SALCOS
Steelmaking. Reinvented.

GrInHy2.0

Green Industrial Hydrogen

Energy-efficient hydrogen production for today's and future steelmaking

Best Practice Steel Industry

Hydrogen @ Mining: Best Practice Examples of Hydrogen Applications in Germany

Simon Kroop, Salzgitter Mannesmann Forschung GmbH

This project has received funding
under grant agreement No 826350.

Salzgitter Flachstahl GmbH – Integrated Steel Production Amidst the EU

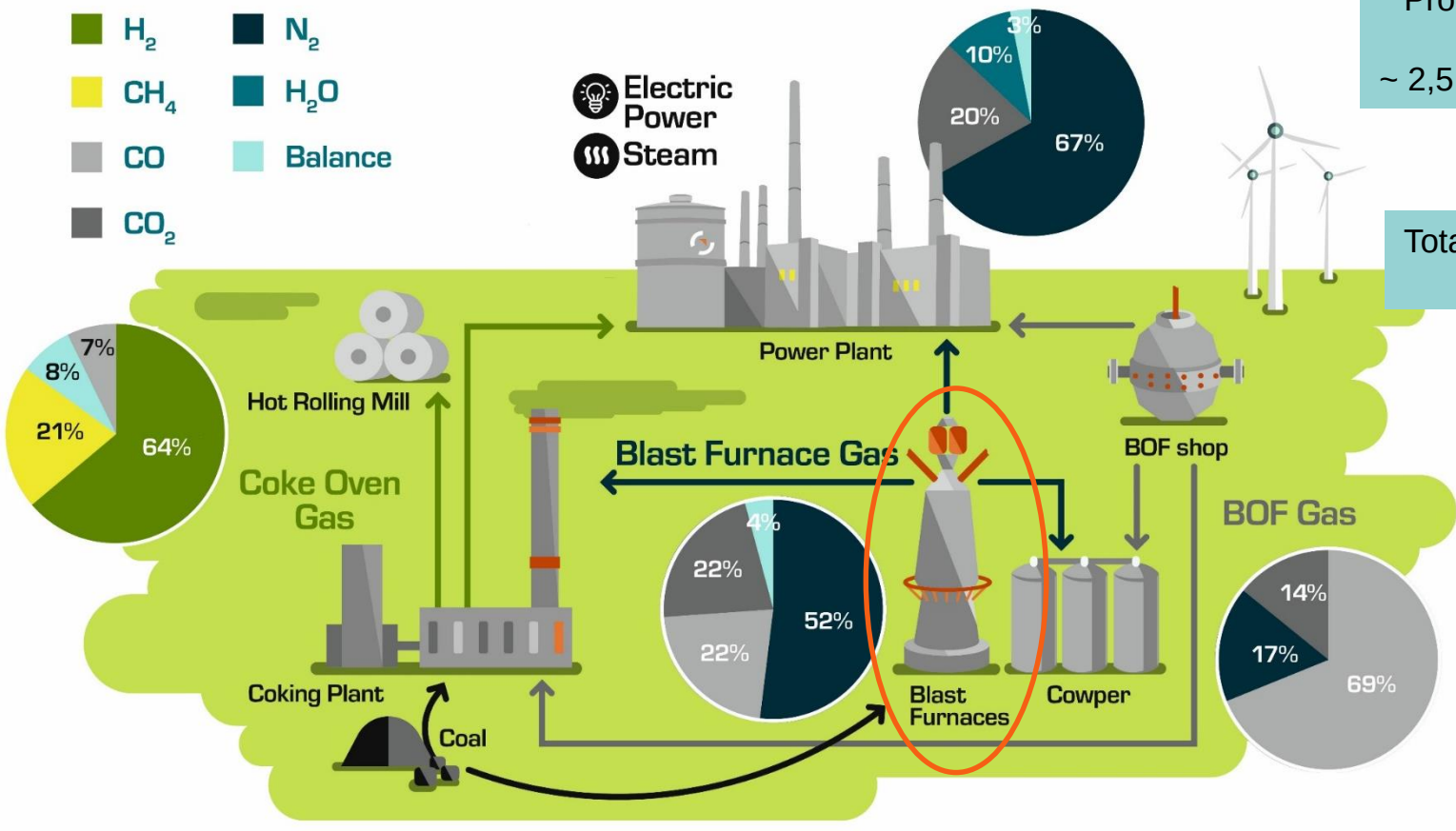
Salzgitter Flachstahl GmbH … *„Heart of the Salzgitter AG group“*

