ARKHITEKTON
ENERGY

The Arkhitekts of Global Change

Green Methanol from Residual Waste

Compressed-Feed High-Temperature Gasification (CFH) – turning waste wood, refuse-derived fuel and biomass residues into certified green methanol, clean syngas and an inert glass-like aggregate.

>1,200°C
tar-free gasification

≥95%
resource utilisation

50,000 t
methanol a year per train

≥85%
volume reduction

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We build green fuel plants on the sites that already handle the waste

Arkhitekton Energy develops, finances and delivers CFH gasification plants in partnership with UK waste operators. The waste stays where it is collected; we bring the technology, the engineering, the finance and the buyers for the product.

150,000 t
Feedstock processed per train each year (20 tonnes an hour)

50,000 t
Methanol produced per train each year, certified for its renewable share

≥85%
Reduction in waste volume, with inorganic ash melted into reusable slag

~2 ha
Footprint of a modular gasification train

1

Technology

A proven compressed-feed gasifier combining the strengths of fixed-bed and entrained-flow designs, with reference plants operating commercially since 2023.

2

Delivery

We take each project from feasibility, permitting and grid connection through EPC, commissioning and long-term operation and maintenance.

3

Partnership

Each plant sits in a project company owned 50/50 with the host site, on a peppercorn lease, with the host saving on its own disposal costs.



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Shipping is choosing methanol

Methanol is the leading alternative marine fuel: it is liquid at room temperature, uses familiar bunkering infrastructure, and conversion costs for ships are low. Regulation is now putting a price on the carbon in conventional fuel.

- **IMO** – at least 40% lower carbon intensity in international shipping by 2030 (vs 2008) and net-zero by around 2050.
- **UK ETS** – domestic shipping and ships in UK ports (5,000 GT and above) brought into the UK Emissions Trading Scheme from 1 July 2026.
- **EU ETS and FuelEU Maritime** – shipping in the EU ETS since 2024; FuelEU sets falling greenhouse-gas limits for energy used on board.
- **UK RTFO** – waste-derived renewable methanol supplied as road fuel earns double-counted Renewable Transport Fuel Certificates.
- **UK supply chain** – the UK's first commercial bio-methanol bunkering service opened at the Port of Immingham in February 2026.

138
methanol-fuelled vessels ordered in 2023 – more than LNG (130), out of 298 alternative-fuel orders (DNV)

20m t
green methanol a year one leading container line estimates it would need if its whole fleet ran on methanol

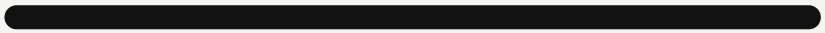
Value of bio-methanol to shipping

Average maximum price a ship operator can pay, 2025–2050 (Methanol Institute)

FuelEU Maritime only – €1,193/t



FuelEU Maritime + EU ETS – €1,335/t



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Sources: DNV; Methanol Institute (2024); UK ETS Authority; DfT RTFO guidance; Methanex/Exolum (Feb 2026)

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Four ways to make green methanol – gasification is ready now

Only methanol made from biomass or from green hydrogen with captured CO2 counts as green methanol (IRENA, 2021). Of the four routes, biomass gasification offers the best combination of feedstock flexibility, carbon conversion and technical maturity today.

Route	Process	Feedstock	Strengths	Constraints
Biomass fermentation	Fermentation → biogas → reforming → methanol	Wet biomass (30–60% moisture)	Mature anaerobic digestion	Slow, large land take, digestate to manage – not recommended
Biomass gasification	**Gasification → syngas clean-up → methanol**	**Dry biomass and waste (<30% moisture)**	**Flexible feedstock, high carbon conversion, mature engineering, suited to large scale**	**Tar and pollutants in conventional gasifiers – solved by CFH's >1,200°C design**
Power-to-methanol	Electrolysis H2 + renewable CO2 → methanol	Water, renewable power, CO2	Fully green, large long-term potential	High cost today, complex integration, depends on cheap renewable power
Biomass + green hydrogen	Gasification with added electrolytic H2	Biomass, water, power	Uses up to 100% of the biomass carbon	Two complex processes; a later upgrade path for a gasification plant

Route 1 – shift, no added H2

Simplest plant. Uses about 32% of the syngas carbon; the rest leaves as high-purity CO2 that can be sold or stored.

Route 3 – partial H2 make-up

Adding green hydrogen raises carbon use to about 55%, almost doubling methanol per tonne of feedstock.

