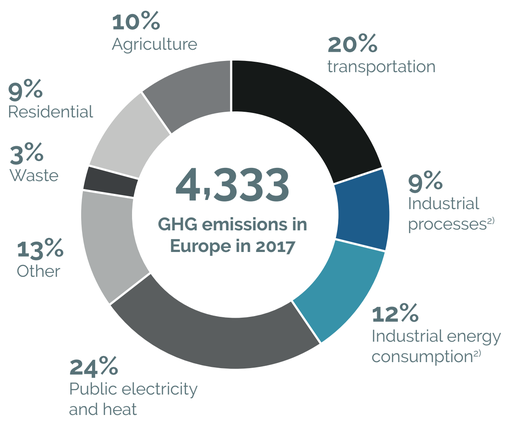
www.achief.eu

ACHIEF

Innovative high performance **A**lloys and **C**oatings for **HI**ghly **EF**ficient intensive energy processes

11 PARTNERS | **7 COUNTRIES** | **48 MONTHS**

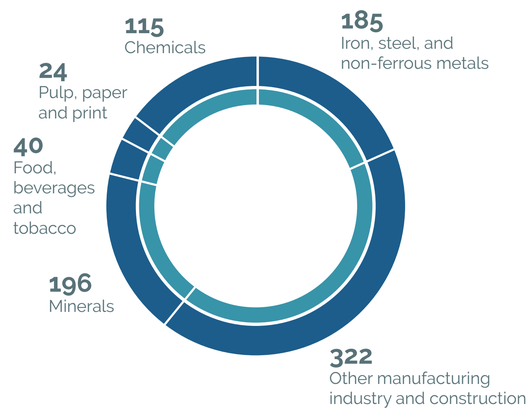


380

1) process emissions of greenhouse gases

500

2) emissions from energy consumption (self-produced and externally purchased)



GHG emissions in the EU by sectors in 2017. Source: European Environment Agency

Key challenges:

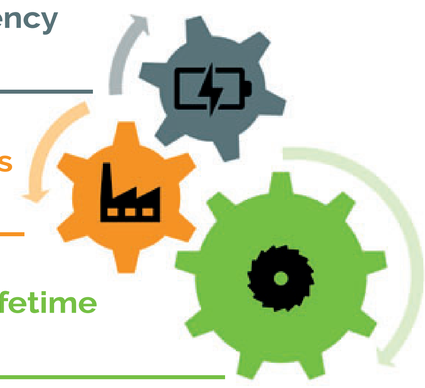
- Energy Intensive industries (EII) represent about 20% of GHG emissions in the EU
- No mitigation measures leads to a share of over 50% in 2050 (Bellona, 2019)
- Metals and chemicals production represent today around 35% of emissions

The **ACHIEF project** aims to develop novel materials and protective coatings that withstand extreme conditions in energy-intensive industries providing thermal stability, minimising energy losses and reducing degradation. By leveraging AI-aided design, these innovations enhance energy efficiency, reduce operational costs, and improve environmental impact in five industrial cases with tailored sensing technology.

Improving energy efficiency by 30%

Reducing CO_2 emissions by 20%

Increasing equipment lifetime >20%



Digital tools and analysis → **Material R&D** → **Process** → **Application and validation**

Integrated Artificial Intelligence-aided Materials Toolbox (IAIMT)

- Merging of Physics- and Data-Driven Modelling
  - Process-Structure-Property Performance relationships
- Generative Machine Learning
- Optimisation and Inverse Modelling
  - Surrogates for complex models

Selected material groups

- High-Entropy Superalloys (HESAs)
- Polymer-Derived Ceramics (PDC)
- High Chromium Steel grades

Selected processes

- Laser beam directed energy deposition
- Laser powder bed fusion
- Laser cladding
- Spraying
- Casting integrate process

Sector	Specific application	Material groups	Key exploitable material
Steel	Reheating furnace rolls and shaft components	HESA1: Ni58,2Al10Co13,8Cr6,3Fe4,9Ti6 HESA2: Al0,5FeNiCo HESA3: Al4Co15,2Cr7Fe5,4Ni64,4Ti4	Optimised HESA 3 formulation validated at TRL7 (component demonstrated in industrial facilities)
Aluminium	Degassing rotors for molten aluminium (degasser unit)	PDC composite: polysiloxane resin, BN and glass. Mixed oxide of ZnO - Al_2O_3 SiO_2 and Na_2Ofritt filler.	PDC formulation and manufacturing parameters for regular (no-angle) surfaces applications at TRL5
Petro-chemical	Pipelines for transporting corrosive fluids monitored via electrochemical impedance spectroscopy sensors	PDC composite: Silres MK resin, SiC, Diestone	PDC formulation and manufacturing parameters for regular (no-angle) surfaces applications at TRL5
Steel pipe	Boiler tubes for steam generation in energy production and petrochemical industries	High Cr-steel multiple grades (X20, P91,P92, T115) including heat treatment	Cr-steel formulation (T115 based) with optimised heat treatment conditions at TRL 5

Key challenges:

Integrating **manufacturability aspects** in the transition **from lab-scale to industrial-scale** for the developed materials. Demonstrating the effectiveness and reliability of these technologies in industrial environments is complex, requiring an **agile innovation process with a focus on the industrial validation** requirements of new materials. Overcoming **initial market resistance and demonstrating clear economic and environmental benefits** are essential for broader industry adoption i.e., infrastructure development including power generation, renewable energy, and waste processing.

RTO and research centers

- cea — Coordinator PDC coatings
- VTT — AI toolbox
- aimen TECHNOLOGY CENTRE — Alloy dev. Sensors
- tecnalia MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE — Alloy dev.

Industrial and supporting partners

- engionic Fiber Optics — Fiber Optic sensors
- Seamthesis — Powder production
- PNO BY PNO GROUP — Communication & dissemination

Industrial End-Users

- Constellium — AI foundry
- Tüpraş — Steel foundry
- ArcelorMittal — Oil&Gas
- TUBOS REUNIDOS — Steel pipes

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Contact us

PROJECT COORDINATOR

Mathieu Boidot / CEA (France)

Mathieu.BOIDOT@cea.fr

Visit

www.achief.eu

@achiefproject

#achief42681668

@achiefproject7674