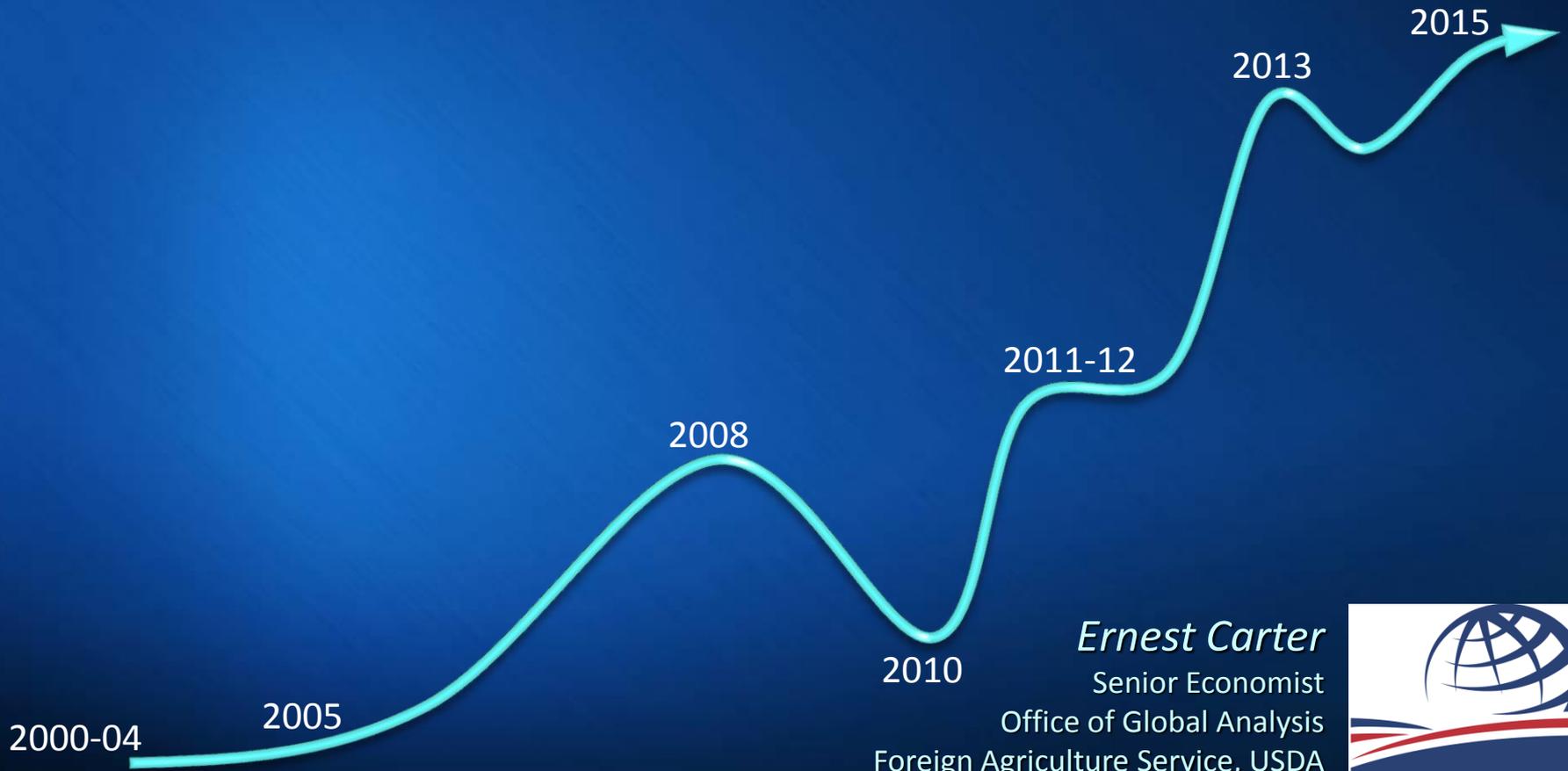


# U.S. Biodiesel/Renewable Diesel Market

## Factors Driving Change



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Washington, D.C.

May 2016





# USDA's Interest in Biofuel Markets

## USDA Programs and Market Intel Support Industry

### USDA Interests in Biofuels

- ❑ Support the rural economy
- ❑ Impact on US & global supply/demand balances for grains & oilseeds

