

Section 3: Office Portfolio Management

This section describes how the U.S. Department of Energy's (DOE's) Bioenergy Technologies Office develops and manages its portfolio of research, development, and demonstration (RD&D) activities. It identifies and relates different types of portfolio management activities, including portfolio decision-making, analysis, and performance assessment.

Overview

The Bioenergy Technologies Office manages a diverse portfolio of technologies across the spectrum of applied RD&D. Management of the Office's technology portfolio is vital and demanding, made even more challenging by the dynamic context of changing federal budgets and administrative priorities.

To meet this challenge, the Office has developed a coordinated framework for managing its portfolio of RD&D projects. The framework is based on systematically investigating, evaluating, and down-selecting the most promising opportunities across a diverse spectrum of emerging technologies and technology readiness levels (TRLs) (see Table 3-1). This approach is intended to support a diverse technological base in applied research and development (R&D) while identifying promising earlier stage technologies and targeting the most favorable technologies for follow-on industrial-scale demonstration. As illustrated in Figure 3-1, this ensures a steady flow of evolving technologies through the RD&D pipeline while providing on-ramps for new technologies and off-ramps for technologies no longer meeting portfolio criteria.

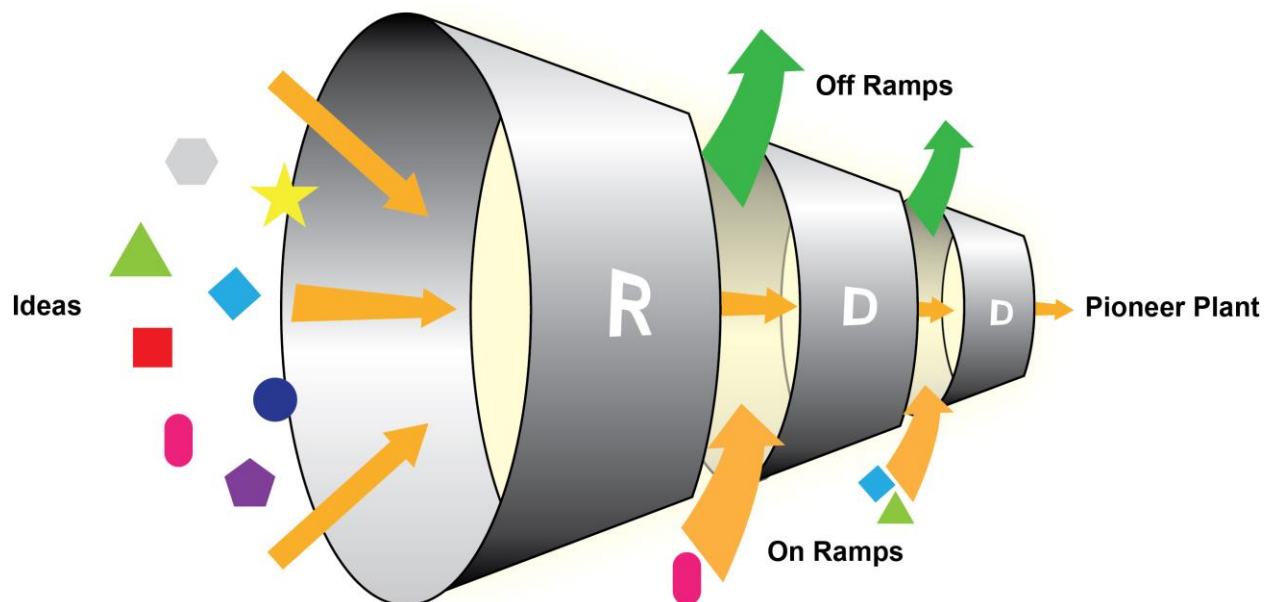


Figure 3-1: The RD&D pipeline concept

Table 3-1: Technology Readiness Level (TRL) Definitions

TRL 1	Basic principles observed and reported: Scientific problem or phenomenon is identified. Essential characteristics and behaviors of systems and architectures are identified using mathematical formulations or algorithms. The observation of basic scientific principles or phenomena has been validated through peer-reviewed research. Technology is ready to transition from scientific research to applied research.
TRL 2	Technology concept and/or application formulated—applied research activity: Theory and scientific principles are focused on specific application areas to define the concept. Characteristics of the application are described. Analytical tools are developed for simulation or analysis of the application.
TRL 3	Analytical and experimental critical function and/or characteristic proof of concept: Proof of concept validation has been achieved at this level. Experimental research and development is initiated with analytical and laboratory studies. System/integrated process requirements for the overall system application are well known. Demonstration of technical feasibility using immature prototype implementations are exercised with representative interface inputs to include electrical, mechanical, or controlling elements to validate predictions.
TRL 4	Component and/or process validation in laboratory environment—alpha prototype (component): Standalone prototyping implementation and testing in laboratory environment demonstrates the concept. Integration and testing of component technology elements are sufficient to validate feasibility.
