Chief scientist Ellen Williams seeks to bring new energy to BP

After spending three decades in academia conducting nanotechnology research, the chemist-turned-physicist is now tackling the energy problem in the faster-paced industrial environment.

Just three months into the job, BP chief scientist Ellen Williams watched the tragic events unfold following the April 2010 explosion of the Deepwater Horizon oil rig in the Gulf of Mexico. The accident killed 11 workers and triggered the largest-ever industrial oil spill; by September more than 500 million liters of crude oil had gushed from the damaged deep-water well owned by BP.

Williams says that in the months following the spill, she got increasingly frustrated as she tried to parse the news media's "confusing and often contradictory" reports of the details of the accident and the attempts to plug the well. "It bothered me that if I couldn't understand on a technical basis what was going on, then what about others?" So heeding her academic instincts, she rounded up experts in oil exploration and environmental sciences and asked them to put together a technical talk on deep-water drilling, which they would take to BP's university research partners around the world. "We wanted to give them just the facts," says Williams. "Not proselytizing. Just giving them the opportunity to decide for themselves what all this stuff meant."

That's the kind of approach that the London-based energy company expects from the chief scientist position. "I was hired by BP to advance the basic science that underpins their technologies and also to serve as a liaison to its university partners," says Williams, who is on leave from her position as Distinguished University Professor at the University of Maryland in College Park.

A Caltech graduate with a PhD in chemistry, Williams has been honored by the National Academy of Sciences and other science organizations for her fundamental contributions to understanding the nanoscale dynamics of electronic materials. She says conversations with her BP predecessor, former Caltech theoretical physicist Steven Koonin, affirmed her decision to accept the chief scientist post. In addition to Caltech and BP, Koonin and Williams are also linked as members of JASON, an independent body of prominent US scientists who provide technical advice to the Pentagon and other federal agencies (see the interview with Koonin on page 19).

At BP, Williams has participated in the establishment of the $500 million Gulf of Mexico Research Initiative, which funds Gulf Coast universities to investigate the impact on the ecosystem of chemical dispersants used for oil-spill remediation. Though funded by BP, she says the initiative is "very independent" of the company.

Williams also administers R&D investments for BP, which touts the slogan, "Beyond Petroleum"—a signal of the company's interest in alternative energy technologies. "Biofuels is our single biggest R&D expenditure right now," she says, noting BP's funding of the $500 million Energy Biosciences Institute, a consortium of researchers at BP, the University of Illinois at Urbana-Champaign, Lawrence Berkeley National Laboratory, and the University of California, Berkeley.

PHYSICS TODAY caught up with Williams in November, a few weeks after she spoke at the Industrial Physics Forum (IPF) on sustainable energy, sponsored by the American Institute of Physics.

PT: What prompted you to make the jump from academia to industry?

WILLIAMS: The big draw for me was the opportunity to get involved in a substantial way with energy issues—energy being a huge important problem for the future of the world—and with technology that could potentially address some of the energy problems.

PT: Almost two years into the job, what do you miss about academia?

WILLIAMS: I miss teaching. I miss having the time to really sit down and just go deep into a subject. Industry is really

BP

BP's 32-MW solar farm at Brookhaven National Laboratory began operating in November 2011.

A missing variable in the clean energy equation

Steven Koonin, a former chief scientist at BP, was confirmed by the Senate in May 2009 as undersecretary for science at the Department of Energy. He resigned from DOE on 18 November to accept what he says is a temporary position at the Institute for Defense Analyses, a think tank in Alexandria, Virginia. PHYSICS TODAY spoke to Koonin on 22 November. Following are excerpts from the interview. The full Q&A is available in the Politics and Policy section of http://www.physicstoday.org.

PT: Did you find your experience at BP useful in your role as undersecretary?

KOONIN: Absolutely. Energy needs to happen through the private sector. It owns, builds, operates essentially all the energy infrastructure in the country, and I don't think we have any intention of changing that. So if you're going to be effective in technology development and regulation, you really have to understand the private sector and how it thinks. That doesn't mean that you fold to it; there has to be a healthy tension between the government and the private sector. I could wish for more people in the government who had that experience. In fact, I would say more generally that many of the people reading PHYSICS TODAY are in the academic world. If they want to really change energy, I would strongly recommend six months or a year out in the private sector, whether in a big company or a small startup. It really is a very different mindset than what a basic researcher has.

PT: That would be enough time to accomplish something? A sabbatical?

KOONIN: Look, you'd like more, but you will have the realities of the academic cycle. Go sit inside a big energy company. And I'm not the only person who's done that. Boy, does it change your view of what's important and what's possible, and of how things happen.

PT: Do you think the energy companies would invite them?

KOONIN: I think for the right kinds of researchers they would. I've made the suggestion on a number of occasions to corporate folks, and there seems to be enthusiasm in the abstract.

PT: What's your next career move?


DOE

Steven Koonin

KOONIN: I think come the start of the next academic year, I will be in one or another of the nation's great universities. My interests are now in fusing the social sciences and policy together with technology. For some of our biggest problems, whether they're energy or other big problems in society, the technology is in many ways the easy part. The rate-limiting steps for many of our problems are societal: how people behave, what incentives there are, et cetera. I think the social sciences have a lot to bring to that discussion that has not really been exploited yet. That's the direction I'm headed in; it's still science, and it's still in some ways goal driven. But we've got to pay attention and better understand the human issues here: policy, behavior, economics, perception, and how we fuse that with technology.

David Kramer

fast paced, and I have to struggle to grab any time to put a lot of attention into a problem.

PT: What kind of impact do you think you can make as an academic in an oil company?

