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International Trends in R&D

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Opening Statement

"Significance of International R&D Trends"

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R&D investment is a key component of the economic policy of all of the advanced industrialized economies. It is the key tool in the drive to maintain innovation and continued growth in a competitive global economy. Any analysis of international R&D trends must invariably look closely at what is happening in the USA, which spent about $265 billion in R&D in 2000, up from $ 221 billion in 1998, and more than the combined spending of the UK, France, Germany and Japan, which are nonetheless among the other large global R&D spenders. So in terms of absolute numbers, the US R&D spending is the most significant. The USA is also the most active in production of new patents on a global basis. US trends and activity are therefore most influential on the global R&D outlook.

At the global level we can note 3 basic trends:

- More externally collaborative projects – e.g. greater emphasis on licensing, greater cooperation between stake-holders in government, private sectors and NGOs
- Stronger focus from management in achieving business objectives through R&D
- R&D targeted more specifically for concrete business results, which corresponds to such factors as reduced share of government spending, change in government priorities, and the current market realities for business and their priorities.[1]

At the US national level, spending by the US federal government on R&D has become broadly focused on two strategic sectors, health and defense. Much of the total US Government R&D spending is targeted toward defense and as such has no effect or a much delayed effect on general commercial activity. The main R&D priority then in which investment is increasing is the health sector. Rapid advancements and scientific and popular excitement over recent and anticipated progress has made it the hottest R&D sector. This is not without reason. Healthcare advances on the horizon could revolutionize human existence. The payback from health care R&D is obvious and "politically correct".

Energy R&D suffers from the "addiction mentality" of those dependent on it. Like a drug user, Americans (particularly), as well as others, do not like to consider changing their habit, or their drug or the method of administration or anything else connected to what is in effect the power behind their lifestyle. As such, Energy R&D is boosted more than anything by crisis, and by little else. But this is not to say that there is no energy program and no energy R&D. Obviously we speak of these issues in relative terms. And when you are talking about total spending of US $ 265 billion, even a small percentage is significant in real terms. For example, the US Department of Energy is currently funding a program to facilitate development of 9 broad segments of US industry that are major users of energy. This is called the Industries of the Future program. The petroleum sector

[1] http://www.onlinejournal.net/iri/RTM/free/html/43_1_11.html

is one of those 9. According to the US Office of Industrial Technologies, "Nine energy-intensive industries are currently targeted as Industries of the Future (IOF) industries for energy savings and waste reduction: agriculture bio-based chemicals, chemicals, glass, forest products, steel, aluminum, metal casting, mining and petroleum. Together, these industries account for over 75 percent of energy use in the entire industrial sector. These industries are also responsible for about 90 percent of the estimated 12 billion tons of waste produced by industry each year."[2] This sort of strategic planning is a good example of how to seek a focus to derive maximum benefit from available funds. The emphasis on energy savings and waste reduction are key aspects and worth considering as themes.

The impact or return on investment (ROI) from the OIT R&D projects has been significant. According to their report, '*Impacts—Summary of Program Results*, energy savings from recent projects amounts to about 1.6 quadrillion Btu, or approximately US $ 6.5 billion, after the initial R&D investment is deducted[3]. The benefits include not only the financial but environmental; in their own words, "the joint efforts of OIT and its partners have also kept 121 million tons of CO2, 246,000 tons of NOx, 463,000 tons of SOx and 124,000 tons of particulates out of the air."[4] Obviously the leading economies of the world do not invest in R&D for nothing; the only question is how to structure it and what to focus on.

At the same time, as referred to above, the dominant trend in US R&D spending that would interest us, is the continuing decrease in energy related R&D. Energy does not seem to be a high US priority, despite the manifest successes of programs such as OIT's. This can be explained by the fact that most fundamental changes in energy use are viewed as benefit-neutral at best and more likely to be both intrinsically unpleasant and financially demanding. Perhaps that is not true; it does not seem that the evidence points that way. But that is the political outlook of American oil insiders and Republicans of which President George Bush seems to be both. The current US political leadership is gambling that no serious oil shortage will occur within the coming 8 years, which is the maximum time the current administration may remain in power. If such were to occur, his taking the "easy way out" would look short-sighted and foolish and bring political consequences; if no energy crisis arises he will have gambled wisely in a political sense.

