



SHAPING THE INDUSTRY SUSTAINABILITY

**TENOVA'S TECHNOLOGY APPLICATION AND
ITS SIGNIFICANCE FOR THE IRON & STEEL
INDUSTRY**

Paolo Argenta

Tenova EVP, Upstream Business Unit

Techint Group for Sustainability

A STRONG COMMITMENT

The Techint Group is a global organization that **promotes health and safety** among employees, that is **socially and environmentally responsible**.

It is a group of companies that **embrace innovation and diversity** as means to create value for its employees, shareholders and the community at large.

A long-standing value that rationally **integrates environmental and social dimensions** into sound financial analysis and investment decision making.

A COMMITMENT WITH THE FUTURE

Tenaris, Ternium, Techint Engineering & Construction, Tecpetrol and Tenova are making great efforts to minimize environmental footprint, developing agendas to climate concerns.

#1-APRIL 2021



→ Ternium announces plan to reduce CO₂ emissions by 20% by 2030

→ Tenaris announces plan to reduce CO₂ emissions by 30% by 2030

Tenova for Sustainability

IT IS NOT A MATTER OF COMPLIANCE

Since the outset, Tenova's mission has been to partner with global clients to develop **technologies that protect the environment and improve employee working conditions**, while generating cost savings.

In 2023, Tenova formalizes its commitment to **pioneer green technologies** that facilitate the industry's decarbonization, as well as its commitment to improve **its own sustainability** with its first **Sustainability Report**, **anticipating by three years any legal obligation** given by the European Directive (now CSRD).



sustenovability.



sustainabilityreport.tenova.com

Tenova's Approach



INDIRECT IMPACT

Technologies and processes to produce **essential metals for the energy transition**

DIRECT IMPACT

Technologies and processes through which our customers can **reduce their emissions**

FLEXIBLE SOLUTIONS

Ability to **consider the specific context** in which the customers operate and the variable conditions ahead of us

“PARTNER” ATTITUDE

Willingness to establish a **partnership relationship** with customers and other business players

