

# Energy Technology Development and Demonstration Programme.

## Application Form 2008

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Please see the separate instructions.

<b>1. Project title</b> Design of energy renovation of typical buildings – elaboration of collection of examples
<b>2. Technology area</b> (see instructions): Efficient energy use in buildings
<b>3. Project type</b> (see instructions): Development, demonstration and dissemination
<b>4. Short description of the project's objectives:</b> The energy saving potential by energy renovating the existing building stock in Denmark is very large but the implementation of energy savings is only carried out to a small extend. In order to encourage the completion of energy renovations in buildings there is a need for improving the foundation for evaluation and selection of the optimised solutions. The objective of the project is to develop a method for design of extensive energy renovations that will encourage the completion of energy savings in existing buildings to reach "low energy class 1" level. The development of the method will be based on detailed analysis on the effect of the partial energy saving measures carried out in buildings. The analyses will be made for typical building types and the results will make up an example collection of buildings that represent the total building stock in Denmark. The developed method including examples will constitute a strong and reliable foundation for implementation of the best energy saving solutions in different building types. If done correctly it will also be possible to improve the indoor environment by energy renovations. This important additional benefit will also be evaluated in the form of improved comfort, less health risk and increased productivity.

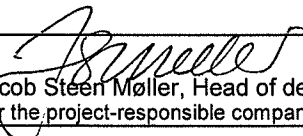
<b>5. Applicants</b>			
Project managing company/institution: Technical University of Denmark, Department of Civil Engineering (DTU Byg)			
Address: Brovej, Building 118, 2800 Kgs. Lyngby			
SE/CVR-nr.: 30 06 09 46	Telephone: 45 25 17 00	Fax: 45 88 32 82	E-mail:
Professional project manager: Svend Svendsen	Telephone: 45 25 18 54	E-mail: ss@byg.dtu.dk	
Other project participants (Name, company/institution):		Domiciled in DK - yes/no	
2. Bjarne Olesen, DTU Byg, International Centre for Indoor Environment and Energy (ICIEE)		yes	
3. Per Heiselberg, AAU - Aalborg University		yes	
4. Søren Aggerholm, SBI-AAU - Danish Building Research Institute, Aalborg University		yes	
5. Søren Østergaard Jensen, TI - Danish Technological Institute		yes	
6. Various consultants		yes	
7.			
8.			
9.			
10.			

### 6. Is this application being processed by other programmes?

No

7. Date 2008-04-11

Signature

  
Jacob Steen Møller, Head of department  
(for the project-responsible company - remember the name stamp)

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### 8. Project description

An elaborated project description may be attached as an annex. (Please note the description in the instructions)

**Background:** The energy saving potential by energy renovation of existing buildings in Denmark is very large since 40 % of the total energy consumption is used in buildings and most of the building stock is in poor condition regarding energy performance. Implementation of the potential energy renovation throughout the building stock in Denmark will to a great extent contribute to reach the goals for energy supply security and CO<sub>2</sub>-reductions. However, for different reasons, only a few of the potential energy saving solutions are accomplished. One of the barriers for conducting energy saving retrofit measures might be lack of knowledge on how the renovations should be handled the right way and which specific measures that will give the largest savings in the actual building. Therefore there are need for guidelines describing the best energy renovation measures for different types of buildings.

There are large differences on how different building types can be energy renovated to obtain the highest energy savings. It depends on the energy performance conditions of the building. Type, age and application of the building have influence on which energy renovation measures that are the most efficient and cost effective. In order to obtain the best energy renovation solutions for specific buildings there is a need for analyzing different energy-efficiency measures in retrofits for typical building types. The effort for implementation of energy savings in retrofitting must be systematized in order to exploit knowledge from different projects and share the good experiences among architects, consultants and building clients etc.

To convince a building owner to invest in an energy renovation it is important also to show the benefits regarding improved indoor environment (comfort-health-productivity) that will be obtained.

**Objective:** The objective of the project is to establish a method for design of extensive energy renovation of buildings to low energy class 1 based on an example collection of energy renovation of typical building types. The development of the method and the examples will be based on detailed analyses of the effect of different energy saving measures on a component level when implemented in typical building types. The work shall include the development of standardised guidance/directions on how to document and report the results and gained experiences in other research or demonstration projects so that future knowledge on the topic will be collected in a useful way. The results from the analysis will form a collection of examples of the best energy renovation solutions accomplished in building scenarios that represent the total building stock in Denmark. The developed method including examples will constitute a strong and reliable foundation for implementation of the best energy saving solutions in different building types. The developed standard documentation system and the example collection must be accessible from the internet so that operators in the building renovation market can upload their results and experiences and take advantage of the knowledge already existing.

