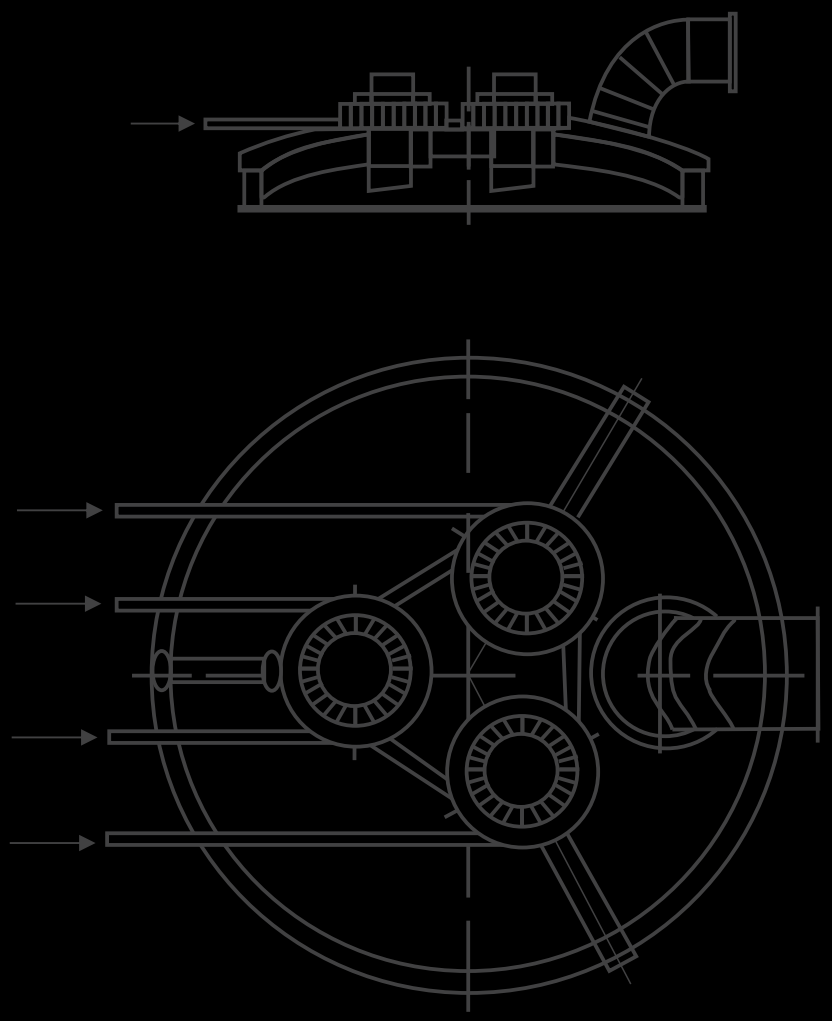
EUROPA ENGINEERING

*Ad maiora*

# INTRODUCTION

AIT is a company specialized in the design and manufacturing of high efficiency technological production systems, for the recovery and treatment of waste streams from mining and metal production, converting these potentially hazardous materials into raw material and eco-friendly inert slag. The study and implementation of cutting-edge technologies in the industrial metabolism makes AIT a worldwide reference for the metallurgical sector. Mines and metallurgical industries, in fact, generate large quantities of wastes, in a variety of forms, such as dusts, fines, slag, etc., whose recovery, treatment or disposal is difficult and expensive. The AIT "Clean Tech" technology transforms a number of fine metal wastes in high added value raw materials, avoiding any pre-agglomeration process, generating economical advantages to the mining and metal industries. AIT becomes a valuable partner for intelligent environmental solutions.

The environmental and health problems related to the production processes of the metallurgical sector, as well as the problems related to the management and costs of disposal of stainless steel EAF Dusts, have prompted the AIT team to intervene by offering a definitive solution. The Clean-Tech technology is what AIT proposes to adopt: it is effective and convenient, it is capable of recovering close to 100% of the metals contained in the EAF Dusts, in the form of Ferroalloys (Eco-alloys) as well as a marketable high concentrated Zinc Oxide powder.



*Spazio chiuso pressione dell'aria nel forno ad arco elettrico*

AIT (Applied Industrial Technologies) was created in 2006 in Johannesburg - South Africa by his founder José Almeida, a mechanical engineer who dedicates his life to the study, design and manufacturing of furnaces for the treatment of mining wastes. After a long phase of design and testing, two prototypes were created, the CLEAN-TECH 5.0 and the CLEAN-TECH 1.0. The first was used in a pilot plant installed in Middelburg (S.A.) in 2008, where a big number of trials were made, processing EAF Dusts, with very positive results in terms of metal recovery and efficiency. The second one was tested in the ENEXAL research project promoted by the European Community and carried out in Greece from 2010 to 2014, at ALSA - Aluminum of Greece. The CLEAN-TECH 1.0 has recovered in the form of ingots 100% of the metals present in the red mud derived from the reduction process of bauxite. In the same period, AIT studies an evolution of technology and creates CLEAN-TECH 5.0. The system (5 MVA EA FURNACE and PROCESS) is adopted by RST for the recycling of EAF Dusts generated by Columbus Steel in Middelburg, South Africa.

