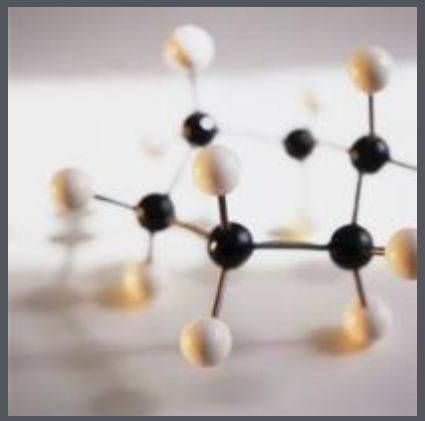
Conversion Technologies for Advanced Biofuels – Biomass Program Introduction

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



Report-Out Webinar

February 9, 2012

Leslie Pezzullo
Office of the Biomass Program
U.S. Department of Energy

The Role of Biomass

1. The need to reduce dependence on foreign oil and lower greenhouse gas (GHG) emissions has renewed the urgency for developing sustainable biofuels, bioproducts, and biopower.

2. The transportation sector accounts for about two-thirds of U.S. oil consumption and contributes to one-third of the nation's GHG emissions.

3. Near term, biomass is the only renewable resource that can supplement petroleum-based liquid transportation fuels, while reducing GHG emissions.

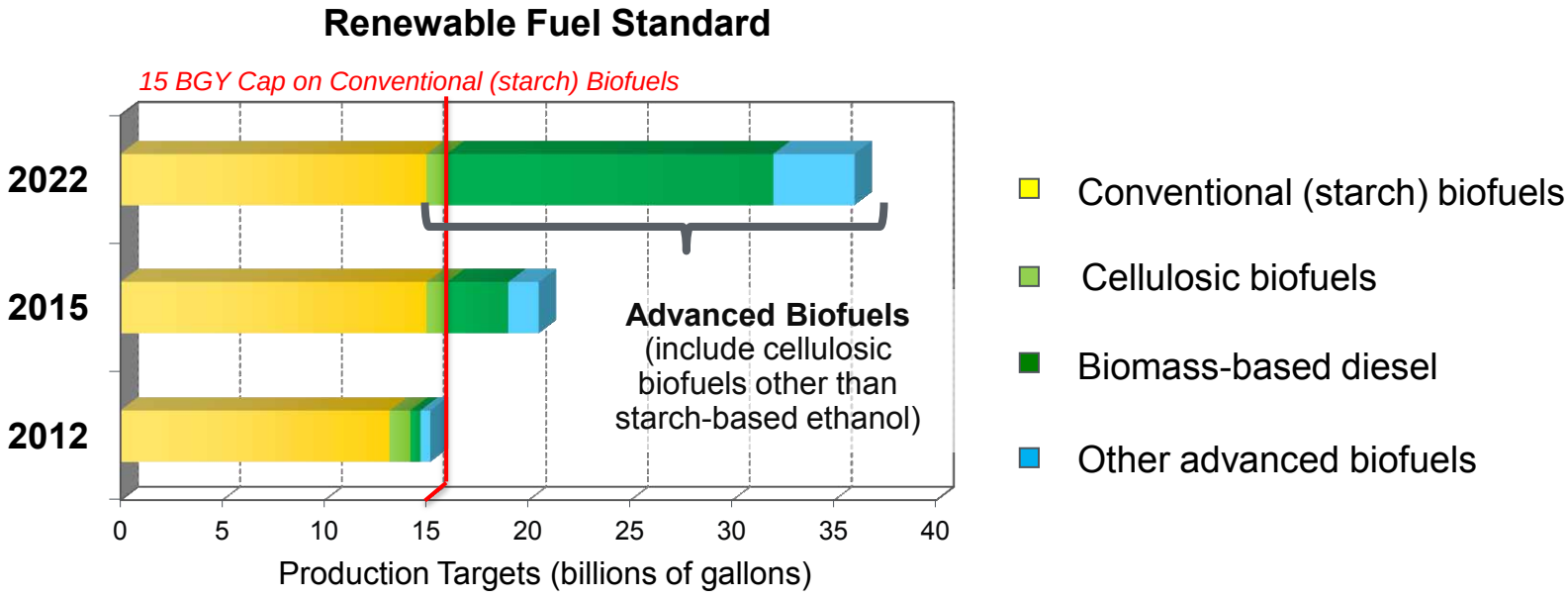
Mandated Goals

EISA 2007 set aggressive goals:

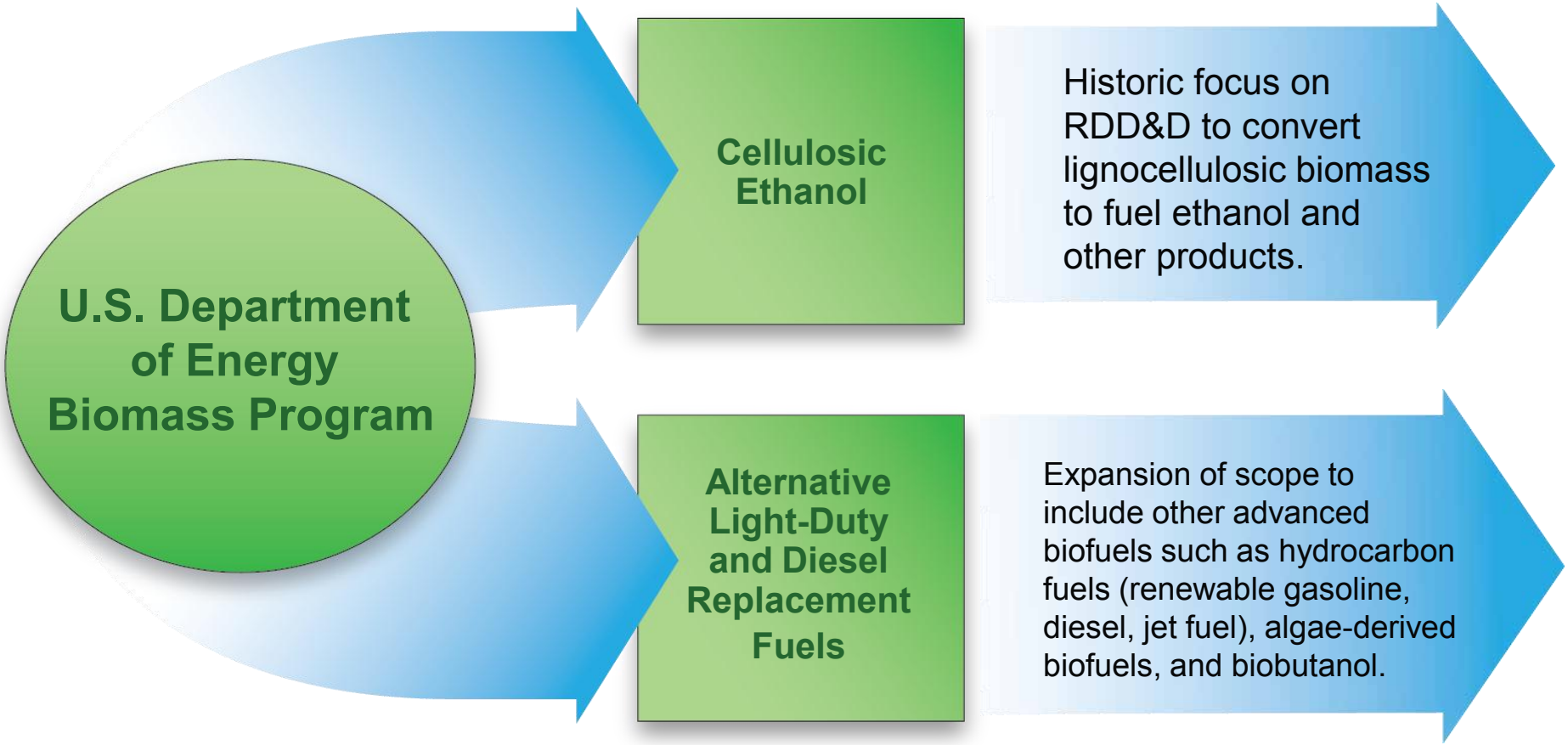
- Move renewable fuels into the marketplace
- Reduce the nation's dependence on foreign sources of energy
- Reduce GHG emissions from the transportation sector

