The Global Energy Outlook in the Post-Kyoto Environment

*By John P. Ferriter**

The International Energy Agency is completing its updated World Energy Outlook for publication later this year. I will share with you today some of the highlights of this new work, and then consider the impact of its findings on policies to meet Kyoto commitments.

I would like to discuss:

- What was agreed at Kyoto?
- What are the key issues that still need to be resolved?
- What are the implications for the energy sector?
- What policies and measures are available to realize the Kyoto commitments?
- Some thoughts about the road ahead.

What Was Agreed at Kyoto

Last December in Kyoto, Japan, negotiators from over 160 countries agreed on a Protocol to reduce greenhouse gas emissions. The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) represents a major step forward in the world's effort to respond to the climate change challenge in the decades to come.

The Protocol text, however, is complex and subject to varied interpretations. The world community is still trying to grasp its major provisions, to comprehend its implications for energy and environmental policies, and to exploit the flexible approaches that it offers to reduce greenhouse gas emissions.

Since exhausted negotiators went home from Kyoto with the completed document in hand, the International Energy Agency has studied the essence of the agreement and the role of IEA governments in the post-Kyoto follow-up. I will share with you today a few tentative conclusions. But to begin, let us review what was actually agreed in the text.

Emissions Reductions

The central commitment in the treaty is quantified greenhouse gas emissions reductions for the world's industrialized countries, the so-called, Annex I countries. The developing countries, for now, are not bound to make commensurate reductions in their own emissions.

Overall, the Annex I countries agreed to reduce greenhouse gas emissions by about 5 percent from 1990 levels.

The specific reductions from 1990 levels vary from country to country. Most Annex I countries agreed to an 8 percent reduction. The United States agreed to 7 percent and Canada, Japan, Hungary, and Poland to 6 percent. Certain countries claimed special circumstances and pledged to stabilize or were even allowed to increase emissions. Russia, New Zealand and Ukraine will maintain their 1990 levels, while Norway will increase by 1 percent and Australia by 8 percent above 1990 levels.

The Protocol deals with six greenhouse gases. It is important to place the relative role of energy in context with these other greenhouse gas sources and carbon sinks. Not all greenhouse gas emissions are energy-related; but the energy sector will be expected to provide the bulk of the prescribed reductions.[1]

Flexibility Mechanisms

The Protocol contains several new "flexibility mechanisms" to help Annex I countries achieve their emission reductions in a flexible manner and at lower cost. First, emissions targets are to be reached over a 5 year period rather than by a single year. Allowing emissions to be averaged across five years is intended to smooth out short-term fluctuations in economic performance or weather. The first target period will be from 2008 to 2012. Second, several articles allow Parties to collaborate in the pursuit of meeting their commitments:

1. Groups of countries may "share out" their targets among themselves. In protocol lingo this has come to be called *bubbling*.
2. *Joint Implementation (JI)*: verifiable emission reductions achieved through specific, individual projects in any Annex I Party may be transferred to other Annex I countries. The Party receiving the reduction would see its allowable emissions increased, while those of the other Party would be correspondingly reduced.
3. *Emissions trading:* Parties with emission commitments may trade emissions to fulfill their respective commitments. Parties that are fortunate enough to have overfilled their reduction requirement may sell the "surplus" to any other Party.
4. *Clean Development Mechanism (CDM):* This is designed to harness the resources of the private sector and extend investments under the Protocol to the developing countries. It will enable certified emission reductions from sustainable development projects in a developing country (non-Annex 1) to be transferred to an industrialized country (in Annex 1).

Outstanding Issues from COP-3

The Kyoto Protocol plainly leaves a number of other questions open.

Entry into Force and Compliance

The first and foremost issue is entry into force. The Kyoto Protocol still has a number of hurdles to clear before it comes into force.

No less than 55 Parties must consent to be bound, including Annex I Parties which must represent at least 55 percent of Annex I greenhouse gas emissions in 1990.