Route 4 – full H2 make-up

All of the carbon is converted to methanol – the long-term upgrade as green hydrogen becomes cheaper.

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Carbon utilisation figures from technology partner process studies

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Certified green, from feedstock to buyer

Buyers pay a premium only for methanol they can prove is green. Every plant is designed to meet the EU Renewable Energy Directive (RED II) and certified under ISCC, the most widely recognised scheme in Europe.

ISCC EU

Mandatory for biofuels sold into the EU energy market, including bio-methanol made from wastes and residues.

ISCC PLUS

Voluntary certification for chemical, marine and other markets outside the EU fuels regime.

ISCC CORSIA

Approved by ICAO for sustainable aviation fuel – relevant if methanol is later upgraded to jet fuel.

Greenhouse-gas saving thresholds

Biomass methanol	**≥65%** saving · max 0.655 kg CO2/kg
Power-to-methanol	**≥70%** saving · max 0.562 kg CO2/kg
Green hydrogen	max 2 kg CO2/kg H2

Chain of custody

Feedstock origin → **Collection point** → **CFH plant** → **Buyer**

Every stage is certified and material is tracked by mass balance; renewable, non-renewable and fossil inputs can be mixed but are recorded separately.

Path to certificate

Register with ISCC and choose a certification body → document review and on-site audit → close out findings → certificate issued.

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Thresholds per RED II as applied by independent certification bodies

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Built to overcome the limits of conventional gasifiers

Most gasifiers were designed for coal. Biomass and waste behave differently – they crumble, melt at low temperature and are rich in alkali metals. CFH was developed specifically for them.

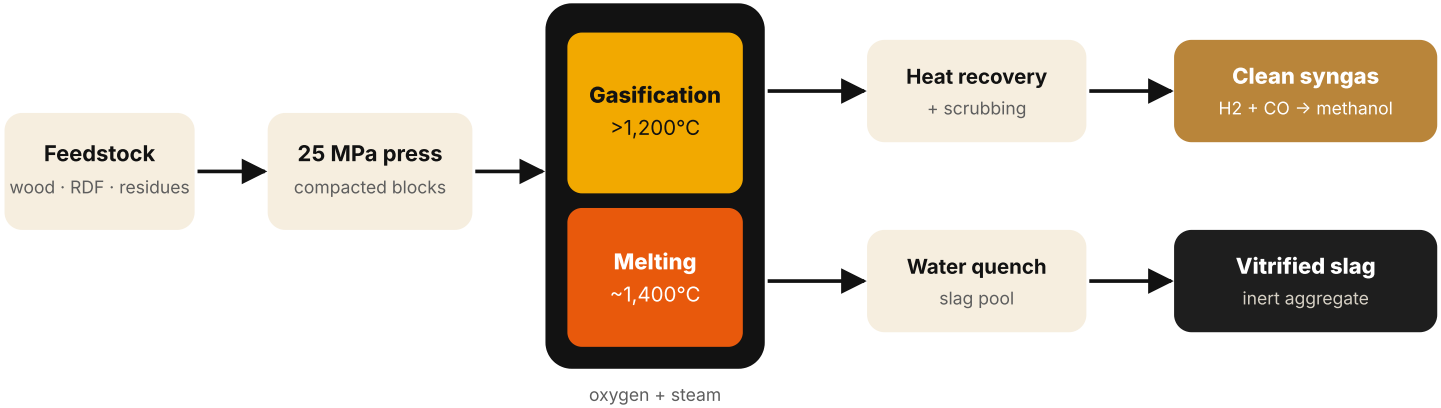
	Fixed bed	Fluidised bed	Entrained flow	CFH (compressed feed)
Feedstock form	Lumps / pellets 5–50 mm	Pellets 3–10 mm	Ultra-fine powder <1 mm	**Hydraulically compacted blocks – size reduction only**
Moisture tolerance	High (≤30%)	Medium (≤20%)	Very low (≤10%)	**High (≤30%)**
Reaction temperature	300–1,200°C, uneven	700–900°C	1,200–1,600°C	**1,200–1,400°C, fairly uniform**
Tar in syngas	High	Low (<50 g/m³)	Near zero	**Near zero (<0.1 g/m³)**
Carbon conversion	90–95%	<90%	>95%	**90–95%**
Equipment cost	Low	Medium	High	**Low**
Energy use	Low	Medium	High (pure oxygen, fine grinding)	**Low – waste heat boosts syngas pressure**
Main problem	Tar, bed collapse	Slagging, coking, low conversion	Costly milling and feeding	**–**

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Comparison based on technology partner engineering assessment

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How CFH works



1

Compaction and feeding

A 25 MPa hydraulic press forms the feedstock into dense blocks with a stable skeleton – no binder, pelletising or fine grinding. The bed does not collapse.

