WORLD ECONOMIC FORUM

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Global Agenda Council on Energy Security

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Getting Serious about Innovation

The world faces a large number of energy challenges whose solutions will require new technology. Deep cuts in emissions of carbon dioxide (CO_2) and other gases that cause climate change will not be possible with existing technologies – whole new energy systems that are affordable, reliable and much cleaner than today's are needed.

For example, solving a new challenge such as the impact that energy systems have on withdrawal and use of fresh water will require new technologies for cooling power plants, as well as systems for extracting fossil fuels that require less water and are less likely to cause water pollution.

Similarly, solving energy poverty problems will require a blend of economic development, better business models for providing energy services to low-income households, and new technologies. In these examples and many others, effective energy policy will require efforts on many fronts; but faster innovation and deployment of technology are common themes in each.

The idea that innovation is crucial to the sustainability of energy supplies is not new. But actual investment in innovation is lagging far behind what is needed. Worldwide, public spending on energy R&D has fallen in real terms since the early 1980s, even as the list of energy-related technology challenges has grown (see Figure 1).

A large number of studies suggest that total public investment in energy innovation should be two to four times current levels, if not higher. Figure 1 does not reveal the full story, since the private sector also spends money on innovation; moreover, a large amount of innovation in energy comes from other fields – such as biology and advanced materials – that are not reflected in Figure 1.

None of the other sources are easy to count reliably. And what the public sector spends on energy R&D remains the single best indicator of how seriously the world's governments are taking the energy challenge. Public spending is especially important to fundamental innovations and testing of ideas long before they are ripe enough for the private sector to take over. In short, governments are talking about energy challenges, but not investing in what is needed to solve these problems.

In this context, the Global Agenda Council on Energy Security discussed how to address the world's energy innovation challenge, and focused on three main themes.

First, **the geographical landscape of energy innovation** has radically changed over the last three decades. Then, innovation was concentrated within major industrial countries – notably the United States, Japan, Germany, France and the United Kingdom. While some technologies spread around the world through markets, innovations tended to stay close to home.

That landscape now includes new players – notably China, but also other emerging economies that have developed specialization in particular technologies, such as Brazil in hydrocarbon production or South Africa in dry-cooled coal-fired power plants. And, most importantly, it is global. Best-in-class nameplates are found on power plants and other energy technologies around the world – regardless of where the original innovation occurred. The net effect of this globalization has been extremely positive and increased the ability of governments and firms alike to provide secure energy supplies.

The global landscape of energy innovation has important implications for policy. New ideas are public goods – they benefit all even though the original innovator cannot appropriate all (or perhaps any) of that extra value. This public good argument has long and correctly been used to justify public spending on innovation.

Where public goods exist, the private sector, on its own, is prone to underinvest. The public sector, however, should provide the needed investment since the beneficiaries are the broader public. For global public goods – as energy technology has now become – the logic is the same, but applies on a global level. Individual firms and governments will underinvest in energy innovation because the beneficiaries are truly global. Therefore, a new form of global collective investment is needed.

One explanation for the continued failure to invest adequately in energy innovation is that governments have not created the right mechanisms for coordinating this global public good. Individual countries are preoccupied with their own concerns, including tight public budgets, and are not automatically prone to invest in global public goods.

However, there are many solutions to this problem. One is to create a forum – perhaps as part of the International Energy Agency (IEA), which already has an active energy technology programme. This forum should have a membership that is broader than IEA's – to include China, India, South Africa and other important emerging economies – and provide a platform for major countries to discuss and coordinate energy innovation policies. This innovation forum can build on the large number of small, focused bilateral and multilateral efforts already underway – such as between the US and China, US and EU, and EU and other countries.

Models for this kind of programme include the highly successful international coordination of funding for large science projects – such as CERN, the Human Genome Project and the Ocean Drilling Program – where individual nations fund and operate science and innovation schemes but coordinate them internationally. The lessons from these models include the fact that investments would not have happened without international coordination; that it is possible for countries with widely varied national priorities to coordinate on global public goods; and that coordination requires looking not just at spending, but also at performance.

What is needed is not only joint commitment to increase spending on R&D, but also coordination on projects that individual nations cannot (or will not) undertake on their own, such as large-scale demonstration projects. And countries must develop mechanisms to "peer review" each other. What matters, in the end, is not simply the total level of

spending, but also the effectiveness with which those funds are spent. While this topic might seem controversial, peer review of this type is already widely done on trade policy (through the WTO) and could build on related efforts, such as a programme at the IEA on advanced energy technology and bilateral diplomacy such as between the US and China.

Second, the Council focused on **the need to get prices right**. While recent decades have seen substantial progress in energy market reforms around the world, the problem of improper pricing remains. One form of improper pricing arises from subsidies. While there are important roles for subsidies, such as in backing infant technologies while they gain early market share, massive subsidies remain for mature technologies that cannot be justified on any reasonable grounds of public interest. In another paper, the Council documented those subsidies and noted the many success stories in reforming subsidies. It is politically difficult for governments – especially governments unsure of their survival – to adjust and phase out subsidies, but many have done exactly that.