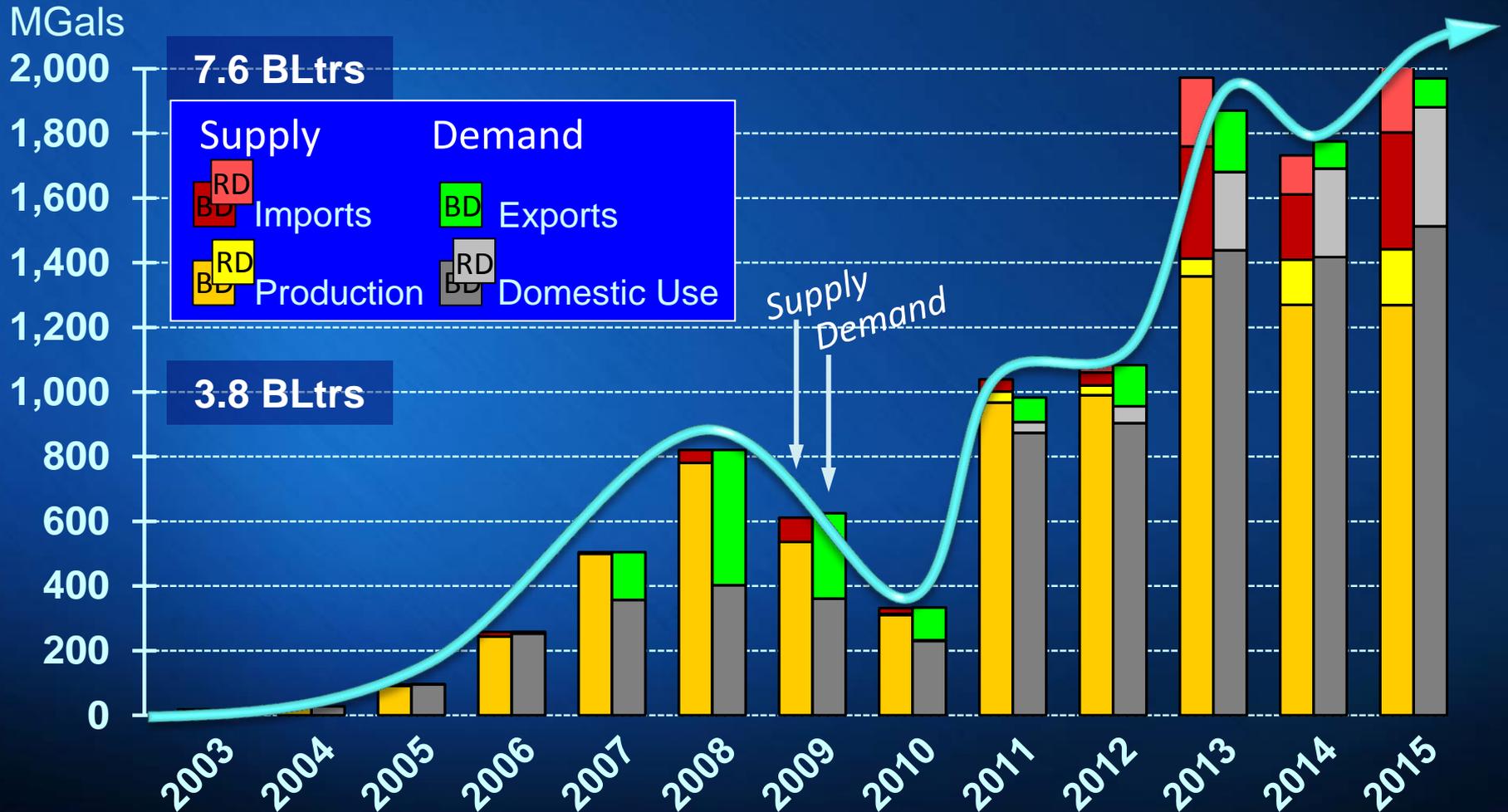
### USDA Activities & Programs

- ❑ 2014 Farm Bill Energy Title IX includes \$700 million for crop & biomass research, biomass handling technologies, education programs, and biorefinery retooling/construction
- ❑ Monthly forecasts on corn and soyoil used for biofuels, and annual long-term projections for world agricultural markets
- ❑ Consultations with EPA and DOE on Renewable Fuel Standard (RFS) management issues
- ❑ USDA's Foreign Agricultural Service is involved in biofuels standard setting bodies, trade policy, ethanol market promotion, and foreign market intel reporting on the European Union and 14 other countries



# US Biodiesel & Renewable Diesel Market 2000-15: Uneven Start Followed by Growing Demand

The Renewable Fuel Standard sets long-term policy to 2022, *but* EPA rulings, court cases, trade policy, and annual federal budget process create risk



BD = biodiesel (fatty acid methyl ester); RD = renewable diesel (only HVO is currently commercialized); MGals (million gallons); BLtrs (billion liters).

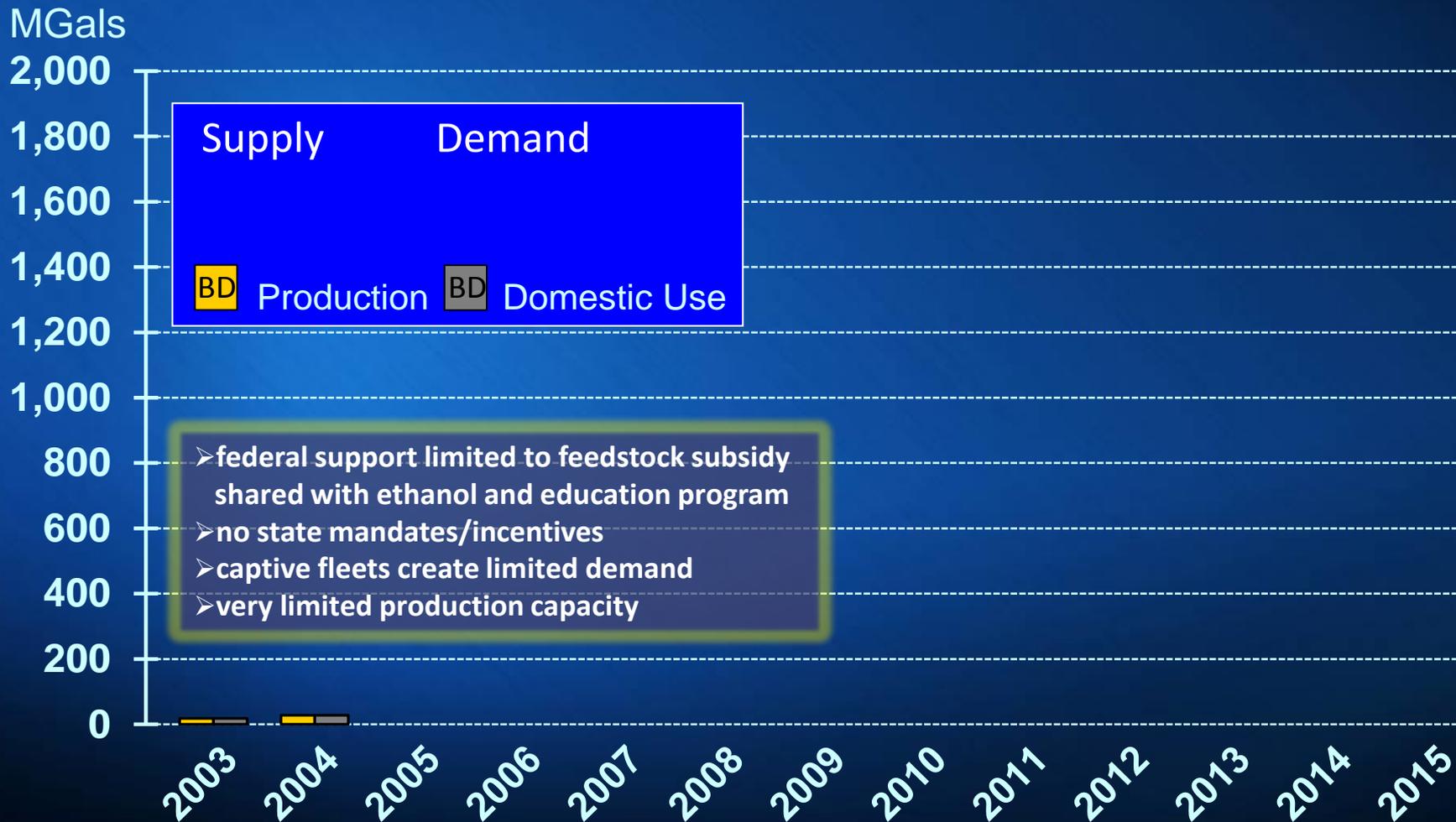


# The Early Years

## 2000-04: Limited Production and Use; No Trade

CCC Bioenergy Prog (2000-6) →

Nat Biodiesel Ed. Prog (2003 – today) →



BD = biodiesel (fatty acid methyl ester); RD = renewable diesel (only HVO is currently commercialized); MGals (million gallons); BLtrs (billion liters).



