

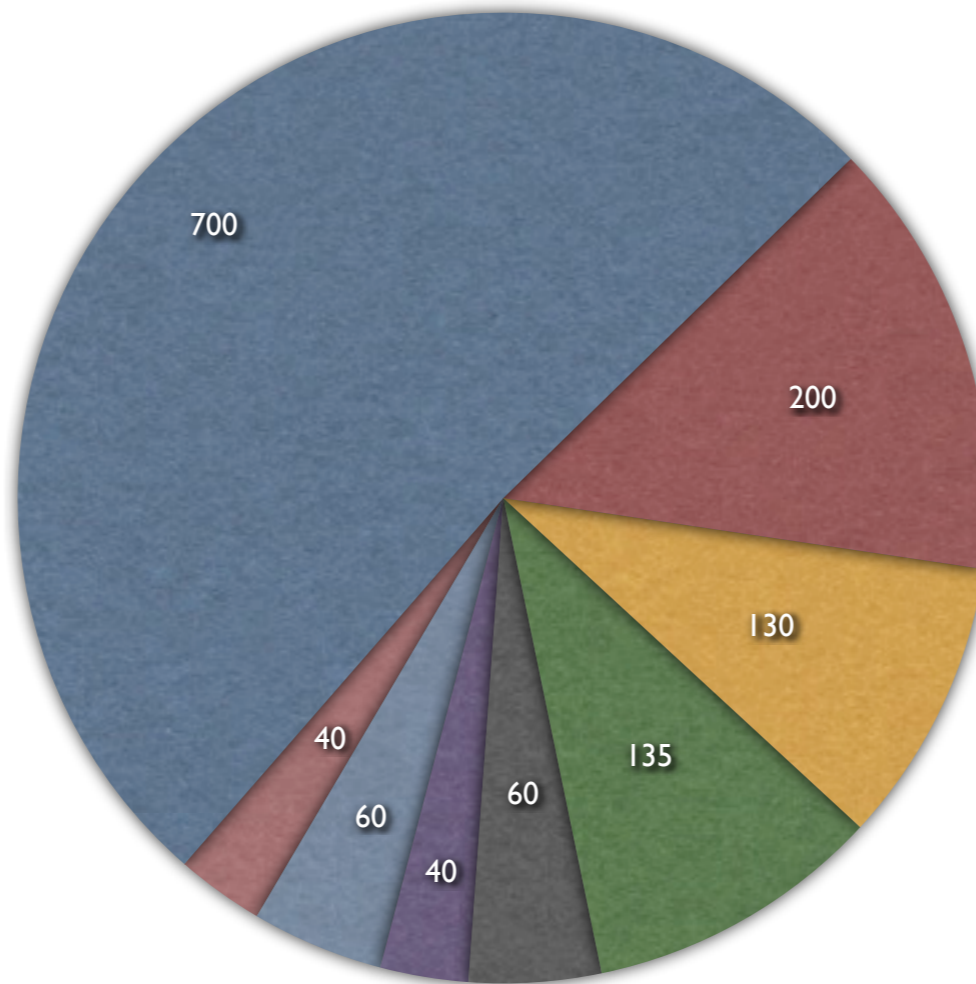
Advanced Biofuels and chemicals

The race for scale 2012-2025

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BiofuelsDigest
The world's most widely read biofuels daily

1300+ refineries by 2025



Number of biorefineries to meet existing targets (based on reference size of 50 million US gallons, 193 million litres)

- US
- EU
- China
- Other Asia-Pac
- Brazil
- India
- Other EMEA
- Other Americas

