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Overview of existing water and energy policies in the MENA region and potential policy approaches to overcome the existing barriers to desalination using renewable energies

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ABSTRACT

Most countries in the Middle East & North Africa (MENA) region currently face water scarcity and rising water demand. In order to respond to these challenges, many MENA countries proceed to the *use of desalination*. As desalination processes are *highly energy-intensive*, the use of conventional energy for the operation of desalination plants contributes to climate change through greenhouse gas emissions, with negative impacts on the water cycle. The use of *renewable energy sources* to supply desalination plants with electricity can be a *more sustainable and environmentally friendlier option* to bridge the water demand gap. The present paper outlines the *main barriers* to *desalination using renewable energies* (referred to in short as 'renewable energy desalination', RED) in most MENA countries, gives an overview of main features of the *water and energy policies* in the MENA region, and compares them to the framework conditions in Australia or Spain. *Supportive policy approaches* to overcome the existing barriers and to promote RED are highlighted. The paper advocates the importance of adopting a *more consistent legal framework* to foster the deployment of RED and thereby reduce the effects of climate change and water scarcity.

Keywords: Renewable energy desalination; Legal framework; Water and energy policies in MENA countries; Supportive mechanisms; Best practices of outrider countries

1. Executive summary

For the desalination of water, different technologies can be applied; likewise, a number of renewable energy (RE) sources can be used for the operation of desalination plants. As a result, a broad variety of combinations of both technologies is possible for renewable energy-powered desalination (RED). The most commonly applied RE source is solar energy that can be either used directly, e.g. as so-called solar still, or indirectly, by using solar thermal collectors connected to a desalination plant. RED is advantageous over conventional desalination in several aspects, especially as it contributes to reduce greenhouse gas (GHG) emissions. Despite the advantages of RED, applicable laws and policies do not always incentivize its use, or do not do so in the most effective way [1].

In general, important barriers to the development of RED concern, for example, the high costs of

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investing in desalination technologies and in RE on the one hand, as well as the existing water and fossil fuel subsidies on the other hand. In answer to the barriers to RE, and in consideration of the rising energy demand in the Middle East and North Africa (MENA) region, most countries have established an RE policy and have set themselves a specific target for the integration of RE into the national energy portfolio. However, few countries have actually enacted binding and enforceable legislation to promote RE. Likewise, in the water sector, a sound and comprehensive institutional, legal and policy framework with respect to desalination in general and to RED in particular is missing. Although many countries have in recent years enacted new water legislation, few laws deal with desalination, or they address desalination-related aspects only indirectly. Moreover, subsidization of water tariffs often conceals the real costs of water and hinders the promotion of desalination.

By contrast, more progressive countries outside the MENA region, like Australia or Spain, have enacted binding energy laws that attract potential investors. This is—amongst others—achieved by providing financial incentives to increase the generation of electricity from RE sources by legislating, for example, feed-in tariffs (FIT) or, like Australia, by demanding for RE certificates or by giving third parties equal access to the energy grid. With respect to the water framework, these countries specifically deal with desalination in their policies. In addition, water tariffs are not (as highly) subsidized, as is the case in most countries in MENA region.

2. Main barriers to increasing the use of sustainable energy and alternative water supply sources in MENA countries

Even though RED can be a viable option to counteract water scarcity and the effects of climate change, most countries face several barriers to the deployment of RED, as briefly outlined below.

2.1. Policy and legal barriers

The separation of the water and energy sectors can lead to inconsistencies in policies or legislation that deal with both sectors. For example, subsidies might be provided for the feed-in of electricity generated by RE into the grid, whereas, according to the water policies, the direct use of RE for RED is not subsidized. Another important policy barrier in the energy sector relates to third parties, especially independent power producers that often lack equal access to the grid or the right to sell electricity directly to customers ([2], 5f.). Furthermore, policies are rarely tailored for small-scale production and seldom reflect technical developments in the field of RED ([3], 51f., p. 73). Another constraint is the lack of clarity of roles and responsibilities of the energy or water authorities involved, for example regarding the issuance of a permit or license required for the construction or operation of a RED plant.

2.2. Technological barriers

From a technical point of view, an important barrier to desalination is the high energy demand of most technologies, rendering it unprofitable and too costly for large-scale applications in most MENA countries. Another technological barrier to RED is the current lack of technologies that are capable of providing constant energy supply (e.g. by energy storage systems), thereby avoiding harmful effects on expensive components of desalination plants such as their membranes ([3], 42ff.). Furthermore, the high complexity of plant components often results in imports of these components from more advanced countries at high prices, because knowledgeable personnel for local manufacturing is lacking.

