

Der reFuels-Ansatz von der Forschung zur industriellen Praxis

The reFuels approach: from research to industrial practice

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20.01.2026



- 1. reFuels as an academic-industrial cooperation project**
- 2. reFuels on the way to a demonstration plant**
- 3. reFuels in implementation**

reFuels as an academic-industrial cooperation project

Names of synthetic Fuels: Definition reFuels

reFuels fuels produced from non-fossil carbon and CO₂ sources, including advanced biofuels, in particular hydrocarbons produced using renewable hydrogen.



reFuels comprise all eFuels and biofuels and must be produced from renewable sources **and** be usable in existing vehicles.



Reducing greenhouse gas levels in the atmosphere requires circular processes!

reFuels as an academic-industrial cooperation project

Classification of reFuels by Source and Process

Drop-in, blend components and feedstock for

- Pressurized and liquefied gases:
- Liquid hydrocarbon fuels (Drop-in-Fuels)
 - Fischer-Tropsch Diesel, Jet Fuel and gasoline
 - Methanol-to-Gasoline
 - Oligomeric gasoline (alkylate based petrol)
 - Synthetic aromatics (blend components)
- Oxygenates (blend components):
 - Methanol
 - Ethanol, Butanol
 - Octanol
 - Oxymethylenether (OME)
 - Methyl-tert.-butylether (MTBE)
- Bio-oil and waste-oil co-processing feedstock



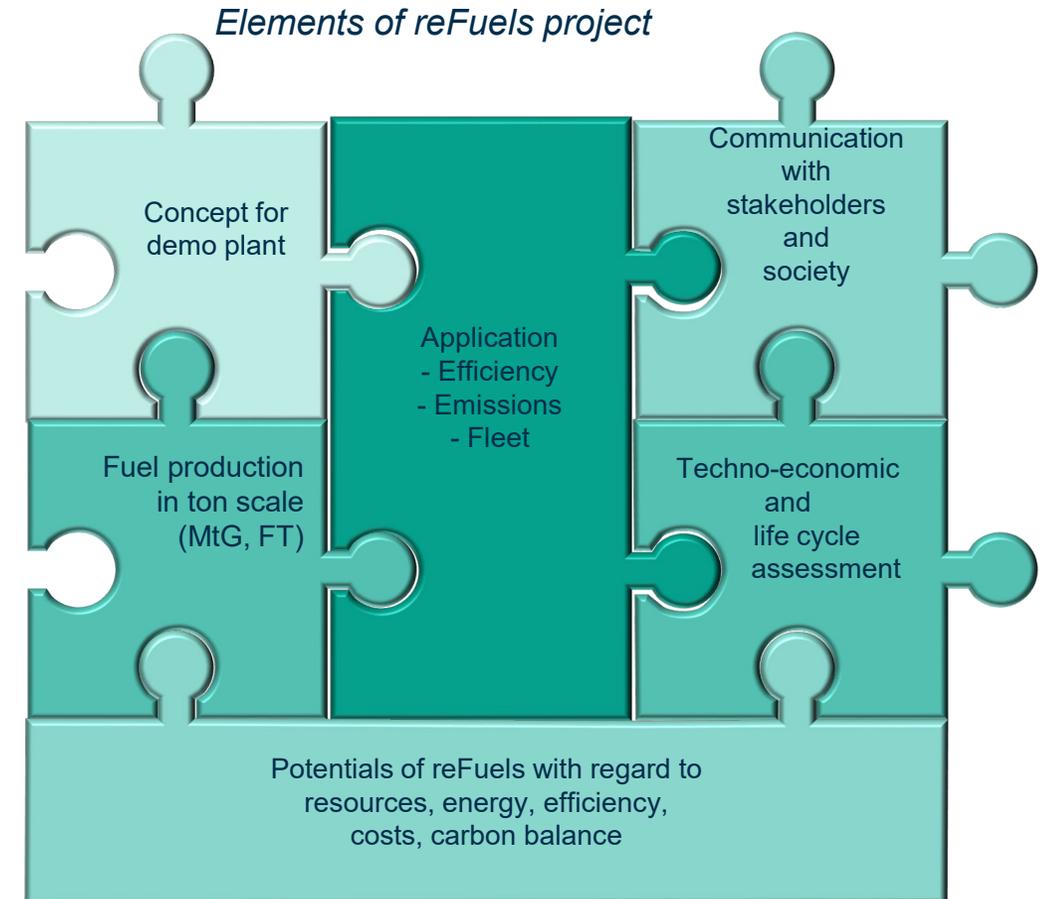
reFuels as an academic-industrial cooperation project

Key question:

We produce fuels and demonstrate that they comply with standards.

- Project starting point: interdisciplinary „Strategiedialog Automobilwirtschaft“ vom the state of Baden-Württemberg, industry and science
- Industrial-scientific workshop at KIT showed urgent necessity to speed up the introduction of reFuels

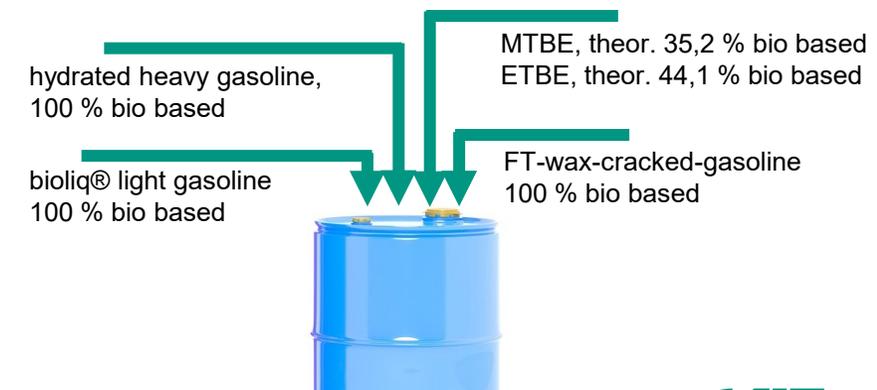
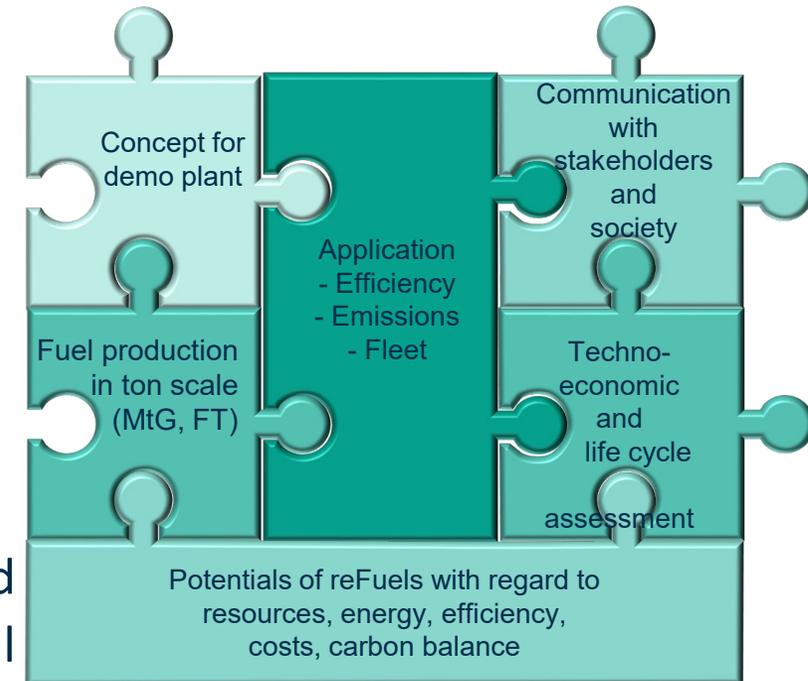
→ **Joint application** for state support, coordinated by KIT



reFuels as an academic-industrial cooperation project

Major results:

- Provision and validation of reFuels product samples (standard-compliant diesel and gasoline product samples) on a ton scale
- Increasing the technology maturity levels for methanol and Fischer-Tropsch-based processes
- Increasing carbon and energy efficiency through the efficient use and processing of co-products and through the use of energy and material flows from coupled plants in the integration of processes
- Stakeholder discourse and communication of results to society
- Increase in blending ratios up to "reFuels pure fuel"



reFuels as an academic-industrial cooperation project

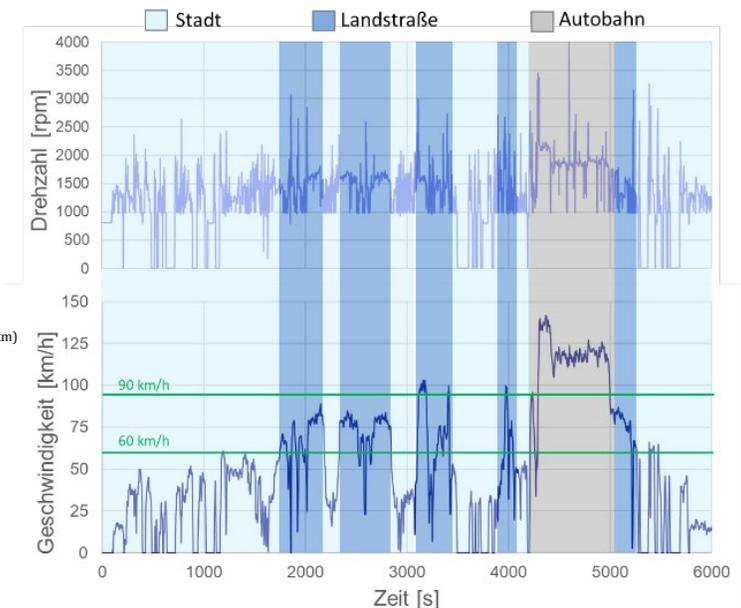
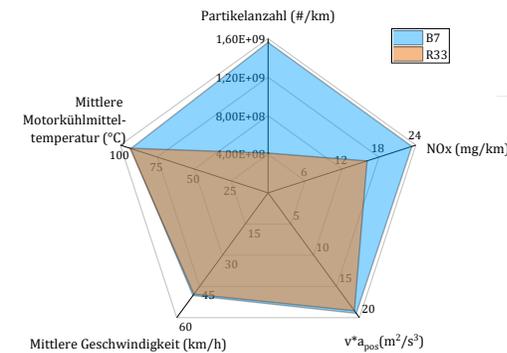
Key question:

What would it look like if this technology were integrated into the existing fuel production infrastructure?

- Analysis of the boundary conditions for implementing reFuels in existing refinery infrastructures
- Holistic assessment – manufacturing processes, manufacturing costs (techno-economic assessment), product properties, environmental impacts (life cycle analysis), and application in existing vehicles.
- Detailed engine emission testing showed significant emission reduction potential
- Endurance run in cooperation with a haulage company covering approx. 1.6 million kilometers



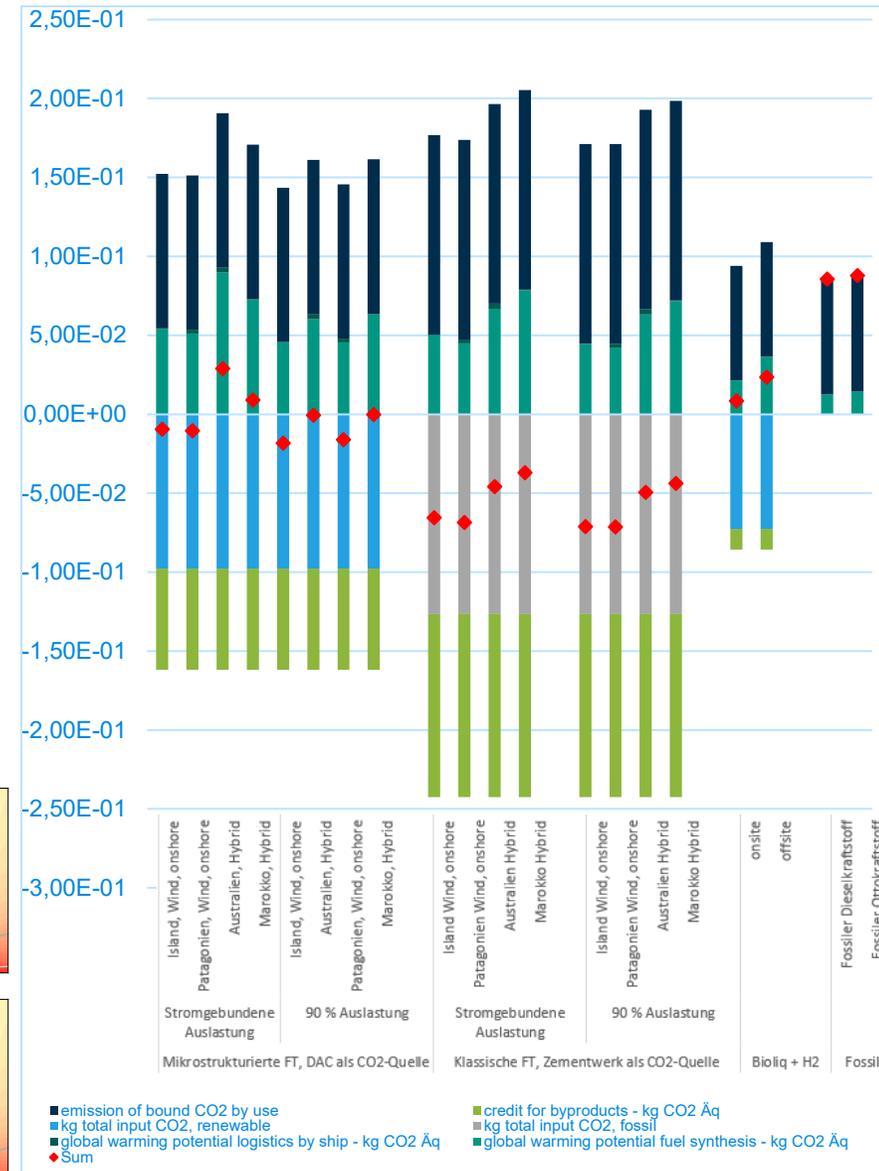
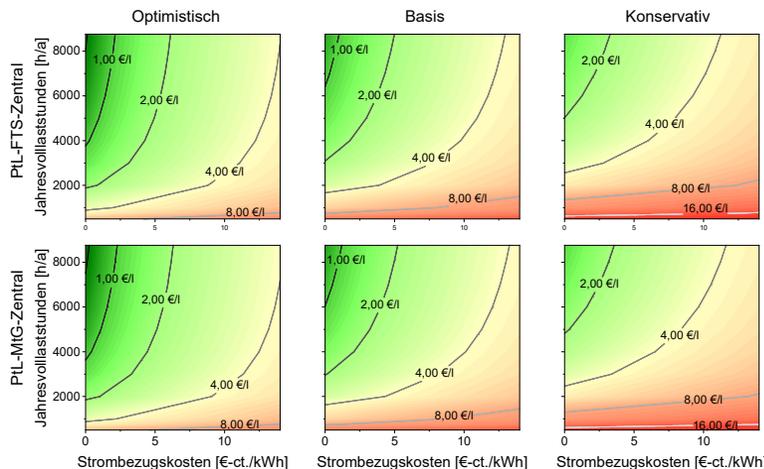
source_: Müller – die LILA Logistik



