Use of alternative fuels - current situation and future prospects for the cement industry

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Congreso Nacional de la Fundación CEMA

„Recuperar residuos como garantía de futuro“

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Alternative Fuels – Challenge and Opportunity

- Facts & figures
- Pre-requisites for high substitution rates
- Sophisticated pre-treatment & the idea of co-processing
- Alternative fuels and CO_2
- Two case studies A & A (Africa & Algae)

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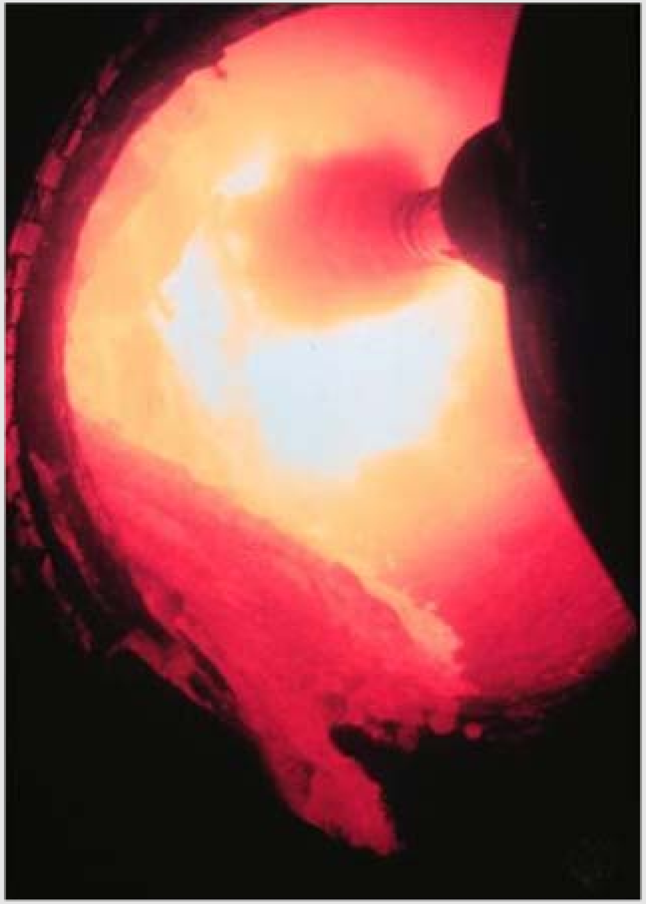
Clinker burning: high temperatures and long residence times



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Process Characteristics of cement kilns

- Uniform burnout conditions
- High temperatures (up to 2000 °C)
- Destruction of organic pollutants
- No de-novo synthesis of dioxines and furanes
- Gas retention times in the secondary firing more than 2 s at temperatures of 1100 °C

The clinker burning process as such offers an excellent option for the save and sound recovery of alternative materials!

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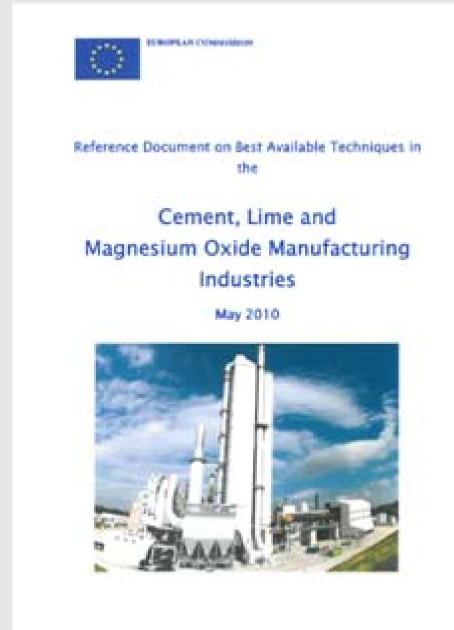
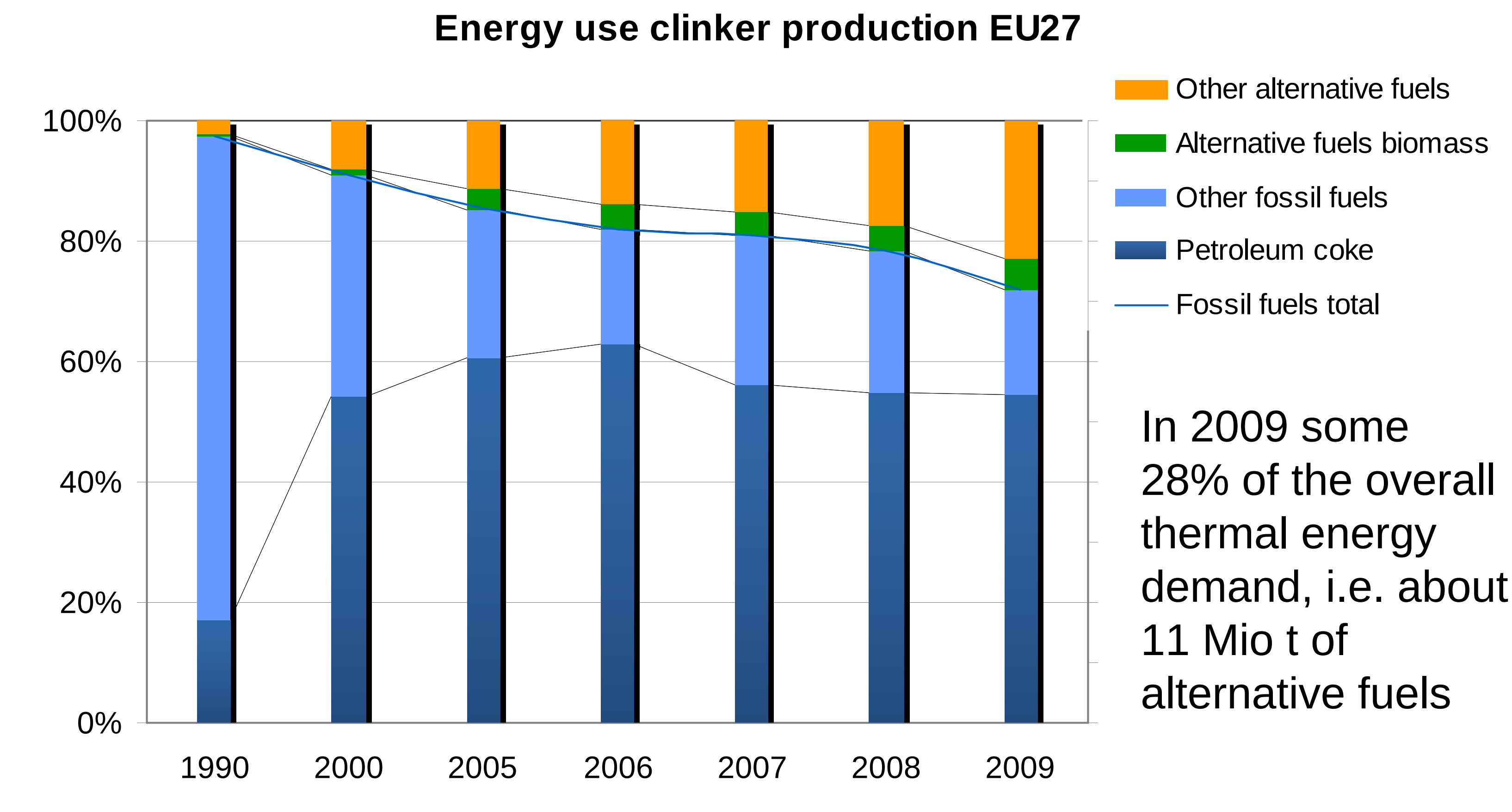
The revised BAT Reference document for the cement industry (May 2010)

