Bioenergy Technologies Office

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

Demonstration and Market Transformation Program Plenary

March 6, 2016

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Technology Manager

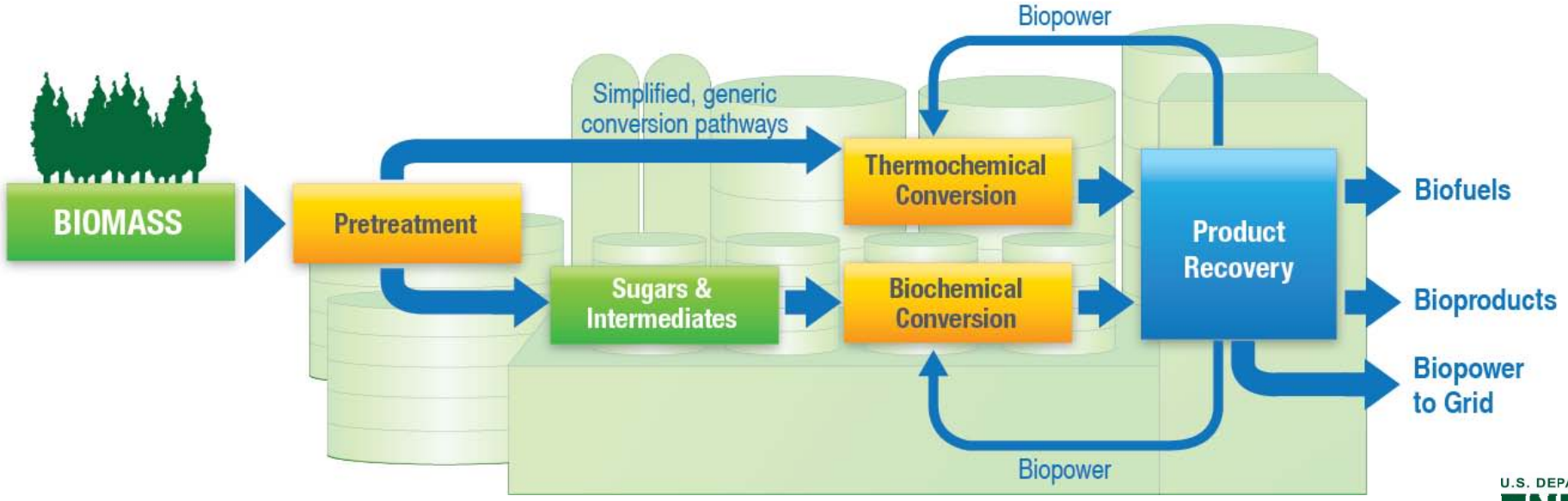
DMT Program Overview

- Program Overview
- Focus Areas
- Funding History
- Program Goals
- Strategic Approach
- Key Accomplishments
- Upcoming Activities
- Recent Funding Opportunities
- Introductions

DMT Key Challenges Involve Lowering Risks

Key Areas

- **IBR activities** focus on demonstration of integrated conversion processes at an engineering scale sufficient to demonstrate and validate commercially acceptable cost, performance, and environmental targets.
- **Biofuels Distribution Infrastructure and End Use** activities focus on coordinating with other federal agencies and DOE offices to develop the required biofuels distribution and end-use infrastructure.



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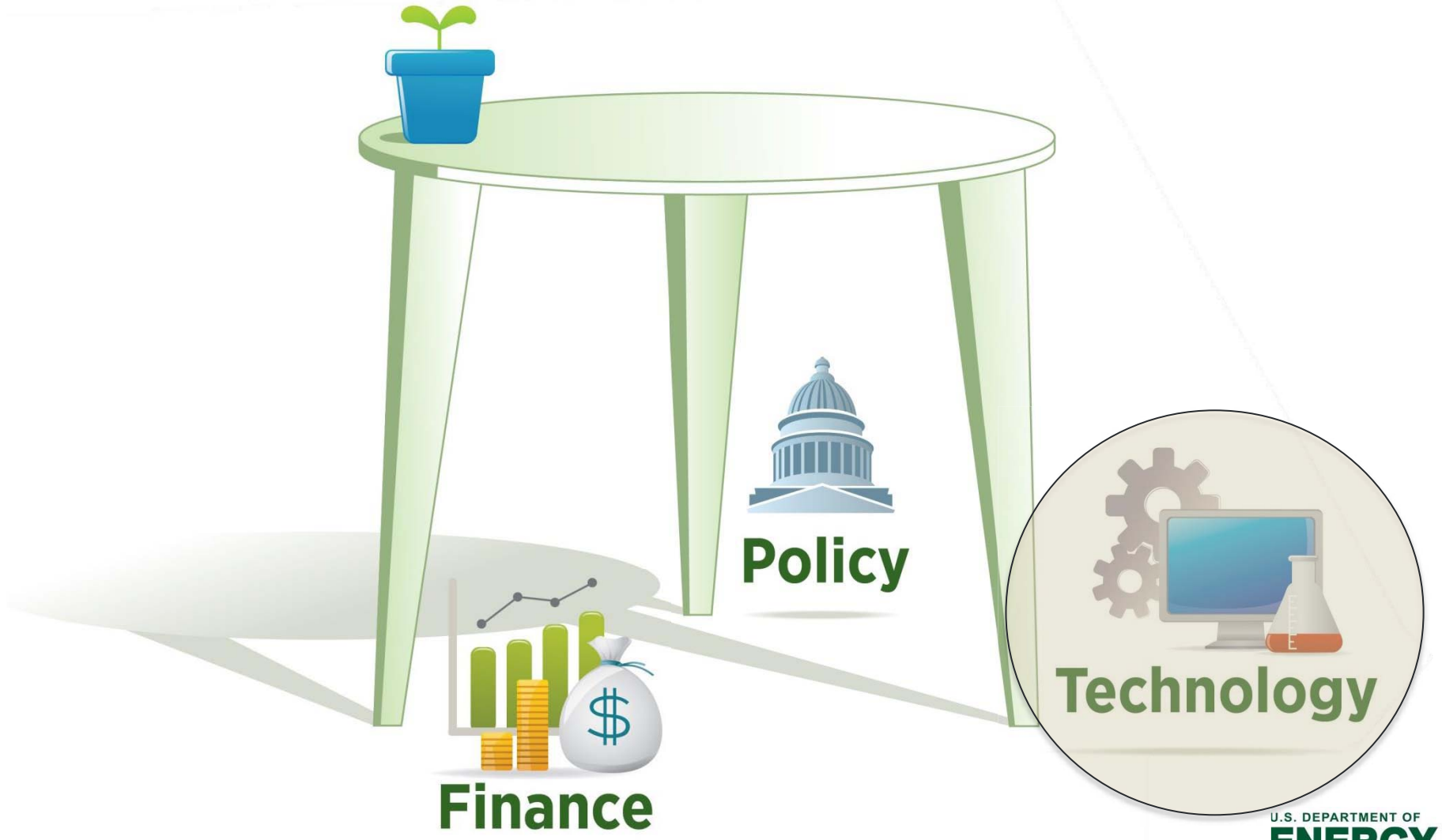
Success Depends On



