

A chef in a white uniform is cooking on a stove. The chef's hands are visible, one holding a metal bowl and the other near a flame. The background is a white tiled wall.

— Sustainable Off-Grid Space and Water Heating for Difficult to Decarbonize Buildings

Dr Keith Simons April 22



SHV ENERGY

Market Leader

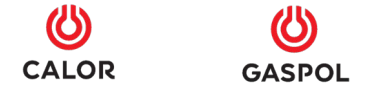
SHV Energy operates with international reach and with local focus. Our energy products and the services we supply are essential for customers across the world. This offers us a unique position to assist with the transition to sustainable, cleaner energy solutions.

4 continents



30 million customers

25 countries

16,700 employees



—SHV Energy Evolution & Product Innovation

Coal	Heating oil	LPG	Biomass	LNG <i>in Europe</i>	BioLPG	Energy efficiency	Solar & rDME
							
1896	1950	1950	2008	2013	2018	2020	2021

— Our Energy Solutions serve multiple applications

In Europe 130 million people live in rural areas

40 million households are not connected to the natural gas grid

The building stock and robustness of the electricity grid limits the choices for low carbon alternatives

www.rural-energy.eu



Heating

LPG for off-grid homes with boilers and heating appliances. Used in offices and by farmers for heating greenhouses.



Transport

LPG, as the brand Autogas, is the most popular automotive fuel used by over 25 million vehicles worldwide.



Cooking

Switching to LPG, a cleaner energy source for cooking and can be used on any appliance.



Commercial

LPG for commercial customers, reducing use of higher-carbon, polluting energy sources. In developing countries, LPG replaces hazardous solid fuel for cooking stoves.



Industry

Supplying LNG for a wide range of industrial applications and processes, such as heating, cooling, drying, processing and food production.



Leisure

LPG for a range of leisure activities from BBQ grills to caravanning and mobile catering.

