Bioenergy Technologies Office

2017 Program Management Review

Co-Optimization of Fuels and Engines

Mike McCurdy

Arlington, Virginia

July 13, 2017

Presentation Outline

1. Peer Review Process (2 slides)
   - Review Panel Members
   - Review Panel Approach
2. Presentation Framework and Scores (1 slide)
   - Presentation format
   - Data Summary
3. Overall Impressions (5 slides)
   - Impact
   - Innovation
   - Synergies
   - Focus
   - Commercialisation
4. Overall Recommendations (1 slide)
   - Actionable Recommendations (~3 suggestions to program)

Co-Optimization of Fuels and Engines Debrief

Mike McCurdy – ICF, Inc.

Andrea Slayton - Slayton Consultants

Brandon Emme - ICM, Inc.

Troy Hawkins - Eastern Research Group, Inc.

Philip Marrone - Leidos, Inc.

Candace Wheeler - General Motors (Retired)

Review Panel Approach

- Co-Optima Project Mangers presented summary update for the program in Denver, Colorado in a public forum in March 2017
- Short summary of the project, what is working well, and opportunities for improvement provided to Steering Committee on March 10th
- Peer Review Panel members provided feedback and 1 to 10 scoring of the various aspects of the Co-Optima project using a DOE website
- Summary report prepared and delivered to DOE BETO/VTO personnel for review
- Summary presentation delivered today July 13 for Steering Committee consideration

Presentation Framework and Scores

- The Co-Optima initiative was reviewed through four separate presentations
  - An overview of the Co-Optima Initiative – **9.05**
  - An overview of the Analysis of Sustainability, Scale, Economics, Risk, and Trade (ASSERT) team's work – **8.60**
  - An overview of the Market Transformation team's work – **7.70**
  - An overview of the High Performance Fuels (HPF) team's work – **8.79**

Co-Optima Program

- Program intent is to catalyze substantial transportation efficiency improvements by optimizing future fuels and engines simultaneously
- Custom fuels to be provided from biological sources in order to:
  - Take advantage of chemical properties that are not available within traditional petroleum sources
  - Boost rural economies, create jobs in disadvantaged areas, and reduce emissions of GHG's and criteria pollutants
- Engine developments are to be pursued in two phases
  - Thrust 1 – Enhance performance of legacy spark engine designs
  - Thrust 2 – Develop new engine designs to improve power and efficiency using new advanced Co-Optima fuels

Overall Impressions: Impact

- Auto manufacturers can't develop new engines without understanding the available fuels, and renewable fuels producers can't build new production plants without a market to sell to
  - BETO/VTO providing the critical link between the two parties as neither party has the Co-Optima knowledge within their core competencies
- Peer Review Panel saw potential value in
  1. Potential for customization for performance, sustainability, or even specific cars/engines
  2. Performance benefits for both the legacy fleet of engines and engines that have not been developed yet
  3. Developing new fuel markets which would provide economic benefits to rural areas and environmental benefits to urban areas

Overall Impressions: Innovation

- Very innovative project, pushing limits on both engine performance and advanced biofuel production technologies
  - Developing the fuels and engines simultaneously will allow technical teams to address problems earlier in the development cycle, when they can be most fully addressed at minimum cost
- Collaborative approach by National Labs approach is innovative with a selection process to deliver results in the near and medium term, particularly the Thrust I spark engine fleet
- Peer Review Panel members noted the potential for new and innovative processes for the qualification of fuels and engines as a stretch goal for the program

Overall Impressions: Synergies

- Synergies are numerous
  - Higher oxygen biofuel components represent a large, unexplored, category of chemicals for the transportation sector with the potential to dramatically increase efficiency of existing and new engines
  - Peer Review Panel saw the program as a natural extension of the DOE's core competencies and that public investment in this underfunded linkage has benefits for both the transportation and biofuel sectors
- Peer Review Panel did see opportunities for better integration with the BETO DMT and Conversion programs;
  - Generation of fuels for testing has been rate limiting for Co-Optima
  - Generation of fuels by Co-Optima may be duplicative with the Conversion programs

Overall Impressions: Focus

- Down-selection process is very good
  - Poised to generate a wealth of new data for fuel production and engine design
  - Down-selection of more than 300 potential Tier 1 candidates to a pool of 40 Tier 3 options was very impressive to the panel
  - Rigorous property based screening approach will be critical to keeping the project on track
- Peer Review Panel noted opportunities in;
  - More emphasis in strategic planning for Market Transformation area as handoff from Co-Optima to the private sector will be paramount to the success of the program
  - Co-Optima team has identified the need for a handoff from public to private sectors, but identification of the downstream stakeholders and their requirements has been limited to date

Overall Impressions: Commercialization

- Project at optimal stage of development pipeline
  - Informally pairs fuels and engine technologies in similar stages of development so that they mature together
  - With each side focusing their designs on the best available technologies in the other sector, the program should speed up development in both sectors
- Early adopter case could add value and strategic direction to the program
  - May assist Co-Optima Market Development team in their development of the rollout strategy for the program
  - Rollout strategy will be key for managing expectations and keeping various stakeholders on board as the project progresses

Overall Recommendations

- Top Three recommendations
  - **Develop a Risk Matrix for Thrust I Market Transformation** – Co-Optima project could benefit from producing a risk matrix of the adoption risks (technology, regulatory issues, consumer value proposition, stakeholder fatigue, etc.) and then adjusting near term work to mitigate the risks described
  - **Source Candidate Materials from BETO Conversion and DMT Teams** – Goal of Co-Optima program is not development of new fuel pathways. By sourcing these materials from DMT and Conversion portfolio partners, BETO/VTO could free up resources which could be redirected into strengthening the dataset and Market Transformation efforts
  - **Add Regulatory Issues to ASSERT Models** – Models address environmental and economic issues well, addition of a regulatory block could make them much more robust

Overall Recommendations