

Aluminium and Steel industries; First step towards decarbonization

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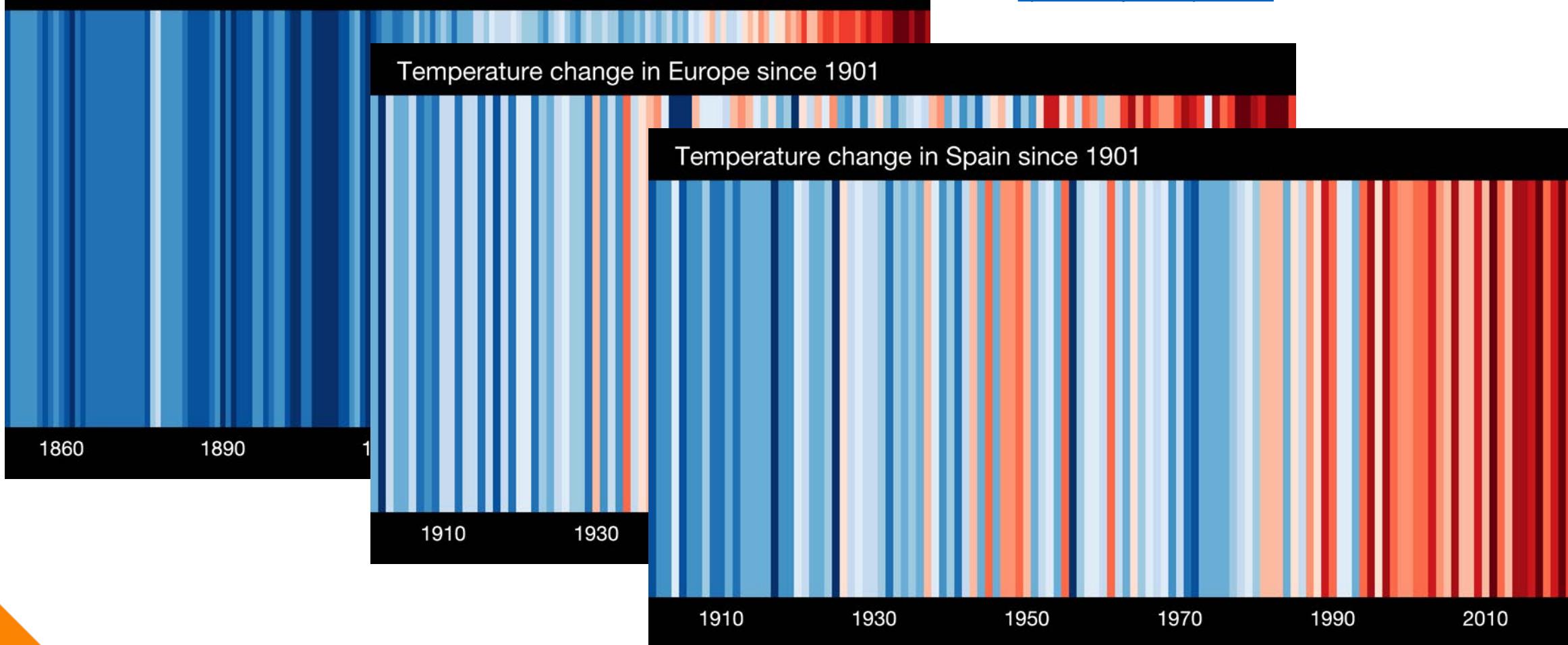


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Something to think about

Global temperature change (1850-2021)

Source: <https://showyourstripes.info/>



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Something to think about

From Social request

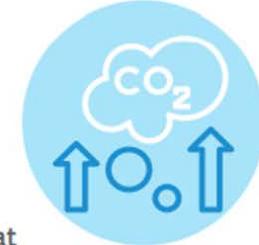
93% OF EUROPEANS
BELIEVE CLIMATE
CHANGE TO BE
CAUSED BY HUMAN
ACTIVITY



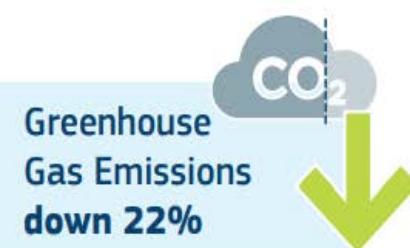
93% OF EUROPEANS
believe climate change to be
caused by human activity



85% OF EUROPEANS agree that
fighting climate change and using
energy more efficiently can create
economic growth and jobs in Europe



THE EU HAS SUCCESSFULLY DECOUPLED GREENHOUSE
GAS EMISSIONS FROM ECONOMIC GROWTH



1990-2017



1990-2017



To business opportunities

Source: Special Eurobarometer 479

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Something to think about

The World is facing up a serious challenge regarding CO₂ footprint...



Aluminium industry is producing around 3% of the world's direct industrial CO₂ emissions



Steelmaking is producing around 7 – 9% of the world's direct industrial CO₂ emissions



