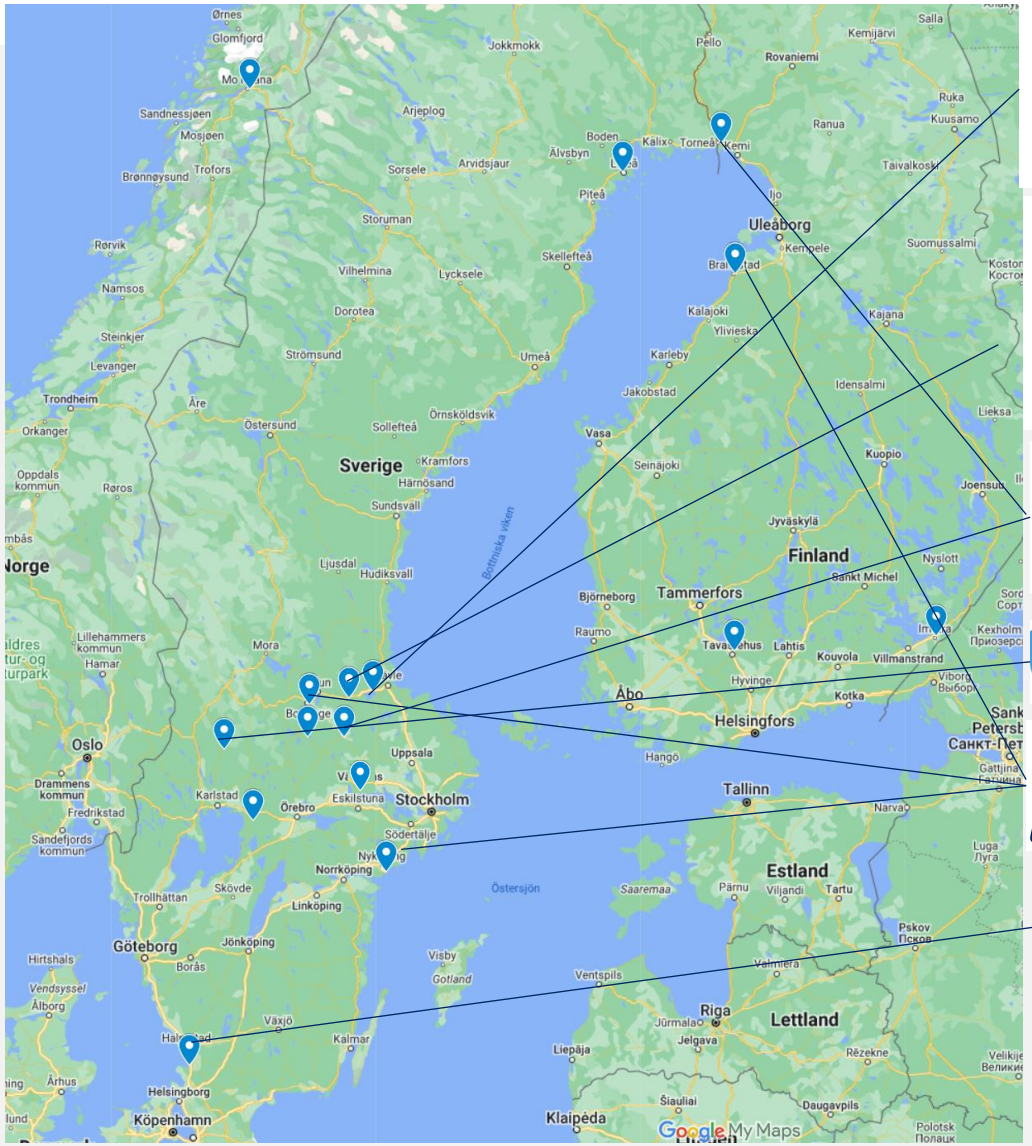
Upcoming requirements and needs for heating from a Nordic perspective

2023-03-15

Nordic Steel Industry

- Many steel mills in category special steel
- Relatively small production units
- Large variety of products

