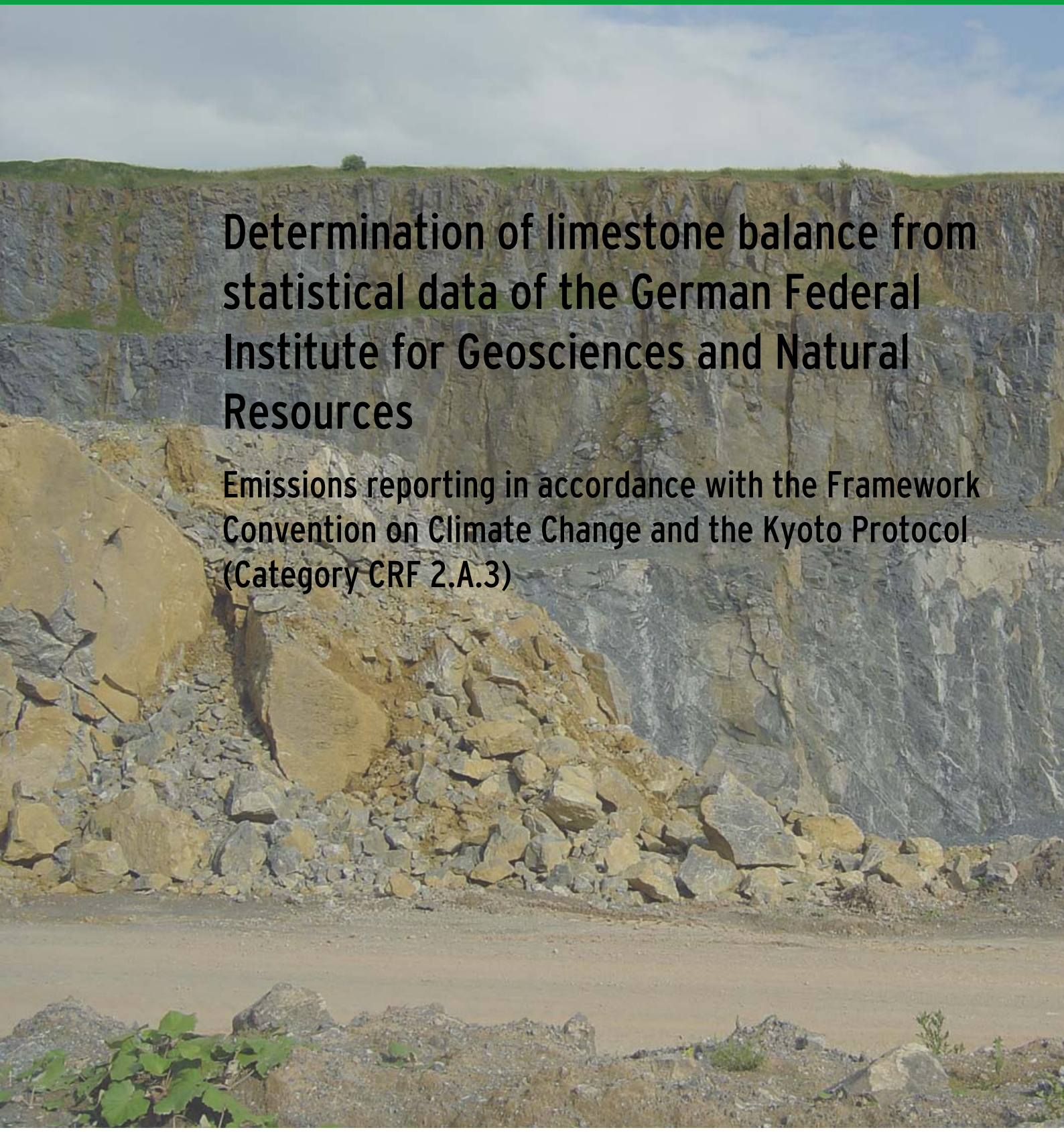

Determination of limestone balance from statistical data of the German Federal Institute for Geosciences and Natural Resources

Emissions reporting in accordance with the Framework Convention on Climate Change and the Kyoto Protocol (Category CRF 2.A.3)

BGR Bundesanstalt für Geowissenschaften und Rohstoffe

Umwelt Bundes Amt
Für Mensch und Umwelt

Determination of limestone balance from statistical data of the German Federal Institute for Geosciences and Natural Resources

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by

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UMWELTBUNDESAMT

This publication is only available online. It can be downloaded from http://www.uba.de/uba-info-medien-e/4034.html along with a German version.

