Electrification of steel industry

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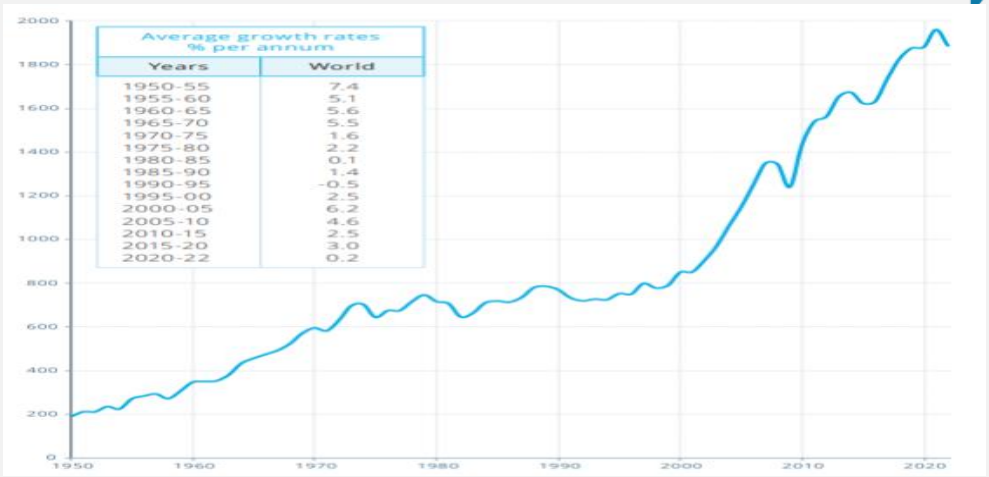
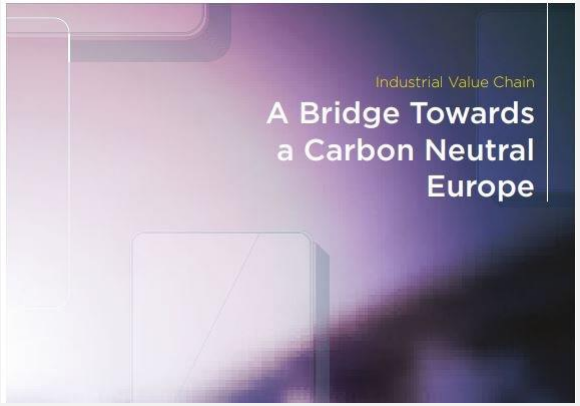
22nd September - Rome

Introduction

Steel is responsible **for 5% of entire CO_2** emissions in Europe (*IEA. (2020). Iron and Steel Technology Roadmap),* and considering the production trend, **decarbonization of steel sector is crucial** for achieving carbon neutrality in 2050.



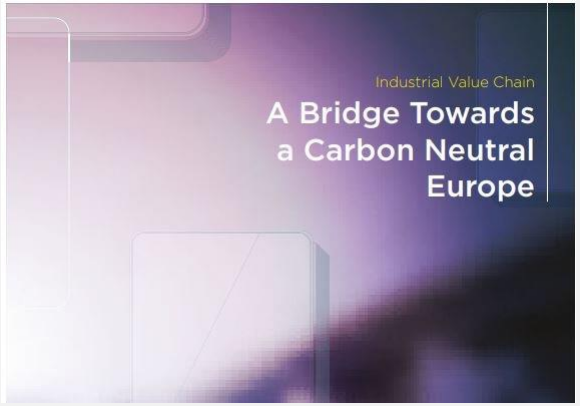
World Steel Production by year in Millions of tons [source World Steel Association]



Application Areas for CO_2 emissions reduction in EIIs

- Process Integration
- Electrification of heating
- Electrification of process
- Hydrogen

Introduction



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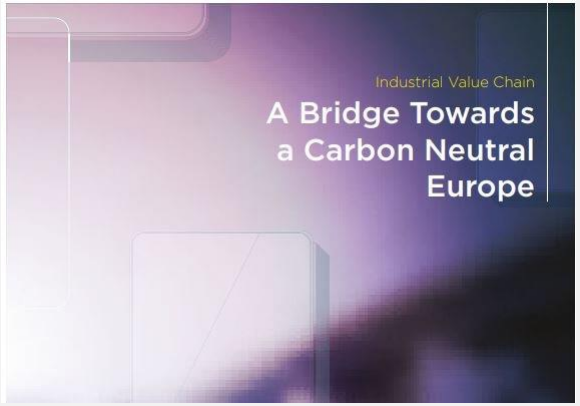
Natural gas

