



# Shell GTL Fuel und Paraffinische Kraftstoffe

VDS Technik-Seminar 28.03.2023

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## Shell’s net carbon footprint

Also, in this presentation we may refer to Shell’s “Net Carbon Footprint” or “Net Carbon Intensity”, which include Shell’s carbon emissions from the production of our energy products, our suppliers’ carbon emissions in supplying energy for that production and our customers’ carbon emissions associated with their use of the energy products we sell. Shell only controls its own emissions. The use of the term Shell’s “Net Carbon Footprint” or “Net Carbon Intensity” are for convenience only and not intended to suggest these emissions are those of Shell plc or its subsidiaries.

## Shell’s net-Zero Emissions Target

Shell’s operating plan, outlook and budgets are forecasted for a ten-year period and are updated every year. They reflect the current economic environment and what we can reasonably expect to see over the next ten years. Accordingly, they reflect our Scope 1, Scope 2 and Net Carbon Footprint (NCF) targets over the next ten years. However, Shell’s operating plans cannot reflect our 2050 net-zero emissions target and 2035 NCF target, as these targets are currently outside our planning period. In the future, as society moves towards net-zero emissions, we expect Shell’s operating plans to reflect this movement. However, if society is not net zero in 2050, as of today, there would be significant risk that Shell may not meet this target.

## Forward Looking Non-GAAP measures

This presentation may contain certain forward-looking non-GAAP measures. We are unable to provide a reconciliation of these forward-looking Non-GAAP measures to the most comparable GAAP financial measures because certain information needed to reconcile those Non-GAAP measures to the most comparable GAAP financial measures is dependent on future events some of which are outside the control of Shell, such as oil and gas prices, interest rates and exchange rates. Moreover, estimating such GAAP measures with the required precision necessary to provide a meaningful reconciliation is extremely difficult and could not be accomplished without unreasonable effort. Non-GAAP measures in respect of future periods which cannot be reconciled to the most comparable GAAP financial measure are calculated in a manner which is consistent with the accounting policies applied in Shell plc’s consolidated financial statements.

The contents of websites referred to in this presentation do not form part of this presentation.

We may have used certain terms, such as resources, in this presentation that the United States Securities and Exchange Commission (SEC) strictly prohibits us from including in our filings with the SEC. Investors are urged to consider closely the disclosure in our Form 20-F, File No 1-32575, available on the SEC website [www.sec.gov](http://www.sec.gov).

# AGENDA

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2 Eigenschaften und Produktvorteile

3 Technische Phänomene

4 Nachhaltige(re) Energielösungen

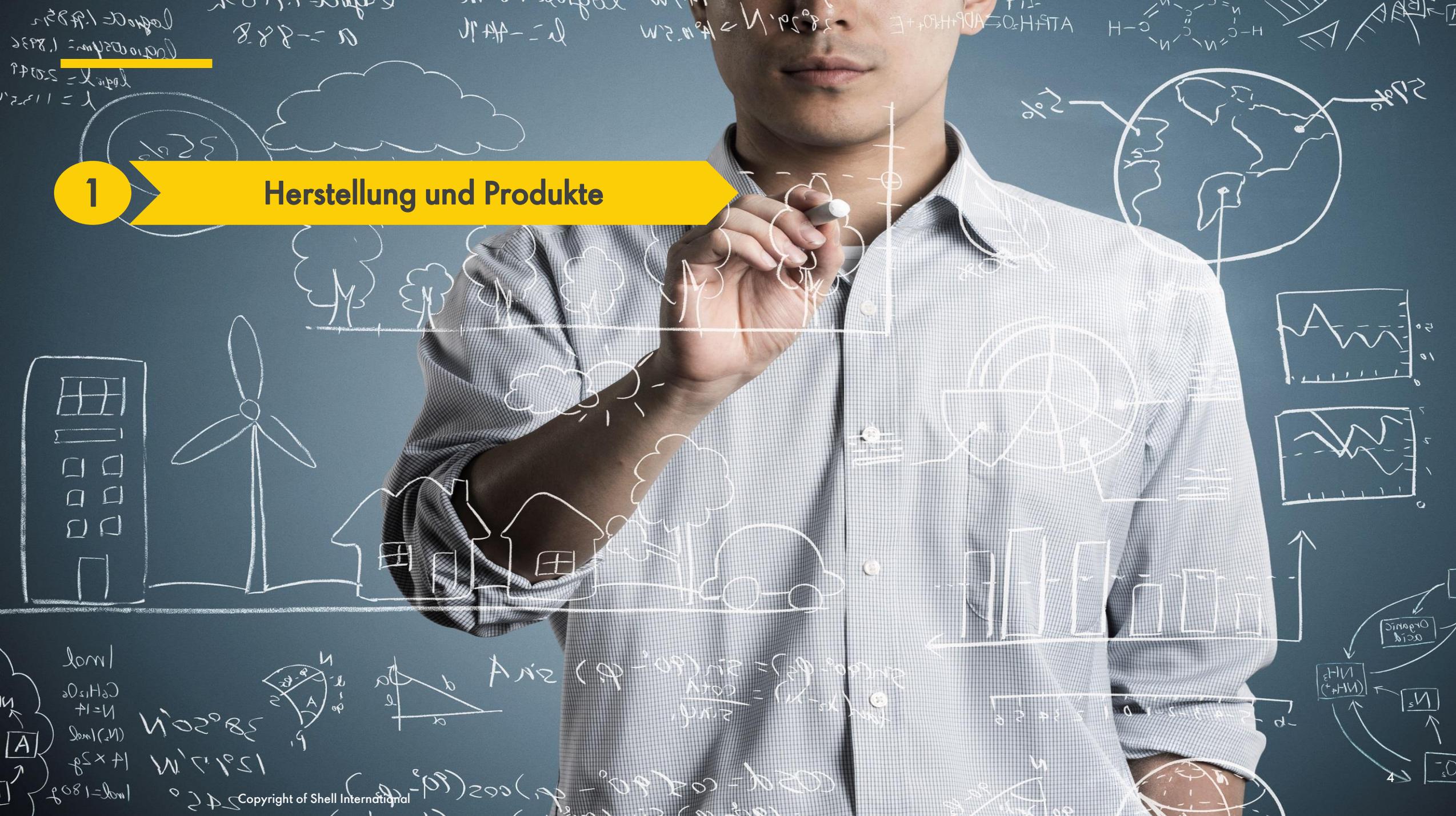
5 E-Fuels

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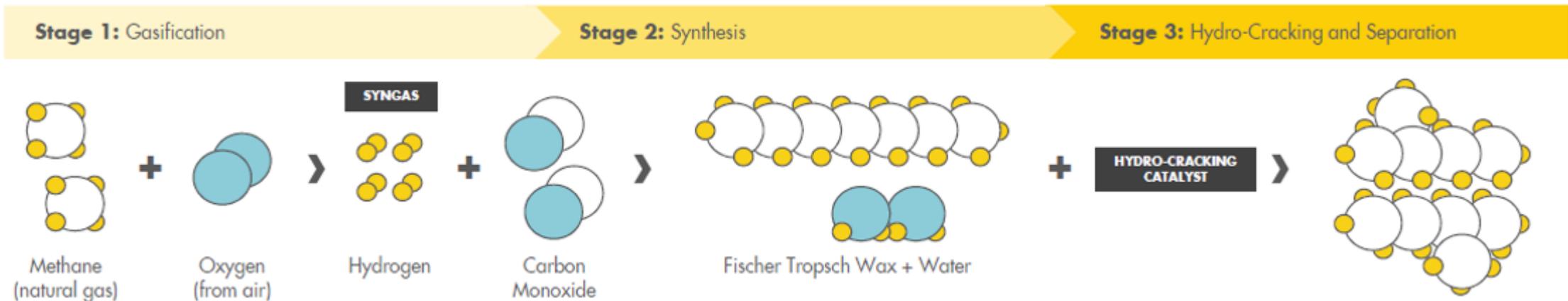
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# Herstellung und Produkte



