

# **LIME INDUSTRY**

## **SYNOPSIS SHEET**

PREPARED IN THE FRAMEWORK OF EGTEI

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## 1 Activity description and EGTEI contribution – summary

Lime (CaO) is the high temperature product of the calcinations of limestone. Only a small portion of natural lime stone is pure enough for industrial lime manufacturing. To be classed as limestone, the rock must contain at least 50 % of calcium carbonate.

The major uses of lime is metallurgical (aluminium, steel, copper, silver and gold industries), environmental (flue gas desulphurisation, water softening, pH control, etc.) and construction (soil stabilisation, asphalt additive, and masonry lime)

The basic processes in the production of lime are:

- ü Winning of limestone,
- ü Limestone storage and preparation
- ü Fuels storage and preparation,
- ü Calcinations of limestone
- ü Quicklime processing
- ü Quicklime hydration and slaking
- ü Storage, handling and transport. [1]

With an annual production of around 20 million tonnes of lime, the EU countries produce about 15% of sales-relevant world lime production. In most EU countries the lime industry are characterised by small and medium-sized companies. Germany, Italy and France are the largest producers of lime in the EU, together accounting about two thirds of the total volume. [1]

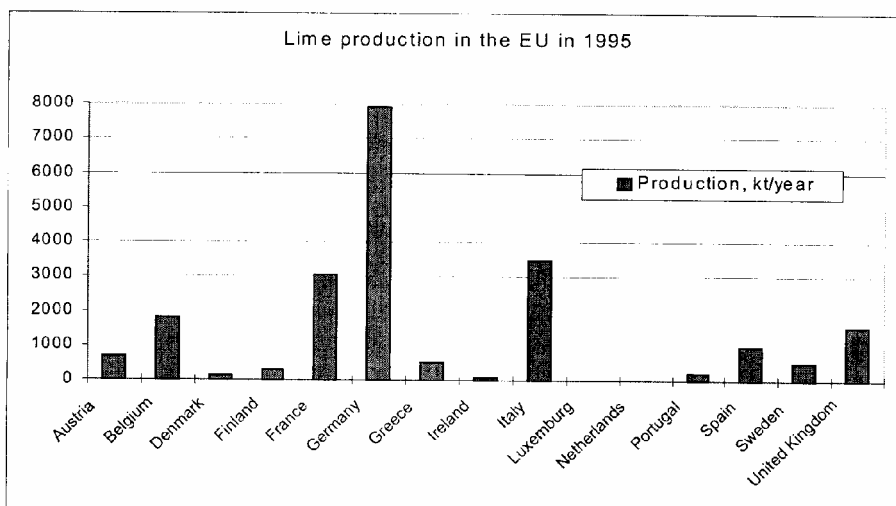


Figure 0.1: Lime production in the EU 1995 [1]

This sector was not considered as an individual sector in the previous NO<sub>x</sub> and SO<sub>2</sub> version of RAINS [2, 3], and **EGTEI has been able to develop an approach for representing this sector and to estimate costs of reduction techniques.** The content of the background document **has neither be assessed nor validated by the European Lime Association or any of its national members.** It has been elaborated in close cooperation with expert of ADEME.

Mise en forme : Puces et numéros

The representative unit used is the ton of lime produced. One reference installation (RI) has been defined.

EGTEI defines different abatement measures. However, as for dust, it seems not be relevant to distinguish between bag filters and ESP. **Only one “deduster”** was defined. For NO<sub>x</sub> abatement measures, **no measure** was defined. The SO<sub>2</sub> emissions are mainly depending on the concentration of sulphur in the raw material and in the fuel burned. The selection of fuels with low sulphur content can therefore limit the SO<sub>2</sub> emissions. **No SO<sub>2</sub> abatement measure** was defined, because of the desulphurisation process made by the kiln itself.

EGTEI provides default emission factors (EF) with abatement efficiencies, investments and variable and fixed operating costs (OC) as well as unit costs (€/t pollutant abated and €/activity unit) for the different abatement measures.

National experts only need to collect **two country specific parameters** (wages, electricity price) and some **country and sector specific parameters** (activity level, fuel consumption and characteristics, and the different pollutant emissions). EGTEI provides default costs for country and specific parameters which can be used if no better data exist. Knowing the sector specific parameters then allows to properly describe the sector and to calculate the application rate of each abatement technique.

