In Search of New Global Frameworks for Energy Security

By April 2006, oil prices had climbed over US$70 per barrel and analysts were warning that the rise in prices was not merely a short-term phenomenon but would persist in the face of steadily increasing demand from rapidly growing economies such as China and India. Meanwhile, an awareness of the potential scope of climate change stemming from carbon emissions had been spreading among mainstream political leaders in the Trilateral countries, particularly after natural disasters such as Hurricane Katrina in September 2005. Against this backdrop, Steven Koonin, chief scientist for BP; Naoki Tanaka, president of a Tokyo-based think tank, the 21st Century Public Policy Institute; and Stefano Silvestri, president of the Institute for International Affairs in Rome, shared their views regarding alternative energy technologies, the prospects for international cooperation to safeguard energy supply and distribution networks, and schemes to ameliorate the long-term environmental impact of energy consumption. Condensed versions of their remarks follow, as well as a summary of the subsequent discussion.

Steven E. Koonin

There are four drivers that will shape the energy future over the next 30 years: growth in demand; the challenges of providing supply to meet that demand; issues of security of supply; and environmental impacts or constraints.

If one looks at primary energy use per capita against GDP per capita over the past two decades, the picture is most informative. It shows, for example, that energy use per capita in the United States has been growing very slowly but is higher by about a factor of two than most other developed countries, whose energy use is also growing relatively slowly as their GDP increases. In terms of developing countries—particularly China and India—it seems almost inevitable, perhaps a law of nature, that their energy use will grow
proportionately as their GDP grows. There are about 1 billion people in the United States and OECD as a whole. There are roughly 2.5 billion people in China and India. The expected economic growth together with growth in population—which is projected to reach 9 billion by mid-century—will drive a strong growth in energy use over the next 25 years. There is expected to be 60 percent growth by 2030, three-quarters of which will be in the developing world, with the balance in the OECD and transition economies.

Turning to supply, the first headline is that there are significant fossil fuel resources. The world is not going to run out of oil or gas or coal anytime soon. However, it is going to take significant investment in infrastructure in order to produce those resources, and for various reasons we expect to see a rise in non-conventional fossil fuels as well.

If one looks at simple straight-line projections of energy sources over the next 25 years, 85 percent of the world’s energy now, and 25 years from now, is expected to come from fossil fuels. The resources to handle that do exist. Right now, the world has 41 years of proven reserves of oil, an equal amount plausibly there to find, and a significant amount beyond that in unconventional oils. There are 67 years of gas supply, again an equal amount plausibly yet to find, and a large amount of unconventional gas. For coal, we have at least 160 years, and in some estimates as much as 1,000 years since no one has really gone exploring for coal yet.

Roughly 1 trillion barrels of oil have already been produced in the world. There are a trillion barrels yet to be produced in the Middle East and another trillion in the rest of the world, and more exotic sources and locations provide yet another 2.5 trillion barrels. The world is expected to need about 1 trillion barrels over the next 25 years, and so it seems that there is plenty of oil in the ground and producable at reasonable prices in order to meet that demand.

Whether the world will create the infrastructure to produce it at the rate required remains to be seen. Right now, the world produces only about 35 percent on average of the oil that is known to be in the ground in any given field. Accordingly, enhanced oil recovery technologies are an important area to work on for the future.

Beyond the liquid hydrocarbons that we might be able to find in the ground, there is the possibility of producing liquid hydrocarbons from either gas or coal. You can make diesel fuel out of gas at about US$25–US$30 a barrel, and you can make diesel fuel or other liquids out of coal at about US$40–US$45 dollars a barrel. It seems inevitable that those technologies will become more prominent should the price of oil remain at anywhere near the level it is at currently.
Turning to the issue of security of supply, it is important to recognize the "dislocation of supply and demand." The three largest energy markets in the world—North America, Asia Pacific, and Europe—currently consume 77 percent of the world’s oil production yet have only 10 percent of the world’s oil reserves. If you look at gas, the situation is not quite as unbalanced but it is still significantly misaligned: those same three regions account for 60 percent of consumption as compared with 15 percent of reserves. For coal, on the other hand, there is a much better balance between where the reserves are and where the consumption is. If energy security becomes a growing issue, therefore, it seems likely that coal will revert to being the fossil fuel of choice.

