POWERING AHEAD

DROP-IN LCI FUELS

For use in diesel engines
Biodiesel and HVO/RD

Perkins®

CONTENT

WHAT ARE LOWER CARBON INTENSITY (LCI) FUELS?

Fuels that reduce the amount of carbon released when used over a lifecycle.

LOWER CARBON INTENSITY FUELS

*Drop-in fuels**

Biodiesel or FAME (Fatty Acid Methyl Ester)

HVO (Hydrotreated vegetable oil) or **RD** (Renewable Diesel)

BTL (Biomass to liquid)

GTL (Gas to liquid)

*Alternative fuels***

DME

Methanol

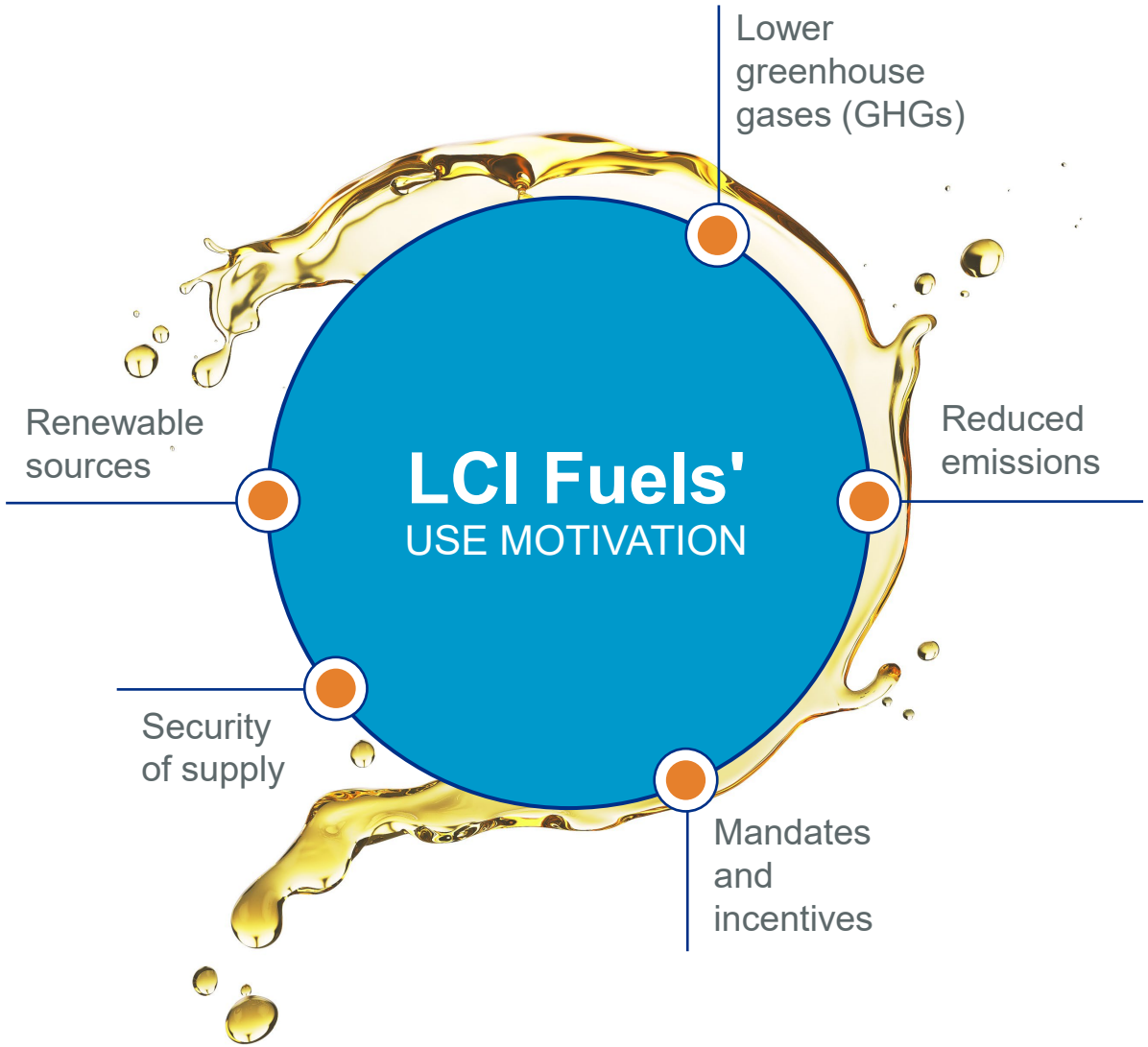
Hydrogen

Natural gas

Ethanol – a biofuel

*Depending on feedstock source the fuel may be considered non-renewable

** These fuels are not discussed in this presentation



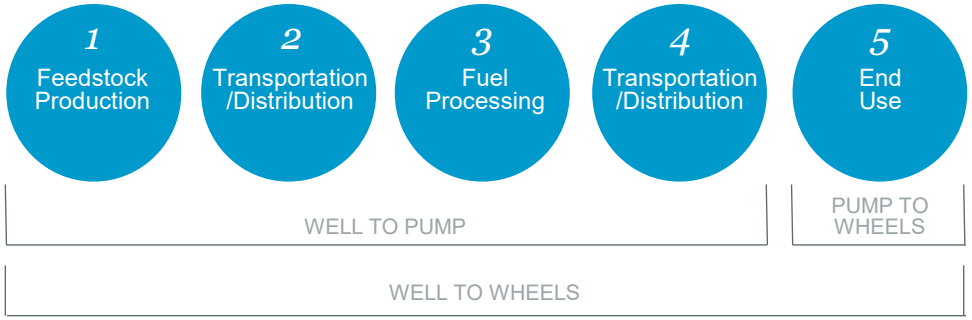
KEY DEFINITIONS

Drop-in fuel

Fuels that can be used in an existing compression ignition diesel engine without any major modification. These fuels have varying levels of renewability and sustainability but can deliver significant CO_2 reductions over a lifecycle analysis for a lower cost/investment.

