Beyond HERS – The Dutch Community Energy Rating System

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ABSTRACT

A Dutch variety of the Home Energy Rating System (HERS) was introduced in the early nineties. This system is the Energy Performance Code, based on the theoretical energy use for heating and cooling of both dwellings and offices. The EPC became part of the Dutch building code in 1995 and has been adjusted twice, since developments made it possible to sharpen the code without unacceptable costs.

In 1996 the Energy Performance on Location (EPL), a new rating system for new housing sites was also introduced. With the EPL, area designs of various energy concepts can be compared with regard to sustainability and economics in a transparent and equal manner. This enables the parties involved to make optimal choices, using the opportunities a particular site offers, to reduce CO_2 emissions. Through this approach at least 10% CO_2 emission is avoided compared to the "business as usual" approach.

The method was originally introduced on a voluntary basis for new building sites of at least 1000 dwellings. The majority of municipalities are using the EPL and its supporting tools.

Since 1998 project designs of energy infrastructures and systems have been benchmarked yearly. In 2001 the first benchmark of realised projects was made. Although the results of these projects are slightly lower than the original designs, they exceed the goals of the original programmes.

After proving its significance, the EPL is now being developed for existing areas where major reconstruction is needed.

This paper describes methods, supporting tools and the benchmark results.

Introduction

The Dutch sister of HERS is called the Energy Performance Standard (EPN). In 1995 the EPN became part of the building regulation in the Netherlands. In order to make progress, but avoid falling into the trap of unaffordable strictly building related measures, a system was developed that would not only contain the buildings, but would also contain the generation and distribution of energy to the end users in a particular district. The breakthrough of many large-scale building related measures is the success of the Energy Performance on locations (EPL), which was part of the Government programme Optimum Energy Infrastructure (OEI).

Despite its high population density, the Netherlands need a large number of new homes in which to house the increasing Dutch population. The expanding population, plus the slow decrease in the number of people living in one house, has resulted in this situation.
In the Fourth National Spatial Planning Policy Document dated 1995 (known as the Vinex policy document) the Dutch government announced that 1.5 million homes would be built

over the 1995-2010 period. However, new insight showed that building these homes in the traditional manner would lead to an unacceptably high use of fossil fuels, if the Netherlands wished to achieve international goals on reducing greenhouse gases.

After a number of experiments the Department of Economic Affairs launched the programme Optimisation of the Energy Infrastructure (OEI) in 1997. This programme focuses on improving the energy infrastructure in residential areas with the aim of reducing CO_2 emissions from housing. The measures are implemented at district level. The OEI approach is designed to put energy saving at the top of the agenda, with consultation between all the parties concerned and in consideration of all available (energy) options. Assistance from the Netherlands Agency for Energy and the Environment (Novem) and subsidies are important elements in this approach. The main targets were the 102 major development areas (known as Vinex locations). At least 1,000 homes a year will be built on each of these locations, and together they account for 800,000 of the 1.5 million homes that are due to be built over the 1995 – 2010 time period. The first main objects of the programme were new building sites, where knowledge distribution, mathematical models and subsidies have already led to a sharp drop in energy consumption.

Since 1999 the OEI programme has also been concerned with existing areas. After all, the Netherlands have six million homes, with potential savings of around 80 Peta Joules (PJ) per annum. Structural modification of the OEI approach can contribute 10 PJ of that 80 PJ.

The OEI Programme for existing areas is designed to encourage the integration of ideas about an optimum energy infrastructure in the decision-making on renovation projects and to promote development of knowledge among local decision-makers. In the first few years only projects with 250 or more homes were eligible for OEI assistance and subsidies.

History of Government Involvement in the Dutch Building Process

After the Second World War, large numbers of homes were built in the Netherlands. However, new building techniques and the introduction of large-scale or high-rise apartment blocks in the 1950s and 1960s led to various problems in the housing market. Not enough buildings could be built to meet the quality criteria such as health, space, comfort, etc. At the same time these houses suffered from high energy consumption, and there were many complaints about draughts and dampness. The “new” Dutch building technique could not win the battle against the windy, often wet Dutch climate. Therefore in the late 1970s and early 1980s a nationwide insulation campaign was established to achieve the first energy savings. At that time a standard house used approximately 2,300 m^2 of natural gas per year for heating.