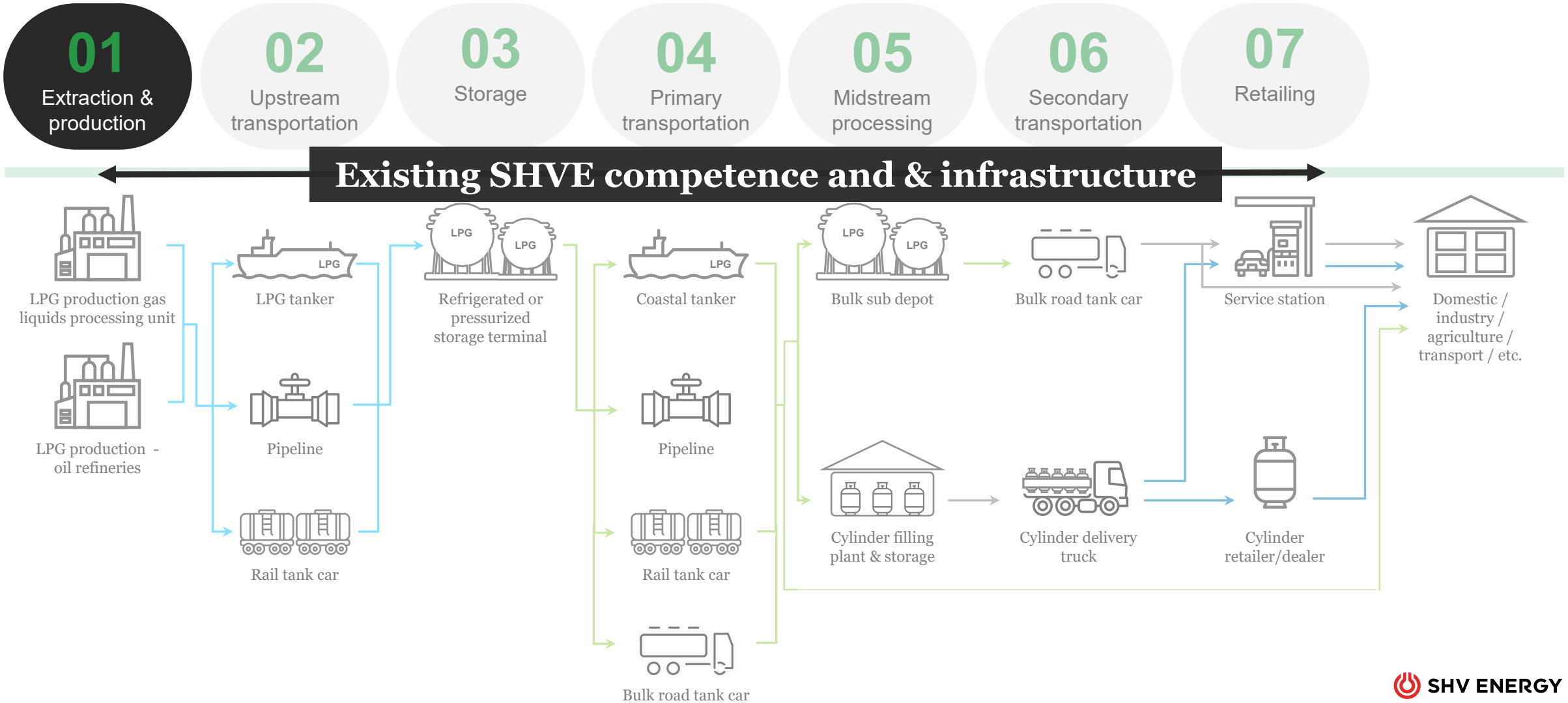
Our bold ambition

100%
of our energy
products to be from
renewable sources in
2040

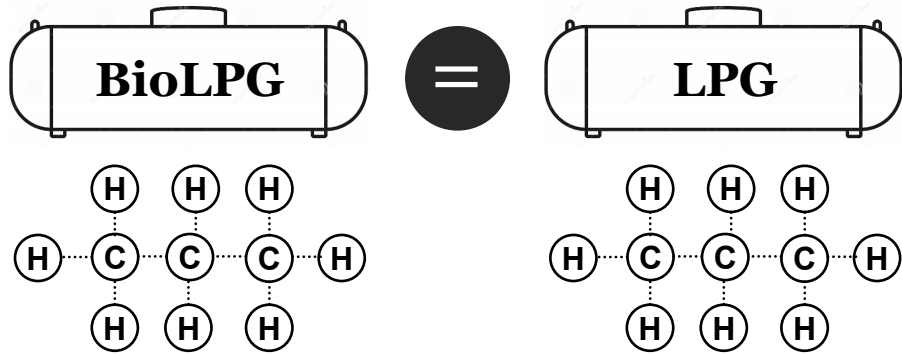


SHV Energy traditional focus is steps 2 to 7

