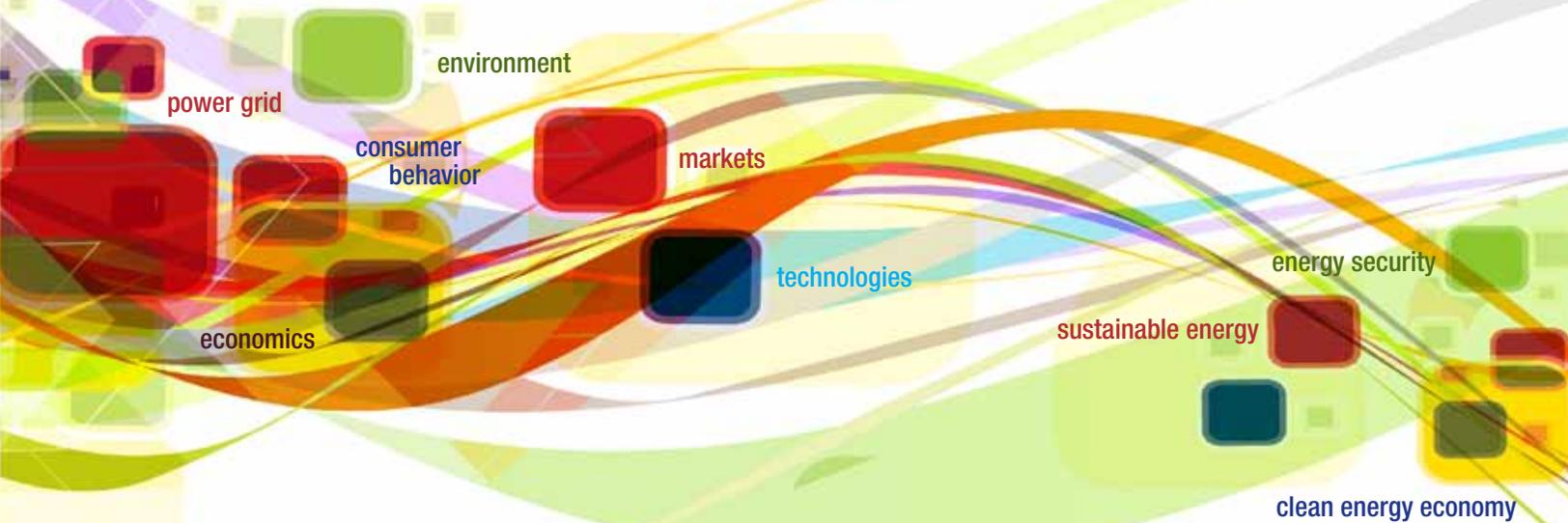


Energy Systems CENTER

for Analysis & Policy Evaluation



Systems Approach

is the Key to Successful U.S. Energy Transformation

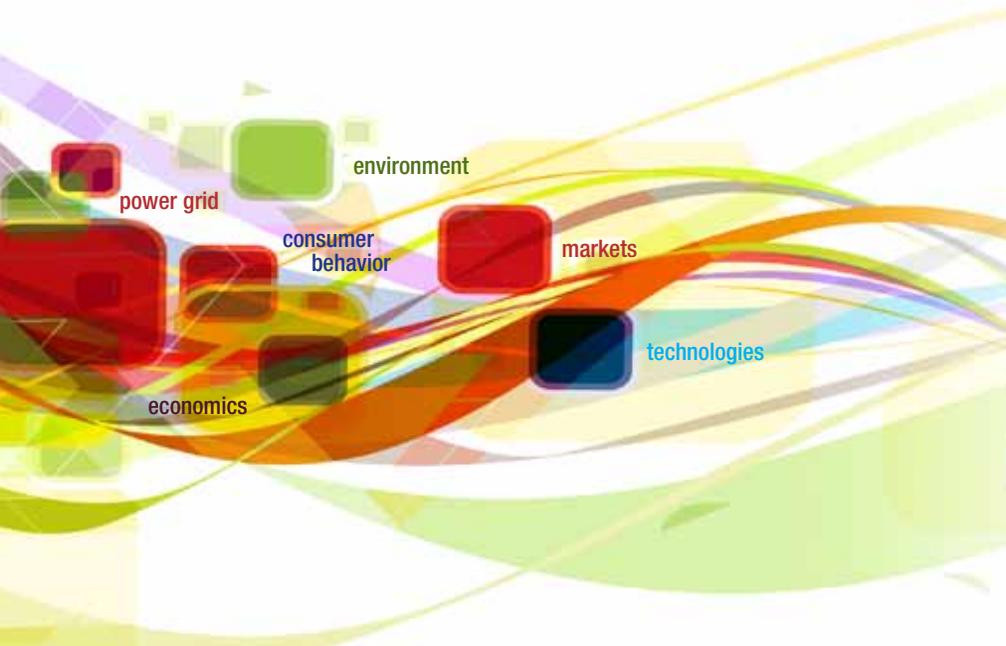
“ American economic competitiveness, environmental stewardship, and enhanced security depend on picking up the pace of energy technology innovation in this decade. ”

