This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952936.

RE4Industry Project
Renewable Energy Solutions for Energy Intensive Industries (EII)

RE4Industry Webinar
Grüne Kalkindustrie: Herausforderungen und Chancen

Rainer Janssen, Olgu Birgi
WIP Renewable Energies, Munich

23 June 2023 (online)

www.re4industry.eu

RE4INDUSTRY

Renewable energies for industries

100% Renewable Energies for Industries

www.re4industry.eu

At a glance

RE4Industry: 100% Renewable Energies for Energy Intensive Industries

11 partners from 6 countries (AT, BE, DE, ES, GR, NL)

Starting date: 1st September 2020 - Duration: 36 months

RE4INDUSTRY

Consortium

TECHNOLOGICAL AND SOCIAL EXPERTS

circe

btg biomass technology group

CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

WIP RENEWABLE ENERGIES

WHITE

RENEWABLE ENERGY-ORIENTED ASSOCIATIONS

Bioenergy EUROPE

ENERGY EFFICIENCY in Industrial Processes

eseia european sustainable energy innovation alliance

ENERGY INTENSIVE INDUSTRIES

sidenor

MYTILINEOS

Corbion

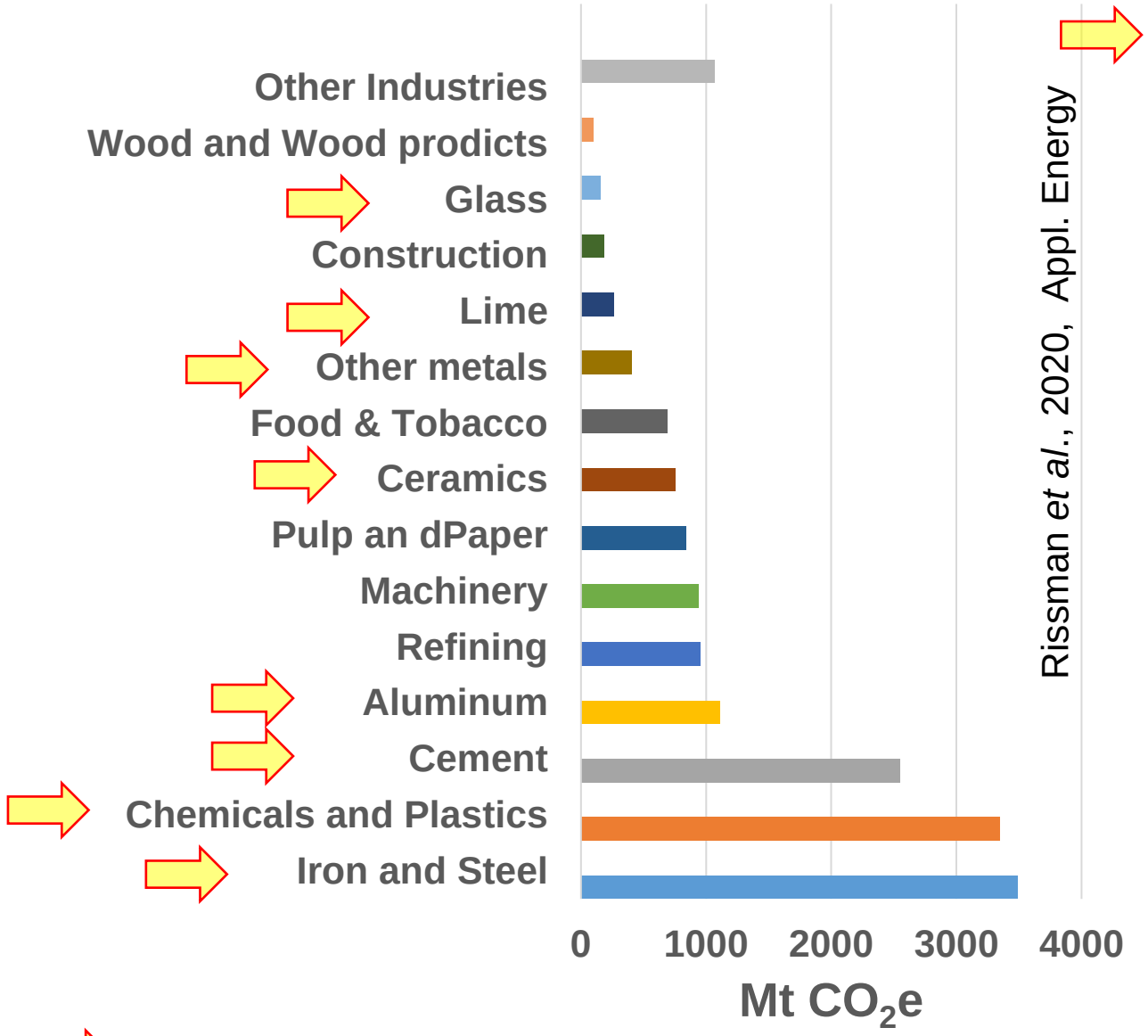
Context

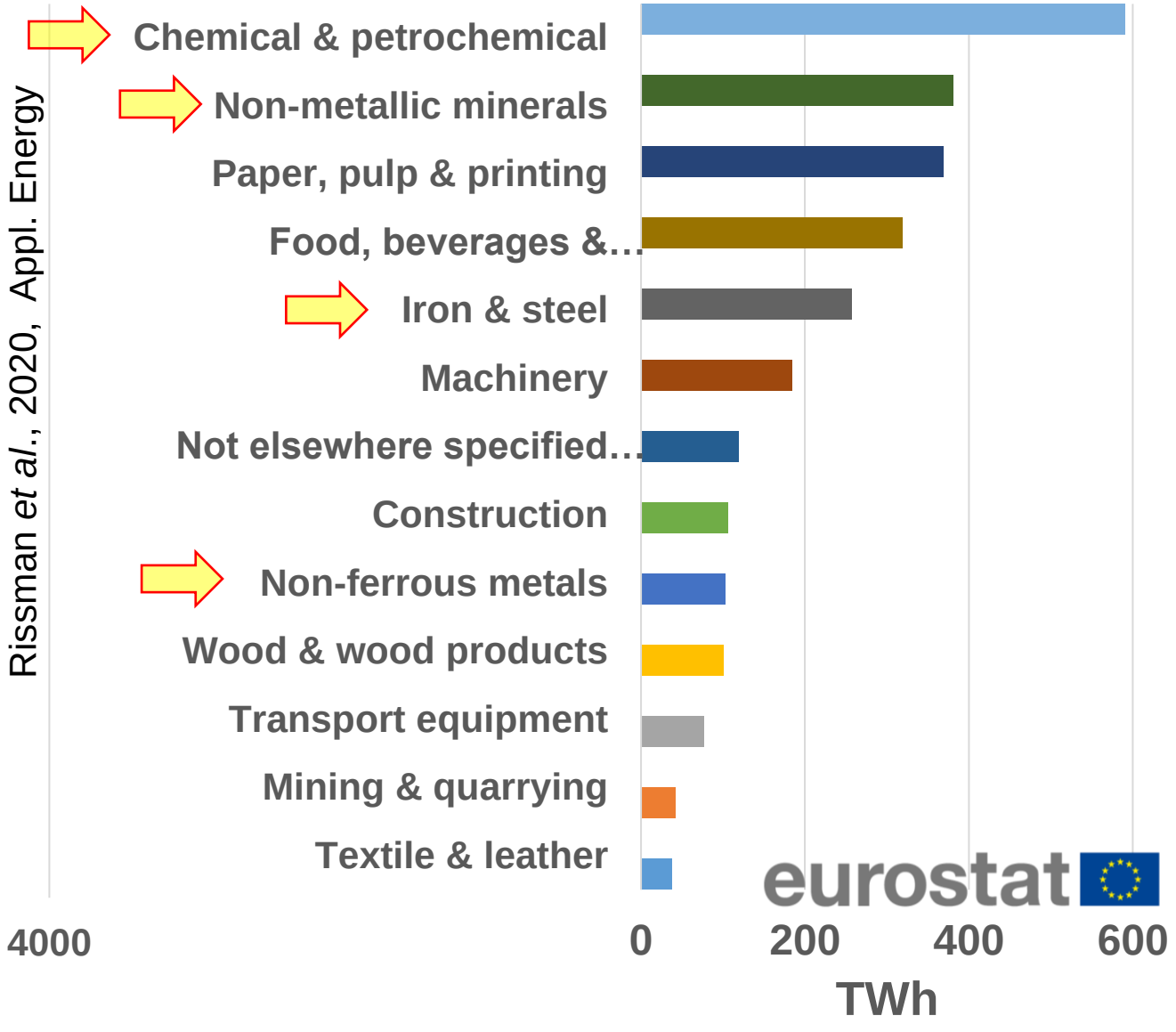
The EU has started a progressive decarbonisation with the **aim to become carbon neutral by 2050**. Energy Intensive Industries (EII) are expected to play an important role in this transition as they represent 24% of the final energy consumption, but **a clear long-term vision and strategy is required** in order to remain competitive while contributing to the decarbonization targets of the EU.

RE4Industry has been conceived under this framework with a twofold aim:

- to support EII in the **identification and integration of renewable energy (RE) solutions** together with the definition of **Action Plans for decarbonisation**
- to transform the EU industrial landscape into **a large market niche for the uptake of RE** while defining the appropriate framework conditions for **short- and long-term scenarios.**

Context: CO_2 emissions and energy consumption by industry





The arrow indicates available analysis on this sector

Source: Plotted from information found in the Eurostat database: https://ec.europa.eu/eurostat/web/energy/data/energy-balances (accessed on May, 2022)

RE4Industry actions

RE4Industry methodology can be expressed through 7 action axes targeted to generate confidence, facilitate vision, provide support and ensure market options to EIIs.

A strong engagement strategy following a multiactor approach

A dialogue with and within EIIs and EII organizations

A thoughtfully review of RE technologies and options for a 100% RE production by 2050

Insights into industry retrofitting and promotion of RE integration

Recommendations for the uptake of RE by EIIs and advocacy

Multiplication and replication

A solid dissemination and communication strategy

RE4Industry - Industrial case studies

Energy sources:

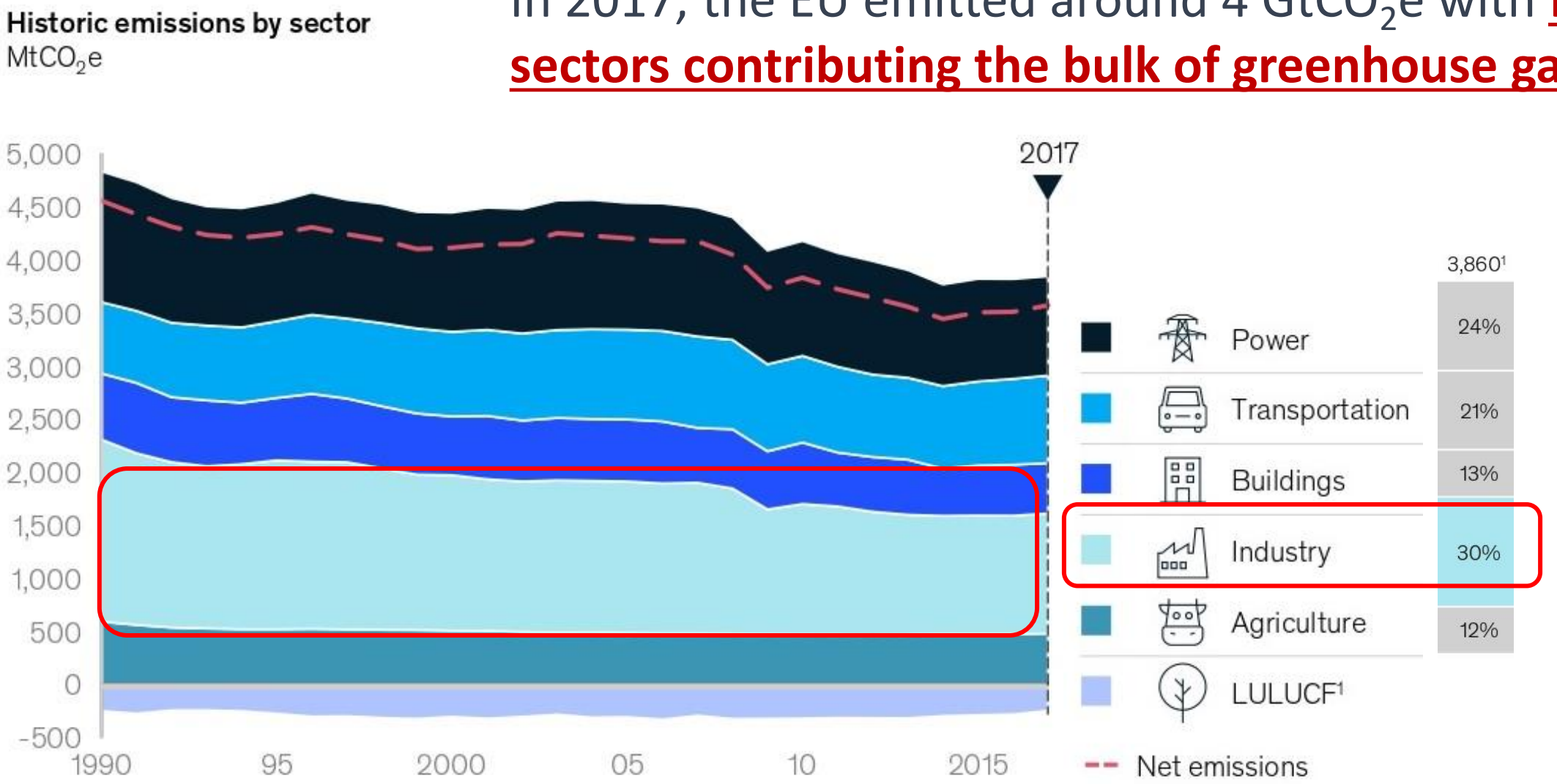
sidenor Corbion MYTILINEOS

- **Electricity** → Green electricity (PPAs, photovoltaics, etc.)
- **Natural gas** → Biomethane (no modification), Green H_2 (needs modifications)
- **Coal** → Biochar (lower efficiency)
- **Steam** → Electric boiler



