Energy saving goals require reform of building regulations and control

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Abstract:

The energy saving potential of the building stock is large and considered to be the most cost efficient sector to contribute to the CO2 reduction ambitions. As long as the price of renewable energy is still not competitive with fossil energy, the energy saving goals can only be reached supported by severe governmental policies. In Europe the Energy Performance of Buildings Directive is a driving force for member states to develop and strengthen energy performance regulations for new buildings and energy certificates for the building stock. The goals are to build net zero energy buildings in 2020 and to reach a neutral energy situation in the whole stock by 2050. Research delivers signals that, although technically feasible, actual results of the policies and regulations are not as expected. Theoretical energy use calculated on base of the design standard for newly built houses and assessment standards for energy certificates of existing dwellings differ largely from the measured actual energy use. The potential of the existing building stock is even higher, but harder to harvest. The paper will present findings of several research projects providing evidence of malfunctioning of current approaches. Based on this, the paper will present some ideas of innovations in the regulatory and control systems and suggestions for research to support alternative solutions.

Keywords:

energy saving, energy performance, building regulations, building control

1 Introduction

The European building sector is responsible for about 40% of the total primary energy consumption. To reduce this share, the European Commission (EC) has introduced the Energy Performance of Buildings Directive, the EPBD (2010/31/EC). This framework requires member states to develop energy performance requirements for new buildings and a system of energy performance certificates for all buildings. It also requires member states to develop policies that require to built only ‘low energy or Passive Houses’ by 2020. More and more countries, but also regions or municipalities, formulate ambitions for net zero energy or carbon neutral houses also on the shorter term.

Most savings can be realised in the existing stock. National and local governments have formulated ambitions, stimulation and subsidy programmes to stimulate large scale renovations.

Formulating ambitions and sharpening regulations is relatively easy to do. Technical solutions are currently available to realize the passive house standard in building projects. There is quite some evidence however that the mainstream of building processes do not lead to the pre-defined quality. Traditionally the municipal departments of building control in most countries had an important role in assuring that building plans and construction processes would lead to buildings that meet the minimum required quality levels. There is a tendency to put more emphasis on the responsibilities of owners and private parties to ensure quality. This means that the private parties will have to improve their working process and will have to learn to handle performance guarantees. Owners will require guarantees from the designers and building companies for the quality of their property. Certification and accreditation of parties, processes and products will become more important for building processes in general.

For the realization of high energy performance standards, a reliable quality assurance system will be very important. In most countries that have some experiences with passive houses some form of performance guarantee and associated quality assurance scheme exists. It is important to study these examples.

In this paper some developments in building regulations and building practice will be described to highlight the role of building regulation and building control in the context of the increasing energy saving target for new as well as for existing dwellings. We start in section 2 with an elaboration on the trends in regulations and building control. In section 3 the results of a study on the relation between the levels of energy performance regulations and the actual energy use in newly built houses are presented. In section 4 we show the example of certification of passive houses as a valuable contribution. In section 5 the situation of the development of policies for the existing dwellings is described. Section 6 presents some conclusions. Finally section 7 introduces the goals and working programme of the CIB-TG79 task group ‘Building Regulations and Control in the face of Climate Change’, which addresses all these issues.

2 Developments in systems of building regulations and building control

Building regulations are the subject of an ongoing debate between, on the one hand, those in favour of deregulation and reducing the administrative burden and, on the other hand, new quality demands that require government intervention. Energy and climate change concerns belong to the core of policy developments of the European Union and lead to directives that demand member states to develop regulations and enforcements schemes that ensure very energy efficient new buildings and instruments that stimulate the improvement of the existing stock. So, although the general development in European countries leads to less government intervention in the building sector, in the field of energy efficiency the number of regulations increases and become more stringent.

Currently in the Netherlands, both sides of this debate appear to be gaining in importance. The desire for deregulation is leading to the opinion that greater emphasis should be placed on the responsibility of property owners, which could lead to less government intervention. However, the existing forms of quality control for private actors in the Dutch building industry seem to be

of quite a low standard. Accidents occur and physical quality does not appear to be sufficiently important. As the CO_2 and energy targets increase, stronger regulations and accurate building control become a priority. In the past ten years, it has become increasingly clear that the quantity and quality of assessments carried out by many municipal authorities leave something to be desired (VROM Inspectorate, 2007).

