

Office of Clean Energy Demonstrations



OCED Investment Risk Approach

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Office of Clean Energy
Demonstrations

Report Disclaimer

This report, “OCED Investment Risk Approach,” outlines the Office of Clean Energy Demonstrations (OCED) general philosophy towards risk-taking in its funding activities. It is intended to provide the private sector and the American public with a clearer understanding of OCED’s approach to its investments and to facilitate a more informed dialogue concerning the commercialization of its portfolio. For the purposes of this report, risk is defined as the effect of uncertainty on objectives.¹

The content herein reflects a broad overview of OCED’s investment philosophy and should not be interpreted as either policy or procedural guidelines, or as an investment decision framework that will apply to OCED projects or operations in all instances. The insights and perspectives shared in this document aim to enhance transparency and understanding of OCED’s risk approach and are not representations of OCED’s operations or commitments.

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¹ [OMB Circular No. A-11 \(2024\), Section 260.30](#)

Investment Risk Approach

Overview of OCED Investment Philosophy

The Department of Energy (DOE) Office of Clean Energy Demonstrations (OCED) directly addresses the need to scale innovative technologies in the energy and industrial sectors in the United States. By partnering with the private sector to demonstrate cutting-edge technology and catalyzing significant private investment, OCED responds to growing demand for energy and energy-related infrastructure, ensuring continued American energy leadership, widespread economic growth, and domestic energy resilience.

OCED's investment philosophy is centered on accelerating commercialization for emerging energy and industrial technologies. By nature of its earlier stage mandate, OCED's investment areas and projects are characterized by a high degree of uncertainty. These uncertainties increase the real and perceived risks of such projects, creating barriers to investment by the private sector. To attract private capital to these projects, OCED deploys a range of investment strategies, the primary one being as an up to 50% co-investor with the private sector in first-of-a-kind (FOAK) and early-of-a-kind commercial-scale demonstration projects. These investments "buy down" (i.e., reduce) the real and perceived risks of emerging critical-path energy technologies through commercial demonstration, familiarizing market and community partners with these solutions. In doing so, OCED's investments act as a catalyst for follow-on private sector investment – taking on early commercialization risks that the private sector cannot or will not at sufficient pace or scale. OCED provides a bridge between high-risk, early-stage technology development and the commercial maturity required for widespread investment and broad market adoption. For an in-depth discussion of OCED's investment instruments, investment philosophy, and market position, see the [OCED Investment Value Proposition](#).

Investment Risk Approach Purpose

In the context of OCED's mission, mandate, and value proposition, this Investment Risk Approach outlines OCED's general approach towards risk-taking in its funding activities, which is heavily based on industry best practices. The Investment Risk Approach informs OCED's risk management strategies, enhances communication with stakeholders, and contributes to a prudent risk culture and approach to federal oversight.

Investment Risk Approach Scope

OCED contemplates a variety of strategic risks, including at the project,² program,³ and portfolio⁴ levels (summarized below in *Table 1*), each critical to the execution of OCED's core strategy and fiduciary stewardship. Each of these strategic risks is described in detail in the following sections.

2 Projects in this context include commercial-scale energy and industrial demonstrations typically covered under cooperative agreements.

3 Programs are collections of projects in a given sector, often aligned with the various funding opportunities. Example OCED program areas include advanced nuclear, hydrogen, industrial demonstrations, and long-duration energy storage, among others.

4 OCED's "portfolio" includes all projects funded across all programs; it intends to achieve OCED's overarching mission and mandate.

Risk level	Strategic risks	Description
(I) Project	Project characteristics	Risks related to a project's commercial features, technology, and team (e.g., technology maturity, product development, project development approach, project execution, business model, track record, and local community support or opposition to a project, recipient, and/or technology).
(II) Program	(A) Progress toward sector-level commercialization	Risks related to an emerging energy or industrial technology's progress toward "commercial liftoff," ⁵ as may be evaluated using the Adoption Readiness Level (ARL) framework. ⁶
	(B) Systemic	Risks related to over- or under-exposure to risk factors across a particular sector such as counterparty, technology pathway, revenue profile, and geography.
(III) Portfolio	(A) Portfolio balancing	Risks related to diversification at the portfolio level across technologies, sectors, technology maturity timeframes, counterparties, geographies, correlated assets, interdependencies, and other key risk factors.
	(B) Market adaptation	Risks related to maintaining a portfolio that remains relevant as new technologies emerge and market conditions evolve.