Source: Ergebnisbericht reFuels <https://doi.org/10.5445/IR/1000159935>

reFuels as an academic-industrial cooperation project

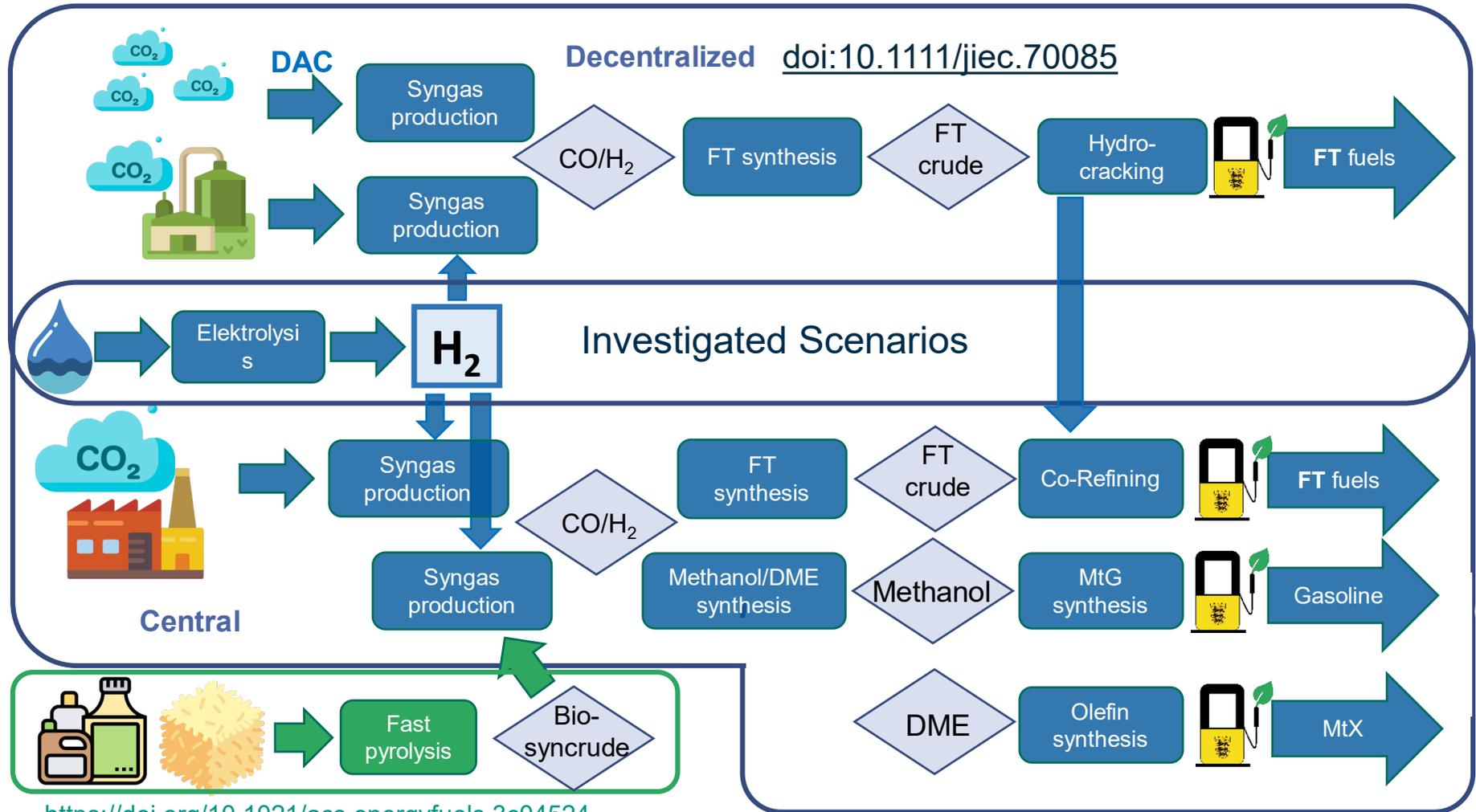
- reFuels in stakeholder discourse: A position analysis by associations from business, environmental, and civil society (<https://doi.org/10.5445/IR/1000128394>)
- Social implications of renewable fuels in expert discourse (<https://doi.org/10.5445/IR/1000128396>)
- Regenerative fuels viewed within the system: on the role of reFuels in energy system analyses (<https://doi.org/10.5445/IR/1000128395>)
- Techno-economic analysis incl. sensitivities
- Ecological life cycle assessment (critical reviewd) shows reFuels as **GHG-negative!!!**



reFuels as an academic-industrial cooperation project

Key questions:

- centralized or decentral production?
- Fischer-Tropsch or Methanol or Pyrolysis path?



<https://doi.org/10.1021/acs.energyfuels.3c04524>

➔ Several selected synthesis paths to be investigated

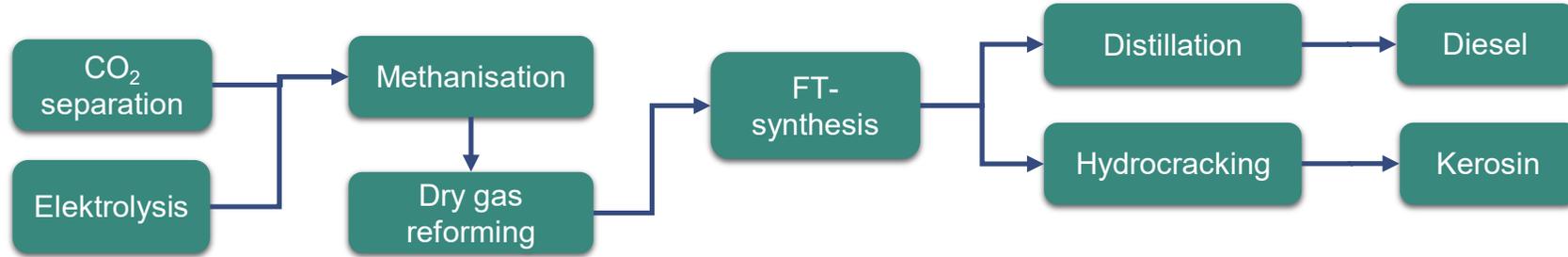
Technology	Decentralized	Central	Extended central	Central with biomass + H ₂	International large scale plant
Fischer-Tropsch micro-reactor	Biogas as CO ₂ source	Modular plant			
Fischer-Tropsch „classical“ synthesis		Refinery or cement plant with CO ₂ separation & H ₂ O electrolysis	Industrial complex with several CO ₂ sources or pipeline	Biomass to liquid with renewable H ₂ -addition	World scale FT with DAC + desalination of sea water
Methanol-to-gasoline	Bioliq BtL concept			MtG BtL as above	

reFuels auf dem Weg zur Demoanlage

Key question:

In which way reFuels can be produced in existing infrastructure?

