JISEA

Joint Institute for
Strategic Energy Analysis

2013 Annual Report

The Transforming Energy Economy

Contents

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Photo by Dennis Schroeder NREL 20282

Message from The Executive Committee Chair

JISEA Well Positioned in a Changing Energy Economy

This has been a remarkable year in the global energy economy, and a phenomenal year for the Joint Institute for Strategic Energy Analysis.

Throughout this annual report, we examine the transforming energy economy and its implications for JISEA's role. Potentially game-changing transformation is underway. In the United States, the sharp and largely unforeseen growth of the U.S. shale gas market has given the country a unique competitive advantage that has, in part, sparked a renaissance in U.S. manufacturing. Recent growth and innovation in renewable energy at home and around the world, together with improving energy efficiency, the growth in natural gas and renewables, and other changes have contributed to a drop in U.S. carbon emissions, which hit a 20-year low in 2012. Given the dynamic circumstances, some energy decision making is stalled as investors and policymakers try to chart a path forward under high uncertainty.

These changes inspire questions about best use of our energy resources, the real and non-monetized costs of infrastructure build-out decisions, and the impacts of the decisions made today on the U.S. economy and global geopolitical landscape in the future.

These are precisely the types of questions that the Alliance for Sustainable Energy launched JISEA to address. I'm very proud of the progress JISEA demonstrated toward its mission in 2012. I'm also pleased with some transformations at JISEA that I think position the organization for continued success.

Morgan Bazilian, Ph.D. joined JISEA in 2012 as Deputy Director. With two decades of experience in the energy sector ranging from upstream oil and gas policy to international energy and climate policy, Morgan will help lead the next phase of development for JISEA and expand its presence in the global energy dialogue.

The value of JISEA's cross-organization strategy came through in the research and publications completed in 2012. JISEA truly leveraged the knowledge and capabilities of its founding institutions. We are pleased that the transdisciplinary, multi-institutional approach, now including multiple new international affiliates, is poised for continued success.

On behalf of the executive committee, I congratulate JISEA on a successful year and express our ongoing commitment to the institution and the partnership behind it. Together, we will continue to forge a deeper understanding of the synergies between all energy pathways and the impacts of the transforming global energy economy.

Bobi Garrett

Bobi Garrett
Executive Committee Chair
Deputy Laboratory Director, Strategic Programs and Partnerships
Alliance/NREL

Photo by Dennis Schroeder NREL 20130

Message from The Executive Director

On Mission

Focused on the nexus of energy, finance, and society, the Joint Institute for Strategic Energy Analysis (JISEA) is helping guide the transformation of the global energy economy through comprehensive, leading-edge, objective, high-impact research and analysis.

In 2012, we published the first report in a new body of work examining the dramatic impact of shale gas on the U.S. energy sector. With *Natural Gas and the Transformation of the U.S. Energy Sector: Electricity*, JISEA provided a new methodological approach to estimate natural gas related greenhouse gas (GHG) emissions, tracked trends in regulatory and voluntary industry practices, and explored various electricity futures. The report demonstrates the unique value and insights our multi-disciplinary, multi-institutional team can provide.

Our natural gas work is an essential and logical part of a larger body of work focused on decarbonization of the energy sector in the Unites States and globally. By funding and publishing innovative energy research, we aim to shed light on policy, technological, economic, and social aspects of energy systems and move them toward sustainability. This report highlights some of our key projects.

We appreciate the support of our institutional partners—the U.S. Department of Energy's National Renewable Energy Laboratory, the University of Colorado-Boulder, the Colorado School of Mines, the Colorado State University, the Massachusetts Institute of Technology, and Stanford University—and our corporate, government, and public sector sponsors who have made possible JISEA's own transformation into the organization we envisioned: a respected and trusted thought leader.

Together, we are delivering on JISEA's mission. In 2013, we look forward to building on our accomplishments and illuminating new possibilities for the transforming energy economy.

Douglas J. Arent, MBA, Ph.D.
Executive Director, Joint Institute for Strategic Energy Analysis
U.S. National Renewable Energy Laboratory

Our Work:
Advancing Integration, Security, and Sustainability in the Transforming Energy Economy

Perhaps nothing exemplifies the transforming energy economy more than the dramatic impact of unconventional gas, and specifically shale gas, on the U.S. energy sector.

Very few energy sector commentators anticipated the scale of changes that we have witnessed in the U.S. natural gas sector—changes that breach the boundaries of traditional energy sector analysis and touch on areas as diverse as foreign policy and industrial competitiveness.

With roots in both academia and the national laboratory research environment, JISEA is well positioned to illuminate the potential positives and pitfalls of this new resource.

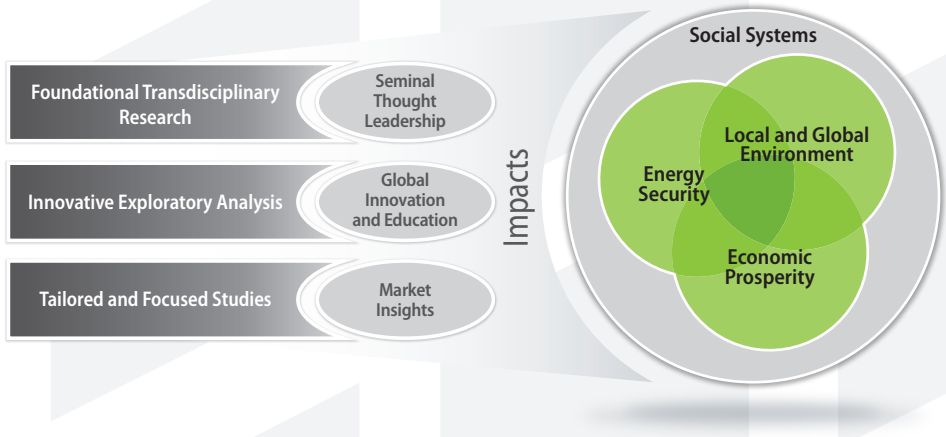
In 2012, JISEA published important works in this field. Our first report, *Natural Gas and the Transformation of the U.S. Energy Sector: Electricity*, is profiled on page 6. An additional study examines synergies between natural gas and renewable energy.

