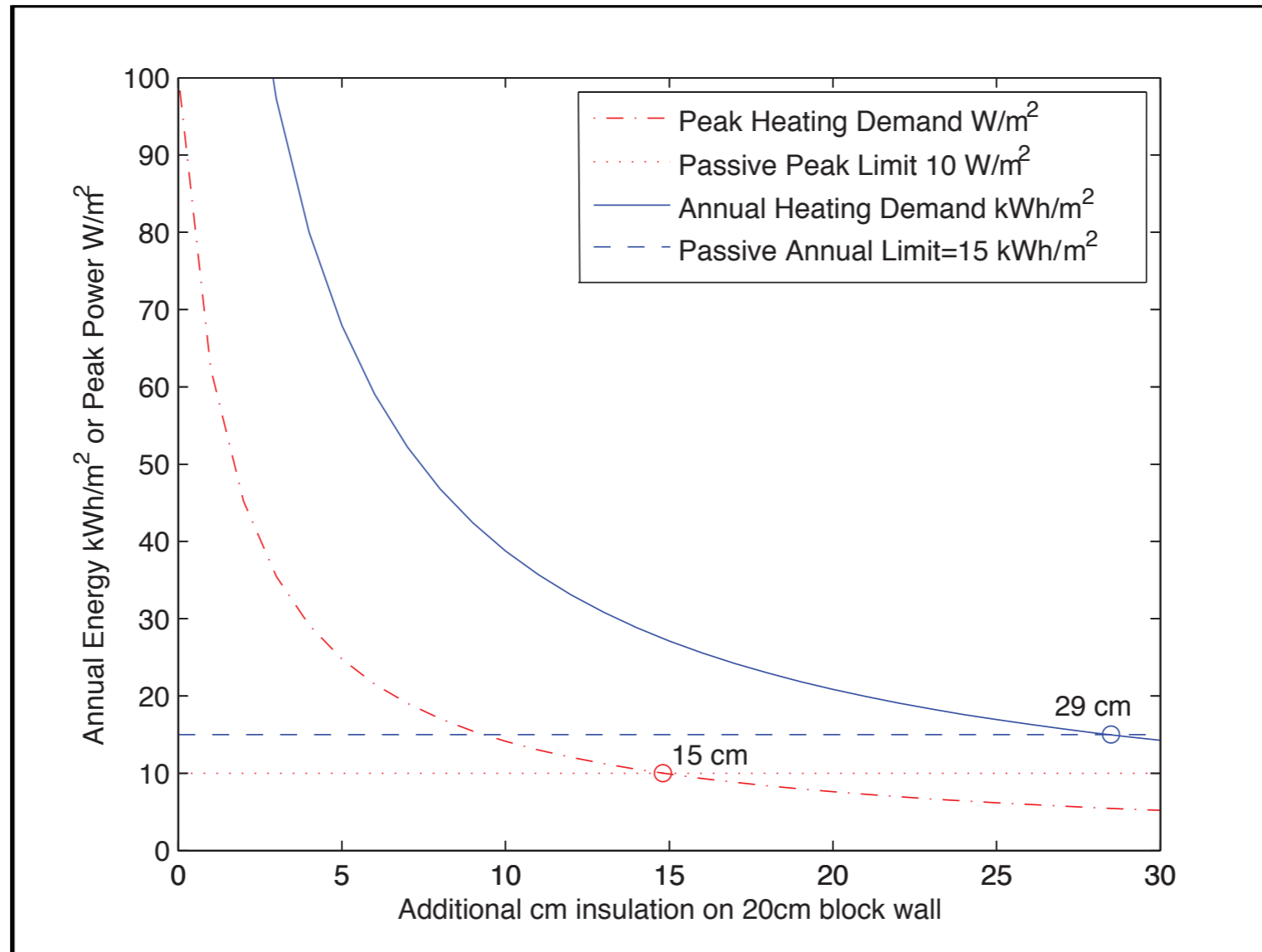
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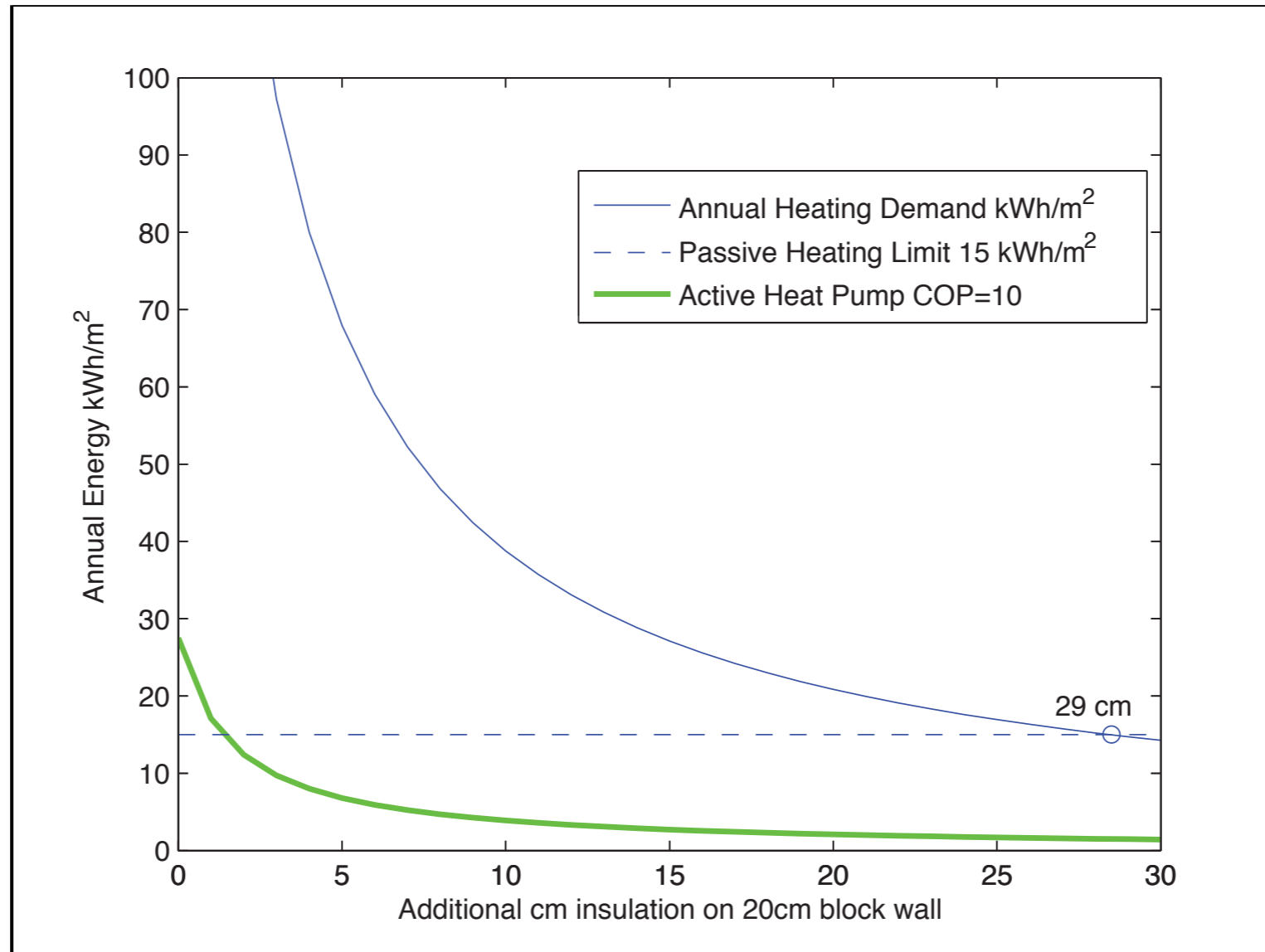