In 2017, AIT merges with Synergie Group, by creating the new Italian company AIT Europa Engineering which today promotes and sells the technology in Europe and Asia from the new headquarters in Italy.

Passion, Commitment, Determination, Research, Technological Innovation, Excellence, Talent and Training; these are the "assets" of AIT Europa Engineering. The formula of AIT success lies in the team and in the experience of each of its members. These ingredients are amalgamated in every sector of the activity: from design to the production of new technologies, from promotion to customer care.

Innovation is part of the AIT DNA. To innovate is to transfer the company vision to products, processes and working methods: to design sustainable production systems and processes in the context of industrial metabolism, which create a circular economy and contribute to the growth of Natural Capital. The partnership with Synergie Group, a company engaged in the development, construction and management of waste recycling centers deriving from the production of metals, has allowed us to strengthen and develop our mission.

EUROPA ENGINEERING

CLEAN-TECH

## CLEAN-TECH TECHNOLOGY

AIT Europa Engineering is proud to present you Clean-Tech Technology, its latest and innovative system for the recovery of metal fines; a real Clean-tech turning point for the mining and metallurgical sector, thanks to a cutting-edge technology, ideal for environmental and sustainable development initiatives. Clean-Tech Technology is an efficient solution, easy to implement thanks to its reduced dimensions, based on technology applied to electric arc furnaces that allows to directly melt the metal fines without the need for pre-agglomeration, considerably increasing the profitability of the process.

