ENERGY FLEXIBLE BUILDINGS

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For: The course AAR4833 Konsepter og strategier i bærekraftige arkitektur

On: 28.Sept 2018

Materials

Constructions

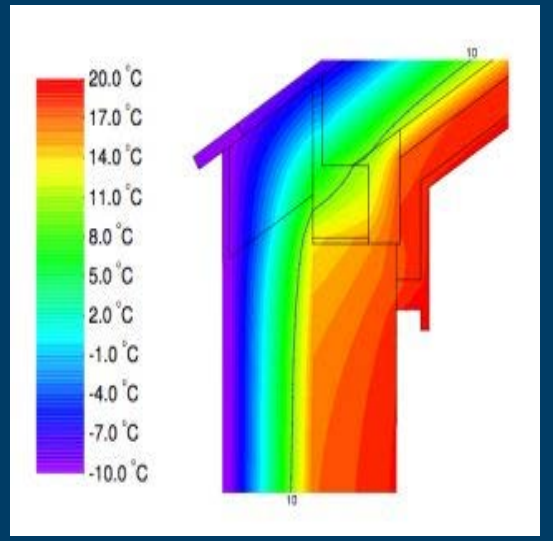
Climate adapt.

Architecture

Processes

Environmental

Energy



Build. physics

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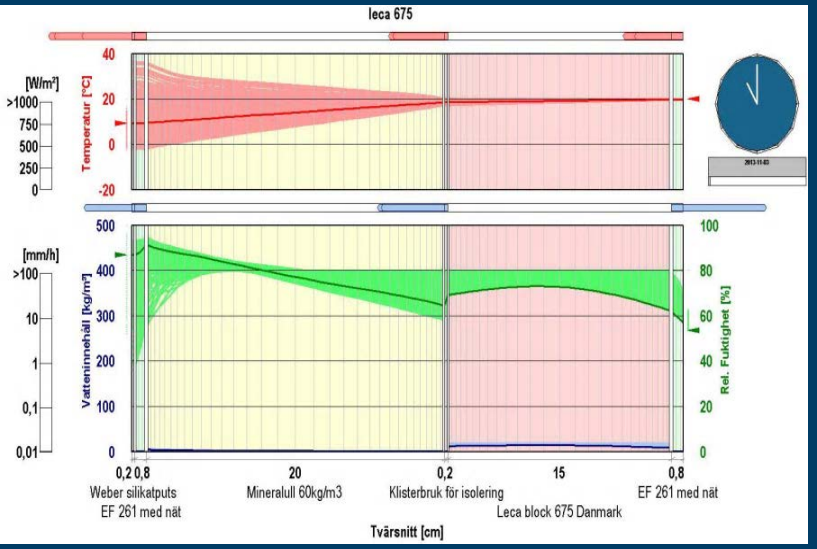
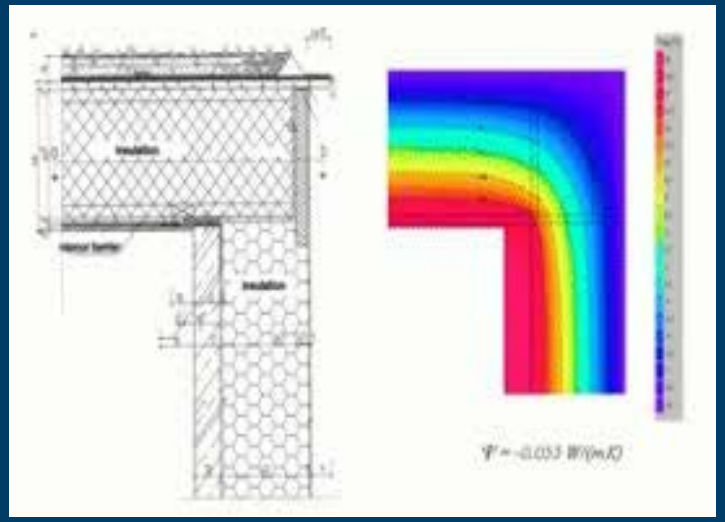


Theoretical

Laboratory and experimental

Field work and damage control



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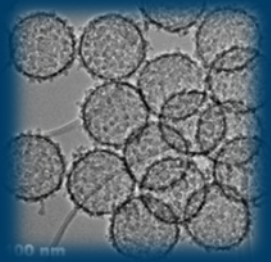
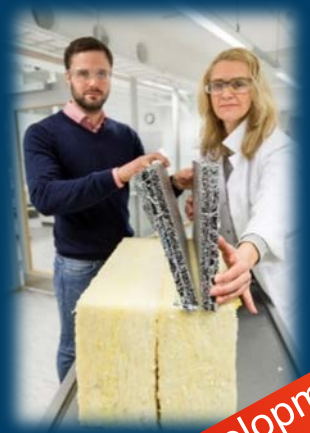
From idea to market

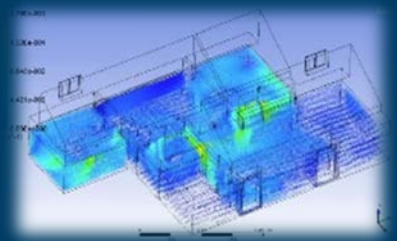
Material development

Material and component testing

Real performance







Material development and characterization

Component and system verification

Market implementation

TRL 2…3 → Technology readiness level → TRL 8…9

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Kilde: C. Schlemminger, T. Jacobsen – ZEB/SINTEF Byggforsk/NTNU

FACADE FUNCTIONALITIES

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The role of facades

Adapted from IEA Transition to Sustainable Buildings - Strategies and opportunities to 2050 (2013)

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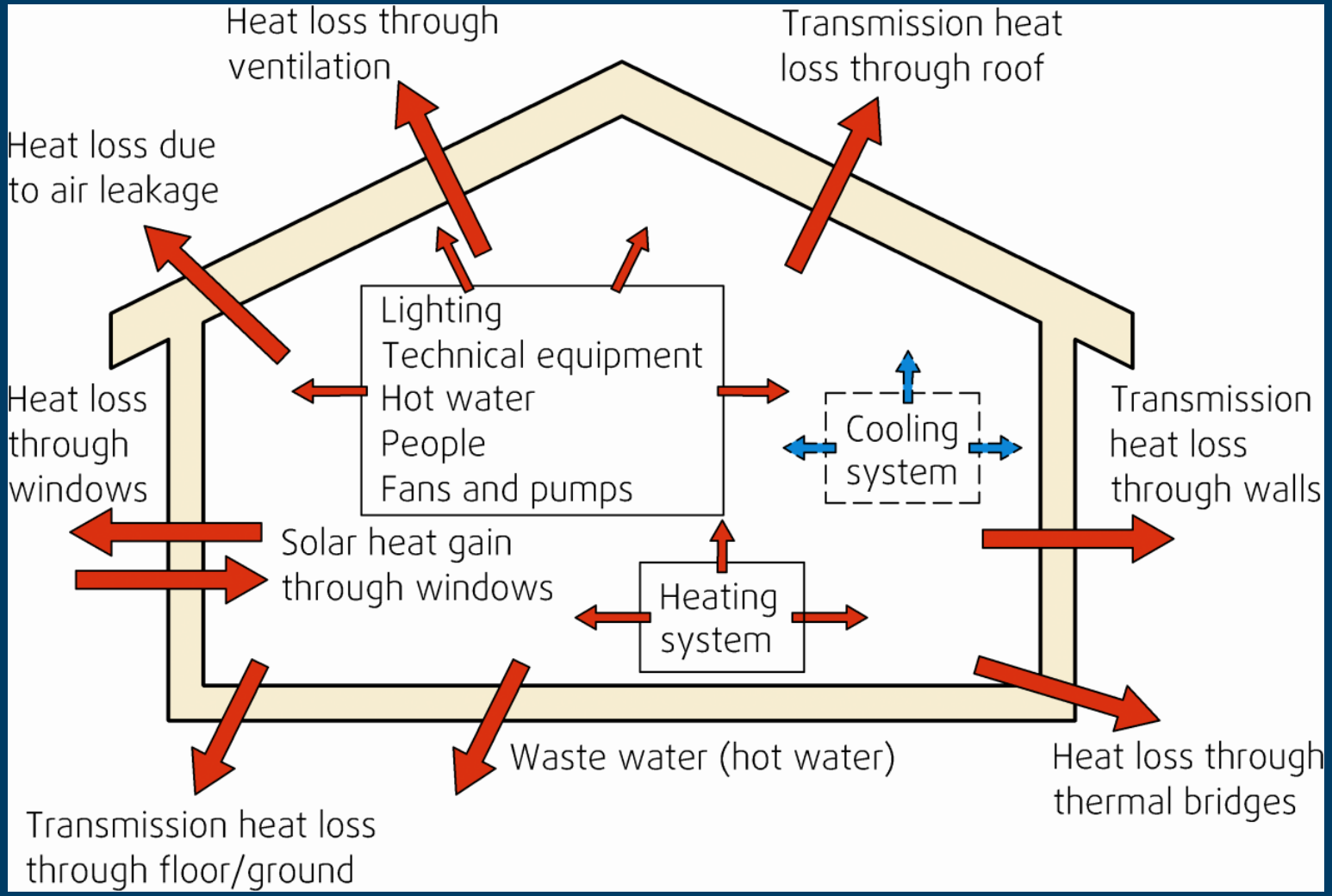
The energy balance



