

Advanced Biofuels Production Potential Impact on U.S. Workforce

Biotechnology Industry Organization
Industrial & Environmental Section

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The Biotechnology Industry Organization (BIO)

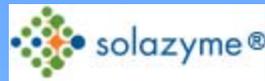


What is BIO?

- The world's largest biotechnology organization with more than 1,100 member companies worldwide.
- Among its membership, BIO represents over 85 leading technology companies in the production of conventional and advanced biofuels and other sustainable solutions to energy and climate change challenges.
- BIO also represents the leaders in developing new crop technologies for food, feed, fiber, and fuel.



Who is BIO? Some BIO Industrial and Environmental Section Members



***bio-era 2009 Report: “U.S. Economic
Impact of Advanced Biofuels Production:
Perspectives to 2030”***



U.S. Economic Impact of Advanced Biofuels Production: Perspectives to 2030 - Shows Potential Job Creation*

➤ Objectives:

- Assess implications of advanced biofuels* production in terms of economic output, job creation, and petroleum import reduction

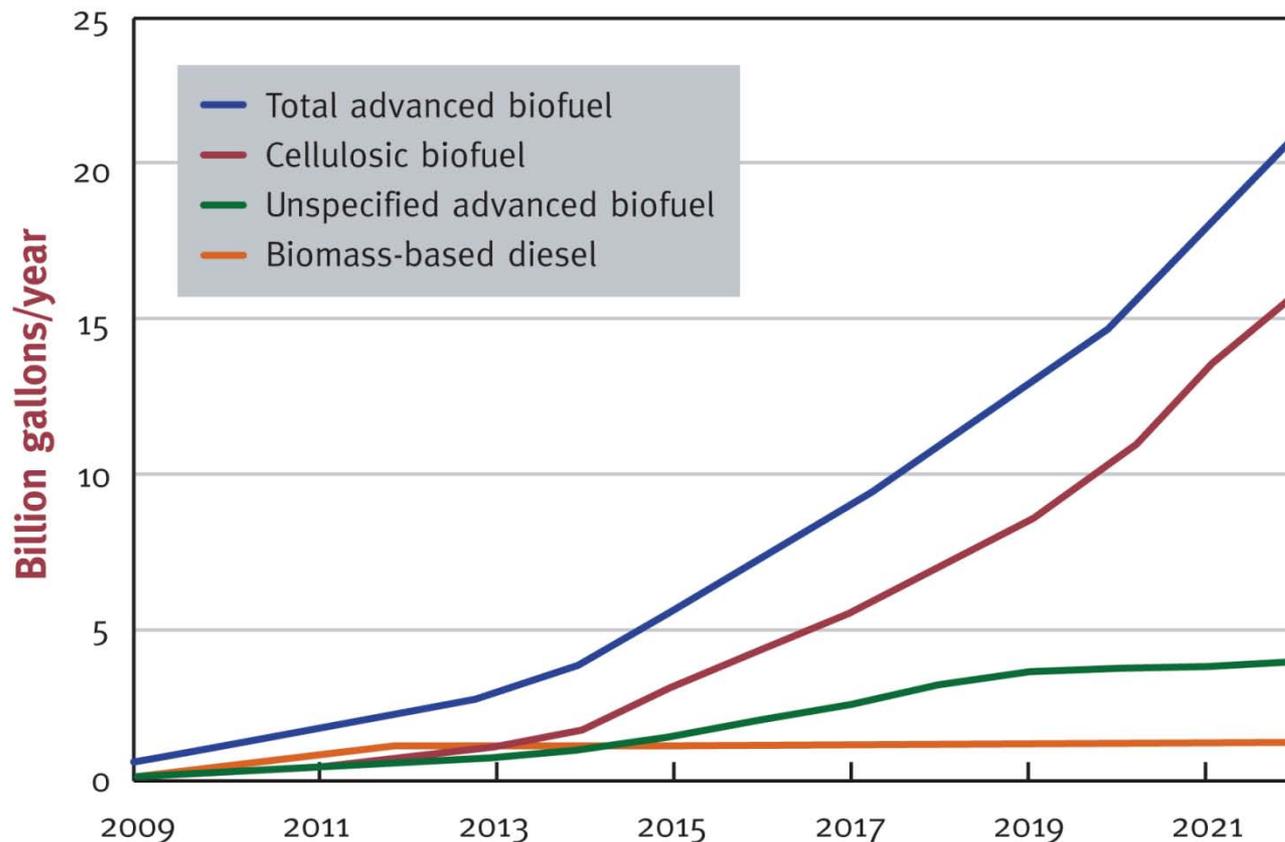
➤ Scope:

- Analyze advanced biofuels production through 2022 at RFS levels in Energy Independence and Security Act of 2007
- Analyze 45 BGY production scenario for 2030, assuming ongoing growth of capacity at 3 BGY per year

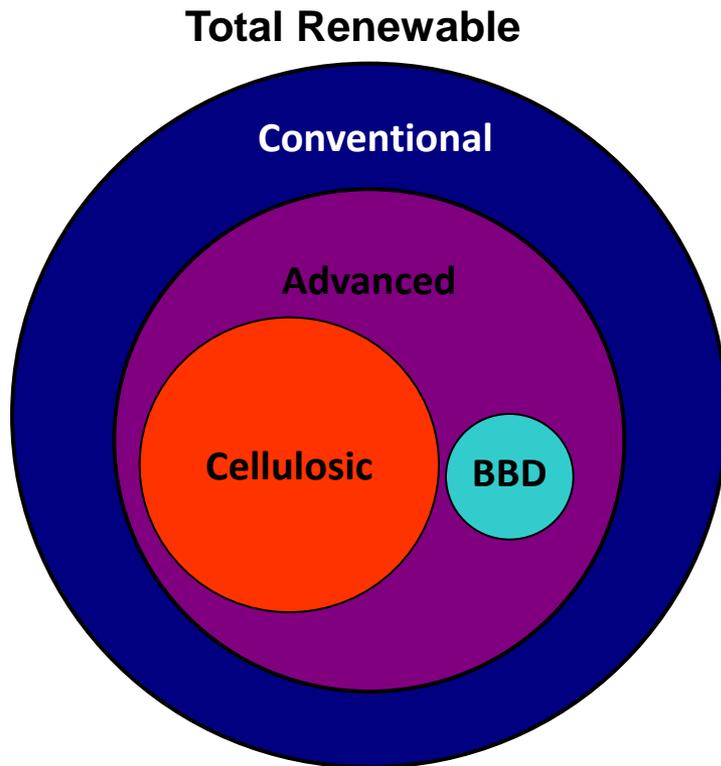
*Research carried out independently by bio-era, with financial support from the Industrial and Environmental section of the Biotechnology Industry Organization (BIO); February 2009

Advanced Biofuels Production to 2022 Under the Federal Renewable Fuel Standard

U.S. Production of Advanced Biofuels under RFS



Maintaining RFS Specific Standards Drives Continued Investment in Advanced Biofuels Production