# Clean-Tech Process

**DIR** DIGITAL IMPEDANCE REGULATOR

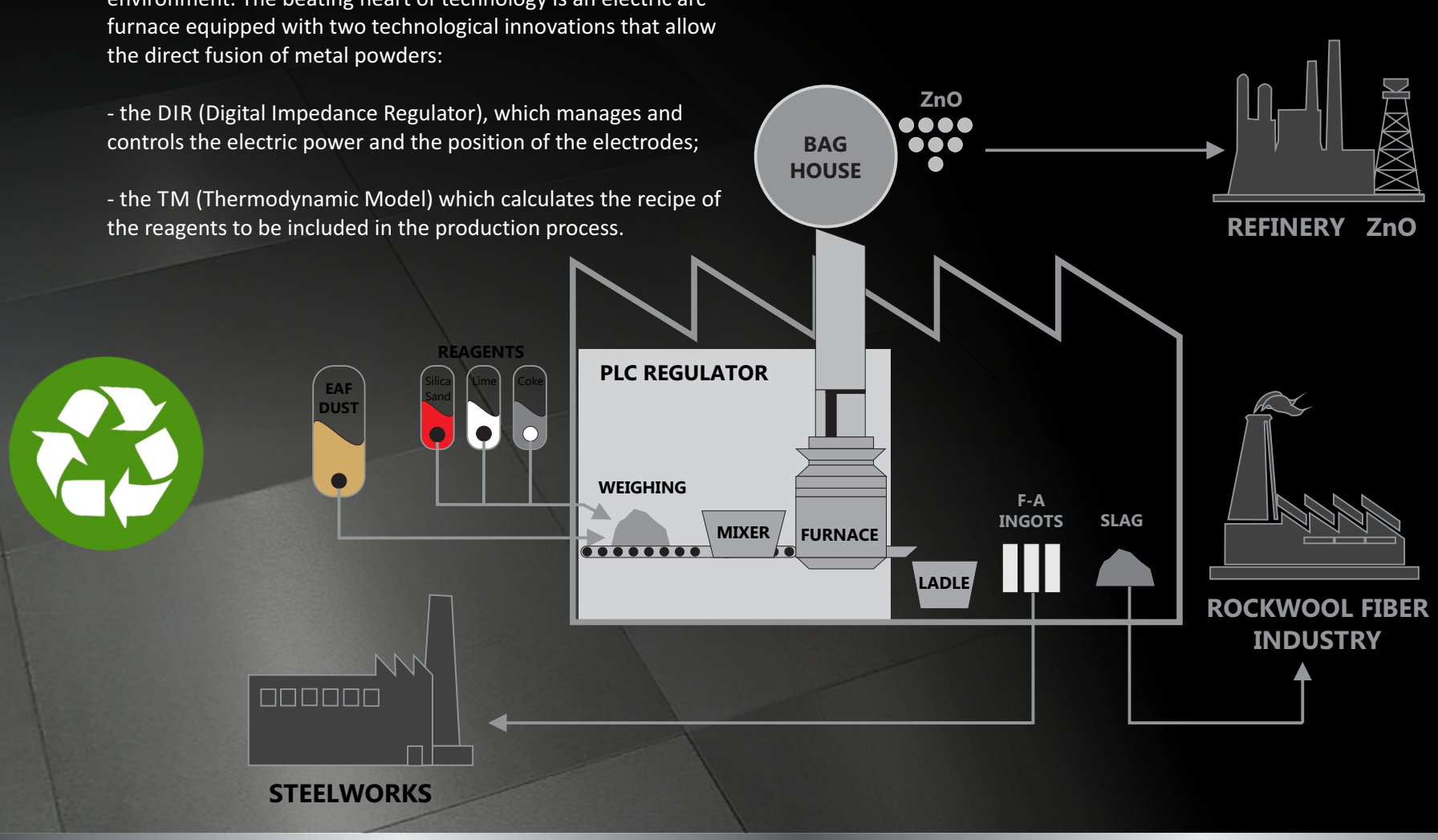
**TM** THERMODYNAMIC MODEL

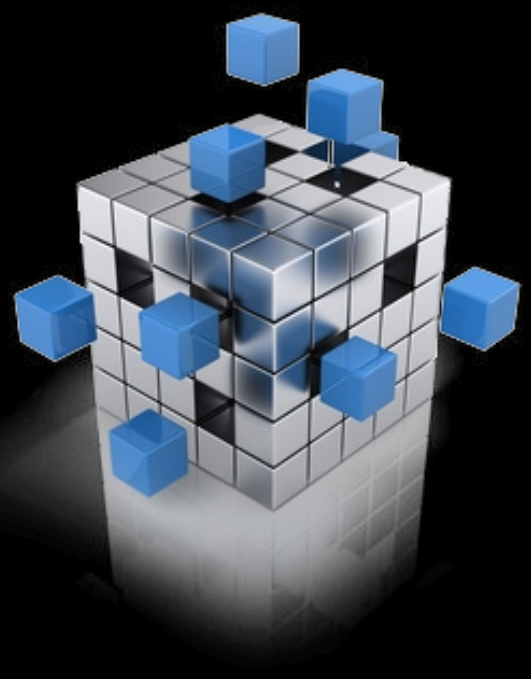
**PLC** PROGRAMMABLE LOGIC CONTROLLER

The production process of Clean-Tech Technology guarantees to the mining and metallurgical companies a complete exploitation of the dust and fine wastes, definitively solving the problem of their disposal. In the case of steelworks EAF dusts, the technology adopted allows them to be converted into ferroalloy ingots and Zinc Oxide, avoiding pre-agglomeration and without producing toxic waste. The slag obtained from the melting process is an inert material and can be used as raw material for the production of cements or mineral wool. The "Clean-Tech" system ensures a "clean" process, as all the processed material and every aspect of the production do not release any type of polluting waste into the environment. The beating heart of technology is an electric arc furnace equipped with two technological innovations that allow the direct fusion of metal powders:

- the DIR (Digital Impedance Regulator), which manages and controls the electric power and the position of the electrodes;

- the TM (Thermodynamic Model) which calculates the recipe of the reagents to be included in the production process.





