

## Off-grid solar sweden

The six buildings, now containing 172 flats, were erected in the mid-seventies as part of the Swedish national public housing plan called "Miljontalsprogrammet" (program for the millions).

However, before the current renovation process began the buildings hadn't met modern housing standards for quite some years. Something had to be done to improve the interior and facilities of the flats as well as indoor climate and energy efficiency.

Front side of a renovated apartment building with an extra floor added as well as high-insulating facades and external wood-clad elevator towers. A significant aesthetic, functional and energy saving upgrade

Obsolete buildings in combination with high operating-, maintenance-, and energy costs kept the real estate value of the municipal properties low which in turn subtracted from the overall economic performance of the municipal housing company Värmdö Bostäder that owns and runs Backgärdegatan as well as other housing projects in the town of Värmdö.

Increases in real estate value from modernization and better energy efficiency obviously improves the financial solidity of the municipal housing company itself and in their efforts to meet the demands Thorsson and his team were not driven by particular technical solutions but searched open-mindedly for ways to refurbish the buildings in a sustainable way as well as ensure an efficient, sustainable and environmentally friendly facility management model with predictable and lower costs.

It just so happened that solar power in combination with batteries plus fuel cells and hydrogen seasonal storage turned out to meet all these criteria and allowed the disconnection of the expensive district heating as well as provide facility power for shared installations such as stairwell lighting, elevators, ventilation and more.

On top of the general architectural and technical improvements following the building renovation, the respective apartment blocks are now equipped with an individual, yet interconnected energy system (microgrid) based on solar power, battery storage and hydrogen fuel cells. All needs for hot water and heating are met by this design driving geothermal heat pumps that feed a conventional central heating system.

In the cold seasons with less or no solar influx, facility power for shared building installations, such as stairwell lighting and elevators as well as heat pumps is generated in fuel cells which run on centrally stored hydrogen. The hydrogen is made by electrolysis with surplus power from the rooftop solar panels during the long Swedish summer days from May to September. Also, auxiliary heat from fuel cell power generation is integrated in the central heating system.

For now, the individual apartments still receive and pay for grid power from a utility company. The solar/hydrogen solution is however prepared for including the apartments' power needs as soon as the system has run long enough to accumulate the necessary operational experience and reliability to integrate a larger and more fluctuating demand from the private households. Yet, as mentioned, the new energy design already provides the heating and hot water for all flats all year round.

Apart from the thorough modernization of the building exteriors, including new roofs, windows and affixing topnotch high-insulating facades, the renovations add a whole extra floor to the buildings with a total of 54 new flats - also the original flats and stairwells have been thoroughly modernized, the latter having elevators added too.

Layouts of a 3-room flat (72 sqm respectively 84 sqm) with kitchen and balcony or without balcony. Other layouts are offered with 1 or 2 rooms with kitchen and with or without balcony.

The visual and technical transformation of the buildings are substantial and uplift the whole complex beyond most contemporary public housing standards even surpassing many newbuilt condones in terms of comfort, energy efficiency, sustainability and environmental footprints.

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