

Advanced 'drop-in' biofuels



Asilmar Biofuels Session

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U.S. Transportation Fuel Needs

Gasoline (cars & trucks)



137 bgy

Diesel (on-road, rail)



43 bgy

Aviation (jet fuel)



23 bgy

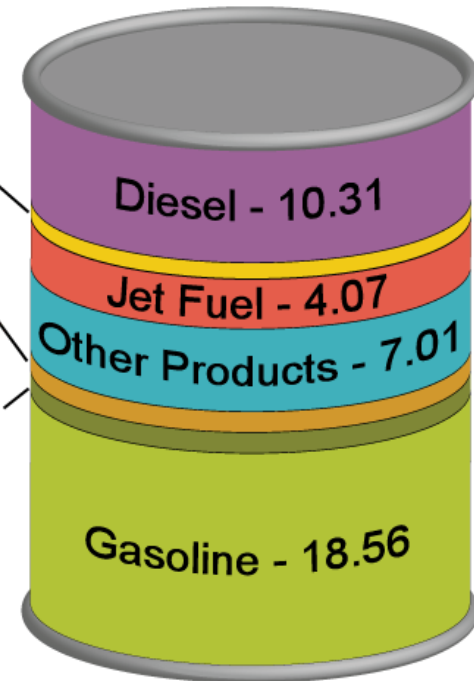
	2008	2030
Motor gasoline	137	126
Diesel	43	71
Jet fuel	23	30

Products in a Barrel of Crude (gal)

