Looking at the Economics of the Next Generation of Biofuels

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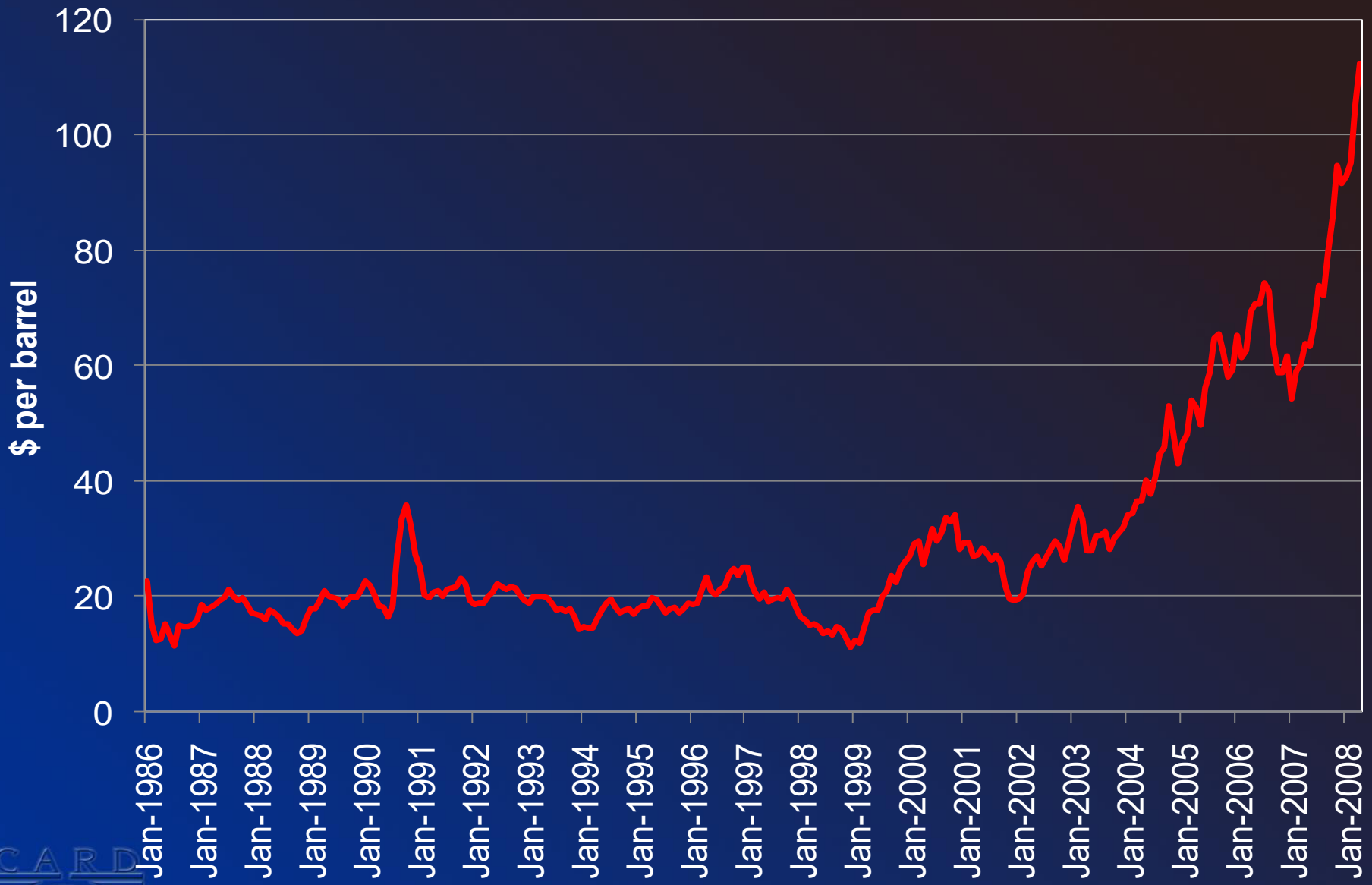
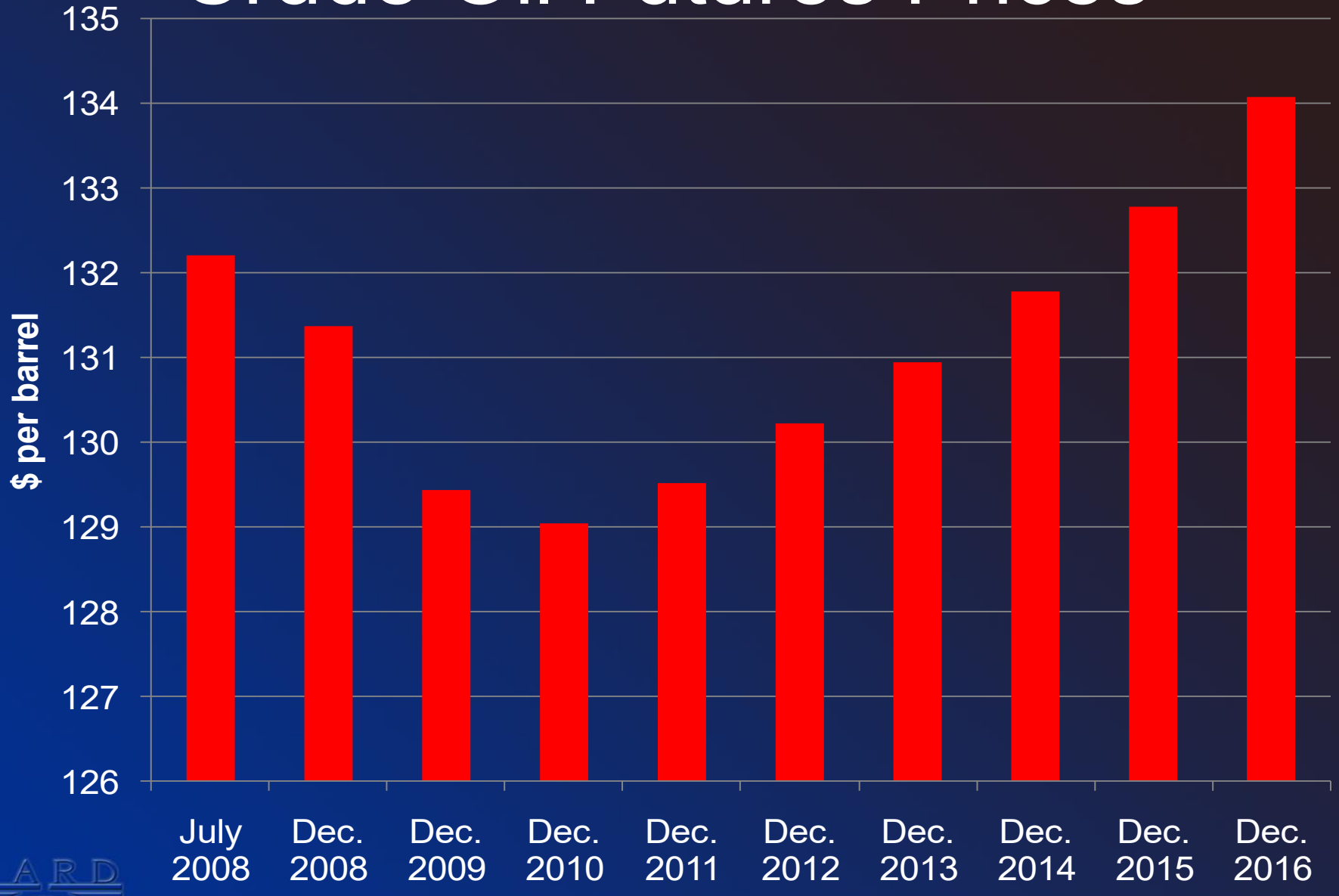
Historical Crude Oil Prices



