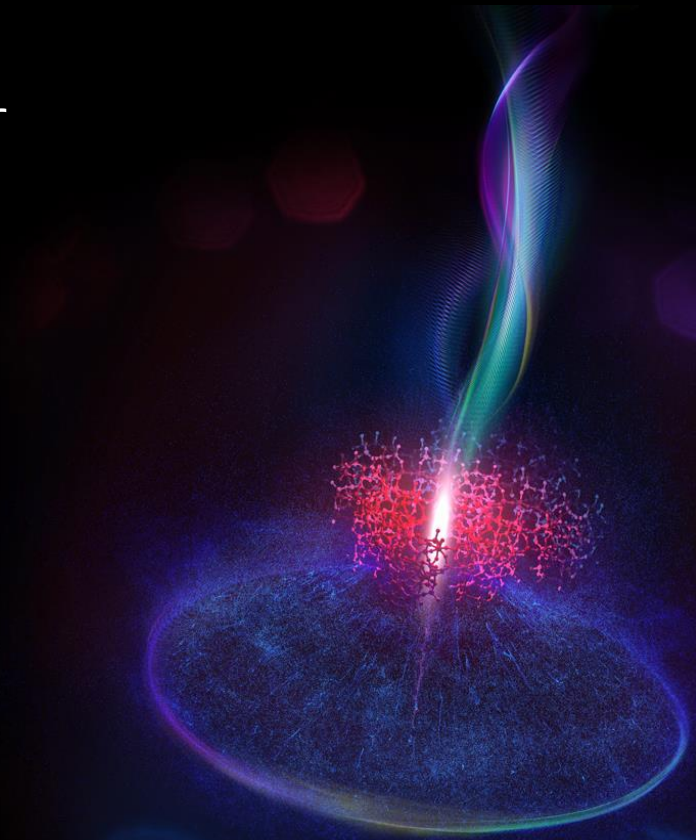
ERTC Virtual Meeting 2020

ExxonMobil dewaxing in bio services

Dean Parker
Technical Sales Manager

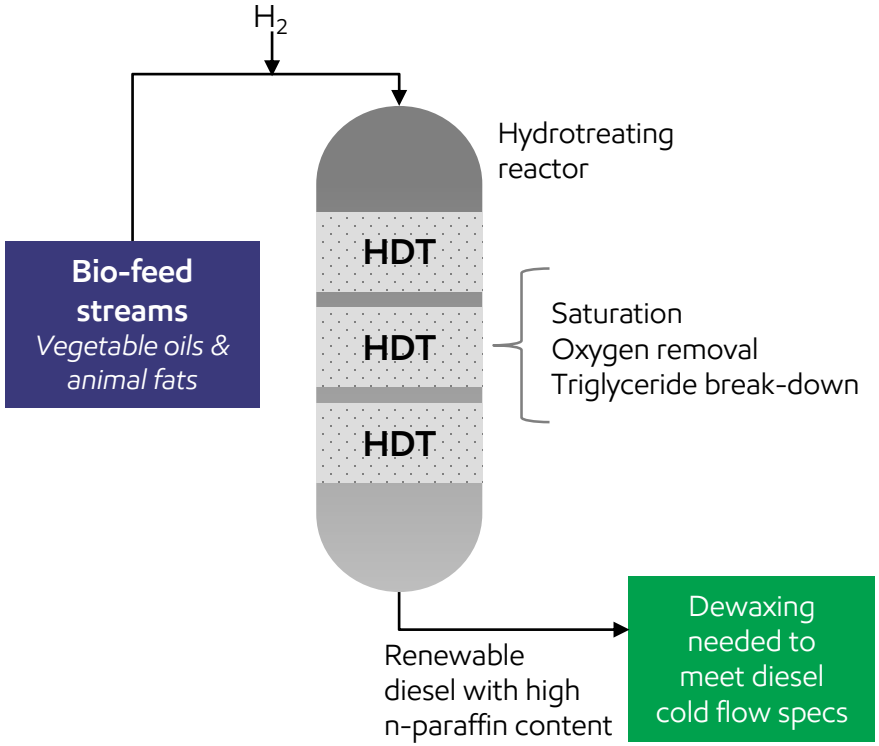
Content

- 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



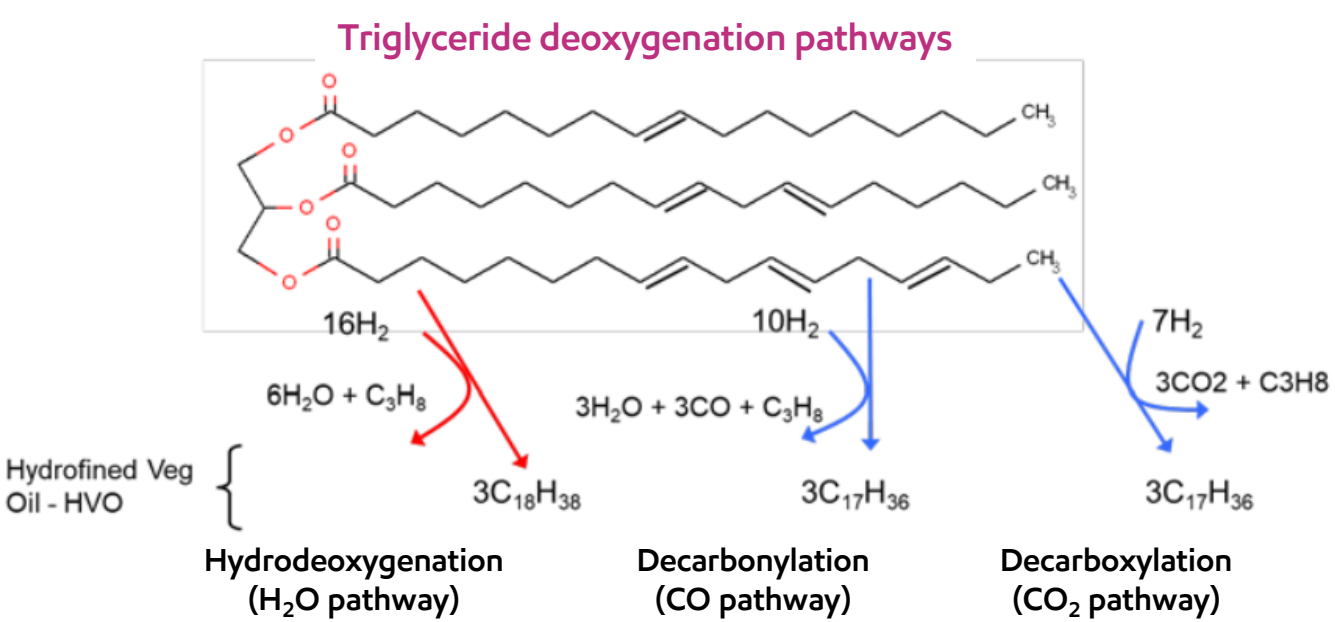