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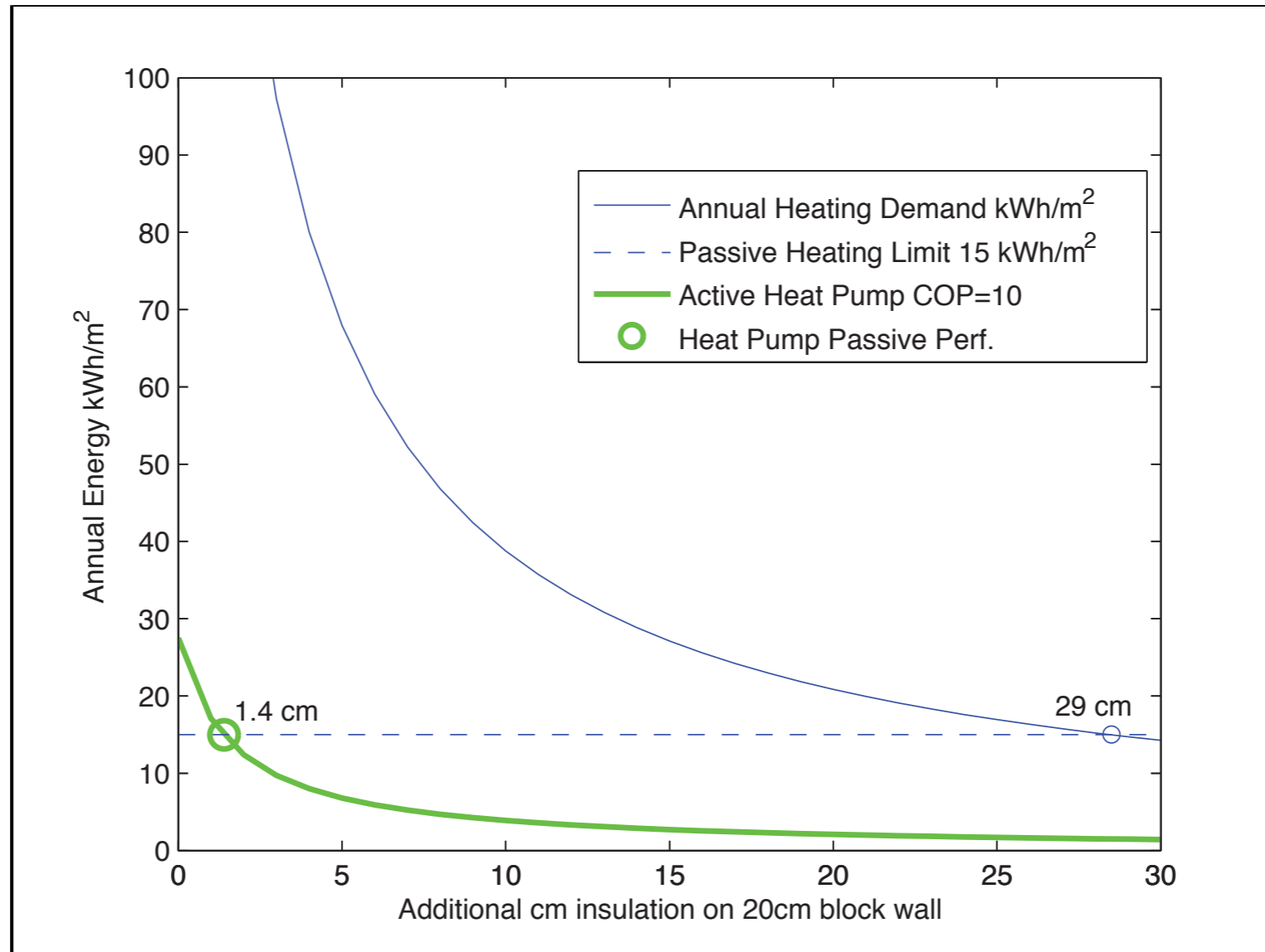
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