

MARKET DRIVERS FOR BIOFUELS

U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



**3rd Annual MSW to Biofuels
Summit, Orlando, FL**

February 20-21, 2013

Brian Duff
Chief Engineer
Bioenergy Technologies Office

- **Mission of the DOE Bioenergy Technologies Office (BETO)**
- **The Potential of Biomass**
- **Market Drivers for Biofuels**
- **Overview of RINS**

Mission of the DOE Bioenergy Technologies Office *

*(no longer the Office of the Biomass Program)

Advancing Presidential Objectives

- **Science & Discovery**
- **Economic Prosperity**
- **Climate Change**
- **Clean, Secure Energy**



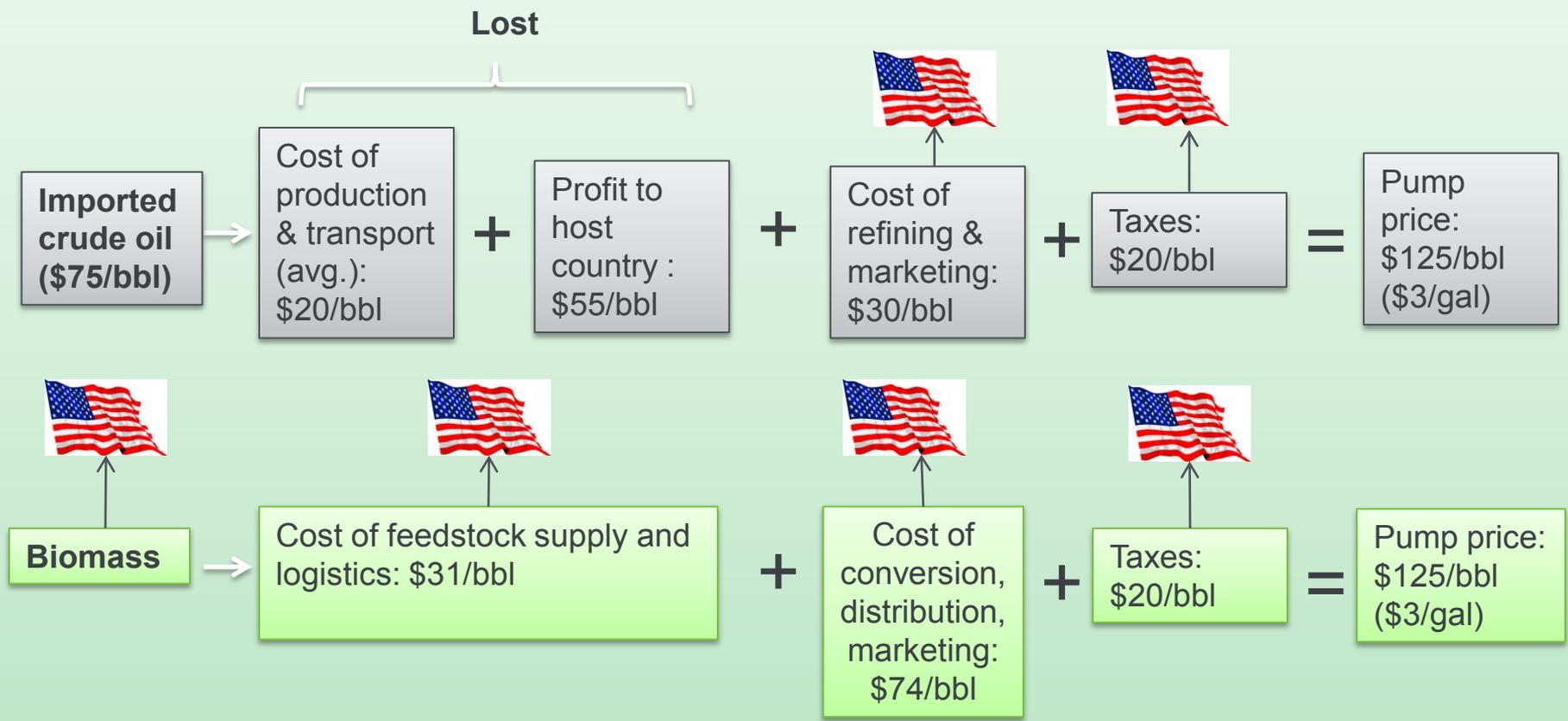
Key Tenets of the Office of Energy Efficiency and Renewable Energy Strategic Plan:

- Dramatically reduce dependence on foreign oil
- Promote the use of diverse, domestic and sustainable energy resources
- Establish a domestic bioindustry
- Reduce carbon emissions from energy production and consumption



The Potential of Biomass for Fuels, Chemicals and Power

Capturing the Value of Biofuels



Price differential between *imported* crude oil vs *domestic* biomass:
 $\$75/\text{bbl} \times 4.3 \times 10^9 \text{ barrels/year} = \323 billion/year

Sources: EIA, Annual Energy Review
 BETO MYPP

Cost of Oil imports.....is equivalent to.....EVERY YEAR! (2010)



\$300 B \approx 2 x Apollo Space Program



\$135 B \approx 5 x Three Gorges Dam



\$300 B \approx 20 x Chunnel



All costs in US\$2011

Sources: IEA, WhatItCosts.com, Wikipedia, CFO.com Magazine, USInflationCalculator.com

Power Potential:

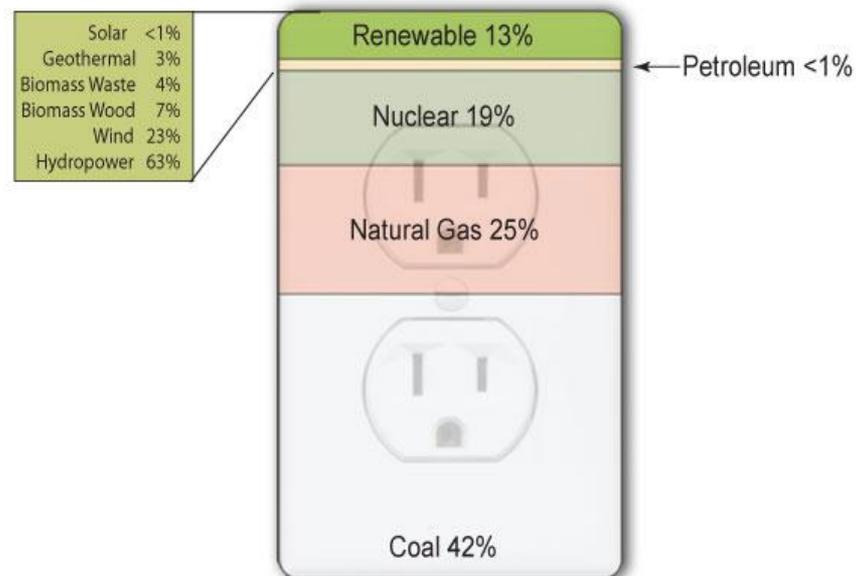
- Electrical Capacity in the US is ~985 GW
- Renewable Energy currently contributes ~125 GW (~13%)
- Hydro is ~78 GW (63% of RE; ~8% of total)
- Biomass (waste and wood) is currently ~13 GW (11% of RE; 1.3% of total)
- 1 billion tons of biomass is ~50 GW of potential; ~5% of total

Fuels Potential

- US currently uses ~212 billion gallons of liquid fuels in 2011
- 1 billion tons of biomass is ~65 billion gallons of potential (~30% of total)

