

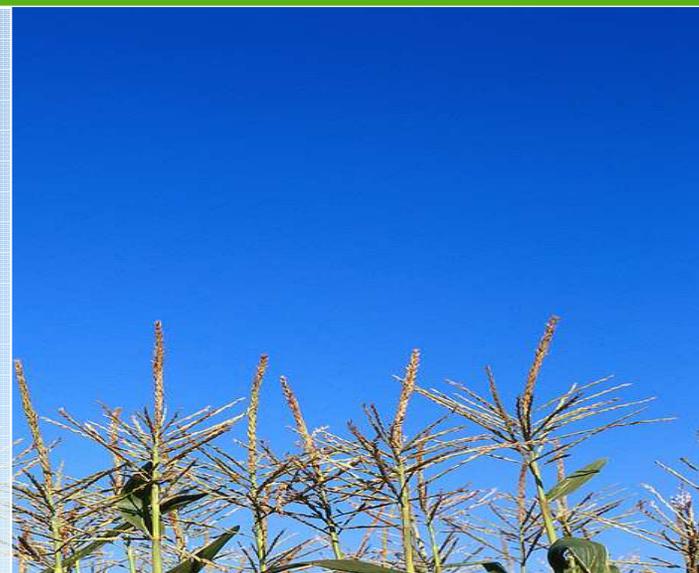


U.S. Department of Energy
**Energy Efficiency
and Renewable Energy**

Bringing you a prosperous future where energy
is clean, abundant, reliable, and affordable

U.S. Department of Energy Biomass Program

*Strengthening U.S. Energy Diversity &
Security with Abundant Domestic Resources*



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Energy Efficiency and Renewable Energy
U.S. Department of Energy



President Bush 2006/2007 SOU Addresses



2006

“America is addicted to oil... The best way to break this addiction is through technology.
Our goal is to make this ethanol practical and competitive within six years.

To replace more than 75 percent of our oil imports from the Middle East by 2025.” – 50 B gallons of EtOH

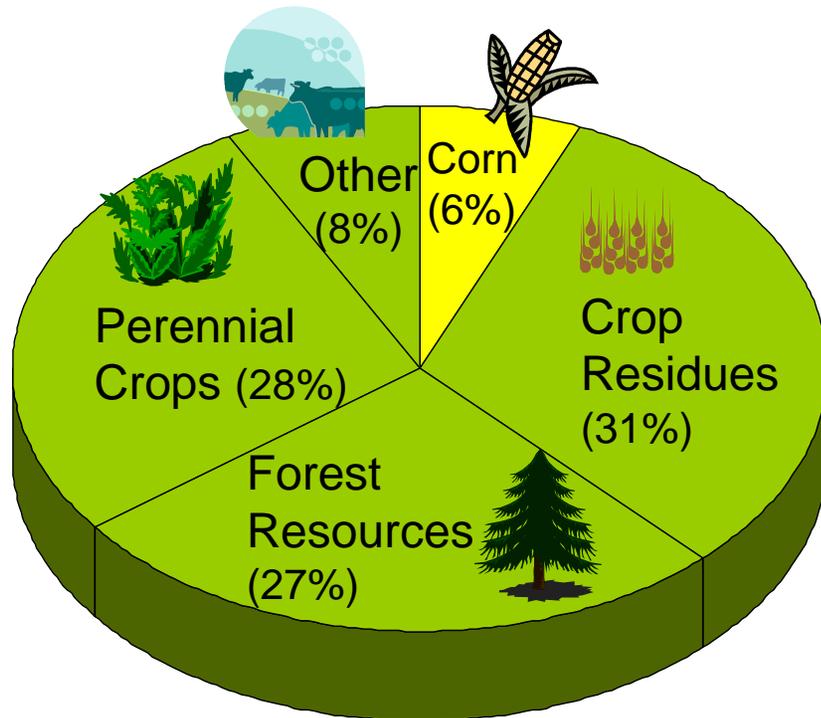
2007

Reduce U.S. gasoline usage by 20 percent in 10 years –
75% from new fuels – 25% from vehicle efficiency

Mandatory fuels standard to require 35 B gallons of renewable and alternative fuels in 2017



