A sustainable LCEC approach for social housing-Factor 4
SUDEN (a non-profit European association on sustainable urban development), France

Summary

The Factor 4 project (2006-2008) is supported by the Executive Agency for Competitiveness and Innovation ("EACI") in the SAVE programme. It follows the Sustainable Development World Strategy worked out in Johannesburg in 2002 and its results are:

1. An operational innovative tool (the Factor 4 models) for a life cycle energy cost approach (LCEC) for optimising social housing retrofitting programmes towards:
   - a sustainable strategic management of the building stock of any social owner,
   - a sustainable policy for social housing at the territorial scale (neighbourhood, city, region, country),
2. Recommendations for all the actors concerned (social owners but also local authorities, public administration and banks), illustrated by the identification of (technical and non technical) problems and by demonstration actions.

First a typology (deliverable 3) was set up, then also a demolition scenario has been set out in order to identify the social housing buildings which will still be there in 2030-2050. Using renewable energy, their energy efficiency will be improved by a minimum of 30 % in a short term and even more in a long term in order to participate to the reduction of greenhouse effect gas (GEG) emission by a factor 4 before 2050 (deliverable 4).

After a survey of existing tools available (deliverable 5), LCEC models were worked out according to the social owners wishes (deliverable 5 in English and 8 in national languages) and each of them was tested and validated through a lot of case studies (deliverable 9 in national languages). A synthesis of the case studies in each country and a factor 4 optimisation has been set up for some of these case studies in order to identify the energy and GEG saving potential (deliverable 7).

A first draft of an Energy Efficient Technologies data base including economic data has been set up (deliverable 6), an analysis of barriers is ongoing (deliverable 11), elements for a national strategy have been suggested (deliverable 10, both in English and in national languages) and demonstration actions (best practices and best policies or strategies) are also ongoing (deliverable 14).

At last, a final synthesis (Factor 4 Brochure) will be available at the end of the project (July 2008).

End-user area

- [ ] New buildings
- [x] Refurbishment of buildings
- [ ] Transport and mobility
- [ ] Financial instruments
- [ ] Industry
- [ ] Legal initiatives (regulations, directives, etc)
- [ ] Planning issues
- [x] Sustainable communities
- [ ] User behaviour
- [ ] Education
- [x] Other

Target Audience

- [ ] Citizens
- [x] Households
- [x] Property owners
- [ ] Schools and universities
- [x] Decision makers
- [x] Local and regional authorities
- [ ] Transport companies
- [ ] Utilities
- [ ] ESCOs
- [x] Architects and engineers
- [x] Financial institutions
- [x] Other

Technical

- [x] Energy efficiency
- [ ] Heating
- [ ] Cooling
- [ ] Appliances
- [ ] Lighting
- [ ] CHP
- [ ] District Heating
- [ ] Solar energy
- [ ] Biomass
- [ ] Wind
- [ ] Geothermal
- [ ] Hydro power
- [ ] Other

Context

The objective is to use a life cycle energy cost analysis, including externalities, for the optimization of retrofitting programmes as regarding 3 optima together: energy consumption, GEG emissions and a socio-economic optimum, using the EPBD with a sustainable development approach.

Objectives

At the building scale the Factor 4 model completes the technical diagnosis with socio economical data. This Factor 4 model is an economic tool to be used with the Energy Performance Building diagnosis and labelling (which is only "technical", as regarding energy savings or GEG emissions, according to the European Directive). The model deals together with the 3 pillars of sustainable development (not only with one pillar and the impacts on the other ones).

The Factor 4 model allows working out various scenarios towards the optimisation of the retrofitting programme for one or more buildings, and so, it helps also to set up a strategy. In regeneration projects at the neighbourhood scale such as in URBACT or in national programmes (ANRU in France, NRU in UK, Contratti di Quartieri in Italy…), the Factor 4 model can also be a decision aid tool for selecting the buildings to be demolished or to be hardly (or softly) renovated. This decision aid tool will be usable by social owners themselves but also by their financial partners or by local authorities as regarding buildings from various social owners.

Process

Reminder on definitions of Life Cycle Costing[1]

LCC (Life Cycle Cost) is the total cost of a building or of its components during its whole life, including the design phase, land cost, maintenance and retrofitting costs and at least demolition cost but without the final benefit when the building or the land is sold.

