”Clean Steel Partnership: the accelerator towards sustainable steel production”

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ESTEP
European Steel Technology Platform

CSP
The Clean Steel Partnership

tenova

EU Clean Steel Partnership
Characteristics

- Partnership in the frame of Horizon Europe (2021-2027)
  - Unique setting due to synergies of public financial pillars
- Projects
  - size: € 10-100 million
  - Developments start at TRL 6 to end up with TRL 8, exceptional start at 5 to end up with at least TRL 7
- CSP-Budget: € 1.7 billion
  - € 350 million from assets of the ECSC in Liquidation (source of funding from RFCS)
  - € 350 million from Horizon Europe
  - At least matched by steel sector (expected €1.000 million)
- ESTEP organises the private side
- Total need for large R&D&I projects on low-carbon steelmaking technologies
  - € 2.55 billion (estimate)
  - Funding gap outside the partnership financed with other EU and national instruments

EU Clean Steel Partnership
Objective

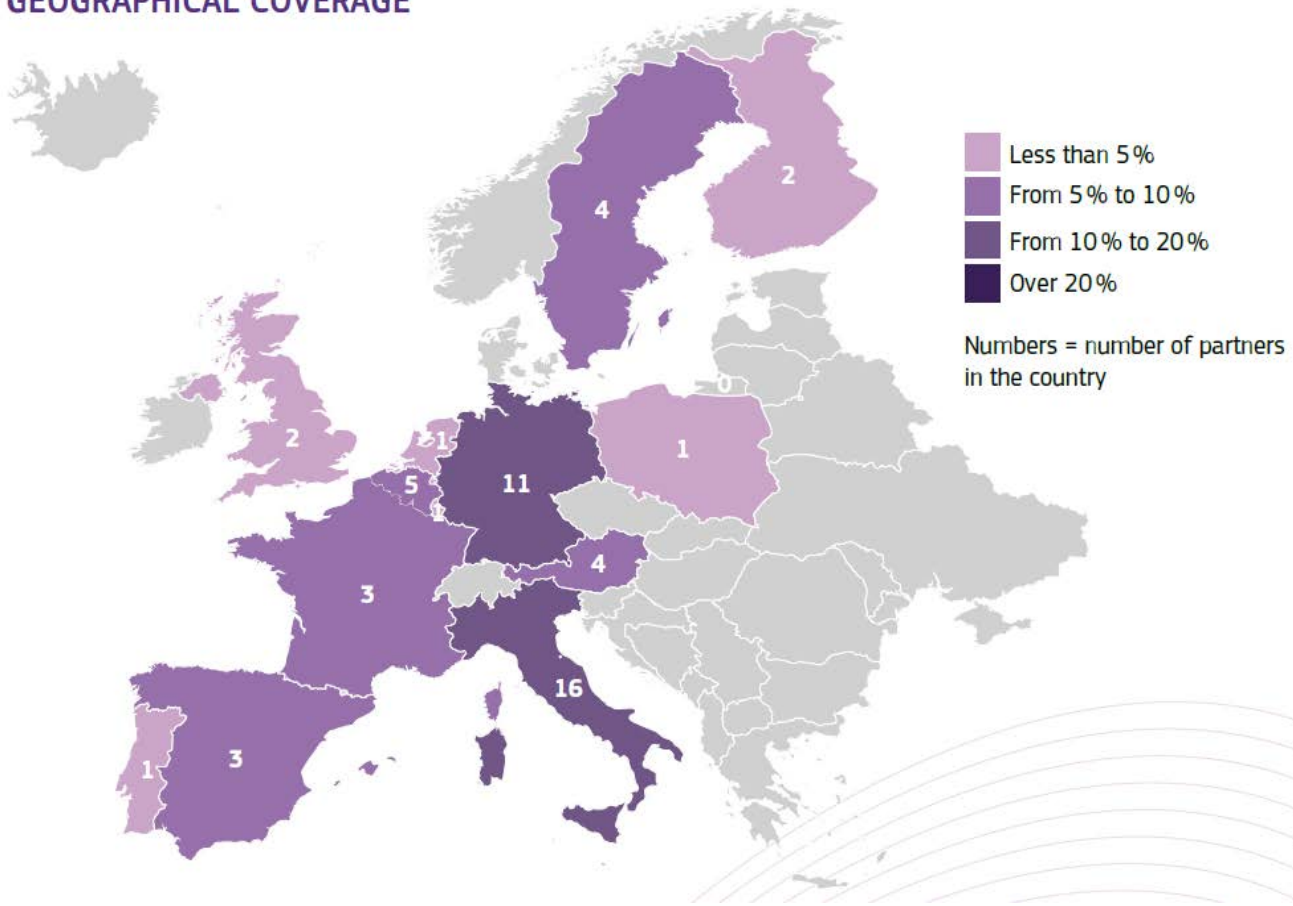
Until 2030, the Clean Steel Partnership will