Publisher: Federal Environment Agency (Umweltbundesamt)
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http://fuer-mensch-und-umwelt.de/

Dessau-Roßlau, November 2010

Umwelt Bundes Amt
For our Environment

BGR Bundesanstalt für Geowissenschaften und Rohstoffe

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Update of limestone balance for Germany based on statistical data from BGR

Background

Germany, as a party to the Framework Convention on Climate Change, has an obligation to prepare emissions inventories and publish them at regular intervals. To meet these reporting requirements, Germany operates the Central System for Emissions *(Zentrale System Emissionen – ZSE)*, a comprehensive database that is used both to calculate and to manage and document relevant emission data. In the light of ongoing advances, the inventory database is constantly updated to take account of the latest research findings and internal and external analyses.

The research project "Limestone Balance"[1] made a substantial contribution to improving the national emissions inventory. Particularly in the field of process emissions, gaps were identified in the data on thermal use of raw materials containing carbonate (especially limestone). It proved possible to provide a complete model picture of limestone use and related CO_2 emissions.

The scope of the project was confined to processing the data up to 2004, and the Federal Environment Agency *(Umweltbundesamt – UBA)* therefore took on the task of updating the data from 2005 onwards. The period studied by this research project now dates back nearly six years. There is an urgent need to check the validity of the results obtained at that time and any other optimisation potential, because the emissions inventories are reviewed annually by international experts.

Relevance to completeness of greenhouse gas inventories

A complete and consistent limestone and lime balance for Germany permits emission calculations – without gaps and without double counting. By analogy with the energy balance, it distinguishes quantity calculations, conversion balance and final consumption (differentiated by sectors).

The IPCC Guidelines currently in force (IPCC 1996) do not describe this approach, but proceed on the basis of known source groups which are to be reported in full. Even the revised IPCC Guidelines (IPCC 2006) have weaknesses, with the result that reporting for carbonates cannot be as consistent as for fuels.[2]

In this respect the methodological approach developed jointly by the UBA and the Federal Institute for Geosciences and Natural Resources *(Bundesanstalt für Geowissenschaften und Rohstoffe – BGR)* represents a counter-proposal to the method suggested in the international Guidelines (IPCC 1996 and 2006), with the aim of showing factually correct calculations in the German greenhouse gas inventories. The National Inventory Report (NIR) regularly serves to document the calculations in the greenhouse gas inventories, and the methods and data used are set out there in compact form. The NIR does not have room for in-depth analyses. Its

[1] FKZ: 205 41 217/02, available from UBA publication database #3102 http://www.umweltbundesamt.de/ubainfo-medien/search-public.php or direct from http://www.umweltdaten.de/publikationen/fpdf-l/3102.pdf

[2] The requirement is literally: "Only emissions from limestone and dolomite used in the mineral industry should be reported in the Mineral Industry Chapter. … may impact, in particular, emission estimates for the Mineral Industry, the Chemical Industry, and Metal Production," but not a summary overview. Even the 2006 Guidelines do not require an overview showing the relationship of production quantities to use.

purpose is to describe inventory practice, and it is not the appropriate place for scientific discussions. The present report also serves to meet this extended purpose.

The proposal ensures transparency regarding the use of limestone by preparing a balance of the quantities used (activity data) and making recommendations for emission calculations in the source categories used. It makes it possible to ensure improved transparency and greater accuracy without sacrificing clarity.

Assessment by UBA in the light of various data sources

The following basic findings are substantiated in detail below:

- A limestone balance guarantees seamless evidence of all relevant limestone uses.
- Model calculations for balance terms can be replaced by statistical data and can thus be updated on a long-term basis.
- Despite the transparency it creates with regard to activity data (raw material input), a balance is less suitable for accurate greenhouse gas calculations than calculation in source categories.

Without a balance approach, declarations about the completeness of an inventory are only reliable to the extent that the reporting formats are complete. Especially in the case of the IPCC Guidelines 1996, the relevant reporting categories are only mentioned as examples. The explicit mention under CRF 2.A.3 of limestone uses not covered elsewhere does not make it easier to compare different inventories. The IPCC Guidelines 2006, by contrast, call for all limestone uses to be included in the source category in which the use takes place. Although this allocation is appropriate and more comparable, it still does not guarantee completeness[3]. It is also possible in a balance to show consistency between limestone production and use.

Balance terms for balances can basically be derived by means of model calculations ("from indicators") or from statistical data. As a rule, statistical data are available on a long-term basis and thus permit updating of balances. Slight discrepancies from models do not disprove the suitability of the statistical data or of the balance calculation itself. They do however point to differences in accuracy.