# Expansion & Collapse

## 2005-10: Exports are Key Driver; Domestic Use Unstable

CCC Bioenergy Prog (2000-6) →

Nat Biodiesel Ed. Prog (2003 – today) →

Federal Tax Credit (2005 – today) →

State mandates/incentives (2005 – today) →

MGals

2,000

1,800

1,600

1,400

1,200

1,000

800

600

400

200

0



### Domestic Use Rises

- federal tax support
- state mandates/incentives
- Production shifts from single to multi-feedstock to control costs

3.0 BLtrs

1.5 BLtrs



BD = biodiesel (fatty acid methyl ester); RD = renewable diesel (only HVO is currently commercialized); MGals (million gallons); BLtrs (billion liters).



# Expansion & Collapse

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1,600

1,400

1,200

1,000

800

600

400

200

0



3.0 BLtrs

1.5 BLtrs

Exports Drive  
Two-thirds of  
Production  
Expansion

➤ 50% of production exported by 2008 (mostly Europe)  
➤ production capacity swells to 2.5 BGals

2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

BD = biodiesel (fatty acid methyl ester); RD = renewable diesel (only HVO is currently commercialized); MGals (million gallons); BLtrs (billion liters).



# Expansion & Collapse

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2,000

1,800

1,600

1,400

1,200

1,000

800

600

400

200

0



### Exports Collapse

➤ Europe imposes Cv/AD duties

### Domestic Use Collapses

➤ RFS2 ruling delayed 18 months to June 2010

➤ 12-month lapse in blenders credit (2009)

➤ Financial Crises of 2008 freezes credit markets, and ensuing severe recession causes on-road diesel use to drop 9% (2008 to 2009)



BD = biodiesel (fatty acid methyl ester); RD = renewable diesel (only HVO is currently commercialized); MGals (million gallons); BLtrs (billion liters).



# Expansion Resumes on Surer Footing

## 2011-12: RFS Builds Domestic Use; Limited Trade

CCC Bioenergy Prog (2000-6) →

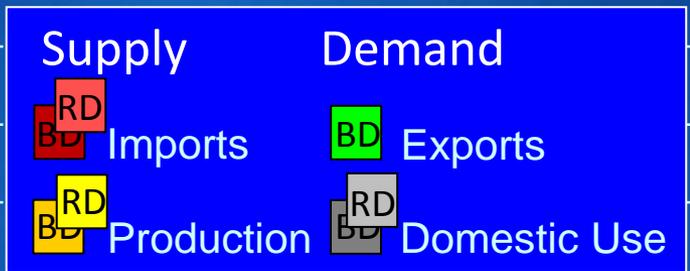
Nat Biodiesel Ed. Prog (2003 – today) →

Federal Tax Credit (2005 – today) →

State mandates/incentives (2005 – today) →

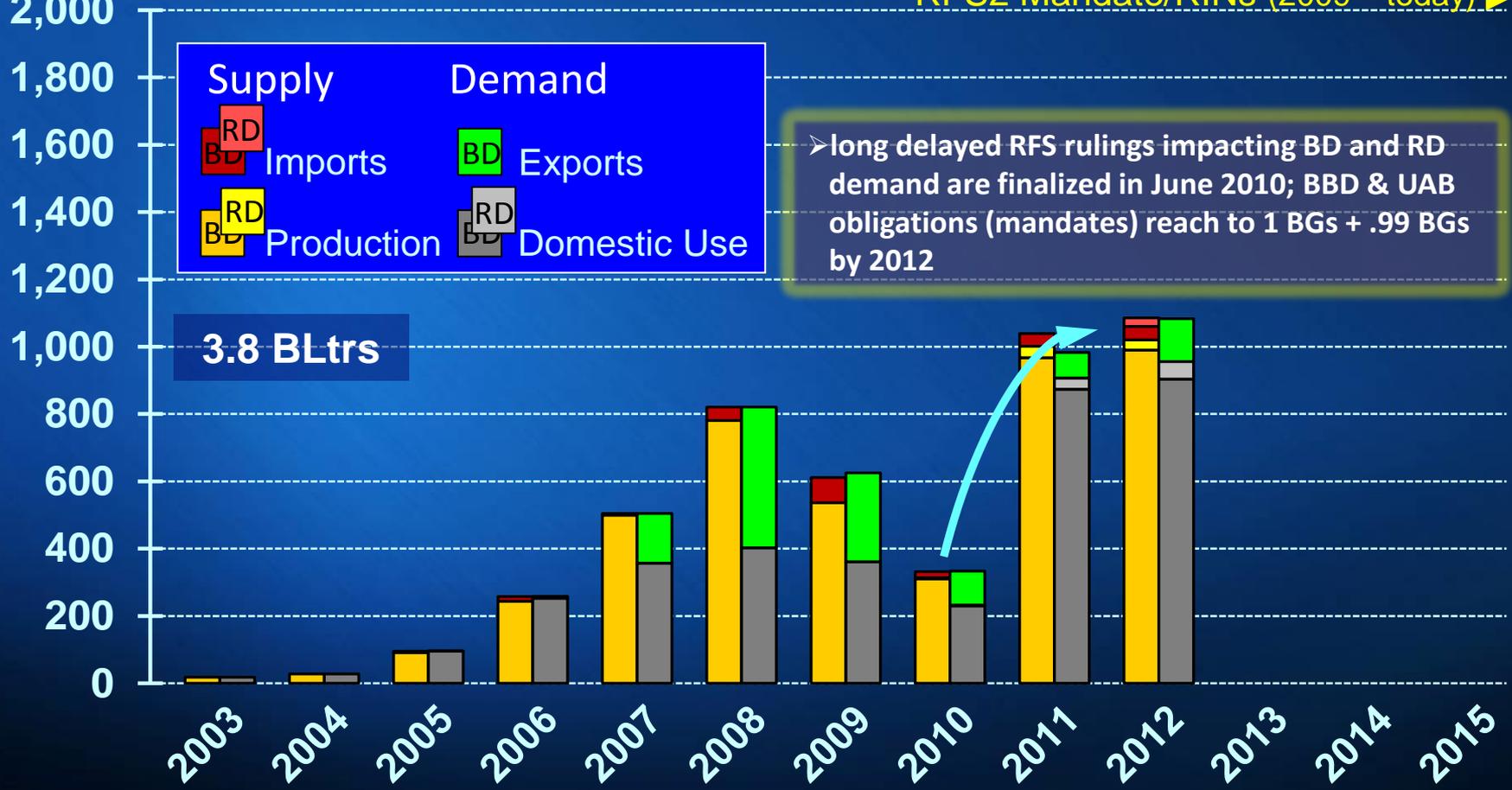
RFS2 Mandate/RINs (2009 – today) →

MGals  
2,000



➤ long delayed RFS rulings impacting BD and RD demand are finalized in June 2010; BBD & UAB obligations (mandates) reach to 1 BGs + .99 BGs by 2012

**3.8 BLtrs**



BBD = biomass-based diesel (BD+RD); UAB = undifferentiated (non-cellulosic) advanced biofuels, ethanol vols.