We believe that natural gas will play a key role, nationally and globally, in a decarbonized energy future. To enable a better understanding of the role natural gas can play, JISEA and Stanford University's Precourt Institute for Energy convened leaders from industry, government, academia, and the environmental community to define and prioritize an agenda for ongoing research. Our goal: answering near-term questions within the long-term context to inform investment and policy decisions relating to U.S. natural gas resources.

Natural gas may be the most disruptive force in the energy market, but it is not the only force at play. JISEA continues to examine renewable energy resources and technologies, energy efficiency, nuclear energy, other technologies, and the potential synergies between all of them.

In the pages that follow, we showcase several projects that demonstrate JISEA's impact in a transforming energy economy as well as our ongoing commitment to our mission: guiding the transformation of the global energy economy through comprehensive, transdisciplinary research focused on the nexus of energy, finance, and society.

JISEA's work focuses on two core program areas: conducting seminal analysis and funding innovative, collaborative research. Through both, we have delivered and continue to provide strategic insights and decision-making support to industry, finance, and government.



At JISEA, we focus our analytical capabilities on the intersections of energy, economy, and environment.

Left page photo from iStock 15714614

Natural Gas and the Transformation of the U.S. Energy Sector: Electricity

JISEA's first report in a series of studies on natural gas and the U.S. energy sector provides a new methodological approach to estimate natural gas-related greenhouse gas emissions, tracks trends in regulatory and voluntary industry practices, and explores various electricity futures. The report is part of a body of work designed to enable effective decision making in regards to energy policy and investments in light of the shale gas "revolution."

Natural Gas, Renewable Energy, and the U.S. Energy Sector

In the early 2000s, planning was under way for dozens of import terminals along the U.S. coasts to meet anticipated demand for liquefied natural gas. However, beginning in the late 1990s, advances linking horizontal drilling techniques with hydraulic fracturing allowed drilling to proceed in shale and other formations at a much lower cost. Shale gas now accounts for about 30% of total U.S. natural gas production—up from only 4% in 2005—and helped make the United States the largest producer of natural gas in the world by 2009.

With the shale gas revolution, the United States has witnessed:

- Lowest natural gas prices in a decade
- Widening oil-to-gas and U.S. gas-to-international gas price spreads
- Immediate coal-to-gas switching in the electric power sector
- Decreasing net imports of natural gas.

Today, the discussion centers on how and how much the U.S. gas supply will affect the economics and geopolitics of energy around the globe.

At the same time, renewable energy production and use are on the rise. Wind and solar PV technologies have begun to concretely demonstrate renewable energy's potential, and a combination of technological improvements, policy incentives, and periodically high prices for conventional energy sources have driven growth in renewable energy deployment and consumption. Between 2009 and 2012, U.S. renewable energy capacity almost doubled, climbing to 85.7 gigawatts in 2012, compared with 43.5 gigawatts in 2008. Today, renewable energy exceeds nuclear in the U.S. energy supply.

Together, these trends have helped reduce U.S. carbon-dioxide emissions to the lowest level since 1994, according to a Bloomberg New Energy Finance report.

JISEA Contributions to this Field of Study

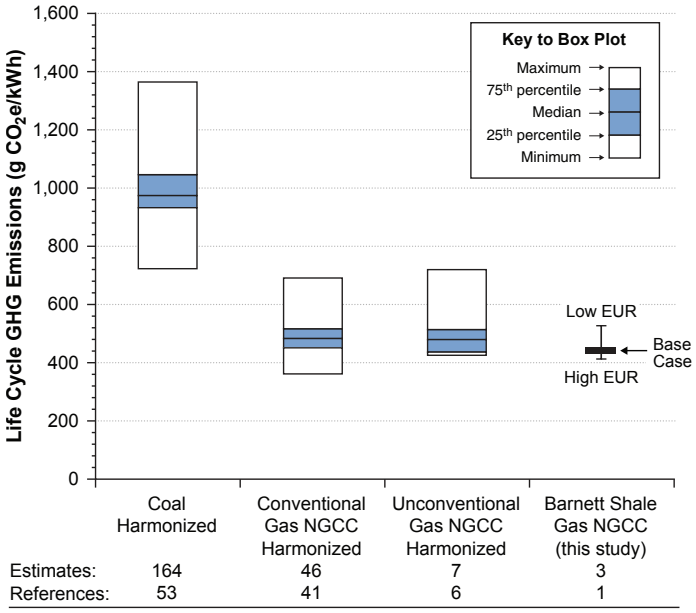
In 2012, JISEA, in partnership with NREL, examined synergies between natural gas and renewable energy and found:

- The dramatic rise of shale gas and growing experience with renewable energy integration have led to deep and still-evolving changes to market structures, physical systems, business practices, and regulatory policies.
- Both natural gas and renewable energy may play important future roles in the electric power sector.
- In this period of industry adaptation to new energy paradigms, active engagement and partnership between the natural gas and renewable energy sectors could lead to electricity markets better situated to achieving long-term goals of energy security and climate change mitigation.

A separate JISEA study addresses four related key questions from the wider dialogue on natural gas. Key findings include:

- **Greenhouse gas emissions:** Based on analysis of more than 16,000 sources of air-pollutant emissions reported in a state inventory of upstream and midstream natural gas industry, life cycle greenhouse gas emissions associated with electricity generated from Barnett Shale gas extracted in 2009 were found to be very similar to conventional natural gas and less than half those of coal-fired electricity generation.

