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MEDITERRANEAN AND THE GULF**

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Introduction

Since 2006, several Arab countries rather suddenly manifested a revived interest in civilian nuclear energy. For some, like Egypt, this was the resurrection of an old interest; however, for others, among which notably the member countries of the Gulf Cooperation Council (GCC)¹, interest in civilian nuclear energy represented the clear reversal of a previously held position of hostility.

Egypt first launched a nuclear energy program already in the 1950s - that is before the majority of the country's most significant oil and gas discoveries were made. The program was intermittently continued under Sadat and the early years of the Mubarak presidency, only to be put in deep freeze following the Chernobyl disaster.

In contrast, the GCC countries always had a negative attitude towards nuclear energy, viewing it primarily as a potential competitor of the hydrocarbons that they are major exporters of.

In both cases, international media and analysts have had a tendency to always interpret interest for nuclear technology as being closely related to security concerns. In the case of Egypt and other countries of North Africa and the Levant, interest in nuclear technology was systematically connected to Israel being an undeclared nuclear power. Israel itself never failed to make the connection, always suspecting that nuclear installations, purported to be for civilian use, were in fact destined to military purposes. Starting in 1981 with the bombing of the Osirak reactor in Iraq - which had been built by France and was monitored by the IAEA - until the 2007 bombing of a not-well-identified nuclear installation in Syria, Israel has viewed any nuclear development in the region as a threat.

By the same token, the Iranian nuclear program, initiated, like the Egyptian one, with the blessing of the US in the 1950s, only became highly controversial after the collapse of the monarchy and the advent of the Islamic Republic. Since then, the rationality of Iran's purported desire to have a nuclear component in their power generation fleet has been questioned. In short, the prevailing attitude has been that the countries of the region have no rational civilian justification for an interest in nuclear energy, and any attempt in that direction should be interpreted as foul play and stopped.

In this vein, the interest of the GCC member countries for nuclear energy has been interpreted as motivated by Iranian actions: in other words an implicit threat to move in the direction of acquiring a military nuclear capability, in case Iran develops its own bomb. Little consideration is paid to the fact that the domestic capabilities of these countries are very limited indeed, and probably easier alternatives would be open to them, if they wished to acquire a nuclear weapon, than developing a capability starting from a civilian nuclear

¹ Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates

energy program. Iran as a triggering factor is of course even less plausible for the North African countries, although Egypt has at times expressed concern towards the much publicized Shi'i resurgence.

This negative attitude, which in essence translates into denial of access to nuclear energy technology – against the letter and spirit of the Non Proliferation Treaty and other relevant international compacts – might have been justified for as long as hydrocarbon energy was abundant and cheap. But since the turn of the century conditions have radically changed, and a reconsideration of the case is today imperative.

In contrast with the prevailing attitude, I will argue that in the new energy landscape which has emerged in the last five years, interest in nuclear energy has strong economic motivations for all Arab countries, although the position of the GCC is quite different from that of North Africa and the Levant.

This is not to deny that some political motivations are also present. Political decisions in complex regimes, such as the GCC countries', always reflect some kind of coalition of different forces. It is clear that some of the key players in the GCC regimes view Iran with deep suspicion, are hostile to any manifestation of greater Shi'i assertiveness, and push in the direction of forcefully opposing Iranian hegemonic ambitions. This component, however, is not shaping actual policy, and probably the shift towards nuclear energy would not be their first best strategy. Instead, I believe the shift has occurred because the attitude of the technocrats in charge of the energy sector has changed. Similarly, in Egypt the renewed interest in nuclear energy is part of a new reform agenda which is being promoted by Gamal Mubarak, in the context of the longer-term process of establishing himself as the legitimate and natural successor to his father.

But while political motivations and processes should not be ignored, it is also important to recognize the underlying economic rationale for an orientation which otherwise may be viewed as having only shallow roots.

As mentioned, I believe that the situation of the GCC countries is quite different from that of the other Arab countries, from the point of view of the cogency of motivation but even more so from that of the ability to concretely and rapidly launch a civilian nuclear program. Accordingly, I divide the discussion in two parts: the first is devoted to the GCC countries, and the second to the Mediterranean Arab countries. A discussion of Europe's interests concludes.

