WATER SECURITY GRAND CHALLENGE

Abundance Through Innovation

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Update on Prize Proposals
October 28, 2019

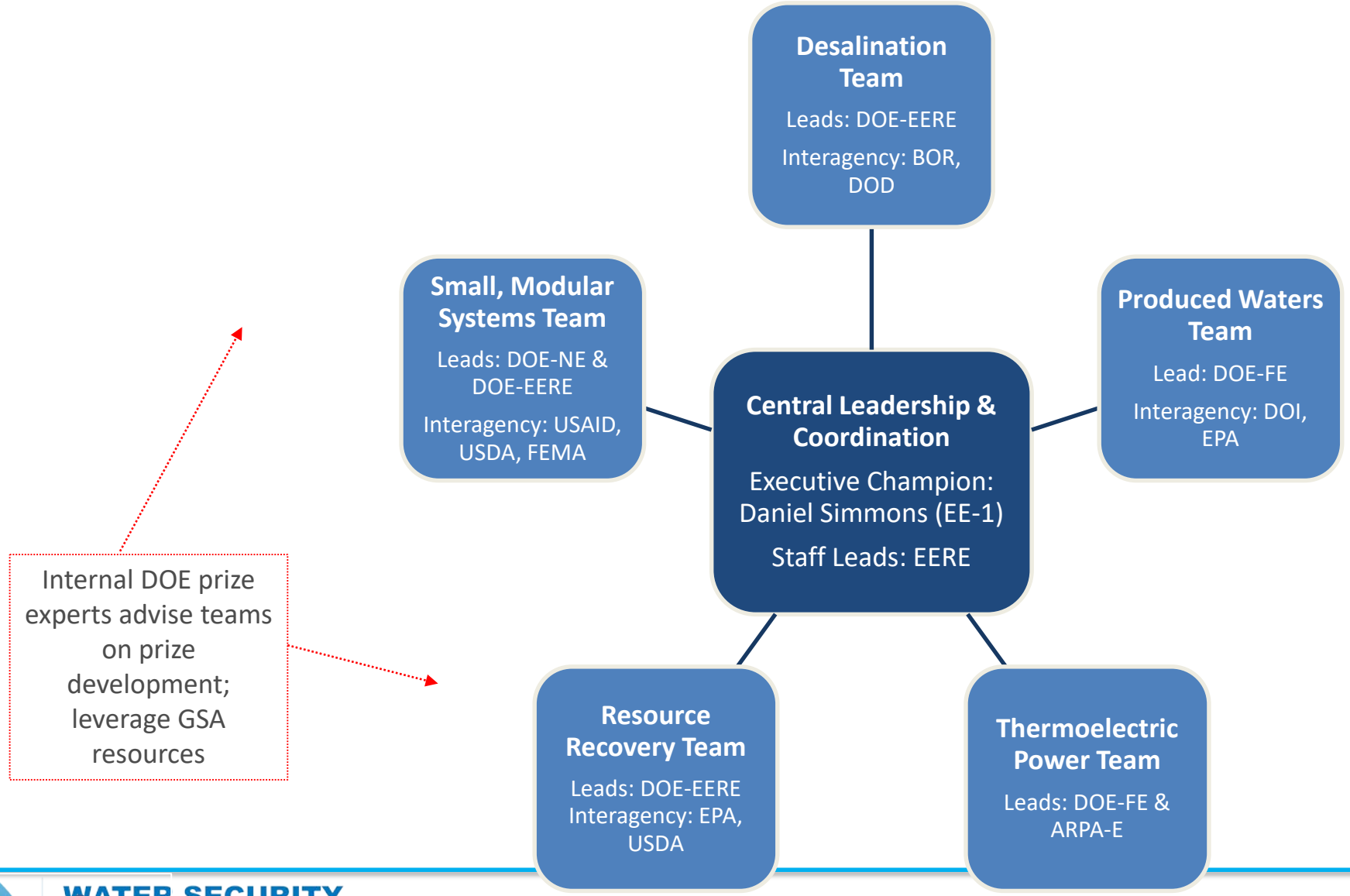
U.S. DEPARTMENT OF ENERGY

The Water Security Grand Challenge

Advance transformational technology and innovation to meet the global need for safe, secure, and affordable water. By 2030:

- Launch desalination technologies that deliver cost-competitive clean water.
- Transform the energy sector's produced water from a waste to a resource.
- Achieve near-zero water impact for new thermoelectric power plants, and significantly lower freshwater use intensity within the existing fleet.
- Double resource recovery from municipal wastewater.
- Develop small, modular energy-water systems for urban, rural, tribal, national security, and disaster response settings.

