SINTEF
75 år

5th Sustainable Energy Day (SustainED)

Topic: Carbon Capture, Utilization, and Storage

CBS COPENHAGEN SCHOOL OF ENERGY INFRASTRUCTURE

NORD NET

SINTEF industry

Dept. Biotechnology and Nanomedicine

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5th Sustainable Energy Day (SustainED)

Topic: Carbon Capture, Utilization, and Storage

Sustainable CO_2 conversion to high-value lipids and proteins for feed and food applications

One of Europe’s largest independent research organisations

TURNOVER
4.4 billlion NOK

EMPLOYEES
2200

PROJECTS
6300

CUSTOMERS
3300

INTERNATIONAL TURNOVER
934 million NOK

NATIONALITIES
80

PUBLICATIONS (INCL. DISSEMINATION)
5900

SINTEF

World-class laboratories

– approx. 270 laboratory rooms and outdoor facilities

CO_2-laboratory, Tiller

Formation Physics

Multiphase Flow, Tiller

Mass spectrometry

Materials characterisation

Nanotechnology

Solar cells

Metal production

Advanced membranes

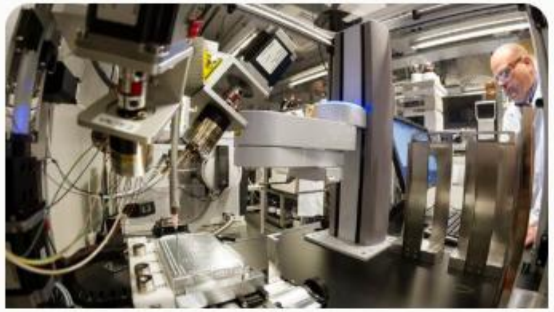
Material technology

Biotechnology

Biotechnology and Nanomedicine

Our expertise: Bioprocess development - Microbial molecular biology - Advanced research-based analyses - Nanomedicine, polymer particles and surface chemistry

Biomass Processing



High throughput screening facility, Trondheim

Mass spectrometry - Advanced research-based analyses

Molecular biology laboratory

Biotechnology and Nanomedicine

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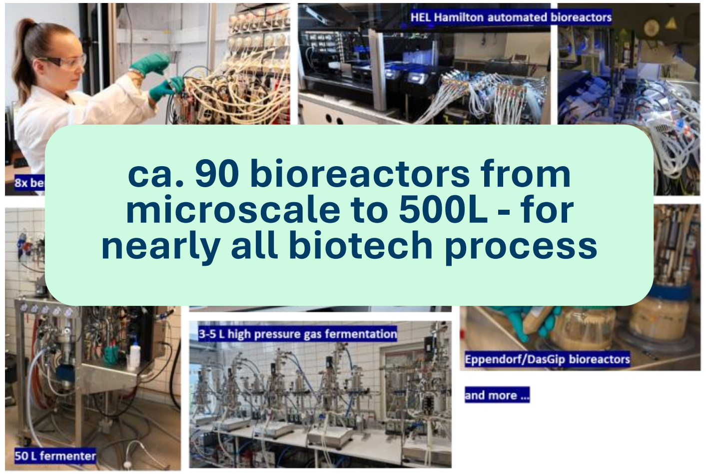
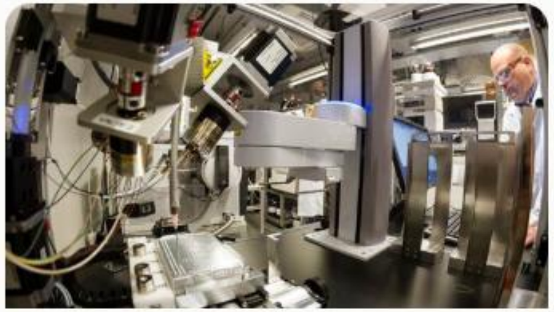


ca. 90 bioreactors from microscale to 500L - for nearly all biotech process

Brand new 1000 m² pilot facility with gas-and traditional bioreactors up to 20 m³