ExxonMobil

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:

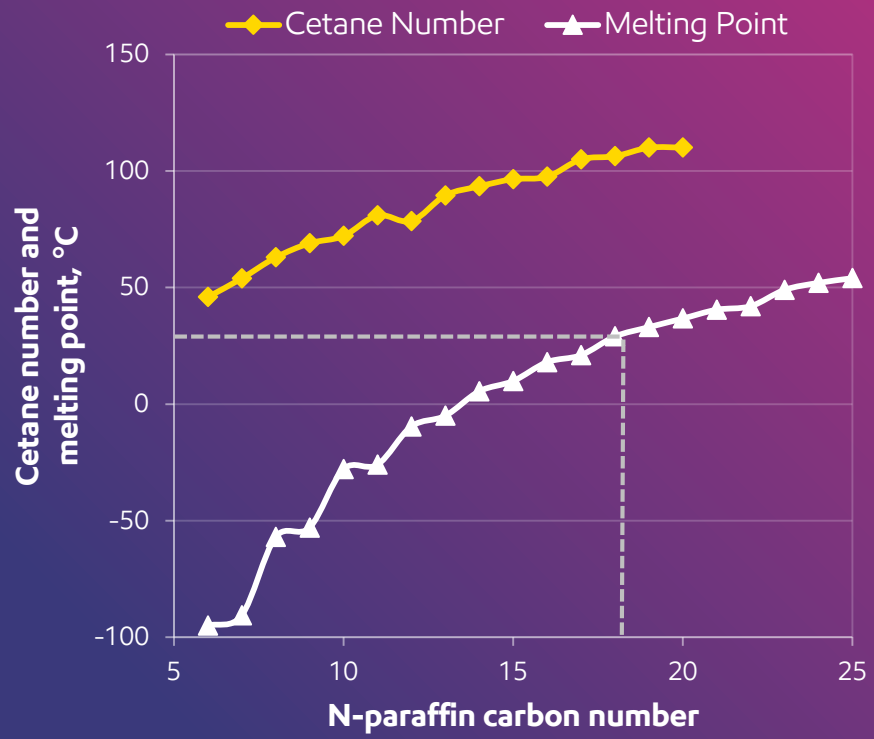
- Saturate double bonds releasing heat
- Triglycerides break into fatty acids chains forming propane
- Oxygens are removed
- High consumption of H_2
- Water gas shift and methanation also occur

