Challenges of the integrated steel mill in the upraising H_2-economy

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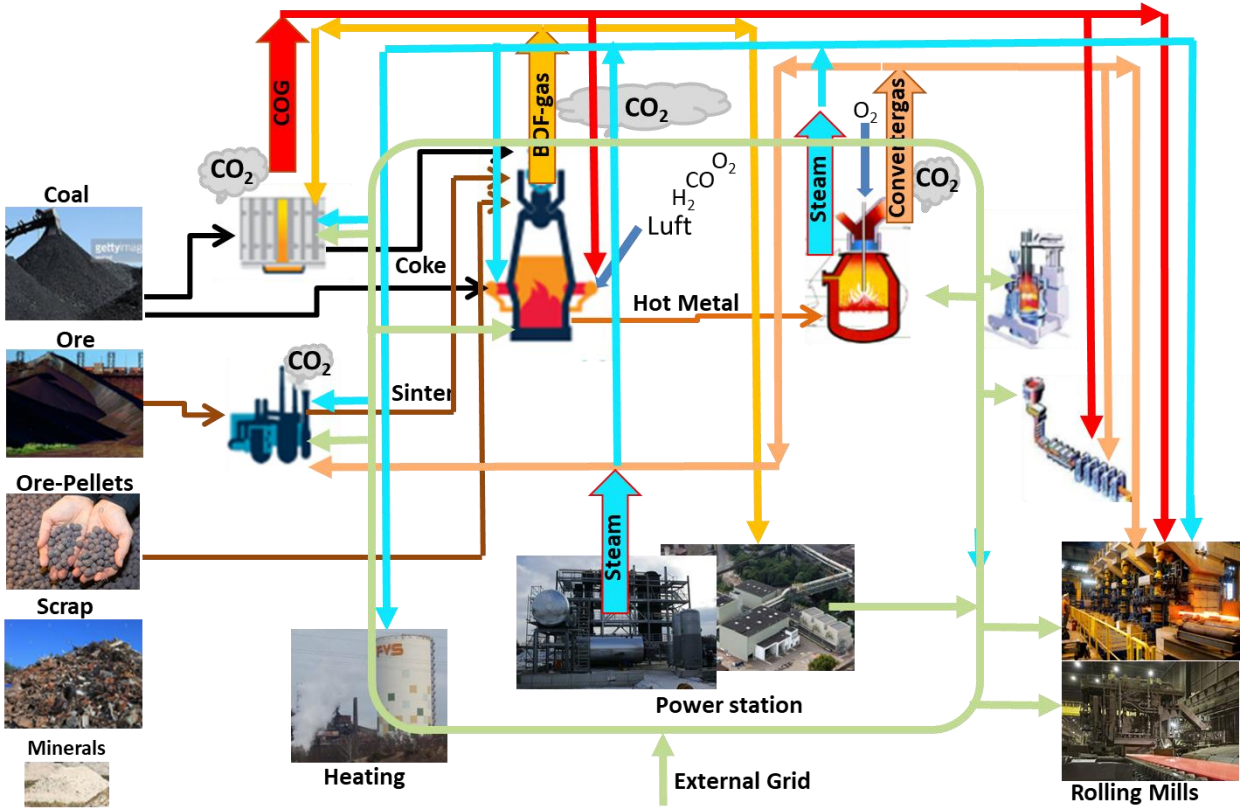
Today
Integrated Steel Plant based on Coal