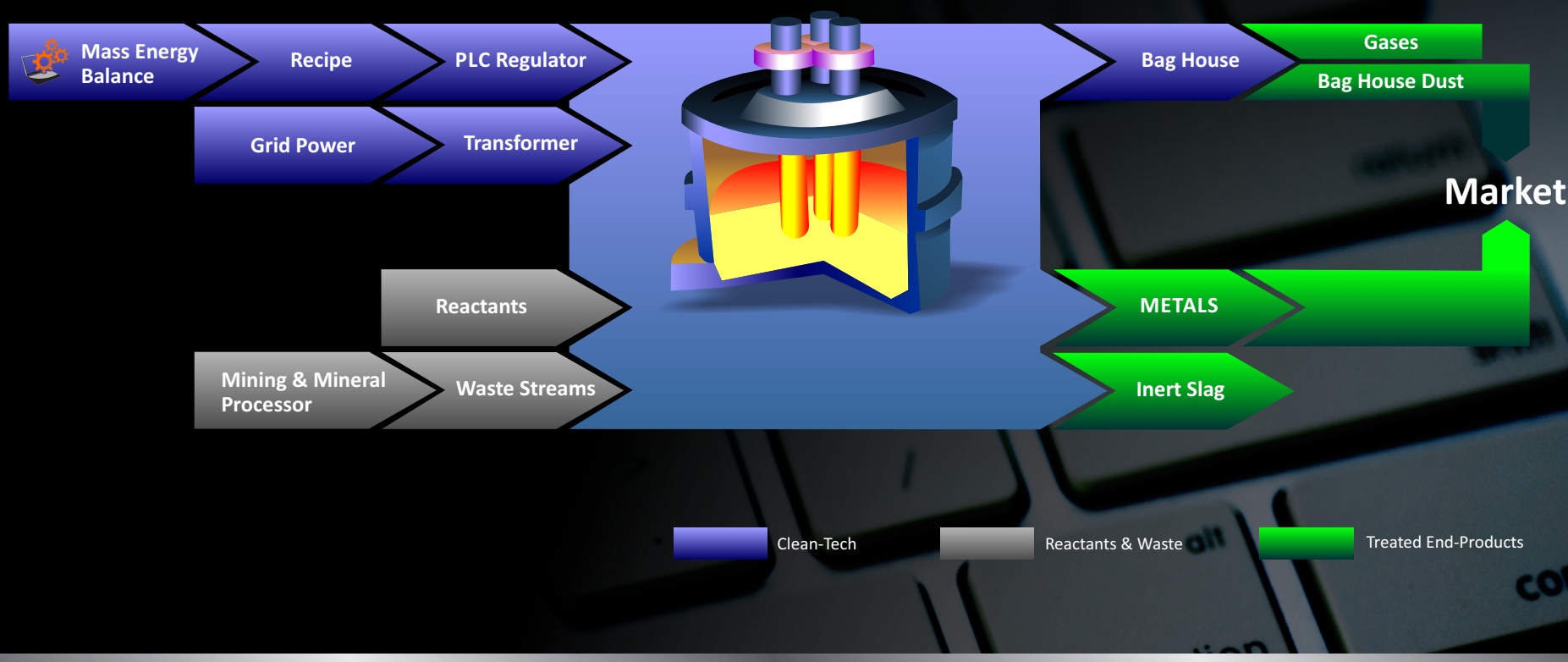
# Programmable Logic Controller

A PLC (Programmable Logic Regulator) manages and integrate the entire production process and specifically the functions of the DIR (Digital Impedance Regulator), the TM (Thermodynamic Model). In the specific case, the PLC has the function of constantly regulating the optimal absorption of electrical energy of the furnace, and the calibration of the position of the electric arcs that are created between the three electrodes, each time the molten bath increases or decreases. level.

The AIT PLC is advantageous for its low cost, ease of use, robustness and reliability.

## Clean-Tech Process Flow

Schematic representation of the Process and Procedures



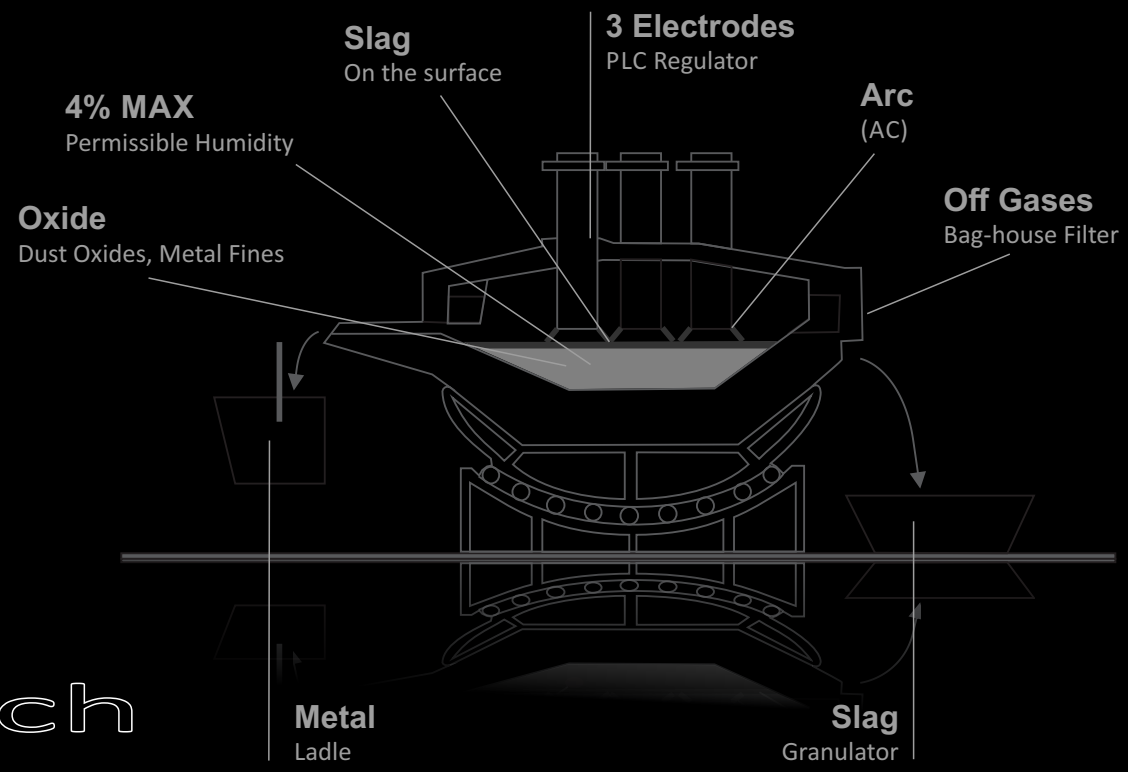
AIT Clean-Tech technology is applied to AC Electric Arc Furnaces where:

- the electrodes are made of carbon or graphite and powered by three-phase alternating current;

- the arc is set between the electrodes and the charge;

- the maximum current density is about 30 A / cm2 for each electrode;

- the adjustment is carried out by means of a vertical movement of the electrodes driven by an electric or hydraulic motor.




# The Clean-Tech Technology

# Electric Arc Furnace

AIT EA Furnaces are particularly suitable for the recycling of metal dusts, both in the form of oxides or metal.

AIT EA Furnaces make it possible to recover over 97% of the metals contained in the dusts.

**1.0** MVA
MAXIMUM POWER

**2.0** MVA
MAXIMUM POWER

**3.5** MVA
MAXIMUM POWER

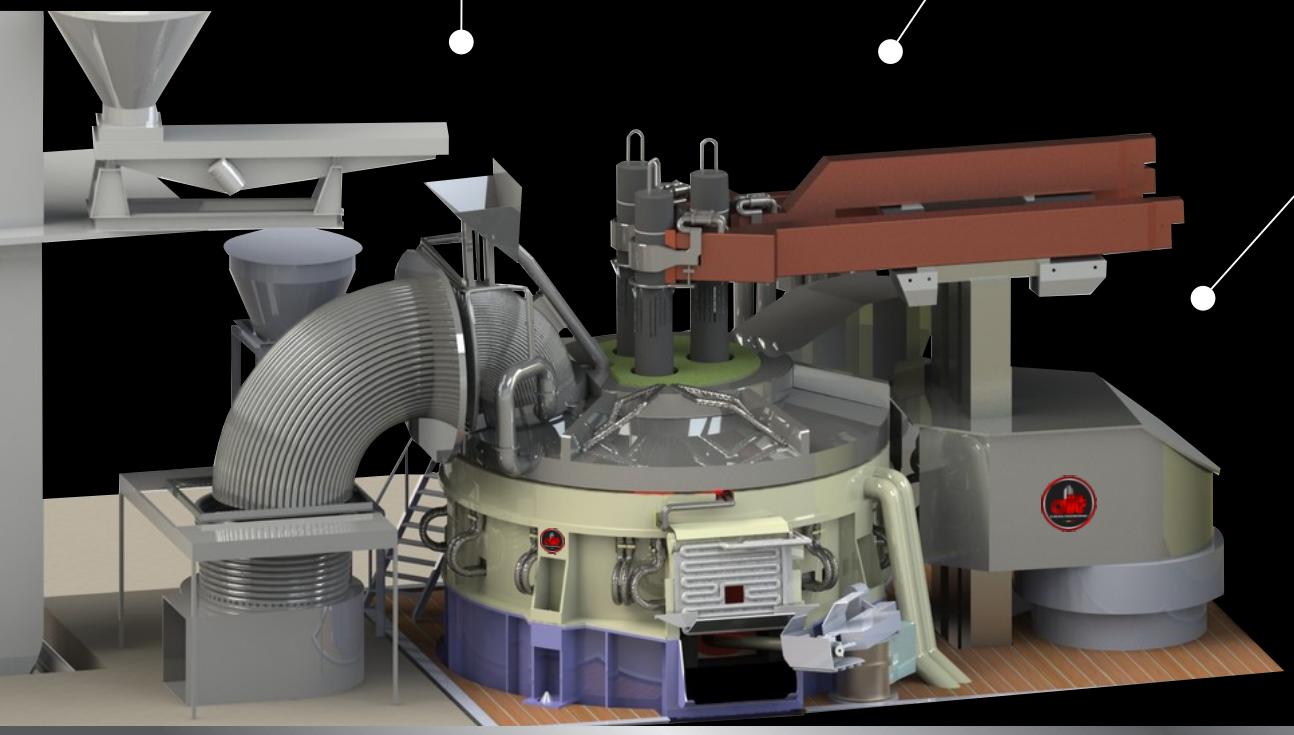
**5.0** MVA
MAXIMUM POWER

# Progressive Technology

**MELT REDUCTION**

It may look like a straight forward scrap-metal melting furnace where tremendous energy is introduced by electrical arcing in alternating current (AC) mode onto a metallic charge contained in the furnace bowl  - this via 3 vertical graphite electrodes that are suspended just above the solid charge, but it's PLC-based control system has now been re-conceptualized in such a way (our invention) that, instead of being in  melting mode, the furnace has now been transformed into melt-reduction mode wherein a whole range of chemical reactions can now also be introduced to take place, but now involving a non-metallic charge.

The AIT Clean-Tech furnace is not the same as a DC (direct current) Plasma-arc furnace, where, by virtue of its single vertically suspended graphite electrode, all the energy is concentrated inside a single long extended arc that is pinned to a tiny small spot on the surface of the molten slag.