Source: Energy Information Administration, Cushing OK Spot Price

Crude Oil Futures Prices



Source: NYMEX, May 23, 2008

Liquid Fuel Use

	2004	2010	2015	2020	2025	2030
	Million Barrels Oil Equivalent per Day	Percent of 2004 Value				
United States	20.7	103	109	115	121	129
Canada	2.3	100	100	104	104	104
Mexico	2.0	110	115	130	135	145
Europe	15.6	99	99	100	101	101
Japan	5.4	96	96	96	96	96
China	6.4	147	164	186	213	245
India	2.5	108	128	144	160	176
Africa	2.8	118	139	154	164	175
Central and South America	5.4	120	137	152	167	180
World	82.5	110	118	126	134	143

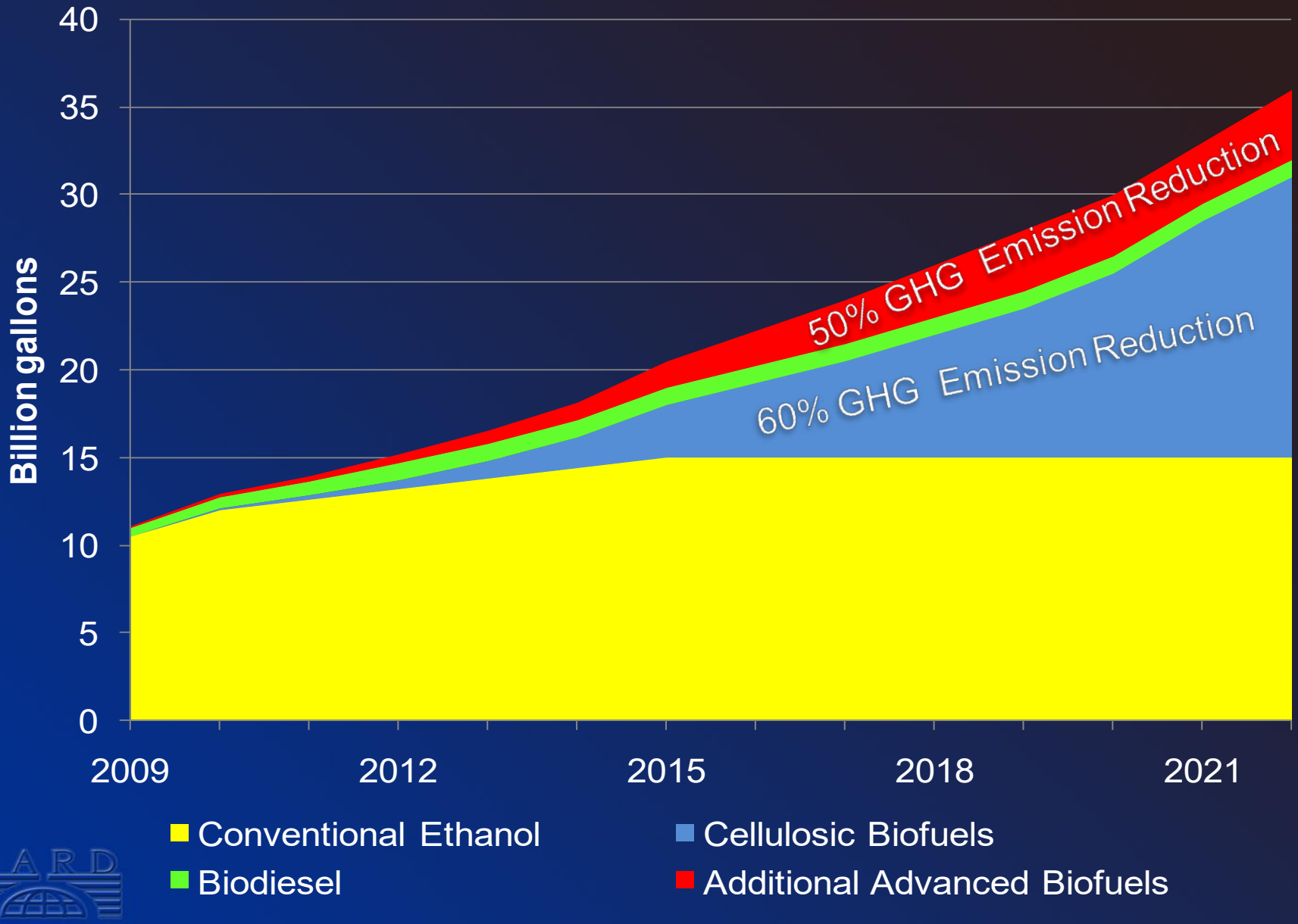
Source: EIA, International Energy Outlook 2007

