Value Creation with Waste-To-Carbon-Negative-Drop-In-Fuel Facilities for Los Angeles County Public Works

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Craig Pichach, P.Eng, MBA, PMP, B.Sc

About

Who are We?

Experienced oil and gas engineers and managers (including offshore) redeploying knowledge and skillset in the renewable energy space.

Team transitioning heavy oil / oil sands upgrading and conventional fossil power generation experience into the renewable energy transition with the CleanCarbon Energy Process – a battery scale biomass-to-drop-in fuel plant design.

Experience includes work with the Enerkem waste-to-fuels gasification plant (Edmonton Alberta), Supercritical Water Upgrader (Japan Gasoline Corporation pilot) and Nexen Long Lake Upgrader and Gasifier (including 80MW syngas-to-power plant).

Mission

Deployment of Renewable Carbon Negative Drop-In-Fuel Production Energy Projects

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Net Zero Strategy

Organic Feedstock (non foodstuffs)
Carbon Balanced

Affordable, convenient drop-in renewable fuels/power

Desalinated Water
+
Carbon Dioxide

Biochar
(Sequestered Carbon)

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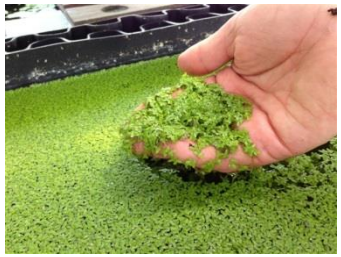
VALUE PROPOSITION

Flexible Design that converts inexpensive biomass sources to carbon balanced fuels

Wet

Municipal / Pulp Sludge



Micro/Macro Algae

Wet and Dry

Non merchantable wood fiber

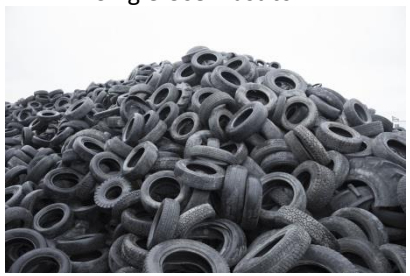
Municipal Waste

Agricultural waste

Bioenergy Crops

Dry

Single Use Plastics



Used Tires

Multiple Value Added Products

Carbon Balanced Power

Waste Reduction

Drop-In Diesel/Gasoline

Biochar

Ammonium Nitrate or Sulfate (Fertilizer)

Recovered Metals

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Drop-In Renewable Crude

Typical Pyrolysis Oil
HHV ~ 16-19MJ/kg
28-40% oxygen

CCE
HHV ~ 45MJ/kg
<0.1wt% oxygen

High Value Renewable diesel, gasoline, jet fuel, naphtha, bunker fuel products

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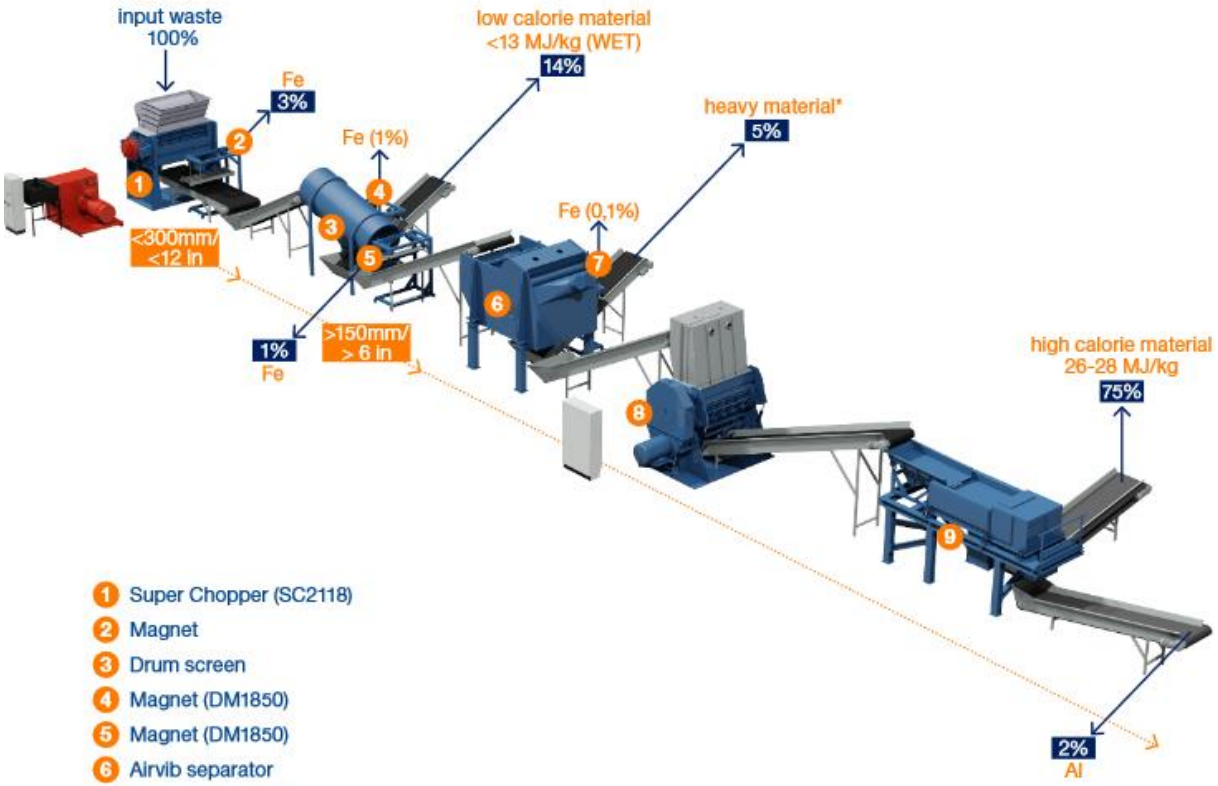
CCE Process – Front End