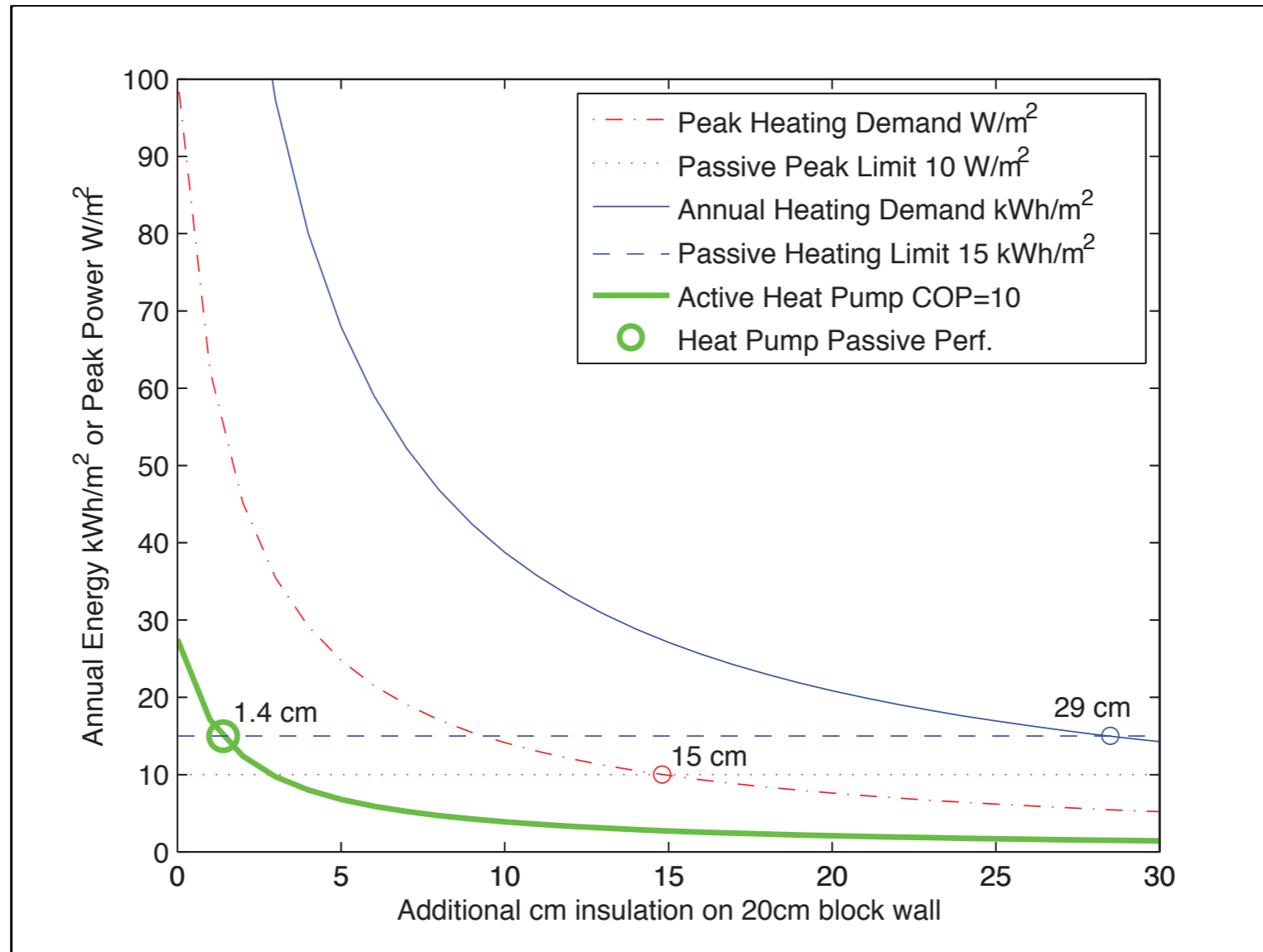
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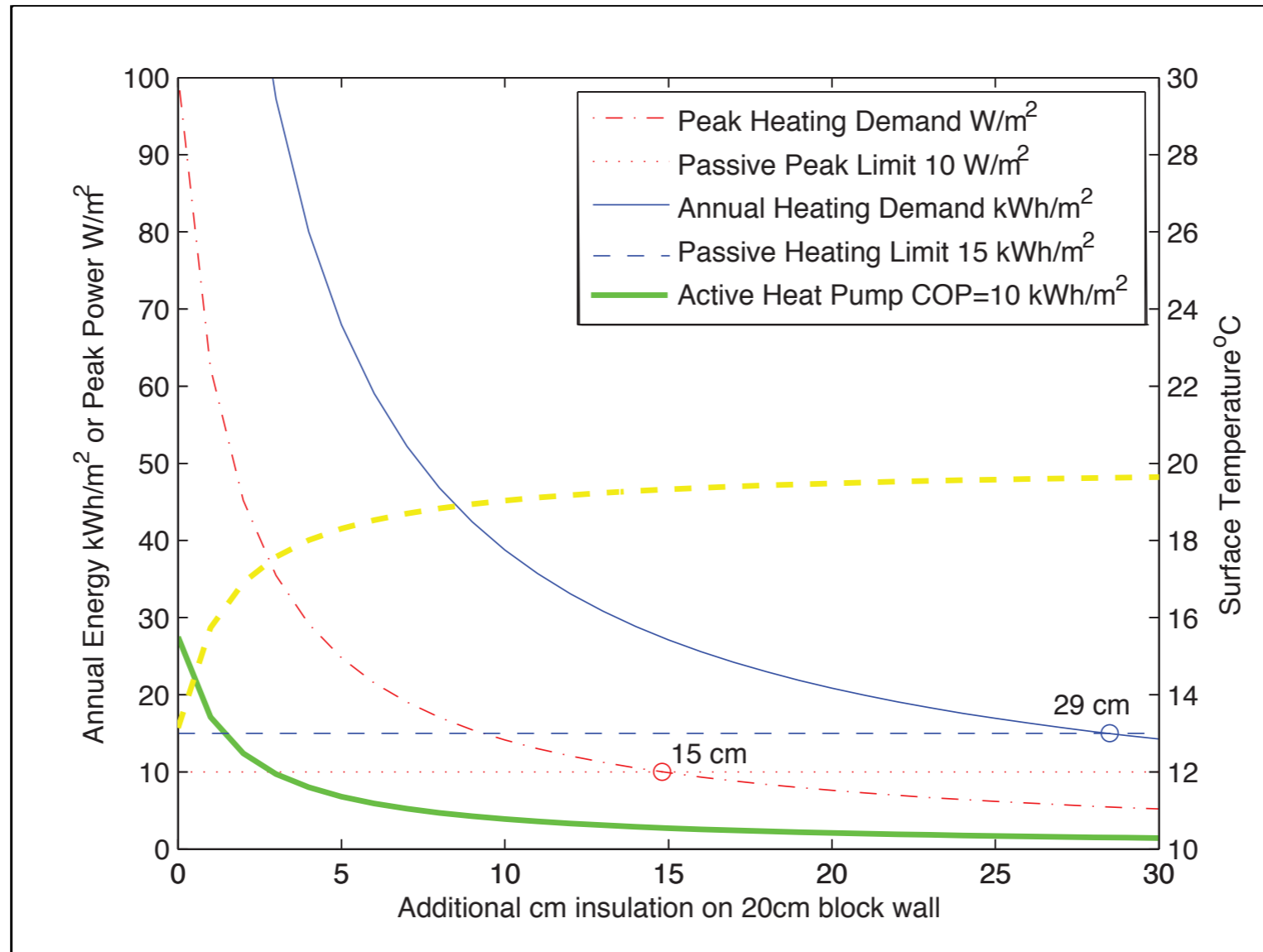