Best use of biomass is for fuels and chemicals

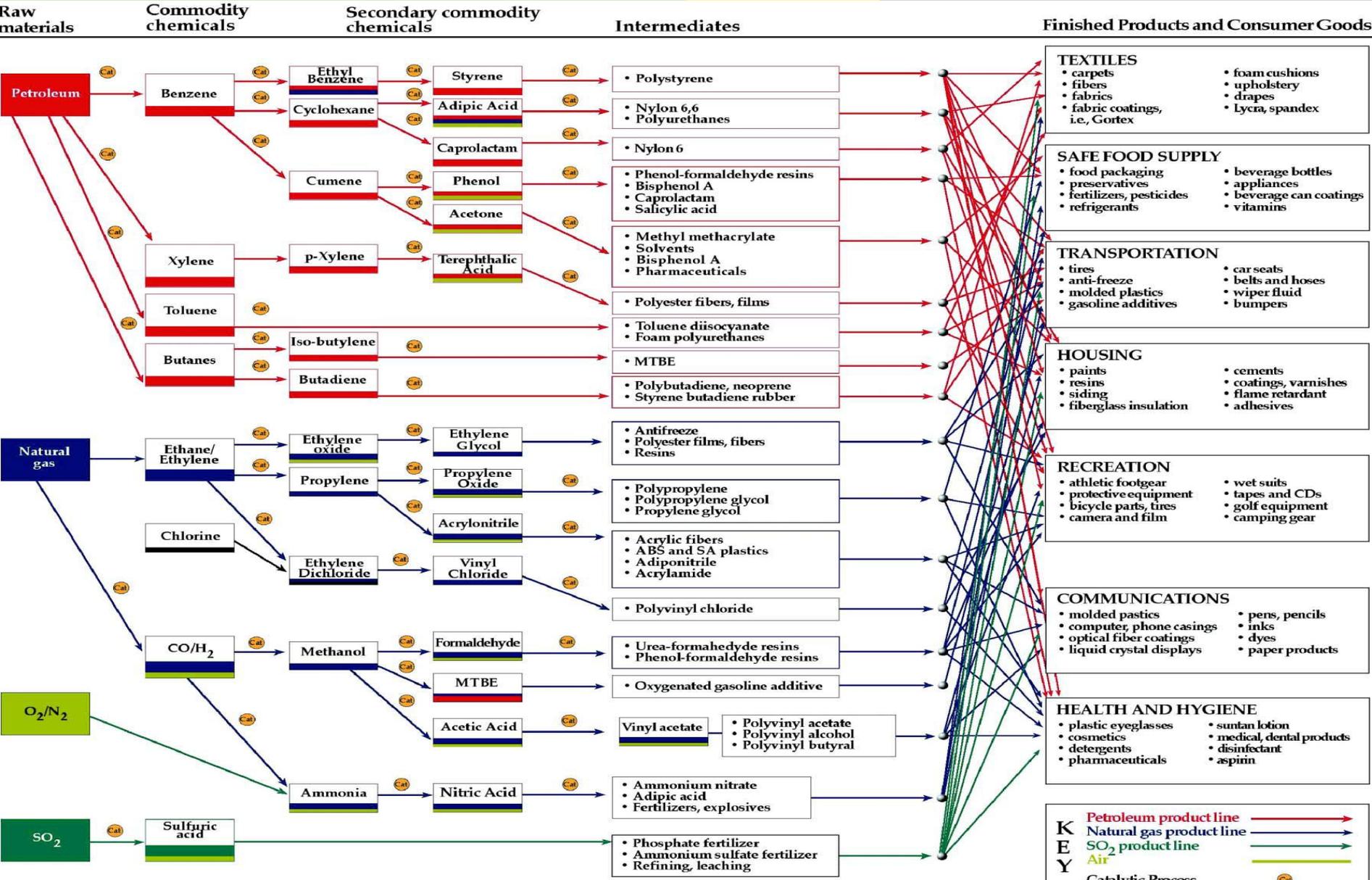
Sources of Electricity Generation, 2011



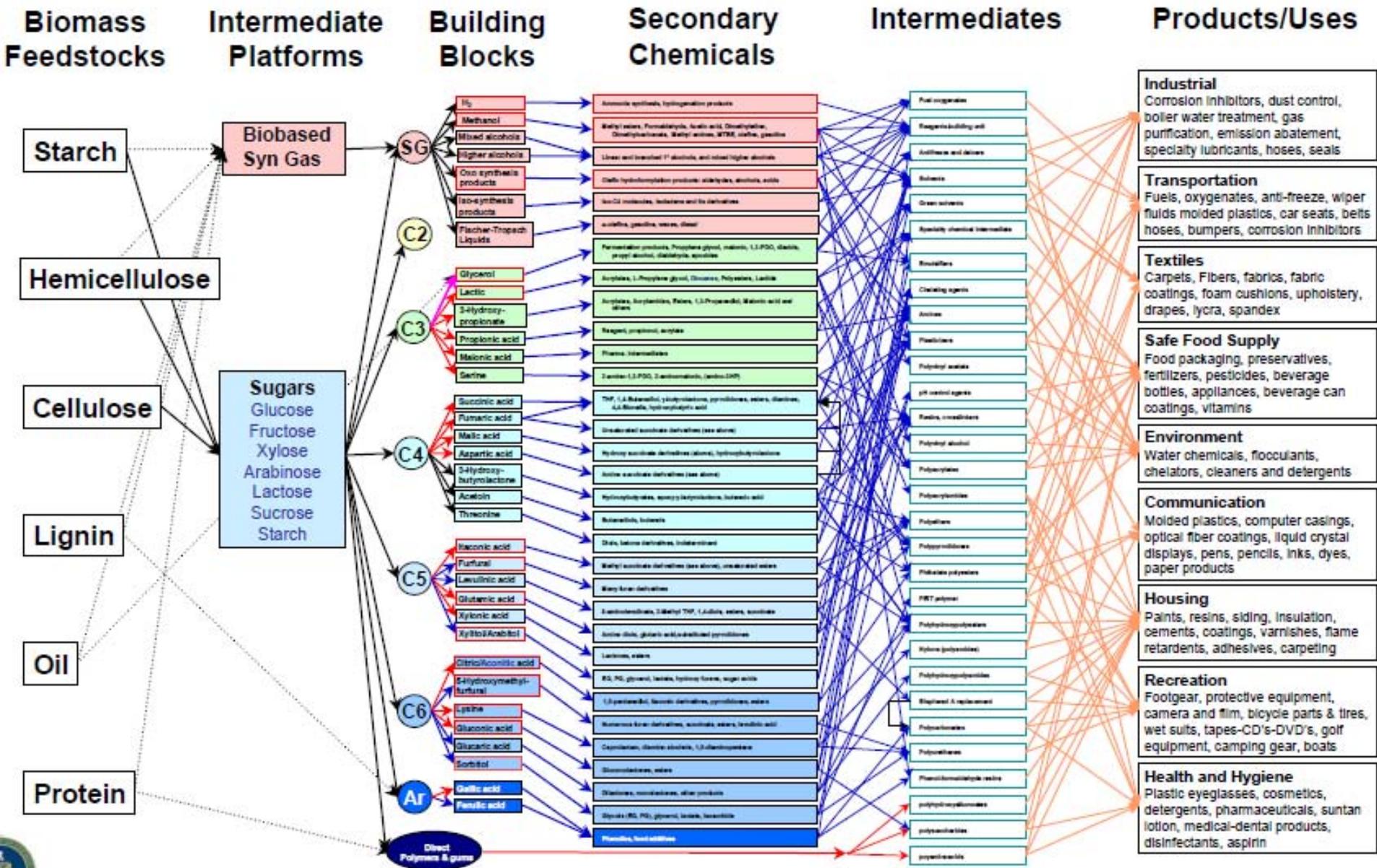
Note: Includes utility-scale generation only. Excludes most customer-sited generation, for example, residential and commercial rooftop solar installations

Source: U.S. Energy Information Administration, *Electric Power Monthly* (March 2012). Percentages based on Table 1.1, preliminary 2011 data.

