Attachment 2 - Poster of the project (A3)

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TRANSLUCENT AEROGEL SOLAR WALLS AS A FAÇADE MATERIAL OF THE FUTURE: AN ENVIRONMENTAL IMPACT AND ENERGY-EFFICIENCY ASSESSMENT

TRANSLUSENTE AEROGEL SOLVEGGER SOM ET FASADEMATERIALE FOR FREMTIDEN SETT I ET ENERGI- OG MILJØPERSPEKTIV

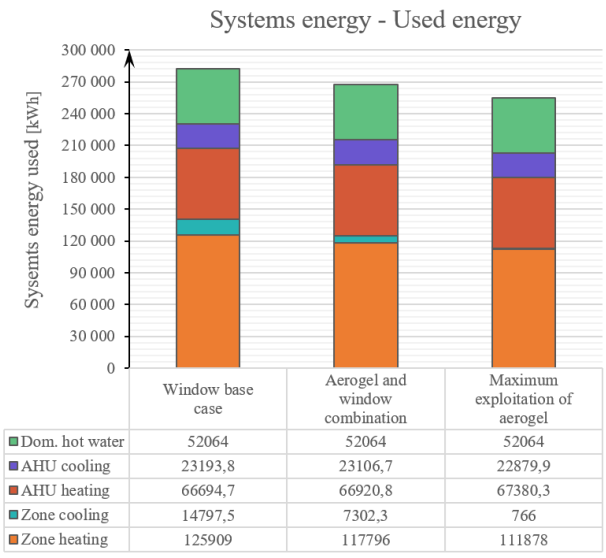
PROJECT DESCRIPTION AND GOALS

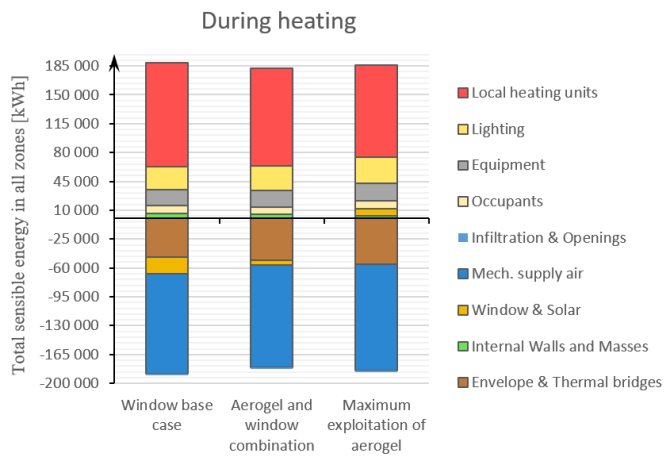
This study focuses on the energy and environmental perspective of aerogels and translucent aerogel solar walls in the context of a given case building in Norway. Energy building simulations are performed where windows are gradually replaced with aerogel solar walls. Additionally, a life cycle assessment is executed of phases A1-4 on aerogel and aerogel solar walls, with consideration of three different production locations in the world.

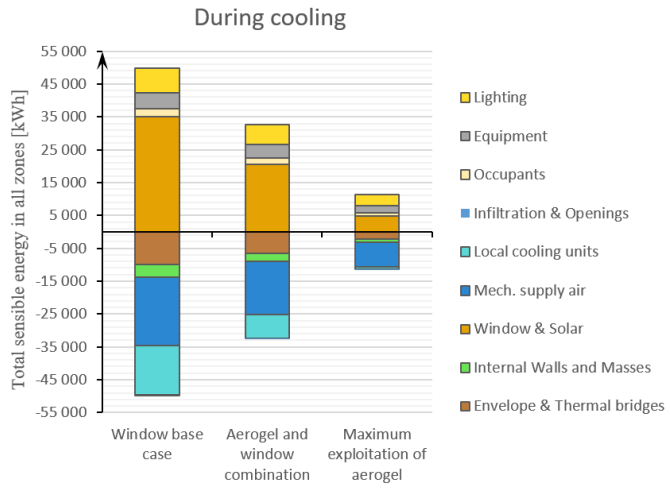
The aim of the study is to investigate the energy savings potential of implementing aerogel glazings to a building's envelope. Conclusions are drawn on these premises, and are meant to be interpreted as an indicator of the value of aerogel glazings.

ENERGY SIMULATION WITH IDA ICE

Implementing aerogel solar walls decreases the energy costs of zone cooling and zone heating by approx.
7 500 kWh (aerogel and window combination), and
14 000 kWh (maximum exploitation of aerogel)

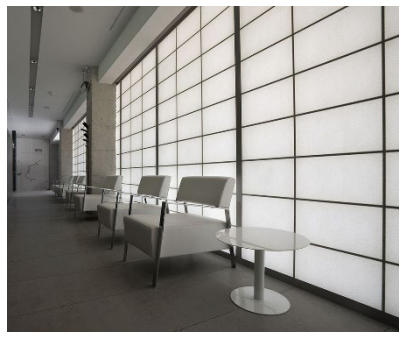






SILICA AEROGEL & AEROGEL SOLAR WALLS

- Silica aerogel is extremely porous, with up to 99,8% air.
- Aerogel solar walls consist of two sheets of fiberglass, filled with silica aerogel granules.
- Aerogel solar walls can have a U value of 0.28 $W/m^2 \cdot K$.
- Aerogel solar walls diffuse daylight and solar heat.
- Production can cause high environmental impact.