heating

CO_2

Introduction



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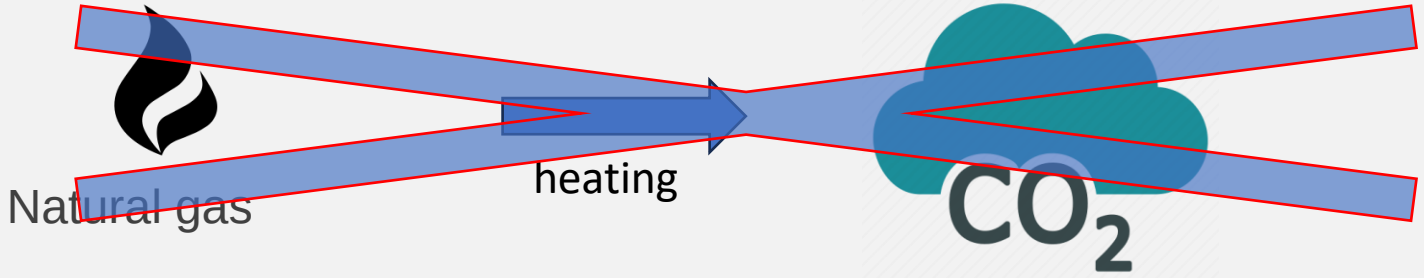
Electrification of heating = substitution of fossil fuels with electrical heating



Electrification of heating

Examples of application in steel Industry

ModHEATech and MODIPLANT are two European funded projects with the aim to study, install and implement **Electrical Heating Technologies** in downstream steel production

ModHEATech project

ModHEATech: MOdular HEAting TECHnology through renewable resources for steel production

HORIZON-CL4-2022-TWIN-TRANSITION-01 –

Modular and hybrid heating technologies in steel production (Clean Steel Partnership)

Funded by the European Union

Start March 2023

End March 2026

6 Partners

2 Research Centres

4 industrials

ModHEATech general

The project **ModHEAtech** proposes to **decarbonize the ROLLING MILL PLANT**, keeping high quality standard without negative impact on productivity and economic needs.

How

- **Induction Heating** for **Long Product** at **industrial scale** in combination with gas burning
- **Study of an Alternative Heating Technology** for **Long Product** at **Pilot Scale**
- Impact **on Material Selection and Maintenance Strategy** for application of **Induction Furnace** and **Hydrogen: Feasibility Study**

ModHEATech – WorkPlan and activities

Route 1 –
- ❑ **Induction Furnace**
- ❑ **Long Product**
- ❑ **Industrial Scale**

Location: ORI MARTIN plant

Design
- Selection of induction technology *(ORI MARTIN)*
- Study of metallurgical impact of induction *(RINA CSM)*
- Process Integration with green energy production (Rina CSM)

Installation and Trials
- Induction system on Reheating Furnace – partialization of heating (*ORI MARTIN)*
- Industrial Tests (*ORI MARTIN)*
- KPIs Monitoring (microstructure, productivity, etc) *(Rina CSM)*