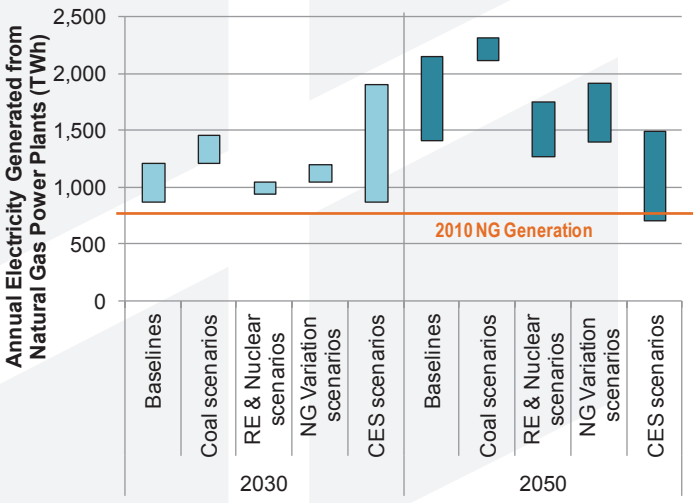
  "There is currently a national debate over life cycle GHG emissions from shale natural gas," NREL Senior Scientist Garvin Heath said. "We addressed it by conducting one of the first independent 'bottom up assessments' in this field."



Estimate of life cycle GHG emissions from 2009 Barnett Shale gas combusted to generate electricity in a modern natural gas combined-cycle (NGCC) turbine compared to previously published estimates for unconventional (mostly shale) gas, conventional natural gas, and coal after methodological harmonization. Notes: EUR = estimated ultimate recovery, or lifetime production

In 2013, JISEA is seeking sponsorship for a comprehensive research agenda that will help inform investment and policy decisions regarding U.S. natural gas resources.

- **Regulatory trends:** The legal and regulatory frameworks governing shale gas development are changing. All states examined in this study have updated their regulatory frameworks to address the opportunities and challenges associated with increasing unconventional natural gas production.
- **Water management:** Many regions evaluated in this study are using innovative water management practices to limit real and perceived risks. However, a lack of reliable, public data on water usage and management—such as total water withdrawals, total wells drilled, and water-recycling techniques—hinders efforts to develop adaptive best management practices.
- **Electric power futures:** JISEA analyzed different future electric power scenarios to evaluate the implications of shale gas development and use, and various policy and technology changes. In most scenarios, natural gas use for power generation grows strongly.



Range of electricity generated from natural gas plants in the scenario analysis.

JISEA's informative analysis appears in respected scientific journals and in JISEA published reports. Access these at *JISEA.org/publications.cfm.*

JISEA Publications

Articles, Presentations, Conference Papers

- *Interactions, Complementarities and Tensions at the Nexus of Natural Gas and Renewable Energy.* The Electricity Journal. Vol. 25, Issue 10, December 2012.
- *Impact of alkalinity sources on the life-cycle energy efficiency of mineral carbonation technologies.* Energy & Environmental Science. Issue 9, 2012.
- *Decarbonizing the Electric Sector: Combining Renewable and Nuclear Energy using Thermal Storage.* Energy Policy. Vol. 44, May 2012.
- *How PV and CSP with Thermal Storage Can Work Together,* presentation to the Clean Energy Regulatory Forum III, April 2012.
- *CSP and Natural Gas Hybrids*, presentation to the Clean Energy Regulatory Forum III, April 2012.
- *U.S. PV Market Landscape*, presentation to the Clean Energy Regulatory Forum III, April 2012.
- *Impacts of Renewable Generation on Fossil Fuel Unit Cycling: Costs and Emissions,* presentation to the Clean Energy Regulatory Forum III, April 2012.
- *Considering the Energy, Water and Food Nexus: Towards an Integrated Modeling Approach.* Energy Policy. Vol. 39(12), December 2011.
- *An Evolutionary Algorithm and Acceleration Approach for Topological Design of Distributed Resource Islands*. Paper accepted for presentation at the 2011 IEEE Trondheim PowerTech.

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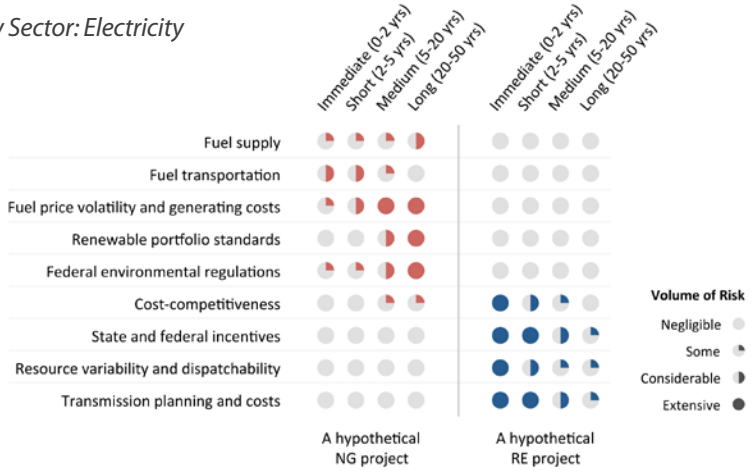
JISEA Reports

- *Natural Gas and the Transformation of the U.S. Energy Sector: Electricity*
  See feature on page 6.
- *Opportunities for Synergy between Natural Gas and Renewable Energy in the Electric Power and Transportation Sectors*

  Natural gas and renewable energy have been touted as key elements of a transition to a cleaner and more secure energy future, but much of the current discourse considers each in isolation or concentrates on the competitive impacts of one on the other. This joint NREL/JISEA paper attempts, instead, to explore potential synergies of natural gas and renewable energy in the U.S. electric power and transportation sectors.



The JISEA/NREL report on synergies between renewable energy and natural gas includes this illustrative framework for evaluating investment options by risk source, magnitude, and timescale.