Countries Pursuing Biofuels

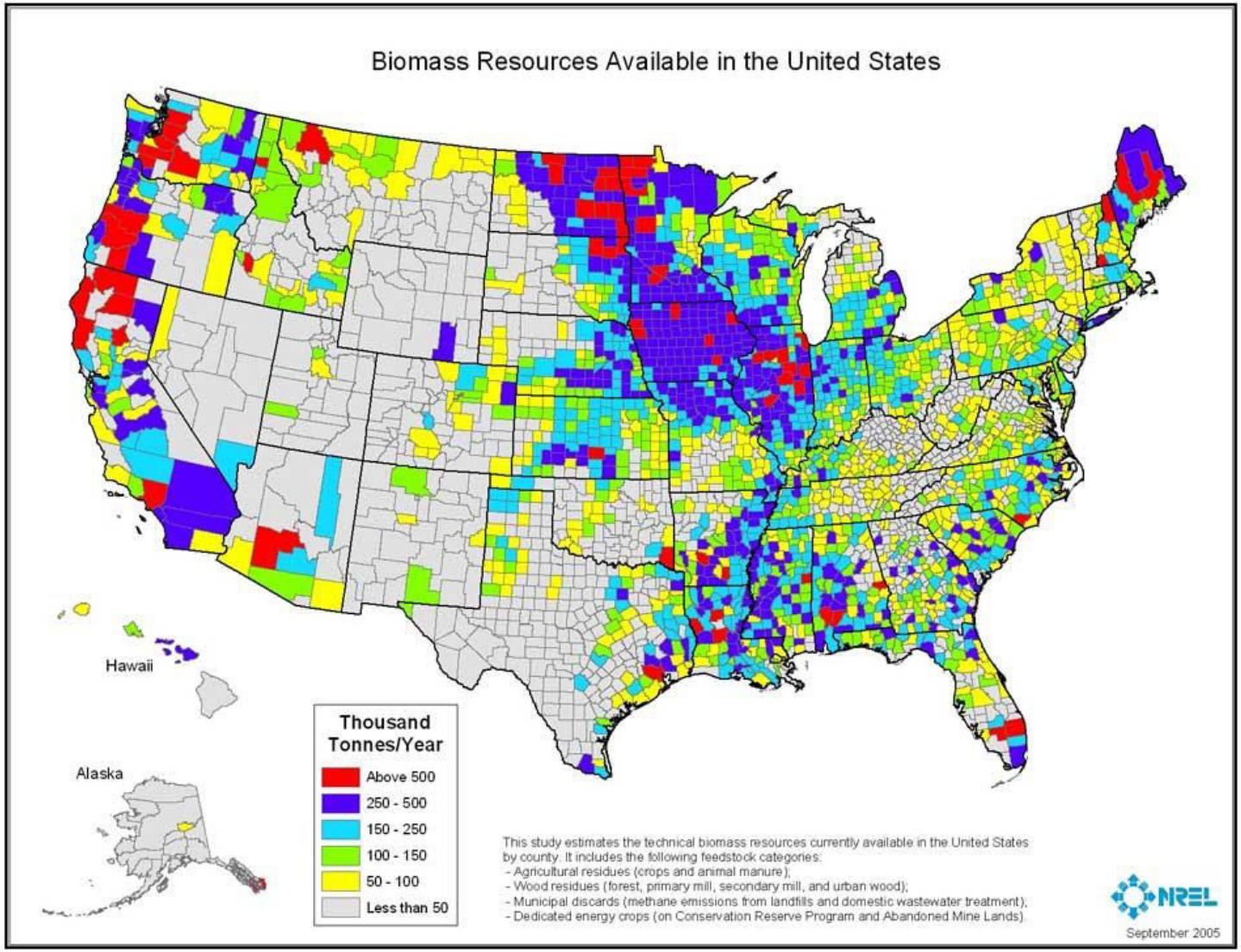
- US
- Brazil
- Argentina
- Colombia
- Paraguay
- Canada
- Uruguay
- Mexico
- Thailand
- New Zealand
- South Africa
- South Korea
- Philippines
- Indonesia
- Pakistan
- China
- India
- Malaysia
- Australia
- Japan
- EU
- Russia

- Not a complete list

Renewable Fuels Standard



Currently Available Biomass



Source: NREL, 2005

Spectrum of Biofuels

- Grain/Sugar Ethanol
- Biodiesel
- Green Gasoline/Diesel
- Cellulosic Ethanol
- Butanol
- Pyrolysis Liquids
- Syngas Liquids