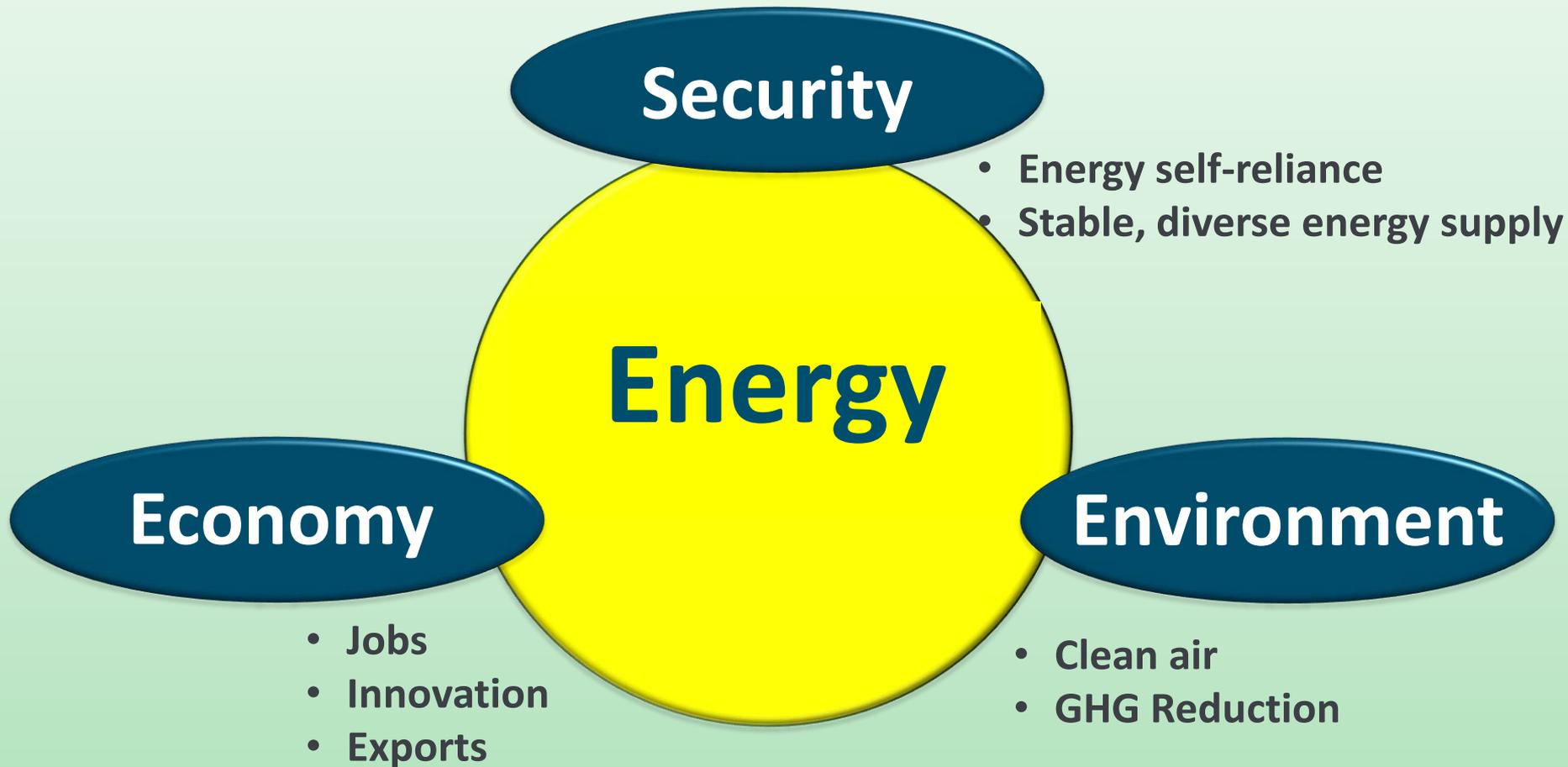
Products from Petroleum



Potential Products from Biomass



Market Drivers for Biofuels



Energy links the major global challenges

- **EPAct 2005** – The Energy Policy Act of 2005 (EPAct, P.L. 109-58) First established a Renewable Fuel Standard (RFS1)
- **EISA 2007** – The Energy Independence and Security Act of 2007 (EISA, P.L. 110-140) (RFS2) Superseded and expanded RFS1

One Hundred Tenth Congress
of the
United States of America

AT THE FIRST SESSION

*Begun and held at the City of Washington on Thursday,
the fourth day of January, two thousand and seven*

An Act

To move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the Federal Government, and for other purposes.

*Be it enacted by the Senate and House of Representatives of
the United States of America in Congress assembled,*

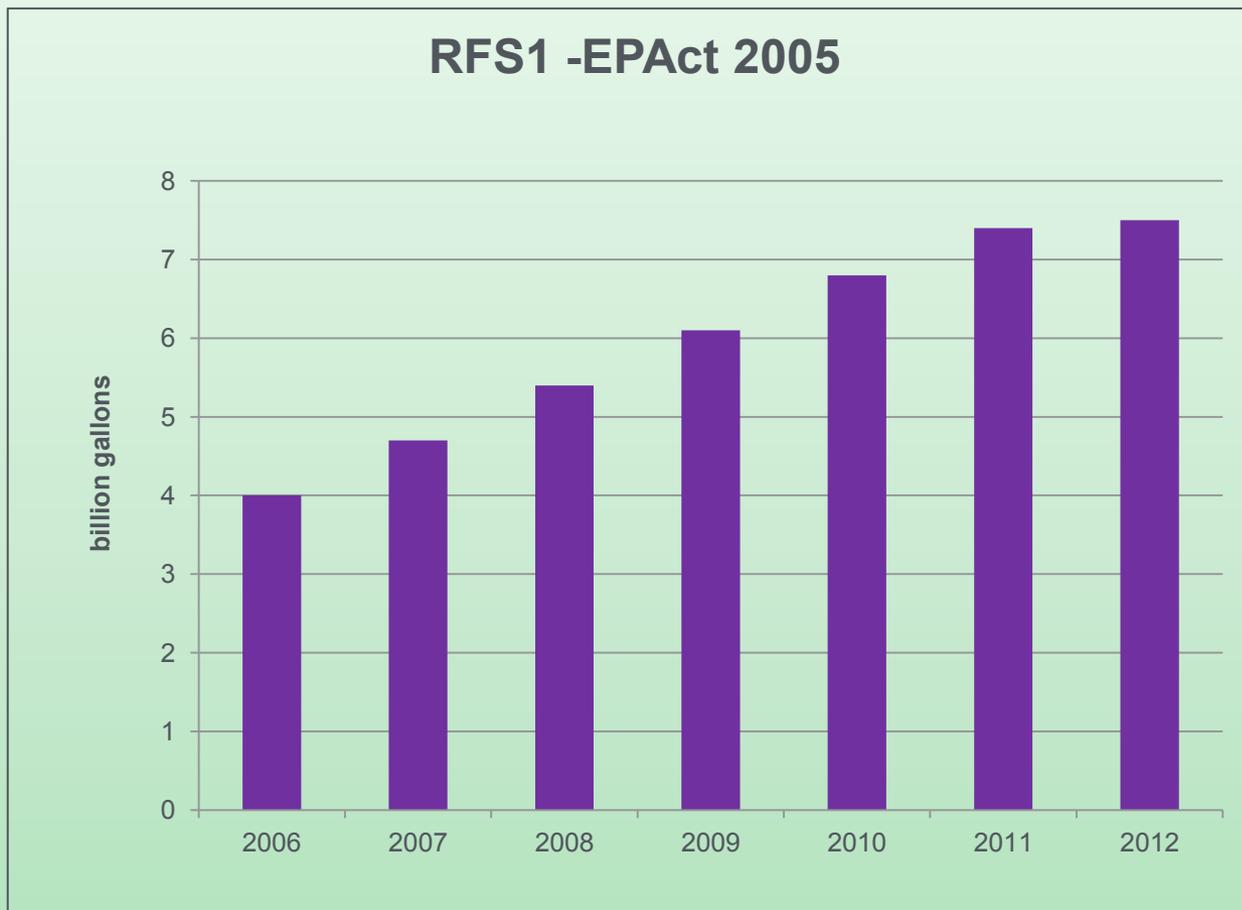
SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

(a) **SHORT TITLE.**—This Act may be cited as the “Energy Independence and Security Act of 2007”.

EPAAct 2005 “RFS1”:

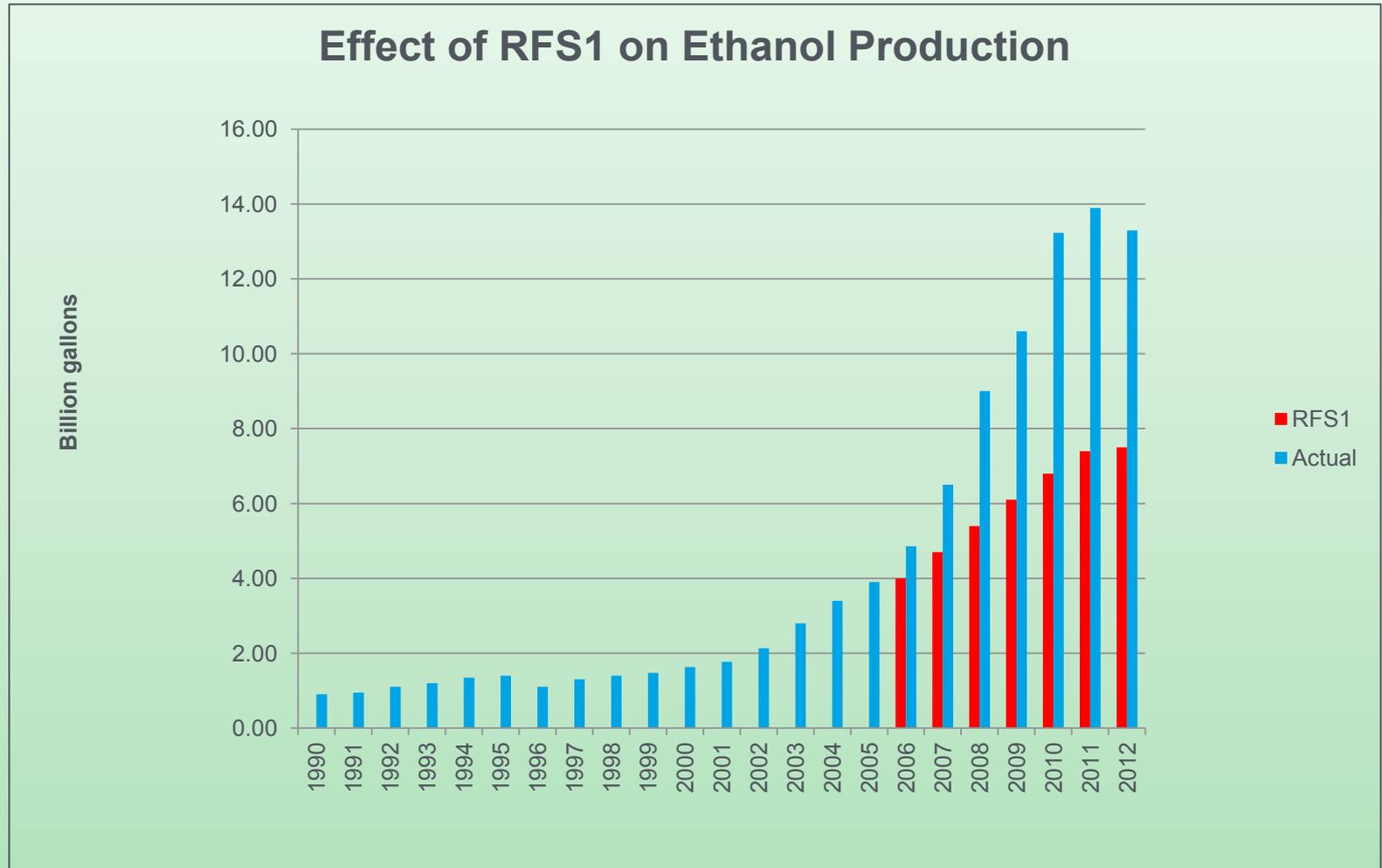
- Established a national standard and general definition for renewable fuels
- Mandated a minimum of 4 billion gallons in the nation’s gasoline supply in 2006
- Full Implementation at 7.5 billion gallons by 2012
- Obligation based on gasoline – on-road only
- 250 million gallons of cellulosic biofuels
- Different qualification for cellulosic fuel - 2.5 Credits (RINs) per gallon of ethanol

EPAct: RFS1 Mandated Biofuel Targets



EPA Act: It Worked

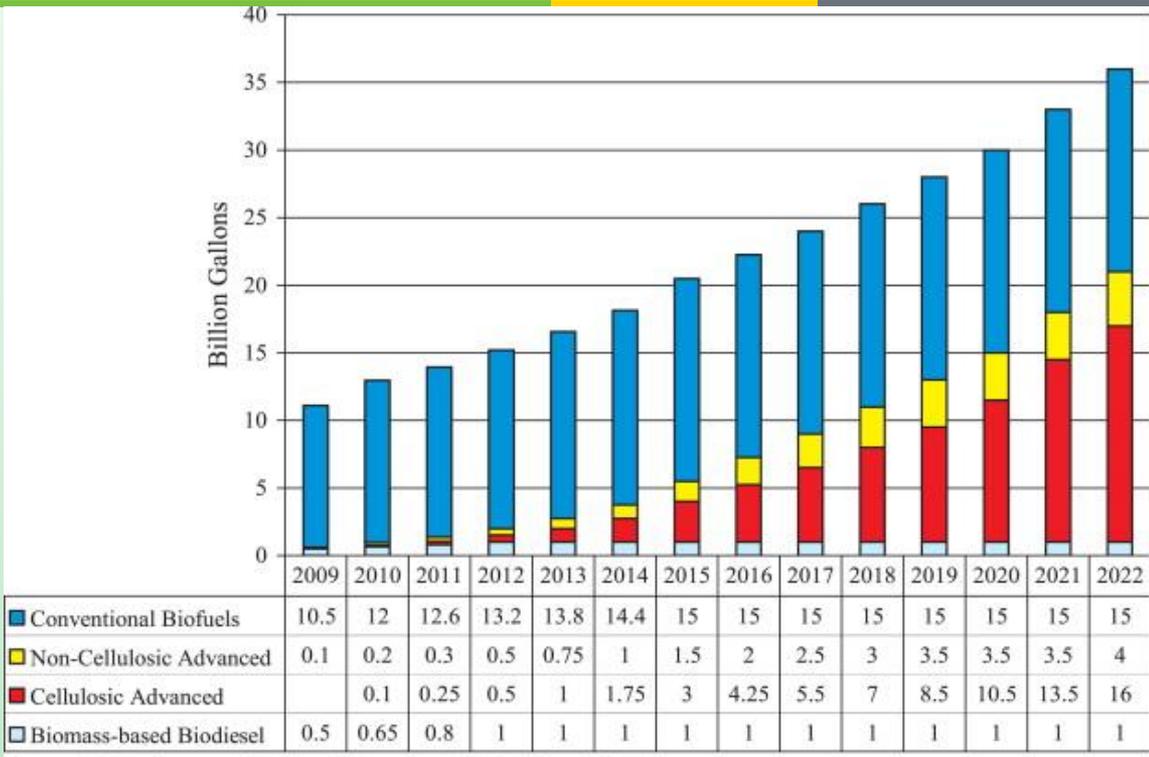
RFS1 Stimulated the Ethanol Industry



EISA 2007 RFS2:

- Superseded RFS1 and expanded the mandate to 36 billion gallons by 2022.
- Established 4 categories of renewable fuels based on GHG reductions
- Expanded to on and off-road gasoline and diesel
- Inclusion of specific types of waivers
- Expanded definitions to include Home Heating Oil and Jet Fuel

EISA: RFS2 Mandated Biofuel Targets



Source: US Environmental Protection Agency (EPA), February 2010

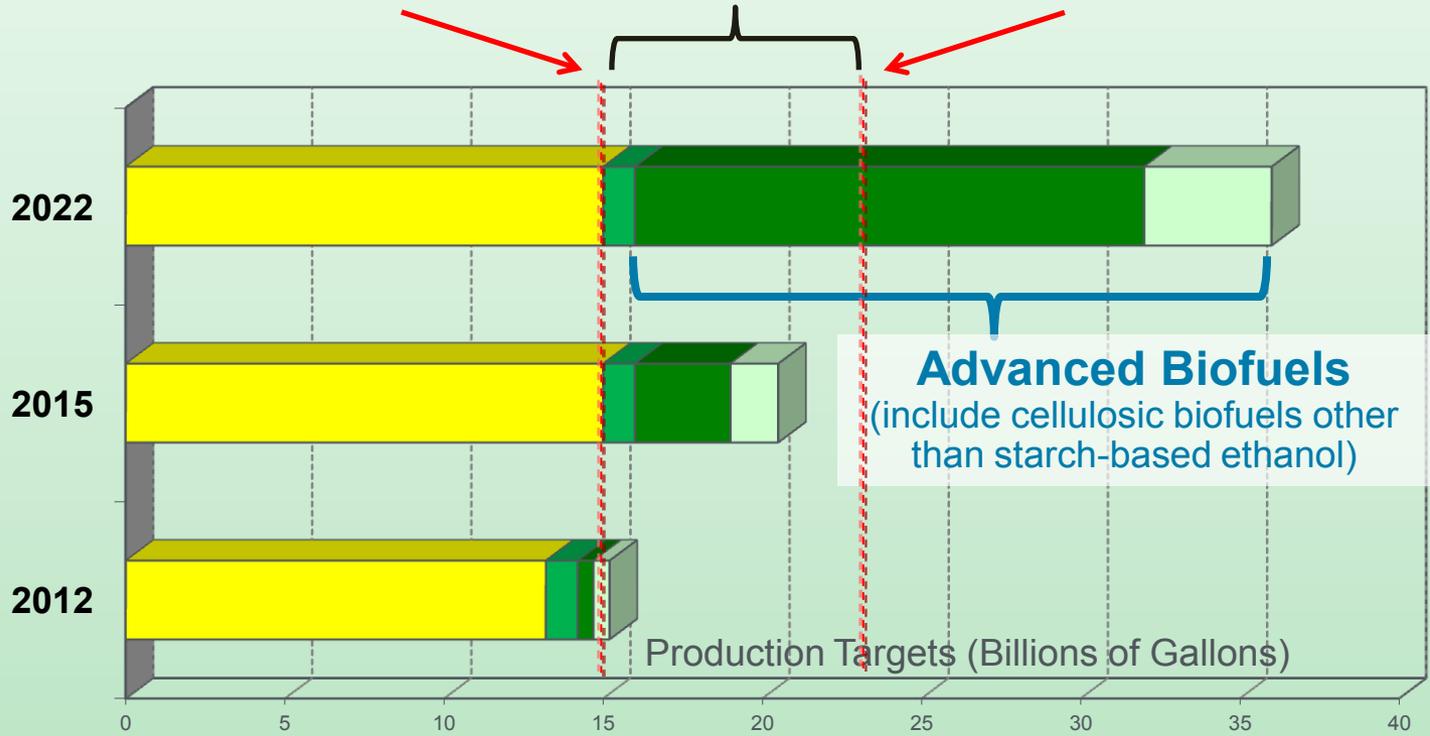
Renewable Fuel Standard (RFS2)