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 performance of diesel involve managing long chain paraffin content



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

ULSD HDT units

- LPG
- Naphtha
- Jet
- **Diesel**

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

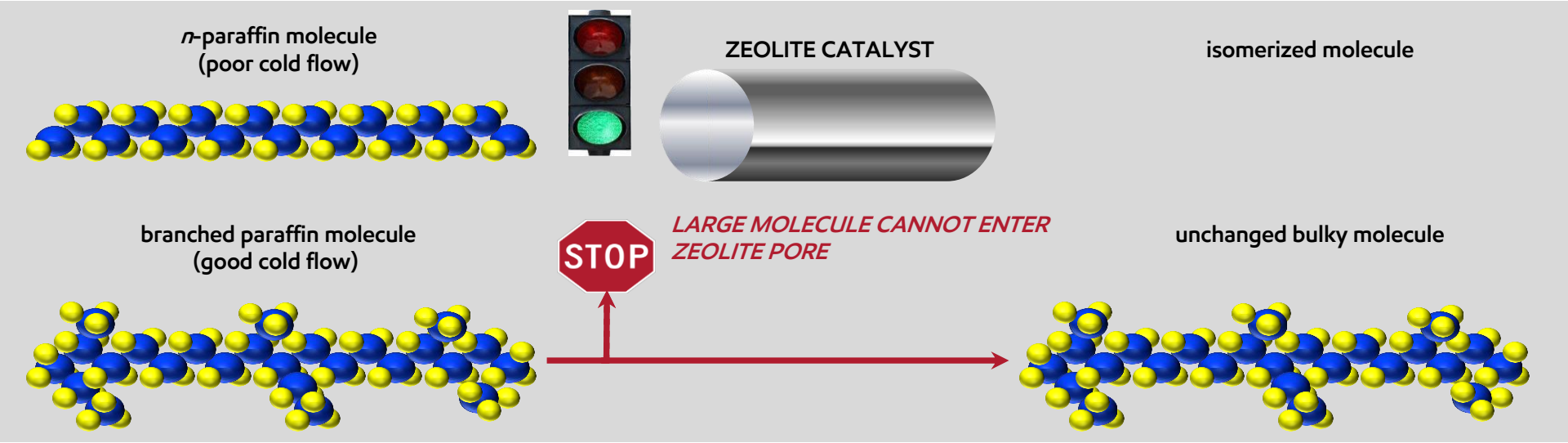
ExxonMobil Dewaxing Catalyst offers an effective solution for cold flow improvement for n-paraffins sourced from traditional fossil feed ***or*** renewable feeds.

