Uncertainty in Odyssee indicators and energy savings – Development of a methodology and first results

CONCEPT 3

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1. Introduction

The ODYSSEE database on energy efficiency indicators (www.odyssee-indicators.org) has been set up to enable the monitoring and evaluation of realised energy efficiency improvements and related energy savings. The database covers the 27 EU countries as well as Norway and Croatia. Energy indicators that relate energy consumption to a physical output (ton of steel), a performance (person-km driven per car) or the number of energy using devices (refrigerators) can show the increase in energy efficiency realised, and the amount of energy saved. By aggregating indicators, Odyssee calculates energy efficiency indices by sector and for the whole economy (so-called ODEX), in order to evaluate overall energy efficiency progress.

This work contributes to the growing need for quantitative monitoring and evaluation of the impacts of energy policies and measures, both at the EU and national level, e.g. due to the Energy Service Directive.

Because of the central role of Odyssee indicators in policy evaluations it becomes more important to know how reliable the Odyssee figures are, or in other words, what is the uncertainty margin for the indicator values and the related savings.

This report presents a first analysis of uncertainty margins in the indicators and savings figures. The work builds on earlier work in the preceding Odyssee project with regard to the quality of input data used in Odyssee.

The first chapter provides a short overview of the Odyssee database, the input data, the calculation of individual indicators and the aggregated ODEX, and the energy savings thereof. The following chapter presents the causes of uncertainty, how it defines the quality of the calculated figures and how it influences the use of the Odyssee results.
Chapter 3 describes the method to calculate the uncertainty margin in indicators and savings, starting from the quality of the input data. Calculation results for a few selected countries are presented in chapter 4. Finally, chapter 5 shows how the approach can be implemented in the Odyssee database.

2. Overview of Odyssee database

2.1. Efficiency indicators

The ODYSSEE database on energy efficiency indicators (www.odyssee-indicators.org) encompasses various types of indicator, which can be classified into the following seven categories:

a. Energy/CO_2 intensities: relate the energy used in the economy or a sector to macroeconomic variables (e.g. GDP, value added).

b. Unit consumption/emissions: relate energy consumption/CO_2 emissions to physical indicators (unit consumption per ton of steel, per car or per dwelling); specific consumption of vehicles, refrigerators, …

c. Energy efficiency indices by sector and for the whole economy (ODEX) to evaluate energy efficiency progress.

d. Energy/CO_2 savings: calculate the amount of energy/CO_2 saved through energy efficiency improvements.

e. Adjusted indicators to allow the comparison of indicators across countries (adjustments for differences in climate, general price level, fuel mix, industry and economic structure…).

f. Benchmark/target indicators by sector to show the potential improvement based on countries with the best performance.

g. Indicators of diffusion to monitor the market penetration of energy-efficient technologies (number of efficient lamps sold) and practices (% of passenger transport by public modes). These indicators are easier to monitor and can be updated more quickly than energy efficiency indicators that depend on the availability of data on end-use consumption.

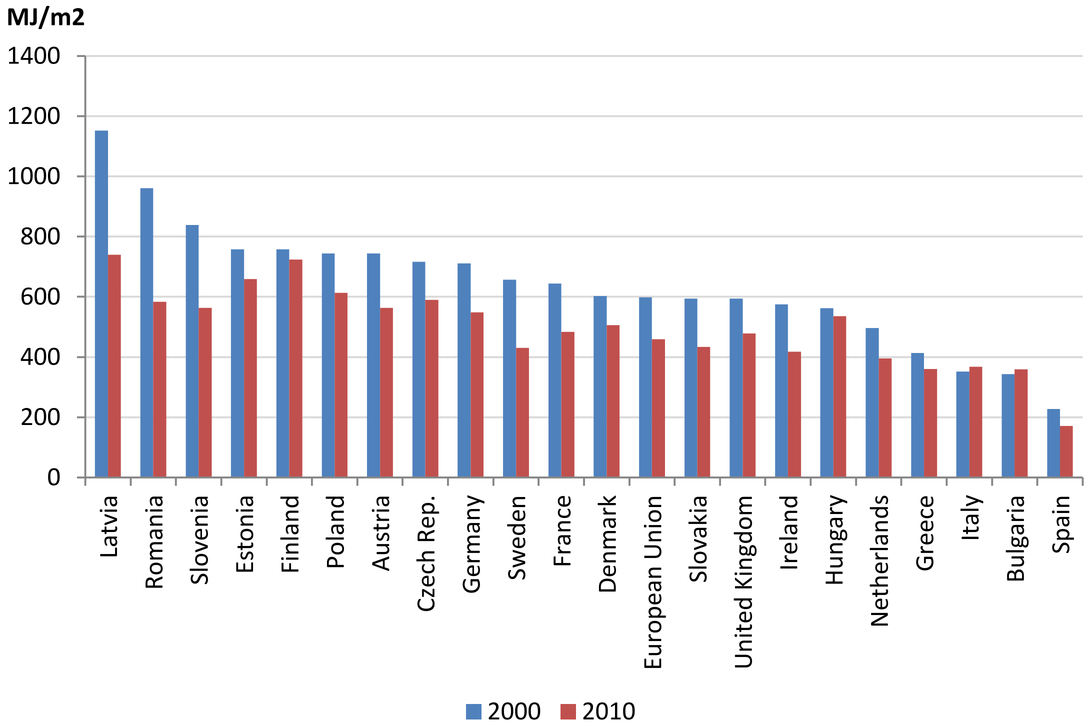
Generally, the indicators regard yearly quantities, e.g. the efficiency index for 2002 or the number of passengers by public transport in 2005.

Here the focus is on unit consumption indicators (b), from which follow the energy efficiency indices per sector and the ODEX for all end-use (c) and the related energy savings (d). Where relevant adjusted indicators (e) are used instead of unit consumption indicators.

2.2. Unit consumption indicators

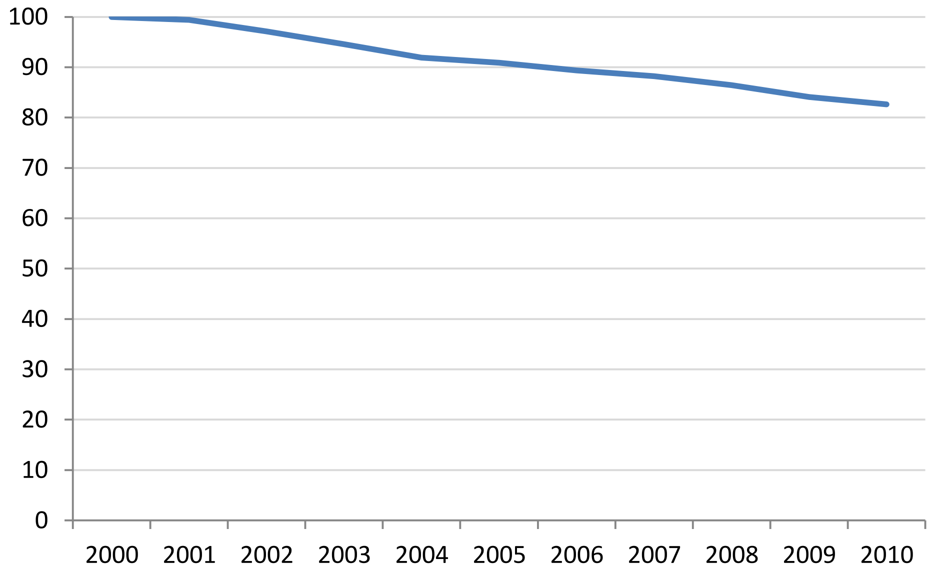
Unit consumption indicators regard trends for a chosen targeted energy use. An example is energy use for space heating per m^2. The unit consumption is calculated from total yearly energy use for space heating, the number of dwellings and the average size of dwellings. The trend for average space heating energy use is shown in **Figure 2-1** for all EU countries. Variations in yearly climate can distort the real trend for unit consumption; therefore, energy consumption figures are corrected for the deviation from average temperature during the heating season and for the severity of winters in the different countries.

