ABLC NEXT 2026 · FEEDSTOCK AVAILABILITY

Wet Waste Feedstock Opportunities

Two paths for converting wet wastes into bioproducts and biofuels: cultivation of microalgae and direct conversion of wet wastes to fuels

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San Francisco · October 21, 2026

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MBE works with national labs, universities and industry

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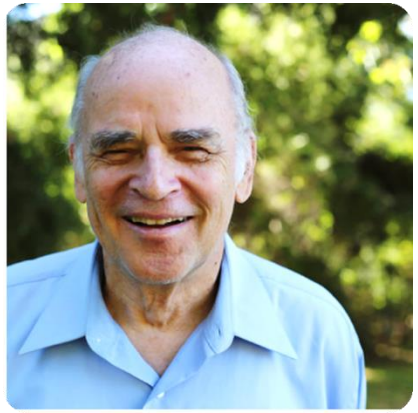
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Our team spans algae biology, wastewater and HTL design



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WHY WET WASTES

Today's disposal costs are tomorrow's feedstocks values.

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Wet wastes are a feedstock that someone is already paying to get rid of, and the bill is rising

THE PERCEPTION

“There isn’t enough feedstock.”

THE REALITY

Aggregation, logistics and contracting decide whether supply works.

+58%

Bay Area biosolids hauling and disposal spending, 2020 to 2023, against ~18% inflation

$70–100

per wet ton for land application or compost in 2023, about double 2017

≥20%

of Southern California biosolids (~260,000 wet tons/yr) trucked up to 300 miles to Arizona

Sources: BACWA 2024 Biosolids Trends Survey; Clean Water SoCal Biennial Trend Survey 2021–23.

We see two complementary ways to turn wet wastes into products and fuels

1

WASTE IN
Wastewater nutrients and CO_2

→

PROCESS
Grow algae

→

PRODUCT
Feeds; Fertilizer + Fuels

Nitrogen and phosphorus from municipal, farm and food-processing wastewater, plus CO_2 from digesters and power plants, grow an algae intermediate.

2

WASTE IN
Biosolids, manures, food wastes

→

PROCESS
HTL (Hydrothermal liquefaction)

→

PRODUCT
Biocrude to refineries (with fertilizer recovery)

The wet wastes themselves, and algae from path 1, are converted directly to biocrude and upgraded at refineries to diesel, jet and marine fuel.

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OPPORTUNITY 1

Waste nutrients and CO_2 can be used to produce algae biomass.

Cleaning water and capturing carbon while producing feed, fertilizer and fuel feedstock

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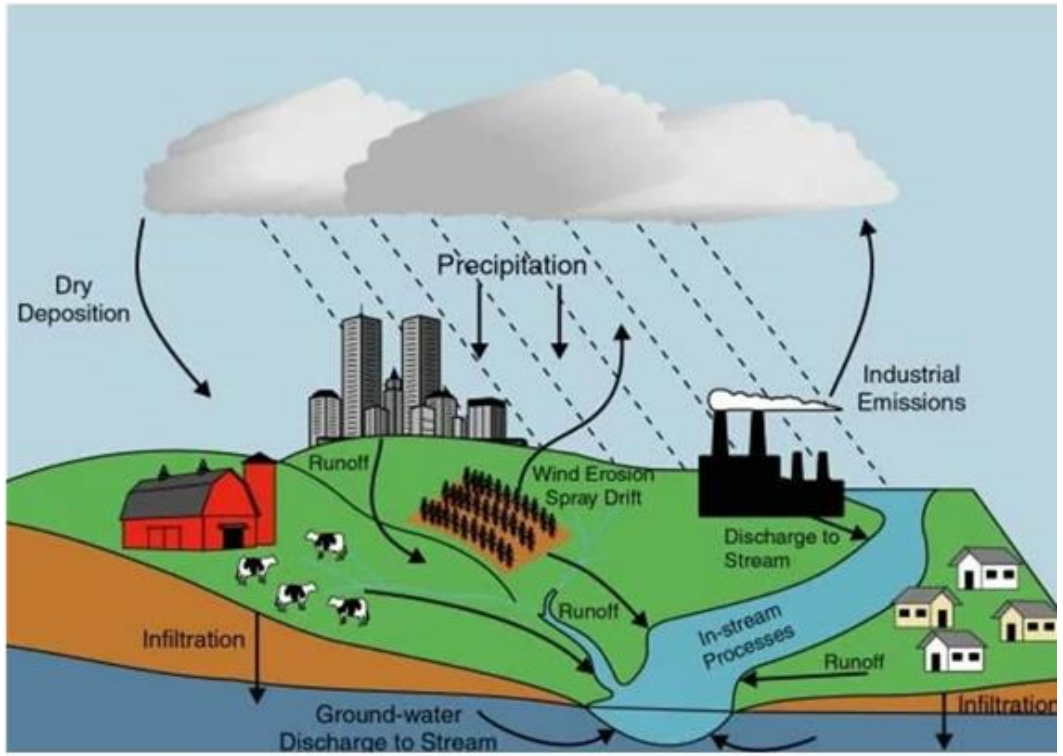
Waste nutrients could grow 12 million tonnes of algae annually

