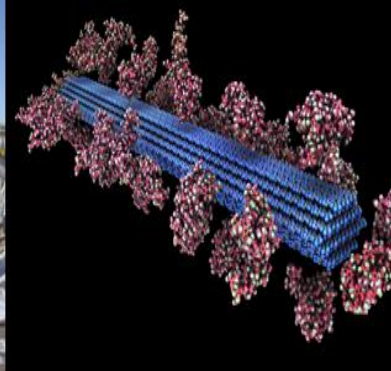




U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



Chemical Catalysis for Bioenergy (ChemCatBio) Consortium

U.S. Department of Energy (DOE)
Bioenergy Technologies Office (BETO)
2017 Project Peer Review

Thermochemical Conversion

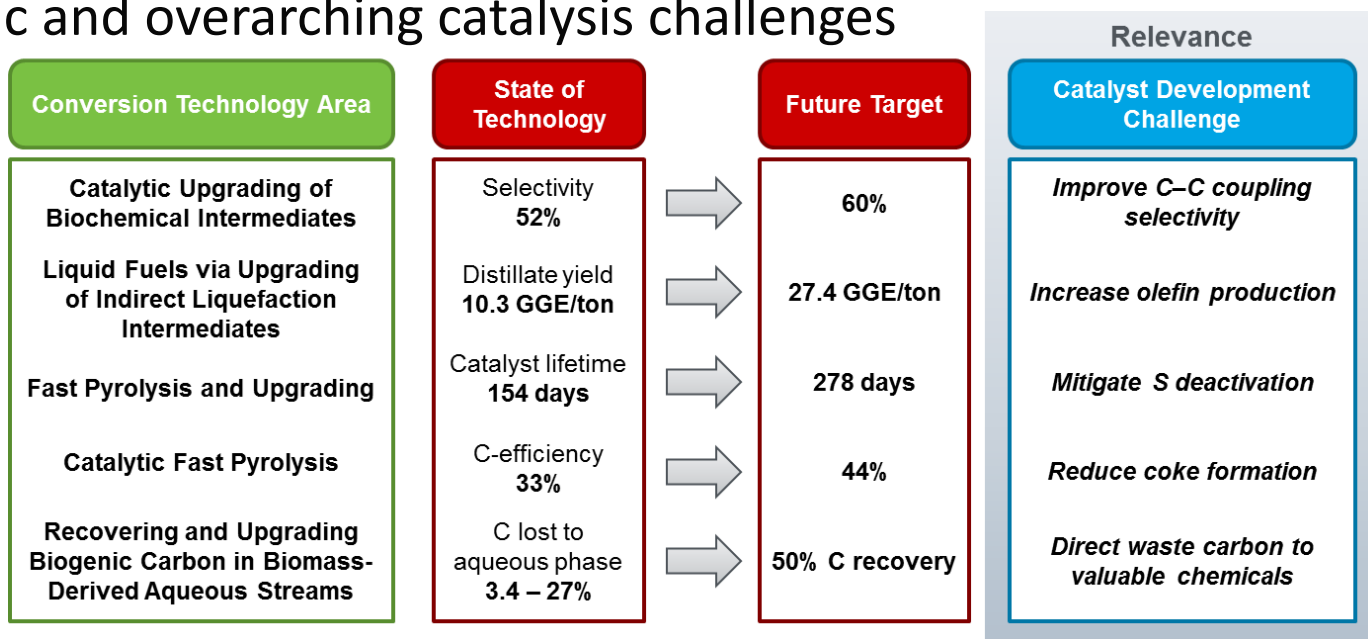
March 7th, 2017

Participating Labs:
NREL, PNNL, ORNL,
ANL, LANL, and NETL

Mission Statement

Mission: ChemCatBio leverages unique US DOE national lab capabilities to address technical risks associated with *accelerating the development of catalysts and related technologies for the commercialization of biomass-derived fuels and chemicals*, leading to enhanced energy security and national leadership in the global bioeconomy.

