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UOP



***Fueling the Bioeconomy***

**Washington, D.C. July 11, 2017**

## Partnering to fuel the bioeconomy

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- ▶ Anchored by Ensyn's commercial RTP® process
- ▶ Supported by Honeywell UOP and Envergent Technologies
- ▶ A world-class strategic relationship across the value chain
- ▶ Built upon almost 30 years of commercial low carbon fuel and chemical production
- ▶ Refinery market represents a large-scale, global opportunity for growth
- ▶ Existing commercial production in Ontario
- ▶ Capacity expansion underway in Canada, Brazil and the U.S.

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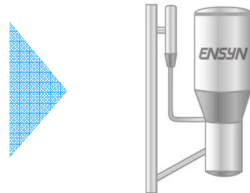
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# Ensyn's commercial biocrude technology

## Biomass Delivered to Ensyn Facility



## Biomass Converted to Biocrude in Ensyn Facility



## Biocrude Delivered to Customers



## Biocrude Applications



Specialty Chemicals



Renewable Heating Oil



Low-carbon Transportation Fuels

- ✓ Ensyn's commercial biocrude technology, known as Rapid Thermal Processing (RTP®), was invented in Canada in 1984 and commercialized in 1989
- ✓ RTP® is a feedstock flexible technology that converts the solid carbon chains in biomass into a liquid biocrude, using a circulating bed of heated silica sand
- ✓ The RTP® process is simple and doesn't use high heat, high pressure, hydrogen, catalysts, or multiple technologies, keeping capital and operating costs low
- ✓ Ensyn's biocrude can be used in multiple applications:
  - Specialty Chemicals – Feedstock for multiple chemical applications
  - Renewable Heating Oil Replacement – Substitute for heating oil and natural gas in boilers
  - Biocrude Co-processing to Transportation Fuels – Upgraded in refineries with crude oil into low-carbon gasoline and diesel

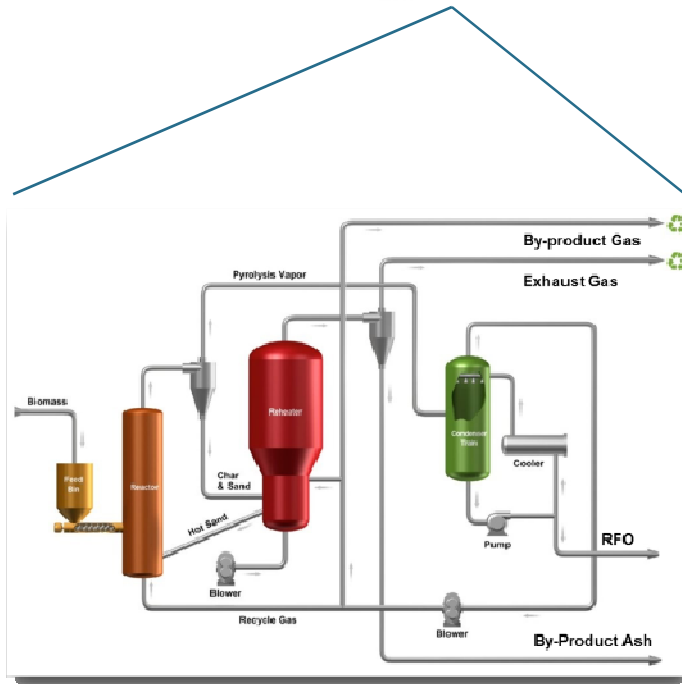
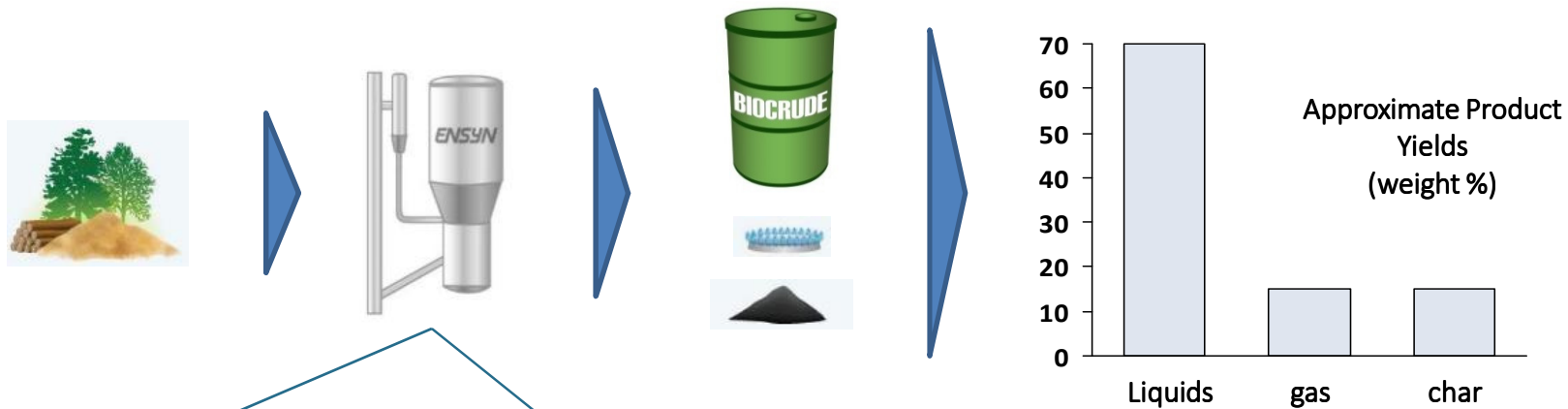
Multiple product applications provide Ensyn with optionality and significant growth opportunity