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Based on Carbon

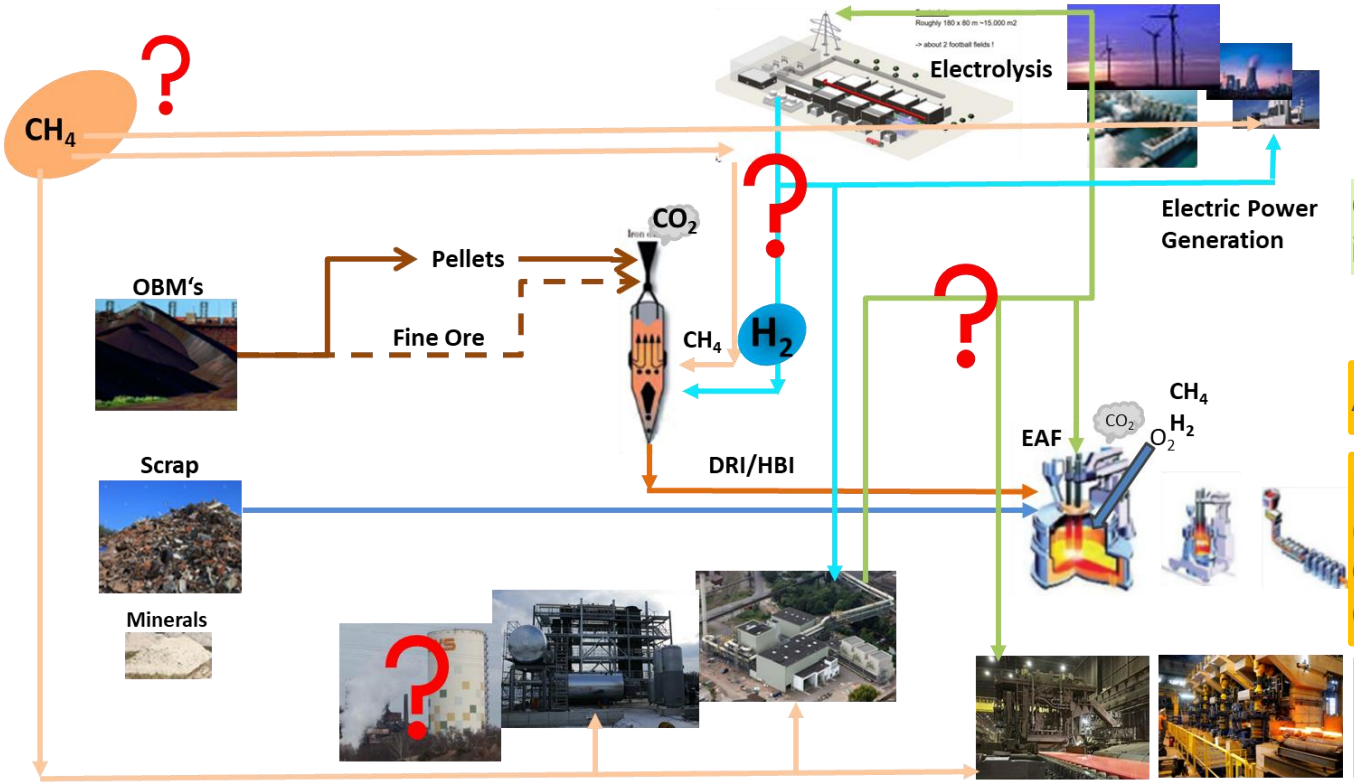
Highly interconnected system

Avoiding waste

Optimized material flow (Gases, Steam, Filterdust, Fines, Slags,….)

Valuable, marketable by-products (e.g. slags)

Future
New integrated steel plant based on H_2



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Based on Hydrogen

Creating of a new interconnected system

Our challenges

Avoiding waste

Flow of materials changes (Massflow, Composition of Gases or Slags, Content of Energy,…)

New by-products (e.g. **Slags**) Valuable?, marketable?

