20 in 10 Summary

Reduce U.S. Gasoline Usage By **20%** In The Next Ten Years

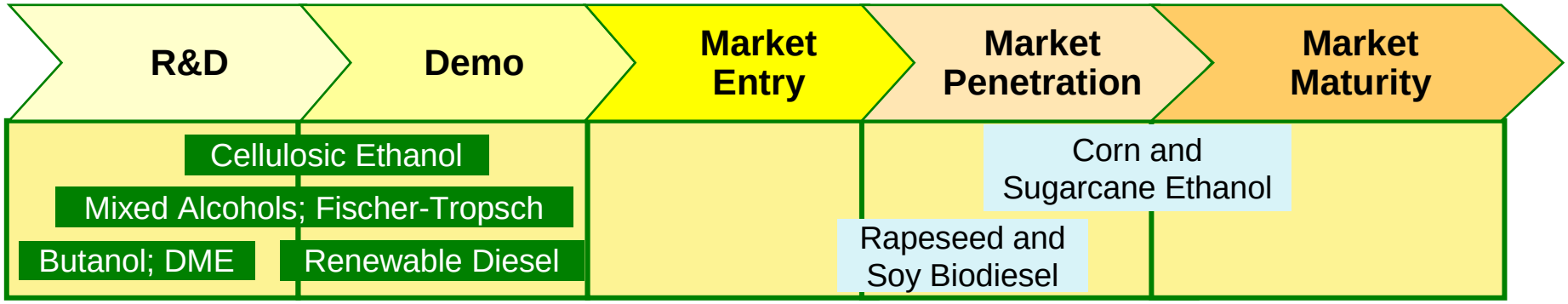
- Increase supply of renewable and alternative fuels
  - Set Alternative Fuels Standards at 35 billion gallons per year by 2017
    - Equates to 5X the current Renewable Fuels Standard for 2012
    - Displaces **15%** of projected annual gasoline use in 2017
- Increase vehicle efficiency
  - Reform and modernize CAFÉ
    - Avoids **5%** of projected annual gasoline use in 2017

Biofuel Technologies: Today and Tomorrow

	Feedstock Pathways	Conversion Processes	Distribution of Biofuels
Today & Near Term	Corn Ethanol	Biochemical Conversion • Fermentation	Existing Distribution Infrastructure
2012 and Beyond	Cellulosic Ethanol *Agricultural residues, energy crops, natural oils, wood/forestry resources*	Biochemical Conversion • Fermentation • Advanced enzymes Thermochemical Conversion • Gasification • Pyrolysis	Expanded, Advanced Distribution Infrastructure

To Market

Cellulosic ethanol will help meet future biofuels demand



2nd Generation Biofuels

- **R&D efforts focus on**:
  - Increasing range of feedstocks
  - Reducing conversion cost
- **Two main technology platforms:**
  - *Biochemical*: conversion of the cellulose to sugars and fermentation to alcohol fuels
  - *Thermochemical*: gasification of biomass to syngas and synthesis to fuels
- **Commercial renewable diesel plants under construction**