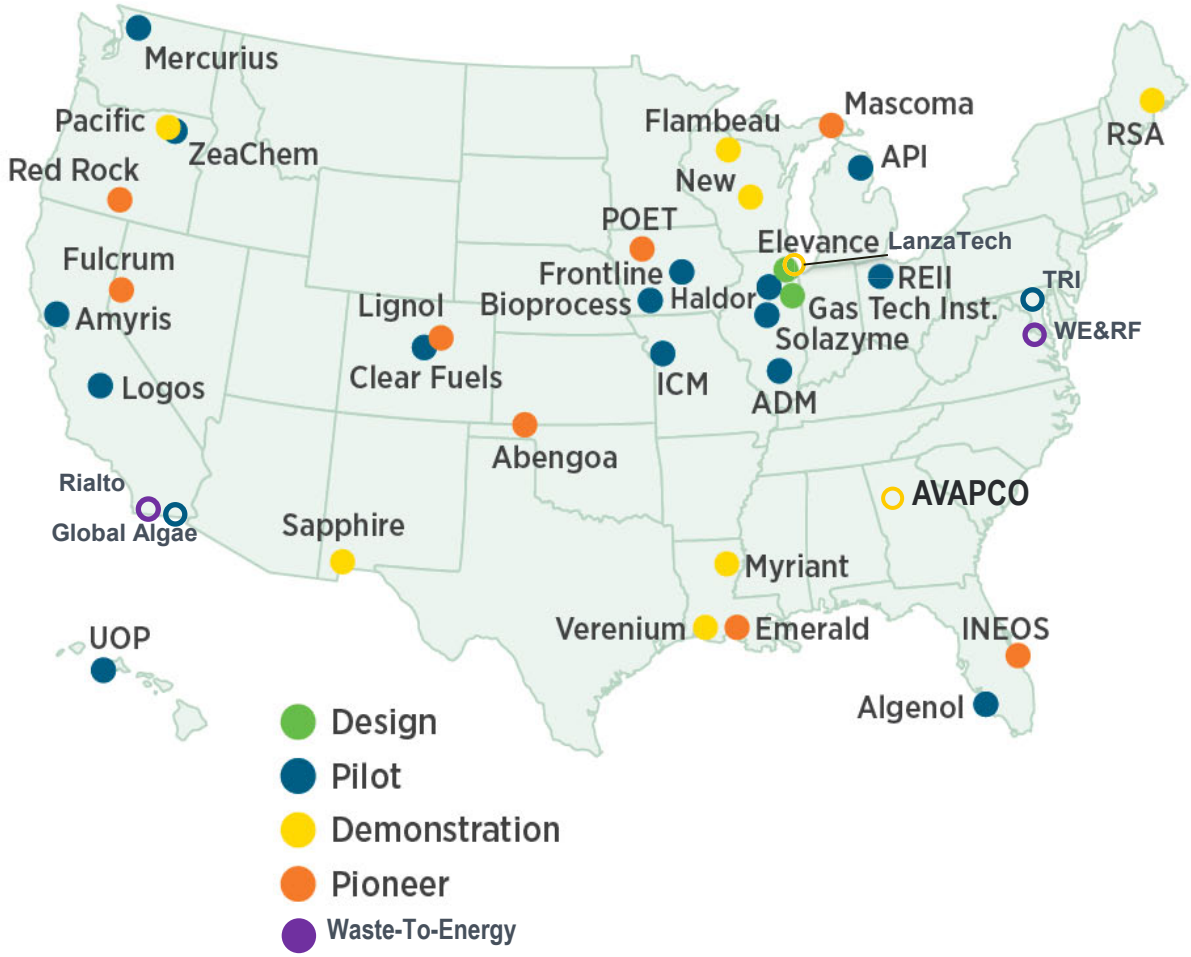
Critical Barriers and Key Challenges

- Inadequate Supply Chain Infrastructure
- Processing, Conversion and Production Costs
- Replicability
- Scalability (sustainability)
- Financing
- Offtake Agreements
- Biofuels Distribution Infrastructure
- Codes, Standards, and Approval for Use
- Consumer Lack of Acceptance and Awareness

DMT Support to IBRs

- BETO has supported since 2006, a total of 36 pilot, demonstration and pioneer-scale facilities
  - Cumulative investment of around $808.5M.

- BETO investments have allowed industry partners to:
  - Enable the development of first-of-a-kind IBRs
  - Prove conversion technologies at scale,
  - Validate techno-economic assessments, and
  - Gain investor confidence