# Energy Acts of 2005 & 2007

## Comparing Original RFS Schedules with EPA Final Rules

Biofuel Obligations Under the Energy Acts of 2005 & 2007 by Fuel Category for RFS1 (2006-8) & RFS2 (2009-22)

Billions of Gallons (ethanol-equivalent)

Year	Conventional Biofuel		Advanced Biofuel								Total Renewable Fuel 1/		
			Cellulosic Biofuel 1/		Biomass-based Diesel (BBD) 2/3/		Other Advanced Biofuel 1/4/		Total Advanced 1/				
	Original Schedule	Final Rule	Original Schedule	Final Rule	Original Schedule	Final Rule	Original Schedule	Final Rule	Original Schedule	Final Rule	Original Schedule	Final Rule	
2006	4.0	4.00										4.00	4.00
2007	4.7	4.70										4.70	4.70
2008 5/	5.4	9.00										5.40	9.00
2009	10.5	10.50	n/a	n/a	0.50	0.50	0.10	0.10000	0.60	0.60		11.10	11.10
2010 6/	12.0	12.00	0.10	0.00500	0.65	0.65	0.20	0.29500	0.95	0.95		12.95	12.95
2011	12.6	12.60	0.25	0.00600	0.80	0.80	0.30	0.54400	1.35	1.35		13.95	13.95
2012	13.2	13.20	0.50	0.01045	1.00	1.00	0.50	0.98955	2.00	2.00		15.20	15.20
2013	13.8	13.80	1.00	0.00600	1.00	1.28	0.75	1.46400	2.75	2.75		16.55	16.55
2014	14.4	13.61	1.75	0.03300	1.00	1.63	1.00	1.00700	3.75	2.67		18.15	16.28
2015	15.0	14.05	3.00	0.12300	1.00	1.73	1.50	1.02700	5.50	2.88		20.50	16.93
2016	15.0	14.50	4.25	0.23000	1.00	1.90	2.00	1.48000	7.25	3.61		22.25	18.11
2017	15.0	14.80	5.50	0.31200	1.00	2.00	2.50	1.68800	9.00	4.00		24.00	18.80
2018	15.0		7.00		1.00	2.10	3.00		11.00			26.00	
2019	15.0		8.50		1.00		3.50		13.00			28.00	
2020	15.0		10.50		1.00		3.50		15.00			30.00	
2021	15.0		13.50		1.00		3.50		18.00			33.00	
2022	15.0		16.00		1.00		4.00		21.00			36.00	

Biodiesel & renewable diesel fill these categories

Red = final rulings differ from the original schedule.

Purple = proposed rules.

1/ Vols assume all cellulosic biofuel is ethanol. Actual vols blended will be lower if any portion has a volumetric energy content greater than ethanol.

2/ BBD values are actual vols, not ethanol-equivalent vols. Multiply BBD (biodiesel & renewable diesel) values by 1.5 and 1.7 to find ethanol-equivalent vols.

3/ BBD volumes starting 2012 (original schedule) are determined by EPA rule-making, but must be no less than 1 billion actual volumes.

4/ Not published by EPA. Known as "undifferentiated (non-cellulosic) advanced biofuel and equals total advanced minus cellulosic biofuel minus BBD

5/ Original Schedule value was set by RFS1 (2005 Energy Policy Act 2005), while Final Rule value was set by RFS2 (EISA 2007).

6/ Delay in EPA rule-making resulted in combining BBD 2009 & 2010 obligations into a single BBD obligation for 2010.

File location: R:\\_Market Intelligence\Commodity Analysis\Biofuels\2 US Mkt Sit & Policy\RFS2

Updated: ECarter, OGA/FAS/USDA, May 2016.



