Virent: Replacing crude oil as a feedstock for fuels and chemicals

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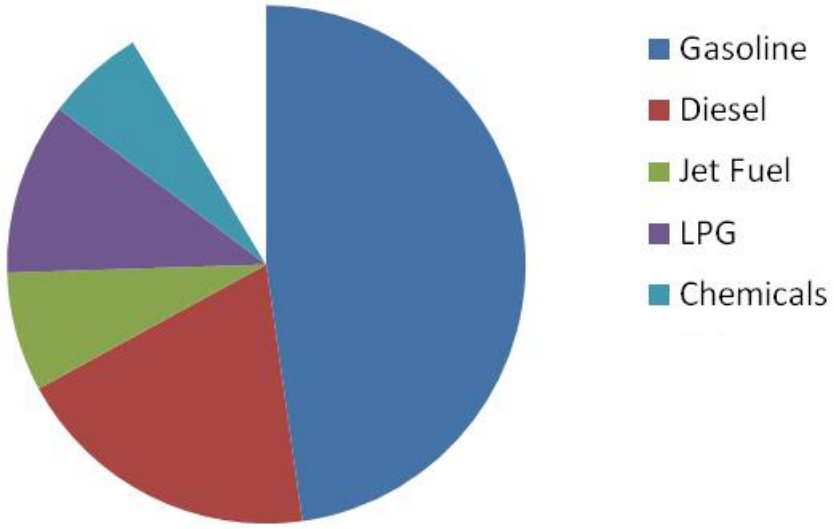
Virent INC.

October 16th, 2013

VIRENT

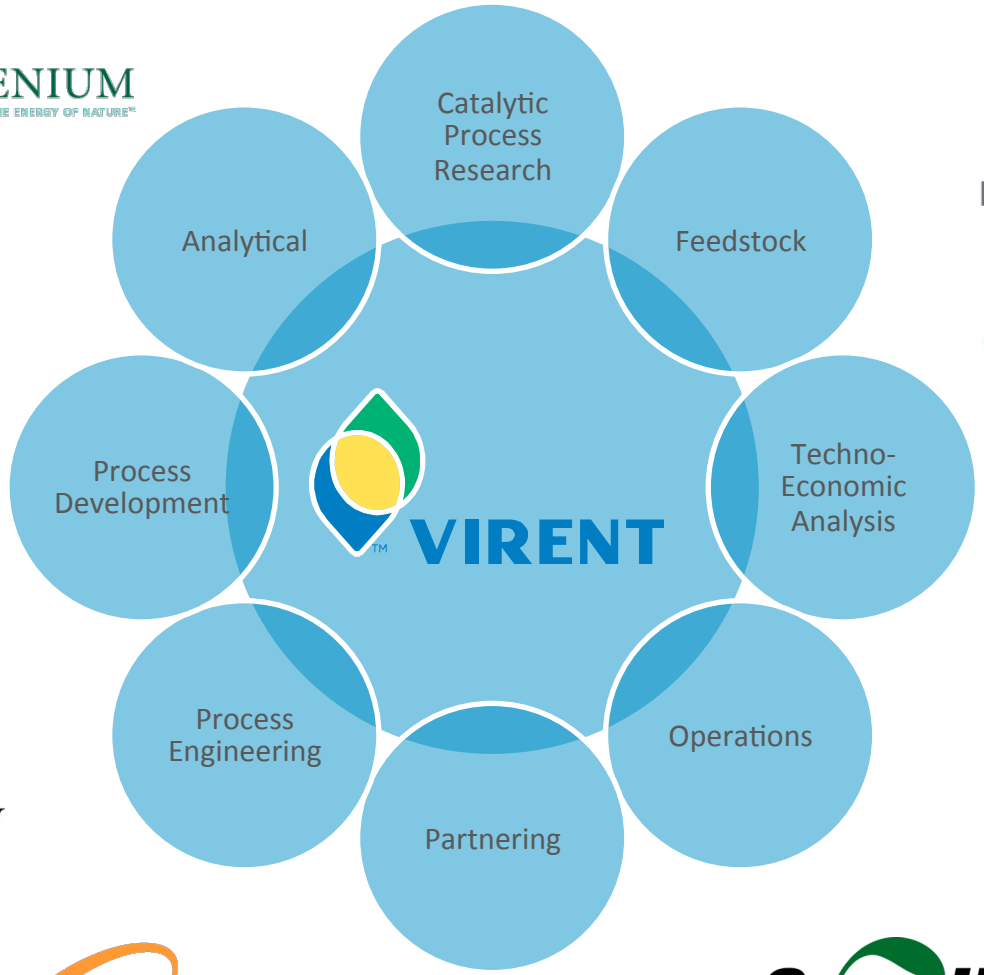
Ending Dependence on Crude Oil

Virent Technology can Replace > 90% of the Barrel



The US consumes over 18 million barrels of oil per day; 49% is imported from foreign countries.