[3] The mention of relevant limestone uses in the 2006 Guidelines ensures completeness for the sources known in Germany. See IPCC 2006, Volume 3, Chapter 2, Table 2.7.

Table 1: Comparison of limestone balances for 2008 from model calculations of specific indicators ("from indicators") and from statistical data ("statistical"); calculations by UBA

Figures in million tonnes in 2008		
	statistical	
Production in Germany	91,659	
Imports	5,214	
Exports	1,367	
Total quantity	**95,506**	
Conversion/ final use	**from indicators**	**statistical**
Cement industry	29.601	42.605
Lime industry	12.319	12.624
Soda manufacture	1.745	IE
Glass	0.902	0.356
Sinter	4.541	3.437
Pig iron	0.790	IE
Sugar	0.655	0.314
Flue-gas desulphurisation in power plants	2.303	1.745
Agriculture	3.410	1.915
Water and sludge treatment	0.226	0.226
Other sectors (e.g. construction, other building material industries and chemicals etc.)	39.014	32.284
Use	**95.506**	**95.506**

It is not possible to decide here whether either of the two calculations provides a better picture of reality. The individual balance items are discussed under *Discussion of statistical balance items* and *Discussion of indicator-based balance items*. The calculation of limestone use with the aid of specific indicators originates to some extent from the calculations of individual categories in the greenhouse gas inventory.

The call for greater and constantly improved accuracy in the greenhouse gas calculations inevitably leads to very detailed calculations of all emission causes. These comprehensive calculations can only be reflected to a limited extent in a balance for limestone, i.e. a specific raw material. Over-estimates or under-estimates may occur in parts of the balance. Since the emission relevance of the balance terms varies (no emissions, partial emissions, totally emission relevant), these inaccuracies lead to variations in emission levels.

Here there is a need for a transition from balance items to reporting categories, because this brings out the emission relevance. The category "2A7 Ceramics manufacture" is added here, because it is not part of the balance. The references from the balance items to the reporting categories can be found in Appendix 1: Limestone and burnt-lime balances for 2006-2008 UBA data analysis)

Table 2: Comparison of all emission-relevant balance items (reporting categories) for 2008 from model calculations of specific indicators ("from indicators") and from statistical data ("statistical"); calculations by UBA

Figures in million tonnes in 2008		
Balance items (limestone use with CO_2 emissions)	**from indicators**	**statistical**
1A1 Flue-gas desulphurisation in large combustion systems	2.303	1.745
2A1 Cement manufacture: cement clinker firing	29.601	42.605
2A2 Lime production: calcination of limestone	12.319	12.624
2A7 Glass manufacture (total)	0.902	0.356
2A7 Ceramics manufacture (external "supplementary balance")	0.751	0.000
2C1 Iron and steel manufacture	5.331	3.437
5D Soil liming in agriculture and forestry	3.410	1.915
CO_2 emissions from limestone (including dolomite, for simplicity)	**24.0 (CO_2)**	**27.6 (CO_2)**

The individual balance items are discussed in the chapters Discussion of statistical balance items and Discussion of indicator-based balance items. The fact that higher emissions can be calculated using statistical data is due solely to the great input of raw material in the cement industry, which cannot be differentiated here for clinker firing. This is not reflected in the calculations for the cement industry in the greenhouse gas inventory (CRF 2.A.1), but is an expression of the differences in accuracy of the balance models.

Basis of BGR data

In the interest of inter-departmental cooperation, the BGR has compiled statistical data to underpin the model-based UBA balance with empirical data. This results in the best available overall picture that can be achieved with reasonable cost and effort.

The individual data are based on official statistics from the Federal Statistical Office and on statistics from the Federal Association of the German Lime Industry and the Federal Association of the German Cement Industry. It should however be noted that production figures may differ from the actual production quantities. In most cases this is due to the fact that not all companies which produce raw materials belong to the federal associations, and that the production surveys by the Federal Statistical Office only include establishments with 10 or 20 employees (see *Appendix 2 Production figures for raw materials containing carbonate (limestone, marlstone and dolomite) in Germany in the years 2006 – 2008 (BGR data analysis)*.

Discussion of statistical balance items

Apart from the basic question of statistical representation, there are several balance items that need to be discussed in terms of primary data and absolute amounts; here reference is made to Table 1.

