EUROPROSPER: DEVELOPING METHODS FOR THE ENERGY CERTIFICATION OF EXISTING BUILDINGS

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ABSTRACT

This paper outlines the EUROPROSPER project whose objectives are to: 1) Consolidate and where appropriate harmonise methodologies for energy certification of existing office buildings across six European countries, whilst allowing customisation in each country to accommodate existing techniques and national contexts, 2) Develop training courses to instruct practitioners on how to use the certification methods, to include self-certification procedures, 3) Conduct a demonstration phase and 4) Define the role and activities of a national centre in each country which would manage a building energy certification programme, to include issuing certificates, maintenance of benchmarks and accreditation of assessors. The project will pave the way for permanent facilities to be established in the participating countries, with the potential to oversee the implementation of the certification aspects of the EU Directive on the Energy Performance of Buildings. It will also prepare the ground for the extension of the methods and training procedures into the other nine EU countries. Further information on the project can be found at www.europrosper.org.

KEYWORDS

Building, energy, certificate, label, audit, benchmark

METHOD OF APPROACH

The concept of benchmarking the energy use in existing office buildings as a tool for saving energy has been promoted on a voluntary basis for many years in some EU countries (and, for example, in the US[1] and Australia[2]), but nevertheless is not widely applied. The EU Directive on the Energy Performance of Buildings, European Commission (2002), will make energy certification mandatory for most buildings in the EU when they are constructed, sold or rented out; and at regular intervals throughout their lives. Good practice methods of benchmarking energy use in office buildings have benefits beyond saving energy, money and CO_2 emissions - if achieving better energy efficiency also becomes a badge of good design and management these can go together with an improved internal environment for occupants, which in turn leads to healthier and more productive working conditions and greater occupant satisfaction. All these benefits, in addition, increase the asset value of the building. The aim of Europrosper is to deliver an energy certification procedure which generates all these benefits.

The project has five main tasks:

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[1] Energy Star Label (www.energystar.gov/benchmark)

[2] Australian Building Greenhouse Rating Scheme (www.abgr.com.au)

- **State of the art review:** The project is starting with a review of the state of the art for benchmarking energy use in office buildings in each of the six countries involved[3], plus an examination of building energy benchmarking schemes that are available on the Web.
- **Develop building energy certification methods:** The second main activity will develop a common rationale for office building energy certification, which will also aim to be compatible with any existing certification methods in each country. The process will start with a workshop in each country to present the state of the art to an Industry Steering Group and receive feedback on the property industry's perspective on energy certification and guidance on prospective methods. Methods will then be developed in each country, including manuals for data collection to produce more prescribed, mechanistic procedures to improve quality assurance. The final step in this task will be a demonstration of the methods in each country using trained assessors (see next paragraph).
- **Develop training courses:** Training material will be developed comprising the following elements: state-of-the-art distance learning material; Web-based tools to ensure both accessibility for users and ease of maintenance by the software support team; a one day face to face course incorporating hands-on training for site survey techniques, and an examination which trainees will have to pass to gain accreditation.
- **Extend to other sectors:** The work needed to extend the methods to other non-residential building types will be reviewed and the steps required to apply the process in the other nine EU countries and eventually CEE countries will be examined.
- **Dissemination and terms of reference for energy certification administration centres:** The final task of the project involves defining the scope and activities of an energy certification administration centre in the six European countries: writing draft terms of reference and preparing a business plan to demonstrate their financial viability.

Target Group and Key Actors

Europrosper will involve the key target groups for building energy certification in advisory roles. The prime target group is the property industry, which will provide appropriate individuals or organisations for Industry Steering Groups (ISGs) in each country.

The development of certification methods will be guided by the ISG in each country to ensure the property industry's perspective is taken into account. It is proposed that each Group will meet formally at two national workshops. The first will be presented with the state of the art review, the project background and the proposals in the EU Directive. The delegates will then be asked their views. The second, in the middle of the project, will allow each Group to verify that their views have been represented in drafts of proposed schemes and enable them to make further comments that can be fed into the final scheme design.

In addition to these two formal meetings, there will be informal contact with a core team of the ISG who will provide an interchange of views through comments by email on draft working papers, etc. It is also envisaged that the members of the ISGs will volunteer buildings for case studies in the demonstration phase of the project.

[3] UK (Energy for Sustainable Development), Denmark (Esbensen), Greece (IASA, University of Athens), Ireland (University College Dublin), Netherlands (DHV) and Sweden (Enerma). Belgium (BBRI) are also participating in a liaison role with the ENPER-TEBUC project.

Project Deliverables

The main deliverables will be a combination of quality assured good practice and harmonised building energy certification procedures, together with training packages that will enable the know-how embodied in the procedures to be disseminated effectively and incorporate arrangements to produce accredited users of the methods.