Program Objectives at Different Levels of Scaling

Pilot Objectives

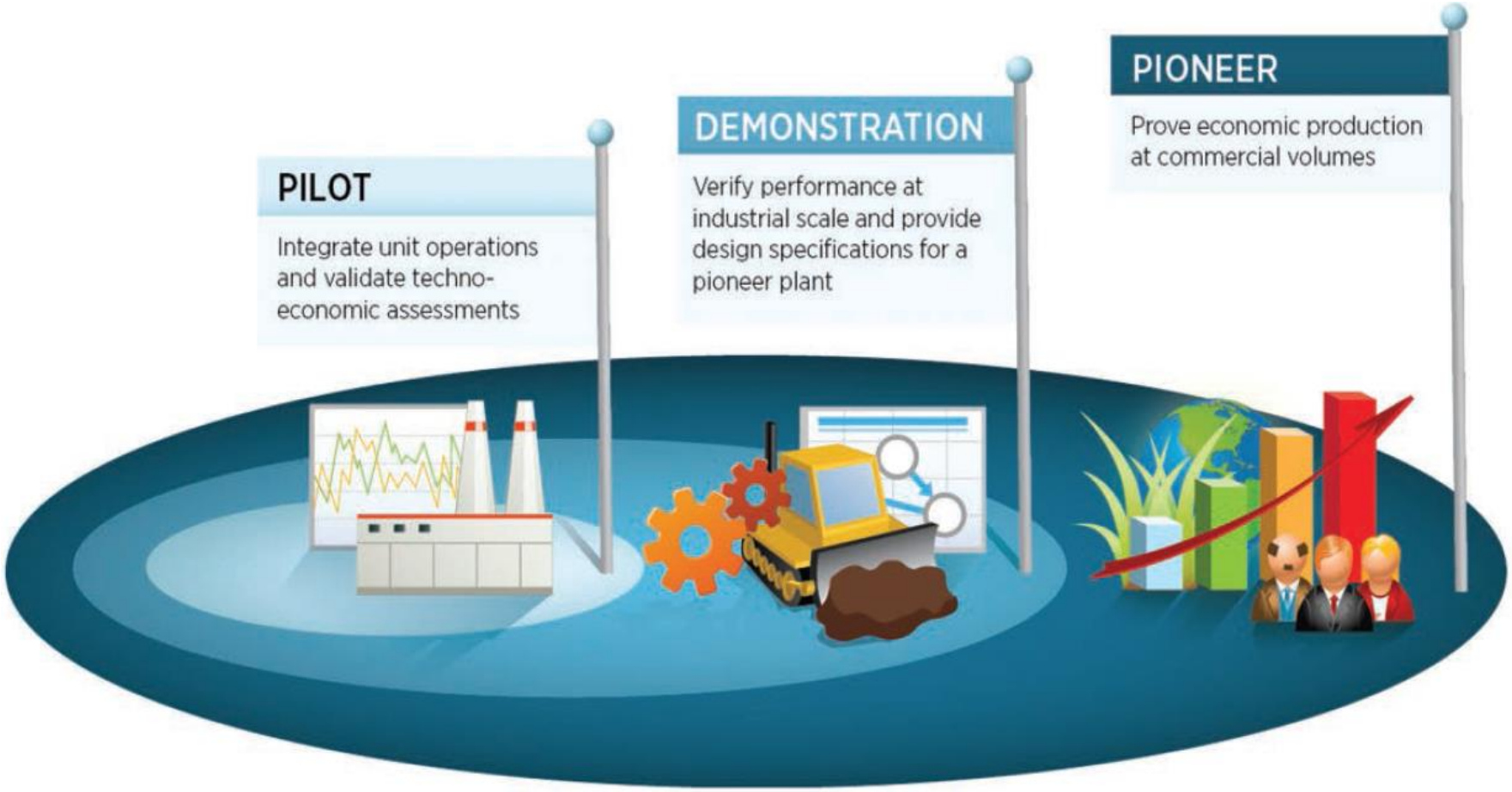
- Technical Performance
- Operations
- Scale-up to demonstration

Demonstration Objectives

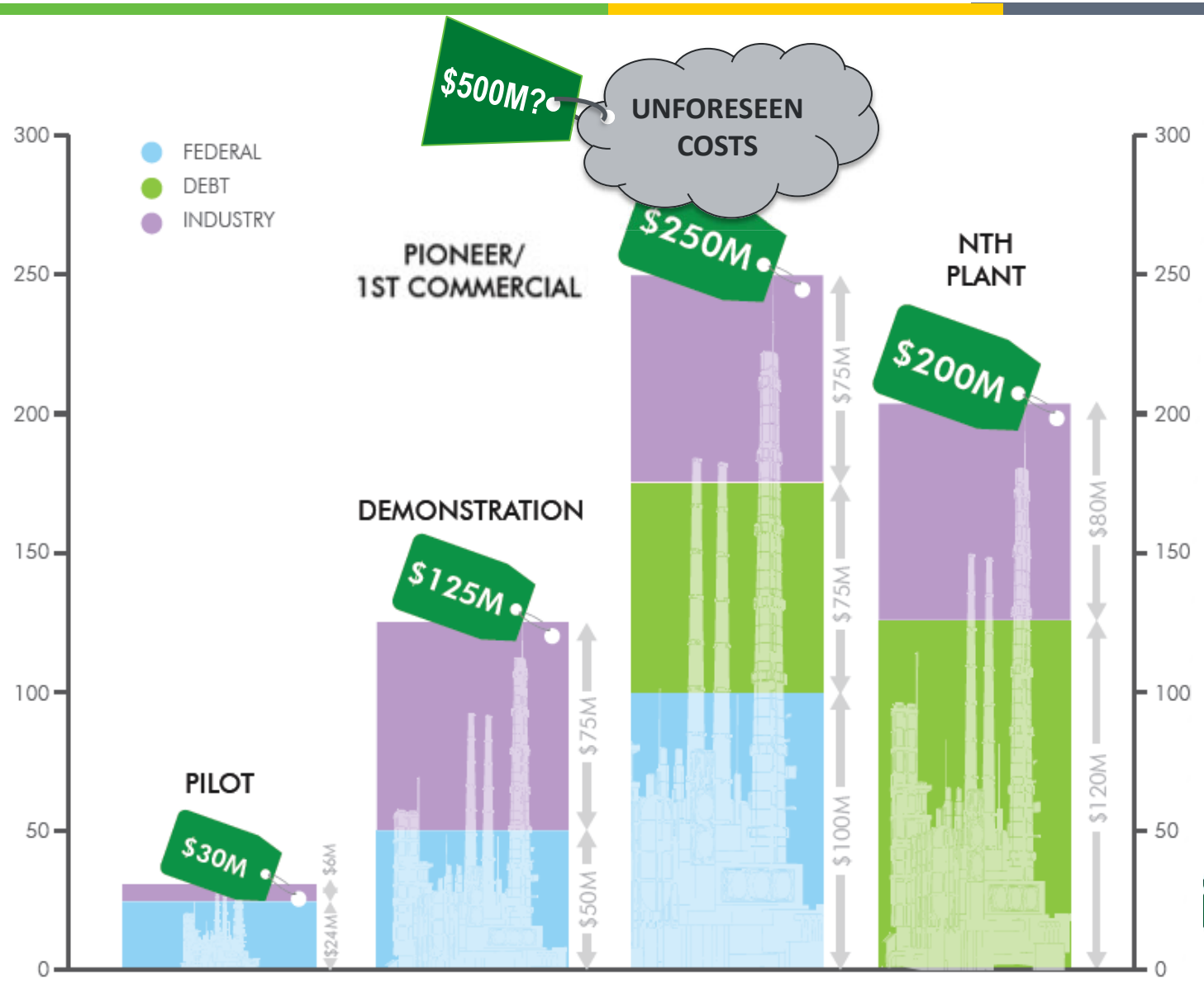
- Market Risk
- Operations
- Scale-up to Pioneer

