PassREg

Calculation programmes for feasibility studies of low energy renovations

Housing and other buildings

‘We need to change the perception that renovating buildings is actually a cost, while in fact it is an investment opportunity which has an enormous return on investment.’

- Oliver Rapf - Executive director, buildings performance institute Europe -

Survey	October 2014
For	IEE-project PassREg
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SUMMARY

Presented is a survey of computer programmes that offer financial calculations regarding renovation plans with a significant impact on the energy consumption of the building. These calculation programmes may be called computation instruments, tools, quick-scans, simulation models, etc. Selected were programmes that take both investment costs and subsequent reductions in operational costs (e.g. heating costs) into account. Investigated are several calculation programmes presently available in Europe that attempt to be comprehensive about the part of the building's life cycle from the renovation till the end of the building's life. The programmes take into consideration likely energy and maintenance savings and possible applications of RES (Renewable Energy Sources). In addition, some of them will point out omissions in the renovation plan.

Calculation programmes of this kind may be particularly useful to elucidate renovations that attempt to realise a building that requires little or no energy by using Passive House technology, supplemented if necessary by energy from sustainable sources.

Assessment

Four calculation programmes have been scored on a number of assessment criteria grouped into assessment themes. Every criterion received one of the six possible scores:

--	very poor
-	poor
+/-	moderate
+	good
++	very good
/	still unknown

The findings can be summarised in the following table of several pages. Under each theme the pertinent criteria are listed. After the name of each theme, a general indication is given for each of the assessed programmes on the criteria of that theme. This is shown in the red part above the specific criteria of that theme. This indication involves the number of positive assessments assigned as a proportion of the total number of scores under that theme. In this, every +/-, + or ++ counts as one positive assessment. The cummulative scores on all themes together provide a rational measure of the quality of the calculation programme.

In addition to the general score on a theme it is interesting to note whether the programme concerned scored a ++ on any of the criteria under that theme. This tells us whether the programme can deliver a result that is so striking or useful that it can be part of the story of the programme user to his or her client. In that case a + is shown after the general indication.

Peter Smit 29/6/2015 23:01
Opmerking [1]: I leave this out because it would take at least half an hour to alphabetise.

Peter Smit 29/6/2015 23:01
Verwijderd: ABBREVIATIONS

Peter Smit 29/6/2015 23:01
Verwijderd: BPIE Buildings Performance Institute Europe ... [1]

Peter Smit 29/6/2015 22:17
Verwijderd: ive

Peter Smit 29/6/2015 22:19
Verwijderd: s

Peter Smit 29/6/2015 22:20
Verwijderd: The cummulative scores on all themes together provides a rational measure of the quality of the calculation programme.

Summary of all calculation programmes	EconCalc 2.0	LZK - Tool	E-calculator	KBA-Renovatie
	1.	2.	3.	4.
A. Relevance	5/5 +	5/5	5/5 +	5/5
Suitable for home / office / other type of building	+/-	+/-	+/-	+
Appropriate for new construction as well as renovation	+	+/-	+/-	+
For designers / developers / building users	++	+	++	+
Usable without deep construction expertise	+/-	+/-	+	+
Does not require great financial expertise	+/-	+/-	+	+/-
B. Scope	5/7	5/7 +	5/7 +	5/7
Can handle rough sketches as well as detailed designs	-	++	++	+
Alternative plans can be entered	+	-	+	-
PHPP input possible	+	-	+/-	-
Offers suggestions and explanations	+/-	+/-	++	+/-
Easy to use / fast calculation	-	+	-	+
Compares before/after renovation	+	+/-	-	+
Allows user generated input	+	+/-	+	+
C. Input items:	19/22	19/22	19/22 +	16/22
Deal with building shell				
Expected energy loss in roofs / walls / floors / windows (thermal insulation)	+	+	+	+/-
Airtightness can be entered	+/-	-	+	+/-
Expected energy use	+	+/-	+/-	+
Climate data	+	-	-	+/-
Deals with installations/energy				
Climate system	+	+	+	-
Option to enter energy sources / RES	--	+/-	+	+
Specification of energy use in heating / cooling / appliances	+	+	+	+/-
PHPP input possible	+	-	+/-	+
Primary energy use	+	+	+	-

Peter Smit 29/6/2015 22:20
Verwijderd: 5.

Peter Smit 29/6/2015 23:02
Verwijderd: H

Peter Smit 29/6/2015 23:03
Verwijderd: N

Peter Smit 29/6/2015 23:06
Verwijderd: Not too much

Peter Smit 29/6/2015 23:06
Verwijderd: required

Peter Smit 29/6/2015 23:07
Verwijderd: N

Peter Smit 29/6/2015 23:07
Verwijderd: too much

Peter Smit 29/6/2015 23:07
Verwijderd: required

Peter Smit 29/6/2015 23:08
Verwijderd: For

Peter Smit 29/6/2015 23:12
Verwijderd: time

Peter Smit 29/6/2015 23:10
Verwijderd: B

Peter Smit 29/6/2015 23:10
Verwijderd: I

Input items (continued)	1. EconCalc 2.0	2. LZK - Tool	3. E-calculator	4. KBA-Renovatie
Deals with costs				
Sensitive to financing/mortgage type	+	+	+	-
Cost of building shell	+	+	+	+/-
Cost of investment other than shell	+	+	+	+/-
Process costs	+	+/-	+	+/-
Subsidies / fiscal benefits	+/-	+/-	+/-	+
Duration	+	+	+	+
Changes in value	+/-	+/-	-	+/-
Energy prices	+	+	+	+/-
Cost of maintenance	-	+	+/-	+/-
Complies with EU regulation 244/2012	-	+/-	++	-
Includes input all LCC aspects	+	+	+	-
Costs of CO2 emission	+	+/-	-	-
Cost of climate system	+	+	+	+/-

D. Output options:	2/6	6/6	6/6 +	2/6
Intelligibility	+	+	+/-	+
Computes cost optimum	-	+	++	-
Cost over life cycle	+	+	++	-
Computes cost to residents / users	-	+/-	++	-
Transparency of calculation method	-	+/-	++	+/-
Dynamic model, shows impact of change in design	-	+/-	+/-	-

E. Availability	6/7	3/7	5/7	6/7
additional software required	+	+/-	+	+
For both PC / Mac	+	+/-	+	+
Price	+	-	+	+/-
Several Languages	-	-	-	-
Available online	+	-	-	+
Installed locally / used online	+/-	+/-	+	+
Periodic updates	+		+	+

Peter Smit 29/6/2015 23:10
Verwijderd: C

Peter Smit 29/6/2015 23:11
Verwijderd:

Recommendation

The four programmes can be characterised as follows:

1. Econ calc

This programme offers a wide range of input possibilities. By featuring an example application, it helps the user to make use of all these input options. One of its strong points is that it can juxtapose five variations on the renovation of a particular building.

2. LZK tool

This programme is very elaborate yet easy to use. It was created by a consultat office for their internl use in new construction. Presently, they re developing a version even more tailored to renovations. That version, however, is not yet available on the Dutch market.

3. E-calculator

This calculation programme was developed by the Knowledge Centre on Energy (KCE) of the Catholic University (KU) at Leuven, Belgium and Thomas More. The computation follows the perspective of the entire life cycle and includes a residual value. A distinguishing element of this programme is that it will identify the set of renovation interventions that is optimal from a cost point of view. So it does more than just calculate the life cycle cost of interventions as entered.

4. KBA-renovatie

This computation tool will provide a quick and celar impression of the energy quality after renovation. It is not very comprehensive on the life cycle aspect, but can be used in a first orientation.

Peter Smit 29/6/2015 22:26
Verwijderd: De vijf programma's zijn behoorlijk verschillend, maar geven samen een goede indruk van de breedte van het palet aan invoer en output mogelijkheden van een programma ... [2]

Peter Smit 29/6/2015 22:26
Verwijderd:

Peter Smit 29/6/2015 23:18
Verwijderd: Het model heeft veel vrijheid voor invoer, wellicht iets te veel voor een snel inzicht in kosten. Voorbeeld model is nuttig, om invoer mogelijkheden te zien. 5 varianten naast elkaar kunnen inzien is goed. ... [3]

Peter Smit 29/6/2015 23:41
Verwijderd: Erg uitgebreid en goed bruikbaar programma. Gemaakt voor intern gebruik voor advise bureau, werkt ook aan een renovatie-model.Helaas (nog) niet beschikbaar voor de markt.

Peter Smit 29/6/2015 23:21
Opmerking [2]: Since the summaries of the other programmes are quite short, I abbreviated this summary a lot.

Peter Smit 29/6/2015 23:21
Verwijderd: The

Peter Smit 29/6/2015 23:21
Verwijderd: calculation programme 'E-calculator' shows the higher overall number of pluses in the table above. Assuming all pluses are of equal value, this makes it the preferred programme at the moment.

Peter Smit 29/6/2015 23:23
Verwijderd: Although this programme in its present form is aimed at new construction projects, it still meets most of our criteria to elucidate renovation plans. The programme complies with the relevant European regulation to compute a 'cost-optimal' design (EU 244/20 ... [4]

Peter Smit 29/6/2015 23:23
Verwijderd: This way, the programme can arrive at combinations that, of ... [5]

Peter Smit 29/6/2015 23:24
Verwijderd: The process of identifying the optium works as follows. Per construction element a number of ... [6]

Peter Smit 30/6/2015 21:52
Verwijderd:

Peter Smit 29/6/2015 23:41
Verwijderd: Kort overzichtelijk geode snelle indruk. Niet heel complete op gebied van LCC maar kan goed wor ... [7]

Towards an all-European model

At preset, the 'E-calculator' programme may be the better one. In the summarising table above, it scored the most plusses. However, it is not very user friendly, and it is not particularly aimed at renovations. Providing the input is an elaborate affair and its computations take a lot of machine time. While the computer is processing the data, one is advised not to use the machine for anything else because doing so may disrupt the calculation process.

The same software development team is presently preparing a more user friendly version for renovation projects. That software development effort started in September 2013 and was expected to last for 4 years.

In order to make this calculation programme suitable for application anywhere in Europe, a few changes would be desirable:

- Translation into English.
- Use of a measurable energy performance indicator, for example in kWh/m^{2}a, instead of an index or the Belgian E- or K-levels. Similarly, climate systems should be characterised in an internationally common way instead of using the Belgian categories of A, B or C.
- Provide a link to a database of European construction materials such as www.constructioncosts.eu; this would simplify the input process.

When making this calculation programme suitable for all of the European Union, the following other programmes may be looked at for inspiration. ENNE (in 3 D) and GREX PLUS are very easy to use and offer dynamic feedback on changes of the input by ticking items on or off in a list or by moving a slide in a bar. LZK TOOL offers its output in a very clear format and features a link to a database of construction materials.

Peter Smit 30/6/2015 21:52
Verwijderd: De weg naar een Europese toepassing van een model

Peter Smit 29/6/2015 23:31
Met opmaak: Lettertype:14 pt, Cursief

Peter Smit 29/6/2015 23:31
Met opmaak: Lettertype:14 pt, Cursief

Peter Smit 29/6/2015 23:29
Met opmaak: Normaal

Peter Smit 29/6/2015 23:31
Verwijderd: However

Peter Smit 29/6/2015 23:34
Verwijderd: used as examples

1. INTRODUCTION

Renovations that include serious energy conserving interventions, such as EnerPHit renovations, will reduce the amount of energy required for a building a great deal. Supplemented by energy form renewable sources this can lead to ‘near zero energy buildings’.

For EnerPHit renovations, interventions in the areas of insulation, economic installations and sustainable energy sources are carefully put together. High insulation factors and airtightness have an impact on the type and size of the systems needed for heating, cooling and ventilation. In order to justify and promote EnerPHit renovations it is important to elucidate the reductions of costs during the use of the building from then on. Investment costs and reductions of operational costs should be juxtaposed clearly. Based on that integral view the ambitions may be adjusted to a joint optimum of costs and energy.

This report explores existing European computation instruments, tools, quick-scans, simulation models and the like that will clarify financial aspects of renovations with strong energy conserving elements and the possible application of energy from sustainable sources. In this report, these instruments are called ‘calculation programmes’. They may take the perspective of the life cycle of the building involved and they may identify omissions in the renovation plan.

As no fully suitable calculation programme could be found, we will give recommendations for the process of developing a tool that can be applied anywhere in the European Union.

Peter Smit 29/6/2015 23:47
Verwijderd: om te komen tot een Europees inzetbaar rekenmodel.

2. OBJECTIVE AND CONSTRAINTS

The objective or purpose of this survey is to explore existing **European** computation instruments, tools, quick-scans, simulation models and the like that will clarify **financial aspects** of **renovations** with strong energy conserving elements and the possible application of energy from sustainable sources (**RES**). In this report, these instruments are called 'calculation programmes'.
The above statement of the objective includes bold phrases indicating a number of limitations of the subject area of this survey. These constraints are dealt with as follows.

European

The survey includes first of all calculation programmes that were developed in the European Union. In case calculation methods are found that meet our criteria but have their origin outside Europe, these will be mentioned on the side. In case a calculation programme is not yet suitable for all EU countries, indications will be given of the adjustments that would help towards that applicability.

Peter Smit 29/6/2015 23:49
Verwijderd: U

Building type or function

The objective is to assess calculation programmes for all types of buildings. In case a programme focuses on one type of building only, e.g. on housing only, this will be stated.

Renovation or new construction

Discussed are mainly calculation programmes suitable for renovation projects. If a particular programme developed for new construction projects meets most of the criteria listed in this report as well, it will be included in the survey as well.

Peter Smit 29/6/2015 23:50
Verwijderd: nonetheless

NZEB – Nearly/Net Zero Energy Building

The survey focuses on calculation programmes that can handle the plans for NZEB renovations. For example, programmes that are limited to interventions with which NZEB performance cannot be reached will not be included.

Peter Smit 29/6/2015 23:53
Verwijderd: die in de keuze opties geen waardes hebben waarmee een NZEB kan worden gerealiseerd worden niet meegenomen.

RES - Renewable Energy Sources

It is the EC's objective to become independent of fossil energy supplies from other continents[1]. The application of renewable energy instead of fossil fuels makes a difference, not only ecologically but also economically. Investments in renewable energy sources can yield a return as they replace non-renewable energy. This in turn will influence the life cycle costs of the project.

Costs: optimal or LCC (Life Cycle Costs)

Optimal costs are the costs of the design solution that will result in the better cost-benefit balance over a particular time period.
This time period may be the life cycle of the building or a shorter period, such as 30 years. In case the latter is adhered to, it will be interesting to note whether the calculation programme takes a residual value into account.

Programme impact on the design

[1] http://www.erec.org/policy.html

The possible impact of an application of a calculation programme on the design is larger early on in the design process. It can have an 80% stronger impact in the very first, initiation phase[2]. Hence, it is of particular importance that the calculation programme is suitable for that early phase in shaping the plan.

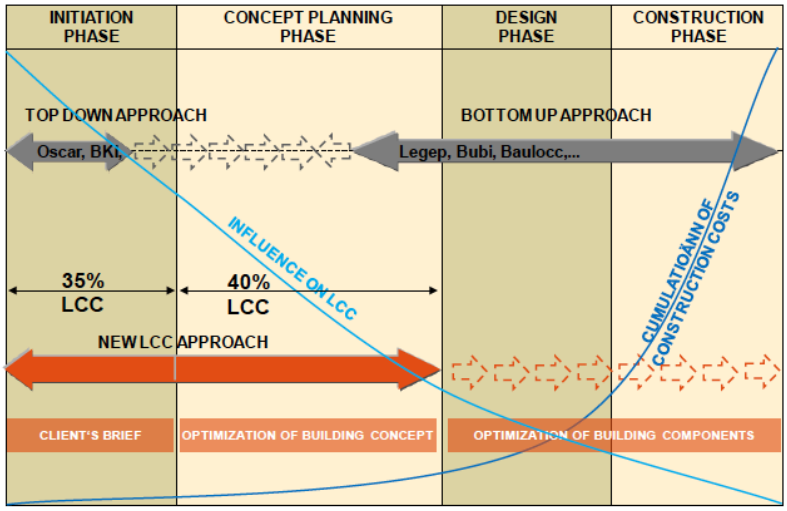


Figure 1: Influence on costs and fields of application for existing tools (Source: original illustration)

[2] Calculating life cycle cost in the early design phase to encourage energy efficient and sustainable buildings – Gerhard Hofer – e7 Energie Markt Analyse GmbH
Bernhard Herzog - M.O.O.CON GmbH
Margot Grim - e7 Energie Markt Analyse GmbH
(LZK-tool)

3. RESEARCH QUESTION

3.1 MAIN QUESTION

High quality renovations that seriously address energy saving often require a larger investment than renovations that merely meet maintenance requirements.

Investments in quality renovations can reduce energy requirements a great deal, improve comfort a lot and extend the life of the building. From the perspective of the life span of the structure, an important shift in cost takes place. To justify the investment decision, an integral view should be taken of the costs from the time the renovation starts. This perpective should also include any life time extension of the building, the change in the building's value and the savings on energy and maintenance during its use after the renovation.

Peter Smit 30/6/2015 21:55
Verwijderd: vanaf start project

Peter Smit 30/6/2015 21:56
Verwijderd: as well as

Peter Smit 30/6/2015 21:57
Verwijderd: over de levenscyclus

How can costs be optimised when considering the full period after renovation? Additional costs may include, for example, a more elaborate ventilation system that is indicated when the insulation of the shell of the building is improved. On the other hand, the better insulation may allow a smaller heating system. In addition to this lower investment cost, the new insulation will reduce monthly heating bills.