Resources for Future Production of Biofuels



Estimated Future Potential
U.S. Biomass Resource

Today: Nearly all ethanol is made from corn grain

The Future: Cellulosic biomass will be primary source for fuel ethanol

Benefits of Cellulosic Ethanol

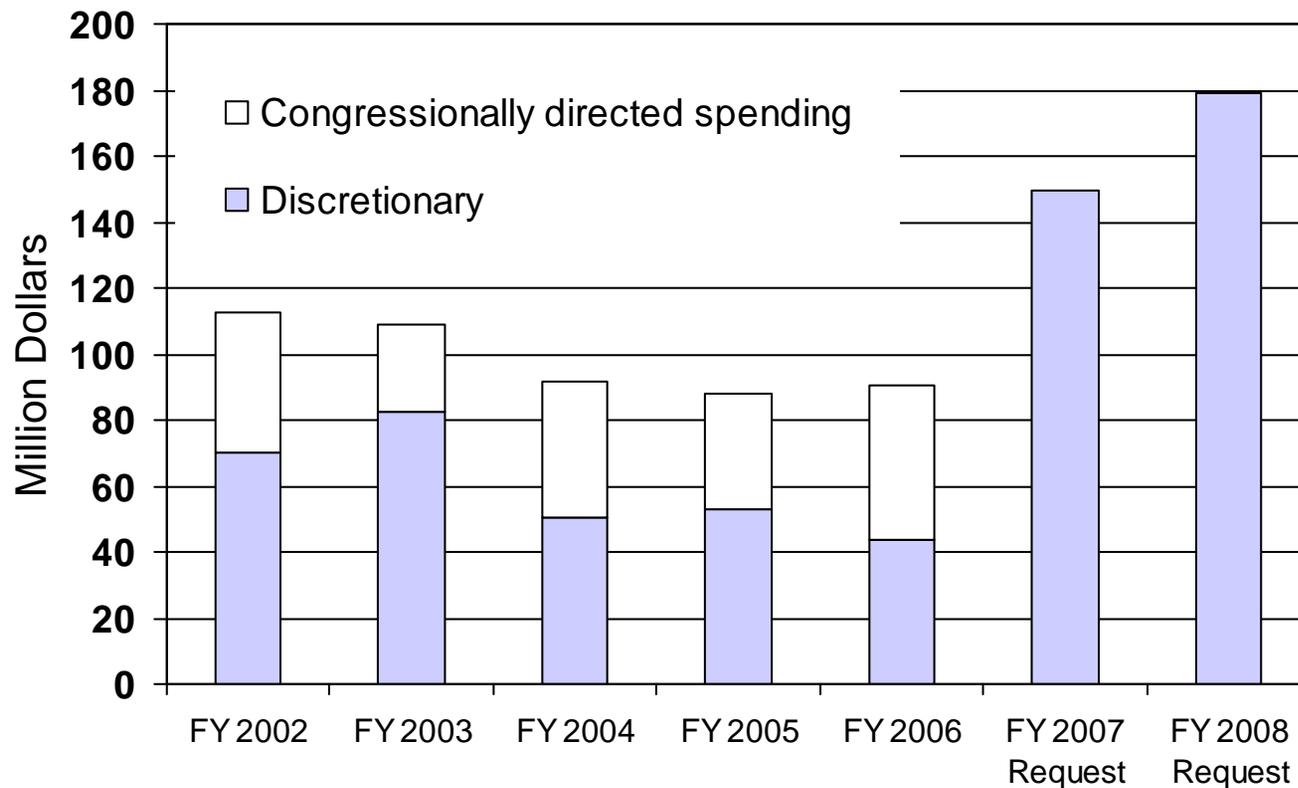
- Emits nearly 60% less greenhouse gases than reformulated gasoline
- Relies on non-food and waste resources

Source: *Biomass as Feedstock for a Bioenergy and Bioproducts Industry: Technical Feasibility of a Billion Ton Annual Supply*. 2005. DOE and USDA.

In future, far more ethanol will be made from cellulosic biomass than from corn.



Biomass Program Budget FY 2002-FY2007



Advanced Energy Initiative provides a boost in funding for critical technologies in FY 2007

* Budget Request



Roadblocks to Implementation



Barriers

- High cost of enzymatic conversion
- Inadequate technology for producing ethanol from sugars derived from cellulosic biomass
- Limitations of thermochemical conversion processes
- Demonstration/integration of technology in biorefineries
- Inadequate distribution infrastructure for expanding markets

