



Advanced Biofuels (*and Bio-products*)  
Process Demonstration Unit

Todd Pray, PhD, MBA

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Biochemical Conversion Area

DOE Bioenergy Technologies Office (BETO)

Project Peer Review

Washington, DC



# ABPDU Goals

**Build a process demonstration unit to support BETO's mission in addressing key barriers to biofuel and bio-economy development,**

**- and -**

**Partner with researchers from industry, the National Labs, and academia to optimize and scale technologies to enable bio-based chemicals, materials, and fuels commercialization.**

# Quad Chart Overview

## Timeline

- Project start date: 2010
- Project end date: 2017
- Percent complete: ~65%

## Barriers addressed

- Bt-B, Biomass Variability
- Bt-D, Pretreatment Chemistry
- Bt-E, Pretreatment Costs
- Bt-G, Cellulase Enzyme Loading
- Bt-I, Cleanup / Separation
- Bt-K, Biological Process Integration

## Budget

	Total Costs FY 10 – FY 12	FY 13 Costs	FY 14 Costs	Total Planned Funding (FY 15-Project End Date)
DOE Funds*	\$22.6M	\$3.9M	\$3.9M	\$10.4M

\*Includes \$17M in ARRA funding

## Partners

- 6 Industry partners over FY14-15
- Collaborations with BRCs (Wyman @ BESC, several @ JBEI, Fox @ GLBRC)
- Formal AOP partnerships with Idaho Nat'l Lab and Sandia Nat'l Lab at Livermore
- Informal collaborations with NREL and Argonne Nat'l Lab
- More (>10) in the pipeline for fuel, chemical, or protein processes as grant sub-awards or sponsored research...

# 1. Project Overview

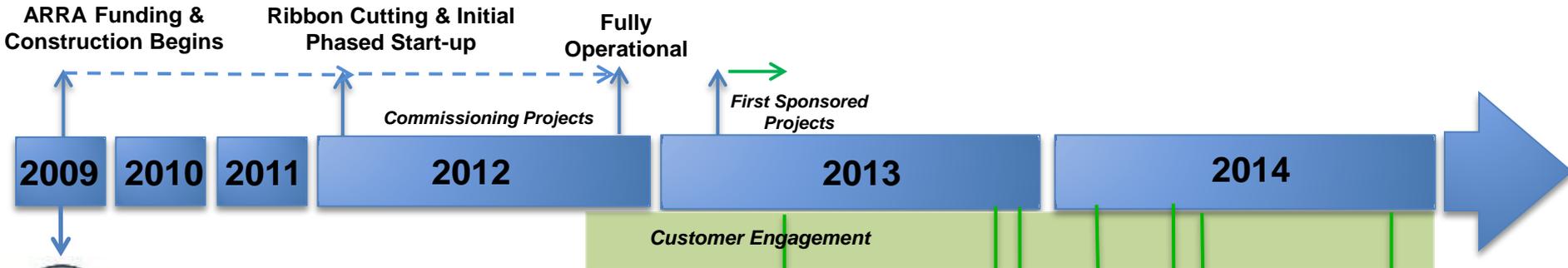
## History and Context

# Origins and governance

- Established by American Recovery and Reinvestment Act funds in 2009 – roughly \$17 million for the 15,000 square foot Demonstration Lab
- Sponsored by DOE's Energy Efficiency and Renewable Energy Division from the Bioenergy Technologies Office



# ABPDU History and Industry Engagement



## Primary objective:

Partner with researchers from industry, the National Labs, and academia to optimize and scale technologies to enable bio-based chemicals, materials, and fuels commercialization.

