The Role of Fuel Ethers Industry in 2050: A Roadmap for Decarbonized Liquid Fuels

ERTC (*European Refining Technology Conference 2020*) organized by WRA (*World Refining Association*)

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europe sustainable fuels
DRIVING CLEANER MOBILITY WITH FUEL ETHERS

A sector group of Cefic
European Chemical Industry Council - Cefic aisbl

Who we are

- Sustainable Fuels is the association of the European fuel ethers industry, is dedicated to the responsible production, usage and promotion of clean, high quality, high-efficiency petrol components.

- Sustainable Fuels bring together producers of MTBE | BIO-MTBE | BIO-ETBE | TAME | BIO-TAME | BIO-TAEE.

- Sustainable Fuels (former EFOA) has been created in 1986 as part of CEFIC, The European Chemical Industry Association and sits within Petrochemicals Europe department.

Better Transport Future:
A Multi-Stake-Holders, Multifaced Challenge and Opportunity

Environment: Reducing CO_2 emissions while improving air quality

Consumers: Access better vehicles reducing fuel consumption

Vehicle Manufacturers: Fulfill ambitious CO_2-saving EU targets

Refiners: Maintain relevance contributing to transport carbon efficiency

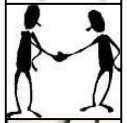
Electromobility: Foster EV acceptancy via more efficient/cleaner hybrids

Society: Obtain better environment while enjoying affordable mobility

All key stake-holders have clear drivers to cooperate towards better transport future

Transport Evolution: Refiners Challenges & Opportunities

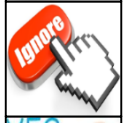
Liquid fuels deselection avoidance: Electric vs. Thermal Engines



Car makers vs. fuel refiners: Cooperation vs. confrontation

To be a solution rather than a problem: Air Quality & Climate Change

Fulfil obligations rather than pay penalties: CO_2 reduction targets



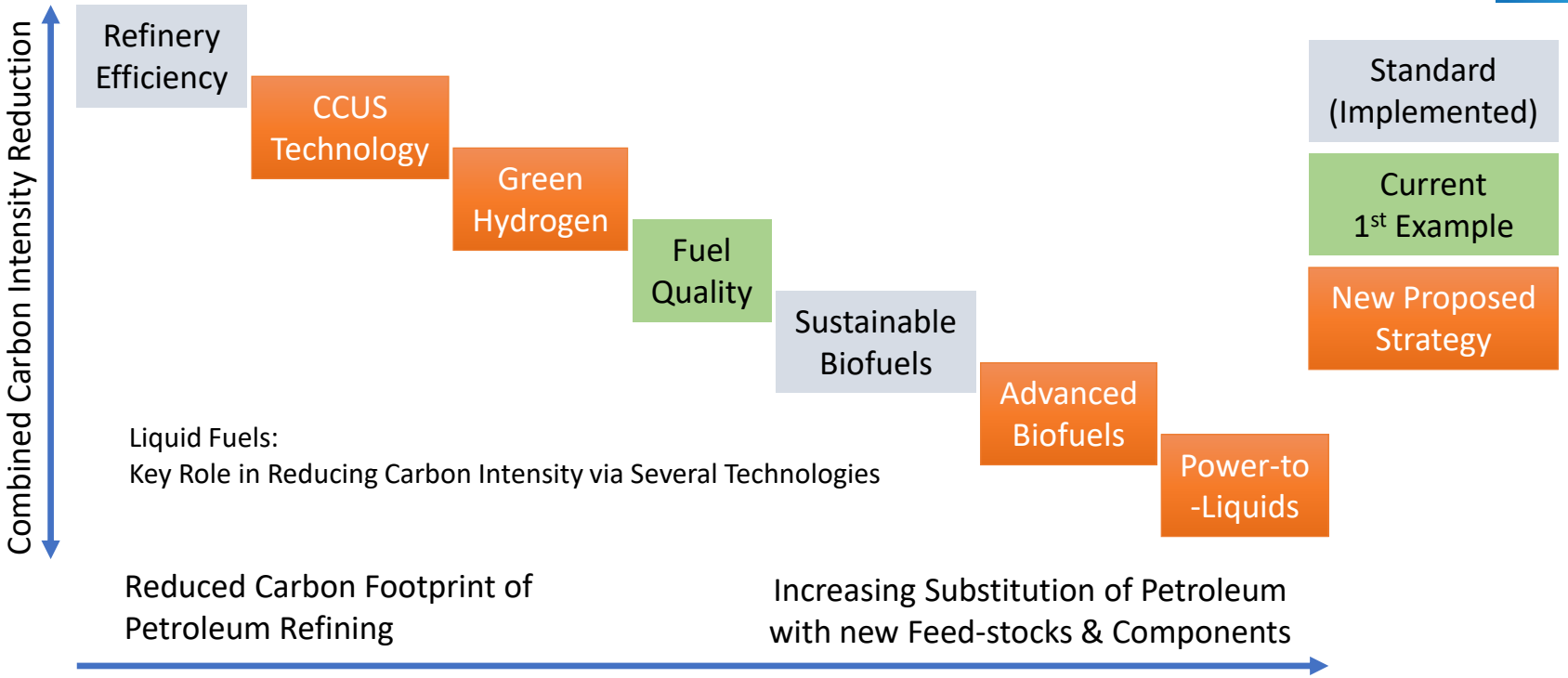
Get entire fuel quality contribution recognized: LCA or WTW, not WTT

Improve public image: from quality “obstacles” to “enablers”/”promoters”