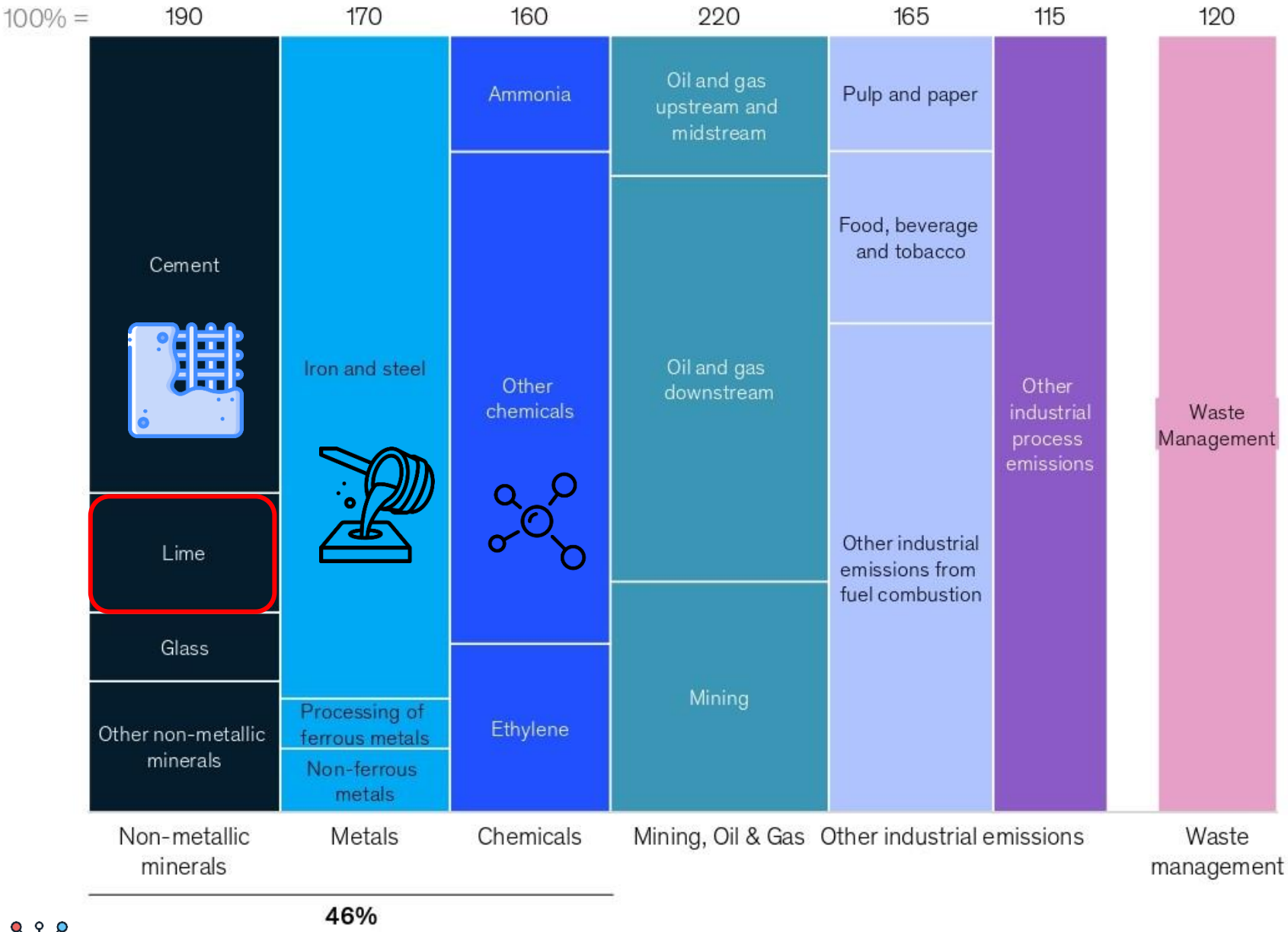
Context: the bulk of Europe's emissions are generated by five sectors

In 2017, the EU emitted around 4 $GtCO_2e$ with **five sectors contributing the bulk of greenhouse gases**



d'Aprile, P., et al. "How the European Union could achieve net-zero emissions at net-zero cost." McKinsey & Company: Chicago, IL, USA (2020)

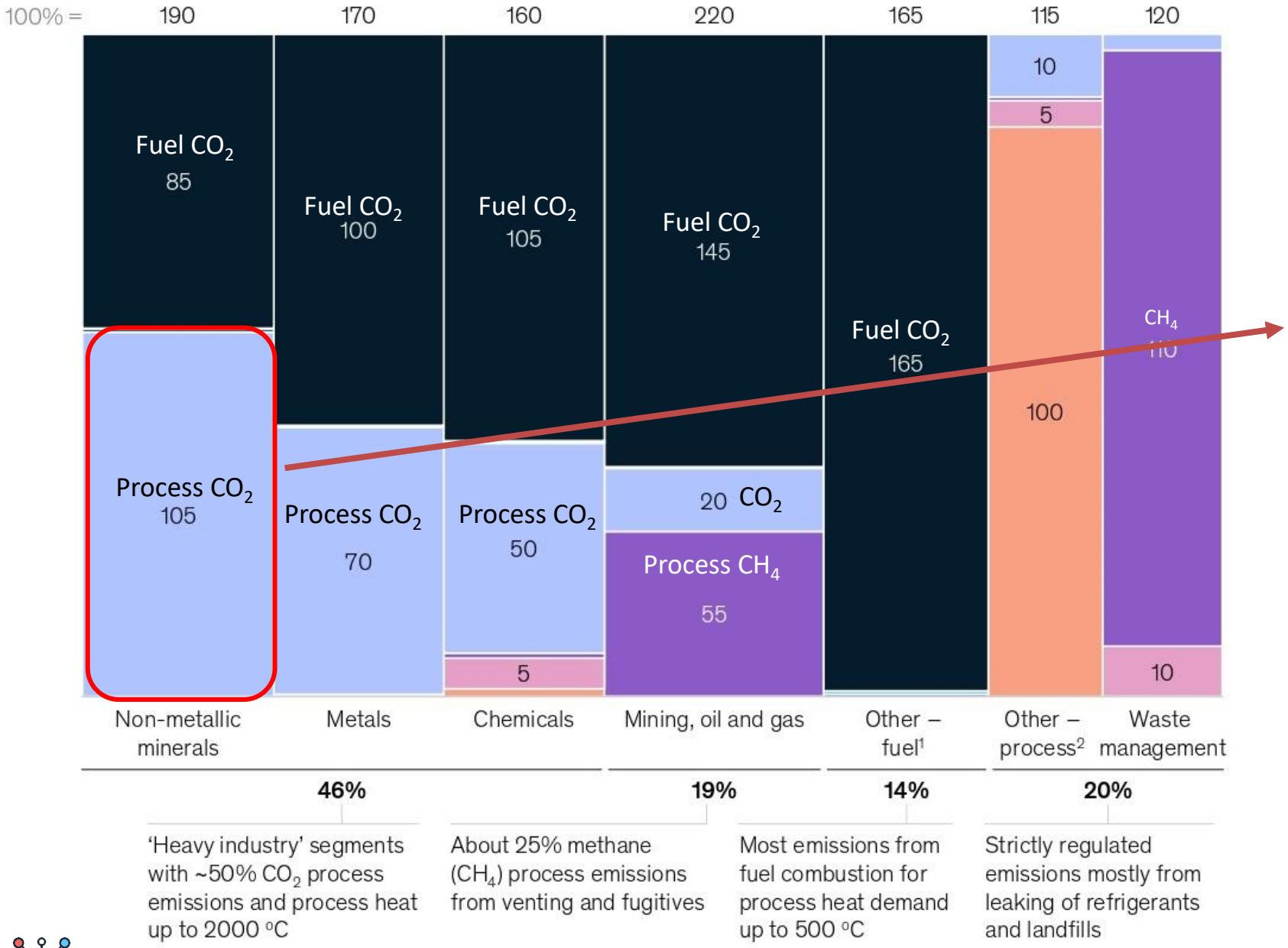
Emission by subsector in $MtCO_2e$, 2017



- Basic products like **cement, glass, steel, and plastics require high temperatures**
- These **hard-to-abate emissions pose a significant challenge to achieving emissions reductions in heavy industry**

d'Aprile, P., et al. "How the European Union could achieve net-zero emissions at net-zero cost." McKinsey & Company: Chicago, IL, USA (2020)

Emissions are split between fuel combustion emissions and process emissions



- Half of industrial emissions come from fuel combustion for process heat
- **Solutions must target both fuel combustion and process emissions** to effectively address industrial emissions

d'Aprile, P., et al. "How the European Union could achieve net-zero emissions at net-zero cost." McKinsey & Company: Chicago, IL, USA (2020)

Renewable energy in EIIs

Lime industry

[B]

Total CO_2 emissions of the European lime industry (2022): **18-20 Mt** (EuLA)

Focus on carbon capture since the bulk of the emissions come from limestone (process emissions).

Category	Measures for CO_2 Reduction
Energy Efficiency	A. Fuel Savings by new and efficient vertical kilns B. Heat exchangers C. Heat recovery from waste streams
Low Carbon Sources	i. Fuel switch to biomass (e.g. wood residues) ii. Solar heating and H_2 via alkaline electrolysis
CCS-CCU	CCS: End of pipe solution CCU: Production of fuels/hydrocarbons
Carbonation	Reverse reaction of lime production. Industrial example: Precipitated Calcium Carbonate (PCC)

SHORT-TERM VISION

2030

LONG-TERM VISION

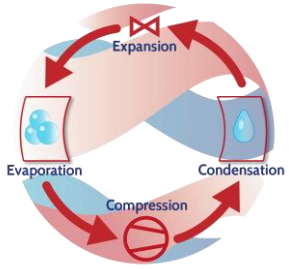
2050

Vision

Renewable technologies within the scope of 2030

1. Heat

Solar thermal



Heat pumps

Geothermal

Biomass

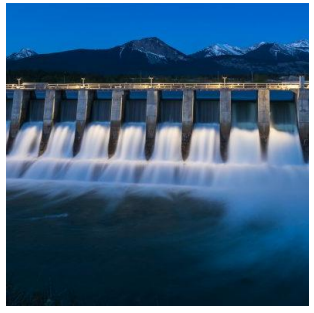
Biofuels

Green hydrogen

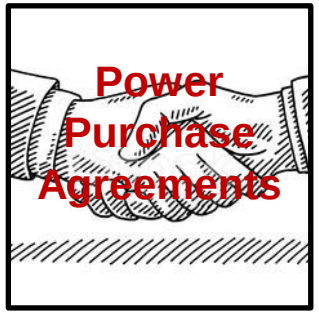
2. Electricity

Photovoltaics

Wind



Hydraulic



Renewable PPAs

Findings

Electrification will be key thanks to the gradual **decrease of renewable power price** and the **conversion of natural-gas-dependent processes**

Industrial **processes** that are **not** readily **eligible for electrification** will still be needing **a form of renewable heat**

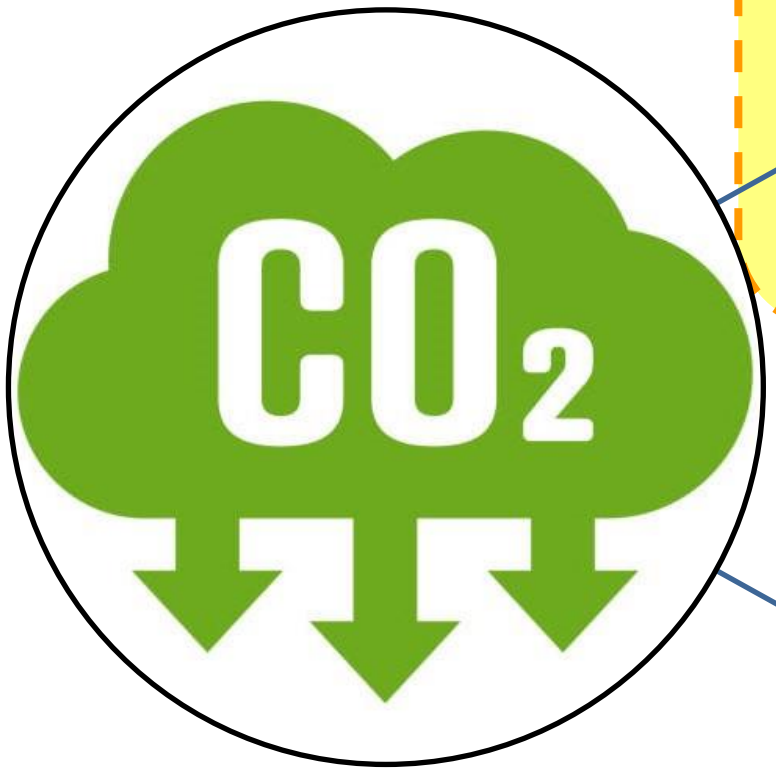
From **concentrating solar power** and **heat pumps to geothermal energy** to supply a **broad range of temperatures needed**

Biomass will be a **key element in the decarbonisation** of not only **conventional combustion systems** but also as a **biofuels feedstock**

Biomethane allows **straightforward transition** from fossil-based natural gas to **renewable gas**

Green hydrogen production technologies will require to **increase maturity** and **availability** all over Europe

Renewable technologies within the scope of -2050-



General innovations

- CCUS
- New cement chemistries
- Alternative materials
- New chemical production methods

Sector specific

- Steel
- Ceramics
- Chemicals and Fertilizers
- Glass
- Non-ferrous metals
- Cement and Lime

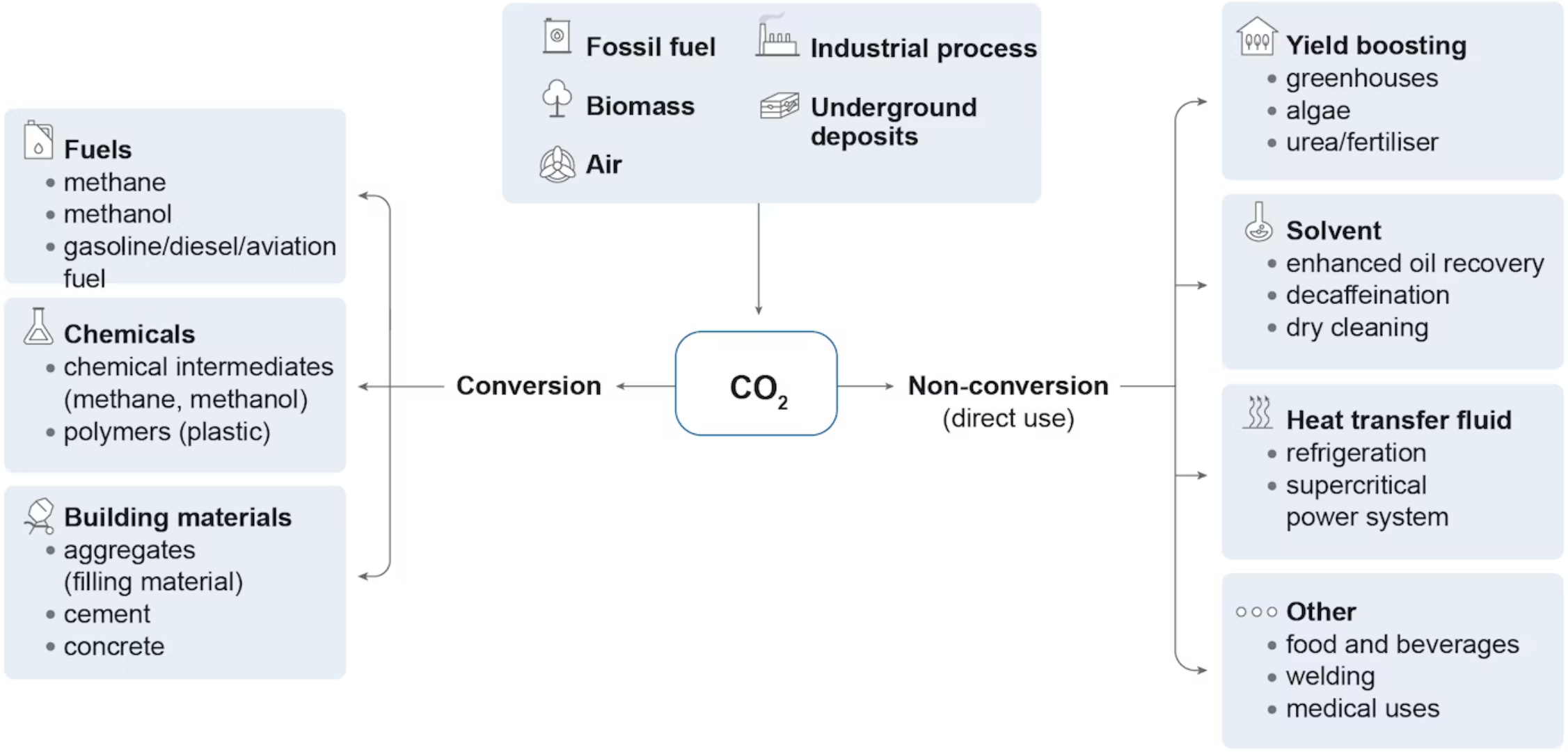
Renewable technologies within the scope of -2050-