However the current administration is not necessarily making a drastic change in policy. US spending for energy R&D has been declining in real terms for years.

A report prepared in 1997 for the president at that time, Bill Clinton, highlighted the situation: "...while the challenges looming in the energy future of the United States and the world have been growing in recent years – or at least growing more apparent – expenditures on R&D have been declining.... Although data for energy R&D in the U.S. private sector are less comprehensive than those for government R&D, the most recent systematic study of energy industry R&D trends found that the industry's spending for

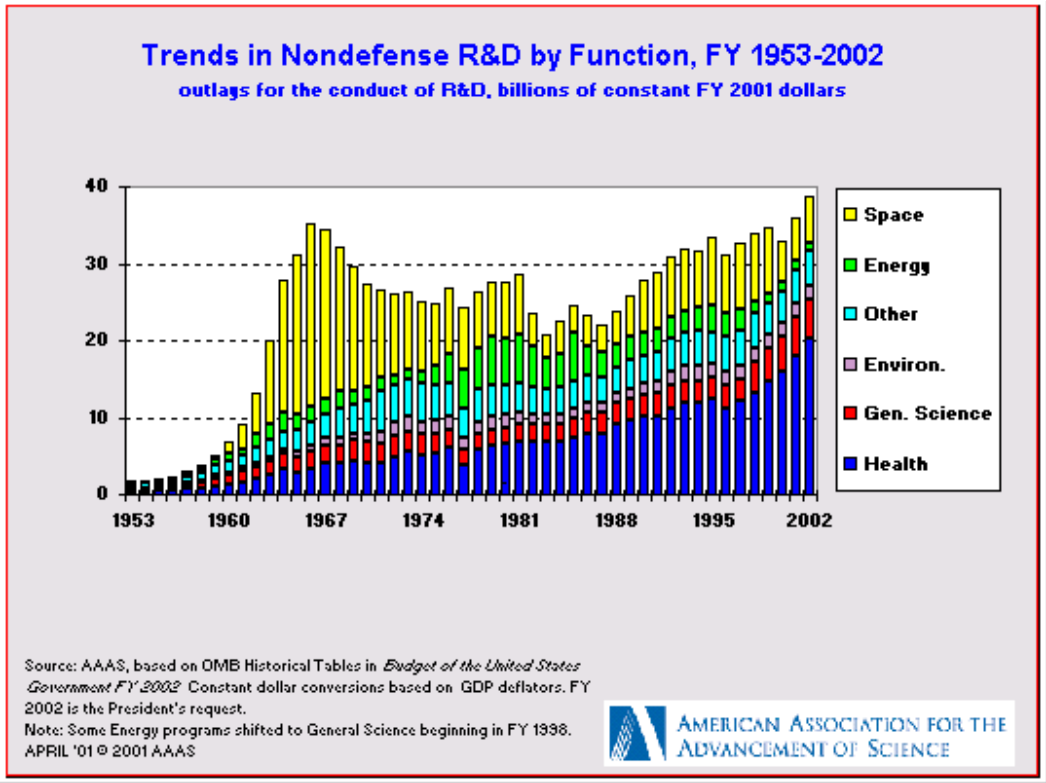
[2] http://www.oit.doe.gov/strategicplan/strategy.html
[3] The OIT Times; http://www.oit.doe.gov/oittimes/sm01/index.shtml
[4] Ibid.