Increased experience and gradual acceptance of new techniques led to better legislation. A 40% reduction in energy use for heating was achieved in the mid-1990s. The cornerstone of this legislation is the Energy Performance Standard (EPN), which is a model for calculating the so-called Energy Performance Coefficient (EPC) of a building.[1] In order

[1] The Energy Performance Coefficient does not predict actual annual energy consumption, however it does show the energy quality of the building. This is expressed as the quotient of two figures.

1. Annual energy consumption of space heating, ventilators, pumps, water heating, lighting, cooling and humidification calculated in accordance with the standards.

2. A standardised energy budget determined by the floor area, the area of the building shell and a number of weighting factors depending on the presence of systems to provide cooling and meet the minimum

to obtain a building permit (issued by the local authority), an architect has to show that the design for a house (or another building) is at least equal to or lower than the legal EPN value. In 1996 the required level of the EPC was 1.4 and was gradually made stricter to meet higher goals. From the year 2000 this limit has been reduced to 1.0. This means that a standard house should use around 1,000 m^3 of natural gas per year for heating.

An architect is free to select which measures will be incorporated to meet the EPN standard. If the design includes large glazed areas then other measures will be included to compensate, e.g. better insulation, better heating boilers etc.

The Ministry of Housing, Spatial Planning and the Environment sets the EPC level. This EPC standard not only gives the Dutch more energy-efficient homes, but the deployment improved building techniques have also made their houses far more comfortable and healthier to live in.

Optimisation of the Energy Infrastructure (OEI)

As the EPC was gradually made stricter, the need arose for more insight into the cost effectiveness of energy conservation techniques. To achieve the best cost effectiveness studies were undertaken to find out whether the most cost-effective energy savings were being achieved. Building-related measures and urban development plans (e.g. district heating) were compared. The answer to this question was "it depends on the circumstances". The government therefore decided to initiate the OEI programme to achieve two things:

- focus on the planning and building process;
- offer participants in the building process instruments to improve the overall energy efficiency.

The Building Process of New Building Sites

Traditionally, participants in the construction industry work sequentially and individually. Local and regional administrators make the regional plans and sell land to the property developers. The latter then make agreements with the energy companies for the planning of the energy grid.

The OEI programme brings together all parties involved at the earliest planning stages. Local authorities play a leading role in the process, as they often own the land, and are responsible for issuing building permits. Their prominent role in the OEI process is widely accepted. Civil servants consult the energy companies, property developers and often environmental lobby groups, which are well organised in the Netherlands. The local authorities can obtain free support from a Novem consultant to help realise collaboration between the parties involved and define an energy ambition for the location. This energy ambition involves parties looking at the energy infrastructure (cogeneration, gas/electricity or all-electric), the orientation of the houses, the EPC that can be achieved etc. Eventually the local authority will set an energy goal, known as the EPL (Energy Performance on Location).

Although this is a voluntary process, parties are very keen to participate. This is understandable, as this is a win-win situation for all stakeholders. In summary:

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ventilation requirements

- local authorities can show they are working on environmental matters as well as improving the overall quality of the local housing stock;
- property developers see a level playing field, where agreements are made on energy (and other environmental) performances. By working together they can also benefit from economies of scale;
- energy companies can learn to operate in a liberalised market. As theirs is the smallest profit of all the parties involved, they are the most difficult in contributing to the optimisation of the energy infrastructure.

OEI in Existing Areas

Since 1999 OEI has also been focusing on existing areas, on sites where there is large-scale restructuring of existing housing.

The buildings and surroundings in these areas are usually of a poor quality and there are often many social problems. In these areas crucial deliberations have to be made about sustainability and economic interests. Part of the aim of the programme is to increase the level of awareness of local decision makers, in order to enable parties involved in the renovation process to make the right decisions with regard to the future of the energy infrastructure in that particular area.

Novem concentrates mainly on areas where large-scale renovation of at least 250 dwellings is the case. The aim to increase the level of comfort and to promote the application of sustainable energy sources in these houses is only a small step in the renovation process.
In the Netherlands social housing corporations account for 50 % of the existing housing supply (6,000,000). [2] The goal of Novem is to be involved in 60 renovation or restructuring sites and facilitate the development and formulation energy visions on these sites in 2003.

