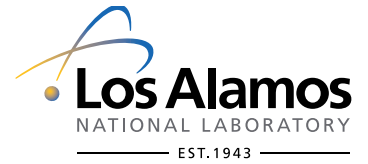# Resilient Energy—Climate Systems
CLEAR—Climate-Energy Assessment for Resiliency

LANL's expertise in system modeling, earth science and atmospheric science uniquely positions us to solve interdependent energy and climate challenges. Energy and climate security depend on our ability to assess the impacts of climate change on human and natural systems while developing energy strategies and technologies that mitigate climate change and environmental impacts.

Left: *Pieces of the energy puzzle—energy strategies must be reconciled with emerging climate goals.*

Background

Global energy demand is rapidly increasing and competes with the need to stabilize the Earth's climate to avoid potentially catastrophic impacts on the Earth's human, engineered and natural systems. The ability of these systems to withstand adverse climate impacts or other disruptions while maintaining their ability to function—that is, their resiliency— will be a key factor in enhancing global stability in the 21st century. Proposals to stabilize atmospheric CO_2 levels at 450–550 ppm require reducing emissions by 50–80% by 2050 compared to current emissions. The global challenge will be to meet energy demand while managing carbon and enhancing the resiliency of Earth and human systems in the face of climate change.

Capabilities

We have developed an integrated assessment framework called Climate-Energy Assessment for Resiliency, or CLEAR. The framework is based in system dynamics modeling and allows understanding of the complex interdependencies, feedbacks, and emergent behavior in natural, engineered, and social systems impacted by energy demand growth and climate change. CLEAR, coupled with our physics-based predictive models and extensive expertise in spatial analysis, renewable, geothermal, and nuclear energy, and carbon sequestration technologies, allows us to address energy and climate challenges at local, regional, and global scales.

Applications

The CLEAR framework allows assessment of multiple goals and trade-offs between energy demand, energy development, technology insertion, emissions goals, and environmental impact from the micro to macroscale. We are using CLEAR to assess emissions goals and energy resource development at the local and regional scales. Future applications of CLEAR will assist decision making, evaluate impacts of new energy technologies, and assist in energy resource planning from the local to national scale.

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Below: By varying the CLEAR model parameters (portion of interface in middle), we can evaluate future energy production scenarios like the EPA's "business-as-usual" future (left) compared to a future energy scenario (right) that would meet proposed climate goals.

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