Delivering higher value to consumers: Fuel efficiency and vehicle protection

Liquid Fuels Business Under Treat: High Quality Fuels Help Survival

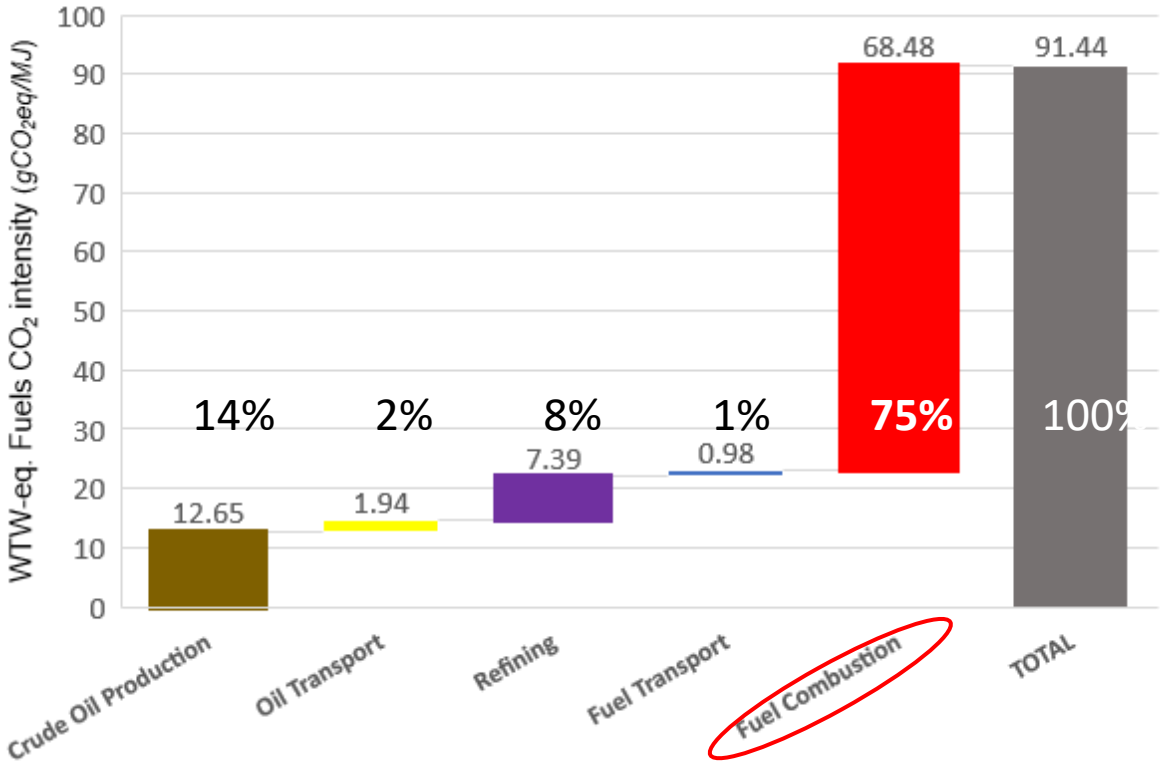
Multiple technologies to be deployed together to deliver significant reduction in carbon intensity of liquid fuels



Fuel Quality: Most readily available option for refiners to contribute to improve carbon efficiency

Source: FuelsEurope Annual Conference – 5 June 2018

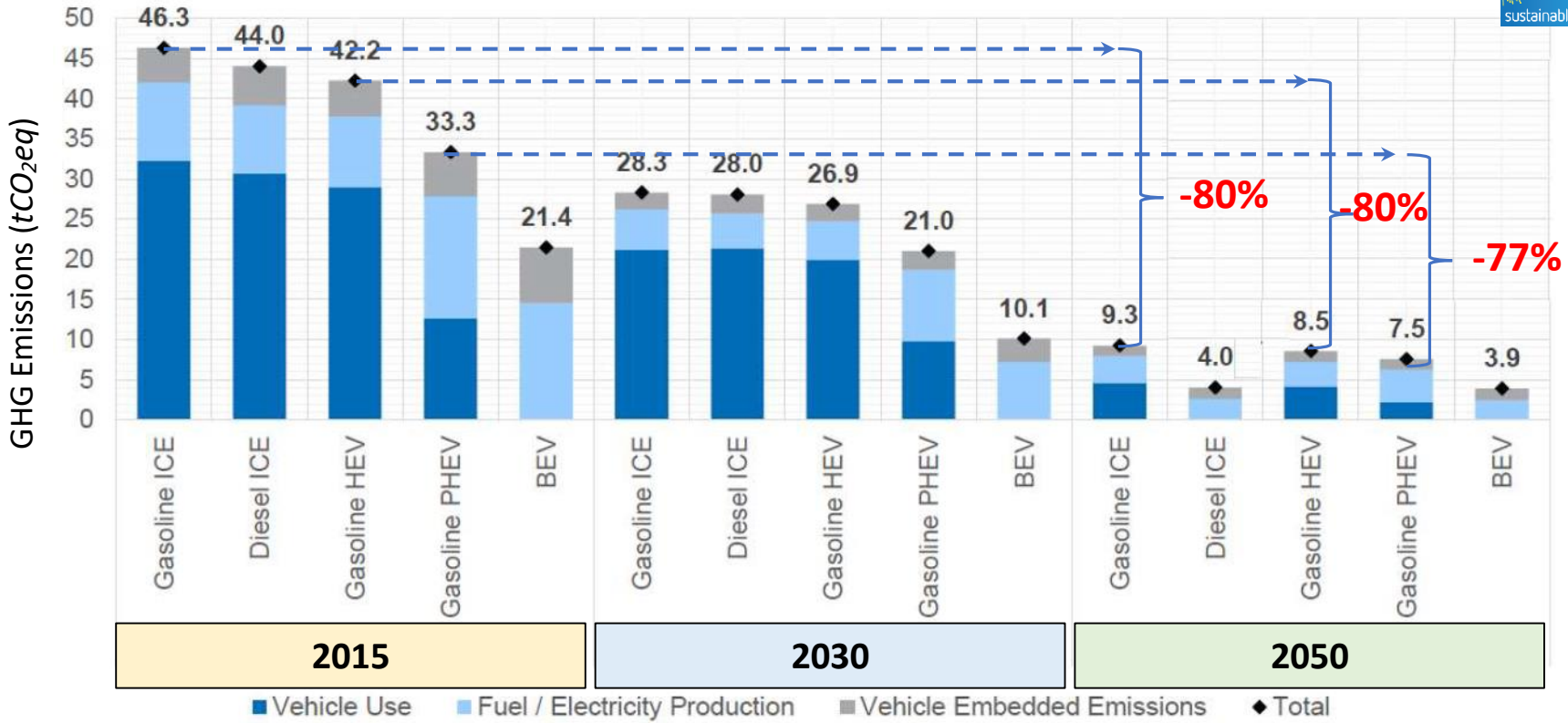
CO_2 Emissions from production & use of fuels