Organizational Capabilities



Virent- How we differ

		Algae	Enzyamatic / Fermentation	Gasification/FT	Pyrolysis	Catalytic
Hydrocarbons	Gasoline/ Aromatic Chemicals					VIRENT
	Jet Fuel	Solazyme	Amyris			VIRENT
	Diesel	Solazyme	Amyris LS-9	Syntroleum Choren Sundrop Fuels Rentech		VIRENT Neste Oil UOP Dynamic Fuels (Tyson/Syntroleum)
	Bio-Crude	Sapphire Cellana			Envergent (UOP/Ensyn) Kior	
Alcohols	Butanol		Butamax Gevo			
	Ethanol	Algenol	DuPont, Poet, BP, Abengoa, Mascoma, Iogen, ZeaChem, Qteros, Coskata, Lanzatech, INEOS Bio	Range Fuels Enerkem		
		Biological		Non-Biological		

Virent's BioForming® Technology

Leading catalytic route to renewable hydrocarbon fuels and chemicals.

Virent's "Eagle" Demonstration Plant- Madison, WI

Fast and Robust

- Inorganic Catalysts
- Moderate Conditions
- Industry Proven Scalability

Energy Efficient

- Exothermic
- Low Energy Separation
- Low Carbon Footprint

Premium Drop-in Products

- Tunable Platform
- Infrastructure Compatible
- Fuels and Chemicals

Feedstock Flexible

- Conventional Sugars
- Non-Food Sugars

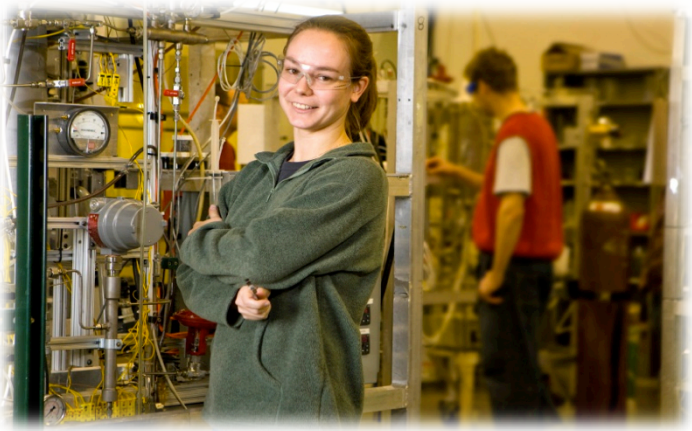
Virent's Capabilities

- Lab Capability (research)
  - >20 continuous and integrated lab plants
  - 0.5- 200cc catalyst
  - 24/7 operation
  - Flexible design
- Demonstration Capability:
  - 10,000 gpy gasoline; 5,000 gpy distillate
    - "More commercial"
    - Product volumes
      - Fleet testing
      - Fuel Registration

Virent at a Glance

The global leader in catalytic biorefinery research, development, and commercialization