The proposed standardisation and harmonisation of methods across six European countries will ensure that data collected from buildings is internally consistent within each participating country and with some comparability between countries. Quality assurance procedures will help to improve the consistency and reliability of the data collected. Taken together, these factors create the foundations for national and European databases of building performance that will prove invaluable for developing credible benchmarks and undertaking meaningful analysis of key building sectors.

The project will finish by defining the terms of reference for a national administration centre in each participating country with the capacity to oversee the implementation of the certification aspects of the EU Directive on the Energy Performance of Buildings.

Potential Impacts of the Project

The EU's Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change, European Commission (2001), shows that the potential to reduce greenhouse gas emissions, and the costs of doing so, are not the same for all sectors. Under a least-cost approach, some sectors would need to reduce their emissions more than others, and the EU's total compliance costs could be as low as €3.7b or 0.06% of the EU GDP in 2010.

The EU would reach the Kyoto target if it implemented all greenhouse gas reduction measures that cost less than 20 €/tonne of CO_2 equivalent. The sectoral reduction objectives of all greenhouse gas emissions in 2010 are shown in Table 1. It can be seen that the Services sector which comprises mainly offices, retail premises, hotels, warehouses and leisure facilities produces some 176 Mt CO_2 equivalent and is targeted for savings of 30 Mt off a business as usual baseline figure for 2010 of 200 Mt. This represents 8% of all the targeted reductions and a percentage reduction for the sector of 15%, the second largest of any sector.

Table 1
Breakdown of EU CO_2 emissions by sector

Millions of tonnes of CO_2 equivalent (with marginal cost €20/tCO_2 eq)	Emissions in 1990 (1995 for fluorinated gases) (Mt CO_2 eq)	Baseline (or business-as- usual) emissions for 2010 (Mt CO_2 eq)	Cost-effective objective for 2010 (Mt CO_2 eq)	Change in emissions vs. 2010 baseline (Mt CO_2 eq)	% change
Energy generation	1190	1206	1054	-152	-13%
Transport	753	984	946	-39	-4%
Industry	894	759	665	-94	-12%
Households	447	445	420	-25	-6%
Agriculture	417	398	382	-16	-4%
Services	176	200	170	-30	-15%
Waste	166	137	119	-18	-13%
Fossil fuel extraction	95	61	51	-10	-16%
All sectors	4138	4190	3807	-383	-9%

The services sector represents the main ultimate market for the deliverables of Europrosper and in the UK accounts for some 16% of total emissions, Bordass (2001), including associated emissions from power stations. The offices sector creates some 25% of the UK services sector's CO_2 emissions, Scrase (2000); in addition, a significant amount of the space in buildings in many other sectors is dedicated to offices. If the UK figures are assumed to apply across the EU, the offices sector contributes some 168 Mt of CO_2 equivalent to the 2010 baseline figure of 4,190 Mt for the EU. The savings potential that could be realised by implementing the energy saving actions that would be identified by an energy certification programme is around 20%. This equates to 34 Mt CO_2 in the offices sector and to some 134 Mt CO_2 if the methods are applied to all building types in the services sector across the EU.

STATE OF THE ART REVIEW

The major purpose of the review is to prepare the ground for the development of energy Certification schemes in each country and to facilitate harmonisation of methods where appropriate. Although Europrosper is clearly focused on energy performance, the state-of-art review will include brief notes on any existing schemes for benchmarking the *environmental* performance of office buildings in each country. It will also consider benchmarking approaches for other building types which may be relevant to offices (in the UK, for example, a new approach to benchmarking sports centres has many interesting attributes).

The review will inform a debate on three core issues for the Certification concept:

1. ***Are we Certifying a building or how it is used?*** The Certification of new and unoccupied buildings may require theoretical calculations, with estimated levels of usage, equipment and management. However, once a building is in use, we presume that Certification will need to take account of its actual levels of fuel consumption. This in turn depends on three main things:
   - the inherent nature of the building and its building services, as-built
   - the way in which it is equipped and used by its occupants
   - how it is operated, managed (or mismanaged), and maintained.

   The review will consider how to account for these different aspects; and how Certification should take account of unusual features (e.g. lift energy in tall buildings) and of "process" energy in end-uses such as computer centres and catering kitchens. For-example, energy sub-metering may become necessary – as is now beginning to be required in UK building regulations, DTLR (2002).

2. ***Is an energy audit necessary?*** The Directive's requirement for a Certificate to "be accompanied by recommendations for the improvement of the energy performance" suggests that some kind of energy audit may need to be undertaken (rather than just taking energy consumption data). However, the scale of the Certification task (the number of buildings to be certified by 2008/9), the cost burden on building owners and the availability of trained assessors may limit the detail of the energy audit. The audit may also need to be at a level consistent with self-certification. Finding the best balance between these conflicting factors will be a key challenge for the project.