The economic rationale for nuclear energy in the GCC

Nuclear energy is used for power generation, and in order to understand its appeal we must look at current trends in electricity demand and supply in the GCC countries.

Power generation in the GCC is primarily based on crude oil and oil products; power plants are of the traditional thermal kind and burn either straight crude oil or residual fuel oil. In some remote areas smaller diesel-powered generators are in operation.

Gas plays a significant role in power generation only in Qatar, while its role in Saudi Arabia and the UAE is more limited. In Saudi Arabia, gas is used in power generation in the Eastern Province and in Riyadh, not in the rest of the country.

Except for Qatar, gas availability has been constrained throughout the region. Dubai and Oman import gas from Qatar through the Dolphin pipeline; Dubai also imports gas from Sharjah and Abu Dhabi. Sharjah, in turn, should soon begin importing gas from Iran on the basis of a deal concluded by Crescent Petroleum whose implementation has been repeatedly delayed.

Saudi Arabia launched four major gas projects in the Empty Quarter in association with major international oil companies, but results have so far been disappointing. Price remains a delicate issue: gas prices are fixed by the government and companies – including the national oil company Saudi Aramco – argue that they are not sufficient to cover the higher cost of new gas reserves. Hence, it is not clear whether insufficient gas production is the outcome of geological or economic factors.

It is highly likely that price liberalization and creation of more liberal conditions for regional trade in gas may lead to a significant improvement of gas availability over time. However, Qatar – which would likely emerge as the key regional supplier – has imposed a moratorium on all new export projects. The expected end of this moratorium keeps being pushed further into the future. At the time of writing, the official line was that it would continue until at least 2013-14.

Furthermore, Qatar is expected to become the marginal supplier of gas in liquefied form to all major global markets, and in this respect there is direct competition between increased local consumption and the demand of remote markets. At the same time, it is expected that the netback value to the producing country of exporting gas will always be considerably lower than the netback of exporting crude oil or oil products, because the transportation of gas, be it by pipeline or as LNG by ship, is intrinsically much more costly. Therefore, producing countries should always target gas for domestic consumption in order to free crude oil or oil products for export.

However, limited availability of natural gas is pushing some key countries in the opposite direction, i.e. limiting the use of gas in power generation and mandating instead the use of crude oil. In Saudi Arabia, the use of gas in new power generation plants has been suspended, as numerous petrochemical projects are being delayed by the inability to find guaranteed supplies of gas to be used as feedstock. To mention just one major example, the new aluminium pole which the minerals company Ma'aden is establishing in al Zour will be based on power generated from crude oil, not gas.

The rising opportunity cost of using oil in power plants

Until recently, the key GCC countries had significant undesired unused oil production capacity. It is important to distinguish between the cushion of unused capacity that some countries – notably Saudi Arabia and Abu Dhabi – wish to maintain in order to be able to compensate for extraordinary short-term disturbances in global oil supplies; and unused capacity in excess of that, which is not deliberate. The existence of undesired unused capacity has been a feature since 1981, because OPEC lost market share due to the increase in non-OPEC production. This condition lasted until about 2003-04, when the combination of rapidly growing demand and stagnating non-OPEC production led to a closing of the gap.

It should be kept in mind that the GCC countries have successfully pursued economic diversification based on low-cost energy. This has meant rapid development of industries which use oil or oil products and gas as feedstock or fuel: petrochemicals, first and foremost; but also cement, iron and steel, glass and more. But it also meant investing in industries which require electricity rather than oil and gas, in particular aluminium smelting, which has been extremely successful and is very rapidly expanding.

One should also consider the intimate link between power production and water desalination. There is very significant and well recognized cost advantage in coupling power generation with water desalination using the multi-stage flash distillation (MSF) technology – indeed coupling power generation and desalination is the only way that reasonably cheap large volumes of sweet water can be produced. The alternative to MSF is reverse osmosis (RO), which requires electricity: whichever of the two processes is used (both are) the connection between water desalination and power generation is inescapable.

