

# Sustainable housing in Europe

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There is considerable variation in the extent to which environmental measures are adopted in housing construction in various European countries. Whereas sustainable housing is clearly part of day-to-day building practice in some countries, in others the topic seldom receives serious attention. None of the environmental measures which are considered as such in the Netherlands are adopted frequently in all countries. On the other hand, various measures are adopted regularly everywhere. An overall comparison of 24 countries shows that Denmark is currently the country where the greatest number of sustainable housing measures are actually adopted, followed (some way behind) by countries such as Austria and Sweden.

*Key words:* sustainable building, Europe, housing, comparison.

## 1 Introduction

The aim of sustainable housing is to minimize damage to the environment and, where possible, to improve environmental quality. The term covers the topics of energy, traffic, water, materials, waste, health, and flora and fauna, and relates to both planning, design, construction, dwelling/use and demolition.

This article gives an indication of the extent to which environmental measures are actually adopted in housing construction in 24 European countries<sup>1</sup>. It does not deal with regulations or with measures which the various countries intend or would like to introduce. Those countries are: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Environmental measures are design and/or technical measures which contribute to the sustainability of housing. The measures relate to both the dwelling and the dwelling place (the concept of "domicile"). In this sense, housing construction can thus be seen in terms of several different levels, on an ascending scale: detailed level, dwelling/workplace level, building level, neighbourhood level, district level, and urban level. The environmental measures in this article are measures which are considered as such in the Netherlands<sup>2</sup>.

<sup>1</sup> The article is based on a survey, entitled "Sustainable Housing in Europe". The survey was commissioned by the Dutch Ministry of Housing, Spatial Planning and the Environment in preparation for the Second European Ministerial Conference on Sustainable Housing Policies, to be held in Amsterdam (Netherlands) on 24–25 September 1997. The original research project was modified in close consultation between BOOM (office of environmental research and design), the Delft University of Technology, and the Ministry as part of a doctoral research.

<sup>2</sup> No list of measures can be equally relevant to all European countries. Approaches may differ because of differing climatic conditions (locations of rooms on the sunny or shaded side of the dwelling), economic circumstances (limitation of paving in order to encourage infiltration of rainwater or to cut costs) or building traditions (cavity walls appear to be a specifically Dutch feature).

It was not possible to carry out extensive country-by-country research, and it should therefore be emphasised that the results simply give an approximate picture of the current situation regarding sustainable housing in the various countries.

## 2 Scope and methodology

The list of environmental measures was compiled by putting together the various lists available in the Netherlands<sup>3</sup>. Respondents were specifically asked for comments (Do you consider certain questions not applicable? Why not? Are there any other measures which should, in your opinion, have been on this list? etc.). These comments were taken into account in the analysis. For example; Various respondents said that the Dutch approach was too technical. Germans felt that the social context and the issue of compact versus dispersed urban development were missing from the questionnaire, while a Swedish respondent noted the absence of measures to combat damp and prevent allergic reactions.

The survey was carried out by means of written interviews, largely based on multiple-choice questions. In order for this method to yield scientifically acceptable findings with random selected respondents, many completed questionnaires would have had to be received from each country. Since 24 countries were involved, this would have meant processing too many questionnaires. Therefore, instead of being chosen at random, respondents were carefully selected. The aim was to find between six and fifteen respondents in each country, from different categories<sup>4</sup>.

The respondents had to have a sufficient command of English, up-to-date knowledge of the current housing situation and knowledge of the situation throughout the country.

To enhance the quality of both the questionnaire and the replies, use was made of so-called "focal points": people working in the building sector who were familiar with the housing situation in both the Netherlands and another European country and who had a command of both Dutch and the language of the other European country (including relevant technical terminology). These were usually either Dutch building experts working in other countries, or building experts from other countries working in the Netherlands.

Such focal points were found for most of the countries concerned.