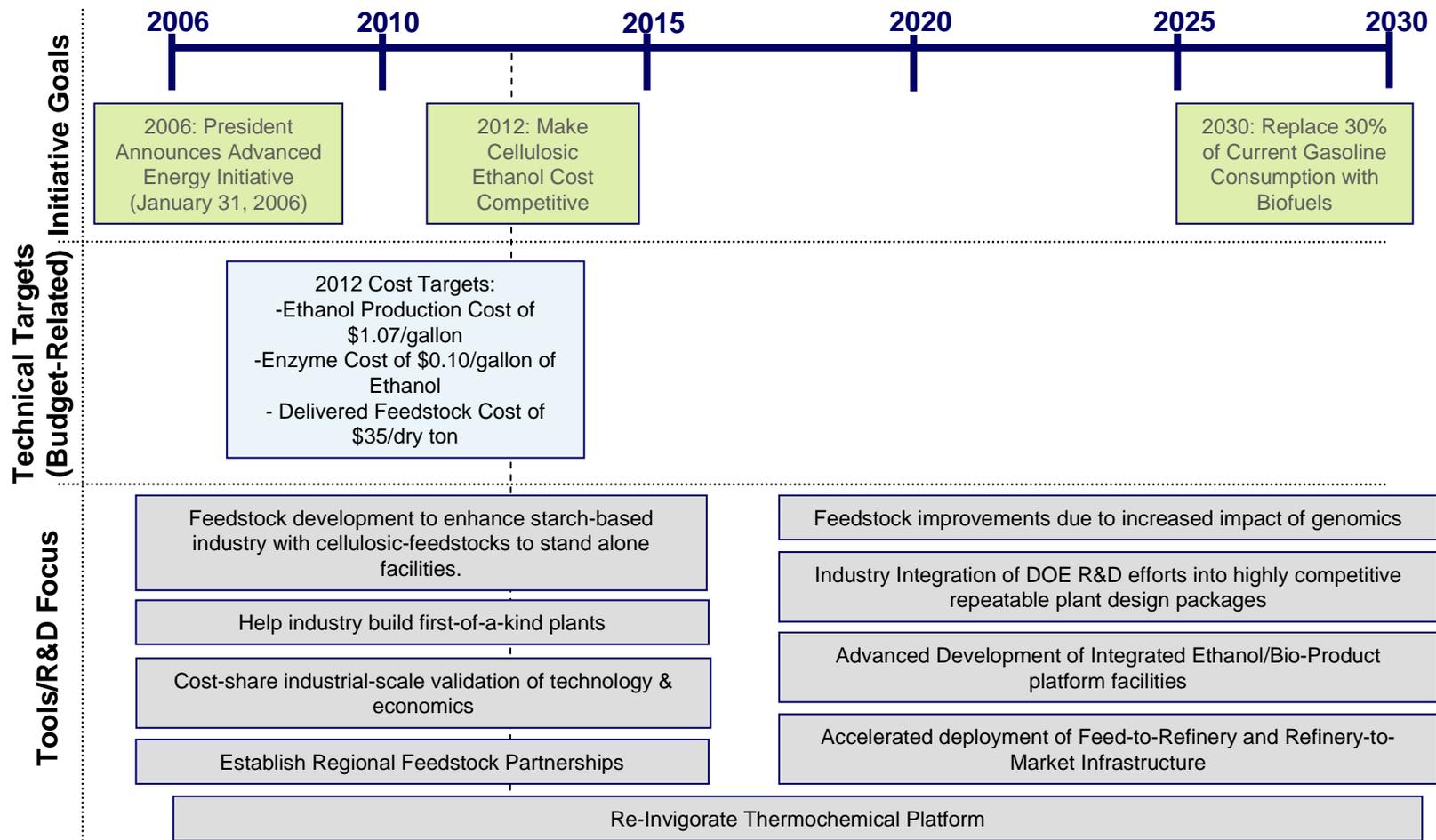
Solutions

- ➔ • R&D to improve effectiveness and reduce costs of enzymatic conversion
- ➔ • R&D on advanced micro-organisms for fermentation of sugars
- ➔ • Re-establish thermochemical conversion as a second path to success
- ➔ • Fund loan guarantees, Section 932 biorefinery demonstrations, and 10% scale validation projects
- ➔ • Form interagency infrastructure team and Regional Feedstock Partnerships

The expertise of national laboratories and cutting-edge industrial partners is helping to solve major challenges to domestic biofuels.



