VALORISATION OF ORGANIC WASTE BY INDUSTRIAL PRODUCTION OF LBG

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Biokraft
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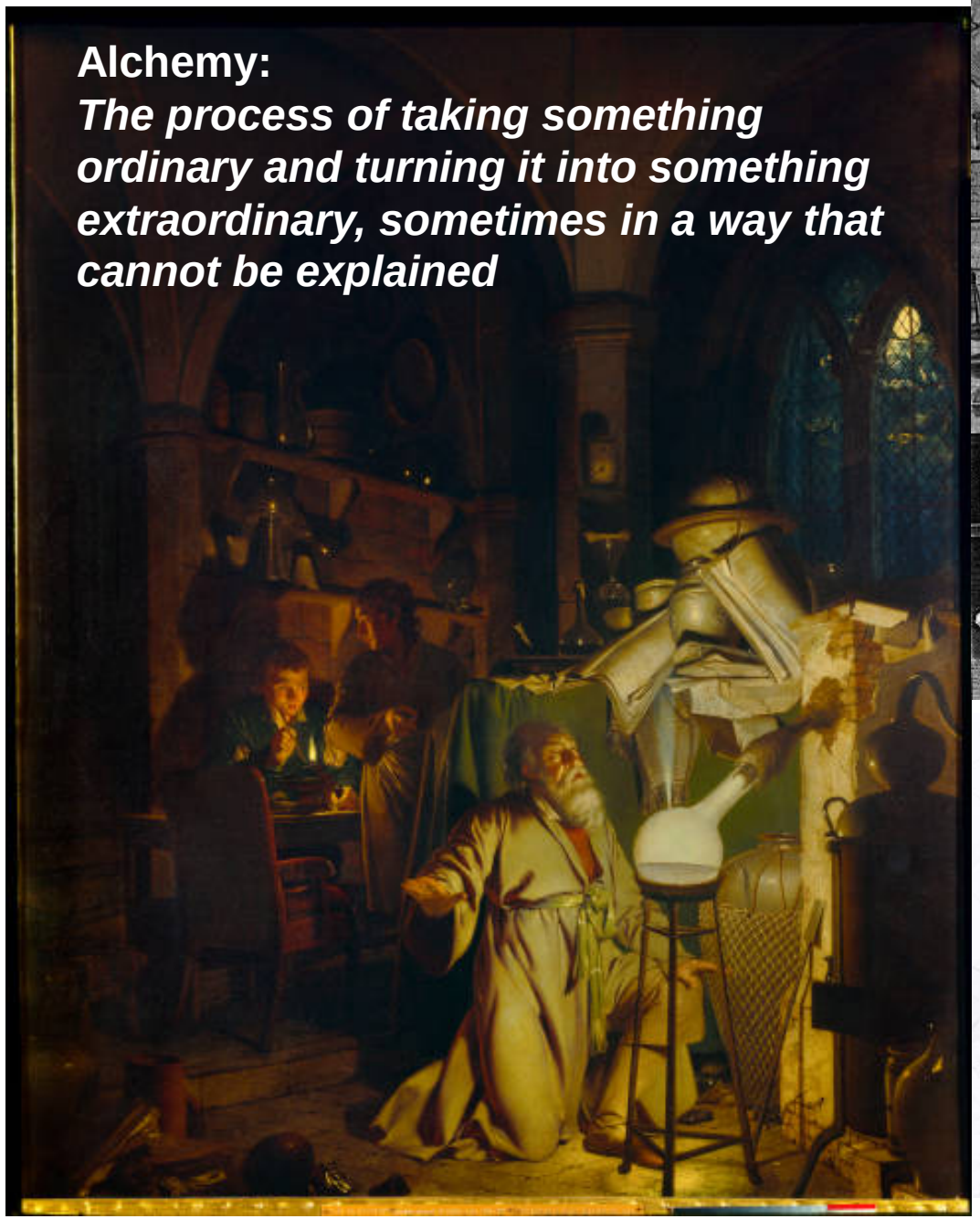
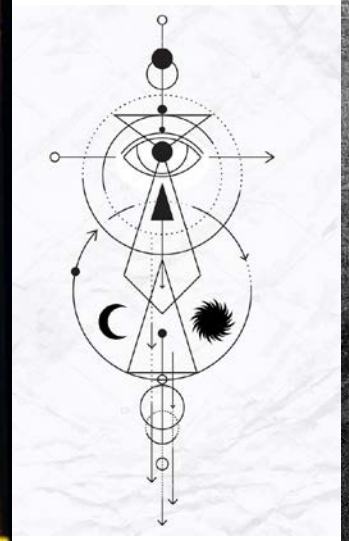
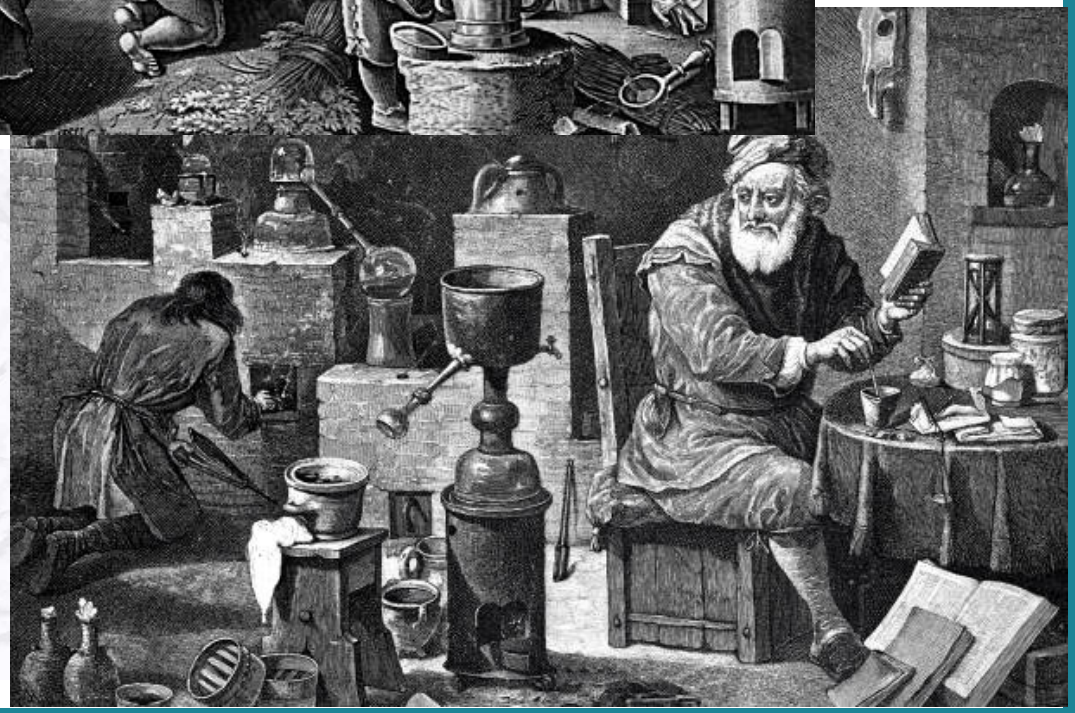
Alchemy:
The process of taking something ordinary and turning it into something extraordinary, sometimes in a way that cannot be explained