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

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

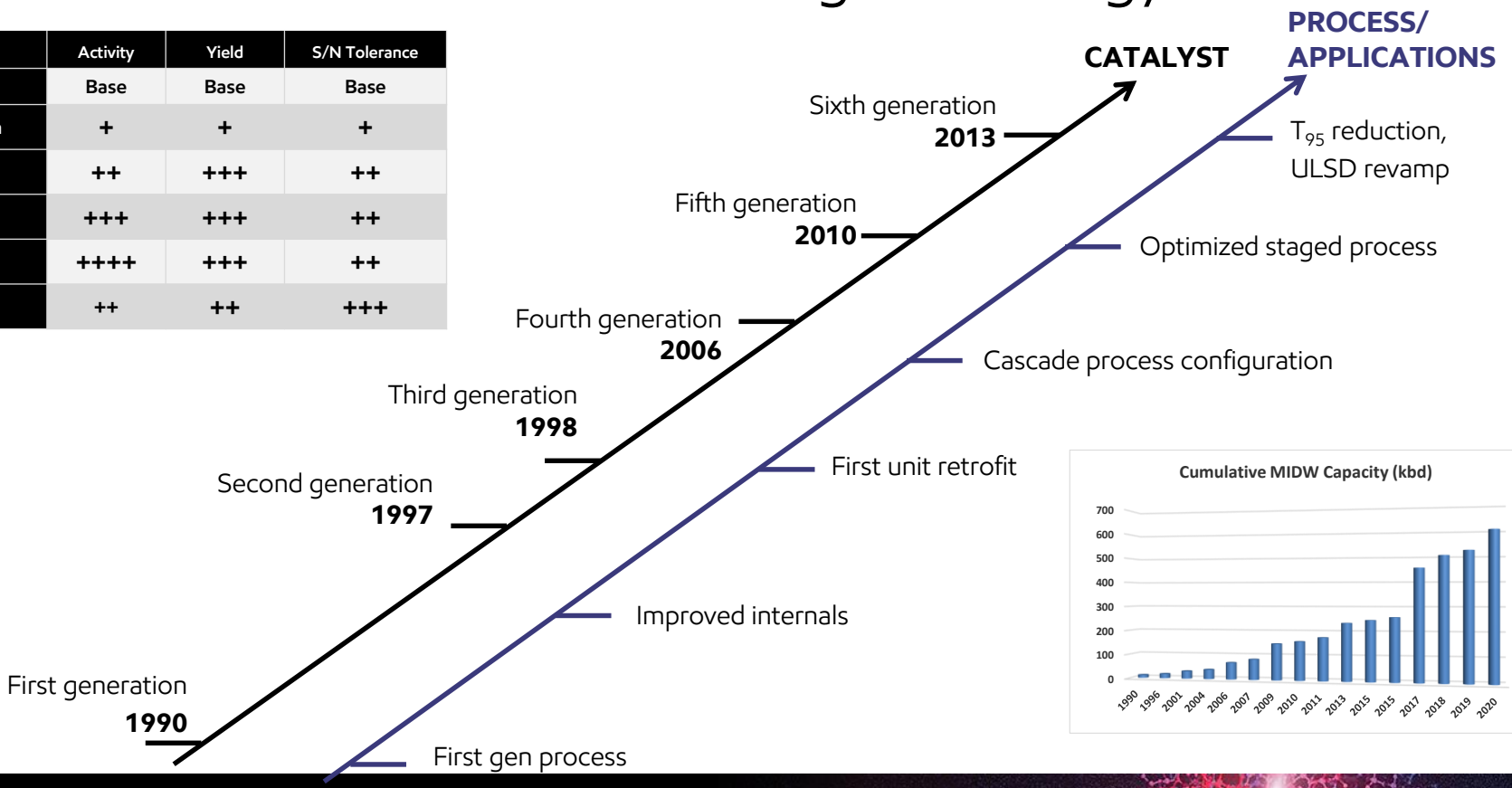
ExxonMobil isomerization dewaxing technology for winter diesel production

