



Global energy challenges

An interview with Ernest Moniz addresses conflicting challenges that demand immediate attention

With an ever-increasing energy demand, rapidly depleting resources and a changing climate, the world is facing many challenges. ABB interviewed Ernest Moniz, professor of physics at the Massachusetts Institute of Technology and director of the MIT Energy Initiative, for his take on the global energy crisis.

What do you see as the main global energy challenges?

There is a perfect storm of three major challenges. One is around the whole issue of global supply and demand. We may be having a slowdown over the next couple of years, but this is a temporary response to the global economic downturn in terms of the greatly increasing future energy demand, driven in large part by the emerging economies. Electricity demand is the fastest-growing component of this and is expected to roughly triple from 2000 to 2050. But we should keep in mind that this increase represents not much more than raising the majority of the world's projected nine billion people in 2050 to what we would term in the OECD today a relatively low per capita use of electricity. In other words, there is a very real pressure for growth.

The second challenge, I would say, is the whole set of issues around energy security, including dependence on a few oil and gas suppliers and concern about nuclear proliferation. These issues are acutely felt, certainly by the populations of wealthy countries.

The third big challenge is the risk associated with climate change. This is, in my view, the most dramatic of the three challenges since we have a global energy system that is roughly 85 percent fossil-fuel dependent. So when we ask to have a major reduc-

tion of carbon use in a system that is mainly carbon based, we are obviously talking about a very dramatic transformation. Now why is it a perfect storm? Because there are inherently some tensions in the responses to these three challenges.

What is wrong with the strategy of continuing with business as usual and adapting as necessary when the time comes?

The remaining uncertainties that we have in understanding climate effects are a strong motivation to limit as far as rationally possible the accumulation of greenhouse gas. We face the big worry that we could experience significantly more abrupt, non-linear changes in our climate that drive us toward fairly catastrophic results. We need to push climate risk mitigation as hard as we can, recognizing that from where we are today, we cannot avoid a substantial measure of adaptation.

Do developed and developing economies face essentially the same challenges?

The obvious common challenge is climate change, in that it has a global impact. However, the nature of the impacts will be different everywhere. Deserts are expanding in China, and the Middle East faces severe water issues. We see a very dangerous reduction of snowfall and ice pack in glaciers in the Himalayas, and we

often forget that the major water flows from the Ganges River to the Mekong River are driven by that. If you decrease these flows, can you contemplate the implications for over a billion people living in that arc?

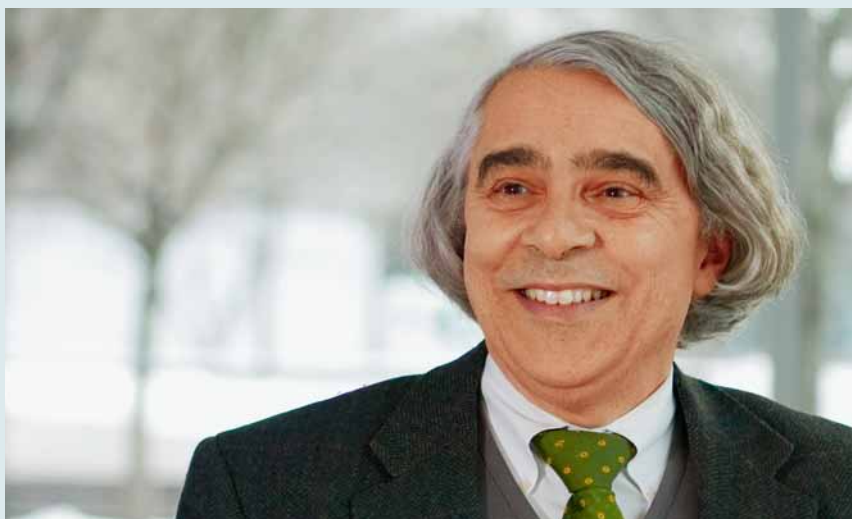
There are opportunities as well. The developing countries will lag the developed countries in terms of a serious climate response, but the rate of growth of their energy infrastructures will be much greater, providing a greater opportunity to employ new technologies. But we have to make sure developing societies can afford these technologies. Change will take a long time, but if these societies develop their energy infrastructures using old technologies, then we are placing an even greater mortgage on the future.