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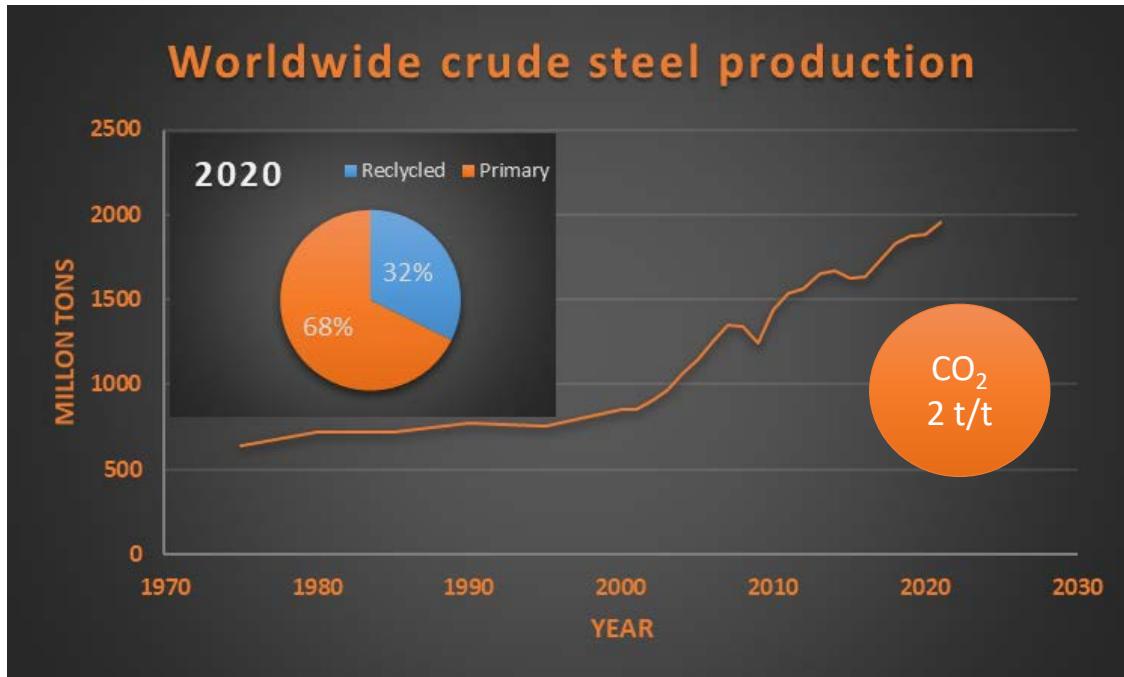
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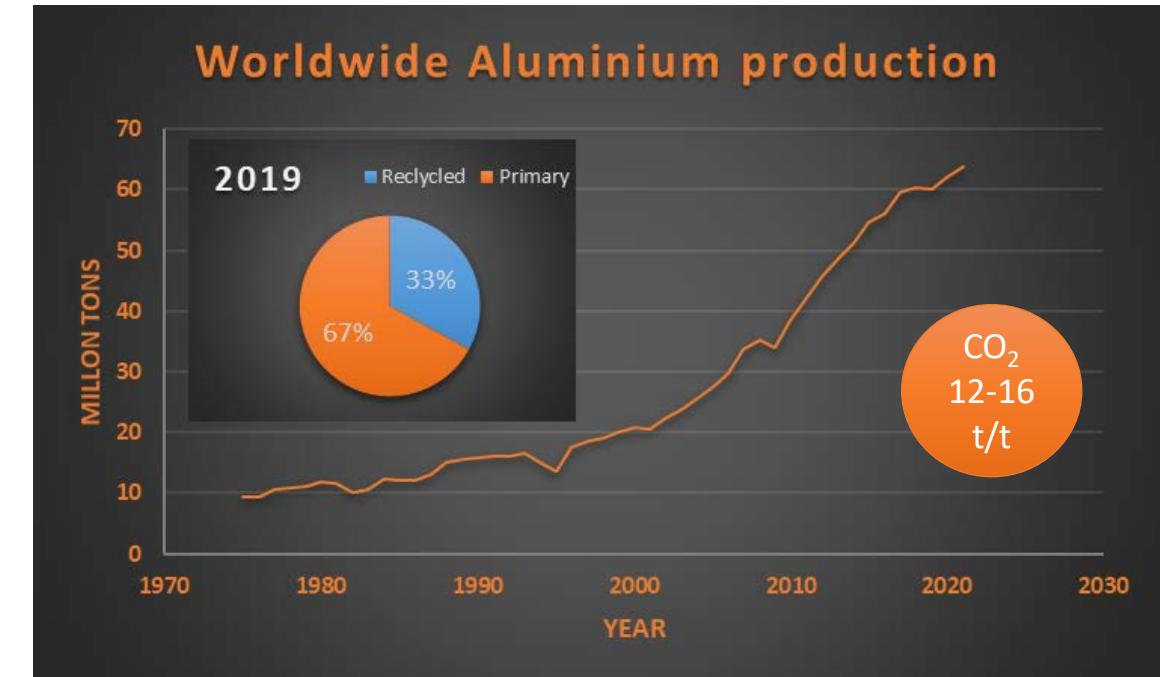
Steel and Aluminium as key materials for mankind evolution



Our World is built around the use of a variety of materials



Source: [worldsteel](#)



Source: [International Aluminium Institute](#)

All industries face the same issues:

→ Meeting the global demands while significantly reduce their climate impact

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Steel industry



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Steel industry historical overview

Steelmaking technology evolution

With the technological evolution of society, the ways of producing steel have been adapting to the evolution of the political, social and technological trends.

50s & 60s



high quality
steel

70s



The energy
crisis

80s & 90s



Environmental
concerns

2008



Digitalization

2020



Decarbonization

The top steel producers have already set ambitious goals to become carbon neutral in the coming years (EU by 2050 and China, by far the largest steel-producing country, by 2060).

To fulfil these goals, a large number of technologies are being suggested, developed and evaluated.

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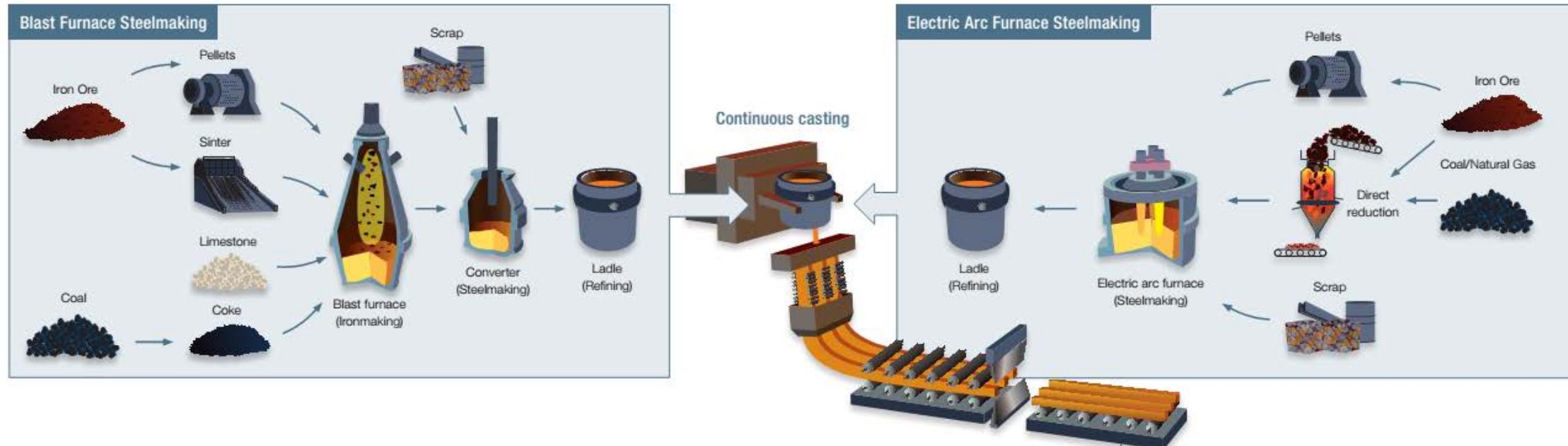
Global Picture of Steelmaking Process



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worldsteel
ASSOCIATION

OVERVIEW OF THE STEELMAKING PROCESS



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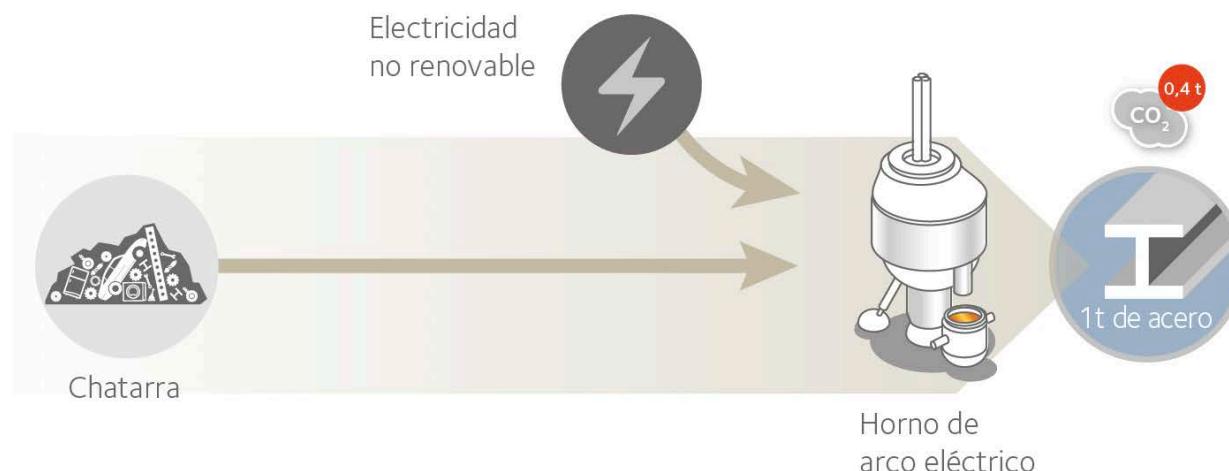
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Global Picture of Steelmaking Process



