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The Gulf Countries and Nuclear Energy

In recent months, the GCC and its member countries have manifested an interest in the development of peaceful uses of nuclear technology, meaning primarily the possibility of adding a nuclear component to their energy supply.

Commentators have interpreted this new interest primarily as a function of regional geopolitical and security developments. In contrast with this view, I will argue in this article that the position of the GCC is justified by sound economic considerations and the requirements of the region's economic development.

The GCC countries pursue a policy of diversification of their economies, in view of the time, however distant, when their oil and gas resources will decline and their sustenance will need to be based on other foundations. Indeed, some of the GCC countries have already experienced a decline in their oil production capacity, this being notably the case for Bahrain, Kuwait, Oman and, within the UAE, Dubai and Sharjah.

Much of the region's recent successes towards economic diversification have been based on the availability of oil and gas at preferential conditions. In the case of gas, provision to industrial users at prices lower than are available in some of the industrial countries is justified by the large avoided cost of transportation. In the case of oil, this justification is less cogent. In both cases, the simple assurance of availability is bound to become an increasingly important consideration in the siting of large scale industrial plants.

It is important to underline that the availability of oil and gas may attract industrial investment on three different counts:

1. as feedstock for petrochemical transformation

2. as source of heat in processes requiring large amounts of caloric energy

3. as a source of heat in power generation, for processes requiring large amounts of electricity.

These three modalities are entirely different, because it is impossible or very difficult to substitute for certain oil products (naphtha or LPG) or gas as chemical feedstock, but it surely is possible to substitute for them as a source of heat. In some industries, natural gas is preferred to other potential sources of heat because the flame is very clean, easily controlled in intensity and directional, allowing to apply heat selectively on different parts of the object to be transformed. These considerations are very important in, e.g., the

glass or ceramics industry. IN other cases, where such special requirements do not exist (e.g. cement) gas competes with other energy sources solely on price.

Power generation specifically is an area in which oil and gas are easily substituted for: they are needed if the plant consists of gas turbines, either alone or in association with steam turbines; but are not at all optimal for pure steam turbine plants, where the heat is used simply to raise the steam.

In discussing the process of diversification of the Gulf economies, these distinctions are frequently forgotten, and reference is made to all "energy intensive industrial processes". However, the advantage that the Gulf countries enjoy is in fact quite different depending on the use that is made of the oil or gas: in petrochemical industries the advantage is very strong, indeed decisive; in other selected industrial processes the availability of gas is important and confers a significant advantage; but in generic heat consuming industrial processes the advantage is much more questionable.

This is especially important in considering those industries that require a lot of electricity. Paramount among these is aluminium smelting, which has been a huge commercial success in the Gulf. Large investment plans are being formulated to increase aluminium smelting capacity, which will translate in further increases for electricity demand. Is it rational for the GCC countries to supply these prospective plants with low-cost electricity?

A somewhat different yet closely related case is water desalination: in fact even more essential to the sustainability of the GCC countries' economic and political future. Water desalination is closely related to electricity generation, because it can be achieved with one of two processes: distillation and reverse osmosis. Distillation implies bringing the water to boil and separating the steam from the brine; it is logically connected to electricity generation because the heat from power generation can be recovered to distillate the water, so that sweet water becomes a by-product of electricity generation. Reverse osmosis is, on the contrary, a process that normally absorbs significant amounts of electricity (to pressurize the salt water and drive it through the membranes that separate the salt from the water).

In both cases, cheap electricity is closely related to affordable and abundant desalinated water supply. The GCC countries are using and will use both desalination technologies: cheap heat is essential for the economic viability of water distillation and power generation; and cheap electricity is required for reverse osmosis.

The cost of electricity is a function of many things: the cost of fuel, the investment cost of the power plant, the number of hours that the power plant is in use. The latter consideration is especially important: electricity cannot be stored, and whenever demand swings widely between seasons and hours of the day (which is always the case) power plants must be available to meet the peak demand, which are not used at other times.