**HOT TOP FUSION**

The advantage of AIT Clean-Tech technology is that, because the extended triply-induced hot arc zone that continuously resides on the surface of the charge – i.e. 'hot-top' mode, **materials in the form of finely disseminated particles, i.e. dry fines, can be added to it from above directly and continuously without the necessity of any preliminary capital-, energy- and  labour- intensive pelletizing or briquetting operation to be in place.**

# Innovative and Performing

**ALTERNATING CURRENT**

Our furnace will be operating in AC (alternating current) mode where arcing will be taking place between the tips of the 3 electrodes:- the tips now being in slight contact with the slag itself. The fact that electrical power is allowed to pass through the slag between the electrode tips means that resistive heating, besides some open-arcing, of the slag will be an additional source of heat energy to the system.

**ADVANTAGES**

Easy to operate – this by virtue of our unique PLC-based control system which continuously automatically resets all 3 of the graphite electrodes according to the level of the slowly rising molten bath.

Easy to manipulate – any person, even with a secondary-school certificate, can be quickly trained to operate and maintain our furnace.

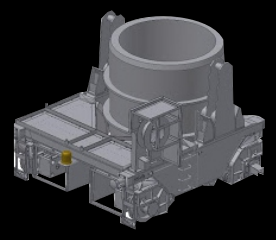
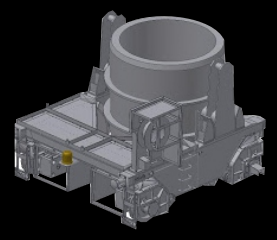
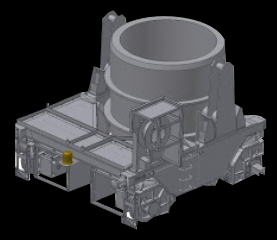
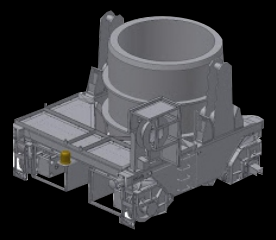
Easy to maintain – occasional new electrode addition/replacement and minor re-patching of worn parts of the refractory lining of the bowl constitutes a large percentage of the furnace maintenance.

Versatility - Clean-Tech EAF can be easily converted from a smelting process to another, according to our TM (Thermodinamic Model)

