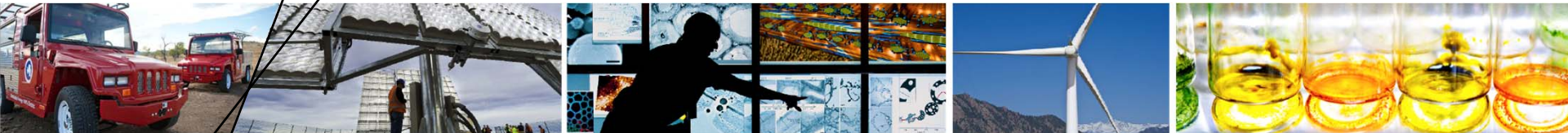


# What Has the Federal Renewable Fuels Standard Accomplished – a National Perspective



## *Great Expectations: The Future of the Nation's Ethanol Industry*

*Sioux, South Dakota*

**Amy Schwab - NREL**

**March 13, 2013**

**NREL/PR-6A10-58179**

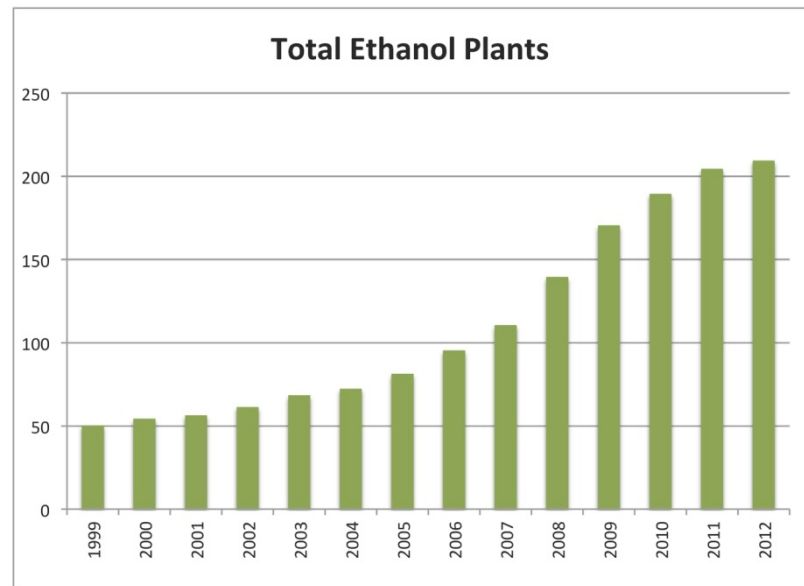
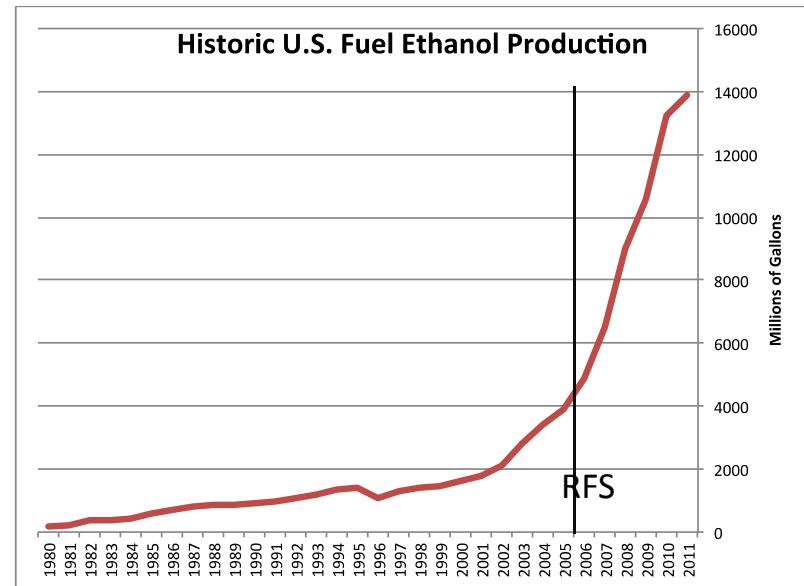
# A National Perspective

