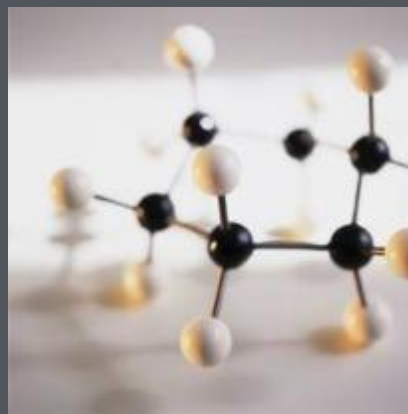


Workshop on Conversion Technologies for Advanced Biofuels - Carbohydrates

U.S. DEPARTMENT OF
ENERGY | Energy Efficiency & Renewable Energy

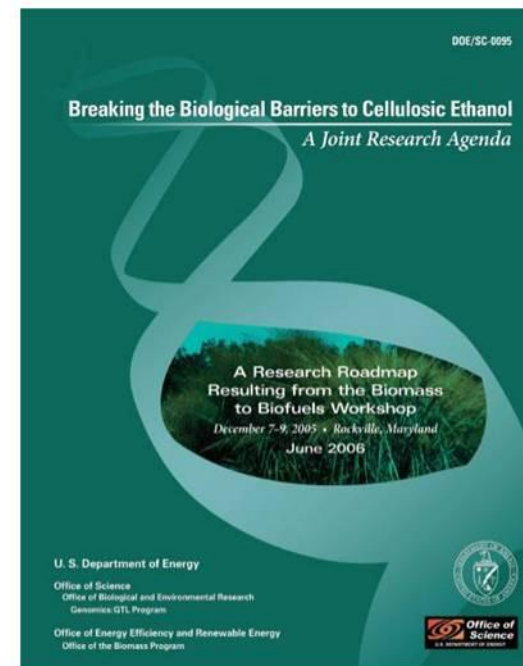


Report-Out Webinar
February 9, 2012

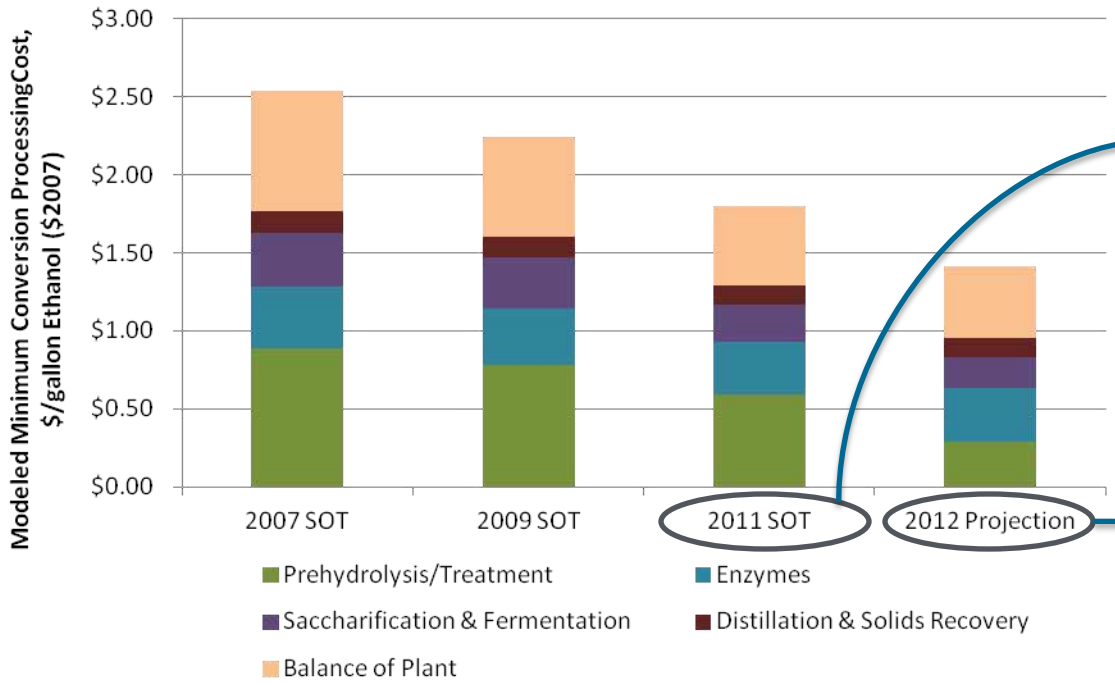
Bryna Berendzen
Office of the Biomass Program
U.S. Department of Energy

OBP and SC publish technology roadmap in 2006

- Report concludes biomass recalcitrance is the core barrier to processing lignocellulosic material to ethanol
- The roadmap centers on two critical goals:
 - ✓ Optimizing enzymatic hydrolysis of biomass derived carbohydrates to fermentable C5/C6 sugars
 - ✓ Cofermentation of C5/C6 sugars to value-added product streams, namely ethanol
- Process integration is identified as a key factor in reducing overall costs and improving biorefinery viability
- Technology deployment-phase of roadmap outlines 10 years to:
 - ✓ Develop enzymes with broad substrate ranges, enhanced inhibitor, pH and temperature tolerance, and decreased loading capacity with increased sugar yield.
 - ✓ Develop robust, high titer, rate and yield organisms for ethanol production