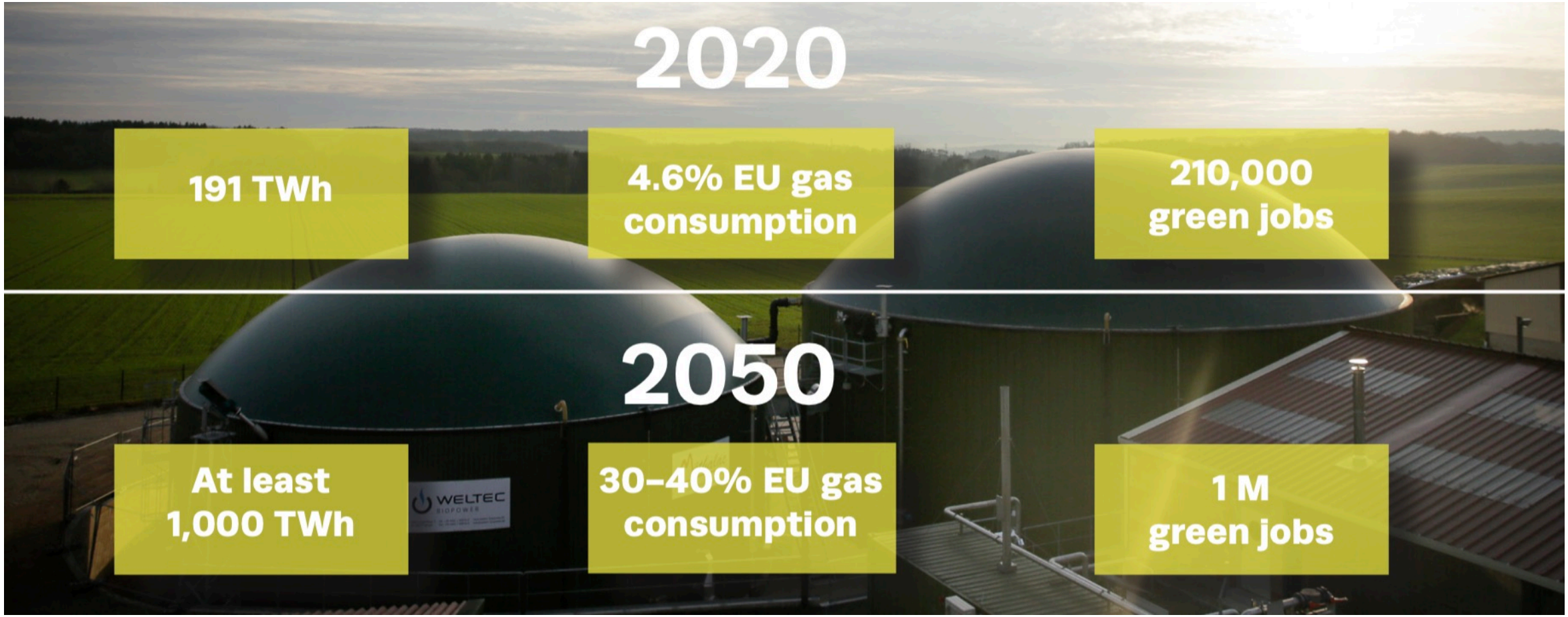


Biokraft AS

- Founded in 2009
- Part of Scandinavian Biogas Group. Listed on Nasdaq Nordic
- Owns and operates the world's largest facility for production of liquid biogas (LBG) at Skogn in Mid-Norway
