Check your school's energy performance

Just check: www.schoolconsumption.dk

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Abstract
This paper presents the design of a poster presentation of a web tool for benchmarking schools. The poster will show how benchmarking makes it possible to compare the energy consumption of schools on the basis of the schools' age, type and location. In this way, the tool will draw attention to poor and good energy performance of the buildings, and in addition make key actors aware of energy-saving measures and if possible, low energy behaviour.

A prototype version based on The Danish Energy Certificate Scheme introduced in 1997 is now available. This however, will be revised as soon as possible to adopt also schools labelled in agreement with a new Danish certification scheme, which is in accordance with The European Energy Performance Building Directive (EPBD).

When entering the tool, the user is required to select a specific school and this school will be used for benchmarking. After this, the benchmarking can be designed at will. Heat, electricity, as well as the water consumption of the school can be objects for benchmarking. Moreover, the user can opt for several units of measurement such as kWh of heat per square meter per year, or cubic meters of water per pupil per day. The criteria for the selection of schools relevant for comparison can also be decided. Among these criteria are period of construction, number of storeys and geographical location. Finally, the tool enables the user to visualise the consequences for the school of different combinations of energy-saving measures, such as using low-energy windows and low-energy lighting.

The tool is intended for energy officials, school caretakers, head teachers, teachers and even pupils. The development of the tool was financially subsidised via public service obligations. The administration and maintenance of the tool will for the next years be in the charge of the Danish Building Research Institute.

Introduction
Benchmarking is an acknowledged way of influencing energy conservation and energy-saving behaviour. The idea of benchmarking is that knowledge about one's own position compared to the position of other players in the same game will induce one to win a better position. This way, people responsible for the energy consumption of a specific building, for instance a school, will be content if benchmarks place the school building at the top or at least in the best half of the field of comparable buildings. In contrast, if benchmarks place the building at the bottom, the people responsible will usually be encouraged to search for measures to improve the energy performance of the building or induce the users of the school to improve their energy behaviour. Thus, efforts of both kinds can contribute to achieving a better energy-saving image for the school and they can save money.

This is the philosophy of the web tool for benchmarking schools' energy consumption. Thanks to an energy-certification scheme for large buildings (mandatory since 1997) all schools in Denmark with a heated area larger than 1.500 m^2 can be part of the benchmarking tool. Actually, the energy labels for schools issued as part of the mandatory building certification system are stored in a database available for research and benchmarking. In other words, the segment of the database

Contents Index Authors

concerning schools will be the core of knowledge of the web tool. At first, all public primary and lower-secondary schools for 7 to 16-year-olds will take part in the web tool.

The tool will be publicly available, and updating will take place annually. However, both annualised trends for the past five years and actual benchmarking against peer schools is available. In a final version the web tool has only been available for a short while. Nevertheless, both individual schools, green school NGO's, energy consultants and politicians have appreciated the tool.

A new energy certification system

Until the implementation of the EU directive on energy performance of buildings (EPBD), two energy certification systems were operating in Denmark, one for small buildings and one for large buildings. The small buildings system was based on asset rating, i.e. inspection and calculation, while the system for large buildings was based on operational rating, i.e. benchmarks and meter readings. Schools are categorised as large buildings and so came under the system based on operational rating. Operational rating is simpler and cheaper to carry out, so energy certification of large buildings was required once a year. In contrast, energy certification of small buildings was only required when a building was sold. Since the EU directive was implemented in Denmark in 2006, energy certification in Denmark has been based on asset rating, and in future large buildings like schools will only be certified once every five years. This unfortunately means that benchmarks for schools will show up less frequently than in the past. For some years to come, the web tool will use the old database, and when new data is available under the new system, the tool will use both old and new data.

Schools' benchmark

The benchmark tool only includes Danish schools and it is available at www.tjekskoleforbrug. When presenting the poster, English subtitles will be available. When entering the web site, the front page encourages the user to select a school. This takes place on the next page, where all Danish municipalities are listed in a scrollbar. By clicking on a municipality, all the schools belonging to that particular municipality will be displayed in another scrollbar. Clicking on a particular school will present the energy performance of this school as bar charts showing the trends in the school's energy consumption over recent years.

If energy labels for less than the last five years are available, only diagrams representing the years available are shown. Diagrams for the trends in electricity as well as heat consumption are shown. For heat consumption, a diagram for the actual consumption is shown side by side with a diagram of climate-adjusted heat consumption. In addition, a diagram of the trend in water consumption is shown.