# TECHNISCHE ENTWICKLUNG GTL & FISCHER-TROPSCH-SYNTHESE

## FORTSCHREITENDE TECHNISCHE ENTWICKLUNG



# SHELL GTL FUEL – PRODUKTVARIANTEN

## Shell GTL Fuel

Der Einsatz von Shell GTL Fuel in Dieselmotoren kann die lokale Luftqualität durch Reduzierung lokaler Emissionen verbessern<sup>1</sup>.

Shell GTL Fuel kann ohne Modifikation in vorhandenen Dieselfahrzeugen eingesetzt werden<sup>2</sup>.

## Shell GTL Fuel Alpine

Auf den Einsatz in besonders kalten Umgebungen optimiert:

kältestabil bis zu -30 °C (CFPP-Wert) und besseres Kaltstartverhalten dank höherer Cetanzahl.

## Shell GTL Fuel Heating

Shell GTL Fuel Heating bringt die Vorteile unseres synthetischen Gas-to-Liquids-Kraftstoffs dorthin, wo bisher mit konventionellem Heizöl geheizt wurde – sauber, effektiv und sofort einsetzbar.

## Shell GTL Fuel Marine

Auf den Einsatz im Bereich der Schifffahrt optimiert:

Niedrigere Wassergefährdungsklasse, bessere biologische Abbaubarkeit und deutlich geringere Geruchsbelastung im Vergleich zu Dieselkraftstoff.



### Verfügbar mit naturbasiertem CO<sub>2</sub>-Ausgleich

Die bei der Nutzung von Shell GTL Fuel entstehenden CO<sub>2</sub>-Emissionen können durch den Shell CO<sub>2</sub>-Ausgleich kompensiert werden. Dabei werden internationale Klimaschutzprojekte gefördert, die nach hohen Standards unabhängig zertifiziert werden.

Jetzt mehr erfahren

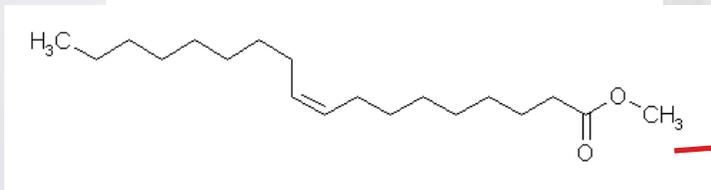
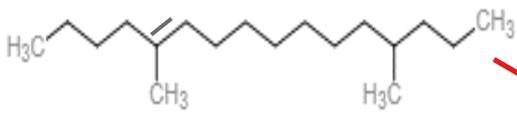
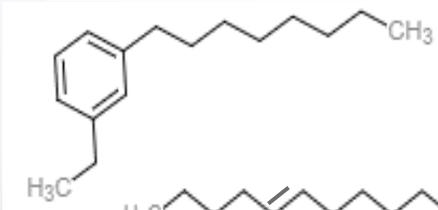
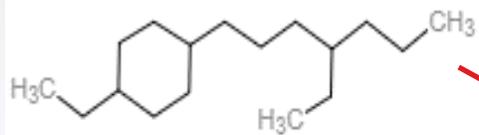
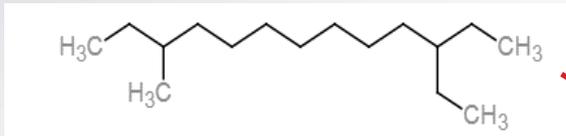
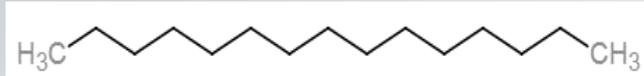


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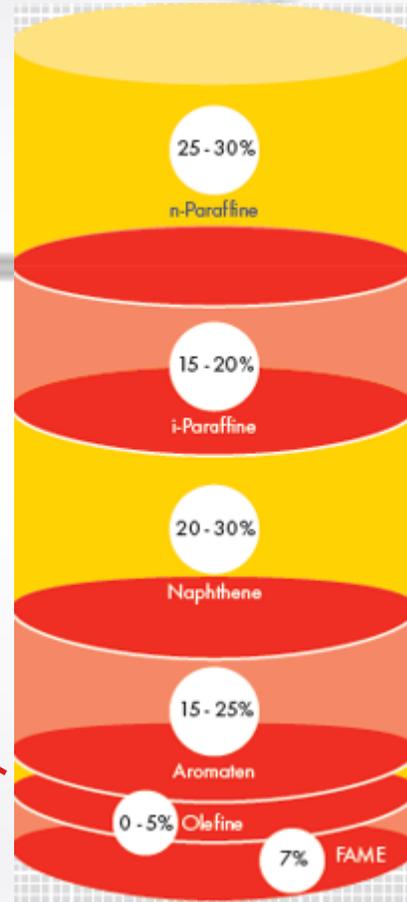
## Eigenschaften und Produktvorteile



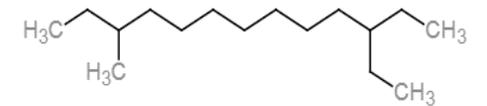
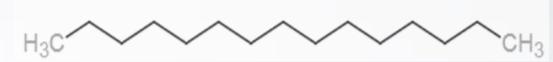
# CHEMISCHE ZUSAMMENSETZUNG DIESEL / GTL