Hitting the boundary

For as long as unwanted excess capacity was available, the correct cost concept for oil and products burned in power plants was direct cost – maybe 2-3 \$/b. The reason for this is that capacity was available and had no other use: therefore investment could be considered as sunk and unrecoverable. Financially, oil sold domestically at very low prices was produced at a loss, but past investment could not in any case be recovered, and the loss would have been even greater if oil had been left in the ground. The long period of unwanted unused capacity therefore provided a strong rationale for providing cheap fuel to power generation, and cheap electricity to industry.

However, when all capacity is used (or unused capacity is below the desired level) and new investment must go into expanding capacity, the correct cost concept becomes opportunity cost: that is the revenue which is forfeited by burning oil and gas domestically rather than exporting it – which today is >100 \$/b. In the long run, the correct cost concept becomes the total investment and direct cost of expanding capacity – which is difficult to estimate in general but surely is quite substantial today. All GCC countries are investing hundreds of billions of dollars into expanding oil production and refining capacity, and this is proof enough of the fact that the marginal barrel costs substantial money.

This means that there has been a quantum leap in the economic cost of burning hydrocarbons to produce electricity. To state this point in more rigorous terms, it is well known that in all optimization problems, when the use of a resource hits the boundary of its availability, the shadow price of the same suddenly jumps. This is exactly what has happened in the GCC countries some time in 2003-04.

Another significant development relates to oil refining. The GCC countries are upgrading and greatly expanding their refining capacity, after many years in which they hardly invested in refining at all. This new wave of investment is driven by the desire to maximise the valorisation of heavier crude oils, which otherwise are difficult to sell on international markets. New refining capacity therefore will tend to reduce the availability of heavy and sour crude oil – the kind that has more frequently been directed to fuel power plants. Possibly even more importantly, the upgrading of existing refineries will drastically reduce

the availability of residual fuel oil, to the benefit of lighter, more valuable products – especially naphtha for petrochemical feedstock. Until now, the reasoning has always been that it was rational to burn fuel oil in power plants, as there was little alternative market available for the product. This meant, in other words, that the opportunity cost of fuel oil was much less than that of crude oil, especially the lighter qualities of crude oil. But now, less fuel oil and heavy crude oil will be available, undermining the rationale of using liquid hydrocarbons in power generation.

The GCC countries' energy crunch

Although it may at first sight appear paradoxical to say so, the GCC countries face an energy crunch which is related mostly to power generation.

- Electricity demand is growing at about 8% per annum or faster in all the GCC countries, driven by population growth, industrialisation and rising incomes. This high growth rates are unlikely to be changed in the foreseeable future, at least until the GCC countries continue on their rapid growth path.
- It has been estimated that meeting electricity demand will require investment of the order of \$50 billion from now to 2015 – that is \$ 7 billion per year. Investment will be needed to significantly increase power generation capacity and to expand, strengthen and interconnect electricity grids.
- Power generation capacity will need to be increased by 60,000 MW, which is equivalent to 80% of currently installed capacity. At the same time, and for the reasons explained above, it is not to be excluded that some of the existing power generation capacity may need to be shifted from the currently used fuel to some other alternative.
- All hydrocarbon fuels have a high opportunity cost under current circumstances, but especially so crude oil. Availability of natural gas is limited and fuel oil may even become scarcer following the upgrading of major refineries to improve their products slate.
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The GCC energy crunch requires a complex response based on multiple lines of action:

- Energy conservation and rational use of energy (RUE). There is growing awareness of the high incidence of waste on total consumption, and measures will be adopted to contain the same. However, as in many other developing countries the issue is politically delicate because promoting energy savings requires higher prices to the final consumer. These must be accompanied by more stringent standards for a wide variety of products, but in the absence of higher prices the final consumer will find insufficient incentive to opt for more efficient systems – which generally require higher initial investment.
- Greater reliance on renewable sources, notably solar. Multiple initiatives are underway especially in Abu Dhabi, Oman and Saudi Arabia to experiment and promote the use of renewable energy sources. The importance of these sources and the favourable position of the GCC countries in the use of some of them is clearly understood.

That said, it is clear that it will not be possible to avoid increased use of oil or gas in power production unless a nuclear and possibly a coal fired component is added to the power generation fleet of the GCC countries.