To ensure that the survey findings would be as reliable as possible, the following procedure was adopted:

- A draft questionnaire was drawn up in Dutch, based on a comparative analysis of Dutch sustainable housing lists. This was completed by ten sustainable housing experts from the Netherlands,

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<sup>3</sup> The following sources were used:

- Handleiding Duurzame Woningbouw ("Handbook of sustainable housing"), WE-consultants, Gouda
- Bouwstenen voor een duurzame stedenbouw ("Basic elements of sustainable urban development"), BOOM, VNG, 1996
- DCBA-methode ("The DCBA method"), BOOM-consultants, Delft
- Milieuclassificatie ("Environmental classification"), NIBE, Naarden
- Nationaal pakket woningbouw ("Sustainable housing package")
- Regelingen Groen Beleggen ("Green Investment Schemes").

<sup>4</sup> architects, urban planners, client/owners, government, consultancies, universities.

who were asked to make comments on both its content and its form (time taken to complete it, ease of completion, etc.).

- A second draft questionnaire was drawn up in Dutch in the light of comments by the experts. This was submitted to the focal points, who were asked to make a critical assessment of it "from a foreigner's point of view". In particular, they were asked to look at whether the questions would be readily understood by people in countries outside the Netherlands.
- A third draft questionnaire was drawn up in Dutch in the light of comments by the focal points. This was assessed by the data analyst to determine whether it was suitable for processing with the help of statistical software.
- After further adjustments, the questionnaire was translated into English, with reference to a recent English translation of the Dutch publication "Handboek voor duurzame woningbouw" (WE-consultants,1996)
- Finally, the English translation was checked and corrected by the British focal point, assisted by various English-speaking building experts.

Eventually 250 respondents were approached, and 126 of them sent back a completed questionnaire – a response rate of just over 50%, which is considered satisfactory in surveys of this kind (written questionnaire, researchers not personally known to respondents). However, the number of questionnaires received from each country ranged from as few as 2 to as many as 10. Therefore, as already stated at the beginning of this article, the results cannot be treated as a detailed country-by-country analysis, but simply give an approximate picture of the current situation regarding sustainable housing in the various European countries.

Of the 126 completed questionnaires, 122 were processed with the help of the SPSS (Statistical Package for the Social Sciences) computer program. All the 126 questionnaires were also analysed manually in order to process additional information and identify any inconsistencies or errors. On the basis of this manual analysis, additional questionnaires were drawn up and submitted to focal points, specific respondents and a number of people attending the international conference on "Buildings and the Environment" in Paris in June 1997.

Finally, the draft texts of the country analyses were submitted for final checking by the focal points, who were asked to indicate whether the information obtained from the respondents had been correctly summarized and reproduced.

In the light of the information thus obtained, it can be concluded that the findings for 21 of the 24 countries are of satisfactory quality. However, the responses from three of the countries – the Czech Republic, Hungary and Spain– were so limited and inconsistent that the statistical findings cannot be considered reliable. Further inquiries were made in an attempt to obtain a reasonably reliable picture of the situation in those countries.

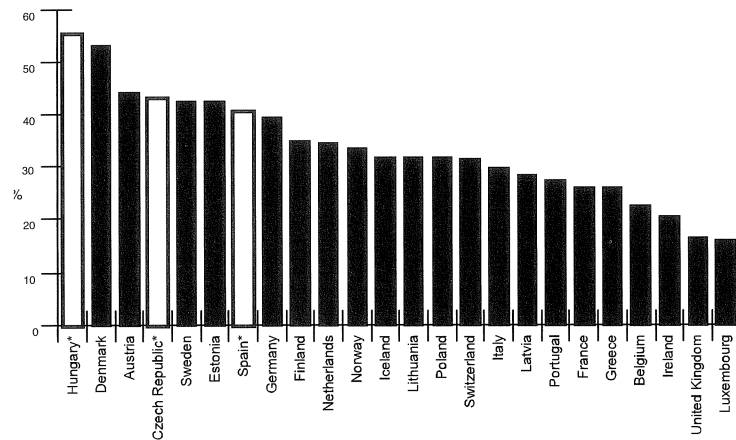
### 3 Findings

This section compares the findings for the various countries. The comparison was mainly carried out on a quantitative basis. As indicated in 2, the data for the Czech Republic, Hungary and Spain cannot be considered reliable. Where a more reliable picture can be provided in the light of information obtained after further inquiries, this is specifically stated at the appropriate point.