- First LBG out in September 2018.
- Monthly EBITDA positive since late 2018 and every month thereafter in 2019, 2020 and 2021

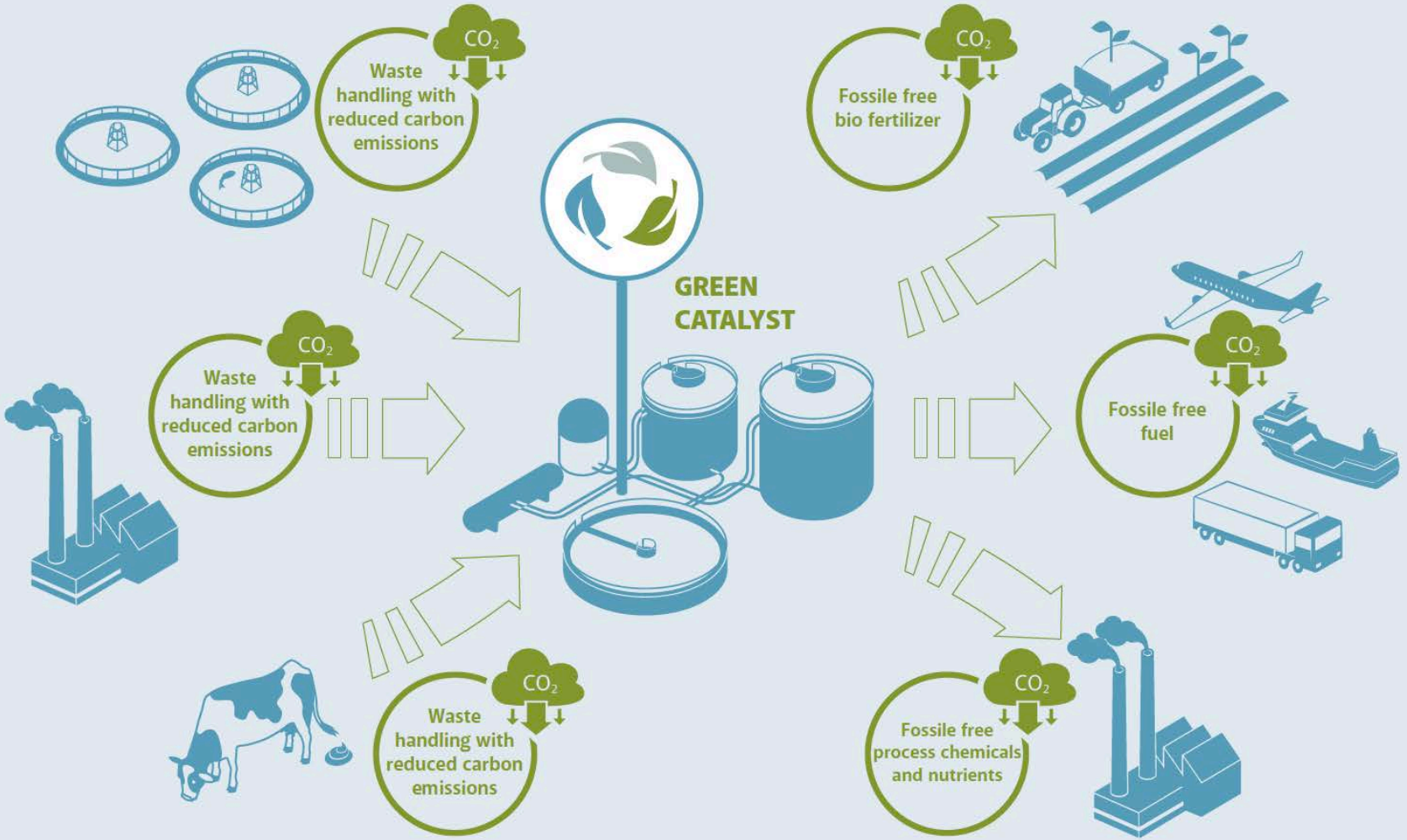
New green, sustainable and profitable industry!