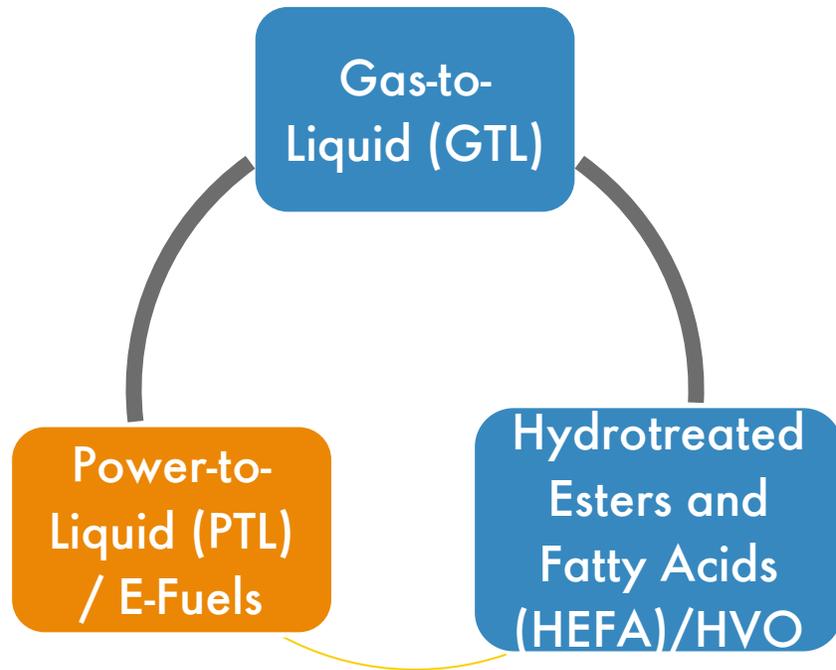
Diesel EN 590



GTL EN 15940

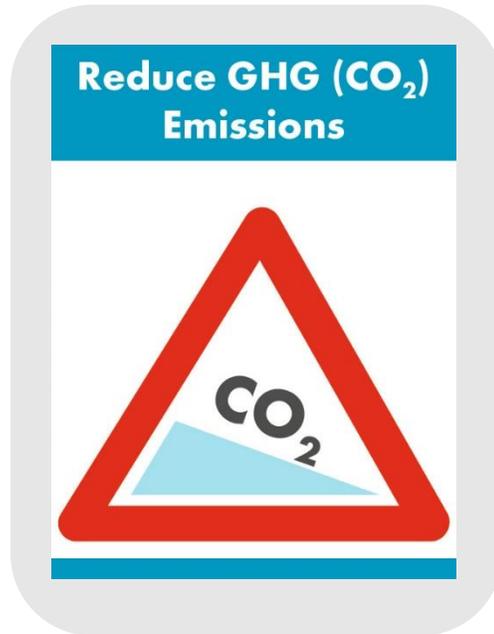


# PARAFFINISCHE KRAFTSTOFFE - EIGENSCHAFTEN



Eigenschaft	Einheit	Limits GTL		Limits EN590	
		Mindestwert	Höchstwert	Mindestwert	Höchstwert
<u>Cetanzahl</u>		70,0	800,0	51,0	-
Dichte bei 15 °C	kg/m³	770,0	800,0	820,0	845,0
<u>Gesamt-Aromatengehalt</u>	%(m/m)	-	1,0	-	-
Gehalt an polyzyklischen Aromaten	%(m/m)	-	0,1	-	8,0
<u>Gesamt-Olefingehalt</u>	%(m/m)	-	0,1	-	-
Schwefelgehalt	mg/kg	-	5,0	-	10,0
Flammpunkt	°C	>55		>55	-
Kohlenstoffgehalt	%(m/m)	-	0,30	-	0,30
Aschegehalt	%(m/m)	-	0,01	-	0,01
Wassergehalt	mg/kg	-	200	-	200
Gesamtverschmutzung	mg/kg	-	24	-	24
Kupferkorrosion (3 h bei 50 °C)	Einstufung	Klasse 1	Klasse 1	Klasse1	Klasse1
Oxidationsbeständigkeit	g/m³	-	25	-	25
<u>Schmierfähigkeit, korrigierter Verschleißkalotten-Durchmesser bei 60°C</u>	µm	-	460	-	460
Viskosität bei 40°C	mm²/s	2,00	4,50	2,0	4,5
Destillation 95% (V/V)	°C		360		360
Rückstand bei					

# DIE EMISSIONS-HERAUSFORDERUNG



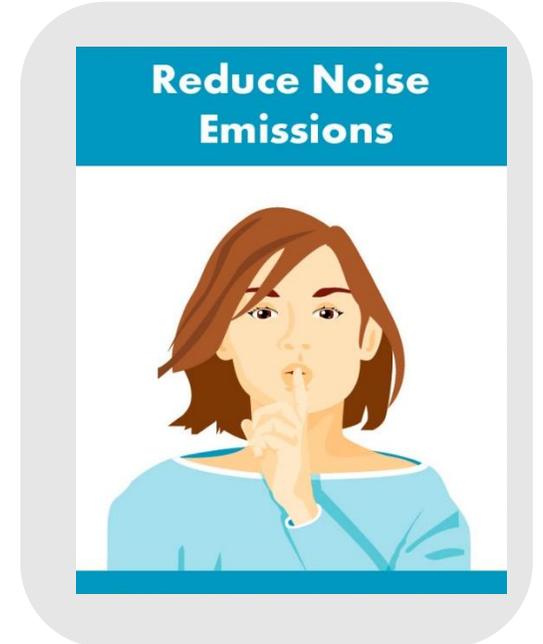
## Globaler Klimawandel

- Auswirkung:** Globale Ökonomie, Ökologie und Gesellschaft
- Zeithorizont:** Kleine kurzfristige Effekte, die langfristig stärker werden
- Ursache:** Treibhausgasemissionen



## Lokale Emissionen

- Auswirkung:** Menschliche Gesundheit
- Zeithorizont:** Unmittelbar/sofort
- Ursache:** Luftschadstoffe wie Stickoxid-(NO<sub>x</sub>) und Partikelemissionen, aber auch Lärmbelastung



# SHELL GTL FUEL – EIGENSCHAFTEN UND VORTEILE

## Eigenschaften

- ✓ Flüssiger, farbloser und geruchsarmer Kraftstoff aus Erdgas
- ✓ Klassifiziert entsprechend EN15940 als paraffinischer Kraftstoff
- ✓ Geringerer Schwefel- und Aromatengehalt als Norm-Diesel (EN 590)
- ✓ Hohe Cetanzahl:  
Paraffinischer Diesel: >70 vs. Mineralölbasierter Diesel: >51



## Vorteile

- ✓ Leichte Handhabung
  - ✓ Einsatz in konventionellen Dieselmotoren (drop-in)
  - ✓ vorhandene Infrastruktur nutzbar
- ✓ Sauberere Verbrennung vs. herkömmlicher Diesel
  - ✓ Senkt lokale Emissionen (PM, NO<sub>x</sub>, CO...)
  - ✓ Kann Wartungsaufwand reduzieren
- ✓ Nicht umweltgefährdend
  - ✓ Leicht biologisch abbaubar
  - ✓ WGK 1 (vs. WGK 2 bei Diesel) – Vorteil in ökologisch sensiblen Bereichen
- ✓ Biofrei
  - ✓ bessere Lagerstabilität
  - ✓ geringeres Mikrowachstum
- ✓ Ganzjährig CFPP -20°C / Shell GTL Fuel Alpine CFPP -30 °C
- ✓ Kann Motorgeräusche reduzieren

# EMISSIONSVORTEILE EN 15940

Prozentuale lokale Emissionsvorteile, die in einer Reihe von Tests Test von Offroad-Motoren mit paraffinischen Kraftstoffen (EN 15940) im Vergleich zu Standarddiesel (EN 590) erzielt wurden:

	PM	NOx	HC	CO	PN
<b>Stage I</b>	Der größte Teil der vorhandenen Motoren in Offroad-Motoren ist Stage IIIA und IIIB zuzuordnen; daher wurden keine GTL-Emissions-Vergleichstests für die sehr alten Motorentechnologien der Stufe I oder II unternommen.				
<b>Stage II</b>					
<b>Stage IIIA</b>	14 bis 46	0 bis 20	0 bis 22	4 bis 65	n/a
<b>Stage IIIB</b>	19	10			n/a
<b>Stage IV</b>	40	12	11		n/a
<b>Stage V</b>	Die absoluten Emissionswerte liegen nahe der Nachweisgrenze, so dass kein konsistenter Nutzen festgestellt werden konnte.				