- Process development essential



Alleima

OVAKO

outokumpu

UDDEHOLM

SSAB

Höganäs

SSAB

Nordic situation

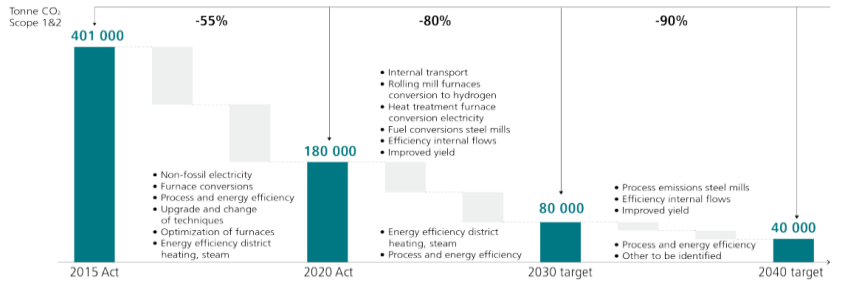
- No major NG pipeline
- Electricity price comparable low and fortunately high degree fossil free.
- Large forest industry
- Cold weather
- Environmental legislations demands (NOx, CO2)

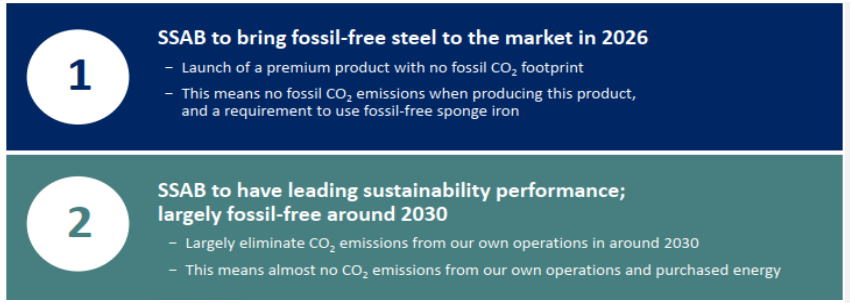
  - Historically a lot of different fuel has been used.
  - High degree of downstream electrification.
  - Oxygen combustion since 1991 and widespread.
  - Potential for gasification of residuals from forest, sawmill and agriculture, Methanol, DME, Syngas…
  - District heating profitable

Major steps in present and upcoming time

- Höganäs: Bio-gasification plant for energy gas and bio-coke, inaugurated 2019.
- Ovako: investment in Hydrogen for reheating, commissioning 2023 (20MW Hofors). Continues with oxyfuel conversion on large scale.
- Bio-DMI tested in industrial scale at Björneborg steel mill 2022.
- SSAB: Planning for CSP in conjunction to new steel mills.
- Alleima: Hydrogen combustion trials in production furnaces. (2022)
- Outokumpu Avesta: Oxygen in slab reheating 2023.
- Several trials and ordinary operation with the mixing of biomethane
- Joint research: plasma burner, H2 tests, electrical heating methods, measuring techniques.

Ovako Roadmap: CO2e emissions, scope 1&2 only
– Tonnes CO2e, all production, fixed volume (2020)





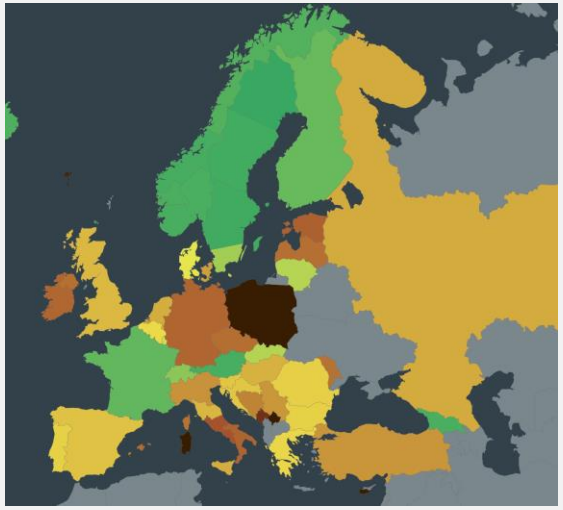
SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Summary of Nordic conditions and premises for CO2-free heating

- The market is the driving force
- Small production units
- Electrification (in any form) an attractive alternative
  - Experience of electrification
  - O2 combustion already in place at many places
  - H2 via electrolyze a tangible alternative
- Bio based fuel (e-fuels) a complementary strategy