The alternative is less oil and gas available for transportation sector in the rest of the world, more emissions of CO₂ in the atmosphere and a less favourable global posture. It is important to view the solution to the GCC energy requirements in the context of global trends and policies. The recent decision of the G8 in Japan to aim at halving CO₂ emissions by 2050 in order to stabilise the global climate offers the key parameter against which we can measure what is desirable for the global community. The implications of the G8 goal have been investigated and spelled out by the International Energy Agency in a set of scenarios published in June 2008, in preparation to the G8 Summit. The scenario yielding the required reduction in CO₂ emissions, dubbed the Blue Map, envisages almost complete decarbonisation of power generation by 2050. This is achieved through a major expansion of renewables, which would provide 46% of total power generation; a major expansion of nuclear, which would provide about 25% of global electricity; and massive use of carbon capture and sequestration for gas and coal-fired power plants, to the point that CCS would become almost universal practice. Such massive transformation of the power generation base of humankind in a space of little more than 40 years (when a major power plant easily takes 10 years from beginning of the investment process to connection to the grid) is obviously extremely ambitious and probably unrealistic. It serves, nevertheless, the purpose to highlight how massive and universal an effort is required in order to face the climate change challenge, and how the active participation of the GCC countries is an essential part of the global effort.

In the international context, the GCC countries happen to be very favourably positioned to quickly develop a nuclear power generation component while at the same time actively pursuing the adoption of CCS technologies to contain their carbon emissions.

Financial motivations

For most countries, the main drawback of nuclear energy is the high initial investment requirement. In most cases, utilities are short of investment funds and must heavily rely on debt or other outside financing; nuclear energy is considered risky and offering returns only in the very long term.

However, the GCC countries have large liquid balances, which are likely to further grow in coming years because of continuing trade surpluses. This has led to the accumulation of Sovereign Wealth Funds as tools for international investment in equities and other assets classes that are not appropriate for Central Bank reserve holdings. Yet, the visibility of some of the deals concluded by large state-owned GCC investors has already created a backlash and multiple calls for regulation and limitations.

Obviously the GCC countries will continue to engage in international investment, but it is already clear that this strategy has risks and limitations. The accumulation of investment funds is normally portrayed as the best solution to extend the benefit of oil production to future generations; but in fact investment always has risks and large losses are possible. Furthermore, the ability of sovereign funds to invest freely and take advantage of profit

opportunities will be limited, either by discriminatory regulation of some sort, or simply by self-imposed limitations in order to avoid controversy. The latter are evidently in place already now.

This means that the opportunity discount rate for GCC official investment is very low or even negative. Rational behaviour in these conditions would tend to favour domestic investment – where risks are much reduced – and capital-intensive projects. Nuclear power plants conform to the desired profile very well, as they cater to an essential need, and especially competitive if the cost of capital is low.

Nuclear energy is capital intensive and an excellent store of value for the future: it is the kind of investment that a country with large financial resources and limited investment opportunities would logically find very attractive as basis for long run economic diversification and sustainability.

“Strategic” motivations

In fact, the development of nuclear energy should be viewed not purely from the point of view of rational financial placement, but also from the point of view of the strategy for longer-term economic and political sustainability. The long-term survival of the GCC countries requires a sustainable source of energy: this is true of all countries, but even more so of countries whose climate is so difficult for human residence and working conditions.

Water desalination requirements are the most obvious aspect of necessarily energy intensive economies. Essentially all water in the Gulf region must be provided for through desalination, and the growing population immediately translates into growing water requirements. If water desalination is insufficient or interrupted, living conditions in most GCC metropolises would quickly become unbearable. Finding a reliable and sustainable solution for water desalination is therefore an essential aspect of GCC security and sustainability.

To a large extent the same applies to air conditioning and other uses of electricity – which have become essential in the kind of buildings and urban centres that characterise the new face of the region.

Oil and gas are not likely to run out in the Gulf any time soon, of course, nevertheless alternative uses will absorb growing volumes of the available production. So, if we combine the prospect of a plateau or slow decline in available volumes with growing demand from petrochemical and other industrial projects – as well as from the rest of the world – we see that nuclear energy is an obvious component to the strategy for achieving economic security and long-run sustainability.