For 1 ton of Liquid Steel	
500 kg	Coke
350 kg	Cal
2250 kg	Iron ore

850 kg	Hot Metal
230 kg	Mixed scraps
6 kg	Iron ore
60 kg	Lime
20 kg	Dolomite
54 Nm ³	Oxygen



For 1 ton of Liquid Steel	
513 kg	Mixed scraps
423 kg	Iron ore
64 kg	Lime

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Decarbonization RoadMap of some of the main steelmakers

Hydrogen, near-zero-emissions ironmaking and carbon capture technologies will play a critical role in the decarbonization pathway

Tech. option	Examples	TRL	Emission reduction	Energy savings	Market entry	Ref. Tech.
H based direct reduction	HYBRID H2Future SALCOS	7	Up to 95%	20%	2030/2035	BF/BOF Steelmaking
Electrolysis of iron ore	SIDERWIN ULCOWIN	6	Up to 95%	40%	2040	BF/BOF Steelmaking
Smelting reduction	HISAMA	5-6	Up to 35%	20%	2025	BF/BOF Steelmaking
BF to gas recycling	ULCOS-BF IGAR	7	Up to 25%	15%	2025	BF
Carbon Capture and usage	Carbon2Chem Steelanol	5-7	TBD	TBD	2030	BF/BOF Steelmaking
Near net shape casting	Castrip ARVEDI ESP	8-9	Up to 60%	60%	2020	Conventional HR processes

Source: [Industrial Innovation: Pathways to deep decarbonization of industry; Part 1 Technology analysis \(Fraunhofer ISI\)](#)

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Decarbonization RoadMap of some of the main steelmakers



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Source: [Arcelormittal](#)

voestalpine

Source: [Voestalpine](#)

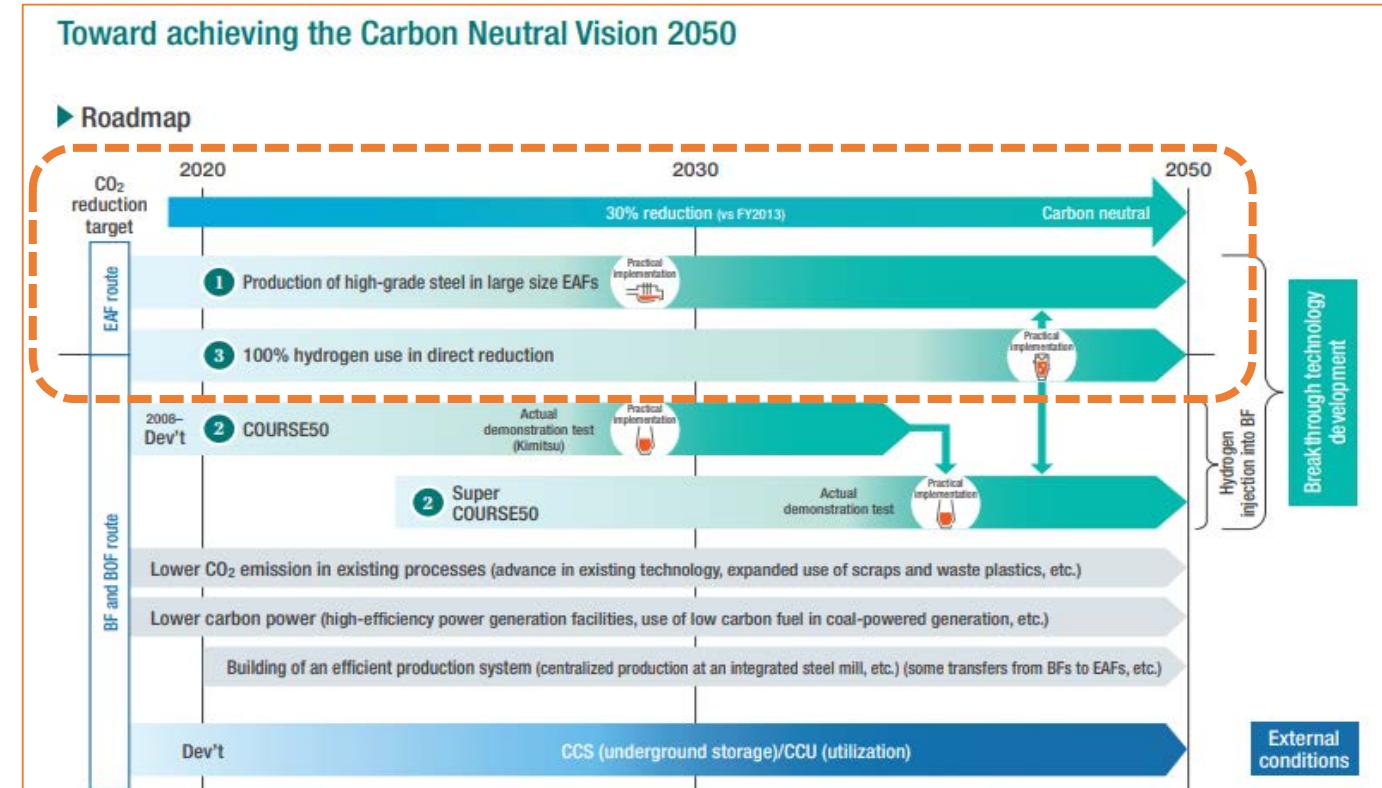


TATA STEEL

Source: [Tata](#)

NIPPON STEEL

Source: [Nipponsteel](#)



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WHAT iF?

We do not succeed?

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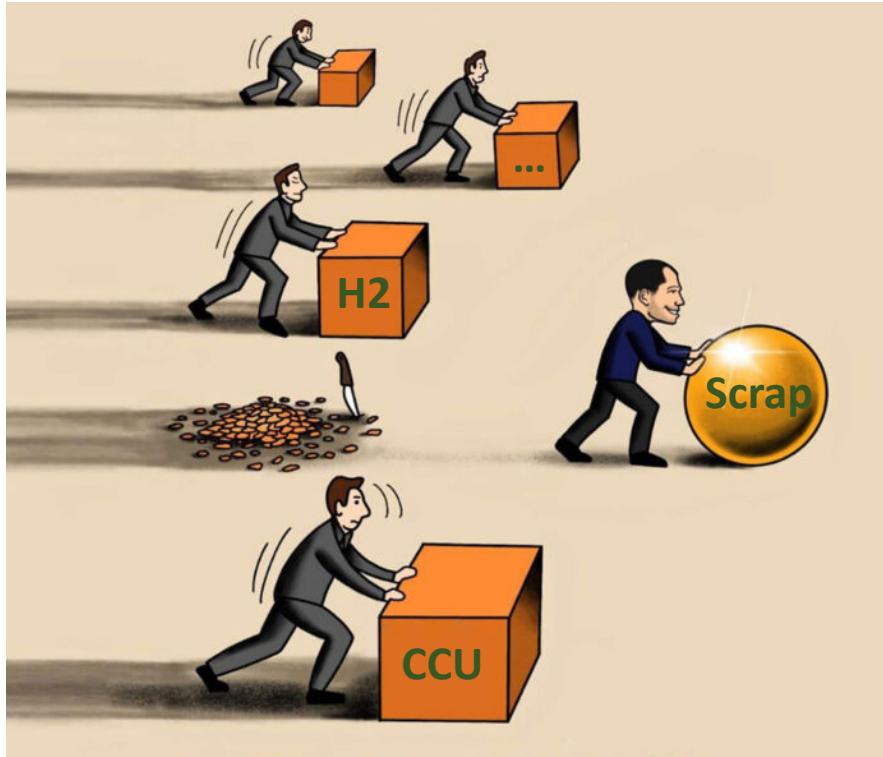