Combustion-improving petrol quality (octane) has the largest beneficial effect on CO_2 emissions reduction

Source: Concawe, based on JEC v4

European passenger car life cycle GHG emissions *("Low C Fuels" Scenario)*



Low-carbon fuels option capable to deliver 80% CO_2 emissions reduction by 2050

Source: RICARDO - Analysis of Mass EV Adoption and Low Carbon Intensity Fuels Scenarios (24 Aug 2018)

Carmakers to deploy all available options to achieve very ambitious efficiency targets

= *Fuel-related options*

Fuel

Higher Compression Ratio

Displacement Downsizing

Turbocharging

Direct Injection and Lean Mixture

Start/Stop

Fully variable Valve train

Intelligent Alternator Control

Hybrid-Drives, Electrification

Friction, Optimization

Tires

Weight

Navigation

Aerodynamics

Dual Clutch, Automatic Transmission

Low Friction, Lube Oil

Thermal-Management Heat Recovery

Air Conditioning

Electrified Auxiliary Drives

Braking Energy Recuperation

High-quality fuel fundamental among vehicle efficiency improvement options

Higher-octane petrol: an extremely cost-effective solution

Type of measure	Measure	Index of CO_2 emissions reduction cost
User Support	Promotion of Eco-Driving	**1** *(base)*
Traffic-Related	Increased Number of Electronic Toll Collection	**4**
Fuel-Related	**Increased Gasoline Octane Rating**	**5**
Vehicle-Related	Greater Use of Idling-prevention Mechanisms	**14**
Vehicle-Related	Greater Introduction of Clean-Diesel Technologies	**16**
Fuel-Related	Introduction of Bio-Fuels	**25**

CO_2 abatement cost via octane increase the most economical available solution

Source: Japan Automobile Manufacturers Association: (JAMA) - "Integrated approach to reduce CO2 emissions"

High Quality Fuel's Key Features

Go farther on the same tank

Minimize air pollutants emission

Limit GHG emissions

Be cost effective

Compatible with engine and materials

Fungible (logistics/refinery)

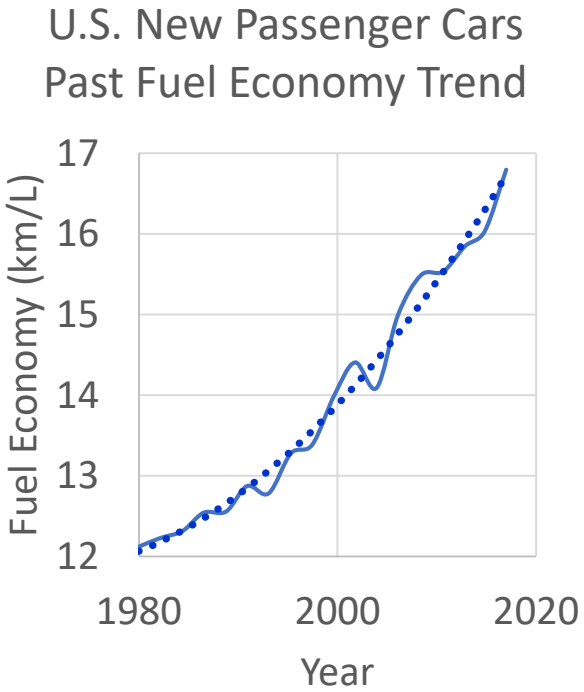
Exceed basic grades minimum standards (i.e. octane)

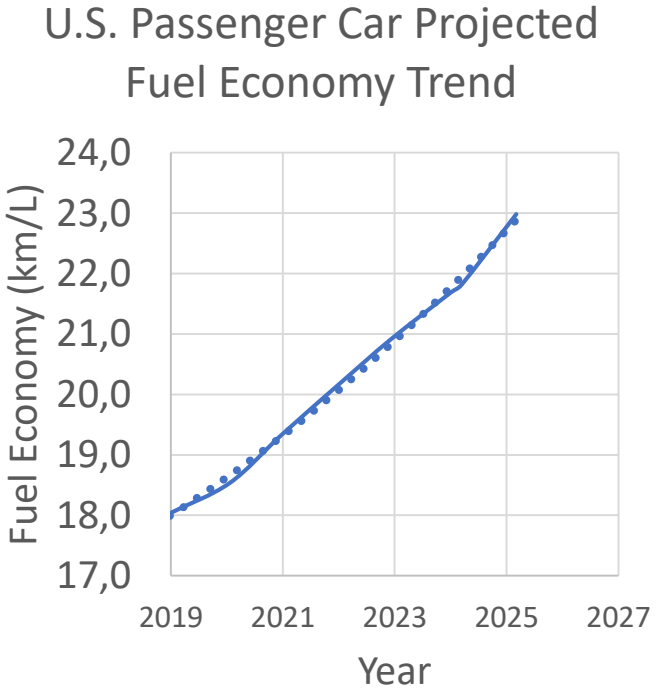
Contribute high energy content

Be free from objectionable components (metallic, NMA)

High Fuel Quality Highly Beneficial for All Stakeholders

Passenger cars fuel economy kept improving in the last four decades. Positive trend expected to continue