1. Super Chopper (SC2118)
2. Magnet
3. Drum screen
4. Magnet (DM1850)
5. Magnet (DM1850)
6. Airvib separator
7. Magnet (DM1850)
8. Heavy Granulator (HG209)
9. Eddy current separator

* heavy material include stones, bricks, iron etc.
** low calorie material <150mm/6 in

Up to 10000 kg/h

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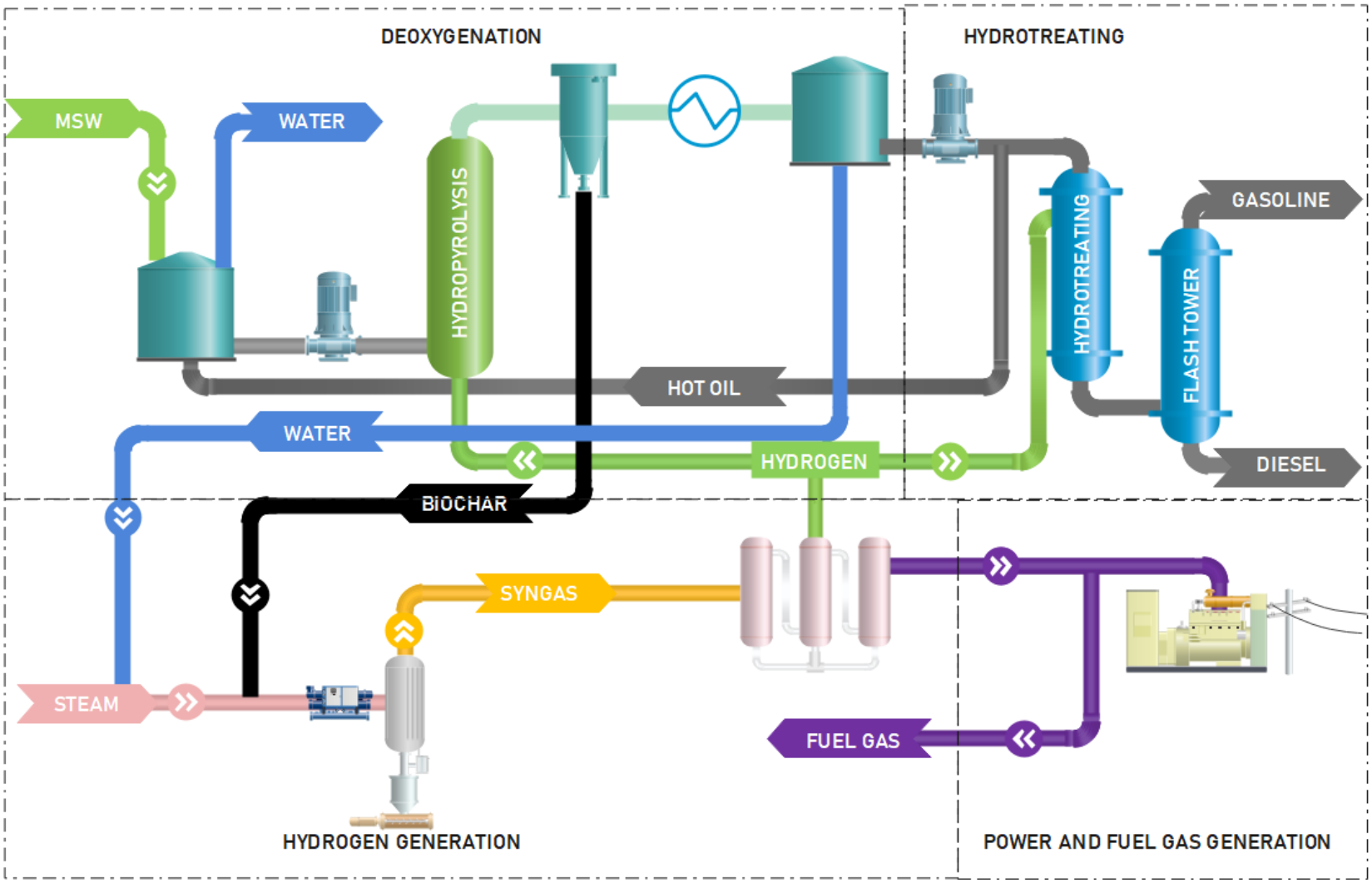
CCE Process – Fuel / Power Prod.