Biomass Processing



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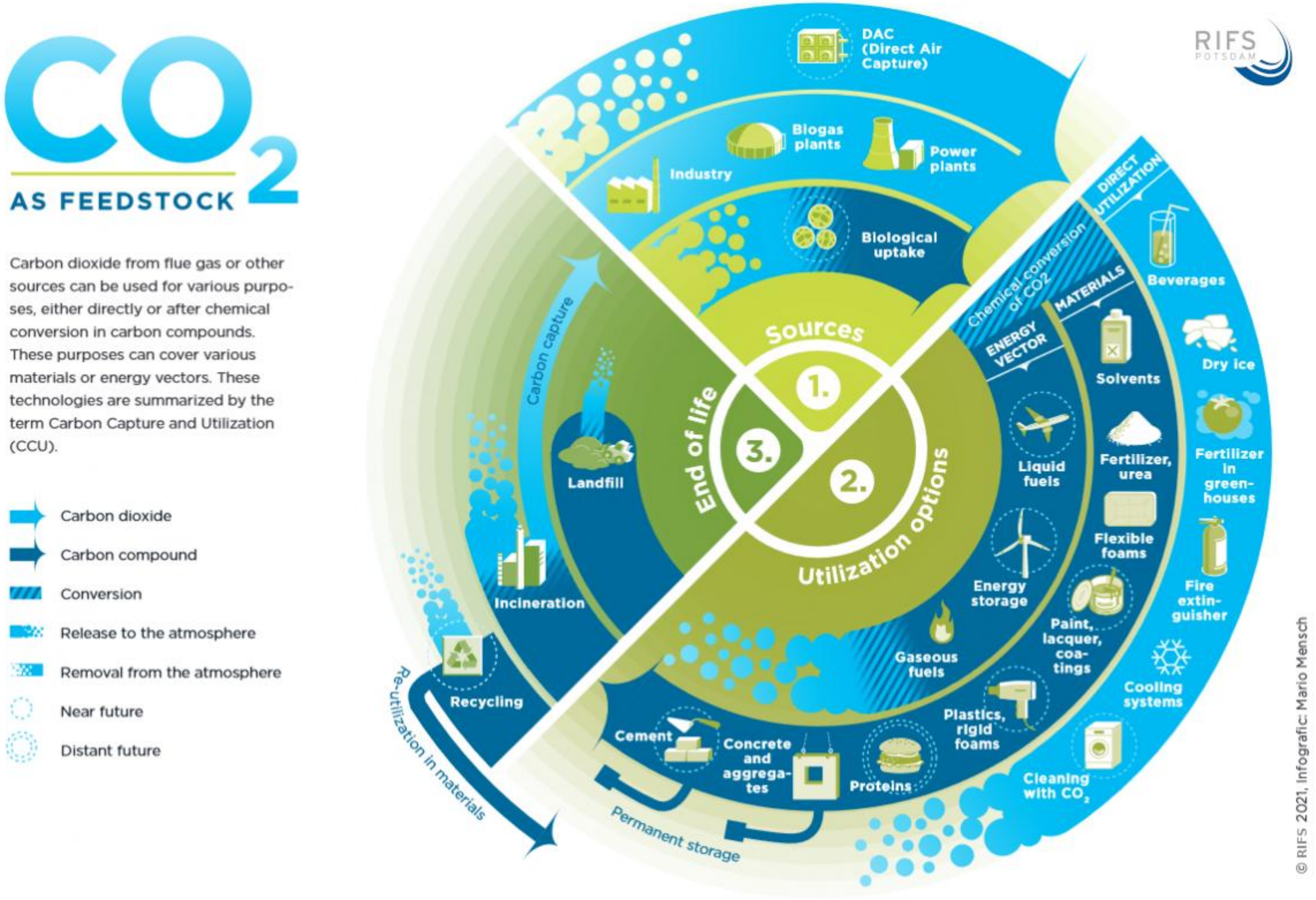
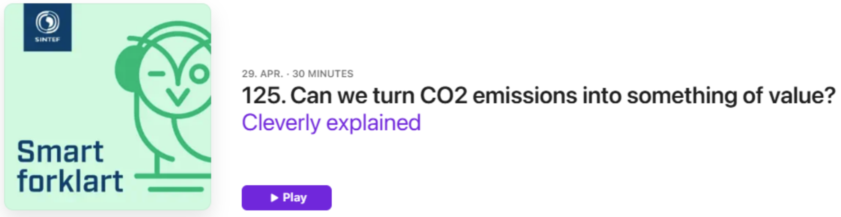
Opportunities and challenges of CO_2-Based Industrial Biotechnology



CO_2 as a resource

There are different paths aimed at the valorisation of CO_2.

