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Title: **National Environmental/Economic Infrastructure System Model**

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National Environmental/Economic Infrastructure System Model

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Abstract

This is the final report of a one-year, Laboratory Directed Research and Development (LDRD) project at the Los Alamos National Laboratory (LANL). The ultimate goal was to develop a new methodology for macroeconomic modeling applied to national environmental and economic problems. A modeling demonstration and briefings were produced, and significant internal technical support and program interest has been generated. External contacts with DOE's Office of Environmental Management (DOE-EM), U.S. State Department, and the U.S. intelligence community were established. As a result of DOE-EM interest and requests for further development, this research as been redirected to national environmental simulations as a new LDRD project.

1. Background and Research Objectives

The dual fields of micro and macroeconomics have simultaneously experienced rapid development in recent years. Yet they remain disjoint with no integrating mechanism. The search in economic theory for such an integrating mechanism is akin to the search for a unified field theory in physics. This theoretical work has not yet resulted in methods capable of adequately aggregating the micro-behaviors into a robust national-level analysis system.

We proposed to leapfrog the standard macroeconomic analysis paradigms by introducing bottom-up microsimulations. This has the potential to bring a new standard of accuracy and confidence to national level economic/environmental models. Los Alamos is in the position to bring about this breakthrough because of our current work pushing the envelope of microsimulations. This project's research objectives were to develop sufficient knowledge of the macroeconomic microfoundations work to integrate it with our contemporary microsimulation work. The resulting modeling tools would bring superior, reliable analyses to environmental and other national economic policy issues.

A new concept for macroeconomic modeling applied to national environmental/economic problems was explored. The approach was based on the integration of microsimulation methodologies with the new microfoundations of

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macroeconomic theory. The intent was to aid in the development of better national environmental policies. The project built a sufficient knowledge base of current macroeconomic theoretical developments to be able to suggest ways to integrate them with breakthrough microsimulation techniques that are already under development at Los Alamos.

2. Importance to LANL's Science and Technology Base and National R&D Needs

This work directly involves the Laboratory's core competency in analysis and assessment and specifically deals with our state-of-the-art microsimulation research. It offers new opportunities for developing these simulation techniques applied to the loosely integrated, self-organizing systems inherent in the economic structure of the national economy.

This work moves towards the highest goals established by Laboratory Director Sig Hecker's March 18, 1992 testimony to the House Armed Services Committee's Department of Energy Defense Nuclear Facilities Panel, which said in part:

> "A broader context of national security.....Having made the argument for the continued investment in R&D associated with the nuclear weapons program, let me hasten to add that it is most appropriate that the nuclear weapons laboratories turn more of their efforts toward meeting nonmilitary challenges facing this nation. It has become increasingly clear that national security now requires economic strength.....The rapidly changing world is bringing about dramatic changes at the laboratories and at the same time is offering new opportunities. The people and facilities that constitute exceptional core technical competencies at these laboratories are poised to contribute to other problems critical to our nation."

3. Scientific Approach and Accomplishments

Exploration, study and synthesis of the current literature concerning the micro-behavioral foundations of macroeconomic analysis were performed. The linkage of natural resource markets and environmental policy to the national economy was an area of special focus.

A concept for a new paradigm for macroeconomic modeling to be applied to national environmental/economic problems was produced. The concept is based on the

integration of LANL's microsimulation methodologies with the new microfoundations of macroeconomic theory. Background analytical research was completed by economists in coordination with simulation scientists within LANL and presentations were made to more than 15 senior level managers. Significant internal technical support and program interest has been generated.

A related macroeconomic modeling project using massively parallel processing at Sandial National Laboratories, headed by Richard Pryor, was investigated and negotiations were conducted concerning possible partnering/joining of our two efforts. The termination of funding for the Sandia project prevented the culmination of any joint research project, but information sharing continues on an informal basis.

We investigated developing an environmental technology evaluation tool that uses simulation science techniques. Such a tool would be used to assist DOE-EM policy makers as well as Laboratory environmental decision makers. A very simplified model was developed to simulate the Laboratory's TRU solid waste stream. This model was used in some briefings and demonstrations.

External contacts with high level officials in DOE-EM, U.S. State Department, and the U.S. intelligence community were established. As a result of DOE-EM interest and requests for further development, this research as beeen redirected to national environmental simulations in a new LDRD project titled "Environmental Management Policy Analysis Using Complex Simulation Techniques."