2.3. Economic, market and financing barriers

One major economic barrier to desalination is its high investment cost, due to its high energy-intensity, increasing raw material prices as well as environmental requirements ([4], 103ff). Another relevant obstacle is the (non-) availability of subsidies for desalination, preventing potential investors from being able to compete with conventional water providers due to water subsidies and low water tariffs ([5], p. 69). This is especially true in countries in which legislation has been influenced by Islamic religious law, notably the belief that water is "a gift of God" and that, therefore, every individual has the right to drink for free ([6], 287). Apart from water subsidies, other forms of subsidies, especially agricultural subsidies, can also negatively impact on the use of groundwater by encouraging—for example—the use of water-intensive crops [7]. Such potentially detrimental agricultural subsidies are widely used in most MENA countries.

Likewise, high initial capital and investment costs hinder the promotion of RE [8,9]. In addition, oil and other fossil fuel subsidies foster the use of conventional energy sources, thereby preventing an increased use of RE sources for power generation ([5], p. 73, 77). Especially in the so-called "rentier states", that is, the

countries of the Gulf Cooperation Council (GCC), the policy of "minimum taxation" prevents the introduction of carbon or other taxes on conventional energies that would reduce the incentives for foreign energy-intensive industries to operate in these countries ([10], p. 3). With regard to RED, water subsidies and a lack of financial support for RED render investments in this technology unprofitable.

2.4. Environmental barriers

Desalination technologies may have adverse environmental impacts; this can prevent (large-scale) investments [11]—for example because of higher costs resulting from environmental requirements or because of difficulties in obtaining necessary permits. Such negative environmental impacts pertain for example to plant siting (in environmentally damageable areas), brine discharge, chemical additives used for antifouling, or the salinity of groundwater caused by seawater intrusion ([12], 111ff). At a global level, desalination negatively contributes to GHG emissions and may have transboundary impacts because of transported pollutants ([12], 115f.) Although the use of RE technologies reduces GHG emissions during desalination processes, the production of raw materials and the manufacturing and disposal of RE components is also highly energy-intensive ([13], 159ff). In order to mitigate negative environmental impacts, environmental impact assessments (EIA) are usually required. Making the planning and construction processes of RED plants more lengthy and costly, environmental policies need to find a balance between setting sufficiently protective environmental standards and at the same time not alienating potential investors.

3. Overview of existing water and energy policies in specific MENA countries

3.1. Summary of RE policies and legislation in MENA countries

The energy policies and legislation in MENA countries can be divided into three main categories:

3.1.1. Countries without target, policy or legislation for the promotion of RE

Most MENA countries have already set themselves a target for the deployment of RE. However, few countries like Iraq or Djibouti—if you count them as countries that belong to the MENA region—fall into the category of countries that have not yet set a target for RE.

3.1.2. Countries with RE target, but without policy or legislation for the promotion of RE

The second category applies to countries that have set themselves a long-term target for the promotion of RE. However, these countries often lack a binding and enforceable legislation and a clear and consistent policy framework for RE at the national level. Instead, these countries often rather focus on specific projects. For example, both, the *Masdar City Project* of the United Arab Emirates and the *Qatar National Food Security Program*, aim to foster the development and promotion of more sustainable, i.e. RE sources via a project-based approach. Furthermore, Oman, for example, aims to implement small-scale RE projects within its existing policy and legal framework.

3.1.3. Countries with target, policy and draft or binding legislation for the promotion of RE

The third category applies to those countries in the MENA region that have set themselves rather ambitious targets as to the percentage of RE in the national energy mix and that have already started to work on a new energy law or adopted a law that aims to foster the deployment of RE. Yet, even these (draft) laws do usually not provide for a comprehensive and consistent framework or lack sufficient enforcement.

For example, the Yemenite government has passed an energy law in 2009 to unbundle the electricity sector and to permit private sector participation (PSP) and plans to establish an independent RE and energy efficiency authority ([14], p. 61, 63). However, to highlight again the example of Yemen, conventional energy sources are still highly subsidized while financial incentives for RE are missing ([14], 59ff). Many other North African countries have likewise introduced rather far-reaching legislation concerning RE. For example, Algeria has a comprehensive and progressive energy law that incentivizes the promotion of RE by means of a FIT. However, the effects of their frameworks could still be increased through other and higher financial incentives for investors and better monitoring processes; in addition, the electricity price should be further regulated ([14], 25ff). Other country legislation, for example, of Egypt, Jordan or Tunisia, provide for supportive financial incentives other than FIT, such as public competitive bidding, tax reductions or dispatching priorities of electricity generated from RE sources. Tunisia, for example, permits the production of electricity from RE sources for the purpose of own consumption and the feed-in into the grid for transmission purposes as well as the selling of that electricity to the national electricity provider

