

Department of Nuclear Science and Engineering  
Massachusetts Institute of Technology

## SPOTLIGHT ON NSE RESEARCH

# Providing for Future Energy Needs



Over the next few decades, the United States and the world will confront two monumental challenges: increasing pressure on oil and gas supplies, and climate change. Our effectiveness at addressing these interconnected problems will have a major impact on the global economy, and on the quality of life for future generations.

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Professor Richard K. Lester, Head  
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Bishop Fellows clockwise from top left:  
Ashley Finan, Fall 08; Nicholas Horelik, Fall 09, Spring 10  
Julien Beccherle, Fall 07, Spring 08; Dustin Langewisch, Spring 08, Fall 09  
Naveen Prabhat, Spring 2010



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NSE faculty and students are working on both strategic and operational aspects of these challenges, looking at broad energy-related strategies while also pursuing practical ways of enhancing the economic and safety performance of nuclear energy technologies. Since 2006 this work has received support from John M. Bishop, a Canadian engineer and environmentalist with a desire to help develop new means of providing for future energy needs.

Ph.D. candidate Ashley Finan notes that the Bishop funding fills an important intellectual gap in energy research. “A lot of nuclear power’s difficulties are not technical, but policy-related,” explains Finan, who received a Bishop Fellowship in 2008 while earning her master’s in nuclear engineering. “I want to go into a position where I can make a difference in the country’s energy policy and energy systems, but there aren’t a lot of fellowships for that kind of research—the Bishop funding was very helpful.”

Finan now works at NSE’s Industrial Performance Center with center director and department head Richard Lester, investigating and modeling the effect of policy options on innovation in the energy system. On one hand, “technology push” policies such as direct government funding of research and indirect R&D subsidies seek to develop new technologies; on the other, “market pull” policies seek to create or expand markets for new or existing technologies with tax credits, portfolio standards for renewable energy, and other methods.


“Both types of policy are useful,” says Finan. “But they act on the innovation system in distinct ways, and have very different cost structures, so it’s important to have an informed approach. We’re developing an energy-technology innovation model that includes the impact of policy and

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research spending on technological progress, and hope to demonstrate the likely impacts of different policy scenarios.”

Julien Beccherle, another Bishop-funded master’s student, focused his efforts on the use of hollow fuel rods for pressurized-water reactors. Because cooling water can contact the annular rods from inside as well as outside, this type of fuel can boost core power density by 50 percent with at least as much safety margin as traditional solid rods. Beccherle’s work, with advisor Mujid Kazimi, showed that the rods could be adopted in existing reactors, with good economic payback.

Beccherle, who says the Bishop grant gave him the financial ability to attend MIT, now works for the Ministry of Energy and the Environment in his native France. His goal is to build reactors, but he is currently cultivating his skills as a project manager for road development. “It helps me get experience in how to manage complex, financially constrained projects, and also how to handle dealing with the public, which is getting more and more important,” he says. “In a few years, I’ll have the scientific and engineering knowledge, and the practical skills.”

Other Bishop recipients have developed newly integrated methods of modeling reactor functions, and better tools for probabilistic risk assessment, which will improve nuclear plant performance, and also provide better safety metrics for policy-makers and the public. Taken together in the broad context of NSE’s efforts, they are fulfilling John M. Bishop’s wish to “help advance the making of nuclear power in a more economical and safe way.” 

*Written by Peter Dunn . Photo by Andrea Robles*