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Sustainability : the Aidic approach and engagement

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Sustainability : the Aidic approach and engagement

- What kind of contribution our Association could bring to the Energy Transition process to ensure the sustainability of our society ?
- Why our contribution could be important to indicate the transformation of manufacturing process, to develop new models and circularity processes and of energy mix ?
- How such a contribution could be moved out of a restricted number of people, our Association, to a large audience : from ordinary people with limited knowledge on sustainability to decision makers ?

Sustainability : the Aidic approach and engagement

- Our approach and engagement on Sustainability was based on two dimensions/elements :

- Activities carried out by our associates together with external professionals to draft **POSITION PAPER** on specific subjects analyzed from a rigorous Chemical Engineering point of view;

- External communication of such position paper, recognizing that communication plays a crucial role in any sustainable strategy .

Position Paper

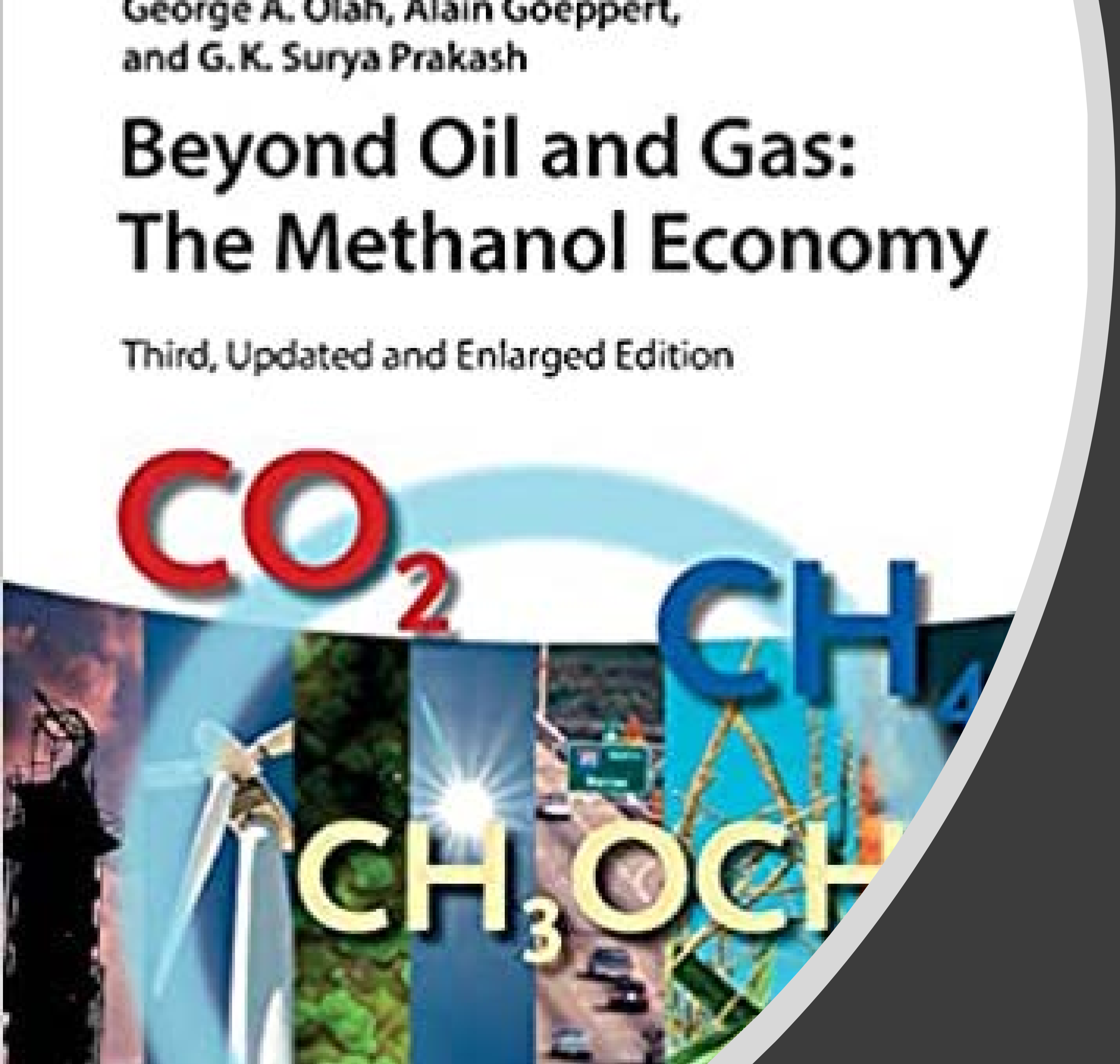
- It is important in drafting such document to remarque the complexity of the subjects, sometime involving conflicts of interests and of values;
- Main topics analyzed are relevant to energy transition targets , but we explored also other issues. New un-conventional approaches in agriculture was an example;
- Among such topics : carbon capture and sequestration (CCS), decarbonization of steel industry, hydrogen and mobility, methanol as fuel , ecc
- Two examples of such position paper will be illustrated today :