3. ***Occupant comfort.*** The third central issue is whether and if so how the Certification process can take into account occupant comfort (thermal and visual), internal air quality and the consequent impacts on productivity. The Directive states explicitly that "minimum energy performance standards should avoid negative effects on indoor climate conditions"

(Article 4) and also calls for indoor temperatures and other relevant climatic factors to be clearly displayed in public buildings (Article 6).

PROPOSED PRINCIPLES OF BUILDING ENERGY CERTIFICATION

The preliminary view of the UK team is that a certification scheme should separate:

- *The framework* - which allows building energy performance and all influencing factors such as standards, climate, and hours of use to be consistently and transparently reported at all stages in a building's life cycle, including briefing, design and specification.
- *Calculation methods* - which allow data to be inserted in the framework. Appropriate methods will vary through the life cycle from early stage predictions, through predictions based on inspection of a completed but empty building, to analysis of an occupied building's actual performance.
- *Reporting* - a way of succinctly presenting in a clear and unambiguous manner a building's energy consumption, together with relevant elements and influencing factors. Reporting will need to deal with both **predictions** based on design and specification of the building and **outcomes**, actual energy performance in use.
- *Assessment* - which will evaluate the **reported** consumption in relation to standards and benchmarks appropriate for the building concerned, ending up with a **grading** of energy efficiency, for example perhaps good/fair/poor, pass/fail, or A to G - as in the European domestic appliance labelling scheme. Separate assessment may be required of building, occupancy and management-related issues.

The framework should contain sufficient underlying richness to recognise the intricacies of real buildings while at the same time being able to produce meaningful headline indicators. Where possible, we need to understand and improve achieved performance and not just theoretical potential ... and to learn from the comparison. Of course, for new and empty buildings initially only the theoretical values will be available.

Reporting should provide bare unvarnished facts without corrections or adjustments; assessment can apply the weightings appropriate to the context. We would expect **reported** information to

1. be split by individual fuel;
2. also be expressed in the form of indices, probably divided by floor area;
3. be accompanied by other relevant information where available, for example U-values, plant efficiencies, commissioning records, air leakage test results and so on;
4. where possible include contextual data such as internal environmental standards, hours of use, equipment levels, etc;

The certification procedures will also need to take into account certain complexities of the property sector:

- Commercial buildings are often rented and frequently multi-tenanted. The energy consumption is often split between items for which the landlord is responsible (and go into the service charge) and those which the tenant pays (and often manages) directly. These may well need to be separately assessed.
- Commercial buildings in particular have a major element of change. Often the use of the building is not known at the time of design - e.g. for speculative offices and mixed use buildings. Even if it is, today's occupier requirements can change very rapidly. Any scheme should not only be able to track these changes and their consequences, but to provide drivers towards change for the better.

CONCLUSIONS

The overall energy performance of a building is the outcome of two main things:
The asset - the basic design, construction and servicing of the building and its capability to perform well as a consequence of good environmental design, efficient technical installations, and effective control systems. Here priorities need to be to design buildings to reduce the requirements for and loads to be met by energy-consuming systems; and for the systems that are installed to be efficient, economically-controlled and user-friendly. Performance also needs to be understood in terms of its underlying elements, including fabric integrity, plant capacity, controllability and systems efficiency.
The management - how the building is equipped, used, operated, controlled and managed. Sometimes this complements the asset, sometimes it doesn't. The differences can be massive - largely owing to unnecessarily long hours or intensities of operation and avoidable waste.

While it is essential to have a method of grading a building on the basis of its design features (both on paper and on the ground), it will also need to be re-graded to take account of the way in which it is actually occupied and managed. Both aspects will need to form part of an integrated systematic framework which includes non-installed equipment. It is the outcome of all these that determines metered fuel consumption and the building's CO_2 emissions.

For the purposes of building certification it is important to concentrate on what a building's energy demands actually are. At present we think that certification will need to be based on nett metering of fuels delivered to the buildings. Further savings in energy and carbon can be made by adopting efficient, low-carbon off-site fuel supply technologies - such as renewable electricity, but that is a different story.

The application of minimum standards of energy performance to new buildings and to certain existing buildings when they are renovated - subject to constraints of technical feasibility, reasonable cost and heritage protection - will permit the building stock, its technical installations and its control and management systems to be raised to higher standards of performance. In the past, what were supposed to be minimum standards have usually become the targets at which nearly everybody aims. Instead, we hope that a suitable certification system can be devised and used in a way which will cause people to strive for higher performance at ALL stages of the life cycle of a building: in briefing, design, specification, construction, commissioning, sale or rental, and in the occupied building - and to use the framework to report their progress.

In short, the requirements of the Directive can potentially be used to add value throughout the chain by laying the foundations for an integrated, joined-up system which has clear purpose and which uses a clear, common language throughout.

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