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- **Accomplishments and challenges**
- **Where are we now?**
- **Looking ahead**

# Thirty Years of Accomplishments

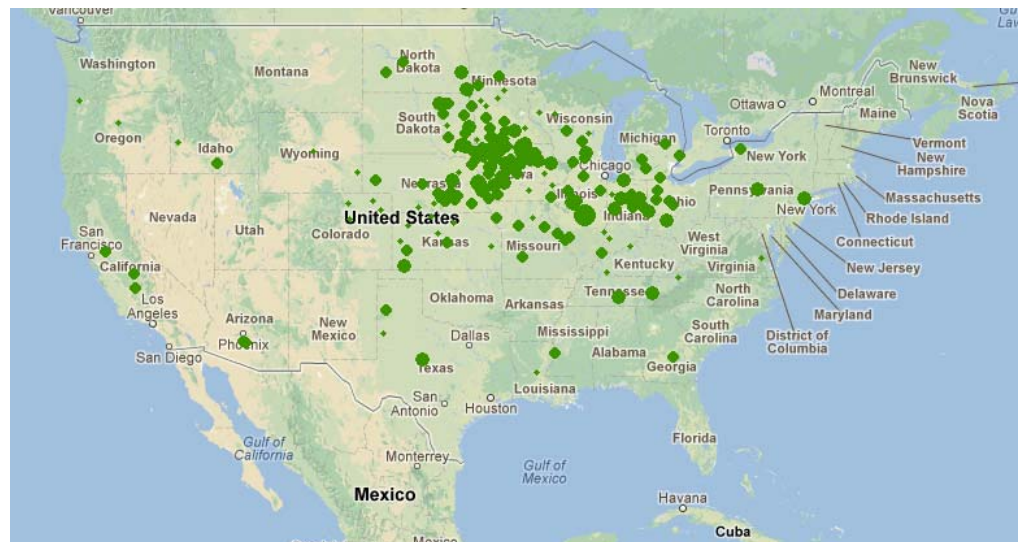
- **Three decades of growth**
  - ~14 billion gallons capacity in 2012
  - >200 corn ethanol plants
  - 29 states
- **Before RFS**
  - Average annual growth rate 14%
- **After RFS**
  - Average annual growth rate 23%



Source for both: Renewable Fuels Association: <http://ethanolrfa.org/pages/statistics>

# Estimates of Job Impacts Vary

- **45,900 new jobs in the United States to produce 14 billion gallons of ethanol<sup>1</sup>**
- **87,292 direct U.S. jobs supported<sup>2</sup>**
  - +295,969 indirect jobs
  - + \$43.4 billion GDP
  - + \$30.2 billion to household income



Source: BioFuels Atlas. Accessed March 7, 2013. <http://maps.nrel.gov/biomass>. Data provided by the Renewable Fuels Association.

<sup>1</sup>Swenson, D. (July 2011). "Planning for Advanced Biofuels Job Growth Expectations." Presented at the Biomass 2011 Conference.

[www1.eere.energy.gov/biomass/pdfs/bio2011\\_swenson\\_2-5.pdf](http://www1.eere.energy.gov/biomass/pdfs/bio2011_swenson_2-5.pdf)

<sup>2</sup>Urbanchuk, J. (January 2013). *Contribution of the Ethanol Industry to the Economy of the United States*.