Table 1: Summary of Investment Risk Approach Scope

In addition to these strategic risks, OCED faces a spectrum of other enterprise-related risks including operational, reporting, environmental, and compliance risks. These risks are inherent to OCED's day-to-day operations, financial and non-financial reporting, and compliance with applicable laws and regulations.⁷ These enterprise risk categories are not within the Investment Risk Approach scope.

5 "Liftoff" is characterized by significant improvement in technology and operating parameters, market recognition of a sector or technology's full value, and realization of industrial-scale manufacturing and deployment capacity. (<https://liftoff.energy.gov/>)

6 See [Adoption Readiness Levels \(ARL\) Framework | Department of Energy](#) for reference.

7 Department of Energy Enterprise Risk Management Guidance 2023. <https://www.energy.gov/sites/default/files/2023-03/fy-2023-doe-enterprise-risk-management-guidance.pdf>

I. Project Level

Preface

OCED’s project selection criteria and decision-making framework are laid out in each Notice of Funding Opportunity (NOFO) and are distinct from the project level risks described below. As discussed in the *Report Disclaimer* section, **the content herein reflects a broad overview of OCED’s investment philosophy and should not be interpreted as either policy or procedural guidelines, or as an investment decision framework that will apply to OCED projects or operations in all instances.**

Commercial Risk Factors

Project level risks can be organized using 20 Commercial Risk Factors, listed below. OCED utilizes these factors to methodically assess, track, and, where appropriate, mitigate the risks associated with its investments on a project-by-project basis. Over the course of specific project development and broader commercialization of emerging energy and industrial technologies, OCED expects decreasing risk exposure with respect to each factor. Although projects may have moderate or high risks early on, OCED expects project risk to decrease during development to be able to achieve Final Investment Decision (FID). At the program level, aggregating these project level assessments enables OCED to gain insights into broader sector trends, challenges, and successes. This holistic view allows OCED to evaluate and manage risks more effectively, seize emerging opportunities, and formulate strategic initiatives targeted at addressing issues that affect the entire technology ecosystem.

1. Delivered Cost	8. Project Development, Integration, & Management	14. Policy Environment
2. Functional Performance	9. Infrastructure	15. Permitting & Siting
3. Ease of Use / Complexity	10. Manufacturing & Supply Chain	16. Environmental & Safety
4. Demand Maturity / Market Openness	11. Materials Sourcing	17. Community Perception
5. Market Size	12. Workforce	18. Technology Maturity
6. Downstream Value Chain	13. Regulatory Environment	19. Product Development
7. Capital Flow		20. Team

Table 2: Commercial Risk Factors

Factors 1-17 correspond to the Adoption Readiness Level (ARL) framework, a complementary framework to the Technology Readiness Level (TRL) framework that considers important factors for private sector uptake beyond technology readiness. As background, “Commercial Adoption Readiness Assessments” can be conducted at the market level for a particular technology solution using the “[Commercial Adoption Readiness Assessment Tool](#)” (CARAT).⁸ The CARAT uses a composite scale derived from an assessment of commercial factors that can limit or prevent market adoption of a particular technology solution. By evaluating each factor as high, medium, or low, evaluators can arrive at an Adoption Readiness Level rating (on a scale of 1–9, similar to TRL ratings). OCED typically funds projects at ARL 5-7 (out of 9). The CARAT is useful for evaluating progress toward liftoff, comparing technologies, and highlighting *which* risks are the primary barriers to a given technology’s commercial adoption.⁹

8 See the full [Adoption Readiness Scorecard Guide](#) for reference. Generally, scores of 1-3 represent low commercial adoption readiness, 4-6 indicate medium, and 7-9 indicate high readiness.

9 It is worth noting that evaluating technologies based on a single-digit Adoption Readiness Level (ARL) score alone can be misleading. A low or high ARL score does not provide a comprehensive view of the technology’s market potential. It is important to consider the detailed assessments across all 17 factors to understand the full scope of commercial adoption barriers.

Factors 18-19 are related to technology risks. Factor 18 corresponds to the TRL framework.¹⁰ As background, “Technology Readiness Assessments” result in a TRL rating of 1 (“basic principles observed and reported,” i.e., an idea) to 9 (“actual system operated over the full range of expected mission conditions,” e.g., the internal combustion engine). OCED’s NOFOs outline expected TRL ratings. Factor 19 corresponds to the system design and testing required to bring an integrated product utilizing the technology to market.

Factor 20 is related to the project’s team. It includes risks related to the potential challenges and uncertainties arising from reliance on external partners and stakeholders for achieving the project’s long-term goals. Partner risks might include the quality of the partner’s management team commitment over the long-term, management alignment, and the partner’s prioritization of the project.

Examples of project level risks that OCED contemplates with respect to each factor are described below.