We partner and collaborate with the skills and competencies to transform step 1



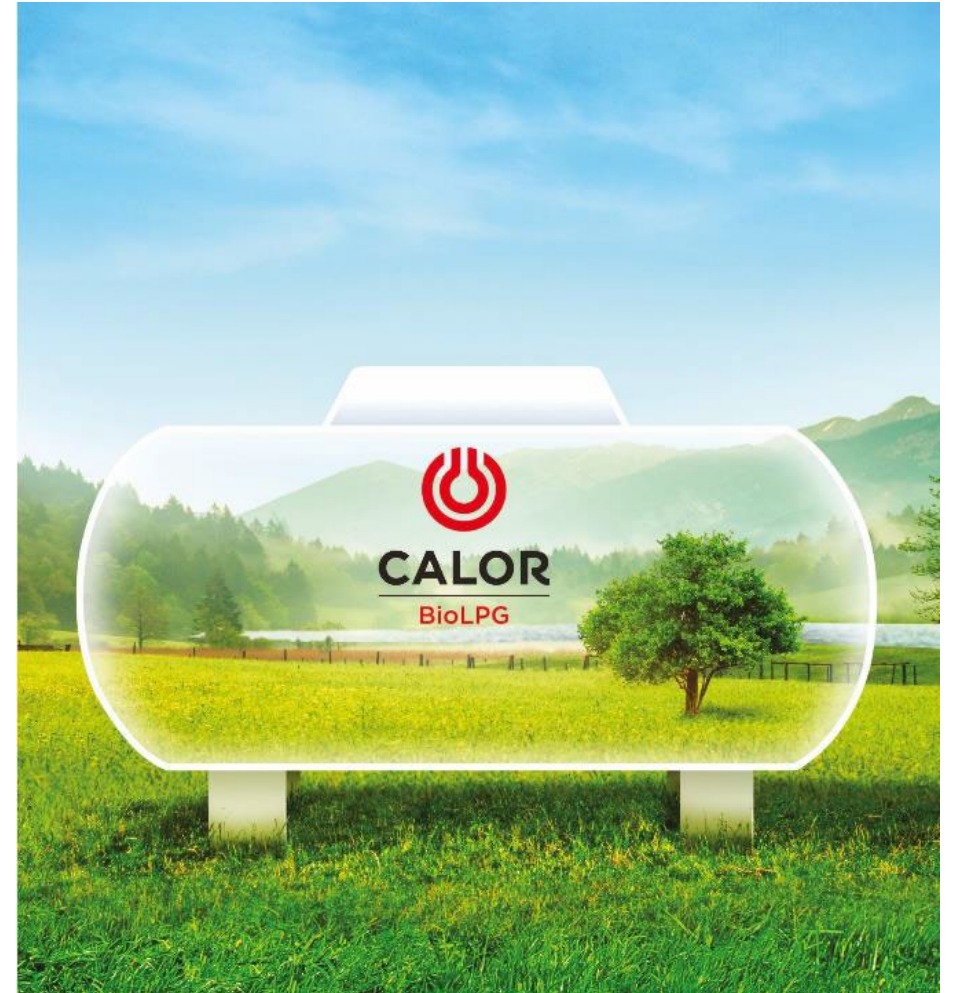
bioLPG available today in 10 European countries



BioLPG is identical in use and performance to fossil LPG: it is a DROP-IN SOLUTION