Established production volumes for the Renewable Fuel Standard Program (RFS), increasing the supply of renewable fuels to 36 billion gallons by 2022

Focuses on developing advanced biofuels to support meeting the RFS

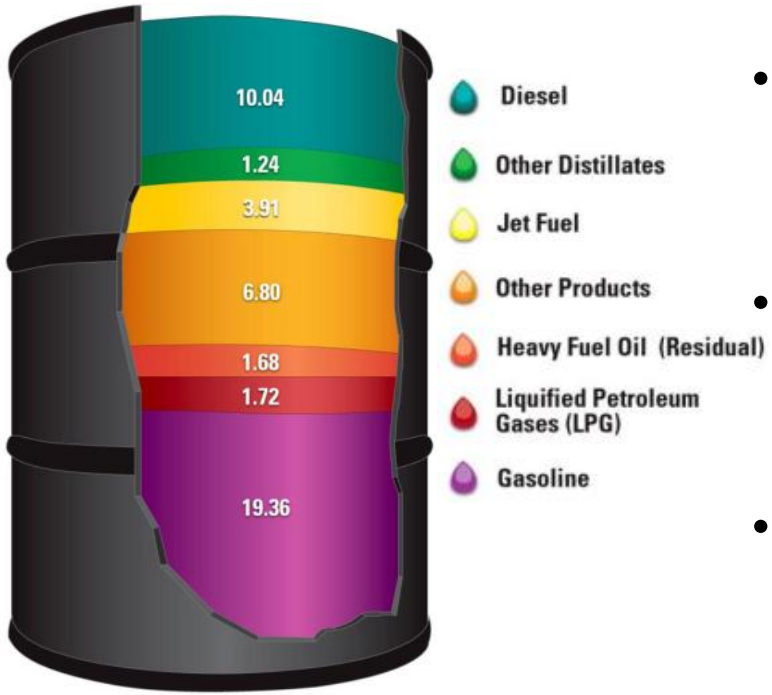


Expanding Scope



Program forms cost-share partnerships with key stakeholders to develop, demonstrate, and deploy technologies for advanced biofuels, bioproducts, and biopower from lignocellulosic and algal biomass.