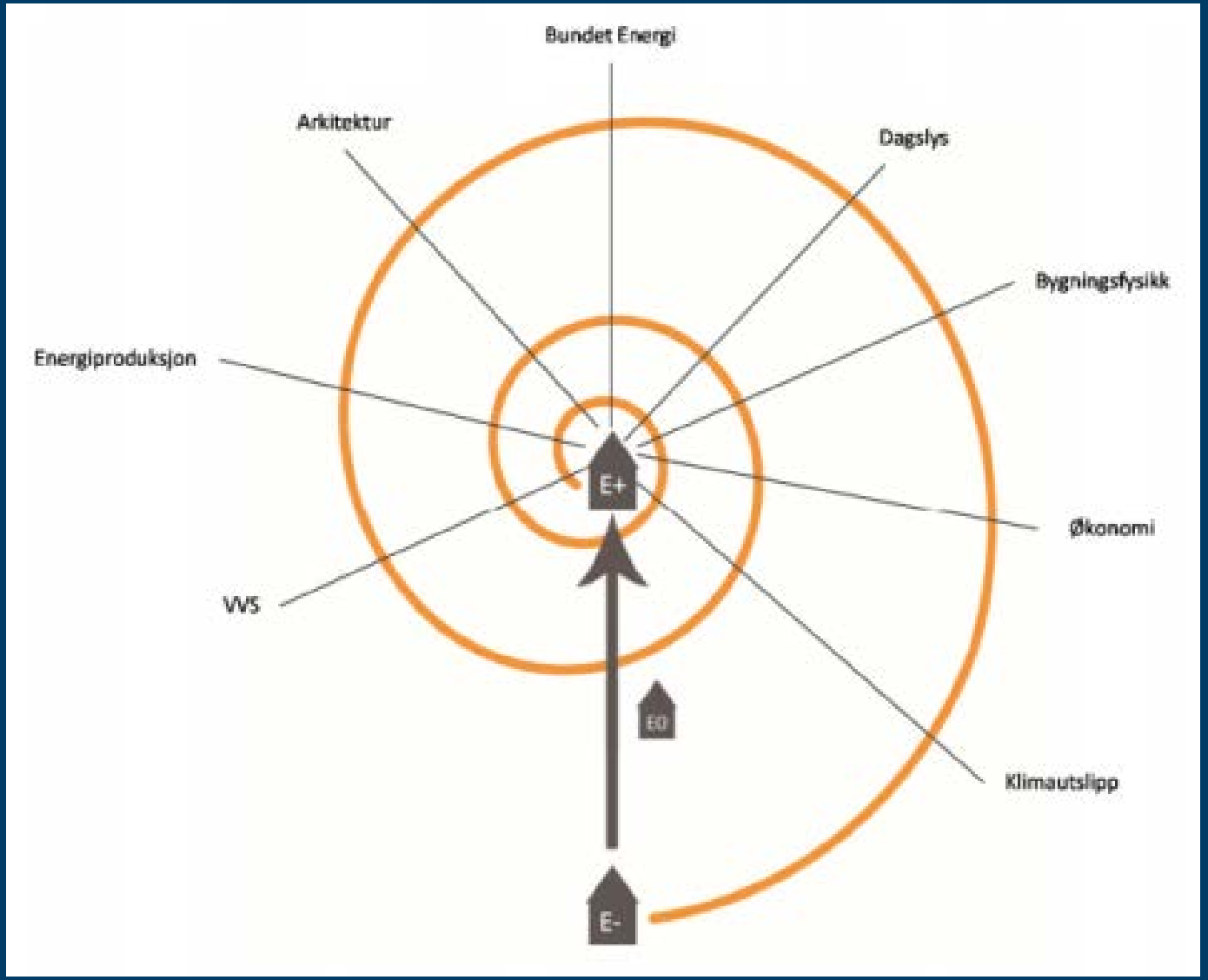
(Grynning et.al, 2011)

The road towards energy positive buildings

- The building design
- Heating/cooling system
- Internal heat loads
- Heat storing ability

Parameters

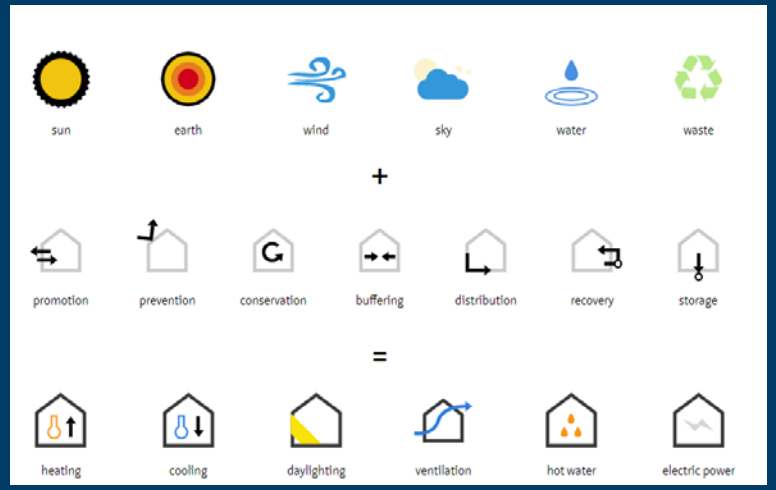
- Window area, **orientation**
  - Daylight, view, energy loss/gain
- Transmission losses, U-value
- Solar transmittance
- Light transmittance
- Thermal comfort
- Shading possibilities
- Ventilation, Fire

