Ecofys bv
P.O. Box 8408
NL-3503 RK Utrecht
Kanaalweg 16-G
NL-3526 KL Utrecht
The Netherlands
www.ecofys.nl

tel +31 (0)30 280 83 00
fax +31 (0)30 280 83 01
e-mail info@ecofys.nl

COOKING BOOK: CO_2-BALANCING

IN FRAMEWORK OF THE BALANCE PROJECT

S. Joosen
M. Luttmer

January 2007

ECS05013

Content

1 Introduction

In the European project, called Balance globally, evaluate locally (BALANCE), the aim is to develop and test tools to evaluate the energy and CO_2 saving potentials of municipalities. The third work package of the project concerns the search for CO_2 balancing method and or tool which can be used in the European Energy Award®-method. One activity within work package three was the investigation of existing tools and methodologies for energy and CO_2 balancing in communities. The results of this investigation are described in a report titled "*Inventory of CO_2 balancing methods and tools in 6 European countries*". One of the main outcomes is that within the BALANCE project a methodology will be selected for CO_2 balancing rather than prescription of one specific tool.

The *aim* of this Cooking Book is to gain insight in what is required for a method or tool so that it is suitable for CO_2 balancing within the eea® methodology. In addition, already several methods and/or tools are listed, which are eligible to be used for CO_2-balancing within countries of the BALANCE project.

There is some overlap between underlying report and the report about the inventory. The reason behind this is that the reports have to be readable separately.

Reading guide
The Cooking Book begins with the general description of the selected CO_2 balancing method and the list of general requirements for the overall method in chapter 2. Subsequently, the specific needs for the various components of the method, such as input, calculation and output data are discussed in chapter 3. The Cooking Book ends with the validation of the found CO_2 balancing methods and/or tools, including a list of tools are eligible to be used in the eea® method.

2 CO_2 balancing method

2.1 Introduction

From the inventory it appears that most CO_2 balancing tools are based on more or less the same method (see *Inventory of CO_2 balancing methods and tools in 6 European countries*). The main differences are in the detail level (input and output data) and the ways how is dealt with transport and electricity. The method is graphically shown in Figure 1.

