

**Office of Science
Financial Assistance
Funding Opportunity Announcement
DE-PS02-07ER07-16**

***Ethical, Legal, and Societal Implications (ELSI) of Research
on Alternative Bioenergy Technologies, Synthetic Genomics,
or Nanotechnologies***

The Office of Biological and Environmental Research (OBER) of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces its interest in receiving applications for research in the area of **Ethical, Legal, and Societal Implications (ELSI)** of research on alternative bioenergy technologies, synthetic genomics, or nanotechnologies. The aims of this Notice are to support explorations of the potential societal implications arising from scientific research in areas of systems microbiology pertaining to the DOE mission of bioenergy, and, in addition, issues arising from synthetic genomics applied to bioenergy, and research on nanomaterials and nanotechnologies relevant to bioenergy.

PREAPPLICATIONS

Potential applicants are required to submit a brief preapplication, referencing **Program Notice DE-PS02-07ER07-16 for receipt by DOE by 4:30 p.m., Eastern Time, February 8, 2007**. Preapplications will be reviewed for conformance with the guidelines presented in this Notice and suitability in the technical areas specified in this Notice. A response to the preapplications encouraging or discouraging formal applications will be communicated to the applicants by **February 22, 2007**. Applicants who have not received a response regarding the status of their preapplication by this date are responsible for contacting the program to confirm this status.

Only those preapplicants that receive notification from DOE encouraging a formal application may submit full applications. **No other formal applications will be considered.**

Potential applicants **must** submit a brief preapplication that consists of no more than three pages of narrative stating the research objectives, describing the technical approach(s), and identifying the proposed team members and their expertise. The intent in requesting a preapplication is to save the time and effort of applicants in preparing and submitting a formal project application that may be inappropriate for the program. Preapplications will be reviewed relative to the scope and research needs as outlined in the summary paragraph and in the SUPPLEMENTARY INFORMATION. The preapplication should identify, on the cover sheet, the title of the project, the institution or organization, principal investigator name, telephone number, fax number, and e-mail address. No budget information or biographical data need be included, nor is an institutional endorsement necessary. Preapplications referencing the first aim in Program Notice DE-PS02-07ER07-16 should be sent as a text file without attachments or a single PDF file attachment via e-mail to: **genomicsGTL@science.doe.gov with "Preapplication DE-PS02-**

07ER07-16 ELSI Lastname Institution" as the subject. No FAX or mail submission of preapplications will be accepted.

APPLICATION DUE DATE: April 19, 2007, 8:00 pm, Eastern Time

Applications must be submitted using Grants.gov, the Funding Opportunity Announcement can be found using the CFDA Number, 81.049 or the Funding Opportunity Announcement number, DE-PS02-07ER07-16. Applicants must follow the instructions and use the forms provided on Grants.gov.

FOR FURTHER INFORMATION CONTACT:

For further information regarding this notice,

Contact: Dr. Daniel Drell
Telephone: (301) 903- 4742
E-mail: Daniel.drell@science.doe.gov

SUPPLEMENTARY INFORMATION:

A complementary request for proposals from DOE national laboratories has been issued, [Program Solicitation LAB 07-16](#).

SUPPLEMENTARY INFORMATION:

Biology has entered the era of systems biology in which we strive to understand entire living organisms and their interactions with the environment. Although scientists have long tried to understand the workings of individual genes or small groups of genes, this new era in biology will focus research on entire networks of genes and even entire biological systems - small, single celled organisms at first, then more complex microbial communities and plant microbe interactions, ultimately ecosystems.

The Department of Energy's Genomics:GTL program is a systems biology research program that is exploring biotechnology solutions that can give us abundant sources of clean energy yet control greenhouse gases such as carbon dioxide (a key factor in global climate change), better understand the cycling of carbon and emissions of CO₂ in the environment, and support more effective efforts to clean up past contamination of the environment. The Genomics:GTL Program supports a combination of large, well integrated, multidisciplinary research teams as well as a portfolio of smaller, focused research projects. The overall aim of the Genomics:GTL program is to encourage the development of new energy sources and supplies, foster more effective technologies and approaches to mitigating greenhouse gas impacts on global climate processes, and to support the development of more effective biological approaches to the cleanup of legacy wastes at DOE sites associated with a 62 year history of nuclear weapons and nuclear materials development. This solicitation will support focused research projects to explore societal implications arising from or consequent to research on alternative bioenergy technologies under the aegis of the Genomics:GTL program. Information on the research projects currently funded by the Genomics:GTL Program and a description of project goals and overall program