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LA County Opportunity

Table 1.2. Example MSW Characterization Table (California Biomass Collaborative 2006)

Material	Landfilled Mass, wet (MM sTon)	% of Total (wet) MSW	Moisture Content (wt.%)	Landfilled Mass (MM BDT)	Ash (wt.%,dry)	Ash (MM sTon)	HHV (MJ/kg dry)	HHV (MJ/kg daf.)	HHV (MJ/kg ar)
Biomass									
Paper/Cardboard	9.1	21.0	5.2	8.7	7.9	0.7	21.2	23.1	20.1
Food	6.4	14.6	36.6	4.0	5.4	0.2	-	23.7	-
Leaves and Grass	1.8	4.2	43.4	1.0	9.2	0.1	-	19.6	-
Other Organics	1.9	4.4	26.4	1.4	10.6	0.1	-	20.9	-
C&D Lumber	4.2	9.6	12.9	3.6	9.9	0.4	-	20.4	-
Prunings and Trimmings	1.0	2.3	31.0	0.7	6.8	0.0	-	19.6	-
Branches and Stumps	0.1	0.3	46.7	0.1	3.2	0.0	20.8	21.5	11.1
Total Biomass Carbon Compounds:	**24.5**	**56.4**	**28.9**	**19.5**	**7.6**	**1.6**	**21.0**	**21.2**	**15.6**
Other Organics									
All non-Film Plastic	2.2	5.1	0.2	2.2	2.3	0.1	41.9	42.9	41.8
Textiles	1.9	4.3	13.5	1.6	16.2	0.3	21.9	26.1	18.9
Film Plastic	1.9	4.4	0.2	1.9	0.1	0.0	40.6	40.7	40.6
Total Non-Biomass Carbon Compounds:	**6.0**	**13.8**	**4.6**	**5.7**	**6.2**	**0.3**	**34.8**	**36.6**	**33.8**
Inorganic									
Other C&D	5.3	12.1	-	5.3	100.0	5.3	-	-	-
Metal	3.3	7.7	-	3.3	100.0	3.3	-	-	-
Other Mixed and Mineralized	3.3	7.7	-	3.3	100.0	3.3	-	-	-
Glass	1.0	2.3	-	1.0	100.0	1.0	-	-	-
Total Mineral:	**13.0**	**29.8**	**-**	**13.0**		**13.0**	**-**	**-**	**-**
Total Landfilled MSW:	**43.5**	**100.0**	**21.6**	**38.2**	**33.7**	**14.8**	**29.3**	**25.8**	**26.5**

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California LA Land Fill Diversion Project All Tons are American Short Tons CNP, March 19 2021						
Organics 2019	5,400,000	t/yr				
	14,795	tpd				
			TPY	TPD	Moisture (water)	
Total			10,534,431	28,861	wt%	
	% of total	Adjust org %	TPY	TPD		
Food Waste	14.9%	29%	1,569,630	4,300	36.6%	
Green Waste	2.3%	5%	242,292	664	43.4%	
Landscape	4.6%	9%	484,584	1,328	31.0%	
Wood	10.8%	21%	1,285,201	3,521	12.9%	
Paper Porducts	12.2%	24%	1,285,201	3,521	5.2%	
Printing/Writing	2.9%	6%	305,498	837	5.2%	
Digestate	0.0%	0%	-	-	0.0%	
Biosolids	3.4%	7%	358,171	981	26.4%	
	51.1%			15,152	**21.4%**	by wt