Recently, the specific lime sector "PR\_LIME" has been introduced in the new RAINS modules. In the future however, new technological developments should be considered by EGTEI to continuously update the background document and hence the representation of the lime sector.

## 2 Representation of the sector in RAINS<sup>1</sup>

In the RAINS model of the year 2003, which has been used for elaborating the background document, the RAINS sector "PR\_LIME" represented the production of lime in the PM module [4]. In the SO<sub>2</sub> and the NO<sub>x</sub> modules [2, 3], the lime production was aggregated with the cement production in the RAINS sector "PR\_CELI".

## 3 Status of EGTEI

EGTEI has developed an approach for representing the lime sector and estimating costs of reduction techniques. The content of the background document **has neither be assessed nor validated by the European Lime Association or any of its national members**. It has been elaborated in close cooperation with expert of ADEME.

## 4 Methodology developed within EGTEI to represent the sector

### 4.1 Definition of reference installations

*[General remark: The representation of the very heterogeneous lime sector is based on a significantly simplified approach (compromise) - for modelling purposes only. Data proposed for pollutant concentrations or emission factors or any other value are not supposed to be presented as regulatory or limit values.]*

With regard to the economic assessment and the availability of data, only **one** reference technology for the whole lime sector has been considered.

**Table 4.1:** Reference Installation

Reference Code	Technique	Capacity [t/d]	Plant factor [h/a]
01	Average capacity installation	170	7,680

### 4.2 Definition of emission abatement techniques and proposed techno-economic data

#### 4.2.1 Dust abatement techniques

For this specific pollutant, it seems not be relevant to distinguish between bag filters and electrostatic precipitators.

**Table 4.2.1.1:** Abatement Measures for dust

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<sup>1</sup>The latest modified versions of the RAINS modules have not been considered. Here we refer to the RAINS model of the year 2003

Secondary Measure Code	Description	Lifetime (a)	Emission factor TSP (mg/Nm <sup>3</sup> )	Emission factor TSP (g/t of lime)
00	None	-	3,750	15,000
01	Deduster	10	50	200

**Table 4.2.1.2:** Investments and Operating costs for dust abatement

Description	Investment (k€)	Fixed Operating costs (%/a)	Variable Operating costs (€/t)	Total Operating costs (€/t)	Cost per tonne TSP abated (€/t) <sup>(1)</sup>	Cost per tonne of lime produced (€/t) <sup>(1)</sup>
None	-	-	-	-	-	-
Deduster	650	4	0.855	1.435	218	3.22

<sup>(1)</sup>: Case of France

## 4.2.2 NO<sub>x</sub> abatement techniques

NO<sub>x</sub> emissions depend mainly on the quality of lime produced and the design of kiln. Low-NO<sub>x</sub> burners have been fitted to few rotary kilns. Other NO<sub>x</sub> reduction technologies have not been applied in the lime industry.

**Table 4.2.2.1:** NO<sub>x</sub> abatement measures

Description	Efficiency (%)	Emission factor (mg/Nm <sup>3</sup> )	Emission factor (kg/t of lime)
None	-	500	2,00

## 4.2.3 SO<sub>2</sub> abatement techniques

SO<sub>2</sub> emissions, principally from rotary kilns, depend on the sulphur content of the fuel, the design of the kiln and the required sulphur content of the lime produced. The selection of fuels with low sulphur content can therefore limit the SO<sub>2</sub> emissions if necessary, and can reduce the production of lime with higher sulphur contents.

**Table 4.2.3.1:** SO<sub>2</sub> abatement measures

Measure Code	Description	Efficiency (%)	Emission factor (mg/Nm <sup>3</sup> )	Emission factor (g/t of lime)
00	None	-	X <sup>(1)</sup>	X <sup>(1)</sup>

<sup>(1)</sup>: the national expert can introduce the unabated emission factor of its country

## 5 Country specific data to be collected

Different types of country specific data have to be collected to give a clear picture of the situation in each Party. EGTEI proposes default values for the economic parameters which can be modified by the national expert if better data are available.

For the lime activity, country specific economic parameters are used to calculate variable operating costs. They are presented in table 5.1 as default costs proposed by EGTEI (these costs are entered only once in the ECODAT database tool).

**Table 5.1:** Country specific costs

Parameters	Default costs provided by EGTEI	Country specific costs
Electricity [€/kWh]	0.0569	To be provided by national experts
Wages [€/h]	37,234	To be provided by national experts

Default data have been used to calculate variable and annual abatement costs presented in table 4.2.1.2.