The Protocol has already started along the long path to entry into force. So far, 24 countries have signed the convention. Just last month, the 15 nations of the European Union signed, along with Canada, Monaco, Brazil and Norway.

Conspicuously absent is the United States where the Protocol is under intense criticism in the Senate that could delay its ratification.

A majority of the Senate pledged before Kyoto that they would not ratify without developing country commitments. There are none in the Protocol.

The United States alone emitted about 36 percent of the Annex I total in 1990. Russia accounted for another 17 percent. Clearly, if both of these countries do not ratify, it will not come into force. However, the Protocol could

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[1] See footnote at end of text.

conceivably come into force without the United States.

Compliance issues have been left largely open for future negotiation. What are Parties legally bound to do? Are there any "teeth" to this treaty? For now, the Protocol lacks a procedure to impose specific consequences for noncompliance.

Future Commtments by Developing Countries

Kyoto did not set in motion an official post-Kyoto process to involve developing countries in future emissions limitations. This is the most important challenge remaining for the convention negotiators, and will be a key issue at the next meeting of the Parties (COP-4) scheduled for this November in Buenos Aires.

Implications for the Energy Sector

Even a superficial reading of the Protocol demonstrates that energy is at the heart of the Kyoto program. Since energy contributes decisively to the problem, energy will have to bear the brunt of the emission reduction burden.

Quantifying the exact level of required reductions in energy-related emissions is extremely difficult. The task is complicated by the wide range of natural and anthropogenic sources of greenhouse gases, as well as by the costs and political implications of abating emissions in various sectors.

What is incontestable is that carbon dioxide emissions from fossil fuel combustion represent about four-fifths of all man-made greenhouse gas emissions in the industrialized countries. Policymakers will have to direct their efforts toward controlling fossil fuel emissions. The question remains which basket of policies and measures should be chosen to meet the Kyoto challenge.

World Energy Prospects to 2020

The IEA World Energy Outlook studies long-term trends in energy supply and demand, with detailed estimates of variations by geographic region and by the type of energy related services demanded.

The preliminary conclusions of this study are available now - *World Energy Prospects to 2020* was presented by Robert Priddle to the G8 Energy Ministers at their Moscow meeting in April. I will use the findings of the *World Energy Prospects* to frame the extent of the challenge we face post-Kyoto - but first I want to say a word about the vaguarities of forecasting the future.

As we all know, the future is uncertain. And we at the IEA have no better ways of seeing into the future than anyone else. So when we talk about the future of energy, we cannot lose sight of these uncertainties. History is replete with surprises that we see now only with the benefit of hindsight. The future will undoubtedly bring more of the same.

Looking back over the last thirty years, we can list several of these watershed changes; few of them were foreseen by the forecasters of yesterday.

- the oil crises of 1974 and 1979;
- the rapid growth in non-OPEC oil supply since then; and
- low oil price levels of today;
- the present concerns over nuclear power, or;
- the rapid economic growth in Asian countries.

Yet they have all affected the way we look at the energy world.

The Business-As-Usual Projection

Of course, there are some trends in energy demand that have been remarkably stable through the last three decades. The IEA has sought to capture these trends in its *World Energy Outlook,* and use them as the basis for the "Business-As-Usual" case.

Business-As-Usual essentially continues these past trends in energy supply and demand through the year 2020. The continuation of past trends is not a simple one. The IEA publishes energy demand and supply statistics for virtually all countries of the world. These data include details for individual fuels and for the different economic sectors.

We have made a detailed energy demand analysis of these data for each of eleven world regions. We have divided the OECD region into Europe, North America and the Pacific. Russia is separate from the other Transition Economies. China, too, is considered separately. The other regions are East Asia, South Asia, Latin America, Africa and the Middle East.

For each region we have analyzed the effects of changing economic activity levels on the demand of each of the main fuels. Where data on fuel prices are available we have taken them into account.