Techno-Economic Assessment

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Techno-Economic Assessment

Route 2 –
- ❑ **Alternative Heating**
- ❑ **Long Product**
- ❑ **Pilot Scale**

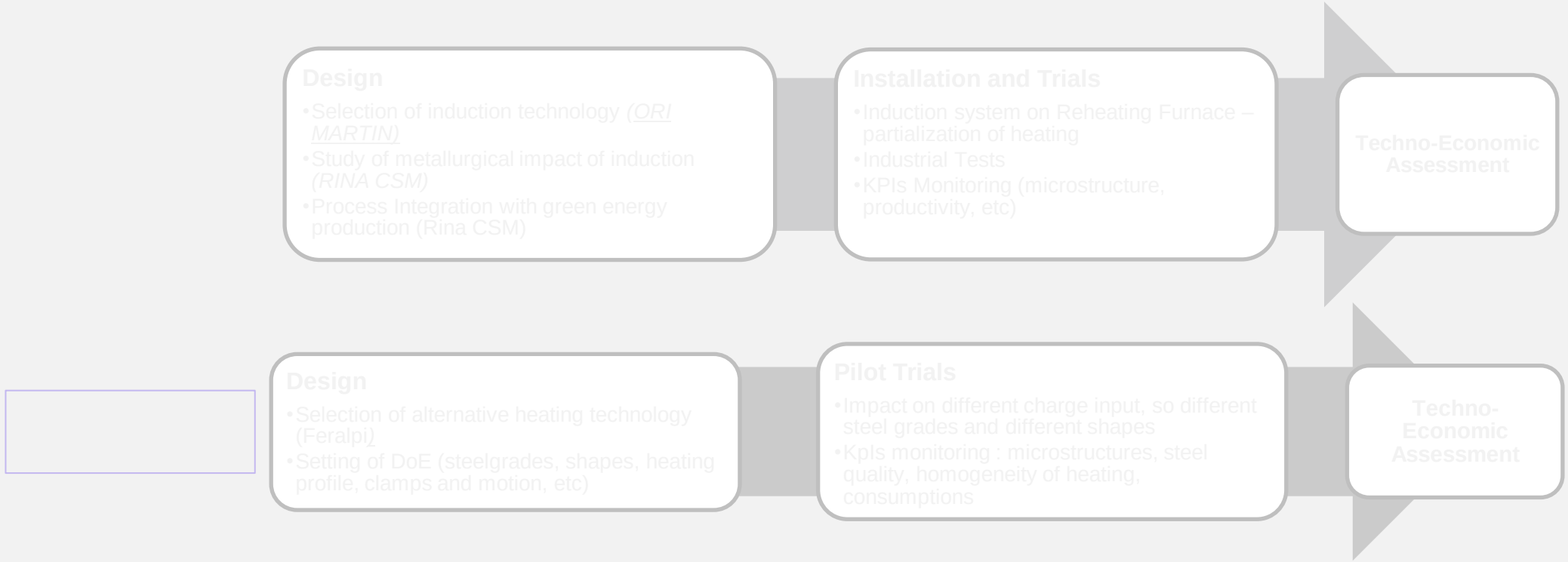
Location: Feralpi plant

Design
- Selection of alternative heating technology (Feralpi)
- Setting of DoE (steelgrades, shapes, heating profile, clamps and motion, etc) (*Rina CSM*)

Pilot Trials
- Impact on different charge input, so different steel grades and different shapes (*Feralpi*)
- KpIs monitoring : microstructures, steel quality, homogeneity of heating, consumptions (*RINA CSM*)

Techno-Economic Assessment

ModHEATech – WorkPlan and activities



Route 3 –

- ❑ **Feasibility Study on Induction Furnace & Hydrogen**
- ❑ **Long Product**

Location: SIDENOR plant

Preliminary LCA

For definition of the current state of rolling mills (Tekniker, SIDENOR)

Feasibility Study *(Tekniker)*:

- H2 Burner
- Induction Heating
- Maintenance (FMCA)
- Materials
- Green Energy Production

Final LCA. LCC and S-LCA analysis

(Tekniker, SIDENOR)

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(Tekniker, SIDENOR)

Expected Outcomes at the end of the project

1. Induction Heating for billets: **-20% of CO_2** with 2MW of inductor installed
2. **Achieve a 50%** of energy supplied to inductor from renewable energy self-produced
3. Increasing productivity **(+10%)** by applying high heating rate
4. Proving the feasibility of **alternative heating technology** in billets heating for **special steel heating**
5. **Roadmap on how decarbonize** rolling mills plant, until a sustainability of 100% sector. Integration of **Induction Heating and Hydrogen Burners.**
6. **Less dependence from fossil fuels,** with protection from harmful market event