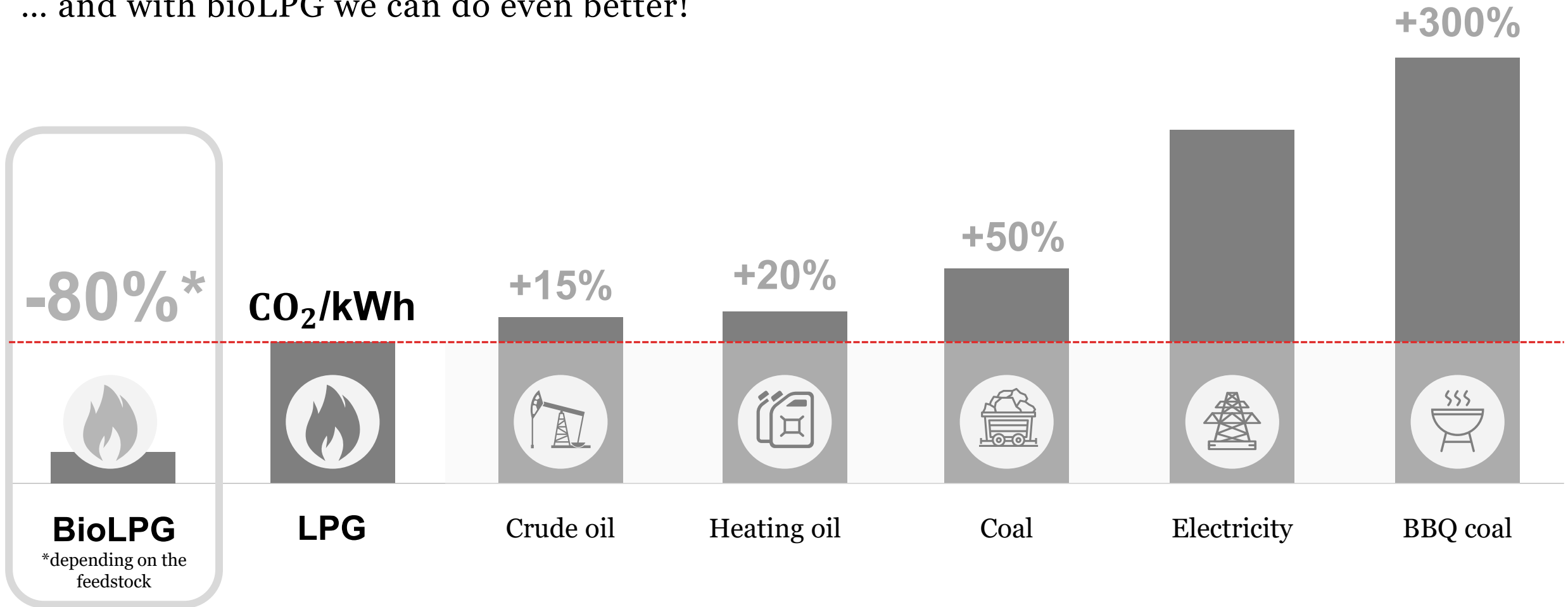
The difference is the

- 1 FEEDSTOCK** (made from 100% renewable sources) and the
- 2 PRODUCTION PROCESS** leading to reduced greenhouse gas emissions by up to 80%



LPG is lower carbon than other fossil fuels and has very low air pollutant emissions

... and with bioLPG we can do even better!



Source : Ecuity analysis for FREE report 'Scenarios for decarbonising EU homes in rural areas'

Multiple pathways to produce bioLPG

Feedstock

(Used) Vegetable oils / animal fats

Glycerine

Bio-Isobutanol

Solid biomass

Solid biomass

Glycerine / aqueous phase of pyrolysis oil

Sugar / starch / solid biomass

Sugar / starch / solid biomass

Syngas

Conversion technology

- 1 Hydrogenation
- 2 Dehydration / hydrogenation
- 3 Dehydration / hydrogenation
- 4 Methanol to DME
- 5 Methanol to Gasoline (MTG)
- 6 Fischer Tropsch (FT) synthesis
- 7 Methanation
- 8 Pyrolysis / hydrogenation
- 9 Aqueous phase reforming
- 10 Supercritical water / biological hydrolysis
- 11 Hydrolysis / fermentation

Drop-in BioFuels

- 5-8 % propane as co-product HVO diesel
- 95% propane from glycerine
- Isobutene / Isobutane
- DME as the main product (further DME to propane possible)
- 10-30% propane + butane as co-product of gasoline
- 1-2% propane + butane as co-product of diesel + kerosene
- Signification fraction of propane + butane as co-product of methane
- 2-3% LPG components as co-product of pyrolysis + hydrogenation oils
- Various fuels including LPG
- Propane
- Isobutanol



—Introducing rDME : A new (yet proven) renewable liquid gas!

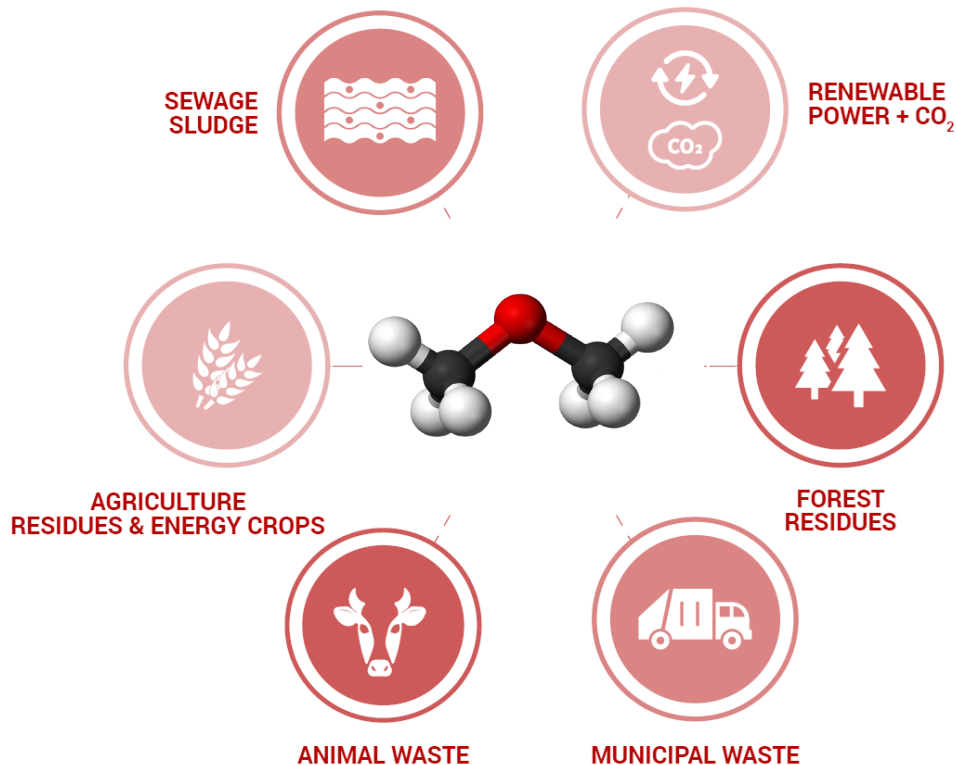
JV between SHV Energy and UGI Corporation, two of the largest LPG distributors to bring scale and critical mass to the rDME market

