ERTC Virtual Meeting 2020

ExxonMobil dewaxing in bio services

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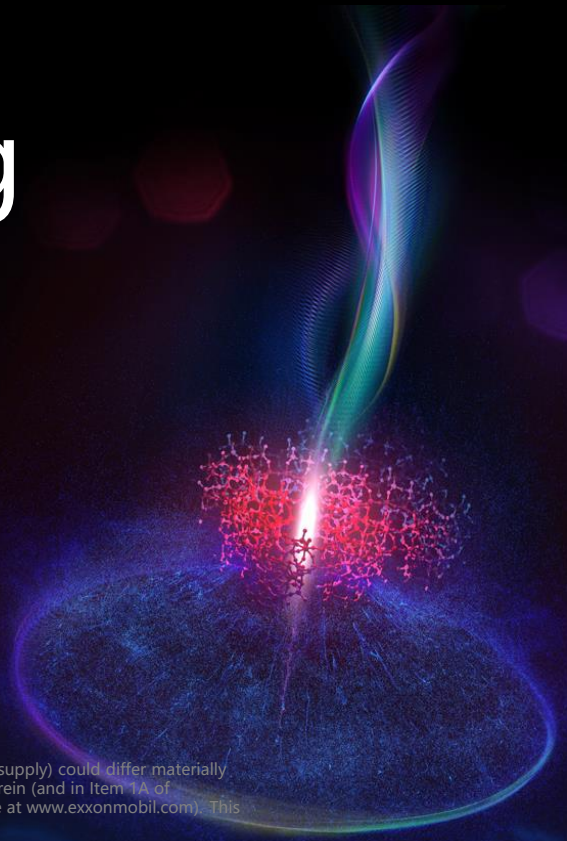
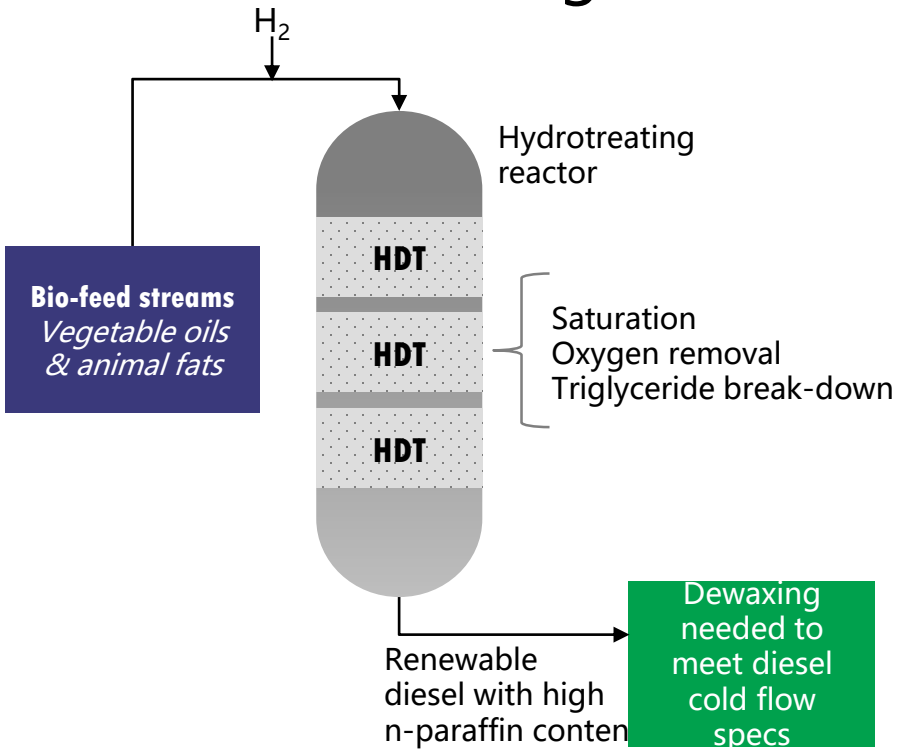


Content

- How bio processing drives the need for dewaxing technology
- Brief intro to ExxonMobil dewaxing catalysts
- Dewaxing catalyst deployment options
- Why ExxonMobil dewaxing meets renewable diesel needs