Well-to-wheel analysis

Looks at the total energy and emissions impact of producing and supplying energy to an application and the use of this energy.
It is often broken down into well-to-tank and tank/pump-to-wheel.



Land use change

A process by which human activities transform the natural landscape, referring to how land had been used.

Renewable diesel

Renewable diesel (RD) or hydrotreated vegetable oils (HVO) is a form of renewable synthetic diesel, produced from certified waste fats and oils through hydro-processing.

Biodiesel

Generally considered a renewable fuel that can be made from vegetable oils, animal fat, and waste cooking oil. The raw oils or animal fats are chemically processed to form a fatty acid methyl ester (FAME).

BENEFITS OF DROP-IN RENEWABLE FUELS

The magnitude of these advantages may differ*:

1

MINIMAL/NO CHANGE REQUIRED

Using existing internal combustion engine architecture

2

CAN REDUCE LOCAL EMISSIONS

Improving air quality

3

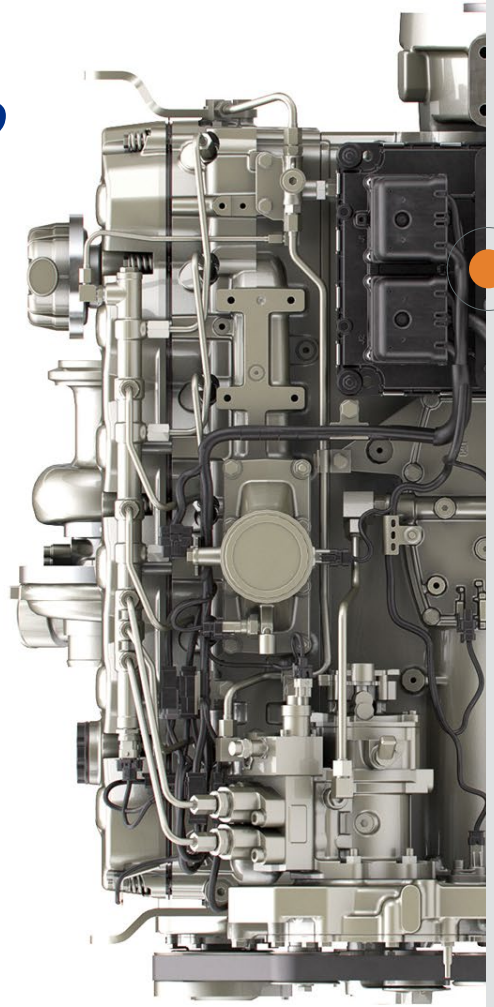
EXISTENCE OF MANDATES

Supportive carbon mandates, incentives and targets

4

LOCALLY SOURCED FEEDSTOCK

Further reduces the life-cycle (well-to-wheel) carbon



*Depending on feedstock source and land use change (LUC)

Additional information

Drop-in LCI fuels must meet the specifications and characteristics described in the fluid manuals referenced in order to be used in Perkins® engines

DROP-IN FUELS

Perkins® range compatibility for engines

Please refer to the fluid manual for the latest updates.

400-1200 Series

1500-2800 Series

4000-5000 Series

Emissions	Max biodiesel blend	Max HVO, e-fuel, BTL & GTL
HRC	B20	100%
LRC	B20*	
Unregulated	B7	
HRC	B20	
LRC	B100	
Unregulated		
LRC	B20*	
Unregulated		

* B35 for LRC where mandated

Drop-in LCI fuels must meet the specifications and characteristics described in the fluid manuals, Perkins® diesel engines fluids recommendations manual.

Stage V engine have been Certified to max of B20

Emissions guide:

High-regulated countries (HRC): EU Stage V, U.S. EPA Tier 4 Final, China Nonroad Stage IV, Korea Stage V, and Japan 2014

Lower-regulated countries (LRC): Brazil MAR-1 and UN ECE R96 Stage IIIa

***Unregulated:** Anything less certified than LRC

Please consult with your distributor for blend levels above B20.

DROP-IN FUELS CONSIDERATIONS

	HVO/RD	Biodiesel
Engine change	No change required*	Minimal/no charge required
Performance	May reduce the power output of engines	At B100, biodiesel has about 8% lower energy density than diesel fuel
Storage	Similar aging life as diesel fuel	Biodiesel storage duration is shorter than diesel and max B5 for standby applications
Blend impact	Using HVO has minimal impact Irrespective of blend level	Higher blend levels has higher risk
Maintenance	No precautions beyond diesel irrespective of blend level	Shorter maintenance intervals are recommended for the first time and use of S.O.S is required for blends > B20
Warranty	Supported through standard warranty policy assuming they comply with the standard fuel specifications	Supported through standard warranty policy assuming they comply with the standard fuel specifications

* Change may be required for engines older than 1990, please refer to fluid manual for more information.

APPENDIX

M0113102-0: Perkins Diesel Engines Fluids Recommendations Manual’

Renewable fuels

Lower carbon intensity fuels

Together, we power ahead.

Perkins®