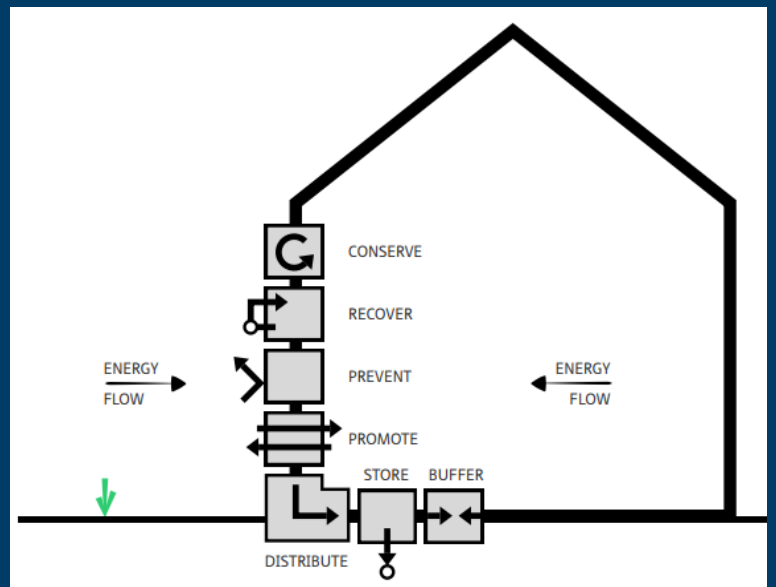


Ill. Snøhetta

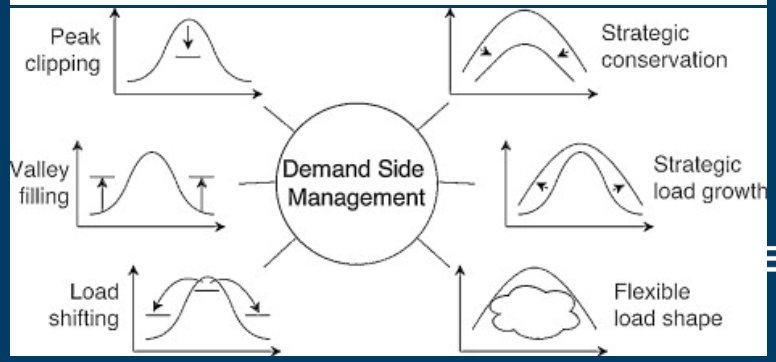
Smart facades

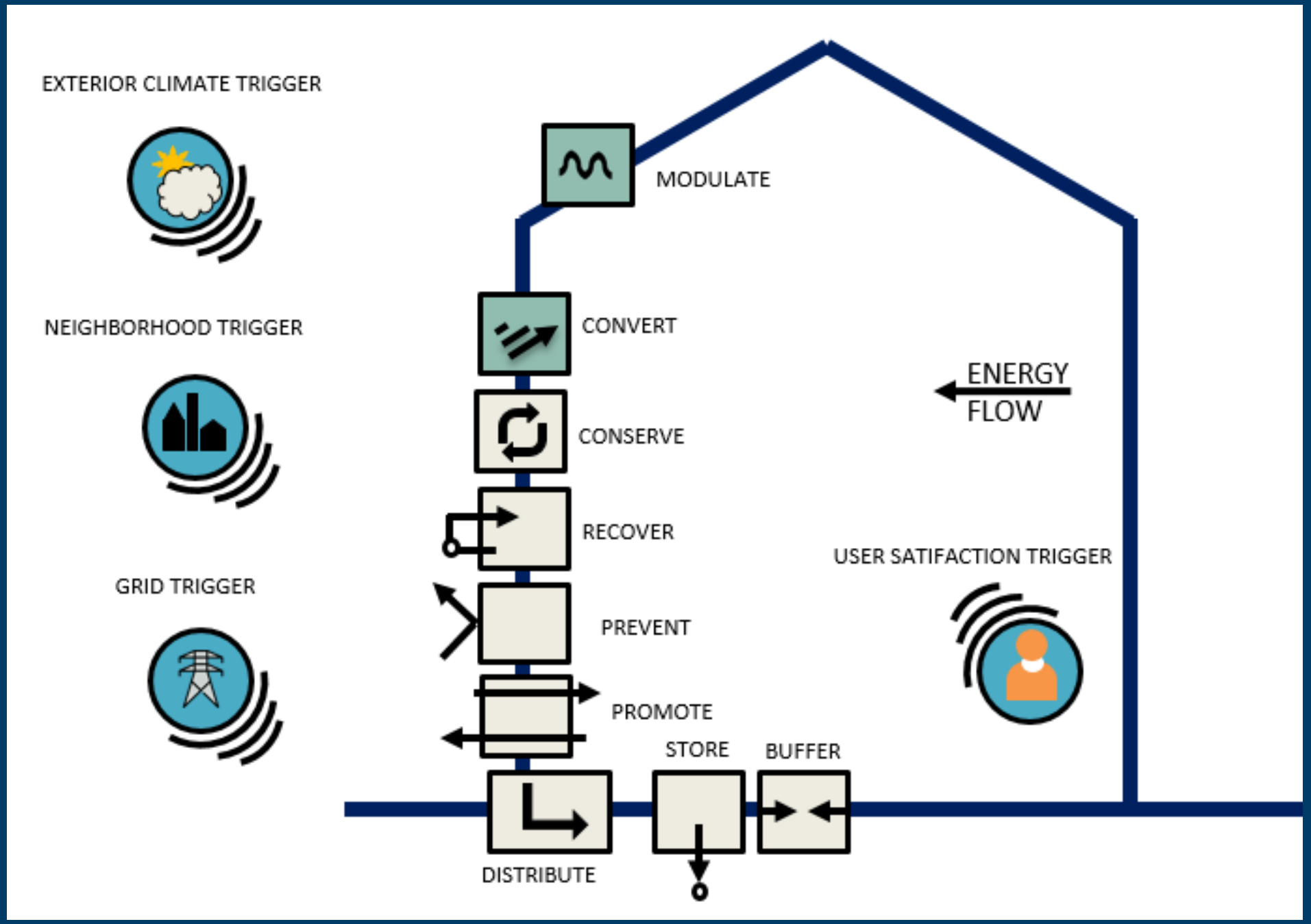
- *Dynamic* performance
- Renewable energy utilization
- Reduce amount of "grid-bought" energy
- Improve thermal and visual comfort
- Enhance control/optimization of energy use, distribution and storage -> reduce operational costs





Looman, 2017




EXTERIOR CLIMATE TRIGGER
NEIGHBORHOOD TRIGGER
GRID TRIGGER
MODULATE
CONVERT
CONSERVE
RECOVER
PREVENT
PROMOTE
STORE
BUFFER
DISTRIBUTE
ENERGY FLOW
USER SATIFACTION TRIGGER

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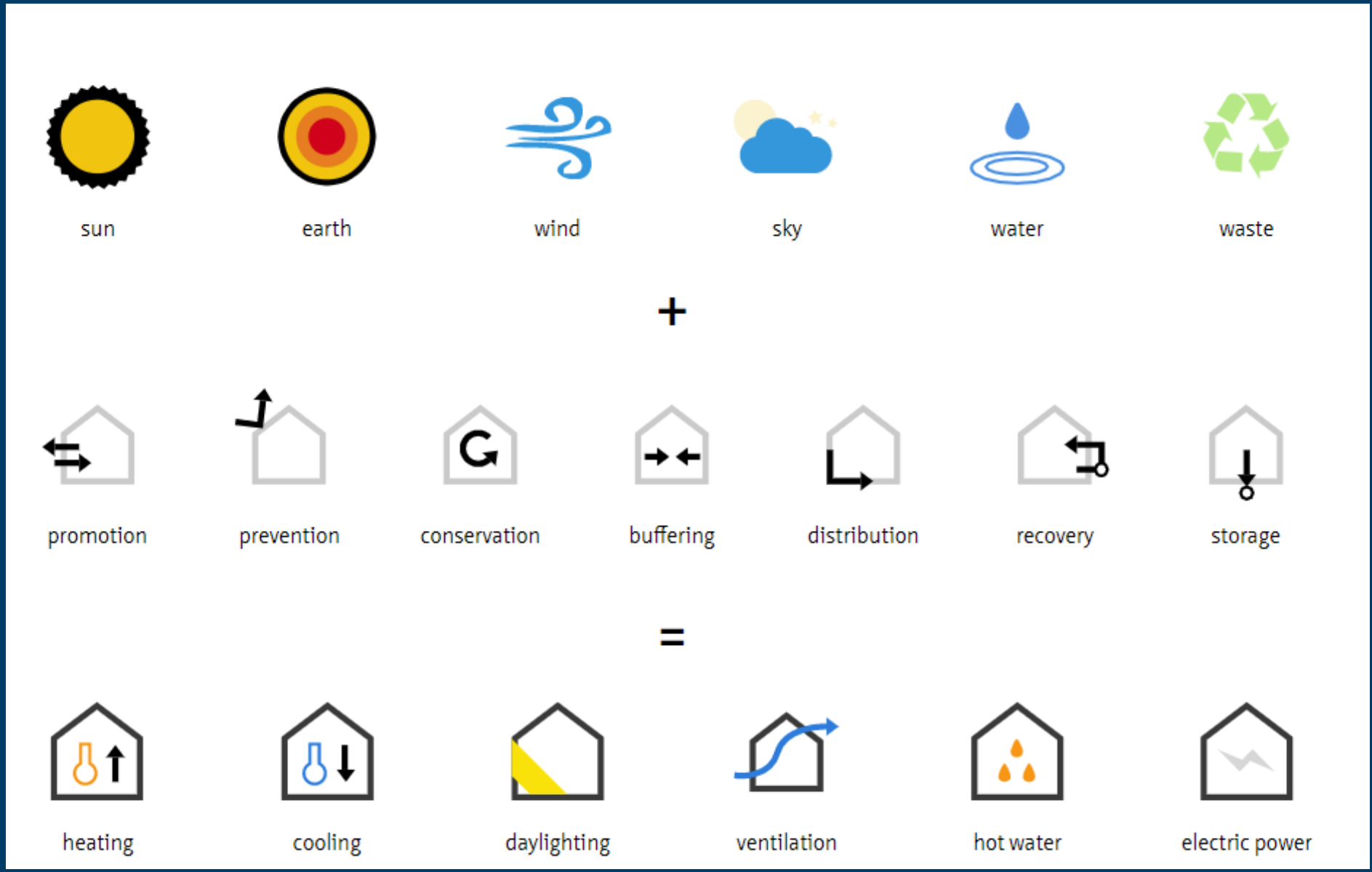
Facade interactions



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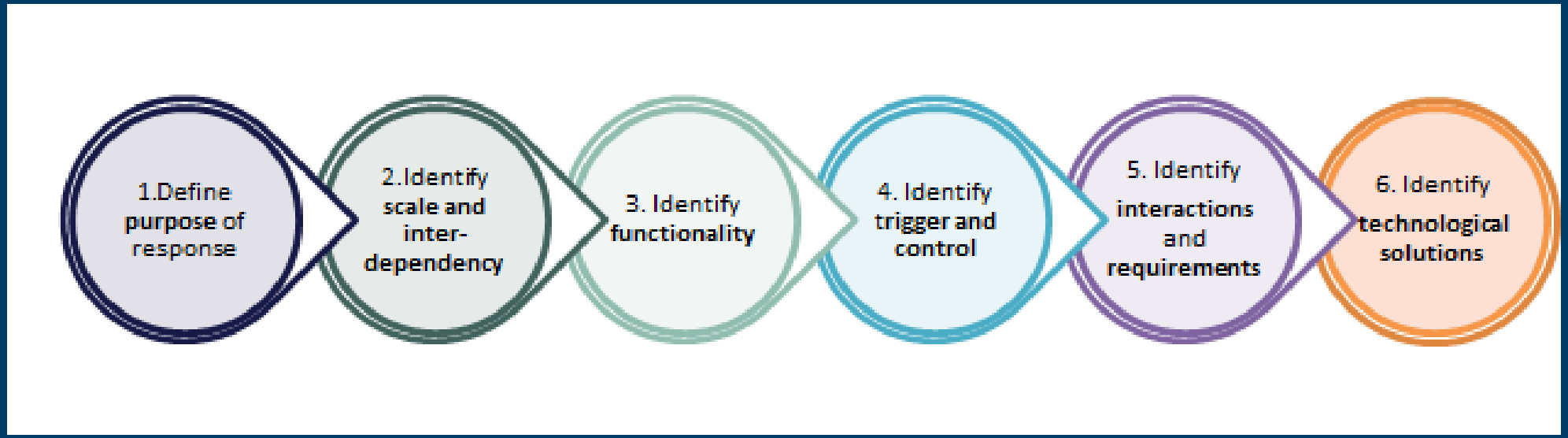
Things to do
→Syracuse
→IEA presentation
→Sensu paper
K-stud
65505
project #
81970832
→SWE Book →BNP

Performance characterization

- We need to balance a lot of (competing?) factors
  - Energy use
  - Peak power demands
  - Indoor environment
  - User satisfaction
  - Costs
- And how do we do that?
  - Simulation tools (of varying complexity and quality?)
  - A rule of thumb; advanced systems => uncertainty in predictions

