U.S.-Israel Integrated Energy and Desalination Design Challenge Lab Call

The U.S.-Israel Integrated Energy and Desalination Design Challenge will give U.S. and Israeli experts the opportunity to learn from each other on desalination and associated system design issues, while also stimulating innovative thinking on next-generation systems. Through this Challenge, the U.S. Department of Energy (DOE) and Israel's Ministry of National Infrastructure, Energy and Water Resources (MIEW) will encourage leading engineers in the U.S. and Israel to design a novel integrated energy and desalinization system that could be suitable for both countries. Challenge specifications have been developed jointly by U.S. and Israeli experts.

This Lab Call represents the U.S. side of the Challenge. There is a parallel competition for Israeli applicants. There will be a joint U.S. and Israel workshop in early 2017, where the U.S. and Israeli Challenge winner will be selected.

I. Topic Description

Desalination Systems to Provide Electricity System Services

This Challenge envisions future desalination systems as both producers of high-quality water and providers of services to an evolving electricity system. While historical views of desalination plants have focused principally on their role as providers of high-quality water, this Challenge takes the perspective of desalination plants as flexible, multi-purpose system components. Desalination plants use source water and energy input flows to produce output flows of high-quality water as well as waste brines. In addition, the fact that water, unlike electricity, is easily stored allows desalination plants to provide services to the electricity system through time-shifting of energy usage, demand response, ancillary services, and potential utilization of overgeneration by variable energy resources. Environmental goals of reducing greenhouse gas emissions and brine volumes can be balanced with other services. This Challenge seeks desalination systems that can flexibly balance their input and output flows of water, electricity, and wastes as required by water demand, electricity system services, and environmental goals.

The goal of the Challenge will be to site and design a desalination system in the U.S. or Israel that can provide drinking water and vary its energy consumption in a flexible manner to provide electricity system services, while also balancing potential adverse environmental impacts and economic feasibility. The energy consumed by the system may be from the electric grid, or from on-site alternative energy sources. The system should interface with the electricity system, so that it can be compensated for services to the electricity system. These services could be enabled by on-site energy storage, such as batteries or pumped hydroelectric storage. The target price for the desalination system to profitably sell drinking water is $0.50 per cubic meter. Innovative desalination technologies may be incorporated into the design to achieve these goals. Opportunities and constraints related to source water, energy prices, market structure, and other factors may vary depending on the area chosen to site the desalination system, but all designs must provide some portfolio of services to the electricity system.

Challenge Specifications and Goals

The Challenge seeks creative, innovative designs that fulfill the vision of future desalination plants as flexible and multi-purpose. Designs must be hypothetically possible to site and feasible to operate, given Challenge goals and constraints, in either the U.S. or Israel. Any set of technologies may be used in the design. It is expected that designs that fulfill this vision will be substantially different from current desalination systems that are widely deployed.

Challenge specifications, below, include goals and constraints that bound the relevant spatial and temporal connections between the desalination system and external water, energy, and waste systems. Within the desalination system, on-site energy generation, energy and/or water storage, utilization of waste heat and/or cooling, productive re-use or mitigation of waste brines, energy recovery from waste brines, and other relevant synergies can be exploited as appropriate to meet Challenge goals and constraints.

Designs for desalination systems should meet the following goals and constraints:

- Profitably produce drinking water at a target price of $0.50 or less per cubic meter according to the acceptable water standards (such as EPA, WHO) that are present in the region where the plant is sited. Demonstrating achievement of this goal must include consideration of the operation of the entire desalination system, including any revenue streams for providing electricity system services or other services. While it is understood that cost calculations will be estimated, designs should include clear assumptions and rigorous estimates specific to the technologies and operations used in the design.
- Provide and be compensated for services to the electricity system, such as time-shifting of energy use, demand response, ancillary services, utilization of overgeneration by variable energy resources, and other services. These services could be provided by innovative technologies or by system design or operations. Flexibility, broadly defined, should be part of this portfolio of services, and should enhance the ability of the desalination system to serve an evolving electricity system.
- A design must be sited in a particular region of the U.S. or Israel. Region-specific constraints on water source, chemical composition of the source water, expected discharge properties, drinking water quality, energy markets, brine disposal, spatial footprint of the plant, spatial footprint of any on-site renewable energy, and any other relevant factors must be addressed. Siting should be at a regional level of detail that is sufficiently specific to address these constraints, but need not be a precise physical location.
- Produce drinking water at a nameplate capacity of at least 1000 m^3 per day, and with an annual productivity factor[1] of 75% or greater.
- Use a water source or sources with salinity of at least 5000 mg/l.
- Energy generation or storage within the plant is allowed but not required; the plant may simply use electricity from the grid. Energy generation or storage located within the plant, if present,