Source: NREL, 2006

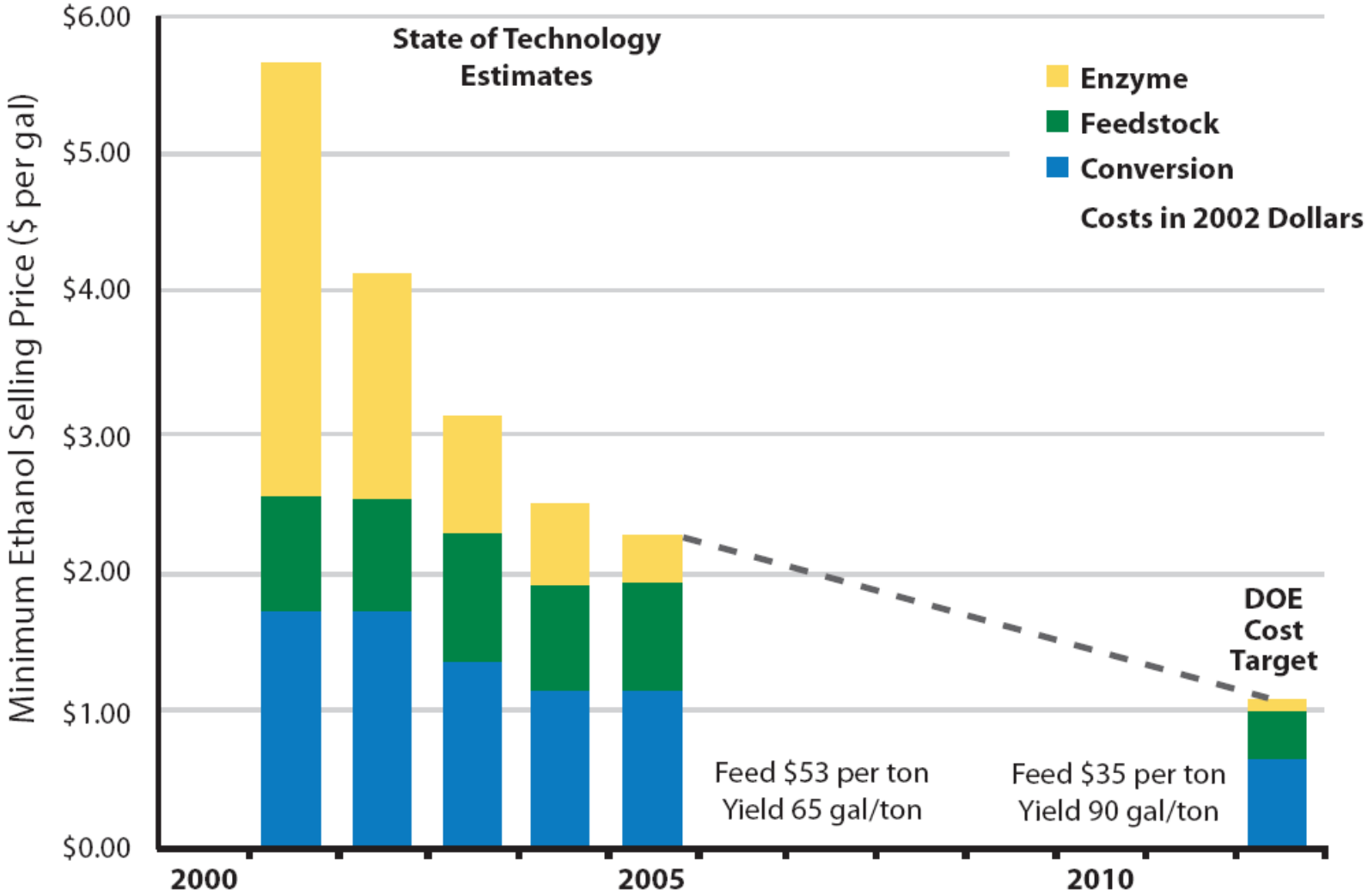
Biofuel Challenges

- Production costs
  - Conversion, ag. production, etc.
- Infrastructure barriers
  - Developing supply chain for biomass
  - Continued development of biofuel distribution system
  - Growth in biofuel-compatible vehicles

Biofuel Challenges

- Investment risks
  - Higher capital costs, emerging technology
- Biomass production shifts
  - Inducing farmers to produce new crops
- Consumer understanding
  - About the fuels
  - About the tradeoffs

Progress on Cellulosic Costs



Source: NREL, 2007

Comparing Costs, 150 Million Gallons Gasoline Equivalent, 2005 $

Plant Type	Capital Costs	Operating Costs
	($ Million)	($/Gallon)
Grain	111	1.22
Cellulosic	756	1.76

