ELKEMS SATSNING INNEN BIOKARBON

Norsk Biokullnettverk – Fagseminar 21.01.2021

Marit Dolmen, Elkem Technology

Elkem

More than 115 years of history as a technology and solutions provider

Founded in 1904 by Sam Eyde

Listed on **Oslo Stock Exchange** since March 2018

31 PLANTS WORLDWIDE
Headquarter in Norway

>450 R&D PEOPLE
R&D centres in Norway, France and China

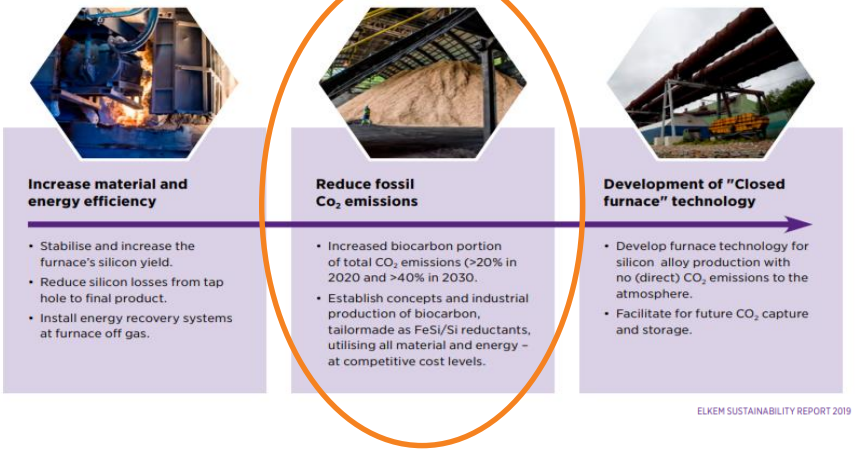
>6.700 EMPLOYEES
Worldwide

22,7 BNOK
Total operating income in 2019

Elkem ASA – our three business areas

Klima tiltak

- Biokarbon: 40% av våre direkte CO2-utslipp fra de norske smelteverkene kommer fra fornybare kilder innen 2030
- Sterkt fokus på forskning og utvikling
- Økt energigjenvinning



CDP
DISCLOSURE INSIGHT ACTION
A LIST
2020
CLIMATE

Elkem Saltens energigjenvinningsanlegg – hva består det av?

Elkem Salten produserer silisium i tre reduksjonsovner. Verket har, i likhet med andre silisium- og ferrolegeringsverk, et formidabelt forbruk ev elektrisk energi. De varme avgassene ut fra ovnene representerer svært mye energi, omtrent av samme størrelsesorden som verkets totale elektrisitetsforbruk. Til nå har de varme, støvholdige avgassene blitt transportert i en 400 meter lang uisolert avgasskanal fra ovnene og bort til filteranlegget som renser avgassene for støv før de rensede avgassene ledes til atmosfæren. Støver som tas ut i filteret et verdifullt produkt som Elkem selger på markedet.

Ved å bygge et energigjenvinningsanlegg vil verket klare å gjenvinne 28 % av verkets elektrisitetsforbruk, og dette vil gjøre Elkem Salten til et av verdens mest energieffektive silisiumverk.

Norwegian Minister of Climate and Environment opened upgraded furnace at Elkem Bremanger

TUE, MAR 10, 2020 21:00 CET

10 MARCH 2020: The Norwegian Minister of Climate and Environment, Sveinung Rotevatn, today opened the upgraded silicon furnace at Elkem Bremanger in Norway. The upgrade increases the plant's cost efficiency and reduces NOx emissions with up to 50% – similar to removing 100.000 diesel cars from the road.

Around NOK 250 million has been invested in the upgrade. The Norwegian NOx fund has supported the project with NOK 90 million. In addition to improving cost efficiency and cut NOx emissions, the project has additional benefits, when it comes to safety standards and work environment.