Turning to the environmental constraints, local pollution is in many ways a solved problem. In the developed world, increasingly stringent regulations have been matched by a series of technical developments such that cities really are becoming cleaner. I saw that firsthand living for 30 years in Los Angeles. The same has happened here in Tokyo. It is a question of whether one wants to pay the costs for cleaning up the local pollution. The expectation is certainly that as the developing world develops, they will also want to do that.

Much more problematic is the issue of climate change. Whatever uncertainties remain in the scientific picture, I think everyone agrees that it is a very bad idea to be putting as much carbon dioxide as we are into the atmosphere. Most of that anthropogenic carbon dioxide comes from the burning of fossil fuels, and so of course it is intimately linked with energy issues. Historically, carbon dioxide emissions have gone up almost monotonically and are projected to rise at 1.5 percent a year absent any major action. The concentration in the atmosphere is the cumulative effect of those emissions because carbon dioxide lives in the atmosphere for many hundreds of years. This is a different situation than local air pollution—if we put it up there, it stays up there effectively forever compared to time scales that matter to us. The carbon dioxide concentration in the atmosphere has gone from 280 parts per million (ppm) before the industrial revolution to its current value of 384 ppm, and it is projected to reach 550 ppm by mid-century. At that level, many in the scientific community believe that there will be the real possibility of a dangerous influence on the climate system. In order to stabilize carbon dioxide concentrations at less than 550, the world must stabilize its emissions at the current level and then decrease them by a factor of two by the end of the century, and it must do so in the face of a doubling of energy demand by mid-century.
What many people do not realize is that doing a little bit for this problem really does not solve it. Because the atmosphere accumulates the carbon dioxide that we emit, we really have to make drastic reductions in carbon dioxide emissions in order to have any impact. In fact, a good rule of thumb is that every 10 percent reduction in emissions simply delays the time at which we will face dangerous concentrations by about seven years.

The carbon dioxide situation is further complicated by the differences in emissions and perceptions of the threat around the world. If you look at carbon dioxide emissions by GDP levels, the picture looks pretty much like the energy usage chart except for two outstanding differences. One is that France is now below the other European countries and Japan. Eighty percent of France’s electricity is produced by nuclear energy. Brazil is also low compared with other countries with similar GDP due to two factors: the significant amount of hydropower in Brazil, and the ethanol that Brazil uses to power its transport.

The heterogeneities of emissions around the world lead to several sobering conclusions that condition any discussion of how we are going to address the carbon dioxide problem. One is that, in this century, emissions from the developing world will be actually more important than those from the industrialized world. The developing world emissions are growing at 2.8 percent a year, while the OECD emissions are growing at 1.2 percent a year. Today, they are just about equal, but they will cross in about 10 years. Therefore, every 10 percent reduction in emissions that the industrialized world might be able to make is offset by less than four years of growth in the developing world.

If you were to take China’s per capita emissions and make those equal to Japan, which is among the most emissions-light of the developed countries, global emissions would go up by 40 percent. Again, remember we need to halve emissions rather than having them go up by 40 percent. The way I like to say it is that there are two big numbers in this problem. One is the per capita emissions in the developed world, and the other is the population in the developing world. One concludes from this that one is going to need new technology to solve this problem. It is not going to be solved by economics and politics alone.

This brings us to the question of the technologies. There are really two dimensions in which to think about technologies. One is the issue of security of supply, and the other is the issue of carbon emissions. By putting technologies on those two axes, you can understand which ones can play a role where. In the transport sector, for example, absent concerns about
climate change, technologies for coal to liquids, heavy oil, gas to liquids, and conventional biofuels are things that one would be developing to address security of supply concerns. The only material supply-side option addressing both security and climate change is advanced biofuels. On the demand side, hybridization and vehicle efficiency seem to be eminently sensible things to do, and are really not so much about technologies as they are about political will and social choice.

