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**Article (Accepted version)  
(Refereed)**

**Original citation:**

Mason, Michael and Kumetat, Dennis (2011) *At the crossroads: energy futures for north africa*. [Energy Policy](#), 39 (8). ISSN 03014215  
DOI: [10.1016/j.enpol.2010.12.031](https://doi.org/10.1016/j.enpol.2010.12.031)

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This version available at: <http://eprints.lse.ac.uk/36662/>

Available in LSE Research Online: June 2011

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## At the Crossroads: Energy Futures for North Africa (pre-proof version)

Michael Mason, Dennis Kumetat

### Introduction

In their plans to move beyond heavy dependence on fossil fuel imports (Morocco and Tunisia) or to maximise export revenues from domestic oil and gas reserves (Libya, Algeria and Egypt), the North African states stand at a crossroads in terms of energy policy: interest in adopting renewable energy and/or nuclear energy presents opportunities for a strategic realignment of national development paths. Placed in the global sunbelt, rich in wind, geothermal and hydropower resources, the North African countries boast abundant potential for renewable energy production. Although a series of clean energy policy initiatives have recently been introduced in the region, renewable energy resources largely remain untapped. Current efforts to establish large-scale solar power exports to the EU - including the Mediterranean Solar Plan and the Desertec industry initiative - anticipate a substantial uptake of renewable energy in North Africa, but so far there has been only limited buy-in by Arab political regimes.

At the same time, several North African states are currently seeking to obtain civil nuclear power for several reasons: to meet rapidly growing domestic energy demand, to protect exports revenues from fossil fuels, to demonstrate national technological advancement, and to increase geopolitical recognition in the face of the growing regional influence of Iran and its nuclear programme. Across North Africa, there is extensive uranium prospecting and exploration being undertaken mainly by Australian, European and Russian companies.

This special issue of *Energy Policy* provides a platform to analyse recent trends in the North African energy systems, as well as their implications for wider energy governance, in the context of this current crossroads for strategic energy investment and development. The geographical focus is on four North African countries of Algeria, Morocco, Tunisia and Egypt. Experts from various professional backgrounds address current trends and prospects for renewable and nuclear energy in North Africa, covering optimisation of market and technological options, regional energy infrastructure challenges (e.g. in terms of generation capacity, energy security and integration with European energy and carbon markets) and political-economic governance contexts. There are also in-depth insights on clean energy policy development in Algeria, Egypt and Morocco.

Most of the papers in the special issue are revised versions of presentations delivered at an expert workshop - *At the Crossroads: Pathways of Renewable and Nuclear Energy in North Africa* - held at the London School of Economics and Political Science, UK from October 16-17 2009. The workshop was convened by the LSE Energy, Water and Environment Community initiative and co-hosted with the Wuppertal Institute for Climate, Environment and Energy. Core funding was kindly provided by the Alcoa Foundation Conservation and Sustainability Programme. Following the workshop, several additional papers were commissioned to address themes that the special issue editors regarded as necessary for a balanced, rigorous treatment of renewable and nuclear energy pathways in the region. All published papers have passed the rigorous peer-review process usual for submissions to *Energy Policy*. In this Introduction we briefly set out the current financial and political context for the interest of North African states in alternative energy futures, then summarise the key themes of the papers featured in this special issue.

## **Non-hydrocarbon energy investment and cooperation in North Africa**

Clean energy investment (renewables and energy efficiency) is proving resilient in the wake of the global economic downturn: at \$162 billion in 2009, new investment in clean energy was only 7% down on 2008 and still the second highest ever total, with new capacity spending exceeding that for fossil fuels (UNEP/SEFI/Bloomberg 2010: 10). The majority of this new investment was in asset financing of utility-scale projects, with a significant (13%) increase in new builds for wind energy, as against a 25% decline in new builds for solar energy. Relatively little of the new global investment in clean energy has made its way to the North African states, and given their policy commitments to renewable energy, the scaling up of such investment is a major challenge over the next decade. None of the three Maghreb countries discussed in this special issue had new clean energy investment exceeding \$100 million in 2009. In contrast, Egypt saw \$500 million of clean energy investment, the great bulk of which was committed to a 200MW wind project in the Gulf of El Zayt (UNEP/SEFI/Bloomberg 2010: 35). As Suding notes in his paper, though, the Egyptian plan to have renewable energy contribute 20% of national power generation by 2020 requires, from the wind sector, an average growth in capacity of 600MW per year. Similarly, while Morocco has announced plans to invest \$9 billion in 2GW of solar energy capacity over the next ten years, the public and private financing needed to achieve this has still to be secured (see the papers in this special issue by Fritzsche and Tänzler).