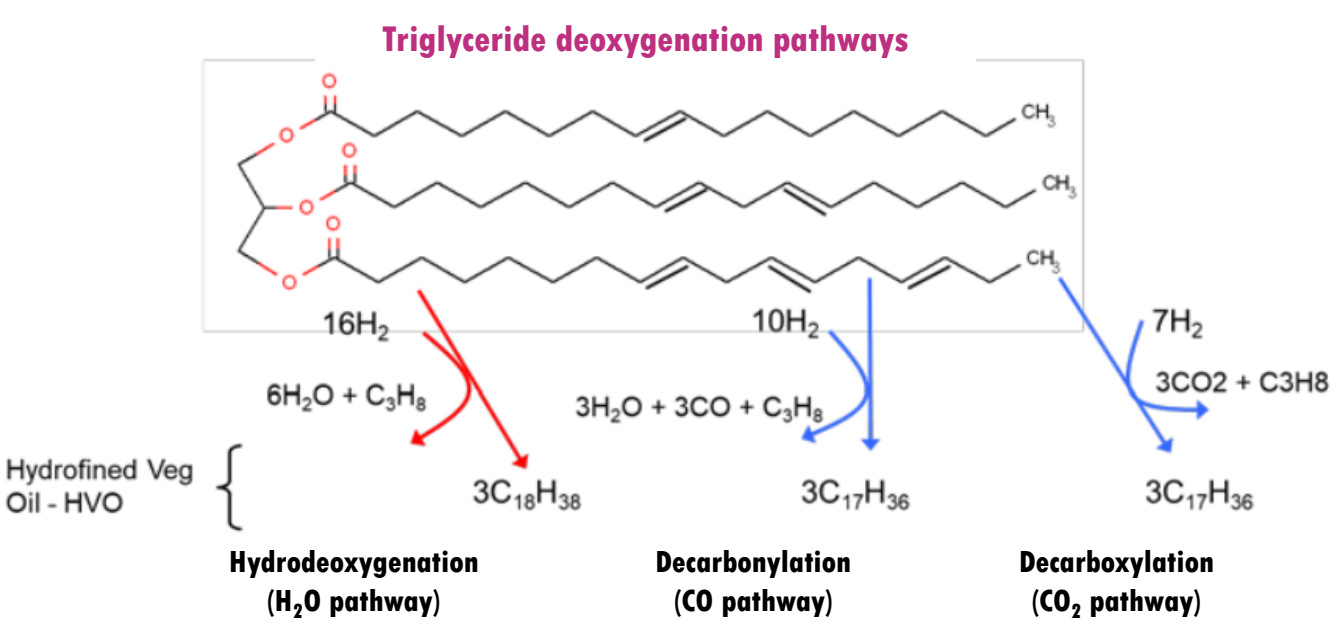
ExxonMobil

Bio processing drives need for dewaxing



- Vegetable oils and animal fats convert to n-paraffins during hydrotreating
- Carbon numbers range from 12 to 24 depending on the bio source
- Most bio feeds result in C17 to C18 carbon number n-paraffins