In the power sector, it is sobering to look at where electricity is generated right now. Forty percent of the world’s electricity comes from coal, 20 percent from gas, and roughly one-sixth each from nuclear and hydropower. The renewables that consume a lot of media attention—including solar and wind—currently account for only about 2 percent of the world’s electricity.

If you look at options for power, there are several that are attractive. Wind is probably good for at most about 10 percent of the world’s electricity because of intermittency issues and the cost of backup. My own feeling is that there are really only two technologies that the world will need to develop, or could develop, if it is going to solve the carbon dioxide problem. One is nuclear. The other is hydrogen power, also called sequestration or capture and storage, in which the carbon dioxide from fossil fuels is captured at the power plant and reinjected into the ground. One expects that it will a) stay there for several thousand years, and b) enhance oil recovery as well. BP is pursuing two projects of this sort right now, one in Scotland and one in California. A number of other companies and governments are very interested in this technology as well.

Looking at the cost of electricity generation, right now fossil fuels remain by far the cheapest. Nuclear power and capture and storage (hydrogen power) are about 30 percent more expensive than those. Onshore wind is competitive at the best sites. Everything else is significantly more expensive in terms of producing electrical power. So if you look at how much it costs to save a ton of carbon dioxide emissions, what you discover is that onshore wind, capture and storage, and nuclear are by far the cheapest methods. Transportation options are factors of three to five more expensive per ton of carbon dioxide saved. That is alright, though, because in fact only 20 percent of the world’s carbon dioxide emissions comes from transportation. Eighty percent comes from stationary sources.

The potential for demand-side reduction is significant. A big target is building efficiency. Fifty percent of the world’s energy is consumed in buildings, and learning how to make them more efficient seems to be an eminently sensible thing to do.
Finally, let me describe my own vision of the probable 30-year energy future. Hydrocarbons will continue to dominate transportation—the energy density and convenience of liquid hydrocarbons is very hard to beat. A succession of conventional crudes, heavy oils, biofuels (which I believe have a lot of potential), and coal- and gas-to-liquids should give us continuity of supply at reasonable cost if we have the foresight to invest in the infrastructure. Vehicle efficiency can be doubled with various technologies. Hydrogen in vehicles, much discussed in the United States and elsewhere, is in my opinion—and in that of many knowledgeable persons in the industry—a long way off if it is there at all, and there remain serious problems about how the hydrogen will be produced in an economic and environmentally responsible manner that also enhances energy security. And for power, the best options will be gas for cleanliness and nuclear for security. Coal will be a decreasing fraction of supply if carbon dioxide is to be addressed. Renewables will find niche applications but will not be a material fraction of the total. Demand will be reduced only when it is economically effective or mandated by policy, and carbon dioxide emissions are going to keep going up unless the world does something dramatic.

*Steven Koonin is chief scientist for BP, the world’s second largest independent oil company.*

---

**Naoki Tanaka**

I will begin by offering a brief summary of the trends in energy-related data from the viewpoint of Japan. The first trend we see is a rapid increase in the Chinese demand for oil, which has already surpassed that of Japan. A second clear trend is that, while Japan’s demand for oil follows a seasonal cycle, the growth trend is very large in the case of China, making seasonal cycles hard to distinguish. That means a very radical change in imports. Around 2008, the year that Olympic Games will be held in Beijing, Chinese oil imports will surpass domestic production. And around 2010, the year that the World Expo will be held in Shanghai, Chinese oil imports will surpass those of Japan. So the regional context is changing very rapidly.
Another important trend is related to the emission of carbon dioxide. India is now catching up to Japan, and Chinese emissions are more than three times greater than those of Japan. The U.S. emissions are more than four times those of Japan. But, the United States, China, and India all refused to commit to the Kyoto Protocol, and that is a problem.

