What if... you could adapt to new demands with renewable feedstock?

HydroFlex™ - Fuel for thought

www.topsoe.com
Future-proof your refinery with HydroFlex™

Tailored to the specific needs of your refinery, HydroFlex™ is a proven industrial technology for hydrotreating almost any renewable feedstock and transforming it into high-quality renewable fuel for transportation.

Diversifying your range of feedstock enables you to meet the demands of changing legislation. And it also puts you in a strong position to win greater market share while supporting your existing business. Because with HydroFlex™, renewable and non-renewable feedstocks thrive alongside each other.

Processing renewable feedstocks is complex. The range of feedstocks is extremely wide, and they can be processed in many different ways. Because of this diversity, unit design is crucial – as is selecting and loading the right catalysts. At Topsoe, we have the knowhow and the proven track record to future-proof your refinery and help you grow your business with biofuels from renewable feedstocks.

**Full feedstock flexibility**
Topsoe can give you the ability to turn practically any renewable feedstock into an on-spec fuel. So, you can future-proof your refinery against changing demands and take advantage of new opportunities to extend your market share – and expand your business.

**Access to renewables knowhow**
We have the industry’s only renewable processing complex with an integrated hydrogen unit. Our unique sour mode single stage design is capable of saving up to 35% of CAPEX. This is just some of the knowhow in the extensive HydroFlex™ portfolio which gives your business renewable feedstock capability – and an opportunity for growth.

**Close collaboration**
We see a direct line between the success of our work and the ongoing success of your business. From feasibility studies to unit commissioning, we are your trusted advisors along every step of the way.

Future-proof your business with HydroFlex™. Find out how at www.topsoe.com/renewables
Fuel for thought
According to the IEA (International Energy Agency), 5% of today’s global energy consumption is fueled by renewable sources. The IEA estimates this will rise to 25% by 2060. That adds up to an incredible opportunity for business growth.
Fuel for thought
Conventional diesel makes a fraction of the profit per barrel than diesel produced by HydroFlex™ running on renewable feedstock.
Legislation creates opportunities for greater market share

There is clearly a trend to apply legislation to reduce emissions. Not only is this trend global, with potentially far-reaching repercussions for the refinery industry, it’s also rapid. Once one law is passed, it seems the next one is already being drafted.

In the US, RFS2 (Renewable Fuel Standard 2) requires refineries to blend 36 billion gallons of renewable fuel into the country’s total transportation fuels consumption by 2022. In Europe, RED (Renewable Energy Directive) requires all EU countries to ensure that at least 1.0% of their transport fuels come from renewable sources by 2020.

**Opportunity for greater business diversity**
What if you could future-proof your refinery business against the ever-tightening demands of legislation? And what if you could view each new law as an opportunity to meet new market demands and win greater market share?

At Topsoe, we have the technology to produce gasoline, jet fuel and diesel from almost any feedstock for almost any size of plant. In fact, we have been developing and refining our technology since 2004 in anticipation of these new market trends.

Best of all, your renewable feedstock does not replace fossil feedstock, but runs alongside it. In effect, you are adding greater diversity, capacity and the opportunity for growth to your refinery – and your business.

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The reliable way to add full feedstock flexibility to your refinery

Our trusted catalyst technologies give you the flexibility to process a wide range of feedstocks – alongside fossil fuels.

No matter the type or quality of feedstock, the result is consistently high-grade fuel

<table>
<thead>
<tr>
<th>Pre-treatment</th>
<th>HydroFlex™ processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetable oils</td>
<td>Gasoline</td>
</tr>
<tr>
<td>Animal fats and used cooking oils</td>
<td>Jet fuel</td>
</tr>
<tr>
<td>Biocrude from waste and biomass</td>
<td>Diesel</td>
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</tbody>
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HydroFlex™ is our tried-and-tested technology for hydrotreating renewable feedstocks. We tailor unit design and catalyst selection to the specific demands of your refinery business, resulting in high-grade gasoline, jet fuel, and diesel. Not only do these fuels meet international standards, they are also fully compatible with modern combustion and jet engines and can be blended safely with regular fuels.

No two refineries are exactly the same. The same is true of renewable feedstocks. So, you need a hydrotreating unit that:

- Fits in with the specifics of your refinery’s size, location and product slate
- Has the flexibility to process feedstocks of varying quality and type
- Can guarantee that the resulting fuels always meet your specified quality

HydroFlex™ combines leading-edge unit design with a comprehensive range of proprietary catalysts for renewable fuel production. The next section shows how investing in full feedstock flexibility gives you so much more than greater chemical processing capabilities.

HydroFlex™ can deliver full feedstock flexibility for your plant. Find out how at www.topsoe.com/renewables
Fuel for thought

Single-stage or two-stage? Which design is right for your refinery? With a lower CAPEX, the single-stage sour mode design can produce renewable diesel from a wide range of feedstocks. The two-stage sweet mode design can produce renewable diesel, jet fuel and gasoline from practically any renewable feedstock.
Fuel for thought

We invest around 9% of our revenue in R&D, enabling us to carry out market-driven research into catalysis and process technologies – including renewables. Resulting in new technologies, solutions, and applications that anticipate changing demands in the refinery industry.
Access to industry-leading renewables knowhow

With HydroFlex™, investing in full feedstock flexibility is substantial but sound.