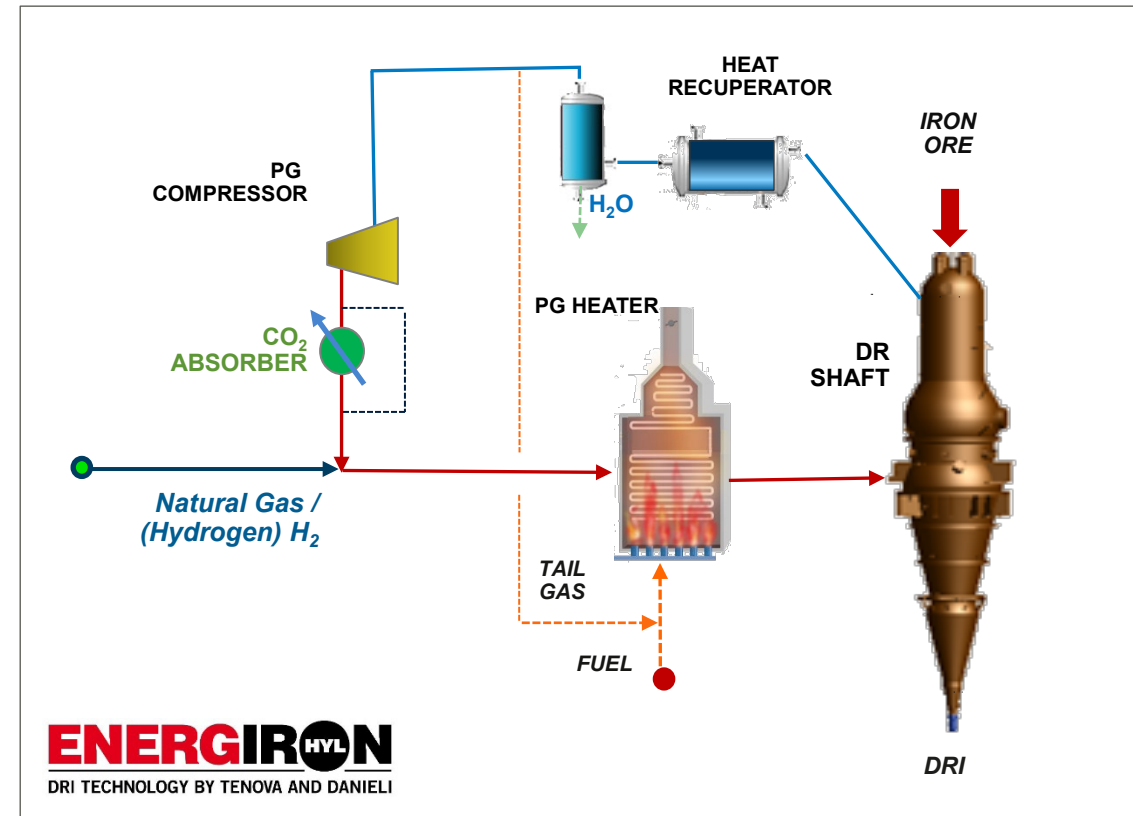


ENERGIRON^{HYL}
DRI TECHNOLOGY BY TENOVA AND DANIELI

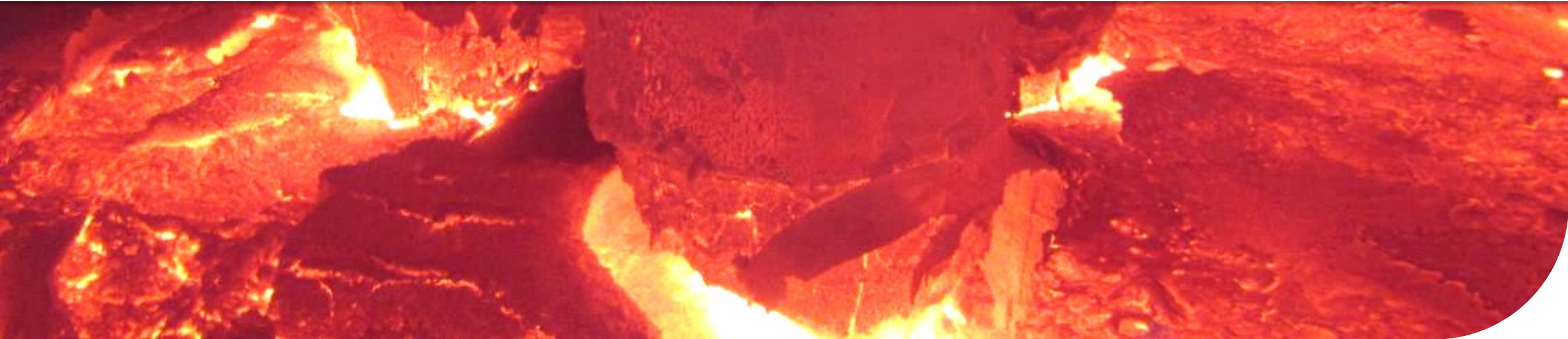
DR technology characteristics for Green Steel

BASIC REQUIREMENTS FOR DECARBONIZING IRONMAKING/STEELMAKING INDUSTRY

1. **Hydrogen Ready!** Flexibility to operate with NG/H₂ from 0-100%
Energiron is capable to operate from 100%NG - 100%H₂ in **reversible operating mode**.
2. Flexibility for **high %C DRI** for HM production
ENERGIRON® is capable to produce >4%C DRI with 100%NG. Even with 30%H₂ (energy), %C >3.3% can be achieved.
3. **Inherent CCU/CCS**
ENERGIRON® DR technology has an inherent selective CO₂ removal as part of its standard and unique scheme.



ENERGIRON DRI Standard Process Scheme

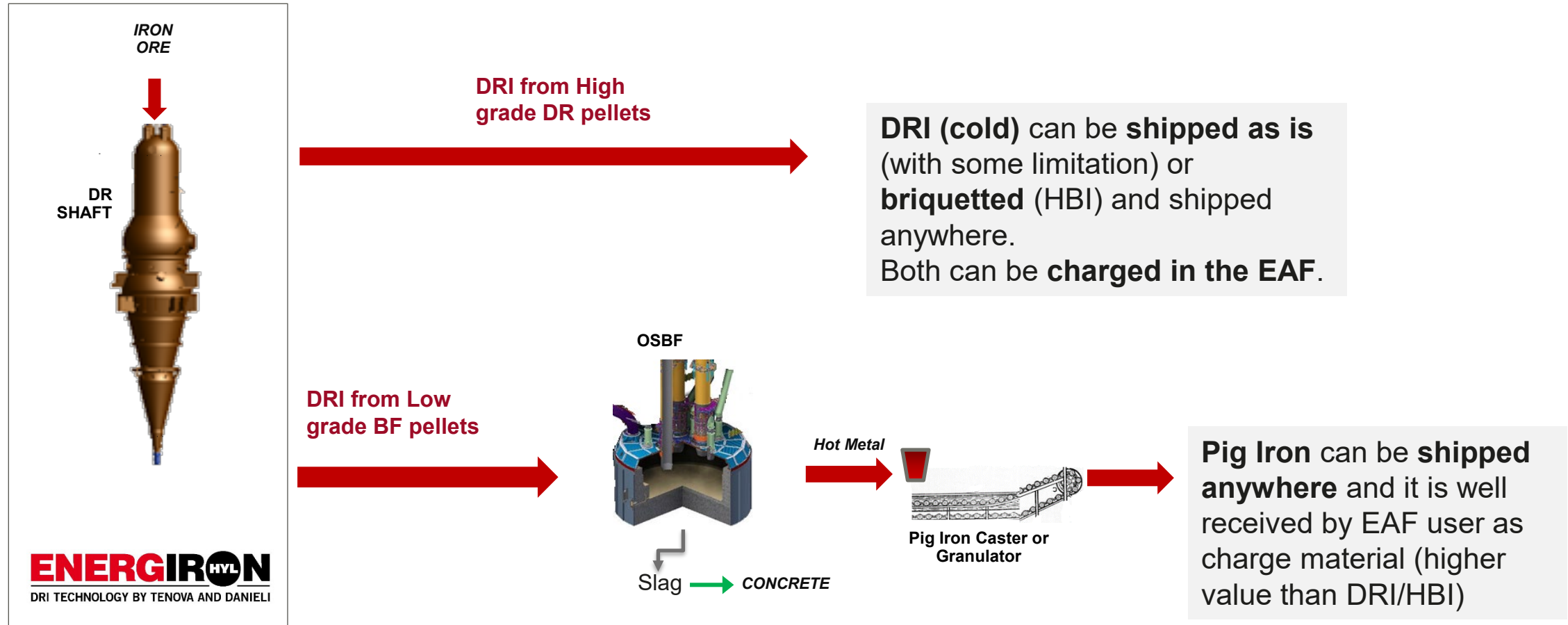


How can we get liquid steel out of DRI?