- Conventional (Starch) Biofuels
- Cellulosic Biofuels
- Biomass-based diesel
- Other Advanced Biofuels

Lifecycle GHG reduction comparisons are based on a 2005 petroleum baseline as required by EISA

EISA: Effect of E15 Waiver on the "Blendwall"

The E10 "Blendwall": 15 BGY Cap on Corn Ethanol *~100 New Starch Plants* *The E15 Waiver: 22.5 bgy*



Renewable Fuel Standard (RFS2)

- Conventional (Starch) Biofuels
- Biomass-based diesel
- Cellulosic Biofuels
- Other Advanced Biofuels

The Department of Defense



Market Driver:

DoD: 5 billion gallons per year

- The DOD uses some 300,000 barrels of oil a day (~5 billion gallons per year). This is 80% of the federal government's total fuel usage.
- DOD uses petroleum for 77% of all of its energy. ²
- Aviation fuel accounted for 56% of DOD's energy consumption in 2008, and about 80% of the Air Force's energy needs. ²
- The DOD spent a total of US\$13.4 billion on energy alone in 2009. ¹
- SECDEF Robert Gates stated in 2008, "every time the price of oil goes up by \$1 per barrel, it cost's us about \$130 million." ²



www.americansecurityproject.org

From www.hartfuel.com, Dec. 2010 Fuel Magazine
1: Sharon Burke, DOD, *American Forces Press Service*
2: "*Fueling the Future Force: Preparing the Department of Defense for a Post-Petroleum Era*", Nagl & Parthemore The Center for a New American Security

Market Driver: DoD: 5 billion gallons per year



- One of DOD's biggest vulnerabilities is its dependence on petroleum imports from unstable or unfriendly countries.
- This dependence makes “fuel supply infrastructure a more valuable target”.²
- “There are countless security benefits to DOD having a diversified range of fuel sources.”²

From www.hartfuel.com, Dec. 2010 Fuel Magazine

1: Sharon Burke, DOD, *American Forces Press Service*

2: “*Fueling the Future Force: Preparing the Department of Defense for a Post-Petroleum Era*”, Nagl & Parthemore The Center for a New American Security

Market Driver: DoD: 5 billion gallons per year



The various military branches have set their own alternative fuel targets:

- The Air Force is aiming to fueling half its aircraft with 50% alternative fuels by 2016
- The Navy plans to displace petroleum use by half by 2015
- The Marine Corps *will* reduce its energy intensity 30% relative to the 2003 baseline by 2015
- The Army has set a goal of achieving "net-zero" energy consumption by 2030.

From www.hartfuel.com, Dec. 2010 Fuel Magazine

1: Sharon Burke, DOD, *American Forces Press Service*

2: *"Fueling the Future Force: Preparing the Department of Defense for a Post-Petroleum Era"*, Nagl & Parthemore The Center for a New American Security

Market Driver: Navy Goals



GREAT GREEN FLEET

<http://greenfleet.dodlive.mil/energy/great-green-fleet/>

Navy Goal: 300 mmgy by 2020

2016 Target :

- 40 K bbls JP-5 or 1.68 mmgy
- 40 K bbls F76 or 1.68 mmgy
- 3,700,000 gallons

2020 Target :

- 8 Million bbls of JP-5/F-76
- 336,000,000 gallons



Defense Production Act (50 U.S.C. App. 2061 et seq.)

- Enacted in 1950
 - DPA authorities available through FY2014
 - Under jurisdiction of Banking Committees
- Provides the President unique authorities to maintain & enhance the defense industrial and technological base for national security reasons
- Title III –Expansion of Productive Capacity and Supply
 - delegates authorities to heads of federal departments
 - SECDEF designated DPA Fund Manager



Market Driver: DPA Advanced Biofuels Initiative with DOE, Navy and USDA



- DOE will use FY13,14 budget authority (if approved by Congress) to support plant construction
- Navy will use appropriated funds to support plant construction
- USDA will use Commodity Credit Corp. authority to support advanced feedstock production

Path Forward

- Carry out \$510M joint USDA-DOE-Navy Initiative to spur U.S. Advanced Biofuels Industry using the Defense Production Act

Purpose of invoking DPA:

- Meet NAVY renewable fuel goals
- Support biofuels industry in the U.S.

Achievements:

- 2011 White House Announcement of USDA-DOE-Navy Initiative
- RFI issued in 2012 followed by BAA
- Awards to be announced sometime in 2013

Market Driver: DPA Advanced Biofuels Initiative with DOE, Navy and USDA

DPA Goals:

- Construct or retrofit multiple domestic commercial or pre-commercial scale plants focused on renewable hydrocarbons
- Establish capability to produce drop-in replacement biofuels meeting military specifications at a competitive price
- Demonstrate commercial viability to further draw down risk and encourage follow-on private-sector investment
- Locate in geographically diverse areas for ready access to feedstocks and markets
- No significant impact on the supply of agricultural commodities used for the production of food

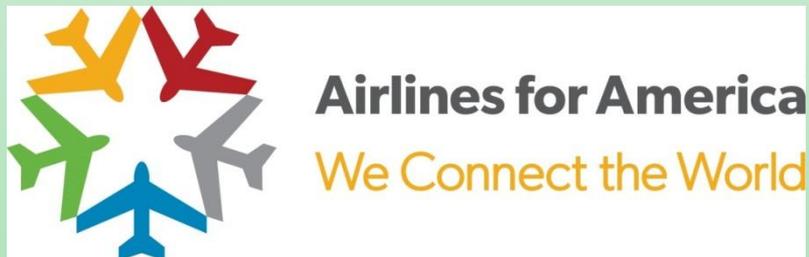


The Commercial Sector

18 Billion gallons per year



www.virgin.com



¹ Commercial Aviation Alternative Fuels Initiative
<http://www.caafi.org>

- Must reduce GHG emissions to fly in to the EU starting in 2014 or else start buying “allowances”
- “Airlines for America” continues to work via CAAFI¹ to establish the supply and logistics at a competitive price
- Alaska, American, Delta, Hawaiian, JetBlue, Southwest, United, US Airways; Atlas, FedEx, UPS