The extent to which sustainable housing measures are adopted in the various European countries was calculated as follows. On the basis of the information of which measures are adopted regularly, frequently or (almost) always in which countries (as reported by at least 50% of respondents from the country in question) each country was given a score, expressed as a percentage of the total number of measures listed in the questionnaire (309). These scores are shown in the first bar chart (fig. 1). The remaining bar charts (relating to the individual topics of energy, water, etc.) were produced by performing a similar calculation on the number of measures relating to the topic in question.

#### 3.1 Sustainable housing in general

There is considerable variation in the extent to which environmental measures are adopted in housing construction in the various countries. Whereas sustainable housing is clearly part of day-to-day building practice in some countries, in others the topic seldom receives serious attention. None of the measures listed is adopted frequently or (almost) always in all 24 countries<sup>5</sup>. On the other hand, various measures are adopted regularly everywhere. In particular, these include measures designed to reduce the use of CFCs and HCFCs and products containing formaldehyde, and to limit the use of asbestos.



\* unreliable data

Further inquiries suggest that Spain's score is similar to those of Greece and France, and that the Czech Republic's score is similar to that of the Netherlands. It is difficult to make a reliable assessment for Hungary, although it seems likely that the situation there is similar to that in the Czech Republic or in Poland and Lithuania; however, no conclusive evidence of this could be found.

Fig. 1. Measures adopted in the 24 countries: all measures listed in the questionnaire.

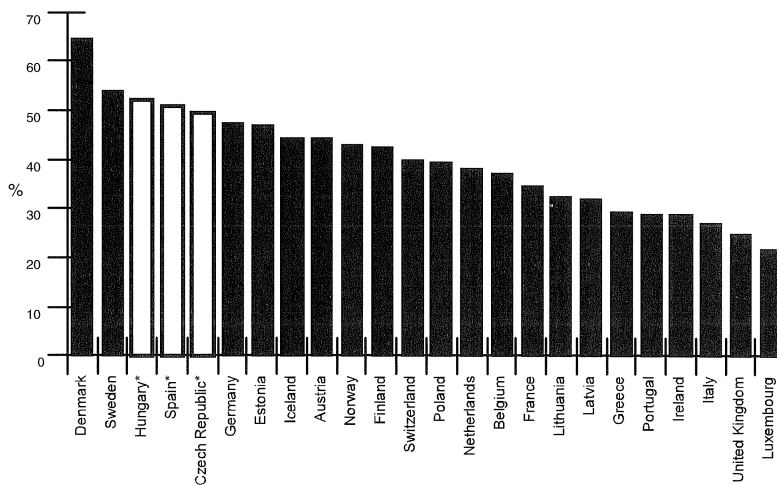
<sup>5</sup> A measure is considered to be adopted frequently or (almost) always in a given country if 50% of respondents filled in the "frequently", "(almost) always" or "compulsory" circle for that measure.

The scores in figure 1 can only be interpreted properly with reference to the country analyses. This is because in some countries (such as Estonia) new building only takes place on a very small scale. Environmental measures are usually very common in such cases. Yet the situation there can hardly be compared to the situation in a country such as the Netherlands, where large numbers of new dwellings are currently being built and where extensive sustainable housing measures are adopted in 5% – and the “national package of sustainable housing measures” in about 15% – of all new housing.

Irrespective of such background information, however, this comparison indicates that Denmark is currently the European leader in sustainable housing.

### 3.2 Sustainable housing topic by topic

The various countries were also compared topic by topic.



