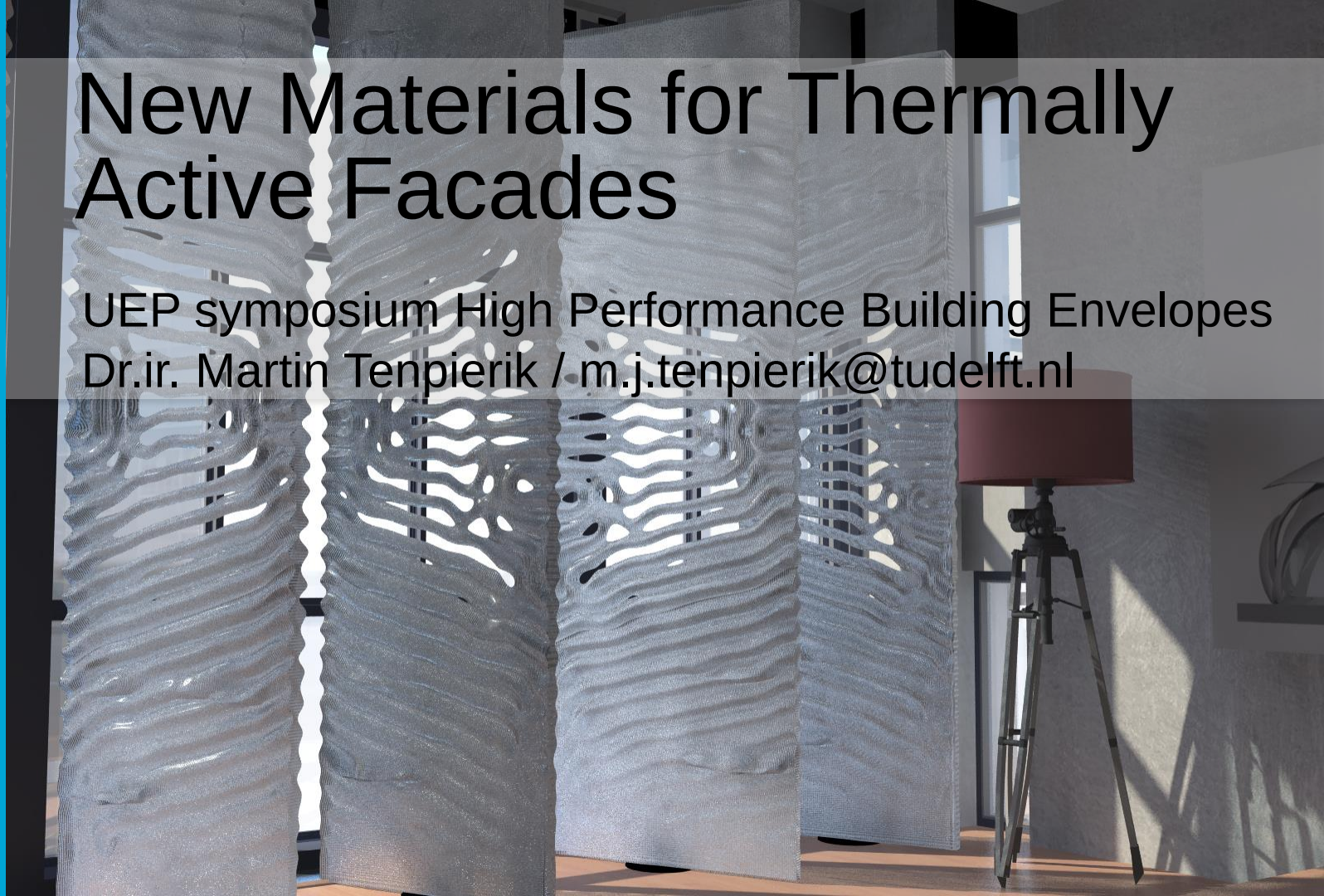
New Materials for Thermally Active Facades

UEP symposium High Performance Building Envelopes

Dr.ir. Martin Tenpierik / m.j.tenpierik@tudelft.nl



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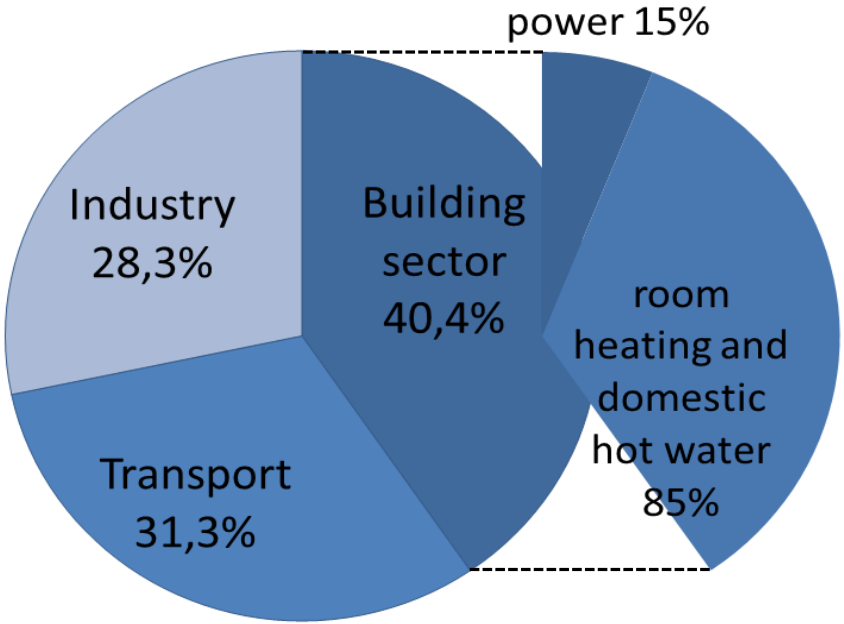
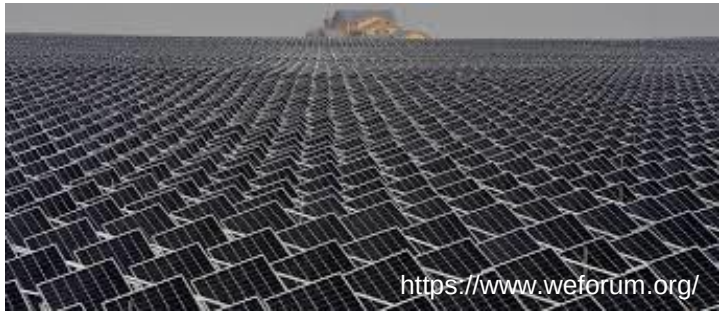
The Problem