- Develop lean CO_2-technologies
- Test technologies at large scale & high TRL
- Ensure a coordinated, sustainable approach across
  - stakeholders
  - technologies
  - production routes and countries
- Leverage private investments
- Open and inclusive approach
- Provide the needed support to accelerate demonstration projects
  - 2 demonstrators leading to 50% CO_2 reduction by 2027
  - 2 demonstrators leading to 80% CO_2 reduction by 2034

CSP
The Clean Steel Partnership

Totally 54 partners*

GEOGRAPHICAL COVERAGE



* source: CSP partnership fiche, 2021 (www.estep.eu)

EU Clean Steel Partnership
Strategic Research and Innovation Agenda (SRIA)

3 Technology Pathways for decarbonization

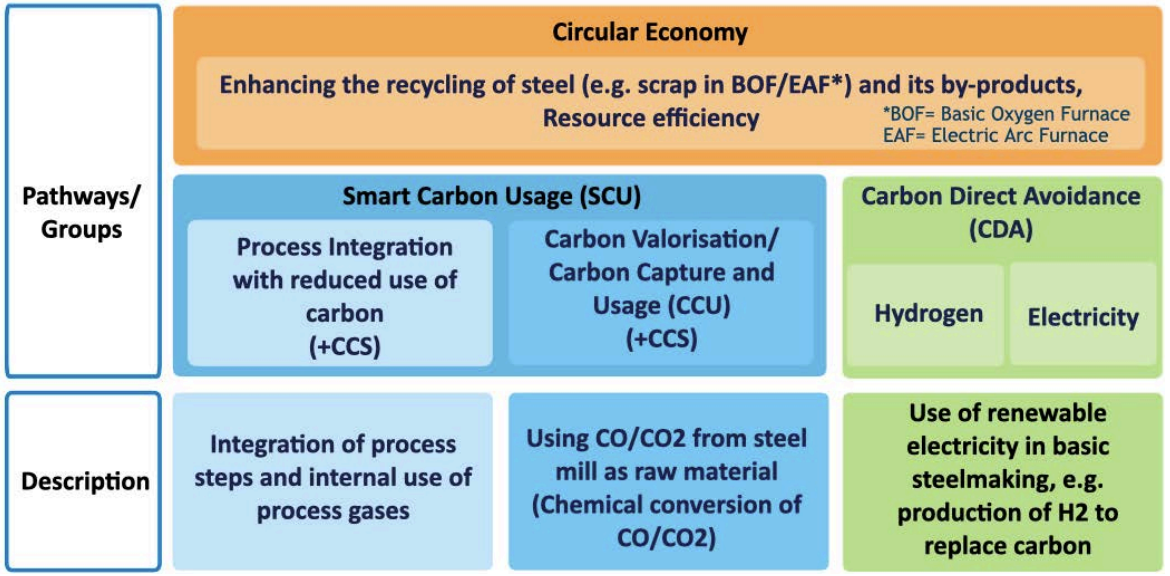
- Carbon direct avoidance (CDA)
- Smart carbon Usage (SCU)
  - Process Integration (PI)
  - Carbon, Capture, Storage, Utilization (CCUS)
- Circular Economy (CE)

6 Areas of Intervention

- Integrating Building Blocks into the 3 Pathways
- CDA, SCU-PI, SCU-CCUS, CE, combination
- Include enablers (Digitalisation + Social Innovation)