- The European legislation requires the use of **BAT (Best Available Techniques)**:
  - for the industry to design and operate their plants
  - for the authorities to set appropriate permit conditions (e.g. determination of ELVs)
- Determination of BAT is the result of an exchange of information between EU Member States and industries concerned ("Seville Process")



Use of suitable waste materials is BAT!
This has been confirmed in Seville in May 2012

Use of alternative fuels in Europe



In 2009 some 28% of the overall thermal energy demand, i.e. about 11 Mio t of alternative fuels

Source: CEMBUREAU contribution to the second interim report "Study on the suitability of the different waste-derived fuels for end-of-waste status in accordance with article 6 of the Waste Framework Directive"

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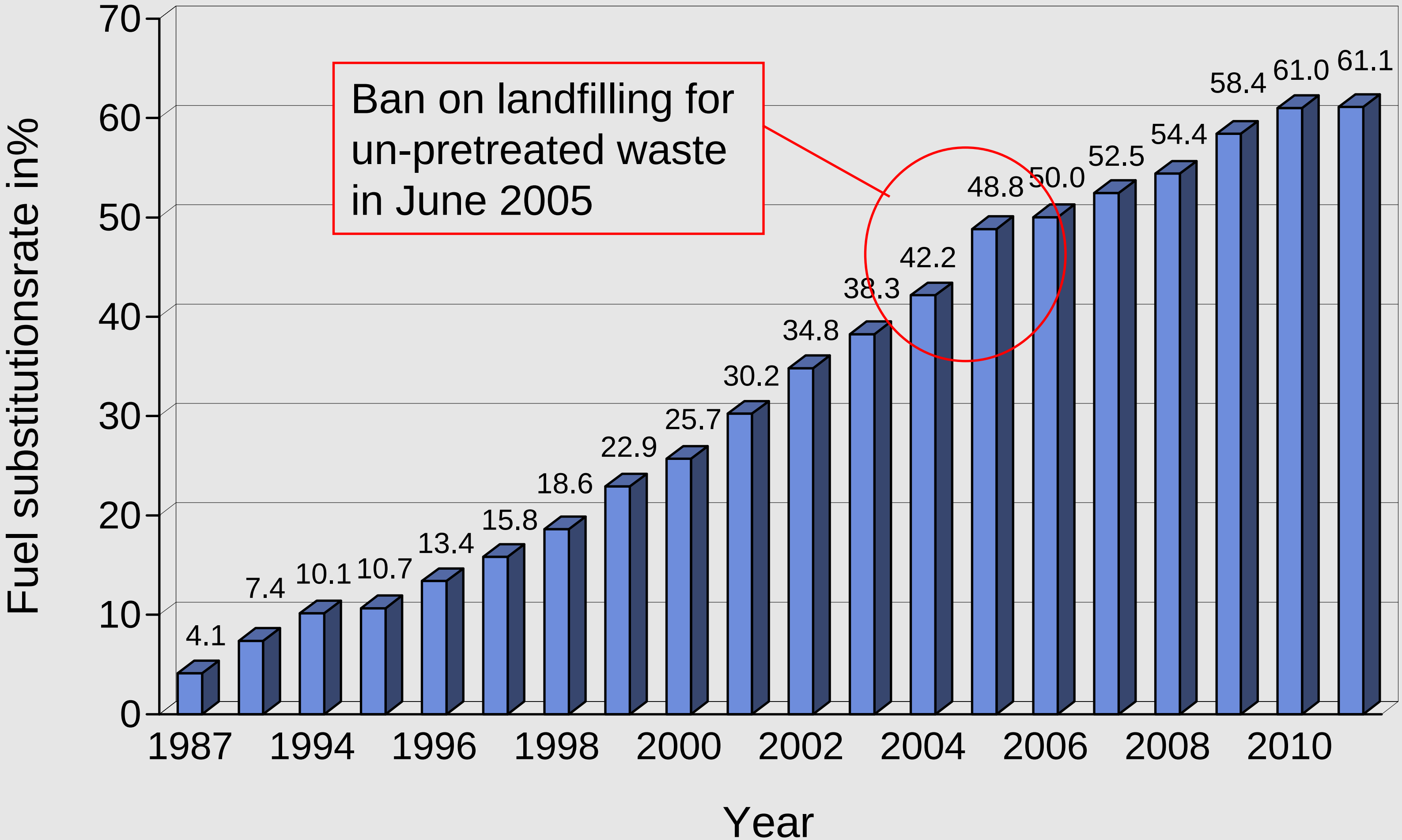
Keyfigures to the German cement industry (2011)

■ Clinker production:	about 25 Mio t	
■ Cement production:	about 34 Mio t	
■ Thermal energy demand:	94.4 Mio GJ/a	
Hard coal:	10.0 Mio GJ/a	36.7 Mio GJ/a
Lignite:	23.7 Mio GJ/a	
Petcoke:	2.1 Mio GJ/a	
Others:	0.9 Mio GJ/a	
Alternative fuels:	57.7 Mio GJ/a	

Substitution of about 2.3 Mio t hard coal equivalents !

