



# SmartCarbon Technologies at ArcelorMittal: Steelanol and Torero

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MUSIC Workshop: Prospects of biocoal for the metallurgical industry

Wim Van der Stricht, CO<sub>2</sub> and Circular Economy

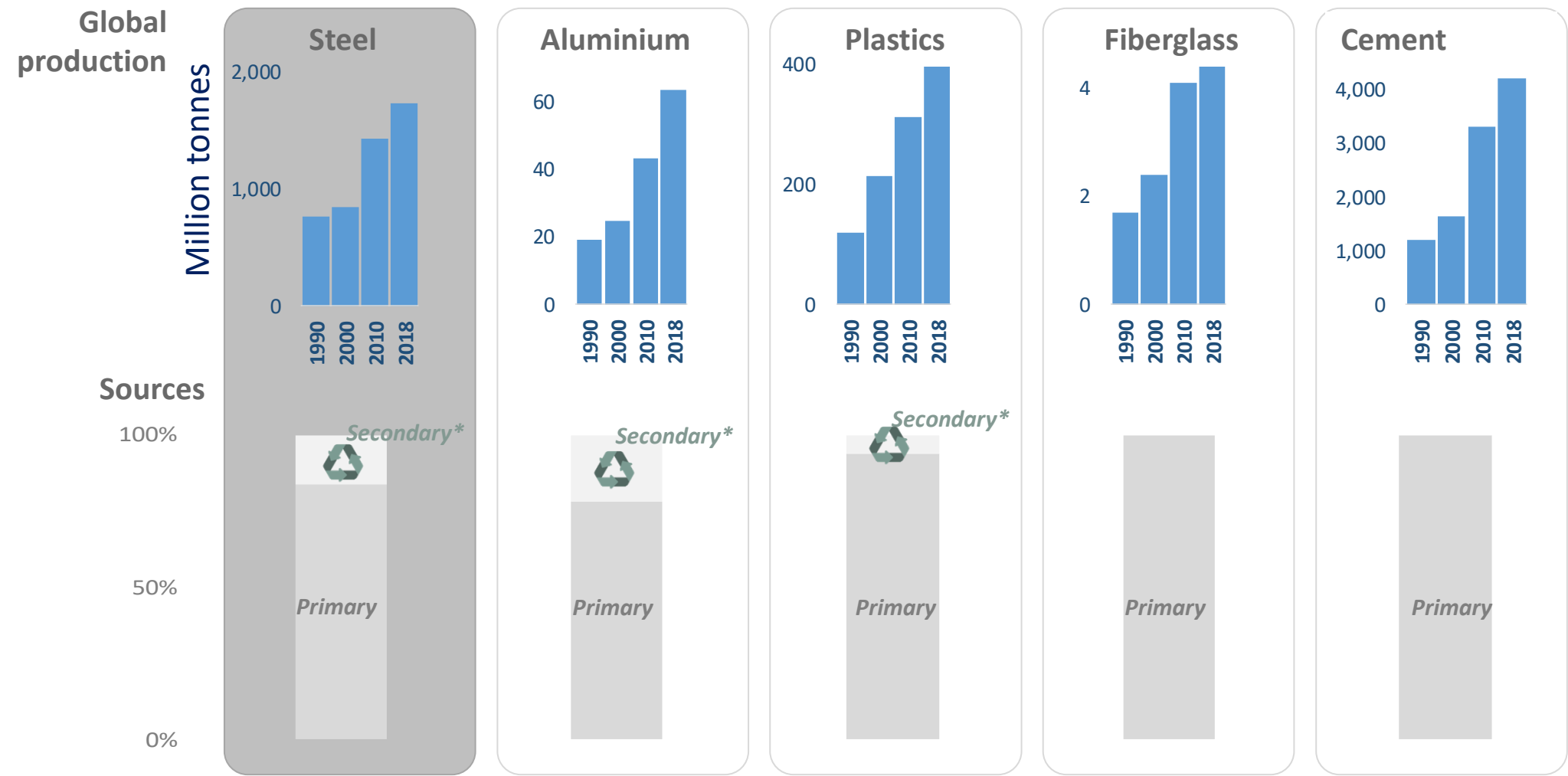


# What is common about all of these plausible futures?

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# Materials: global consumption for most materials has tripled since 1990; material production today relies heavily on primary sources