Time frame: 2020-2035 / Achievable emissions reductions: 20%

Actions	Technologies achieving materiality	Key R&D areas to enable future technologies (2050)
• Efficiency improves continuously, with most industrial processes undergoing incremental improvements • **A growing number of processes shift towards electricity** • Material efficiency, longevity, and re-use are recognized as key strategies • **Heavy R&D investments are directed into technologies that will be important in subsequent phases (*e.g.*, CCUS)**	• **Electrification** • Material efficiency • Energy efficiency • Increased re-use and recycling (circular economy)	• **CCUS** • **Zero-carbon hydrogen production** • **Hydrogen and renewable gases use** • Novel chemical catalysts and separations • New cement chemistries

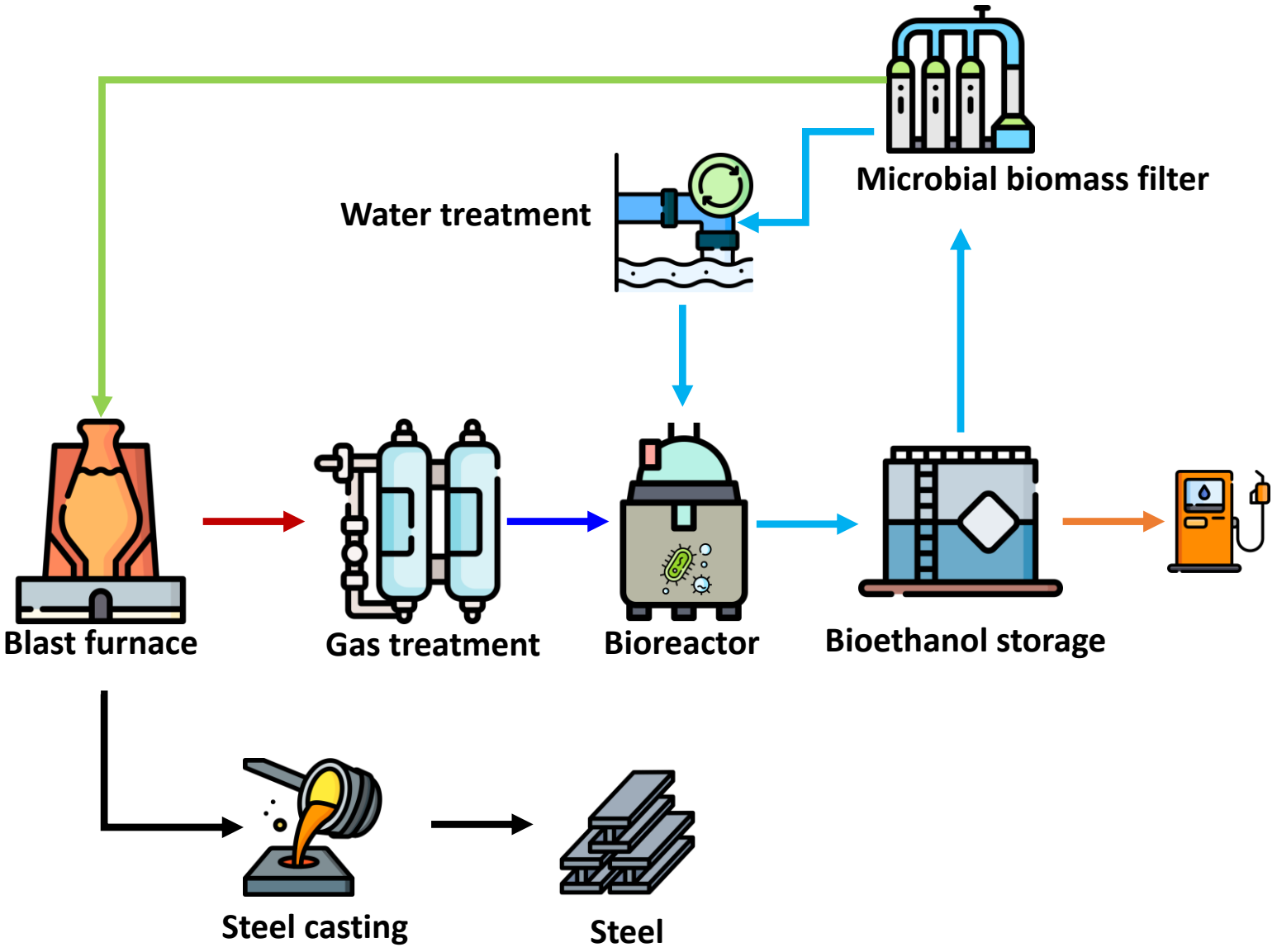
Adapted from Rissman, et al. (2020), Applied Energy

Carbon Capture and Use (CCU) Pathways



IEA, 2019

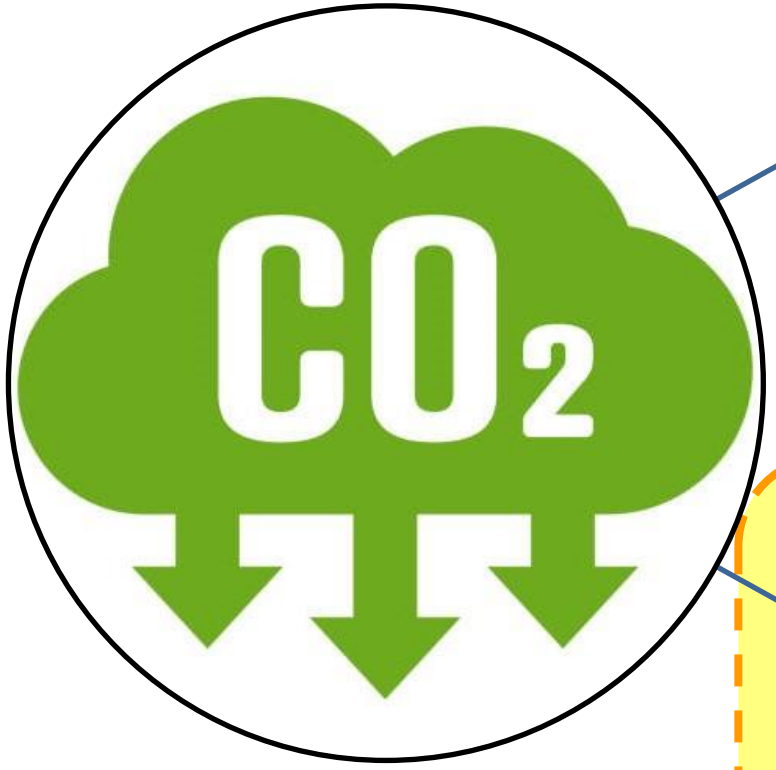
Industrialisation of CO_2 bioconversion into fuels



- **CO_2 bioconversion into fuels is possible**, as demonstrated by examples such as the Steelanol project within the steel sector
- The Steelanol project operates a plant in Ghent, Belgium, with the goal of **producing 80 million liters of bioethanol**
- The bioethanol produced by the Steelanol plant will be used as a **low carbon alternative fuel in the transport sector**
- This decarbonization initiative has received funding from various sources, including the EU, and is expected to **prevent the emission of approximately 130k tonnes of CO_2 per year**

Drawing based on the scheme by: Perathoner, et al. "Reuse of CO_2 in energy intensive process industries." Chemical Communications (2021)

Renewable technologies within the scope of -2050-



General innovations

- CCUS
- New cement chemistries
- Alternative materials
- New chemical production methods

Sector specific

- Steel
- Ceramics
- Chemicals and Fertilizers
- Glass
- Non-ferrous metals
- Cement and Lime

Suitable RE combination options for Energy Intensive Industries

Sector	Renewable power for process electrification		Renewable heat and its sources				CCUS technologies	
	Heat and mechanical	Electrochem. processes (excluding H_2)	Biomass combustion (and biofuels feedstock)	Other RE (Geotherm. & Conc. solar)	Green H_2 (electrolysis/ gasification)	Biomethane (anaerobic digestion)	Carbon Capture and Storage	Carbon Capture and Utilisation
Steel								
Chemicals								
Fertilizers								
Cement								
Lime								
Refining								
Ceramics								
Paper								
Glass								
Non-Fe metals								
Alloys								

Sector already applies the technology on a large scale (it can be expanded in some cases)

High potential

Medium potential

Limited or no significant application foreseen

Possible application but no main route or wide scale application

Table adapted from: *Tomas W, Gauri K, Isobel R. Industrial Value Chain – Abridge Towards a Carbon Neutral Europe. 2018*

Conclusions

Energy intensive industries' **decarbonisation will occur** through a progressive use of an **energy mix** that allows European industrial sectors to **remain competitive** in a global scale

Each industrial sector will require **specific renewable energy solutions**, especially those **top greenhouse gas emitting** industries

RE4Industry has also been conceived as an **initial point of discussion** to be shared with potential decision makers to favor a **transition of Energy intensive industries to full decarbonisation**

RE4Industry Outcomes

- Public Deliverables of the project are available on the project website
- RE4Industry Brochure
- Knowledge transfer Seminars – RE4Industry project
- Webinar “Sustainable Syngas Production for the German and European Glass Industry”
- Published article on Processes: Renewable Power and Heat for the Decarbonisation of Energy-Intensive Industries
- T5.1 Report on Current options for retrofitting EIIs and assessment of identified gaps for market uptake
- T5.2 Repot on Identification of RE options for 100% RE use towards 2050

Rainer Janssen, Rainer.Janssen@wip-munich.de

Olgu Birgi, olgu.birgi@wip-munich.de

www.re4industry.eu

@eu_industry #re4industry

www.linkedin.com/company/re4industry

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952936. The information and views set out on this presentation are those of the authors and do not necessarily reflect the official opinion of the European Union. Neither the European Union institutions and bodies nor any person acting on their behalf may be held responsible for the use which may be made of the following information.

Towards 100% Decarbonisation of Energy Intensive Industries with Renewable Energy Integration

RE4INDUSTRY

Renewable energies for industries

Knowledge Transfer Webinar

-

"Greening the Lime Industry: Challenges and Opportunities for Decarbonisation"

RE4INDUSTRY
Renewable energies for industries

Decarbonisation strategy for the German Lime Industry (F. Ohnemüller)

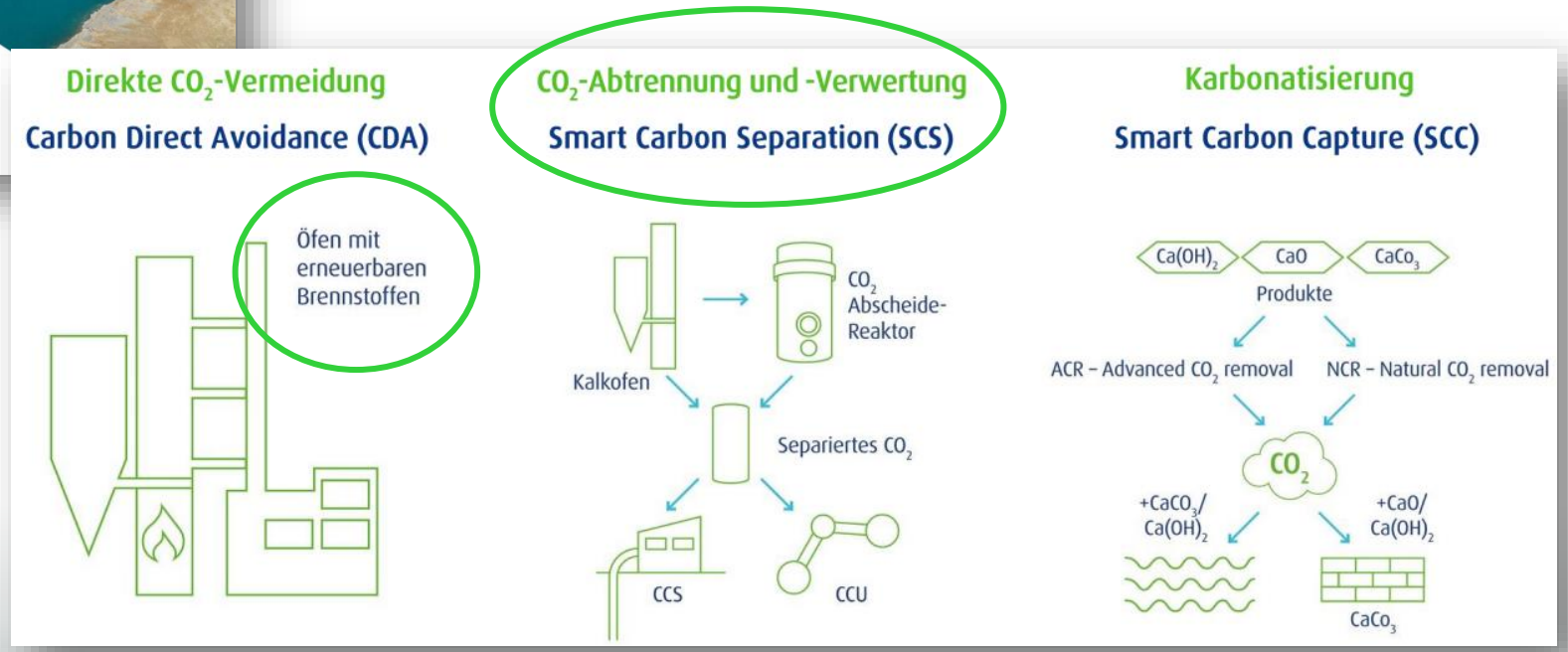
WIP RENEWABLE ENERGIES

Kalk
vielseitig
faszinierend
wertvoll

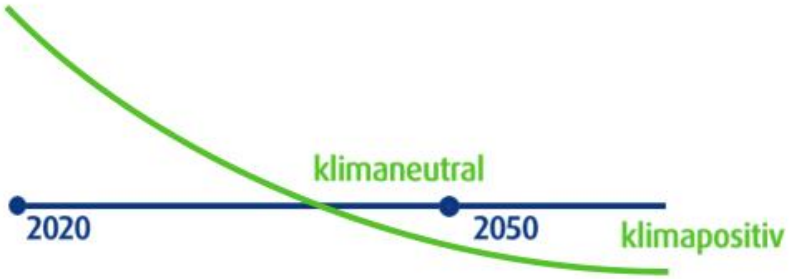
Horizon2020
European Union Funding
for Research & Innovation

CO_2-Minderungsstrategie der deutschen Kalkindustrie

- CO_2-Reduktion und Dekarbonisierung festgelegt in Roadmap Kalkindustrie 2050
  - Überarbeitung und Erstellung Roadmap 2.0
- Drei Technologiepfade sind definiert:
  1. Direkte Vermeidung von CO_2
  2. CO_2 Abtrennung und Verwertung (CCU/CCS)
  3. Karbonatisierung -> CO_2 Wiederaufnahme