Other Distillates
(heating oil) - 1.38

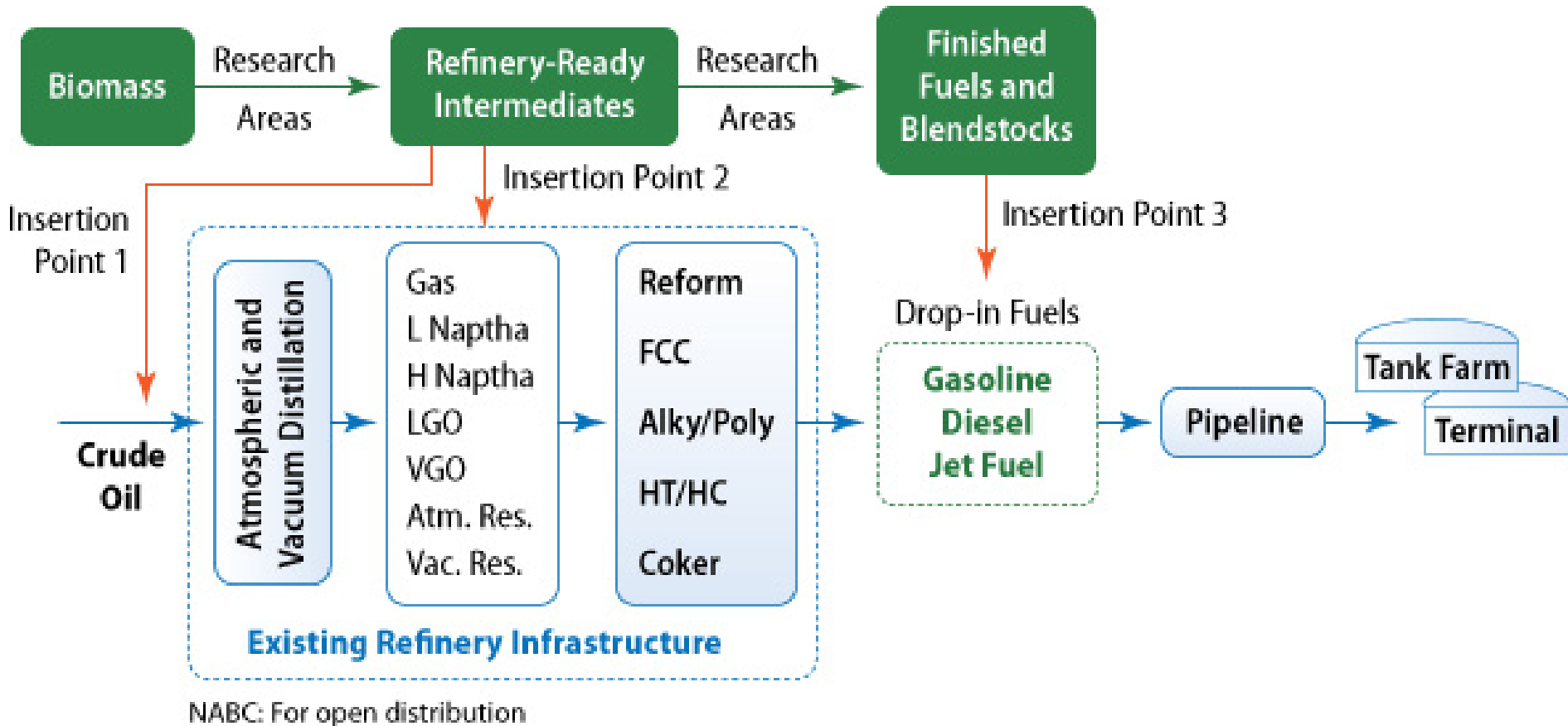
Heavy Fuel Oil
(Residual) - 1.68

Liquefied
Petroleum Gases
(LPG) - 1.72



Source: Energy Information Agency

Refinery Integration

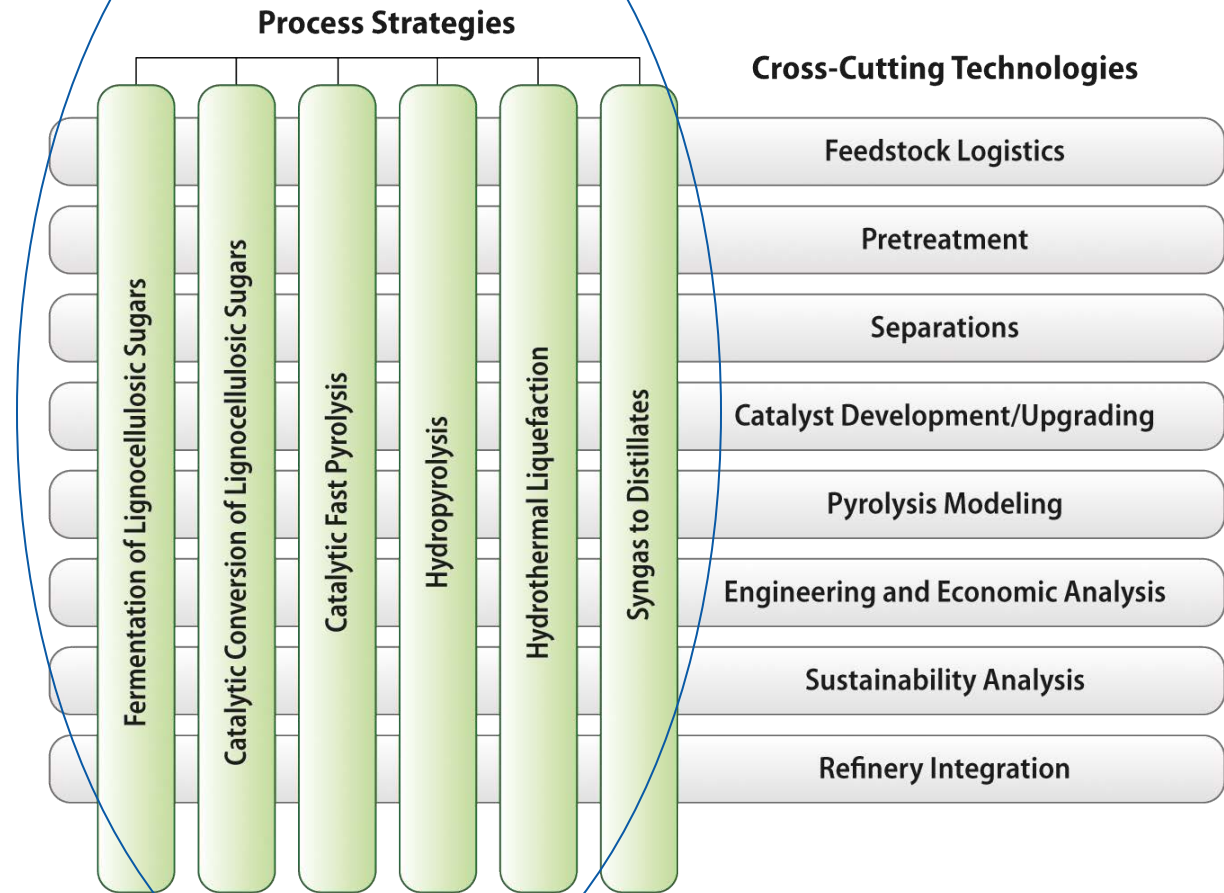


- Three possible insertion points
