

Requirements for the Design of Sustainable Solar Housing

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The design of concepts for sustainable solar housing is in practice often limited in time and resources for doing sophisticated analysis of the different options and comparing different technologies and strategies. Nevertheless, the market offer some integrated pre-design tools including energy-, environmental- and economic- analysis - easy to use, fast and user-friendly but also accurate.

The first schematic and conceptual design is always the starting point for generating effective concepts for building energy systems. Advanced components, new materials, advanced technologies and innovative architectural design concepts are available today and have opened a quite new area in the energy conscious building design. Together these have the potential of reducing significantly the energy needs of buildings but at the same time maintaining, or even improving the living conditions and occupant comfort. It is important that these innovative approaches are handled properly in the pre-design phases.

In addition to building or architectural components, there exists a range of energy technologies that could be incorporated into a building, e.g. solar thermal and solar electric, heat recovery and heat pumps, advanced biomass boilers, control and different operating strategies, etc. All these measures influence significantly the building energy performance and should be included in the pre-design.

Sustainable Housing have some building requirements, but there exist a wide range for architectural design. Nevertheless, sustainable buildings should be attractive in design and function as well as cost-effective.

The main benefit of *Sustainable Housing* is its potential for saving both fuels and CO₂-emissions.

The **main / overall criteria's for the assessment of "Sustainability"** during the operation period are:

- Total primary energy demand per year and during lifetime
- Total energy-related and environmental relevant CO₂-emissions per year and during lifetime.

The **elements of Sustainable Solar Housing** are: Building insulation, renewable energy technologies and heat recovery; Figure 1.

The use of solar energy in the building sector is a key element to achieve the goals for *sustainable buildings*: An efficient use of solar energy requires both the reduction of building heat demand as well as a solution to overcome the mismatch between the intermittent solar energy resource and the heat requirements.

The ways to reduce energy demand for space heating are measures on the building envelope within energy-saving building constructions including well designed elements and systems for "passive" use of solar irradiation via *solar architecture*; Figure 2. The remaining heat demand

has to be covered by an efficient heating system on the basis of a high contribution of renewable energy sources; Figure 3.

To achieve the goals for Sustainable Housing the following **guidelines for planning and construction** should be considered.

(1) Building environment

Land use, infrastructure, building materials etc.
(“Total Building Quality Assessment”).

(2) Building construction and heating system

- *Passive house standard and heat recovery*
Strong requirements for minimizing heat bridges in the building envelope as well as high-insulated windows. Automatically controlled air conditioning with heat recovery needs an efficient operating of the heat recovery system.
- *Low-energy- and Factor 4-standard in combination **with renewable energy technologies***
Energy-economic design of solar thermal system combined with bioenergy- (e.g. pellets-) boiler or heat pump (e.g. ground coupled).

(3) Household appliances and lighting

Electricity-efficient products.

An **economic assessment of Sustainable Solar Housing** has to compare costs between existing both housing and energy systems employing different primary energy sources such as oil, gas, nuclear energy and new energy systems with renewable sources of energy is basically a trade-off between capital-intensive projects with low fuel prices and projects with relatively small capital investments and high fuel costs. In general, sustainable solar housing are freer from future fluctuations in energy prices but are quite capital-intensive compared with conventional energy systems such as those using fossil fuels. Therefore, capital costs and fuel prices have been the key factors in determining the relative economy of sustainable solar housing. Specific cost estimates can only be carried out when based on concrete examples and it should be clearly born in mind that cost estimates are basically site-specific.

Realized examples in Austria demonstrate, that high-efficient housing – based on life-time assessment – are cost-competitive with present “standard” housing, related to the actual building codes; Figure 4.