Bio reaction pathways



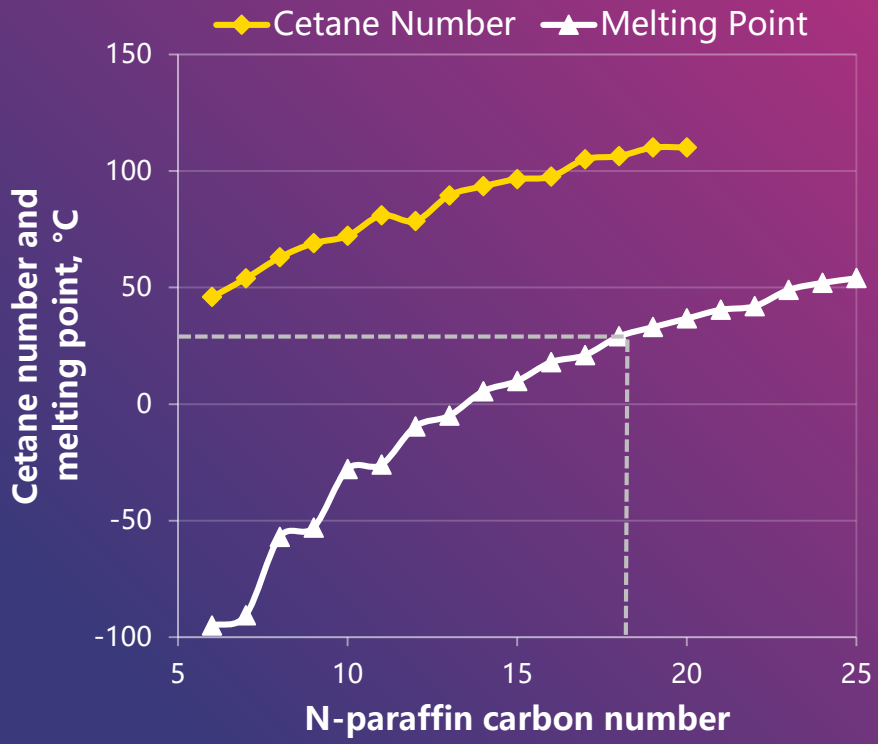
Major reactions steps:

- Saturate double bonds releasing heat
- Triglycerides break into fatty acids chains forming propane
- Oxygens are removed
- High consumption of H_2
- Water gas shift and methanation also occur

End result:
Long chain n-paraffins remain

Renewable diesel requires cold flow management

- There are three main diesel cold temperature specifications required
  - Cloud point – temp wax crystals begin to form
  - Cold filter plugging point (CFPP) – temp at which a filter plugs with wax crystals
  - Pour point – temp when the diesel solidifies
- Long chain normal paraffin (C15+) primarily influence these properties
  - Excellent diesel cetane
  - High melting point (pour point)
- Solutions to correct poor low temperature



Conventional & renewables diesels face same winter diesel specifications

Conventional feeds

- Kerosene
- Virgin GO
- Cracked GO
- Vacuum GO

Green diesel feeds

- 100% bio feeds
- Co-processed bio with conventional

Renewable diesels: more challenged to meet CFPP specifications due to high n-paraffin content

Euro V diesel specifications

Property	Specification Min	Max
Density, kg/m³	820	845
Sulfur, ppm		10
Cetane Number	51	
PAH, wt%		11
Flash Point, °C	55	
T95 Recovered, °C		360

Winter diesel

Class	A	B	C	D	E	F
CFPP, °C	5	0	-5	-10	-15	-20

Or for more severe cold environments

Arctic diesel

Class	0	1	2	3	4
CFPP, °C	-20	-26	-32	-38	-44
CP, °C	-10	-16	-22	-28	-34

Traditional corrections for cold flow adjustment

	Blending kero into diesel pool	Reducing the feed endpoint	Selectively crack paraffin
Paraffin management strategy	Dilute the n-paraffin with lower CP material	Cut out the high Carbon # n-paraffin from the diesel	Catalytically crack the n-paraffin to naphtha and LPG
Benefit	Simple blending in the feed or prod tank	Better hydrotreating performance	Feed flexibility
Disadvantage	• Downgrade to diesel • May back out EP	• Downgrade to VGO • Lower yield of diesel	• High naphtha/LPG yield • Lower cetane