- Develop new technologies that use today's infrastructure

Process Strategies Technical Progress

NABC matrix of technology and strategy teams will ensure development of complete integrated processes.

Converting biomass into infrastructure-compatible materials

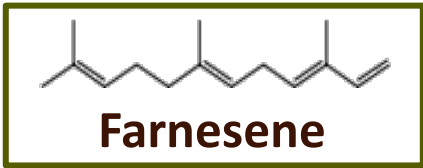
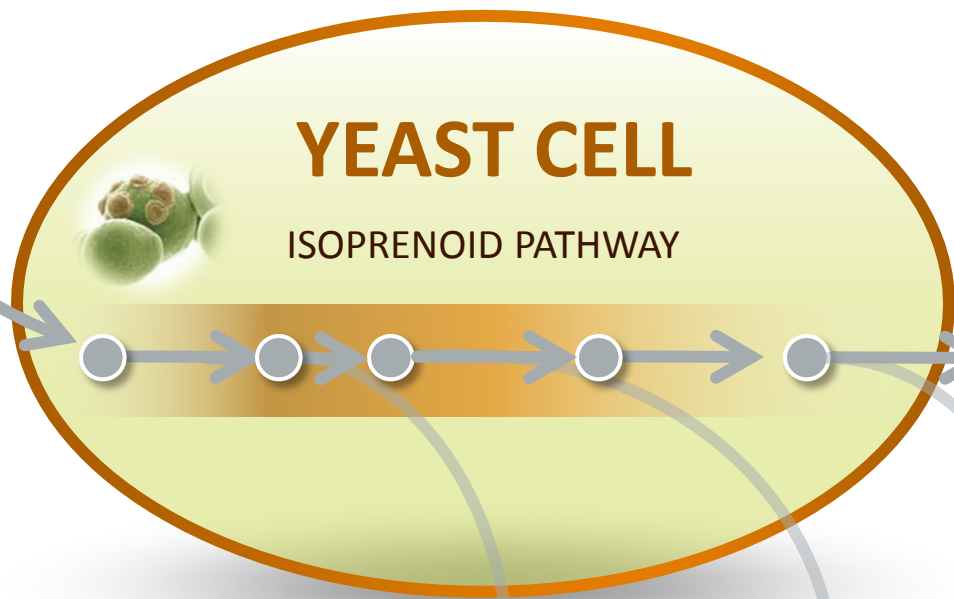


