ICARUS 4
The new database structure

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Abstract
In this report we describe the new database structure that will be implemented for version 4 of the ICARUS database. ICARUS gives an inventory of the technological options for energy savings for all economic sectors in the Netherlands. For all described measures it will provide data on the achievable energy savings, costs and actual penetration data in the base year of 1995. On the basis of these data assessments can be made of the technical potential of energys savings and CO_2 mitigation per economic sector in the viewing years 2010 and 2020 in comparison with the base year.

Status of this report
This report describes the proposed database structure at the beginning of the ICARUS-4 project. In the course of the project additions and/or modifications to the structure may prove to be necessary. This document will therefore be updated at the end project

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1. Introduction

ICARUS is a database of technological options for energy savings, inventarized for all economic sectors in the Netherlands. For all described measures it will provide data on the achievable energy savings, costs and actual penetration data. On the basis of these data assessments can be made of the technical potential of energys savings and CO_2 mitigation per economic sector in the viewing years 2010 and 2020 in comparison with the base year (1995 or 1990) . Also “supply curves” can be generated depicting the achievable CO_2 emission reductions with the different options versus their costs.

Work on the Icarus database was started in the Departement of Science, Technology and Society (STS) in 1988. The previous version (version 3) of the ICARUS database was issued in 1994 [1] and has been used frequently for policy studies regarding energy savings. Important examples are the application of ICARUS data within the NEMO model for energy studies of the CPB Netherlands Bureau for Economic Policy Analysis (Centraal Plan Bureau) and within the SAVE modelling studies of the Netherlands Energy Research Foundation ECN. Also the RIVM uses the ICARUS database for its environmental policy studies.

In november 1998 a project was started at the department of STS to update the ICARUS database to incorporate the changes and new information since 1994. This project is funded by the Dutch Ministry of Economic Affairs, the Ministry of Housing, Spatial Planning and the Einvironment and by the RIVM. Because of new demands on the type of data and in order to improve the transparency of the database it was decided also to establish a new structure of the database. The structure of the previous version was seriously constrained by the possibilities of the employed software package at that time (Quattro Pro 4.0).

A definition study which outlined a new setup of the database was published in december 1998 [2]. In April 1999 a workshop was organized with all ICARUS users to get feedback on these proposals [3].

In this report we will present the new database structure, as implemented in MS Excel. This version is still open for comments by selected users. Also some elements may be changed during the further process of collecting and entering technology and sector data.

2. Requirements for the new database

According to the definition study the new database structure should at least comprise the following data:

1) An overview of (technical) saving measures

Per measure the following data will be included:

a) Name of measure
b) (sub)sector code
c) "Energy function" or process on which measure has effect (see definition below)
d) savings on the specific electricity consumption of the energy function
e) savings on the specific heat/fuel consumption of the energy function
f) type of measure (new, retrofit, good housekeeping)
g) first possible year of implementation of the measure
h) present penetration of the measure
i) technical maximum penetration of the measure
j) additional investment costs
k) additional O&M-costs
l) technical lifetime of the measure
m) "complexity" of the measure with regard to its implementation (only in RIVM version and only for industry sectors)

*2) The energy consumption data for the base year **1995**, broken up into:*

- energy carriers (i.c. coal, oil, natural gas, electricity, steam /hot water, fermentation gas);
- economic subsectors;
- energy functions per subsector, with realized throughput data for 1995.

An energy function is defined by us as an coherent assembly of processes which achieves a certain product transformation, for example the conversion of iron ore into pig iron, the conversion of pig iron into steel, etc. The corresponding throughput data should specify the amounts of pig iron, steel, etc. produced in 1995.

*3) The energy consumption data for the year **1990**, broken up into:*

- energy carriers;
- major economic sectors;

(The reason for specifying 1990 consumption data too, is that 1990 is the reference year for international agreements like the Kyoto protocol).

4) Scenario data for the view years 2010 and 2020;

Data derived from standard CPB scenarios en user-defined scenarios with regard to

- economic growth rate per sector;
- energy prices;
- fuel shares for the electricity production sector in 1995, 2010, 2020.

5) Utilities
Data per sektor on:

- application in 1995 and potential in 2010/2020 for cogeneration per sector;
- application in 1995 and potential in 2010/2020 for heat pumps per sector;
- production and consumption of steam / hot water for external supply (eg. heat delivery from industry to horticulture), data for 1995, 2010, 2020.

In the following sections we will describe how this has actually been implemented in the database spreadsheet.