Not a valid option for bio feeds

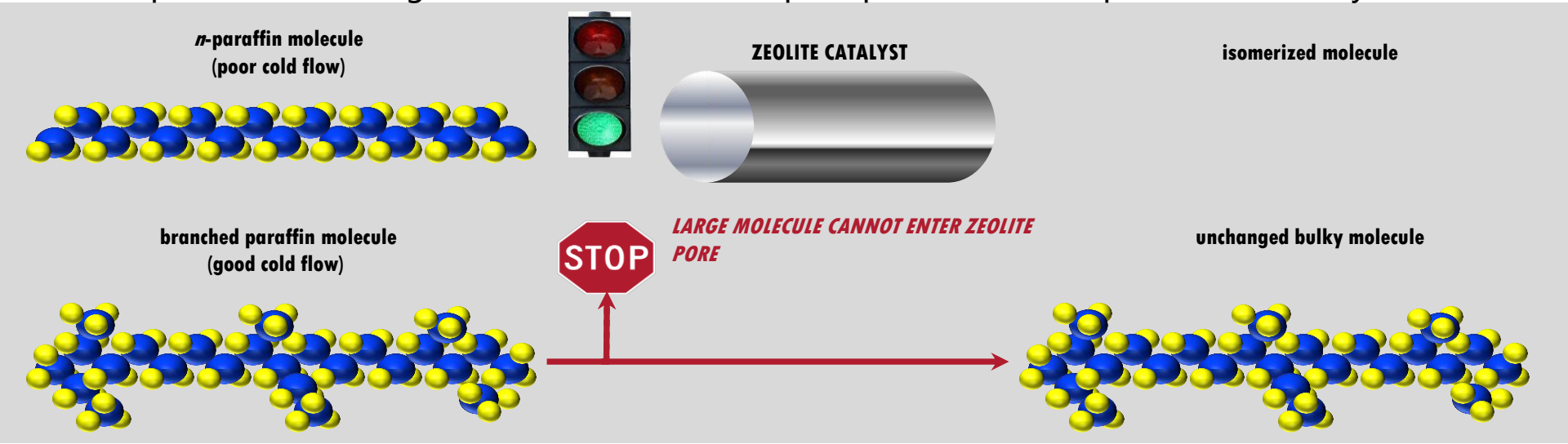
ExxonMobil Dewaxing Catalyst offers an effective solution for cold flow improvement for n-paraffins sourced from traditional fossil feed ***or*** renewable feeds.

ExxonMobil Dewaxing Catalyst isomerizes n-paraffins to iso-paraffins, which maximizes distillate yield

- Iso-paraffins have excellent low temperature performance while retaining high cetane

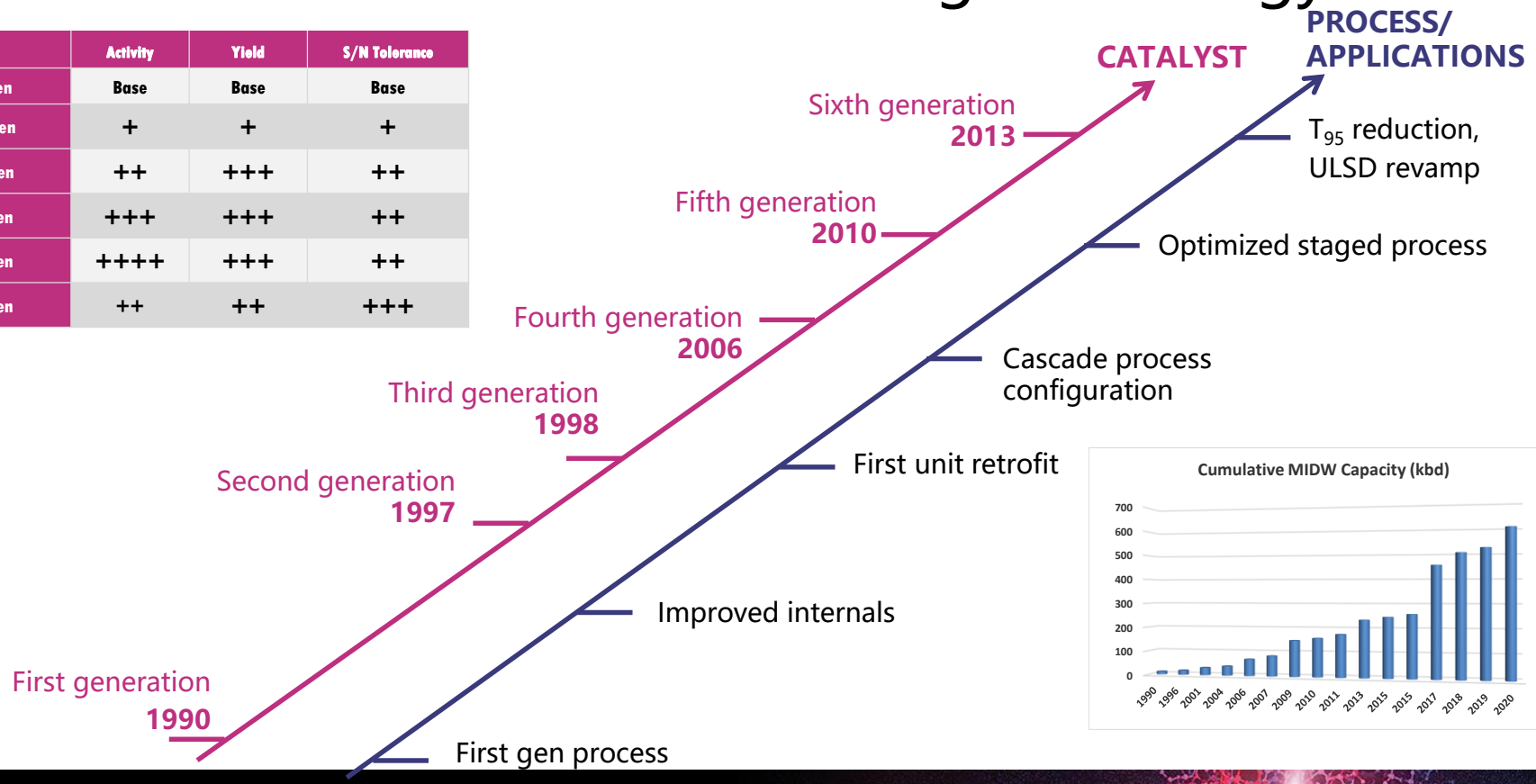
ExxonMobil isomerization dewaxing technology for winter diesel production