In this context we should remember that the client and the parties who engage for the design and construction stages have primary responsibility for complying with regulations. When a building permit is granted, this suggests that the plan has been shown to comply with all the regulations. But this is not the case. In practice, a permit is granted because, during the checking process, the plan was not found to deviate from the regulations.

We will now return to the continuing call by politicians for greater deregulation and easing of the administrative burden. In 1997 we contributed to the building-regulations project as part of the MDW (Market Forces, Deregulation & Legislative Quality) programme of the Ministry of Economic Affairs. The purpose of our research was to formulate deregulation proposals on the basis of examples from other European countries (Visscher, 1997). Notably, in those countries, many private-sector parties are involved in assessment and inspection. We have studied (Visscher, 2000) how the responsibility for these tasks could be transferred to the private sector in the Netherlands too, primarily through the certification instrument. The Ministry of Housing, Spatial Planning and the Environment (VROM) also took up this idea. Since the end of the 1990s, it has been developing a process certificate for assessing building plans against the requirements of the Building Decree.

In current government is aiming to drastically reduce the administrative burden. Again, the field of building regulation is seen to have a great deal of potential in this regard. A few years ago, the government appointed the Construction Sector Fundamental Review Committee (Commissie Fundamentele Verkenning Bouw) chaired by Sybilla Dekker, a former Minister, to draw up proposals for the far-reaching simplification of building regulations. The committee recommended the abolition of preventive assessment of building plans by local authorities. The client should be responsible for complying with the regulations and should also ensure that sufficient checks are in place. It can engage a certified body to do this, but there may be alternatives. The role of the municipal authorities will shift towards that of process auditing, i.e. supervising the checks. The question is then: how this can be put into practice?

In many countries there are problems with a lack of compliance with building regulations, and this often serves as a stimulus for reviewing and improving the system of building control. The considerable pressure to deregulate in the Netherlands has parallels in other countries. There is a clear trend towards increasing the role of private parties. In many countries, the role of local authorities in carrying out assessments and implementation inspections has virtually disappeared.

Therefore it is interesting to study innovative ways in which quality is guaranteed by private parties. The certification of passive houses is a field that requires building actors to transform the usual building process into a performance based approach and to learn by doing. In section 4 we illustrate quality assurance processes for passive houses that exist in some countries. First in the next section the need for more quality assurance will be illustrated.

3 The realisation of required energy performances in building processes

In 1995 energy performance regulations were introduced in the national building regulations. It consists of a calculation method laid down in a national standard EPN (energy performance norm) and a limit value, the EPC (energy performance co-efficient). Since the introduction the EPC was sharpened several times. It started at 1.5 in 1995 and since the 1st of January 2011 it is now on the level of 0.6. The EPC is a non dimensional digit. All building characteristics and building services that affect the energy demand for space and hot water heating, ventilation and lighting are incorporated in the calculation of the energy index (EI), which is the basis for the EPC.

After more than 15 years of Energy performance regulations in the Netherlands, only few representative statistical studies were conducted to assess the effect of the regulation on the actual energy use. The samples were of limited size. In two of these samples, no statistical correlation was found between the EPC-level and actual energy use per dwelling or per square meter. In the analysis of the WoON survey, carried out on behalf of the Ministry for Housing, Planning and the Environment in 2006 and which is representative for the Dutch housing stock, no correlation was found between the different levels of the EI and the actual energy use per dwelling and per square meter.

We found that building characteristics (including heating and ventilation equipment) were responsible for 19 to 23% of the variation in energy used in the recent building stock. Household characteristics and occupant behaviour seem to be responsible for 3 to 15% of the total variance. Neither our study nor the studies found in the literature allow to state that building characteristics, household characteristics and occupant behaviour altogether are responsible for more than 38% of the variation on energy consumption of dwellings built after 1995. Therefore at least 62% of the variation in energy use is unexplained yet.