3. General structure of the ICARUS-4 database

It was decided to use standard spreadsheet software for the database instead of dedicated database software, for the following reasons:
- modern spreadsheet software also incorporates simple database functions;
- there is no real need for more sophisticated datbase functions, like queries;
- a spreadsheet is more transparant for the user with regard to the incorporated data;
- a spreadsheet is needed anyway for performing calculations of energy reduction potentials and for generating "supply curves".

Sub-databases
Within MS Excel (version '97), the selected spreadsheet software, several *worksheets* can be defined within one *spreadsheet file*. This option was use to set up the following sub-databases:
- **Measures:** containing a list of all energy reduction technologies;
- **E-balance 1995:** specifying the energy consumption data for the year 1995;
- **E-balance 1990:** specifying the energy consumption data for the year 1990;
- **Functions:** describing the energy functions that are distinguished within each sector and corresponding production (or consumption) data;
- **E-consumption by function:** specifying the energy consumption for each function within a sector;
- **CHP:** specifying the energy consumption and production by cogeneration units within each sector; realized data for 1995 and potentials for 2010 and 2020;
- **Heat pumps:** idem for heat pumps;
- **External heat supply:** the production / consumption of steam and hot water for external supply in each sector (eg. heat delivery from industry to horticulture); realized data for 1995, potentials for 2010, 2020;
- **Scenarios:** Scenario-dependent data on production growth rate, interest rate, and energy carrier prices for each sector for the view years 2010 and 2020;
- **Electricity:** the shares of different fuels used in the electricity production sector and the average conversion efficiency for the corresponding generating plants, for the years 1995, 2010 and 2020;
- **Basic data:** some general data which are not scenario- or sector-dependant, like specific CO_2 emissions for each fuel type;

Units
All energy data are presented in either PJ (energy balances '95/'90) or GJ (all other worksheets). Financial data are presented in Euros (€).
N.B.: The euro symbol (€) does not always display correctly on all computers and printers. In most cases this can be corrected by modifying the software configuration.

Regional validity
All presented data are valid for the Netherlands only. In other countries the situation may be different due to differences in industrial environment, (past) energy policy and energy carrier shares.

Comment / help
At some places a comment is added to spreadsheet cells to explain the meaning of the corresponding data field or to account for the data source or estimation procedure.

4. The "Measures" worksheet

The list of technologies and technical measures which can reduce energy consumption forms the core of the ICARUS database. It is contained in the "*Measures*" worksheet of ICARUS. The measures are listed in the different rows of the worksheet. The parameters characterizing the measure are given in the columns, divided into 9 clusters:

1) Column A-F: *Measure identifiers:*
   describing and/or identifying the measure itself, as well as the sector and the energy function where the measure can be applied. Column F, gives the *functional unit*, that is the unit in which the energy function's throughput data are expressed (e.g ton steel)[1]. This same functional unit is used furtheron to specify the "absolute" energy savings.
2) Column G-J: *Penetration data:*
   giving respectively the first year the measure may be implemented, the actual penetration in 1995 and the technical maximum penetration. The latter parameter may be used if there is some kind of technical limit which constrains the penetration rate; if no such constraint exists a value of 100% should be entered.
   N.B.: In some cases it may be known that between 1995 and 1999 the penetration rate of the measure has increased (or decreased). For this purpose an extra column "penetration 1999" has been added. This field will be used to "force" the implementation of the corresponding measure when calculating a potential for a view year. This is an optional field, which need not contain data.
3) Column K-M: *Energy savings (absolute):*
   Here the savings on electricity, fossil fuel or steam / hot water can be specified in GJ per functional unit (e.g. GJ/ton steel). Increases in consumption of an energy carrier can be entered as negative values. Although specification of absolute savings data is preferred such data will not always be available. In that case relative savings data may be entered (see below) and the corresponding absolute savings data will be calculated on the basis of relative savings, energy consumption for the specific function and throughput data for the function.
4) Column M-P: *Energy savings (relative):*
   Here the savings on electricity, fossil fuel[2] or steam / hot water can be specified in percents of the original energy consumption. Values can be entered in this field if absolute savings data are not available.
5) Column Q-R: *Cost data (absolute):*
   The additional investment costs and the additonal operation & maintenance costs of the measure specified in Euro per functional unit. Note that we specify *additional* costs that is the extra costs of the measure *in comparison with standard technology* as available in 1995. Especially for completely new process technologies a careful definition of the basis for comparison should be given in the accompanying documentation.
6) Column S-T: *Cost data (relative):*
   Here the additional investment costs and the additonal operation & maintenance costs of the measure may be specified in Euro per unit of saved energy. Although absolute cost data are preffered, the relative values may also be entered if absolute data are unavailable.
7) Column U-W: *Other economic data:*
   Here the technical lifetime of the measure can be given. Also there are optional fields to specify and describe possible non-energy benefits, like increased product value or savings on environmental control costs.

