conclusion of my analysis is that future oil prices will also be lower. So the region takes a double hit in revenue terms- lower prices and lower volumes. Furthermore, my analysis suggests that within the next 20 or so years, the region is likely to find itself sitting on huge reserves of oil which no one wants. If this sound very implausible, the example of British coal provides real life support for this view. In the 1860s there was growing concern that Britain would run out of coal which would means the end of economic power and the end of Empire. What happened? Well we did not run out of coal- technology solved all the answers. Furthermore over the last 10 years we have been closing down the vast majority of coal mines leaving huge quantities stranded underground because nobody wants them.

Let me finish my rather pessimistic analysis with some suggestions as to how the region might tackle what would be, if I am correct, a major problem. The first solution is to try and diversify the region away from total dependence on oil revenues. This has been the objective of most countries in the Persian Gulf since the early 1970s but the results have been very disappointing. A major problem has been that governments have been the instigators of new resource based industrialization projects and governments are notoriously bad at spotting winners. Far better to try and create an environment in which the private sector can flourish and drive diversification. I suspect of all the countries in the region, Iran is best placed to move in this direction.

A second possibility is to try and change the perception of the region in the West. Iran to its credit has initiated the idea of making 2001 the dialogue of cultures. While I congratulate your government and wish the project well unfortunately I am too much of an old cynic to hold out great hopes for global understanding, at least for this part of the world which continually receives a very negative press in the West.

My final solution is more practical. in 1973, if we take the OPEC GCC countries and Iran, together they produced a little over 17 mbd. in March of this year they were producing 16.5 mbd. If you gave these countries the same R/P ratio as the rest of the world without their reserves, they should be producing about 60 mbd not just over 16 mbd! Why this limited contribution? It is simply because since the early 1970s, and arguably even earlier, the supply curve for crude oil has sloped the wrong way. normally we expect in economics that low cost producers supply first and then higher cost producers. The reality for oil has been the opposite. The high cost regions such as North Slope Alaska and the North Sea have supplied first and the low cost suppliers of the Persian Gulf have supplied last.

There are two solutions to this problem. The first, a horribly dangerous option is the so-called "volume game". This was being discussed widely in Saudi Arabia, Kuwait and Abu Dhabi during the end of 1998 and early 1999 at the height of the recent low price crisis. The game goes as follows. Low cost producers oversupply and force the oil price right down. This puts the high cost producers out of business and any future increase in demand is met from the low cost producers, most obviously the Persian Gulf. Hence the fall in price eventually is more than offset by a rise in volume. This is a dangerous strategy for many reasons. First it may take a very long time to put the low cost producers out of business. Provding they are covering their variable costs and making some contribution to their fixed costs they will continue to produce. In the meantime the implied revenue collapse would severely damage economies in this part of the world leading to serious economic and political problems. It is not a strategy I would recommend and it is unlikely to be a proactive strategy for anyone. Any instigator would face serious anger from other producers. However, as in 1998-99 it could be viewed as a strategy if prices were very low for some other reason.

The second solution is more hopeful. This involves diverting oil company investment away from high cost areas into the Persian Gulf. The major oil companies are desperate to cut costs to maintain shareholder value. One sure way to do this is to get access to low cost geology. So the region must open up more to these companies so that incremental demand comes here rather than to high cost alternatives. you may well argue that this is already underway but frankly it is too slow. For example Iranian buy backs are not that attractive but for oil companies they are the only game in town. However, there is too much downside risk and not enough upside gain, especially given the geology of some of the acrege on offer.

However, always look on the bright side. I could be completely wrong. Demand could indeed rise forever and non-OPEC could peak very soon. The call for your oil could rise forever. The issue I guess is are you feeling lucky? A key point however is that the solution of encouraging foreign company entry is a no regrets strategy. If I am right you will lengthen the life of your reserves and if I am wrong you will be well positioned to take advantage of greater demand. These are difficult choices and I am glad I only have to talk about them and not make then!

