



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

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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

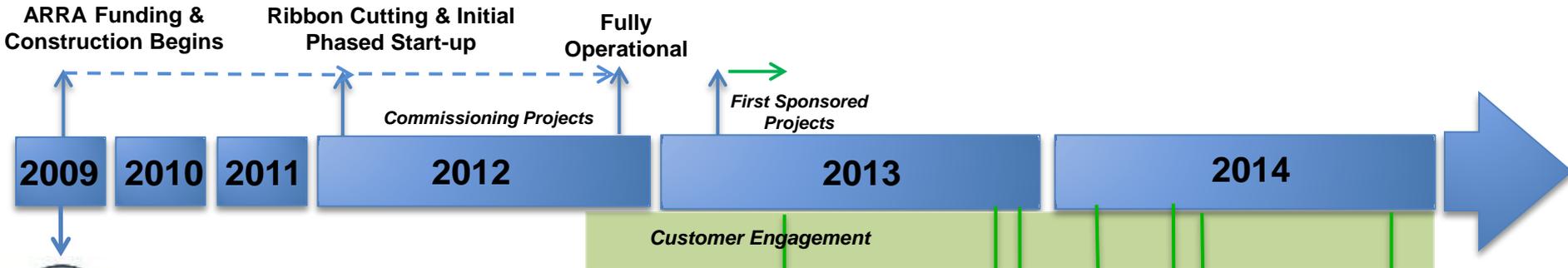
History and Context

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

The Bio Incredibles

ABPDU / LBNL tour

ABPDU / LBNL tour

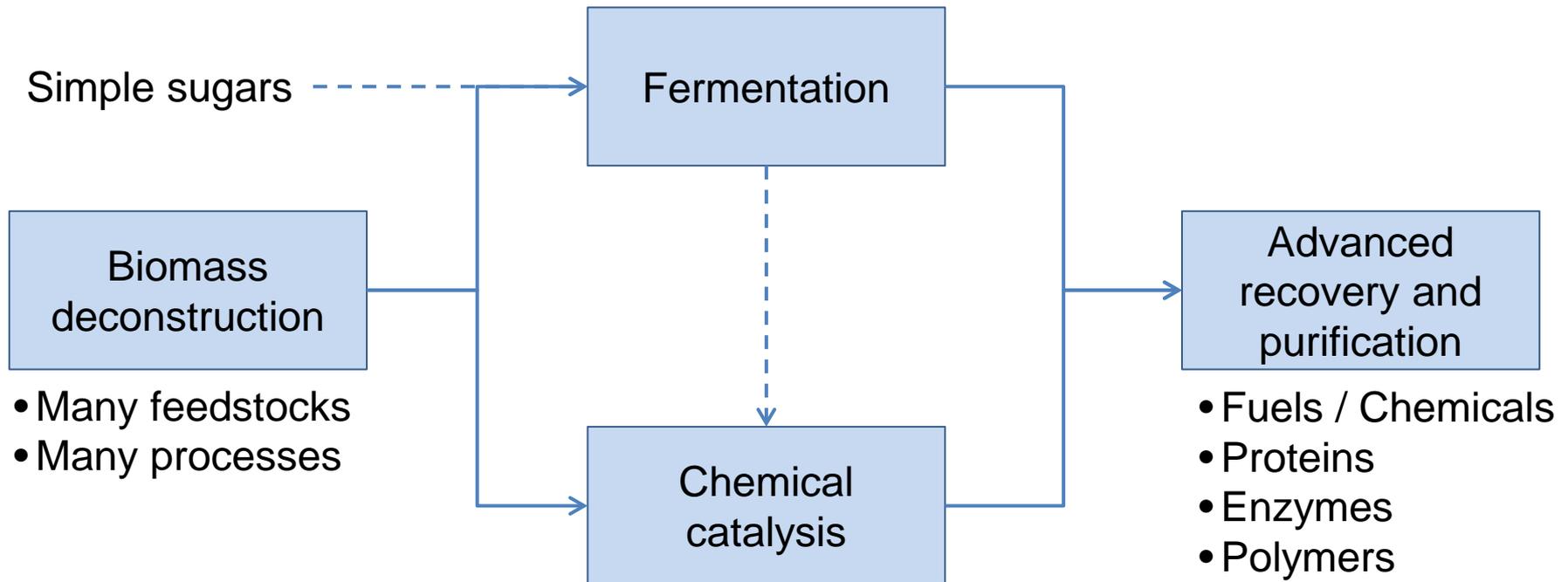
Team

- 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

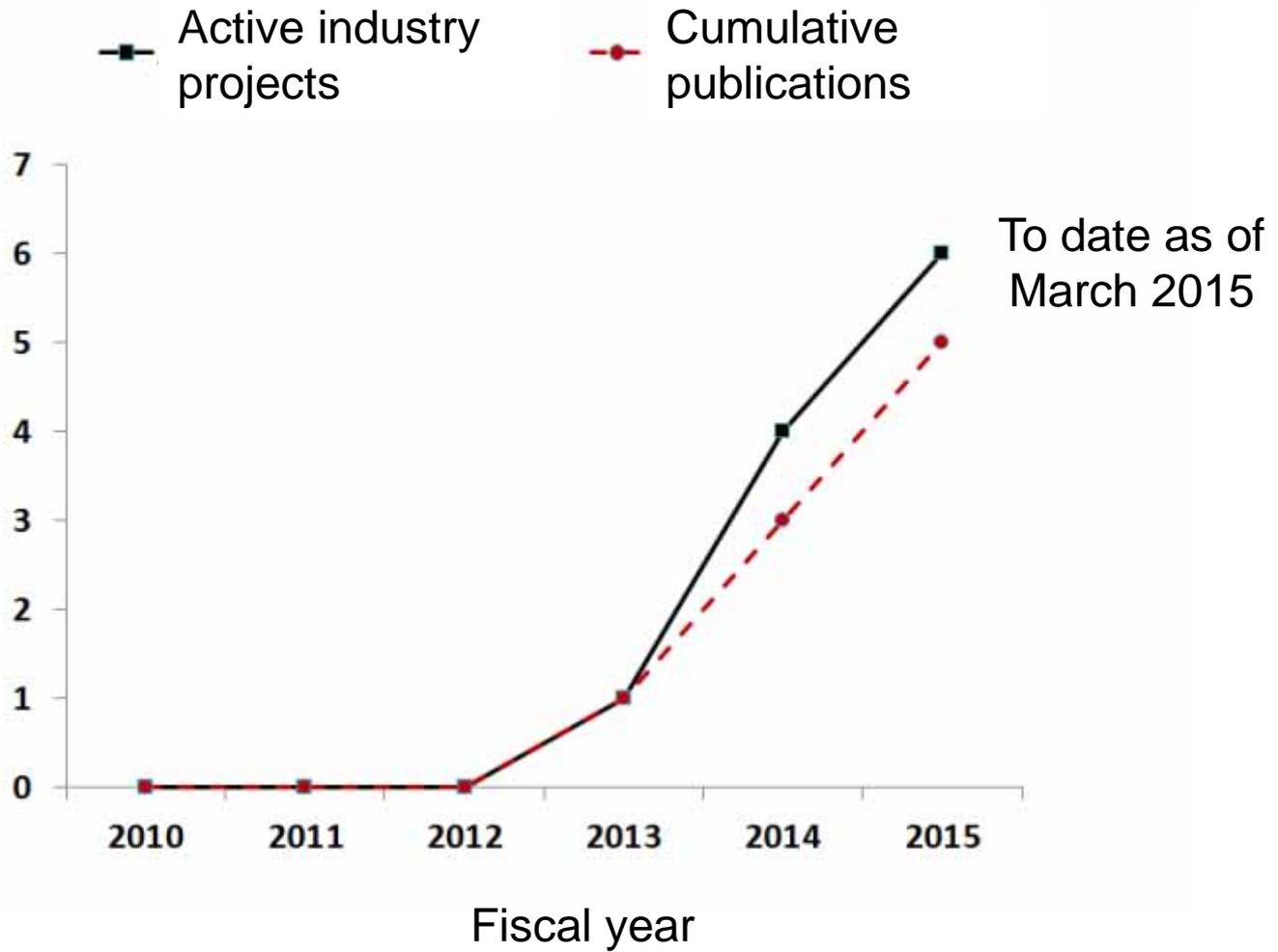
- Primary management success factors (market & business)
 - Delivering on business objectives of our partners – adapting processes to a changing feedstock supply chain landscape; growing their markets with bio-based products
 - Working with small companies (pre-seed, seed-stage, and early round VC-backed) 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



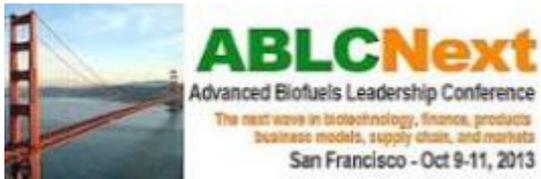
Pending...



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

Results – Outreach to increase utilization

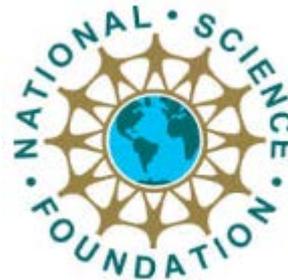
- ABPDU group / conference tours & demos – AIChE Norcal 2013, ABLCNext 2013 & 14, World Bio Markets 2013, Cleantech Open 2013
- Technical and business presentations – SIMB SBFC 2014-15, AIChE 2014, Bio World Congress 2014, Bio PacRim Summit 2014, ABLCNext 2014, etc.



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.