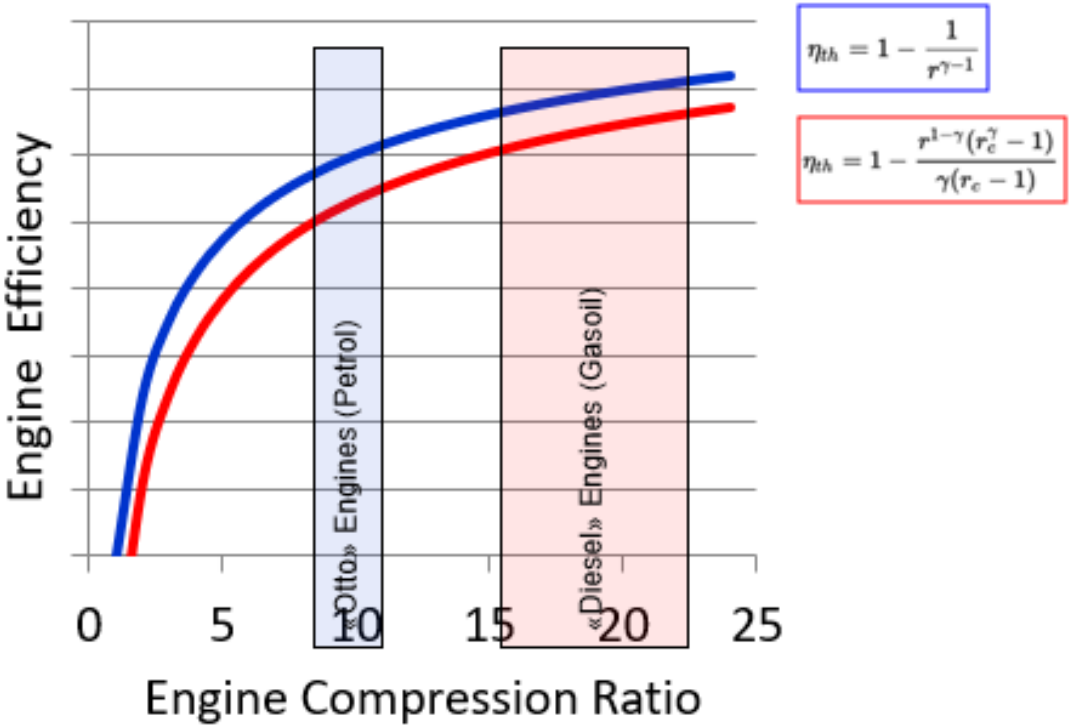




Plenty of room for further significant ICE engines' fuel economy improvements

Source: 1) US Bureau of Transportation Statistics; 2) US Energy Information Administration (AEO2020)

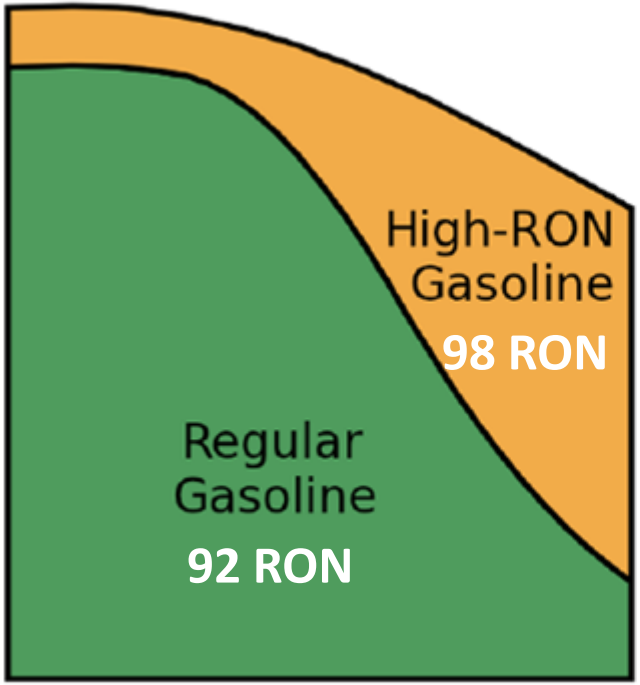
Petrol Engines More Efficient than Diesel @ Same Compression Ratio

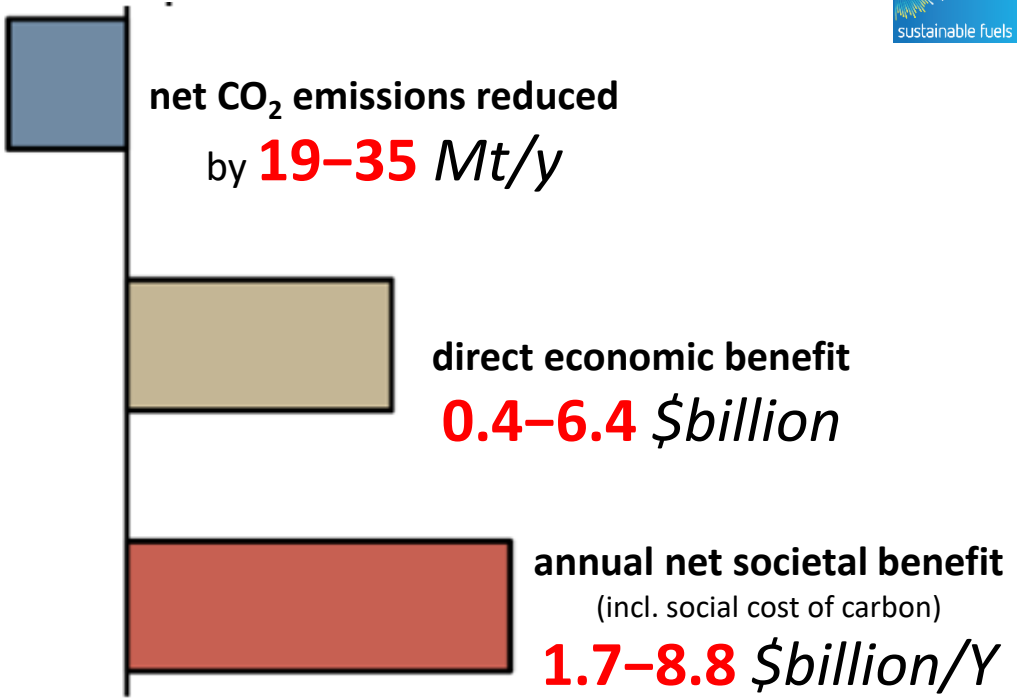


Octane-Enabled High Compression Ratio Fundamental to Engine Efficiency

Source: Mirabella (LyondellBasell)

