Design Area Eight: Federal Laboratories and Other Assets of the Last 50 Years

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CROW: Design area number eight focuses on federal laboratories and other assets that, in a sense, have been developed as a legacy to the Bush design. Just let me throw out a couple of numbers to put that into perspective. In the spring and summer of 1945, when Bush was putting together *Science: The Endless Frontier* with his panel, there were about 30 research universities in the United States, five of which he identified as mature. There were about 500 R&D laboratories in the entire country. And outside of the technician class of individual working as a part of the Manhattan project, there were fewer than 15,000 scientists operating in the United States, at that time. We now have 150 research universities, 800 federal laboratories, 16,000 or more other research laboratories. Ten thousand of those institutions receive some funding from the federal government.

That's an institutional legacy of immense proportions. As one thinks ahead about what one needs to do in terms of the design of science policy, it's one thing to change policies that affect the tax code or what have you – it's quite another thing, as we were learning in the biomedical area, to change public policy where it affects institutional structures that are numerous and large.

Our panel today, we have shrunk to three people, quite purposefully, because we know everyone's at about their limit. (chuckle)

Our first speaker is Barry Bozeman. Barry is the director of the School of Public Policy and professor of public policy at the Georgia Institute of Technology. Prior to that, he was the director of the Center for Technology and Information Policy at the Maxwell School at Syracuse University. And for the past 13 years, he has been the co-director of the National Comparative Research and Development Project, a multinational project involving more than 30 researchers, focusing on the structure and policy environment of R&D laboratories in several nations. And so Barry will talk to us about the future.

BOZEMAN: Federal labs came under siege when the Republicans won a majority of seats in the House of Representatives in November, 1994, and Newt Gingrich became Speaker. Already reeling from an outbreak of peace, the last thing the federal laboratories needed was political leadership devoted to the arcane 19th Century, nihilist political principle, "Let's blow it up and start all over again." As it turns out, very few labs have been blown up, the only significant one being, appropriately enough, the Bureau of Mines Explosives Testing Lab in suburban Pittsburgh.

However, federal laboratory personnel cannot feel too much at ease as long as influential members of Congress have the Departments of Energy and Commerce in their gun sights.

Federal labs have been victims of social and political forces over which they have no control. They have also, in many instances, been their own worst enemy. Federal laboratories have been accused by the General Accounting Office of waste due to poor accounting practices. The Department of Energy's Inspector General's Office accused the Department's federal labs of mismanaging cleanup of contaminated land. A whistle-blower who called attention to the vulnerability of a nuclear plant was demoted. Perhaps strangest of all, a ghost from the 1950s came back to haunt us as we found out about insidious nuclear experiments being performed on non-volunteers.

My personal favorite came from *The Consumer's Digest*. Amongst all the product reviews of leaf blowers and new cars, there was an article about the war on Washington waste. In it, *Consumer's Digest* complained erroneously that the Energy Department spends one-fifth of its budget on cooperative energy development programs, giving money to firms like General Electric and Westinghouse to support research so they can turn a profit.

I do not want to blow up federal laboratories. That may be an extreme position these days, but to me, it makes about as much sense as blowing up land grant universities because we no longer have a predominantly agricultural economy.

In my view, the fate of the U.S. federal laboratories is a matter of great consequence. Whether or not you agree with a former laboratory director that federal laboratories are "a reservoir of scientific and technological talent that can help to compete in international markets," whether or not you are impressed with the Nobel laureates working in federal labs, the resources devoted to federal laboratories have to command attention.

More than $20 billion per year is spent on R&D for the 627 federal R&D laboratories, which amounts to about one-third of all federal R&D funds expended. Federal laboratories employ nearly 60,000 scientists and engineers, a significant fraction of the U.S. scientific and technical resource base. In addition to producing tens of thousands of scientific and technical papers each year, federal laboratory personnel file nearly 1,000 patent applications. The range of functions performed by federal laboratories is remarkable.

