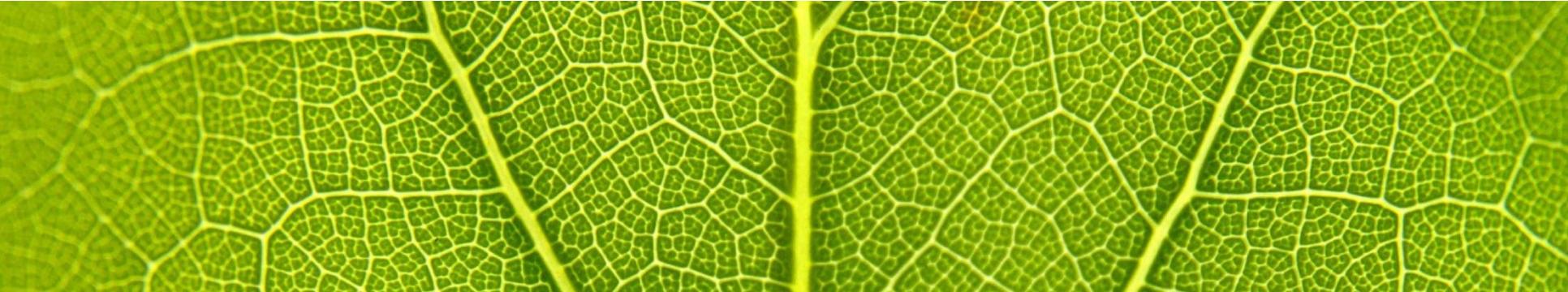




sustainable energy for everyone



A Competitive and Efficient Lime Industry

Cornerstone for a Sustainable Europe

Michiel Stork

December 3rd:

Raw Materials and Decarbonisation:

The way forward for European lime sector

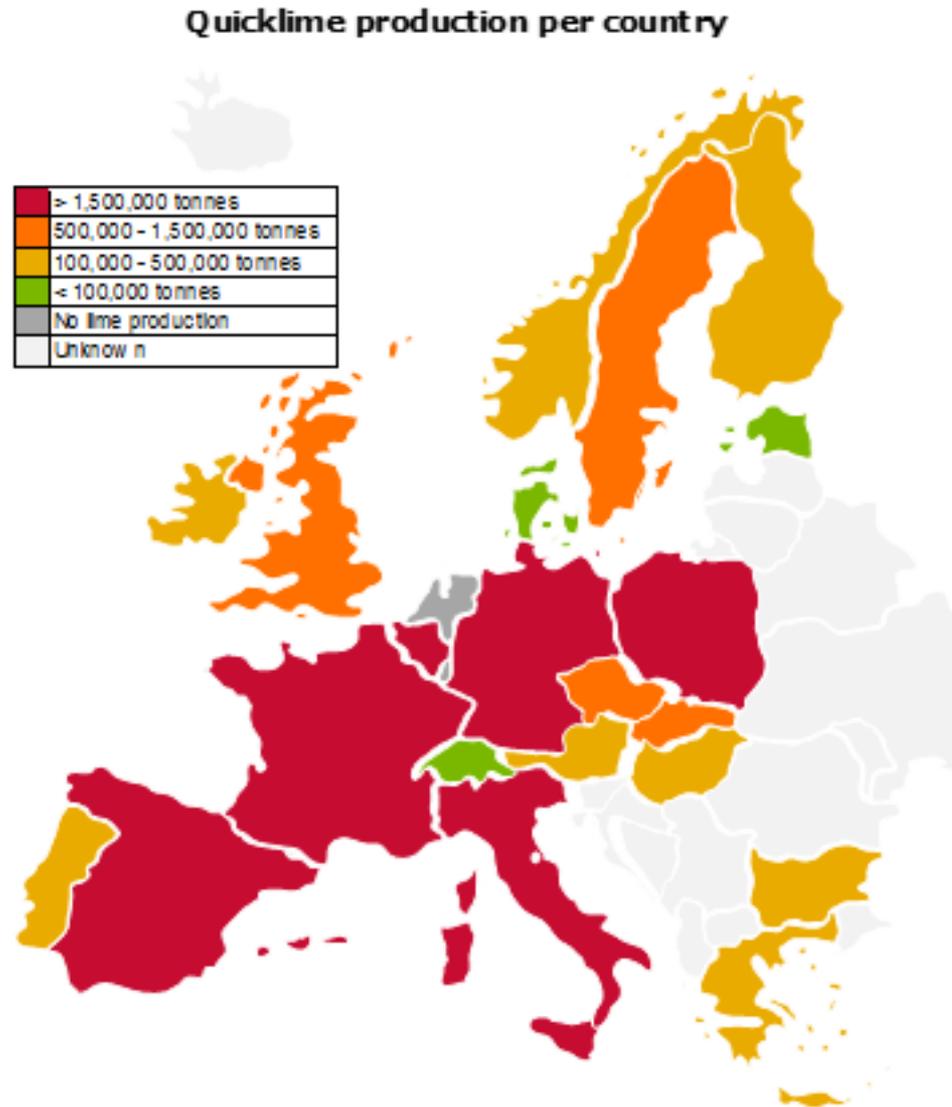
Key Take Aways

CO₂ abatement is possible, but comes at a price

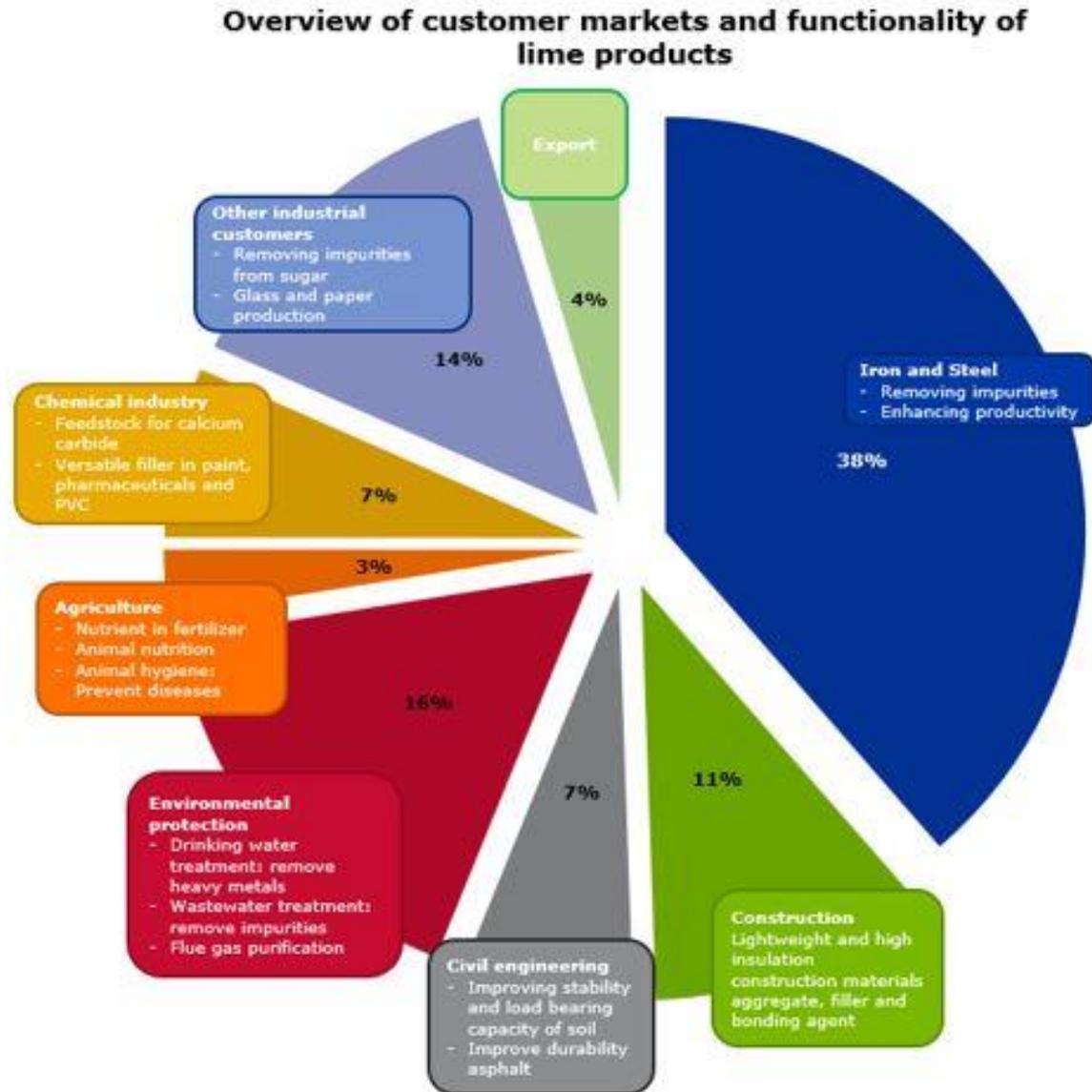
For deep reductions, CCS would be needed

Carbon costs seriously impact the production costs of lime

We are the EU lime industry!