Our analysis is not only organized along regional differences, but also by the type of service for which energy is used. Today, we'll look at three: electricity consumption; fuels used for transportation - called mobility; and fossil fuels used for stationary energy (mainly for heat in buildings and processes).

The IEA has observed the following past and future demand trends in these services:

- Electricity consumption has grown in step with GDP since 1960. Its growth apparently is not affected by the oil shocks.
- Mobility demand has also grown in step with GDP since 1960 with the exception of the downward shift in North America at the time of the second oil shock (1979-82).
- Fossil fuels used in stationary energy include heating in buildings and industrial processes. Fossil fuel demand for stationary heat purposes has been strongly influenced by the two oil shocks. Heat-related fossil fuel demand in OECD countries as a whole has stabilized. Since the late seventies, most of the increase in the stationary use of fossil fuels for heat services has taken place outside the OECD, where it is expected to continue to rise with income in developing countries.

Fuel used for these three services has moved closely with economic activity - Gross Domestic Product - over the period since about 1971. Our Business-As-Usual Case finds that these trends are likely to continue into the future provided that energy policies, economic activity and energy prices continue into the future much as they have in the past. I would like to return to these important qualifiers a bit later. But for now, let's delve a little more into the Business-As-Usual case and what it means for the regions and services.

The result of our analysis indicates the Business-As-Usual world will continue to be a world powered by fossil fuels. Fossil fuels are expected to provide 95 percent of additional global energy demands to 2020. Oil continues to dominate world energy consumption, with transport use increasing its share of oil demand. Gas consumption rises to equal that of coal consumption by the end of the period. Nuclear power and the use of hydro power stabilize while

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other new renewables increase steadily, but from a very low base. Relative to fossil fuels, they remain at low levels.

We believe that over the period to 2020, decisions on new nuclear power plants will be made on mainly political, rather than on economic grounds. The same holds true for renewables, as site specific and political issues tend to dominate economic considerations.

The geographical pattern of energy demand is projected to shift from the OECD region to developing countries. China and the other developing countries are expected to account for 68 percent of the increase in energy demand between 1995 and 2020.

The distribution of world energy use will, of course, depend on assumptions of economic growth for the world regions. The Business-As-Usual projection has assumed average rates of growth roughly equal to those we have seen in the last 25 years - about 3.1 percent per annum in real GDP using 1990 prices and purchasing power parities.

We assume that the developing countries will continue to grow faster than the developed world. But we see all regions having lower economic growth rates in the future than they have had in the past. This is due to falling birth rates and aging populations in the OECD. In developing countries, we expect declines as countries achieve higher living standards.

Because the faster growing countries are gaining larger shares of world GDP, the world economic growth rate remains unchanged with Business-As-Usual.

While the world economy is expected to continue to grow, energy intensity is expected to fall for the world as a whole, continuing the downward path observed over the past 15 years.

CO_2 emissions rise with primary energy demand; and slightly faster than in the past, meaning that carbon intensity does not fall with energy intensity. Contributing factors are the halt to new nuclear power generation and the continued rapid growth in solid fuel use in China and other Asian countries.

Since there are so many of us here who study the oil market, let me digress for a moment and show you our latest thinking on long-term prospects for oil.

We expect that demand for oil to continue to rise at about 1.8 percent per annum to 2030 under Business-As-Usual.

The supply trend of oil is based on estimates of the ultimate recoverable reserves of conventional crude oil - an uncertain number that has been under brisk debate recently. The U.S. Geological Survey in 1993 reported a range of 2.1 to 2.8 trillion barrels. Experts differ on these figures. Some take a longer view, emphasizing geological and statistical issues. Some take a higher view, arguing that advancing technology will help discover more reserves and make a wider range of already known deposits economic to produce.

Experience in mature oil regions indicates that oil production builds to a peak then falls away. This peak occurs when approximately half of the ultimately recoverable reserves has been produced. This has been the experience in the United States.