Framework for responsive façade definition

In six steps



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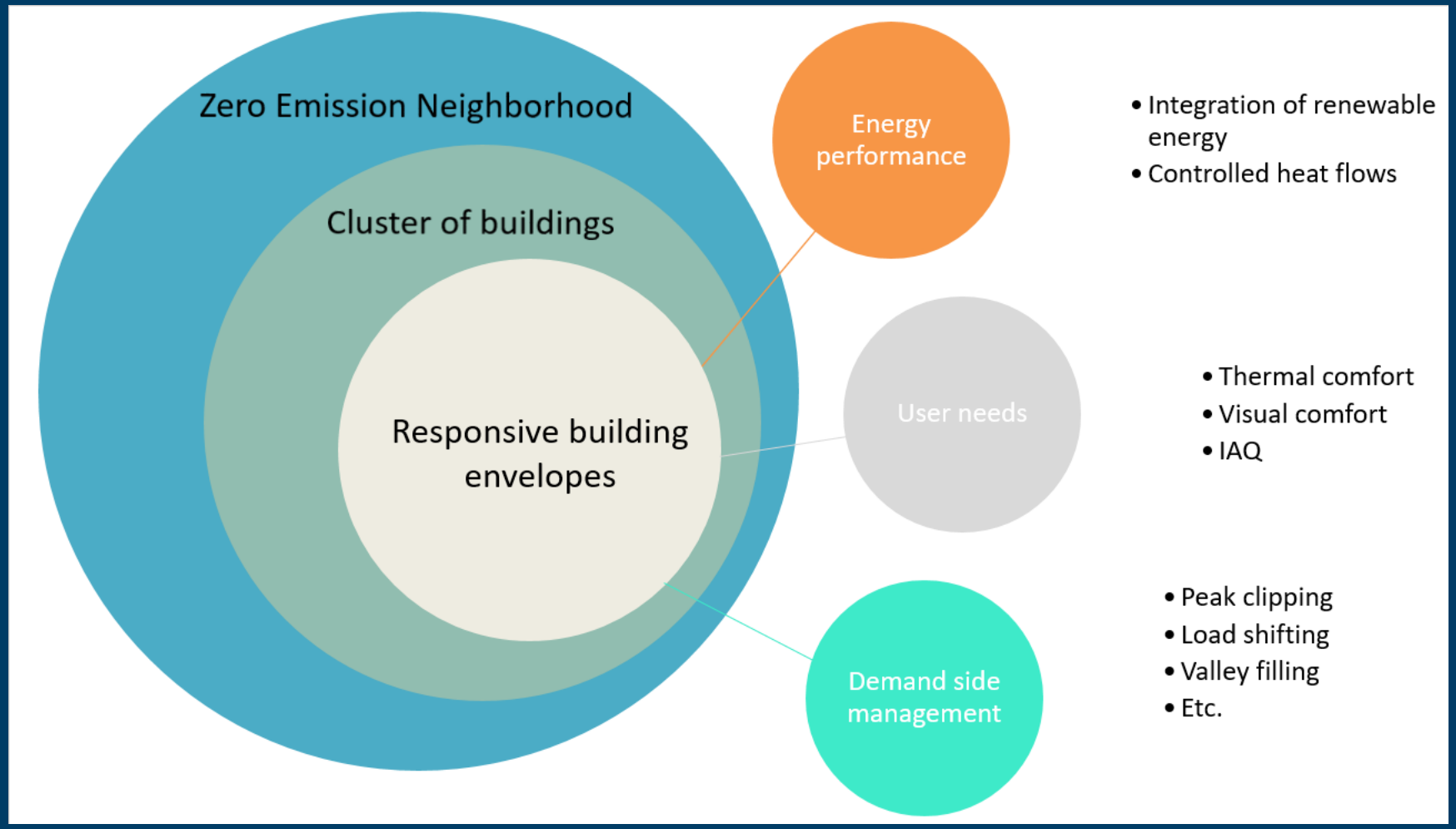
Step 1 - The levels of interaction



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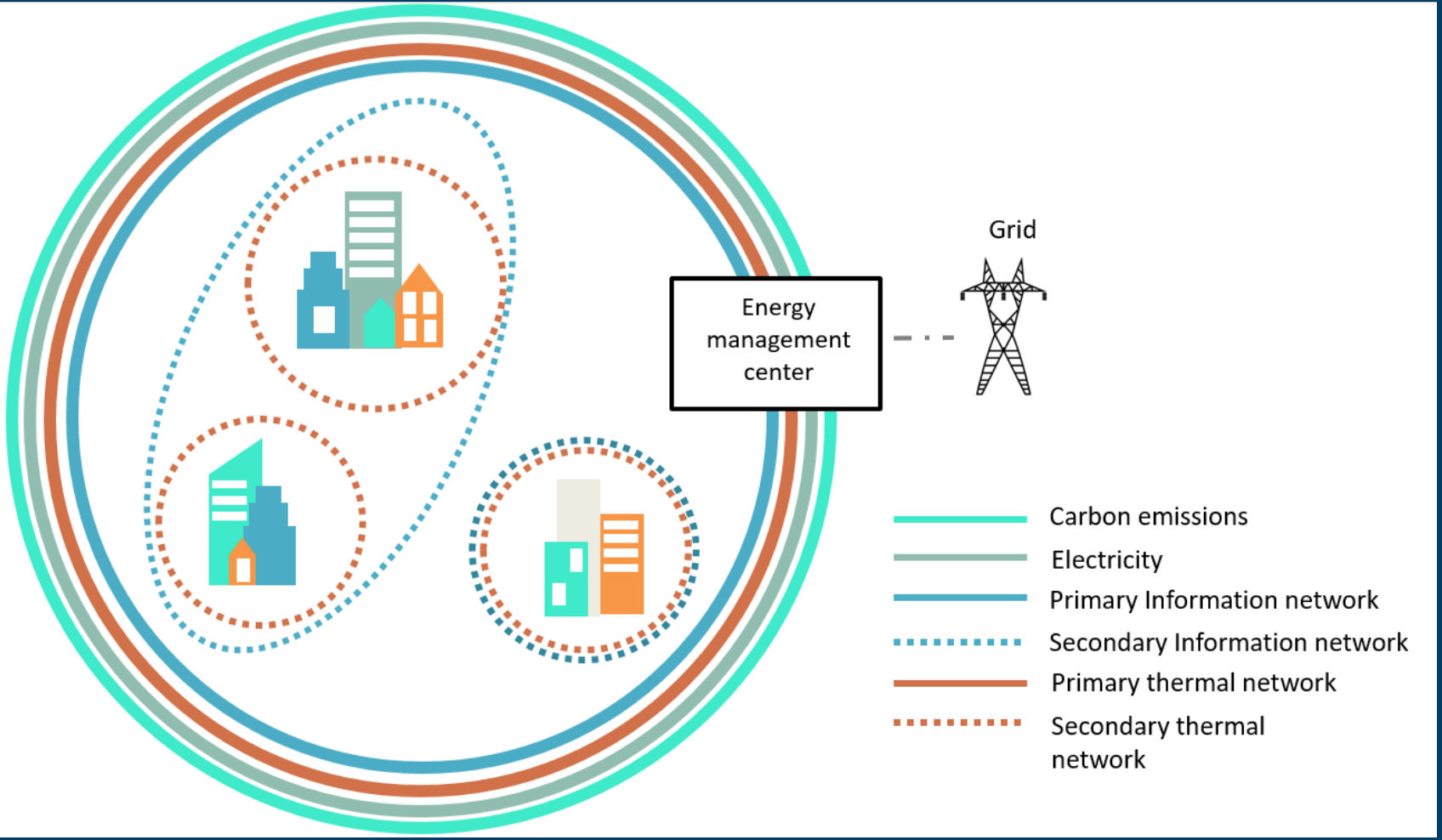
Step 2: Scale and interdependency