Figure 2-1: Energy use for space heating per m² adjusted to EU climate (EU-27)



The trend for unit consumption is converted into an index, with a value of 100 for the base year. In this way the trends for all indicators can be shown in a comparable fashion. The unit consumption indicator for space heating in dwellings is shown in Figure 2-2.

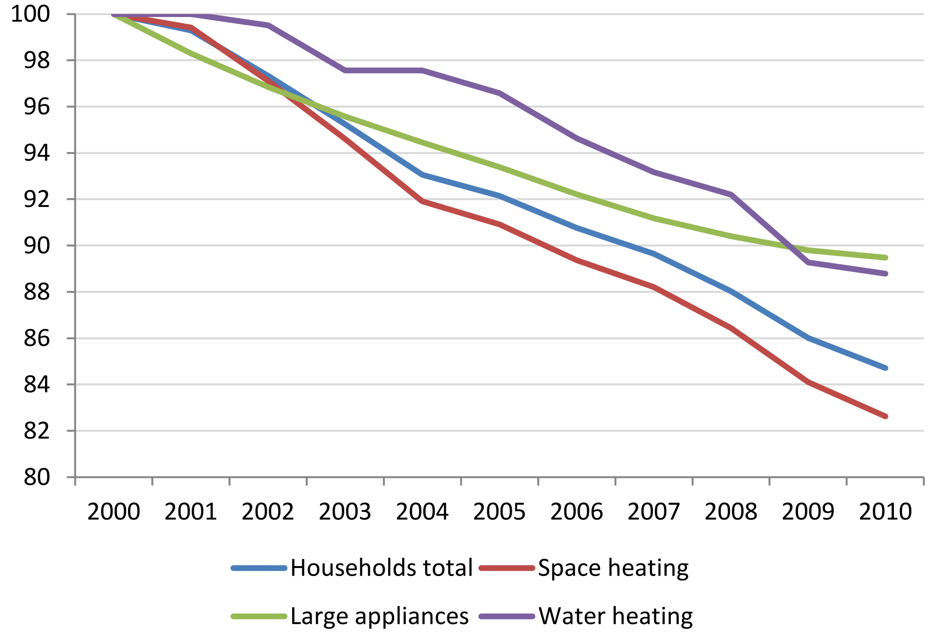
Figure 2-2: Indicator on space heating energy use per dwelling (EU-27)



2.3. Aggregated ODEX indices

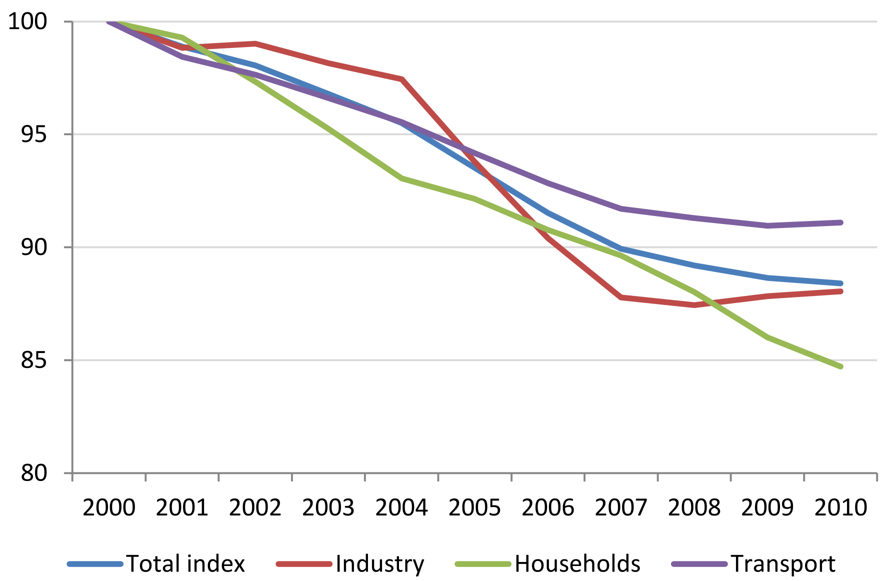
The trends for unit consumptions by sub-sector or targeted end-use are aggregated into one index, called ODEX. The ODEX per sector is based on the adjacent unit consumption indicators, each weighted with its share in the total energy consumption of the sector. **Figure 2-3** shows the ODEX-Households which comprises indicators for space heating, hot water use and a set of large electric appliances.

Figure 2-3: ODEX-Households for 2000-2010 (EU-27)



For the overall ODEX the same method is applied with weighting factors based on the shares in total final energy consumption. The indices for the sectors and for the overall ODEX are shown in **Figure 2-4**.

Figure 2-4: ODEX for end-use (sectors) for 2000-2010 (EU-27)

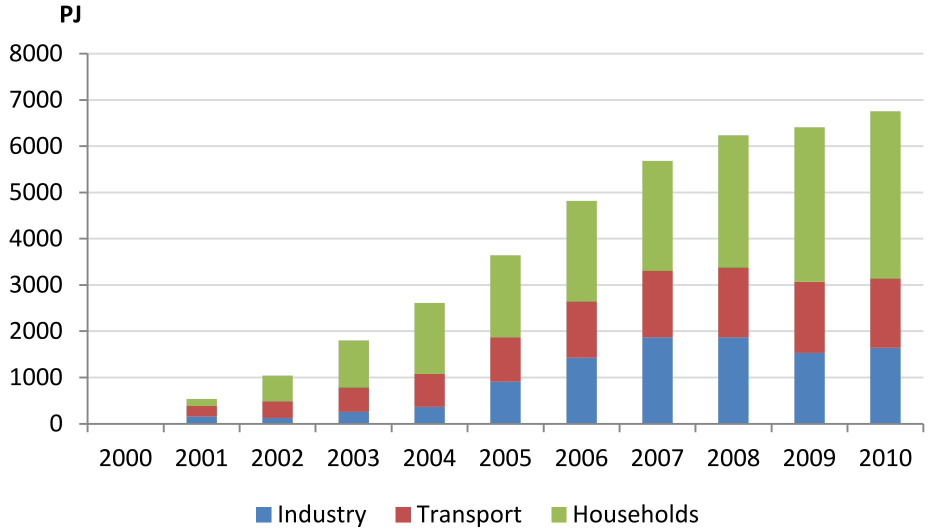


2.4. Energy savings

The decrease in the value of the indicator is assumed to be due to savings. For example, if the index for average energy use per dwelling decreases from 100 to 85 in a period, the relative savings are 15%, or (100 – 85)/100. The absolute savings, expressed in Joule or physical quantities, are found by dividing the energy consumption (in all dwellings) in the end year by the index for the end year, and subtracting the actual use in the end year