Thank you very much for your kind attention.

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Oil companies are increasingly insulated from oil price risk

developing economies develop this stock of appliances is likely to increase. However, beyond 10 to 15 years I can suggest several factors which may actually turn positive oil demand growth negative.

First there is quite a bit of empirical evidence that oil is an inferior good in the technical economic sense i.e. a good whose consumption initially rises with rising income but after a certain point as income increases further consumption declines as users switch to more preferred goods. A good example is household kerosene use. As households move out of traditional fuels such as wood, charcoal and animal and vegetable residues their first stop is kerosene. However, very quickly as income continues to rise they move to LPG and then electricity and if available, networked gas.

Second, many governments in developing countries are following their richer cousins and are beginning to increase sales taxes. The importance of this is that many developing countries did not experience the oil shocks of the 1970s and hence their oil efficiency use is extremely poor because oil has previously been under priced. As sales taxes force prices higher, greater efficiency will reduce oil demand.

The third factor which might contribute to lower oil demand is environmental pressure. Its very difficult to predict precisely what impact this will have but it is all downside as far as demand is concerned. My view for what it is worth is that Kyoto and climate change issues will have limited impact. They fail to mobilize public opinion which is an necessary condition if policy is to be driven. However, what will drive policy is growing concern over urban air pollution caused by traffic congestion. You do not need a panel of scientific experts to tell you it is bad for your health, you just need to try and walk down the street without choking on the fumes. Today, the auto-manufacturers are investigating four or five new technologies for automobiles, all of them hydrogen based.

The fourth reasons demand may begin to decline is the availability of alternative fuels. There are of course renewables. For example, the cost of generating electricity from wind turbines in California was 24 cents per kilowatt hour in 1984. By 1994 this had fallen to 6 cents per kilo watt hour and is now probably even lower. There is also gas. Last November here in Tehran I gave a paper which explained that gas in the past was a constrained industry but that today those constraints were coming off in many parts of the world and that as a result gas was beginning to take off as an alternative fuel. Of course for this part of the world this may be seen as good news- never mind the oil, we have the gas reserves as well and so will benefit. The problem of course is that gas is not oil. There is nothing like the same level of rent in gas as oil. As a generalization, governments will not get rich on exporting gas.

So far all these reasons I am suggesting that the methodology behind the conventional wisdom which argues for growing dependence upon Persian Gulf oil is flawed. It neglects potential discontinuities and changes in the behavioural drivers. Now it is perfectly legitimate for you to come back to me and argue that I have only picked at changes which would flatten demand and increase supply. Are there other changes which could increase demand and reduce supply? On the demand side it is difficult to see anything which would sharply increase oil demand above the conventional forecasts unless somehow we were to go into a golden age of huge unbroken economic growth. It could be a pooibility but as a professional economist I doubt it. On the supply side there are more possibilities. There is always the possibility of a supply disruption. Or I could be completely wrong about reserves and maybe for the next 15 economists were.

Let me turn quickly to the second challenge to this conventional wisdom. This is the neglect of the feedback loop. Conventional wisdom's often generate the seeds of their own destruction. In the 1960s there was a conventional wisdom that oil prices would continue to fall forever. What happened as a result was that consumers bought ever more oil burning appliances and investment in producing capacity declined. Slowing supply and increased demand were a major contributor to the first oil shock. In the 1970s the conventional wisdom was that oil prices would rise forever. As a result people moved away from oil burning appliances but also invested very large amounts to develop new sources of oil. demand falls, supply rises and the conventional wisdom is destroyed by the 1986 oil price collapse. If this current conventional wisdom is widely believed, given the West rightly or wrongly perceives the Persian Gulf to be unstable and vulnerable to supply disruption, there will be a clear policy response to move away from imported oil in general and from Persian Gulf oil in particular.

