



Reduced Carbon Footprint with **Linde Green**

SHTE Heat Treatment conference, 6-7 November 2024.
Munktell museúm Eskilstuna

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Background

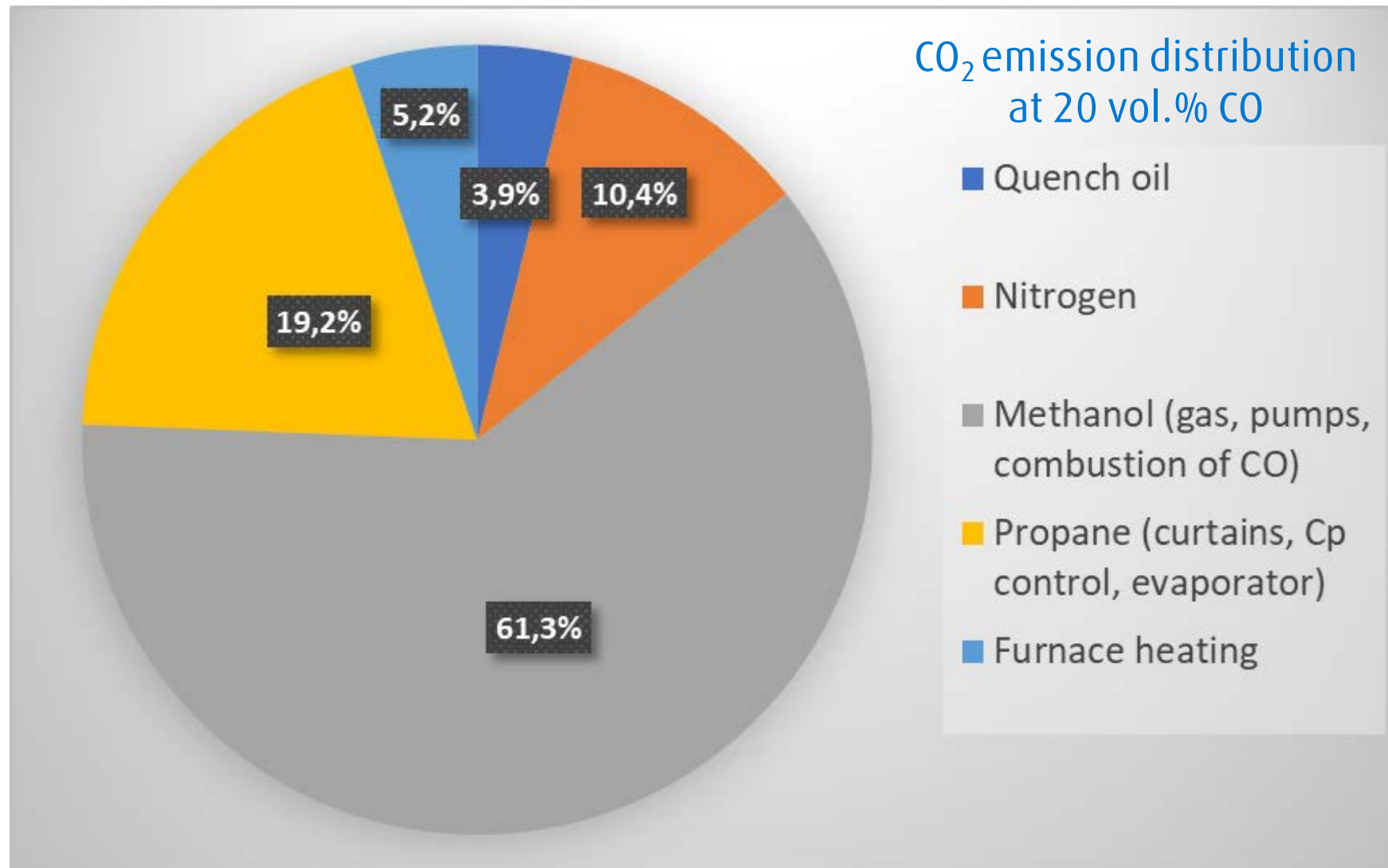


Reduced carbon footprint with **Linde Green**

- The Heat Treatment industry is changing. More focus than ever is put on **reducing its carbon footprint**. Traditionally, focus was on **eliminating environmentally harmful substances, minimizing waste losses and energy consumption**, plus, better **recycling of materials**. This was often driven by care for **human health** (regulations) and potential **cost reductions**.
- Within the Vinnova financed project, DynaSty, one successively showed **reductions of the gas related carbon footprint by up to 50 % !**
- This presentation demonstrates how the Heat Treatment industry can take the **next step** and **lower the carbon footprint** even further by making an active choice of **Linde Green !**
- Also, it demonstrates that an **active process optimization** and **Linde Green** doesn't increase your **costs**. On the contrary, **costs are saved !**