>80 Employees



Partners & Investors

Cargill

HONDA
The Power of Dreams

The Coca-Cola Company

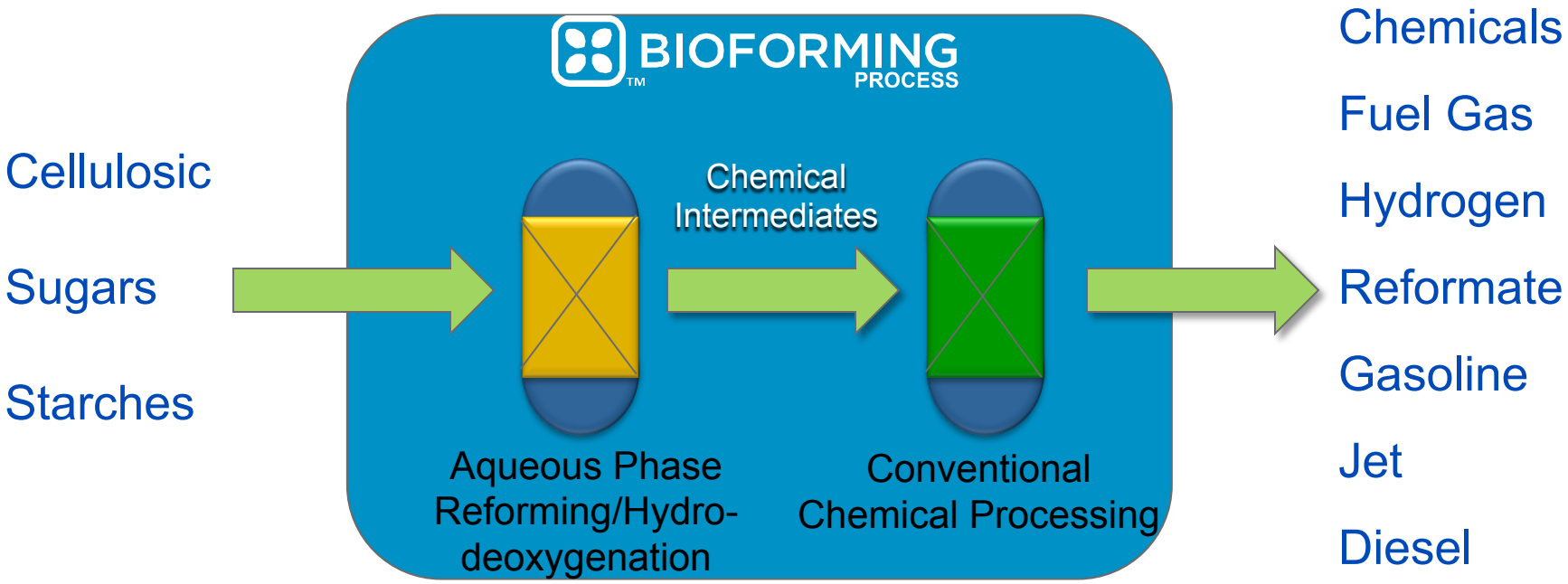
Financial

Infrastructure

> $77 MM in Equity Funding, > $75 MM in Gov & Industry

The BioForming® Process

Converting Multiple Feedstocks to High Value Hydrocarbons



Familiar to Petrochemical Industry

- Similar Reactor Processing Practices
- Proven Catalytic Scale-Up Engineering
- Industry Experience Operating at Scale

High Quality Drop-in Products

- Premium Hydrocarbon Mixtures
- Tunable to Produce Desired Blends
- Adaptable to Provide Chemicals
- Compatible with Logistics Infrastructure

Virent Gasoline and Chemicals projects

NABC (US department of energy)

- Biomass derived motor fuels
- Techno economics of biofuels
- Project Close-out 11/2013