For total quantity of limestone

- Production in Germany: only statistically recordable, but not complete (see above)
- Imports/exports: only statistically recordable, covers various types of limestone, more complete than association statistics (BVK 2007, 2009)

For use of limestone

- Cement industry: input of raw material cannot be differentiated and cannot therefore be shown precisely as a percentage of cement clinker production
- Lime industry: as a calculation based on lime production this involves uncertainties relating to the types of lime covered
- Soda manufacture: no differentiated data possible
- Glass: less than real requirements of glass industry
- Sinter/pig iron: only recordable jointly, and therefore involves uncertainties
- Sugar: less than real requirements of sugar industry
- Flue-gas desulphurisation in power generation: less than real requirements
- Agriculture: less than Federal Statistical Office figures used by farmers
- Water and sludge treatment: no assessment possible or necessary, since not emission relevant
- Other sectors (e.g. construction, other building material industries and chemicals etc.): calculated residual amount, but not emission relevant. This item makes it clear that significant amounts are missing from the official statistics for total quantity of limestone, as they are not covered by the statistics (see above)[4].

[4] To illustrate the plausibility of this finding, it should be noted that every year Germany produces approx. 50 million tonnes of mixed asphalt products consisting of at least 95% mineral raw materials (aggregates) that contain considerable amounts of limestone.

Discussion of indicator-based balance items

In addition to the fundamental possibility of showing balance items based on statistics, more accurate calculations are possible with the aid of industry-specific/technology-based indicators; here reference is made to Table 1.

For total quantity of limestone

- Domestic production and imports/exports: see *Discussion of statistical balance items*

For use of limestone

- Cement industry: plausible technology-based calculation of limestone input required for clinker manufacture; this is more accurate than using the very heterogeneous raw material mixes for clinker firing, but disregards the non emission-relevant admixtures of limestone for cement
- Lime industry: almost identical to statistical data
- Soda manufacture: plausible technology-based calculation of necessary limestone input, though in this category it is not emission relevant
- Glass: plausible technology-based calculation of necessary limestone input; this is higher than the statistical figure
- Sinter/pig iron: plausible technology-based calculation of necessary limestone input; this can be differentiated for the two manufacturing processes and in total exceeds the statistical figures
- Sugar: plausible technology-based calculation of necessary limestone input, though in this category it is not emission relevant
- Flue-gas desulphurisation in power generation: plausible technology-based calculation of necessary limestone input; this is higher in total than the statistical figure
- Agriculture: Federal Statistical Office figures used by farmers; the limestone input is calculated from nutrient input, which involves similar uncertainties to the association statistics (BVK 2009)
- Water and sludge treatment: statistical data used, as differences are marginal
- Other sectors (e.g. construction, other building material industries and chemicals etc.): calculated residual amount, but not emission relevant. Regarding the absolute size of this item, the same applies as to exclusive use of statistics (see *Discussion of statistical balance items*), even though the absolute quantity is greater here.

Special evaluation of various allocations (IPCC 1996 and IPCC 2006)

The preceding two chapters served to describe the feasibility of preparing limestone balances on the basis of statistical data and using technology-specific indicators derived largely from the research project (BUTTERMANN & NANNING, 2006).

It was shown in Table 2 that the two basically balance approaches which are basically possible result in substantial differences in the calculation of carbon dioxide emissions. This is remarkable, because it is merely a matter of shifts in the size of the balance items[5].

This becomes particularly clear if the rules of the 1996 Guidelines are strictly followed in CRF Category 2.A.3[6] and all explicitly required limestone used are shown and their emissions calculated and totalled.

Table 3: Comparison in accordance with 1996 Guidelines of all emission-relevant balance items (reporting category 2.A.3) for 2008 from model calculations of specific indicators ("from indicators") and from statistical data ("statistical"); calculations by UBA

Figures in million tonnes in 2008				
Balance items (limestone use with CO_2 emissions)	**CO_2**	**2.A.3[6]**	**from indicators**	**statistical**
1A1 Flue-gas desulphurisation in large combustion systems	**x**	**x**	2.303	1.745
2A7 Glass manufacture (total)	**x**	**x**	0.902	0.356
2A7 Ceramics manufacture (external "supplementary balance")	**x**	**x**	0.751	0.000
2C1 Iron and steel manufacture	**x**	**x**	5.331	3.437
CO_2 emissions from limestone (including dolomite, for simplicity)	**x**	**x**	**4.1 (CO_2)**	**2.4 (CO_2)**

The statistical data for limestone input into the applications addressed in Category 2.A.3 result in lower carbon dioxide emissions than the balance items determined using indicators.

If one looks separately at all emission-relevant limestone applications on the lines of the 2006 Guidelines, the emission calculations still show discrepancies between the two balance models.