Building the Pipeline of New Solutions: Cross-Cutting Teams



Cross-cutting, interagency teams have been formed to:

- Develop new prize proposals, building off public workshop and RFI
- Advance understanding of key barriers/opportunities in each goal area
- Coordinate and inform future R&D and related activities
- Identify and pursue high-impact partnerships
- Track and coordinate communications opportunities

Goal 1: American-Made Challenge: Solar Desalination

Objective: Demonstrate cost-effective solar thermal desalination technologies for specific, smaller-scale markets and applications.

Why?

- A prize will help clarify potential markets, such as treating produced waters from oil and gas fields, providing clean water to island communities, and serving agricultural districts
- Strong response to recent, related FOA suggests a number of innovators ready to participate.
- Prize structure is able to be easily iterated, allowing multiple rounds as future appropriations allow

Prize Structure and Features:

- Multi-phase competition, progressing from concept design through demonstration
- Will seek to connect technology developers with test facilities (government and private)

Sample Metrics:

- Thermal Efficiency ($kWh_{thermal}/m^3$ product water)
- Recovery Ratio ($V_{product\ water}/V_{brine}$)
- Continuous Operations (Continuous hours of water production)
- Solar Efficiency (kWh_{solar}/m^3 product water)
- Projected levelized cost of heat (LCOH) and water (LCOW)

Goal 1 Team

- Avi Shultz, EERE-SETO
- Melissa Klembara, EERE-AMO
- Carrie Schmaus, EERE-WPTO
- Hoyt Battey, EERE-WPTO
- Simon Gore, EERE-WPTO
- Andrew Tiffenbach, DOI-Reclamation
- Jennifer Beadsley, DOI-Reclamation
- Jay Dusenberry, DOD-TARDEC

Estimated Budget

Phase	Awardees	Prize $	Total Purse
1—Concept	TBD	TBD	TBD
2—Team Building	TBD	TBD	TBD
3—Detailed Design	TBD	TBD	TBD
4—Testing	TBD	TBD	TBD

Total (estimated): $5 million, over approximately 3 years, including administrative costs

Goal 1: Desalination Prize Potential Stakeholders and Next Steps

Potential Stakeholders

Competitors
Technology Developers • Solar Desal FOA awardees • Component suppliers • Start-up companies
Potential Test Facilities
• DOD • Bureau of Reclamation • National Labs • Universities and Research Institutes • Water districts, utilities
Market Actors (Post-Prize)
• Oil and gas industry • Desalination technology providers – consultants, finance • Western water districts

Preliminary Timeline of Next Steps

Activity	Approximate Timing
Announce Prize	September 22, 2019
Launch Phase 1 and release draft rules for later Phases	Fall 2019
Announce Phase 1 winners / Hold workshop / release final rules for Phases 2-4	Winter 2020

Goal 2: Ideation for Optimization of Produced Water Transport

Objective: Accelerate the development of a robust "midstream" water transport industry for cost-effective conveyance of treated and untreated produced water from source to demand.

Why?

- A prize will help identify barriers to market entry by new water transport participants on a geologic basin-by-basin basis.
- Intra-basin and inter-basin transportation could facilitate the reuse of produced waters for a greater variety of beneficial uses.
- Lower cost produced water treatment technologies could more easily penetrate the market if unencumbered by transportation costs.

Prize Structure and Features:

- Multi-phase competition along two themes: 1) basin-specific ideation and business plan supporting midstream water services for intra- and/or inter-basin transport; 2) technology development for new designs, approaches, or material for efficient/cost-effective transport.
- Will seek to connections between high volume suppliers and users.