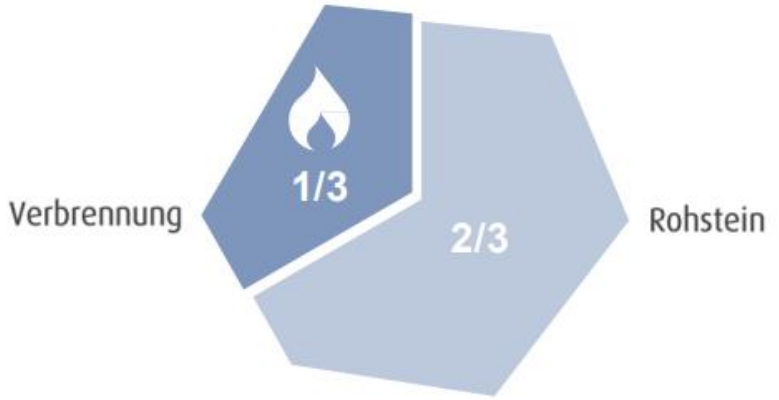


Besondere Herausforderungen - Prozessemissionen

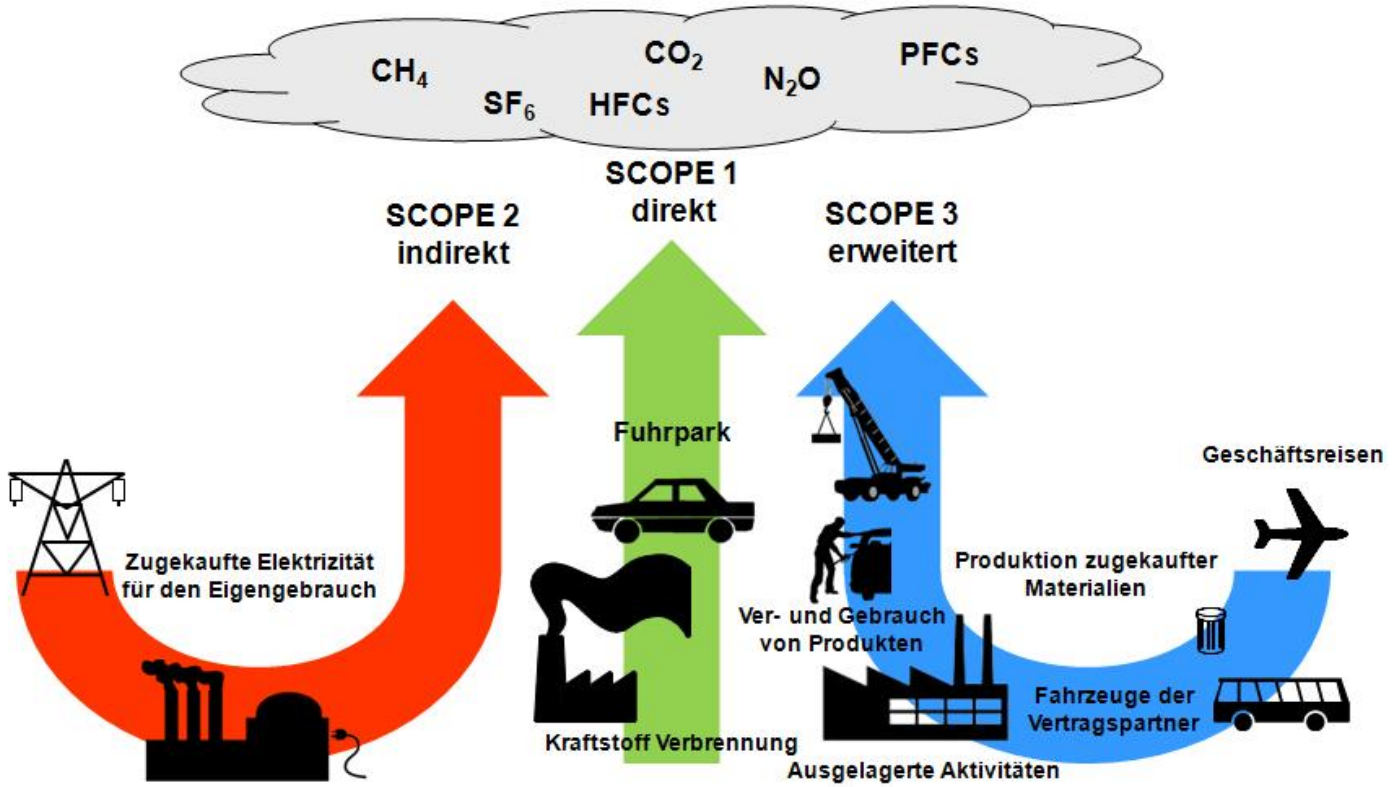


Zwei Drittel unserer CO_2-Emissionen kommen aus dem Kalkstein und sind nicht minderbar.

Trotzdem wollen wir spätestens 2050 klimaneutral Kalk produzieren und durch die teilweise und dauerhafte Recarbonisierung in unseren Produkten zu einer klimapositiven Industrie werden.



Fokus im Hinblick auf Nutzung Erneuerbarer Energie

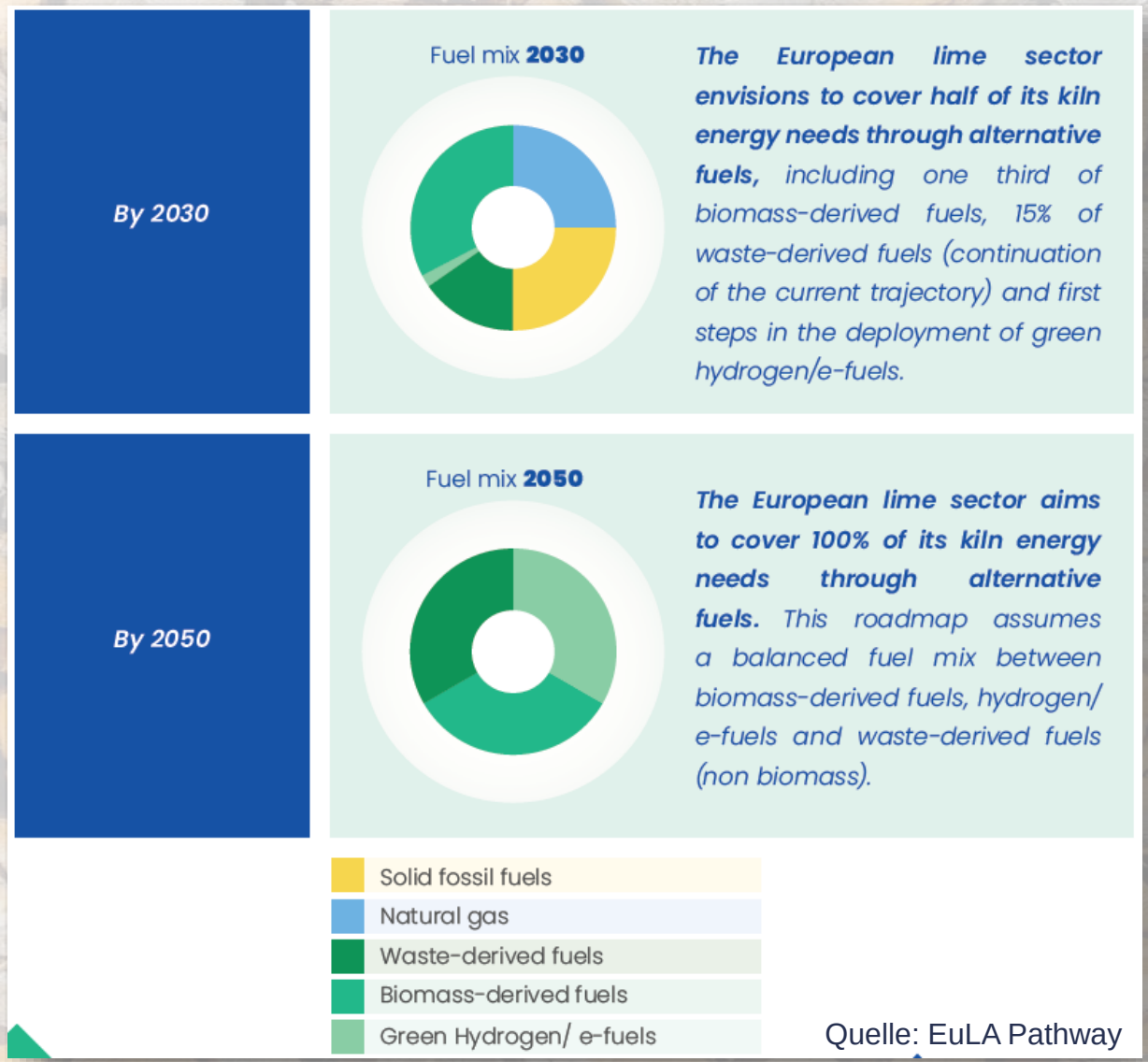


Quelle: GHG Protocol

1. Reduzierung direkter CO_2-Emissionen des Ofens (Scope I)
   - Nutzung von erneuerbaren Brennstoffe wie Biomasse, E-Fuels, H_2, ggf. elektrische (Hybrid) Öfen
2. Reduzierung indirekterer Emissionen (z.B. zugekaufte Elektrizität, Scope II)
   - Trotz Umstellung auf Carbon Capture und CCU/CCS mittels ern. Energie bis 2045 auf Null reduzieren

Brennstoffwechsel (Scope I)

- Die Umstellung des Brennstoffs wird kontinuierlich voran getrieben, wobei neue Abschätzungen für D in der überarbeiteten Roadmap der deutschen Kalkindustrie publiziert werden
- EU-weit wird davon ausgegangen, dass **bis 2030** etwa **50%** der eingesetzten Brennstoffe erneuerbaren Ursprungs sind
- EU-weit wird der Brennstoffmix bis **2050** zu **100%** aus erneuerbaren Quellen bestehen
- Elektrifizierung/elektrisch betriebene Öfen werden auch eine Rolle spielen

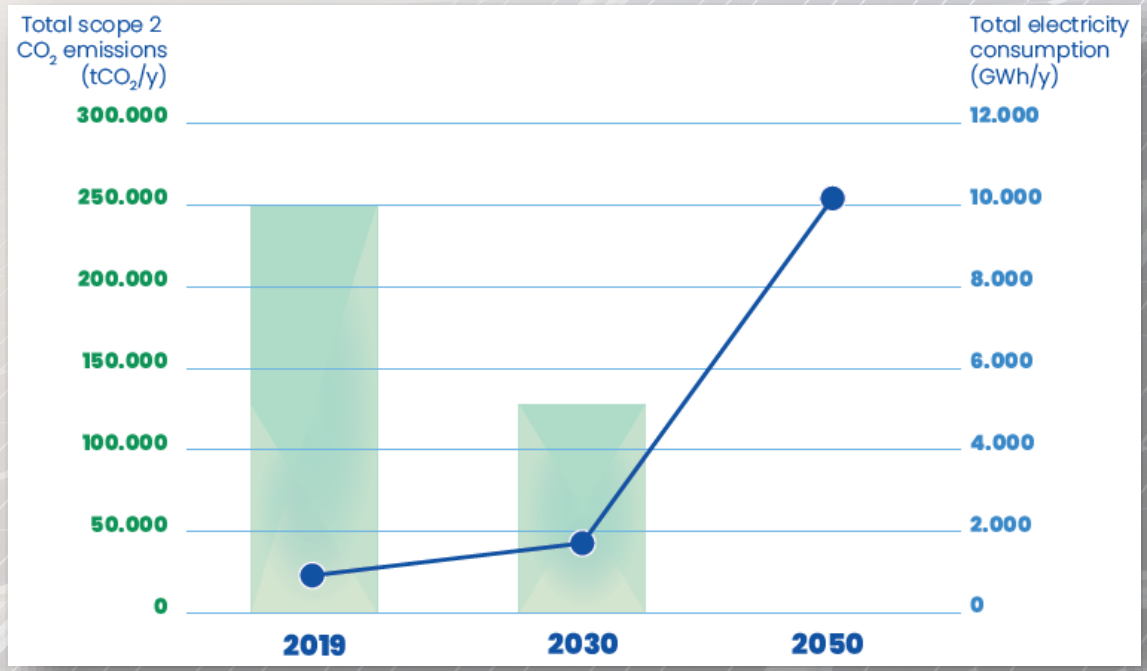


Quelle: EuLA Pathway

Hintergrund: Alexander Schimmeck

Bedarf erneuerbare Energien für Capture, CCU/CCS

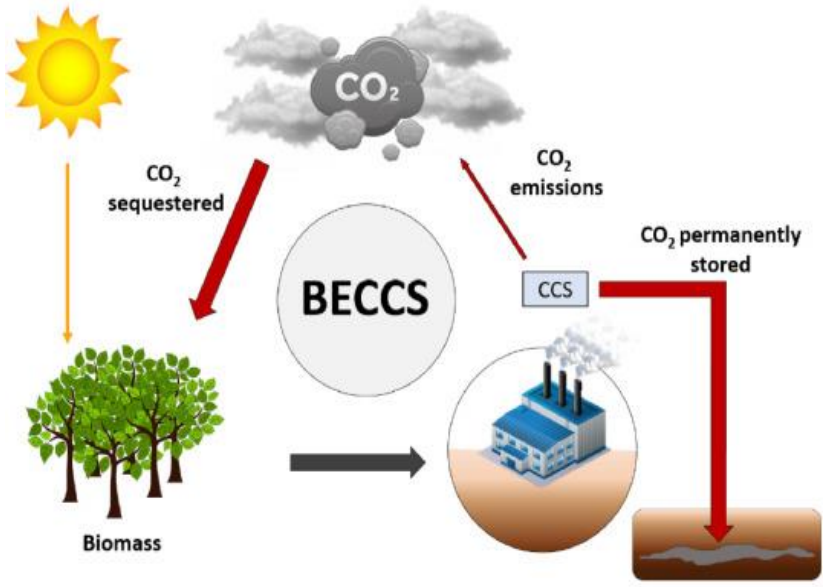
- Bedarf an erneuerbarer, elektrischer Energie wird sich durch Transformation der Industrie in allen energieintensiven Industrien (EIIs) erhöhen
- CO_2-Abtrennung/Capture, CCU & CCS sind (sehr) energieintensiv
- EuLA Roadmap nimmt an:
  - **bis 2030: ca. Faktor 2**
  - **bis 2050: ca. Faktor 10!**
- Gleichzeitig wandelt sich der Energiemix (EU/D) hin zu 100% erneuerbarer Energie



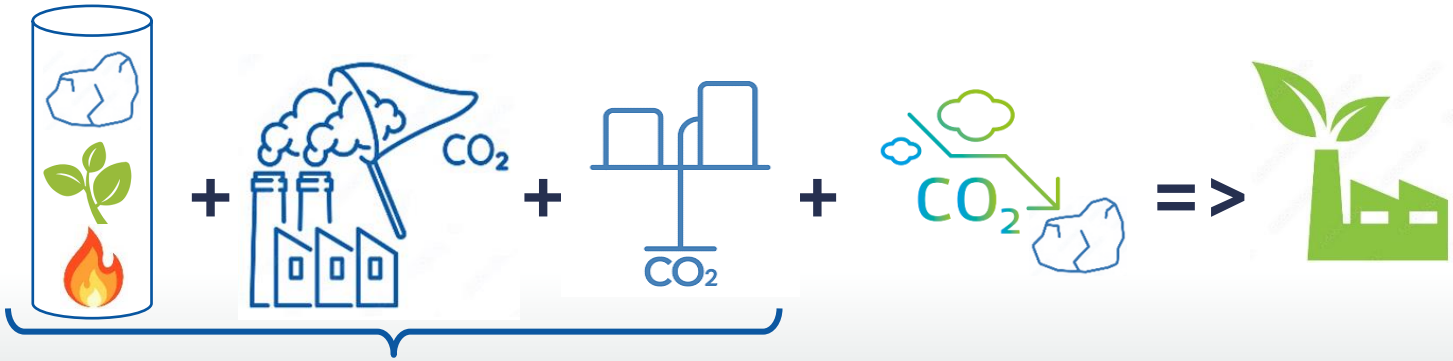
Quelle: EuLA Pathway

Potential für negativ Emissionen durch BECCS

- **BECCS** steht für "Bioenergy with Carbon Capture and Storage" (Bioenergie mit Kohlenstoffabscheidung und -speicherung)
- Q1/2023: Biomasse/Holz bleibt erneuerbare Energie (RED III)
- End-of-Pipe CO_2-Abscheidung birgt großes Potential zum Erzielen von **Negativ-Emissionen** beim Einsatz von Biomasse
- Die natürliche und verstärkte **Karbonatisierung** (CO_2-Wiederaufnahme im Lebenszyklus von Kalkprodukten und Anwendungen) erhöht in Kombination mit **BECCS** das Potential zum Erzielen von **Negativ-Emissionen** nochmals



Almena et al., 2022 (*Biomass and Bioenergy)*



BECCS + Carbonation => klimapositive Kalkindustrie

Forderungen & Herausforderungen

- Verlässliche und langfriste politische Rahmenbedingungen und Planungssicherheit
- dauerhafter Zugang und Verfügbarkeit zu günstiger nachhaltiger/erneuerbarer Energie
- Schaffung geeigneter Infrastrukturen, z.B. für grünen Wasserstoff und CO_2
- Forschungsförderung und Implementierungsunterstützung
- Erhaltung der Wettbewerbsfähigkeit
- OpEx- bzw. Betriebskostenförderung und Offset-Hilfe #Klimaschutzverträge

Take-Home Message

- Der ern. Energiebedarf der Kalkindustrie wird immens steigen
  - Zukünftige Vermeidung von Scope I als auch Scope II Emissionen
- Eine dauerhafte Verfügbarkeit von bezahlbarer erneuerbarer Energie muss sichergestellt werden
- BECCS birgt große Potentiale für Negativemissionen

Vielen Dank an die Projekt-Partner von RE4INDUSTRY Renewable energies for industries und WIP RENEWABLE ENERGIES

Biomass Solutions for the Lime Sector

RE4Industry Knowledge Transfer Webinar

Greening the Lime Industry: Challenges and Opportunities for Decarbonisation

23 June 2023

Manolis Karampinis
Bioenergy Europe, Business Development & Membership Director | EPC Manager

The RE4Industry project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952936.