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Steel recycling will play a major role in every decarbonization scenario

Ockham's Razor Principle



- EAFs can consume 100% scrap,
- BF-BOF steel mills cannot use more than 20%
- Approximately 70% of the world's existing BFs will reach their end of life before 2030
- If These BF-BOF are replaced with EAFs fed by the same proportion of scrap (20%) and further reduce their emissions in 55% by 2030.
- These reductions could reach 73% (scrap + DRI from H₂),

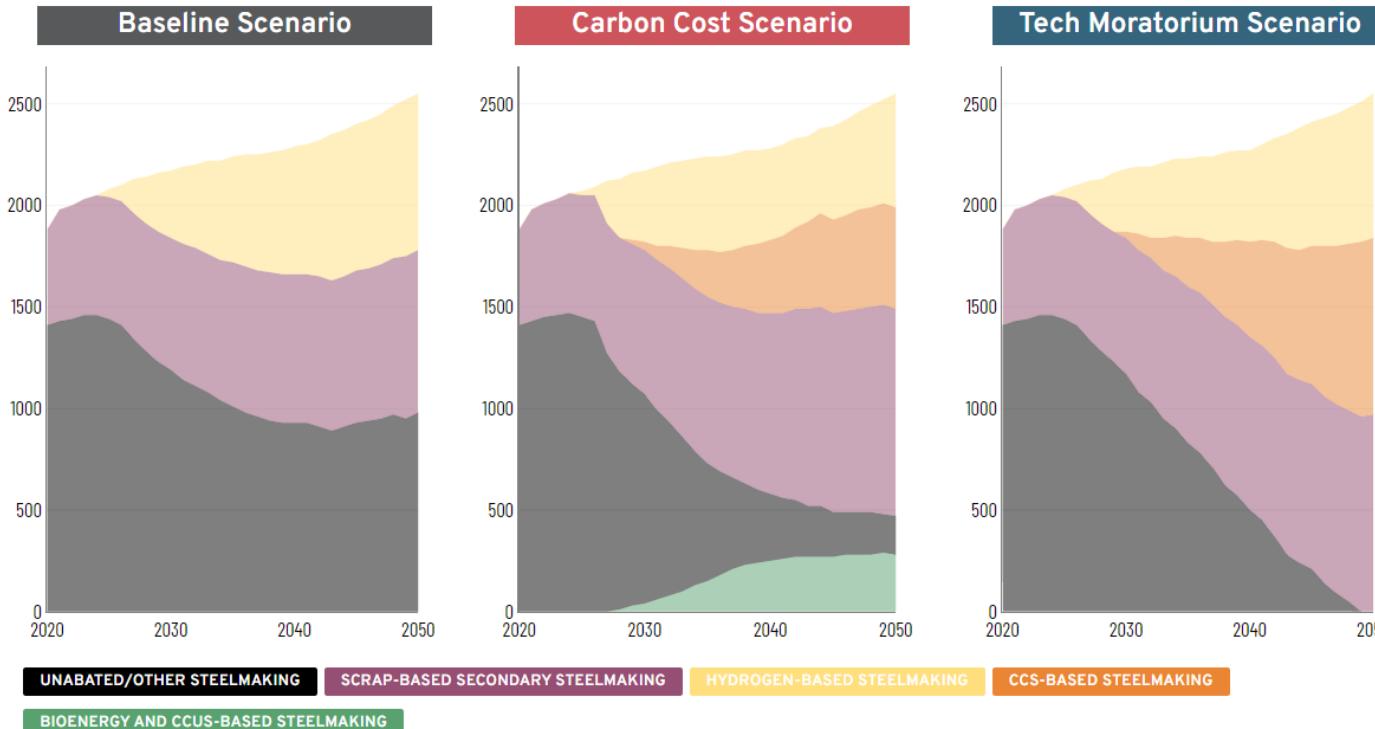


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Steel recycling will play a major role in every decarbonization scenario

Scrap-based steelmaking and BF-BOF route switch to DRI-EAF route seems to be the industrial trend for the future

Technology route share estimation based on plausible scenarios



Source: <https://dash-mpp.plotly.host/mpp-steel-net-zero-explorer/>

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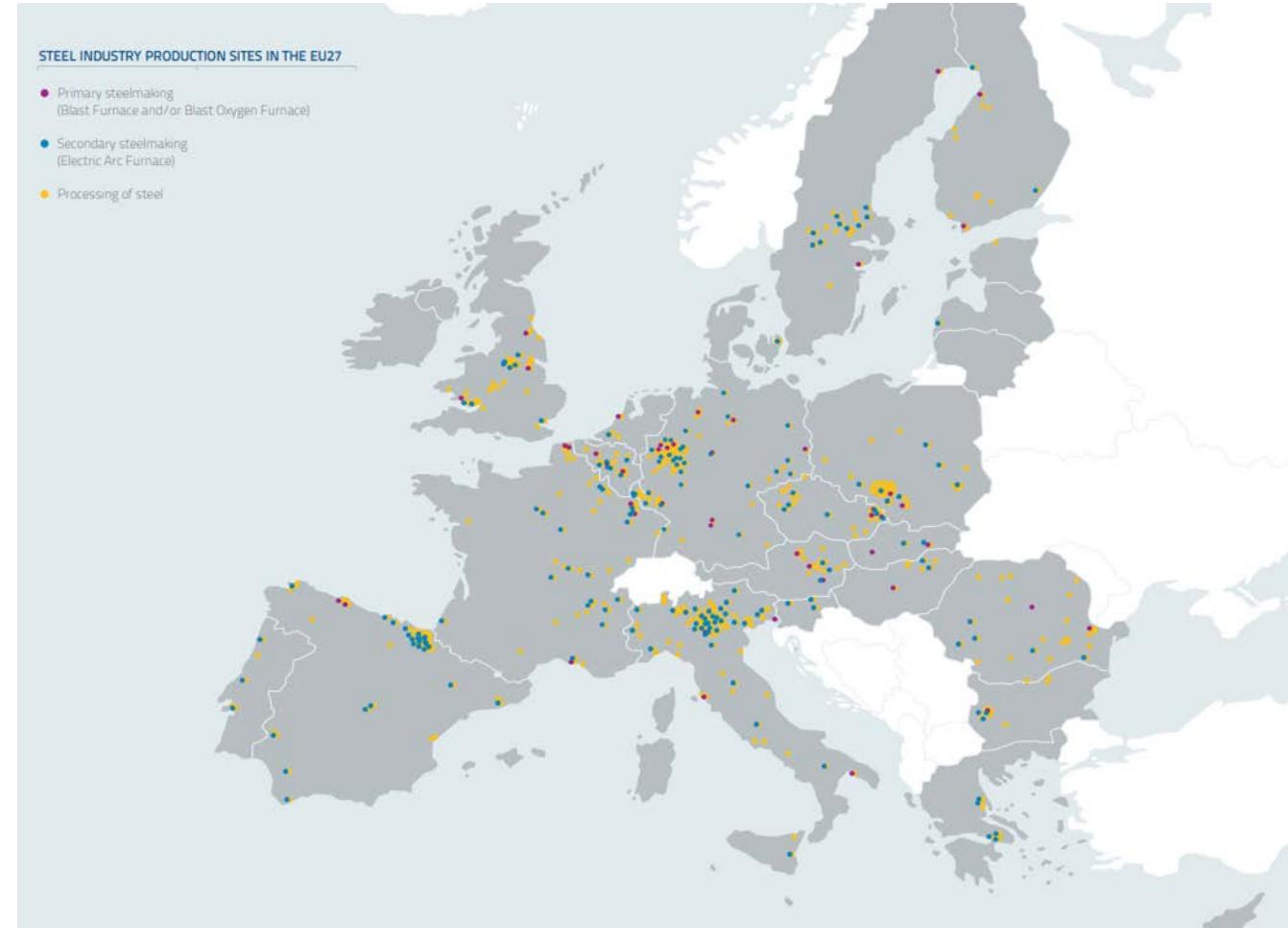
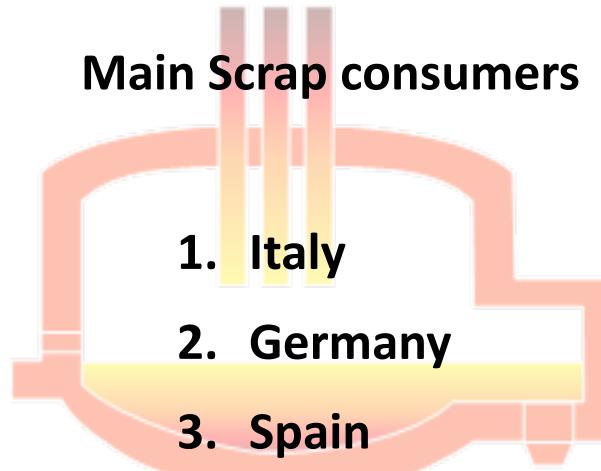