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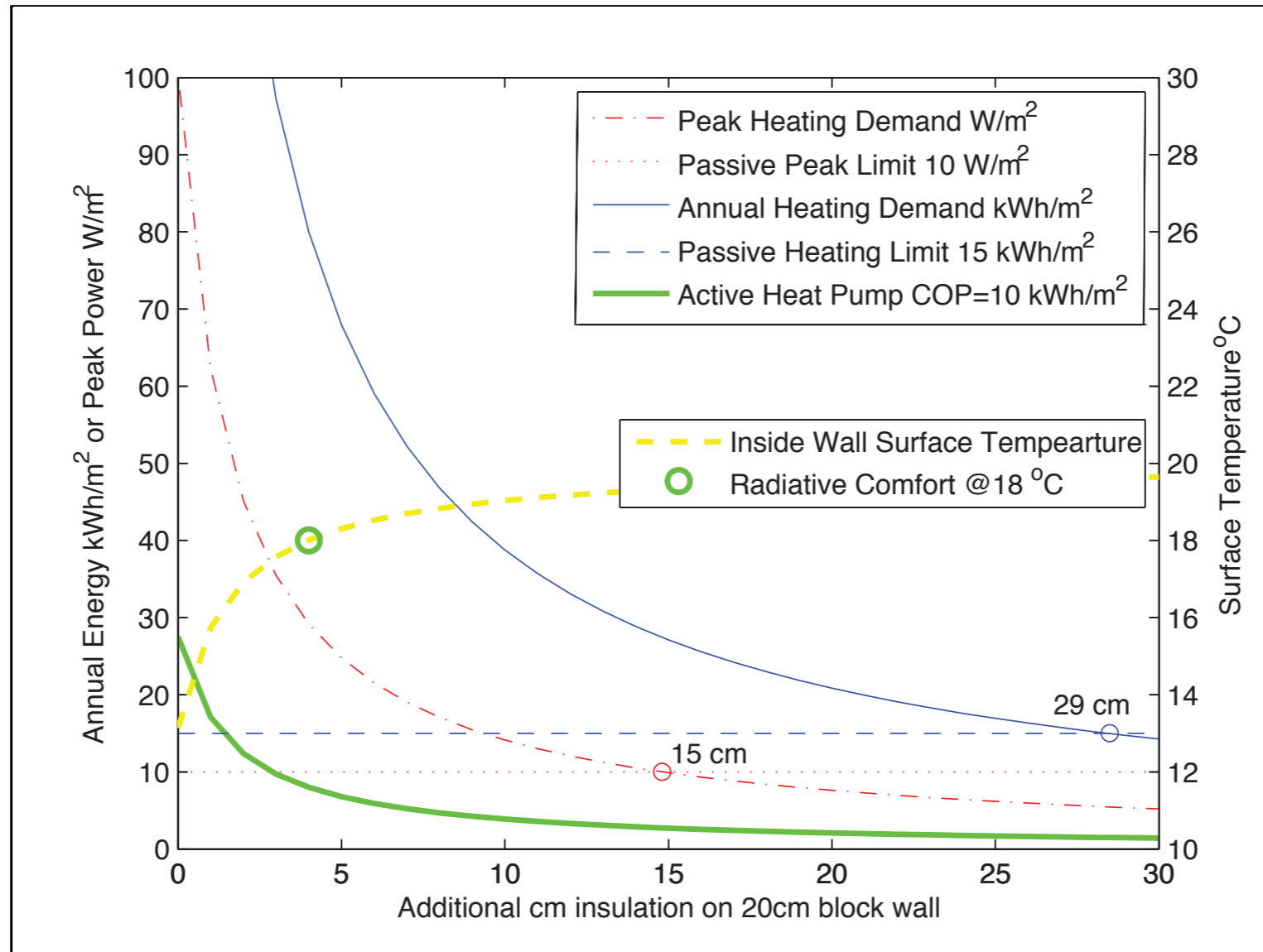