About Us

Common voice of European bioenergy since 1990

Unites **40+ national associations** and around **140 companies**

Hosting the European Pellet Council (EPC)

Quality & Sustainability **Certifications**

Our Services:

- EU Policy Monitoring & Influence
- Market Data
- Visibility
- Networking
- Free & Discounted Events

Our Members

*as of June 2023

BioEnergy EUROPE

Companies

Associations

Academia

Our Members

*as of June 2023

Two members from the lime industry:

CARMEUSE

Lhoist

Our Working Groups

Members Only

Pellets

Next Date: 29 Aug 2023

Main topics: updates on European and global pellet markets (residential, commercial, industrial); pelletization technologies; agropellets and advanced pellets; communication and promotion of pellet usage

Competitiveness

Next Date: 16 Nov 2023

Main topics: policy files affecting the competitiveness of bioenergy sector within the EU (e.g. carbon tax, state aid, RePowerEU, Net Zero Industry Act, etc.)

Agro-biomass

Next Date: 17 Oct 2023

Main topics: markets and emerging initiatives for the use of agricultural residues, agro-industrial residues and energy crops; interconnections between agriculture & energy policy files

Sustainability

Next Date: 14 Jun 2023

Main topics: EU legislation impacting the sustainable mobilization of biomass feedstocks for energy production, e.g. RED II, RED III, Taxonomy, etc.

Wood Supply

Next Date: TBC

Main topics: markets for wood fuels (e.g. wood chips, sawdust, firewood, etc.); market and policy factors affecting wood supply; forest management & interaction with wood fuels markets

Domestic Heating

Next Date: 27 Sep 2023

Main topics: policy files related to biomass use for the domestic heating sector, such as building regulations, air emissions, Ecodesign and Ecolabelling regulations for biomass stove & boilers

Carbon Dioxide Removals

Next Date: 25 Oct 2023

Main topics: policy files regarding negative emissions (e.g carbon removals certification framework); technologies and projects for carbon removals from biomass (e.g. BECCS and biochar)

Task Force National Advocacy

Next Date: 21 Sep 2023

Scope: enhance cooperation between Bioenergy Europe and National biomass associations for more effective advocacy on EU and national levels

Task Force Communications

Next Date: TBC

Scope: share experiences and coordinate efforts on issues related to bioenergy communication for policy makers, stakeholders and the general public

Two EU H2020 projects addressing bioenergy use by Energy Intensive Industries

RE4INDUSTRY
Renewable energies for industries

- Increased renewable energy use in the European Energy Intensive Industries (EIIs) sector
- Website: https://re4industry.eu/
- Duration: Sep 2020 – Aug 2023

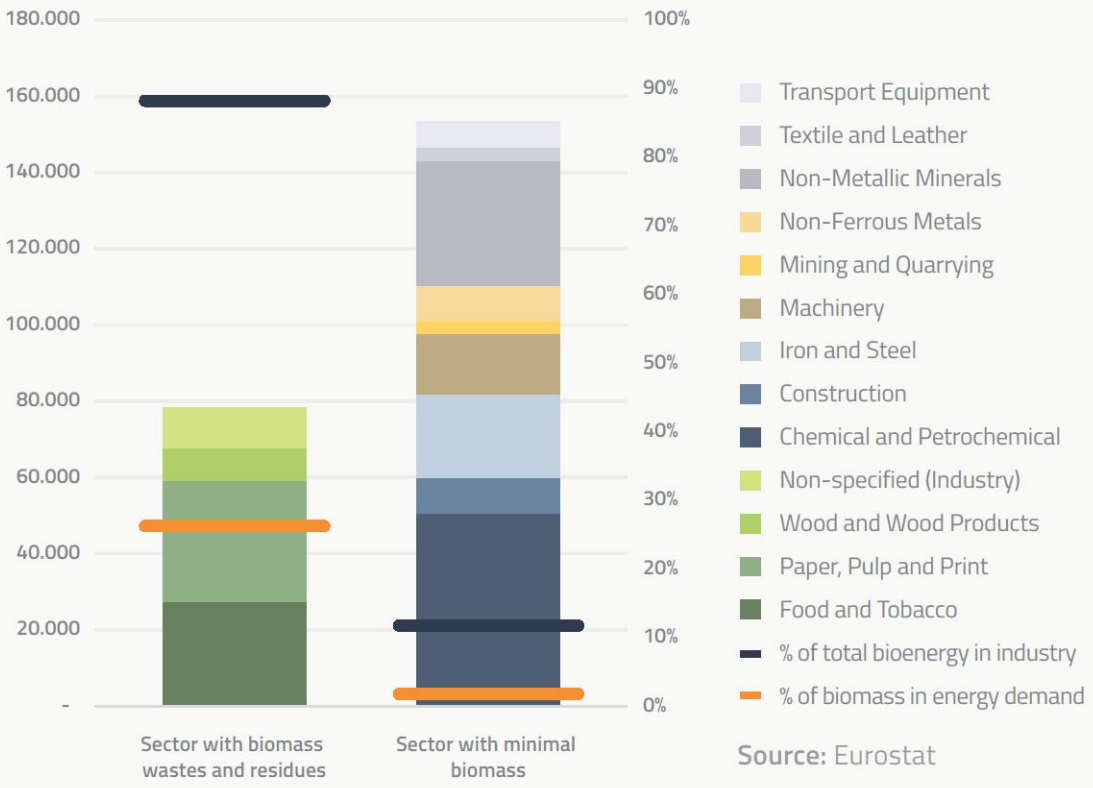
MUSIC
Market Uptake Support for Intermediate Bioenergy Carriers

- Focus on Intermediate Bioenergy Carriers (IBCs): torrefied biomass, fast pyrolysis bio-oil, microbial oil
- Website: https://www.music-h2020.eu/
- Duration: Sep 2019 – Feb 2023

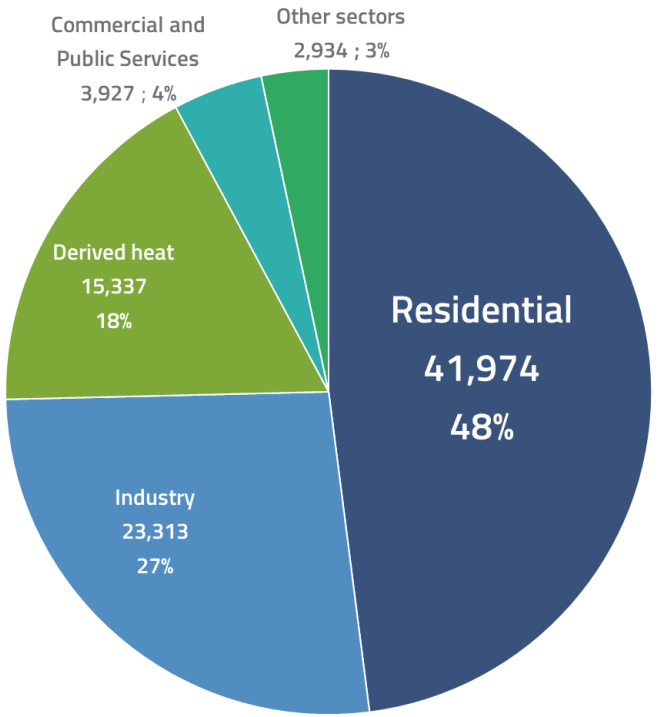
The RE4Industry and MUSIC projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952936 and 857806 respectively.

Bioenergy and energy consumption in the industrial sector

Energy demand by industry and share of bioenergy for sectors dealing with biomass wastes and residues and for other sectors in EU27 in 2020 (ktoe and %)



Total bioheat consumption in the different sectors in EU27 in 2020 (in ktoe, %)



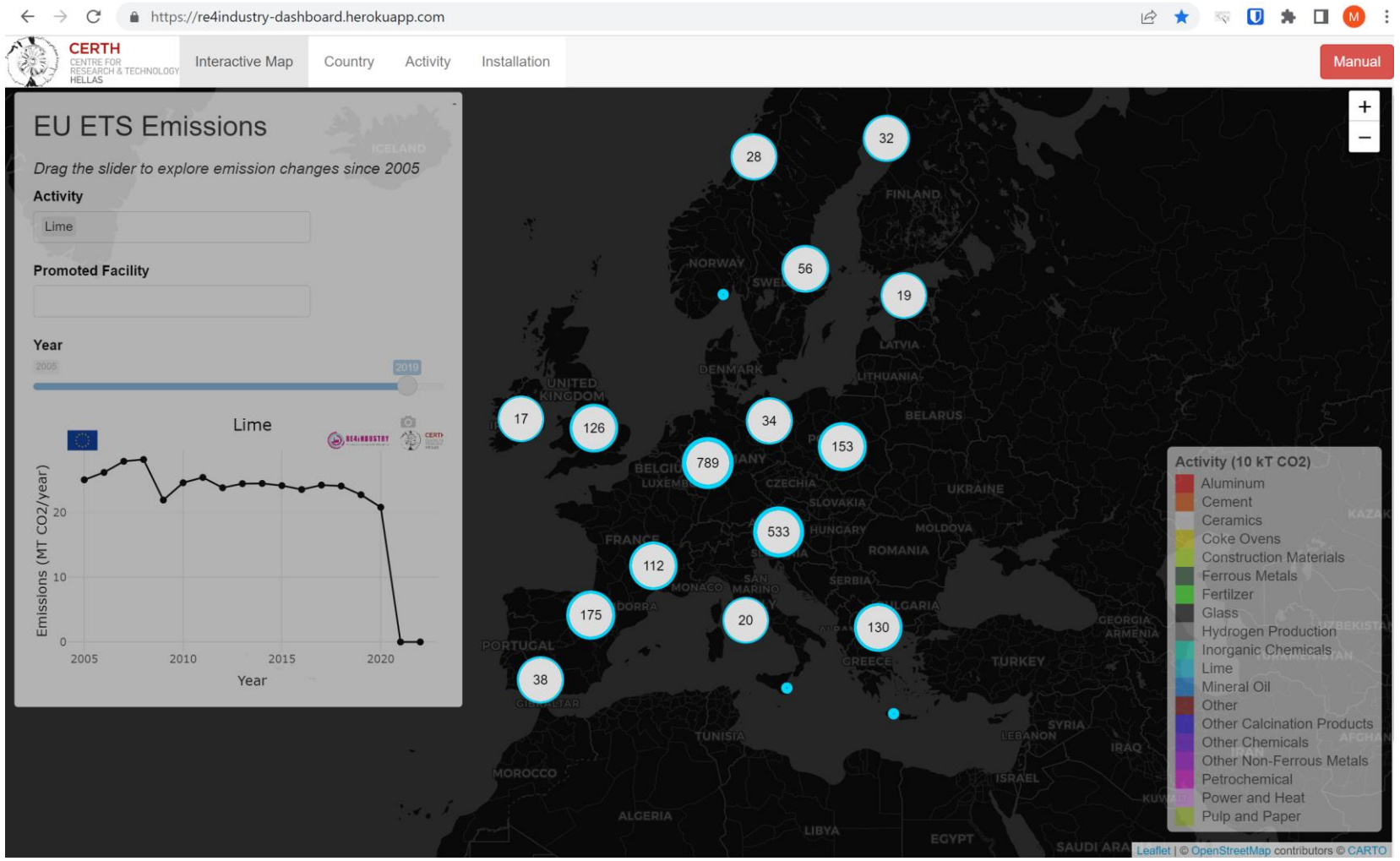
Biomass is a well-established option for wood & food processing industries – but what **about Energy Intensive Industries** such as cement, **lime**, steel and others?

Source: Bioenergy Europe, Bioheat Statistical Report 2022

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

The European lime industry



- Around 167 lime installations operating, i.e. producing CO_2 emissions in EU-27; 10 installations in the UK and 4 in Norway (2019)
- Total EU-ETS emission from lime plants: 21.1 Mt (2019)
- Largest site (Germany) → 1.7 Mt CO_2
- Smallest site (Latvia) → 1,767 t CO_2

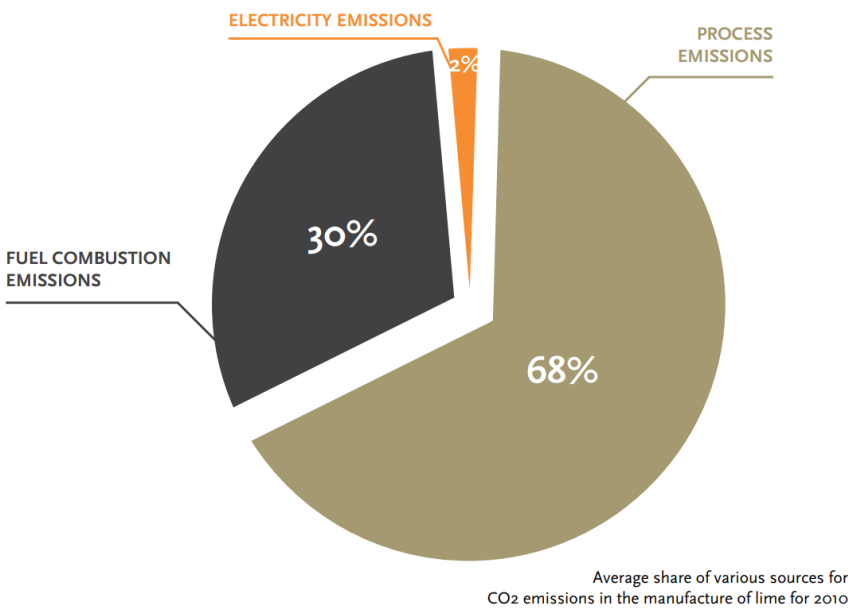
Source: RE4Industry mapping tool; EU-ETS data

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

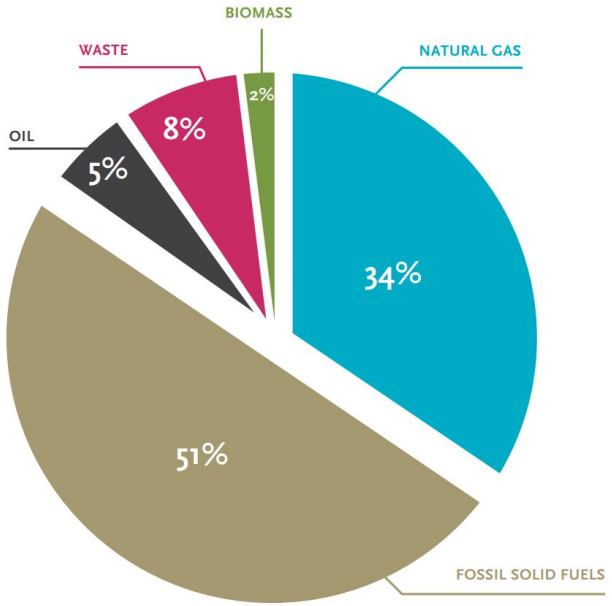
CO_2 emissions & fuel use in lime industry

AVERAGE SHARE OF CO_2 EMISSIONS FROM THE MANUFACTURE OF LIME



Average share of various sources for CO_2 emissions in the manufacture of lime for 2010

FUEL MIX 2010, (EULA, 2012).