Average fuel substitution rate in the German cement industry



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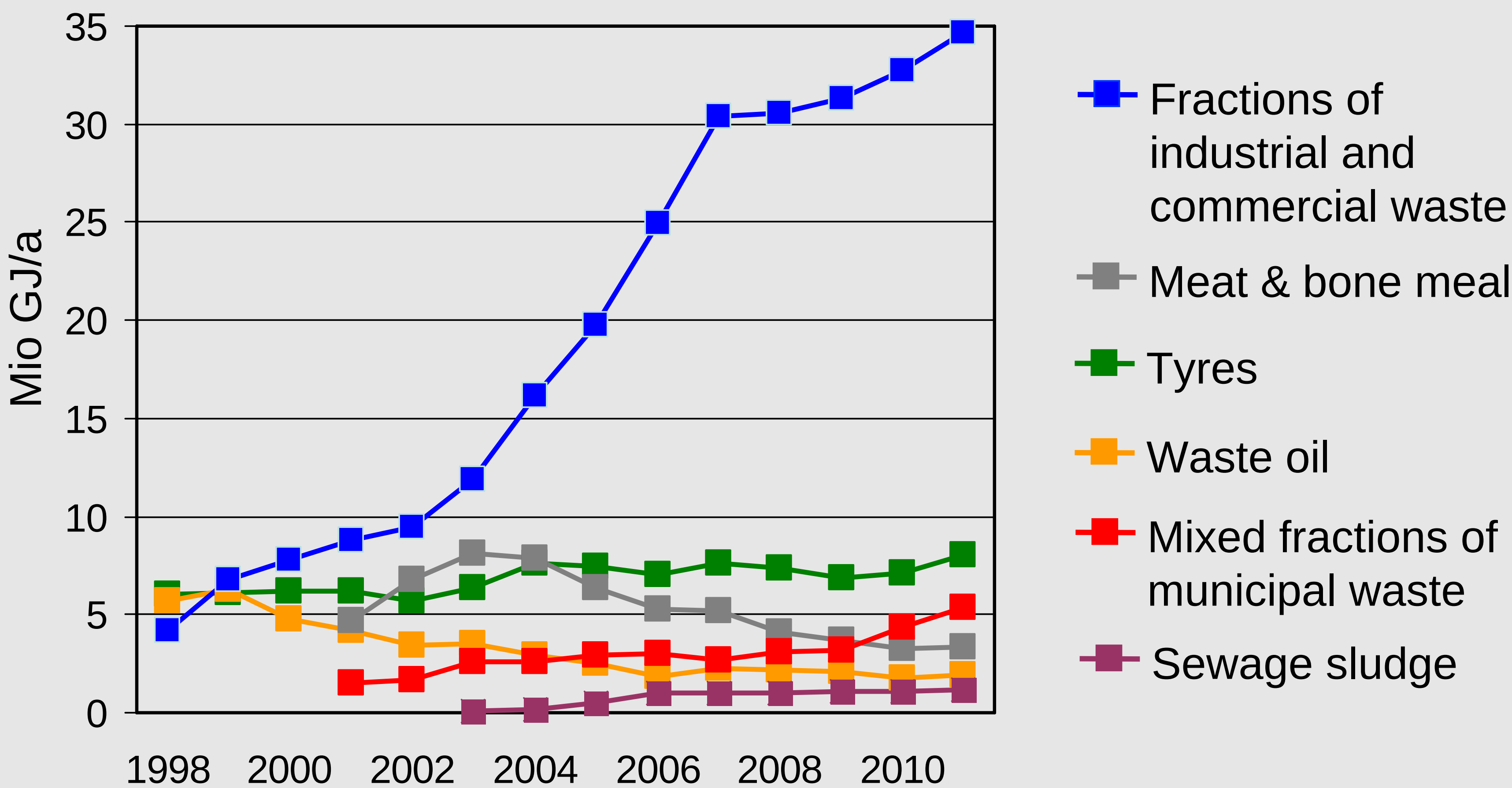
Substitution rate of selected alternative fuels (Germany)



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Reasons for high substitution rates & specific constraints

- Lots of domestic industrial activities leads to a (still) sufficient supply of suitable waste materials
- Reliable collecting and pre-treatment systems
- Waste management as such is an issue of public concern
- Ban on landfilling for un-pretreated waste materials

- The German cement manufacturers have to invest a lot in order to meet the strict legislative requirements (e.g. NO_x, dust for substitution rates above 60 %)
- Increasing competition between dedicated incinerators, „waste-to-energy“ plants, other co-incinerators and the cement industry
- The higher the substitution rate the better the fuel-quality has to be

Examples for intake materials to be treated

Unpretreated municipal waste is not suitable for the cement manufacturing process!