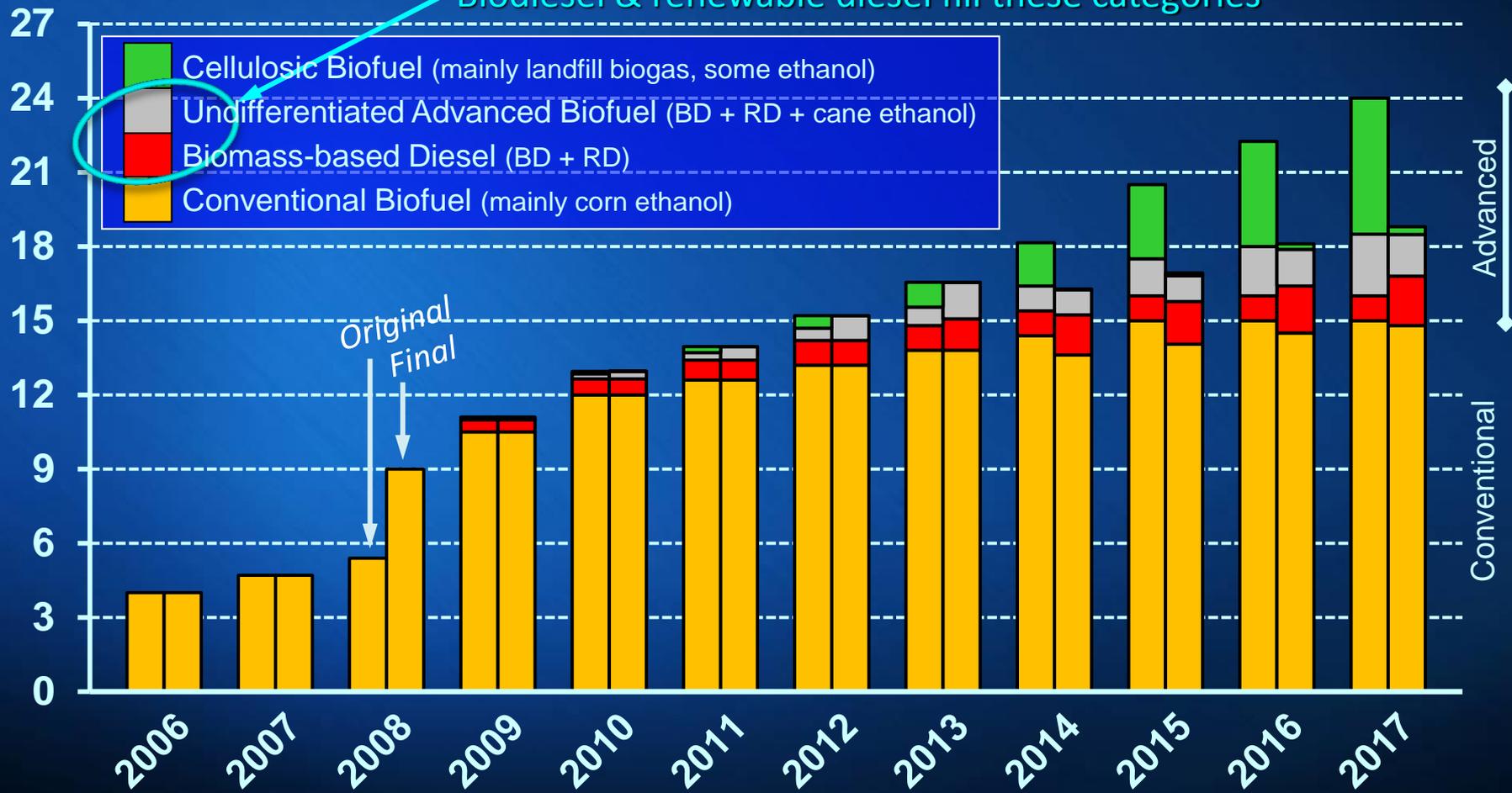
# Energy Acts of 2005 & 2007

## Comparing Original RFS Schedules with EPA Final Rules

Advanced biofuels remain far behind original schedule due to lack of cellulosic fuels, but EPA is increasing the “space” for BD/RD beyond original schedule!

Billion Gals

Biodiesel & renewable diesel fill these categories



Includes EPA's proposed 2017 rules for total, advanced and cellulosic biofuels. The proposed 2018 rule for BBD (not shown) is 2.1 BGs. Proposed rules are expected to be finalized by fall 2016.



# Expansion Continues

## 2013-15: RFS Builds Domestic Use; Production & Imports Rise

CCC Bioenergy Prog (2000-6) →

Nat Biodiesel Ed. Prog (2003 – today) →

Federal Tax Credit (2005 – today) →

State mandates/incentives (2005 – today) →

RFS2 Mandate/RINs (2009 – today) →

MGals  
2,000

7.6 BLtrs

Supply

RD  
BD Imports

RD  
BD Production

Demand

BD Exports

RD  
BD Domestic Use

- RFS builds BBD & UAB to 1.73 BGs + 1.03 BGs by 2015
- production & imports rise equally to cover growing demand
- renewable diesel arrives

3.8 BLtrs

2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

BBD = biomass-based diesel (BD+RD); UAB = undifferentiated (non-cellulosic) advanced biofuels, ethanol vols.



# US Biodiesel & Renewable Diesel Market

## Dataset Updated by USDA's OEPNU and FAS

### US Biomass-based Diesel (biodiesel + renewable diesel) Supply/Demand, MGals

Year	SUPPLY											DEMAND									FAME		FAME + HVO				
	BEGIN STOCKS			PRODUCTION			Imp (FAME)		IMPORTS			DOMESTIC USE			Exp (FAME)		EXPORTS			END STOCKS			Exp	Imp	Exp	Imp	
	FAME	RD	TOTAL	FAME	RD	TOTAL	Total	Re-Exp	FAME	RD	TOTAL	FAME	RD	TOTAL	Total	For-Orig	FAME	RD	TOTAL	FAME	RD	TOTAL	Reliance		Reliance		
2000				2.0		2.0							2.0		2.0												
2001				8.1		8.1							8.1		8.1												
2002				13.8		13.8							13.8		13.8												
2003				17.6		17.6							17.6		17.6												
2004				28.0		28.0							28.0		28.0												
2005				91.2		91.2	4.5	0.3	4.2		4.2		95.0		95.0	0.8	0.3	0.5		0.5				0%	4%	0%	4%
2006				243.4		243.4	35.2	20.8	14.4		14.4		252.4		252.4	26.2	20.8	5.5		5.5				2%	6%	2%	6%
2007				499.7		499.7	124.4	119.4	5.0		5.0		357.3		357.3	266.7	119.4	147.3		147.3				29%	1%	29%	1%
2008				780.6		780.6	312.5	272.2	40.3		40.3		402.8		402.8	690.3	272.2	418.1		418.1				54%	10%	54%	10%
2009	44.0	0.0	44.01	536.3	0.0	536.3	74.8	0.0	74.8		74.8		360.9		360.9	264.2	0.0	264.2		264.2	29.9	0.0	29.9	49%	21%	49%	21%
2010	29.9	0.0	29.86	310.4	3.0	313.4	18.5	0.0	18.5		18.5		229.4	3.0	232.5	101.1	0.0	101.1		101.1	28.2	0.0	28.2	33%	8%	32%	8%
2011	28.2	0.0	28.22	967.5	34.2	1,001.6	37.5	0.0	37.5		37.5		873.3	33.9	907.2	75.7	0.0	75.7		75.7	84.2	0.3	84.5	8%	4%	8%	4%
2012	84.2	0.3	84.50	990.0	30.2	1,020.2	39.3	0.0	40.1	25.4	65.5		903.7	51.9	955.7	127.2	0.0	127.2		127.2	83.3	3.9	87.3	13%	4%	12%	7%
2013	83.3	3.9	87.28	1,358.0	54.4	1,412.4	346.1	0.0	347.4	212.9	560.2		1,438.7	242.2	1,680.9	190.0	0.0	190.0		190.0	160.0	29.0	189.0	14%	24%	13%	33%
2014	160.0	29.0	189.04	1,270.0	138.8	1,408.8	202.7	0.0	202.7	120.7	323.4		1,417.6	273.8	1,691.4	83.6	0.0	83.6		83.6	131.5	14.7	146.2	7%	14%	6%	19%
2015	131.5	14.7	146.20	1,269.0	172.6	1,441.6	360.8	0.0	360.8	203.7	564.5		1,512.4	368.6	1,881.0	88.7	0.0	88.7		88.7	160.2	22.3	182.6	7%	24%	6%	30%
2016	160.2	22.3	182.57																								