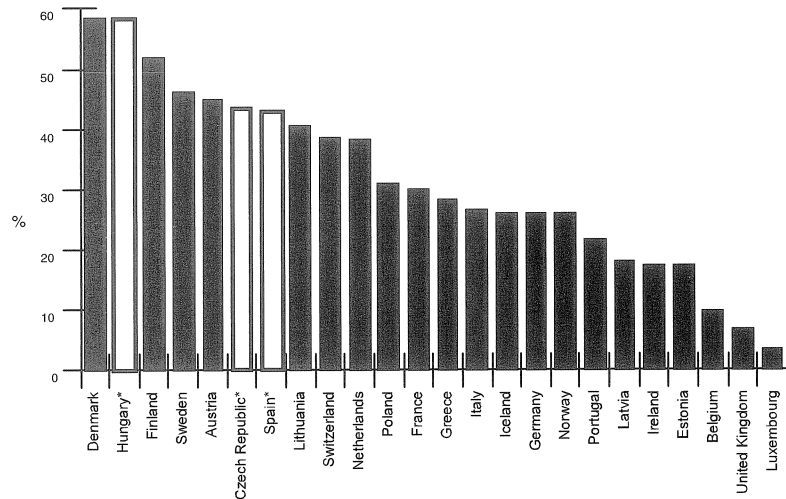
\* unreliable data  
 Further inquiries suggest that the situation in the Czech Republic is similar to that in Poland. No reliable information could be obtained for Hungary or Spain.

Fig. 2. Measures adopted in the 24 countries: energy.

Energy is the topic which receives the most attention almost everywhere. The questionnaire consists of 61 measures in this field. For example; façades facing south, enclosed kitchen, the insulation values, solar boilers and photovoltaic conversion.

Here again, Denmark is the leader, followed (some way behind) by Sweden. As expected, energy-saving measures are only adopted to a limited extent in southern European countries. The scores in this chart thus make reasonable sense in climatic terms. Iceland adopts fewer energy-saving measures than might be expected in view of its geographical location; however, this is explained by the fact that the main local source of heating is geothermal energy, which is available in such abundance that energy-saving measures have relatively low priority.

There are great differences between countries when it comes to thermal insulation values. Climatic factors obviously play an important part here. The Scandinavian countries pay a great deal of attention to thermal insulation of dwellings. Various Danish and Swedish respondents quote an Rc value of  $6.50 \text{ m}^2 \text{ K/W}$  for roof insulation, which is a high value compared with other countries. In Belgium, on the other hand, surprisingly little attention is paid to this topic. Belgian respondents indicate that an Rc value of  $1.50 \text{ m}^2 \text{ K/W}$  is usual for façades, ground floors and roofs. A number of countries do not lay down requirements for individual parts of buildings; instead, a sort of overall energy coefficient is calculated for the entire building.



\* unreliable data

Further inquiries suggest that the situation in the Czech Republic is similar to those in Latvia, Ireland and Estonia. No reliable information could be obtained for Spain or Hungary.

Fig. 3. Measures adopted in the 24 countries: traffic.

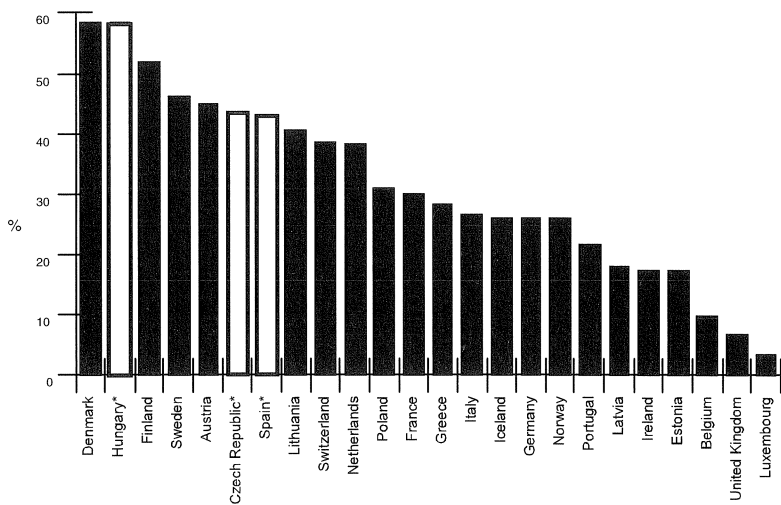
The questionnaire consists of 26 measures in the topic traffic. For example; network of cycling routes, parking area for car pooling, cycle parking near public transport stops, . . .