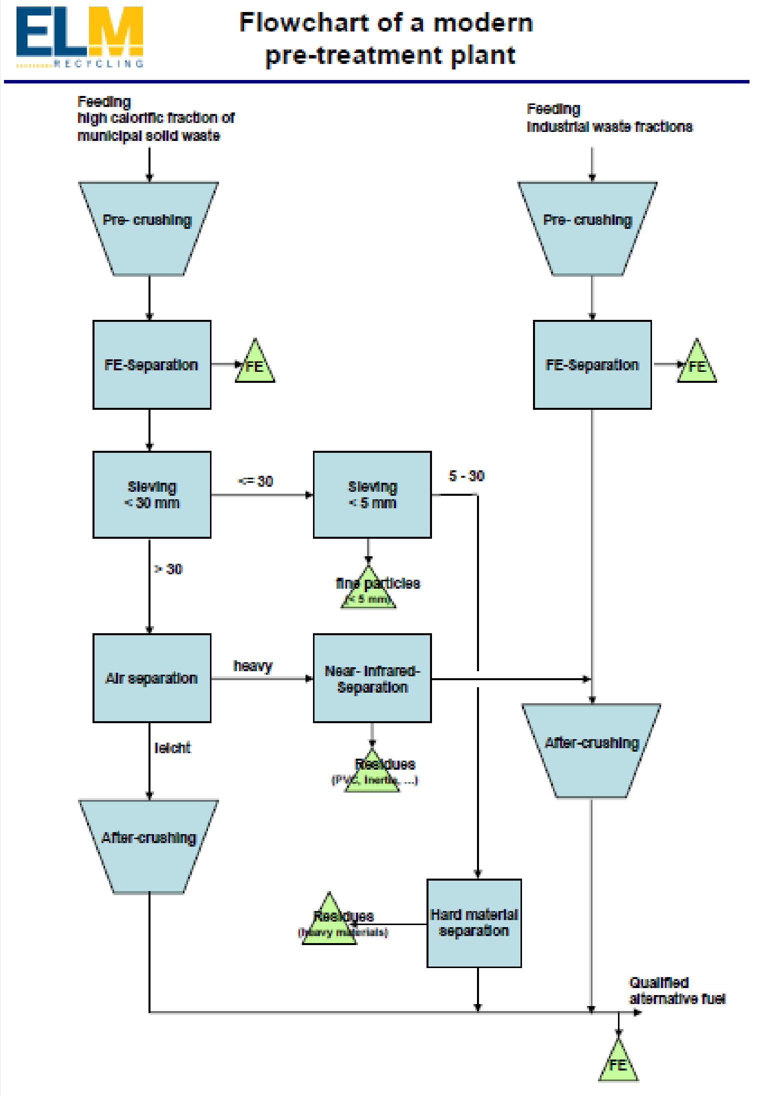
Characterization of alternative fuels

T lue

L
A
Alternative fuel type B
Alternative fuel type C

Additional properties:
- Particle size distribution
- Dispersibility
- Ignition and burnout behaviour
- Homogeneity and preparation
- ....

High substitution rates require sophisticated pre-treatment processes

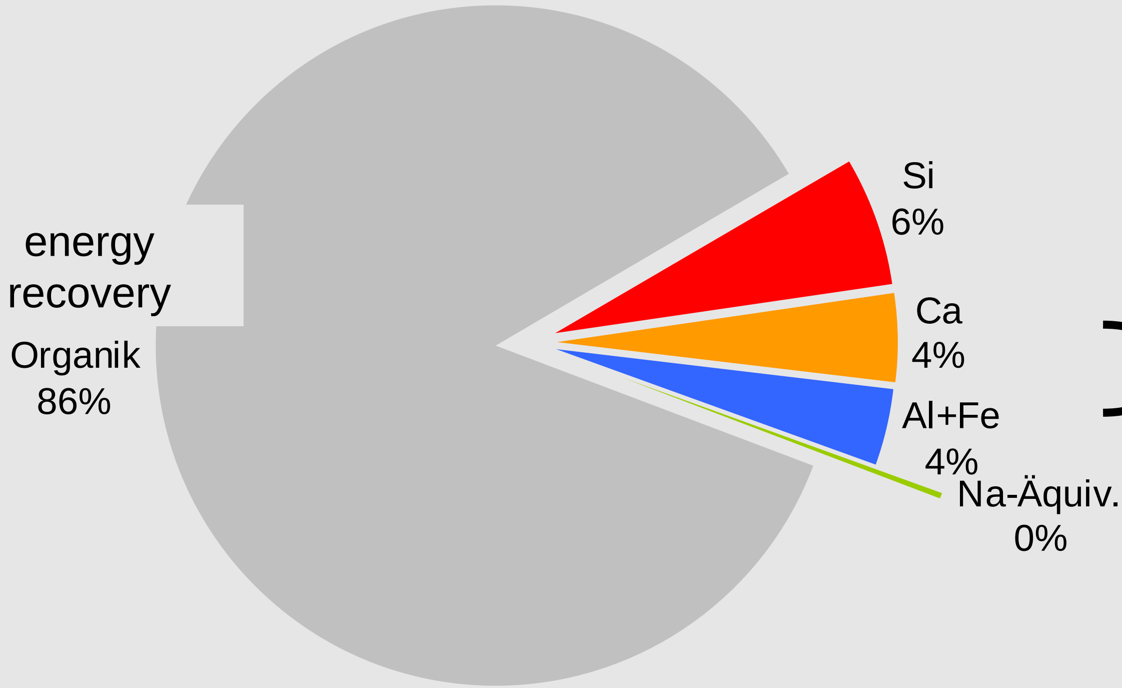


Example of a pre-treatment plant which is operated in Germany nearby a cement kiln

Source: ELM Recycling

The idea of co-processing: alternative materials always serve as fuels and raw materials

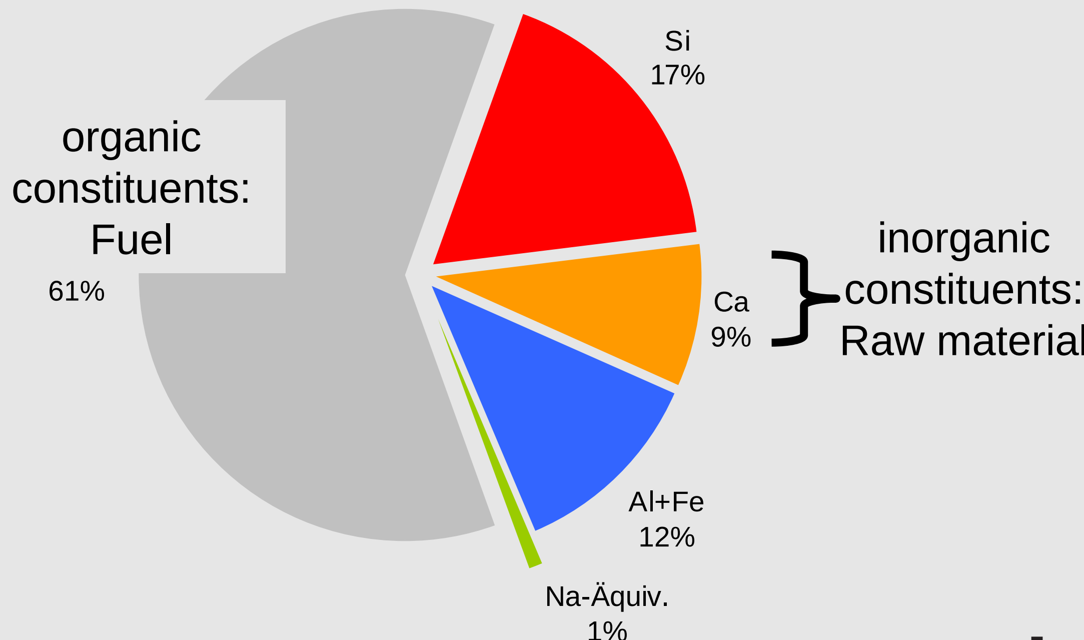
Example: Fluff (RDF)



material
recovery

Almost no additional waste such as slag etc.