NABC: For open distribution

Modified yeast to produce diesel fuel



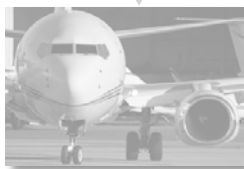
SUGAR SOURCE



Isoprenoid-based Diesel Fuel



ISOPRENE

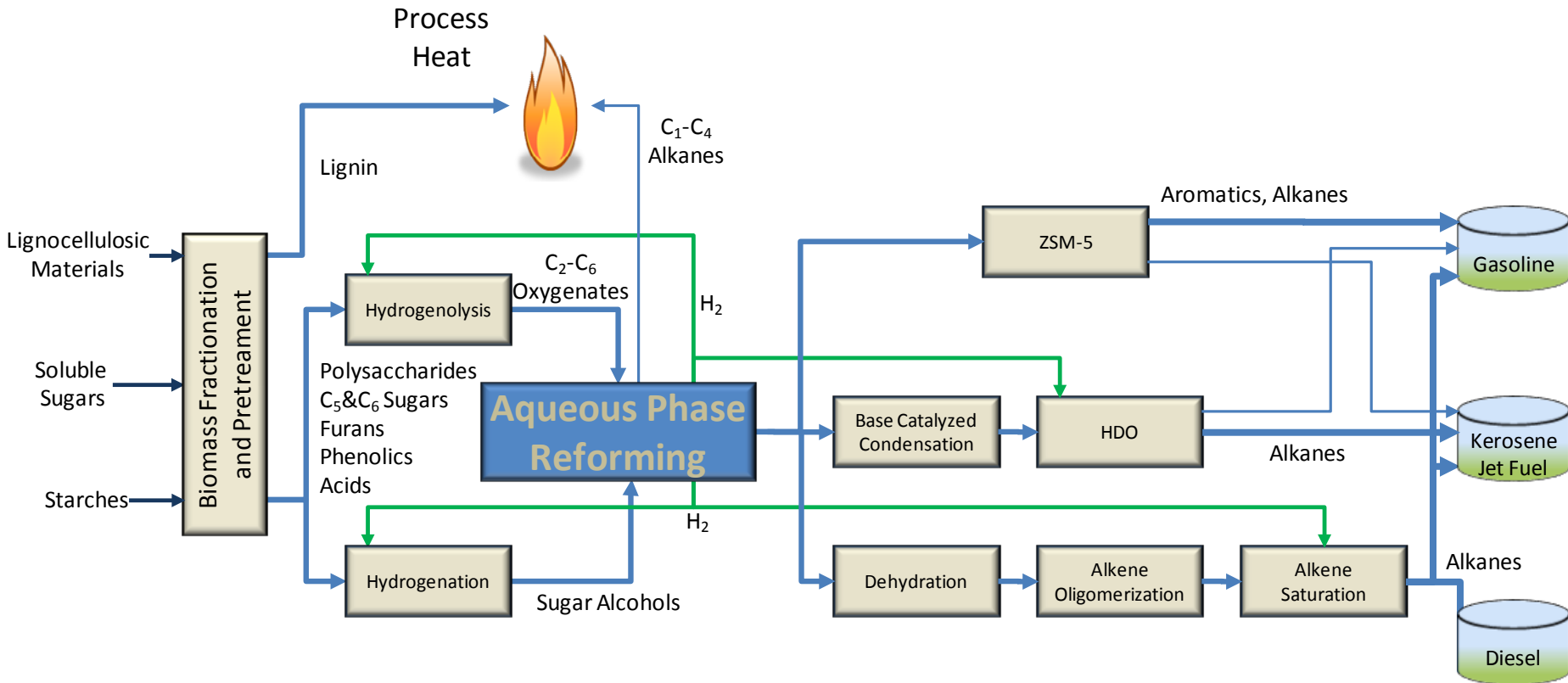


PINENE
(JET FUEL)