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# Ensyn's RTP<sup>®</sup> technology



## Maximum Conversion of Solid Carbon to Liquid

- Not “severe” – a non-catalytic, thermal process
- Similar to Fluid Catalytic Cracking
- No need for catalysts, high pressure or hydrogen
- Gas and char used to run the facility and dry the biomass; the process is energy self-sufficient
- 35 patents issued, 97 pending

# Ensyn - a 30 year growth story built by commercial operations



1984



1989  
Commercial  
Deployment



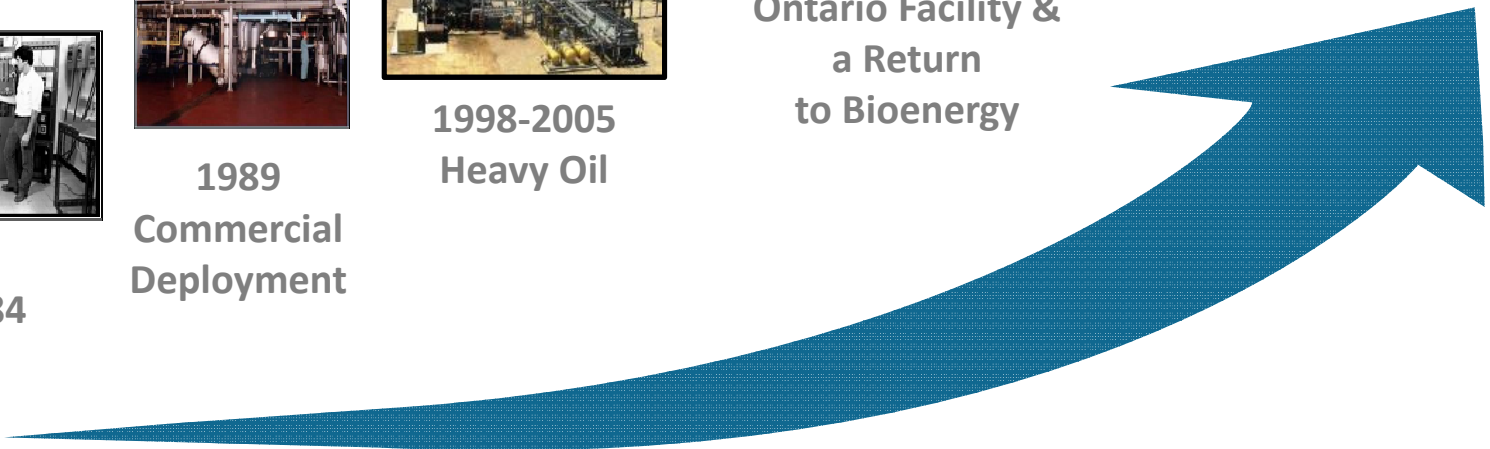
1998-2005  
Heavy Oil



2006  
Ontario Facility &  
a Return  
to Bioenergy



Ongoing  
Capacity Expansion



# Honeywell UOP

Honeywell UOP has *created knowledge through invention and innovation* and applied it to the energy industry for over 100 years

**2,000+**

Engineers and scientists



**150+** with PhDs

**800+**

R&D employees



**3,000+**

Active patents

**100+**

Years of Experience

- Process Technology
- Catalysts and Adsorbents
- Equipment
- Services



Renewables



Refining



Petrochemicals



Natural Gas

60% of the World's Gasoline, 70% of PET Bottles, 90% of Biodegradable Detergents Produced with Honeywell UOP Technology

# Envergent Technologies LLC

Envergent is a Honeywell UOP - Ensyn joint venture that licenses Ensyn's RTP® technology, and provides equipment & services