- Refinery integrated FT-synthesis using FCC-cracker off-gas via dry gas reforming, RWGS and SOEC
- Case study for max. 50 kt/a fuels (EDL)
- Demonstration plant useful at > 10 kt/a
- Upcoming technologies promise higher efficiencies

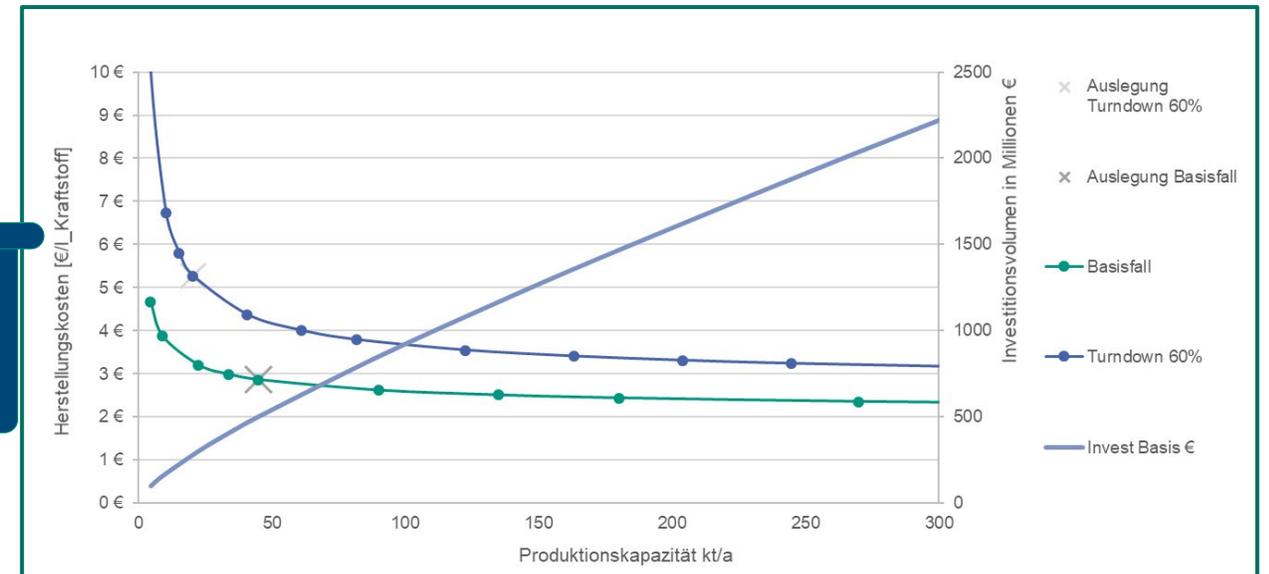


	DGR base	RWGS	Co-SOEC
C-utilization	61 %	85 %	100 %
CO ₂ -reduction	7,3 t/h	12,5 t/h	14,2 t/h
Product capacity	20.400 t/a	27750 t/a	38500 t/a
Energy recovery	42 %	50 %	52 -55 %



**EU RED II
Delegated
Acts**

Source: Ergebnisbericht reFuels – Kraftstoffe
neu denken DOI: [10.5445/IR/1000159935](https://doi.org/10.5445/IR/1000159935)



reFuels on the way to a demonstration plant

Key question:

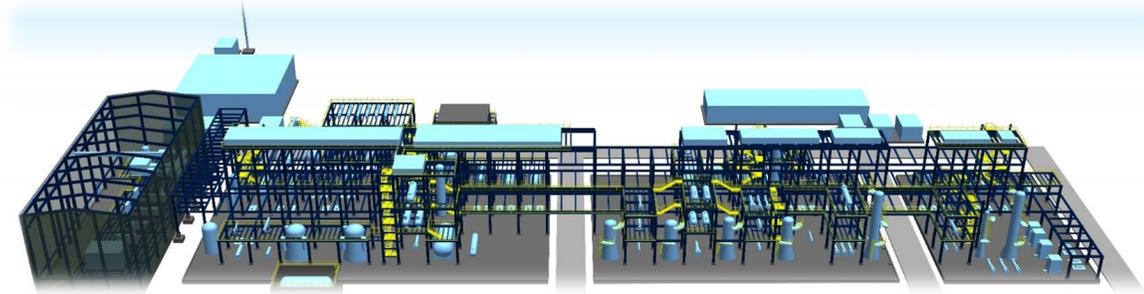
What do you need to do to get involved in a larger project?

- Projects in southern Germany must be adapted to intermediate products (MeOH and FT crude) as educts, as delegated acts require electrolysis and CO₂ processing to be relocated to preferred regions.
- Methanol-to gasoline (MtG) and Methanol-to-Jet via olefines (MtO – OtX) as preferred pathway
- Analysis of Fischer-Tropsch as „supplying path“ for additional blending components

Political focus on synthetic jetfuel

- Detailed analysis MtO – OtJ with higher yields on kerosene after principal feasibility was shown in separate study

Source: DOI : [10.5445/IR/1000189548](https://doi.org/10.5445/IR/1000189548)



Source: Ergebnisbericht Forschungsunterstützte Maßnahmen zur Transformation von Anlagen für klimaneutrale Kraftstoffe (reFuels) in den industriellen Maßstab; DOI : [10.5445/IR/1000189548](https://doi.org/10.5445/IR/1000189548)



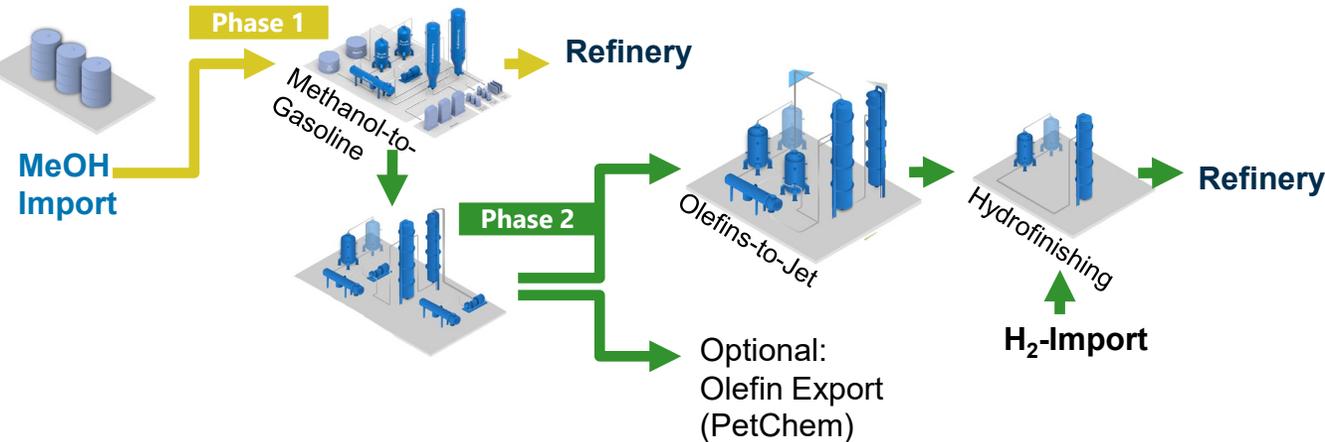
Source: Mineralö Raffinerie Oberrhein MiRO