There are greater differences between countries in the case of traffic than in the case of energy.

In Luxembourg, for example, average incomes are relatively high and petrol is cheap, so cars are used a great deal and there is little interest in measures to limit car traffic.

In many countries, however, such measures are common, either for environmental reasons ( $\text{CO}_2$  emissions) or for practical reasons (time lost through traffic jams).

The popularity or otherwise of cycling also helps to account for the differences. In Poland, for example, cycling is a popular sport, but one respondent says it is 'not done' to cycle to work (unlike in Finland and the Netherlands, where cycling is very common).



\* unreliable data

Further inquiries suggest that the Czech Republic is correctly positioned on this chart. The situation in Spain appears similar to that in Italy. No reliable information could be obtained for Hungary.

Fig. 4. Measures adopted in the 24 countries: water.

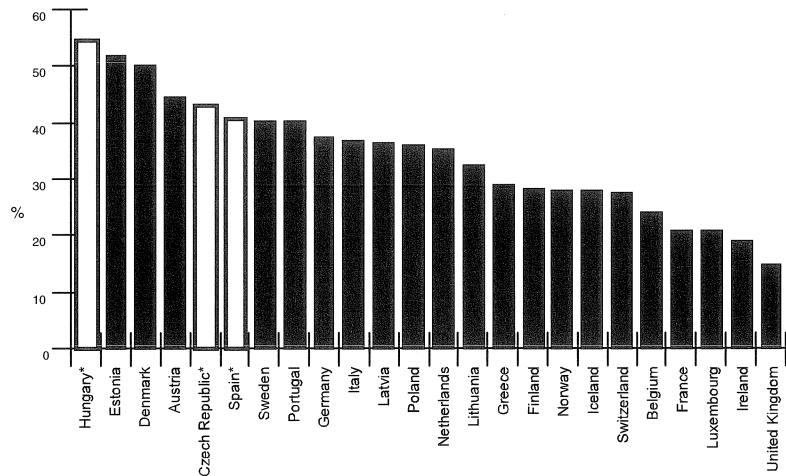
The questionnaire consists of 25 measures for the topic water. For example; closed water system in district (no intake from elsewhere), separate water meter in each dwelling, rainwater used to flush toilet, roof vegetation, . . .

Water is a topic which appears to be receiving increasing attention. Dehydration is currently a problem in many countries.

Since the survey is based on the situation in the Netherlands, the scores in this chart do not always reflect the true picture. The water-saving measures listed in the questionnaire (such as water-saving toilets, taps and showers) are too advanced for many countries. In some countries, installing water meters in all dwellings and/or increasing the price of water are the main measures to reduce water consumption. These measures, which all greatly reduce water consumption, were not listed in the questionnaire.

In some countries, certain measures listed in the questionnaire are quite simply prohibited.

In France, for example, recycling of rainwater – and, according to one respondent, even the use of rainwater barrels – is against the law.



\* unreliable data

Further inquiries suggest that the situation in the Czech Republic is similar to that in Latvia and Poland. Spain's score appears similar to that of Belgium. No reliable information could be obtained for Hungary.

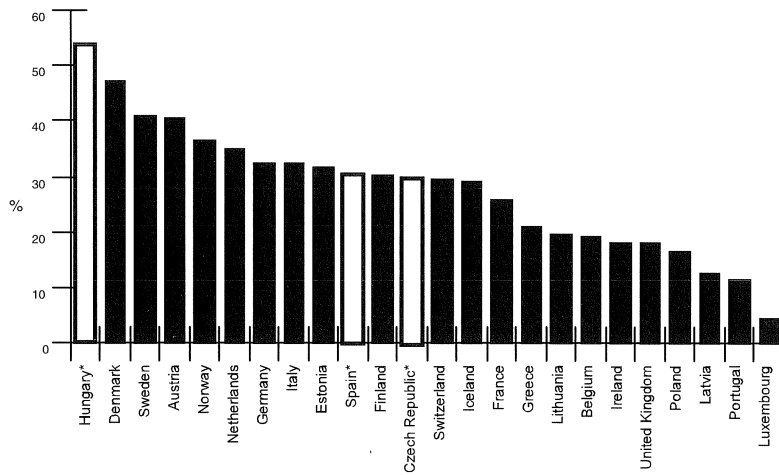
Fig. 5. Measures adopted in the 24 countries: materials.