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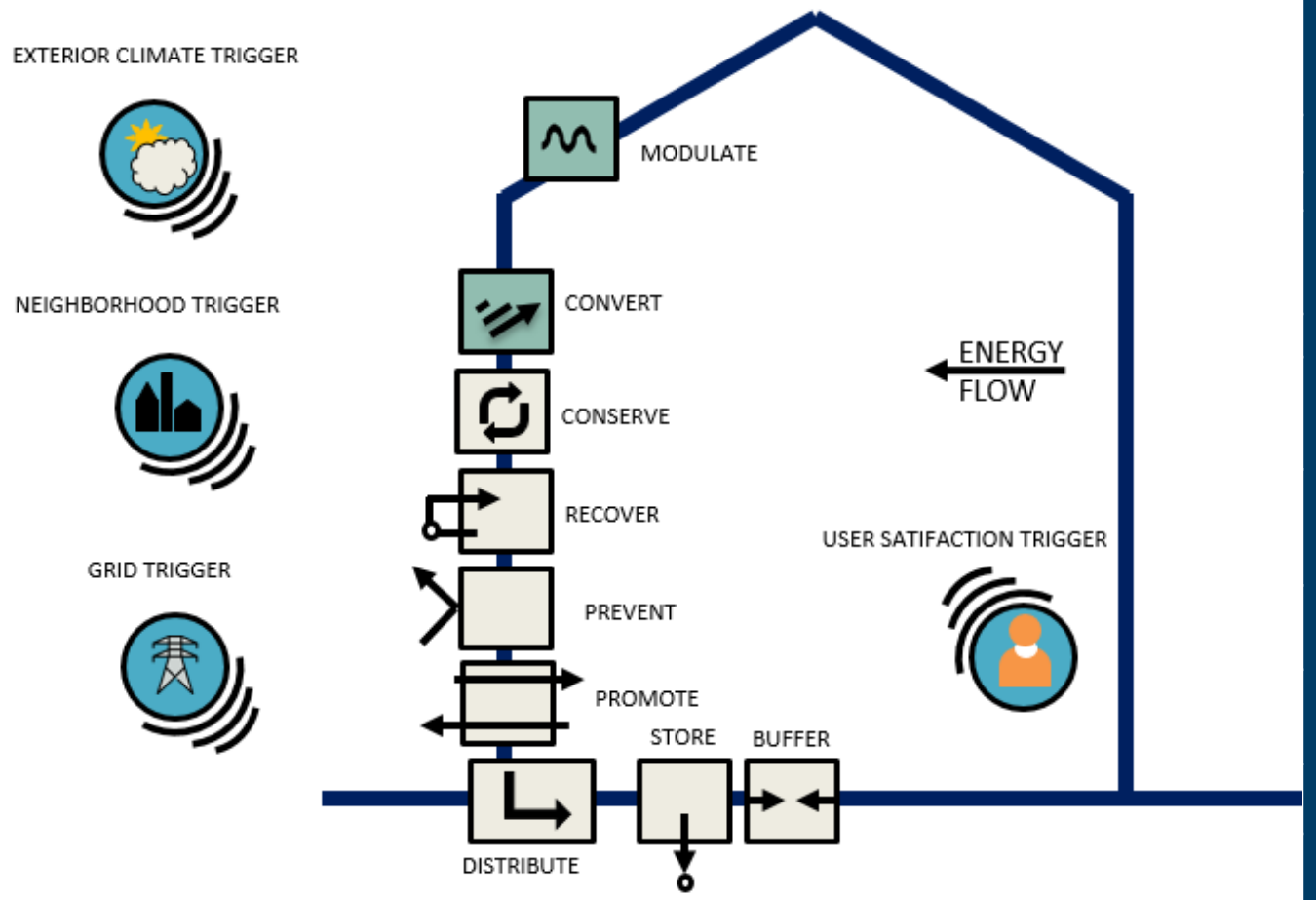
Step 3: Functionality of the response

Purpose	Objective	Functionality	Description
Building energy performance			
User comfort			
Demand side management			



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Step 4 - Triggers

Trigger types			Type of control		
			Passive	Actice Extrinsic	Active Intrinsic
Trigger category	Type				
Local climatic	Fixed value				
	Scheduled value				
	Real time value				
User demand	Fixed value				Not Applicable
	Scheduled value				N.A.
	Real time value				N.A.
Neighborhood management	Fixed value				N.A.
	Scheduled value				N.A.
	Real time value				N.A.

Step 6 – Identify solutions

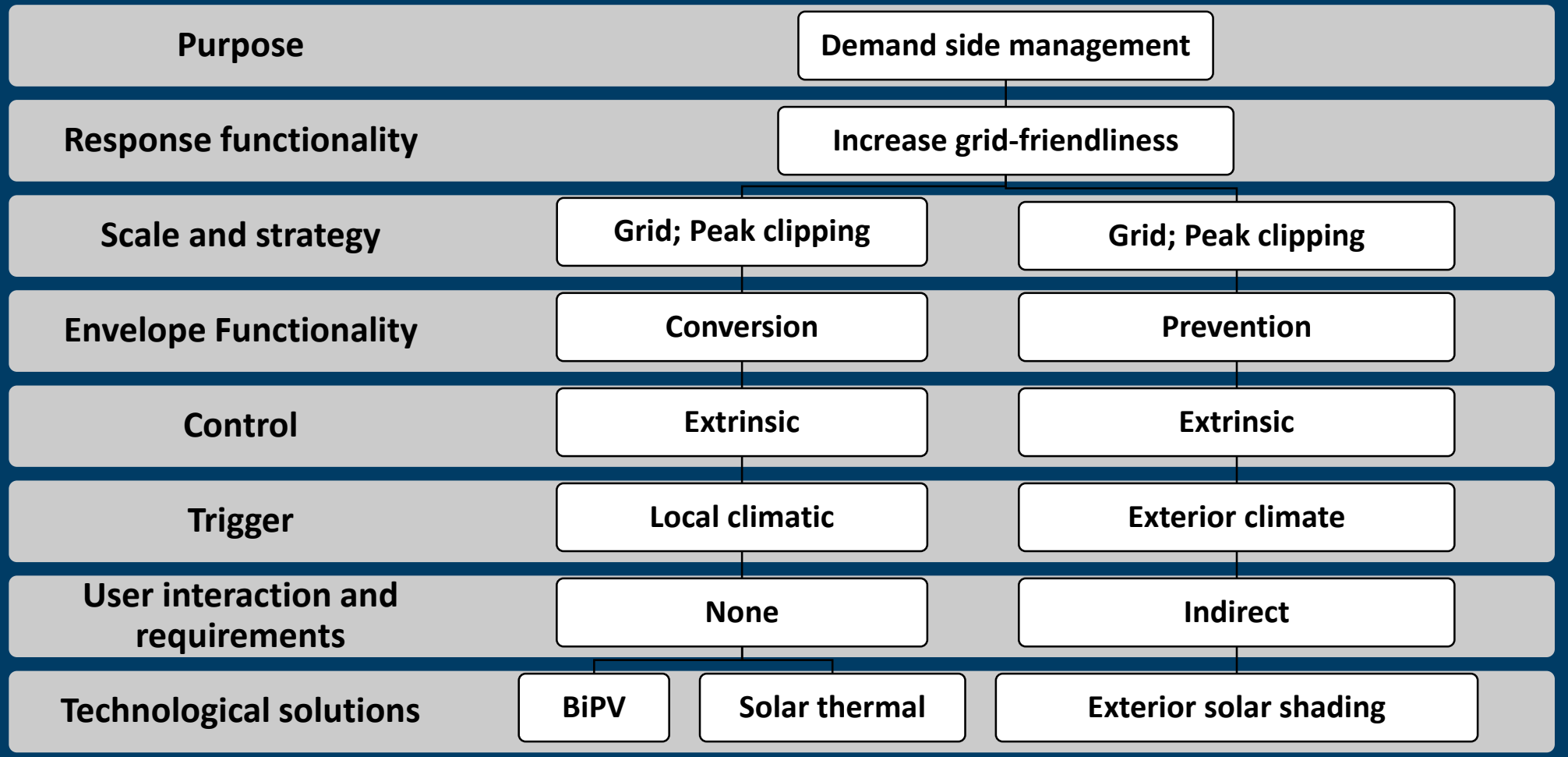

Figure 8 Example of pathways to achieve good demand side management.

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ENERGY DESIGN

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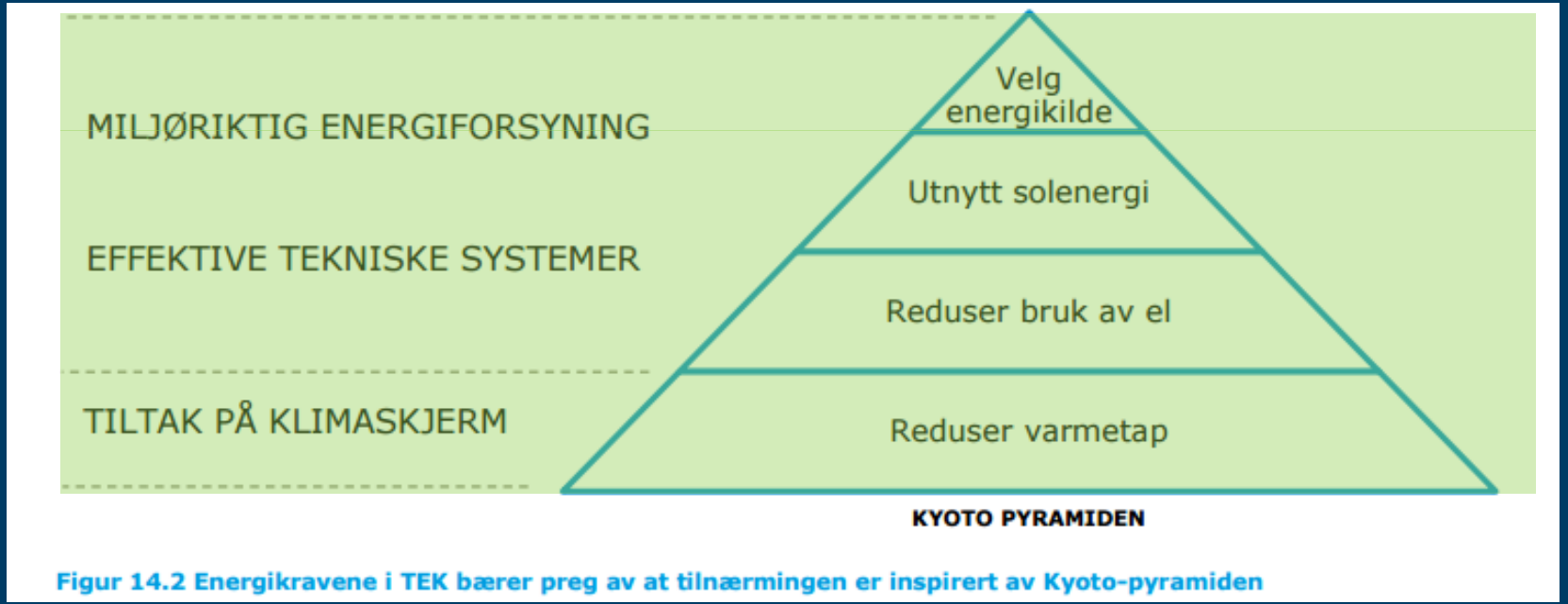
«den mest miljøvennlige energien er den man ikke bruker»