[5] It is indeed merely a matter of shifts in limestone percentages between the balance items, because the overall framework is determined by the statistical total quantity.

[6] IPCC 1996

Table 4: Comparison of all emission-relevant balance items (in accordance with 2006 Guidelines, reporting categories based on 1996 Guidelines) for 2008 from model calculations of specific indicators ("from indicators") and from statistical data ("statistical"); calculations by UBA

Figures in million tonnes in 2008			
Balance items (limestone use with CO_2 emissions)	**CO_2**	**from indicators**	**statistical**
1A1 Flue-gas desulphurisation in large combustion systems	**x**	2.303	1.745
2A1 Cement manufacture: cement clinker firing	**x**	29.601	42.605
2A2 Lime production: calcination of limestone	**x**	12.319	12.624
2A2 Lime production: calcination of dolomite	**x**	IE	IE
2A7 Glass manufacture (total)	**x**	0.902	0.356
2A7 Ceramics manufacture (external "supplementary balance")	**x**	0.751	0.000
2C1 Iron and steel manufacture	**x**	5.331	3.437
5D Soil liming in agriculture and forestry	**x**	3.410	1.915
CO_2 emissions from limestone (including dolomite, for simplicity)	**x**	**24.0 (CO_2)**	**27.6 (CO_2)**

In the case of the overall picture based on the 2006 Guidelines, the higher emissions are based on statistical data. The generally higher emissions result from the aggregation of all emission-relevant balance items. A separate entry for limestone use other than the category-specific calculations is no longer required here, which means that it is difficult to compare the two calculations[7]. This does not affect the actual emission calculations of the emission-relevant components of limestone use, but merely their allocation.

Conclusion:

Balances are possible on the basis of statistical data or on the basis of indicators. The indicator-based approach in combination with the irreplaceable statistical balance items would seem to be more appropriate from a technical point of view.

The balance calculations should however only be used to provide an overview of limestone use, i.e. they should only be used to verify the activity data[8]. The emission calculations should always be made in the source groups in which limestone is used. This also makes it possible to take account of all emissionrelevant carbonates in the source groups, which results in much more accurate calculations[9].

[7] There is still a separate item "2A4 Other Process Uses of Carbonates", but this would not be used from the point of view of the German emission inventories.

[8] In the stricter sense, activity data in emissions inventories are only those data that are used for the emission calculations. Thus in the present proposal it is only a question of limestone input balance items.

[9] Although the inclusion of all carbonates used is not described until the 2006 Guidelines, it represents long-standing practice in the German inventories, for example in the glass industry.

Appendix 1: Limestone and burnt-lime balances for 2006-2008 UBA data analysis)

The following tables originate from calculations by the UBA which present the balances as time series (without evaluations). Specifically for the year 2008 they are evaluated in the main body of this paper.

Table 1-1: Limestone balance 2006 to 2008 on the basis of statistical data, compiled by the BGR, sources in Appendix 2, figures in million tonnes, references to inventory categories according to 1996 Guidelines by UBA[10]

	2006	**2007**	**2008**	Category - link
Domestic production	84.785	87.139	91 .659	2.A.3
Imports	5.882	6.156	5.214	2.A.3
Exports	1.380	1.447	1.367	2.A.3
Total quantity	**89.287**	**91.848**	**95.506**	2.A.3
Conversion/ final use				
Cement industry	38.606	40.207	42.605	2.A.1
Lime industry	12.123	12.445	12.624	2.A.2
Soda manufacture	IE	IE	IE	2.A.4, but without EM
Glass	0.344	0.351	0.356	2.A.7
Sinter	3.323	3.578	3.437	2.C.1
Pig iron	IE	IE	IE	2.C.1
Sugar	0.302	0.328	0.314	2.D.2
Flue-gas desulphurisation in power plants	1.896	1.839	1.745	1.A.1
Agriculture	1.771	1.771	1.915	5.G
Water and sludge treatment	0.082	0.188	0.226	NE, but without EM
Other sectors (e.g. construction, other building material industries and chemicals etc.)	30.840	31.141	32.284	NE, but without EM
Use	**89.287**	**91 .848**	**95.506**	2.A.3
Supplementary balance (limestone in raw material)				
Ceramics manufacture	NE	NE	NE	2.A.7

[10] Legends mean: EM = emissions, NE = not estimated, i.e. no data available, IE = included elsewhere

Table 1-2: Limestone balance 2006 to 2008 on basis of production-specific/technology-based indicators, calculations by UBA, figures in million tonnes, references to inventory categories according to 1996 Guidelines by UBA[11]