**2,000+**

Engineers and scientists



**150+** with PhDs

**800+**

R&D employees



- Process Technology
- Equipment
- Services

**50+** million gallons produced from **8** commercial units

**25+** years of experience



Leaders in the Production of Cellulosic-based Renewable Fuels

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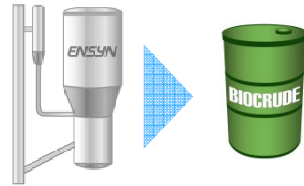
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# Strategic relationships across the supply chain

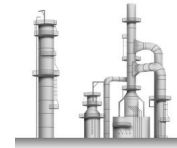
Feedstock



Conversion to Biocrude



Refinery Feedstocks



Heating & Cooling



Specialty Chemicals & Food Ingredients





## Specialty chemicals provided initial commercialization

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- Initial commercial application – specialty chemicals & heating fuels
- 25+ years of commercial production
- Over 40 million gallons produced
- Five commercial RTP<sup>®</sup> facilities in operation
- Kerry Group (Red Arrow Products) is the licensee
- Over 30 food products developed
- Kerry/Red Arrow is the market leader



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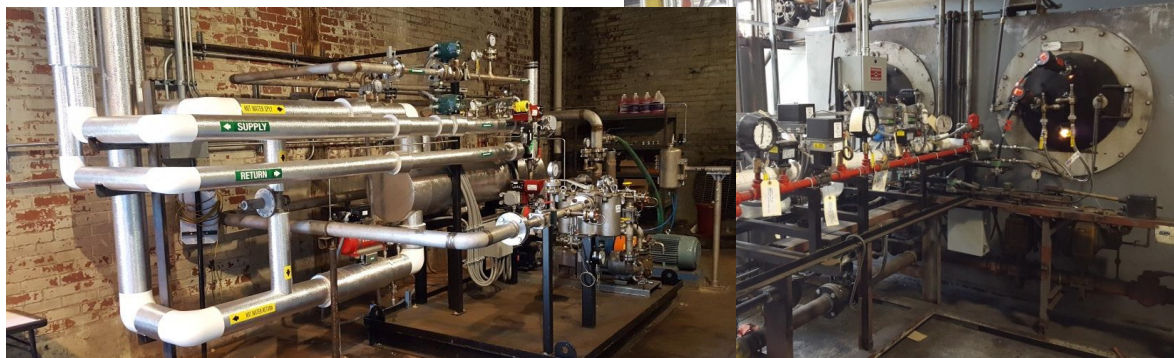
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# Heating fuels drove production scale and volumes