Figur 14.2 Energikravene i TEK bærer preg av at tilnærmingen er inspirert av Kyoto-pyramiden

Solskjermingens rolle:

- Regulere solinnslipp
- Redusere oppvarmingsbehov
- Redusere kjølebehov
- Dagslys

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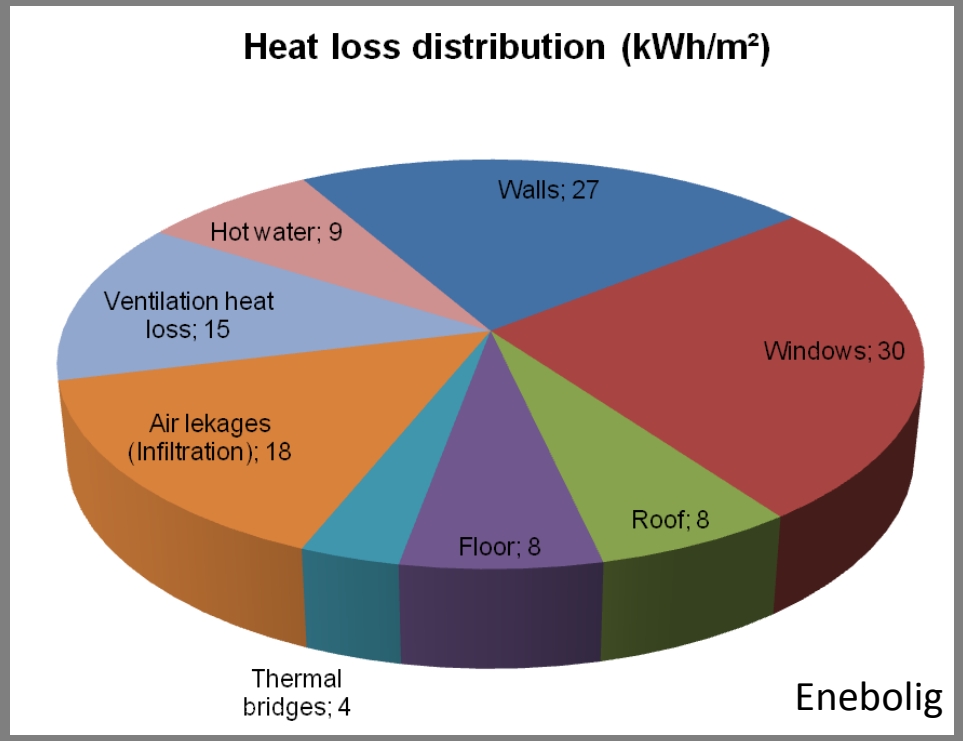
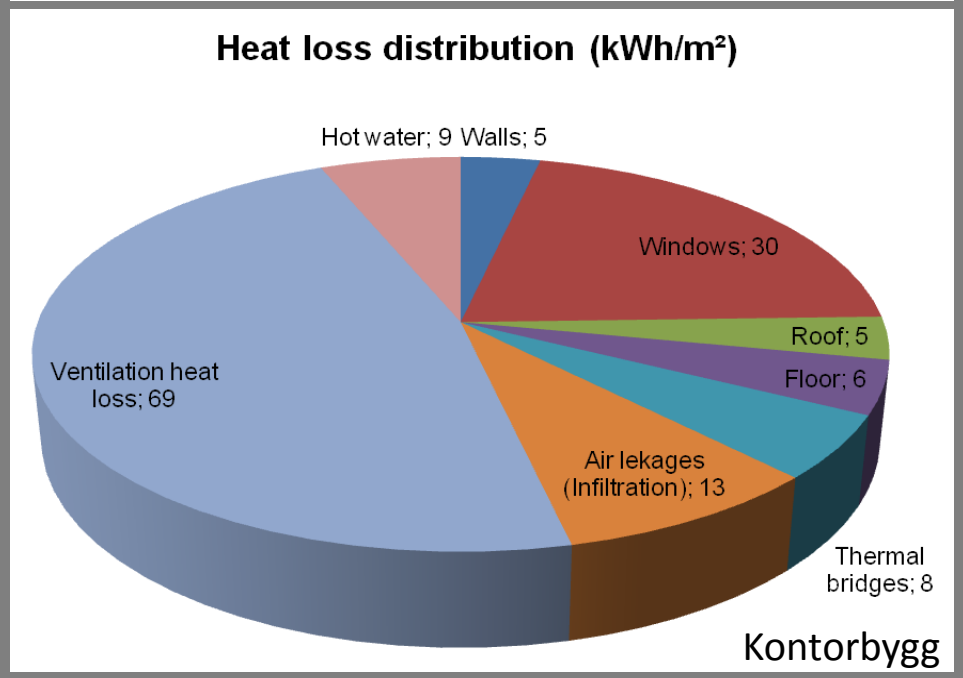
Heat loss distribution





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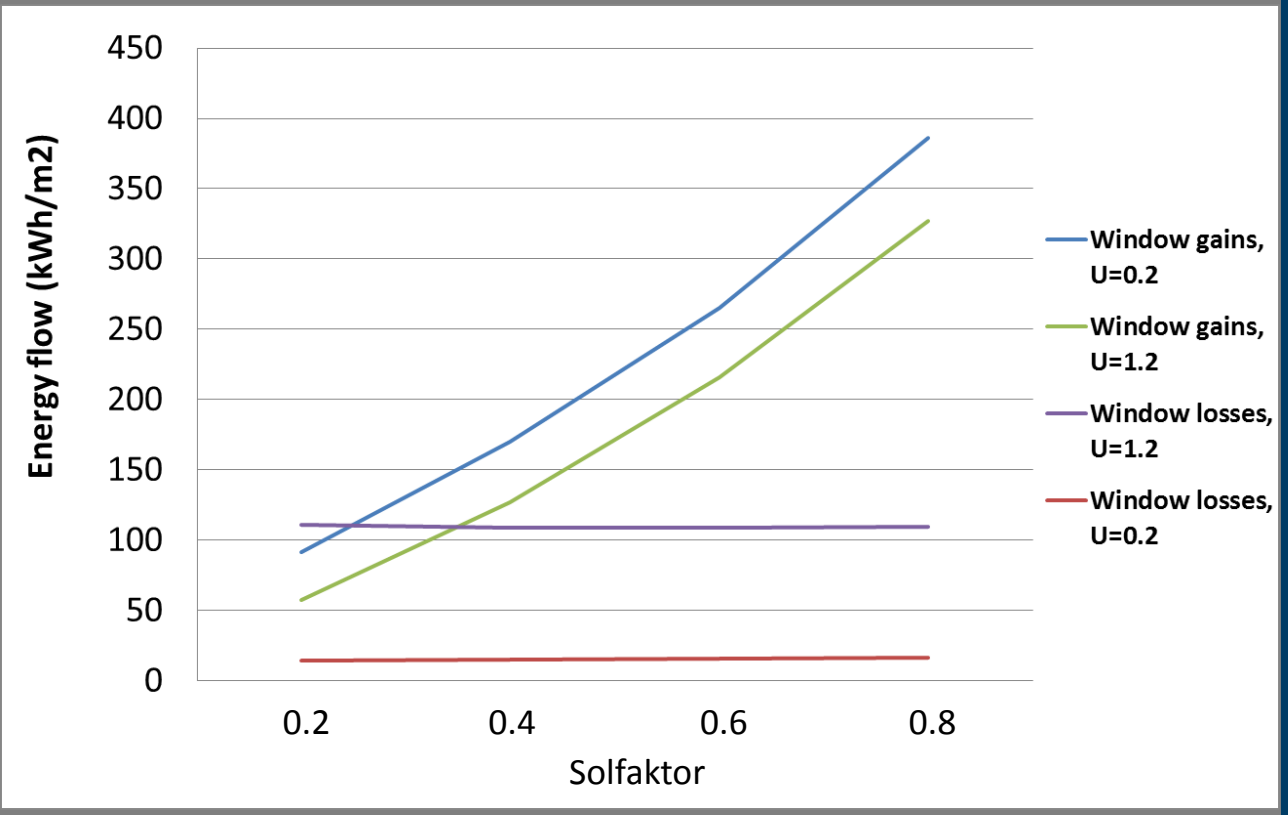
Solar energy



- There is more to it than heat losses
- The balance is important!

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Solar potential

- Solar gains; "lys og varme"

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Solar potential

- Desirable amounts of "lys og varme"
- Dynamics
- Control?

