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The GCC and the Nuclear Question

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Introduction

For many years, nuclear energy has appeared to be an unlikely scenario for the Gulf Cooperation Council (GCC)[1] states. The Gulf region's traditional reliance on domestically produced fossil fuels, coupled to a stance taken by GCC leaders in favour of a nuclear-free Gulf (a stance reiterated over many years in view of Iran's contentious nuclear programme[2]) had made the nuclear option unappealing, both politically and economically, until the late 2000s. In a somewhat surprising policy U-turn, in the late 2000s several Gulf states announced their intention to acquire nuclear technology for peaceful purposes.[3] So far, the United Arab Emirates (UAE) and Saudi Arabia have the most advanced nuclear power production plans; Abu Dhabi began construction of its first nuclear reactor, Barakah-1, in July 2012, and it is planned to follow this with three further reactors, bringing the contribution of nuclear power to the UAE's power sector to 5.6GW by 2020.[4] Should Saudi Arabia's plans be realized, the Kingdom could become the Middle East's largest nuclear power producer over the next 20 years, current plans envisaging the construction of 16 nuclear power plants with a combined capacity of 17GW, one-sixth of the Kingdom's anticipated electricity needs, by 2032.[5]

The introduction of civilian nuclear programmes to the GCC is symptomatic of a more structural shift in the way the GCC and the wider Gulf produces and consumes energy. Rapidly rising levels of domestic energy consumption have already made the GCC a regional

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[1] The six GCC members consist of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE).

[2] As late as 2006, Saudi Arabia's Foreign Affairs Minister Prince Saud al-Faisal declared, in view of Teheran's nuclear programme, that he wanted a nuclear-free Gulf: 'We are urging Iran to follow our position' he said, and 'the Gulf and the Middle East should be nuclear-free'. 'Going nuclear', *Middle East Economic Digest*, 50:44, 11 March 2006, 1.

[3] GCC heads of state announced at their annual summit in 2007 the right of their countries 'to possess nuclear energy for peaceful purposes.' 'Atomic bombshell', *Middle East Economic Digest*, 50:50, 15 December 2006, 4–5; 'Gulf seeks entry to the atomic club', Bains, E., *Middle East Economic Digest*, 4 September 2009.

[4] 'UAE Secures $2Bn Ex-Im Bank Loan To Buy US Nuclear Equipment', *Middle East Economic Survey*, 55:38, 14 September 2012.

[5] 'Iran's Bushehr At Full Capacity, MENA States Pursue Nuclear Programs', *Middle East Economic Survey*, 55:17, 7 September 2012.

energy consumer which rivals the combined energy demand of Latin American countries. This renders alternative sources of energy, including nuclear power, an increasingly attractive long-term solution, in view of the region's otherwise rapidly rising drain on its own main export products, crude oil and natural gas.

Whether nuclear power will realistically offer the region the structural long-term solution it needs to manage its rising consumption levels, however, remains uncertain. The substantial initial investment costs, coupled with the high expected level of long-run variable costs, is unlikely to render nuclear power cost-effective vis-à-vis conventional oil- and gas-fired power plants in the producer region. The existing absence of cost-recovering power tariffs throughout the GCC already renders effective cost recovery for nuclear power unlikely, implying a substantial bill – in the form of nuclear power subsidies – to be picked up by GCC governments. Nuclear power, moreover, involves a number of hidden costs, for instance in the form of national and regional security concerns along the densely populated Gulf coast in the wake of the 2011 Fukushima disaster, and the thorny question of the future disposal of nuclear waste. And the acquisition of nuclear technology by GCC states, albeit for civilian purposes, provides fuel to those critics of nuclear power in the region who fear a nuclear arms race in the Gulf should Iran pursue a nuclear weapons programme in the future. All these concerns make nuclear power a potentially costly option for the GCC, which raises a whole set of future political and economic challenges.