Steel production and slag as a byproduct

Usage of Slags and influence on other sectors

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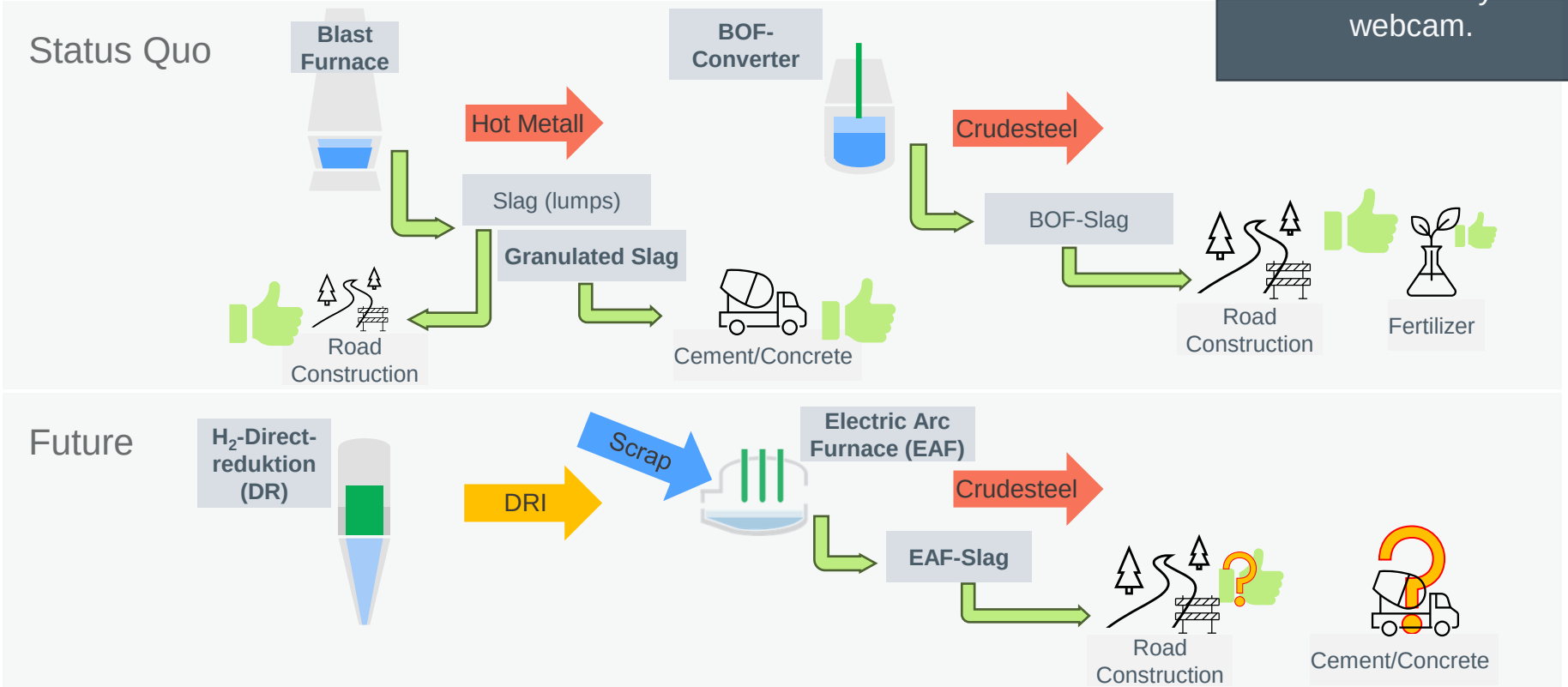

Steel production and slag as a byproduct
Usage of Slags and influence on other sectors

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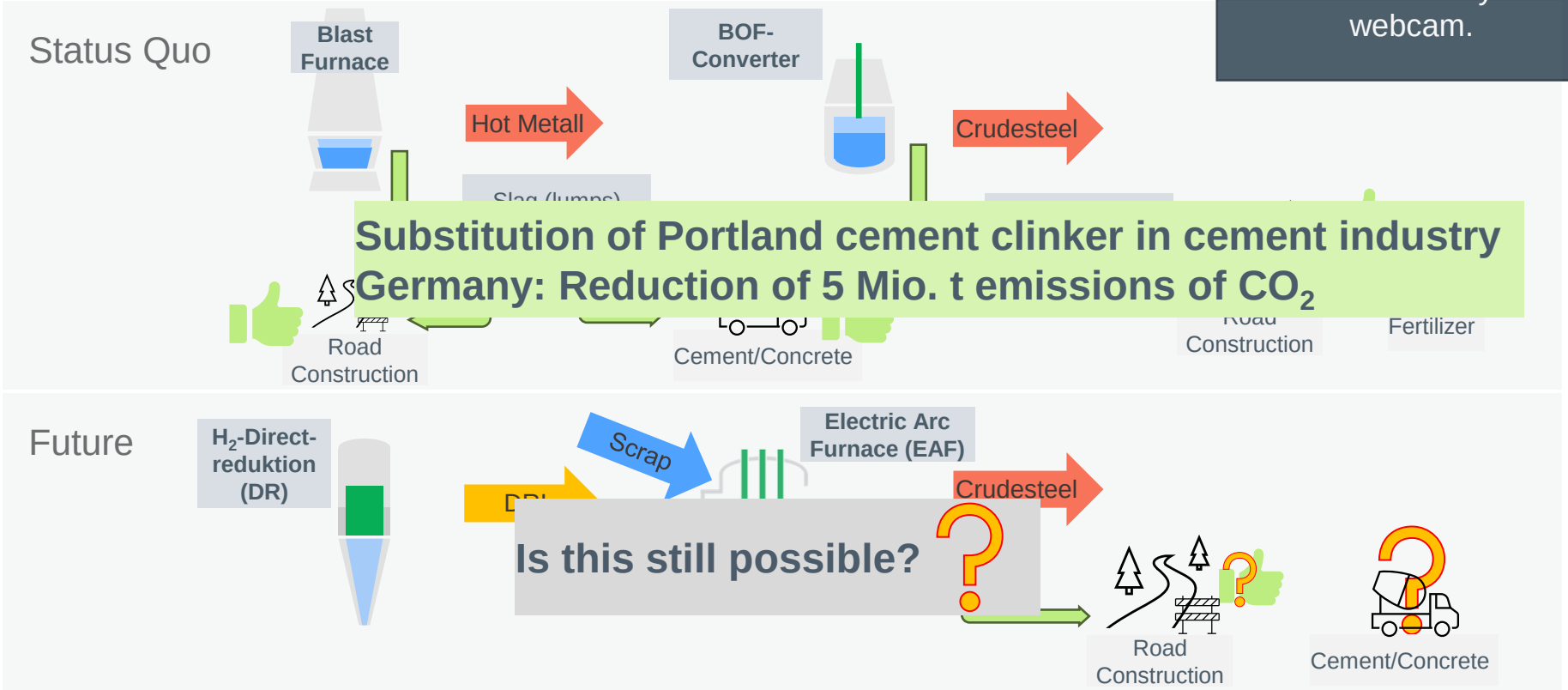