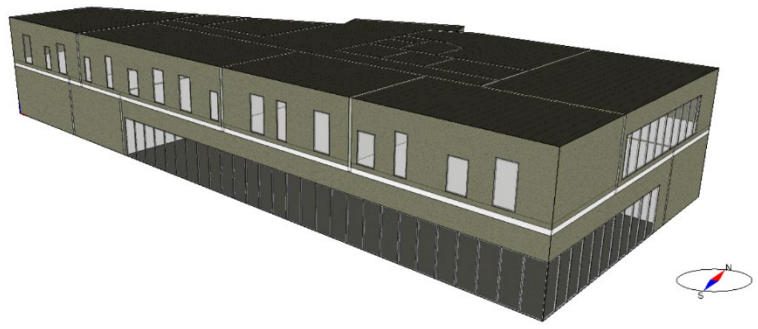


Source: Kalwall, 2022

BUILDING CASE STUDY

Three cases of aerogel solar walls application are considered for energy simulations:

- **Window base case**: no windows are replaced
- **Aerogel and window combination**: windows are partially replaced
- **Aerogel maximum exploitation**: all windows are replaced



IDA ICE model of Mosseveien 104 (Fredrikstad, Norway)

LIFE CYCLE ASSESSMENT OF AEROGEL & AEROGEL SOLAR WALLS

Emissions from the production of silica aerogel and aerogel solar walls from USA to Mosseveien 104, Norway

	Material	GWP [kg CO_2-eq]	FEP [kg SO_2-eq]	PMFP [kg 1,4-DC]	POFP [kg CFC-11]	HTP [kg 1,4-DC]	ODP [kg CFC-11]
Silica aerogel	Methanol	3.0425E+02	5.8354E-02	3.5655E-01	9.9243E-01	9.1348E+01	9.0874E-05
	Ammonia 2 M	1.1998E-01	1.0875E-05	1.4473E-04	2.2855E-04	2.7036E-02	1.8480E-08
	Tetramethoxysilane	2.8990E+02	1.5894E-01	5.7076E-01	9.9457E-01	1.4194E+02	4.6430E-05
	Methyltrimethoxysilane	2.6931E+01	1.4765E-02	5.3021E-02	9.2392E-02	1.3186E+01	4.3131E-06
	Nitrogen	5.7290E-02	5.9393E-05	1.0492E-04	1.4014E-04	3.9891E-02	6.1968E-09
	Reagent grade water	1.7885E-02	1.0021E-05	5.1082E-05	5.9455E-05	1.0075E-02	3.3843E-09
	Electricity	1.1180E+02	3.2997E-02	1.8117E-01	1.7535E-01	3.6718E+01	2.2925E-05
Translucent aerogel solar walls	Translucent FRP Faces	1.3745E+01	1.3710E-03	1.7939E-02	3.5015E-02	1.0226E+00	2.6096E-07
	Polyamide, Thermal Break	5.2936E+01	5.2802E-03	6.9087E-02	1.3485E-01	3.9382E+00	1.0050E-06
	Aluminum (6063-T6 or 600-T5 alloy)	3.4130E+02	1.2743E-01	8.2084E-01	1.1347E+00	1.4875E+02	2.6948E-05
	Steel, Screws	1.8508E-01	1.9068E-04	8.3519E-04	9.2567E-04	3.1004E-01	8.0046E-09
	Electricity	2.6072E+02	7.6947E-02	4.2248E-01	4.0892E-01	8.5626E+01	5.3461E-05
Transport	Ship	5.7702E+00	7.8934E-04	3.6600E-02	8.6068E-02	7.0142E-01	9.2015E-07
	Truck (EURO6) *Lorry 16-32 metric ton*	5.3746E+00	4.4517E-04	7.2335E-03	1.2647E-02	1.5060E+00	9.9038E-07

- Aerogel releases approx. 733 kg of CO_2 (52% of total aerogel solar wall emissions).
- Transportation had little impact.
- Electricity amounts to half of emissions from production and transportation.

Material composition	Global warming potential [kg CO2-eq] Location of production *		
	USA	Germany	Norway
Big (1.5x6.0 m)	1527.58	1869.48	1194.73
Medium (1.2x2.4 m)	1413.11	1758.59	1069.30
Small (0.9x1.2 m)	1356.51	1706.71	1010.32

Degree of recycled methanol	Global warming potential [kg CO2-eq] Location of production *		
	USA	Germany	Norway
Bench (0%)	2499.46	2844.94	2155.65
Industry 1 (80%)	1413.11	1758.59	1069.30
Industry 2 (90%)	1277.32	1622.80	933.51

The degree of recycled methanol, in combination with location of production, have the greatest significance for GWP.

CONCLUSIONS

Aerogel solar walls gave a 38% reduction in needed cooling and 7% reduction in heating. The life cycle assessment results gave higher values than regular windows, but overall, the translucent aerogel solar walls showed promising results, and may be able to realize its potential as a "façade material of the future".