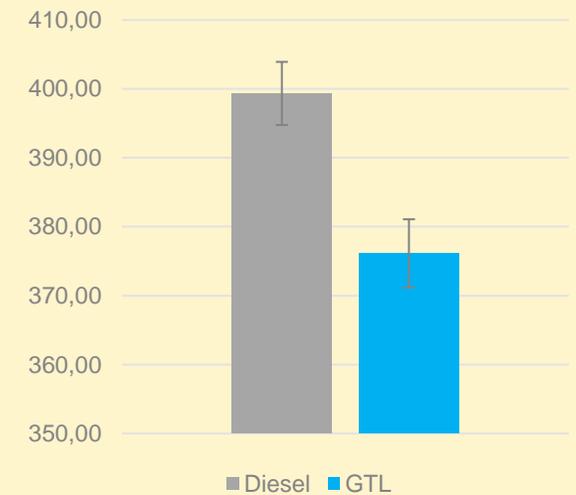
# Actros Euro VI: Einfluss von GTL Fuel auf das Abgasnachbehandlungssystem - Motor OM 471, 350 kW



Average DEF usage(g/hr)



NOx Pre-Cat (ppm)



- DEF/AdBlue Verbrauchsvorteil von 8.2% mit GTL Fuel
- Pre-Cat NOx Vorteil von 5.8%

# AGENDA

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## Technische Phänomene

## TECHNISCHE PHÄNOMENE / BESONDERHEITEN

Wahrscheinlichkeit des Auftretens ist gering, dennoch könnte es bei der Umstellung von EN 590 zu EN 15940 Auffälligkeiten geben:

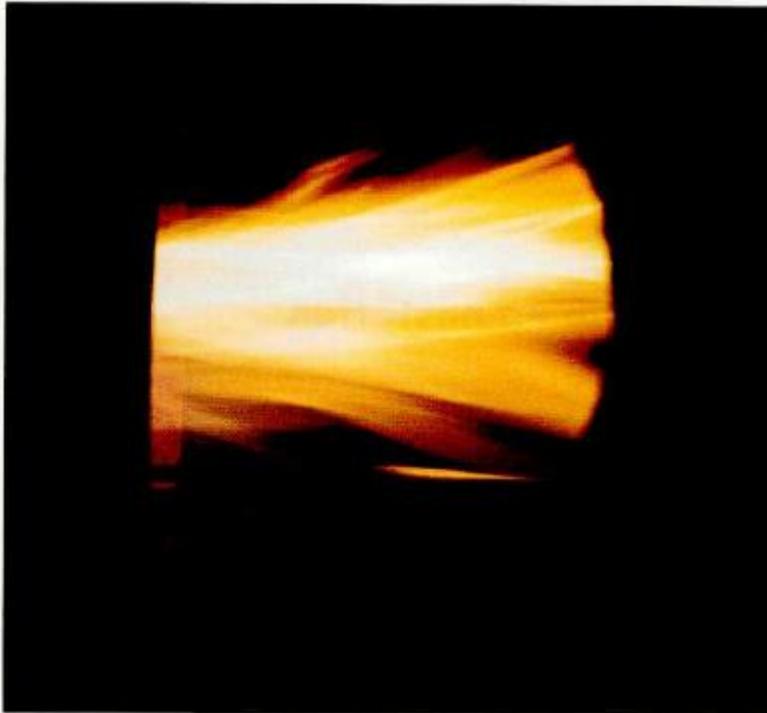
- ✓ **Flammenwächter erkennt bläuliche GTL Flamme nicht (Brenner Standheizungssystem)**
- ✓ **Tröpfchenbildung an Dichtungen oder Schläuchen (trotz Elastomerverträglichkeit von GTL)**
- ✓ **Füllstandsensoren zeigen leeren Kraftstofftank an (Dichte des Schwimmers)**

\* Shell GTL Fuel verbrennt sauberer und produziert weniger lokale Emissionen als herkömmlicher, aus Mineralöl hergestellter Diesel.

# FLAMMENÜBERWACHUNG BRENNER

✓ Optische Flammenwächter erkennen die transparentere Flamme von GTL nicht

➤ Adjustierung (Empfindlichkeit) oder Austausch gegen modernen Flammenwächter in vielen Fällen möglich



Flammenbild HEL/DIESEL

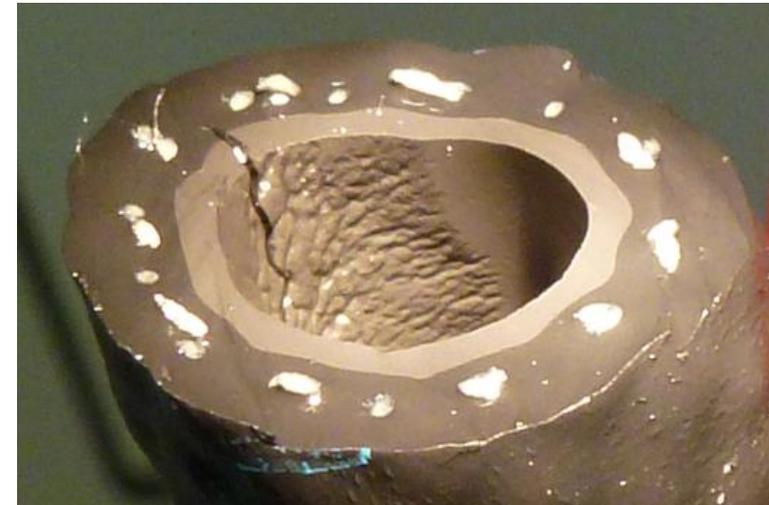


Flammenbild GTL Fuel

# ELASTOMERVERTRÄGLICHKEIT

✓ Undichtigkeiten Dichtungen und Schläuche  
Wechselwirkung veränderte Kraftstoffzusammensetzung und  
spröde Elastomere

