Energy-Intensive Industries:
an outline of different needs for different industries

Online Briefing Session specially prepared for MEPs and Political Groups Advisers

in cooperation with the EEF Associate Members

Eurometaux
European Association of Metals

EUROFER
THE EUROPEAN STEEL ASSOCIATION

Cepi
RENEWABLE RECYCLED RESPONSIBLE EUROPEAN PAPER

fertilizers europe

Our event will start soon

@EEF_EnergyForum #EEFdebates

Please keep the Chatham House rule in mind when tweeting, thank you!

Non-Ferrous Metals Industry

Presented by Cillian O’Donoghue, Energy and Climate Change Director, **Eurometaux**

13 Al Aluminium | 29 Cu Copper | 28 Ni Nickel | 82 Pb Lead | 30 Zn Zinc | 79 Au Gold | 47 Ag Silver | 78 Pt Platinum | 51 Sb Antimony | 4 Be Beryllium | 14 Si Silicon | 27 Co Cobalt | 42 Mo Molybdenum | 23 V Vanadium | 50 Sn Tin | 46 Pd Palladium | 44 Ru Ruthenium | 75 Re Rhenium | 76 Os Osmium | 77 Ir Iridium | 74 W Tungsten | 73 Ta Tantalum | 32 Ge Germanium | 34 Se Selenium | 31 Ga Gallium | 24 Cr Chromium | 12 Mg Magnesium

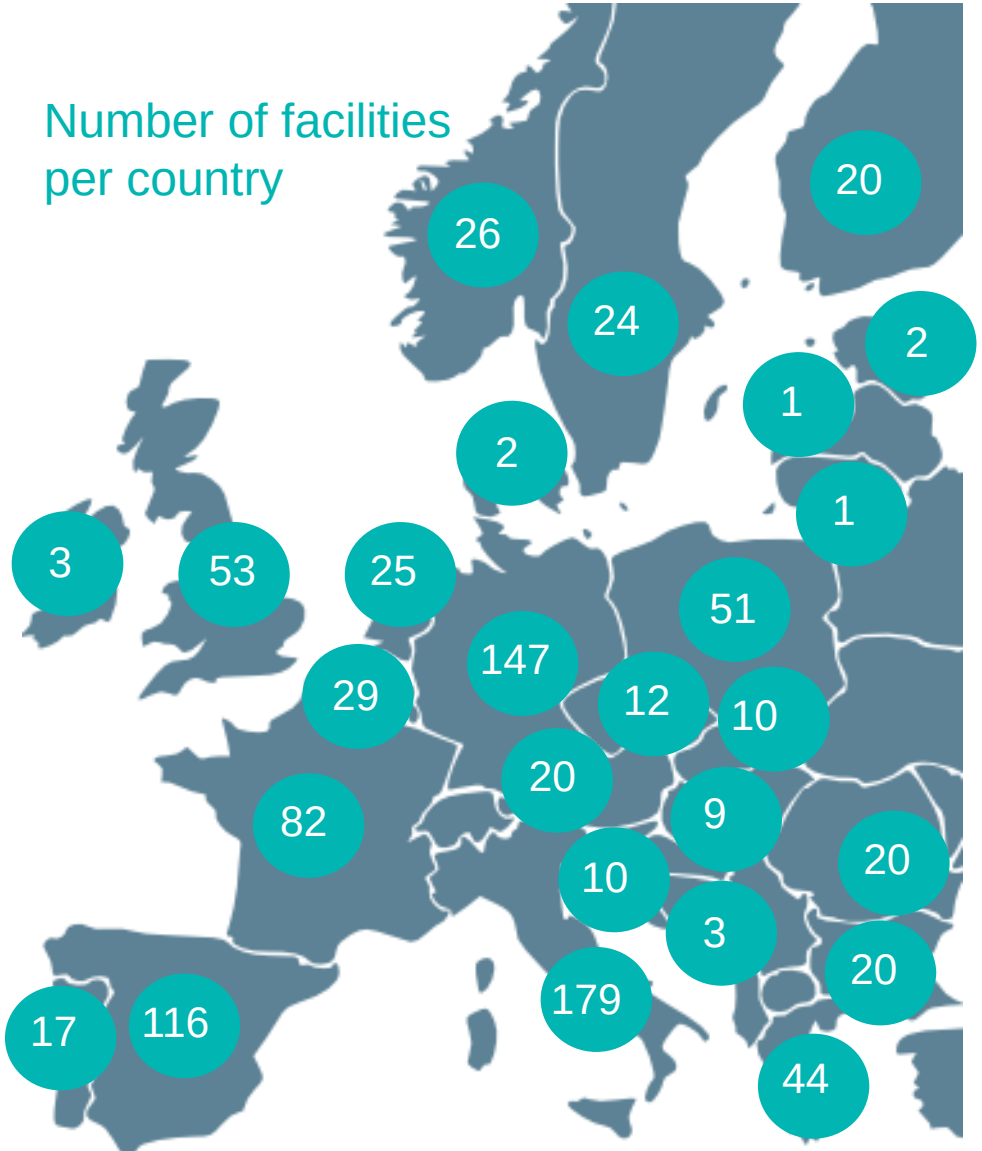
Europe’s non-ferrous metals industry – United

900+
facilities

500,000
direct jobs

€120 bn
annual turnover

1/5
global production



Slide provided by Eurometaux

Introducing the metals

Base Metals

13 Al Aluminium
29 Cu Copper
82 Pb Lead
28 Ni Nickel
30 Zn Zinc
50 Sn Tin

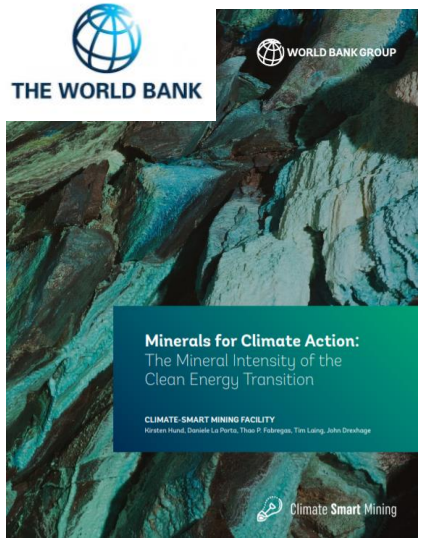
Precious Metals

79 Au Gold
47 Ag Silver
78 Pt Platinium
46 Pd Palladium
44 Ru Ruthenium
45 Rh Rhodium
76 Os Osmium
77 Ir Iridium

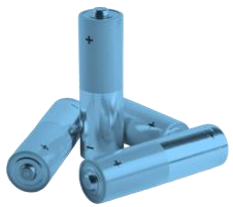
Technology Metals

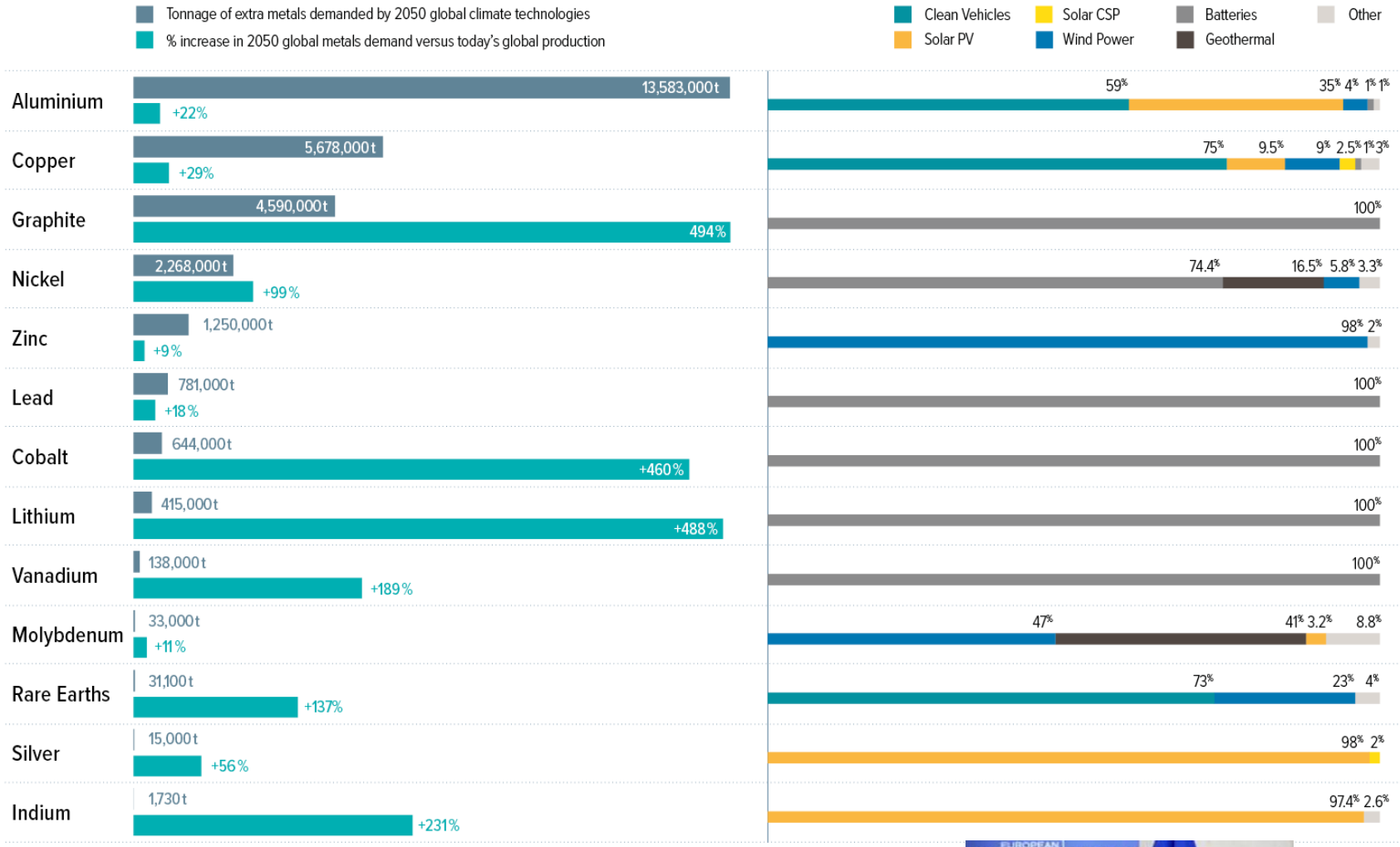
42 Mo Molybdenum
4 Be Beryllium
14 Si Silicon
51 Sb Antimony
27 Co Cobalt
23 V Vanadium
74 W Tungsten
73 Ta Tantalum
49 In Indium
34 Se Selenium
32 Ge Germanium
31 Ga Gallium
75 Re Rhenium
83 Bi Bismuth
52 Te Tellurium
25 Mn Manganese
3 Li Lithium
24 Cr Chromium
22 Ti Titanium
12 Mg Magnesium

Metals: The key raw materials of Europe's energy transition



Up to 500% more metals needed in the low-CO2 future





Data based on The World Bank "Minerals for Climate Action: The mineral intensity of the clean energy transition" (2020), UBS electric vehicle projections (2017), and author's own calculations.
Other metals - e.g. silicon, gallium, germanium, platinum group metals, magnesium, antimony - will also be required for climate technologies, but were not included in the World Bank's analysis.

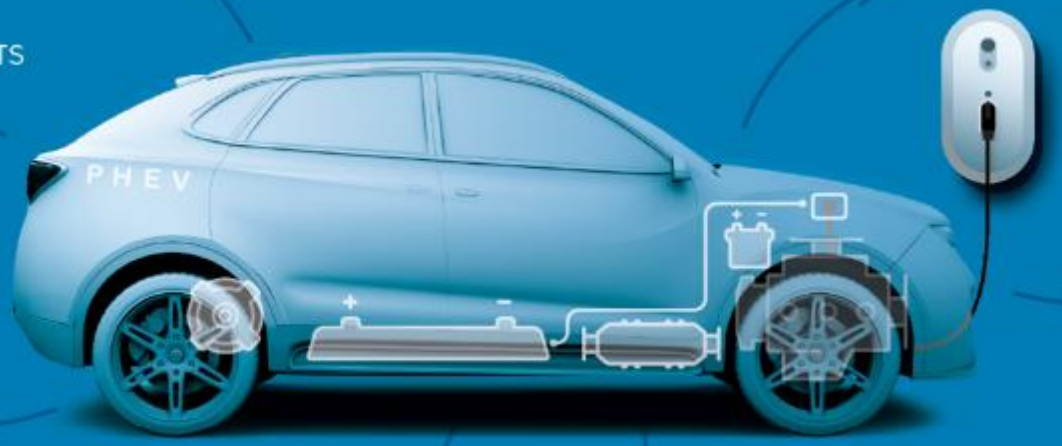
Sustainable investment prioritised in European Raw Materials Alliance

What raw materials drive EU clean mobility?