Outcome: *Reduce the time and cost required to transition catalytic materials from discovery to deployment by targeting both pathway-specific and overarching catalysis challenges*



Overview: Motivation for ChemCatBio

2015 PROJECT PEER REVIEW

U.S. DEPARTMENT OF ENERGY
BIOENERGY TECHNOLOGIES OFFICE

Feedback: *Establish an “Experimental Catalysis Consortium”*

- Address *overarching issues* such as deactivation and physical stability
- Needs to be a *highly-coordinated* effort focused on *advancing the state of technology for catalysis*, not just pathway-specific challenges
- Integrate valorization of organics in *aqueous waste streams*



Energy Materials Network

U.S. Department of Energy

Goal: *Accelerate the development of advanced materials for clean energy applications*

- Consists of national lab-led *consortia*
- Integrates all phases of R&D from *discovery through deployment*
- Facilitates *industry access* to a world class network of capabilities tools, and expertise



Overview: Structure

Core Catalysis Projects

Catalytic Upgrading of Biochemical Intermediates
(NREL, PNNL, ORNL, LANL)

Liquid Fuels via Upgrading of Indirect Liquefaction Intermediates
(NREL, PNNL)

Fast Pyrolysis and Upgrading
(PNNL, ORNL)

Catalytic Fast Pyrolysis
(NREL, PNNL)

Recovering and Upgrading Biogenic Carbon in Aqueous Waste Streams
(PNNL, NREL)

Zeolites and Metal Oxide Catalysts

Supported Metal Catalysts

Cross-cutting Discussion Groups

Enabling Projects

Advanced Catalyst Synthesis and Characterization
(NREL, ANL, ORNL)

Catalyst Cost Model Development
(NREL, PNNL)

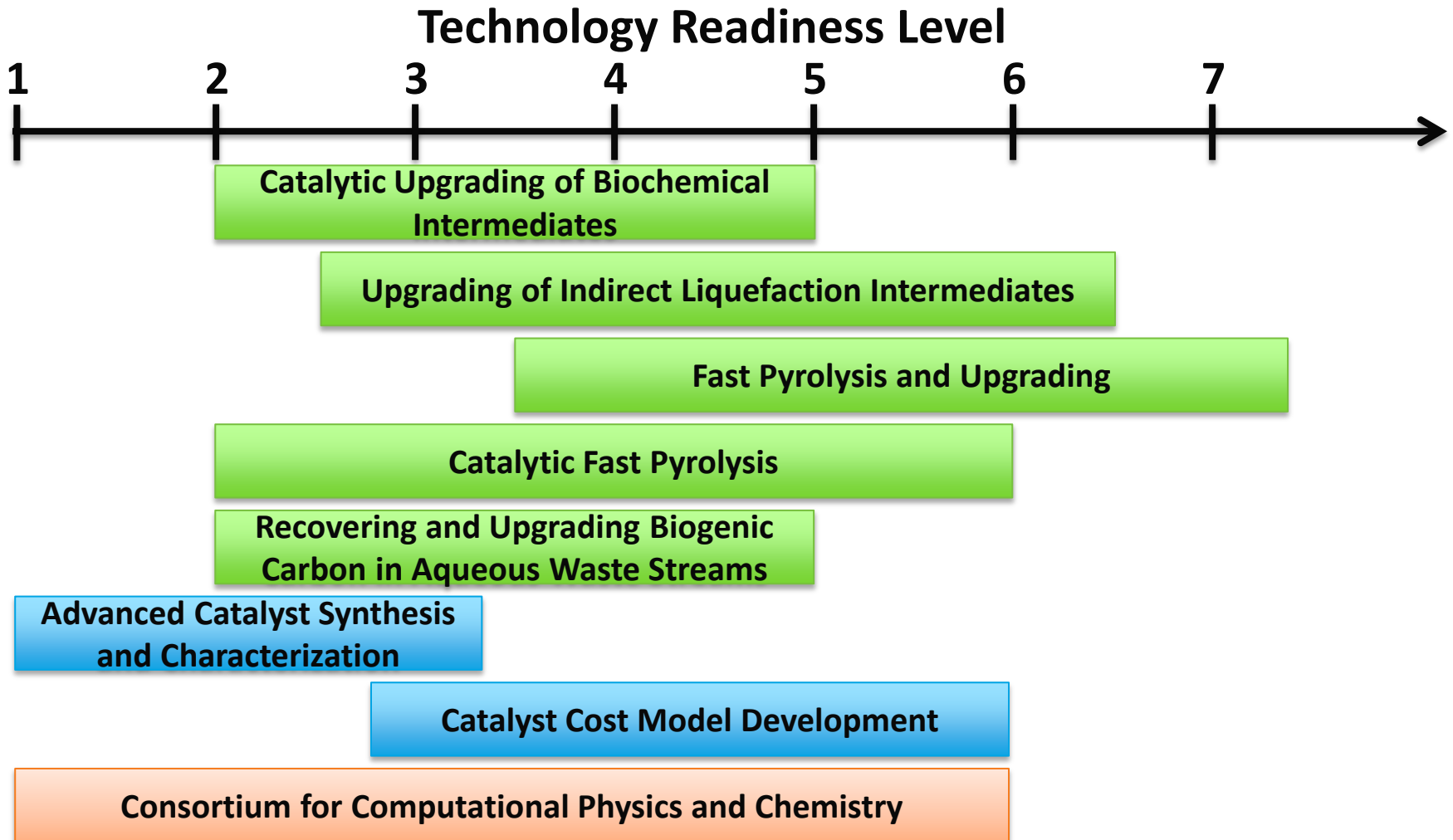
Consortium for Computational Physics and Chemistry
(ORNL, NREL, PNNL, ANL, NETL)