[1] Productivity factor is the average percentage of a plant's nameplate capacity that is utilized. For example, if a plant has a nameplate capacity of 1000 m^3 per day and operates with a 75% productivity factor, it will produce, on average, 750 m^3 per day.

should operate with zero or negative net greenhouse gas emissions (e.g. onsite diesel generators are not allowed).

II. Eligible Applicants

Applicant teams must be led by a National Laboratory Principal Investigator. A Principal Investigator may lead on only one Concept Paper. However, multiple Principal Investigators from one National Laboratory may submit Concept Papers. Collaboration among investigators from multiple National Laboratories and non-laboratory entities is encouraged. Other team members may include individuals or organizations from academia, industry, utilities, nonprofits, state and local government, or other sectors. Federal employees and organizations may not be included as team members.

III. Team Matchmaking

DOE will offer an optional mechanism for national laboratories and non-laboratory persons or organizations wishing to be part of an applicant team to express their interest to potential collaborators. Concurrent with the announcement of the Challenge, interested National Laboratory and non-laboratory entities may submit to DOE their names and affiliations and one sentence describing their interest in partnering. Two weeks after the announcement of the Challenge, DOE will compile and send this information to all those who submitted their information to facilitate the formation of collaborative teams. Entities submitting information through this process consent to their information being shared among all other entities.

Entities wishing to participate in the matchmaking process should input their information into the attached **Matchmaking Spreadsheet Template** and email it to:

Samuel Bockenhauer
Office of Energy Policy and Systems Analysis
U.S. Department of Energy
Samuel.bockenhauer@hq.doe.gov

With a subject line beginning with “DESALINATION MATCHMAKING”.

IV. Design Challenge Content and Submission Requirements

The Challenge will proceed in two phases. In Phase 1, each Applicant team will submit one Concept Paper. In Phase 2, teams whose Concept Papers are judged most promising will receive funding to complete a Full Design Analysis. The best U.S. Full Design Analysis will be selected as the U.S. Challenge winner at a design workshop with industry partners in early 2017 and will receive funding to further develop the idea.

Phase 1: Concept Papers

To be eligible to be selected to submit a Full Design Analysis, Applicants must first submit a Concept Paper by the specified due date. The body of the Concept Papers is limited to a maximum length of 3 pages. Applicants may provide an Addendum, not to exceed 2 pages, that includes design schematics, graphs, charts, or other supplemental text and data.

DOE will assess each Concept Paper using the criteria in Section V. DOE will select up to three outstanding Concept Papers for funding at $50,000 to develop and submit a Full Design Analysis. Applicants whose Concept Papers are not selected will be notified of their non-selection.

Phase 2: Full Design Analyses

Phase 1 Applicants selected for advancement to Phase 2 will submit a Full Design Analysis. The completed Full Design Analysis should not exceed 25 pages total, including any figures, appendices, or other materials. This document should include: (1) a description of the site or region and relevant boundary conditions; (2) a discussion and valuation of services provided to the electricity system; (3) a description of the design; (4) an energy analysis under different operating conditions; (5) a cost analysis; and (6) a description of a potential next phase of work.

DOE, in consultation with Israeli representatives, will perform an assessment of each Full Design Analysis. The winning Full Design Analysis will be selected at the workshop, based on both the written Full Design Analysis submitted prior to the workshop, and the team's presentation at the workshop. Following the workshop, the U.S. Challenge winner will receive funding of up to $100,000 for further work on the design.