- **methanol and mobility**
- **decarbonization of steel industry**

Comunication' campaign strategy

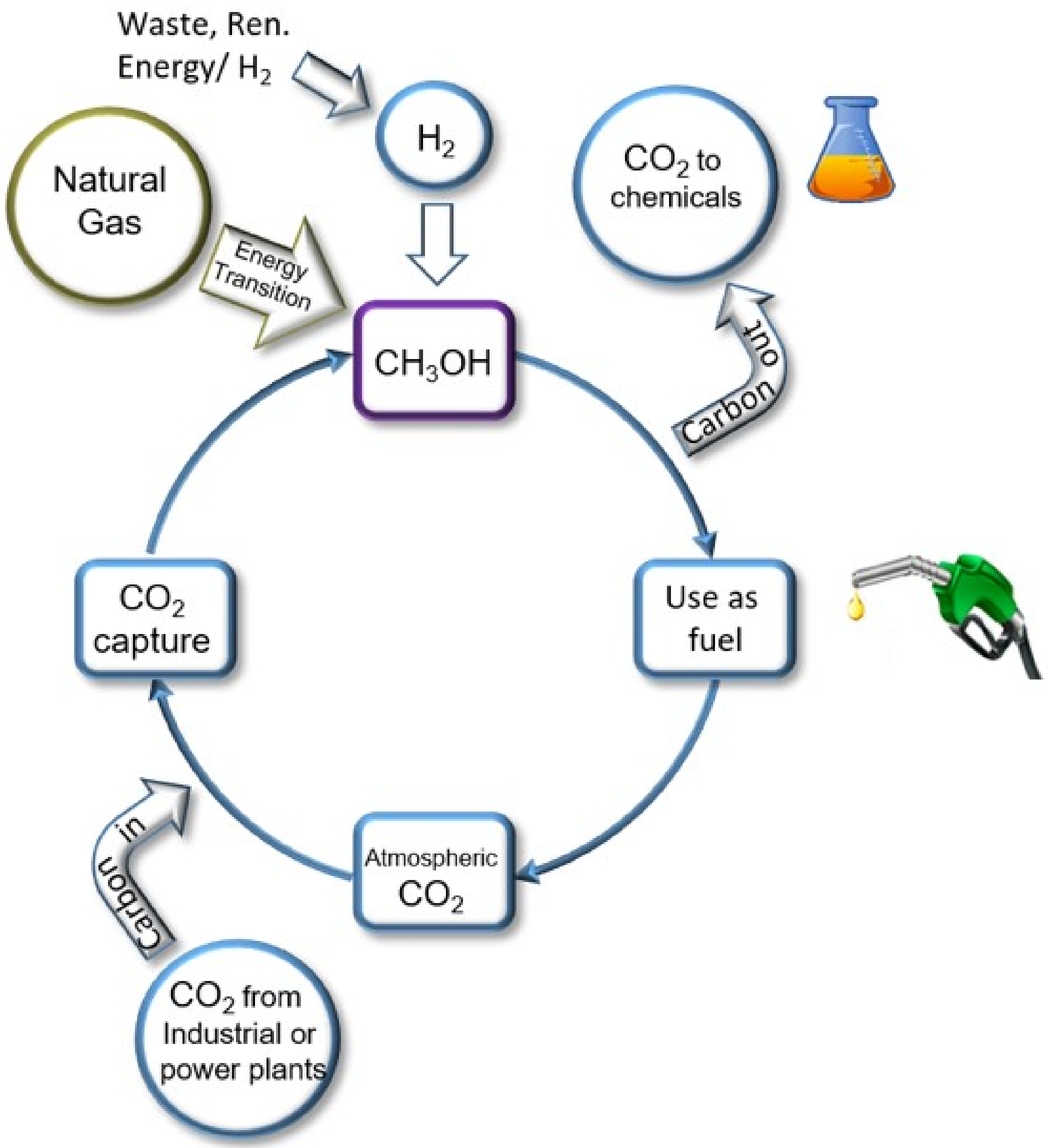
- It was focused on presenting our positioning paper in round tables, summer school, events at university and any other platform to present and discuss in a simple, direct and transparent way all the major issues of a specific topics;
- Informing and educating people is a first result, although it is not always clear how to assess if the recipients have understood the message and change their values and behaviours ;
- In a couple of cases, we have been able to interact with local authorities to explain and promote our analysis

Methanol and Transport : position paper Index



The methanol economy

The methanol economy



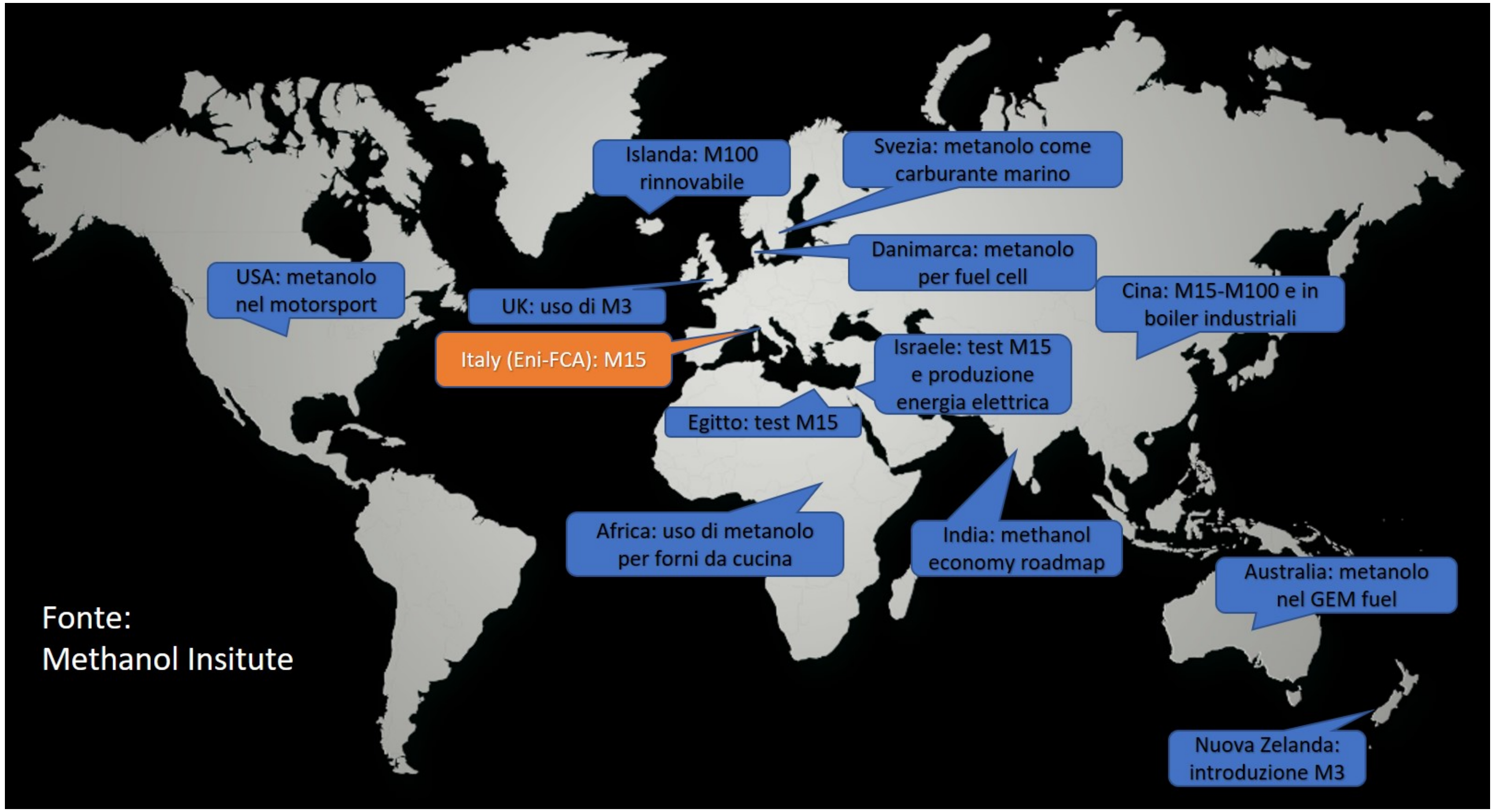
CO2 emissions : a comparison

	Rapporto C/H	Pot Cal Sup (kJ/g)	CO_2 rilasciata (moli/MJ)	CO_2 rilasciata (Kg/MJ)	CO_2 rilasciata (Kg/Kg)
Carbone	1/1	39.3	2.0	0.088	3.5
Petrolio	1/2	43.6	1.6	0.070	3.1
Metano	1/4	51.6	1.2	0,053	2.7
Metanolo	1/4	22.7	1.4	0.061	1.4

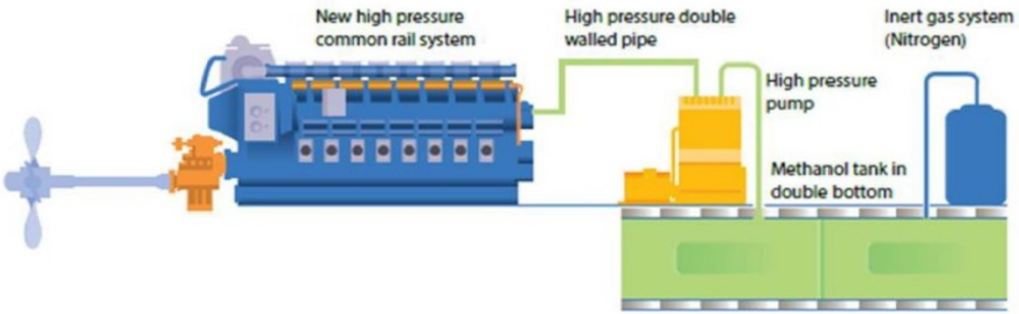
Gas turbine retrofit with methanol ,Eilat-Israel .

