



# EPA's STAR Grant Research on Carbon Geosequestration

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National Center for Environmental Research  
Office of Research and Development  
US Environmental Protection Agency

U.S. Department of Energy  
National Energy Technology Laboratory  
Carbon Storage R&D Project Review Meeting  
Developing the Technologies and Building the  
Infrastructure for CO<sub>2</sub> Storage  
August 21-23, 2012



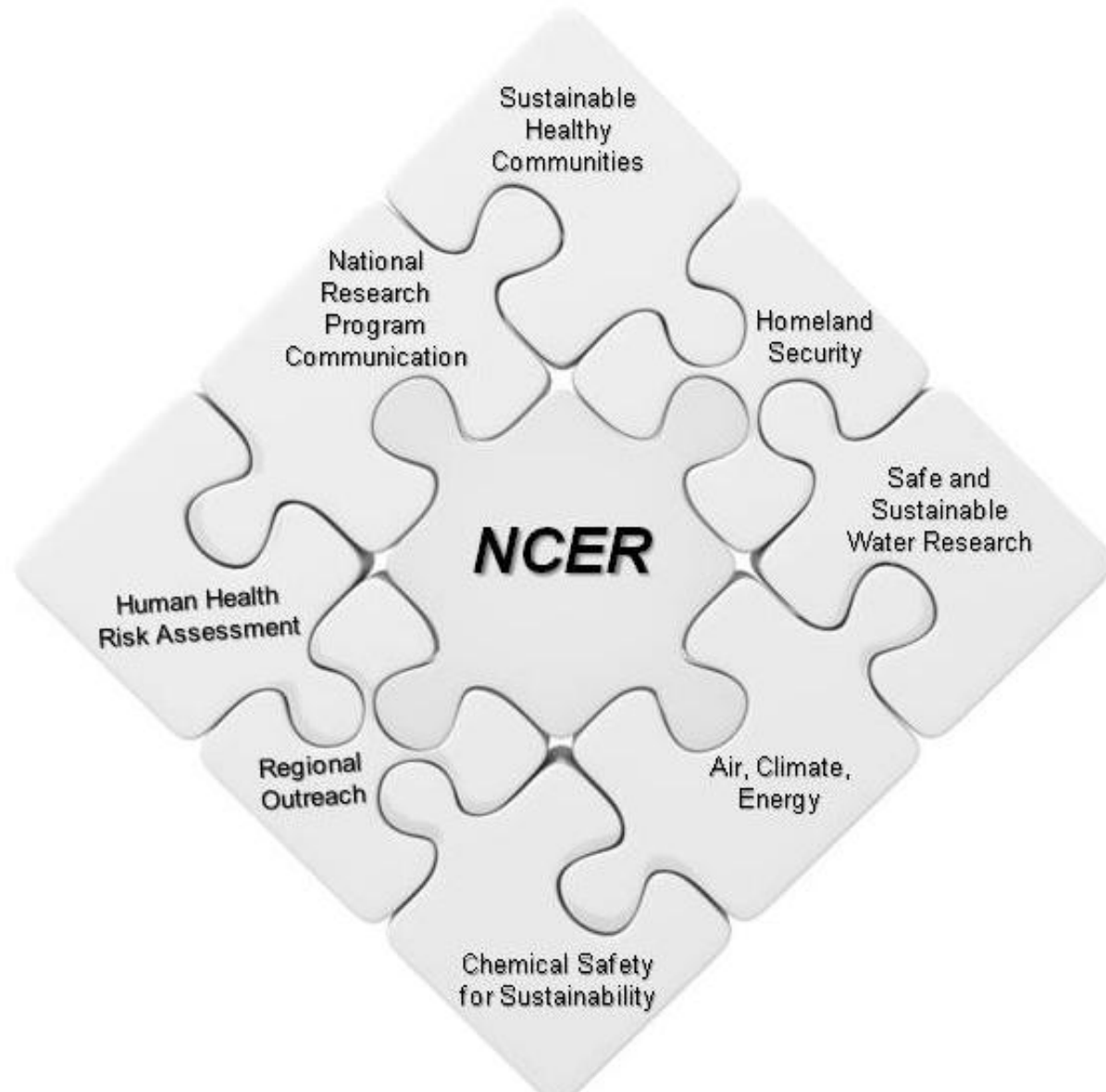
# NCER's Extramural Programs

- **Science To Achieve Results (STAR)**
  - Targeted Research Grants through RFAs
  - Competed Centers
- **Fellowship Programs**
  - STAR Graduate
  - Greater Research Opportunities (GRO) Undergraduate
- **Small Business Innovation Research (SBIR) Contracts**