Figures in million t	**2006**	**2007**	**2008**	Category
Domestic production	84.785	87.139	91 .659	2.A.3
Imports	5.882	6.156	5.214	2.A.3
Exports	1.380	1.447	1.367	2.A.3
Total quantity	**89.287**	**91 .848**	**95.506**	2.A.3
Conversion/ final use				
Cement industry	29.081	31 .498	29.601	2.A.1
Lime industry	11.996	12.318	12.319	2.A.2
Soda manufacture	1.727	1.695	1.745	2.A.4, but without EM
Glass	0.874	0.904	0.902	2.A.7
Sinter	4.410	4.608	4.541	2.C.1
Pig iron	0.823	0.841	0.790	2.C.1
Sugar	0.697	0.702	0.655	2.D.2
Flue-gas desulphurisation in power plants	2.446	2.310	2.303	1.A.1
Agriculture	2.994	3.403	3.410	5.G
Water and sludge treatment	0.082	0.188	0.226	NE, but without EM
Other sectors (e.g. construction, other building material industries and chemicals etc.)	34.155	33.381	39.014	NE, but without EM
Use	**89.287**	**91 .848**	**95.506**	2.A.3
Supplementary balance (limestone in raw material)				
Ceramics manufacture				
Bricks/tiles	0.880	0.878	0.751	2.A.7
of which: roof tiles	IE	IE	IE	
of which: bricks	IE	IE	IE	

[11] Legends mean: EM = emissions, NE = not estimated, i.e. no data available, IE = included elsewhere

Table 1-3: Burnt-lime balance 2006 to 2008 on basis of production-specific/technology-based indicators and statistical data from BGR, calculations by UBA, figures in million tonnes, legends to missing data by UBA[12]

	2006	**2007**	**2008**
Domestic production	6.784	6.967	6.968
Imports	0.721	0.760	0.751
Exports	0.694	0.819	0.944
Total quantity	**6.811**	**6.908**	**6.775**
Limestone	IE	IE	IE
Aerated concrete	IE	IE	IE
Calcium carbide	IE	IE	IE
Oxygen steel	IE	IE	IE
Electro-steel	IE	IE	IE
Iron and steel	2.444	2.511	2.426
Other industrial uses (alumina production for primary aluminium, paper industry)	IE	IE	IE
Flue-gas desulphurisation in power plants	1.069	1.074	1.078
Agriculture	0.097	0.124	0.103
Water and sludge treatment	0.329	0.292	0.246
Other sectors (such as construction, other buildings material industries, industrial flue-gas desulphurisation, chemicals etc.)	2.872	2.907	2.923
Final consumption	**6.811**	**6.908**	**6.776**

[12] Legends mean: IE = included elsewhere

Table 1-4: Comparison of all emission-relevant balance items (mostly as reporting categories) for 2008 on the basis of model calculations with specific indicators ("from indicators") and on the basis of statistical data ("statistical") with categorisation "CO_2" and "2.A.3 (GL 1996)", compiled by UBA

Figures in million tonnes in 2008							
Balance items (limestone use with CO_2 emissions)		**CO_2**	**2.A.3**[13]	**from indicators**		**statistical**	
1A1 Flue-gas desulphurisation in large combustion systems	Limestone uses	x	x	2.303	Flue-gas desulphurisation model	1.745	less than real requirements
2A1 Cement manufacture: cement clinker firing		x		29.601	recalculated from clinker (UBA 2010)	42.605	admixture cannot be shown separately
2A1 Cement manufacture: admixture of limestone				IE	included in Other Sectors	IE	included in clinker
2A2 Lime production: calcination of limestone		x		12.319	recalculated from burnt lime (UBA 2010)	12.624	recalculated from burnt lime (BVK)
2A2 Lime production: calcination of dolomite		x		IE	included in burnt lime	IE	included in burnt lime
2A4 Soda manufacture				IE	included in Other Sectors	IE	included in Other Sectors
2A7 Glass manufacture		x	x	0.902	recalculated from glass (UBA 2010)	0.356	less than real needs of glass industry
2A7 Ceramics manufacture (external "supplementary balance")		x	x	0.751	calculated via emission factor (UBA 2010)	0.000	cannot be shown statistically
2C1 Iron and steel manufacture, total		x	x	5.331	Total	3.437	Iron and steel total
Sinter		x		4.541	Iron and steel model	IE	under Total
Pig iron		x		0.790	Iron and steel model	IE	under Total
2D2 Sugar manufacture				0.655	recalculated from sugar (UBA 2010)	0.314	less than real needs of sugar industry
5D Soil liming in agriculture and forestry		x		3.410	Trade statistics, recalculated from CaO	1.915	recalculations not plausible
6B Water and sludge treatment				0.226	marginal, therefore statistics retained	0.226	tend to be incomplete
Other sectors (e.g. construction industry, other building materials industry and chemicals etc.)				39.014	calculated remainder	32.284	calculated remainder
Production in Germany	**Total limestone quantity**			91.659		91.659	
Imports				5.214		5.214	
Exports				1.367		1.367	

