

Scientific methods for biomass reference scenarios

WBS 3.1.3.3

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Analysis and Sustainability Peer Review

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ORNL is managed by UT-Battelle, LLC
for the US Department of Energy

Goal Statement

- **Goal:** Develop and test a “Protocol for Reference Scenarios involving Bio-based Systems”

Protocol (n): a defined set of rules and procedures

- **Outcome:** Net effects of an expanding bio-economy are more clearly and consistently documented.
- **Project impacts:**
 - A published protocol provides a science-based approach to justify how a reference scenario is selected and parameterized
 - Standard guidance increases comparability and transparency of input values and assumptions.
 - Application of the protocol generates more consistent quantification of trade-offs and opportunities to guide decision-making.

Quad Chart Overview

Timeline

- Project start: Oct 2017
- Project end: Sept 2020
- % complete: 42% (ongoing)

\$	Pre '17	FY 17 Costs	FY 18 Costs	Total Planned Funding
DOE Funded	0	250,000	270,000	770,000

Partners: Private sector entities, EPA, USDA, NREL, other labs (NREL I-O Matrix), Antares team, voluntary standard-setting bodies world-wide... **Partners contribute in-kind effort to most aspects of the work: webinars, drafting and reviews of comments on draft documents.**

Barriers addressed

At-E. Quantification of Economic, Environmental, and Other Benefits and Costs

ADO-C. Codes, Standards, and Approval for Use

A reference scenario is an essential starting point from which to measure impacts & inform how synergies can be enhanced and trade-offs minimized.

Objective: Develop and publish a Protocol for Reference Scenarios involving Bio-based Systems.

End of Project Goal: More consistent, transparent and useful assessments of the net effects of bio-based products result from applying the protocol & lessons learned in its development

1 - Project Overview

- State of the art: Variable assessment results are often attributable to different reference scenario assumptions
 - Lack of standard procedures constrain fair analysis, confuse decision-makers, and undermine clear communications and trust among stakeholders
 - What is an appropriate reference scenario when conducting assessments of the effects of biomass-based production systems?
- Gaps in existing guidance verified by industry stakeholders
 - ISO and ASTM International Standards processes
 - Clarification of reference scenarios is key for equitable assessments of bio-based products

Conclusion: better guidance is needed to support more transparent and reasonable reference scenario assumptions

- Best practices for science-based reference scenarios will support most BETO A&S projects
- Multiple BETO barriers: documenting that standards are met (ADO-C) & consistent communication & measurement of costs/benefits (At-A-G).

2 – Approach (management team, strategy)

- Kline (PI), Davis (ORNL) and Corr (private sector) coordinate work groups
 - Private & public sector stakeholders for biofuels & related industries
 - Organize & host webinars, conference calls, meetings
- Coordination
 - Monthly BETO A&S calls, quarterly progress reports, milestone reports, etc.
 - Quarterly financial and milestone reviews with BETO
- Additional interface with other BETO projects and National Labs
 - Early-stage AOP planning to cooperate, develop complementary work (e.g., with NREL for a test application)
 - Other labs participation in quarterly reviews with BETO
 - Drafting team webinars, meetings & calls (weekly, bi-weekly)
- Lead work groups as required to
 - Fill gaps in technical information to complete deliverables on time
 - Engage partners to draft, test and refine protocol via iterative process
- Strategic use of resources
 - International participation via webinars
 - In-kind contributions from others are critical for success



2 – Approach: technical plan & key milestones

- *Overview of the detailed 3-Year plan approved Oct 2017:*

1. Outreach & team formation
2. Procedures & role assignments
3. Solicit input, Joint research plan
4. Lit. reviews & initial drafting

Year 1



5. Drafting team Action Plan (Go/No Go)
6. Participatory reviews
7. Testing ideas with stakeholders
8. Feedback → revisions (iterative)

Year 2



9. Trial application(s) & feedback
10. Drafting team - revisions
11. Publish protocol & papers
12. Disseminate lessons & promote adoption

Year 3



2 – Approach: Tech-Financial Planning & Go / No-Go decisions

- Detailed resource allocation plans (time & budgets for three years) in spreadsheets and Gant Charts
- Comprehensive Merit Review
- Extensive exchanges for AOP (work plan) development with multiple potential partners and other labs
- Outreach plan to reach >100 potential stakeholders from government, private sector, research centers, other labs
- Go/No-go considerations
 - Q2: Are stakeholders supportive?
 - Q4: Is draft guidance practical & relevant?
 - Q5: Analysis of review comments received on draft
 - Are most comments supportive or constructive?
 - AND
 - Did team document how all comments will be addressed?