Consortium Integration

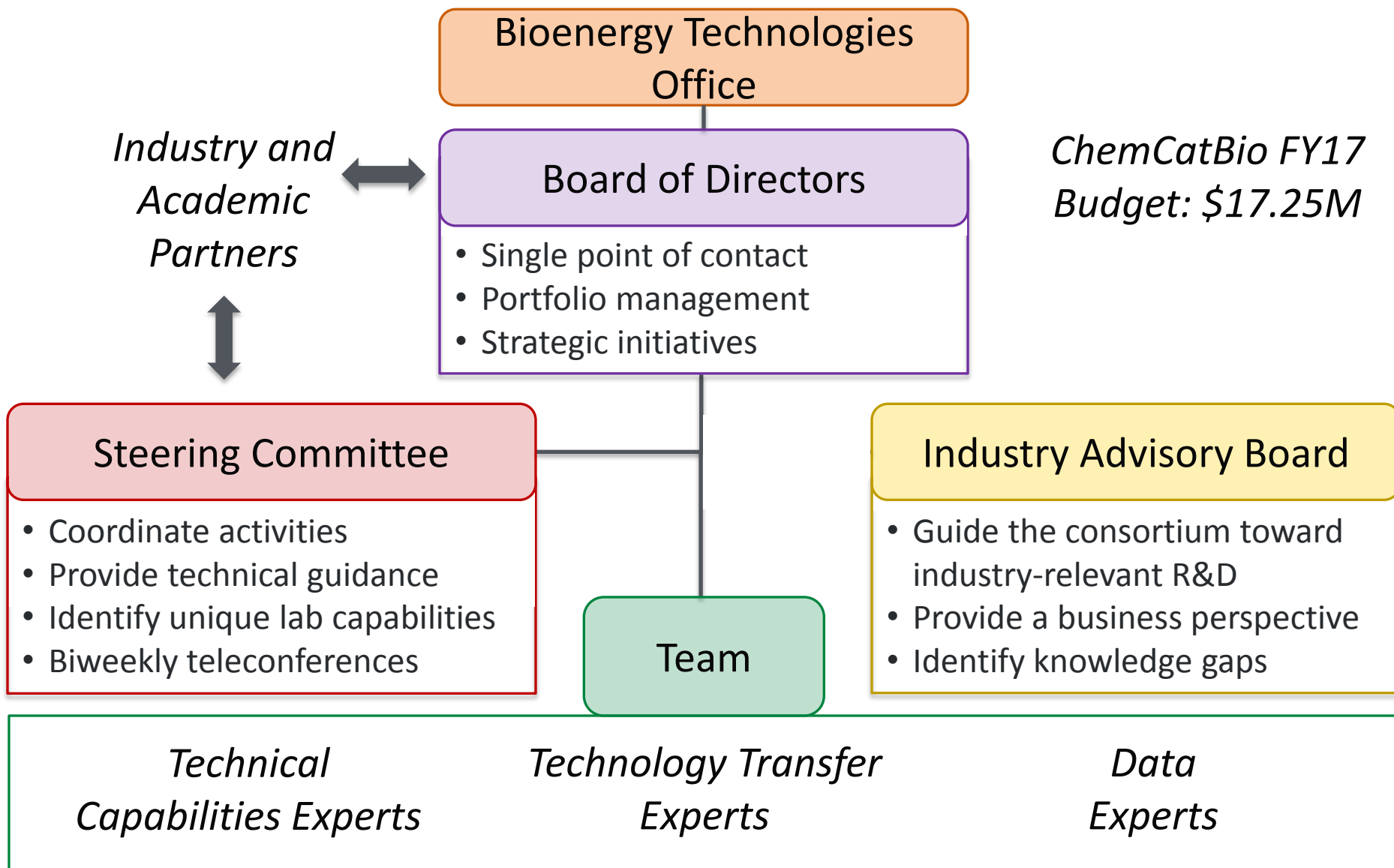
- Core catalysis projects focused on specific *applications*
- *Collaborative* projects leveraging core capabilities across DOE laboratories
- *Cross-fertilization* through discussion groups