- Average thermal energy consumption: 4,250 MJ/t quicklime; temperature level of around 900 – 1,200 °C
- EU quicklime production: 22 Mt (2021)
- EU-ETS emission from lime plants: 21.1 Mt (2019) → **around 6.3 Mt of CO_2 can be abated by a switch to carbon neutral biomass in the EU lime industry → around 5.5 Mt of pellets (17 MJ/kg) or equivalent biomass fuels would be need**

Sources: EuLA (2019) Summary of technical report: "A competitive and efficient lime industry"; Eurostat; RE4Industry mapping tool; Bioenergy Europe calculations

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

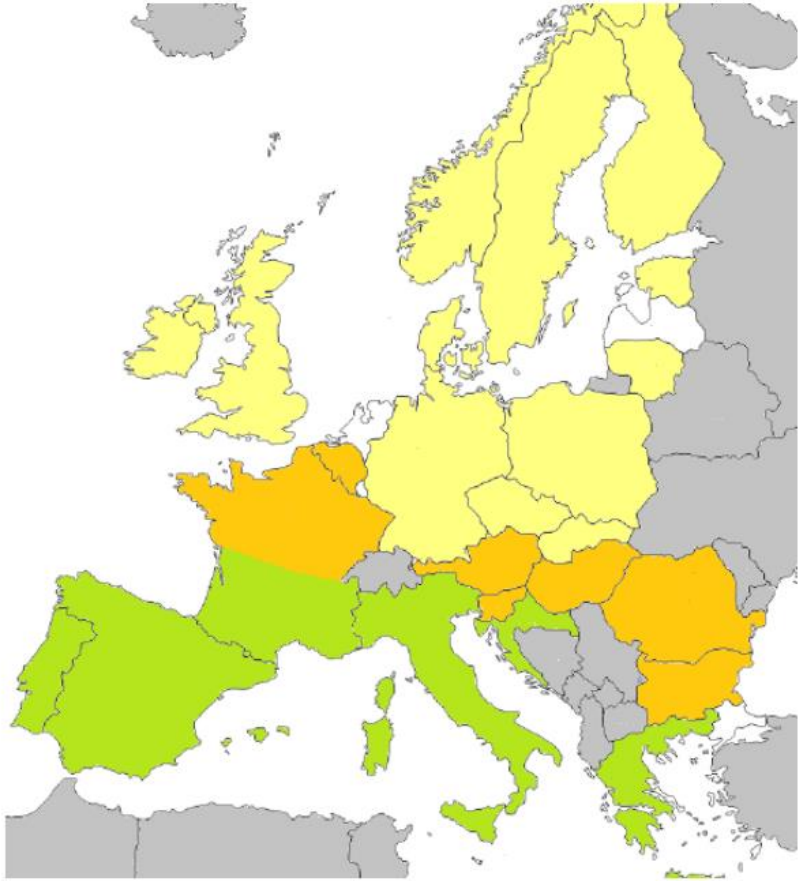
Bioenergy and the lime industry – status quo

FIGURE 1: GEOGRAPHICAL CONSUMPTION OF BIOMASS IN THE LIME SECTOR IN 2018

Northern Europe: no biomass used

Middle Europe: 1% of the biomass used in Europe

Southern Europe: 99% of the biomass used in Europe



- Biomass "represents only 5% of the fuel mix used in the EU lime sector"
- "(very) small sub-installations (**using only biomass as a fuel**) exclusively in Southern Europe due to very specific local conditions" → among 10 most efficient installations for the purposes of Article 10a (1) of the Directive 2003/87/EC

Source: EuLA (2018) EU ETS position paper on how to consider biomass when updating the lime & dolime product benchmarks in Phase IV

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

Bioenergy and the lime industry – status quo & targets

Lhoist

	Unit	2022 target	2021 target		2021	2020	2019	2018	Notes
Planet									
Emission intensity lime and dolomitic lime production									
CO_2 emissions (Scope 1)	kg CO_2/t				**1 204**	1 211	1 216	1 228	(3)
CO_2 emissions from fuel	kg CO_2/t	392	405	✔	**400**	404	408	413	
CO_2 emissions from raw materials	kg CO_2/t				**791**	794	794	801	
Fuel mix for lime and dolomitic lime production									
Solid fossil fuels	% GJ				**65%**	66%	69%	72%	
Low-carbon fossil fuels (e.g. natural gas)	% GJ				**24%**	23%	19%	17%	
Recycled	% GJ				**6%**	6%	7%	7%	
Biomass	% GJ				**5%**	5%	5%	4%	
Electricity									
Electricity consumption	GWh				**1 385**	1 298	1 376	1 397	
Renewable electricity share	%				**34.3%**	33.0%	31.5%	29.2%	(4)
Own and contracted renewable electricity share	%	2.5%			**2.3%**	2.4%	0.0%	0.0%	(5)
Renewable electricity projects	#		> 7	✔	**10**	NR	NR	NR	
Valorisation and preservation of resources									
Sites with lime and dolomitic lime processing yield above 95%	%	85%			**76%**	74%	NR	NR	
Active sites with long term mine plans	%	> 90%			**87%**	NR	NR	NR	
Biodiversity									
Regions with biodiversity management plans	%		100%		**75%**	NR	NR	NR	
Active quarries with a biodiversity management plan	%	25%			**9%**	NR	NR	NR	

Table with key figures

CARMEUSE

Topic	Current status (2022)	Target 2030
Ecovadis rating	6 countries achieved Platinum level, 3 Gold, 1 Silver	All Platinum
Recordable Injury rate	7.9 in 2022	0
Training hours/ employee/ year	32.1	25 (equally spread over all Carmeuse locations)
Community projects	27 in 2022	Min. 2 per site per year
Biodiversity	46 ha (or 121 acres) restored for biodiversity purposes globally	330 ha (cumulative between 2020 and 2030)
Quarry yield improvement (Kiln Feed Limestone) compared to 2019	2.1 %	5%
CO_2 emissions	1.3 tons of CO_2 /ton of lime	0.9 tons of CO_2 /ton of lime
Alternative fuels (Waste Fuels, Biomass, ...)	2.1%	35%

Source: Lhoist 2021 Sustainability Report (left) & Carmeuse Sustainability State of Play 2023 (right)

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

Bioenergy for the lime industry: the whys and hows

The motivation:	The questions:
Carbon neutral & cost-attractive fuel	How can I fit biomass in my lime plant?
Solution available now	Is there enough biomass available…
Easier technical integration in existing facilities	… and under what conditions?
In combination with CCS → carbon removals	Is biomass sustainable?

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

Technical integration – wood powder firing

PFR (Parallel Flow Regenerative) kiln – proven technology

Post-milling wood dust requirements

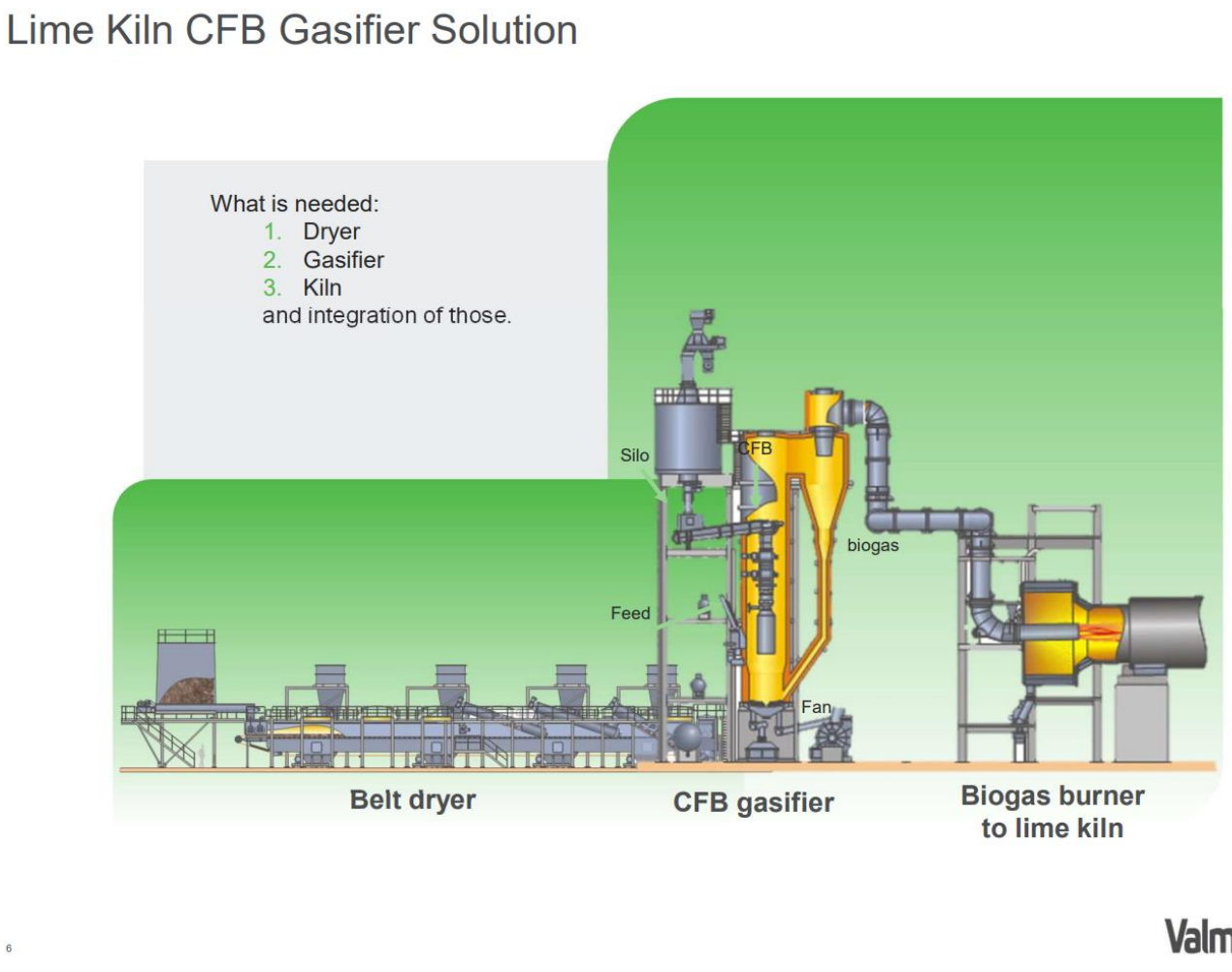
General specification for wood dust or other biomass used in Maerz PFR lime kilns		Enviva wood pellets after milling
Lower calorific value	>16 MJ/kg	17GJ/t
Particle size distribution	>1.0 mm <20 wt.% >2.0 mm <5 wt.% >3.0 mm =0 wt.%	✓
Volatiles	>50 % wt.% (ad)	✓
Ash	<2 wt.% (ad)	✓
Sulphur	depending on lime quality	✓
Total water content	<12 wt.%	✓
Nitrogen	< 0.5%	✓
Bulk density	>200 kg/m^3	✓
Particle shape	no needles, no fibres	✓
Minimal limestone size*	40 to 80 mm	✓

Sources: Maerz, Enviva Biomass

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

Technical integration – gasification

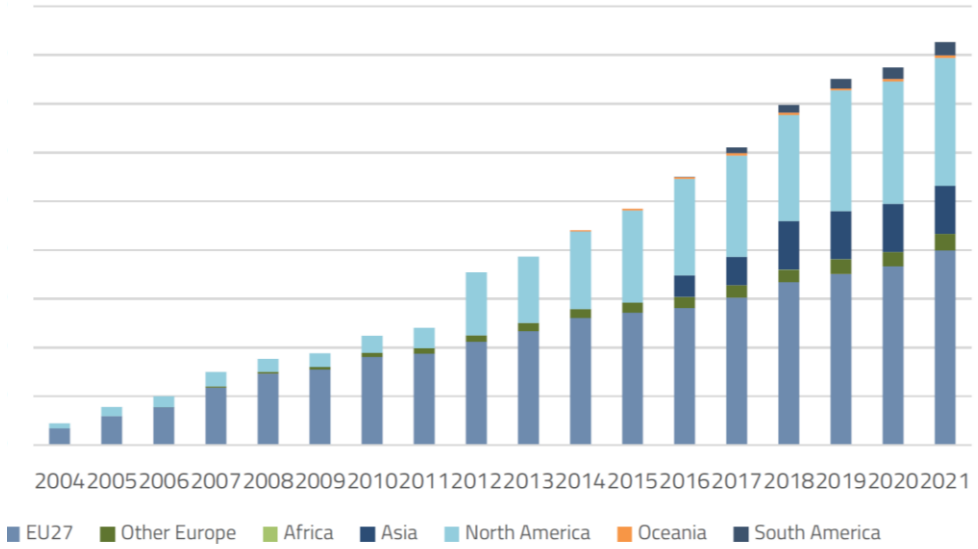


- At least 6 applications in larger lime kilns integrated in pulp mills
- Increased fuel flexibility → use of bark, waste, etc. is feasible

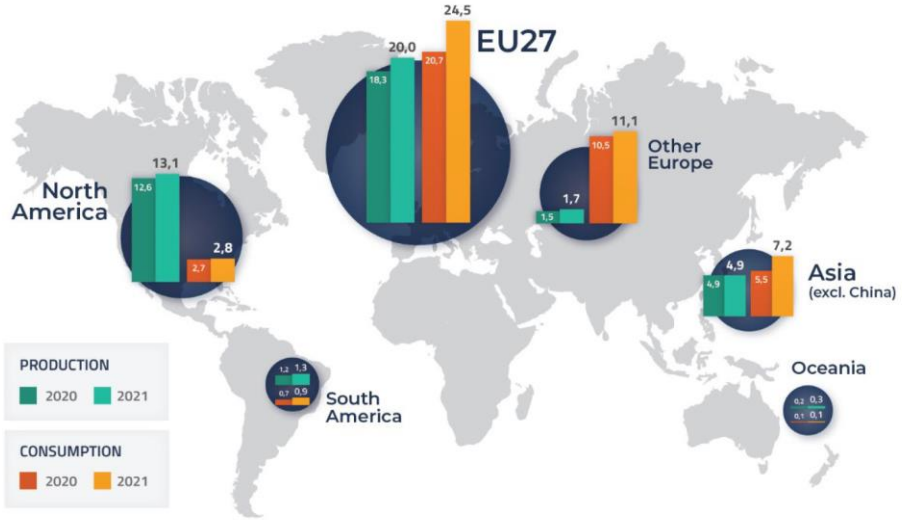
Sources: Valmet presentation at IEA Bioenergy eWorkshop (20 October 2020)