~2.5 M

tonnes/yr of algae from municipal wastewater N and P

>10 M

tonnes/yr from agricultural runoff (7.3 M from the Mississippi basin alone)



Biomass equivalents at 7% N. Sources: USGS (2000) municipal WWTP loads; USGS (2024) Mississippi River Basin loads; DeRose et al., J. Great Lakes Res. (2021).

Municipal wastewaters, farm runoffs, animal manures potential for algae biomass feedstock production for biofuels/biofertilizers



Photos: Delhi, CA WWTP harvested algae slurry and solar dried biomass

Dairy digester CO_2

Biogas upgrading leaves a steady, nearly pure CO_2 stream at the farm, next to the manure nutrients.

Municipal wastewater

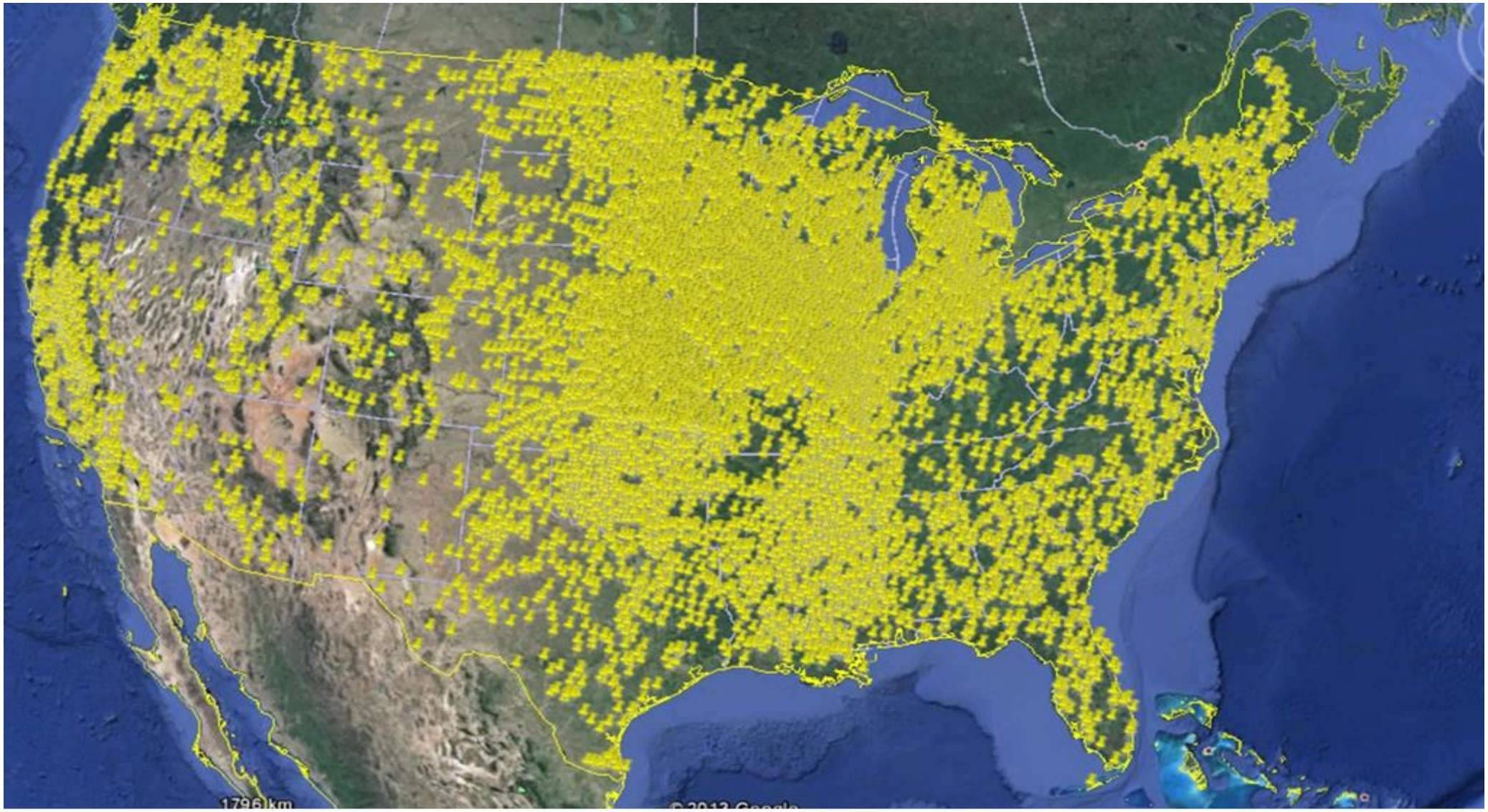
Permits keep pushing effluent N and P limits down; algae can polish what treatment leaves.