Market Driver: Cars & Trucks, Ships & Trains

Total liquid fuel use in 2011 was 212 bgy

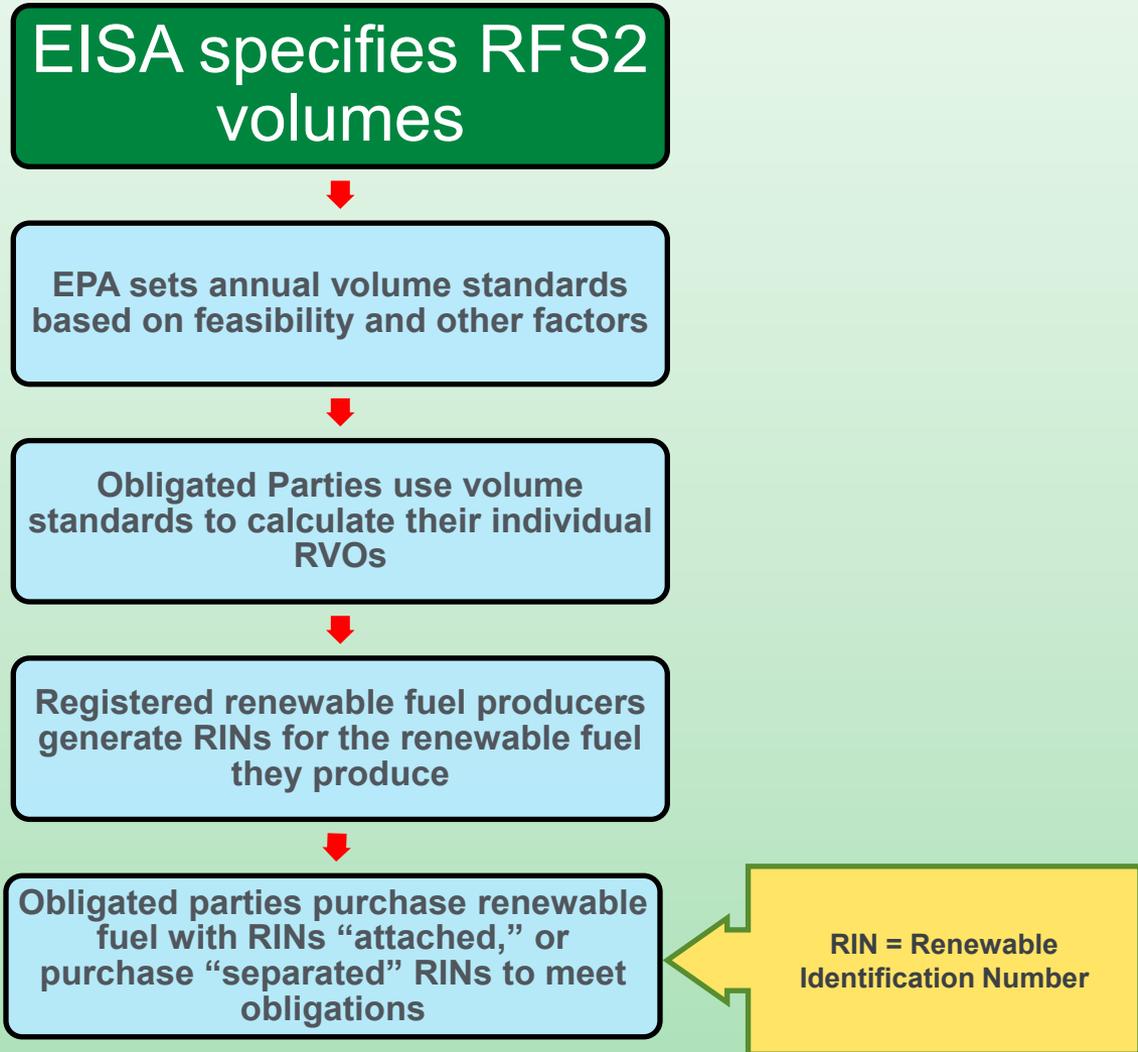
- Gasoline consumption was 8.565 million barrels/day or 131 bgy
- Diesel consumption was 3.849 million barrels/day or 59 bgy
- Jet consumption was 1.425 million barrels/day or 22 bgy



Source: EIA, "Annual Energy Review 2011", Table 5.11.

Overview of RINS

Compiled by Kristen Johnson & Chris Ramig
DOE Bioenergy Technologies Office
February, 2013



Simplified Process Flow Chart

Approved Feedstock Provider



Biorefinery: Renewable Fuel Production and RIN Generation with D Code and Equivalence Value



Supply Transportation



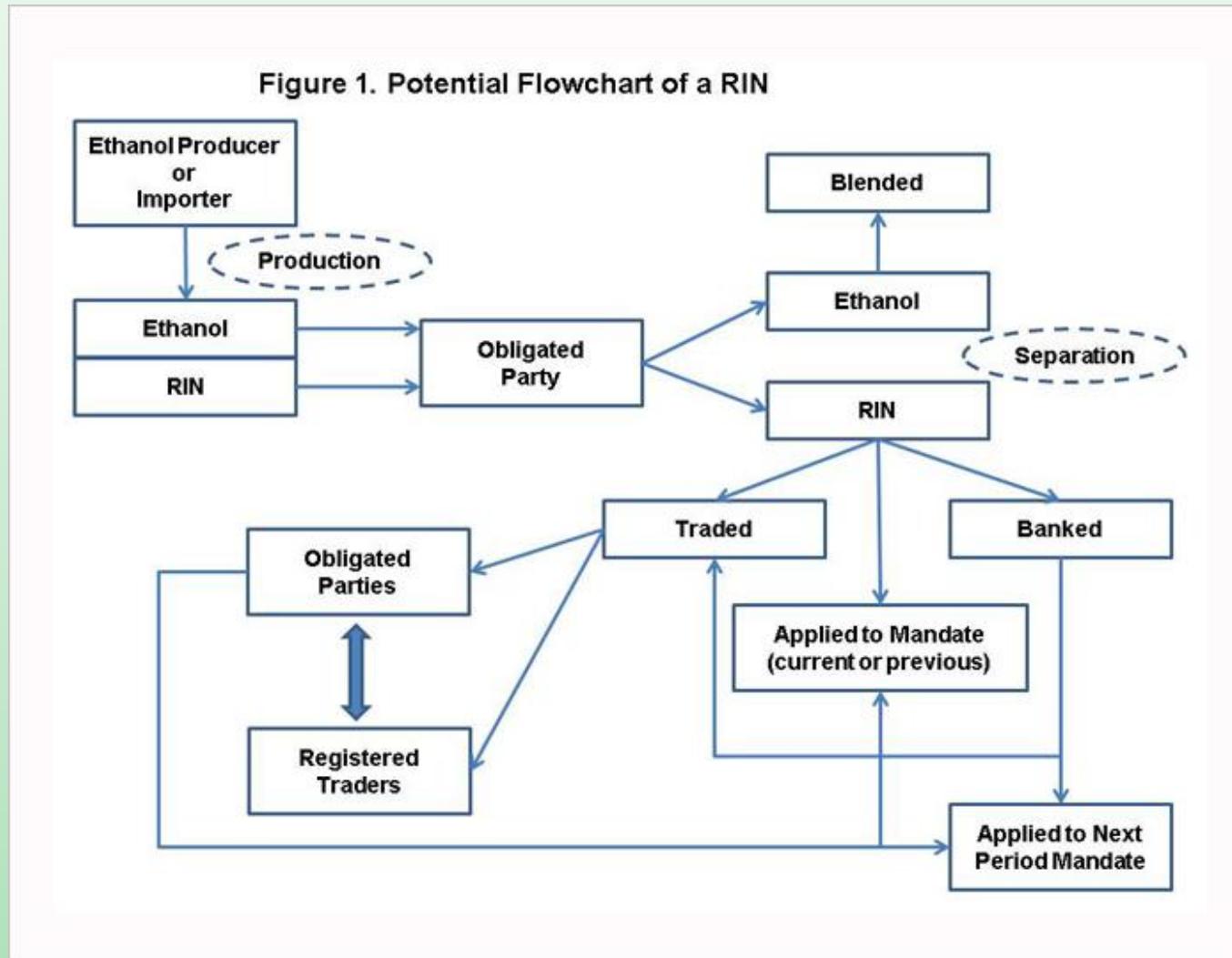
Obligated Parties: Refiner, Blender, Importer -- Blending Facility



Compliance

How do obligated parties demonstrate compliance?

- RINs are the “currency” used to demonstrate compliance with the RFS mandates
 - A RIN identifies information such as facility, fuel product type, etc.
 - RINs are generated by a registered domestic renewable fuel producer (or importer, if importing from registered foreign producer)
- RINs are initially attached to a volume of renewable fuel
 - Obligated parties must separate RINs from gallons of fuel in order to use them to demonstrate compliance.
- There are a number of ways obligated parties can obtain RINs
 - Direct purchase of renewable fuel
 - Trade, exchange, purchase on the market
- The RFS program also has other provisions allowing for flexibility in compliance
 - Deficit carryover (limitations apply)
 - RINs can be used for compliance for the year that they’re generated and the following year (up to 20% of an obligated party’s total RVO)



From: http://www.farmdocdaily.illinois.edu/2012/04/understanding_the_lifespan_and_1.html

- There are currently 5 “D Codes” that signify different types of renewable fuel:
 - D3 – Cellulosic Biofuel (e.g. miscanthus ethanol)
 - D4 – Biomass-Based Diesel (e.g. soybean-based distillate fuels)
 - D5 – Advanced Biofuel (e.g. sugarcane ethanol)
 - D6 – Renewable Fuel (e.g. corn ethanol)
 - D7 – Cellulosic Diesel (e.g. Fischer-Tropsch diesel fuels from cellulose)
- RIN Equivalency Values (Examples)
 - One RIN represents a volume of a given fuel equal to one gallon of ethanol equivalent
 - 1 gallon ethanol = 1.0 RIN
 - 1 gallon biodiesel = 1.5 RINs
 - 1 gallon butanol = 1.3 RINs
 - 1 gallon non-ester renewable diesel = 1.7 RINs

- The primary obstacles for the emerging Biofuels industry are no longer technological, they are financial.
- The two primary obstacles for the Biofuels industry are linked:
 1. Inability to attract private sector debt financing
 2. Lack of a long-term, consistent set of Federal energy and environmental policies that can be relied on to last the length of the tenor of the loan.
- “Until and unless RINs can be counted on as revenue on a pro forma for debt financing, the market driver associated with RFS2 will fail to fully materialize.” – B. Duff

Thank you!