- *Integrating Wind and Solar Energy in the U.S. Bulk Power System: Lessons from Regional Integration Studies*

  Two recent studies sponsored by the U.S. Department of Energy and NREL examined the impacts of integrating high penetrations of wind and solar energy on the Eastern and Western electric grids. Drawing from these studies, JISEA identifies key insights for integrating high penetrations of renewables in the U.S. electric grid.
- *Integrating Variable Renewable Energy in Electric Power Markets: Best Practices from International Experience*

  This study documents diverse approaches to effective integration of variable renewable energy among six countries—Australia, Denmark, Germany, Ireland, Spain, and the United States. A separate *Summary for Policymakers* highlights policy best practices to ensure that electricity markets and power systems can effectively coevolve with increasing penetrations of variable renewable energy.
- *Mobilizing Public Markets to Finance Renewable Energy Projects: Insights from Expert Stakeholders*

  In April 2012, renewable energy and financing experts assembled at two roundtable discussions to address renewable energy financing challenges and to identify new sources of capital for the U.S. market. This report summarizes the key messages of those discussions and is designed to provide insights to the U.S. market and inform the international conversation on renewable energy financing innovations.
- *Summary Report of the INL-JISEA Workshop on Nuclear Hybrid Energy Systems*

  The Institute for Nuclear Energy Science and Technology and JISEA co-sponsored an international workshop to identify research topics important in advancing the potential use of hybrid systems with a specific focus on nuclear-renewable hybrid systems.
- *Nuclear and Renewable Energy Synergies Workshop: Report of Proceedings*

  This report records the outcomes of JISEA's 2011 Nuclear and Renewable Energy Synergies Workshop, which identified potential synergies and strategic leveraging opportunities between nuclear energy and renewable energy.
- *Renewable Electricity Futures Study (NREL)*

  NREL's Renewable Electricity Futures Study (RE Futures), the most comprehensive analysis of its kind to date, is an initial investigation of the extent to which renewable energy supply can meet the electricity demands of the continental United States over the next several decades. RE Futures was funded by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, in collaboration with more than 110 contributors from 35 organizations. JISEA's Doug Arent is a co-author.

Through the IRAAP, JISEA seeks to fund collaborative, multidisciplinary energy analysis projects which:

- **Emphasize the environmental, economic and financial, policy, technological, and social and behavioral aspects of energy systems**
- **Encompass an integrated systems perspective**
- **Consider the implications of findings in economic, social, and environmental terms**
- **Apply at local, domestic, and international scales**
- **Lead to significant global impacts on energy sector transformation.**

JISEA's Innovative Research Analysis Award Program: Funding Innovative Energy Research

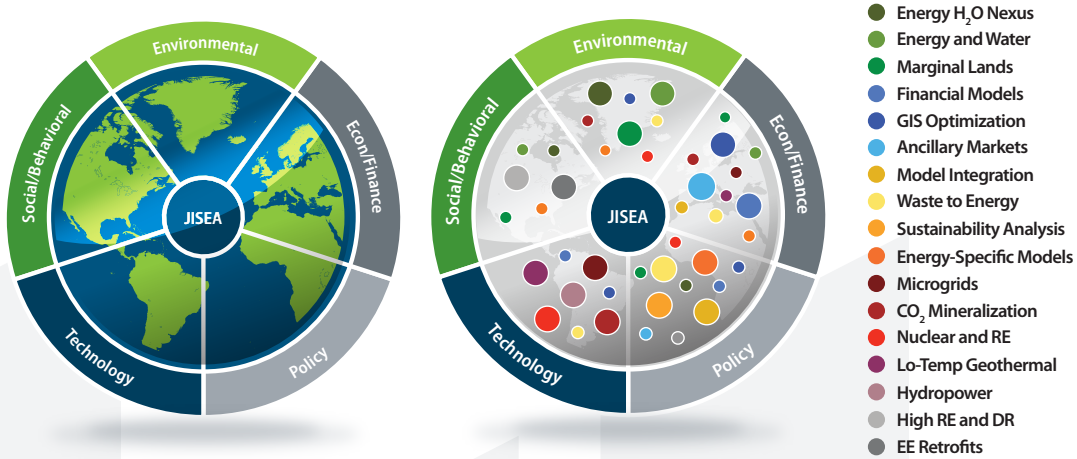
JISEA's Innovative Research Analysis Award Program (IRAAP) provides research awards for innovative analytical energy research. JISEA makes awards to selected collaborative teams of faculty members and researchers from its founding partner institutions:

- Colorado School of Mines
- Colorado State University
- Massachusetts Institute of Technology
- National Renewable Energy Laboratory
- Stanford University
- University of Colorado at Boulder

JISEA has provided $850,000 in funding to 17 research teams.

We fund a balanced portfolio of research, with projects emphasizing environmental, economic and financial, policy, technological, and social and behavioral aspects of energy systems. The projects also range in geographic scope.

The following pages summarize the work and accomplishments of our IRAAP research teams.



IRAAP projects place major (large dots) and minor (small dots) emphasis on environmental, economic and financial, policy, technological, and social and behavioral aspects of energy systems. *Illustration by Stacy Buchanan, NREL*

IRAAP Projects with Environmental Emphasis

Energy-Water Nexus in a Drying West: A Case Study Analysis and Methodology

Collaborators: Colorado State University, National Renewable Energy Laboratory, University of Colorado at Boulder

Through a case study analysis of the South Platte River Basin in northeastern Colorado, this research team evaluated energy generation risk and resiliency in the face of changing and uncertain water availability in the West. Researchers analyzed the intersection of energy generation and transmission planning, water demands, climate change, and agricultural water use to determine the water impacts of different energy and climate change scenarios. The results can inform long-term energy and transmission planning strategies.