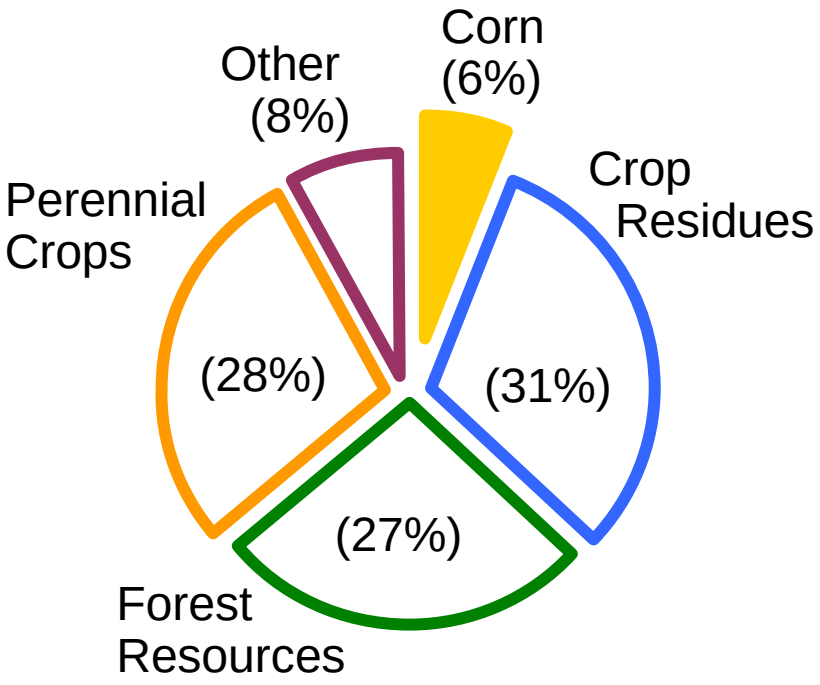
1st Generation Biofuels

- ***Ethanol:*** clean burning, high-octane alcohol fuel as replacement or extender for gasoline
  - Commercially produced since the 70s in U.S. and Brazil, still market leaders
  - Corn ethanol is cost competitive (without subsidies) with gasoline when crude oil is >$50/barrel ($30/brl from sugar cane)
- ***Biodiesel:*** high-cetane, sulfur-free alternative to (or extender of) diesel fuel and heating oil
  - Commercialized in Europe in the 90's
  - Inferior economics & market to ethanol

