
U.S. DEPARTMENT OF
ENERGY

# Restoring Gold Standard Science DOE Implementation Plan

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**United States Department of Energy**
**Washington, DC 20585**

# Executive Summary

The mission of the Department of Energy (DOE) is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions. The science supported by DOE spans the full breadth from grand challenge, fundamental science through applied science in support of energy technologies. DOE has a long-standing commitment to the highest standards of scientific integrity in the research that we support at national laboratories, academic and other research institutions, and industry.

The DOE reflects the tenets of Gold Standard Science, covered in Executive Order (E.O.) 14303, in much of the Department's existing culture and management of scientific activities, including in its funding opportunities, resource allocations, award selection, and reporting requirements. The purpose of this implementation plan is to determine the DOE's baseline Gold Standard Science activities, determine next steps and identify potential challenges.

- DOE awards are made pursuant to various statutory authorities and in compliance with 2 CFR Part 200, as supplemented by 2 CFR Part 910, that require: disclosure of conflicts of interest; an objective merit review process for proposals; performance reporting, using OMB-approved common information collections (for example, Research Performance Progress Reports); and procedures for addressing research misconduct. Additional regulations and guidance for award selection and review processes apply to specific transaction authorities or programs within DOE, including 2 CFR Part 930 (Other Transaction Agreements), 10 CFR Part 605 (Office of Science Financial Assistance Program), EERE G 413.001 (Peer Review Guidance). (Without conflicts of interest, subject to unbiased peer review, transparent)
- DOE Policy 411.2 and the implementing DOE Order 411.2 on Scientific Integrity provide guidance aimed at enhancing and promoting a culture that ensures the integrity of all aspects of scientific activities, including but not limited to proposing, conducting, reviewing, managing, and using the results of scientific work. Earlier this year, DOE Policy 411.2B was superseded by DOE Policy 411.2C, which is the same content as DOE Policy 411.2A and approved on January 4$^{th}$, 2017. (Without conflicts of interest)
- The 2023 DOE Public Access Plan, recently updated under E.O. 14303 Restoring Gold Standard Science, and its implementation through DOE Order 241.1C, on Scientific and Technical Information Management, enhances the management of the scientific and technical information generated by DOE-funded research and ensure its availability to the American taxpayer, and public at large, in a timely manner, without unnecessary delays or limits to access. This includes public access to peer-reviewed journal articles, scientific conference proceedings, scientific software, and the scientific research data underlying publications or otherwise generated by DOE-funded R&D. (Transparent)
- DOE's Office of Scientific and Technical Information (OSTI) fulfills agency-wide responsibilities to collect, preserve, and disseminate both unclassified and classified

scientific and technical information emanating from DOE-funded research and development activities at DOE national laboratories and facilities and at universities and other institutions nationwide. OSTI provides public access to this information through the web, fulfilling Gold Standard Science tenets including transparency. (Transparent)

- Standard language in DOE Notice of Funding Opportunity (NOFO) announcements, as well as common practices in the scientific communities DOE supports, further exemplify Gold Standard Science by emphasizing hypothesis-driven research in proposals (to lead to development of hypothesis-tested results), encouraging use of the peer review process for building skepticism into the process of disseminating scientific results, supporting the publication of negative results, and enabling collaborative and interdisciplinary science when it provides a sensible path for scientific advancement. (Subject to unbiased peer review, accepting of negative results as positive outcomes, collaborative and interdisciplinary)
- Recent actions have improved the transparency of DOE's research activities. For example, the Office of Science has released a new requirement for public posting of annual progress reports for financial assistance awards and is in the process of expanding online information to include national laboratory research awards. (Transperancy)
- DOE has implemented a multi-office data, modeling, and analysis transparency initiative to ensure sophisticated models that inform policy decisions with far-reaching economic and environmental impacts have clear assumptions, use best in-class methodologies, have open-source code, and produce results that can be replicated or validated by third parties. (Reproducible, transparent, communicative of error and uncertainty)
- DOE has a history of funding research proposals that seek to confirm or disprove claims made in the published scientific literature. (Skeptical of its findings and assumptions, structured for falsifiability of hypotheses)
- Development of topic areas in NOFO are informed by numerous transparent processes that leverage expertise in the relevant scientific and technical communities, including issuing public Requests for Information (RFI), advisory committee reports, workshops, and roundtables. (Unbiased peer review)

# Restoring Gold Standard Science DOE Implementation Plan

## Table of Contents

# I. Implementation Plan

Starting from this strong foundation, there are opportunities to further enhance the DOE's alignment with the tenets of Gold Standard Science.