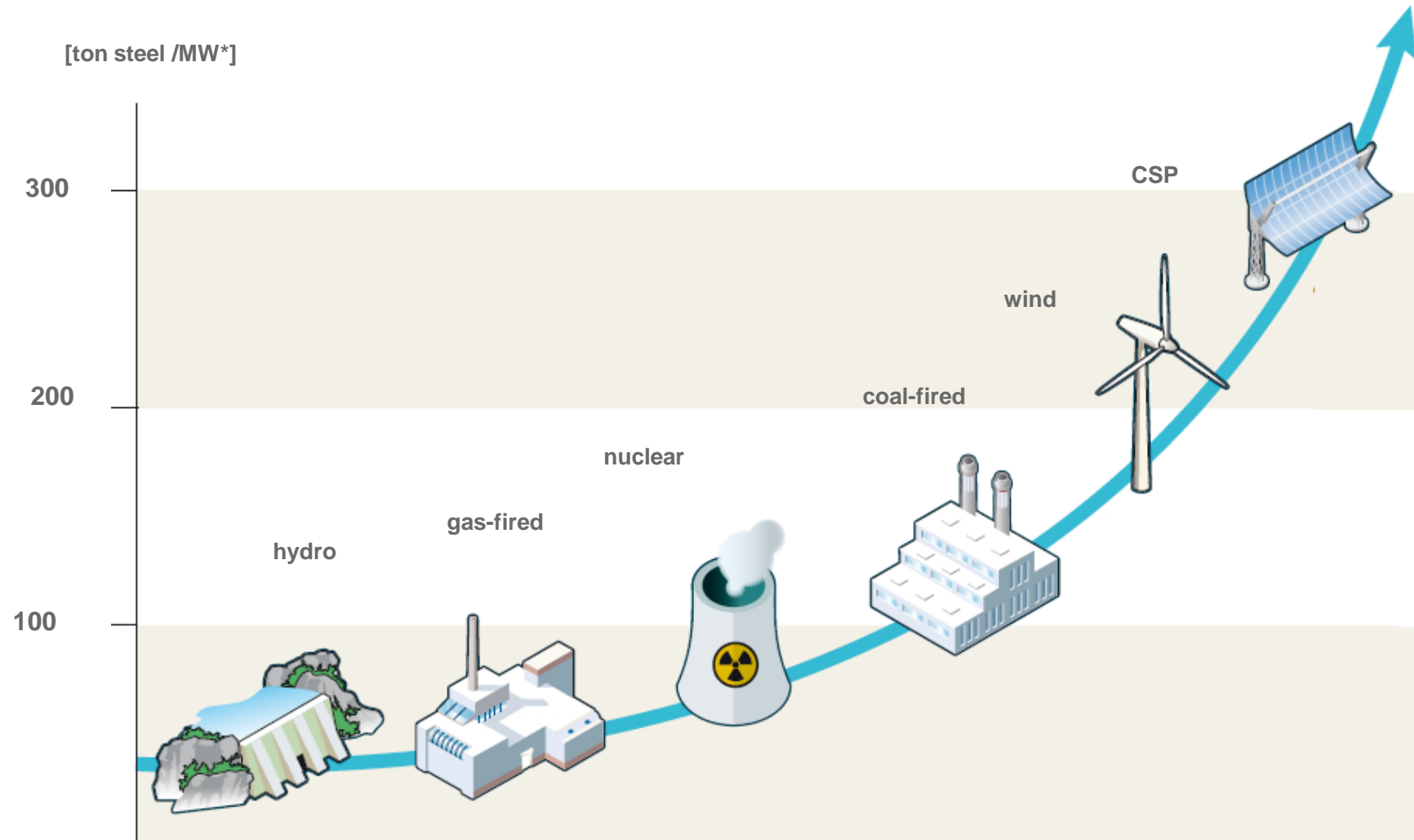
\* Defined as end of life material recycled to make same material again  
Sources: WSA, World Aluminium, Plastics Europe, ArcelorMittal Corporate Strategy analysis