Tenova Melting Solutions

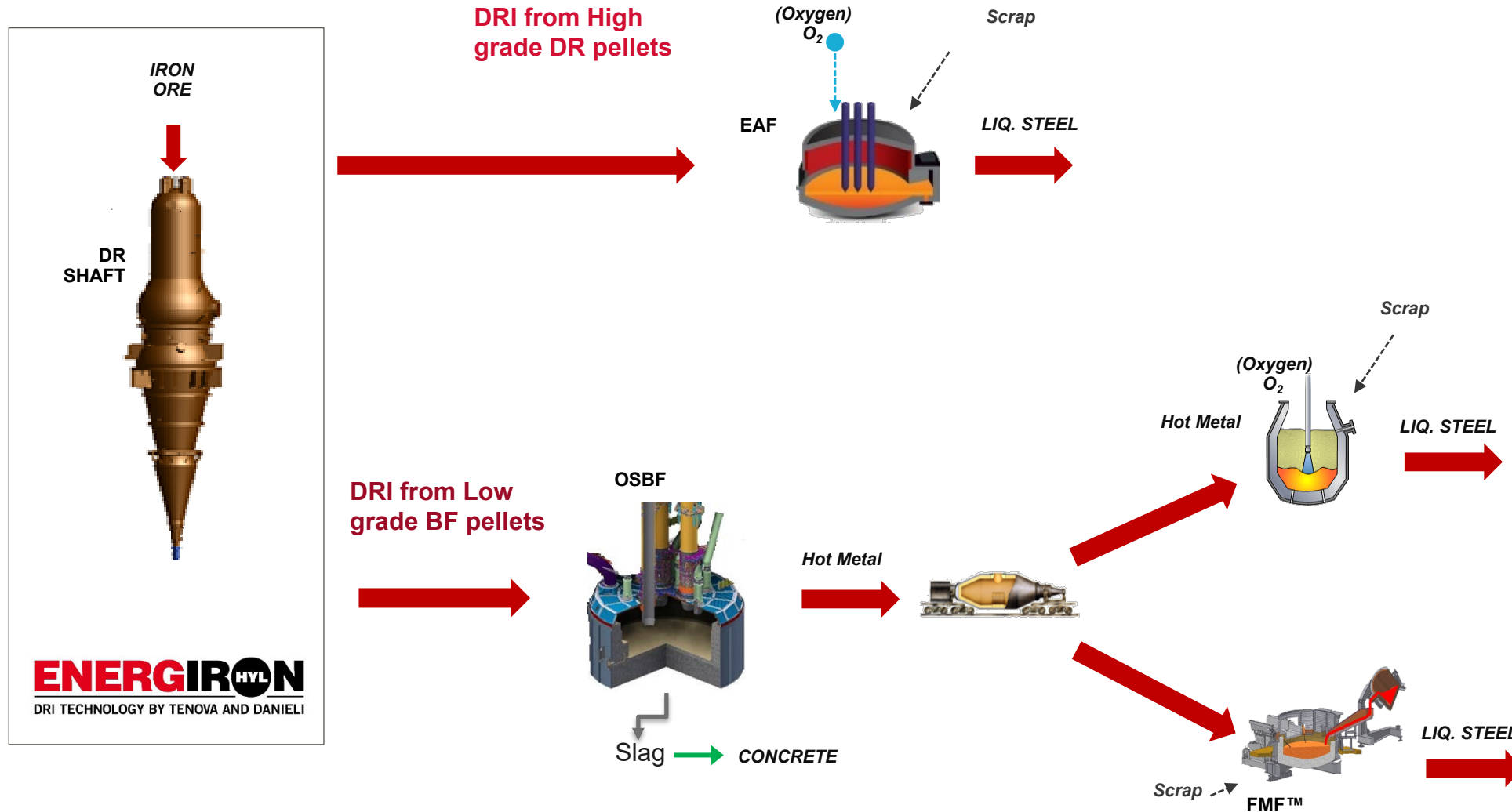
Routes to produce Steel from DRI 1/2

RAW MATERIAL FOR EAF CHARGE – MERCHANT APPROACH

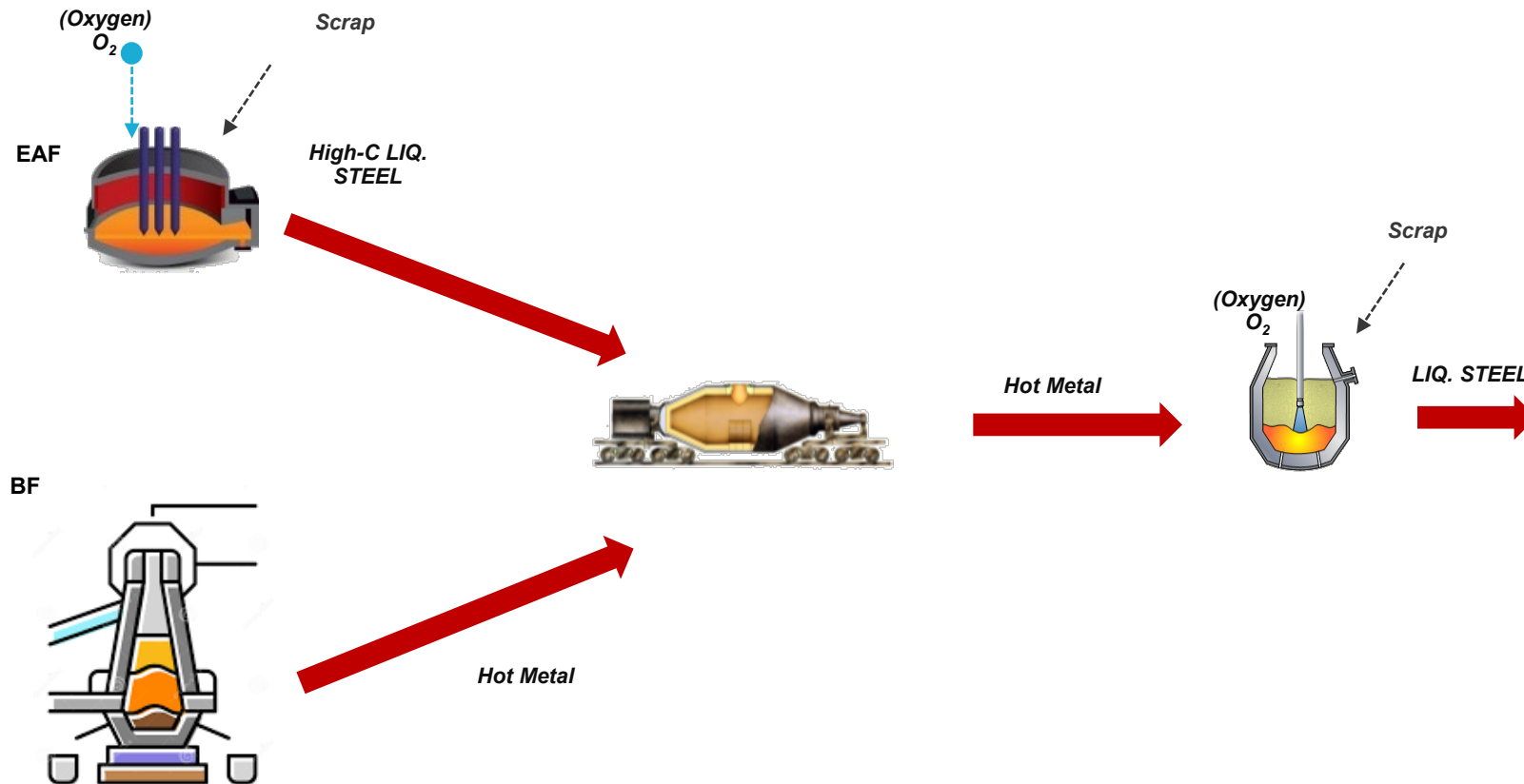


Routes to produce Steel from DRI 2/2

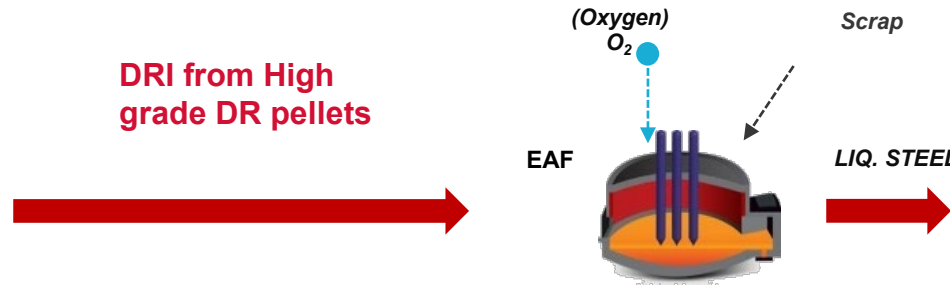
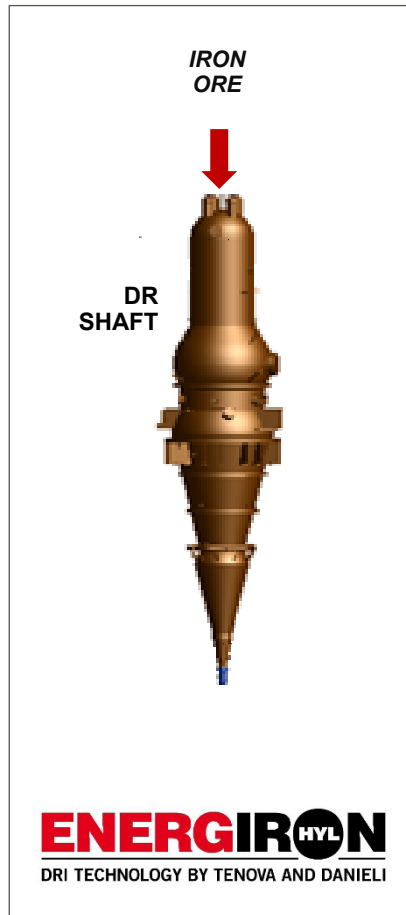