Higher-octane petrol economically delivers environmental & societal benefits





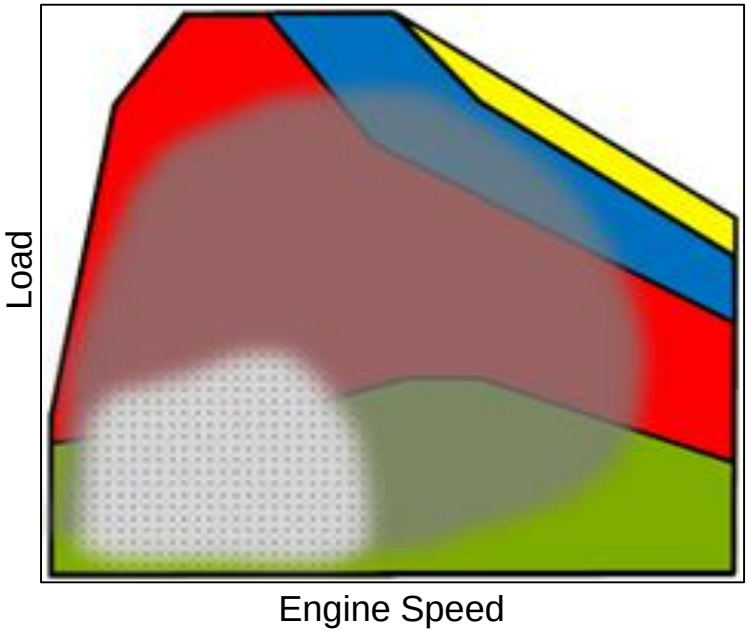
U.S. to significantly reduce CO_2 emissions, save big money & achieve large societal benefits via higher-octane petrol

Source: MIT report "Economic and Environmental Benefits of Higher-Octane

Beyond higher compression ratio effect: Multiple beneficial effects of high-octane petrol to improve engine efficiency and performance

"Simultaneously increasing compression ratio and RON improved BSFC between 4% and 15% depending on operating point"

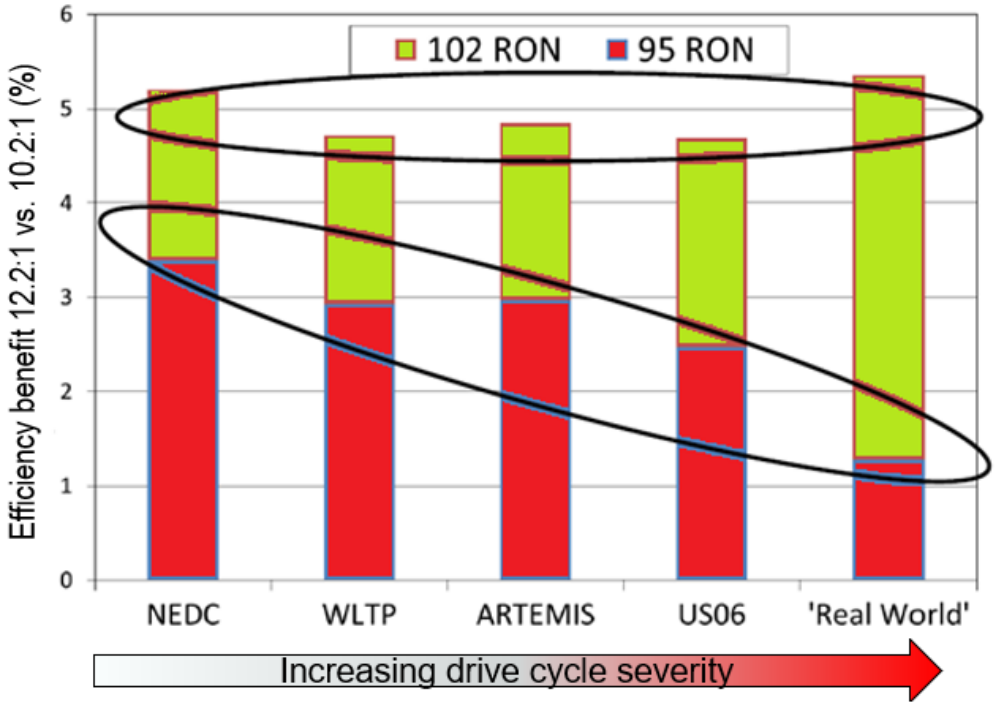
- Thermodynamic efficiency benefits from increased compression ratio
- Thermodynamic efficiency benefits from improved combustion phasing
- Combustion efficiency benefits from reduced thermal protection over fuelling
- Power increase due to improved efficiency and more stable combustion
- Operating area on NEDC
- Operating area "real driving"



High-Octane-enabled petrol efficiency improvement well beyond compression ratio

Source: Ben Leach (BP) – "CO2 Emission Reduction Synergies of Advanced Engine Design and Fuel Octane Number" SAE 2014-01-2610

EU drive cycles closer to 'Real-world':
High-octane consistently improves efficiency



Benefits **insensitive** to cycle severity

Benefits **sensitive** to cycle severity

Higher-octane delivers efficiency benefits in all drive cycles

Source: Ben Leach (BP) – "CO2 Emission Reduction Synergies of Advanced Engine Design and Fuel Octane Number" SAE 2014-01-2610