- 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

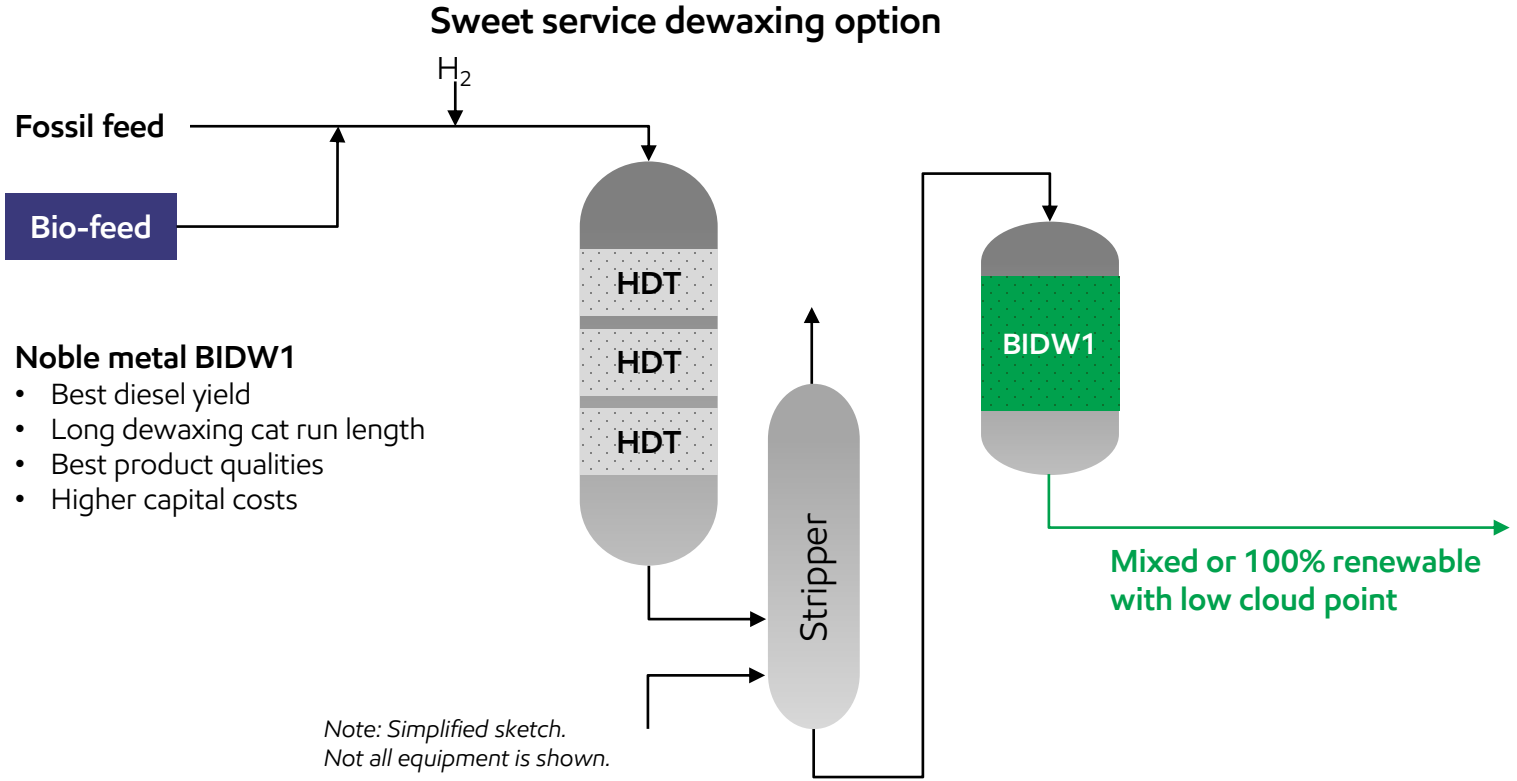
100% renewable feed or co-processing: SWEET SERVICE OPTION