Solar gains

- Both positive and negative sides

Advantages	disadvantages
Heat gains	Overheating
Reduced heating demand	Cooling demand
Daylight	Glare
Reduced need for artif. light	

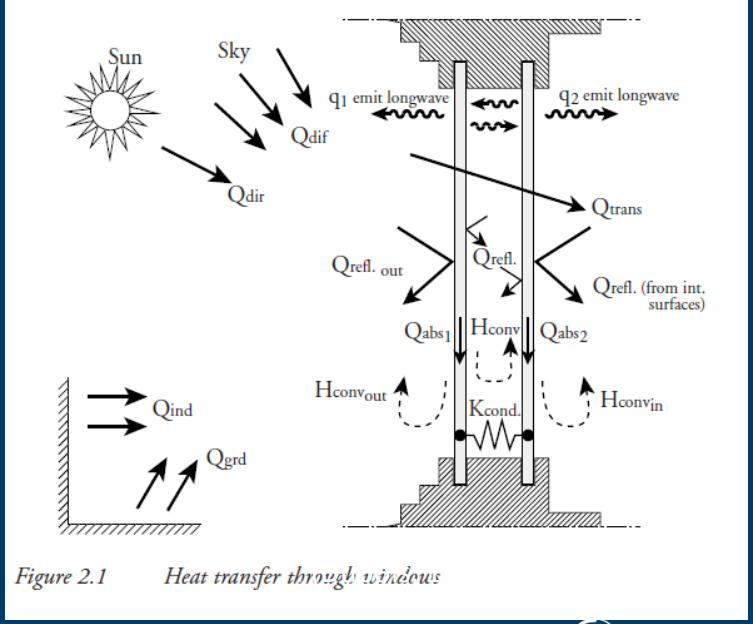

Figure 2.1 Heat transfer through windows

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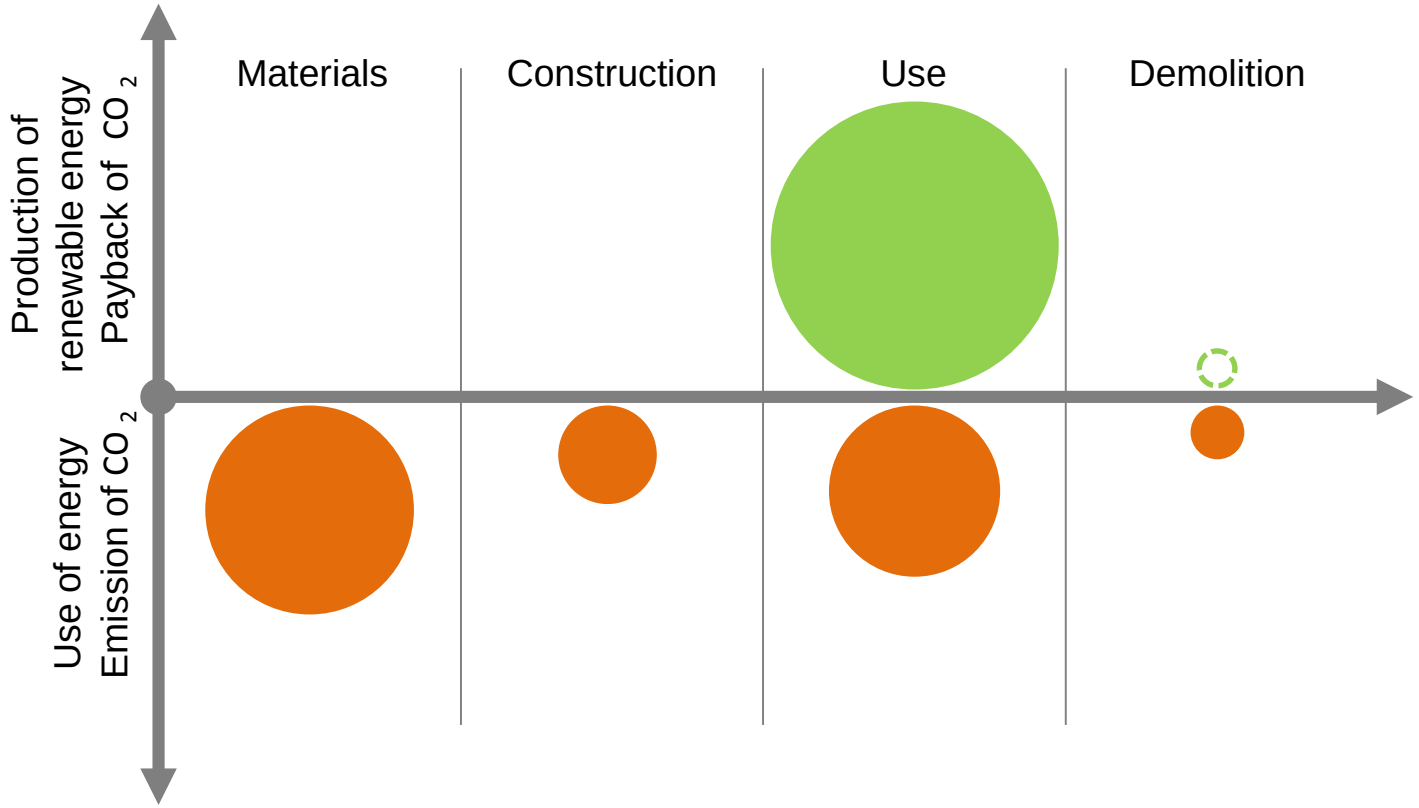
Towards zero emission buildings



Ref: B. Risholt et al.

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Evaluering av boliger med lavt energibehov (EBLE) 2012–2016

FORSKNING PÅ PASSIVHUS

Hva lurte vi på?

Brukererfaringer og brukeropplevelser

Energibruk

Inneklima og komfort

Erfaringer med byggeprosess for alle prosjekter

Kostnader

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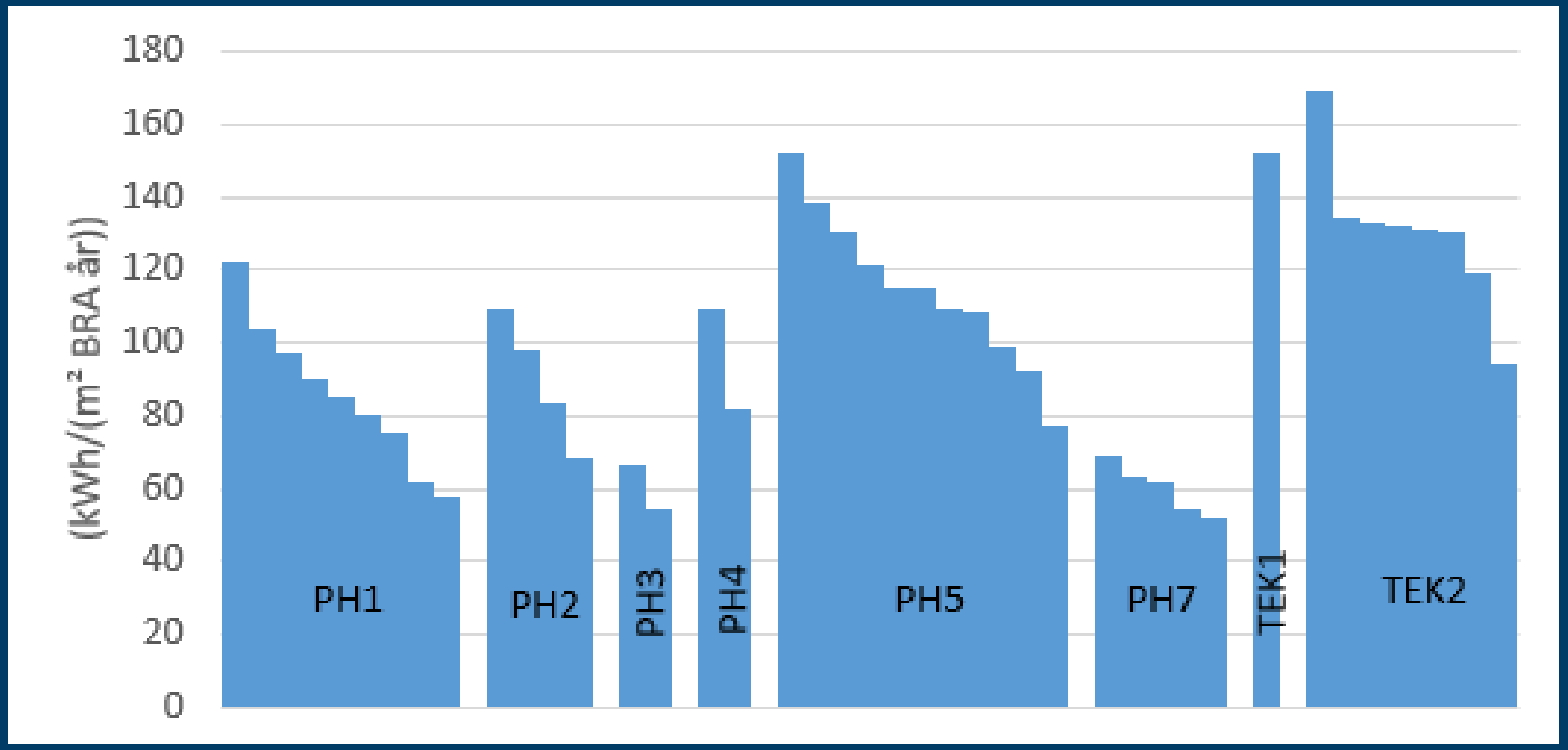
Energy use