The Economics of Nuclear Power in the GCC

Nuclear power offers the GCC many economic benefits – at least on paper. Over the last 30 years the GCC's energy consumption has grown at some of the fastest rates in the world, ranging from 3.5 to 9 per cent annually.[6] So far, the substantial hydrocarbon wealth of the GCC members has helped the region buy time – the GCC states hold, between them, about a third of proven world crude oil and a fifth of world natural gas reserves. However, not only do rising energy needs require investment in more conventional capacity – which is already compromising the region's incremental export potential for natural gas – but also into a more diversified portfolio of domestic sources of energy, including renewables. By now, natural gas is short everywhere in the region, except for Qatar, and some GCC members have been net importers of gas since the late 2000s.[7] Rising living standards, high rates of population growth (including through labour migration), and the systematic pursuit of energy-intensive industrialization all render energy solutions essential for the long-term viability of the GCC states' very own development model.

Proponents of nuclear power in the GCC see it as a reliable and – in the long run supposedly – cheap source of energy and electricity,[8] now considered sufficiently safe to employ in the region.[9] Significantly, nuclear power promises fast and large capacity additions, typically at above 1 GW per plant, in contrast to renewable options, which so far range between 40 and 100 MW in the region. At the same time, nuclear power holds the potential to reduce the region's dependence on energy imports, particularly those of natural gas, in the future. With

[6] El-Katiri, L. (2013 forthcoming). 'The Gulf Energy Paradox' Research Paper, Oxford Institute for Energy Studies.

[7] The most recent case has involved Kuwait in summer 2012, after the country largely avoided power cuts in 2011. 'Power Failures Hit Kuwait' *Middle East Economic Survey* 55:33, 13 August 2012.

[8] For instance, see Squassoni, S. (2009). *Nuclear Energy: Rebirth or Resuscitation?*, Carnegie Endowment for International Peace, Washington D.C., 14. See also Ian Jackson (2009). 'Nuclear energy and proliferation risks: myths and realities in the Persian Gulf', *International Affairs*, 85:6, 1157–72.

[9] For a comprehensive discussion, see Luciani, G. (2012). 'The Role of Nuclear Energy in Gulf States' Economic Development', in: Kamrava, M. (ed.), *The Nuclear Question in the Middle East*, New York: Columbia University Press, 2012. For a technical discussion, see El-Genk, Mohamed S. (2008). 'On the introduction of nuclear power in Middle East countries: Promise, strategies, vision and challenges', *Energy Conversion and Management*, 49, 2618–28.

low carbon emissions, nuclear energy is widely seen as a 'clean' source of energy, an advantage in a region otherwise almost totally reliant on fossil fuels.[10] Nuclear power is also seen as making an important contribution to wider economic development – for example through the acquisition of technical know-how, the creation of highly skilled jobs for GCC nationals, and the possible creation of a nuclear research value-chain.[11]

The UAE, which to date holds the region's most advanced nuclear investment plan, is among those GCC economies in most dire need of a long-term solution for its rapidly growing energy needs. While the federation sits on some 6 per cent of world crude oil reserves, the burning of its oil domestically entails a constantly rising opportunity cost, in the form of foregone export revenues.[12] Nearly 100 per cent of the UAE's power generation is based on natural gas, which is currently produced from associated oil fields, and in the future will come from new, non-associated sour-gas reservoirs.[13] The UAE as a whole already depends for more than a third of its power consumption on natural gas imports, primarily by pipeline from neighbouring Qatar, but increasingly also via imports of liquefied natural gas (LNG) through several short- and medium-term contracts. The emirate of Dubai itself depends for 90 per cent of its power consumption on such imports.[14] With an anticipated annual growth rate in power generation of 8–9 per cent per year,[15] the UAE has ample reason to consider the use of alternative sources of energy, including the nuclear option.