# Supporting the New ORD Structure

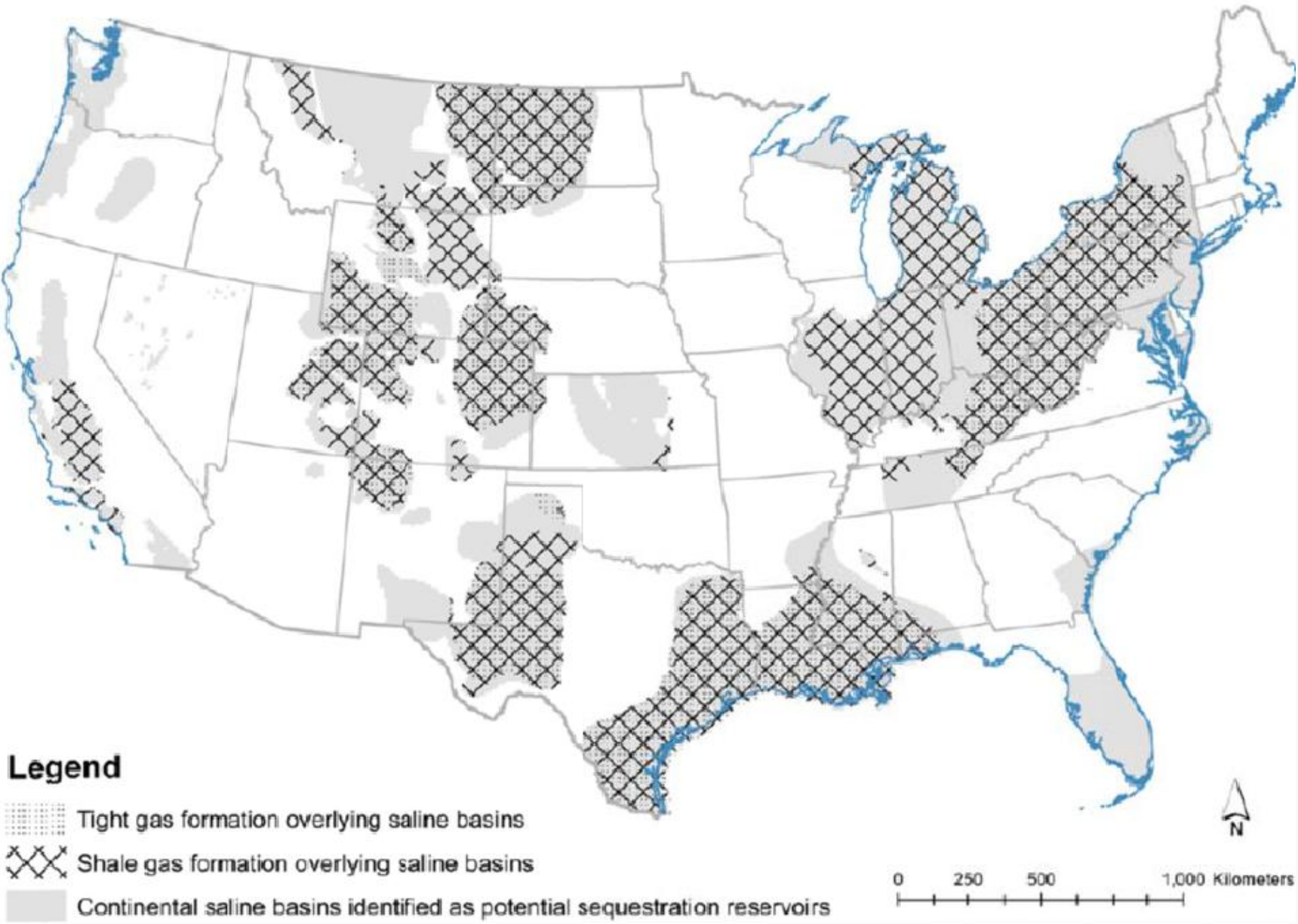


# CO<sub>2</sub> GeoSequestration



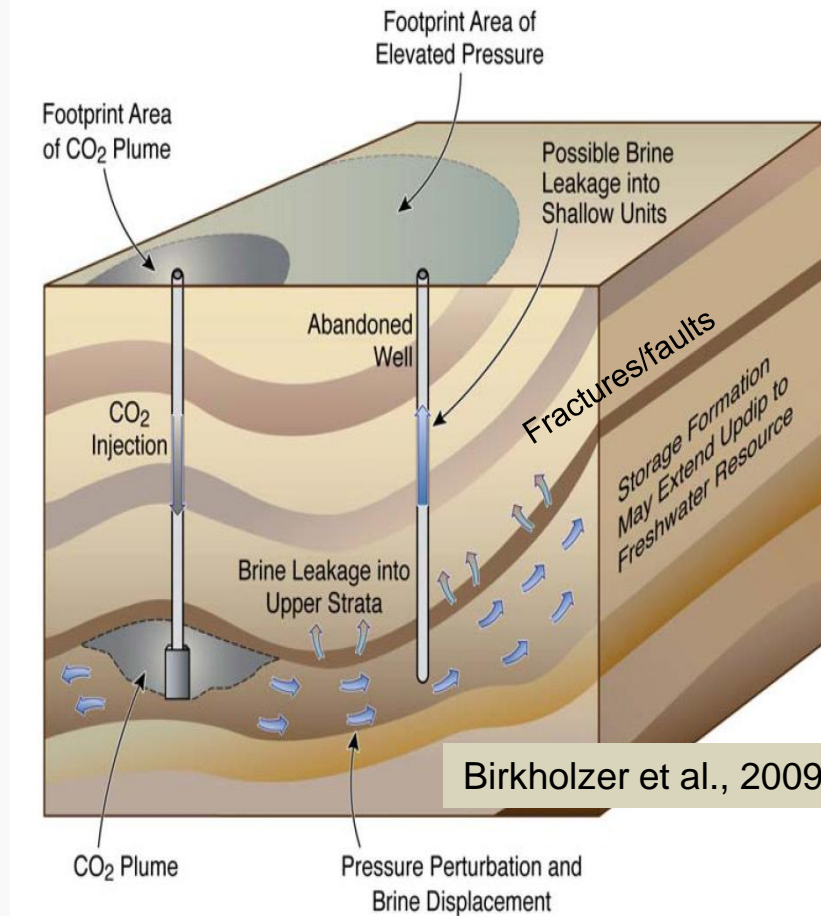
- Unprecedented timescale & scope imposes novel science and engineering challenges to ensure the safeguarding of human health, environmental protection.
- Potential impacts depend on the role of site-specific geology, geochemistry, and regional-scale hydrology

# Overlap Of Saline Formations With Tight & Shale Gas Basins



# Risks to Current & Potential Underground Sources Of Drinking Water

- Protection of sources of drinking water is a priority research area for EPA's Office of Research and Development (ORD) in support of the Agency's mission to protect public health and safeguard the environment.
- Geographically diverse deep saline aquifers have the largest storage volume



# ***Integrated Design, Modeling, and Monitoring of GeoSequestration of CO<sub>2</sub> to Safeguard Sources of Drinking Water***



- RFA to further fundamental scientific understanding
- GW protection research ties in to multiple EPA priorities
- Multi-institution/investigators
- \$900K per project
- Information needed for the scientific community, state and tribal co-regulators, and regulated industries.

# ***Integrated Design, Modeling, and Monitoring of GeoSequestration of CO<sub>2</sub> to Safeguard Sources of Drinking Water***

## **Areas of research requested:**

- Interrelationships between design, siting & potential impacts on quality & availability of USDWs
  - Focus on regional-scale tools for protecting public health and safeguarding the environment
- Integrated site characterization, monitoring & modeling for tracking CO<sub>2</sub> plume, mobilized constituents, and areas of elevated pressure.
- Advance RA & RM of potential risks
  - Emphasis on preventing endangerment of USDWs.