TRL 5	Component and/or process validation in relevant environment—beta prototype (component): Thorough prototype testing of the component/process in a relevant environment to the end user is performed. Basic technology elements are integrated with reasonably realistic supporting elements based on available technologies. Prototyping implementations conform to the target environment and interfaces.
TRL 6	System/process model or prototype demonstration in a relevant environment—beta prototype (system): Prototyping implementations are partially integrated with existing systems. Engineering feasibility is fully demonstrated in actual- or high-fidelity system applications in an environment relevant to the end user.
TRL 7	System/process prototype demonstration in an operational environment—integrated pilot (system): System prototype demonstrated in an operational environment. System is at or near full scale (pilot or engineering scale) of the operational system, with most functions available for demonstration and test. The system, component, or process is integrated with collateral and ancillary systems in a near production quality prototype.
TRL 8	Actual system/process completed and qualified through test and demonstration—pre-commercial demonstration: End of system development with full-scale system fully integrated into operational environment with fully operational hardware and software systems. All functionality is tested in simulated and operational scenarios with demonstrated achievement of end-user specifications. Technology is ready to move from development to commercialization.

The Office's approach to portfolio management has several distinct advantages:

- It ensures that the Office will examine diverse feedstocks and conversion technologies for producing biofuels, biopower, and bioproducts
- It brings new ideas and projects into the technology development cycle from applied research through commercial demonstration
- It provides structured decision-making for down-selection to ensure focus on the most most promising technologies and highest priority challenges
- It successfully identifies gaps within the portfolio, as well as crucial linkages between the stages of RD&D
- It is adequately flexible to accommodate new ideas and approaches, as well as various combinations of feedstock and process in real biorefineries
- It incorporates a structured management process, which guarantees a series of periodic technology reviews to help inform decision-making.

3.1 Office Portfolio Management Process

The Bioenergy Technologies Office manages its portfolio based on the approach recommended under the Office of Energy Efficiency and Renewable Energy (EERE) Program Management Initiative¹ and supplemented by Active Project Management and other structured systems approaches. The four major steps in the Office portfolio management process are shown in Figure 3-2 and are described on the following pages.