There are, nevertheless, good reasons to question the use of nuclear power as a structural long-term solution to the region's energy woes. Despite the initial promises of nuclear power – clean, plentiful, cheap electricity – substantial initial investment costs render the technology anything but 'cheap' for the GCC states. The initial value of investment for the construction of four reactors has currently been pegged by the UAE at a total of US$20 billion, which translates into a cost of $3.6 billion per reactor.[16] The IAEA in 2009, by contrast, estimated that the potential cost for a 1GW nuclear power plant of the type commissioned by the UAE could amount to between US$ 4–8 billion, suggesting an eventual bill of up to $32 billion for the UAE's four planned reactors.[17] In the past, prior to the dramatic increase in the industry's costs since 2011, Saudi Arabia has estimated the cost of its potential 16 reactor programme at US$80 billion.[18]

Not included under these costs are the additional cost of fuel,[19] other variable costs, and the subsequent high, and politically charged, costs associated with spent fuel disposal and decommissioning of nuclear plants. With regards to nuclear fuel disposal, some memoranda

[10] Jackson (2009).
[11] Luciani (2012).
[12] E.g. see 'Abu Dhabi Burns More Crude And Gasoil To Meet Power Challenge', *Middle East Economic Survey* 55:17, 23 April 2012.
[13] See ADWEC website for statistics on the UAE's power sector at: http://www.adwec.ae/Statistical.html.
[14] See El-Katiri (2013 forthcoming).
[15] Emirates Nuclear Energy Corporation (2008). *Policy of the United Arab Emirates on the Evaluation and Potential Development of Peaceful Nuclear Energy*, available at: https://pcs.enec.gov.ae/Content/NewsAndEvents.aspx (Retrieved: December 2009).
[16] 'United Arab Emirates', *Nuclear Intelligence Weekly*, 19 October 2012.
[17] 'Enec prequalifies bidders for nuclear power programme', Maree, K., *Middle East Economic Digest*, 5:15, 4 October 2009, 10.
[18] *Middle East Economic Survey*, 54:42, 17 October 2011; *Middle East Economic Survey*, 55:7, 7 September 2012.
[19] A transparent breakdown of the expected initial investment costs has not been published by the UAE. A first set of contracts for the provision of enriched uranium fuel assemblies worth US$ 3 billion was awarded in summer 2012 to a consortium led by Kepco. Given the UAE's own conservative cost estimate of $20 billion for their four reactors, it seems likely that this fuel cost is excluded in their reactor programme cost estimate. 'UAE Secures $2Bn Ex-Im Bank Loan To Buy US Nuclear Equipment', *Middle East Economic Survey*, 55:38, 14 September 2012.

of understanding concluded by the UAE include specific take-back clauses for nuclear fuel waste by the selling country (a security measure more than anything else), but this clause, too, will need to be paid for within the contract framework.[20] The GCC states also currently lack the R&D infrastructure, trained and skilled specialists, as well as training facilities and the technical infrastructure for nuclear power. The training of skilled staff, key to the security of the sector and pledged to be a key development sector for the coming years by the Saudi and UAE governments, will require substantial long-term investment at significant extra cost.[21] All of these costs will be sunk costs, to be carried by the national governments, before the latter can even begin to think about how to recover subsequent running costs through existing electricity tariffs.

Currently, it remains unclear how, or whether, these costs will be recovered from domestic power sales. Abu Dhabi Water and Electricity Company's (ADWEC) current domestic price for electricity lies between 3 and 5 fils/kWh for residential users, and 15 fils/kWh for commercial and industrial users – which amounts to average rates of between US$0.008 and $0.041/kWh, an absurdly low price for electricity.[22] It is acknowledged that Saudi Arabia's tariff increases in summer 2010 failed to raise domestic prices to cost levels, implying that Saudi Arabia's national power provider has been making losses despite the relatively low running costs associated with the existing availability of very low-cost input fuels, in the form of domestically produced oil and natural gas.[23] This problem of low electricity tariffs is, in fact, a problem throughout the GCC, where power producers typically struggle to recover costs, not to mention making profits – a situation which has also hampered efforts to attract more private investment into the sector.[24]

While no detailed data about the expected long-term fixed and variable cost components of the UAE's nuclear power reactors exists, typical estimates for the reactor generation planned by the UAE, using levelized cost of energy (LCOE) as a measure, lie well above these tariffs.[25] An Environmental Investigation Agency (EIA) projection for US average levelized costs for advanced nuclear power plants entering service in 2017 suggests a price range of between US$0.107 and $0.118/kWh.[26] Meanwhile, both the UAE and Saudi Arabia lack the

[20] It is highly unlikely that contracting partners would dispose of the nuclear waste for free. Details about these agreements are not public.