Société Tunisienne de l'Electricité et du Gaz, but only up to 30%. Another law is currently being drafted that shall allow the selling of electricity generated from RE sources by independent power producers to third parties. In Egypt, the legal framework contains provisions on a reduction of conventional energy subsidies and the unbundling of production, transmission and distribution activities. The new draft Electricity Law, *Decree of the President of the Arab Republic of Egypt for a Draft Law Promulgating the Electricity Law*, aims to introduce third party access to the transmission and distribution grid (Art. 29 and 39) and better conditions for private sector investment in RE. Although the law intends to establish a "Fund for Development of Power Generation from Renewable Energies" (Art. 47), this fund does still not yet exist. Another example of a rather progressive RE legislation is the Renewable Energy and Energy Efficiency Law (*REEE Law 3/2010*) of Jordan, and the adoption of an FIT is currently in preparation.

3.2. Summary of water policies and legislation in specific MENA countries

Many countries in the MENA region have enacted new water legislation, but most laws only cover specific aspects relating to desalination activities and do not provide for a clear and comprehensive institutional, legal and policy framework ([15], 144ff). In particular, RED is usually not covered at all. In the following section, certain common characteristics of the water policies and laws of specific MENA countries will be highlighted that may (positively or negatively) affect the deployment of RED. However, a comprehensive overview of the legal framework conditions in the MENA region would be beyond the scope of this paper.

One aspect common to most water laws is that the roles and responsibilities are often distributed between a range of institutions, resulting both in a rather complex system of agencies with unclear roles and in inefficiencies ([12], 70f.; [15], p. 144). This unclear distribution of responsibilities might deter potential investors, in particular with respect to RED, because of the separation of the authorities responsible for the issuance of permits in the energy and water sectors. Another limiting factor of most water legislation relates to the economical barriers to desalination, namely the subsidization of water tariffs that do not reflect the real cost of water. As regards PSP, most laws regulate that water as natural resource is owned by the state or attributed to be in the public domain ([6], 289ff.). This might have negative impacts on private sector investments if private entities cannot acquire ownership of the assets involved. Another important issue in the water sector is the transferability of water rights. If water rights are linked to land ownership, they might be not transferable, making investments in RED less appealing.

With regard to environmental aspects, many countries (e.g. Jordan) have enacted new, progressive environmental legislation ([6], p. 310). However, implementation and enforcement of these laws is often insufficient due to a lack of specification and clarity of the law and/or because of political, financial constraints or shortcomings in personnel ([16], p. 49). Depending on the actual enforcement, these laws can positively impact the sustainable development of RED. But as strict environmental standards can result in lengthy and costly procedures that are especially burdensome for small investors, the policies should be drafted in a clear manner that can be adhered to by less knowledgeable and solvent investors.

4. Brief review of water and energy policies in specific outrider countries

4.1. Energy policies and legislation

At a global level, government policies have in the past positively contributed to overcome the existing barriers to RE ([17], 22ff., 163ff.). Especially since 2000, many countries all over the world have enacted and implemented supportive policies in order to promote the deployment of RE ([17], p. 164). In terms of support mechanisms, policies can either support investments (by providing, e.g. capital grants, tax exemptions or reductions on the purchase of goods) or support the operation (like price subsidies, quota obligations, green certificates or tax reductions on the electricity production) ([18], p. 9). The following section highlights the cutting-edge support mechanisms for the promotion of RE introduced by Australia and Spain.

4.1.1. Australia

Australia has in the past rapidly developed desalination and RE capacities and continues to amend its laws and policies and to invest in both technologies. It has enacted several laws that encourage the generation of electricity from RE sources. In 2009, the Renewable Energy Target Scheme 2009 was introduced, which aims to develop incentives for industry and households to meet the RE target of Australia, namely 20% electricity generation from RE sources by 2020. The policy consists of the Large-scale Renewable

Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES). In principle, both schemes apply the same mechanism: they create financial incentives to promote the use of RE by legislating demand for so-called "Large-scale Generation Certificates" (LGCs) and "Small-scale Technology Certificates" (STCs).[1] Entities that are liable under one of the schemes are legally obliged to buy LGCs or STCs with a fixed price and surrender them in the national certificate market on a regular basis ([1], p. 50). In addition to that, third party access to the grid was introduced to enhance competition in the electricity sector by the enactment of the *National Electricity Act* and the *Trade Practices Act* (*renamed Competition and Consumer Act*) *2010*. This has led to a greater liberalization and privatization of the energy sector. Due to these reforms, significant growth in the renewable electricity generation capacity is planned for the next decade, as reflected by several new solar plants being considered as part of the Australian Government's Solar Flagships Program ([19], 31ff.).