So what do you see as the most promising strategies for tackling the challenges we've discussed?

The number-one target should be to increase energy efficiency in residential and commercial buildings – the proverbial low-hanging fruit.

Decarbonizing the electricity sector is very likely to be another major focus in the relatively near term. There are multiple opportunities, one of which is simply moving from carbon-intensive to less carbon-intensive fuels: coal to natural gas, for example. There's also the possibility of carbon

Factbox Professor Ernest Moniz



Ernest Moniz is professor of physics at the Massachusetts Institute of Technology (in the United States) and director of the MIT Energy Initiative, an institute-wide program designed to help transform the global energy system to meet the challenges of the future. He served as Under Secretary of the U.S. Department of Energy from 1997 to 2001. ABB and the MIT Energy Initiative formed a research partnership in 2008.

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capture and sequestration in coal mines. The technology is yet to be demonstrated in a material way for commercial application, but it's an important option. Then, of course, there is a potential major expansion of nuclear power, which apart from hydro is the major non-carbon source today, providing a sixth of the world's electricity. In a few select regions, hydro may still have some opportunities; and then there are the other renewable sources of energy. Wind is beginning to make a material contribution, at reasonable cost in good

sites, and solar is seeing rapid cost reductions and has very considerable potential. Improved electricity delivery will be an important enabler. So there are multiple technology pathways to address the issues in the power sector. The real issue is getting on with the job.

There's clearly a big role for policy in all these strategies, but how can the government help without trying to pick technology winners?

It's in principle fairly simple, although by observation apparently politically

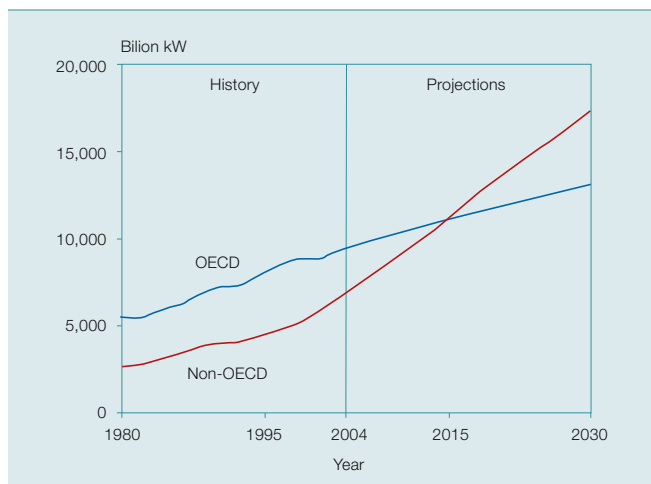
fairly difficult. First of all, a policy to incentivize lower carbon should do just that, and not pick the technology. Secondly, technology development and demonstration should be as technology neutral as possible. Choices must be made when funding demonstration projects, but we need to be funding much more aggressively a portfolio of projects that push us in the low-carbon direction.

With technologies that we have in hand today and a dedicated program, we could have a dramatic transformation of the energy delivery system in a 10-year period.