- Reproducibility
    - DOE will improve reproducibility of results by **completing implementation of the 2023 Public Access Plan** folowing the Gold Standard Science tenets to provide free, immediate access to peer-reviewed, scholarly publications and maximize appropriate sharing of scientific data and code. Awards may include associated costs of public access implementation as allowable expenses.
    - DOE will employ **new mechanisms to ensure all scientific results, including agency-directed reports, undergo an enhanced scientific peer-review process by domain experts.** The peer-review process promotes the dissemination of accurate and reproducible evidence-based scientific results. Specific options include expanded use of RFIs on report topics and engagement of advisory committees and public forums (e.g., annual merit reviews) for initial presentation, discussion, and input on reports. DOE will investigate additional mechanisms to support open science infrastructure and practices.
- Transparency
    - The enhanced Data Management and Sharing Plan requirements in the 2023 Public Access Plan will ensure appropriate public sharing of scientific data, tools, and code for all DOE-funded R&D efforts, including specifying the timelines and specific repositories that will be used for release.
    - DOE will **continue to invest in mission-driven data resources that enable curated data sharing and will explore opportunities to increase interoperability.** These efforts will build upon initiatives to provide broader AI-ready data as part of DOE's research activities, including expansion of Public Reusable Research (PuRe) Data resources in the Office of Science and the development and deployment of the American Science Cloud to serve as a foundation for accelerating the DOE's mission through transformative AI models for science and engineering.
    - **DOE NOFOs will continue to include the specific criteria used for merit review of proposals, expanding standard text to reflect the Gold Standard Science tenets.** A cross-DOE forum will develop "best practices" and innovations to further promote transparency in the selection processes for awards, while maintaining the competitiveness of the process and mitigating conflicts of interest.
    - DOE will continue using standardized, machine-readable metadata and require persistent identifiers for both researchers and research outputs to promote data provenance and tracking and connections across the research lifecycle.
- Communicative of Error and Uncertainty

  - DOE will continue to use the scientific peer-review process to enforce scientific community standards for communicating, and visualizing as appropriate, methodological constraints, assumptions, uncertainties, and confidence intervals associated with results. **NOFO text will be enhanced to further encourage communication of scientific results through peer-reviewed journals as part of the reporting for sponsored research.**
  - DOE will continue to consider falsification of results and misrepresentation of conditions as research misconduct, and address accordingly. DOE's policy for research misconduct for financial assistance recipients is covered by 2 CFR Part 910.132, and the overarching federal regulations governing procedures for handling research misconduct allegations are found in 10 CFR Part 733, and 48 CFR Parts 935, 952 and 970.
- Collaborative and Interdisciplinary
  - DOE will continue its rich history of advancing discovery science, applied research, and innovation through collaboration and interdisciplinary partnerships with academia, federal laboratories, other funding agencies, and private industry.
  - DOE will continue to facilitate collaboration through its funding opportunities, state-of-the-art user facilities, and DOE-supported community data resources.
  - An appropriate balance among research modalities will continue to be assessed by DOE, recognizing that the balance will appropriately vary for fundamental science, applied research, and technology research activities. **Federal advisory committees and other public assessment options will be used to assess the balance of research modalities and their effectiveness**.
- Skeptical of its Findings and Assumptions
  - DOE will continue to foster a culture that encourages program managers for sponsored research to engage in active management of their portfolios, including critical reviews of research progress appropriate for each research project, which may include quarterly to annual processes, evaluation against pre-established milestones, and other decision points.
  - Research portfolios in fundamental science will continue to be designed to support differing approaches and scientific hypotheses to ensure progress towards understanding the underlying phenomena. For fundamental and applied research programs focused on advancing technologies, DOE will continue the long-standing approach of broad investment in nascent technologies without pre-selecting which will ultimately be the best commercially.
- Structured for Falsifiability of Hypotheses; Accepting of Negative Results as Positive Outcomes
  - **DOE will revise the template for NOFOs to include these tenets of Gold Standard Science to the greatest extent possible.** Specifically, text will broaden discussion of hypothesis-driven research to promote research proposals that articulate clear, falsifiable hypotheses with explicitly defined, measurable criteria, supported by solid experimental designs and statistical methods. In

addition, the text revisions will promote practices that enhance falsifiability (e.g., pre-registration of study protocols, use of appropriate control groups) and will encourage transparent reporting of null or negative results in publications and data repositories. Transparent reporting of all results is essential to maximally inform the development of future research areas.