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Steel recycling will play a major role in every decarbonization scenario

Where is the risk?



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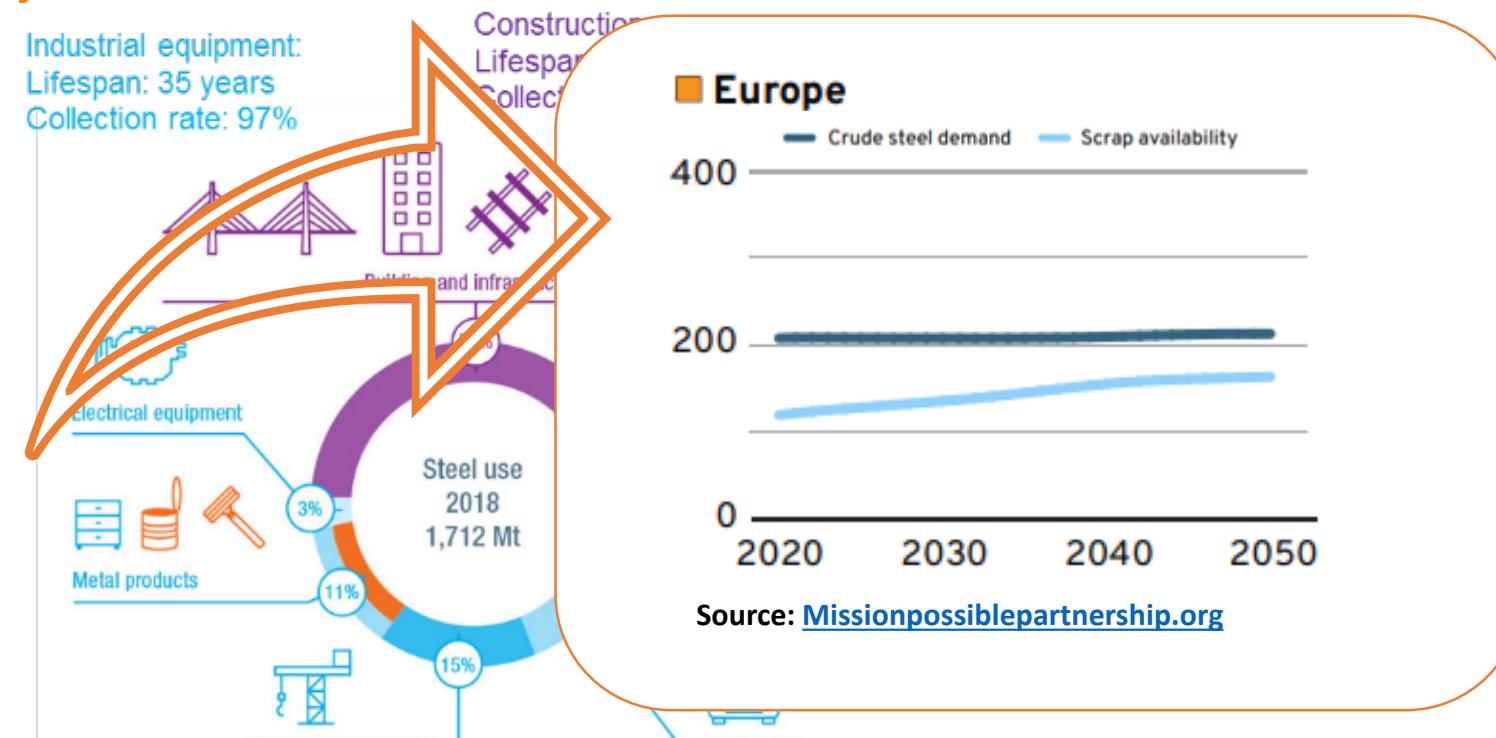




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Steel recycling will play a major role in every decarbonization scenario

Where is the opportunity?



Packaging, appliances and others:
Lifespan: 20 years
Collection rate: 90%

Vehicles:
Lifespan: 20 years
Collection rate: 95%

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Aluminium industry



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Global Picture of Aluminium Process

•2022's Aluminum industry concerns



Source: International Aluminium Institute; European Aluminium; World Economic Forum

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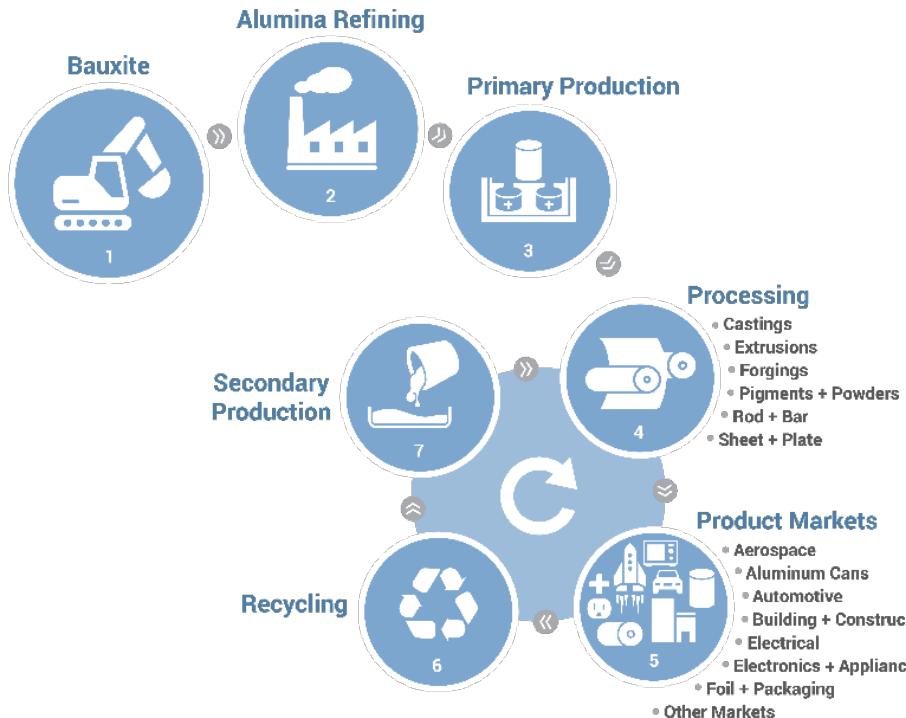
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Global Picture of Aluminium Process