The questionnaire consists of 86 measures in the field of materials. For example; zero net soil transport, ceramic material for sewers, no asbestos, european wood, mineral paint, recycled bricks used for masonry, . . .

All 24 countries show at least some interest in the environmental impact of materials, and the differences between countries are not very great with regard to this topic. The use of asbestos, red lead, products that damage the ozone layer and products with high levels of formaldehyde has been reduced to a minimum or completely banned almost everywhere. Another striking detail is that many countries have replaced PVC with the less harmful PP and PE for use in internal drains.

Some countries still have many traditional materials which were not originally adopted on environmental grounds but now turn out to be environmentally sound. A good example is the use of European wood. Other countries which switched over to tropical hardwood in the past are now switching back to traditional types of wood for environmental reasons. Another material which has traditionally been used almost everywhere is brick; one Danish respondent, however, says that brick should not be considered environmentally sound, because of the large amount of energy used in producing it.





\* unreliable data

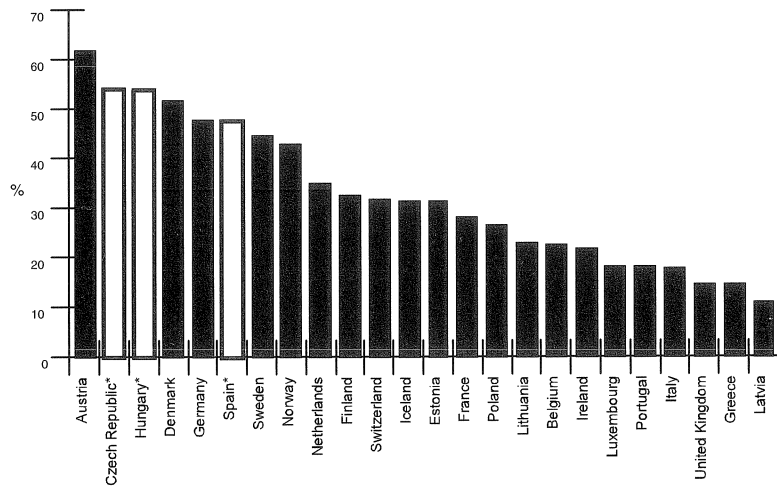
Further inquiries suggest that the Czech Republic is correctly positioned on this chart. The situation in Spain appears similar to that in Portugal. No reliable information could be obtained for Hungary.

Fig. 6. Measures adopted in the 24 countries: waste.

There were 43 questions on the topic of waste. They can be subdivided into the following subsidiary topics: separation of domestic and building-sites waste; prevention of waste due to premature replacement of materials (for example, by making dwellings accessible to disabled people from the outset); measures to make separation of materials easier at the demolition stage; and measures to limit waste on building sites.

Domestic waste is separated in most countries, but the number of fractions varies considerably. Paper and glass are separated almost everywhere. There is also great variation in the extent to which building-site waste is separated (ranging from no separation to seven different fractions).

Various countries take specific measures to ensure that dwellings are accessible to disabled people (so that less waste is generated when the dwellings are adapted), but few measures are adopted as yet to limit the use of foams, sealants, etc. so that materials can be separated more easily at the demolition stage.