[21] El-Genk (2008, 2627).

[22] ADWEC website at: www.rsb.gov.ae/En/PrimaryMenu/index.aspx?LeftType=1&SubCatLeftMenu_Name=Customer%20Tariffs%20&%20Charges&SubCatLeftMenu_ID=152&SubCatMenu_Name=Tariffs%20&%20Charges&SubCatMenu_ID=151&CatMenu_ID=67&PriMenu_ID=177&CatMenu_Name=Tariffs&PriMenu_Name=Sector%20Structure.

[23] Saudi Arabia, for instance, raised domestic electricity prices in July 2010, but prices are still well below the cost of production. According to the July 2010 tariff changes, residential users are now charged an average of SAR0.137/kWh (US$0.0365/kWh), up from the previous SAR0.125 (US$0.0333), and industrial users between SAR0.0125 and 0.02 (SAR0.02 equating to US$0.0053). The Saudi-quoted cost price is SAR0.372/kWh (US$0.0992), implying a subsidy of between SAR0.359 and SAR0.352/kWh for industrial users, and an average subsidy of SAR0.235/kWh for residential consumption. 'Saudi Arabia to implement new power tariff', *Saudi Gazette*, 1 July 2010.

[24] See Fattouh, Bassam and El-Katiri, Laura (2012). 'Energy Subsidies in the Arab World', Arab Human Development Report Research Paper Series, United Nations Development Programme. Available online at: www.undp.org/content/dam/undp/library/Environment%20and%20Energy/UNDP-EE-AHDR-Energy-Subsidies-2012-Final.pdf.

[25] The Levelized Cost of Energy (LCOE) is a concept frequently used to compare the long-run cost per unit of generated energy/electricity using different types of fuels and technology. It is based on the simple formula LCOE = SUM[Expenses/(1+discount rate)^t] / SUM[Electricity Output/(1+discount rate)^t)]. For a detailed explanation, see EIA (2010). *Updated Capital Cost Estimates for Electricity Generation Plants*, Washington D.C.: State Department of Energy.

[26] EIA (2012). 'Levelized Cost of New Generation Resources in the Annual Energy Outlook 2012',

economies of scale achieved by larger nuclear power markets, such as that of the USA, which are key to bringing down the costs of nuclear power to its typical long-run cost estimates. With only 23GW of installed generation capacity,[27] the UAE's electricity market on its own offers precious little potential for economies of scale, but even Saudi Arabia's market – about three times the size of the UAE's – is small in comparison to the larger markets of European and south Asian power markets. The US case also underlines the fact that even in the presence of substantial economies of scale, nuclear power is cost-competitive only in comparison to some renewables technologies (solar and wind in particular). For the USA as a major natural gas producer, the costs of power plants supplied by domestically produced natural gas are below the cost of nuclear power – suggesting the potential for a commercial fallacy in the case of nuclear power in the GCC.

Unlike oil, natural gas, or renewable power projects, nuclear power also entails a number of non-commercial, and at first sight invisible, costs. On a diplomatic level, the acquisition of nuclear technology requires time, effort, and the long-term alignment of national interests with those of the countries and companies transferring technology. Indirect channels such as trade agreements, support for other nations' goals in international forums, and the vexed long-term duty of allowing foreign advisors to access some of the nation's most sensitive energy providers – its nuclear power plants – need to be taken as a given for any country joining the nuclear club. None of these costs can be quantified, or indeed be assessed in any transparent way – they are probably sunk costs already, given the GCC countries' long-term efforts on the matter for the past ten years or more.

