

Swerea MEFOS

The low CO₂ R&D infrastructure at Swerea MEFOS

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swerea|MEFOS

swerea
swedish research

Short facts

- Independent metallurgical research institute
- Founded in 1963
- Situated in Luleå
- 85 employees
- Turnover SEK 130 millions/year
- 35 member companies
- Clients all over the world



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Leading expertise

Iron and steelmaking, ferro alloys and base metals

- All processes for manufacturing and metalworking
- Reduction, melting, refining, casting

Residues

- Recycling of metals, incineration, gasification

Process analysis, measuring technique, flue-gas cleaning

Excellence

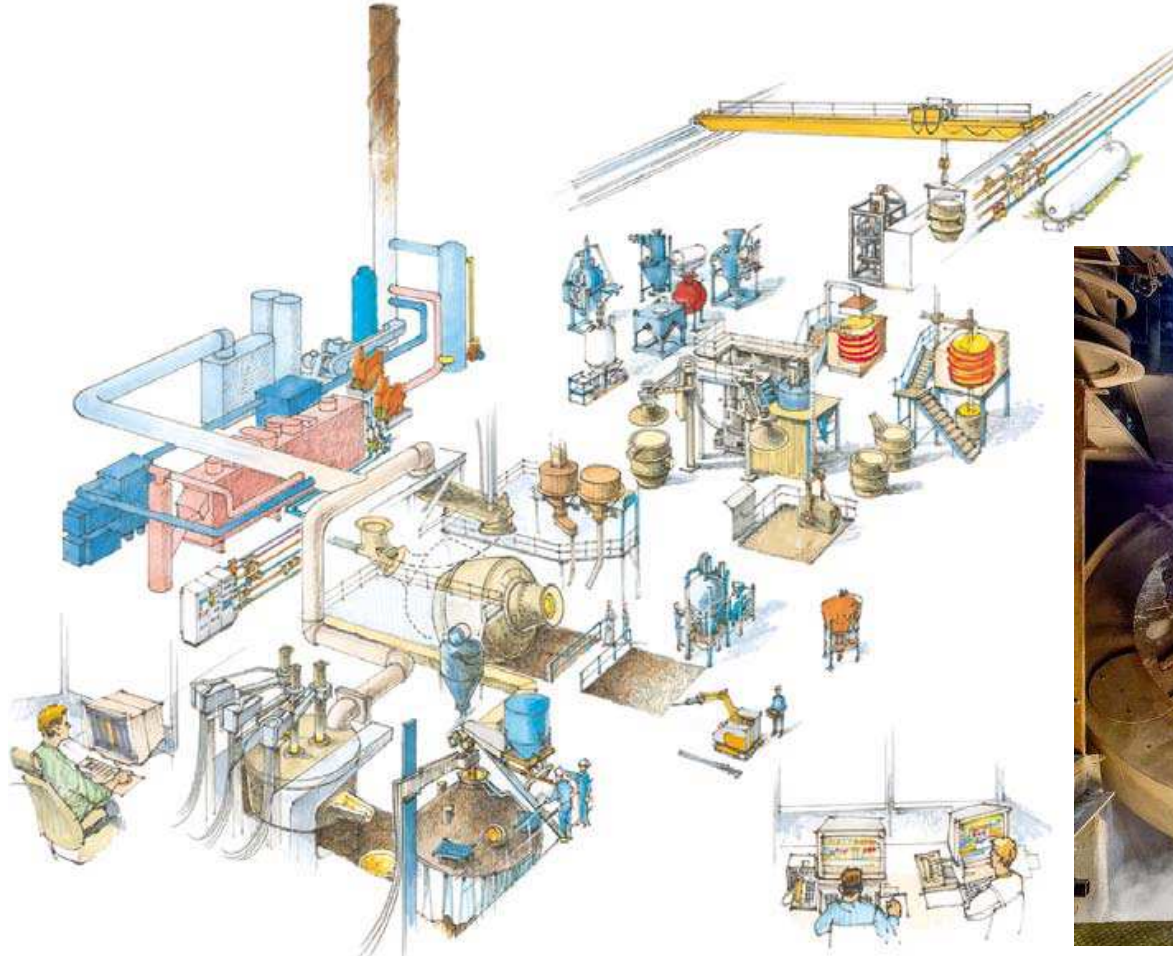
- Design, management and operation of large pilot and demonstration installations
- Reduction metallurgy
- Process integration
- CFD and FE modelling with advanced process knowledge
- Ferrous alloys
- Fluid bed processes