There are indications from literature that the explanation for this remaining part could be related to buildings being realized differently than written in official documents and to HVAC services running under very different conditions than assumed on paper. A report by Nieman (2007) showed that in a sample of 154 dwellings, 25% did not meet the EPC requirements: the EPC was incorrectly calculated; nevertheless the building permit was issued. In 50% of the dwellings, the realization was not in accordance with the data used to calculate the EPC. Gommans (2007) monitored for 17 years the energy performances of energy efficient buildings. 40% of solar boilers appeared to function poorly. Only 25% of the heat pumps reached the expected efficiency. This was essentially due to realization faults, lack of control and lack of continuous monitoring. Another study by Elkhuizen e.a. (2006) in office buildings showed that up to 28% energy could be saved by better monitoring.

Taking into account the fact that tightening the EPC did not lead to less energy use for heating and that 62% of the variation in energy use is still unexplained, it seems legitimate to be careful about a further tightening of the EPC and to search if there are more efficient means to really decrease the energy consumption of newly built dwellings. This could be done by ensuring a correct realization and monitoring of the calculated performances, putting attention on the knowledge needed by contractors and on an effective building control process.

4 Certification of passive houses

According to the EPBD recast before 2020 all newly built buildings will be at the level of nearly zero energy buildings. In section 3 we have seen that in the Dutch practice current required levels of energy use are not met and it is not likely that the European targets will be realised by only putting the regulations at a higher level. In this respect it is useful to look to examples of quality assurance of passive houses that exist in some countries.

Quality assurance of passive houses, and associated technologies, has its origin in the verification and prediction of a restricted energy demand. Passive house project certification is not focused on issues like stability, safety, or more general environmental performance. Guaranteeing an energy performance is a relative new issue in building processes, requiring a shift in general thinking from means contracting to performance contracting. The urgency of the energy issue requires a swift implementation of (energy) performance contracting in the construction sector. In this paper passive house certification is regarded as an innovation in building processes to provide better building quality in general. Related to the introduction of passive house certification schemes the issue was raised how such initiatives can also upgrade knowledge in the construction sector.

Different European countries show a different embedding phase and related market penetration of passive houses and quality assurance of passive houses. Some countries like the UK, Ireland and the Netherlands are still starting up initiatives, while others like Germany, Austria, Switzerland, Belgium, France, and so on, provide a framework for grants and/or tax reductions and associated quality control procedures. In Western Europe the passive house standard is still a voluntary standard, while regions in Central Europe are already developing initiatives to include the passive house standard as a legal instrument and/or obligation for new constructions. Existing voluntary certification initiatives are different in different countries. Some harmonization between the different national initiatives might be interesting. Especially countries with no certification can already duplicate the most successful initiatives. Early adaptor countries have developed financial aid for passive houses, as well as a performance oriented quality approach for the design and construction process of passive houses. Control of quality of the design process, the construction process and the post construction inspection and testing of passive houses is considered as an essential feature, before stimulating the dissemination of information considering best practice demonstration projects.

Since the implementation of the European Directive 2002/91/EC and since the introduction of project related energy performance requirements and e.g. the passive house concept, problems about guaranteeing (energy) performances and information flow among building partners and quality control have become more significant. The EPBD and the passive house certification are being used to improve product and process modelling in commissioning for existing and new buildings as they are accompanied by a process of certification. EPBD calculation procedures are in many countries still not adapted to specific passive house technologies. This means that in many countries for passive house projects both PHPP and EPBD calculations have to be performed. The cost of an extra certification next to the legal energy performance certificate is considered to be a bottleneck.

As part of the process of demonstrating compliance with required energy performance, assessment of the energy performance of design of new dwellings is becoming mandatory in many countries and regions. For most buildings with a building permit, requirements are set for the energy performance as a consequence of the implementation of the EPBD, but also aspects of indoor climate and ecological criteria are sometimes introduced at the same time. It is generally perceived that a good energy requirement does not necessarily bring thermal comfort and good indoor air. Especially summer comfort can be a critical issue to be included in passive house certification as well as the proper working of balanced ventilation systems. In many cases the existing structures for energy performance evaluation, developed in the framework of the EPBD, are not sufficient to guarantee the quality and definition of the passive house.