Number	MILESTONES: Title in bold detail below	FY 2018				FY 2019				FY 2020			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	Form a research team (Hours: 221, Cost: \$46K)	-	Q1										
2	Establish research plan with roles, responsibilities and timeline (Hours: 202, Cost: \$43K)			Q2									
3	Draft Protocol (Hours: 261, Cost: \$53K)				Q3								
4	Conduct trial application of draft Protocol (Hours: 202, Cost: \$43K)					Q4							
FY18 total cost: \$200k, carryover \$20k = \$200k spend plan													
5	Analysis of trial results and of comments on draft protocol (Hours: 207, Cost: \$46K)						Q1						
6	Draft protocol is distributed and comments from reviewers are collated and evaluated (Hours: 158, Cost: \$33K)						Q1						
7	Revise protocol (Hours: 295, Cost: \$63K)							Q2					
8	Engage broader set of domestic and international stakeholders (Hours: 365, Cost: \$67.5k staff, \$12k meeting = \$79.5k)								Q3				
9	Comments resolved and recommendations produced (Hours: 195, Cost: \$41.5k staff)									Q4			

2 – Approach (challenges, risks, success factors)

- **Challenges:**

- *The process – stakeholder “ownership”*
- *Identifying science-based methods*
 - Procedures relevant for different analyses & feedstocks
 - Balancing scientific rigor with broad applicability
- *Consensus* when stakeholders perspectives & needs vary
- *Insufficient contributions*, losing stakeholder interest over time

- **Risk mitigation:**

- Proactive outreach to facilitate broad, multi-disciplinary input
- Adjust and revise to better fit stakeholder needs
- Stay focused on strategic outcomes







- **Success Factors:**

- Stakeholder participation
 - Diversity of input and support (industry, government, academia...)
 - Collaboration in all phases including outreach, dissemination
- Dissemination & adoption by others
 - Via publications (peer-reviewed &/or approval of International Standard)
 - Develop coordinated outreach plans