President's AEI and DOE Biofuels Initiative Timeline

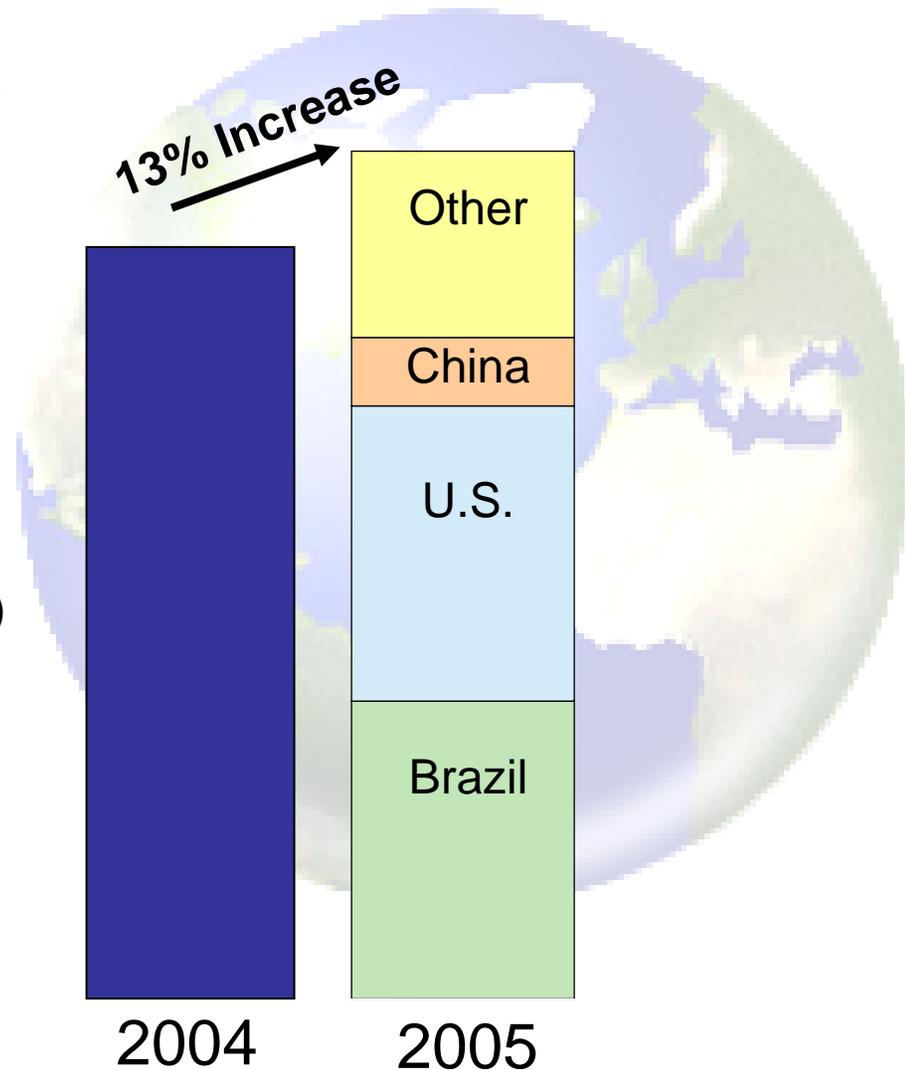


Longer-term RD&D will help meet goal of replacing 30% of gasoline by 2030



Global Ethanol Status

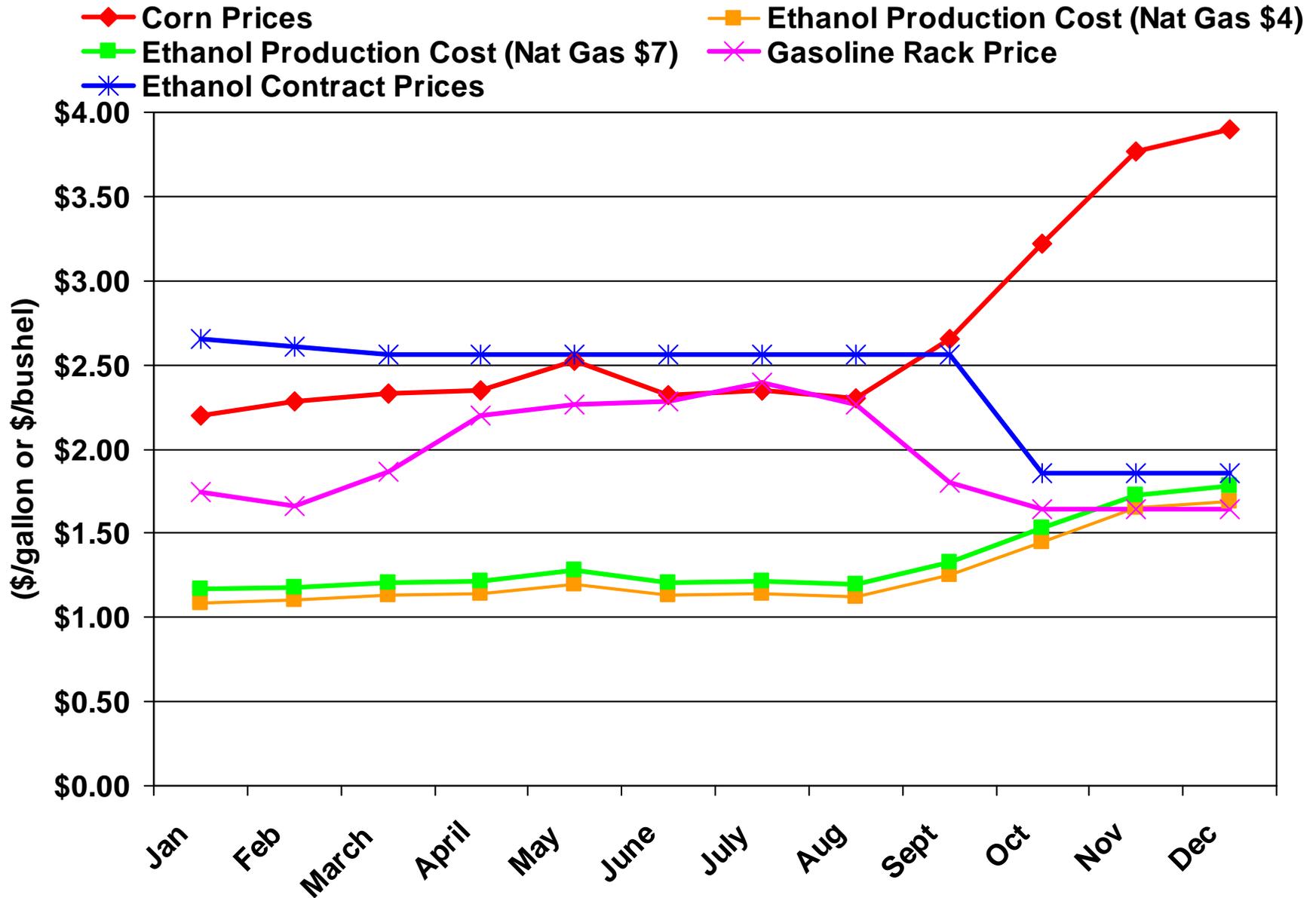
- 2005 Production:
12,150 million gallons
 - 35% U.S. (corn)
 - 35% Brazil (sugarcane)
 - 8% China (feedstock unknown)
 - 22% Others (wheat, barley, beet)
- 2004 Production:
10,770 million gallons