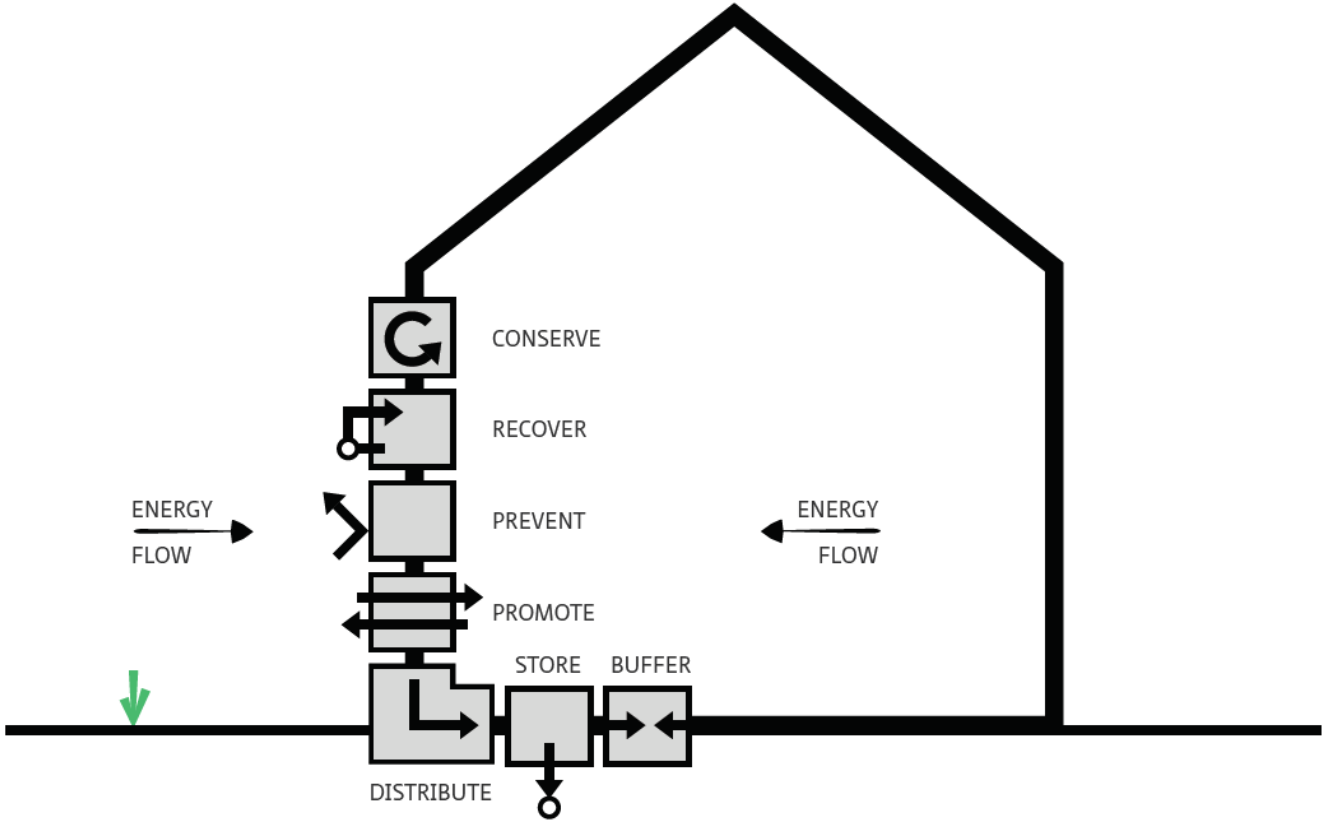
Buildings account for about 40% of the primary energy consumption in EU. Most of it is used for room heating and DHW.