Farm runoff and food processors

CAFOs, field runoff and processing water carry large, untapped nutrient volumes.

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Over 12,000 Wastewater Treatment systems operating in the US
About a third are municipal WWT algae ponds, only ~5% of total flow



US DOE has funded MBE research projects to de-risk microalgae cultivation for waste conversion

$5 M

Cultivation of filamentous algae using power-plant CO_2 grows algae for poultry feed

Target: > 80% CO_2 fixed

$2.35 M

Improved strains grown on wastewater and flue gas

Target: >80% CO_2 use efficiency

$5 M

Attached algae systems to treat nutrient polluted water

Target: 12,500 GGE/yr via HTL

$1.25 M

Optimization of CO2 use efficiency in highly productive marine strain

Target: >70% CO_2 use

$1.25 M

Cyanobacteria fix air nitrogen, waste CO_2 into organic fertilizer

Target: >80% CO_2 use

$0.6 M

Diatoms turn waste concrete into cement additive

Target: 25% higher tensile strength than fly ash

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Waste-fed algae could achieve market price breakthrough

Feed

$704

per tonne, expected selling price for a 10,000-acre plant beside a power plant

Soybean feed sells for $393–1,200/t; algae feed carries 63–153% lower GHG.

Organic Biofertilizer

$879

per tonne biomass from a 400-hectare plant with improved strains

Below the $1,000/t viability benchmark, with 62% lower global-warming potential.

Fuel

$3.48

per gallon-equivalent for attached algae, improved case

Parity is about $3/GGE; nutrient credits of $10–15/lb bring it under $4.

Sources: MBE TEAs — NETL final report, DE-FE0031717 (feed); CRIAS final report, DE-FE0032189, 400 ha plant (biostimulant); AAFW proposal narrative (fuel).