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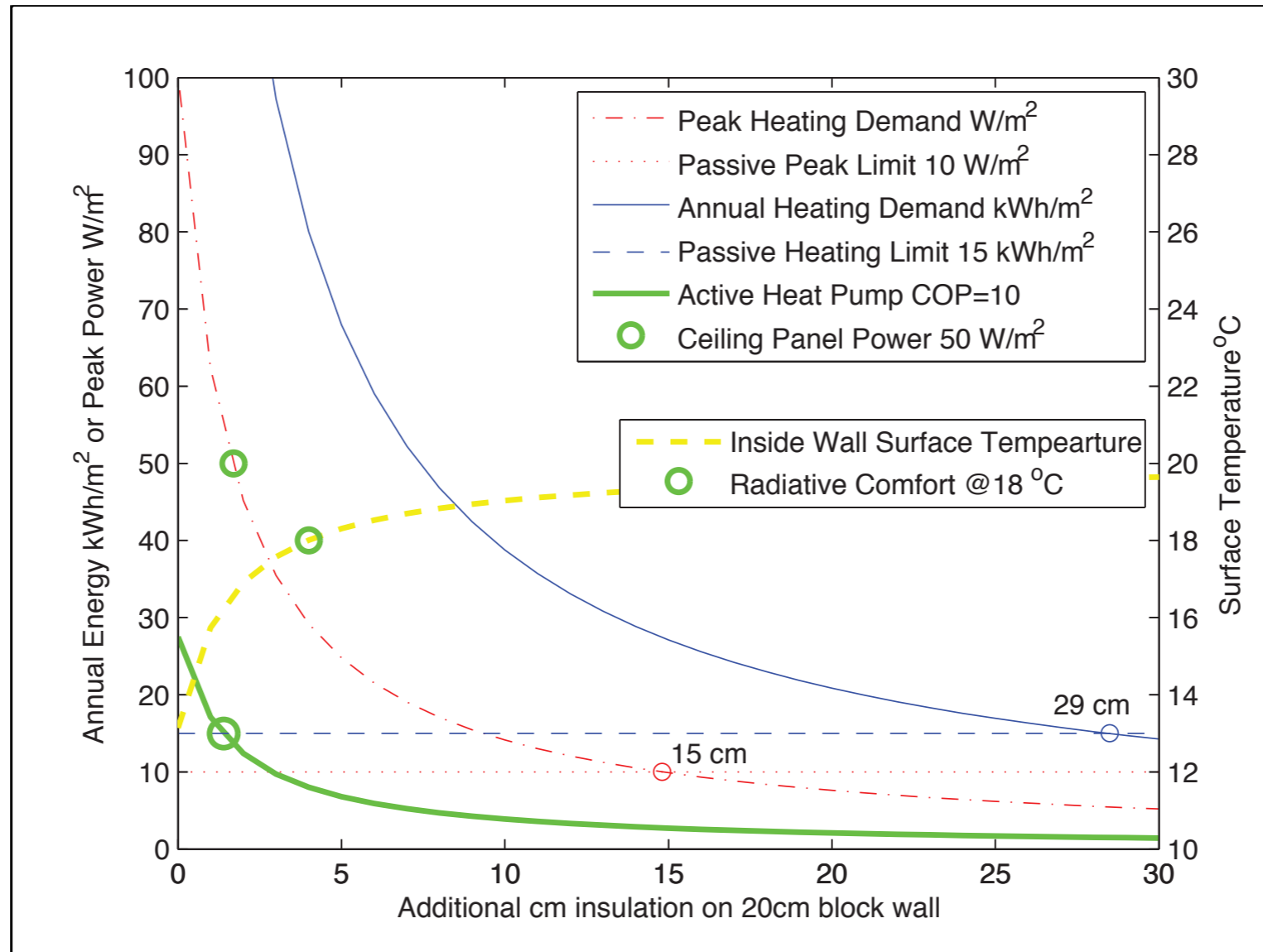
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