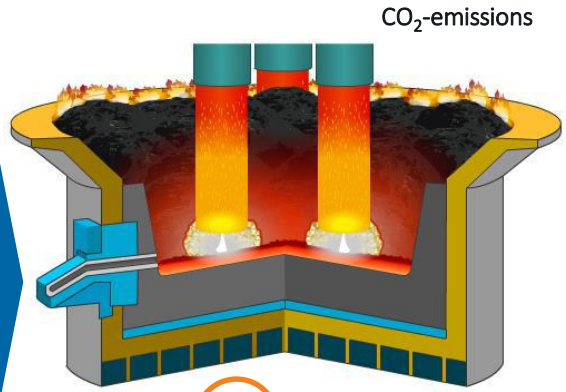
Biocarbon for metallurgical industry - reducing CO2 emissions

Silicon production – Carbothermic reduction

Quartz (SiO_2)
The source of silicon

Carbon (C)
Reduction agent

Electricity
Energy input



$SiO_2 + 2C = Si + 2CO$

The process requires very high temperatures – above 2000 C.

Si

Carbon raw materials

Coal

Fossil source
Restricted resource
Readily available
High mechanical strength
Devolatilizes to reactive char in the furnace
Low cost
High availability, but limited resource
Mining is energy, land and CO_2 intensive
Long transport route to plant

Char/coke

Fossil source
Restricted resource
Includes coke, char and petroleum coke
High reactivity
High cost
High availability, but limited resource
Mining and processing is highly energy, land and CO_2 intensive
Long transport route to plant

Charcoal

- Bio source
- Devolatilized wood
- Low mechanical strength
- High reactivity
- High cost
- Constraint, but renewable resource
- Cultivation, harvesting and processing is relatively little energy and CO_2 intensive compared to coal mining, bur require much land
- May be viable resources located in close plant proximity

Woodchips

- Bio source
- High mechanical strength
- Devolatilizes to reactive biochar in the furnace
- High cost
- Constraint, but renewable resource
- Cultivation and harvesting is relatively little energy and CO_2 intensive compared to coal mining but require much land
- May be viable resources located in close plant proximity

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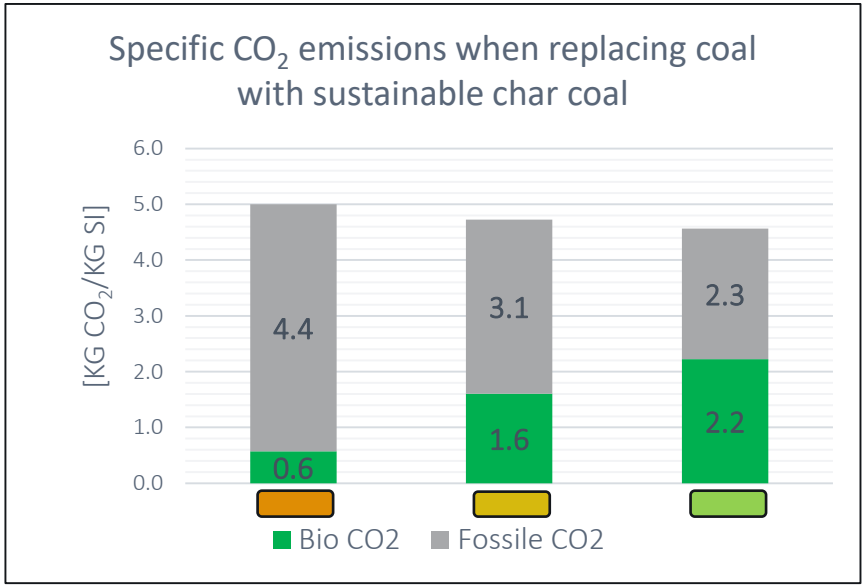
Increased use of sustainable charcoal significantly reduces the fossil CO2 emissions, but also the total CO2 emissions.

CO_2 emissions [kg CO_2/kg Si] vs Charge mix						
Coal	Char coal	Wood chips	Si yield	Total CO_2	Bio CO_2	Fossil CO_2
85 %	0 %	15 %	84 %	5.0	0.6	4.4
60 %	25%	15 %	84 %	4.7	1.6	3.1
45 %	40 %	15 %	84 %	4.6	2.2	2.3
45 %	40 %	15 %	92 %	4.4	2.2	2.2



Replacement of coal with sustainable charcoal (up to 40% of carbon used) halves the emission of fossil CO_2.