Photo by Dennis Schroeder, NREL 23240

Toward an Improved Methodology for Comparing Water-related Impacts of Electricity Generation: A Preliminary Analysis of Concentrating Solar Power Data

Collaborators: National Renewable Energy Laboratory, Stanford University, University of Colorado at Boulder

This research team analyzed the inputs, internal uses, and outputs of water in concentrating solar power facilities in an effort to develop more comprehensive and accurate water quality and water quantity metrics for use by energy system planners and regulators. Water use is an important factor to consider when evaluating large industrial systems such as power plants. This research helps fill gaps in current water analyses, which sometimes ignore important attributes of water (e.g., salinity, flow rate, temperature) that can vary spatially, temporally, and across electricity-generating technologies.

Renewable Energy Potential for U.S. Marginal Lands

Collaborators: Stanford University, National Renewable Energy Laboratory

Illustration by Joshua Bauer, NREL

This research team defined and identified the marginal lands in the United States and assessed their potential for renewable energy, including biomass, wind, solar, geothermal, and hydro. The team integrated and analyzed land characteristics (e.g., soil, topography, climate, land use/cover) and applied state-of-the-art geographic information systems (GIS) to map U.S. marginal lands. Data are also presented in a tabular form. This study provides policymakers and industry developers with valuable information to guide strategic decisions.

IRAAP Projects with Economic and Financial Emphasis

Financial Models for Electric Utility Market Transformation

Collaborators: Colorado State University, National Renewable Energy Laboratory

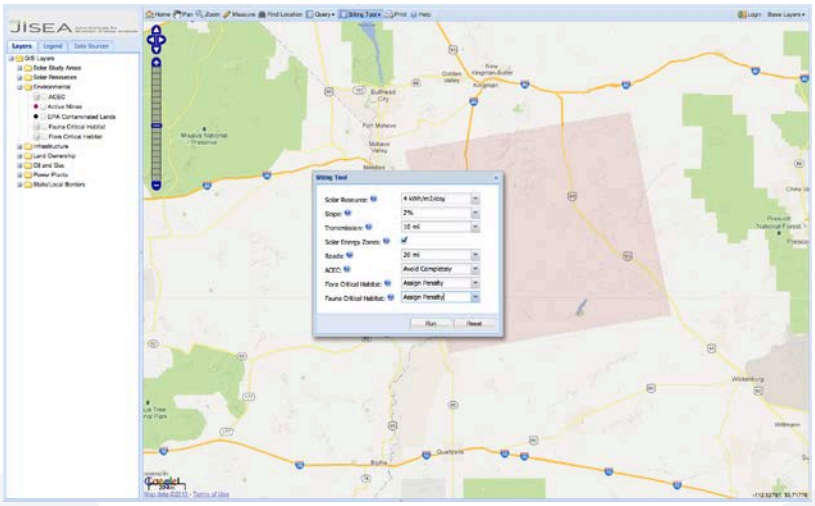
In-kind Collaborator: Rocky Mountain Institute

Distributed generation (DG) technologies can enable diffusion of energy choice, appropriate energy systems, and clean energy technologies. But traditional utility business models can discourage DG deployment. This study identifies the business model that utility customers are using to justify DG development and installation, and quantifies the deleterious effect of DG on traditional utility business models. Finally, alternative business models are evaluated for potential to recognize and monetize the potential benefits of DG resources.

A GIS-based Mapping and Optimization Tool to Aid Siting, Design, and Assessment of Utility Scale Energy Development

Collaborators: National Renewable Energy Laboratory, Stanford University

Solar developers must take into consideration many environmental, social, and economic factors when evaluating a potential site for large-scale solar projects. This research team developed a proof-of-concept, web-based GIS tool that evaluates multiple user-defined criteria in an optimization algorithm to inform site selection decisions. This tool could be expanded to optimize siting decisions for other mineral and energy developments, and could also be utilized to better understand the cumulative effects of multiple developments on a region.



This JISEA-funded GIS tool informs renewable energy site selection.

Emerging Ancillary Service Markets in Non-restricted Regions of the Western Power Grid

Collaborators: University of Colorado at Boulder, National Renewable Energy Laboratory
In-kind Collaborator: RASEI

This research will provide advanced technical, market, and legal/regulatory analysis of needs and barriers with respect to the proposed regional energy imbalance market (EIM) for the western interconnection. This information will provide market participants and state and federal regulators with a more transparent view of a future EIM, identify potential regulatory and policy problems before they emerge, and allow for more efficient planning in both the private and public sectors of the electricity market with respect to the EIM.

IRAAP Projects with Policy Emphasis

Creation of an Energy-Specific Computable General Equilibrium Model to Analyze State Level Policy

Collaborators: Colorado State University, National Renewable Energy Laboratory

This project will integrate the best capabilities of three distinct socioeconomic modeling systems into one computable general equilibrium model. This research will produce a new proof of concept energy-specific model that can help state and federal decision makers assess far-reaching impacts of investments in different energy technologies.