12 Building Blocks (BB)

- Bring to TRL8 at large scale



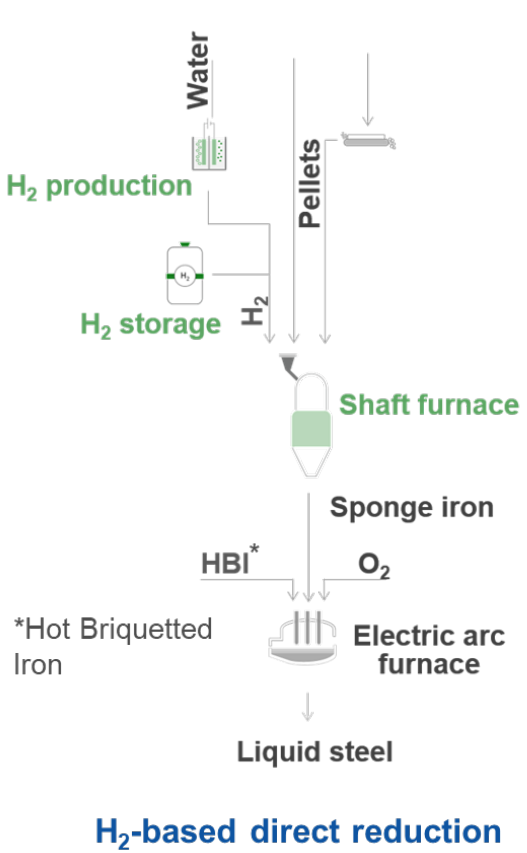
CSP roadmap (SRIA): www.estep.eu/clean-steel-roadmap

Decarbonization pathways
Carbon Direct Avoidance (CDA)

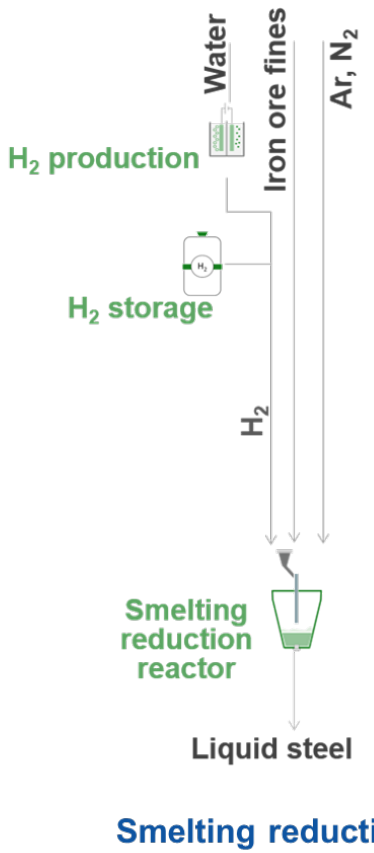
Pathways/ Groups	Circular Economy	Smart Carbon Usage (SCU)		Carbon Direct Avoidance (CDA)	
	Enhancing the recycling of steel (e.g. scrap in BOF/EAF*) and its by-products, Resource efficiency *BOF= Basic Oxygen Furnace EAF= Electric Arc Furnace	Process Integration with reduced use of carbon (+CCS)	Carbon Valorisation/ Carbon Capture and Usage (CCU) (+CCS)	Hydrogen	Electricity
Description		Integration of process steps and internal use of process gases	Using CO/CO2 from steel mill as raw material (Chemical conversion of CO/CO2)	Use of renewable electricity in basic steelmaking, e.g. production of H2 to replace carbon	

Operational objectives

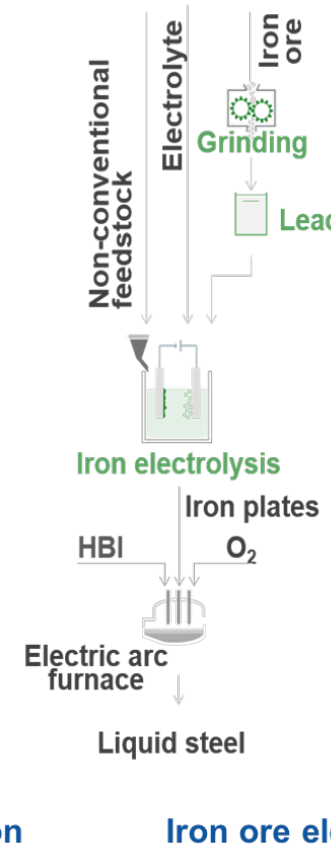
- Carbon replacement by renewable energy
- Development of reduction and/or melting processes using hydrogen
- Reduction using green electricity (electrolysis)