Example: Dried sewage sludge



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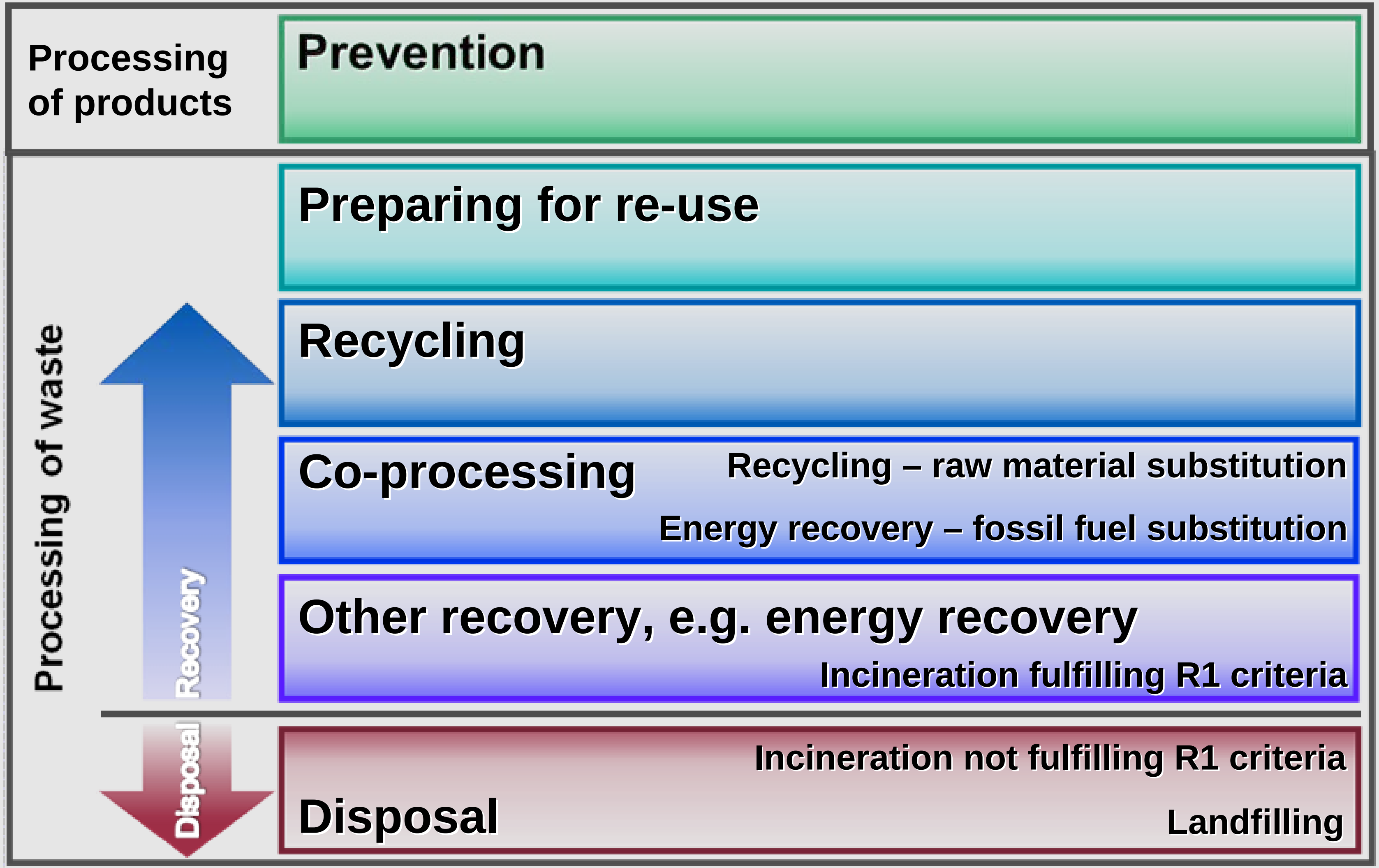
Co-processing in the waste hierarchy



Source: CEMBUREAU

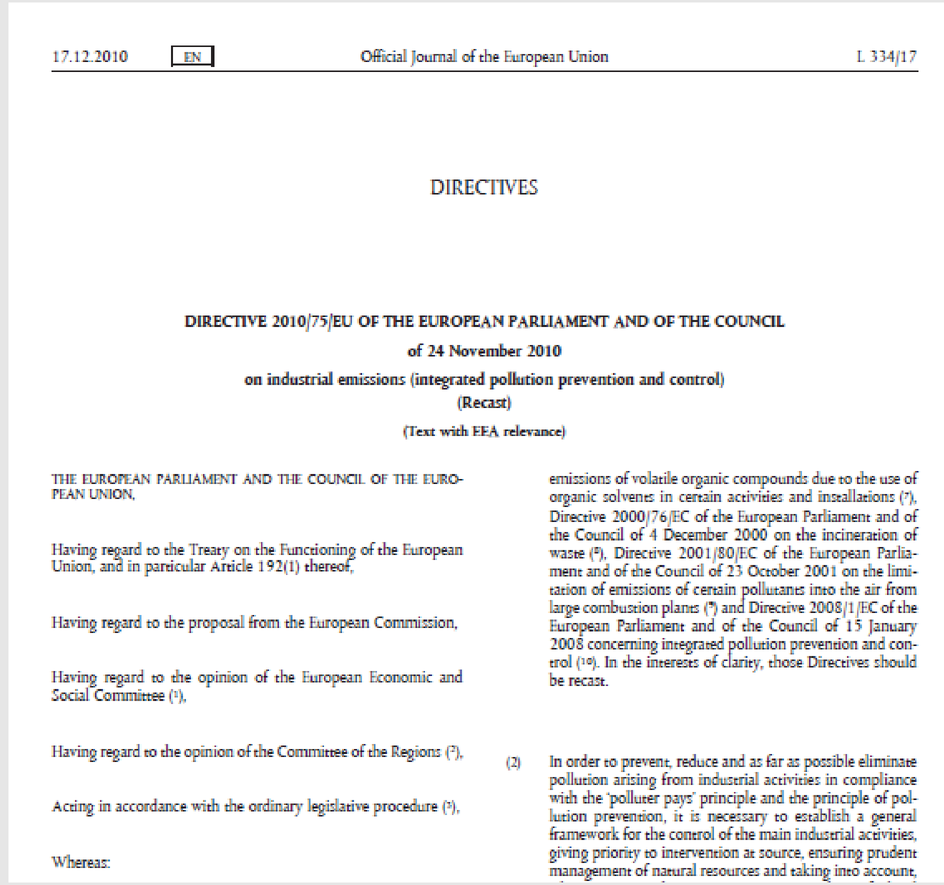
IED = Industrial Emissions Directive (2010/75/EU)