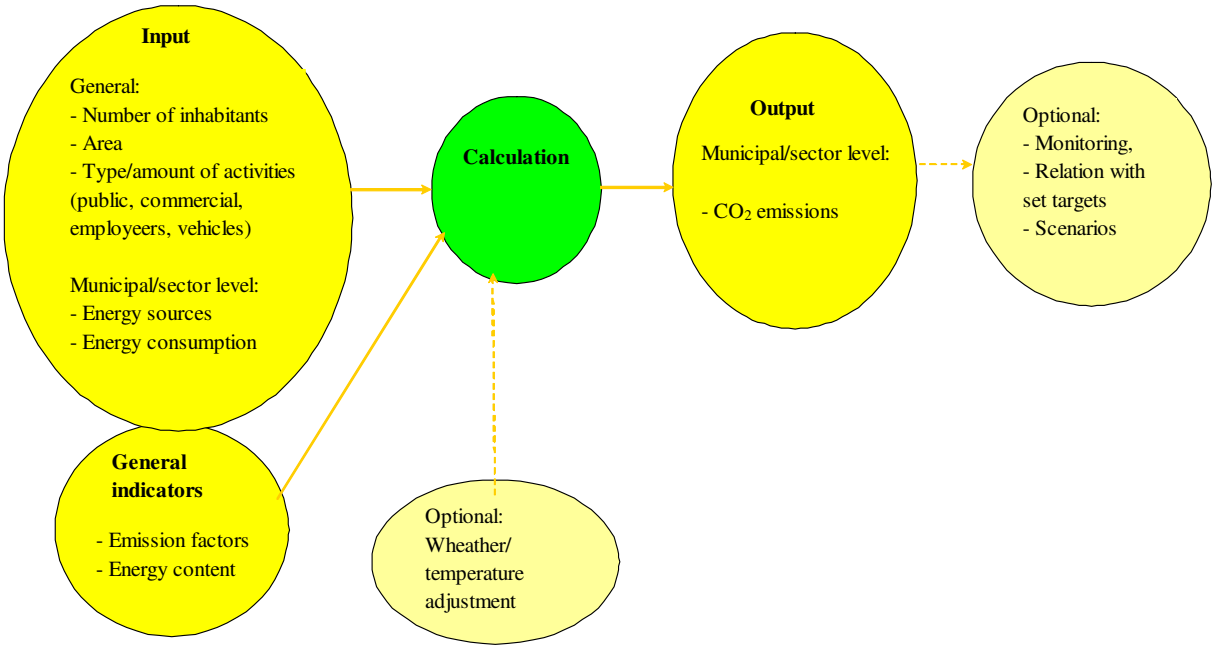

Figure 1 Main characteristics of CO_2 Balancing method

In the next paragraphs of chapter 2 the general requirements for CO_2 balancing methods are being discussed first. Secondly, the demands for each specific component (e.g. input, calculation and output) are described in chapter 3.

2.2 Requirements for CO_2 balancing methods

In the inventory report the requirements for CO_2 balancing methods are determined in the way that they can be used within the eea® approach. The main requirements relate to the following points:

- Top down and/or an bottom up methodology
- The system boundaries
- International comparability

2.2.1 Top down, bottom up methodology

It is difficult to find an optimal balance regarding the availability of local data, the necessary workload and costs to collect the data and the required accuracy of a methodology. In principle there are three main approaches each with their specific characteristics. These three are:

1. Top down approach, using international and national statistics to allocate emissions over municipalities.
2. Bottom up approach, using specific municipal data to determine emissions in the municipality
3. Combination of top down with bottom up approach, using default values based on (inter)national statistics, unless better data at regional and/or local level are available.

From the inventory report, it can be concluded that the third approach is a good compromise between balance of workload of collecting the data and accuracy. One attention point is to be aware that an aggregation of all local balances should be identical with a national or European balance.

2.2.2 System boundaries

Principles

A CO_2 balancing method for a local authority is defined as a method which determines the CO_2 emissions caused by energy consumption within the municipalities' borders. This implies that in general the territory principle is applied: the place where CO_2 is emitted through burning of fossil fuels is leading. There are two exceptions: national large energy plants and transportation. In these cases the cause principle is leading: the emissions are accounted to the place where the energy is consumed. Example: emissions caused by electricity production are attributed at the electricity consumers. The same is true for heat.

Required data and which data are not necessarily needed
All energy sources used for the energy consumption in the local authority are needed. Also energy sources for own energy production. The availability of the data will differ per municipality and per country. Important possible providers for data are energy companies or national statistics offices. If data are not available, assumptions have to be made based on physical parameters (such as number of inhabitants, dwellings, economic activities etc.). For more detailed information is referred to paragraph 3.2 which goes into the data input and especially, Table 2 about indicators. Further conversion of energy sources, for instance through cogeneration, is not taken into consideration. This means the method is a black-box, looks only to which energy flows enter the municipality and what is consumed within its borders.

Non-CO_2 greenhouse gasses and non-energetic consumption (embodied energy in purchased goods and services) do not have to be taken into account. Use of landfill gas (containing methane, CH_4 an important non-CO_2 greenhouse gas) is included as one of the measures in the eea-assessment tool.
Waste incineration installations on municipalities' ground can be included in the balance. Only the CO_2-emissions from the non-bio-organic part are counted, while the burning of organic substances is CO_2 neutral.

Definition of emission factors
The definition of the emission factors for district heat and electricity depend on the selected systems boundaries. Attention has to be paid to avoid double counting of the impact of measures. This means, that CO_2 balancing method has to have in principle same system boundaries as the CO_2-reduction measures. For example, in case purchase of green electricity is a measure, the emission factor has to be based on an electricity balance without renewable produced electricity. In Table 1 an overview is presented of the factors which determine the emission factors for district heat and electricity.