To be able to predict the joint effect of the initial investment and the subsequent savings, a calculation programme is needed that will include all these factors. It should provide an overview of the remaining life span of the building. Moreover, the calculation programme should be applicable in all of Europe.

What calculation programmes are available in Europe that are fit for use in feasibility studies of renovation projects with high energy saving ambitions (to the level of a Passive House, an energy-neutral or a no-bill home) and that incorporate utility costs from an LCC or DBFMO perspective?

3.2 SECUNDARY QUESTIONS

Europe

This survey intends to provide an overview of calculation programmes available in Europe. When a programme can be used in a set of countries it may foster the exchange of knowledge and experience between those countries.

1. *What calculation programmes are available in Europe?*
2. *What is it that ties some programmes to particular countries?*

Applicability

The question to what extent a particular programme is applicable is a broad one demanding further specification. Applicability may be seen in terms of ease of access to the software, demands on the input, quality of the output, direct or visual presentation tools and the required level of expertise of the user.

1. *Through what criteria can applicability of a calculation programme be assessed?*
2. *How can scores on these criteria be ascribed and compared?*

Feasibility study / computation of optimum

Calculation programmes should not only consider investments during renovation, but also the financial benefits for the rest of time.

1. *How can a cost optimum be defined and how will it be computed?*
2. *How is any optimum represented in the calculation programme?*

Peter Smit 30/6/2015 21:59
Verwijderd: *What is cost optimal en hoe wordt het berekend?*

Far reaching energy conserving interventions

There are many labels for renovations with thorough or extreme energy saving impacts. Do these refer to measurable concepts? Can these concepts be integrated in a calculation programme? If a particular type of far reaching renovation originated in one country, is it important that calculations can be done about it throughout the EC countries?

1. *What types of renovations with for reaching energy savings have been defined in Europe? How can these be quantified / measured?*

4. EUROPE

Sub 1: What calculation programmes are available in Europe?

The selection of calculation programmes focused on hybrid models. These are (see appendix 4) models of energy use, yielding figures for both renovation investment costs and subsequent cost reductions through lower operating expenditures due, as a whole or in part, to lower energy requirements. An extensive internet search and query among experts resulted in a list of 17 calculation programmes. After applying the selection criterion a short list of 6 calculation programmes remained. The other 11 programmes are discussed in chapter 8.3.

Sub 2: What is it that makes some programmes particular to a specific country?

Energy label

The European Energy Performance of Buildings Directives (EPBD) 2002/91/CE and 2010/31/EU were approved by the European Parliament in 2002 (EU27 + Norway and Croatia). The directives stipulate that every member country of the EU has to use a label representing the building's Energy Performance Coefficient (EPC) in categories such as A++ (very good) or G (very bad). It leaves al countries free to prescribe a minimal EPC for new construction. Any prescribed value for new construction, however, should not deviate from the cost-optimal level for that country by more than 15%. This cost-optimal level is computed according to directive 2012/244.

Calculation programmes that allow manual input of energy consumption can be used in all EU countries.

Tax, rebates and fiscal regulations

The types of taxes, subsidies and fiscal regulations differ between different countries in the EU. When rebates and tax regulations can be entered in a calculation programme by hand, the programme can still be applied throughout the EU.

Mortgage/loan structure

The calculation programme gains in realism if a variety of mortgage forms can be entered in the calculation programme. At least it should be possible to enter all pertinent interest levels over the period of the mortgage or loan that will bear the costs of the renovation.
The most common forms of mortgages include:

- Linear mortgage
- Annuity mortgage
- Mortgage with life insurance
- Mortgage with savings arrangement
- Mortgage with arrangement to invest
- Mixed savings and investment mortgage

Of course mortgages are a common form on financing construction activities in privately held homes only. The portion of homes that is user-owned differs by country. In Southern Europe and Belgium it is high (about 80%), while in the Netherlands it is about 50% to 56% and in Germany 43%[3].

A good calculation programme can serve private home owners as well as organisations that rent out homes or apartments.

As long as a calculation programme facilitates the manual entry of financial stipulations such as interest rate and duration, its use in different countries should not present a problem.

Construction costs

To test the feasibility of a project, the difference in construction costs between counties is not relevant. However, the situation is different when a calculation programme is linked to a particular library listing construction materials and their costs. If this listing holds for one country it may not be very useful in other countries.

In this perspective it would be useful either to extend the library to an all-Europe library, or to transpose it through an index.

An example of the first is www.constructioncosts.eu and its effort to create a transparent, up to date and correct database on costs for Europe.

An example of the second is the Cost Index for Buildings and Construction, developed by Eurostat for new residential construction[4].

Moreover, construction costs will form no barrier to the use of a calculation programme in many countries if the data on costs can be entered or selected manually.

Construction regulations

While the regulations concerning construction may differ between countries, this should not impair the use of a calculation programme in a variety of countries as long as the regulations are not incorporated in the programme.

Climate data

If the amount of energy to be consumed is entered in a calculation programme by entering a climate zone then it is important that options are available in the programme for all European climate zones.
If the amount of energy is to be entered as such, manually, then one is advised to compute this with a tool that includes climate data, such as PHPP.

[3] Peter Neuteboom **Een internationale vergelijking van de kosten en risico's van hypotheken** DGVH/NETHUR 2002
[4] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sts_copi_q&lang=en

5. APPLICABILITY

Sub 1: Through what criteria can applicability of a calculation programme be assessed?

There are many ways to evaluate the applicability of a calculation programme. The most important criteria for the present survey were compiled in the following list. Categories of criteria in this list are: scope, utility, input items, output options and availability.

Relevance

To whom and for what kinds of projects is the programme targeted?

- Home / office / other type of building

Is het rekenmodel voor een of meerdere type gebouwen te gebruiken.

- New construction / renovation

Is het rekenmodel geschikt voor nieuwbouw projecten of juist renovaties?

- For designers / developer / building users

Welke achtergrond informatie en kennis is nodig om het model in te vullen, is het daardoor geschikt voor bijvoorbeeld opdrachtgever, of juist ontwerper.

- Not too much construction expertise required
- Not too much financial expertise required

Beide aansluitend op vorige vraag, waar ligt het accent van de vereiste kennis?

Scope

In what phases of the design process scan this programme be used to improve design decisions?

- For rough sketches as well as detailed designs

Het is belang belang dat de haalbaarheid in vroeg stadium kan worden getoetst omdat hier nog veel bepaald kan worden. Ook interessant om te weten of het rekenmodel gehanteerd kan worden om tijdens de uitwerking te benutten om steeds gedetailleerdere informative in te kunnen vullen.

- Alternative plans can be entered

Bij het zoeken naar een optimal plan, is het nuttig als er meerdere alternatieven kunnen worden ingevoerd.

- PHPP-input possible

Indien PHPP invoer kan worden gebruikt, levert dat nauwkeurige data op en scheelt dat voor in het rekenprogramma veel invulwerk. Indien het rekenmodel zelf op basis van invoer een nauwkeurige berekening van energiebehoefte kan maken is da took nuttig.

- Offers suggestions / input options / user-generated input

Geeft het rekenmodel suggesties voor in te voeren data of keuze opties, dat maakt een globale berekening in vroege fase eenvoudig en snel. Indien deze waarden in latere fase verfijnd kunnen worden, wordt de berekening steeds nauwkeuriger.

- Easy to use / calculation time

Een vervolg op de eerdere criterium, is het rekenmodel eenvoudig te gebruiken, vergt het veel of juist weinig invoer tijd voor er een resultaat zichtbaar is.

- Compares before/after renovation

Is het mogelijk om een project in te voeren op basis van voor- en na- renovatie? Zodat het effect van de renovatie inzichtelijk wordt.

Input items

To what level of detail can input be provided and how self-evident is the use of programme?

Building shell

- Expected energy loss in roofs / walls / floors / windows (thermal insulation)

Indien rekenmodel zelf energie behoefte genereert, is het van belang dat de invoer nauwkeurig kan. Indien energie verlies/gebruik rechtstreeks in te voeren vanuit PHPP minder van belang

- Airtightness as separate item

idem

- Expected energy use in installations

Energieverbruik als resultante van berekening van het model of als ingevoerde data vanuit PHPP in combinatie met energieverbruik tapwater, installaties en huishoudelijk verbruik.

- Climate data

Indien rekenmodel zelf energie behoefte genereert, is het van belang dat de invoer nauwkeurig kan. Indien energie verlies/gebruik rechtstreeks in te voeren vanuit PHPP minder van belang

- Installations/energy

Energie verbruik van installaties

- Climate system

Invoer mogelijkheden betreft samenstelling klimaatsysteem

- Option to enter energy sources / RES

Is er ruimte om in te voeren of en welke hernieuwbare bronnen er worden toegepast?

- Specification of energy use in heating / cooling / appliances

Is er een verdeling in energiebehoefte uitgeplitst naar verwarming/koeling/huishoudelijk gebruik.

- Energy required according to PPHP

Is de energie behoefte direct uit PHPP berekening in te voeren?

- Primary energy use

Wordt in de berekening meegenomen om hoeveel primaire energie het gaat? Verschillend per energiebron.

Costs

- Sensitive to financing/mortgage type

Zijn er verschillende invoer mogelijkheden met betrekking tot financieringsafspraken. Type hypotheek, rente etc.

- Costs of building shell

Kosten voor de bouwkundige aanpassing van de gebouwschil

- Costs other than shell

Bouwkosten niet behorende tot de gebouwschil, fundering, installaties, constructive etc.

- Process costs

Kosten die samenhangen met het process zoals advieskosten

- Subsidies / tax benefits

Financiele voordelen door subsidie of fiscale regelingen

- Costs of Climate System (operational)

Apart de kosten van het klimaat system.

- Costs of maintenance

Onderhoudskosten gezien over de rest van de levensduur

- Duration

Rekentermijn. Volgens europese richtlijnen voor woongebouwen 30 jaar. Daarna restwaarde voor een total van LCC.

- Change in value

Is er door de renovatie een verandering in waarde van het vastgoed?

- Energy prices

Zijn huidige energieprijzen en mogelijk toekomstige verwachtingen van prijsveranderingen in te voeren?

- Complies with EU regulation 244 (see chapter 6 - feasibility or optimum – Sub 2)

Is het rekenmodel opgesteld op basis van de door de EU opgestelde rekenmethode?

- Provides LCC analysis

Voldoet het model aan de voorwaarden van totale LCC?

- Costs of CO_2 emissions

Worden emissiekosten ook meegenomen in het model?

Output options

Is the programme output intelligible, reliable and useful? What can be learned from it?

- Intelligibility

Komt er een duidelijk overzicht tot stand met betrekking tot kosten over de levenscyclus na het invoeren, op basis waarvan keuzes worden gemaakt?

- Reliability

including objective source and financing, contact person, familiarity, number of users

- Computes cost optimum

Het rekenmodel berekend een kosten optimum

- Takes life cycle into account

In output duidelijk de uikomst van LCC zichtbaar.

- Computes cost to residents / users

Geeft inzicht in maandelijkse woonlasten

- Transparency of calculation method

is er inzichtelijk op welke wijze er gerekend is?

- Dynamic model showing impact of a change in design

Real time feedback over aanpassingen in de invoer.

Availability

Can this calculation programme be used on any computer? Is it easy to obtain?

- Additional software requirement

Is het programma gemaakt in een software pakket dat moet worden geinstalleerd? Is het rekenmodel te gebruiken met gangbare software zoals excel

- For both PC/ Mac

Is het programma geschikt om op verschillende besturingsprogrammas te draaien.

- Price

Wat zijn de kosten van het rekenmodel?

- Several language

Is het programma beschikbaar in een toegankelijke taal (Engels)

- Available online, ease of retrieving

Is het programma online verkrijgbaar?

- Installed locally / used online

Is het programma zonder installaties online te gebruiken?

- Source can be downloaded

Is er een webadres beschikbaar waar het rekenmodel beschikbaar is?

- Updated recently

Wordt het rekenmodel met regelmaat up to date gehouden?

2. *Sub 2: How can scores on these criteria be ascribed and compared?*

Not all criteria are quantifiable. Therefore assessments will be given in categories ranging from 'very poor' to 'very good'.

--	very poor
-	poor
+/-	moderate
+	good
++	very good
/	still unknown (further investigation will follow)

6. FEASIBILITY STUDY / CALCULATION OF COST OPTIMUM

Sub 1: What is cost optimal en hoe wordt het berekend?

Om kosten optimal niveau te berekeningen berekent men de totale actuele kosten.
The issue of what to include in cost calculations for buidlings and their renovation was addessed by the European Union in 2012. In compliance with … appropriate calculation programmes should include: Appropriate calculation programmes include, in compliance with the directive on the computation of optimum cost levels of minimal energy performance requirements for buildings or parts thereof (EU. Nr. 244/2012):
Aanvulling op richtlijn 2010/31/EU, die bevordert tot energie reductie in bebouwde omgeving.

Calculation of the total cost takes into account:

- Initial investment costs (including the impact of price developments of parts of buildings)
- Annual Maintenance costs
- Operational costs (gebruikskosten, verzekeringen, vaste lasten en belasting)
- Calculation period
- Price of energy (including prognosis)
- Cost of emitting greenhouse gasses
- Residual value
- Discount rate
- Economic lifespan
- Cost of removal

For a detailed explanation of the computation of life cycle costs or see appendix 5.

According to a subsection of the same directive cost optimal level is the energy performance level which leads to the lowest cost during the estimated economic lifecycle (244/2012 Sec. 2.14)

- The lowest cost is determined taking into account energy-related investment costs, maintenance and operating costs (including energy costs and savings, the type of building concerned, earnings from energy produced), where applicable, and disposal costs, where applicable; and
- The estimated economic life cycle is determined by each Member State. It refers to the remaining estimated economic life cycle of a building where energy performance requirements are set for a building as a whole,
- Or to the estimated economic life cycle of a building element where energy performance requirements are set for building elements
- The cost-optimal level shall lie within the range of performance levels where the cost-benefit analysis calculated over the estimated economic life-cycle is positive;[5]

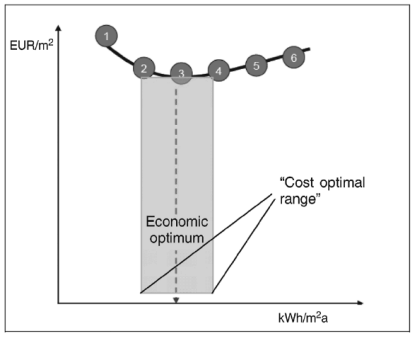
The concepts of cost-effectiveness and cost-optimality are related, but still different, the latter being a special case of the first. Both are based on comparing the costs and (priced) savings of a

[5] http://www.eeb.org

potential action - in this case, of introducing a particular level of minimum energy performance requirements for buildings. In general, a measure or package of measures is cost-effective when the cost of implementation is lower than the value of the benefits that result over the expected life of the measure. Future costs and savings are discounted, with the final result being a "net present value". If the "net present value" is positive (NPV>0), the action is "cost-effective" (for the particular set of assumptions used in the calculation). The action or combinations of actions that maximise the net present value are the "cost-optimal" actions.[6]

Figure 5

Different variants within the graph and position of the cost-optimal range (1)



[7]

Sub 2: How is any optimum represented in the calculation programme?

For computing the project optimal from a cost point of view, European directive is available (EU nr. 244/2012).
This directive indicates how the cost optimum per country may be computed. Preferably, this computation takes into account the full lifecycle of a building and the pertinent national financial conditions. It should exclude taxes and subsidies in order to keep outcomes comparable.

While these guidelines are not legally binding, they provide relevant additional information to the Member States and indicate accepted principles for the cost calculations required in the context of the directive. As such, the guidelines are intended for facilitating the application of the regulation. It is the text of the directive which is legally binding and which is directly applicable in the Member States[8]

[6] Implementing the cost-optimal methodology in EU countries. Lessons learned from three case studies BPIE

[7] Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012 (2012/C 115/01)
[8] http://www.buildup.eu/publications/27125

7. FAR REACHING ENERGY CONSERVING INTERVENTIONS

Sub 1: What types of renovations with for reaching energy savings have been defined in Europe? How can these be quantified / measured?

Commonly used phrases for four well defined types of renovations will be explained here.

- NZEBDeep retrofit
- BEN
- Passive house renovation = EnerPHit
-

The first two are conceptual, non-quantified objectives. The latter two refer to ways in which Renewable energy sources (RES) may be applied to achieve a Nearly Zero Energy Building (NZEB).

NZEB – Nearly Zero Energy Building

The phrase Nearly Zero Energy Building is common in documents of the European Union (EU). No quantitative boundaries have been described for it at this point, however. The EU is still working on that. Buildings Performance Institute Europe (BPIE) reported how the definition of this concept may be further refined and what requirements it should meet[9].

A nearly zero energy building is a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including renewable energy produced on-site or nearby[10].

BEN - Bijna Energie Neutraal gebouw

The abbreviation BEN originates from the literal translation of NZEB into Dutch. It is commonly used in a part of Belgium. Contrary to NZEB, BEN is a quantitative concept because specific levels of energy performance are associated with it. Minimally, the E-level (aanduiding voor energie prestatie) of a BEN building should be equal to or below 30 and its K-level (aanduiding voor thermische verliezen) should be equal to or below 40.

The following table of insulation values applies.