Status and plan – biogas growth in Europe



Source: European Biogas Association © 2022

Beautifuel– a kinderegg

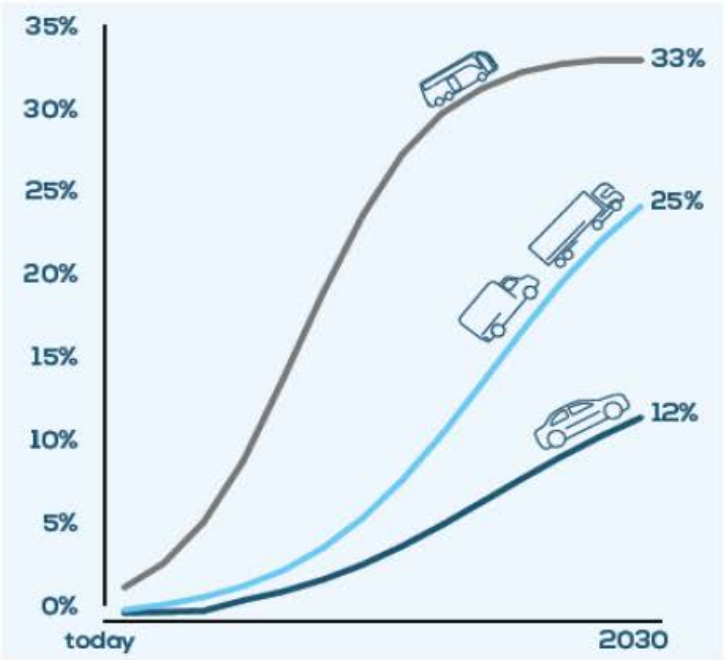


Growth driver for LBG - Green trucking

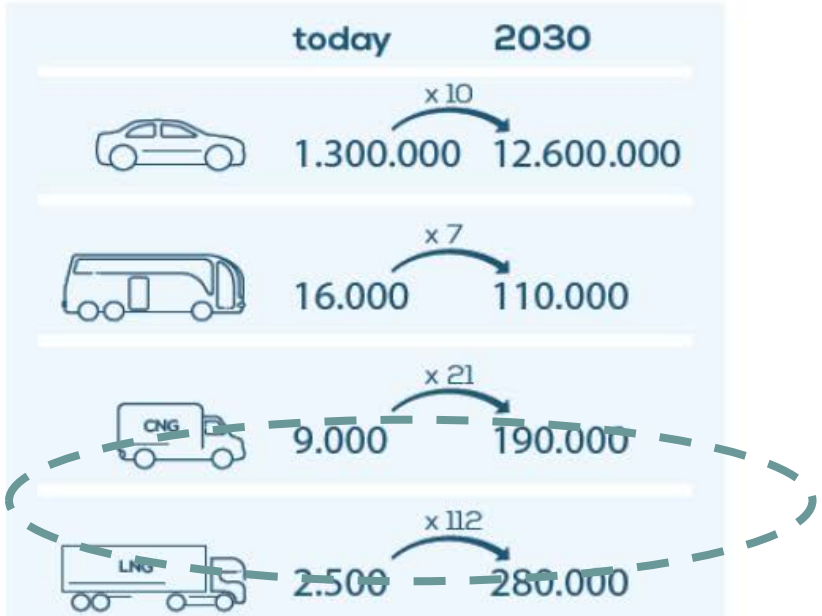
NGVA Europe

Looking to 2030: NGVs fleet development