The indicator value (normally) decreases over time, which reflects relative savings that increase year by year. Therefore, the absolute savings thereof show the cumulative savings over a period from the base year (see **Figure 2-5).**

Figure 2-5: Cumulative energy savings for 1996-2007 for EU-27



3. Uncertainty margins for indicators and savings

3.1. Margin for energy indicators

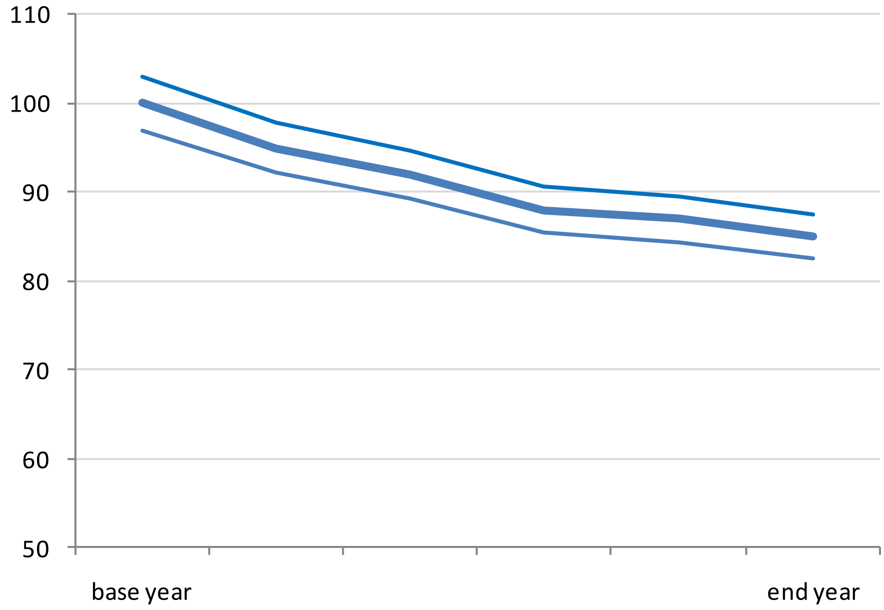
Energy indicators constitute the ratio between an energy quantity and a quantity that explains energy consumption, e.g. gas use for space heating that is explained by the number of dwellings. The value of both quantities is based on data from statistics or surveys that have a limited exactness. Therefore, the calculated value of the indicator will have an uncertainty margin.

Both the margin for the energy quantity and the margin for the explaining quantity contribute to the uncertainty margin for the indicator. The relation between the three margins is described in chapter 4.

The indicator value is normally expressed as an index with a value of 100 for the base year. For a given year with calculated index value of 90 and a margin of +/- 3 the possible value could be between 87 and 93 (see example in **Figure 3-1**).

The ODEX represents an aggregated indicator for a sector or a country, which is based on indicators that all have uncertainty margins. The relation between the ODEX margin and that of the contributing indicators is also described in chapter 4.

Figure 3-1: Energy efficiency index and uncertainty margin (example)



3.2. Margin for input data used

The margins for the quantities, used as inputs in the calculation of energy indicators, depend on the way the input data have been gathered. Data from official statistics are normally based on extensive surveys that strive for (almost) full coverage and check the answers of the respondents. However, not all statistical data are gathered in this way. Therefore, the margins can differ substantially between the same set of official data. Table 3-1 shows that the margin in energy consumption data for the Netherlands ranges[1] from 0.5% for primary sources to 6% for other end-users. For total primary energy consumption (TPEC) the margin is 2.6%.

Table 3-1: Uncertainty margins for energy consumption data in the Netherlands

Quantity	Amount1999 in PJ	Uncertainty margin (%)
Extraction	2484	0.5
Import	6842	0.5
Export	5812	1.1
Bunkers	677	2.1
TPEC	2974	2.6
Total energy sector	593	3
- Refineries	171	10
- Power stations	242	1
- Incineration	32	2
- Distribution	33	2
Total end-users	2381	1.5
- Industry	1027	1
- Transport	457	2
- Households	421	3
- Other end-users	476	6

Source: W. Tinbergen, CBS, 2001

Data from other surveys can show a much lower quality due to limited coverage, respondents not being representative for the population, unfitting set up of the questionnaire, etc. However, surveys for scientific purposes or recognized private surveys can have a good quality as well.

Another quality factor regards the repetition rate of data gathering. Yearly surveys are most appropriate because the indicators regard yearly quantities. For non-yearly surveys an interpolation has to be made which creates extra uncertainty for the calculated indicator.

3.3. Margin for energy savings

The decrease in the value of the indicator is assumed to be due to savings. The savings related to the indicator are found by dividing the energy consumption in the end year by the savings index for the end year and subtracting the actual use in the end year (see section 2.4).

The uncertainty in the savings figure is dependent on:

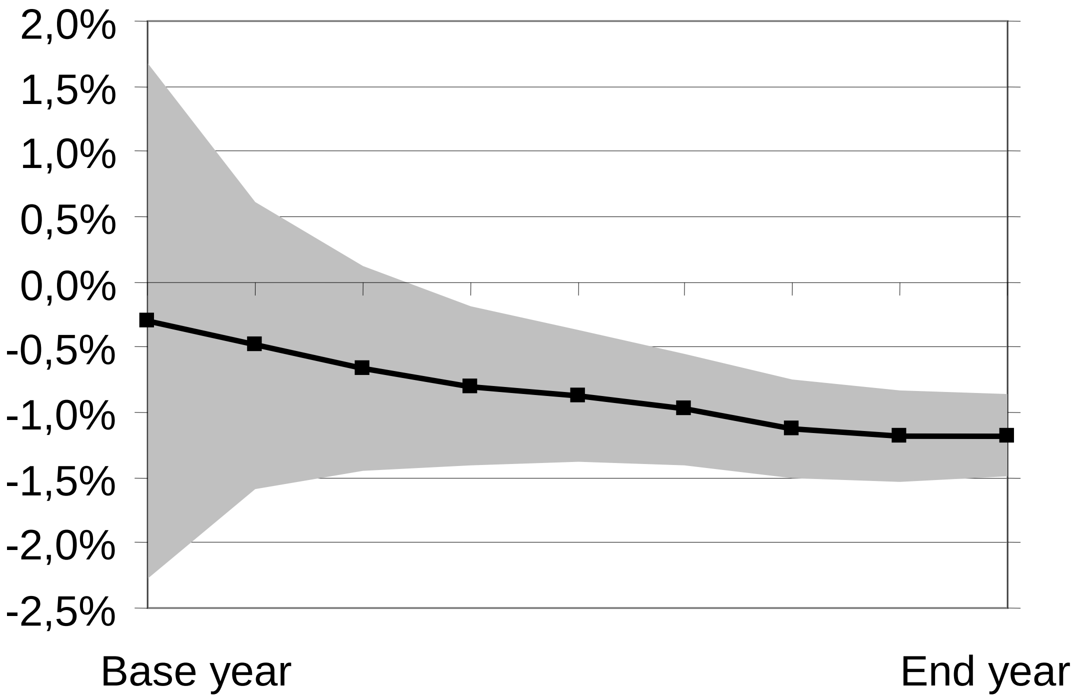
- The margin in the yearly values for the indicator
- The length of the period at stake
- The margin for energy consumption in the base year
- The appropriateness of the indicator in representing the savings.