**Project plan:** The project encompasses 3 parallel activities:

1. Thorough analyses of the many possible energy saving retrofit measures on component level including energy saving potentials for upgrading to energy improved components and price calculation of the additional costs of construction and operating costs compared to conventional renovation. The analyses will focus on retrofitting measures regarding walls, roofs, slab on ground, foundation, air tightness of building envelope, windows, solar shadings, heating and cooling systems, ventilation, lighting, solar energy, building maintenance service and operation.
2. Analyses of the different energy renovation measures used on whole buildings – carried out on typical buildings. This activity include: 1) Selection of the buildings to be analyzed, i.e. the most typical buildings in Denmark based on age, application and types, 2) Calculations of the energy saving potentials for implementation of complete extensive energy improvements to the level of "low energy class 1", 3) Calculation of the costs of construction etc. involved. 4) Evaluate and quantify the potential indoor climate effect (comfort-health and productivity) of the energy renovation. This evaluation will include an estimation of potential cost savings due to better health (less sick leaves etc), better learning effect (educational facilities) and increased productivity
3. Development of a standard documentation system containing all necessary information concerning energy renovations. This system and the example collection of state-of-the art energy renovation solutions for typical buildings will be part of the homepage for the LavEByg network – Innovation network for integrated low energy solutions in buildings (see [www.lavebyg.dk](http://www.lavebyg.dk)).

### Expected results:

The results from the project will form the basis of an example collection of energy renovation solutions for building categories representing the whole building stock in Denmark. The method for design and documentation of energy renovations is supposed to be used in future related projects within the LavEByg network. In this way the results and experiences from related project concerning renovation will be registered and added to the collection which will benefit other energy renovation projects.

The project will most likely document that comprehensive energy renovations in most cases are cost effective although the initial costs of the constructions seems high compared to the energy savings. By including the lifetime of the application, the indoor environmental improvements and the fact that only the extra cost for implementing energy savings should be taken into account in connection with need of renovation, an extensive energy renovation is often economical lucrative.

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**9. Information about the energy-related criteria of evaluation (call for proposals §4.1).** Possibly in the form of a reference to an annex.

### **9.1 Impact on the environment and supply security** (quantified to the extent possible)

The analyses and the development of a relevant collection of examples will stimulate to low energy renovation of the existing building stock as they visualize the optimal solutions and support consultants in the development and design of the best solutions.

There are until now Danish examples of energy renovations that have reduced the energy demand with approximately a factor 4. In Germany, there are many examples of energy renovations of multi-family buildings that have reduced the energy consumption for heating with a factor 10 or from about 250 to 25 kWh/m<sup>2</sup> (<http://www.dbu.de/643publikation489.html>).

Showing examples of low energy class 1 renovations corresponding to almost factor 10 renovations will encourage to energy renovation to that level and therefore major energy savings which will have a great impact on the environment and supply security.

### **9.2 The project's relevance to technology-specific research strategies**

The project is in good correlation with a draft strategy for low energy renovation of existing buildings developed in the LavEByg innovation network, which will be developed further in 2008-09. The project is also relevant to the Danish Energy Agency's strategy for energy efficient technologies 2005 – 2015 where energy savings in buildings is one of the focus areas. The strategy points out a focus on the possibilities for improving the energy efficiency of existing buildings, which is the focus area of the present project. The outcome of the project also contributes to reach the goals in the new energy agreement (of 21. February 2008) settled by a majority of the parties in the Danish parliament. The project results will also contribute to the work with a strategy for reduction of energy consumption in existing buildings that has to be carried out in the near future according to the agreement.

### **9.3 The project's professional quality and relevance, including possible inclusion in the overall energy system** (preferably international perspective)

An improvement of the energy efficiency in buildings is a necessary tool to fight climate change and will even apply beyond the Danish borders. The project has the potential to make a great contribution to the fulfilment of Danish Kyoto and Bali goals, and also EU goals regarding CO<sub>2</sub> emissions and energy savings. Figures are well known, several nations have initiated national programs in the field of energy efficiency in buildings (and especially existing buildings), but there is a need to speed up the process. The project contributes to solve technical difficulty to apply existing technologies for affordable building energy renovation and is therefore very relevant.

### **9.4 Professional environment and cooperation with research institutions and companies, etc.**

The project is initiated by the LavEByg innovation network and will be carried out by the knowledge institutions within the network, which are also the key actors. DTU Byg and the other partners are the leading knowledge institutions in Denmark in the field of low energy solutions in buildings. The project will be carried out in dialogue with the companies, associations, authorities and others that are members of LavEByg.

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### 9.5 How could the results be exploited?

The results from the project will be exploited by consultants working with planning and design of energy renovations in specific buildings. The collection of example of energy renovation solutions for different buildings will make it easier for consultants to distinguish between different energy saving measures and make it easier to obtain an optimal solution.

The developed standardized way to report project results will facilitate a more accurate and useful documentation of also the results and experiences of other energy renovation retrofit projects. By collecting data in a complete database that will be located on LavEByg homepage the knowledge about energy renovation will be accessible for everyone in the building renovation industry, which will benefit other energy renovation projects.

### 9.6 Is researcher education part of the project?

No

### 9.7 Publication plans

The energy renovation guidelines and the database containing all the energy renovation examples will be available free of charge from the LavEByg homepage. The results will also be published in articles and in conference papers etc. The results of the project are highly relevant to integrate in the education of students at DTU and AAU that specializes in building energy.