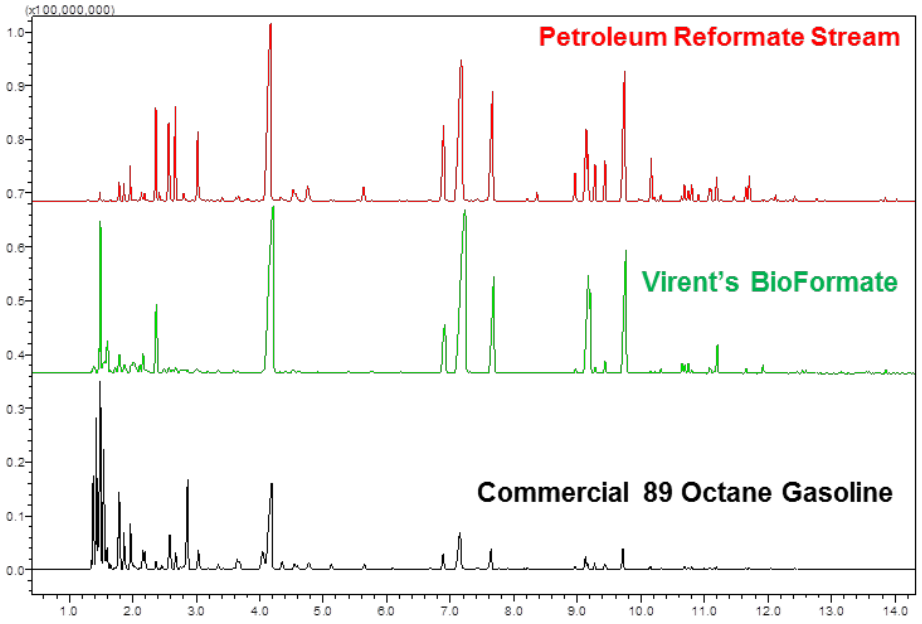
Shell Collaboration

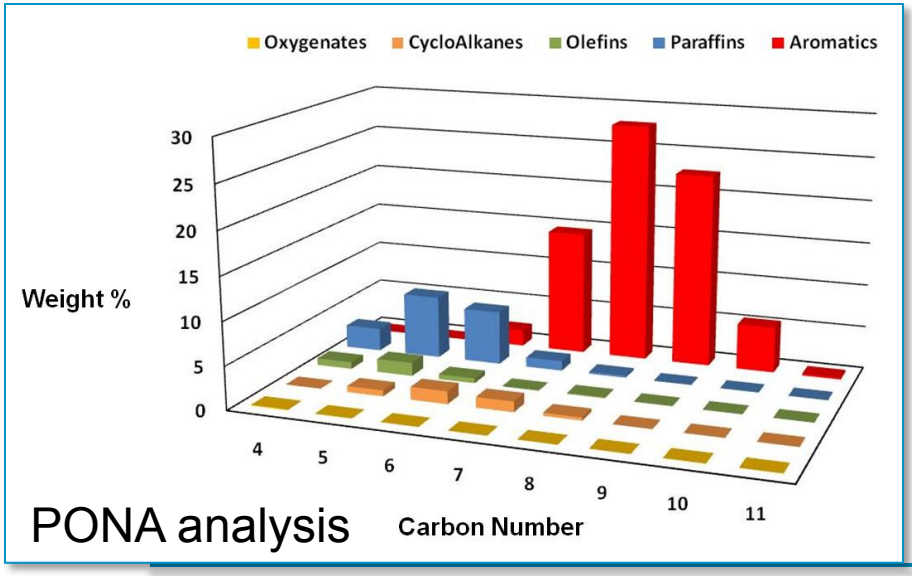
- Gasoline process development & scale-up
- Collaboration completed 06/2013

Coca-Cola Joint Development

- Customer acceptance of bio-renewables
- Long-term “Path to parity” with crude

Virent's BioFormate® Product





- Due to the high energy density of aromatics reformate materials are blended in to high performance gasoline to increase octane.

	Petroleum Reformate (Vol%)	Virent BioReformate Product (Vol%)
Paraffins	22.5	20.6
Naphthenes	0.7	3.9
Aromatics	60.8	64.4
Overall Totals	84.0	88.9
Typical RON	~95 - 105	105

Virent's Product in Scuderia Ferrari Race Fuel

Virent has provided fuel to Ferrari/Shell for the past 3 seasons

Virent's BioFormate® A renewable source of aromatics

- Reformate:
  - Primary source of the world's aromatics (Benzene, Toluene, and Xylenes) which are vital building blocks for modern polymer fibers.
  - Downward trending production due to shale gas and gasoline market dynamics leading to increase cost.
  - Aromatics processing infrastructure would be compatible with Virent reformate for the production of PET and other polyesters