PHPP software is mostly used as a basis for certification of passive houses. Its main advantage compared to other design and evaluation tools is that is has been specifically created as a design and certification tool for passive houses and that it regularly takes up new research results in its calculation procedures. Certification of passive houses usually also includes an air tightness test. In some cases, also the functioning of technical systems and its effect on indoor climate is directly, or indirectly through evaluation by PHPP, considered. Some countries express the need to include, besides the PHPP calculations, comfort criteria (e.g. Belgium) or health criteria (e.g. UK, Austria). A differentiation in standard including low energy definitions, like in the Klimahaus CasaClima programme, can contribute to success of widespread certification.

In most advanced countries educational programmes for specific target groups were introduced, accompanying the introduction of certification systems. Experiences in Germany, Austria, Switzerland, Belgium and Italy illustrate that quality assurance of passive houses is necessarily related to the provision of passive house education initiatives. New fields like non-residential buildings and renovations require for the further development of more specific quality assurance procedures. It is not clear if the strict passive house definition can or should be maintained, especially since it is sometimes difficult to achieve for small houses or renovations. Also, PHPP calculation procedures in themselves are often not sufficient to evaluate the design of, for example, technical systems in office and school buildings.

5 Policies and instruments for energy reduction in existing dwellings

The largest energy saving potential is in the existing building stock. National and local governments have formulated ambitions, programmes policies and instruments to stimulate the improvement of the energy performance of the existing stock. The most important policy tool required by the EPBD in the European member states, is the issuing of Energy Performance Certificates. In most countries it is current practice to produce an energy label for a building at the moment it is sold or re-rented. In the Netherlands the labels are also mandatory for all dwellings of social housing associations. The label indicates the energy demand for heating and cooling. It is a communicative instrument and there are no obligations to improve buildings as a consequence of a low label, but the labels are used as a basis for recommendations of improvement. Subsidy schemes are more and more related or combined with the labels. And there are some signs that a better label affects the price of houses.

The label data bases already cover a reasonable share of the housing stock in the Netherlands. They form a basis to monitor the progress of the renovation practices. Besides this it is also

useful to study the effect of improving energy labels on the reduction of the actual energy use. Later in 2011 accurate figures and insight can be produced by the OTB Research Institute of the Build Environment of Delft University of Technology. As for now already some expectations can be formulated.

The progress of renovations and energy upgrading measures stays far behind expectations and formulated ambitions in 2008 when most of the policies, covenants and improvement programmes were set up. The social sector in the Netherlands is still relatively large (35%), well organised and relatively ridge. A few years ago the sector formulated ambitious programmes, but these are nowadays scaled down because of several reasons. The economic crises reduced the financial position of the housing associations. The housing market also dramatically slowed down which also affected the funding for renovations because this largely depends on the sales of property. Also it proved to be difficult to get improvement of tenant for renovations that require an increase of the rents (70% of the tenants have to agree). It is hard to assure the saving of energy costs resulting of the improvement of the dwellings. The actual energy use is largely influenced by the use and behaviour of the tenants. The aforementioned study of OTB will provide good insight in this relation, but there are already some preliminary figures that demonstrate the difficulty in 'forcing' reduced energy use by improvements of dwellings. The dwellings with the worst energy label (G) in practise use far less energy as expected, while the most advanced dwellings (A) use much more. This can be explained by a combination of the rebound effect and an increase in comfort level of the dwellings.

In the home owner sector the issuing of energy labels stays yet far behind. Although they were mandatory, until now there has not been an enforcement system. From 2012 on a label will be required for each property transaction and this will be checked by the notary in the Netherlands. Energy labels will become common practice and affect the sales price. Still there are no obligations foreseen to make improvements and higher labels mandatory. It is hard to require investments and property rights are probably an obstruction. Still there are some ideas for taxation measures. Bad labels could be punished with higher transaction taxes or higher property taxes than good labels. Such measures were suggested by the Platform for Energy Transition in the Build Environment. It is not likely that these measures will be adopted by the government on a short term however. But if the saving potential of the existing stock is taken seriously it seems that firm policies and regulations will be needed.

