SURE-BUILD
POLISH/NORWEGIAN COOPERATION FOR SUSTAINABLE REDEVELOPMENT OF BUILDINGS IN POLAND

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SUMMARY

Much of the existing older building stock in Poland is deteriorated and in need of major redevelopment. Researchers working with sustainability issues in the construction sector in Warsaw, Poland and Trondheim, Norway, have joined forces in a 3-year project for sustainable redevelopment of existing buildings in Poland.

The project, with acronym SURE-BUILD, has as overall aim to develop knowledge, integrated solutions and technologies that will reduce the energy use and environmental impacts of existing buildings. The project is financed with funds from the Norwegian Ministry of Foreign affairs, earmarked for cooperation with the EU candidate countries.

In the first stages of the project, the national state-of-art in the two countries as to potential technologies for this purpose has been analysed. The project group has also studied the Polish buildings stock to find a suitable category of buildings for case studies. The conclusion here was to use Polish schools constructed in the Millenium tradition as case study, and a specific case in Zgierz was found for the next stage of the project.

The potentials for improvements with respect to energy and environment will now be analysed, and hopefully implemented in the chosen school, in cooperation with Polish and

Norwegian industry. The experiences gained in this process will later be generalized and made available for repeated projects through "user packages" for different actors in normal practise, this material will form a Design Guidelines for such projects in the future. The school in Zgierz will serve as a demonstration site for advanced redevelopment which show better energy management, better utilisation of materials, and less generation of waste.

1. Introduction

The construction sector in industrialized countries is often called "the 40% industry", because it typically consumes 40% of the material resources and the energy, and generates 40% of the refuse. Therefore, the construction sector is a major challenge in the development for a more sustainable society, and several international activities to further this goal have already been launched in the framework of United Nations and international organisations in the construction sector. The Global Alliance for Building Sustainability was formed to accelerate the achievement of sustainable development in the land, property, construction and development sectors.

Norway has been active for many years in UN forums introducing formally the sustainability paradigm. Poland is a country of new dynamic challenges with a great potential to follow the world's best practice. Poland has a large stock of buildings that need redevelopment and upgrading in order to meet new requirements for indoor climate and energy use in operation. By introducing the sustainability concept to such activities, Poland will contribute to a better local and global environment in the future. It is important to avoid repeating the mistakes made in other countries that started this type of redevelopment earlier.

In the period 2000 - 2002 two major technological universities in the two countries, Warsaw University of Technology (WUT), and the Norwegian University of Science and Technology (NTNU), exchanged visits and staged top-level discussions about cooperation in the field of sustainable energy developments. The SURE-BUILD project is a major outcome of these contacts.

2. The SURE-BUILD project

In 2002, relevant units at the two universities decided to propose a common R&D effort aimed at redevelopment of the building stock in Poland: SUstainable REdevelopment of BUILDings in Poland, SURE-BUILD. The units involved are the Faculties of Environmental Engineering, Architecture and Electrical Engineering at WUT, at NTNU the Faculty of Architecture and Fine Art, which is also responsible for the overall project management. The Norwegian SINTEF R&D institute is also engaged in the project through the division Architecture and Building Technology in the Department for Construction and Environmental Engineering.

Funding was secured through a programme for cooperation between Norway and the new (2004) EU candidate countries, financed through the Norwegian Ministry of Foreign Affairs. The main objective of this project is to develop new knowledge, integrated solution and technologies that will make it possible to reduce the energy use and environmental impacts of existing buildings in Poland. In particular, this will reduce the country's dependence on fossil fuels, and thereby contribute to sustainable development in Europe.

The main project's goals are:

- Support to scientific co-operation in the areas of specific importance for both countries Norway and Poland.