R&D fell 40 percent in real terms between 1985 and 1994.... The R&D spending of the 112 largest U.S. operating electric utilities fell 38 percent between 1993 and 1996 alone, and the R&D of the four U.S. oil firms with the largest research efforts approximately halved between 1990 and 1996."[5]

This trend has continued up to the present as can be seen in the following chart with a sharp decrease in energy R&D from 1995 to 2000, with no sudden reversal anticipated. I would label this as the most significant global R&D trend for Saudi Aramco, because whenever money has been thrown at the "energy problem", significant advances have been made. As you are well aware, slight changes in the price of oil have tremendous consequences for both general investment and R&D related projects. In fact it is oil policy of the producer nations and other variables of global supply that seem to control energy R&D. This is a very beneficial situation for the oil-producing nations, because a more far-sighted policy by the United States could begin to pressure the demand and price for oil rather than the reverse.

The fact that energy R&D is declining, in combination with other important variables such as supply and demand and price, is likely to postpone the inevitable, the end of the Petroleum Age. Although Stone Age man and Iron Age man and the like may have taken many centuries to develop, one of the defining realities of our era is the speed of transformations, technical, cultural and otherwise. The Petroleum Age, which is as accurate a name for the current era as any other, is coming to a close as sure as death. Different and more foresightful energy policies toward R&D by industrialized nations could impact the end of this era by developing non-petroleum energy sources. It is coming one way or another but by delaying alternatives, the industrialized countries will end up paying more later, one way or another.

[5] Report of the Energy Research and Development Panel; The President's Committee of Advisors on Science & Technology, November 5, 1997. http://www.fe.doe.gov/strategic_plan/festrategy_outlook.html



taken from: http://www.aaas.org/spp/dspp 1

But prognosticating is never an easy job and current trends can shift like the winds. Sudden forward leaps in current technology or changes in policy could radically alter the status quo.

For example, the fuel cell battery is currently in the early stages of development. US government funding for this technology amounts to a little more than $ 100 million a year. That amount is dwarfed by private sector contributions; for example, DaimlerChrysler recently invested CAN $ 450 million in Ballard Systems, a leading fuel cell developer in Canada[6]. Meanwhile other industrialized nations, such as Germany and Japan are offering strong competition in the race to commercialize this technology, with government subsidies and other support. If the United States was to heighten their commitment to this technology it could conceivably bring the technology to the level where it could pose a real threat to the global dominance of petroleum.

One of the things that can be observed from the case of fuel cells, and that applies to all types of R&D, is that direct government funding of R&D is only one of the important ways that R&D is supported. First it can be noted that industry is putting much more cash on the table than government. But regarding direct cash grants, subsidies and the like, government's role is very important as a catalyst in developing new technologies.

[6] http://216.51.18.233/fcfaqs.html

An equally important role of government is supporting the new technologies through government procurement and spending policies and other indirect ways.

Supporters of fuel cell technology note that the US spends $ 5 billion dollars a month on imported oil. A small percentage of that amount could result in fuel cells being commercially feasible on a large scale within 5 years.[7] What would be the effect of such a development on oil producers such as Saudi Aramco? It is difficult to say with certainty. I certainly am not going to try and paint any sort of a "gloom and doom" scenario. Most analysis of the petroleum industry's next 50 years will paint a picture of increasing demand in the face of relatively static supply and corresponding increases in revenue.

The point I wish to stress is not only this particular technology, despite its potential importance, but the impact of R&D investment or the lack of it. R&D spending and other types of indirect support are potent tools for industrial and economic development. The extent of investment has great significance not just for the investors but also for 3rd parties and other nations. We are being impacted by the decisions that are being made, elsewhere, whether we know it or not. And it is still possible that the situation could change.

As far as I can see, the global petroleum status quo is in our interest. We don't really need any changes, but we won't be able to stop them from coming when they do. The US may be turning a relatively blind eye to energy R&D, but the commercial pressures and competition from other nations could encourage greater interest, particularly if development looks promising and there is a fear of being left behind in a watershed technology. US supporters of the fuel cell technology recommend three basic steps for greater government support; they want greater R&D spending, government purchasing policies that support the new technology and government support to bring down the price of units initially established around the country.[8]

What we can and should do is try to learn lessons from this ourselves and make the correct strategic decisions. What are our R&D goals? What are the strategic objectives? What sorts of changes are imminent, how will we respond to them, and where do we want to find ourselves when changes come? After answering these questions we need to apply the right mix of private and government investment in R&D and seek the appropriate facilitation from the government to make our goals commercially feasible. However we have to avoid the trap of investing in industries that do not show clear promise of future self-sustainability.