# Energy transition: Sustainable energy production increases the need for materials

## Steel intensity in modern society is further increasing



ArcelorMittal



\* steel consumptions per installed MW capacity



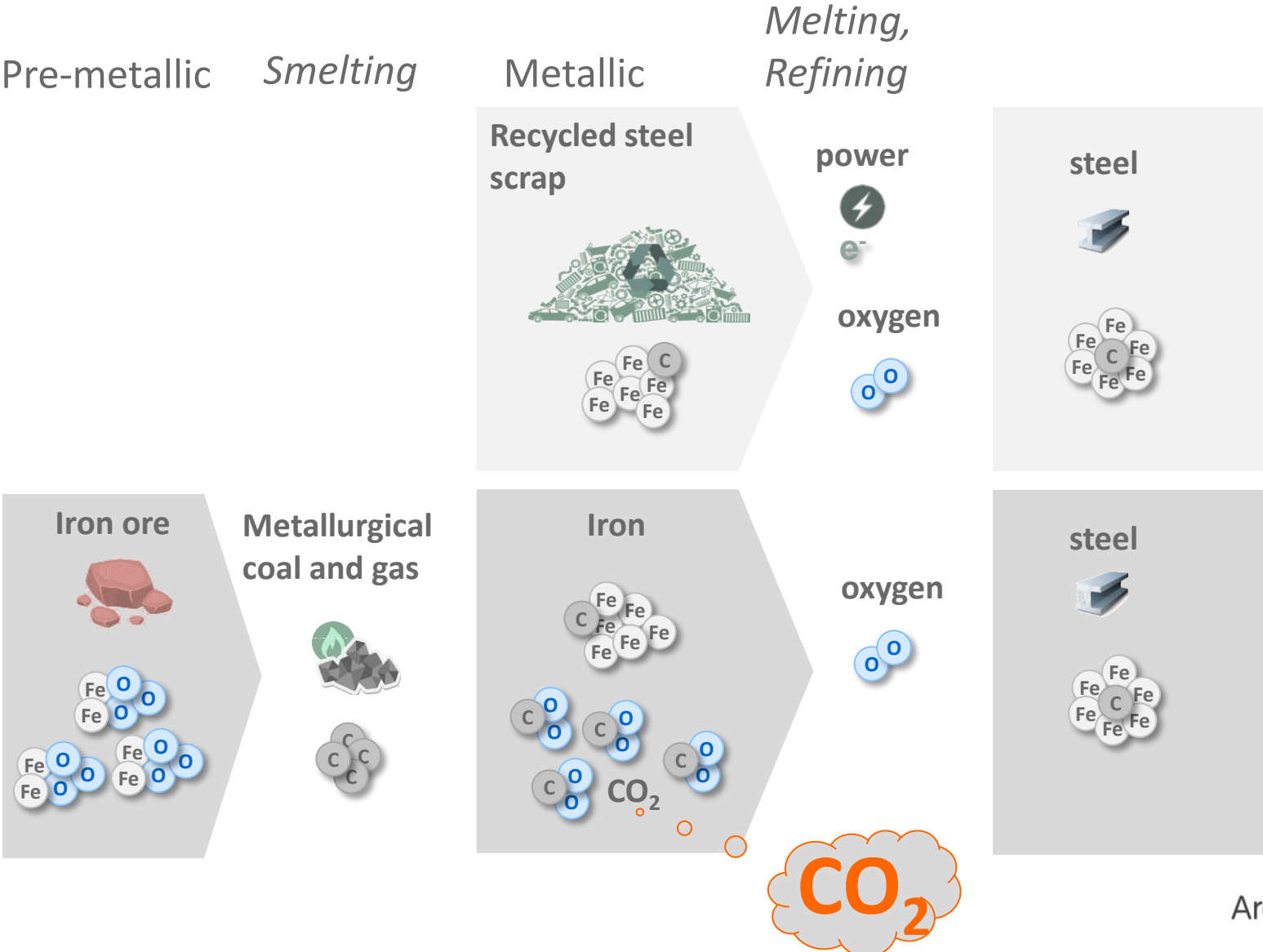
ArcelorMittal

# As with virtually all materials, producing steel from primary sources requires significant energy, today's main source of CO<sub>2</sub> emissions

- BUT:**
- no high quality steel grades possible with scrap
  - not sufficient scrap in circulation (until 2070)

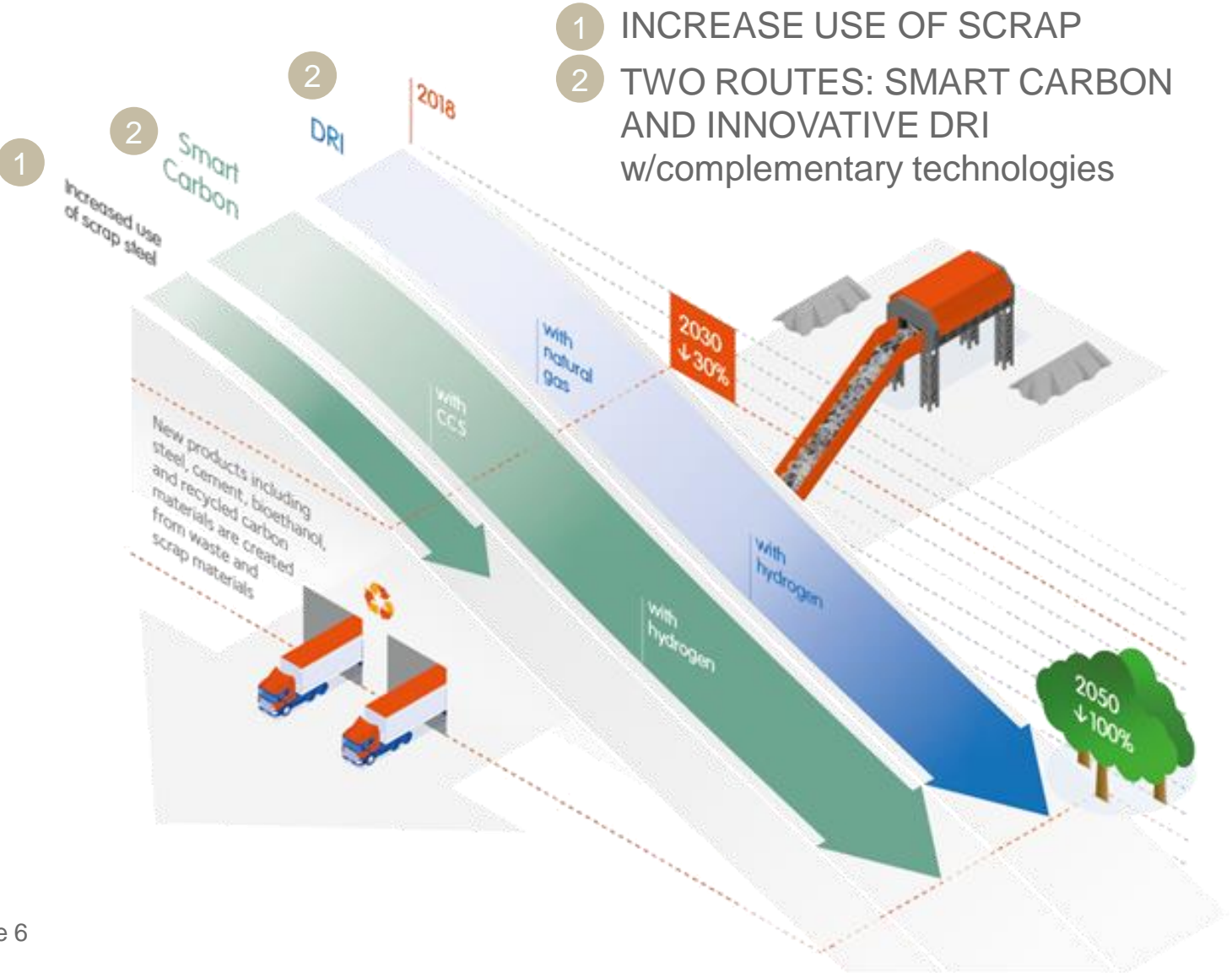
 **Secondary sources**  
*5-7 GJ for a tonne of steel*