organization can be found at: <http://genomicsgtl.energy.gov>. The topic areas of particular interest to this Notice include but may not be limited to: societal implications of alternate bioenergy technologies, considerations impacting the use of "dual-use" crops (food vs. energy), and possible international implications. Additionally, a large biomass to biofuels contribution to the energy supply sector will require the exploration, and the exploitation, of microbes and microbial capabilities, which may raise issues of the use of altered microbes. The development of sustainable biofuels may involve a large shift in crop growth patterns in the US, involving growing biofuel feedstocks on acres that are currently fallow, used for pasture and grazing, managed for timber crops, or crops grown for food. Research is requested to help understand the societal issues and concerns associated with changes from any of the previous land use patterns to likely biomass crops.

Synthetic genomics and nanotechnology are two recent areas of technology development that the DOE (among other agencies) supports. While these programs promise great benefits, they also raise possible issues of misuse or unanticipated consequences. Synthetic genomics is the rapidly advancing area of gene, viral, and genome synthesis from single base pairs and short oligonucleotide fragments to introduce properties into living organisms that hitherto lacked them (e.g. a bioenergy synthesis pathway into a previously nonsynthetic microbe, or genetic control regions that could enhance an existing process (for example, cellulose degradation) in a fungus). At its most ambitious, synthetic genomics could lead to the reconstruction, de novo, of an entire microbial genome either in native form, or engineered to have useful properties. Assuming success at these efforts, what societal implications could be expected and what challenges will they present to us? (Note: biodefense implications will not be supported under this notice, since those are the subject of discussions by the National Science Advisory Board on Biosecurity, <http://www.biosecurityboard.gov/>).

Nanotechnology is a very broad area of activity focused on the science and properties of substances from 1 to 100 nanometers in size. As such, nanotechnology includes most scientific disciplines from chemistry and physics to materials sciences, biology, engineering and computational science. Activities are already being funded to explore environmental, safety and health questions (e.g. toxicities of certain nanomaterials) arising from nanotechnologies and work is needed to look at longer range at potential societal implications if nanotechnologies (including nanoparticles and nanomaterials) are successfully developed. Assuming success at these efforts, what societal implications could be expected and what challenges will they present to us?

Research Focus: *Ethical, Legal, and Societal Implications of Research on Alternative Bioenergy Technologies, Synthetic Genomics, and Nanotechnologies.*

In this Notice, research is solicited into the potential societal implications arising from research being conducted under the auspices of the Genomics:GTL program on bioenergy technologies and synthetic genomics, as well as nanotechnologies relevant to the development of alternative bioenergy approaches. Responsive applications could propose studies of various energy scenarios to which GTL science might contribute; exploring international implications and sensitivities, opportunities and barriers, to the use of bioenergy advances, synthetic genomics technologies, and nanotechnologies. This could include studies, conferences and workshops,

research efforts aimed either at more precisely defining the agenda of issues that may arise and/or analyzing potential options for dealing with identified issues arising from GTL Bioenergy research, synthetic genomics, or nanoscience research. While the national interest is in developing biofuels as an alternative to imported oil and ensuring sustainability of the biofuels production pipeline while balancing competing interests for land use, the purpose of this notice is to objectively analyze the implications of biofuels, not to advocate for their adoption. The results of this research should provide a better understanding of the potential environmental and societal impacts of biofuels throughout the entire supply chain, and contribute to the development of informed policies on bioenergy crops and their consequences. Similarly, it is the aim of this notice to encourage analyses of societal implications of synthetic genomics and nanotechnologies without passing judgment on their respective merits for any particular application. **Two considerations are paramount: 1) activities for which support is sought under this Notice must be strongly scientifically and technically grounded and 2) activities for which support is sought under this Notice must recognize that it is not the role or place of this program to advocate or defend particular policy options.**

Investigations are encouraged that focus on:

- Defining the range, nature, scope, and potential societal, legal, or economic impacts that may arise from research on alternative bioenergy technologies, synthetic genomics, or nanotechnologies, and the applications of that research. A principal need is to explore how to balance conflicting values and imperatives between environmental, economic, and societal implications of biologically-based energy technologies. Literature reviews, focus groups, and other approaches that do not involve opinion-surveys will be considered.
- Expanding the cultivation of biofuel crops has the potential to change a range of societal characteristics, patterns, and practices, among them land use practices (e.g. soil depletion and erosion, habitat availability, biodiversity, topography, landscapes, competing demands for resources such as acreage and water), employment, property values, and economic realities (which may raise issues of social justice). Questions of interest to this program may include: What impacts would the construction and ownership pattern of biorefineries have on societal preferences and practices and how might these vary by stakeholder, e.g. local farmer, local non-farming resident, stockholder in a major industrial entity that owns the facility, biofuels consumer, etc.? What impacts might changes in the availability or use patterns of bioenergy crops have on other markets and societal preferences and practices? In what ways might altering the types of microbes or other aspects of pathways inside the biorefinery affect the utility of bioproducts for animal feed and other uses? For instance, if a biorefinery has a permit to use one organism for fermentation, what flexibility is there for introducing alternative organisms or alternative techniques for degradation and conversion? What issues may arise in siting of biofuels production facilities?
- Conversion of large tracts of agricultural (or previously marginal) lands to cultivation of biofuel crops will result in a host of changes that will disproportionately affect adjacent communities. Potential impacts could include shifting employment opportunities, changes in local/regional economics, and alterations to the landscape. What are the most probable short and long term societal impacts of these types of changes? What would be

the broader public perception of such changes? How could potential negative impacts best be minimized?

- Exploring legal issues such as intellectual property protection and commercialization practices that may be relevant to advances from research on alternative bioenergy technologies, synthetic genomics, and nanomaterials and nanotechnologies. This could include analytic studies on the range of outcomes that could follow from different commercialization options, the impact(s) of the fractionation of patents in any of these areas into small pieces requiring patent pools, cross licensing or other strategies for achieving translation from research scale discoveries to useful and commercially viable inventions, to how potentially commercially viable inventions might impact different economic sectors.

In all cases, proposed research in societal implications of research activities, whether Genomics:GTL or synthetic genomics, should address issues arising in the context of BER missions of bioenergy development. For nanotechnology research, the focus should be on mid-term implications, grounded in the presumption that environment, safety and health issues are already under sufficient study, and presuming "success" in the development of nanotechnologies and nanomaterials with topicality for bioenergy. It is acknowledged that the scope of research in the ELSI Program is evolving as opportunities are identified to explore the consequences of Genomics:GTL science, synthetic genomics research, and nanoscience research activities for society.

References:

Genomics:GTL Program: <http://genomicsgtl.energy.gov>

Genomics:GTL Roadmap: <http://genomicsgtl.energy.gov/roadmap/index.shtml>

Genomics:GTL Bioenergy Mission Appendix to Roadmap:
http://genomicsgtl.energy.gov/roadmap/pdf/GTL05_05Energy.pdf

Genomics:GTL Biomass to Biofuels Report:
<http://genomicsgtl.energy.gov/biofuels/b2bworkshop.shtml>

History of DOE ELSI Research:
http://www.ornl.gov/sci/techresources/Human_Genome/elsi/elsi.shtml

BERAC report on Synthetic Genomics: <http://www.science.doe.gov/ober/berac/SynBio.pdf>

National Nanotechnology Initiative: <http://www.nano.gov/>

Office of Basic Energy Sciences Nanotechnology Home Page:
http://www.science.doe.gov/News_Information/News_Room/2006/nano/index.htm

Program Funding

It is anticipated that up to \$1,000,000 is available in Fiscal Year 2007, contingent upon availability of appropriated funds. It is anticipated that from 5 to 9 individual research grants will be funded at a level of not more than \$300,000 per year (total costs). Annual budgets are expected to range from \$50,000 to \$300,000, total costs. Terms of requested award should not exceed 3 years, subject to continued programmatic need, satisfactory progress and the availability of funds. DOE is under no obligation to pay for any costs associated with preparation or submission of applications. **DOE reserves the right to fund, in whole or in part, any, all, or none of the applications submitted in response to this Notice.**

Posted on the Office of Science Grants and Contracts Web Site
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