[http://ethanolrfa.3cdn.net/af18baea89e31dadbe\\_68m6bnto3.pdf](http://ethanolrfa.3cdn.net/af18baea89e31dadbe_68m6bnto3.pdf)

# Impact to the Consumer

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## Lower retail gasoline prices

- **2008 McKinsey study @ 6% market share**
  - Retail prices \$0.17/gallon lower due to ethanol
    - \$115 annual savings to consumer
    - \$24 billion savings for all U.S. drivers
  - Compared with Cost of Subsidy
    - \$4.6 billion/year or \$0.03/gallon
    - \$22/driver or \$15/citizen
- **@ 10% share of market with \$60-120/bbl oil**
  - \$0.19 to \$0.50/gallon lower retail price

Source: *The Impact of Ethanol Blending on U.S. Gasoline Prices*. NREL/McKinsey and Company

# Challenges Remain

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- **Production declined 5% in 2012**
  - E10 blend wall / **↑** corn prices / **↓** gasoline demand
- **Infrastructure compatibility concerns continue**
  - E15 slow to take off
  - High blends
    - Hampered by public perceptions
    - Limited availability – of fuel/of FFVs
- **Public perceptions - food versus fuel**
  - Ethanol's contribution to record corn prices

# Positioning for the Future

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- **2012 DOE cellulosic R&D ethanol milestones**
  - Successful demonstration of technologies capable of producing cost-competitive cellulosic ethanol<sup>1</sup>
  - Via two pathways:
    - Biochemical conversion pathway – biomass pretreatment and enzymatic hydrolysis followed by fermentation
    - Thermochemical conversion pathway – gasification, syngas cleanup, and catalytic fuels synthesis

<sup>1</sup>DOE Biomass Program: Multi-Year Program Plan. November 2012

# Cellulosic Biorefineries Coming Online

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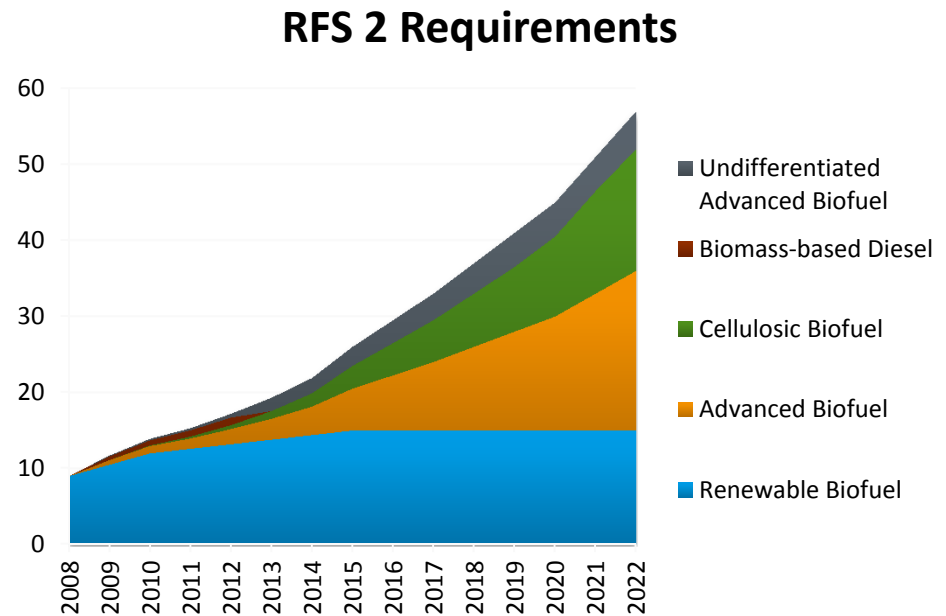
- Two DOE-supported commercial-scale cellulosic biorefineries under construction and expected to begin production in 2014
- Other biorefineries have started up and are due to start up in the next few years

Source: *Cellulosic Biofuel to Surge in 2013 as First Plants Open*. [www.bloomberg.com/news/2012-12-11/cellulosic-biofuel-to-surge-in-2013-as-first-plants-open.html](http://www.bloomberg.com/news/2012-12-11/cellulosic-biofuel-to-surge-in-2013-as-first-plants-open.html). December 2012.