Steel production and slag as a byproduct

Hot Metal vs. HBI/DRI and slag formation

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Images: ROGESA and MIDREX

Steel production and slag as a byproduct
Hot Metal vs. HBI/DRI and slag formation

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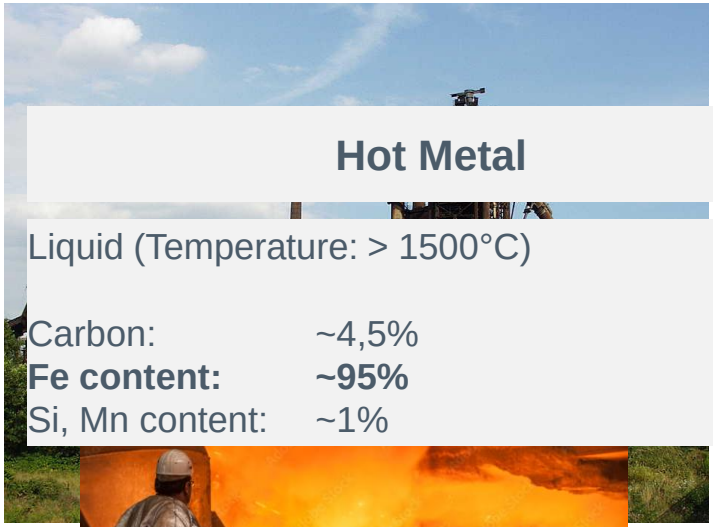


Hot Metal

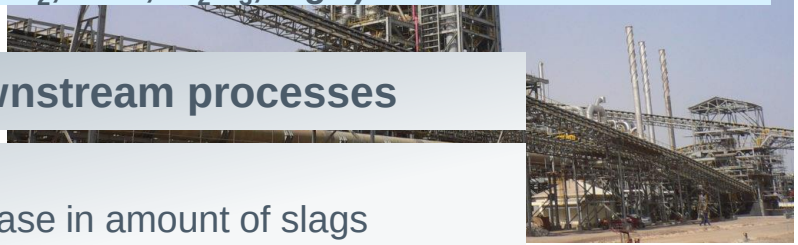
Liquid (Temperature: > 1500°C)

Carbon:	~4,5%
Fe content:	**~95%**
Si, Mn content:	~1%

DRI/HBI

Solid (Temperature: 20°C – 600°C)

Carbon:	0 – 4%
Fe metallic content:	**~85%**
FeO:	**4 – 9%**
Gangue (SiO_2, CaO, Al_2O_3, MgO):	**5 – 10%**



OGESA and MIDREX

Consequences for downstream processes

- Lower Fe-Yield
- In EAF-process significant increase in amount of slags
- Chemistry of slags is completely different