Political Aspects: Risks of Proliferation and of a Regional Arms Race

Nuclear power also holds significant potential to become deeply entangled in the region's existing geopolitical context. The acquisition of strategically sensitive nuclear technology, as well as nuclear cooperation agreements with major international technology providers such as the USA, France, Britain, and Russia, have tremendous significance, both at home, and in the wider Arab world. The significance of the GCC's nuclear plans extends to the region's wider regional relationships, including those with nearby Iran, whose nuclear programme has been a source of tension between Teheran and the International Atomic Energy Agency (IAEA) for years. After Iran, the UAE and (possibly) Saudi Arabia will only be the Middle East's second and third nuclear power producers, and the first Arab countries with access to nuclear technology. Although the GCC states have emphasized their exclusively civilian interest in nuclear power, the option to develop a nuclear weapons programme once the technology is in the country is, of course, a risk that can never be fully excluded. An ability to draw level with Iran's own nuclear programme in every possible aspect is potentially – even if only in theory – a very powerful message to be sent out by the GCC states to Teheran.[28]

Internationally and regionally, not every observer has viewed the GCC states' nuclear plans positively. Two related reasons are typically cited: first, the risk of the wider dissemination of nuclear technology expertise and its subsequent proliferation to third party countries; and second, the risk of a nuclear arms race in the Middle East, most significantly between Iran and its Arab Gulf neighbours.[29] The risk of nuclear proliferation has, to a large extent in the

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Table 2. Available online at www.eia.gov/forecasts/aeo/electricity_generation.cfm.

[27] ADWEC website, accessed September 2012.

[28] In fact, some critics suggest the GCC, and Saudi Arabia in particular, might be entirely driven in their nuclear plans by this factor. Edward Markey, a US congress member in 2008, outlined this position in the following words: 'Saudi Arabia's interest in nuclear technology can only be explained by the dangerous politics of the Middle East. Saudi Arabia, a champion and kingpin of the Sunni Arab world, is deeply threatened by the rise of Shiite-ruled Iran'. 'Why Is Bush Helping Saudi Arabia Build Nukes?' Markey, E.J., *The Wall Street Journal*, 10 June 2008.

[29] E.g. 'A Nuclear Arms Race in the Middle East: Myth or Reality?', Bahgat, G., *Mediterranean Quarterly*, Winter 2011 22(1): 27–40; 'Chain Reaction', Cirincione, J., *Foreign Policy*, 7 May 2009.

GCC context, been taken care of in a series of nuclear security and non-proliferation agreements which have been signed by the GCC states. This is something the GCC states have been eager to point out, to distinguish them from other countries that have acquired nuclear weapons technology, including Israel, Pakistan, India, and North Korea. All GCC members are members of the IAEA and have signed, and confirmed their commitment to, all IAEA agreements to limit the risk of nuclear proliferation.[30] The intention of individual GCC states to use nuclear energy peacefully, safely, and transparently has variously been declared in public by GCC leaders, such as in the case of the UAE, and enshrined in agreements with the USA and Europe, many of which *ex ante* rule out a transfer of sensitive technology, or of highly enriched materials suitable for nuclear weapons production.[31] Under a separate agreement with the USA in May 2009 the UAE, for instance, committed to 'renounce any intention to develop domestic enrichment and reprocessing capabilities' that could lead to the production of nuclear weapons. Abu Dhabi will obtain its nuclear fuel from 'reliable and responsible international suppliers', and will return any radioactive waste to them.[32]

Of course none of these agreements protects the region from a nuclear arms race, in the event of real intent once the technology has found its way into the region.[33] Nor do they protect contract partners from an involuntary proliferation of nuclear technology in the event of war, with critics pointing to the potentially disastrous consequences of the 1990/91 Gulf crisis had Kuwait been in possession of nuclear technology when attacked by Iraq.[34] A 2008 US Congress report criticizes US political support for nuclear programmes in the GCC in the following words:

> This growing presence of nuclear energy in the Middle East will exacerbate current global trends in which nuclear materials and technology are becoming increasingly available. Without comprehensive international reform, this increased availability of nuclear materials and technology will reduce the supply-side obstacles to acquiring a nuclear weapons capability, thereby shifting the cost–benefit analysis of many states in a dangerous direction. Increasingly, states that seek a nuclear weapons capability will have access to the knowledge and materials necessary to obtain it.[35]