The Problem



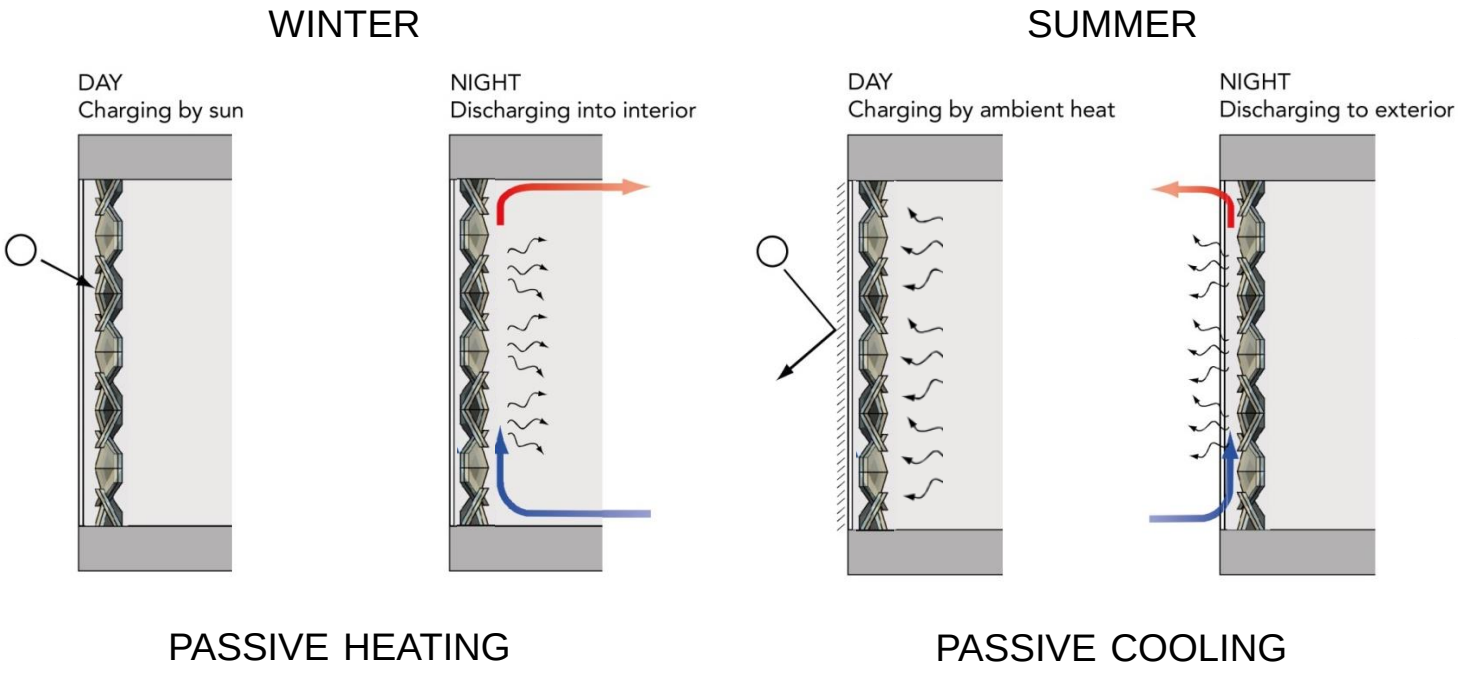
The Solution



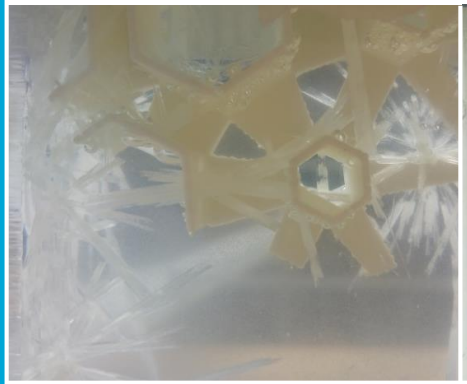
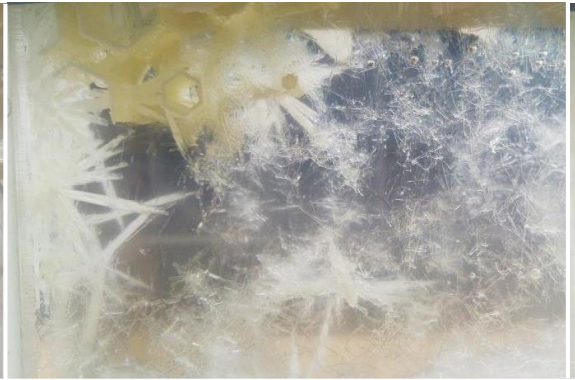
Looman, R.H.J. (2017), *Climate Responsive Design*, PhD dissertation, Delft: TU Delft.