Information concerning activity levels from 2000 to 2020 as well as the description of the control strategy is also necessary (these data can be directly entered in the database ECODAT). A full specification of the work to be done by national experts is provided in the general EGTEI methodology.

**Table 5.2:** Activity levels for Reference Installations (t lime produced / year)

RIC	2000	2005	2010	2015	2020
01					

National experts can also modify - in a range of  $\pm 10\%$  - the default unabated emission factor proposed by EGTEI to represent the reference situation of the lime industry for all Parties.

**Table 5.3:** Unabated emission factor [g/ t lime]

Pollutants	Default data mean	User input mean
EF NO <sub>x</sub>	2,000	To be provided by national expert
EF PM <sub>TSP</sub>	15,000	To be provided by national expert
EF PM <sub>10</sub>	X <sup>(1)</sup>	To be provided by national expert
EF PM <sub>2.5</sub>	X <sup>(1)</sup>	To be provided by national expert
EF SO <sub>2</sub>	X <sup>(1)</sup>	To be provided by national expert

<sup>(1)</sup>: the national expert can introduce the unabated emission factor of its country

## 6 Application rate and applicability of deduster

The national experts are kindly asked to provide for the deduster its application rate and its applicability in 2000, 2005, 2010, 2015, 2020. If a national expert has this information at hand, he can fill in the table 6.1.

Knowing different input parameter, such the dust emissions and the activity level for the years 1990 until 2000, the application rate and the applicability of the deduster can be determined for the years 1990 until 2000.

**Table 6.1:** Input parameter needed to calculate application rates

PARAMETER	2000	2005	2010	2015	2020
E <sub>dust</sub> : Emission of Dust [t]					
Activity level for RI (t lime produced)					

For the years 2005 until 2020, the regulatory constraints can be taken into account or if available the provisions of dust emissions in the sector.

**Table 6.2:** Application rate and applicability for dust abatement measures

Description	Application rate in 2000 [%]	Application rate in 2005 [%]	Applicability [%]	Application rate in 2010 [%]	Applicability [%]	Application rate in 2015 [%]	Applicability [%]	Application rate 2020 [%]	Applicability [%]
None									
Deduster			100		100		100		100

## 7 Relevance of EGTEI information for Integrated Assessment Modelling (IAM)

In the previous version of the NO<sub>x</sub> and SO<sub>2</sub> RAINS model [2, 3], the lime sector was not represented as a separate sector. It was aggregated with the cement production in the sector "IN\_PR\_CELI". Thus, emission factors, abatement techniques and costs considered were not specific to this sector and it

was very difficult to define a reduction scenario. For this reason, the sector was identified as a priority sector at the beginning of the work.

EGTEI now provides an approach to specifically consider the lime sector. The category "PR\_LIME" has now been introduced in the new RAINS modules. The validation of the document by the European association is needed.

## 8 Perspective for the future

At first, the background document needs to be assessed or validated by the European Lime Association or any of its national members.

For a good description of the sector, more information is necessary about the size of the particulate matter in order to calculate the emission of PM10 and PM2.5.

In future, new production technologies which could gain relevant market shares should be considered by EGTEI in the background document to continuously develop the representation of the sector.

## 9 Bibliography

- [1] Reference document on Best Available Techniques in the Cement and Lime Manufacturing Industries, December 2001.
- [2] Nitrogen oxides emissions, abatement technologies and related cost for Europe in the RAINS model database, IIASA, 1998. <http://www.iiasa.ac.at/~rains/reports/noxpap.pdf>
- [3] Sulfur emissions, abatement technologies and related cost for Europe in the RAINS model database, IIASA, 1998. <http://www.iiasa.ac.at/~rains/reports/so2-1.pdf>
- [4] Modelling Particulate Emissions in Europe, A framework to Estimate Reduction Potential and Control Costs, IIASA, 2002. <http://www.iiasa.ac.at/rains/reports/ir-02-076.pdf>
- [5] Background document on the sector of the lime industry prepared in the framework of EGTEI

**ANNEXE: Example of data collection and use of EGTEI data – Case of France**

**A. Country specific data collection and CLE scenario developed**

Contacts with the French Lime Association need to be taken in order to collect the different information. But, at the moment, the background document has not been validated by the European Lime Association.