\* unreliable data

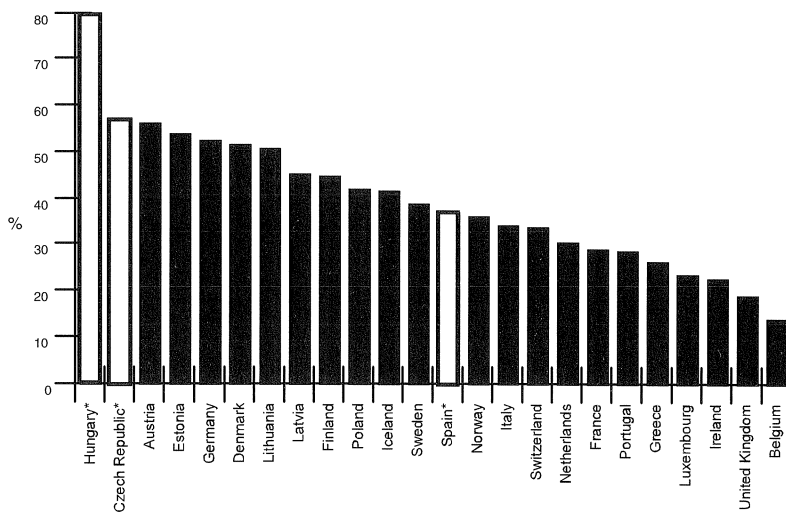
Further inquiries suggest that the Czech Republic is correctly positioned on this chart. Spain's score appears similar to that of the Netherlands. No reliable information could be obtained for Hungary.

Fig. 7. Measures adopted in the 24 countries: health.

The 11 questions on the topic of health mainly concern sound insulation. There is also an occasional question on radon and emissions of harmful gases from open fireplaces. Austria appears to adopt the most measures in this area. Denmark and Germany also pay a great deal of attention to this topic.

Only seven of the 24 countries frequently take measures to deal with radon. Dwellings in a number of countries never have open fireplaces, but this is usually for reasons of cost rather than environmental reasons. In Portugal, in fact, open fireplaces are very popular at the moment.

The respondents' replies indicate that sound insulation measures are adopted to some extent everywhere. At least one such measure is said to be adopted frequently or (almost) always in every country except Latvia, Italy, Poland and Portugal.



\* unreliable data

Further inquiries suggest that the Czech Republic is correctly positioned on this chart. Spain's score appears to be in between those of Belgium and the United Kingdom. No reliable information could be obtained for Hungary.

Fig. 8. Measures adopted in the 24 countries: flora & fauna.

There were 36 questions for the topic flora & fauna. For example; inventory of existing flora and fauna, tunnels and viaducts for fauna, vegetation on façades, maintenance of groundwater level, no pesticides for maintenance of public vegetation, . . .

The above chart shows that Austria is the country that adopts the most measures relating to flora and fauna. The measures listed in the questionnaire can be subdivided into those adopted at urban development/ dwelling environment level and those adopted at dwelling level. Few extensive measures are adopted at dwelling level, but far more are taken at urban development and dwelling environment level. The most common measures are inventories of archaeological and historical features and soil quality investigation.

In principle, all 24 countries take account of existing flora and fauna, but the extent to which they do so varies considerably. Specific features such as ponds for frogs and tunnels or viaducts for fauna are not common anywhere.

### 3.3 Sustainable housing country by country

This section examines the extent to which environmental measures are adopted in new housing construction in the various countries. This has been analysed topic by topic.

The analysis in this section consists of both quantitative and qualitative analysis. The quantitative data consist of a chart. The chart indicates the extent to which measures associated with a given topic are adopted.

The charts were compiled as follows. For each topic, the number of measures adopted regularly, frequently or (almost) always was determined. The average number of measures per country was then calculated, and this number was divided by the total number of measures for the topic concerned. The maximum score for each topic was thus 100%. The y-axis is not the same length for each country. It proved impossible to have a y-axis of equal length for each country, because of the great differences in their scores.

The qualitative analysis is based on perusal of the responses to the questionnaire and such further inquiries as proved to be necessary. Unexpected data and additional comments by respondents and focal points were processed into an explanatory text which is intended to help readers interpret the quantitative data properly.

Of the 24 countries three examples of the quantitative analysis are given: Austria, Denmark and the Netherlands.