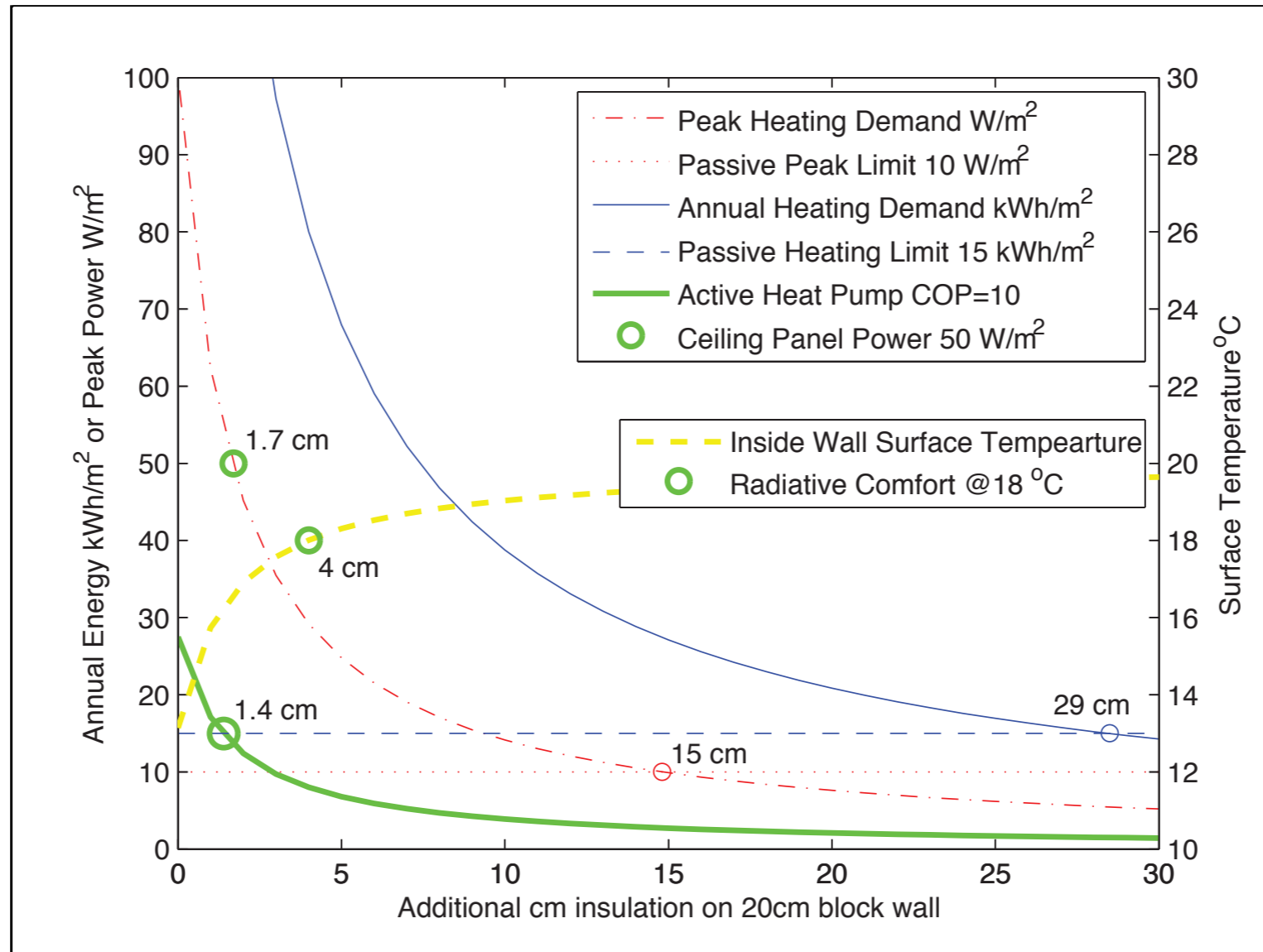
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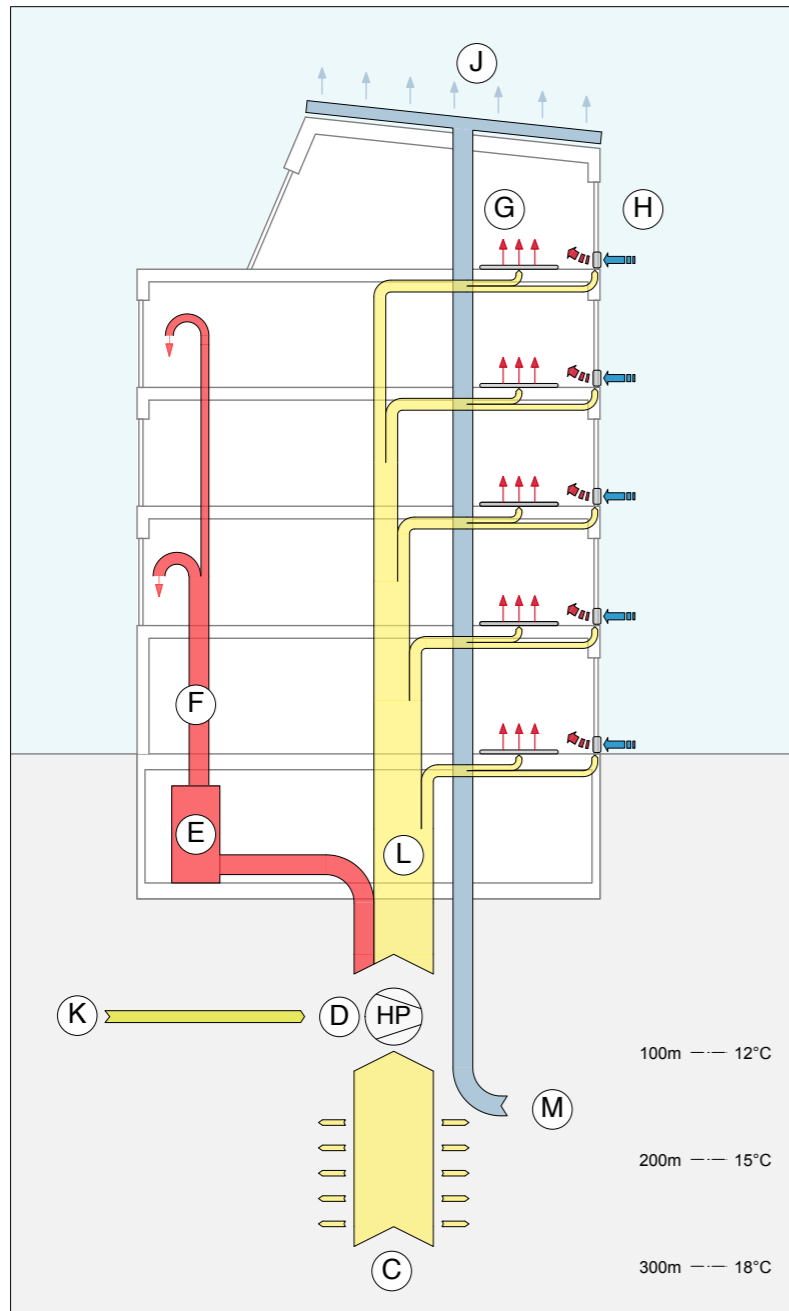