Lime is a versatile product, many markets, many benefits



Mining and hauling

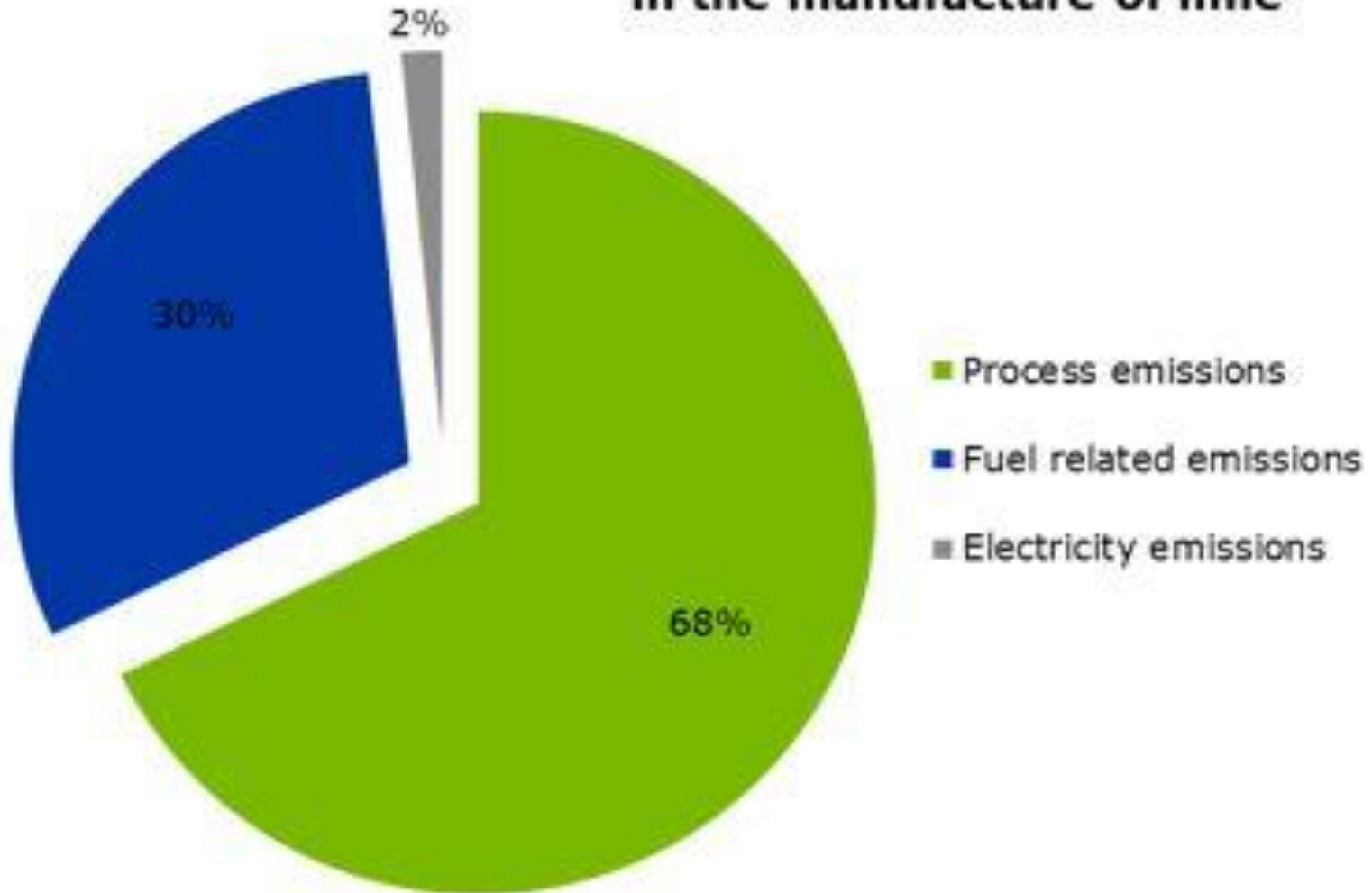
Crushing and sieving

Production

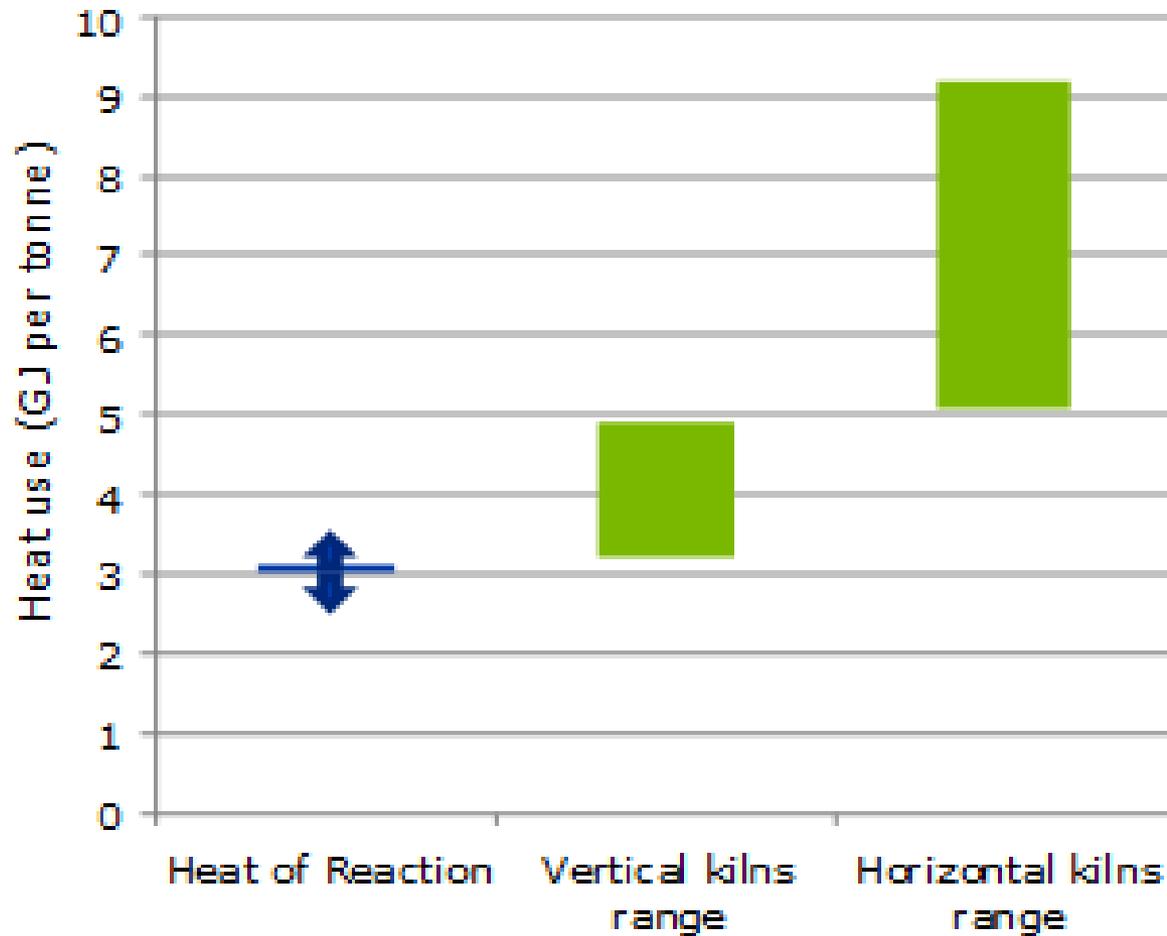