[1] In some cases it may be difficult to define a representative functional unit which allows us to express the throughput of a function in an adequate manner. In those case an intermediate or index variable may be used. See the discussion in the section 6.

[2] Savings on fossil fuel will be allocated to the different fuels (i.e. coal, oil, gas) according to the ratio of their consumption within the considered sector.

8) Column X: *Non-efficiency CO_2 reduction*:
   There may be measures which do not enhance the energy efficiency of the function but which *do* reduce CO_2 emissions. Examples of such measures are: fuel shift, from coal or oil towards natural gas, or CO_2 sequestration technologies, like underground CO_2 storage. This optional field offers the possibility to incorporate such measures into the database[3].
9) Column Y-Z: *Measure classification:*
   In column Y the measure must be classified as either *New* process equipment, *Retrofit* technology or *Good housekeeping*. Examples of "good housekeeping" measures are: prevention of equipment running idle and reduction of uncontrolled ventilation in buildings.
   In column Z a further characterization is given according to the taxonomy decribed in table 1.
10) Column AA-AG: *Implementation characteristics*:
   These columns give some additional characteristics with respect to implementation issues. These fields have a provisional status and are only intended for internal use by Utrecht University and RIVM. Furthermore they will only be used for the industry sectors.
9) Column AH-AJ: *Other information:*
   In these columns references to the accompanying documentation and to the literature will be given, as well as comments and remarks.

[3] This field may also be used to account for measures where the type of fossil fuel that is saved is different from the average fossil fuel mix of the sector (cf. note 2).

Table 1: Taxonomy of energy efficiency measures [4]

Application area	ID	Category	Examples
End use	1	Process control and management	Energy management systems. Automatic lighting control systems.
	2	Reduction of heat losses through surfaces	Insulation of building surfaces. Insulation of kilns and other process equipment.
	3	Heat recovery	Heat exchangers.
	4	Process integration	Optimization of heat exchanger networks, by means of pinch or exergy analysis.
	5	Energy recovery other than heat	Power recovery by expansion turbines for natural gas. Gas recovery at BOF-furnace
	6	Improved lighting systems;	Compact fluorescent lamps
	7	Reduction of friction losses during movement;	Better piping design. Reduction of aerodynamic drag of vehicles
	8	More efficient conversion of electricity into movement	Adjustable speed drives for pumps, fans and compessors. Reduce over-sizing over motors.
	9	New process technologies	New separation techniques, e.g. with membranes. New catalysts. LCD screens.
Conversion	10	More efficient furnaces and burners	Condensing boilers.
	11	More efficient conversion of fuel into power.	More efficient gas turbines. Improve car engines. Fuel cells.
	-	CHP *	Gas turbine / waste heat boiler. Combined cycle waste district heating.
	-	Heat upgrading *	Heat pumps Heat transformers. Mechanical vapour recompression.

* CHP and heat upgrading measures are presented in separate worksheets.

5. The “Energy balance 1995 / 1990” worksheets

Sector division
In this worksheet we present the energy consumption data for the discerned (sub)sectors. The sector classification is based mainly on the classification employed by the CBS in the Netherlands Energy Account (NEH) for 1995, especially with regard to the industry sectors. In some sectors a more detailed classification is choosen to get more coherent sectors.
The general guiding principles in establishing the sector classifications have been:

1. Maintain a good correspondence with the economic sector classifications as defined in the Standard Company Classification of CBS (SBI’93). This SBI classification has a close correspondence to the internationally agreed NACE classification.
2. Establish separate categories for sectors with a final energy consumption which is larger than 2% of the total final energy consumption in the Netherlands. (This may seem a rather fine level detail but remember that 2% of the total final consumption corresponds to 5% of the industry’s final consumption.)
3. Compose sectors with a coherent set of activities, especially with regard to energy-intensive processes;
4. Distinguish sectors which may show a markedly different growth of production / consumption in the next 20 years.