Table 1 Definitions of emission factors

Emission factors	**Determining factors in definition**
District heat	- input fuels power station - additional input of fuel to generate similar amount of electricity in case the heat demand had not to be fulfilled - distribution losses
Electricity	- input fuels power stations - import of electricity - electricity from renewable sources - centralised and decentralised cogeneration

The conclusion is that attention has to be paid to the fact that the definition of the emission factor fits the method for valuing energy saving measures. At least used definitions and sources of emission factors have to be clear and always being reported.

2.2.3 Comparability

An important characteristic of the eea® method is the direct comparability between various municipalities within the national and international context. This is also a requirement for the CO_2 balance of municipalities. The expectation is that per country a tool should be chosen, so that comparison of CO_2 balances at national level is possible. For the international comparison, it needs to be clear:

(1) On which tool the balance is based,
(2) What are differences between the basics, such as system boundaries and emission factors, of the chosen tools? In addition, what are the influences of these differences?

Answering above questions goes beyond the scope of the activities at this stage of the BALANCE project. The proposition is to take these questions into account during working with the eea® procedure in practice with municipalities. So later on in the project the findings can be reported.

Flexible input of emission factor data is needed to make national and international comparison possible. For instance, the following electricity emission factors can be used:

(1) Based on local fuel mix, for electricity production, for instance specific purchase of nuclear or green power
(2) Based on national fuel mix for electricity production
(3) Based on European fuel mix for electricity production

Within the latter electricity emission factors international comparison will be become possible (see also Figure 2).

3 Ingredients

This chapter contains requirements for specific components of the CO_2 balancing method or tool.

3.1 Calculation of CO_2 emissions

The first step, necessary to determine the CO_2 emissions, is to determine the final energy consumption within the municipality. If national statistics do not supply data on local consumption, indicators can be used to make estimations. The next step is to multiply the consumption with the energy content of the fuel used and with the CO_2 emission factor.

The calculation method and at which level international comparison is possible between different tools is schematically presented in Figure 2.