There is a growing need from the community to involve energy aspects in spatial and city planning. The government responded to this with the OEI programme. This programme strives for a high-quality integral, energy supply, which makes use of local circumstances and chances and thus enables a reduction of CO_2 and a reduction of the use of fossil fuels through various energy concepts. The application of these energy concepts will also improve the level of comfort, sustainability, energy savings, and houses will become more attractive to live in.

The Optimal Energy infrastructure approach is very important to the Dutch government and should be achieved as effectively as possible. This means that there is a possibility to obtain grants that will support the parties to conduct a pre-feasibility study. This study focuses on the deliberation between architectural and installation technical measures and combinations that will reinforce each other. This study will be the starting point from to determine if and how an optimal energy infrastructure can be achieved. It maps out the opportunities of an area, how these can be integrated in an overall energy plan and which choices have to be made together with occupants, inhabitants and developers of the area.

[2] Social housing corporations also have a responsibility to society for providing good quality housing at a relatively low price. There is a maximum price level and prices must not exceed this level.

Differences Between OEI Existing Areas and OEI New Buildings Sites

The philosophy of OEI in existing areas is based on OEI in newly built areas. However, there are major differences between these two target areas. In existing areas there are more parties involved that have an existing interest. There is already an existing energy infrastructure. The economic feasibility of different energy concepts or options is much more critical. It also involves the inhabitants of the buildings being renovated who will monitor the entire process very closely.

The Instruments

In order to ensure that the OEI process is a success, a number of instruments have been developed, the most important of which are listed below.

- A step-by-step plan on location development, designed particularly for the laymen in the process. It offers a wide variety of possible measures that can be taken at each step of the environmental planning process, from the first regional planning sketches to the actual building process.
- Brochures and information on best practice via the Internet.
- Studies concerning "green" financing.
- Support from a Novem consultant.
- (Small) subsidies for studies to determine the most obvious alternatives regarding optimisation of the energy infrastructure (which includes sustainable energy). These studies do not usually lead to a specific selection, but describe a limited set of options (in a transparent way) for all involved.
- A calculation model to determine whether an alternative is economically viable.
- The Energy Performance on Location (EPL) norm for new and existing areas, see below for an explanation of this concept.
- A nationwide benchmark of the EPL, which shows participants the results of their actions compared to other locations.

Energy Performance on Location of New Building Sites

The Energy Performance on Location (EPL) is a standard developed in collaboration with Novem, the Ministry of Economic Affairs and the Ministry of Housing, Spatial Planning and the Environment in order to translate the reduction of CO_2 into a numerical term.

The EPL formula is:

$$EPL = 10 - 4 * \frac{F_{choice}}{F_{ref.}}$$

In this formula F stands for the calculated primary use of fossil fuels. F*choice* is the primary use of the location by the chosen energy supply. F*ref.* is the use when natural gas

and electricity are chosen for houses with an EPN of 1 and heating via a heating appliance. Local authorities can achieve a higher EPL by:

- constructional energy-saving measures e.g. better insulation and passive use of solar energy (= EPN < 1.0);
- using technically more advanced appliances e.g. electric heat pumps, heating appliances with condenser and solar boilers;
- using photovoltaic electricity;
- using district heating with few duct losses;
- using industrial "waste" heat, cogeneration etc.;
- using sustainable energy (including biomass and ecogas) outside.

Table 1 shows the EPL in relation to certain standard choices at various EPN levels in new building areas. Table 2 shows the EPL in relation to various energy supply options

Table 1. The EPL of Certain Standard Choices at Various EPN Levels

	EPN	1.4	1.2	1.0	0.75
EPL	Gas & Electric	4.9	5.5	6.0	6.6
	Heat & Electric	5.3	5.6	6.1	6.6

Table 2. EPL for Various Energy Supply Options

Production gas and/or electricity	Gas and electricity	Cogeneration via gas engine	Electricity & individual electric heat pumps
Natural gas and conventional electricity	6.0	6.1	5.9
10% sustainable electricity	6.2	6.3	6.3
50% sustainable electricity	7.0	7.2	8.0
10% ecogas	6.2	---	---
50% ecogas	7.0	---	---

If all standard options (natural gas, conventional electricity and an EPN of 1.0) are used, a location will have an EPL value of "6". Theoretically, a location can score a "10" if the use of fossil fuels is reduced to zero. Those involved in the energy industry might consider the use of nuclear energy as a good example of energy supply with zero greenhouse gas emissions, but the Dutch population voted against nuclear energy as an option for the future, so this option is excluded.