Report to the President on Accelerating the Pace of Change in Energy Technologies Through an Integrated Federal Energy Policy, Executive Office of the President, President's Council of Advisors on Science and Technology

Proposed transformations to the nation's energy system will introduce astonishing new technologies into the market, cause widespread changes in our energy consumption patterns, and even physical changes to the power grid. The result? Our energy system will be altered in complex and interdependent ways that are far too difficult to envision.

Moving quickly to transform our nation's energy system is an urgent need. It is equally important for us, however, to gain an in-depth understanding of the transformation's cumulative impacts on our future environment, economy, and security before we proceed.

Only comprehensive systems analysis – and the wisdom and foresight gained from systems analysis – can give us this understanding.





Argonne Center will bring Informed Decision Making to Energy Systems Planning

Argonne National Laboratory has partnered with Northwestern University and the University of Chicago to bring informed and inspired decision making to our nation's energy system planning. The Energy Systems Center for Analysis and Policy Evaluation (ESCAPE) whole-system analysis and advanced computing capabilities will provide flexible, expeditious, and independent evaluation and comparison of energy technology innovations and policy alternatives.

ESCAPE will give us the means to develop a blueprint for our nation's successful transition to a sustainable, environmentally friendly, and secure energy system.

ESCAPE built on Decades of Energy Systems Experience

For more than 30 years, local, regional, national, and international governments and private sector organizations have sought Argonne to develop complex energy systems analysis tools and conduct strategic energy studies. Argonne's very broad expertise crosses many relevant domains, including:

- ▶ Energy technology research/design/development/deployment
- ▶ Transportation technology development and systems engineering
- ▶ Power grid modeling
- ▶ Economic analysis
- ▶ Environmental assessment
- ▶ Life cycle analysis
- ▶ Social and behavioral modeling
- ▶ Energy infrastructure vulnerability and resiliency

Leveraging the Strengths of ESCAPE Partners

NORTHWESTERN UNIVERSITY

ESCAPE is closely aligned with the Initiative for Sustainability and Energy at Northwestern (ISEN), an organization for the advancement and communication of new science, technology, and policy for sustainability and energy. ISEN's research extends into many areas of energy production, storage, and use, with a focus on solar energy, transportation, carbon cycle, and policy.

ISEN faculty and graduate students will be instrumental in creating realistic future energy scenarios, generating and validating large datasets, conducting research using ESCAPE technologies, and producing policy recommendations. And, very importantly, by providing a wealth of opportunities for students, ISEN will maximize ESCAPE's educational and community outreach benefits.