Målt total levert energi til boligene

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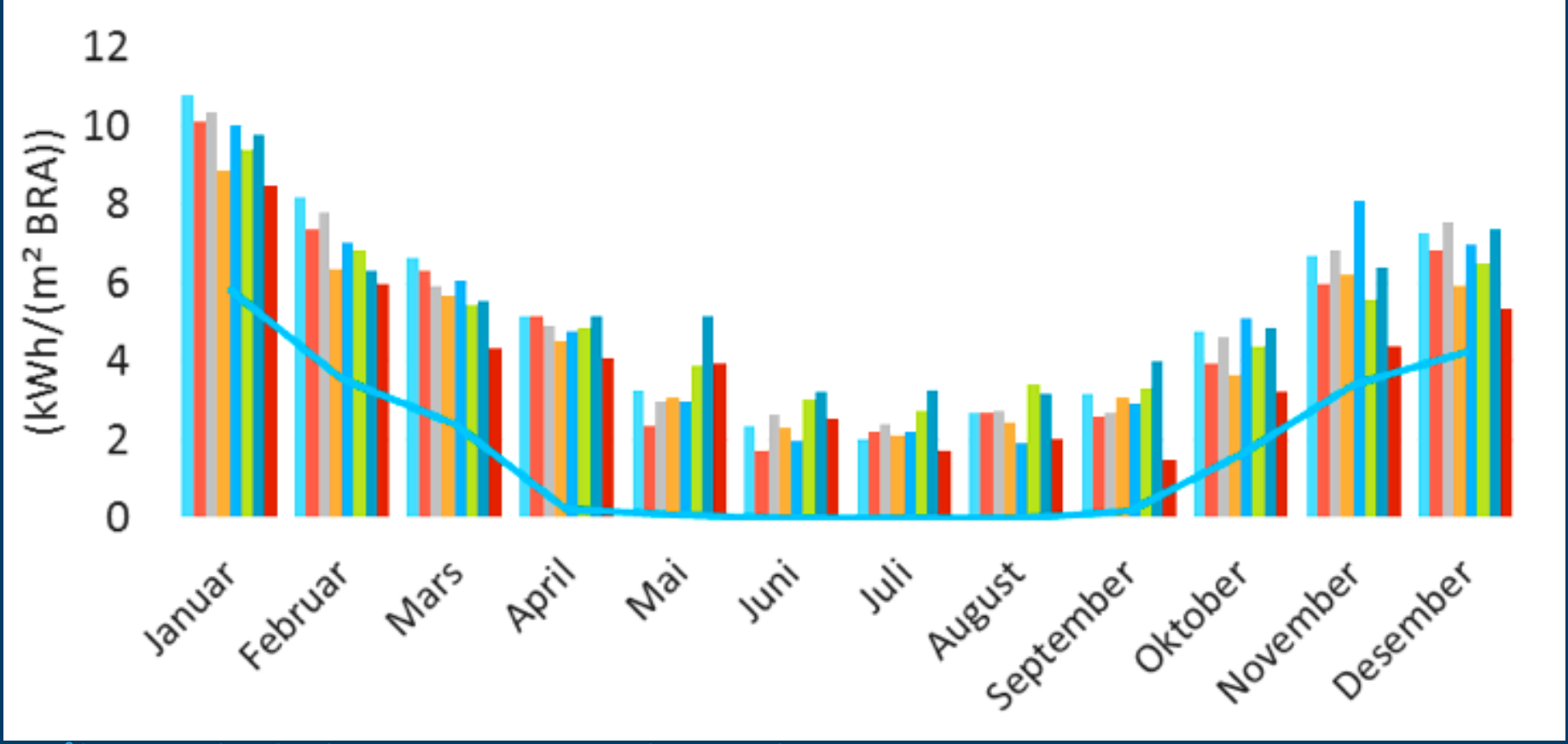
Heating demands – measured and *designed*



Målt energibruk til oppvarming – et eksempel

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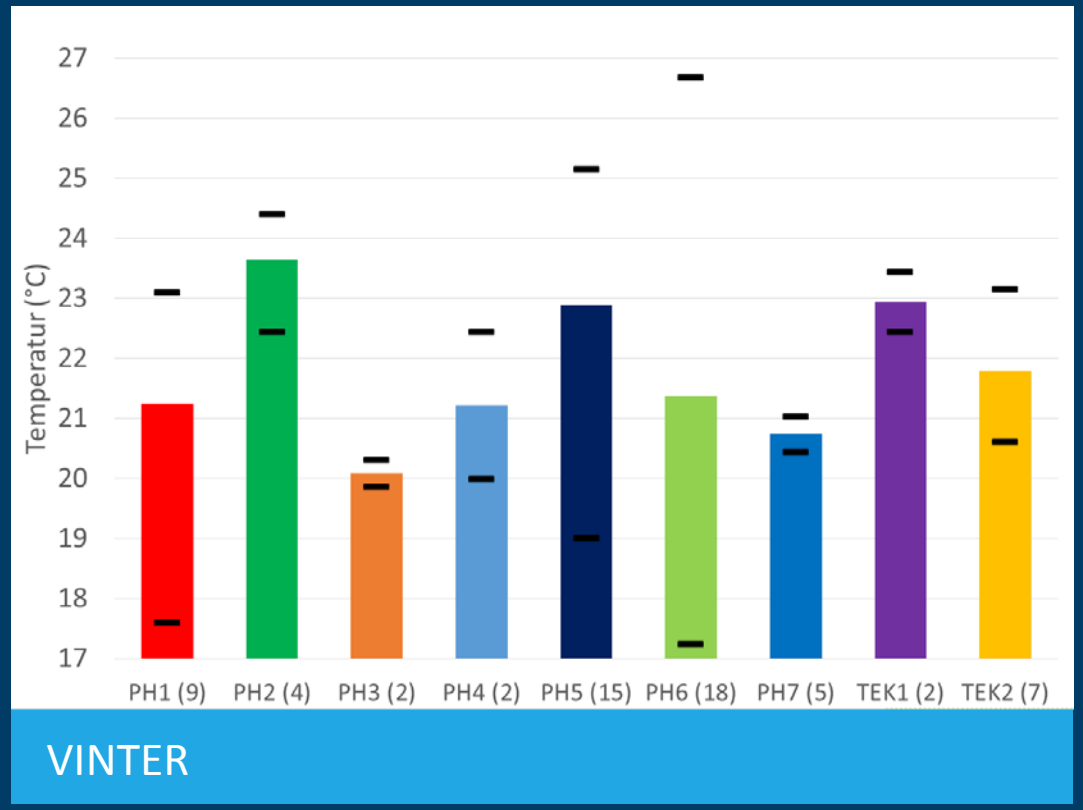
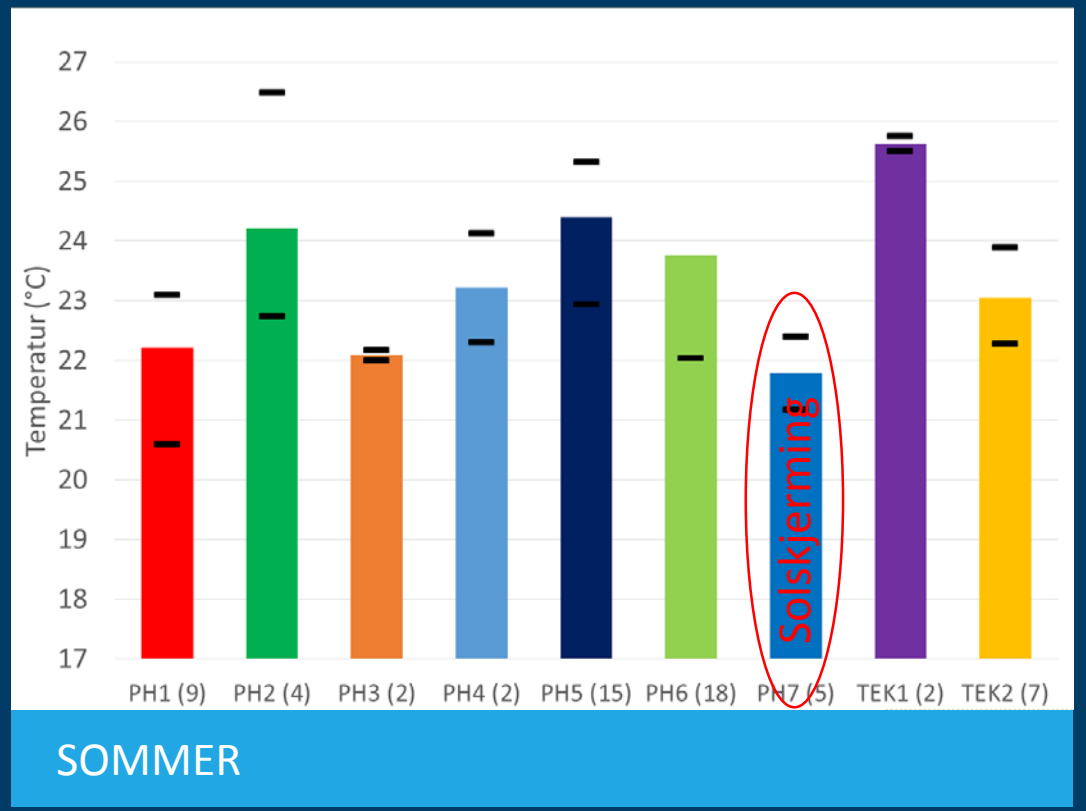
Temperatures in the living room



VINTER



SOMMER

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