LCC (Life Cycle Costing) is the technique enabling a comparison during a period by taking into account the investment costs as well as maintenance and retrofitting costs. This LCC analysis is used for a comparison with reference costs or the costs of a reference building, in the design and the operational phases as well as for a comparison between costs and benefits.

LCA (Life Cycle Analysis) is used for the environmental impact's assessment of a product or equipment process. LCA has not any social nor economical data but, as LCC, it gives the indisputable environmental indicators but it gives only environmental indicators without any social or economic information.

External costs: costs linked to the project which are not necessary taken into account in the sale price.

Externalities are the cost or benefit for other actors. If externalities are added to the private cost or benefit (when the product or building is sold), it becomes the social cost or benefit (source ISO 15686).

The Factor 4 model is a life cycle energy costing (LCEC) model including externalities (the greenhouse gas emissions) and giving money values to these externalities.

It can be used at the building scale as well as for setting out strategies at a territorial scale (national, local, neighbourhood) or at a building stock scale.

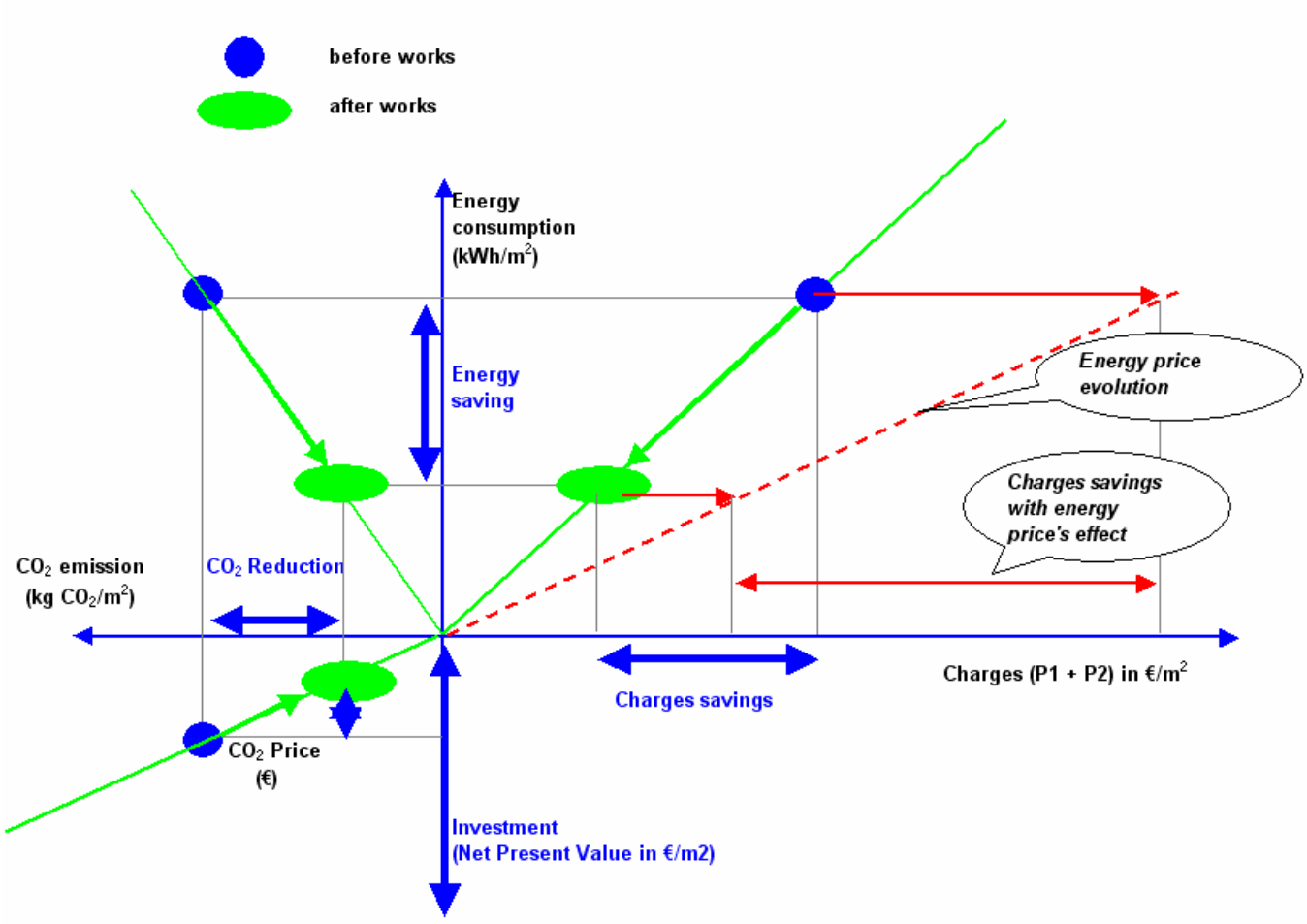
[1] Source ISO 158686, ISO 14040 and the final report of the « task Group 4 » on the LCC analysis in the building sector, Novembre 2005