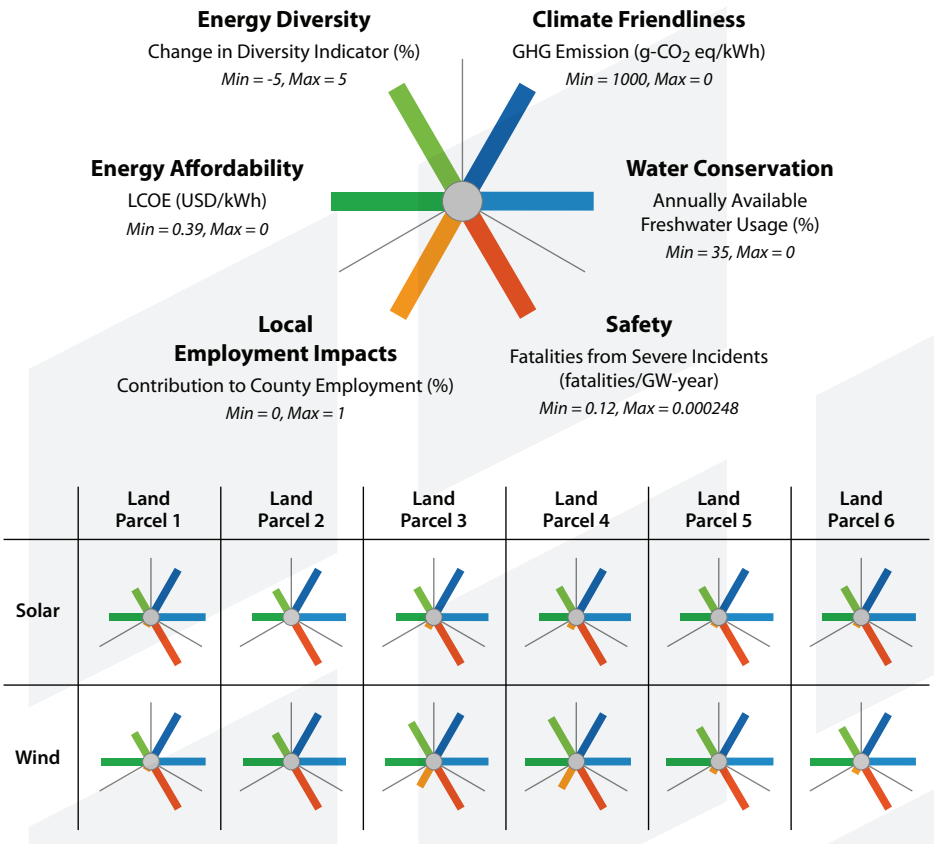
IRAAP in Focus: Multi-metric Sustainability Analysis

Collaborators: Colorado School of Mines, National Renewable Energy Laboratory

Common metrics for comparing energy technologies, such as levelized cost of energy, greenhouse gas emission profiles, and criteria air pollutant emissions, are instructive, but not always adequate for informing policy or investment decisions. These decisions often take into account a combination of social, environmental, and economic factors that vary by locality. Recognizing the need for a framework that allows for evaluating impacts and comparing trade-offs among these factors, JISEA funded this exploration of multi-metric sustainability analysis (MMSA) to provide energy decision makers with a means to make more comprehensive comparisons of energy technologies.

The resulting analysis tool lets decision makers simultaneously compare technologies and potential deployment locations by several indicators of sustainability. For simplicity, the project team chose six possible indicators—two social indicators, two environmental, and two economic. However, the designers intend for this visual comparison tool to be scalable and adaptable to fit specific local needs and easily interpreted so that trade-offs between technology and location options are clear.

The report reviews the state of MMSA, explains the methodology for developing the new MMSA tool, tests the concept by applying it to an evaluation of two energy technologies at six different U.S. locations, and discusses potential directions for additional work on this topic.



In this proposed visual tool for multi-metric sustainability analysis, created by a JISEA-funded research team, larger "spoke" lengths represent more positive outcomes

Waste Not, Want Not: Analyzing the Economic and Environmental Viability of Waste-to-Energy Technology for Site-specific Optimization of Renewable Energy Options

Collaborators: National Renewable Energy Laboratory, University of Colorado at Boulder

Waste-to-energy technology burns municipal waste in an environmentally safe incinerator to generate electricity, provide district heat, and reduce the need for landfill disposal. While this technology has gained acceptance in Europe, it has yet to be commonly recognized as an option in the United States. This study investigated the environmental, policy, economic, and technical factors that have contributed to the success of the technology abroad, and considered how they are likely to impact the adoption of the technology in the United States.

Distributional and Efficiency Impacts of Clean and Renewable Energy Standards for Electricity

Collaborators: Massachusetts Institute of Technology, National Renewable Energy Laboratory

By combining the strengths of an economy-wide, "top down" computable general equilibrium model (MIT's U.S. Regional Energy Policy model, or USREP) and a technology-rich "bottom up" electric-sector-only model (NREL's Regional Energy Deployment System model, or ReEDS), this research team developed an innovative analysis tool to examine economy-wide impacts of climate and energy policy. The integrated model framework is applied to analyze the efficiency and distributional implications of a clean energy standard policy in the U.S. electric power sector.

IRAAP Projects with Technology Emphasis

Verifiable Decision-making Algorithms for Reconfiguration of Electric Microgrids

Collaborators: Colorado State University, University of Colorado at Boulder

Researchers worked to discover new algorithms for reconfiguration of electric power microgrids subject to specific objectives such as maximized economic benefits and minimized losses. They used detailed modeling and simulation along with formal verification techniques for validation of these algorithms, addressing issues such as reliability and cyber-security. The research has yielded new topologies and operations aspects of electric power microgrids that will accelerate the penetration of renewables in the grid.

Impact of Alkalinity Sources on the Life Cycle Energy Efficiency of CO_2 Mineralization Technologies

Collaborators: Massachusetts Institute of Technology, Stanford University

Carbon dioxide (CO_2) mineralization has been proposed as a scalable method to reduce greenhouse gas emissions from fossil fuel combustion. Mineralization technology is highly dependent on efficient and inexpensive alkalinity generation or extraction. In this project, researchers assessed the usefulness of several potential alkalinity sources, providing findings usable in life cycle assessments of mineralization-based CO_2 capture systems.

A Combined Nuclear and Renewable Solution to Decarbonizing the Electric Sector

Collaborators: Colorado School of Mines, National Renewable Energy Laboratory
In-kind Collaborator: University of Wisconsin at Madison

This project investigated the potential compatibility of a high renewable energy grid with load-following nuclear power plants. Using a systems approach, it described

combinations of wind, solar, and nuclear that can provide a large fraction of a system's electricity, along with the characteristics of high-temperature nuclear power plants needed to support these scenarios.

- ***Integration of Low-Temperature Geothermal Resources with Other Power Generation Technologies to Improve System Performance and Resource Utilization***

  Collaborators: Colorado State University, National Renewable Energy Laboratory

  The low-temperature (<150°C) geothermal resource base for the United States is estimated to be >500 GW, but is under-utilized largely due to the current limitations on geothermal power plant technology. Using a techno-economic analysis, this research team is seeking to identify promising novel applications for low-temperature geothermal resources, and provide insight into the impact that low-temperature geothermal could have on other energy resources.