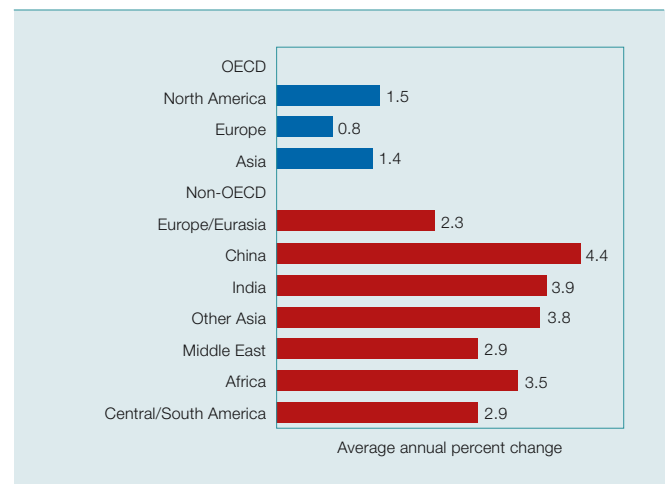
Is a cap-and-trade system, which many markets seem to be evolving toward, sufficiently neutral to achieve the goal of carbon reduction?

A cap-and-trade system is in principle neutral if it really is an economy-wide cap, eventually with auction of the emissions credits. If you design an efficient system for gathering the revenues and returning the revenue to the population – payroll tax reduction, income tax reduction, check per unit of population – GDP should not suffer in any appreciable way. However, different regions and industries get hit in very different ways, and that inevitably leads the political system to consider how to compensate for these

World electric power generation by region
(Source: IEA World Energy Report 2007)



Projected growth rates in electricity generation for OECD and non-OECD countries (Source: IEA World Energy Outlook 2007)



impacts. It leads you away from carbon neutrality and from the most economically efficient system, but addresses the realities that any political system has to deal with.

Why is it that electricity demand has been rising so much faster than overall energy demand?

With electricity, there is enormous simplicity and cleanliness of use: You flip a switch and you get energy, and you don't have to do any fuel combustion locally. Electricity is also a very strong indicator of quality of life, so there is an enormous pressure toward modernization through the electrification of society. I'm not arguing that one should have a total electrification, but I think there is strong impetus and this underlies the fast growth. The US National Academy of Engineering designated electrification as the greatest engineering achievement of the 20th century with good reason.

The number-one target should be to increase energy efficiency in residential and commercial buildings.

So if demand for electricity is set to continue rising strongly, is our infrastructure able to cope?

Clearly we have inadequate infrastructure for the future. In the United States we are essentially working with a 50-year-old system that has many shortcomings, but this is where I think a new generation of energy delivery technologies can make a difference. For example, long-distance, high-voltage direct current (HVDC) grids level out the fluctuations caused by intermittent renewables, and information technology can be integrated with the grid at a much more sophisticated level. This will improve reliability and distribution efficiency. The technologies to accomplish this are fundamentally there. Sure, there are opportunities for additional research and development. But frankly, with technologies that we have in hand today and a dedicated program, we could have a dramatic transformation of the energy delivery system in a 10-year period. In



the United States the new administration has come in with this as a very high priority, and I do hope that there is a clear national commitment to just go out there and do it.

There are multiple technology pathways to address the issues in the power sector. The real issue is getting on with the job.

That brings us to another point. What impact do you think the economic slow-down will have on the energy infrastructure sector?

The recession has already reduced energy prices and demand. The question is, will those factors lead us to repeat our mistake of the 1980s and revert to business as usual, once again delaying the job at hand? I think we can avoid much of that this time, largely because the populations of the world, including the United States, have become much more sensitive to the climate challenge. Large stimulus packages are being put forward in the United States, in Europe, China and India, and not surprisingly they are focused on near-term job preservation

and job creation. In all of these countries, there is discussion of a substantial part of these packages being devoted to the growth and transformation of the energy infrastructure; and that's great. If done properly that will be a good investment and support jobs as well as our energy, security and climate goals.

Finally, if you were to embark on a career in the energy sector today, what area would you choose to go into?

First of all, I would start out with a strong grounding in science and/or engineering. I believe this is a critical foundation for having an impact on the system, and not just in a technology sense. Strong, technically grounded analyses at the intersection of energy technology and policy are a major opportunity to influence the system positively and are an important focus of our MIT Energy Initiative.

Interview conducted by Malcolm Shearmur,
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