[1] These are 95% reliability margins provided by the statistical office of the Netherlands

The margin in the yearly index values has been discussed already in section 3.1. The margin in the change of the index is larger than that for the index itself. For an index value of e.g. 100 in 2000 and 90 in 2008 the change is 10 points; for an indicator margin of +/- 3 points the change can fall between 7 (for a value of 90 + 3 = 93) and 13 (for a value of 90 – 3 = 87) points. In this example the change differs by a factor of 2. The relative margin is about +/- 30%, much larger than that for the indicator itself.

The change in the index value normally increases with the number of years after the base year. In the previous example the change can be 20 points in 2015. However, the indicator margin will be more or less the same for each year. Therefore the change ranges between 17 and 23 and the margin is about 15%. Thus the relative margin for the savings will become lower for a longer period (see **Figure 3-2**).

Figure 3-2: Uncertainty margin savings and length of observation period



The savings follow from multiplication of the indicator change with the energy consumption figure for the end year. Therefore, uncertainty in end year consumption contributes also to the margin for the savings figure.

Finally, it is assumed that the trend in energy indicators represents the savings related to the indicators. For example, the decrease in energy use per m^2 of floor space in dwellings shows the savings on space heating of dwellings. However, other factors such as the occupation rate and the thermostat setting can also influence energy use for space heating. If the indicator does not cover these factors the indicator trend might not show the “real” savings. Thus, the appropriateness of the indicator can create extra uncertainty as to the savings figure.

In the Odyssee project energy savings are calculated on the basis of the available indicators and are presented as such; therefore the appropriateness of the indicators as to the “real” savings is not considered. Another reason to leave this factor out is the unresolved issue of what effects of actions exactly constitute savings.

4. Calculation of uncertainty margins

4.1. Odyssee calculations

The starting point for the uncertainty analysis is the common Excel workbook to calculate the Odyssee indicators and savings for each country. The workbook comprises sheets for:

- Industry
- Transport
- Households

In each sector sheet the input data are stored. For Services no sheet is present. The indicators are calculated in the sheets IndustryODEX, HouseholdsODEX, TransportODEX and the overall GlobalODEX.

The calculation of uncertainty margins is performed in combination with the calculation of the indicator values. The uncertainties in all variables are assumed to be independent. The random error in the observed yearly energy data, e.g. due to survey problems, is not connected to the random error for economic/production data. It has also been assumed that any structural error has no effect on the outcome, as the calculation of indicators and savings is based on relative changes instead of absolute figures. For instance, in case of a structural error because an industrial survey covers only the largest energy consumers with 90% of all industrial energy consumption, it can be assumed that the **trend** for total industry is represented by the survey results, although the **absolute** figures deviate from reality. In calculating growth, a structural error will disappear.

It should be noted that in this report the term ‘margin’ is used to describe one standard deviation. The 95% confidence interval falls between the indicated value and +/- two standard deviations. One standard deviation above and below the central value describes a 67% confidence interval, assuming a normal distribution.

4.2. Margins attached to input data

The data series that are used to calculate the Odyssee indicators have already been given a rating for the quality of the source and a ‘grade’ for the accurateness of the figures.
The quality of the source is rated in Odyssee as:
A: Official statistics/surveys (national statistical office, Eurostat/AIE, statistics of Ministries), model estimations used as official statistics or data “stamped” by Ministries
B: Surveys/modeling estimates (consulting firms, research centres, universities, industrial associations)
C: Estimations made by national teams (for the project)

The grade of accurateness can be:
1: good
2: medium
3: poor

For official sources the grade is 1 or 2, depending on the (subjective) appreciation made by national teams in connection with the source of data. For surveys the quality grade depends on the size of the sample; for large sample the grade is 1 but for small samples 2 or even 3.

For estimates by national team the quality grade depends on the method: formal modeling gives a higher quality (1 or 2) than expert estimate (2 to 3).

Here the uncertainty margin is assumed to depend only on the source grade. This leads to 3 different values for the uncertainty margin (see Table 4-1), irrespective of the source. The uncertainty margins are presented in the form of a single relative standard deviation, expressed as a percentage. The chance that the real value lies between the estimated value plus or minus the standard deviation is 67%; the chance to find it between the estimated value plus or minus 2 standard deviations is 95%.

Table 4-1: Assumed uncertainty margin for different data sources and grades

Grade	1	2	3
Uncertainty margin	1%	2%	3%

The values in the table do not have an official status yet; they have been entered to get indicative results from the uncertainty calculations. The ratings for grades 1 to 3 are based on uncertainties reported by the Dutch Central Bureau for Statistics, the other values are estimates. The effect of different assumptions is shown in the next chapter.

4.3. Simple energy indicators

Simple indicators are formulated in the form of I = E / D with:
- I = indicator
- E = energy consumption
- D = driver (explaining quantity).

The calculation of the uncertainty margin (expressed in one **relative** standard deviation σ_{rel}, which equals the standard deviation of a variable divided by the value of the same variable) follows the standard rules for adding up uncertainty margins in the numerator (E) and the denominator (D), which has the form of:

$$\sigma_{rel,I} \approx \sqrt{{\sigma_{rel,E}}^2 + {\sigma_{rel,D}}^2}$$

The formula is valid for cases where the uncertainty margins for the data series E and D are independent from each other, and the probability distribution is Gaussian. As to the first, it is assumed here that the margins are not interdependent because they are gathered by different routes. For the Gaussian, or normal, distribution the chance that the indicator value lies in a specified range around the mean value is given. For one standard variation this is 67% and for two standard variations 95%. The normal distribution might not be valid for near zero values of the indicator, but normally the value is nearer to 100 (base year value).

As described in section 2.4 the appropriateness of the driving quantity D is not taken into account in the calculation of the margin.

4.4. Aggregated energy indicators

Aggregated indicators show the combined effect for a set of simple indicators. For instance, the ODEX-Households covers the indicators for space heating, for hot water use and for electric appliances.

The aggregated ODEX is the weighted sum of the individual indicators and is calculated as follows:

ODEX = $I_1 * f_1 + I_2 * f_2 + \ldots$

with f = fraction in sectoral energy consumption.

The calculation of the uncertainty margin follows the same scheme as used for calculating the ODEX value. Well established rules for error propagation have been applied. For some values an uncertainty of 0% has been assumed, e.g. for the share in total energy consumption that act as a weight factor.

The standard deviation in index points is

$$\sigma_{abs,I} \approx \sqrt{2 \times \left[\left(f_1 \times \sigma_{rel,1} \times I_1\right)^2 + \left(f_2 \times \sigma_{rel,2} \times I_2\right)^2 + \cdots \right]}$$

The factor of 2 at the beginning is added to account for an identical margin in the numerator and the denominator of the aggregated index. It follows from the formula for the margin in a function f = A/B when the relative margins in A and B are equal:

$$\sigma_{rel,f} \approx \sqrt{{\sigma_{rel,A}}^2 + {\sigma_{rel,B}}^2} = \sqrt{2 \times {\sigma_{rel,A}}^2}$$

The overall ODEX is an aggregate of the ODEX for each end-use sector. Here the same rules apply for the calculation of the uncertainty margin in the overall ODEX.

4.5. Energy savings

Energy savings are calculated from the change in an indicator value and the energy consumption in the end year according to the following formula:

$$s = 1 - \left(\frac{I}{100}\right)^{(1/y)}$$

With:
s = the average yearly savings,
I = the energy efficiency index
y = the number of years after the base year for which I = 100.