 **Primary sources**  
*18-22 GJ for a tonne of steel*





# ArcelorMittal roadmap to low-emissions steelmaking



- 1 INCREASE USE OF SCRAP
- 2 TWO ROUTES: SMART CARBON AND INNOVATIVE DRI w/complementary technologies

Smart Carbon includes:

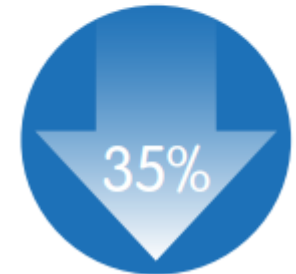
- Carbalyst
- Torero
- IGAR
- 3D - carbon capture

DRI includes:

- ArcelorMittal Hamburg hydrogen project



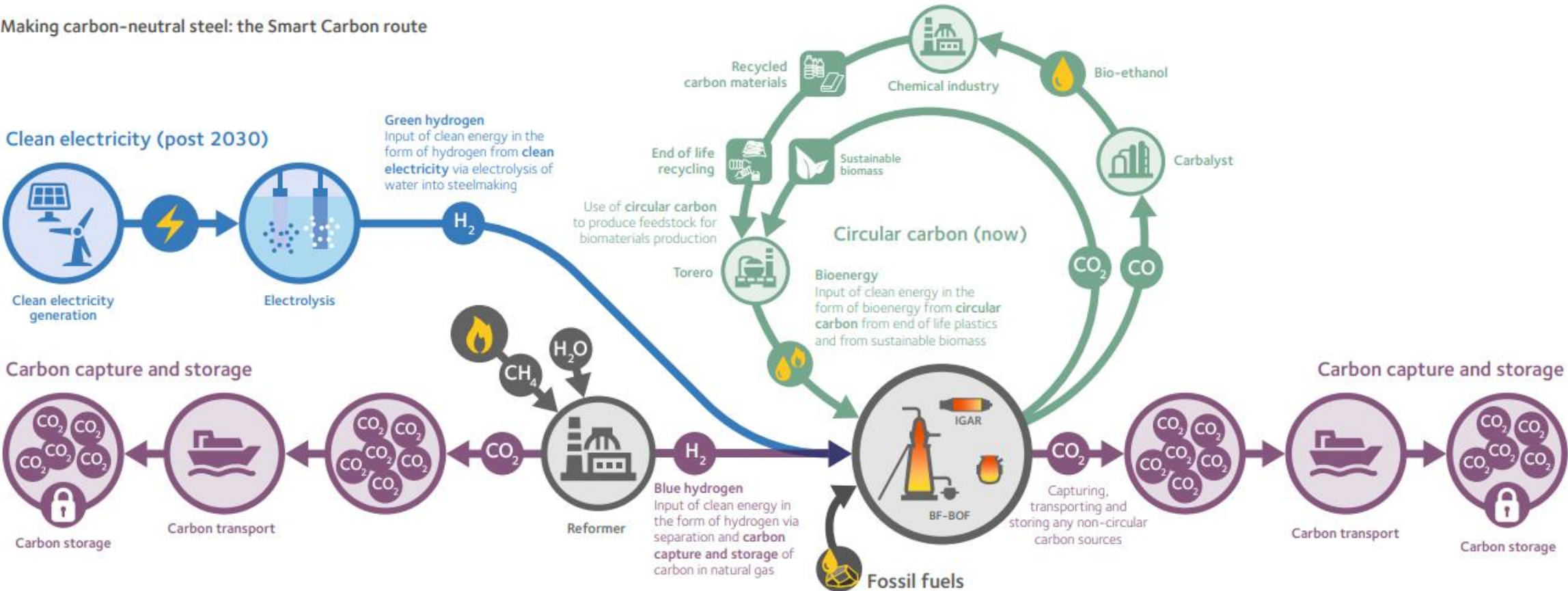
New Group target of a 25% reduction in CO<sub>2</sub>e emissions intensity by 2030 (scope 1 and 2)



Europe target increased to 35% reduction in CO<sub>2</sub>e emissions intensity by 2030 (scopes 1 and 2)

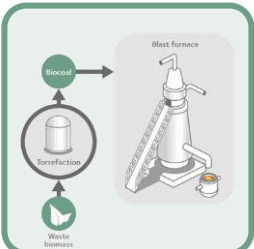
# Our roadmap: Smart Carbon technologies