3 – Technical Accomplishments – Planned

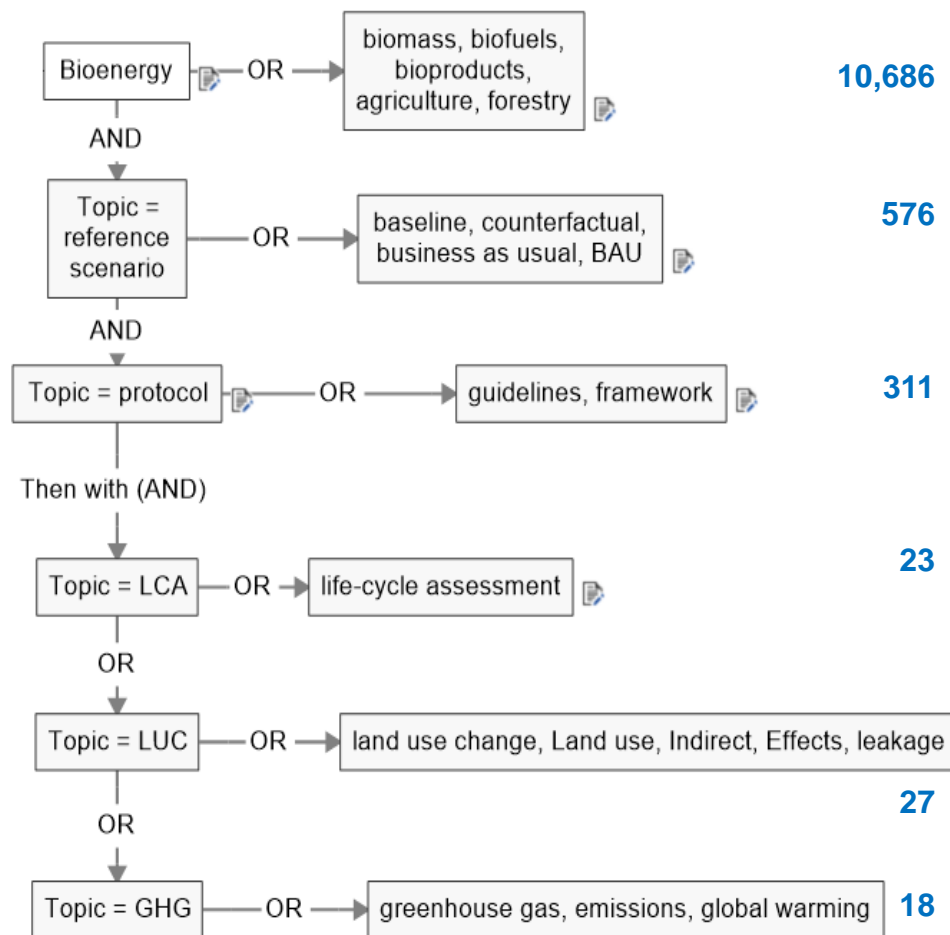
Qtr	Milestones per Project Management Plan (AOP) <i>from project approval date to present</i>
1	Form team: A multi-disciplinary Reference Scenario Research (RSR) team will be identified and organized...
2	Establish a joint research plan... and team timeline for completing the protocol.
3	First draft of protocol... to get initial feedback from BETO and stakeholders (are we on right track?)
4	Trial of initial draft... can this work in practice? Provide additional feedback and practical insights
5	Collate review comments and develop action plan for addressing issues identified by stakeholders

3 – Accomplishments – Progress to date

Q	Milestones per Project Management Plan (AOP) <i>from project approval to present</i>	
1	Form team: Research team identified; kick-off webinar held; 100 potential stakeholders invited & 59 expressed interest (academia, industry, EPA, USDA, other DOE labs represented)	
2	Establish a joint research plan: <i>Research Plan</i> & timeline drafted, reviewed twice, approved by participants, & distributed with anti-trust guidance to BETO and 59 interested stakeholders	
3	First draft of protocol distributed to BETO and >100 stakeholders for comment	
4	Trial application with selected modeling partners to develop common reference scenario for the landscape design project	
5	Comments collated: General comments + 360 tracked-changes distributed to stakeholders & reviewed in weekly calls	
	Action plan completed: Next steps reviewed in draft via webinars and approved in December 2018 workshop	

3 – Accomplishments: Progress (examples)

- **Lit review & outreach:**
 - Identified key needs for good practices
 - Procedures
 - Data types & sources
 - Benchmarks (common reference points)
- **Conclusions:**
 - Most literature notes importance of reference scenarios
 - No existing standards with required guidance
- Several recent reports and papers illustrate need for guidance



3 – Accomplishments: Progress (examples)

Draft Ref Scenario Protocol for REVIEW & COMMENT

OUTLINE

- Introduction / rationale / Lit Review
- Objective and scope
- Definitions
- Characterizing the test scenario
- Characterizing the reference scenario
 - Hypothesis
 - Purpose and intended application of the project under the test scenario
 - Context
 - Define the scope (system boundaries, categories)
 - Indicators and values (with supporting references)
 - Describe uncertainty and variability
 - Assumptions underlying projected values and trends for selected indicators
- Documentation of choices (assuring replicability)
- Table(s) or Figure(s) summarizing results and levels of confidence
- References and Appendices
 - Appendix A: Terms & Definitions
 - Appendix B: Literature Review
 - Appendix C: Guidelines for documenting effects of a bio-based system (test scenario)

3 – Accomplishments: Progress (examples)