State of Technology and FY12 Joule

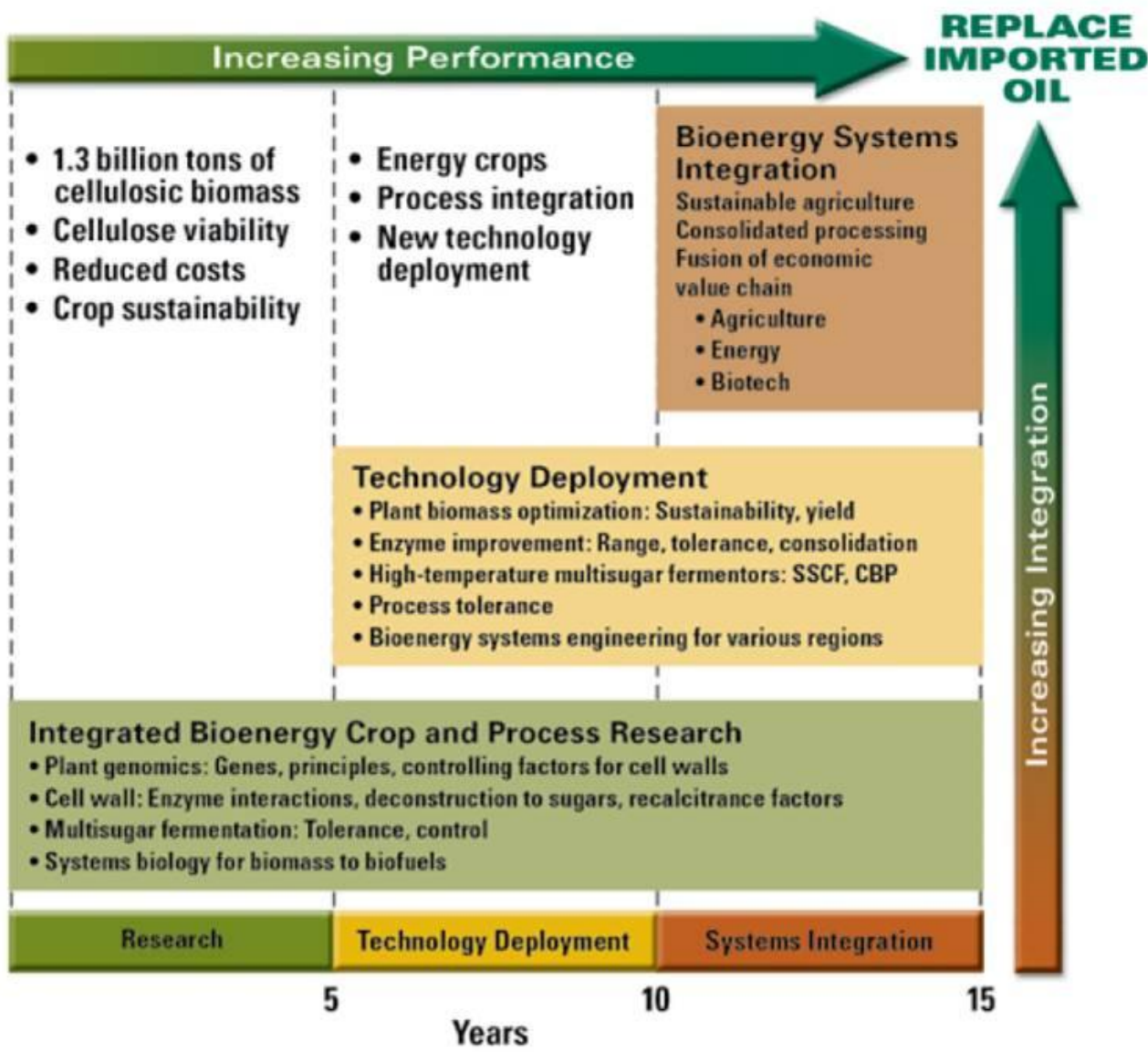


The latest (FY11) SOT beats the original projection (\$1.80/gal in reality vs. \$1.85/gal modeled cost)

On track to achieve 86% cellulose-to-ethanol and 85% xylose-to-ethanol at 20% total solids loading and meet or beat the required \$0.04 cost reduction to hit the FY12 joule