Of course, the investment potential to the North African states of new energy sources rests largely on their long-term cost advantages relative to the import costs (and, where relevant, export revenues) attached to fossil fuels. In recent years, a preference in the region for onshore wind technology over solar energy (whether solar thermal electricity generation or photovoltaic) reflects its status as the cheapest renewable source of electricity, as evident in wind farm commissioning and development in Egypt and Morocco (Bloomberg New Energy Finance 2010). However, the costs of photovoltaic modules are falling and, as noted in the paper by Peter Viebahn and colleagues, major reductions in energy generating costs are also forecast for solar thermal technologies as a result of major investments in concentrated solar power (CSP) with associated technological and efficiency gains. In their paper Marktanner and Salman note that the financial viability of nuclear power is questionable for the North African states, but the technology is attractive for political and wider economic development reasons. For example, in Egypt, the recent commissioning of a 1200MW nuclear power plant is seen as a means of meeting rising domestic energy demand while protecting the export value of its substantial natural gas reserves. While Egypt has significant uranium ore deposits, the other North African countries do not currently have economically viable sources of uranium, so will likely have to import reactor fuel if they choose to adopt nuclear power (see the papers by Supersberger and Jewell).

A major constraint on the development of low-carbon futures in North Africa is the low level of regional cooperation on renewable and nuclear energy technologies. There are at least symbolic commitments: since the 2001 Abu Dhabi Declaration issued by the Council of Arab Ministers Responsible for the Environment, a number of high-level meetings have taken place under the Middle East and North Africa Renewable Energy Conference (MENAREC): the MENAREC 4 meeting in Damascus, June 2007, released a declaration calling on Arab countries to set national targets for renewable energy deployment and energy efficiency, and expressed support for regional renewable energy systems. Similarly, in July 2008 the Arab Maghreb Union (UMA) affirmed its strong support for renewable energy cooperation and called for the creation of a regional Maghreb electricity market, open to competition. The same meeting also saw a commitment to cooperate over the development of nuclear power for peaceful use in the Maghreb (Union of the Arab

Maghreb 2008). In practice, though, the North African states have not moved significantly beyond technical and legal discussions, stopping short of the scale of coordination needed for the regional production and distribution of low-carbon energy. This reflects both the jealous guarding of their sovereign powers and the existence of wider political tensions that serve to frustrate effective regional cooperation (e.g. tensions between Morocco and Algeria over the status of Western Sahara).

New opportunities for increased regional coordination arise, firstly, from efforts to upgrade and integrate the energy grid infrastructure in North Africa, as noted in the paper by Brand and Zingerle. The UMA electricity generators and distributors are grouped within the Comité Maghrebin de l'Electricité (COMELEEC). While the COMELEEC grid infrastructure has underdeveloped transmission networks and lines, Morocco, Algeria and Tunisia are already linked to the European electricity system (through a 400kV connection between Morocco and Spain with a current capacity of 1400MW) with plans for a 400kV transmission line between Tunisia and Italy (ELMED-cable; 800-1200 MW capacity): attempts are also underway to forge a Tunisia-Libyan connection to facilitate synchronisation with Libya, Egypt and the Arab states in the Levant (Bloomberg New Energy Finance 2010: 11). According to European advocates of renewable energy, the emergence of a Mediterranean Electricity Ring can facilitate the mass importation of electricity to the European Union from the North African states, increasing the economic viability for investment in concentrated solar power (CSP) plants within the Maghreb region. This is essentially the vision of the Mediterranean Solar Plan and Desertec initiative: in this issue Viebahn et al. assess the relevant technological and cost parameters of long-term scenarios for the development of CSP systems, while Folkmanis examines the potential role of carbon markets in inducing the large-scale investments required. At the same time, improvements to electricity transmission capacity may make nuclear power generation more attractive in North African countries, though Supersberger argues in this special issue that effective domestic integration of the power capacity involved is not technically feasible for at least 15 to 20 years.