Worldwide production of ethanol is growing steadily

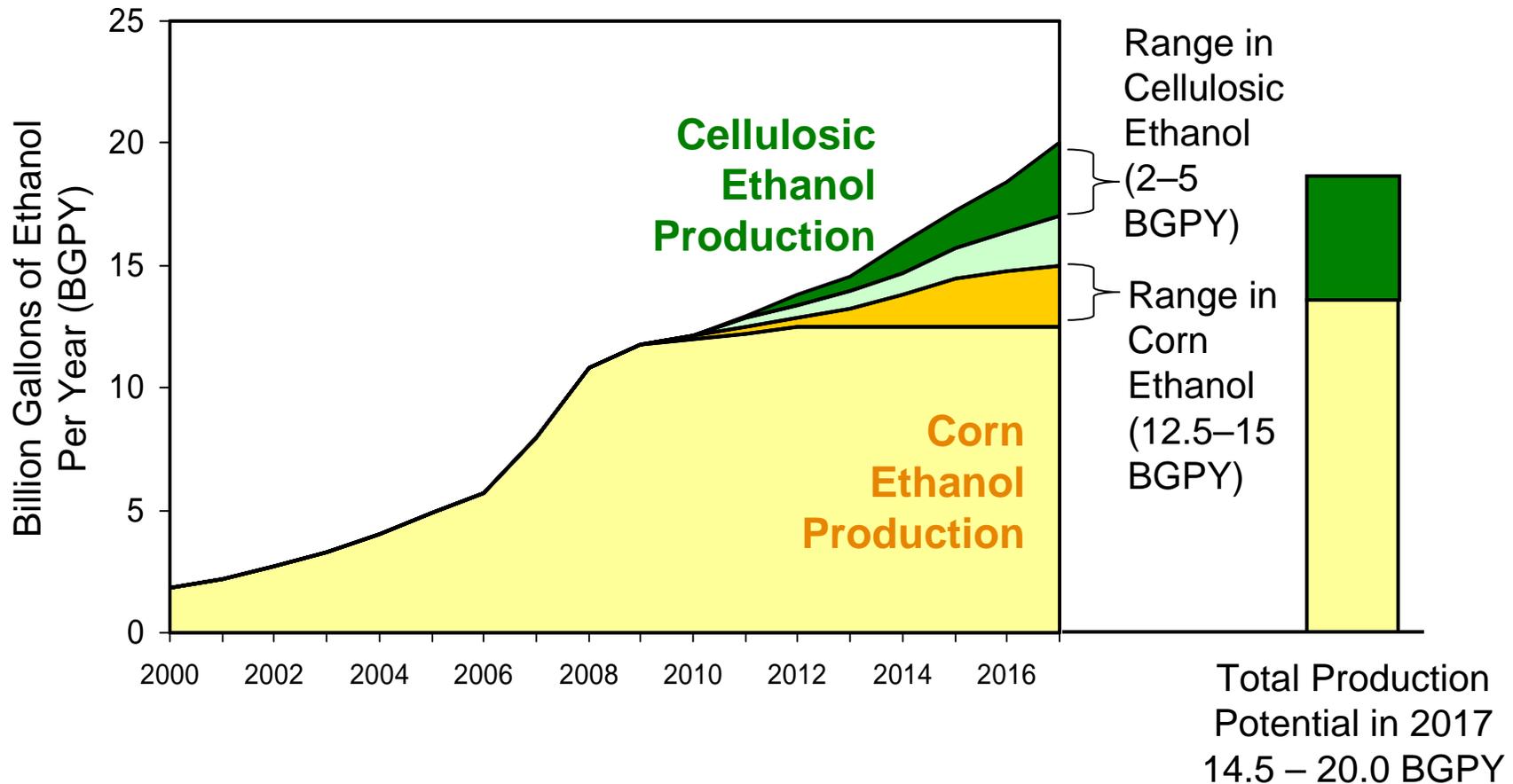


Corn Prices and Estimated EtOH Production Costs for 2006





Potential Growth in U.S. Ethanol Production



Advances in technology will enable commercial production of cellulosic ethanol by 2012.



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The cover features a collage of images related to biomass and ethanol production, including corn cobs, a combine harvester, ethanol distillation tanks, and a line of cars. The title '30x30' is prominently displayed in large white font on a blue background, with the subtitle 'A Scenario for Supplying 30% of 2004 Motor Gasoline with Ethanol by 2030' below it. The U.S. Department of Energy logo and the 'Biomass' logo are also present.