H_2-based direct reduction



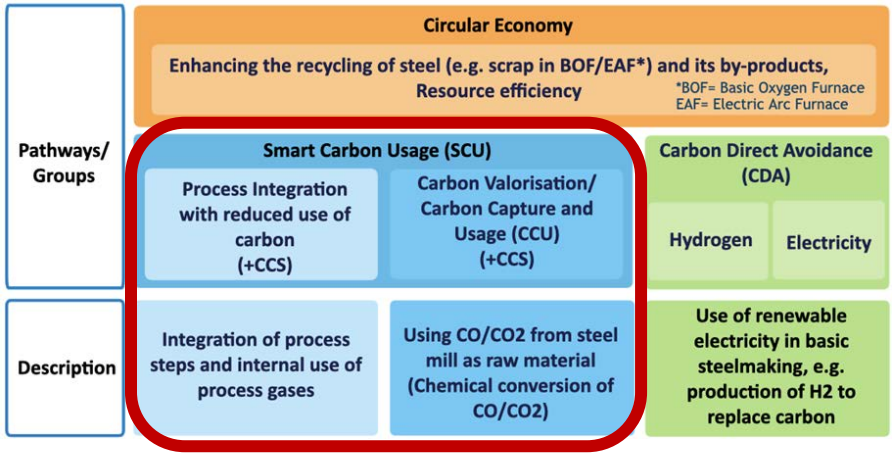
Smelting reduction



Iron ore electrolysis

RFCS Project „Green Steel for Europe“ (Grant Agr. No. 882151, https://www.estep.eu/green-steel-for-europe/)

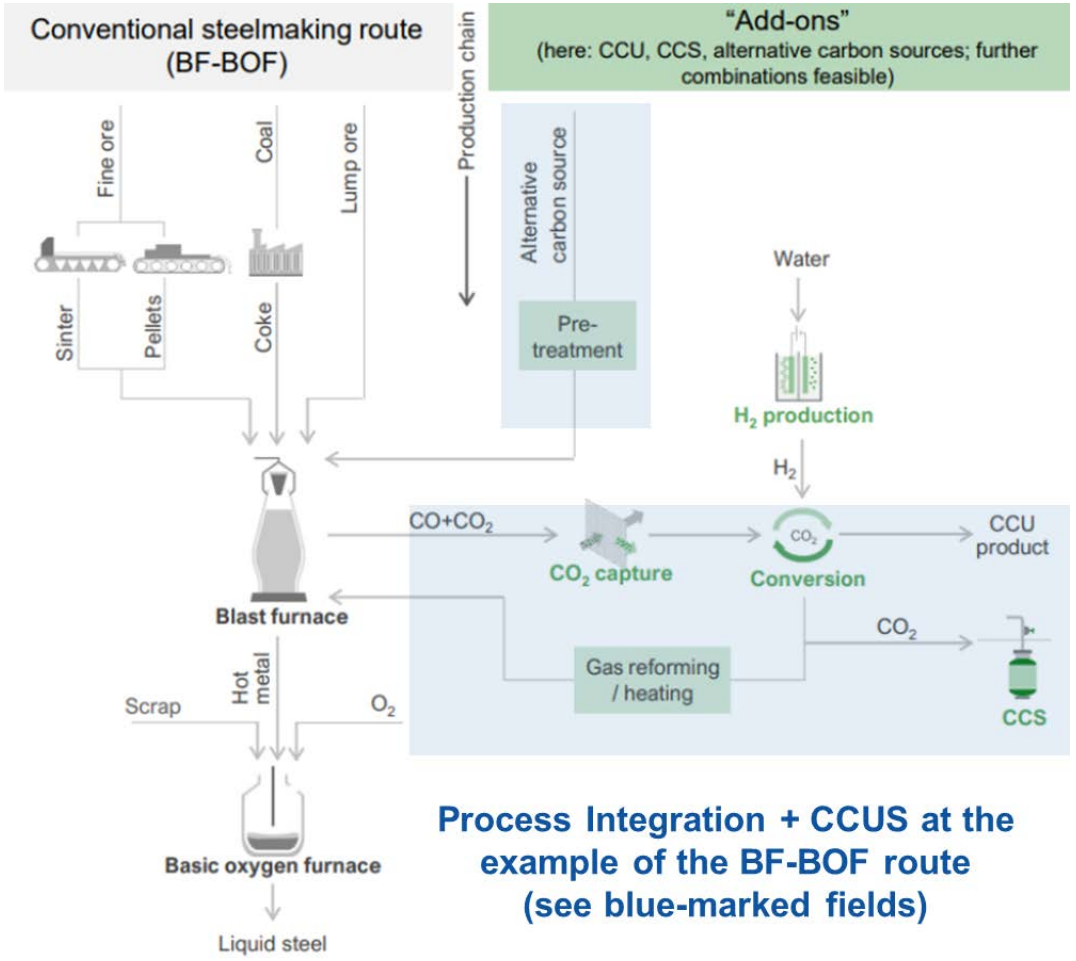
Decarbonization pathways
Smart Carbon Usage (SCU)