Secondly, the absence of strategic energy policy cooperation amongst the North African states has created opportunities for structural interventions by external actors in favour of alternative energy sources. With regard to renewables, the European Union is heavily promoting the idea of an integrated power grid involving the purchase of North African solar energy, which is also backed by multilateral development banks (e.g. European Investment Bank) and major corporate coalitions (e.g. the Desertec Industrial Initiative and the Transgreen/MedGrid initiative: see Fritzsche et al.). The commitment of European actors to the liberalisation of national and regional energy markets serves as a conditionality on their promise to undertake low-carbon energy investments in North African states. Indeed, the energy regimes of the states neighbouring the EU have been under strong pressure to adopt European *acquis communautaire* into their national legislation. As noted in this issue by Suding and Fritzsche et al., Egypt and Morocco have already responded to such signals with energy law reforms featuring long-term power purchase agreements, competitive private sector bidding, and moves to institutionalise feed-in tariffs for renewable energy. Similarly, the need of North African states for external assistance in the development of nuclear power means their acceptance of political conditionalities to restrict its use to peaceful means. Thus, Egypt's close cooperation with the International Atomic Energy Agency in supporting its plans to develop a nuclear power station, and the nuclear power accords signed in 2008 by France with Algeria and Libya which closely control the relevant technology transfer and training.

Thirdly, amongst at least some of the North African states, shared perceptions of energy insecurity provide an incentive for enhanced cooperation over the development of alternative energy sources. In their paper, Brand and Zingerle forecast a rapidly increasing power demand for the Maghreb region, with total electricity generation almost tripling by 2025 for Morocco, Algeria and Tunisia. Thus, even assuming success in meeting relatively ambitious targets for renewable energy (and not considering longer-term plans for nuclear energy), a heavy dependence on fossil fuels is at best significantly reduced rather than eliminated within the next fifteen years. Indeed, Brand and Zingerle predict that, if integrated into the European power market, the Maghreb region will remain a net *importer* of electricity by 2025 partly because of the availability of lower-cost electricity from Spain. The rising domestic energy demands of the North African states reveals that, at least in the short-term, their own plans for greater energy security may clash with European Union goals to source North African solar electricity as a means of reducing its high energy dependence on Russia (Bloomberg New Energy Finance 2010: 11). However, in their paper Lacher and Kumetat identify more positively a transnational concept of energy security fostered by the growing energy interconnectedness between North Africa and Europe. They also reject claims that renewable energy infrastructure is more vulnerable than fossil fuel counterparts to insurgent attacks by non-state actors (e.g. by Algerian Islamist militants).

### **The papers**

The special issue begins with two papers exploring future scenarios of renewable energy use for North Africa, both including consideration of the effects of the progressive integration of the Maghreb electricity grid into the European energy system. Brand and Zingerle apply a linear electricity optimisation model to evaluate the impact of Maghreb renewable energy targets on their energy generation systems by 2025. Their focus on Morocco, Algeria and Tunisia reflects, in the context of North Africa, both the more ambitious renewable energy goals of these countries as well as their greater moves to energy market liberalisation. According to Brand and Zingerle, the realisation of their renewable targets would lead in the short-term to substantial additional supply costs for regional power markets, which can partly be offset for Morocco and Algeria by increasing the share of wind over solar power in their renewable energy planning. In their paper, Viebahn, Lechon and Trieb extend the scenario horizon to 2050 and focus on the potential role of CSP. Here the cost development of renewable energy technologies becomes more favourable over the long-term, because of the technological and efficiency savings that are expected to accompany a major scaling up of investments.

Suding provides the first of the country-specific studies in this special issue with an in-depth analysis of Egyptian energy policy. Using as a benchmark the energy policy strategy adopted in 2007 by the governing National Democratic Party, which prioritises long-term energy sufficiency and supply security, he reveals a number of challenges to the effective delivery of this strategy. Major difficulties have included political opposition to market-led reforms on energy pricing and also to greater investment in renewable energy schemes. The paper indicates the implementation gap that typically faces North African regimes whose political legitimacy derives at least in part from subsidised energy pricing for consumers and the capture of resource rents by governing elites.

In her article, Jewell provides an overview of the other non-hydrocarbon energy future for North Africa – nuclear power. All North African countries have announced plans to develop nuclear power and Jewell estimates that nuclear energy could supply up to 9-15% of all electricity consumption in the region by 2030. She locates this nuclear power interest in

the rapidly growing energy demand of the region and concerns with energy security. However, as noted by Jewell and also by Supersberger in the following article, a move to nuclear power by the North African states would create new external dependencies because of the need to import nuclear fuels and technologies. Supersberger considers nuclear power in relation to renewable energy options, making necessary distinctions between the greater energy insecurity of Morocco and Tunisia and the continuing fossil fuel export interests of Egypt, Libya and Algeria. He also argues that separate assessments are necessary for the different options available within nuclear and renewable energy technologies. After examining the various energy import and export effects of alternative energy futures, he concludes that the North African states have more opportunity for developing domestic industries in clean energy by embracing renewable energy technologies.