Primary aluminium production is significantly more energy and emissions intensive than secondary production

The flowchart shows the primary aluminium production process:

```

    graph LR
      BM[Bauxite mining] --> DR[Alumina refining]
      DR --> D[Digestion]
      DR --> C[Calcination]
      D --> C
      C --> AS[Aluminium smelting]
      AS --> PC[Primary casting]
      PC --> PA[Anode production]
      PA --> AS
  
```

Primary aluminium total includes Anode production and Primary casting.

Secondary aluminium includes Scrap melting and casting.

	Primary aluminium total	Secondary aluminium
Energy gigajoules/t Al	~77	3.3
GHG t CO ₂ e/t Al	~16	0.5
Material requirements	About 2-3 t bauxite for 1 t alumina About 0.4-0.45 t carbon anodes for 1 t Al	About 1.9-1.95 t alumina for 1 t Al

Source: International Aluminium Institute; European Aluminium; World Economic Forum

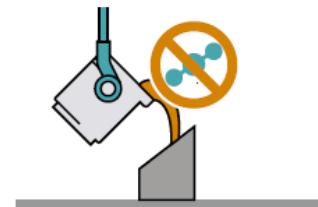
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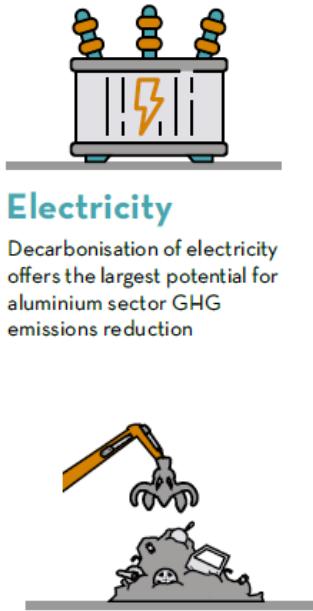


Decarbonization RoadMap of Aluminium industry



Process emissions

Novel technologies for heat and steam, and zero carbon smelting are required

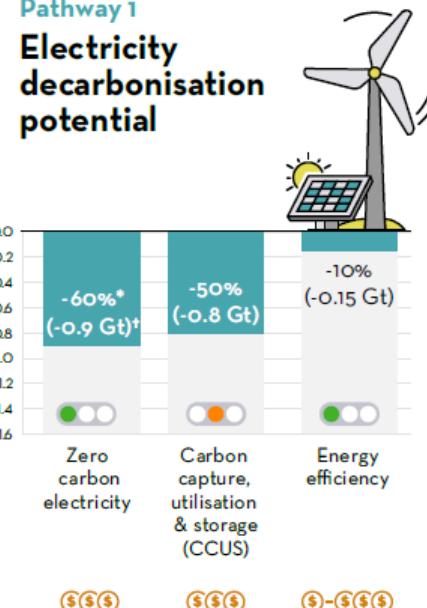


Recycling

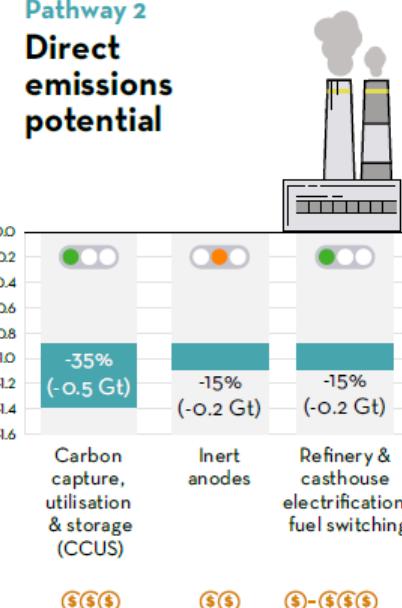
Improving post-consumer scrap recycling requires action from players all along the aluminium value chain

GREENHOUSE GAS EMISSIONS REDUCTION PATHWAYS

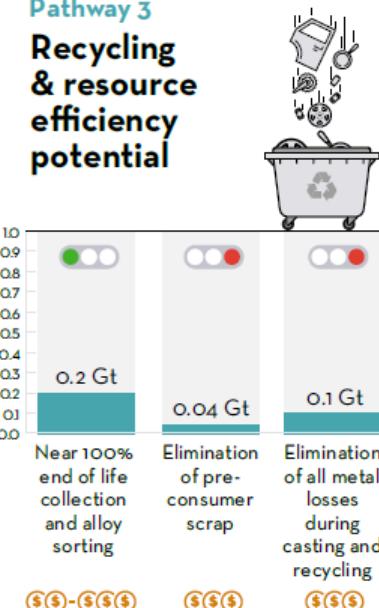
Pathway 1 Electricity decarbonisation potential



Pathway 2 Direct emissions potential



Pathway 3 Recycling & resource efficiency potential



\$ Investment required

Green Yellow Red Technological readiness

Source: Missionpossiblepartnership.org

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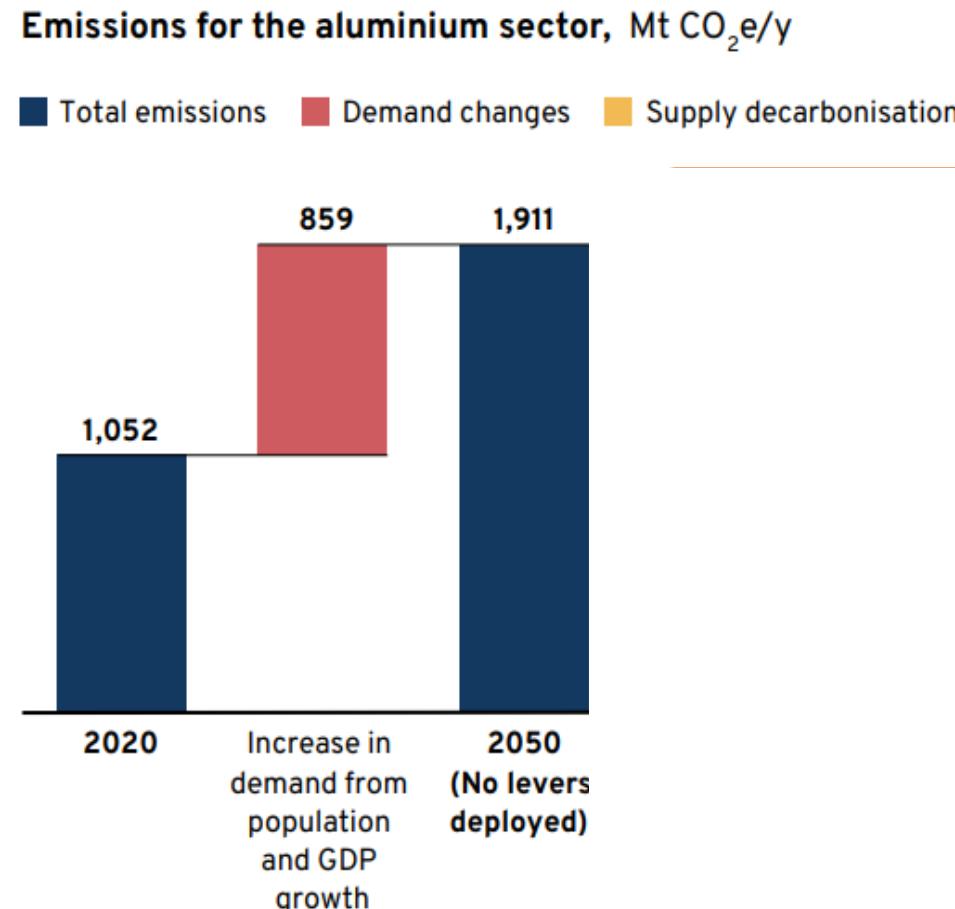
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EUROPA SUSTAINABLE BUSINESS FORUM