Operational objectives

- Increased use of non-fossil carbon and pre-reduced iron carriers
- Capturing CO_2 for CCUS solutions (1)
- Conditioning of metallurgical gases (containing CO_2, CO, CH_4, etc.) to meet specifications to finally produce chemical feedstock/alternative fuels
- Developing technologies to reduce the energy required to produce steel

[1] Steel sector is one of most advanced ones for CCUS having industrial-scale plants worldwide integrated with production of Direct Reduced Iron (DRI)



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Decarbonization pathways
Circular Economy (CE)

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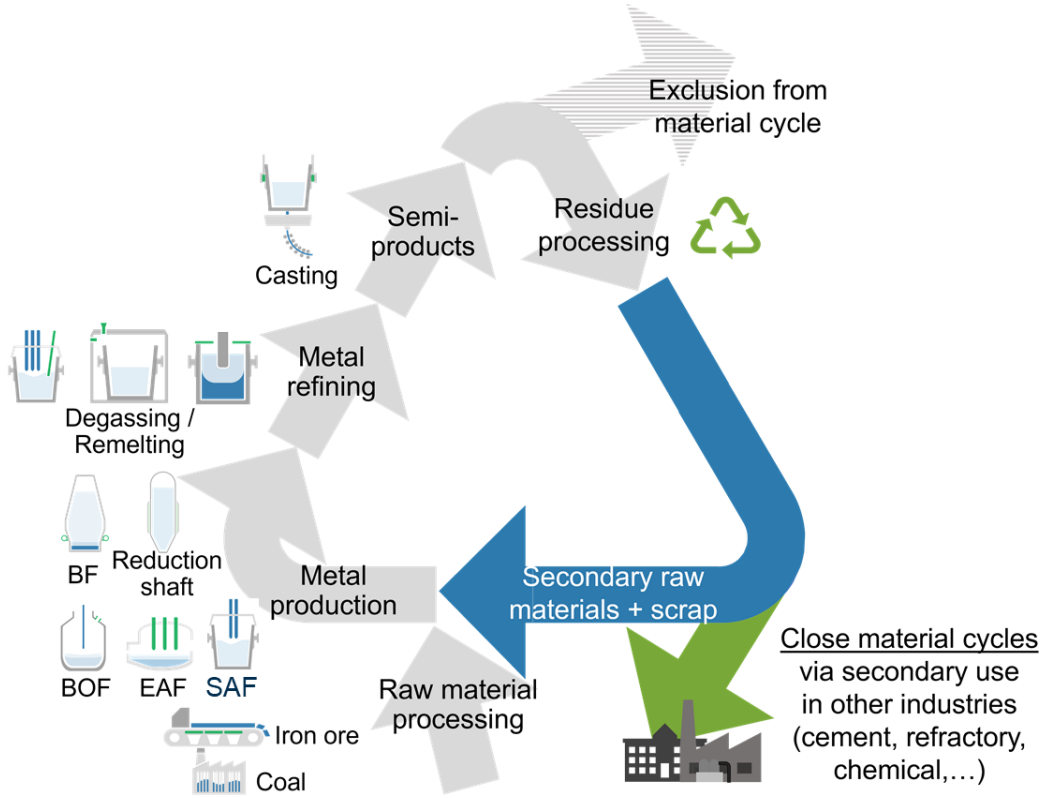
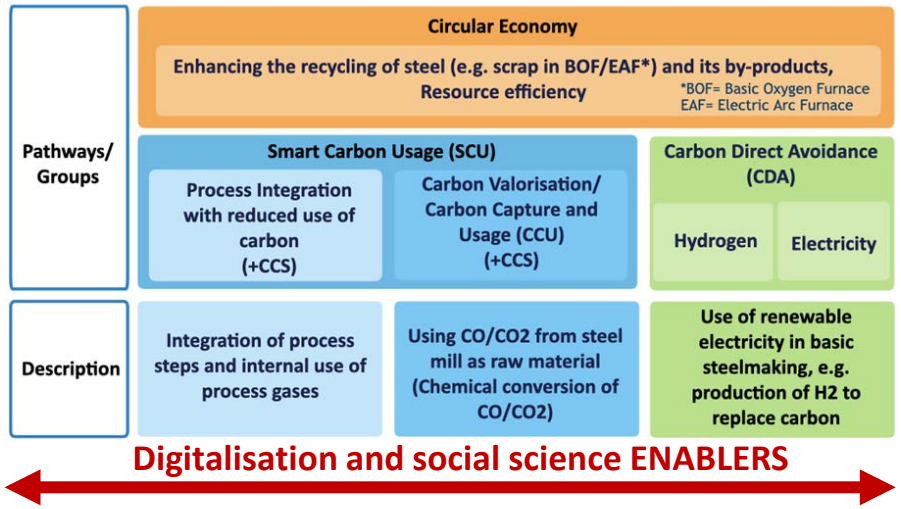
Operational objectives