Looking at the fluctuation of oil prices, there was a decrease in Iraqi oil production of only 500,000 barrels per day after the Iraq War. But this had a big effect on prices because it coincided with increased demand from China and India, as well as the start of the economic recovery in the developed countries. That led to huge fluctuations in prices.

Now we are focusing on the Iranian situation and their plans for full-scale uranium enrichment, which may lead to economic sanctions. Oil production in Iran is more than twofold that of Iraq. If economic sanctions are carried out against Iran, the oil situation will further deteriorate.

Finally, I want to note Japan’s efforts to control inflationary expectations. Of course, oil prices have been very high, but in other areas our government and central bank have controlled inflation.

Based on these various trends, I would like to focus on three points. The first point is about differentiating between the Chinese oil and energy situation and the viewpoint of Japan. In connection with the economic growth in China, there has been a great deal of wasteful use of energy. China’s investment as a portion of GDP is around 40 percent, and when you visit Chinese cities, you will see a lot of commercial buildings that are empty. They cannot find tenants. Huge investments are being made in rural areas of China as well, and there have been many efforts to attract Western investment in factories. But these efforts have not been successful in most cases. So a huge demand for energy is now coming from China. Because of that, neighboring countries like Japan have to be differentiated from China.

Some people say joint projects should be undertaken to develop oil supplies. However, the current data show that Japan’s oil demand is not going to increase. Our demand for oil is leveling off. As you know, our economic recovery started in 2003, but oil consumption is leveling off because of efforts by Japanese businesses to streamline the supply side and because our government committed to the Kyoto Protocol. So, we should see a reduction in oil consumption from current levels. The Kyoto Protocol commitment entails an almost 15 percent reduction in carbon dioxide emissions, and through streamlining and R&D activities, Japanese industry should be able to stay within the protocol ceiling.

The second point involves the environment. We are now committing resources to this area, which is closely related to our search for greater
energy independence. Our efforts to become less dependent on oil are very important. We hope to be able to contribute to the improvement of environmental problems.

The third point is related to the characteristics of the Japanese economy. We are now starting to see the post-industrial characteristics of the economy that have resulted from deep industrialization. We have experienced a deflationary process and, even though the price of petroleum products has increased 30 percent over the previous year, the price of motor vehicles and electrical machinery and equipment—the frontrunners of Japanese industry—have shown a very different trend. The increase in motor vehicle prices was almost zero over the previous year, and electrical machinery and equipment fell. The automobile and electronics industries have made impressive innovations and they are now leaders in the world industry. The Japanese economy recovered thanks to their efforts, but prices have remained under control.

Now, the U.S. economy is relying a great deal on the outside world. In terms of labor-intensive goods, a lot of imports are going from China into the U.S. market. Meanwhile, in terms of high value-added industrial goods, Japan has been keeping prices down through R&D and by streamlining business activities. So, in order to understand the future course of inflationary expectations, we should focus on Japan’s process of deep industrialization. Many economists and analysts are paying a lot of attention to the industrial innovation process in Japan and, if there continues to be considerable industrial innovation, inflationary expectation will be controlled.

One of Japan’s leading economic commentators, Naoki Tanaka is president of the 21st Century Public Policy Institute.

Stefano Silvestri

When we first began speaking of energy security, when we set up the International Energy Agency, the main problem was the disruption of supply because of the risk of oil embargoes. Today, though, the problem is probably more complex and growing. We are looking at a complex set
of factors that are affecting the entire energy supply chain, including of course production, but also transport and transformation. These can all be threatened by natural or manmade events. And while supply levels might be maintained, there will apparently be fewer countries involved in the growth of the supply. The diminished number of producers might itself create a security problem in the longer term. But nonetheless, the situation is becoming more fragile in the short term because increasing consumption and the absence of diversification policies has created a diminished element of flexibility. So there is less spare capacity to compensate for unforeseen events or crises.