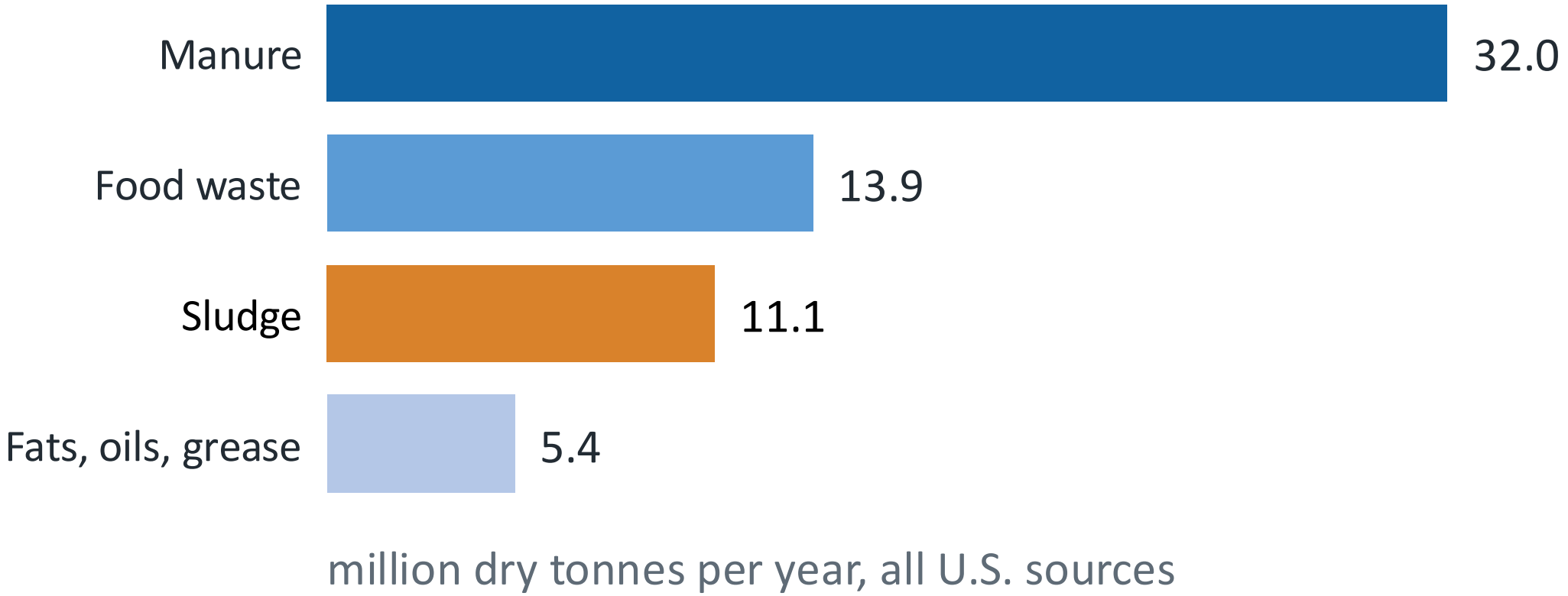
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OPPORTUNITY 2

Sludges (biosolids), manure and food waste can become biocrude.

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The U.S. makes 62 million dry tonnes of wet waste a year



Source: Seiple & Bakker, PNNL-35569 (2024), Table 10, from the National Wet Waste Inventory.

HTL: a pressure cooker, quickly converts wet waste into biocrude

The Process:

1. **Pump**
   ~20% solids to ~200 bar
2. **Heat**
   to ~350 ° C, heat recovered
3. **React**
   C converted to crude
4. **Separate**
   biocrude, aqueous, solids

The Products:

Biocrude



~50% of the feed carbon; trucked to a refinery for diesel, jet or marine fuel

Aqueous phase



Nitrogen recovered as ammonium sulfate, then returned to the plant headworks

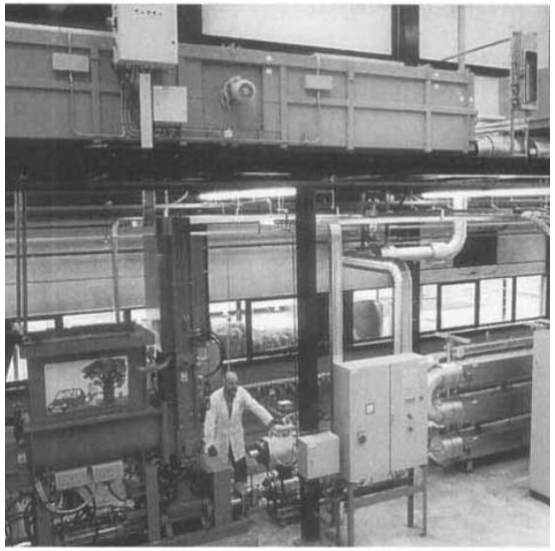
Solids



Holds nearly all the phosphorus; ~85% fewer wet tons than digested cake

Sources: Metro Vancouver HTL fact sheets (SRFEOI 25-767, App. A, Nov 2025); MBE process model, ~100 MGD case (preliminary); influent TKN per PNNL-27186; digestate ammonia per Snowden-Swan 2022; influent COD typical value.