CONCAWE's high-octane petrol study

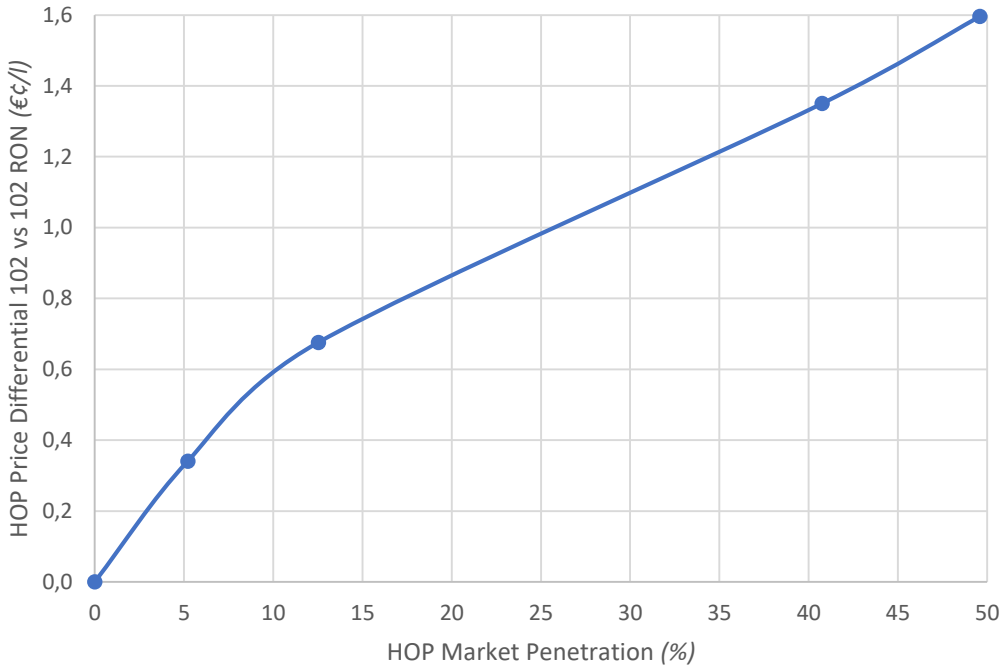
The LP modelling study demonstrated the feasibility of producing a High-Octane Petrol (HOP) in the EU refining system

A significant reduction in CO_2 emissions is expected (≈ 5 *Mt/year* vs 2030 base case)

The study recommends the endorsement of RON 102 as a pragmatic way forward for HOP

HOP domestic demand % vs HOP-RON 95 price differential

(2016 price set, Brent at 43 $/bbl)



The study recommends the endorsement of RON 102 as a pragmatic way forward for high-octane petrol

Source: CONCAWE Report no. 17/20 Sept. 2020: "High Octane Petrol Study"

Need to improve fuel quality-impacting relevant EU legislation

Update the test fuel regulation 2017/1151, adding new high-octane petrol specification for Euro 6 and post-Euro-6

Consider parallel inclusion of high-octane petrol specification within future revision of Fuel Quality Directive

Improved regulation would enable the advent of more efficient engines, benefit emissions & consumers and help EU fleet hybridization

A voluntary agreement between carmakers and fuel producers could also be a viable option of moving forward as it would:

Encourage the development and actual market deployment of the higher performing engine

Stimulate production of better fuel while not adding an additional mandate on fuel producers

Industry together can play a key role in the transition towards higher-octane fuel & higher efficiency vehicles

It's not about electrical engines against thermal ones, but rather about improved thermal engines, reducing carbon and toxic emission of ICE vehicles while, at the same time, improving HEVs carbon efficiency, their acceptance and hence fostering transition towards BEVs.

Which future scenario would be preferable ?

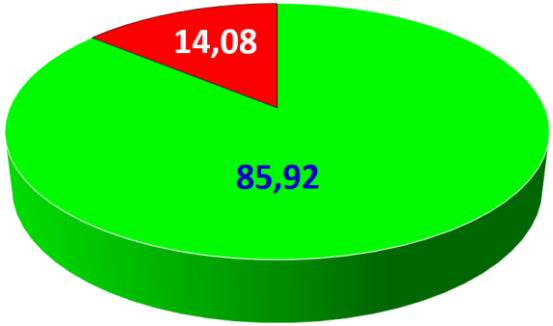
1) Unimproved new ICE vehicles + new HEVs with unimproved ICE engine + BEVs penetration
2) Improved new ICE vehicles + new HEVs with improved ICE engine + BEVs penetration

Not only scenario (2) would be better for Climate, Environment and Consumers, but it would also help transitioning to quicker BEV success

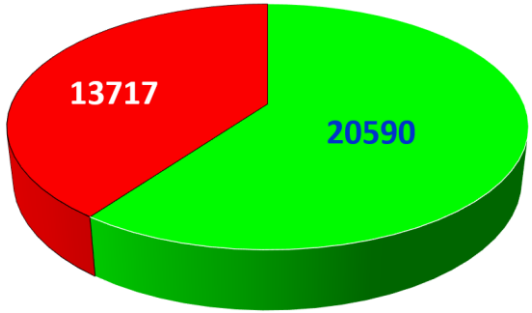
Efficiency-Improved ICE Engines Help Electro-mobility

Over 90% of all EVs Mileage Run by Hybrid Types

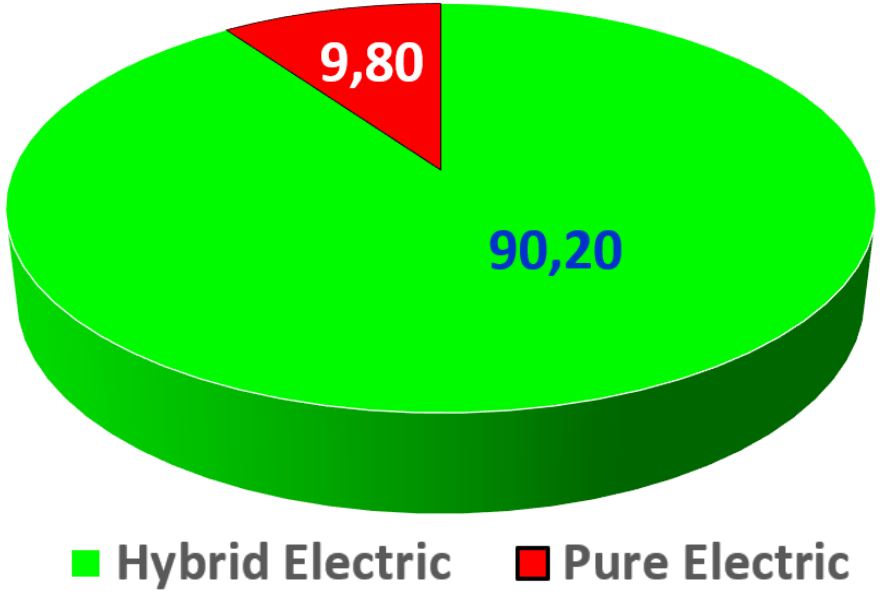
[1] Number of EVs Registered in EU in 2017



