Global Growth and Adjustment: The Energy Dimension

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Various dimensions of the global energy system have been discussed by the G-20 leaders since the group was first convened in late 2008. The sharp spike in crude oil prices in mid-2008, just before the Lehman crash, and their volatility in the period that has followed impelled the French G-20 presidency to examine price formation and transparency in commodity markets. Climate change finance as a part of broader development finance has been a recurring theme, as has been the need to phase out subsidies on hydrocarbon consumption, something which is particularly prevalent among the emerging market members of the G-20. The links between high and volatile oil prices, the balance of payments, and food prices and affordability have been another preoccupation of the G-20 leaders. A healthy, resilient and stable global energy system is as important to strong, balanced and sustainable global growth as the global financial system.

Since February this year, I have been fortunate to obtain a deeper perspective on these issues in my new role as the chief economist of Shell International. I am grateful to Brookings and to Kemal Derviş and Homi Kharas for allowing me to remain a part of the Brookings Think Tank 20 (TT-20) group, and to continue to contribute to its series of reflections on policy coordination in the global economy. Accordingly, in this contribution I would like to reflect on adjustment in the global energy system as part of the overall adjustment of the global economy. I will concentrate on longer-term structural developments rather than concerning myself with the short term. I do so also because such structural analysis is the hallmark of work that Shell has been doing for 40 years as part of its global scenarios (www.shell.com/scenarios), and in which I am now immersed.

Shell's current published energy scenarios (labeled 'Signals and Signposts') date to early 2011 and were designed to take on board the global financial crash of 2008 as well as the outcome of the 2009 Copenhagen conference on climate change. The long-term perspective on energy demand and supply in those scenarios was, however, substantially based on work undertaken at the height of the boom in 2008. Using Shell's own World Energy Model, that work attempted to reconcile global growth, energy needs and environmental constraints in the period until 2050.

In this effort it was not alone. Particularly in the run-up to the Copenhagen conference a number of international, academic and policy organizations were similarly engaged in peering into the world's carbon future over the medium run. Being exposed now to the scenario process, what I personally find valuable about the Shell discipline is its willingness to examine alternative futures even-handedly, recognizing the inherent uncertainty of global developments. Once having systematically examined a range of alternatives, Shell as a business is obviously obliged to form its own view both for business decisions as well as in its advocacy. Through experience and practice, though, it has found that its corporate interests are better served if such considerations do not influence the scenario analysis.

To be helpful, even scenarios have to be grounded in a view of the future. Given the ebullience of that time, it is hardly surprising that the 2008 scenarios accepted that the economic growth of the major emerging markets was likely to be sustained into the foreseeable future. Given their earlier stage of development, this growth was likely to be both faster and much more materials-intensive than growth in the mature economies, and would therefore put demands on a range of global resources particularly, but not only, the global energy system. A relook at growth prospects following the crisis concluded that the fundamental drivers of poor country growth remained largely intact, even as the prospects for growth in the rich countries had been harmed for at least a while. The prospect of key economies encountering a "middle-income trap" or encountering a financial crisis cannot be discounted. These at a minimum could affect the trajectory of growth, if not the end point.

Global demand for energy in 2050 could triple from its 2000 level if the energy intensity of the emerging economies were to follow historical patterns, including that followed by successful recent developers. Ordinary market forces and developments will of course respond to this enhanced demand, although most probably along a rising cost curve as cheaper sources of energy, particularly crude oil, are replaced by less easily accessed sources. Sensible policies on both demand and supply (on which more below) could help these trends to deviate from historical experience to a degree, but the finding of the World Energy Model is that, by 2050, there could remain a gap between prospective demand and supply equivalent to the size of the entire global energy industry in 2000. This gap, (dubbed a "Zone of Uncertainty" in the Shell work) could be bridged either through smart and purposive national and global policy actions, or by chaotic and disruptive economic and energy market adjustments. One implication was that there was little margin for choice among energy alternatives: coal, oil, gas, wind, nuclear, solar, all would need to be pressed into service if poor countries were to grow and to urbanize.

The Shell energy scenarios broadly accept the scientific consensus on global warming and its causal association with global concentrations of carbon dioxide. While a rising share of renewables in the primary energy mix is both desirable and likely, the transition will take a long time. Both policy and technology matter. Taking technology (and finance) first, the basic observation of the scenarios on the supply side is how slow change is likely to be, given the sheer scale of the global energy system, and the need for new technologies to go to competitive scale. Work done by Shell staff, and published in the peer-reviewed science journal *Nature,* examines the historical experience with the introduction of new energy technologies. It finds that it typically takes 30 years for a new energy technology to go from pilot-plant scale to the point where it constitutes even 1-2 percent of the world's primary energy resources. Emerging technologies studied since the 1960s include nuclear, liquid natural gas, bio-fuels, wind and solar photovoltaic. The scale of the global energy system implies that even this level of penetration requires a sustained compound growth rate of 26 percent per year.

Following this "establishment phase" which typically requires exceptional policy support, the technology in question enters the zone of "materiality". Thereafter growth moderates, and the technology in question assumes its long-term position in the energy mix based on considerations of commercial competitiveness and convenience. With the best will in the world, then, there are limits to the rate at which the supply mix can evolve, even in the presence of policies supportive of technological development. If we assume that the next 30 years are critical for the world's carbon future, an important implication of this work is that the technologies for shifting the world's primary energy mix are already known. The point is to rear them from youth to adulthood.