HTL is moving from pre-pilot to utility led pilot-demos



1980s

Oil-crisis pilots: Albany, OR; EPA sludge-to-oil at Richland, WA; Shell HTU in the Netherlands



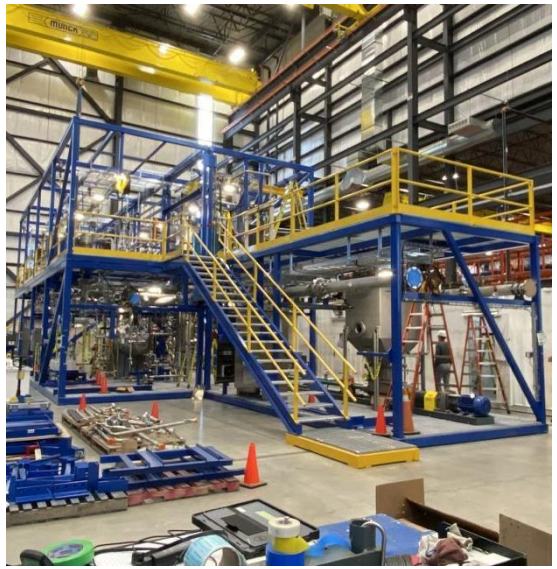
1991

PNNL develops continuous HTL; Genifuel licenses the technology in 2008



2015

Genifuel & PNNL pilots and a mobile unit tested at utilities incl. GLWA and Miami-Dade



2026

Continuous pilots worldwide; Metro Vancouver's (PNNL & Genifuel participants) demo unit in fabrication, 2026

Sources: dos Passos (Procen), "HTL: Past, Present and Future," and Oyler (Genifuel), PNNL HTL Workshop, Aug 2026; images from those presentations.

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Utilities are now hosting HTL demonstrations, and the first commercial plant is nearing financing

Metro Vancouver, BC
10 wet t/d

Demo at Annacis Island; factory testing Sept 2026, operating 2027–28

Great Lakes Water Authority, MI
110 dry t/d

Hosted Genifuel pilots; PNNL's site-specific design case

Central Coast, CA
9 WRRFs

Supplied sludge to MBE's DOE-funded regional HTL study

New Zealand
~$400 M

First large commercial plant nearing financing



"Utilities are not technology developers — collaborators are key."

— Metro Vancouver, PNNL HTL Workshop, Aug 2026

Left: PNNL concept for a ~100 dry t/d plant, about the solids of a 100 MGD treatment plant.

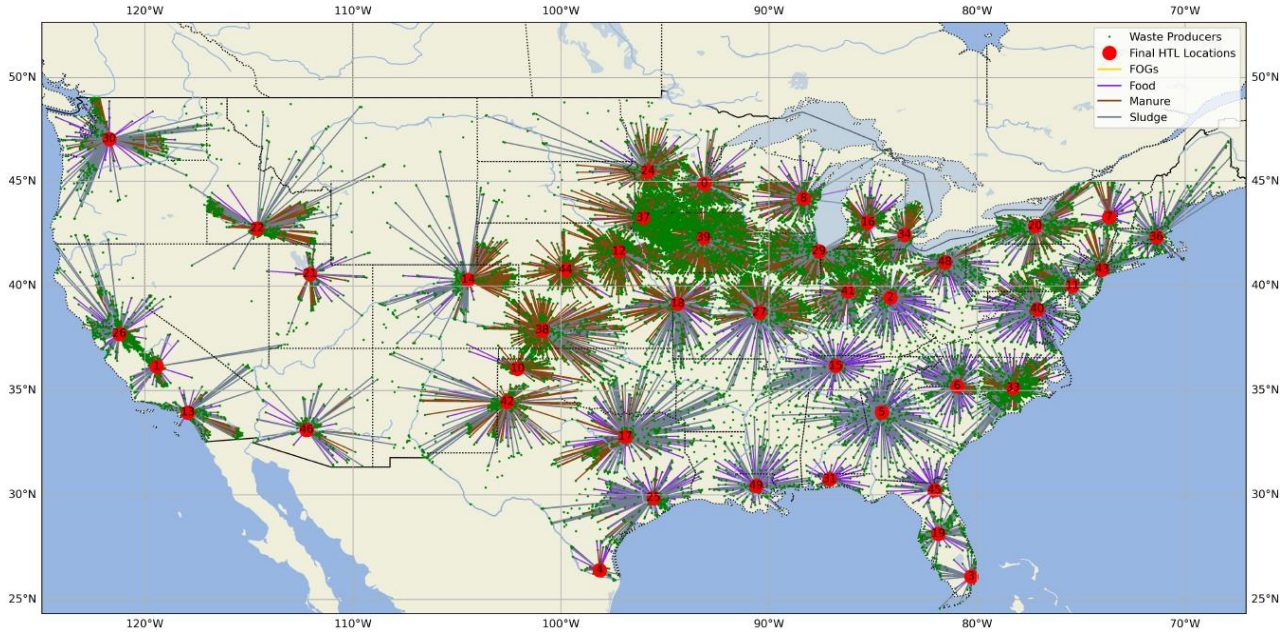
Sources: Zaremba (Metro Vancouver), IEA Bioenergy Task 34, May 2025; Fromberg and Oyler, PNNL HTL Workshop, Aug 2026; PNNL-37046; Santosa (PNNL) 2024.