Source: Wright and Brown, *Biofuels, Bioproducts, & Biorefining* 1(2007):49-56

Production and Infrastructure Costs

Costs for Agricultural Straws and Switchgrass

	2007 Cost	2017 Projected Cost
	($ per dry ton)	($ per dry ton)
Production	13.10	26.20
Harvest & Collection	18.40	10.60
Storage & Queuing	6.10	3.70
Preprocessing	7.80	6.20
Transportation & Handling	14.70	12.30

Source: DOE, Biomass Multi-Year Program Plan, March 2008

CARD

Production and Infrastructure Costs

Costs for Agricultural Stovers

	2007 Cost	2017 Projected Cost
	($ per dry ton)	($ per dry ton)
Production	13.10	26.20
Harvest & Collection	29.50	10.60
Storage & Queuing	22.20	8.60
Preprocessing	16.40	7.80
Transportation & Handling	20.10	14.70

Source: DOE, Biomass Multi-Year Program Plan, March 2008

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Conversion Costs

Costs for Corn Stover, 2007 $

	2005 Cost	2012 Projected Cost
	($ per gallon)	($ per gallon)
Pretreatment	0.44	0.25
Enzymes	0.32	0.10
Fermentation	0.31	0.10
Distillation & Solids Recovery	0.18	0.15
	(gallons/dry ton)	(gallons/dry ton)
Ethanol Yield	65.3	89.8

Source: DOE, Biomass Multi-Year Program Plan, March 2008

Conversion Costs

Costs for Hybrid Poplar, 2007 $

	2006 Cost	2012 Projected Cost
	($ per gallon)	($ per gallon)
Feed Handling & Drying	0.18	0.16
Gasification	0.14	0.13
Synthesis Gas Clean-up	0.69	0.43
Fuel Synthesis	0.08	-0.03
Product Purification	0.05	0.05
	(gallons/dry ton)	(gallons/dry ton)
Ethanol Yield	63.2	69.8

Source: DOE, Biomass Multi-Year Program Plan, March 2008

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Switchgrass in the Plains

- Found ethanol yields per acre comparable to corn grain ethanol

- But indicated that switchgrass would likely be targeted to marginal land where row crop production is less profitable

Source: Schmer, Vogel, Mitchell, and Perrin, *Proceedings of the National Academy of Sciences* 105(2008):464-469

Competing for Acreage

Crop	Net Return
	($ per acre)
Wheat	115 – 135
Rice	230 – 370
Corn	330 – 400
Sorghum	85 – 105
Soybeans	305 – 345
Cotton	150 – 200