reFuels on the way to a demonstration plant

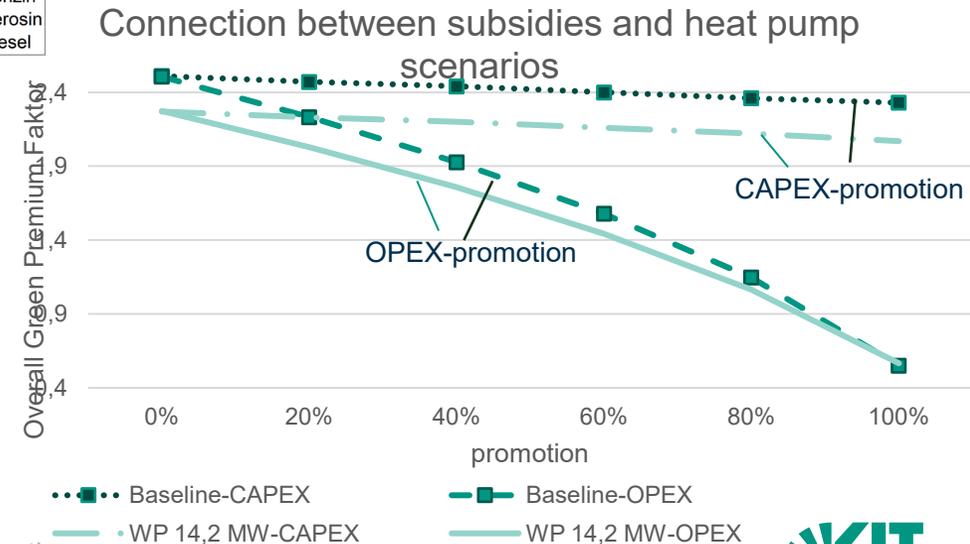
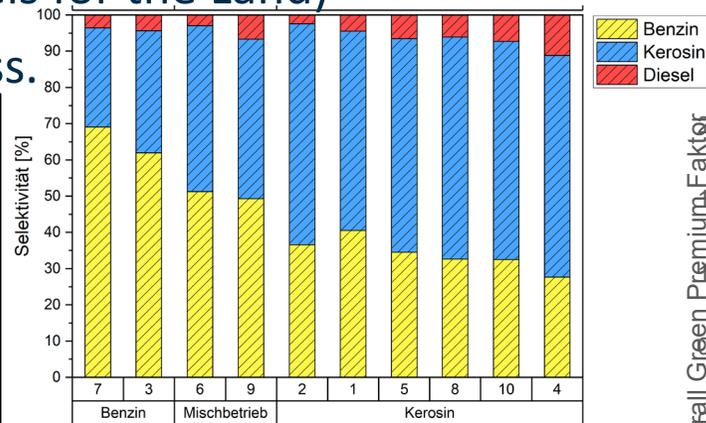
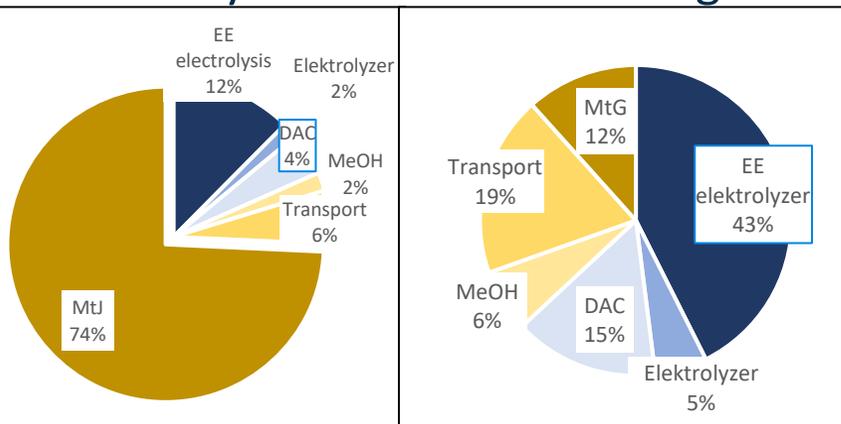
Key question: How can we mitigate the risk of the balancing act between technical maturity and market readiness?

How advantageous is a modular concept (first gasoline, then jet fuel)?

- Premium factor for kerosine is generally higher
- DME shows advantages related to MeOH
- ➔ separate research activities (reFuels for the Länd)
- Life cycle and techno-ecological ass.



Source: Ergebnisbericht Forschungsunterstützte Maßnahmen zur Transformation von Anlagen für klimaneutrale Kraftstoffe (reFuels) in den industriellen Maßstab; DOI : [10.5445/IR/1000189548](https://doi.org/10.5445/IR/1000189548)



reFuels in implementation

Key question:

How can I best put the fuels to use?

Closing the gaps between the stakeholders

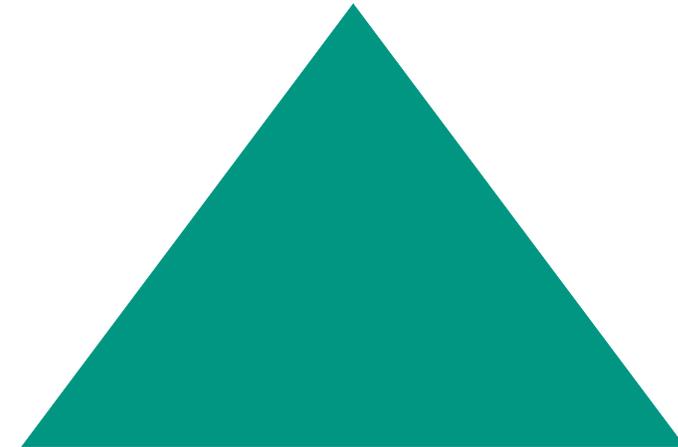
- How can I enable smaller blend quantities during ramp-up? (blending as enabling supporter)
- How and where do I blend SAF jet fuels and ensure the required fuel quality?
- How do I convert refueling options? (example implementation in a closed private boating environment)

Construction and commissioning of a variable blending plant for the production of reFuels fuel blends suitable for balancing in order to achieve higher admixture quantities for increasing GHG reduction in mobility (BlendBilanz4Mobility)

Source: DOI:10.5445/IR/1000189550



reFuels
logistics



reFuels user

reFuels – distributor
(initial tax payer)

Implement greenhouse gas reduction at Bodensee through the use of reFuels and make it verifiable



Preparation of a production infrastructure for e-kerosene and co-products for processing / production / quality assurance and logistics using MiRO as an example

DOI: 10.5445/IR/1000189551



reFuels in implementation

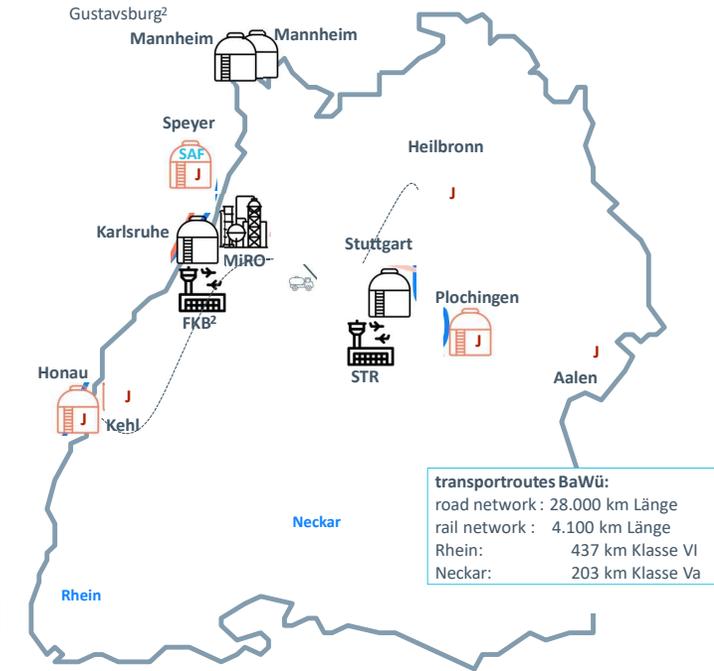
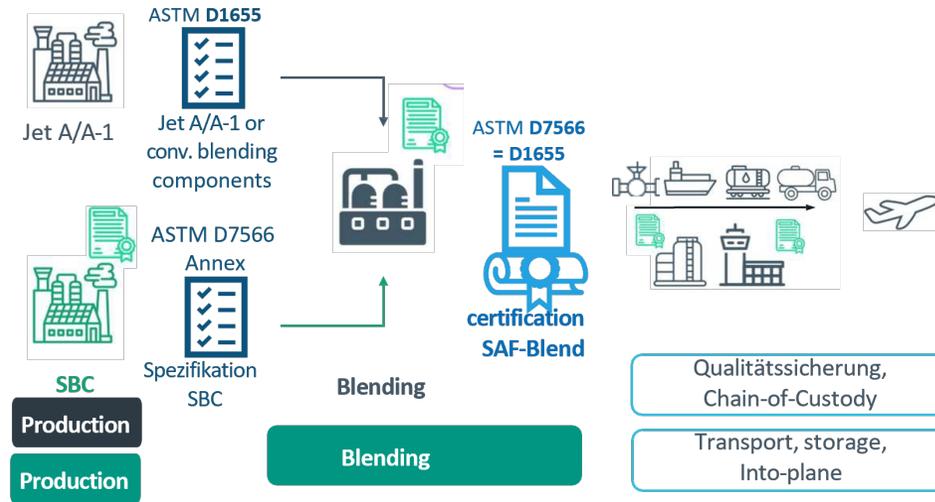
Key questions:

How can I best put the fuels to use?