“The E-level is a function of the thermal insulation, airtightness, compactness, orientation and solar exposure of the building. In addition, the fixed installations (for heating, hot water supply, ventilation, cooling and illumination) determine this characteristic of the building.”[11]

Om het E-peil van 30 te behalen dienen de Construction elements of a BEN residential unit should meet the following U-value (max)

[9] http://www.bpie.eu/documents/BPIE/publications/LR_executive%20summary_nZEB.pdf
[10] http://epbd-ca.eu
[11] http://www.energiesparen.be/epb/epeileis

Construction element	U-value (max) in W/m^{2}K
Roofs and ceilings	0.24 (as EPB requires as of 2014)
Exterior walls	0.24 (as EPB requires as of 2014)
Floors	0.24 (i.e. stronger than 0.3 that EPB requires as of 2014)
Windows (frame and glazing)	1.50 (i.e. stronger than 0.18 that EPB requires as of 2014)
Glazing	1.10 (as EPB requires as of 2014)
Doors and gates	2.00 (as EPB requires as of 2014)

For the full list of U(max) values see www.energiesparen.be/BEN.

Further requirements for a BEN residential unit include:

- A solar boiler including collector with a working surface area of at least 0.02 m^2 per m^2 of floor space in the housing unit, oriented between East and West (on the South side) and with a slope of between 0 and 70 degrees;
- A photovoltaic installation yielding at least 7 kWh per m^2 floor space of the housing unit, oriented between East and West (on the South side) and with a slope of between 0 and 70 degrees;
- A heat pump used as the main source of heat, with a seasonal performance factor of at least 4;
- A bio-mass installation used as the main source of heat, with an efficiency of at least 85% w hile its emissions of CO and particulate matter do not exceed grenswaarden uit fase III van Koninklijk Besluit (Belgie) van 12/10/2010
- A connection to a local heat exchange network or cooling network drawing its energy for at least 45% from renewable sources;
- A share in a project of renewable energy in the same province or county to a value of at least €20 per m^2 floor space of the housing unit.

Another way to meet this ambition is to facilitate the production of at least 10 kWh of renewable energy per m^2 of floor space of the housing unit by means of a combination of the above. In that case the underlined specifications do not apply[12].

Schools or offices that meet the BEN standard have an E-level of at most 40 and a K-level of at most 40.

[12] http://www2.vlaanderen.be/economie/energiesparen/epb/doc/watiseenbenwoning.pdf

Renovation to the standard of a Passive House = EnerPHit

- EnerPHit is the international standard for certified renovations to the level of a Passive House. EnerPHit+i is for buildings waarvan more than 25 % of the opaque exterior wall surface has interior insulation. It is tailored for use with the majority of existing buildings. Hence there are two options for certification van beide :
- EnerPHit based on a heat requirement of 25kWh/(m^2a) at most
- EnerPHit based on the consistent application of certified Passive House components

General requirements[13]:

- Primary energy use of at most 120 kWh/(m^2a) + ((QH -15 kWh/(m^2a)) *1,2)
- Air tightness n_{50} of at most 1.0 and h^{-1}, with a target value of 0.6 and h^{-1}
- Rule out excessive moisture on the interior surface with cross sections and connection details
- Thermal comfort conditions in accordance with EN ISO 7730 is provided.
- Exterior wall $f_t * U \leq 0.85$ W/(m2K)
- Roof/uppermost ceiling having U-value of at most 0,35 W.m2K
- Floor must be at least 17 degrees Centigrade (indoor temperature 20 degrees Centigrade)
- Facade openings having a U-value of at most 0.85 W/(m^2K)

EnerPHit based on the consistent application of certified Passive House components extra requirements:

- For exterior insulation: $f_t * U \leq 0.15$ W/(m^2K)
- For interior insulation: $f_t * U \leq 0.35$ W/(m^2K)
- Facade openings having a U-value of at most 0.85 W/(m^2K)
- Glass surfaces having a U-value of at most 1.6 W/m^2K
- Doors having a U-value of at most 0.80 W/m^2K
- Heat exchanger having efficiency of at least 75% while its electricity use does not exceed 0.45 Wh/m^3

Deep Retrofit

Deep retrofit is the phrase that is used here to cover deep renovation or deep refurbishment as well. The Global Building Performance Network (GBPN) acknowledges that this concept covers a wide range of solutions over the world. This network organisation is developing a more precise definition and criterion. In Europe, deep retrofit usually refers to a reduction in energy required for heating and cooling by 75%. In the US it refers to a reduction of the total amount of energy required by 30 to 50%. In China and India the phrase is used without specific criteria[14].

In accordance with the Energy Efficiency Directive, cost-effective deep renovations lead to a refurbishment that reduces both the delivered and final energy consumption of a building by a significant percentage compared with the pre-renovation levels leading to a very high energy performance. Such deep renovations could also be carried out in stages. The Commission services have indicated (see SWD (2013) 143 final) that the significant efficiency improvements resulting from deep renovation are typically of more than 60% energy savings. [15]

[13] http://www.passiv.de/downloads/03_certification_criteria_enerphit_en.pdf
[14] http://www.gbpn.org/sites/default/files/02.DR_Briefing.pdf
[15] Technical guidance, financing the energy renovation of buildings with cohesion policy funding. Final report EC – February 2014

8. Findings

8.1 Shortlist for the assessment

Six calculation programmes were found that meet the selection criteria.

1. Econ Calc V1.0 (Austria)
2. LZK tool (Austria)
3. E-calculator (Belgium)
4. KBA Renovatie (Netherlands)

Every calculation programme was scored on all the assessment criteria listed in the sub-section on 'Applicability'.

The assessment criteria are grouped in five themes:

A. Relevance
B. Scope
C. Input opportunities
D. Output options
E. Availability

Below, every calculation programme will be discussed including some visual examples from the interface. Each discussion will end with a conclusion.

1. Econ Calc V1.0

A. Relevance		Score 5/5 +
Home / office / other type of building	Residential buildings	+/-
New construction as well as renovation	Both possible	+
For designers / developers / building users	All target groups	++
Not too much construction expertise required	Extensive expertise required	+/-
Not too much financial expertise required	Extensive expertise required	+/-
B. Scope		**5/7**
For rough sketches as well as detailed designs	Detailed input is required, so the programme will be applicable only from the preliminary design onward	-
Alternative plans can be entered	Up to five alternatives for energy and financing can be entered	+
PHPP input possible	PHPP/ OIB RL 6 (Österreichisches Institut für Bautechnik Richtlinie 6- Energieeinsparung und wärmeschutz) possible	+
Offers suggestions and explanations	An add-in Econcalc-assistant is available. A manual is mentioned, but is not readily found. A completed example is available.	+/-
Easy to use / / calculation time	Few hints or checklists, but completed example is available	-
Compares before/after renovation	Up to five alternatives for energy and financing can be entered. By entering the situation before renovation as one of the 5 alternatives, and the sitution thereafter as another, the comparison can be made. But all that will be shown then is a juxtaposition, no differences of % improvements will be computed.	+
Allows input options / user generated input	User generated input possible	+

C. Input items:		19/22
Building shell		
Expected energy loss in roofs / walls / floors / windows (thermal insulation)	Yes, handmatig per construction element, per m^2	+
Airtightness as separate item	No,but kwh/m^2a entry from PHPP calculation possible, then it is included	+/-
Expected energy use in installations	Yes. Per installation or part thereof in kWh/m^2a. COP/efficiency-input possible as well.	+
Climate data	Energy required per m^2 is entered directly, in case this is calculated by PHPP then it is included	+
Installations/energy		
Climate system	Yes, for heating, hot-water, cooling, ventilation and auxiliary energy of all elements	+
Option to enter energy sources / RES	No detailed input possible. A limited number of options can be selected: coal, gas, electricity, city heating system, heat pump. No wide choice of RES. However, options can be added.	--
Specification of energy use in heating / cooling / appliances	Yes	+
Energy required according to PHPP	Yes, optional. PHPP or OIB RL 6 Österreichisches Institut für Bautechnik Richtlinie 6- Energieeinsparung und wärmeschutz).	+
Primary energy use	Yes, according to OIB RL 6, DIN V4701-10 (PHPP), ESU-service (Frischknecht) or Öko Institute	+
Costs		
Sensitive to financing/mortgage type	Yes, loan conditions, interest rate and duration can be entered	+
Cost of building's shell	Yes, five alternatives can be entered so cost differences can be made apparent	+
Cost other than shell	Yes	+
Process costs	Yes: Land costs, administration costs, management costs, insurance, cleaning costs, utility connections. [Not clear whether engineering costs of advisors and architects can be entered]	+
Subsidies / tax benefits	[Unknown]	+/-
Duration	Yes, can be specified per construction element	+
Change in value	[Unknown]	+/-
Energy prices	Yes, can be entered for various types of energy. Expected price rises can be entered as well.	+
Cost of maintenance	Yes	+
Cost of climate system (operation)	Yes, costs of 5 alternatives can be entered. Covers heating, ventilation, cooling, domestic electricity supplies and control systems	+
Complies with EU regulation 244	[Unknown]	-
Provides LCC analysis	[Unknown]	-

Costs of CO2 emission	Yes, and the consequential costs of this emission	+

D. Output options:		**2/6**
Intelligibility	Output of clear graphs, including one showing an annuity comparison of up to five alternatives. Also total present value. And the sheet 'Ecology' shows staafdiagrammen of energy requirements, primary energy use and CO_2 emission	+
Computes cost optimum	No. It will show cost differences between alternatives.	-
Cost over life cycle	Yes	+
Computes cost to residents / users	No. It will show annuity per year and residual value	-
Transparency of calculation method	Not in the programme. It is included in the manual	-
Dynamic model, shows impact of change in design	No	-
E. Availability		**6/7**
Additional software required	Excel	+
For both PC / Mac	Both (wanneer MS office is geinstalleerd)	+
Price	Free	+
Several languages	German	-
Available online	Yes, http://www.klimaaktiv.at/tools/bauen_sanieren/econcalc.html	+
Installed locally / used online	Can be used when Excel is installed on PC/Mac. Add-ins and development tools are available when needed. [How can these be obtained?] A configuration assistant can be downloaded directly from the site.	+/-
Recent update	26-06-2014 (less than 1 year ago)	+

Independence	
Made by	Energie Institut Vorarlberg Austria TU Graz (Energy Institute of the Voralberg Province, Technical University, Graz, Austria)/ Institut für Betriebswirtschaftslehre und Betriebssoziologie (Intitule for Management Science and Corporate Sociology)
Development financed by	Institute sponsored in part by 'illwerke vkw' (energy supplier) and 'raiffeneisen meine bank' klima:activ / bauen & sanieren / IG Passivhaus Austria
Contact person	Martin Ploss (Arch. Dipl.-Ing- Austria)
Unbiased	
Familiarity	
Number of users	Unknown
Easy to find	good

Notes on EconCalc 2.0

A. Relevance

This calculation programme was made for residential units

B. Scope

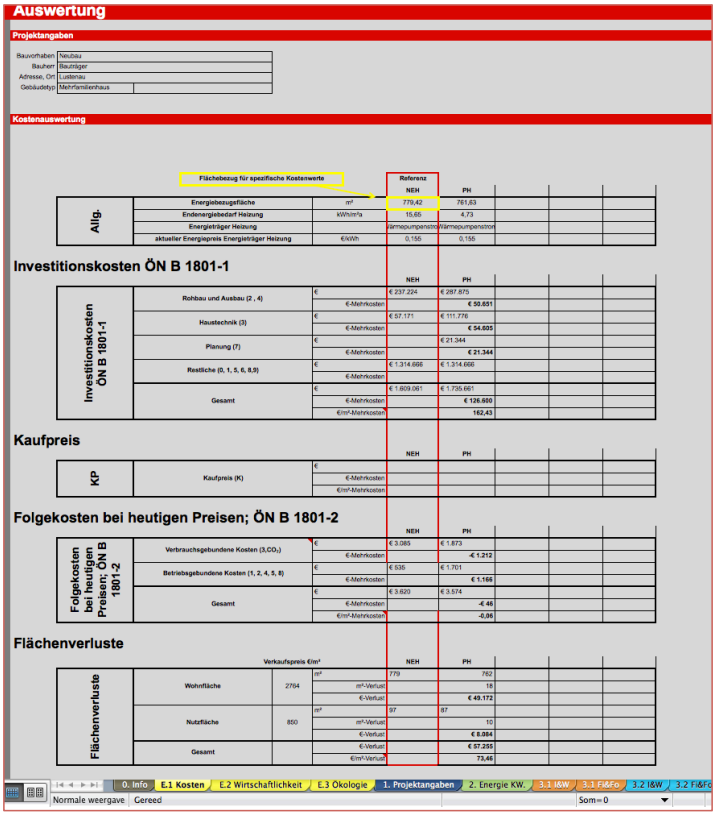
To enter costs, a lot of detailed information is required. Whether that is readily available in practice for up to 5 alternative designs for 1 building is hard to say.

The programme will show the differences between the entered alternatives, but it won't advise on combinations of these nor compute an optimum.

Completed examples are available, one for new construction and one for renovation.

C. Input items

The programme features a number of excel sheets:



1. Project definition
- Up to five alternative designs can be entered. They may differ in built up surface area and/or in usable residential surface area.
- Interest rate / inflation / current energy prices and their expected development.
- CO2 emission costs

2. Installations
- Complimentary to these five construction alternatives…up to five alternative heating and ventilation systems can be entered.
- (renewable) energy source / COP

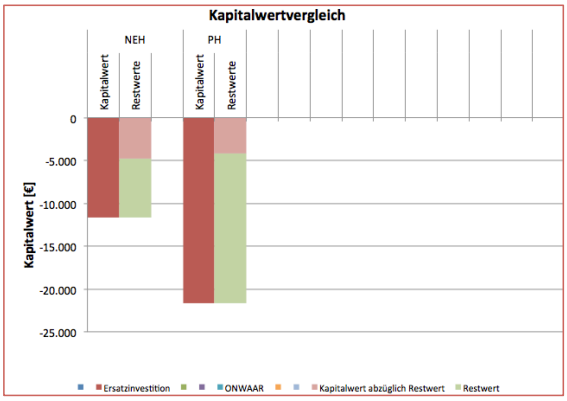
3.1 Building shell and investment as well as related costs and expected maintenance costs
For every alternative one should enter:
- U-values per face of the building's shell
- Costs per face of the building's shell, as costs per m^2 or as lump sum
- Costs per type of installation, as costs per m^2 or as lump sum

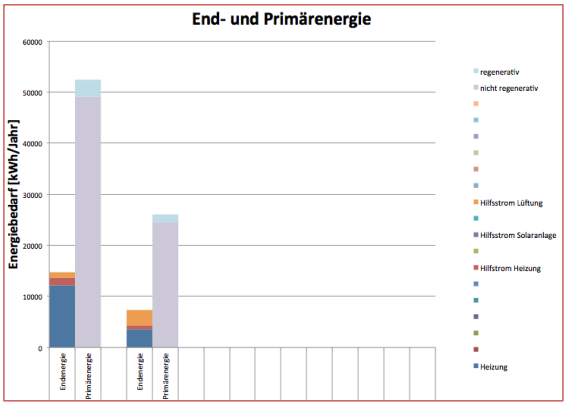
3.1 Costs of financing and consequential costs
Again this is to be entered for each of the five alternatives. It includes
- type of loan/mortgage and its conditions
- expected maintenance costs

D. Output options

The programme will produce six charts presenting the alternatives side by side.
- Capital
- Annuity
- montly costs vs. energy usage
- costs per saved kwh
- end energy and primary energy
- CO_2 emission and CO2 equivalent

The following illustrations are taken from the case that is presented as an example.





Above examples of two alternatives, low energy house and passive house.

The number of charts is limited and their information density is not very high.

E. Availability

Downloading this programme is easy and free of charge. It is available in the German language only.

Conclusion EconCalc2.0:

This calculation programme scores well on availability and input items. Although the required input is rather complex, the included examples make it relatively easy to complete all the items.
On user-friendliness and advisory capability in the making of design decisions, the programme scores not quite as highly.

For application throughout Europe, the translation of the programme into English and/or other languages would be necessary.

EconCalc2.0 is a calculation programme with many input items. The overview of up to five alternatives in the output graphs can facilitate the choice between those alternatives.