The other kind of improper pricing concerns the failure to price externalities – such as pollution. In general, governments are making a lot of progress on pricing (and regulating) local externalities, such as urban air pollution. For international externalities, such as CO_2, the track record is still awful. A few governments have adopted carbon taxes; the EU, California, some provinces in China and a few other jurisdictions have adopted cap-and-trade programmes; and some firms and governments have adopted policies that incorporate the "social cost of carbon" into decision-making. All these efforts are notable, but also notable is that the prices are low, often not credible, and efforts are not widespread. A fuller pricing of carbon and other externalities is needed.

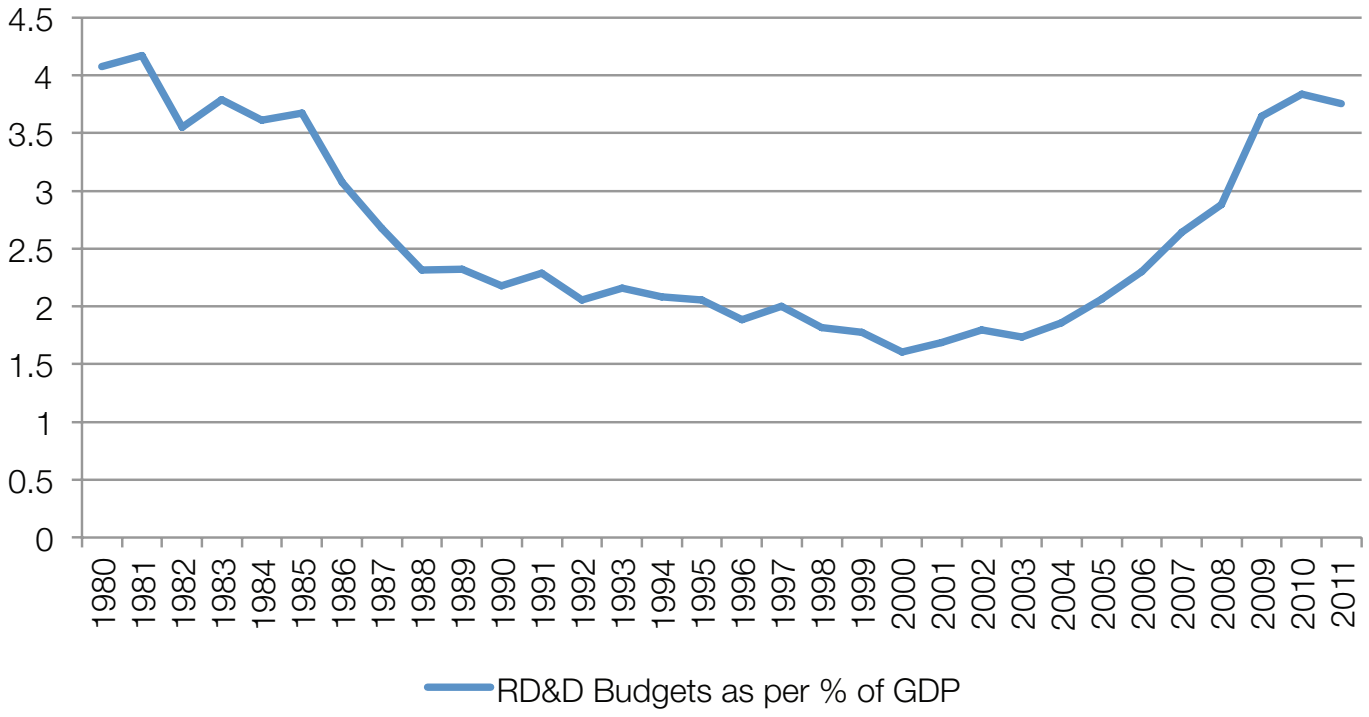
Better pricing is essential so that governments and firms align their behaviour, including their investments in new technology, to reflect the real costs and benefits of energy technologies. Some of the trouble identified in the public sector in Figure 1 can be addressed with more private sector innovation, but that will not happen unless prices reflect underlying realities. Much of the international debate – such as through the G20, which adopted a subsidy reform initiative in September 2009 – has focused on irrational subsidies, especially in the developing world. Yet with all the progress on subsidy reform, we think a much more looming, unsolved problem is the lack of rational pricing for externalities.

Third, the Council focused on **the need for realism**. The energy sector is among the slowest invention-to-commercial-deployment sectors in the world. Due to the cost of development, R&D, its highly regulated environment and its significant size, innovations in energy take an entire generation to deploy. Unrealistic policies are perhaps one of the biggest threats to energy innovation. Energy agendas come with fads, and investors know it – they are wary about taking on new agendas (e.g. climate change) unless the support for new technologies and business practices will be sustained from the early stages through testing, deployment and market transformation.

Realism is required because technology policies require public support. Energy policy-makers must not overlook the fact that one of the key goals is to generate competitive and commercially sustainable cost-to-kilowatt electricity in the long term. The investment made by the public sector must be assessed in terms of the ultimate goal of meeting sustainability quotas and increasing energy security at a competitive and commercially sustainable cost to the general public.

RD&D Budgets as per % of GDP

Graph is missing data from 2012 and only includes IEA countries



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