Metallurgical research – building infrastructure

- Demonstration halls 1 & 2
- Furnace hall – Fixed equipment
- Office building
- 3 ATEX compliant buildings available (70-320 m²)
- Storage/Material handling



Furnace hall – A pilot steel plant at a 5-10 ton scale



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Furnace hall – A pilot steel plant at a 5-10 ton scale

Technical data

Heat size	10 t
Transformer	4.9 MVA
Furnace shell diameter	2.8 m
Furnace diameter, lined	2.1 m
Electrode diameter	250 mm
Oxy-fuel burners	



AC furnace

Technical data

Heat size	5 t
Transformer	4.9 MVA
Rectifier	≤ 400 V or ≤ 37.5 kA
Furnace shell diameter	2.6 m
Furnace inner diameter, lined	1.8 m
Electrode diameter	250 mm
Inner hole diameter	70 mm



DC furnace

Demonstration hall 1

Fluidized bed pilot plant



- Calcination
- Drying
- Reduction
- Roasting
- Gasification
- Catalytic
- Combustion

Demonstration hall 1

Stepwise pilot plant

BFG compression unit



Demonstration hall 2

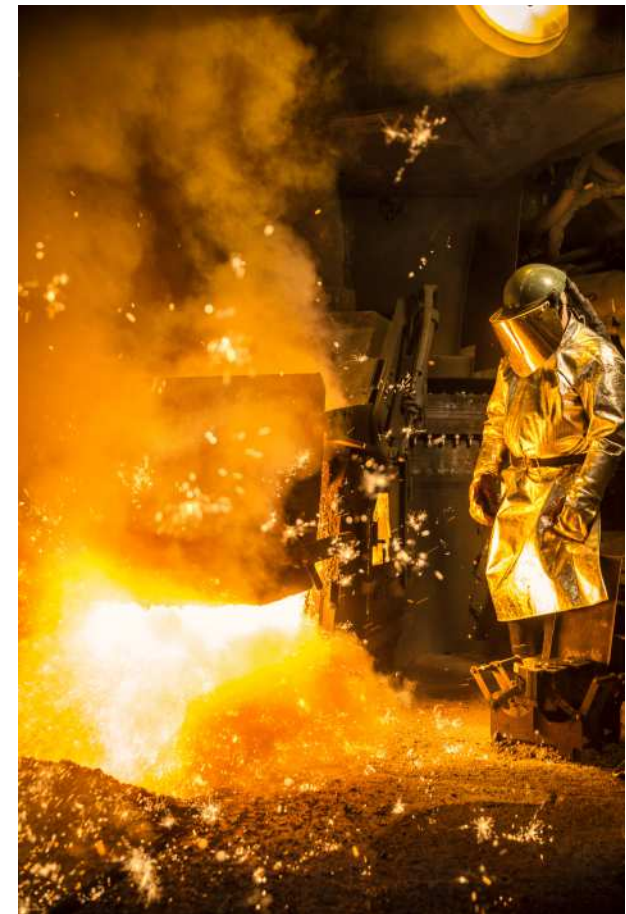


Customer owned: LKAB
Experimental Blast
Furnace in operation since
1997

33 campaigns conducted,
typically 6-8 weeks each

Two well known projects
are ULCOS TGRBF and
COURSE50

Photo: Fredric Alm/LKAB



Demonstration hall 2

ULCOS TGRBF Concept

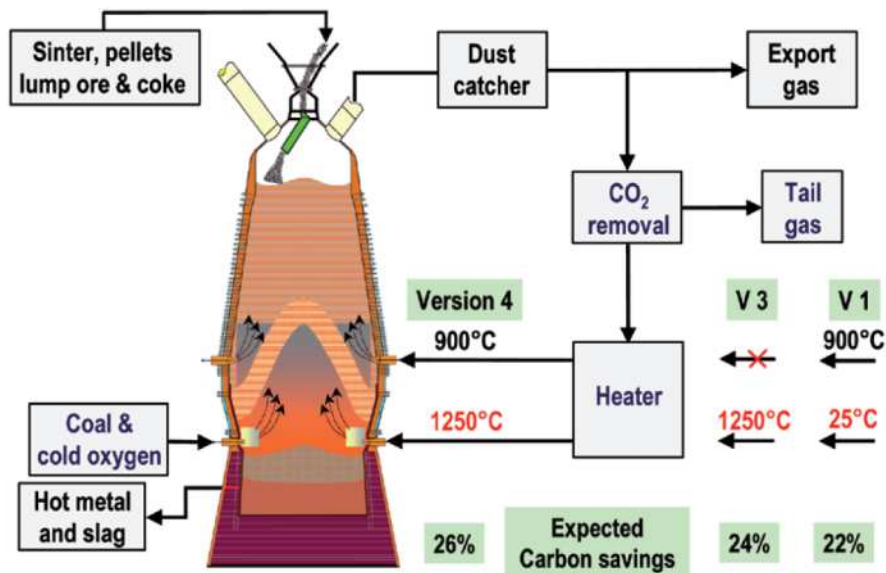
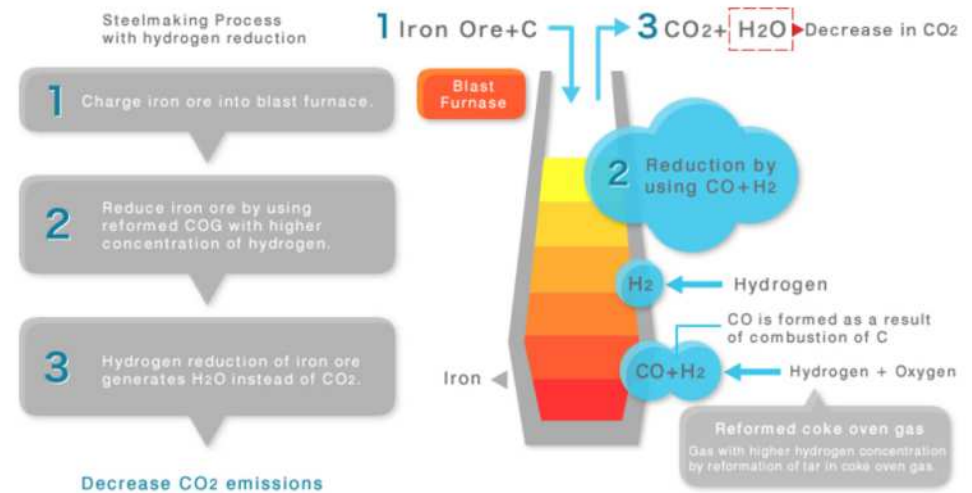


Figure from, *Revue de Metallurgie* Jan 2009



COURSE 50 Concept



http://www.jisf.or.jp/course50/tecnology01/index_en.html

Publication; Watakabe et al. *ISIJ International*, Vol. 53 (2013), No. 12, pp. 2065–2071

Gas infrastructure



Swerea MEFOS is connected to the gas infrastructure of the neighbor SSAB steel plant

- Nitrogen, 17 bar, 2000 nm³/h
- Oxygen, 17 bar, 3000 nm³/h
- Compressed Air, 8 bar, 600 nm³/h
- Blast Furnace Gas, 1.1 bar, 2500 nm³/h

Tie-ins and pipe support for Basic Oxygen Furnace Gas and Coke Oven Gas between SSAB and Swerea MEFOS are in place but pipe-lines not completed.