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Decarbonization RoadMap of Aluminium industry



Just by implementing efficient recycling strategies

Source: [Missionpossiblepartnership.org](https://missionpossiblepartnership.org)

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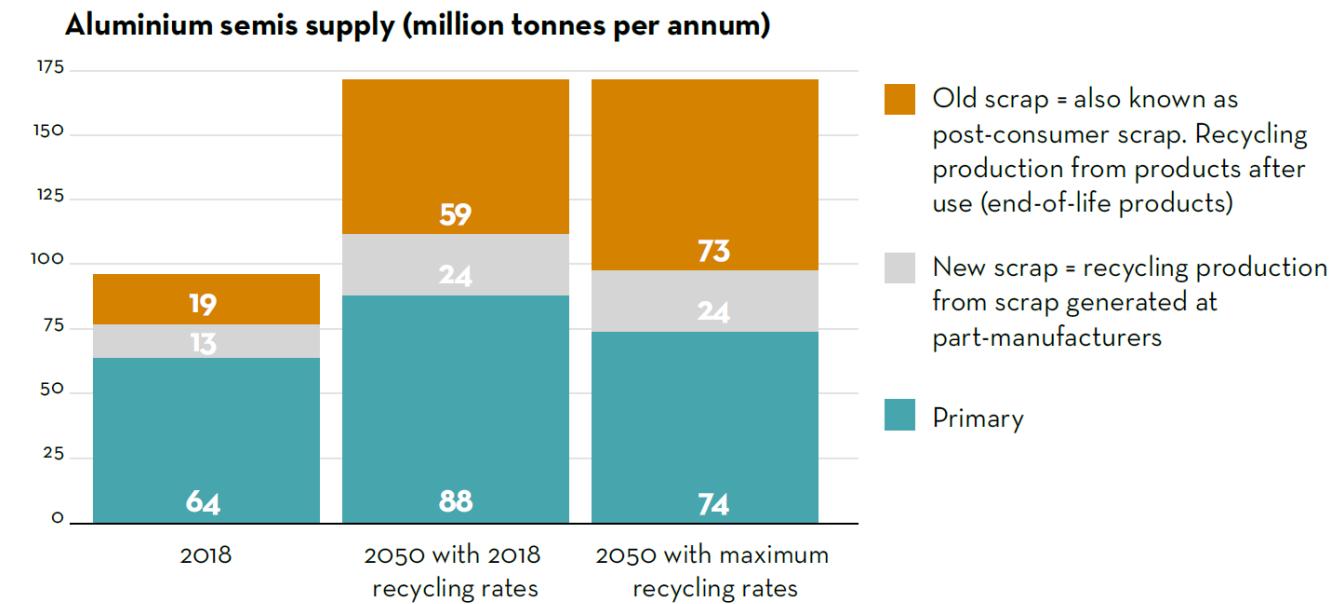


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Steel recycling will play a major role in every decarbonization scenario Where is the opportunity?

Global demand for aluminium is expected to **increase by 70% by 2050**, due to rapid population and economic growth and the drive for sustainable solutions for a low-carbon society.

This demand could be met by a **50/50 balance of recycled and primary** metal, based on 2019 collection rates for end-of-life products.



Source: [Missionpossiblepartnership.org](https://missionpossiblepartnership.org)

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Aluminium & Steel scrap



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Focus on Scrap as raw material

The main problem with Ferrous and Non Ferrous scrap is that not all is scrap!

Non Ferrous metals



Dirt

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Coatings / paintings

Non metallic materials



Rust



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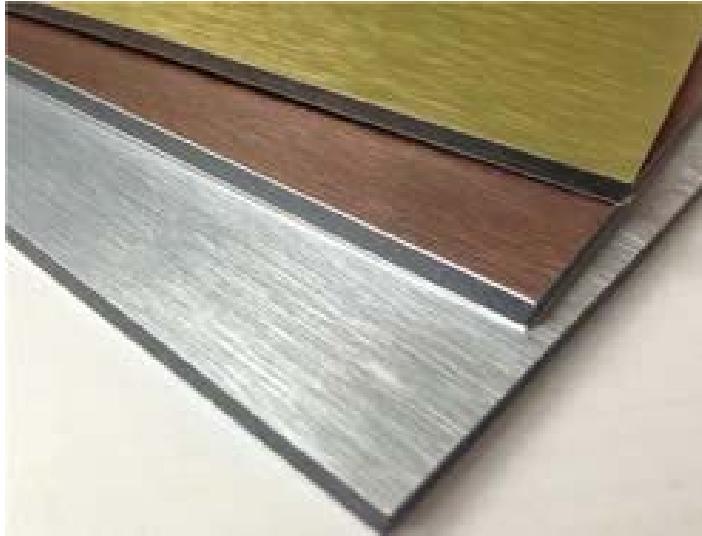
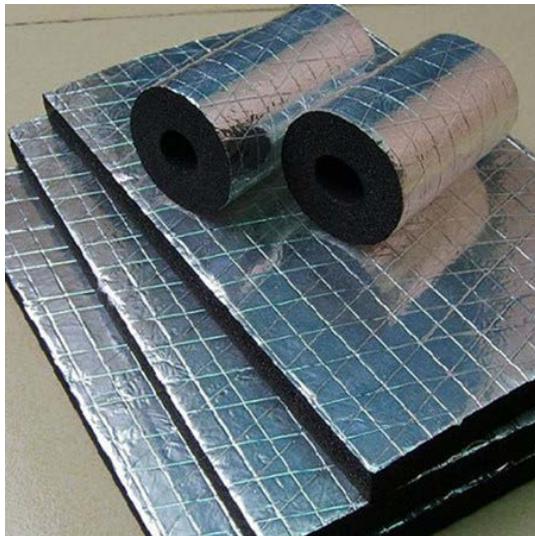




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Focus on Scrap as raw material

In Non Ferrous metals there are many very complexes to recycle materials!!