2. LZK tool

A. Relevance		Score 5/5
Home / office / other type of building	Developed for offices first of all, but renovations, schools and housing structures will be added in future versions.	+/-
New construction as well as renovation	New construction first of all, renovation in the future.	+/-
For designers / developers / building users	Ontwerper /ontwikkelaar/gebruiker	+
Not too much construction expertise required	2 invoer mogelijkheden. Op basis van een ontworpen gebouw of op basis van principes van het gebouwontwerp. Bij beide is een redelijke bouwkundige kennis nodig. De laatste vergt meer tijd, maar kan in een nog eerdere fase.	+
Not too much financial expertise required	Veel op basis van kosten database.	+/-
B. Scope		**5+/7**
For rough sketches as well as detailed designs	Initiatief fase, zelfs zonder gebouwontwerp kan er al een berekening worden gemaakt op basis van ontwerpprincipes.	++
Alternative plans can be entered	Nee. Het programma berekent de uitkomsten van 1 invoer. Om verschillende varianten te berekenen kun je een model opslaan in een tweede versie en daar aanpassingen aan doen.	+
PHPP input possible	Nee	-
Offers suggestions and explanations	Ja er zijn veel pull down menus waar verschillende keuze opties zijn. Bij invoer van bouwelementen zijn de bijbehorende kosten uit de database van gebouwelementen gekoppeld. (op dit moment zijn er voor gebruik van de database geen rechten voor gebruik buiten Oostenrijk)	+/-
Easy to use / calculation time	De berekeningstijd is kort, direct zijn er grafieken zichtbaar bij beide.	+
Compares before/after renovation	Nee. Het huidige programma is gericht op nieuwbouw. In de toekomst zal er wel een renovatie programma worden ontwikkeld.	-
Allows input options / user generated input	De pull down menus zijn handig en geven veel opties. Maar hoe goed er aanpassingen te maken zijn op deze voorbereidde keuzes is niet bekend. De twee invoer mogelijkheden: op basis van ontwerp en op basis van ontwerpprincipes zijn verschillend in invoer tijd.	+

C. Input items:		19/22
Building shell		
Expected energy loss in roofs / walls / floors / windows (thermal insulation)	Het warmte verlies of de isolatie waarde van het pakket is gekoppeld aan het gekozen pakket voor wand-, dak- of vloerkeuze.	+
Airtightness as separate item	Nee.	-
Expected energy use in installations	niet bekend.	+/-
Climate data	Alleen voor Oostenrijk en Duitsland	-
Installations/energy		
Climate system	Ja. Keuze in verschillende opties, ook combinaties mogelijk. Er kan in % worden aangegeven voor werlk aandeel er gebruik wordt gemaakt van de optie.	+
Option to enter energy sources / RES	Ja, PV en zonnecollectoren. Ook het meet- en regelsysteem of gebouw beheersstysteem kan worden opgegeven.	+/-
Specification of energy use in heating / cooling / appliances	ja.	+
Energy required according to PHPP	nee.	-
Primary energy use	Ja de energievraag en de eind-energie worden getoond in de eind table.	+
Costs		
Sensitive to financing/mortgage type	Ja er zijn verschillende manieren van investeren te kiezen. Daarnaast kan er een looptijd worden ingevoerd, de inflatie en rente veranderingen.	+
Cost of building's shell	Alle bouwkosten zijn op basis van een uitgebreide bouwkostendatabase (oostenrijks) met 1200 bouw elementen beschikbaar om uit te kiezen. Deze databank is gevuld met isolatiewaarden, kosten, emissies en gevolgkosten.	+
Cost other than shell	Ja, in resulterende grafieken een duidelijk onderscheid in investeringskosten (grond, bouwkosten, installaties, afbouw, inrichting, omgeving, management) en de gebruikskosten (schoonmaak, energie, onderhoud en reparaties en sloop.)	+
Process costs	Niet bekend.	+/-
Subsidies / tax benefits	Niet bekend	+/-
Duration	Ja. In rekenvoorbeelden 30 jaar.	+
Change in value	Bij nieuwbouw niet relevant. Niet bekend of dat bij renovatie model wordt opgenomen.	+/-
Energy prices	Ja. en (te verwachten) veranderingen	+
Cost of maintenance	Ja, operational costs (total/ by type of costs/by building elements and cost catagories)	+
Complies with EU regulation 244	Niet bekend. Rekenmethode: EN15643-4 Brussel 2009 /	+/-

	ÖNORM B 1801-4.	
Provides LCC analysis	Ja. Net present value methode or method of complete financial plans. Gekoppeld aan een al functionerende LCC tool van Alpha Carinae KEG- Austria.	+
Costs of CO2 emission	Niet bekend of het van het gebouw in gebruik wordt omgerekend in kosten. Er wordt wel gekeken naar emissies bij productie van bouwmaterialen.	+/-
Cost of climate system (operation)	Ja, invoer mogelijk.	+

D. Output options:		**6/6**
Intelligibility	Er is een grafiek waarin de verschillende kosten duidelijk inzichtelijk zijn in tijd. Daarnaast is er inzichtelijk gemaakt hoe hoog de bouwkosten per thema zijn.	+
Computes cost optimum	Nee.	+
Cost over life cycle	Ja.	+
Computes cost to residents / users	Niet bekend.	+/-
Transparency of calculation method	Niet bekend	+/-
Dynamic model, shows impact of change in design	de grafieken met output veranderen direct mee met aangepaste input.	+/-
E. Availability		**3/7**
Additional software required	Het programma is een combinatie van specifieke software, waarin de invulvelden zichtbaar zijn. En een excel model waarin berekeningen worden uitgevoerd en de output zichtbaar is.	+/-
For both PC / Mac	Niet bekend	+/-
Price	Niet bekend. Op dit moment voor intern gebruik adviesbureau. Nog niet commercial verkrijgbaar.	-
Several languages	Duits	-
Available online	http://www.lzk-tool.at/images/downloads/LZK_Tool_Oeko_Folder.pdf - geen werkelijke versie beschikbaar	-
Installed locally / used online	Niet bekend	+/-
Recent update	Onbekend. Er wordt gewerkt aan een renovatie model.	-

Onafhankelijkheid	
Gemaakt door	E7 (e-sieben.com) M.O.OCON Alpha Carinae KEG
Ontwikkeling gefinancierd door	In opdracht van M.O.O.CON GmbH
Contactpersoon	
Onafhankelijkheid	
Bekendheid	
Aantal gebruikers	?
Vindbaarheid	?

Toelichting op LZK-tool

Ontstaan vanuit de vraag naar gebouwen die lagere gebruikskosten hebben, gebruikskosten worden belangrijker dan de investeringskosten.

Het rekenmodel is gericht om te ondersteunen in de initiatieffase. 80% van de investeringskosten en gebruikskosten wordt inde eerste twee fasen, initiatieffase en conceptontwerp fase bepaald.

Deze methode maakt gebruik van ruimte efficiëntie energie efficiëntie en kosten efficiëntie van de investering. Op basis van een 3D gebouwmodel.

- Construction costs (total / by cost areas/ by building elements)
- Operational costs (total / by type of costs/ by building elements and cost categories)
- Gross floor area (total / by utilization areas/ by space)
- Energy consumption (total/ by causer (cooling, heating, lighting, work equipment, other) [16]

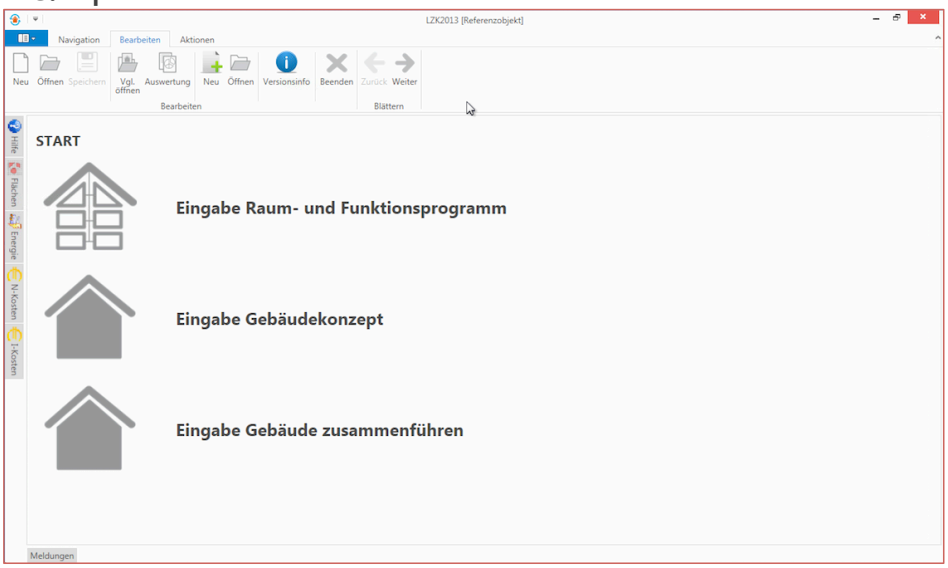
A. Relevance

Er zijn algoritmen gebruikt om het model te toetsen aan bouwbesluit en brandveiligheid. Daarnaast zijn werkplek vereisten (vanuit bouwbesluit?) verwerkt om ruimte gebruik te optimaliseren.

B. Scope

Het rekenmodel is gemaakt in de Duitse taal en gebaseerd op Oostenrijkse regelgeving.

C. Input items

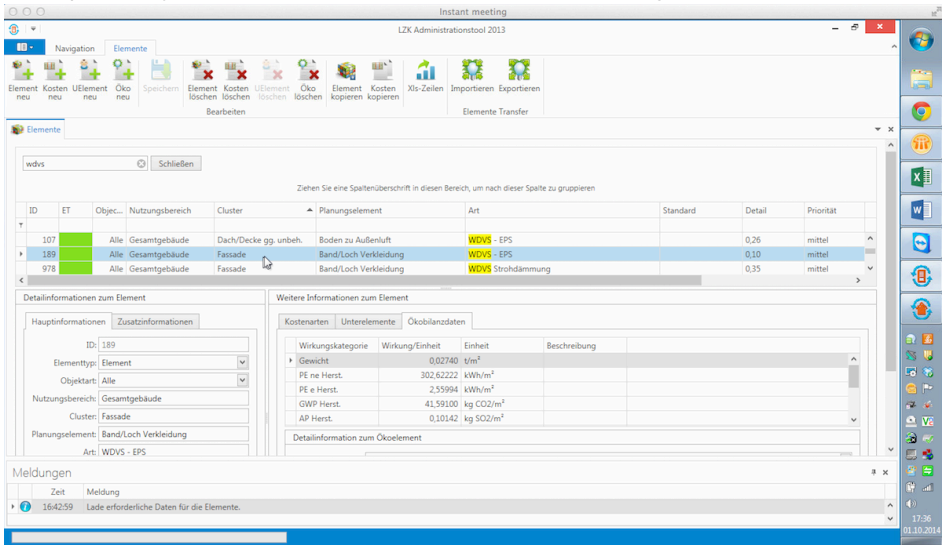


[16] http://www.lzk-tool.at/images/downloads/Calculating_Life_Cycle_Cost.pdf

Er zijn twee invoermogelijkheden: op basis van een gebouw ontwerp en op basis van ontwerpprinciepen. Bij de laatste kan er bijvoorbeeld worden ingevoerd hoeveel kernen (lift+trap) er in het gebouw zijn, het aantal lagen en de stramienmaten.

Er zijn vele tabbladen die helpen bij het invoeren van het totale gebouw. Met iconen en pulldown menus wordt de gebruiker daarbij geholpen.

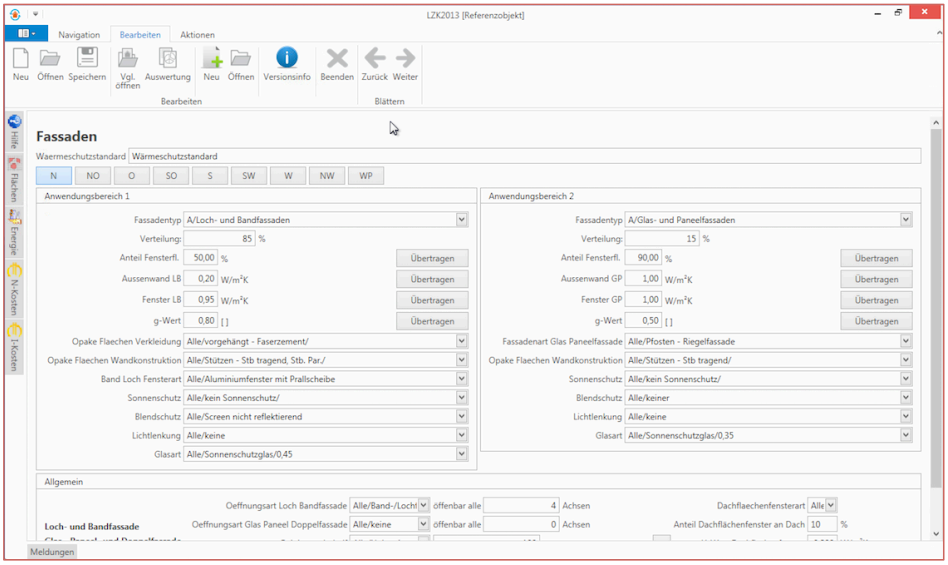
De keuzes in de puldown menus zijn elders in het programma uitvoerig ingevoerd en ook eventueel aan te passen. Bij deze keuzes worden oa. onderhoud, emissies, energieverbruik meeberekend.

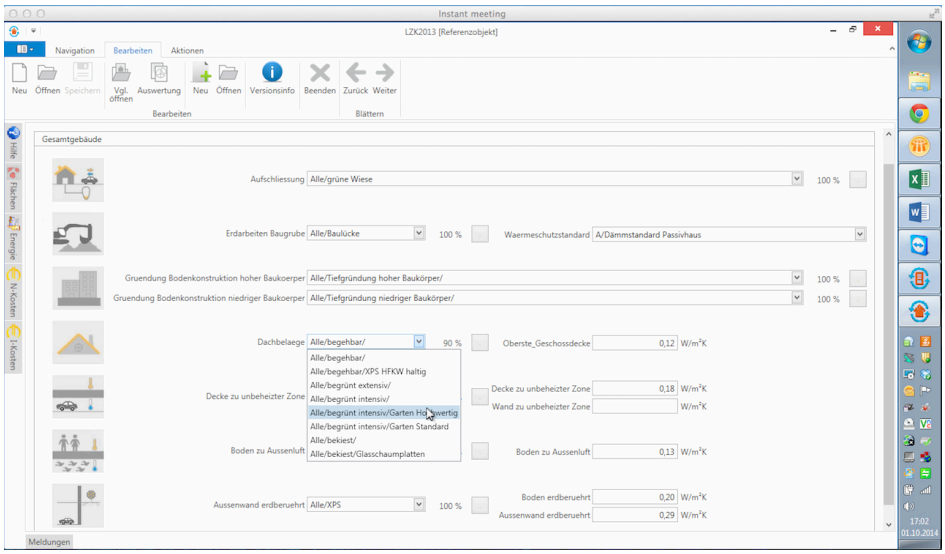


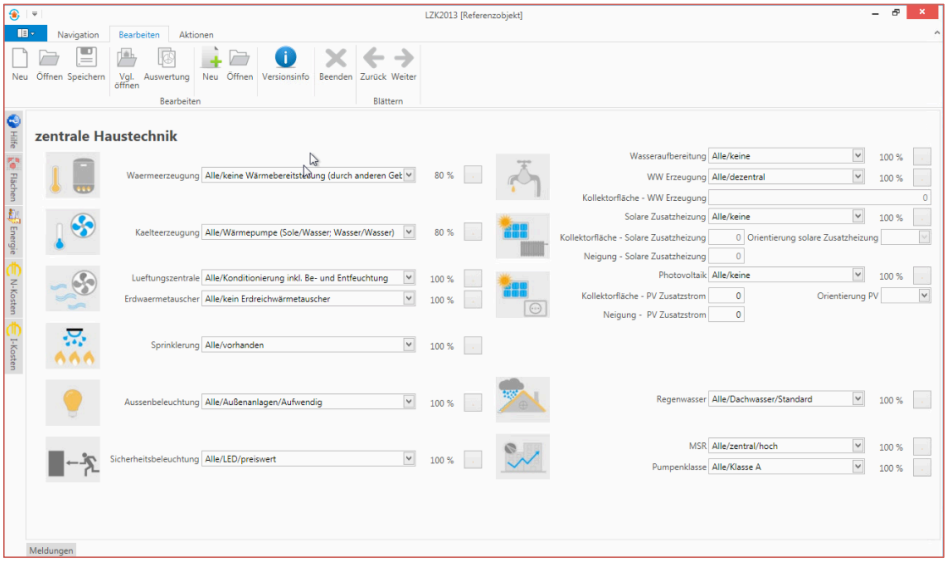
Waarden die meewegen:
De invloed van thermische massa, daglicht, multifunctionaliteit van ruimten, energie consumptie. De relatie tussen gebouwontwerp en energieverbruik wordt zichtbaar. Bij een hogere isolatie waarde resulteert in een lagere investering voor installaties en lagere gebruikskosten.

Doordat het een gebouwmodel is, zijn vloeroppervlak en geveloppervlak een resultante van het model. Het model heeft ook een energie calculatie tool. Hoe deze precies functioneert is niet bekend, omdat het rekenmodel niet in bezit is.

Noot van de schrijver: Het rekenmodel is een nuttig en krachtig model om in vroege fase van het ontwerpproces in te zetten. De uitkomst biedt een nuttig uitgangspunt, echter vergt het proces een goede architect om niet een computer gemodelleerd optimaal gebouw te realiseren, maar aantrekkelijke en waardevolle architectuur.