[2] Average Yearly Distance Traveled (km)



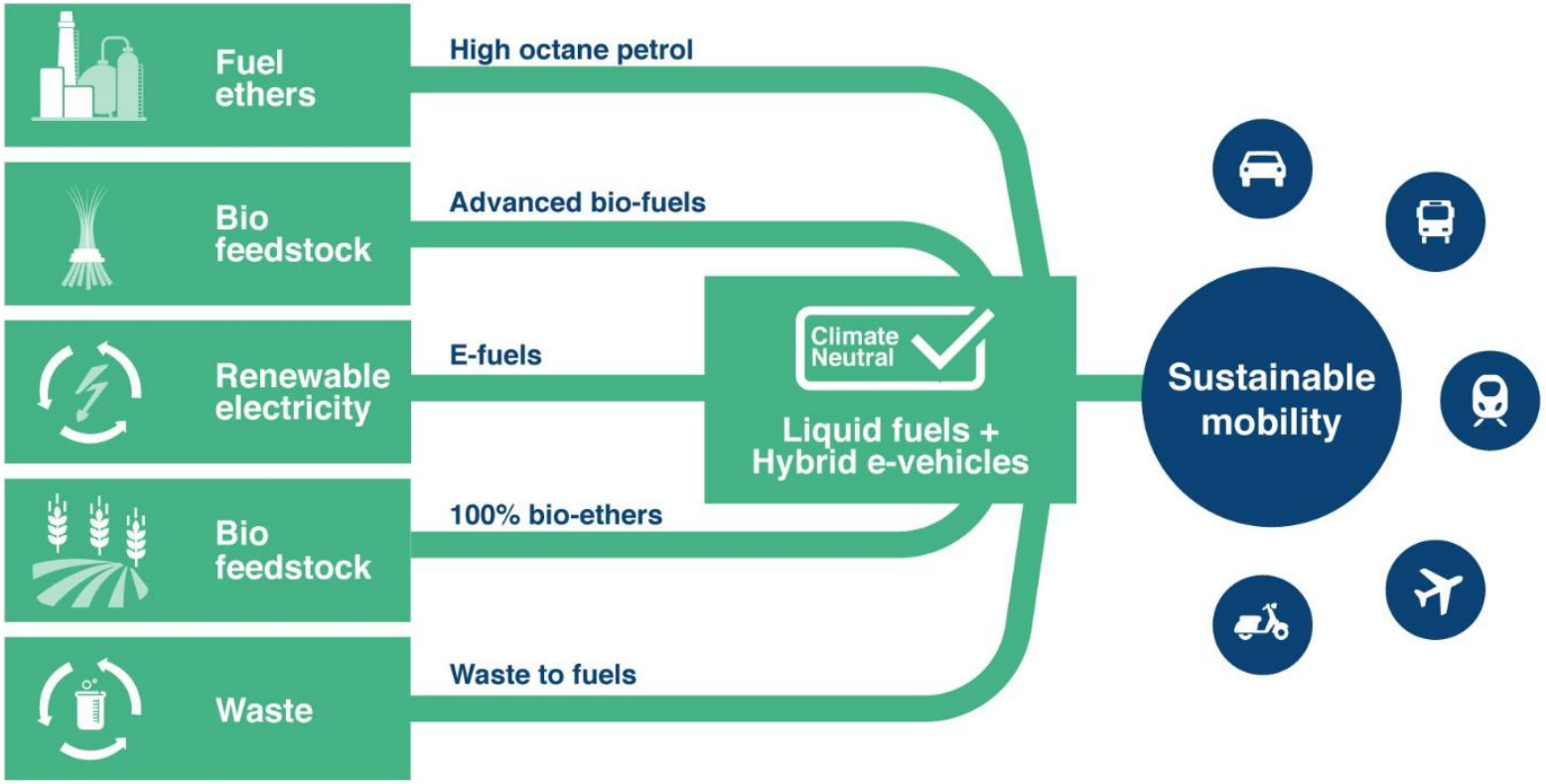
Percentage EVs Annual Mileage Traveled by Types