<https://www.ziclainnovation.com/>

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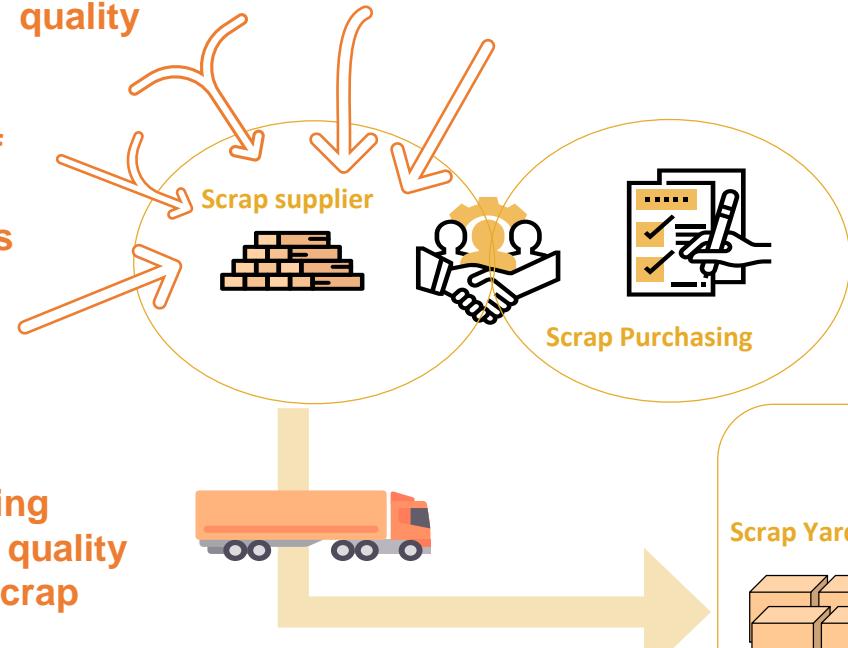


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Focus on Scrap as raw material: Identified challenges

The business
is volume, no
quality

Huge
number of
suppliers
and origins



55 – 60% of the total cost in electrical steelmaking route

Long-term
purchasing
strategies

Impact on
process
efficiency

How to stabilize
the process

Impact on
product quality

Handling huge
volumes of
heavy material

How to
characterize the
material (Value
In Use)

Scrap
processing /
upgrading
strategies

Short term scrap
mix definition
strategies

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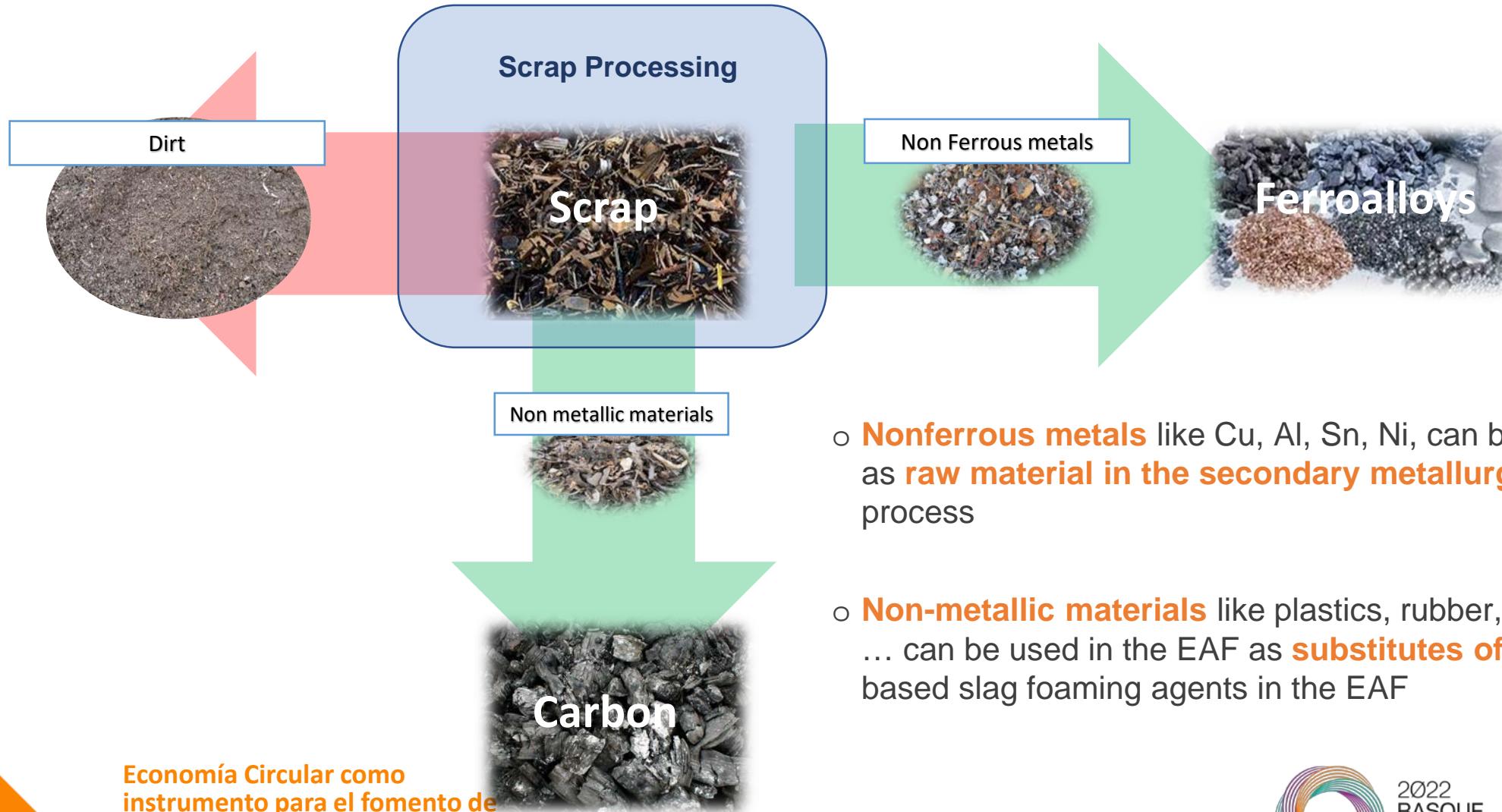
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Focus on Scrap as raw material: Opportunities



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Focus on Scrap as raw material: Opportunities

To increase the recycling capacity and energy efficiency, innovative technologies to “treat” the scrap before it reaches the steelmaking reactors needs to be implemented



Identify and characterize new opportunities to use and reuse lower-quality scrap by having a better **understanding** of the **scrap market** and the opportunities.



Select and integrate the best available technologies to **upgrade**, **sort and characterize** lower-quality scrap to enhance the scrap quality



Industrial demonstrator of scrap sorting/ cleaning based on innovative combinations of BATs



Define **valorization** routes of the **waste** generated by the upgrading schemas

Conclusion



Industry decarbonization is a must.

This is boosting a **technological transformation** of steel and aluminium industries where secondary production routes will play an important role.

Fortunately for us, this is **positive** (we are already doing)

There are some **risks**:

- High scrap quality is a limited raw material
- Scrap is an extremely complex raw material
- Scrap quality is barely stable

There are some **opportunities**:

- Larger availability of low-quality scrap
- Development of advanced solutions is needed
- Scrap business includes all the supply chain

Profitability of our activities must be ensured. It is time now to think on that and to consolidate the strategies

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Thanks for your attention

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