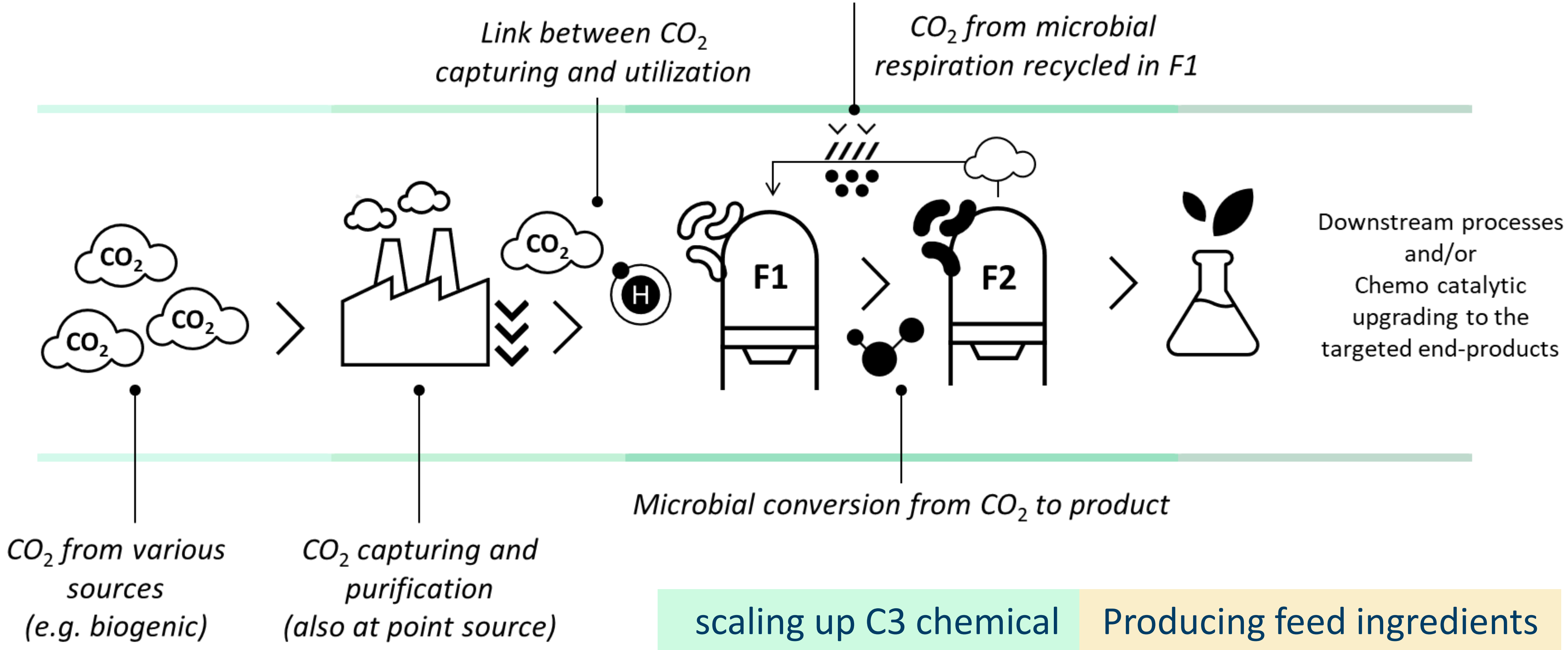
The aim is to combat climate change, replace fossil derived/less sustainable chemicals, materials and commodities and supplement the biomass resource that would not be sufficient to cover all our needs.