In our analysis, this approach has been applied on a regional basis. It indicates that a peaking of conventional oil could occur between years 2010 and 2020. The timing depends mainly on assumptions for the level of oil reserves.

Our assumption is 2.3 trillion barrels of ultimate recoverable reserves of conventional oil - the most probable value given in the United States Geological Survey study.

Oil supply from producers outside the Middle East OPEC countries is expected to decline after the year 2000. Oil supply from Middle East OPEC producers is expected to peak around 2015. Liquid fuels from non-conventional sources (natural gas liquids, deep off-shore oil, heavy oils and tar sands) could begin to play an increasingly important role as 2020 approaches, and the price of conventional oil rises.

The key message from this analysis is that the world will be increasingly dependent on OPEC Middle East oil reserves into the next millennium. We may differ on the numbers and the timing might vary - but we all should consider how to prepare for the day when the falling curve of non-OPEC supply crosses the still rising curve of Middle East conventional supply.

Emissions growth has up to now gone hand in hand with economic growth, particularly in the developing world. The growth in emissions will continue despite continuing reductions in energy intensity.

Under these assumptions, the IEA model predicts world energy demand growth of 65 percent between 1995 and 2020. In the absence of new policies to curb energy use and greenhouse gas emissions, CO_2 emissions will grow by 70 percent in the same period.

Developing countries will contribute a large share of the emissions growth. The increases in CO_2 emissions projected for China and the rest of the developing world between 1995 and 2010 are large - almost three quarters of the total projected increase.

The situation is not much different in Annex I countries; CO_2 emissions in the OECD are expected to rise continuously during the outlook period in the Business-As-Usual case.

So, how does the OECD break the link between economic growth, increasing energy demand and greenhouse gas emissions? Before we can begin to answer, we have to have an idea of how energy is used in the economy and where our options lie.

The Kyoto Gap

Without significant new policies, the OECD countries will experience a widening gap between their Treaty targets and actual emissions. Preliminary IEA analysis points to an increase of approximately 2.4 billion tonnes in energy-related CO_2 emissions in Annex I countries between 1990 and 2010. OECD countries, as a whole, will have to reduce their energy-related emissions by approximately 3.2 billion tonnes CO_2 by the first "commitment period".

This reduction is huge - it represents almost a 30 percent cut from the Business-As-Usual level in 2010. It is roughly equal to CO_2 emissions from fuel combustion for all of countries of the European Union in the year 1995.

Response to the Challenge: Two Illustrative Policy Approaches

So far governments have not yet chosen the policies they plan to adopt to meet their Kyoto commitments. For this reason, I will hold myself to the constraints of Business-As-Usual when talking about how the Kyoto commitments will be met.

Here are two illustrative "Kyoto analyses" which describe the scale of measures that will be needed to effect changes in energy use sufficient to meet Treaty commitments. They both require a combination of energy saving and replacement of coal use in power generation by nuclear or renewable energy forms of generation.

The first analysis assumes that approximately half the reduction in CO_2 emissions is achieved by imposing the same additional uniform reduction in energy intensity across all of the energy related services. This is the classic "command and control" regulatory approach to promoting energy savings.

In the command and control model, energy intensity would have to be reduced approximately 1.25 percent in each energy service in all of the OECD regions. (This is in addition to the 1.25 percent decline already assumed in our Business -as-Usual case.) This would achieve half of what was promised at Kyoto.

The second analysis achieves half the reduction in energy intensity by adding a carbon value to the price of fossil fuels. This is the "uniform carbon value" approach to energy savings.

In the "uniform carbon value" approach, fossil fuel prices would have to increase by the equivalent of $250 per ton of carbon to bring about the same demand reduction. This again would achieve only *half* of what was promised at Kyoto.

What would be the impact of an increase in the cost of fuels of $250 per ton of carbon? Real energy prices for end users would rise to levels not seen since the 1979-80 energy crisis.