Zn Zinc
17kg†
>85%*
GALVANISED STEEL

Cu Copper
70kg†
>90%*
WIRING, BATTERY AND MOTORS

Al Aluminium
151kg†
>90%*
LIGHTWEIGHT AUTOMOTIVE PARTS



Dy Dysprosium **Nd** Neodymium
3kg† (combined)
PERMANENT MAGNETS
(in electric motor)

Pb Lead
12kg†
>99%*
LEAD-ACID CAR BATTERIES

LITHIUM-ION BATTERY PACKS

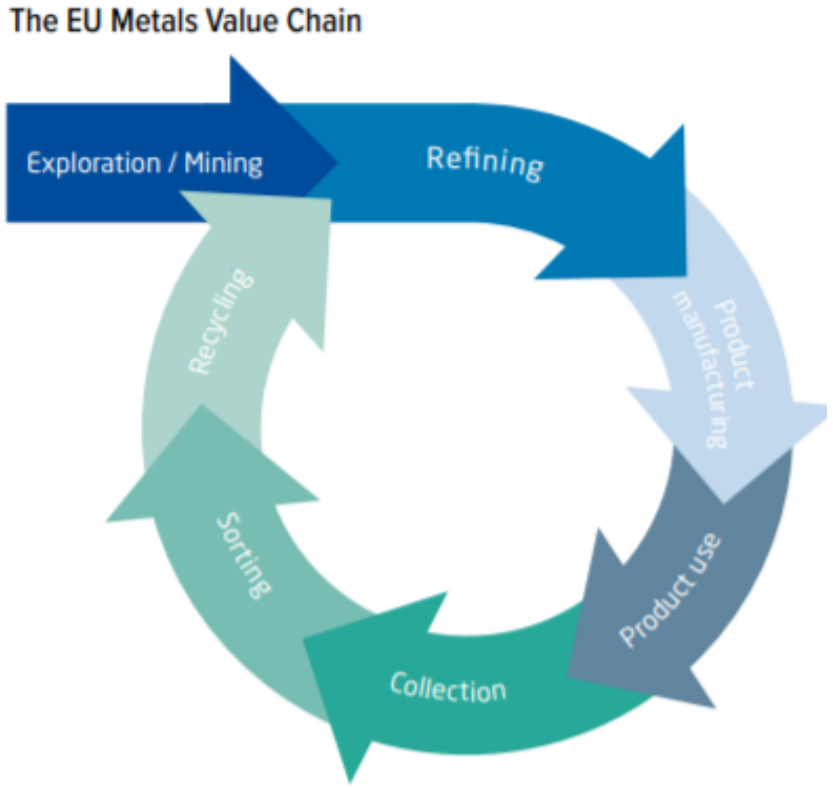
Li Lithium	Co Cobalt	Ni Nickel	Cu Copper
13kg†	14kg†	46kg†	30kg†

Rh Rhodium **Pd** Palladium **Pt** Platinum
15g† (combined)
>60%*
CATALYTIC CONVERTER

Source: World Bank

†Approximate weight in an average single vehicle | *percentage of the metal currently being recycled from European cars

From mining to recycling: The EU metals value chain



Non-ferrous base metals produced and/or recycled in the EU

EXTRACTION
Mining metal ores from the surface of the earth and separating them into concentrates

1% of world total*

SMELTING/REFINING
Treating primary ores and concentrates to separate the metals and refine into a purer form

6% of world total*

TRANSFORMATION
Processing pure metal into semi-finished and finished products (e.g. sheets, rods, extrusion)

figures not currently available

RECYCLING
Treating & refining secondary raw material (e.g. scrap, products)

24% of world total*

% Share of global production per metal
Al - 0.6%
Cu - 4.1%
Ni - 3.0%
Pb - 9.7%
Zn - 5.4%
Al - 4.0% **
Cu - 13.1%
Ni - 9.6%
Pb - 9.4%
Zn - 13.4%
Al - 30%
Cu - 23%
Ni - 29%
Pb - 18%
Zn - 19%

Over 50% of the base metals produced in Europe are already from recycled sources

Slide provided by Eurometaux

3 key climate facts about Europe's base metals production

Electro-intensive

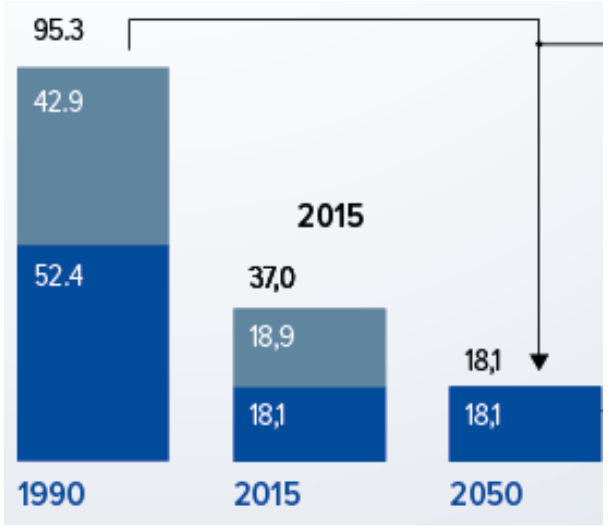
One of Europe's most electro-intensive industries

30 Zn Zinc — Electricity = ***40%*** of production costs

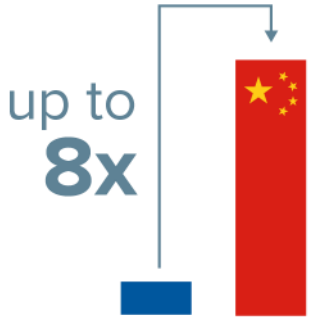
13 Al Aluminium — Electricity = ***40%*** of production costs

14 Si Silicon — Electricity = ***35-40%*** of production costs

81% GHG emission reduction potential from a decarbonised power system

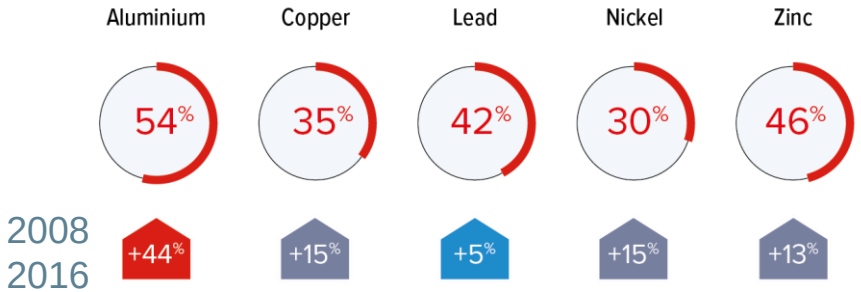


European Metals: Cleaner than our competitors**



European production is being replaced by imports with higher carbon footprint **

China dominates the global market



Government

€5.2bn

Direct subsidies to non-ferrous metals (2011-2016)

= 44% of after-tax profits

Slide provided by Eurometaux

* Source: World Bank 2017

** IES-VUB, 2019: Metals in a climate-neutral Europe

How can the Non-Ferrous Metals achieve decarbonisation

Our industry will continue to decarbonise building upon 3 pillars:

1.

Carbon-free Electricity

2.

Shift to low-CO_2 production processes through electrification and other technologies

3.

Circular Economy

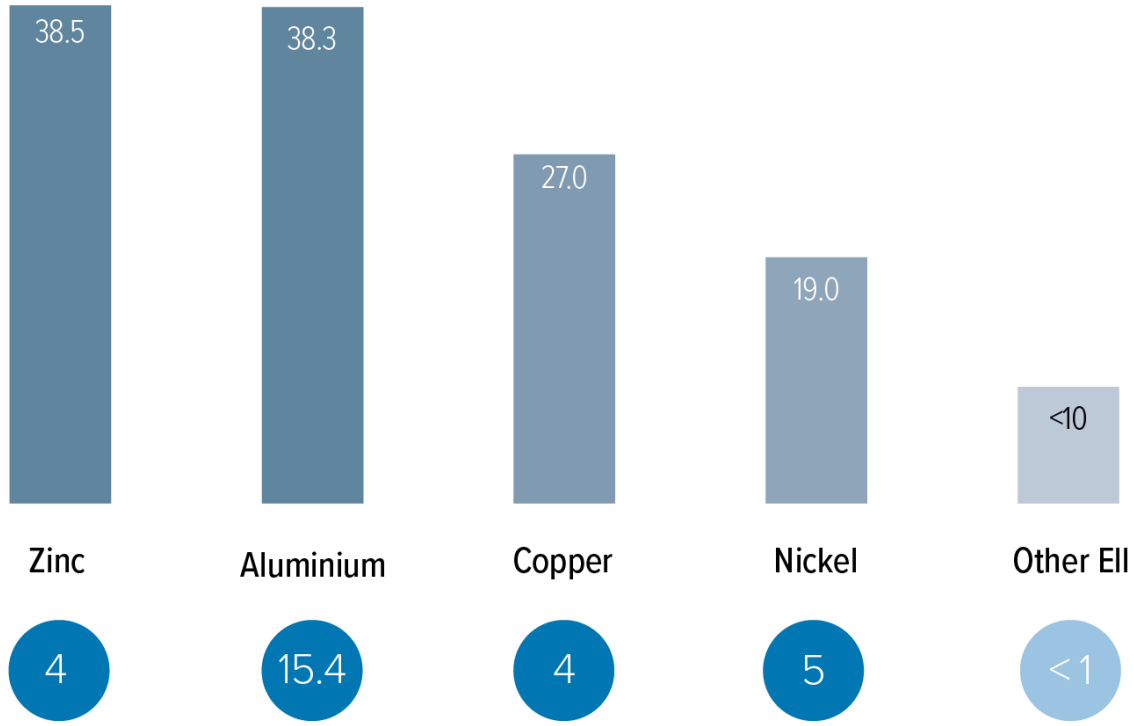
Let's have a look in detail...

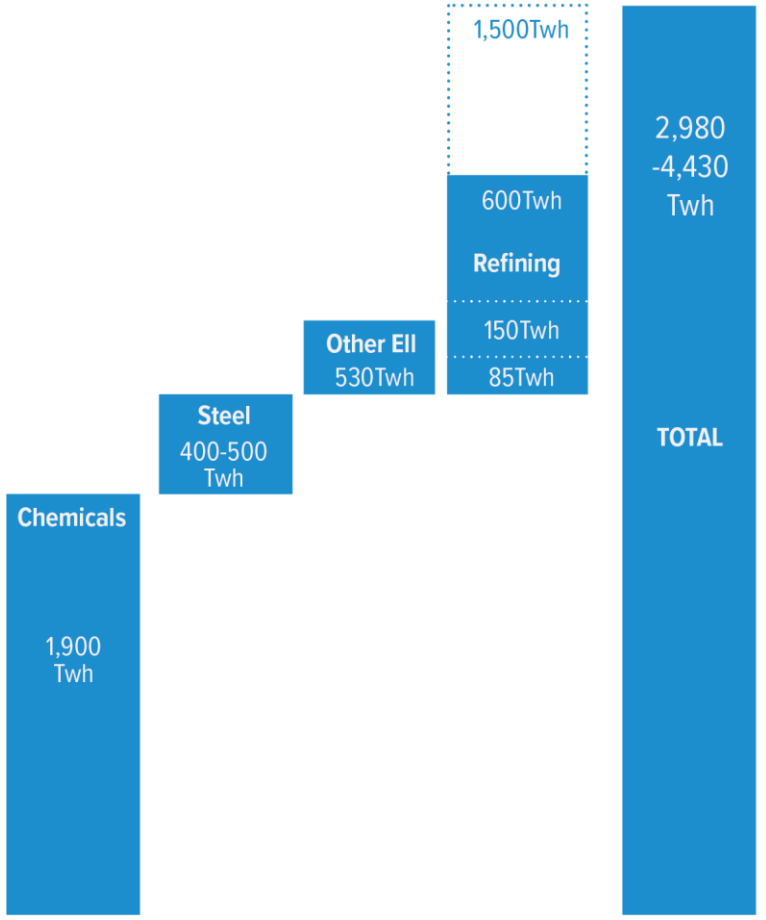
Electricity Consumption

Addressing 81% of our emissions

Electrification: Where the metals industry is a real bellwether

High levels of electrification vs. other energy-intensives





& Other Energy-Intensive Industries are expected to follow

Source: IES/VUB 2019 – Metals for a Climate Neutral Europe

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A decarbonised power system: the biggest factor in our climate transition

Scope 1
Direct Emissions from our industrial activities

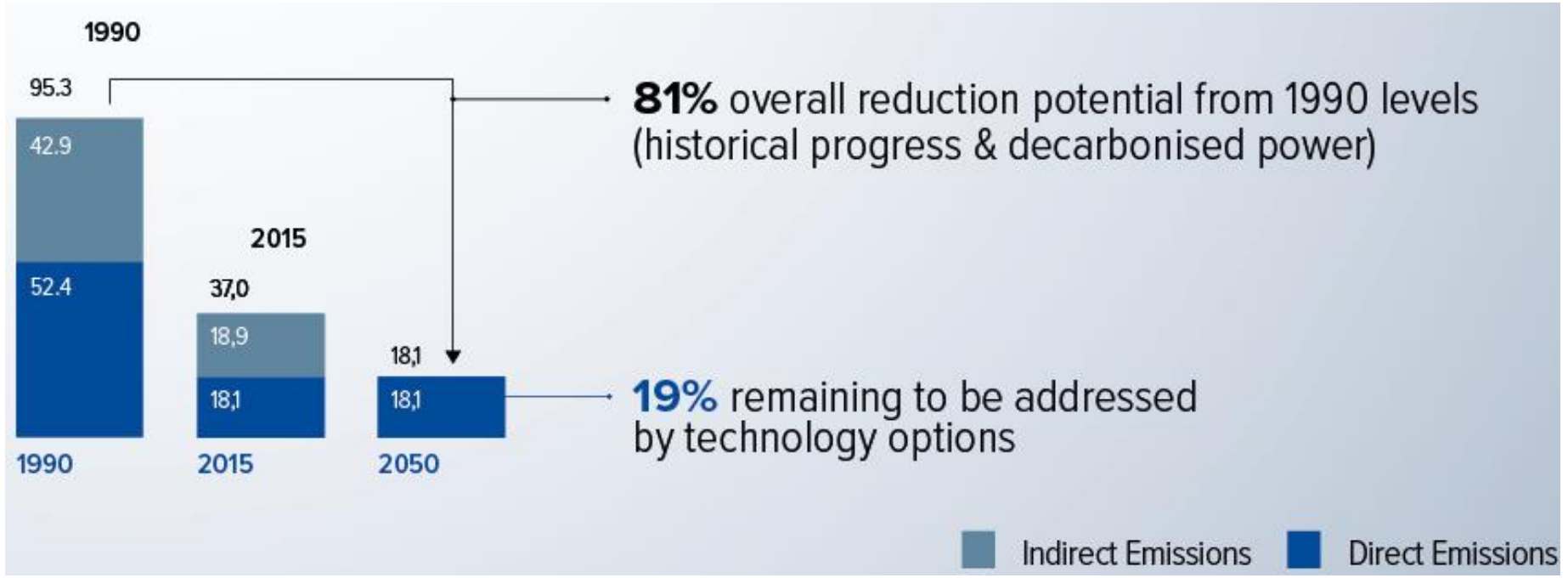
Scope 2
Indirect Emissions from the power purchased and consumed by industry

Scope 3
All other Indirect Emissions from sources industry doesn't control.

Due to our extremely high electrointensity, for non-ferrous metals the most important fraction of our GHG footprint to address are the indirect emissions embedded in the electricity we consume

Decarbonisation of power sector is essential

= **81%**
reduction of overall GHG emissions vs. 1990

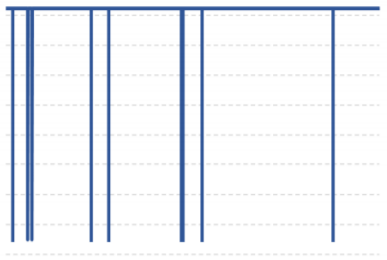


Renewable PPAs: Non-Ferrous Metals Leadership

We are baseload consumers

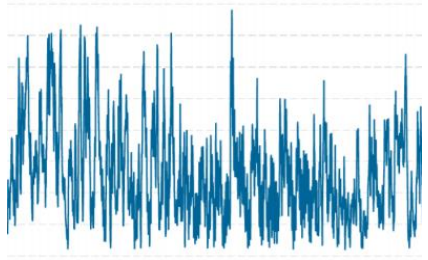
Wind/solar intermittent generation and aluminium baseload consumption production may not be natural allies at first sight…

Aluminium smelter hourly consumption profile in a year



Vs.