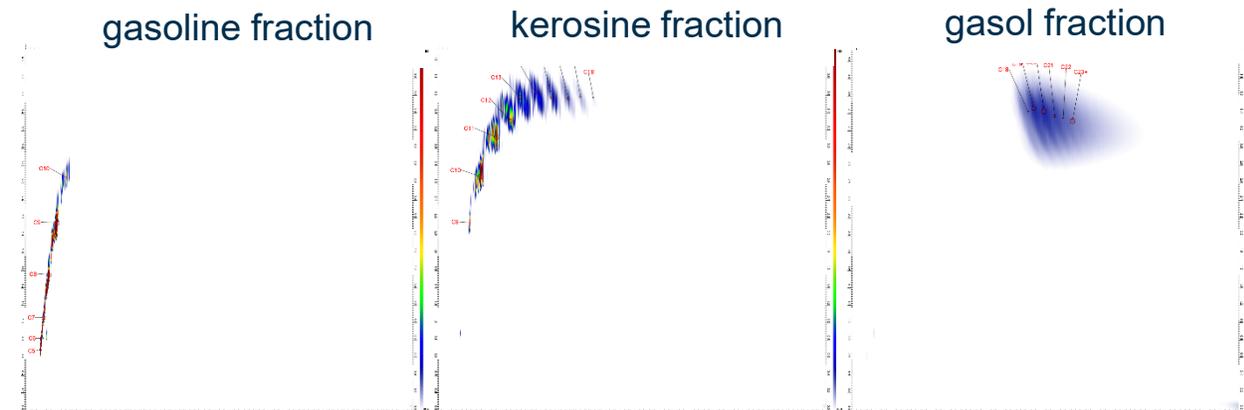
How and where can I blend jet fuels and ensure the required fuel quality for the Stuttgart and Karlsruhe applications?

Results:

- Development of a prediction model for the distribution of partial products in the synthesis of re-kerosene
- Optimization of the yield of re-kerosene from the quantity of partial products
- Concept study on the development of a scalable infrastructure for kerosene fractions, taking into account geographical and technical conditions



Source: Ergebnisbericht Vorbereitung einer Produktionsinfrastruktur für e-Kerosin und Koppelprodukte für Verarbeitung / Produktion/ Qualitätssicherung und Logistik am Beispiel der MiRO, DOI: [10.5445/IR/1000189551](https://doi.org/10.5445/IR/1000189551)



reFuels in implementation

Implement greenhouse gas reduction at Bodensee through the use of reFuels and make it verifiable

Key question: How can I best put the fuels to use?

What obstacles arise?

- due to the potential unsuitability of old boats
- The conversion of marine fuel stations?
(organizational obstacles)
- Availability, prices, boat owners' concerns about incompatibilities, and how can these be addressed?
- How high is the respective fuel-dependent greenhouse gas footprint per tank filling?
- How can other neighboring countries be involved and motivated?



Source: Ergebnisbericht reFuels Bodensee

reFuels in implementation

Implement greenhouse gas reduction at Bodensee through the use of reFuels and make it verifiable

Results:

- Fuel quality as a deciding factor for implementation (Nautic E10 + Nautic HVO)
- Workshops with boat workshops incl. customer flyers
- Accounting of GHG-reduction as the key (linking Nabisy data with gas stations)
- Public visibility (political attention)



Wir bedanken uns herzlich für die Unterstützung

Getestet durch: Baden-Württemberg, Ministerium für Verkehr, Organisation durch: KIT

Kooperationspartner: BOSCH

Interessengruppe: [Logos]

Vorteile

- **Ökologischer** - reduziert über 10% weniger CO₂-Emissionen über den gesamten Lebenszyklus (Blick auf CO₂-Emissionen im gesamten Lebenszyklus)
- **Sparen mit Dieselkraftstoff** - Leistung bleibt bis 100% gleich, während der Kraftstoffverbrauch bis zu 10% sinkt
- **Aggressive Partikel im Diesel** - keine unangenehme Dieselgeruch
- **Längere Lagerfähigkeit** - nicht oxidieren und versäueren, selbst nach längerer Standzeit
- **Längere Laufzeit** - nicht oxidieren und versäueren, selbst nach längerer Standzeit
- **Bessere Benetzung** - kein Tübeln an Schiffspropellern
- **Wirdige Benetzung** - direkt reduzierter Schiffspropeller Verschleiß für saubere Luft
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Fragen zu Nautic HVO? Ihre Werkstatt hilft gem!

Tanken Sie mit - für einen klimafreundlichen Bodensee!

Jede Tankung mit Nautic HVO oder Nautic E10 spart CO₂ und trägt zur Klimawende bei. So können Sie Ihren Beitrag leisten.

Muss ich meinen Tank reinigen lassen?

Empfehlen wir für den optimalen Tank mit HVO-Diesel - insbesondere, wenn sich Dieselpartikel im Tank bei kaltem Tank - nach dem Einfüllen und Start.

Muss ich meinen Motor einstellen lassen?

Nein, nur bei älteren Motor-Einstellungen (Getriebe) ist eine Einstellung notwendig. Dies kann durch einen Fachmann (z.B. durch einen Boot-Händler) durchgeführt werden.

Kann Nautic HVO mit normalem Diesel gemischt werden?

Ja - jedoch nur mit einem HVO.

Steigt der Verbrauch mit Nautic HVO?

In der Praxis HVO spart bis zu - je nach Motor - bis zu 10% mehr Kraftstoff.

Ist Nautic HVO mit Diesel-Additiven mischbar?

Ja, aber nicht nötig. Regelmäßige Reinigung des Motorschleppensystems für saubere Luft und Frischluft - ohne Zusatzkosten vor Ort.

Gibt es bereits Praxiserfahrungen?

Ja - bereits in Sport- und Berufsschiffen, Landmaschinen und sogar bei Offroadern.

Muss auf Winterdiesel umgestellt werden?