Results of OEI in New Building Areas

At the start of the OEI programme plans had already been made for a large number of Vinex locations. However, the management teams at all the locations contacted Novem and 75 of the 102 locations participated in an OEI process, which included both subsidies and

consultancy. Although some sites are still under construction, there are also quite a number of sites that are well into actual realisation of the EPL. (See Table 3)

Eventually this will lead to an extra energy saving of 11% on top of the savings already achieved by natural technical developments such as better insulation, better heating boilers, etc.

The programme already predicted this increase in EPL. More surprisingly was the consequent introduction of sustainable energy at a number of locations. Visitors to the Vinex locations can now witness how the collaborating parties are truly creating locations that are energy efficient. However, there were also a number of side effects. In the first place the programme proved to be very successful at smaller locations. Many of those responsible for these locations attended extra courses given by Novem, and many local authorities used the "best practice" information distributed by Novem. Estimates show that construction of another 105,000 houses has been strongly influenced by the programme. Another side effect is that the OEI method is spreading to other fields e.g. the use of water, safety, use of materials etc. The programme has therefore been far more beneficial than originally envisaged.

Table 3. EPL Benchmark Realisation for 2001

2001	Local authority	EPL	Houses	Start
1	Lelystad, De Landerijen	8.9	1,600	2000
2	Breda, De Kroeten	8.6	875	1998
3	Heerhugowaard, Stad van de Zon plandeel 2	8.5	1,410	2002
4	Amsterdam, IJburg fase !. Haveneiland en Rieteilanden	7.8	6,900	2001
5	Ede, Kernhem	7.8	3,500	1999
6	Tilburg, DE Wijk	7.8	3,000	2001
7	Amsterdam, IIburg fase 1 Steigereiland	7.7	1,940	2003
8	Den Haag, Wateringse Veld middengebied	7.4	3,310	2002
9	Heerhugowaard, Stad van de Zon plandeel 3 + 4	7.4	687	2003
10	Nijmegen, Waalsprong	7.4	11,000	1999
11	Amersfoort, Vathorst	7.2	10,900	2001
12	Utrecht, Leidsche Rijn	7.2	20,050	1997
13	Alkmaar, Vroonermeer Zuid	7.1	1,321	2000
14	Leiden Roomburg	7.1	975	2002
15	Rotterdam, Katendrecht-Zuid	7.1	1,280	2001
16	Oegstgeest, Poelgeest	7.0	1,047	1997
17	Rotterdam, Stadionweg/Veranda	7.0	1,300	1997
18	Heerhugowaard, Stad van de Zon plandeel 1	6.9	788	2001
19	Culemborg, Parijsch	6.8	545	2001
20	Harderwijk	6.8	369	1998

Energy Performance on Location of Existing Areas

As is explained in this text, the Energy Performance of a Location indicates the level of the energy quality of an area. In newly built areas the standard is defined with a numerical term of "6". This is the result of strict building regulations of new houses and a traditional energy infrastructure of gas and electricity. The EPL for existing areas is more complicated.

The numbers indicate the same level of energy quality. However, as is the case of many existing areas, the present number is more than 'insufficient'. Scoring a "4 "or "5 after large-scale renovation and restructuring can be quite an achievement and improvement. Unlike EPL for new building sites, not all options are open in existing areas, however it is very important to make use of the opportunities present within an existing area.

Conclusions

The benchmark of the OEI method has proven that substantial reduction of energy consumption can be achieved. The Dutch government, together with Novem are looking beyond the home energy rating systems for buildings. Dutch experience shows that is it not however a method that works everywhere and every time. Densely built areas where there is new construction or substantial renovation are ideal areas for applying this method of measuring and improving sustainable housing. When parties are willing to cooperate, buildings can be constructed and renovated that are more cost effective and still have more comfortable and energy efficient dwellings as a result.

Due to the result of this programme, the methods were incorporated into the new strategic framework on market implementation of energy efficiency within the Dutch built environment. The programme that was designed as result of this framework will add extra support to this success formula.

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