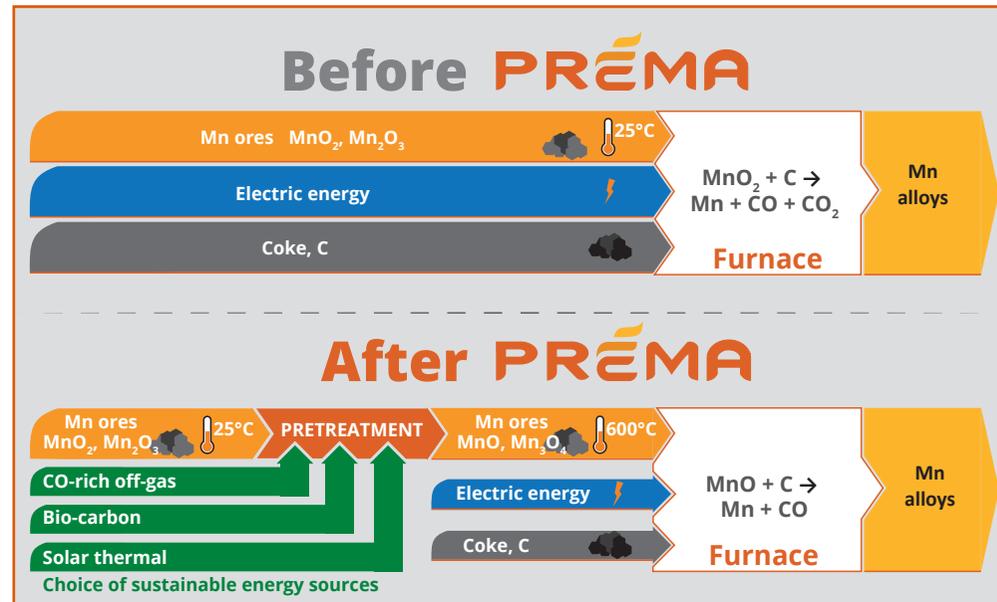


## WHAT IS PREMA?

PREMA is a H2020 project aimed at demonstrating an innovative suite of technologies involving utilization of industrial off-gases and solar thermal energy to reduce energy consumption and CO<sub>2</sub> emissions from manganese production as a mean to obtain sustainable production of Mn alloys and steel.

The main concept of PREMA is to increase energy flexibility and the use of sustainable energy sources to reduce the overall energy consumption and CO<sub>2</sub> emissions in Mn alloy production. This will be achieved by dividing the Mn alloy production - today carried out in submerged furnaces (SAF) - into two separate units as illustrated below. A pretreatment unit will be added before the existing furnace. Within the project various pretreatment technologies using different energy sources like: CO-rich industrial off-gas, bio-carbon and solar thermal energy will be developed and demonstrated.



Integration of the novel PREMA pretreatment technologies with the process currently used by smelters will lead to a better flexibility in terms of raw materials leading to a 20% reduction in the consumption of fossil carbon, more energy efficient production processes giving a potential for a 20% reduction in overall energy consumption and a global reduction of operating costs by at least 10%. The ultimate ambition of PREMA is to scale the technology up to use in industrial manganese alloy production both in Europe and South Africa.



The Vernon Furnace

The planned pretreatment unit in front of the furnace will change the properties and the temperature for the raw material fed to the furnace. This will affect furnace performance and reduce energy and carbon consumption in the furnace.

## PREMA'S ACTION LINES

WHAT IS PREMA?

### Action line 1

#### Pilot testing and engineering of Mn ores pretreatment technology

Identification and pilot testing of the most promising preheating and prereduction technology options to increase energy flexibility and CO<sub>2</sub> emission reduction taking into account different furnace set ups, properties of the input material and site specific conditions related to the availability of energy sources/carriers

#### Development of a solar thermal technology

Assessment of the critical parameters determining industrial implementation of Mn ores pretreatment with solar thermal energy

Design and testing of two pilot facilities: a solar thermal plant with thermal storage for a continuous production of hot air at 800°C in Germany and a solar thermal plant to preheat manganese ores with hot air continuously at 800°C in South Africa

### Action line 2

### Action line 3

#### Characteristics of raw materials

In-depth characteristics of Mn ores and the effects of their pretreatment to obtain input data for selection and design of a pretreatment technology enabling obtaining target temperatures and material properties and to model its upscaling from pilot tests to industrial pretreatment units

#### Demonstration of the effect on furnace energy efficiency and CO<sub>2</sub> emissions

Demonstration of an integrated pretreatment and furnace operation in pilot-scale at MINTEK, South Africa with one Mn ore

Pilot scale tests at SINTEF facilities for other Mn ores to determine the effect of the pretreatment on energy consumption and CO<sub>2</sub> emissions

Preheating pilot tests at FerroGlobe to determine the effect of using industrial CO-rich off-gases on Mn ore pretreatment

### Action line 4

### Action line 5

#### System integration, environmental impact and business models

A simulation-based approach to environmental footprint analysis, exergy destruction and thermoeconomics will be used to evaluate the different options for technology implementation at industrial scale, their integration with the existing industrial facilities and the overall environmental footprint

Development of an exploitation strategy for the implementation of pretreatment technology at the facilities of the industrial project partners

Global Mn alloy production in 2017 required 12 200 GWh electrical energy and emitted around 14.2 million tons of CO<sub>2</sub>. PREMA will contribute to the reduction of energy consumption up to 25% and CO<sub>2</sub> emission up to 15% for the Mn alloy industry in Europe



