Cycles of Invention and Discovery: Implications for Energy Policy

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Finding a way to recreate the culture of the great industrial laboratories of past decades, such as Bell Labs, may be the key to sparking inventions that can address serious problems like finding affordable sources of energy in an age of climate change, argued Venkatesh (Venky) Narayanamurti, Benjamin Peirce Research Professor of Technology and Public Policy, Professor Physics at Harvard, and former Dean of the School of Engineering and Applied Sciences.

However, the interdisciplinary, innovation-fostering culture of the 20th century industrial laboratories is a long way from where we are today, in part because of policymakers' reliance on an outdated but powerful paradigm for thinking about research as properly segregated into "basic" and "applied" work. The current paradigm, Narayanamurti explained, was created by the influential 1945 report, *Science: The Endless Frontier*, which popularized the paradigm of scientific research as divided into "basic" and "applied" categories, with a special need for government support of basic research. This dichotomy, along with a linear, progressive conception of how science works, is steering policymakers in the wrong direction when it comes to research funding, Narayanamurti argued.

Change will require new thinking, Narayanamurti said, observing that, "Until you give an intellectual rationale, you can't change the political discourse." In his new book, *Cycles of Invention and Discovery: Rethinking the Endless Frontier*, written with co-author Toluwalogo Odumosu, Narayanamurti attempts to construct an intellectual framework powerful enough to replace this old paradigm, one in which research is understood broadly, and in which science and engineering are treated equally as bodies of knowledge that feed off each other, without a pecking order, and with a focus on the new categories of "invention" and "discovery," rather than the old categories of "basic" (or, ever worse, "pure") research and applied research.

The model for the new paradigm, Narayanamurti suggested, can be found in the work of great research labs, such as Bell Labs in its heyday, which produced an impressive array of innovations, including solar cells, wireless technology, the C computer language, and radio astronomy. There, talent was organized by task, with teams that combined scientists and engineers in an environment that fostered both collaboration and competition, rewarded excellence, and provided the "freedom to fail and the patience to succeed," Narayanamurti (whose career includes 20 years at Bell Labs and at Sandia National Laboratories) explained.

A precondition for these kinds of efforts, Narayanamurti said, is that research funding should be stable and separated from short term profits. The era of the great labs ended, Narayanamurti said, when the Bell monopoly (which had allowed for a steady stream of funding for lab research) was ended. In the current era of competition, government may be the source most capable of providing the kind of steady, reliable funding that such research needs.

Recently, under the leadership of Steve Chu and Ernie Moniz, the Department of Energy has taken steps to try to re-create some of the interdisciplinary research capabilities of the old labs, through programs like ARPA-E (the Advanced Research Projects Agency-Energy) and the DOE's "innovation hubs." While these efforts show some promise, Narayanamurti noted, funding for these efforts is subject to continual attack, in part because policymakers continue to try to view and divide the research into the old categories of "basic" and "applied."

Narayanamurti spoke as part of the Kennedy School's Energy Policy Seminar Series, which is sponsored by the Consortium for Energy Policy Research of the Mossavar-Rahmani Center on Business and Government.