At the other end of the spectrum stand those for whom political support of the GCC's nuclear programmes promises valuable political returns. The peaceful pursuit of nuclear power in the Arab Middle East is seen by many as a substantial political success for Western governments and international organizations alike – both have previously been accused by Iran of not having been willing to share nuclear technology with Muslim countries or developing nations.[36] Supporters of nuclear power in the GCC, including those in high-ranking US government circles, have described the UAE as a 'model for the region'[37] and as 'the kind of counterexample to Iran we need to actively support'.[38] The commercial interests of fuel and

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Saudi Prince Turki Al Faisal warned as recently as Spring 2012 of a possible nuclear arms race in the Middle East if the region is not declared a 'nuclear-free' zone. 'Saudi prince warns of Middle East nuclear arms race', Ferris-Ley, C., *Arabian Business*, 26 January 2012.

[30] A complete list of members, as well as membership agreements, can be found on the IAEA's website at www.iaea.org.

[31] A complete list of these contracts can be found in Emirates Nuclear Energy Corporation (2008); 'Abu Dhabi Probes Nuclear Power', Reed, S., *BusinessWeek* Online, 15 January 2009.

[32] Smith P.A. (2009). 'Nuclear energy gains ground in Arab states', *The Middle East*, 401, 1 June, 40.

[33] For a discussion of the wider problematique, see Squassoni, S. (2009).

[34] Jackson (2009, 1161).

[35] *Chain Reaction: Avoiding a Nuclear Arms Race in the Middle East*, Report to the Committee on Foreign Relations, United States Senate. 110th Congress, 2nd Session, Washington D.C., 2008, 1, 9.

[36] Jackson (2009, 1170).

[37] Jon Wolfsthal, an advisor to US Vice President Joseph Biden. Smith, P.A. (2009).

[38] Jackie Wolcott, a former US envoy who helped negotiate a USA–UAE agreement in January 2009. 'News in Depth: Oil-rich Arab state pushes nuclear bid with U.S. help – American government and

technology suppliers may also play a role in this positive view of the GCC states' nuclear programmes, a matter evident in the frequent support by various heads of states who, accompanied by nuclear industry representatives, have been promoting nuclear power during various visits in the region.[39]

Conclusion

Whether or not nuclear power offers the GCC an economic solution, it will soon be a reality in at least one GCC member, the UAE. With this step, the Gulf clearly contradicts the trend towards a decline in nuclear power in other parts of the world, particularly in Europe and North America.[40] The main questions which should now engage both the region and the international community are the various, unaccounted security questions related to nuclear power in the GCC. In the aftermath of the 2011 Fukushima incident, regional and national security concerns in the GCC should have increased significantly. The densely populated Gulf coastline provides little space for evacuation in the case of a serious technical incident. The proximity of many GCC states implies that accidents in one country's nuclear facilities will affect all other neighbouring states as well. The region itself has been volatile, and has been subject to repeated conflict between neighbours Iraq and Iran, with the invasion of Kuwait in 1990/91 drawing in a GCC member itself. Current tensions between the West and Iran over the latter's nuclear programme have sparked threats of military attacks, resulting in Iranian threats to close the Straits of Hormuz or to plant mines along its coastline.[41] Iran is, moreover, known to be in an earthquake zone, an uncomfortable truth for the GCC countries, whose nuclear plans will be fully exposed to the region's geologically fragile Gulf coastline. Kuwait was the first GCC member to shelve its nuclear plans following the Fukushima incident of 2011, owing to security concerns.[42] The UAE's nuclear plans and security provisions were all revised, and the federation maintains that the resulting nuclear programme is 'among the safest in the world'.[43]

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businesses work to build energy program in U.A.E.', Solomon, J., Coker, M., *The Wall Street Journal Europe*, 3 April 2009, 14.

[39] For instance the then French President, Nicolas Sarkozy, a fervent supporter of nuclear energy in the Middle East and North Africa, paid personal visits to Saudi Arabia, Qatar, Abu Dhabi, Kuwait, and Oman in 2008 and 2009, keen to promote French nuclear companies in the Gulf. Similar offers were previously made to Saudi Arabia and Qatar by Russia in 2007.