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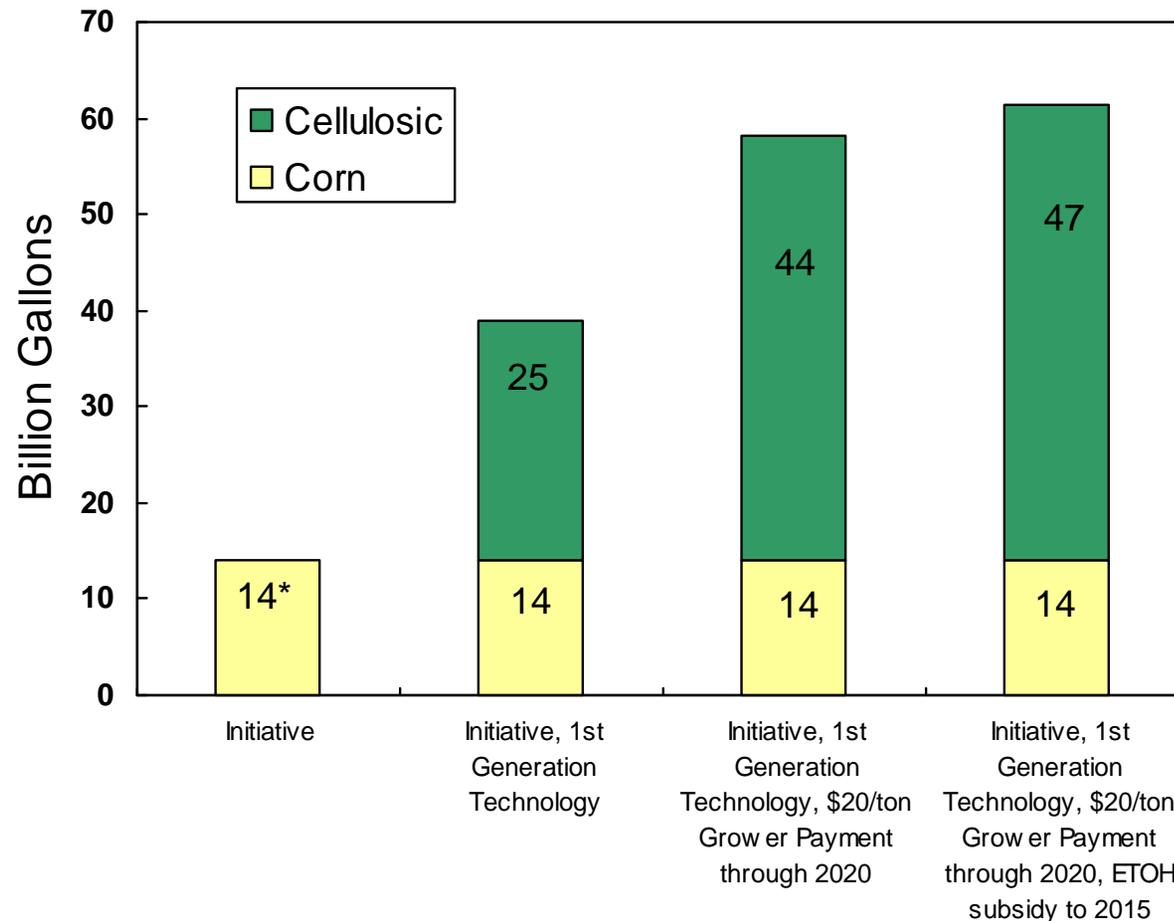
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Projected Ethanol Production in 2030 Under a High Oil Price Scenario



*Assumes an average corn ethanol production of ~14 BGPY.

Source: NREL, A National Laboratory Market and Technology Assessment of the 30x30 Scenario

High oil prices will boost production of cellulosic ethanol by 2030.