Heat Insulation

Solar Energy and Ambient Heat, Bioenergy

Heat Recovery

Fig. 1: Components for sustainable housing

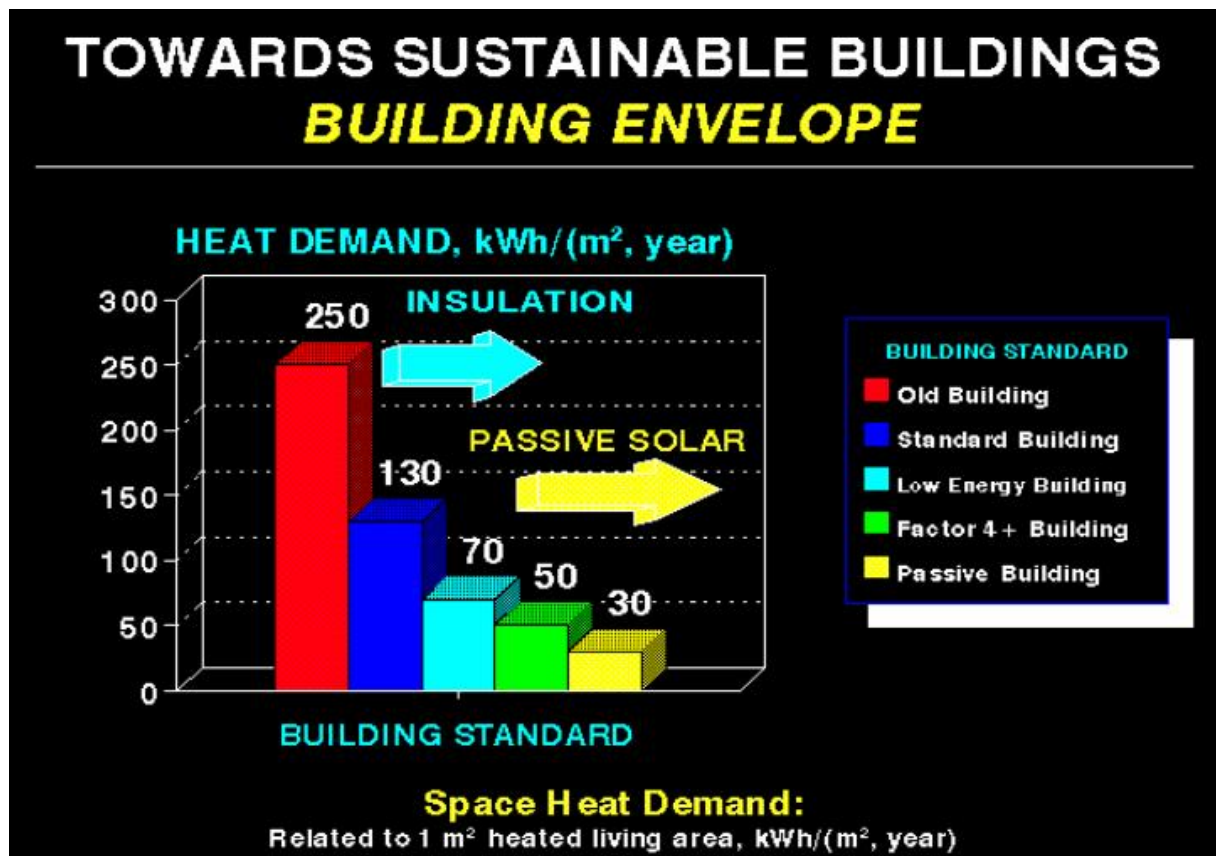


Fig. 2: Ways to reduce space heat demand