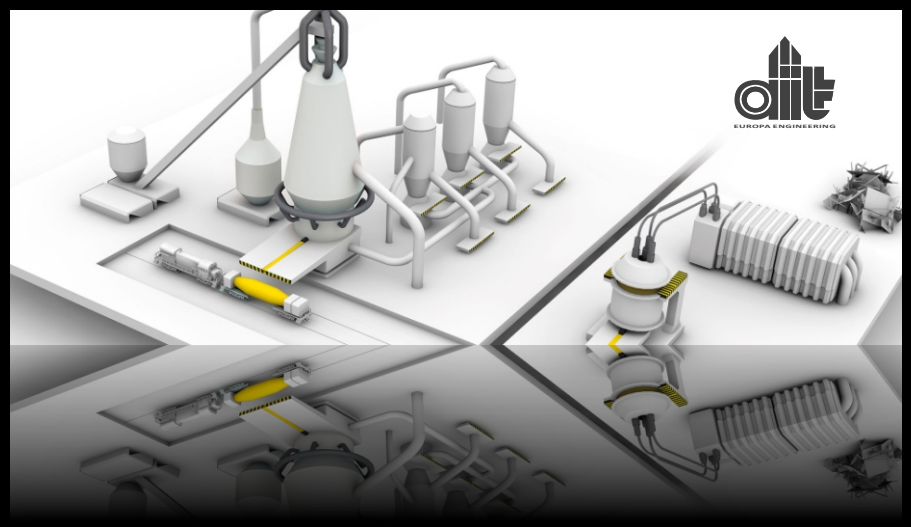
# Furnace Electrical Parameters

| Model | CLEAN-TECH 2.0 | CLEAN-TECH 3.5 | CLEAN-TECH 5.0 | CLEAN-TECH 10.0 |
|---|---|---|---|---|
| **Transformers rating** | 2.0 MVA | 3.5 MVA | 5.0 MVA | 10.0 MVA |
| **Furnaces nominal rating** | - | 3.15 MW | 4.50 MW | - |
| **Electrode diameter** | - | 250 mm | 305 mm | - |
| **Maximum electrode current** | - | 20 kA (UHP) | 30 kA | - |
| **Transformer secondary voltage range** | - | 110-200 Volts | 110-200 Volts | - |

# Technical Spacifications

| Model | CLEAN-TECH 2.0 | CLEAN-TECH 3.5 | CLEAN-TECH 5.0 | CLEAN-TECH 10.0 |
|---|---|---|---|---|
| **Type** | Semi-rigid superstructure | Semi-rigid superstructure | Semi-rigid superstructure | Semi-rigid superstructure |
| **Power input** | 2000 kWA | 3500 kWA | 5000 kWA | 10000 kWA |
| **Voltage** | - | 6.6 to 33 kV 3 ϕ Furnace transformer + 550 V/400 V 3 ϕ Auxiliares | 6.6 to 33 kV 3 ϕ Furnace transformer + 550 V/400 V 3 ϕ Auxiliares | - |
| **Power factor** | - | Better than 0.9 | Better than 0.9 | - |
| **Bowl capacity** | - | 13.2 m3 | 19.05 m3 | - |
| **Bowl size** | - | 3.9 m diameter 3.0 m deep | 4.5 m diameter 3.0 m deep | - |
| **Bowl tilting** | Tilting | Fixed | Fixed | Fixed |
| **Bowl temperature monitoring** | - | 16 channel thermocouple supervision | 16 channel thermocouple supervision | - |
| **Electrode size** | - | 3x250 mm diameter graphite | 3x305 mm diameter graphite | - |
| **Electrode current density 15kA** | - | 0.350 A/mm2 | 0.473 A/mm2 | - |
| **Electrode clamping** | - | Failsafe hydraulically actuated > 80 kN clamping force | Failsafe hydraulically actuated > 120 kN clamping force | - |
| **Roof** | - | Fixed, forced water cooled, freezer lined | Fixed, forced water cooled, freezer lined | - |
| **Total length** | - | 8 m | 9 m | - |
| **Total width** | - | 5 m | 5.5 m | - |
| **Total height** | - | 9 m | 9.5 m | - |
| **Weight (tined)** | - | 70 - 100 tons | 70 - 100 tons | - |
| **Flexible cables** | - | 6x10 kA forced water cooled annealed copper 8.66 A/mm2. Two per electode | 6x25 kA forced water cooled annealed copper 8.8 A/mm2. Two per electode | - |
| **Main control** | - | SCADA system / PLC | SCADA system / PLC | - |
| **Electrode movement** | - | 3xAC motors/vector control drives 5.5 kW | 3xAC motors/vector control drives 7.5 kW | - |
| **Hydraulic pump** | - | 11 kW (furnace plus ancillaries) | 7.5 kW or as required | - |