Pioneer Objectives

- Financial Risk
- Feedstock Supply and Logistics
- Operations



IBR Project Funding Profile – Investment Required



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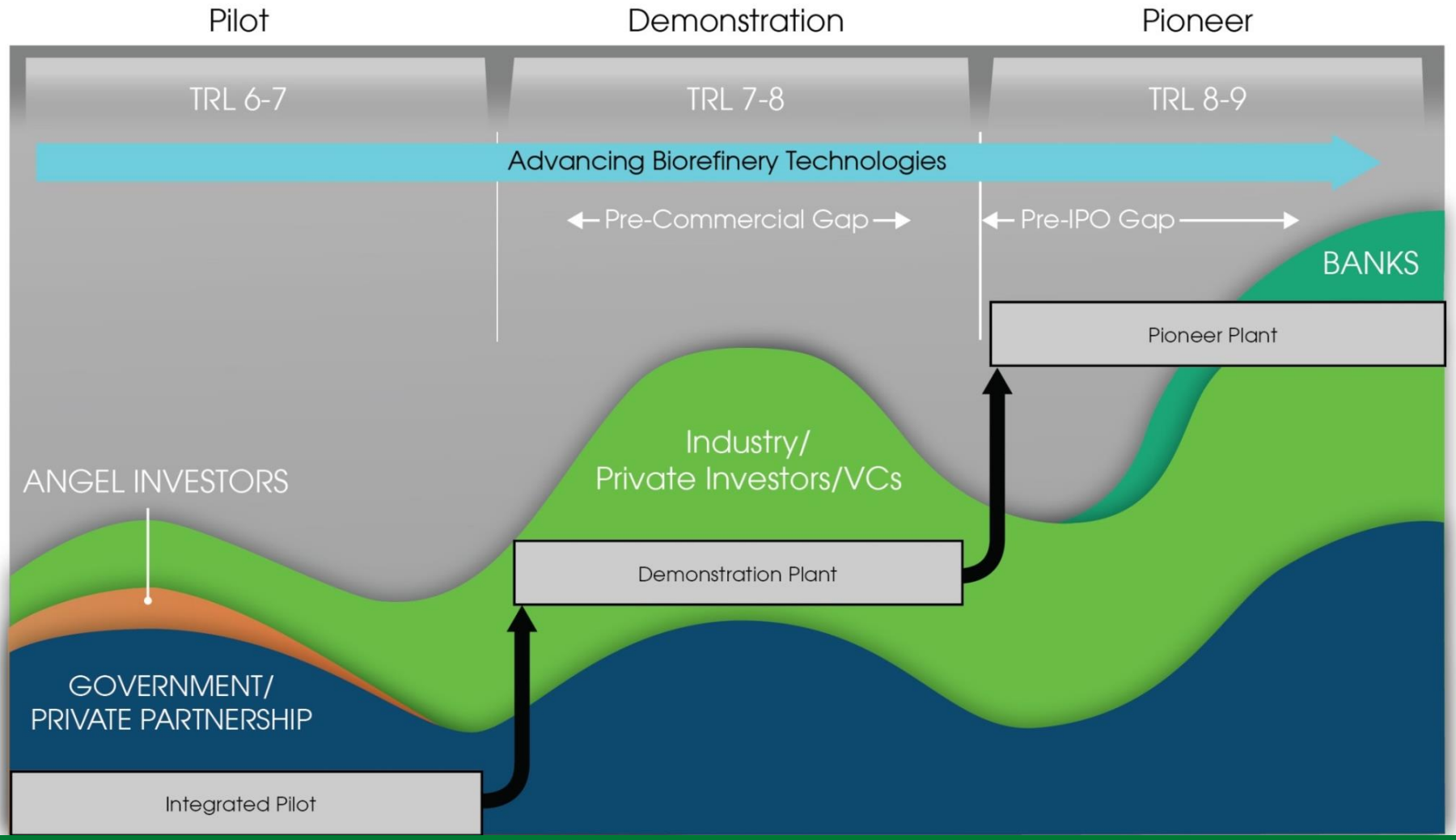
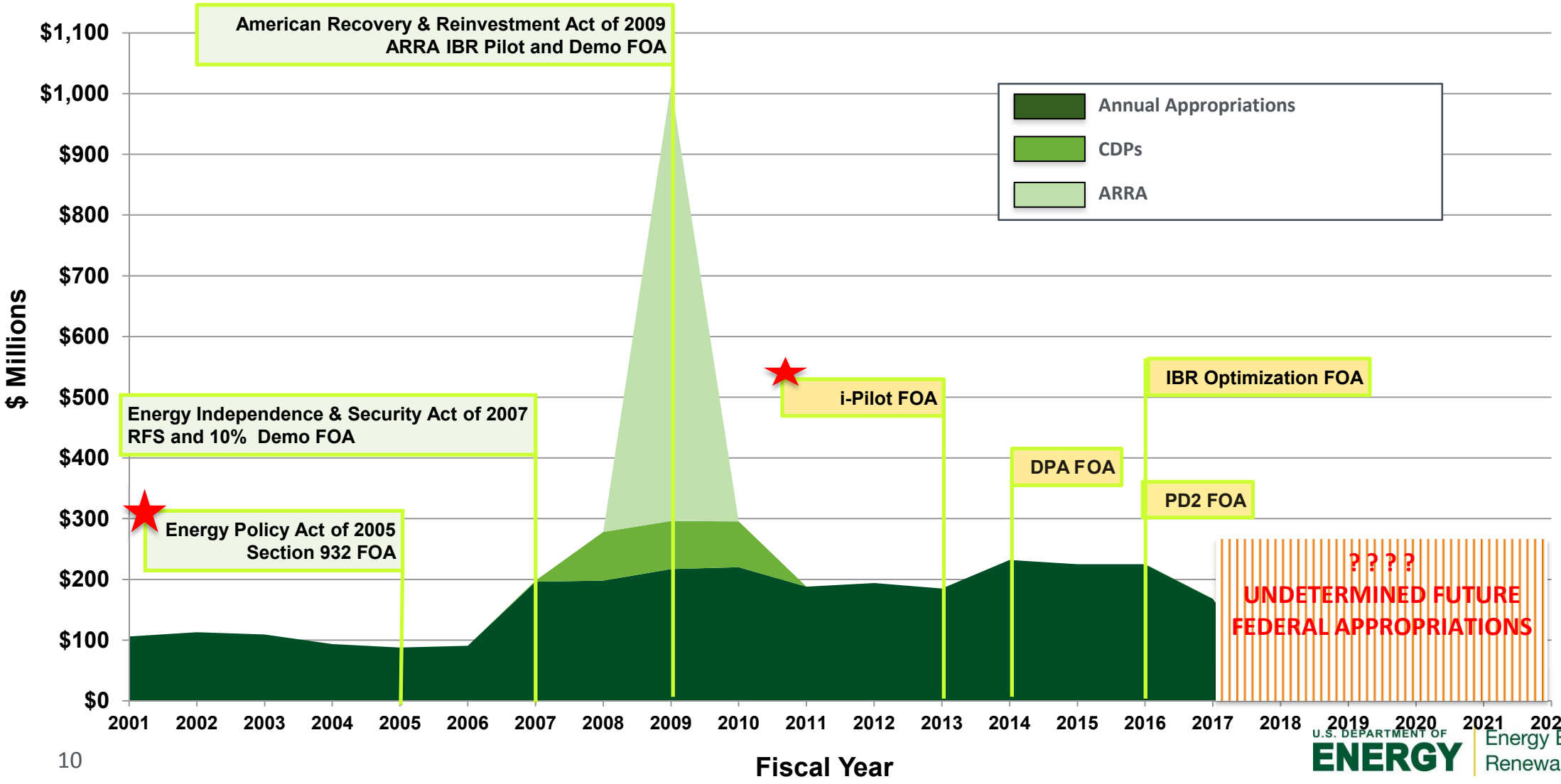
Financial Support at Different Levels of Scaling