Past and present

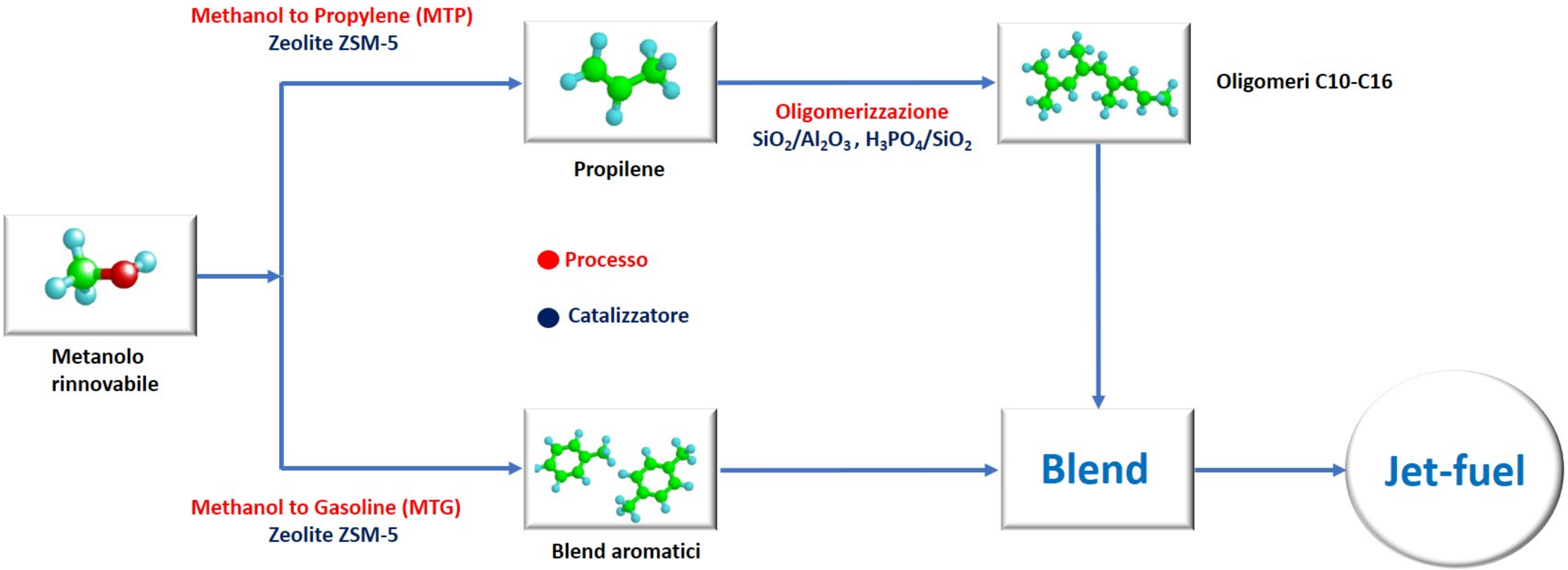
Methanol as fuel : road testing



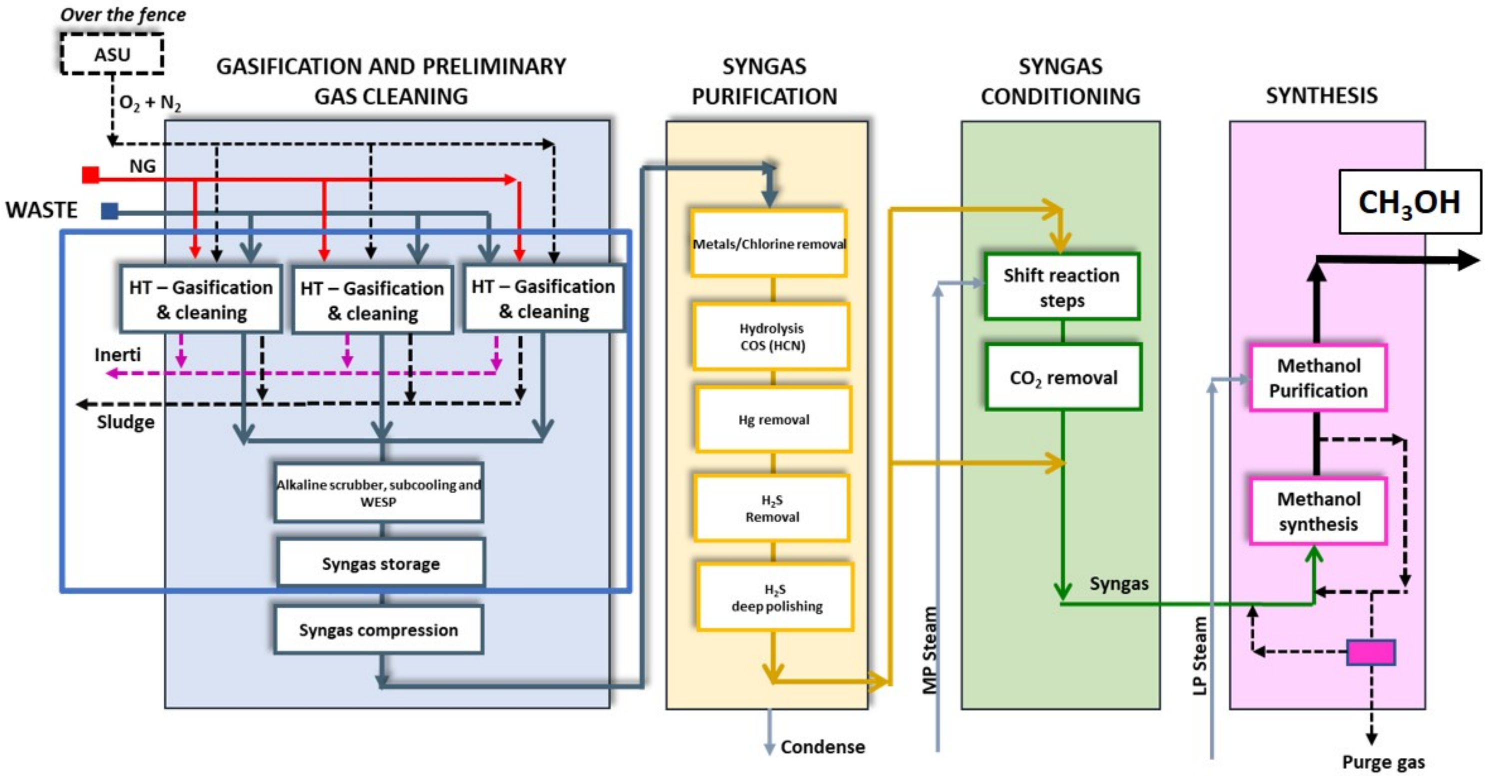
Dual-fuel vessel



Methanol to jet fuel

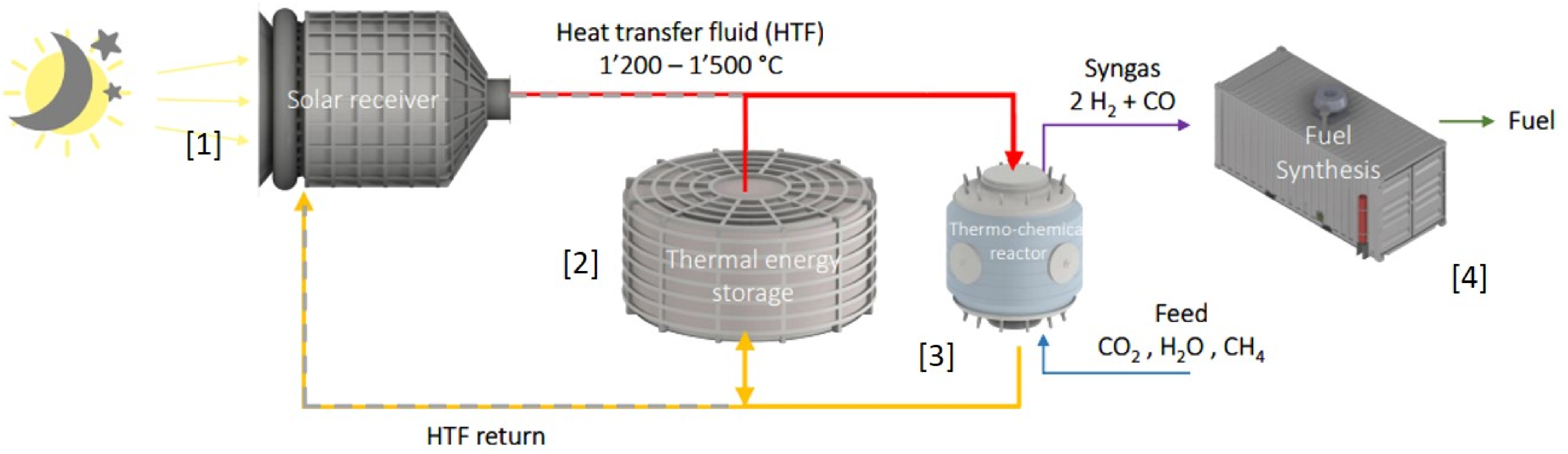


Waste-to-methanol



$$CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$$

Solar methanol



Conclusions

- The European Parlament has decided to ban the sale of petrol-powered cars from by 2035;
- Such a decision will shift the use to electric or hydrogen fuelled car;
- Manufacturing of critical metals and bacteries will done mainly in Asia

Conclusions