Defining “best available data”

- Assessments should strive to identify and utilize the best available data. Best available data are selected from sources with the following characteristics:
 - verifiable and citable
 - based on objective, quantified measurements
 - credible and representative of the case under study
- Additionally, best available data should:
 - permit public access to support replication
 - acknowledge differences between source data and the local case and system boundaries that could affect data representativeness relative to the situation to be analyzed
 - not rely exclusively on models and unverifiable assumptions
 - acknowledge other data limitations or alternative sources that may generate significantly different values

3 – Accomplishments (examples)

- Based on Dec 2018 draft protocol, an ASTM International Standard is now in development:
 - E48.80 Work Item Wk-61363
 - “Ballot to create a Standard Practice for Selecting a Reference Case to be Used when Evaluating Relative Sustainability Involving energy or Chemicals from Biomass”
- Papers emphasize the importance of documenting reference conditions

SE US forest reference conditions

Dec. 2018

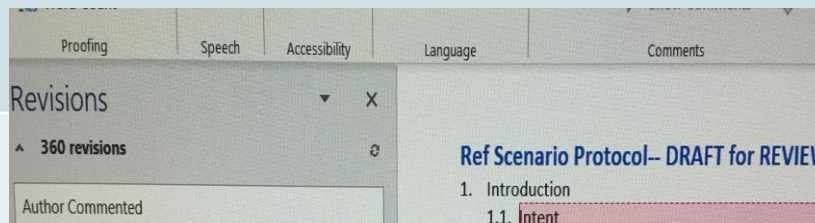


The importance of reference conditions in assessing effects of bioenergy wood pellets produced in the southeastern United States

By **Keith L. Kline & Esther Parish**, Environmental Sciences Division, Oak Ridge National Laboratory

3 – Accomplishments – summary of deliverables

Q	<u>16 Deliverables</u> from project approval to Jan 2019	
1	<ul style="list-style-type: none"> Project kick-off presentation and report. Background, rationale for initiative & related publication. Outline and strawman for comment. Lists: invitees and responding volunteers on research team 	<ul style="list-style-type: none"> ✓ ✓ ✓ ✓
2	<ul style="list-style-type: none"> <i>Research Plan</i> & Timeline Anti-trust guidance for webinars Drafting work group notes (after each webinar) 	<ul style="list-style-type: none"> ✓ ✓ ✓
3	<ul style="list-style-type: none"> Literature review First draft protocol 	<ul style="list-style-type: none"> ✓ ✓
4	<ul style="list-style-type: none"> Report on trial application Go/No-go decision Memo Table summarizing & collating comments received 	<ul style="list-style-type: none"> ✓ ✓ ✓
5	<ul style="list-style-type: none"> Action plan to address comments Updated draft protocol distributed Strategic outreach plan Publication on importance of Reference Scenarios (in World Biomass 2018-2019) 	<ul style="list-style-type: none"> ✓ ✓ ✓ ✓



4 – Relevance

- *Goal:* Develop protocol to support consistent, transparent and useful assessments of the net effects of bio-based products
- *Why is the project important?*
 - When documenting and communicating net benefits, reference scenario assumptions are equally as important as the values associated with the biomass-based production scenario.
 - Analyses generate variable & potentially conflicting results under different reference scenario assumptions.
 - Inconsistent results undermine consumer trust & investor confidence.

“even an analysis that begins with a clear set of simple assumptions about a single pellet production facility replacing a pulp mill can lead to a wide range of projected impacts depending on the scenario(s) selected for comparison.”