**Sources:** Fame Stocks: DOE/Energy Information Agency (EIA), Monthly Energy Review (MER), Table 10.4  
 Fame Production: 2000-05 (CCC Bioenergy Program, USDA); 2006-10 DOC Industry Survey (Rpt M311K); 2011-forward (DOE/EIA)  
 RD Production: Quarterly reports from REG Geismar (previously Dynamic Fuels), Diamond Green (Darling Corp.), AltAir Fuels, and UOP Honeywell collected by PRX (ProExporter Network)  
 Fame Trade: DOC/US Census Bureau, B30-100 Chapt. 38 HTS codes (assume B100) plus Petroleum Oils Containing Biodiesel (>B30) Chapter. 27 HTS codes (assume average B5 content) beginning 2012  
 RD Imports: DOE/EIA "Company Level Imports" from Petroleum and Other Liquids, product code = 205  
 RD Exports: no reliable data source due to code classification problems; assume no significant exports to date  
 Fame and RD Domestic Use: derived by balancing supply and demand

RD Stocks: EIA Monthly Petroleum Supply Report (PSM) minus MER

Export reliance = exports/production  
 Import reliance = imports/dom. use



# US Distillate Market: Large Market But Limited Growth

## Growth Potential for Biodiesel Comes Mainly From Higher Blending

### Distillate Market Flattens

- ❑ Dropping 3% or 1.95 MGs (2014-16)
- ❑ Annual growth of 0.3% (180 MGs), currently projected for 2020-25, may drop due to rising fuel efficiency
- ❑ National avg. blend rate only B3

### On-Highway Use Flattens

- ❑ Market size = 40 MGs (2015)
- ❑ Demand is sensitive to general economic activity
- ❑ Projected growth could eventually level off due to proposed Phase II GHG Savings & Efficiency Standards for Heavy Duty Vehicles (2021-27)

### Heating Oil Market in Decline

- ❑ US market = 6.3 MGs (5 yr/avg 2010-14)
- ❑ Long-term decline due to erosion from competition with natural gas (market is 50% smaller today than it was in 1985)
- ❑ 88% of US 3.7-MG residential market is located in Northeast which has some mandates for “bio” heat

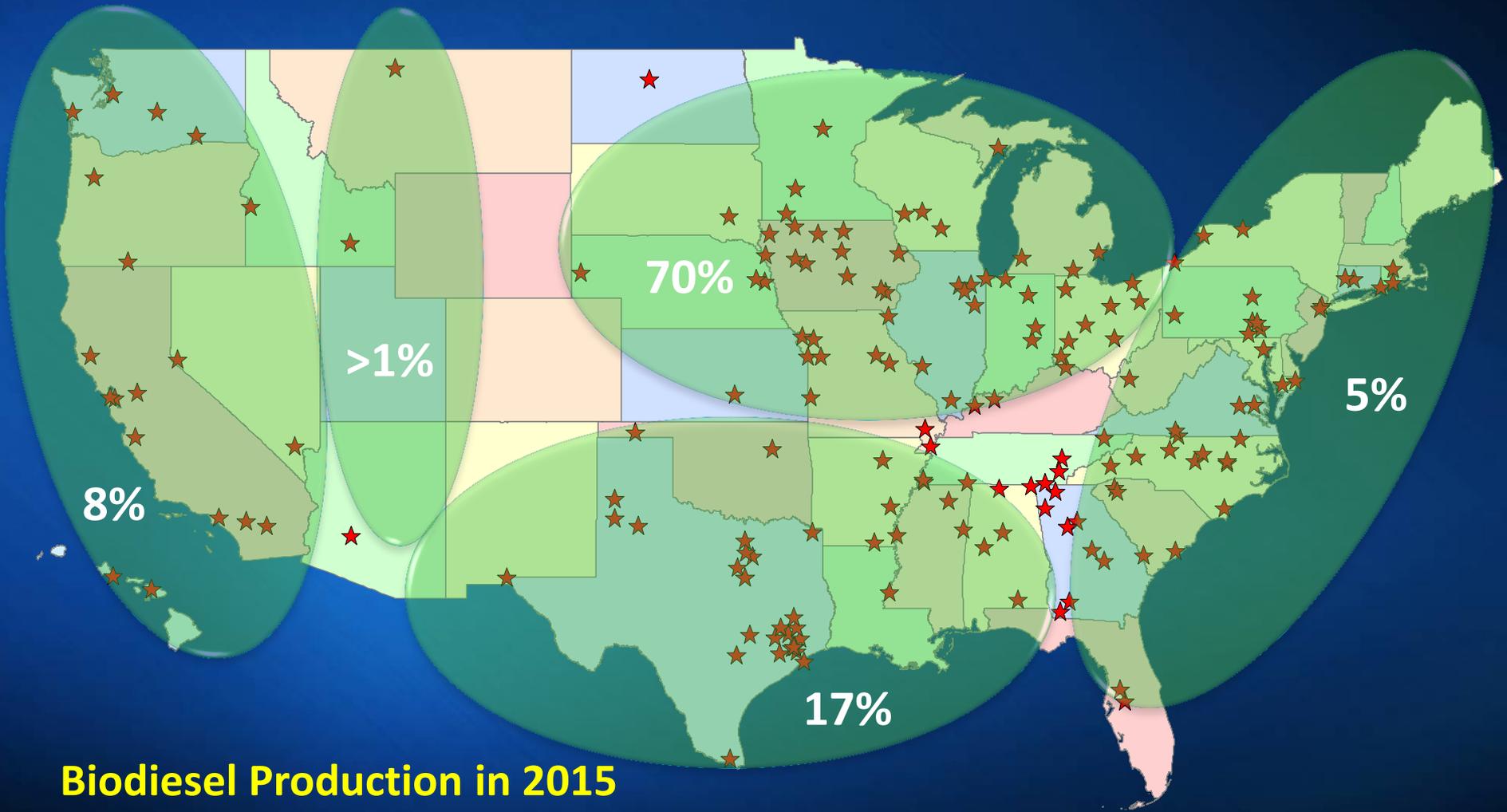
### Small Growth Projected for Distillate Market



\*Other markets = residential/commercial heating + farm + off-road

Total distillate projection from EIA 's April 2016 STEO (2015-17) + 2015 AEO (2018-25)

# Regional Imbalance: Biodiesel Production is Centered in Midwest but Not Diesel Consumption



## Biodiesel Production in 2015

Biodiesel production capacity = 2.1 BGs (RD adds 275 MGs)