The Dimeta will:

- develop opportunities for investment in **production capacity**
- promote the use of rDME by driving efforts geared at broad **market acceptance**, including:
 - Development of the **end use** technologies for the use of rDME
 - Support for the development of **infrastructure**
 - Support for the development of **regulations and standards** for the safe use of rDME in the off-grid energy sector



— rDME* the closest drop-in solution to LPG... and more!



✓ Volumes of bioLPG via HVO are limited:

- Constrained by volume and price of feedstock
- Alternative routes to bioLPG are in development – but will take at least 5 years to get to maturity

✓ rDME is (potentially) available today:

- rDME production technologies are already available
- rDME as main product
- Different abundant feedstocks can be used: manure, MSW, biomass + intermediates (biogas / rMeOH)

✓ rDME is very similar (but not identical) to LPG:

- It can be used blended (e.g. 20%w) or pure (100%) with limited modifications to existing LPG industry infrastructure
- CO₂ and pollution reduction similar compared to bioLPG (dependent on processes / feedstocks)

rDME* = renewable dimethylether (C_2H_6O)

New joint venture to scale-up rDME production



Circular Fuels Limited

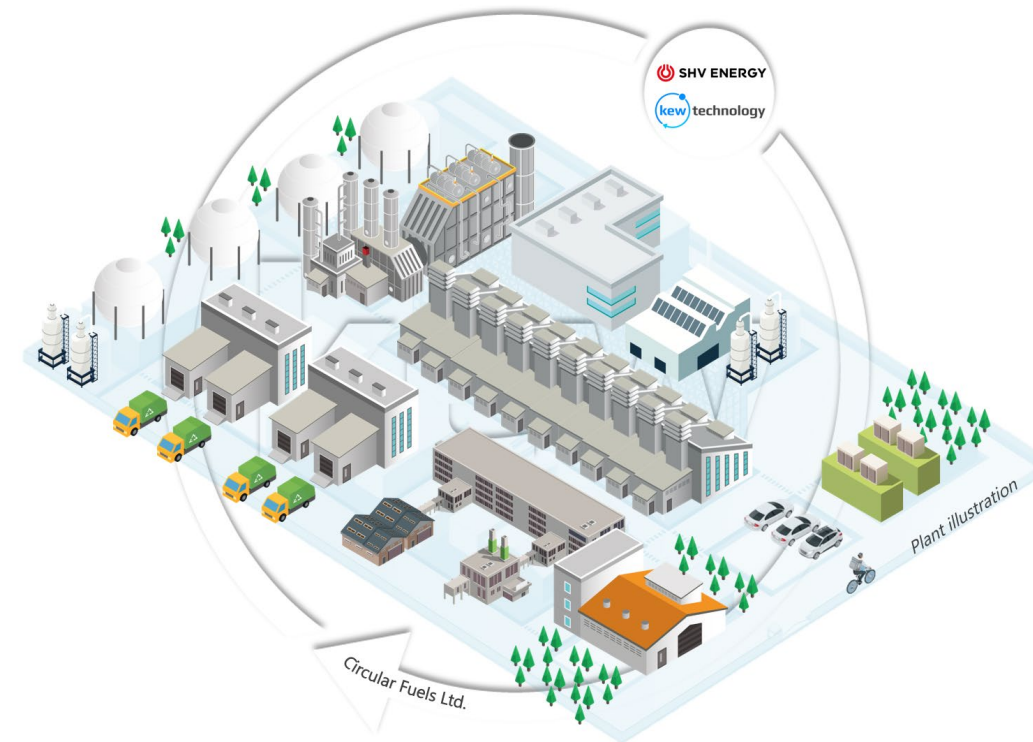
Circular Fuels Ltd (CFL): Originally joint venture between KEW technology and SHV Energy*. CFL is a DevCo to develop rDME production plants through SPVs.