Source: FAPRI, 2008

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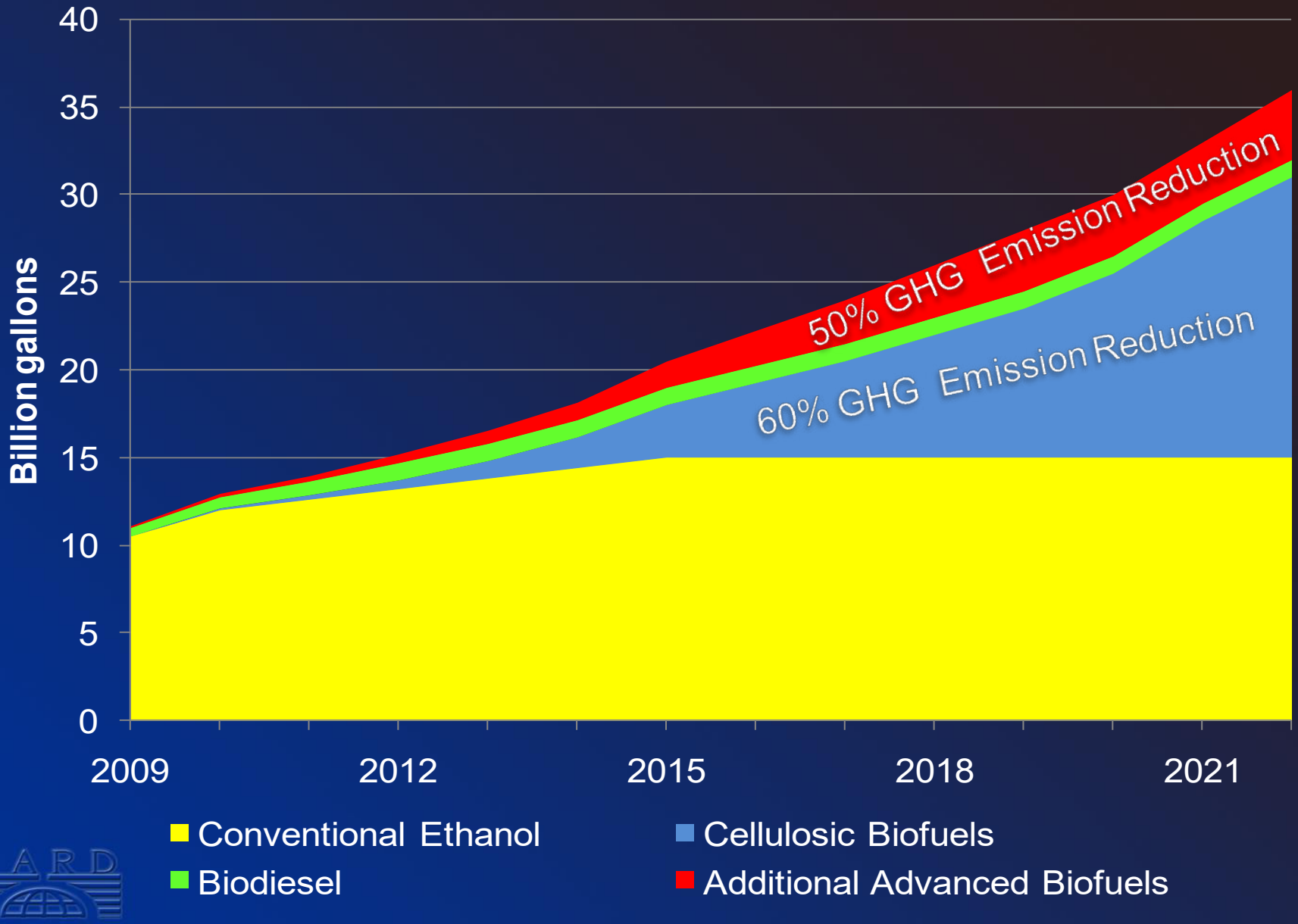
Renewable Fuels Standard



Cellulosic Biofuel Waiver Provisions

- EPA (in consultation with DOE and USDA) can reduce the cellulosic biofuel mandated volume
- Waiver trigger based on EIA projections
- EPA will also sell cellulosic biofuel credits
  - Price set at Max($0.25 per gallon, $3.00 – Average wholesale gasoline price per gallon)

Components of 2007 Energy Act

- Up to $500 million per year in grants for the production of advanced biofuels (with at least an 80% reduction in GHG emissions relative to current fuels)

- Up to $25 million per year in grants for R&D for biofuel production in states with low rates of biofuel production

Energy in the Farm Bill

- Grants for the development and construction of advanced biofuel biorefineries, up to 30% of the cost of the project

- Loans for the same, up to $250 million or 80% of the cost per project

Bioenergy Program for Advanced Biofuels

- Payments to support advanced biofuel production
- Payment structure to be determined by USDA
- Mandatory funding: $55 million for 2008-2009, $85 million for 2010, $105 million for 2011

Bioenergy Program for Advanced Biofuels

- Discretionary funding: $25 million each year

- Not more than 5% of the funds can be directed to biorefineries with production capacities above 150 million gallons per year

Biomass R&D Technical Advisory Committee

- 3 key areas of direction
  - Feedstock development
  - Biofuels and biobased products development
  - Biofuels development analysis

- Funding
  - Mandatory: $20-40 million for 2009-2012
  - Discretionary: $35 million each year

Biomass Crop Assistance Program

- To support production of crops for bioenergy and assist with collection, harvest, storage, and transportation of biomass to conversion facilities

- Excluded materials
  - Farm program crops, animal byproducts, food waste, yard waste, algae

Biomass Crop Assistance Program

- Requires producers and conversion facilities to submit proposal establishing a project area
- Establishes contracts between USDA, producers, and facilities to promote project
- Sets up establishment payments for perennial crops and annual payment to biomass producers

Biomass Crop Assistance Program

- Payments are also authorized for biomass collection, harvest, storage, and transportation

- Matching payments
  - $1 for each $1 per ton paid by conversion facility, up to $45 per ton, for 2 years

Other Energy Provisions in the Farm Bill

- Cellulosic biofuel producer tax credit: $1.01 per gallon
  - Restricted to domestic production

- Waives limits on small ethanol producer credit for cellulosic ($0.10 per gallon)

Thank you for your time.

Any questions?