- Moving out from the technology of internal combustion engine is going to have a strong negative impact on European manufacturing industry to the advantage of China and other Asian countries;
- The use of methanol as fuel may represent a valid alternative from the environmental point of view: it does not require to change the actual infrastructure and will allow to maintain in Europe a strong manufacturing basis

Decarbonizing steel industry

The overall picture

- I NUMERI

- **24%**

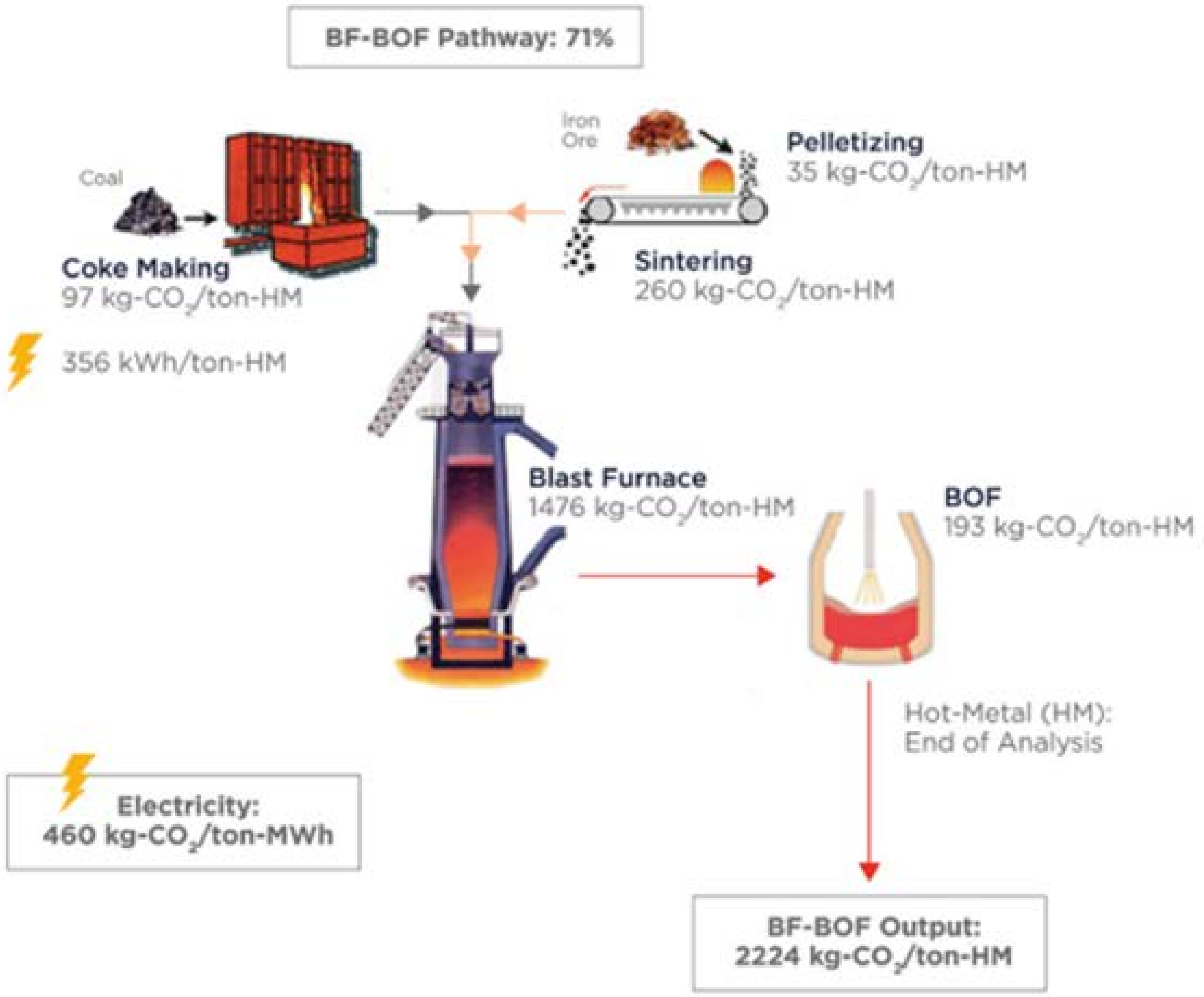
- La percentuale delle emissioni industriali di CO_2 attribuibile alla produzione di acciaio.