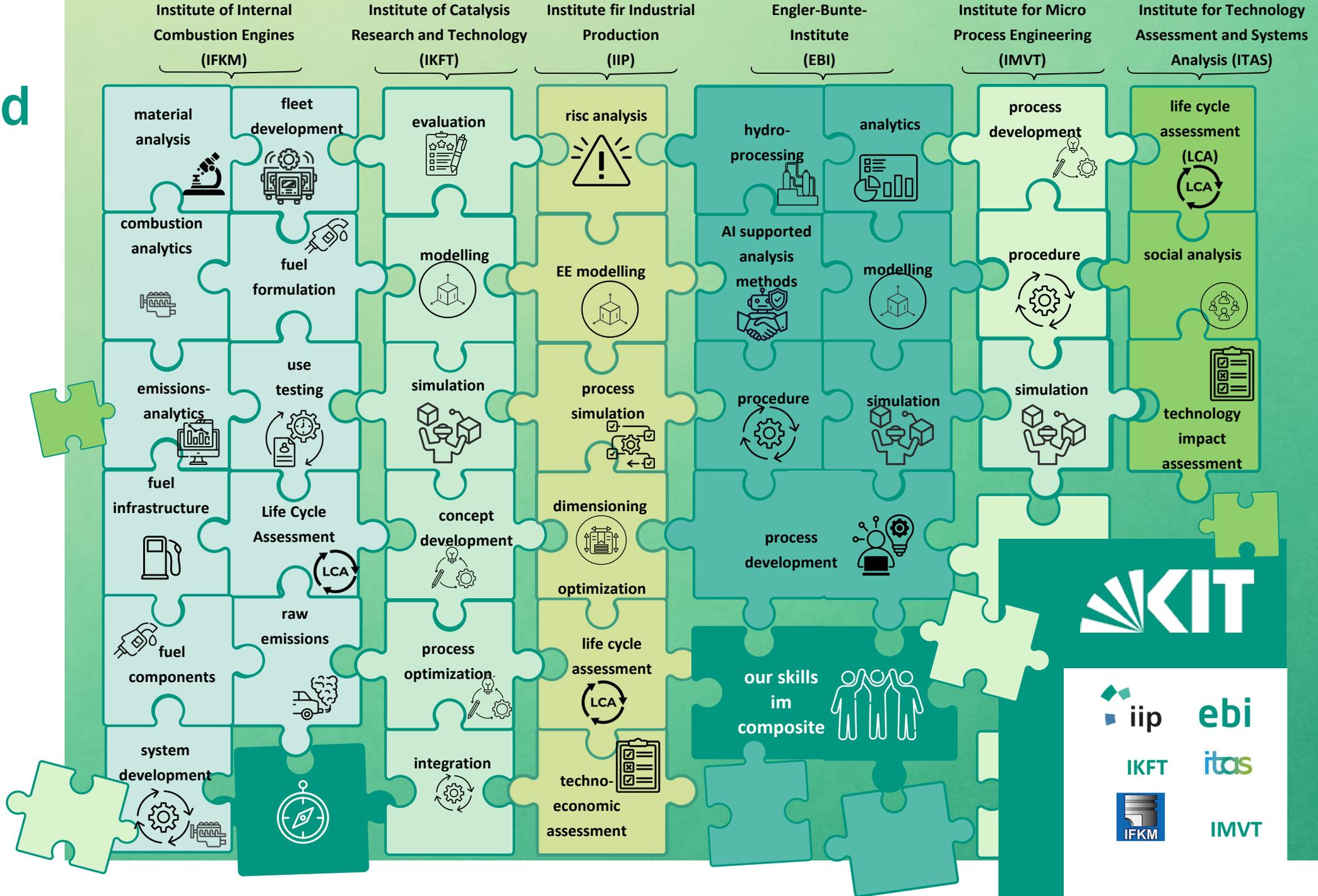
Nein - Nautic HVO ist eine geeignete Lösung für die Winterzeit. Es ist ein klimafreundliches Diesel.



Source: Ergebnisbericht reFuels Bodensee

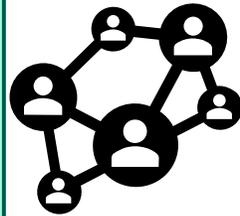
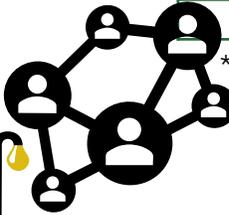


Our combined skills



reFuels in implementation

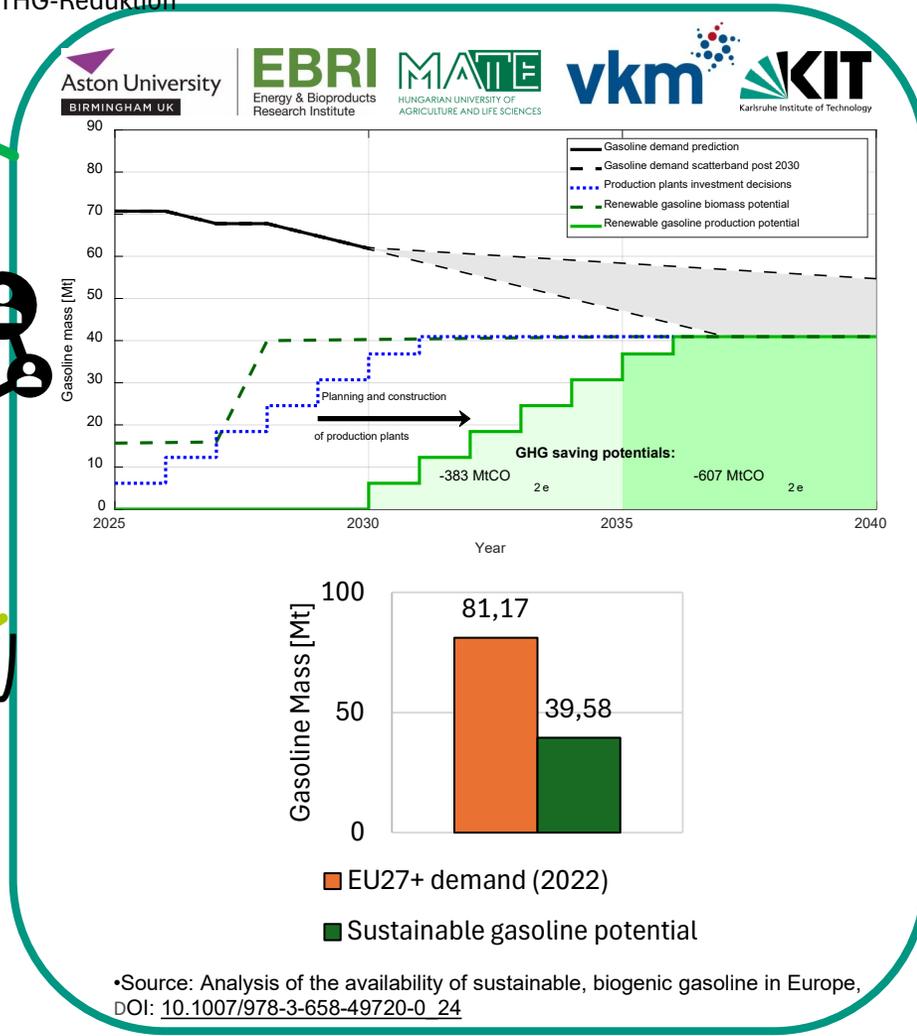
Potential to be expanded by partner network

	2030	2035	2040
Rohstoffe Bioenergie Potenzial [Mtoe]			
Verfügbare CNF* [Mtoe]			
Kraftstoffbedarf Gesamtflotte Straße [Mtoe]			
Anteil CNF an Bedarf Gesamtflotte			