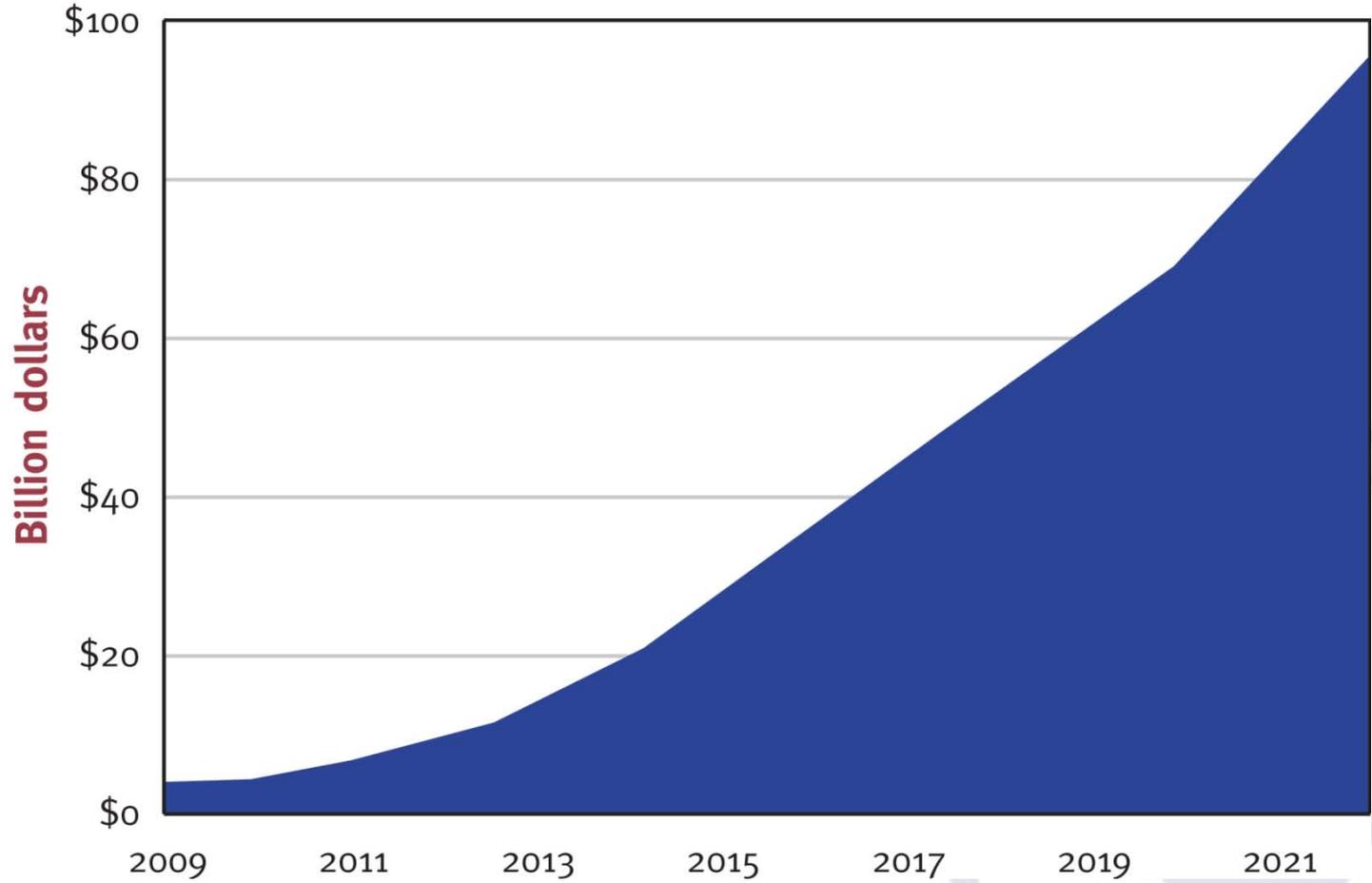


- Total Renewable Obligation by 2022 = 36 billion gallons, of which:
 - Advanced Fuels must comprise at least 21 billion gallons, of which
 - Cellulosic Fuels must comprise at least 16 billion gallons
- Compliance with Cellulosic also provides compliance with Advanced and Total Renewable obligations
- The U.S. EPA has kept annual levels of both conventional and advanced biofuels at the levels mandated under the RFS law.
- The current shortfall in cellulosic biofuel production has not impacted the requirement to meet the overall mandated level of advanced biofuels.