- **7–9%**

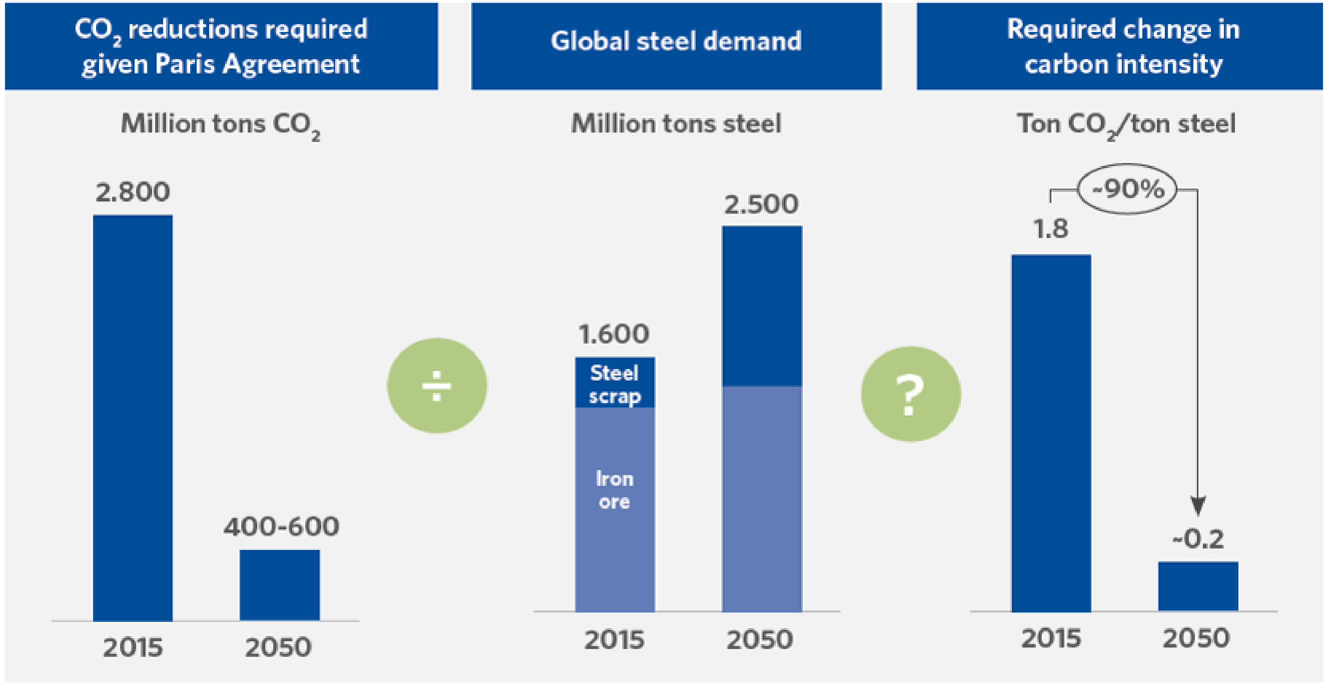
- La percentuale di tutte le emissioni di CO_2 attribuibili alle attivita'umane .