The total CO_2 emission will be reduced by 10% because of reduced amount of volatiles.

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Utfordringer med dagens trekull

BRUK AV TRADISJONELT TREKULL

- Trekull er et svært dyrt reduksjonsmateriale.
  - Typisk tre ganger dyrere enn kull per «fix carbon».
- Trekull har svak mekanisk styrke og danner lett finstoff ved håndtering.
  - Tap i form av finstoff «fra kai til ovn» kan fort bli 10-15%.
  - Finstoffet kan ikke brukes direkte på ovnen.

TRADISJONELL TREKULLPRODUKSJON

- Lavt karbonutbytte under pyrolyse fra trevirke til ferdig trekull.
- Stort tap i form av finstoff (>15%).
- Lokalt miljøproblem.
- Tilgang på trevirke – avskoging, redusert biodiversitet.

Critical properties of charcoal in silicon and ferrosilicon production

Carbon content	• Avoid handling large tonnages • Decreases mechanical strength
Volatile content	• Affects energy in off gas system of furnace
Particle size distribution	• Affects reactivity • Must match requirements in feeding system
Mechanical Properties	• Avoid degradation of material • Minimize losses
SiO reactivity	• Affects silicon yield • Operation of furnace
Ash content and chemistry	• Affects Si, FeSi and Microsilica product quality

Economy

Operation

EHS

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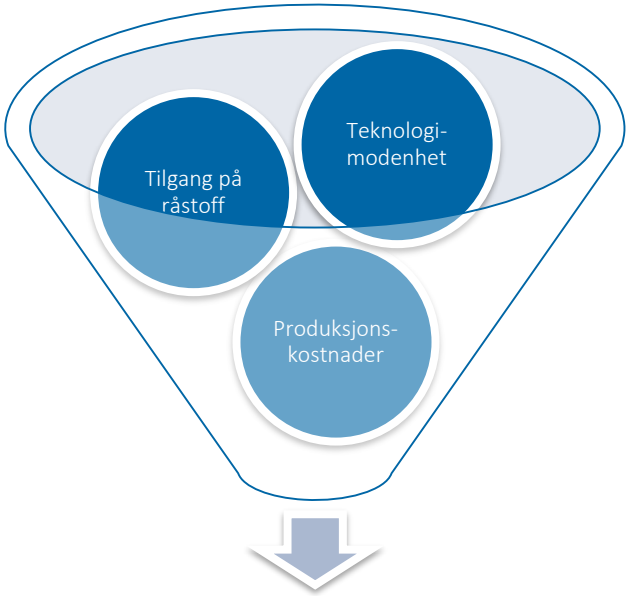
Biocarbon Pilot investment

- Approval of new **biocarbon pilot plant** in Canada.
- To secure **industrial verification** of Elkem's technology for renewable biocarbon.
- The total investment for the pilot plant amounts to NOK 180 million. Will receive **financial support** from the Canadian government, reducing Elkem's net investment to NOK 60 million.
- The plant will be constructed near Elkem's production site in Chicoutimi, Quebec, Canada, with start of construction planned end 2020.
- Based on conclusions from the pilot, Elkem will evaluate the **basis for a full-scale plant**.
- Elkem remains **involved in several activities related to biocarbon, in Norway** and other countries around the world. This includes work to develop competitive and sustainable sources of biocarbon as well as longer-term R&D projects.
  - BioCarMet: Biomass resource studies and value chain in Norway (Pilot E)
  - KPN BioCarbUp and IPN's

Jean Villeneuve, Elkem's Head of Biocarbon Business

Hva må til for å lykkes med industrialisering av biokarbon?