Relatively less energy consumption (I < 100) thus leads to a positive value for s.

The standard deviation for the yearly savings is calculated as: since base year

$$\sigma_{rel,s} = \frac{\sigma_{rel,I}}{y}$$

With:

$\sigma_{rel,s}$ = relative standard deviation of the yearly savings,
$\sigma_{rel,I}$ = relative standard deviation of the efficiency index
y = number of years since the base year.

As described in chapter 2, the margin in the savings figures will depend on the length of the observation period. Therefore, the formula for the margin in the savings figure contains a time dependent factor.

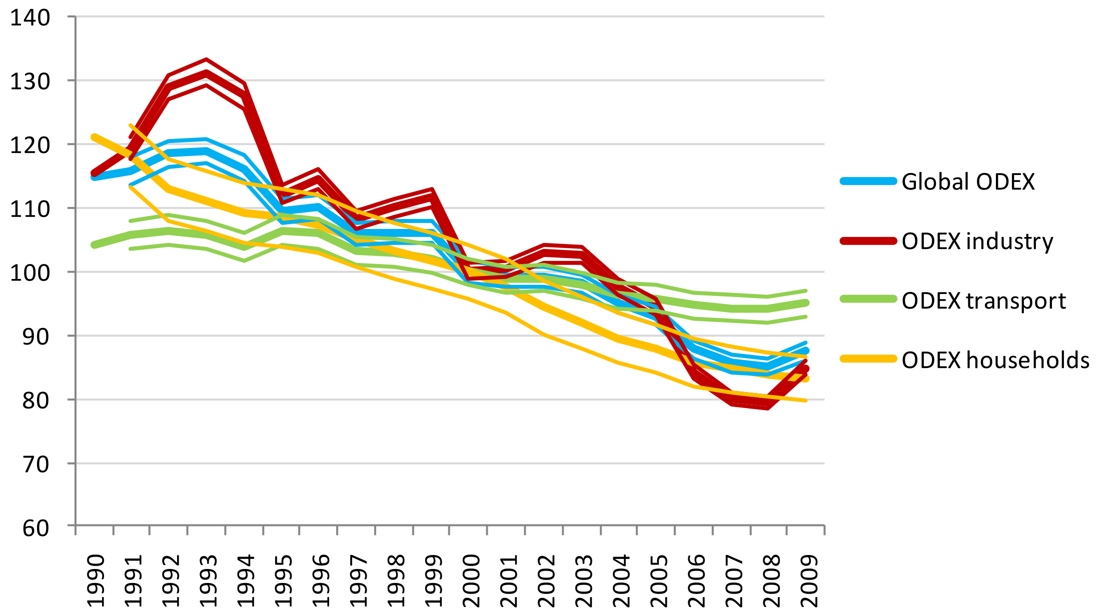
5. Uncertainty margins for selected countries

Calculation of uncertainty margins has been done for the Netherlands, France and Germany, using data margins that are based on the specified sources and grades, and the conversion table (see Table 4-1)..

5.1. Margins for the Netherlands

The calculated values for the Netherlands are shown in Figure 5-1 (the central lines; the thinner lines indicate the margins). The input values on margins were based loosely on uncertainty levels used in the national energy savings protocol.

Figure 5-1: ODEX values for The Netherlands



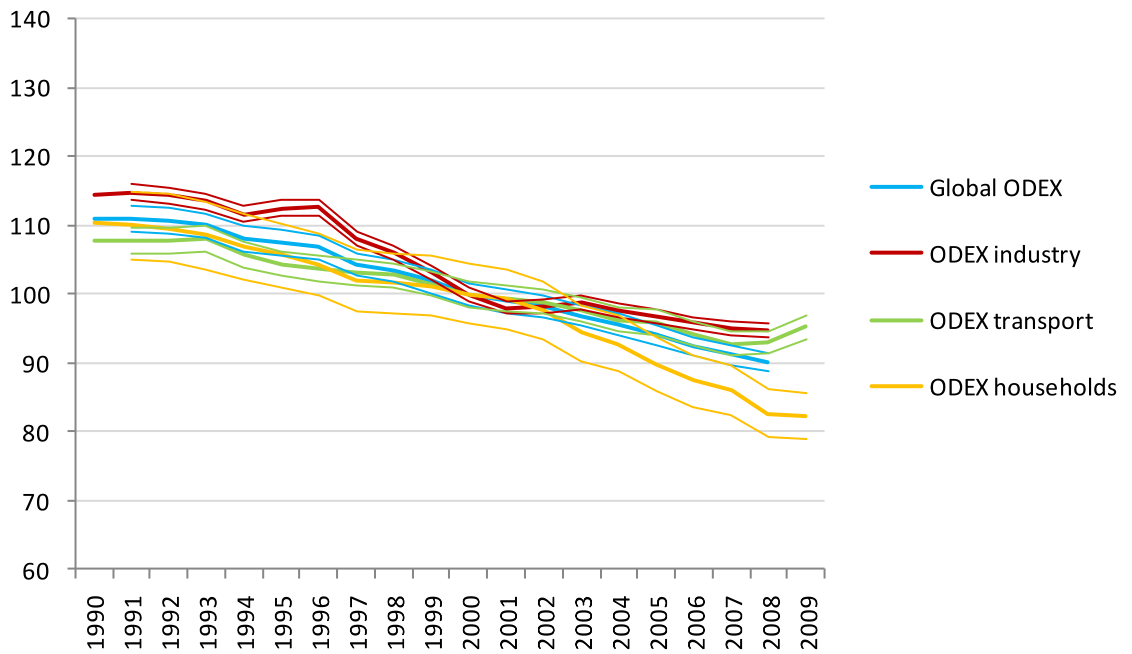
The industry ODEX has low uncertainty margins, but its fluctuating development is believed to include structural effects. As expected, the uncertainty at the national level (Global ODEX) is lower than the average uncertainty at the sectoral level.

5.2. Margins for France

The calculated values for France are shown in Figure 5-2. The input values on margins were based on the rating of sources and grades as supplied by experts from France.

All sectoral ODEX quantities show fairly small margins; the margin for the Global ODEX is again smallest.