4.1.2. Spain

The Spanish RE system is largely based on the European legislation, which consists of several Directives ([18], 2ff.) that have been implemented by amending the Spanish law accordingly. The RE portfolio in Spain accounted already for more than 12% of gross final energy consumption in 2009, due to the 2005–2010 Renewable Energy Plan ([20], 9.) Based on European Directive 2009/28/EC, Spain has set itself a target of 20% in 2020 and a 10% contribution from RE sources in the transportation sector. The National Renewable Energy Action Plan (NREAP) 2011–2020 further specifies the objectives in specific RE sectors ([20], 109).

The key energy law in Spain is the Electricity Sector Act (*Law 54/1997 of 27 November 1997*) supplemented by a number of Royal Decrees. The financial aid provided for the generation of electricity using RE is governed by the "Special Regime" (Régimen Especial) that was for the first time introduced in 1998 by the *Royal Decree 2818/1998*. The decree gave RE generators the option of obtaining either a fixed premium in addition to the electricity market price or a fixed FIT (i.e. total price) ([21], p. 11). The Special Regime was amended by *Royal Decree 436/2004* and subsequently by *Law 54/2007* as well as *Royal Decree 661/2007* that decoupled the financial support for RE from the Average Electricity Tariff, coupled it instead to the Consumer Price Index, and established a "cap-and-floor-system" for the premium on top of the electricity market price ([21], 11f.) The modified Special Regime directly supported the production of electricity from RE sources by providing: (i) either a regulated FIT if electricity was supplied to a distributor or (ii) a specific premium paid on top of the market price for installations that chose to sell their electricity on the market. Financial assistance for investments was also granted to RE technologies in the form of low-interest subsidies, loans or tax benefits ([20], p. 117). In the Special Regime, the financial incentives for electricity generated using RE and provided to the grid were guaranteed for a period of 25 years until 2013 ([21], 11f.) As in Australia, the Spanish legal framework also ensures third party access to the electricity grid (*Art. 17 RD 661/2007*). These past legislative reforms, especially the financial incentives under the Special Regime and the third party access to the grid, resulted in the already mentioned increase in the share of RE in the Spanish energy portfolio. However, according to the latest adoption of *Royal Decree 1/2012*, all subsidies for new RE installations will end as of 2013. The law has been introduced to address the "tariff deficit", i.e. the difference between the amount that operators have to pay to buy and supply electricity and the amount that they are legally allowed to collect from electricity consumers. Yet, as this new law might infringe upon EU Directives 2009/28/EC and 2010/30/EU, it is presently an open issue whether it will be declared to conform to EU law or not.

4.2. Water policies and legislation

Having outlined some important policy instruments for the promotion of RE sources, the progressive water policies and laws of Australia and Spain shall also be highlighted.

4.2.1. Australia

The main act of the Australian water legislation is the *Water Act 2007* amended by the *Water Amendment Act 2008* that implemented key elements of the water management reforms and that was supplemented by several water regulations. Several separate water markets exist within the states and territories of Australia, between which water is traded by using water entitlements or access rights ([22], p. 24); such interstate water trading activities are of major relevance for the most valued allocation and hence the most efficient use of

[1]*LGCs are created based on the amount of eligible renewable electricity produced by the power stations. One LGC equals one megawatt hour (MWh) of generated RE electricity, whereas STCs are created for these installations according to the amount of electricity they produce or displace.*

water. The "National Water Initiative" (NWI), agreed upon in 2004 by the Council of Australian Governments (COAG), is the national blueprint for water reforms.

The government subsequently initiated other water policies and programs, amongst them the "National Urban Water and Desalination Plan" (NUWDP) of 2008 that provides funding for urban water infrastructure and research to secure water supplies in larger cities. If a project is funded according to the NUWDP, the Ministry of Water issues a certificate according to which a company may be entitled to a refundable tax offset or other grants. A number of desalination projects have been funded so far by the NUWDP. Furthermore, in Western Australia, the Integrated Water Supply Scheme (IWSS) establishes a Source Development Plan for the period 2005–2050. The scheme envisages a seawater desalination plant, water trading mechanisms and a groundwater aquifer to be used for an integrated water pipeline.