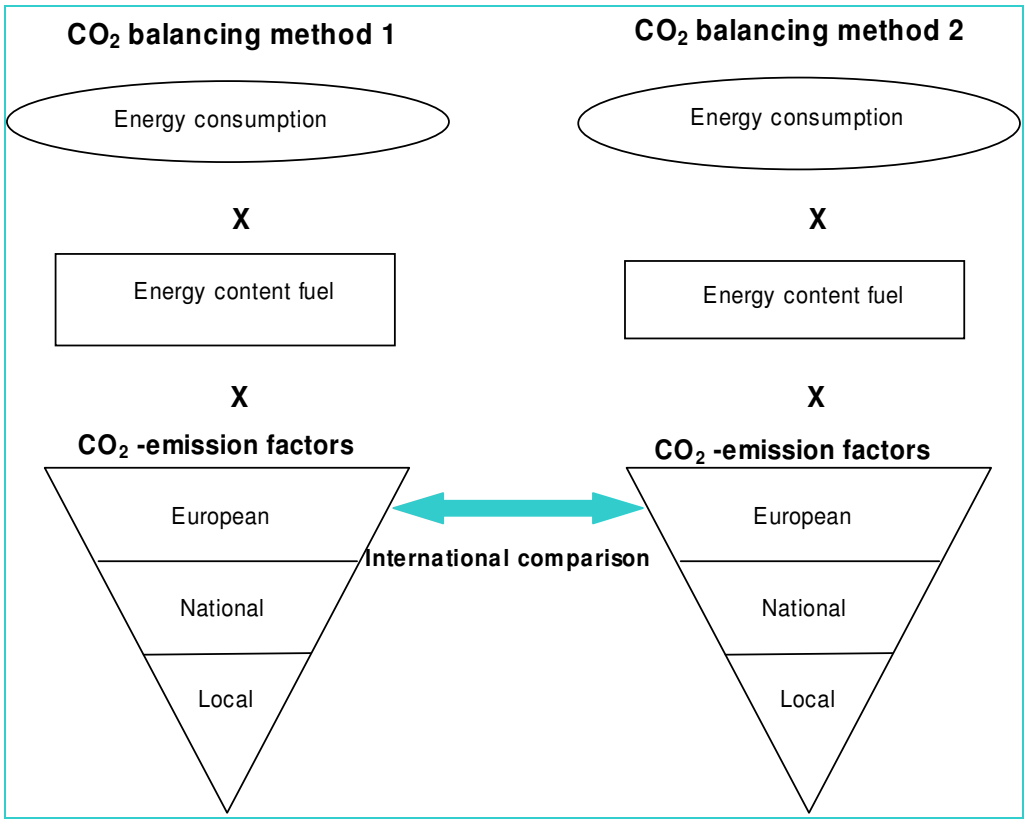

Figure 2 Schematic overview of calculation method and at which level international comparison should be carried out.

3.2 Input

3.2.1 Energy consumption

The final energy consumption and the related fuel input of the municipality are basic data for CO_2 balancing. On national and European level all relevant data for CO_2-balancing are available, because this is required in framework of several international agreements. However, often it is not easy to break down these national or international data on municipal level or even on municipal sector level (Climate alliance, 2003)[1]. The latter is necessary because energy and climate policies and measures within the eea® method are also distinguished per sector. At least sectors should be considered which fall under the direct influence of the municipal policy. The municipal level alone is too aggregated to place the impact of measures in perspective.

It is recommended to co-operate with local energy suppliers to collect data on end-energy. This means energy that is sold by energy suppliers (gas, oil, district heat, coal and others). Regarding data on electricity, it can be promising to co-operate with the company, which is providing the net service (Climate Alliance, 2003). Data about as well public as private transport should become available. Recommended sources to consult are: UITP Millennium Cities database for sustainable transport (UITP, 1995)[2] and for national information: countries own national statistic office or World Road Statistics (IRF, 2005)[3].

In any case, it is recommended to base the CO_2 balance on data which will be also available on the long run.

Next to these input data, the emission factors and energy content of the various fuels, electricity production and district heating are needed. All these ingredients are discussed in the next paragraphs.

---

[1] (Climate Alliance, 2003) CO_2-rapid assessment Method, working paper, method for municipalities, main factors affecting CO_2 emission levels, J. Fechner et al., Vienna, 14 April 2003

[2] (UITP, 1995) database with an extensive digest of land use, transport, economic and environmental data related to urban transport in 100 cities worldwide. Data is for the year 1995, available on CD from the International Union (association) of Public Transport (UITP) in Brussels. Email: heather.allen@uitp.com for further information, more information http://www.sustainability.murdoch.edu.au/links/uitpmill/uitpmill.html

[3] (IRF, 2005) World road statistics, data 1999-2003, International Road Federation

Sectors and their indicators

All sectors which are under the direct influence of municipality policy have to be covered. These sectors and possible input indicators are presented in Table 2.

Table 2 Input indicators per sector (indicative)

Sector	Subsectors	Required indicators	Optional data
Buildings	Households	number of habitants	number of dwellings contruction period housing type
	Municipal buildings	floor area specific energy use per floor area number of buildings In case floor area data are not available: number of employers and floor area per employer	construction period building type
	Public buildings	floor area specific energy use per floor area number of buildings In case floor area data are not available: number of employers and floor area per employer	construction period building type
Transport	Private transport	type of vehicles number of vehicles fuel use average km per vehicle	
	Public transport	type of vehicles number of vehicles fuel use average km per vehicle	
Agriculture	per agriculture sector	land area specific use per land area animal stock specific energy use per animal	number of buildings, floor area
Industry	per industry sector	values added number of employers production specific energy use per produced unit	
Waste		type of waste installations number of installations a amount and source of waste input yield of installations energy content of waste flow gross and net energy production	
Energy production		type of energy production units number of installations amount and source of energy input yield of installation gross and net energy production	

As an example how to deal with input data of various sectors the guidelines for the application of the CO_2 rapid assessment tool are presented in Annex I.