Market share natural gas vehicles in Europe



Natural gas vehicles fleet development



NGVs fleet up to 13 million units in 2030

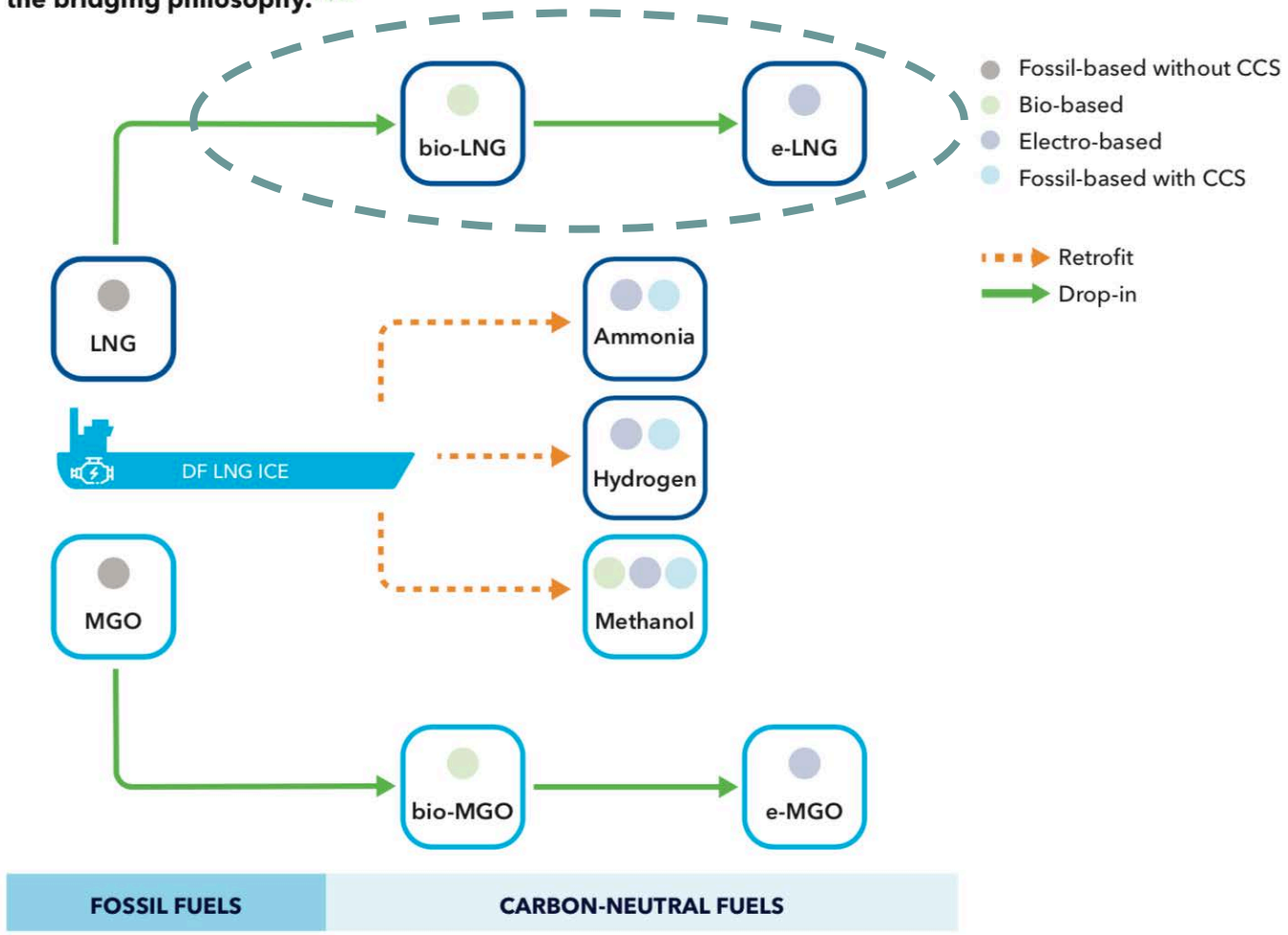
Unprecedented TTF Prices volatility

TINE – #kukraft

TINE's cowpower trucks are heavy duty long-range solutions, running on liquid biogas fuel.