Biomass availability

Evolution of global wood pellet production



World pellet map of production and consumption in 2020 and 2021 (million tonnes)



- Wood pellets: global commodity with production > 45 Mt (2021)
- Consumption split almost equally between residential/commercial sector and industrial (power/CHP)
- **Large-scale wood pellet suppliers actively targeting the lime sector**
- **Beyond wood pellets, other biomass fuels (e.g. wood chips, agropellets, agroresidues) may be of interest for lime installations**

Source: Bioenergy Europe (2022) Pellets Statistical Report
Note: Other Europe excludes data from Russia, Belarus and Ukraine

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

European Wood Pellet Consumption

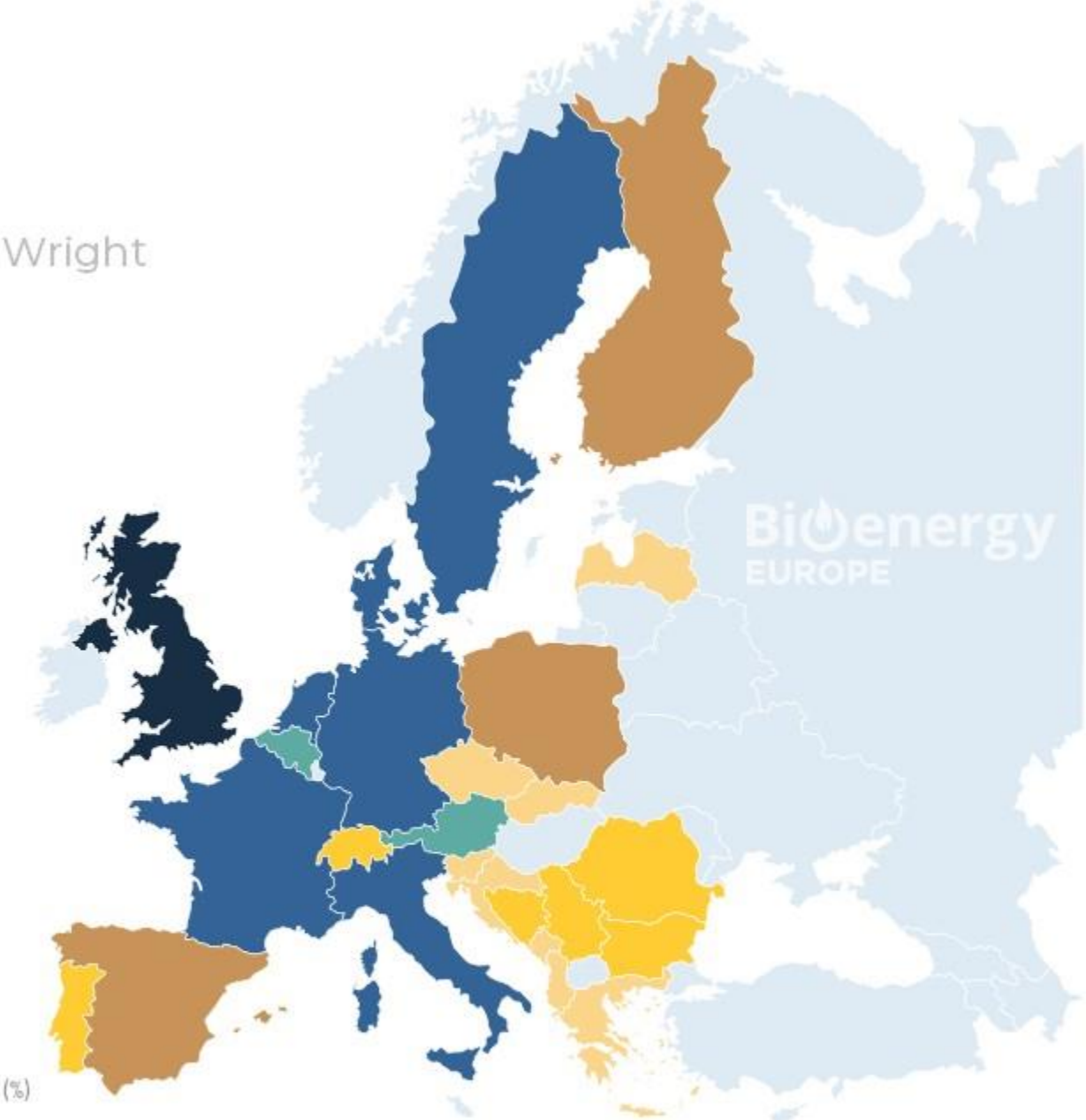
(in 2021, tonnes, %) Source: EPC Survey 2022, Hawkins Wright

Actual Consumption (tonnes/year)

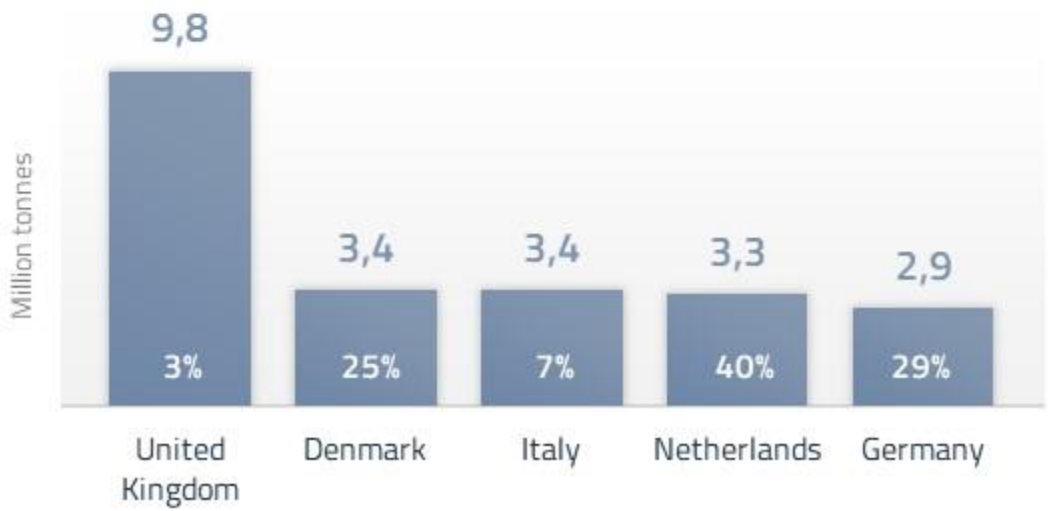
- > 4M
- < 4M
- < 2M
- < 1M
- < 500.000
- < 200.000

EU-27 consumption increased by 18% between 2020 and 2021

2021 European Consumption	2021 EU-27 Consumption
35,6 Million tonnes	24,5 Million tonnes



Consumption in top 5 European countries in 2021



Bioenergy EUROPE

BIOENERGY EUROPE STATISTICAL REPORT 2022

EUROPEAN PELLET COUNCIL
A NETWORK OF BIOENERGY EUROPE

Biomass Sustainability - REDII

Why are biomass sustainability criteria of REDII (Directive 2018/2001) important?

1. To be accounted for **RES-target** and **sectorial sub-targets**
2. To be elibigible for **public financial support**
3. To be **zero-rated in ETS system**

Harvesting requirements

LULUCF requirements

GHG emissions savings requirements

SPECIAL CONSIDERATIONS AND EXEMPTIONS

- **Biomass fuels produced from waste and residues**: only GHG criteria and soil quality requirements for agricultural biomass apply
- **Small installations** below 20 MW for solid biomass fuels and 2 MW for gaseous biomass fuels of thermal capacity are exempted (but MS may set lower threshold)
- **Energy efficiency criteria** apply only to large-scale bioelectricity installations (above 50 MW)

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

How to certify biomass sustainability?

- 15 Voluntary schemes & National Schemes formally recognized by the EC as of June 2023
- Some applications for recognition pending to be approved
- The recognition by the Commission is not a pre-requisite for certification. EU countries may accept evidence from voluntary schemes or national certifications schemes set up by EU countries not recognised by the Commission if the competent authorities in those countries are confident about the quality of the certification services provided by these schemes.

More information:
https://energy.ec.europa.eu/topics/renewable-energy/bioenergy/voluntary-schemes_en

- Biomass Biofuels voluntary scheme (2BSvs)
- Better Biomass
- Bonsucro EU
- International Sustainability and Carbon Certification (ISCC EU)
- KZR INiG system
- REDcert
- Red Tractor Farm Assurance Combinable Crops & Sugar Beet Scheme (Red Tractor)
- Roundtable of Sustainable Biofuels EU RED (RSB EU RED)
- Round Table on Responsible Soy EU RED (RTRS EU RED)
- Scottish Quality Farm Assured Combinable Crops (SQC)
- Trade Assurance Scheme for Combinable Crops (TASCC)
- Universal Feed Assurance Scheme (UFAS)
- Sustainable Resources (SURE) voluntary scheme
- Sustainable Biomass Program (SBP)
- Austrian Agricultural Certification Scheme (AACS)

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

CHANGES IN REDIII – OUTCOME OF TRILOGUE DEAL

Lower exemption threshold, covering smaller plants
(EP 7.5 MW thermal capacity)

Ban on feedstocks
(No new definitions, such as primary woody biomass, and no bans)

Ability to provide support
(End of subsidies for IGR and stumps and roots, restrictions on new power-only using forest-biomass)

Cascading use of biomass
(Regulated in the text, allows for exceptions)

Details on SFM practices
(stricter language, explicit references to clear cuts and deadwood extraction)

GHG emissions saving thresholds
(All installations will have to reach 80% with a grace-period for existing installations)

No-Go areas:
(Risk-based approach for A-level countries, strictly applied for B-level countries)

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

Bioenergy in the Net Zero Industry Act (NZIA)

- Meeting with Commissioner for Internal Market Thierry Breton with delegation of CEOs (including Lhoist) on 6 June
- Letter with more than 300 signatories to include bioenergy as a strategic technology in NZIA
- **Read more and sign the petition here:** https://bioenergyeurope.org/articles/424-open-letter-europe-can-count-on-the-bioenergy-industry-for-its-net-zero-goals.html

RE4INDUSTRY Renewable energies for industries

Bioenergy EUROPE

Concluding remarks

- The interest of the lime industry in biomass in real and growing
- Biomass is a good fit for the requirements of the lime industry
- Technical solutions are available for integrating biomass in lime plants: wood powder firing & biomass gasification
- The biomass fuels market has capacity to grow and in the medium-to-long term is expected to be able to supply the lime industry without major issues; building / adapting supply chains for the size of lime installations has some challenges
- Instability in sustainability framework is the most threatening factor → hopefully settled with REDIII?
- **Bioenergy Europe** will keep monitoring the evolution of biomass use in the lime sector and other energy intensive industries both within RE4Industry project and beyond

RE4INDUSTRY
Renewable energies for industries

Bioenergy
EUROPE

Thank You!

BioEnergy EUROPE

Manolis Karampinis | Business Development & Membership Director
karampinis@bioenergyeurope.org

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952936.

RE4Industry Success Cases – Decarbonising the Cement Industry

RE4Industry Webinar
Grüne Kalkindustrie: Herausforderungen und Chancen

Rainer Janssen, Olgu Birgi
WIP Renewable Energies, Munich

23 June 2023 (online)

www.re4industry.eu

RE4Industry Success Cases

Successful implementation or demonstration projects on integration of various forms of renewable energy in EIIs.

- ❑ Non-ferrous metals
- ❑ Cement & Lime
- ❑ Chemicals & Fertilizers
- ❑ Ceramics
- ❑ Glass
- ❑ Steel

Greece:

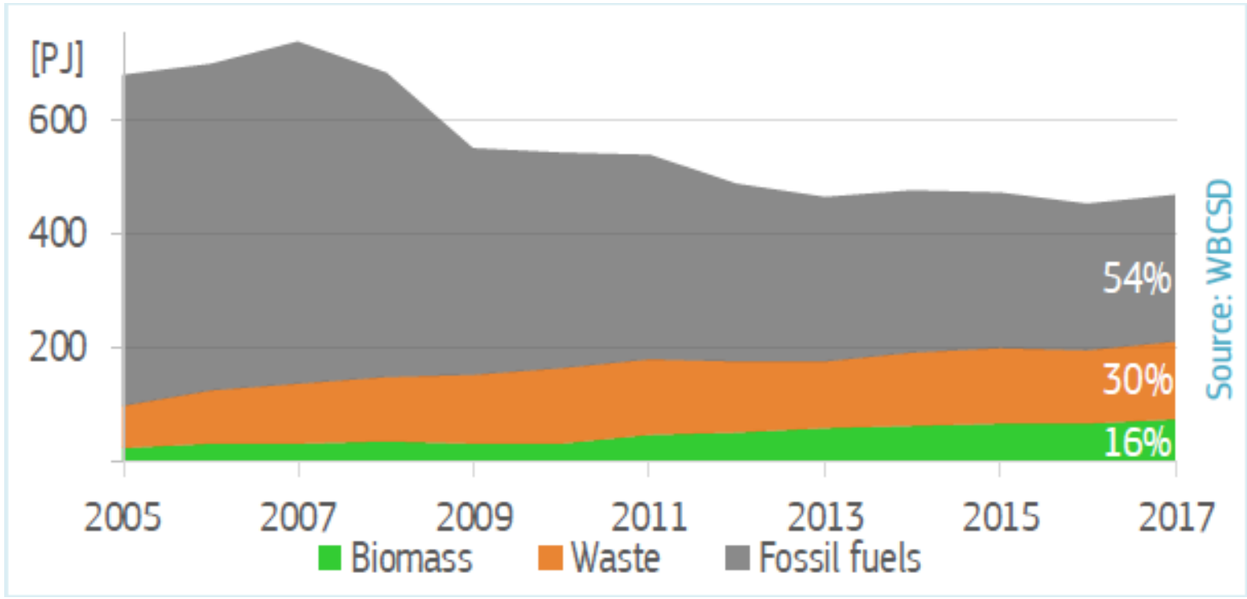
HERACLES/ Holcim Group

RE4INDUSTRY

HERACLES/ Holcim Group

HERACLES Group, a member of Holcim Group, founded in 1911
largest cement production company in Greece (annual turnover of more than 188 million EUR in 2020)

- Cement manufacturing is an energy intensive process – **high temperature needed (around 1450 °C).**
- **3,300 MJ of thermal energy** needed to produce one ton of clinker (In Europe with state-of-the-art technology).
- **Cement industry is a forerunner in the utilisation of alternative, low-cost fuels and reducing CO2 emissions.**
- The non-metallic minerals industry sector (cement and lime are a part) is the third largest industrial end-user **of biomass** in Europe and the only one that does not deal with biomass or organic wastes in its main activities.