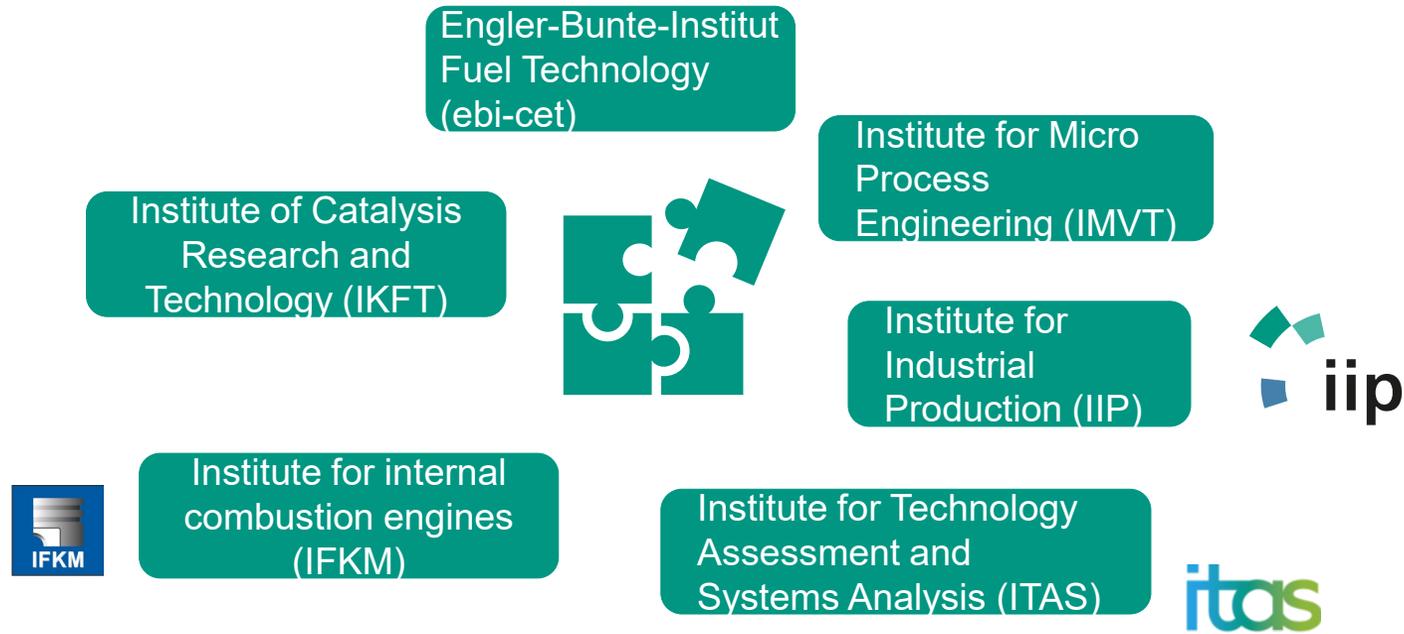
to be released soon

* inkl. 1st Gen gem. RED und RFNBO gem. dt. Gesetzesentwurfs zur Umsetzung der RED III
 >70% THG-Reduktion



Leveraging synergies

Results achieved by leveraging existing synergies within the framework of our partner network.



**We thank for the financial support
and the constructive discussions and workshops of the projects
by**



With funding from the



by decision of the
German Bundestag

Coordinated by



Project management agency



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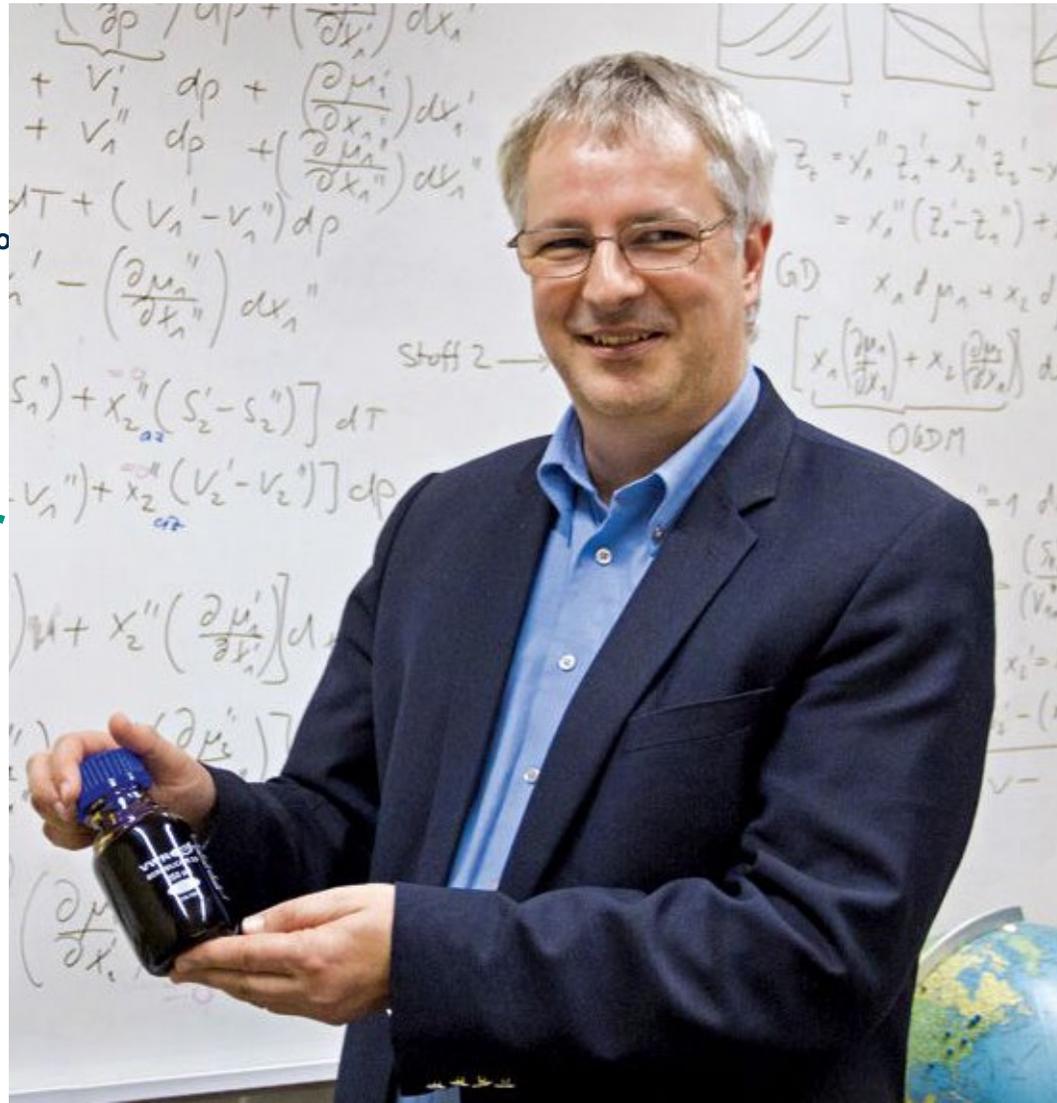


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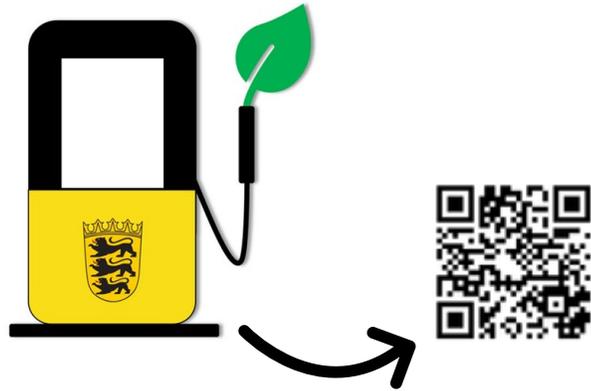


Project management agency





Sie möchten noch weitere Informationen? Dann kommen Sie gerne an unserem Stand vorbei!



reFuels – Kraftstoffe neu denken

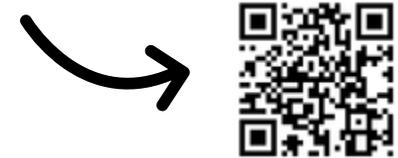


Baden-Württemberg
Ministerium für Verkehr

strategiedialog
automobilwirtschaft BW



aufgrund eines Beschlusses
des Deutschen Bundestages



aufgrund eines Beschlusses
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reTHINK - reSEARCH
reINVENT - reFUELS