Of course, these diagrams are not actual benchmarks, but rather a documentation of the position and trends for the selected school. Benchmarks are not available before energy arrows for the selected school are retrieved from the next page. Energy arrows of this kind are well known throughout Europe, for instance on energy-saving refrigerators and light bulbs. Here, the benchmarks are set according to the Danish energy rating system for energy labelling of schools and in this way they follow a predefined benchmark line. Arrows for electricity, heat and water are shown. A capital letter marks the actual position of the school.

Next, the particular school is benchmarked against the other schools in the municipality. This is illustrated by using a diagram in which the relevant school is located in the middle of a vertical scale, the five schools with the best score are placed above and the five with the lowest score are placed below. If less than five schools or possibly no school has a higher score than the selected one, the number of schools above will be correspondingly less. Similarly, if the selected school has a low score and there are less than five schools below it, then less than five schools will appear.

The score criteria can be changed on the web page. In one scrollbar, choice of municipality can be expanded in order to cover a region, county or the whole country. In a second scrollbar, the type of consumption (electricity, heat or water) can be selected. Finally, a third scrollbar allows you to choose different units for the figure, such as consumption per pupil

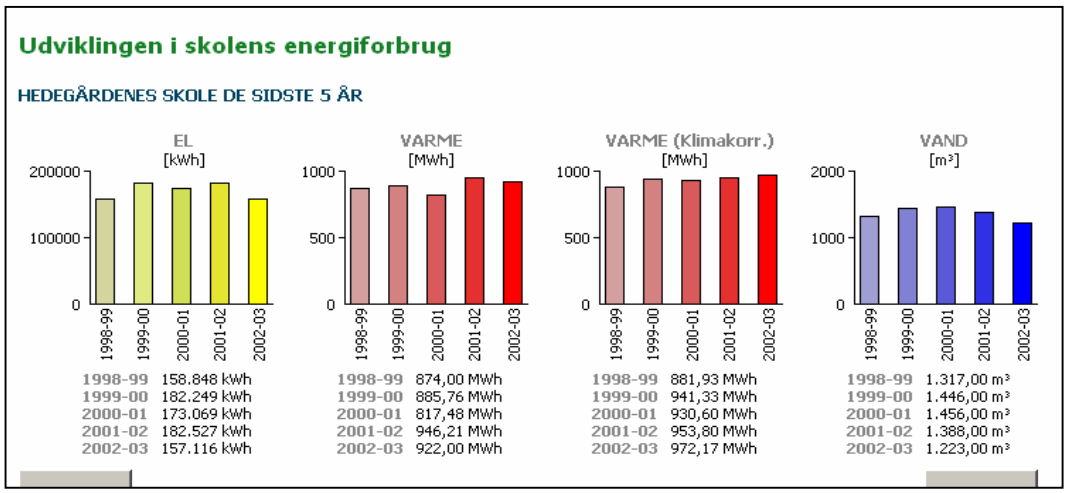

Figure 1. The energy performance of the school. The trends (Udviklingen) in the actual school's electricity (EL), heat (VARME), heat climate-adjusted (klimakorr.) and water (VAND) consumption for five years.

Contents Index Authors

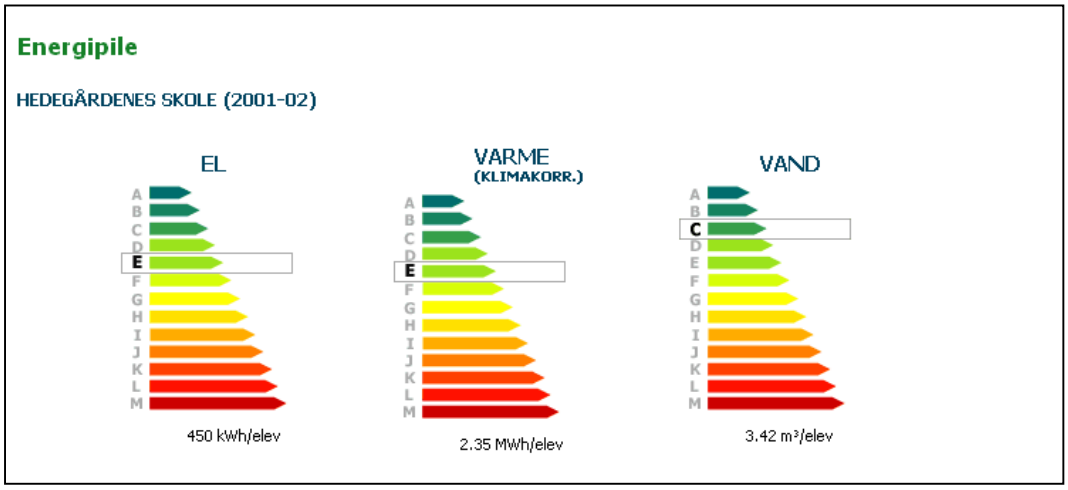

Figure 2. Energy arrows. The level of electricity (EL) and heat (VARME) consumption for the particular school (Hedegaardens skole) and the level of water consumption (VAND)

per year, per pupil per school day or consumption per m². As a result, the figure will change when choice of unit is changed and the position of the school in the hierarchy of consumption will change as well.