- **Integrated steel works operating 3 blast furnaces**
  - Concentrated at one location in Salzgitter/ Lower Saxony on an area of 7 square kilometers (~980 soccer fields)
  - ~5 mt yearly crude steel capacity
- **Top modern production plants**
  - High-tech downstream facilities
  - Very energy-efficient processes
  - Compliant with all EU ecological standards
- **High-quality steel grades for sophisticated applications**
  - Hot-rolled and cold-rolled coil
  - Electrogalvanized, hot dip galvanized and organic coated sheet
  - Fabricated products for automobile and construction industry

Winner „Energy Efficiency Award 2013“ dena Deutsche Energie-Agentur

		2017	2018
Crude steel production	kt	4,492	4,645
Sales	€m	2,652	2,887
Total workforce	31/12/	5,761	5,778

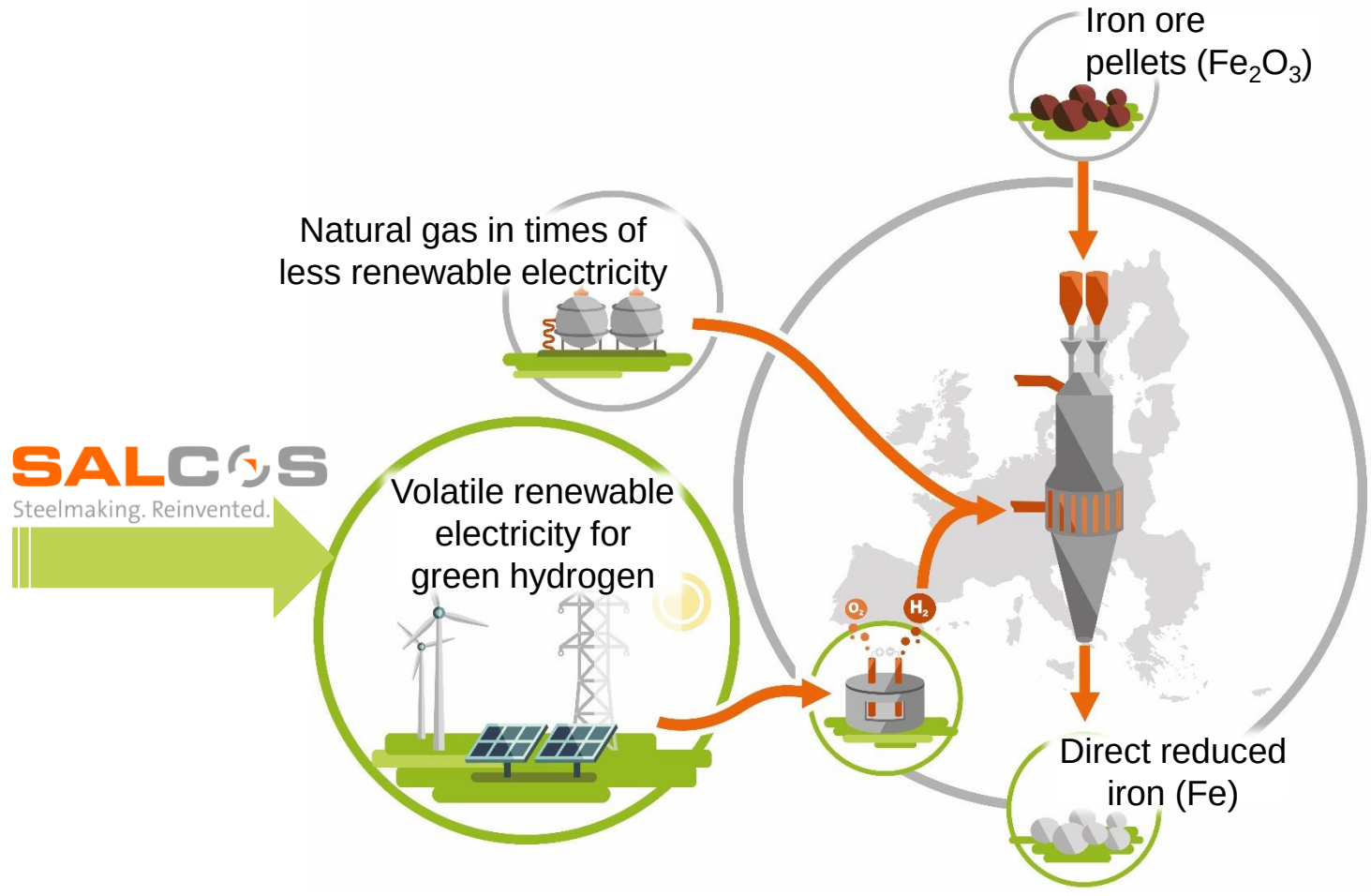
Status quo – Energy flows of carbon-based integrated steelmaking