Steel production and slag as a byproduct
HBI/DRI and slag formation

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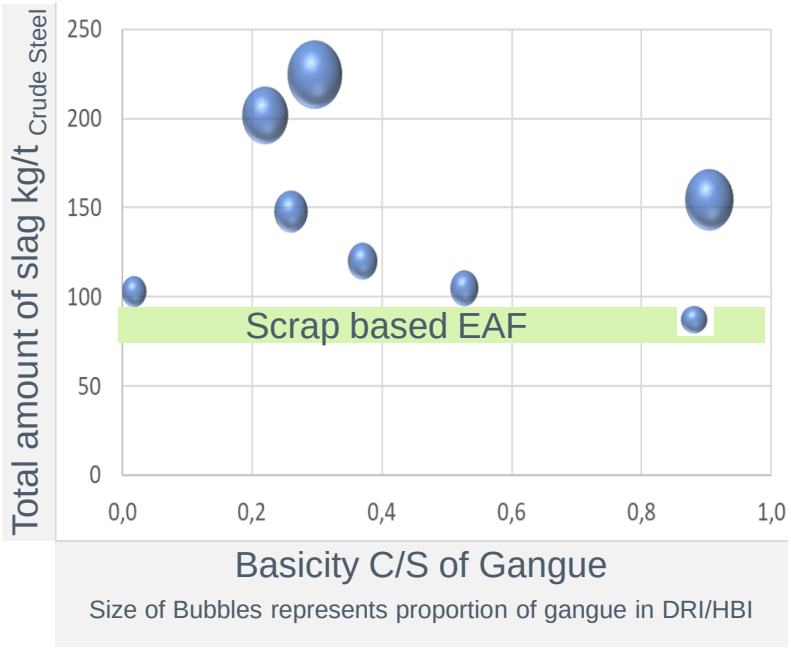
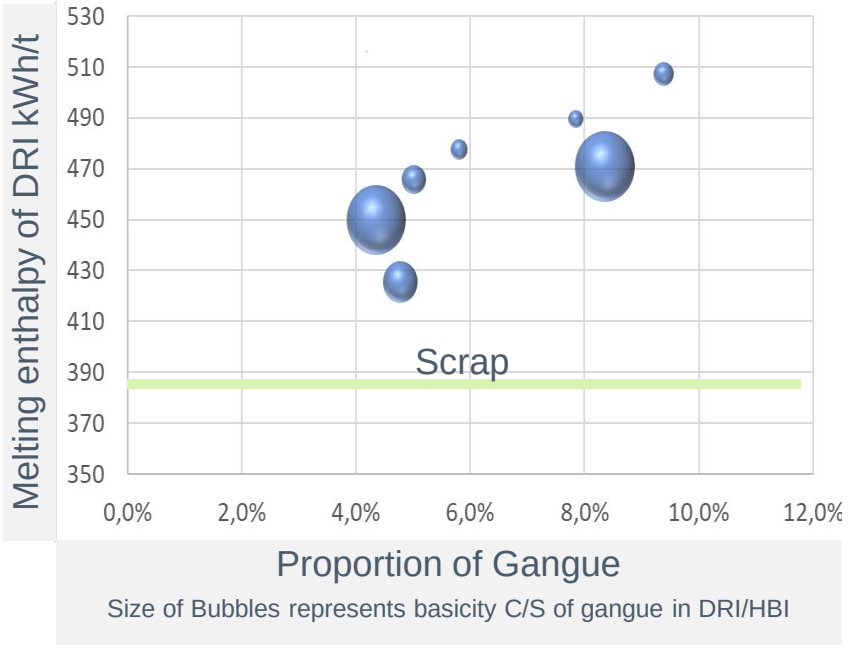
Model-based Calculations





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Steel production and slag as a byproduct