Emissions from lime production: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

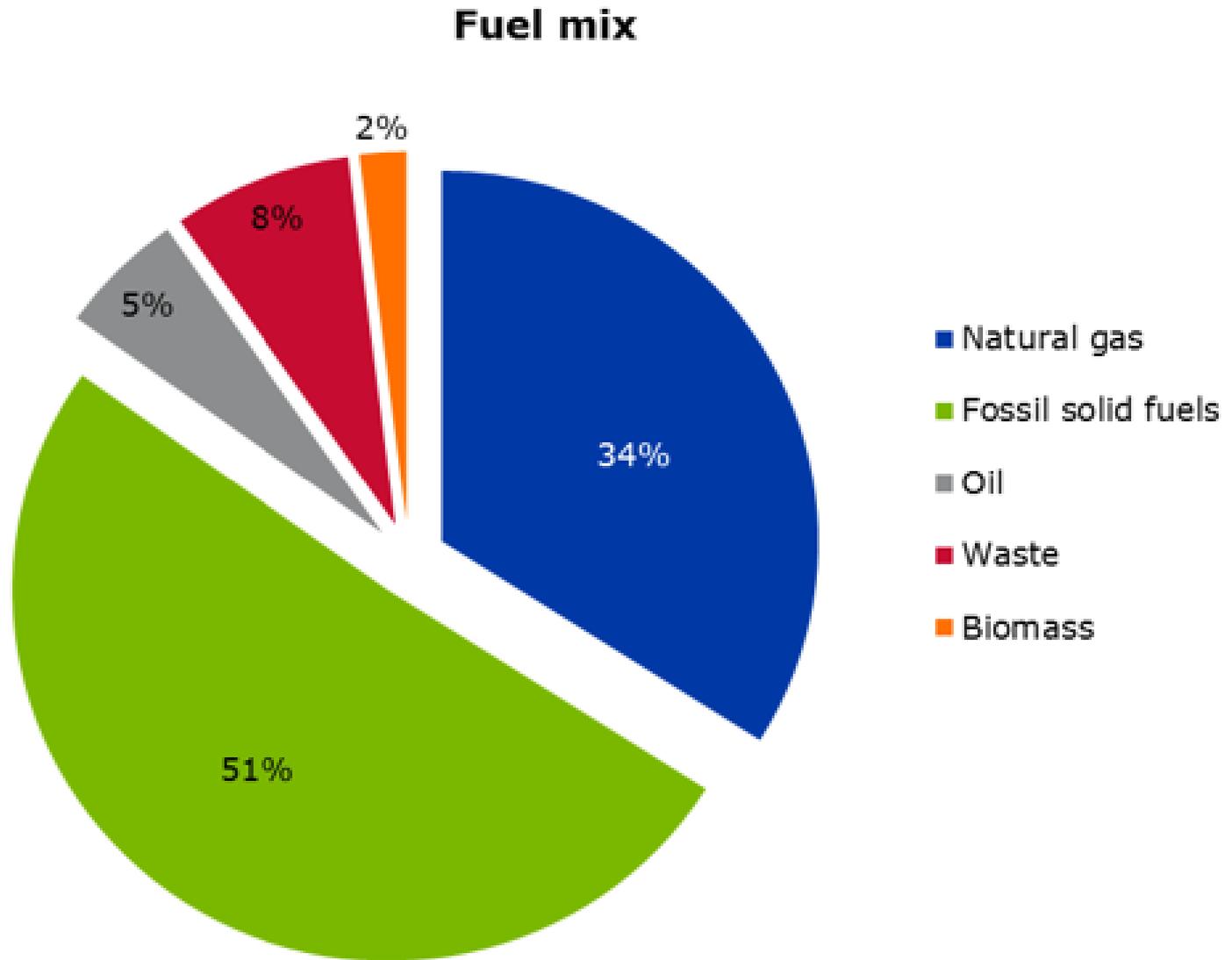
Average share of CO₂ emissions in the manufacture of lime