Converting CO_2 emission into products

Putting CO2 in good use through integrated value chains that combine CO2 sourcing and capturing – biotechnological conversion – chemo catalytic product diversification

We can target a vast array of end-products From chemicals to materials – from efuels to feed

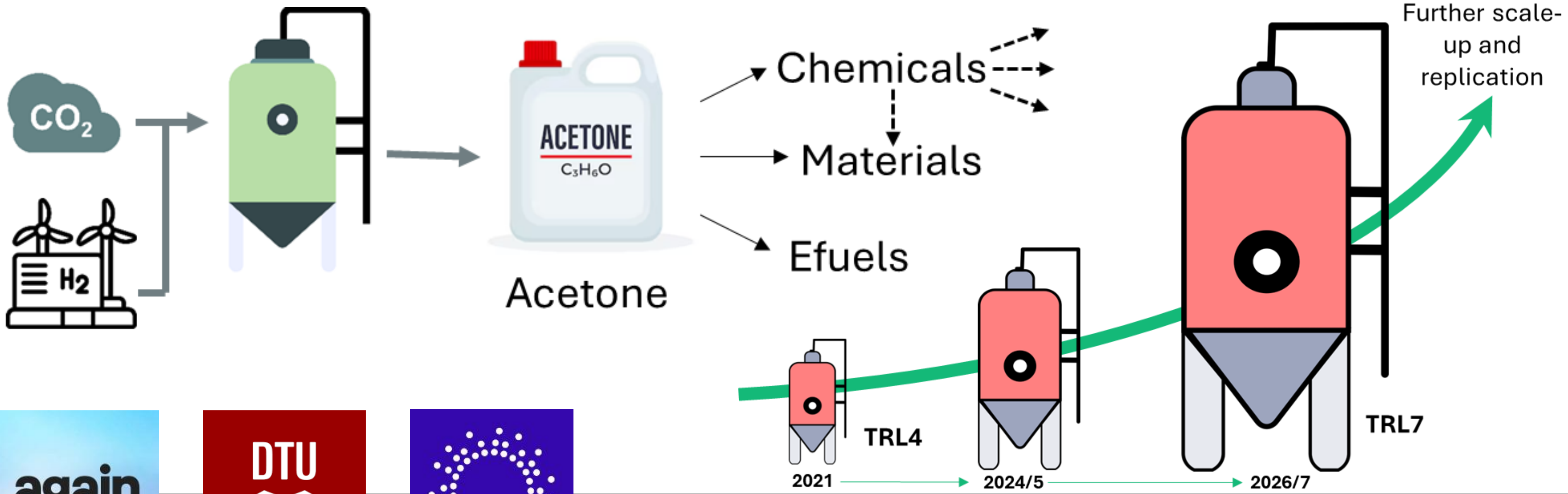


scaling up C3 chemical production in the PYROCO$_2$ project	Producing feed ingredients from CO_2 and optimization of CO_2 utilization.

C3 chemicals from CO_2

PYROCO2 Project: Converting CO_2 to high-value acetone

The PYROCO2 project addresses the challenge of producing **C3 chemicals from CO_2** by focusing on acetone, a building block less accessible than C2 molecules. Using thermophilic microbial fermentation, we convert CO_2 and green hydrogen into sustainable acetone. Scaled up to 10-50 m^3, this process is well projected towards industrial applications, providing a versatile petrochemical alternative with uses in **plastics, specialty materials, and fuels -** demonstrating the potential of circular carbon solutions.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101037009.