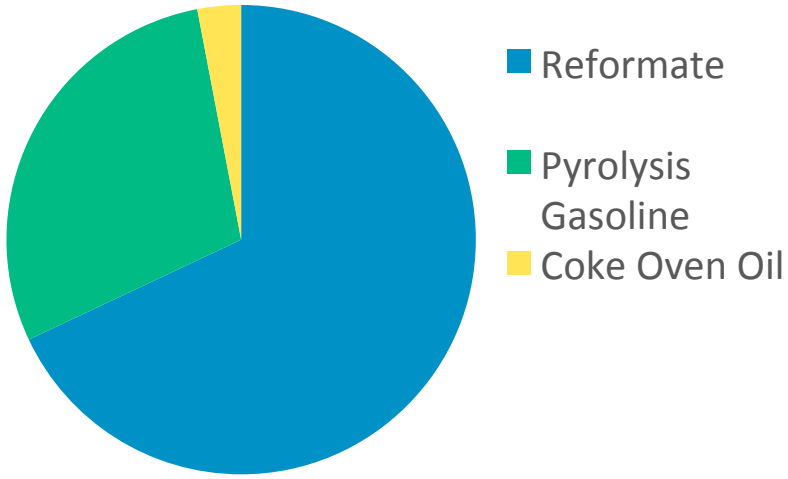
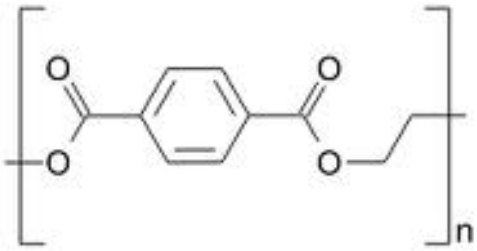
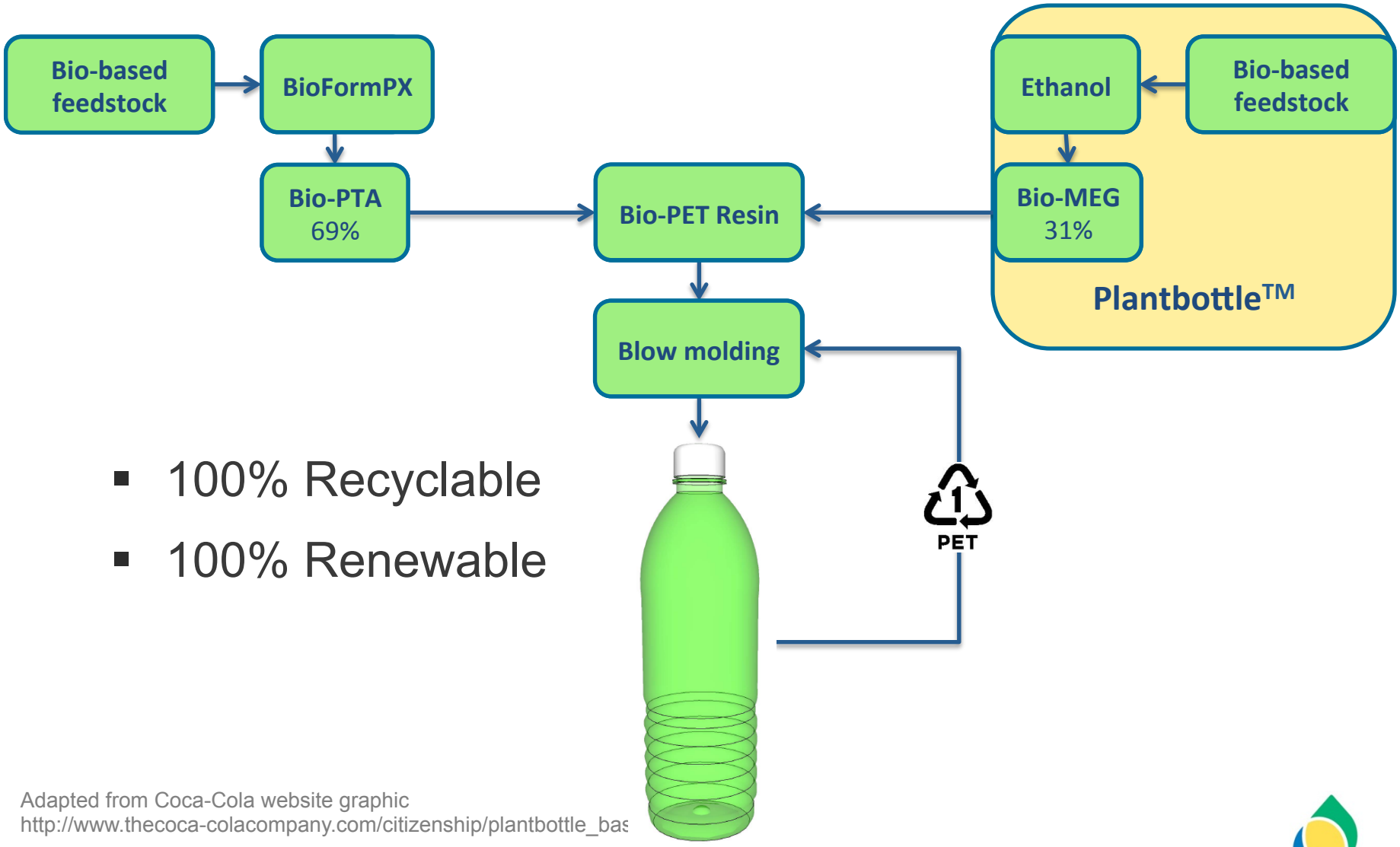


Figure: sources for aromatics.