On this basis we have come to a division into about 60 sectors. In some cases different economic sectors have been clustered because:

a) the sectors have a fairly small energy consumption and there is probably not sufficient information to detail the energy efficiency meausures per sector. An example of this is the metal products sector which comprises manufacturing of machinery, transport equipment and electrical equipment;
b) the sectors are very homogeneous with respect to their energy-consuming processes, for example all office-based service sectors like banking, insurance, computer services.

In a few other sectors a further subdivision will be probably be necessary, but it will established at a later time, when the concerned sector study is done. Examples of this are the sector of households (subdivison into building age?) and the transportation sector (subdivision into means of transport).

In general we expect that some further fine-tuning of the sector divisons will occur during the sector studies themselves.

Energy carrier consumption data
In accordance with the CBS energy statistics (NEH’95) we have discerned the following energy carriers:

- coal and coal products;
- oil and oil products;
- natural gas;
- electricity;
- steam / hot water;
- fermentation gas.

In the latter category we will include all biomass-derived fuels, also non-gaseous fuels because they all have a net CO_2 emission of zero.

Apart from the final consumption of the energy carriers we have also presented the non-energetic use of energy carriers.

N.B. :
1) Note that the final consumption data as they are presented now include the energy consumption for industrial CHP installations, but only for those CHP installations that CBS has accounted to the industry sectors (i.e. excuding CHP installations owned by joint ventures of industrial companies and energy companies). In later releases of the database this will be made more consistent.
2) Data for gas consumption in 1995 have not yet been corrected for the deviation in temperature from the climatological normal year (degree-days correction).

Table 2: The sector division and classification within ICARUS-4. The third column gives the SBI codes that are comprised by the sector, while the fourth column gives those SBI codes that are excluded. Note that energy consumption data for most subsectors have not been collected yet.

Sector Name	**Sector_ID**	**SBI**	**SBI Excl.**	**Final energy consump. 1995** (PJ)	**Share of total final** (%)
Food & Drugs	**F&D_tot**	**15-16**		**90.3**	**3.6**
slaughter/meat	meat	151			
potato prods.	potato	1531			
Edible oil & fat	oil&fat	154			
dairy	dairy	155			
starch	starch	1562			
fodder	fodder	157			
Bakeries	bakeries	1581-2			
sugar industry	sugar	1583			
brewing/malting	beer	1596-7			
others Food&Drugs	F&D_o	152,153, 1561,1584-9, 159,16	1531		
Textile, Clothes, Leather	**textile**	**17-19**		**8.8**	**0.3**
Paper & board	**pap_tot**	**21-22**		**36.5**	**1.4**
pulp, paper & board	paper_manuf	211			
paper & board products	paper_prod	212			
Printing & Publishing	printing	22			
Chemical Industry	**chem_tot**	**24**		**635.4**	**25.1**
anorganic base chemicals	anorg_b_chem	2413		25.4	
organic base chemicals	org_b_chem	2414		448.7	
fertilizers	fertilizer	2415		110.6	
other base chemicals	o_b_chem	2411-2, 2416-7, 247		41.0	
chemical products ind.	chem_prods	242-6		9.7	
Building materials	**build_mat_tot**	**26**		**35.6**	**1.4**
glass industry	glass	261			
fine ceramics	f_ceramics	262-3			
bricks & roof tiles	brick	264			
cement prep.	cement	2651			
other building materials	build_mat_o	2652-3, 266-8			
Basic metal industry	**b_metal_tot**	**27**		**123.6**	**4.9**
Iron & Steel	ferro	271-3		98.5	
Non-ferro metals	non-ferro	274		25.1	
Foundries	foundries	275			

