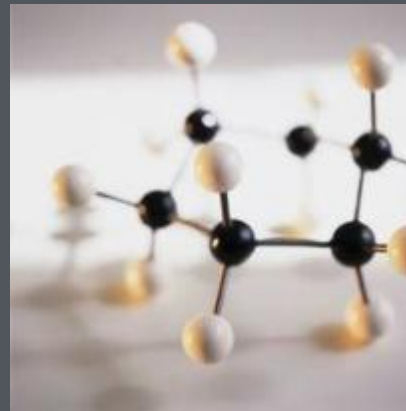


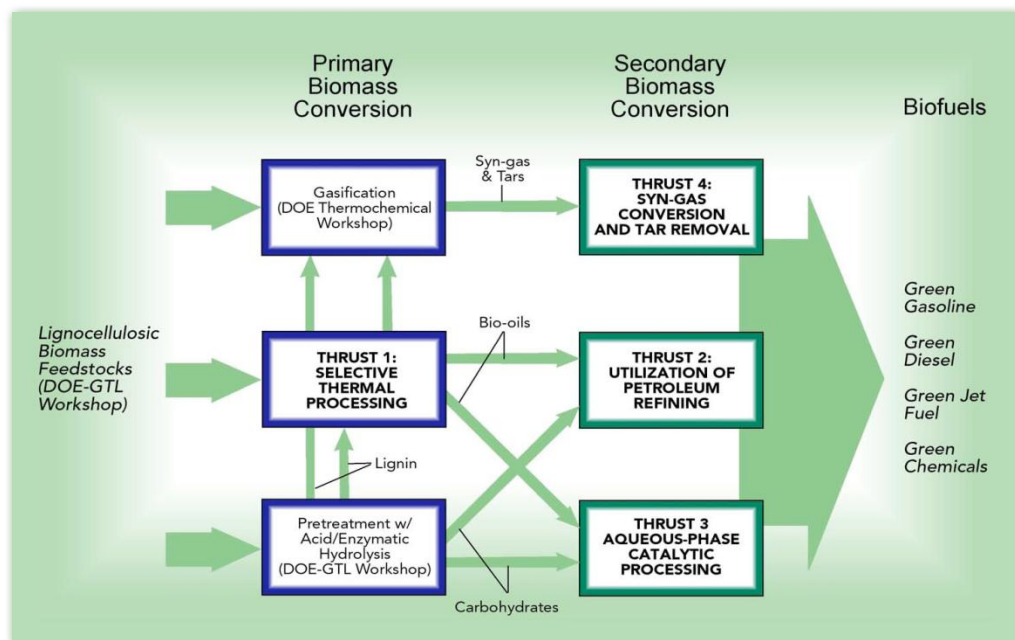
Workshop on Conversion Technologies for Advanced Biofuels – Bio-Oils

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



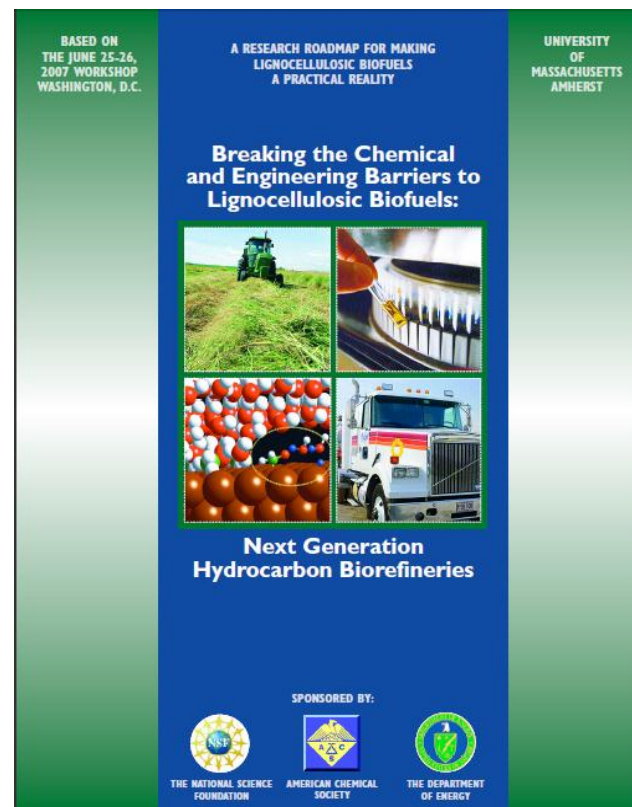
Report-Out Webinar
February 9, 2012

Melissa Klembara
Office of the Biomass Program
U.S. Department of Energy



2007 Roadmap "Thrust" Areas

- Selective thermal processing
- Syngas conversion
- Utilization of conventional refinery technologies
- Liquid-phase catalytic processing
- Process engineering & design
- Crosscutting issues



Challenges Identified in 2007

Pyrolysis	Liquefaction	Gasification
Stability	High viscosity	Feedstock processing
Acidity	Elevated oxygen content	Tar Reduction
High oxygen content	Pressure	Fuel Synthesis
Upgrading required for use as fuel	Upgrading required for use as fuel	Catalyst Discovery & Development
Chemical complexity	Chemical complexity	

Gasification - successes resulting from last roadmap

- Minimized Ash and moisture of feedstock
- More cost effective biomass gasification systems
- Limited Tar formation in the gasifier
- Maximized reforming of methane and tar
- Mitigated Sulfur
- Mixed alcohol and higher yield ethanol catalysis
- Reaction modeling/computation at molecular scale
- Speciation modeling techniques