WILLIAMS: My research is in condensed-matter physics and electronic materials, but a lot of people don't know that my background in graduate school was in chemistry and catalysis and in surface chemistry. The other aspect of my background is that, as a member of the JASONs for close to 20 years, I've had the opportunity to look at a range of technology programs and to understand technology assessment and technology development. In industry, people have learned to push really hard to drive through programs to completion, so part of my job is to bring that academic perspective of really rigorous science, asking deep questions, and being very demanding of proposed hypotheses.

PT: At the beginning of your IPF talk you spent a few minutes on BP's ongoing response to the Gulf Coast oil spill. As BP's chief scientist, are you obligated to do that at every public appearance?

WILLIAMS: I think it's really important to address the oil spill. I've been doing it in all my talks, and I've been watching the audience reaction. So far, I haven't reached the point where I've had the feeling that the audience was bored with what I was saying. Once I reach that point where people say, "That's old news, we don't want to hear about that anymore," I'll stop doing it. But I get the feeling that people are still concerned and worried and want to know what really happened and where things stand.

PT: At the IPF, you said that the company is pulling out of the solar-panel manufacturing business. Why is that?

WILLIAMS: Yes. We used to have a big solar manufacturing capability in Frederick, Maryland, but Chinese manufacturing has driven the price of solar panels down more than 30%. In one sense, that's a good thing for the world because it makes solar energy much more affordable. But it's a bad thing for US manufacturing because we can no longer be competitive.

We still have a solar research farm at Brookhaven [National Laboratory] and at sites in a few other countries. The Brookhaven initiative is a solar farm where we're manufacturing power, combined with a research activity trying to understand how to make solar energy sustainable.

PT: Is wind energy still a focus at BP?

WILLIAMS: Wind is a good business for us. We've got a lot of wind farms up and a whole lot more under way. Wind is coming very close to being breakeven with more traditional forms of power generation, but you still have to deal with intermittency. So for us, R&D in wind energy has been focused on developing best practices of running the wind farms right at the cutting edge of efficiency.

PT: Why has BP decided to focus on biofuels?

WILLIAMS: BP made a decision to leap into biofuels as part of our commitment to a diversity of energy options. Of the potential types of alternative energy options, biofuels is well suited to an oil company because, of course, it's a liquid fuel and matches a lot of the value chains and capabilities that we already have in place for petrochemicals and

BP

BP chief scientist Ellen Williams stands with her manager David Eyton (center) and her colleague Roger Humphreville in front of a crop of napier grass in Highlands County, Florida, where the company is building a commercial cellulosic biofuels production plant.

refining. So in a sense, it's a natural fit.

We are aware of the pitfalls and environmental concerns—for example, deforestation and the conflict of food versus fuel. So the real leap we wanted to take was to move beyond the food component and make use of the entire plant. The cellulose and hemicellulose, the woody components, can be broken down into sugars using acid treatments. But the challenge is taking the mix of sugars and economically fermenting it into fuel. We've been working with traditional fermentation yeast, and the Energy Biosciences Institute has been doing great experimentation with new types of yeast that can be bred to address those specific types of sugar mixtures.

PT: BP is also an industrial partner on the carbon-capture and storage demonstration plant in In Salah, Algeria, a region rich in natural gas. What progress has been made with CCS technology?

WILLIAMS: There have been some promising results from In Salah. They're working out the practical how-tos. Basically, CCS makes sense because the oil and gas industry already knows how to put CO_2 underground. We're just figuring out the best ways of keeping it there. A bigger challenge, though, is the declining support around the world for dealing with CO_2 mitigation. That's frustrating [because] BP is a business, and CCS would only bring value if we can make it commercially viable.

PT: You were involved in various science education outreach programs at the University of Maryland. Will you look to do the same at BP?

WILLIAMS: We sponsor an annual program called the Ultimate Field Trip, where we take university students and form teams to address one technical question, such as, "What can you use the platforms in the North Sea for once all the oil is gone?" The winning team this year got to intern on a BP oil and gas platform in the North Sea. Next year, [the internship] will be in the Gulf of Mexico and Trinidad.

Jermey N. A. Matthews

Chile aims to better exploit role as telescope host

The country's scientists and engineers are starting to take part in the design and construction of telescopes, a trend that could boost other industries and the economy.

Wine, copper, and mountains, move over! Add astronomy to the things that Chile is known for and that make up its cultural identity. The country has been home to international telescopes for nearly 50 years. Now the Chilean government is stepping up its efforts to reap economic, educational, and cultural benefits from the observatories' presence.

Some of the world's best sites for astronomy are in Chile, thanks to high altitudes and clear, dry skies. In September, the international Atacama Large Millimeter/Submillimeter Array (ALMA) opened to experiments, joining dozens of telescopes that have made Chile their home since the early 1960s. Future projects coming to the country include the European Extremely Large Telescope, the Tokyo Atacama Observatory, the Cornell Caltech Atacama Telescope, the Giant Magellan Telescope, and the LSST (Large Synoptic Survey Telescope). By 2020 Chile will have an estimated 70% of the total surface area of the world's telescopes, notes Mónica Rubio, director of astronomy for Chile's National Committee for Science and Technology (CONICYT). "The main discoveries in astronomy in the next decade will come from Chile."

About three years ago CONICYT declared astronomy a "strategic area." That means, says Rubio, "there will be major efforts by the agency to attract more funding from the government." A national decree issued more than a decade ago protects three northern regions of the country from light pollution; now the government is establishing an "astronomy park" for future observatories, where mining and geothermal and water exploitation are prohibited. And to leverage the telescopes to have the biggest possible impact on

J. STOKE (NRAO/AUI/NSF)

The Atacama Large Millimeter/Submillimeter Array in northern Chile is more than one-third complete. When finished in 2013, it will consist of 66 radio telescopes spread over nearly 260 square kilometers at an altitude of about 5000 meters.