The Vernon Furnace output

PREMA'S ACTION LINES

## PROJECT CONSORTIUM

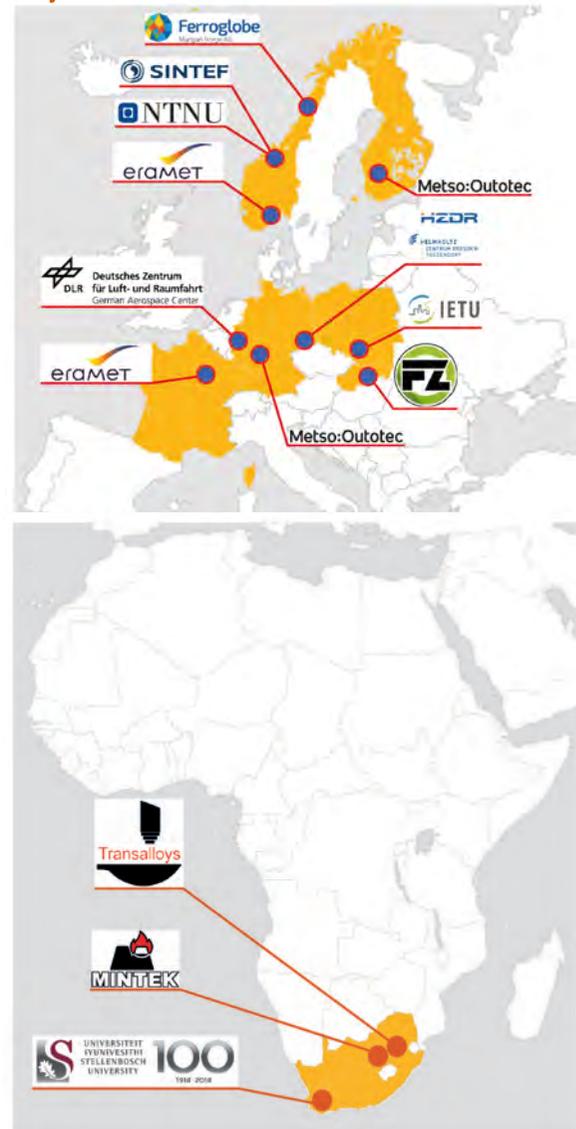
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### Project Partners:



## PREMA DEMONSTRATIONS

**DLR - experimental solar thermal power plant, Jülich, Germany**  
Demonstration of hot air production at 800°C 24h/day at Jülich experimental solar tower with thermal storage.

**MINTEK Randburg, South Africa**  
Demonstration of Mn ore heating with hot air (800°C) using a solar thermal plant.  
Demonstration of the impact of integrated pretreatment technology and furnace operation with Mn ore preheated at 600°C in a rotary kiln on the electrical energy consumption and CO<sub>2</sub> emissions in a submerged arc furnace.

**FerroGlobe Mangan AS Mo i Rana, Norway**  
Pilot tests to determine the effect of the use of industrial CO-rich off-gases and their variations on the pretreatment of Mn ore in a custom built continuous shaft furnace placed in the tapping hall and connected to the gas distribution system.

**Outotec Finland & Germany**  
For the selection of the right pretreating technology (fluidized bed, shaft furnace or rotary kiln), the Mn ore reduction behavior will be analyzed and the optimum operation windows will be determined. The conceptual study will result in first cost estimates.

**SINTEF Trondheim, Norway**  
Pilot tests to demonstrate the effect of pretreated raw materials on energy consumption and CO<sub>2</sub> emission from furnaces for Mn-alloy production.  
Effect of untreated and pretreated ore of the same type will be compared by production of Mn alloys in an existing pilot submerged arc furnace. 10 pilot experiments each using around 1 ton of industrial raw materials will be run. Different ores and materials pretreated with different technologies will be investigated.

## PREMA AIMS TO ACHIEVE

**20% less fossil carbon consumption**  
PREMA Mn ores pretreatment technologies will provide a higher flexibility in the use of energy sources and allow substitution of coal and electricity with solar energy, bio-carbon and energy containing waste gas streams.

**10% less electrical energy used**  
Pretreatment of Mn ores in a separate unit will allow flexibility in using different energy sources including renewable energy sources.

**25% less primary energy used and 15% less CO<sub>2</sub> emissions**  
Dividing the current operations of Mn alloy production in SAF into two separate units will make the process more energy efficient and thus reduce the overall energy consumption by up to 25% resulting in a 15% reduction of the CO<sub>2</sub> emissions.

**30% more potential for reducing energy and carbon consumption utilized**  
Industrial experience shows that only around 50% of the potential for reduced energy and carbon consumption from reactions during pretreatment are utilized in the furnace in today's operation. The use of waste byproducts such as CO rich off-gas for pretreatment may increase this potential to 80%.

**10% lower global Mn ores processing operating costs**  
Implementation of a flexible scheme in raw materials, including secondary raw materials, process and product quality specifications will ensure competitive production of Mn alloys in Western Europe and South Africa by reducing the operating cost and mitigating the effects of high energy prices.

## PROJECT FACTS

Project acronym: PreMa  
Grant Agreement No.: 820561  
Project start date: 01/10/2018  
Project duration: 48 months

[www.prema-project.eu](http://www.prema-project.eu)

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PREMA DEMONSTRATIONS AND AIMS



photo by © Joalet Steenkamp

# PREMA

Energy efficient, primary production of manganese ferroalloys through the application of novel energy systems in the drying and preheating of furnace feed materials