Contribution to CO₂ emissions at 20 vol.% CO

Based on production numbers at Bulten Hallstahammar AB, continuous link belt furnace










⇒ Expect great impact if Methanol can be reduced !

The role of the furnace atmosphere

- All times keep the process / furnace at an overpressure
- To purge away oxygen, water, oil fumes etc.
- Being reducing or oxidizing versus the treated material / alloy
- Fulfill the carbon (nitrogen/oxygen) need of the material (neutral, carburizing, decarburizing)
- Hold enough buffer capacity to minimize / eliminate process irregularities, such as air leakages, door openings, etc. H_2 and CO reacts with intruding oxygen forming H_2O and CO_2
- To support an even hardening result, the atmosphere should be repeatable in all positions. Do not underestimate the influence of the temperature !
- Safety purging, in case of an incident / emergency

Challenges when going for leaner atmospheres

- All times keep the process / furnace at an overpressure 
- To purge away oxygen, water, oil fumes etc. 
- Being reducing or oxidizing versus the treated material / alloy 
- Fulfill the carbon (nitrogen/oxygen) need of the material (neutral, carburizing, decarburizing) 
- Hold enough buffer capacity to minimize / eliminate process irregularities, such as air leakages, door openings, etc. Process robustness at the new lower CO level? 
- To support an even hardening result at all positions of the charge. CO depletion? 
- Safety purging, in case of an incident / emergency 
- Any risk of C_3H_8 overcompensation leading to soot and carbides?
- Reduced carbon mass transfer, gas-surface, prolonging total process time, reduced hardening depth?
- Risk of a more sluggish process control?

When curiosity takes over...

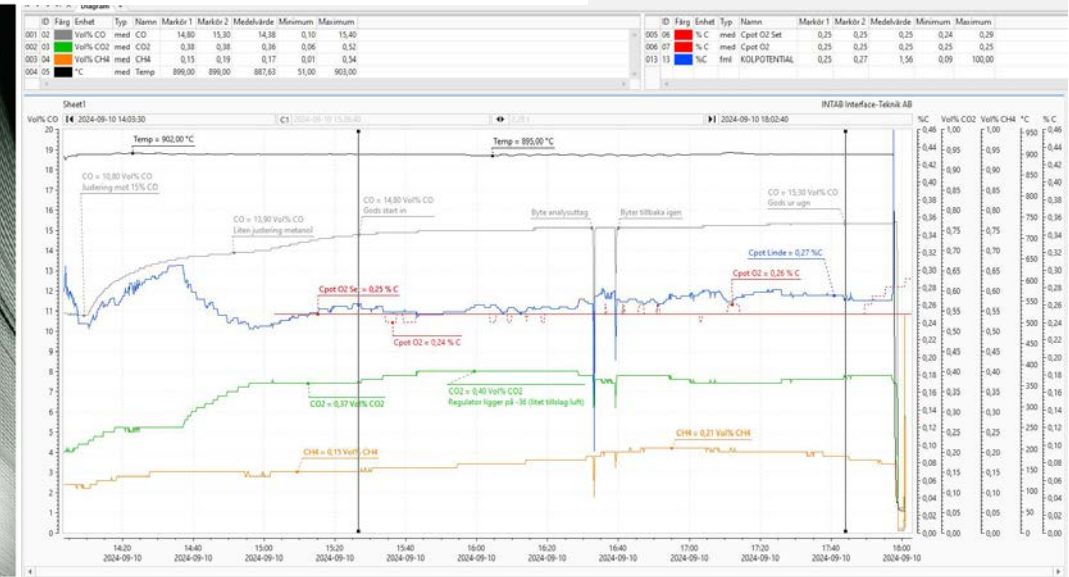
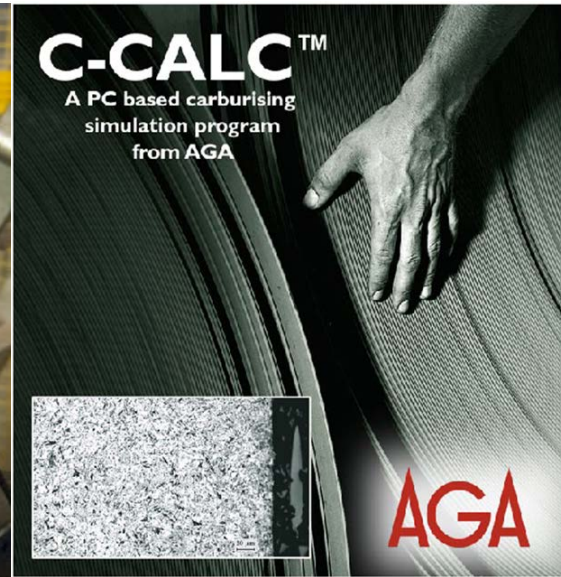