The Factor 4 model can be illustrated thanks to a graph setting out the four dimensions of the analysis:

- investment costs,
- energy savings,
- the greenhouse gas emissions reduction effect (which will result in an avoided carbon benefit),
- the charges' savings (for tenants).

The economic optimum of an energy retrofitting building programme is the programme for which the Life Cycle Energy Costing is minimised, integrating the hypothesis on the investments depreciation linked to components' life span and to the energy price increase.

The Life Cycle Energy Costing approach takes into account these different monetized items[2].



The energy optimisation of a retrofitting programme with the Factor 4 model

Source La Calade for Factor 4

[2] This "moneytisation" or their value in Euro takes into account inflation or the decrease value of the money. This is not done in most of the analyses on social housings up to now.

By using the Factor 4 model, social owners can:

- optimise both each of their building retrofitting programmes and their building stock strategy,
- improve their dialogue with financial partners.

Local authorities could also set out their social housing strategy at various territorial scales.

Financial resources and partners

The project is coordinated by **SUDEN** and gathers the following partners (social owners are underlined):

Crdd La Calade (France)	Cenergia (Denmark)	Volkswohnung (Germany)
Moulins Habitat (France)	KAB (Denmark)	Association of Local Development Promotors (Romania)
L'Union Sociale pour l'Habitat (F)	Ricerca e Progetto (Italy)	
Habitat & Territoires Conseil (France)	Soc Coop ABITA ARL (Italy)	

The overall budget is 675 200 € with 337 600 supported by the European Commission
HTC helped for the previous building typology.

The 3 research partners (La Calade, Cenergia and R&P) worked out the Factor 4 model and they helped social owners in the optimisation of their retrofitting programmes. They worked out a socioeconomic data base on energy efficient technologies. At least they suggested elements for a strategy at a territorial scale (neighbourhood, city, region or nation) as well as for a building stock.

Social owners collected the data and managed the demonstration projects.
At last APDL tried to underline how such a LCEC approach could be used in Romania

Results

The approach and its philosophy are usable everywhere in Europe but the Factor 4 model cannot be the same for all the European countries. At the end of the project, Factor 4 models for a life cycle energy cost analysis (integrating greenhouse gas effect emissions as an externality) are available for 3 countries**:**

- **the ASCOT** model (Assessment of Sustainable Construction and Technology cost)[3] worked out by Cenergia for Denmark,
- the **BREA** model (Building Retrofitting Energy efficiency Assessment) worked out by Ricerca & Progetto for Italy
- the **SEC** model (Sustainable Energy Cost) worked out by La Calade for France . This model has specific regional versions for taking into account the various prices and technologies. French social owners want now to get an official label for the model and to add the mention of the year on each model in order to improve the official version to be used every year.

The Factor 4 project was only the first step of an innovative approach which should be improved and used at various scales and in each European country. And the Factor 4 partners have already written new proposals for the European Commission calls for tenders.

All the deliverables are available on the web site http://www.suden.org/english/actions_projects/factor4.php

[3] This ASCOT model is an up to date version of the model worked out for the HQE^{2}R approach for a sustainable neighbourhood regeneration (cf. www.suden.org and http://hqe2r.cstb.fr)

Lessons learned and repeatability

1. **The sustainable LCEC approach allows an optimisation of the retrofitting programmes**

   The simulations has shown that **it is necessary to think more in economic than in technical terms for setting win – win energy policies** (win for the users and win for the society).

   The EPBD has to be managed in a sustainable approach including socioeconomic aspects.

   The Factor 4 models are useful for optimising the retrofitting programme of any building but its interest is more at a strategic level for a building stock strategy or a territorial strategy (managed both by local authorities or social owners themselves). But these developments are still to be tested.