Overview: State of Technology

R&D activities within ChemCatBio span from foundational science to demonstration-scale integrated biomass-to-fuels processes

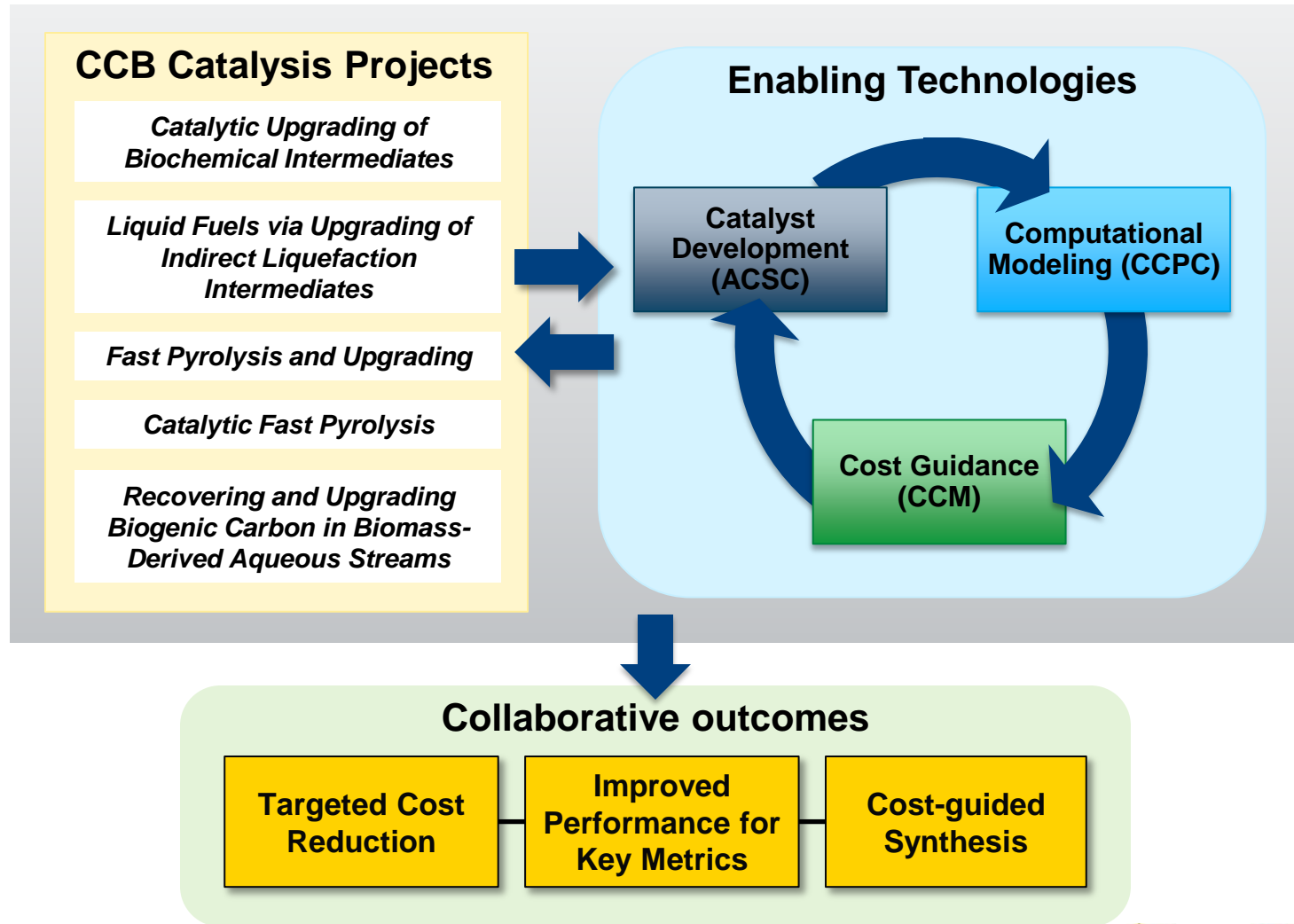


Management Approach



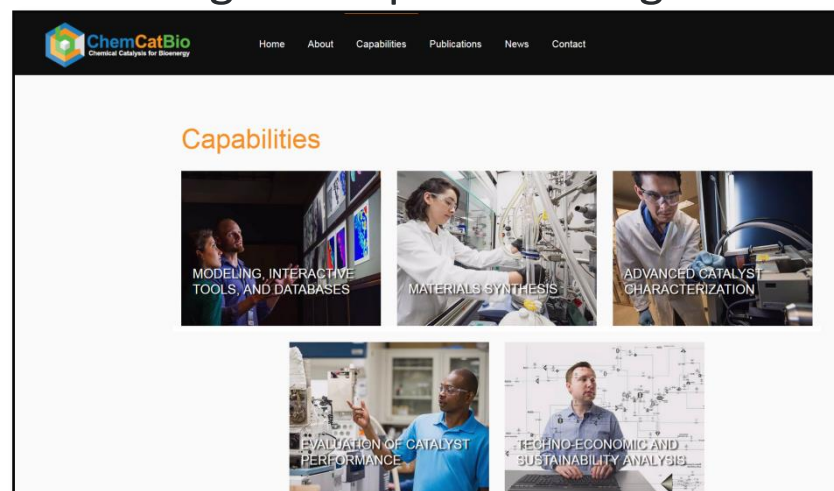
Technical Approach

Establish an integrated and collaborative portfolio of catalytic and enabling technologies



Progress: Consortium Developed from the Ground Up

- **October 2015:** First face-to-face meeting of BETO catalysis teams
 - Symposium format with presentations from all projects
 - Identified key overarching catalysis challenges
- **January 2016:** Consortium structure proposed to BETO
 - Integrated projects developed joint AOPs as part of the consortium
- **August 2016:** ChemCatBio kick-off meeting
 - Establish core capabilities and initiate IP management plan drafting
- **September 2016:** ChemCatBio website launched
 - 1466 visits from 9/29/16 – 1/30/17
 - Highlights our capabilities, publications, and collaborations with industry
 - Easy access for potential partners
- **Dec 2016 – Jan 2017:** Face-to-face meeting of technical teams and IP management plan finalized
 - Developed mission statement



