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The future of energy: new energy policies and technologies

Opening plenary: How energy policies (government and corporate) should deal with the sometimes rapid advance of new energy technologies

Toward Real Energy Economics

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I feel uneasily that I'm here under false pretences. I'm not an economist at all, much less an energy economist. I'm not even sure what you mean by energy economics, or indeed by energy. I started out as a nuclear physicist, and I still think of energy as a physicist does. For me, energy is the fundamental unifying principle of science. Energy is how the universe works. But that's not what politicians and journalists mean by the word 'energy', in English at least. Politicians and journalists say 'energy' when they really mean fuel - oil or coal or natural gas - or even electricity. Fuels are not all the same. They are not interchangeable. You can't substitute one for another - not without changing the technology to use it. Electricity is not even a fuel; it's a process in technology. To me, using the word 'energy' with all these different meanings, smearing them all together, is confusing and misleading. I think we are managing energy wrong. As a result we are getting ourselves into deep trouble, with fuel security, with climate, and with global equity and stability.

With this trouble looming, we are considering this morning how government and corporate energy policy should respond to new energy technology. We had better first establish what we mean by 'energy policy' and 'energy technology'. What we now call 'energy policy' is still almost entirely what we used to call 'fuel and power policy', focused on supplies and prices of the various fuels and electricity. That's important; but it's not the whole story; and what's missing is at least as important. Why do we need these supplies? We need them to *run stuff* - to run the physical technology that actually delivers the services we desire: comfort, cooked food, illumination, motive power, refrigeration, mobility, information and communication. We get these services from the technology we use - the lamps and cookers and heaters and chillers and motors and electronics and vehicles, and especially the buildings. The technology, what we can call user-technology, delivers the services.

The topic of this session refers to 'new energy technologies'. When you say 'energy technology', most people think first of pipelines and power lines, refineries and power stations. New energy technology does of course include innovative electricity generation, carbon capture and storage, shale gas, tar sands and other new ways to supply fuels and electricity. But energy technology also includes the user-technology that delivers our energy services. Indeed the most important energy technology of all is buildings. The new energy technologies we should consider must also include new user-technology. One report after another has detailed the abundant opportunities to improve and upgrade the energy performance of our user-technology. This must surely be the top priority, the first stage of action if we are to avert or at least minimize the energy trouble ahead of us. Can we identify, implement and enforce policies that recognize and seize these opportunities? User-technology, especially buildings and their contents, ought to be the immediate focus of real *energy* policy, and of real energy economics.

To the limited extent that I understand the discipline, energy economics today appears to be primarily economics of flow. It tracks the movement of commodity fuels and electricity, the short-term batch transactions involved, and the prices per measured unit at various points in the flow. But it seems to take for granted the stock of physical assets through which the energy flows. To a physicist, energy processes take place in systems. Within appropriate boundaries you need to consider the whole system. Traditional energy policy puts far too much emphasis on economics of flow, and not enough on economics of stock - especially the stock of user-technology through which we channel flows of energy for human purposes.

If I were an economist, I might even talk about competition between economics of flow and economics of stock. We now lay great stress on the importance of competition, as a way to optimize economic outcomes. In energy policy that is usually construed as competition between different suppliers of a particular fuel. But in our human energy systems, the most important competition is that between fuel and user-technology: the better the user-technology, the less fuel or electricity it requires to function. You'll hear that called 'energy efficiency'. I prefer to call it 'energy performance', focusing not on how well the technology uses fuel but how well it delivers the service.

The competition between fuel and user-technology presents us with a huge opportunity, but also with a daunting challenge to traditional energy policy and energy economics. It suggests that we need to rebalance energy economics as it applies to energy use, to lay more stress on economics of stock and less on economics of flow. At the moment, what we think of as energy business entails major long-term investment in facilities to produce and deliver fuels and electricity, with concomitant long-term finances and contracts, business relationships and risks - economics of stock, on what we call the 'supply side'. For energy users, however, energy business as we traditionally understand it is essentially short-term batch transactions in commodities. This adds up to a vast global business based on flow transactions. The more fuels and electricity you use, the better for the business. Traditional energy economics functions accordingly. That may be a key reason why we're getting into trouble.

If you ask what governments or corporations want from energy policy, the answer must surely be straightforward. Both governments and corporations want reliable, affordable and sustainable energy services - not just fuel security but security of services. The best way to reduce vulnerability to disruption of fuel or electricity supply is to require less of it. Energy economics, and the energy policy it underpins, might do well to consider such an option. What if we were able to shift the balance away from flow economics toward stock economics for entire energy systems, including the user-technology? What might this mean for government and corporate energy policy, and indeed for energy practice?

When I began to explore this possibility I found that we do indeed already have a remarkable body of data on the energy performance of user-techologies in many parts of the world. But these data have been gathered and analyzed mainly by non-commercial bodies such as universities and international agencies, effectively for scientific rather than commercial purposes. For some reason neither governments nor corporations make adequate use of what we already know about the potential for improvement of user-technology. They fail to factor it into active energy policy or energy decision-making. Instead their policy concentrates on trying to increase the supply of fuel and electricity, much of which will then be wasted. Today's energy policy is like opening the bath-tap wider without putting the plug in the bathtub.

The change we need is for corporations to see good business in upgrading user-technology and infrastructure, and for governments and regulators to make this happen. I think that the key, and a promising answer to at least some of Joe's questions, is for governments to recognize that they themselves are major energy users, with substantial estates of user-technology, especially buildings, much if not most of which is well below the latest standards of energy performance. We are already beginning to see government upgrade programmes in places such as California; but they should be much more widespread, comprehensive, urgent and not only transparent but publicized, continuously, as a demonstration of the possibilities and an educational process. Whatever your country, such programmes would create skilled jobs all over it, create attractive business opportunities for real energy service companies, foster competition and innovation, bring down the unit cost of innovative technology, make innovative supply targets easier to hit, offer vivid examples to the private sector, and – if properly designed and managed – save all us taxpayers money. We need the appropriate energy policy and the corresponding energy economics, focused on our stock of physical assets, our user-technology, and its potential for improvement.

Then, once we begin getting our user-technology right, the next step also depends on economics of stock. Our problems with supply security and climate arise not from energy but from fuel – our use of and dependence on fuel. The key attribute of much innovative electricity generation, including wind power, all forms of water power and all forms of solar power, is that it does not use fuel. It uses physical assets to turn natural ambient energy flows into usable electricity. You'll hear such electricity called 'renewable'; I prefer to call it 'infrastructure electricity'. Like user-technology, infrastructure electricity is best described and analyzed by economics of stock. Many of the difficulties we now face worldwide with electricity arise because we have tried for two decades to pursue electricity policy based on a commodity market and economics of flow. I think we need to take a different approach, one that unites infrastructure electricity and user-technology in optimized local systems, with finances, business relations, energy policy and energy economics to match.

How this might work in practice I am still trying to understand; but I find the prospect fascinating, and exciting. As a physicist I am all too conscious of my limitations. If my ruminations this morning strike you as potentially fertile ground for further deliberation, I'll be relieved and delighted. I'm convinced that we can show governments and corporations a better way to think about energy in society. I hope energy economists lead the way.