## Making carbon-neutral steel: the Smart Carbon route

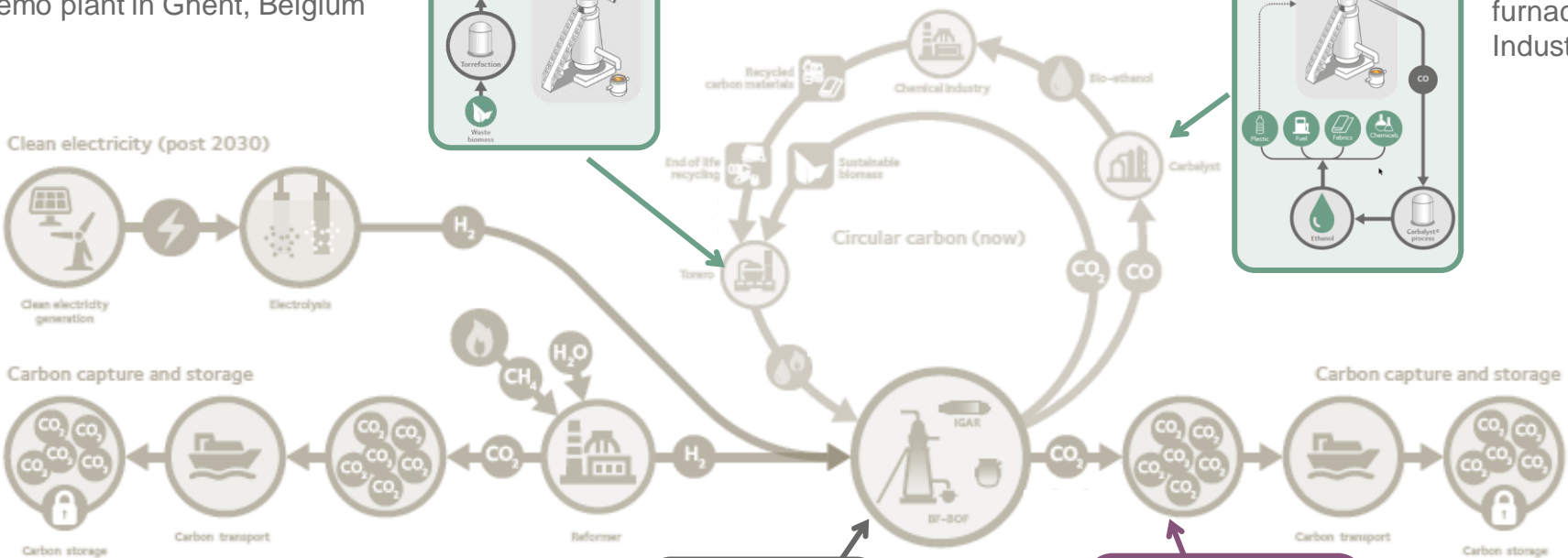
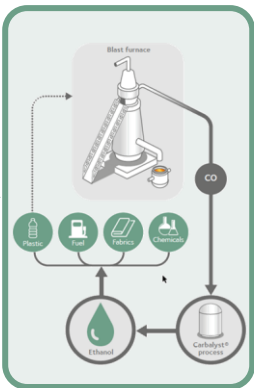


# Our roadmap: Smart Carbon technologies

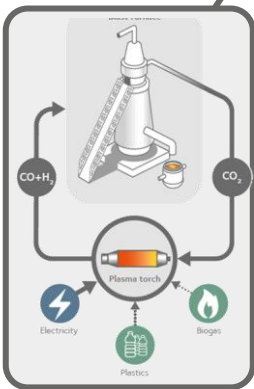
**Torero**  
converts waste wood into bio-coal,  
replacing the coal currently injected as a  
reductant  
Large-scale demo plant in Ghent, Belgium



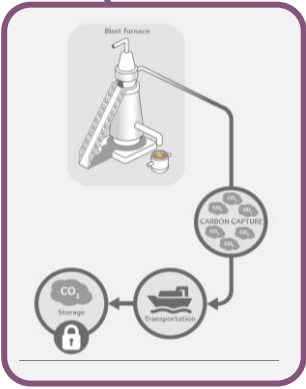
**Carbalyst (Steelanol)**  
captures carbon off-gases from the blast furnace and converts into ethanol  
Industrial demo plant in Ghent, Belgium



**Top Gas Recycling**  
captures waste CO<sub>2</sub> and waste  
hydrogen from the steelmaking  
process and internally converts it  
into synthetic gas to replace fossil  
fuels  
Industrial-scale pilot in  
Dunkirk, France



**Carbon2Value**  
*Pilot project in Gent, Belgium*  
**3D – carbon capture**  
carbon capture of off gases  
Pilot project in Dunkirk, France  
Captures 0.5 metric tonnes of CO<sub>2</sub>  
an hour

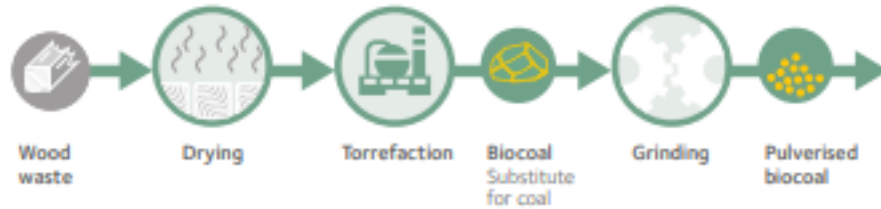




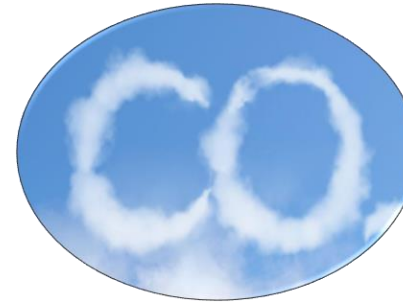
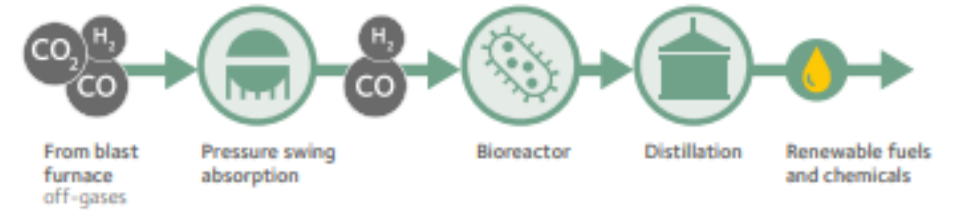
# Carbalyst (Steelanol) and Torero: converting waste wood into advanced bio-fuel