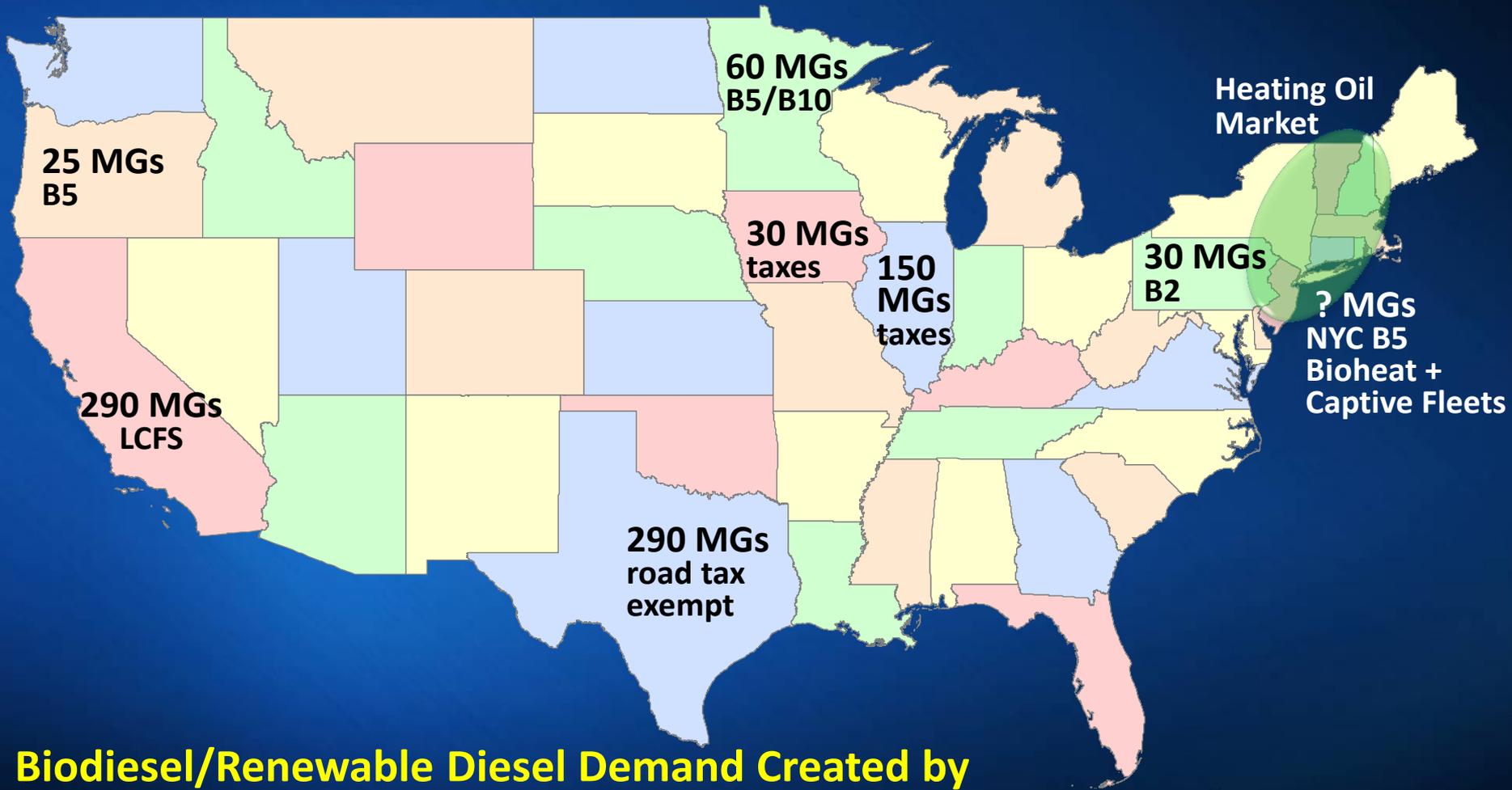
★ Biodiesel plant locations (94 plants)

% = proportion of total US biodiesel production by PADD (green zones)

Source: Energy Information Agency



# Regional Imbalance: State Policy Supports Partly Rebalance Midwest but Exacerbate Coastal Imbalance



## Biodiesel/Renewable Diesel Demand Created by Key State Mandates/Tax Policy in 2015

Identified states support half of US biodiesel/renewable diesel demand in 2015

Sources: National Biodiesel Board and California Air Resource Board



# California Moves Towards Lower Carbon Fuels

## How Has the California Diesel Transport Market Changed?

### Calif's Global Warming Solutions Act of 2008 requires GHG emissions rollback to 1990 level

- Lower the carbon intensity (CI) of the transport fuel pool 10% by 2020 from 1990 level
- reduce emission of other air pollutants (NOx, PM)

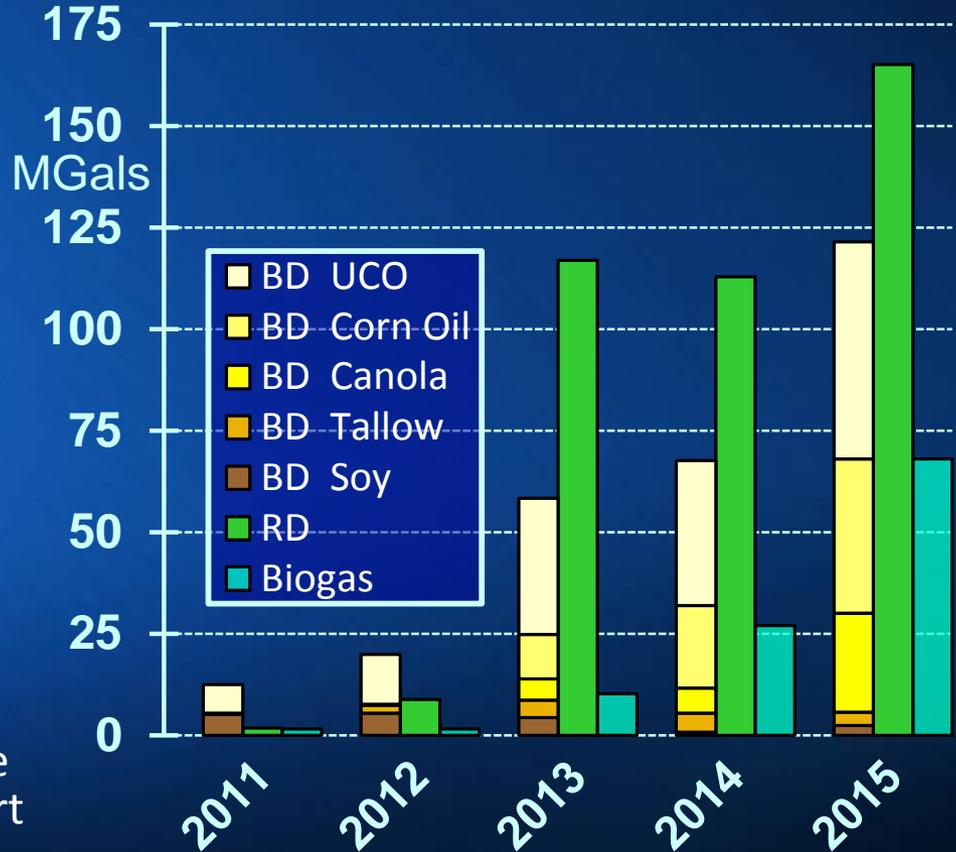
### Change Forced by...