Linde Application and Ferronova® process supports you to a **Greener** process

Accredited by SWEDAC, Process measurements by Ferronova®

Carburizing or neutral hardening, recipe simulations

Results documented in a report. Verified traceability.

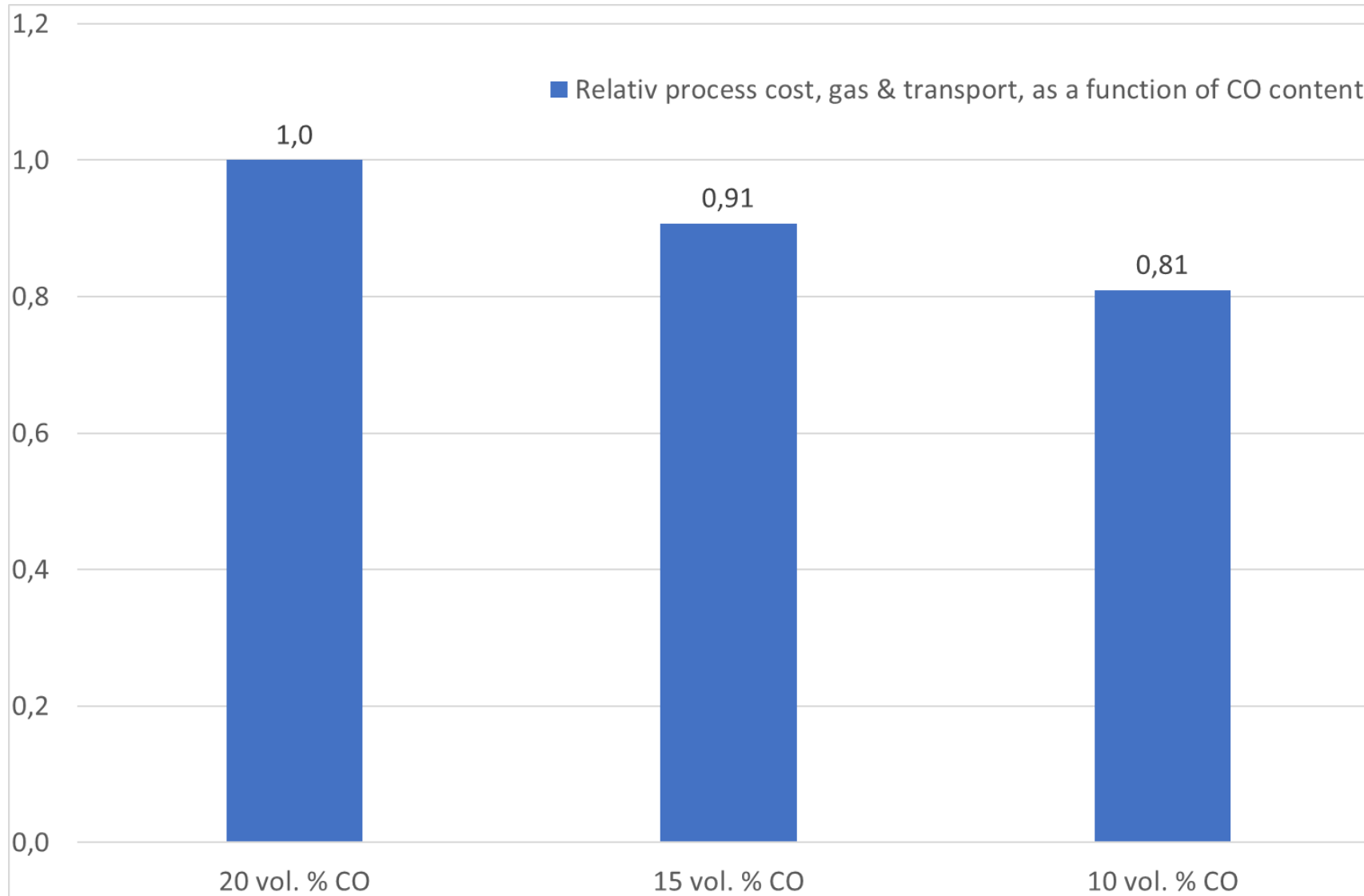


1) Observe & Measure

2) Evaluate Simulate Propose recipe

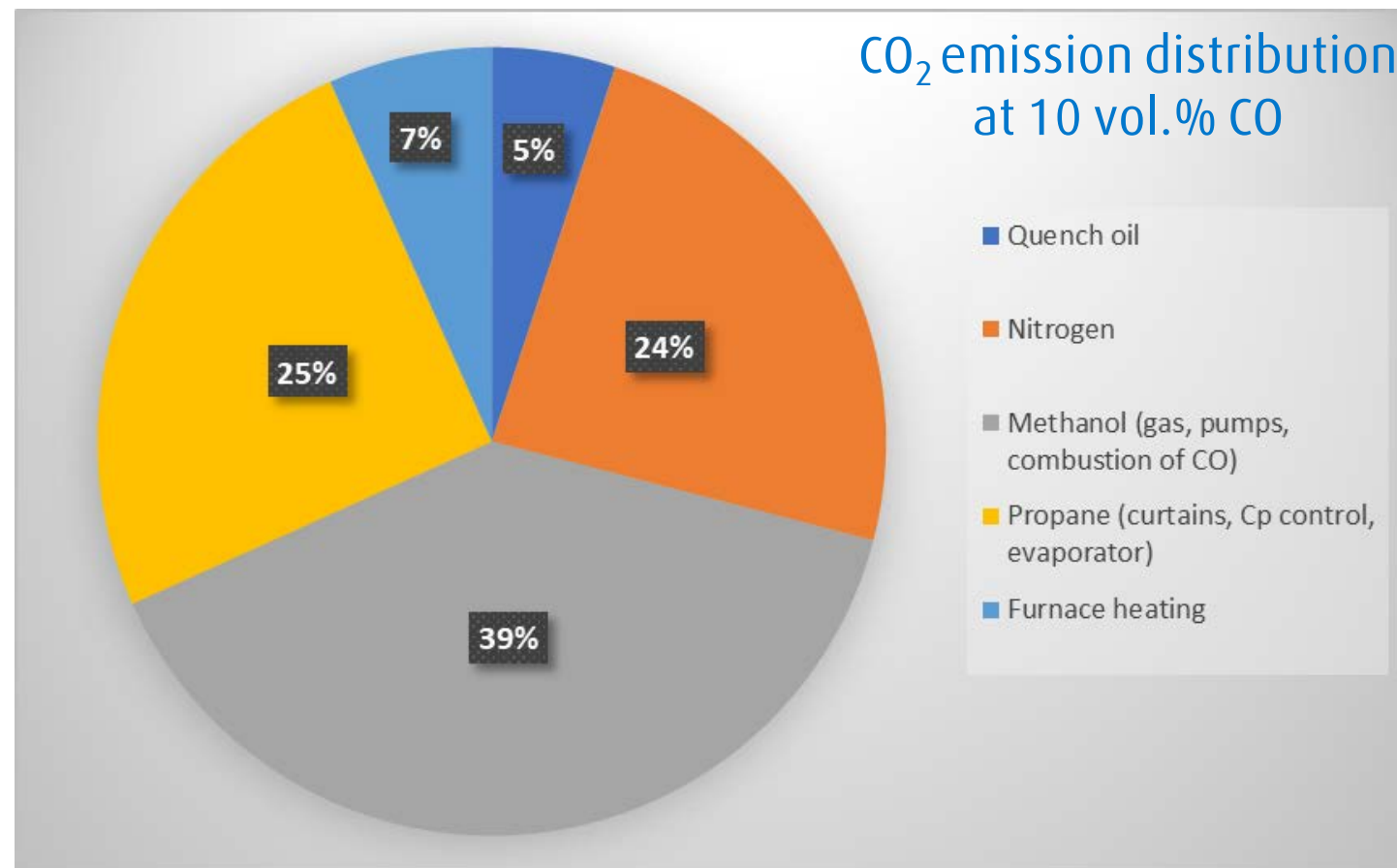
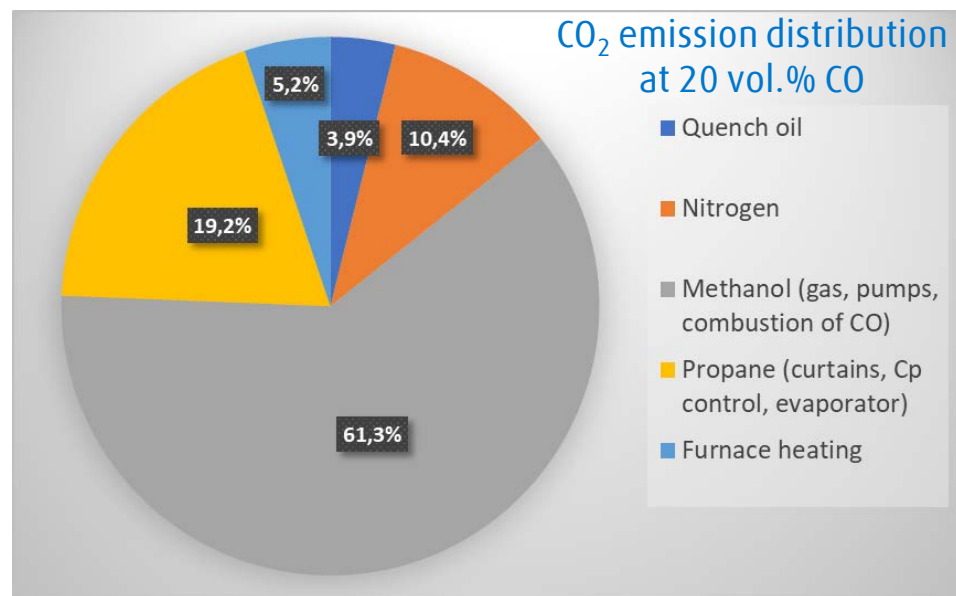
3) Test and validate new recipe

Relative cost calculation gas, reduction of CO content



20 vol.% vs. 10 vol.% CO, N₂ / Methanol system

Decreased CO₂ emissions by -23%
at 19% lower gas cost



Can we do more?





Linde Green.
**Liquid Gases without
Carbon Footprint.**

Take the next step!

Aron Joshi
Sustainability manager



Linde Green in a nutshell



- Same **product quality and reliability** – without carbon footprint
- Available for **LIN, LOX, LAR, LIC**
- We use **renewable sources**: air or recovered CO₂, e.g. extracted as a side stream from bioethanol or chemical processes
- Only **renewable electricity** is used in the production of Linde Green gases
- **Transports** to customers performed with renewable fuels
- Linde Green is **audited and verified** by a third-party
- Customers receive an **annual certificate** showing reduced carbon footprint



Linde Green in a nutshell: Liquefied Gases without Carbon Footprint



Renewable electricity sources + renewable fuel + climate compensation



You as a customer...

... reduce your Scope 3 emissions in your supply chain by purchasing climate neutral gases from Linde. Full 3rd party verification of emission savings and certification of saved quantity of CO₂.

Linde...