GCC attitude towards ROW

There is one very important further aspect that needs to be highlighted when discussing the GCC’s nuclear energy plans. This is that the GCC countries, differently from many other emerging countries, have consistently built their development model on strong global integration and reliance on external sources of technology, know-how and manpower. Rather than aiming at total self reliance or technological independence early on, the GCC

countries have banked on joint ventures, foreign direct investment and massive reliance on expatriate labour at all levels of skill to facilitate the absorption and implementation of technical know-how and managerial best practices.

This approach has been spectacularly successful in many areas, and is especially important in judging of the prospects of nuclear energy development. In essence, it is certain that nuclear energy know-how will be imported lock, stock and barrel: this includes copying of all required national and international legislation and regulation, including reliance on foreign experts for the implementation of the same. Nationalisation of personnel will take place only very gradually, and paying attention to maintaining the desirable standard of quality.

This strategic approach to reliance on outside sources of technology and specialised manpower means on the one hand that implementation can be greatly accelerated – to the extent that international providers will be available – and on the other hand that the international community will be able to maintain very close surveillance over what the kind of technology and equipment that is being transferred and the use that is being made of the same. The latter might not be a total guarantee against proliferation (which, after all, was in most cases assisted by foreign providers anyhow, legally or illegally) but is in any case more reassuring than the attitude of countries that would insist on extensive or total national control.

In fact, local conditions (social and environmental) for nuclear energy deployment in the GCC countries are ideal, and permit very rapid implementation. The complex authorization phase that is so long and cumbersome in most industrial countries, is likely to be greatly simplified in the GCC countries, especially the smaller ones. Once the decision taken, implementation will not be hindered by financial difficulties or bureaucratic delays: a tender will be published and international providers will be invited to bid. Construction times may well turn out to be shorter than in most other countries that are developing their nuclear energy capacity.

Summary: the case for the GCC countries

We summarise our argument by concluding that the GCC countries offer an extremely favourable set of characteristics for the development of nuclear energy for power generation:

- While it is true that these countries control huge oil and gas reserves, they no longer have unwanted unused production capacity. Domestic consumption competes with exports in a global environment in which hydrocarbons are growing scarcer and prices are climbing. Hydrocarbons burned in power plants have a high opportunity cost, which cannot be ignored.
- Specifically, the process of upgrading of GCC refineries and their integration with petrochemical plants means that residual fuel oil will become scarcer.
- Nuclear power plants offer a financially attractive investment profile from the point of view of countries enjoying large trade and budget surpluses and facing limitations in their international investment.

- Nuclear energy appears to be essential to meeting the strategic requirement for long-term sustainability of the Gulf economies, in view of local environmental conditions and expected demand growth for a production of hydrocarbons that is likely to grow only marginally or stagnate, while demand will grow constantly.
- Nuclear energy uptake in the GCC countries is functional to global requirements, because it contributes to the massive effort that will be required to reduce CO2 emissions in the coming decades and frees locally produced oil and gas for other uses, containing the cost of energy in the long run and reducing the need to develop more costly – and environmentally damaging – non conventional sources of liquid fuels.

The situation in North Africa and the Levant

The same strong case in favour of nuclear energy does not apply to countries in North Africa and the Levant (except perhaps Libya, but substantial differences exist also in that case).

Countries in North Africa and the Levant do not possess oil and gas reserves comparable to those of the Gulf countries. Some in fact are not hydrocarbon producers at all, while others have much smaller reserves. Their energy consumption profile is therefore much closer to that of other developing countries, meaning much lower energy consumption per unit of value added. If, on one hand, the dependence on oil and gas imports or the limited horizon for national oil and gas production may be viewed as further reason to diversify away from hydrocarbons in electricity production, on the other hand the nuclear option faces many of the same obstacles that we find in most developing countries: small domestic electricity markets, limited ability to pay, less reliance on energy intensive industry.

Specifically, none of the North African and Levant countries is flush with liquidity in a way comparable to the GCC countries. The financial profile of nuclear energy is a real problem for most of them.

Finally, local conditions are more difficult, both environmentally and politically.

We shall now review these points in greater detail.

Power sector mostly dependent on gas

The countries of North Africa and the Levant never experienced the condition of having large unwanted unused capacity to produce crude oil. Leaving aside for a moment those countries that do not have hydrocarbon reserves, in the North African exporting countries the opportunity cost of oil always was high, and a policy to increase domestic reliance on gas in order to maximise exports of oil has been in place for some time. Consequently, reliance on gas in power production is already very high.