Analysis Approach: Building on Existing Knowledge and Estimates of Advanced Biofuels Production Economics

- Conducted meta-analysis of engineering, economic, and input-output studies of advanced biofuels production
- Assessed direct economic impacts based on:
 - capital and operating costs of processing facilities
 - feedstock production, harvest, transport and storage costs
 - biofuels transportation and distribution costs
 - investments in R&D; revenues from technology licensing
- Modeled economic multiplier effects to estimate indirect and induced output and job creation
- Estimated reductions in petroleum imports based on displaced gasoline and diesel consumption

Cumulative Investment in Advanced Biofuels Processing Plants Could Reach \$95 billion by 2022

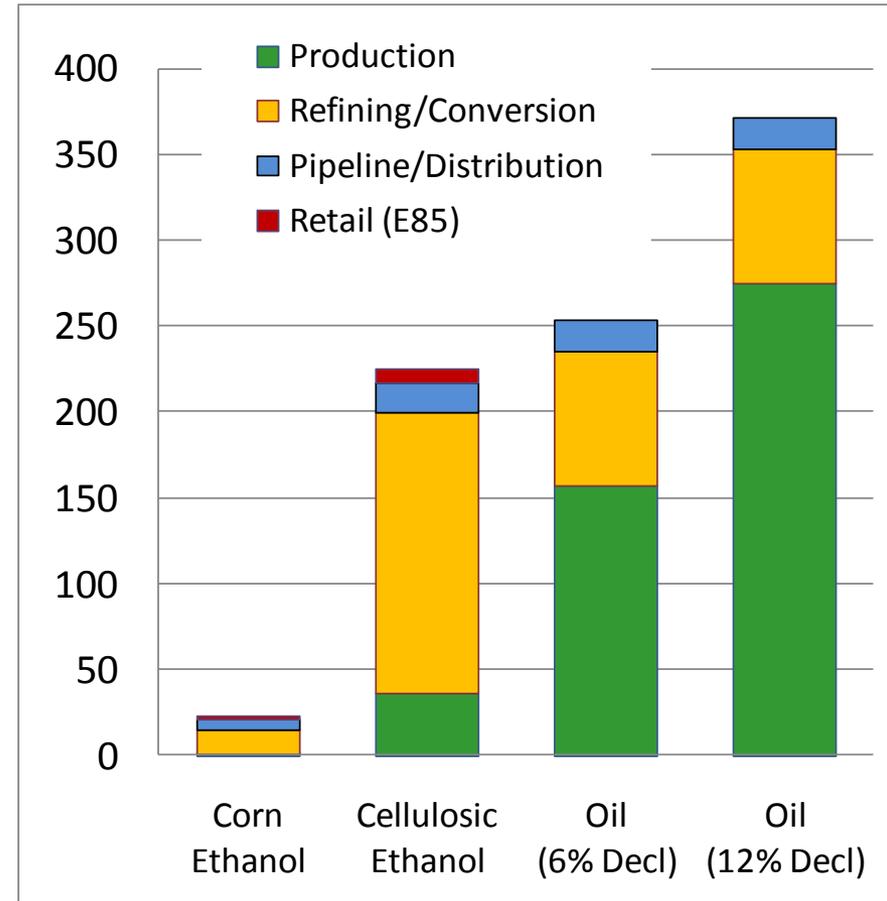


Capital Needs for Biofuels is Significant, But Developing New Oil Supplies Will Be Equally Capital Intensive

- CAPEX for 60 BGY ethanol: \$250B
- CAPEX for 40 BGY petroleum: \$250B-\$370B
- \$160B to \$270B for exploration and production