... significantly reduces its own environmental impact (Scope 2 & 3 emissions)

Linde Green in practice

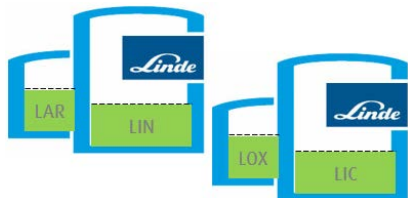


Reducing CO₂ emissions by ca. 95% compared to conventional product

Renewable electricity
GoO's – Guarantees of Origin



Linde Green
Product pool



Renewable fuel –
Hydrogenated vegetable oil, biogas



Reducing remaining 5% of emissions

Climate compensation
for residual emissions & utilities



zero mission



[CommuniTree – Nicaragua | Plan Vivo Foundation](#)

How much CO₂ can be saved with Linde Green?



EXAMPLE: Company uses 100 tons of LIN (liquid nitrogen) gas per year
Total average carbon footprint

35 tons

Reduction through the use of renewable energy and fuel in production and transport

34.5 tons

Climate compensation

0.5 tons

Linde Green Customer's carbon footprint
0 kg



The amount of CO₂ saved in the production of 100 tons of Linde Green nitrogen is roughly equivalent to the carbon sequestered by **350 tree seedlings grown for 10 years.**

The amount of CO₂ saved in the production of 100 tons of Linde Green nitrogen is roughly corresponds to the **greenhouse gas emissions of 8 cars driven for a year.**



CO₂ reduction from 100 tons of LIN equals to emissions from:

8

passenger vehicles driven for 1 year

14,908

liter of gasoline

4

home's electricity for 1 year

291,667

km driven by an average passenger vehicle

2,917

smartphones used for 1 year



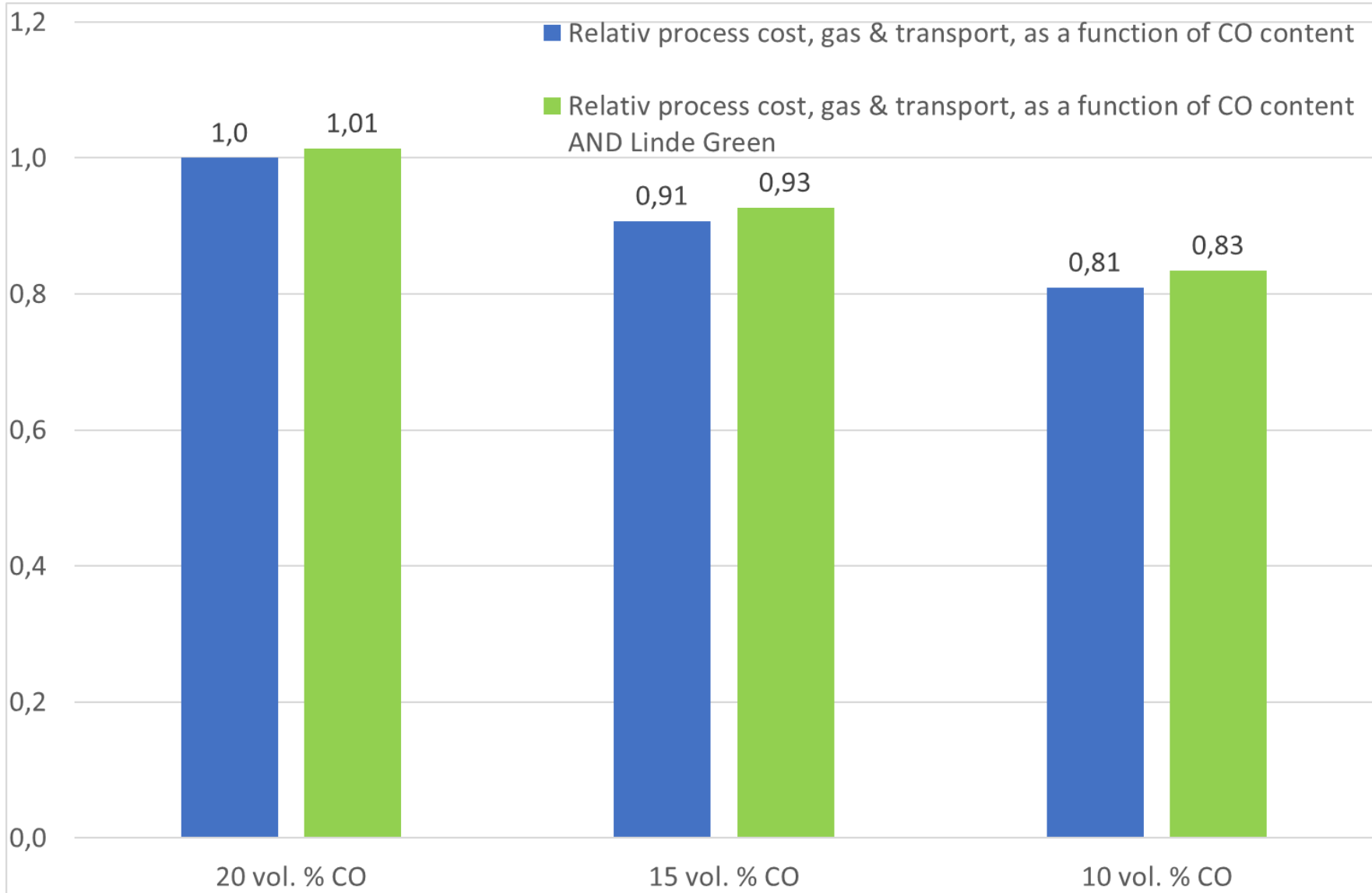
Linde Green.
**Liquid Gases without
Carbon Footprint.**