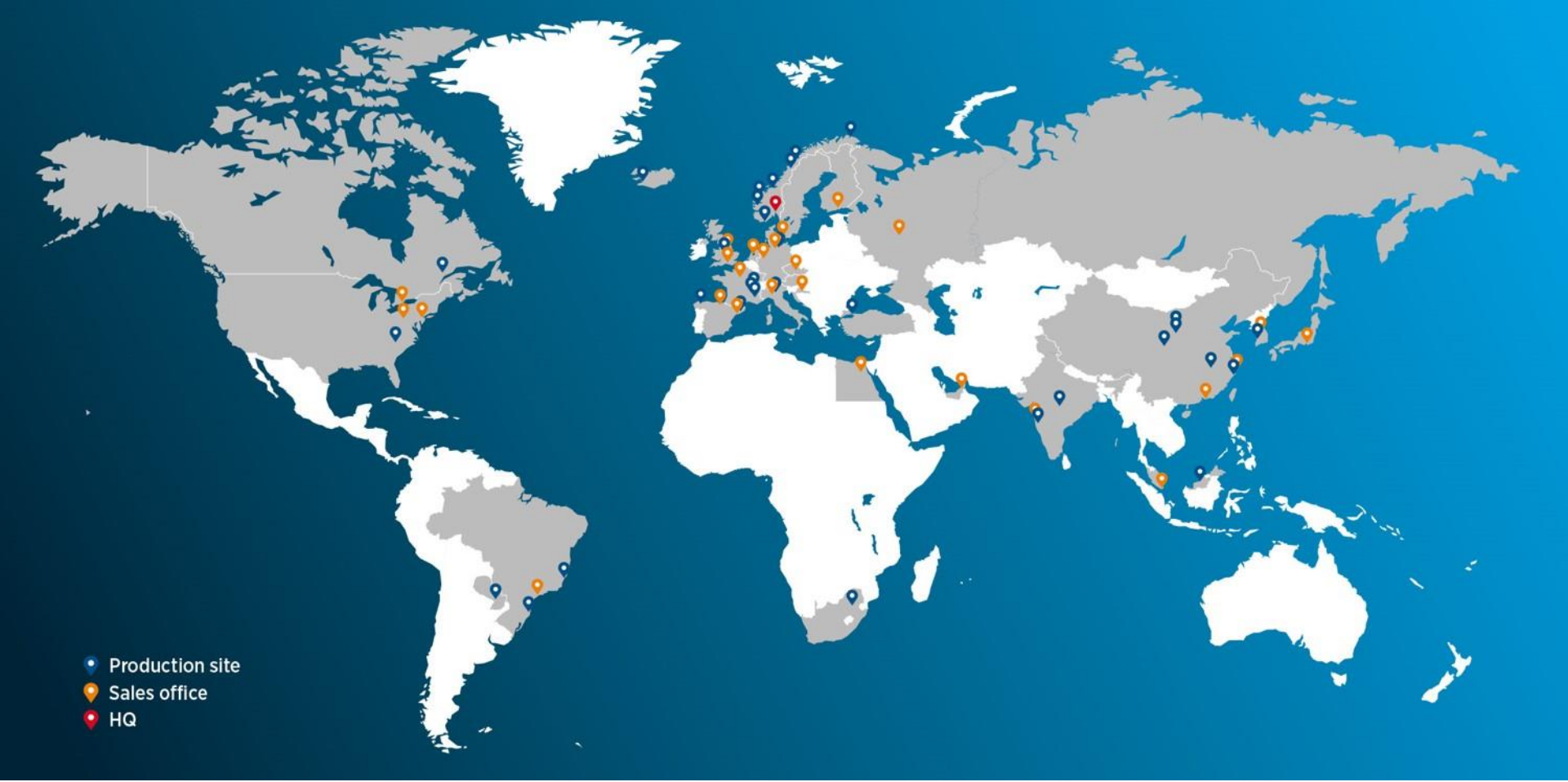
Industrialisering

Nye teknologier for bærekraftig produksjon av biokarbon til silisiumproduksjon må testes i industriell skala– komme over «the valley of death of innovation». Utløsende støtteordninger for testing i større skala.

Forutsigbar tilgang og pris på trevirke og bioråstoff over tid.

Bærekraftig / lønnsom verdikjede på plass.

Tilgang på industriell kapital og ekspertise. Forutsigbare rammebetingelser for industriell virksomhet.


Production site
Sales office
HQ

DELIVERING YOUR POTENTIAL