Process: Gasification + DME synthesis

First commercial plant:

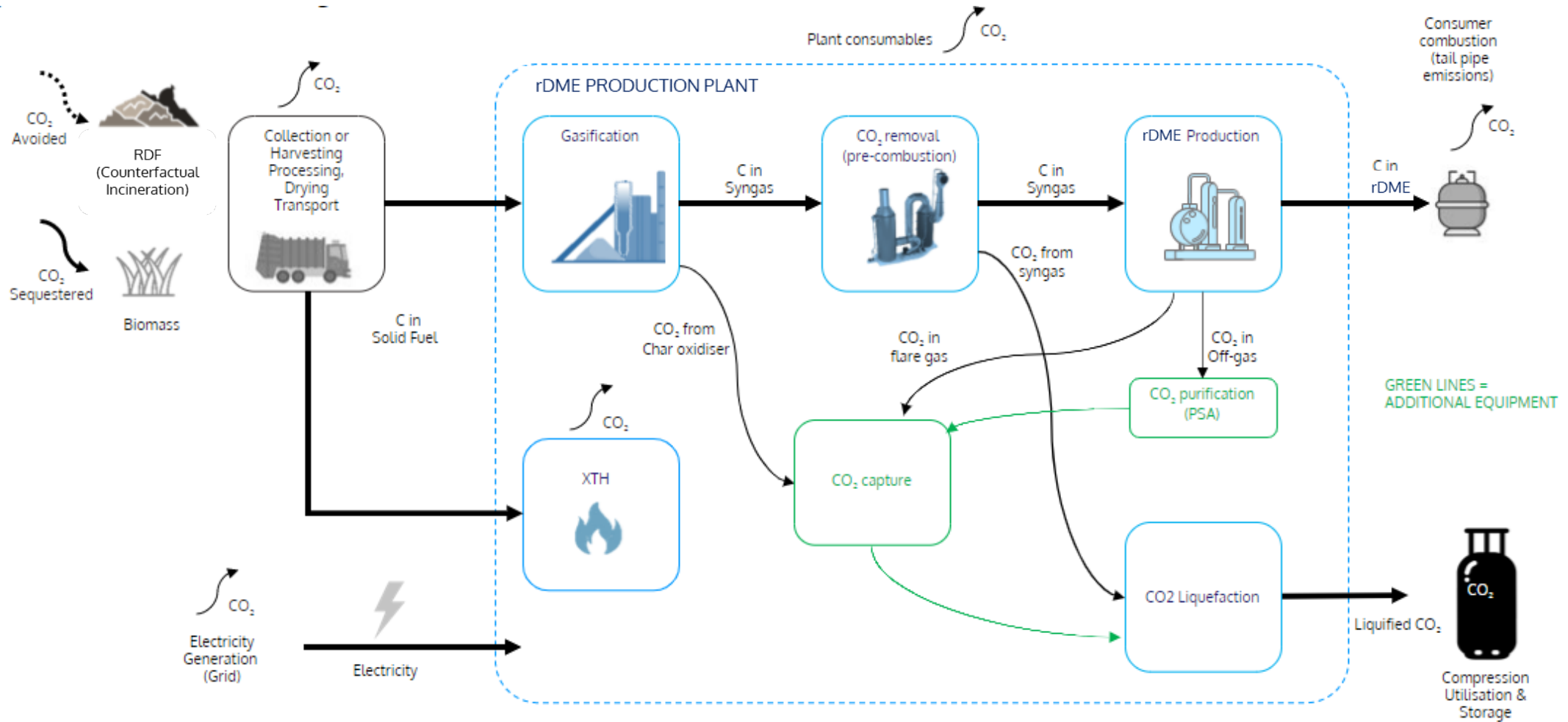
- 50 ktonnes / year rDME produced from MSW / RDF
- Located in UK
- FEED study completed
- Production expected Q4-23