Internal infrastructure

- Propane, 13 bar, 400 kg/h
- Cooling water, 7 bar, 500 m³/h

Some examples of ongoing R&D for CO₂-reduction at Swerea MEFOS

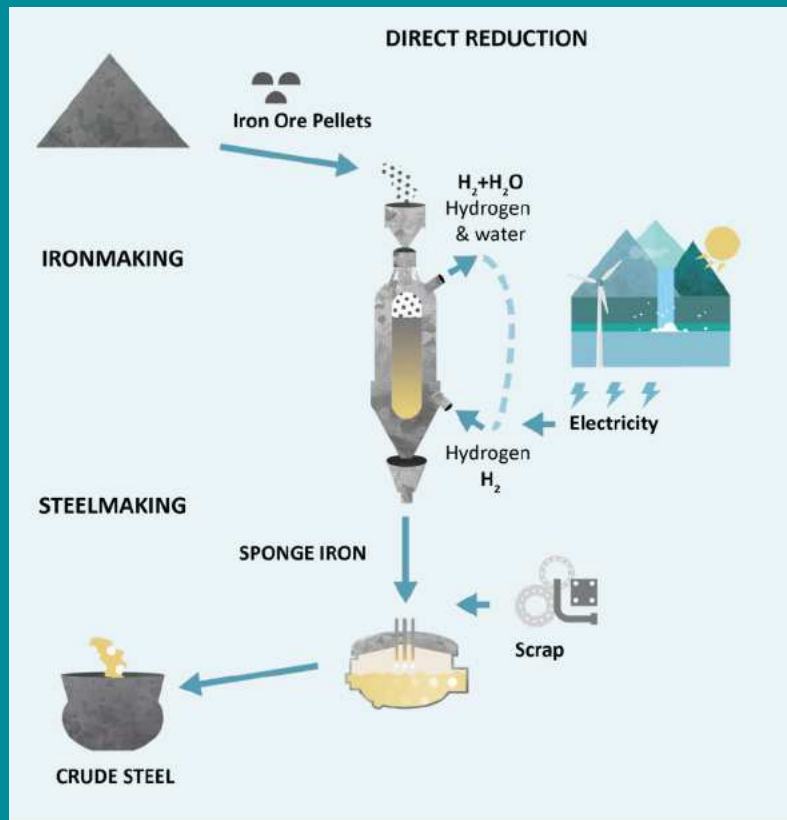
Two ways forward to significantly reduce CO₂ emissions in ironmaking

- Replace fossil fuel: Fuel switching and new processes. Biomass and electrification (hydrogen society) are two of the options
- CCUS

The techniques can be combined and the solution will most likely be unique to each site depending on the site specific conditions

Hybrit

Hydrogen Breakthrough Ironmaking Technology



Initiated by SSAB, LKAB and Vattenfall

The aim is to reduce carbon dioxide emissions from ironmaking to zero by eliminating the need to use fossil fuel for iron ore reduction. The idea is to replace the blast furnaces with an alternative process, using hydrogen produced from "clean" electricity