C3 chemicals from CO_2

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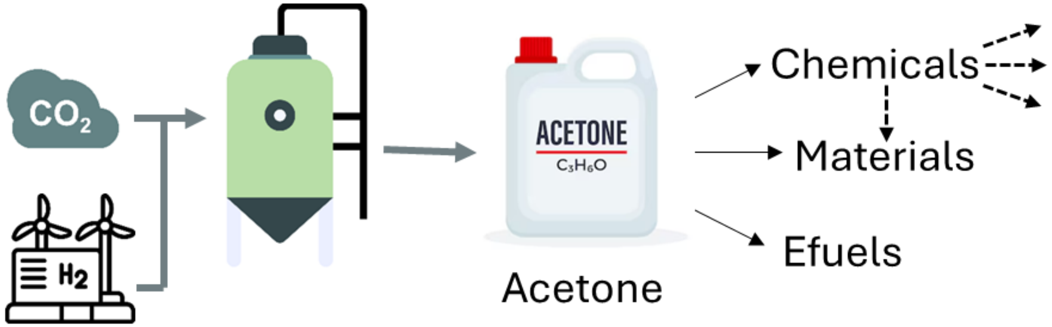

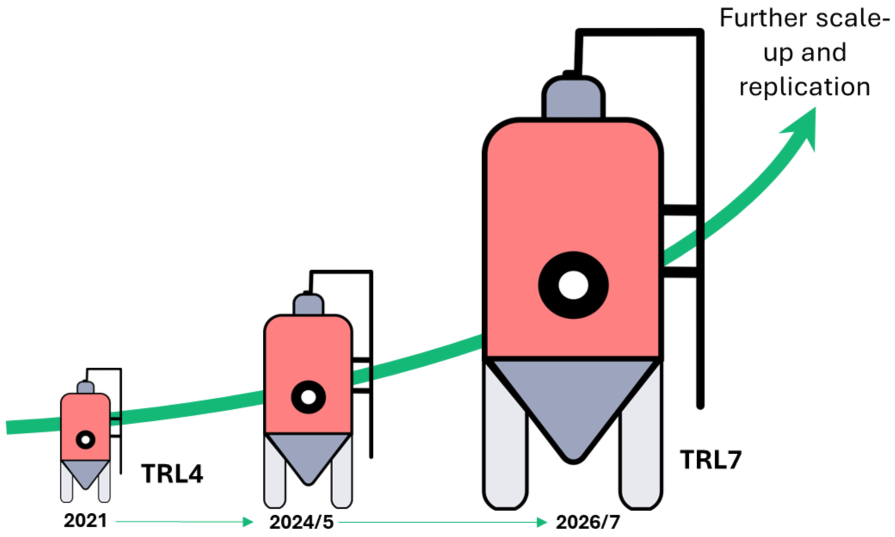

Solidifies SINTEF's leading position in industrial bioprocesses reaching higher TRLs (up to TRL7+)

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Converting CO_2 emission into feed ingredients

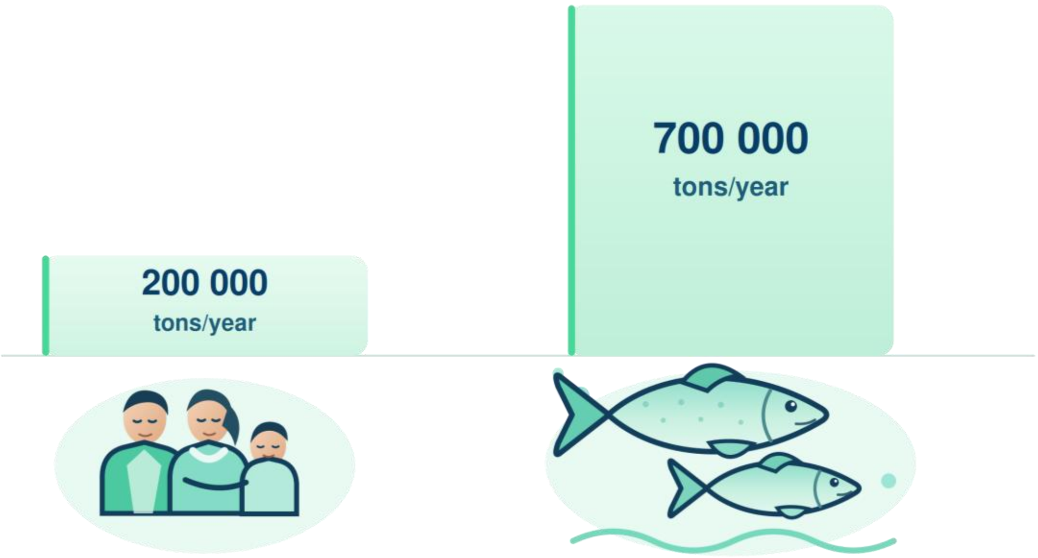
CO_2 into feed ingredients, a strategy poised to disrupt the traditional feed industry by significantly reducing costs and dependency on imported materials.