DOE support helps new technologies overcome gaps in private sector funding

Major Legislative Drivers, BETO Funding, and DMT FOAs



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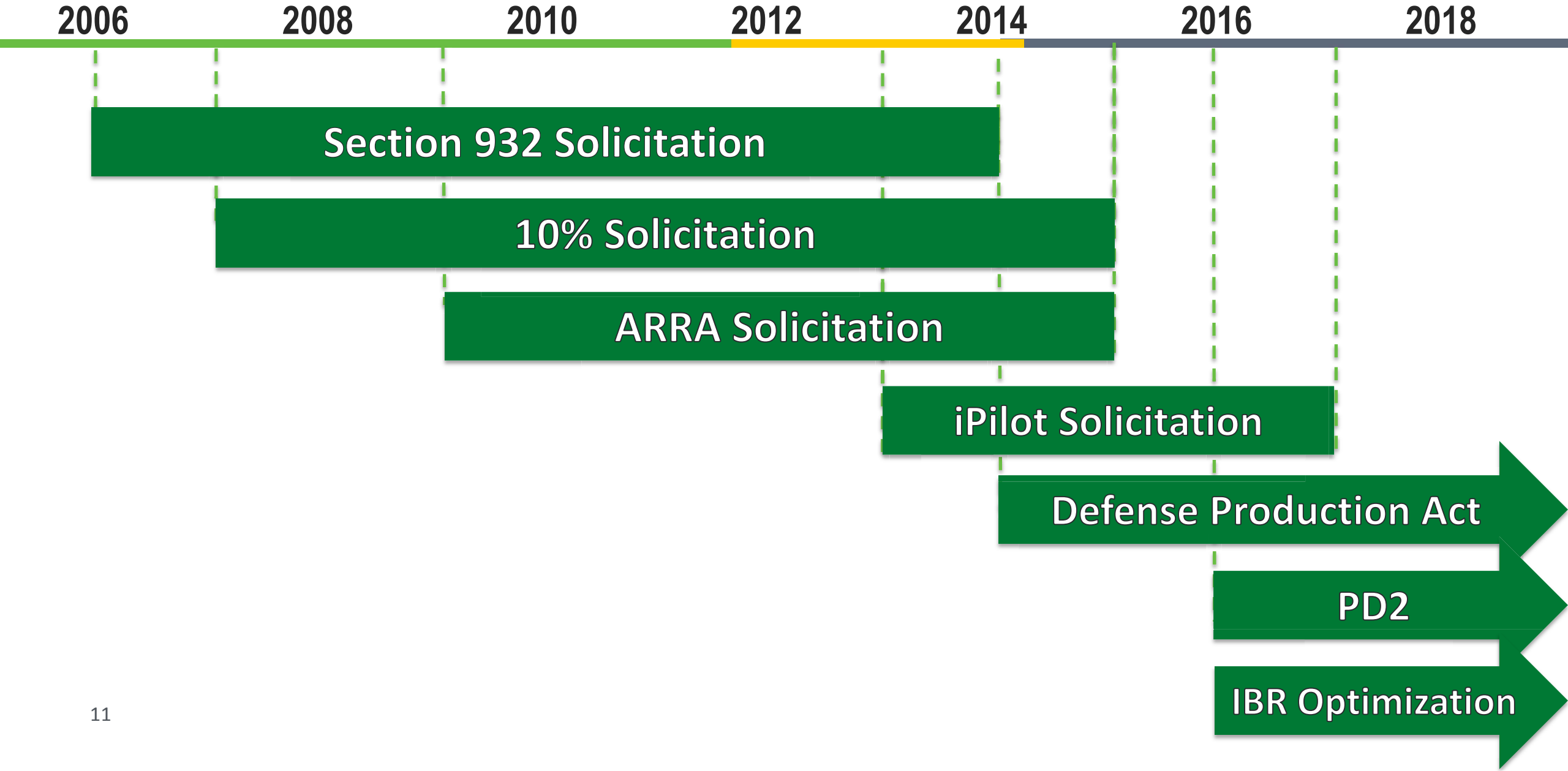
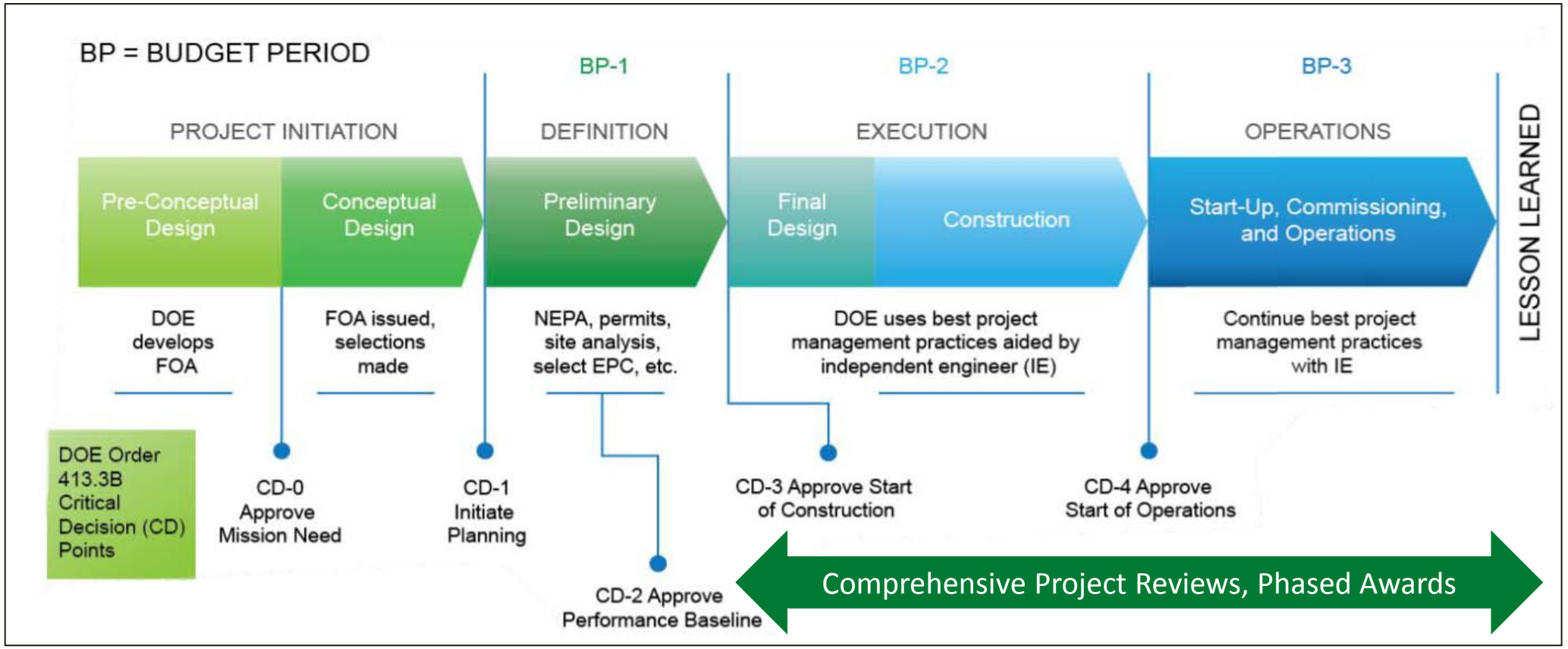
DMT Program FOA History