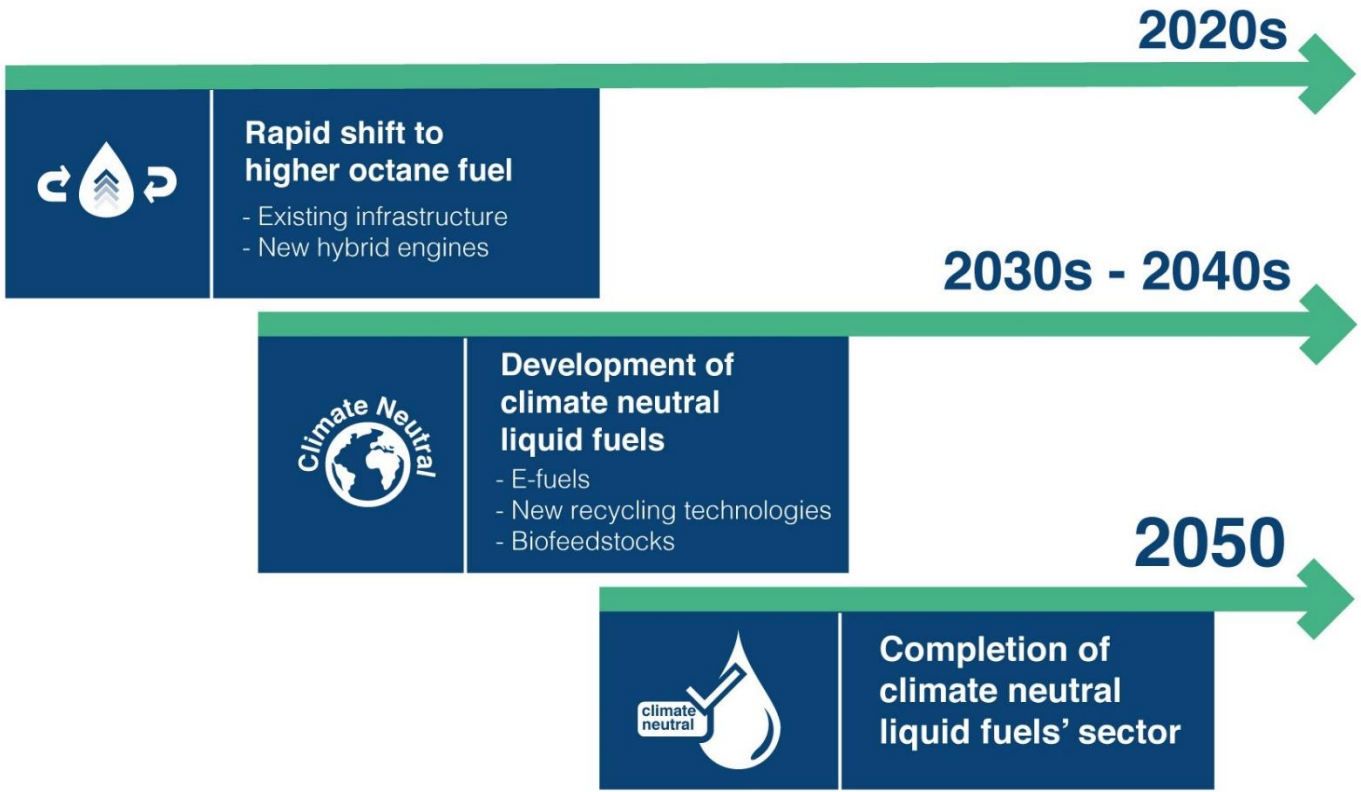
Higher ICE Efficiency Improves Performance of over 90% of EVs Actual Mileage

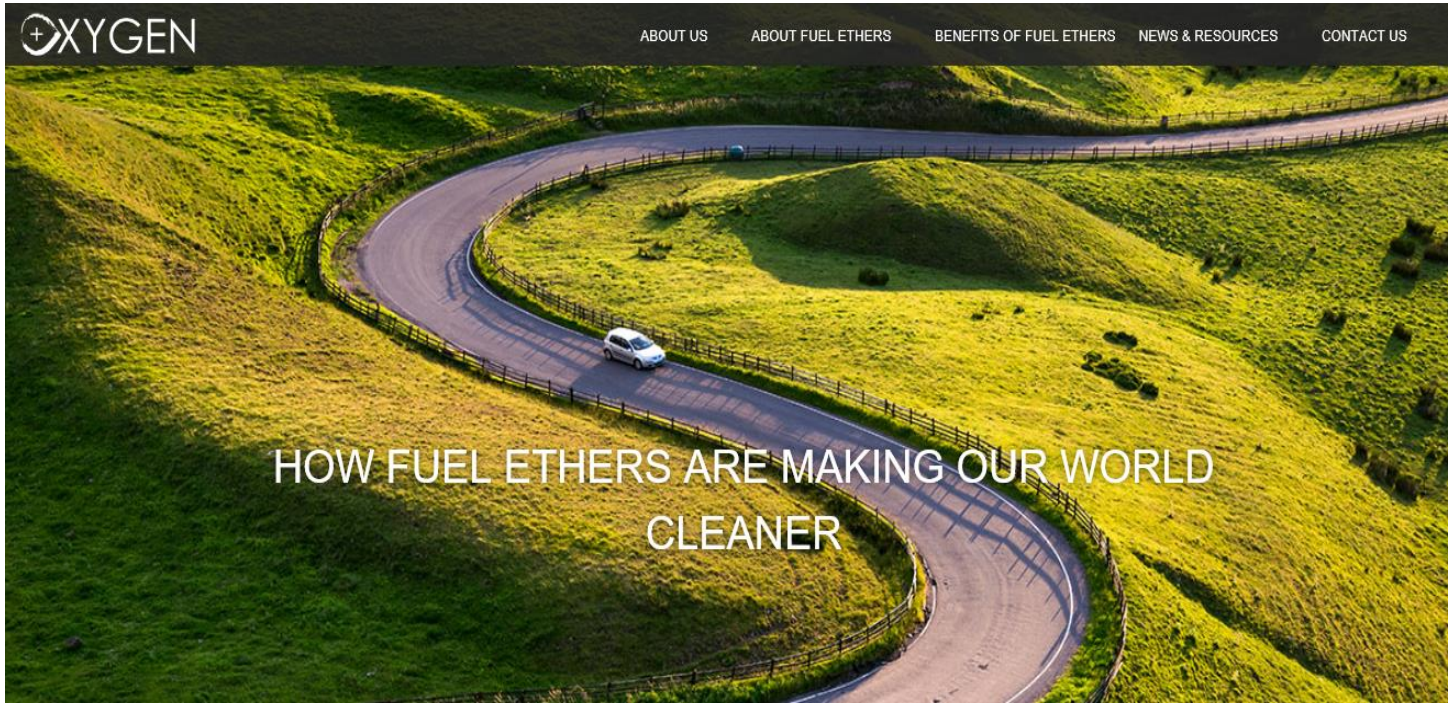
Sources: [1] EUROSTAT: "Number of EVs Registered in EU in 2017" …; [2] Daniel Boston & Alyssa Werthman –Ford "Plug-in Vehicle Behaviors" June 2016"

Sustainable Fuels' "Vision 2050": 1) Solutions' Portfolio



Sustainable Fuels' "Vision 2050": 2) Improvement's Stages





https://globalfuelethers.com
https://sustainablefuels.eu