# GS STAR Grant Projects



- All doing RA, Modeling, Field, Lab & in-situ work
- Ground-truth modeling efforts with field observations
- Work begun late 2009
- Highly leveraged with other efforts

# GS STAR Grant Project

This research is funded by  
U.S. EPA - Science To Achieve  
Results (STAR) Program  
Grant # 8284382

## ***Reducing Uncertainties Associated with Geologic Carbon Sequestration in Deep Saline Aquifers***

William Roy, University of Illinois at Champaign  
Sally Benson, Stanford University

- Profiles from natural gas storage sites and the IL Basin-Decatur Project
- Regional Flow and Transport Models
- Geochemical Investigations
- Analysis of natural Saline springs

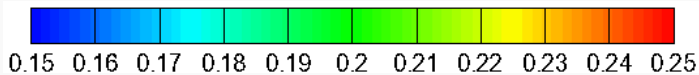
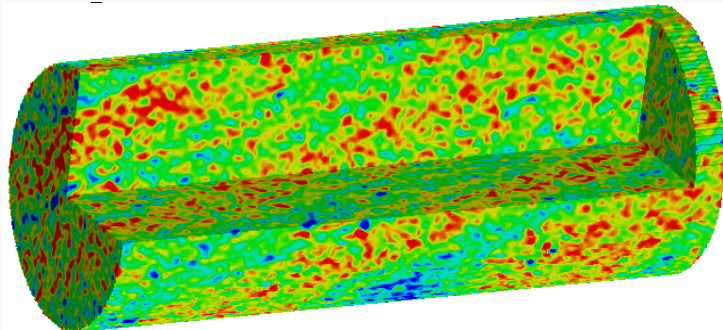


# STAR Grant Project



## *Risks Posed by Brines Containing Dissolved CO<sub>2</sub>*

Ron Falta, Lawrence Murdoch, Clemson University  
Sally Benson, Stanford University



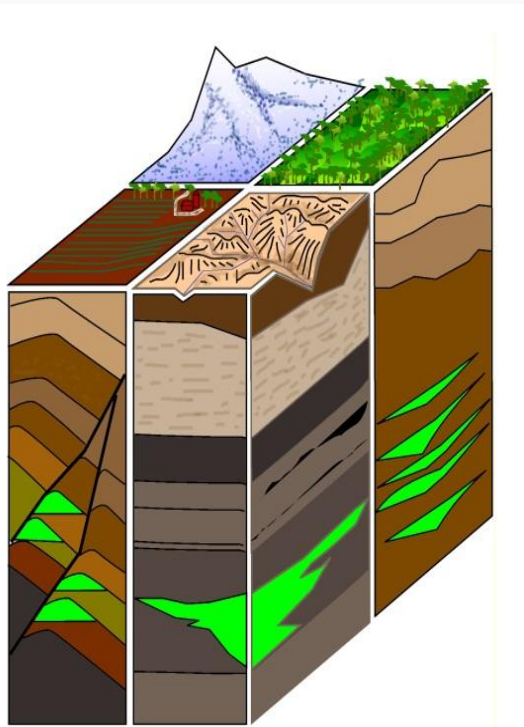
**CO<sub>2</sub> saturation after exsolution**

- CO<sub>2</sub> exsolution of depressurized saturated brines
- Laboratory and Modeling at Pore-Scale and Core-Scale levels
- Multiphase Flow Models
- Remediation Designs

# GS STAR Grant Project



## Development of Site-specific Monitoring Standards



Sue Hovorka and J.P. Nicot  
University of Texas at Austin

- Specific site risk monitoring/mitigation
- Training manual for prospective site developers and regulators
- Drinking water suppliers' education
- Theoretical data linked to specific field sites

# STAR Grant GS Project

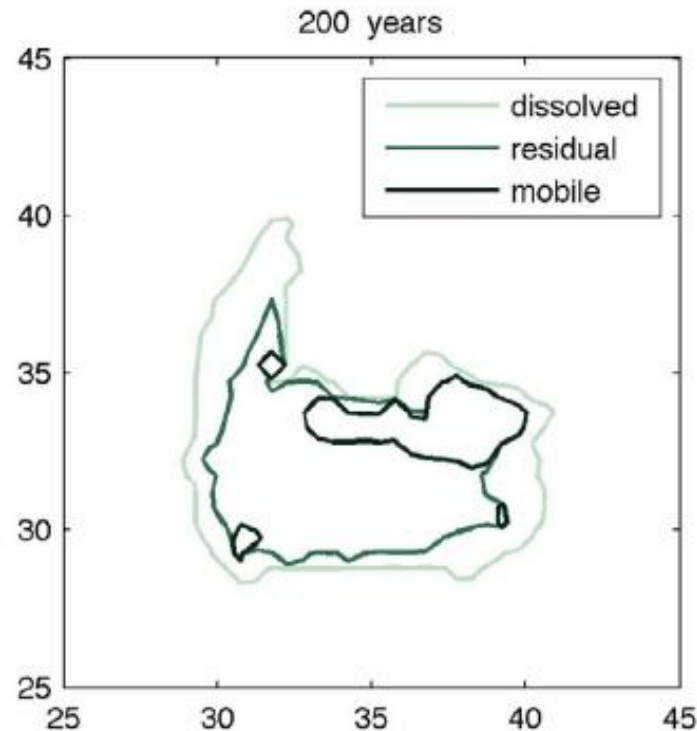
This research is funded by  
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Results (STAR) Program