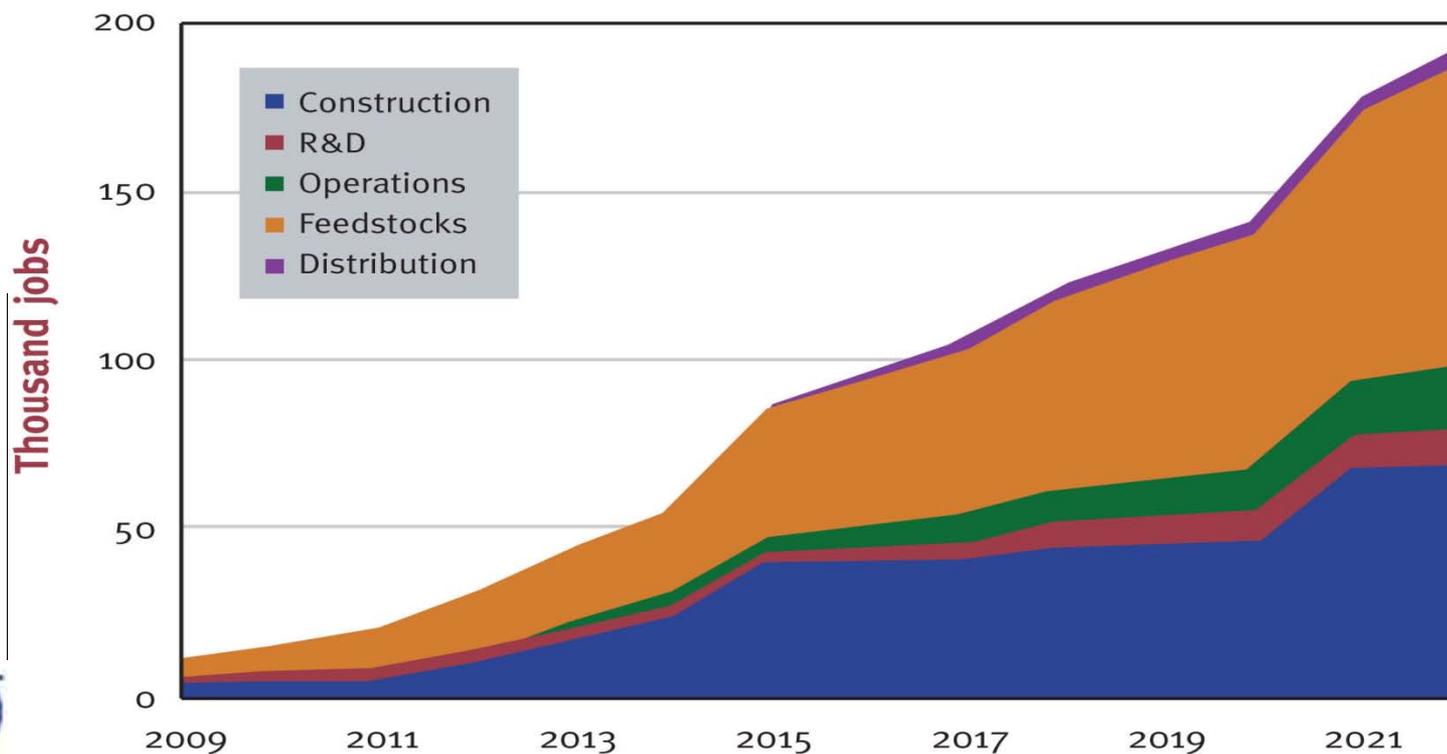
Capital Investments Required, \$B



*New production of 40B gal oil per year in Gulf of Mexico assumes 6% or 12% decline in field over a 50-year period. (Requires ongoing investment in oil field production)

