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## Student Thesis

Level: Master's

### Early Design Stage Energy Optimization of Bysjöstrand Ecovillage, Sweden.

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## **Abstract:**

Decisions made at the early stage of building and settlement design can greatly influence the energy performance of the built environment. However, the type of feasible design intervention and their impact strongly depends on project: if it is a new development or a re-development, whether the setting of the project is urban or rural, etc.

Utilizing Bysjöstrand EcoVillage as a case, the aim of this thesis is to improve the energy performance of a new development at its early design stage through the passive and active use of solar energy.

The study evaluated the energy saving potential of various passive solar design strategies as well as the solar energy potential of the new development. The steps taken to reduce the energy consumption are focused on the annual heating demand of buildings, since it accounts for more than a half of the total energy consumed by the village. The energy saving potential of the following passive solar design approaches were considered: building siting, building orientation, windows-to-wall ratio (WWR) analysis and insulation thickness optimization from the economic perspective. Furthermore, an assessment of energy generation potential from on-site photovoltaic (PV) systems was conducted. The financial viability of each building's PV system was also conducted.

According to the results, the evaluated passive solar design strategies can reduce the annual heating energy consumption close to 17 %. Regarding onsite energy generation, electricity from roof-installed PV systems can cover over 100% of the annual energy consumption estimated for the residential lighting and equipment within the eco-village. In summary, this study has demonstrated that with the above design considerations a 50 % reduction of energy consumption from the utility grid is possible. This study is useful for architects, energy engineers, and other parties who are involved in residential buildings energy performance optimization.

**Keywords:** Energy optimization, energy efficiency, passive design, active design, early design stage, neighborhood