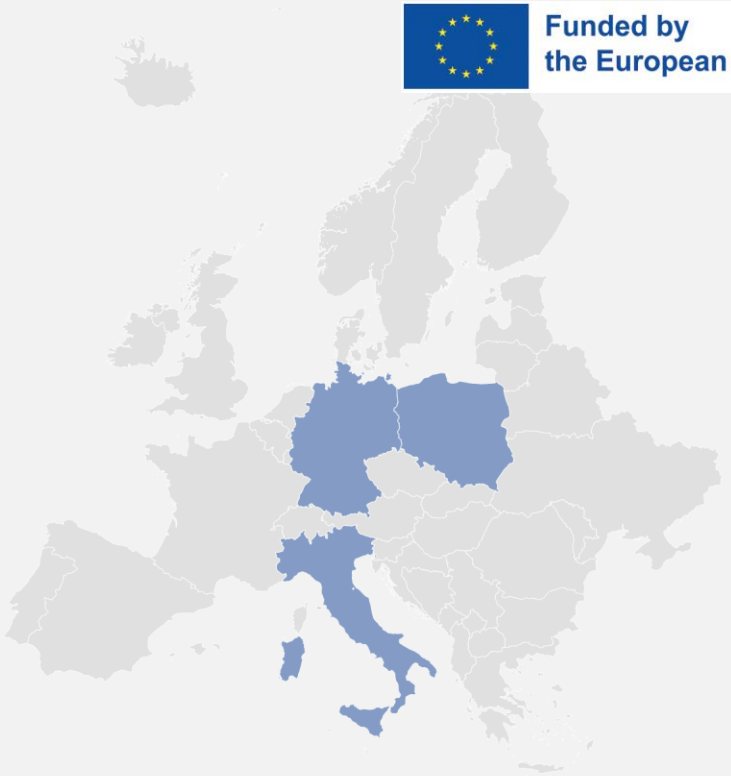
MODIPLANT project

MODIPLANT: MODular hybrId technology in the Steel PLANT production

Start
March 2023

End
September 2027

Funded by the European Union



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1 Academia

MODIPLANT project – Objectives

OB.1 - Integration of induction furnace module on hot dip metal coating process

OB.2 - Realization of Alternative heating technology, for full scale billet heating in rolling mills

OB.3 - Definition of optimized operating windows for long and flat product

OB.4 - Development of Management IT tool: identify possible inefficiencies and bottlenecks and define corrective actions towards optimization.

OB.5 -Ensuring the exploitation and visibility of the project, through the elaboration of business plan and stakeholder management

MODIPLANT - routes

Demosite 1 – Induction system	
Location	Marcegaglia site
Target Plant	Hot Dip Coating Line
Product	Coils

MODIPLANT

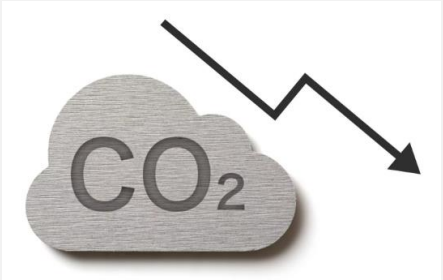
Induction furnace for flat product at industrial scale for coating process

Alternative Heating System for long product at industrial scale for rolling mill process

Demosite 2 – Alternative Heating	
Location	Feralpi site
Target Plant	Rolling Mills
Product	Billetts

DECARBONIZATION

Increase the use of electric energy to reduce the natural gas consumption



Global organization and responsability

Design – 24 Months

- **Marcegaglia** - Design of induction furnace
- **Rina CSM** – development of mathematical model for microstructure control. Validation, definition of operative conditions. Digital Management tool
- **IMZ** – Definition of expected mechanical properties model.
- **Feralpi Sid** - Design of alternative heating for one specific product
- **TUBAF** - Design of heating curves and operative parameters for alternative heating technology

Installation – 9 Months

- **Marcegaglia** - Installation of induction furnace on Coating Line in combination with burning heating
- **Feralpi SID** - Installation of alternative heating for full scale application for one specific product

Industrial Test – 18 Months

- **Marcegaglia** – Management of industrial campaign
- **Feralpi Sid -** Management of industrial campaign
- **Rina CSM -** Digital Management tool calibration and validation

Techno-Economic Evaluations – 12 Months

- **All Partners** – Support in techno-economic evaluations.
- **Rina CSM -** Business Plan
- **All Partners -** Finalization of exploitation/dissemination strategy

Expected Outcomes at the end of project

1. 60-80% CO_2 savings in hot dip metal coating process through the use of induction furnace
2. **60 – 100% Fossil Fuel Consumption Reduction** in rolling mills process through the use of Alternative Billett Heating
3. Introduction **new operative practices** specifically designed for electrical heating
4. **Business case** for fully electrification of targeted processes
5. **Digitalization of production** with focus on energy supply sources

Conclusions

MODIPLANT and MODHEATECH – final comments and target groups

The two projects represent a step forward towards the EU mission of zero carbon **emissions in 2055**.

They plan to adopt **electricity in substitution of fossil fuel** for reheting of steel products and aim to prove the feasibility of the technology at different levels:

- ❑ *Billets and coils heating by induction,*
- ❑ *Billets heating by conduction*
- ❑ *Pilot and demo scale,*
- ❑ *Process digitalization*
- ❑ *Roadmap for zero emissions in steel reheating process*

Who Will Benefit?

- ✓ **Steel producers**: from the implementation of such technologies, they will benefit in term of reduction of CO2 emissions with consequent economic advantages and in term of OPEX costs that result lesser than conventional rolling mills heating system. Additionally, dependence from price increase of NG is mitigated since part of the energy can be self- produced.
- ✓ **Energy producers**: the increase of renewable energy use requires the upgrading of infrastructure with new drive for investments
- ✓ **Renewable energy technology provider**: once the benefits of substitution fossil fuel with electric energy is proven, there is the necessity to produce electricity in sustainable way. This means the realization and long-term maintenance of such technologies

Thanks for the Attention

For any questions
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Photo from https://climate.ec.europa.eu/eu-action/climate-strategies-targets_it