The core functions of such mega-labs as Sandia or the Naval Research Lab are familiar. These labs are involved in a wide range of activities, many of which stretch well beyond the core concept of their missions. If the largest labs receive the lion's share of attention, 700 or so less visible federal labs undertake an even more diverse array of scientific and technical tasks, ranging from collecting and analyzing seed samples at the U.S. Department of Agriculture's National Seed Storage Laboratory in Fort Collins, to devising building materials that will resist terrorist attacks at the Army Construction Engineering Research Laboratory in Bloomington, Illinois. Federal laboratories are engaged in research at every point on the spectrum: basic, pre-commercial, direct, applied, development, and testing.

My objective is to assess and add to the list of ideas about policy change in the federal laboratory system. Before doing so, I am going to outline some of the characteristic flaws in policy frameworks that have been used to analyze R&D policy in the United States. My perspective on this has been developed during my work under the aegis of the National Comparative Research and Development Project (NCRDP), which was begun in 1984 and involved researchers in four nations on a wide variety of technical reports and papers.

During nearly 13 years of work in the NCRDP, we interviewed or sent questionnaires to more than 1,000 scientists, science administrators, and science policy makers in Japan, the United States, Canada, Russia, Korea, Germany, and England. We visited R&D laboratories of every sector and stripe: industry, government, university. Many of these include the largest R&D laboratories, including Lucky Goldstar in Korea, the National Institute for Metals in Japan, and the Brookhaven National Lab. We also spent a good deal of time in the hinterlands, the Fort Keough livestock research center and the Chalk River Atomic Laboratory.

There have been three predominant science and technology policy paradigms in the United States since the beginning of our science policy. The market paradigm for science and technology policy and its attendant economic development implications is based on familiar premises, that free markets are the most efficient allocators of goods and services, and that left to its own devices, an unfettered market will lead to optimal technology and economic growth outcomes. Most policy in the United States, not just laboratory policy or science and technology policy, is strongly influenced by the market paradigm. This paradigm is alive and well.

The mission paradigm has been particularly prominent. The earliest government involvement in science and technology policy was within its framework. The mission paradigm assumes that the federal laboratories' role in science and technology should flow directly from legitimated missions of agencies and should not extend beyond those missions in pursuit of more generalized goals such as technology development, innovation, or competitiveness goals. As such, the mission paradigm is not radically different from the market paradigm. Its roots can be traced to early government involvement in national defense, public health, and, to some extent, agriculture. The mission paradigm is alive and well – witness the Department of Energy's "Alternative Futures for the Department of Energy National Laboratories" (Galvin Panel 1995).

More recent is what I call the cooperative technology paradigm. During the economic downturn of the late 1980s and a perceived crisis in U.S. competitiveness, many of our core assumptions began to be examined, including the bedrock faith in the private sector as a source of all innovation. This was particularly the case as other nations, especially Japan, began to take a different tack and have some success in technology development.

During the 1980s, a number of policy initiatives challenged the preeminence of the market paradigm with a new model, the cooperative technology paradigm. As I use the term, the cooperative technology paradigm is an umbrella term for a set of values that emphasizes cooperation among the sectors: university, government, industry, and cooperation among rival firms in development of pre-competitive technology. Today, the cooperative technology paradigm is alive, but on support systems. It's not doing so well.

The time has come for a new paradigm, one I call the institutional design paradigm. It is oriented toward resolving three major problems that permeate policy making in the United States pertaining to federal laboratories.

First, and probably most important, is a poor basis of empirical knowledge about laboratories in the United States. Not many people even know there are over 16,000 of them. We are concerned about licenses that come out of the federal laboratories, but don't know how many came out last year. In the interest of managing laboratories, we might want to know the administrative intensity level, or the ratio of administrators to scientists. What is the average level? What would be a good level? Nobody knows the answer to questions like that. While we know a great deal about specific labs, we have a very poor empirical base of the system as a whole. We know a great deal about specific sectors, but very little about the system as a whole and its mechanics. That is problem number one.

A second problem is what I call the hazards of stereotyping. It is no longer possible to try to define a "government lab," versus a "university lab," versus an "industry lab." The truth of the matter is, there is as much variance within sectors as there is across sectors. Increasingly, assumptions such as universities are for basic research or industry is for development and commercialization of technology run at odds with the configuration of research resources that we have in the United States.