- Subject to Unbiased Peer Review; Without Conflicts of Interest
    - DOE will continue to perform the review, selection, and awarding of grants and contracts in compliance with relevant federal code and the DOE policy and implementing order on scientific integrity to ensure an objective and unbiased process informed by independent merit review by domain experts.
    - DOE will continue to enforce strict conflict-of-interest policies, as required by federal code and DOE scientific integrity policies, including the disclosure of potential conflicts of interest by applicants, reviewers, and agency officials involved in the funding or performance of research.
    - **DOE will explore opportunities to further standardize and streamline elements of the impartial peer review process and consider innovative ways to apply double-blind review processes** given the constraints of the standard evaluation criteria required by federal code.
    - DOE's adoption of persistent identifiers for researchers will provide an additional technical mechanism for detection of conflicts of interest.

# II. Future Changes

In order to promote and monitor efforts to advance the tenets of Gold Standard Science, DOE will develop standardized metrics, evaluation mechanisms, and provide appropriate training and resources to agency personnel.

- **DOE will evaluate and consider revisions to relevant DOE Policies and Orders to strengthen their responsiveness to the tenets of Gold Standard Science,** including DOE P 411.2, DOE O 411.2, and DOE O 241.1C.
- **DOE will explore opportunities to create or revise standardized metrics to assess adherence to the tenets of Gold Standard Science** and their impact on scientific quality, including scientific and technical information collected by OSTI as well as data from DOE grants and other DOE-supported activities.
- **DOE will include evaluation criteria on adherence to the tenets of Gold Standard Science in external agency portfolio review activities**, including the Federal Advisory Committee reviews, through Committees of Visitors reviews of the Office of Science portfolios.
- **DOE will develop training materials and resources to ensure agency personnel understand and adhere to the tenets of Gold Standard Science** when managing scientific activities.

- **DOE will explore opportunities to streamline and enhance aspects of proposal review and selection process with advanced AI-driven tools**, when practicable and appropriately addressing confidential information.
- **DOE will ensure that any rulemaking or regulatory activity, especially DOE's Energy Appliance and Equipment Standards Program is predicated on Gold Standard Science.** This includes ensuring that highly unlikely and overly precautionary assumptions and scenarios should only be relied upon in DOE decision-making where required by law or otherwise pertinent to DOE's action.

# III. Challenges

Several **potential challenges** will be carefully considered as the DOE moves forward in the implementation of the tenets of Gold Standard Science.

- **An action plan with deliverable dates and responsibilities will be the first requirement for successful implementation of the above actions.**
- The breadth of scientific activities DOE supports to advance its mission requires implementation for each scientific domain, i.e., acceptable data-sharing standards and timelines as well as expectations for the appropriate communication of results with uncertainty.
- Gold Standard Science tenets must be applied to the full breadth of DOE's activities, spanning basic research to applied research to development, demonstration, and deployment, regardless of technology readiness level.
- Constraints of federal code may limit the potential applicability of certain approaches, such as double-blind peer review processes.
- Efforts to enhance reproducibility will need to accommodate specific cases where fully recreating an analysis may be untenable (i.e., the dynamic field conditions faced by a demonstration project or the availability of high-performance computational power needed to reproduce a specific simulation or result).
- Research transparency improvements will need to be carefully balanced against the national security and buisness proprietary aspects of the DOE mission. Timelines for dissemination of results and underlying data must ensure appropriate protection of business proprietary information to enable the successful commercialization of the resulting technology.
- Standardizing approaches needs balance with common tools to aid the scientific management processes, allowing the DOE to act quickly on new ideas and innovative approaches to address the energy, environmental, and nuclear challenges of the American people.
- DOE will need to appropriately communicate the increased expectations for applicants and awardees to adhere to the tenents of Gold Standard Science throughout the research lifecycle, from proposal to performance and reporting, and ensure researcher compliance.

- The DOE will review increased burdens on the subject matter experts participating in merit review, peer-review, and other processes related to implementing the tenents of Gold Standard Science and may need to adjust procedures and processes accordingly.