LZK2013 [Referenzobjekt]
Navigation
Bearbeiten
Aktionen
Neu
Öffnen
Speichern
Vgl. öffnen
Auswertung
Versionsinfo
Beenden
Zurück
Weiter
Bearbeiten
Blättern
Fassaden
Waermeschutzstandard
Wärmeschutzstandard
N
NO
O
SO
S
SW
W
NW
WP
Anwendungsbereich 1
Fassadentyp
A/Loch- und Bandfassaden
Verteilung:
85
%
Anteil Fensterfl.
50,00
Aussenwand LB
0,20
W/m²K
Fenster LB
0,95
g-Wert
0,80
Übertragen
Opake Flaechen Verkleidung
Alle/vorgehängt - Faserzement/
Opake Flaechen Wandkonstruktion
Alle/Stützen - Stb tragend, Stb. Par./
Band Loch Fensterart
Alle/Aluminiumfenster mit Prallscheibe
Sonnenschutz
Alle/kein Sonnenschutz/
Blendschutz
Alle/Screen nicht reflektierend
Lichtlenkung
Alle/keine
Glasart
Alle/Sonnenschutzglas/0,45
Anwendungsbereich 2
A/Glas- und Paneelfassaden
15
90,00
1,00
0,50
Alle/Pfosten - Riegelfassade
Alle/Stützen - Stb tragend/
Alle/keiner
Alle/Sonnenschutzglas/0,35
Allgemein
Oeffnungsart Loch Bandfassade
Alle/Band-/Loch
öffenbar alle
4
Achsen
Oeffnungsart Glas Paneel Doppelfassade
Alle/keine
0
Dachflaechenfensterart
Anteil Dachflächenfenster an Dach
10
Loch- und Bandfassade
Meldungen


Instant meeting
LZK2013 [Referenzobjekt]
Navigation
Bearbeiten
Aktionen
Neu
Öffnen
Speichern
Vgl. öffnen
Auswertung
Versionsinfo
Beenden
Zurück
Weiter
Bearbeiten
Blättern
Gesamtgebäude
Aufschliessung
Alle/grüne Wiese
100 %
Erdarbeiten Baugrube
Alle/Baulücke
Waermeschutzstandard
A/Dämmstandard Passivhaus
Gruendung Bodenkonstruktion hoher Baukoerper
Alle/Tiefgründung hoher Baukörper/
Gruendung Bodenkonstruktion niedriger Baukoerper
Alle/Tiefgründung niedriger Baukörper/
Dachbelaege
Alle/begehbar/
90 %
Alle/begehbar/
Alle/begehbar/XPS HFKW haltig
Alle/begrünt extensiv/
Alle/begrünt intensiv/
Alle/begrünt intensiv/Garten Hochwertig
Alle/begrünt intensiv/Garten Standard
Alle/bekiest/
Alle/bekiest/Glasschaumplatten
Oberste_Geschossdecke
0,12
W/m²K
Decke zu unbeheizter Zone
0,18
Wand zu unbeheizter Zone
Boden zu Aussenluft
0,13
Aussenwand erdberuehrt
Alle/XPS
Boden erdberuehrt
0,20
0,29
17:02
01.10.2014
Meldungen



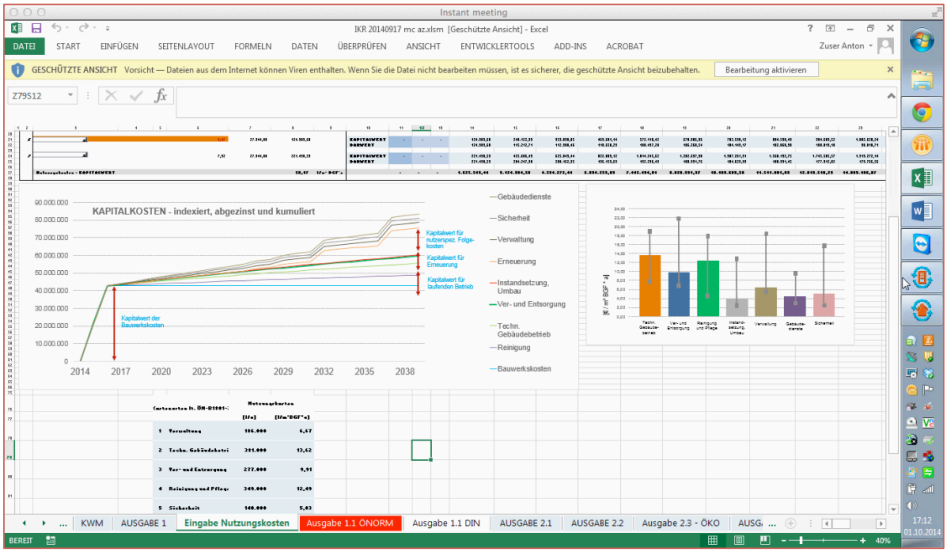
Naar aanleiding van bovenstaande afbeeldingen, lijkt het programma een omvangrijke elementen bibliotheek te bevatten met 1200 elementen. Gebaseerd op gegevens van Allplan, Cofely en Porr. De elementen geven waarden weer op gebied van LCC en score op gebied van ecologie.

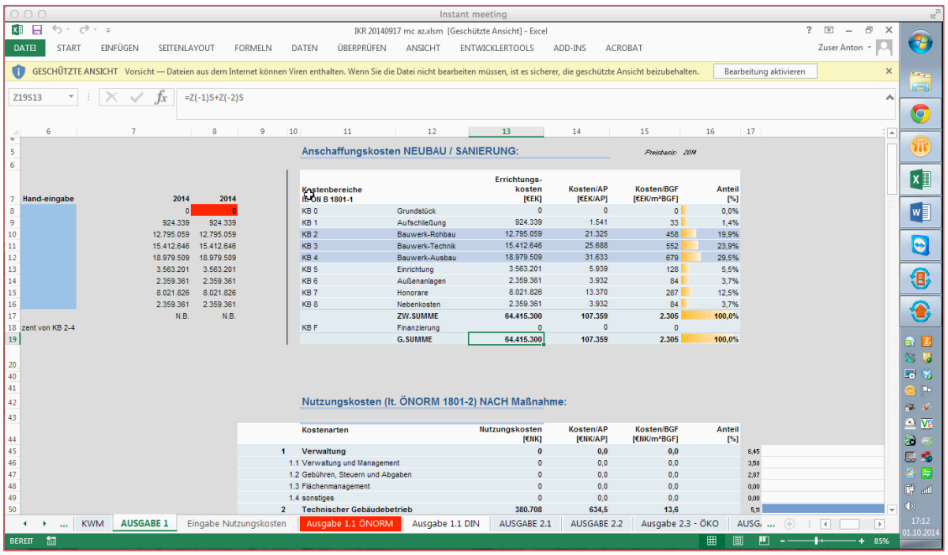
Aanpasbaar: de mate van inflatie, constructiekosten index, energie kosten index, afschrijvingsperiode en financieringsopties

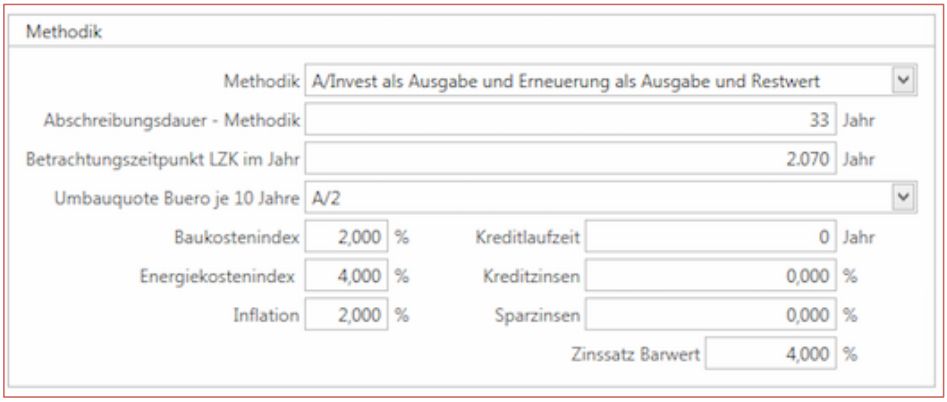
D. Output options

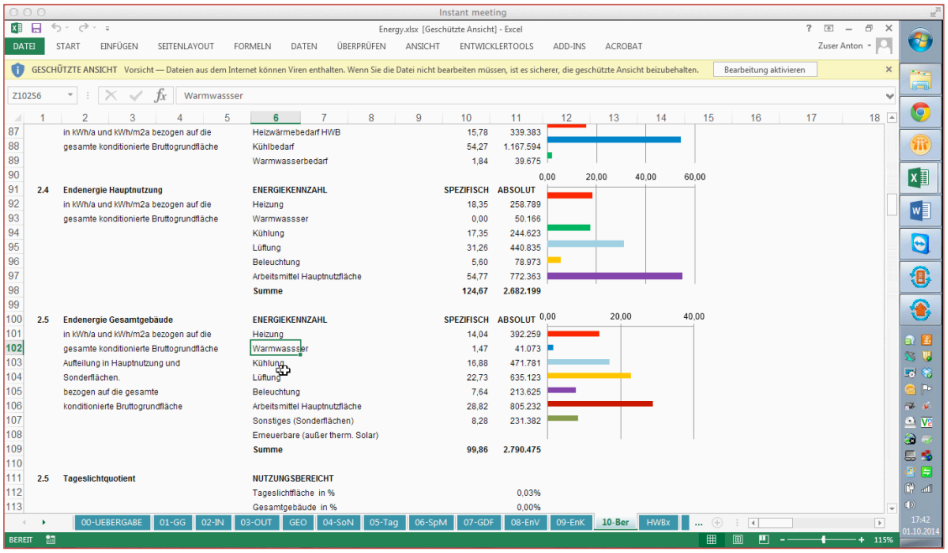
De output grafieken zien er duidelijk uit en verschaffen in een oogopslag veel informatie en inzicht.

Onderstaande grafiek geeft weer: initiele kosten en alle kosten die daar in de loop van de tijd bijkomen, daardoor is goed te zien dat bij dit project de initiele kosten ongeveer de helft zijn van de kosten over de levensduur genomen. Daarnaast een staafdiagram met €/m2 BVO (Bruto Vloer Oppervlak) per jaar(waarvan de kleuren niet corresponderen met de grafiek) met 7 van de 9 onderdelen (bauwerkskosten en erneuerung ontbreken)


Instant meeting
IKR 20140917 mc az.xlsm [Geschützte Ansicht] - Excel
GESCHÜTZTE ANSICHT
Bearbeitung aktivieren
KAPITALKOSTEN - indexiert, abgezinst und kumuliert
Gebäudedienste
Sicherheit
Verwaltung
Erneuerung
Instandsetzung, Umbau
Ver- und Entsorgung
Techn. Gebäudebetrieb
Reinigung
Bauwerkskosten
KWM
AUSGABE 1
Eingabe Nutzungskosten
Ausgabe 1.1 ÖNORM
Ausgabe 1.1 DIN
AUSGABE 2.1
AUSGABE 2.2
Ausgabe 2.3 - ÖKO


Instant meeting
IKR 20140917 mc az.xlsm [Geschützte Ansicht] - Excel
GESCHÜTZTE ANSICHT
Bearbeitung aktivieren
Anschaffungskosten NEUBAU / SANIERUNG:
Nutzungskosten (lt. ÖNORM 1801-2) NACH Maßnahme:
KWM
AUSGABE 1
Eingabe Nutzungskosten
Ausgabe 1.1 ÖNORM
Ausgabe 1.1 DIN
AUSGABE 2.1
AUSGABE 2.2
Ausgabe 2.3 - ÖKO





E. Availability

Volgens criteria van DGNB (German Sustainable Building Council) en Oostenrijkse certificering. Ook ISO 15686-5

CEN = Europese commissie voor standaardisatie. Werkt aan criteria om een evaluatie methode voor heel Europa te kunnen ontwikkelen.

Invoertijd is redelijk kort indien er een gebouw bekend is. Indien er aan de hand van ontwerpprincipes wordt ingevoerd is de invoertijd iets langer, de betrouwbaarheid van de uitkomsten bij de eersten planningsfasen zijn binnen de marges van betrouwbaarheid 10-20%

In de toekomst uitbreiding met: ecologische waarde van materiale en comfort.[17]

Conclusies LZK-tool

Het rekenmodel geeft een goed inzicht op de levenscyclus kosten en het aandeel in de totale kosten per thema. Het model geeft al een van de weinige inzicht in het meewegen van de uitstoot en erergie vraag voor productie van de toegepaste materialen.

Het gunstige van het rekenmodel is dat het al in een vroege fase kan worden toegepast.

Project heeft Weense toekomstprijs van 2009 gewonnen.

Het rekenmodel wordt op dit moment enkel toegepast voor intern consultancy werk van M.O.O.CON

Richtlijnen voor berekeningsmethoden:
Das LZK Tool [ÖKO] richtet sich bei allen Arten der Berechnung der Lebenszykluskosten nach der ÖNORM B 1801-4. Es erfüllt außerdem die Anforderungen aller Normen zur Wirtschaftlichkeits- und Lebenszykluskostenberechnung. Die wichtigsten nationalen und internationalen (VDI) Normen sind:

- ÖNORM B 1801-4 – Bauprojekt und Objektmanagement Teil 4: Berechnung von Gebäudelebenszykluskosten
- ÖNORM B 8110-4 Wärmeschutz im Hochbau — Teil 4: Betriebswirtschaftliche Optimierung des Wärmschutzes
- ÖNORM M 7140 Betriebswirtschaftliche Vergleichsrechnung für Energiesysteme nach der erweiterten Annuitätenmethode - Begriffsbestimmungen, Rechenverfahren
- ÖNORM EN 15459 Energieeffizienz von Gebäuden – Wirtschaftlichkeitsberechnungen für Energieanlagen in Gebäuden
- ÖNORM EN 15643-4 Nachhaltigkeit von Bauwerken — Integrierte Bewertung der Qualität von Gebäuden — Teil 4: Rahmenbedingungen für die Bewertung der ökonomischen Qualität
- VDI 2067 Wirtschaftlichkeit gebäudetechnischer Anlagen — Blatt 1: Grundlagen und Kostenberechnung
- GEFMA 220-1 und 220-2 Lebenszykluskostenberechnung im FM[18]

[17] Calculating life cycle cost in the early design phase to encourage energy efficient and sustainable buildings. Gerhard Hofer e7 Energie Markt Analyse GmbH
[18] http://www.lzk-tool.at/index.php/lzk-tool-oeko/lzk-tool-lebenszykluskosten

3. E-calculator

A. Relevance		Score 5/5 +
Home / office / other type of building	Housing	+/-
New construction as well as renovation	Intended for new construction first of all. The same team is presently developing a so called “Renophase-tool”. That will be specifically intended for renovations, will be more user-friendly and web-based. It is expected to be on line in 2 years.	+/-
For designers / developers / building users	For anyone who wants to know what design and choice of installations is optimal from a cost point of view, or how much the total cost is over the life-cycle of the building.	+
Not too much construction expertise required	An understanding is desirable of “U-vales”, airtightness and capacities of installations.	+
Not too much financial expertise required	Average knowledge required. On the sheet for financial data many items are completed already.	+
B. Scope		**6/7+**
For rough sketches as well as detailed designs	Can be applied from a rough sketch onward, so it can help in making essential choices in the design process.	++
Alternative plans can be entered	Yes, Eén plan met verschillende variabelen kan worden ingevoerd. Op basis van deze variabelen wordt een optimale variant berekendt. Dus in zekere zin zijn dit alternatieven.	+
PHPP input possible	No direct importing. Still, certain variables can be derived from PHPP, such as total glass surface, orientation, surface area of shell, thermal bridges, length of pipelines, floor area and building volume.	+/-
Offers suggestions and explanations	Yes. In some input sheets certain fields are completed already, subject to correction.	+
Easy to use / calculation time	Input fairly easy, but processing takes a lot of time. While processing, the function copy-paste must not be used. In andere programmas op de computer terwijl de berekening loopt.	+/-
Compares before/after renovation	No. (Not needed when programme is used for new construction.) Als de renovatie alleen bestaat uit na-isoleren U waarden, is het wel mogelijk dit in de berekening mee te nemen, indien een renovatie grootschaliger is, uitbreidingen, aanpassing raamvlakken voldoet 1 berekening niet. Dan zouden er meerdere berekeningen gemaakt moeten worden.	-
Allows input options / user generated input	Lot of freedom. All input items can be changed from the keyboard.	+

C. Input items:		19/22
Building shell		
Expected energy loss in roofs / walls / floors / windows (thermal insulation)	Input U value requested for roof, facade, floor, floor above basement, doors and windows. Meerdere U waardes invullen mogelijk.	+
Airtightness as separate item	Yes.	+
Expected energy use in installations	Includes energy simulation using Belgian EPB calculation method (EPB = Energy Performance and Interior Climate). This complies with ISO standard 13790 (energy performance of buildings).	+/-
Climate data	Are included in EPB (Belgium)	-
Installations/energy		
Climate system	The input for up to six possible heating systems is prepared and can be adjusted from the keyboard. Daarnaast tot 6 opties voor tapwater verwarming en ventilatie.	+
Option to enter energy sources / RES	The six possible systems for which the input is prepared include energy sources. Again, a completely different system can be added. 6 varianten van een PV system can be added aswell	+
Specification of energy use in heating / cooling / appliances	Yes, input option available	+
Energy required according to PHPP	No, the programme will do its own energy computation. Input out of PHPP is possible.	+/-
Primary energy use	Yes, computed in MJ/a	+
Costs		
Sensitive to financing/mortgage type	Open to input on interest rate, period till next rate adjustment, inflation, discount rate, fixed costs of the building and real estate tax. One financing invoer can be entered.	+
Cost of building's shell	Input is requested on the cost per m^2 of the shell in the design alternatives.	+
Cost other than shell	Expressed as TAK (present value of integral costs) over the period till the next interest rate adjustment.	+
Process costs	niet goed terug te vinden waar dit is in te voeren in model	+
Subsidies / tax benefits	Real estate tax is included according to Belgian tax system. Templates available for certificates of sustainable electricity and other Belgian national and provincial regulations. (This has to be altered when the programme is for use in all of Europe.)	+/-
Duration	Yes, 30 years in Europe according EU regulation 2012/244.	+
Change in value	No. (Not relevant when applied to new construction.)	-
Energy prices	Yes 1 percentage voor algemene energiekosten.	+
Cost of maintenance	To be covered in output of monthly costs, but input is not clear.	+/-
Complies with EU regulation 244	Yes	+

Provides LCC analysis	Yes	+
Costs of CO_2 emission	No	-
Cost of climate system (operation)	Yes. Per onderdeel.	+

D. Output options:		**6/6+**
Intelligibility	Not during input, only after computation.	+/-
Computes cost optimum	Yes, hierin is dit programma uniek zie uitleg output 'pareto grafiek'	++
Cost over life cycle	Yes, shows monthly cost of energy, of repaying the loan, of maintenance and total. Oriented to building owners.	++
Computes cost to residents / users	Yes, added are energy costs, loan payments and maintenance costs while subsidies are subtracted, so total computed monthly costs will give an integral impression to house owners.	++
Transparency of calculation method	Calculation explained in handbook. According EU regulation 2012/244	++
Dynamic model, shows impact of change in design	For any set of input data a calculation can be made; however this will last one or more hours.	+/-
E. Availability		**5/7**
Additional software required	Excel	+
For both PC / Mac	Both	+
Price	Free for members of VCB (Vlaamse Confederatie Bouw)	+
Several languages	Dutch only	-
Available online	No, for members of VCB only (Vlaamse Confederatie Bouw) Reveived it by e-mailing.	-
Installed locally / used online	No, excel.	+
Recent update	Either in 2013 or 2014, uncertain	+

Independence	
Created by	KCE (Knowledge Centre on Energy) 'Thomas More', governmental organisation VEA, University institute KU Leuven Belgium
Development sponsored by	?
Contact person	Jeroen van der Veeken
Unbiased	?
Familiarity	
Number of users	unknown
Accessibility	poor

Notes on E-calculator

A. Relevance

The outstanding feature of 'E-calculator' is the computation of the Pareto-optimum. This is the situation where a maximum is reached of two objectives at the same time: any extra gain on the one objective would result in a disproportionally large loss on the other onjective. The programme will investigate combinations of U-values and climate system options and present in a graph the most favourable combination from a cost point of view on long term.