The third problem is too much ideology and not enough pragmatism. In many instances, the reasons that discussions of science and technology policy in federal laboratories seem to push people into ideological corners is that ideology becomes a sort of a shorthand for a lack of empirical knowledge. It helps us keep a handle on assumptions that we want to make in policy making, in the absence of any empirical knowledge about the outcomes and effects of particular policies. The institutional design approach was developed to try to alleviate some of those problems that are characteristic of policy making for science and technology.

The institutional design approach for science and technology policy is based on just a few straightforward principles. The *player principle* says that most R&D organizations in the United States should be ignored. Most R&D organizations in the United States, more than 10,000, are basically small engineering job shops run out of firms. They may be very helpful to the firms, but they are not particularly innovative and do not contribute to national innovation.

On the one hand, we can ask, "With 16,000 R&D laboratories, how are we ever going to understand enough to make empirically-based decisions about them?" The answer is, "We don't focus on all of them." Because, in fact, there are only about 500 or so that really have the potential to contribute to the national innovation system. This is particularly so if we exclude the handful of small firms that are producing most of the innovations.

The second principle, the *systemic principle*, is that we need to know something about the dynamics by which laboratories inter-relate and respond to environmental change. If we want to understand the impacts that public policies will have on laboratories and not just science and technology policies, but tax policies or labor policies, we have to understand more about the system as a whole.

The *never in neutral* principle says that when we implement public policies in laboratories, those policies are never going to be neutral with respect to existing functions. For example, if we provide a manufacturing extension function to federal laboratories, it affects the preexisting mission of the lab. The work we have done trying to assess the impact of industrial partnerships with federal laboratories has certainly made that clear.

The *comparative advantage principle* says that public policy should be differentiated, targeted, and based on a lab's capabilities and proven areas of effectiveness, not its particular affiliation with respect to agency or sector. Laboratories, quite simply, should be reinforced for doing what they do well. If we want to talk about downsizing or closing laboratories, the reason to close them is because they are not doing well what they are supposed to be doing well.

The *opportunity cost principle* has more to do with the way we should evaluate federal laboratories. It is actually a pretty complicated notion about evaluation, which is that it is not enough for a laboratory to show a positive marginal cost benefit ratio. It is not enough to be able to say that this money was expended in a certain way with a certain multiplier effect. The real question is, "What would have happened if the money had been expended in some other way, particularly ways in which money is already being expended by the laboratory?"

The problem with the institutional design approach is that there are a number of prerequisites, most of which are not now in place. One of the most important prerequisites is a greater knowledge of laboratory assets, capabilities, and performances. Most efforts to measure the assets of laboratories have met with little success. In our own efforts, we have focused on certain areas, but there are wide gaps in the kind of knowledge that we have been able to develop.

Another prerequisite is greater coordination and coordinating apparatus. If we are going to implement an institutional design approach, greater coordination is absolutely required. That does not necessarily mean coordination by bureaucrats, but a variety of stakeholders should be involved in coordinating federal laboratory change.

An additional prerequisite for institutional design is a reduced role for line agency management. I have seen nothing to convince me that the federal laboratory systems' agency affiliation is rationalized in terms of mission or management structure. There is relatively little flexibility even now and not enough decentralization in the federal laboratory system to allow the implementation of an institutional design approach. If we are going to get serious about changing federal laboratories, we have to identify likely agents of change and provide the resources and political will to help federal laboratories fulfill their enormous promise.

CROW: Here is Nick Samios, a physicist. He's been the director of the Brookhaven National Laboratory for about 15 years, prior to that working in a wide range of physics areas – those that are the most complicated, I might add. Nick's going to give his perspective from the seat of a national laboratory director.

SAMIOS: As you noticed, the paradigm changed, and mission went to industry mission and so on, and being lab director through all this is quite a job. And in fact, in my 15 years, I never had a budget at the beginning of any fiscal year. So managing a DOE lab or any federal lab is difficult.

As you've heard, the federal lab complex is rather diverse and under many agencies: Department of Agriculture, Defense, NIH, NSF, and DOE. One distinguishing feature between the DOE labs and the others is that the DOE labs are so-called GOCO labs: government owned but contractor operated.