In both cases, the other half of the CO_2 emissions reductions is achieved in the power generation sector. Both cases assume that post-Kyoto decisionmakers will substitute non-fossil (nuclear or renewable) as much as possible for fossil power generation. This is a key condition, and is a major part of both our cases.

It is clear from this projection that early retirement of a large number of coal-fired plants would be required to replace half of the coal-fired power generation in OECD countries in 2020 by non-fossil technologies to meet Kyoto commitments.

Solid fuels use will grow to take a larger share of power generation in the world as a whole over the outlook period. Under these assumptions, most new plants built use natural gas when it is available. They use coal where gas is scarce or gas imports are expensive, as in China and India. Only countries with current nuclear programs are assumed to build nuclear plants in the future.

Response to Kyoto: Policies to Close the Gap

The Scale of the Problem

These Kyoto analyses are purely illustrative. But they do indicate that new policies adopted to meet the Kyoto commitments will involve major changes in the Business-As-Usual projection that have yet to be determined.

I imagine we would all agree that achieving 1.25 percent reduction in energy intensity across all sectors will be extremely challenging. The effort would require a comprehensive and aggressive set of policies that could meet considerable resistance in the affected sectors.

Governments will choose the set of policies and measures that fit their own domestic economic and political circumstances. There are many potential responses other than the two general approaches mentioned here.

In fact, several IEA governments have undertaken studies that conclude that Kyoto reductions can be met at reasonable net cost and possibly with positive impacts when efficiency gains from innovation are realized throughout the global economy.

The key to interpreting the many renditions of the post Kyoto energy world is the mix of measures proposed to address the problem. The Business-As-Usual case demonstrates the scale of the problem; not the methodology for solutions.

For these reasons, it is best that you take with you today not a formula for how to respond to the Kyoto challenge, but a notion of the scale of the response necessary to achieve it and the variety of measures available to policymakers.

Where Can We Find the Reductions?

So where will the Annex I countries find the emissions reductions to which they are committed?

Electricity generation is perhaps the best vehicle for greenhouse reductions. It is the largest, fastest-growing sector and most sensitive to higher fuel costs. It is also the easiest to tackle since there is a limited number of individual actors. The biggest potential for emissions reduction in electricity generation is fuel switching, mostly from coal to gas, nuclear and renewables.

Stationary fossil fuel end use – mostly heating – represents the second most promising area. It is the second largest sector in IEA countries (the first in developing countries), and there are significant opportunities to switch to cleaner fuels.

While transport is the smallest energy service in terms of energy demand, it is growing rapidly. However, transport's sensitivity to higher fuel prices is extremely low, therefore, measures will have to aim less at influencing demand and more at improving the efficiency and carbon intensity of transport.

When looking at transport one must keep in mind:

- The level of taxes which already exists on gasoline. In most IEA countries they are already quite high;
- That most people, for their pleasure and convenience, want to benefit from individual mobility; and
- Fuel costs, including taxes, are only a small portion of the total cost of mobility. Depending on the car and the location, they account for only 20 to 30 percent of total costs.

New technology can offer the road to a sustainable transport sector; but in this case a dramatic breakthrough is needed. Recent improvements in alternative technologies lead me to optimism, but I am more guarded on whether the Annex I countries will be able to make a dent in transport emission in the Kyoto time frame.

There is, however, an opportunity to "get transport right" in developing countries. Facing enormous costs to build the transport infrastructure, produce or import cars, and import or produce fuels, the developing countries have a clear incentive to explore efficient alternatives.

What Kind of Policies

Now that we have identified the areas of opportunity, let's consider the policies that can achieve reductions in energy related CO_2 emissions.

These policies will fall mainly into the following categories: 1) switching to less carbon-intensive fossil fuels: from coal to oil or gas, from oil to gas; 2) switching from fossil to non-fossil fuels; 3) switching to more energy efficient equipment, and management practices to provide the same level of service; and 4) switching expenditures to less energy-intensive products and services.