Second generation" technologies aim to resolve limitations

Source: Navigant

Future Production of Biofuels: Sources



Projected U.S. Biofuel Sources

Today: Nearly all ethanol is made from corn grain

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

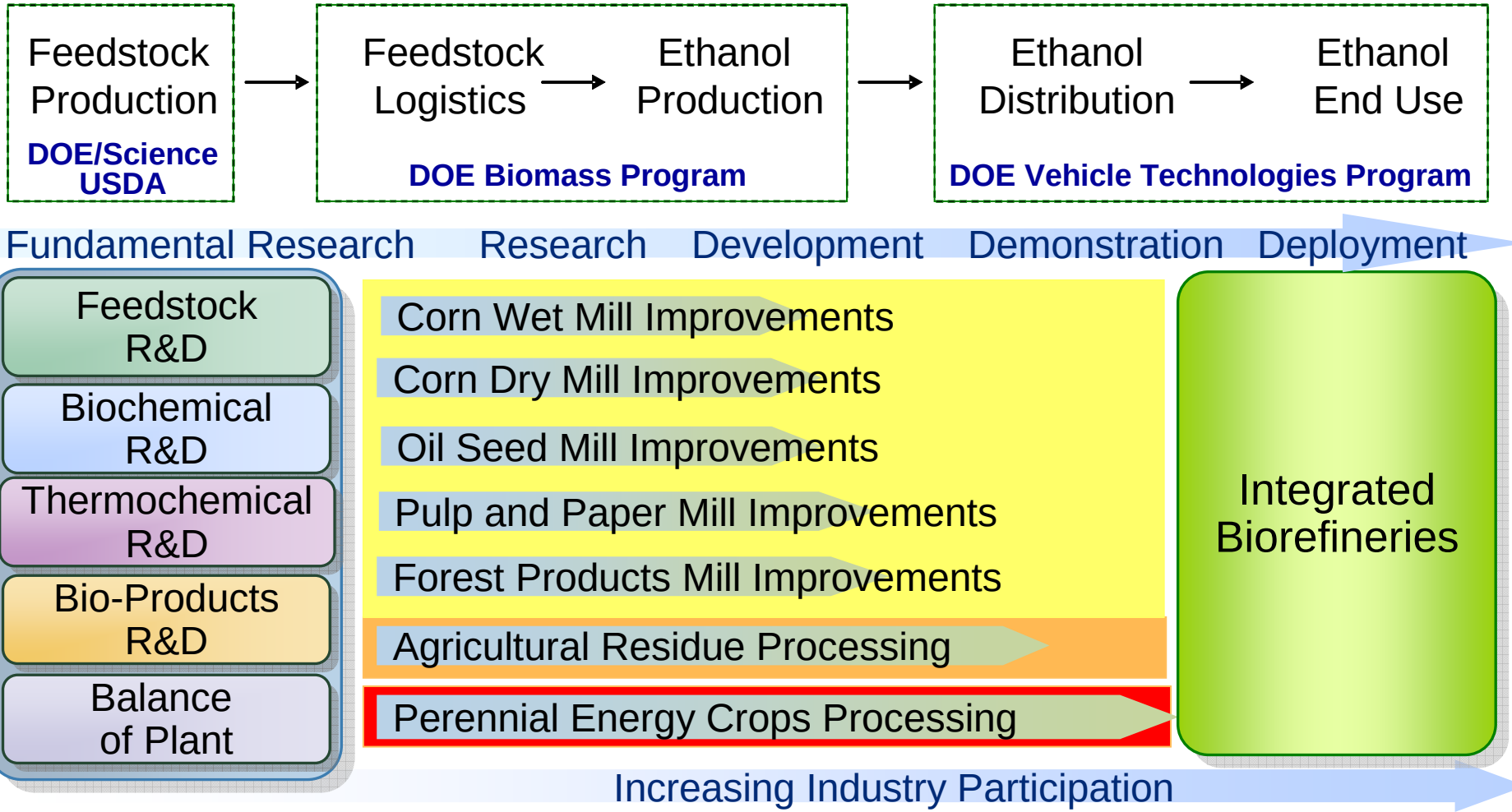
Benefits of Cellulosic Ethanol

- Emits up to 86% 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.

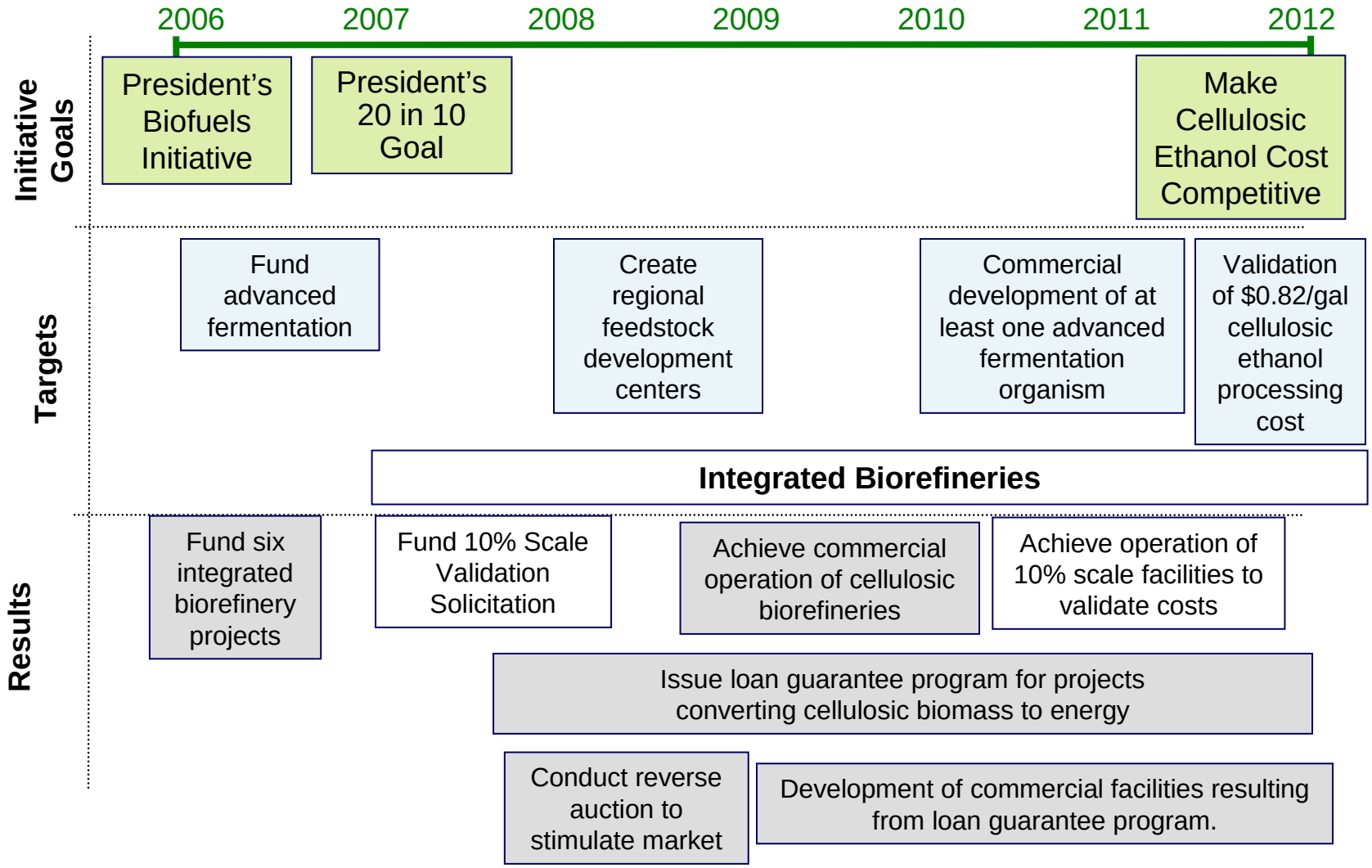
In the future, far more ethanol will be made from cellulosic biomass than from corn.