Virent Enables 100% RR-PET



- 100% Recyclable
- 100% Renewable

Adapted from Coca-Cola website graphic
http://www.thecoca-colacompany.com/citizenship/plantbottle_bas

Chemicals Strategic Investors & Partners

Develop, deploy and commercialize at scale a renewable "petrochemical" platform that can utilize existing infrastructure

Feedstock Logistics	Conversion Platform	Deployment Opportunity	Customer Acceptance
Cargill	VIRENT	*In Progress*	Coca-Cola
▪ Major shareholder ▪ Participating in feedstock development and commercial deployment	▪ Platform Research & Development ▪ Technology provider ▪ Feedstock R&D ▪ Catalyst development ▪ Operations	▪ Development Partner ▪ In existing petrochem supply chain ▪ Scale-Up partner ▪ Market channels	▪ Demand and supply chain "pull-through" ▪ Strategic alignment on alternative feedstocks ▪ Support validation of final product

Major Distillate Projects

Shell Collaboration

- Distillate fuel production and process development
- Collaboration completed 06/2013

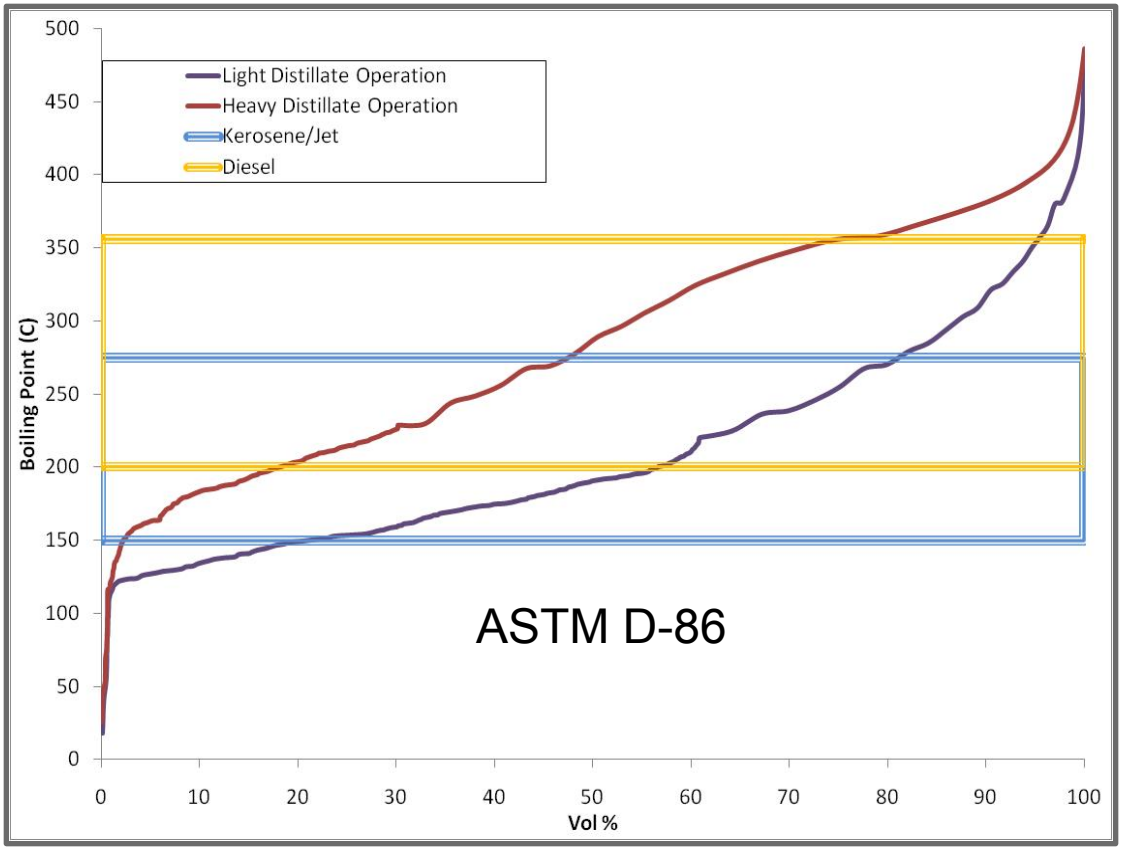
FAA Award

- Jet fuel production and qualification
- $1.5 MM Grant
- Project closeout 05/2013