6 Conclusions

The necessity to drastically reduce fossil fuels seems without any doubts these days. The built environment offers a large potential of savings. Severe insulation and product innovations can reduce the energy demand for heating and cooling for a large part. The remaining energy demand can be delivered by renewables like sunlight and heat, district heating, heat pumps etc. The remaining electricity demand for appliance's can in the first place be reduced by further product innovation and then be provided by photo voltaic panels. Solutions are there. There are no reasons not to apply this in new buildings at a large scale on the short term. However, a successful transition requires a lot from the designers, engineers, installers and builders. They will have to use new techniques and improve the quality and accuracy of the work. Solutions have to be found that are robust. Solutions that are vulnerable for the application in practice

and/or for the unpredictable use of the occupants should be avoided. Evaluations of the current practice show that there is still a large world to win. The building regulations should set demanding targets, but what is surely needed is a better quality control in the whole process. This control should be carried out by the building practitioners themselves. They are the experts! But this will only start working if it is demanded and supported by regulations for certification of people and processes.

Although the potential is higher, the existing stock will be harder to tackle. Experiences show that it is hard to increase the numbers of severe renovations. And even more that the savings in renovated dwellings stay behind expectations because of rebound effects. There are many barriers: renovations are expensive, occupants mostly do not want the trouble and sometimes aesthetics make a change of the facade unwanted or impossible. On the other hand a large share of the current existing stock will have a very long life span, just because the replacement grade by new dwellings will simply be too low to provide enough new dwellings. In this perspective, there will always be a large need for renovations to expand the life span and this provides possibilities to improve the energetic quality. The fear however is that this 'normal' process goes to slowly. Maybe there is still a need for further smart product innovations to develop solutions that have a high contribution to the reduction of energy demand, are cheap, easy to apply and do not cause trouble to the occupants. The fast decrease of the price of PV cells is promising. The markets needs to be stimulated by regulations. It is especially hard to persuade homeowners to invest in energy saving measures. Besides that more insight has to be developed in the effect of behaviour on the actual energy use. Possibly the pricing of energy could contribute to more consciousness use.

7 CIB Taskgroup 79

Since a few years the attention for building regulatory systems and enforcement procedures is growing. Various developments in society, politics and the construction industry have influenced changes in the systems of building control in the last 20 years. The influence of climate change and the related demands on buildings will have a very strong impact of further transformations in this field. Therefore CIB has established Task group 79, Building Regulations and Control in the Face Climate Change. It will be useful to compare developments of the systems of building control in countries worldwide. How do the various countries deal with the demand of deregulation and privatization of enforcement tasks? What are the effectiveness and efficiency of the systems? Could green promotion incentives be incorporated to improve the systems? How do the public regulations and enforcement systems contribute to the basic quality of buildings? Are the current systems suitable to ensure that buildings will have a very low energy demand and are comfortable, healthy and safe at the same time? What are the ideas to improve or change the systems? And what will be the impact on these systems from climate adaptation measures in the longer run?

The task group will make an original contribution to the CIB Sustainable Construction priority theme. The majority of research on sustainable construction addresses the development of innovative techniques. However, there is now awareness that it is equally important that mechanisms are developed which can effectively implement the new techniques on a large scale. These will include building regulations which incorporate appropriate incentives for the

promotion of the green agenda and which therefore stimulate the use of new techniques. Equally, systems of building control will also be required which are capable of monitoring the effective and accurate design and construction of the buildings. These and similar issues will be addressed by the proposed task group.

7.1 Working programme

The core interest of TG79 is: new alternative visions on the role, the system, the formulation, the content, the organization of building regulations and building control because of the changing circumstances of climate change.

The changing circumstance leads to research to address:

The balance between command and control regulations versus incentives;

The balance between the role of public and private parties in carrying out the tasks of control;

The new role of control and supervision: form a strong focus on control of the design to more monitoring of the building process and testing of the quality of the final building and post occupancy monitoring.

The role of regulations for existing buildings and adaptive re-use of buildings.

Alternative approaches to reduce the gap between level of energy regulations and level of actual energy use?

Contributions of members of the task group can be various and will report about recent research findings from different countries worldwide that lead to new insight in these matters.

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