Job Creation Potential in Agriculture, Construction, Research, Operations

Jobs Directly Created from U.S. Advanced Biofuels Production

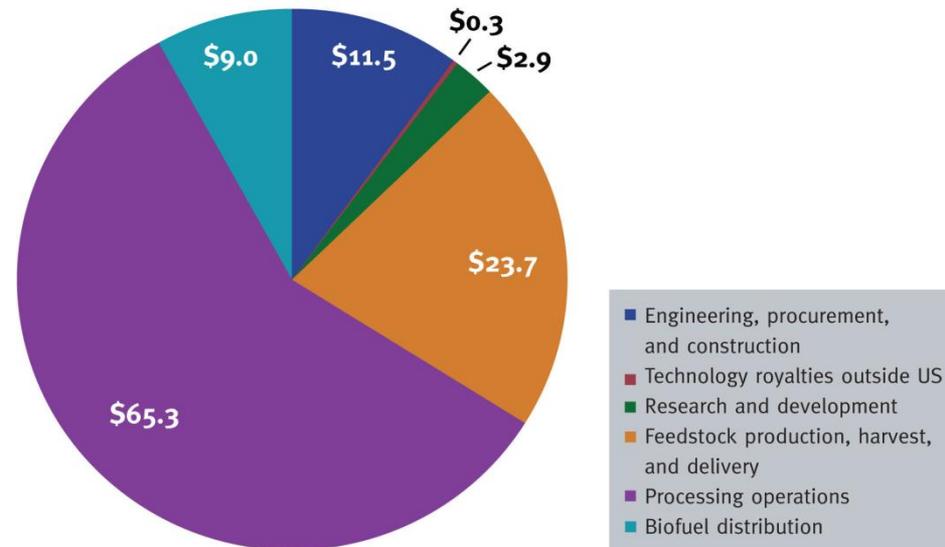


Increasing Advanced Biofuel Production to 45 BGY by 2030

➤ **Would create:**

- More than 400,000 jobs within the industry
- Nearly 1.9 million jobs throughout the economy
- Direct economic activity of \$113 billion
- Total economic boost of \$300 billion

Direct Economic Output from 45 BGY Advanced Biofuels Production (billion dollars)



Current Advanced Biofuels Workforce Needs and Outlook



Public-Private Partnerships Already Creating Jobs

DOE, USDA Partnerships: Jobs Created

- Abengoa Bioenergy 94 permanent, 250 construction
- Algenol* 120
- Alpena Biorefinery 10 permanent
- Amyris 50
- Bluefire Ethanol 50 permanent, 250 construction
- Coskata 700 direct and indirect
- Enerkem, Inc. 70 permanent
- INEOS Bio 50 permanent, 175 construction
- Lignol 39 permanent, 200 construction
- Logos 43 permanent
- Mascoma 50 permanent and 150 construction
- Myriant 50 permanent, 250 construction
- POET Project Liberty 35 permanent and 200 construction
- Sapphire Energy 30 direct
- Solazyme 388 direct and 256 indirect
- UOP Renewables 40 direct
- ZeaChem 19 permanent

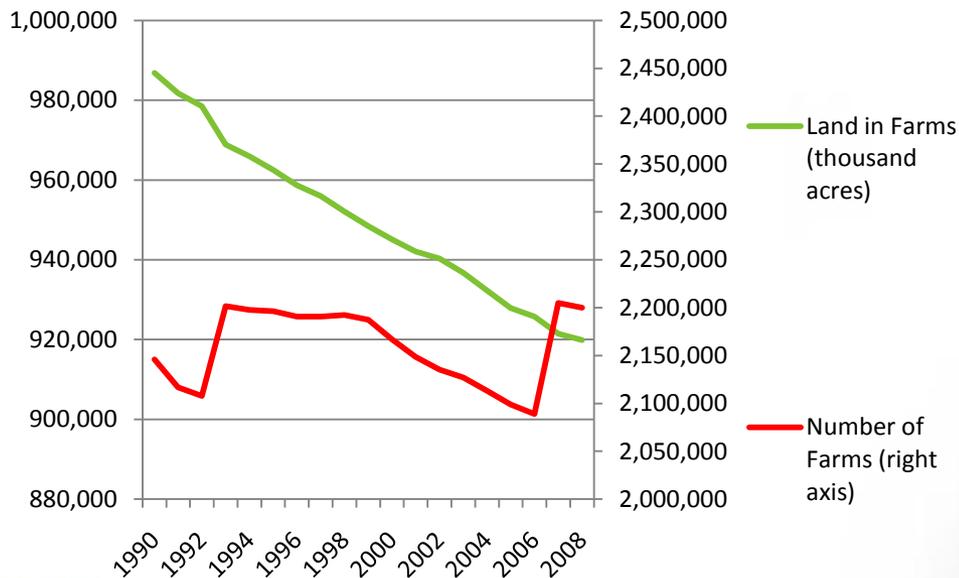
Advanced Biofuels Job Creation Expected to Increase in Various Sectors of the Industry