A GENERAL APPROACH VIA DRI



Increasing Scrap use in the Integrated Route



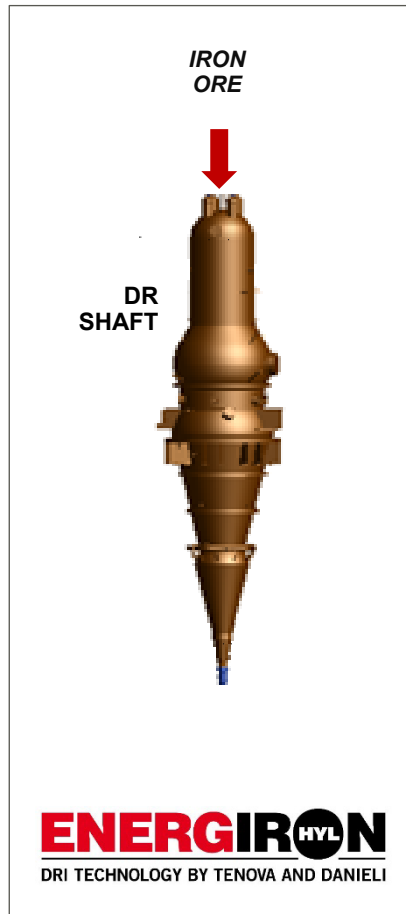
The “Classic” Solution is always mainstream



Most of the plants sold nowadays are designed based upon the “classic” concept of DRI being fed (with different percentages) in one or more EAFs.