The culmination of years of dedicated research into catalysts and process design, HydroFlex™ gives you access to catalytical processing technologies that are leading edge. Yet, because of fast-changing market demands, they are already tried and tested.

When it comes to full feedstock flexibility, Topsoe has the in-depth chemical processing expertise and experience to deliver the complete package. Working closely with us on future-proofing your plant gives you not only a one-stop shop for the necessary technologies and catalysts, but also immediate access to the knowhow and services that will turn a major project into a long-term strategic collaboration – and business success.

Hydrogen integration
Processing renewable feedstocks is more complex than processing non-renewables. For one thing, it requires extra hydrogen. We are the only provider able to integrate the hydrogen unit with the hydrotreater – and we license both technologies.

High-yield catalysts
With our sour mode design, you can achieve CAPEX savings of up to 35% compared to standard designs. The catalysts we use favor a hydrodeoxygenation (HDO) route which, in combination with our highly selective dewaxing catalysts, results in a higher yield.

HydroFlex™ provides you with a comprehensive package, including a level of catalysis and process expertise that no other provider can match. The next section explains how we work closely together with you to achieve the most efficient processes, the highest performance and the best possible outcomes for your refinery – and your business.

Join the discussion on renewables knowhow.
Get the latest news on renewables at www.topsoe.com/renewables
Meet rising demand for high-grade biofuels

We have a track record of developing innovative solutions for clean, competitive fuels from renewable feedstock since 2004.

Although the legislation concerning renewable feedstock is relatively recent, we are ready to help you meet demand for modern, high-grade biofuels today. With HydroFlex™, you can produce renewable gasoline, jet fuel and diesel from almost any feedstock, including tall oil, algae, animal fats, and vegetable oils. The process is complex, very different to refining non-renewable fuels and requires a substantial investment. But it is also profitable.

Working closely with you, we tailor HydroFlex™ to the layout of your unit, your intended range of feedstocks, and the specifications of the renewable fuels you aim to produce. Renewable feedstocks, for example, all require dewaxing to optimize the cold flow properties of the resulting fuels. 

Clean renewable fuels with a high market value
Whether you are refining in sweet or sour mode, we take care of every catalyst selection and specification. So, your HydroFlex™ unit produces an optimal yield, free from contaminants such as potassium, sodium, and silicon. Or, put another way, your unit will produce exceptionally clean renewable fuel with a high market value – and the opportunity to raise the profitability of your business.

Fuel for thought
Compared to conventional biodiesel (FAME), renewable diesel produced with HydroFlex™ has the highest cetane content, best cold flow properties and the highest market value.

HydroFlex™ helps you meet demand for high-grade biofuels. Find out how at www.topsoe.com/renewables
Expert guidance from the market leaders

When you work with us, not only are you investing in new capabilities, but also in a team you can trust to go the extra mile in future-proofing your business.

From feasibility study to commissioning and beyond, we ensure optimal processes and solutions to help your business and our collaboration thrive. Even when design, construction, commissioning, and start-up are complete, we are available to ensure your HydroFlex™ unit continues to run at peak performance.

SCOPE & DESIGN
- First meeting
- Contract signed
- ZERO DATE
- Kick-off meeting
- Talk and project development phase
- Process Flow Diagram (PFD) review
- Process & Instrumentation Diagram (P&ID)

3 - 24 months
3 - 6 months

CONSTRUCTION
- Design package finished
- Construction phase FEED/EPC
12 - 24 months
1. Feasibility study
This is where we make it as easy as possible for you to take the crucial decisions on the feeds, product slate and capacities of your new plant.

2. Design
We optimize your plant for flexibility of feedstock and quality of fuel so you will get the maximum return on your investment – without stepping outside the constraints of your budget.

3. Construction
We work closely with reputable EPC contractors, and as the licensor we are onsite during commissioning to help ensure project success.

STARTUP & OPERATION

REACTORS READY
- Installation of proprietary hardware (internals)
- Loading of catalysts
- Check that everything works

Commissioning
- Activation of catalysts

UNIT STARTUP
- Unit in operation
- Performance test run
- Normal operation (catalyst lifetime)
- Catalyst replacement

4 - 8 months
1 - 4 years
Five ways to turn renewable feedstocks into high-grade transport fuels

- Processing renewables
  - Co-processing
    - Catalyst loading
    - Revamp existing unit
    - Grassroot unit
  - Stand-alone (100% renewables)
    - Revamp existing unit
    - Grassroot unit
Haldor Topsoe is the world leader in high-performance catalysts and proprietary technologies for the chemical and refining industries. We are committed to helping our customers achieve optimal performance, using the least possible energy and resources, in the most responsible way. All based on cutting-edge research & development. Topsoe is headquartered in Denmark and serve customers across the globe.

Get in touch today
www.topsoe.com/renewables

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