In my earlier comments I noted some general comments about general trends that have been observed in global R&D spending. Of those, I think the first (more externally collaborative approach) is more important for Saudi Aramco. The others, management seeking more concrete results and achieving (short-term?) business goals through R&D seems less significant. Certainly it is always desirable to achieve concrete results and

[7] Ibid.
[8] Fuel Cells 2000 , http://216.51.18.233/fcfaqs.html

meet objectives. But in this context, the opposite is not necessarily to fail in bringing results, but to have a longer-term focus. One of the reasons for these trends is fierce competition and increasing pressures by the market to achieve ever-greater profitability. Saudi Aramco's situation is quite different I would say. Controlling much of the world's oil and the most easily accessible at that, does not make competition to great a challenge. And the market pressures of Wall Street do not have to dictate policy. So, it is possible and in my opinion desirable, to take a long-term view.

That is not to say that we shouldn't set concrete objectives or hope to meet them. For example, there is no reason that Arab producers should squander resources simply because there seems an abundance. Nor do we need to say no to environmentally friendly production because of the vastness of our deserts. But I would say that in the long term we will have to look beyond the end of the Petroleum Age to set our priorities, and we should be glad to have the luxury of doing so. I have no doubt that these issues are already quite an active subject among the Arab world's finest engineers and businessmen. But the question is where to start.

Relative to the industrialized countries, R&D does not exist in the Arab world. I don't mean any disrespect to all the excellent Arab scientists who are giving their hearts, minds and labor to very exciting scientific projects, but as I said, I am speaking in relative terms. We simply lack the infrastructure, financial, industrial, political and human. That is why the tendency toward externally collaborative projects is relevant. Because we need to work with many different sources and build linkages that can develop the linkages that allow our science and technology infrastructure to function effectively and support sustained and targeted R&D efforts.

Even in the developed industrialized countries, there is constant effort made to building and maintaining the linkages between industry, government, academia, smaller specialized R&D firms and other organizations. This takes constant work, effort, attention and investment, although we can be grateful that the digital revolution has greatly facilitated this global networked knowledge society. But for the developed countries, these trends have a different meaning than for us. For them, these are subtle changes based on changes in government policy, market conditions, specific industry characteristics, competition, and a variety of other factors. For the Arab countries we are looking at building a foundation.

It is easy to look at the international trends and say, 'yes, this is what is happening elsewhere now." And as you see, I have applied lessons from the West to bring focus to this discussion. But in my own mind, I see it as an almost arbitrary form of order for this discussion. Our situation is totally different.

Still, it is a learning experience to observe what is going on elsewhere. And the biggest lesson we can learn is that R&D is very, very important and the key to industrial development and long-term competitiveness. But getting from this realization to the point where we can actually establish the sort of foundation we need is no easy task. And like

all complex challenges, throwing money at it will not necessarily work; although there is no doubt that serious financial commitment is necessary.

But the most important part is the human element. I realized long ago that human capacity building is the most important priority we can have. There are many ways to go about this: formal education, vocational education, on the job training, seminars, and countless others. In the West, virtually all professions organize themselves and take an active role in regulating or developing their profession, with a special emphasis on education, certification, and networking for business and personal success. I have followed this Western model in developing Arab societies such as the Arab Knowledge Management Society and Licensing Executives Society-Arab Countries. You may wonder about the linkage between these subjects and our topic today. I can assure you that they are integrally related.