### 9.8 Incentive effects

Not relevant

### 9.9 The results' significance to other important social conditions

The results from the project will have a positive effect on employment and economy in the building industry. Energy renovated buildings will typically have an improved indoor climate, which will result in a reduction in days lost through sickness and more efficient employees. The International Centre for Indoor Environment and Energy (ICIEE) at DTU Byg has calculated that society thereby can save a two-figured amount in billions per year.

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**Information about the commercial criteria of evaluation (call for proposals §4.2).** Possibly in the form of a reference to an annex.

### 10.1 The project's organisation Management's competence

The project is organized by a technical project leader with management qualifications and formal powers to make the necessary decisions, and also a steering group consisting of the project participants. They have agreed upon distribution of the responsibility for project activities when funding for the project is obtained.

The project leader is professor Svend Svendsen of DTU Byg who is also the manager of the LavEByg-network. He has almost 15 years of experience with energy efficient buildings based on development and optimization of high performance building envelopes, windows and technical building services. He is an initiator and project leader of numerous research projects in close cooperation with the building industry.

### 10.2 Draft financial agreement

The "other project participants" serve as consultants in the project. The financing of their activities is visible in the budget for the project managing institution (DTU Byg) under item 6: "External services" (budget of DKK 200,000,- for each – AAU, SBI, TI and various consultants). Due to the project managing responsibilities of DTU Byg the budget is larger. ICIEE is part of DTU Byg.

### 10.3 Draft agreement on assignment of rights

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### 10.4 Business plan (The call for proposals § 4.3, items 4-9 list questions that must be included in the description)

To describe how this project fits in a business plan is not relevant. The aim of the project is to develop a method for design of energy renovation of typical buildings and to make an example collection of state-of-the-art energy renovation available for LavEByg members and others. The participants in the project will obtain valuable experience in the field of energy renovation of buildings. This gained experience can be exploited by the participants, companies producing energy saving products, consultants in design and operation, and contractors in their future activities in the field of energy renovation of existing buildings.

**11. Information about the research criteria of evaluation (call for proposals §4.3).** CVs should be attached to the extent they are relevant.

-

### 12. Connection to current or concluded projects

Project title:

Energirigtig renovering af større bygninger – udvikling og demonstration med hovedvægt på installationer og energiforsyning

Renovering 2010 – Initiativ til udvikling af bygningsrenovering i Danmark

Reference (jr. no.):

EFP06 – 033001/33032-0209

[www.renovering2010.dk](http://www.renovering2010.dk) – fonden Realdania og Grundejernes investeringsfond

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13. Starting date: 2008-08-01  Finishing date: 2009-08-01	<b>Timetable</b>											
	Year 1				Year 2				Year 3			
Activity:												
1. Analyses of measures - component level	x	x	x	x								
2. Analyses of measures – whole typical buildings	x	x	x	x								
3. Documentation system/example collection	x	x	x	x								

**14. Please list annexes to the application here:**

1. Budget

(13 February 2008)



Project expenses for participating company 1 (project managing company)			
Project title			
Company/Institution	Design of energy renovation of typical buildings – elaboration of collection of examples		
DTU Byg	To be filled in		
SE/CVR no	30.05.09.48		
Journal no.	063001/	630xx-	Oxxx

15. Total participant expenses	Funding	Project participant	Other financing	Total	Total	Total year 1	Total year 2	Total year 3	Must be zero Check kr
	(1000 kr)	(1000 kr)	(1000 kr)	(1000 kr)	Hours	(1000 kr)	(1000 kr)	(1000 kr)	
1. Research salaries	445			445	1.251	445			0
2. Tech/admin pay contributions				0					0
Total salaries (1-2)	445	0	0	445	1.251	445	0	0	0
3. Equipment over 40 000 kr.	0	0	0	0					0
4. Materials		0		0					0
5. Travel				0					0
6. External services	800			800		800			0
7. Reporting/communication				0					0
8. Plants	0	0	0	0					0
9. Other (specify)				0					0
Total other expenses (3-9)	800	0	0	800		800	0	0	0
10. Overhead (35%)	156			156		156			0
Total expenses (1-10)	1.401	0	0	1.401		1.401	0	0	0

#### 16. Key figures

Researchers hour kr.	0,35571543
TAP hour kr.	#DIV/0!
Other expenses %	57,11%
Overhead	12,51%
Funding as % of total budget	100,00%
No. of employees in company	182
Annual turnover (mio. DKK)	
Assets (mio. DKK)	

#### Comments on the budget (incl. re: other financing)

The "other project participants" serve as consultants in the project. The financing of their activities is visible in the budget for the project managing institution (DTU Byg) under item 6: "External services" (budget of DKK 200,000,- including overhead for each – AAU, SBI, TI and various other consultants). Overhead (item 10) is only related to DTU Byg (ICIEE is part of DTU Byg).