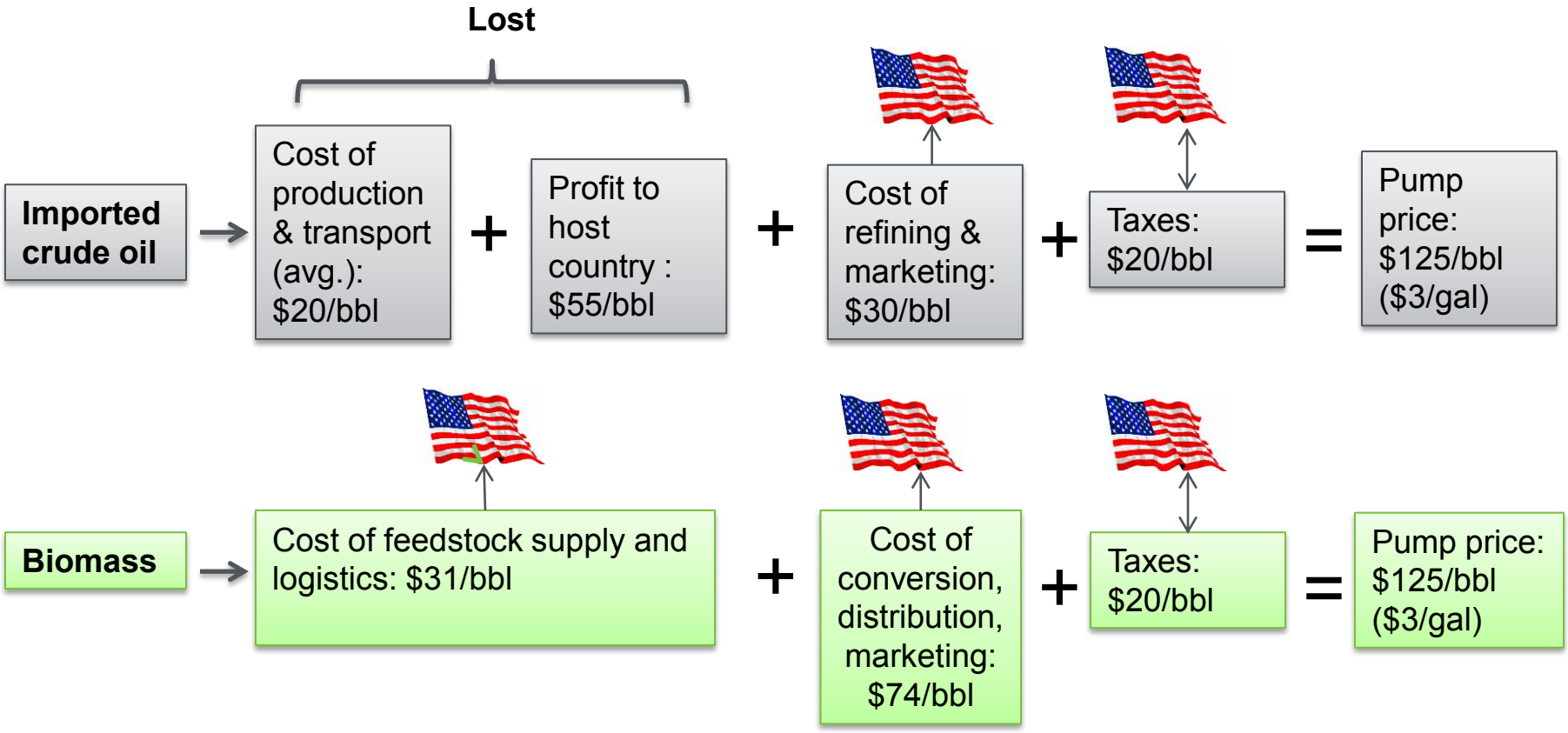
Replacing the Whole Barrel



- U.S. spends more than $1,197M each day on crude oil imports*
- Cellulosic ethanol displaces light duty gasoline fraction only
- Only about 40% of a barrel of crude oil is used to produce light duty petroleum gasoline
- Reducing dependence on oil requires replacing diesel, jet, heavy distillates, and a range of other chemicals and products
- Greater focus needed on RDD&D for a range of technologies to displace the entire barrel of petroleum crude

Source: Energy Information Administration, "Oil: Crude Oil and Petroleum Products Explained" and AEO2009, Updated February 2010, Reference Case.
*American Petroleum Institute.