A comment was made earlier today that it would be nice to separate the government from running the laboratories and that this was wisely done by the Atomic Energy Commission, many years ago in 1946. The other labs are GOGOs, meaning government owned, government operated. In fact, John Deutch, when he was at the Department of Energy, had a review of his GOGO labs about four or five years ago, and the answer was, change them all to GOCOs in order to increase their efficiency and yield of science.

In the discussions here, everyone's familiar with the GOCOs, NIH has been discussed at some length, the NSF has been discussed at some length, so I'm going to concentrate my remarks on the DOE labs – one, because I'm more familiar with them, and secondly, there seems to be really a lack of knowledge on the part of many people of what they are and what they do. Let me take my remaining time to discuss them.

The DOE labs, which are not large in number, break up into three large categories. The first are the defense labs that have been tasked with worrying about national security from the beginning, Los Alamos, (UNINTEL) and Livermore. And now they're going into weapon stockpile stewardship, so their mission is rather straightforward.

Second category is what I would call the single-purpose labs, those that have a single, well-defined mission such as FermiLab, which does high-energy physics, and Stanford Slack and CBATH lab at Virginia, which does nuclear physics.

What they do is really defined by their missions. National security goes out the window? The national security labs have some difficulty. If high energy goes out the window, then these other labs have to do something.

The labs that are more confusing are what I would call the multipurpose labs, which also rose after the Second World War – laboratories such as Oregon, Oak Ridge, Berkeley, Brookhaven, and Pacific Northwest. They are more complex and, as a result of the AEC coming in, these labs did a multitude of things – very little in national security but in the energy domain, in nuclear medicine, and so on.

They evolved for another reason also. One of the main reasons for these labs is the ability to design and construct very large facilities – large facilities that universities and industry acknowledge are too big for them to manage.

So I'd like to make a few comments about this capability of the DOE labs. First, the ER part of DOE, the part that is responsible for research, is in funding comparable to the NSF. Its budget is $2 billion to $2.5 billion a year. That's the first secret that people don't understand. In the research area, DOE is as big a player as, if not a bigger player than, NSF.

The second comment I would make is, most of these labs, nearly all of them, operate under a peer review system in the sense that DOE sets up committees to review them with outside gunslingers mainly from universities. The contractors who are responsible for the health labs do that whether they're universities such as University of Chicago, University of California, or consortia such as associated universities and University Research Associated, AUI (Associated Universities, Inc.)and URA (University Research Administration).

Third, universities are starting to realize that the single-investigator mode has seen its better days and that one should have groups of people working together and go for block granting. This occurred at the national labs years ago, and most labs are getting their scientists to be less and less individual investigators and more and more in groups.

Furthermore, to evaluate how good the science and international labs were, there have been two national studies over the last six years, one in materials science and one in nuclear physics, where the research of the group of national labs and universities as funded by DOE and NSF was evaluated – and if anything, the DOE research was deemed slightly better, but you couldn't distinguish. So on all these things, I wanted to point out just as background that the research labs, the DOE labs have their Nobel prizes and so on, on a peer review system.

The other asset of these multipurpose labs is their ability to do multidisciplinary research. Universities know how difficult it is to get two departments together or make one appointment between two departments – but in national labs, setting up new departments, getting rid of old departments is rather straightforward. One has to be a little careful. I personally have probably wiped out at least three departments and created a similar number. Not easy but doable.

There's a synergism at these labs in a sense that there are things that one can play with and pull together. One good example is the evolution of light sources, the devices that produce intense beams of light. These came about at national labs because there was accelerator expertise there and expertise in chemistry, biology, and materials sciences. Now, there are comments that maybe we have too many light sources, but it certainly has been one of the great successes of the DOE system.

Even lately, the labs are working together, hard to believe but it's true. In the national security area, that’s been true although there's been competition between Livermore and Los Alamos. In fact, they were created to have some competition, but they have worked together in the national security area and rather successfully in the other areas, for instance,, in accelerators. Several accelerators have been built on the West Coast jointly between Stanford and Berkeley laboratory. Another example is a joint effort going on now to design and build a very large neutron source, a pulse neutron source at Oak Ridge and the laboratories involved are Oak Ridge, Brookhaven, Berkeley, Los Alamos, and Argonne. So we have synergism, and we have cooperation.