New materials

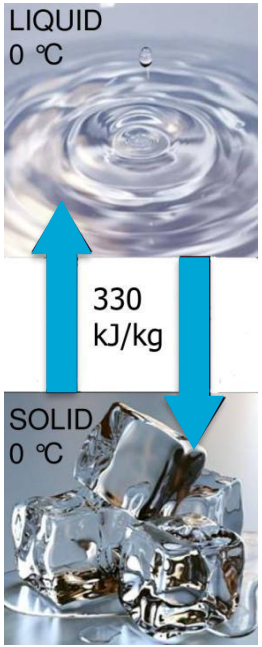
Double Face 2.0

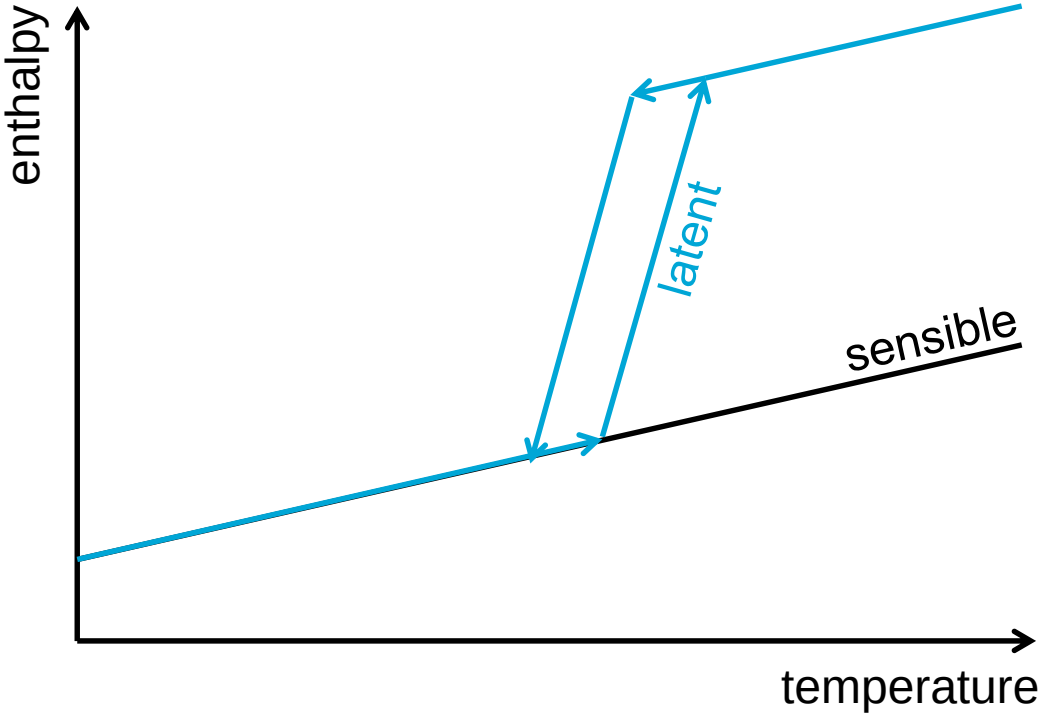


Phase change materials

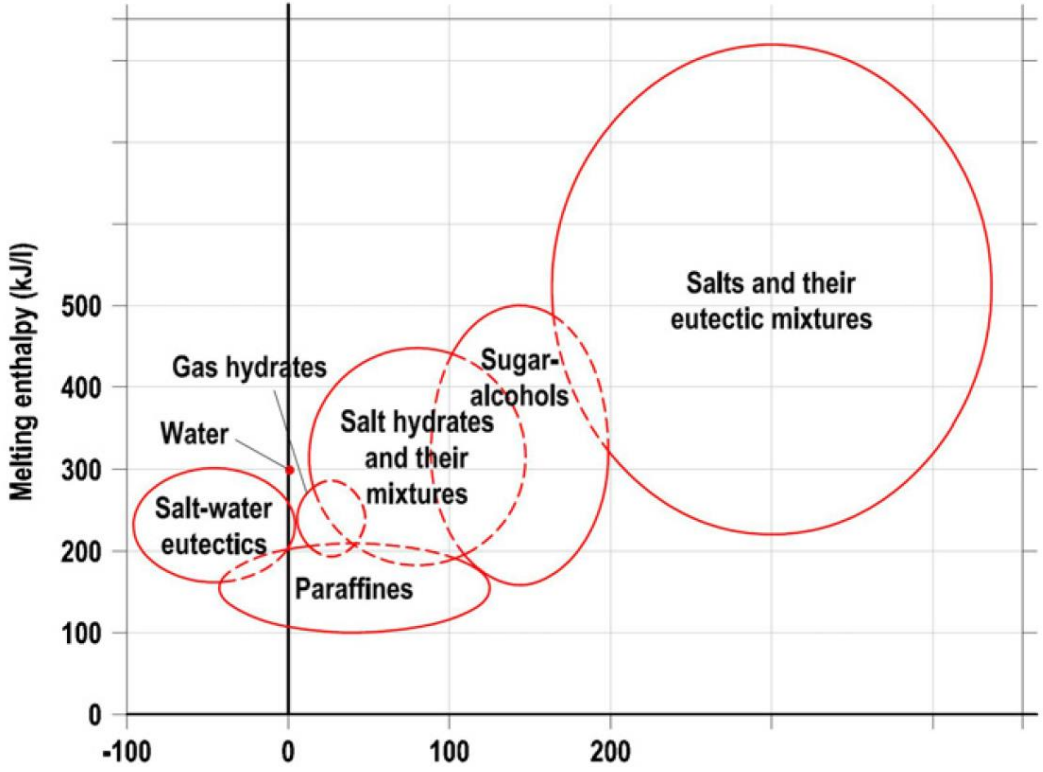




Phase change materials





Phase change materials



Baetens, R., Jelle, B.P., Gustavsen, A. (2010), "Phase change materials for building applications: a state of the art review", *Energy and Buildings* 42: 1361-1368.

Phase change materials

Paraffins

- flammable
  expensive
  large volume change
  low thermal conductivity

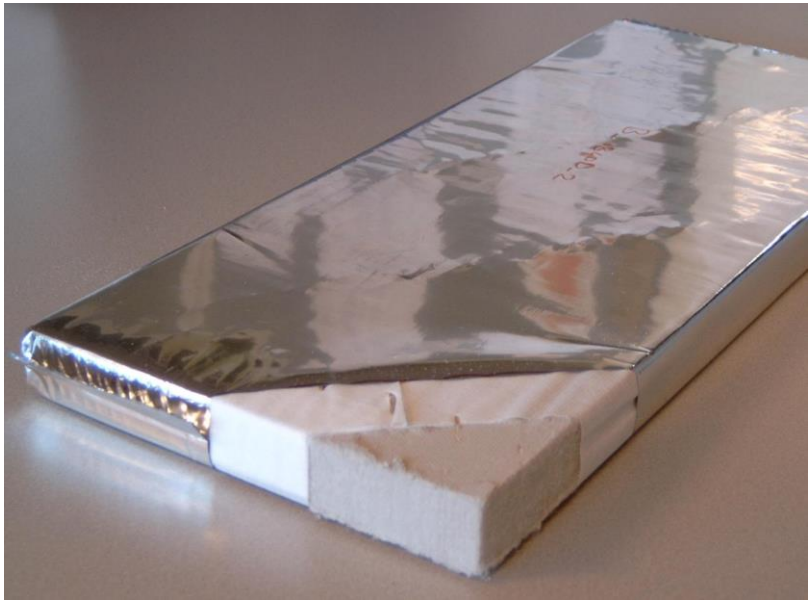
+ chemically stable
  no super cooling
  non corrosive