Torero

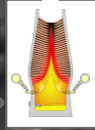


Steelanol

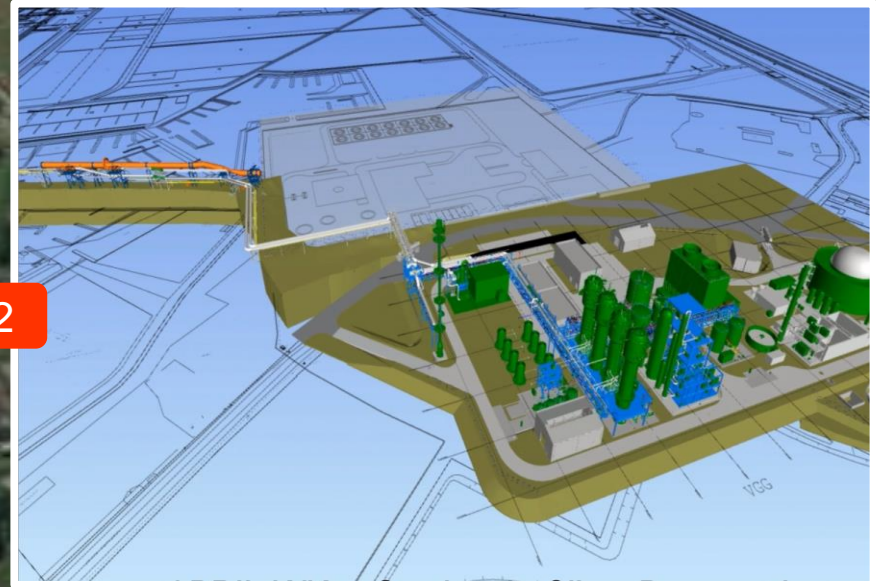




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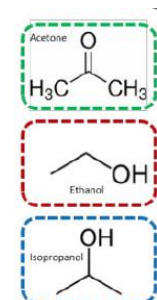
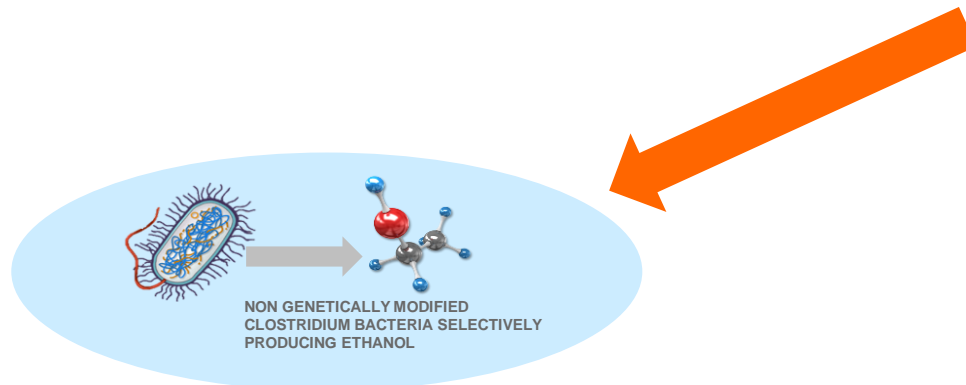
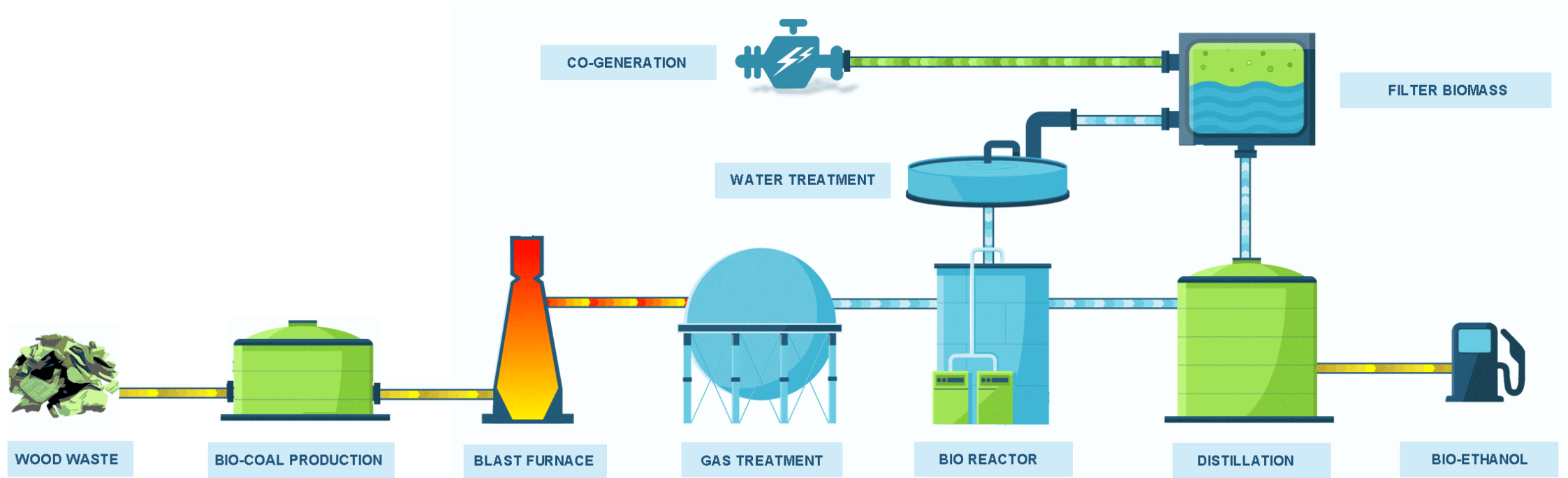
2