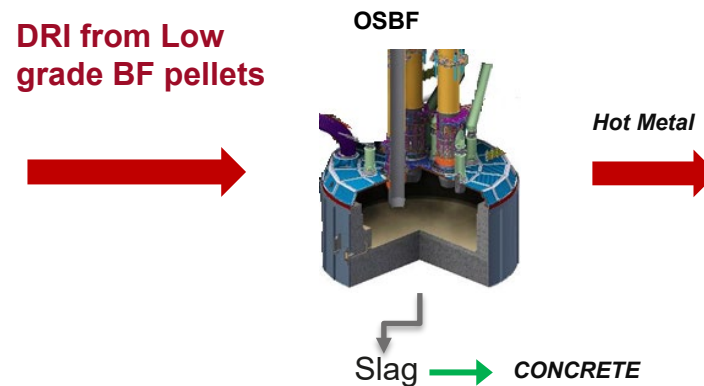
This year in October the **HBIS project**: “Unique coke oven gas zero-reforming DRI process combined with EAF” won the **WSA award** for “Excellence in low-carbon steel production”

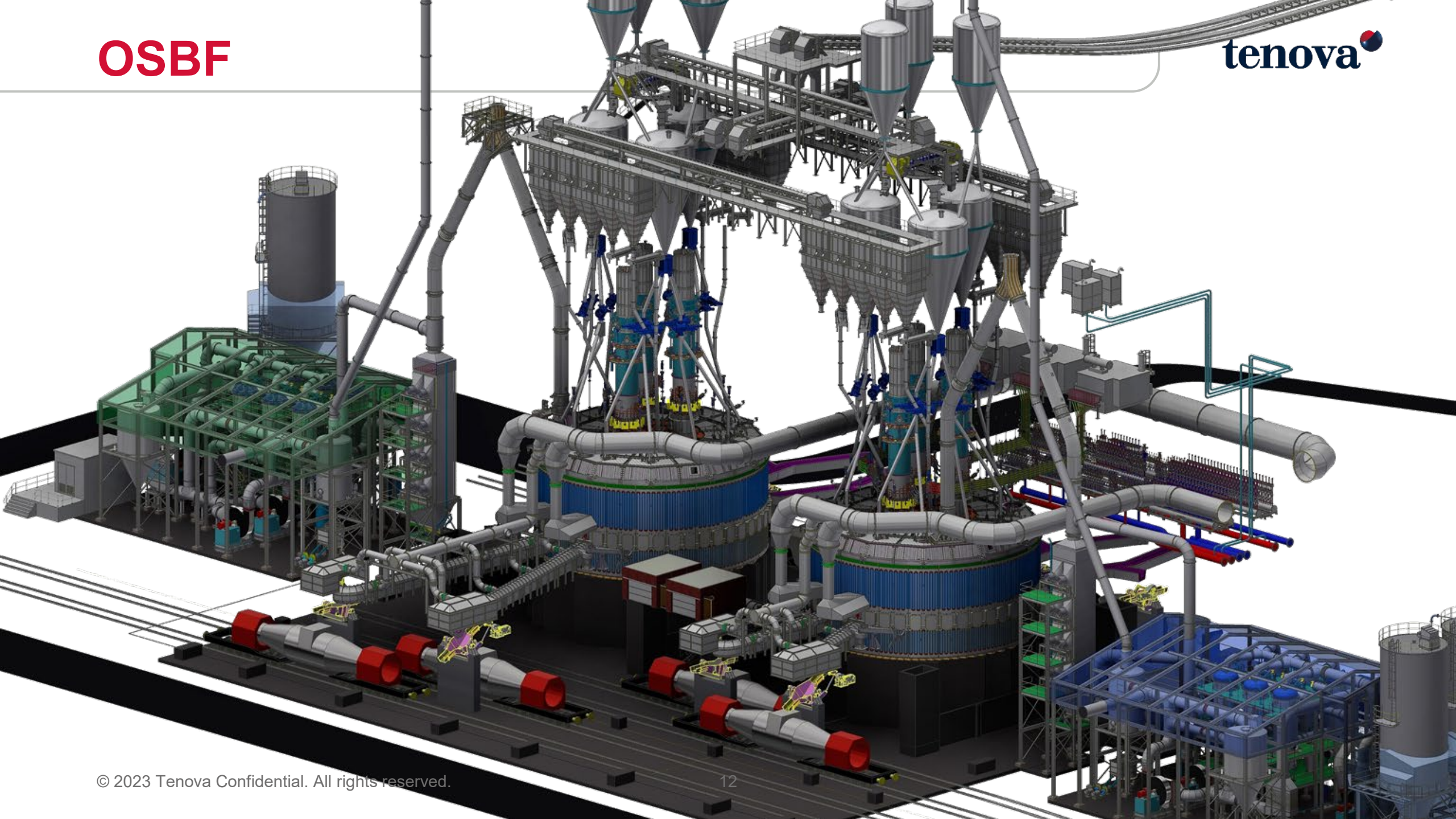
A different type of Blast Furnace



Coupling DRI plant with an OSBF allows to emulate the same outcome of a BF.