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- Over 25 years of combustion on an industrial scale
- Approximately 20 million gallons used in industrial boilers
- Now deployed across a range of applications
  - ▶ Heating & cooling markets
  - ▶ Large commercial and institutional users
  - ▶ District heating systems
  - ▶ Mining (indurating furnaces)

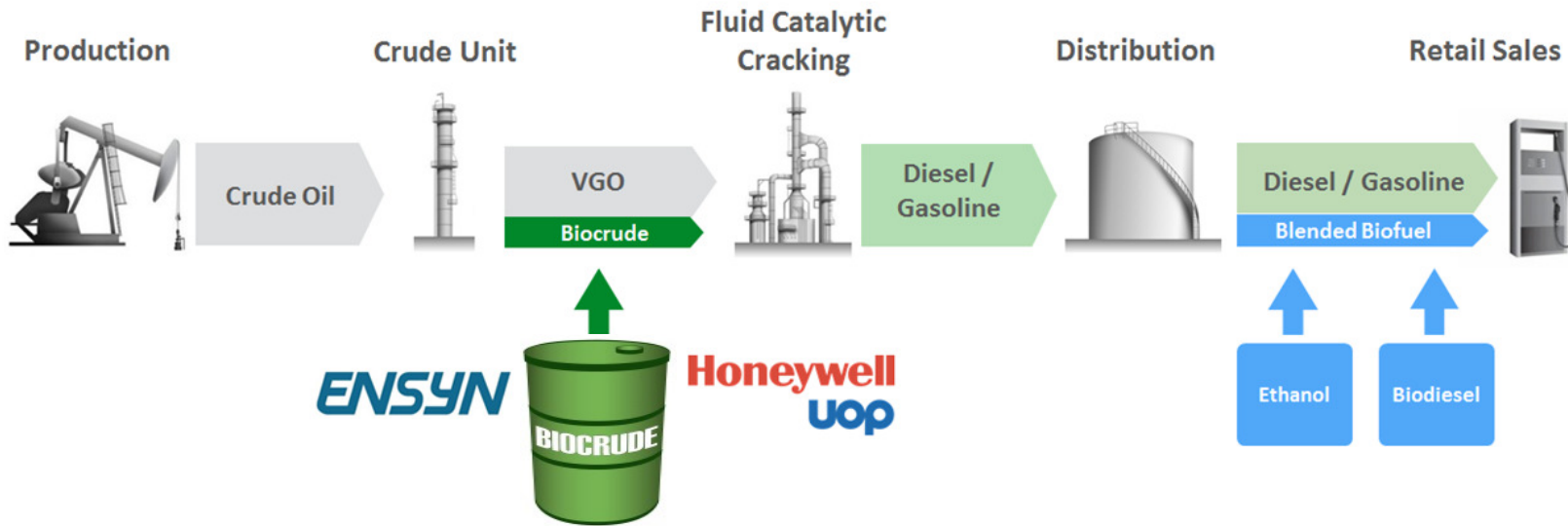


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# Refinery co-processing represents a significant opportunity



## Leveraging existing refinery infrastructure:

- Lowers the refiners CAPEX & OPEX of compliance
- Facilitates implementation
- Up to 5% biocrude processed with conventional petroleum feedstocks
- Provides comparable yields on a volumetric basis
- Does not compete for market share with the refiner
- Allows refiner to control generation of their regulatory credits

## Co-processing commercialization

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- Over 8 years of development
- Ensyn's strategic alliance with Honeywell UOP expanded beyond Envergent Technologies to include refinery co-processing
- Accepted by a motivated group of "Early Adopter" refiners
- Biocrude supply for these refiners:
  - ▶ Initially from Ensyn's Ontario facility
  - ▶ Larger deliveries from facilities in development
- Honeywell UOP has developed an Optimix distributor for the injection of Ensyn's biocrude into the FCC where it is co-processed alongside conventional petroleum feedstocks