1. Delivered Cost

At the sector level, this factor contemplates risks associated with achieving delivered cost competitiveness when produced at full scale, including amortization of incurred development and capital costs, and accounting for switching costs (if any).

In the context of OCED-funded projects, this factor contemplates risks associated with pricing factors that impact the project’s ability to deliver unit cost projections.

2. Functional Performance

At the sector level, this factor contemplates risks associated with the ability of the technology solution to meet or exceed the performance and feature-set of incumbent solutions or create new end-use markets.

In the context of OCED-funded projects, this factor contemplates risks associated with a project’s downtime.

3. Ease of Use / Complexity

At the sector level, this factor contemplates risks associated with operational switching costs: the ability of a new user (individual, company, system integrator) to adopt and operationalize the technology with limited training, few new requirements, or special resources (e.g., tools, workforce, contract structures).

In the context of OCED-funded projects, this factor contemplates risks associated with the technical complexity of projects after commissioning (i.e., during operations, maintenance, decommissioning (as relevant)) and the project developer’s ability to operate the project without significant new-to-industry requirements or resources.

4. Demand Maturity / Market Openness

At the sector level, this factor contemplates risks associated with demand certainty and access to standardized sales and contracting mechanisms (if required), as well as with natural barriers to entry in the market(s) (e.g., network effects, first-mover-advantages) and/or structural (e.g., existing monopolies/oligopolies) to which the technology solution can be applied.

In the context of OCED-funded projects, this factor contemplates risks associated with barriers to market entry, market’s willingness to pay, and offtake profile (e.g., certainty, structure).

¹⁰ See more on Technology Readiness Assessments here: <https://www.directives.doe.gov/directives-documents/400-series/0413.3-EGuide-04a-admchg1/@images/file>

5. Market Size

At the sector level, this factor contemplates risks associated with the overall size of the market that can be served by the technology, and the level of uncertainty with which it may materialize.

In the context of OCED-funded projects, this factor contemplates risks associated with a project's total addressable market and market liquidity.

6. Downstream Value Chain

At the sector level, this factor contemplates risks associated with the projected path to get the product from a producer to a customer along the value chain (e.g., considering split incentives, technology acceptance, business model changes).

In the context of OCED-funded projects, this factor contemplates risks associated with a project's relevance, value proposition, and relationships with various participants along the downstream value chain.

7. Capital Flow

At the sector level, this factor contemplates risks associated with the availability of capital needed to move the technology solution from its current state to production at scale, including total investment required, availability of willing investors, availability of associated financial and insurance products, and the speed of capital flow.

In the context of OCED-funded projects, this factor contemplates risks associated with the availability of capital required to finance the private sector partner's cost share.

8. Project Development, Integration, & Management

At the sector level, this factor contemplates risks associated with the existence of processes and capabilities to successfully and repeatably execute projects using the technology solution.

In the context of OCED-funded projects, this factor contemplates risks associated with the project's ability to conduct development, planning and engineering, construction, and commissioning of the asset.

9. Infrastructure

At the sector level, this factor contemplates risks associated with the physical and digital systems that need to be in place to support, enable, or facilitate deployment at full scale (e.g., pipelines, storage, transmission lines, roads and bridges). The risks also include physical, digital, and cybersecurity risks associated with critical infrastructure of national importance.

In the context of OCED-funded projects, this factor contemplates risks associated with access to and availability of such physical and digital systems.

10. Manufacturing & Supply Chain

At the sector level, this factor contemplates risks associated with the entities and processes that will produce the end-product, including integrators, component, and sub-component manufacturers and providers.

In the context of OCED-funded projects, this factor contemplates risks associated with the project's own supply chain and manufacturing base.

11. Materials Sourcing

At the sector level, this factor contemplates risks associated with the availability of raw materials required by the technology (e.g., rare earth, critical minerals, and other limited availability materials).

In the context of OCED-funded projects, this factor contemplates risks associated with the project's own raw materials supply chain.

12. Workforce

At the sector level, this factor contemplates risks associated with the human capital and capabilities required to design, produce, install/construct, maintain, and operate the technology solution at scale.

In the context of OCED-funded projects, this factor contemplates risks associated with the project's own access to and relationship with a skilled workforce.

13. Regulatory Environment

At the sector level, this factor contemplates risks associated with local, state, and federal regulations or other requirements / standards that must be met to deploy the technology at scale.

In the context of OCED-funded projects, this factor contemplates risks associated with the project's regulatory environment and plans for compliance with all relevant regulation and standards.

14. Policy Environment

At the sector level, this factor contemplates risks associated with local, state, and federal government policy actions that affect the adoption of the technology at scale.