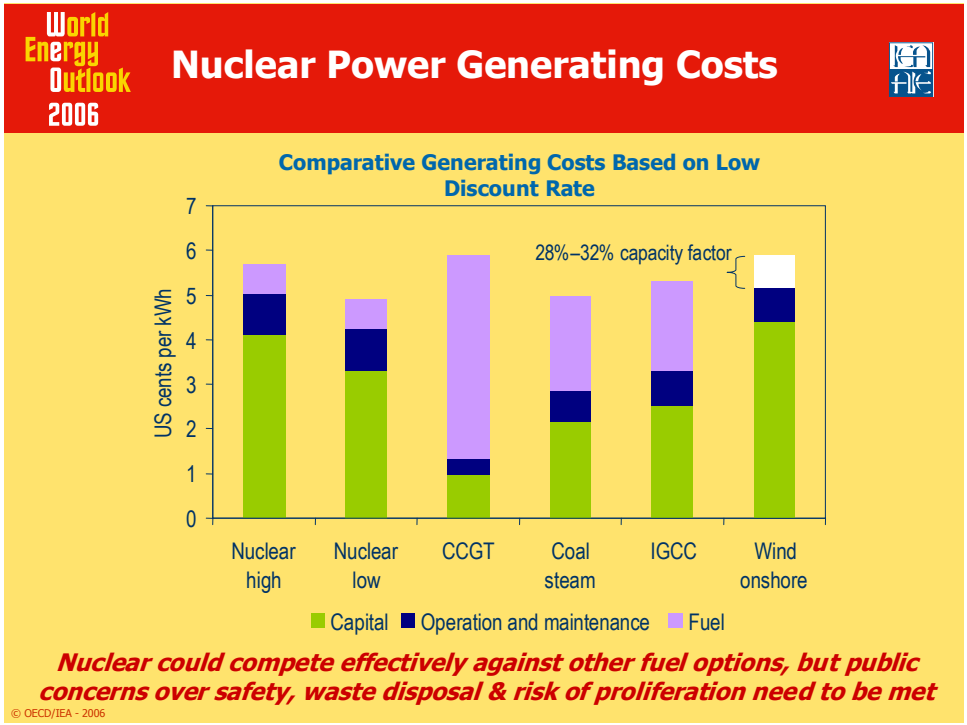
In the Gulf countries, seasonal variations in electricity demand are especially wide, because of the large demand for air conditioning in the summer. Considerable savings

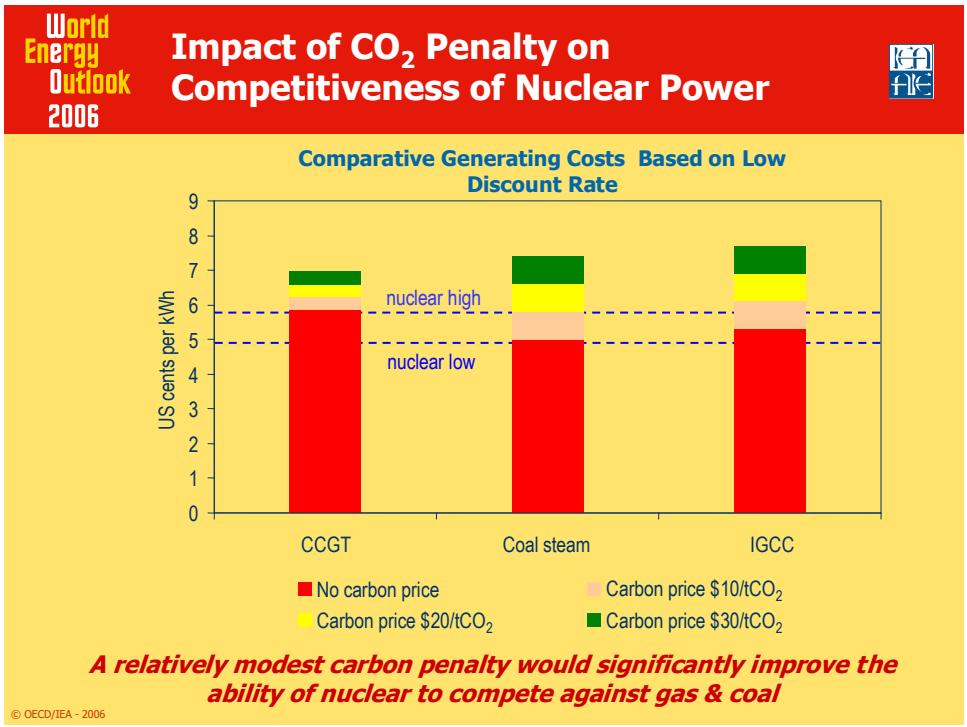
could be obtained if the public could be induced to discard old and inefficient air conditioning units and opt for efficient – and more expensive – ones. This is difficult to achieve if the price of electricity is not increased, especially at times of peak demand. Another possibility is to encourage the growth of interruptible users – i.e. users that will accept to be cut off at times of peak demand. Interruptible users generally are found in industry, including both aluminium and water desalination by reverse osmosis.

It is thus certainly the case that considerable rationalization would be possible in the GCC countries through policies aimed at the management of demand at more rational use of energy, but demand for electricity is bound to increase nevertheless – as it does in all countries, more rapidly so than demand for other forms of energy.

The choice of the optimal power generation technology depends on the degree of utilization of the plant. Plants that are used for peak shaving will not run many hours, and the cost of fuel is relatively less important for them: more important it is to minimize the initial investment. For this use, gas turbines are the most competitive, either alone (for pure peak shaving plants) or in combination with steam turbines (so-called combined cycle gas turbine plants – for medium load). However, for base load plants, i.e. plants that are intended to run almost in permanence, the cost of fuel becomes of paramount importance, and compensates for the higher initial investment.