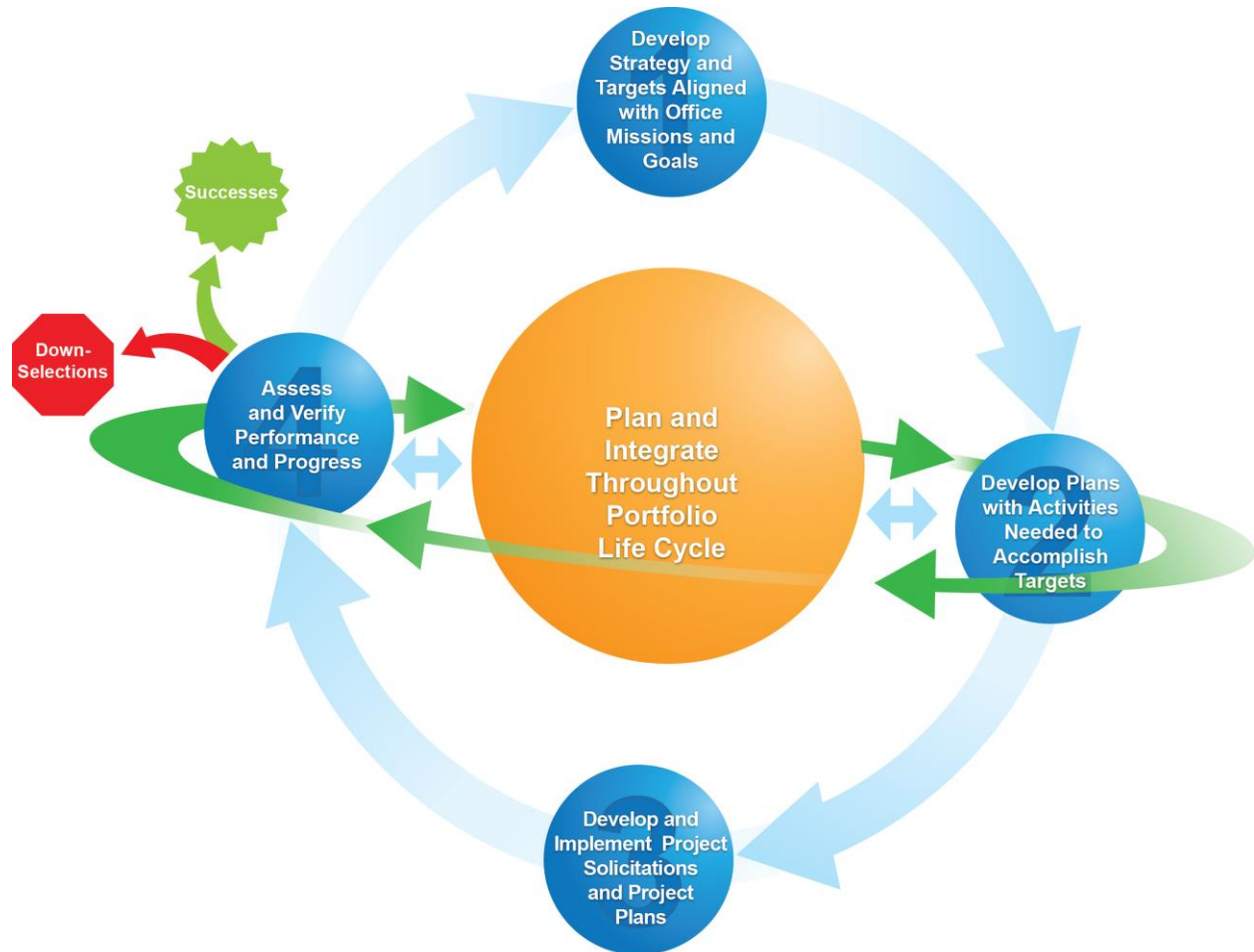


Figure 3-2: Office portfolio management process

¹ The EERE Program Management Initiative was launched in 2003 to address stakeholder expectations, the President's Management Agenda, DOE and EERE strategic plans, findings and recommendations by the National Academy of Public Administration, and the Government Performance and Results Act. Complete information is available at <http://energy.gov/eere/downloads/eere-program-management-initiative-pmi-brochure>.

Step 1: Develop Office Strategy and Targets Aligned with Office Mission and Goals

Step 1 encompasses the process of developing the Office mission and goals (outlined in Section 1), both of which are developed from a combination of the Office's strategic goal hierarchy (see Figure 1-5) based on national goals, administrative and legislative priorities, and DOE and EERE strategic goals and priorities. The mission and goals are also developed in alignment with the goals of other federal agencies. The Office is currently undertaking a strategic planning process to update the Office's strategic goals and objectives.

The Office portfolio logic diagram (see Figure 1-7) outlines how the mission and goals fit within the planning and budgetary framework of the Office. Combining that Office portfolio logic with an understanding of market needs and technical scenarios leads to a definition of Office technical targets consistent with government objectives. Targets are allocated to Office program areas responsible for managing and funding research related to the targets. As shown in Figure 1-6, those program areas are organized around the two broad categories of RD&D and Crosscutting activities. RD&D is split into four technical areas: Terrestrial Feedstock Supply and Logistics R&D, Advanced Algal Systems R&D, Conversion R&D, and Demonstration and Market Transformation. Crosscutting areas include Sustainability, Strategic Analysis, and Strategic Communications.

Portfolio decision-making at the strategic level is based on three main criteria:

1. Does the portfolio balance the correct elements and priorities across the spectrum of RD&D and crosscutting activities to meet the technical and/or market targets required to achieve Office goals?
2. Does the portfolio support diverse technologies that can buy down the risk of producing competitively priced bioenergy and bioproducts?
3. Does the portfolio support the establishment of the bioenergy industry in the United States?