In 2024, Norway sold 1.55 million tonnes of farmed Atlantic salmon and 96,000 tonnes of rainbow trout, **requiring 2.19 million tonnes of aquaculture feed.**

Feed is the dominant climate and resource hotspot in salmon farming, accounting for around 75% of the farm-gate carbon footprint of Norwegian salmon. At the same time, Norway's sustainable-feed mission aims for all feed for farmed fish and livestock to come from **sustainable sources by 2034, while increasing the share of Norwegian-produced salmon-feed raw materials from about 8% to 25%**.

This creates an urgent need for scalable, low-footprint feed ingredients. CO_2-based biomanufacturing offers two complementary routes for **microbial protein and DHA-rich oils form CO_2-derived carbon streams**.

Protein consumption – Norwegian salmon and Norwegian population (2024)



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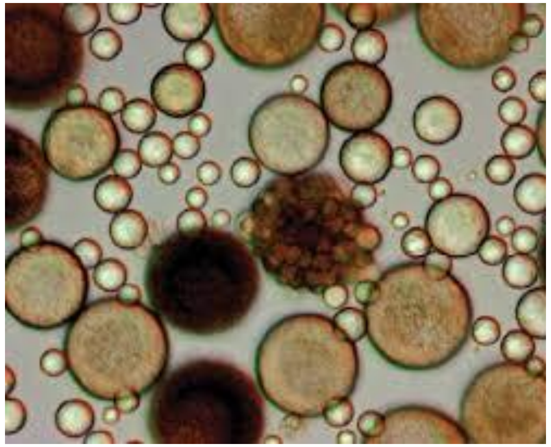
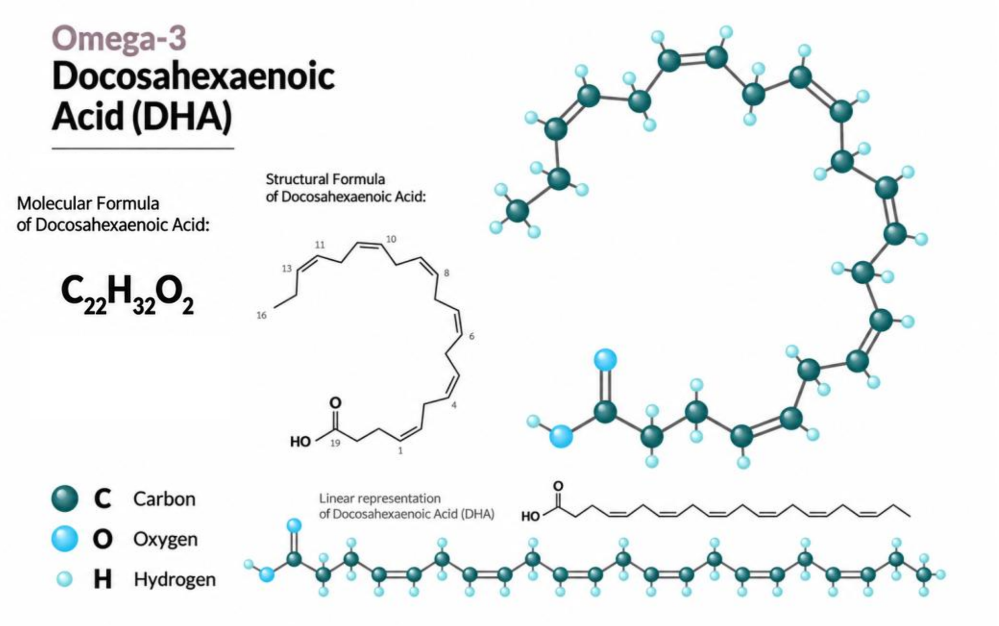