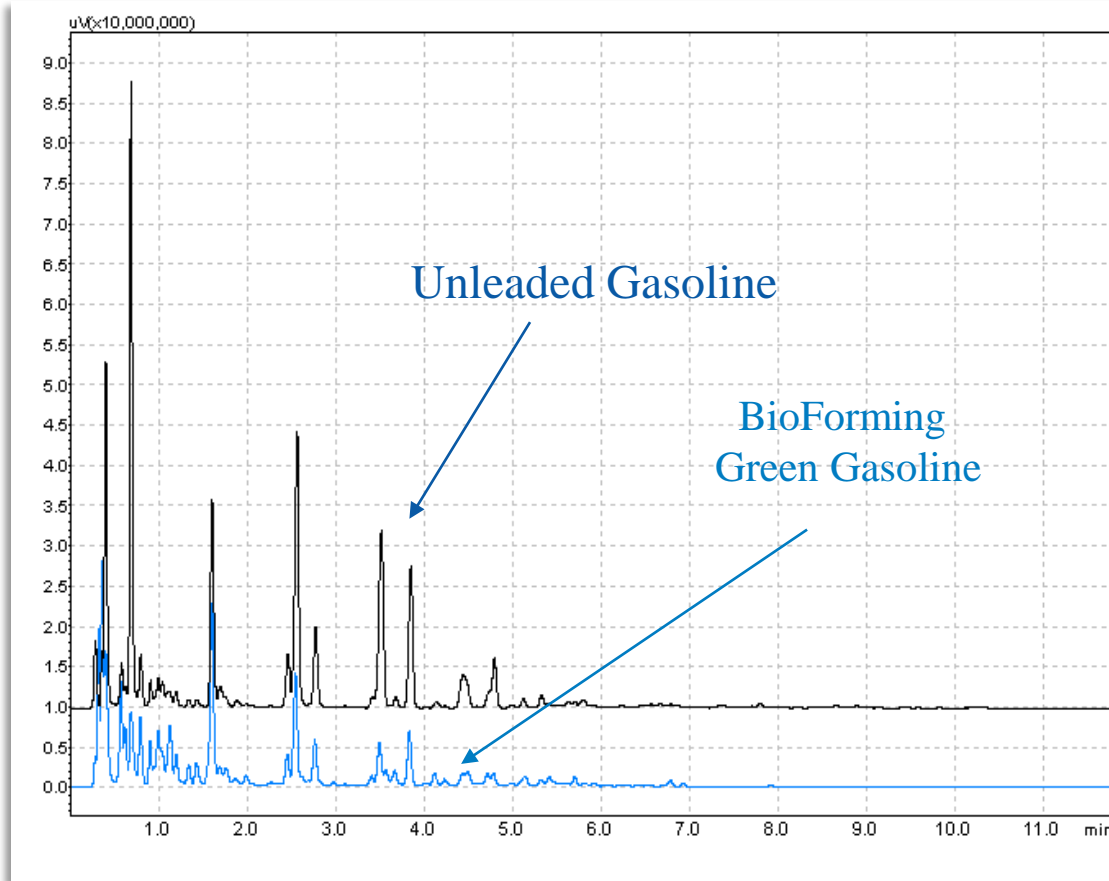


ANTI-MALARIAL
DRUG

Virent Technology Overview



Biogasoline Product



Unleaded Gasoline
115,000 BTUs/Gal

BioForming BioGasoline
+120,000 BTUs/Gal

Ethanol
76,000 BTUs/Gal

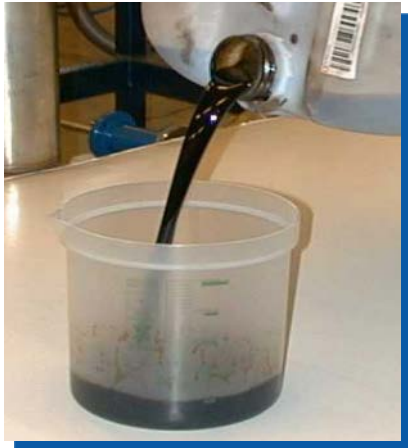


~ 20 liters of sugar derived gasoline from Virent's BioForming process.