Sample Metrics:

- Number of new inter- and intra-basin market entrants
- Number of new inter- and intra-basin beneficial uses beyond oilfield use
- Overall transport cost reduction
- Volume decrease of underground injection

Goal 1 Team

- Elena Melchert, FE-O&G
- Yinka Ogunsola, FE-O&G
- Kate Peretti, EERE-AMO Fellow
- Diana Bauer, EERE-AMO
- Steve Martin, EERE-AMO Fellow
- Cheryl Herman, NE-AFT
- Joh Carmack, NE-1
- Bob Schmidt, OP-ESIA
- Jesse Pritts, EPA-S&T
- Bill Cunningham, DOI-USGS

Estimated Budget

Theme/Phase	Awardees	Prize $	Total Purse
1/1—Ideation	TBD	TBD	TBD
1/2—Business Plan	TBD	TBD	TBD
1/3—Basin Validation	TBD	TBD	TBD
2/1—TRL 2-3	TBD	TBD	TBD
2/2—TRL 4-5	TBD	TBD	TBD

Total (estimated): $6 million, over 4 years

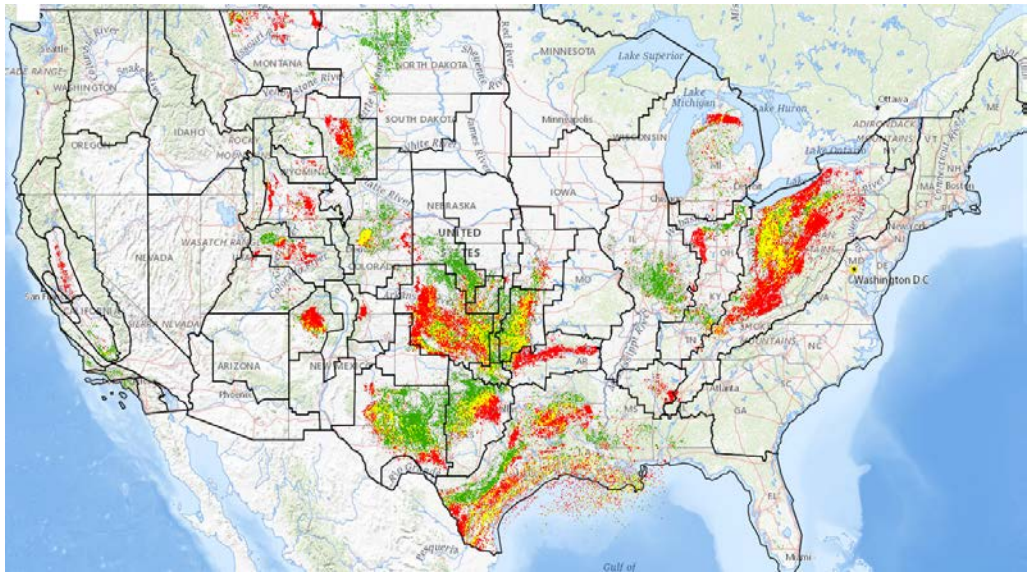
Goal 2: Optimized Transport Prize Potential Stakeholders and Next Steps

Potential Stakeholders

Water Suppliers
• Oil and Gas Producers • 32 oil & gas producing states + Federal offshore • States water regulators
Midstream Water Participant Capabilities
• Site Management/Treatment Trains/Transport • Establish interconnection points • Create storage and market hubs • Buy and/or sell treated and/or untreated water
Water Users
• Thermal electric power generation • Mining, paper, chemical, wood products • Metals, textiles, plastics, cement • Agriculture • Other: food, beverages, computers

Preliminary Timeline of Next Steps

Activity	Approximate Timing
Issue RFIs	Winter 2020
Announce Prizes/ Hold Workshops	Spring/Summer 2020
Launch Phases I	Winter 2020-2021



Goal 3: Proposed Thermoelectric Power Prize Summary

Objective: Develop and demonstrate new equipment designs that provide more cost-effective heat transfer, resulting in lower water use at power plants

Goal 1 Team

- Madhav Acharya, ARPA-E
- Robie Lewis, FE
- Alison Hahn, NE
- Kenny Kort, EERE-AMO
- Kate Peretti, EERE-AMO
- Diana Bauer, EERE-AMO
- Kevin Jayne, EERE

Why?

