SunThink - Development of a Novel Solar Active Sunshading System with Thin Film Photovoltaic Cells

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Part I - Set-Up of the Prototype

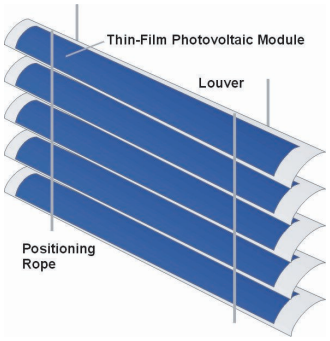


Figure 1: Functional Design of SunThink

Advantages

- → Cost-effective due to parallel use of Venetian Blind and solar generator
- → Aesthetic aspects
- → Already implemented one-axis tracking in Venetian Blinds

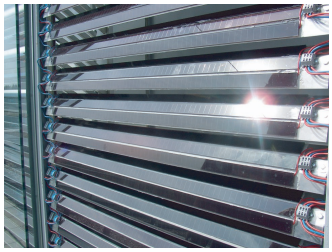
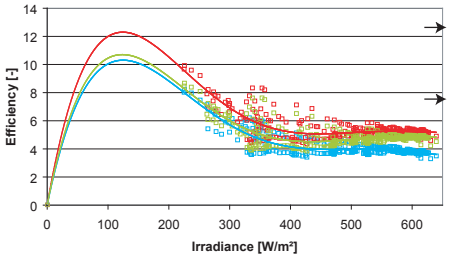


Figure 2: SunThink Prototype

Research Topics

- → Technical Feasibility
- → Self-Shading Problem
- → Optimal PV-area
- → Energy Yield

Part II - Experimental Data



→ Sunny Winter Day (s=700 W/m², T=5°C)

→ STC Efficiency nearly 6.5%

Figure 3: Efficiency of Three SunThink Louver Thirds: Upper, Center and Lower String

The Center String is adjusted to the sun and therefore reaches theoretical STC efficiencies in the case of low ambient temperature. The upper string efficiency has a negative gradient at high radiation due to it´s self-shading charateristics.

Comparing simulated and measured data, a good agreement can be achieved. At low irradiation values in the afternoon, simulated curves show a 2-5 % deviation compared to measured data.

→ Sunny Winter Day (s=700 W/m², T=5°C)

→ Small Deviation can be tolerated

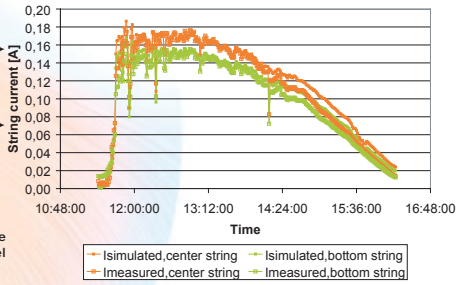
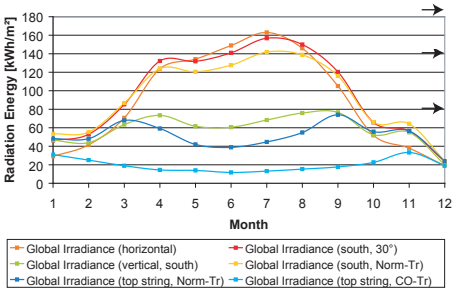


Figure 4: Accuracy of the Simulation Model

Part III - Simulation



→ Test Reference Year as data base

→ Significant Difference at vertical Facade

→ Top string shows less yield than vertical surface

Figure 5: Monthly Solar Energy Yield, also included Top String values

SunThink systems with their already implemented one-axis tracking (yellow) nearly reach values for optimal elevations (red) and are therefore able to work economically.

One axis tracking nearly has twice the energy yield of vertically fixed, south oriented PV.

→ Yearly Surplus of solar irradiation with a horizontal surface as reference

→ Losses due to shading

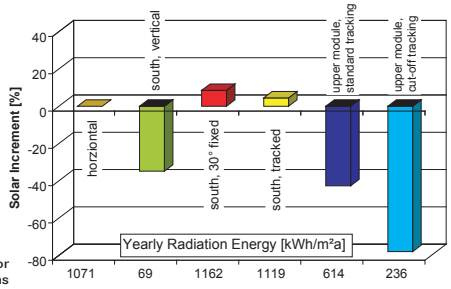


Figure 6: Solar Energy for Various Orientations

Part IV - Results

- → Bar Chart, which refers to the left coordinate
- → Line Chart, which refers to the right coordinate
- → Bar Chart shows cumulated solar energy
- → Line Chart gives cumulated electrical energy yields with dots depicting the exact values

KfW-credit: 3.4 % interest, 10 years duration, 2 years redemption free

The optimally tracked center module of SunThink is cost-effective like standard generators. The lower module just reaches profitability, whereas the upper module mostly is shaded and does therefore not work cost-effectively.

It can be concluded that the lower 2/3 of the total louver are an optimal PV equipment area. SunThink reaches economic operation for the first time in façade integrated systems.

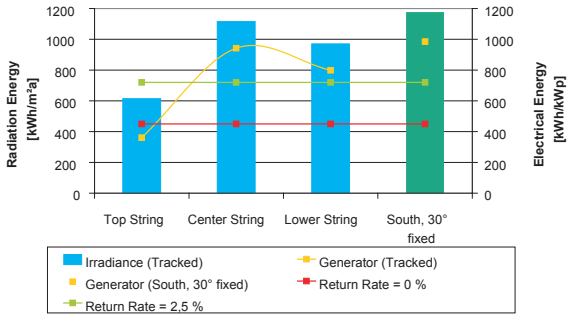


Figure 7: Energetic and Economical Results

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