The name energy, Department of Energy, is probably a misnomer, it's giving us problems, and maybe it should be changed at some time. The business of the Department of Energy has been national security and science, at the tune of three billion bucks a year, but they also do energy and environmental missions. So they really have four missions. However, they're called energy labs, and so that causes some difficulty. Maybe a better nomer is science and technology national labs.

Although they're under attack, one has to look at their missions and what they should be tasked to do. One of the basic things is certainly long-term, high-risk research that has a general, national impact, which universities and industry can't do or won't do. It's scale. It's very hard for an institution even as great as Columbia, which built Nevis and I did my work there.

These facilities are really used by the community at large, both universities and industry. The number of users from universities in each area is on the order of four to five thousand. And in fact, the facilities are used in a manner that inside groups and outside groups compete on an equal basis, and I think that's terrific. I would comment that the light sources have been a great benefit to industry. If you look at the people who are utilizing them, you will find industrial participation at the tune of 30%. And that translates into hard dollars.

For instance, at the light source at Brookhaven, where we have 2,000 users per year, take a third of that, that's the industrial component – but equally important, industry has pumped in over $100 million in equipment on the floor. So I would say in these discussions of dismantlement, changing whatever we do, it should be done in such a way that we have a seamless transition that preserves these great national assets that we have in our national labs.

I'd like to close now with a story and an observation. The story is one told by Vice President Gore, and I read it in The New York Times, so it's got at least a 25% chance of being true. It seems that he was addressing the UJA (United Jewish Appeal), and he said, "The time came when the United States elected a Jewish President." And so the president got on the phone with his mother, who was in New York, and said, "Ma, you gotta come down, I'm being inaugurated." She said, "No, no, I can't do it." Finally, he said, "I'll send Air Force One to get you, I'll even send the Secretary of State to accompany you." "Fine." So she agrees to go down. And she's on the reviewing stand. He's raising his hand, his mother turns across to the Secretary of State, and says, "You see that man? His brother's a doctor."

I tell that because of the NIH exponential curves of funding, and I wish I had their problem. I think one thing I've learned here is that we've got to work together. As we've all said, we've had the great luxury of not having to go to Washington for the last 30 years to really battle as other fields for our funding. We got it very easily. They used to say, you're a great scientist, we love you. That's changed. What did it? Everyone agrees. Partially the end of the Cold War, but equally important is this agreement by the Democrats and the Republicans that the budget deficit at least on paper has to be closed by 2002. That drives the funding in many ways, especially in discussions with OMB. We are part of the discretionary funding, and that's getting smaller and smaller. So it seems to me all that points to working together to make our case, and we must make our case.

Peter Eisenberger asked, what are we doing about it? I have one positive comment to make on that. At least the physicists are convinced that we must work together. I chair the policy committee on the American Physical Society, and at one of our meetings, we set up a group to work with all other disciplines, chemists, biologists, to try to organize an effort whereby we make our case for all of science, not for our individual parochial disciplines. So I'm very optimistic.

In my interactions with Congress, even the Young Republicans, everyone agrees science is great. But then they have a choice, and you've got to give them the arguments why they've got to give us the funds instead of taking them away from us. So I think we've got a good story to tell, let's work together and do it. Thank you.

CROW: Our last panelist of the conference is Michael Telson. Mike is presently the special assistant to the Deputy Secretary of Energy; he's been doing that the last two years or so. For the 20 years before that, he was a principal advisor and policy maker to a range of groups within the Congress, primarily the Budget Committee on the House side, where he dealt extensively with issues of science, technology, energy, the environment, and so forth from a macro-policy perspective as well as a micro-policy perspective. Prior to his service in the House, and he may even be one of the earliest MIT Ph.D. s who has served on the House staff for a long period of time, Mike traversed his way through that program. So, Mike Telson.

TELSON: I was going to tell a little racy story, given the end of the day and the lateness and our willingness to get out of here, but I can't let Nick Samios get away with telling a Jewish joke and me not doing it, seeing that I am Jewish. So, to reinforce the point of the story of working together, I don't know how many of you heard the story about the yeshiva crew team. They were losing every single race, and so they finally decided they had to go up to Harvard to find out how to really win races.

So Moshe goes up to Harvard and learns and comes back and Aaron says, well, Moshe, so how'd it go?