[13] IPCC 1996

Appendix 2 Production figures for raw materials containing carbonate (limestone, marlstone and dolomite) in Germany in the years 2006 – 2008 (BGR data analysis)

Data on domestic production of raw materials containing carbonate (limestone, marlstone and dolomite) are fundamentally based on the official quarterly production statistics of the Federal Statistical Office and on statistics provided by the Federal Association of the German Lime Industry and the German Cement Industry.

The Federal Statistical Office covers:

- Limestone for the manufacture of cement, burnt lime and limestone for industry and environmental engineering (reporting number 1412 10 530)
- Limestone, ground (reporting number 1412 10 550)
- Dolomite, neither burnt nor sintered (reporting number 1412 20 530)
- Broken limestone for concrete construction or as stone material for road and railway construction (reporting number 1421 20 301).

For the years 2006 to 2008 the relevant data can be seen in Table 2-1. However, these figures are likely to differ considerably from actual domestic production, since the official production statistics only cover establishments with more than 10 (reporting numbers 1421) or more than 20 employees (reporting numbers 1412). No data are available for establishments with fewer employees. Moreover, Germany imports more than 5 million tonnes of raw materials containing carbonate and exports more than 1 million tonnes (see Table 2-2).

Table 2-1: Domestic production 2006-2008 of raw materials containing carbonate (source: Federal Statistical Office 2009), figures in thousand tonnes.

	2006	**2007**	**2008**
Limestone and marlstone for manufacture of cement, burnt lime and for industrial and environmental purposes, total	59,298	60,906	60,200
Limestone and marlstone, broken	50,783	52,765	51,445
Limestone and marlstone, ground	8,515	8,141	8,755
Broken limestone and dolomite for concrete, road and railway construction	12,372	12,347	14,726
Aggregates, chippings and ground marble	727	541	619
Dolomite, neither burnt nor sintered	no data	0.88	no data

Table 2-2: Imports and exports in 2006-2008 of raw materials containing carbonate (source: Federal Statistical Office 2009), figures in thousand tonnes

	2006	2007	2008
Imports			
Limestone for cement manufacture	2,926	2,396	2,095
Limestone and dolomite, comminuted	7	34	22
Dolomite, neither burnt nor sintered	477	538	461
Aggregates, chippings and ground marble	2,052	2,309	2,377
Chalk	421	879	260
Total	5,882	6,156	5,214
Exports			
Limestone for cement manufacture	217	280	220
Limestone and dolomite, comminuted	197	217	218
Dolomite, neither burnt nor sintered	675	669	645
Aggregates, chippings and ground marble	92	79	79
Chalk	199	202	205
Total	1,380	1,447	1,367

It is clear from Table 2-1 that the data situation for production and use of raw materials containing carbonate differentiated by fields of use in Germany is very limited. The Federal Association of the German Lime Industry (BVK) provides a more differentiated picture than the Federal Statistical Office, but the figures only relate to companies that are members of the association (see Table 2-3). The actual limestone quantities are considerably larger. Neither do the figures take account of the limestone and dolomite produced by the BVK members for the manufacture of burnt lime.

Table 2-3: Sales of unburned limestone and dolomite products of the German lime industry in the whole of Germany 2006-2008 (source: Federal Association of the German Lime Industry – BVK), figures in thousand tonnes

	2006	**2007**	**2008**
Unburned products			
- Construction industry, total	13,300	13,318	11,955
Lime-sand industry	6	6	4
Aerated concrete industry	no data	13	10
Cement industry	910	906	770
Aggregates for concrete	582	552	409
Mortar works	930	945	907
Miscellaneous construction industry	294	206	163
- Agriculture, total	1,771	1,771	1,915
for fertiliser	1,419	1,442	1,534
for feed	318	305	352
- Environmental protection, total	1,979	2,026	2,969
Water treatment	22	35	26
Wastewater treatment	59	152	199
Sludge treatment	1	1	1
Air quality control	1,896	1,839	1,745
- Industry, total	4,634	5,024	4,865
Iron and steel industry	3,323	3,578	3,437
Chemical industry	92	69	138
Oil and coal mining	no data	no data	no data
Sugar industry	302	328	314
Glass industry	344	351	356
Other	573	699	620
- Exports	702	625	630
Total	**22,409**	**22,763**	**21,334**

According to the BVK, its member companies produced about 7 million tonnes each of limestone and dolomite in the years 2006-2008 which were sold to the various industries (Table 2-4). This does not include the input of lime for cement production by the member companies.