Wind hourly production profile in a year



However, these obstacles can be overcome

Renewable Energy + Add to myFT

FT FINANCIAL TIMES

Norsk Hydro in 'biggest' deal to secure wind farm energy

New renewables PPAs in our industry:

Hydro

~ 9 TWh/yr
Wind Power contracts in Norway beyond 2021

~4.5 TWh/yr
Wind Power contracts

Alcoa

~ 3 TWh/yr

Elkem

~ 1.8 TWh/yr

Long term renewable PPAs – a 'win-win' for both:

- **Developers:** Enabling new large scale wind farms through a stable revenue
- **Industry:** Long term horizon for investment– reduce risk of volatility by achieving predictable power costs

Shift to low-carbon production processes

Tackling the remaining 19% direct emissions

Remaining 19% direct emisssions requires a mix of mitigation technologies

Technology options	Relevance
Energy efficiency	+++
Anode technology aluminium	+++
Electrification (incl. shift to hydrometallurgical processes)	+++
Fuel shift – bio-based	+++
Higher metals recovery (slag and scrap)	+++
Sector coupling: demand response and waste heat	+++ (Decarbonisation enabler for other sectors)
Non-carbon reducing agents/hydrogen	++
CC(U)S	+

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New innovation: within reasonable business models

RioTinto Alcoa

Elysis: Carbon-free aluminium in Canada

- **Eliminates 100% GHG** emissions from the smelting
- First technology ever that **emits pure oxygen** as by-product

Hydro

Karmoy: world's most efficient aluminium

- **12.3 MWh** energy consumption
- **15%** more efficient than world average

Aurubis

Using copper heat to power Hamburg

- **20,000t** CO_2 savings
- **7x** potential increase potential in future

Elkem

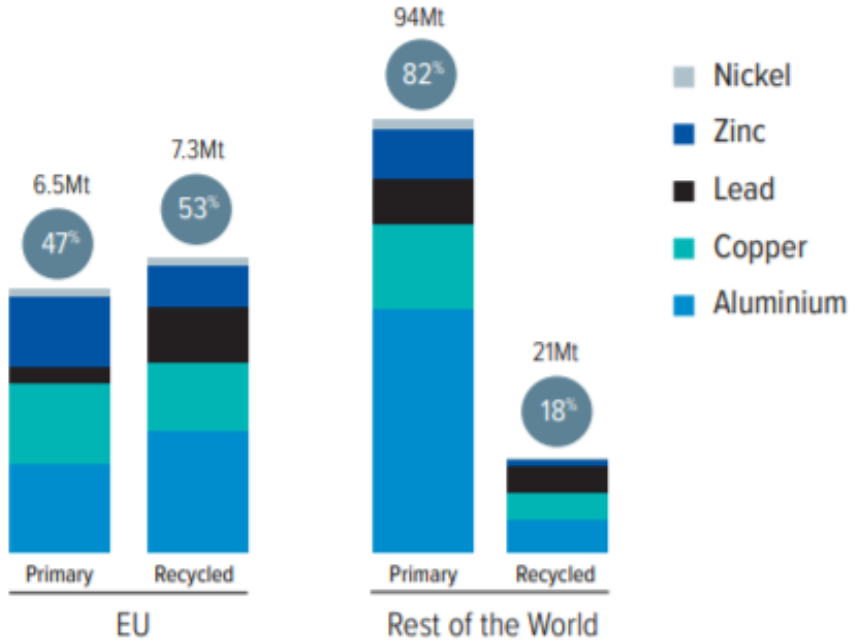
Towards carbon-neutral silicon

- **CO2 neutral** biomass charcoal
- **1.6mt** potential CO_2 savings

We are committed to invest & innovate when business conditions are right

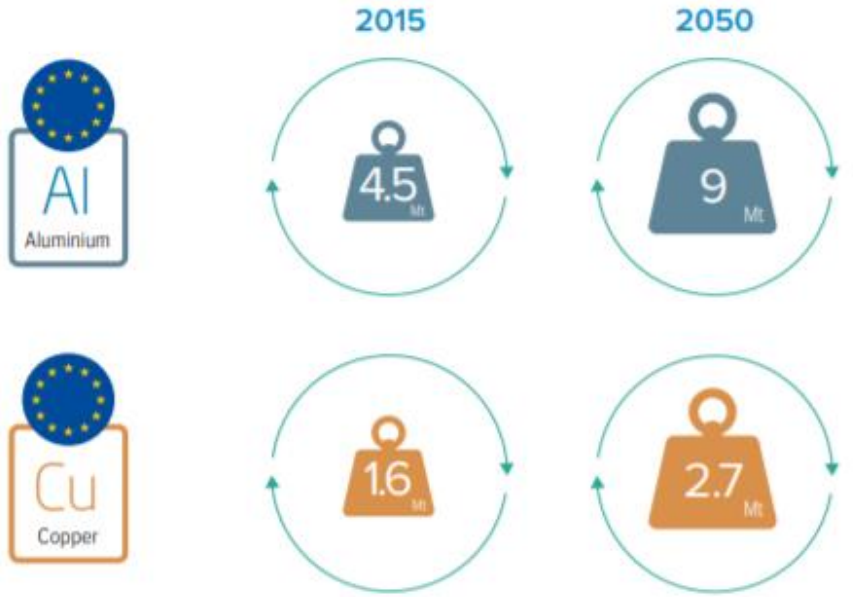
Circular Economy: Europe's metals scrap volumes to double between now and 2050

Percentage of primary and recycled base metals production in total base metals production EU and the Rest of the World.



Source: Fraunhofer ISI, OECD

Projected increase in EU aluminium and copper scrap volumes, 2015-2050 (Mt)



Sources: European Aluminium & OECD

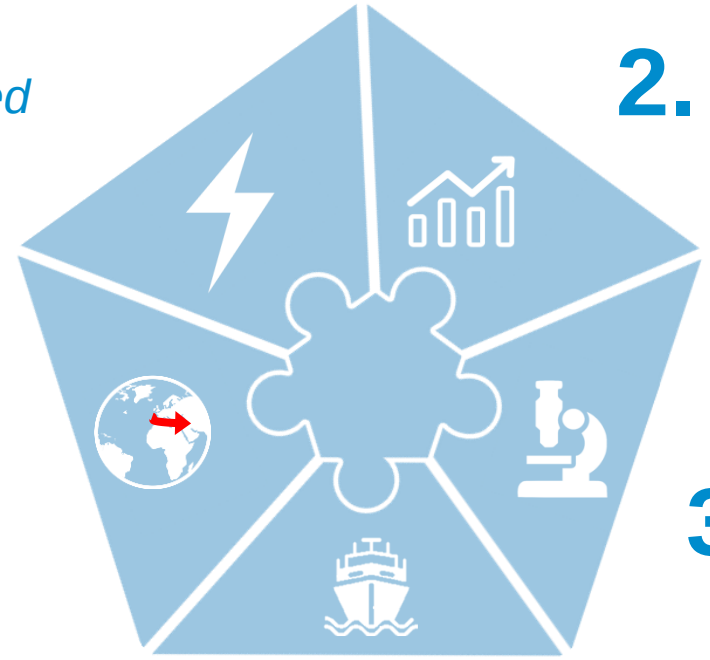
Europe's shift to more secondary production should aim to replace dependence on high-polluting imports, complementing consistent European primary production levels to match demand requirements

A five-part Industrial Strategy is needed to grow Europe's metals ecosystem alongside EU 2050 climate-neutral strategy

The framework conditions have been identified. We now call on EU policymakers to come forward with a combined climate and industry plan on how to deliver these conditions:

1. *Unlock competitively priced carbon-free electricity*

2. *Create Demand for low-carbon products*



5. *Adequate Carbon Leakage Protection*

3. *Financing & funding of breakthrough climate-neutral solutions*

4. *Assertive competition & trade policies*

Our Policy Requests

1

Our main policy request is to ensure a level playing field vis-à-vis non EU regions for our industry to compete.

2

In order to achieve this, we need three things:

i. **Competitive industry electricity prices**;

ii. **Adequate carbon leakage protection;** and

iii. **Funding for research and innovation**

3

Key pieces of legislation will soon be going through co-decision, most notably:

- **EU ETS review** → adequate carbon leakage protection
- **Carbon border adjustments mechanism (CBAM)** → a level playing field on indirect carbon costs

THANK YOU

- **Any Questions?**
- **If you want to learn more, please**
  - ✓ **Have a look at the IES/VUB 2019 Report →**
  - ✓ **Reach out to us at:**

bit.ly/metals2050

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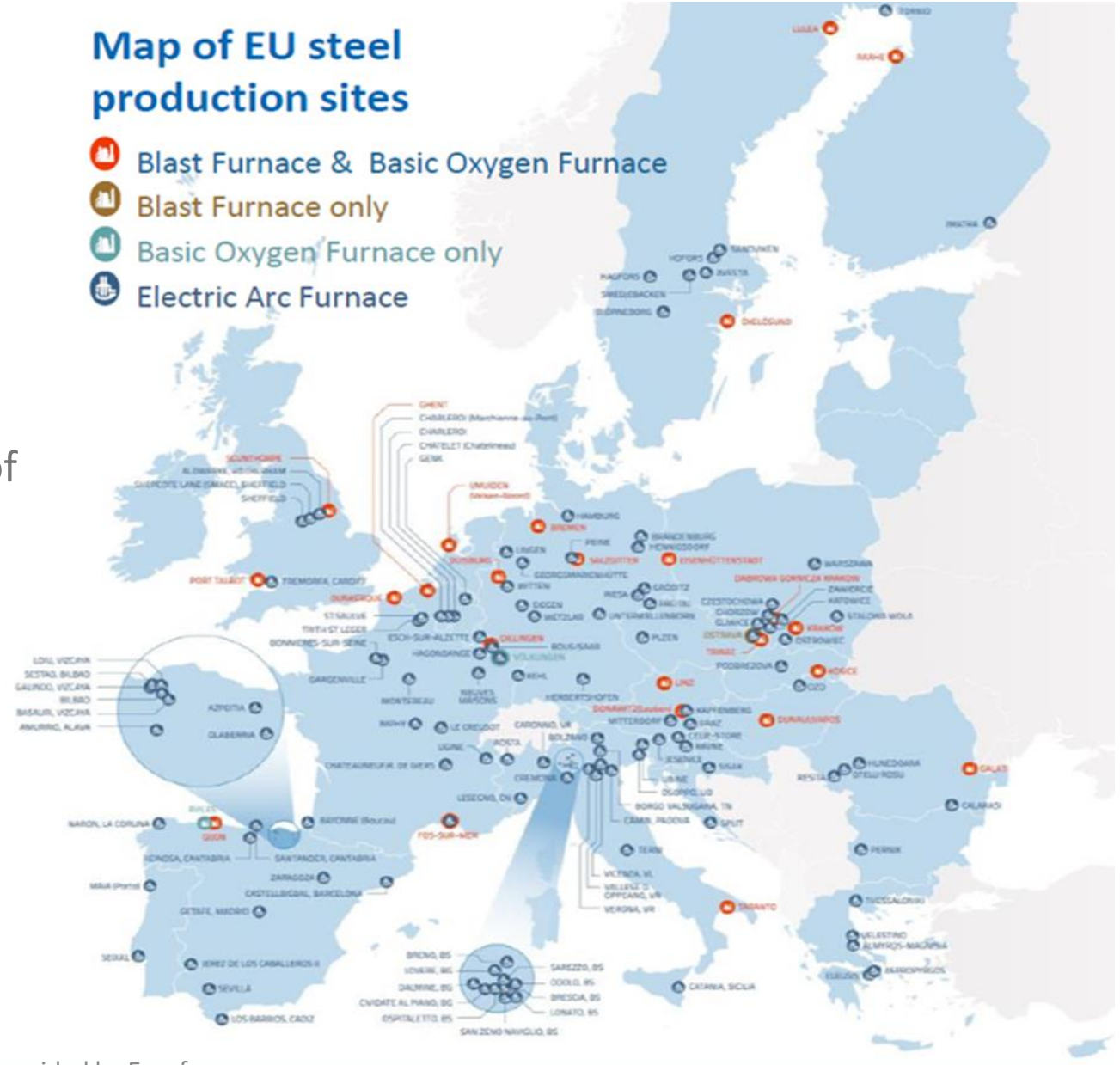
Steel Industry

Presented by Adolfo Aiello, Director Climate & Energy, **Eurofer**

About the European steel industry

- The EU steel industry employs directly **330,000 people** at over **500 sites** in **22 members states** and supports up to 2.5 million direct, indirect and induced jobs.
- The EU steel industry creates around **€140 billion** of Gross Value Added
- The sector's total contribution to EU GVA is **5.8 times** its direct impact alone