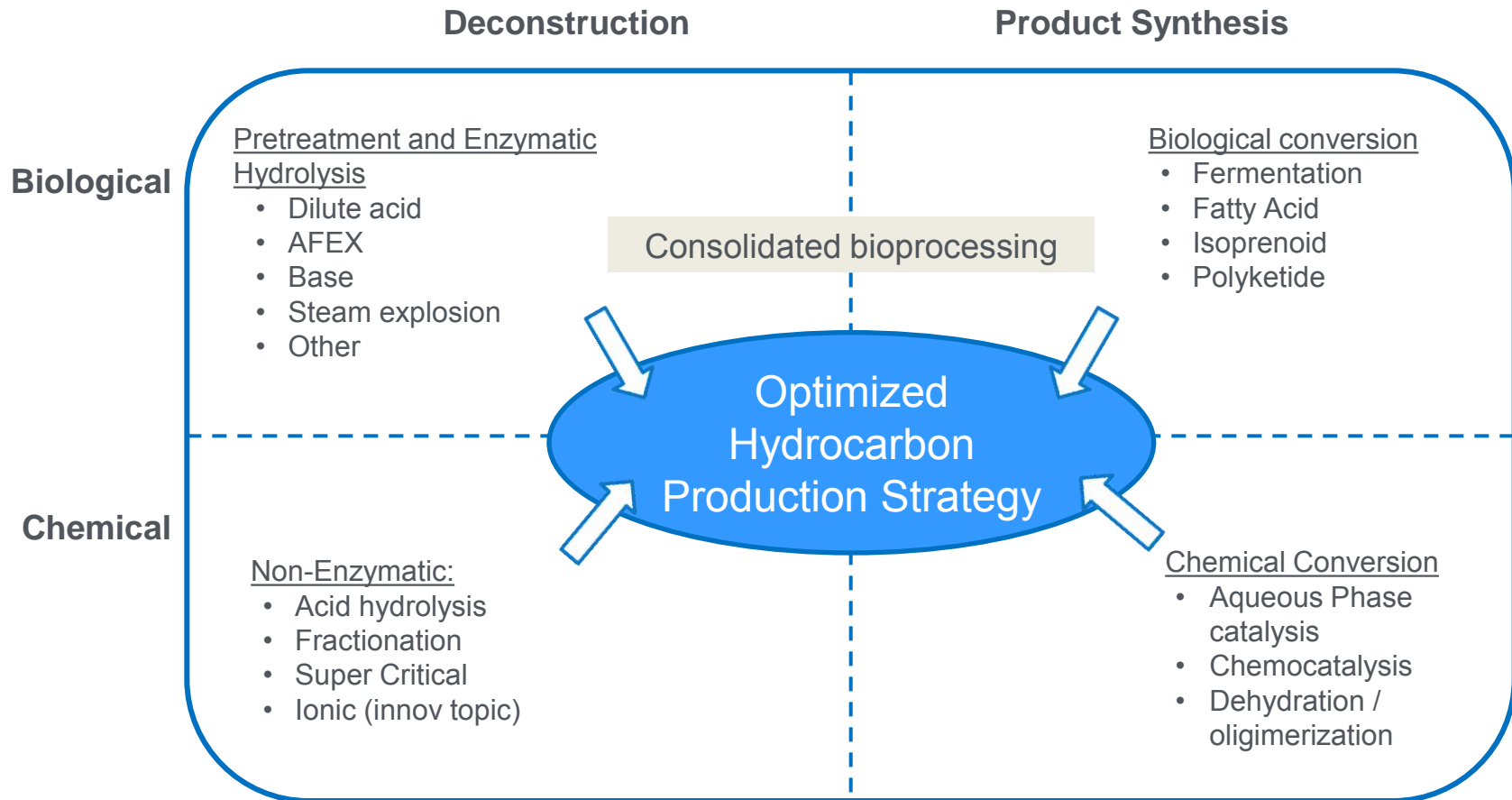
	2007 State of Technology	2009 State of Technology	2011 State of Technology	2012 Projection
Processing Total	\$2.54	\$2.24	\$1.80	\$1.41
Prehydrolysis/Treatment	\$0.89	\$0.78	\$0.59	\$0.29
Enzymes	\$0.39	\$0.36	\$0.34	\$0.34
Saccharification & Fermentation	\$0.35	\$0.33	\$0.24	\$0.20
Distillation & Solids Recovery	\$0.14	\$0.13	\$0.12	\$0.12
Balance of Plant	\$0.77	\$0.64	\$0.51	\$0.46

Start Formulating Out-year Goals



Significant Differences to be considered in:

- Shifting Focus from Fundamental/Basic to Applied Science
- Limiting Discussion of Feedstocks
- Expanding Suite of Considered Carbohydrate Intermediates
- Expanding Processing Considerations
- Including Discussions of Innovative Topic



Gather input from industry, academia, and national labs to:

- Expand upon existing R&D roadmaps
- Define areas of focus: R&D Barriers and Activities
- Deliver 1 combined or 2 individual R&D Roadmaps

- Basic questions were used for all sessions
- Co-Chairs were able to pose additional questions

- Questions included:

- What has the industry accomplished (i.e., where are we today)?
- What's left to do in the current plan and progress to date?

Primary
Focus

- **What are the remaining research barriers that need to be overcome to reach our out-year goals?**
 - What research needs to be done/targets?
 - Are there fundamental techniques missing that are necessary to overcome the remaining?
 - Approach vs. barrier discussion and prioritization

(Barrier area and R&D Prioritization in the final roadmap won't necessarily reflect the output of the conference due to internal programmatic considerations as well as economic factors and others)