Source: *Biofuels Digest* : "Biofuels mandates around the world" July 2011

207+ Advanced Biofuels Projects In Development 2010-2015

19.7 billion litres in capacity

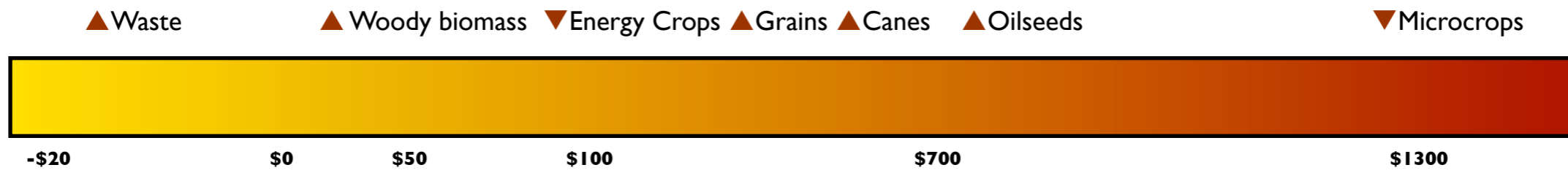
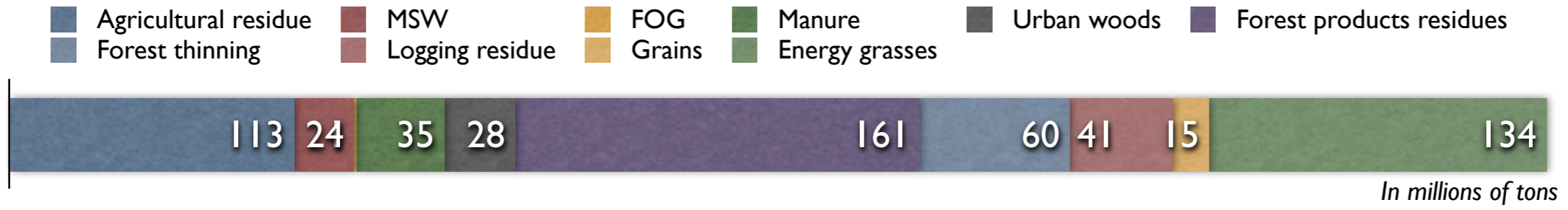
	2009	2010	2011	2012	2013	2014	2015	City	State	Country	Fuel	Technology	Feedstock(s)	RFS2 Category (US)
Abengoa	0.00	0.01	0.01	0.01	15.00	15.00	15.00	Hugoton	Kansas	USA	Ethanol	EH	Corn stover	Cellulosic biofuel
ADM	0.00	0.00	0.00	1.00	1.00	1.00	1.00	Decatur	Illinois	USA	Ethanol	EH	Stover	Cellulosic biofuel
AE Biofuels	0.01	0.02	0.05	10.04	10.05	10.05	10.05	Butte	Montana	USA	Ethanol	EH		Cellulosic biofuel
Algae.Tec	0.00	0.00	0.00	0.01	0.01	0.01	0.01		New South	Australia	Biodiesel	Algae transesterification	Algae	Cellulosic biofuel
Algenol - demonstration farm	0.01	0.10	0.10	0.10	0.10	0.10	0.10	Fl Myers	Florida	Mexico	Ethanol	Algae fermentation	Algae	Advanced Biofuel
Algenol - first commercial	0.00	0.00	0.00	0.00	0.00	250.00	750.00	Puerta Libertada	Sonora	Mexico	Ethanol	Algae fermentation	Algae	Advanced Biofuel
ATAr	0.00	0.00	0.00	100.00	100.00	100.00	100.00	Anacortes	Washington	USA	RDIF	Hydroprocessing	Camelina	Advanced Biofuel
American Process	0.00	0.00	0.00	0.47	0.47	0.47	0.47	Alpena	Michigan	USA	Biobutanol	EH		Advanced Biofuel
Amyris - pilot	0.01	0.01	0.01	0.01	0.01	0.01	0.01	Emeryville	California	USA	RDIF	CBP	Sugar	Advanced Biofuel
Amyris - 1st commercial	0.00	0.00	2.50	17.00	17.00	17.00	17.00	Paracicaba	Sao Paulo	Brazil	RDIF	CBP	Sugar	Advanced Biofuel
Amyris - 2nd commercial	0.00	0.00	0.00	0.00	27.00	27.00	27.00	Campinas	Sao Paulo	Brazil	RDIF	CBP	Sugar	Advanced Biofuel
Aquatic Energy	0.00	0.00	0.03	0.03	0.03	0.03	0.03		Louisiana	USA	Renewable oils	Algal oil extraction	Algae	Advanced Biofuel
Aurora Algae - pilot	0.01	0.01	0.01	0.50	0.50	0.50	0.50	Vero Beach	Florida	USA	Biodiesel	Algae transesterification	Algae	Biomass-based diesel
Aurora Algae - demonstration	0.00	0.00	0.02	0.02	0.02	0.02	0.02	Karratha	WA	Australia	Biodiesel	Algae transesterification	Algae	Biomass-based diesel
Avantium	0.00	0.00	0.01	0.01	0.01	0.01	0.01	Geleen	Netherlands	Netherlands	Furanics	Catalysis		