The IED has to be implemented by the EU-member States by January 2013

The role of **BAT (Best Available Techniques)** is strengthened

Annex VI of the IED contains strict emission limits for cement kilns co-incinerating waste

By applying strict rules the IED strengthens the role of co-processing


17.12.2010 EN Official Journal of the European Union L 334/17

DIRECTIVES

DIRECTIVE 2010/75/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 24 November 2010

on industrial emissions (integrated pollution prevention and control)

(Recast)

(Text with EEA relevance)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 192(1) thereof,

Having regard to the proposal from the European Commission,

Having regard to the opinion of the European Economic and Social Committee (1),

Having regard to the opinion of the Committee of the Regions (2),

Acting in accordance with the ordinary legislative procedure (3),

Whereas:

emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations (7), Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste (8), Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants (9) and Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control (10). In the interests of clarity, those Directives should be recast.

(2) In order to prevent, reduce and as far as possible eliminate pollution arising from industrial activities in compliance with the 'polluter pays' principle and the principle of pollution prevention, it is necessary to establish a general framework for the control of the main industrial activities, giving priority to intervention at source, ensuring prudent management of natural resources and taking into account,

Current and future emissions limits (ELV) for cement kilns co-incinerating waste fuels

For PCDD/F and all heavy metals the same ELVs apply as for dedicated incinerators!

	ELV [mg/Nm³]	
	IPPC / WID	New IED
Total dust	30	30
HCl	10	10
HF	1	1
NO_x	800 / 500 existing / new kilns	500 possible exemptions for long and lepol kilns (max. 800)
Cd + Tl	0.05	0.05
Hg	0.05	0.05
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V	0.5	0.5
Dioxins + Furans (ng/Nm³)	0.1	0.1
SO_2	50 raw material exemptions possible	50 raw material exemptions possible
Total organic carbon	10 raw material exemptions possible	10 raw material exemptions possible
CO	ELV can be set by the competent authority	ELV can be set by the competent authority

Emissions have to be monitored according to the Industrial Emissions Directive

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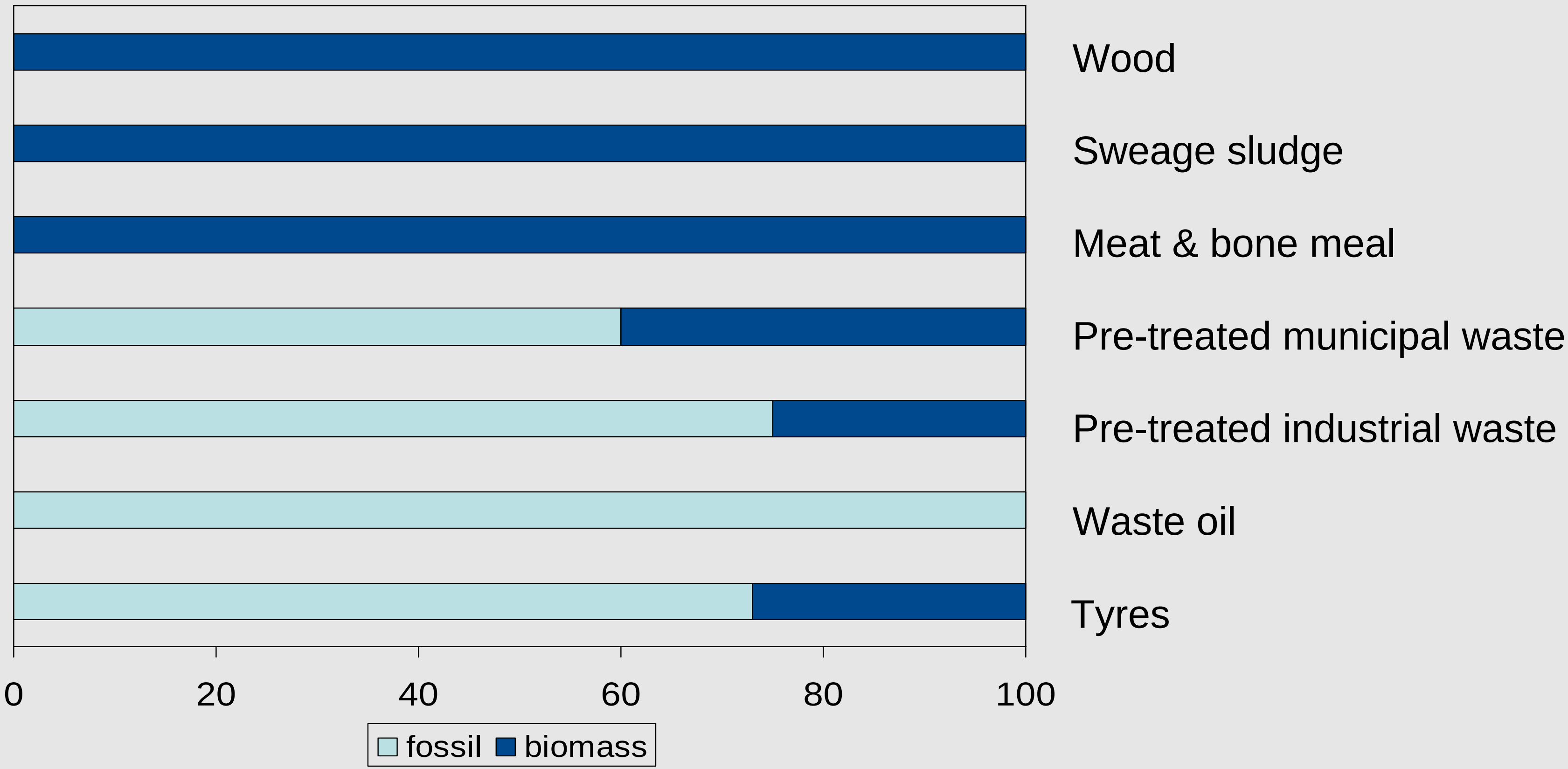
Landfills result in methane emissions

Potential of methane emissions
(kg CO_2eq/t) given for European landfills:

food wastes	1500
agricultural wastes	1700
textiles	800
paper	1600
plastics	0

Uncontrolled landfills emit about
700 kg CO_2eq per tonne of waste.