Nuclear power plants are the cheapest source of base load electricity, followed by coal burning plants. Oil or gas plants can only offer competitive base load electricity if the fuel is available at a discount to international prices. To the extent that well-designed policies will succeed in flattening electricity demand and reduce swings, base load capacity will increase and peak load may be reduced.





For many years, the main GCC oil exporting countries (Kuwait, Saudi Arabia and Abu Dhabi in the UAE) have enjoyed significant non-utilized oil production capacity. This was historically the result of the decline in the demand for Opec oil and the imposition of quotas to defend certain price levels. For as long as non-utilized capacity has been available, the marginal cost of an additional barrel of oil might have been considered to be close to zero. At the same time, minimizing the cost of initial investment was an important consideration for all GCC countries, which had to weather a considerable worsening in their financial situation. Hence, for a long period of time the exclusive reliance on oil or gas fired power plants was indeed perfectly rational.

However, the situation has changed, and non utilized capacity has become scarce: all GCC countries are investing billions in increasing their crude oil production capacity, and under the new circumstances the marginal barrel of oil has indeed a significant cost - on top of the fact that it has an opportunity cost, i.e. the price that it would fetch if sold on the international market.

The availability of cheap fuel for power generation is further constrained by developments in the refining and petrochemical industry. In the case of refining, in the past several major Gulf refineries were simple distillation plants, whose products slate had a relative small component of the most valuable products (gasoline, kerosene, diesel) and a relatively large component of residual fuel oil (generally high in sulphur). Fuel oil is being phased out everywhere in the world, and it has less and less of a market internationally. It was therefore rational to use the fuel oil domestically for power generation (provided that the negative environmental impact is ignored). Investment in improving the refineries was discouraged by the availability of excess refining capacity globally.

But here too the situation has changed: refining capacity is short globally, and the Gulf countries find it difficult to sell their heavier oil. Consequently, they are now investing massively in improving the product slate that can be obtained from older refineries and in adding new refineries: the net effect of these developments is likely to be that residual fuel oil will be relatively less abundant.

The growth of petrochemical industry is important because it requires gas as feedstock. There is a significant pipeline of petrochemical projects that is waiting to secure its gas supply; gas fired power plants now compete with petrochemical plants for the allocation of available gas.

All of these effects are simply some of the multiple consequences of the fact that we have now entered an era of tight global oil and gas supplies. It is by now fairly clear that oil and gas supply are unlikely to grow at the same pace as demand, meaning that globally other sources of energy will need to play a bigger role. The price of oil and gas on international markets is likely to remain high, even if possibly not quite as high as it is at the time of writing. The use of oil products, in particular, will increasingly be concentrated in the transportation sector, where they are most difficult or altogether impossible to substitute for. For heat generation, other sources will increasingly be used.

The fact that the Gulf countries have abundant oil and gas production, certainly in excess of their domestic needs, does not mean that they should not participate in the global process of energy diversification. As oil and gas become more valuable, it will pay to rein in domestic consumption and make as much as possible available for export, especially if embodied in higher value added products such as petrochemicals. Today, several large scale power plant projects and electricity-intensive industrial projects are being launched, all of which need to receive crude oil or fuel oil at prices far removed from international realities. Sooner rather than later, the alternative of nuclear for some of these plants will be considered (the alternative of coal is already being considered, although in my opinion it is even more paradoxical than nuclear, in addition to having a negative environmental impact).

Today the GCC countries enjoy a comfortable financial position and are constantly scouting for long-run investment opportunities that might be functional to their development and economic viability. Nuclear power plants require higher initial investment but are a form of insurance for the future. Developing a nuclear component to power generation in the region is a valid way to reduce excessive dependency on oil and gas and lay the premises for a more balanced future.

Generally, one of the obstacles on the path to developing nuclear power generation is the non availability of trained personnel. But the GCC countries have extraordinary experience in making the best use of internationally available expertise, and progressively internalizing the know-how and technology without prejudice to the competitiveness of operations: they have succeeded in this in several areas, and there is no reason why they should not succeed in nuclear power generation technology.

The key to success is exactly in viewing nuclear technology as an economic, not a political or security choice. Nuclear power plants can be bought from international suppliers including operations and maintenance: initially there is no need to develop a domestic capability to design a plant, enrich the fuel or even less reprocess it, and possibly even treat the spent fuel. One should, in other words, do the exact opposite of what Iran is doing – they are investing in fuel enrichment even before they have a single nuclear power plant running.

Recognizing the economic motivation and rational for investing in nuclear power generation is important to avoid misunderstandings and misrepresentation of intentions. To the extent that investment decisions are based on sound economics, no one will be able to object.

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