In the context of OCED-funded projects, this factor contemplates risks associated with the project's policy environment and ability to plan for and execute on compliance with relevant policy/incentives.

15. Permitting & Siting

At the sector level, this factor contemplates risks associated with the process to secure approvals to site and build equipment and infrastructure associated with deploying the technology at scale.

In the context of OCED-funded projects, this factor contemplates risks associated with the project's own permitting, site control, and strategic location.

16. Environmental & Safety

At the sector level, this factor contemplates risks associated with the potential for hazardous side effects or adverse events inherent to the production, transport, or use of the technology solution or end-product in the absence of sufficient controls.

In the context of OCED-funded projects, this factor contemplates risks associated with the project's ability to identify environmental and safety risks and plan for mitigants.

17. Community Perception

At the sector level, this factor contemplates risks associated with the perception of the potential impacts of the technology or project on the host community.

In the context of OCED-funded projects, this factor contemplates risks associated with the project's relationship with the community, the potential project impacts, and the strength of the project's community benefits commitments.

18. Technology Maturity

This factor contemplates risks associated with a project's critical technology elements (including basic science, technology concept and speculative practical applications, R&D and lab-scale studies, basic component integration, and uncertainty in performance of core technology elements). For example, a project's critical technology elements may still be undergoing R&D, indicating high uncertainty.

19. Product Development

This factor contemplates risks associated with designing and testing an integrated product (including meeting cost, schedule, and performance objectives). Relevant factors include the prior organizational experience developing new products, the ability to achieve performance targets including utilization of testing for appropriate risk reduction, and ability to maintain a reasonable and appropriate development schedule.

20. Team

This factor contemplates risks associated with OCED's reliance on private sector partners to propose, design, develop, implement, and co-finance the demonstration projects. These risks may include the quality of the management team, viability and commitment of the partner, management alignment, and the prioritization of projects.

II. Program Level

At the program level, OCED contemplates strategic risks around progress toward commercialization across a program area or sector, and systemic investment risks driven by concentrated exposure in key areas. By monitoring risks at the program level, OCED is able to draw insights about common challenges and opportunities which can inform proactive risk mitigation, new program design, and public reports on learnings.

A. Sector-Level Commercialization

Risks associated with the collective challenges and themes impacting the commercial adoption readiness of certain technologies or projects within a particular sector.

B. Systemic Risk

Among projects within an OCED program, risks associated with under- or overexposure to project characteristics such as geography, technology, infrastructure, and counterparty that may present material execution challenges.

III. Portfolio Level

At the portfolio level, OCED contemplates strategic risks around balancing the portfolio and adapting to market changes. Assessing risks at this level informs a variety of strategic work including OCED's Multi-Year Program Plan and OCED 2030, which identifies new demonstration opportunities and Liftoff Enabling Programs.

A. Portfolio Balancing

Risks associated with:

- Optimally allocating resources across diverse programs, projects, technologies, geographies, and other risk factors;
- Managing interplay and dependencies among programs, sectors, and technologies to achieve OCED's strategic objectives;
- Key concentration issues associated with shared prime recipients, suppliers, EPCs, and other project characteristics among projects in multiple OCED programs; and
- Compliance with statutory mandates and limitations on appropriations, which typically prescribe capital allocations to certain sectors, constraining flexibility in portfolio management.

B. Market Adaptation

Risks associated with OCED's portfolio becoming tangential to the market, which could occur due to unforeseen market developments or otherwise.

Risk Management Strategies

As discussed above, OCED has appetite for a wide range of strategic risks at the project, program, and portfolio levels. To manage these risks, OCED follows a structured risk management process, assessing and addressing risks at every phase of the investment lifecycle. The objective of this risk management approach is not solely to minimize risks but also to recognize and leverage potential gaps and opportunities that align with OCED’s mandate.

