## SESSION 3: 11:00-11:15



BioRe Steel

#### ESTEP workshop SecCarb4Stee

Preparation and use of biogenic and non-biogenic secondary carbon carriers (SCC) in processes for iron and steelmaking

# Valorisation of biomass residues for sustainable steel production – EU RFCS project of BioReSteel

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#### **BioReSteel**

Valorization of wet biomass residues for sustainable steel production with efficient nutrient recycling Chuan Wang, Swerim AB

Call: *(RFCS-2022)* Instrument: *RPJ* Start date: 01/10/2023 End date: 31/03/2027 Budget: 2 052 476.00 € (total 3 420 795.00 €)



BioRe Steel

## **Objective & methodology**

**Objective**: to replace fossil carbon in the electric arc furnace (EAF) by biocoal, produced from low-value locally available wet biomass residues by means of a hydrothermal carbonization (HTC) process.

<u>Methodology</u>: The BioReSteel concept will be proved by the means of laboratory and EAF testbed trials. Furthermore, the industrial EAF trials will be performed at three EAF plants to test hydrochar injection, hydrochar top charging and bio-oxides agglomerates in order to prove the concept's flexibility and generality.



#### Main targets

- Reduce fossil CO<sub>2</sub> emissions in the European steel industry by approximately 2.5 million tons per year through the substitution of fossil coal with hydrochar derived from wet biomass residues in electric arc furnace (EAF) steelmaking.
- Achieve a 30% reduction in energy costs in EAF steelmaking by replacing 50% of fossil fuels with biocarbon, while ensuring the production of a solid inorganic phosphorusbased fertilizer from biomass waste, critical raw material, complying with EU regulations.





- 3. Carburization
- 4. Slag foaming



#### **Overall structure of Work Plan**







#### Partners' contribution in value chain





#### Hydrothermal carbonization (HTC)

Compared with traditional pyrolysis carbonization, hydrothermal carbonization has the characteristics of mild reaction conditions, low energy consumption and less pollutant generation, a possible nutrient recovery (NPK).

**SWERI**M



#### Functions of biocarbon in the EAF



#### Electric arc furnace (EAF)



#### **Required properties carbon in the EAF**

**Functions of carbon:** 

Measurable properties of carbon:

- Heating
- Carburization
- Slag foaming
- Impurities

- Lower heating value (LHV)
- Fixed carbon content (FC)
- Total gas formation (TGF)\*
- Low ash, alkalis, S, P

\*TGF (g-gas/g-CM)=(%VM/100)+(%FC/100)\*(28/12) Volatiles All fixed carbon forms CO gas



#### Laboratory investigation

**Self-reduction and carburization** 

Slag foaming









#### **Pilot trials at Swerim AB**



10-ton EAF at Swerim, Luleå, Sweden

- Injection test
- Top-charging test
- Bio-agglomerates top charging



#### Industrial trials at EAF steel plants



EAF (150 ton), PITTINI, Italy - Top charging hydrochar pellet EAF (85 ton), ORI Martin, Italy

- Top charging hydrochar-mill scale briquettes

EAF (150 ton), CELSA, Spain

- Hydrochar injection trials



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