- **1,86 miliardi di ton per anno**

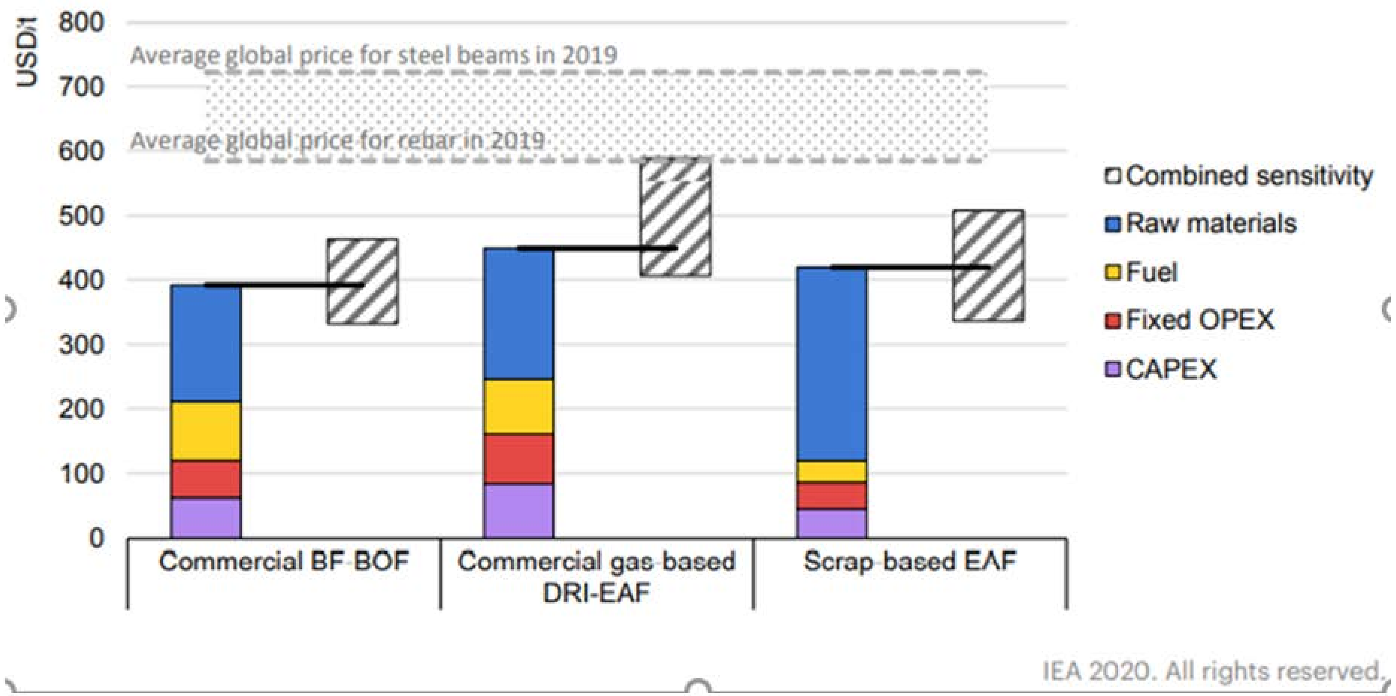
CO2 emissions per ton of BF-BOF



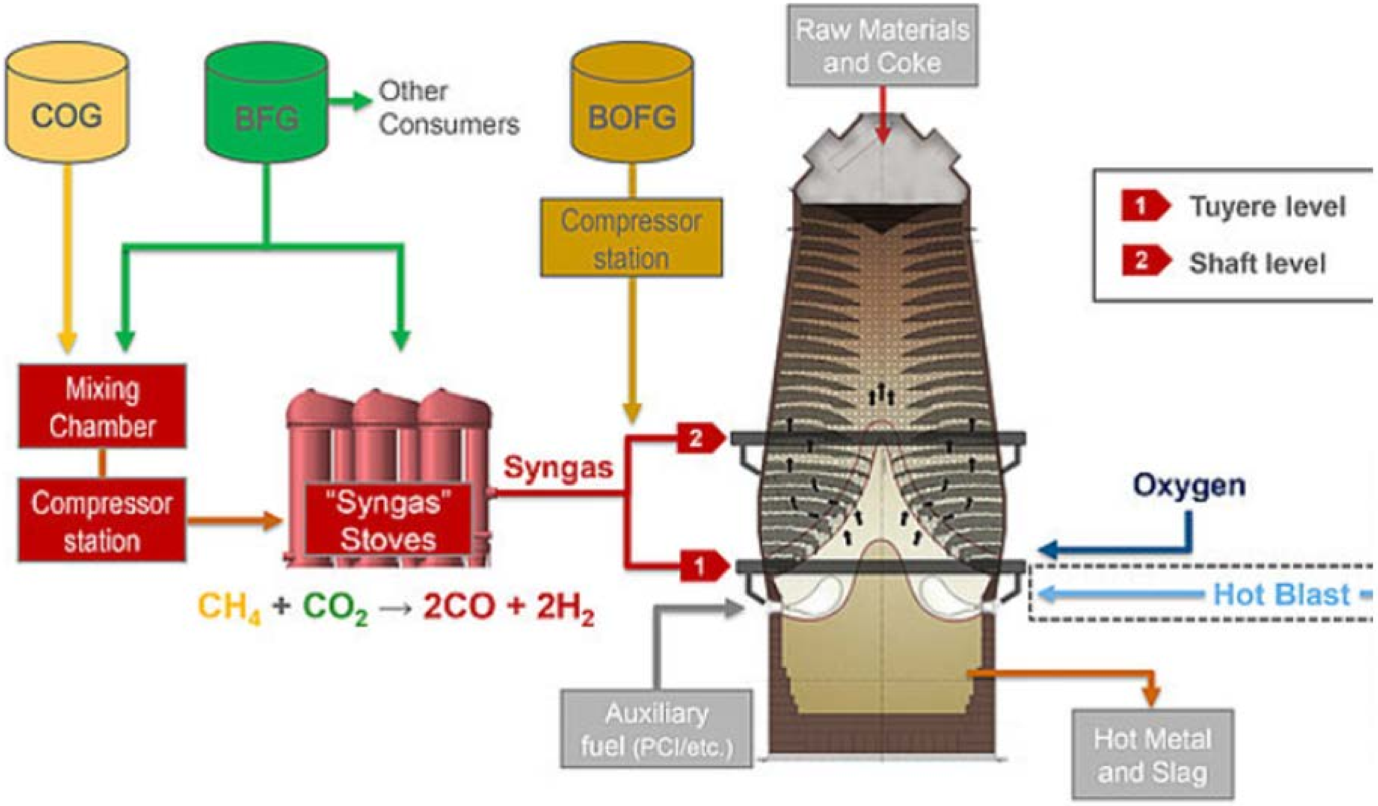
Emissions targets in 2050



Production Costs

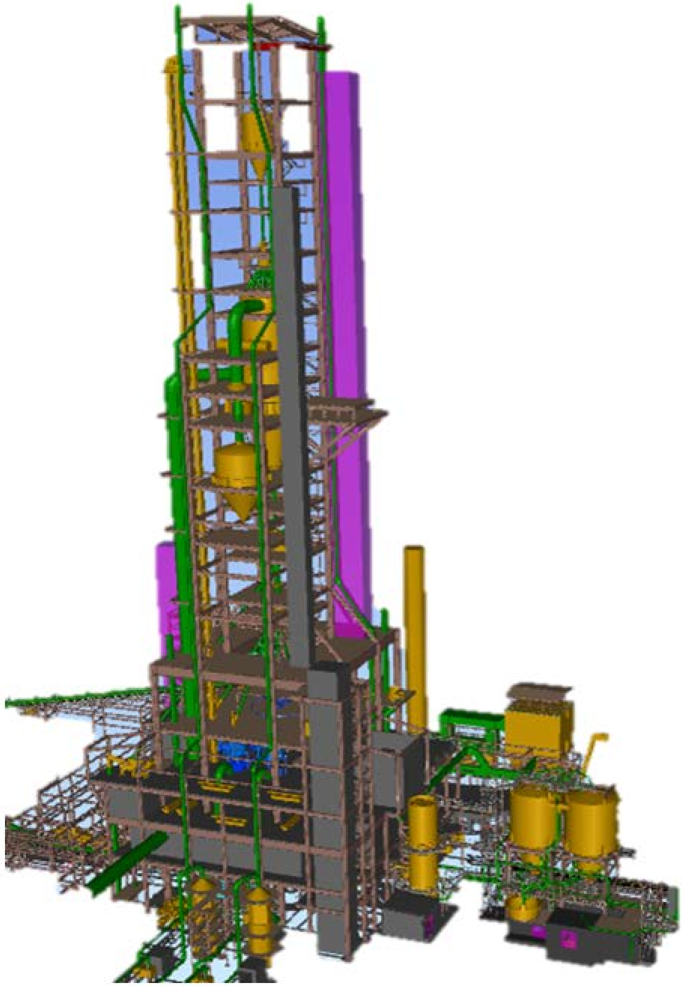


Retrofitting BF with dry reforming



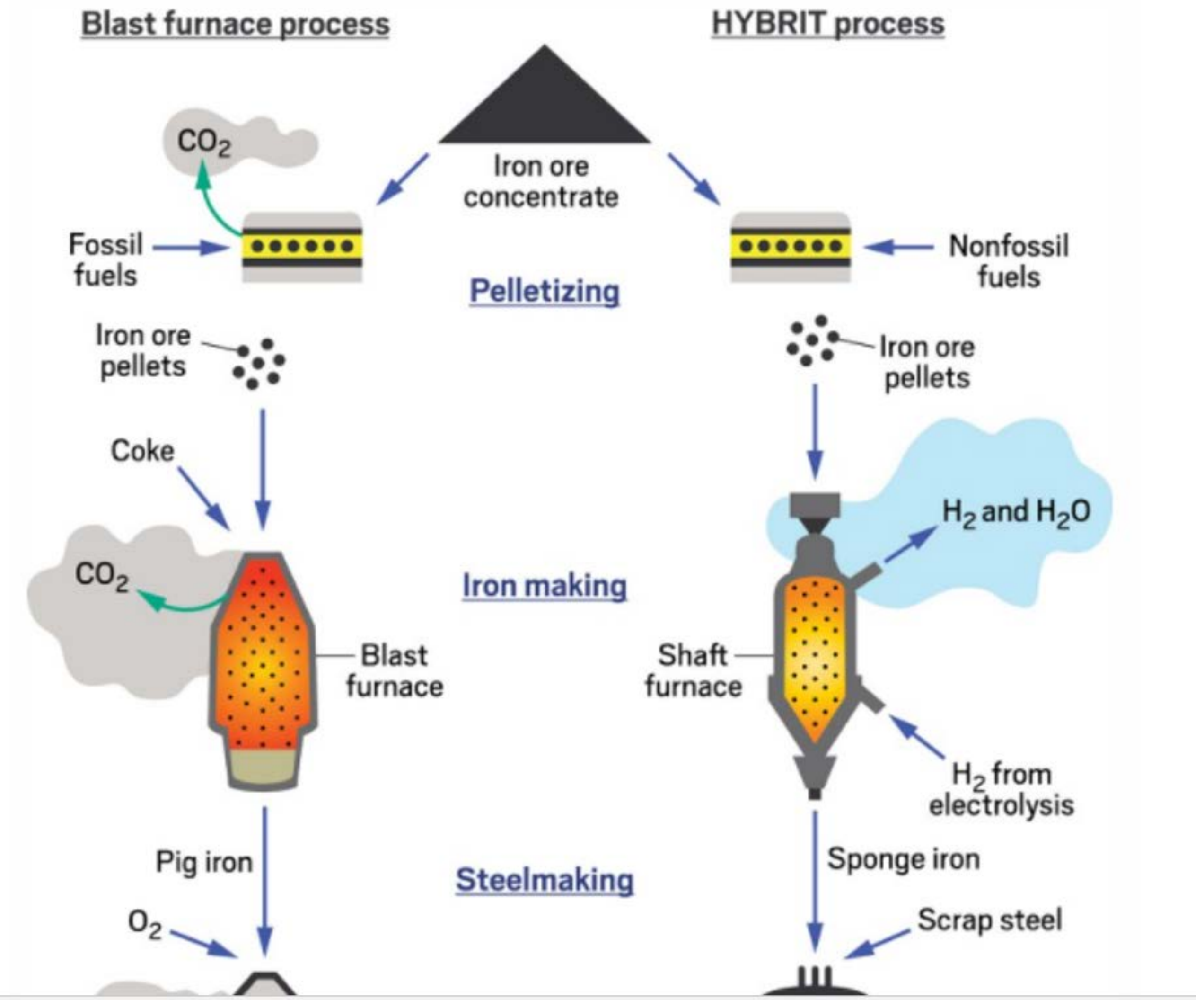
COG = coke oven gas; BFG = blast furnace gas; BOFG = converter gas

DRI + electric SAF (courtesy PW)