Relevance

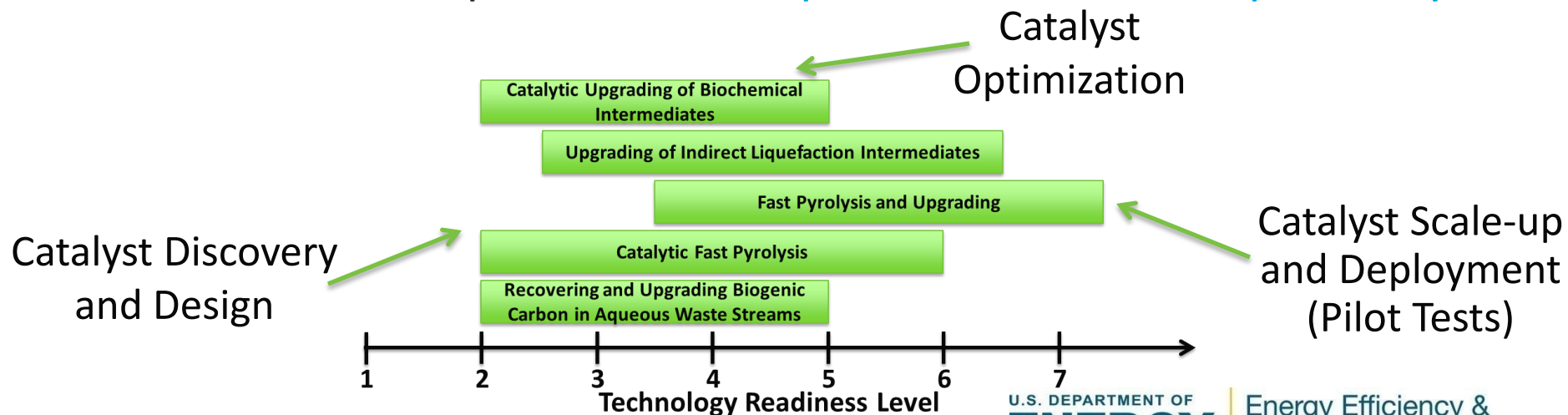
Accelerating Development of Advanced Catalytic Materials through an Integrated Portfolio of Catalytic and Enabling Technologies

- 85% of all existing chemical processes rely on the use of catalysts
 - \$1 spent on a catalyst can produce up to \$1000 worth of product
 - Trend will likely persist for biomass processes, but **new materials are needed to address biomass-specific challenges and advance the industry**
- Typical catalyst development cycle is 15-20 years
 - **Our goal: Reduce that time to 7-10 years**
- ChemCatBio approach will enable us to meet that goal:
 - Single point of contact for industry
 - Access to **world-class capabilities** across multiple national labs
 - **Streamlined access** for external partners
 - Focused R&D **addressing critical barriers based on industry input, TEA, and overarching challenges**

Conversion Technology Area	State of Technology	Future Target
Catalytic Upgrading of Biochemical Intermediates	Selectivity 52%	60%
Liquid Fuels via Upgrading of Indirect Liquefaction Intermediates	Distillate yield 10.3 GGE/ton	27.4 GGE/ton
Fast Pyrolysis and Upgrading	Catalyst lifetime 154 days	278 days
Catalytic Fast Pyrolysis	C-efficiency 33%	44%
Recovering and Upgrading Biogenic Carbon in Biomass-Derived Aqueous Streams	C lost to aqueous phase 3.4 – 27%	50% C recovery

Future Work: Industry Focused

- Form an **Industry Advisory Board (IAB)**
 - Identify advisors that:
 - Span the value chain (discovery to deployment)
 - Complement the core capabilities of ChemCatBio
 - Fill knowledge/competency gaps
 - Develop IAB charter
- Hold an **Industry Listening Day** within the next 3 months
 - Identify the key catalysis challenges for bioenergy applications
- Solve industrial problems at **all phases of the development cycle**



Acknowledgements



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Bioenergy Technologies Office

BETO

Kevin Craig
Nichole Fitzgerald
Jeremy Leong
Andrea Bailey

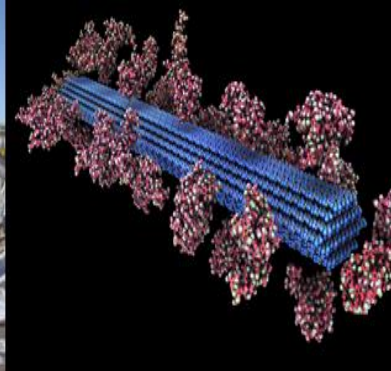
Board of Directors, Steering Committee, and PI's

Corinne Drennan	Alan Zacher	David Johnson
Rick Elander	Andy Sutton	Kim Magrini
Karl Albrecht	Lesley Snowden-Swan	Huamin Wang
Fred Baddour	Rob Dagle	Mike Lilga
Susan Habas	Calvin Mukarakate	David Robichaud
Jim Parks	Ted Krause	Jae-Soon Choi
Dan Ruddy	Kinga Unocic	



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