- CI target for fuels is lowered each year
- fuels above/below target generate credits/deficits
- exchange sets value for carbon credits

### What Happened from 2011 to 2015?

- Renewable diesel use > biodiesel use
- Increased use of lowest CI biodiesels made from UCO and technical corn oil byproduct of corn ethanol plants; demand for soyoil biodiesel almost gone
- Biogas: rises from 2% to 50% of transport compressed gas market

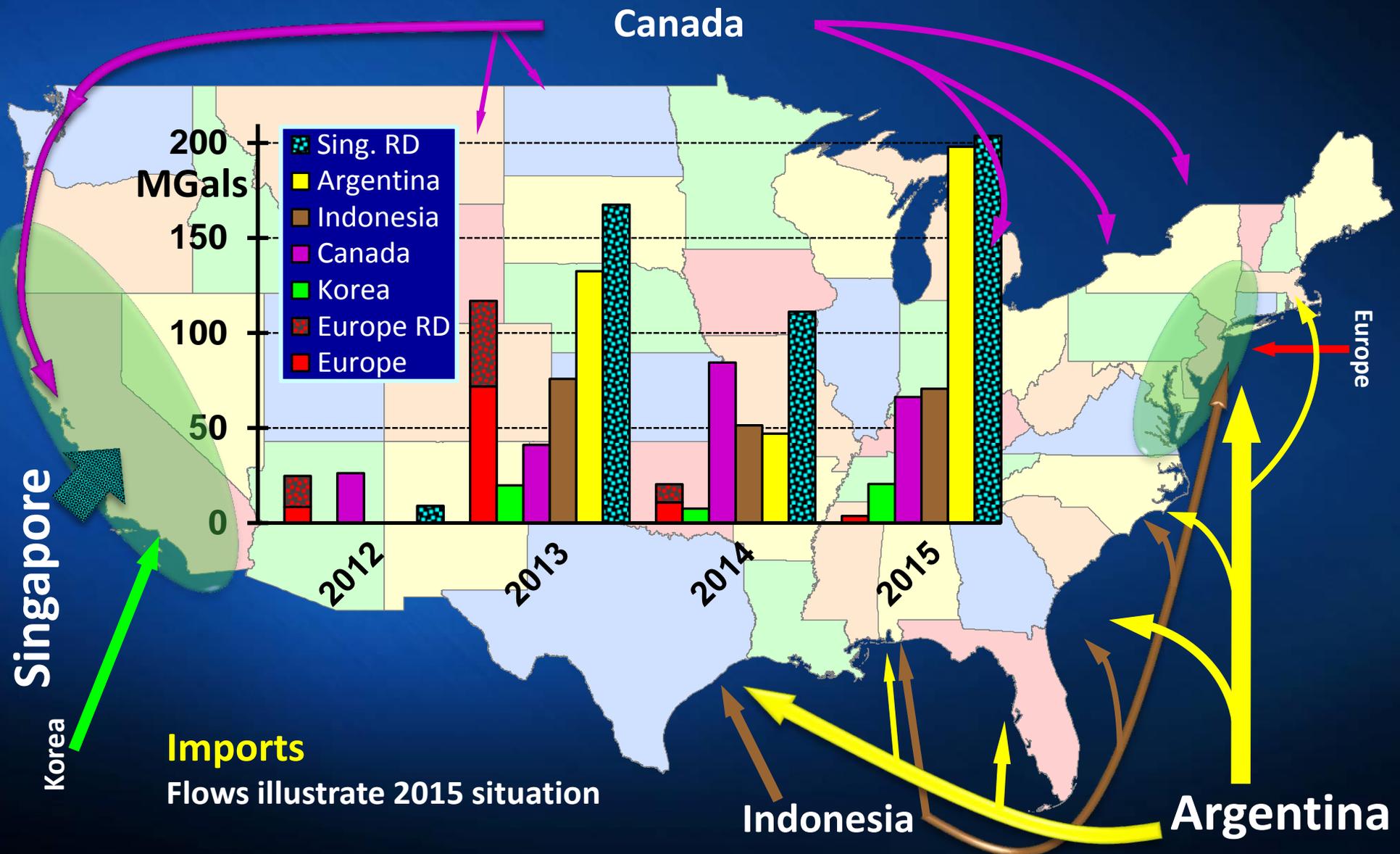
BD	0.4%	0.6%	1.7%	1.9%	3.5%
BD + RD	0.4%	0.8%	4.9%	5.0%	8.3%
Biogas	2.1%	1.9%	10.3%	21.8%	50.1%



Biogas : converted to diesel gallons equivalent; blend rate = biogas/total natural gas  
 Source: CARB LCFS Reports at <http://www.arb.ca.gov/fuels/lcfs/lrtqsummaries.htm>

# US Biodiesel/RD Imports

## Imports Target Coastal Deficit Regions





# US Biodiesel/Renewable Diesel Market

## Final Remarks

### Market Expansion Through Higher Blending

- ❑ Current average blend rate is close to B3, while nearly all OEMs approve B20
- ❑ Blend level of B10 in transport plus bioheat mandates for residential heating equals 5-6 BGs of biofuel; B20 would double this figure
- ❑ Biodiesel consumption was 1.5 BGs\* in 2015, so there is lots of room to expand from a technical engine standpoint, but delivery infrastructure must evolve further

### Past EPA Rulings Are a Positive Sign for Future

- ❑ EPA continues to increase the 'space' for biodiesel/renewable diesel, but US biodiesel industry is lobbying for larger increases
- ❑ RIN values are market responsive and will support expansion even if the \$1/gal tax credit is dropped
- ❑ US biodiesel industry is lobbying to change federal blenders tax credit to a US producers tax credit to limit foreign supplier presence in US market

\*Excludes 370 MGs of renewable diesel use in 2015, because there is no technical blending limit on this fuel.