Pre-feasibility study

2016-2017

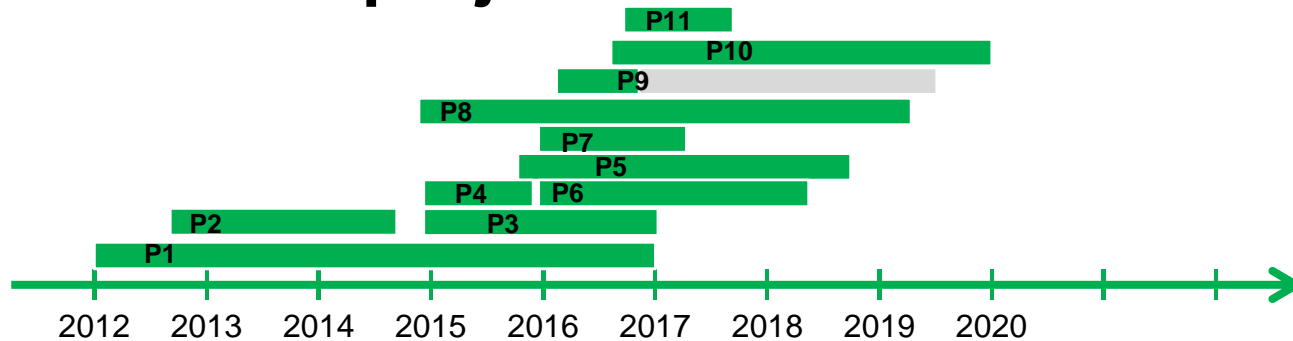
Feasibility study – pilot trials

2018-2022

Demonstration plant trials

2025-2035

Biomass project activities at Sweres MEFOS

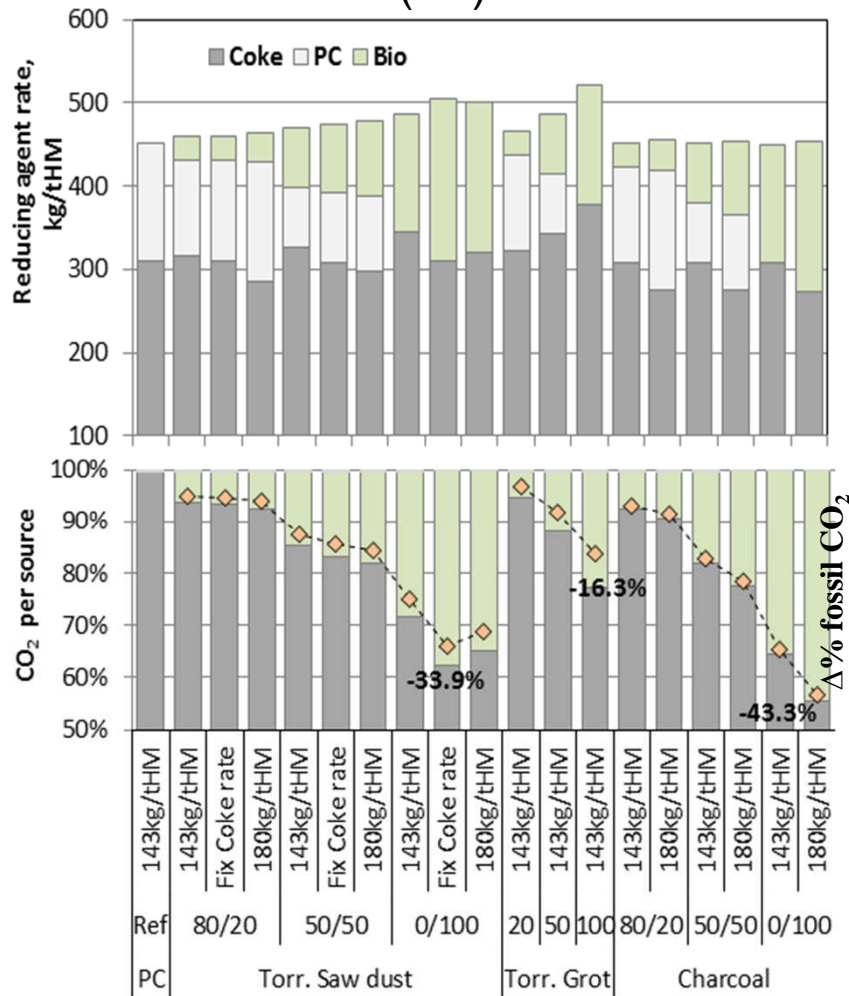


Fundamental research and collaboration regarding P1, P3, P6, P7, P8, P11 within



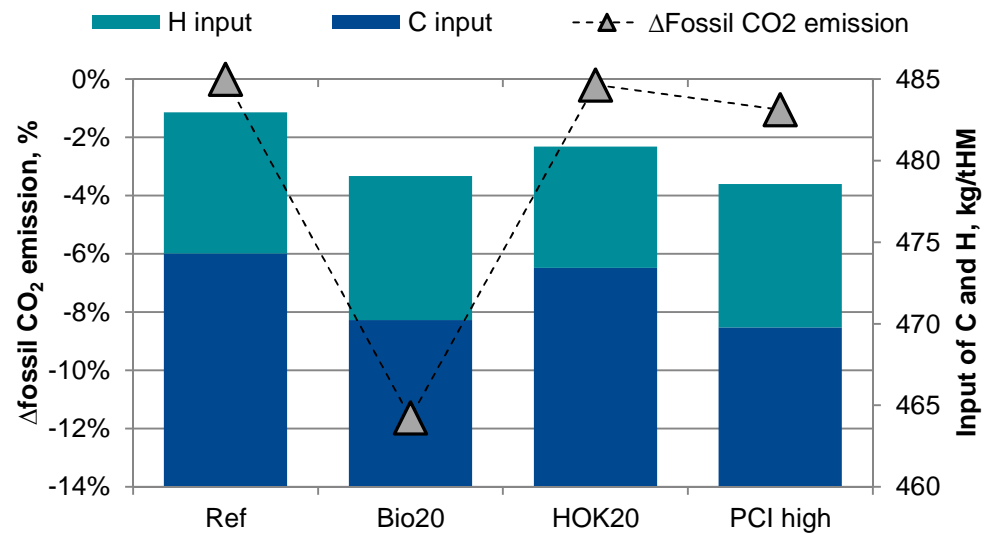
	Title	Start date	End date
P1	IMPCO Improved coal combustion under variable BF conditions – RFCS project	2012-07-01	2016-12-31
P2	Preliminary investigation and evaluation of biomass utilization in the blast furnace	2012-10-01	2014-09-30
P3	Bio-agglomerate	2015-01-01	2017-12-15
P4	Utilization of biomass lignin in the integrated steel plant briquettes	2015-02-01	2016-01-31