Risks	Management Strategies Executed by OCED
Project Risks	Pre-award (includes post-selection negotiation) ➤ Widely promotes funding opportunities to attract a diverse array of qualified applicants. ➤ Conducts a structured merit review process to perform strong due diligence of key project features like technical merit, financial and market viability, workplan, management team and project partners, community benefits, and others. ➤ Conducts rigorous analysis to support the merit review process, including techno-economic and life-cycle assessment analyses. ➤ Post-selection, engages in thorough negotiations to establish a clear cooperative agreement (or other mechanism) that defines the terms of OCED’s investment. ➤ Conducts a pre-award evaluation of partners, to verify their financial standing; accounting capabilities for fraud, waste, and abuse detection; adherence to NEPA guidelines; and community benefits integration. ➤ Mandates a minimum 50% cost share¹¹ from the private sector to align incentives, ensure private sector partners’ commitment, and limit exposure to overruns/delays. Post-award ➤ Employs phase-based award structure to ensure projects make adequate progress before additional funds are provided or accessible. ➤ Assigns dedicated Federal Project Managers and Project Teams to each project and tracks progress on technology maturity, product and project development, stakeholder engagement (including community and labor engagement), and commercial adoption readiness for each project through risk registers, site visits, and regular updates to actively oversee the projects. ➤ Monitors projects to ensure requirements such as permitting, environmental, and safety compliance, along with NEPA reviews, and integration of community benefits commitments into project planning, are being met. ➤ Wherever possible, provides funding after performing confirmation of performance and conducts reviews of some post-payments as another check. ➤ Requires ongoing reporting from the projects to keep up to date with asset-level and market-level trends. ➤ Implements independent evaluation and assessment of projects to provide evidence-based reviews of status and risk. ➤ Receives advisory recommendations and guidance from DOE’s Demonstration & Deployment Advisory Board (DDAB) that reviews large-scale clean energy demonstration and deployment projects, each funded through \$100 million or more in federal financial assistance.

¹¹ Certain programs may adjust the standard requirement for a minimum 50% cost share, through approval by the Secretary of Energy or the Secretary’s delegate, based on an assessment of current market needs, the state of technological advancement, and the specific characteristics or circumstances of the impacted communities.

Program Risks	Sector-Level Commercialization ➤ Compiles and analyzes common risks across projects and programs to highlight key trends, opportunities, and challenges across a sector to share publicly through OCED's Portfolio Insights reports and Multi-Year Program Plan (MYPP), DOE's Pathways to Commercial Liftoff reports, as well as directly with other DOE offices and external stakeholders to influence program planning and capital allocation decisions. ➤ Develops and implements Liftoff Enabling Programs (e.g., Small Business Innovation Research (SBIR) and Technology Commercialization Funds (TCF)) to respond to both emergent program risks and future needs for technology commercialization. ➤ Develops and implements initiatives focused on identifying and crafting financial mechanisms to address persistent risks like low willingness to pay, lack of offtake agreements, and other commercial obstacles to OCED projects achieving FID and clean energy deployment more broadly. ➤ Develops and implements cohorts across programs to address shared challenges and opportunities (e.g., workforce development, pipeline safety and training). Systemic Risk ➤ Tracks exposure to key factors like counterparties, technologies, and geographies. This analysis aids in identifying gaps and managing concentrations, including working with partners to mitigate risks and supplying data to guide future selection decisions.
Portfolio Risks	Portfolio Balancing ➤ Tracks exposure to certain factors across the portfolio and employs tools like portfolio, emergent risk, and replicability analyses to identify gaps and inform future project selection and new program concepts. ➤ Fulfills legislative capital allocation requirements to ensure compliance with legally required funding directives. ➤ Develops a rigorous, data-driven out-year strategic plan to inform future budget requests critical to achieving OCED's mission and continued portfolio balancing. Market Adaptation ➤ Prepares a Multi-Year Program Plan and conducts out-year strategy planning to align emerging needs with its mission, including creating new commercial-scale demonstration programs and Liftoff Enabling Programs to overcome commercialization and value chain barriers, as well as reallocating funds from discontinued projects. ➤ Actively collaborates with other DOE offices and the private sector to gather fresh insights into the clean energy landscape and integrates this intelligence into its planning process. ➤ Prepares or updates Pathway to Commercial Liftoff reports or similar analysis on clean energy sectors to spotlight gaps and opportunities.

Conclusion

By nature of OCED's mandate, OCED's investment areas and projects are characterized by both high potential impact and high uncertainty. Some sectors are somewhat nascent, and some project features may be unknown at the time investment is needed. These uncertainties increase the real and perceived risks of projects, creating barriers to investment by the private sector. OCED has a clear appetite for such project level risks and analyzes them using the 20 described factors; all project stakeholders bear these risks, including OCED and private co-investors. Minimizing the impacts of these known risks through a disciplined approach to project management oversight is a cornerstone of OCED's strategy. Furthermore, OCED analyzes risks at the program and portfolio levels to understand sector-wide challenges and opportunities, manage concentrated exposure to certain project characteristics, balance the portfolio through diversification, and maintain relevance to an ever-evolving energy transition.

OCED's Investment Risk Approach is more than an overview of the risks considered in its funding activities, and their management—it is an **invitation for continued dialogue among energy transition stakeholders about OCED's investment approach and potential follow-on investment** to support commercialization of technologies that will significantly extend the longevity of United States energy dominance.