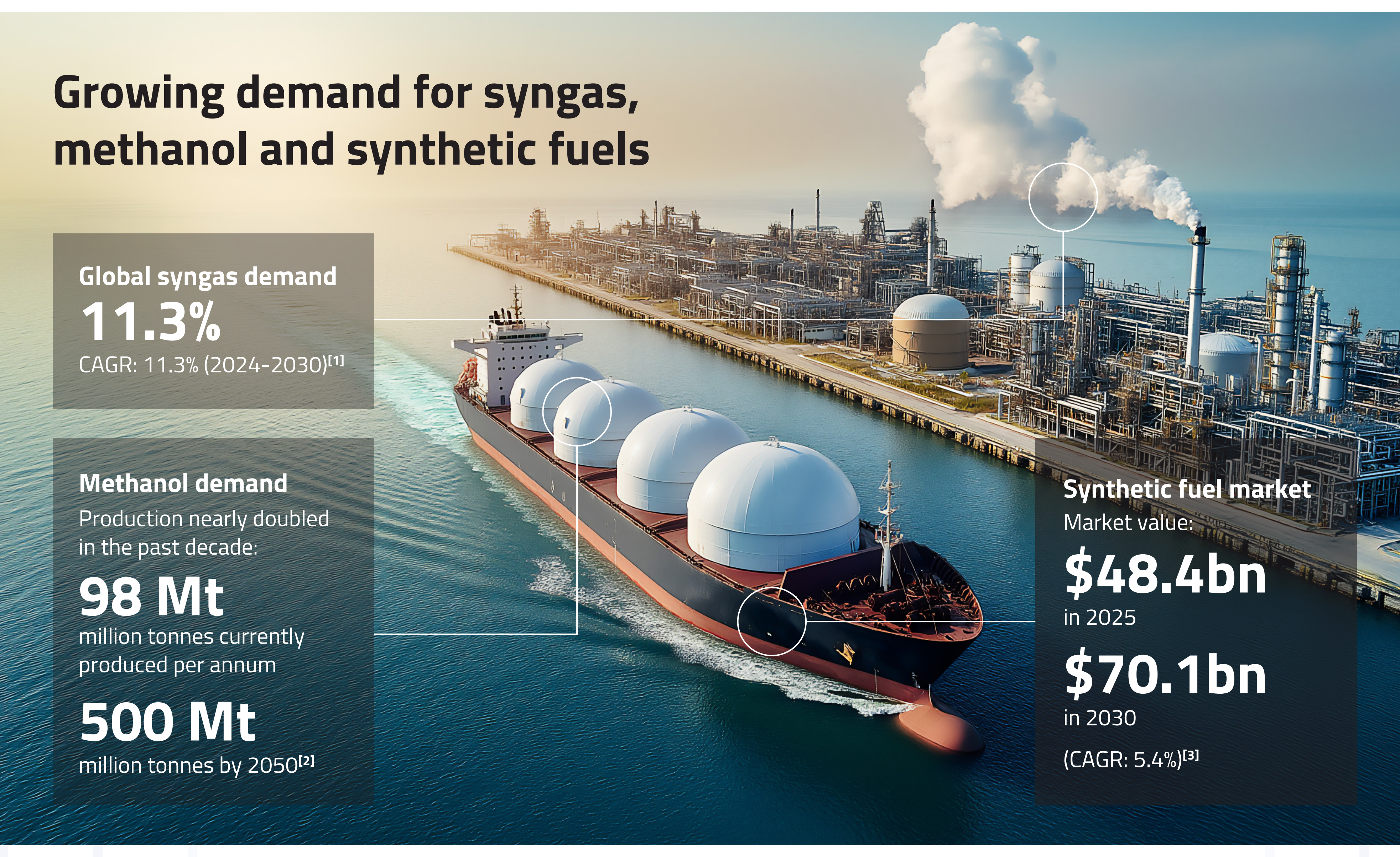
Solving reverse water-gas shift (RWGS) challenges with DRIFTS

The reverse water-gas shift (RWGS) reaction converts CO_2 and H_2 into CO and H_2O. It is crucial for syngas, methanol, and synthetic fuel production in petrochemicals, chemical manufacturing, and green fuels.

$$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$$

Growing demand for syngas, methanol and synthetic fuels



Global syngas demand
11.3%
CAGR: 11.3% (2024–2030)[1]

Methanol demand
Production nearly doubled in the past decade:
98 Mt
million tonnes currently produced per annum
500 Mt
million tonnes by 2050[2]

Synthetic fuel market
Market value:
$48.4bn
in 2025
$70.1bn
in 2030
(CAGR: 5.4%)[3]

Challenges with the RWGS reaction

Despite its significance, the RWGS reaction faces some challenges.

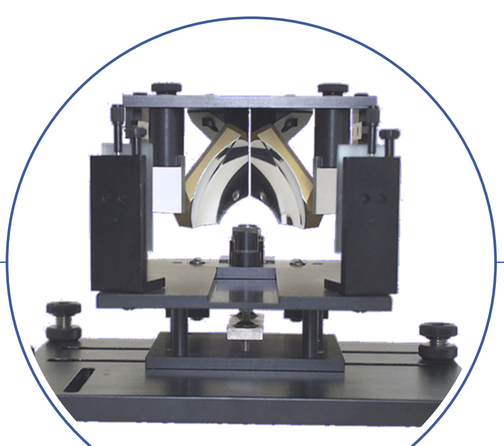
Catalyst efficiency
Developing catalysts that are both active and selective at lower temperatures remains a critical hurdle.