And sailing up green shipping

A vessel with dual-fuel engine capable of burning LNG and MGO illustrates fuel flexibility, building on the bridging philosophy.[11, 12]



MGO, marine gas oil; LNG, liquefied natural gas

The Biokraft Skogn I facility and Skogn II site

May 2021

Biokraft BioN Fertilizer

- More renewable food production with application of bio fertilizer
  - First season (2019):
    - ✓Good agronomy
    - ✓Good economy
- Biokraft works to further refine this important product, as well as develop other bio products
  - Phosphorus rich soil/ soil improvers
  - Errosion control products

Biogenic CO_2

CCU

- Secure supply of CO_2 for food production
- With the right upgrade and polish technology Biogenic CO_2 from biogassproduction can be foodgrad and used for CA storage, packaging and in carbonated drinks
  - Substitute for fossile CO_2 (most commionly a biproduct from fossile fertilizer production)
  - Replace burning of fossile gas to procuce CO_2 for greenhouses
- Via methanation of CO_2 can be used to produce e-lbg
  - e-lbg is an effective Hydrogen strategy.

CCS

- CO_2 from production of LBG is captured, and can be stored, in same manner as other CO_2 storage projects

FNs BÆREKRAFTSMÅL

Sustainability and circularity

- How to address this in daily work, how to ducument
- EU regulations
- 3 party audits
- RED II directive (annex IX)

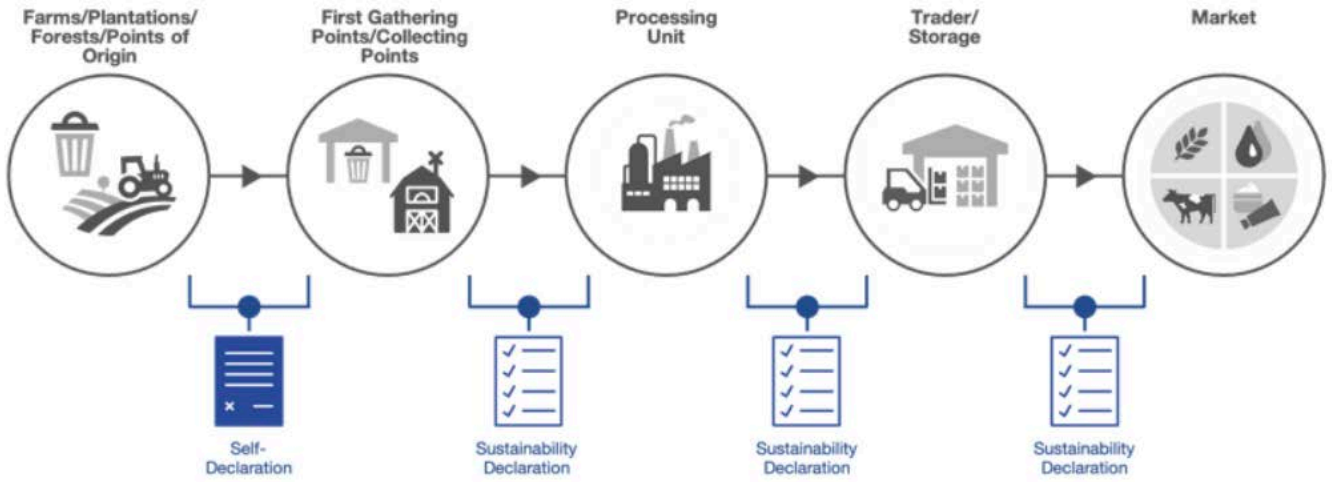
ISCC International Sustainability & Carbon Certification

