There is a need to reduce energy consumption in buildings and in general improve energy efficiency in the building sector in Denmark, as in the rest of the EU. Energy savings, however, should go hand in hand with providing a healthy and comfortable indoor environment. So, the aim of this thesis is to contribute to the development of Danish low-energy residential buildings with good indoor environment. To reach the target of a fossil-free energy supply in Denmark by 2050, both new building design and renovation of existing buildings to meet future energy requirements need to be taken into account.

To encourage the development of appropriate designs for new low-energy buildings and façade renovation of existing buildings, improved knowledge is needed on window design. The research consisted of two parts. First in relation to window design in a typical Danish single-family house constructed in accordance with current and future energy requirements, the influence of window size, type and orientation on space heating demand and thermal indoor environment were investigated in EnergyPlus by comparing a window design with an even distribution (same glazing-to-floor-area in each room) with a traditional window design with large south-oriented windows. The influence of the thermal zone configuration on the prediction of space heating demand and thermal indoor environment, and therefore on the choice of window design, was also investigated. When distinguishing between thermal zones with direct and non-direct solar gains, results showed that the choice of window size and orientation is no longer a big issue from the perspective of heating demand as long as low glazing U-values are used. If an even window distribution is used in combination with an appropriate venting rate and solar control in critical south-oriented rooms, windows can be positioned in the façade of well-insulated residential buildings with considerable architectural freedom. Second, daylight was considered and the relationship between various window parameters (glazing area, orientation, U-value, g-value and light transmittance) and how these affect energy performance, daylight and thermal indoor environment was investigated using DAYSIM and EnergyPlus for rooms with various geometries. With regard to daylight performance, a climate-dependent daylight factor taking into account building location was used and compared with the use of climate-based modelling. Charts illustrating a space of solutions for space heating demand defined by targets for daylight and thermal indoor environment were used to discuss the effect of different window parameters and potential conflicts related to window design were identified in deep or narrow south-oriented side-lit rooms in well-insulated dwellings. Thereafter, recommendations on window solutions were given based on results showing that they can be chosen on a room-by-room basis with the choice of glazing-to-floor ratio based on daylight requirements. To achieve a good thermal indoor environment and minimum space heating demand, for example, a high g-value is recommended in north-oriented rooms, and glazing with solar-control coating can be used as an alternative to dynamically controlled solar shading in south-oriented rooms.