Average biomass content of alternative fuels



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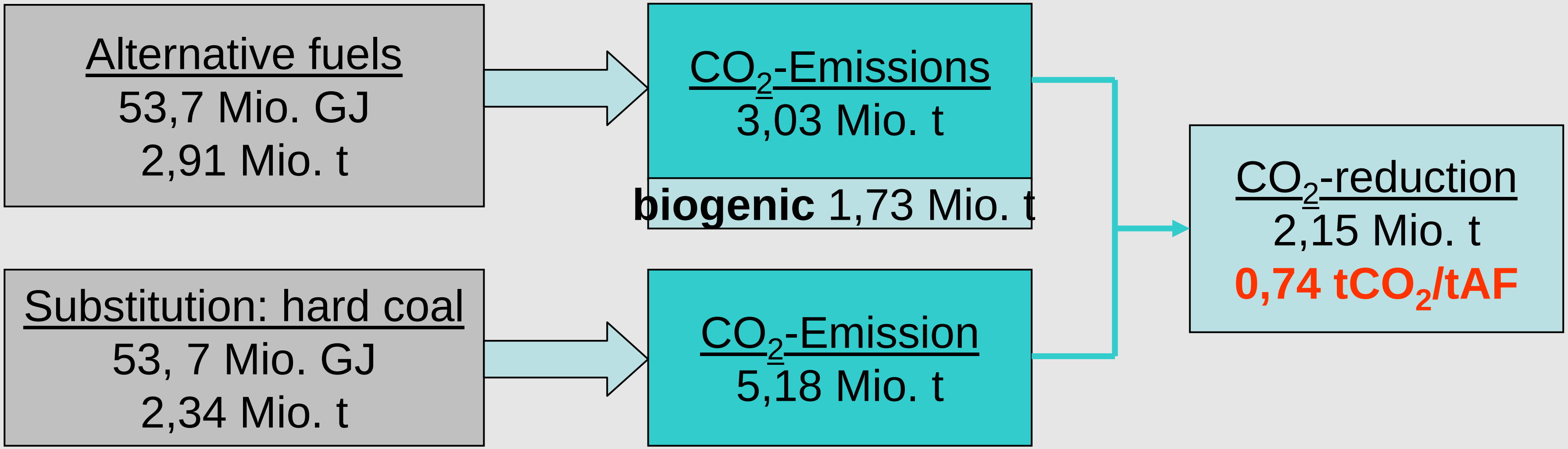
CO_2-reduction by alternative fuels (AF) in 2010



The co-processing of alternative fuels in Germany

- Saved more than 2,3 Mio tons of coal
- Reduced the fossil fuel related CO_2 emissions by 0,74 t CO_2 per ton of alternative fuel

Source: VDZ / German Cement Industry

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An uncommon case study: Namibia‘s Ohorongo plant & the Energy for Future project

Schwenk‘s Ohorongo plant:

700,000 t / year capacity

In operation since end of 2010

Specific challenge in Namibia:

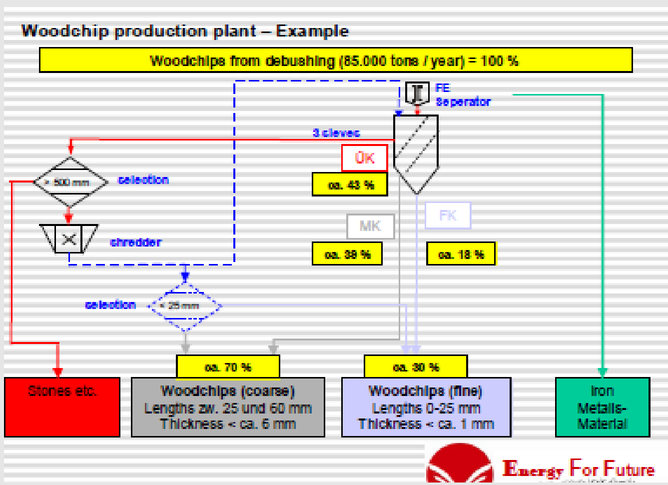
Bush encroachment, i.e. an invasion of undesired woody species resulting in an ecological imbalance

This situation led to the “Energy for Future” project

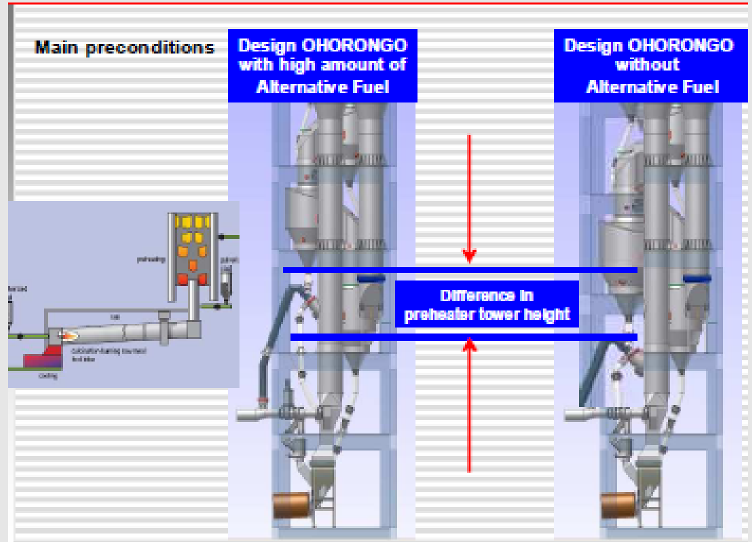
The local boundary conditions can be decisive