The situation of the non-hydrocarbon countries has been influenced mainly by political circumstances. Lebanon has been hoping to be able to import gas for its power plants for longer than a decade, but has not yet found a reliable supplier because of regional political realities. Jordan has for a long time enjoyed subsidised access to Iraqi oil, but is now

rapidly turning to gas, thanks to imports from Egypt made possible by the progress of the Arab Gas Pipeline. Morocco has allowed the transit of Algerian gas to Spain but has refrained from becoming itself an importer of Algerian gas, preferring to use coal or oil for power generation.

Among oil exporting countries, Egypt, facing declines in its oil production and export, has adopted the most vigorous policy to expand domestic consumption of natural gas. It has however now reached a stage where the increase in natural gas production is not sufficient to meet at the same time the expected increase in domestic demand and the expected requirements of export projects. Algeria has not gone as far as Egypt in promoting domestic gas utilisation, but is relying on gas for more than 90% of power generation. In Tunisia the role of gas in power generation is only marginally lower. Libya is the only country in which power still is mostly produced out of burning fuel oil, but this is expected to change rapidly as more gas becomes available.

It should be stressed once again that the opportunity cost of burning gas for power generation is much lower than that of burning oil. The reason is very simply that the netback from exports of gas is considerably lower than the netback of exports of oil, because of lower prices and much higher transportation costs. Therefore, countries whose power generation sector is mostly reliant on gas do not experience the same incentive for a shift to nuclear as countries relying primarily on crude oil and oil products.

In short, it is fair to say that the economic incentive of the nuclear power option is less clear in the case of the North African and Levant countries. This is a combination of the fact that they have small domestic electricity markets and mostly rely on gas to produce their electricity.

Financial profile

Furthermore, financial considerations also discourage embracing the nuclear option. All North African and Levant countries (except possibly Libya) are short of capital and face major investment requirements in infrastructure and for meeting the basic needs of their population, notably in housing and social services.

In these countries, nuclear energy needs to compete with other domestic investment. In this sense, the opportunity rate of interest is high, and obviously discourages opting for nuclear power plants. Gas fired power plants can be much smaller, therefore investment decisions do not need to be taken much in advance of demand growth, but can be delayed until the requirement is clear. Gas fired plants are also easier to procure and put into operation, thus minimizing the time lag between the investment decision and demand requirements. Finally, gas fired power plants are less capital intensive.

North African governments will therefore either shy away from opting for nuclear, or face difficulties in financing nuclear power plants. For the same reason, vendors may be less keen to supply them: the market for new nuclear plants will be tight in the coming decades as available vendors are few and demand is picking up quickly. Vendors may therefore be expected to concentrate their energies on the most promising clients, and most of the North African countries would not qualify as such.

However, some key vendors also are very much influenced by their respective governments and their priorities may be politically motivated. This is specifically (not exclusively) the case of Areva in France, and the recent conclusion of nuclear cooperation agreements between France on one side and Egypt and Algeria on the other may be interpreted in this light.

Self sufficiency

None of the North African countries has the same attitude as the GCC countries with respect to depending on outside sources for technology, know-how and manpower. They have consistently adopted a much more nationalist attitude, insisting on developing industry independently of international investors or joint ventures.

This attitude is not uniform throughout the region, and has been evolving over time – more out of necessity than out of conviction. Some countries are more open than others, but foreign participation is de facto restricted especially in utilities such as power generation.

If a nuclear programme is effectively launched, it is highly likely that the North African countries will insist on much greater local content than the GCC countries. The required development of domestic capabilities will slow down the process, and therefore in all likelihood add to the cost of investment.

Greater insistence on national control may also increase proliferation fears: these are not likely to be very significant for the countries of the Maghreb, but are surely material for the countries bordering Israel. Proliferation fears are not likely to be an insurmountable obstacle, but may combine with other considerations in slowing down the process.

Difficulty of execution

Finally, nuclear power development in North Africa and the Levant meets social and environmental obstacles. Nuclear power requires a strong central government and stable institutions – and may reciprocally be used to strengthen central government and stabilise institutions. Several countries in the region do not enjoy sufficient strong and stable central governments, or are ruled by regimes which several potential technology suppliers would find unpalatable. In a context in which vendors are likely to be in a position of being forced to choose among clients because of the impossibility of satisfying all, political and economic reliability will play a role.