Overview of the minimum and maximum heat use of kilns

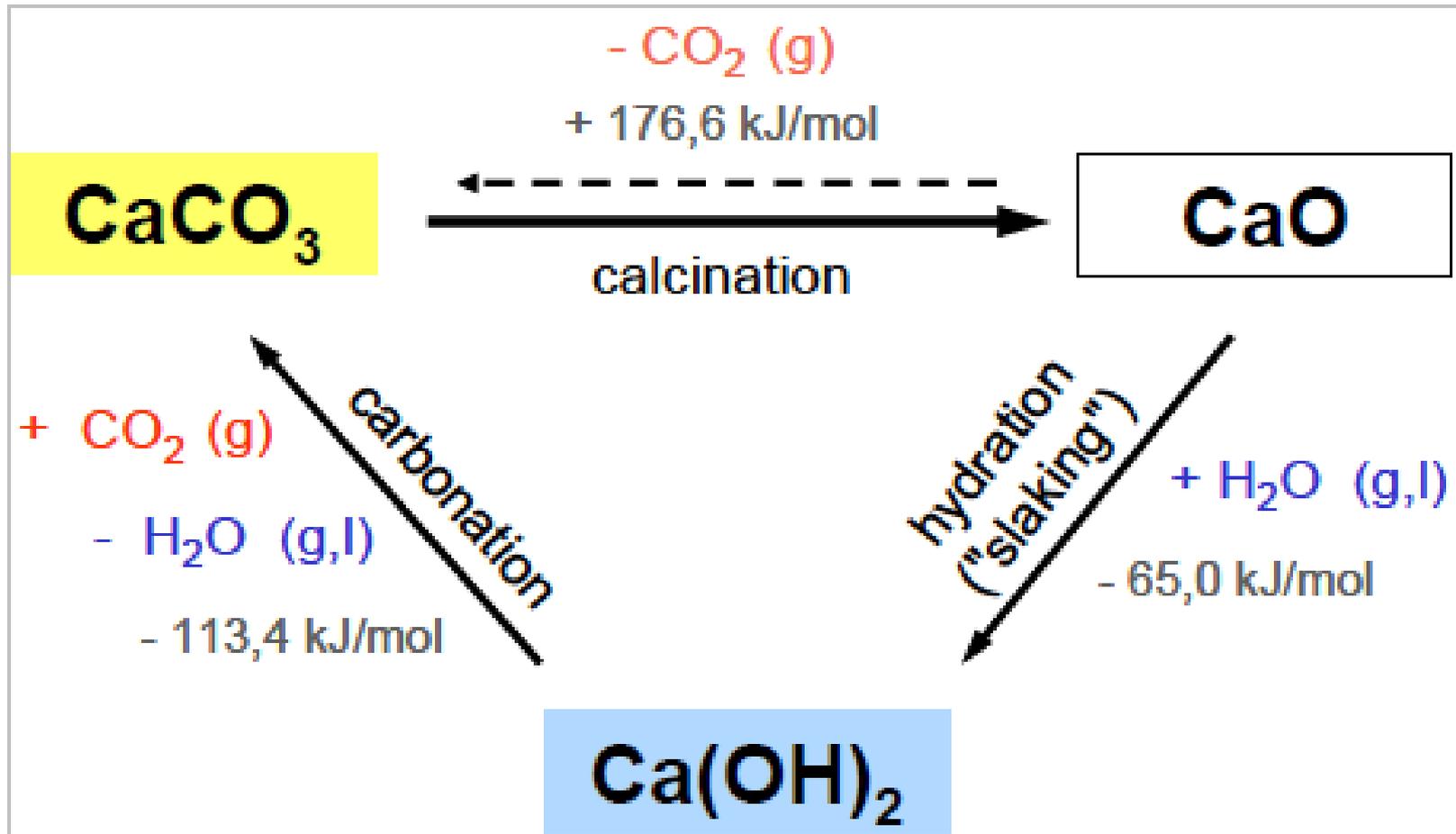


Fuel Mix



- CCS is the only option to reduce the process emissions.
- Uncertainties:
 - Economic viability;
 - Availability of large scale infrastructure;
 - Energy use;
 - Capture rate;
 - Future innovations;
- > Biomass + CCS leads to negative emissions.
- > CCU could actually give carbon a value and increase the economic viability of capturing carbon.