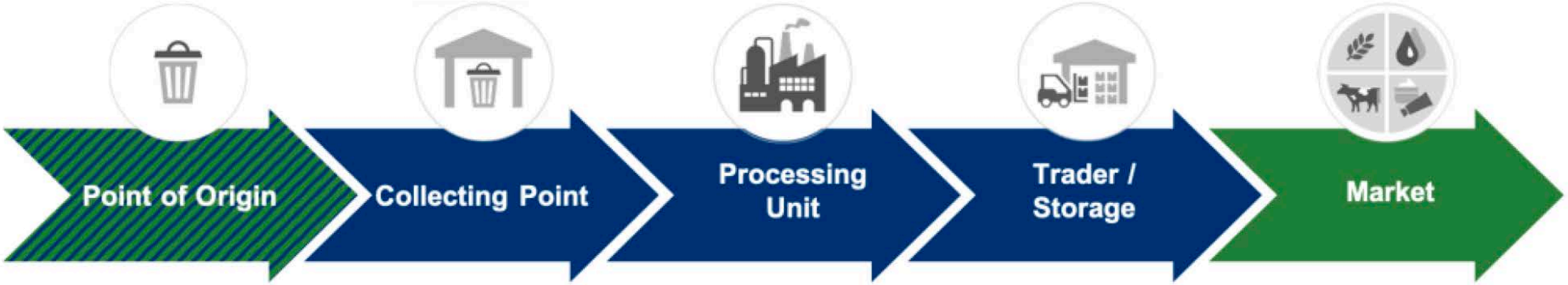
ISCC is an international certification system covering all kinds of bio-based feedstocks and renewables catering to energy, food, feed, and chemicals sectors.

Incorporating sustainability criteria such as reduction of greenhouse gas emissions, sustainable use of land, protection of natural biospheres and social sustainability.

Key ISCC principle

Unbroken chain of certifiable control





Usually coverd by collection point. Self declaration

Individual certification needed. Sustainability declarations

Individual certification needed. Sustainability declarations

3 options

- individual certification
- Group certification under logistics centre
- Dependent storage under certificate of 3rd party. eg trader

Proof of sustainability

$$E = \sum_{1}^{n} S_n \cdot \left(e_{ec,n} + e_{td,feedstock,n} + e_{l,n} - e_{sca,n}\right) + e_p + e_{td,product} + e_u - e_{ccs} - e_{ccr}$$

where

E	= total emissions from the production of the biogas or biomethane before energy conversion;
S_n	= Share of feedstock n, as a fraction of input to digester;
$e_{ec,n}$	= emissions from the extraction or cultivation of feedstock n;
$e_{td,feedstock,n}$	= emissions from transport of feedstock n to the digester;
$e_{l,n}$	= annualised emissions from carbon stock changes caused by land-use change, for feedstock n;
e_{sca}	= emission savings from improved agricultural management of feedstock n (*);
e_p	= emissions from processing;
$e_{td,product}$	= emissions from transport and distribution of biogas and/or biomethane;
e_u	= emissions from the fuel in use, that is greenhouse gases emitted during combustion
e_{ccs}	= emission saving from CO_2 capture and geological storage;
e_{ccr}	= emission savings from CO_2 capture and replacement

(*) For e^{sca} a bonus of 45 g CO_2eq/MJ manure shall be attributed for improved agricultural and manure management in the case animal manure is used as a substrate for the production of biogas and biomethane.

Emissions from the manufacture of machinery and equipment shall not be taken into account.

Balancing actual values

$$E = \sum_{1}^{n} S_n \times (e_{ec,n} + e_{td,\ feedstock,n} + e_{l,n} - e_{sca,n}\ ) + e_p + e_{td,product} + e_u - e_{ccs} - e_{ccr}$$

$$E = \begin{bmatrix} 40\% & \text{maize} & x\ (e_{ec} + e_{td}) \\ 40\% & \text{manure} & x\ (0 + e_{td} - e_{sca}) \\ 20\% & \text{food waste} & x\ (0 + e_{td}) \end{bmatrix} + e_p + \ldots$$

Different feedstock in a digester with different GHG emission can be balanced according to it's share.

Potential to 2030 and beyond

European Biogas Association (EBA):

- The biomethane potential Europe by 2050: 1170 TWh

- Main uses: heavy transport and maritime transport

Growth

+ Skogn II, 2021 – 2022

+ Skogn III, 2021 – 2023

+ Other locations

= Building portfolio of LBG production capacities

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It’s beautifuel!