Moshe says, well, geez, I learned a hell of a lot.

Aaron says, really? Is it going to be helpful?

It's going to be incredible. We're going to start winning.

Really? Why?

Well, in Harvard, they do it exactly the opposite of what we do.

Really?

Yeah, there they have eight guys rowing and only one guy shouting.

So, that is a very good story about this because the cacophony of voices in D.C. when you're seeing everybody shouting is a pretty ugly picture by the way. And we can get into it later. That's not the main point of my story right now.

Let me first talk about some of my observations of the program today as a whole. One of the things I noticed today in the discussion of the Bush report, I found troubling. The lessons of the report don't lie in a line by line analysis of the report. In other words, we're sort of looking at each sentence, each prescription. That's not the point.

The point – and other people have said this – is that the idea was basically right in the historical context in which it occurred. And even though the precise prescriptions that he made did not come to pass, in large part, they affected the development of the postwar scientific establishment, basically because the report came at a time when World War II had taught our parents and our grandparents the power of bringing science to bear on the solution to national problems.

That was really what happened. John Holmsfeld said earlier today how groups of physicists worked in labs to create the radar and the bomb, and of course the bomb was what created DOE. That was the beginning of DOE, the Atomic Energy Commission. And of course the Atomic Energy Commission didn't seem to hurt the Atomic Energy Commission's labs even though I would find that a more objectionable name than the Department of Energy. Wouldn't you say?

Roosevelt said it very well in his letter to Bush, which probably Bush wrote for him. I don't know how many of you remember reading the letter request. He said, "New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness and drive with which we have waged this war, we can create a fuller and more fruitful employment and a fuller and more fruitful life." There's no mention of science there. It's more fruitful employment and more fruitful life. To me, that's the basic point.

The group of physicists who worked on the bomb led to the establishment of the AEC, born as a nuclear weapons agency as well as, and few people realize this, a national nuclear physics agency. It was a science agency from the word go. That was not an accident, it was very much in the charter. It could have been called the Department of Physics, but it wasn't quite sexy to call it that at the time.

That's how Brookhaven was born. Nick didn't touch on this because it was a little bit of an embarrassment, the accidental nature of how it was born. I recommend to you Norm Ramsey's comments on the occasion of the 50th Anniversary of Brookhaven, of AUI – really the Associating Universities, Inc., which runs Brookhaven for the Department of Energy. That happened in January of last year, and in that celebration, I read the materials, letters from 1946 leading to the establishment of the agency, and it was basically a deal between Leslie Groves, who had some money left over after the war and who had a hell of a lot of authority, and scientists, physicists mostly. Norm Ramsey, who was at Columbia then, who is still around and who is a Nobel Prize winner at Harvard in physics, who basically said, if you liked what we did for you during the war, let us show you something else – we've got a few more tricks in our bag.

And the kinds of things they referred to, in retrospect, are mind blowing. This is 1946, but let me just name a couple of things they mentioned. This is in a letter to Leslie Groves, who was then head of the Manhattan Project. They identified the application of radioactive tracer methods to the study of physical, chemical, and biological processes, the use of radioactive materials for therapy, and for the production of power. They proposed addressing problems of the biological synthesis of proteins, the photosynthesis of sugars and cellulose, and fixation of nitrogen by bacteria.

These are things that now we take for granted. Then, they were dreams. But these people knew how to express those dreams in ways that would be urgent and real to the policy makers of that time. That's essentially what I think we ought to be doing now.

In fact, just to digress a second, I'm here today because Martha Krebs, who is director of energy research now at the Department of Energy, is scheduled to attend today the 50th anniversary of the founding of the Argonne laboratory. So we're going through a lot of these 50th anniversary situations in the next few months.

Let me turn now specifically to the Department of Energy. Nick touched on some of these things, so I may be repeating some of them. The Department of Energy has a wonderful system of laboratories. When I was on the Hill, I did NSF, NASA, the overall science budget, federal R&D budget preparation, sort of looking over how much we spent each year and divvied up among the different agencies and DOE. And I was always impressed by the different characters of research, the different styles among the agencies. Very different.

Nick mentioned some of the laboratories, I think we face three kinds of problems right now. One is the general budget-cutting climate, which we will deal with over time.