Brian Duff
Chief Engineer
DOE Bioenergy Technologies Office
303-619-1747
brian.duff@ee.doe.gov
<http://www1.eere.energy.gov/biomass/>



Backup Slides

- ▶ Cellulosic volume obligation is based on EIA projections, EPA's market assessment, and information gathered through notice and comment

Table I.B.3-1
Proposed Volumes Used to Determine the Proposed 2013 Percentage Standards^a

Cellulosic biofuel	14 mill gal
Biomass-based diesel	1.28 bill gal
Advanced biofuel	2.75 bill gal
Renewable fuel	16.55 bill gal

^a All volumes are ethanol-equivalent, except for biomass-based diesel which is actual.

- ▶ The percentage standards represent the ratio of renewable fuel volume to non-renewable gasoline and diesel volume

Table I.B.3-2
Proposed Percentage Standards for 2013

Cellulosic biofuel	0.008%
Biomass-based diesel	1.12%
Advanced biofuel	1.60%
Renewable fuel	9.63%

RVO Determination for Obligated Parties

- ▶ A formula is used to calculate each OP's RVO, based on the gasoline and diesel volume they produce/sell in that calendar year

$$RVO = (RFStd \times (GV + DV)) + D$$

Renewable Volume Obligation
 Number of RINs that must be acquired

Percentage standard
 Cellulosic biofuel
 Biomass-based diesel
 Advanced biofuel
 Total renewable fuel

Gasoline volume

Diesel volume

Deficit carryover

- ▶ Obligated Parties have four RVOs and must acquire a sufficient number of RINs to meet each RVO

Standard	Obligation	Allowable D codes
Cellulosic biofuel	RVO_{CB}	3 and 7
Biomass-based diesel	RVO_{BBD}	4 and 7
Advanced biofuel	RVO_{AB}	3, 4, 5, and 7
Renewable fuel	RVO_{RF}	3, 4, 5, 6, and 7

Recall that BBD & cellulosic are "nested" within advanced biofuel

How do obligated parties comply if RINs aren't available?

- Under EISA, EPA is required to make cellulosic biofuel waiver credits available for years where it waives some portion of the statutory volume [or amended volume] for cellulosic biofuel.
- If the total volume of required renewable fuel isn't produced, obligated parties can:
 - 1) Purchase cellulosic waiver credits from EPA (only good for year they are purchased)
 - 2) Carry a deficit over to following year
- In 2011, EPA made cellulosic biofuel waiver credits available for end-of-year compliance at \$1.13 per gallon-RIN

- The EPA Moderated Transaction System (EMTS) is a closed, moderated system for tracking and trading RINs.
 - EMTS tracks each RIN over its whole lifecycle
 - All information in EMTS is supplied by properly registered RIN market participants
- EMTS includes internal QA checks that help identify some errors in submitted information before it is uploaded into EMTS.
 - These checks are based on company (and facility) registration and RFS regulatory parameters
 - EMTS will notify relevant parties if a submission for generating RINs fails, a trade expires, a trade is pending, a trade has been denied, etc.
- EMTS does not validate RINs
 - System design reflects that RIN buyers are responsible for ensuring RIN validity
 - There is a proposed rulemaking that may change this somewhat.

2012 RFS mandate vs. actual 2012 RIN generation

(in millions of RINs)	Mandated RINs	Estimated Actual RINs Generated	Actual – Mandate
D3 & D7 – Cellulosic Biofuel & Diesel	10.45	0.022	-10.428
Cellulosic Ethanol		0.02	
Cellulosic Diesel		0.002	
D4 – Biomass-Based Diesel	1,500	1,725	225
Biodiesel		1,580	
Non-Ester Renewable Diesel		145	
D5 – Advanced Biofuel ¹	500	600	100
Ethanol		585	
Biogas		3	
Heating Oil		0.2	
Non-Ester Renewable Diesel		20	
D6 – Renewable Fuel ²	13,200	12,972	-228
Ethanol		12,971	
Biodiesel		0.6	

¹ Subtracting D3, D4, and D7 RINs from the D5 total mandate of 2,000 mil RINs gives you an effective D5 mandate.

² Subtracting the 2,000 mil RIN Advanced Biofuel mandate from the 15,200 mil RIN total Renewable Fuel mandate gives you the effective D6 mandate. The remainder of the effective D6 mandate for 2012 will be met with carryover RINs from 2011.

RFS Pathways & the Petition Process

- To be used for RFS compliance, a fuel pathway must be approved by EPA.
- EPA must perform a full GHG lifecycle analysis (LCA) of the fuel pathway, including all emissions associated with the feedstock, process, and fuel.
 - The results of this lifecycle analysis determine which, if any, RIN D codes the fuel qualifies to generate.
- Key to EPA's GHG LCA are the emissions stemming from direct and indirect land use change (DLUC & ILUC), caused by feedstock production.

- When the final RFS2 rulemaking was released in 2010, EPA made compliance determinations for select pathways
- See Table 1 to §80.1426 (following slides) for existing qualified pathways
- Acknowledging that EPA did not have sufficient time to analyze *all* fuels that could contribute to the RFS, a supplemental process was put in place.
- This process allows parties to petition EPA for the inclusion of new pathways under the RFS.

Applicable D Codes for Each Fuel Pathway

Fuel type	Feedstock	Production process requirements	D-Code
Ethanol	Corn starch	All of the following: Dry mill process, using natural gas, biomass, or biogas for process energy and at least two advanced technologies from Table 2 to this section	6
Ethanol	Corn starch	All of the following: Dry mill process, using natural gas, biomass, or biogas for process energy and at least one of the advanced technologies from Table 2 to this section plus drying no more than 65% of the distillers grains with solubles it markets annually	6
Ethanol	Corn starch	All of the following: Dry mill process, using natural gas, biomass, or biogas for process energy and drying no more than 50% of the distillers grains with solubles it markets annually	6
Ethanol	Corn starch	Wet mill process using biomass or biogas for process energy	6
Ethanol	Starches from crop residue and annual covercrops	Fermentation using natural gas, biomass, or biogas for process energy	6
Biodiesel, and renewable diesel	Soy bean oil; Oil from annual covercrops; Algal oil; Biogenic waste oils/fats/greases; Non-food grade corn oil	One of the following: Trans-Esterification Hydrotreating Excluding processes that co-process renewable biomass and petroleum	4
Biodiesel	Canola oil	Trans-Esterification using natural gas or biomass for process energy	4
Biodiesel, and renewable diesel	Soy bean oil; Oil from annual covercrops; Algal oil; Biogenic waste oils/fats/greases; Non-food grade corn oil	One of the following: Trans-Esterification Hydrotreating Includes only processes that co-process renewable biomass and petroleum	5
Ethanol	Sugarcane	Fermentation	5

Applicable D Codes for Each Fuel Pathway

Fuel type	Feedstock	Production process requirements	D-Code
Ethanol	Cellulosic Biomass from crop residue, slash, pre-commercial thinnings and tree residue, annual covercrops, switchgrass, and miscanthus; cellulosic components of separated yard waste; cellulosic components of separated food waste; and cellulosic components of separated MSW	Any	3
Cellulosic Diesel, Jet Fuel and Heating Oil	Cellulosic Biomass from crop residue, slash, pre-commercial thinnings and tree residue, annual covercrops, switchgrass, and miscanthus; cellulosic components of separated yard waste; cellulosic components of separated food waste; and cellulosic components of separated MSW	Any	7
Butanol	Corn starch	Fermentation; dry mill using natural gas, biomass, or biogas for process energy	6
Cellulosic Naphtha	Cellulosic Biomass from crop residue, slash, pre-commercial thinnings and tree residue, annual covercrops, switchgrass, and miscanthus; cellulosic components of separated yard waste; cellulosic components of separated food waste; and cellulosic components of separated MSW	Fischer-Tropsch process	3
Ethanol, renewable diesel, jet fuel, heating oil, and naphtha	The non-cellulosic portions of separated food waste	Any	5
Biogas	Landfills, sewage waste treatment plants, manure digesters	Any	5
Ethanol	Grain Sorghum	Dry mill process using biogas from landfills, waste treatment plants, and/or waste digesters, and/or natural gas, for process energy	6
Ethanol	Grain Sorghum	Dry mill process, using only biogas from landfills, waste treatment plants, and/or waste digesters for process energy and for on-site production of all electricity used at the site other than up to 0.15 kWh of electricity from the grid per gallon of ethanol produced, calculated on a per batch basis	5