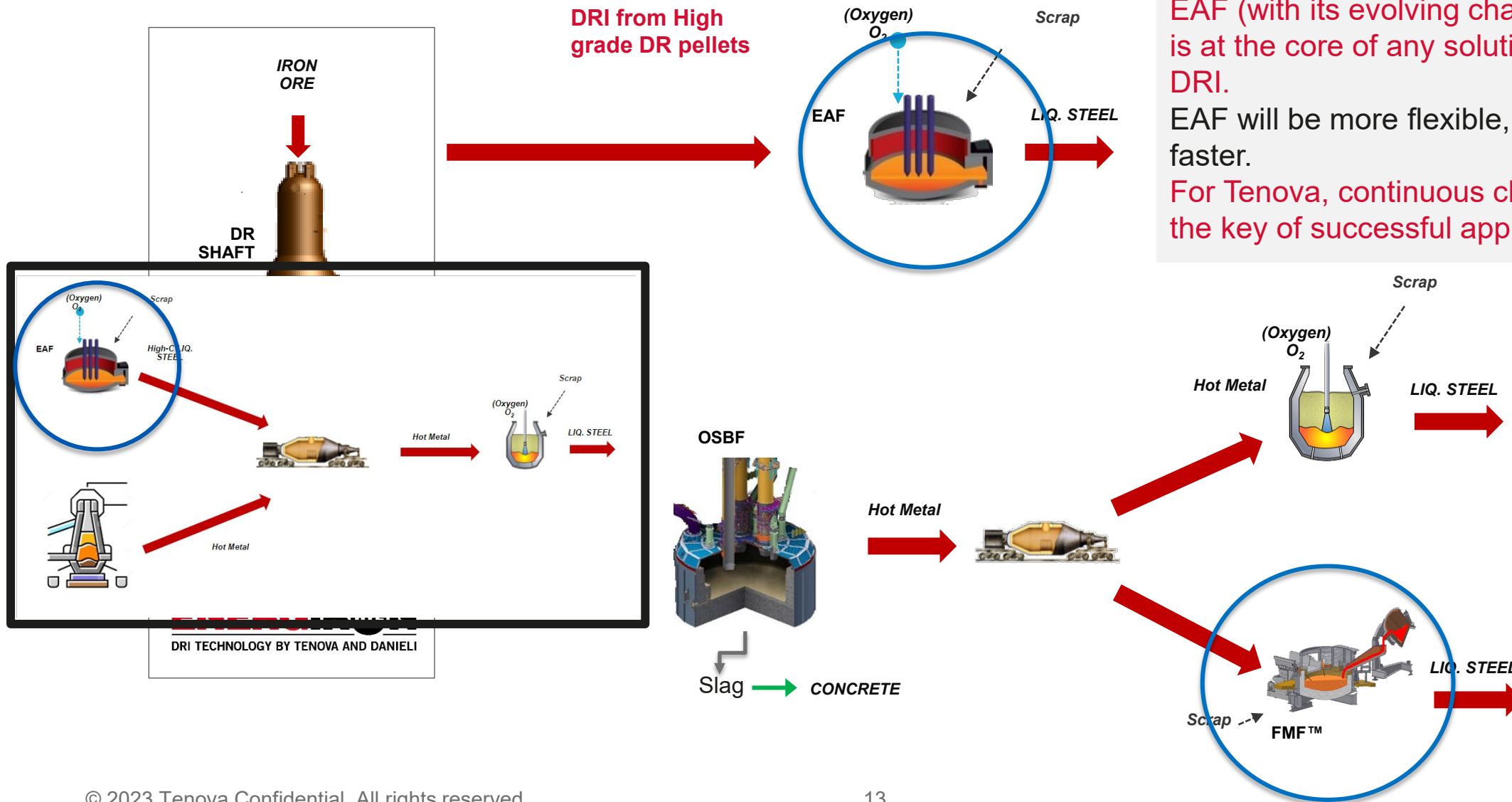
Not only the Hot Metal is similar (allowing to produce the BF/BOF quality steels with the same processes), but the **slag tapped is similar to the BF** allowing to sell it to the cement industry (not feasible for the EAF slag).