Closed cycle of CO₂ in calcium carbonate

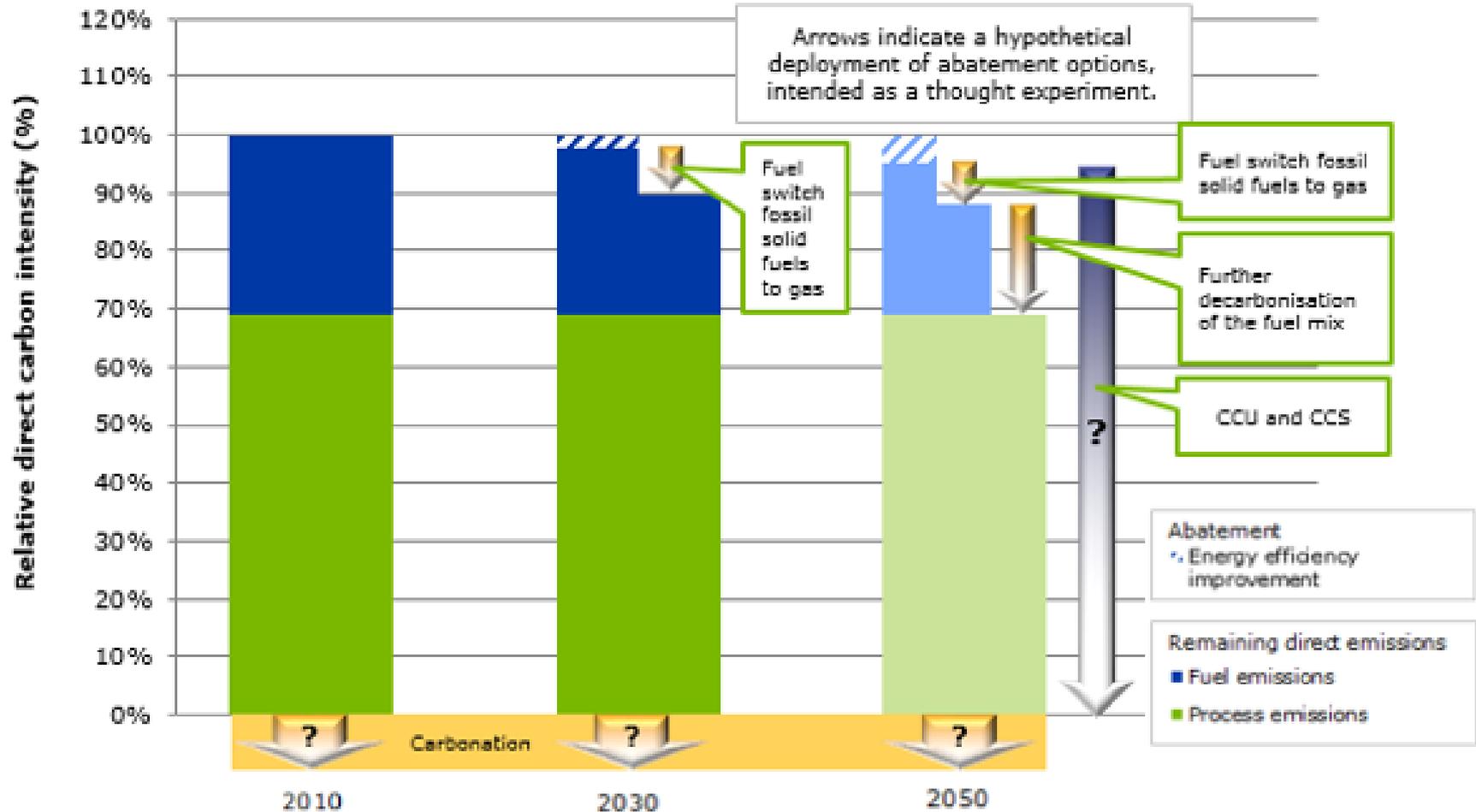


Abatement Costs

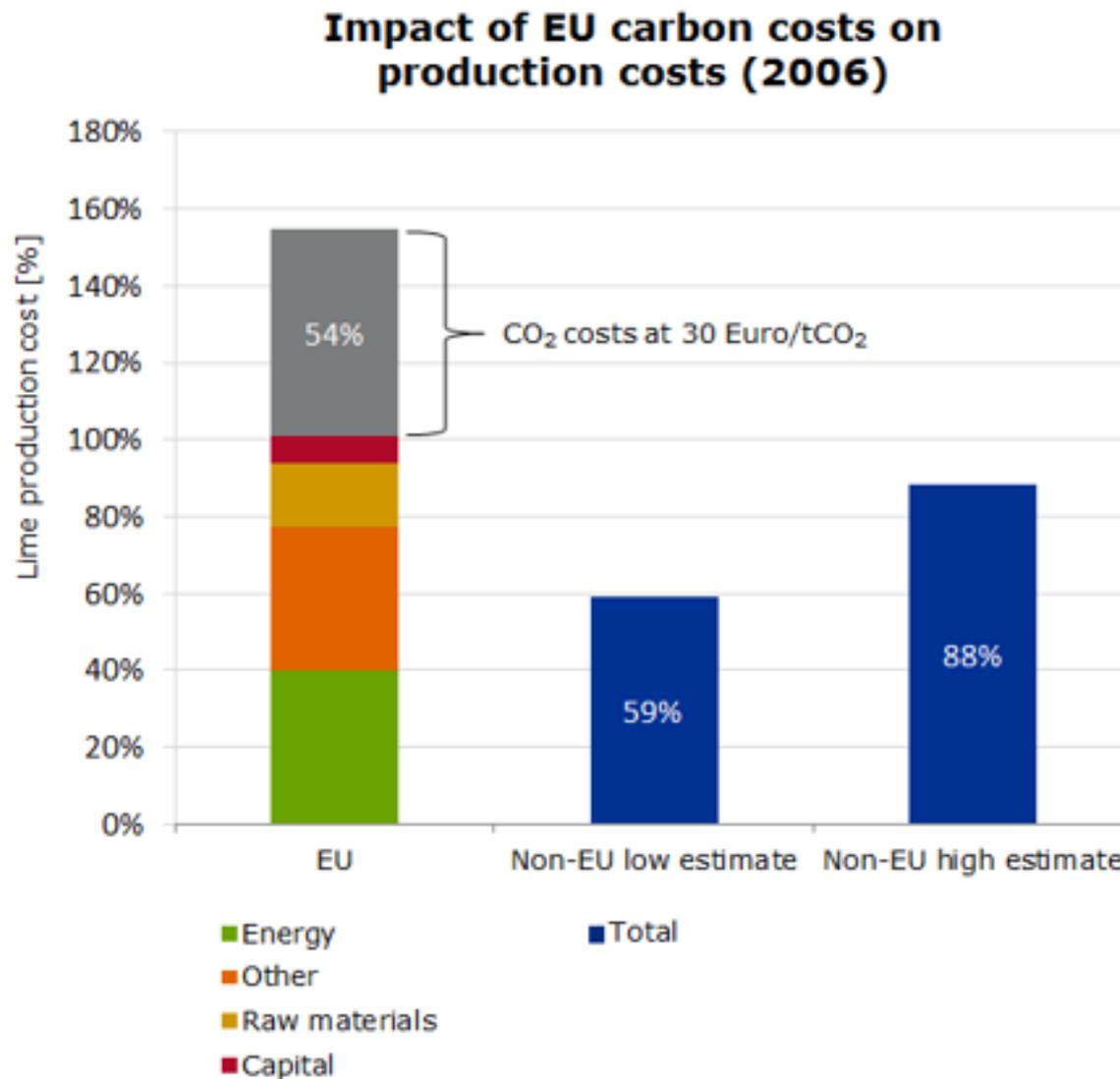
Measure:	Abatement costs (€/tonne CO ₂):	Investment costs:	Savings (%):
<i>Energy efficiency:</i>			
Rotary kilns → Shaft kilns	45	€100/tpy	45%
LRK → PRK	38	€72.5/tpy	30%
All shaft kilns → PFRK	331	€100/tpy	19%
Continuous improvements	Varies	Not assessed	3-7%
<i>Fuel Switch:</i>			
All solid fossil fuels → Natural gas	91	No investment	28%
All → Biomass	43	10.9 €/GJ	100%
CCS (Capture)	94	€76/ton CO ₂ avoided	70%

Pathway: Direct Emissions

Decarbonisation towards 2050: Relative Direct Carbon Intensity (98% of total emissions)