Benchmark injustices

Of course schools are different, some are new and some are old. Some schools provide classrooms for a nursery school or evening classes, while others provide sports facilities like a sports centre, a football field or a swimming pool. In such cases, the direct benchmark does not give an accurate picture of the school's position and it is clear that figures should be adjusted. Such adjustments can be made using a special correction module. This can be activated and different adjustment options are available. Within each kind of adjustment, different levels of use can be selected. For instance, a nursery school can be less than 100 pupils, between 100 and 200 pupils, or above 200 pupils. Correspondingly, the relevant number or evening classes can be selected, as can sports centres, swimming pools and football fields. The adjustment factors incorporated into the web tool are based on statistics collected from 54 schools in the municipality of Aarhus, the second largest city in Denmark.

Other facilities are contemplated. Among these are for instance access for schools to make their own adjustments by way of logins assigned each school.

Possible improvements

When "playing" with the web tool, it is likely that the user will start to look for improvements in the school's energy performance. To help the user, the tool is equipped with a module for technical improvements. A catalogue of possible improvements includes measures to save electricity, heat as well as water. Three obvious measures to save electricity are supported by the tool. These are replacement of strip-lighting systems, replacement of traditional bulbs in favour of low-energy bulbs and replacement of old computers. For the heat envelope of the school, the glazing in the windows is the most obvious target for energy savings. So, the tool helps the user to calculate how much energy can be saved by replacing old windows with new low-energy

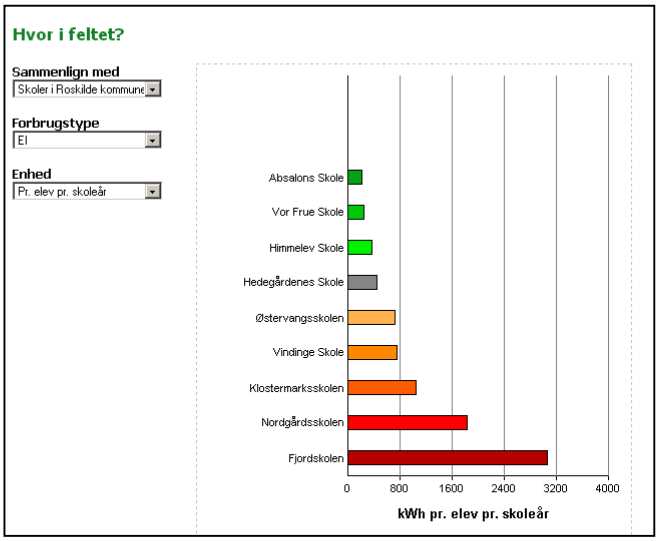

Figure 3. School's field position. The level of electricity consumption of the selected school (grey) compared to the five schools in the municipality with the highest – if higher than the depicted - and the five schools with the lowest position. In the example, The Hedegaardens Skole is the fourth best school in the municipality of Roskilde, concerning electricity (EL) consumption per pupil (ELEV) per school year.

windows. Finally, the user can calculate how much water can be saved by replacing toilets and shower heads.

When adjustments and improvements have been carried out, the tool presents a new set of energy arrows (see figure 2). In this way, it becomes clear whether the adjustments make any difference and whether the improvements are cost-effective.

Findings

The web tool www.tjekskoleforbrug.dk has been available on the Internet for almost a year. Since its launch, new energy-saving tools for use in teaching schoolchildren have emerged. None of them, however, enable the user to compare different

Contents Index Authors

schools, and very often www.tjekskoleforbrug.dk is involved in different kinds of education courses. Moreover, a real computer game is now being developed by professional game programmers at the Danish University of Education. The game is based on www.tjekskoleforbrug.dk, and it uses the same database and the same visualisation of benchmarks. However, the target group of the game is only schoolchildren, whereas the target group of the benchmark tool is energy officials, school caretakers, head teachers, teachers and pupils. The wide target group makes it worthwhile creating other benchmarking tools in order to promote energy savings. Therefore, a new tool aimed at buildings' energy performance in various authorities is now being developed.

The Poster

The poster will show the main elements of the web tool. In the same way as a user manual, text and illustrations will support the visitor in his or her use of the web tool. Thus, a computer with access to the Internet will enable the visitor to the poster presentation to find his or her way through benchmarking, adjustments and improving a selected school. Although developed for Denmark, the support system will enable English-speaking visitors to operate the web tool as well.