3.2.2 Energy content of fuels

After the fuel input for the energy consumption of the municipality has been collected, the next step to calculate CO_2 emissions is multiplying these fuel amounts with their energy content. The eea® method already includes these energy content of fuel as one of the data input items.

Traditionally the energy content of fuels is expressed as low heating value of fuels. Low heating value (LHV) is defined as the heat which is released by combustion in proportion to the mass (capacity) of the burned fuel (expressed in MJ per kg fuel). In contrast to LHV, the higher heating value (HHV) takes into account the latent heat of water vapour. In plain words: LHV stands for the energy content of a fuel when after combustion water is in vapour phase; with HHV after combustion water is in liquid phase.
Because LHV is generally accepted, it is recommended to use this definition for the energy content of the fuels.
As default data, it recommended to use data from Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Reference Manual (Volume 3) www.ipcc-nggip.iges.or.jp/public/gl/invs6.htm.or data from IEA_ energy balances. As with the emission factors attention has to be paid to report which sources are used to fill in other than default data.

Table 3 Energy content per fuel (IPCC)

	Factors (TJ/10³ tonnes)
Refined Petroleum Products	
Gasoline	44.80
Jet Kerosene	44.59
Other Kerosene	44.75
Shale Oil	36.00
Gas/Diesel Oil	43.33
Residual Fuel Oil	40.19
LPG	47.31
Ethane	47.49
Naphtha	45.01
Bitumen	40.19
Lubricants	40.19
Petroleum Coke	31.00
Refinery Feedstocks	44.80
Refinery Gas	48.15
Other Oil Products	40.19

Other Products	
Coal Oils and Tars derived from Coking Oils	28.00
Oil Shale	9.40
Orimulsion	27.50

3.2.3 CO_2 emission factors

Within the eea® method CO_2 emission factors are already taken into account. Standardised European and national emission factors for the energy sources and the electricity mix are needed. As default data from Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Reference Manual (Volume 3) www.ipcc-nggip.iges.or.jp/public/gl/invs6.htm (page I.13) will be used. It is important to report which sources are used to fill in the national data. For instance, in Germany the GEMIS database can be used. An emission factor for European electricity production can be used to filter out differences in emission factors of national electricity production (see also Figure 2 and annex 1 Data for electricity). In this way the results of the same measure between various countries can be compared.

Table 4 CO_2 emission factors (IPCC)

Fuel	*Carbon Emission Factor (t C/TJ)*
LIQUID FOSSIL	
Primary fuels	
Crude Oil	20.0
Orimulsion	22.0
Natural Gas Liquids	17.2
Secondary fuels/ products	
Gasoline	18.9
Jet Kerosene	19.5
Other Kerosene	19.6
Shale Oil	20.0
Gas/Diesel Oil	20.2
Residual Fuel Oil	21.1
LPG	17.2
Ethane	16.8
Naphtha	(20.0)
Bitumen	22.0
Lubricants	(20.0)
Petroleum Coke	27.5
Refinery Feedstocks	(20.0)
Refinery Gas	18.2
Other Oil	(20.0)

SOLID FOSSIL	
Primary fuels	
Anthracite	26.8
Coking Coal	25.8

3.2.4 Optional data

Some advanced models also take annual weather conditions into account (heating, cooling degree days). Of course this improves the accuracy of the outcomes. However, in our opinion this accuracy level is not needed for a first approximate CO_2 inventory within the eea® framework. So it is regarded as optional.

3.3 Output

Based on these input data the CO_2 emissions caused by energy consumption within the community borders can be calculated. The output exists of the calculated CO_2 emissions of the total municipality and the various sectors. Several models already relate the outcomes to monitoring and forecast purposes. Also this aspect is not regarded as essential for a first good approximate CO_2 inventory.