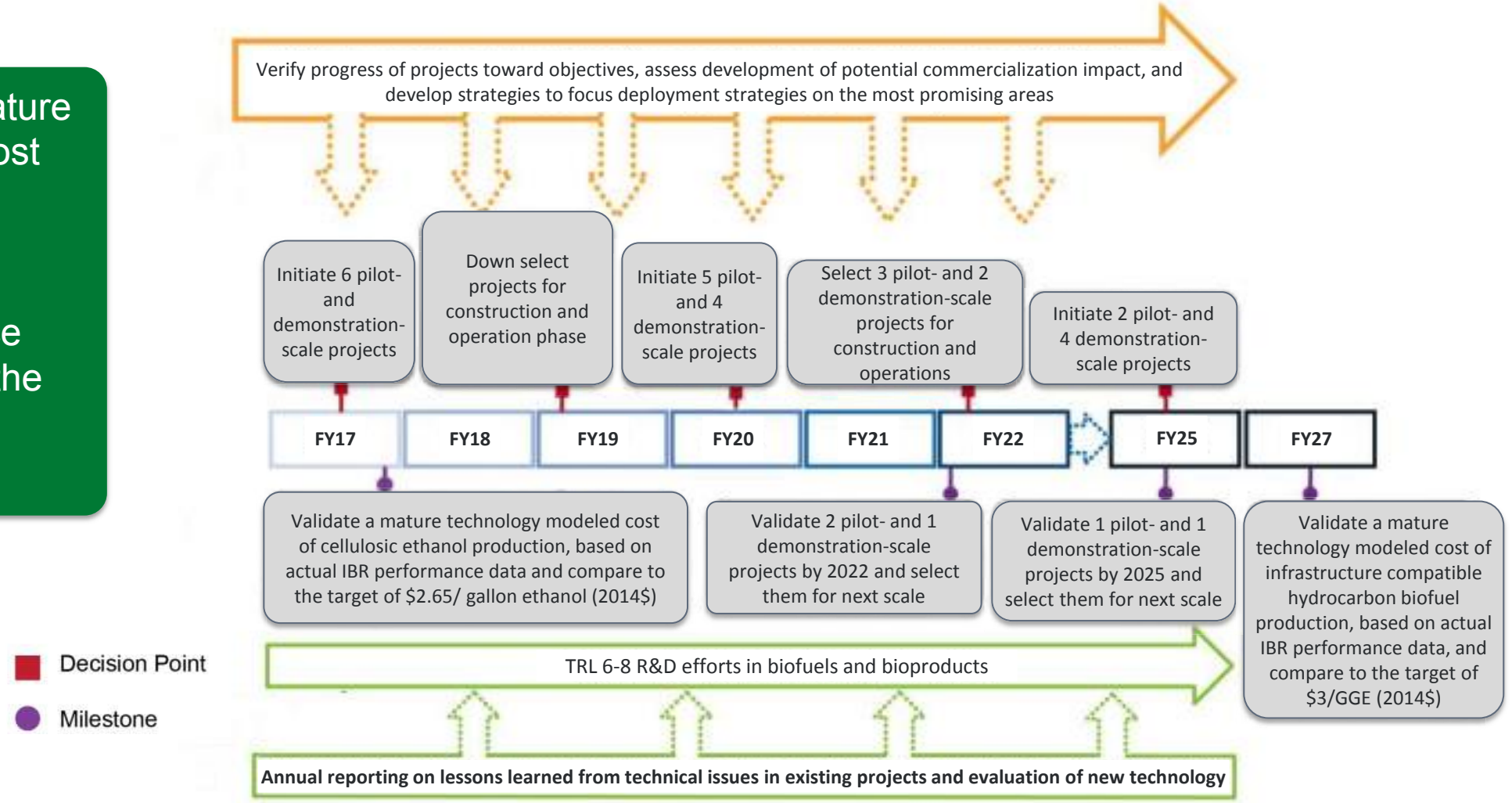
Project Management Framework for Active Monitoring

- Includes project management, verification, and oversight procedures to effectively manage large-scale, capital intensive IBR activities.
- Incorporates DOE standards for management of capital assets as well as industry best practices including use of an independent engineer



DMT Goals for FY17-FY22

By 2017, validate a mature technology modeled cost of cellulosic ethanol production, based on actual integrated biorefinery performance data, and compare to the target of $2.65/gallon ethanol (2014$).