One of the best ways to spread education and knowledge cost effectively is through development of information and communication technologies. In my capacity as Chairman of the ICC Commission on Information and Communication Technologies, I have made development of the IT infrastructure of Arab (and other developing) countries a high priority. This is critically important to the development of the linkages (communication) between Arab participants in the global knowledge society, which is essential to both Arab R&D efforts and development in general.

Let me give an example to show this more clearly. Arab scientists are already at a disadvantage coming from countries with less developed infrastructure. Yet they may still have the potential to develop creative innovations that are commercially valuable. But how do they know that they are really the first to come up with the idea? Maybe they came up with the idea all by themselves but it may already have been developed elsewhere. It is not an uncommon occurrence. The fact is that an amazingly, intimidating large amount of scientific information exists and is waiting to be explored. Within those mountains of data is the information that could save a developer months or years of unnecessary effort. In other words, if you understand the prior art (the prior developments around the world) you do not reinvent the wheel and can create innovations that have global novelty, utility and patentability (i.e. commercial value).

Yet most Arabs are not familiar with this information or how to access it. They are not aware of the huge volume of scientific information available in global patent offices or the fact that they may use that information to develop newer ideas, or that the expired patents of 20 or 30 years ago, may hold information that could yield new discoveries or ideas with commercial applicability.

Not only scientists and our technicians, but also even our attorneys are not aware of these issues and do not understand the way in which partnerships through licensing of patent rights can help to build industrial ventures or develop industrial R&D projects. So you can see, I believe, that there is a real linkage between all these things and the subject today. I organized the formation of Licensing Executives Society – Arab Countries to provide an Arab society that can help Arabs to link to and learn from the intellectual

resources of the world. These resources cannot be accessed effectively without developing the technical and human ICT infrastructure.

These are key, absolutely essential issues to work on if we want to this region to develop. International scientific cooperation through digital means is one of the important trends in the R&D field. Previously it was not possible to stay so up to date with developments in real time on a global basis as it is today.

As we seek to learn from international trends and methods some other potential ideas to pursue include the following:

- Cooperate with other national industrial firms to forge mutually beneficial broad industrial goals.
- Form alliances and cooperate on mutual technology goals
- Support university and 3rd party research within the country
- Work closely with government, other private sector, academia and 3rd party research institutions
- Learn from other's experience: emulate their successes and seek to avoid their failures
- In regard to the point above, we should seek to avoid looking only at short-term gains and try and take a long-term view of things, a view that is ultimately responsible to our children, their children, our world, God, and our own integrity.

By cooperating with one's corporate peers in setting broad R&D goals for the industry, it is helpful to both government and the individual companies in knowing what to do. It is also important to avoid the trap of doing everything in-house based on corporate pride, as it can minimize risks and create synergy to work with competitors for mutual advancement. This may require the formation of equity R&D joint ventures to solve issues of trust. Another important factor for large companies is to generously support 3rd party research within the country, particularly specialized research centers, keeping in mind that the trend is toward outsourcing of R&D tasks.

Working closely in partnership with all stakeholders including the government, other firms, universities, etc. is an established requirement for real success. Benchmarking is important to observe what works and what doesn't. There is quite a lot of information available and many foreign R&D and technology transfer specialists are more than willing to share their knowledge. In the last 20 years the Arab world has come a long way in developing its labor force and building many skill sets that were weak or non-existent previously. However with regard to R&D, licensing, and technology transfer issues, we still have to look outside, as we have a dearth of expertise in this area.

And in conclusion, I believe that ultimately we should look at R&D in a long-term perspective and how it can help to shape the future of our children and grandchildren. It is not an investment that pays instant dividends; it requires steady committed investment,

diligent work, and a long-term strategic focus. I believe that Saudi Aramco is quite capable of leading the way for the other Arab companies and nations, by their example.

It also gives me pleasure from my position within the ICC to convey to you the greetings of its dynamic Secretary General, Maria Cattawi, with whom I am closely working in my capacity as the ICC candidate to the UN ICT Task Force whose inaugural meeting will be hosted by the UN Secretary General on September 14 in New York.