Partnering to fuel the bioeconomy

- 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.
Ensyn’s commercial biocrude technology

- 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.
Ensyn’s RTP® 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

1989 Commercial Deployment

1998-2005 Heavy Oil

2006 Ontario Facility & a Return to Bioenergy

Ongoing Capacity Expansion
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
- **800+** R&D employees
- **3,000+** Active patents
- **100+** Years of Experience
- **150+** with PhDs
- • 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

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UOP 7301-6
Envergent Technologies LLC

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

- 50+ million gallons produced from 8 commercial units
- 2,000+ Engineers and scientists
- 150+ with PhDs
- 800+ R&D employees
- 25+ years of experience
- Process Technology
- Equipment
- Services

Leaders in the Production of Cellulosic-based Renewable Fuels

Envergent

2,000+ engineers and scientists
150+ PhDs
800+ R&D employees
50+ million gallons produced from 8 commercial units
25+ years of experience

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Strategic relationships across the supply chain

Feedstock → Conversion to Biocrude → Refinery Feedstocks → Heating & Cooling → Specialty Chemicals & Food Ingredients

- Fibria
- Honeywell UOP
- ARBEC
- Envergent Technologies (A Honeywell Company)
- Roseburg (A Forest Products Company)
- Chevron Technology Ventures
- Cleaver Brooks
- ENSYN
- Petrobras
- Preferred Utilities MFG Corporation
- Red Arrow
- KERRY

A diagram showing the process flow and partnership logos for each stage.
Specialty chemicals provided initial commercialization

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

- 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)
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

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

| Compliance solution controlled by the refiner | • Produce renewable gasoline & diesel blendstocks for finished fuels  
|                                               | • Generate cellulosic D3 and D7 RINs in the refinery |
| Utilizes existing refinery infrastructure     | • Produce pipeline-compatible biofuels with existing FCC equipment  
|                                               | • Eliminate dedicated blending infrastructure without blendwall limits |
| Low oil prices increase value cellulosic fuels| • Cellulosic waiver (and RIN) value inversely related to crude prices |
| Ease of implementation                        | • Minor capital costs for biocrude storage & injection equipment  
|                                               | • Honeywell UOP provides biocrude injection equipment & operations assistance |
Current regulatory framework supports deployment

- 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$_2$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
Capacity expansion under development

- Operating Plants
- Projects Under Construction
- Projects in Development
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
Aracruz, Brazil

- 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

- 10 million gpy facility being constructed by Ensyn and Arbec Forest Products
- RTP® equipment supplied by Envergent Technologies
- RTP® 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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