Grant # 834385

## *Hierarchical Modeling Framework*

Mike Celia, Princeton University

Jan Nordbotten, University of Bergen, Norway

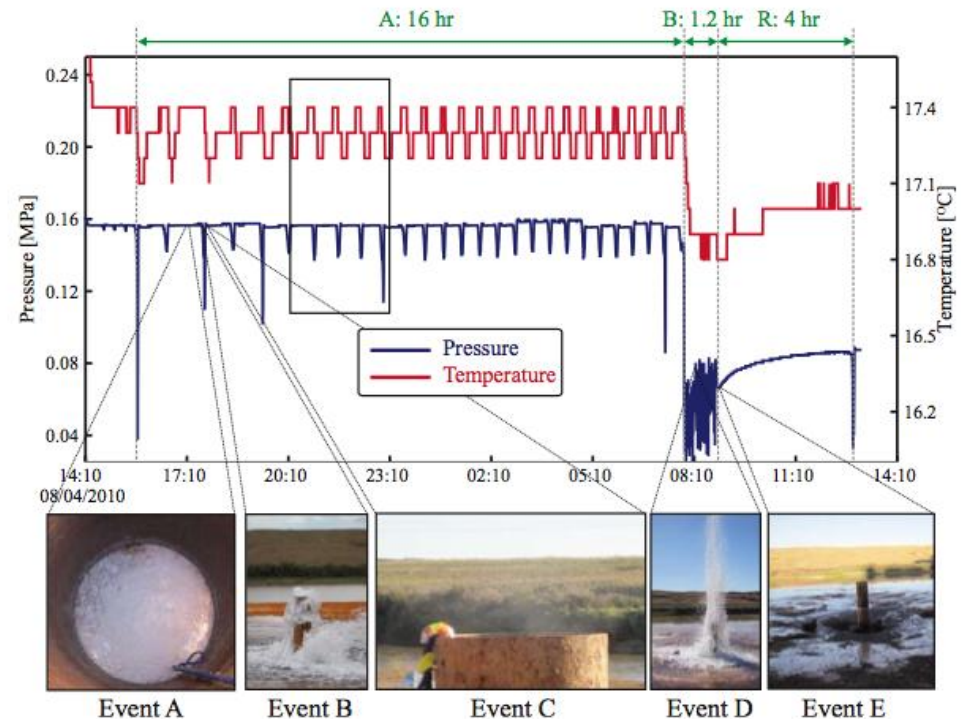


- Probability-based risk assessment and hierarchical modeling framework,
- Modeling across range of complexity
- Space-time pressure perturbations
- Water management

## *Aquifer Risk Assessment Framework*

Brian McPherson, Milind Deo, Ramesh Goel, Kip Solomon  
University of Utah

- Analysis of known leakage sites
- Simulation of engineered storage sites
- Probability Density Functions and Risk Elements



**Figure 4.** Time-series changes of pressure and temperature collected at August 4-5 2010.

## ***Risk-Based Decision Making for Assessing Potential Impacts***

John McCray, Reed Maxwell, & Alexis Navarre-Sitchler  
Colorado School of Mines

- Integrated Lab, Modeling, and Field work
- Geochemical reactions between CO<sub>2</sub>, aquifer fluids, and minerals
- Quantifying uncertainties



# STAR Grant Project



## ***Biogeochemical Interaction of a Shallow Aquifer in Response to a CO<sub>2</sub> leak***

**Dave Goldberg, Jens Matter, Martin Stute, Taro Takahashi  
Lamont-Doherty Earth Observatory of Columbia  
University  
Greg O'Mullan, Queens College, CUNY**

Effects on native microbiology  
and biogeochemistry  
Laboratory and *in situ*  
experiments in the Newark  
Basin







# APPENDIX

- Bibliography
- Individual STAR Project Slides

[http://cfpub.epa.gov/ncer\\_abstracts/index.cfm/fuseaction/recipients.display/rfa\\_id/504](http://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/recipients.display/rfa_id/504)



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