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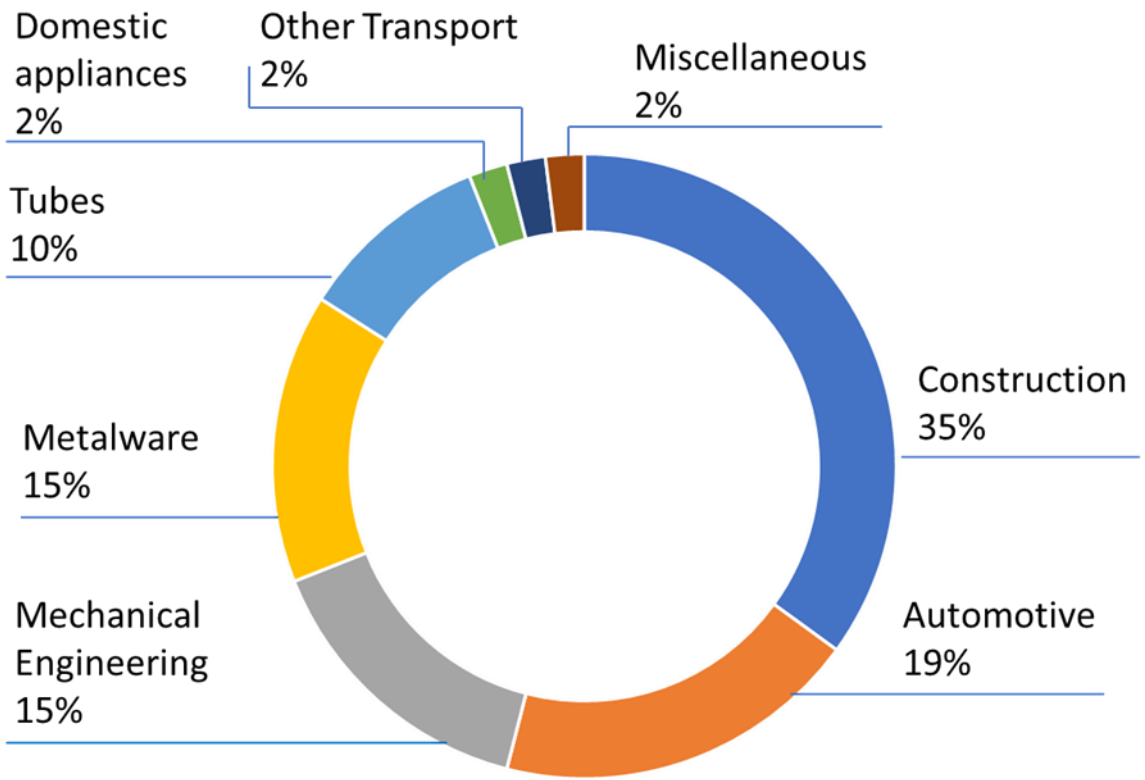
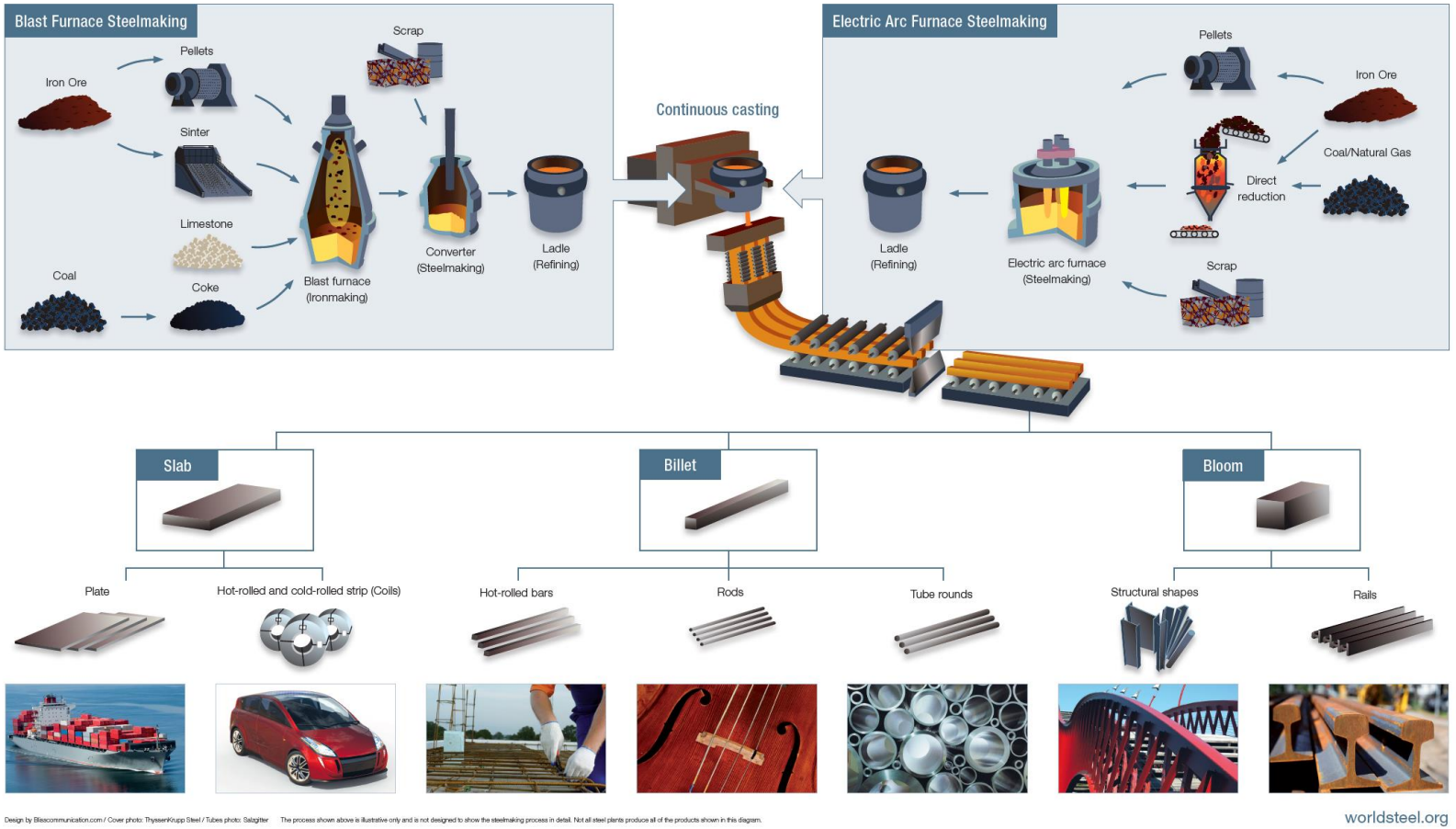
Steel using sectors

- Steel is the **most versatile** industrial material in the world. The **thousands of different grades** and types of steel developed by the industry make the modern world possible.
- The grades depend on the combination with other alloying elements (such as nickel, ferro-chromium, manganese, etc). They contribute to the properties of the material (strength, toughness, ductility, weldability, durability, etc.)
- Steel is used in every aspect of our lives:
  - Construction
  - Automotive and mobility
  - Mechanical engineering
  - Metalware
  - Tubes
  - Domestic appliances and others
- Steel is **100% and infinitely recyclable** and therefore is a fundamental part of the circular climate neutral economy



Steel production processes & energy consumption

- Europe produces 160 million tonnes of steel annually, of which
  - **About 60% from primary route** (blast furnace and basic oxygen furnace): iron ore as main raw materia and coking coal as reducing agent (to remove oxygen from iron ore), with some addition of scrap
    - Process gases called “waste gases” generated unavoidably in the production process are collected and re-used for heat and electricity production
  - **About 40% from secondary route** (electric arc furnace): scrap as main raw material and electricity as main energy carrier
- The two routes are complementary and both indispensable due to constraints on:
  - scrap availability
  - scrap quality
  - final products’ requirements
- The EU steel industry emits annually around 200 Mt CO2 directly and around 20Mt indirectly.
- The EU steel industry consumes annually around 85 TWh of electricity, of which 55 TWh are purchased from the grid and the remaining part is self-generated.



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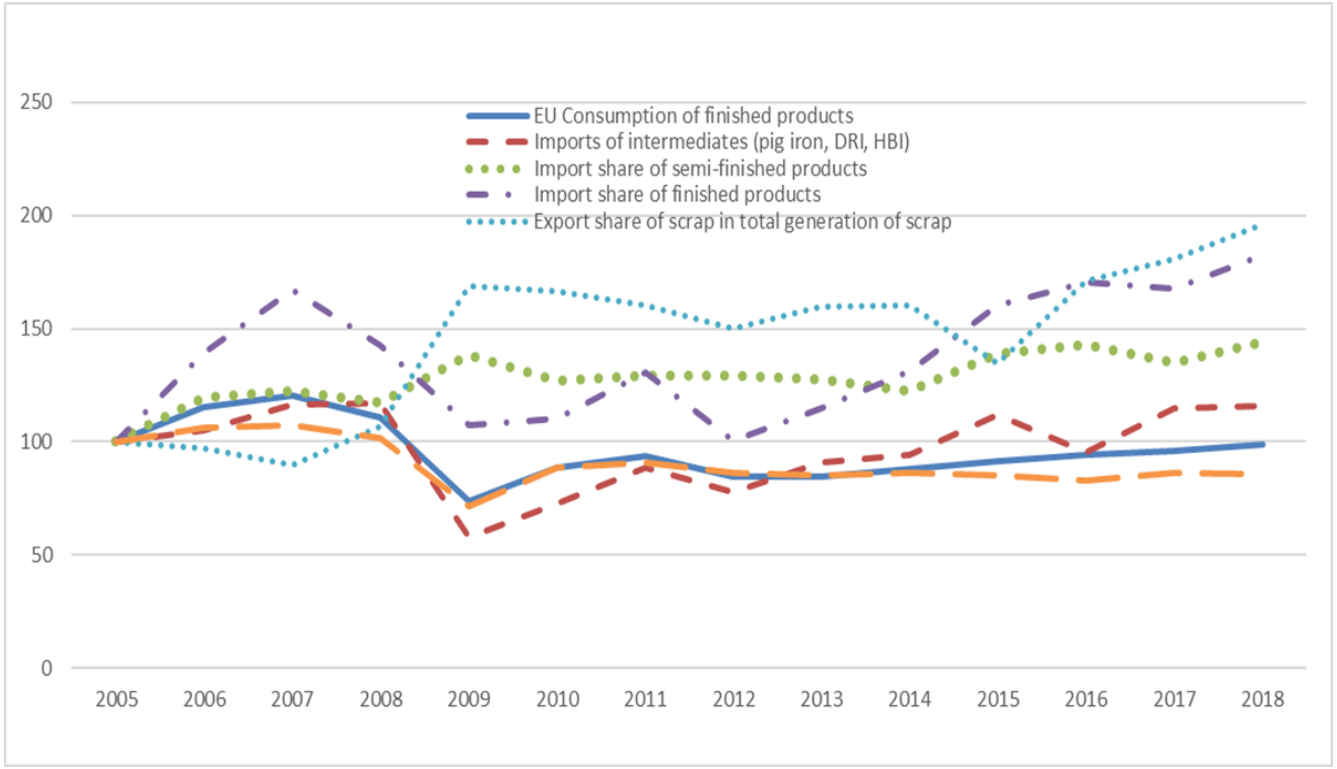
Key facts on the EU steel industry

- Highly capital intensive
- Long investment cycles
- Close to technical limits of current technologies
- Highly energy intensive
- Most CO2 emissions are unavoidable
- Highly exposed to international trade
- Highly exposed to unfair trade practices (overcapacities, subsidies, dumping)
- Declining trade balance
- Increasing leakage of jobs, production and emissions in the last decade



In 2018 the EU consumed as many finished products as in 2005, but in the meantime:

- The EU crude steel production declined by **14%**
- The market share of imported finished products increased by more than **80%**
- The market share of imported semi-finished products (in EU consumption of semi-finished) increased by more than **40%**
- The amount of intermediates (e.g. pig iron, directly reduced iron, hot-briquetted iron) imported from third countries increased by more than **15%**
- The share of scrap generated in the EU and exported to third countries increased by more than **95%**

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Technological pathways to climate neutrality in steel

Pathways/ Groups	Circular Economy: Enhancing the recycling of steel (e.g. scrap in BOF/EAF*) and its by-products, Resource efficiency (*BOF= Basic Oxygen Furnace EAF= Electric Arc Furnace)		
	Smart Carbon Usage (SCU): Process Integration with reduced use of carbon (+CCS)	Smart Carbon Usage (SCU): Carbon Valorisation/ Carbon Capture and Usage (CCU) (+CCS)	Carbon Direct Avoidance (CDA): Hydrogen / Electricity
Description	Integration of process steps and internal use of process gases	Using CO/CO_2 from steel mill as raw material (Chemical and biological conversion of CO/CO_2)	Use of renewable electricity in basic steelmaking, e.g. production of H_2 to replace carbon
Projects/ Initiatives	HISARNA , TGR-BF-Plasma (IGAR), PEM, STEPWISE, Torero	Steelanol, Carbon2Chem, FReSMe, Everest, Carbon2Value	HYBRIT, H2Steel (H2Future, SuSteel, Hybrid Steel Making), tkH_2Steel, GrInHy, SALCOS, Hydrogen Hamburg, SIDERWIN

- 16 project applications in the first call of the Innovation Fund
- 33 projects in the Important Projects of Common European Interest
- 32 projects under the Clean Steel Partnership

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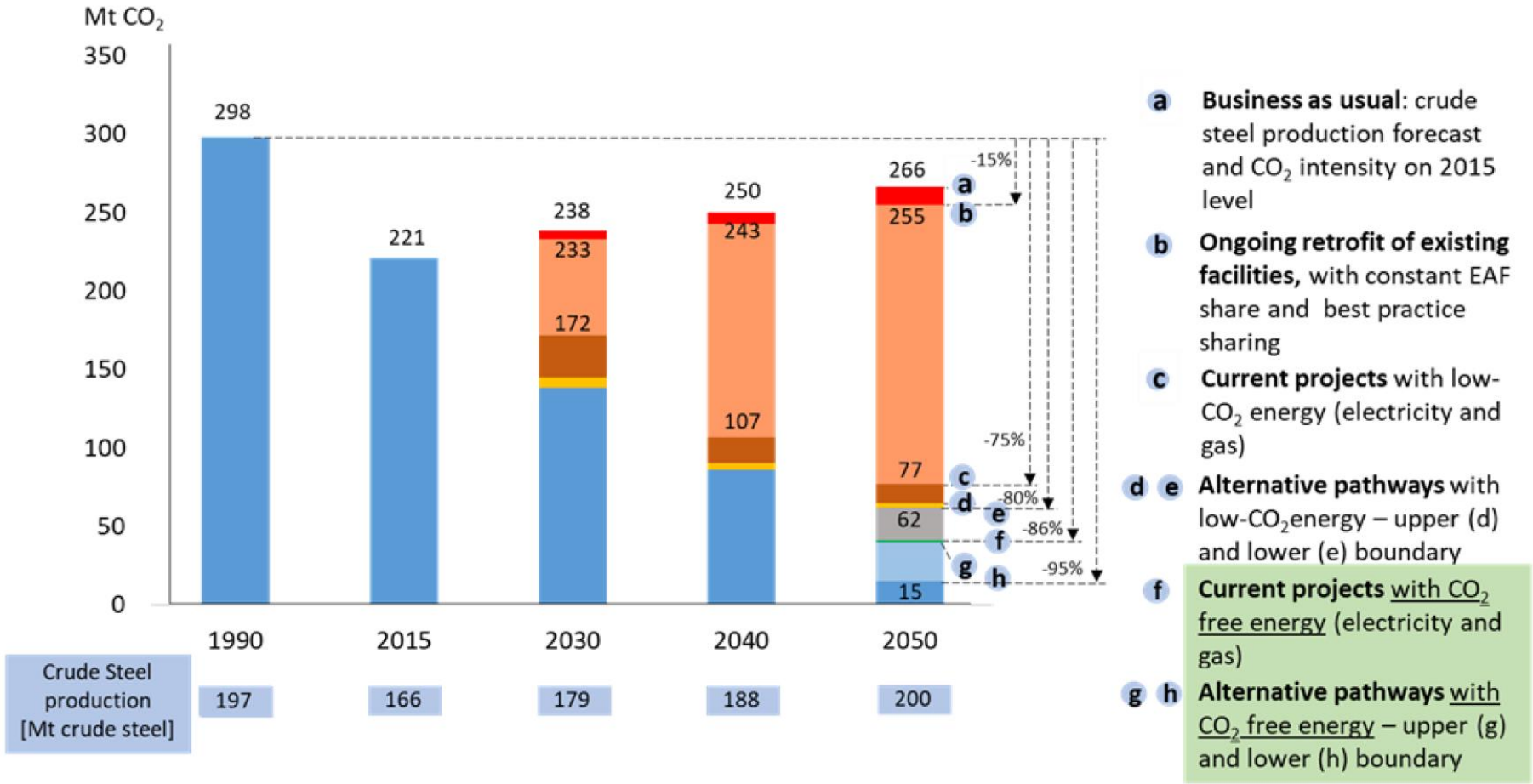
Abatement potential in the EU steel industry….