- ExxonMobil dewaxing catalysts are shape-selective catalysts designed to convert n-paraffins to
- iso-paraffins; result is MAX Diesel Production
- Iso-paraffins retain high cetane but reduce the pour point and cloud point dramatically



Evolution of ExxonMobil dewaxing technology

	Activity	Yield	S/N Tolerance
1st Gen	Base	Base	Base
2nd Gen	+	+	+
3rd Gen	++	+++	++
4th Gen	+++	+++	++
5th Gen	++++	+++	++
6th Gen	++	++	+++



Dewaxing deployment options in bio services- BIDW™ catalyst

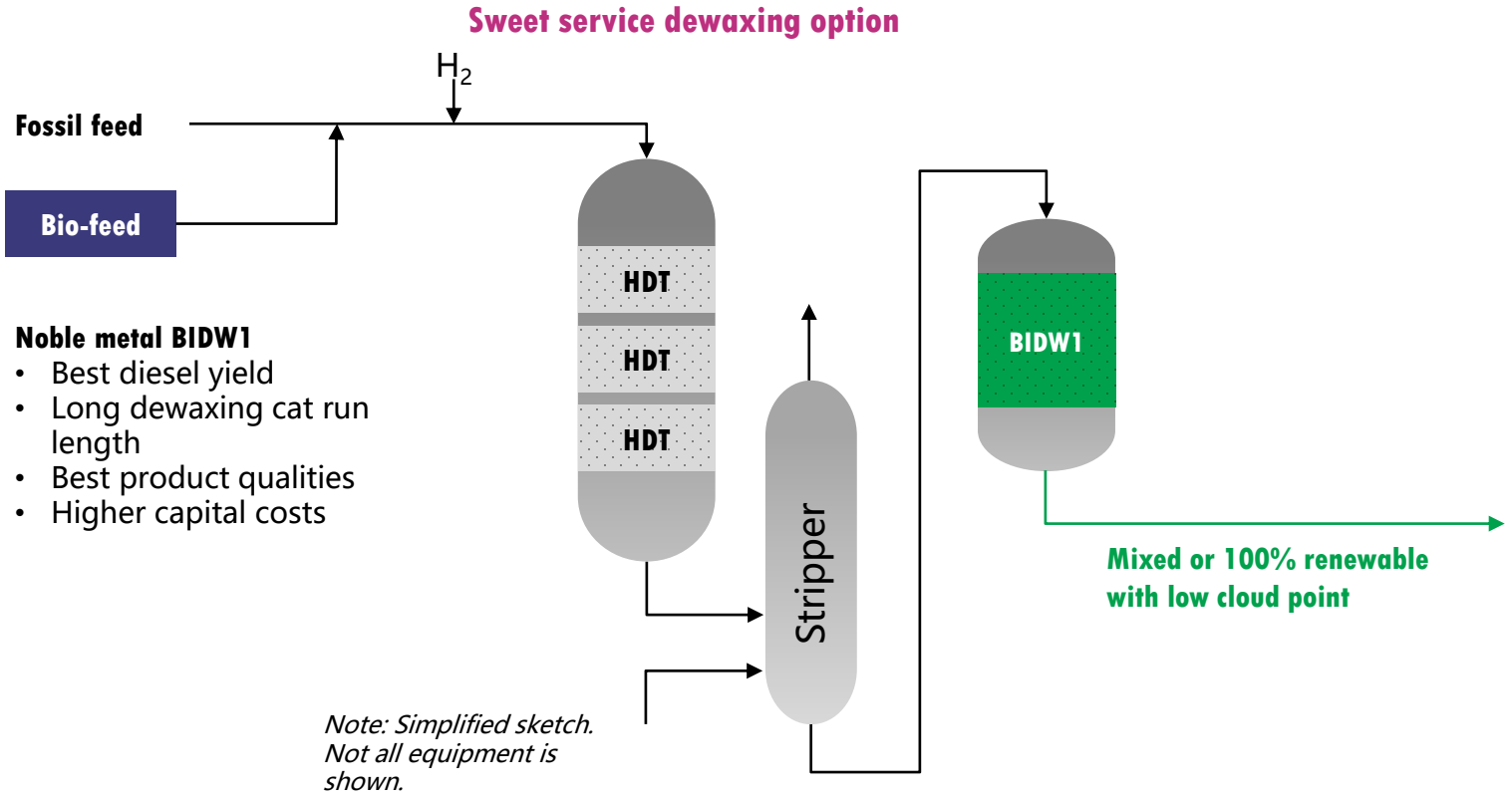
100% renewable feed or co-processing: SWEET SERVICE OPTION