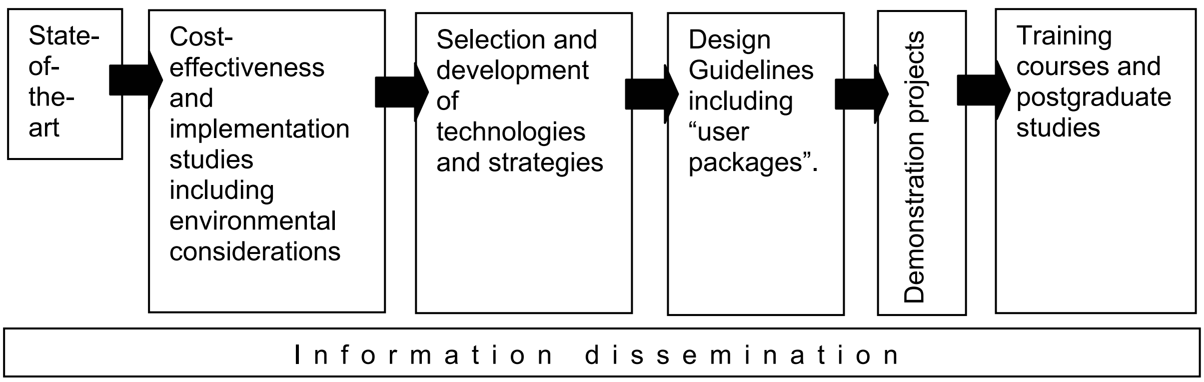
- Promoting the idea of sustainable development in lights of ratification of the Kyoto protocol.
- Recognition of countries' markets for future economical co-operation in the building sector.

Some important sub-goals for the project are:

- Development of a new area of co-operation between Norway and Poland within research and education.
- Development, demonstration and dissemination of concepts for introduction of sustainability into Polish building sector.
- Implementation and demonstration of sustainable energy technologies that have been developed within previous national and EU research projects.
- Proposal of new building integrated energy saving solutions that have the potential to reduce the energy use in existing buildings in Poland by about 50% of existing standard.
- Contribution to the EU goal of at least 18% energy savings and at least 10% reduction of CO_2-emissions by 2010.
- Strengthen education, research, economic growth, and sustainable development of industry and communities in Norway and Poland.
- Better understanding of countries' achievements and barriers towards the implementation of sustainability measures.

3. Project activities and outcomes

The project work is organised in 7 main tasks:



State-of-the-art analysis. A detailed recognition of the state-of-the-art of strategies and technologies for sustainable low-energy buildings in Norway and Poland, and world-wide.
Analysis of cost-effectiveness and implementation opportunities. This involves estimating the potential cost-effectiveness of different strategies and technologies, including an assessment of the environmental impacts.
Selection and development of strategies and technologies. Based on the previous research tasks, the most promising strategies and technologies for sustainable low-energy building in Poland will be selected and further developed to fit Polish conditions.
Definition of "user packages". The outcome of the previous tasks will be documented and operationalised in a Design Guideline aimed at practitioners.

Demonstration projects. The technologies and strategies that have been developed will be implemented and tested in an actual building project in Poland.
Training courses. The material and software developed in the project will be used in training courses and curricula of postgraduate studies for professionals.
Information dissemination. The results of the project will be actively disseminated through training courses and university education, through demonstration projects, and through articles and papers in magazines, journals and conferences both nationally and internationally.

4. Sustainability issues in the energy and construction sector

In both of the two participating countries there are many important sustainability issues in the construction sector that has to be addressed within the project scope. The state-of-art analysis has demonstrated that Poland has a large stock of buildings erected after the Second World War that is suffering from a long neglect of maintenance. Many buildings are also built with materials and construction methods that later proved to be of a quality insufficient to cope with the tear and wear of time. This is true first of all of publicly owned and operated buildings.

The thermal standard is also often inferior, considering the relatively severe heating requirements during winter. Energy prices has increased rapidly after introduction of market economy, this makes it important to improve the insulation standard of existing buildings [1,2]. The indoor air quality is also often low [3]. Another important energy related issue is that both thermal energy and electricity is often generated with brown or hard coal as fuel.

