



# U.S. Department of Energy

## Categorical Exclusion Determination Form

**Program or Field Office:** Advanced Research Projects Agency - Energy (ARPA-E)

**Project Title:** 25A4746 -Carbon Nanotube Membrane Elements for Energy Efficient and Low Cost Reverse Osmosis

**Location:** \*- Multiple States - California, Washington, Florida

**Proposed Action or Project Description:**

American Recovery and Reinvestment Act:

NanOasis proposes to utilize carbon nanotubes (CNTs) to make industrially-scalable reverse osmosis (RO) membranes having a performance improvement that could transform desalination and wastewater reuse, and produce dramatic energy savings. We target a ten-fold permeability increase compared to today's commercial state-of-the-art, resulting in a 30-50% energy savings, up to 90% reduced membrane utilization, 10-23% lower capital cost for new plants because of smaller footprint, and hence a reduction in the total cost of water by as much as 40%. The potential annual energy savings in 2016 is more than 20TWh, corresponding to the avoidance of more than 12 million metric tons of CO2 emissions per year. Over 10 years, 290TWh could be saved corresponding to 177 million tons of CO2. This technology development would directly and indirectly create several thousand new jobs, helping the U.S. regain technology leadership in the area of water treatment.

NanOasis was founded to commercialize the pioneering CNT membrane research conducted by Dr. Jason K. Holt while at the DOE's Lawrence Livermore National Lab. In less than a year, NanOasis has produced CNT seawater RO membranes with performance hitherto unseen in the desalination industry, all with an industrially-scalable fabrication process. In this ARPA-E R&D project, NanOasis will further refine this fabrication process to achieve the ten-fold permeability target. We expect per-unit-area costs to be lower than today's membranes, despite the use of CNTs.

**Categorical Exclusion(s) Applied:**

X - B3.6 Siting/construction/operation/decommissioning of facilities for bench-scale research, conventional laboratory operations, small-scale research and development and pilot projects

\*-For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, see Subpart D of 10 CFR10 21 [Click Here](#)

This action would not: threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, including DOE and/or Executive Orders; require siting, construction, or major expansion of waste storage, disposal, recovery, or treatment facilities, but may include such categorically excluded facilities; disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; or adversely affect environmentally sensitive resources (including but not limited to those listed in paragraph B.(4)) of Appendix B to Subpart D of 10 CFR 1021). Furthermore, there are no extraordinary circumstances related to this action that may affect the significance of the environmental effects of the action; this action is not "connected" to other actions with potentially significant impacts, is not related to other proposed actions with cumulatively significant impacts, and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211.

Based on my review of information conveyed to me and in my possession (or attached) concerning the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1B), I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

NEPA Compliance Officer: /s/ William J. Bierbower

Digitally signed by William J. Bierbower  
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Date Determined: 12/16/2009

Comments:

Webmaster:



## 25A4746 - Proposed Action or Project Description (Continued)

process to achieve the ten-fold permeability target. We expect per unit area costs to be lower than today's membranes, despite the use of CNTs. Packaged in the industry standard form-factor, NanOasis membranes will be drop-in replacements in existing plants. With their low cost and high energy savings, customer payback could be as short as a few months, resulting in rapid adoption.

Demand for potable water is growing while conventional supplies are being exhausted. Second only to agriculture, power generation is the highest consumer of water in the U.S. In addition to water for drinking and industry, America needs more water to power its economy. As RO is the lowest cost and most energy efficient technology for desalination and given the ubiquity of seawater and wastewater, RO desalination is being used to produce more than 6 billion gallons of water daily, with capacity growing at 16% annually. NanOasis' target membranes enable RO to approach its theoretical energy minimum, a goal decades away on the industry's current development trajectory.

NanOasis' technology is extensible to many other separations. By replacing thermal distillation with a NanOasis membrane process, industries ranging from petroleum to pharmaceuticals could be made more energy efficient, while having a reduced environmental footprint. The potential energy savings across these industries could exceed that in water applications.

NanOasis' intellectual property, the achievement of the proposed technical milestones, as well as the significance of the opportunity will attract investment to finance scale-up and deployment. In this project, the technology will be advanced from TRL 3-4 to TRL 8-9. The viability of the technology, meeting commercial specifications, as well as validation by external industry partners will enable bringing a product to market by 2012-13. Given the experience and record of the NanOasis senior management team, the probability of success is high.