Of course, there are some nightmare scenarios, although they do not seem likely. One such scenario is the collapse of Saudi Arabia. There could be an escalating confrontation between the Sunnis and Shiites, an effective terrorist campaign conducted by the Saudi “veterans” returning from Iraq, or divisions within the Saudi family. This scenario, however, is generally considered unlikely, mainly because Saudi Arabia now runs—thanks to the high price of oil—a very comfortable surplus. It is estimated at more than US$30 billion for the current year, and there is no debt. Moreover, there has been a recent increase in per capita income, which had declined from US$20,000 per capita at the beginning of the early 1980s to about US$6,000 by the end of the 1990s. It has started climbing again, rising to about US$13,000. So the expectations of the Saudis may be that the situation is going to improve, not worsen. There will, however, still be some disaffected parts of the population, especially among the Bedouins, who may be more attracted by the jihadist, Wahhabi, or Al-Qaeda positions.

Another nightmare scenario would be an Iran crisis, which could escalate into economic sanctions, embargoes, a blockade, increased violence in Iraq and Saudi Arabia, attacks on oil facilities and tankers, and possibly a regional war. In that case, of course, not only would there be problems in terms of supply, but suddenly the price of oil would increase to more than US$100 per barrel—the objective set by Osama bin Laden in one of his messages.

One does not have to go to these more unlikely extremes, however, to have energy insecurity. There are other questions that should be considered, including the various segments of the energy supply that have been threatened in the recent past. Natural events such as Hurricane Katrina shut down the electric grid and effectively shut down most of the refinery capacity in the United States, thus creating a shortage. Attacks have been conducted, for instance by Al-Qaeda in Saudi Arabia or against pipelines. Even years ago, this was occurring in Algeria with differing degrees of effectiveness,
but it had the cumulative effect of diminishing supply. Political crises in
Nigeria, Venezuela, and elsewhere have also had the same effect.

Pipelines are vulnerable. They can also be used as a tool of influence by
the exporter, as well as by the importer or the transit country depending
on the situation. Sea lines of communication have choke points, of course,
and vulnerabilities include the security of terminals, which seems to be a
bit undervalued presently and should probably be heightened. Normally,
the most effective way to protect such a complex system is through redun-
dancy. But, of course, redundancy is what we are lacking today because of
its high cost and because of the greater rigidity of the relationship between
supply, demand, and consumption.

Politically speaking, what are the possible scenarios that should be
considered in terms of the future of energy security? I would raise three
potential approaches for discussion, which are very theoretical but might
help us to define the range of options.

The first is market fragmentation. Market fragmentation would require
more than a mercantilist approach of bilateral agreements between consumer
and producer, or generalized attempts by individual nations to guarantee
energy security through preferential deals—“unholy” exchanges involving
military technologies for energy supplies and so on, which have happened
in the past and could happen on a larger scale in the future. To succeed,
this must entail a pervasive attempt to protect critical infrastructures and
strategic lines of communications from disruptions. It requires that there be
no regime change that will threaten the countries’ bilateral relations. Such
a strategy would be very expensive and at the same time vulnerable, and it
may multiply the need for military interventions overseas.

A second option, the opposite, would be greater market integration. This
would require setting up global, institutionalized markets—a kind of WTO
for oil and energy. The starting point would be the existing Energy Charter
of 1991, and the aim would be to increase energy security by recognizing and
protecting the vital interests of all of its members, increasing redundancy,
managing conflicts, and sharing a joint approach to the physical security
of the infrastructure and transportation.

A third option is an intermediate approach, falling between these two,
which would entail a number of large regional agreements. Some are more
possible than others. I can imagine, for instance, a regional agreement
among the American countries, producers, and consumers. It is, however,
much more difficult to imagine a regional agreement among Mediterranean
countries, or between the European Union and the Gulf countries. It is more
likely—despite the many political difficulties—to imagine an agreement
between the European Union and Russia. This would involve preferential agreements based on an increase in infrastructure for transportation, for transformation, etcetera, in which there would be a shared interest to try to increase respective security.