- Several RFS pathways already exist to generate RINs from MSW
 - Ethanol, cellulosic diesel, jet fuel, heating oil, and cellulosic naphtha can all be produced from the “cellulosic components of separated MSW”.
 - Biogas may also be produced from MSW, in specific cases per the preceding pathways slides
 - See 40 CFR 80, Subpart M, specifically §80.1426:
 - <http://www.ecfr.gov/cgibin/retrieveECFR?gp=&SID=878ac8ee7c48ea1dfd4442874da451ca&n=40y17.0.1.1.9&r=PART&ty=HTML#40:17.0.1.1.9.13>
- Several RFS pathways exist for biogas
 - The biogas must be produced from renewable biomass from *landfills, sewage waste treatment plants, or manure digesters*.
 - Also see Table 1 of the RFS regulations.
- Producers seeking to generate RINs via MSW-derived fuels must submit a separation plan to demonstrate how they will separate approved feedstocks from unapproved feedstocks in the MSW stream.
 - EPA recently approved such a plan for Fiberight. See “Notice of Approval of RFS2 MSW Separation Plan”:
 - <http://www.epa.gov/otaq/fuels/renewablefuels/notices.htm>.

- Via the supplemental process, any party may petition EPA to:
 - 1) Conduct a **plant-specific determination**.
 - If approved, applies only to the petitioner.
 - Utilized when a producer is *utilizing an already-approved feedstock*
 - Negates the need for consideration of DLUC & ILUC
 - Analyzes a *previously unapproved process and/or a new fuel product*.
 - Producers often request a plant-specific determination if their process is novel and/or proprietary.
 - 1) Conduct a **new pathway determination** (feedstock, process, & fuel).
 - If approved, *anyone* can use the pathway (it is added to Table 1)
 - This method is generally only used when the petitioner is utilizing a *previously unapproved feedstock*.
 - The process and fuel may or may not be novel.

The Framework for generating lifecycle GHG estimates:

- Example results from grain sorghum pathway determination:

TABLE II-9—LIFECYCLE GHG EMISSIONS FOR GRAIN SORGHUM ETHANOL PRODUCED IN DRY MILL PLANTS THAT USE NATURAL GAS FOR PROCESS ENERGY AND PRODUCE 92% WET DISTILLERS GRAINS
[gCO₂e/mmBtu]

Fuel type	Grain sorghum ethanol	2005 gasoline baseline
Net Agriculture (w/o land use change), Domestic and International	12,698	
Land Use Change, Mean (<i>Low/High</i>), Domestic and International	27,620 (<i>16,196/41,903</i>)	
Fuel Production	22,111	19,200
Fuel and Feedstock Transport	3,661	*
Tailpipe Emissions	880	79,004
Total Emissions, Mean (<i>Low/High</i>)	66,971 (<i>55,547/81,254</i>)	98,204
Midpoint Lifecycle GHG Percent Reduction Compared to Petroleum Baseline	32%	

* Emissions included in fuel production stage.

- EPA determined that grain sorghum qualified to generate D6 RINs (the same category as corn ethanol) under most circumstances.

Petitions Under Evaluation

Company	Fuel	Feedstock	Process
11 Good Energy, Inc.	New (G2 Diesel)	Soy bean oil, Oil from annual cover crops, Algal oil, Biogenic waste oils, fats, greases, and Canola oil	Esterification
Absolute Energy, LLC	Ethanol	Corn	New (proprietary)
Arvens Technology, Inc.	Biodiesel	New (pennycress)	Transesterification
BP Biofuels North America, LLC	Cellulosic biofuel	New (energy cane)	Any
	Cellulosic biofuel	New (napiergrass)	Any
Chemtex Group	Cellulosic biofuel	New (arundo donax)	Any
Conestoga Energy Partners, LLC, and Bonanza Bioenergy, LLC*	Ethanol	New (grain sorghum)	New (proprietary)
Dakota Spirit AgEnergy, LLC	Ethanol	Corn	New (proprietary)
Diamond Green Diesel, LLC	New (renewable naphtha)	Biogenic waste oils, fats, greases	Hydrotreating
DriveGreen, LLC	New (renewable electricity)	Landfill biogas	New (proprietary)
EdeniQ, Inc.	Ethanol	Corn kernel fiber	Any
E Energy Adams, LLC	Ethanol	Corn	New (proprietary)
Element Markets, LLC	CNG	Biogas from anaerobic digesters	Any
Emerald Biofuels LLC, Global Clean Energy Holdings, and UOP LLC	Renewable diesel, jet fuel, and naphtha	New (Jatropha)	Hydrotreating

From EPA website: "Guidance on New Fuel Pathway Approval Process"
<http://www.epa.gov/otaq/fuels/renewablefuels/compliancehelp/rfs2-lca-pathways.htm>

Petitions Under Evaluation (cont'd)

Company	Fuel	Feedstock	Process
Emerald Biofuels LLC and Global Clean Energy Holdings	Biodiesel	New (Jatropha)	Transesterification
Gevo	Isobutanol	Corn	<i>New (proprietary)</i>
Golden Renewable Energy, LLC	Renewable diesel	<i>New (municipal sewage sludge), Biogenic waste oils, fats, greases</i>	<i>New (proprietary)</i>
Green Vision Group	Ethanol	<i>New (energy beets)</i>	Fermentation
Growing Power Hairy Hill**	Ethanol	<i>New (wheat starch)</i>	<i>New (proprietary)</i>
ICM	Ethanol	Corn	<i>New (proprietary)</i>
logen	Ethanol	<i>New (grain sorghum)</i>	<i>New (proprietary)</i>
Kior, Inc.	<i>New (renewable gasoline blendstock)</i>	Cellulosic biomass	<i>New (proprietary)</i>
Montana Advanced Biofuels, LLC	Ethanol	<i>New (barley, wheat starch residue)</i>	Fermentation
National Cottonseed Products Association	Biodiesel, renewable diesel	<i>New (cottonseed oil)</i>	Transesterification
National Sorghum Producers	Ethanol	New (biomass sorghum)	Any
New Generation Biofuels Holdings Inc.	Renewable diesel, heating oil	Biogenic waste oils, fats, greases	<i>New (proprietary)</i>
	Renewable diesel, heating oil	Biogenic waste oils, fats, greases	<i>New (proprietary)</i>
Osage Bio Energy, LLC	Ethanol	<i>New (barley)</i>	Fermentation

From EPA website: "Guidance on New Fuel Pathway Approval Process"
<http://www.epa.gov/otaq/fuels/renewablefuels/compliancehelp/rfs2-lca-pathways.htm>

Petitions Under Evaluation (cont'd)

Company	Fuel	Feedstock	Process
Permeate Refining, LLC	Ethanol	Non-cellulosic separated food waste	Any
POP Diesel, Inc.	<i>New (un-transesterified plant oil)</i>	<i>New (jatropha oil)</i>	<i>New (proprietary)</i>
Rothsay Biodiesel	<i>New (biodiesel)</i>	Biogenic waste oils, fats, greases	Transesterification
Solazyme	Biodiesel, renewable diesel, jet fuel	Carbohydrate, Algae	Transesterification Hydrotreating
Sundrop Fuels, Inc.	<i>New (renewable gasoline)</i>	Cellulosic biomass	<i>New (proprietary)</i>
Terrabon, Inc.	<i>New (renewable gasoline)</i>	Cellulosic biomass	<i>New (proprietary)</i>
WM GTL, Inc.	Cellulosic Diesel	<i>New (landfill biogas)</i>	Any

From EPA website: "Guidance on New Fuel Pathway Approval Process"
<http://www.epa.gov/otaq/fuels/renewablefuels/compliancehelp/rfs2-lca-pathways.htm>