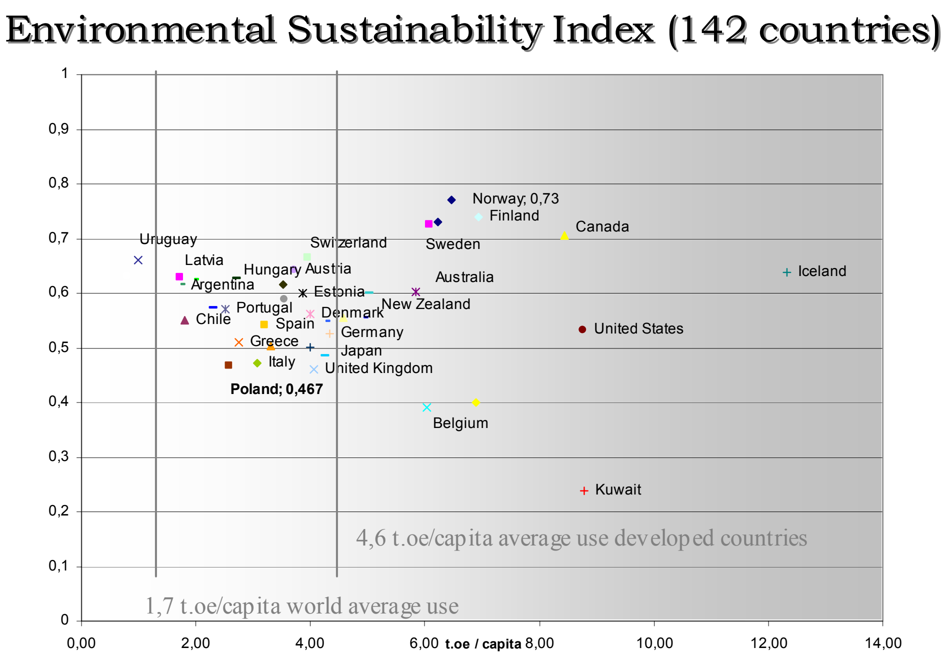


Fig. 1. The Environmental Sustainable Index (ESI) vs. energy use in toe. per capita for some industrialized countries [4].

Norway scores very high on UN-developed indexes of human development and sustainability. In general, the buildings have a better thermal standard than buildings in Poland, but then again the winters are longer and more severe. High on the energy agenda in Norway is the very high dependency on direct electric heating in buildings, mainly in housing. This is a result of many years of inexpensive electricity supply through large-scale hydropower developments. In the new deregulated market, the electricity prices are now escalating because there is no more hydropower capacity available for development. For Norway then, it is now very important to reduce the electricity demand in the construction sector, and switch to thermal energy when possible [5].

5. The state-of-art analysis

Furthermore, the state-of-art report [5] discusses other sustainability issues, and describes many national assessment systems for buildings. The E-Audit is used in Poland, the Eco-Profile is used in Norway.

The Polish building stock is also reviewed, and the developments in the housing sector since the Second World War is described in detail. Both countries have several completed and on-going R&D programmes that will be a source of useful information for the SURE-BUILD project, many of these are international, within the framework of the International Energy Society and the R&D programmes of the European Union.

The report also gives a menu of redevelopment technologies that are relevant for application to the SURE-BUILD demonstration building. These technologies cover heating, cooling, ventilation, electric lighting and daylighting, and included is also a some important advice on effective design processes.

6. The SURE-BUILD demonstration building

It was clear from the project planning phase onward that the best way to disseminate results from the project is to implement practical measures to case study buildings. Therefore, much effort has been centred on how to choose a suitable demonstration building. The first issue was type or category of building. Here are listed some of the parameters on the table when this issue was discussed by the project group:

Technological opportunities. The R&D results expected from the project will cover a wide range of technical opportunities for reducing the energy use in a sustainable manner, while at the same time improving the indoor conditions. This implies that the case buildings should encompass all types of energy using equipment and energy systems normally found in buildings.