The next two papers widen out the criteria for assessing alternative energy futures by including political and hard security considerations. Lacher and Kumetat address the security of energy infrastructure in North Africa by comparing the vulnerability of hydrocarbon and renewable energy supply networks - including the potential threat to European states from deliberate supply disruptions by North African governments. Their article investigates the political and security profile of the growing role of renewable energy technologies in the North African energy supply portfolio. They treat as exaggerated some of the European security anxieties concerning large-scale renewable energy imports from North Africa, notably the possibility of supply stoppages as a result of the actions of state or non-state actors. Marktanner and Salman apply a similarly broad scale of geopolitical analysis to encompass nuclear energy choices in relation to renewable energy, inviting scholars to consider the embeddedness of energy choices in the political power structures of the North African countries. For example, the adoption of nuclear energy is seen as promising for reasons of political regime preservation, but forecast to be harmful in terms of economic development and political liberalisation.

In his paper Folkmanis questions whether there are sufficient international and European market incentives to encourage export-led investment in North African renewable energy. Despite European involvement in the Mediterranean Solar Plan, Folkmanis notes that the 2009 EU renewable energy directive requires the physical exchange of electrical power, militating against the type of 'virtual trading' in clean energy promoted under the UNFCCC/Kyoto flexibility mechanisms. This restricts scope for the use of the Clean Development Mechanism in supporting energy trading between North Africa and Europe. Moreover, with the strong domestic expansion of renewable energy in Europe, there is also a question whether there would be an adequate market for bulk imports of clean generated electricity from North Africa. Folkmanis concludes that only an increase to 30% (by 2020) of the share of energy from renewable sources within the EU will provide the necessary impetus for strong external investment in renewable energy in North Africa; and, he adds, this needs to be accompanied by a modification of EU legislation to allow virtual energy trading.

Completing this special issue are two other country case studies, although both papers draw more general lessons for navigating alternative energy futures in North Africa. Fritzsche, Tänzler and Zejli explore energy governance issues, in particular various institutional conditions (policy, financing, infrastructure, knowledge and partnerships) for promoting the uptake of renewable energy. As a North African front-runner with regard to renewable energy implementation, including active membership of relevant regional and international initiatives, the experience of Morocco is discussed in order to highlight institutional barriers and opportunities facing low carbon development pathways. Fritzsche

et al. identify major failings in the regional coordination of clean energy governance and provide concrete recommendations for promoting renewable energy adoption. In the last paper Stambouli similarly addresses governance conditions for accelerating renewable energy development in Algeria, which nevertheless stands in a different position from Morocco on account of its significant oil and gas resources and associated export revenues. Algeria holds one of the highest solar energy reservoirs in the world, and there is a high-level political commitment to develop renewable energy sources. As in the Moroccan case, though, there are major institutional challenges to such development: Stambouli stresses the need for a close alignment of strategic policy choices and technology investments in clean energy.

## Conclusion

The papers in this special issue are united by a scholarly interest in energy futures for North Africa rather than a shared manifesto of policy prescriptions for a clean energy transition in the region. Their different thematic and empirical perspectives nevertheless highlight significant barriers facing the increased uptake of non-hydrocarbon energy generation, including outdated power sector infrastructures, investment and technological constraints, minimal regional coordination of energy policies, and trading restrictions on renewable energy exchanges. At the same time, the papers also identify emerging opportunities for a significant growth in the regional adoption of low-carbon energy. We would argue that a careful assessment of renewable- and nuclear energy options for North Africa should rest on criteria that, above all, reflect the long-term human development needs of domestic publics rather than European energy security imperatives. So much the better if the two interest domains overlap, but this should not be taken for granted.

There is also scope for greater acknowledgment by low carbon energy advocates of the substantial economic and political inertia accompanying fossil fuel energy use (and production) in North Africa. Hydrocarbon energy infrastructures have sunk capital costs which dwarf existing investments in low-carbon energies. And with its rapidly increasing energy demand, the Maghreb region will remain a net *importer* of oil and gas in 2025 even if those countries with the most advanced renewable energy goals (Morocco, Algeria, Tunisia) are successful in meeting these targets. Similarly, while the accelerated removal of fossil fuel subsidies may be necessary for scaling up the adoption of low-carbon technologies (International Energy Agency 2010), subsidised tariffs for electricity from fossil fuel power plants are essential to regime legitimacy for North African states: this means their energy choices remain highly political.

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