- Investment cost is **210 Meuro**
- **90 000 Nm<sup>3</sup>** waste gas/h from BF
- 180 000 ton waste wood (type B) is converted to **75 000 biocoal**
- Production of **80 million liter of biofuel**
- Start production **2023**

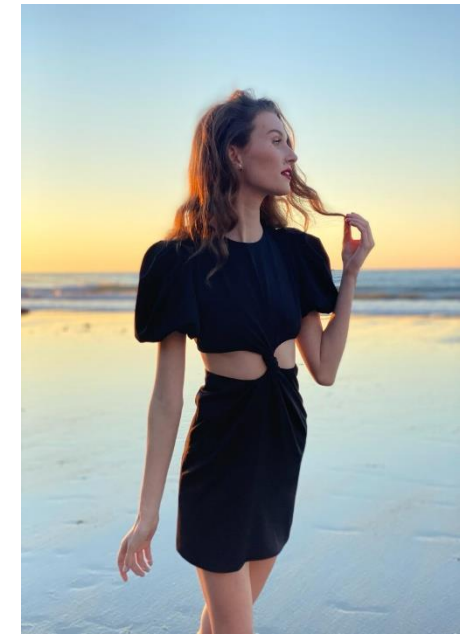


# Carbalyst (Steelman) and Torero: converting waste wood into sustainable chemicals

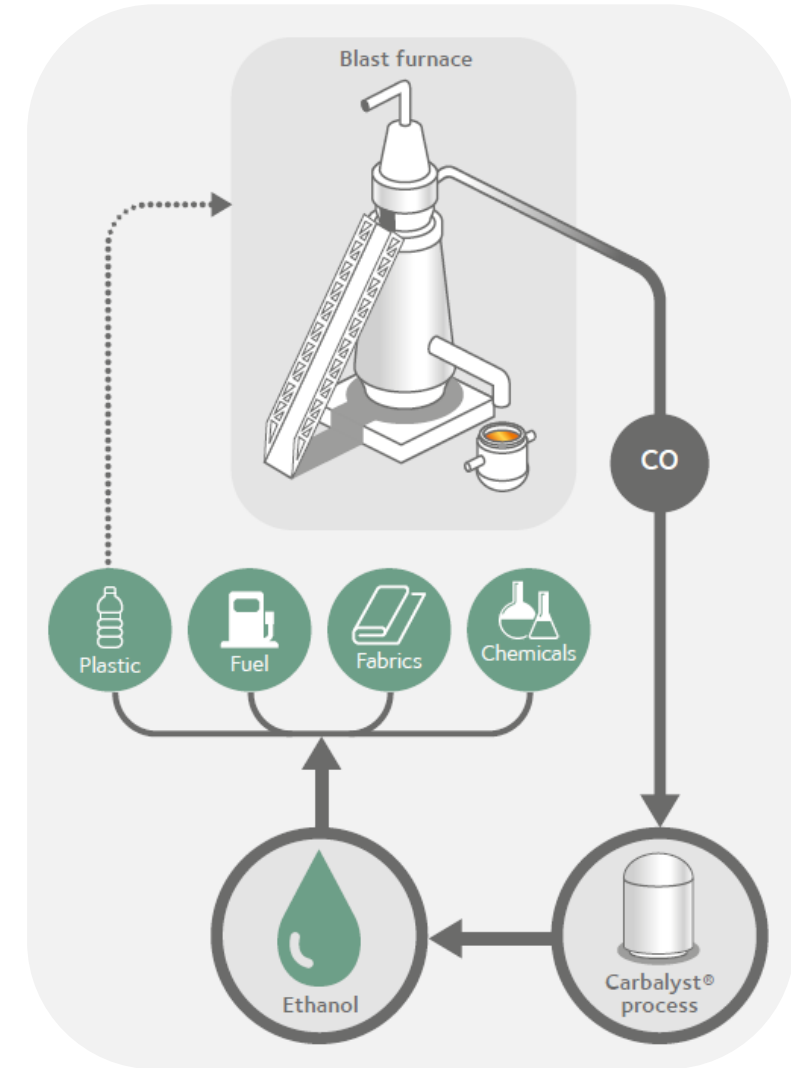
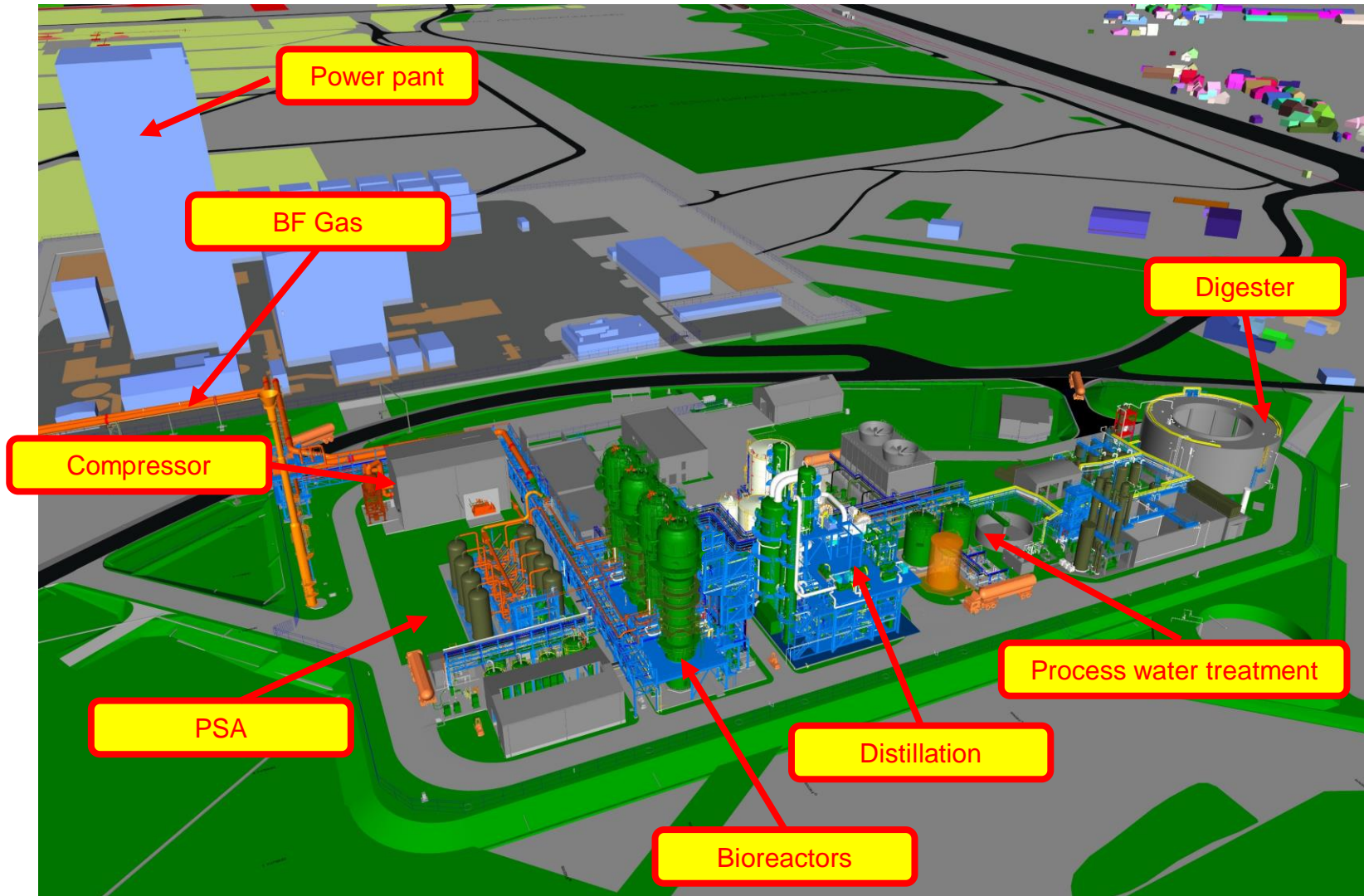