➤ Austausch des betroffenen Bauteils behebt das Problem  
nachhaltig



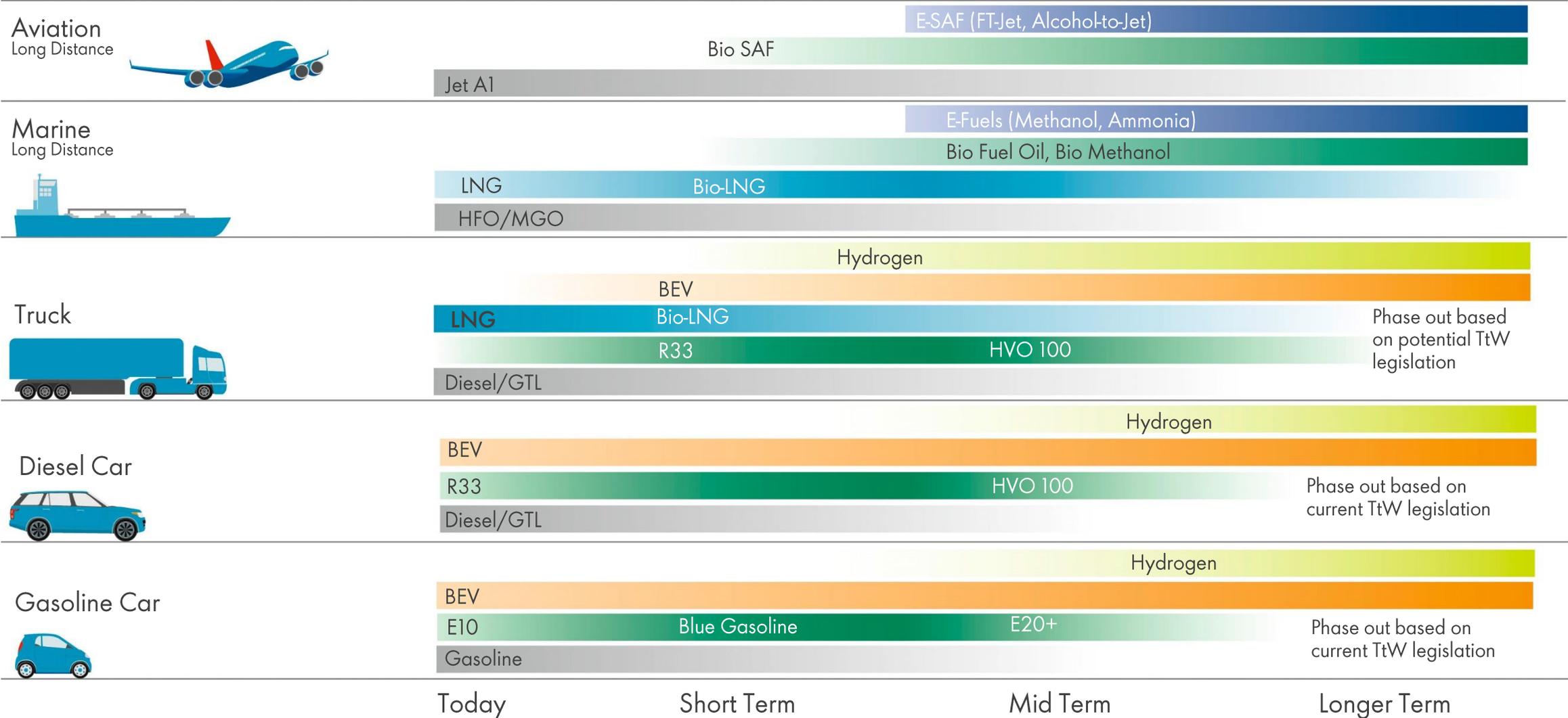
# AGENDA

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## Nachhaltige(re) Energielösungen

# Fuel decarbonisation roadmap for EU vehicle fleet\*

MGO = Marine Gasoil  
 HFO = Heavy Fuel Oil  
 HVO = Hydrotreated vegetable oils  
 MtG = Methanol-to-gasoline  
 SAF = Sustainable aviation fuels  
 GTL = Gas-to-Liquid



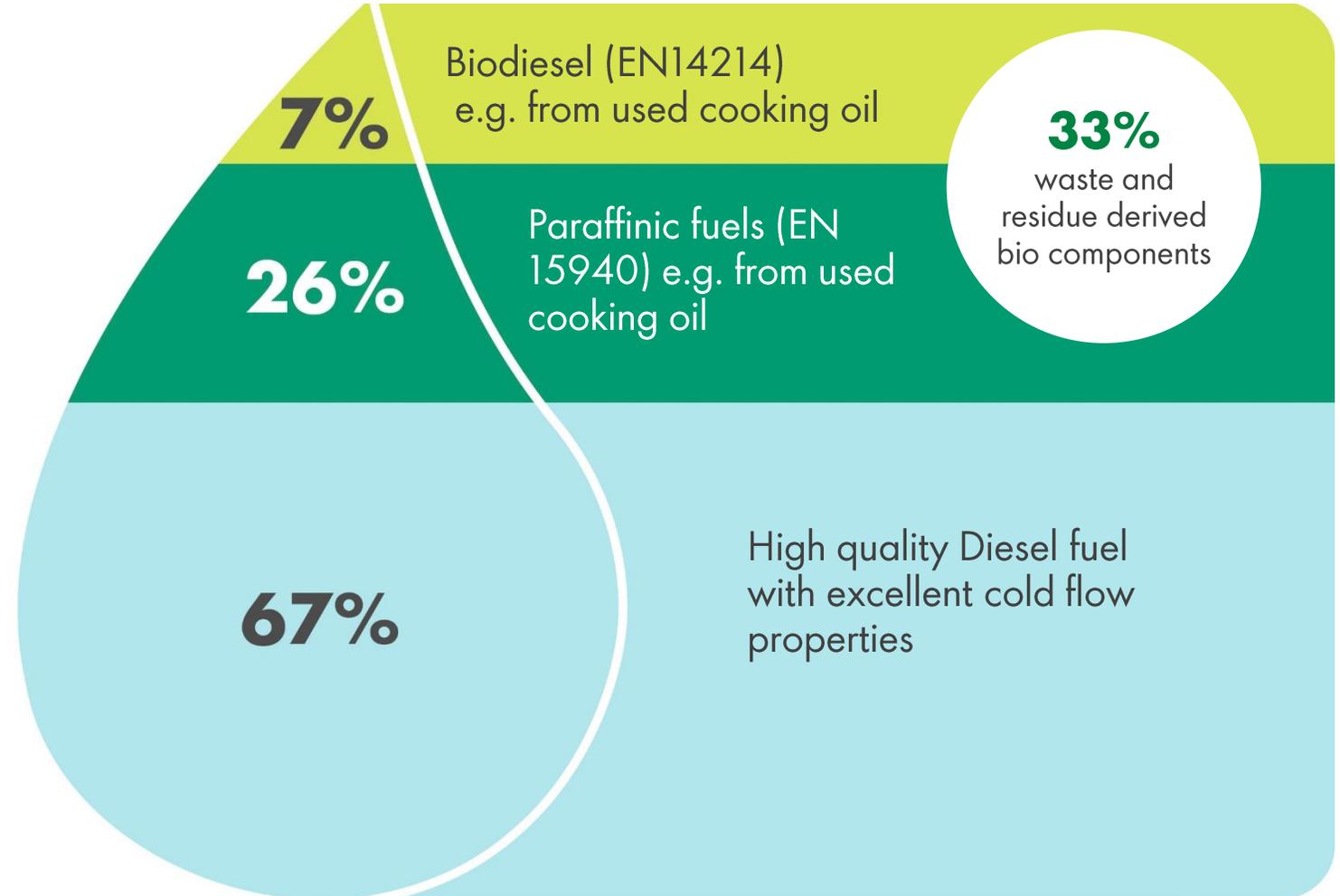
Quelle: Karsten Wilbrand, Shell

\* Non-road excluded

# Blue Diesel - Composition



- Increased share of renewable components to up to 33%
- Clearly defined sustainability criteria – waste and residue only\*
- At least 22% CO<sub>2</sub>\*\* reduction via biofuels and ~80% CO<sub>2</sub> compensation via NBS\*\*\*
- Meets the specification EN590