80%-95% emissions reductions are technically feasible with the appropriate technical and regulatory conditions

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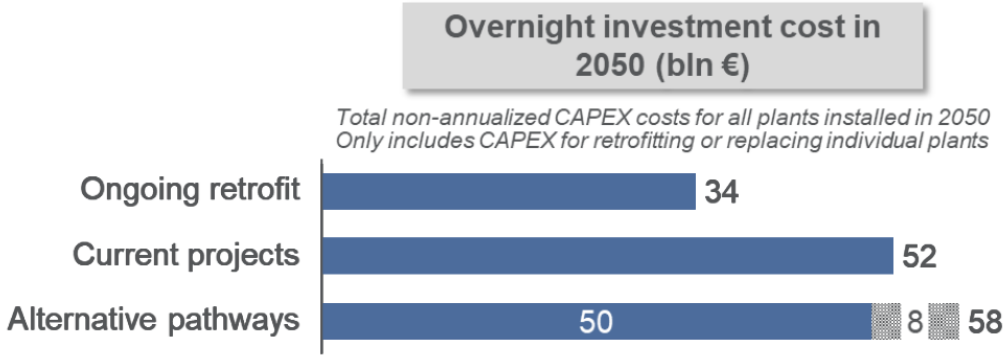
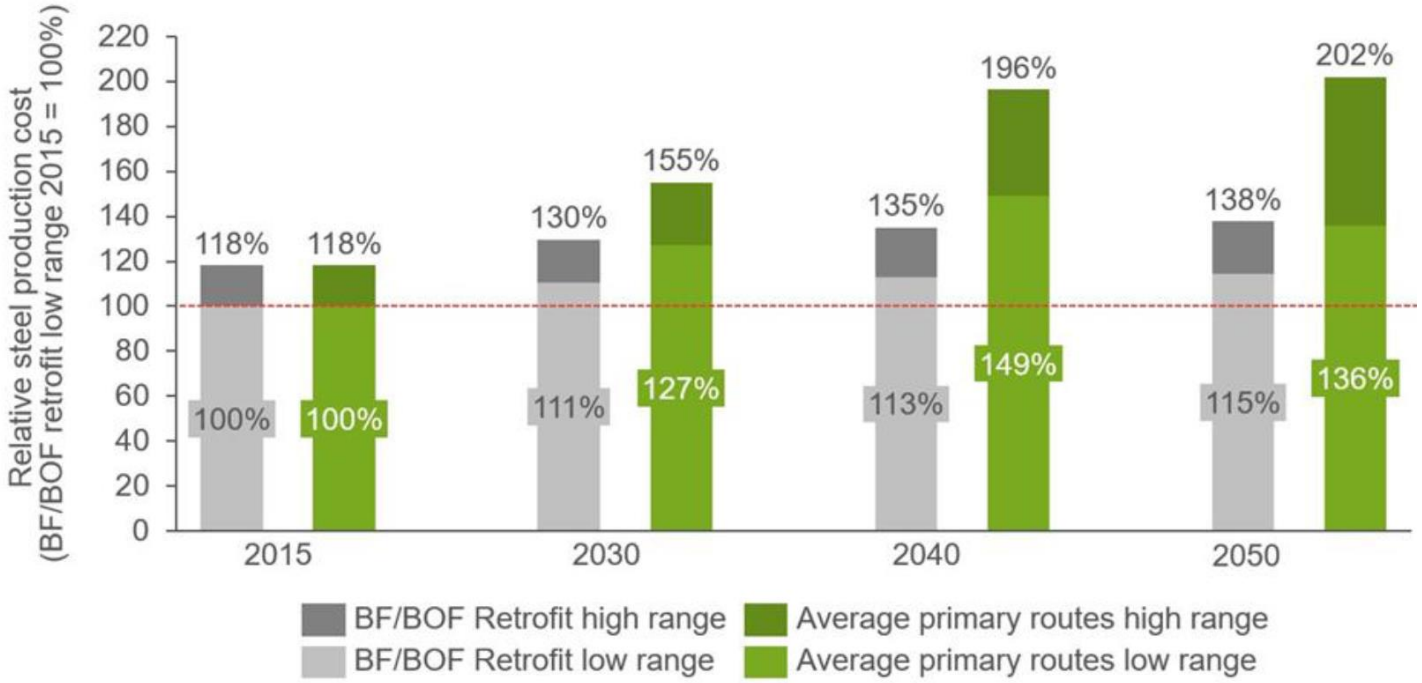
….related costs ….



Up to 70% increase of investment needs

Note: Cost projections are based on estimated full-size scale, material and energy consumption of commercial scale production installations.



35%-100% increase of production costs in primary steel making

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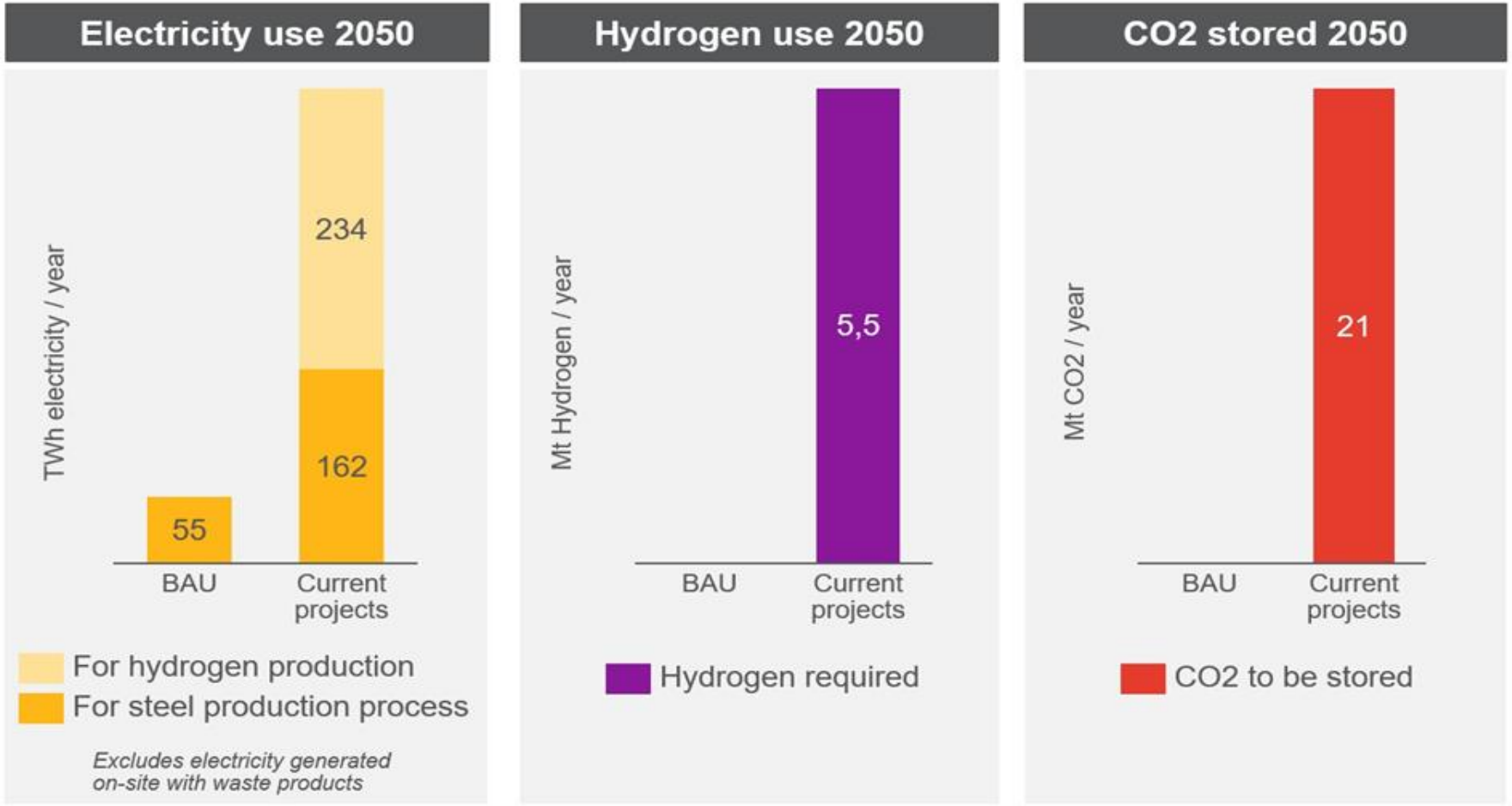
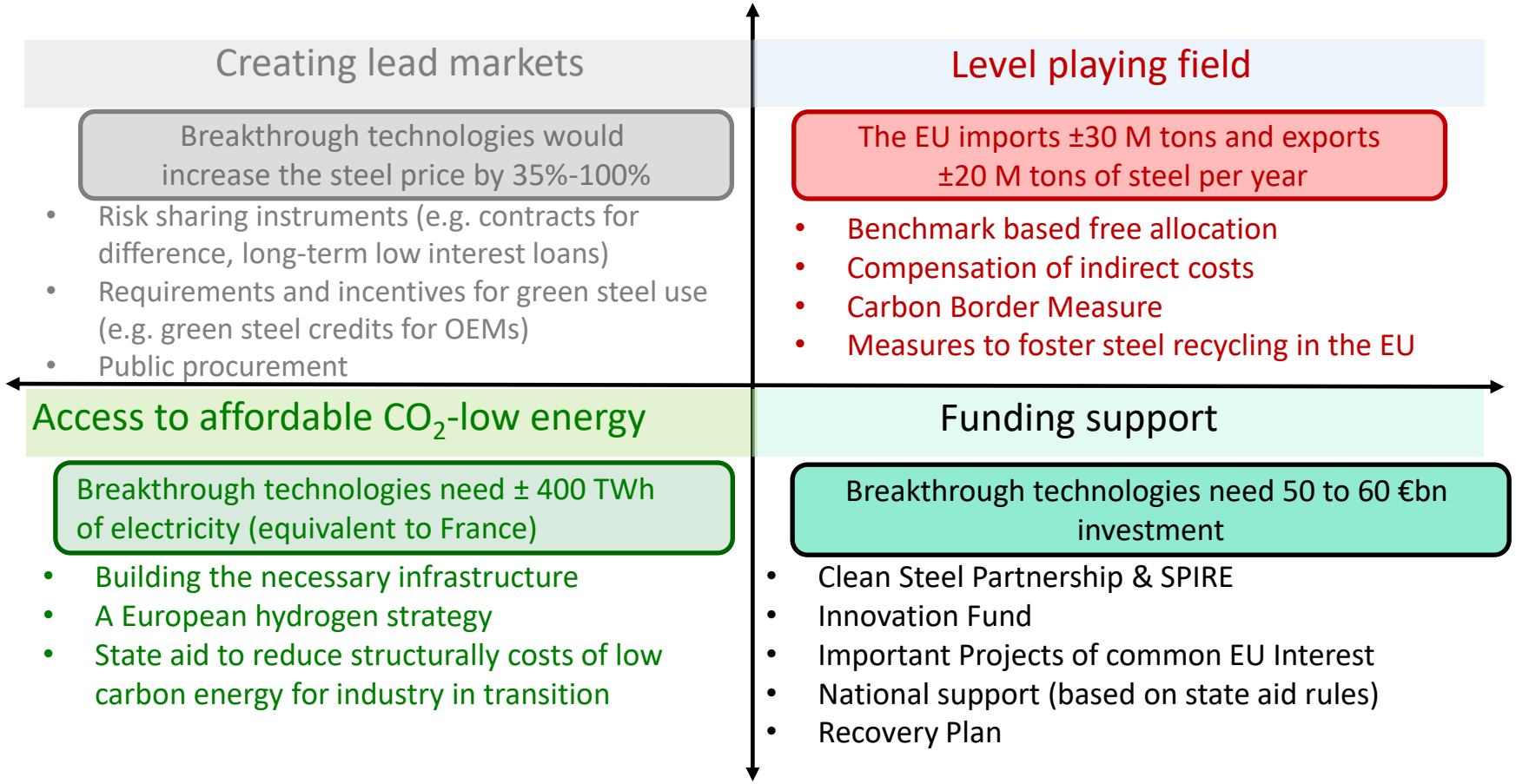
….and energy needs



Source: EUROFER low-Carbon Roadmap, Nov 2019

- **Up to 400TWh** of CO2-free electricity (including for the production of yearly 5.5 Mt hydrogen), which is **7 times more** than what the sector purchases from the grid today

A comprehensive regulatory framework



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Thank you for your attention