BioBasedDigest

AIChE  
American Institute of Chemical Engineers  
ABPDU tour / demo

CLEAN TECH OPEN  
Business Briefing Presentations, Tours

World Bio Markets USA  
ABPDU / LBNL tour

ABLNext  
Advanced Biofuels Leadership Conference  
ABPDU / LBNL tour

BiofuelsDigest

The Bio Incredibles

ABLNext2014  
ABPDU / LBNL tour

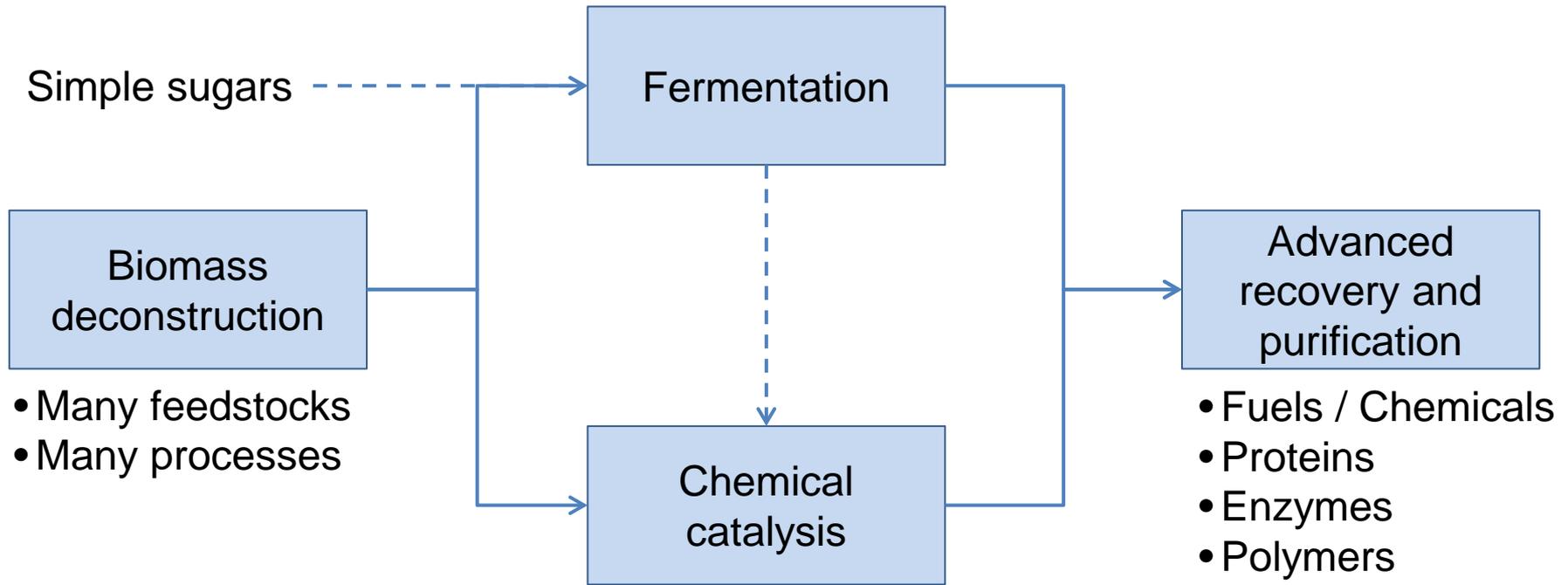
# Team

- Flexible group of 12-14 engineers, associates and scientists with collectively decades of industry and related experience in diverse areas of energy, materials, biofuel and biochemical process development and manufacturing from the organizations below...



# Key technical capabilities

- Process development, demonstration, integration and techno-economic analysis across varied bio-process scales, configurations, feedstocks and products.



- Can focus on individual unit operations or several processes in succession.
- A unique North American facility that has focused on advanced solvents, including ionic liquids, to improve energy efficiency of biomass conversion.

# Facility at a glance – from bench-to-pilot scale



## 2. Approach

Technical & Management Success Criteria,  
Challenges and Processes

- Critical success factors
  - Upstream Flexibility – feedstock types and process technologies
  - Excellence in bioprocess execution – across bench and pilot scale bioreactors
  - Product Diversity – recovery, purification and analytical capabilities to support partners
  
- Key technical challenges and approach
  - Adapting equipment to client / sponsor requirements – focus on understanding industry needs and updating / upgrading hardware and software capabilities with LBNL Engineering Division to stay current
  - Maintaining process readiness across several technical disciplines under (and in between) tight project timelines – focus on cross-training and proactive PM and aggressive uptime metrics