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LA County Opportunity

Production Frontier

- 11515tpd (dry biomass) feeding 8700BOPD Gasoline, 13600BOPD diesel 935000GPD of liquid fuels
- ~50MW to the grid
- Can alter mix to make naphtha, jet fuel and bunker fuel.
- Recover 3135 m3/d water
- Economies of scale at play

Pilot

- 100tpd (dry basis), recover 27m3/d water
- ~500kW excess power to grid
- 8115GPD of liquid fuels
- $25-30MM project

Commercial Train

- 500tpd (dry basis), recover 136m3/d water.
- 40000GPD of liquid fuels (gasoline/diesel) or cycle oil to refineries
- ~2.5MW excess power to the grid
- Recovery 136m3/d water
- $65-70MM project

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ADVANTAGES FOR LA COUNTY

- Decreased tipping fees offset by production of high value drop-in fuels.
- Benefit from carbon price, Renewable Identification Number (RIN) program, Low Carbon Fuel Standard (LCFS).
- Increased landfill diversion
- Decreased capital cost with simplified sorting requirements
- Water recovery/desalination
- Economic development / spin-offs
- Carbon balance existing city transportation fleet
- Battery scale strategy can be deployed in manageable financeable trains (California Pollution Control Financing Authority) as opposed to massive mega-project.

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RIN / LCFS

Fuel (D Code)