These three approaches, of course, all have weaknesses and all create problems. The first option, fragmentation, is very fragile, not only because it creates a general element of confrontation among all the countries, but also because it creates a need to protect infrastructure, which may become very difficult to achieve on a national basis. The global approach is certainly the most stable in its result, but is very difficult to achieve. Also, it might create the need to police security on a global scale, which may create opposition and raise accusations of imperialism or that the rich are working against the poor. The third option, the regional approach, is also very risky because it may create different patterns of solidarity that are completely contrary to the kind of agreements and alliances existing today. For instance, one can imagine the political effect of a strong agreement between Europe and Russia on this basis.

In conclusion, in order to avoid the negative effects on global governance and on the present international system, alliances, and relationships, the best approach is the attempt to build up, even if slowly, a global governance system for energy. This could start with a gradual increase in the competencies of the International Energy Agency, giving it the task of looking at the security of the entire energy supply chain. And it would start with an examination of the best ways to cope with these issues in a multilateral fashion.

Stefano Silvestri is president of the Institute for International Affairs in Rome and a commentator for Il Sole 24 Ore.

Summary of Discussion

Seemingly convinced that high energy prices are here to stay, conference participants debated the dual challenges of energy scarcity and the long-term environmental damage stemming from energy use. The linkages between energy access and national security were at the forefront of
discussants’ minds, and several cited how China, India, and other countries are increasingly modifying their diplomatic approaches in order to diversify and safeguard their energy sources. China, for example, has moved closer to Russia; it has increasingly provided support for despotic governments in Africa and Asia as part of its quest to secure energy access; and some participants suggested it is likely to face stronger pressures to expand its naval capacity so that it can depend less on the U.S. military to safeguard vital oil shipping routes. At the same time, in China, concerns about energy access seem to be fueling a greater desire for energy cooperation with the United States and other countries. Similar tensions are shaping geopolitical considerations for policymakers around the world, as energy security has been thrust to the top of the international agenda.

The diverse group of participants seemed to share a sense that climate change as a result of energy consumption is one of the greatest long-term challenges facing the human race, and this gave a new urgency to the discussion of the tradeoffs between energy security and environmental protection. While stressing the long-term necessity of stemming climate change, several participants remarked that it is already becoming clear that security concerns and national interest, particularly on the part of rapidly growing countries such as China and India, are liable to trump environmental considerations. The G-8 countries, noted one participant, may already be on the verge of accepting the domestic costs of stabilizing carbon emissions, but the dilemma that faces the world lies in finding the political will to underwrite the costs of doing so for the Chinas and Indias of the world, which cannot afford to stem their own increasing emissions. This was tied to a degree of pessimism on the part of some participants about the prospects of heading off climate change and a sense that greater attention now needs to be paid to adaptation techniques, such as gradually relocating low-lying cities, building seawalls, and using innovative construction methods such as painting roofs white in urban areas.

A general consensus seemed to take shape around the pressing need for greater international cooperation on the political, economic, and environmental aspects of energy and environmental issues. First, energy production needs to be increased, especially as consumption rises in the developing world, and numerous participants argued that, in addition to various industry incentives for oil production, there is a need to diversify energy sources, for example investing more in safer nuclear power. Alternative fuels, especially biofuels, received special attention as a very promising area, albeit only over the long term, and numerous participants pointed to the Brazil’s promotion of sugar cane ethanol as one model case.
Second, considerable focus was also placed on energy lines and networks. Several participants who focus on security issues noted that there is much room for cooperation in protecting oil shipping routes and pipelines, and others concerned with energy efficiency pointed to the plentiful opportunities to improve energy storage and transmission.

According to various participants, a third key area of cooperation involves improving the efficiency and cleanliness of energy production. In many instances, technology to produce cleaner energy already exists, but it is still not being deployed. For example, there have been significant advances in technology related to the sequestration of carbon dioxide from power plant emissions, but nobody has yet built a large-scale plant that completely sequesters it. Infrastructure tends to take so long to go online and to have such a long life span, that it is critical to incorporate advanced sequestration technology into power plants in rapidly growing countries such as China and India over the next 20–25 years in order to have any chance of impacting atmospheric carbon dioxide levels. And at the same time, international cooperation is needed in order to make this economically feasible.