BARD	0.00	0.00	0.00	10.00	10.00	10.00	10.00	Augusta	Georgia	USA	Biodiesel	Algae transesterification	Algae	Biomass-based diesel
BioGasol	0.00	0.01	0.08	0.08	0.08	0.08	0.08	Ballerup		Denmark	Ethanol	EH	Mixed biomass	Cellulosic biofuel
BioFuel	0.00	0.00	0.00	0.02	0.02	0.02	0.02			France	RDIF			Advanced Biofuel
BioProcess Algae	0.00	0.00	0.01	0.01	0.01	0.01	0.01	Shenandoah	Iowa	USA	Biodiesel	Algae transesterification	Algae	Advanced biofuel
BlueFire Renewables	0.01	0.01	3.91	3.91	22.91	22.91	22.91	Lancaster	California	USA	Ethanol	AH	MSW	Cellulosic biofuel
Borregaard	0.00	0.00	0.00	0.11	0.11	0.11	0.11	Sarpsborg		Norway	Ethanol	EH	Mixed cellulosic resid	Cellulosic biofuel
BP Biofuels / Veropia	1.40	1.40	1.40	37.40	37.40	37.40	37.40	Jennings	Louisiana	USA	Ethanol	EH	Bagasse	Cellulosic biofuel
British Airways/Bolena	0.00	0.00	0.00	0.00	0.00	19.00	19.00	East London	Middlesex	UK	RDIF	FT	MSW	Cellulosic biofuel
Buckeye Technologies/University of Florida	0.00	0.00	0.01	0.01	0.01	0.01	0.01	Perry	Florida	USA	Ethanol	EH		Cellulosic biofuel
Butalco	0.01	0.01	0.01	0.01	0.01	0.01	0.01			Germany	Biobutanol			Cellulosic biofuel
Butamax	0.00	0.50	0.50	80.50	160.50	160.50	160.50	Hull		UK	Biobutanol	Fermentation	Corn	Cellulosic biofuel
Chempolis	0.00	0.00	1.20	3.70	3.70	3.70	3.70	Oulu		Finland	Ethanol		Ag, paper waste	Cellulosic biofuel
Chemrec - demonstration	0.00	0.00	0.58	0.58	0.58	0.58	0.58	Pitea		Sweden	BioDME	BLG	Black liquor	Advanced Biofuel
Chemrec - commercial	0.00	0.00	0.00	0.00	30.00	30.00	30.00	Onsaskidsvik		Sweden	BioDME	BLG	Black liquor	Advanced Biofuel
Chemtex	0.00	0.00	0.00	12.00	12.00	12.00	12.00			Italy	Ethanol	EH	Mixed biomass	Cellulosic biofuel
Choren	0.00	4.10	4.10	4.10	4.10	4.10	4.10	Frieburg		Germany	RDIF	FT		Advanced Biofuel
ClearFuel	0.00	0.00	0.07	0.07	0.07	0.07	0.07	Commerce City	Colorado	USA	Renewable diesel/je	Steam reform/FT	Woodwaste/bagasse	Advanced Biofuel
ClearFuel	0.00	0.00	0.00	0.00	0.00	20.00	20.00	Collinswood	Tennessee	USA	Renewable diesel/je	Steam reform/FT	Woodwaste	Advanced Biofuel