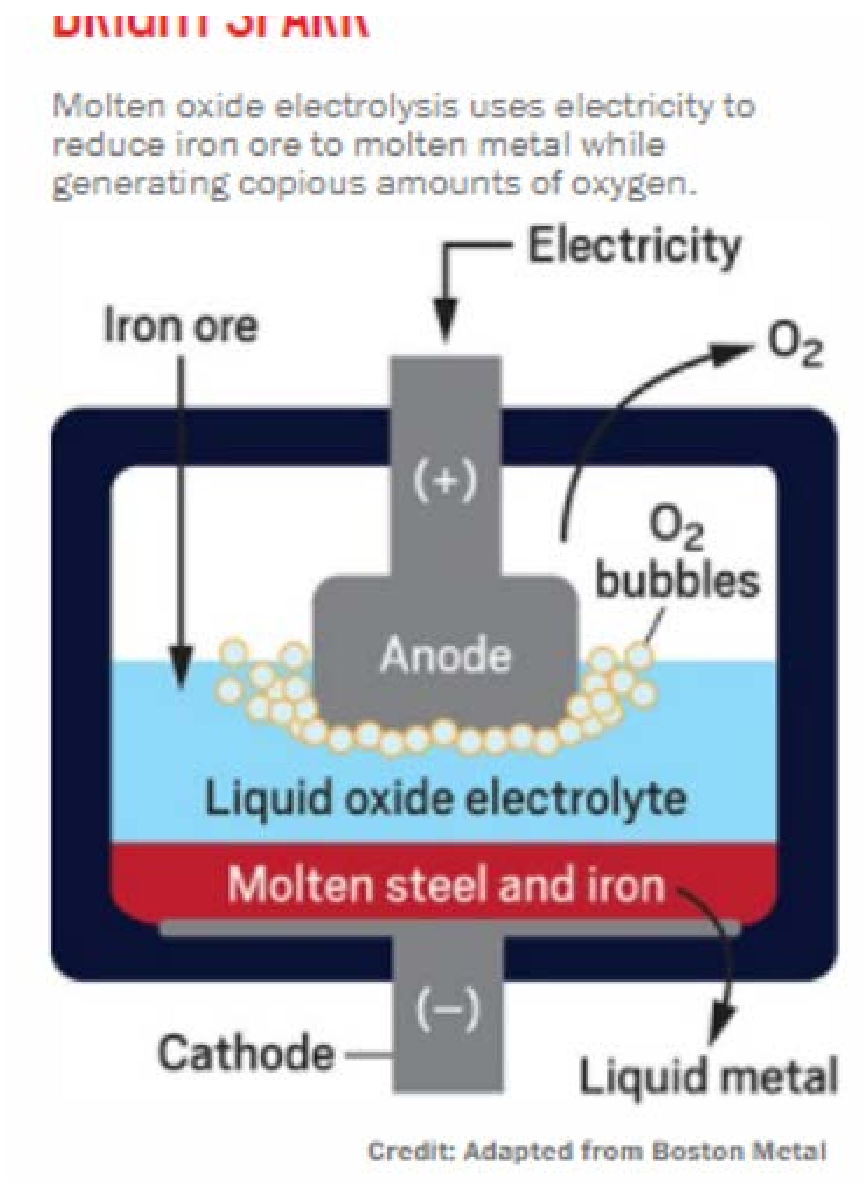


HyBRIT Process

The Hydrogen Breakthrough Ironmaking Technology (HYBRIT) process aims to replace the coke and other fossil fuels used in traditional, blast furnace-based steelmaking and instead relies on hydrogen created with renewable electricity. The process should lower carbon dioxide emissions in all stages of steelmaking, including pelletizing iron ore, reducing iron oxides to iron, and producing crude steel.