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

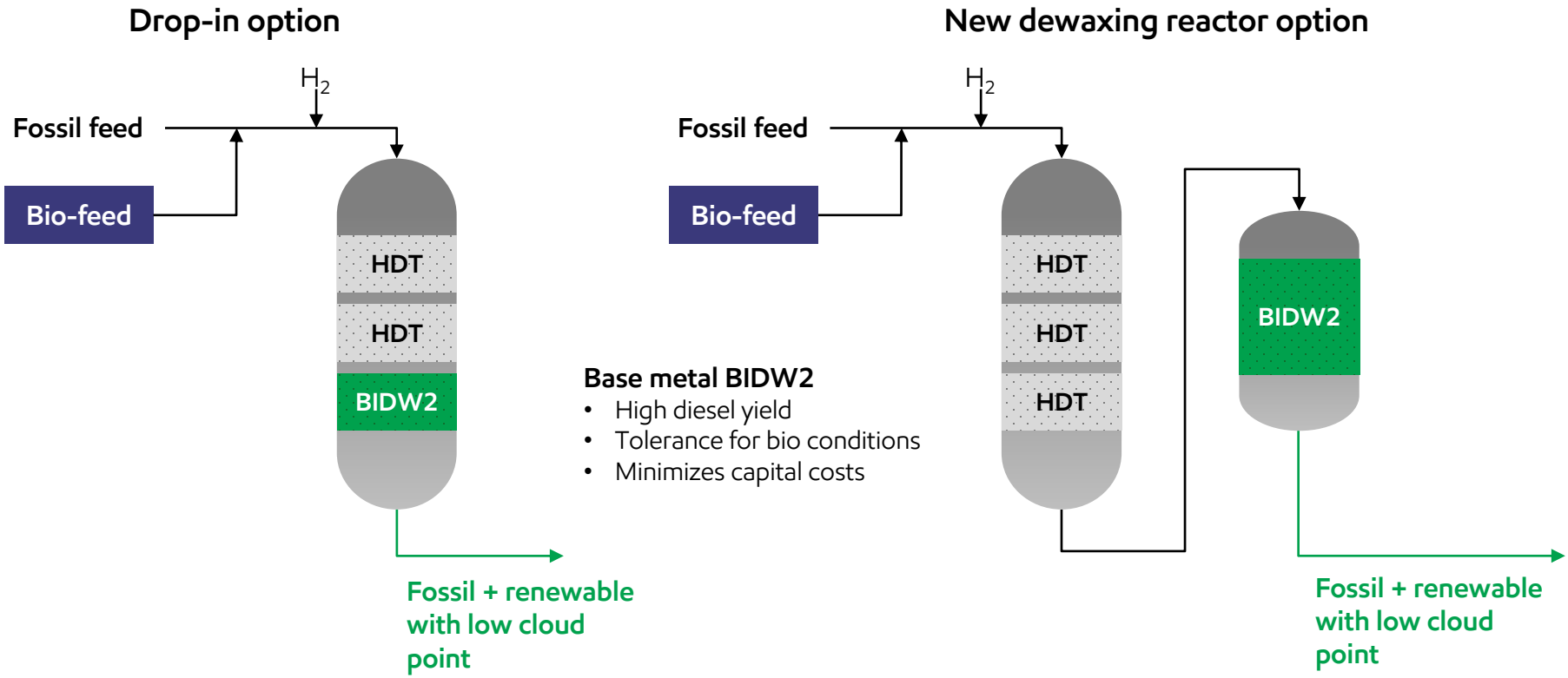
Co-processing with HDT effluent direct feed to dewaxing: SOUR SERVICE

- 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

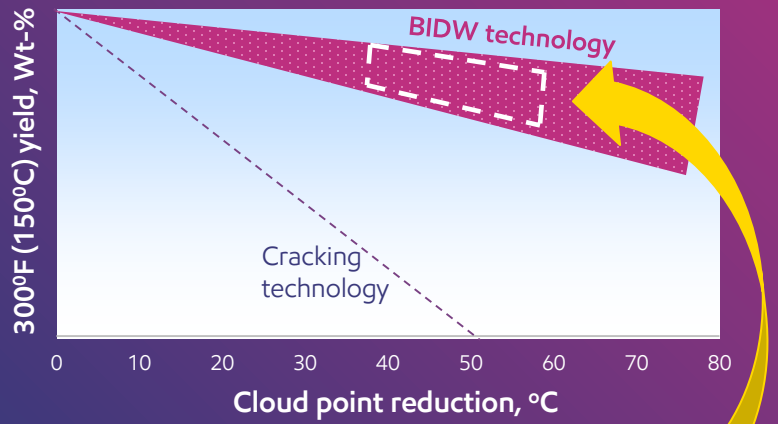
Lower hydrogen consumption vs. alternatives

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.

Dean Parker
Technical Sales Manager
Dean.e.parker@exxonmobil.com
+1-832-625-5351

Evguenia Copley
Sales Manager, Europe, Russia
evguenia.copley@exxonmobil.com
+832-625-9018

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