High energy requirements
The endothermic nature of the reaction requires elevated temperatures, leading to increased energy consumption.

Side reactions
Unwanted methanation can lower CO yield, while coking decreases catalyst efficiency, shortening its lifespan.

Advancing RWGS research with DRIFTS

Diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) is instrumental in advancing RWGS research.



In-situ monitoring
Allows real-time observation of catalyst surfaces under reaction conditions, providing insights into reaction mechanisms.

Data-driven decisions
Facilitates rapid assessment and optimisation, accelerating the development process.

Surface interaction analysis
Identifies intermediate species and pathways, aiding in the design of more efficient catalysts.

Innovating catalyst development through the RWGS

Recent research using DRIFTS has led to significant advancements and critical findings.

150°C
TEMPERATURES
Low-temperature catalysis
Iron-based catalysts have demonstrated high activity and selectivity for the RWGS reaction at temperatures as low as 423 K (150°C), reducing energy use.[4]

100
HOUR STABILITY
Enhanced catalyst stability
Nickel-based catalysts are showing superior performance; achieving near-theoretical CO_2 conversions at 450°C (44%) and 500°C (49%). 100-hour durability tests confirm long-term catalyst stability to help drive operation costs down.[5]

x2.6
IMPROVEMENT
Improved CO_2 conversion
A 1.51 Pt:Co ratio boosted CO_2 conversion 2.6 times more than pure Pt at 500°C in RWGS reaction, with over 98% CO selectivity, reducing unwanted methane.[6]

Ti^{3+}
FASTER RATES
Efficiency and faster reaction times
Gold-based catalysts boost RWGS efficiency. Au/TiO_2 catalysts convert CO_2 more effectively by using Ti^{3+} sites and oxygen vacancies. Operando UV-Vis confirms that more Ti^{3+} leads to faster reaction rates.[7]

x2
LIFESPAN
Doubling catalyst lifespan
Adding a small amount of silicon to Cu/ZnO methanol catalysts slows down wear and tear, making them last twice as long. This boosts the RWGS reaction, making CO_2-to-methanol conversion more efficient and sustainable.[8]

Industry impact

Petrochemical Companies and Refineries
Optimise processes for efficient CO_2 conversion.

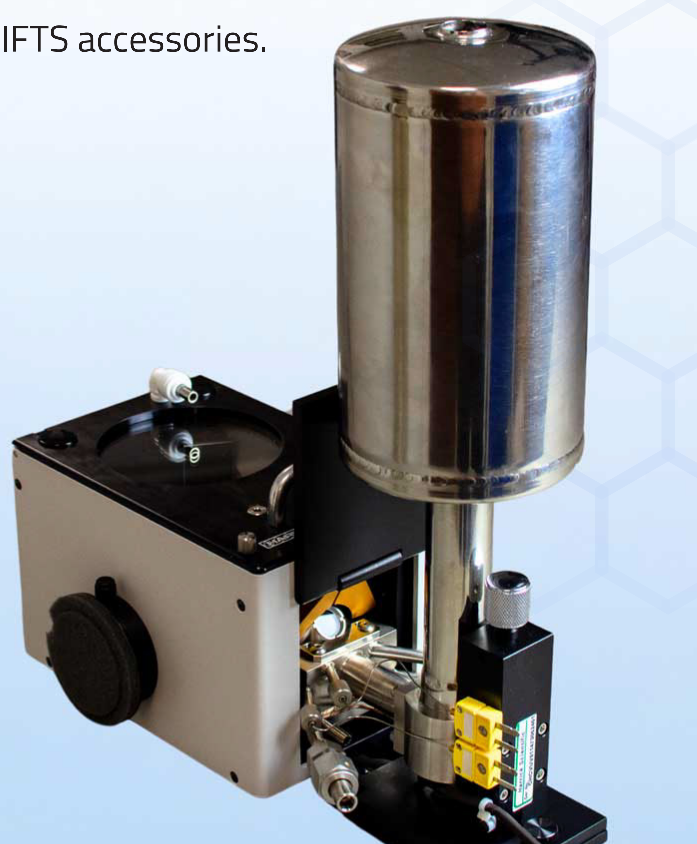
Quality Control Managers
Gain precise insights into catalyst performance.

Chemical Engineers and Sustainability Officers
Drive innovation in green technologies.

R&D Leads
Enhanced understanding of surface interactions.

The Praying Mantis™: the performance standard in DRIFTS

Unlock the full potential of your RWGS research with Specac's advanced DRIFTS accessories.



Performance excellence
Designed for accurate, real-time analysis of catalytic processes. 90° off-axis optical design efficiently collects diffusely reflecting light while minimising the specular reflection.

Enhanced data quality
Provides reliable insights, enabling informed decision-making in catalyst development. Delivers pure data even for complex powdered catalytic samples.

Robustness and versatility
Suitable for a wide range of applications, from academic research to industrial process optimisation. Handles extreme conditions (from -150°C to 910°C and up to 34 Bar of pressure).

Customisable components
Our team will happily tailor solutions to meet the unique needs of your project (e.g. designing custom low internal volume reaction chambers).

Ready to shift your catalyst research into new gear? Request a demo today.

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Specac, a leading provider of spectroscopic equipment for advanced research and industrial applications, now offers the Harrick Scientific Praying Mantis™ accessory- designed to deliver high-quality data for demanding R&D environments.

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