- Water use in power plants is directly related to the effectiveness of heat transfer
- R&D in new equipment design that could improve heat transfer is limited with little incentive to change legacy equipment at sites
- High-value prize can draw attention to the problem and attract a diverse set of participants

Prize Structure and Features:

- Two-phase competition, progressing from design through demonstration
- Potential to partner with EPRI to inform prize and access test facility(ies)

Sample Metrics:

- Water usage for specified cooling load
- Cost effectiveness
- Manufacturability

Estimated Budget

Phase	Awardees	Prize $	Total Purse
1—Design	TBD	TBD	TBD
2—Demonstration	TBD	TBD	TBD

Total (estimated): $3.5 to $5.5 million over approximately 3-4 years, including administrative costs

Goal 3: Thermoelectric Prize Potential Stakeholders and Next Steps

Potential Stakeholders

Competitors
• Academia • Equipment manufacturers (e.g. EvapCo) • Technology companies
Sponsors/Amplifiers
• Utilities • Water-focused NGOs • State agencies
Judges
• Academia • EPRI*/Utilities • Federal agencies/national labs
Market Actors (Post-Prize)
• Utilities • Equipment manufacturers

Preliminary Timeline of Next Steps

Activity	Approximate Timing
Initial Consultation with EPRI	Summer 2019
Issue RFI	Fall 2019
Launch Phase I	Winter 2020

*NDA signed with EPRI to work with us as a formal partner

Goal 4: Resource Recovery Prize Summary

Objective: Scale resource recovery through local, systems-based solutions centered around small-to-medium sized wastewater treatment plants

Why?

- Resource recovery is currently taking place among the largest wastewater treatment plants. To achieve scale, need to target the next layer down.
- Recovery technologies exist, but creative, system-wide solutions that link resource providers with customers are in shorter supply.
- Prize will seek to draw out coalitions of partners that may not have taken the time to work together absent a financial incentive.

Prize Structure and Features:

- Two-phases: first, seeks to build library of creative solutions; second, focuses on more detailed and rigorous system design.
- Seeking alignment with public financing programs (e.g. WIFIA, SRF, USDA programs) to facilitate access to capital for successful designs.

Sample Metrics:

- Recovery rate (total resources recovered/total resources present in influent)
- Improvement rate (percent improvement from facility's own baseline)

Goal 1 Team

- John Smegal, EERE-AMO
- Mark Philbrick, EERE-BETO
- Ben King, EERE-SPIA
- Bob Schmitt, OP
- Catherine Harsanyi, OP
- Danusha Chandy, EPA
- Denice Shaw, EPA
- Diana Bauer, EERE-AMO
- Heather Goetsch, EERE-BTO
- Helena Khazdozian, EERE-AMO
- Jim Dobrolowski, USDA
- Teferi Tsegaye, USDA

Estimated Budget

Phase	Awardees	Prize $	Total Purse
1—Solutions Library	TBD	TBD	TBD
2—Systems Designs	TBD	TBD	TBD

Total (estimated): $2 million over approximately 3 years, including administrative costs

Goal 4: Resource Recovery Prize Potential Stakeholders and Next Steps

Potential Stakeholders

Competitors	Judges	Sponsors/Amplifiers	Post-Prize, Market Actors
Water Resource Recovery Facilities as central entity with support from: • Consulting, systems engineering, legal, financial firms • Watershed partners—farmers, electric and gas utilities, local policymakers, solid waste facilities, etc. • Academics • Technology developers	Resource recovery and related experts from a range of disciplines and sectors, including: • Engineering • Finance • Agriculture • Business • Local government • Waste management • Wastewater treatment sector	• Major water groups, such as WEF, WRF, NACWA, WateReuse • Federal partners, such as EPA, USDA, DOD • State associations, such as NGA, NASEO, NARUC • Municipal associations such as National League of Cities, US Conference of Mayors	• Public and private financing institutions • Broader community of wastewater treatment plants • Technology developers • Local and state policymakers • Resource customers broadly

Preliminary Timeline of Next Steps

Activity	Approximate Timing
Issue RFI	September 2019
Announce Prize	September 2019
Launch Phase I	November 2019

Goal 5: Proposed Small, Modular Systems Prize Summary

Objective: Develop fuel-agnostic "energy-water in a box" solutions that are modular, portable, reliable, and cost effective

Why?