P5	Renewable Energy Sources in Steel Plant Processes: Biomass-based Reductants, Fuels and Chemicals	2015-10-01	2018-09-30
P6	Injection of renewable and hydrogen rich reducing agents	2015-11-10	2018-01-10
P7	Green BF (Grön Masugn)	2015-12-09	2017-02-28
P8	Bio4Metal	2016-01-01	2019-04-30
P9	Utilization of organic sludge in metal industry (OSMet S1)	2016-04-18	2017-01-19
P10	Forest biomass in metal industry – future possibilities and consequences	2016-09-01	2019-12-31
P11	Green BF- Focus Bio Mass (Grön Masugn-Fokus biomassa)	2016-12-01	2017-10-30

Potential to reduce CO₂ emission by injection of bio-coal (P7)



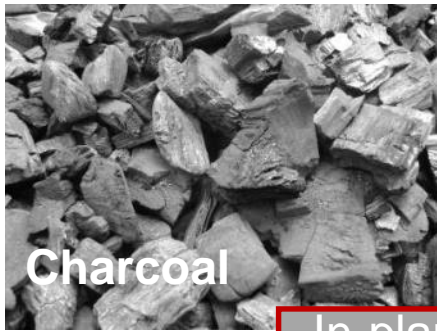
		Ref	Bio-coal cases		
Bio/PC	wt./wt.%	0/100	20/80	50/50	100/0
Inj. Rate	kg/tHM	143	as ref./calc./180		
Coke rate	kg/tHM	309	As calc./ as ref/as calc.		