\*According to massbalanced PoS/certified feedstock

\*\*Well to Wheel CO<sub>2</sub> reduction based on GHG value of PoS of used components with 95.1g CO<sub>2</sub>/MJ as reference for fossil diesel

\*\*\*Compensation via nature based solutions: Nature-based solutions | Shell Global

# What is Shell Renewable Diesel?

100%

HVO/  
HEFA

- 100% Paraffinic fuels (EN 15940) e.g. from used cooking oil
- 100% waste & residue\* derived bio components
- Up to 90% CO<sub>2</sub> emission reduction\*\*



### Drop in fuel

Easy to utilize with new and older on-road diesel engines. No infrastructure investment required



### Can reduce noise

Engine noise reductions of 1-4 dB



### Lower emissions

Lower regulated emissions (PM, NO<sub>x</sub>, CO, & HC)

\*Depends on feedstocks & is proved according by massbalanced PoS/certified feedstock

\*\*Well to Wheel CO<sub>2</sub> reduction based on GHG value of PoS of used components with 95.1g CO<sub>2</sub>/MJ as reference for fossil diesel

# Nachhaltigere flüssige Energieangebote im Vergleich

			
<b>Beschreibung</b>	Besteht zur 33% aus nachhaltigen Komponenten (7% FAME, 26% HVO), erfüllt EN 590	Alternativer, synthetischer Kraftstoff nach DIN EN 15940	Hydriertes Pflanzenöl aus Rest- und Abfallstoffen wie z.B. Altspeisefett
<b>CO<sub>2</sub> - Einsparung / Senkung lokaler Emissionen</b>	mind. 22% weniger CO <sub>2</sub> <sup>1,2</sup>	Weniger Stickoxide und Feinstaub	Bis zu 90% weniger CO <sub>2</sub> <sup>1</sup> , Weniger Stickoxide und Feinstaub
<b>Kälteeigenschaften</b>	max. -20°C CFPP (ganzjährig)	max. -20°C CFPP (Shell GTL Fuel) max. -30°C CFPP (Shell GTL Fuel Alpine) (beides ganzjährig)	max. -30°C CFPP im Winter (Finnland) max. -20°C CFPP im Winter (Niederlande)
<b>Wassergefährdungsklasse</b>	2	1	1
<b>Drop In</b>	✓	✓	✓
<b>Verfügbarkeit</b>	Deutschland	Deutschland Österreich Schweiz	Niederlande Finnland