Energy saving potential. The case buildings should in existing conventional state have high energy consumption, giving a large potential for improvement through new technologies. The number of buildings, and the number of square meters there, should in Poland be substantial within the category of buildings chosen to be case buildings.

National and local policy. It would be easier to find follow-up funding for improvement of the whole stock of case buildings in Poland, if national and local/regional policies for such improvement are already in place. Since the project will also exploit experiences with similar efforts in Norway, the project should also look for parallel policies there. The same tactics apply for official policies within the European Union.

Ownership and public impact. In order to make an immediate impact on a large stock of buildings and square meters, it is important to look for a class of buildings where there are few and easily identified owners. This could mean publicly owned buildings, or a category of buildings where there are large corporations involved in construction and/or facility management.

Existing R&D work and development programmes. The project would benefit from existing knowledge and experience if the class of case building chosen has already be subjected to R&D work and development programs in both countries

Architectural and functional considerations. The choice of project case building should also pose an architectural challenge: if the redevelopment measures could also include architectural and functional improvements, the public interest in the efforts may be raised, which again would give the project results a larger arena for demonstration.

Costs. It is important to find a class of buildings were major improvements can be introduced in a cost-effective manner.

After carefully considering all the criteria listed above for choice of building category for the project case buildings, the project group concluded that **school buildings** would be an interesting class of buildings. They offer many technological opportunities (some have also swimming pools), they have a large energy saving potential, and are normally owned and operated by local communities. Schools have also been subject to several international R&D programmes.

In Poland, a special opportunity for using school buildings as case study category is available: in conjunction with the celebration of the country's millennium, a large number of new of school buildings (around 1000) were constructed in the 1960s. These building are technically quite similar, even though they may differ in layout according to the local site. This means that new energy saving technologies developed within the project can be applied to a large number of case buildings, giving the project a potential for substantial impact on the energy use in Polish buildings.

The school demonstration building

After this conclusion was reached, the project group embarked on a search for a real case millennium school that gives optimal opportunities for the implementation of the project results. This search ended up with Primary School No.1 in Zgierz, shown in photos below.

The school state-of-art analysis completed in the project [6] included an analysis of feasibility of implementing all the technological opportunities given in the first state-of-art report. For each class of energy efficiency measure, it was performed a SWOT analysis: Strengths, Weaknesses, Opportunities, and Threats. An example is given below.

After completion of the analysis phase, the project will embark on implementation. It is hoped that both Polish and Norwegian construction industry will seize the opportunity to participate in the sustainable redevelopment of the Zgierz school.

Table 1. SWOT analysis of technologies for effective space cooling.

	Potential technology for sustainable modernisation of Polish schools	SWOT analysis			
		Strengths	Weaknesses	Opportunities	Threats
1.	Shading systems	Simple, effective, low cost. Do not use energy for operation.	Some outside shading solutions strongly affects architecture of building.	Reduction of direct solar gains.	Certain solutions may not fulfil requirements on minimum insolation time.
2.	Switchable glazing	Easy adjustment to the conditions.	High cost.	Promotion of new technology at Polish market.	Long term stability not proved.
3.	Cooling by ventilation using thermal mass	System environmentally friendly that does not use potentially harmful refrigerants.	Technology relevant rather for new buildings. Important thermal effects require intensive ventilation during night.	Promotion of new technology at Polish market.	May create problems at the beginning of the teaching day due to too low mean radiant temperature.
4.	Ground-air heat exchangers	Low cost, very low cost of energy.	Requires central ventilation system (mechanical or hybrid), schools are closed during hottest season. requires accessable ground, low temperature difference.	Promotion of renewable sources of energy.	May be impossible in urban situations.
5.	Heat pumps used for cooling	Energy efficient, low exploitation costs.	High investment cost, schools are not used in periods when coolings loads are maximum Needs for specific local conditions (water wells and dumps).	Promotion of renewable sources of energy.	May not be economically feasible. Still recognised as new technology.

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