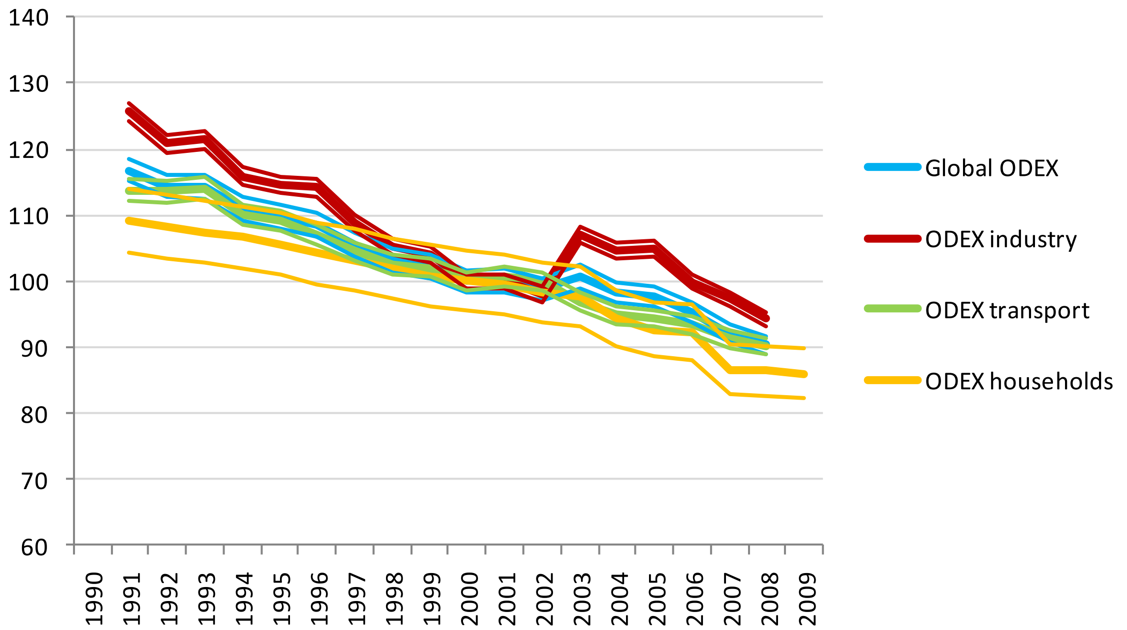
Figure 5-2: ODEX values for France



5.3. Margins for Germany

The calculated values for Germany are shown in Figure 5-3. The input values on margins were based on the rating of sources and grades as supplied by experts from Germany.

Figure 5-3: ODEX values for Germany



The margin in the Global ODEX for Germany is relatively large due to the large margin in the households ODEX. The industry ODEX for Germany shows a large change in 2003 that is significant compared to the margin

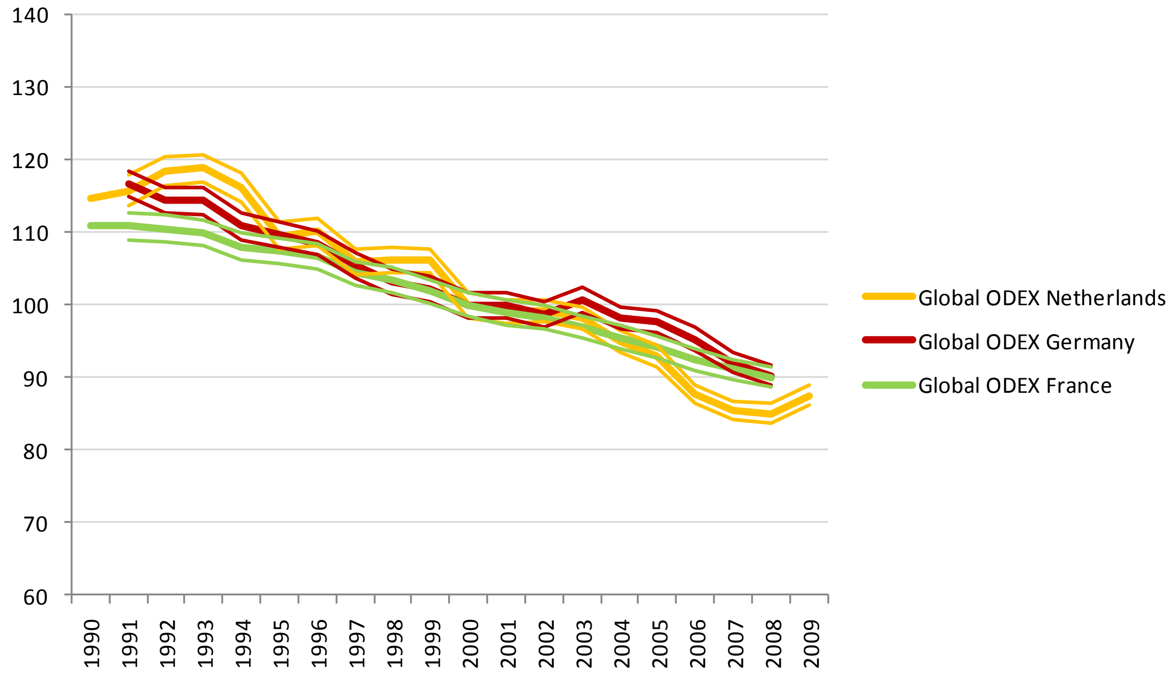
5.4. Comparison of margins for the three countries

The margins for the three countries are compared for:
- Global ODEX
- Industry ODEX
- Transport ODEX
- Household ODEX

Global ODEX

The decline of the Global ODEX over the period is significant for all three countries (see Figure 5-4). The increase of the index in The Netherlands in 2009 can also be said to be more than just a statistical fluctuation.

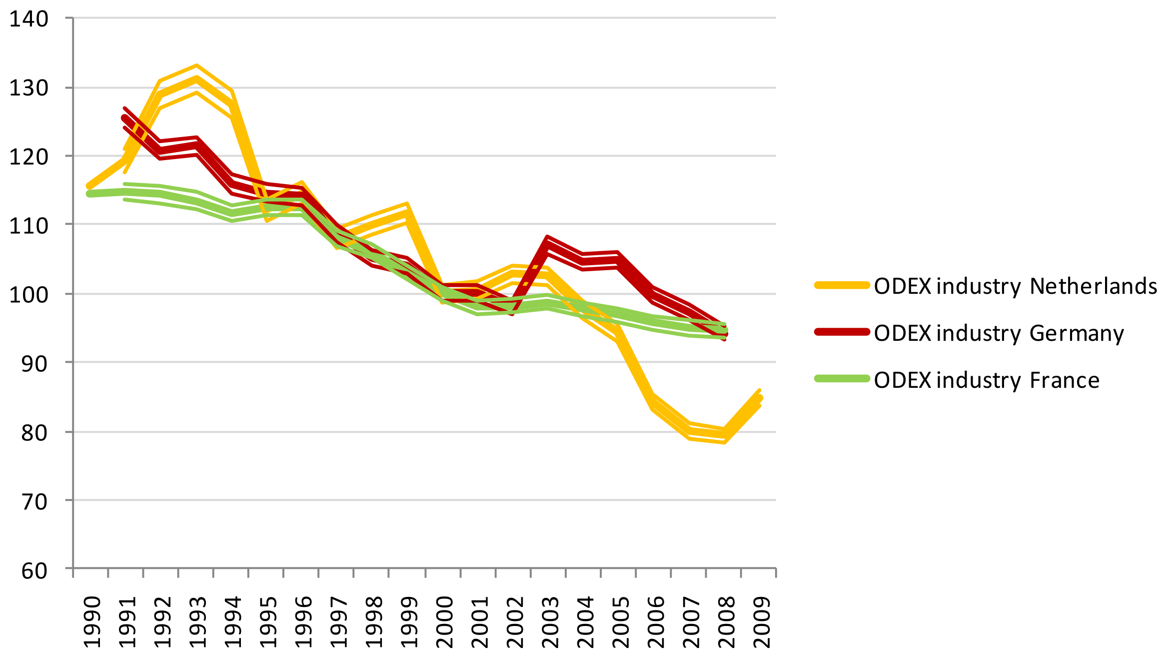
Figure 5-4: Global ODEX for France, Germany and The Netherlands



Industry ODEX

The comparison for the industry ODEX shows a more varied picture (see Figure 5-5Figure 5-4). The large changes are well above the uncertainty margin, so they describe real efficiency effects. The explanation of these effects lies outside the scope of this report.