Process energy is supplied via solid carbon:
~ 2,5 Mio. tons/a of coal and coke

Total CO_2 emissions by SZFG:
~ 8 million t CO_2/a

Direct Reduction Process – Central Element of SALCOS



SALCOS is…

- pairing already established technologies with hydrogen technologies and an innovative operational concept
- a step-wise transformation of the integrated steelmaking route supporting the transition of the energy system
- reducing today's CO_2 emissions by more than 95%
- a sustainable "Carbon Direct Avoidance" approach: Reducing instead of recycling!

First GrInHy Project – Proof of energy-efficient hydrogen production

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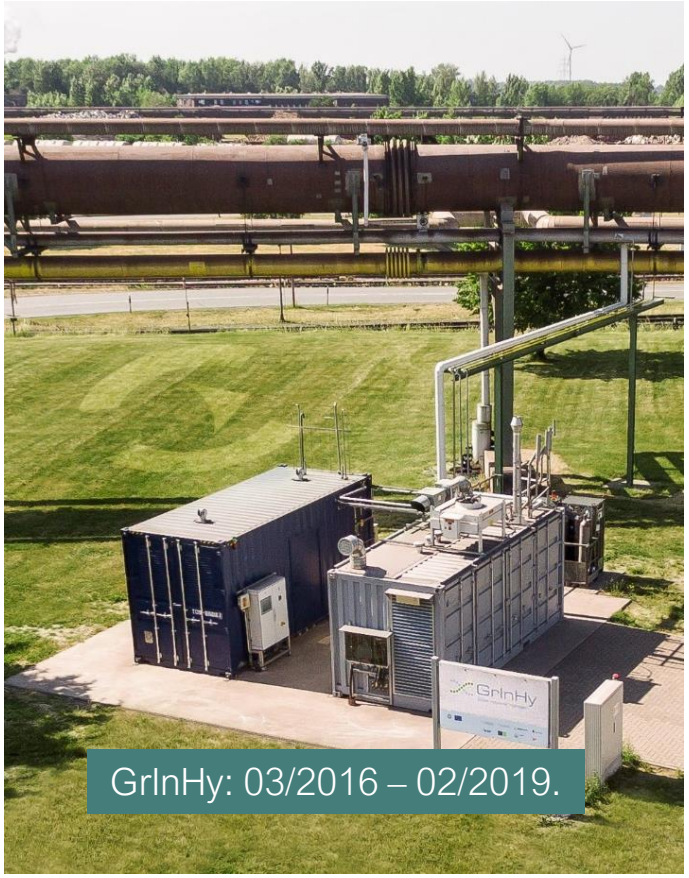
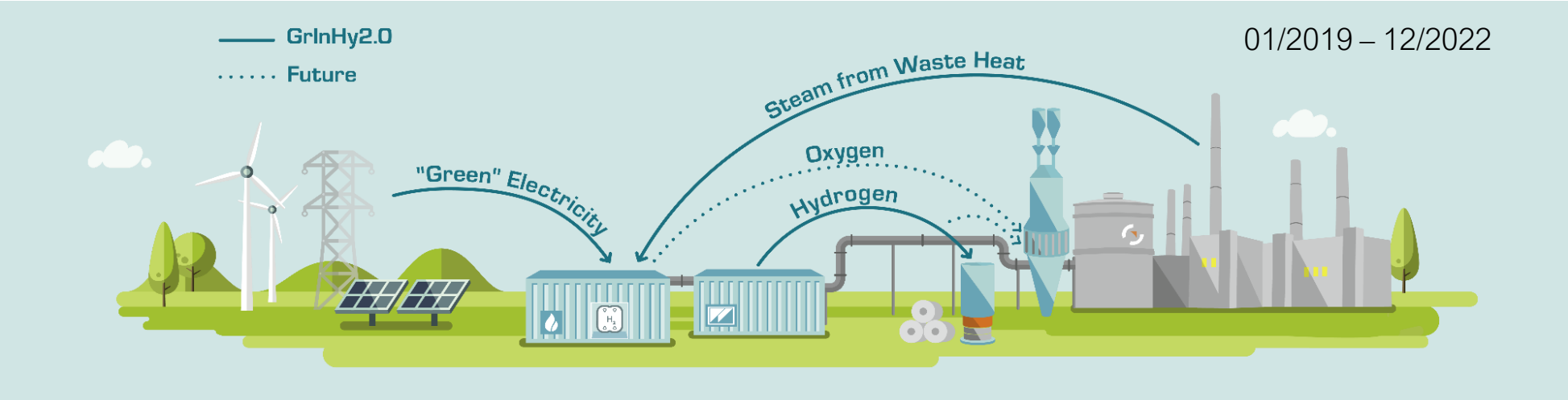


GrInHy: 03/2016 – 02/2019.

- World's biggest steam electrolyser producing 40 Nm^3_{H2}/h (150 kW_{AC})
- Integration into infrastructure of Salzgitter's iron-and-steel works
- Hydrogen production with steam from waste heat and electricity
- Electrolyser electrical efficiency of 78 $\%_{LHV}$ sets new standards
- Operational experience from 12/2017 – 08/2019
- Meeting hydrogen quality for today's steel annealing processes
- In total, the system was operated for approx. 10,000 hours during project duration

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 700300. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Hydrogen Europe and N.ERGHY.

GrInHy2.0 – Next milestone towards green steel



- First Steam Electrolyser (StE) demonstration in megawatt class in an industrial environment
- Green hydrogen production using green electricity and industrial steam from waste heat
- Optimal control & integration into existing infrastructure and energy management system
- Investigation of regulatory frameworks for Green Hydrogen
- Assessment of CO_2 avoidance potential of a European hydrogen-based steel industry
- Validation of stack technology

Role of Partners

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SALZGITTER MANNESMANN FORSCHUNG
A Member of the Salzgitter Group

Overall project coordination and environmental studies

SALZGITTER FLACHSTAHL
A Member of the Salzgitter Group

Integration of electrolyser system and operation with steam from waste heat

sunfire®

Technical coordinator and manufacturering of steam electrolyser

PAUL WURTH
SMS group

Engineering and assembling of hydrogen processing unit for compression and drying