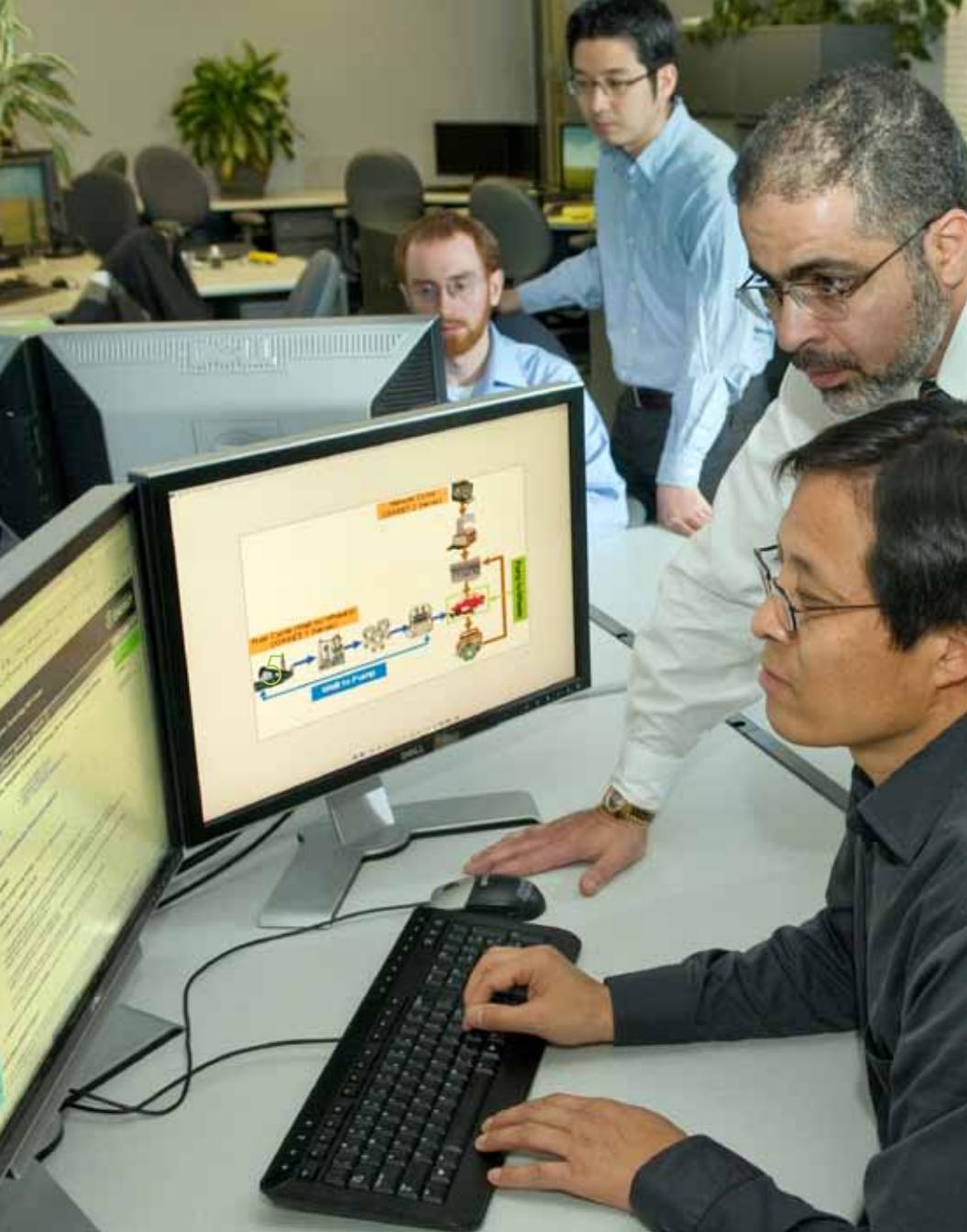
UNIVERSITY OF CHICAGO

The University of Chicago energy initiative interdisciplinary research program studies the economic, environmental, and geopolitical impacts of energy use. Research done through the initiative, based at the Booth School of Business, Computation Institute, and the Harris School Energy Policy Institute, concentrates on the development and distribution of abundant energy and the constraints posed by three interrelated features of energy use:

- ▶ Current energy sources are dominantly derived from depleting natural resource stocks
- ▶ Energy use raises environmental concerns both local and global
- ▶ Energy use and commerce create national and international security concerns.