Thraustochytrids
Heterotrophic protists

Adult healthy fish needs 250 to 500 mg of omega-3 EPA+DHA per day

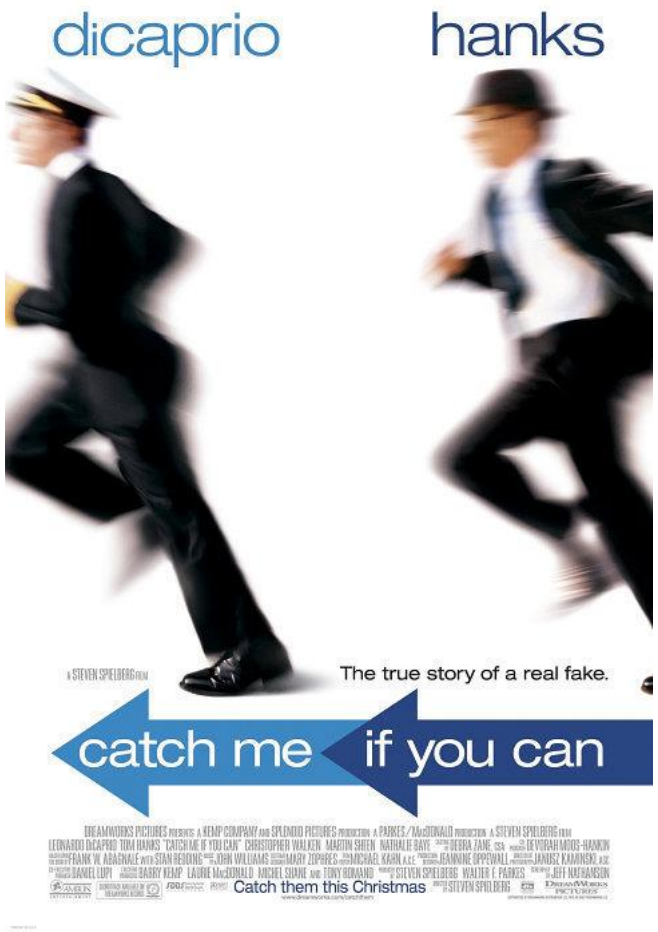


Accumulate bioactive substances such as docosahexaenoic acid (DHA), eicosapentaenoic acid (EPA), squalene and carotenoids.

DHA is a major structural component of the brain and retina. It is essential for the rapid growth and functional development of infants and young animals.

Food Sci Nutr. 2021 Jul 23;9(9):5229–5243. doi: 10.1002/fsn3.2299

Catch me if you can: The Carbon Chase – Capture, Use & Storage?



Capture the CO_2 and Let biology unlock its value

Use me if you manage….

Biotechnology creates new routes for turning CO_2 into valuable products.

Some of the key challenges of CO_2 utilization remains.

Some key advantages

- Mild operating conditions
- High product selectivity
- CO_2 replaces sugar feedstocks
- Broad product flexibility

Some key bottlenecks

- Low rates and titers
- Gas-transfer limitations
- High renewable-H_2 demand
- Difficult downstream recovery

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Biological CCU: strengths and trade-offs

Mild conditions and high selectivity ↔
Slow kinetics and low titers

CO_2 instead of sugar feedstocks ↔
Renewable-H_2 and energy demand

Self-renewing, adaptable biocatalysts ↔
Inhibition and culture instability

Flexible gas-stream utilization ↔
Impurities and mass-transfer limitations

Acetate as a versatile platform ↔
Dilute broth and product inhibition

Two-stage product flexibility ↔
Integration and compatibility challenges

Modular fermentation platforms ↔
Complex gas recycling and scale-up

Broad product portfolio ↔
Potentially costly downstream recovery

We have come a long way, but the chase is not over. Further optimization requires a truly multidisciplinary approach.

Let's collaborate

Acknowledgements

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PYROCO2

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NMBU

Our industrial collaborators:

again

NoMy Norwegian Mycelium

SKRETTING a Nutreco company

Technology for a better society