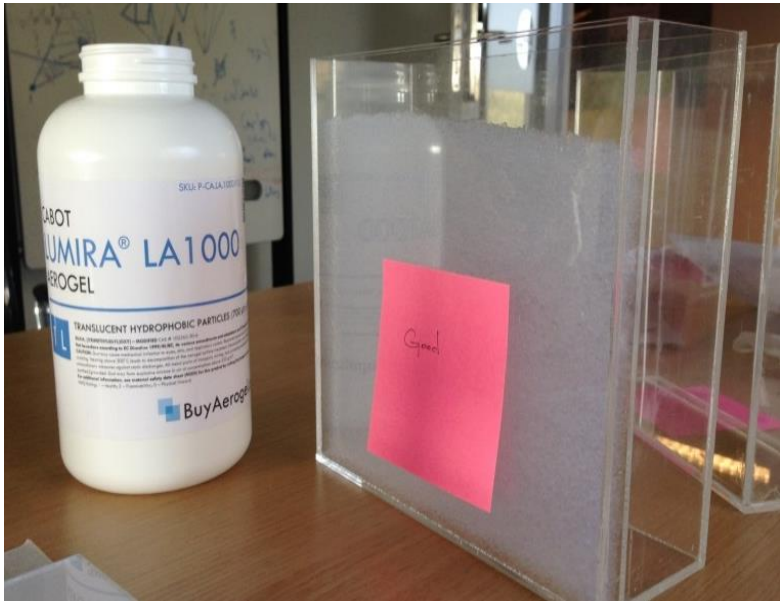
Salt hydrates

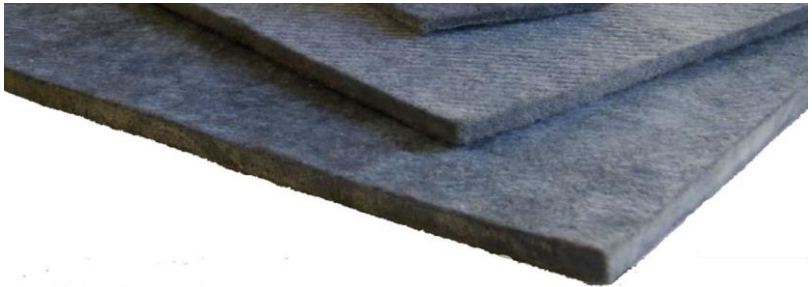
- phase segragation
  super cooling
  corrosive
  higher density

+ non flammable
  relatively cheap
  small volume change
  high thermal conductivity
  recyclable

Insulation materials

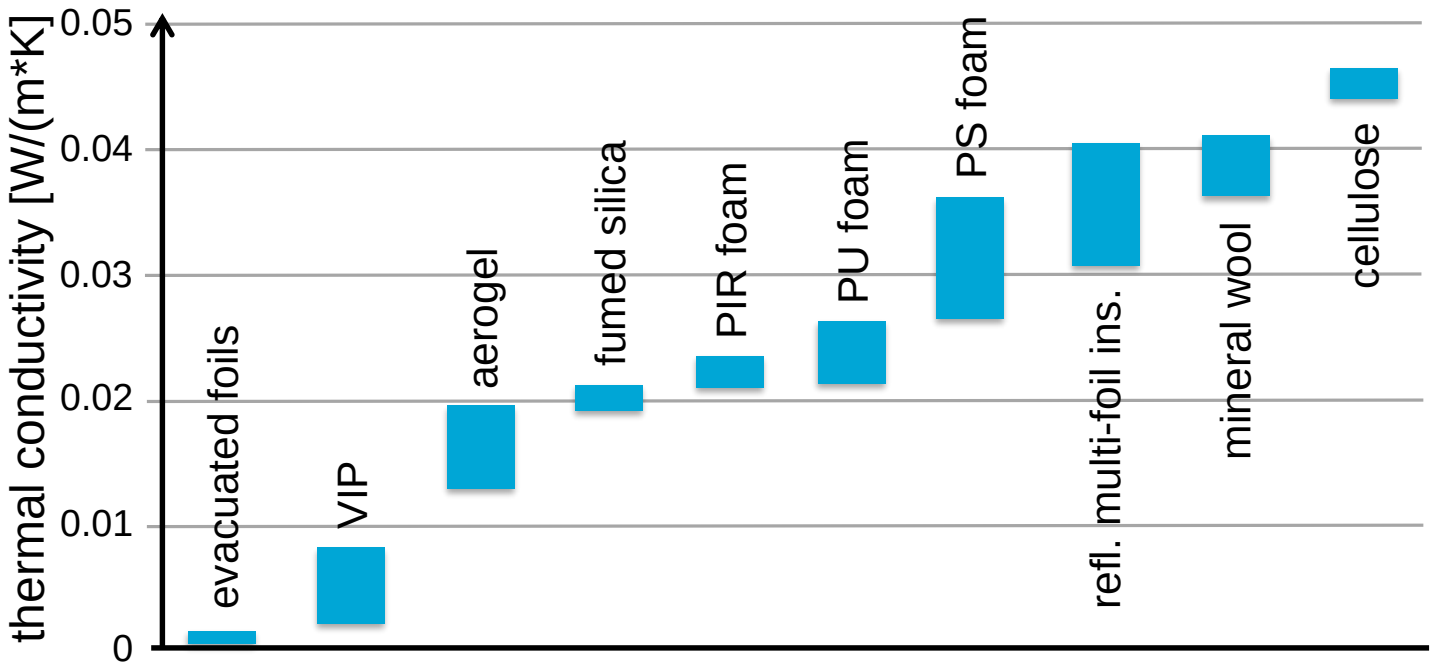






Vacuum Insulation Panels
Lumira aerogel
Spaceloft aerogel

Insulation materials



Tenpierik, M.J. (2010), *Vacuum Insulation Panels Applied in Building Constructions*, PhD thesis, TUDelft, Delft.