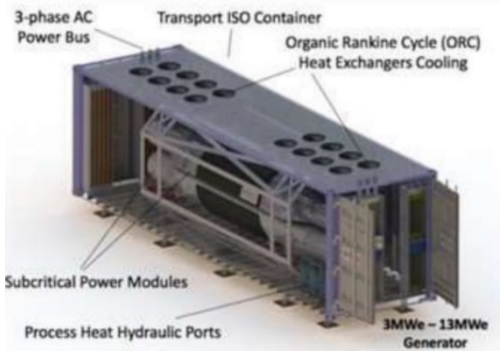
- Small, modular energy-water systems have the potential to serve areas where energy and/or clean water is scarce, expensive, or challenging to obtain, such as islands, rural areas, and communities affected by a disaster.
- But innovation is needed to improve the cost-effectiveness of linked energy-water systems and test performance in a range of use-cases.
- A Department-level prize across all applied energy offices could capture the public's imagination, draw a range of innovators, and lead to ground-breaking new solutions.

Prize Structure and Features:

  - Begin with a multi technology, ideation prize to identify promising concepts and business plans across 3 use cases: 1) Response and Recovery; 2) Water Scarce Developing Nations; 3) Remote and Island Communities. Prize outcomes would provide information to multiple DOE program offices and agency partners to plan future investments.
  - Launch in FY 19/FY 20

Sample Metrics (will vary by use case):

- Portability and speed to deploy
- Continuous operation with low maintenance
- Cost effectiveness



Goal 5 Team

- Jon Carmack, NE
- Simon Geerlofs, EERE-WPTO
- Diana Bauer, OP
- Kirsten Verclas, CESER
- Stephen Martin, EERE-AMO
- Anne Dare, USAID
- John Wilson, USAID
- Melissa Bates, NE
- Madhav Acharya, ARPA-E
- Hoyt Battey, EERE-WPTO
- Tom Miller, NE
- Holly Carr, EERE-BTO
- Christopher Lewis, OE
- John Cybulski, DHS-FEMA

Estimated Budget

Activity	Notional Timing	Notional Prize $
1—Ideation Prize	TBD	TBD
2—Subsequent Activities Informed by Ideation Prize	TBD	TBD

Total (estimated): $1.5 million

Goal 5: Small, Modular Systems Prize Potential Stakeholders and Next Steps

Potential Stakeholders

Competitors	Judges	Sponsors/Amplifiers	Post-Prize, Market Actors
• Water and Energy Technology Developers • Academia • Disaster Response Contractors • Disaster Response NGOs	• State, Local, Tribal, and territorial officials • National Laboratories • Federal Government Partner Technical Experts • Independent NGOs • Academia and Independent consultant/experts	• Angel and Prize Foundations (such as Gates, Bezos, Venture capital, Rockefeller, etc..) • Major water groups, such as WEF, WRF, NACWA • Federal partners, such as DHS-FEMA, USAID, DOD • State and Local associations, such as NEMA, NGA, NASEO, NARUC	• FEMA, DOD, Disaster response NGOs • Public and private financing institutions • Technology developers • Local and state policymakers • NEMA

Preliminary Timeline

Activity	Approximate Timing
Issue RFI	Late 2019
Launch Ideation Prize	Spring 2020
Subsequent Investments	FY 2021

Energy-Water Desalination Hub

The strategic goal for DOE's $100-million Energy-Water Desalination Hub is to advance technologies that will **enable pipe parity water for a range of non-traditional water sources** using energy-efficient, water-efficient, cost-competitive, and manufacturable technologies.

The Hub will prioritize R&D, modeling, and analysis through the development of a Roadmap that illuminates key water-source-to-end-use pathways to achieve the most energy/water/cost savings, based on performance metrics:

- Energy intensity (energy/m^3 water);
- Levelized Cost of Water ($/$m^3$ water);
- Water intensity (m^3/unit of end product);
- Utilization of unconventional water or energy sources; and
- Water system security and resilience (risk of disruption, number of days of lost service).

The Hub supports all of the Water Security Grand Challenge goals.

Next Steps

- WEFTEC (September 23): Secretary Perry Video; Additional DOE Leadership Attendance
  - Energy-Water Desalination Hub Announcement
  - American-Made Challenge: Solar Desalination Prize Announcement
  - Resource Recovery Prize Announcement, RFI Release
- Fall 2019
  - Waves to Water Prize: Phase 1 Proposal Reviews
  - Launch American-Made Challenge: Solar Desalination Prize
  - Launch Resource Recovery Prize
  - Small Modular Systems RFI Release
  - Thermoelectric Prize RFI Release
- 2020
  - More prize announcements and launches
  - Teams continue to meet to coordinate DOE (and targeted interagency) activities around goal areas

Contact Information

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