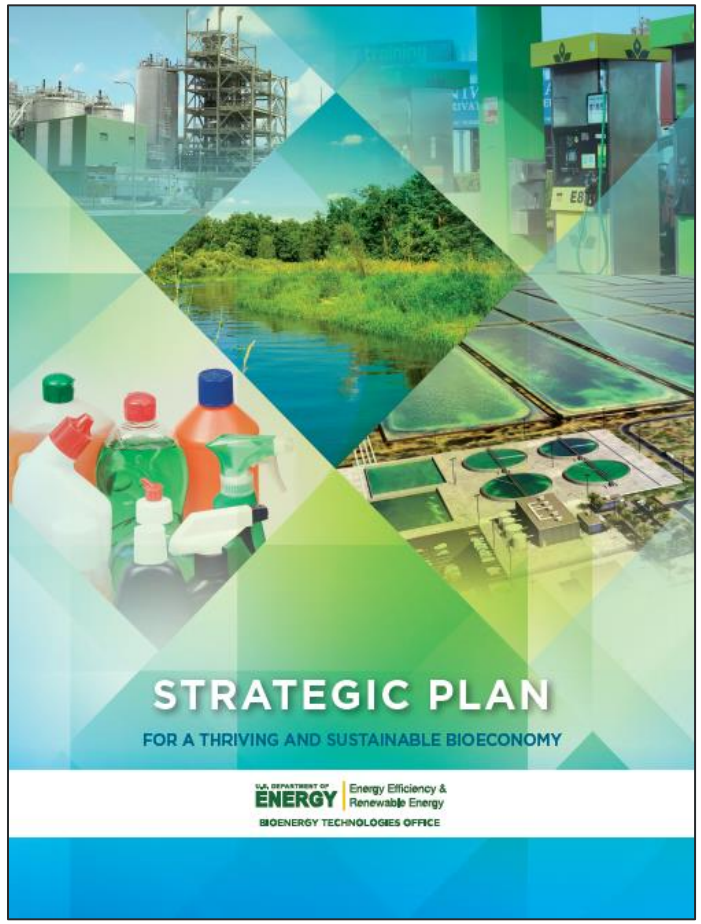


BETO Strategic Plan

- **Strategy: Reduce Cost and Increase Performance**
  - **Substrategy:** Support Pilot and Demonstration Facilities To De-Risk Biofuels and Bioproducts Production

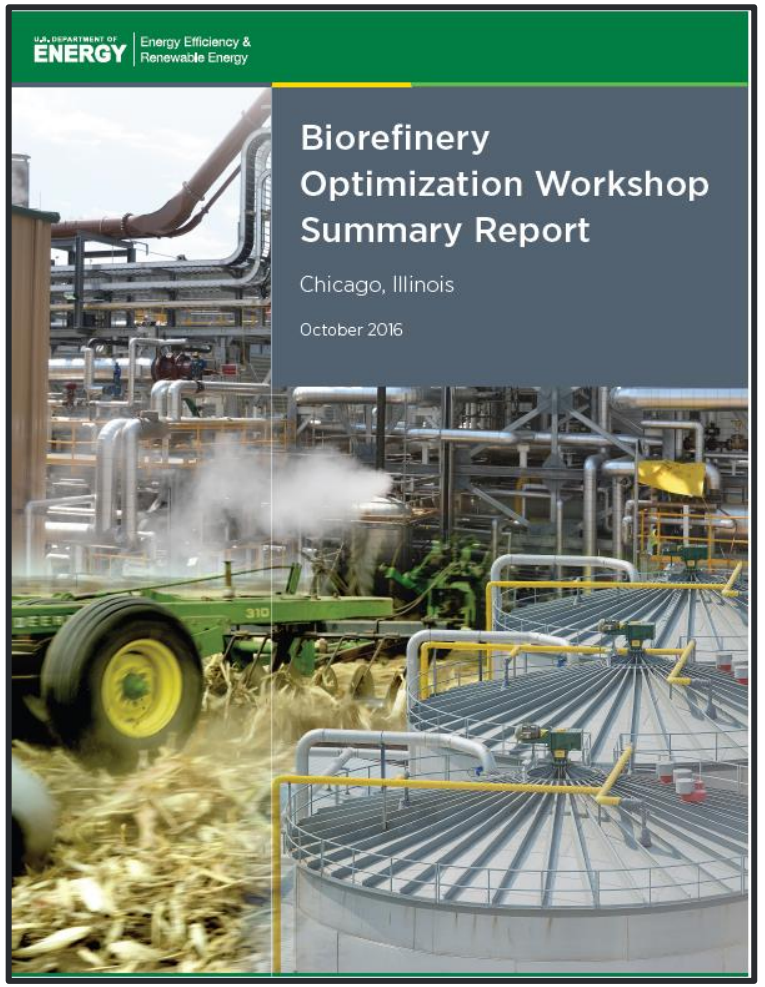
• By 2022, verify at pilot or demonstration scale two additional pathways for hydrocarbon biofuel production at a mature modeled price of $3/gge with GHG emissions reduction of 50% or more with the option of incorporating a bioproducts strategy.

• By 2027, demonstrate, at pilot scale, conversion technologies that meet low water use, low harmful emissions, and minimal wastewater treatment needs as defined by the 2019 multi-dimensional analysis that increase the cost of fuel by <$1/gge.



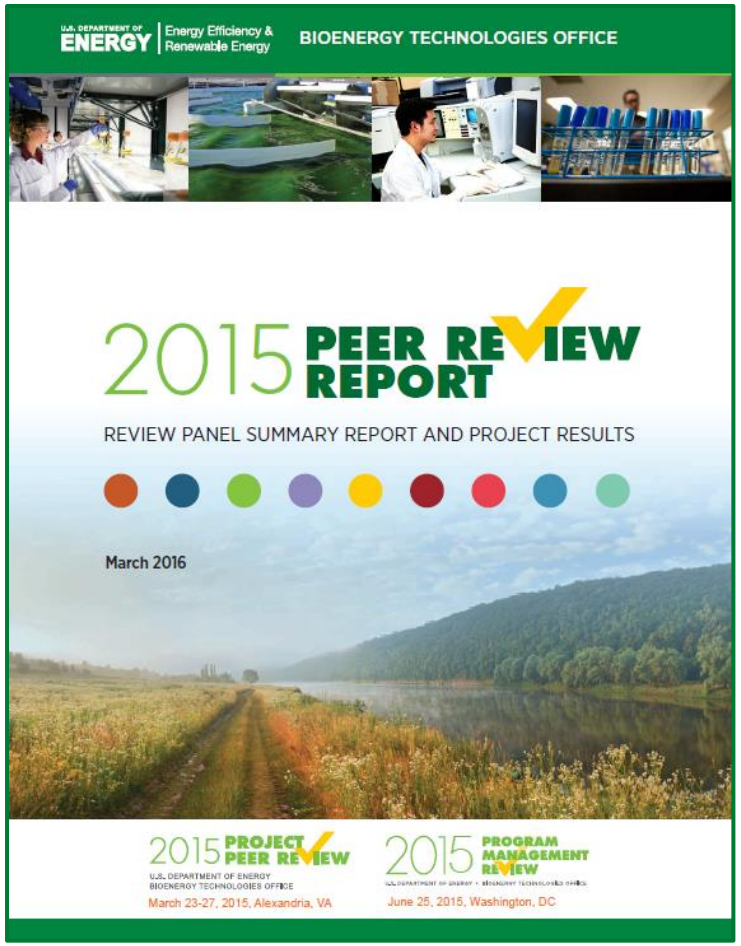
Workshops and Stakeholder Engagement

- Tiger Team Effort
- Executive Stakeholder Engagements
  - BIO
  - Growth Energy
  - RFA
- IBR Optimization Workshop
  - Workshop Summary Report Published on 2/27/2017