Double Face 2.0

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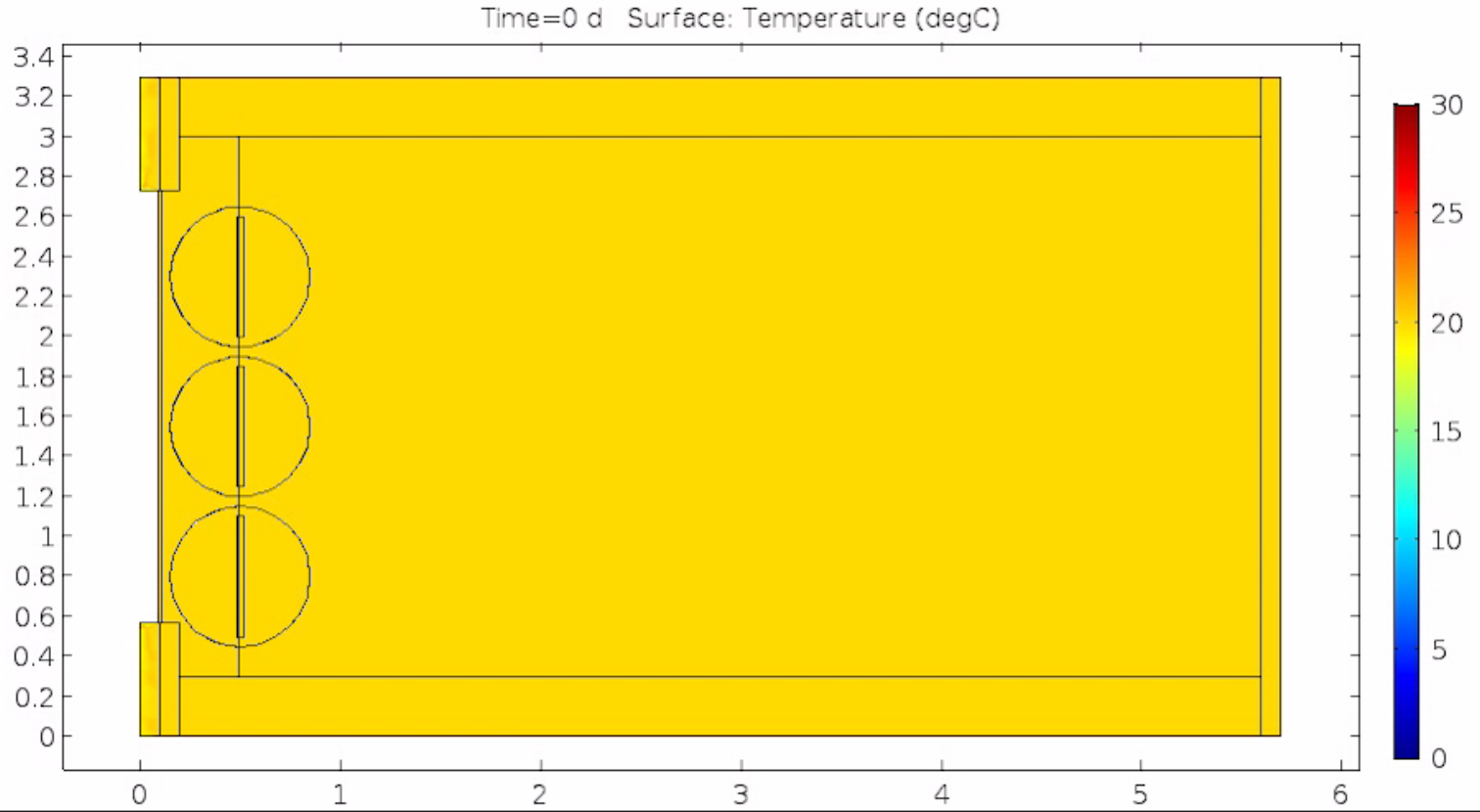
Double Face 2.0



Wattez, Y., T. Cosmatu, M. Tenpierik, M. Turrin and F. Heinzelmann (2017), “Renewed Trombe wall passively reduces energy consumption”, In: L. Brotas, S. Roaf and F. Nicol (eds.), Proceedings of the 33rd international conference on passive and low energy architecture – Design to thrive, Volume III, PLEA/ Heriot Watt University/NCEUB, Edinburgh, July 2-5, pp. 902-909.

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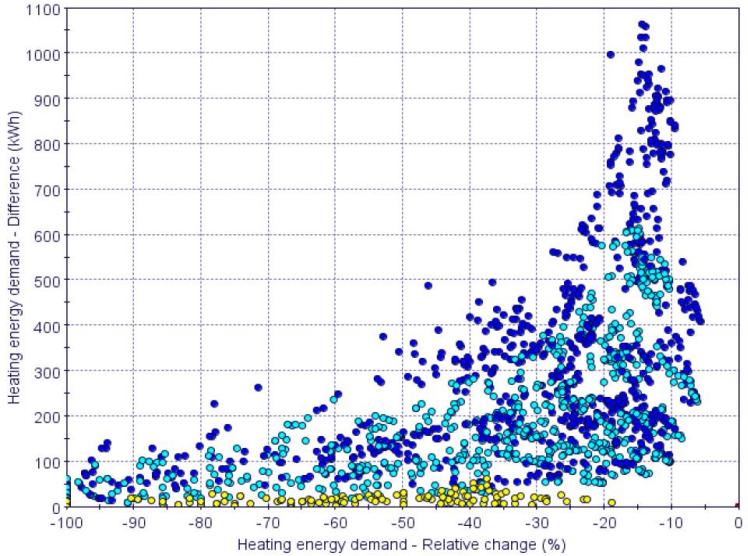
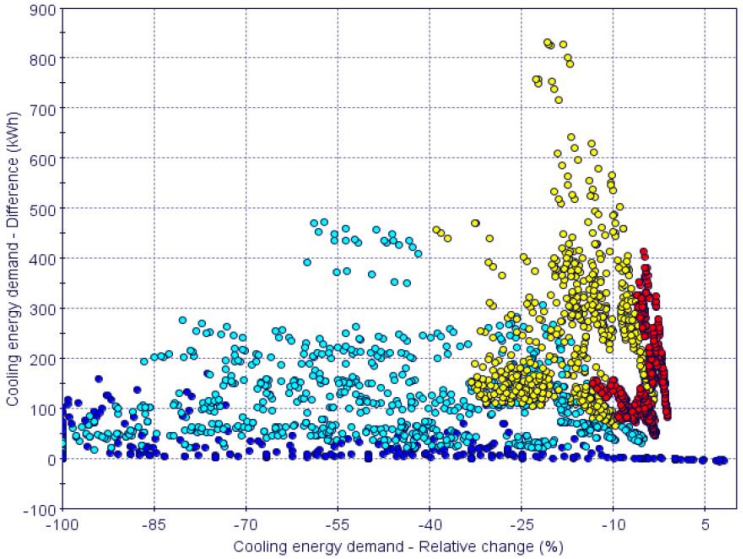
Double Face 2.0