IMPCO-trials at the LKAB EBF with 21% torrefied biomass mixed with MV PC resulted in more than 10% lowering of fossil CO₂ emission



(P1)

Bio-agglomerate (P3)



Charcoal



Production in existing briquette plant



Torrified wood

Top charging in ferrous layers



Funded by the Swedish Energy Agency and the industry

Partners: MEFOS (Coordinator), SSAB, SSAB Merox, LKAB, LTU, SveaSkog, BioEndev

Metnet, your pilot partner

Nobody has all the answers. That is why we believe that the best way to create innovative solutions for the industry is to work together. The strength lies in cooperation!

Metnet is a network of research institutes located Europe-wide that design, construct and operate large pilot-scale equipment for mineral and metallurgical processes.

www.metnet.eu

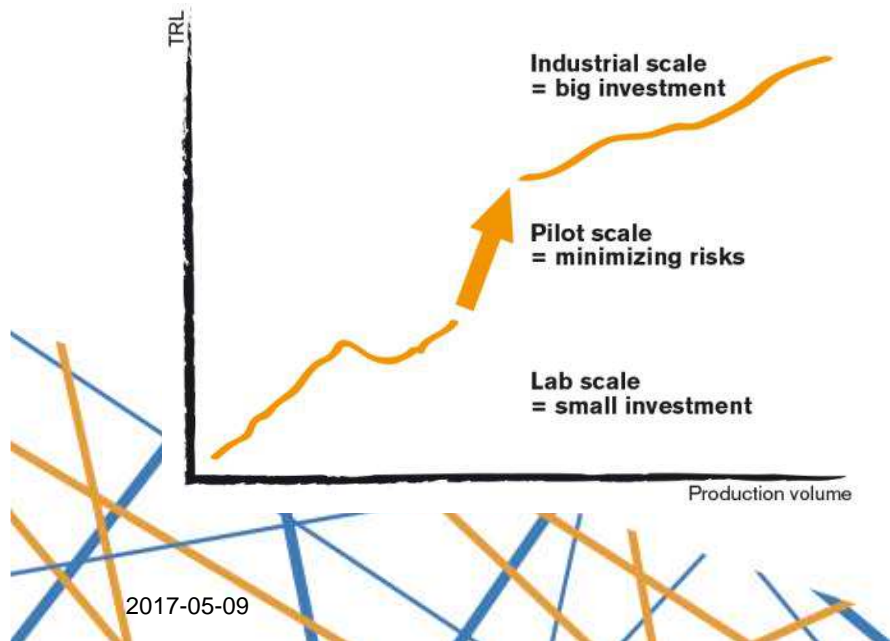
- | | |
|-----------------|---|
| 1 BRGM | 6 Extractive |
| 2 CEA | 7 GTK |
| 3 CRM | 8 IMN |
| 4 Elkem | 9 Materials Processing Institute |
| 5 ERAMET | 10 Swerea MEFOS |



The strength lies in cooperation

Metnet is the bridge between lab scale and industrial scale, and will minimize the technical and financial risk for up-scaling and help speed-up the process of getting ideas and research into industrial use.

- By combining competence and equipment of pilot plants in Europe the stakeholder is provided an overall solution for development, validation and up-scaling of new processes and technologies.
- The Metnet platform offers mineral and metallurgical upscaling infrastructure capability from raw materials to metals.
- The capability of process integration by combining equipment from different sites offers a unique testing environment for the stakeholder.



BENEFITS

- Easy access by single point contact
- Cluster of expertise
- Cross-sectorial competence and equipment
- Wide scope and flexibility
- Technical guidance
- High confidentiality
- Financial guidance for funding opportunities
- Good track record up to highest TRL (valley of death)