Visit www.eurofer.eu for more information

Adolfo Aiello

Director climate & energy

Pulp & Paper Industry

Presented by Malgosia Rybak, Climate Change & Energy Director, **Cepi**

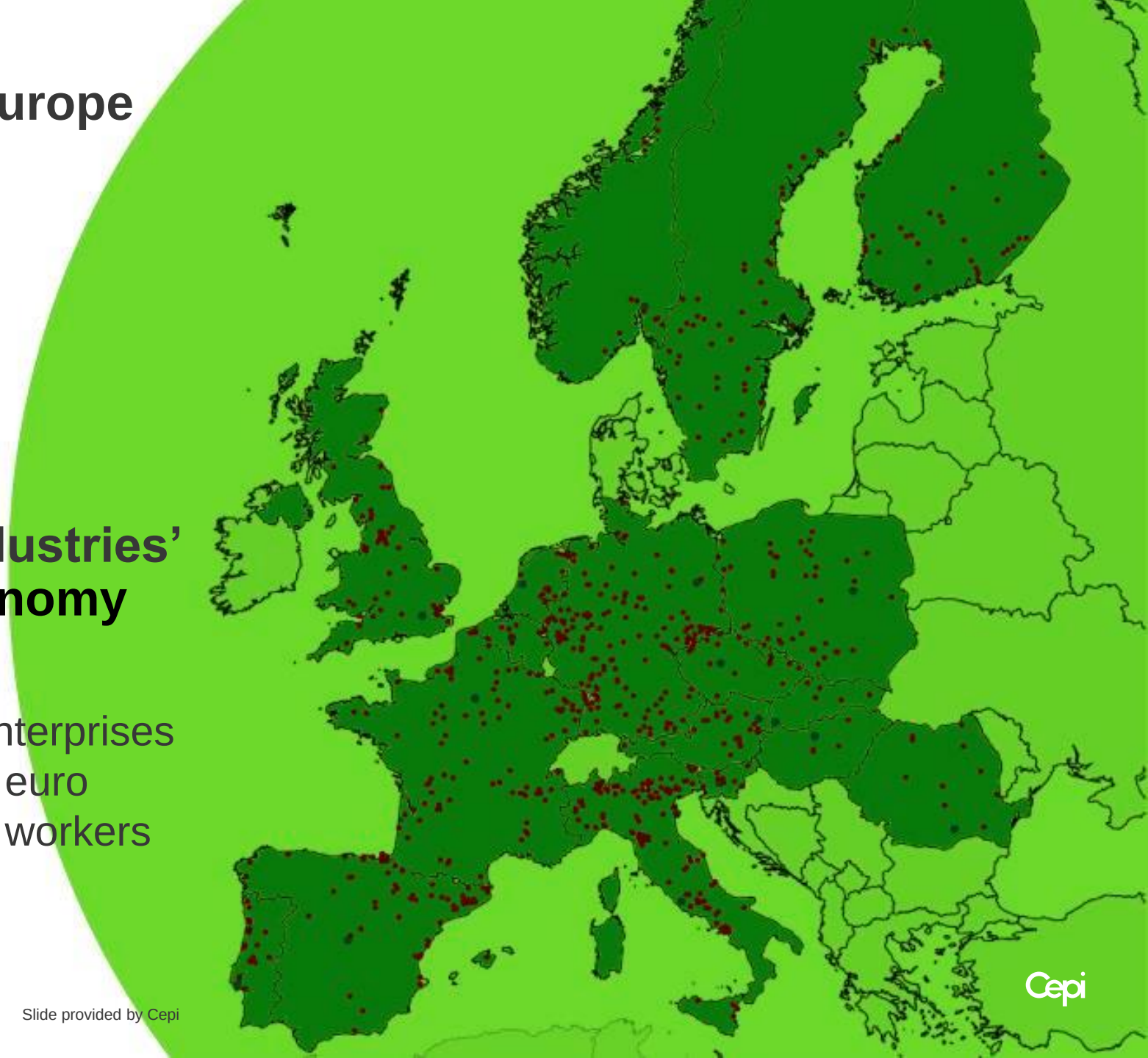
Pulp & Paper Industry in Europe

897
mills

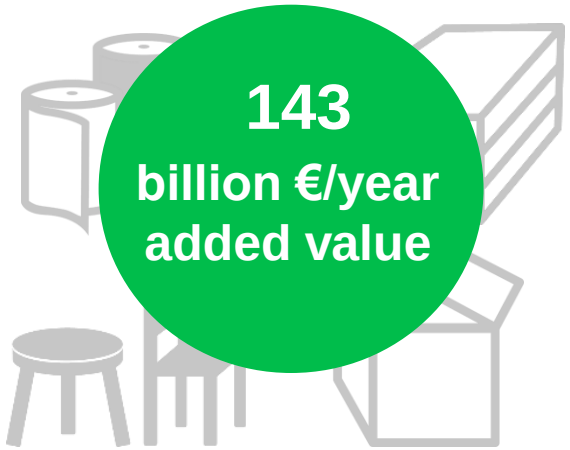
500
companies

18
European countries

22%
of global paper production



European forest-based industries' importance for the EU economy



143
billion €/year added value

420.000 enterprises
520 billion euro
3.5 million workers

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More than paper – diversity of products made out of fibres

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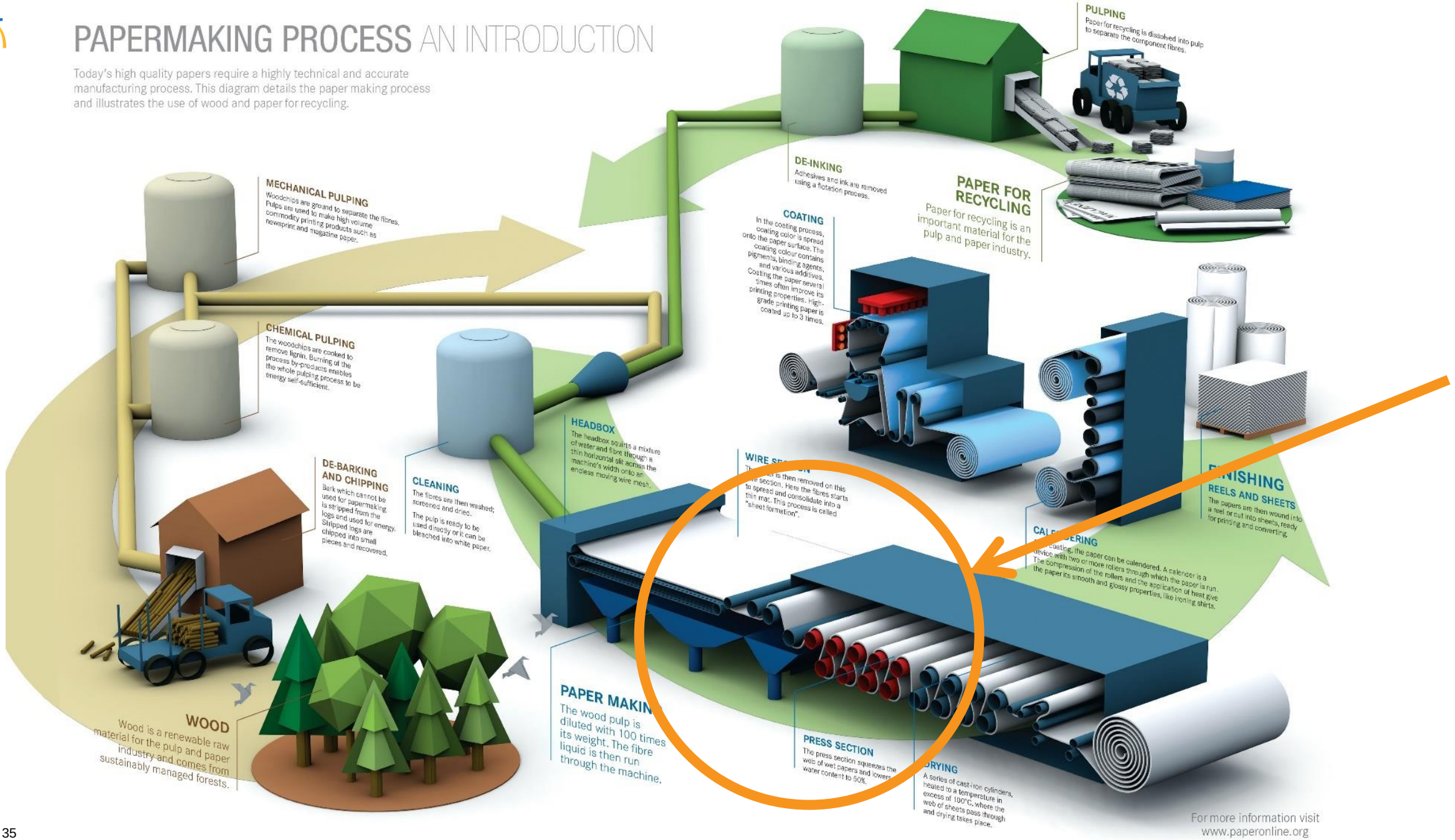
PAPERMAKING PROCESS AN INTRODUCTION

Today's high quality papers require a highly technical and accurate manufacturing process. This diagram details the paper making process and illustrates the use of wood and paper for recycling.



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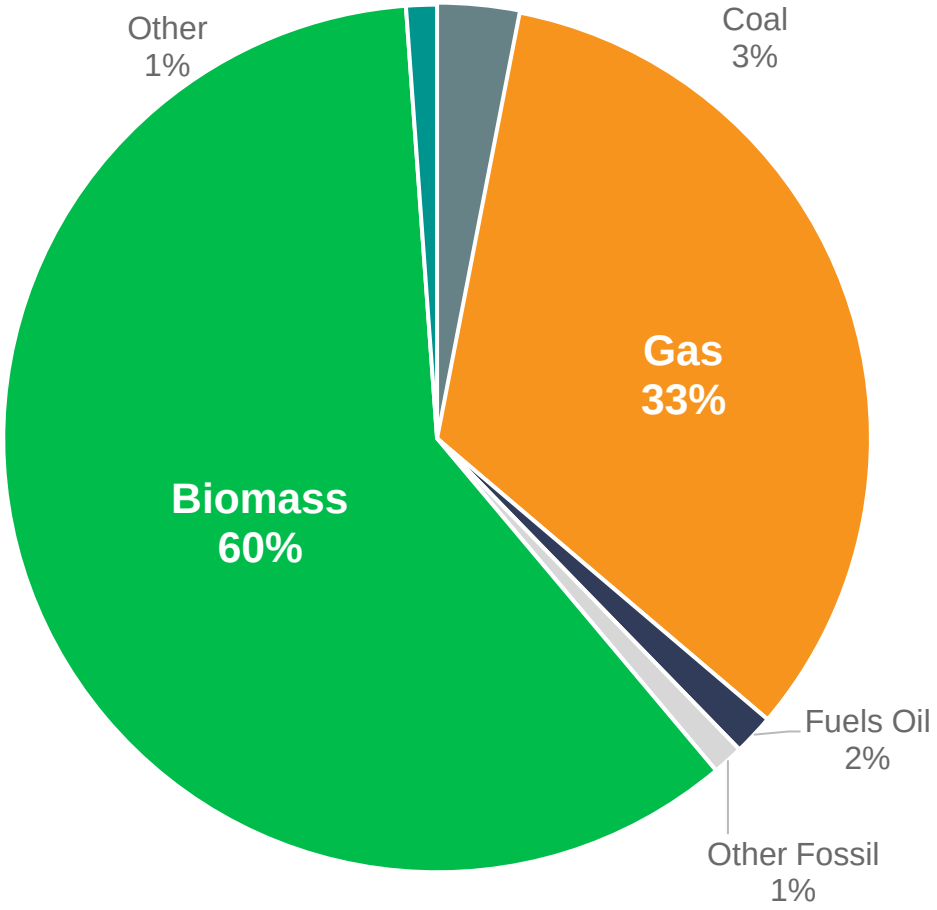
Energy mix in the pulp and paper industry

Combustion of fuels



Total: 319 TWh

269 TWh for steam production

50 TWh for electricity production

45 TWh net bought electricity

- **The pulp and paper industry is the largest industrial generator and user of renewable energy**
- *Some* of our companies are already now climate neutral
- In some countries *all our companies* will soon be climate neutral
- *Other companies* are simply depending on their country's energy mix, often natural gas
- Need equal access to affordable clean energy in all member states.

Source: Cepi statistics 2018

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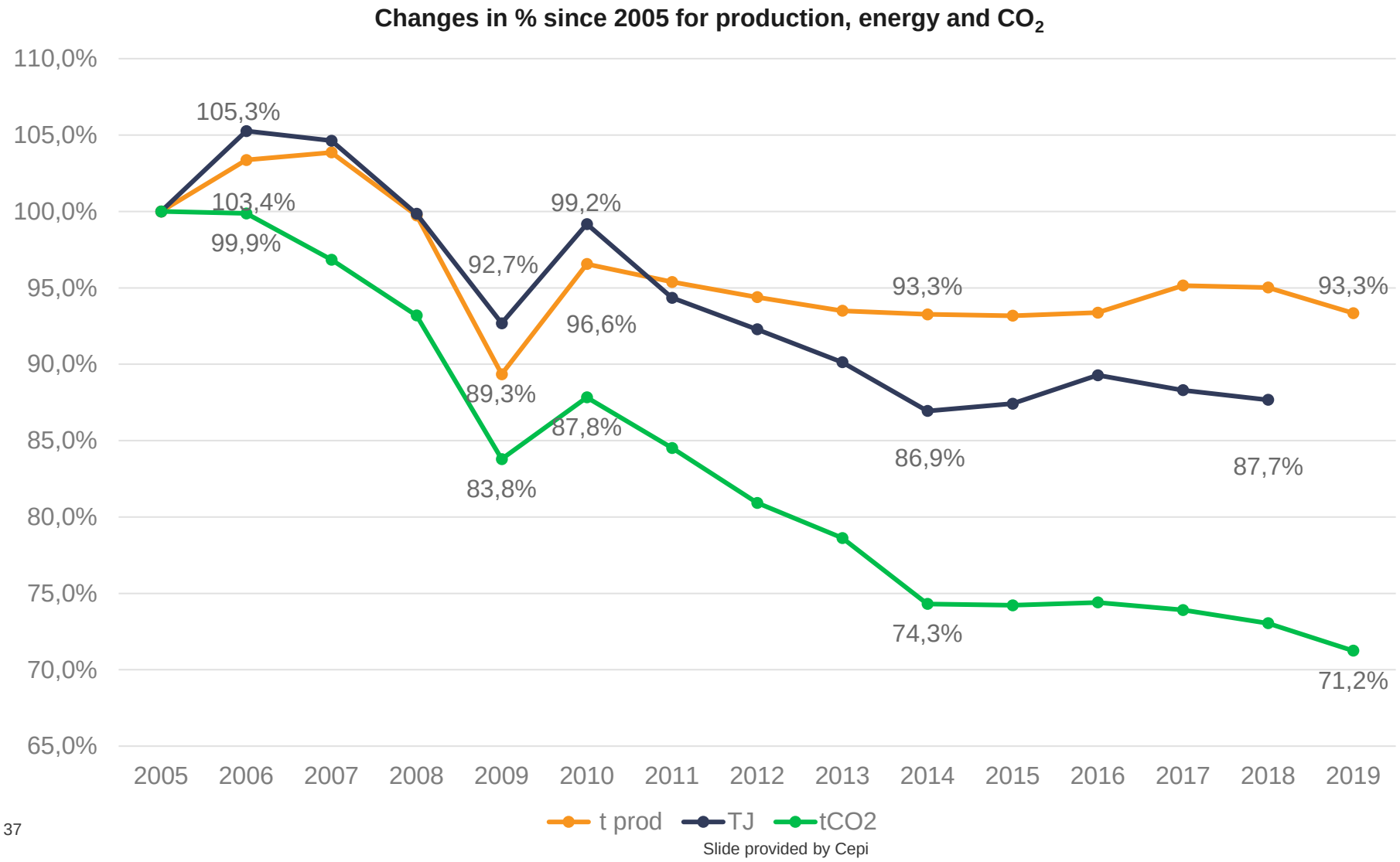
Decoupling economic growth from carbon emissions



-28% CO_2 emissions reduction since 2005

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Investment case study

Smurfit Kappa to deploy hydrogen gas turbine demonstrator

- Smurfit Kappa participates in the HYFLEXPOWER project that will see its **Saillat Paper Mill in France become the world's first plant to introduce an integrated hydrogen gas turbine demonstrator**.
- The research project aims to prove that hydrogen can be produced and stored from renewable electricity and ultimately replace up to 100% of natural gas currently used by combined heat and power plants.
- The project represents an investment of €15.2 million with two thirds of the funding coming from the EU's Horizon 2020 Framework Programme for Research and Innovation.
- The project will be split into several phases with construction due to begin in 2021 and the pilot to commence in 2022.

