

CERA ENERGY WEEK 2008

Why we Need a Global Energy Revolution?

Keynote Dinner Speech

Mr. Nobuo Tanaka

Executive Director, International Energy Agency

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Distinguished guests, ladies and gentlemen, I am truly delighted and honored to be here and would like to express my gratitude to Dan Yergin for inviting me to address such a gathering of experts.

Let me begin with a few words on the International Energy Agency for those of you who don't know the organization. The IEA is an energy policy advisor to its 27 member countries and was founded during the first oil crisis. Our initial role was to respond to oil supply emergencies. But during the last decades, energy markets have changed, and so has the IEA. We now focus beyond oil security to broader energy issues, including climate change, market reform, energy technology collaboration and outreach. I took over as Executive Director last September and am hopeful that during my tenure we will become known as a truly global "comprehensive energy policy body".

As I will outline shortly, environmental concerns, ongoing high prices and energy security considerations, are stimulating support for measures that could increase the uncertainty over the longer-term demand for oil. However, there is no need for you to close the valves on the oil pumps just yet. After all, IEA analysis continues to demonstrate that even if measures to moderate demand growth are introduced, and are a success, there is relatively little doubt that demand will remain robust over the foreseeable future. That is not to say that these policies are not worth pursuing but simply reflects the time they will take to make an impact. Although the situation in 2030 or 2050 is less certain, the investment decisions that will deliver supply at that time need not be taken for decades to come, particularly as the planning horizon for incremental capacity can be relatively short if investors have access to the resource base.

However, whilst we are sure that the demand will be there, we have growing doubts on the supply side in the short to medium term. For this reason the IEA remains adamant that there is an urgent need to strengthen the flow of capital into upstream oil. After all, surging prices, diminishing discoveries and, in some cases, poor data on remaining

reserves are fuelling concerns amongst some about the availability of the hydrocarbon reserves base. We remain comfortable with the adequacy of the world's hydrocarbon reserves, but we are anxious to mitigate the above ground risks that complicate today's markets.

The 2008 edition of the IEA's World Energy Outlook publication will shed light on these issues. It will assess in detail the prospects for crude oil and natural gas production, based on an in-depth analysis of the production profiles of more than 200 of the biggest fields, of planned and ongoing investments in maintaining production at those fields, and in developing new reserves, and of longer-term investment requirements. It will look at the prospects for further advances in upstream technologies, the potential for improved and enhanced recovery techniques to bolster conventional oil and gas output and recovery rates, and the prospects for producing oil and gas from non-conventional sources. It will also consider the factors that may hinder capital flows and capacity additions - including the international oil companies' access to upstream opportunities.

Whilst on the topic of the World Energy Outlook 2008, I would like to pay a very special mention to Ron Mobed, President & Chief Operating

officer of IHS Energy. Ron has provided essential and invaluable support to the IEA for a number of years now and has agreed to play a particularly important role in this year's edition of our flagship publication.

Now I would like to be a little provocative and discuss the long-term implications for the oil industry of achieving deep greenhouse gas emission reduction targets. As you may know, the EU countries, Japan and Canada have pledged to reduce emissions by 50% in 2050. The leaders of the G8 countries agreed at their summit in Heiligendamm in July 2007 that they would "seriously consider" to follow suite. This push for action gained momentum last December in Bali when 178 countries at the U.N. climate conference signed off on the "Bali Roadmap", which will take up where the Kyoto treaty leaves off.

After witnessing firsthand the negotiations in Bali, I am extremely grateful that the IEA's job is not to broker deals on climate change. However, whilst the entire world's attention has been focusing on negotiations to set the reduction target, it is important that we do not lose sight of the fact that a target alone will not miraculously solve the problem. What is needed is practical action to transform our energy

system. To this end, the IEA has analyzed the steps that would be required to actually achieve a 50% cut in emissions, which corresponds to the IPCC's scenarios of limiting the increase in global temperatures to 2.4°C. To understand the extent of this challenge we first need to appreciate the current level of emissions and the outlook for their growth.

Starting with current emissions. CO₂ emissions from the energy sector currently stand at 27 Gt. Perhaps, like me, you have difficulty picturing exactly what a gigatonne of CO₂ emissions is. If so, think of it as the emissions produced each year by 300 coal power plants, each of 500 MW, operating at base load. Now for future emissions. According to the World Energy Outlook 2007, in the absence of strong policy action, emissions will rise to 42 GT in 2030 and 62 GT in 2050. We will be on track for an increase in global temperature of 6°C. You do not have to be a climatologist to realize that this would be catastrophic.

In contrast, to achieve the goal of cutting emissions by 50%, emissions would have to peak during the next decade and decline to 14 Gt in 2050 a reduction of 48 Gt from the reference. An upcoming IEA publication, titled Energy Technology Perspectives 2008, will outline what would need

to be done in practical terms to achieve this goal. Though this study is still in the preliminary stages, it will show that improving energy efficiency is top of the list. Next we would need to de-carbonise electricity generation. And finally, we would need to revolutionize the transportation sector. Let me talk about each of these in turn.

Firstly, improving energy efficiency is fundamental. However, currently it is not happening. The improvement in energy efficiency in IEA member countries in the last ten years has been poor, and only about half the rate of improvement in previous decades. A fundamental turn-around is needed. To achieve the 50% cut in emissions we would have to improve energy intensity from the current rate of just 1.6% annually to 2.7 % annually. Thankfully, we know what to do. The IEA has identified 16 concrete recommendations for improving energy efficiency covering all energy end-uses. These were endorsed by leaders at the past two G8 Summits. If fully implemented, they could save up to 5.7 Gigatonnes of CO₂ by 2030.

