TECHNISCHE UNIVERSITÄT DRESDEN

Integration of Renewable Energies into Cityscape

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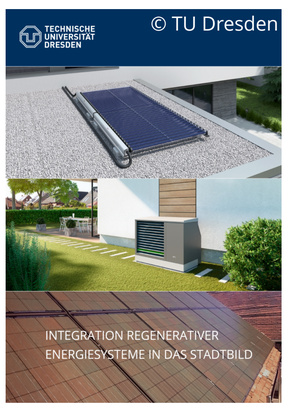
High yield at any price?

Solar energy is quite popular

Acceptance of solar energy is high among the population in Germany [1]. To ensure that this remains the case, aesthetic aspects must be considered in planning more than has been the case to date.

On behalf of the Urban Planning Office: Guideline for the Integration of Renewable Energies into Cityscape



Front page of basic document

For this reason, the Chair of Building Energy Systems and Heat Supply of the Technische Universität Dresden has developed recommendations for the integration of photovoltaic and solar thermal systems as well as the outdoor units of heat pumps into the cityscape. This was on behalf of and in interaction with the Urban Planning Office of the City of Dresden.

Recommendations were published in a guideline and accompanying basic document [2]. Based on this, the main recommendations are presented here. In addition, exemplary simulations show the effects of urban planning optimization measures on the yield and total costs of photovoltaic power generation using the example of a new multi-family house with a flat roof.

Recommendations for pitched roofs: Matching shape and color

Please don't!

Roof-parallel is great...

...roof-integrated even better.

Not ideal: Color contrasts

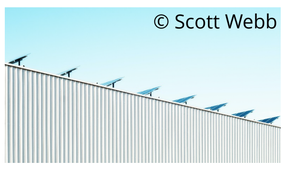
Optimum: Matching colors

Color selection coming soon?

Recommendations for flat roofs

Preferably invisible!

For reasons of aesthetics, visibility of the modules/ collectors should generally be avoided, as the roof edges appear unsettled due to the irregular outline of elevated modules/ collectors. In addition, people perceive the urban space as more pleasant if it is delimited by clearly defined shapes towards the sky.



No irregular outlines, please!

Elevation angle: As small as possible

From an urban planning perspective, solar systems on flat roofs should be installed horizontally (i.e., with an installation angle of 0°) if possible. But this requirement often conflicts with yield optimization, which requires an installation angle of 25° to 70°. In addition, for reasons of module/collector statics, certain minimum angles of inclination must usually be observed.

Vacuum tube collectors which can be installed with a minimum elevation angle of 1 to 3 ° have been on the market for more than 10 years.

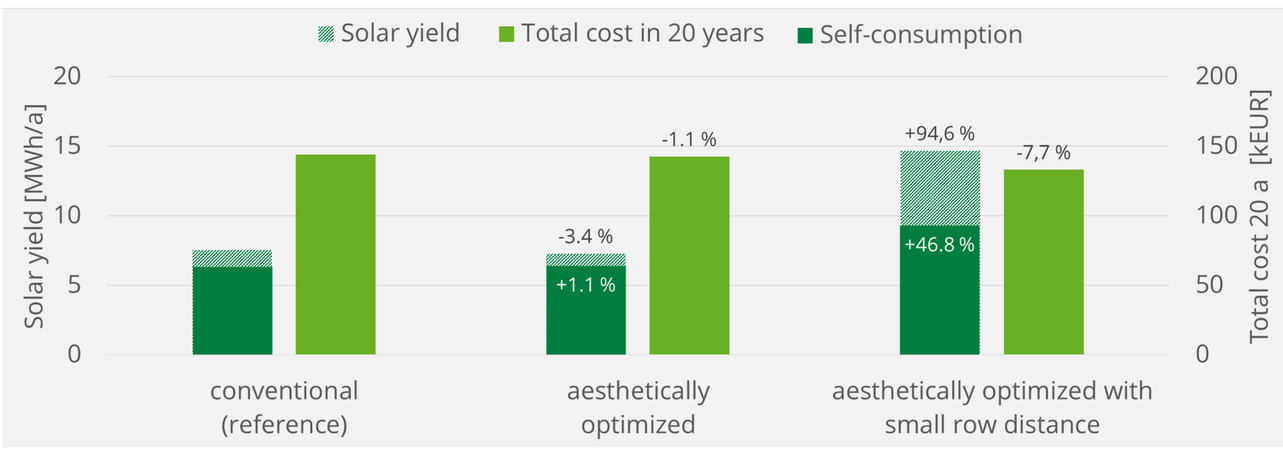
(Almost) invisible from below: Horizontal collector

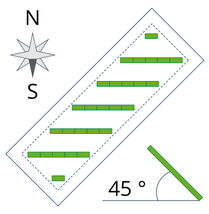
Orientation: Parallel to the roof edge instead of yield optimized

On flat roofs, a south exposure for yield maximization is almost always possible. However, this is not to be favored from an aesthetical point of view. The orientation should always be parallel to the roof edge.

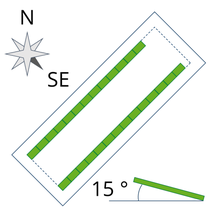
Parallel to the edge, please!

Simulations for a multi-family house with flat roof: Aesthetical optimization leads to increased yield

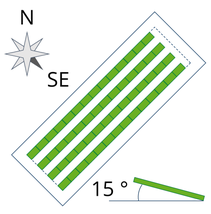




27 modules



27 modules



56 modules

Yield simulations using Polysun and estimations of overall cost in 20 years

...were conducted for a multi-family house with a flat roof. The three presented scenarios differ in orientation and elevation angle.

Most important boundary conditions

- 28 m x 10 m floor/roof area
- Electricity demand: 28,000 kWh/a
- Module dimensions: 1.00 m x 1.72 m
- Module efficiency at STC: 17.5 %
- Feed-in tariff: 6 ct/kWh
- Electricity price: 30 ct/kWh

A common rule for row distance

...was used for the conventional scenario, resulting in 27 modules fitting on the roof. The same number of modules leads to slightly decreased overall cost due to higher self-consumption in the aesthetically optimized scenario. Applying the same rule for row distance to the aesthetically optimized version, the yield is almost doubled and cost are significantly reduced.

Conventional design approaches should be adapted to meet requirements regarding cityscape, as this might even lead to higher yields and decreased cost.

References:

[1] LichtBlick SE (Volker Walzer): Repräsentative Umfrage zu erneuerbaren Energien - Mehrheit der Deutschen für Solaranlagen auf Dächern. Hamburg : YouGov im Auftrag der LichtBlick SE, 2020.

[2] C. Felsmann, V. Volmer, K. Rühling, H. Hundt: Integration Regenerativer Energien in das Stadtbild – Ergänzendes Grundlagendokument zum Leitfaden für regenerative Energien im Stadtbild. Dresden, Dezember 2018 mit red. Änderungen im Januar 2020.

Member of network:

DRESDEN concept

The extensive basic document „Integration Regenerativer Energiesysteme in das Stadtbild" can be found here: https://tud.link/ftwu.

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