mean reduction heating demand
temperate climate: 36%



mean reduction cooling demand
temperate climate: 50%

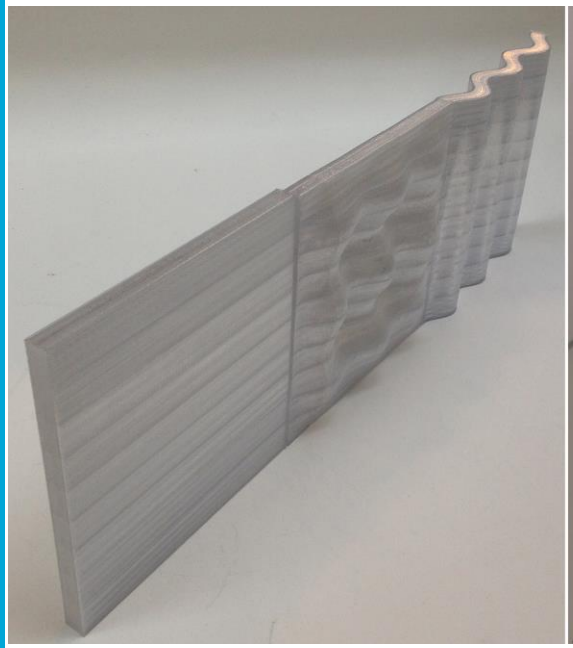


Climate

Cold
Dry
Temperate
Tropical

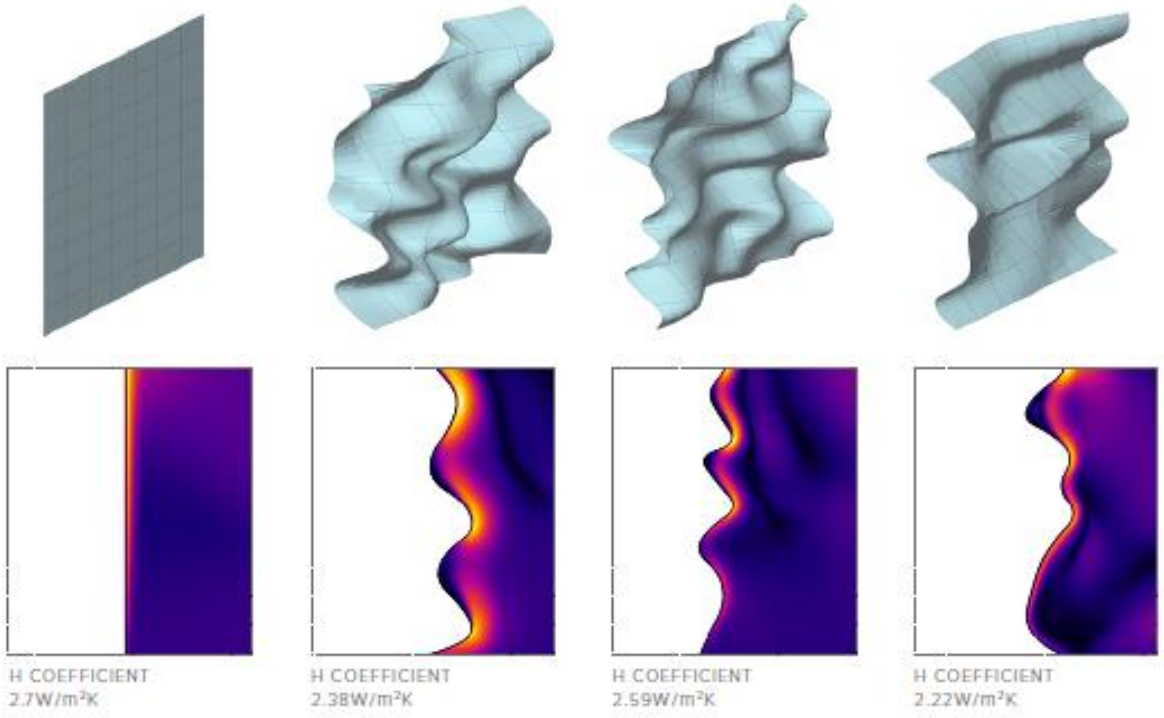
Unen, J. van (2019), "The energy and comfort performance of a lightweight translucent adaptable Trombe wall in different buildings and climates", MSc thesis, Delft: TUDelft.