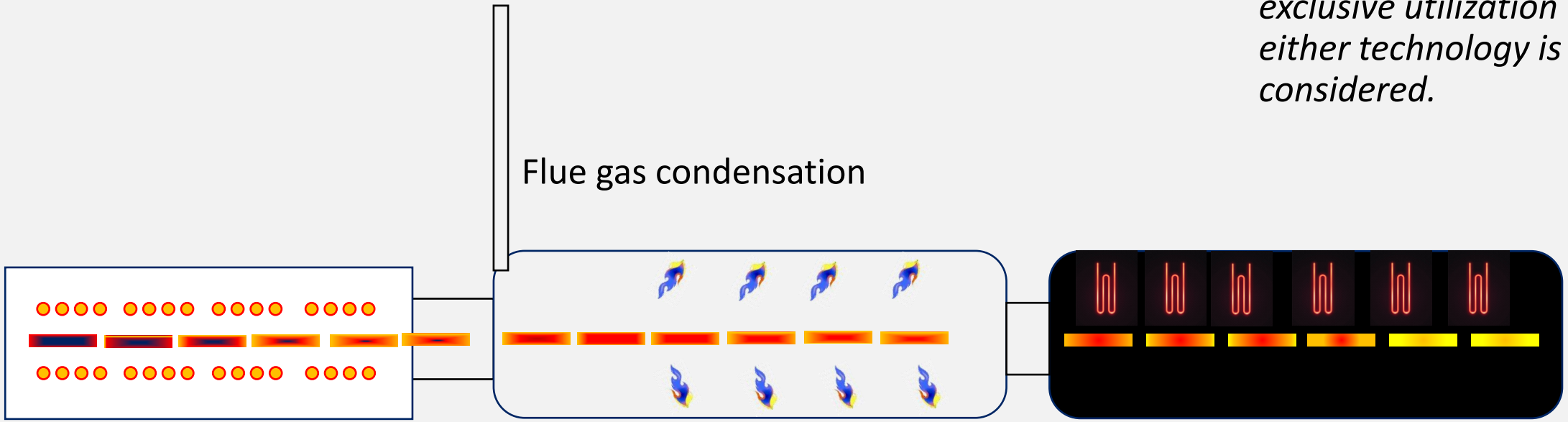
Will Nordic countries lead the implementation of new technologies?



electricitymaps.com

Change in technology

A combination or exclusive utilization of either technology is to be considered.



Induction heating

Fast and high efficiency at low temperature

Hydrogen/Biogas + Oxygen

Heating high atmosphere T

Electrical element heating.

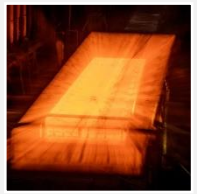
When lower heating demands. Eg soaking

Heating Systems Hardware

- Support the demands for meeting material properties
  - Temperature distribution within material
    Example: heating solutions that eliminates/avoids skid marks.
  - Surface quality
    Example: oxidizing/reducing atmosphere
- Controllability
  - Behave consistent and predictable
  - Example: heat distribution, correctly dimensioned valves for precise oxidizer/fuel ratio setting in all operating modes
- Efficiency
  - Eliminate heat losses
  - Heat recovery, flue gas condensation
- Durability
  - Direct electricity methods, refractory…

Sustainable Environment

Material



Efficient

Durable

SSAB

Heating System Control

Today:

Furnace (material) is controlled by temperature. Temperature is the “only” measure for fulfill heating criteria.

Future:

Material properties to be controlled.

- Measuring or other approaches for establish initial state
  - Analyses, dimension, oxide, defects, grain size, carbide size distribution
- Online methods for predict material properties during heating
  - Material physical properties (T&t- depended) *)
  - Measuring techniques, direct: elongation of material boundary conditions: temperature, atm…
  - Models, 3d representation of material and boundary conditions.
  - Scale formation
- Feedback systems
  - Short: mill temperature or LUS measurements
  - Long: material properties at samples

*) Especially the electromagnetic properties when utilizing induction.

Heating System Control & Supervision

1. Need to meet requirements for material conditions
2. Energy and environmental optimized
3. A minimum of unplanned maintenance and rework

- Ensure basic measurement and settings.
  - E.g. thermocouple placing, air/fuel control, distribution of fuel to several burners
  - Condition Monitoring of equipment and furnace (AI)
    - Thermocouples, Electrical elements, energy consumption and emissions.
- Expanding the scope of measurements and control capabilities.
  - IR-cameras for measuring flame conditions or hot spots
  - Refractory status measurements
  - Flame length control

Questions during the panel discussions!