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## Biocrude co-processing - Why it makes sense to refiners

|  |   |
|--|---|
| <p><b>Compliance solution controlled by the refiner</b></p>  | <ul style="list-style-type: none"> <li>• Produce renewable gasoline &amp; diesel blendstocks for finished fuels</li> <li>• Generate cellulosic D3 and D7 RINs in the refinery</li> </ul>                          |
| <p><b>Utilizes existing refinery infrastructure</b></p>      | <ul style="list-style-type: none"> <li>• Produce pipeline-compatible biofuels with existing FCC equipment</li> <li>• Eliminate dedicated blending infrastructure without blendwall limits</li> </ul>              |
| <p><b>Low oil prices increase value cellulosic fuels</b></p> | <ul style="list-style-type: none"> <li>• Cellulosic waiver (and RIN) value inversely related to crude prices</li> </ul>   |
| <p><b>Ease of implementation</b></p>                         | <ul style="list-style-type: none"> <li>• Minor capital costs for biocrude storage &amp; injection equipment</li> <li>• Honeywell UOP provides biocrude injection equipment &amp; operations assistance</li> </ul> |

## Current regulatory framework supports deployment

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- RFS – the following pathways are in place
  - ▶ RFO Heating (D7 RINs – Ensyn is the leading producer of D7 RINs)
  - ▶ Co-processing gasoline (D3 RINs)
  - ▶ Co-processing diesel (D7 RINs)
- LCFS – California pathway approved:
  - ▶ For Ensyn's renewable gasoline and diesel
  - ▶ Carbon intensity determined to be approximately 20-25 g CO<sub>2</sub>e/MJ
- RECs
  - ▶ Generation of REC- eligible heat since 2015 in New Hampshire
  - ▶ Final stages of measurement protocols with the regulatory authorities

# Ontario production facility

- Operational with capacity of 3 million gallons per year
- Deliveries ongoing to commercial markets – focus on U.S. markets
- Commissioned in 2006 with a focus on chemicals & fuels production
- Improved in 2014 as Ensyn's anchor fuels facility operating 24/7
- Qualified by the U.S. EPA under the RFS program
- Sales to qualified users in the U.S. are generating D-7 RINs
- Provisional pathway granted by the California ARB for refinery co-processing



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# Capacity expansion under development



Operating Plants



Projects Under Construction



Projects in Development





## Vienna, Georgia



- 20 million gallon per year facility being developed by Ensyn, Renova Capital Partners, and Roseburg Forest Products
- Location is a mothballed mill in Dooly County, Georgia
- Feedstock is forest residues and thinnings from local sources
- Product targeted for U.S. refineries
- Conditional commitment from the USDA for a \$70 million loan guarantee with Citibank as the Lender of Record
- Preliminary engineering substantially complete; air permit received



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## Aracruz, Brazil

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- 22 million gallon per year facility being developed in partnership with Fibria Celulose
- Located at Fibria's pulp mill in Aracruz, Espirito Santo
- Feedstock is eucalyptus forest residues
- Product supply targeted for U.S. refineries
- Preliminary engineering substantially complete, permits received



## Cote-Nord, Quebec

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- 10 million gpy facility being constructed by Ensyn and Arbec Forest Products
- RTP<sup>®</sup> equipment supplied by Envergent Technologies
- RTP<sup>®</sup> modules fabricated by Honeywell UOP's petrochemical suppliers
- Product will be sold to heating and refining customers in the U.S. Northeast
- Major equipment modules being delivered, commissioning begins early Q1 2018
- Project capex US\$78 million, fully funded, financing parties include:
  - ▶ Partner equity
  - ▶ Sustainable Development Technology Canada
  - ▶ Investments in Forestry Industry Transformation
  - ▶ Investissement Quebec



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Cote Nord Slideshow Inserted Here

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