Hence my challenge to the conventional wisdom suggests that eventually the demand for oil from this region will stop growing and start to decline. Furthermore, the logical

over the next 10 to 15 years non-OPEC supply is likely to stay strong

signalled by costs. If depletion is winning production costs will rise. If ingenuity wins costs will fall. All the evidence so far shows falling costs.

The second error in the forecasting methodology is that these forecasts ignore discontinuities which might bend the extrapolation. The oil shocks of the 1970s, nuclear accidents at Three Mile Island and Chernobyl and the development of combined cycle gas turbine technology. Why do forecasters neglect such discontinuities? It is not because they are stupid or irresponsible. The better forecasters do pay homage to them in passing but their timing is impossible to predict as is their likely impact. You cannot forecast discontinuity yet the history of the international oil industry has been driven by such discontinities. What will come next? Fuel cells, perhaps gas-to-liquids technology or perhaps some political shock. Who can say what or where or when and with what impact?

The third error in forecasting in this context, linked to the last error, is that almost by definition the forcasts take a conventional view of the behavioural drivers. Straight lines tend to be extrapolated from the past. But behaviour can change. Again, this form of neglect is entirely understand. It is difficult to predict the form of changing behaviour or their impact. But again, as with discontinuities, the history of the industry is littered with such changes ranging from changes to the income etasticity of demand for oil in the 1970s to falling production costs after 1986. Again, it is necessary to ask what may change in the future?

What I want to do now is to suggest some discontinuities and some changes to behavioural drivers which may undermine the conventional wisdom of ever growing dependence upon Persian Gulf oil.

Let me begin with the supply side. Look at the history. The side shows obsolute growth in non-OPEC supply. Only in three years did non-OPEC supply go negative- 1974, 1986 and 1989. In 1986 of course price collapsed and non-OPEC production fell but bounced back pretty quickly. In 1998, price collapsed again and non-OPEC supply nearly went negative. However, again various estimates suggest another 1 mbd this year out of non-OPEC. Let me suggest several reasons why over the next 5 to 10 to 15 years non-OPEC supply is likely to stay strong. first, is the technological revolution which has taken place in the upstream. The details are known to many here and I will not repeat them. One statistic tells it all. In 1982 the private companies' finding and development costs averaged $16 per barrel. By 1994 that had fallen to $4. Some of these new techniques are only just beginning to bear fruit. Ten years ago, if you had a salt dome you could do nothing with it. You could not tell what lay underneath and even if you did you could not drill through it. Today you can find out what is beneath and you can drill it. There are a lot of slat domes out there waiting to be explored. There is a similar story for deep offshore with West Africa provding a series of major new discoveries.

The fiscal terms on which companies operate are becoming more progressive. Hence oil companies are increasingly insulated from oil price risk. If oil prices fall, conventional economic analysis says quantity supplied falls. But because of the fiscal system, the price could stay low for a long time without affecting supply. It is the host government which now takes the hit not the oil company. New exploration and development acreage is opening up. This is due to a combination of technology allowing deeper offshore operation and political change bringing new acreage into play. Those of you with a good sense of history will remember that the last time the industry saw this combination was in the 1950s when the result was a dramatic increase in oil production globally. The national oil companies which have been responsible for exploration and development in many cases are undergoing fundamental reform which in turn is going to lead to greater efficiency, lower costs, more discoveries and more capacity developed.

Overall, it is very difficult over the next 5 to 10 to 15 years to see much diminution in non-OPEC supply. If you also look at non-Persian gulf OPEC, the story is the same. This is reinforced because in recent years many have encouraged the entry of foreign companies or tried to revive existing foreign company interest. If you take Venezuela, Algeria, Qatar and Nigeria, these four together between 1990-97 increased capacity by over 2 mbd.

Hence there will be plenty of oil and OPEC's market control role means that OPEC in general and Persian Gulf in particular will remain residual supplier with incremental demand barrels going first to non-OPEC.