This then leads to policy, and the implications of different policy pathways for global warming. Interestingly, even as far back as 2008, well before Copenhagen, the Shell scenario team was not particularly optimistic about action by national governments being the principal driver of coordinated regulatory policies toward climate change. Instead in a scenario that it labeled "Blueprints" the spur to action initially comes from a patchwork of local initiatives which in turn stimulate business and government to back coordinated and consistent global policies. The tipping point occurs as consumers and investors realize that "change is not necessarily painful, but can also be attractive". Success breeds success and ever more ambitious actions become politically possible.

The crucial variable is timing: policy actions are taken early on and the world is able to stay on a high growth, but economically sustainable growth path. The alternative (but equally plausible) scenario, entitled "Scramble" is one where the imperative of energy security in a world of apparently finite energy resources puts a premium on negotiation of bilateral agreements and incentives for local resource development, both bio-fuels and coal. This focus on supply leads to demand and climate action being postponed until supply shortages and climate events force drastic action. This delay imposes a larger, though later, growth penalty than under "Blueprints".

Even under the more orderly "Blueprints" scenario, there are expected to be immense difficulties in keeping greenhouse gas atmospheric concentrations below the 450 parts per million (ppm) threshold that scientists believe is the safe limit if global warming is to be restrained to the politically endorsed target of no more than 2^0C (above pre-industrial levels) by 2050. Achieving this goal would require, among other things, greenhouse gas emissions to peak before 2015; a zero-emissions power sector by 2050 and a near zero-emissions transport sector over the same period. Under "Scramble" the dynamics of adjustment are harder because of the later start.

This brings us then to the world of today and the prospects currently facing both the U.S. (the specific focus of this TT-20 volume) and the G-20 in the global energy economy. Here, important recent developments are the reappraisal of nuclear energy by the advanced countries, particularly Japan and Germany following the Fukushima failure a year ago, and the dramatic expansion in hydrocarbons extracted from shale, both gas and liquids. The former has not so far affected the nuclear investment plans of the developing countries and, as such, is more likely to have short-term rather than long-term effects, and is currently particularly affecting global liquid natural gas (LNG) markets.

Similarly, the shale revolution is also so far largely restricted to the U.S., for both geological and institutional reasons, and this is likely to remain so for some time before other parts of the world are able to replicate the U.S.'s success, even though promising geological structures do exist elsewhere, such as China and Argentina. However the U.S. is a big part of the global energy scene, so that these domestic improvements in gas and liquids supply, when coupled with moderation in demand resulting both from slower growth and improvements in efficiency, could affect global markets by reducing U.S. oil imports in the medium-term. The fragmented structure of the shale gas industry in the U.S. with a number of smaller-scale operators, has resulted in considerable volatility in natural gas prices (currently below the long-run marginal cost of supply), which acts as a disincentive for the huge investments needed for sustained LNG exports. There are also regulatory constraints on the export of such gas. Some investments in liquid natural gas for export (largely to Asia)from the U.S. Gulf Coast, based on these unconventional gas finds, are now beginning to be made, exploiting the huge price differentials that currently exist.

For the present, therefore the major application of this unconventional gas bonanza is likely to be within the U.S. itself, as a replacement for coal in the generation of electric power, with attendant benefits for reduced emissions of greenhouse gases. Some analysts have claimed that this cheap energy advantage will confer significant benefits both to the U.S. balance of payments (and hence the dollar); others argue that this additional source of cheap, locally sourced hydrocarbons will provide the basis for an American industrial renaissance particularly in chemicals. What is more certain is that, in the absence of exceptional government regulatory or financial support, hydrocarbons in the U.S. will continue to provide stiff competition for the expansion of renewable energy sources at commercial scale.

In many ways these developments in unconventional gas and oil are consistent with the fundamental supply adjustment mechanisms foreseen in the Shell scenarios. High oil prices, sustained by expectations of buoyant long-term demand from the poorer countries, have stimulated exploration and innovation, one outcome of which has been the unconventional gas revolution in the U.S. This should be seen less as the application of a new energy source than a dramatic expansion in application of existing technologies in response to attractive price prospects. The fact that this expansion has been largely in gas, at least so far, is also in line with the Shell 2011 scenarios, which predicted a steady shift in the global primary energy mix away from crude oil toward natural gas, both conventional and unconventional. The acceleration of this trend could mean a slight easing in the pressure on energy supply, so that the world may actually have a choice in reducing the importance of coal as a source of primary energy while maintaining the growth prospects of poor countries.

It also seems that another premise of the Shell scenarios will remain valid for the foreseeable future. Divergence in national resource endowments and differing environmental beliefs together with profound disagreements on international burden-sharing will continue to make it difficult to agree on a uniform, global long-term price for carbon, even though this is what would most efficiently encourage the massive investments needed to bring renewables to scale. While the world waits for a series of local initiatives to cumulate into a consistent global consensus, an important task facing the G-20 is to ensure that diverse local initiatives do not fracture the framework of global commerce, in pursuit of the ever-elusive "level playing field". While finance steals the headlines, rules-based trade is the true flywheel of the global economy. The G-20 must ensure that it remains so.