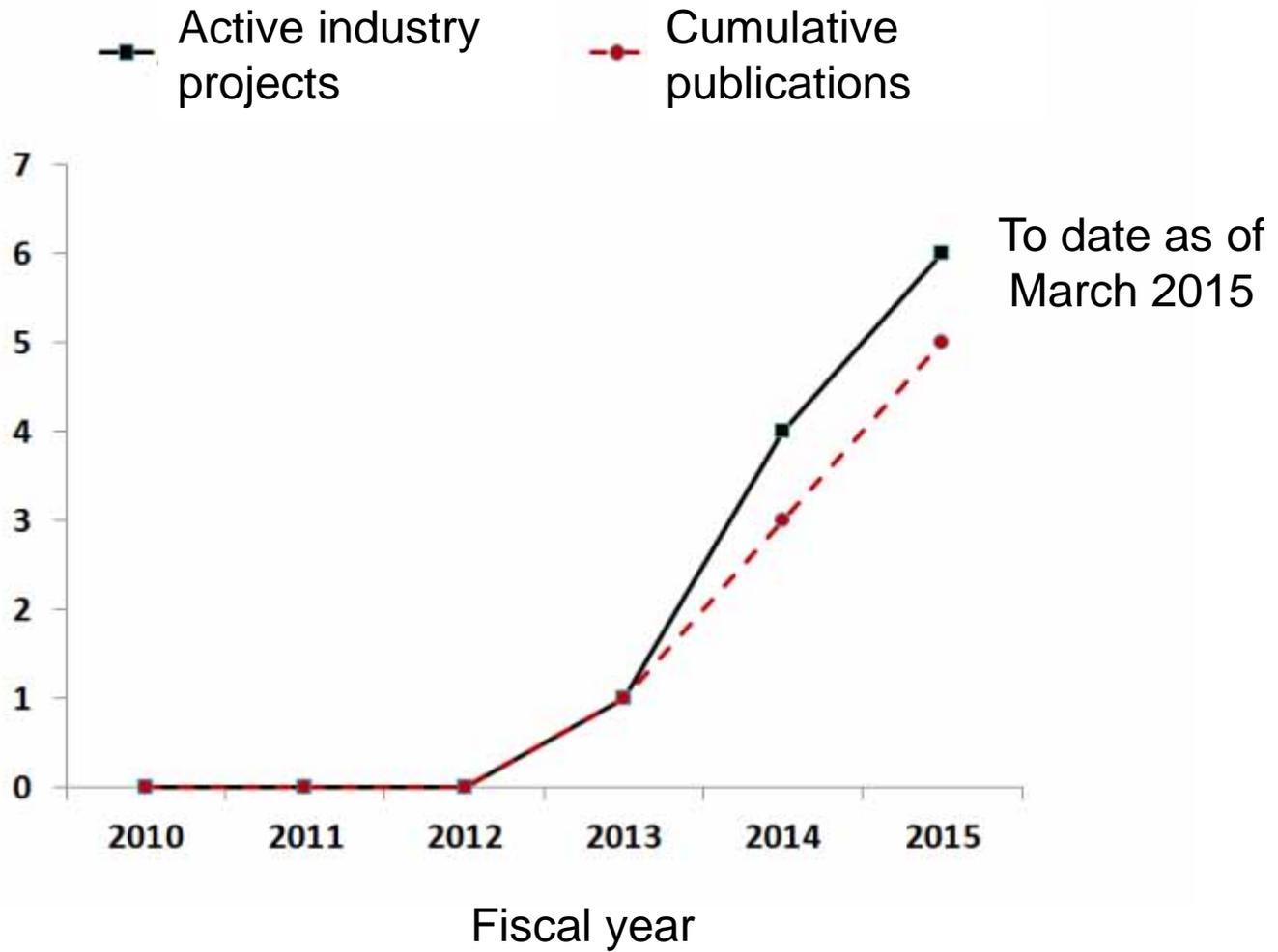
- Primary management success factors (market & business)
  - Delivering on business objectives of our partners – adapting processes to a changing feedstock supply chain landscape; growing their markets with bio-based products
  - Working with small companies (pre-seed, seed-stage, and early round VC-backed) to develop projects and help them access additional public or private funding
- Key management challenges and approach
  - Establishing industry presence and awareness of ABPDU – focus on constant “over-communication” via conferences, publications, networking, busdev and marketing
  - Building, training and maintaining a small team (12-14 technical staff) capable of developing and executing on a wide variety of ever-changing project types – focus on individual and team development
  - Maintaining broad team awareness of project goals, priorities – focus on a common understanding and excellent communication between project teams