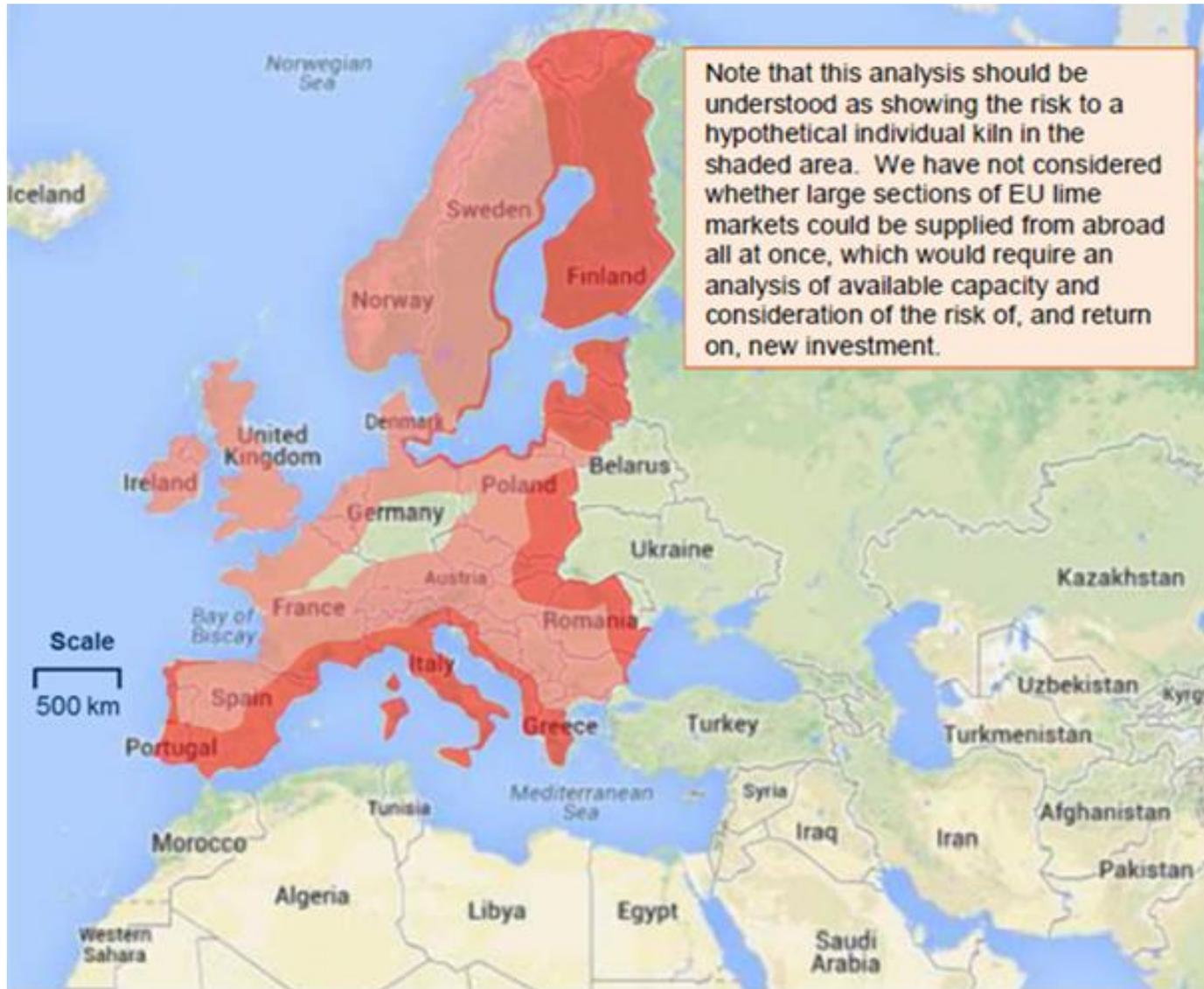
Lime Production Cost



Comparison of Energy Costs (€ / GJ)

Region	Natural Gas	Fossil Solid Fuels	Liquid Fuel
EU	9	3	9
Brazil	5	<i>n.a.</i>	10
US	3	2	12
Egypt	3	<i>n.a.</i>	4
India	3	2	7
Russia	2	1	5
Belarus	3	3	8
Turkey	9	3	9
Ukraine	5	2	8
Middle East	<1	<i>n.a.</i>	<1
Maghreb	<1	<i>n.a.</i>	2

Locations in EU where: Transport Costs < (Δ Energy Costs + Carbon Cost)



The Lime Industry: Working on Tomorrow!

Improved use of lime

Dust Minimization

Lime Audits

Innovative applications of lime

Concrete with Reduced CO₂ impact

Recovery of Metals

Production of Syngas

Innovative production of lime

Organic Rankine Cycles

Heat delivery to nearby town

Research into CCS / Biomass

Key Take Aways

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For deep reductions, CCS would be needed

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Mission, Vision & Values – Facts & Figures

Mission

sustainable energy for everyone

Vision

Based on our deep expertise in energy & carbon-efficiency, renewable energy, energy systems & markets, and energy & climate policy, we develop smart policies and solutions and bring them to life.

We know that, if we act now, by 2050 our global energy system can be sustainable, secure, affordable and fully based on renewable sources.

We aim to create a sustainable energy system for everyone.

Values

Dedication Originality Impact Trust

Facts & Figures

- Founded in 1984
- Over 250 professionals, 7 offices in 6 countries
- Over 500 clients served across 50 countries
- Leading experts: the Nobel Peace Prize 2007, awarded to Al Gore and the IPCC, was supported by 10 Ecofys experts
- Eneco Shareholder since 2009



sustainable energy for everyone