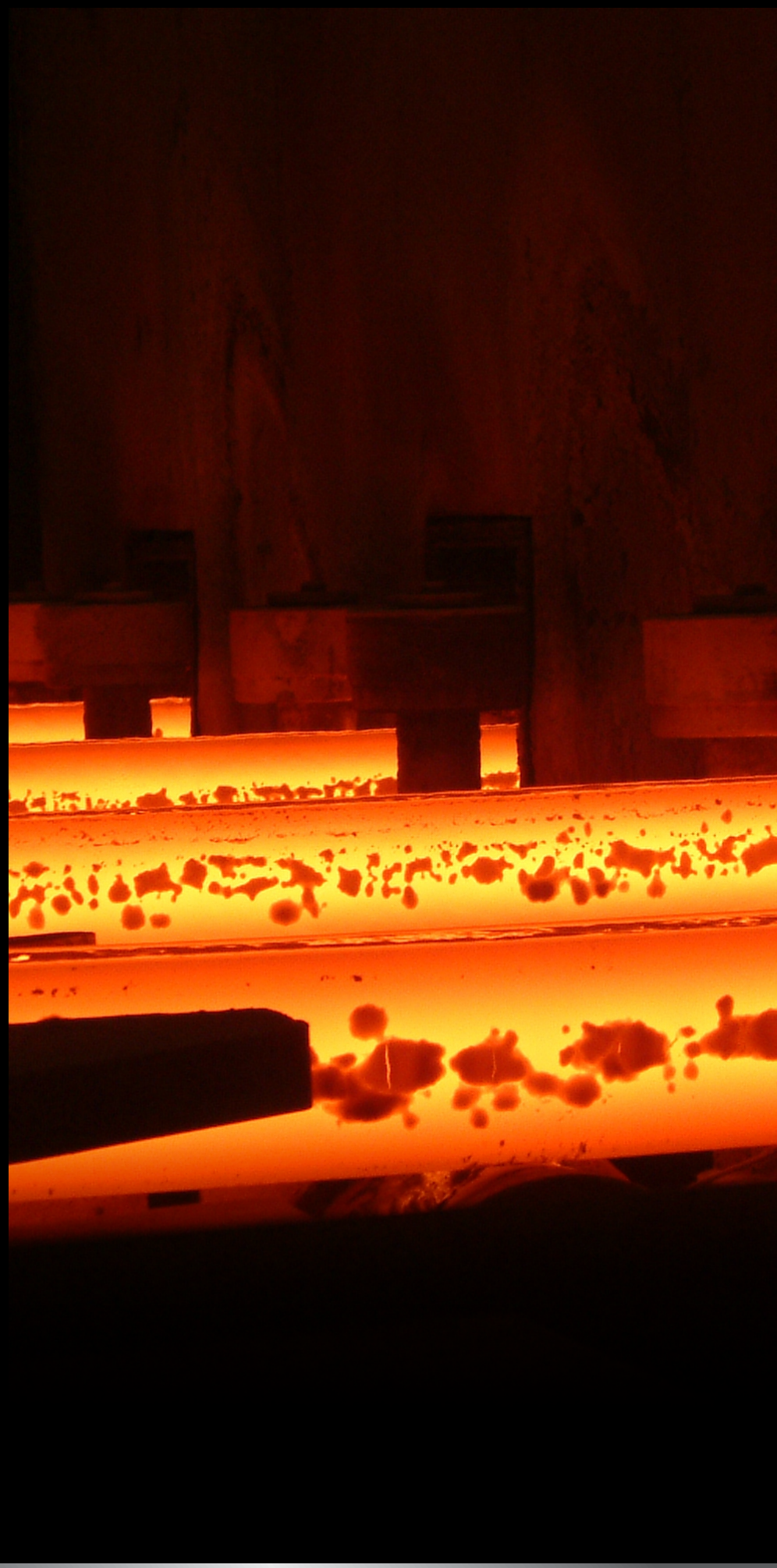
# The Advantages

The innovative Clean-Tech Technology industrial process has the ability to directly treat powders, avoiding their pre-agglomeration, through an "open arc" control system, which is managed directly by the **DIR (Digital Impedance Regulator).** During this process the software automatically calculates a recipe of fine metals and reagents to be treated.

The reagents used are: lime, silica sand and carbon coke.

The mixture is charged into the furnace through a safety slide, positioned between the three vertical electrodes, which fall directly into the "arc-zone".
During the melting process the gases generated are immediately aspirated by the off-gas duct, and filtered in the bag-house.

In other words, our furnaces operate in "hot-top" condition, completely eliminating the risk of explosion "blow backs". In addition, the levels of secondary dust formation, deriving from the production process, are lower than expected, due to the furnace charging mode: "plug-flow" and "cross-flow" .



# List of major industries that generate waste or hazardous materials applicable to being processed or used in the AIT furnaces

The Steel industry

The Stainless steel industry

The Ferro-alloy industry

Ferro-nickel

Ferro-chromium

Ferromanganese

Ferro-silicon

Ferro-vanadium, Ferro-titanium, Ferro-molybdenum, and Ferro-tungsten

The Aluminum industry

The Copper industry

The Tin industry

The Lead and Zinc industry

The Platinum industry

The Gold and Silver industry

The Catalyst industry

The Electronic waste (e-waste) industry

The Rare-earth industry

The Tailings dam and Slag dump recycling industry

The Petroleum industry

*Porta itineris dicitur longissima esse*

EUROPA ENGINEERING

*Ad maiora*

Via Pastrengo, 12/1 - 16122 Genova - ITALIA

www.aiteuropaengineering.io

EUROPA ENGINEERING

*Ad maiora*