2

High-temperature gasification

Above 1,200°C the organic matter is fully gasified – no tar, no methane or long-chain hydrocarbons, very little coking.

3

Melting and quench

A separate zone at about 1,400°C melts the ash, which is quenched into a glass-like slag well within national standards.

4

Gas cooling and heat recovery

Waste heat raises steam and boosts syngas pressure, cutting the energy needed downstream.

5

Water treatment

Low ash and no tar keep scrubbing and wastewater treatment simple; salts and sulphur are recovered.

6

Syngas purification

The clean syngas goes on to methanol synthesis – or to hydrogen, power or substitute natural gas.

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Schematic – not to scale

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Clean by design

100%
of waste rendered harmless

≥95%
resource utilisation

≥85%
volume reduction

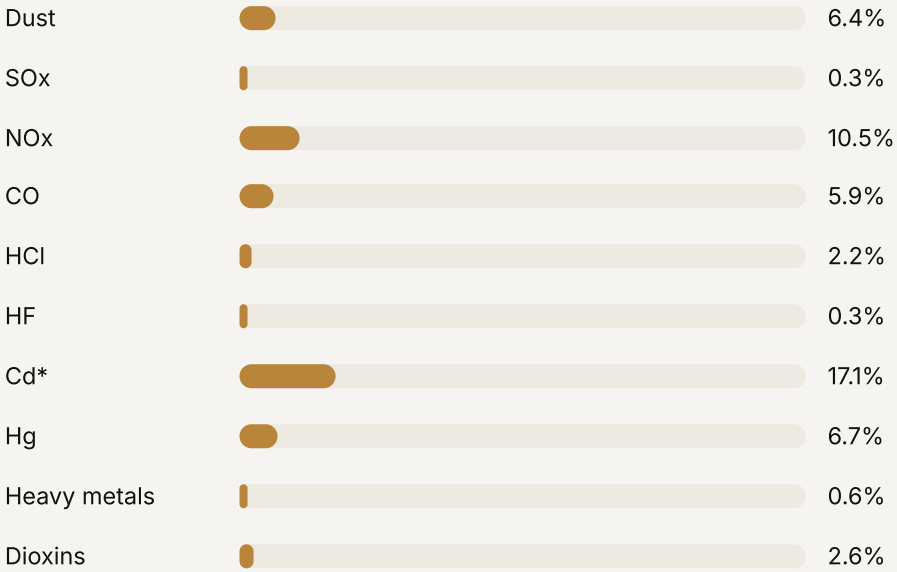
1,000 Nm³
syngas per tonne of feedstock

10–15 MJ/kg
feedstock design range, up to 30% moisture

60–110%
turndown range of a train

Emissions as a share of the international limit

Measured flue gas when the syngas is used to generate power, reference plant



Every pollutant measured at under a fifth of the limit; most under a tenth. Gasification itself creates no secondary pollution. *Label partly illegible in the source data; to be confirmed with the technology partner.

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Reference plant data supplied by our technology partner; UK permits will set site-specific limits

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Two products from one gasifier

Syngas

Mainly hydrogen, carbon monoxide and carbon dioxide, with no methane, tar or ammonia – an ideal feed for methanol synthesis.

Component	mol %	Component	mol %
Hydrogen (H2)	26.4	Nitrogen (N2)	4.58
Carbon monoxide (CO)	32.5	Hydrogen sulphide (H2S)	0.26
Carbon dioxide (CO2)	26.6	Carbonyl sulphide (COS)	0.03
Water (H2O)	9.7	Methane / ammonia	0

At 1,200°C and 10 kPa(g); calorific value 2,060 kcal/Nm³ including sensible heat.

Why the gas is so clean

Gasifying above 1,200°C breaks down tars and long-chain hydrocarbons completely, so the syngas needs only simple scrubbing and purification before synthesis – fewer process steps, less wastewater and lower operating cost.

Vitrified slag



SiO2	Al2O3	CaO	Na2O	MgO	K2O	Other
42.4%	16.8%	16.1%	5.32%	1.64%	0.78%	<0.5%

A dense, glass-like granulate suitable as secondary aggregate for building materials, subject to UK end-of-waste approval.