In all these cases, governments, industries and other institutions must choose whether and how strenuously to act in their own or in other countries.

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Some actions are already taking place and will not require new policies. We have included these trends in our Business-As-Usual case projections:

1. The share of gas will rise relative to that of oil and coal;
2. New nuclear plants will be built and the use of renewables in power generation will increase; and
3. Energy use will rise more slowly than economic activity.

Generally, policy instruments that can promote emissions reductions tend to fall into two main categories: command and control (regulation), and policies that affect prices. The IEA is examining the merits of a wide range of instruments in these categories. Of course, no single measure will suffice. Actions will be required in all sectors, but they will need to be tailored to those sectors.

The Kyoto Protocol is part of a longer-term process that will extend far beyond the first "budget period" from 2008 to 2012. For longer term solutions, innovation in energy technology will be a key factor.

The Kyoto commitments call for this long-term view, but IEA countries have, nevertheless, passed through a R&D drought where budgets declined in real terms during the 1980s, as private sector R&D budgets continue to be squeezed by the effects of global competition.

I am happy to report that the drought might be over and that budgets have appeared to stabilize recently. However, the question remains if current research is enough to stimulate tomorrow's innovation. R&D resources invested today are a down payment for the technologies we will rely upon in the future.

The involvement of industry in the Kyoto response will be critical. However, for industry to work effectively, certain conditions must be in place. First, a clear goal is essential. Uncertainty and lack of clarity drain energy and effort and money away from meeting goals.

Second, industry must be given the flexibility to meet the goals as it deems best. Flexibility will ensure cost-effective and creative responses.

Third, transparent and competitive markets and other incentives are needed to increase the use of efficient and cleaner technologies. This is true for both developed and developing nations.

Conclusions

The challenge for governments to meet their Kyoto commitments is a daunting one. The energy Ministries of IEA and other Annex I countries are actively considering the basket of policies and measures that they will need to implement the Kyoto targets.

At the end of the day, each country will have to make its own decisions on these matters. I believe, however, that IEA countries will seek to utilize market forces to reduce emissions at lower cost. They will adopt policies that are consistent with a sustainable development approach, which will maintain global economic growth and energy security on an environmentally sound basis.

Progress towards achieving the Kyoto objectives will require:

- Close cooperation among governments and between governments and industry;
- Recognition by individual consumers of the need to act;
- Development of "flexible measures", particularly emissions trading;
- Stronger efforts to promote energy efficiency;
- Enhanced collaboration in research and development of renewable and energy efficiency technologies;
- A public airing of the nuclear option; and
- Participation of developing countries, since there can be no solution to the global climate change problem without them.

The world has taken an historic step by agreeing to the Kyoto Protocol. Judging from our analysis, an historic response will be necessary to achieve our goals.

I am still confident that we can meet the challenge. The Kyoto Protocol demonstrates that our countries possess the indisposable ingredient in making social change - political will. If we have the will, we can find the way, and the next 25 years will move far away from "Business-As-Usual".

Footnote

[1] The six greenhouse gases covered by this agreement are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCS) and sulphur hexafluoride (SF_6).

President's Message *(continued from page 1)*

Journal in the past year. Hossein Razavi and Headquarters are now updating the guidelines for the selection of these winners.

Finally, Council is anxious to expand the number of Affiliates and toward this end has asked Headquarters to provide all necessary assistance to individuals willing to spearhead such an effort in their country or area. Elsewhere in this issue you'll find an ad to this effect. I encourage anyone interested in this to contact IAEE Headquarters directly.

As you can see, the summer months are not idle ones for your Council. It is busy at work. I hope the summer is going well with all of you and will look forward to seeing many of you at the Berlin Regional Conference on *Energy Markets: What's New?* on 9 and 10 September.

Charles Spierer