- Recent *Biofuels Digest* research shows expected growth and opportunities in the following types of industry jobs*:
 - Baling systems and sales
 - Agriculture residue pick-up, storage and aggregation
 - Algae protein shipping & distribution
 - Pellet sales & distribution
 - Forest slash pick-up and storage
 - Grease pick-up
 - Truck stops near integrated biorefineries
 - RIN pricing services
 - Low-cost sugar sales and distribution
- This list represents just some of the areas of job growth expected as the advanced biofuels industry continues to develop. For instance, as the bio-era report shows, other areas of expected growth are in feedstock production and construction, processing, research and development, and distribution.

*Source: *Biofuels Digest*, —Jobs, Jobs, Jobs: What Color is Your Biochute?,” July 18, 2011, available at: <http://biofuelsdigest.com/bdigest/2011/07/18/jobs-jobs-jobs-what-color-is-your-biochute/>

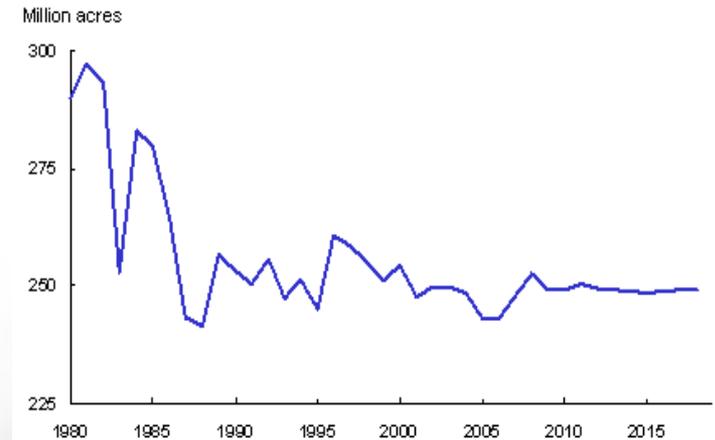
Biofuel Production Has Stemmed Loss of Farms/Farmland

- Since 1990, the amount of land available to U.S. farmers decreased, but is now projected to remain stable.
- Area devoted to 8 major crops has declined since 1980, but is projected to remain stable through 2018.



Source: USDA NASS

U.S. planted area: Eight major crops 1/



1/ The eight major crops are corn, sorghum, barley, oats, wheat, rice, upland cotton, and soybeans.

Source: USDA Agricultural Projections to 2018, February 2009. USDA, Economic Research Service.

Conclusion

- The bio-era report shows the potential for job creation resulting from advanced biofuels production under certain scenarios, including meeting all RFS mandates as established under the law
- Potential for meeting RFS mandates—and corresponding expected job creation—remains as long as EPA continues to implement the policy as it has so far so that the overall advanced biofuels mandate will continue to be an investment driver for those types of fuels
- Challenges also remain due to lasting effects on the industry from the economic downturn, combined with the huge amount of investment needed to meet the RFS mandates by 2022
- Current research shows expected continued investment in advanced biofuels production resulting in significant numbers of new jobs

Pacific Rim Summit on Industrial Biotechnology & Energy

In conjunction with **BioMalaysia**

November 21-23, 2011

Kuala Lumpur, Malaysia

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