PNNL's national siting model finds 44 regional HTL hubs could use nearly all large-source wet waste

44 optimally sited hubs, averaging ~3,200 dry t/day each. Collecting from sites of > 1 dry t/day, avg round trip haul of 4hr

329k barrels of biocrude per day, ~2.8% of U.S. crude production

~23% of 2019 U.S. jet fuel use, by volume



Profitable as a system

$48 B net NPV and $155 B in avoided disposal costs

Source: Seiple & Bakker, PNNL-35569 (2024), Co-Processing with Pipelines case (biocrude piped to existing refineries).

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Sludge anchors a hub's economics, manure and food waste scale it

Feed to the 44 hubs, by dry mass



~$400

per dry tonne gate fee from sludge producers, who already pay to dispose of it

~$0

per dry tonne for manure: it adds scale, not revenue

Source: Seiple & Bakker, PNNL-35569 (2024), Tables 11–12, Co-Processing with Pipelines case. FOG was too costly to use in that model.

Fuel from sewage-sludge HTL is projected at $2.30–3.50 a gallon, with emissions cut by three-quarters

$2.3–3.5

per gallon-equivalent, minimum fuel selling price (median $2.80)

73–82%

lower supply-chain GHG than petroleum diesel

110

dry tons/day of sludge per HTL plant in PNNL's design case

576

U.S. treatment plants where HTL is cheaper than current sludge disposal

They handle 53% of U.S. wastewater solids. Together they would save ~$4.8 M a day and avoid ~1,300 t CO_2e a day while recovering N and P fertilizer. Shared hubs extend this to plant networks above 5–7 t/day within 80–155 km.

Sources: Jiang et al., PNNL (J. Environ. Chem. Eng., 2023), 10th–90th percentile of 10,000 Monte Carlo runs, 2016$; Feng, Strathmann & Guest, Environ. Sci. Technol. 59 (2025), utility-owned at 3% IRR.

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Three DOE-funded MBE projects take HTL from feed handling to the conceptual design of a regional plant.