tenova

Implemention study of a hydrogen-based, low CO_2 steelmaking route in Europe

FROM RESEARCH TO INDUSTRY
cea

Intensive long-term stack testing of steam electrolyser cells

Set-up of the 720 kWel steam electrolyser

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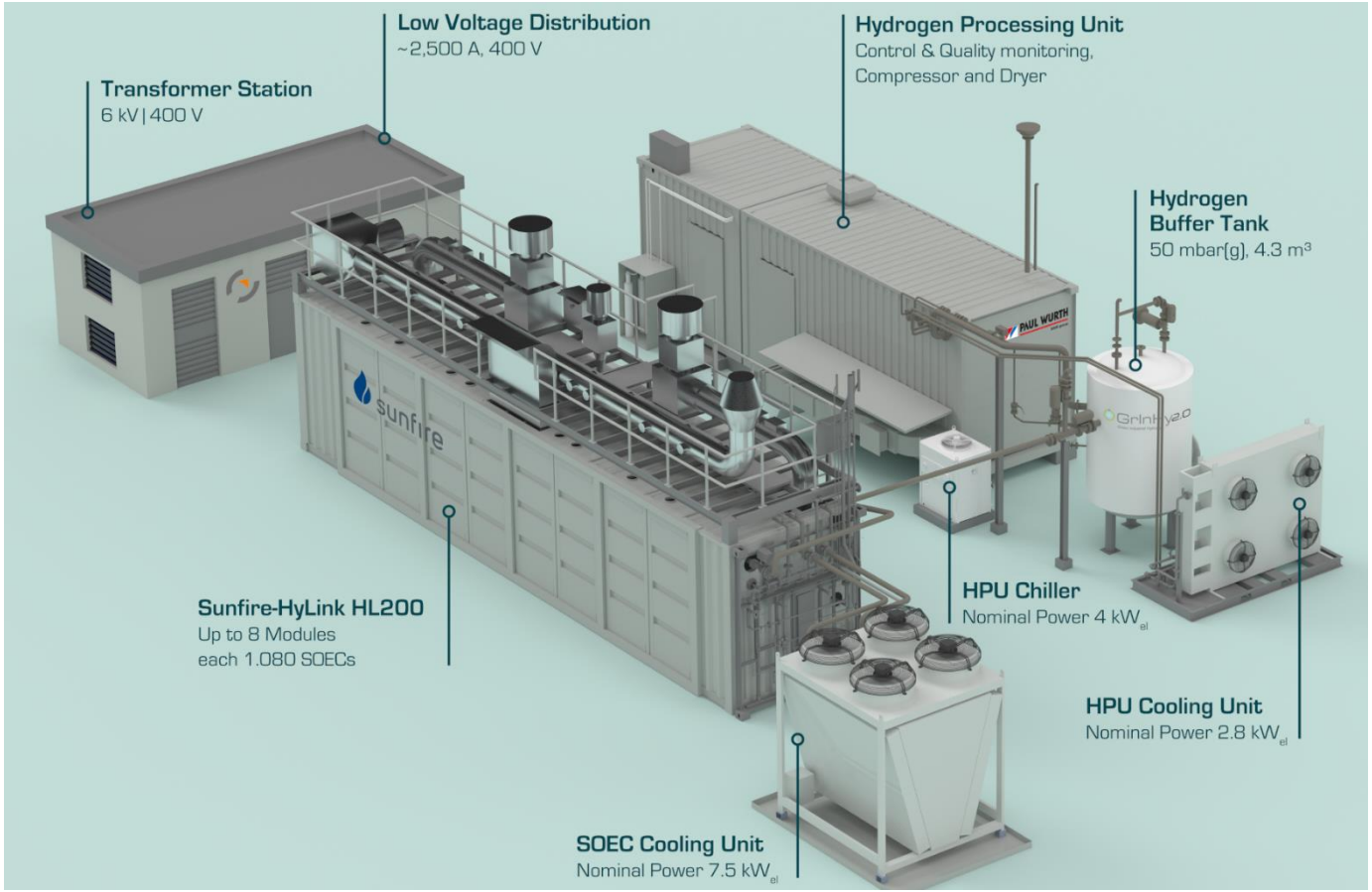

How does it look like today?

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Simon Kroop
Project Coordinator

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