- HDT effluent stripped prior to dewaxing reactor
- Noble metal BIDW1
- Best yields & run length
- Best product quality

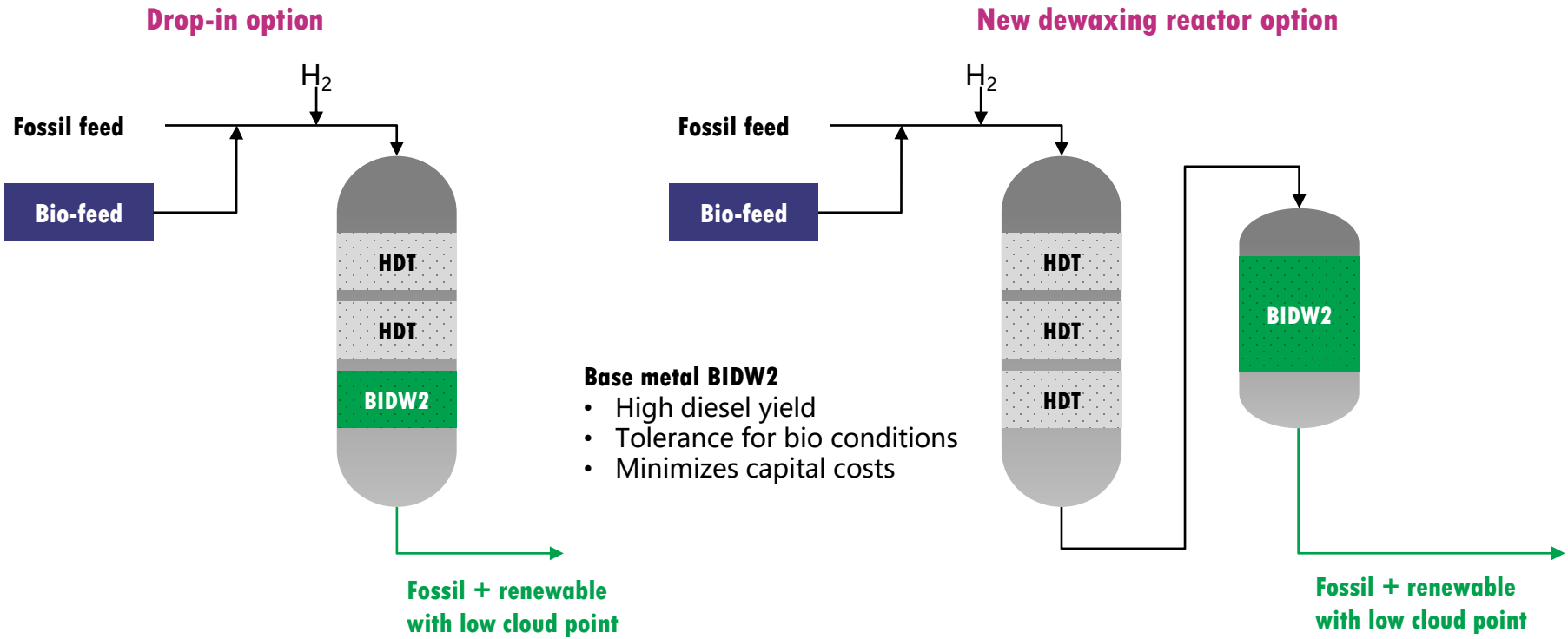
Co-processing with HDT effluent direct feed to dewaxing: SOUR SERVICE