I like to think of energy efficiency as a 'triple win' solution. Firstly, it delivers the same service to the user, at lower cost. Second, it leads to lower dependence on imported fuels. Third, it improves the environment.

Based on this "triple win", I have some very blunt advice which is applicable to all countries, whether or not they are ready to adopt greenhouse gas targets. It is, we have shown you the policies to improve energy efficiency, now it is up to you to implement! implement! implement!

After energy efficiency, reducing CO₂ emissions from power generation is the next step. Any meaningful emission reduction in coming decades implies a virtual decarbonisation of this sector. After all, the rapid growth in CO₂ emissions from coal-fired power stations led to the surge in global emissions in the last few years. China alone added over 70 gigawatts of new coal-fired power plant capacity in 2007 - the equivalent of a new unit every two and a half days. Thankfully, its new units are large at 500 MW and are largely state-of-the-art technologies. Deployment of Carbon Capture and Storage, or CCS as it is commonly referred to, will therefore be vital as coal will undoubtedly remain the lowest cost and most accessible fuel for some of the most dynamic developing economies.

So how can power generation be decarbonized? We have calculated that, given the growing demand for electricity, a significant number of coal- and gas-fired power plants would have to be fitted with CCS technology,

each and every year between 2010 and 2050. In addition, we would have to build an many more new nuclear plants each year throughout that period. Furthermore, renewables would have to play a much stronger role. For example, wind capacity would have to increase at an unprecedented rate.

To achieve a 50% cut in emissions we would also have to make a dramatic reduction of the carbon intensity of transport. This represents the most difficult and costly step due to the ongoing rapid demand growth and limited potential based on existing technology. It is the part that comes last in these next decades. Cost effective efficiency improvements of up to 50% are already possible, provided that the trend towards heavier vehicles can be contained. But we would also require the widespread deployment of new technologies. Advanced bio-fuels and hydrogen fuel cells, advanced plug-in hybrids and electric vehicles all fuelled by carbon-free electricity, are all possible options, but it is hard to tell which technology or combination of technologies will prevail.

So what would all this cost? Our preliminary analysis suggests that an enormous amount of investment - trillions of US dollars -- would be needed for a 50% reduction in emissions, on top of what would be

required under a business as usual scenario. The impact would be more significant for certain sectors, certain regions and countries. Predictable and long term incentives alongside stable government policy would be needed to empower industry to accept the risk associated with this huge investment. A value of CO₂ needed to decarbonize the power sector would be higher than \$25/t, the level we had presumed in our previous study in 2006. . Remarkably, that needed to revolutionize the transportation sector would be much higher. These prices would have to be applied in the 2020-2030 timeframe and be sustained for decades.

However there are other challenges which may prove to be more difficult than attracting investment. For instance there remain a huge amount of technical issues that have to be overcome before many of the promising new energy technologies could be widely deployed. The public would also have to become more accepting of living with wind farms in their backyards, not to mention nuclear reactors. We would also have to dramatically boost the numbers of engineering and technical graduates. Questions exist on the availability of sufficient geological formations for captured carbon dioxide or geologically stable sites for nuclear reactors or waste storage. In short, meeting the target of a 50% cut in emissions

represents a formidable challenge. We would require immediate policy action and technological transformation on an unprecedented scale. We would also need the participation of all major economies. It would essentially require a third industrial revolution, or an energy revolution, which would completely transform the way we produce and use energy and entail painful adjustments.

Governments have a key role to play in this new energy revolution. They must be prepared to invest in researching and developing key technologies that are not yet commercial. This will not be easy - don't forget energy research budgets on IEA governments have declined both absolutely and, even more, as a percentage of GDP since the early 1980s. But in the end, it will be left to you, the industry, to consider the policy options and then put them to work to deliver the desired results. Government, industry, financial markets, and consumers will all have to work together. As I said, this is clearly an unprecedented challenge, and I will leave it to each of you to decide for yourselves whether such a program would be feasible or is mere science fiction.

But if the scenario I have just outlined was to be achieved, what would it mean for the oil industry? Our analysis sheds some light on this question.

It shows that demand for all fossil fuels would be well below where it otherwise would be due to a massive switch to low carbon fuels. Upstream prices for oil would be lower as a consequence of this lower demand. However, at the same time there would be significant new opportunities. It is estimated that markets for low-carbon energy products are likely to be worth at least \$500bn per year by 2050. The oil sector readily lends itself to providing the type of transferable skills required to benefit from a major shift in demand towards low carbon fuels. Likewise opportunities exist for the world's major producers to play a role in the development and deployment of carbon capture and storage technology. By doing so they could gain dual benefits of reducing carbon dioxide emissions and enhancing oil recovery. In short, businesses who become leaders in the fight against climate change may well profit from lucrative new growth opportunities.

Let me close my remarks by reiterating that the world's energy economy is on a pathway that is not sustainable, on many fronts. This statement is not new. But it is nevertheless shocking, particularly given the political capital that has been devoted to improving the situation in recent years. In terms of the short- to medium term oil market, the situation is not

sustainable as we continue to remain in a period of high and volatile prices, low spare capacity and low stock coverage. There is an urgent need for investment to ensure an adequate cushion between supply and demand returns to the market. At the same time, the energy economy is not sustainable from an environmental perspective. But things can change. We have identified policies and technologies that can lead to very substantial savings in both energy consumption and carbon dioxide emissions. But for these to be achieved decisions have to be taken now and implementation has to begin now. The primary scarcity facing the planet is not of natural resources nor money, but time. We will need to start putting our words and commitments into actions. Delay is no longer an option. It is time to act.