TOWARDS SUSTAINABLE BUILDINGS

THE HEATING SYSTEM

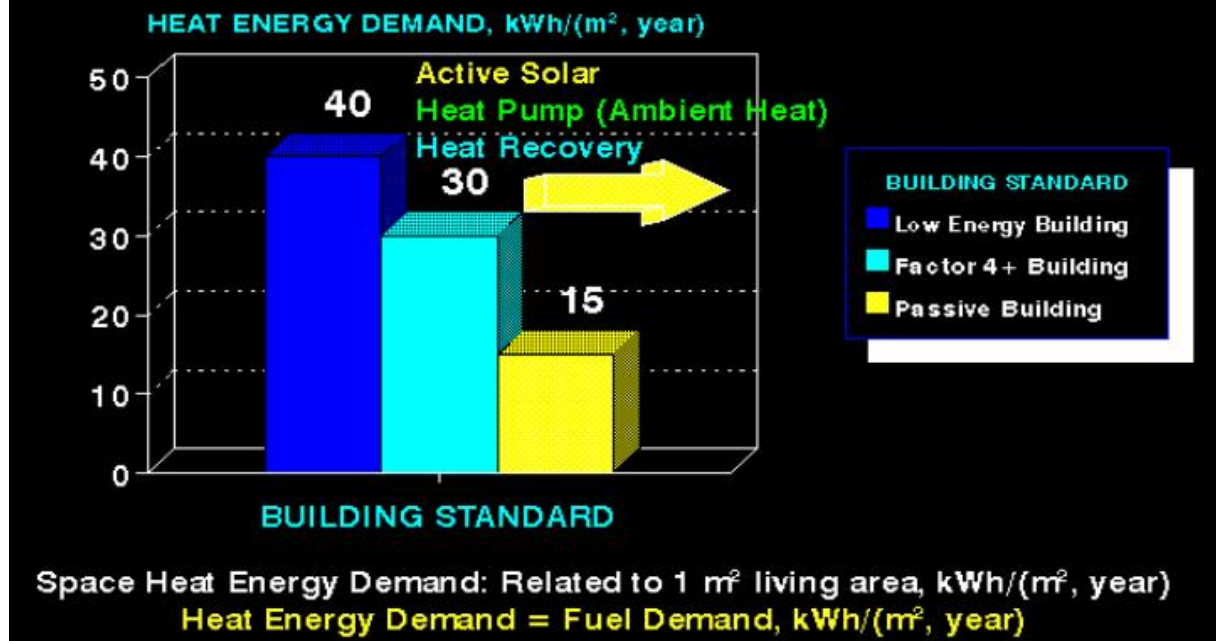


Fig. 3: Ways to reduce fuel demand

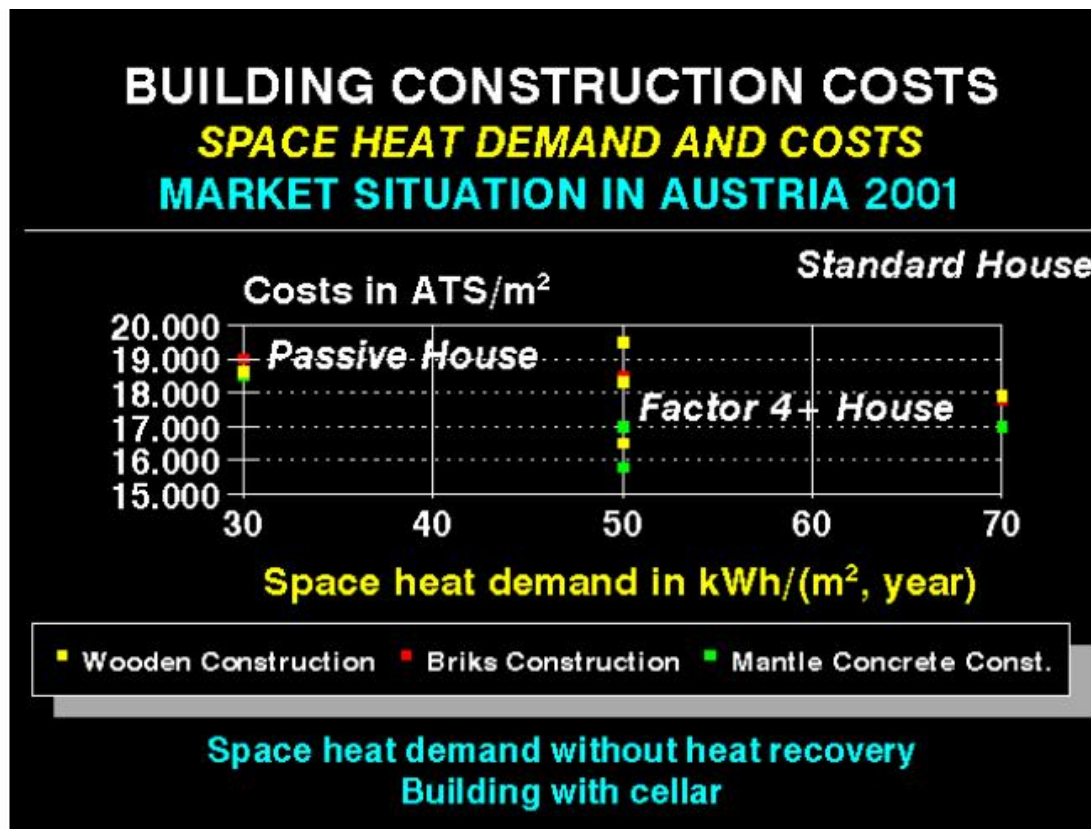


Fig. 4: Building standards and construction costs