B. Scope

Het is beschikbaar voor aannemers, terwijl de ontwikkelende partij en/of architect het meest baat hebben bij deze tool.

C. Input items

The programme invites the user to specify a building in full detail.

Het gebouw wordt ingevoerd in het tapblad 'input data'. Afmetingen, u warden, en type klimaatinstallaties. Uit deze invoer worden specifieke verwarmingsvraag en warm-en-koel vraag in kwh/m2 berkend. De energievraag wordt ook omgezet een waarde van het het belgische E en K peil.

Per onderdeel gebouwschil, ventilatie, verwarming, tapwater systeem en PV systeem worden geselecteerd. Bij elk onderdeel kunnen tot 6 of 7 varianten worden ingevoerd, waarvan er een geselecteerd wordt bij de input data.

The costs over the life cycle are the present value of the integral costs, including:

- Initial investment costs K_I
- Utility costs K_E
- Total annual maintenance costs K_O
- Replacement costs K_R
- Residual value of investment V_{Tf}
- Grants and tax benefits V_{SUB}
- CO_2 emission costs K_{CO2}

A distinction is made between a micro-economic and a macro-economic cost analysis. One of the differences is that in the macro-economic TAK (total present value of all costs) the cost of emitting CO_2 is included.

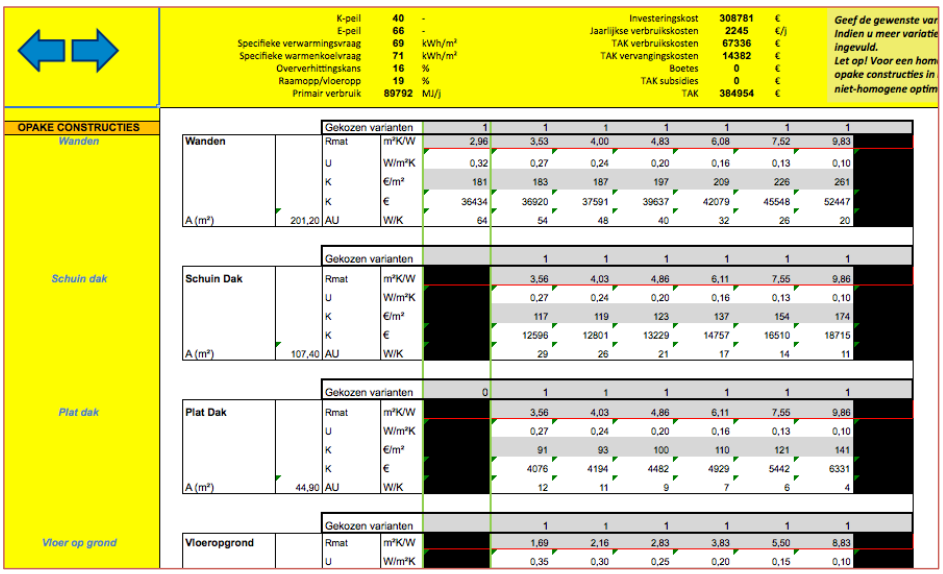
Micro-economic (or private)

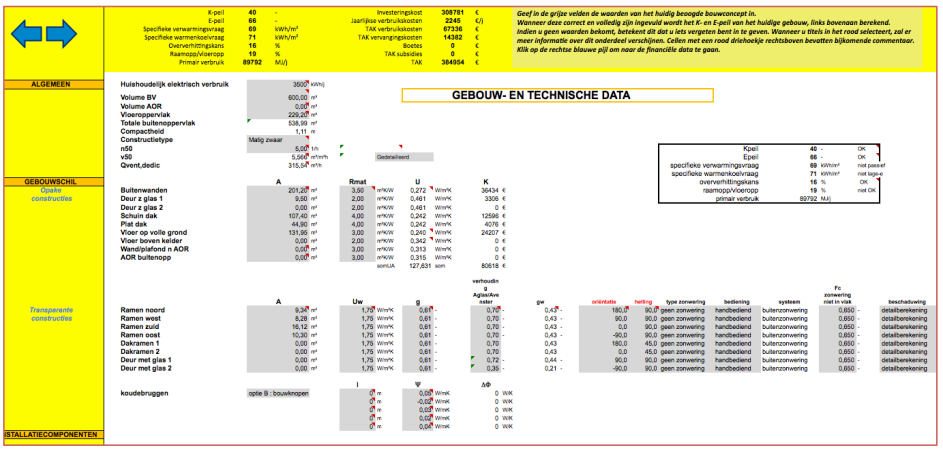
$T'K_{micro} = K_I + K_E + K_O + K_R - V_{Tf} (- V_{SUB})$

Macro-economic (or social)

$T'K_{macro} = K_I + K_E + K_O + K_R - V_{Tf} + K\_{CO2}$ [19]

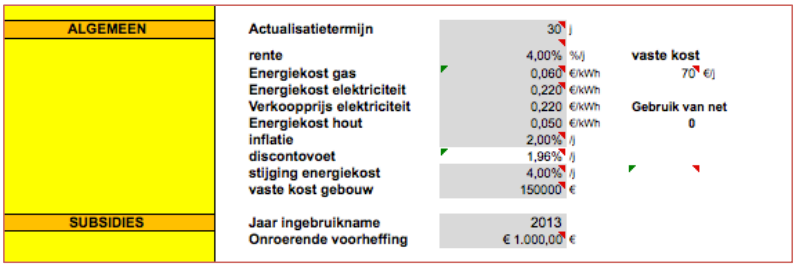
[19] "Studie naar kostenoptimale niveaus van de minimumeisen inzake energieprestaties van nieuwe residentiele gebouwen" (Study on the optimal cost of meeting minimal requirements for energy performance of residential structures), Thomas More and KU Leuven, 22 april 2013.





Input of costs

From the keyboard, data can be entered on Flemish subsidies for particular E-levels, on charges of the grid operator, on tax breaks, photovoltaics, geothermals, solar collectors as well as any subsidies and grants of counties and cities.



Input shell

As many as 4 to 7 alternatives with their specific “U-value” can be entered for every building element. Building elements may be, for example:

- roof, facade, floor, (part of) ground floor that has a basement underneath, doors, windows.

Moreover, information can be entered about sun screens and blinds, airtightness (N50) and the presence of an unheated room next door (AOR, in 4 variants).

Input climate systems:

The programme provides space for:

- ventilation system: up to 6 options
- heating system: up to 6 options
- hot tapwater: up to 6 options
- solar power: up to 6 options

Van alle systemen kan worden ingevuld welk t.ype, vermogen, kosten, variabele kosten en levensduur

The specific heat requirement is computed in approximation and expressed in kWh/m^2. This is an estimate based on EPB (EN ISO 13790- energy performance of buildings). However, this does not predict future energy use exactly.

D. Output options

Aan de hand van de project invoer (zonder alle variabelen)

The E-level indicates the energy performance of a housing unit and its fixed systems under standard conditions. The lower the E-level, the more energy is saved.

Further to the E-level, the present requirement for housing in Belgium (as of January 1, 2014) is E-60, which corresponds to an amount of energy required for heating of 70 kWh/m^2a.

The K-level indicates the level of insulation. In addition, the K-level indicates the insulation value of building elements. The present requirement in Belgium is K-40. In the case of K-40, the required ‘U-value” of a roof, for example, is 0.24 W/m^2K. Again, the lower de K-level, the better the insulation and the more energy will be saved

The probability of overheating and the surface area of glass are presented as percentages.

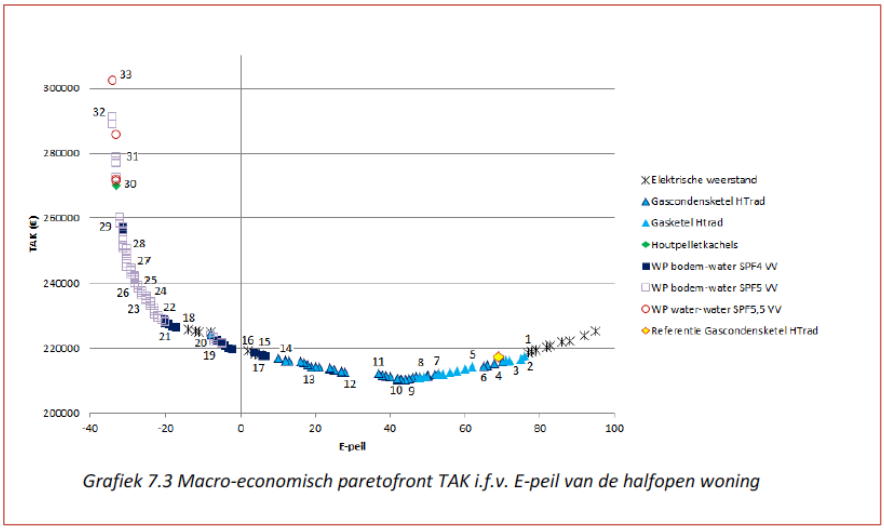
Naast algemene gegevens als het E en K peil en oververhitting. Wordt aan de hand van alle variableen een optimale samenstelling van maatregelen berekend.

Several variants of insulation (“U-values”) and installations (heating and ventilation) can be entered. Subsequently, the programme will go through and compute all combinations of these variants and arrange them in a Pareto graph, showing the extent to which the objective is reached of lower overall costs (including investment costs as well as later operational costs). In this, the perspective is taken of opgegeven calculatie periode.

Three types of graphs can be requested:

- Building only, including the thermal resistance of all building parts, airtightness and outdoor sun protection
- Installations only, including type of ventilation, type of heating, facility for hot tap water and surface area of photovoltaic cells
- Building and installations combined, including all of the above. The below two output screens show this option.

The Pareto-optimal option from the perspective of the total life cycle costs will be identified. The optimum of this graph below is at 10, which corresponds to an E-level of 43. i.e. well below the required E-60. This shows that investement in a high level of insulation pays off for this building over the time of the mortgage or construction **loan. Het** E-peil zou in een EU versie weergegeven moeten worden als kwh/m^2/a.



Grafiek 7.3 Macro-economisch paretofront TAK i.f.v. E-peil van de halfopen woning

TAK = present value of integral costs
Electrische weerstand = electrical resitance (= electric heaters?)
Gas concensketel HT rad = gas fired condensing boiler
Gas ketel HT rad = gas heater with H rt?

Houtpelletkachels = wood pellet furnace
WP bodem water SPF4 = heat pump with Seasonal Performance Factor = 4
WP bodem water SPF5 = heat pump with Seasonal Performance Factor = 5
WP bodem water SPF5.5 = heat pump with Seasonal Performance Factor = 5.5
Refefentie Gascondensketel HT rad = reference gas fired condensing boiler
'E-peil' = E-level (Belgium standard for energy performance)
Grafiek 7.3 macro-economisch paretofront TAK i.f.v. E-peil van de halfopen woning = graph 7.3: Macro-economic Pareto frontier of the present value of integral costs as a function of the E-level of the half-open home.

Preto frontier: The full set of combinations of built and installed options form a cloud in this graph of annually required energy and current value of integral costs; the plotted combinations are only those on the left hand edge and bottom edge of that cloud; that edge on the desirable side is called the Pareto forntier'.

Pareto-graph showing the integral cost of al the combinations of interventions, with the combinations arranged in … order'

TAK (€)	Totale Investering (€)	TT (jaar)	K-peil (-)	E-peil (-)	NEBv (kWh/ m²jaar)	PEV (kWh/ m²jaar)	Opmerkingen
217310	188237	/	38	69	65	110.05	referentie
219471	183446	/	33	79	84	127.08	(1) Ventilatie C++, gevel- en zoldervloerisolatie U=0.27, vloerisolatie U=0.25, raamprofielen Uf=1.60 en glas Ug=1.00; v50-waarde = 3m³/hm², maar elektrische weerstandsverwarming
217455	186382	-20	39	76	65	122.40	(2) HR gasketel met raamprofielen Uf=1.60 en glas Ug=1.30, maar ventilatie C; v50=4.70
216041	186827	-8	37	71	50	114.43	(3) = (2) met betere raamprofielen en beglazing (Uf=1.40;Ug=1.00) en v50=3.00
215892	187314	-5	39	70	50	111.69	(4) = (2) met gascondensatieketel
214252	187656	-2	39	62	48	98.44	(5) = (2) met ventilatie C++
214632	187760	-2	37	65	61	104.39	(6) = (4) betere raamprofielen en beglazing (Uf=1.40;Ug=1.00) en v50=3.00
211941	189034	2	37	52	44	82.65	(7) = (6) met ventilatie C++
211487	189480	3	34	50	41	79.44	(8) = (7) met betere gevel- en vloerisolatie (U=0.27;U=0.30), maar slechtere raamprofielen (Uf=1.60)
211061	189862	3	33	48	39	76.37	(9) = (5) met betere gevel- en vloerisolatie (U=0.27;U=0.25), beter isolerende beglazing (Ug=1.00) en betere luchtdichtheid (v50=3.00) + doucheWTW
210412	191181	5	32	43	38	68.28	(10) = (8) met betere gevel- en vloerisolatie (U=0.24;U=0.25) en beter isolerende raamprofielen (Uf=1.40) + doucheWTW
212423	195752	11	26	37	31	59.50	(11) = (10) met betere gevel- en zoldervloerisolatie (U=0.20;U=0.16) en beter isolerende beglazing (Ug=0.70;g-waarde=0.40)
212571	199332	13	32	28	38	44.31	(12) = (10) + 2.5kWp PV
214355	202731	13	30	19	35	30.16	(13) = (12) met 3.75kWp PV en betere zoldervloerisolatie (U=0.24)
216232	205256	13	30	12	35	18.18	(14) = (13) met 5kWp PV

“The tinted option is listed as:
- TAK (present value of integral costs): € 210,412;
- Total investment: € 191,181;
- TT (cost recovery period): 5 years;
- K-peil (K-level, about insulation) 32 -;
- E-peil (E-level, about energy performance) 43 -;
- NBEv (?) 38 kWh/m2a;
- PEV (Primay energy required) 68.28 kWh/m2a;

Remarks: (10) = (8) with improved wall- and floor insulation (U=0.24; U=0.25), better insulation window frames (Uf=1.40), and heat exchanger on shower drain.

The (10) in this remark refers to the number of this option in the list: this is the tenth ‘line’ of the list.

The fact that (8) is cited means that the interventions for this option also include the items listed under 8: (8) = (7) with improved wall and floor insulation (U=0.27, U=0.30), but worse [cheaper] window frames (Uf=1.60).

The fact that (7) is cited on this line implies that also the following interventions should be included: (7) = (6) with ventilation that meet the Belgian standard C++.
Since (7) calls for (6), included also are: (6) = (4) with better window frames and windows (Uf=1.40; Ug=1.00) and v%)=3.00.

As (6) calls for (4), inluded is also: (4) = (2) with better gas fired condensing boiler.
With (2) cited, included is, moreover, (2) Highly eficient gas heater for central heating, window frames with Uf=1.60 and glass with Ug=1.30 and ventilation to the Belgian standard C (v50=4.70).

The optimal option is identified in the list of construction and installation combinations. This list shows for each combination the total present value of all costs (TAK), the initial investment, a number of other indicators and the required amounts of energy, while the right hand column itemizes the interventions that constitute this option.

E. Availability

For this survey this calculation programme was obtained by e-mail. Whether and when the programme will be available on line is not clear at this point. Op dit moment alleen voor leden van de VCB.