Value of Biofuels

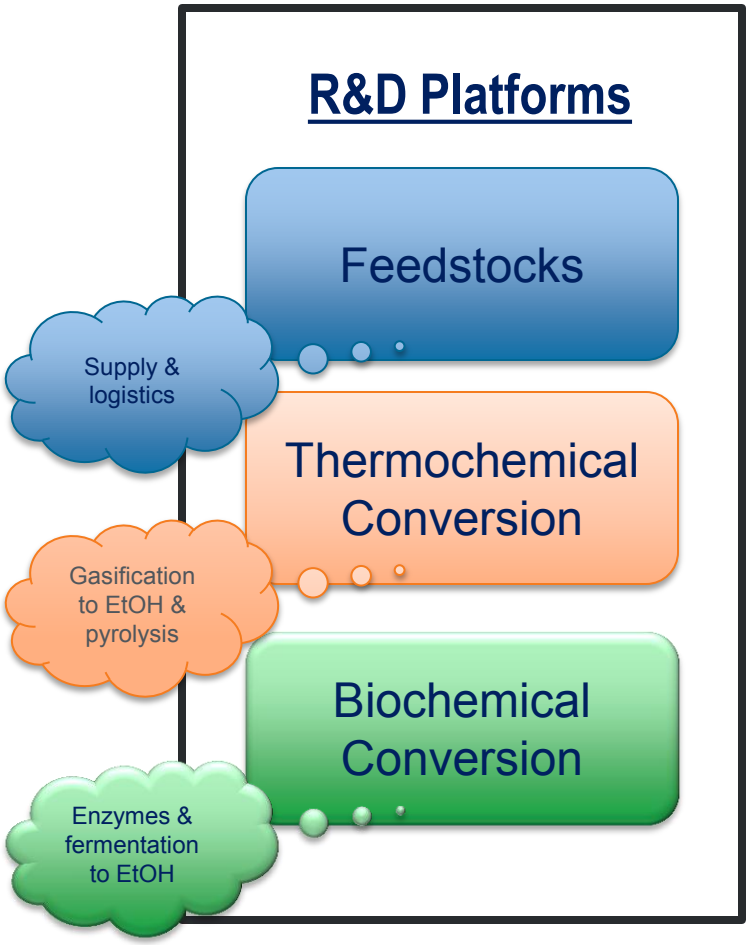


Price differential between imported crude oil and biomass:
$75/bbl x 4.3 x 10^9 barrels/year = $323 billion/year

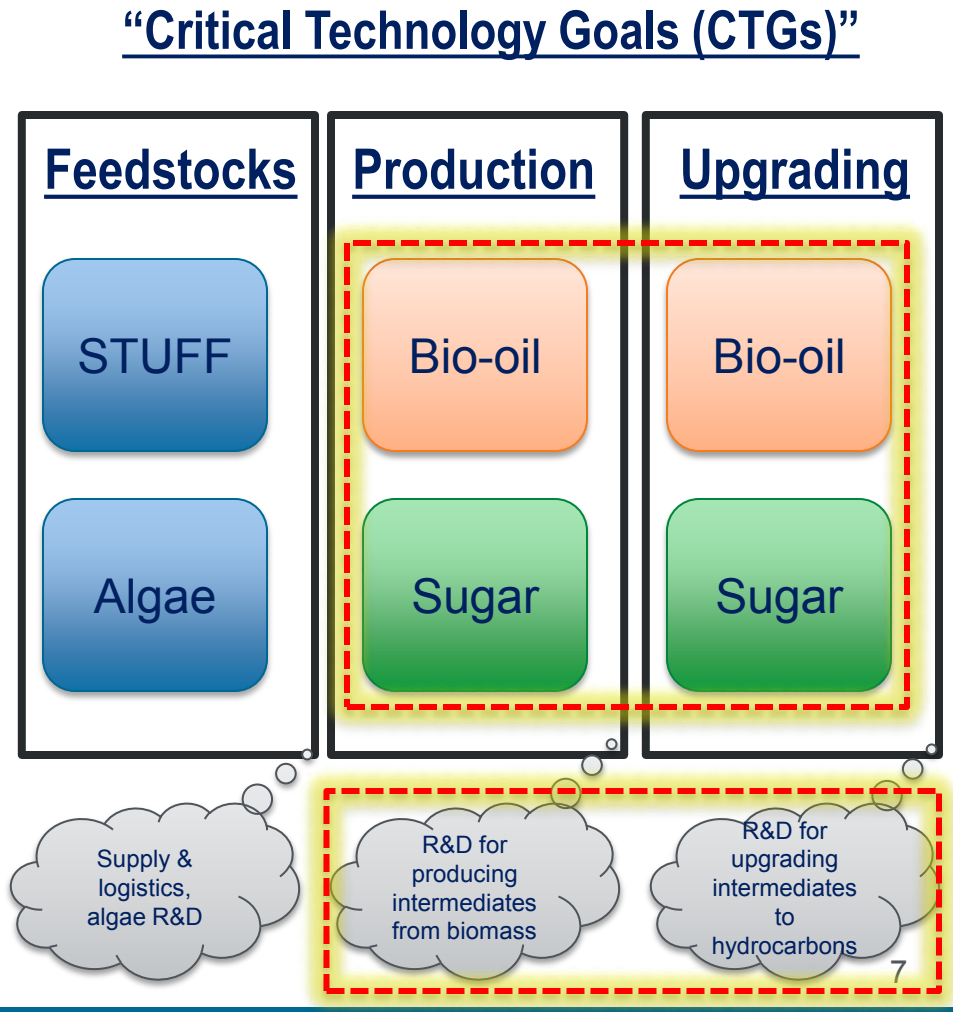
Sources: EIA, Annual Energy Review
OBP MYPP