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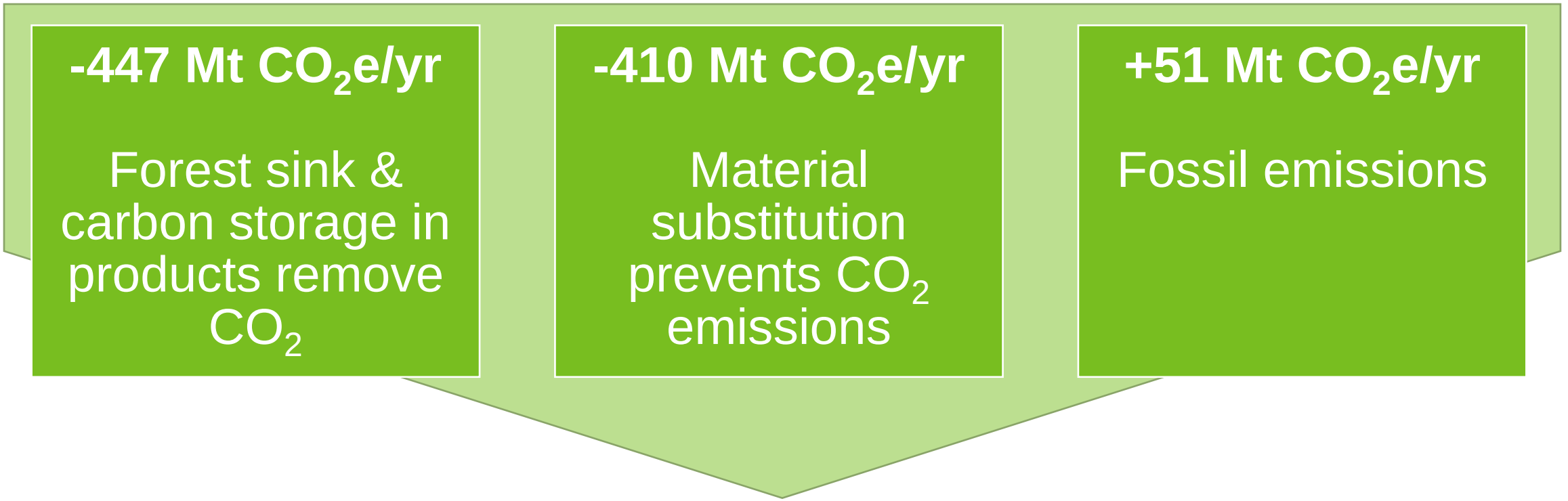
Climate effects of the forest-based sector



Mitigation effect corresponds to 20% (-806 Mt CO2e/yr) of total EU CO_2 emissions

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Investment case study

UPM’s construction of the state-of-the-art biochemicals facility in Leuna, Germany

- In Leuna, UPM will produce a range of 100% wood-based biochemicals that enable **a switch from fossil-based products to sustainable alternatives** in a number of end-uses such as plastics, textiles, cosmetics and industrial applications.
- Technology and process have been developed by UPM over the past ten years, mainly building on the company’s own innovation capabilities and selectively working with international partners.
- The biorefinery is expected to start up by the end of 2022.

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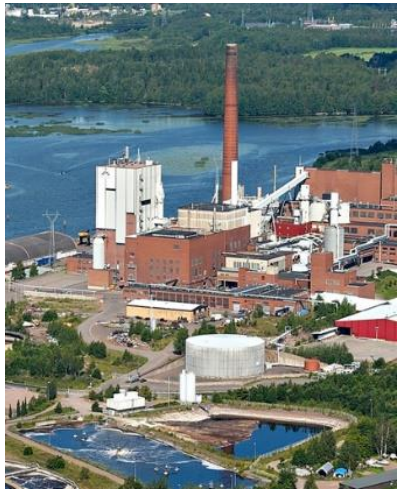
Meeting consumer demand for eco-friendly and circular solutions

Bio-based carbon for energy storage by Stora Enso



- Wood-based carbon can be utilised as a crucial component to replace graphite in batteries typically used in consumer electronics, the automotive industry, and large-scale energy storage systems.
- Stora Enso’s pilot facility for producing bio-based carbon materials based on lignin is starting in Q1 2021 at the company’s Sunila Mill in Finland.

Slide provided by Cepi

Policy recommendations

- **Incentivise the forest-based circular economy**
  - Promote renewable and recyclable bio-based products and the creation of new markets
  - Ensure that bio-based products have access to high quality virgin fibre in order to achieve climate benefits and raw material for recycling to achieve a circular economy
  - Further improve and harmonise of European waste collection systems for large scale and high quality recycling

- **Induce investments in emission reductions ensuring a cost-competitive carbon neutral energy supply**
  - Promote, de-risk, support and reward investments in energy efficiency, CO_2 avoidance and renewable energies
  - Ensure availability of affordable climate-neutral energies sources – such as electricity, biogas or hydrogen – without sectoral restrictions
  - Support the phasing out of fossil fuel combustion
  - Secure effective protection for our sector against the risk of carbon leakage

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For more information:

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Fertilizers industry

Presented by

Antoine Hoxha, Technical Director, Fertilizers Europe

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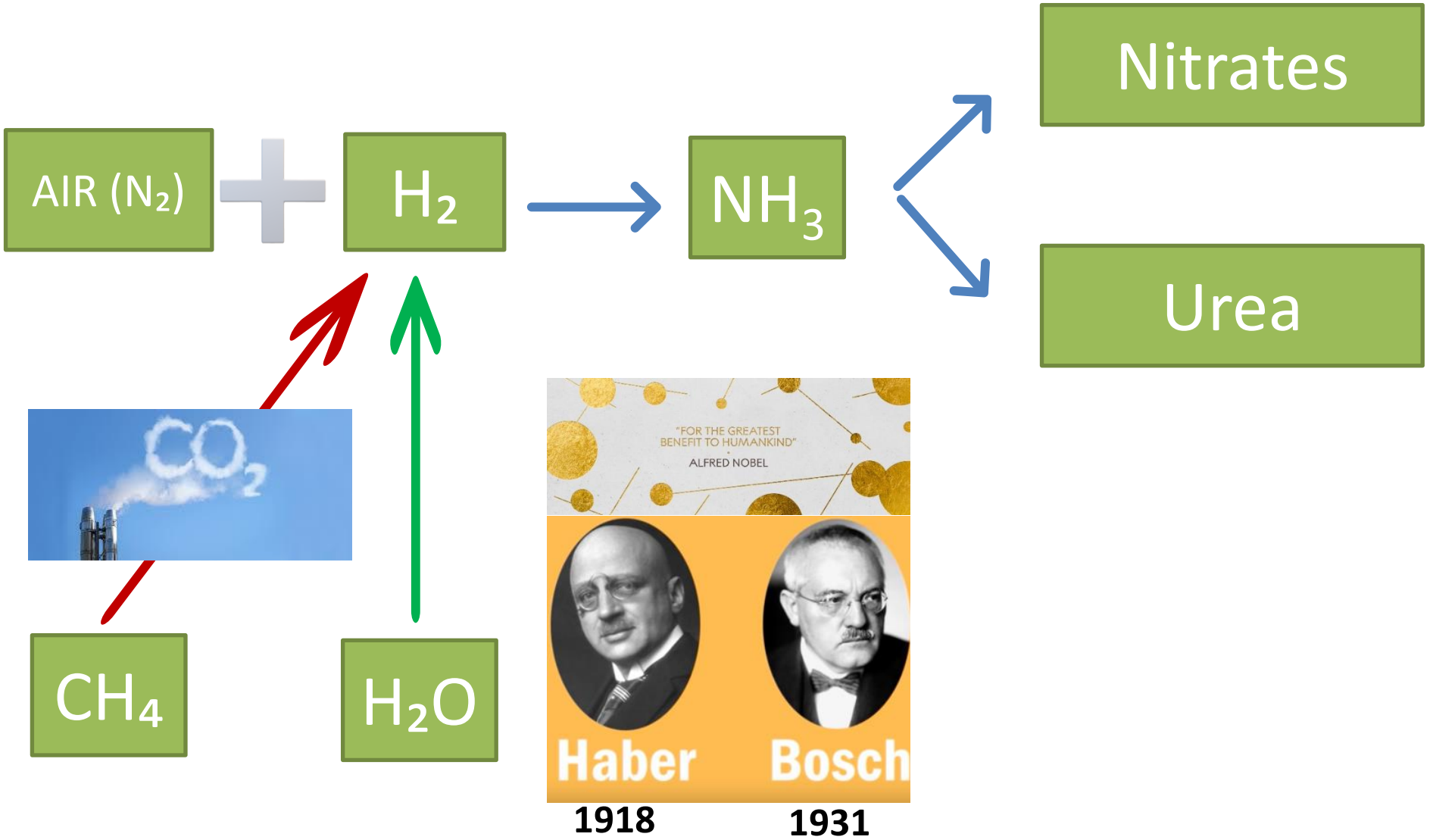
FERTILIZERS: N, P, K