Second is a move to a closure commission, submitting labs, not only DOE labs but other labs as well, to a base closure commission model of legislation. Basically, you get a group of people together to form a commission, and these people go away, deliberate for six months or a year, and come back with a list of labs that will be closed. And if the Congress, on an up or down vote, agrees to it, they're closed.

It turns out that one of the bills in Congress actually says that if the Congress does not vote to keep them open, they would all close. So these are the kinds of deals that are going on these days that have to be watched.

Third, the dismantlement thing. I don't want to take too much time on that, but I can give you chapter and verse why dismantlement would be not helpful to the long-term survival of the system that we have right now at DOE.

The other thing that surprised me about the labs is that, as Nick said, very few people know about the labs outside of the labs. You see, in Congress, you get a very distorted perspective, because the congressmen from the labs know it, the senators from the lab know it, and you know it because they know it. But you hear from everybody else that it's like a free good. I call it the tragedy of the commons being applied to laboratories. Everybody takes them for granted, and because they're everybody's property, they're nobody's property.

So you ask researchers all over the country about Brookhaven, using some of the facilities there, and they'll say, oh, is that a DOE lab? Or, gee, we thought Brookhaven's funding came from Columbia. It's an incredible thing to see where people think the money comes from. They think it grows on trees. They don't realize that there's a system that feeds the laboratories, that basically brings the money, and that they have a stake, even though they don't know it, in making sure those common user facilities – where their students might be employed, where the faculty may have joint research projects – those places have their own funding problems. It's surprising to me how little understanding there is of that.

Just to touch on a couple of other things, the DOE system Nick mentioned – $6.4 billion in '97 is what we think we'll be spending in R&D, $600 million of that to universities. The basic research component, or if you will, the university support component is more than a quarter of the size of NSF, just to universities – that's also not well understood. It's not understood that the DOE and the labs support 40% of federal support of physical sciences in the United States. No other agency, including DOD, NASA, NSF, you name it, Commerce, provides more than half of that amount. There's good reason – we spend about a billion on just high-energy and nuclear physics, $1 billion on just those two fields.

We are very busily engaged in a system of revealing the labs of the Department of Energy to make sure that they're as efficiently run and there's as little overhead as possible. It is not a perfect system, but we have a very detailed, very torturous process underway, called the Strategic Laboratory Missions Plan. We have published some of the materials, opening up what the labs do to everybody, which I think is unprecedented. That will make it clear what they do, how the outside community can work with the labs, how they can compete with the labs, all these aspects.

What I would say to bring us back to the beginning is, I would not blow them up. I would mend them, don't end them, to quote another member of ours. In any event, I think I'll end there and look forward to your questions. Thanks.

QUESTION: Just a speculative question about policy for large-scale facilities such as light sources. Under similar cost pressures in other parts of the world, there's been a move to introduce user fees for these facilities. Would you comment on the feasibility of this, its political implications, if possible, ramifications for the research communities of going in that direction?

MALE VOICE: This is an idea that has surfaced at least twice before in the United States, once when John Deutch was head of ER and even once before that. We ought to keep the books of why we didn't do it.

From an operational point of view, it's a disaster. Every large facility has a leverage factor. In other words, if you ask, how much money does it take just to open up the door and what is the fraction that it takes to do the science? – the factor is between four-to-one and eight-to-one, which means that if you reduce the budget between 10% and 20%, you will do zero science with that facility. And you can't operate that way.

The people who run these facilities are highly skilled. It takes two to three years to train a person to run these facilities, so you don't have the luxury when you reduce their budget of firing 20% of your people to take care of it. That's why the leverage factor is so large. So you must know that number at the beginning of the year. If you have user fees, how do you do that operationally?

I had the pleasure once of running a facility that had funding from four separate pockets: materials science, biology, high energy, and nuclear, and with a leverage factor. At the beginning of the year, one of these disciplines would drop the budget a little bit, and as a result, the budget would have to go up in another discipline, so you had a feedback mechanism that was absolutely out of whack. So that's why I comment that, operationally at least, it doesn't work. There are other reasons why it’s a bad idea, but I'll give it to Mr. Telson.