RD&D Focus Areas



DOE is conducting RD&D on multiple fronts

Timeframe for Meeting 2012 Goal



Research, Development and Demonstration

Collaborative R&D

- **Feedstocks:** integration of feedstocks with conversion processes
- **Conversion Technologies:** biochemical and thermochemical
- **Integrated Biorefineries:** systems integration, demonstrations, infrastructure development

Integrated Biorefineries

- **Systems Integration:** feedstocks, conversion, biopower, infrastructure
- **Demonstration:** pilot scale, commercial scale

DOE efforts are paving the way for a strong, domestic bioenergy industry—with commercial success possible by 2012.

Policies Accelerating Biofuel Production

Energy Policy Act 2005 (EPAct 2005)

- Section 932: **Commercial Integrated Biorefineries**
  - Six awards made in March 2007
  - Up to $385 million in DOE funds over next 5 years
- Section 941: **Revisions to Biomass R&D Act of 2000**
  - Interagency workshop Fall 2006; strategy document expected Fall 2007
- Section 942: **Cellulosic Ethanol Reverse Auction**
  - Request for Information completed
  - $5 million requested for FY 2008
- Sections 1510, 1511, and Title XVII: **Loan Guarantees**
  - On October 4, 2007, DOE announced the final regulations for the loan guarantee program and invited 16 project sponsors to submit full applications for loan guarantees. Six of these are projects in biomass.

EPAct 2005 goals are integrated into core technology priorities.

Working with DOE's Office of Science on Complementary Basic Research

- Office of Science investing $375 million to fund three new **Bioenergy Research Centers** to accelerate basic research on the development of cellulosic ethanol and other biofuels.
- Science and EERE recently issued a joint **biofuels research agenda:** *Breaking the Biological Barriers to Cellulosic Ethanol*.

- Part of the National **Biofuels Action Plan** effort
- In 2007, Office of Science joined USDA in offering $8.3 million for research in biomass genomics to accelerate the production of alternative fuels

Biomass R&D Initiative (BRDI)

- Multi-agency effort to coordinate and accelerate all Federal biobased products and bioenergy research and development
- Mandated under the Biomass Research & Development Act of 2000, further revised by Energy Policy Act of 2005 (Sec 937)
- BRDI coordinating bodies
  - Biomass R&D Board, a cabinet-level council co-chaired by DOE and USDA (also includes DOI, DOT, EPA, DOC)
  - Biomass R&D Technical Advisory Committee – 30 senior individuals from industry, academia, state government
- Aims to deliver National Biofuels Action (NBA) Plan by Fall 2007.
- Making up to $18 million available for R&D in biomass-based fuels, energy, products, and processing

BR&Di
BIOMASS RESEARCH & DEVELOPMENT INITIATIVE

www.brdisolutions.com

Biomass R&D Board Members

- ***Co-Chairs***
  - **Thomas C. Dorr**, Under Secretary for Rural Development, USDA
  - **Alexander A. Karsner**, Assistant Secretary, Energy Efficiency and Renewable Energy, DOE
- ***Members***
  - **C. Stephen Allred**, Assistant Secretary, Land and Minerals Management, DOI
  - **Vice Admiral Thomas J. Barrett**, Acting Deputy Secretary, DOT
  - **Dr. Arden Bement**, Director, NSF
  - **Dr. Gale Buchanan**, Under Secretary for Research, Education and Economics, USDA
  - **Dr. George Gray**, Assistant Administrator for Research and Development, Science Advisor, EPA
  - **Dr. Sharon Hays**, Chief of Staff, OSTP
  - **Dr. Raymond Orbach**, Under Secretary for Science, DOE
  - **Edwin Piñero**, Federal Environmental Executive, OFEE
  - **Dr. Willie E. May**, Director of Chemical Science and Technology Laboratory, National Institute of Standards and Technology, DOC
  - **Phillip Swagel**, Assistant Secretary for Economic Policy, Treasury