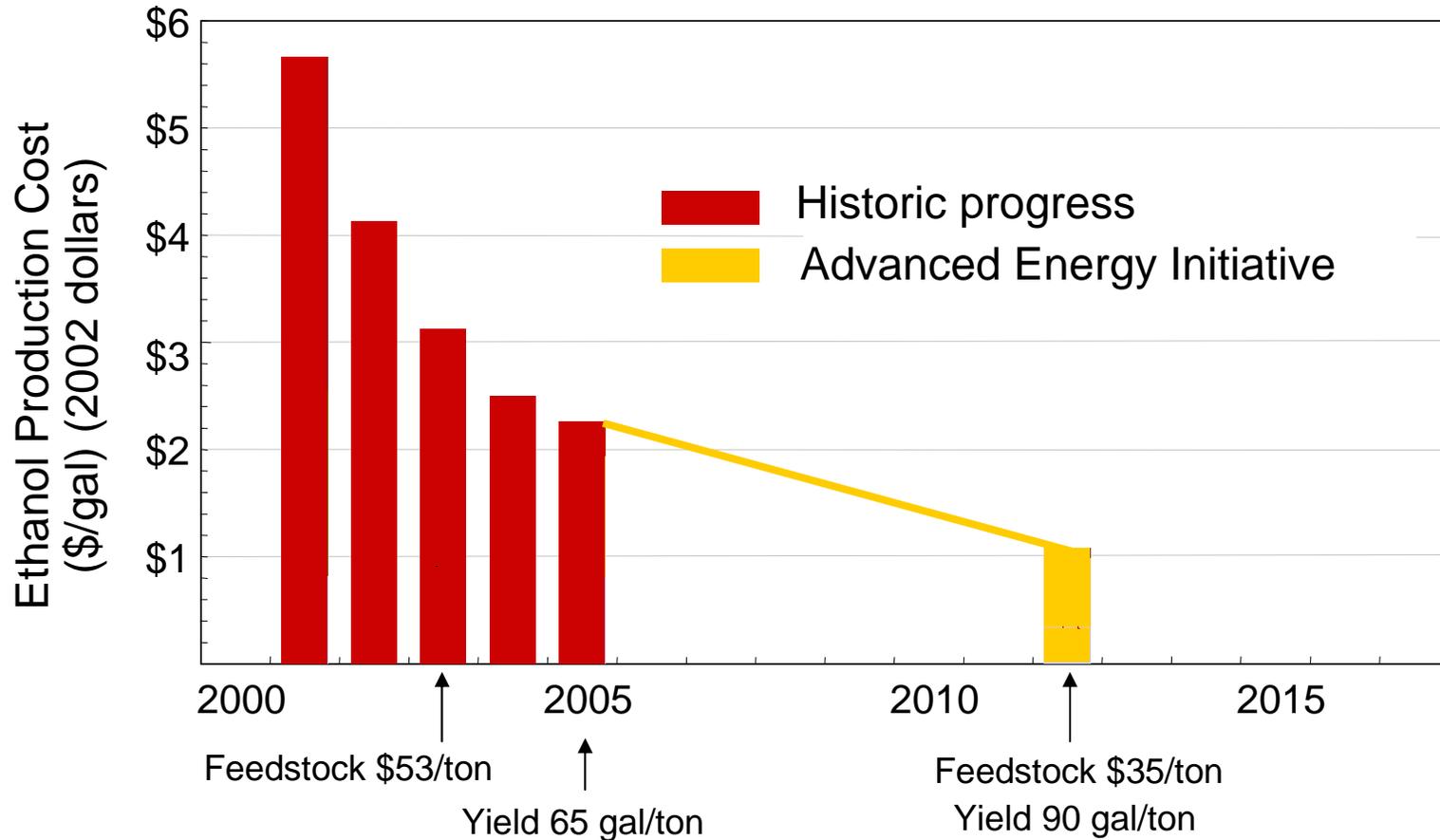


Five Critical Aspects to Achieving the 30 x 30 Scenario

1. Continue rapid deployment of starch based ethanol technology in the next decade
2. Achieve "\$1.07/gallon" production cost target in 2012
3. Cost share deployment with industry to reduce risk hurdle
4. Achieve the advanced technology target to reduce the conversion cost component of the ethanol production cost by addressing identified barriers in 2025 – 2030
5. Continue tax incentive of \$0.50/gallon and raise Renewable Fuels Standard ceiling to 20 billion gallons or develop more dynamic market driven incentive (5 years)
6. Initial \$20/ton incentive for cellulosic feedstocks – accelerate cellulosic ethanol into marketplace



Reducing the Cost of Ethanol

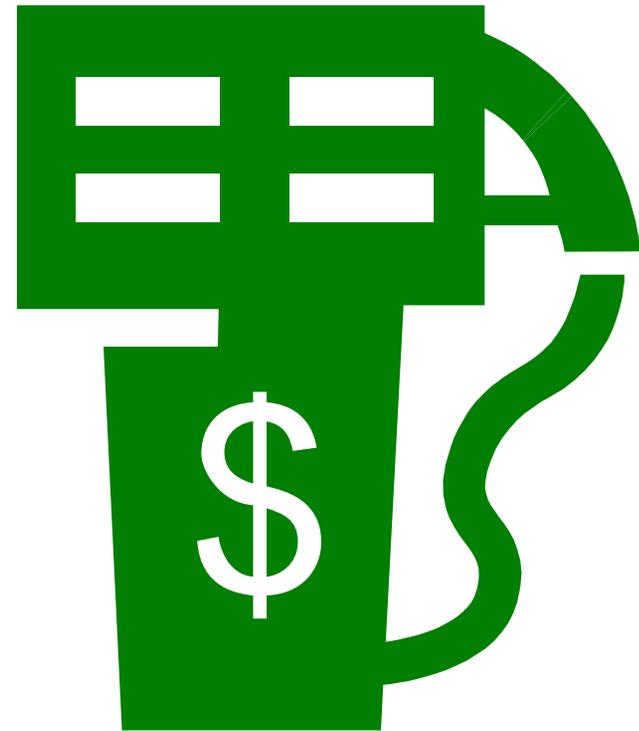


DOE collaborative R&D activities are expected to increase cellulosic ethanol yields by about 40% by 2012.