Conclusie E-calculator

Dit programma is het enige programma uit de geselecteerde programma's die met variabelen voor isolatiewaarden en installaties een optimale combinatie berekend. En je tot nieuwe inzichten brengt. Zonder dat je combinatie zelf hebt ingevoerd. Daarom scoort dit programma hoog.

Echter om het programma toegankelijk te maken voor de hele EU:
Several quantities are expressed in a way that is specific to the country of origin: e.g. the E-levels, K-levels, the use of kWh/m^2a for heating and cooling and the ventilation types A, C and D according to Belgian standards. This will stand in the way of general application of this programme in any EC country.

4. KBA Renovatie

A. Relevance		Score 5/5
Home / office / other type of building	All types of buildings can be accomodated	+
New construction as well as renovation	Renovation	+
For designers / developers / building users	All types of users can be served	+
Not too much construction expertise required	A fair amount of knowledge is demanded to enter the correct figures. Less knowledgeable people can use the programme alright but the outcomes will be less reliable.	+
Not too much financial expertise required	Again, a fair amount of knowledge is demanded to enter the correct figures. Less knowledgeable people can use the programme alright but the outcomes will be less reliable.	+/-
B. Scope		**5/7**
For rough sketches as well as detailed designs	This calculation programme is well suited for feasibility studies in the initial phases.	+
Alternative plans can be entered	No.	-
PHPP input possible	No, not directly. Indirect use of PHPP is possible when entering energy data.	-
Offers suggestions and explanations	The copy obtaied for this survey was completely filled out. Vanaf dat model kunnen wijzigen worden ingevoerd en is er een referentie voor de in te vullen warden.	+/-
Easy to use / calculation time	Very	+
Compares before/after renovation	Yes	+
Allows input options / user generated input	Free to enter one's own design	+

C. Input items:		16/22
Building shell		
Expected energy loss in roofs / walls / floors / windows (thermal insulation)	No, cannot be entered separately. Input possible of total energy requirement only in gas en electriciteit, vóór en na renovatie.	+/-
Airtightness as separate item	No, not to be entered separately. Indien invoer van energie behoefte vanhuis calculatie met PHPP dan zit luchtdichting daarin verwerkt.	+/-
Expected energy use in installations	Should be entered (will not be computed).	+
Climate data	No, but if the input is prepared with PHPP then climate data wll have been brought to bear.	+/-
Installations/energy		
Climate system	No	-
Option to enter energy sources / RES	Yes. Energy from renewable sources can be included. However, timing of supply and demand is not considered, and exess heat of collectors is not identified.	+
Specification of energy use in heating / cooling / appliances	No, only total is to be entered. However, heat can be distinguished from electricity.	+/-
Energy required according to PHPP	Yes, could be used to arrive at total required energy to be entered.	+
Primary energy use	No.	-
Costs		
Sensitive to financing/mortgage type	Yes, annuity can be entered. Calculations include Dutch tax deduction based on mortgage interest payments, which does not apply to all European countries.	-
Cost of building's shell	Total renovation costs only	+/-
Cost other than shell	Total renovation costs only	+/-
Process costs	Total renovation costs only	+/-
Subsidies / tax benefits	Yes. To be entered separately.	+
Duration	Yes. In te voeren: te beschouwen periode, looptijd financiering en belastingen.	+
Change in value	Yes, rise in assessed value for real estate tax purposes is included. Not clear whether this figures in with computed income tax burden only or with other computations as well. Dit is een van de weinige rekenmodellen die dit meeneemt.	+/-
Energy prices	Yes. zowel eenheidsprijs als vaste kosten. Voor gas, electra en stadsverwarming. Ook invoer mogelijk voor pellets en biogas. Daarnaast indexering voor de verschillende bronnen.	+/-
Cost of maintenance	Yes. 5 types of exisiting maitenance costs and room for 5 types of new ones. Kosten in te voeren als kosten per jaar.	+/-
Complies with EU regulation 244	Not clear	-
Provides LCC analysis	Not clompletely. LCC calcualtion not visible	-
Costs of CO2 emission	No	-
Cost of climate system	No. Only total energy requirement is to be entered, not	+/-

(operation)	that of separate systems.

D. Output options:		2/6
Intelligibility	Good	+
Computes cost optimum	No. Output is in the form of graphs. A break-even point is indicated in one of the graphs.	-
Cost over life cycle	Ja, van bestaande uit hypotheek, Belasting, subsidie, onderhoud en energiekosten.	-
Computes cost to residents / users	Vaste lasten worden per jaar berekend bestaande uit hypotheek, Belasting, subsidie, onderhoud en energiekosten.	-
Transparency of calculation method	While some outcomes can be inpected, actual computations take place on an inaccessible sheet.	+/-
Dynamic model, shows impact of change in design	No.	-
E. Availability		**6/7**
Additional software requiered	Excel	+
For both PC / Mac	either	+
Price	free	+/-
Taal	Dutch	-
Available online	http://www.hartmanbouwvisie.nl/kosten-baten-analyse-download-formulier/	+
Installed locally / used online	No, excel file	+
Recent update	2013	+

Onafhankelijkheid	
Gemaakt door	Hartman, BouwNEXT
Ontwikkeling gefinancierd door	Gemeente Wageningen, Platform 31
Contactpersoon	Ben Hartman
Onafhankelijkheid	
Bekendheid	
Aantal gebruikers	Niet bekend
Vindbaarheid	Niet bekend

Notes on KBA Renovatie

The calculation programme provides a quick overveiw of the investment and its consequences in the long run. Energy required and the break-even point are indicated clearly.

A. Relevance

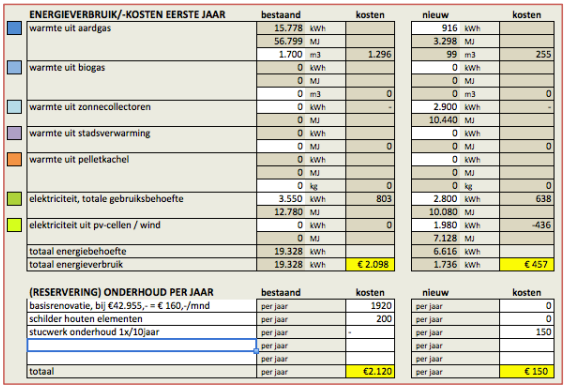
The calculation programme was made for renovation prjects an can be used in their early stages.

B. Scope

For a reliable result, a good understanding of costs is required.

C. Input items

Many items can be entered or altered from the keyboard. Information on mortgages and tax rebates is requested, based on Dutch regulations.



ENERGIEVERBRUIK/-KOSTEN EERSTE JAAR	bestaand		kosten	nieuw		kosten
warmte uit aardgas	15.778	kWh		916	kWh	
	56.799	MJ		3.298	MJ	
	1.700	m3	1.296	99	m3	255
warmte uit biogas	0	kWh		0	kWh	
	0	MJ		0	MJ	
	0	m3	0	0	m3	0
warmte uit zonnecollectoren	0	kWh	-	2.900	kWh	-
	0	MJ		10.440	MJ	
warmte uit stadsverwarming	0	kWh		0	kWh	
	0	MJ	0	0	MJ	0
warmte uit pelletkachel	0	kWh		0	kWh	
	0	MJ		0	MJ	
	0	kg	0	0	kg	0
elektriciteit, totale gebruiksbehoefte	3.550	kWh	803	2.800	kWh	638
	12.780	MJ		10.080	MJ	
elektriciteit uit pv-cellen / wind	0	kWh	0	1.980	kWh	-436
	0	MJ		7.128	MJ	
totaal energiebehoefte	19.328	kWh		6.616	kWh	
totaal energieverbruik	19.328	kWh	€ 2.098	1.736	kWh	€ 457

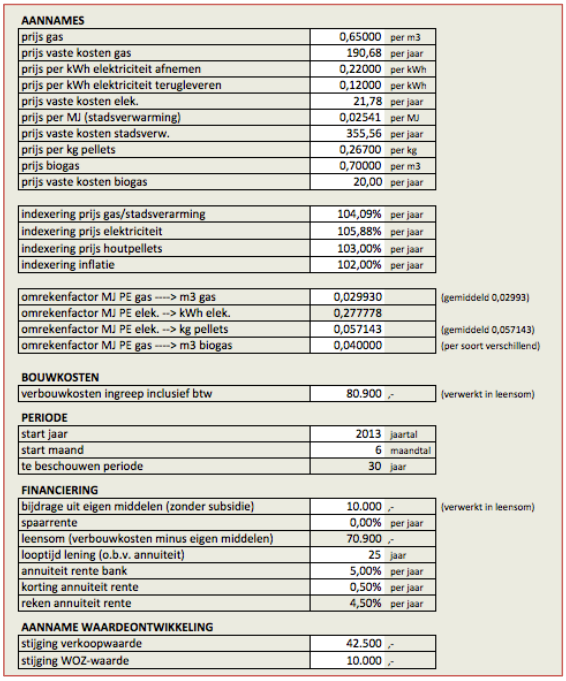
(RESERVERING) ONDERHOUD PER JAAR	bestaand	kosten	nieuw	kosten
basisrenovatie, bij €42.955,- = € 160,-/mnd	per jaar	1920	per jaar	0
schilder houten elementen	per jaar	200	per jaar	0
stucwerk onderhoud 1x/10jaar	per jaar	-	per jaar	150
	per jaar		per jaar	
	per jaar		per jaar	
totaal	per jaar	€2.120	per jaar	€ 150

The above figure is called “energy requirements/costs in the first year”. Tabulated are the existing situation and the new one after renovation. Items are:

- Heat from natural gas
- Heat from biogas
- Heat from solar collectors
- Heat from district heating
- Heat from pellet furnace
- Electricity, total required
- Electricity from photovoltaics/wind
- Total energy required
- Total energy purchased

Tabulated also are annualised costs of maintenance for the existing and the new situation. Items are:

- Payments towards the renovation
- Keeping wooden part painted
- Maintaining plasterwork
- Total



AANNAMES

prijs gas	0,65000	per m3
prijs vaste kosten gas	190,68	per jaar
prijs per kWh elektriciteit afnemen	0,22000	per kWh
prijs per kWh elektriciteit terugleveren	0,12000	per kWh
prijs vaste kosten elek.	21,78	per jaar
prijs per MJ (stadsverwarming)	0,02541	per MJ
prijs vaste kosten stadsverw.	355,56	per jaar
prijs per kg pellets	0,26700	per kg
prijs biogas	0,70000	per m3
prijs vaste kosten biogas	20,00	per jaar

indexering prijs gas/stadsverarming	104,09%	per jaar
indexering prijs elektriciteit	105,88%	per jaar
indexering prijs houtpellets	103,00%	per jaar
indexering inflatie	102,00%	per jaar

omrekenfactor MJ PE gas ----> m3 gas	0,029930	(gemiddeld 0,02993)
omrekenfactor MJ PE elek. --> kWh elek.	0,277778	
omrekenfactor MJ PE elek. --> kg pellets	0,057143	(gemiddeld 0,057143)
omrekenfactor MJ PE gas ----> m3 biogas	0,040000	(per soort verschillend)

BOUWKOSTEN

verbouwkosten ingreep inclusief btw	80.900 ,-	(verwerkt in leensom)

PERIODE

start jaar	2013	jaartal
start maand	6	maandtal
te beschouwen periode	30	jaar

FINANCIERING

bijdrage uit eigen middelen (zonder subsidie)	10.000 ,-	(verwerkt in leensom)
spaarrente	0,00%	per jaar
leensom (verbouwkosten minus eigen middelen)	70.900 ,-	
looptijd lening (o.b.v. annuiteit)	25	jaar
annuiteit rente bank	5,00%	per jaar
korting annuiteit rente	0,50%	per jaar
reken annuiteit rente	4,50%	per jaar

AANNAME WAARDEONTWIKKELING

stijging verkoopwaarde	42.500 ,-	
stijging WOZ-waarde	10.000 ,-	

The above figure is called “assumptions” and includes:

- Price of natural gas
- Fixed costs natural gas
- Price of electricity
- Feed-in tariff of electricity
- Fixed cost of electricity
- Per unit price of district heating
- Price of pellets
- Price of biogas
- Fixed costs biogas

- Index for natural gas / district heating
- Index for electricity
- Index for pellets
- Inflation

- Conversion factor heat from natural gas → volume of natural gas
- Conversion factor heat from electricity → kWh electricity
- Conversion factor heat from pellets → weight of pellets
- Conversion factor gas → volume of biogas

- Cost of renovation including VAT

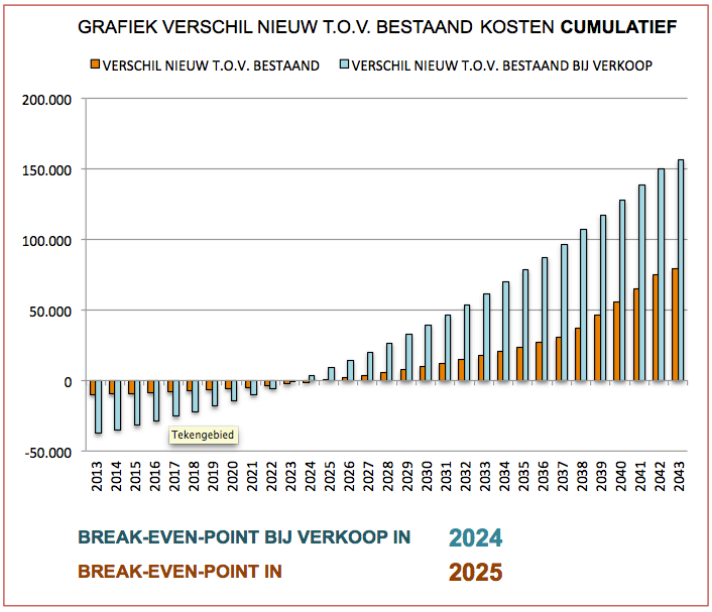
- Beginning year
- Beginning month
- Period to be analysed

- Contributions out of own funds (no grants)
- Interest rate
- Loan (cost of renovation minus contributions out of own funds)
- Duration of the loan
- Bank's annuity interest rate
- Rebate on annuity interest rate
- Annuity interest rate for calculation purposes

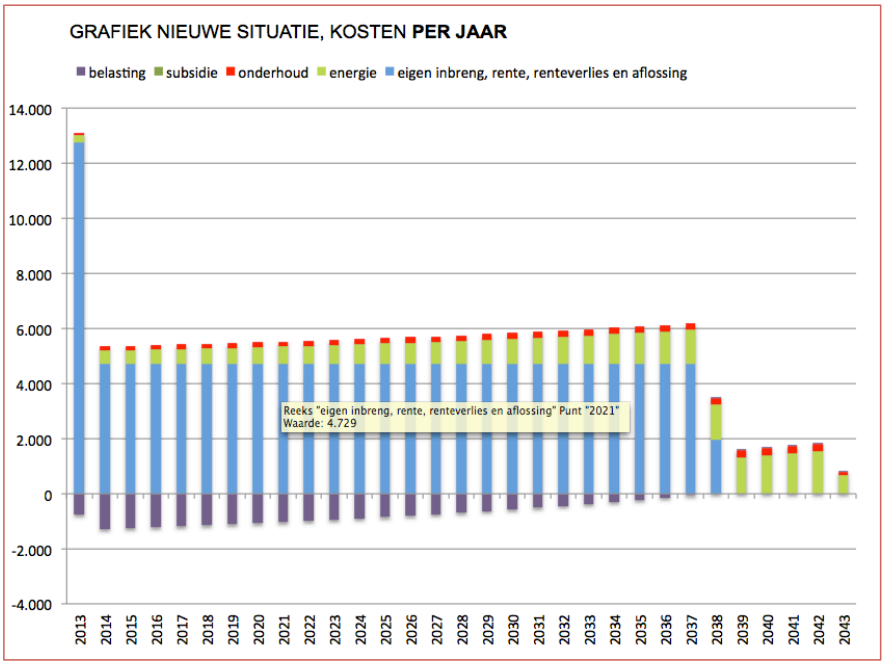
- Increase of book value
- Increase of tax base

D. Output mogelijkheden

The output of KBA Renovatie is clear and will be computed quickly.

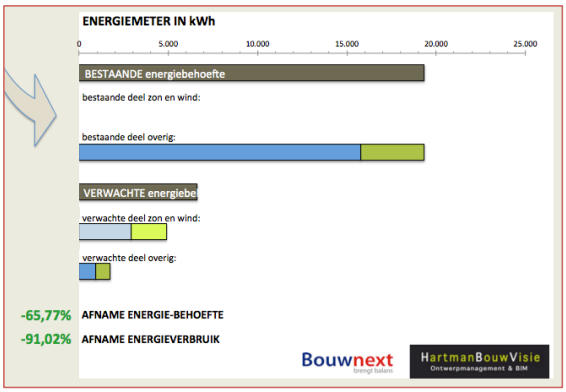


The above illustration is called "Graph of the difference between the existing and the new cumulative costs"
The red bars indicate the simple cost difference and the blue bars indicate the difference in case the property is sold.
The bottom lines say:
Break-even point in case of sale is reached in 2024
And the Break-even point in simple costs is reached in 2025



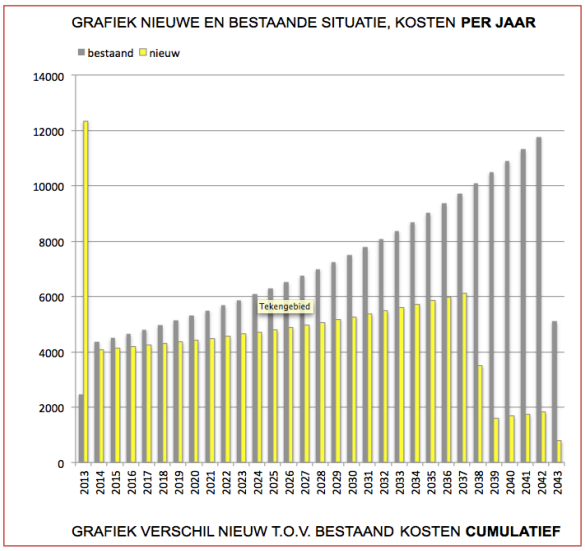
The above illustration is called “New situation, costs per year”

- Purple is taxes
- Grey is grants
- Red is maintenance
- Green is energy
- Blue is contribution from own funds, interest, forgone interest and loan payments.