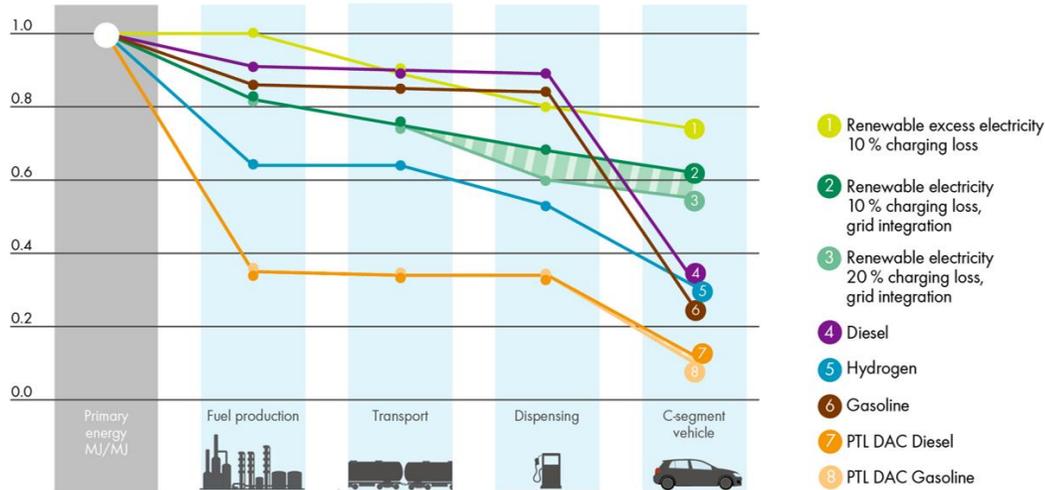
# AGENDA

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E-Fuels

# E-FUELS – BEREITS HEUTE ODER EHER IN DER ZUKUNFT?

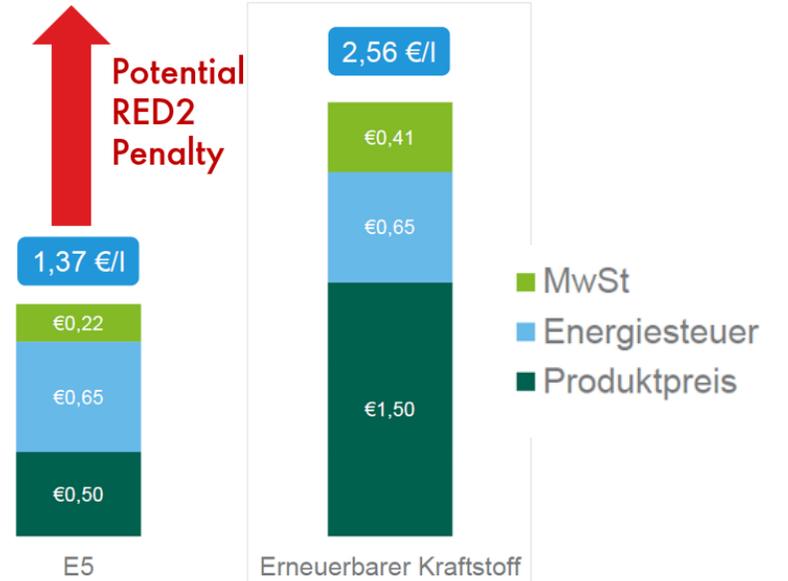
CUMULATED FUEL-POWERTRAIN EFFICIENCY FOR LIGHT DUTY VEHICLES



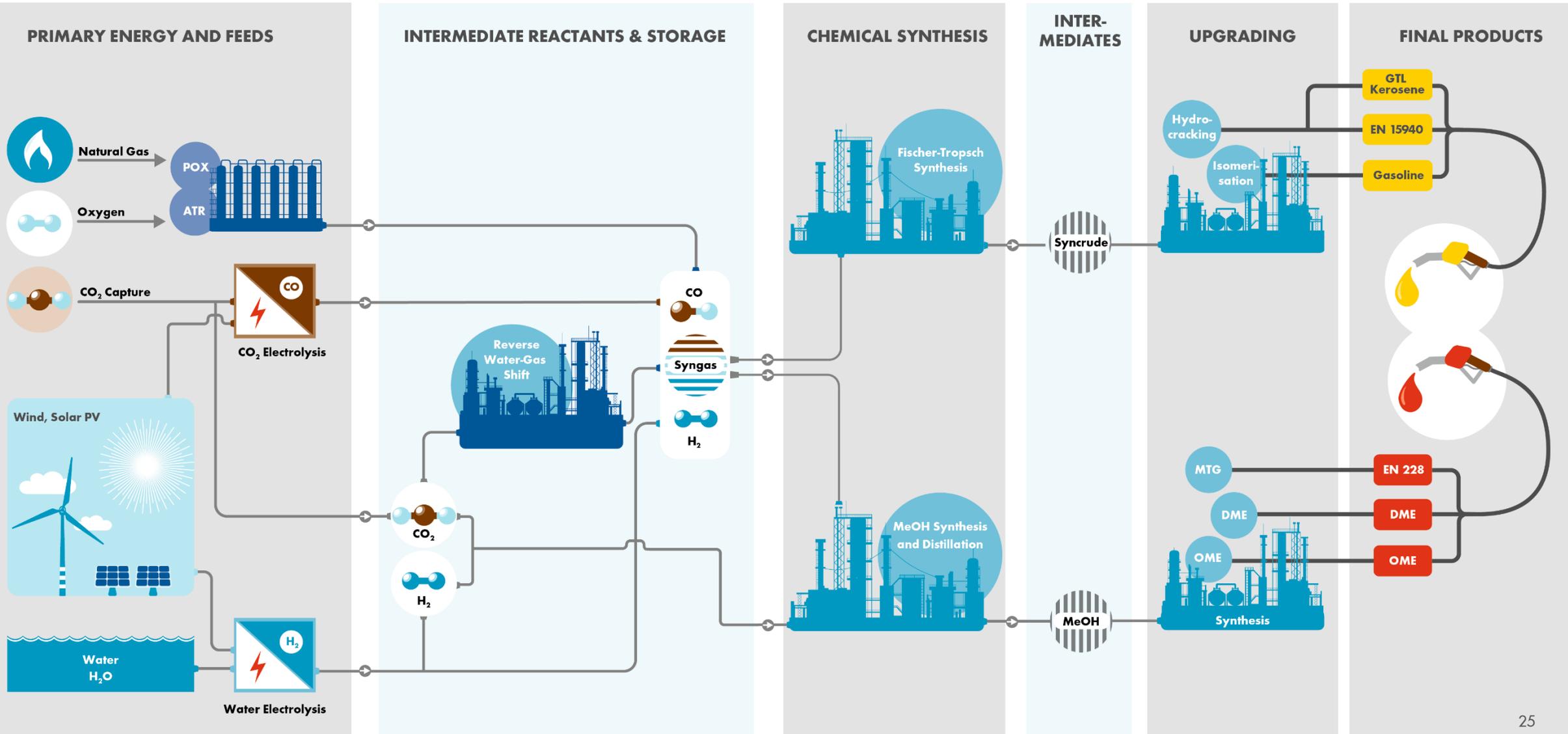
## Heutige Rahmenbedingungen in Deutschland - Besteuerung: Kein Business-Case für PtX-Kraftstoffe



- No Business Case for PTX today
- But RED2 Penalty could be up to 1,50 per Liter > a business case seems in reach



# SYNTHETIC FUEL PRODUCTION PATHWAYS



# AGENDA

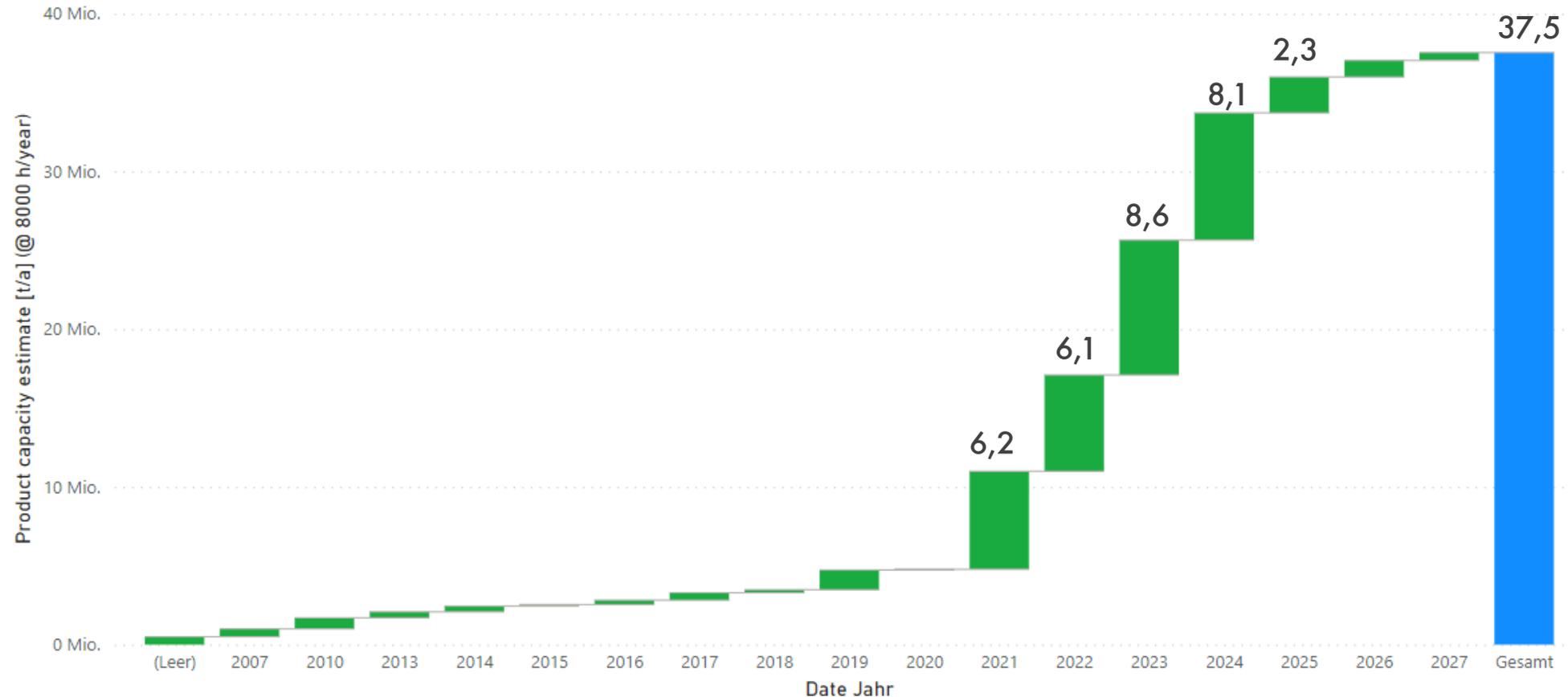
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Ausblick