# Opportunities: Advanced Biofuels Mandate

- Build markets for E15 and mid-level blends
- Build on technologies for producing cellulosic ethanol
- Deliver on promise of infrastructure compatible hydrocarbons



Source: "Renewable Fuels Standard." Renewable Fuels Association. Accessed January 2013. [www.ethanolrfa.org/pages/renewable-fuels-standard](http://www.ethanolrfa.org/pages/renewable-fuels-standard)

# Projections of RFS Impact

- **Economic impact of additional 21 billion gallons advanced biofuels by 2022<sup>1</sup>**
  - 190,000 direct jobs/ 807,000 total jobs
  - \$37 billion direct economic output
  - \$148.7 billion total economic output effect for the U.S. economy
  - \$70 billion reduction in U.S. petroleum imports
  - The cumulative total of avoided petroleum imports over the period 2010–2022 would exceed \$350 billion.
- **.8% GDP contribution to U.S. GDP/.21% globally<sup>2</sup>**

<sup>1</sup>Bio-era 2009 Report: *U.S. Economic Impact of Advanced Biofuels Production: Perspectives to 2009*

<sup>2</sup>"Global economic effects of US biofuel policy and the potential contribution from advanced biofuels." Oladosu, Biofuels, 2012

# Projections of RFS Impact

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- **Environmental impact of additional 21 billion gallons advanced biofuels by 2022**
  - Displace imports of ~13.6 billion gallons petroleum fuels<sup>1</sup>
  - Reduce GHG emissions equivalent to taking 27 million vehicles off the road

<sup>1</sup> Schnepf, Randy. *Renewable Fuel Standard (RFS): Overview and Issues*. Congressional Research Service. July 2010.

# Challenges to Overcome

## Cellulosic and Algal Biofuels

Need performance on multiple dimensions

### Feedstocks

Need high  
production  
and sustain-  
able yields &  
removal rates

Herbaceous /  
Woody / MSW /  
Algae

### Logistics

Need cost  
effective,  
stable, flowable,  
transportable,  
on-spec  
feedstocks

### Conversion

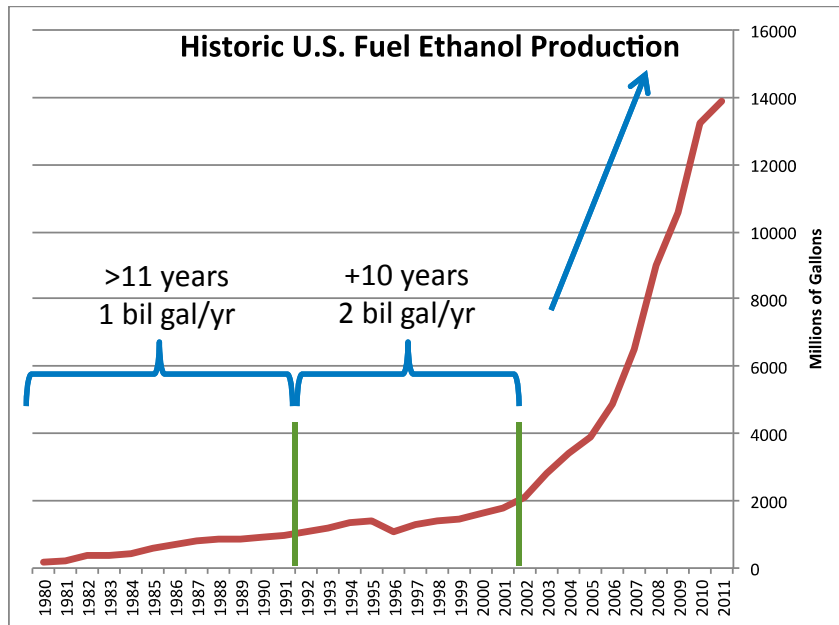
Need high yield  
Low cost  
Scale

Options -  
BC/TC/hybrid

# Great Expectations – Cautious Outlook

## Corn Ethanol

We didn't get here overnight



Source: Renewable Fuels Association: <http://ethanolrfa.org/pages/statistics>

- >11 years to reach 1 billion gallons/year
- +10 years to exceed 2 billion gallons
- Latest decade
  - From 2 billion gallons/year to nearly 14 billion gallons/year

# **Thank You**

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