- ***Improving Hydropower Operational Models for Integrating High Penetrations of Renewable Energy***

  Collaborators: National Renewable Energy Laboratory, University of Colorado at Boulder

  Variable generation penetration into the electric power system in the Western United States could lead to increased demand for flexible resources. Hydropower is physically capable of providing flexibility but must meet a complex mix of constraints that often prevail over electricity generation. This research team will explore the contribution that a more accurate representation of hydropower could have to the electric system and the integration of variable generation.

IRAAP Projects with Social and Behavioral Emphasis

- ***Power System Balancing with High Renewable Penetration: The Potential of Demand Response in Hawaii***

  Collaborators: Massachusetts Institute of Technology, National Renewable Energy Laboratory

  The State of Hawaii has adopted an aggressive renewable portfolio standard of 40% renewables by 2030. Hawaii has targeted a renewable energy mix that will (according to traditional methodology) rely on additional expensive spinning reserve or energy storage to balance the electrical grid. Using advanced modeling techniques and benchmarks for best practices in program design, the JISEA researchers found that Demand Response provided a lower-cost solution to balancing intermittent supplies and may enable Hawaii to achieve its goal for reduced energy dependence.

- ***Accelerating the Pace of Residential Energy Efficiency Retrofits***

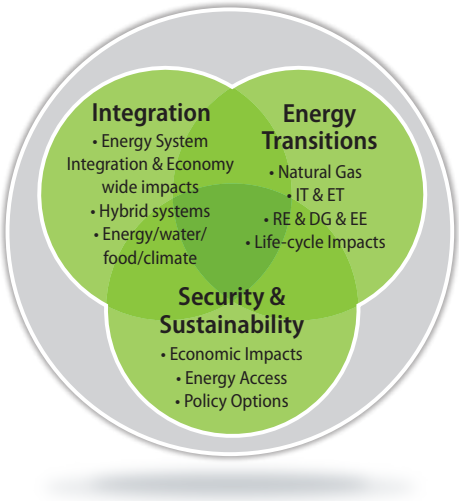
  Collaborators: Massachusetts Institute of Technology, National Renewable Energy Laboratory

  This research team will investigate how to reduce the time and costs associated with home energy audits and increase the uptake rate of home energy retrofits. The team intends to construct a model that predicts potential for retrofit based on home heating costs. This model will provide the capacity to predict which homes might be good candidates for retrofit without access to utility bills or a visit to the home.

Learn More About IRAAP at *JISEA.org/our_work.cfm*.

Looking Forward: Projects in Development

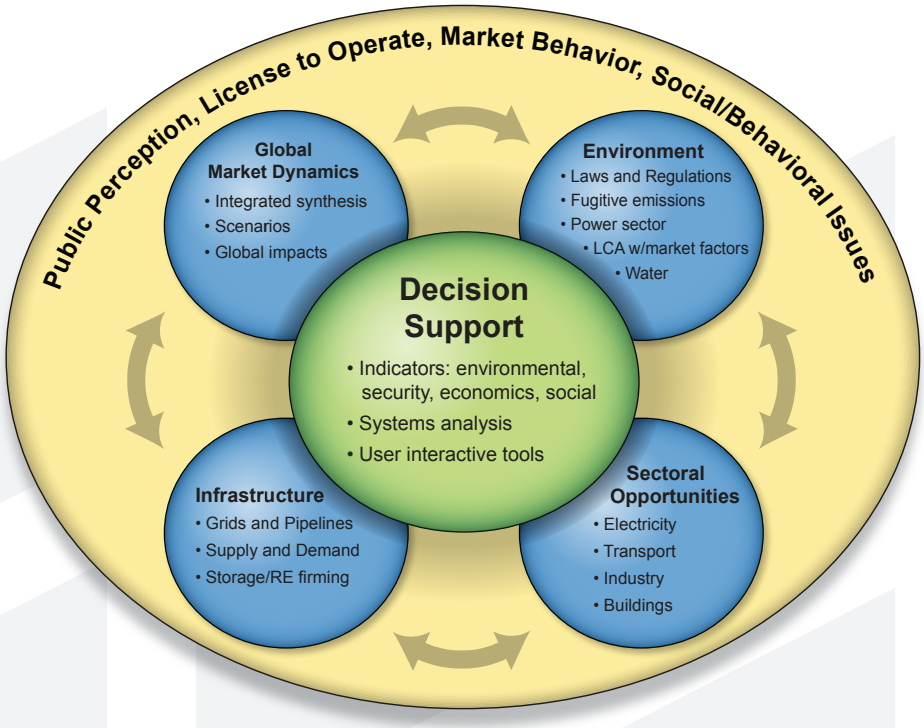
In 2013, JISEA looks to expand on its mission through additional program areas that describe the intersection of energy systems integration, energy security, and sustainability.



At JISEA, we focus our analytical capabilities on the intersections of energy, economy, and environment.

Natural Gas Research

Together with Stanford University's Precourt Institute for Energy, JISEA is pursuing a comprehensive research agenda focused on the potential and best uses for natural gas.



The JISEA/Precourt Institute research program aims to bolster decision support through work in four areas:

- Global NG market dynamics
- Environmental issues and opportunities
- Sectoral opportunities
- Infrastructure.

We seek to place these in context of market realities and societal constraints, and to develop interactive tools for stakeholders to better understand sensitivities and pathways.

Supporting Research

JISEA is working to launch a working paper series, which will give energy policy researchers an opportunity to share ideas under development and receive feedback from expert peers.

Thinking and Working Globally

Using the united research and analysis capabilities of its partner institutions and a global network of research affiliates, JISEA is working around the world to advance energy systems integration and energy security.