Step 2: Develop Plans with Activities Needed to Accomplish Targets

Step 2 guides how the Office develops its multi-year plans to outline the path to achieving the high-level Office technical and market targets defined in Step 1.

Based on overall Office goals, priorities, and relationships with other agencies, each program area develops performance goals and barriers through internal evaluation and public-private collaborative meetings. Based on the performance goals and barriers, programs develop long-term plans that inform budget priorities. To ensure alignment with Office goals and enable integration with other program area efforts, programs have used a structured resource loaded planning (RLP) process to detail activities required to meet strategic objectives and develop funding projections for achieving program targets. Each program area prioritizes and sequences activities for addressing challenges and barriers while considering the needs, developments, and driving forces behind the emerging industry within the context of inherently governmental activities. RLPs—integrated across program areas—identify gaps and linkages so gaps can be addressed and so linkages and interfaces between programs can be strengthened.

Future updates of program area RLPs may be based on updated Office strategies and goals. Updated plans align with and inform the activities described here in the Multi-Year Program Plan (MYPP). This MYPP is reviewed and updated annually to incorporate technology advances, cross-program learning, and changes in direction and priorities. Program plans are used to inform budget development process and are updated iteratively based on actual funding.

Program area priorities are informed by the five EERE core questions:²

- **Impact:** Is this a high-impact problem?
- **Additionality:** Will EERE funding make a large difference relative to existing funding from other sources, including the private sector?
- **Openness:** Are we focusing on the broad problem we are trying to solve and open to new ideas, approaches, and performers?
- **Enduring Economic Impact:** How will EERE funding result in enduring economic impact for the United States?
- **Proper Role of Government:** Why is this investment a necessary, proper, and unique role of government rather than something best left to the private sector?

Step 3: Develop and Implement Project Solicitations and Project Plans

Step 3 involves defining specific activities and goals required to meet strategic objectives, soliciting performers either competitively or non-competitively, and defining work scope of projects to meet those goals. Projects selected through competitive awards, as well as national laboratory projects developed through Annual Operating Plans (AOPs) and selected through the AOP merit review process, develop Project Management Plans (PMPs) that align with the MYPP and program area plans. PMPs outline the projects' approaches for achieving project objectives and aligning to technical and market targets and program barriers and milestones. At the initiation of a project, a PMP is prepared for the entire project duration, with special attention to the activities planned for the upcoming year. PMPs are updated annually based on actual progress, results of interim reviews, and updates to the Office MYPP.

Step 4: Assess and Verify Performance and Progress

As program area plans are implemented, Step 4 involves a system of performance assessments held on multiple levels to monitor and evaluate performance and progress (described in detail in Section 3.2). Individual projects are managed using Active Project Management (APM) practices required under EERE guidance. APM ensures that project progress is managed against program goals, the statement of work, and agreed upon milestones. APM includes a prescribed series of activities and reporting based on a graded approach that provides more oversight to projects with larger funding and higher risks.

² U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (2016), *2016–2020 Strategic Plan and Implementing Framework*, <http://www.energy.gov/eere/downloads/eere-strategic-plan>.

The Office also monitors project performance on a quarterly basis against baseline schedule, scope, and cost provided in the AOP and PMP. Project assessments also inform program portfolio assessments. Program areas regularly assess their project portfolios to identify changes needed to more effectively achieve program and Office goals and targets. Within the program portfolio context, individual projects' scope, cost, schedule, risks, and potential benefits are assessed in comparison to other projects and based on their relevance towards addressing barriers and challenges and on reaching program area goals. Portfolio assessments identify overlaps and gaps and identify changes needed to better implement existing program plans while informing future plan updates.

The Office conducts biannual program area peer reviews and an overall Office peer review to provide input to decision making for future funding and direction. Project validations, go/no-go, and comprehensive project reviews are also conducted at the individual project level to assess technical, economic, environmental, and market potential, as well as risk.

In large-scale demonstration projects and pioneer conversion facilities involving public-private partnerships, independent expert analysis, project management processes such as DOE's Critical Decision process, and on-going evaluation by the Office contribute to project risk assessments and go/no-go decisions. BETO has adopted a modified approach of the acquisition-focused Critical Decision structure described in DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets,³ to be more applicable to the Financial Assistance projects in the portfolio. The Critical Decision process is very similar to Front-End Engineering Design more commonly used by industry.