ClearFuel	0.00	0.00	0.00	0.00	0.00	0.00	18.00		Hawaii	USA	Renewable diesel	Steam reform/FT	Bagasse/cane trash	Advanced Biofuel
Cobalt -pilot	0.01	0.01	0.01	0.01	0.01	0.01	0.01	Sausalito	California	USA	Biobutanol	Fermentation	Corn	Cellulosic biofuel
COFCO/Sinopec	0.00	0.00	3.00	3.00	3.00	3.00	3.00			China	Ethanol	EH	Corn stover	Cellulosic biofuel
CORE Biofuel	0.00	0.00	0.00	4.40	17.80	17.80	17.80	Houston	B.C.	Canada	Gasoline	Gasification	Wood Waste	
Coskata	0.05	0.05	0.05	55.05	55.05	55.05	55.05	TBD	Alabama	USA	Ethanol	Gasification	Multi-feedstock	Cellulosic biofuel
DOCE	0.00	0.25	0.25	0.25	0.25	25.00	25.00		Iowa	USA	Ethanol	EH	Corn cob	Cellulosic biofuel
DOCE	0.00	0.25	0.25	0.25	0.25	25.25	25.25	Vonore	Tennessee	USA	Ethanol	EH	Corn cob	Cellulosic biofuel
Diamond Green	0.00	0.00	0.00	137.00	137.00	137.00	137.00	Norco	Louisiana	USA	Renewable diesel	Hydroprocessing	Animal residue	Advanced biofuel
Dupont-BAL	0.00	0.00	0.00	0.01	0.01	0.01	0.01				Biobutanol		Macroalgae	Cellulosic biofuel
Dynamic Fuels	0.00	75.00	75.00	75.00	75.00	75.00	75.00	Geismar	Louisiana	USA	Renewable diesel	FT	Animal wastes	Advanced Biofuel
Dynatome	0.01	1.01	1.01	1.01	1.01	1.01	1.01	West Lorne	BC	Canada	Bio-oil	Pyrolysis		Advanced Biofuel
Enerkem	1.30	1.30	11.30	11.30	21.30	21.30	21.30		Quebec	Canada	Ethanol	Gasification		Cellulosic biofuel
ENN	0.01	0.01	0.01	0.01	0.01	0.01	0.01	TBD			Biodiesel	Algae transesterification		Biomass-based diesel
Ensyn	0.00	0.00	0.00	0.00	0.00	0.00	316.00	TBD		Malaysia	RDIF	Fast pyrolysis	Pal waste	
Fiberight	0.00	0.01	0.01	6.00	6.00	6.00	6.00	Blainstown	Iowa	USA	Ethanol	EH	MSW	Cellulosic biofuel
Fulcrum	0.01	0.01	0.01	10.51	10.51	10.51	10.51		California	USA	Ethanol	Gasification		Cellulosic biofuel
Gevo	1.00	1.00	1.00	16.00	300.00	300.00	300.00	St Joseph	Missouri	USA	Biobutanol	Fermentation		Advanced Biofuel
Greenfield Ethanol	0.00	0.00	0.01	0.01	0.01	0.01	0.01	Chatham	Ontario	Canada	Ethanol	EH		Cellulosic biofuel
Green Star Products	0.00	0.00	0.00	2.00	2.00	2.00	2.00	TBD		USA	Biodiesel	Algae transesterification	Algae	Advanced Biofuel
Haldor Topsoe	0.00	0.00	0.00	0.80	0.80	0.80	0.80	TBD		USA	Ethanol	EH		Cellulosic biofuel