Double Face 2.0



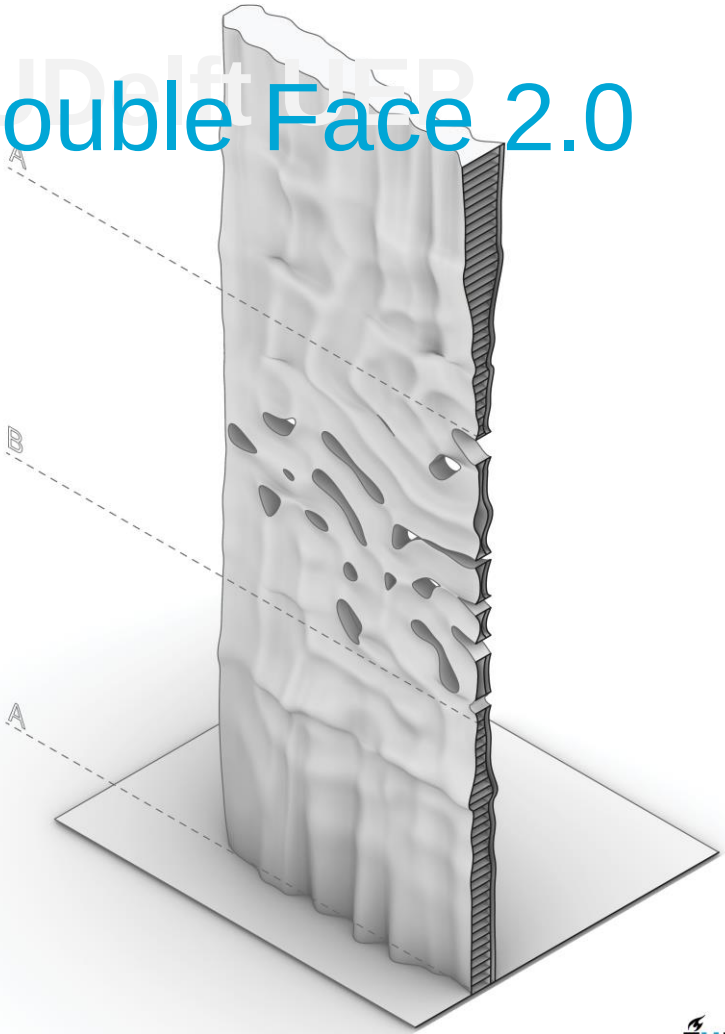
Tenpierik, M.J., Y. Wattez, M. Turrin, T. Cosmatu and S. Tafou (2018), Double Face 2.0: A lightweight, Adjustable, Translucent Trombe wall, Final report for NWO, TUDelft, Delft.

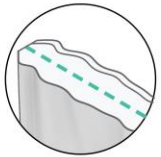
Double Face 2.0



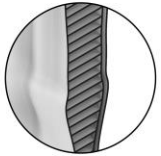
Farrugia, E. (2018), "Thermal Morphology. A Geometrically Optimised Trombe Wall", MSc thesis, Delft: TUDelft.

Double Face 2.0

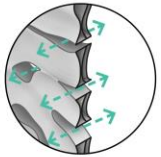




• Symmetric section filled with phase change material (pcm) and offset for aerogel

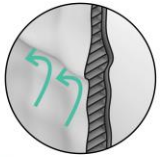


• Horizontal channels for minimizing overheating of pcm

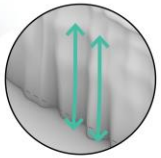


• In middle section, holes for seeing through

• Control of opening percentage (10-20%)
• Control of opening dimension (50x100mm)



• Local geometric articulation for air flow and heat flux control



• Geometric articulation for stiffness, stability, air flow and heat flux control

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Double Face 2.0

Researchers
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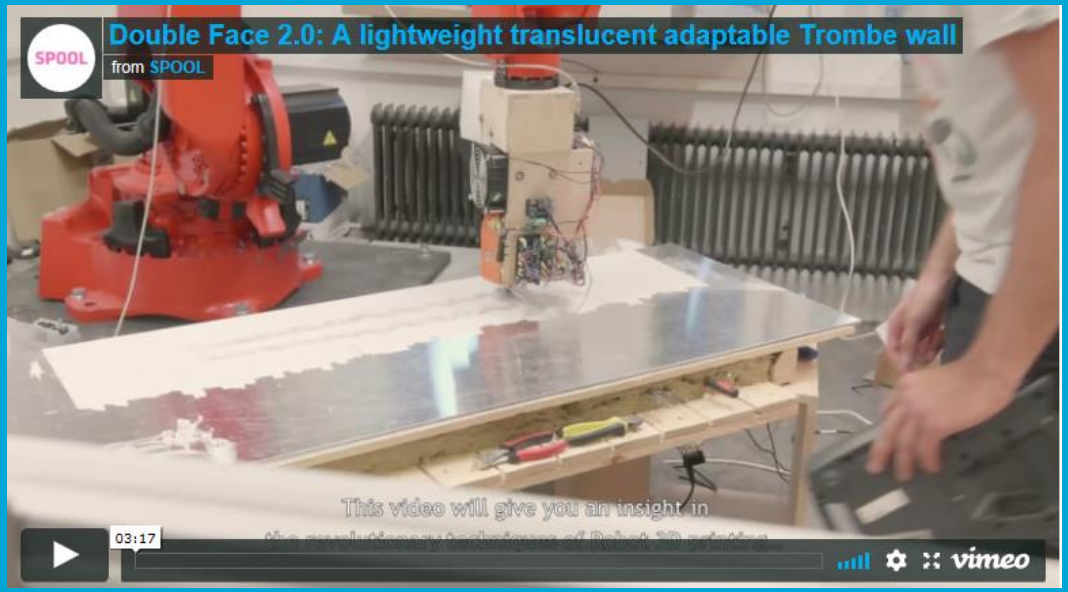
Dr. M. Turrin MArch
Ir. Y.C.M. Wattez
T. Cosmatu MArch
S. Tsafou MSc Mas

TU Delft

Thank you for listening!

https://vimeo.com/277038530



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