- Parish et al., 2017

4 – Relevance to BETO & EERE

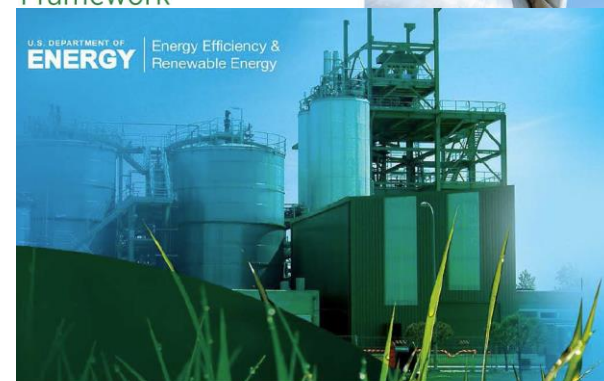
Support *BETO MYPP* goals:

1. “Multidimensional analyses on specific economic, environmental, and other benefits of an expanding Bioeconomy” (Goal 19AS19)
 - Benefits require reference scenario for quantification
 - Choice of reference scenario determines analytical results
2. Evaluation of additional technologies capable of utilizing economically advantaged feedstocks (goal 19ADO23)
3. Verify landscape-design approaches for at least one bioenergy system that, when compared to the conventional agricultural and logistics systems, will increase...” (goal 19AS22)

Achievement of EERE and inter-agency strategies for rural development and jobs based on an expanding bio-economy will require science-based analyses and clear messaging about **net** benefits.

United States Department of Energy
Office of Energy Efficiency
and Renewable Energy

2016-2020
**STRATEGIC
PLAN**
and Implementing
Framework



BIOENERGY TECHNOLOGIES OFFICE
Multi-Year Program Plan

4 – Relevance: Industry and researchers agree that a protocol is needed to enable fair comparisons when assessing effects of biobased products

- There is not an existing protocol to standardize the procedures for characterizing and documenting reference scenarios.
- Misinterpretation of assessment results occurs if reference scenario assumptions are poorly documented.
- Benchmarks are lacking due in part to costs & complexities of interacting human and biological systems.



Application of the protocol will

- Increase confidence in results
- Reduce threats to US export markets
- Provide incentives for using best practices
- Be broadly applicable to products from biomass

4 – Relevance: industry and researchers agree...

“Inconsistent methods to define and justify the counterfactual scenario result in conflicting estimates and large uncertainties about the impacts of pellet production on SE US forests.”


- [WIREs Energy Environ 2017, e259. doi: 10.1002/wene.259](#)

Problems persist: - [GCB Bioenergy Jan 2019 DOI:10.1111/gcbb.12597](#)


“biodiversity loss from biofuels exceeds fossil fuels” but if you read the fine print, this study assumed natural forests and natural grasslands as counterfactual for all land occupied for biofuel production.

Reference scenarios that are poorly documented permit bias, generate conflicting results, and undermine the legitimacy of assessments. Publication and use of a protocol will allow net effects of an expanding bio-economy to be more clearly and consistently documented.

5 – Future Work - overview

1. Trial applications & feedback
 2. Drafting WGs - parallel products
 - a) Lit review paper
 - b) Science guidance paper
 - c) Draft standard (in-kind)
 6. Reviews
 7. Feedback → revisions (iterative)
- 

Year 2

- 
8. Strategic outreach
 9. Finalize case studies
 10. Document benchmarks & resources
 11. Finalize products
 - Respond to reviews; publish 3 papers
 - Ballot Standard via in-kind contributions
 12. Engage stakeholders to promote wide adoption

Year 3

5 – Future work: milestones & deliverables

Milestones going forward - examples

Trial applications:

- (a) Draft reference scenario for BETO Input/Output (I/O) framework in collaboration with the NREL
- (b) Report on reference scenario for BETO Iowa landscape design project

Benchmarks:

Document key specifications, published scenarios, and relevant studies that serve as benchmarks & reference materials to enable more consistent assessment of net effects of Bioeconomy

Peer-review publications:

- (a) Literature review & rationale
- (b) Summary of protocol: user guide, supporting materials (RSER)
- (c) Guidelines for LCA

Implement strategic outreach plans (see next slide)

5 – Future work: milestones & deliverables

Strategic Outreach

- Presentations – materials available to work group participants to share as in-kind contributions in multiple events (e.g.)
 - US DOE / BETO conferences
 - EUBCE & similar
- Short educational video(s)
- Additional in-kind applications & case studies

Plan for publications

- Publish rationale and literature review in a peer reviewed journal.
- Publish key steps, best practices, and guidelines on what to document (RSER)
- In-kind parallel effort: Develop a draft ASTM Standard under Committee E-48
- Publish a ***call to action*** as a *perspective article* in LCA journal—this will follow completion of the ASTM International Standard.