Molten oxide electrolysis – Boston Metal



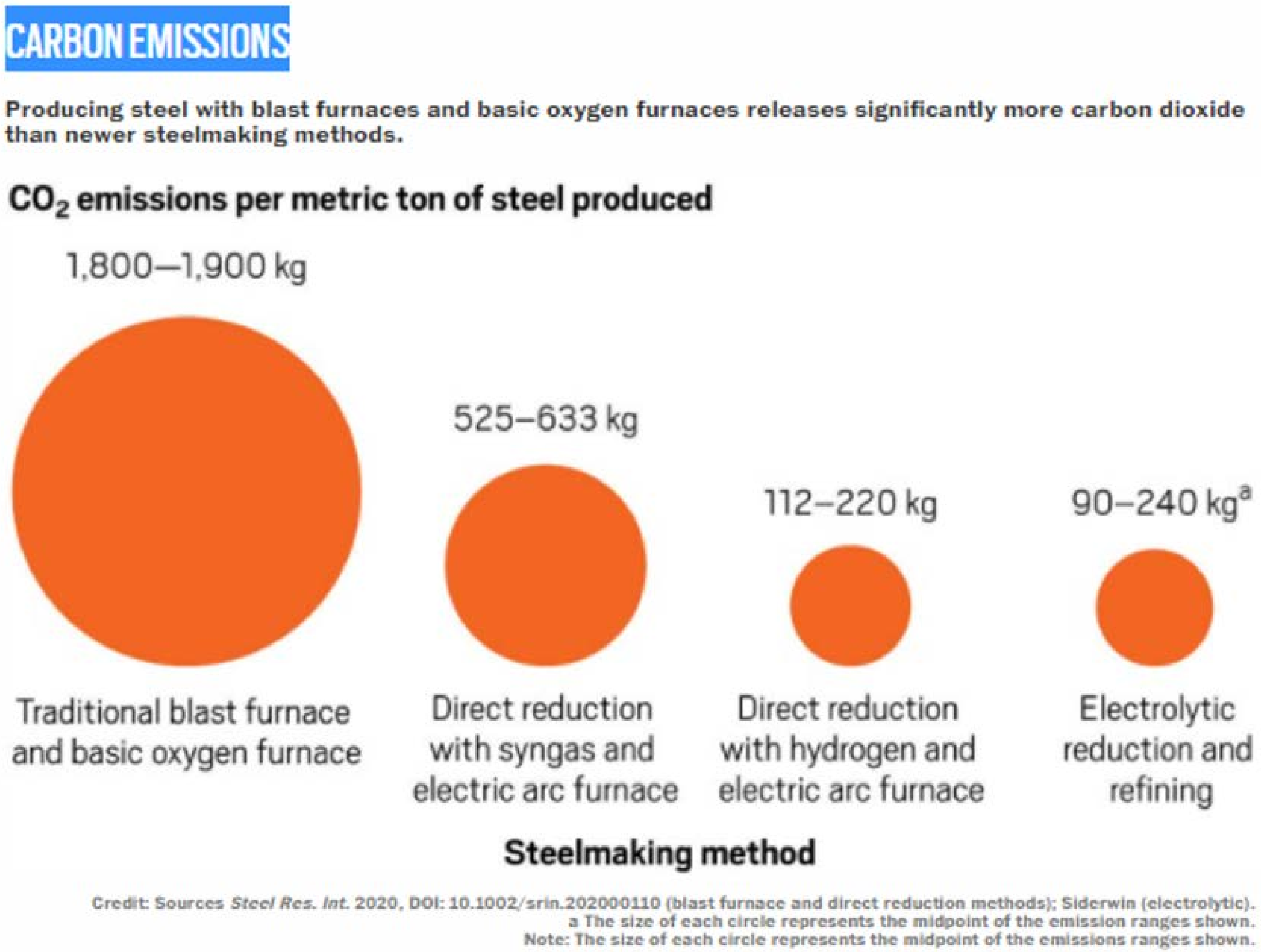
Medium-to-full decarbonization strategies

Medium- to full-decarbonization strategies

	Strategy	Examples	Current outlook
Basic oxygen furnace (BOF)	Make efficiency improvements to optimize BF–BOF[1] operations	Optimized BOF inputs (DRI,[2] scrap), increased fuel injection in BF (eg, hydrogen, PCI)	Technology readily available at competitive cost
Biomass reductants	Use biomass as an alternative reductant or fuel	Tecnored process[3]	Process possible in Latin America and Russia, due to biomass availability
Carbon capture and usage (CCU)	Capture fossil fuels and emissions, and create new products	Bioethanol production from CO_2 emissions	Currently at a pivot stage
Carbon capture and storage (CCS)	Capture and store CO_2 from steelmaking process and release or inject them as fuel in another process	CO_2 captured from iron-making process injected into oil fields to enhance recovery	Currently at a pivot stage
Electric arc furnace (EAF)	Maximize secondary flows and recycling by melting more scrap in EAF	EAF usage to melt scrap	Technology readily available at competitive cost
DRI plus EAF using natural gas	Increase usage of DRI in EAF	Current DRI plus EAF plants using natural gas (NG)	Technology readily available
DRI plus EAF using H_2	Replace fossil fuels in DRI process with renewable energy or H_2	MIDREX DRI process running on H_2 ENERGIRON DRI process running on H_2	Technology available at high cost

[1]Blast furnace–basic oxygen furnace.
[2]Direct reduced iron.
[3]Process developed by Tecnored Desenvolvimento Tecnológico S.A. of Brazil using carbon-bearing, self-fluxing, and self-reducing pellets for "coke-less" iron making.

CO_2 emissions per metric ton of steel produced



The situation in Italy

- **A first strategy** will consist of integrate into the existing BF+BOF process the production of fertilizer from the off-gas and the capture and storage of excess of CO2, being the ratio C/H non enough for a complete conversion of all the carbon.

- **A second strategy** could be based by replacing totally or partially the BF+BOF with DRI+ EAF. In such a case, becomes important the supply chain of the feedstock to DRI, which is not the same of BF

Conclusions

- Replacing the steel production with **DRI technology** using natural gas and EAF will allow to reach the CO_2 reduction target by 2030/35, at least with ematite feedstock. Moving from EAF to SAF may allow to use BF feedstock grade.

- **The production of syngas from natural gas** may be replaced partially by using other feedstoock as municipal wastes, plastic wastes, ecc in order to reduce the production costs.

- **The rate of introduction of hydrogen** as alternative to syng-gas will depend on how fast its production cost will be lowered

Conclusions

- As alternative of the use of H2 in DRI process, new solutions are investigated as the one proposed by a spin-off of MIT, Boston Metal, where direct power in a sort of **high temperature electolysis of iron oxides;**

- **Renewable power production** is then the key element in such a technology transition. Considering the amount of green energy and the need to have round-the-clock clean power by the steel making process, solar and wind generation may be too stressed .

- We should ask ourself if a **small nuclear reactor** integrated in the steel production may not represent an alternative to avoid CO2 emissions and indipendence from the grid