Biomass Program Reorganization

Before



After



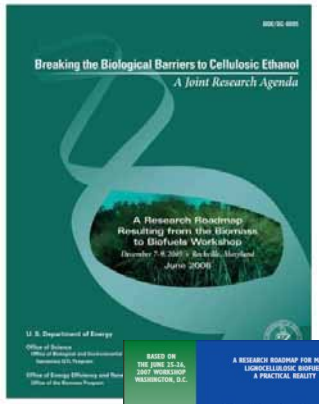
Moving Forward

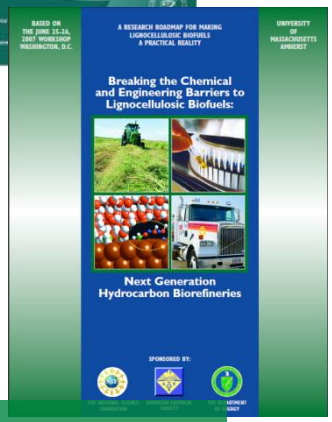
- **What technologies are necessary to replace the whole barrel?**
  - Efficient technologies utilizing intermediate streams made up of:
    - Carbohydrate
    - Bio-oil
  - Innovative new processing technologies

- **How are the areas of R&D identified?**
  - The program needs a revised guiding document outlining the R&D needs of the future biorefinery industry
  - The Biomass Program's Conversion Technologies for Advanced Biofuels workshop (CTAB) was held to determine priortity barriers and R&D activities