3.4 Other remarks

Based on outcomes of a discussion with all BALANCE partners, it appears that it is not necessary to update the content of CO_2 balances every year. An update every 5 years is satisfactory. In addition, according to all BALANCE partners a CO_2 balancing method and/or tool has to comply with the following issues:

- The tool has to be flexible, for instance adding and eliminating of sectors must be easy.
- The confidence in the eea®-method may not be disturbed.
- Final energy consumption has to be reported (in addition to primary energy consumption). This has to done to avoid misunderstandings about for instance system boundaries and conversion factors.

4 Cooking competition: Validation of CO_2 balancing tools

The requirements for the method and the ingredients (see chapter 2 and 3) are the basic criteria for the validation of the various CO_2 balancing tools. Ecofys developed a system in close cooperation with the other BALANCE partners to validate the CO_2 balancing tools. This system including requirements and their validation is shown in Table 4 and Table 5.

The tools which are regarded eligible to be used in the eea® procedure are expressed in Table 3.

Table 3 (Probably) Eligible CO_2 balancing methods and/or tools for the eea® procedure

CO_2 balancing tools
ECO_2 regio (ecospeed)
CO_2 grobbilanz (Climate Alliance Austria)
CO_2 rapid assessment
CarBase™

Based on the experiences during the national workshops of the BALANCE project team it has been decided that countries have a free choice which eligible software tool they are going to use (reference: *Inventory of CO_2 balancing methods and tools in 6 European countries*).
Fortunately, the implemented or planned software tools in Austria (CO_2 grobbilanz (Climate Alliance Austria), Germany (ECO_2 regio (ecospeed)) and Switzerland (ECO_2 regio (ecospeed)), are eligible in the framework of BALANCE. It is expected that these countries will use these tools for CO_2 balances of their municipalities.
Most tools and their users' instructions are available in one language, the national language. Currently, only the CO_2 rapid assessment tool and its instructions are available in English. In addition, it seems a straightforward tool which does not require too much detailed information. These are the underlying reasons to recommend this CO_2 rapid assessment tool in the test cases of the countries participating in the BALANCE project that do have not an own national CO_2 tool available (yet).
As an example how to deal with input data of various se.ctors the guidelines for the

application of the recommended CO_2 rapid assessment tool are presented in Annex I.

Table 4 Requirements for a good CO_2 balancing method/tool so that it can be used within the eea®-procedure

Topic	Level	Requirements
Programmed in	Minimal	electronical, software applicable for most used PCs excell, access
	Preferably	webbased
Used sources	Minimal	has to be known
	Preferably	regular updated official sources
Used estimation	Minimal	has to be known
	Preferably	based on official (monitoring) protocols
Method	Minimal	Bottom up
	Preferably	Combination bottom up, check with top down figures
Input	Minimal	Approximately level, default values, in case information is not available at municipal level
	Preferably	Two levels: approximately and detailed
Output	Minimal	energy use and CO_2 emission of the municipality check with macro energy use figures
	Preferably	energy use and CO_2 emission of the municpality total overview and per sector
Detail level	Minimal	Municipality
	Preferably	Sector
Work load	Minimal	not more than two weeks per year
	Preferably	limited to few hours to a few days per year
Usability	Minimal	it takes half a day to a day work to understand the working
	Preferably	webbased and works intuitively
Systems boundaries	Minimal	has to be known (see also paragraph 2.2.2)
	Preferably	based on official national and/or international agreements
Number of applications	Minimal	applied in several municipalities (at least 5)
	Preferably	applied in many municipalities in a several European countries
Cost	Minimal	limited cost (not above 1000 euro)
	Preferably	limited cost (less than 100 euro)
Flexibility	Minimal	easy to update/adjust information, connect to monitoring programmes
	Preferably	interactive with other planning, budget programs, monitoring program, set target(s) and outlooks

