

ARA

Value Building with Carinata Coproducts

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Why Coproducts from Carinata Oil?

- **Provides a market for initial low-rate or intermittent production of carinata oil**
 - Smaller volume required than for a dedicated renewable fuels refinery
- **Coproducts may be produced via separate unit operations co-located with a biofuels refinery**
 - Recovery of, or conversion of select compounds to high value products
 - Remainder of oil components or byproducts would go to fuels production
- **Coproducts must have a higher market value than fuels**
 - Higher value than: Fuel + RINs + LCFS + Blenders credits
 - Or provide cost avoidance or an additional revenue stream
- **Overall goal is to make the carinata oil refining operation more economically viable**

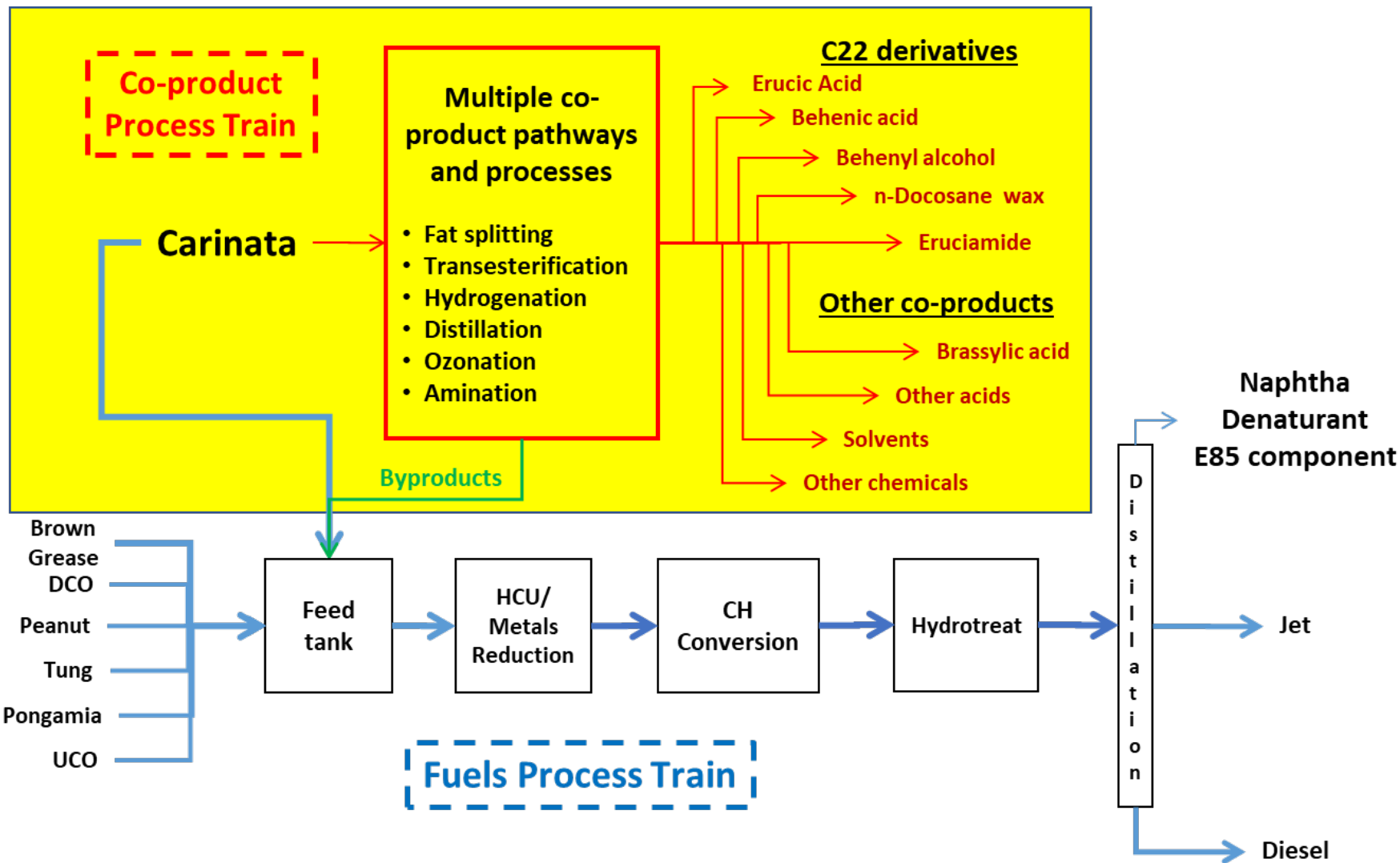


What Coproducts from Carinata Oil?

- **Early in the SPARC project ARA identified potential coproducts and developed two tools to help prioritize market strategies**
- **Compilation of information on all potential coproducts**
- **Coproduct rating tool using weighted factors based on:**
 - Market size/demand, value, potential yield, and capital and operating cost to produce
- **Included results from previous studies by ARA and market survey as part of UF/FDACS project**
- **Solicited input from Industry consultants**



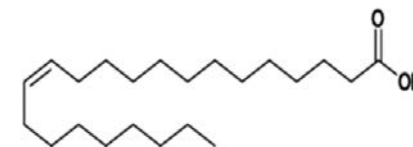
Two Process Pathways to Fuels and Coproducts





Most Promising Coproducts

- **Erucic acid (C22:1)**
 - Oleochemical producers have, or are acquiring distillation systems capable of producing erucic acid from carinata FFAs
 - ARA fat-splitting process – variation of HCU
- **Erucic acid derivatives**
 - Especially brassylic acid – nylon 1313 precursor
- **Behenyl alcohol (C22 – 80°C melting point)**
 - BASF catalysts & technology - achieved >98% yield - emollient, emulsifier, thickener in cosmetics
- **Renewable acetic acid or acetate recovery**
 - Modeling a Biofuels ISOCONVERSION configuration that greatly improves economics
 - 70-90% reduction in water consumption and wastewater generation
 - Increase product yields and reduced BOD by 50%





Hydrothermal Cleanup (HCU)

- Potential enabling technology for commercialization of Carinata
- HCU process can be co-located with carinata crushing facilities
 - Replaces edible oil refining processes
 - Removes metals to <5 ppm and Phosphorus to <2 ppm
 - No yield loss, no solid waste
 - Lower cost, lower carbon intensity, higher carbon credits
 - Produces fungible oil ready for renewable fuels or chemicals
 - Can operate in the fat-splitting mode – complete hydrolysis