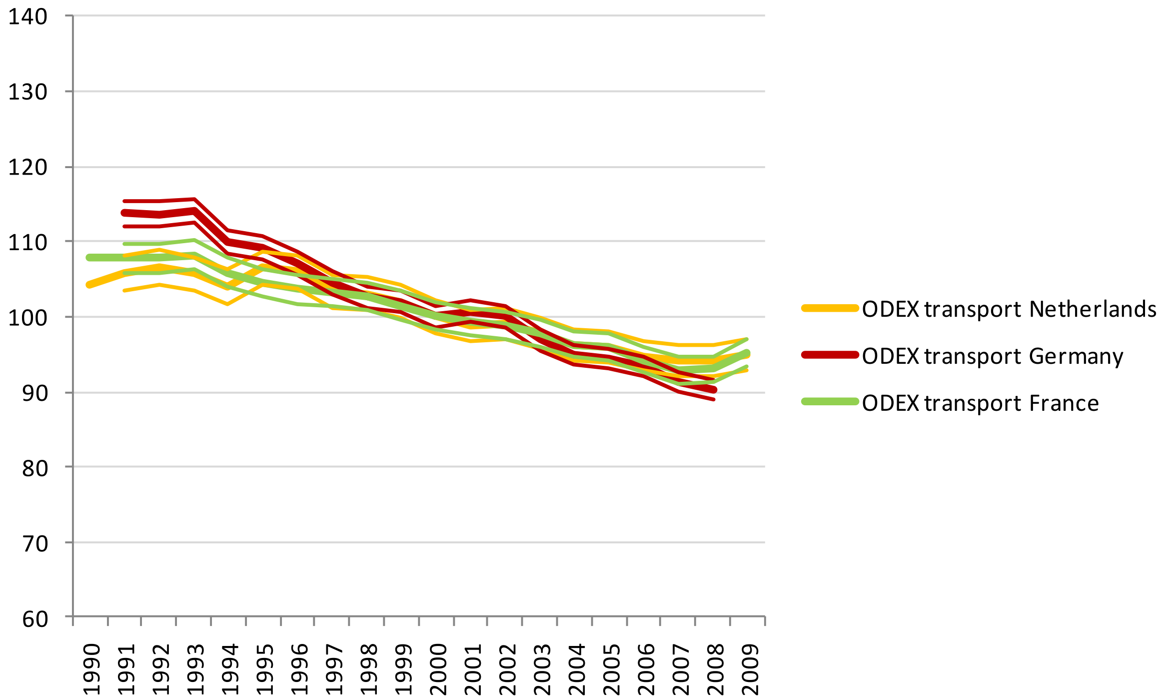
Figure 5-5: Industry ODEX for France, Germany and The Netherlands



Transport ODEX

The most noticeable issue for Transport-ODEX is the steady decline without large margins (see Figure 5-6). The increase in 2009 for France is large enough compared to the margins that it can be seen as a real reversal of the trend.

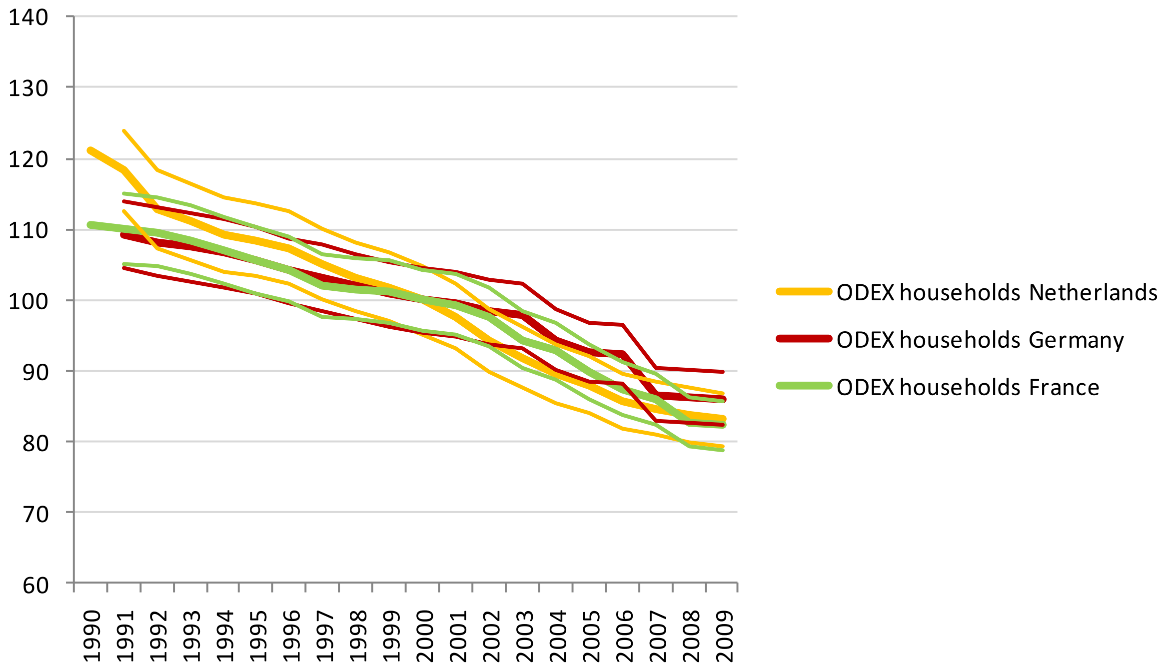
Figure 5-6: Transport ODEX for France, Germany and The Netherlands



Household ODEX

The household ODEX in all three countries shows a clear and steady downward trend, and an accelerated decrease after 2000 (see Figure 5-7).

Figure 5-7: Households ODEX for France, Germany and The Netherlands



5.5. Margins at EU level

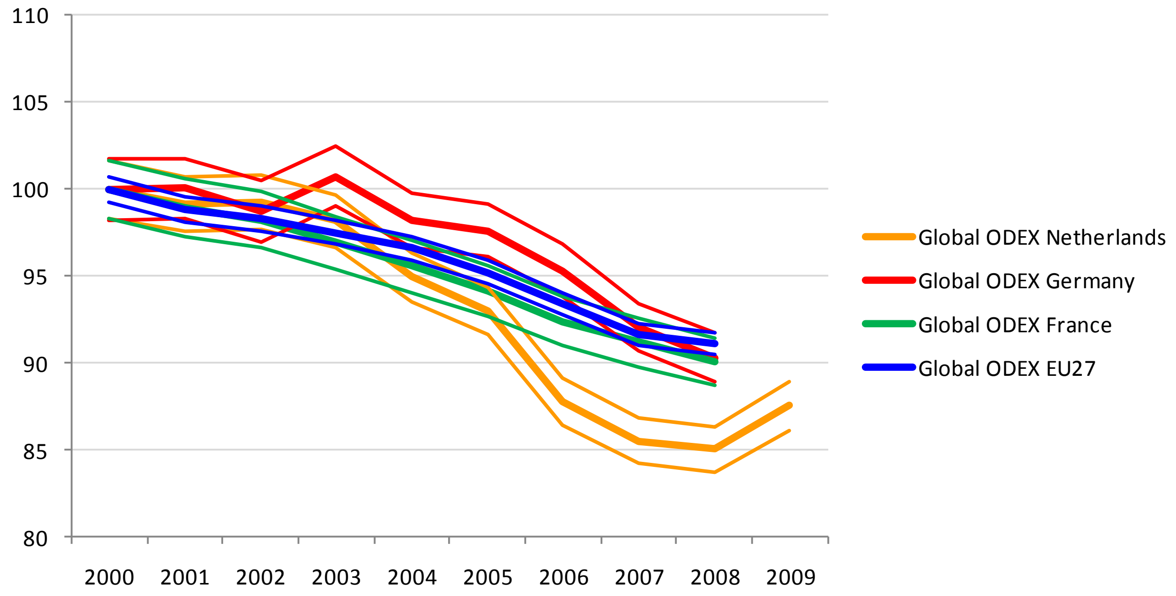
An additional analysis was done for the Global index of all participating countries in Odyssee, except Lithuania and Malta (as there was no Global ODEX available for them in the on line database). For France, Germany and The Netherlands, the uncertainties calculated earlier were used (1,5%, 1,6% and 1,5%); for the other countries the uncertainty was assumed to be 2,5%. This results in a value of just 0,6% for the Global ODEX. This relatively low figure reveals an expected lower uncertainty for all countries combined compared to that for the individual countries (see Figure 5-8).