TELSON: As you'd expect, management's perspective is somewhat different. We are looking for ways to do it, but Nick is right, that it’s not a trivial thing to do. We do have a policy to charge industrial users who are using the facilities for commercial purposes, uses for which they appropriate the benefits. They have to pay, I think, full cost of their use – full cost defined as, they pay the variable cost plus some contribution to depreciation. We had a hearing on the Hill, on August 1, and the transcript of that should be available soon. Deputy Henson Moore under the Bush administration was very interested in the issue, and we are as well, but it's not a trivial thing as you can imagine.

SAMIOS: I’d like to continue on that because Henson Moore was at the lab over three years ago, and he brought it up when he was there, and I told him it was a dumb idea then. The full cost recovery, for instance. Suppose you wanted eight hours on the light source – how much would it cost? At Brookhaven, it would cost you something like $300. You'd say, how can you do that, with it having cost $50 million to build it and operate it and so on? But if you do the arithmetic, and you amortize it over ten years, and you divide by 100 because that's the number of beam lines that are run simultaneously, you could see it's a very cheap thing for industry to come in and do proprietary research at our research institutions.

MALE VOICE: I'd like to comment a little bit on that, surprisingly. Nick doesn't know this, but I did a case study at Brookhaven in 1987, and one of the things that I used as a case study was the light source. One of the first things that I asked the director of the light source was about user fees. While I won't go into this in great detail, I became convinced, one, that user fees were not a good idea for the light source and, two, that the light source is not a good example for the question of whether there should be user fees. So the light source is distinctive in many ways. Perhaps unique.

On the much more broad issue of industry payment for property of research with federal laboratories, our research has shown again and again that it makes a lot of sense and that a very modest amount of industrial financing of government partnerships or federal laboratory partnerships has a big payoff. Apparently, just a modest amount of an investment gets a different degree of attention than what otherwise would be brought to a cooperative research agreement. So I think probably the question of user fees has to be separated out from the light sources, and the question of user fees also needs to be separated out from a question of industrial financing of property or research.

QUESTION: First, I'd like to say that this has been a terrific session. I've enjoyed every one of the presentations. I'd like for each of you to inform us of your ideas on how we can best convince Congress, the media, and the American public to support the national laboratories. Could you each say a few words on that subject?

MALE VOICE: That's not a mission I would undertake personally. I think probably one of the mistakes that we've made is not only overselling the national laboratories but selling the wrong thing. If you look at the policy deliberations about national laboratories – and I know that people at DOE haven't been responsible for this – it's absolutely astonishing what percentage is dominated by technology transfer, industrial partnerships, and so forth, and that's such a small percent of what's going on at DOE labs. So I think I would try to sell something a little bit different than regional economic development. How to go about selling the activities of the national laboratories, I will defer to the people who run them.

MALE VOICE: I'll take a short answer. As I mentioned, one of the great strength of the lab, if it's true, is our user community. It's rather large, and so if we speak for the national labs, it's self-serving. I believe it's up to the user community to say, are these things important and how important to the marketplace are they? I think we've been a little bit negligent about asking for some help, but since times are difficult, I think we've got to turn to the user community to state the usefulness of the labs. And it's a rather large community, it's rather largely geographically distributed, it's in all of 40 states, and those people writing their congressmen and senators, I think, would have a very large effect on this issue.

MALE VOICE: Nick is a very good example. He works very well with his communities, in the case of Brookhaven. In certain places, it's so obvious that this thing is important economically, it's important politically, industrially, that the sale job is not much. But in other places, they're having major problems, particularly where the labs are smaller, or where there is a lot of other activity in the state or in the district.

There's no magic to it. I think every lab has had to discover its own formula for doing it, but the formula basically is, you have to make sure people understand your contributions to the public well-being, both directly and in long term, and you have to tell the public what that means in terms of what the public official representing that area is supposed to do. If you just say great things but it turns out that what the public official does has nothing to do with what he's being asked to do, that's not good for business over the long term. So it's a matter of working with the public just like you'd work with any other issue. It's not just the labs.

MALE VOICE: Well, I want to thank particularly the last set of panelists. It's not easy in a very, very densely packed two-day conference to be the last ones on a Saturday at around five o'clock.