Changes Since Peer Review 2015

- Greater validation at smaller scales.
  - More support to pilot- and demonstration-scale projects
- Focus on renewable hydrocarbons
- Additional focus on current barriers to continuous IBR operation and fuel production



POET-DSM and DuPont

POET-DSM Project LIBERTY

- Grand Opening on September 3, 2014
- Capacity of 25 million gallons per year
- Currently producing cellulosic ethanol
- Announced POET-DSM investment for On Site Manufacturing of enzymes

DuPont Cellulosic Ethanol Facility

- Grand Opening on October 30, 2015
- Capacity of 30 million gallons per year
- DOE investment supported development work with NREL
- Cellulosic Ethanol will be sold to P&G for use in detergent

DMT Activities in FY17

PD2B3 FOA
- Validation of technologies for the 6 selected projects: Global Algae Innovations, AVAPCO, LanzaTech, TRI, Rialto bioenergy, and WERF
- Kick-off planning and design phase

Integrated Biorefinery Optimization FOA
- Evaluation, selection, finalization of contracts and awarding of funds to successful proposals

Co-Optimization of Fuels and Engines
- Continuation of Lab AOP projects
- Kickoff University FOA projects

Portfolio Management
- POET-DSM, Mercurius Biorefining, Inc., DPA projects (Emerald Biofuels, Fulcrum Bioenergy, Red Rock Biofuels), and ORNL
- Comprehensive Project Review (CPR) Activities
- Lessons learned and portfolio analysis

Project Definition for Pilot and Demonstration Scale Manufacturing of Biofuels, Bioproducts, and Biopower (PD2B3) FOA

- Up to **$90 million** in funding for projects focused on designing, constructing, and operating **integrated biorefinery facilities** that manufacture **biofuels, bioproducts, or biopower**.

Six Project Selections Announced December 28, 2016:

- **Demonstration-Scale Integrated Biorefineries:**
  - AVAPCO, LLC (Atlanta, Georgia) and LanzaTech, Inc. (Skokie, Illinois)
- **Pilot-Scale Integrated Biorefineries:**
  - Global Algae Innovations (San Diego, California) and ThermoChem Recovery International, Inc. (Baltimore, Maryland)
- **Pilot-Scale Waste-to-Energy Projects:**
  - Rialto Bioenergy, LLC (Carlsbad, California) and Water Environment & Reuse Foundation (Alexandria, Virginia)

Integrated Biorefinery Optimization FOA

- **Joint FOA with USDA up to $22.7 million in support of the optimization of IBRs**
  - DOE share of up to $19.8 million
  - USDA-NIFA share of up to $2.9 million
  - Projects will focus on lowering technical and financial risk, addressing challenges encountered with the successful scale-up, and reliable, continuous operation of IBRs.

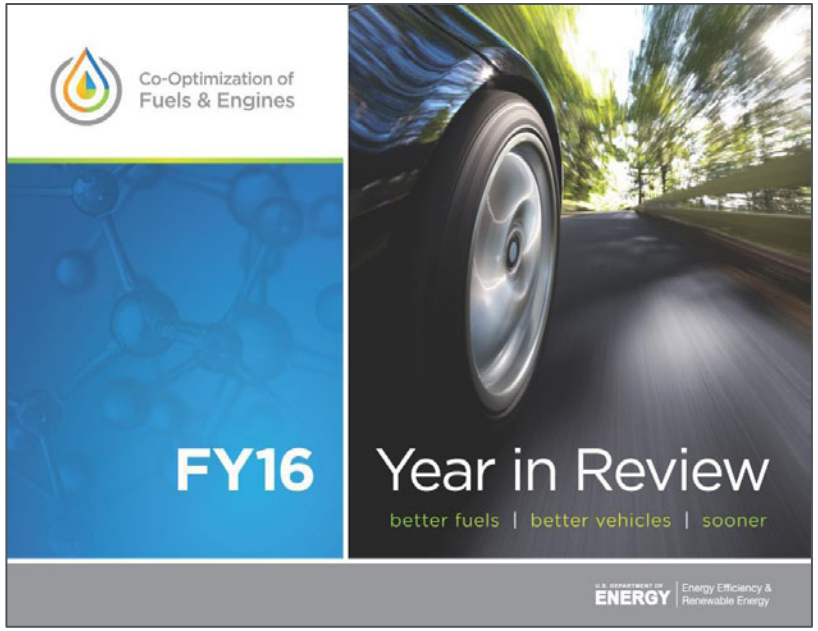
- **Four topic areas:**
  - **Topic Area 1:** Robust, continuous handling of solid materials and feeding systems to reactors under various operating conditions.
  - **Topic Area 2:** High value products from waste and/or other under-valued streams in an IBR.
  - **Topic Area 3:** Industrial separations within an IBR.
  - **Topic Area 4:** Analytical modeling of solid materials (dry and wet feedstocks, and/or residual solids remaining in the process) and reactor feeding systems.

To view the full FOA, visit EERE Exchange. Submission deadline for full applications is April 3, 2017.

Initiated Co-Optima Consortium Project at National Labs

Co-Optima Goal:
better fuels and
better vehicles
sooner

- In FY 16, initiated a nine lab consortium project focused on co-optimization of fuels and engines (joint with the vehicle technologies office)
- ~$25 M/year combined budget from BETO and VTO
- FY16 year in review highlights key project accomplishments



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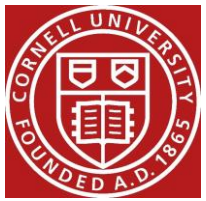
Co-Optima University FOA

- December 29, 2016 - Announced up to $7 million for eight universities to accelerate the introduction of affordable, scalable, and sustainable high-performance fuels for use in high-efficiency, low-emission engines.
- Projects will complement the ongoing National Laboratory Project and support the broader Co-Optima initiative.

BETO Managed				
	Cornell University	Massachusetts Institute of Technology	University of Michigan-Dearborn	University of Central Florida
VTO Managed				
	Louisiana State University	University of Michigan	Yale University	University of Alabama

BETO Staff – DMT

Staff	Title
Jim Spaeth	Program Manager
Liz Moore	Technology Manager
Borka Kostova	Technology Manager
Mark Shmorhun	Technology Manager

***Special thanks to recently retired Elliott Levine!**

DMT Peer Review Panel Introductions

Reviewer	Organization
F. Michael McCurdy (Lead)	Leidos
Andrea Slayton	Northrup Grumman*
Alan Propp	Merrick and Company
Danielle Sexton	Harris Group
Kerri Neary	DOE Loan Programs Office*
Mark Penshorn	RES Kaidi

*Correction to printed program booklet

Thank You

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