D3 | D4 | D5 | D6

QAP Service Type

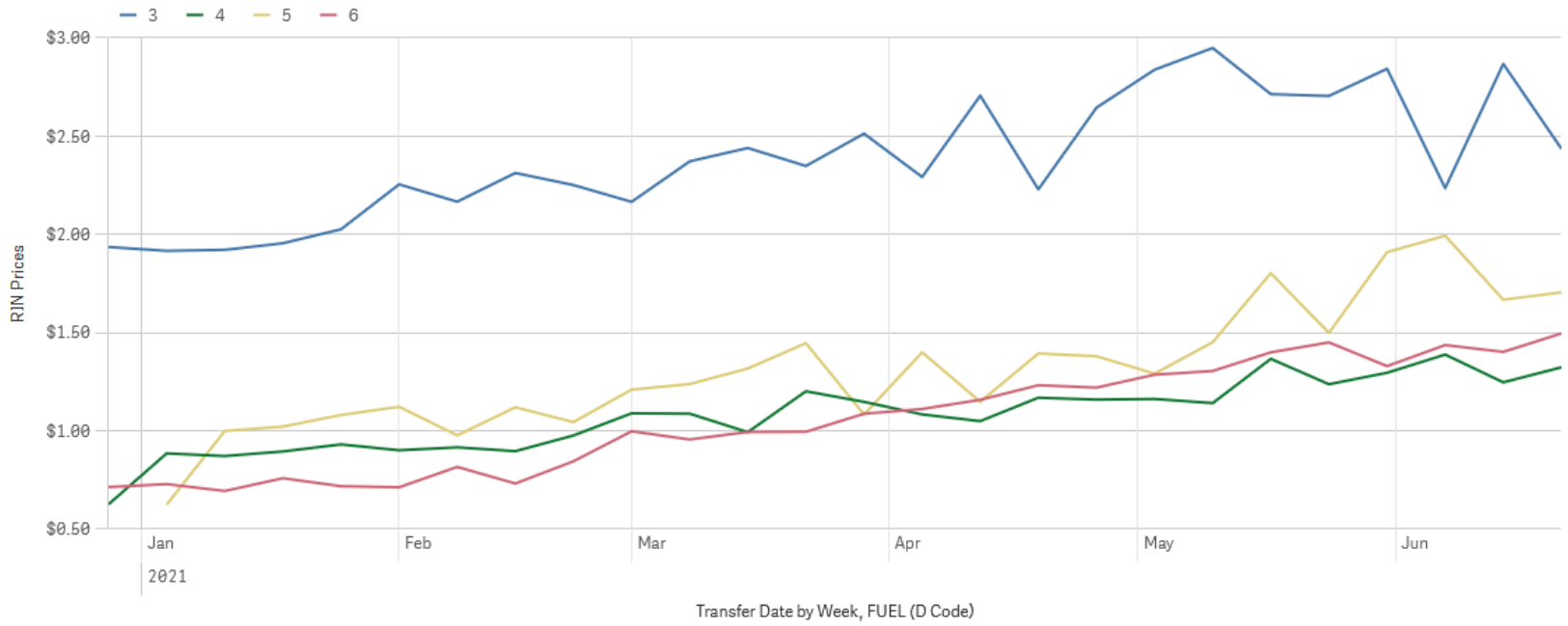
Q-RIN | Unverified

Transfer Years

2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021

Last updated date: Jul, 10, 2021 (Updated monthly)

Weekly D3, D4, D5 and D6 RINs Prices



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DEPLOYMENT

Concept Validation
(2019-2020)

Economic Modelling
(2020)

Benchscale
2021

Nampa
Demonstration
2022

Commercial
Demonstration
2023

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DEPLOYMENT STRATEGY

Initial Deployment Locations

Nampa Alberta

- Potential Sustainable Technology Development funding 50% matching
- Potential Emissions Reduction Alberta (ERA) funding for 25%
- Land with existing Sawmill, rail terminal and agreed upon biomass pricing
- 60tpd->95BOPD demonstration.

Imperial Valley California

- 3:1 Debt financing through California Pollution Control Financing Authority
- Available land
- Feedstock agreement to 500tpd wood waste -> 790BOPD
- Close proximity to US refineries with RFS pricing
- Energy crops for future expansion

Future Locations (Existing low cost Biomass)

Gayana (Giant King Grass/Forest residue), East Texas (Giant King Grass/ag waste), Australia (Mallee), Philippines (Bagasse/Giant King Grass)

COMPETITION

ENERGY TRANSITION
Electric Vehicles vs. Renewable Drop-in Crude

Renewable Crude At the Pump

- Continue to use existing infrastructure (refineries, gas stations, cars, tankers, airplanes)
- Continue to use existing high performance internal combustion engines but with carbon balanced fuels.

Electric Vehicles

- Where does the electricity come from?
- Need to rebuild electric infrastructure to allow for cars to charge.
- Need new cars with battery issues, replacement batteries (exotic metals)
- Declining performance over time, inconvenience
- What about airplanes? Trucks?

RENEWABLE CRUDE THE CLEANER ENERGY TRANSITION

FUTURE

Cost effective feedstocks and locations identified for exponential growth

Organic Municipal Waste (Everywhere)

Giant King Grass
(California/Texas/Gayana/Philippines/Timor)

Mallee (Australia)

Sugarcane Bagasse
(California/Texas/Lousianna/Philippines)

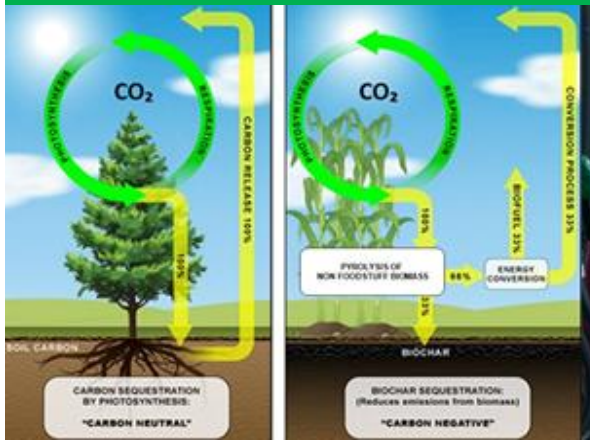
Switchgrass
(North Dakota)

Hog Fuel
(BC/Alberta/Montana/Idaho)

SUMMARY

What if every gallon of fuel that powered your affordable and convenient vehicle was not only net zero…. but carbon negative?

CARBON NEGATIVE



Process is self recuperating and designed to sequester carbon without the need for expensive compression, pipelines or storage caverns.

DROP-IN

Process hydro-converts to drop in fuels such as gasoline, diesel, bunker fuel and jet fuel to carbon balance the existing fleet. Excess power and biochar is sold to the grid.

AFFORDABLE

Affordable fuels produced from low cost non foodstuff organic feedstocks including wood, agricultural waste and energy crops in a battery scale process.

Enable the Circular Economy with CleanCarbon Energy Carbon Negative Drop-In Fuels

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Thank you!

cpichach@cleancarbon.energy

Learn more about renewable drop-in fuels at rincrude.com