Sector Name	Sector_ID	SBI	SBI Excl.	Final energy consump. 1995 (PJ)	Share of total final (%)
Metal products industry	**metal_prods**	**28-32, 34-35**		**48.6**	**1.9**
Plastic, rubber and other industry	**other_ind_tot**	**20,25, 33, 36-37**		**13.3**	**0.5**
Wood industry	wood	20			
Plastic and rubber prods.	plastic_prods	25			
others	other_ind	33,36-37			
Non specified	**non_spec**			**4.5**	**0.2**
TOTAL INDUSTRIES	**ind_tot**	**15-37**		**996.6**	**39.4**
Agriculture, forestry, fishery	**agri_tot**	**01-05**		**174.1**	**6.9**
Greenhouse Horticulture	horti	0112.1*		135.1	
cattle farming	cattle	012		26.4	
Other agriculture	agri_o	0111,112.2, 0113, 013-5,` 02, 05		12.6	
Mining of sand, etc.	**mining_other**	**14**		**2.0**	**0.1**
Building & construction	**construction**	**45**		**29.8**	**1.2**
Trade & repair	**trade_tot**	**50-52**		**64.6**	**2.6**
Car trade & repair	car_trade	50		9.1	
Retail trade	retail	52		31.2	
Other trade	trade_o	51		24.2	
Catering	**catering**	**55**		**23.6**	**0.9**
Transport, storage & communication	**trans_comm**	**60-64**		**16.3**	**0.6**
Commercial & public services	**serv_tot**	**65-75, 90-93**		**71.7**	**2.8**
Comm. serv. office-based	serv_comm_off	65-74		20.9	
Public serv. office-based	serv_publ_off	75		22.1	
non-office services	non_off_serv	65-75			
environmental services	serv_envir	90		6.3	
Culture	culture	921-5		3.2	
sport & recreation	sport	926-7		9.0	
other services	serv_o	91,93-99		10.2	
Education	**educ**	**80**		**18.2**	**0.7**
Health & welfare	**Health_tot**	**85**		**38.9**	**1.5**
intramural health care	intramur_health	8511, 8531.1-4		20.4	
homes for elderly	homes_elderly	8531.7		9.1	
other health & welfare	health_o	85	8511, 8531	9.4	

Sector Name	Sector_ID	SBI	SBI Excl.	Final energy consump. 1995 (PJ)	Share of total final (%)
Statistical diff.				**35.1**	**1.4**
Total other consumers		01-14, 45-99		**474.4**	**18.7**
Transportation	**transp_tot**	**60-62**		**417.9**	**16.5**
Passenger transp.	transp_pers				
Freight transp.	transp_fre				
Households	**households**			**445.1**	**17.6**
Total consumption				**2334.0**	**92.2**
NEH				2333.9	
Energy Supply					
Mining of oil, gas	**mining_oil&gas**	**11**		**28.2**	**1.1**
Oil & Coal conv.	**oil&coal_conv**	**23**		**146.7**	**5.8**
refineries	refinieries	23201		146.7	
cokes factories	cokes	23	23201		
Energy Conversion	**Energy_conv**	**40**		**19.8**	**0.8**
electr. prod. central	el_prod_centr			0.0	
electr. prod. decentral	el_prod_decentr			0.0	
refuse incinerators	ref_incin			0.0	
oil distribution	oil_distr			0.0	
energy distribution	en_distr			19.8	
Water supply	**water**	**41**		**2.27**	**0.1**
Total energy supply sector				**197.0**	**7.8**
TOTAL ENERGY CARRIER BALANCE	**TOTAL**			**2530.9**	**100.0**

* SBI code 0112.1 (“horticulture”) has a broader definition than the ICARUS sector “greenhouse horticulture”. The remaining companies which do horticulture in the open air are included by us in the category “other agriculture”.

Energy balance 1990

The energy balance for 1990 is set up along the same lines as for 1995. Because the sector classification and the level of detail of the CBS energy statistics for 1990 are different, energy data on subsector level may sometimes be unavailable. Also some sector definitions have changed between 1990 and 1995, thus necessitating data conversion and adaptation with respect to the ICARUS-3 values.

6. The “Functions” worksheet

In the “functions” worksheet up to four[4] different energy functions within a sector can be described, together with their functional unit and the throughput in 1995. An energy function is defined by us as an coherent assembly of processes which achieves a certain product transformation, for example the conversion of iron ore into pig iron, the conversion of pig iron into steel, etc. The corresponding throughput data should specify the amounts of pig iron, steel, etc. produced in 1995. Instead of the amounts of intermediate products we will often use the amount of end-product as indicator for the throughput.
The functions of a sector may also be used to identify different end-products, for example milk and cheese as different products from the dairy industry sector.
The selected functions will be used in the rest of the ICARUS database to specify which part of the sector’s energy consumption is affected by certain energy-efficiency measures.

In some cases it may be difficult to define a representative functional unit which allows us to express the throughput of a function in an adequate manner. For example if we consider the sector of greenhouse horticulture or the services sectors. In such cases some intermediate quantity which is a fairly good determinant of both throughput and energy consumption, may be employed as functional unit. In the examples of horticulture and services the “cultivated” area may be such an intermediate quantity. However there may also be sectors where even this is impossible, in those cases an index variable setting the function’s energy consumption of 1995 at 100, may be used.