Composition of slags

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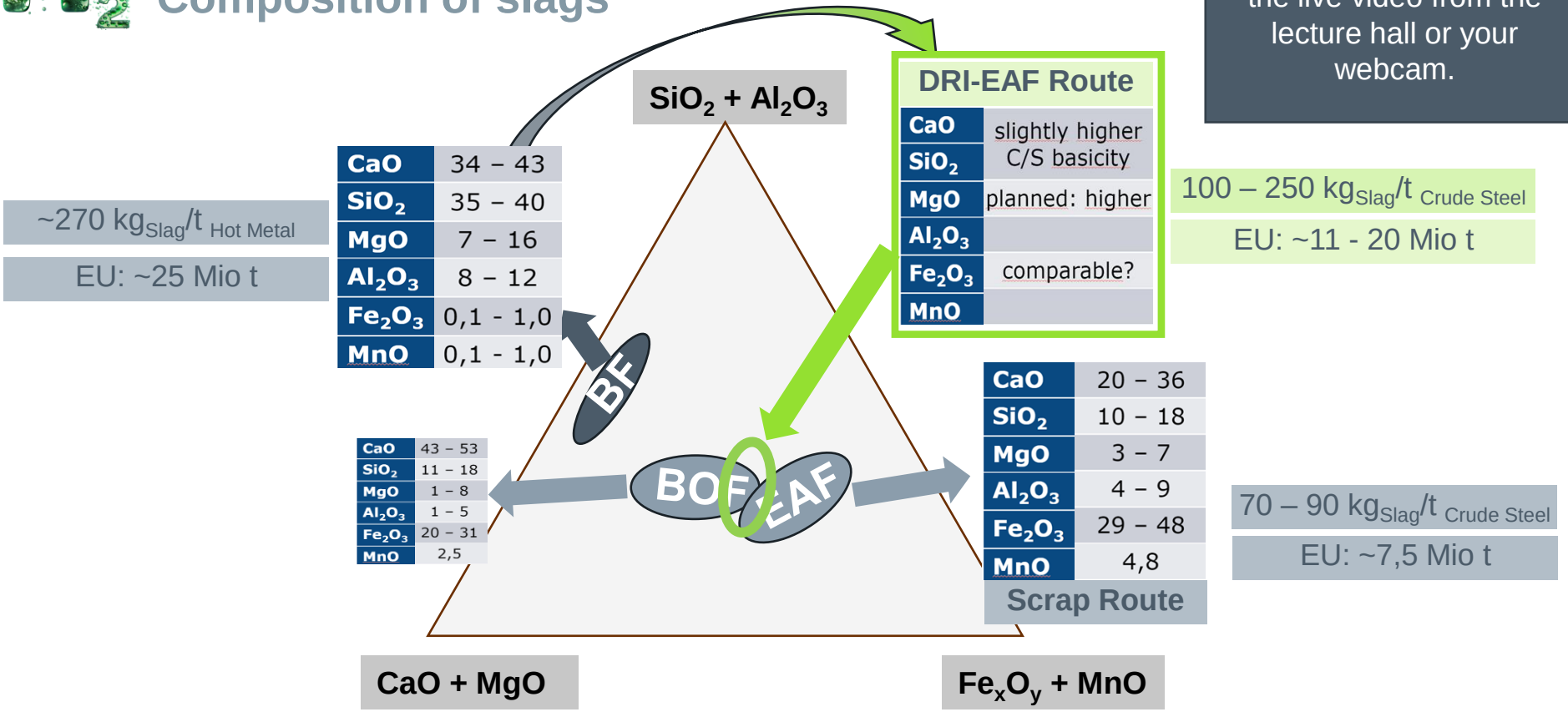

Slag as a by product
EU funded project - Objectives

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DRI-EAF Route

DRI brings considerable amounts of additional mineral components (gangue)
- ⇨ Chemical composition changes
- ⇨ Mineral composition changes

New methods of follow-up treatment
- ⇨ Conditioning
- ⇨ New cooling processes

Slags with “new” properties
- ⇨ Proof of performance properties
- ⇨ Amendment of existing regulations
- ⇨ Extension of REACH and registration

⇨ **Considerable R+D effort necessary** ⇨ InSGeP

Slag as a by product
EU funded project - Targets

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- Investigation of the direct reduction of different ore-based feedstocks with increasing proportion of hydrogen in the process gas
- Investigation of the melting behavior of DRI/HBI in the EAF
- Data collection and modelling of the "new" hydrogen-based process routes

- Investigation and characterization of the resulting slags from the "new" hydrogen-based process routes
- Production of slag in laboratory tests, pilot plants and in EAF (using significant proportions of DRI/HBI)
- Experiments on the modification/conditioning of the slags (addition of additives in different process steps)
- Trials for cooling/granulation of slags

- Investigations of the “new” slags as a marketable by-product
- Evaluation of existing regulations for by-products
- Recommendations for adapting of the regulations

Acknowledgements

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Thank you for your attention!

Any Questions?

Investigations of Slags from Next Generation Steel Making Processes

1st July 2023 to 30th May 2027 (48 months)

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