Workshop Objective

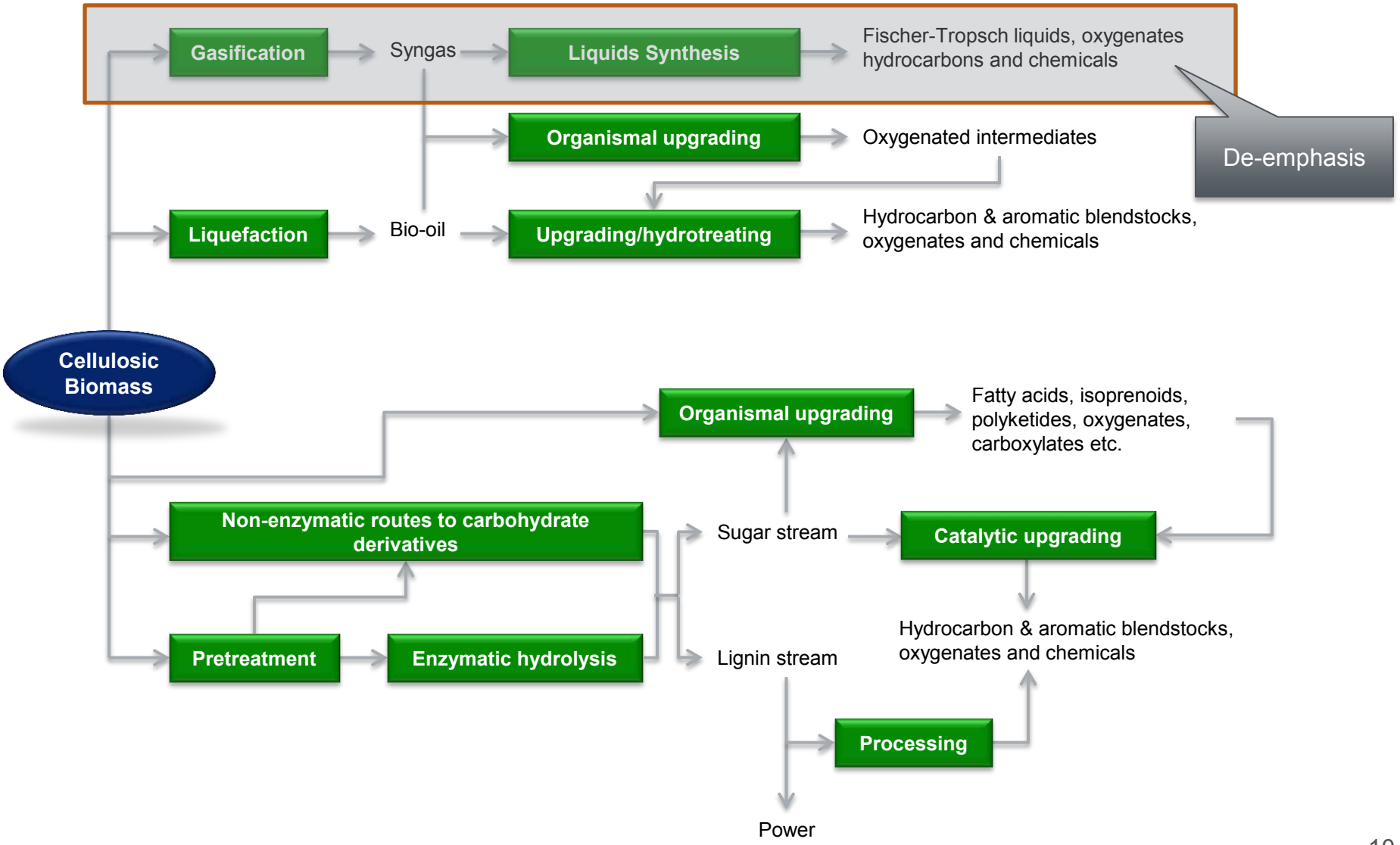
- Expand upon existing R&D roadmaps
  - *Breaking the Biological Barriers to Cellulosic Ethanol*
  - *Breaking the Chemical and Engineering Barriers to Lignocellulosic Biofuels*
- Areas of focus: R&D Barriers and Activities
  - R&D progress as laid out in existing roadmaps, evaluate gaps
  - Identification and inclusion of hybrid routes
  - Dedicated focus to hydrocarbon fuels and products
- Gather input from industry, national labs and academia
- Deliverable: Roadmap for public dissemination which will guide Biomass program out-year R&D directions





Advanced Conversion Technology Roadmap

Processing Strategies



Conference Agenda

Wednesday December, 7

Morning Session

Sugar Upgrading Sessions:

- Chemical and biological upgrading

Bio-Oil Upgrading Sessions:

- Removal of desstabilizing components, chemical composition modification and selective fractionation

Afternoon Session

Innovative Topics:

- Hybrid biochemical/thermochemical processing systems, lignin utilization and direct microbial conversion

Thursday December, 8

Morning Session

Sugar Production Sessions:

- Pretreatment and enzymatic hydrolysis, non-enzymatic routes to sugars

Bio-Oil Production Sessions:

- Removal of desstabilizing components, chemical composition modification and selective fractionation

Afternoon Session

Innovative Topics:

- Solvent systems in biomass processing, separation systems in biomass processing and conversion systems for GMO feedstocks.

Program Opportunities

Resulting from the workshop:

- Application of Synthetic Biology to Improve Biofuels Production Technologies
- Refinery integration for bio-oil blending

Other Program Opportunities:

- Innovative Pilots
- Algae Feedstocks

Be on look out for announcements on rants.gov!

Webinar Outline

	Moderator: Dan Lehrburger, BCS, Inc.
2:30 – 2:50 PM	Biomass Program Overview: Leslie Pezzullo, DOE Biomass Program
2:50 – 3:00 PM	Overview of Carbohydrate Breakout Sessions: Bryna Berendzen, DOE Biomass Program
3:00 – 3:15 PM	Production of Biomass Derived Carbohydrates: Mike Ladisch, Ph.D., Purdue University
3:15 – 3:30 PM	Upgrading of Biomass Derived Carbohydrates: Ellen Panisko, Ph.D., PNNL
3:30 – 3:40 PM	Overview of Bio-Oil Breakout Sessions: Melissa Klembara, DOE Biomass Program
3:40 – 3:55 PM	Production of Bio-Oils from Biomass: David Dayton, Ph.D., RTI International
3:55 – 4:10 PM	Upgrading Biomass Derived Bio-Oils: Doug C. Elliott, Ph.D., PNNL
4:10 – 4:30 PM	Innovative Topics in Biomass Processing: Jonathan Male, Ph.D., PNNL
4:30 – 4:50 PM	Cross-Cutting Topics in Biomass Processing: Adam Bratis, Ph.D., NREL
4:50 – 5:00 PM	Question and Answer