- Enhanced recycling and re-use of residues of the steel production processes
  - Recovery of metals and/or mineral fractions for an internal and external use (industrial symbiosis vial sector coupling)
- Enhanced recycling of steel scrap
  - Scrap valorisation (quality upgrading) and improved scrap yard management (characterization, sorting)
  - Optimized scrap charging depending on the final steel product qualities



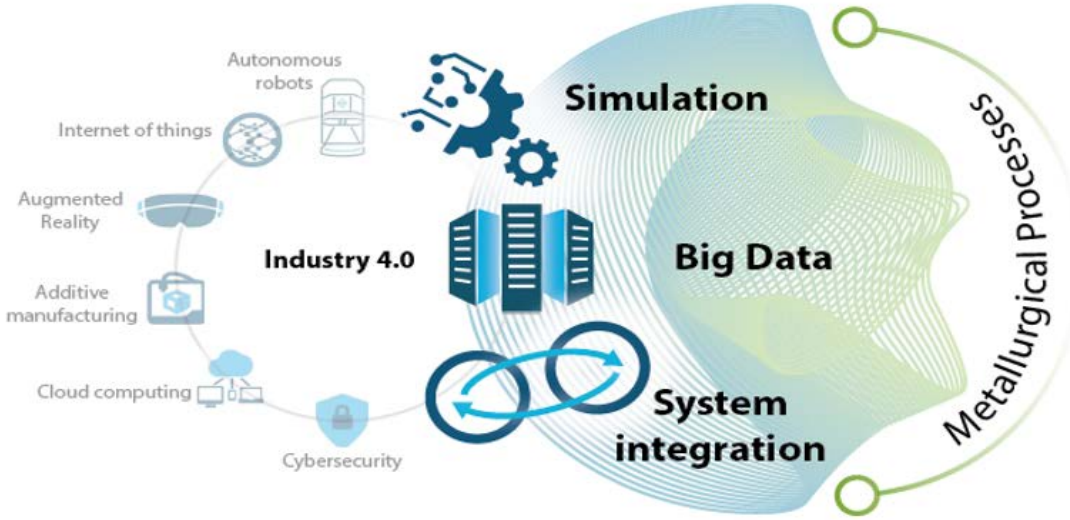
Own creation by K1-MET

Decarbonization pathways
Enablers (digitalization and social sciences)