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EU Fertilizer industry

16 Corporate members

8 National Associations

Feeding **people**

TODAY,
FERTILIZERS* ENABLE

50% OF GLOBAL FOOD PRODUCTION

Feeding **economy**

120 +
PRODUCTION SITES

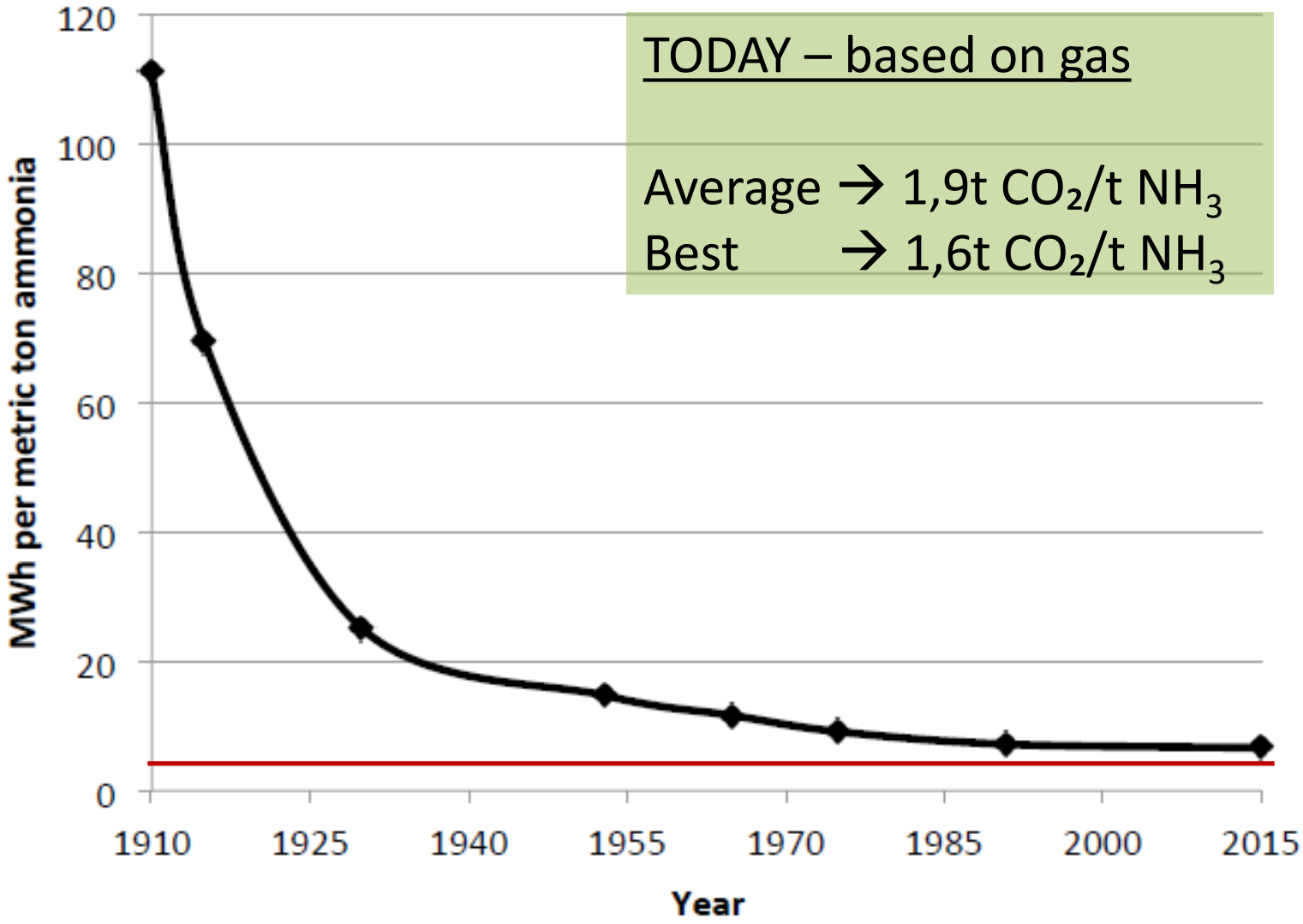
€9.8 BN
TURNOVER

€1.4 BN
INVESTMENT

75.000
EMPLOYEES

Slide provided by Fertilizers Europe

Ammonia Technology Evolution, 1910-2015



TODAY – based on gas

Average → 1,9t CO_2/t NH_3

Best → 1,6t CO_2/t NH_3

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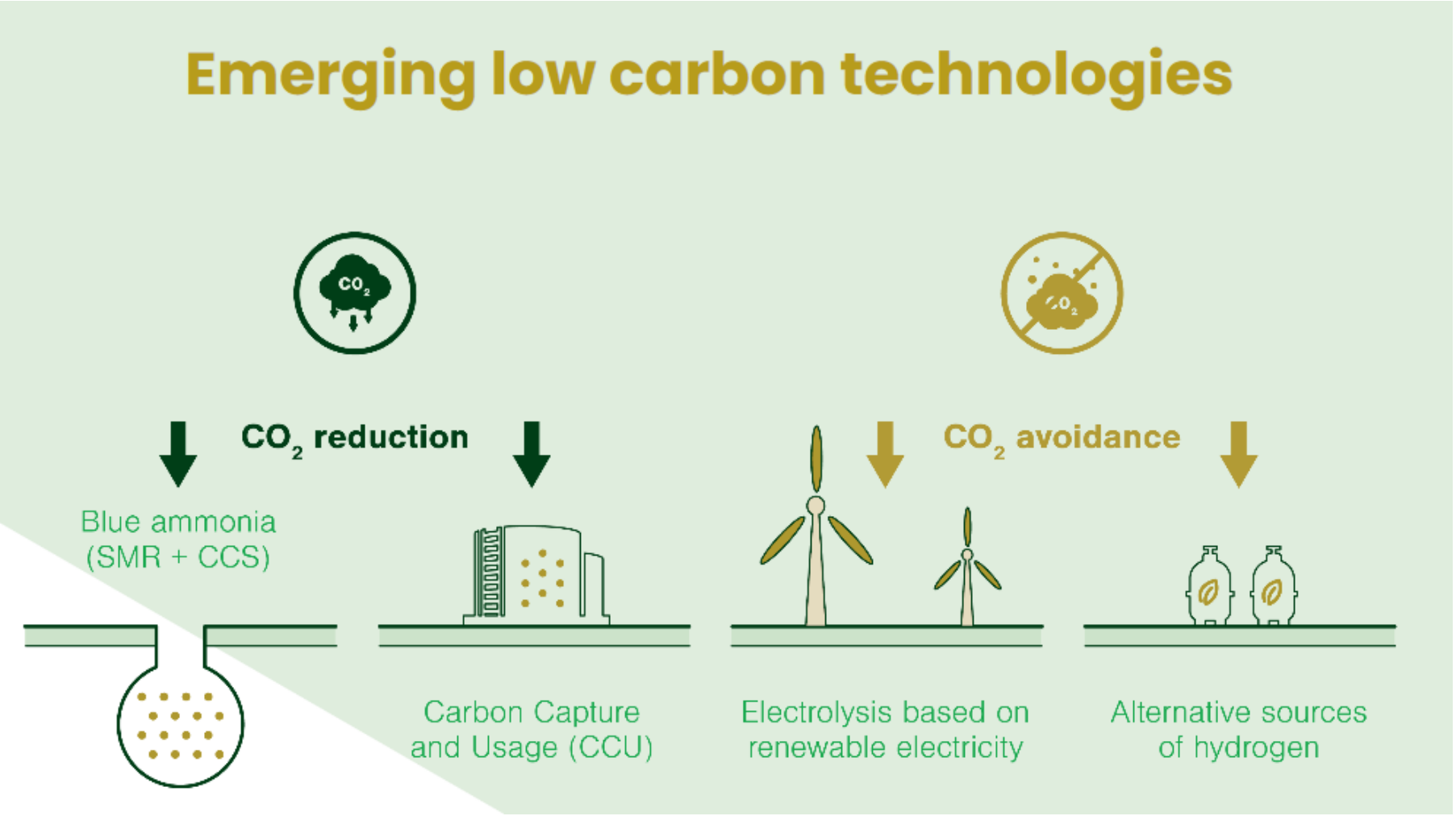
What can be done to further decarbonise?



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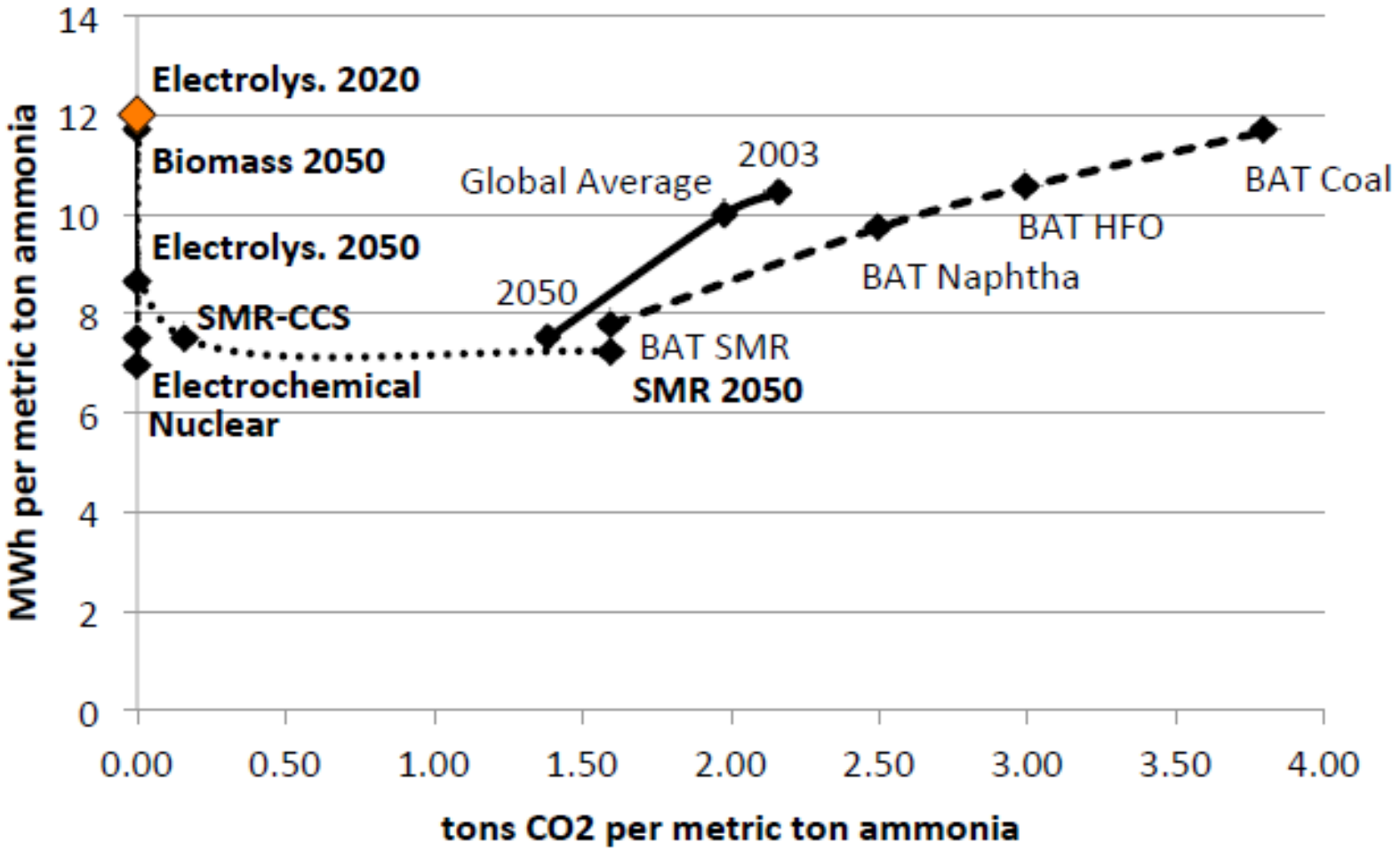
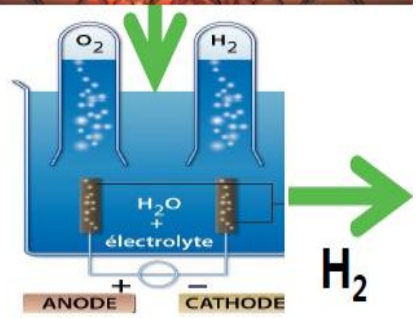
Ammonia Technology Evolution, 2000-2050

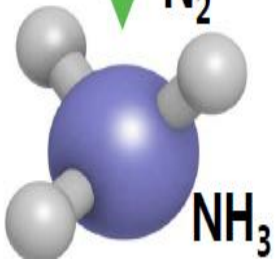


Hydrogen economy: Ammonia as the real workhorse



H_2

N_2



NH_3

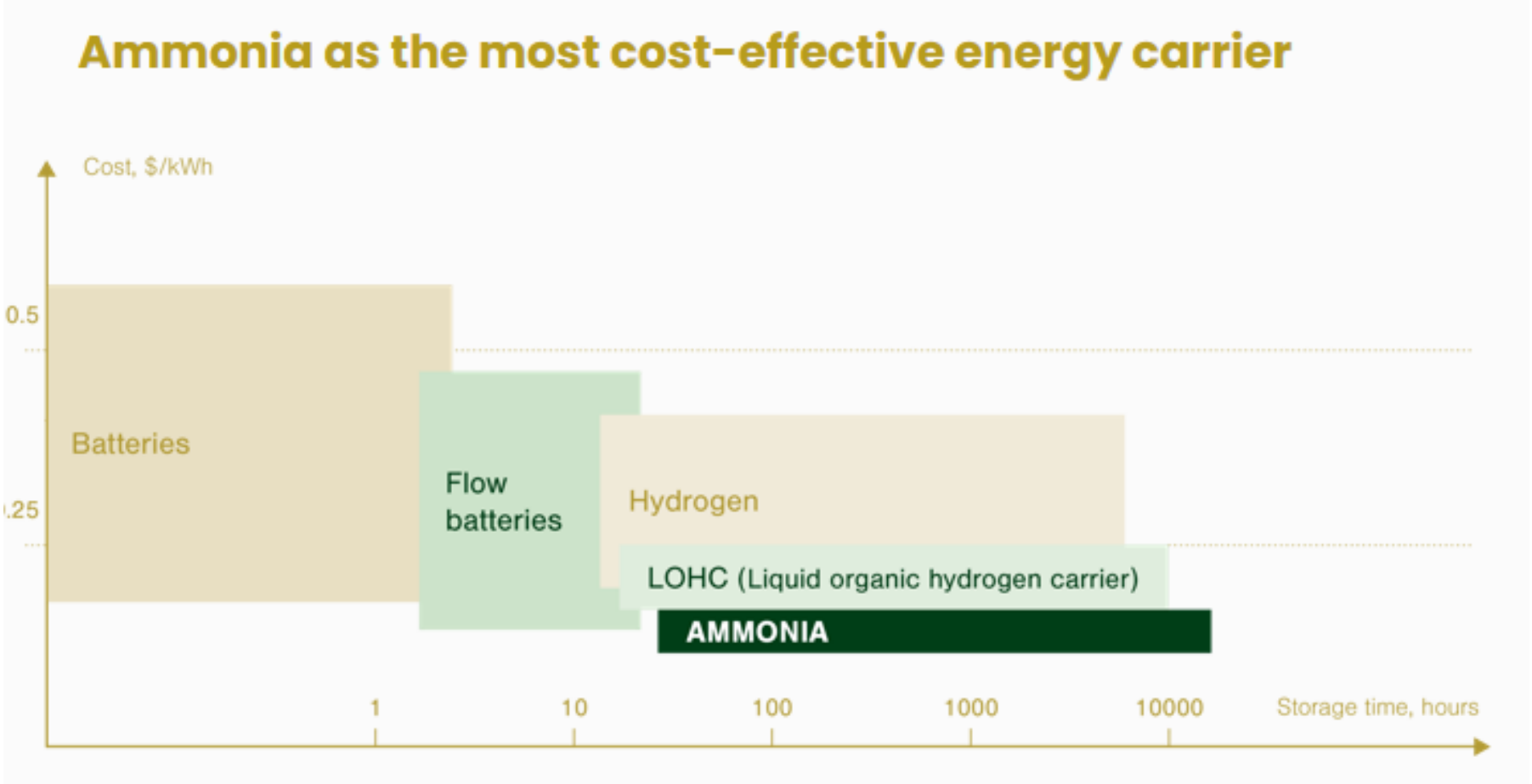
Precursor fertilizers industry

Carrier of H_2 for, e.g., iron & steel

Fuel

Ammonia is much easier to store and transport than hydrogen gas
Ammonia may have multiple uses in industry as feedstock and fuel

Hydrogen economy: Ammonia as the real workhorse

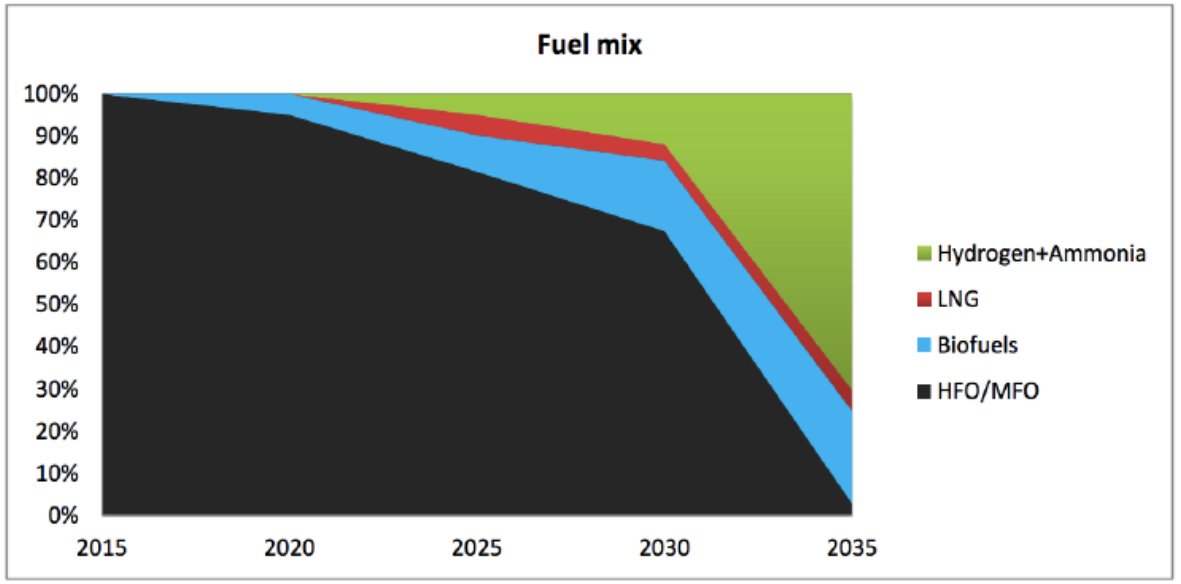


Hydrogen economy: Ammonia as the real workhorse

International Maritime Organization
New demand: Energy Markets

- *Decarbonising Maritime Transport* (International Transport Forum / OECD), March 2018
- Possible to reduce shipping emissions by 95%, by 2035
- Ammonia-Hydrogen fuel makes 70% “mix of ship”
- ~1 million tons NH3 per day

Figure 9. **Fuel mix evolution between 2015-2035 for 80% carbon factor reduction**



Announced new investments in the European fertilizer industry

SPAIN
800 MW green hydrogen
€1.8 billion investment
Phase I – 2023
Phase II - 2027

25% of the hydrogen currently consumed in Spain to be emissions free

NORWAY
- Full scale green ammonia project
500,000 tonnes per annum green ammonia production

Result – in cutting 800,000 tonnes of CO_2 per annum = 300,000 passenger cars.
Operational in 2026

THE NETHERLANDS
100 MW wind powered electrolyser (renewable hydrogen production)

75,000 tons of green ammonia, approx. 10% of the capacity of ammonia plant

Production of carbon neutral fertilizer products, decarbonizing the food value chain

By 2050 – under the right conditions – ammonia production could be decarbonised and support decarbonisation of many sectors

Policy recommendations

Priorities to advance the transition:

- Low-carbon and competitively priced energy
- Infrastructure
- Funds to support financing the transition
- Creation of new markets (e.g. certification)

For more information contact:

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Intervention by the European Commission

Titas Anuskevicius, Policy Officer “Energy Intensive Industries and Raw Materials”

DG GROW, European Commission

Thank you for your attention

It’s now time for a fruitful Q&A session!