Main Sessions and Chairs

Sugar Upgrading, Dec 7			
Chemical/Catalytic Upgrading			
Non Lab Chairs	Held	Andrew	Virent
Lab Chairs	Lilga	Mike	PNNL
Recorder	Beckham	Gregg	NREL
Biological Upgrading			
Non Lab Chairs	Granda	Cesar	Terrabon
Lab Chairs	Panisko	Ellen	PNNL
Recorder	Bruno	Ken	PNNL

Sugar Production, Dec 8			
Pre-Treatment/Enzymatic			
Non Lab Chairs	Ladisch	Mike	Purdue
Lab Chairs	Elander	Rick	NREL
Recorder	Shekiro	Joe	NREL
Non-Enzymatic			
Non Lab Chairs	Dinello	Mark	Purevision
Lab Chairs	Gresham	Garold	INL
Recorder	Westover	Tyler	INL

Bio-oil Upgrading, Dec 7			
Chemical Composition Modification			
Non Lab Chairs	Jones	Mark	Dow Chemical
Lab Chairs	Elliott	Doug	PNNL
Recorder	Zacher	Alan	PNNL
Destabilizing Components Removal			
Non Lab Chairs	Lewnard	Jack	gti
Lab Chairs	Davis	Mark	NREL
Recorder	Yung	Matthew	NREL
Selective Fractionation			
Non Lab Chairs	Galloway	Doug	UOP
Lab Chairs	Biddy	Mary	NREL
Recorder	Cheah	Singfoong	NREL

Bio-oil Production, Dec 8			
Chemical Composition Modification			
Non Lab Chairs	Whitty	Kevin	Univ of Utah
Lab Chairs	Snyder	Seth	ANL
Recorder	Shunn	Lee	INL
Destabilizing Components Removal			
Non Lab Chairs	Dayton	David	RTI
Lab Chairs	Babu	Suresh	BNL
Recorder	Yung	Matthew	NREL
Selective Fractionation			
Non Lab Chairs	Brown	Robert	Iowa State
Lab Chairs	Czernik	Stefan	NREL
Recorder	Cheah	Singfoong	NREL

Acknowledgments

Session Co-Chairs

- Andrew Held (Virent)
- Cesar Granda (Terrabon)
- David Dayton (RTI, Intnl)
- Doug Elliott (PNNL)
- Doug Galloway (UOP)
- Ellen Panisko (PNNL)
- Garold Gresham (INL)
- Jack Lewnard (GTI)
- Kevin Whitty (University of Utah)
- Mark Davis (NREL)
- Mark Dinello (PureVision)
- Mark Jones (Dow)
- Mary Biddy (NREL)
- Mike Ladisch (Purdue)
- Mike Lilga (PNNL)
- Rick Elander (NREL)
- Robert Brown (Iowa State University)
- Seth Snyder (ANL)
- Stefan Czernik (NREL)
- Suresh Babu (BNL)

Recorders

- Alan Zacher (PNNL)
- Gregg Beckham (NREL)
- Joe Shekiro (NREL)
- Ken Bruno (PNNL)
- Lee Shunn (INL)
- Matthew Yung (NREL)
- Singfoong Cheah (NREL)
- Tyler Westover (INL)

OBP Planning Committee

- Alicia Lindauer
- Bryna Berendzen
- Corinne Valkenburg (PNNL)
- Dan Lehrburger (BCS, Inc.)
- Leslie Pezzullo
- Melissa Klembara
- Paul Grabowski