Key Factors Impacting Cost Targets

- Availability and cost of feedstocks
- High cost of capital for cellulosic ethanol technologies
- Ability to effectively integrate systems
- Cost-effective infrastructure for distribution of biofuels
- Cost of conversion technologies, including cost of enzymes



Cost of technology, infrastructure and feedstocks could impact cost targets



Achievements

- Achieved substantial decrease in cost of ethanol production – from over \$5 to approximately \$2.26 per gallon
- Developed organisms with superior ability to convert mixed sugars to ethanol – an important step toward cellulosic ethanol and the 2012 goal
- Developed high-value plastics, foams, and coatings from oil crops and corn sugar



Cell phone casings made from bio-based polymers developed through DOE-industry cost-shared R&D

Using biomass for both biofuels and high-value bioproducts will enable more cost-effective operation of integrated biorefineries.



Policies Accelerating Biofuel Production

Energy Policy Act 2005 (EPAct 2005)

- **Section 932: Commercial Integrated Biorefinery**
 - Proposals to the August 2006 solicitation have undergone independent merit review. Chairman's report submitted to selection official. Awards pending final Continuing Resolution language
 - \$42 million in FY 2007 budget request
- **Section 941: Revisions to Biomass R&D Act of 2000**
 - *Vision* document released November 2006; updated *Roadmap* due May 2007
- **Section 942: Cellulosic Ethanol Reverse Auction**
 - Request For Information and Options papers completed
- **Sections 1510, 1511, and Title XVII: Loan Guarantees**
 - DOE issued guidelines for the first Loan Guarantees under Title XVII in August 2006
 - Loans for conversion of Municipal Solid Waste and cellulosic biomass to fuel ethanol and other commercial byproducts also considered under this offering

EPAct 2005 goals are integrated into core technology priorities.



Policy Barriers

- Competing subsidies for commodity crops – an equal playing field is needed
- Inadequacies in current loan guarantee policies that inhibit their use
- Lack of standardization and mandates to support new infrastructure development and encourage installation of ethanol-compatible equipment (e.g., pumps)
- Lack of flex fuel vehicle mandates



Subsidies, standardization, and inadequate financing policies could create barriers to biofuels



New Policies May Foster Market Expansion

- National strategy for E-10
 - Mandate to expand use of 10% blends of ethanol nationwide
- Regional strategy for E-85
 - Mandates for use of E-85 that consider unique regional opportunities
- Extension of ethanol subsidies to 2015
- Payments to lignocellulosic biomass suppliers for residues and energy crops
- Support for Energy Title in next Farm Bill with greater focus on biofuels and bioenergy
- RFS more geared toward increasing use of cellulosic ethanol



Ramp-up of ethanol production will require innovative and focused policies for infrastructure and feedstocks



Local and Regional Economic Benefits

In 2004, the ethanol industry:

- Created 147,000 jobs in all economies
- Increased household income by \$4.4 billion
- Added \$1.3 billion in federal tax revenue
- Added \$1.2 billion in state and local tax revenues



Source: LEGC LLC 2004, for the
National Corn Growers
Association.

Today's ethanol industry is creating jobs and increasing revenues for state and local governments

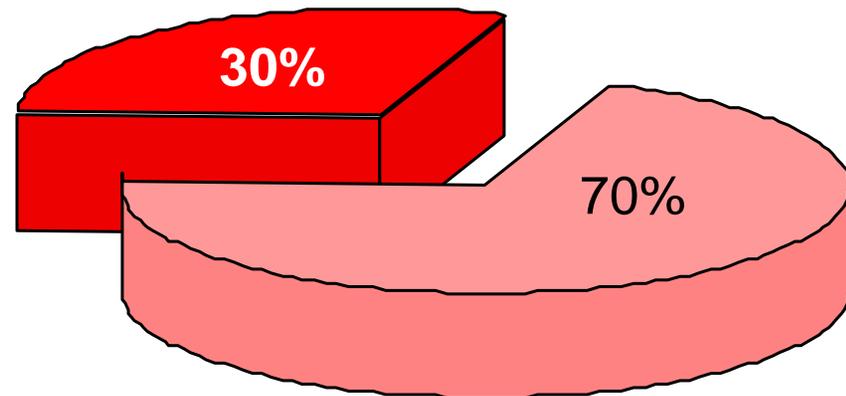


National Economic Benefits

- Reduces purchases of petroleum imports and increases domestic trade in ethanol, reducing trade deficit
- Opens up new markets for rural commodities and markets for various renewable energy technologies

Total U.S. Trade Deficit, 2005

\$231 Billion Petroleum Deficit



An expanded biofuels industry will create economic benefits nationwide, including new markets for rural commodities

Source: EIA Monthly Petroleum Review, October 2006. Merchandise Trade Value