# CCU based sustainable chemicals: applications



# Carbalyst (Steelmanol): : industrial Scalable Bio-Technology enables to convert by-product gas into valuable chemicals with high energy efficiency





# Steelmanol: January 2019





# Steelmanol: September 2020





# Steelmanol: December 2020





# Steelmanol: September 2021





# Steelmanol: today







Waste collection

Waste wood



Torrefaction

Bio Coal

45 % Powder coal

5 %

50 % Cokes

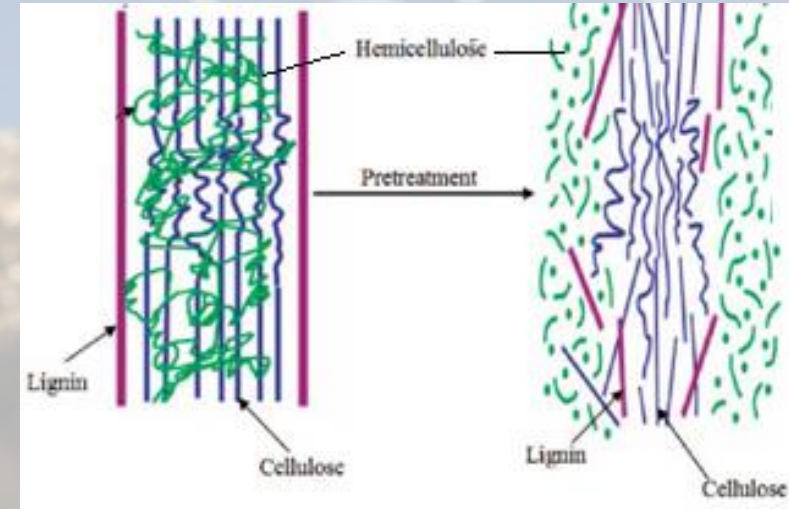


Blast furnace



# Torrefaction process

- A biomass pre-treatment at a temperature of  $250\text{--}320^{\circ}\text{C}$  in absence of  $\text{O}_2$ , leading to removal of moisture and volatiles
- Similar thermal degradation process as charcoal



Wood chips



Wood(pellets)



Torrefied wood



Charcoal



Coal



Coke



# TORERO PLANT



Biocoal loading



Waste wood dosing



Reactor

Conveyor

Combustion Chamber

Heat - Recovery

Reactor

Substation Reactor

Substation Pre-handling

Cooling screw

Dryer

Nitrogen backup

Metal Separator

Sieve

Hopper

Pre-handling

Waste Wood-storage





# Torero: March 2021





# Torero: June 2021





Torero: July 2022





Torero today





# Thank you



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*MUSIC has received funding from the European Union Horizon 2020 program. Related to work program topic LC-SC3-RES-28-2018-2019-2020.*



Thank you for your attention !  
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