³ U.S. Department of Energy, Office of Information Resources, "DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets," <https://www.directives.doe.gov/directives-documents/400-series/0413.3-BOrder-b>.

3.2 Performance Assessment

The Office assesses its progress, decisions, goals, and approaches by monitoring and evaluating program and project performance. The performance assessment activities outlined in Table 3-2 provide avenues for input from other government agencies, stakeholders, and independent expert reviewers on program effectiveness and progress towards Office mission and goals.

Table 3-2: Office and Project-Level Assessments that Support Decision Making

Assessment Type		Assessment Synopsis	Documentation
Performance Monitoring	<i>External Monitoring</i>	DOE's Annual Performance Target Tracking System	Annual Performance Target Reports
	<i>Internal Monitoring</i>	Quarterly Portfolio Reviews	Quarterly Portfolio Review Reports
		Active Project Management and project monitoring with quarterly reports	Project Management Database and Quarterly Assessment and Site Visit Memos
		Project validations, integrated biorefinery (IBR) technical performance tracking	Biomass Database and IBR Performance data base and Annual ComPASS Report
		Independent Engineer evaluations and Comprehensive Project Reviews (CPRs)	Office Internal Reports
Office Evaluation	<i>Peer Reviews</i>	Conducted by independent experts outside of the Office portfolio to assess quality, productivity, and accomplishments, as well as relevance of Office success to EERE and Office strategic goals and to management ⁴	Public Summary Documents (including Office Response)
	<i>General Office Evaluation Studies</i>	Conducted by independent external experts to examine process, quantify outcomes or impacts, identify market needs and baselines, or quantify cost-benefit measures as appropriate ⁵	Public Reports and Documentation
Performance Monitoring and Office Evaluation	<i>Technical Office Reviews</i>	EERE Senior Management	EERE Internal
		Biomass R&D Technical Advisory Committee	Report to Congress (including Office Response)
	<i>Technical Project Reviews</i>	Project validations and go/no-go reviews conducted by DOE and other technical experts for select competitively awarded R&D and all public/private demonstration projects. Reviews are conducted by DOE plus independent industry, academia, or other government for pre-competitive R&D projects.	Internal reports for select competitively awarded R&D and all public-private demonstration projects.

Performance Monitoring

External Performance Monitoring

The Office of Management and Budget monitors Office performance against technical annual performance targets. Each EERE office is responsible for establishing and monitoring quarterly milestones, as well as meeting annual performance targets established in congressional budget requests.

⁴ U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (2004), *Peer Review Guide*, <http://www1.eere.energy.gov/analysis/pdfs/2004peerreviewguide.pdf>.

⁵ U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (2006), *EERE Guide for Managing General Program Evaluation Studies: Getting the Information You Need*, <http://www.seachangecop.org/sites/default/files/documents/2006%2002%20EERE%20-%20EERE%20Guide%20for%20Managing%20General%20Program.pdf>.

Internal Performance Monitoring

The Office utilizes Quarterly Portfolio Reviews (QPRs) to summarize and report project schedule and cost performance for over 300 projects in the Office portfolio. Along with Active Project Management and other standardized processes, this review ensures on-going monitoring of project status, early identification of project issues, and notification of significant variances enabling a timely response.

Active Project Management and other standardized processes used to monitor and manage project performance include the following:

- Project Management Plans (PMPs) provide details of work planned throughout the entire project duration, as well as to establish measures for evaluating performance. The plans include multi-year descriptions, milestones, schedules, cost projections, and also identify other project subcontractors or partners. The PMPs are updated annually.
- Annual Operating Plans (AOPs) outline the scope of work, milestones, risks, and funding details of projects performed by national laboratories. These one- to three-year plans detail activities that have been selected through a merit review process or directly selected by program areas to focus on specific program or Office objectives, as appropriate based on the core capabilities of each national laboratory.
- Quarterly project progress reports are submitted by the funded organizations, outlining financial and technical status, identifying problem areas, and highlighting achievements. The Office performs a quarterly assessment of project progress against the planned scope and schedule and financial performance against the cost projection and documents the assessment in a quarterly management report.
- The performance of large-scale demonstration projects is also monitored through annual comprehensive project reviews and ongoing performance monitoring and analysis. The results of the reviews and performance monitoring are used for portfolio management and planning.
- Face-to-face meetings are held between DOE technical project officers and contractors with the project principal investigator or project team at least two times per year.