Drawing on the intellectual resources at Argonne and the University, ESCAPE provides the platform for progress on these issues, involving interdisciplinary skills ranging from economics, business, and other social sciences to the physical sciences and engineering disciplines. In one collaborative effort, CIM-EARTH – an innovative open source model of climate and energy policy – is drawing upon Argonne's advanced computing and the University's economic expertise.





Argonne's Complex Energy Systems Analysis Tools

Argonne has developed large data sets and constructed integrated modeling architectures that allow the complexity of energy systems to be investigated as a whole system instead of component parts. Just a few examples of Argonne's many widely used energy-systems models:

- ▶ **Energy and Power Evaluation Program (ENPEP-BALANCE):** a nonlinear equilibrium model that determines the response of various segments of the energy system to changes in energy prices and demand levels.
- ▶ **Electricity Market Complex Adaptive System (EMCAS):** a novel agent-based modeling approach that simulates the operation of today's complex power systems. EMCAS can be used as an "electronic laboratory" to probe the possible operational and economic impacts of various external events on the power system.
- ▶ **The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model:** a life cycle model that fully evaluates energy and emission impacts of advanced vehicle technologies and new transportation fuels, the well-to-wheels fuel cycle, and the vehicle cycle from production through material recovery and vehicle disposal.

Argonne's Advanced Leadership Computing

Advanced computers perform the trillions of computations needed to understand the complex interactions within our energy system. Computers process vast databases and identify trends and patterns that the human mind alone cannot see. Computers allow us to model and study the many complex relationships, feedback effects, and interdependencies that exist throughout the energy system, and make informed tradeoffs between energy and the environment, employment, and economic growth.

One of the world's most powerful computers, the IBM Blue Gene/P is part of Argonne's Leadership Computing Facility. Argonne is at the forefront of advanced scientific computing and is a leader in the development of the next-generation "exascale" computers that will be a thousand times more powerful than today's advanced computers.

Using Argonne's advanced computing capability and whole-systems analysis tools, ESCAPE will be able to create the information that allows us to make informed energy decisions.

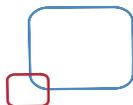


ESCAPE Collaboration and Communication

Will Accelerate Our Energy Systems' Transformation

ESCAPE's open approach, accessible computing platforms, and advanced informatics tools will facilitate communication and collaboration among analysts, researchers, academics, policy makers, and others seeking to understand energy, environmental, economic, and security issues. It will house, integrate, and make available data, models, and analysis tools for use by:

- ▶ Energy planners and policy makers to explore and test various energy scenarios,
- ▶ Researchers interested in testing new technologies or methodologies in a whole-systems environment, and
- ▶ University students and faculty for interdisciplinary education, research and community outreach.



“For more than three decades, researchers at Argonne National Laboratory have used the tools of energy systems analysis to measure and predict the energy, environmental and economic impacts of new technologies. By building on Argonne’s strong collaborative, cross-disciplinary resources, ESCAPE creates exciting new opportunities to address the complexities of our nation’s energy system and to inform decisions on energy planning, at every scale.”

*Eric D. Isaacs, Director
Argonne National Laboratory*

“Northwestern University is proud to bring its strong multi-disciplinary approach to sustainability and energy research, education, and outreach to ESCAPE. This powerful three-institution partnership will provide a valuable center of expertise, an advanced training/teaching focus and a set of leading-edge systems analysis tools to further our nation’s ability to make the wise and judicious decisions necessary for global sustainability.”

*Dr. Mark A. Ratner, Co-Director,
Initiative for Sustainability and Energy at Northwestern (ISEN)*

“ESCAPE’s combined expertise in systems-level modeling – and in the natural science, engineering and social science core disciplines that underpin such modeling – provide the building blocks for a major competence center in energy and environmental research that has the intellectual heft required to potentially influence regional and national energy and environmental policies.”

*Dr. Robert Rosner, Director
Harris School Energy Policy Institute, University of Chicago*



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