Johnson Matthey and bp: 
FT CANS™ Technology – Enabling Waste to Jet Fuels

Global Syngas Technologies Council 2020 Conference 27Oct20
Overall XTL Flowsheet

- For natural gas / CO2 feedstocks JM also provides the syngas generation technology and catalysts
- For MSW, biomass and coal feedstocks, JM can provide the secondary gas clean-up
History of JM / bp development in FT

- 1980: BP initiated FT R&D programme
- 1990: Established technology co-operation with JM
- 2000: Nikiski demonstration plant operation
- 2010: Development & launch of FT CANS technology
- 2020: First commercial licence signed with Fulcrum
## Benefits of Fixed-Bed FT Technology

### Benefits confirmed by JM/bp at Nikiski Demonstration Unit

<table>
<thead>
<tr>
<th>Category</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Catalyst Movement</td>
<td>• No catalyst loss in product&lt;br&gt;• Benign environment</td>
</tr>
<tr>
<td>Simple Design</td>
<td>• Easy to operate&lt;br&gt;• Minimal scale up risk</td>
</tr>
<tr>
<td>Developments easy to incorporate</td>
<td>• Demonstrate on single tube</td>
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<tr>
<td>Modular</td>
<td>• Increase capacity by adding tubes</td>
</tr>
<tr>
<td>Well proven technology</td>
<td>• Many manufacturers of equipment&lt;br&gt;• Not proprietary supply</td>
</tr>
<tr>
<td>Attractive product slate</td>
<td>• High S-F alpha&lt;br&gt;• Maximise middle distillate production after product upgrading (hydroprocessing /fractionation)</td>
</tr>
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Benefits of FT **CANS** technology compared to conventional Fixed-Bed FT Technology

<table>
<thead>
<tr>
<th>Increased Productivity</th>
<th>• 3 fold increase in production for same size reactor</th>
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| Easier to Manufacture Reactor | • Larger tubes, low weight  
 • Tube numbers reduced by 95% |
| Large Cost Savings | • FT Unit cost reduced by ~50% |
| Improved Catalyst Performance | • Volumes reduced by >50%  
 • 3 years life without regen. expected |
| No catalyst handling in life cycle | • Prefilled in factory  
 • Spent catalyst returned in CANS carriers for metals recovery |
| Improved Efficiency | • >90% overall CO conversion in single stage recycle loop which can operate with >50% inerts |

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bp 2030 aims – low carbon electricity and energy

Low carbon electricity
- 50GW developed renewables
- Position across generation and customers
- 500TWh traded\(^1\)

Hydrogen and CCUS
- 10% hydrogen share in core markets
- Net Zero Teesside

Integrated gas
- 25Mtpa customer sales
- >30Mtpa LNG portfolio

Bioenergy
- >100Kbd produced and integrated across value chain
- 20% biojet market share
- Cost advantaged platforms across Brazil

\(^1\) Traded electricity may include electricity sourced from the grid
Long-term aviation industry goals

- The aviation industry and IATA have committed to halving aviation emissions by 2050 compared to 2005 levels and carbon neutral growth from 2020
- Achieving this requires a concerted effort across all aspects of the industry
- Biofuels are a critical component of aviation decarbonization strategy and the industry is expecting them to deliver 30-40% of the 2050 emissions reduction target

Source: International Energy Agency (IEA)
What is sustainable aviation fuel?

- A jet fuel produced from sustainable, renewable feedstocks
- It must be blended with regular jet fuel before use in aircraft
- Once blended, it is identical to regular jet fuel, and fully approved for use
- Using sustainable aviation fuel results in a reduction of CO$_2$ emissions compared to fossil jet fuel over the lifecycle of the fuel
- Some typical feedstocks used are
  - Used cooking oil and other waste oils
  - Solid waste from home and businesses that would otherwise go to landfill or incineration
Why municipal solid waste to biojet?

- Feedstock volume match with product demand
- Municipal solid waste, MSW, is the lowest cost feedstock available at suitable scale
- Feedstock is not suitable for re-use/recycling
- MSW is gasified to syngas
- Purified syngas is converted to wax using FT technology
- Wax product is upgraded by hydrocracking/isomerization to sustainable fuels

[Bar chart showing feedstock potential (mmboe/yr) with labels for different sources such as sewage waste, municipal solid waste, agricultural waste, forestry waste, energy crops, sugar & starch, vegetable oil, recovered oil, and novel oil crops.]

*IRENA estimates of potential biomass supply
Waste to biojet commercial production

- BP Ventures investment in Fulcrum Bioenergy
- First commercial-scale plant in Sierra, Nevada, US under construction
- It will convert ca. 175,000 tons of municipal solid waste feedstock that would otherwise be landfilled, into a low-carbon, renewable transportation fuel
- First plant designed to produce ca. 11 million gallons of sustainable fuel each year
- BP/JM FT CANS™ technology was selected by Fulcrum Bioenergy for its first commercial-scale waste to sustainable fuels facility
Awards and Acknowledgements

- Winner – Bioenergy Award
- Winner – Clean Energy Award