Table 2-4: Sales of burned limestone and dolomite products by the German lime industry in the whole of Germany 2006-2008 (source: Federal Association of the German Lime Industry – BVK), figures in thousand tonnes

	2006	**2007**	**2008**
Burned products			
- Iron and steel	2,444	2,511	2,426
- Construction industry	1,303	1,284	1,274
- Environmental protection	1,398	1,366	1,324
- Chemicals	729	729	776
- Agriculture	97	124	103
- Other industrial uses	119	134	122
- Exports	694	819	944
Total[1)]	**6,785**	**6,967**	**6,968**

1) Excluding limestone input for cement production by member companies

According to BGR calculations, the sales of burnt products quoted by BVK (some 7 million t/a) correspond to a primary limestone and dolomite input of approximately 12.5 million t/a (see Table 2-5).

Table 2-5: Primary limestone and dolomite input for production of burnt products sold by BVK, figures in thousand tonnes (own calculations).

	2006	**2007**	**2008**
Production of burnt lime	12,123	12,445	12,624

The BVK assumes that the non-association quantities of limestone account for about 70% of German limestone production and that this is used almost entirely in the road construction sector. It may be assumed that uses in this field are not emission relevant.

The BVK figures do not include those quantities of limestone and marlstone which are produced by the cement industry for the manufacture of cement clinker, since generally speaking the companies in the cement industry are not members of the BVK, but of the Federal Association of the German Cement Industry. For the year 2008, the Association of German Cement Factories *(Verein Deutscher Zementwerke – VDZ)* quotes an input of 42.07 million tonnes of limestone, marlstone and chalk (see Table 2-6). This input is mainly as a raw material component in the clinker firing process; a small quantity of limestone is also used as a constituent of cement. Since this latter quantity is only added to the cement in ground form, it is not CO_2 relevant.

Table 2-6: Raw materials input in cement industry 2006-2008, figures in thousand tonnes (source: VDZ)

	2006	2007	2008
Limestone, marlstone, chalk	38,606	40,207	42,605

Table 2-7 sets out the relevant data on the production and consumption of carbonate raw materials in Germany. The figures for limestone quantities used in road construction are based on surveys by the Federal Statistical Office. They are mentioned for the sake of completeness, but must be regarded as far too low. In any case these figures do not play any role in the assessment of CO_2 relevance, since limestone and dolomite used in the road construction sector takes the form of ballast and chippings.

Table 2-7: Production and sales of carbonate raw materials in Germany 2006-2008, figures in thousand tonnes (sources: BGR database, BVK (2007, 2009), VDZ (2007, 2008, 2009), own calculations, LECHTENBÖHMER & NANNING 2006)

	2006	2007	2008
Raw material sales			
Cement industry (VDZ)	38,606	40,207	42,605
Iron and steel industry (BVK)	3,323	3,578	3,437
Lime industry (burnt-lime production) (BVK, BGR)	12,123	12,445	12,624
Glass industry (BVK)	344	351	356
Construction industry (BVK)[1)]	13,300	13,318	11,955
Agriculture (BVK)	1,771	1,771	1,915
Environmental protection (BVK)	1,979	2,026	2,969
Sugar industry (BVK)	302	328	314
Chemical industry (BVK)	92	69	138
Other industries (BVK)	573	699	620
Road construction (Federal Statistical Office)[1)]	> 12,372	> 12,347	> 14,726
Raw material production	> 84,785	> 87,139	> 91,659
Imports	5,882	6,156	5,214
Exports	1,380	1,447	1,367
Consumption[2)]	**> 89,287**	**> 91,848**	**> 95,506**

1) There may be some overlap between these two figures, though the potential duplication can be assumed to be less than the under-represented components (non-members or below reporting threshold, see *Basis of BGR data*).

2) In the UBA limestone use balances this item is referred to as total quantity, the use described there is obtained by summation of balance items. In numerical terms, total quantity and use (balance consistency) and the consumption stated here are identical.

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