Submission Requirements

Applicant teams may submit Concept Papers for Phase 1, and Full Design Analyses if selected for Phase 2, as MS Word documents. A cover page using the **Desalination Challenge Cover Page** template provided should be included as the first page of each Concept Paper or Full Design Analysis submission document (the cover page will not count against the page limit). Documents may not exceed 10 MB in size. Entries should be emailed to:

Samuel Bockenhauer
Office of Energy Policy and Systems Analysis
U.S. Department of Energy
Samuel.bockenhauer@hq.doe.gov

With a subject line beginning with "DESALINATION CHALLENGE".

V. Evaluation and Selection

Concept Papers submitted in response to this Lab Call will be evaluated based on the criteria listed below. Bullet lists under each criterion give illustrative examples of characteristics that reviewers may use to evaluate that criterion. These evaluations will be used to select the most promising Concept Papers for invitation to submit a Full Design Analysis. Full Design Analyses will be evaluated according to the same criteria (and in addition including evaluation of the workshop presentation) to select the final winner.

Criterion 1: Technical Merit

- Degree to which the proposed design achieves the goals stated in the Challenge.
- Degree to which the proposed design and all relevant technologies, processes, operations, cost estimates, etc., are clearly described and all assumptions are justified.
- Degree to which a systems perspective is incorporated into the proposed design, including both consideration of the desalination design itself and its connection to the electricity system, as informed by the Challenge goals.
- Degree to which the proposed design is without major technical flaws or omissions, and is cognizant of inherent physical limitations.
- The potential impact of the proposed design on the energy and water sectors in the U.S., Israel, and the rest of the world.

Criterion 2: Creativity and Innovation

- Extent to which the design, including proposed technologies or processes, is innovative, creative, and has the potential to advance desalination in the U.S. and Israel.
- Extent to which the design goes beyond traditional existing designs, harnesses innovative thinking and, uses nontraditional approaches to achieve Challenge goals.

Criterion 3: Diversity of Team and Resources

- Level of participation and involvement by diverse team members from multiple disciplines and/or partner organizations.

Criterion 4: Commercialization Potential

- Degree to which the team demonstrates the ability to facilitate and expedite further development and commercial deployment of the proposed technologies.

Other Selection Factors - Program Policy Factors

In addition to the above criteria, the Selection Official may consider the following program policy factors in determining which Concept Papers or Full Design Analyses to select for award negotiations:

- It may be desirable to select design(s) with collaborative efforts among national laboratories, academia, states and regions, and other organizations that provide a balanced program portfolio.
- It may be desirable to select complementary design(s) and/or duplicative efforts or designs, which, when taken together, will best achieve the program research goals and objectives.

- It may be desirable to select a group of designs that represent a diversity of technologies, applications and approaches in order to provide a balanced programmatic effort and a variety of different technical perspectives.

VI. Challenge Overview and Timeline

Amount to be Awarded	$50,000 each for up to 3 Concept Papers in Phase 1; $100,000 for winning Full Design Analysis in Phase 2.
Cost Share Requirement	None required, but industry partnership and/or cost share is encouraged.
Submission of Proposals, Review Process, and Required Dates	Concept Papers and Full Design Analyses should be submitted including a cover page that follows the **Desalination Challenge Cover Page** template provided. **Any submissions received after the specified deadlines will be considered late and rejected upon arrival.** Project submissions should be emailed to samuel.bockenhauer@hq.doe.gov. Each Concept Paper or Full Design Analysis submission should be in the form of a MS Word document smaller than 10 MB.
Lab Call Released	May 23, 2016
Deadline for Submission of Matchmaking Information (Optional)	June 6, 2016 Due 11:59 pm EDT
Deadline for Submission of Concept Papers	July 6, 2016 Due 11:59 pm EDT
Notification of Request for Full Design Analysis	July 18, 2016 (Approximate)
Deadline for Submission of Full Design Analysis	Late 2016 or Early 2017 (Deadline to be announced)
Workshop for Full Design Analysis Presentation and Selection of Challenge Winner	Early 2017
Partners	While not required, national laboratories are encouraged to partner with academia, industry, utilities, nonprofits, state and local government, other national laboratories, or other sectors. Note that diversity of team and resources is a criterion for Evaluation and Selection.