From this it follows that Australia has initiated some broad and cutting-edge policy and law reforms on water trading and other market mechanisms to incentivize sound water management and desalination. The financial incentives of the NUWDP have increased the number of desalination plants, and the reforms of the energy policies also had positive effects on the development of RED. As of 2010, a number of RED projects are in operation or in the pipeline in Australia, such as "The Kwinana Desalination Plant", the "Aquasol Plant: Port Augusta municipal-scale solar desalination plant" or the "Port Kembla" plant in New South Wales ([2], 31ff).

4.2.2. Spain

The Spanish water law, analogous to the Spanish energy law, is largely based on the European water law, in particular the *European Council Directive on Drinking Water Standards*, the *Water Framework Directive 2000/60/EC* of 23 October 2000 and the *EIA Directive 85/337/EEC*. The European framework provides for a sound water framework, but RED activities are only rarely covered. Whereas the Water Framework Directive mentions desalination plants as supplementary measure that Member States can implement to achieve the objectives of the Directive (Art. 11 para. 4, Annex VI), the EIA Directive does not refer to a certain salinity or demineralization level ([23], p. 19); likewise, groundwater abstraction is covered, whereas seawater abstraction or desalination are not ([24], p. 7).

The Spanish water framework consists of a broad range of different laws and policies, with the Water Law of 1985 (*Ley de Aguas*) as main legislation. Desalination is mentioned in the *Royal Decree 1327/1995* as subject to concession. Although L*aw 46/1999* changed this requirement, it was re-introduced by *Royal Decree 1/2001* and *Law 11/2005*, according to which desalination belongs to the hydraulic domain and is subject to concession. *Royal Decree 1/2008* introduced an important mechanism as it sets out that desalination plants are exempt from the need to undergo an EIA if they involve a new or added volume of less than 3,000 m^3/day or if the plants do not affect the *Natura 2000 net* protected areas. Although no explicit nation-wide applicable "RED policy" or plan for the future exists, some important subsidy mechanisms can be mentioned. Such subsidies are for example provided for water saving and efficiency measures or improvements of the irrigation systems to foster desalination or the re-use of water. In addition, on the Canary Islands, water prices that were higher than elsewhere in Spain, were reduced by introducing subsidies for desalination, thereby increasing the amount of available water ([18], p. 166).

5. Summary comparison of existing policies in MENA versus outrider countries

The above description of common features of the energy and water policies in MENA countries and the comparison with outrider countries like Australia or Spain can be summarized as follows:

With regard to the energy sector, the main difference between most MENA countries and countries with more progressive RE laws is the fact that most MENA countries still subsidize conventional energies and few have actually introduced FITs or provide sufficient financial incentives for investments into RE despite—the fact that (reasonable designed) FITs as well as quotas or renewable portfolio standard policies are globally regarded as the most commonly applied and most effective forms to support energy policies ([1], 55ff.). Yet, since they are costly and require large fiscal means, this hinders their more extensive application in the MENA region. Furthermore, governments especially in GCC countries still subsidize oil or other conventional energy sources. As another major difference to countries of the MENA region, the energy legislation of more progressive countries usually guarantees the (enforceable) right to produce electricity from RE sources, the provision of equal access to the electricity grid, or the right to use regional interconnectors. Whereas these conditions are met in the unbundled and competitive energy markets of rather progressive countries outside the MENA region, like Australia or Spain, secured and

non-discriminatory third party access to the electricity grid is usually missing in the legislation of most MENA countries or not enforceable. One example of a country heading into the right direction is the draft Electricity Law of Egypt, which is more progressive and intends to give up the Single Buyer Model and permit third party access to the grid. Another important mechanism applied in Australia is the implementation of trading schemes for RE certificates, not existing in most MENA countries. In addition, technical and personnel capacities are often lacking in MENA countries, with the consequence that research and development initiatives or RE projects are just in the planning phase and need to be further funded.

With regard to the water sector, an unclear allocation of tasks and responsibilities between the authorities, in particular regarding the issuance of relevant permits, prevents investments into RED. In addition, water tariffs are still largely subsidized in the water policies of MENA countries, especially in the irrigation field. It is therefore also of importance to reconsider water-related subsidies in agriculture and to examine the use of desalinated water instead of groundwater for irrigation purposes. By contrast, as in the Spanish example, the provision of certain kinds of subsidies for desalination indirectly also contributes to the greater deployment of RED. Australia has furthermore introduced financial incentives for desalination in the NUWDP as well as water trading rights and water saving incentives, thereby successfully contributing to enhancing water management.

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