Advancing Smart Grid Deployment in India

At the request of the 21st Century Power Partnership, an initiative of the Clean Energy Ministerial that aims to accelerate the global transition to clean, efficient, reliable and cost-effective power systems, JISEA is facilitating peer-to-peer exchanges of power system professionals and conducting analysis of the electrical system in India. JISEA also provides support to the 21st Century Power Partnership through the operating agent.

Collaborating to Promote Renewable Energy Finance

JISEA works with the Low Emission Development Strategies Global Partnership (LEDS GP), a network of more than 100 countries and international institutions supporting collaboration and peer learning on low emission development strategies, to coordinate and promote the LEDS GP finance advisory service. This service assists any country developing and implementing LEDS with financing strategies, policies and/or programs. Types of assistance include reviewing draft financing strategies, and advising on policies and measures for mobilizing investment.

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Our Team

Leadership for a Transforming Energy Economy

JISEA's thought leadership stems from its organizational leaders and unique institutional structure.

JISEA is operated by the Alliance for Sustainable Energy, LLC, on behalf of the U.S. Department of Energy's National Renewable Energy Laboratory, the University of Colorado-Boulder, the Colorado School of Mines, the Colorado State University, the Massachusetts Institute of Technology, and Stanford University.

For more information on JISEA staff and leadership, visit *JISEA.org/about.cfm*.

JISEA Core Staff

Photo by Dennis Schroeder, NREL 20130

Douglas Jay Arent, MBA, Ph.D.
Executive Director

Doug Arent specializes in strategic planning and financial analysis competencies; clean energy technologies and energy and water issues; and international and governmental policies. In addition to his NREL responsibilities, Arent is a Senior Visiting Fellow at the Center for Strategic and International Studies. Arent was appointed as a Coordinating Lead Author for the 5th Assessment Report of the Nobel Prize-winning Intergovernmental Panel on Climate Change (IPCC) and serves on the National Research Council Committee to Advise the U.S. Global Change Research Program.

Photo by Dennis Schroeder, NREL 22072

Morgan Bazilian, Ph.D.
Deputy Director

Morgan Bazilian joined JISEA with two decades of experience in the energy sector ranging from upstream oil and gas policy to the design of fiscal instruments to promote clean energy. Before joining JISEA, Bazilian was the Senior Advisor to the Director-General of UNIDO on international energy and climate policy. In this role, he helped shape the United Nations' approach to energy for development, and managed the UN's interagency energy mechanism—UN-Energy.

Photo by Dennis Schroeder, NREL 20109

Patricia Statwick
Program Administrator

Patricia Statwick works with JISEA executives to develop and implement JISEA programs. Prior to joining JISEA, Statwick was associate director of an entrepreneurship development program at Northwestern University that was focused on launching Homeland Security technology start-ups.

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Program Committee

JISEA's program committee provides guidance on program direction to the executive director and reviews and approves JISEA's research agenda, priorities, and annual research program plan.

- **John Weyant** — Professor of Management Science and Engineering, Stanford University
- **John Reilly** — Co-Director, Joint Program on the Science and Policy of Global Change, and Senior Lecturer, MIT Sloan School of Management, Massachusetts Institute of Technology
- **William Boyd** — Associate Professor, University of Colorado Law School
- **Dag Nummedal** — Director, Colorado Energy Research Institute, Colorado School of Mines
- **Ron Sega** — Woodward Professor of Systems Engineering, Colorado State University; and Vice President for Energy, Environment and Applied Research, Colorado State University Research Foundation
- **Gian Porro** — Laboratory Program Manager for Strategic Analysis, National Renewable Energy Laboratory.

Executive Committee

JISEA is governed by an executive committee representing the Alliance for Sustainable Energy's board of directors. The executive committee provides oversight and advice to the executive director in our leadership and management on behalf of the Alliance board. The executive committee also provides guidance and governance over strategic intent, evaluates performance, and makes recommendations for improvement.

Research Affiliates

To augment the capabilities of its founding partner institutions with specialized and complementary skills and knowledge needed for particular studies, JISEA assembles teams from a virtual network of global affiliates and partners.

KTH Royal Institute of Technology

Kungliga Tekniska högskolan (KTH) is the largest, oldest, and most international technical university in Sweden. Education and research spans from natural sciences to all the branches of engineering and includes architecture, industrial management, and urban planning. Five strategic multidisciplinary research platforms enhance KTH's attraction as a major strategic research partner: energy, information and communication technology, materials, life science technology, and transport.

Renewable and Appropriate Energy Laboratory (RAEL)

RAEL is a research, development, project implementation, and community outreach facility based at the University of California, Berkeley. RAEL was founded in 1999 by Class of 1935 Distinguished Professor of Energy Daniel Kammen. RAEL focuses on systems-level analysis of integrated sustainable energy systems, and on the decarbonization of energy networks, and the social and cultural contexts of energy networks.

Interested in becoming a JISEA research affiliate? Contact JISEA's program administrator at *patricia.statwick@jisea.org*.

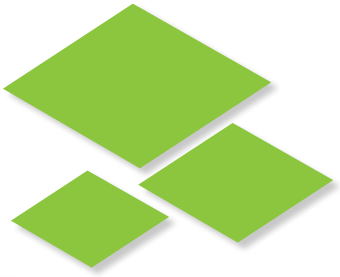
Our Sponsors

JISEA appreciates and welcomes the support of all of our generous sponsors, including those who choose to remain anonymous.

JISEA offers unique analytic capabilities and an effective organization promising value, quality, and comprehensiveness.

To learn more about JISEA sponsorship opportunities, contact JISEA's program administrator at *patricia.statwick@jisea.org*.

JISEA Joint Institute for Strategic Energy Analysis



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To receive announcements about the IRAAP program and other JISEA activities, sign up for our e-mail newsletter at *JISEA.org/news_subscribe.cfm*.

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