$5M

Feed formatting and scale-up

Thick feed that heats up without plugging

0.5 dry t/d

20% cost share
Partners: PNNL, Cal Poly, UIUC

Up to $30M

HTL pilot build & demonstration

Host-site integration: feed, aqueous return, nutrient recovery

3 dry t/d

50% Cost Share
Partners: PNNL, City of SLO

$1.25M

Central Coast regional HTL

Siting and feasibility study for regional sludge disposal solution

Maximize PFAS destruction

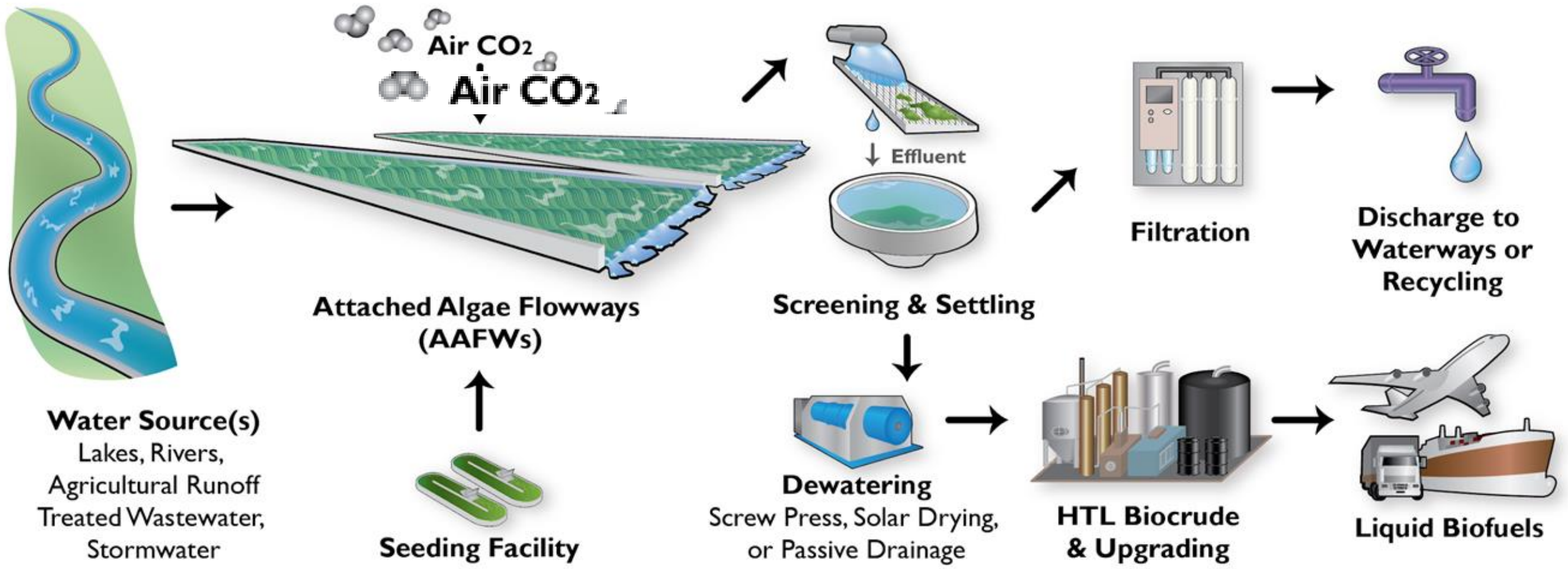
9 WRRFs

20% Cost Share
Led by USLT-Resource Conservation District

Sources: award terms, DE-EE0009752 and DE-EE0010462 (DOE EERE/BETO); HTL Regional Project go/no-go, Jul 2025.

Ongoing project: Attached Algae Flow Ways (AAFW)

U.S. DEPARTMENT OF ENERGY



Sandia National Laboratories · HydroMentia Water Treatment Technologies · Indian River County Florida · μBIO MicroBio Engineering · Cal Poly San Luis Obispo · Pacific Northwest National Laboratory Proudly Operated by Battelle Since 1965 · heliae · Harbor Branch Florida Atlantic University · AECOM

MBE HTL Project: Wastewater Sludges to SAF, diesel



Bacterial
Wastewater Treatment

Sludge
(Primary,
Secondary,
Digested)



Wastewater Treatment

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN



Bench Scale
Continuous HTL



Hydrothermal liquefaction

U.S. DEPARTMENT OF ENERGY

Pacific Northwest
NATIONAL LABORATORY

Biocrude →



→ Jet Fuel
→ Naphtha
→ Diesel
→ Heavies

Hydrotreating
& Distillation



Finished Fuel
ASTM Testing

AP,
Solids

CAL POLY
SAN LUIS OBISPO



Liquid Fuels Markets



Feedstock Characterization
Ash, AFDW, CHNOS,
Carbs/Fats/Protein

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AP Treatment,
Nutrient Recovery

Let’s build the first wet-waste hubs.

Investors

Provide cost share to help fund the first regional hubs.

Refiners and Manufacturers

Take the biocrude and the algae

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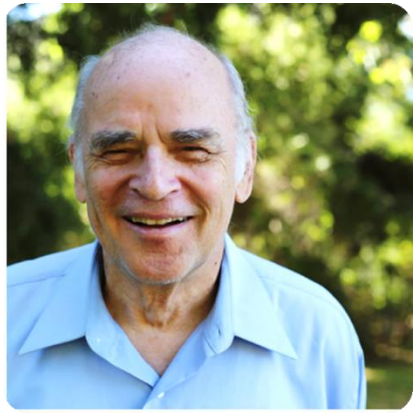
Project Development, TEA, siting and engineering.

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