- Base metal BIDW2
- BIDW2 drop-in to existing HDT reactor
- Or new BIDW reactor added
- Minimizes capital costs

100% bio feed or co-processing in sweet service



Co-processing with sour service dewaxing



Why choose BIDW™ for your bio processing needs?

High selectivity to maximize diesel yield

- In deep delta cloud service typically required with bio feeds, BIDW has exceptional ability to retain more diesel product and avoid cracking

Robust catalyst with high tolerance for poisons

- Base metal BIDW can withstand HDT effluent conditions in bio
- Both base and noble metal have high tolerance for N and S

Run length maximization

- Sweet service options run exceptionally long
- Sour service can match HDT life

Reduced H_2 consumption

- Isomerization is generally H_2 neutral
- High selectivity saves H_2 by avoiding cracking

BIDW™ catalyst advantage for bio-feedstocks

BIDW provides higher yield of green diesel vs. alternatives

H_2

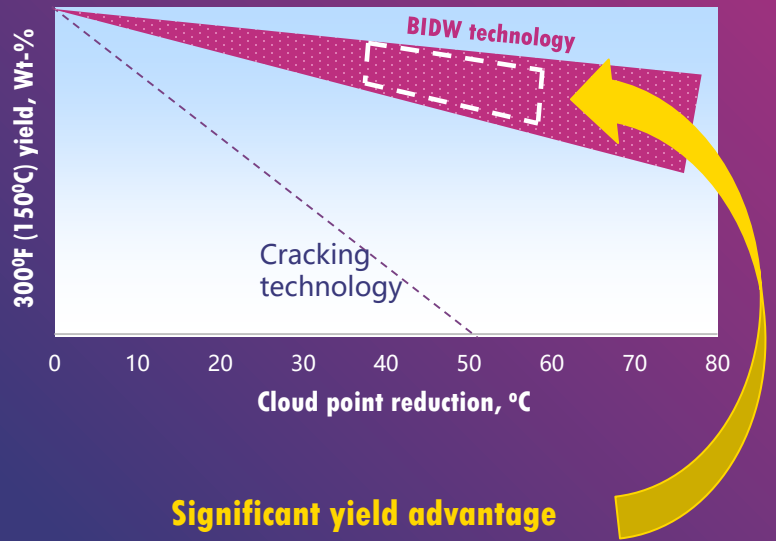
Lower hydrogen consumption vs. alternatives