[40] Germany's exit from nuclear power following the Fukushima incident is but one of the many ramifications of heightened security concerns throughout Europe, North America, and even some parts of Asia. For a comment in the UK context, see Keay, M. (2007). 'Nuclear power in the UK: is it necessary? Is it viable?', Oxford Energy Comment, October 2007. Available at: www.oxfordenergy.org/wpcms/wp-content/uploads/2011/01/October2007-NuclearpowerintheUK-MalcolmKeay.pdf. For a discussion of the German case, see Buchan, D. (2012). 'The Energiewende – Germany's Gamble', SP26, Working Paper, Oxford Institute for Energy Studies, June 2012. Available at: www.oxfordenergy.org/2012/06/the-energiewende-–-germany's-gamble/ and Wettman, R.W. (2011). 'Germany's Withdrawal from Nuclear Energy: Reasons and Strategies behind a New Energy Policy', Friedrich Ebert Stiftung Perspektive, September 2011. Available at: http://library.fes.de/pdf-files/bueros/london/08424-20111007.pdf.

[41] El-Katiri, L. and Fattouh, B. (2012). 'On Oil Embargos and the Myth of the Iranian Oil Weapon', *Energy Comment*, Oxford Institute for Energy Studies, February 2012. Available at: www.oxfordenergy.org/wpcms/wp-content/uploads/2012/02/On-Oil-Embargos-and-the-Myth-of-the-Iranian-Oil-Weapon1.pdf.

[42] 'Kuwait', *Energy Compass*, 7 October 2011.

[43] ENEC CEO Muhammad al-Hammadi said this in a joint ENEC/NECMA statement in September 2012. Plans involve state-of-the-art reactor design, developed by Korea Electric Power Corporation (Kepco) based on Korea's APR-1400 newest generation reactor installed in July 2010 at the Shin-Kori Unit 3 power plant. 'UAE Secures $2Bn Ex-Im Bank Loan To Buy US Nuclear Equipment', *Middle East Economic Survey*, 55:38, 14 September 2012; 'Abu Dhabi Moves Ahead With Nuclear Program', *Middle East Economic Survey*, 55:34, 20 August 2012.

A second security concern, unlikely to be resolved, remains the question of the eventual character of the GCC states' nuclear programmes. Iran, so close to the GCC, must be seen as a warning both to the GCC and to international observers. The Iranian case highlights the serious ramifications of entertaining ambiguous nuclear programmes; for the international community, and the wider Gulf, any possible escalation in tensions with Iran may create incentives for states on the western Gulf coast to invest in nuclear weapons research, drawing level with Iran. Irrespective of the GCC states' credible denial of any interest in the development of nuclear weapons, the material and the technical knowledge to enrich uranium will soon make its way to the Arab side of the Gulf.

The incentives for nations to enrich uranium, when they already host nuclear technology, are typically high in spite of frequently held public positions, given the politically sensitive issue of nuclear nation's long-run dependence on enriched nuclear fuel imports. The truth is that nuclear energy itself simply does not guarantee supply security. The commercial costs of enriching uranium domestically, solely for power generation purposes, are high, suggesting at least a commercial – if not a scientific – incentive to make the greatest possible technical use of existing and future facilities. Past experience has shown that it has at times been national scientists, rather than governments, who have driven the shift from civilian towards military use of nuclear power.[44] With increasing scientific knowledge and interest, the GCC's own capabilities to develop nuclear weapons may lie a mere decade away.

[44] Both in the Indian and the Brazilian case it is believed to have been national scientists, rather than the government or military, who have pushed for a national nuclear weapons programme. India successfully developed a weapons programme in the 2000s, and Brazil stopped its non-civilian nuclear programme in 1991. See 'New Nuclear Realities', Brown, H., *The Washington Quarterly* 31:1, Winter 2008/2009, 7–22 for a discussion of India's case, and 'Lessons from the Denuclearization of Brazil and Argentina', Goldemberg, J., *Arms Control Today*, April 2006, 41–3 for the case of Brazil.