The Office uses structured systems approaches including interface management, project validation, independent performance verification, and information management tools to monitor overall progress toward achieving technical targets and to track lessons learned.

Office Evaluation

Peer Reviews

The Bioenergy Technologies Office uses an external peer review process to assess program area performance, as well as overall Office and portfolio performance. The Office implements the peer review process through a combination of program area peer reviews and an overall Office peer review, which are conducted at least biennially. The emphasis of the Office peer review is on the MYPP and the overall portfolio to determine whether or not it is balanced, organized, and performing appropriately. In contrast, the emphasis of the program area reviews is on the performance and execution of individual projects that comprise that program area and whether

those projects are performing appropriately and contributing to program area goals as well as on the program area's overall portfolio balance.

The program area peer reviews evaluate the RD&D contributions of each program area toward the overall Office goals, as well as the processes, organization, management, and effectiveness of the Bioenergy Technologies Office. The review is led by an independent steering committee that selects independent experts to review both the Office and program area portfolios. The results of the review provide feedback on the performance of the Office and its portfolio and identify opportunities for improved Office management, as well as gaps or imbalances in funding that need to be addressed. By addressing these gaps and imbalances, the Office ensures focus on the highest priorities.

The program area peer reviews are conducted prior to the Office review. Information and findings from the program area peer reviews are incorporated into the comprehensive Office peer review process. The objectives of the program area peer review meetings are the following:

- Review and evaluate RD&D accomplishments and future plans of projects in each program area portfolio following the process guidelines of the EERE Peer Review Guide and incorporating the project evaluation criteria used in Office decision-making and project assessment processes
- Define and communicate Office strategic and performance goals applicable to the projects in that portfolio
- Provide an opportunity for stakeholders and participants to learn about and provide feedback on the projects in that portfolio to help shape future efforts so that the highest priority work is identified and addressed
- Foster interactions among industry, universities, and national laboratories conducting the RD&D, thereby facilitating technology transfer.

Technical experts from industry and academia are selected as reviewers based on their experience in various aspects of bioenergy technologies under review, including project finance, public policy, and infrastructure. The reviewers score and provide qualitative comments on RD&D based on the presentations given at the meeting and the background information provided. The reviewers also are asked to identify specific strengths and weaknesses as related to technical progress, project relevance, project approach, critical success factors, future work, and technology transfer plans.

The Office analyzes all of the information gathered at the review and develops appropriate responses to the findings for each program. Individual projects are given the opportunity to provide responses to the reviewers' comments. This information, including the Office response, is documented and published in a review report that is made available to the public through the Office website.⁶

⁶ Visit the 2015 Project Peer Review Web page for the most recent peer review report: <http://energy.gov/eere/bioenergy/2015-project-peer-review>.

General Office Evaluation Studies

The Office sponsors several activities and processes that are aligned with the program evaluation studies described in the EERE Guide for Managing General Program Evaluation Studies. The Office is conducting general program evaluations based on this guide, including the following:

- Needs/Market Assessments
- Outcome Evaluations
- Impact Evaluations
- Cost-Benefit Evaluations.

Needs/Market Assessments: In the past several years, the Office has held a number of workshops that have brought together stakeholders from federal and state government agencies, industry, academia, trade associations, and environmental organizations. These workshops have identified the key needs and opportunities for biobased fuels, power, and products in the United States. Recent workshops have focused on advanced feedstock supply systems, bioproducts, waste-to-energy, advanced conversion technologies, and advanced algal supply systems.

Outcome, Impact, and Cost/Benefit Evaluations: These types of evaluations are carried out by the EERE Office of Planning Budget and Analysis and were described previously in the Benefits Analysis portion of Section 2.4.2.

Performance Monitoring and Office Evaluation

The Office uses several forms of technical review to assess Office and program area progress and promote improvement. These include the Biomass R&D Technical Advisory Committee Office reviews, EERE strategic office reviews, the project validation and go/no-go processes, and comprehensive project reviews.