Operational objectives

- Advanced measurement techniques and digital tools to monitor and control new steel production processes
- Digital manufacturing by predictive/dynamic models and scheduling tools to ensure adequate planning, assessment and optimization of the industrial transition process using concepts of digital twins
- Analysis of potential occupational safety and health risks (OSH) and impact on job tasks of affected workers and according changes on skill requirements
- Upskilling of the steel industry workforce



Own creation by K1-MET

Overview of Awarded Projects in 2021/22
HE Cluster 4 for Clean Steel and RFCS

Prg.	Year	Topic	Project Acronym
HEU CSP	2021	18	MaxH2DR
		19	HiYield
		19	ReMFra
		19	CAESAR
		22	RecHycle
	2022	13	PureScrap
		13	TransZeroWaste
		16	GreenHeatEAF
		16	ModHEATech
		16	HyTecHeat

Topic 18: Carbon Direct Avoidance in steel: Electricity and hydrogen-based metallurgy

Topic 19: Improvement of the yield of the iron and steel making

Topic 22: Adjustment of Steel process production to prepare for the transition towards climate neutrality

Topic 13: Raw material preparation for clean steel production

Topic 16: Modular and hybrid heating technologies in steel production

Prg.	Year	Obj.	Project Acronym
RFCS Big Ticket Steel	2022	2	MODIPLANT
		2	FullH2Reheat
		2	HYDREAMS
		2	TWINGHY

Obj. 1: Preparation of steel CO/CO2 gases for Carbon Capture Use and Storage (CCUS)

Obj. 2: Process Integration (PI) in steel plants to reduce the use of fossil carbon and associated CO2 emissions

Obj. 3: CO2 neutral iron ore reduction (Increasing the use of pre-reduced iron carriers)

Obj. 4: Developing technologies to reduce the specific energy required to produce steel

Clean Steel Partnership
2023/24 Overview

Horizon Europe

		Topics in 2023		Topics in 2024	
		# 43	# 45	# 44	# 46
TRL Level	8				
	7				
	6				
	5				
	4				
	3				
	2				
	1				
Type of Action		IA	RIA	IA Lump Sum	RIA
€ per Project		€ 4-6 M	€ 3-6 M	€ 3-5 M	€ 3-5 M
€ per Topic		€ 23 M	€ 12 M	€ 10 M	€ 20 M

Covered by RFCS Big Tickets

2023 (April)	
€ per Projects	€ 6-18 M
€ per All topics	€ 90-150 M

Covered by RFCS Annual Call

2023 (September)	
€ per Projects	€ 1-1,5 M
€ per All topics	€ 20-30 M

Topic 43: Low CO_2 emission technologies for melting iron-bearing feed materials or SCU and improved energy & resources efficiency via progress integration

Topic 45: Circular Economy solutions for the valorization of low-quality scrap streams, material recirculation with high recycling rate and residual valorization for long term goal towards zero waste

Topic 44: Digital transformation and ensuring a better use of industrial data, which can optimise steel supply chains

Topic 46: CO2-neutral steel production with hydrogen, secondary carbon carriers and electricity OR innovative steel application for low CO” emissions

Expected impacts of the CSP for industry and society
Tackling climate change and fostering sustainable growth

Political, economic, societal/environmental, technological, and scientific impact

- **Political:** Increasing the uptake of new „green“ technologies being in-line with the EU Green Deal and the „Fit-for-55“ package and synergies with other EU partnerships (e.g., Clean Hydrogen, Processes4Planet)
- **Economic:** EU competitiveness (technology leader, new markets for clean steel products), upskilling workforce, create new jobs
- **Societal/environmental:** contribute to the UN‘s Sustainable Development Goals (see Figure below), reduce CO_2 emissions (contribute to climate targets), increase social acceptance that transition of the steelmaking processes should take place in steps leading to increased costs

- **Technological impact:** resource efficiency (low-grade ores, scrap, residues), high-quality clean steel products, intersectoral cooperation along value chain (use of secondary products from resources)
- **Scientific impact:** contribute to the missions and program pillars of Horizon Europe

Thank for your attention

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