Gasoline produced by the Virent Process is a high quality, premium hydrocarbon fuel

State of Technology at Start of NABC Program: Fast Pyrolysis (RTP™)

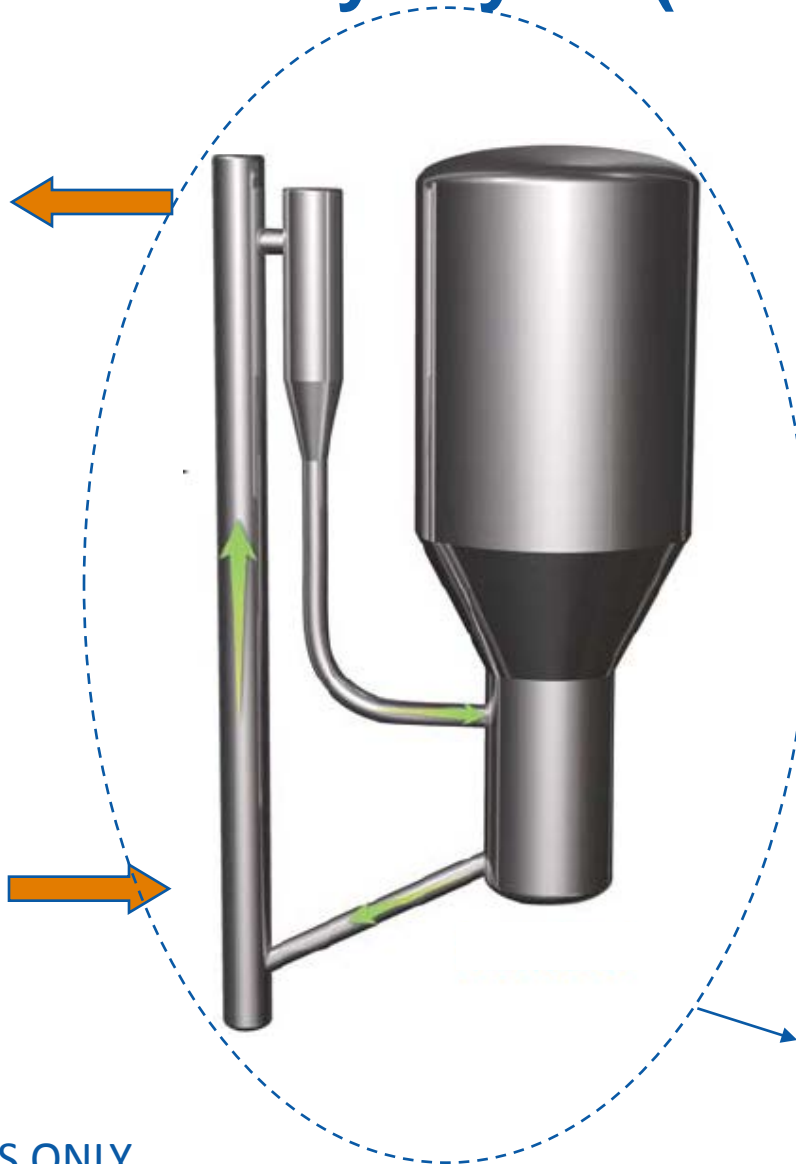
Pyrolysis Oil



Solid Biomass



Moisture content 4-8%
0.5 mm < Particles < 6 mm



- 510° C, <2 secs
- Biomass converted to liquid pyrolysis oil
- Fast fluidized bed, sand as heat carrier
- High yields → 70 wt% liquid on woody biomass
- Light gas and char by-product provide heat to dry feed and operate unit



FOR NABC PURPOSES ONLY

Status

- Future “nth” plant costs competitive with ~\$80 - \$120 crude
- Technologies still in r&d stage
 - Process robustness and scale-up
 - Utilization of lignin component
 - Refinery integration
- Three to five years needed to develop to a pilot ready state
- Three to five years needed for pilot scale demonstrations
- Commercial ready end of this decade early 20 decade

Advanced Biofuel Conversion Routes