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Typical analyses from reference plant operation

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Takes what other gasifiers can't

Because CFH compacts its feed rather than pelletising or grinding it, it accepts bulky, mixed and wet material straight from the waste yard – including bales and lump material over a metre long.



Waste wood

Grade B and C wood, offcuts and oversize from shredding.



RDF and SRF

Refuse-derived fuel and solid recovered fuel from residual waste.



Agricultural residues

Straw, husks and other crop residues, baled or loose.



Biomass

Forestry residues, chip and pellets.

10–15 MJ/kg
calorific value

≤30%
moisture

20 t/h
per train

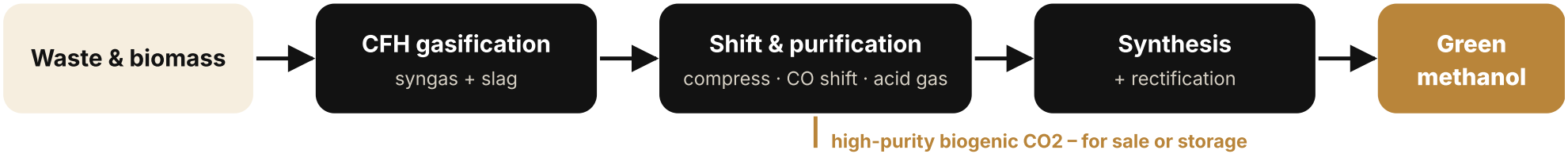
The biogenic share of the feed sets how much of the methanol can be certified as renewable, so plants are designed around the highest practical share of wood and biomass.

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Feedstock suitability is confirmed by testing for each site

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One train: 150,000 tonnes in, 50,000 tonnes of methanol out



Reference project – commercial green methanol plant

Annual methanol output	**50,000 t**
Feedstock for gasification	**20 t/h · 150,000 t/yr**
Feedstock specification	<30% moisture, >2,500 kcal/kg
Operating hours	8,000 h/yr design
Flexibility	60–110%
Jobs	~50 direct · ~100 indirect
Supporting utilities	8–10 MW power supply

One of the first commercial green methanol demonstration plants in its market, built by our technology partner.

Three process units

Gasification – continuous high-temperature gasification of the organics and melting of the inorganics into glassy minerals.

Shift and purification – raw syngas is compressed, CO-shifted and stripped of acid gases to give a clean synthesis gas.

Synthesis and rectification – the gas is converted to methanol over catalyst, separated at high pressure and distilled to specification.

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Reference data supplied by our technology partner

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One gasifier, five markets

01
Green methanol
Marine fuel, chemicals and road-fuel blending

02
Power
Syngas co-firing to decarbonise existing boilers

03
Aviation fuel
Syngas and methanol as routes to sustainable aviation fuel

04
Natural gas
Substitute natural gas for grid or transport

05
Hydrogen
Shift and PSA separation to high-purity hydrogen

Reference: 20 MW power decarbonisation

Feedstock	18 t/h · 150,000 t/yr
Syngas output	18,615 Nm³/h
Electricity generated	160 GWh/yr
Coal displaced	63,000 t/yr
CO2 avoided	**123,000 t/yr**

Reference: biomass to hydrogen

Feedstock	500 t/day · 160,000 t/yr
Hydrogen output	8,000 t/yr
Steam output	200,000 t/yr
Footprint	~25,000 m²
Project IRR (after tax)	**>15% · ~6-year payback**

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Reference projects delivered by our technology partner outside the UK; UK economics differ

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A partnership model built for waste operators

50/50 project company

The host site and Arkhitekton Energy each own half and share profit equally after costs, debt and tax.

£1 peppercorn lease

About 2.5 hectares for 20 years, with lender step-in and full decommissioning at the end.

Half-price disposal

The host pays 50% of the daily spot price for each waste stream it supplies – an immediate saving on every tonne.

We bring the rest

Technology, EPC, finance, permits, certification and the buyers for methanol, CO2 and slag.

Technology heritage

- **2016–17** Research into biomass use and market need
- **2017–18** Thermal-sorting prototype adapted for biomass
- **2018–20** Collaborative R&D with high-technology partners
- **2020–23** Demonstration plant built on pilot results
- **2023 →** Commercial plants in operation

12 yrs
committed feedstock period

£1
peppercorn rent a year

50%
of spot disposal price saved by the host

50/50
share of distributable profit

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Terms summarised for information; binding terms are in the Project Documents

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Turn your waste stream into a green fuel business

Talk to us about hosting a CFH green methanol plant on your site.

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