Subsequent plants: Across Europe and North America

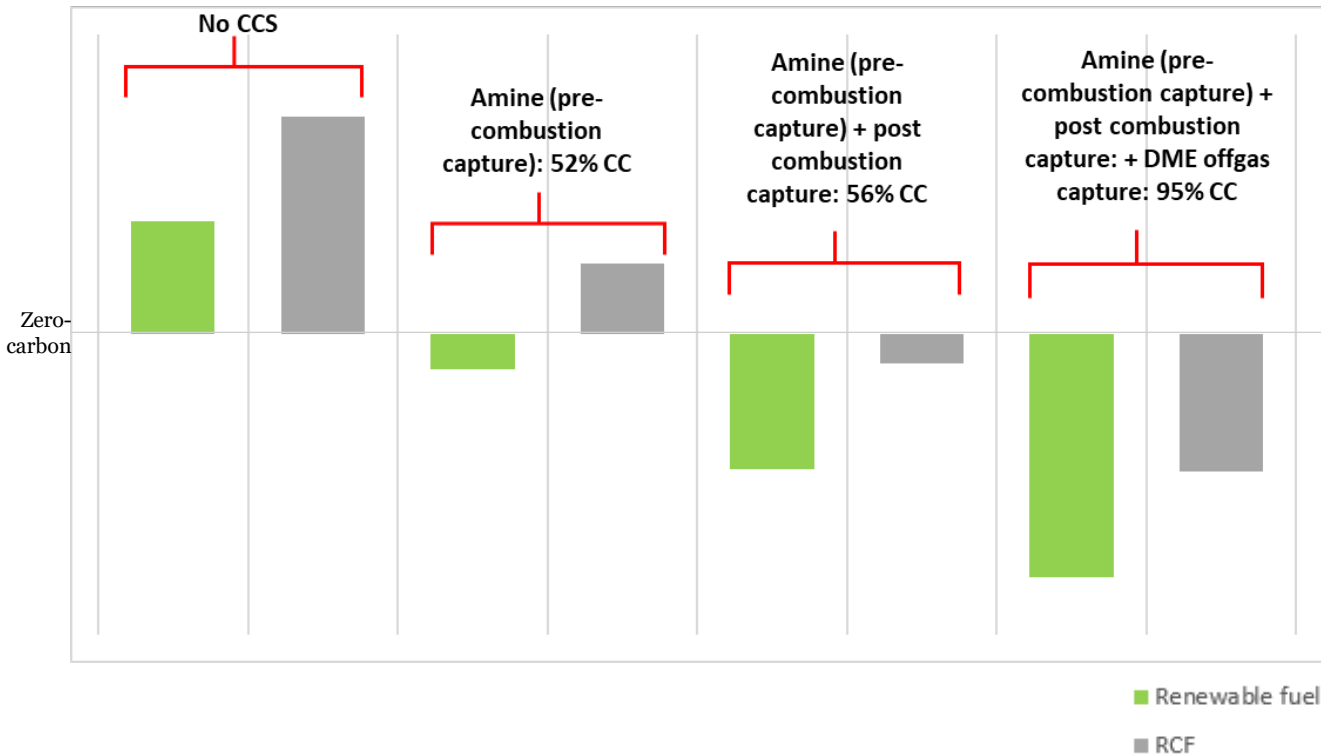


*CFL has now been transferred to SHVE / UGI JV Dimeta

Carbon capture ready



Carbon capture can progressively reduce the GHG intensity of rDME produced from municipal waste



rDME Carbon intensity dependent on

- Methodology
- Degree of capture (CAPEX) and configuration
- Availability of CO₂ pipeline/transportation
- CI of electrical supply
- Renewable content of feedstock

Note that rDME will be a single product (not separate biogenic/recycled carbon molecules)

*Preliminary results
Plant configuration assuming heat and power provided from waste.*

Final message

**The fastest way to
decarbonisation is
defossilisation**



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