[4] The number of functions may be increased if necessary.

7. The “Energy consumption by function” worksheet

In this worksheet the energy consumption for each function can be specified separately for the different energy carriers.
As energy carrier we distinguish here between electricity, fossil fuels, steam / hot water and non-fossil fuels (fermentation gas, biomass-derived fuel). The shares per function can be entered as percentages of the total consumption in the sector of the considered energy carrier. Because of this the percentages entered for the four functions should always add up to 100%[5]. For reasons of compactness we do not discern the three different fossil fuels. The (savings on) fossil fuel consumption will be divided according to the consumption data in the 1995 energy balance (cf. footnotes in section 4).
Apart from the shares in energy carrier consumption two additional sets of columns are incorporated in the worksheet to specify each function’s share in the non-energetic consumption and the share in the consumption of heat generated by CHP and/or heat pumps. The latter data fields will be used to evaluate the impact of CHP/HP penetration on heat demand reduction measures and vice versa.

In the same worksheet, in the columns further to the right, we display the calculated values of absolute energy carrier consumption per function, and the specific primary energy consumpation, that is the energy consumption per functional unit.

[5] Data fields that do not meet this requirement will be marked in *red* by the spreadsheet software.

8. The “CHP” worksheet

In the “CHP” worksheet data on the installed or potentially installable capacity of cogeneration units can be specified for the base year 1995/1999 and the view years 2010 and 2020. For each sector and year the installed capacity, the load factor, the heat-to-electricity ratio and the shares of different fuels can be specified, and for the view years also data on the investment cost and O&M costs. If necessary the heat input (e.g. process waste heat) for the cogeneration unit can also be specified. The fields giving the fuel input and electricity and heat output will be calculated automatically from the previous data fields.
The first four rows in the worksheet allow us to specify generic cost data for the industry, agriculture, services and households. Cost data for specific sectors need only be specified if they deviate from these generic data.

If revised data for 1999 are available they can be entered into the optional “1999” data fields.

N.B.: The division of the heat output over the different energy functions within the sector can be specified in the worksheet “Energy consumption by function”.

9. The “Heat pump” worksheet

This worksheet contains similar data as the CHP worksheet, only now for heat pumps and other “heat upgrading” technologies. MVR (Mechanical Vapour Recompression) units should also be entered in this same sheet.

10. The “External heat supply” worksheet

In this worksheet the inter-sectoral heat exchange (e.g. from industry to horticulture) can be specified for the different view years. Heat imported into the sector is accounted as a positive value and exported heat is negative. If a sector has both export and import the net value should be entered. The (average) price for the delivered heat should be specified in the scenario worksheet.

11. The “Scenario” worksheet

This worksheet contains the scenario-specific data on production growth (in physical terms), interest rates, and energy carrier prices for the view years 2010 and 2020. Generic data for industry, agriculture, services and households can be entered in the first four rows. Data for specific sectors need only be specified if they deviate from these generic data.
Cost data for natural gas and electricity can be entered in (euro)cents per m^3 respectively kWh; the coresponding values per GJ will be calculated automatically.
For the different scenarios separate worksheets will be included.

12. The “Electricity supply” worksheet

This worksheet also contains scenario-dependent data but now on the composition of the electricity supply system. For each scenario and view year data can be entered on the share of coal-, oil- and gas-fired generating units in the Netherlands and their average conversion efficiencies. Also the shares of nuclear and renewable electricity generation, and of imported electricity, can be specified. The imported electricity[6] is assumed to be delivered by an average European utility system, which can be specified in the same way as the Dutch system. From these data an average CO_2 emission rate for electricity will be calculated.

13. The “Basic data” worksheet

Here some scenario- and sector-independent data will be stored, for example CO_2 emision data per fuel type.

14. Further work on the ICARUS database

Now that general structure of the database has been laid down sector studies will be needed to provide the input data on energy-efficiency measures, ass well as energy consumption per subsector and function. Also calculation schemes to evaluate the listed options on the basis of the data contained in the separate worksheets will have to be implemented. Also a simple user interface, allowing the user to modify cost or scenario data, will be added.
When this is done it may become clear that some adaptions in the structure are necessary or desirable. However, I expect that such modifications will be relatively minor.

References:

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[6] It might be argued that import shares for electricity and their respective CO_2 emission rates should be specified for each sector separately because in a liberalized energy market each sector can make its own arrangements with foreign suppliers. However it does not seem probable that this level of detail will be needed or even possible when looking at 2010 or 2020.