Some 26 Mio hectare are affected

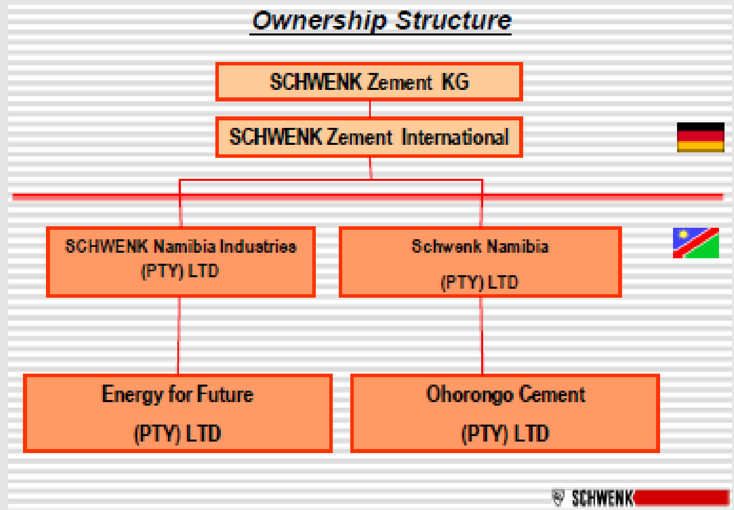
Energy for Future takes care for a ecological safe and sound harvesting of the alien wood species and the wood chip production



Safe fuel supply for the cement kiln



The whole project is finally targeted at gaining about 75 % of the overall fuel energy demand by the wood chips (bio-fuel!)



Local boundary conditions can offer very specific options

Case Study: The Algae-Project of RWE

RWE had implemented a pilot plant for feeding algae from the flue gases of a lignite fired power plant

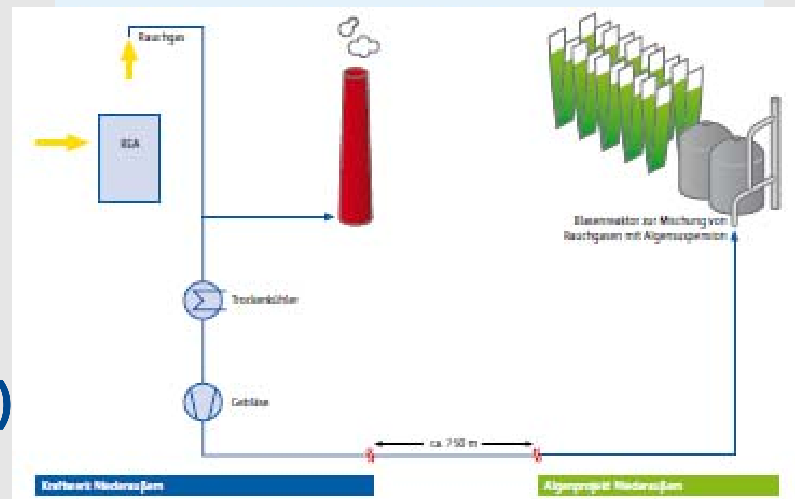
The project was targeted at gaining feedstock material for the production of biofuels and/or biogas

Size of the facility: 600 m^2

Average yield: **ca. 60 - 100 t_{DM} / (hectare*a)**

Average embedding of CO_2: **ca. 2 t CO_2 / t_{DM}**

Specific binding capacity: **ca. 120 - 200 t CO_2 / (hectare*a)**



Specific CO_2 emissions from the clinker burning process

Source: RWE

Specific CO_2 emissions: 0.8 t CO_2 / $t_{Clinker}$

A 3000 t / day cement kiln emits about 800,000 t CO_2 / year

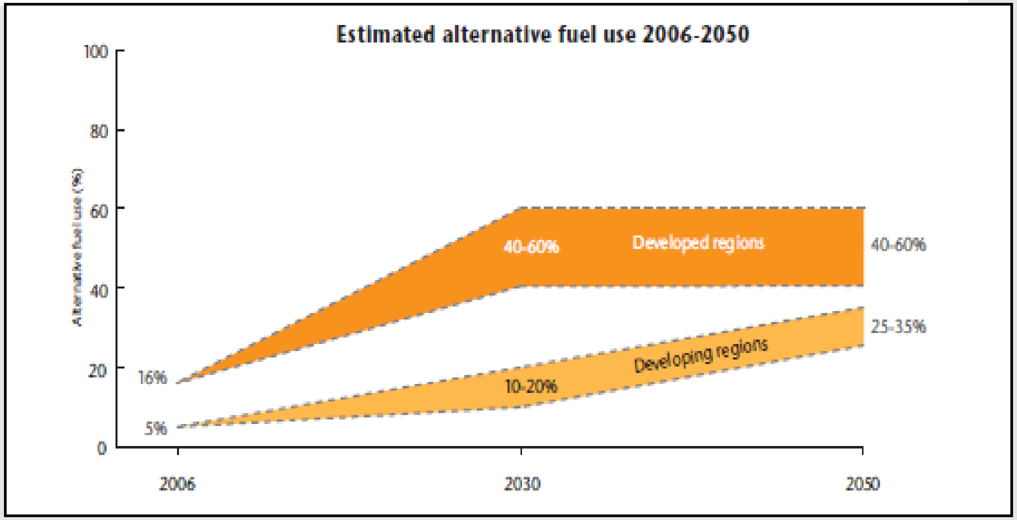
I.e. the land requirements for catching the CO_2 emissions of one single kiln would be about at least **4000 hectare (40 km²)!!!**

No option for the cement industry - even if the efficiency of the overall process could be increased dramatically

Future options and developments

The successful co-processing requires:

- Predictable availability and supply of suitable alternative materials
- Adequate pre-treatment processes and safe handling of the materials on-site
- Support from administration (e.g. ban on landfilling)
- Acceptance by the society
- Open and transparent behaviour from the cement company's management



Source: WBCSD IEA Cement Technology Roadmap

The „conventional“ co-processing offers sufficient options for the international / European cement industry until 2020 and beyond

Beyond 2030… CO_2 capture and production of CH_4 on-site ?....

Co-processing creates an ecological and economical win-win situation

- Cement works utilize selected wastes – the intake material must suit the process and the product
- The local options and opportunities have to be taken into consideration
- Co-processing directly preserves natural resources
- Reduction of fossil fuel related greenhouse gas emissions
- The cement industry is a solution provider for an environmentally safe and sound waste management