Quality

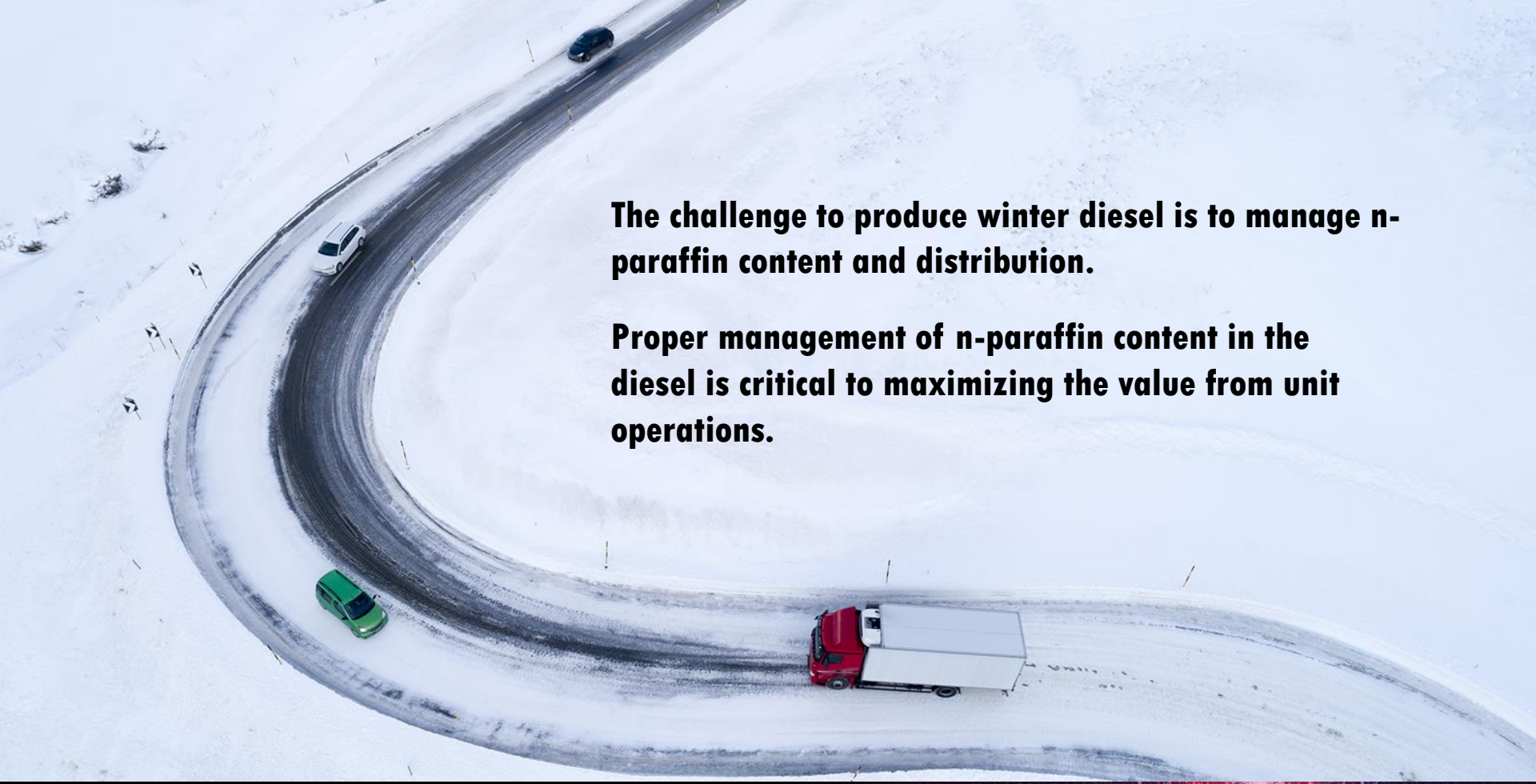
Improved cetane value

Proven stability and longer catalyst life easily >5 years

Renewable diesel yield vs. Cloud point reduction



Significant yield advantage observed at high delta cloud



The challenge to produce winter diesel is to manage n-paraffin content and distribution.

Proper management of n-paraffin content in the diesel is critical to maximizing the value from unit operations.

ExxonMobil dewaxing technology enables a refiner to maximize value from the diesel and kerosene range molecules from both traditional fossil feeds and bio feeds

- ExxonMobil Dewaxing Catalysts have been managing refiner cold flow needs for 50 years
- ExxonMobil has experience and technology to meet a refiner's needs
- BIDW™ catalysts are well suited to handle the additional dewaxing severity and conditions required from bio feed sources

Connect and collaborate with us to advance your business today.

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