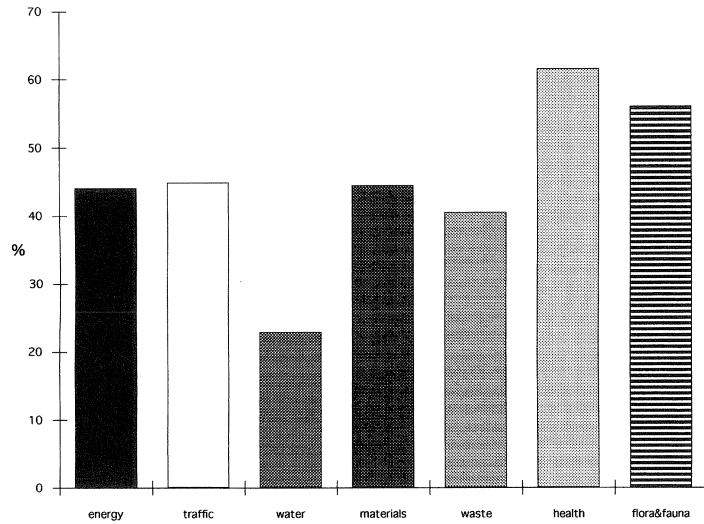


Fig. 9. The extent to which measures associated with a given topic are adopted in Austria.

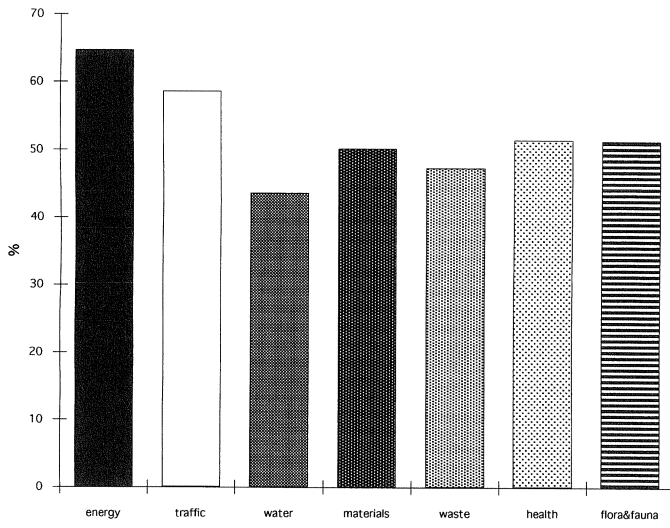


Fig. 10. The extent to which measures associated with a given topic are adopted in Denmark.

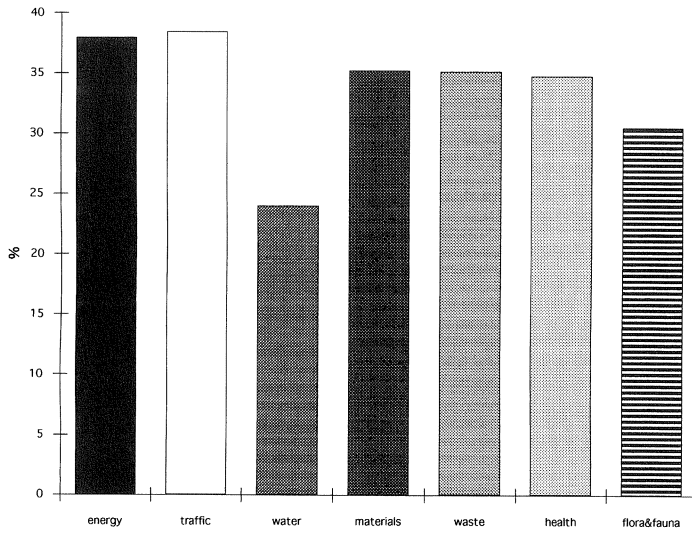


Fig. 11. The extent to which measures associated with a given topic are adopted in the Netherlands.

#### **4 Conclusion**

Sustainable housing practice varies considerably from one country to another. Sometimes there are good reasons for these differences. But there are also differences that can not be easily explained. Why, for example, is watersaving so common in countries without a lack of sweet water, like Sweden? And why is watersaving not common at all in a country as Italy which has a lot of water-problems? Why 'scores' Belgium worse than the Netherlands and Denmark so much better? And why do countries with a comparable climate not take the same energy saving measures? These questions demand further research. For this moment the conclusion is that the various countries can learn a great deal from one another, and that it is definitely worthwhile to look at what other countries are doing.

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