The above illustration is called ‘energy gauge’ in kWh
Items are:

- Energy required in the existing situation
- Energy from sun and wind in the existing situation
- Other energy sources in the existing situation
- Energy required after renovation
- Energy from sun and wind after renovation
- Energy from other sources after renovation
- The bottom lines are:
- Reduction of energy required
- Reduction of energy purchases



The above illustration is called “Graph of the new and existing situation, cumulative cost per year”

- Grey = existing
- Yellow = new

F. Availability

The calculation model was financed regionally and is not (yet) being promoted nationally.

Conclusion:

The calculation program is useful for analysing a particular design. It is not dynamic and it does not identify an optimum. Based on expertise on construction and construction cost, this tool makes it fairly simple to test the impact of choices in the design.

8.2 Recommendation

De vijf programma's zijn behoorlijk verschillend, maar geven samen een goede indruk van de breedte van het palet aan invoer en output mogelijkheden van een programma.
Beschikbaarheid van een aantal tools is op dit moment nog een probleem.

Kort per tool:

1. Econ calc
Het model heeft veel vrijheid voor invoer, wellicht iets te veel voor een snel inzicht in kosten. Voorbeeld model is nuttig, om invoer mogelijkheden te zien. 5 varianten naast elkaar kunnen inzien is goed.

2. LZK tool
Erg uitgebreid en goed bruikbaar programma. Gemaakt voor intern gebruik voor advise bureau, werkt ook aan een renovatie-model. Helaas (nog) niet beschikbaar voor de markt.

'E-calculator'
Shows the higher overall number of pluses in the table above. Assuming all pluses are of equal value, this makes it the preferred programme at the moment. This calculation programme was developed by the Knowledge Centre on Energy (KCE) of the Catholic University (KU) at Leuven, Belgium and Thomas More. Although this programme in its present form is aimed at new construction projects, it still meets most of our criteria. The programme complies with the relevant European regulation to compute a 'cost-optimal' design (EU 244/2012), making it officially relevant anywhere in the European Union. Options for input and output are plentiful. The computation follows the perspective of the entire life cycle and includes a residual value. A distinguishing element of this programme is that it will identify the set of renovation interventions that is optimal from a cost point of view. So it does more than just calculate the life cycle cost of interventions as entered. This way, the programme can arrive at solutions or combinations that, off hand, the designer had not even thought of.

Climate systems should be characterised in an internationally common way instead of using the Belgian categories of A, B or C.

The process of identifying the optium works as follows per construction element a number of possible insulation measures and their quantification can be entered. Similarly, several possible designs of the heating/cooling system can be entered. After this data entry, the programme will make all combinations and compare their costs of investment and operation during the period of the mortgage or loan. The outcome is presented in a Pareto graph, showing the optimal combination from a cost point of view for the specified time period. In addition, the programme will show the additional costs if another insulation value or climate system is preferred.

However, the 'E-calculator' programme is not very user friendly, and it is not particularly aimed at renovations. Providing the input is an elaborate affair and its computations take a lot of machine time. While the computer is processing the data, one is advised not to use the machine for anything else because doing so may disrupt the calculation process.

The same software development team is presently preparing a more user friendly version for renovation projects. That software development effort started in September 2013 and was expected to last for 4 years.

4. KBA- renovatie
The calculation programme provides a quick overveiw of the investment and its consequences in the long run. Energy required and the break-even point are indicated clearly.

Aanbeveling algemeen:
None of the calculation programmes is in English, in order to make the calculation programmes suitable for application anywhere in Europe, a few changes would be desirable:

- Translation into English.
- Gebruik maken van de europese regelgeving 2012/244 zoals e-calculator doet.
- Provide a link to a database of European construction materials such as www.constructioncosts.eu; this would simplify the input process. LZK past dit principe toe op basis van een Oostenrijkse database.
- Een link van de gebruikte bouwmaterialen naar de LCA van de betreffende materialen zou ook een pre zijn, zoals LZK toepast.
- Uiteraard een renovatie variant van het betreffende rekenmodel vervaardigen.

When making this calculation programme suitable for all of the European Union, the following other programmes may be used as examples. ENNE (in 3 D) and GREX PLUS are very easy to use and offer dynamic feedback on changes of the input by ticking items on or off in a list or by moving a slide in a bar. LZK TOOL offers its output in a very clear format and features a link to a database of construction materials.

8.3 Other interesting tools

A number of calculation programs came to our attention during the survey. Although they do not meet all required criteria, they are of interest when it comes to examining the financial feasibility of renovations that focus on energy conservation.

In addition, some tools are still under development and will be available only after this survey is completed.

The following calculation programs will be discussed below.

1. Entranze
2. BeOpt
3. Energo - IT – toolkit
4. eVALUator 4.0
5. IEA EBC Annex 56
6. ENNE
7. GREX-plus Strategis
8. Retrofitwheel
9. Policy tool for Renovation
10. Fimaren
11. Epiqr
12. VisualDOE 4.0 (DOE2. 1^{E})

1. ENTRANZE

Notes on Entranze

The calculaution programme ENTRANZE (ENforce the TRAnsition to Nearly Zero Energy buildings in de EU-27) is the result of an IEE project. Financed by the EU, it was presented in 2012. IEE (Intelligent Energy Europe) actively supports 9 countries.

At the time of the review the model was limted to 10 cities for which data were entered:

- Sevilla (ES)
- Madrid (ES)
- Rome (IT)
- Milan (IT)
- Bucharest (RO)
- Vienna (AT)
- Paris (FR)
- Prague (CZ)
- Berlin (DE)
- Helsinki (FI)

Thus, the calculation programme does not appear to be ready for use throughout Europe.
As the information changes rapidly, updates should be at least annual to keep the tool up to date.

Approximately 3600 renovation options result from a combination matrix for the particular city. Alle data betreffende bouwkosten, voor small en large buildings. Kosten voor installaties en energiebronnen en energieprijzen. Their computation outcomes are shown in the dot-plot.

“ This spread sheet allows to assess the policy impact of renovation packages in existing buildings, by cost/energy curves and clouds. This tool focuses on building renovation and provides a comparative analysis expressed as a dot plot (cloud) graph of global cost versus (net) primary energy of various renovation options. This spreadsheet produces both graphical and numerical outputs. The “Cost_Energy calculation tool" allows to evaluate the impact of various parameters on cost/energy cloud for a specific building in a specific climate context. For every set simulated it is possible to define an encouraged target of primary energy for comparison with the minimum limits for energy performance requirements in force. The base refurbishment level (i.e. the base renovation of the building/HVAC technologies for esthetical/ obsolescence /safety reasons without specific energy efficiency aims) is always marked separately in the graph.” [20]

[20] http://www.entranze.eu/tools/cost-tool

Variant n.	Building Variants				Building Variant-Code			
	Packages				Packages			
	1	2	3	4	1	2	3	4
1	n	n	n	n	1	1	1	1
2	n	n	+	n	1	1	2	1
3	n	+	n	n	1	2	1	1
4	n	+	+	n	1	2	2	1
5	n	+	n	+	1	2	1	2
6	n	+	+	+	1	2	2	2
7	+	n	n	n	2	1	1	1
8	+	n	+	n	2	1	2	1
9	+	+	n	n	2	2	1	1
10	+	+	+	n	2	2	2	1
11	+	+	n	+	2	2	1	2
12	+	+	+	+	2	2	2	2
13	+	++	n	n	2	3	1	1
14	+	++	+	n	2	3	2	1
15	+	++	n	+	2	3	1	2
16	+	++	+	+	2	3	2	2
17	++	n	n	n	3	1	1	1
18	++	n	+	n	3	1	2	1
19	++	+	n	n	3	2	1	1
20	++	+	+	n	3	2	2	1
21	++	+	n	+	3	2	1	2
22	++	+	+	+	3	2	2	2
23	++	++	n	n	3	3	1	1
24	++	++	+	n	3	3	2	1
25	++	++	n	+	3	3	1	2
26	++	++	+	+	3	3	2	2
27	+++	+	n	n	4	2	1	1
28	+++	+	+	n	4	2	2	1
29	+++	+	n	+	4	2	1	2
30	+++	+	+	+	4	2	2	2
31	+++	++	n	n	4	3	1	1
32	+++	++	+	n	4	3	2	1
33	+++	++	n	+	4	3	1	2
34	+++	++	+	+	4	3	2	2
-					nd	nd	nd	nd
-					nd	nd	nd	nd
-					nd	nd	nd	nd
-					nd	nd	nd	nd
-					nd	nd	nd	nd
-					nd	nd	nd	nd

INSTRUCTIONS:
in column B insert the number of the building simulated. It is possibile to insert a maximum of 40 building variants. INSERT THE SYMBOL "-" if the variant are less than 40

INSERT:

n:	for base refurbishment packages
+:	packages with low performance
++:	packages with medium performance
+++:	packages with high performance

Er zijn 4 hoofdgroepen in 4 kolommen. In elke groep zijn er 4 pakket keuzes Elk nr. Voor een pakket staat voor een samenstelling van maatreglen en waarden. Waarbij 1 de pakketten zijn met een lage prestatie en 4 zijn de pakketen met een hoge (energie besparende) prestatie.
Dit resulteert in 34 gebouwvarianten.

Kolom 1 Opaque envelope (isolatie schil)
kolom 2 window (U waarde, g waarde, Zta waarde, luchtdichting)
kolom 3 cooling (schaduw, zomernachtkoeling, verlichting)
kolom 4 Heat recovery (niet duidelijk)

en daarnaast:
HE_G: heating generation,
CO_G: cooling generation
HE_E: heating emission,
CO_E: cooling emission
HR: heat recovery,
VE: ventilation,
HE_D: distribution
CO_D: Cooling distribution

HE_C: Heating control
CO_C: Cooling control
RES PV :RES photo voltaic
RES ST: RES solar thermal

Het wordt niet goed duidelijk welke opties er in kolom 4 zijn en wat er bij de 34 snelkeuzes aan installaties wordt gekozen.

A. Relevance

Te gebruiken voor renovatie van large or small buildings

B. Scope

Aimed at early phases of design: Initiative, sketches.

C. Input items

- Costs incl remove and disposal costs
- Duration
- increase or decreace of annual costs as a percentage of those costs
- cost of maintenance in % per year

Energy use: To be entered by user Gebruik hiervoor een ander programma naar wens. Bijvoorbeeld PHPP. Kan daardoor wel heel nauwkeurig worden ingevoerd.

Er zijn 10 steden in gevuld. Dit betreft data over klimaat en bouwkosten. Het is mogelijk om nieuwe steden toe te voegen.

In entering another city or system all construction knowledge will come in handy.

ENVELOPE COSTS:
Building shell in 4 options of U-values covering:
- facades
- roof
- basement

Openings in 3 options regarding
- U-value
- G-value
- LTA value
- Air permeability

Cooling:
- Solar shading
- Night cooling in 1/h
- Lighting load in W/m2
- Lighting control

HR:
Onduidelijk wat er onder deze groep valt.

Naast de 4 hoofd groepen zijn er ook invoeropties per installatie onderdeel :
bij elk onderdeel van heating generation tot RES solar thermal is er keuze uit 1 of 7 varianten. Afhankelijk van het onderdeel. Voor heating generation zijn er bijvoorbeeld 7 opties en voor RES photo voltaic zijn er twee opties 'present' of 'absent'

Mbt RES PV: er is per stad aangegeven hoeveel kwh/m2 er kan worden opgewekt. Daarnaast kan efficientie, verlies en orientatie en nog een aantal opties.

Voor elke keuze is er per stad aangegeven wat de totalkosten zijn van:
Material costs, labour costs, business profit, general expanditure

In addition to entering costs of construction elements, input is also requested for:

PRIMARY ENERGY
- KWh/kWh per kind of energy per city per year.

EMISSION
- CO_2/kWh

			SEVILLE (ES)
Primary Energy Factor (PEF) - GAS	PEF_{gas}	kWh/kWh	1,00
Primary Energy Factor (Total PEF renewable + non-renewable part) - BIOMASS	$PEF_{biomass}$	kWh/kWh	1,25
Primary Energy Factor (PEF) - DISTRICT HEATING	$PEF_{districtHE}$	kWh/kWh	1,20
gCO2/kWh - ELECTRIC		gCO2/kWh	287
gCO2/kWh - GAS		gCO2/kWh	202
gCO2/kWh - BIOMASS		gCO2/kWh	0
gCO2/kWh - DISTRICT HEATING		gCO2/kWh	170
taxes (VAT) - refurbishment on residential		%	10,0%
taxes (VAT) - refurbishment on other building destination		%	21,0%
taxes on electric carrier		%	27,0%
taxes on gas carrier		%	21,0%
taxes on biomass carrier		%	21,0%
taxes on district heating carrier		%	21,0%
Professional Fees		%	11,0%

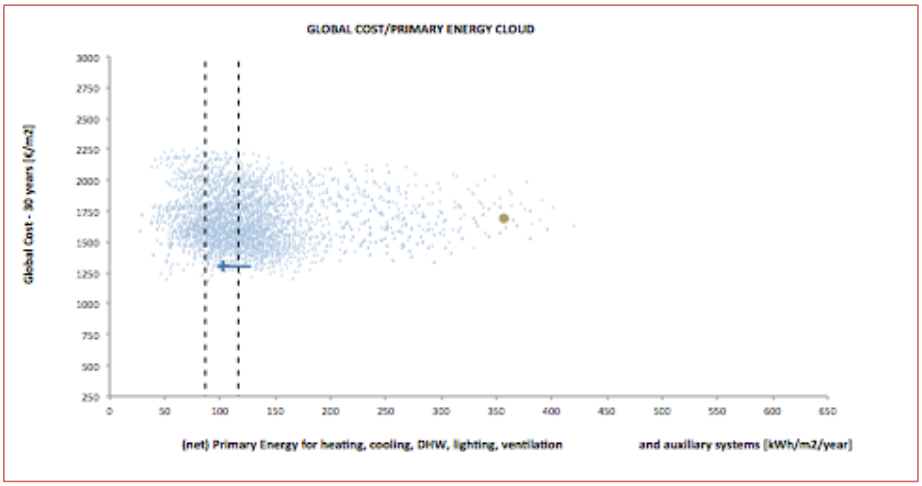
DEFINITION OF ENCOURAGED TARGET PRIMARY ENERGY		Note
percintile global cost	0,01	value between 0-0,05
reference min global cost	1285,46	
check variant under refernce	27,00	
range on y axis [%]	1,00%	value between 0-5%
upper limit CO area	1298,31	
upper limit CO area correct	1300,00	
min (net) PE area in CO area	101,94	
max (net) PE area in CO area	127,12	
upper (net)PE limit [%]	15,00%	
upper (net)PE limit [kWh/m2]a]	117,24	
lower (net)PE limit [%]	15,00%	
lower (net)PE limit [kWh/m2]a]	86,65	

FINANCIAL
- data on interest and inflation
- economic perspectives finanacial standard private en macro economic twee opties.

There are 34 alternatives with several variations on each, resulting in 3600 variants. For each of these, the amount of energy required for heating, cooling, ventilation, illumination and other appliances is to be entered. PHPP can be used to compute the energy for heating (and cooling).

D. Output options

'An important part of the output is the graphic presentation in a dot-plot i.e. cloud. Included is a zone of cost-optimal designs.
However, this plot is not very intelligible, and what can be done with it is not clear.



The dot-plot will show a band of optimal variants, but no indications is given what interventions are included in those variants.
The output also includes a sheet with about 3600 possible variants with their costs (initial + maintenance + periodic + energy + residual value = total costs). But the order and clarity of this table leaves to be desired.

Output includes a dot-plot, i.e. a graph of costs against required primary energy with a cloud of about 3600 variant designs for the project.

In the sheet main output kun je oa. aflezen welke initial-, prelace-, annual-, energy-, environmental damage en totale kosten er per elke van de 3600 opties zijn gemaakt.

E. Availability

Available for downloading free of charge. Language English.
The available version is a beta test that can be improved based on user feedback.

http://www.entranze.eu/tools/cost-tool
Contact person: lorenzo.pagliano@polimi.it

Conclusions Entranze

The input options of this calculation programme are extensive. User friendliness and quality of the output leave to be desired. Based on the 'main output', it should be possible to produce a series of eye-catching graphs, identifying the more interesting combinations of intervenions at a glance.

This caluclation programme shows a lot of promise but is not in full use.

Made by: BUILD UP - The European Portal for Energy Efficiency in Buildings.
E-ERG (End-use Efficiency Research Group) Politecnico di Milano (Engineering School, Milan, Italy)