The EAF importance is growing

A GENERAL APPROACH VIA DRI



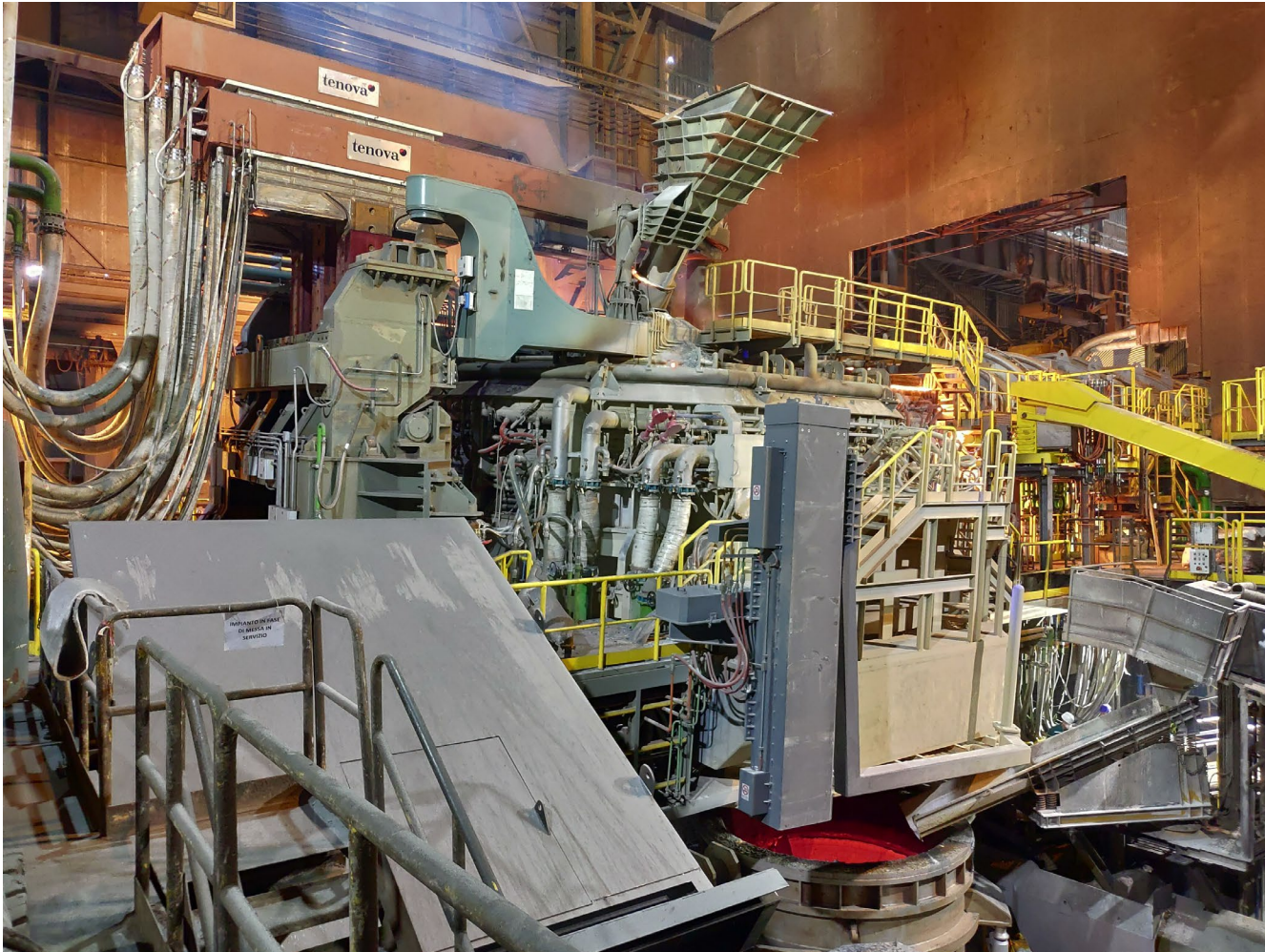
EAF (with its evolving characteristics), is at the core of any solution including DRI.

EAF will be more flexible, bigger and faster.

For Tenova, continuous charging is the key of successful applications.

High productivity EAFs

TWO INNOVATIVE EAF PROJECTS FOR THE PRODUCTION OF HIGH QUALITY STEEL GRADES



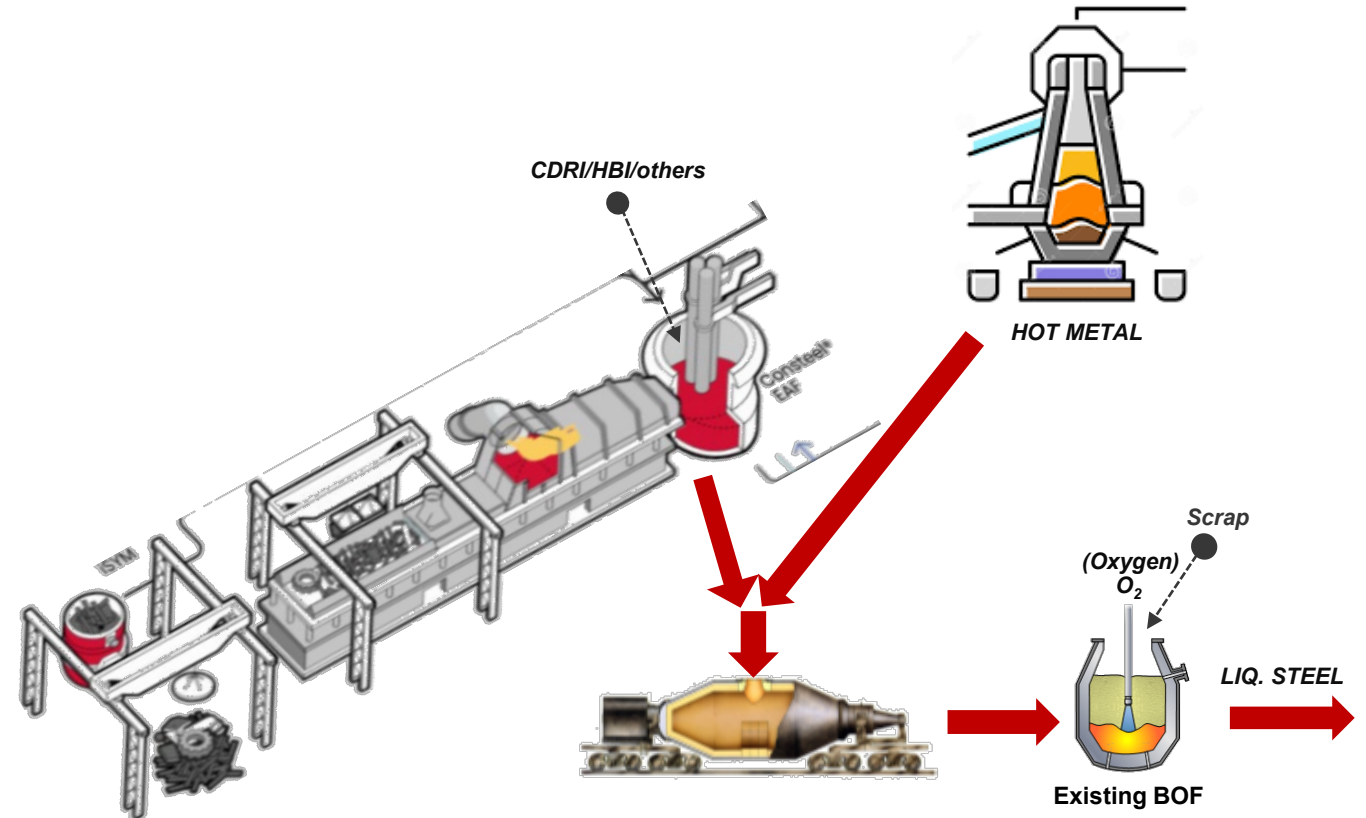
Acciaierie Arvedi (Italy) – Consteel+EMS,
300t tapping size, productivity >400tls/hour