OBP FOAs issued in response to Breaking the Chemical and Engineering Barriers Report

Synthesis Gas to Liquid Fuels Validation – 2007 (\$9.7M)

- Goal: Prove validity of cleanup technologies used in converting a wide range of feedstocks into biofuels
- 5 Awards: Emery Energy, GTI, ISU, RTI, SRI

FY12 target is demonstration of a modeled minimum ethanol selling price of \$2.05/gal (based on feedstock cost of \$61.57/dry US ton)

Pyrolysis Oil Stabilization – 2008 (\$7M)

- Overall Goal: Develop processes or techniques that stabilize fast pyrolysis bio oils generated from woody biomass
- 5 Awards: UOP, Virginia Tech, ISU, RTI, U Mass

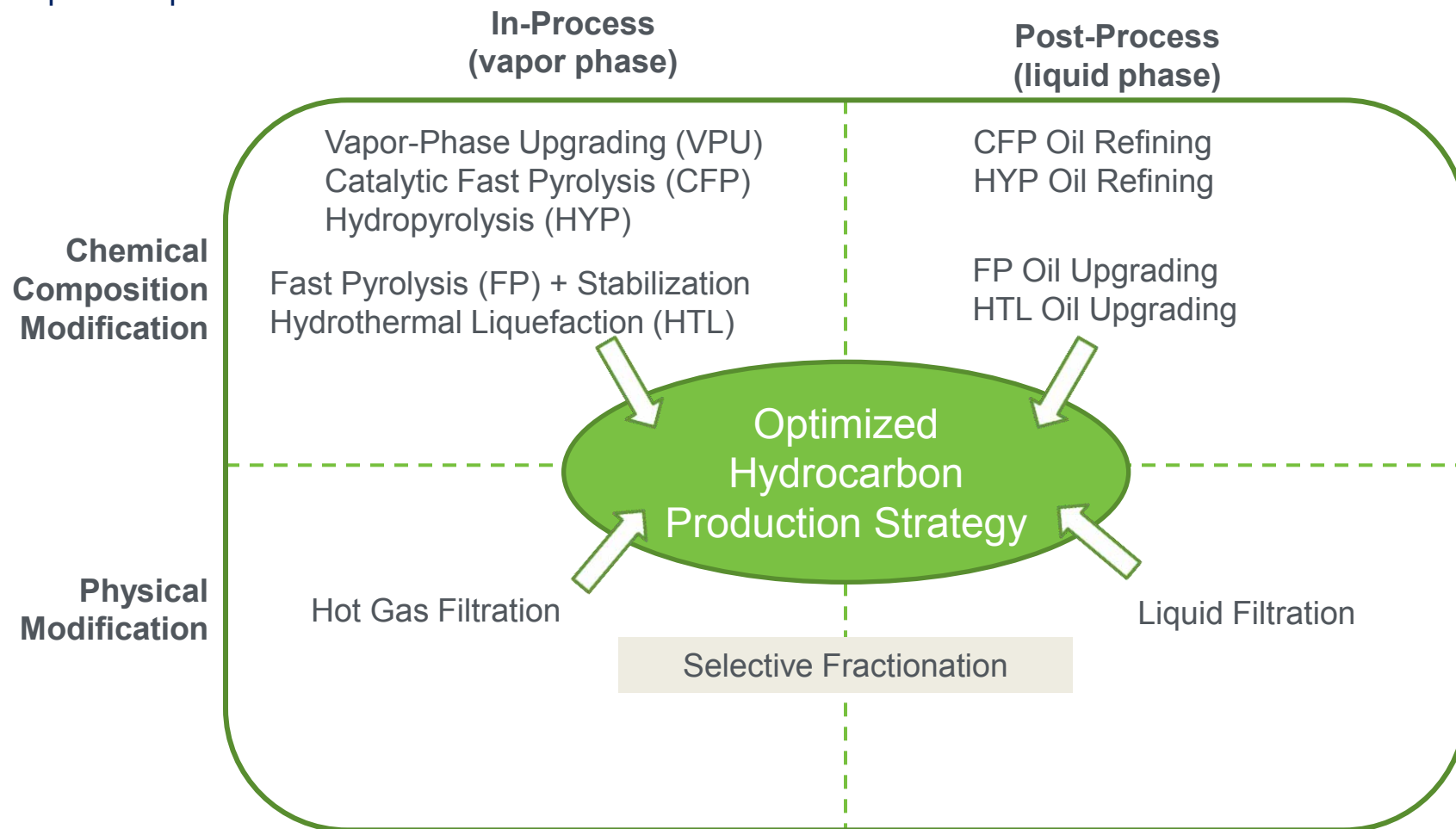
Pyrolysis Oil Upgrading – 2010 (\$11M)

- Overall Goal: Demonstrate ability to produce hydrocarbon transportation fuel that can be blended at up to 30 wt% or an upgraded bio-oil compatible with existing petroleum refining unit operations
- 4 Awards: WR Grace, PNNL, GTI, Battelle

Bio oil FOAs and FY11 “Thermochemical Intermediates Upgrading” FOA work toward FY17 Programmatic target of ~\$3/gal

CTAB – Overview of Bio Oil Breakouts

Graphic adapted from UOP



CTAB aimed to capture R&D challenges associated with each quadrant; understanding that that these challenges are a function of a given pathway as well as the “in process” conditions

- 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)