	For valuation
?	unknown (yet)
-	Tool does not fulfill minimal requirement
+	Tool fulfills minimal requirements
++	Tool fulfills preferable requirements

Table 5 Validation of various CO_2 balancing methods and/or tools

			Requirements for a good CO2 balancing tool so that it can be used within the EEA procedure											
No	Name of the tool	Ownership	Programmed in	Used sources	Used estimation	Method	Input	Output	Detail level	Work load	Systems boundaries	Number of application	Cost	Flexibility	Overall judgement
1	CarBase™	Ecofys b.v.	++	++	++	++	++	++	++	++	++	+	++	++	probably eligible, still under development
2	Part of the eea® assessment tool	Trägerverein Energiestadt, CL GmbH	+	+	+	+	-	-	-	++	+	+	+	-	not eligible, provides insight in CO2 emission reduction, not a real balance
3	CO_2 Rapid Assessment	Climate Alliance	+	++	++	++	+	+	++	++	+	?	++	+	eligible
4	ECO2 regio	ecospeed	++	++	+	++	++	++	++	?	?	?/+	-/+	++	probably eligible, to be sure more information is needed
5	CO_2potential pro	Solar Cities	?	?	?	?	?	?	?	?	?	?	?	?	unknown if the tool is eligible, more information is needed
6	Greenhouse Gas Strategy Software for Cities	ICLEI	?	?	?	?	?	?	?	?	?	?	?	?	unknown if the tool is eligible, more information is needed
7	CO_2-emission check and planning	e+u	+	++	+	+	-	++	+/++	++	-	+	+/-?	-	not eligible
8	GEMIS	Ökoinstitut Freiburg und Gesamthochschule Kassel	+	?	?	++	?	?	+	?	+	+	++	?	unknown if the tool is eligible, more information is needed
9	CO_2-Grobbilanz Klimabündnis Österreich	Climate Alliance Austria (Klimabündnis Österreich)	++	++	?	++	++	++	++	++	?/+	++	+/++	+	probably eligible, to be sure more information is needed
10	EMSIG	Energieagentur Waldviertel	+	++	?/+	++	+/++	++	++	?/'++	?/+	+	-	+	not eligible
11	no tool - just a standardised report; e5 energy- and co2 balance by Robert Siller (diploma thesis), Land Salzburg (Abt. 16), SIR	Land Salzburg, Abt. 16	-	+/++	?	++	+	?/+/++	+	?/'++	+	+	?	-	not eligible
12	Tool and standardised report; e5 energy- and co2 balance Energieinstitut Vorarlberg	Energieinstitut Vorarlberg	+	++	?	+/++	++	?/+/++	+	-	+	+	+	-	only eligible in case the work load is sized down and flexibility will be guaranteed
13	CO_2 emission calculator for energy generating companies	Ekostrategija	++	+	++	-	-	+	+/++	++	++	+	++	+	only eligible in case bottom up can be used for municipality level
14	National Energy Balance	SEI	+	+	+	-	?	-	-	?	++	-	-	?	not eligible
15	County Energy Balance	Tipperary Energy Agency. Limerick Clare Energy Agency	+	+	+	-	-/+	-	++	-	+	-	-	-	probably not eligible, for internal use only

	For valuation
?	unknown (yet)
-	Tool does not fulfill minimal requirement
+	Tool fulfills minimal requirements
++	Tool fulfills preferable requirements

ANNEX 1 Guidelines for the application of the CO_2 Rapid Assement tool

Copy from Source (Climate alliance, 2003).

The Assessment is a simple excel tool, it is divided in sheets:

- Title
- 2-6 Residential, Commercial, Industry, Public, Transport
- 7. Overview
- 8. Total

Yellow fields

All yellow fields must be filled in with the specific data for your city.