Take the next step!

www.linde-gas.xx/lindegreen



Relative cost calculation gas, reduction of CO content AND Linde Green implementation

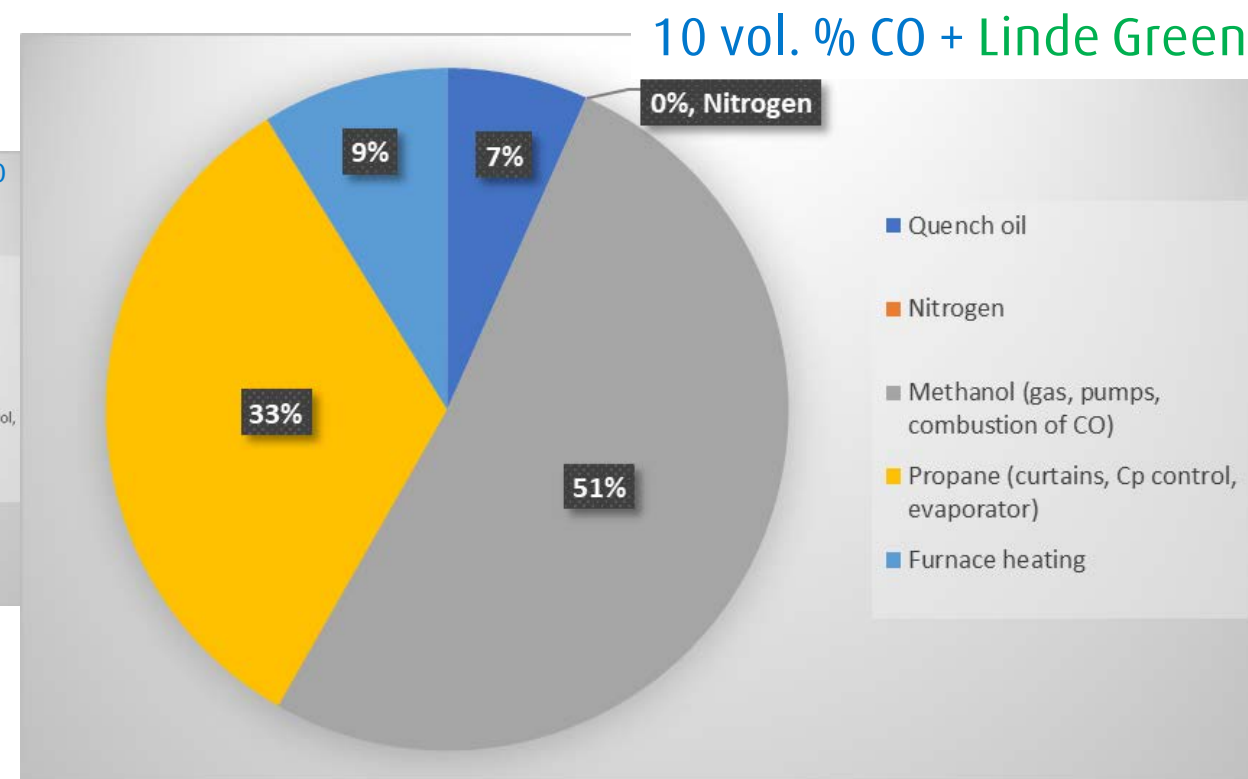
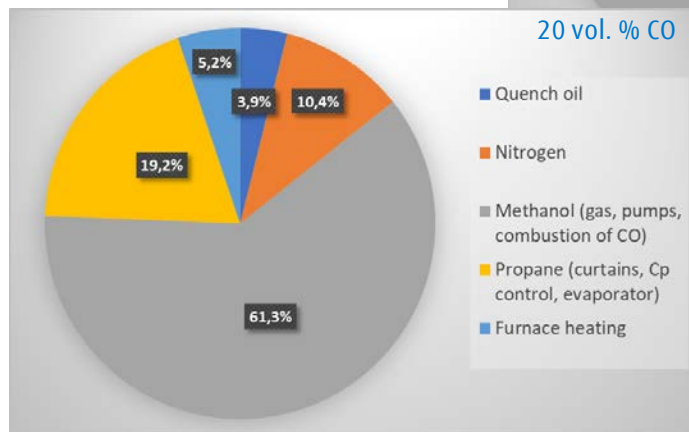
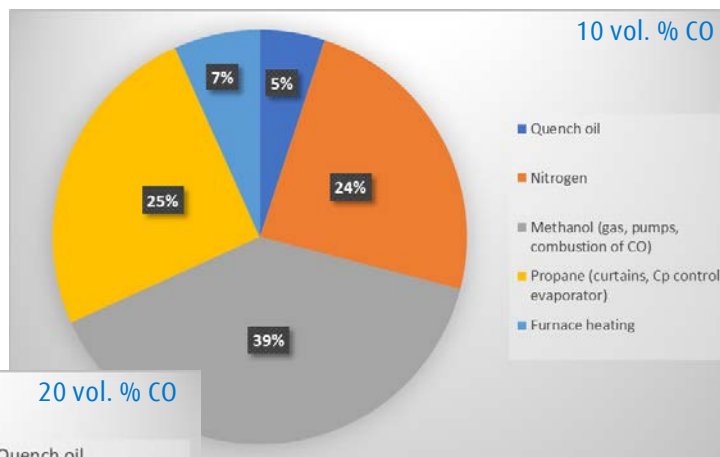




10 vol.% CO, N₂ / Methanol system And Linde Green

Based on production numbers at Bulten Hallstahammar AB, continuous link belt furnace

Savings with CO reductions + Linde Green:
~200 Tons CO₂/year at 17% lower cost



Summary

- Many of today's HT processes are run identical to once erected (30 years ago or more)
- Taking an active climate decision opens to investigate if the process window can be modified without risking yield and quality
- As shown, savings in both CO₂ emissions and money is within reach!
- Don't hesitate, contact Linde Gas and start your **GREEN** journey today!



Vill du minska dina värmebehandlingskostnader samt ert klimatavtryck?

Låt Linde hjälpa dig med att nå båda dessa mål!

Vi hjälper dig att skräddarsy en kostnadseffektiv processcykel utifrån dina kvalitetskrav och ugnsförutsättningar. Följande punkter är exempel på vad som åstadkommit och kan förväntas:

- Upp till 20% minskade gaskostnader
- Upp till 50% reduktion av atmosfärens CO₂-utsläpp
- Minskat ugnsslitage och underhållskostnader
- Ökad ugnstillgänglighet

Vill du veta mer? Kontakta oss via mail: magnus.dahlstrom@linde.com så går vi igenom följande steg tillsammans:

- Analys av befintlig sätt-/neutralhärtningsprocess
- Utvärdering av resultat
- Framtagning av ny processcykel
- Testkörning och verifiering av process och resultat

linde.se

Making our world more productive



Thank you for
your attention

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