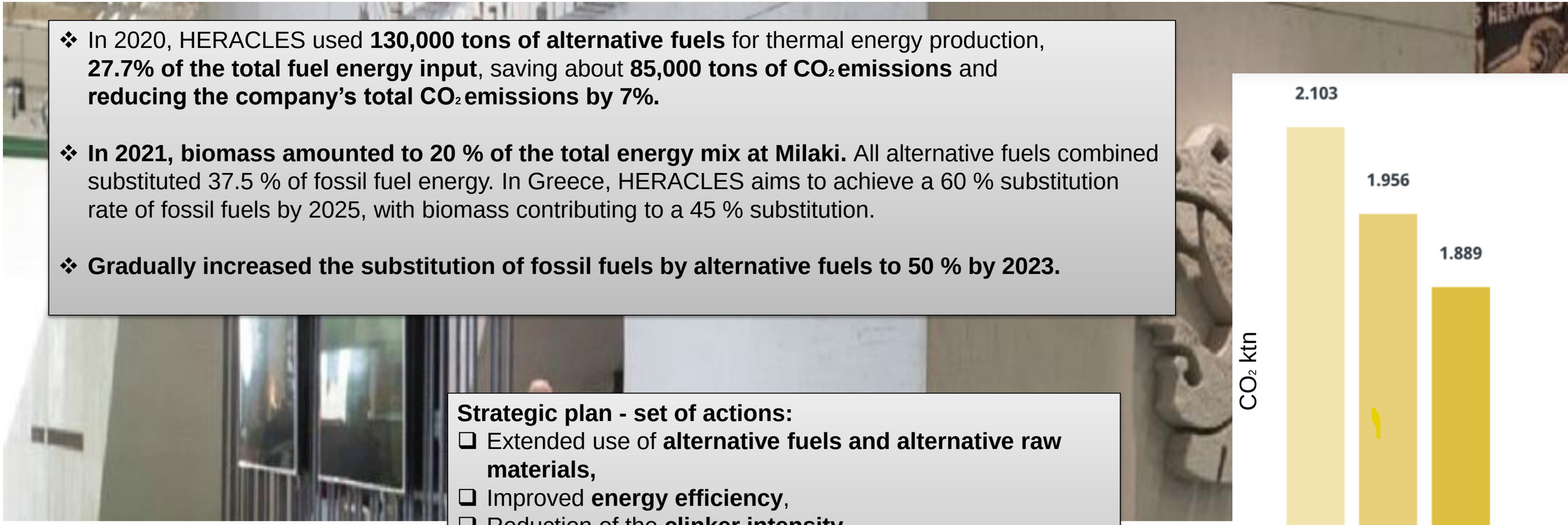


Share of fuels in the EU cement industry (https://www.wbcsd.org/)

Heracles designed and implemented an innovative project for **the co-processing of biomass for cement production** at its facilities in the Milaki Cement Plant

HERACLES/Holcim Group

HERACLES GROUP OF COMPANIES
A MEMBER OF HOLCIM GROUP



- In 2020, HERACLES used **130,000 tons of alternative fuels** for thermal energy production, **27.7% of the total fuel energy input**, saving about **85,000 tons of CO_2 emissions** and **reducing the company's total CO_2 emissions by 7%.**
- **In 2021, biomass amounted to 20 % of the total energy mix at Milaki.** All alternative fuels combined substituted 37.5 % of fossil fuel energy. In Greece, HERACLES aims to achieve a 60 % substitution rate of fossil fuels by 2025, with biomass contributing to a 45 % substitution.
- **Gradually increased the substitution of fossil fuels by alternative fuels to 50 % by 2023.**

Strategic plan - set of actions:

- ❑ Extended use of **alternative fuels and alternative raw materials,**
- ❑ Improved **energy efficiency**,
- ❑ Reduction of the **clinker intensity**
- ❑ Carbon Capture and Sequestration or Utilization (**CCS/U**)
- ❑ Use of **green hydrogen** as an alternative fuel for the kilns and as a feedstock in CCU processes

https://heracles-footprint.gr/gia-to-klima/ekpompes-co2/

RE4Industry

Success Case Factsheet

HERACLES/Holcim Group cement plant

Key information

Strategic goals of the company:
Reduction of the total gross CO_2 emissions to 1,522 kt CO_2 (2030) from 2,103 kt of CO_2 (2019)
Increase the substitution of fossil fuels by **alternative fuels** to **50 %** by 2023

Company: HERACLES Group (member of Holcim Group)

Founded: 1911

Plant: Milaki Cement Plant (founded in 1982)

Located: Evoia, Greece

Products:

- 6 types of Cement &
- 4 types of Clinker (EN, ASTM & API 10A),
- 6 categories of Solid Fuels

Decarbonisation activities

- The RE technology applied at the Milaki Cement Plant **(MCP**) is based on the co-processing concept of simultaneous recycling of mineral materials and recovery of energy within cement manufacturing;
- MCP is co-processing biomass, SRF and dried sewage sludge;
- The co-processing technology / alternative fuels use in the cement plants of HERACLES started in 2013. along with other measures applied at HERACLES facilities, contributes to the reduction of the total/specific CO_2 emissions;
- Supply of alternative fuels, including biomass, is carried out through Geocycle Hellas – a subsidiary of HERACLES focusing on non-hazardous waste management.

Environmental aspects

- ✓ GHG emission reduction
- ✓ Gaseous pollutants regulation
- ✓ Reduction of landfiling

Social aspects

- Fossil fuels substitution from alternative fuels & biomass is a key pillar of HERACLES sustainability program.
- Not developed AF market (few streams, circular economy is not yet established in all fields) maturity of AF production (not stable quantities/qualities), distance from big cities/industrial hub
- Use of biomass is a less controversial practice compared to the use of waste-derived fuelsSocial aspects

The future…

- The use of **alternative fuels** – including biomass – will continue to grow in importance, both for Holcim Group and for HERACLES. HERACLES aims to achieve a 60 % substitution rate of fossil fuels by 2025, with biomass contributing to a 45 % substitution
- **Carbon neutrality** is the ultimate goal for Milaki Cement Plant by adopting several actions: extended use of alternative fuels & raw materials, improved energy efficiency, reduction of clinker factor, preparation for carbon neutrality CCS/U.
- **CCS/U:** Milaki is getting prepared to become carbon neutral. A CCS scheme is under design: the CO_2 that can not be avoided by all other actions will be captured before emission & transported in appropriate facility for underground storage. The captured CO_2 will be also considered for utilization (e.g.CO22MeOH) in a later stage, as the market is not mature & synergies need to be developed.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952936.

Success cases can be found in the interactive mapping tool

Poland:

Witnica Solar Park- PPA with Heidelberg Materials Cement Plant

RE4INDUSTRY

Heidelberg Materials Cement Plant

Heidelberg Materials is one of the world's largest integrated manufacturers of building materials and solutions and has been contributing to these fields for over 50 years.
The company holds leading market positions in aggregates, cement, and ready-mixed concrete. By 2030, Heidelberg Materials aims to **reduce specific net CO2 emissions to 400 kg per ton** of cementitious material.

Since the beginning of 2021, Heidelberg Materials has signed agreements with pilot projects on various continents for renewable energy generation from wind and solar.

Witnica Solarpark is Poland's first industrial-scale, subsidy-free solar plant whose electricity is marketed through a long-term virtual power purchase agreement (VPPA).

The VPPA was signed between **Heidelberg Materials** and **BayWa r.e**. for 10 years.

The Witnica Project (solar park) is a significant step for Górażdże plant towards carbon neutrality.

- Installation of 159,856 PV panels from Jinko Solar
- Electricity sourced by Alternus Energy
- BayWa r.e. provides operation and maintenance activities at Witnica site for Alternus Energy

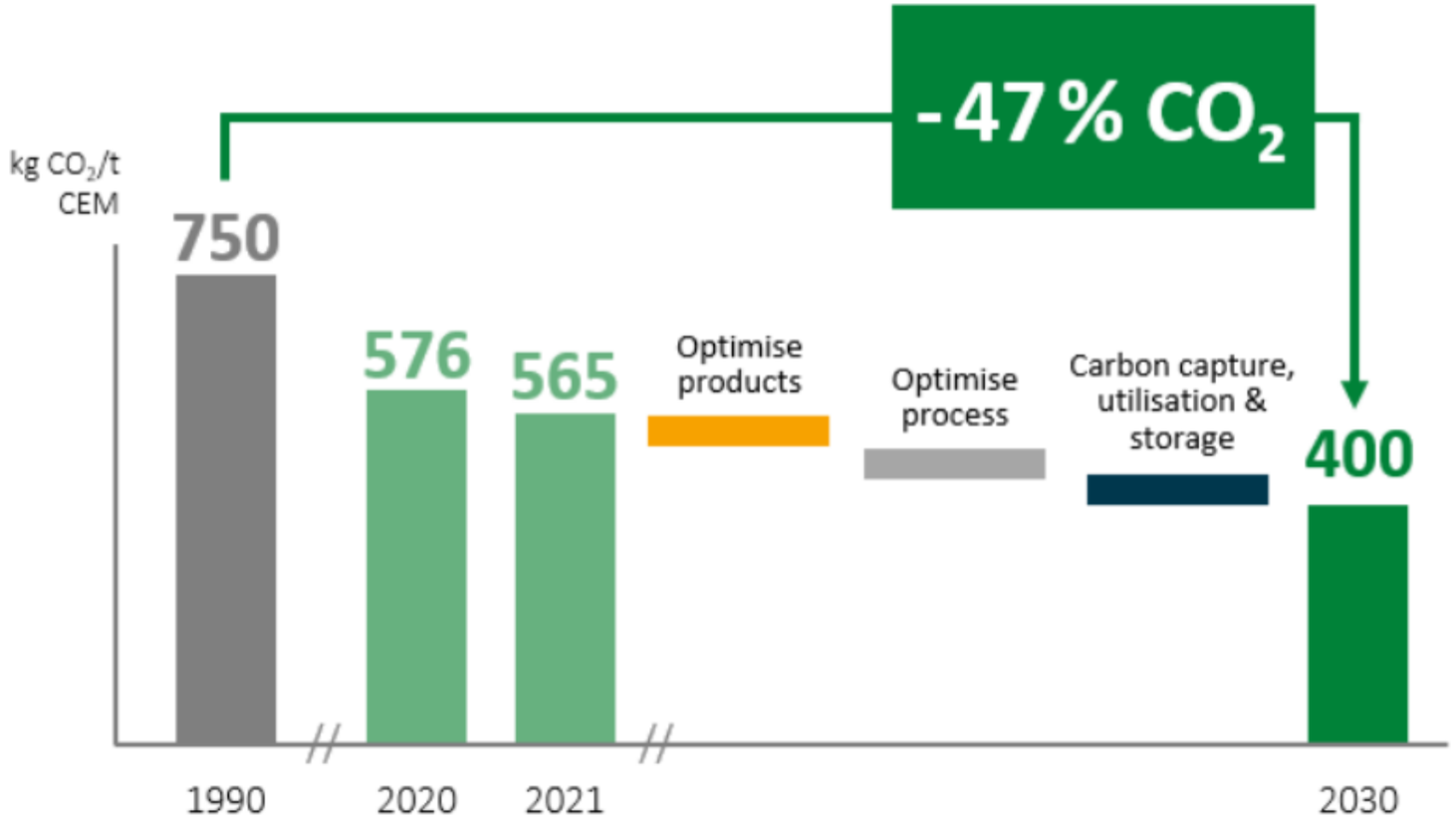
This project leads to:

- **63,000 t CO_2** emission reduction
- **68 GWh electricity produced** from RES annually
- The VPPA represents a significant step in Heidelberg Materials' road to **carbon neutrality in Scope 2 emissions.**

Heidelberg Materials Cement Plant

The measures Heidelberg Materials has been taking to lower the CO_2 emission include:

- Increased use of alternative raw materials and fuels (**alternative fuels, incl. biomass, accounted for 26.4% of the company's entire energy consumption in 2021**)
- **Substituting the CO_2 intensive clinker in cement by secondary cementitious materials** with a significantly lower CO_2 footprint.
- **Investing in plant efficiency** and **CO_2 reduction** at plant level
- Increasing the share of **sustainable low-carbon concrete products**



Targeted CO2 emission reduction by Heidelberg Materials between 1990-2030

RE4Industry

Success Case Factsheet

Heidelberg Materials Cement Plant

Key information

- Solarpark Witnica is Poland's first industrial-scale, subsidy-free solar plant whose electricity is marketed through a long-term virtual power purchase agreement (VPPA).
- The VPPA was signed between Heidelberg Materials and BayWa r.e. for 10 years.
- The Witnica Project (solar park) is a significant step for Górażdże towards carbon neutrality.

Heidelberg Materials

Founded: 1873

Products: Aggregates, cement & ready-mixed concrete

Target: Reduce CO_2 emissions by 400 kg/per ton of cementitious material (by 2030)

BayWa r.e.

Founded: Part of BayWa group (1923)

Products: End-to-end project solutions

Target: Climate neutrality by 2030

Operations: BayWa r.e. active in Poland since 2009

Plant: Górazdze (constructed in 1977)

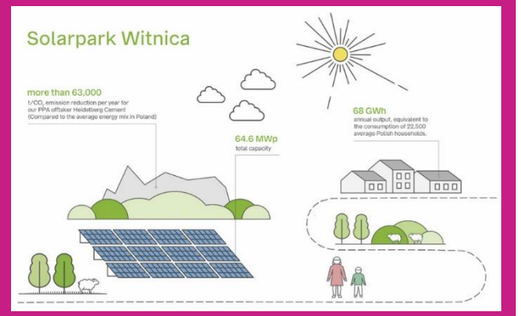
CO_2 emissions at Górazdze: 2.73 Mton (2018)

Goradze Cement SA, Target: Carbon-neutral concrete by 2050,

Achieving to a reduction of specific net CO_2 emissions to below 525 kg per tonne of cement-based material.

Technical aspects

- Installation of 159,856 PV panels from Jinko Solar
- Electricity sourced by Alternus Energy
- BayWa r.e. provides operation and maintenance activities at Witnica site for Alternus Energy



Organisational aspects

- The electricity produced is virtually provided to Heidelberg Materials for a period of 10 years.
- BayWa r.e. is involved as energy producer and Heidelberg Materials as off-taker.
- The solar park was sold to Alternus Energy Group in 2021.

Environmental aspects

- 63,000 t CO_2 emission reduction
- 68 GWh electricity produced from RES annually
- Provision of grid-connected green electricity contributing to Poland´s carbon reduction targets.
- Around 2,500 homes could be powered with the green electricity from the solar park .
- The VPPA represents a significant step in Heidelberg Materials' road to carbon neutrality in Scope 2 emissions.

Social & Marketing aspects

- The realisation of a solar park required extensive and detailed planning.
- The Environmental Impact Assessment was approved in 2014 by Urząd Miasta i Gminy, Witnica.
- Around 80% of Poland´s electricity is powered by fossil fuels ;however, the demand for renewables especially from the commercial and industrial sectors is growing day by day.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952936.

RE4INDUSTRY Renewable energies for industries

Success cases can be found in the interactive mapping tool

Share your

Renewable Energy experience

Become a RE4Industry sucess case!

Facilitate for Energy Intensive Industry sectors in Europe to a smooth and more secure transition towards the adoption of Renewable Energies (RE) in their production processes and facilities

We are looking for industrial success cases that can serve as an inspirational example for other industries in the European EII sector

Targeted technologies and applications

Successf implementation or **industrial R&D**, through demonstration projects, integration of various forms of renewable energy sourcing in the productive processes:

Targeted industries

RE4Industry is primarily targeting success cases from the following **Energy Intensive Industries sectors**:

Interested in becoming a RE4Industry success case?

Express your interest at **olgu.birgi@wip-munich.de**

RE4INDUSTRY
Renewable energies for industries

Rainer Janssen, Rainer.Janssen@wip-munich.de

Olgu Birgi, olgu.birgi@wip-munich.de

www.re4industry.eu

@eu_industry #re4industry

www.linkedin.com/company/re4industry

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 952936. The information and views set out on this presentation are those of the authors and do not necessarily reflect the official opinion of the European Union. Neither the European Union institutions and bodies nor any person acting on their behalf may be held responsible for the use which may be made of the following information.