



Exceeding Transportation GHG Reduction Targets through 2020

What does success look like?

A greater than 10% reduction in GHG emissions can occur by 2020 through a combination of:

- Efficiency: Reduced demand for transportation fuels due to more efficient vehicles and reduced vehicle miles traveled.
- Alternative vehicles: Meaningful number of alternative fuel vehicles, including electric, natural gas and hydrogen
- Low Carbon fuels
 - Reduced carbon ethanol
 - Significant growth of biodiesel from non-food sources
 - Renewable gasoline/diesel from non-food sources at scale
- More competition: Expanded and distributed fuel generation brings new players into the market, drives more competitive fuel prices

Parallel paths that phase in by 2020

There are four parallel strategies to reduce transportation fuel emissions:

1. Alternative vehicles will be integrated slowly as the fleet turns over. These vehicles are important long term, with investment needed today.
2. Existing biofuels, like ethanol provide immediate reduction opportunities. The carbon content of these fuels can be reduced for longer term reductions.
3. Biodiesel can be used immediately and includes low carbon options that provide long-term benefits.
4. Renewable “drop-in” fuel projects are beginning commercial capacity and will be significant in last few years of the LCFS target.

Biofuels today

In the next four years, GHG reductions will primarily come from improvements in ethanol and significant growth in the use of biodiesel made from reprocessed, waste oils.

Ethanol in gasoline vehicles is limited long term because vehicles and pipelines have a blend cap at 10%. Cellulosic ethanol has a lower carbon content than corn-based counterparts, and can lower greenhouse gas emissions by up to 40% compared to gasoline.¹ Significant investment has gone into these fuels and some projects are achieving completion beginning this year. The table on the left lists known cellulosic projects coming on-line in this year through 2015.

Bridge Fuels

Biodiesel existing capacity can produce significant quantities of fuel for use in diesel vehicles. Biodiesel is limited long term because most vehicle warranties are limited to 5% - 20% blend caps.

Cellulosic Ethanol Projects		
	Capacity (million gal)	Year Operating
Amer Process	1	2013
INEOs	8	2013
DuPont	27	2013
Abengoa	25	2013
Fiberight	3	2013
BlueFire	19	2014
POET	25	2014
Beta Renewables	20	2014
ZeaChem	25	2014
Enerkem	10	2014
Fulcrum	10	2015
LanzaTech	20	2015
Mascoma	40	2015
Aemetis	11	2015
US Envirofuels	36	2015
TOTAL	280	

Amended from 2012 E2 Market Report, Appendix B

¹ http://www.arb.ca.gov/fuels/lcfs/lu_tables_11282012.pdf

These limitations do not come into effect in the next four years. Biodiesel will play a primary role for diesel compliance, with 564 million gallons of non-food based biodiesel produced in 2012.² EPA projections indicate this number will reach two billion gallons by 2022.³

Renewable gasoline & diesel

Drop-in fuels (renewable gasoline & renewable diesel) can work in existing vehicles and existing infrastructure, thereby requiring no change in vehicles or infrastructure for replacing petroleum. All other solutions require changes to vehicles or infrastructure. There were 75 million gallons of drop-in fuels produced in the U.S. in 2012 and we project this to remain stable in 2013. In addition to this 75 million gallons, there are 6 projects we have identified that may be on-line by 2015 totaling 312 million gallons by 2015.⁴ Drop-in fuels made from non-food feedstocks are key to meeting GHG reductions in 2017-2020.

Company	Capacity (million gal)	Year Operating
Dynamic Fuels	75	2010
KiOR	11	2013
Cool Planet	2	2013
Diamond Green	140	2014
Sapphire	1	2014
KiOR	33	2015
Sundrop	50	2015
TOTAL	312	

Amended from 2012 E2 Market Report, Appendix B

Local and Refinery Scale biofuels

Local scale biofuel refineries are designed to process biomass that already exists in a 50 mile radius or can be economically rotated into local agriculture. Refinery output is typically under 10 MG but could be as high as 40 MG. They are scaled to operate year-round based by securing long term contracts for local biomass. Because they produced finished product, they are ideal for being sold into local fleets and avoid the overhead of existing distribution racks. Projects like CoolPlanet Biofuels are working to launch mobile, small scale facilities.

Local scale facilities provide new rural economic opportunities. Mendota Sugar Beet Cooperative, based near Fresno, will grow sugar beets on a crop rotation basis to produce 40 million gallons of ethanol.⁵ Such projects have significant rural income opportunities, for example, Abengoa will pay local farmers \$17 million/year for biomass.⁶

Refinery scale biofuel such as bio-crude is designed for large volume and delivered to existing or new refineries and processed as sweet crude oil. These operations require large amounts of continuously available biomass and consequently are unlikely to be located in California. Sapphire Energy, based in San Diego, is producing green crude from algae in a New Mexico facility. This is at demonstration scale today with testing on commercial production.

Summary

Overachievement of GHG targets from transportation is achievable and likely under current regulations. Achievement will not be met through business-as-usual practices in the next seven years but rather through the growth of many smaller scale, local refineries supplying fuel for existing vehicles coupled with the development of alternative fuel vehicles.

² <http://www.e2.org/ext/doc/E2AdvancedBiofuelMarketReport2012.pdf>, Page 6 and Appendix A

³ Kruse, John. "Biodiesel Production Prospects for the Next Decade." IHS Global Insight Report. March 2011.

⁴ <http://www.e2.org/ext/doc/E2AdvancedBiofuelMarketReport2012.pdf>, Appendix B

⁵ <http://www.fresnobee.com/2013/02/28/3193086/mendota-bioenergy-beet-plant-gets.html>

⁶ http://www.abengoabioenergy.com/web/en/prensa/noticias/historico/2012/bio_20121113_2.html