Technical Reviews

The Biomass Research and Development Technical Advisory Committee annually reviews the joint USDA/DOE Biomass R&D Initiative processes and portfolio and also provides recommendations to the Secretary of Energy and Secretary of Agriculture concerning the technical focus and future biofuels and bioproduct directions. The Committee provides periodic briefings to the Biomass R&D Board. Internally, DOE-EERE senior management meets frequently with the Bioenergy Technologies Office Director on strategic issues, including preparation of congressional budget submissions and evaluation of strategic direction.

Technical Project Reviews

The Office conducts project-level technical reviews. R&D projects are subject to review via three main processes: (1) project-level validations, (2) go/no-go reviews, and (3) comprehensive integrated biorefinery project reviews.

Project-level validations, performed by independent subject matter experts, verify technical and economic performance related to technical data provided in FOA applications and provide benchmarks and targets for interim and final reviews.

Go/no-go reviews, conducted either by BETO staff or external, independent reviewers, provide recommendations to inform go/no-go project decisions. Go/no-go reviews are generally aligned with the budget periods defined in the contractual Assistance Agreement or Annual Operating Plan for each project. Milestones and associated completion criteria are set at the beginning of a budget period or project. Projects are required to present not only progress to date, but also plans for the remainder of the project. At a pre-determined point in the project, progress is evaluated against these review criteria resulting in one of three possible outcomes: (1) review criteria are met resulting in a “go” decision to continue with the project as originally scoped, (2) review criteria are not met resulting in project termination (“no-go”), or (3) review criteria are partially met, resulting in required changes to the project; for example, by changing the scope of the effort or by extending the timeline to completion.



Figure 3-3: Office portfolio management process

The Office conducts annual comprehensive reviews on each of its large-scale demonstration- and pioneer-scale facility projects throughout the period of performance to monitor progress, identify key risks, and assess commercial viability. These in-depth reviews consider company structure and project management, technical performance, financial health, and commercial viability. Table 3-3 shows the key areas being assessed. These reviews also identify critical lessons learned to inform future DOE program activities. In conjunction with these reviews, key performance metrics for each major demonstration project are monitored, and the results are compiled and analyzed at least annually.

Table 3-3: Comprehensive Project Review Evaluation Criteria

Evaluation Category	Illustrative Evaluation Criteria
COMPANY STRUCTURE AND PROJECT MANAGEMENT	
1A: Project Management	<ul style="list-style-type: none"> • Project team is aligned to manage completion of performance baseline (cost/schedule) • Risks identified and mitigated • Key expertise and staff retained • Intellectual property secured/licensed
1B: Performance Against Baseline Scope, Budget, and Schedule	<ul style="list-style-type: none"> • Execution plans for operations are complete or appropriate for project stage • Performance baseline is well defined and complete • Earned value management metrics consistent with expectations, variances are addressed, plans for baseline are credible and achievable
1C: Risk Mitigation	<ul style="list-style-type: none"> • Risks adequately identified and risk mitigation plan maintained
TECHNICAL PERFORMANCE	
2A: Process Operations and Technical Targets	<ul style="list-style-type: none"> • Minimal new or untested technologies and process integrations • Technical performance appropriate for current stage and technical targets met • Environmental sustainability issues considered, measured, and addressed
2B: Feedstock Supply	<ul style="list-style-type: none"> • Feedstocks supply demonstrated at adequate scale to support commercial applications • Project feedstock(s) same as experimentally demonstrated and future commercial applications • Feedstock secured at reasonable cost to support long-term operations and feedstock supply logistics addressed • Environmental implications of feedstock production, logistics, and procurement assessed and addressed
FINANCIAL HEALTH AND MARKETING APPROVAL / COMMERCIALIZATION PLANS	
3A: Marketing Approval and Commercialization Plans	<ul style="list-style-type: none"> • Off-take agreements secured, production volumes aligned, and achievable path to market penetration defined • Marketing plan including fuel testing and approval coordinated with long-term project plans • Commercialization plans developed
3B: Project Financing	<ul style="list-style-type: none"> • Adequate access to financing and cost-share secured • Post-construction working capital sources defined • Future financing needs supported by performance baseline and critical path • Financing risks adequately addressed in contingency plans
3C: Project Economics	<ul style="list-style-type: none"> • The projected <i>pro forma</i> for the envisioned first commercial plant incorporates achievable performance targets and cost goals adequate for financial returns and debt coverage required for future commercialization.