Summary

1. Response to an identified need for guidance
2. Approach: Engage stakeholders in open and iterative processes. Adapt products; be practical; meet needs
3. Accomplishments as of Jan 2019:
 - 16 deliverables including Lit Review and published paper
 - Completed and reviewed drafts (V_0 & V_1) of protocol
 - Developed plan to address comments
 - Multiple parties helping with strategic outreach plan
 - On track and on budget
4. Relevance: key for determining whether biofuels and bioproducts are accepted by regulated markets
5. Future work: (a) test applications, (b) develop manuscripts, benchmarks & reports per action plan, (c) reviews → revise & finalize products based on feedback, (d) strategic outreach & publications, (e) ASTM International Standard (& possibly others).

Thank you!

Additional Slides

Responses to Previous Reviewers' Comments and Go/No-Go Review

- New project FY18. *External Merit Review comments were applied to define project tasks, milestones & approach*
- **Go/No-Go review completed December, 2018**

Description: “Research team will synthesize comments received from stakeholder reviewers of the draft protocol and will describe how each issue will be addressed in the next iteration of the protocol.”

Go/No-Go Criteria:

“Decision = No-go if the majority (>50%) of comments received on the draft protocol are unfavorable, or if >50% of the comments received cannot be addressed by the team.”

“Decision = Go if the majority of comments are constructive AND the team is able to describe how the majority of comments will be constructively addressed in the next iteration of the protocol.”

- **Recommendation:** “go” due to overwhelmingly favorable comments and documented Action Plan to address them. Action Plan was reviewed with interested stakeholders & delivered to BETO (Dec 2018).

Publications, reports, presentations



- Kline KL, Parish ES and Dale VH. 2018. The importance of reference conditions in assessing effects of bioenergy wood pellets produced in the southeastern United States. World Biomass 2018-2019; p 82-86. DCM United Kingdom. <http://www.dcm-productions.co.uk>
- **Reference Scenario Protocol for Assessing Bio-Based Systems** Draft V₀ (Q3) and Draft V₁ (Q5) distributed for comment.
- Report: Kline KL (2018) “December 4th Kick-off webinar notes, Q&A, and related ASTM E-48 side meeting notes.”
- Notes from each webinar with updated DRAFT protocol prepared every two weeks (Q2 onward).
- 5 Milestone Completion Reports prepared and submitted (one per quarter since project start).
- 1 Go/No-go Memorandum prepared and submitted
- Report on trial application & Table summarizing modeling teams data issues relevant to reference scenario parameters
- **Reference Scenario Protocol for Assessing Bio-Based Systems** incorporating changes per comments; distributed
- **Action Plan** and Strategic Outreach Plan distributed (Q5)

PRESENTATIONS

- Feb 27, 2018: PPT for NREL Workshop and Report generated for the “Framework to assess effects of expanding Bioeconomy” project. The report and recommendations were reviewed with NREL in March 2018.
- Nov. 15-17: Annual Society of American Foresters (SAF) National Convention in Albuquerque, NM: Davis, M., Kline, K., and Langholtz, M. 2017. “Measuring Sustainability: The Role of International Standards & Relevance to Bioenergy Trade & Industry.”
- Dec 4th : Davis, Kline and Raschke organized the Reference Scenario kick-off webinar. Davis led the overview presentation describing the project goals, procedures, next steps, timeline etc.
- Dec. 6: Presentation in Houston, Texas, about the new project to develop a Protocol for Reference Scenarios involving Bio-based Product Systems in conjunction with the annual meeting of ASTM International Committee E48 on Bioenergy and Industrial Chemicals from Biomass. Recruited several additional interested stakeholders.
- Jan-Aug 2018: Reference scenario initiative shared with potential interested stakeholders in 7 public events and new work group members added for new total >70