source: Advanced Biofuels Project database v2.04 (Biofuels Digest)

The inflection point

- Credit worthy feedstock supplier, 15 year terms, US\$50/tonne (cellulosic) \$0.15 per pound (renewable sugars)
- Demonstration of technology at scale
- Credit worthy offtake partner, 10-15 years
- Parity with \$80 oil, unsubsidized, on comparable BTUs

Feedstocks: What's hot, what's not



- | | |
|-----------------|---|
| ▲ Waste | ▲ Enerkem, INEOS Bio, Bluefire, POET, Envergent |
| ▲ Woody biomass | ▲ Coskata, Mascoma |
| ▼ Energy Crops | ▼ DDCE, Ceres, Mendel, Codexis |
| ▲ Grains | ▲ Gevo, Cobalt |
| ▲ Canes | ▲ Raizen, Codexis, Amyris, Virent, |
| ▲ Oilseeds | ▲ SG Biofuels |
| ▼ Microcrops | ▼ Sapphire Energy, Solazyme, Phycal |

Source: USDA Biofuels Report June 2010

Projects to watch in 2012-13

Project	Year	Capacity	Location	Country	Feedstock	Technology	Product(s)
Solazyme-Roquette	2012	2	Lestrem	France	Sugar	Algal fermentation	Renewable oils
INEOS Bio	2012	8	Florida	USA	MSW, ag waste	Syngas fermentation	Ethanol
Gevo	2012	16	Minnesota	USA	Corn starch	Fermentation	Isobutanol
Beta Renewables	2012	13	Crescentino	Italy	Ag waste	Fermentation	Ethanol
Enerkem	2012	10	Alberta	Canada	MSW	Thermocatalytic	Ethanol
DSM-Roquette	2012	10	Cassano Spin	Italy	Mixed cellulosic	Yeast fermentation	Succinic acid
KIOR	2012	62	Mississippi	USA	Wood	Pyrolysis	Diesel, jet
Diamond Green Diesel	2012	137	Louisiana	USA	Animal residue	Hydrotreating	Diesel, jet
BP Biofuels	2012	36	Florida	USA	Mixed cellulosic	Enzymatic hydrolysis	Ethanol
COFCO	2013	15	Hei Long Jian	China	Mixed cellulosic	Enzymatic hydrolysis	Ethanol
Fiberight	2013	6	Iowa	USA	Mixed cellulosic	Enzymatic hydrolysis	Ethanol
POET Project Liberty	2013	25	Iowa	USA	Mixed cellulosic	Enzymatic hydrolysis	Ethanol
Abengoa Bioenergy	2013	25	Kansas	USA	Mixed cellulosic	Enzymatic hydrolysis	Ethanol
Dupont Cellulosic Et	2013	25	Iowa	USA	Mixed cellulosic	Enzymatic hydrolysis	Ethanol
Elevance	2013	80	Mississippi	USA	Mixed veggie oil	Olefin metathesis	Specialty chemicals
Gevo	2013	37	South Dakota	USA	Corn Starch	Fermentation	Isobutanol
Cool Planet	2013	4	California	USA	Miscanthus	Biomass fractionation	Gasoline
LanzaTech	2013	40	Shanghai	China	Industrial waste gas	Syngas fermentation	Ethanol
Fulcrum Bioenergy	2013	10	Nevada	USA	MSW	Thermocatalytic	Ethanol
LS9	2013	2	Florida	USA	Sugar	Fermentation	Diesel, fatty alcohols
Mascoma	2013	20	Michigan	USA	Wood	Consolidate bioproc	Ethanol
Coskata	2013	55	Alabama	USA	Wood	Syngas fermentation	Ethanol
Joule Unlimited	2013	18	New Mexico	USA	CO2, water	Heliocconversion	Ethanol, diesel