Building upon the experience in **Arvedi** with **electromagnetic stirring systems (EMS)** applied to continuously charged EAFs and in **Nippon Steel**, Tenova developed for **POSCO** and **TERNIUM** two technological steelmaking solutions for the **production of high-quality flat steel grades**, including IF:

- **POSCO Gwangyang** South Korea, 07/2023
280t tapping size, 280MVA, EMS by ABB
Avg. charge mix 80% scrap, 20% HBI
- **TERNIUM Pesqueria** Mexico, 10/2023
300t tapping size, 340MVA, EMS by ABB
Avg. charge mix 60% HDRI, 40% scrap

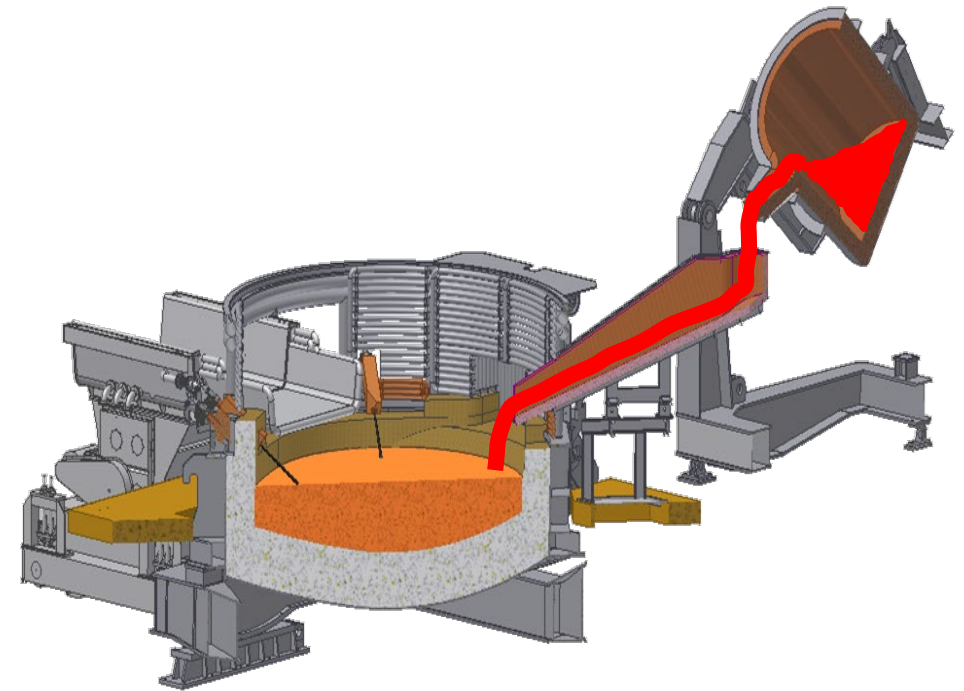
EAF as a Melter

- The use of an **EAF upstream the BOF** allows to increase dramatically the use of low-impacting feeds such as scrap and other substitutes.
- The liquid produced has **little to none active oxygen dissolved** (unlike standards EAF melt), and can be safely **mixed with the Hot Metal** coming from the BFs upstream the BOF.
- **Melting speed and homogeneity of the liquid guaranteed** by electromagnetic stirring (EMS).
- **Continuous charge of all material inputs** to guarantee the targeted chemical endpoint (content of tramp elements).



FMF[®]: Hardware – Continuous HM charge

CONTROLLING THE INPUT TO CONTROL THE PROCESS



Drivers in the Decision-making Process

- **Availability and forecasted price of raw materials and energy** (ores, scrap, natural gas, Hydrogen, electricity, ...).
- Expected **market/customers behaviour**
- **Local regulations**, "license to operate"
- **Quality of steel produced** (more fun to come on **secondary metallurgy**...)
- **Financial support** to decarbonization/transition investments
- **Electrical network strenght**
- **Slag disposal** and/or **sales opportunities**
- **Availability of CCS or CCU solutions**





- **Steelmakers need different alternatives to decarbonize their plants.** Local conditions, raw materials and energy sourcing, specific strategies do require evaluating different solutions.
- **The market of available technologies to produce liquid steel has evolved** dramatically in the last five years. Many new approaches are being deployed worldwide.
- Tenova believes that **Technology suppliers have a role in opening opportunities for the customers** without taking a one-size-fits-all approach.

THANKS TO THE STEELMARKERS FOR THE WILLINGNESS TO DEVELOP WITH US NEW APPROACHES.

CONGRATULATIONS TO ALL OUR COMPETITORS AND PARTNERS FOR THE GREAT CONTRIBUTION TO THIS EXCITING JOURNEY.



Paolo Argenta

paolo.argenta@tenova.com

Tenova S.p.A.

Via Gerenzano, 58
21053 Castellanza (VA) – Italy

tenova@tenova.com

www.tenova.com

TECHINT GROUP