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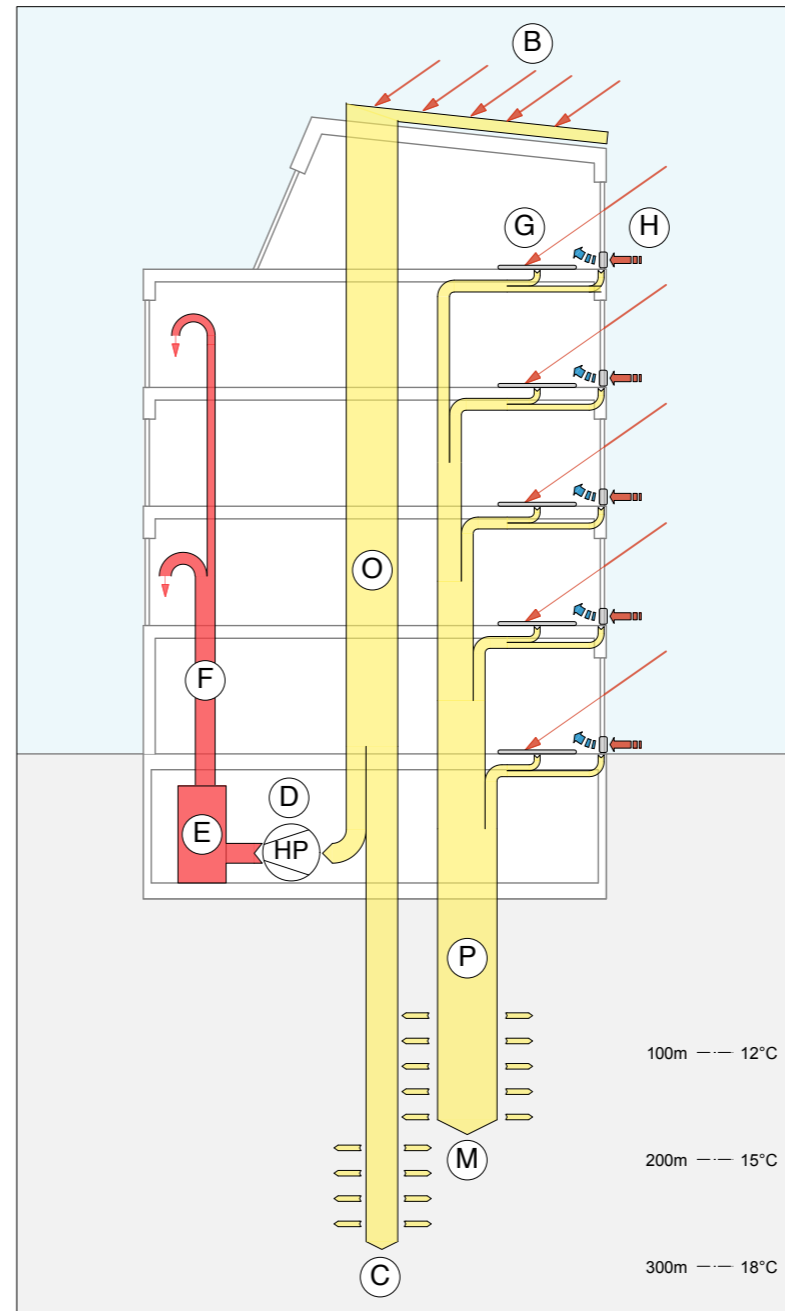


B35 Heat pump system overview

Heating



Cooling



B35 Heat pump system overview

- a) Exhaust recovery
- b) PVT Panel
- c) Dual Zone Borehole
- d) Heat pump
- e/f) How water system