# HVO – geschätzte Entwicklung der globalen Produktionskapazitäten bis 2027\*

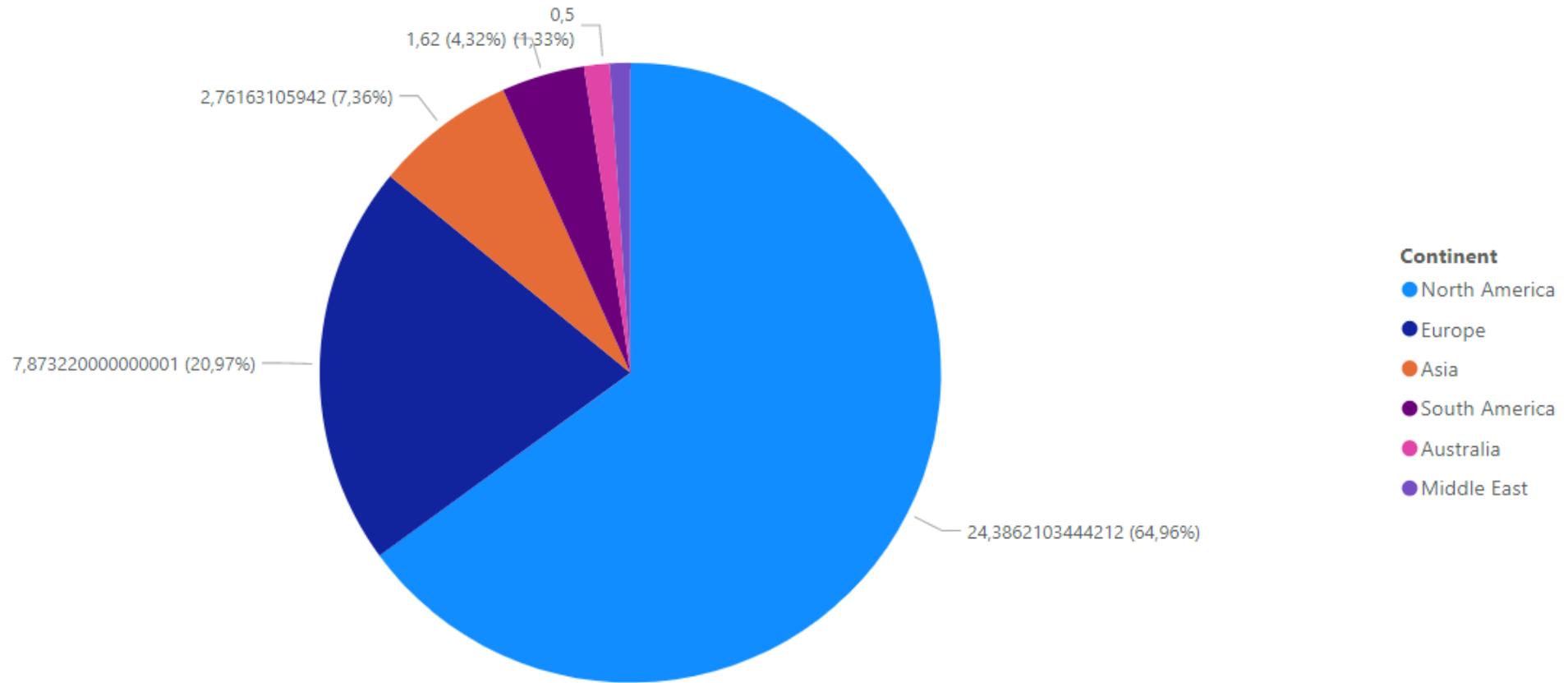
Product capacity estimate [t/a] (@ 8000 h/year) nach Jahr

● Erhöhung ● Abnahme ● Gesamt



# HVO – geschätzte Verteilung der Produktionskapazitäten in 2027 nach Kontinenten\*

Product capacity estimate [mio t/a] (@ 8000 h/year) nach Continent



# AGENDA

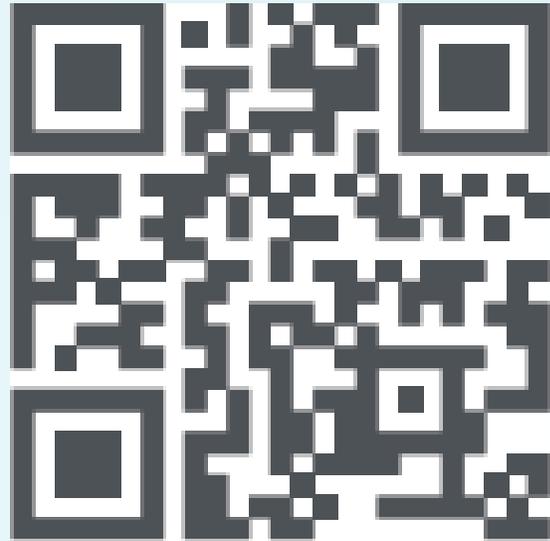
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Fragen



# VERKAUF VON SHELL GTL FUEL ÜBER SHELL PARTNER AN ENDKUNDEN

Jetzt mehr erfahren



# ANWENDUNGSBEISPIELE SHELL GTL FUEL ALPINE



„EIN ABGASGERUCH IST KAUM NOCH WAHRNEHMBAR, DER RUßAUSSTOß HAT SICH WESENTLICH VERRINGERT UND ES KOMMEN KEINE SCHWARZEN WOLKEN MEHR AUS DER PISTENRAUPE“



„WIR HABEN IN DER TESTPHASE NUR BESTE ERFAHRUNGEN GEMACHT UND GUTE RÜCKMELDUNGEN VON UNSEREN MITARBEITERN BEKOMMEN.“



„SHELL GTL FUEL HEATING BESTICHT DURCH SEINE EINFACHE ANWENDUNG UND SAUBERE VERBRENNUNG. DARÜBER HINAUS KONNTEN WIR SOGAR EINEN GERINGEREN VERBRAUCH FESTSTELLEN.“



FOSSIL BASED

RENEWABLES BASED

- ++ (FULLY) COMPATIBLE
- + WITH MINOR RESTRICTIONS
- WITH MAJOR RESTRICTIONS
- ▬ NO OPTION

	NUCLEAR*	OIL	GAS	COAL*	BIO	SUN	WIND	* No Shell option
		FOSSIL LIQUID FUELS	RENEWABLE LIQUID FUELS (Biofuels + PtL) **	CNG + Biogas/PtG	LNG + Biogas/PtG	HYDROGEN	ELECTRICITY	
City Car 		++	+	++	▬	+	++	
Long Distance Car 		++	+	++	▬	++	+	
Light Truck 		++	+	++	▬	++	+	
Municipal Fleets 		++	+	++	▬	++	++	
Heavy Truck 		++	+	○	+	+	○	
Off road: Agriculture, Construction, Mining 		++	+	○	○	○	○	
Rail 		++	+	○	+	+	++	
Marine 		++	+	○	+	▬	▬	
Aircraft 		++	+	▬	▬	▬	▬	