- Number of inhabitants
- Energy consumption
- Mileage, number of vehicles

Blue values

These factors should be regarded as default values. If available, use more specific data, corresponding to your local situation. Note: The emission factors are European values, and contain also emissions from the production phase.
The method is foreseeing to split the energy consumption in five sectors: Residential, Commercial, Industry, Public, Transport

It makes sense to use the indicated sections for monitoring, because the relevance of each sector can be made visible. If it is not possible to gain data on this level, you can go directly to "Overview" and fill in the data there. In any case, fill in all sections, incl. Transport.

2-Residential

Data for "heating" and "electricity" of residential buildings are requested. By this the total energy consumption of residential buildings should be included, also gas for cooking and electricity for heating.

Data for gas and district heat should be available from the supplying companies.

Data for heating oil, coal, biomass (wood, wood-chops, pellets etc.) are not available in many cases. Statistical methods must be used here in these cases (random sample), e.g. collecting the fuel/coal/biomass consumption for heating per block of flats. With data for a sample of 10-15 buildings the data for the specific area can be extrapolated, using the total square meters of buildings ex-

isting in the specific area. The researched buildings should cover the typical mixture of building periods and building forms in an adequate ratio. (e.g. 30% concrete panel construction built between, 30% brick buildings panel, etc.)

Data for electricity
The emission factor must be selected here. The European standard factor for Electricity (grid) is 500 tCO_2/GWh. It is urgently recommended to take into consideration the generation mix (hydro power, combined heat power generation, thermal, biomass, nuclear, other). In Austria e.g. the emission factor varies between 100 t CO_2/GWh in summer (70% hydro power) and 350 t CO_2/GWh in winter (50% hydro power). An important source is IEA report CO_2-emissions from fuel combustion 1971-2003, see also information in paragraph 3.2.3.

3-5 Commercial, Industry, Public
The same approach can be used for these sections.

6-Transport
Public transport
At first the service companies should be asked for their **annual mileage** of their fleet. If these data are not available you can use the following method:

- Identify all the bus lines and the routes that service the municipality
- Find out the km each line makes inside the municipality.
- Define the km for each line (counting the km each bus makes on the traffic map of the municipality, frequency of service)

You can use average fuel consumption of public transport as indicated.

Motorized individual traffic
In many cities the number of registered cars is available. If not, use the below described method. The annual mileage can be taken from statistical data. Additionally you can use the following method: Contact your car mechanics and make a commitment to deliver data on annual mileage (anonym), which can be taken from car inspection. These data can be used as random sample for extrapolation. The relevant fact is to survey changes in mobility on local level.

If the number of registered cars is not available, you can use the following method:
Consumption of diesel and petrol in municipality x emission factor
The emission factors:

- Diesel: 2,63 kg CO_2 per litre
- Petrol: 2,32 kg CO_2 per litre
- Bio-Diesel: 0,67 kg CO_2 per litre

It is evident, that due to its' higher emission factor diesel cars cannot contribute to climate protection, although they usually have less fuel consumption per kilometer.

For this version the excel sheet "6-transport" can be adapted like this:

Motorised individual traffic	Unit	Petrol	Diesel	Other e.g. Biodiesel	Total
Consumption	l / a	1.000.000	1.000.000	1.000	**2.001.000**
Emission factor	kg CO2 / l	**2,32**	**2,63**	**0,67**	-
CO_2-emission	t	2.320.000	2.630.000	670	**4.950.670**
Share of traffic emission	%	46,87	53,13	0,00	**100,00**
Contribution to CO_2-emission	t CO2 / inh.	1,45	1,64	0,00	**3,09**

Recommendations:
Use data, which make it possible to monitor increase or decrease of traffic in your city!
In general, the impact of public transport is less important than individual traffic. Do not spend too much time for accurate data in the public transport sector, as long as you have no specific data in the other sector.

7-Overview
In this sheet you find an overview, if data cannot be split up in sectors (residential, commercial, etc.) you can start here.

8-Total
Here you find the result of the CO_2-assessment, further information (date, etc.)

Diagram
It is recommended to make some diagrams to visualize the results!