Environmentally conditions are also more difficult because in most cases coastal areas are much more densely inhabited and utilised. Choosing a site for nuclear power plants will therefore encounter significant opportunity costs for the potential negative impact on other activities, notably tourism.

Finally some countries in the region are also affected by significant seismic activity, which may further complicate the decision on finding an appropriate location, or the cost of construction of a nuclear power plant capable of withstanding a possible major earthquake.

Europe's interest

All that said, it is nevertheless clear that Europe has a strong interest in promoting the nuclear energy option in North Africa – less so in the Levant. This is reflected in recent activism of some European governments, notably France, and in the statements of some of the major European oil and gas companies.

Put very simply, nuclear energy development in countries like Algeria, Egypt, Tunisia and even Libya is a tool to increase the availability of gas for Europe. The alternative to nuclear energy in a context in which electricity demand is bound to grow rapidly is less gas available for Europe, therefore greater dependence on Russia. Because of the regional nature of gas trade, it is not at all indifferent for Europe where in the world gas consumption may be substituted by nuclear: nuclear energy development in North Africa is a better option from the European point of view than nuclear energy elsewhere in the world. Nuclear energy cooperation therefore has the potential of becoming an important item for Mediterranean cooperation in the context of the Mediterranean Union sponsored by France. It is a controversial item on the European side, but might have significant interest for the prospective Mediterranean partners.

On the European side, France is the nuclear technology leader and has therefore an obvious interest in promoting a market for its enterprises operating in the field. In fact, the extent of French dominance is even excessive, and may lead to a negative attitude on the part of the rest of the member countries – unless they found a way to participate in the benefits, which is not impossible.

A change of attitude towards nuclear energy is underway throughout Europe, and even in Germany, where the issue is most controversial, a change of direction is just a question of time. Simply put, the force of energy realities will eventually overcome all ideological reserves. A Mediterranean nuclear cooperation scheme may serve as the proxy and facilitator to a progressive evolution of European attitudes.

The biggest obstacle is likely to be financial. It is very unlikely that Europe will be ready to finance the nuclear programme of the North African countries, but the latter will aim just at that. How could the financial requirements be met? In a context in which the North African countries further open to international investment and nuclear cooperation develops between the European providers and the main GCC utilities, it is not to be excluded that some GCC electricity operators may be attracted to investing in nuclear power production in North Africa. However, a lot of ground needs to be covered before this prospect becomes real.

In conclusion

The interest of the Arab countries in developing nuclear energy must be viewed in the context of the nuclear renaissance as a global phenomenon. All energy and environmental scenarios point to the need for reducing reliance on hydrocarbons for power generation, and carbon emissions in the atmosphere. In all scenarios, the role of nuclear energy is expected to grow significantly.

The GCC countries have strong economic motivations and ideal conditions to pursue an aggressive nuclear energy programme, and should be expected to do so. The industrial countries have strong interest in cooperating in this direction, in order to relatively increase the volumes of oil and gas available for other uses.

North Africa and the Levant are different from the GCC: local conditions are much less favourable, because of smaller markets, financing difficulties, and a more nationalistic attitude to technology transfer. Under pure market conditions, it is to be expected that the countries would significantly lag behind the GCC countries.

However, Europe has reason to promote nuclear energy uptake in North Africa especially, in the context of the Mediterranean Union. The interest of France is especially clear, but other EU member countries may also find an interest in Mediterranean nuclear energy cooperation. It is possible that the inclusion of a strong nuclear energy chapter in Mediterranean cooperation may serve the purpose of facilitating its uptake in North Africa. The GCC may be part of a nuclear cooperation project between the EU and North Africa to the extent that its own ties with European suppliers will deepen and joint ventures may be formed to invest together in a more decisively liberalised North African electricity market. This perspective would greatly help in overcoming the problem of securing adequate finance, as the GCC countries might be ready to engage in such investment. However, realistically speaking a lot of ground needs to be covered before such triangular cooperation becomes attractive for all sides, and we may have to wait quite a few years before we can salute the practical implementation of a first project.