In addition, it showed how big the influence is of the uncertainty in the ODEX of large countries (with their associated large energy consumption) on the EU wide ODEX, compared to the influence of uncertainties of smaller countries. A change of 1% for the uncertainty of Germany, with a share of 18% of the total final energy consumption, leads to a change of 0,15% in the uncertainty of all countries combined. For Cyprus, with a 0,2% share of the energy consumption, a change of 10% in the uncertainty is not even noticeable at the European level.

A similar calculation can be done to combine the indices at the sectoral level for all 29 countries, but these are not shown here as relative shares for industry, households and transport per country generally do not deviate too much from the share of total energy consumption.

Figure 5-8: Global ODEX for selected countries and EU-27 level

(except Lithuania and Malta, but including Croatia and Norway)



5.6. Margins for different treatment of input data rating

Earlier, the quality grade of data (1, 2 or 3) has been converted into standard deviations for all input data used (see Table 4-1). However, the assumption behind the conversion can be discussed. In order to get insight in the sensitivity of results for other assumptions the calculations have been repeated with different conversion assumptions (see Table 5-1). In alternative case 2 all standard deviations have been doubled compared to the original case 1. In case 3, the assumed standard deviation is the same for grade 1, but it increases faster for grades 2 and 3.

Table 5-1: Alternative assumptions on conversion of sources and grades

Grade >	1	2	3
Alternative case 2			
Uncertainty margin	2%	4%	6%
Alternative case 3			
Uncertainty margin	1%	5%	20%

The effect of different assumptions is analysed at the level of the Global ODEX. In order to show different effects per country, calculations regard all three example countries. This results in nine values for the Global ODEX (see Table 5-2).

Table 5-2: Uncertainty margin global ODEX for different conversion assumptions

	France	Germany	The Netherlands
Case 1 (standard)	1,5%	1,6%	1,5%
Case 2 (double)	3,0%	3,1%	3,0%
Case 3 (differences larger per grade)	2,7%	2,5%	4,3%

For case 2 all uncertainties become twice as high suggesting a linear relationship between the margin in inputs and the uncertainty in the output.

For case 3, with a larger increase of uncertainties for grades 2 and 3, the effect depends on the amount and importance of low grade data series that countries provide. This is illustrated by the uncertainty for France: the uncertainty is lowest because France uses mainly grade 1 in contrast to the Netherlands. The margin of France is even lower than the uncertainty in case 2 with a doubling of all grades, including grade 1.

6. Implementation of uncertainty in Odyssee

For this report the uncertainty margins for the indicators have been tentatively calculated for three countries. The excel-sheets for industry, transport and households (industryODEX, transportODEX and householdODEX) have been modified first, to provide the uncertainties at the sector level. Subsequently, the GlobalODEX sheet was modified to convert the uncertainties for the sectors into an uncertainty margin at the national level. It should be noted that the GlobalODEX lacks a contribution for the Services sector, so the GlobalODEX does not represent all efficiency developments for energy end-use.

In order to have a fully working system of automatically providing margins for the Odyssee results the following actions are needed:

- Specification, for all relevant input data, of source type and grade
- Conversion of source rating and grade into a margin for inputs
- Accounting for not available quantities
- Calculation of uncertainty margins parallel to that for indicator values
- Reporting of margins for indicators
- Formulating rules for drawing conclusions

The specification of source and grade was part of an earlier Odyssee project, but has not been fully implemented. Getting proper estimates for the uncertainty levels depending on quality and grade for all Odyssee participating countries is a task that remains, as is the estimating of the quality and grades themselves.

The conversion of source rating and grades to specific margins has been done here by the authors. This has to be checked with the statistical agencies, and with other processing of data from different sources with different quality.

Input data that are not available prohibit the calculation of simple indicators; therefore the absence of a calculated margin is no problem. Absence of data leads to an incomplete calculation of aggregated indicators. On the one hand this increases the uncertainty margin because the margin of input is not known. On the other hand, the smaller defined aggregated indicator cannot be influenced by an indicator that is not part of it. This problem has to be dealt with on a case by case basis.

The reporting of margins can be coupled directly to that of the indicator values and the saving figures, e.g. in the form of: x +/- y%. In graphs, the solid line for the indicator value can be accompanied with a band that presents the margin.

A large uncertainty margin should lead to caution as to drawing conclusions. The amount of uncertainty determines if observed trends can be said to be real with sufficient confidence or not. This is especially true for individual indicators, for year-to-year effects and for results for individual countries. For aggregated indicators, over a period of several years, or at the overall EU level, more robust conclusions can be drawn because the margins will be relatively smaller.

Annex: Definition and calculation of ODEX

ODEX indicators aggregate energy efficiency trends by sub-sector (or end-uses or transport mode) in a single indicator by main sector (industry, households, transport and services) and for the economy as a whole. They are calculated from the unit consumption indices by sub-sector based on the weight of each sub-sector in the total energy consumption of the sector. As indices are used, it is possible to combine different units for unit consumption to provide the best proxy of energy efficiency, e.g. toe/dwelling, koe/m^2, or kWh/appliance for households. A decrease in the index means an energy efficiency improvement: a value of 85 in 2004, for instance, means a 15 % efficiency improvement compared to the base year (1990). ODEX provides an alternative indicator for energy intensities (industry and transport) or unit consumption (per dwelling for households) to describe the overall trends by sector.

Energy efficiency gains are measured in relation to the previous year, and not to a fixed base year to avoid having results influenced by the situation in the base year. It is calculated as a 3 years moving average to avoid short-term fluctuations (imperfect climatic corrections, behavioural factors, business cycles).

In industry, ODEX is calculated from the unit energy consumption indices of individual branches (11 branches). Unit consumptions are expressed in toe per ton produced for steel, cement, and paper and in toe per unit of production index for other branches.

In transport, ODEX is calculated from the unit energy consumption indices of individual modes (7 modes). For cars, motorcycles and buses, energy efficiency is captured by specific consumption measured in litres/100km. For freight transport (trucks and light vehicles), energy efficiency is measured by the unit consumption per ton-km as, ultimately, the main activity involved here is the transportation of goods (at least for trucks). For other modes, the most relevant indicators of unit consumption were taken depending on the statistics available: toe/passenger for air transport, goe (gram oil equivalent) /passenger-km for passenger rail, goe/ton-km for transport of goods by rail and water.