What of the demand side? I have no problem at all with the view that says over the next 10 to 15 years global oil demand will continue to rise. I am quite sure it will and the only debate is how fast or slow that rise will be. This is simply because demand is determined by the stock of oil using appliances. As

MIDDLE EAST AND OIL IN THE 21ST CENTURY

by: Paul Stevens

The following is the transcript of a talk given by Professor Paul Stevens of the Center for Energy, Petroleum and Mineral law and Policy at the University of Dundee in Scotland to the Institute of International and Political Studies in Tehran on Saturday 27 may 2000.

Its a great pleasure to be here and address you this afternoon. Let me begin by giving you a little background to the subject I wish to adress. There exists in the international oil business a very strong conventional wisdom- a conventional wisdom is a view held by the majority of people. This states that the world will become increasingly dependent upon Persian Gulf oil as we move into the 21st Century. I have been studying the international oil industry for over 30 years and one thing I have learnt is that the industry is a graveyard for conventional wisdoms. As soon as one begins to emerge, either things change or the conventional wisdom itself promotes changes which provide the seeds of its own destruction.

As a university professor I believe that I have two functions. The first is to challenge conventional wisdoms since they are the enemy of thought. The second is to say things that people do not wish to hear. This afternoon, I intend to do both and in the process hope to initiate a discussion in what is a controversial area. There are no right answers here, only interesting questions. My talk is based upon a paper published in Energy Policy but while I have presented this paper all over the world, I have never actually delivered it in the region. This gives me an opportunity to rectify that.

The conventional wisdom I am talking about is the successor to the myth of the "energy crisis" which was supposed to befall the 1970s. This consisted of two assumptions. First that oil demand would grow forever. Second, that oil reserves are fixed. Given a fixed stock of oil therefore the oil reserves are fixed. Given a fixed stock of oil therefore the oil runs out and you have an energy crisis. This approach is what can be called gapology. If you put two lines and the same graph with different slopes, they are likely to cross and thereby identify a gap. This view of the energy world was rapidly discredited as it became obvious that the finite stock of oil magically kept renewing itself and there was clearly no energy crisis. The result was a revised version- second edition. This time it was only non-OPEC oil supplies which were constrained hence while there would be no shortage, as demand increased forever, the world would become increasingly dependent upon Persian Gulf oil.

Let me show you on this slide a typical example of this conventional wisdom. I have chosen this simply because it comes from a consultant and hence can be regarded as politically neutral. As the slide shows, up to 2010, non-OPEC stays flat. Non-Persian Gulf OPEC increases a little but most of the increase in demand comes from the Gulf. Since it is now 2000- the first forecast point on the graph we can actually test the accuracy of the forecast. Overall demand is not too bad. It claims 75 million barrels per day (mbd) while the actual is closer to 76.5 mbd. Supply sources however are way out. Non-OPEC is forecast to be 44 mbd when the outurn is likely to be closer to 49 mbd. Non-Middle East OPEC is supposed to be 6 mbd while the actual is over 8 mbd. So the forecast for Middle East OPEC of 25 shows on actual outrun of 19.7. An error of 5.3 over only four years is not encouraging.

I want to challenge this conventional wisdom on two grounds. First that the forecasting methodology is fundamentally flawed. Second that it ignores the feedback loops it creats which changes behaviour and the future.

There are three basic errors in the forecasting methodology. First, there is a fundamental misunderstanding of the nature of oil reserves. This is a long standing battle which has been going on for years between the economists and the geologists although some economists courtesy of the work of Harold Hotelling find themselves in the geologists' camp and one of the best recent articles on the subject was by Peter McCabe, a geologist. The economists standpoint is simple. Oil reserves are not a gift of nature, they are the result of investment and human ingenuity. Perhaps at some point if there is depletion, the cost will exceed the price. At that point investment in the industry stops. The amount of oil remaining in the words of Adelman of MIT is "unknown, unknowable and totally uninteresting". Hence there is a constant battle between depletion and human ingenuity. Who is winning will be