### 3. Technical Accomplishments Progress and Results

# Key activities supported by ABPDU AOP

- Project development
  - Outreach to understand and address technical and business drivers of potential partners (especially small businesses)
  - Proposal development and project planning by the team in consultation with sponsors and collaborators
  - Technical preparations, team training, and mock process execution
- Technology development
  - BRC and Lab collaborations – fermentation scale-up for enzyme and hydrocarbon production; biomass characterization and biomass deconstruction; analytical and predictive model method development leading to several publications
  - Engineering – hardware and software upgrades and modifications for safety, automation, and performance with one reactor design patent application to date

# Ramping up partnerships and outcomes



# Results – Partnering and project execution

*Projects spanning a wide range of biomass and waste stream conversion processes to fuels, chemicals, proteins, materials at both bench and pilot scale.*

## Projects completed



## Active projects



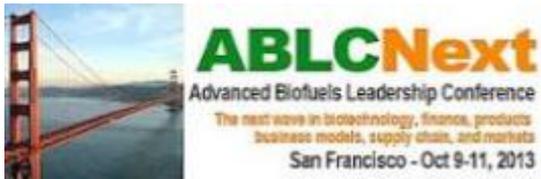
## Pending...



Have met quarterly occupancy, partnering and downtime targets / milestones through FY14-15.

# Results – Outreach to increase utilization

- ABPDU group / conference tours & demos – AIChE Norcal 2013, ABLCNext 2013 & 14, World Bio Markets 2013, Cleantech Open 2013
- Technical and business presentations – SIMB SBFC 2014-15, AIChE 2014, Bio World Congress 2014, Bio PacRim Summit 2014, ABLCNext 2014, etc.



Have met quarterly outreach milestones through FY14-15.

# Results – Funding with small businesses

- Over 20 FOA sub-award proposals developed in partnership with more than 10 small businesses as leads - 3 projects awarded to-date (*distinct from the ABPDU Support AOP*)
  - one active at the ABPDU – DOE FOA/BAA
  - one awarded project not funded – DOE Phase I SBIR
  - one start pending ABPDU scope finalization – USDA Phase II SBIR



Increasing technology market impact by partnering with and supporting funding applications.

## 4. Relevance

# Relevance

- Directly enabling bench scale development and early piloting for biomass conversion and fuel, chemical and protein production platforms relevant to DOE and the broader bio-economy.
- Executing projects under Lab partnerships (under recently developed AOP projects) directly addressing key BETO barriers:
  - Bt-B, Biomass Variability
  - Bt-D, Pretreatment Chemistry
  - Bt-E, Pretreatment Costs
  - Bt-G, Cellulase Enzyme Loading
  - Bt-I, Cleanup / Separation
  - Bt-K, Biological Process Integration
- Highly focused on tech transfer and TRL increase via 1) developing and scaling industry sponsor technology, and 2) patenting and out-licensing technology developed internally. BETO awareness and input on all projects.

## 5. Future Work

# Future Work

- Build on success and momentum in partnering with industry
  - New products, feedstocks, and industry sectors → grow development, scale-up and demonstration support for start-ups, multinationals, and everything in between
- Work with BETO to plan and implement transition to a self-sustained facility
  - Protect and leverage the DOE / EERE / BETO investment in the ABPDU
  - Continue to provide industry partners and researchers aid in developing, demonstrating and deploying advanced biofuel technologies
- Transition to and build on R&D efforts in current / future AOPs and LDRDs
  - MSW and other waste stream and mixed feedstock strategies, validation and demonstration of novel conversion technologies, products and markets
- Maintain focus and effort in partnering with small businesses on FOAs to strengthen their TRL and market impact in a financially challenged industry
- Continually upgrade and improve lab and pilot capabilities

# Summary

- 1. Overview** - A highly flexible, capable team and facility – supporting bench- and pilot-scale development and demonstration for emerging technologies from industry, the National Lab ecosystem, and academia.
- 2. Approach** - Market- and customer-oriented business and technical strategy.
- 3. Technical Accomplishments/Progress/Results** - Have transitioned from commissioning (end-2012) to a fully operational (and very busy) development partner / site for our industry clients and National Lab and academic partners.
- 4. Relevance** - Hyper-focused on enabling bio-economy product and process commercialization, both through addressing specific BETO barriers and also based on input from potential industry partners.
- 5. Future work** - Build on our momentum with current and new partners, and in upgrading and maintaining our facility to stay cutting edge.