2. **It can sometimes be better not to reach the factor 4**

   These simulations also showed that the aim in retrofitting projects is not to reach absolutely the factor 4 objective, and that a factor 3 can be sufficient in the present state of techniques and market (the construction of new buildings balancing the difference).

3. **A limited energy retrofitting (as it is still often managed in many European countries) is not a good strategy at all**

   This analysis also showed that a limited energy retrofitting (a frequent practice in France nowadays) with a GEG reduction of only 30% for example (e.g. factor 1.4) doesn't enable to reach the economic optimum.

   Of course this effort towards the optimum is difficult because of the calculation rules for the level of the rents (especially in some countries such in France) or because of the financial capacities of social owners… but, in case of public financial support, it should be indisputable to manage such an analysis in order to allow the best potential use of public funds.

4. **Optimising retrofitting programmes can be done only with some energy efficient technologies**

   To reach a factor 4 requires the development of some technologies. Some are already on the market and others are not yet. Some professionals have already understood that.

   Condensation boilers, heat pumps, solar water boilers, roof insulation techniques, floor insulation techniques (ground floor under non heated spaces), individual meters, thermal insulation pipes, low emissive double glazing windows with argon are available on the market and raise no real problems (we have however to distinguish between great agglomerations and some regions where the techniques are known or used competently by professionals and other regions and cities which don't gather companies with enough qualified staff). It's thus often the costs that constitute a barrier to the development of these techniques.

   Techniques as external wall insulation, double flow mechanically controlled ventilation with energy recuperation and passive solar heating are not well known in all the countries, except in some demonstration projects.

   There is thus a need to put the emphasis on awareness awakening and professionals 'training to these techniques.

5. **The Factor 4 case studies and simulations enabled to get some useful indications of prices range**

   For example in France we can say that:

   - a retrofitting reducing from 25 to 30 % energy consumption and CO_2 emissions (CO_2 factor 1.4) requires an investment of 5 000 to 6 000 € by dwelling.
   - a retrofitting reducing from 60 to 65 % energy consumption and CO_2 emissions (CO_2 factor 2.7) requires an investment of 10 000 to 12 000 € by dwelling.
   - a retrofitting reducing from 75 to 80 % energy consumption and CO_2 emissions (CO_2 factor 4 to 5) requires an investment of 12 000 to 16 000 € by dwelling.

6. **We must deal with the household electricity consumption**

   Social owners never deal with the household electricity consumption, whereas the tenants' expenses for electricity are far to be insignificant. Electricity saving actions in residential units and common parts (which consumption could reach 2 to 12 kWh /m² of the living area) can reduce these expenses by more than 40%[4]

   Energy efficiency policies in social housings have to take this into account, a fortiori in poor urban areas, even if it's not in the social owners province. This is important ***for reducing energy precariousness.***

7. **At last it demonstrated the importance of a long term or sustainable strategy both at a territorial scale and for each building stock**

   This analysis requires more precision in the definition of retrofitting strategies both at a territorial scale level and at the building stock level (social owner's building stock strategy for example) particularly by taking into account the building components lifespan and the local particularities.

8. **Factor 4 models or LCEC models have to be worked out for each European country**

   There are too much technical and economical specificity for using only one model. A LCEC model has to be worked out for each country and perhaps for each region and the hypothesis have to be discussed towards a consensus among all the actors (social owners, local authorities, public administration…).

Contact for more information:

Project Web Site: http://www.suden.org/english/actions_projects/factor4.php

Organisation / Agency: **SUDEN, Sustainable Urban Development European Network** (a result of the European HQE²R project (FP5) for gathering researchers and practitioners in order to close the gap between knowledge and practice and to work out the tools needed by practitioners towards urban sustainability)

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Printed reports or other literature available:

A lot of deliverables are on the web site with the typology, the potential energy and GEG saving, the case studies in each country, the synthesis, elements for a national strategy, the barriers analysis, recommendations for all the types of actors, etc.

All these results are or will be available on the web site, except the models themselves.

Other contacts: For getting the models, as the rules in the various countries are different according to the countries and not always yet fixed, please contact:

Cenergia (Denmark): obo@cenergia.dk

La Calade (France) outrequin.philippe@wanadoo.fr (FEDARENE member and ManagEnergy expert)

Ricerca & Progetto (Italy) studio@ricercaeprogetto.it

[4] Our estimations are consistent with those from Olivier Sidler