DOE Award

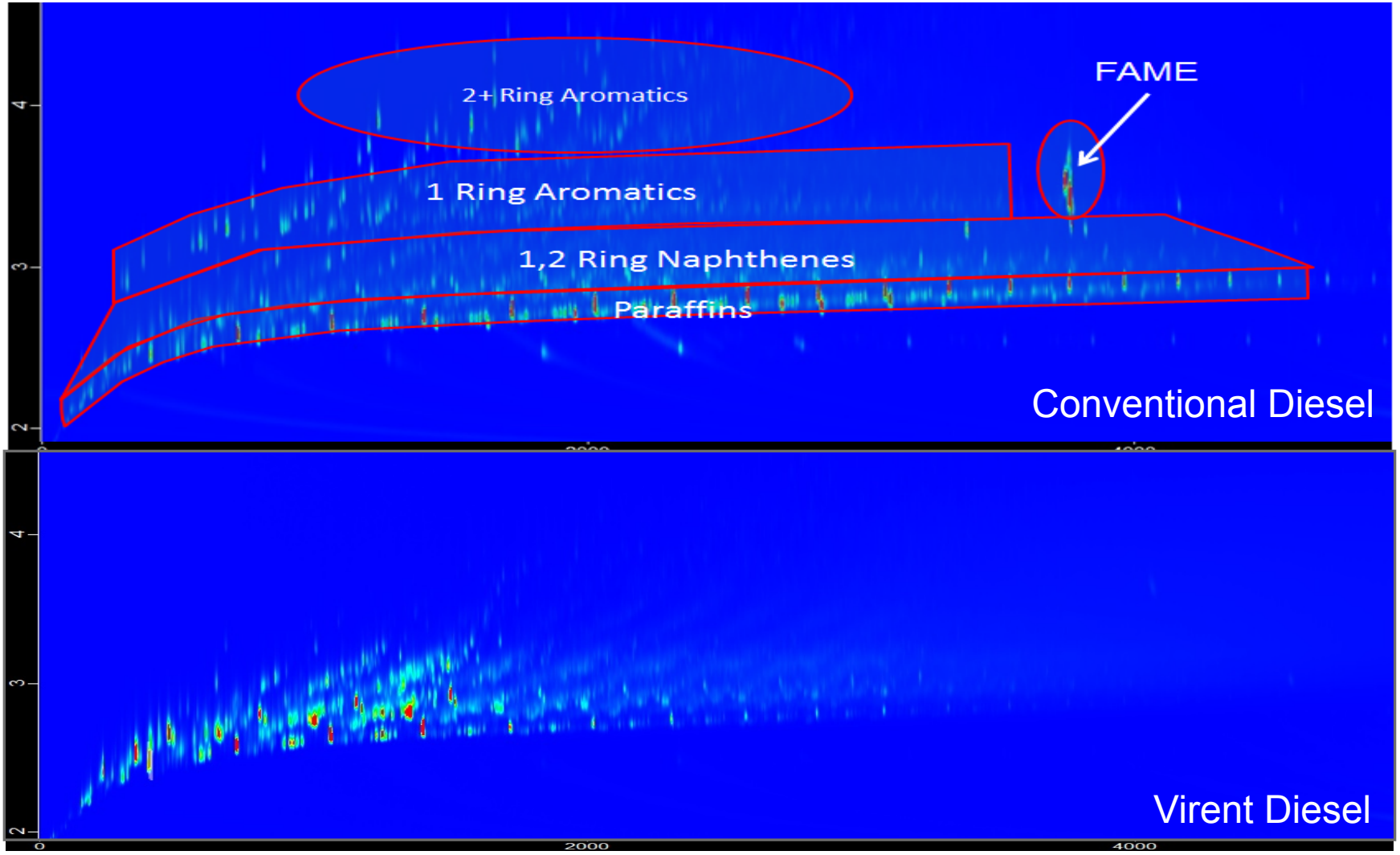
- Cellulosic sugars to jet fuel
- $13.4 MM Grant

Virent's Renewable Distillate



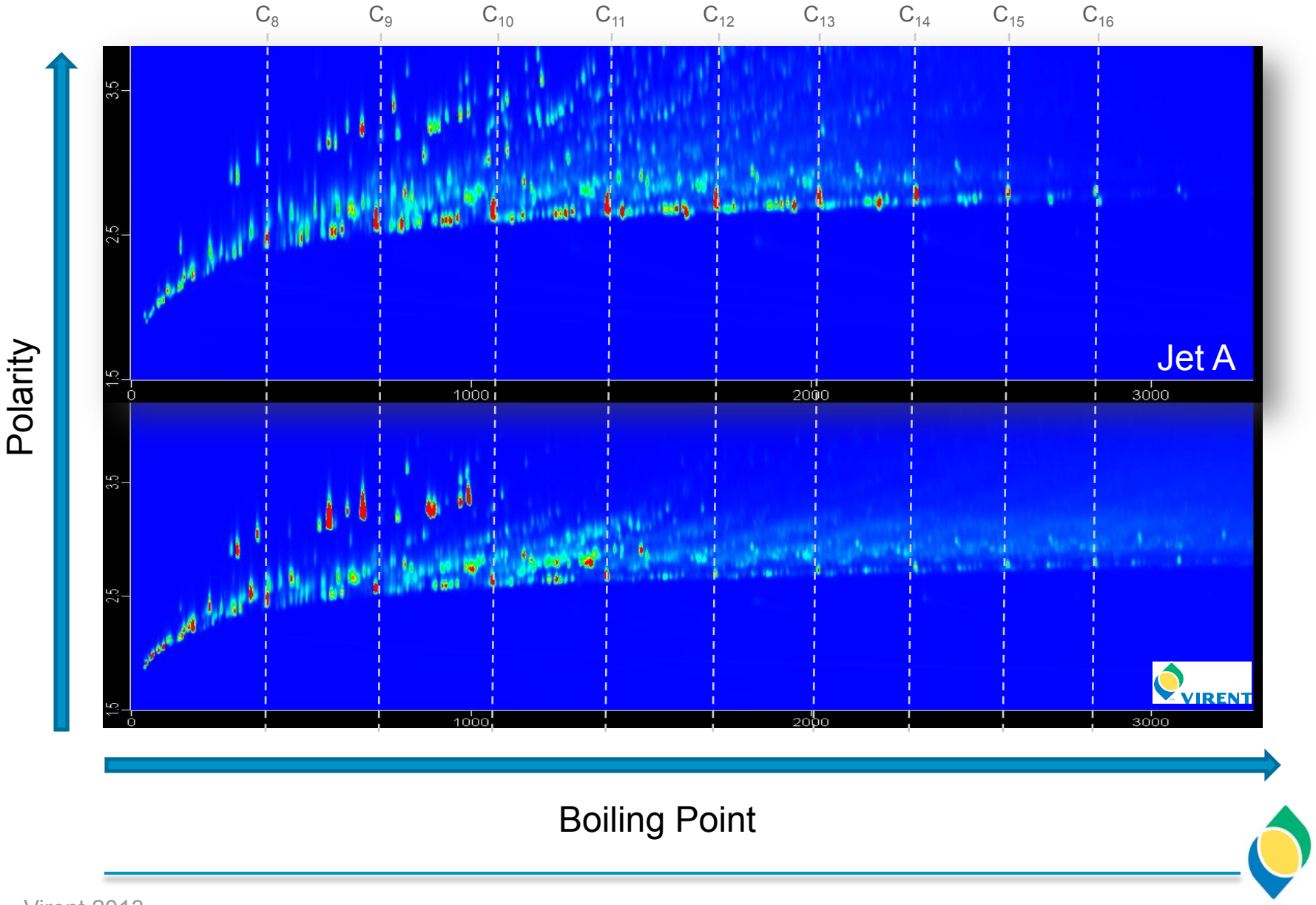
- Broad distribution of boiling points
  - Preferred over single components
- Tunable composition
  - Flexibility to maximize desired fuel

Virent Renewable Diesel Composition



***Polynuclear aromatics (2+ ring aromatics) increase particulate emissions**

Virent's Renewable Jet Composition



Jet Specification Evaluation Wright Patterson AFB

Specification Test	MIL-DTL-83133G Spec Requirement	JP-8	VIRENT
Physical and Chemical Properties			
Heat of Combustion (measured), MJ/Kg	≥42.8	43.3	43.3
Flash point, °C	≥38	51	40
Freeze Point, °C	≤-47	-50	<-60
Density @ 15°C, kg/L	0.775 - 0.840	0.804	0.805
Distillation			
10% recovered (T_{10}), °C	≤205	182	164
EP, °C	≤300	265	290
T_{90}-T_{10}, °C	≥22	62	86
Thermal Stability			
Temperature		260°C	325°C
Tube Deposit Rating	<3	1	1
Change in Pressure, mm Hg	≤25	2	0

Excellent freeze point and density due to unique Virent jet composition

High thermal stability ensures low levels of impurities

Thank you.

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VIRENT